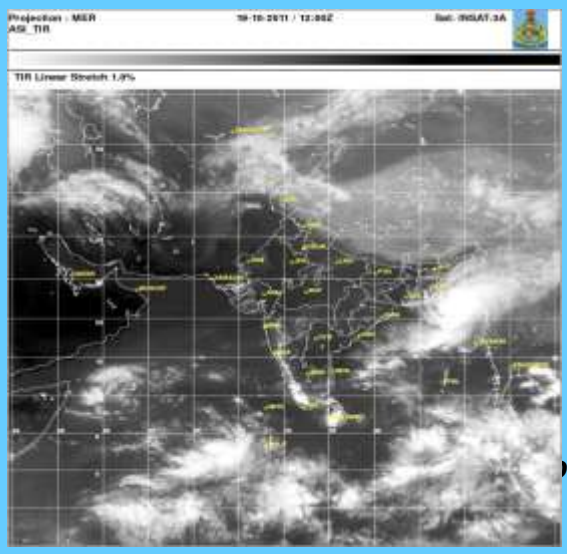
INDIA METEOROLOGICAL DEPARTMENT

Report No.: FDP/TCR/1/2013

Forecast Demonstration Project (FDP) for Improving Track, Intensity and Landfall of Bay of Bengal Tropical Cyclones

Implementation of Pilot Phase, 2013: A Report



M. Mohapatra, Ranjit Singh, Kamaljit Ray,T.N. Jha, S.D. Kotal, Suman Goel, Charan Singh, Naresh Kumar, R.G. Ashrit, S. Balachandran, L.S. Rathore, B.K. Bandyopadhyay, U.C. Mohanty, Osuri Krishna, D.R. Sikka, Swati Basu, S.B. Thampi, S.R. Ramanan & K. Ramachandra Rao

Forecast Demonstration Project (FDP) for Improving Track, Intensity and Landfall of Bay of Bengal Tropical Cyclones

Implementation of Pilot Phase, 2013: A Report

(15 October-13 December, 2013)

M. Mohapatra[1], Ranjit Singh[1], Kamaljit Ray[1], T.N. Jha[1], S.D. Kotal[1],Suman Goel[1], Charan Singh[1], Naresh Kumar[1], R.G. Ashrit[4], S. Balachandran[5], L.S. Rathore[1], B.K. Bandyopadhyay[1], , U.C. Mohanty[2], Osuri Krishna[2], D.R.Sikka[3], Swati Basu[4], S.B. Thampi[5], S.R. Ramanan[5] & K. Ramachandra Rao[6]

1. India Meteorological Department, Lodi Road, New Delhi-110003.

2. Centre for Atmospheric Sciences, India Institute of Technology, Bhubaneswar

3. 40, Mausam Vihar, New Delhi.

4. National Centre for Medium Range Forecast, Noida.

5. RMC, Chennai

6. CWC, Visakhapatanam

CONTENTS

Preface

Worldwide huge technological advancements have been achieved to observe the inner core of the cyclone. Accordingly a programme has been evolved on prediction of track of tropical cyclone over north Indian ocean resulting in planning of the Forecast Demonstration Project (FDP) over Bay of Bengal since 2008 (15 October – 30 November). The programme is aimed to demonstrate the improvement in cyclogenesis, intensification and movement of cyclones over the north Indian Ocean with enhanced observations over the data sparse region. This report deals with implementation of the programme, salient features of the systems developed, weather summaries issued and the lessons learnt during the pilot phase, 2013 (15 October – 13 December).

The FDP on landfalling cyclones over the Bay of Bengal was conducted during 15th October to 13th December, 2013 as per the Implementation Plan. The daily bulletin was prepared during the period and circulated to all concerned. The NOC meeting was held thrice a week, viz. Monday, Wednesday and Friday.

The FDP helped in continuous monitoring of environmental conditions for cyclogenesis. Further, intense observation during IOP helped in better monitoring and prediction of cyclonic disturbances. The additional data collected during the FDP included enhanced AWS network of the coast, twelve activated buoy observations from the Bay of Bengal, Oceansat-II observations and microwave imagery products. As a result of above, the cyclone track forecast errors reduced in 2013 compared to previous FDP campaigns. It also helped in refining the Standard Operation Procedure of the IMD and in strengthening the multi-institutional mechanism which will further improve the FDP campaign in future. Various lessons were also learnt during the campaign.

Many research and observational inputs were received from various national agencies including Indian Space Research Organisation, National Centre for Medium Range Weather Forecasting, Indian Air Force, Indian Navy, Indian Institute of Technology- Delhi & Bhubaneswar, Indian National Centre for Ocean Information Services, National Institute of Ocean Technology, and Cyclone Warning Division at India Meteorological Department, New Delhi, which are highly appreciated and duly acknowledged. I would like to place my appreciation on record to Dr. M. Mohapatra, Shri. B. K. Bandyopadhyay and Shri R.P. Sharma of IMD, New Delhi for their contribution in compilation, editing and publication of this document. I also thank to Mr. D. P. Nayak, Mr. V.Vijay Kumar, Mr. R.G. Bali and Mrs. Monica Sharma of Cyclone Warning Division for their valuable contribution to bring out this report on “Pilot Phase of Forecast Demonstration Project -2013”.

I am thankful to Shri D.R. Sikka for reviewing this document and providing useful suggestions.

Dr. L.S. Rathore
Director General of Meteorology

January 2014

Abstract

During the past few years huge technological advancements have been achieved elsewhere in the world to observe the inner core of the cyclone. Accordingly a programme has been evolved on prediction of track of tropical cyclone over north Indian Ocean resulting in planning of the Forecast Demonstration Project (FDP) over the Bay of Bengal.

FDP programme is aimed to demonstrate the improvement in cyclogenesis, intensification and movement of cyclones over the north Indian Ocean with enhanced observations over the data sparse region. Several national institutions participated for joint observational, communicational & NWP activities during FDP-2013. This report deals with implementation programme, salient features of the systems developed, weather summaries issued and the lessons learnt during the FDP-2013.

The FDP on landfalling cyclones over the Bay of Bengal was conducted during 15th October to 13th December, 2013 as per the implementation plan. The intense observation period (IOP) was declared for 31 days including 7 days during depression over the Bay of Bengal (13-17 Nov.2013), 6 days during the severe cyclonic strom(SCS), Helen over the Bay of Bengal (19-23 Nov.2013), 5 days during very severe cyclonic storm(VSCS), Lehar over the Bay of Bengal (23-28 Nov2013) and 13 days during very severe cyclonic storm(VSCS), Madi over the Bay of Bengal (06-13 Dec.2013). The daily bulletin was prepared during the period and circulated to all concerned. The NOC meeting was held thrice a week, viz. Monday, Wednesday and Friday.

The FDP helped in continuous monitoring of environmental conditions for cyclogenesis. Further, intense observation during IOP helped in better monitoring and prediction of cyclonic disturbances. The additional data collected during FDP 2013 included enhanced AWS network of the coast, twelve activated buoy observations from the Bay of Bengal, Oceansat-II observations and microwave imagery products. The Tropical Cyclone module in Synergie System was also used for monitoring, prediction and preparation of track of cyclone.

As a result of above, the average cyclone track forecast error was reduced in 2013 compared to previous FDP campaign. It helped in refining the Standard Operation Procedure of the IMD and in strengthening the multi-institutional mechanism. Various lessons were also learnt from the FDP campaign 2013, which will further help in improving the campaign in future. To mention a few, we should have better availability of consumables and other logistic support for the coastal observatories and ships to ensure good collection of data, GPS-sonde based upper air observation, better data reception from the coastal stations of all WMO/ESCAP Panel countries on real time basis, improved buoy network, improved NWP model guidance, objective analysis of various cyclogenesis, intensification and track forecast parameters by preparing a check list, threshold values of various NWP products for genesis, intensification and movement and structured satellite bulletin like oher international centres.

Key words: Tropical cyclone, Bay of Bengal, Forecast Demonstration Project (FDP)

CHAPTER–I

Introduction

1.1 Background

Extensive operational mode activities are in place involving a range of global(T-386 & currently T-574) and meso-scale(MM5, ETA, WRF/HWRF) models for generating short(up to 3 days in advance) and medium range (4-7 days in advance) forecast products for use in the prediction of tropical cyclone genesis, intensification, movement and landfall characteristics. Continuous assimilation of all available land based, ocean based and space based observations is carried out at the NCMRWF and IMD for Global models. Regional scale assimilation is also carried out at NCMRWF and IMD for generating most representative 3-D atmospheric fields for forcing the regional and meso-scale models.

Extensive performance evaluation and numerical experimentation studies carried out by the operational, R & D and academic groups on tropical cyclone forecasting over the Indian Seas of Bay of Bengal and Arabian Sea have concluded that the large tropical cyclone track and intensity forecast errors are due to lack of critical observations from the cyclone core environment. Hence, it is strongly believed that the establishment of necessary aircraft probing of cyclone (APC) facility for generating data from the cyclone core environment can successfully address this critical data gap in cyclone intensity and track forecasting.

Follow up meetings between Indo-US groups have culminated to the organizational planning of the Forecast Demonstration Project (FDP) over Bay of Bengal on the lines of NOAA-HRD and NCARs experience on cyclone probing over the Atlantic region. A Committee chaired by Shri D. R. Sikka had addressed this issue and came out with an overall Science Plan for the FDP. Keeping in mind the nature and scale of the programme that needs to be supported with adequate funding, an appropriate project management structure has been put in place to ensure the deliverables to get fully integrated with the operational cyclone forecast systems. IMD has been made the nodal agency for this purpose.

1.2. Key Scientific Objectives and Goals for FDP

The key objectives of the FDP are:

i) To demonstrate the ability of the Numerical Models using enhanced observation over the region including the measurements from the dropsonde's over the periphery of the cyclone and to assess overall accuracy limits in terms of the cyclone track, intensity and landfall for one to two Seasons.

ii) To incorporate modification into the models which could be specific to the Bay of Bengal based on the in-situ measurements and following the actual track through Satellite and Radar observations.

1.3. Programme

An FDP on landfalling tropical cyclones over the Bay of Bengal has been taken up by the IMD which aims to improve the skill of TC track prediction and even in intensity forecastsduring 15 Oct.-30 Nov. since 2008.

During pilot phase **(15 Oct - 13 Dec, 2013),** several national institutions participated for joint observational, communicational & NWP activities like that during previous years. In the Pilot Phase (October –December, 2013), IOP was declared for 31 days including 7 days during depression over the Bay of Bengal (13-17 Nov.2013), 6 days during the severe cyclonic strom(SCS), Helen over the Bay of Bengal (19-23 Nov.2013), 5 days during very severe cyclonic storm(VSCS), Lehar over the Bay of Bengal (23-28 Nov2013) and 13 days during very severe cyclonic storm(VSCS), Madi over the Bay of Bengal (06-13 Dec.2013)..

The detailed implementation programme is presented in Chapter-II. The salient features of cyclone Season 2013 are presented and discussed in Chapter-III. Daily weather summary and advisory issued during FDP-2013 are presented in Chapter-IV. The lessons learnt are presented in Chapter-V. The summary and conclusions are presented in Chapter-VI.

CHAPTER–II
PROGRAMME IMPLEMENTATION PLAN FOR FDP-2013

Background

Currently in India, extensive operational mode activities are in place involving a range of global(GFS-IMD,NCMRWF, T-574), regional(QLM) and meso-scale(WRF/HWRF) models for generating short(up to 3 days in advance) and medium range(4-7 days in advance) forecast products for use in the prediction of tropical cyclone genesis, intensification, movement and landfall characteristics. Continuous assimilation of all available land based, ocean based and space based observations is carried out at the NCMRWF and regional scale assimilation is carried out at NCMRWF and IMD for generating most representative 3-D atmospheric fields for forcing the regional and meso-scale models.

Recent initiatives for FDP Planning

IMD has been made the nodal agency for this purpose. The programme started in 2008 based upon the available observational, NWP and communication infrastructure in the absence of aircraft probing. It continued in 2009-13 with the upgradation of observational network and NWP modeling system. Based on the experience of these past phases of FDP, the implementation plan has been modified for the year 2013.

Key Scientific Objectives and Goals for FDP-2013

i) To demonstrate the ability of the Numerical Models using enhanced observation over the region and to assess overall accuracy limits in terms of the cyclone track, intensity and landfall for one to two seasons.

ii) To incorporate modification into the models which could be specific to the Bay of Bengal based on the in-situ measurements and following the actual track through Satellite and Radar observations.

Programme

The objectives of the programme will be met by conducting a joint observational communication and NWP effort by several institutes in the country during the period 15 Oct.-13 Dec. 2013. There will be Intensive Observational Phases (IOP) within this period tuning actual cyclone events. There will be a National Operational Centre (NOC) and a Field Operational Centre (FOC) at Chennai.

National Operational Centre (NOC):

The overall campaign will be monitored and guided by a Weather Monitoring and Advisory Group (WMAG) at National Weather Forecasting Centre (NWFC), IMD. In addition, communication conferencing and data exchange will be facilitated from this nodal cell. It will be called the NOC. The announcement of IOP will be made by NOC. (Contact: Dr. M. Mohapatra, Cyclone Warning Division, IMD, New Delhi, e-mail mohapatraimd@gmail.com & cwdhq2008@gmail.com, Phone no. 011-24652484, 24631913 Mobil: 9868623475, Fax No. 011-24623220).

Field Operational Centre (FOC):

The FOC, Chennai will work in unison with the NOC coordinating all activities of every institution during the IOP (Contact: Dr. Y.E.A. Raj, DDGM, RMC Chennai e-mail: yearaj@gmail.com & Dr. S. Balachandran, Sc. E, Cyclone Warning Research Centre, RMC, Chennai, E-mail: balaimd@gmail.com, Phone No. 044-28276752, Fax No. 044-28276752)

Multi institutional initiative

The institutions involved in the program are as follows:-

1. IMD
2. NCMRWF
3. ISRO
4. IAF
5. INDIAN NAVY
6. IIT KHARAGPUR
7. IIT DELHI
8. INDIAN INSTITUTE OF SCIENCE
9. NIOT
10. INCOIS
11. NCAOR

Targeted FDP Requirements for the FDP Campaign of October-November 2013
Observational program:

(I)AWS:

Operational meso-scale AWS network of IMD along the east coast of India available for FDP is shown below.

S. No.	State	Existing No. of AWS Stations
1	West Bengal	17
2	Orissa	30
3	Andhra Pradesh	22
4	Tamilnadu and Puducherry	18
5	Andaman & Nicobar	1
6	Lakshadweep	1
7	Kerala	10
8	Karnataka	21
9	Goa	2
10	Maharashtra	37
11	Gujarat, Daman & Diu and Dadra Nagar & Haveli	27
12	East coast + A&N Islands	88
13	West coast + Lakshadweep	97

The locations of the stations are shown in Fig.1

- DDGM(SI), Pune will ensure the real time transmission of data from AWS stations along east coast of India and additional 14 in the Northeast to DDGM(ISSD) Delhi in

GTS mobile synop format. DDGM(SI) will submit status report by 1st October 2013 to Project Manager on the availability of such data.

- Data from PRWONAM and northeast India Meso-scale AWS network will be made available by ISRO from the MOSDAC server of SAC, Ahmedabad on real time (Fig.2).
- DDGM(Sat. Met) will make arrangements to download ISRO AWS data and relay it to NOC for operational and NWP application.
- Data formatting issues associated with ISRO AWS data are to be sorted out through joint effort of Shri A.K. Sharma DDGM (Satmet) and Dr S.K. Roy Bhowmik, DDGM (NWP) of IMD by first 30th September 2013. On finalisation the process of converting ISRO AWS data into mobile synop (GTS) format need to be automated in liaison with DDGM(ISSD) prior to the FDP-2013 period.
- AWS data from 10 stations commissioned (under STORM Project) by Kolkata University and Guwahati university will also be communicated to NOC. DDGM, RMC, Kolkata and Guwahati will coordinate and intimate the status to NOC and FOC by 1ST October 2013.
- RMCs at Kolkata and Guwahati will work out modalities to collect and transmit data on real time basis from AWS network established under the storm programme by Kolkata University, Jadavpur University and Guwahati University by 1st October. Formatting issues as described above shall also be addressed. The data will be transmitted through AMSS of respective RMC. FOC shall coordinate the exercise.

IMD AWS network over NE India is given below.

S. No.	State	Existing No. of AWS Stations
1	Assam	26
2	Meghalaya	7
3	Nagaland	7
4	Arunachal Pradesh	7
5	Tripura	4
6	Manipur	10
7	Mizoram	8
8	Sikkim	3

(II) Synoptic observation

- Synoptic observatories of IMD network (Fig.3 and Fig.4) over the peninsular/east India under the RMCs of Chennai and Kolkata shall report data on hourly basis, during IOP. During normal period of FDP, 3 hrly. SYNOP will be collected.
- RMC Kolkata and Chennai will ensure hourly observation and transmission through telephone/fax/e-mail of all synops of coastal stations during IOP to NOC and FOC. In addition, RMC Chennai shall organize transmission of such data through AMSS.

- RSMC, New Delhi will write to concerned WMO/ESCAP Panel member countries to ensure the availability of synoptic data from there respective region for the FDP period.
- FOC will also intimate the status of Cyclone Distress Mitigation Committee (CDMC) stations along east coast to NOC and ensure their functioning during FDP period.

(III) Buoys:

Real-time collection of hourly data from deep ocean and met-ocean buoy network over the Bay of Bengal from INCOIS Server will be ensured by DDGM(ISSD).

- NOC & FOC will utilize these data received through GTS/E-mail.
- INCOIS will ensure availability of additional marine surface pressure observation through E-mail to NOC & FOC

(IV) High wind speed recorder(HWSR)

There are twelve HWSRs along the coast of India in the operational conditions as mentioned below.

Digha	: West Bengal
Visakhapatnam	: Andhra Pradesh
Machilipatnam	: Andhra Pradesh
Nellore	: Andhra Pradesh
Chennai	: Tamil Nadu
Karaikal	: Puducherry
Mumbai	: Maharashtra
Puri	: Orissa
Paradip	: Orissa
Gopalpur	: Orissa
Veraval	: Gujarat
Dwarka	: Gujarat

FOC, Chennai will ascertain the functioning of the HWSRs along the east coast. It will make arrangement for collection and dissemination of HWSR data on real time basis to NOC and NWP Division of IMD. It will also make arrangement for archival of this data. NWP Division of IMD and NCMRWF will try to ingest these data in NWP models. The performance of HWSRs during IOP period will be evaluated.

(V) Upper air:

Augmentation of coastal/peninsular upper air measurements (Fig.5)

- Upper air RS/RW data from IMD stations (Guwahati, Kolkata, Port Blair, Bhubaneswar, Visakhapatnam, Machilipatnam, Hyderabad, Chennai, Karaikal, Minicoy/Amini Divi, Trivendrum) will be collected at least once(based on 0000 UTC) for normal days of FDP period. However, during the IOP phase of FDP, 12 hrly. data shall be collected. The flights terminating below 250 hPa are to be repeated.

- DDGM(UI), RMCs Kolkata, Chennai and Guwahati will take all necessary steps in support of FDP observational requirements. The readiness report should be sent to NOC by 1st October 2013.
- Additional GPS Sonde soundings will be taken at Balasore, Gopalpur, Kalingapatnam, Ongole/Bapatla and Pamban with the support of ISRO.
- DDGM, Chennai and DDGM(UI) shall liaise with VSSC, Trivendrum to ensure commissioning of equipment along with training to IMD staff to operate during the IOP phase of FDP. DDGM, Kolkata will depute suitable staff for Balasore and Gopalpur and remain in touch with RMC Chennai.
- Upper air GPS Sonde data from Indian Navy stations shall be made available by the DNOM HQs, Delhi through e-mail. DDGM(UI) shall liaise with DNOM and ensure real time data transfer for the FDP period.
- FOC may explore the availability of Upper air data from GPS Sonde network of ISRO at Gadanki, SHAR, Arakkonam, Kochi etc. for the IOP Phase of FDP. DDGM, Chennai shall liaise with VSSC, Trivendrum to ensure commissioning of equipment along with training to IMD staff to operate at these station if agreed by ISRO during the IOP phase.
- Due arrangements are to be made by DDGM (UI) to receive all available Pilot Balloon data sets for the FDP 2013 period.
- Arrangements have to be made by DDGM(UI) to collect pilot balloon data from IAF. In case of becoming dark by 12UTC, IAF be advised to take the Pilot assent by 11UTC. Daily flight level winds as collected by IAF flights between Carnicobar and Tambaram are also to be received for FDP 2013 period. DDGM(UI) shall liaison with IAF to receive GTS coded data.
- DDGM(NWP) of IMD shall ensure the synchronization of data formats and collection at the NWP/NWFC of data received from outside IMD institutions in order to facilitate for the Data Processing and quality control systems at IMD and NCMRWF.
- Wind profiler support from the existing Gadanki and SHAR is to be activated so as to receive hourly profiles in the lower troposphere. FOC, Chennai will request ISRO (Principal Scientist) for organizing necessary observational support during FDP campaign. ISSD, IMD, New Delhi will identify nodal officers to workout real time data reception modalities in this regard.

(VI) DWR Support

DWR Support from 5 locations (Fig.6) at Kolkata, Visakhapatanm, Machillipatnam, SHAR and Chennai with uniform storm scanning strategy will be ensured prior to the FDP-2013. DDGM(UI) shall make due arrangements to receive the DWR data in real time to DDGM (ISSD) for the FDP 2013.

(VII) Satellite observations

DDG(Sat Met) shall make all available satellite derived products (high resolution AMVs; rapid scan winds; OLR; OceanSat and WINDSAT winds; local HRPT Temperature and moisture profiles from INCOIS; GPS occultation data; MODIS moisture data; TMI; SSMI

and AMSU data sets etc.) for its utilization by the global and regional data assimilation-forecast systems of IMD and NCMRWF during the FDP 2013 period.

Satmet. Division will issue special bulletin every three hourly about the cyclonic disturbance.

Telecommunication

i. DDG(ISSD) shall take all necessary steps so as to receive the observational data at the NOC and FOC from all identified sources both from FDP partners and the regional countries (Bangladesh, Myanmar, Malaysia, Thailand, Indonesia and Sri Lanka) in real time. ISSD and NWP division shall continuously monitor the data reception at NWP/Telecom and ensure the timely data reception and onward transmission of data to NWP Division and NCMRWF throughout the FDP 2013 period.

ii. IMD shall update FDP Web Page on IMD (linked at NCMRWF as well). The existing FDP e-mail group will be updated with full contact details). An FDP discussion group for the exchange of FDP related information among the FDP partners may be created. DDGM (ISSD), IT cell will take necessary action in this regard.

NWP analysis and prediction

a) NWP Division shall make all necessary arrangements for the generation of global and regional analyses fields by using special FDP 2013 data at 4 analysis times (00, 06,12,18 UTC) for the whole of FDP 2013 period. Arrangements are also to be made to keep FDP 2013 analyses and forecast boundary fields upto 72hrs on ftp servers of NCMRWF and IMD for their utilization by FDP partners in India. Efforts will be made to bring out the Regional Model forecast within three hours of the observation time.

b) NWP Division, IMD shall workout arrangements to provide analyses fields of ECMWF and UKMO as well on the ftp servers at NCMRWF and IMD for the FDP 2013 period.

International Cooperation

Director RSMC, New Delhi shall request the ESCAP Panel, SAARC and BIMSTEC countries about the FDP over the Bay of Bengal programme of India and solicit their cooperation in the real time exchange of data (surface, upper air and special observations) for their utilization in the generation of most representative meso-scale analysis fields over the Bay of Bengal and its neighbourhood for generating improved quality of track, intensity and landfall of tropical cyclones.

FDP Operation Centre

Project Director will be assisted by a National FDP Operations Centre (NOC) at NWFC and a FDP Weather Monitoring and Advisory Group will be constituted to identify the IOP phases during FDP 2013 period.

FDP Weather Monitoring and Advisory Group (WMAG)

1. DGM Chairman
2. Shri D.R. Sikka
3. Prof. U.C. Mohanty
4. Head ,NCMRWF
5. DDGM(S)
6. All members of FDP Project Team
7. Representatives from IAF, Indian Navy.

The WMAG shall meet thrice a week (Monday, Wednesday & Friday) at 1530 hrs. (including holidays) during the period 15 Oct.- 30 Nov., 2013 at NWFC Meeting Room IInd floor to review the FDP activity regularly and decide on IOP declaration. Weather summaries and current information will be presented by Project Scientist, FDP. The weather summaries and information will be prepared daily and uploaded in the website along with circulation through e-mail like previous years.

Implementation Strategy

- Preparatory Phase for the
  FDP Pilot 2013: 1-30 September 2013
  (Actions to be completed as mentioned above)
- FDP-2013 Field Phase: 15 October to 13 December
  (Actions to be completed as mentioned above)
- IOP Phase: Identified by the NOC at NWFC in consultation with the Weather Monitoring and Advisory Group

The NOC will be established at NWFC, New Delhi which will be responsible for entire co-ordination and declaration of IOP. The center will function independently. The usual operational activity of RSMC will be separate.

Cyclone Warning Research Centre at RMC, Chennai shall function as the FOC and establish links with all FDP partners, notify all IOP phases to FDP partners, coordinate and update the status of observation collection and transmission from FDP partners from time to time. The RMCs at Kolkata and Guwahati; ACWCs at Kolkata and CWCs at Visakhapatnam and Bhubaneswar shall work in close liaison with FDP FOC and NOC, NWFC, Delhi for smooth and efficient organization of FDP 2013 pilot observational campaign.

- FDP Data Centre: All special observations collected by the FDP project partners shall be archived along with meso-scale analysis and forecast fields at IMD and NCMRWF computing centres.
- Post Experiment Phase:

1. Preparation of weather summery data CD will be carried out by the project management team and NWP group of IMD.
2. Project management team shall Plan and coordinate necessary R&D work involving not only FDP partners but also other academic and research groups in the country to maximize the utilization of FDP data for accomplishing the envisaged targets of the project.

3. An article on implementation report will be prepared at the end of FDP-2013. It will highlight societal issues along with the programme implementation, out come and lessons learnt.
4. The daily rainfall data along the coast during landfall of a cyclone will be analysed to find out the diurnal variation of rainfall.
5. A report will be prepared at the end of FDP about the performance of HWSR.

Fig.1(a). IMD's network of 675 (127 Agro+548) AWS

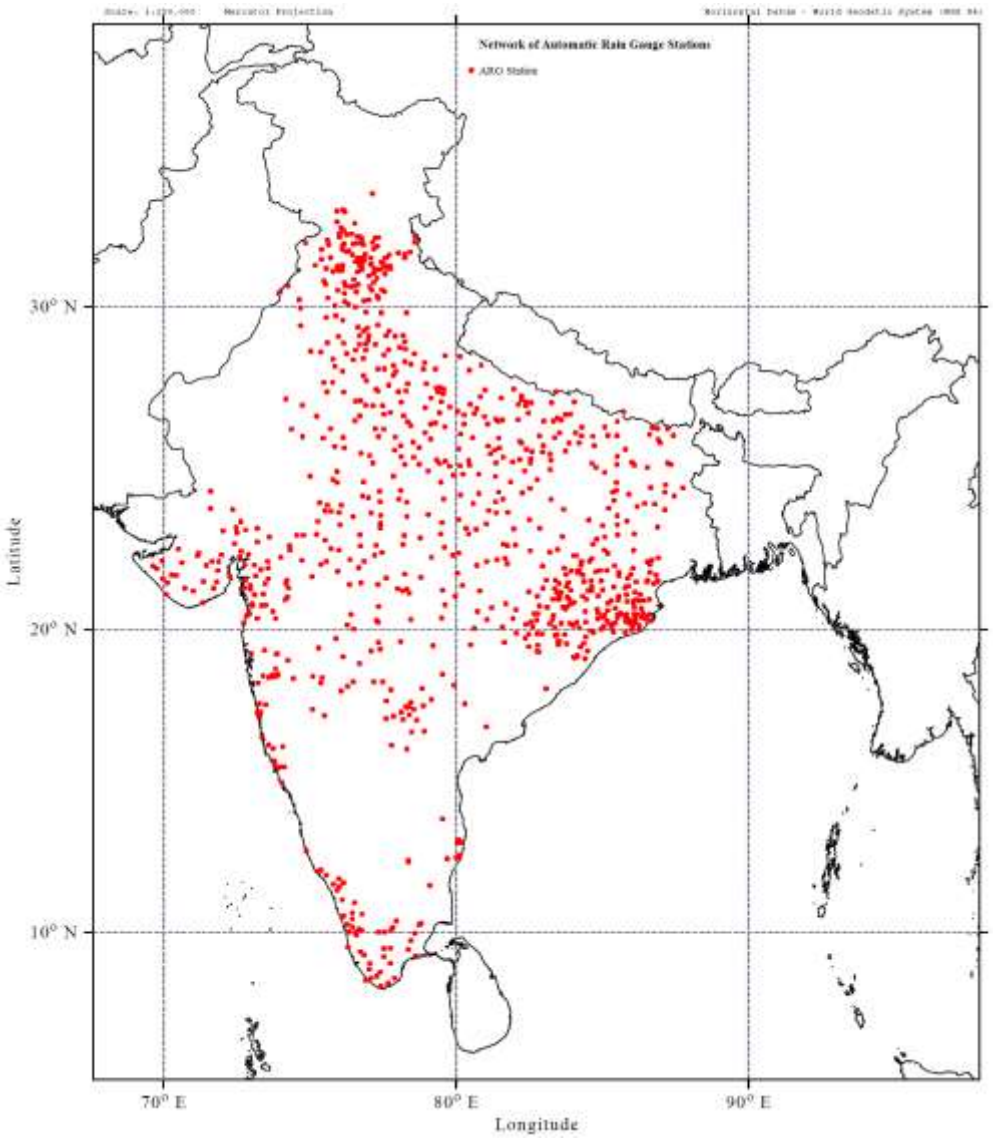


Fig.1(b). IMD's network of 900 Automatic Rain Gauge (ARG)

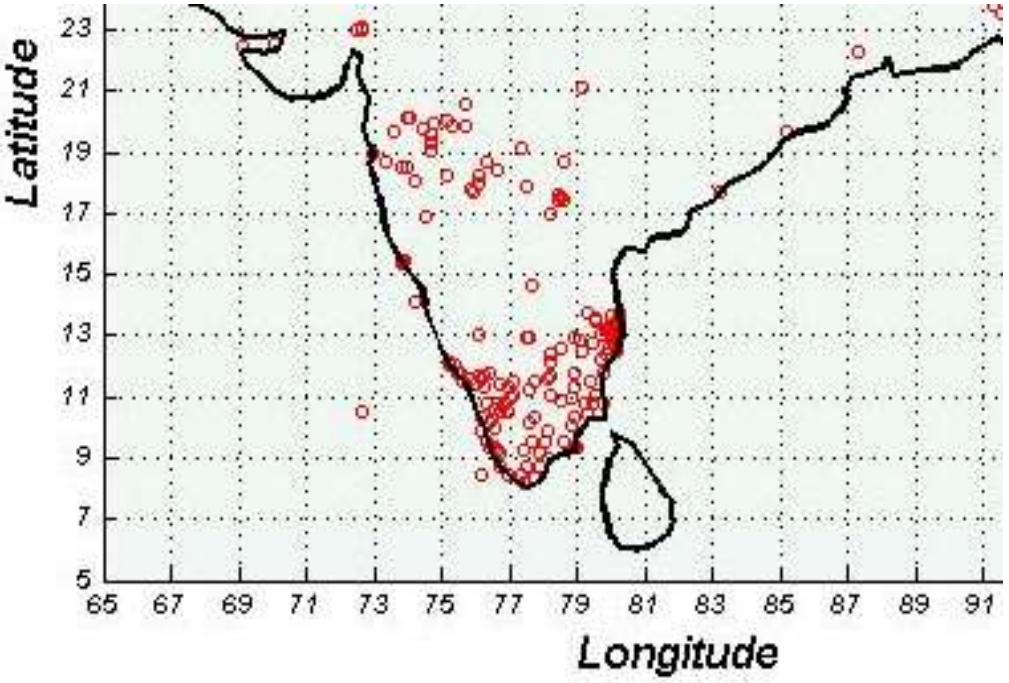


Fig.2. ISRO AWS stations under PRWONAM project.

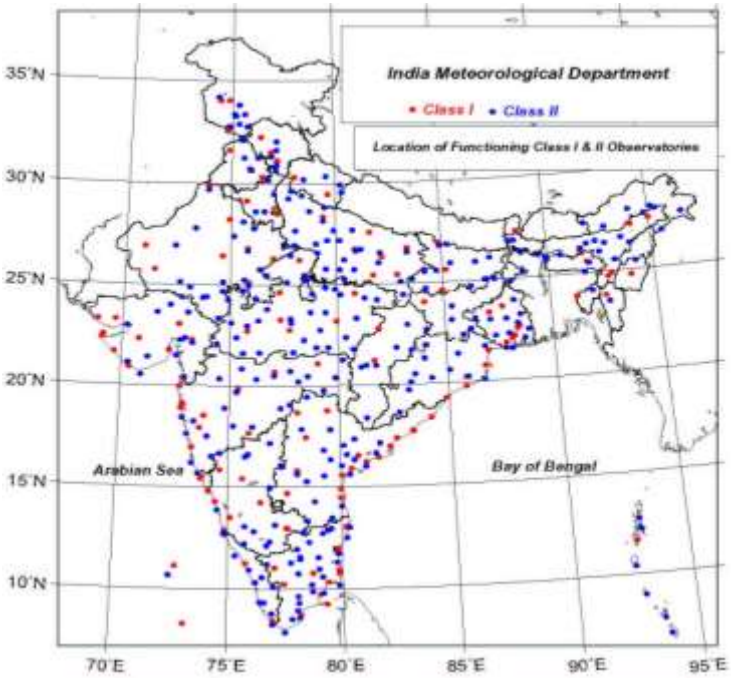


Fig.3. Synoptic stations of IMD

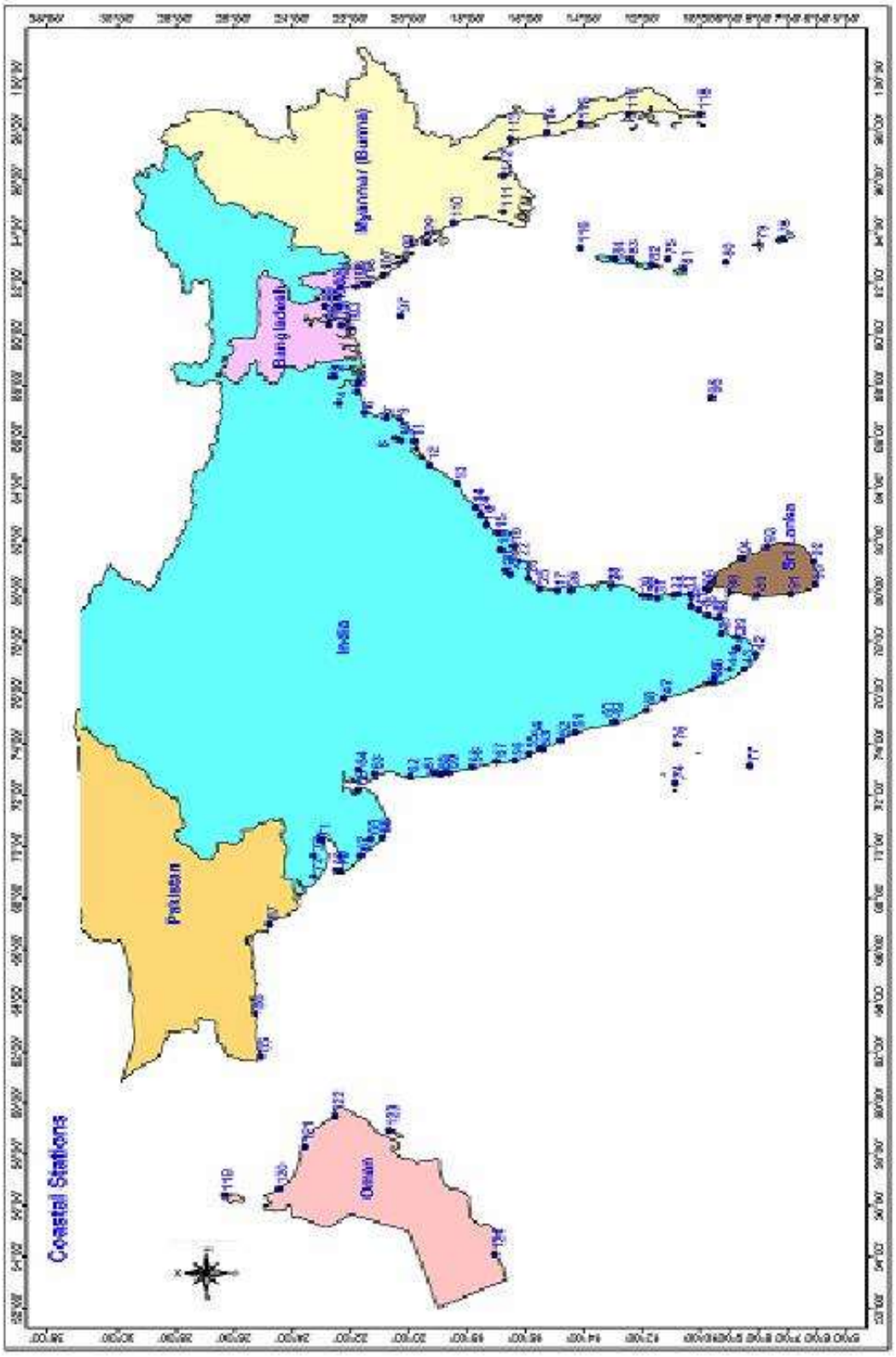
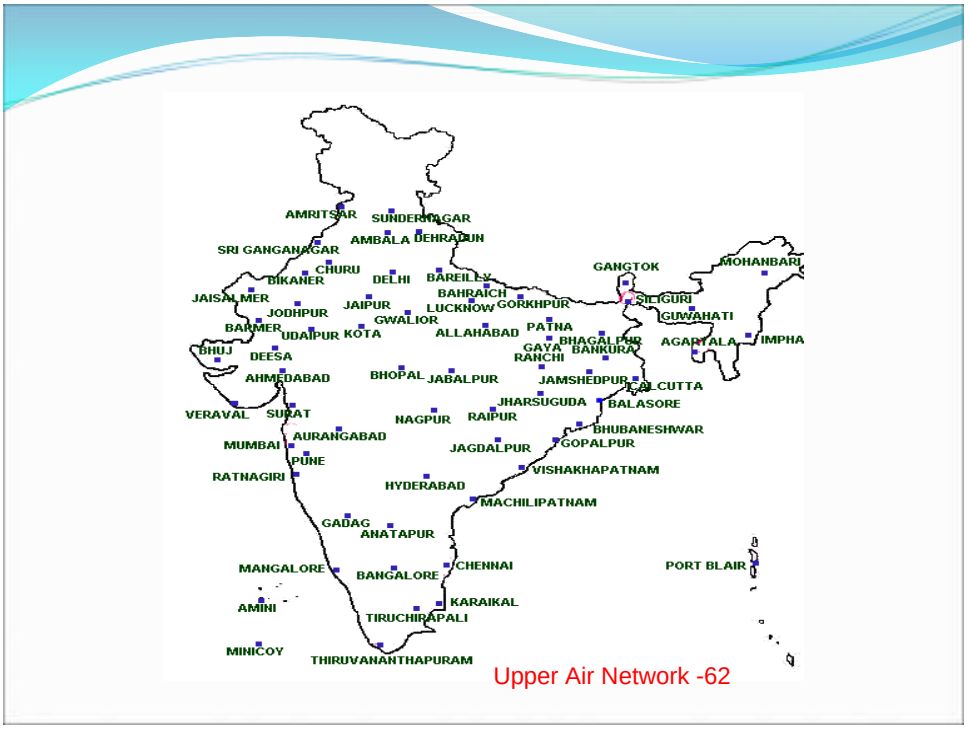


Fig.4. Coastal synoptic stations



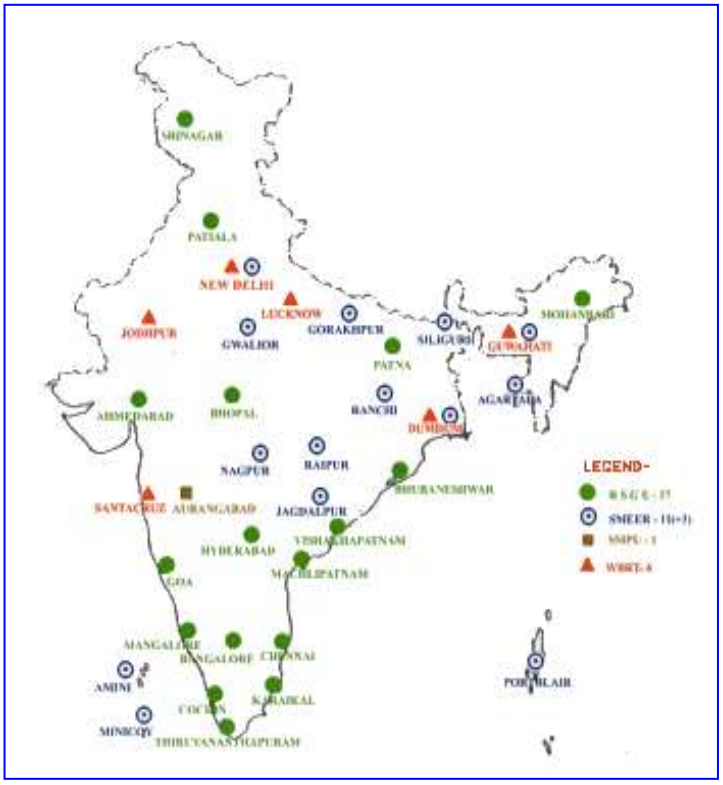


Fig.5. Pilot balloon and RS/RW (including 10 GPS stations) network of IMD

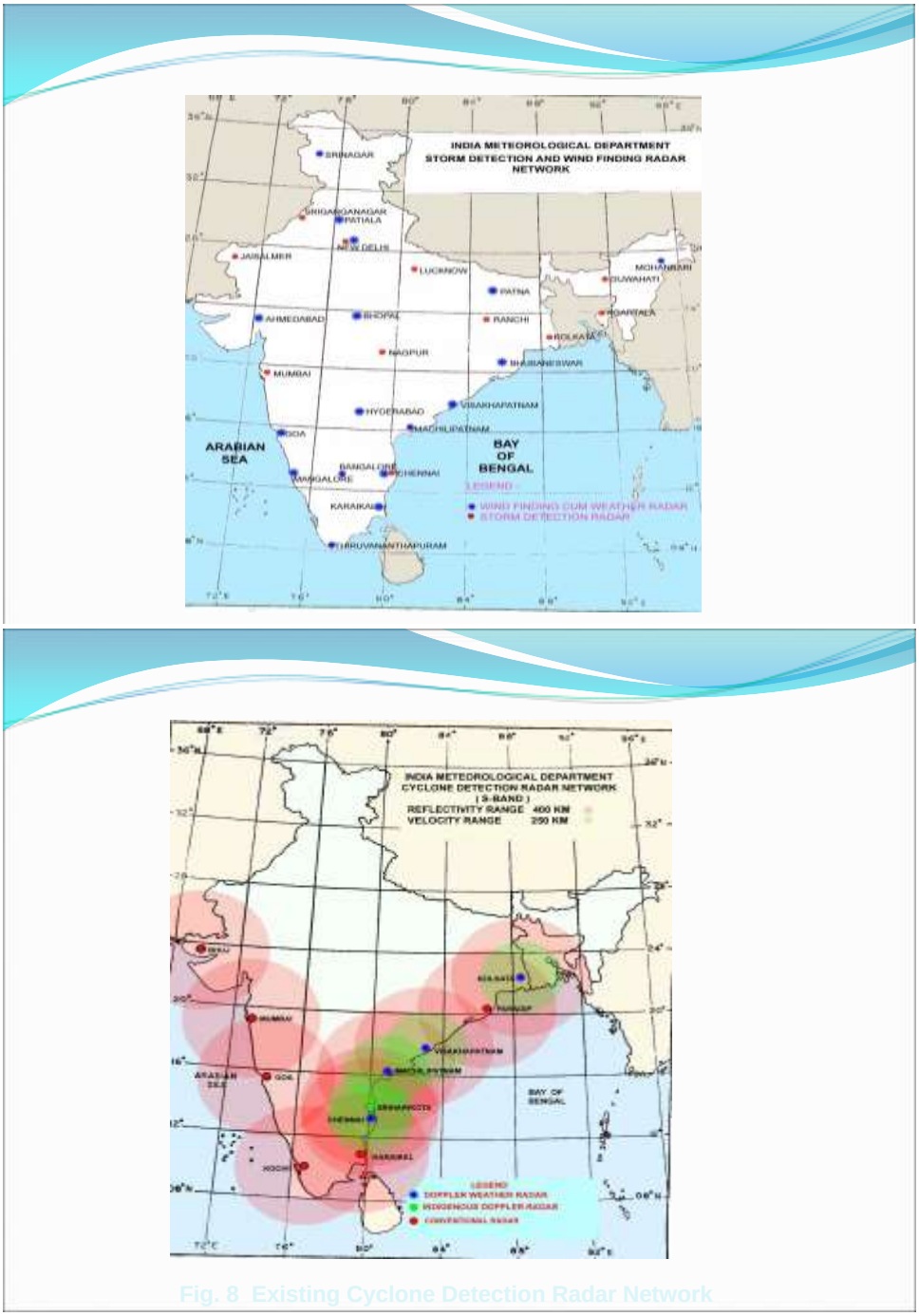


Fig. 8 Existing Cyclone Detection Radar Network

Fig.6. Cyclone detection radar network of IMD

Table 1. List of East Coast stations in India

Station	Index	Latitude	Longitude	Class	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
Kolkota(Alipore)	42807	22 32N	88 20E	I	X	X	X	X	X	X	X	X
Kolkota(DumDum)	42809	22 39N	88 20E	I	X	X	X	X	X	X	X	X
Diamond Harbour	42811	22 11N	88 12E		X	X	X	X	X	X	X	X
Canning	42812	22 15n	88 40 E		0	X	0	0	X	0	0	0
Midnapore	42803	22 25N	87 19E	IIb	0	X	0	0	X	0	0	0
Digha	42901	21 50N	87 47 E		X	X	X	X	X	X	X	X
Basirhat	42810				0	X	X	X	X	0	0	0
Contai	42900	21 47N	87 45E	IIb	0	X	0	0	X	0	0	0
Balasore	42895	21 31N	86 56E	I	0	X	X	X	X	X	0	0
Chandbali	42973	20 47N	86 44E	I	0	X	X	X	X	X	X	X
Cuttack	42970	20 28N	85 56E	IIb	0	X	0	0	X	0	0	0
Paradip	42976	20 18N	86 41E	IIa	0	X	0	0	X	0	0	0
Bubaneshwar	42971	20 15N	85 50E	I	X	X	X	X	X	X	X	X
Puri	43053	19 48N	85 49E	I	X	X	X	X	X	X	X	X
Gopalpur	43049	19 16N	84 53E	I	X	X	X	X	X	X	X	X
Kalingapatnam	43105	18 20N	84 08E	I	X	X	X	X	X	X	X	X
Vishakapatnam	43149	17 43N	83 14E	I	X	X	X	X	X	X	X	X
Kakinada	43189	16 57N	82 14E	I	X	X	X	X	X	X	X	X
Tuni	43147	17 21N	82 33E	I	X	X	X	X	X	X	X	X
Kavali	43243	14 54N	79 59E	I	X	X	X	X	X	X	X	X
Nidadavole	43184	16 50N	81 35E	IIb	0	X	0	X	X	0	0	0
Narsapur	43187	16 26N	81 42E	I	X	X	X	X	X	X	X	X
Gannavaram	43181	16 42N	80 48E	I	X	X	X	X	X	X	X	X
Machlipatnam	43185	16 12N	81 09E	I	X	X	X	X	X	X	X	X
Bapatla	43220	15 54N	80 28E	I	0	X	X	X	X	0	0	0
Ongole	43221	15 30N	80 05E	I	X	X	X	X	X	X	X	X
Nellore	43245	14 27N	79 59E	I	X	X	X	X	X	X	X	X
Minambakkam	43279	13 00N	80 12E	I	X	X	X	X	X	X	X	X
Pondicherry	43331	11 58N	79 49E	I	X	X	X	X	X	X	X	X
Cuddalore	43329	11 46N	79 46E	I	X	X	X	X	X	X	X	X
Karaikal	43346	10 55N	79 50E	I	X	X	X	X	X	X	X	X
Nagapattinam	43347	10 46N	79 51E	I	X	X	X	X	X	X	X	X
Vedaranyam	43349	10 22N	79 51E	IIb	0	X	0	0	X	0	0	0
Adiramapattinam	43348	10 20N	79 23E	I	X	X	X	X	X	X	X	X
Tondi	43361	09 44N	79 02E	I	X	X	X	X	X	X	X	X
Pamban	43363	09 16N	78 18E	I	X	X	X	X	X	X	X	X
Tuticorin	43379	08 45N	78 11E	I0	0	X	X	X	X	0	0	0
Palayamkottai	43376	08 44N	77 45E	IIb	0	X	0	0	X	0	0	0
Kanniyakumari	43377	08 05N	77 30E	IIa	0	X	X	0	X	0	0	0
Kondul	43385	07 13N	93 44E	IIb	0	X	0	0	X	0	0	0
Nancowri	43382	07 59N	93 32E	IIb	0	X	0	0	X	0	0	0
Carnicobar	43367	09 09N	92 49E	IIb	X	X	X	X	X	X	X	X

Hut bay	43364	10 35N	92 33E	IIb0	0	X	0	0	X	0	0	0
Portblair	43333	11 40N	92 43E	I	X	X	X	X	X	X	X	X
Longisland	43310	12 25N	92 56E	IIb	0	X	0	0	X	0	0	0
Mayabandar	43309	12 55N	92 55E	IIb	0	X	0	0	X	0	0	0

Table 2. List of Foreign Coastal stations

Station	Index	Latitude	Longitude	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
SRILANKA											
Mannar	43413	08 59N	79 55E	X	X	X	X	X	X	X	X
Puttalam	43424	08 02N	79 50E	X	X	X	X	X	X	X	X
Galle	43495	06 02N	80 13E	X	X	X	X	X	0	X	0
Colombo	43466	06 54N	79 52E	X	X	X	X	X	X	X	X
Hambantota	43497	06 07N	81 08E	X	X	X	X	X	X	X	X
Batticloa	43436	07 43N	81 42E	X	X	X	X	X	X	X	X
Trincomalee	43418	08 35N	81 15E	X	X	X	X	X	X	X	X
Jaffna	43404	09 39N	88 01E	X	X	X	X	X	0	X	0
BANGLADESH											
Chandpur	41941	20 16N	90 42E	X	X	X	X	X	X	X	X
Barisal	41950	22 45N	90 22E	X	X	X	X	X	X	X	X
Majidcourt	41953	22 52N	91 06E	X	X	X	X	X	X	X	X
Patuakhali	41960	22 20N	90 20E	X	X	X	X	X	X	X	X
Hatia	41963	22 26N	91 06E	X	X	X	X	X	X	X	X
Sandwip	41964	22 29N	91 26E	X	X	X	X	X	X	X	X
Khepura	41984	21 59N	90 14E	X	X	X	X	X	X	X	X
Chittagong	41977	22 21N	91 49E	X	X	X	X	X	X	X	X
Cox'sBazzar	41992	21 26N	91 56E	X	X	X	X	X	X	X	X
Kutubdia	41989	21 49N	91 51E	X	X	X	X	X	X	X	X
Teknaf	41998	20 52N	92 18E	X	X	X	X	X	X	X	X
MYANMAR											
Sittwe	48062	20 08N	92 53E	X	X	X	X	X	0	X	0
Kyaukpyu	48071	19 25N	93 33E	X	X	X	X	X	0	X	0
Sandoway	48080	18 28N	94 21E	X	X	X	X	X	0	X	0
Pathein	48094	16 46N	94 46E	X	X	X	X	X	0	X	0
Yangon	48097	16 46N	96 10E	X	X	X	X	X	X	X	X
Moulmein	48103	16 30N	97 37E	X	X	X	X	X	0	X	0
Ye	48107	15 15N	97 52E	X	X	X	X	X	0	X	0
Dawei	48108	14 06N	98 13E	X	X	X	X	X	0	X	0
Mergui	48110	12 26N	98 36E	X	X	X	X	X	0	X	0
Bictoria Point	48112	09 58N	98 35E	X	X	X	X	X	0	X	0
THIALAND											
Phuket Airport	48565	08 07 N	98 19 E	X	X	X	X	X	X	X	X

Table 3. List of Co-operative Cyclone Reporting Network of Stations (Andhra Pradesh & Orissa)

S. No	Station	District	Nearest Telegraphic Office	Distance From Station
Andhra Pradesh				
	Palasa	Srikakulam	Palasa	2 km
2	Sompeta	Srikakulam	Sompeta	100 meters
3	Anakapalli	Vishakapatnam	Anakapalli	1.5 km
4	Rajamundry	East Godavari	Rajamundry	2.5 km
5	Yanam	East Godavari	Yanam	1.0 km
6	Razaole	East Godavari	Razaole	200 meters
7	Eluru	West Godavari	Eluru	1.0 km
8	Challapalli	Krishna	Challapalli	0.5 km
9	Avani Gadda	Krishna	Avani Gadda	200 meters
10	Nagayalanka	Krishna	Nagayalanka	1.0 km
11	Bantimalli	Krishna	Bantimalli	1.0 km
12	Kothapatnam	Prakasam	Kothapatnam	200 meters
13	Narasapuram	Nellore	Narasapuram	0.5 km
ORISSA				
1	Bhogral	Balasore	Bhogral	2Km
2	Basta	Balasore	Basta	1 Km
3	Bhadrak	Balasore	Bhadrak	2 Km
4	Bansara	Balasore	Bansara	2 Km
5	Rajkanika	Cuttack	Rajkanika	2 Km
6	Aul	Cuttack	Aul	2 Km
7	Rajnagar	Cuttack	Rajnagar	1 Km
8	Kendrapara	Cuttack	Kendrapara	2 Km
9	Mahakalpara	Cuttack	Mahakalpara	2 Km
10	Jagatsingpur	Cuttack	Jagatsingpur	1 Km
11	Ersama	Cuttack	Ersama	2 Km
12	Nimapara	Puri	Nimapara	0.5 Km
13	Brahmagiri	Puri	Brahmagiri	1 Km
14	Krishnaprasad	Puri	Krishnaprasad	0.5 Km
15	Chatrapur	Ganjam	Chatrapur	0.5 Km
16	Berhampur	Ganjam	Berhampur	3 Km

CHAPTER–III
IMPLEMENTATION OF FDP – 2013

3.1. Introduction

The objectives of the programme were met by conducting a joint observational communication and NWP effort by several institutes in the country during the period 15 Oct.-13 Dec.2013. There were 31 days of Intensive Observational Period (IOP) with 4 cyclonic disturbances over the Bay of Bengal.

The overall campaign was monitored and guided by a Weather Monitoring and Advisory Group (WMAG) at National Operation Centre (NOC) in NWFC, IMD. In addition, communication conferencing and data exchange were facilitated from this nodal cell.

Field Operational Centre (FOC) worked at Regional Meteorological Centre, Chennai in unison with the NOC coordinating all activities of every institution during the IOP.

3.2. Observational programme

The observational programme was taken up as per the project implementation plan prepared by NOC. However, the buoy data improved with 12 such stations in Bay of Bengal during the campaign in 2013.

IMD has augmented AWS network under its modernisation programme. The number of AWS/ Automatic Rain Gauge (ARG) stations in the country is 675 by the end of 2013. The AWS data including wind and pressure could very well help in monitoring the genesis, intensity, structure and movement of the landfalling cyclonic disturbances.

Availability of hourly observations without an observer's need at the site helped immensely the monitoring and prediction of cyclonic disturbances.

Eleven GPS sonde stations at Thiruvananthapuram, Mohanbari, Chennai, Port Blair, Minicoy, Goa, Hyderabad, Visakhapatnam, Patna, Srinagar and New Delhi helped in improving the initial conditions of the NWP models resulting in forecast also. The DWR products from Chennai and Machilipatnam helped immensely in monitoring and prediction of cyclonic storms.

3.3. Operation Management

The announcement of IOP was made by NOC. Field Operational Centre (FOC) worked at Regional Meteorological Centre, Chennai in unison with the NOC coordinating all activities of every institution during the IOP.

The following were the periods of IOP declared during 2013

IOP was declared for 31 days in view of Depression (13-17 Nov.2013)-7 days. The severe cyclonic strom, Helen (19-23 Nov.2013)-6 days, very severe cyclonic storm, Lehar (23-28 Nov2013)-5 days and very severe cyclonic storm, Madi (06-13 Dec.2013)-13 days over the Bay of Bengal

The following methods were used for monitoring and forecasting of cyclonic disturbances.

Genesis:

Genesis of the disturbances (formation of depression) was monitored and predicted using following methods.

- Synoptic
- Satellite
- NWP Models
- Dynamic Statistical Models
- Genesis Potential Parameter(GPP)

GPP was calculated based on a dynamic statistical model. It uses mainly the Gray's parameters for the IMD GFS model. If the GPP> 30, it suggests cyclogenesis, otherwise not.

Track forecasting:

i) Analogue Techniques
ii) Methods based on climatology
iii) Methods based on Persistence
iv) Climatology and persistence(CLIPER)
v) Synoptic Techniques
vi) Satellite Techniques
vii) Radar Technique
viii) NWP Models
- IMD GFS (T-574), NCMRWF(GFS),NCEP GFS, JMA, IMD WRF,
- ARP Model of Meteo France
- NCMRWF Unified Model
- HWRF

ix) Multi Model Ensemble (MME) technique developed by NWP Division
x) MME based on Tropical Cyclone Module (TCM)
xi) Ensemble Prediction System(EPS) (JMA, UKMO, ECMWF, NCEP)
xii) TIGGE (THORPEX Grand Global Ensemble) forecast

Operational consensus is based mainly on the above NWP guidance supported with synoptic and statistical guidance. The forecast was issued up to 72 hrs. lead time alongwith cone of uncertainty.

Intensity forecasting:

Intensity forecast was mainly based on deterministic NWP modelS, dynamical statistical model, synoptic, satellite and Radar inputs. However following techniques were used.

- Climatology persistence Analogue
- Synoptic
- Satellite

- Radar
- NWP Models (same as those for track forecasting)
- Dynamical Statistical Model: Statistical Cyclone Intensity Prediction (SCIP) model of IMD

Tropical Cyclone Module:

The Tropical Cyclone Module (TCM) installed in this forecasting system has the facilities to serve the above purpose. The automation of the process has increased the efficiency of system, visibility of IMD and utility of warning products.

The TCM installed in this forecasting system has the following facilities.

- Analysis of all synoptic, satellite, radar and NWP model products for genesis, intensity and track monitoring and prediction
- Preparation of past and forecast tracks upto 120 hrs.
- Depiction of uncertainty in track forecast
- Structure forecasting (Forecast of wind in four geographical quadrants of cyclone)
- However all the data are not still available in TCM through synergie system. For better monitoring and prediction, additional help is taken of ftp and websites

3.4. Achievements

3.4.1. Official forecast

During FDP-2013 only four cyclonic disturbances formed over the Bay of Bengal and one cyclonic disturbance formed over the Arabian Sea. Three of them intensified into a severe cyclonic storm namely HELEN (19– 23 Nov.), LEHAR (23 – 28 Nov.) and MADI (06 – 13 Dec.) whereas other intensified into a depression over Bay of Bengal (13 – 17 Nov.). The official landfall point & time, average track and intensity forecast errors are shown in Table 3.1-3.10 for these systems.

Table 3.1 Landfall point and time error of Cyclone 'HELEN over the Bay of Bengal (19 – 23 Nov 2013)

Lead Period	Landfall point and time forecast error (Difference of forecast landfall point and time and actual landfall point and time			
	Landfall point Error (km)	Landfall Time Error (hrs)	Long period average landfall point error(km) during 2008-12	Long period average landfall time error(hrs) during 2008-12
12	16	+ ½	41.6	2.5
24	12	+3 ½	90.8	5.5
36	129	-2 ½	102.7	8.5
48	188	-7 ½	95.8	7.3
60	184	-8 ½	67.7	2.2

Table 3.2 Average track forecast errors (Direct position error in Km) of cyclone, Helen

Lead Period	Track Forecast Error (km)	Long period average (2008-2012)
12	46.7 (11)	75.4
24	97.6 (09)	132.6
36	165.9 (07)	190.2
48	236.5 (05)	253.6
60	317.1 (03)	308.9

Table 3.3 Average Intensity forecast error of cyclone, Helen

Lead Period of forecast	Intensity Error (knots)		No. of Forecasts verified
	Average	RMS	
12	5.7	6.9	11
24	7.8	9.2	10
36	6.8	8.4	9
48	8.6	11.7	7
60	7.9	8.5	5
72	6.7	7.8	3

Table 3.4 Landfall point and time error of Cyclone 'LEHAR" the Bay of Bengal (23 – 28 Nov 2013)

Lead Period	Landfall point and time forecast error (Difference of forecast landfall point and time and actual landfall point and time)			
	Landfall point Error (km) (Forecast landfall point- Actual landfall point)	Landfall Time Error (Forecast landfall time- Actual landfall time) (hrs)	Long period average landfall point error(km) during 2008-2012	Long period average landfall time error(hrs) during 2008-2012
12	50	-½	41.6	2.5
24	20	+5 ½	90.8	5.5
36	52	+½	102.7	8.5
48	83	+2 ½	95.8	7.3
60	156	+½	67.7	2.2
72	156	-2 ½	134.8	1.2
84	156	-2 ½	-	-
96	156	-1	-	-
108	162	-1½ hr	-	-

Table 3.5 Average track forecast errors (Direct position error in Km) of cyclone, Lehar

Lead Period	Intensity Forecast Error (knots)		Long period Average (2008-2012):Absolute Error (knots)	Long period Average (2008-2012): RMS Error (knots)
	Absolute error	Root mean square error		
12	10.2	13.4	7.3	9.9
24	18.4	24.5	10.4	13.5
36	25.5	33.1	12.7	16.1
48	29.2	38.0	13.4	17.8
60	32.4	39.3	13.4	15.3
72	41.0	47.3	19.0	24.0
84	47.0	49.6	-	-
96	48.5	54.3	-	-
108	34.5	36.9	-	-
120	-	-	-	-

Table 3.6 Average Intensity forecast error of cyclone, Lehar

Lead Period	Intensity Forecast Error (knots)		Long period Average (2008-2012):Absolute Error (knots)	Long period Average (2008-2012): RMS Error (knots)
	Absolute error	Root mean square error		
12	10.2	13.4	7.3	9.9
24	18.4	24.5	10.4	13.5
36	25.5	33.1	12.7	16.1
48	29.2	38.0	13.4	17.8
60	32.4	39.3	13.4	15.3
72	41.0	47.3	19.0	24.0
84	47.0	49.6	-	-
96	48.5	54.3	-	-
108	34.5	36.9	-	-
120	-	-	-	-

Table 3.7 Average track forecast errors (Direct position error in Km) of cyclone, MADI (06 – 13 Dec) in Bay Of Bengal

Lead Period (hrs)	Track Forecast Error in km	Long period average (2008-2012)
12	49.5 (21)	75.4
24	88.5 (19)	132.6
36	115.4 (17)	190.2
48	150.0 (17)	253.6
60	196.4 (15)	308.9
72	231.2 (13)	376.1
84	272.2 (11)	-
96	313.4 (9)	-
108	438.0 (7)	-
120	462.6 (4)	-

Table 3.8 Average Intensity forecast error of cyclone, MADI

Lead Period	Intensity Forecast Error (knots)		Long period Average (2008-2012):Absolute Error (knots)	Long period Average (2008-2012): RMS Error (knots)
	Absolute error	Root mean square error		
12	5.0 (23)	6.5 (23)	7.3	9.9
24	6.6 (21)	8.1 (21)	10.4	13.5
36	8.8 (19)	10.6 (19)	12.7	16.1
48	8.7 (17)	9.9 (17)	13.4	17.8
60	7.5 (15)	8.9 (15)	13.4	15.3
72	7.3 (13)	9.8 (13)	19.0	24.0
84	9.0 (11)	11.8 (11)	-	-
96	11.3 (09)	13.0 (09)	-	-
108	14.8 (07)	15.2 (07)	-	-
120	14.2 (05)	14.4 (05)	-	-
24	6.6 (21)	8.1 (21)	10.4	13.5
36	8.8 (19)	10.6 (19)	12.7	16.1
48	8.7 (17)	9.9 (17)	13.4	17.8
60	7.5 (15)	8.9 (15)	13.4	15.3
72	7.3 (13)	9.8 (13)	19.0	24.0
84	9.0 (11)	11.8 (11)	-	-
96	11.3 (09)	13.0 (09)	-	-
108	14.8 (07)	15.2 (07)	-	-
120	14.2 (05)	14.4 (05)	-	-

Table 3.9 Average track forecast errors (Direct position error in km) for deep depression over Bay of Bengal (17-19 Nov. 2013)

Lead time (hours)	Direct position error (km)	Number of forecasts verified
12	55	6
24	66	5
36	80	3
48	55	1

Table 3.10 Average Intensity forecast error for deep depression over Bay of Bengal (17-19 Nov. 2013)

Lead Period of forecast	Intensity Error (knots)		No. of forecasts verified
	Average	RMS	
12	16.4	18.4	6
24	14.9	16.3	5
36	9.1	9.4	3
48	9.7	9.7	1

Mean landfall forecast has been less than the long period average and has decreased. Track forecast has been issued upto 120 hrs. lead period during 2013. However, track and landfall error can be further reduced. Intensity forecast still needs improvements.

3.4.2 NWP models forecast performance

3.4.2.1 Introduction:

India Meteorological Department (IMD) operationally runs one regional models, WRF for short-range prediction and one Global model T574L64 for medium range prediction (7 days). The WRF-Var model is run at the horizontal resolution of 27 km, 9 km and 3 km with 38 Eta levels in the vertical and the integration is carried up to 72 hours over three domains covering the area between lat. 25^{o} S to 45^{o} N long 40^{o} E to 120^{o} E. Initial and boundary conditions are obtained from the IMD Global Forecast System (IMD-GFS) at the resolution of 23 km. The boundary conditions are updated at every six hours interval. IMD also makes use of NWP products prepared by some other operational NWP Centres like, ECMWF (European Centre for Medium Range Weather Forecasting), GFS (NCEP), JMA (Japan Meteorological Agency). A multi-model ensemble (MME) for predicting the track of tropical cyclones for the Indian Seas is developed. The MME is developed applying multiple linear regression technique using the member models IMD-GFS, IMD-WRF, QLM, GFS (NCEP), ECMWF and JMA. In addition to the above NWP models, IMD also run operationally the SCIP model for 12 hourly intensity predictions upto 72h and Genesis potential parameter (GPP) for potential of cyclogenesis and forecast for potential cyclogenesis zone. In this report performance of these individual models, MME forecasts, SCIP and GPP for cyclones during FDP-2013 are presented and discussed.

Recently the Hurricane WRF (HWRF) model and Ensemble prediction system (EPS) has been implemented at the NWP Division of the IMD HQ for operational forecasting of cyclones and a rapid intensification index (RII) is developed for the probability forecast of rapid intensification (RI). The performances of these models for cyclones during FDP-2013 are also presented.

Cyclonic storm "HELEN" (28 October-01 November, 2013)

(a) Genesis

Analysis of Genesis Potential Parameter (GPP) values computed (Kotal et al, 2009) for cyclone 'HELEN' on the basis of real time model analysis fields along with the GPP values for Developing Systems and Non-Developing Systems are shown in Table 3.11. The higher GPP values (> 8.0, the threshold value) at early stages of development (T.No. 1.0, 2.0) have clearly indicated that the cyclone "HELEN" had enough potential to intensify into a developing system (>35 knots).

Table 3.11 GPP ($x10^{-5}$) for Developing System, Non-Developing System and Cyclone "HELEN"

Date/Time	27.10.2013 0000 UTC	28.10.2013 0000 UTC	29.10.2013 0000 UTC
T.No. →	**1.0**	**1.0**	**2.0**
Developing	11.1	11.1	13.3
Non-Developing	3.4	3.4	4.6
HELEN	**17.7**	**20.5**	**19.2**

(b) Track

The average track forecast errors for different NWP models are shown in Table 3.12. The 24 hrs error ranged from 96 km for HWRF to 193 km for WRF(IMD).

Table 3.12 Average Track forecast errors (Direct position error in Km) (28 October-01 November 2013): HELEN

Models	**Lead time →**					
	12 hr	**24 hr**	**36 hr**	**48 hr**	**60 hr**	**72 hr**
ECMWF	87 (4)	109 (4)	110 (3)	113 (3)	105 (2)	171 (2)
GFS (NCEP)	127 (4)	110 (4)	74 (3)	135 (3)	146 (3)	137 (2)
JMA-25	119 (4)	105 (4)	114 (3)	186 (3)	224 (3)	206 (2)
QLM (IMD)	130 (3)	182 (3)	180 (2)	319 (2)	269 (2)	-
MME (IMD)	97 (4)	99 (4)	72 (3)	113 (3)	97 (3)	130 (2)
GFS (IMD)	117 (4)	168 (4)	118 (3)	129 (3)	186 (3)	233 (2)
WRF(IMD)	113 (4)	193 (4)	118 (3)	225 (3)	232 (3)	353 (2)
HWRF	41 (4)	96 (4)	150 (3)	206 (1)	-	-

(c) Intensity

The average absolute intensity forecast errors for different NWP models are shown in Table 3.13 & 3.14. The average absolute intensity forecast error for SCIP is ranging from 5kts to 8 kts and for HWRF model it is higher in short range (up to 24 hrs.) and gradually deceases with increase in forecast lead time.

Table 3.13 Average Absolute Intensity forecast error (SCIP) for TC HELEN

Date/Time	**Error (knots)**					
	Forecast hours					
	12 hr	**24 hr**	**36 hr**	**48 hr**	**60 hr**	**72 hr**
00/28.10.12	-1	-2	+6	+9	+5	+6
00/29.10.12	+5	+8	-4	-7	-5	-
00/30.10.12	-5	-7	-5	-	-	-
00/31.10.12	+14	+11	-	-	-	-
Average Absolute Error(AAE) (knots)	6.3	7.0	5.0	8.0	5.0	6.0

Table 3.14 Average Absolute Intensity forecast error (HWRF) for TC HELEN

Date/Time	Error (knots)				
	Forecast hours				
	12 hr	24 hr	36 hr	48 hr	60 hr
00/29.10.12	+17	+14	+5	-4	-1
00/30.10.12	+18	+20	+7	+9	-
12/30.10.12	+32	+16	+15	-	-
00/31.10.12	+27	+8	-	-	-
Average Absolute Error(AAE) (knots)	**23.5**	**14.5**	**9.0**	**6.5**	**1.0**

(d) Landfall forecast error

The landfall point and landfall time forecast errors for different models for different lead times are shown in Table 3.15 & 3.16.

Table 3.15 Landfall forecast error (km); F/C-Forecast; L/F-Land Fall

Model	12 (11:00) based on 31.10.2013	36 (35:00) based on 30.10.2013	60 (59:00) based on 29.10.2013
	F/C	F/C	F/C
ECMWF	11	156	156
NCEP-GFS	95	16	183
JMA-25	At L/F Point	At L/F Point	95
IMD-QLM	167	267	139
IMD-MME	At L/F Point	16	95
IMD-T574	16	16	No L/F
IMD-WRF	16	16	358
HWRF	55	49	236 (based on 29.10.2013/1200UTC)

Table 3.16 Landfall time error (in Hour Min.). (E- Early; D- Delay; F/C-Forecast)

Model	12 (11:00) based on 31.10.2013	36 (35:00) based on 30.10.2013	60 (59:00) based on 29.10.2013
	F/C	**F/C**	**F/C**
ECMWF	at L/F Time	02:00D	08:00D
NCEP-GFS	02:00E	01:00E	10:00E
JMA-25	06:00D	07:00D	08:00D
IMD-QLM	01:00D	22:00D	11:00E
IMD-MME	03:00D	02:00D	03:30E
IMD-T574	03:00D	00:30D	No L/F
IMD- WRF	01:00D	at L/F Time	03:00E
HWRF	01:00D	07:30E	11:00E(based on 29.10.2013/1200UTC)

Deep Depression (17-19 November, 2013)

(a) Genesis

Analysis of Genesis Potential Parameter (GPP) values computed (Kotal et al, 2009) for Depression on the basis of real time model analysis fields along with the GPP values for Developing Systems and Non-Developing Systems are shown in Table 3.17. Although the higher GPP values (> 8.0, the threshold value) at early stages of development at 0000 UTC of 17.11.2013 (T.No. 1.0) have indicated that the Depression had potential to intensify into a developing system (>35 knots) but on subsequent hours 0000 UTC of 18.11.2013 and 19.11.2013 clearly indicated weakening of the system, as GPP was less than the threshold value 8.0.

Table 3.17 GPP ($x10^{-5}$) for Developing System, Non-Developing System and the Depression

Date/Time	17.11.2013 0000 UTC	18.11.2013 0000 UTC	19.11.2013 0000 UTC
T.No. →	1.0	2.0	1.5
Developing	11.1	13.3	11.1
Non-Developing	3.4	4.6	3.4
Depression	13.7	6.6	3.7

(b) Track

The average track forecast errors for different NWP models are shown in Table 3.18. The 12 hrs error ranged from 1 km for GFS(IMD) to 69 km for ECMWF.

Table 3.18 Average track forecast errors (Direct position error in Km) (18 November-19 November 2013)

Models	Lead time		
	12 hr	24 hr	36 hr
ECMWF	69 (2)	133 (1)	131 (1)
GFS(NCEP)	27 (2)	56 (1)	111 (1)
JMA-25	46 (2)	116 (1)	140 (1)
MME (IMD)	20 (2)	70 (1)	86 (1)
GFS (IMD)	1 (2)	56 (1)	56 (1)
WRF(IMD)	32 (2)	139 (1)	216 (1)
HWRF	63(2)	135(1)	177(1)

(c) Intensity

The average absolute intensity forecast errors for different NWP models are shown in Table 3.19 & 3.20. The average absolute intensity forecast error for SCIP is ranging from 1 kt to 3 kts and for HWRF model it is ranging from 5 to 13 kts.

Table 3.19 Average Absolute intensity forecast error (SCIP) for DD

Date/Time	Error (knots)		
	Forecast hours		
	12 hr	24 hr	36 hr
00/18.11.12	0	+1	+3
00/19.11.12	+5	-	-
Average Absolute Error(AAE) (knots)	**2.5**	**1.0**	**3.0**

Table 3.20 Average Absolute intensity forecast error (HWRF) for DD

Date/Time	Error (knots)		
	Forecast hours		
	12 hr	24 hr	36 hr
00/18.11.12	+5	+5	+13
00/19.11.12	+6	-	-
Average Absolute Error(AAE) (knots)	**5.5**	**5.0**	**13.0**

CHAPTER-IV

CYCLONIC ACTIVITIES OVER THE BAY OF BENGAL DURING PILOT PHASE - 2013

4.1 Introduction

During the year 2013, 10 cyclonic disturbances developed over NIO including one deep depression over Arabian Sea, one land depression and 8 cyclonic disturbances over Bay of Bengal. Out of 8 disturbances in Bay of Bengal, 3 intensified into Very Severe Cyclonic Storm (VSCS), one each into a Severe Cyclonic Storm (SCS) & Cyclonic Storm (CS), and three upto depressions. Considering season-wise distribution, out of 10 disturbances, 2 developed during pre-monsoon, 2 during monsoon and 6 during post-monsoon seasonas shown in Table 4.1. The track of cyclonic disturbances formed over the NIO during the year are shown in Fig. 4.1

During pilot phase-2013**,** one depression and 3 cyclones Helen, Lehar and Madi formed over the Bay of Bengal.The salient features of these systems are discussed in section 4.2.

Table 4.1: Cyclonic disturbances formed over north Indian Ocean and adjoining land areas during 2013

1.	Cyclonic storm Viyaru over the Bay of Bengal (10-16 May 2013)
2.	Depression over the Bay of Bengal (29-31 May 2013)
3.	Depression over the Bay of Bengal (30 July-01 Aug. 2013)
4.	Land Depression (20-23 Aug.2013)
5.	Very Severe cyclonic storm Phailin over the Bay of Bengal (08-14 Oct. 2013)
6.	Deep Depression over Arabian Sea (08-11 Nov.2013)
7.	Depression over the Bay of Bengal 13-17 Nov.2013
8.	Severe cyclonic storm Helenover the Bay of Bengal (19-23 Nov.2013)
9.	Very Severe cyclonic storm over the Bay of Bengal Lehar (23-28 Nov2013)
10.	Very Severe cyclonic storm over the Bay of Bengal Madi (06-13 Dec.2013)

4.2 Salient features of the systems formed during FDP Phase-2013

4.2.1 Depression over the Bay of Bengal (13 – 17 November 2013)

4.2.1.1 Introduction

A depression formed over southwest and adjoining southeast Bay of Bengal on 13th November 2013 near latitude 11.50N and longitude 86.50E, about 700 km east-southeast of Chennai. The system crossed Tamil Nadu coast near Nagapattinam around 0730 UTC of 16th November, 2013. It then moved westwards and weakened gradually into a well marked low pressure area over north interior Tamil Nadu at 0000 UTC of 17th November, 2013. The salient features of this depression are given below:

(i) The depression initially moved westward and then it moved southwestwards and after that it moved west-northwestwards up to north interior Tamil Nadu.

(ii) Due to its slow movement over north Tamil Nadu, it caused very good rainfall activity over the region.

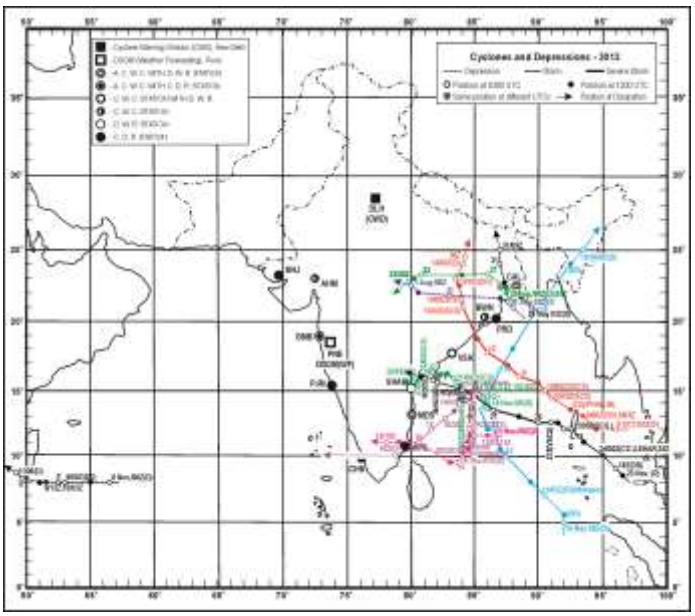


Fig. 4.1 Tracks of the cyclonic disturbances formed over the north Indian Ocean during the year, 2013

4.2.1.2 Genesis

The remnant of the tropical depression (Wilma) over south China Sea moved over Malay peninsula and emerged as a low pressure area over Andaman Sea & neighbourhood with associated upper air cyclonic circulation extending upto mid-tropospheric levels on 9th November, 2013. It lay over southeast Bay of Bengal and adjoining Andaman & Nicobar Islands on 10th November. It lay as a well marked low pressure area on 11th and persisted over the same region on 12th. It further concentrated into a depression and lay centred at 0300 UTC of 13th near lat. 11.5°N and long. 86.0°E, about 650 km east-southeast of Chennai. The low level convergence and relative vorticity increased over the south Bay of Bengal. The sea surface temperature over southwest Bay of Bengal was also warmer (28-30°C). The ocean thermal energy was about 80-100 KJ/cm2over the region. The Madden Julian Oscillation (MJO) index lay in phase 3 during these periods with amplitude less than 1. Past studies indicate that phase 3 is favourable for genesis of depression as it helps in enhancing the convection. The vertical wind shear was moderate to high (15-25 knots).. Under these conditions the depression formed at 0000 UTC of 13th November near Lat. 11.5°N/Long. 86.5°E. The best track position and other parameters of depression is given in Table 4.2.1.1 and the track of the depression is given in Fig. 4.1. The typical satellite imageries, DWR Chennai imageries and IMD GFS MSLP and wind at 850, 500 and 200 hPa are shown in Fig. 4.2.1.1-3 respectively.

Table 4.2.1.1 Best track positions and other parameters of Depression over the Bay of Bengal during 13 – 17 November, 2013

Date	Time (UTC)	Centre lat.^{0} N/ long.^{0} E	C.I. NO.	Estimated Central Pressure (hPa)	Estimated Maximum Sustained Surface Wind (kt)	Estimated Pressure drop at theCentre (hPa)	Grade
13.11.2013	0000	11.5/86.5	1.5	1004	25	3	D
	0300	11.5/86.0	1.5	1004	25	3	D
	0600	11.5/86.0	1.5	1004	25	3	D
	1200	11.5/86.0	1.5	1003	25	3	D
	1800	11.5/85.5	1.5	1003	25	3	D
14.11.2013	0000	11.5/85.0	1.5	1003	25	3	D
	0300	11.5/85.0	1.5	1003	25	3	D
	0600	11.5/85.0	1.5	1003	25	3	D
	1200	10.5/84.5	1.5	1003	25	3	D
	1800	10.5/84.5	1.5	1003	25	3	D
15.11.2013	0000	10.0/84.0	1.5	1003	25	3	D
	0300	9.5/83.5	1.5	1003	25	3	D
	0600	9.5/83.5	1.5	1003	25	3	D
	1200	9.5/83.0	1.5	1003	25	3	D
	1800	10.0/82.0	1.5	1003	25	3	D
16.11.2013	0000	10.5/81.5	1.5	1003	25	3	D
	0300	11.0/80.5	1.5	1003	25	3	D
	0600	11.0/80.0	1.5	1003	25	3	D
	Crossed Tamil Nadu coast near Nagapattinam at 0730 UTC of 16.11.2013						
	0900	11.0/79.5	-	1004	25	3	D
	1200	11.0/79.0	-	1004	25	3	D
17.11.2013	0000	Weakened into a well marked low pressure area over north interior Tamil Nadu & neighbourhood.					

4.2.1.3 Intensification and movement

The depression initially moved westwards upto 0600 UTC of 14th November 2013. After that the system moved southwestwards till 1200 UTC of 15th November, 2013 and then moved west-northwest wards and crossed Tamil Nadu coast near Nagapattanam around 0730 UTC of 16th November, 2013. It weakened into a well-marked low pressure area over north interior Tamil Nadu at 00 UTC of 17th November 2013.

Though most of the NWP models suggested slow intensification upto deep depression stage, the system did not intensify into a deep depression due to increase in vertical wind shear as the system moved towards the coast. The wind shear became high (20-30 knots) in the evening of 14th November. Due to the high wind shear, the convection got sheared gradually. Further the low amplitude of MJO was not supportive for

intensification of the system. The Ocean thermal energy was also less over southwest Bay of Bengal near to Sri Lanka and Tamil Nadu. As the system came closer to Tamil Nadu coast, it did not weaken and maintained its intensity of depression due to decrease in vertical wind shear. The wind shear was low to moderate (10-20 knots) at 1200 UTC of 15th Nov 2013. As a result, the system crossed coast as a depression.

The upper tropospheric ridge ran along 13-14° N throughout the life period of the system. Hence the depression lay to the south of the upper tropospheric ridge. The system moved southwestwards on 14th and 15th November, 2013, under the influence of the mid-tropospheric steering ridge. It then started moving west-northwestwards under the influence of the anticyclonic circulation lying to the northeast of the system centre. The convective cloud which was lying to the southwest of the system centre, shifted to the west and northwest indicating west-northwestward movement of the system.

4.2.1.4 Realised Weather

Chief amounts of 24 hrs. Rainfall (7 cm or more) ending at 0300 UTC from 14th November to 18th November, 2013 are given below:

14 November 2013

Tamilnadu & Puducherry: Srivaikuntam 7

16 November 2013

Tamilnadu & Puducherry: Chidambaram AWS 7**.**

17 November 2013

Coastal Andhra Pradesh: Tada 9, Atmakur 7, Sriharikota 7

Rayalaseema: Tirumalla 9

Tamilnadu & Puducherry: Mayiladuthurai 22, Tirupattur AP 14, Sathanur Dam 13, Vandavasi 13, Chembarabakkam 13, Chennai AP 12, Tirupattur Town 12, Poonamallee 12, Tiruvallur 11, Maduranthagam 11, Musiri 11, Gingee 11, Harur 11, Tindivanam 10, Upper Anaicut 10, Pondicherry 10, Tiruttani 10, Pullambadi 10, Uthangarai 9, Poondi 9, Pochampalli 9, Mylam AWS 9, Dharmapuri PTO 9, Thiruvalangadu 9, Thogamalai 9, Lalgudi 9, Penucondapuram 9, Panchapatti 8, Chettikulam 8, Venbavur 8, Thuraiyur 8, Thuvakudi Imti 8, Vanur 8, Dharamapuri 8, Anaikaranchatram(Kollid 8, Chennai(N) 8, Samayapuram 8, Tozhudur 8, Barur 8, Tiruvannamalai 8, Anna University 7, Chengam 7, Mayanur 7, Perambalur 7, DGP Office 7, Jayamkondam 7, Thammampatty 7, Thathiengrpet 7, Padalur 7, Virudachalam 7, Tirukoilur 7, Coonoor PTO 7, Pallipattu 7, Grand Anaicut 7, Ulundurpet 7, Alangayam 7, Palacode 7,

Sirkali 7, Chidambaram 7, Thiruvidaimaruthur 7, Trangambadi(Or)Tranqueb 7, Uthiramerur 7

South Interior Karnataka: M M Hills 7.

18 November 2013

Coastal Andhra Pradesh: Kavali 7, Nellore 7, Kerala: Vadakkancherry 7, Irinjalakuda 7, Lakshadweep:Amini 7.

4.2.1.5 Damage: No damage has been reported due this system.

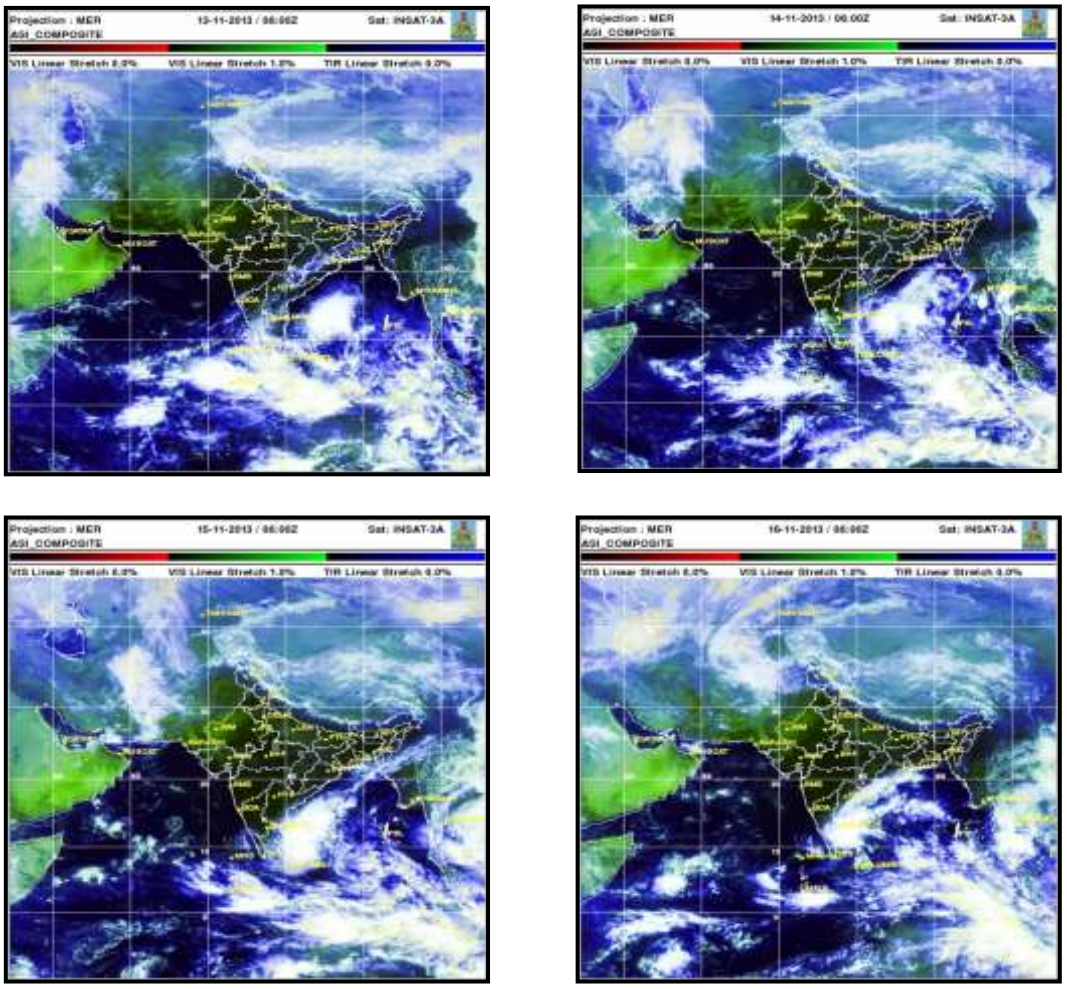
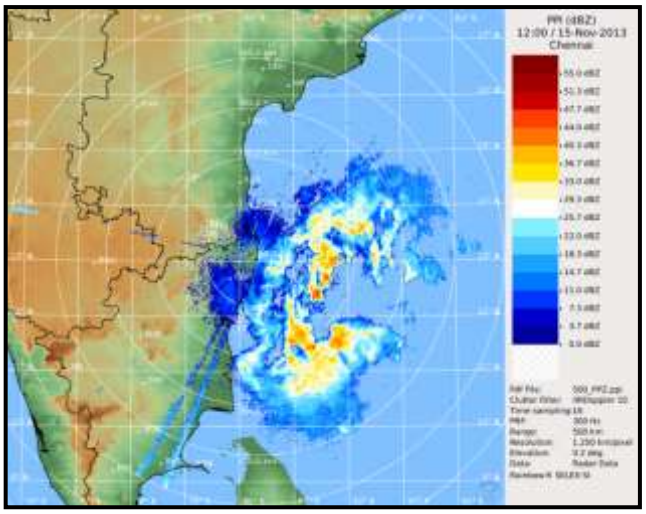
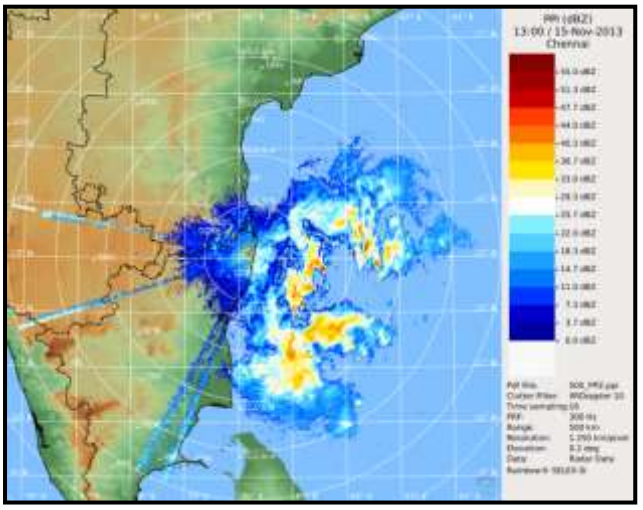
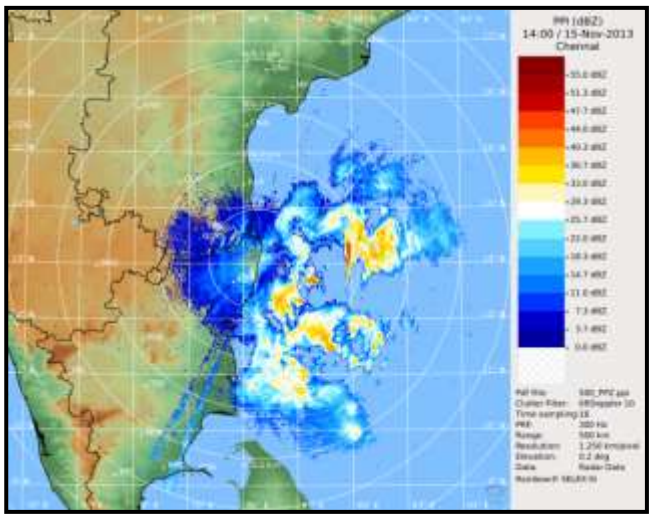


Fig.4.2.1.1 Typical satellite imageries showing genesis, intensification, movement of the depression (13-16 November 2013)







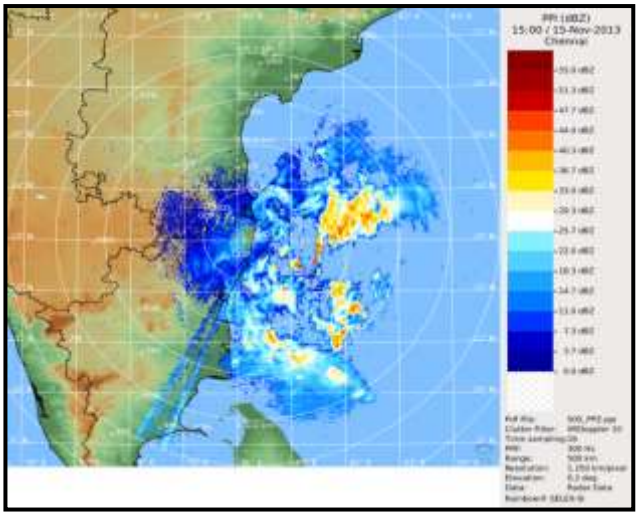


Fig. 4.2.1.2(a) DWR Chennai imageries based on 12,13,14 & 15 UTC of 15th November 2013 during depression over Bay of Bengal.

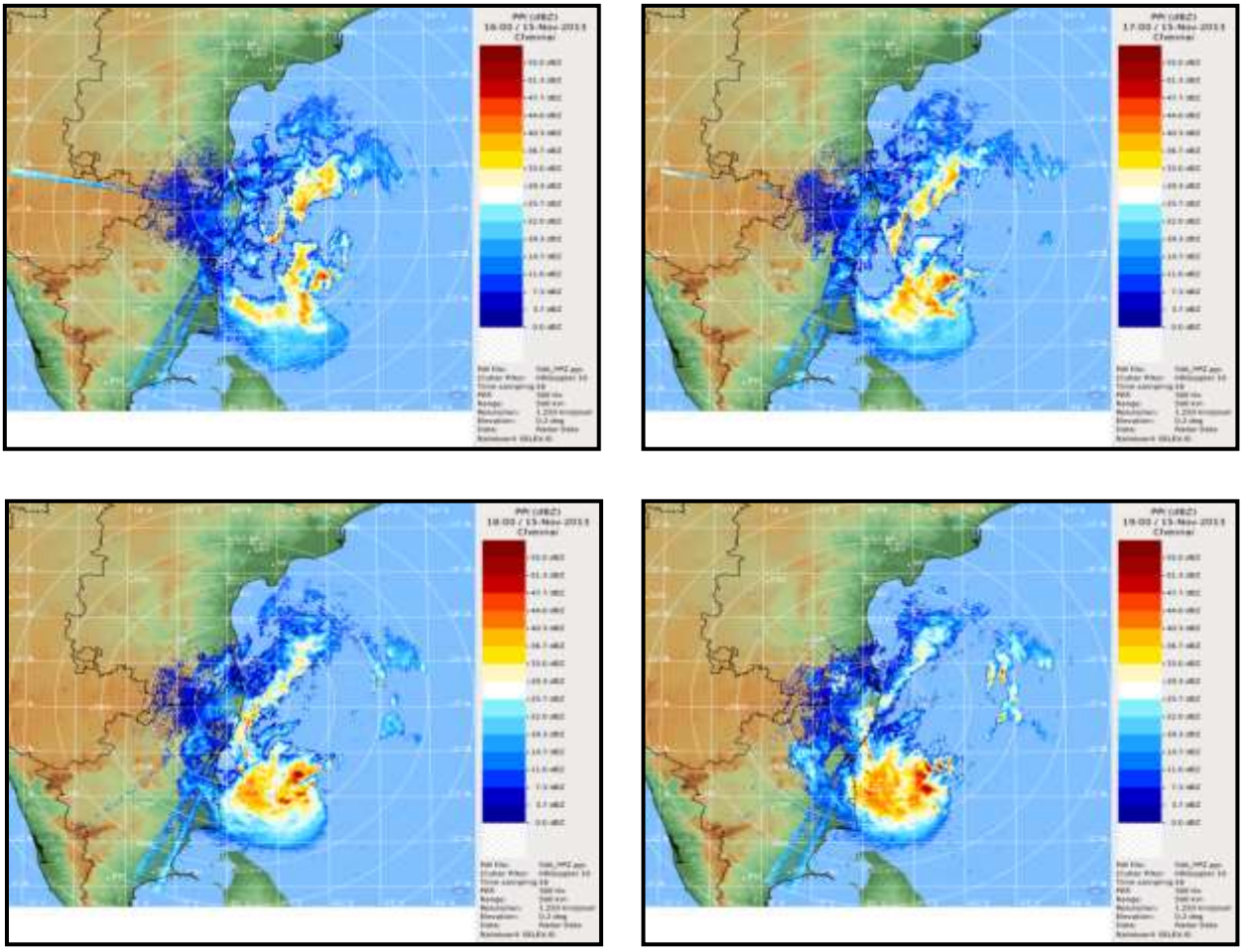


Fig.4.2.1.2.(b) DWR Chennai imageries based on 16,17,18 & 19 UTC of 15 November 2013 during depression over Bay of Bengal.

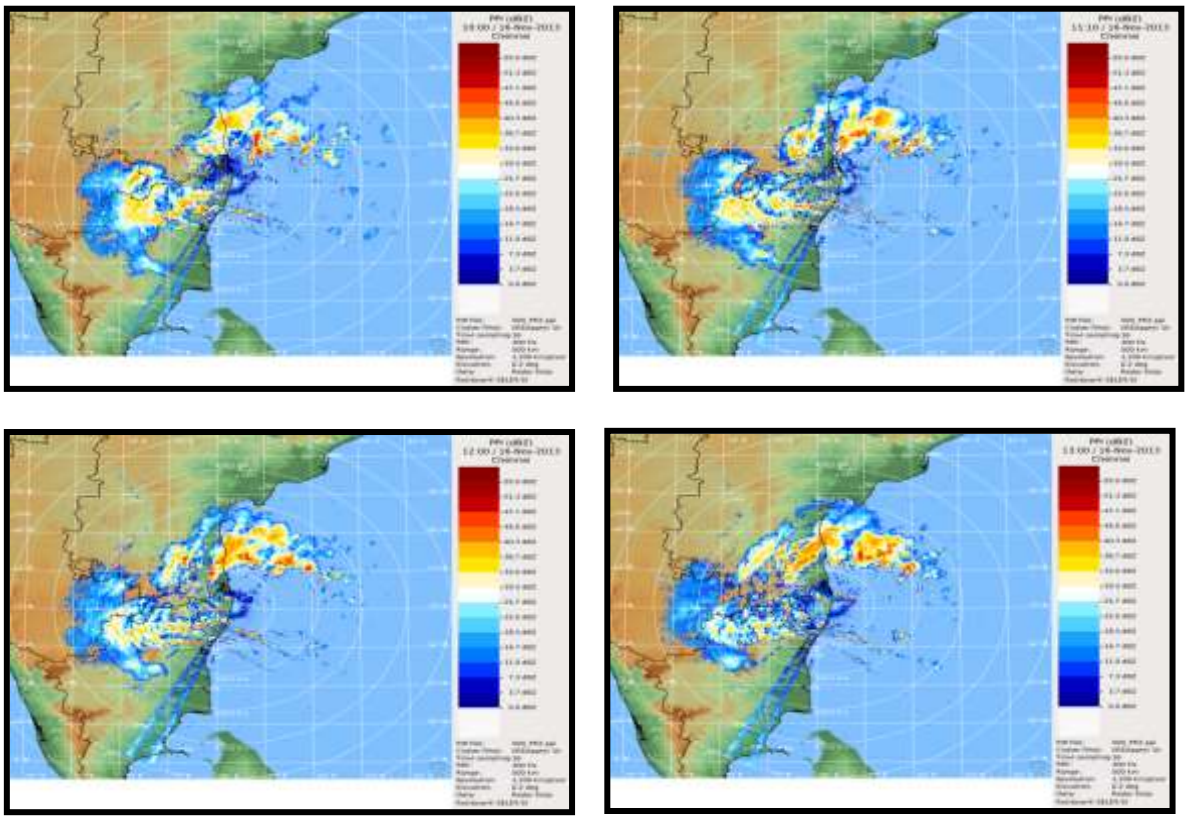


Fig.4.2.1.2.(c) DWR Chennai imageries based on 10,11,12 & 13 UTC of 16th November 2013 during depression over Bay of Bengal.

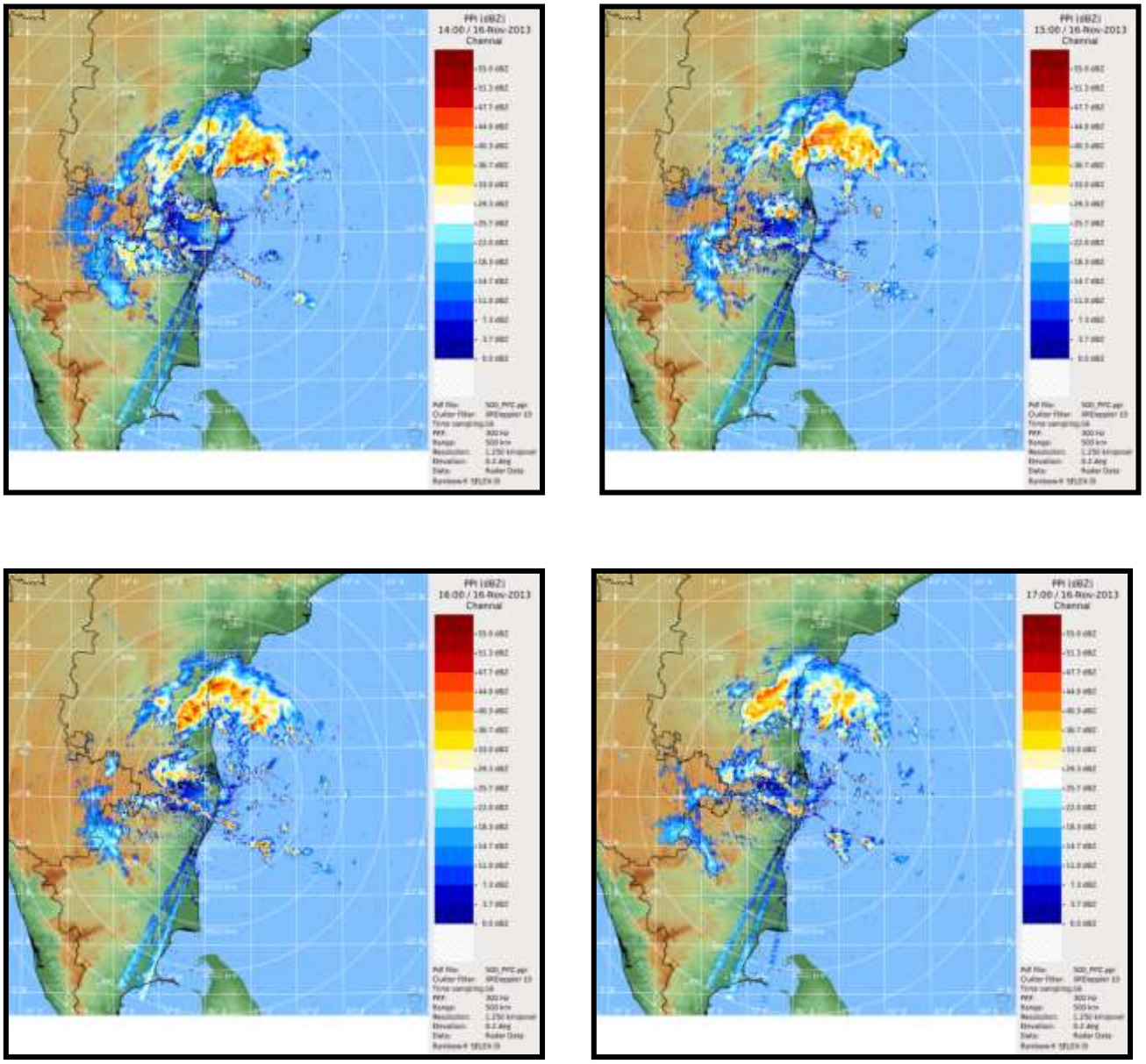


Fig.4.2.1.2(d) DWR Chennai imageries based on 14,15,16 & 17 UTC of 16th November 2013 during depression over Bay of Bengal.

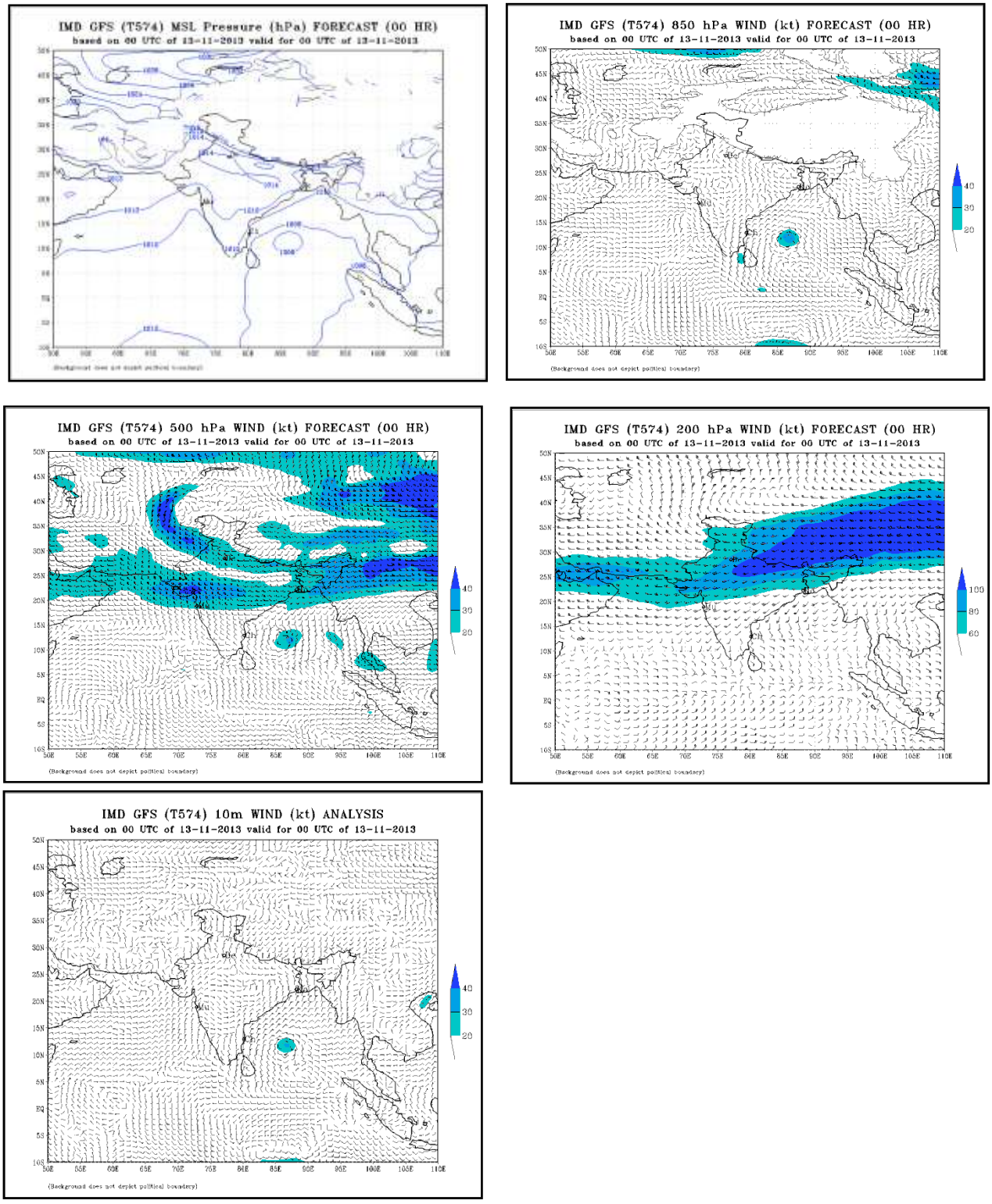
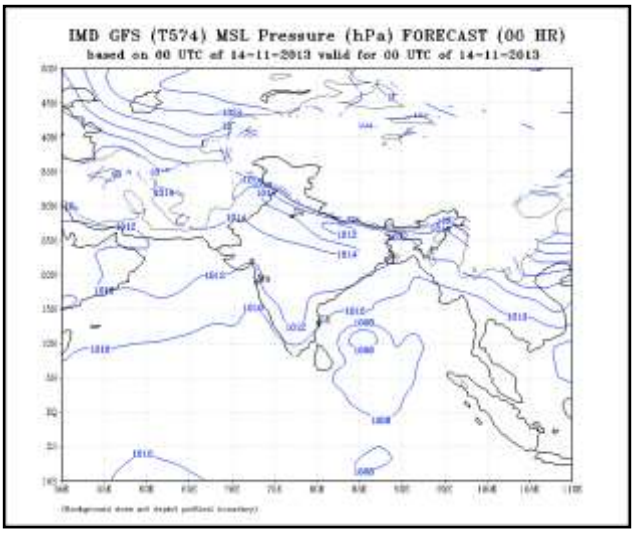
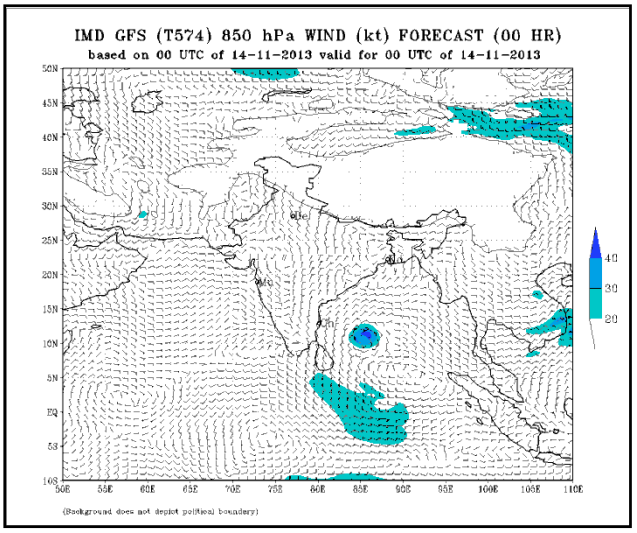
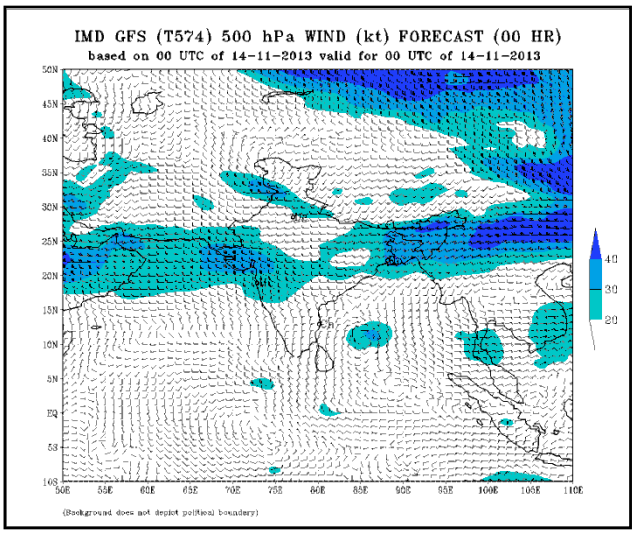
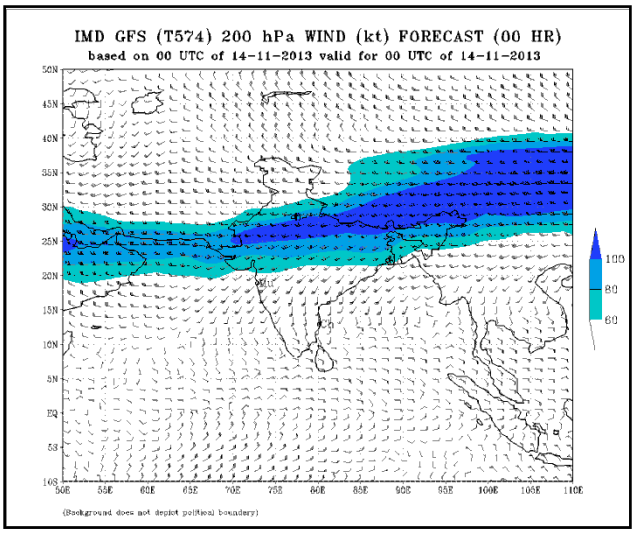


Fig. 4.2.1.3 (a) IMD GFS MSLP and winds at 850, 500 & 200 hPa levels analysis and 10 meter wind based on 00 UTC of 13th November, 2013.









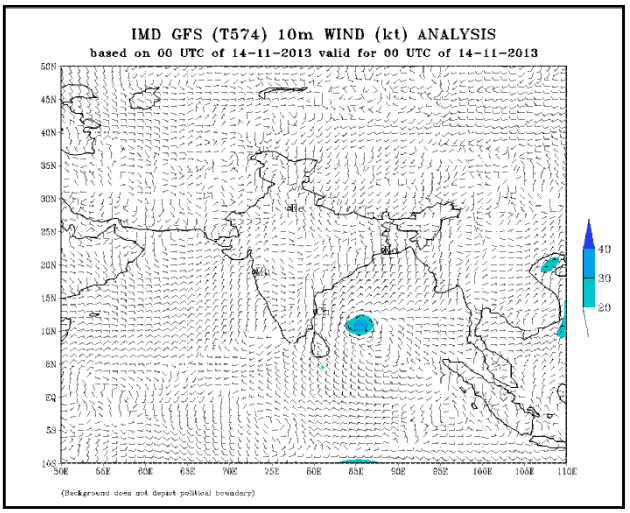
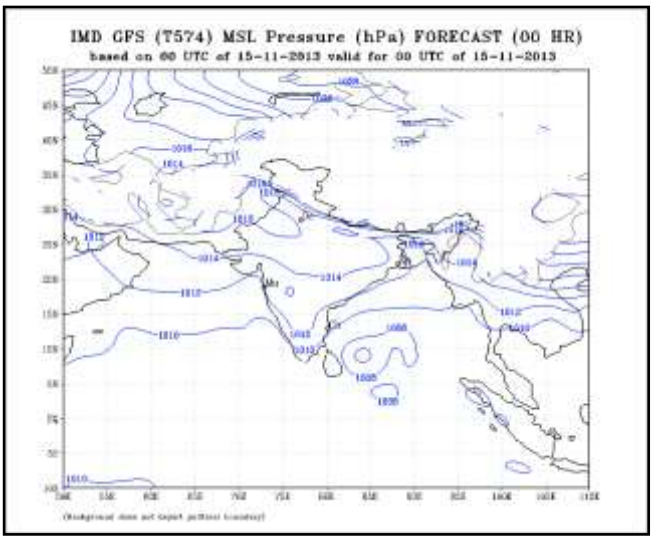
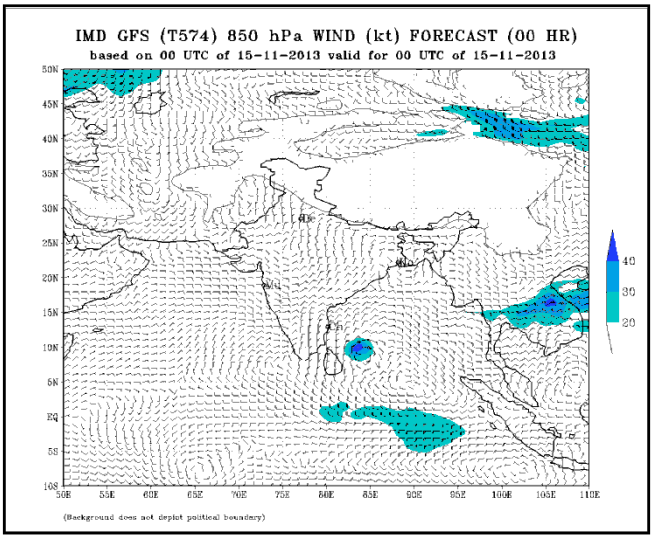
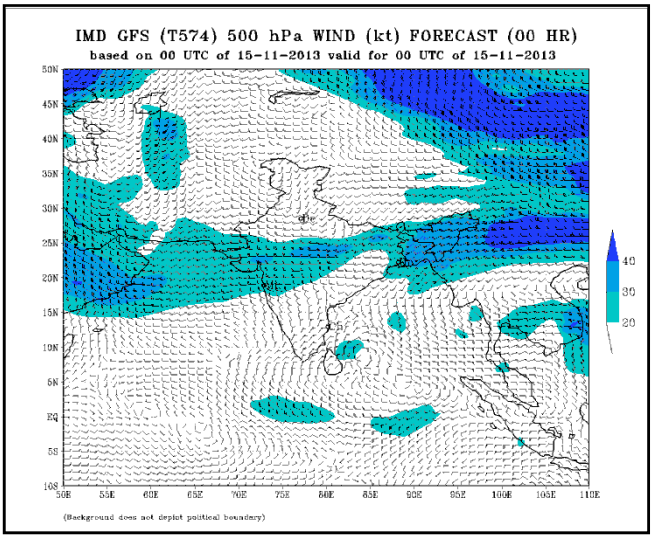
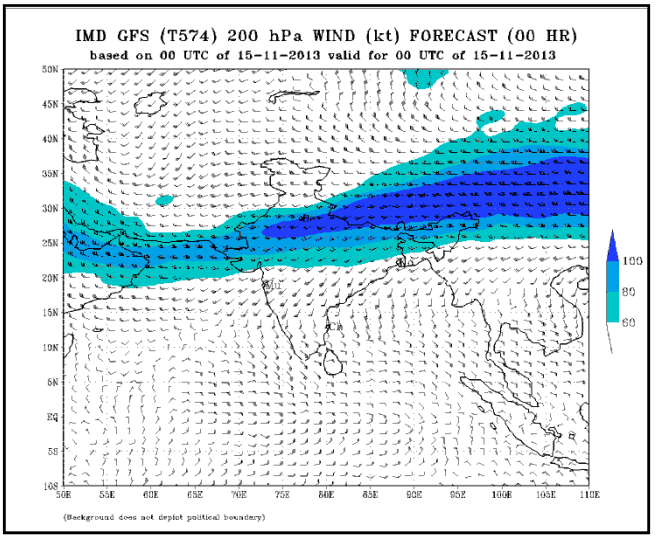


Fig. 4.2.1.3(b) IMD GFS MSLP and winds at 850, 500 & 200 hPa levels analysis and 10 meter wind based on 00 UTC of 14th November, 2013.









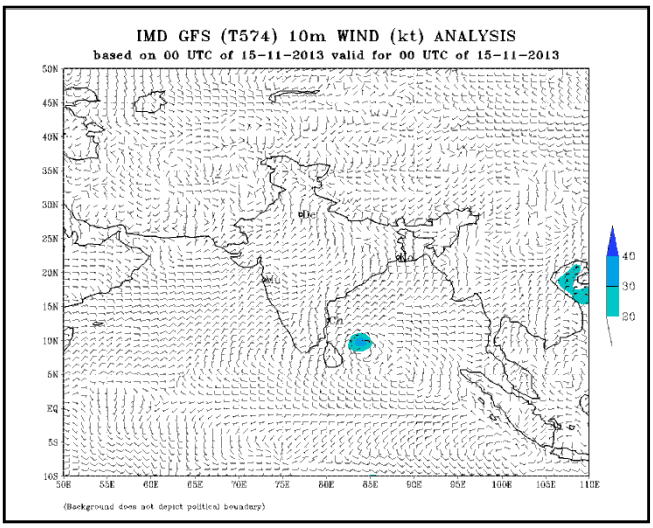
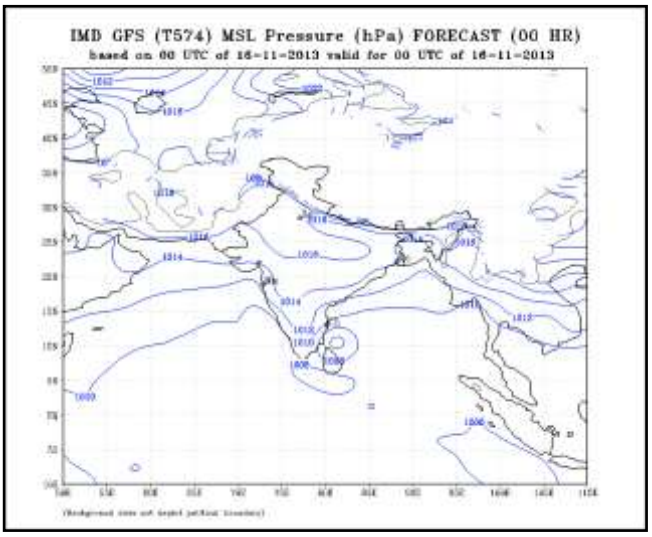
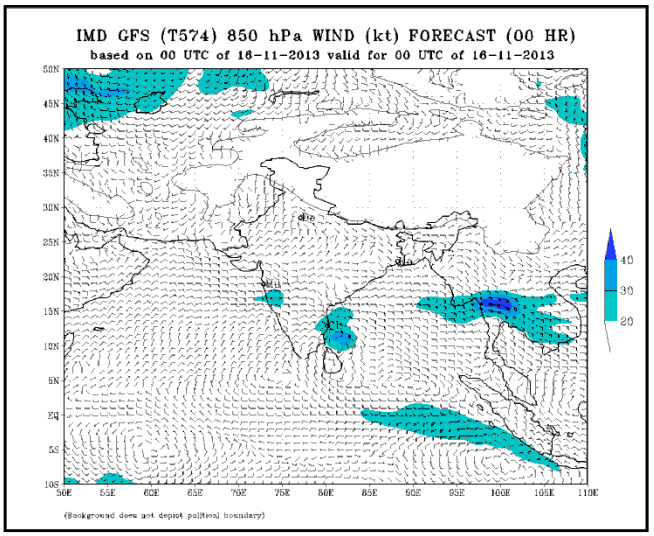
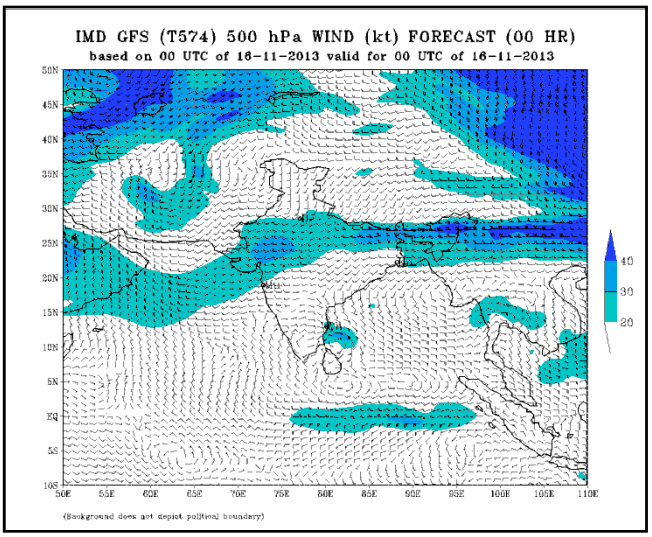
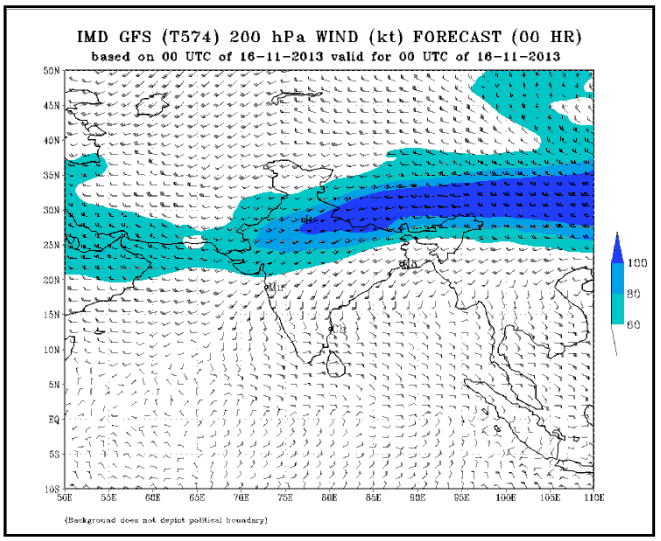


Fig.4.2.1.3(c) IMD GFS MSLP and winds at 850, 500 & 200 hPa levels analysis and 10meter wind based on 00 UTC of 15th November, 2013.









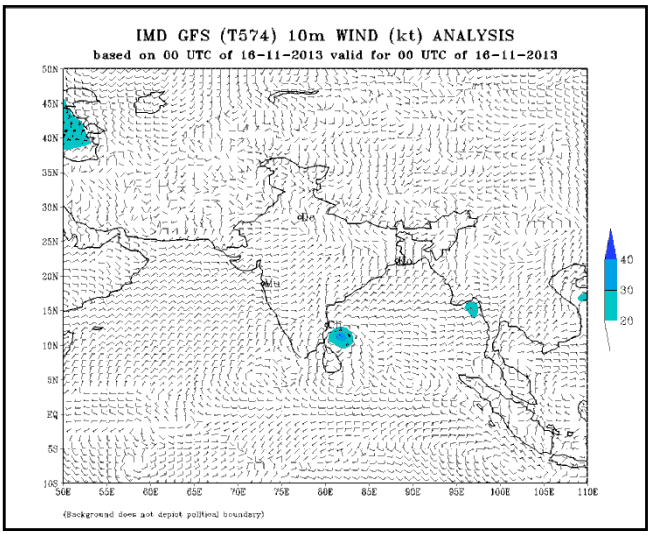


Fig. 4.2.1.3(d) IMD GFS MSLP and winds at 850, 500 & 200 hPa levels analysis and 10 meter wind based on 00 UTC of 16th November, 2013.

4.2.2 Severe Cyclonic Storm ‘Helen’ over Bay of Bengal (19-23 Nov 2013)

4.2.2.1 Introduction

A severe cyclonic storm Helen crossed Andhra Pradesh coast close to south of Machilipatnam (near lat. 16.1°N and long. 81.2°E) between 0800 and 0900 UTC of 22nd Nov. 2013 as a cyclonic storm with a wind speed of 80-90 kmph gusting to 100 kmph. The salient features of this storm are as follows:

(i) It moved west-southwestward 12 hrs before landfall

(ii) It weakened rapidly after the landfall and hence caused less rainfall over coastal Andhra Pradesh.

Brief life history and other characteristic features of cyclone are described in the following sections**.**

4.2.2.2 Genesis

The remnant of the tropical storm (Podul) contributed to the development of a trough over the Bay of Bengal near the Andaman Islands on 16th November. It became organised as a low pressure area over the east central Bay of Bengal on 17th with the active intertropical convergence zone. It became well marked on 18th over the central Bay of Bengal and concentrated into a depression over the west central Bay of Bengal in the early morning of 19th Nov. 2013 with centre near lat. 14.50N and long. 86.50E, about 600 km east-southeast of Machillipatnam. The genesis took place due to favourable location of the low pressure system with warmer sea surface temperature (28-290C), low to moderate vertical wind shear of horizontal winds (10-20 knots), increase in lower level convergence from 18th to 19th November along with upper level divergence. The upper level divergence was provided by the anticyclonic circulation which lay to the northeast of the system centre and associated ridge ran along 16.00N. The Madden Julian Oscillation (MJO) index lay in phase 2 with amplitude less than 1.

4.2.2.3 Intensification and movement

The depression moved west-northwestwards and intensified into a deep depression in the night of 19th Nov. 2013 and further into a cyclonic storm, ‘Helen’ in the morning of 20th Nov. at about 330 km east-southeast of Machilipatnam. It then moved north-northwestwards till 1200 UTC of 21st and intensified into a severe cyclonic storm in the early morning of 21st Nov. at a distance of 260 km east-southeast of Machilipatnam. On 22nd November, It moved initially westwards and then west-southwestwards and crossed Andhra Pradesh coast close to south of Machilipatnam (near lat. 16.1°N and long. 81.2°E) between 0800 and 0900 UTC of 22nd Nov. 2013 as a cyclonic storm with a wind speed of 80-90 kmph gusting to 100 kmph. It then weakened gradually while moving west-southwestwards across Andhra Pradesh and lay as a low pressure area over coastal Andhra Pradesh and neighborhood in the early morning of 23rd Nov. 2013. As the system moved towards the coast, it experienced decreasing vertical wind shear. The vertical wind shear was low to moderate (5-15 knots) on 20th morning when the

system intensified into a cyclonic storm. The low to moderate vertical wind shear continued till 20th leading to further intensification of the system into severe cyclonic storm in the early morning of 21st. Thereafter the vertical wind shear increased gradually becoming moderate on 21st (10-20 knots) and moderate to high (15-25 knots) on 22nd Nov. As a result, the system weakened slightly and crossed coast on 22nd Nov. as a cyclonic storm. Over land surface, it weakened further due to interaction with land surface and cut off in moisture supply.

The system initially moved northwestwards till 20th morning under the influence of the upper tropospheric steering ridge which ran along 16.00N in association with the anticyclonic circulation lying to the northeast of the system centre. On 20th Nov. the system came closer to the steering ridge leading to north-northwesterly movement till 1200 UTC of 21st Nov. After that the northerly movement of the system got restricted and started moving nearly westward under the influence of the anticyclonic circulation at middle levels located to the northeast and northwest of the system centre. As the system came closer to the coast the steering anticyclonic circulation over India i.e. to the northwest of the system centre became more dominant leading to west-southwestward movement from 22nd Nov. The track of the system is given in Fig.4.1 and the best track position and other parameters are given in Table 4.2.2.1. The DWR Machilipatnam radar imagery, typical satellite imagery and IMD GFS MSLP and wind at 850, 500 and 200 hPa are shown in fig.4.2.2.1-3 respectively. The location of centre of the system as observed by DWR Visakhapatnam is given in Table 2.8.2.

Table 4.2.2.1 Best track positions and other parameters of the Severe Cyclonic Storm 'Helen' over the Bay of Bengal during 19-23 November, 2013

Date	Time (UTC)	Centre lat.^{0} N/ long.^{0} E	C.I. NO.	Estimated Central Pressure (hPa)	Estimated Maximum Sustained Surface Wind (kt)	Estimated Pressure drop at the Centre (hPa)	Grade
19-11-2013	0000	14.5/86.5	1.5	1004	25	3	D
	0300	14.5/86.0	1.5	1004	25	3	D
	0600	14.5/85.5	1.5	1004	25	3	D
	1200	15.0/85.0	1.5	1004	25	3	D
	1500	15.0/85.0	2.0	1002	30	5	DD
	1800	15.0/84.5	2.0	1002	30	5	DD
20-11-2013	0000	15.0/84.0	2.0	1002	30	5	DD
	0300	15.0/84.0	2.5	1000	35	8	CS
	0600	15.2/84.0	2.5	1000	40	8	CS
	0900	15.2/84.0	2.5	1000	40	8	CS
	1200	15.3/83.9	3.0	998	45	10	CS
	1500	15.3/83.9	3.0	998	45	10	CS
	1800	15.4/83.7	3.0	996	45	10	CS
	2100	15.5/83.6	3.0	996	45	10	CS
21-11-2013	0000	15.6/83.5	3.0	994	50	15	SCS
	0300	15.8/83.4	3.0	992	50	17	SCS
	0600	15.9/83.3	3.5	990	55	17	SCS

	0900	16.0/83.1	3.5	990	55	17	SCS
	1200	16.1/82.9	3.5	990	55	17	SCS
	1500	16.1/82.7	3.5	990	55	17	SCS
	1800	16.2/82.7	3.5	990	55	17	SCS
	2100	16.2/82.3	3.5	990	55	17	SCS
22-11-2013	0000	16.2/81.9	3.5	990	55	17	SCS
	0300	16.2/81.7	3.5	990	55	17	SCS
	0600	16.2/81.3	3.5	990	55	17	SCS
	The system crossed Andhra Pradesh coast close to south of Machilliptnam near 16.1^0N/81.2^0E between 0800-0900UTC						
	0900	16.1/81.2	-	1000	40	8	CS
	1200	15.9/80.7	-	1002	30	5	DD
	1800	15.9/80.4	-	1004	25	3	D
23-11-2013	0000	The system weakened into a well marked low pressure area over coastal Andhra Pradesh and neighbourhood.					

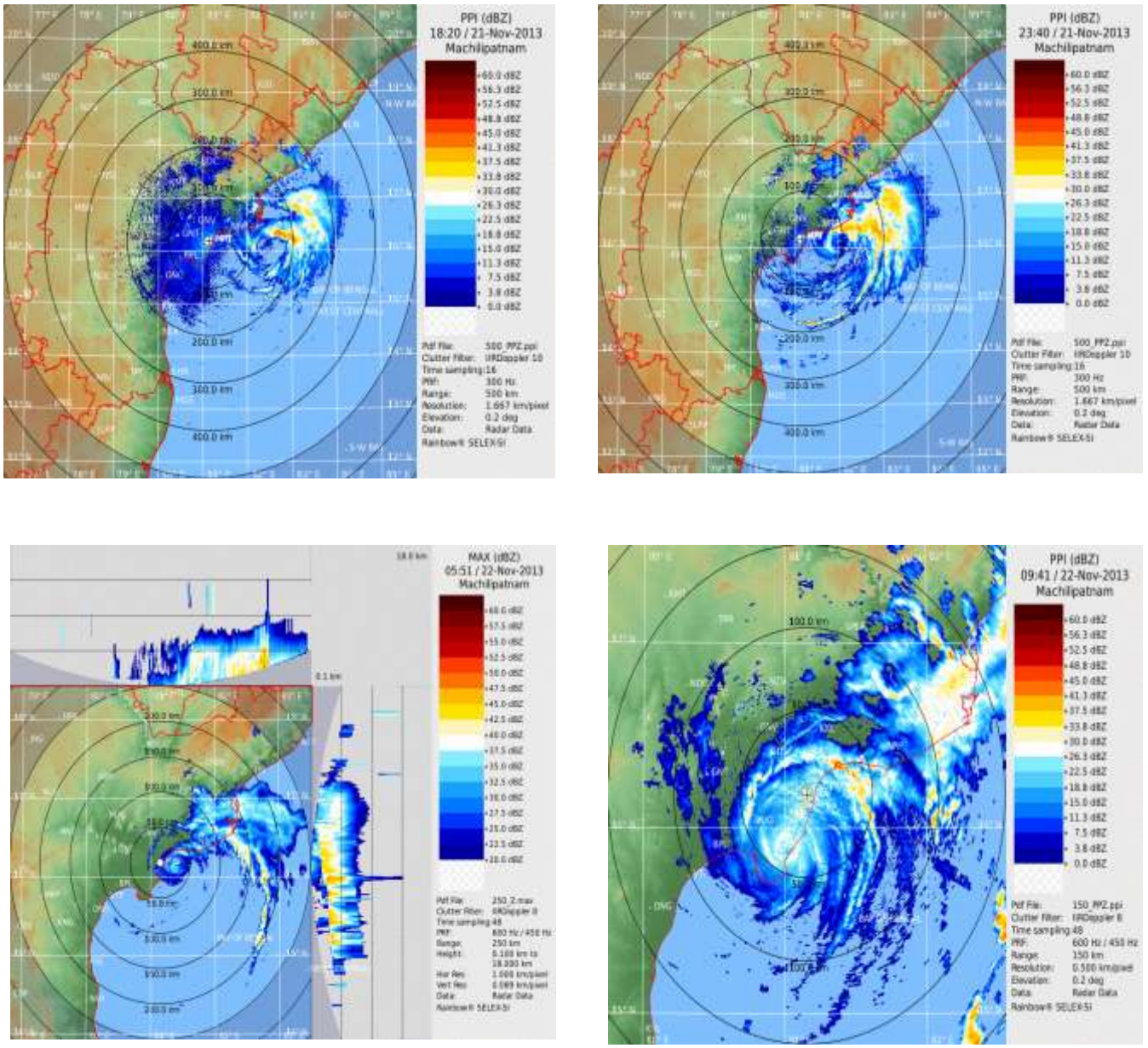


Fig.4.2.2.1 Typical Radar imageries of DWR Machilipatnam at 1800 UTC of 21st and 00, 06 & 10 UTC of 22nd November 2013.

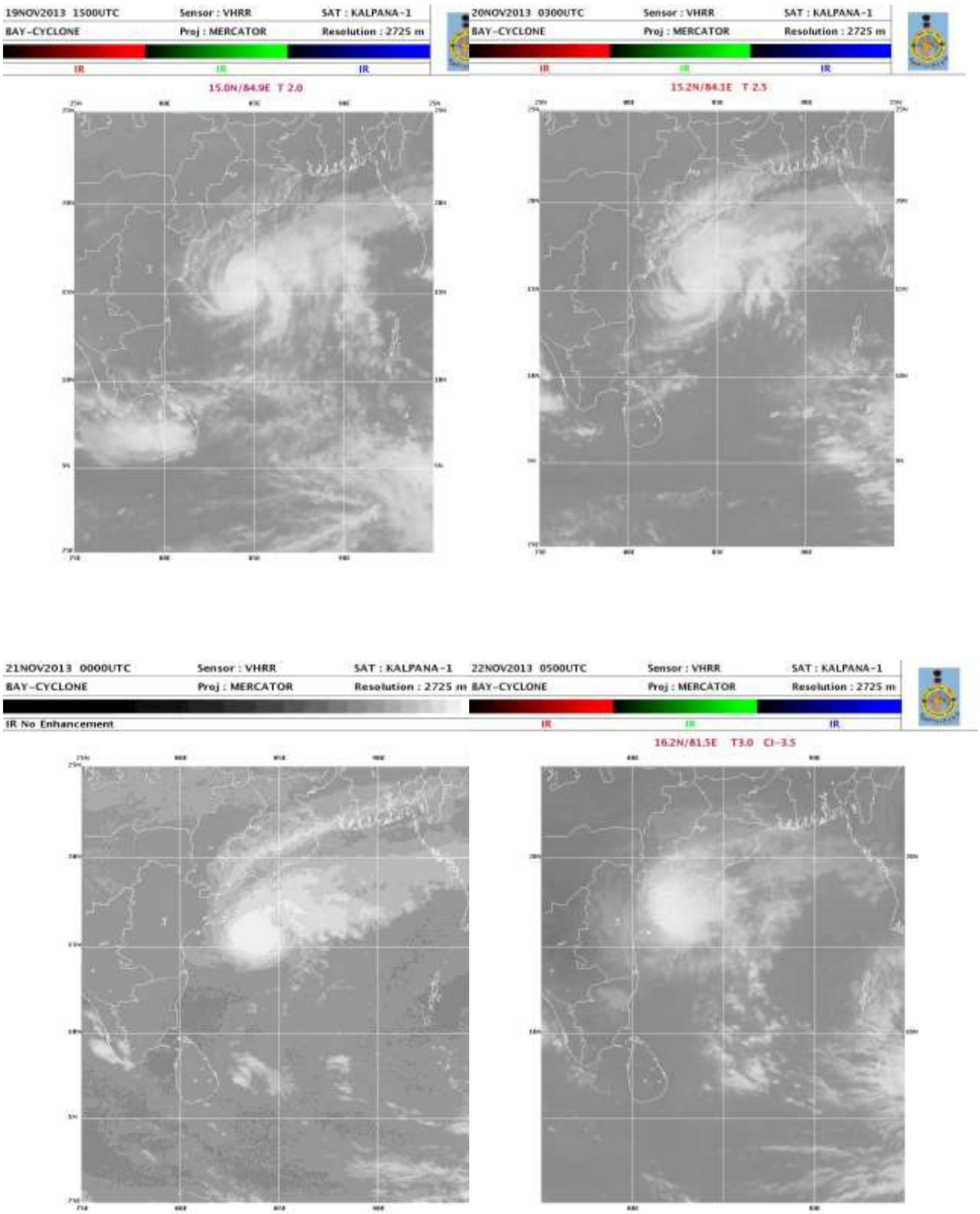
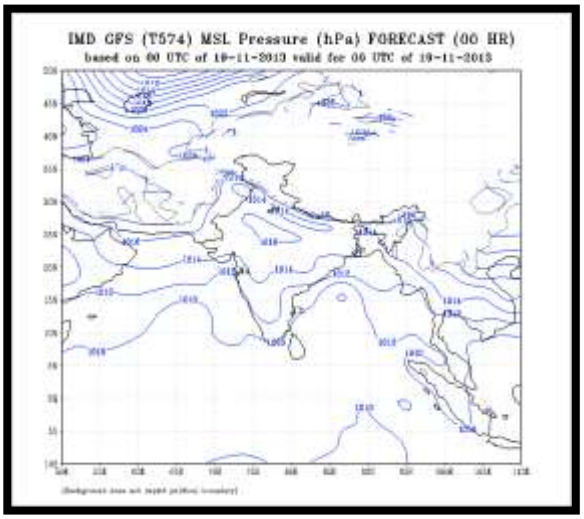
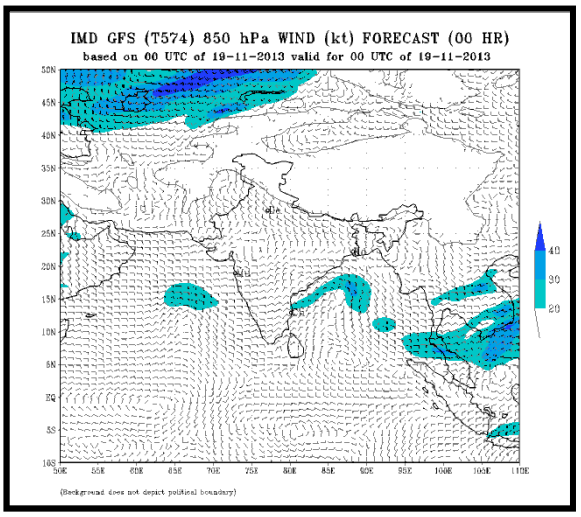
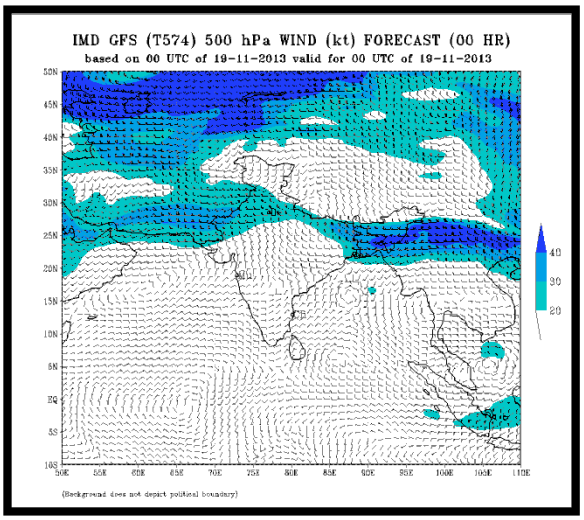
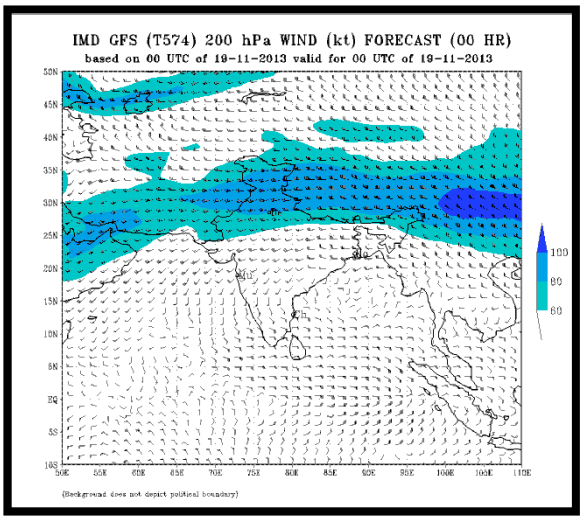


Fig.4.2.2.2 Typical Kalpana-1 Satellite imageries of severe cyclonic storm Helen at 1500 UTC of 19th, 0300 UTC of 20th, 0000 UTC of 21st and 0500 UTC of 22 November 2013.









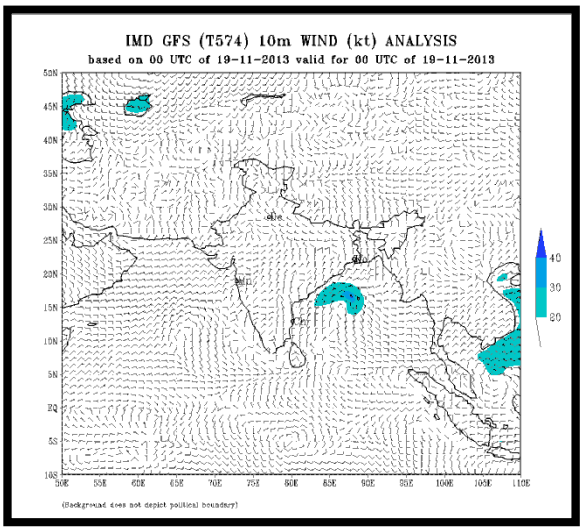


Fig.4.2.2.3 (a) IMD GFS MSLP and winds at 850, 500 & 200 hPa levels analysis and 10 meter wind based on 00 UTC of 19th November, 2013.

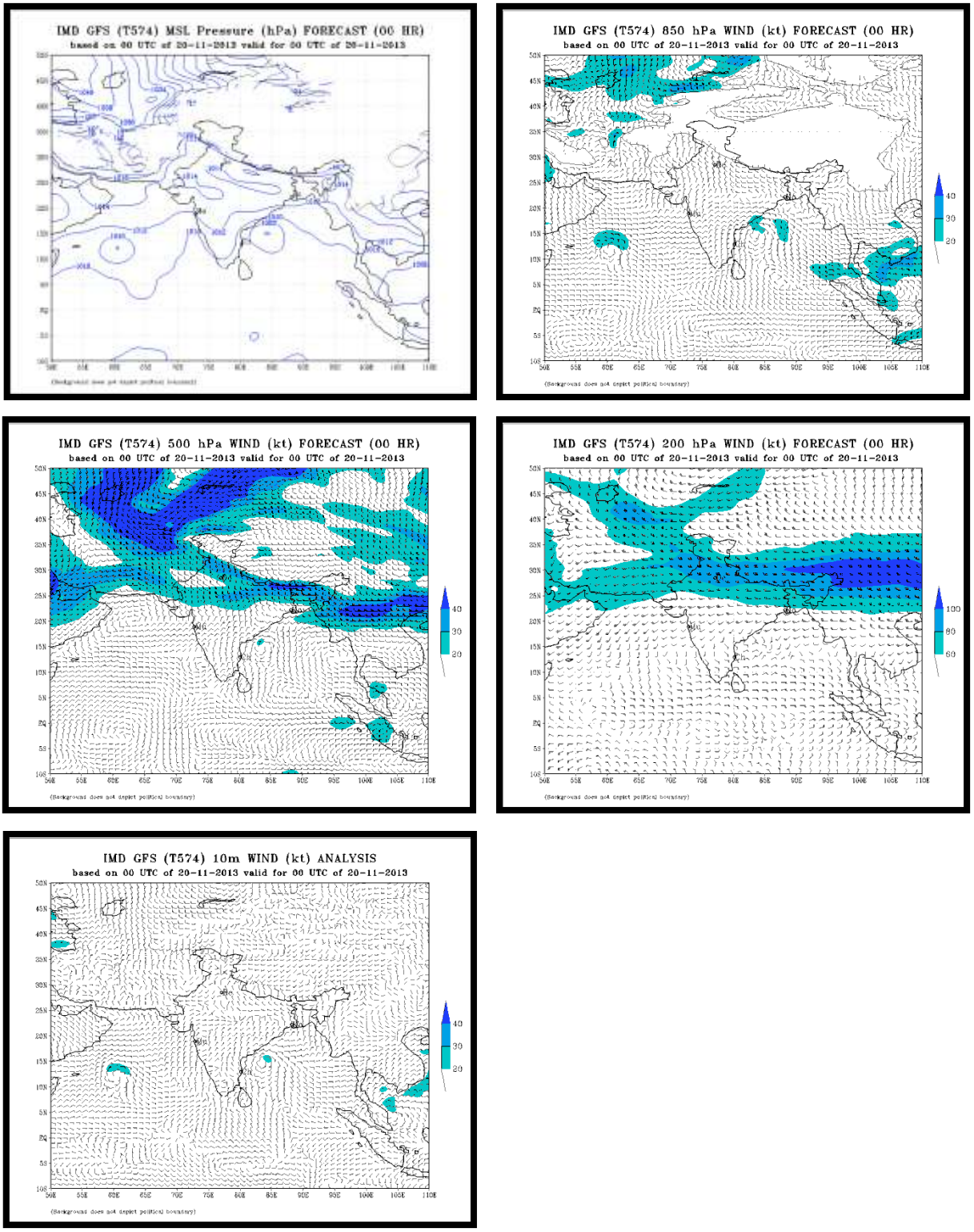


Fig.4.2.2.3(b) IMD GFS MSLP and winds at 850, 500 & 200 hPa levels analysis and 10 meter wind based on 00 UTC of 20th November, 2013.

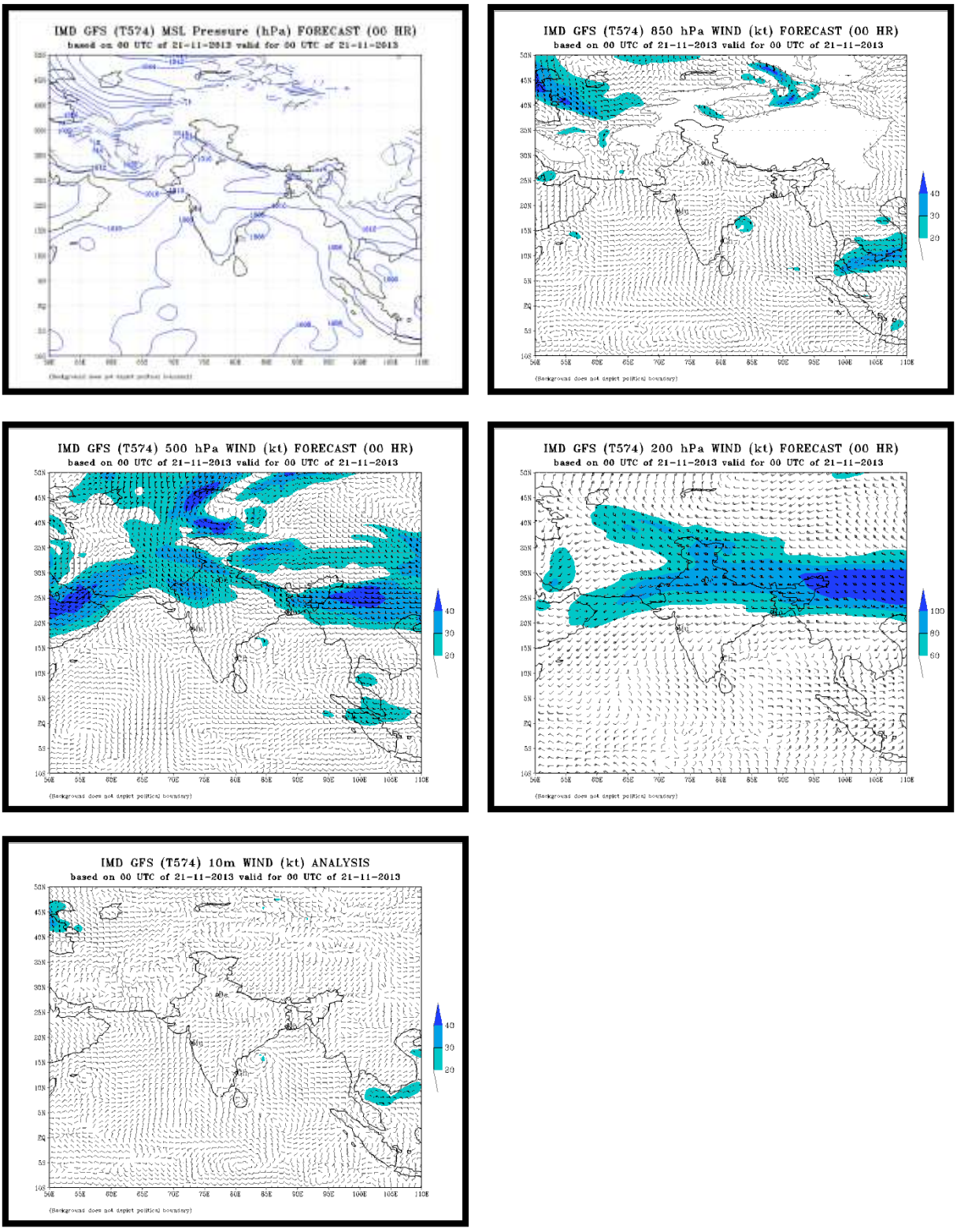
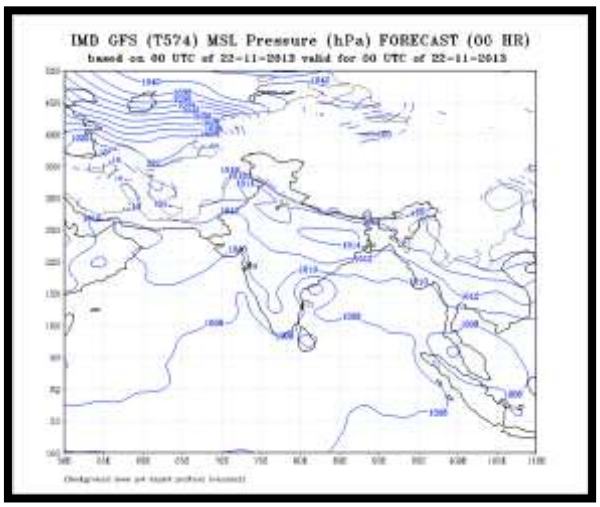
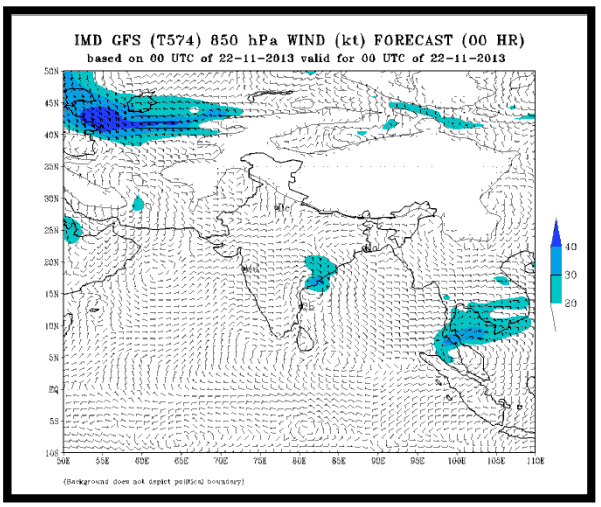
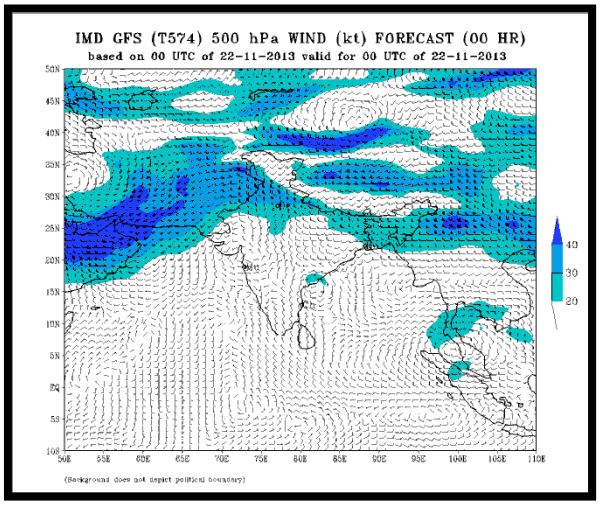
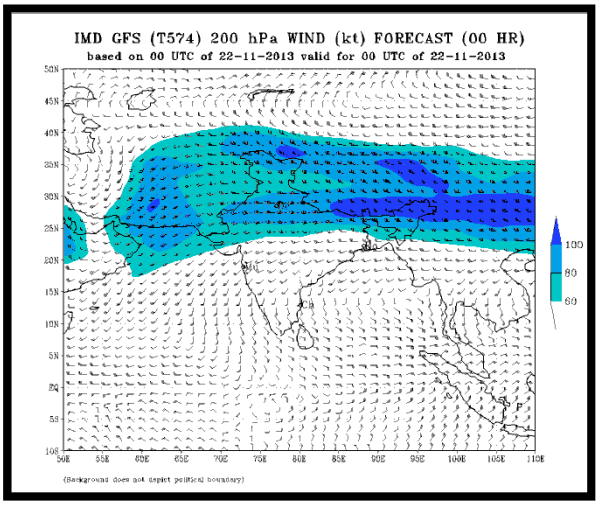


Fig.4.2.2.3(c) IMD GFS MSLP and winds at 850, 500 & 200 hPa levels analysis and 10 meter wind based on 00 UTC of 21st November, 2013.









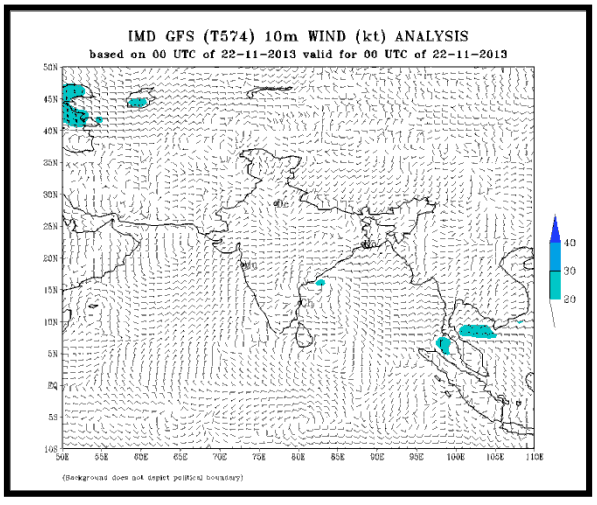


Fig.4.2.2.3 (d) IMD GFS MSLP and winds at 850, 500 & 200 hPa levels analysis and 10 meter wind based on 00 UTC of 22st November, 2013.

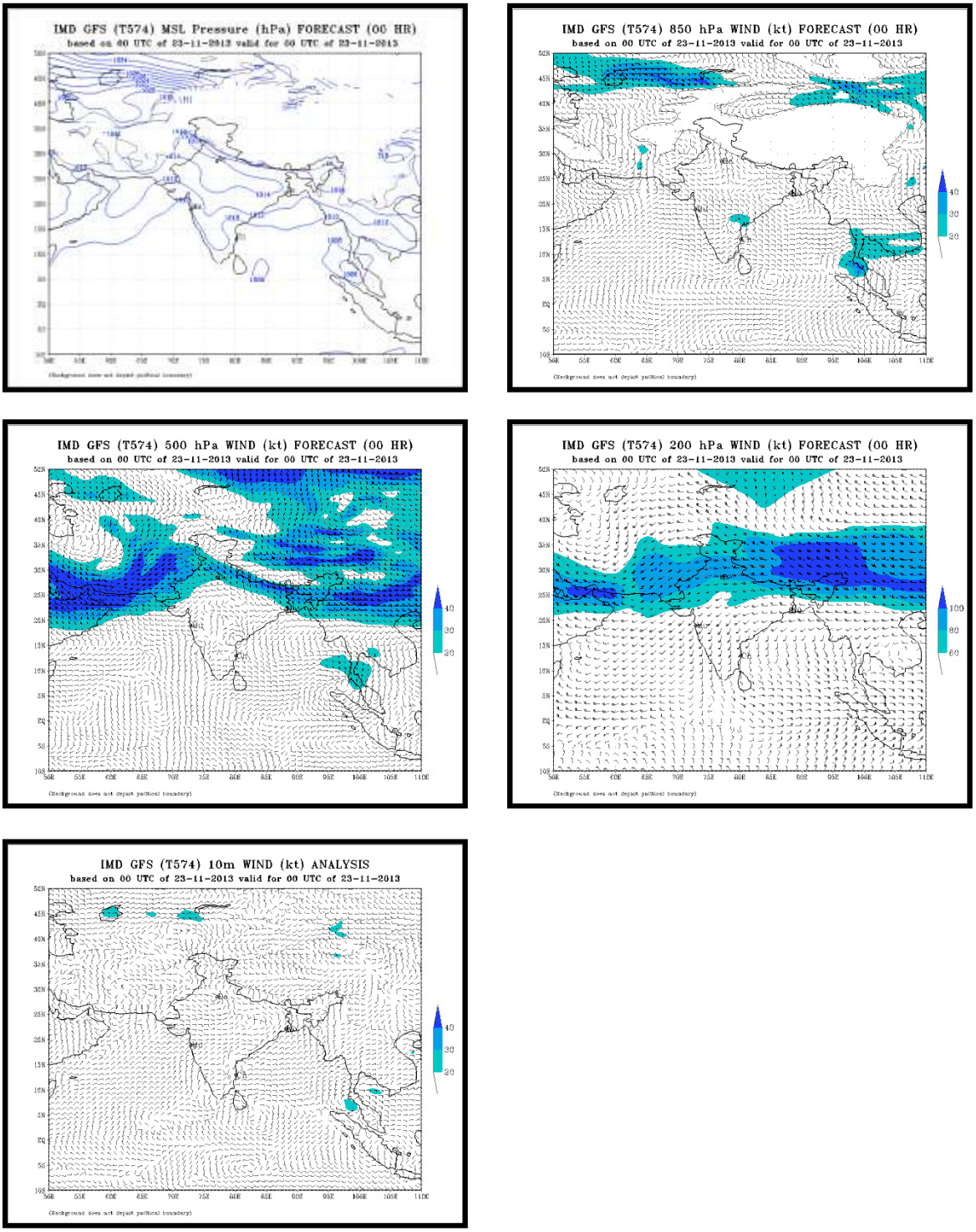


Fig.4.2.2.3(e) IMD GFS MSLP and winds at 850, 500 & 200 hPa levels analysis and 10 meter wind based on 00 UTC of 23rd November, 2013.

Table 4.2.2.2 Centre of Cyclone HELEN based on DWR, Visakhapatnam

Date/Time (UTC)	Intensity	Lat/Long N/E
19.11.13/0000	Depression	14.5/86.5
19.11.13/0300	Depression	14.5/86.0
19.11.13/0600	Depression	14.5/85.5
19.11.13/1200	Depression	15.0/85.0
19.11.13/1500	Deep Depression	15.0/85.0
19.11.13/1800	Deep Depression	15.0/84.5
20.11.13/0000	Deep Depression	15.0/84.0
20.11.13/0300	Cyclonic Storm	15.0/84.0
20.11.13/0600	Cyclonic Storm	15.2/84.0
20.11.13/0900	Cyclonic Storm	15.2/84.0
20.11.13/1200	Cyclonic Storm	15.3/83.9
20.11.13/1800	Cyclonic Storm	15.4/83.7
20.11.13/2100	Cyclonic Storm	15.5/83.6
21.11.13/0000	Severe Cyclonic Storm	15.6/83.5
21.11.13/0300	Severe Cyclonic Storm	15.8/83.4
21.11.13/0600	Severe Cyclonic Storm	15.9/83.3
21.11.13/0900	Severe Cyclonic Storm	16.0/83.1
21.11.13/1200	Severe Cyclonic Storm	16.1/82.9
21.11.13/1500	Severe Cyclonic Storm	16.1/82.7
21.11.13/1800	Severe Cyclonic Storm	16.2/82.5
21.11.13/2100	Severe Cyclonic Storm	16.2/82.3
22.11.13/0000	Severe Cyclonic Storm	16.2/81.9
22.11.13/0300	Severe Cyclonic Storm	16.2/81.7
22.11.13/0600	Severe Cyclonic Storm	16.2/81.3
22.11.13/0800-0900	Cyclonic Storm	16.1/81.2
22.11.13/0900	Cyclonic Storm	16.1/81.0
22.11.13/1200	Deep Depression	15.9/80.7
22.11.13/1800	Depression	15.9/80.4

4.2.2.4 Realized Weather:

a. Surface Wind: Gale wind speed reaching of 80-90 kmph gusting to 100 kmph prevailed along and off Andhra Pradesh coast at the time of land fall.

b. Rainfall: Chief amounts of 24 hrs. Rainfall (7 cm or more) ending at 0300 UTC from 19th November to 23rd November, 2013 are given below:

19 November 2013
Andaman & Nicobar Islands: Maya Bandar 7
Tamilnadu & Puducherry: Sankarapuram 10, Mayiladuthurai 8 Karaikal 7, Kodavasal 7, Kerala: Piravom 8
20 November 2013 – Nil
21 November 2013
Tamilnadu & Puducherry: Colachel 12, Thuckalay 9, Eraniel 8
22 November 2013

Coastal Andhra Pradesh: Visakhapatnam 11
Tamilnadu & Puducherry: Sivagiri 9
Kerala: Nedumangad 7, Alappuzha 7

23 November 2013

Coastal Andhra Pradesh: Gudivada 13, Vijayawada A.P. 10, Visakhapatnam Ap 10, Masulipatnam 9, Visakhapatnam 7

24 November 2013

Telangana: Narayan Khed 12

Tamilnadu & Puducherry: Watrap 15, Rajapalayam 14, Nanguneri 10, Sivakasi 9, Sivagiri 8, Colachel 8, Uttamapalayam 7, Sankarankoil 7, Coastal Karnataka: Dharmasthala 7

South Interior Karnataka: Bangalore 11, Devanhalli 9, K.R.Nagara 7, Kottigehara 7, Arkalgud 7,

Kerala: Punalur 9, Kurudamannil 9.

4.2.2.5 Damage Report:

The cyclone, Helen caused considerable damage over coastal Andhra Pradesh, especially over Krishna, west & east Godavari districts. It uprooted trees and electrical poles and damaged crops (paddy, banana & coconut etc). The typical damage photographs are shown in Fig. 2.8.4. Number of human death was 11 due to this system.

Fig.4.2.2.4. Damage over Machilipatnam and Koduru due to SCS Helen.

4.2.3 Very Severe Cyclonic Storm VSCS 'Lehar'(23-28 November, 2013)

4.2.3.1 Introduction

A depression formed over south Andaman Sea on 23rd evening and it intensified into a cyclonic storm, Lehar in the early morning of 24th November 2013 near Latitude 10.0°N and longitude 95.0°E. Moving northwestward, it crossed Andaman & Nicobar Islands near Port Blair around 0000 UTCof 25th November as a severe cyclonic storm. On 25th morning it emerged into southeast Bay of Bengal and moved west-northwestward, intensified into a very severe cyclonic storm in the early hours of 26th Nov. However while moving west-northwestwards over westcentral Bay of Bengal, it rapidly weakened from 27th afternoon and crossed Andhra Pradesh coast close to south of Machilipatnam around 0830 UTC of 28th Nov. 2013 as a depression.

The salient features of this system are given below:

(i) It was the first severe cyclonic storm to cross Andaman and Nicobar Islands after November, 1989.

(ii) It had second landfall near Machilipatnam as a depression.

(iii) It rapidly weakened over the sea from the stage of very severe cyclonic storm to depression in 18 hrs.

Brief life history and other characteristics of the system are described below:

4.2.3.2 Genesis:

A remnant of tropical depression over south China Sea moved across Malay peninsula and lay as a low pressure area over south Andaman Sea on 21st November, 2013. It became well marked over the same area on 22nd and concentrated into a depression over south Andaman Sea near latitude 08.5°N and longitude 96.5°E about 550 km south-southeast of Port Blair at 1200 UTC of 23rd November, 2013. The genesis was detected with the Ocean Sat-II winds and the observation from the coast of Thailand in addition to satellite imageries. The genesis was associated with upper troposphere ridge which ran along 13° N and provided adequate upper level divergence through Poleward outflow. The lower level convergence and relative vorticity increased over the area from 22nd to 23rd November. The sea surface temperature was 28-29°C and Ocean thermal energy was 60-80 KJ/cm2. The vertical wind shear of horizontal wind was moderate (10-20 knots). The Madden Julian oscillation (MJO) index lay in Phase 3 i.e. over east equatorial Indian Ocean. Past studies indicate that the Phase 3 is favorable for genesis of depression.

4.2.3.3 Intensification and movement:

Due to the favourable atmospheric and Oceanic condition as mentioned above, the depression over south Andaman Sea moved northwestwards, intensified into a deep depression at 1800 UTC of 23rd and further into a cyclonic storm, 'Lehar' at 0300 UTC of 24th November and lay centred near latitude 10.0°N and longitude 95.0° E. It further intensified into a severe cyclonic storm, continued to move northwestwards and crossed Andaman & Nicobar Island near Port Blair around 0100 UTC of 25th November, 2013. It then emerged into southeast Bay of Bengal, moved west-northwestwards and intensified into a very severe cyclonic storm at 2100 UTC of 26th November, 2013 over southeast Bay of Bengal near latitude 12.5° N and longitude 91.0°E. It attained the maximum intensity of 75 knots at 1800 UTC of 26th November, 2013 and the same intensity continued till 0300 UTC of 27th November, 2013 when it lay over central Bay of Bengal.

As the westcentral Bay of Bengal was colder with Ocean thermal energy less than 50 KJ/cm2 and there was entrainment of dry and cold air from central and northern parts of India into the cyclone field and vertical wind shear of horizontal wind increased and became high, the very severe cyclonic storm started to weaken rapidly from the afternoon of 27th November, 2013. It weakened into a severe cyclonic storm at 1200 UTC of 27th November and lay centred near latitude 14.5°N and longitude 85.0°E. It further weakened into a cyclonic storm at 1800 UTC of 27th November, 2013 with centre near latitude 15.0°N and longitude 84.0°E over westcentral Bay of Bengal. It weakened

into a deep depression at 0000 UTC of 28th November, 2013 with centre near latitude 15.5°N and longitude 82.0°E. At this time the vertical wind shear was high (about 20 knots). It weakened into a depression and crossed Andhra Pradesh coast near latitude 15.9°N and longitude 81.1°E (close to south of Machilipatnam) around 0830 UTC of 28th November, 2013. It weakened into a well marked low pressure area over coastal Andhra Pradesh and adjoining Telengana at 1800 UTC of 28th November, 2013.

The system moved northwestwards/west-northwestwards as it lay to the south of the upper tropospheric steering ridge which moved northward from its position near latitude 13.0°N on the day of genesis to latitude 17°N on the day of landfall. The best track position and other parameters ofthe Very Severe Cyclonic Storm 'Lehar' over the Bay of Bengal is given in Table 4.2.3.1 and the track of the very severe cyclonic storm 'Lehar'is given in Fig 4.1. Visakhapatnam & Machilipatnam RADAR imageries, Satellite imageries and IMD GFS MSLP and wind at 850, 500 and 200 hPa levels are shown in Fig. 4.2.3.1-3 respectively. The position of the cyclone 'Lehar' based on DWR, Visakhapatnam is shown in Table 4.2.3.2.

Table 4.2.3.1 Best track positions and other parameters of the Very Severe Cyclonic Storm 'Lehar' over the Bay of Bengal during 23-28 November, 2013

Date	Time (UTC)	Centre lat.^{0} N/ long.^{0} E	C.I. NO.	Estimated Central Pressure(hPa)	Estimated Maximum Sustained Surface Wind (kt)	Estimated Pressure drop at theCentre (hPa)	Grade
23-11-2013	1200	8.5/96.5	1.5	1004	25	3	D
	1800	9.0/96.0	2.0	1002	30	5	DD
24-11-2013	0000	10.0/95.0	2.5	999	35	7	CS
	0300	10.0/95.0	2.5	998	40	8	CS
	0600	10.5/94.5	2.5	998	40	8	CS
	0900	10.7/94.0	3.0	996	45	10	CS
	1200	11.0/93.5	3.0	996	45	10	CS
	1500	11.0/93.5	3.0	996	45	10	CS
	1800	11.5/93.0	3.0	996	45	10	CS
	2100	11.5/92.5	3.0	996	45	12	CS
25-11-2013	0000	12.0/92.5	3.5	992	55	15	SCS
	The system crossed Andaman & Nicobar island, south of Port Blair around 0100 UTC						
	0300	12.0/92.0	3.5	988	55	17	SCS
	0600	12.0/91.5	3.5	988	55	17	SCS
	0900	12.0/91.5	3.5	988	60	17	SCS
	1200	12.5/91.5	3.5	988	60	17	SCS
	1500	12.5/91.0	3.5	988	60	17	SCS
	1800	12.5/91.0	3.5	988	55	17	SCS
	2100	12.5/91.0	4.0	984	65	22	VSCS
26-11-2013	0000	12.5/90.5	4.0	982	70	24	VSCS
	0300	12.5/90.0	4.0	982	70	24	VSCS

	0600	12.5/89.5	4.0	982	70	24	VSCS
	0900	13.0/89.0	4.0	982	70	24	VSCS
	1200	13.0/88.5	4.0	982	70	24	VSCS
	1500	13.0/88.5	4.0	982	70	24	VSCS
	1800	13.1/88.0	4.0	980	75	26	VSCS
	2100	13.2/87.5	4.0	980	75	26	VSCS
27-11-2013	0000	13.5/87.0	4.0	980	75	26	VSCS
	0300	13.5/86.5	4.0	980	75	26	VSCS
	0600	14.0/86.0	4.0	982	70	24	VSCS
	0900	14.0/85.5	4.0	984	65	22	VSCS
	1200	14.5/85.0	3.5	988	55	17	SCS
	1500	14.5/84.5	3.5	988	55	17	SCS
	1800	15.0/84.0	3.0	996	45	10	CS
	2100	15.0/83.5	2.5	998	40	8	CS
28-11-2013	0000	15.5/82.0	2.0	1000	30	5	DD
	0300	15.7/81.7	2.0	1000	30	5	DD
	0600	15.7/81.3	2.0	1000	30	5	DD
	The system crossed Andhra Pradesh close to south of Machilipatnam near 15.9^0N/81.1^0 E around 0830 UTC						
	0900	15.9/81.0	-	1002	25	4	D
	1200	16.0/80.8	-	1004	20	3	D
	1800	Weakened into a well marked low pressure area over coastal Andhra Pradesh and adjoining Telengana.					

Table 4.2.3.2 Position of Very Severe Cyclonic Storm 'LEHAR' based on DWR Visakhapatnam

Date	Time(UTC)	Intensity	Lat ^{O}N	Long^{O}E
23.11.13	1200	D	08.5	96.5
	1800	DD	09.0	96.0
	2100	DD	---	---
24.11.13	0000	CS	10.0	95.0
	0300	CS	10.0	95.0
	0600	CS	10.5	94.5
	0900	CS	10.5	94.0
	1200	CS	11.0	93.5
	1800	CS	11.5	93.0
	2100	CS	11.5	92.5
25.11.13	0000	SCS	12.0	92.5
	0300	SCS	12.0	92.0
	0600	SCS	12.0	91.5
	0900	SCS	12.0	91.5
	1200	SCS	12.5	91.0
	1500	SCS	12.5	91 .0
	1800	SCS	12.5	91.0
	2100	VSCS	12.5	91.0.

26.11.13	0000	VSCS	12.5	90.5
	0300	VSCS	12.5	90.0
	0600	VSCS	12.6	89.5
	0900	VSCS	13.0	89.0
	1200	VSCS	13.0	88.5
	1500	VSCS	13.0	88.5
	1800	VSCS	13.0	88.0
	2100	VSCS	13.2	87.5
27.11.13	0000	VSCS	13.5	87.0
	0300	VSCS	13.5	86.5
	0600	VSCS	14.0	86.0
	0900	VSCS	14.0	85.5
	1200	SCS	14.5	85.0
	1500	SCS	14.5	84.5
	1800	CS	15.0	84.0
	2100	CS	15.0	83.5
28.11.13	0000	DD	15.5	82.0
	0300	DD	15.7	81.7
	0600	DD	15.7	81.3
	0900	D	15.9	81.1

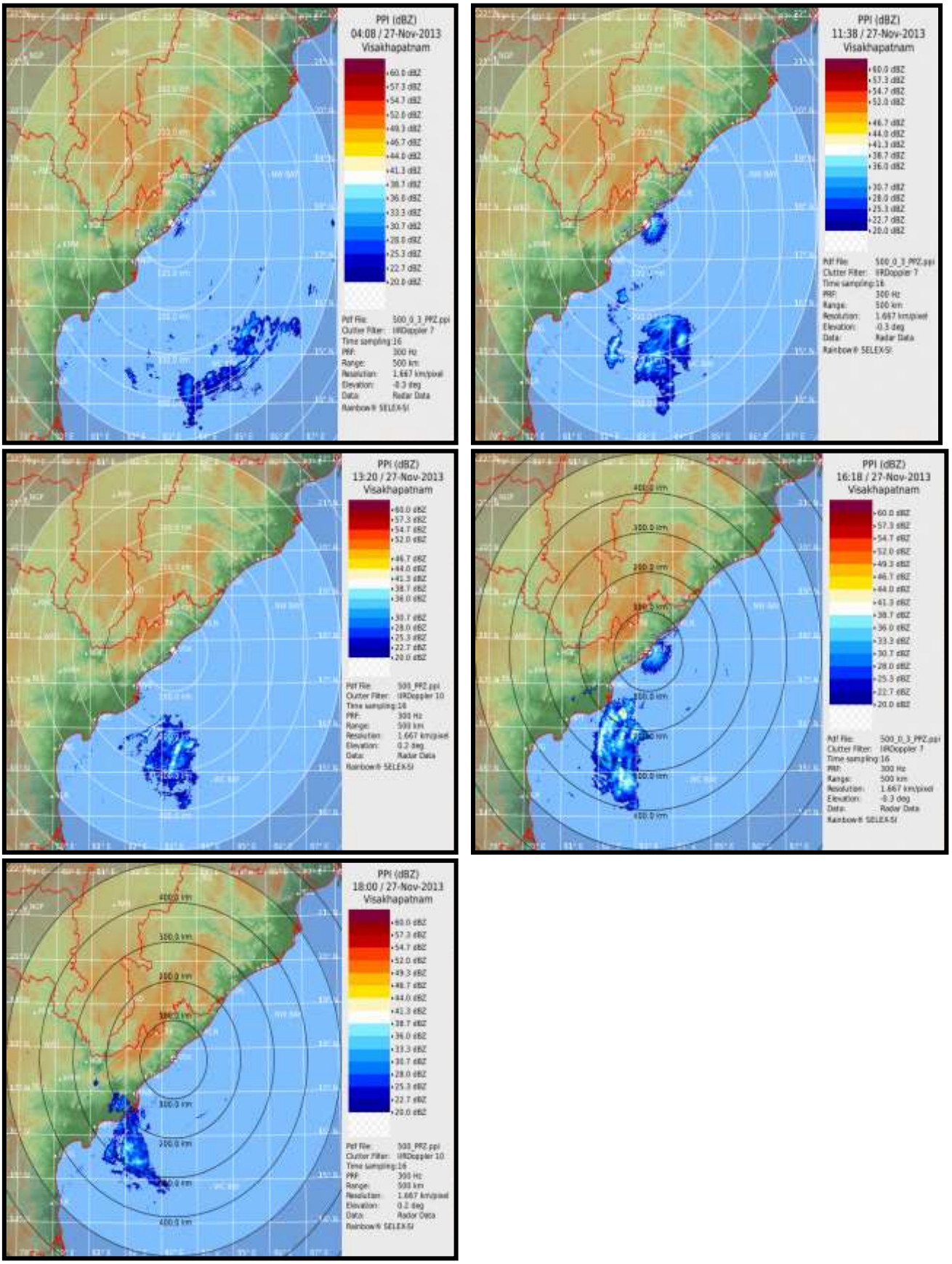


Fig. 4.2.3.1(a) Visakhapatnam RADAR imageries based on 0400, 1140, 1320, 1620 & 1800 UTC of 27thNovember, 2013

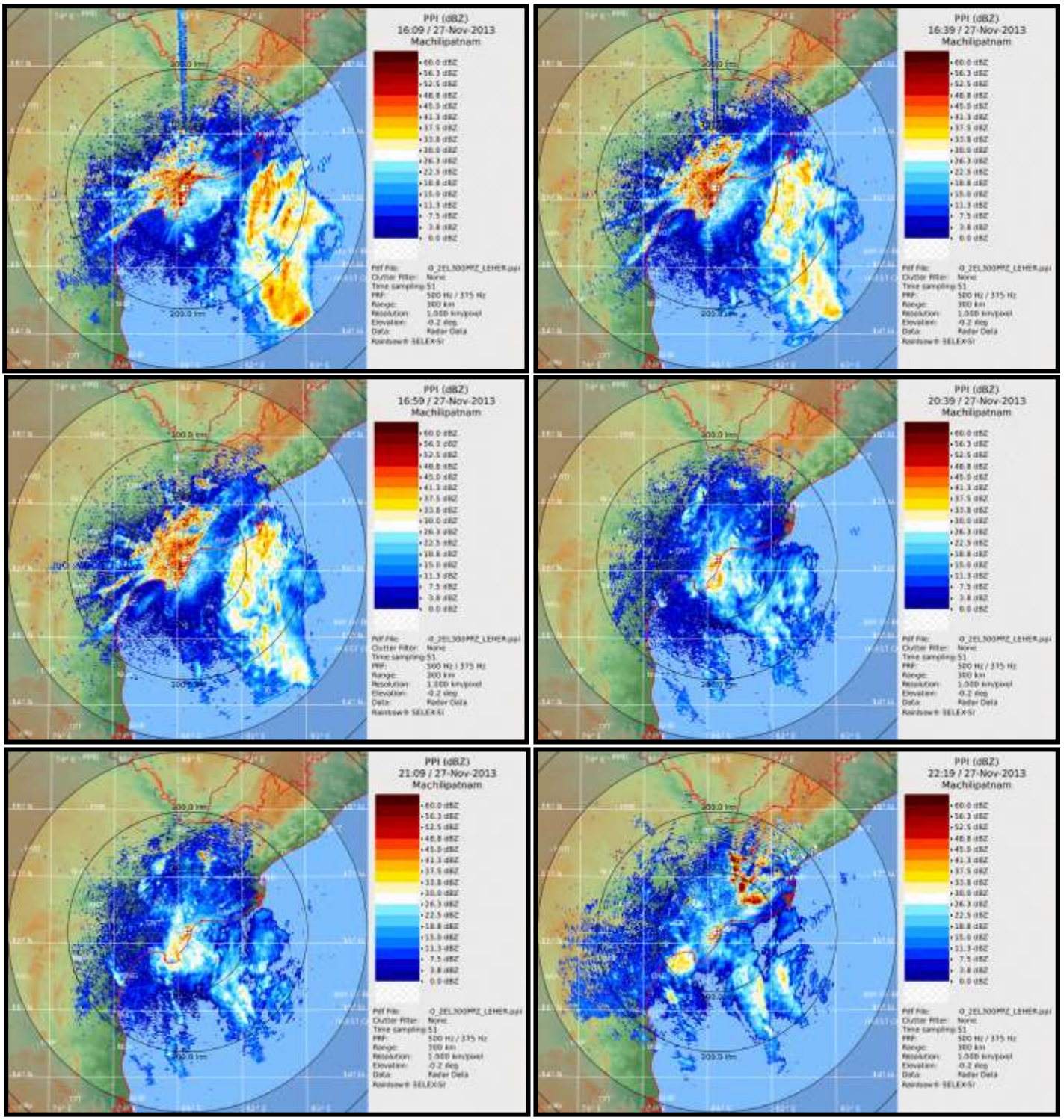


Fig. 4.2.3.1(b) Machilipatnam RADAR imageries on 27th November, 2013

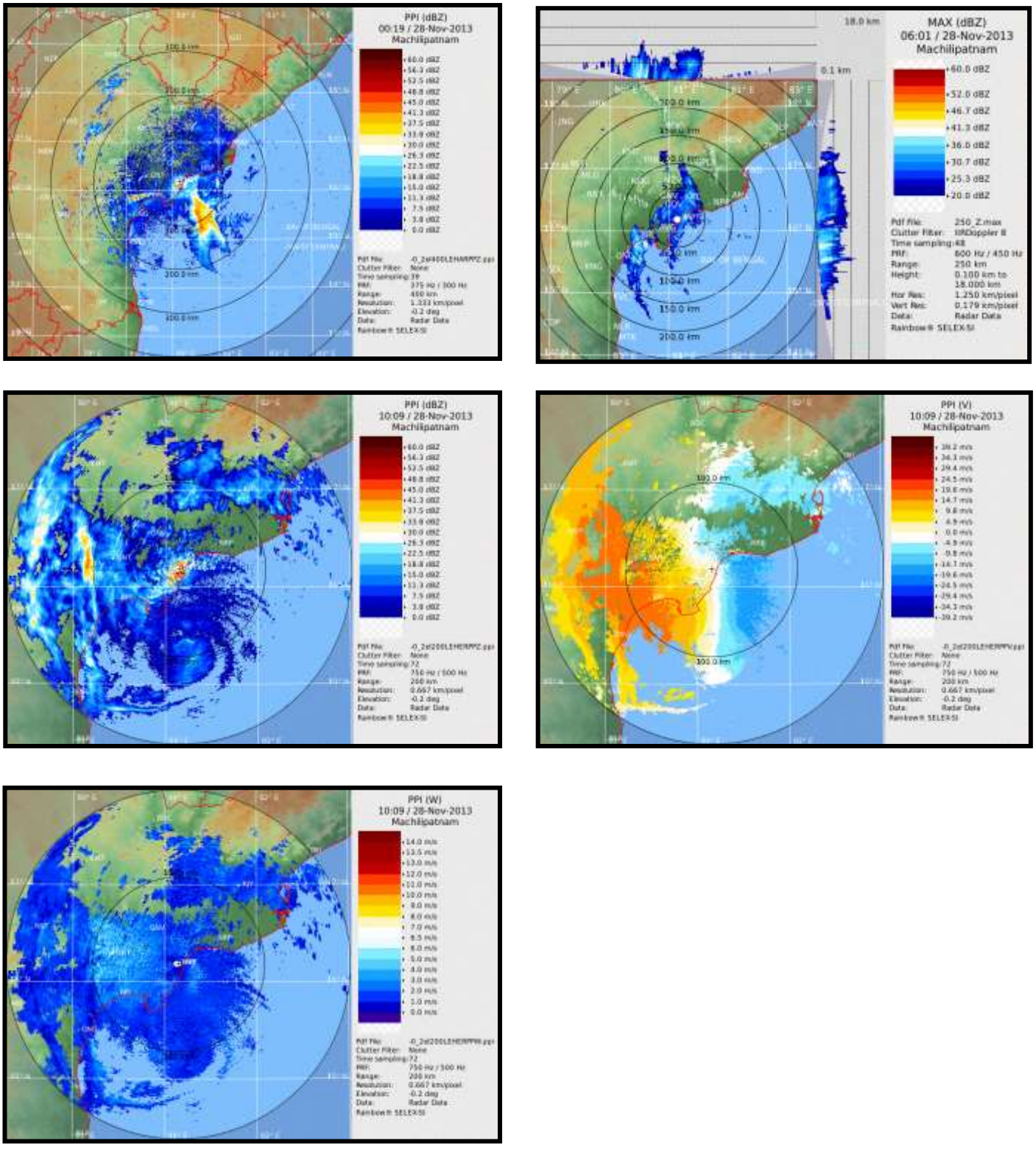


Fig.4.2.3.1(c) Machilipatnam RADAR imageries on 28th November, 2013

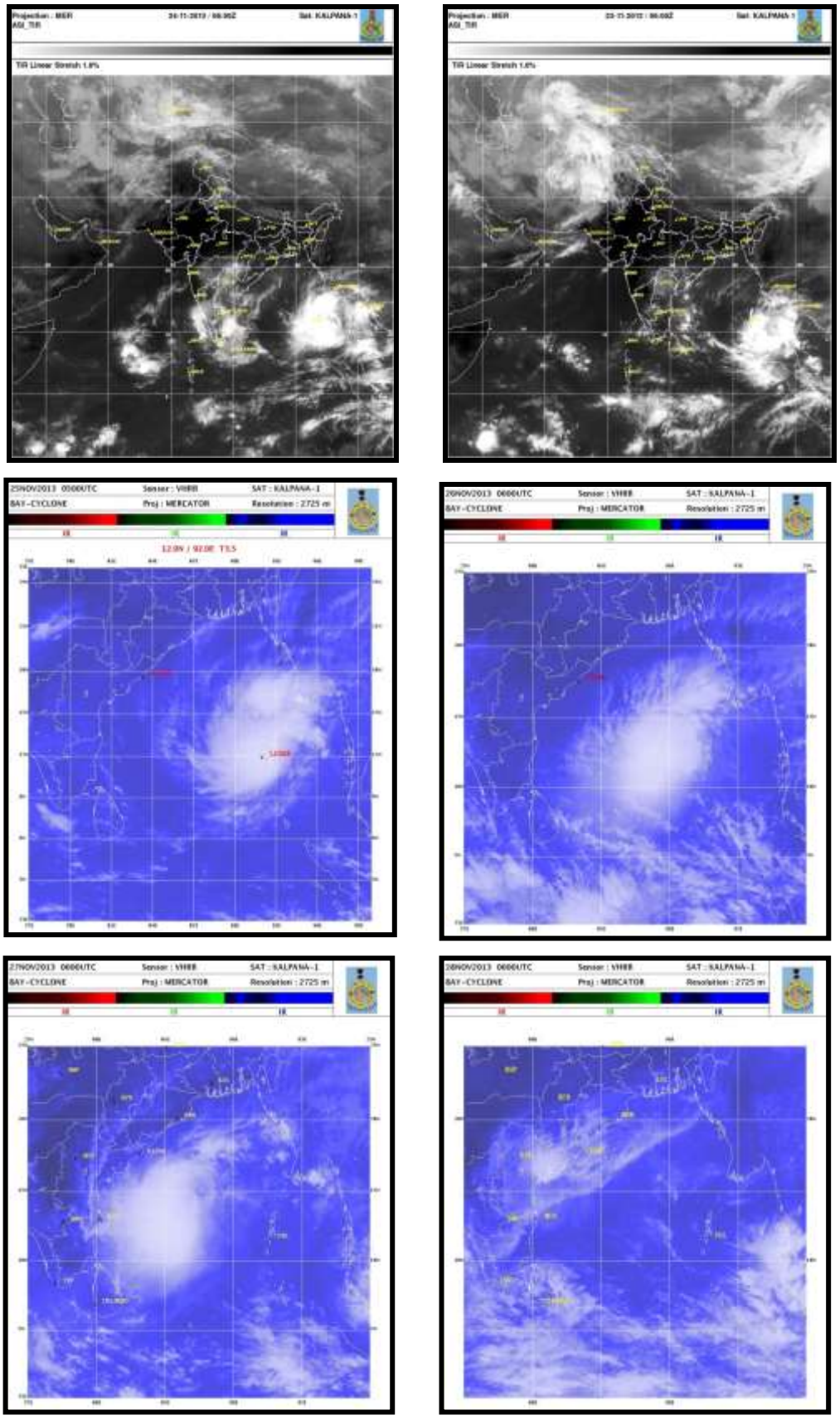
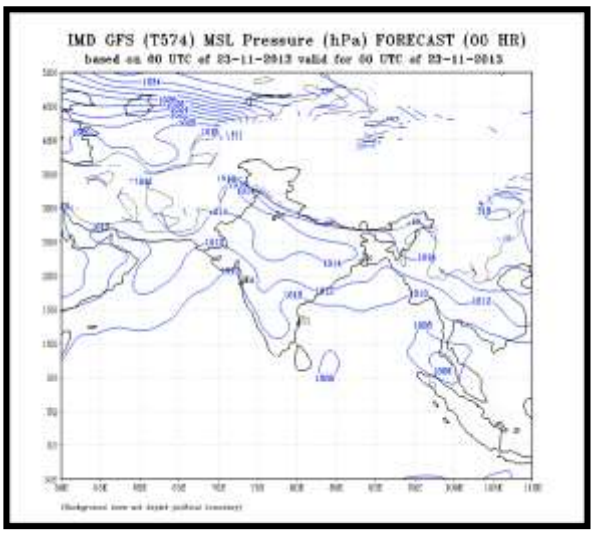
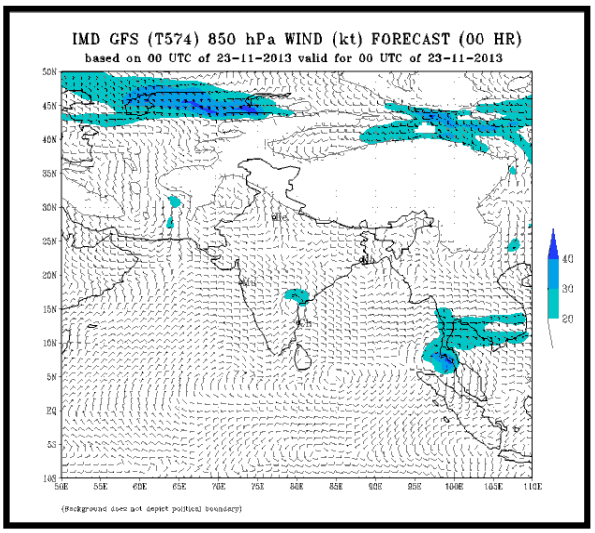
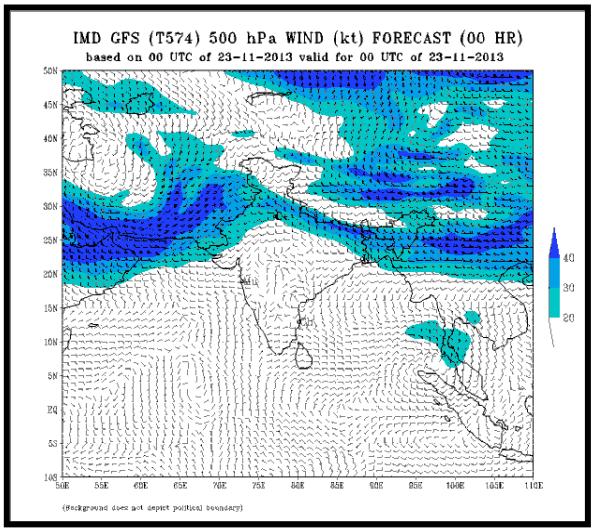
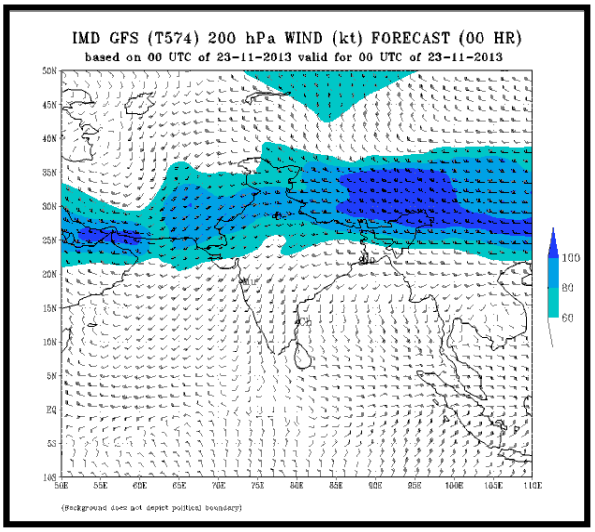


Fig. 4.2.3.2 Satellite imageries based on 0600 UTC of 23rd, 24th, 26th, 27th and 28thNovember, 2013









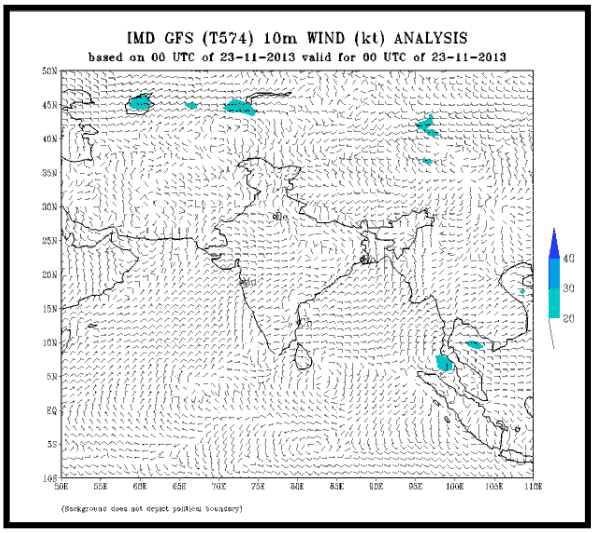


Fig. 4.2.3.3 (a) IMD GFS MSLP and winds at 850, 500 & 200 hpa levels analysis and 10meter wind based on 00 UTC of 23rd November, 2013.

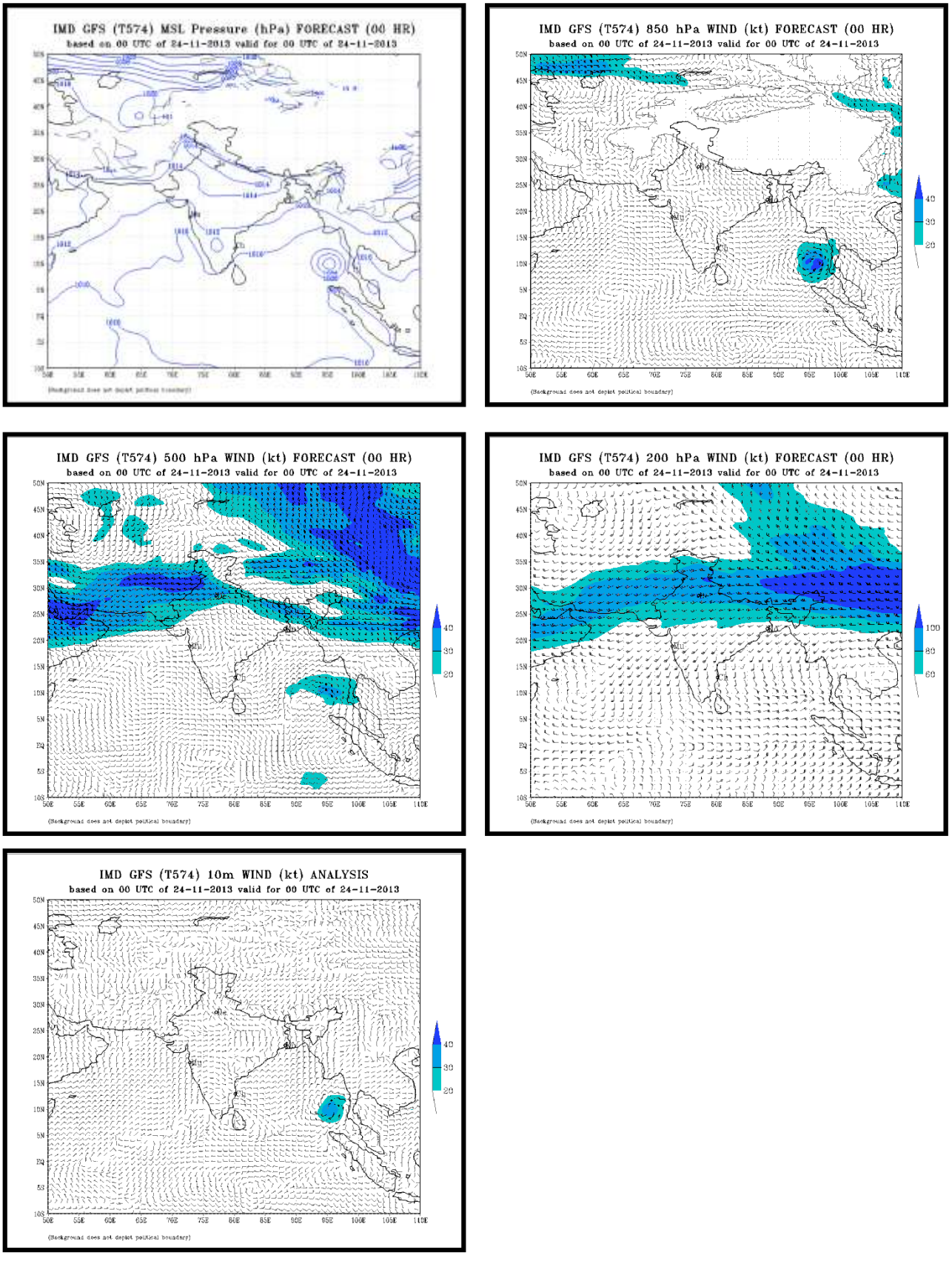
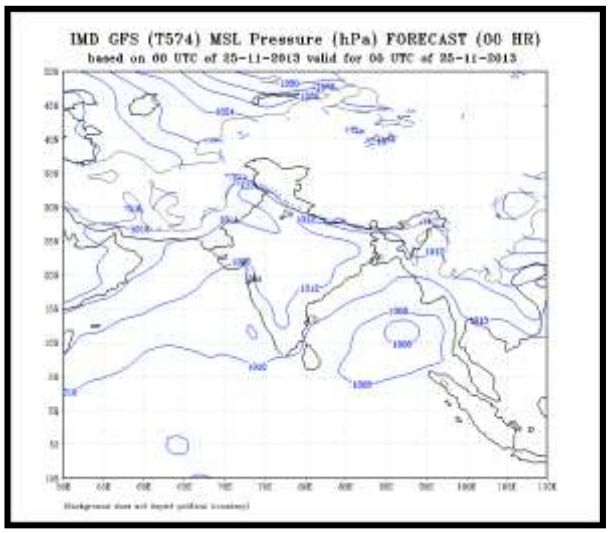
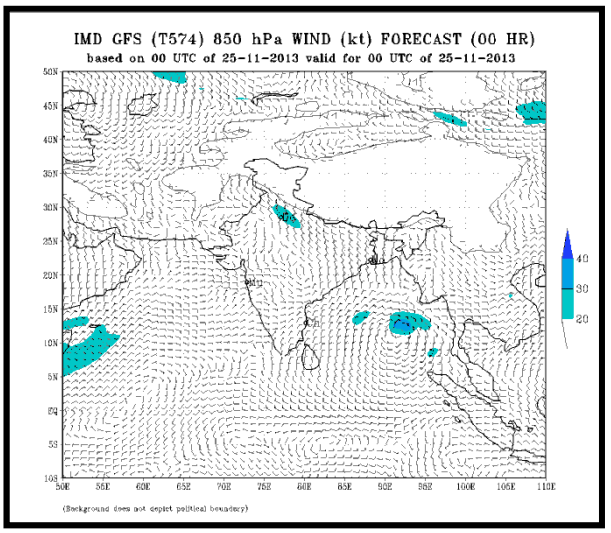
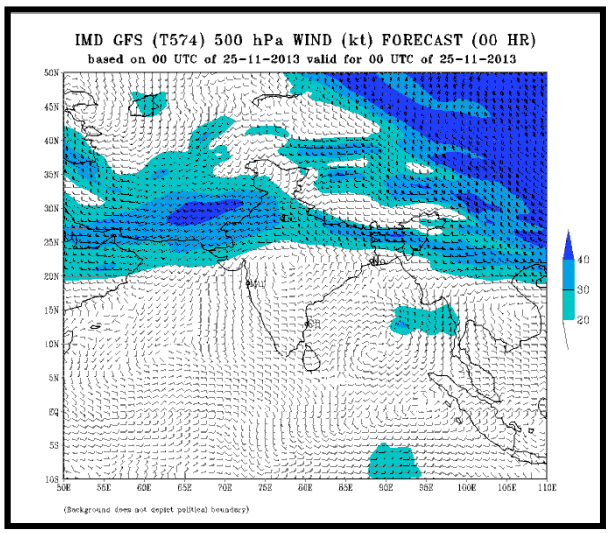
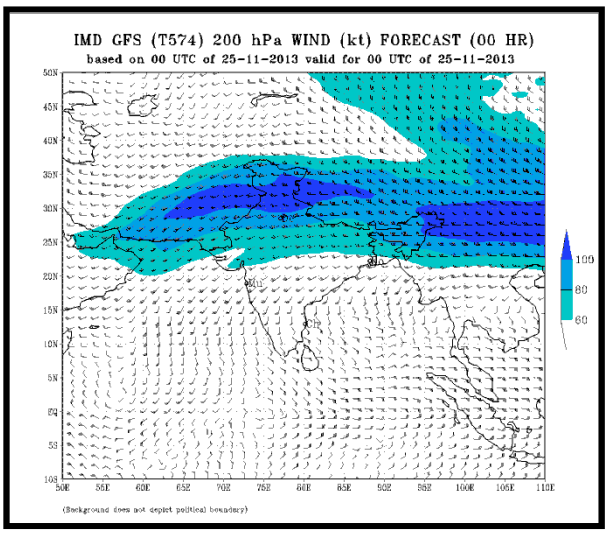


Fig. 4.2.3.3(b) IMD GFS MSLP and winds at 850, 500 & 200 hpa levels analysis and 10meter wind based on 00 UTC of 24th November, 2013.









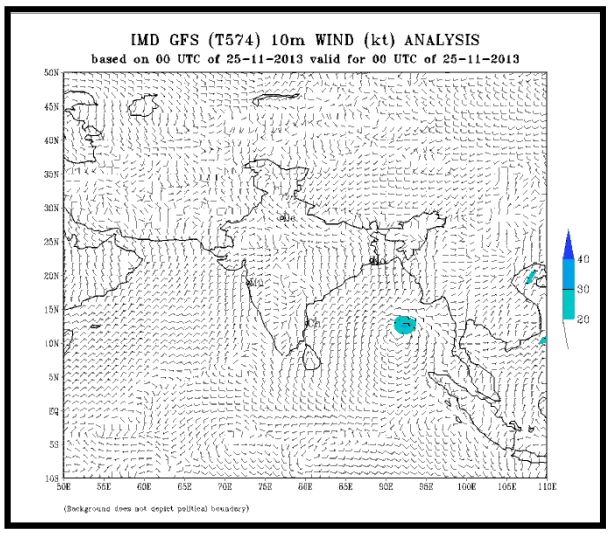
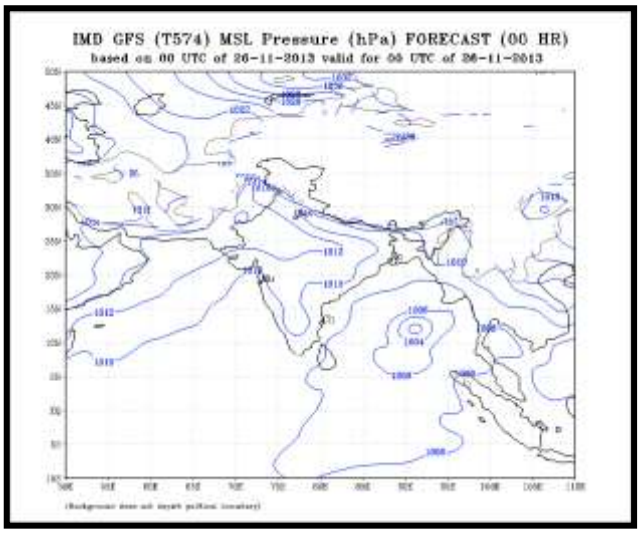
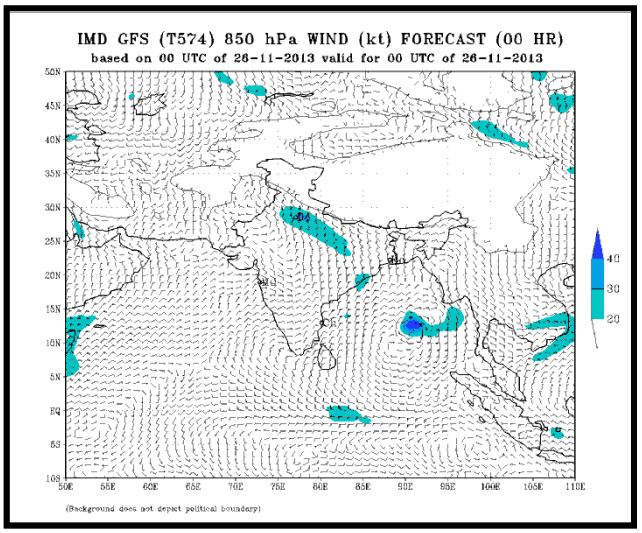
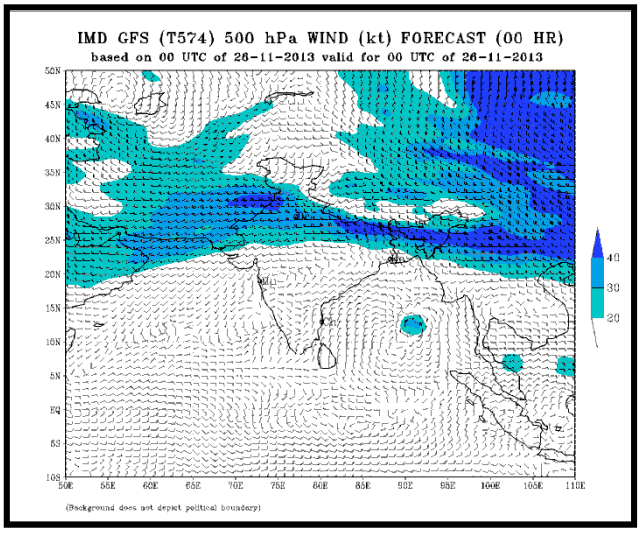
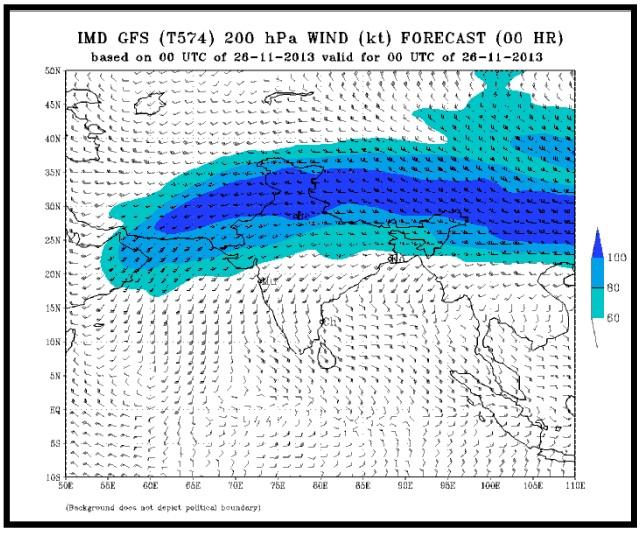


Fig. 4.2.3.3(c) IMD GFS MSLP and winds at 850, 500 & 200 hpa levels analysis and 10meter wind based on 00 UTC of 25th November, 2013.









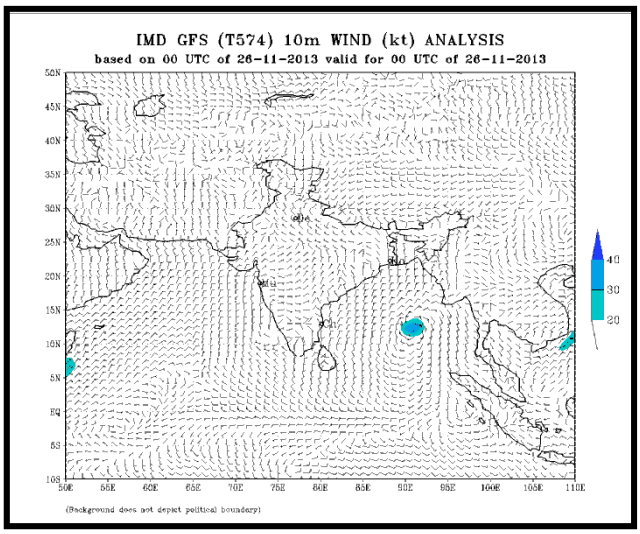


Fig. 4.2.3.3(d) IMD GFS MSLP and winds at 850, 500 & 200 hpa levels analysis and 10meter wind based on 00 UTC of 26th November, 2013.

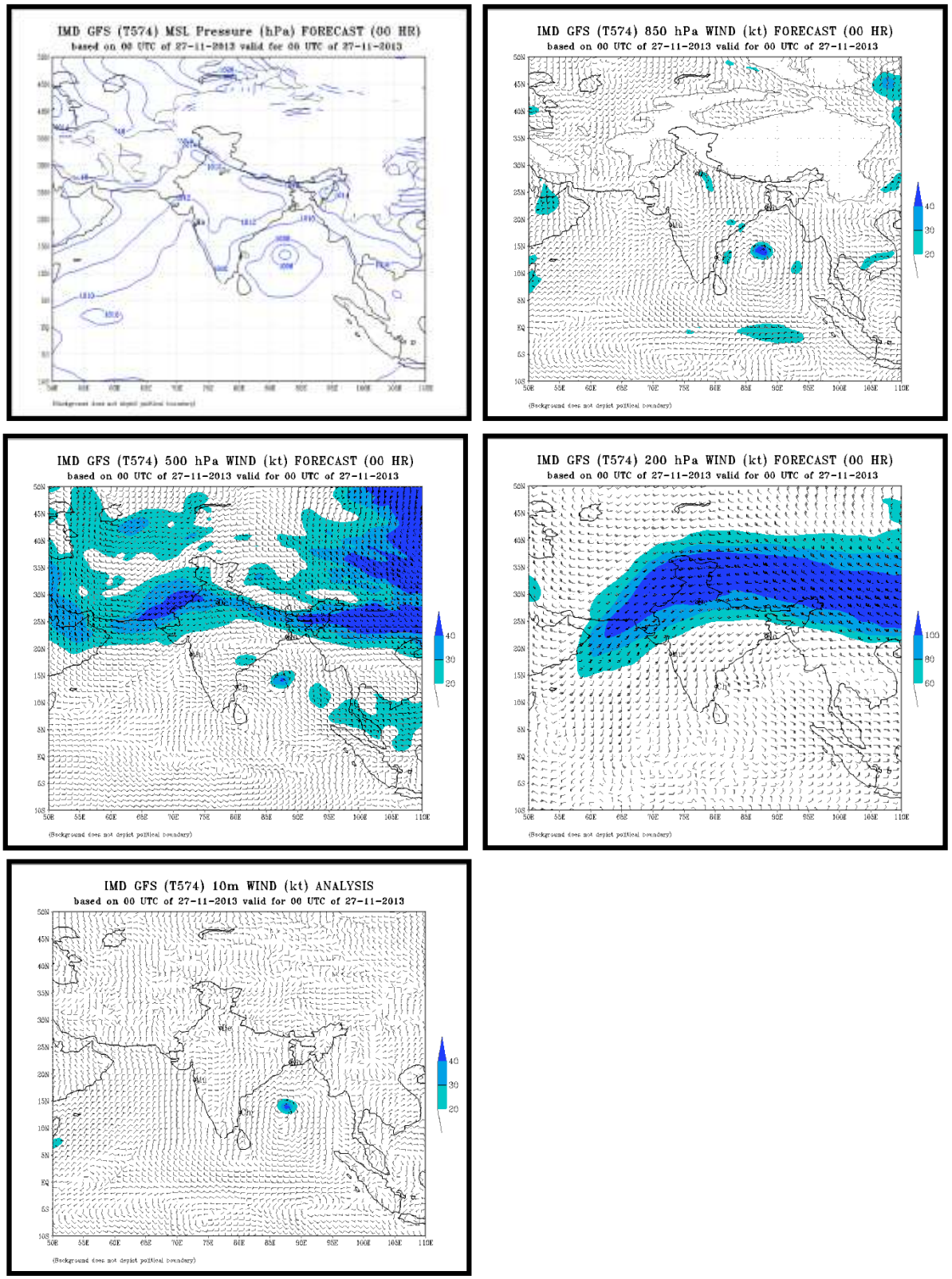


Fig. 4.4.3(e) IMD GFS MSLP and winds at 850, 500 & 200 hpa levels analysis and 10meter wind based on 00 UTC of 27th November, 2013.

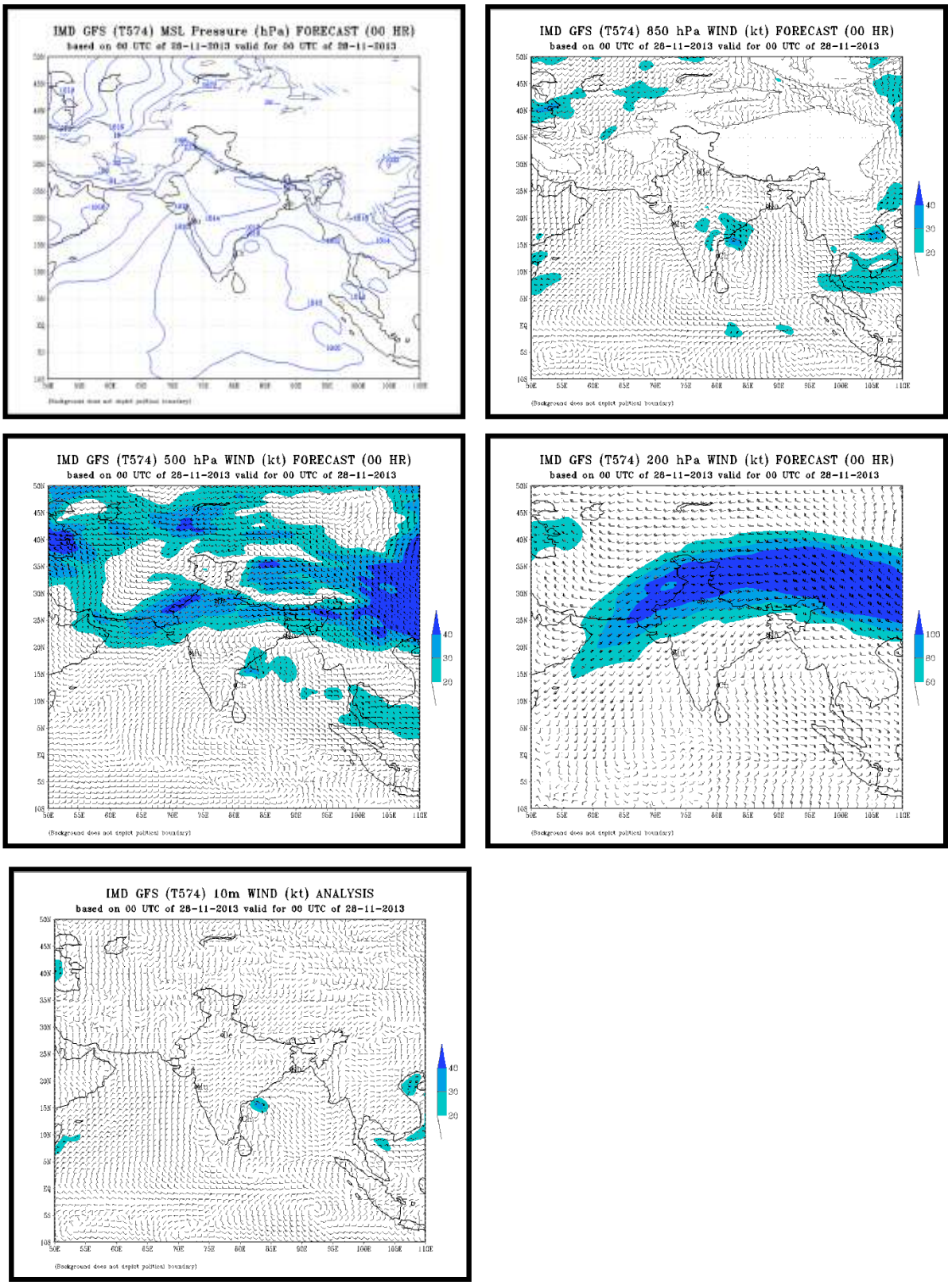


Fig. 4.2.3.3(f) IMD GFS MSLP and winds at 850, 500 & 200 hpa levels analysis and 10meter wind based on 00 UTC of 28th November, 2013.

4.2.3.5 Realized Weather:

Chief amounts of 24 hrs. Rainfall (7 cm or more) ending at 0300 UTC from 23rd November to 29th November, 2013 are given below:

23 November 2013 - Nil
24 November 2013 – Nil
25 November 2013
Andaman & Nicobar Islands: Maya Bandar 24, Port Blair 21, Long Island 11.
26 and 27 November 2013 – Nil
28 November 2013
Kerala: Angadippuram 8,
29 November 2013
Coastal Andhra Pradesh: Macharla 7

4.2.3.5 Damage: No damage has been reported due to this system.

4.2.4 Very Severe Cyclonic Storm 'Madi' (06-13 December 2013)

4.2.4.1 Introduction:

A cyclonic storm 'Madi' formed over southwest Bay of Bengal on 7th December. It initially moved northwards and intensified upto very severe cyclonic storm. After crossing Lat. 150 N it wekened due to unfavourable conditions and recurved southwestwards. It crossed Tamil Nadu coast near Vedaranyam around 1330 UTC of 12th Dec as a depression, emerged into Palk strait around 1500 UTC and again crossed Tamil Nadu coast near Tondi around 1700 UTC of 12th December 2013. It then emerged into southeast Arabian Sea as a well marked low pressure area in the early morning of 13th Oct. 2013. Salient features of the system are given below:

(i) It has a unique track with near northerly movement till 15.70N and then recurving southwestwards to Tamil Nadu coast.

(ii) It moved very slowly during its northward journey and speed peaked up gradually after the recurvature to southwest.

4.2.4.2 Genesis

A low pressure area from south China Sea moved across Malay peninsula and emerged into south Andaman Sea on 01st December, morning. Moving westwards it lay over southeast Bay of Bengal on 02nd December. Continuing its westwards movement, it lay over southwest Bay of Bengal off Sri Lanka coast on 03rd December, 2013. It persisted over the same region and became well marked on 04th December. It further concentrated into a depression in the morning of 06th December over southwest Bay of Bengal and lay centered near latitude 10.0°N and longitude 84.0°E, about 350 km northeast of Tricomalee (Sri Lanka). The genesis was declared using the sea surface wind observations based on ASCAT and Ocean Sat-II alongwith satellite imageries. Also the ship and buoy observations near the centre supported the genesis. A ship near latitude 11.9°N and Longitude 85.4°E reported wind speed of 080/23 knots. The sea surface temperature during genesis was about 26-28°C and ocean thermal energy was about 60-80 KJ/cm2. The vertical wind shear was moderate (10-20 knots). The lower

level convergence and relative vorticity increased from 05th to 06th December, 2013, along with increase in upper tropospheric divergence. The Madden Julian Oscillation (MJO) index lay over phase-3 i.e. equatorial Indian Ocean adjoining Bay of Bengal with amplitude less than1. Past studies indicate that phase 3 is favourable for genesis of the system.

4.2.4.3 Intensification and movement

As the system lay over the warmer sea surface alongwith higher ocean thermal energy and low to moderate vertical wind shear, it gradually intensified into a deep depression at 1800 UTC of 06th December while remaining practically stationary over the region. The depression remained practically stationary, as it lay close to the upper troposphere ridge which ran along 10°N. It led to very slow northward movement afterwards. The deep depression further intensified into a cyclonic storm 'MADI' with centre near latitude 10.5°N and longitude 84.0°E at 0000 UTC of 07th December, 2013. It intensified into a severe cyclonic storm over the same region at 0900 UTC of 07th December, 2013. As it lay slightly to the north of the ridge, the severe cyclonic storm then moved slightly north-northeastwards and intensified into a very severe cyclonic storm at 0600 UTC of 08th December, 2013 near latitude 12.3°N and longitude 84.7°E.

As the very severe cyclonic storm moved to the north of 13.0°N i.e. to west central Bay of Bengal, it experienced colder sea surface temperature and low Ocean thermal energy (< 50 KJ/cm2). Also the vertical wind shear of horizontal wind gradually increased and became high (20-30 knots). As a result, the very severe cyclonic storm weakened into a severe cyclonic storm at 1200 UTC of 09th December and lay centered near latitude14.6°N and longitude 84.7°E. It continued to move slowly north-northeastwards till 0900 UTC of 10th December as a severe cyclonic storm upto latitude 15.7°N and longitude 85.3°E under the influence of the upper tropospheric steering ridge which moved northward alongwith northward movement of system. However, due to gradual weakening of system, the steering level changed from upper troposphere to lower and middle troposphere. The influence of the upper tropospheric anticyclonic circulation to the east of system centre decreased and that of lower and middle level anticyclonic circulation lying to the west of the system centre (over central India) increased. As a result, the severe cyclonic storm re-curved westwards initially and then southwestwards commencing from 0900 UTC of 10th December.

At the same time, the animation of Total Precipitated Water (TPW) imageries indicated that the dry and cold air penetrated into the southwestern periphery of the cyclone. It gradually penetrated further towards the centre of the cyclone from the southern side. As a result, it isolated the core of the cyclone from the warm and moist air from the southeast sector. Hence due to combined impact of colder sea surface temperature, low Ocean thermal energy, high vertical wind shear and incursion of cold and dry air into the core of the cyclone, it gradually weakened into a cyclonic storm near latitude 14.6°N and longitude 84.6°E at 2100 UTC of 10th December 2013, further into a deep depression near latitude14.0°N and longitude 83.8°E at 0300 UTC of 11th December and into a depression near latitude 12.9°N and longitude 82.7°E at 1800 UTC of 11th December.

The depression crossed Tamil Nadu coast close to Vedaranyam around 1330 UTC of 12th December. It then emerged into Palk strait at 1500 UTC, moved west-southwestwards and again crossed Tamil Nadu coast near Tondi around 1700 UTC of 12th December. It continued to move west-southwestwards across south peninsula and weakened further into a well-marked low pressure area over southeast Arabian Sea and adjoining Kerala at 0000 UTC of 13th December, 2013. It may be mentioned that due to increased convection and organization as per Dvorak estimate the system showed temporary increase in intensity upto very severe cyclonic storm stage during the weakening phase on 10th December (0300-0900 UTC). The best track position and other parameters of the very severe cyclonic Storm 'MADI' over the Bay of Bengal is given in Table 4.2.4.1 and the track is given in Fig. 4.1. The DWR imageries are shown in Fig.4.2.4.1. The satellite imageries are shown in fig. 4.2.4.2. The IMD GFS model analyses are shown in Fig. 4.2.4.3.

Table 4.2.4.1 Best track positions and other parameters of the Very Cyclonic Storm 'MADI' over the Bay of Bengal during 06-13 Dec 2013

Date	Time (UTC)	Centre lat.^{0} N/ long.^{0} E	C.I. NO	Estimated Central Pressure(hPa)	Estimated Maximum sustained Surface Wind (kt)	Estimated Pressure drop at the Centre (hPa)	Grade
06-12-2013	0300	10.0/84.0	1.5	1004	25	3	D
	0600	10.0/84.0	1.5	1004	25	3	D
	1200	10.2/84.0	1.5	1004	25	3	D
	1800	10.4/84.0	2.0	1002	30	5	DD
07-12-2013	0000	10.5/84.1	2.5	998	35	7	CS
	0300	10.5/84.1	2.5	998	35	7	CS
	0600	10.7/84.2	3.0	996	45	10	CS
	0900	10.8/84.3	3.5	992	55	14	SCS
	1200	11.0/84.4	3.5	992	55	14	SCS
	1500	11.0/84.5	3.5	992	55	14	SCS
	1800	11.2/84.5	3.5	990	55	16	SCS
	2100	11.5/84.6	3.5	990	55	16	SCS
08-12-2013	0000	11.8/84.6	3.5	988	60	18	SCS
	0300	12.0/84.6	3.5	988	60	18	SCS
	0600	12.3/84.7	4.0	986	65	20	VSCS
	0900	12.6/84.7	4.0	986	65	20	VSCS
	1200	13.0/84.7	4.0	986	65	20	VSCS
	1500	13.2/84.7	4.0	986	65	20	VSCS
	1800	13.4/84.7	4.0	986	65	20	VSCS
	2100	13.6/84.7	4.0	986	65	20	VSCS
09-12-2013	0000	13.8/84.7	4.0	986	65	20	VSCS
	0300	14.0/84.7	4.0	986	65	20	VSCS
	0600	14.3/84.7	4.0	986	65	20	VSCS
	0900	14.4/84.7	4.0	986	65	20	VSCS
	1200	14.6/84.7	3.5	988	60	18	SCS

	1500	14.7/84.7	3.5	988	60	18	SCS
	1800	14.8/84.8	3.5	988	60	18	SCS
	2100	14.8/84.8	3.5	988	60	16	SCS
10-12-2013	0000	15.0/85.0	3.5	988	60	16	SCS
	0300	15.3/85.3	4.0	986	65	20	VSCS
	0600	15.4/85.3	4.0	986	65	20	VSCS
	0900	15.7/85.3	4.0	986	65	20	VSCS
	1200	15.4/85.0	3.5	990	55	14	SCS
	1500	15.1/84.8	3.5	990	55	14	SCS
	1800	14.9/84.7	3.5	992	50	12	SCS
	2100	14.6/84.6	3.0	994	45	10	CS
11-12-2013	0000	14.3/84.2	3.0	996	40	8	CS
	0300	14.0/83.8	2.0	998	30	6	DD
	0600	13.7/83.5	2.0	998	30	6	DD
	0900	13.5/83.4	2.0	1000	30	5	DD
	1200	13.3/83.3	2.0	1000	30	5	DD
	1800	12.9/82.7	1.5	1000	25	4	D
12-12-2013	0000	12.5/82.0	1.5	1000	25	3	D
	0300	12.0/81.5	1.5	1000	25	3	D
	0600	11.5/81.2	1.5	1000	25	3	D
	0900	11.0/80.7	1.5	1000	25	3	D
	1200	10.5/80.0	1.5	1000	25	3	D
	The system crossed Tamil Nadu coast near Vedaranyam aound 1330 UTC and emerge into Palk straight and again crossed Tamil Nadu coast near Tondi around 1700 UTC						
	1800	10.0/78.8	-	1004	20	3	D
13-12-2013	0000	Weakened into a Well marked low pressure area over southeast Arabian Sea and adjoining Kerala.					

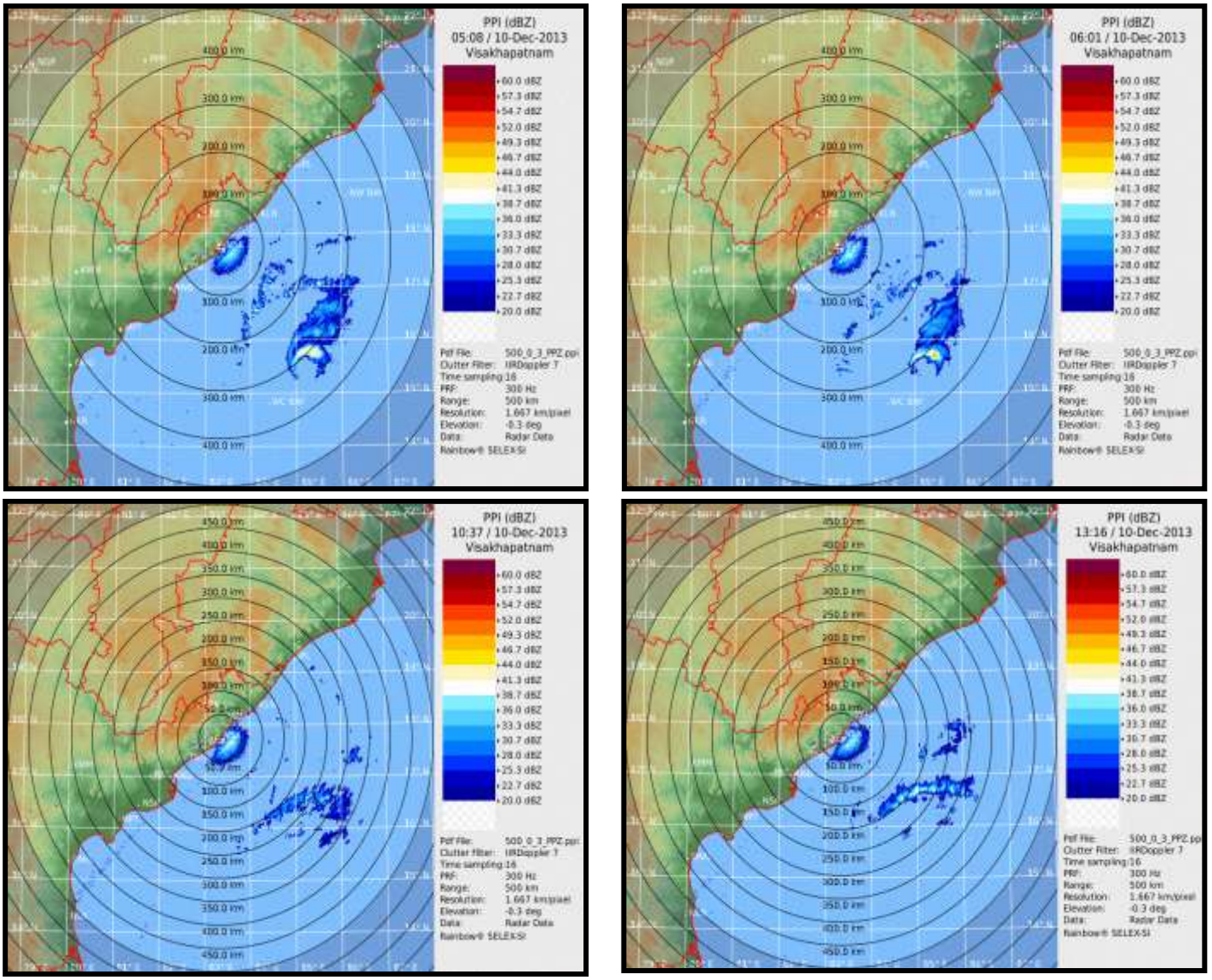


Fig. 4.2.4.1 Visakhapatnam RADAR imageries based on 0510, 0600, 1040 & 1320 UTC of 10th December, 2013

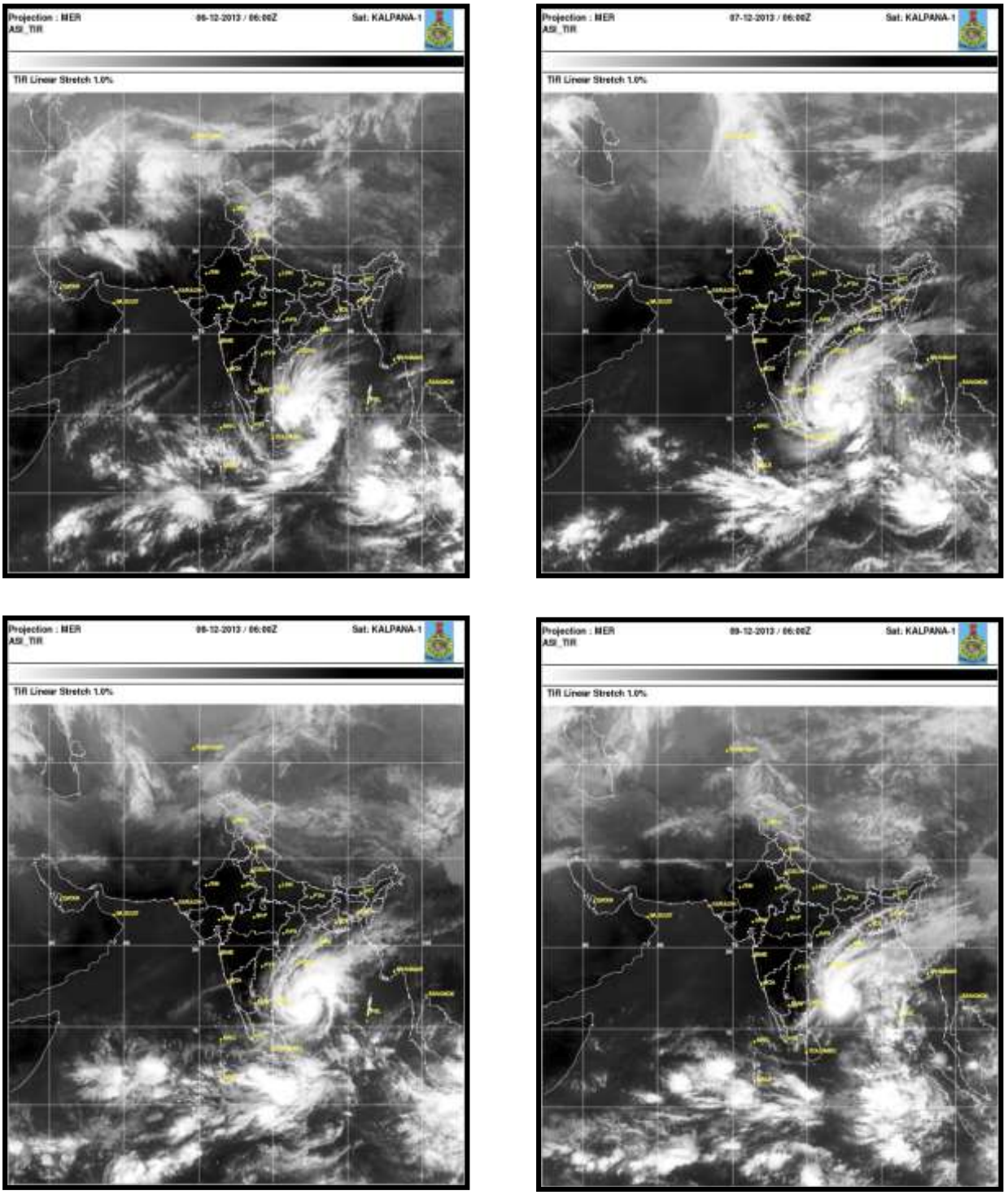


Fig. 4.2.4.2(a) Typical Kalpana-1 Satellite imageries of very severe cyclonic storm 'Madi' at 0600 UTC of 06th, 07th, 08th and 09th December 2013.

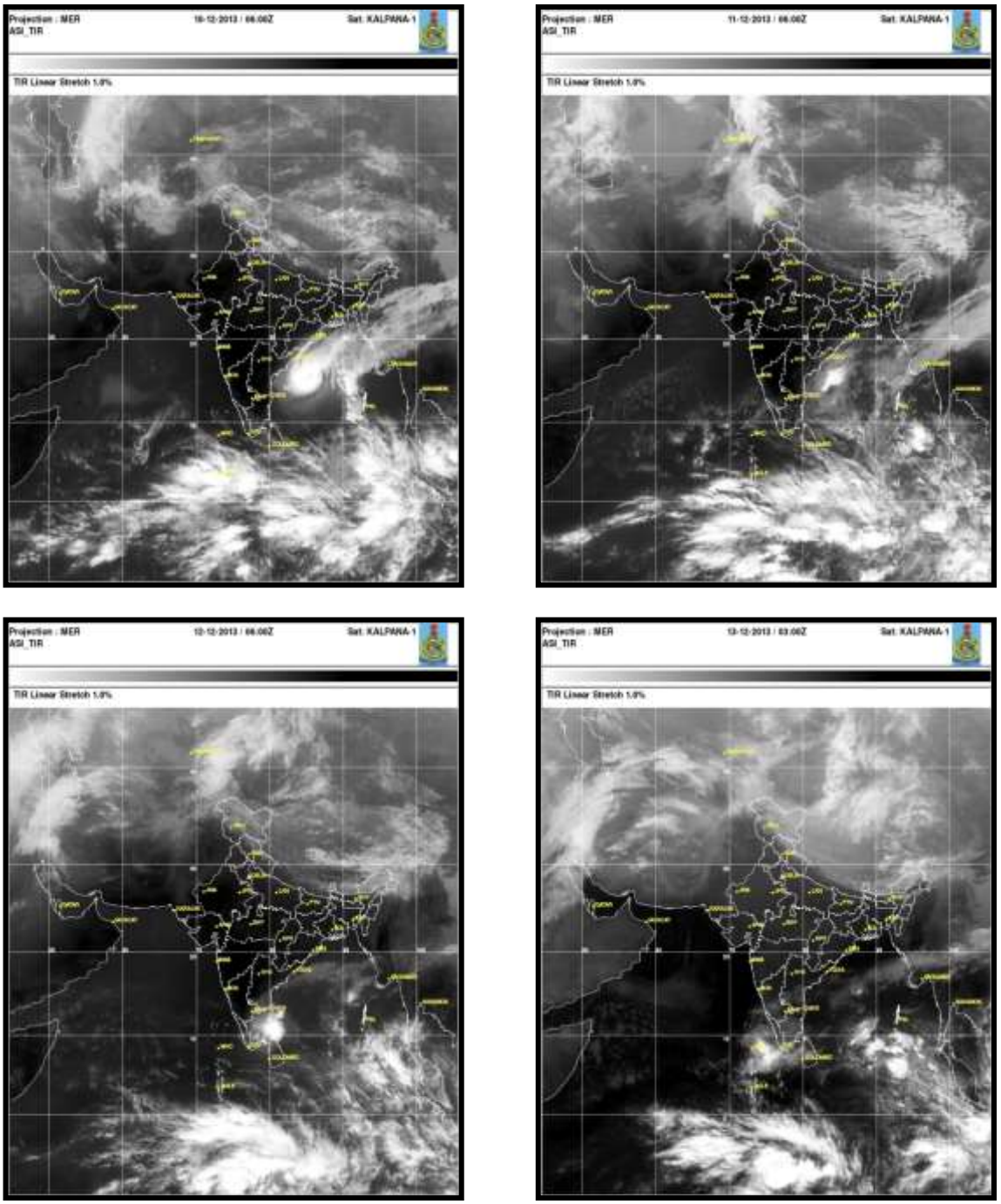


Fig.4.2.4.2(b) Typical Kalpana-1 Satellite imageries of very severe cyclonic storm 'Madi' at 0600 UTC of 10th, 11th, 12th and 0300 UTC of 13th December 2013.

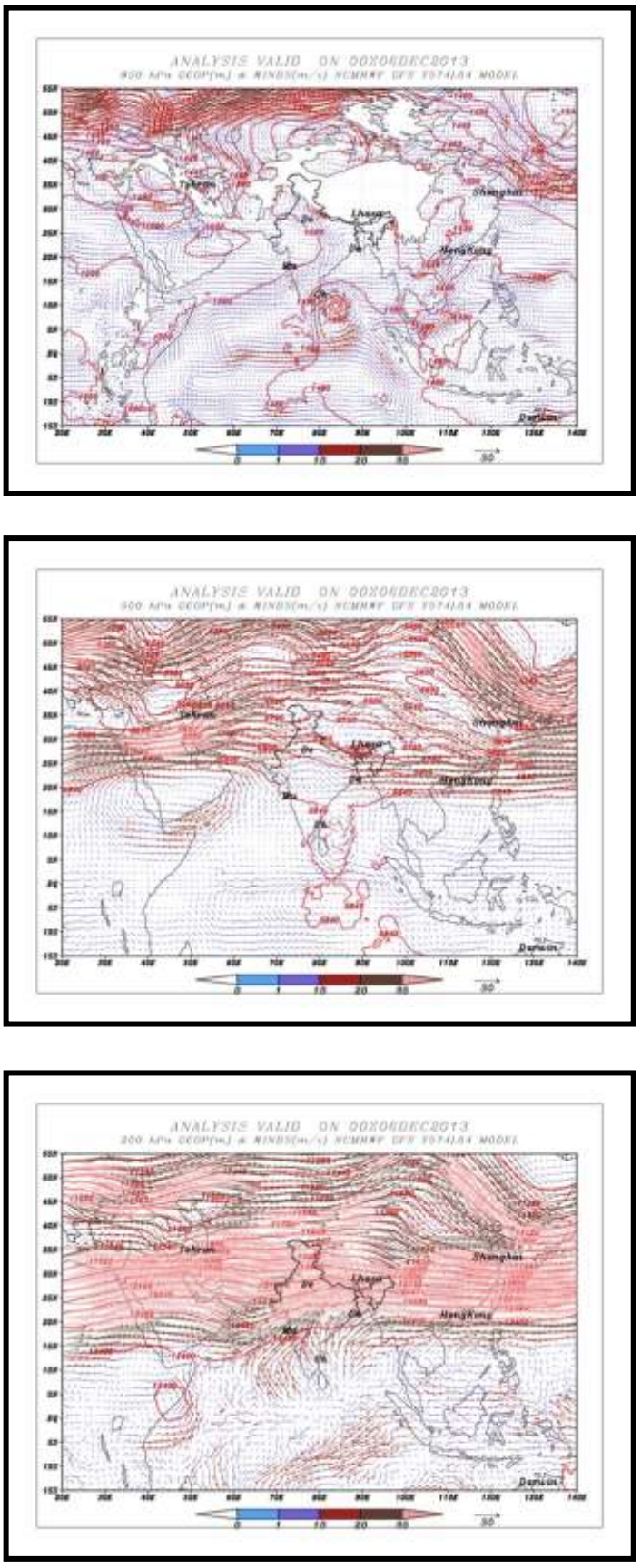


Fig. 4.2.4.3(a): NCMRWF GFS Analysis based on 00 UTC of 6th Dec. 2013 in association with VSCS MAADI

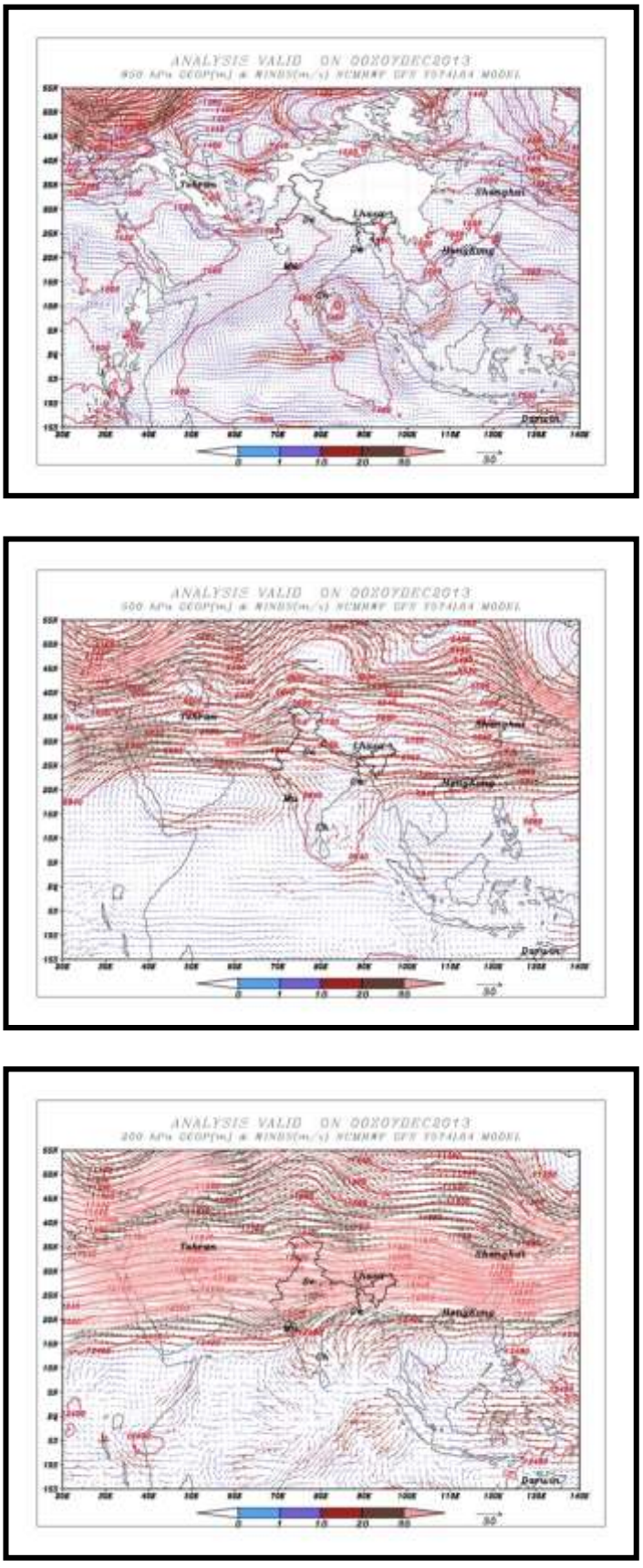


Fig 4.2.4.3(b) NCMRWF GFS Analysis based on 00 UTC of 7th Dec. 2013 in association with VSCS MAADI

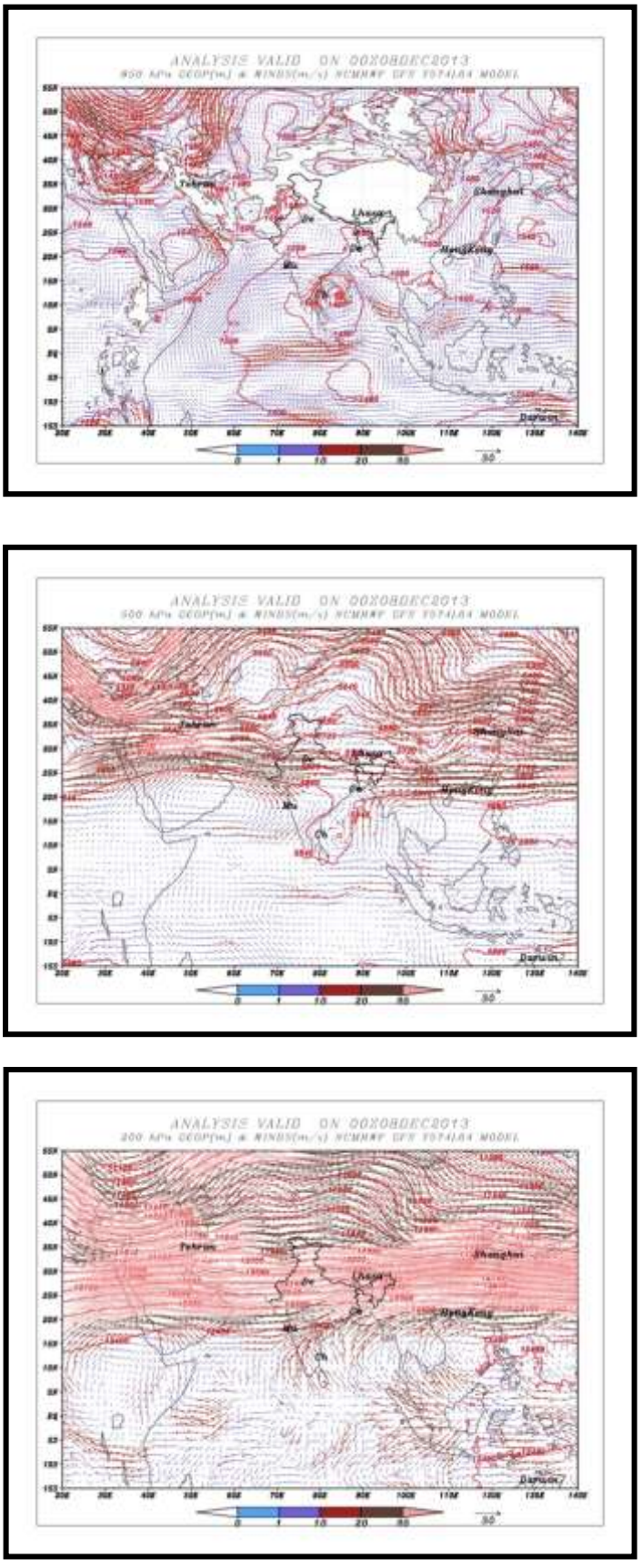


Fig 4.2.4.3(c) NCMRWF GFS Analysis based on 00 UTC of 8th Dec. 2013 in association with VSCS MAADI

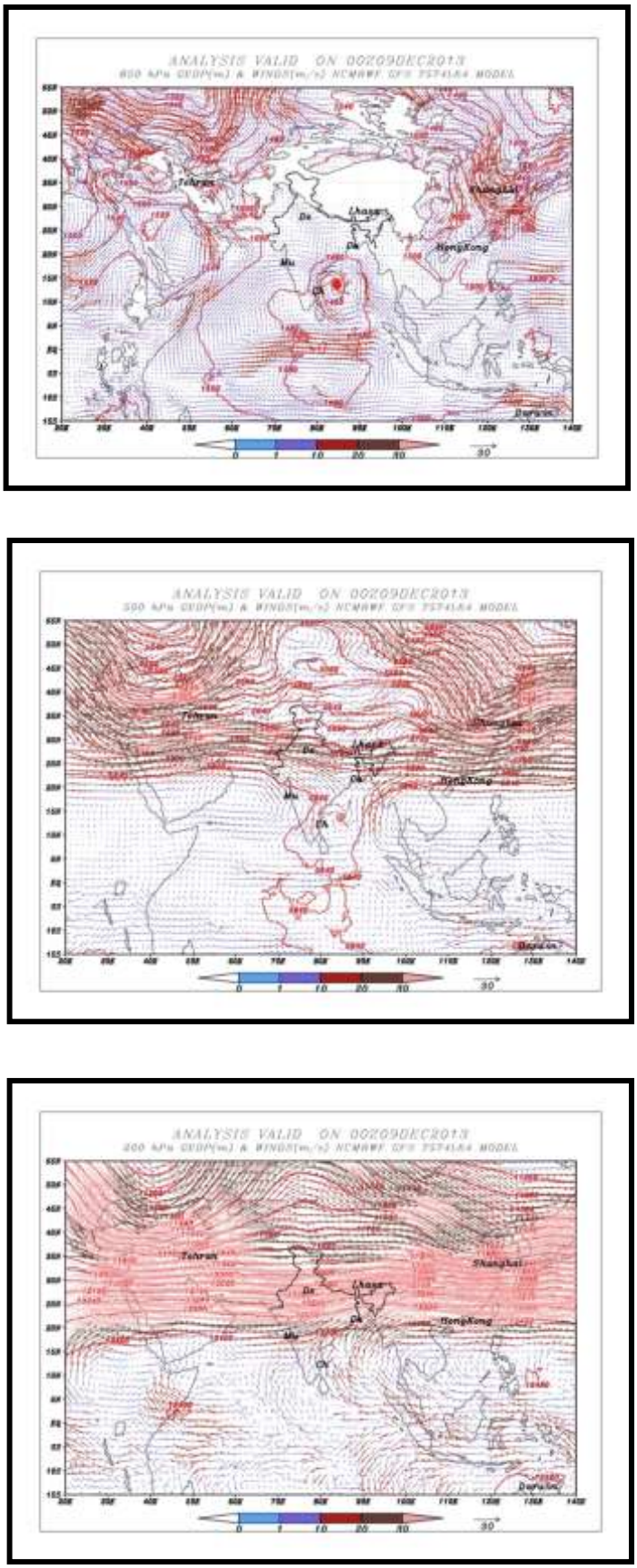


Fig 4.2.4.3(d) NCMRWF GFS Analysis based on 00 UTC of 9 Dec. 2013 in association with VSCS MAADI

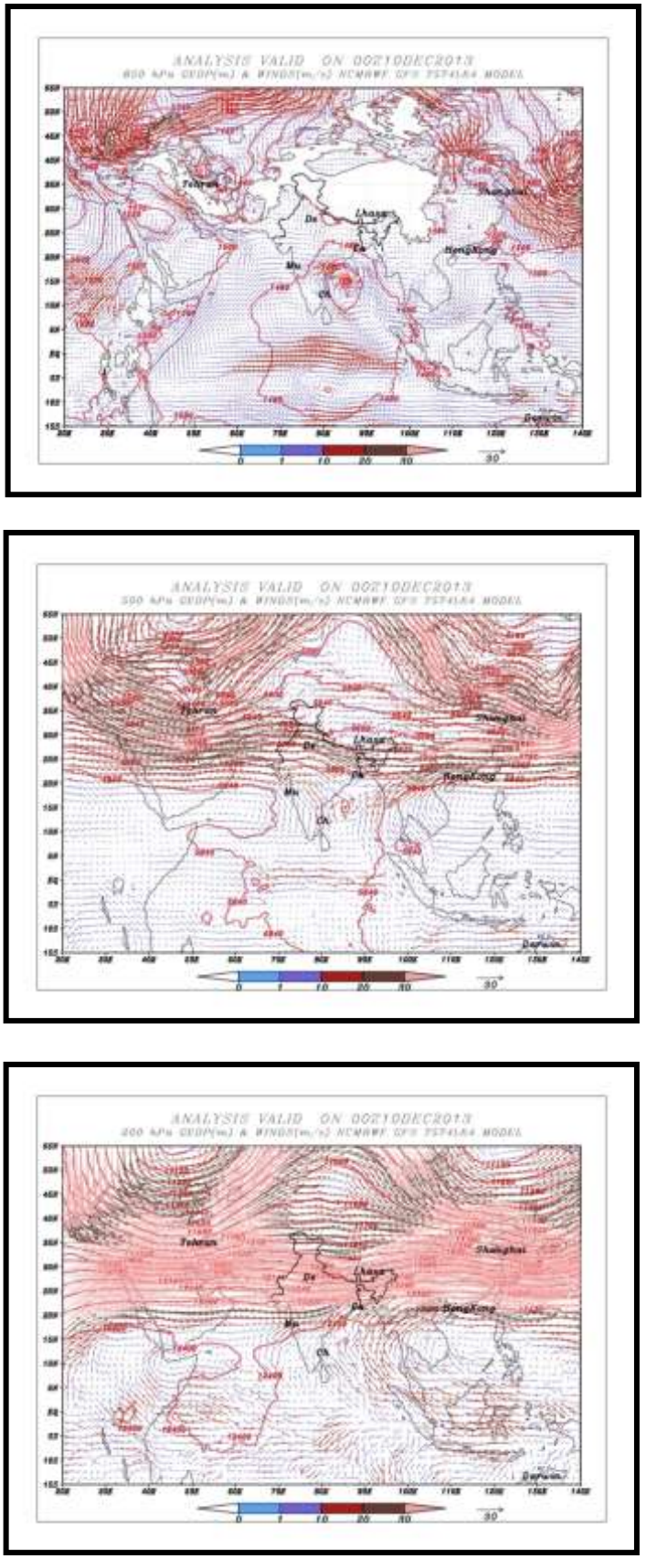


Fig 4.2.4.3(e) NCMRWF GFS Analysis based on 00 UTC of 10th Dec. 2013 in association with VSCS MAADI

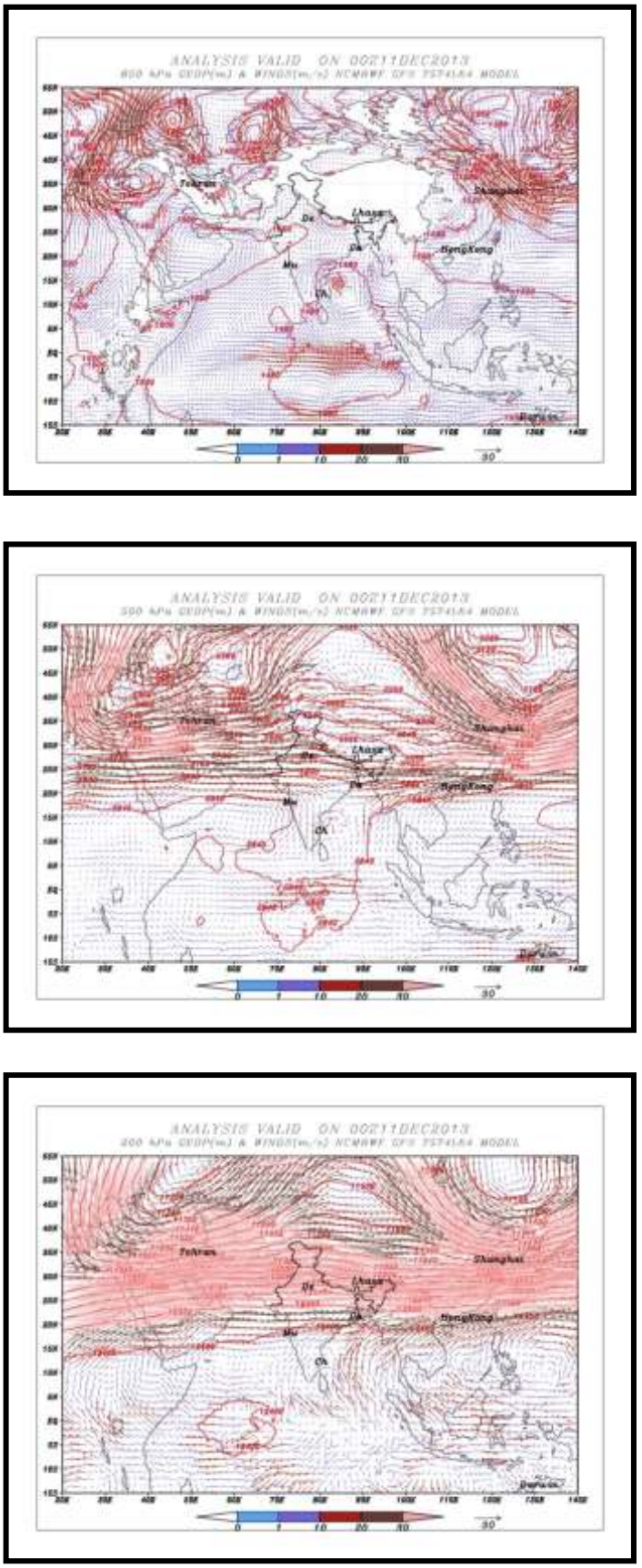


Fig 4.2.4.3(f): NCMRWF GFS Analysis based on 00 UTC of 11th Dec. 2013 in association with VSCS MAADI

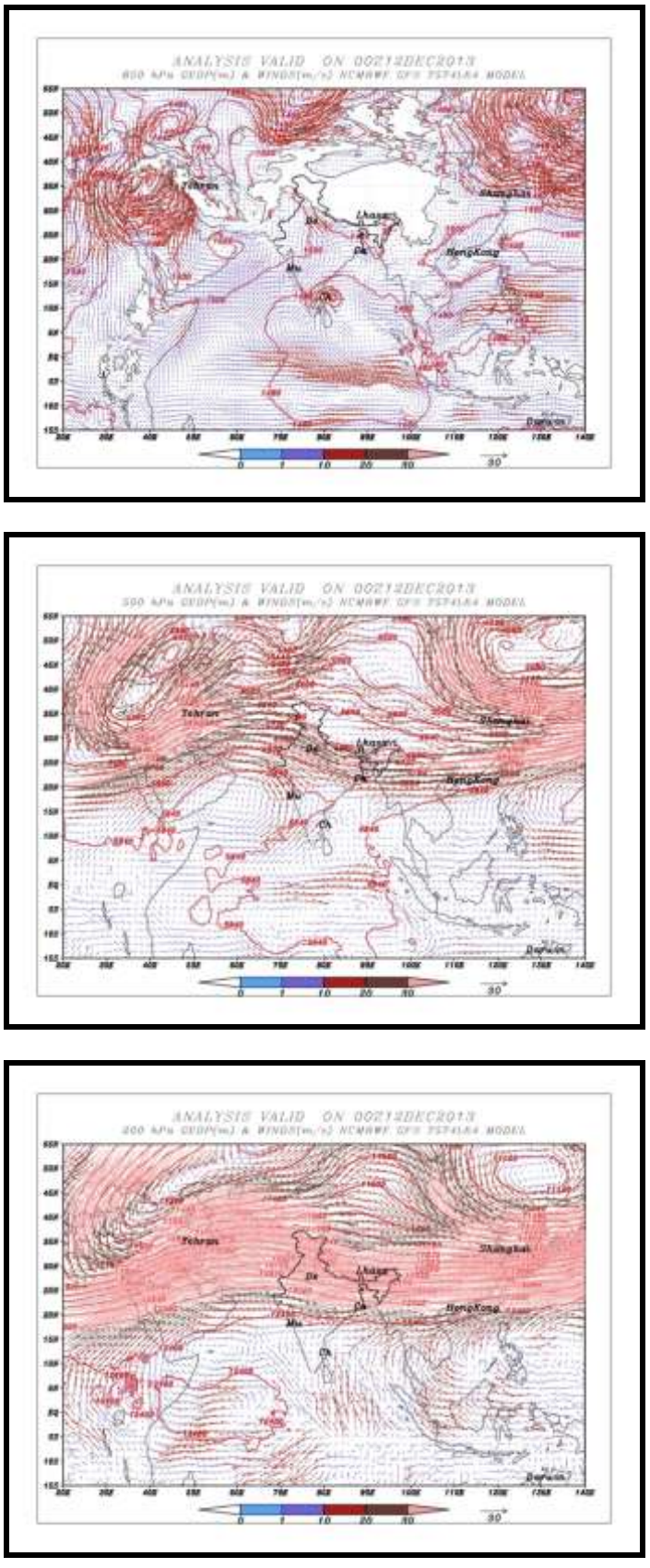


Fig 4.2.4.3(g) NCMRWF GFS Analysis based on 00 UTC of 12th Dec. 2013 in association with VSCS MAADI

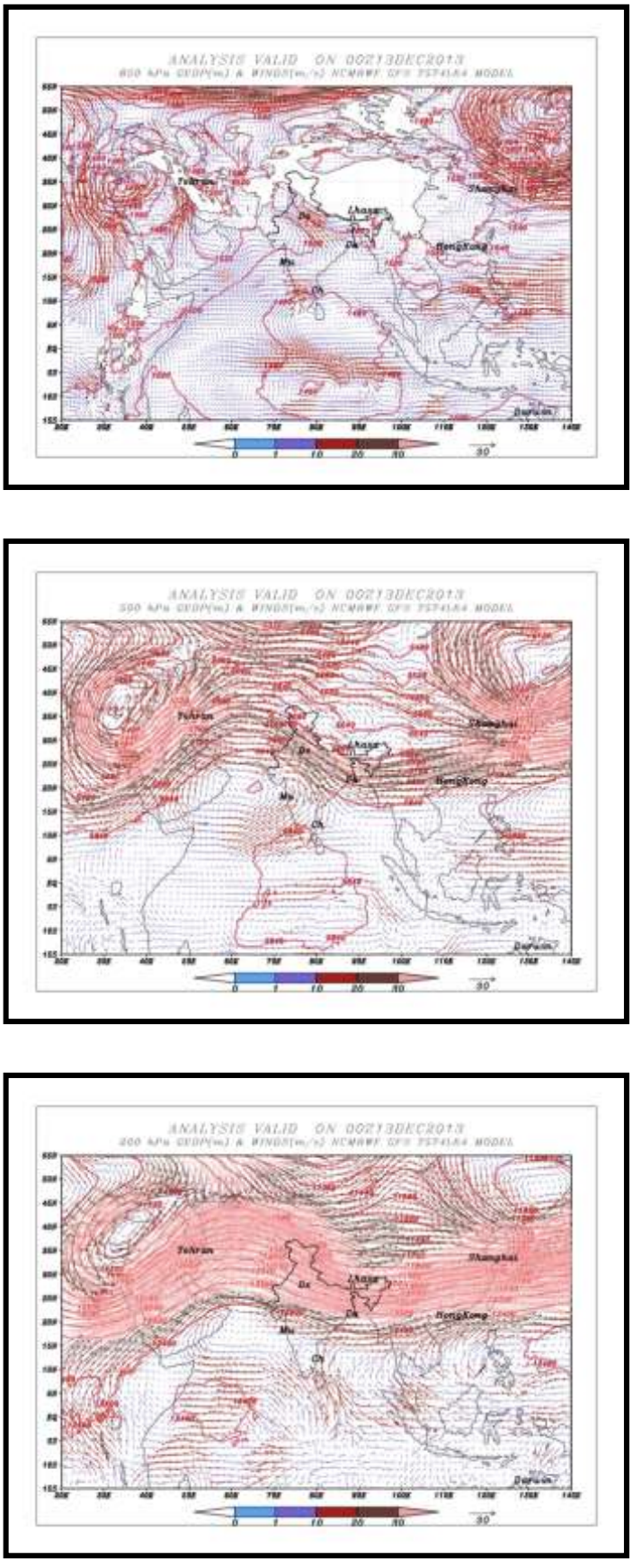


Fig 4.2.4.3(h) NCMRWF GFS Analysis based on 00 UTC of 13th Dec. 2013 in association with VSCS MAADI

4.2.4.4 Realised Weather

Chief amounts of 24 hrs. Rainfall (7 cm or more) ending at 0300 UTC from 07th December to 14th December, 2013 are given below:

7th December - Nil

8th December

ANDAMAN & NICOBAR ISLANDS: Hut Bay 9,

9th December

ANDAMAN & NICOBAR ISLANDS: Port Blair 10,

10th December-Nil
11th Decmber -NIL
12th December -NIL
13th December-
Tamilnadu & Puducherry:Colachel 11, Tindivanam 11, Kallakurichi 11, Eraniel 11, Cheyyur 11, Pondicherry 10, Ulundurpet 9, Virudhunagar 9, Attur 8, Airport Madurai 7, Tirumangalam 7, Vilupuram 7,
14th December -NIL

4.2.4.5 Damage: No damage has been reported due to this system

CHAPTER-V

FDP (Cyclone) NOC Report Dated 15 October, 2013

Synoptic features based on 0300 UTC:

- The withdrawal line continues to pass through Kalpa, Hissar, Jodhpur and Naliya. Conditions continue to be indicative of further withdrawal of southwest Monsoon from remaining parts of Himachal Pradesh, Haryana, Chandigarh & Delhi, Rajasthan; entire Uttarakhand most parts of west Uttar Pradesh; some parts of west Madhya Pradesh and some more parts of Gujarat State around 17th October.
- The southwest Monsoon has been vigorous over West Bengal & Sikkim and Bihar. It has been subdued over Arunachal Pradesh, Assam & Meghalaya,Nagaland-Manipur-Mizoram-Tripura, Uttarakhand, Haryana, Gujarat State, coastal Andhra Pradesh, Tamil Nadu, south interior Karnataka and Kerala.
- The Depression over Jharkhand and neighbourhood moved north-northeastwards, weakened into a well marked low pressure area and lay over southwest Bihar and neighbourhood at 0900 UTC of yesterday, the 14th October 2013. It persisted over the same region yesterday evening, and has become less marked today morning. However, the associated cyclonic circulation lies over Bihar & neighbourhood and extends upto 3.1 kms a.s.l.
- A trough in the lower tropospheric levels extends from the above cyclonic circulation over Bihar and neighbourhood to southwest Bay of Bengal with an embedded cyclonic circulation over north coastal Andhra Pradesh and neighbourhood.
- The cyclonic circulation over east Rajasthan and neighbourhood has become less marked.
- The trough in mid tropospheric westerlies has moved away northeastwards

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST around 28-30^{0}C over central Bay of Bengal.

Ocean thermal energy:

- It is < 50 KJ cm^{-2} over Bay of Bengal

Relative Vorticity:

- Relative vorticity at 850 hPa is negative over west central and adjoining NW Bay of Bengal and positive along east coast and Southwest Bay.

Convergence:

- No area of Lower level convergence exists over Indian Ocean except near the equatorial region.

Divergence:

- Upper air positive divergence of 5*10^{-5} s^{-1} prevails over the west central and adjoining Northwest bay.

Wind Shear:

- Wind Shear is high (20-40 knots) over Bay of Bengal.

Wind Shear Tendency:

- Increasing order of 5 to 10 knots over Bay of Bengal.

Upper tropospheric ridge:

- The upper tropospheric **RIDGE** LINE AT 200 hpa passes through lat 22.0°N.

M.J.O. Index:

- Located over phase 8 with amplitude about 1.0.
- Dynamical forecast:- MJO located in phase 8 with amplitude about 1.0 and may continue with phase 8 during next 4 days with increasing amplitude.

Satellite

Inference based on INSAT imagery of 150900 UTC

- Broken Low / Medium clouds with embedded isolated weak convection over Bihar, Nepal, east Uttar Pradesh, North Chhattisgarh, Jharkhand in association with feeble low level circulation.

Bay of Bengal:

- Scattered Low / Medium clouds with embedded isolated weak convection over the bay and Andaman sea.

NWP Analysis

- **IMD-GFS** model shows formation of a CYCIR over southeast Bay of Bengal during next 72 hrs. The system likely to move Northwestwards and shows no intensification of the system during next seven days. The 500 hPa and 200 hPa wind are given in **Annexure I**
- **UKMET Unified** model analysis of 0000 UTC of 15 October 2013 shows no significant circulation in Bay of Bengal for the next 72 hours.
  (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
  (http://www.ncmrwf.gov.in/)

Genesis Potential Parameter (GPP): Model forecast of GPP suggests no development of GPP area during next seven days. GPP charts for 24 and 48 hours are shown in Annexure **II**.
(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- No cyclogenesis is likely over Bay of Bengal during next 5 days.

Advisory:

- **NO IOP is declared for next 3 days.**

- **Annexure-I**

Data statistics over RMC, Chennai region
No of Synop data

Date→	**14.10.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**07**	**13**	**19**	**19**	**22**	**18**	**18**	**18**

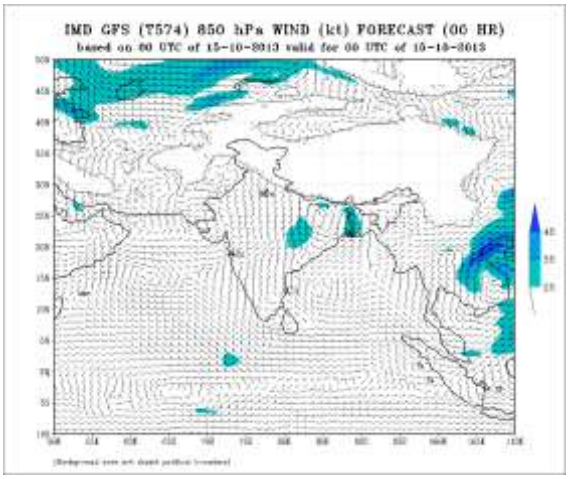
No. of RS/RW Ascents
00Z /14.10.2013 : 2
No. of Ascents reaching 250 hPa level =2
MISDA : 6

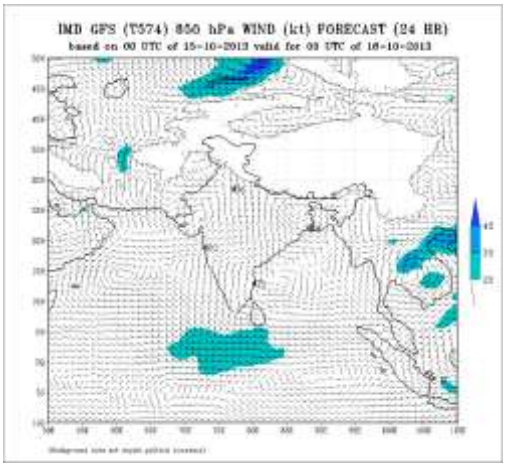
12Z /14.10.2013 : 4
No. of Ascents reaching 250 hPa level =4
MISDA : 4

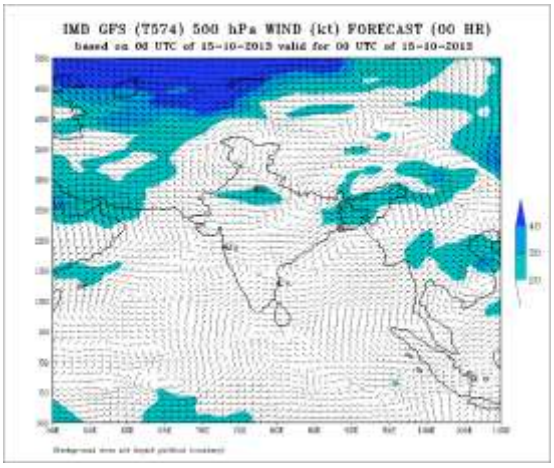
No. of PILOT Ascents:

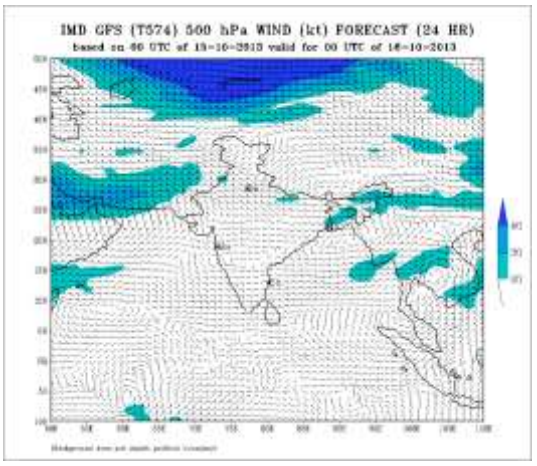
14.10.2013	
06Z	18Z
5	5

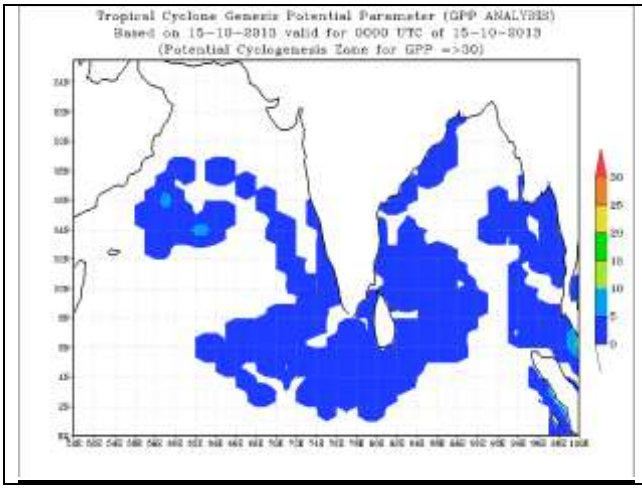
Annexure II

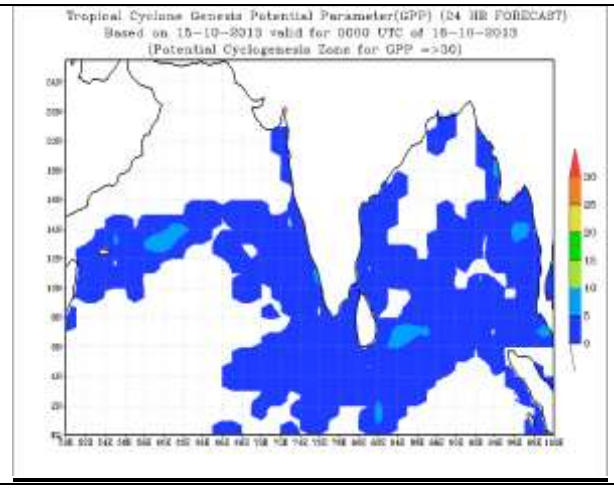

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 15-10-2013 valid for 00 UTC of 15-10-2013


IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 15-10-2013 valid for 00 UTC of 16-10-2013


IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 15-10-2013 valid for 00 UTC of 15-10-2013


IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 15-10-2013 valid for 00 UTC of 16-10-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 15-10-2013 valid for 0000 UTC of 15-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 15-10-2013 valid for 0000 UTC of 16-10-2013
(Potential Cyclogenesis Zone for GPP =>30)

FDP (Cyclone) NOC Report Dated 16 October, 2013

Synoptic features based on 0300 UTC:

- The withdrawal line continues to pass through Kalpa, Hissar, Jodhpur and Naliya. Conditions continue to be indicative of further withdrawal of southwest Monsoon from remaining parts of Himachal Pradesh, Haryana, Chandigarh & Delhi, Rajasthan; entire Uttarakhand; most parts of west Uttar Pradesh; some parts of west Madhya Pradesh and some more parts of Gujarat State around 17th October.
- The cyclonic circulation over Bihar & neighbourhood now lies over Bihar and adjoining areas of Jharkhand and Gangetic West Bengal and extends upto 3.6 kms a.s.l.
- A cyclonic circulation extending upto 4.5 kms a.s.l. lies over southwest Bay of Bengal off Tamil Nadu – south Andhra Pradesh coasts.
- A trough in mid tropospheric westerlies with its axis at 5.8 kms a.s.l. runs roughly along Long. 65° E to the north of Lat. 30° N. System would move eastnortheastwards.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST around 28-30^{0}C over central Bay of Bengal.

Ocean thermal energy:

- It is < 50 KJ cm^{-2} over Bay of Bengal

Relative Vorticity:

- Relative vorticity at 850 hPa is negative over west central and adjoining NW Bay of Bengal and positive along east coast and Southwest Bay.

Convergence:

- No area of Lower level convergence exists over Indian Ocean except near the equatorial region.

Divergence:

- Upper air positive divergence of 5*10^{-5} s^{-1} prevails over the east central Bay and negative divergence of the order -5 to 10*10^{-5} s^{-1} over southwest Bay and adjoining Pak straight.

Wind Shear:

- Wind Shear is high (20-40 knots) over Bay of Bengal except over northeast Bay where it is of the order 5-10 knots

Wind Shear Tendency:

- Increasing order of 5 to 10 knots over southwest Bay of Bengal and decreasing of the order 5 to 20 over rest Bay of Bengal.

Upper tropospheric ridge:

- The upper tropospheric **RIDGE** LINE AT 200 hpa passes through lat 20.0°N.

M.J.O. Index:

- Located over phase 8 with amplitude less than 1.0.
- Dynamical forecast:- MJO may continue with phase 8 during next 4 days with lower amplitude.

Satellite

Inference based on INSAT imagery of 160900 UTC

Broken Low/Medium clouds with embedded isolated moderate to intense convection seen over south Bay to the south of latitude 11.0 deg N, Andaman Sea and Tenasserim coast.

NWP Analysis

- **IMD-GFS** model shows a CYCIR over southwest Bay of Bengal during next 72 hrs. The system likely to move Northwestwards and shows no intensification of the system during next seven days. The 850, 500 hPa and 200 hPa wind are given in **Annexure I**
- **UKMET Unified** model analysis of 0000 UTC of 15 October 2013 shows no significant circulation in Bay of Bengal for the next 72 hours.
  (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
  (http://www.ncmrwf.gov.in/)

- JMA shows formation of two lows over west central and east central Arabian Sea during next 72 hrs without further intensification
- Meteo-France Global Tropics model does not suggest any low formation in next 72 hrs.
- ECMWF model also does not suggest any cyclogenesis over the NIO during next three days
- Different models indicate that the remnant of NIRA typhoon which is currently lying over Vietnam and neighbourhood would move westwards and dissipate further and is not expected to intensify over Bay of Bengal.
- **Genesis Potential Parameter (GPP):** Model forecast of GPP suggests no development of GPP area during next seven days. GPP charts for 24 and 48 hours are shown in Annexure **II**.

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- No cyclogenesis is likely over Bay of Bengal during next 5 days.

Advisory:

- **NO IOP is declared for next 3 days.**

Annexure-I

Data statistics over RMC, Chennai region

No of Synop data

Date→				**15.10.2013**				
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /15.10.2013 : 4

No. of Ascents reaching 250 hPa level =3

MISDA : 4

12Z /15.10.2013 : 3

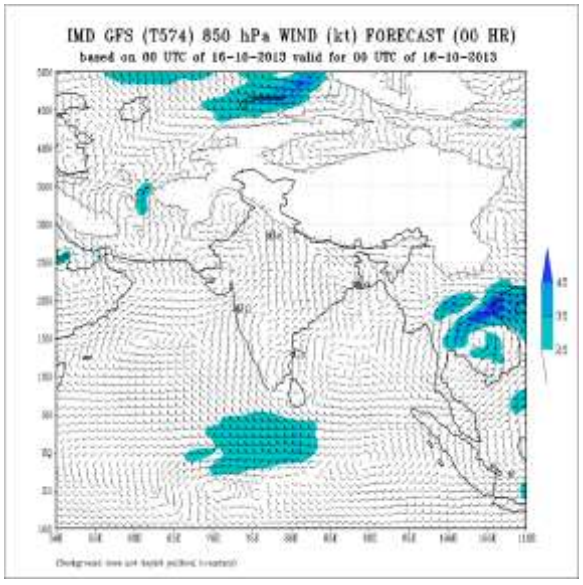
No. of Ascents reaching 250 hPa level =3

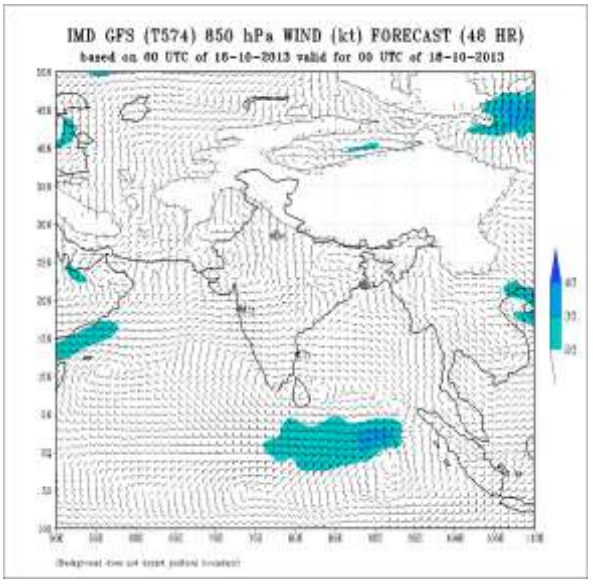
MISDA : 5

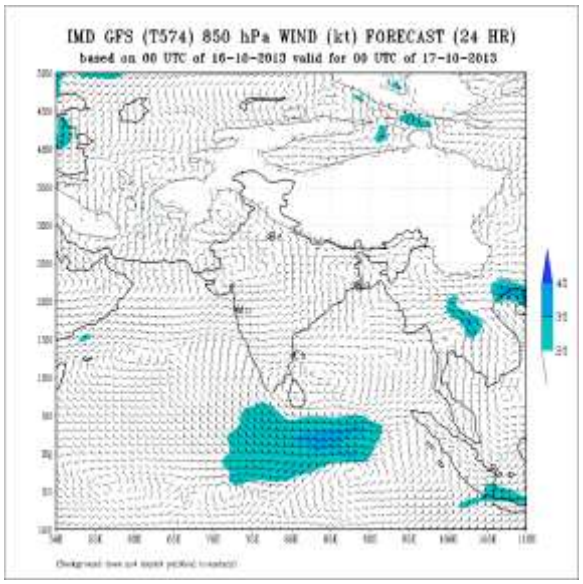
No. of PILOT Ascents:

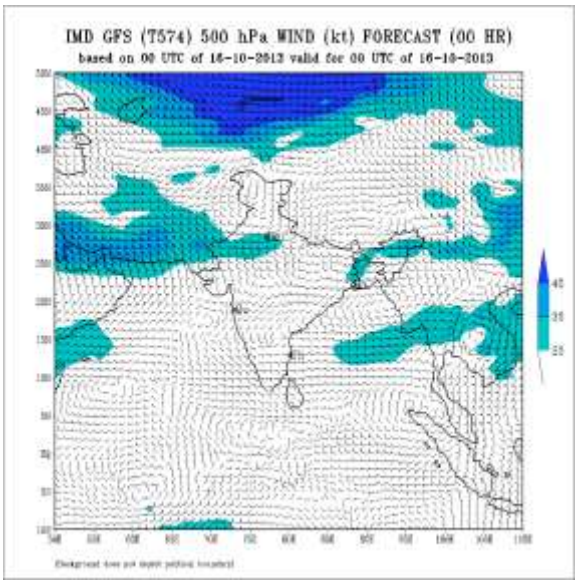
15.10.2013	
06Z	18Z
4	5

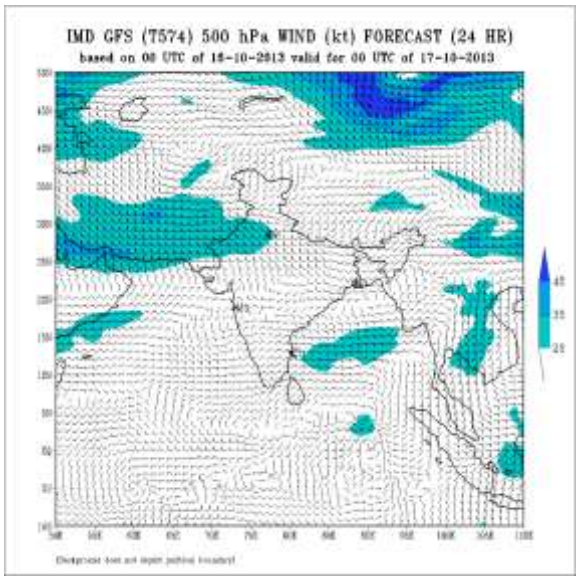
Annexure II

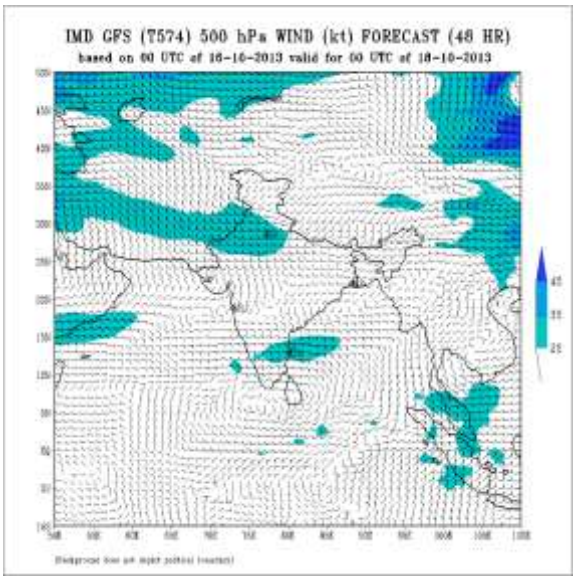

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 16-10-2013 valid for 00 UTC of 16-10-2013

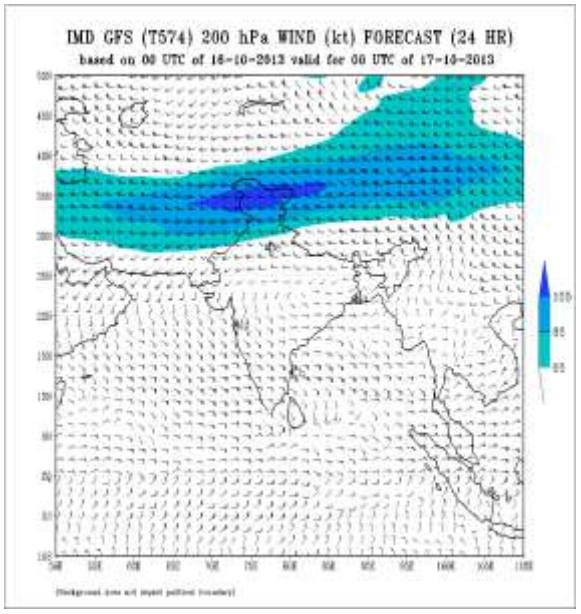

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 16-10-2013 valid for 00 UTC of 18-10-2013

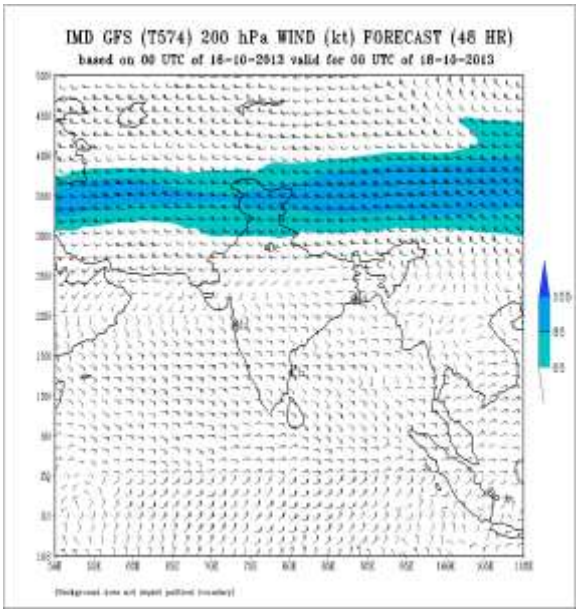

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 16-10-2013 valid for 00 UTC of 17-10-2013

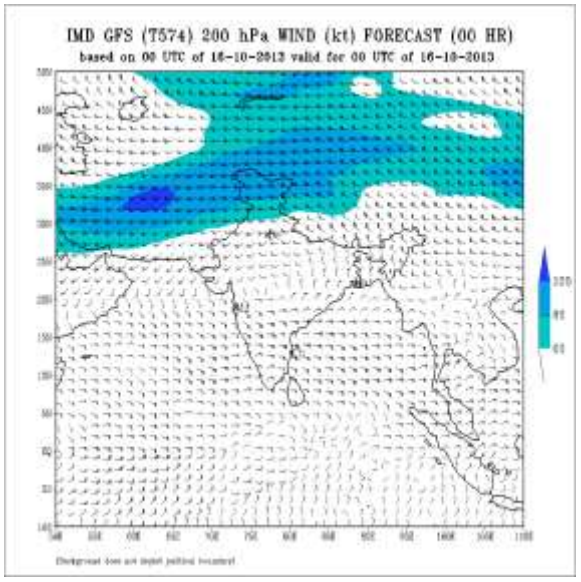

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 16-10-2013 valid for 00 UTC of 16-10-2013

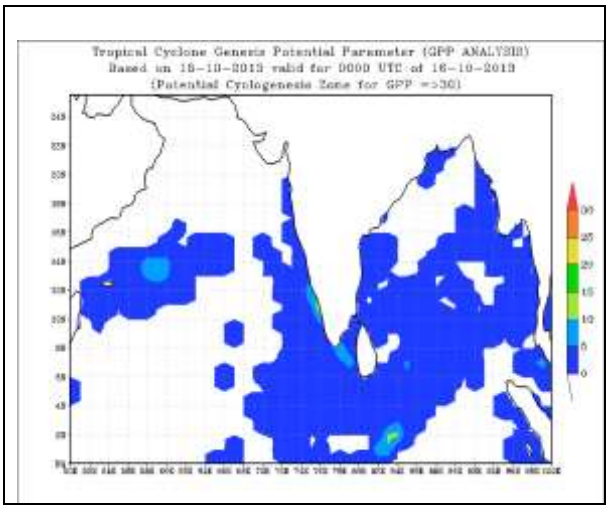

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 16-10-2013 valid for 00 UTC of 17-10-2013

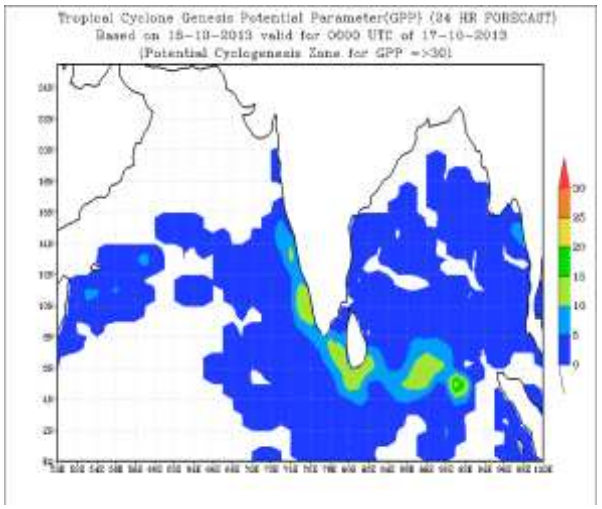

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 16-10-2013 valid for 00 UTC of 18-10-2013

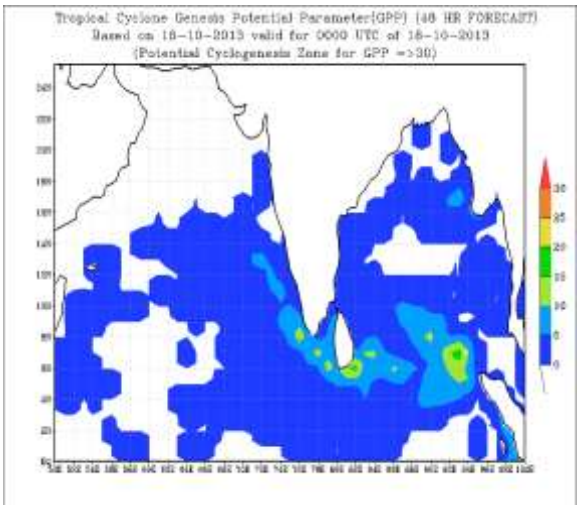

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 16-10-2013 valid for 00 UTC of 17-10-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 16-10-2013 valid for 00 UTC of 18-10-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 16-10-2013 valid for 00 UTC of 16-10-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 16-10-2013 valid for 0000 UTC of 16-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 16-10-2013 valid for 0000 UTC of 17-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 16-10-2013 valid for 0000 UTC of 18-10-2013
(Potential Cyclogenesis Zone for GPP =>30)

FDP (Cyclone) NOC Report Dated 17 October, 2013

Synoptic features based on 0300 UTC:

- The Southwest Monsoon has further withdrawn from remaining parts of Himachal Pradesh, Haryana, Chandigarh & Delhi, Rajasthan; entire Uttarakhand, west Uttar Pradesh; most parts of west Madhya Pradesh, Gujarat State and north Arabian Sea and some parts of east Uttar Pradesh.
- The withdrawal line passes through Lat 28° N / Long. 81° E, Kheri, Kanpur, Bhopal, Khargone, Surat, Veraval, Lat 21° N / Long. 65° E and Lat 21° N / Long. 60° E.
- Conditions are indicative of further withdrawal of southwest Monsoon from remaining parts of Uttar Pradesh, Madhya Pradesh and Gujarat state; some parts of Bihar, Jharkhand, Chattisgarh and Maharashtra during next 2 – 3 days.
- The cyclonic circulation extending upto 4.5 kms a.s.l. over southwest Bay of Bengal off Tamil Nadu – south Andhra Pradesh coasts now lies over southwest Bay of Bengal off Tamil Nadu – Sri Lanka coasts.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST around 28-30^{0}C over Bay of Bengal.

Ocean thermal energy:

- It is between 50- 80 KJ cm^{-2} over northcentral Bay of Bengal
- It is < 50 KJ cm^{-2} over rest part of Bay of Bengal

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over southwest Bay of Bengal and negative over the rest part of Bay of Bengal.
-

Convergence:

- No area of Lower level convergence exists over Indian Ocean except near the equatorial region.

Divergence:

- Upper air negative divergence of the order -5 to 10*10^{-5} s^{-1} over north and central Bay of Bengal and positive divergence of 5-10*10^{-5} s^{-1} prevails over south Bay of Bengal and adjoining Arabian Sea.

Wind Shear:

- Wind Shear is high (20 knots) over north west Bay of Bengal & 5-10 knots over rest part of Bay of Bengal.

Wind Shear Tendency:

- Increasing order of 5 knots over northeast Bay of Bengal and decreasing of the order 5 to 20 over rest Bay of Bengal.

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 20.0°N.

M.J.O. Index:

- Located over phase 8 with amplitude less than 1.0.
- Dynamical forecast:- MJO may continue with phase 8 during next 4 days with lower amplitude.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite

Inference based on INSAT imagery of 170900 UTC

Broken Low/Medium clouds with embedded scattered moderate to intense convection seen over south Bay to the south of latitude 13.0 deg N, Andaman Sea and Gulf of Martaban and adjoining Mayanmar and Arkan coast.

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 17 October 2013 shows a CYCIR formed over southwest Bay of Bengal. Model forecasts show that the system likely to move northwestwards and entered into southeast Arabian Sea on 23 October 2013. Model forecast also shows intensification of the system on day7 over the Arabian Sea. The analysis and forecasts for 72 h, 120 h and 168 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure I.**
- **IMD-WRF** model analysis of 0000 UTC of 17 October 2013 shows a CYCIR formed over southwest Bay of Bengal and forecasts show no intensification in next 72 hours.

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 17 October 2013 suggests development of a cyclogenesis zone over southwest Bay of Bengal on day3 (20 October 2013). Model forecasts also show that the system likely to move northwestwards and entered into southeast Arabian Sea on 23 October 2013 and further organization of GPP over the area. GPP charts for analysis and forecasts for 72 h, 120 h and 168 h are shown in Annexure **II**.

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- No cyclogenesis is likely over Bay of Bengal during next 5 days.

Advisory:

- **NO IOP is declared for next 3 days.**

Annexure-I.

No of Synop data

Date→				**16.10.2013**				
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**21**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /16.10.2013 : 2

No. of Ascents reaching 250 hPa level =2

MISDA : 6

12Z /16.10.2013 : 2

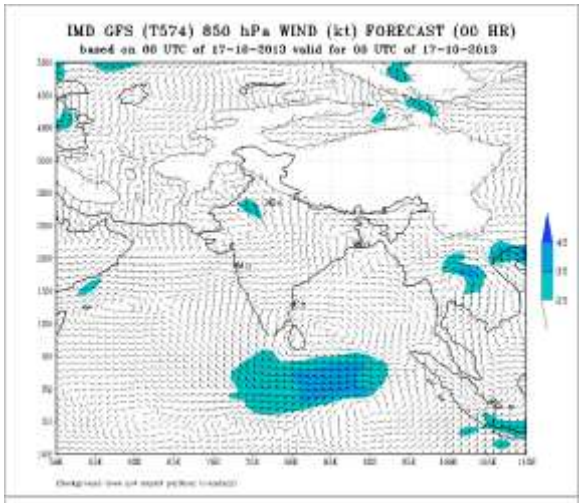
No. of Ascents reaching 250 hPa level =2

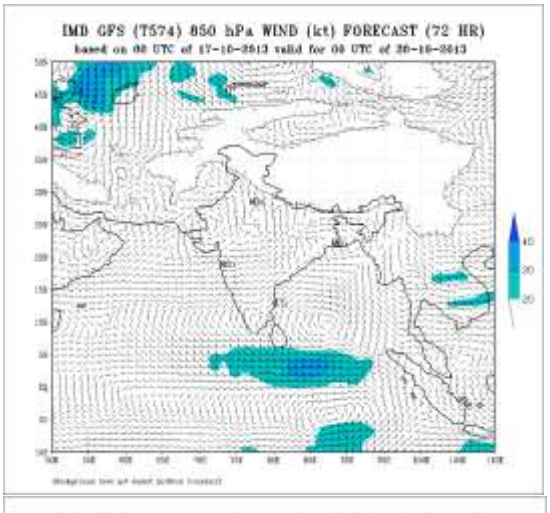
MISDA : 6

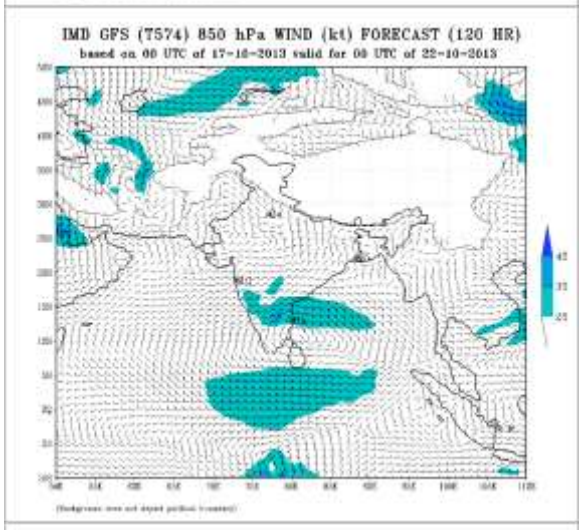
No. of PILOT Ascents:

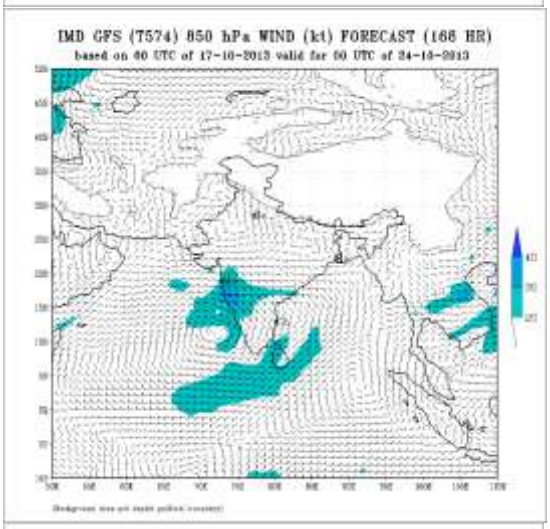
16.10.2013	
06Z	18Z
5	4

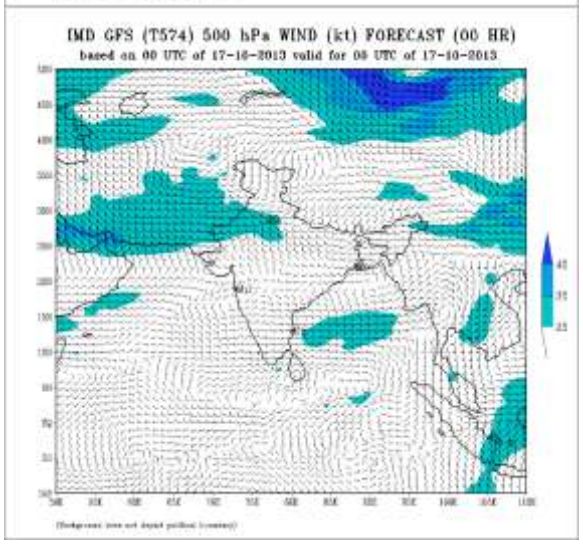
Annexure-II

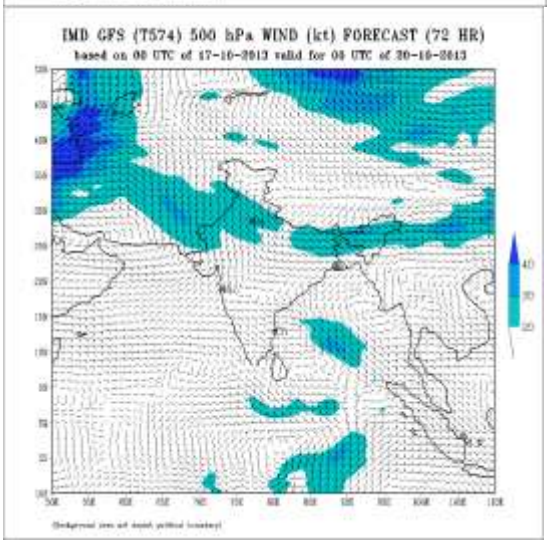

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 17-10-2013 valid for 00 UTC of 17-10-2013

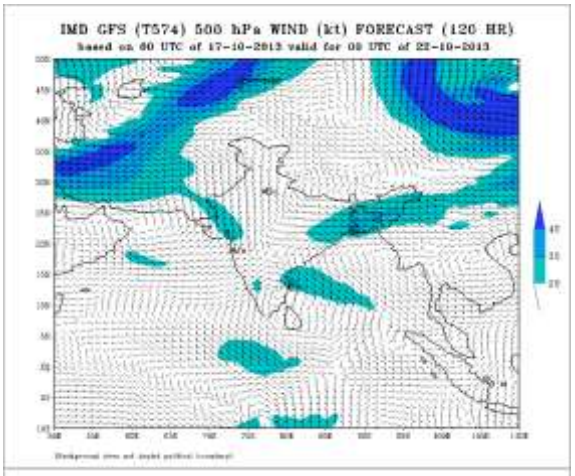

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 17-10-2013 valid for 00 UTC of 20-10-2013

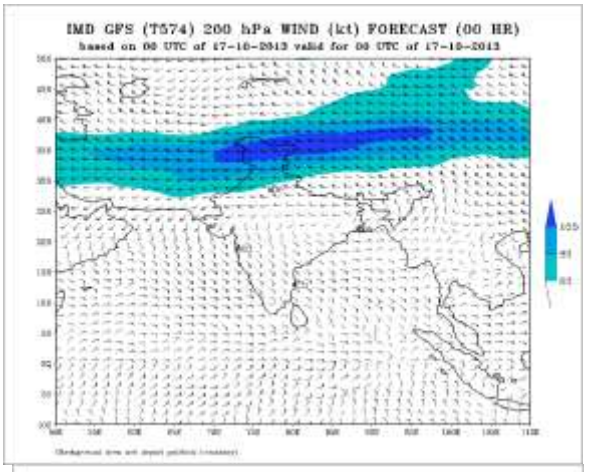

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 17-10-2013 valid for 00 UTC of 22-10-2013

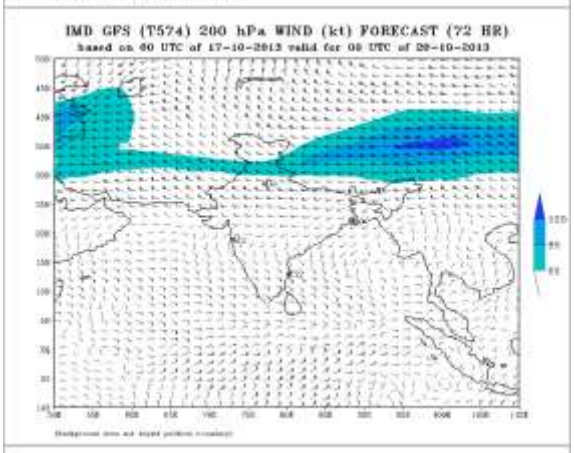

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 17-10-2013 valid for 00 UTC of 24-10-2013

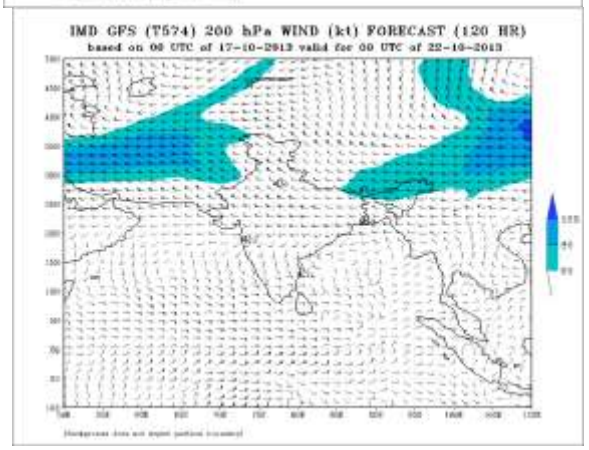

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 17-10-2013 valid for 00 UTC of 17-10-2013

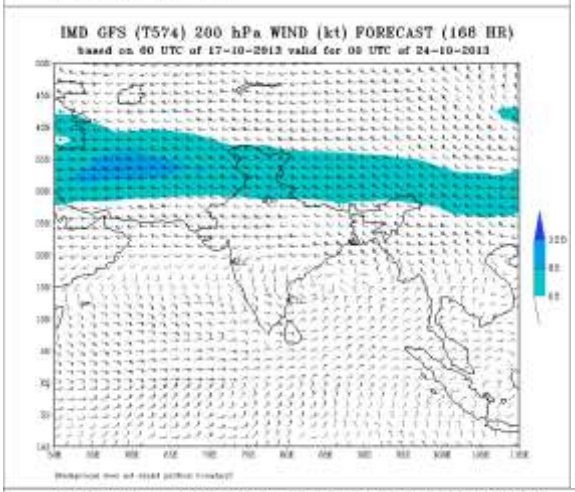

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 17-10-2013 valid for 00 UTC of 20-10-2013

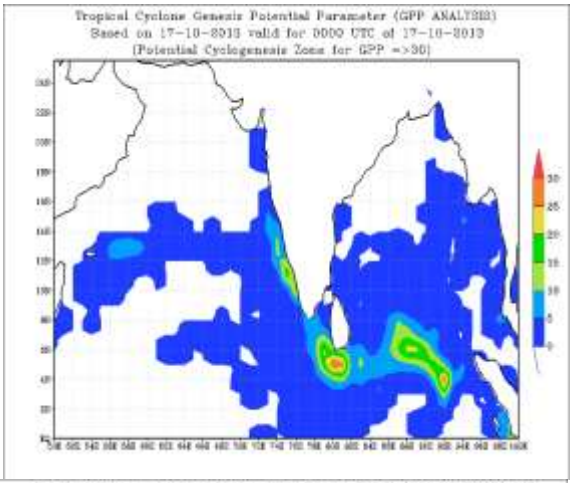

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 17-10-2013 valid for 00 UTC of 22-10-2013

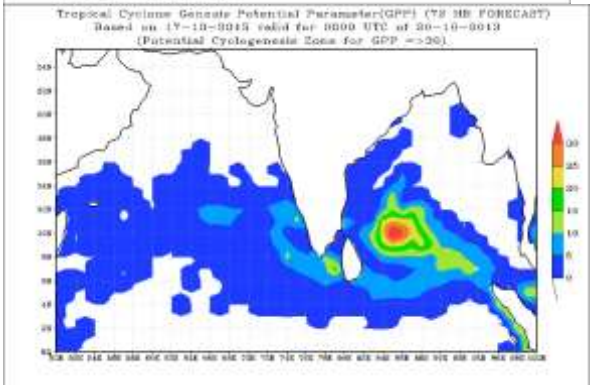

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 17-10-2013 valid for 00 UTC of 17-10-2013

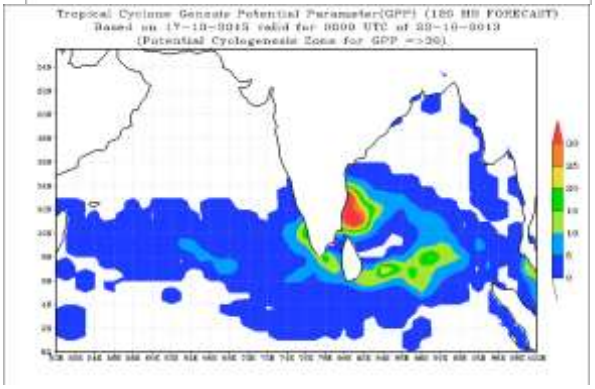

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 17-10-2013 valid for 00 UTC of 20-10-2013

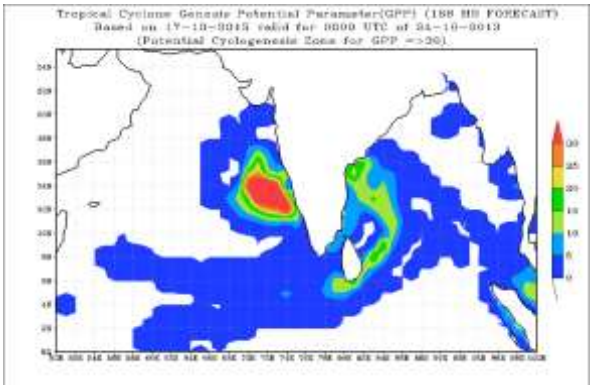

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 17-10-2013 valid for 00 UTC of 22-10-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 17-10-2013 valid for 00 UTC of 24-10-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 17-10-2013 valid for 0000 UTC of 17-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 17-10-2013 valid for 0000 UTC of 20-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (120 HR FORECAST)
Based on 17-10-2013 valid for 0000 UTC of 22-10-2013
(Potential Cyclogenesis Zone for GPP =>30)



FDP (Cyclone) NOC Report Dated 18 October, 2013

Synoptic features based on 0300 UTC:

- The withdrawal line continues to pass through Lat 28° N / Long. 81° E, Kheri, Kanpur, Bhopal, Khargone, Surat, Veraval, Lat 21° N / Long. 65° E and Lat 21° N / Long. 60° E.
- Conditions continue to be indicative of further withdrawal of southwest Monsoon from remaining parts of Uttar Pradesh, Madhya Pradesh, Gujarat state and north Arabian Sea; most parts of Bihar, Jharkhand, Chattisgarh, Vidarbha; some parts of Gangetic West Bengal, Odisha, Marathwada,Madhya Maharashtra and Konkan around 19th October.
- The cyclonic circulation extending upto 4.5 kms a.s.l. over southwest Bay of Bengal off Tamil Nadu – Sri Lanka coasts persists.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST around 28-30^{0}C over Bay of Bengal.

Ocean thermal energy:

- It is between 50- 80 KJ cm^{-2} over northeast, central and south Bay of Bengal
- It is < 50 KJ cm^{-2} over rest part of Bay of Bengal

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over south Bay of Bengal and negative over the rest part of Bay of Bengal.

Convergence:

- Lower level convergence exists over south Bay of Bengal.

Divergence:

- Upper air negative divergence of the order -5*10^{-5} s^{-1} over north and central Bay of Bengal and positive divergence of 5-20*10^{-5} s^{-1} prevails over south Bay of Bengal and 5-10*10^{-5} s^{-1} over adjoining Arabian Sea.

Wind Shear:

- Wind Shear is 10-20 knots over north Bay of Bengal & more than 20 knots over south of Bay of Bengal.

Wind Shear Tendency:

- Shear Tendency over north Bay of Bengal is negative and over south Bay of Bengal it is positive

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 21.5°N.

M.J.O. Index:

- Located with amplitude less than 1.0.
- Dynamical forecast:- MJO may continue with amplitude less than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite

Inference based on INSAT imagery of 180900 UTC

- Broken Low/Medium clouds with embedded scattered moderate to intense convection over east central and adjoining northeast Bay between latitude 15.0 deg N to 21.0 deg N, east of longitude 91.0 E, also south bay south of latitude 12.0° N south Andaman Sea and Gulf of Martaban, Tenaserrium coast and Arkan coast.
- Broken Low/Medium clouds with embedded isolated moderate to intense convection over between latitude 9.0° N to 12.0° N, west of longitude 52.0° E in association with low level circulation over the **area (.)** Broken Low/Medium clouds with embedded isolated moderate to intense convection over east Arabian sea between latitude 5.0° N to 15.0° N, east of longitude 70.0° E.

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 18 October 2013 shows a CYCIR formed over southwest Bay of Bengal. Model forecasts show that the system likely to move initially westwards and intensify into a depression off TN coast 22 morning and emerge into southeast Arabian Sea on 24 October 2013 as a depression after crossing south peninsula. Model forecast also shows intensification of the system on 25 Oct.over the east central Arabian Sea while moving north-northwestwards. The analysis and forecasts for 72 h, 120 h and 168 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II.**
- **IMD-WRF** model analysis of 0000 UTC of 18 October 2013 shows a CYCIR formed over southwest Bay of Bengal and forecasts show no intensification in next 72 hours.

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- UKMO model also suggests similar development
- ECMWF indicates depression on 22 October over southwest Bay
- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 18 October 2013 suggests development of a cyclogenesis zone over southwest Bay of Bengal on day3 (21 October 2013). Model forecasts also show that the system likely to move northwestwards and entered into southeast Arabian Sea on 24 October 2013 and further organization of GPP over the area. GPP charts for analysis and forecasts for 72 h, 120 h and 168 h are shown in Annexure **II**.

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- A low pressure are is likely to form over central part of south Bay of Bengal during next 48 hrs. It is likely to move west-northwestwards and concentrate into a depression over southwest Bay of Bengal off north Tamilnadu coast around morning of 22 October 2013.

Advisory:

- **IOP is declared for the period of 21-23 October 2013.**
- **Intense observations as per FDP guidelines may be taken for Tamilnadu, Puducherry and north AP coast**

Annexure-I.

No of Synop data

Date→	**17.10.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /17.10.2013 : 3

No. of Ascents reaching 250 hPa level =3

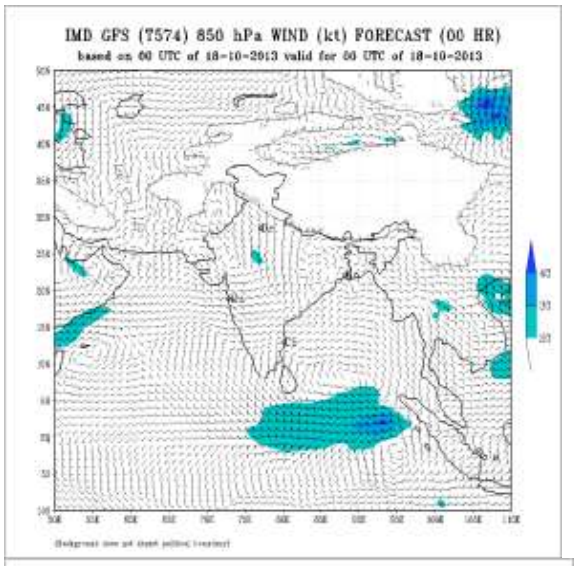
MISDA : 5

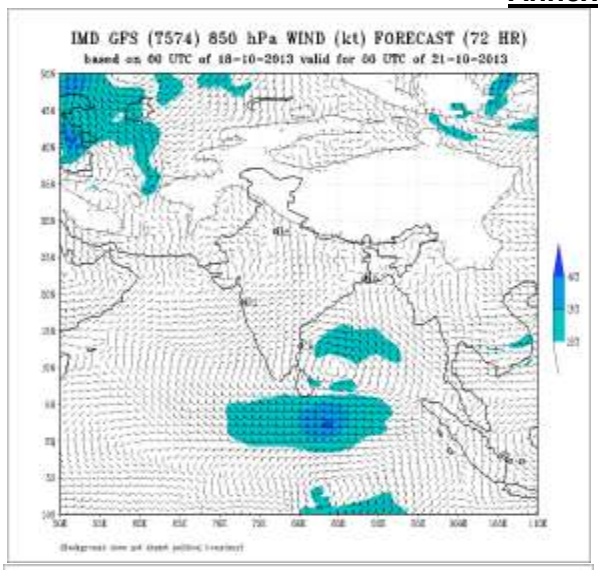
12Z /17.10.2013 : 4
No. of Ascents reaching 250 hPa level =4
MISDA : 4
No. of PILOT Ascents:

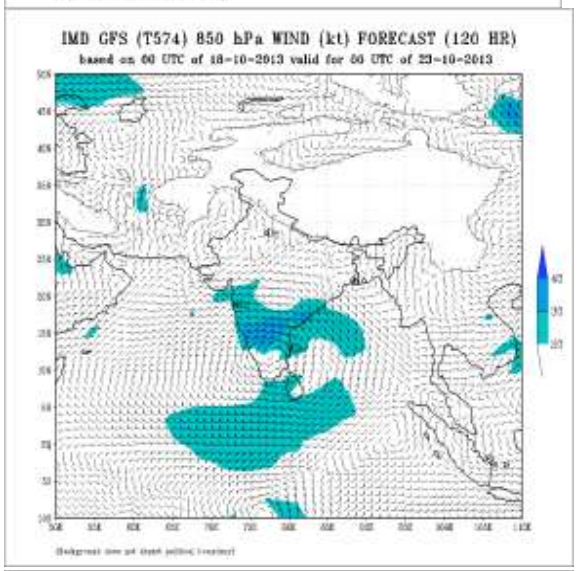
17.10.2013

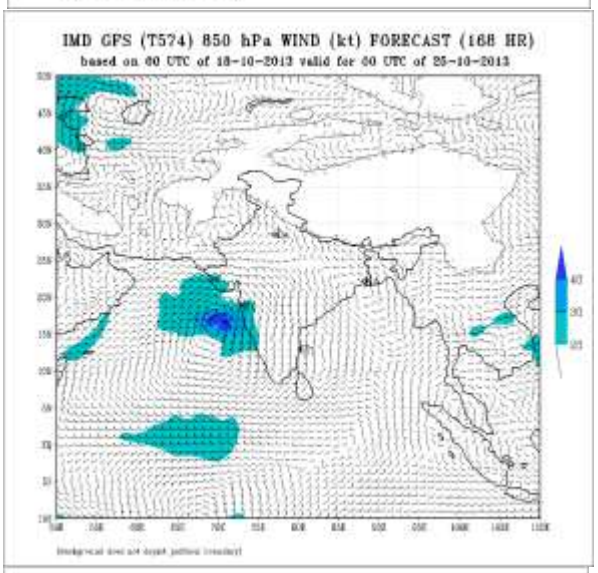
06Z	18Z
3	3

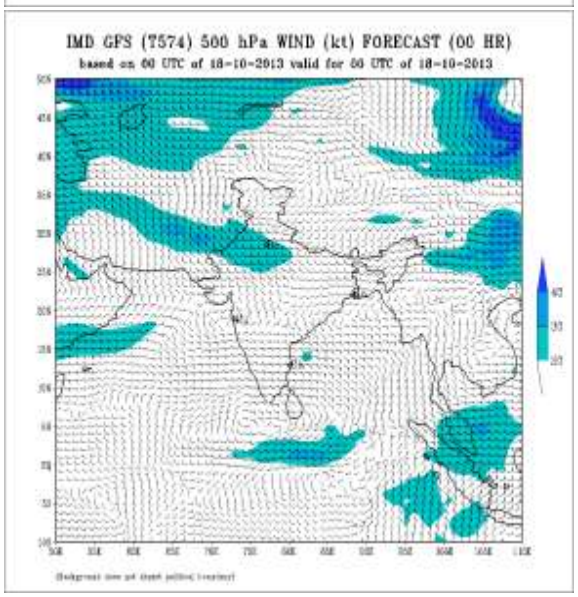
Annexure-II

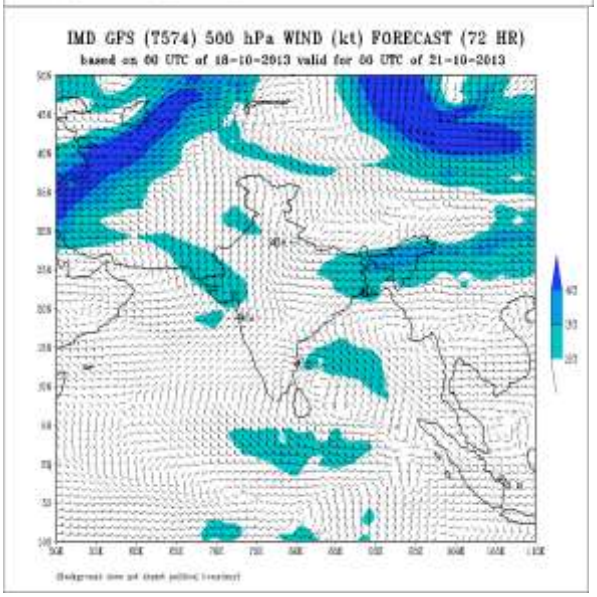

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 18-10-2013

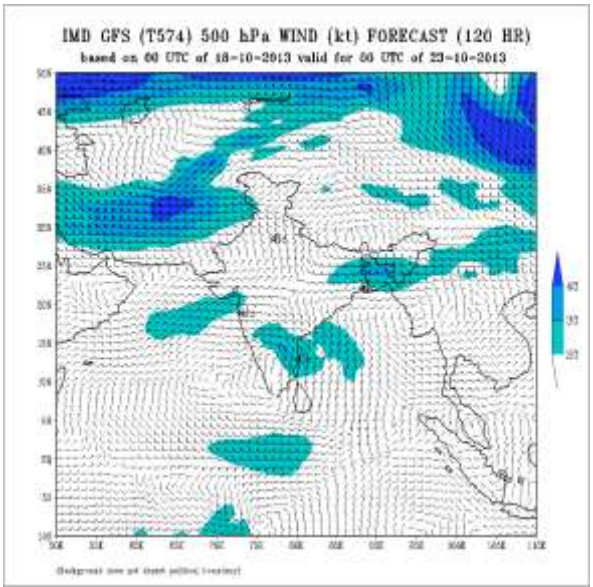

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 21-10-2013

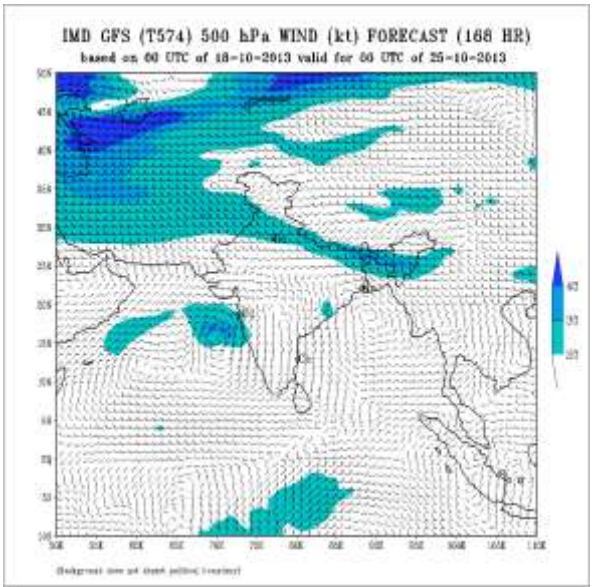

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 23-10-2013

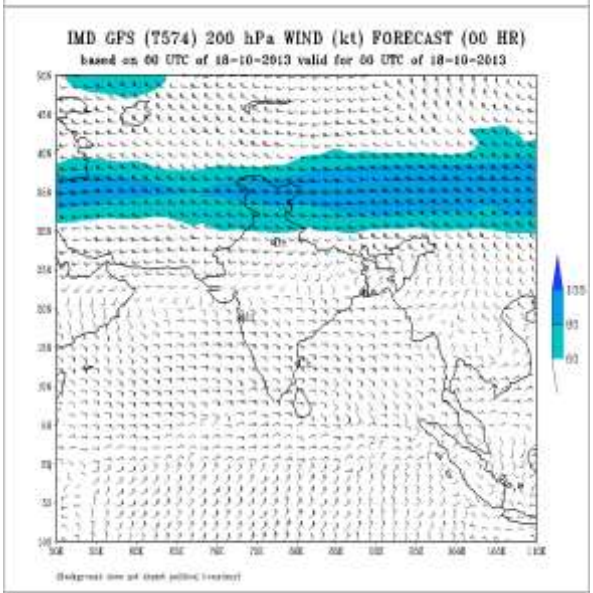

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 25-10-2013

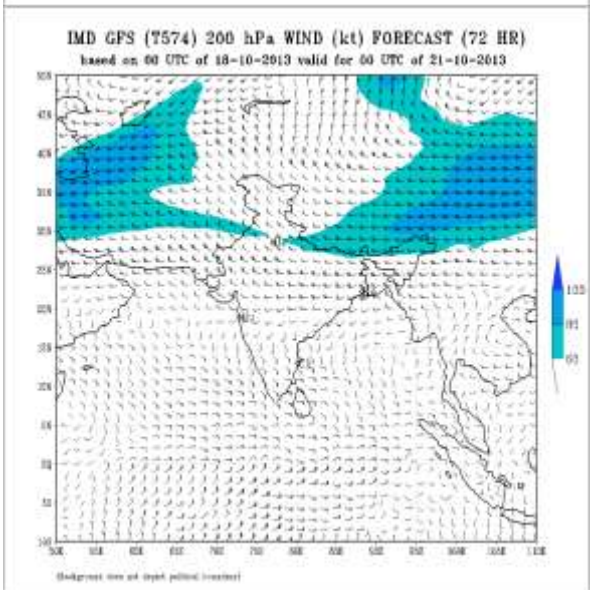

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 18-10-2013

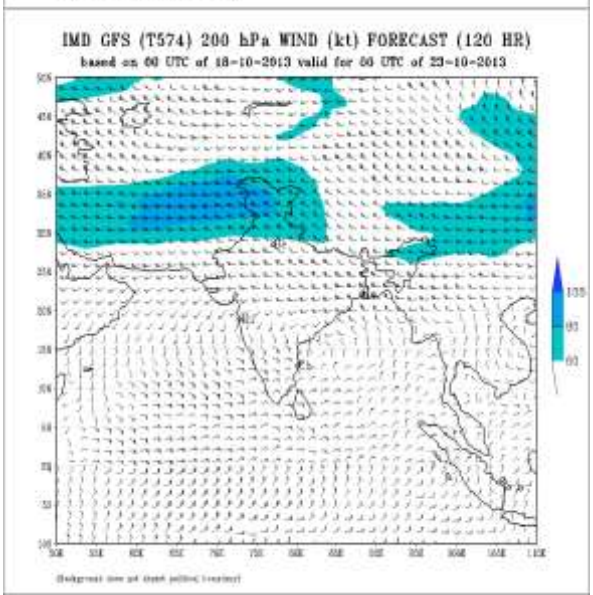

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 21-10-2013

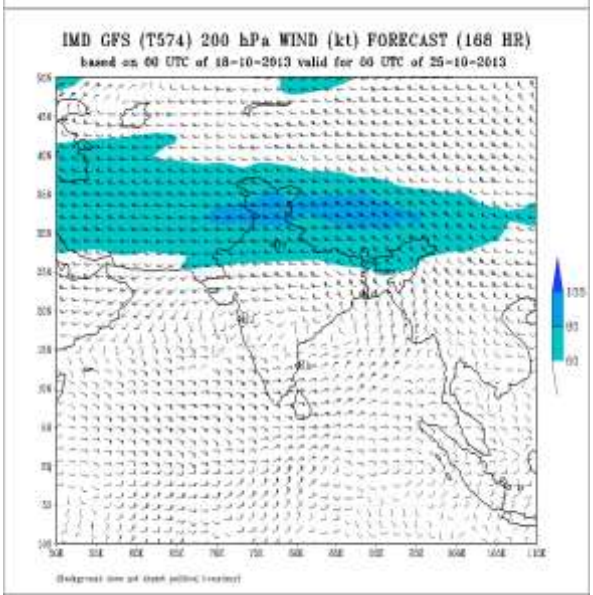

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 23-10-2013

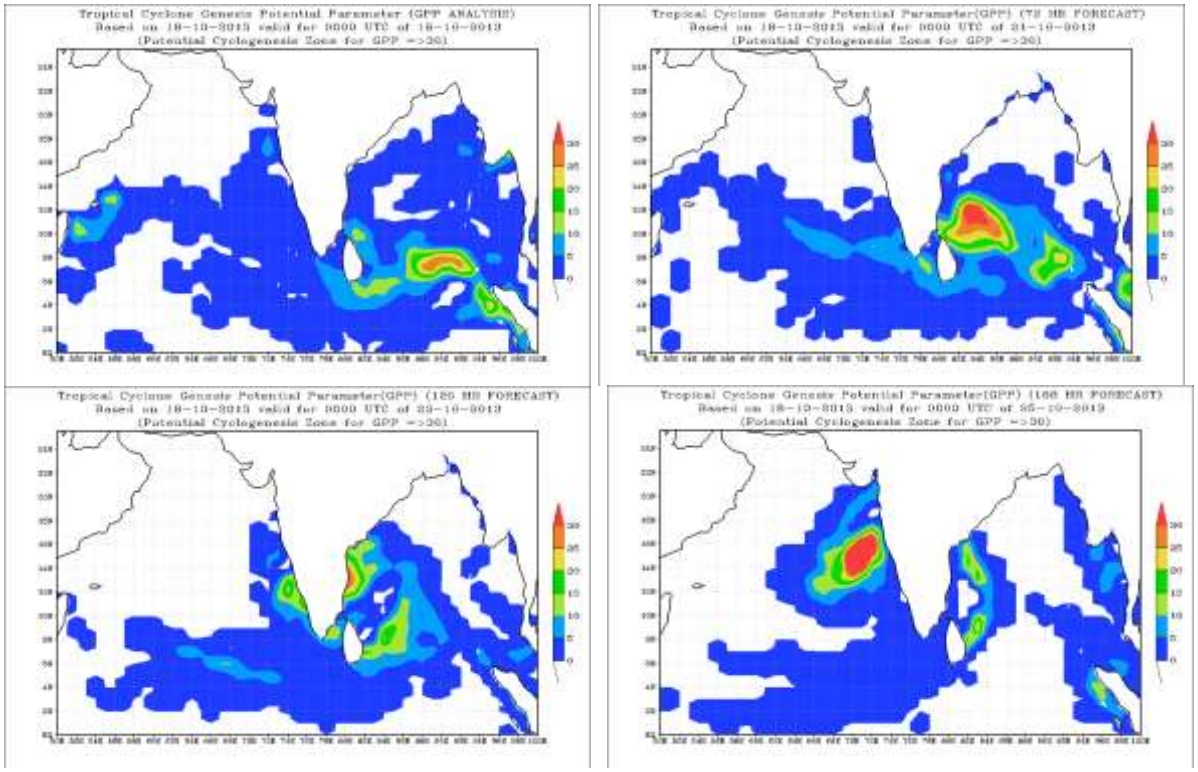

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 25-10-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 18-10-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 21-10-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 23-10-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 25-10-2013



FDP (Cyclone) NOC Report Dated 19 October, 2013

Synoptic features based on 0300 UTC:

- The southwest Monsoon further withdrew from remaining parts of Uttar Pradesh,Madhya Pradesh, Gujarat, north Arabian Sea, entire Bihar, Jharkhand, Chhattisgarh, Vidarbha, Marathwada; most parts of Odisha, Madhya Maharashtra and Konkan and some parts of Gangetic West Bengal, Telangana, north interior Karnataka and central Arabian Sea.
- The withdrawal line passes through Forbesganj, Bankura, Cuttack, Hanamkonda, Gulbarga, Ratnagiri, Lat 17° N / Long. 70° E and Lat 17° N / Long.60° E.
- Conditions are indicative of further withdrawal of southwest Monsoon fromremaining parts of country during next 3-4 days. Conditions are favourable for commencement of northeast monsoon rains over Tamil Nadu, Kerala and adjoining areas of Andhra Pradesh and Karnataka around 22nd October 2013.
- The cyclonic circulation over southwest Bay of Bengal off Tamil Nadu –Sri Lanka coasts now lies over Sri Lanka and neighbourhood and extends upto 3.1 kms a.s.l.
- A cyclonic circulation lies over southeast Bay of Bengal and neighbourhood and extends upto 3.1 kms a.s.l.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST around 28-30^{0}C over Bay of Bengal.

Ocean thermal energy:

- It is between 50- 80 KJ cm^{-2} over northeast, central and south Bay of Bengal
- It is < 50 KJ cm^{-2} over rest part of Bay of Bengal

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over south Bay of Bengal and negative over the rest part of Bay of Bengal.

Convergence:

- Lower level convergence exists over south Bay of Bengal.

Divergence:

- Upper air negative divergence of the order $-5*10^{-5}$ s^{-1} over north and central Bay of Bengal and positive divergence of $5\text{-}20*10^{-5}$ s^{-1} prevails over south Bay of Bengal and $5\text{-}10*10^{-5}$ s^{-1} over adjoining Arabian Sea.

Wind Shear:

- Wind Shear is 10-20 knots over north Bay of Bengal & more than 20 knots over south of Bay of Bengal.

Wind Shear Tendency:

- Shear Tendency over north Bay of Bengal is negative and over south Bay of Bengal it is positive

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 21.5°N.

M.J.O. Index:

- Located with amplitude less than 1.0.
- Dynamical forecast:- MJO may continue with amplitude less than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite

Inference based on INSAT imagery of 190900 UTC

- Broken Low/Medium clouds with embedded scattered moderate to intense convection over east central and adjoining northeast Bay between latitude 15.0 deg N to 21.0 deg N, east of longitude 91.0 E, also south bay south of latitude 12.0° N south Andaman Sea and Gulf of Martaban, Tenaserrium coast and Arkan coast.
- Broken Low/Medium clouds with embedded isolated moderate to intense convection over between latitude 9.0° N to 12.0° N, west of longitude 52.0° E in association with low level circulation over the **area (.)** Broken Low/Medium clouds with embedded isolated moderate to intense convection over east Arabian sea between latitude 5.0° N to 15.0° N, east of longitude 70.0° E.

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 19 October 2013 shows a CYCIR formed over southwest Bay of Bengal. Model forecasts show that the system likely to move initially westwards and intensify into a depression off TN coast 22 morning and emerge into southeast Arabian Sea on 24 October 2013 as a depression after crossing south peninsula. Model forecast also shows intensification of the system on 25 Oct.over the east central Arabian Sea while moving north-northwestwards. The analysis and forecasts for 72 h, 120 h and 168 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II.**
- **IMD-WRF** model analysis of 0000 UTC of 19 October 2013 shows a CYCIR formed over southwest Bay of Bengal and forecasts show no intensification in next 72 hours.

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- UKMO model also suggests similar development
- ECMWF indicates depression on 22 October over southwest Bay
- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 19 October 2013 suggests development of a cyclogenesis zone over southwest Bay of Bengal on day3 (21 October 2013). Model forecasts also show that the system likely to move northwestwards and entered into southeast Arabian Sea on 24 October 2013 and further organization of GPP over the area. GPP charts for analysis and forecasts for 72 h, 120 h and 168 h are shown in Annexure **II**.

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- A low pressure would form over southwest Bay of Bengal on 21 October. It is likely to move northwestwards and become a WML/depression on 22 October off north Tamilnadu and south AP coast.

Advisory:

- IOP is declared for the period of 21-23 October 2013.
- Intense observations as per FDP guidelines may be taken for Tamilnadu, Puducherry and south AP coast

Annexure-I.

No of Synop data

Date→	**18.10.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

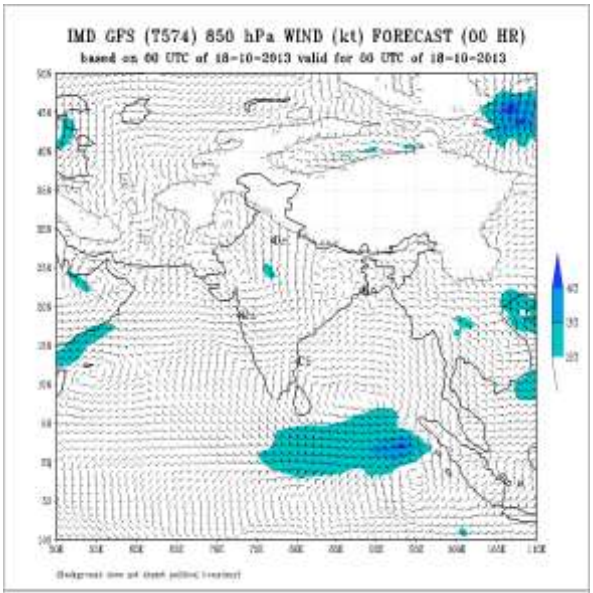
No. of RS/RW Ascents

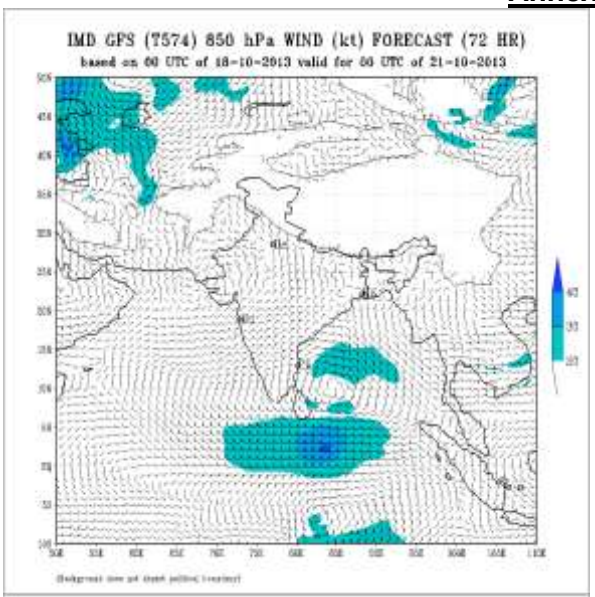
00Z /18.10.2013 : 3
No. of Ascents reaching 250 hPa level =3
MISDA : 5
12Z /18.10.2013 : 4
No. of Ascents reaching 250 hPa level =4
MISDA : 4

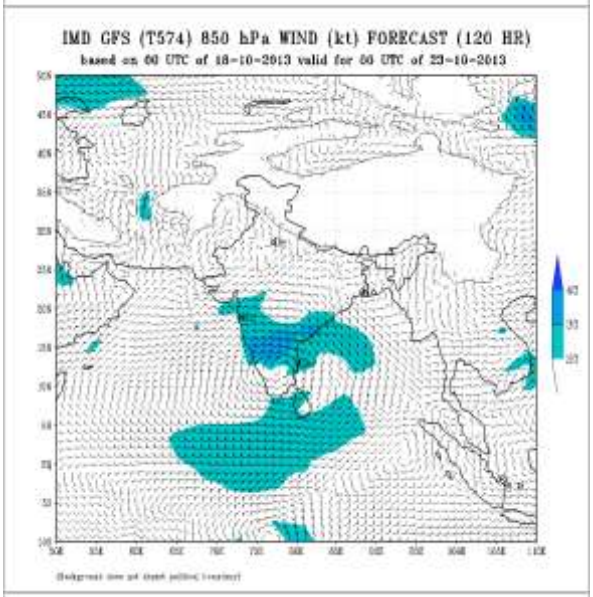
No. of PILOT Ascents:

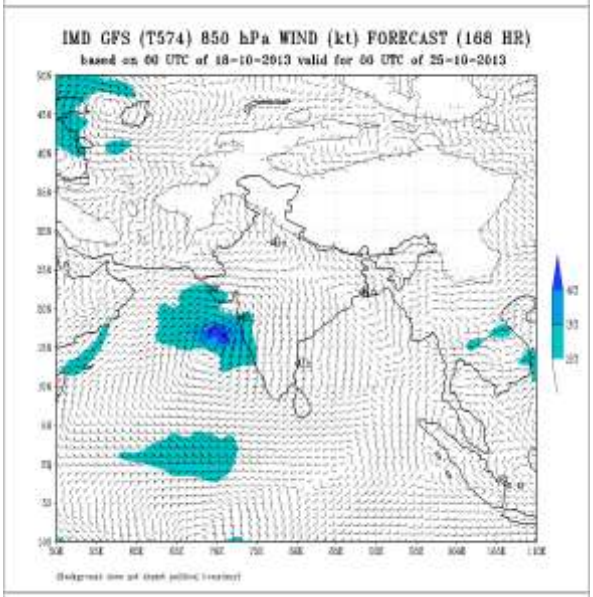
18.10.2013	
06Z	18Z
3	3

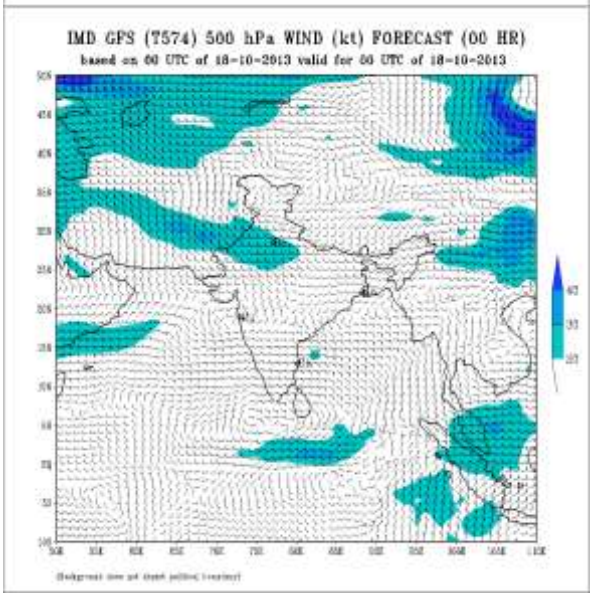
Annexure-II

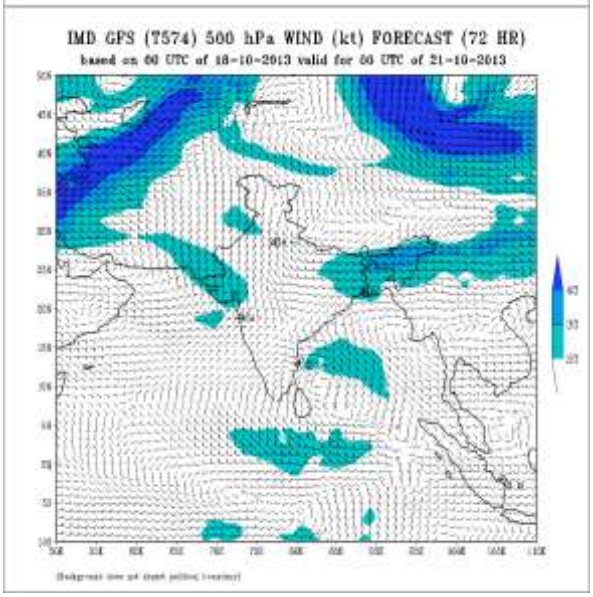

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 18-10-2013

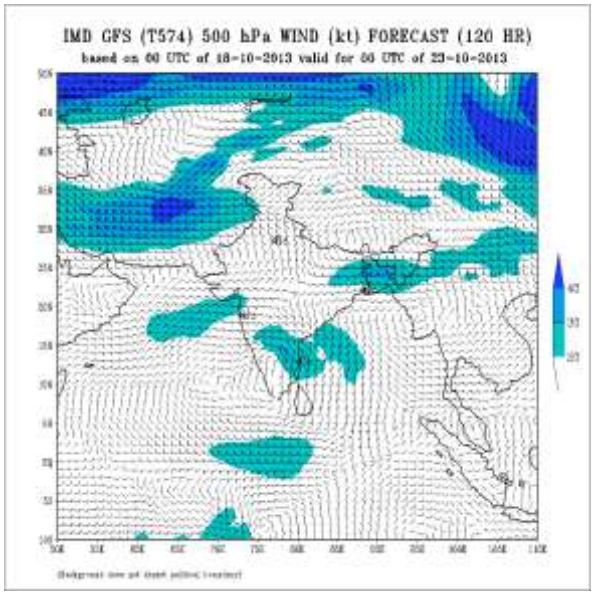

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 21-10-2013

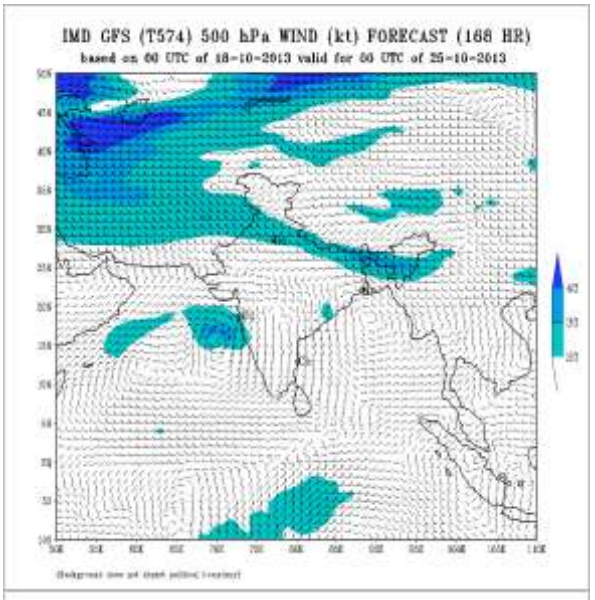

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 23-10-2013

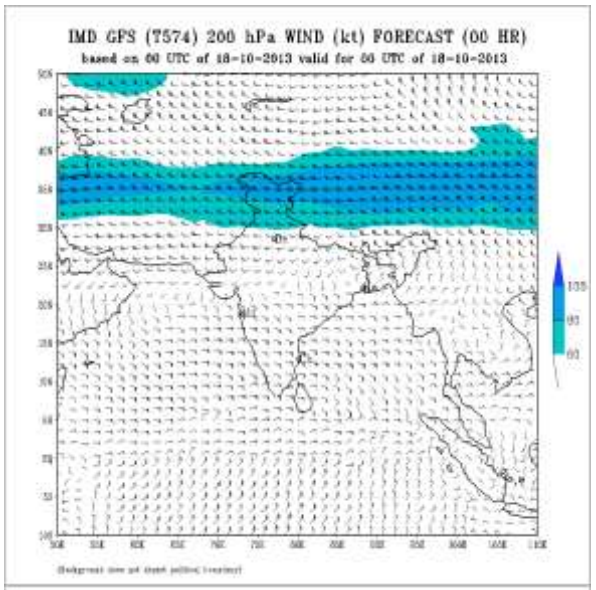

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 25-10-2013

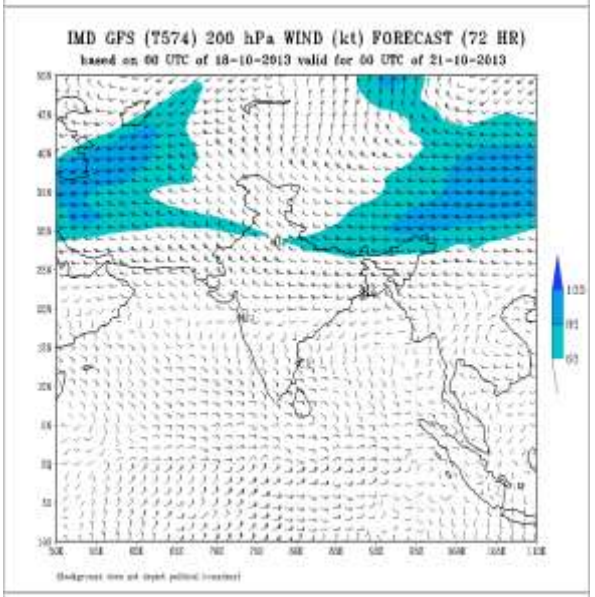

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 18-10-2013

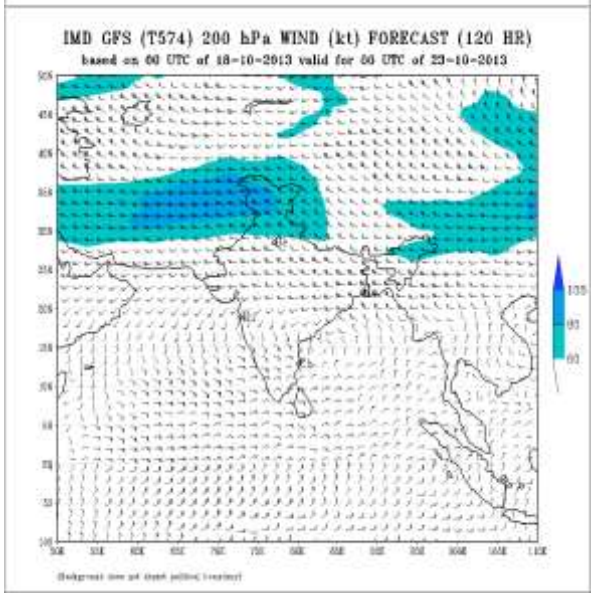

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 21-10-2013

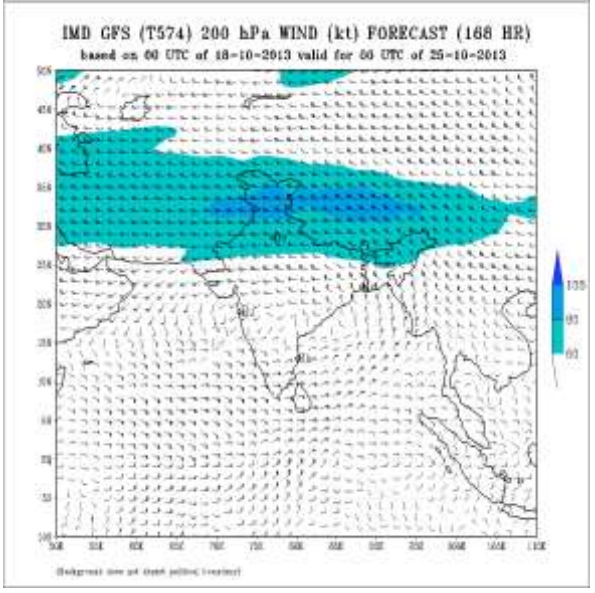

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 23-10-2013

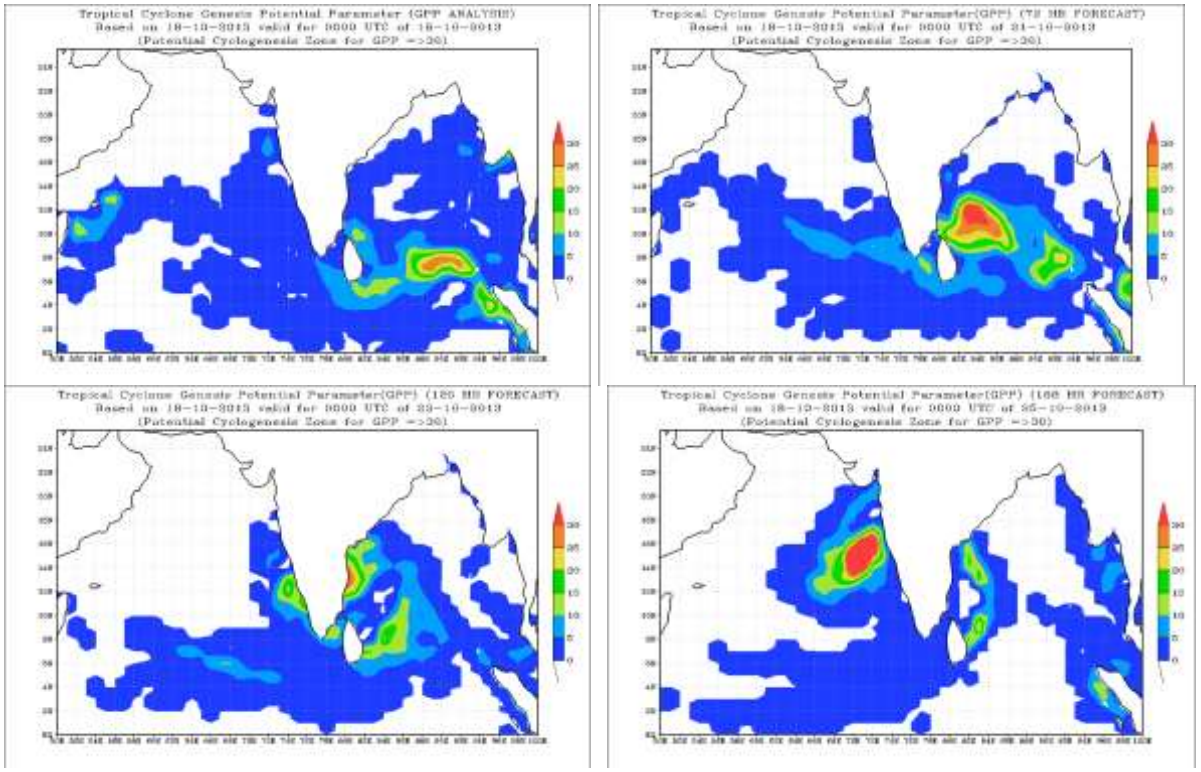

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 25-10-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 18-10-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 21-10-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 23-10-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 18-10-2013 valid for 00 UTC of 25-10-2013



FDP (Cyclone) NOC Report Dated 20 October, 2013

Synoptic features based on 0300 UTC:

- The withdrawal line continues to pass through Forbesganj, Bankura, Cuttack, Hanamkonda, Gulbarga, Ratnagiri, Lat 17° N / Long. 70° E and Lat 17° N / Long. 60° E.
- Conditions are indicative of further withdrawal of southwest Monsoon from remaining parts of country during next 48 hours. Also, conditions are favourable for commencement of northeast monsoon rains over Tamil Nadu, Kerala and adjoining areas of Andhra Pradesh and Karnataka during next 48 hours.
- The southwest Monsoon has been active over Tamil Nadu, coastal & south interior Karnataka and Kerala. It has been subdued over Odisha, Telangana and north interior Karnataka.
- Under the influence of the cyclonic circulation over southeast Bay of Bengal and neighbourhood, a low pressure area has formed over central parts of south Bay of Bengal. System may become a well marked low pressure area during next 48 hours.
- A trough in easterlies in the lower tropospheric levels runs from the above low pressure area to north Odisha coast.
- The cyclonic circulation over Sri Lanka and neighbourhood has also become less marked.
-

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST around 29-31^{0}C over Bay of Bengal warmer towards north Tamilnadu coast.

Ocean thermal energy:

- It is between 50- 80 KJ cm^{-2} over southwest Bay of Bengal

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over south Bay of Bengal and negative over the rest part of Bay of Bengal. It has increased during past 24 hrs over southwest Bay.

Convergence:

- Lower level convergence has also increased over southwest Bay of Bengal and maximum ($5*10^{-5}$ s^{-1}) to the southwest of low pressure area.

Divergence:

- Upper air negative divergence of the order $-5*10^{-5}$ s^{-1} over north and central Bay of Bengal and positive divergence of $10*10^{-5}$ s^{-1} prevails over south Bay of Bengal and $5-10*10^{-5}$ s^{-1} over adjoining Arabian Sea.

Wind Shear:

- Wind Shear is 05-10 knots over southwest Bay of Bengal

Wind Shear Tendency:

- Shear Tendency around the low pressure area is negative

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 16°N.

M.J.O. Index:

- Located in phase 8 with amplitude less than 1.0.
- Dynamical forecast:- MJO may continue in phase 8 with amplitude less than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite

Inference based on INSAT imagery of 200900 UTC

- Broken Low/Medium clouds with embedded scattered moderate to intense convection over east central and adjoining northeast Bay between latitude 15.0 deg N to 21.0 deg N, east of longitude 91.0 E, also south bay south of latitude 12.0° N south Andaman Sea and Gulf of Martaban, Tenaserrium coast and Arkan coast.
- Broken Low/Medium clouds with embedded isolated moderate to intense convection over between latitude 9.0° N to 12.0° N, west of longitude 52.0° E in association with low level circulation over the **area (.)** Broken Low/Medium clouds with embedded isolated moderate to intense convection over east Arabian sea between latitude 5.0° N to 15.0° N, east of longitude 70.0° E.

NWP Analysis

IMD-GFS model analysis of 0000 UTC of 20 October 2013 shows a LOW pressure area formed over southwest Bay of Bengal. Model forecasts show that the system likely to move initially westwards and intensify into a well marked low over off TN coast 21 morning. The analysis and forecasts for 24h to 168 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.

• **IMD-WRF** model analysis of 0000 UTC of 20 October 2013 shows a LOW formed over southwest Bay of Bengal and forecasts show intensification into well marked low over off TN coast on 21 Oct. 2013.

JMA model suggests low over south central Bay on 20th. The same would lie over southwest Bay on 21st over southwest Bay off north Tamilnadu and south AP coasts on 22nd and southwest Bay and adjoining west central Bay, north Tamilnadu, south coastal AP on 23rd.

ECMWF: Suggests low over low over south central Bay on 20th. The same would lie over southwest Bay on 21st & 22nd as well marked low while moving west north-westwards. It would lie over southwest and adjoining west central Bay off south AP coast on 23rd and adjoining south AP coast on 24th. It will be low over Rayalaseema on 25th.

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

METEOFRANCE-ARP: Low over low over south central Bay on 20th. The same would lie over southwest Bay on 21st & 22nd as well marked low while moving west north-westwards. It would lie over southwest and adjoining west central Bay off south AP coast on 23rd it would lie as a low over north Tamilnadu coast.

• **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 20 October 2013 suggests development of a cyclogenesis zone over southwest Bay of Bengal off TN coast on 21 October 2013. Model forecasts also show that the system likely to move northwestwards and entered into southeast Arabian Sea on 24 October 2013 and further

organization of GPP on 26 Oct to 27 Oct over east central Arabian Sea. GPP charts for analysis and forecasts for 24h to 168 h are shown in **Annexure II**.
(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- The low pressure area formed over central part of south **Bay** is likely to become well marked during next 48 hrs. It is likely to move west-northwestwards. Though most of the models don't suggest intensification in to depression but most of the environmental atmospheric & Oceanic conditions are favourable for formation of depression. Also genesis potential parameter based on dynamical statistical model suggest cyclogenesis.

Advisory:

- **IOP is declared for the period of 21-23 October 2013.**
- **Intense observations as per FDP guidelines may be taken for Tamilnadu, Puducherry and south AP coast.**

Annexure-I.

No of Synop data

Date→	**19.10.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /19.10.2013 : 3

No. of Ascents reaching 250 hPa level =3

MISDA : 5

12Z /19.10.2013 : 4

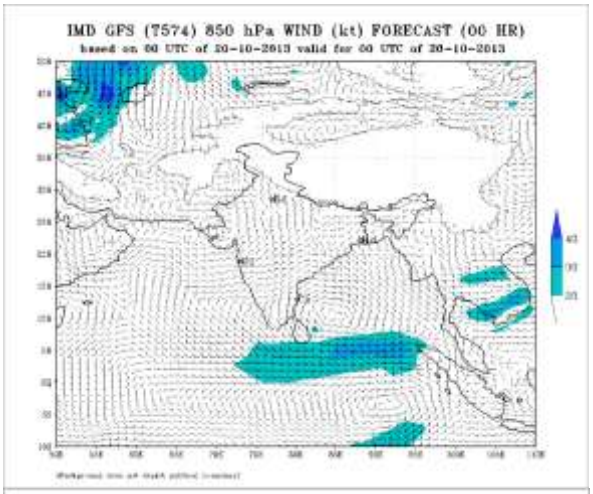
No. of Ascents reaching 250 hPa level =4

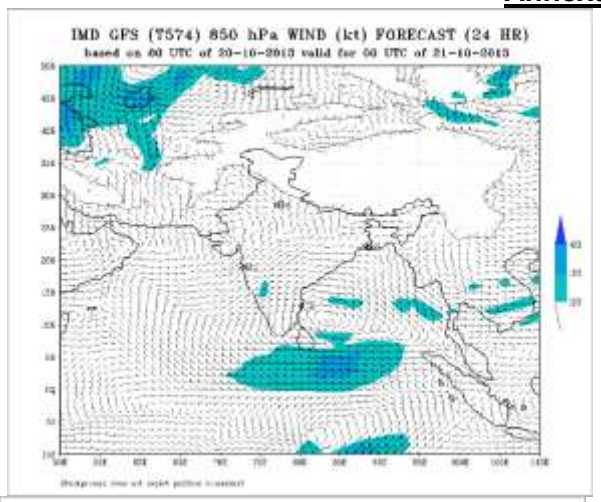
MISDA : 4

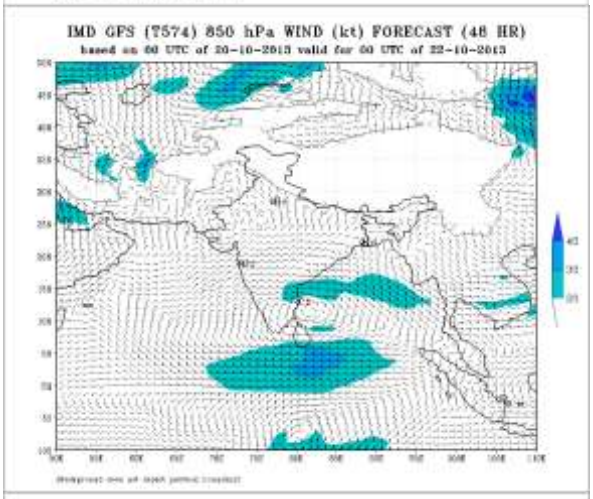
No. of PILOT Ascents:

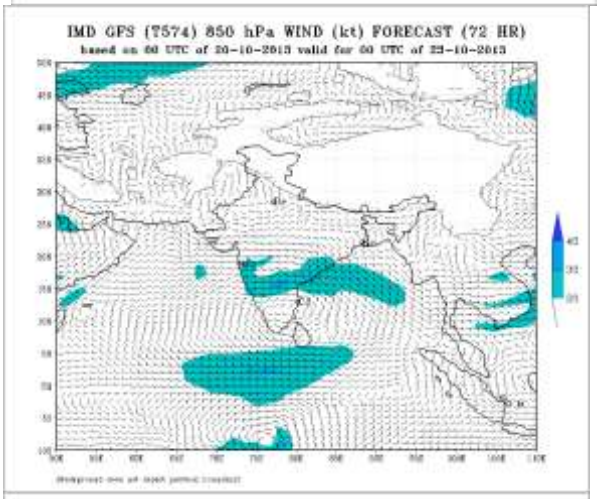
19.10.2013	
06Z	18Z
3	3

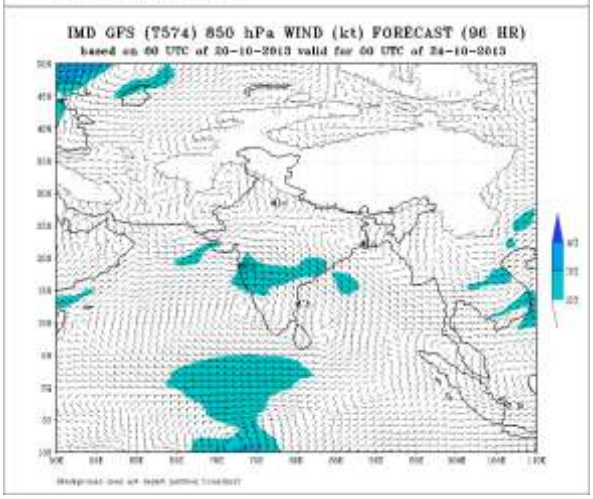
Annexure-II

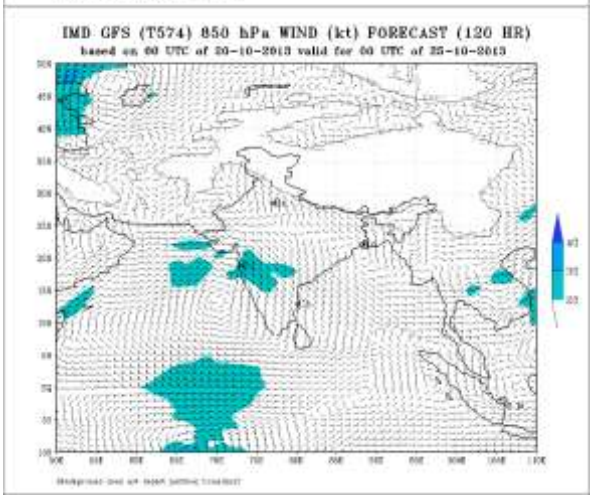

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 20-10-2013

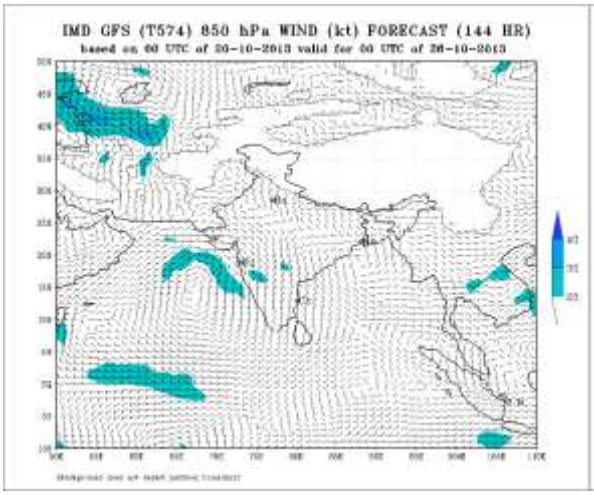

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 21-10-2013

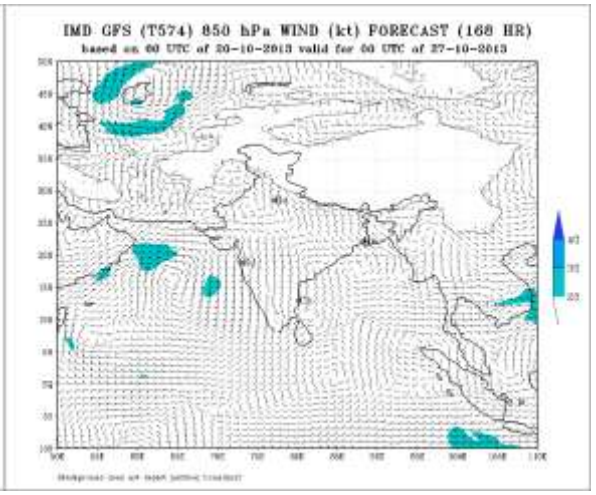

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 22-10-2013

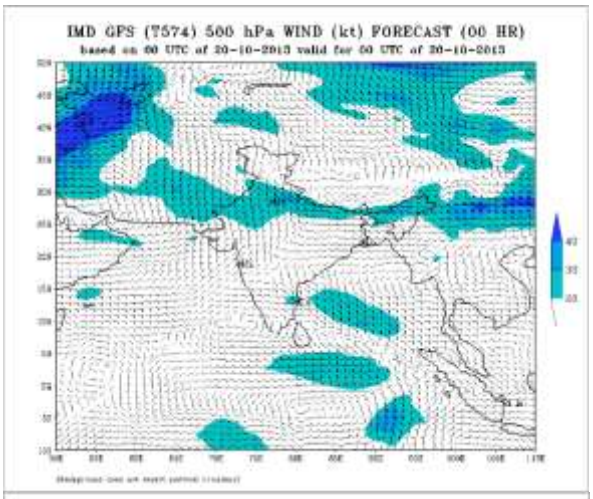

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 23-10-2013

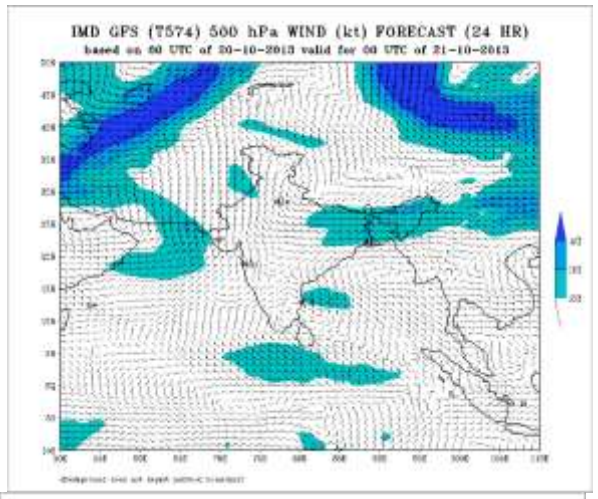

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 24-10-2013

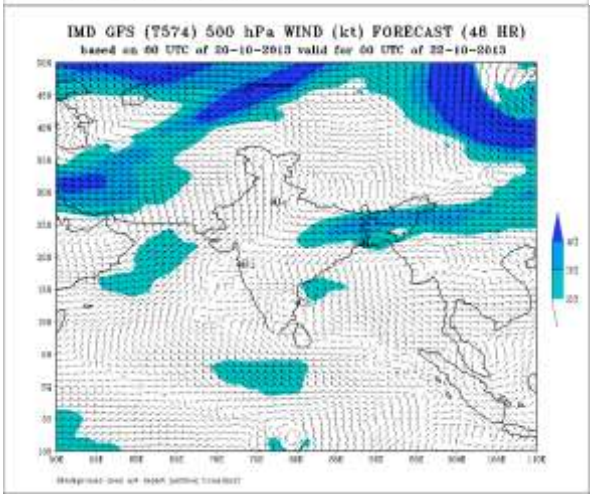

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 25-10-2013

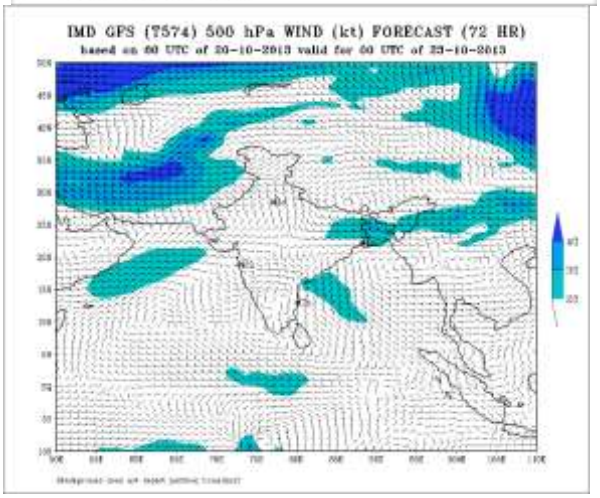

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 26-10-2013

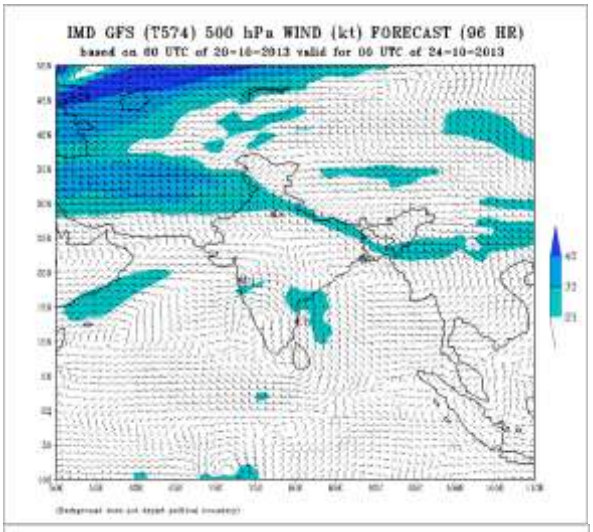

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 27-10-2013

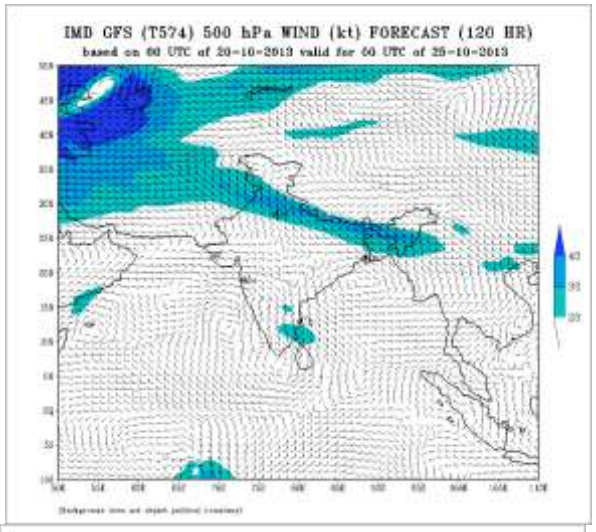

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 20-10-2013

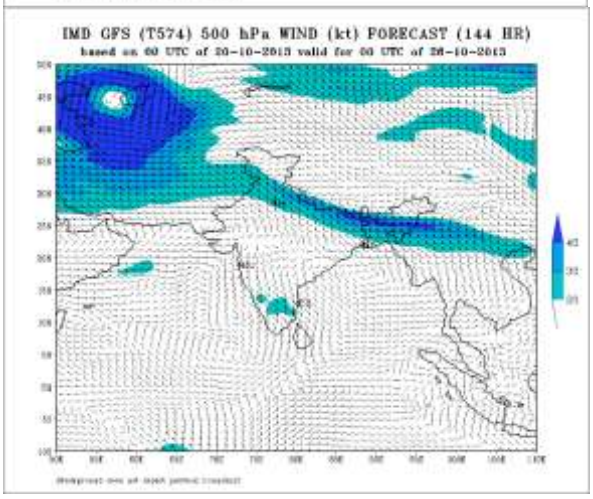

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 21-10-2013

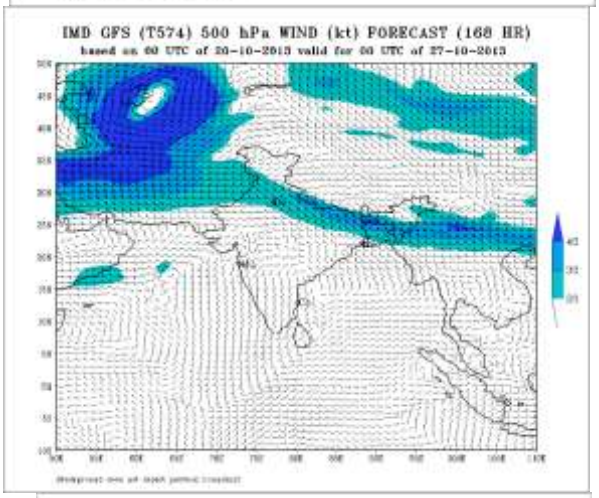

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 22-10-2013

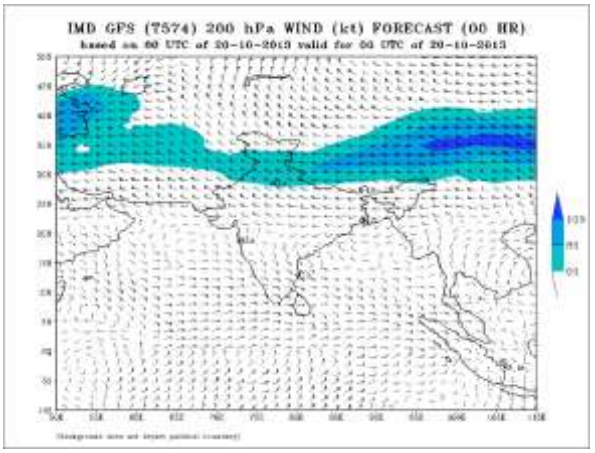

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 23-10-2013

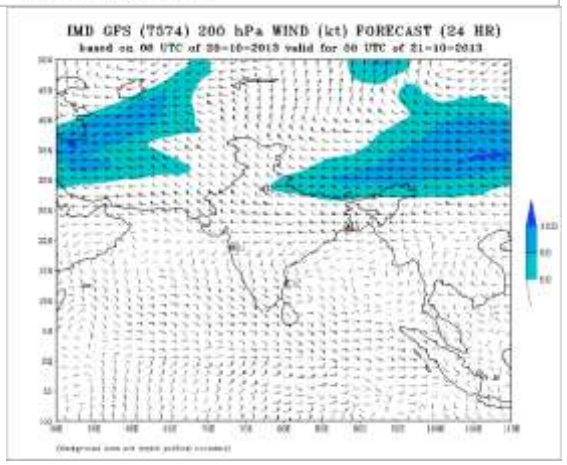

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 24-10-2013

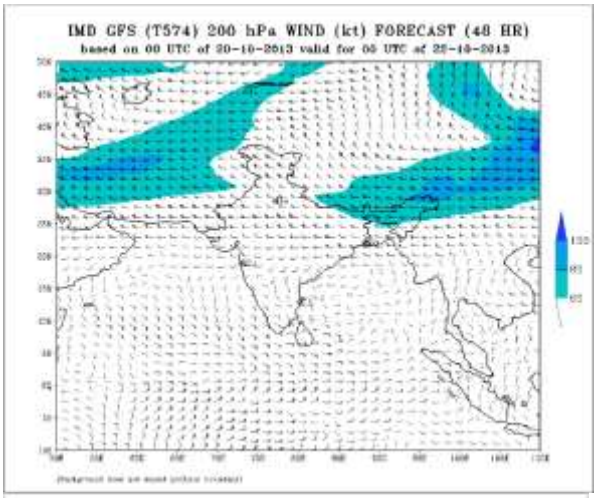

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 25-10-2013

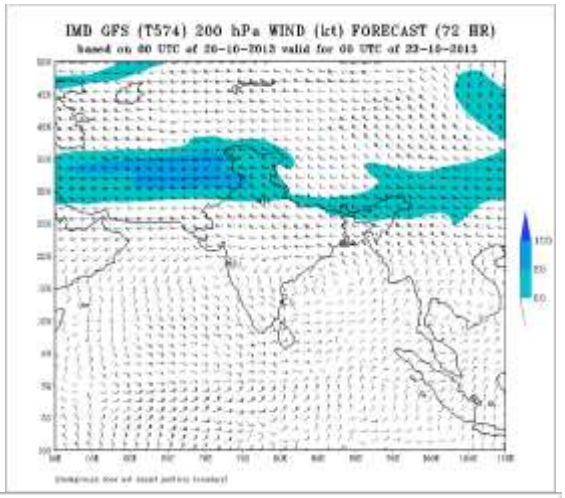

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 26-10-2013

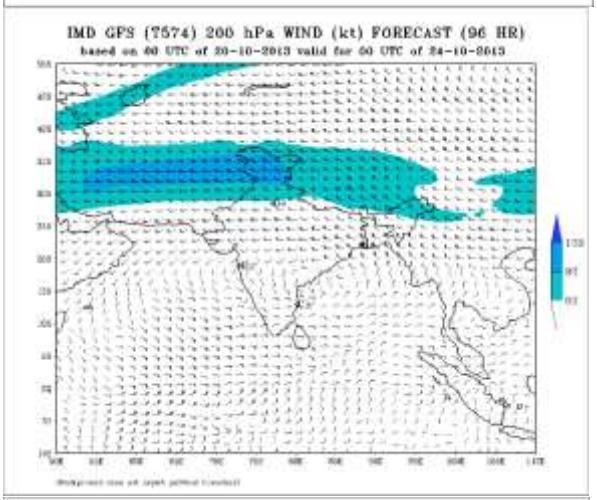

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 27-10-2013

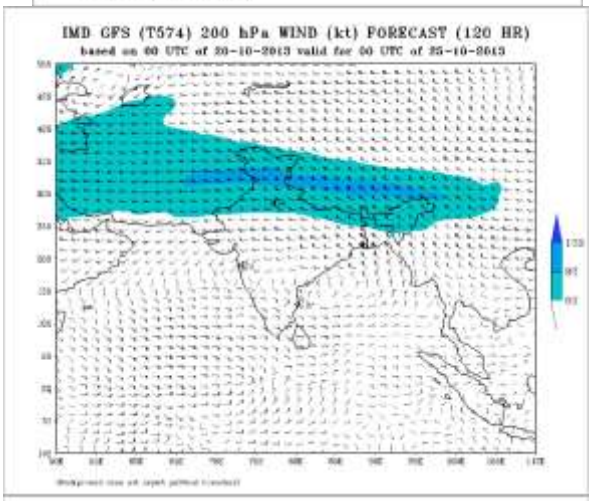

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 20-10-2013

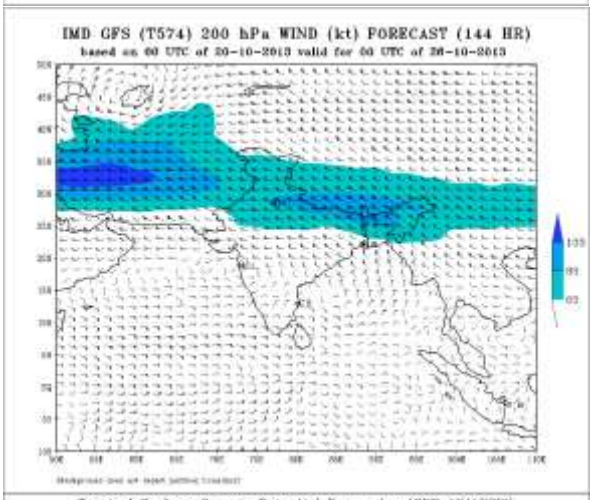

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 21-10-2013

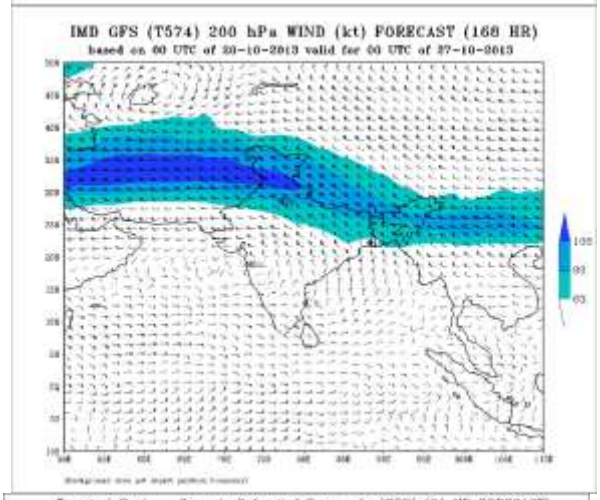

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 22-10-2013

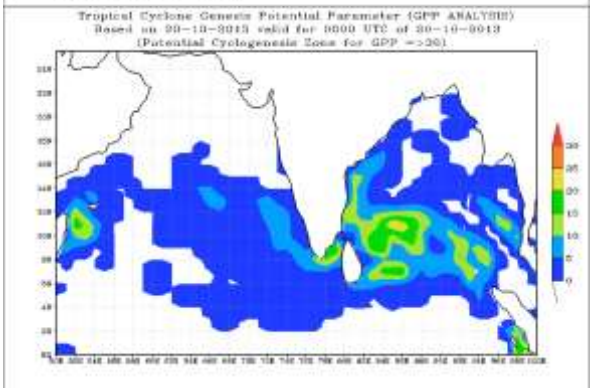

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 23-10-2013

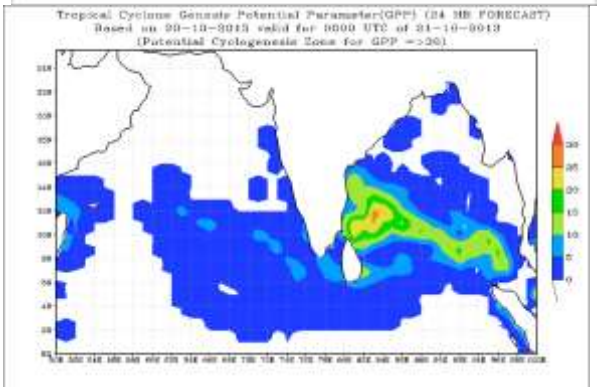

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 24-10-2013

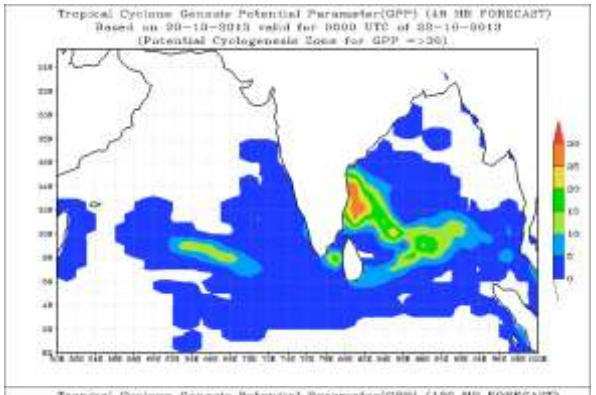

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 25-10-2013

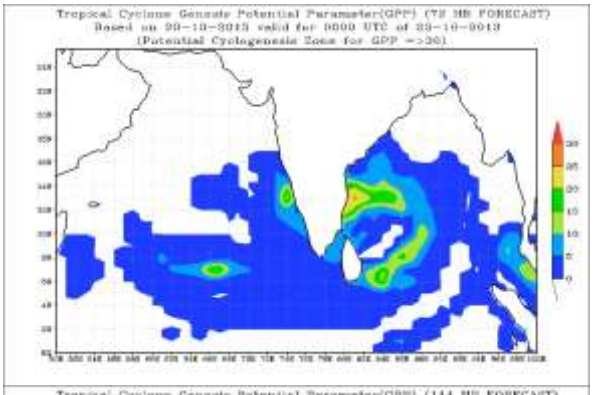

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 26-10-2013

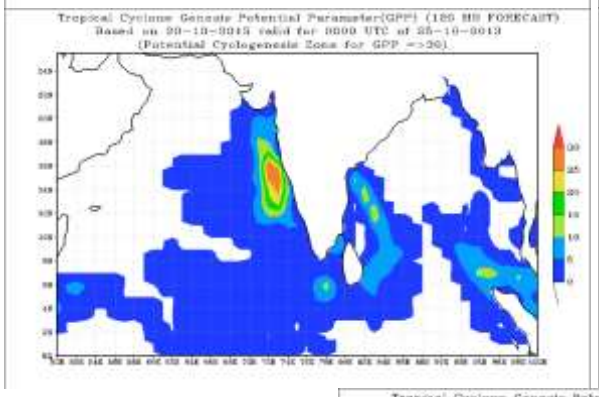

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 20-10-2013 valid for 00 UTC of 27-10-2013

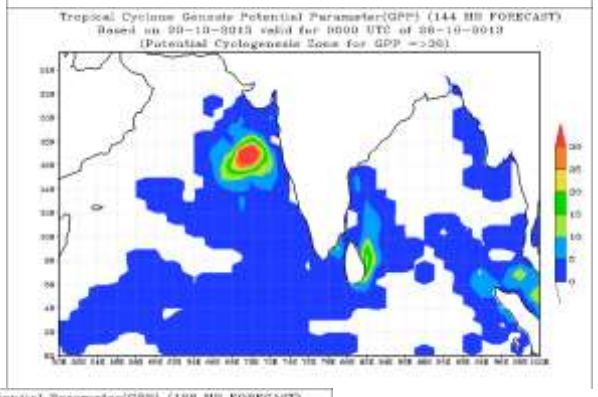

Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 20-10-2013 valid for 0000 UTC of 20-10-2013
(Potential Cyclogenesis Zone for GPP =>26)

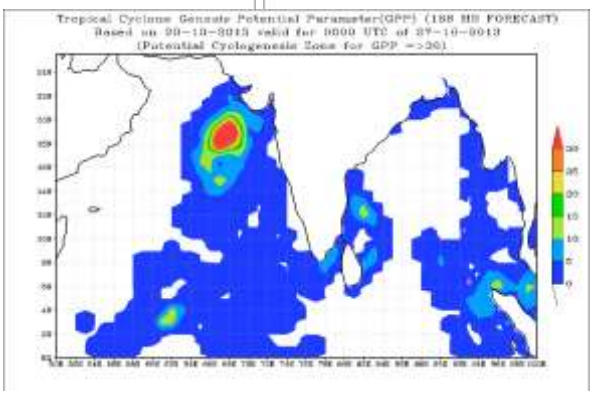

Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 20-10-2013 valid for 0000 UTC of 21-10-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 00-10-0013 valid for 0000 UTC of 28-10-0013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 00-10-0013 valid for 0000 UTC of 29-10-0013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (120 HR FORECAST)
Based on 00-10-0013 valid for 0000 UTC of 25-10-0013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (144 HR FORECAST)
Based on 00-10-0013 valid for 0000 UTC of 26-10-0013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (168 HR FORECAST)
Based on 00-10-0013 valid for 0000 UTC of 27-10-0013
(Potential Cyclogenesis Zone for GPP =>20)

FDP (Cyclone) NOC Report Dated 21 October, 2013

Synoptic features based on 0300 UTC:

The Southwest Monsoon has further withdrawn from remaining parts of the Country, Bay of Bengal and Arabian Sea. Thus, it has withdrawn from the entire country today, the 21st October 2013. Simultaneously, the northeast Monsoon rains have commenced over Tamil Nadu, Kerala and adjoining areas of Andhra Pradesh and Karnataka on today, the 21st October 2013.
The northeast Monsoon has been active over coastal Andhra Pradesh.
The low pressure area over central parts of south Bay of Bengal now lies as well marked Low pressure area over southwest Bay of Bengal off north Tamil Nadu – south Andhra Pradesh coasts. Associated cyclonic circulation extends upto 3.1 kms a.s.l. System may concentrate into a Depression during next 24 hours.
The trough in easterlies in the lower tropospheric levels now extends from the centre of the above well marked low pressure area to Gangetic West Bengal.has also become less marked.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST around 29-31^{0}C over Bay of Bengal warmer towards north Tamilnadu coast.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over southwest Bay of Bengal, east coast of India, northwest Bay and Gulf of Martaban. It is 50-80 KJ cm^{-2} over rest Bay except equatorial region where it is 100-120 KJ cm^{-2}.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over south Bay of Bengal and negative over the rest part of Bay of Bengal. It has increased during past 24 hrs over southwest Bay.

Convergence:

- Lower level convergence has also increased over southwest Bay of Bengal and maximum (5-10*10^{-5} s^{-1}) over the low pressure area.

Divergence:

- Upper air negative divergence has also increased and is of the order 10-20*10^{-5} s^{-1} over the low pressure area. It is also positive over northwest Bay and south east Bay and of the order of 5-10*10^{-5} s^{-1} and 10*10^{-5} s^{-1} respectively. It is negative over south-central Bay.

Wind Shear:

- Wind Shear is 05-10 knots over southwest Bay of Bengal

Wind Shear Tendency:

- Shear Tendency is decreasing over the low pressure area and increasing over rest Bay.

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 18°N.

M.J.O. Index:

- Located in phase 1 with amplitude less than 1.0.
- Dynamical forecast:- MJO may continue in phase 1 with amplitude less than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite

Inference based on INSAT imagery of 210900 UTC

- Broken Low/Medium clouds with embedded moderate to intense convection over North Bay and scattered over rest west central & south Bay and south Andaman sea. Scattered Low/Medium cloud with embedded isolated weak to moderate convection over rest Bay and rest Andaman Sea and Gulf of Martaban.
- Broken Low/Medium clouds with embedded isolated moderate to intense convection between Longitude 46.3°E to 49.0^{0}E and also over southeast Arabian Sea off Kerala coast.

NWP Analysis

• **IMD-GFS** model analysis of 0000 UTC of 21 October 2013 shows a LOW pressure area over southwest Bay of Bengal off TN coast. Model forecasts show that the system likely to move initially westwards and emerge into southeast Arabian Sea on 24 October 2013 after crossing south peninsula. Model forecast also shows no intensification of the system over the east central Arabian Sea while moving northwestwards. The analysis and forecasts for 24h to 168 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.

• **IMD-WRF** model analysis of 0000 UTC of 21 October 2013 shows a LOW over southwest Bay of Bengal and forecasts show intensification into Depression over southeast Arabian Sea coast on 24 Oct. 2013.

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- JMA model shows low over south central Bay on 21st. The same would move NW'ly and lie over southwest Bay off north Tamilnadu and south AP coasts on 22nd and over southwest Bay and adjoining west central Bay, north Tamilnadu, south coastal AP on 23rd.It would move inland on 24 October.
- **ECMWF:** Shows low over south west Bay on 21October. The same would continue to lie over southwest Bay on 22nd & 23rd while moving west north-westwards. It would lie over southwest and adjoining west central Bay off and adjoining south AP coast on 24th. It will be low over Rayalaseema on 25th.

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **METEOFRANCE-ARP:** Low over south central Bay on 21st. The same would lie over southwest Bay on 22nd ,while moving west north-westwards it will cross near South Tamil Nadu coast on 23 October.
- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 21 October 2013 suggests development of a cyclogenesis zone over southwest Bay of Bengal off TN coast on 21 October 2013. Model forecasts also show that the system likely to move northwestwards and entered into southeast Arabian Sea on 25 October 2013 and no further organization of GPP over east central Arabian Sea. GPP charts for analysis and forecasts for 24h to 168 h are shown in **Annexure II**.

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- The low pressure area formed over central part of south **Bay** has become well marked during past 24 hrs. It is likely to move west-northwestwards. Though most of the models don't suggest intensification in to depression but most of the environmental atmospheric & Oceanic conditions are favourable for formation of depression. Also genesis potential parameter based on dynamical statistical model suggests intensification till 22nd and then weakening.

Advisory:

- **IOP is declared for the period of 22,23 and 24th October 2013.**
- **Intense observations as per FDP guidelines may be taken for Tamilnadu, Puducherry and south AP coast.**

Annexure-I.

Status of Observation system:

Synoptic observation:

Region	Date/Time (UTC)		
	20/12	21/00	21/03
India	55/39	44/45	55/55
Coastal stations			
WB	10/11	7/7	11/11
Odisha	2/10	7/7	10/10
AP	18/18	17/18	18/18

Tamil Nadu	7/13	10/10	13/13
Puducherry	1/2	2/2	2/2
A & N	1/1	1/1	1/1
Bangladesh	7/11	10/11	09/11
Myanmar	9/11	9/11	9/11
Thailand	1/3	2/3	2/3
Srilanka	8/9	7/9	8/9

- **RS/RW** (12Z) of 20-10-2012: 02/39
- **No. of Ascents reaching 250 hPa levels:, MISDA:-37**

- **RS/RW** (00Z) of 21-10-2012: 27/39
- **No. of Ascents reaching 250 hPa levels: , MISDA:12**

No. of PILOT Ascents

20/12Z	**21/00Z**
8/37	12/34

Buoy Data

20/12Z	**21/00Z**	**21/03Z**
6	4	8

Data Statistics over RMC Chennai Region

No of Synop data

Date→				**20.10.2013**				
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**21**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /20.10.2013 : 5

No. of Ascents reaching 250 hPa level =5

MISDA : 3

12Z /20.10.2013 : 5

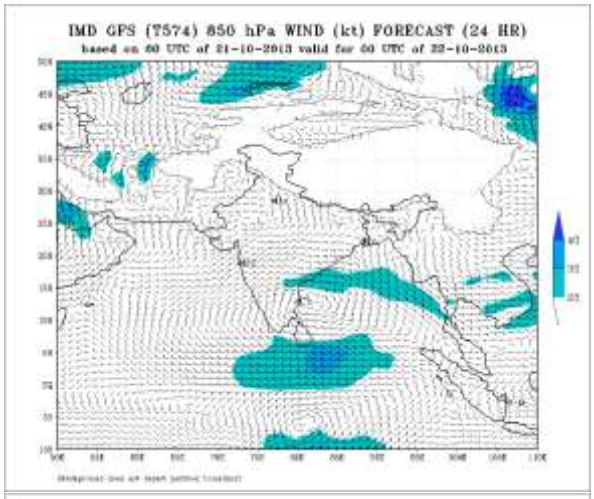
No. of Ascents reaching 250 hPa level =5

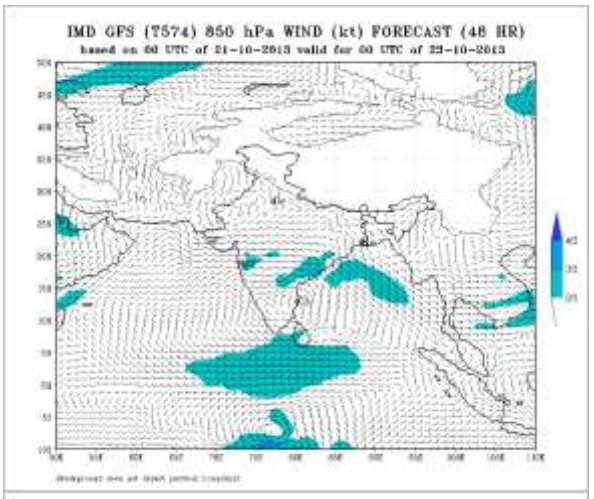
MISDA : 3

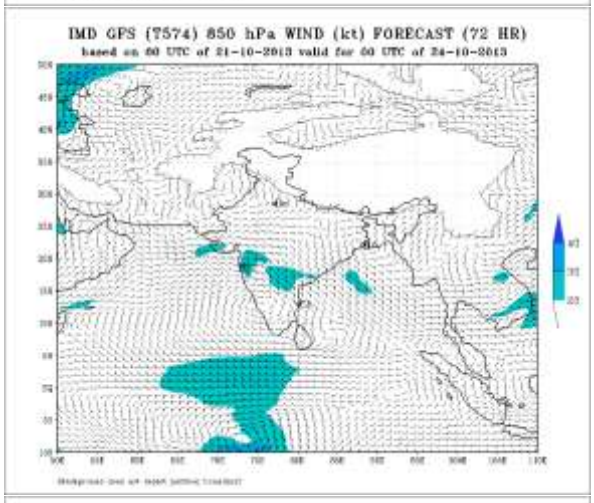
No. of PILOT Ascents:

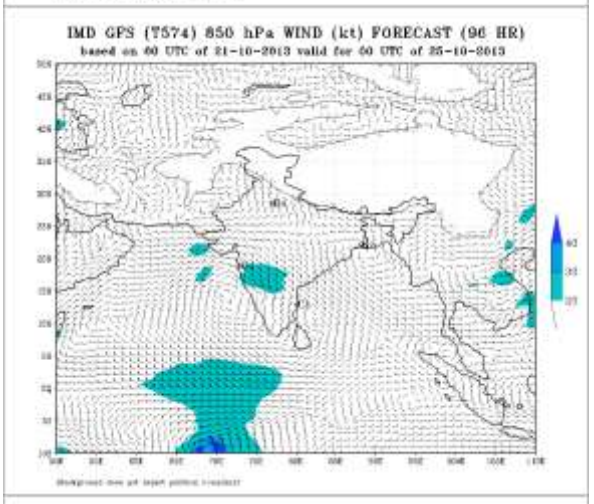
20.10.2013	
06Z	18Z
0	1

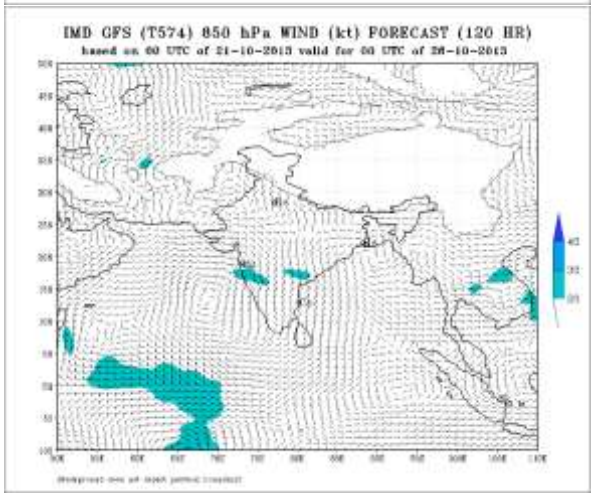
Annexure-II

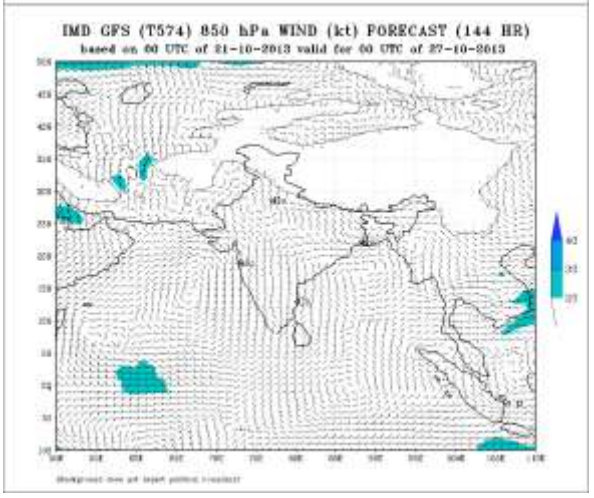

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 22-10-2013

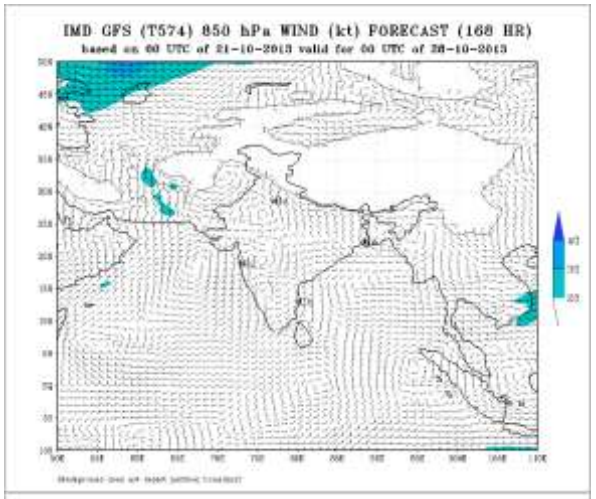

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 23-10-2013

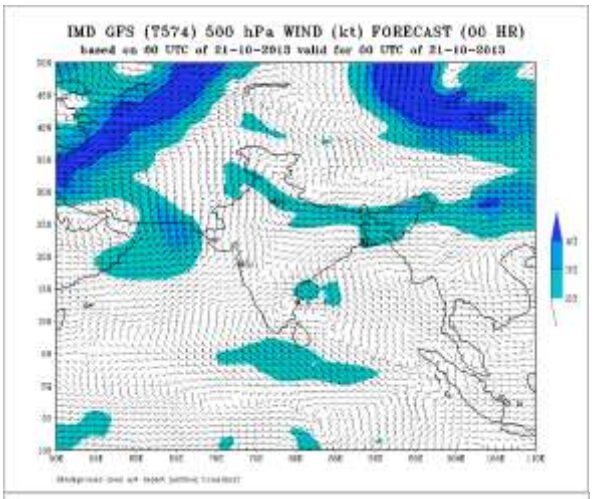

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 24-10-2013

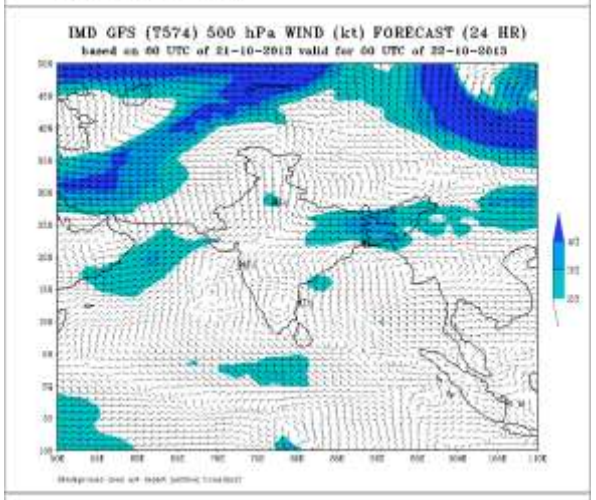

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 25-10-2013

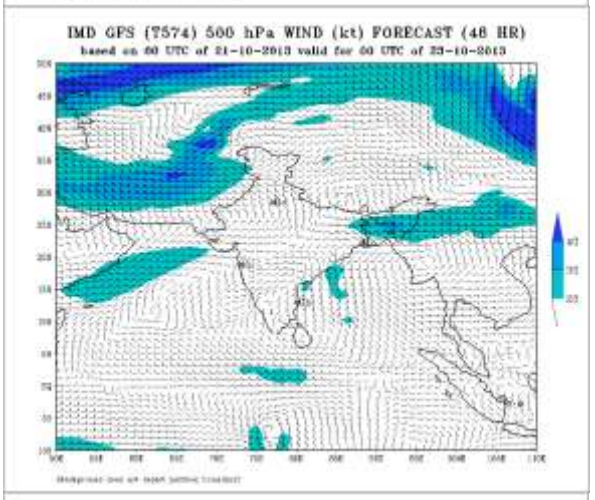

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 26-10-2013

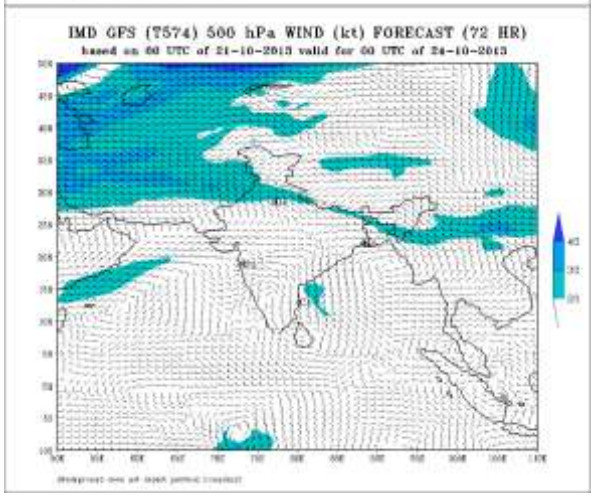

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 27-10-2013

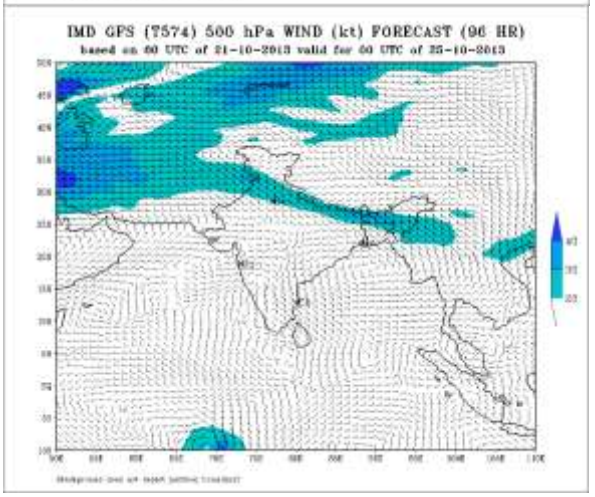

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 28-10-2013

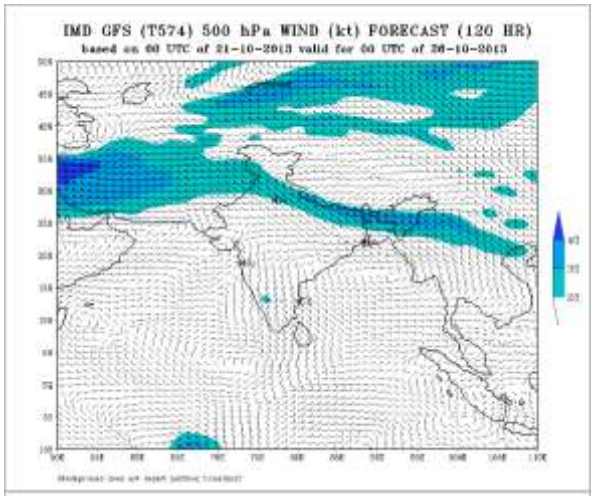

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 21-10-2013

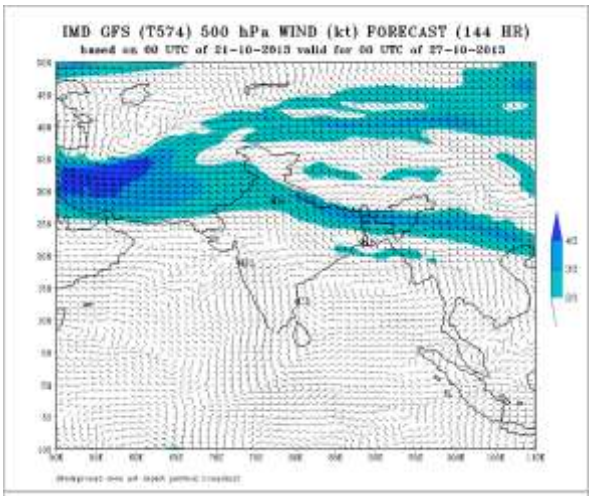

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 22-10-2013

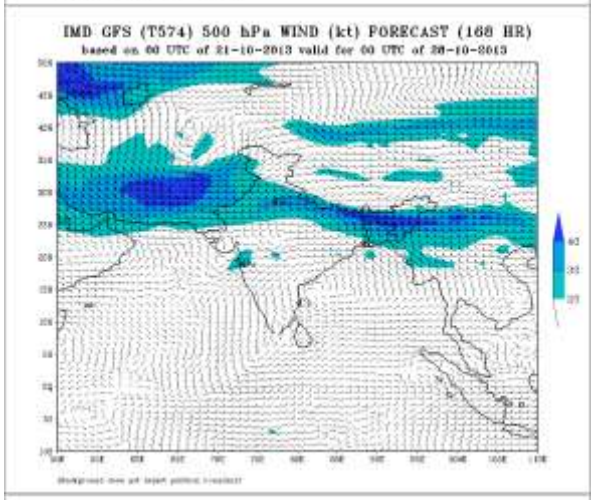

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 23-10-2013

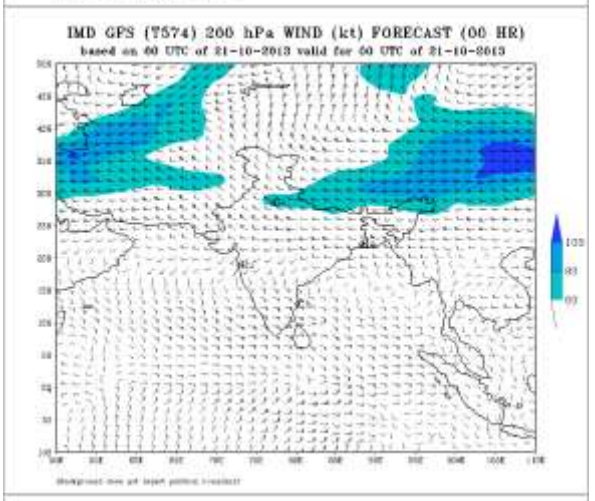

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 24-10-2013

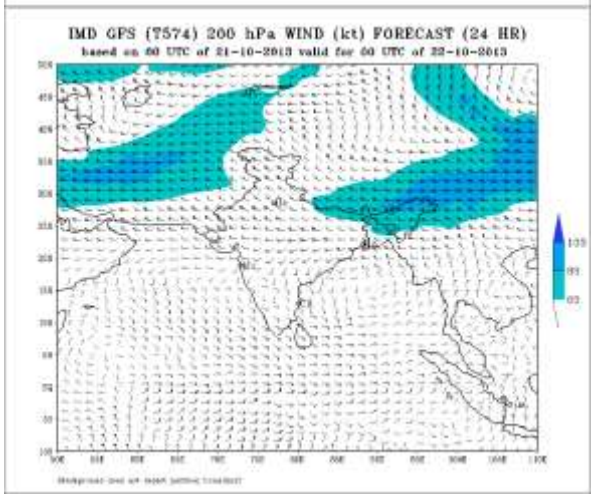

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 25-10-2013

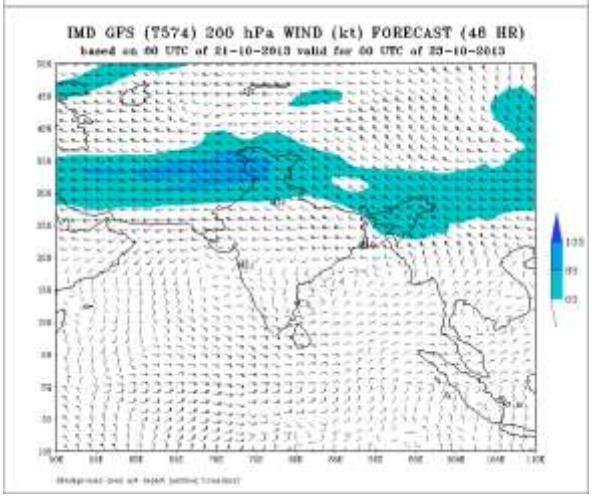

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 26-10-2013

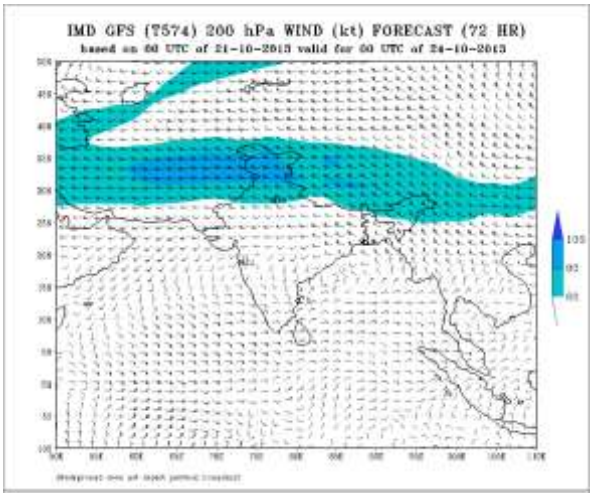

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 27-10-2013

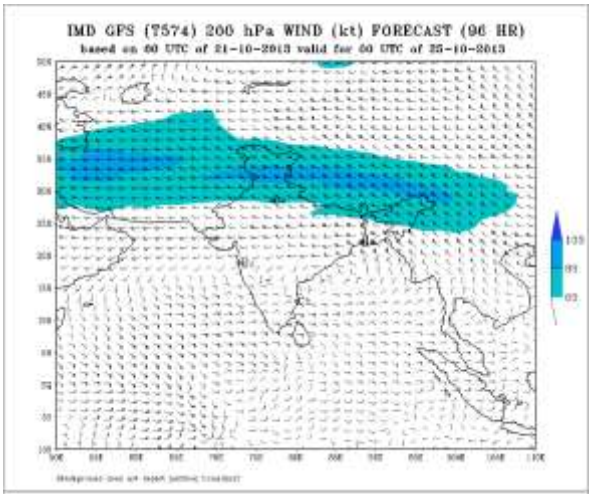

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 28-10-2013

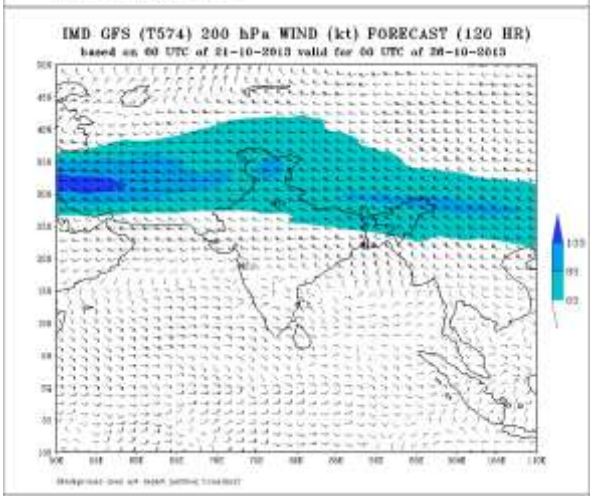

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 21-10-2013

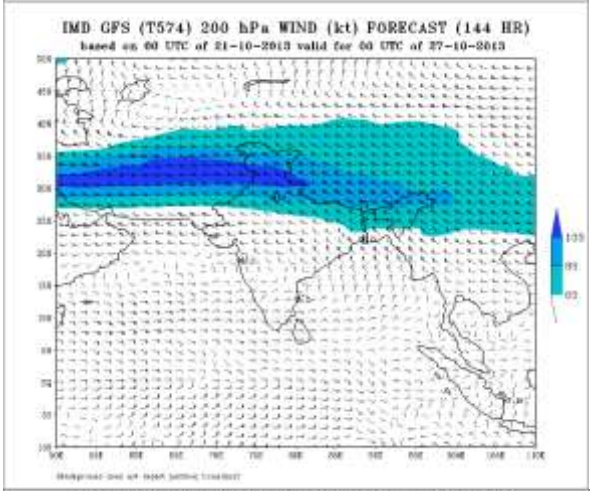

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 22-10-2013

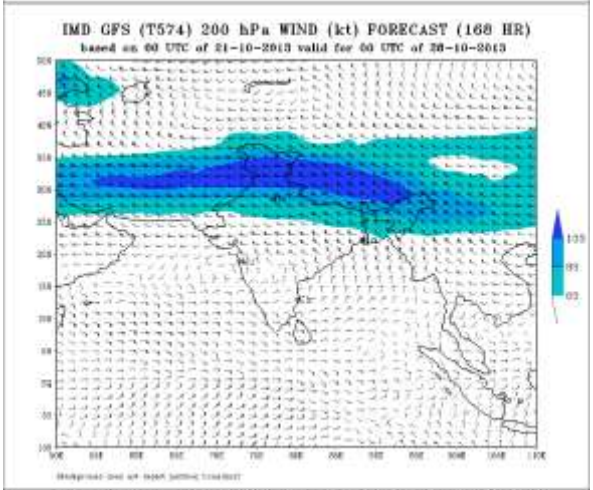

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 23-10-2013

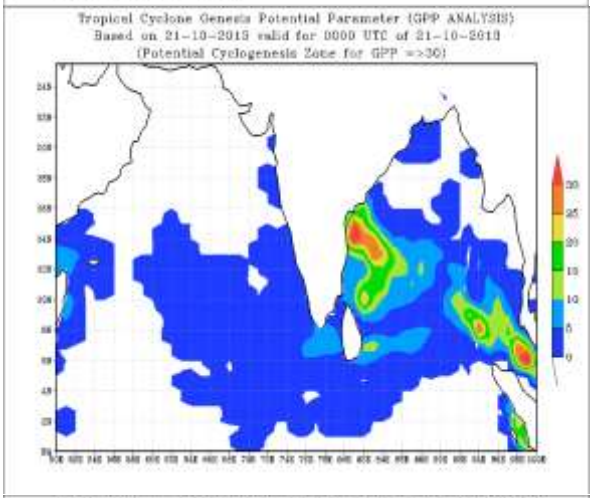

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 24-10-2013

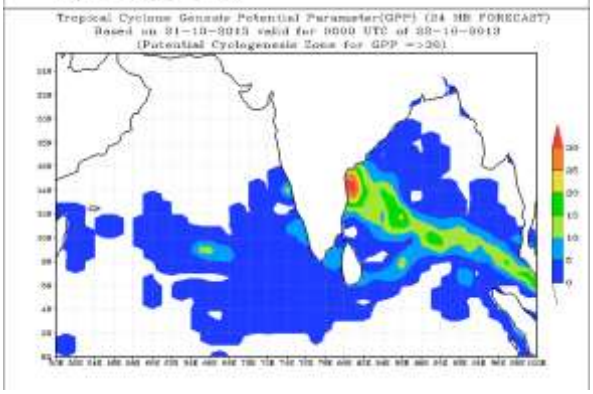

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 25-10-2013

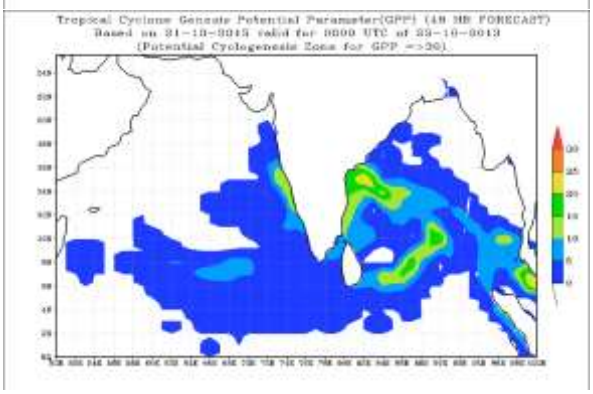

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 26-10-2013

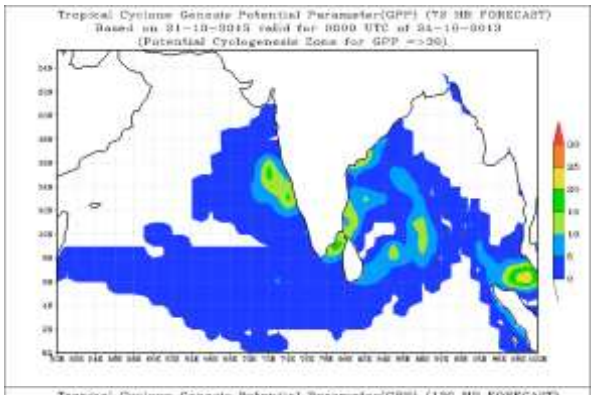

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 27-10-2013

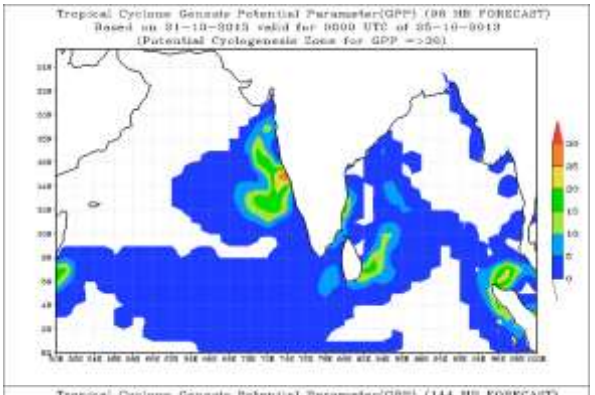

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 21-10-2013 valid for 00 UTC of 28-10-2013

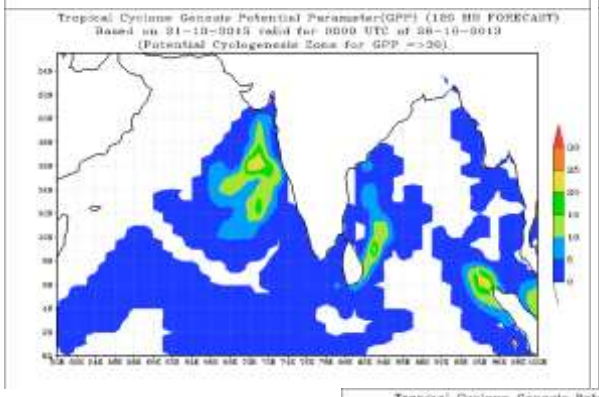

Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 21-10-2013 valid for 0000 UTC of 21-10-2013
(Potential Cyclogenesis Zone for GPP =>30)

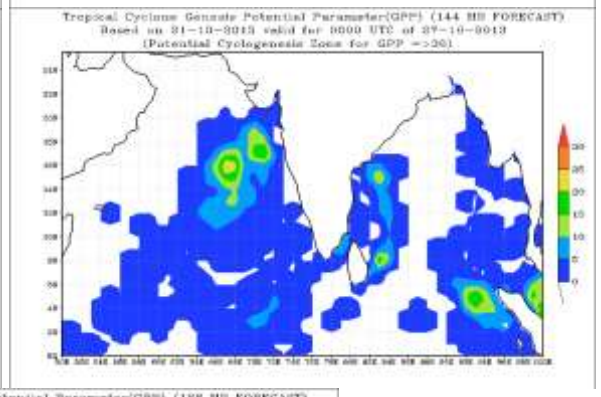

Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 21-10-2013 valid for 0000 UTC of 22-10-2013
(Potential Cyclogenesis Zone for GPP =>30)

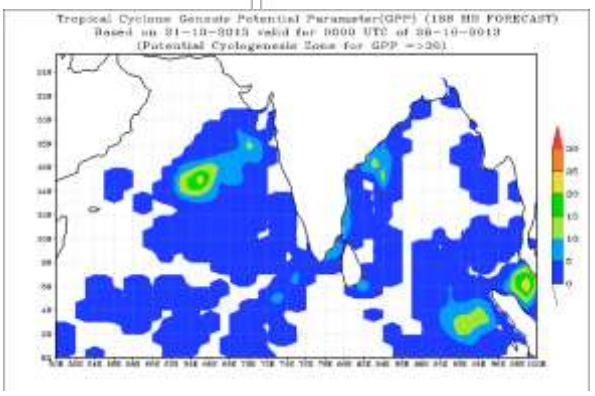

Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 21-10-2013 valid for 0000 UTC of 23-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 31-10-2013 valid for 0000 UTC of 34-10-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (96 HR FORECAST)
Based on 31-10-2013 valid for 0000 UTC of 35-10-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (120 HR FORECAST)
Based on 31-10-2013 valid for 0000 UTC of 36-10-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (144 HR FORECAST)
Based on 31-10-2013 valid for 0000 UTC of 37-10-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (168 HR FORECAST)
Based on 31-10-2013 valid for 0000 UTC of 38-10-2013
(Potential Cyclogenesis Zone for GPP =>26)

FDP (Cyclone) NOC Report Dated 22 October, 2013

Synoptic features based on 0300 UTC:

- The northeast Monsoon has been active over coastal Andhra Pradesh, Rayalaseema and Kerala.
- The well marked low pressure area over southwest Bay of Bengal off north Tamil Nadu–south Andhra Pradesh coasts now lies over west central and adjoining southwest Bay of Bengal off south Andhra Pradesh – north Tamil Nadu coasts. Associated cyclonic circulation extends upto 4.5 kms a.s.l.
- The trough in easterlies in the lower tropospheric levels from the centre of the above well marked low pressure area to Gangetic West Bengal persists..

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST around 29-31^{0}C over Bay of Bengal warmer towards north Tamilnadu and south Andhra Pradesh coast.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over southwest Bay of Bengal, northeast & northwest Bay and Gulf of Martaban. It is 50-80 KJ cm^{-2} over rest Bay except equatorial region where it is 100-120 KJ cm^{-2}.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over south and west central Bay of Bengal. It is negative over the rest part of Bay of Bengal.

Convergence:

- Lower level convergence is of the order of 5-10*10^{-5} s^{-1} over southwest and west central Bay of Bengal.

Divergence:

- Upper air negative divergence is of the order 10-20*10^{-5} s^{-1} over the over southwest and westcentral Bay of Bengal . It is also positive over north Bay and of the order of 5-10*10^{-5} s^{-1}. It is negative over south-central Bay.

Wind Shear:

- Wind Shear is 05-10 knots over southwest Bay of Bengal

Wind Shear Tendency:

- Shear Tendency is decreasing over southwest Bay of Bengal and increasing over rest Bay.

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 18°N.

M.J.O. Index:

- Located in phase 1 with amplitude more than 1.0.
- Dynamical forecast:- MJO may continue in phase 1 with amplitude more than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 220900 UTC

- **Vortex over west central adjoining southwest Bay centred within half a degree of Lat. 14.5N/ Long. 81.0E. Intensity T1.5**. Associated broken low/med clouds with embedded intense to very intense convection over west central Bay between Lat 12.0^{0}N to 19.0^{0}N west of long 86.0^{0}E and costal Andhra Pradesh Rayalaseema south Telengana and north Tamilnadu.

Radar:

The observations from DWR, Chennai indicates the surface wind of about 15-20 knots justifying the intensity of a well marked low pressure area.

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 22 October 2013 shows a LOW pressure area over southwest Bay of Bengal off TN coast. Model forecasts show that the system likely to move in northwestwards and emerge into southeast Arabian Sea on 24 October 2013 after crossing south peninsula. Model forecast also shows intensification of the system into Depression over the east central Arabian Sea while moving northwestwards. The analysis and forecasts for 24h to 168 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.
- **IMD-WRF** model analysis of 0000 UTC of 22 October 2013 shows a LOW over southwest Bay of Bengal and forecasts show intensification into Depression over east central Arabian Sea coast on 25 Oct. 2013 after crossing south peninsula. (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
- **JMA** : JMA model shows that a low pressure area lies over southwest and adjoining west central Bay on 22nd. It would move northwest wards and lay over south coastal AP on 23rd. The same would move NW'ly and lay over Rayalaseema on 24th and became less marked over Karnataka on 25th October 2013.
- **ECMWF:** Shows well marked low over west central and adjoining southwest Bay on 22 October. The same would move west-northwestwards and lie close to south coastal AP on 2 3rd morning and cross and dissipate over peninsula on 2 4th. However, the remnant may emerge into east central Arabian Sea on 2 6th and intensify gradually into a cyclonic storm on 31 October while moving northwestwards towards Oman.
- **METEOFRANCE-ARP:** Model prediction shows that a low pressure area lies over west central adjoining southwest Bay on 22nd. It would move north westerly direction and lay over south coastal AP on 23rd. It would emerge into eastcentral Arabian sea off Konkan-Karnataka coast on 24th and move west northwest wards and lay over as Low over westcentral Arabian sea on 25th October 2013.
- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 22 October 2013 suggests development of a cyclogenesis zone over southwest Bay of Bengal off TN coast on 22 October 2013. Model forecasts also show that the system likely to move northwestwards and emerge into southeast Arabian Sea on 26 October 2013 and becomes insignificant on 28 Oct 2013. GPP charts for analysis and forecasts for 24h to 168 h are shown in **Annexure II**.

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- The well marked low pressure area over southwest Bay of Bengal moved northwestwards and lay over westcentral and adjoining southwest Bay of Bengal off south AP and north TN coast. It is likely to move west-northwestwards and cross south AP coast by tomorrow morning.

  After moving across south peninsula, it is likely to emerge into east-central Arabian Sea off north Karnataka-south Konkan coast by 25th/26th October. It may move then northwestwards and intensify gradually into a cyclonic storm

Advisory:

- **IOP will continue till 23rd October 2013.**
- **Intense observations as per FDP guidelines may be taken for Tamilnadu, Puducherry and south AP coast.**

Annexure-I.

Synoptic observation:

Region	Date/Time (UTC)		
	21/12	**22/00**	**22/03**
India	55/39	44/45	55/55
Coastal stations			
WB	10/11	7/7	11/11
Odisha	2/10	7/7	10/10
AP	18/18	17/18	18/18
Tamil Nadu	7/13	10/10	13/13
Puducherry	1/2	2/2	2/2
A & N	1/1	1/1	1/1
Bangladesh	7/11	10/11	09/11
Myanmar	9/11	9/11	9/11
Thailand	1/3	2/3	2/3
Srilanka	8/9	7/9	8/9

- **RS/RW** (12Z) of 21-10-2012: 02/39
- **No. of Ascents reaching 250 hPa levels:, MISDA:-37**
- **RS/RW** (00Z) of 22-10-2012: 27/39
- **No. of Ascents reaching 250 hPa levels: , MISDA:12**

No. of PILOT Ascents

21/12Z	22/00Z
8/37	12/34

Buoy Data

21/12Z	22/00Z	22/03Z
6	4	8

Data Statistics over RMC Chennai Region

Date→	**21.10.2013**																							
UTC→	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
Chennai Region (Coasts of AP & TN)	**20**	**7**	**8**	**22**	**9**	**1**	**20**	**1**	**8**	**20**	**9**	**9**	**22**	**8**	**9**	**20**	**9**	**10**	**20**	**7**	**7**	**20**	**7**	**7**

No of Synop data

No. of RS/RW Ascents

00Z /21.10.2013 : 6

No. of Ascents reaching 250 hPa level =5

MISDA : 2

12Z /21.10.2013 : 3

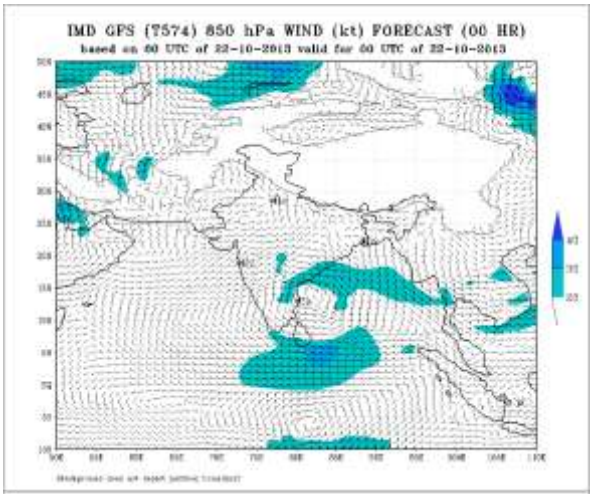
No. of Ascents reaching 250 hPa level =3

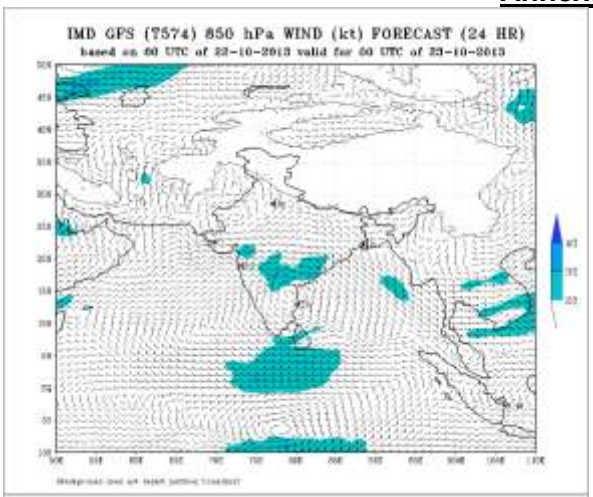
MISDA : 5

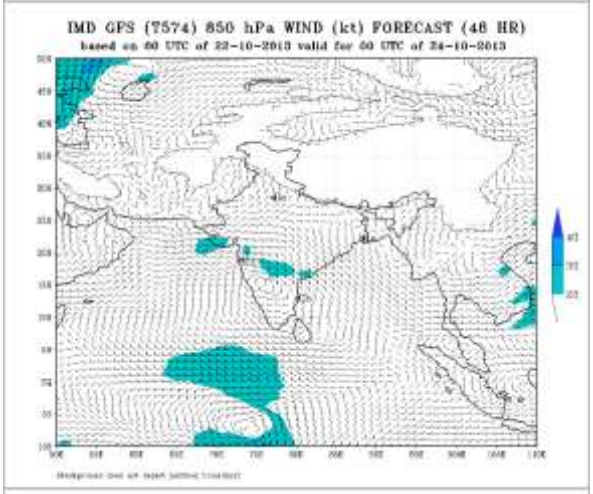
No. of PILOT Ascents:

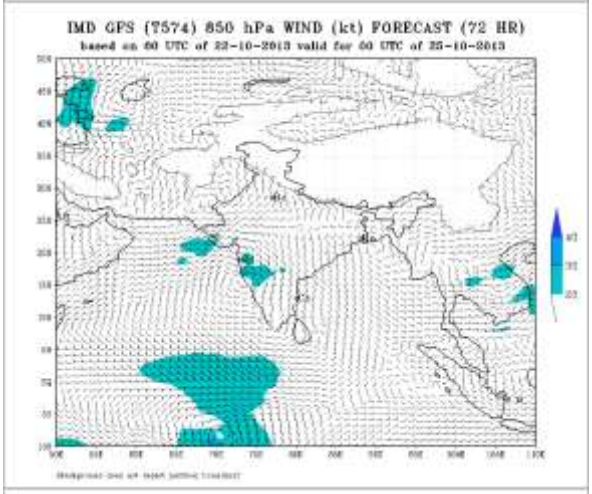
21.10.2013	
06Z	18Z
1	3

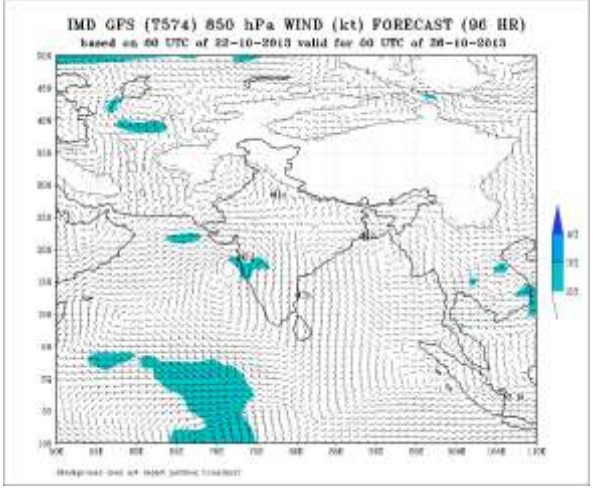
Annexure-II.

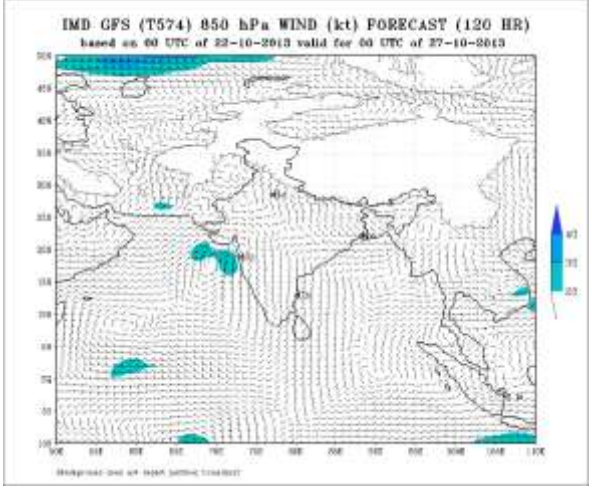

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 22-10-2013

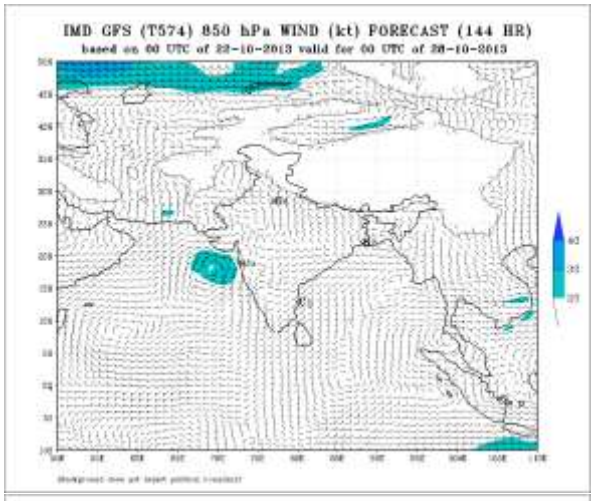

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 23-10-2013

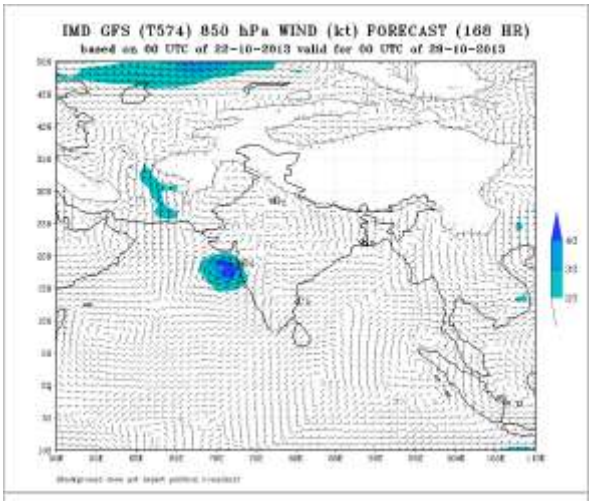

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 24-10-2013

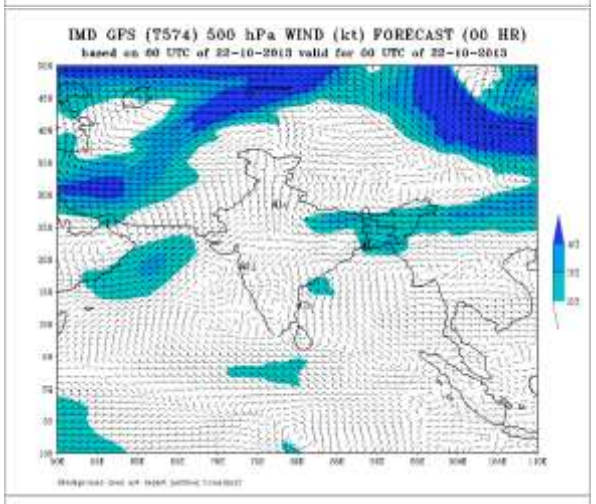

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 25-10-2013

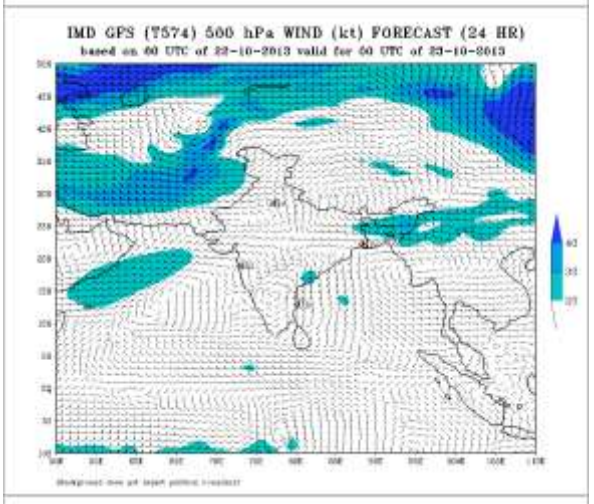

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 26-10-2013

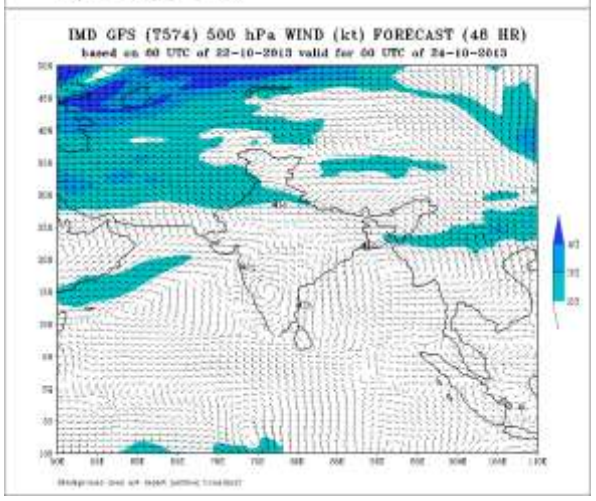

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 27-10-2013

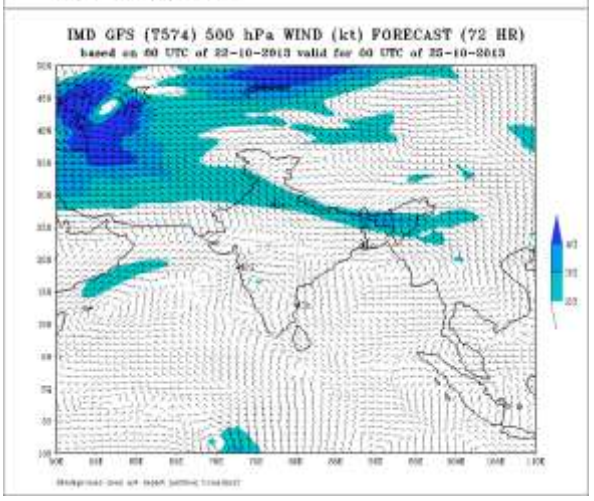

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 28-10-2013

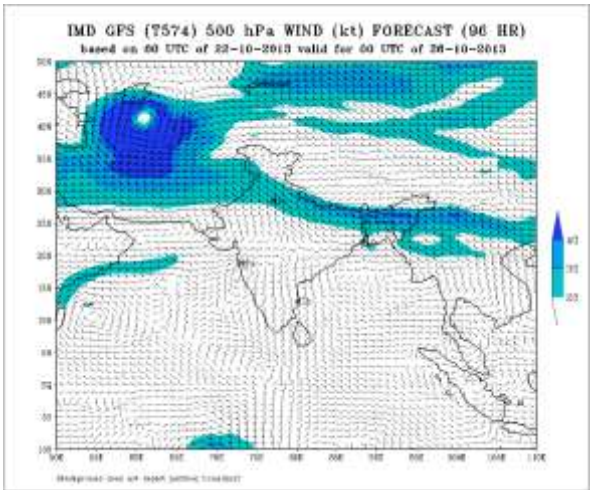

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 29-10-2013

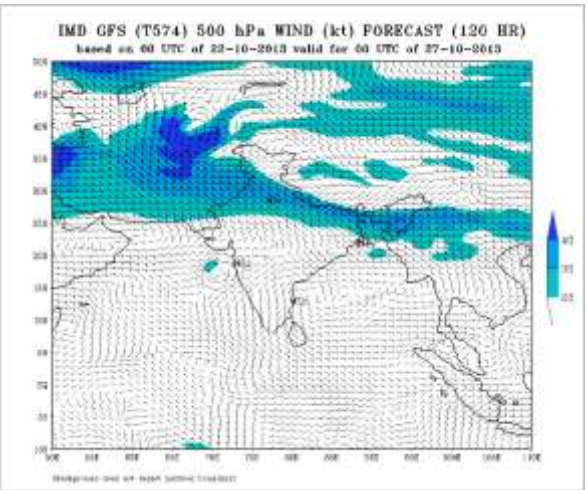

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 22-10-2013

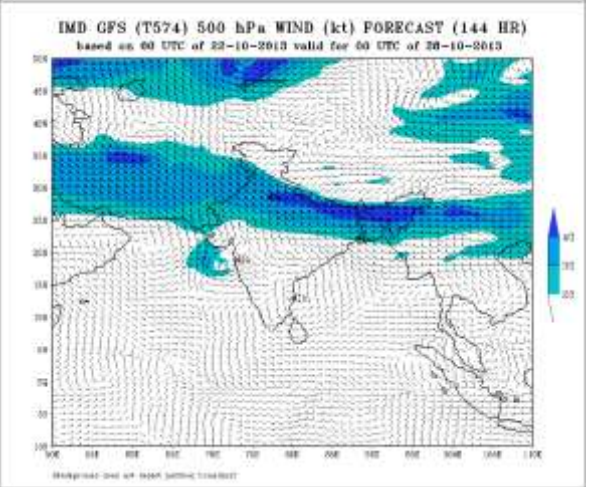

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 23-10-2013

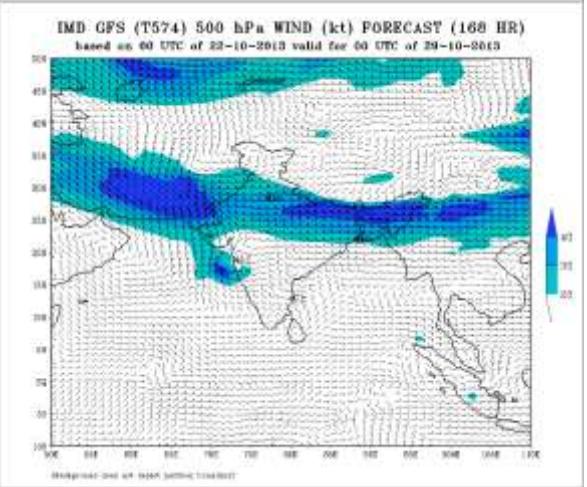

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 24-10-2013

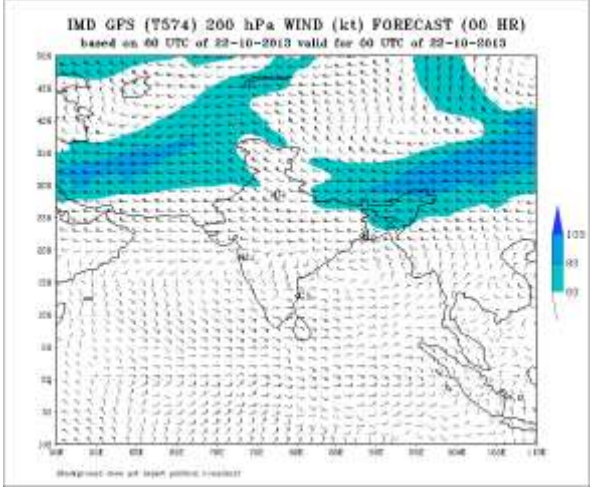

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 25-10-2013

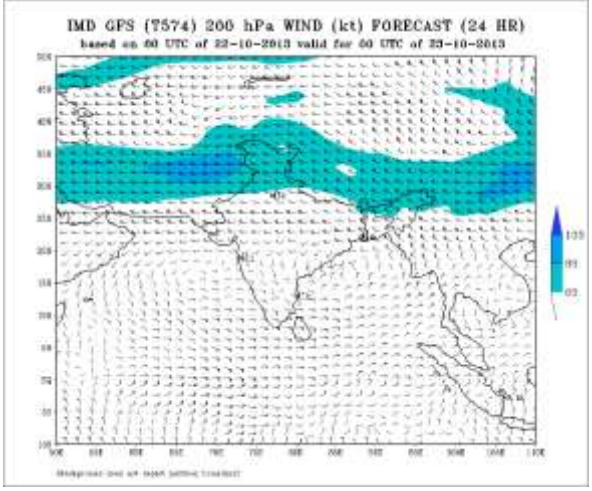

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 26-10-2013

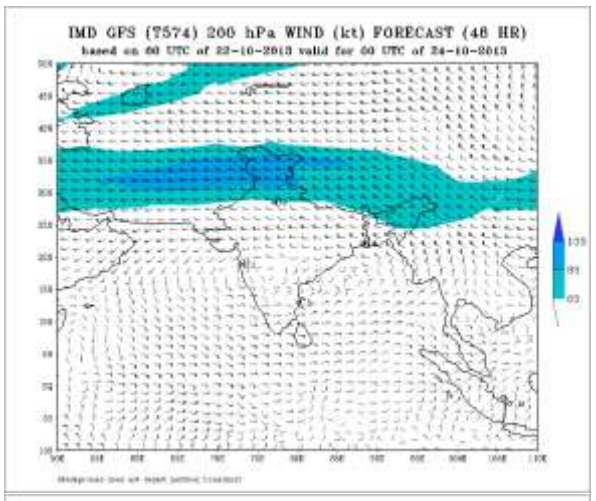

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 27-10-2013

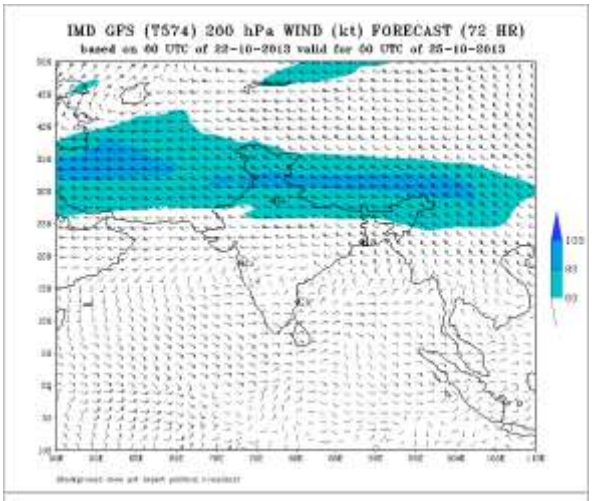

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 28-10-2013

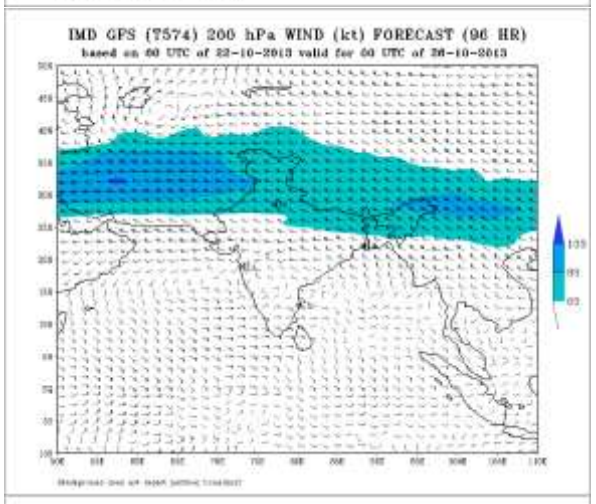

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 29-10-2013

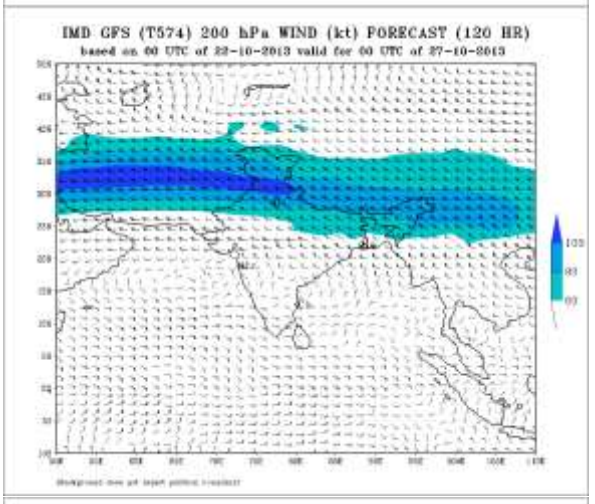

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 22-10-2013

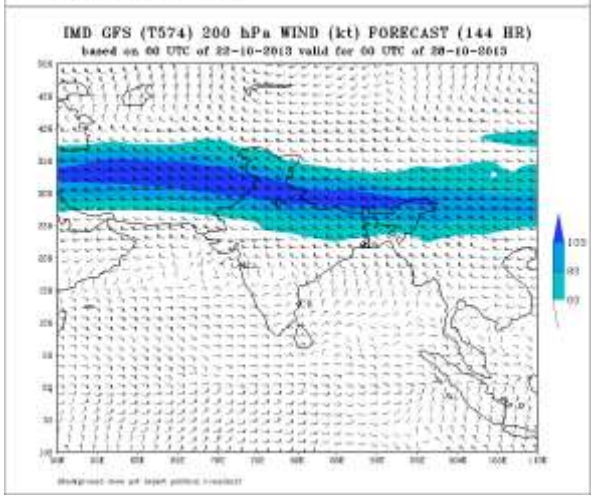

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 23-10-2013

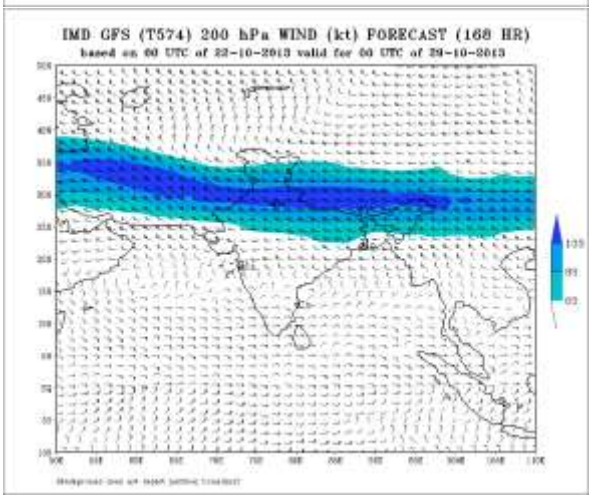

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 24-10-2013

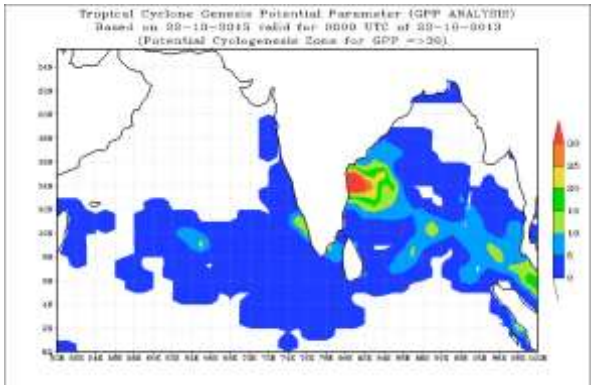

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 25-10-2013

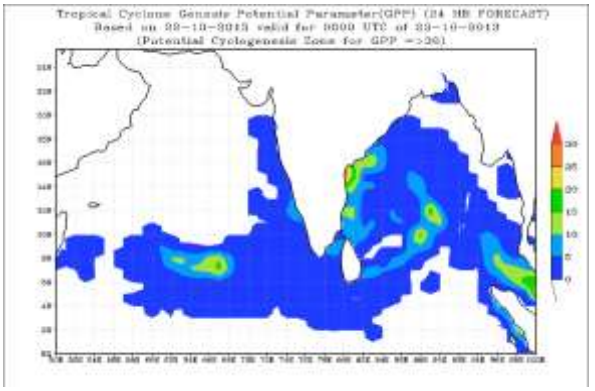

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 26-10-2013

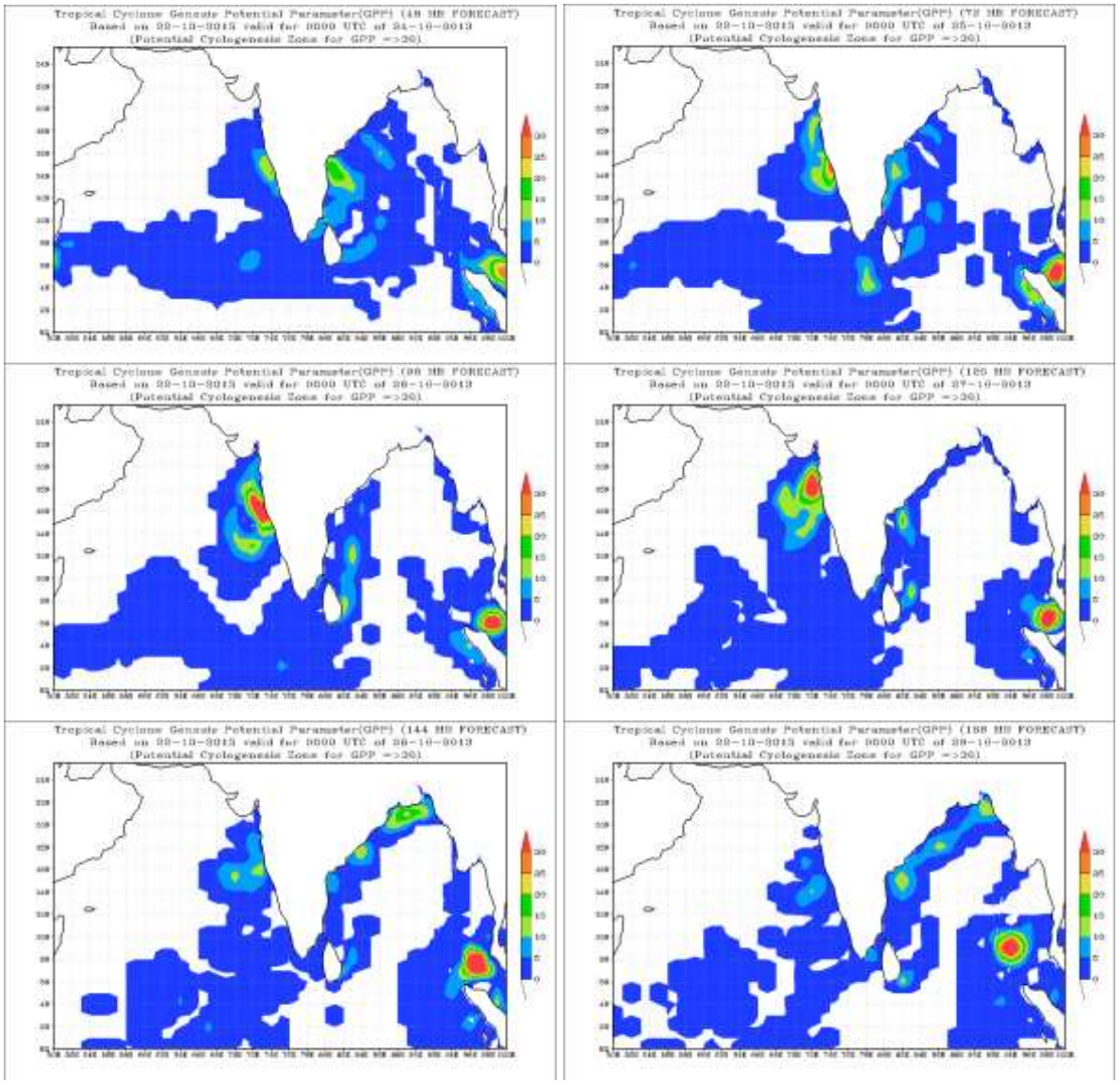

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 27-10-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 28-10-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 22-10-2013 valid for 00 UTC of 29-10-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 22-10-2013 valid for 0000 UTC of 22-10-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 22-10-2013 valid for 0000 UTC of 23-10-2013
(Potential Cyclogenesis Zone for GPP =>26)



FDP (Cyclone) NOC Report Dated 23 October, 2013

Synoptic features based on 0300 UTC:

- The northeast Monsoon has been vigorous over coastal Andhra Pradesh and active over Rayalaseema and south interior Karnataka**.**

- The well marked low pressure area over south coastal Andhra Pradesh Adjoining west central Bay of Bengal and neighbourhood now lies over coastal Andhra

Pradesh and adjoining areas of Telangana and Rayalaseema. Associated cyclonic circulation extends upto 7.6 kms a.s.l.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST around 29-32^{0}C over Bay of Bengal warmer towards north Tamilnadu and south Andhra Pradesh coast.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over southwest Bay of Bengal, north Bay and Gulf of Martaban. It is 50-110 KJ cm^{-2} over rest Bay except equatorial region where it is 80-120 KJ cm^{-2}.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over south and west central Bay of Bengal. It is negative over the rest part of Bay of Bengal.

Convergence:

- Lower level convergence is of the order of 5-15*10^{-5} s^{-1} over southwest and west central Bay of Bengal.

Divergence:

- Upper air positive divergence is of the order 5-20*10^{-5} s^{-1} over southwest and westcentral Bay of Bengal . It is negative order -5*10^{-5} s^{-1}10 over rest bay.

Wind Shear:

- Wind Shear is 10-20 knots over southwest Bay of Bengal

Wind Shear Tendency:

- Shear Tendency is increasing over southwest and north Bay of Bengal and decreasing over central Bay.

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 19°N.

M.J.O. Index:

- Located in phase 1 with amplitude more than 1.0.
- Dynamical forecast:- MJO may continue in phase 1 with amplitude more than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 230900 UTC

- Broken low/medium clouds with embedded moderate to intense convection over Bay north of Lat 9.5N. Scattered low/medium clouds with embedded isolated weak to moderate convection over rest Bay & Andaman Sea
- Broken low/medium clouds with embedded isolated moderate to intense convection over south east Arabian Sea off Kerala coast.

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 23 October 2013 shows a LOW pressure area over the coastal north Tamil Nadu and adjoining south coastal Andhra Pradesh. Model forecasts show that the system likely to move in west-northwestwards during next 24 hr and northwestwards during subsequent 48 hrs and seen as a low and emerge into the Arabian Sea southwest off Mumbai and oriented in southwest-northeast direction on 26 October 2013 after crossing south peninsula. Model forecast also shows bifurcation of the system into two with one over the land region northeast off Mumbai and other over the Arabian Sea southwest off Mumbai. The analysis and forecasts for 24h to 168 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure I**.
- **IMD-WRF** model analysis of 0000 UTC of 23 October 2013 shows a LOW over coastal north Tamil Nadu and adjoining south coastal Andhra Pradesh. Forecasts

show slight intensification over east central Arabian Sea coast on 26 Oct. 2013 after crossing south peninsula.

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **JMA** : Model show that a Low pressure area lies over south AP and adjoining Rayalaseema and Telangana on 23th and it would practically stationary on 25th. The system would be weaken over NIK adjoining Maharashtra on 26th October 2013.
- **ECMWF:** Model shows that WML lies over south coastal AP and adjoining west central Bay on 24th, it would move northwest ward and weaken as low pressure area lay over Telangana and adjoining area. The system would oscillate during next two days.
- **METEOFRANCE-ARP:** Model show that a Low pressure area lies over south coastal AP and adjoining Rayalaseema and Telangana on 24th and it would practically stationary on 25th. The system would be weaken over SIK adjoining area on 26th October 2013. This model also suggest the formation of another low pressure area over east central Arabian sea on 25th and it would continue till 27th October 2013.
- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 23 October 2013 suggests development of a cyclogenesis zone over coastal TN and adjoining CAP on 23 October 2013. Model forecasts also show that the system likely to move northwestwards and emerge into southeast Arabian Sea on 26 October 2013 and remains active till 27 Oct 2013. GPP charts for analysis and forecasts for 24h to 168 h are shown in **Annexure II**.

  (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- The well marked low pressure area over south coastal Andhra Pradesh Adjoining west central Bay of Bengal moved northwest wards and lay over coastal Andhra Pradesh and adjoining areas of Telangana and Rayalaseema. It is likely to move northwest wards towards NIK and adjoining Maharashtra coast.
- After moving across south peninsula, it is likely to emerge into east-central Arabian Sea off north Karnataka-south Konkan coast by 26th/27th October 2013. The system would not be intensified further.

Advisory:

- **No IOP during next 4 days.**

Annexure-I

Data Statistics over RMC Chennai Region
No of Synop data

Date→																
UTC→	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**12**	**13**	**22**	**17**	**15**	**20**	**16**	**16**	**20**	**14**	**16**	**22**	**20**	**20**	**20**

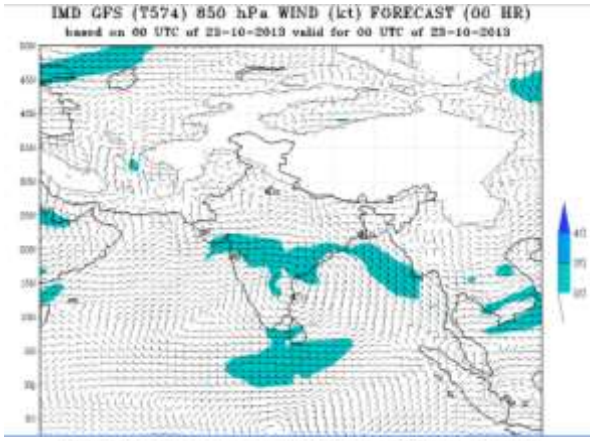
No. of RS/RW Ascents

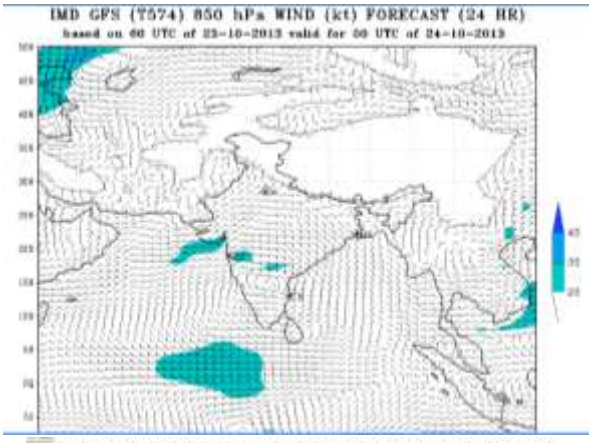
00Z /22.10.2013 : 6
No. of Ascents reaching 250 hPa level =4
MISDA : 2
12Z /22.10.2013 : 3
No. of Ascents reaching 250 hPa level =3
MISDA : 5

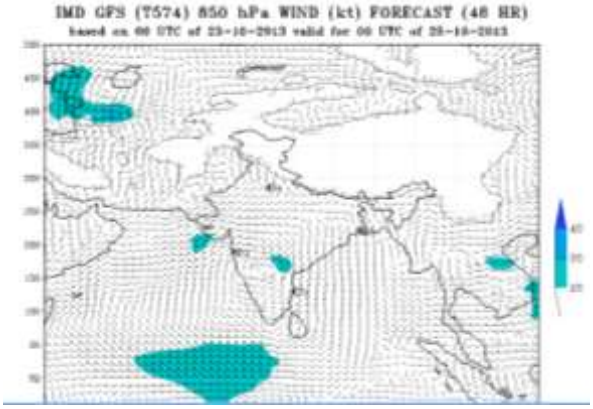
No. of PILOT Ascents:

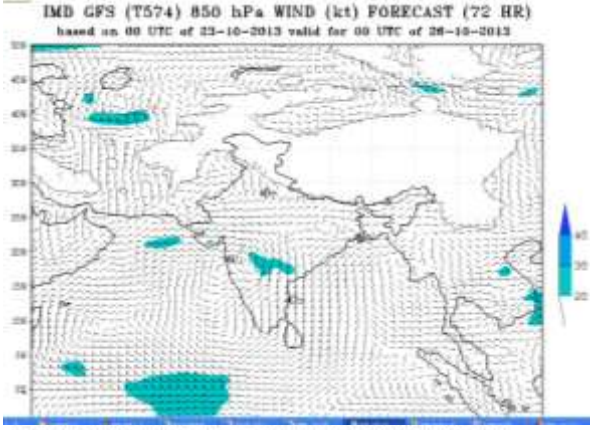
22.10.2013	
06Z	18Z
3	1

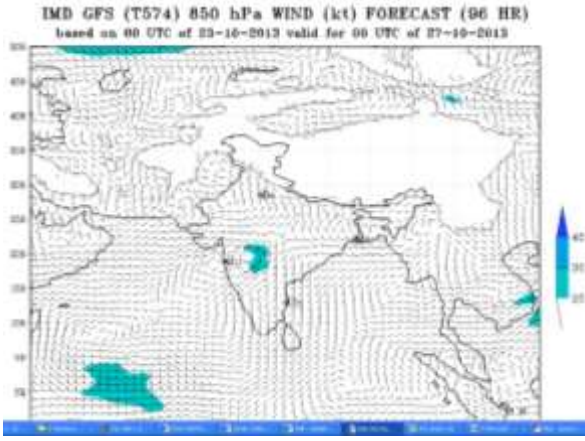
Annexure-II

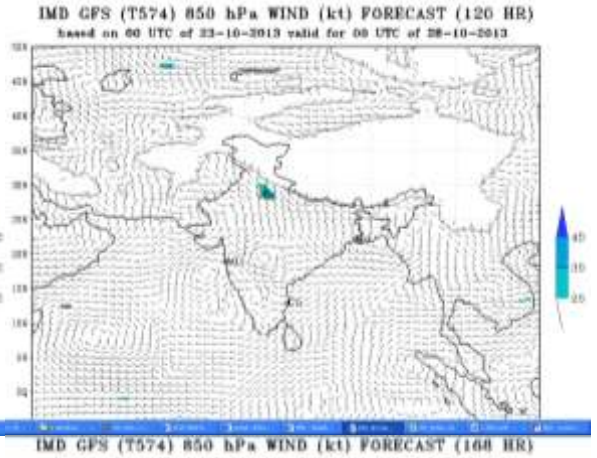

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 23-10-2013

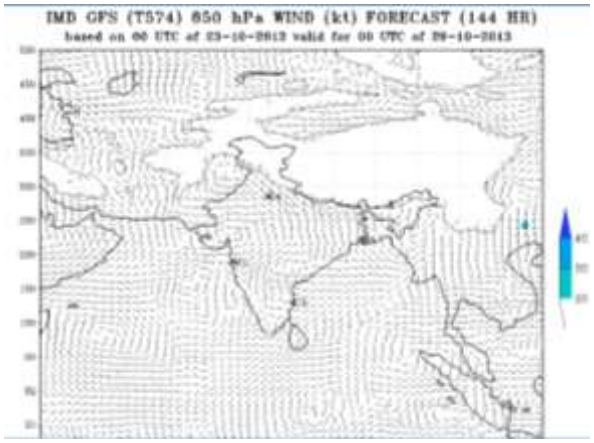

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 24-10-2013

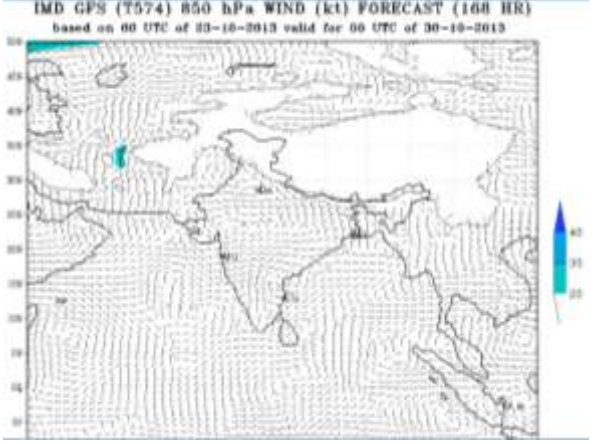

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 25-10-2013

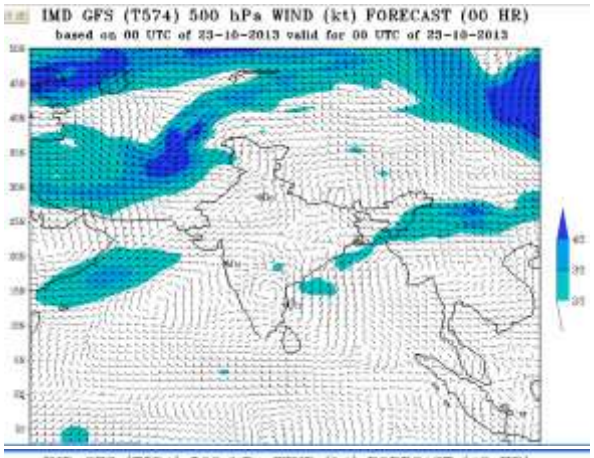

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 26-10-2013

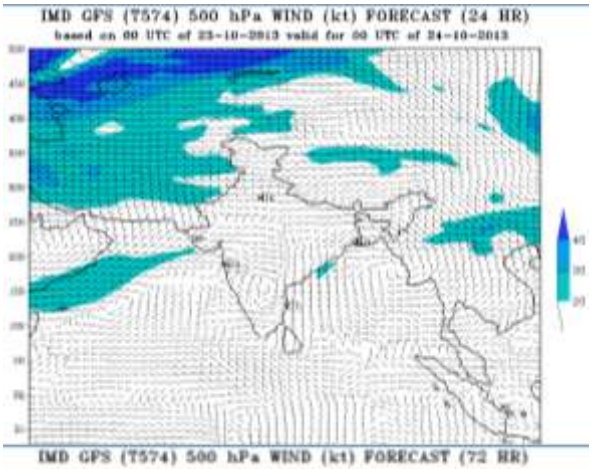

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 27-10-2013

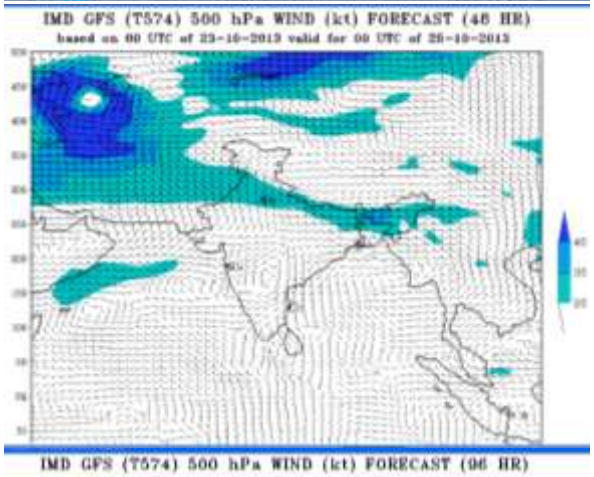

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 28-10-2013

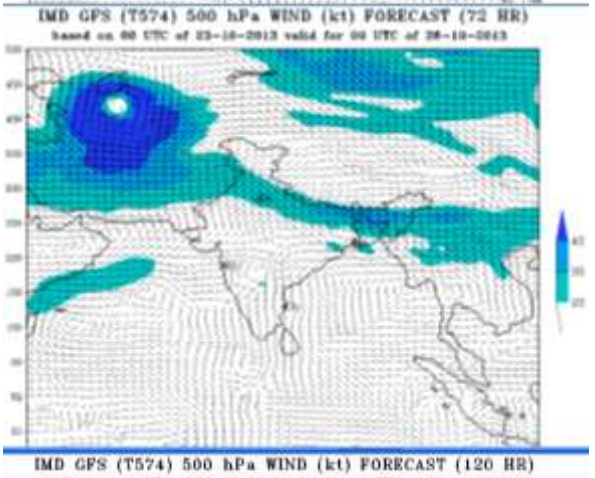

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 29-10-2013

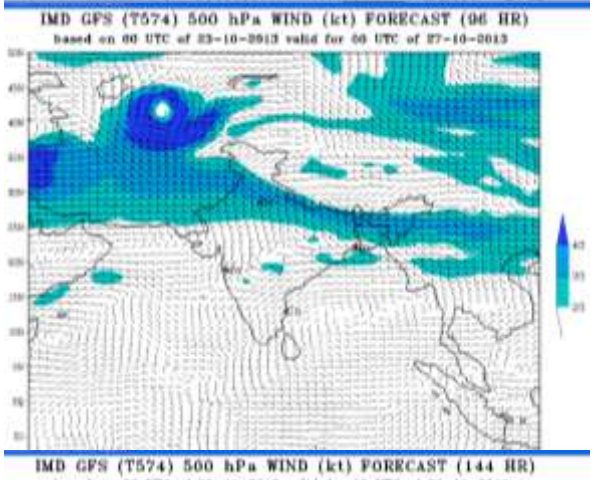

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 30-10-2013

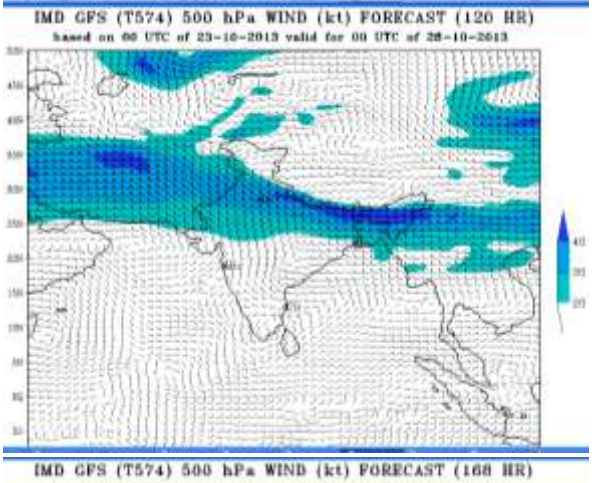

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 23-10-2013

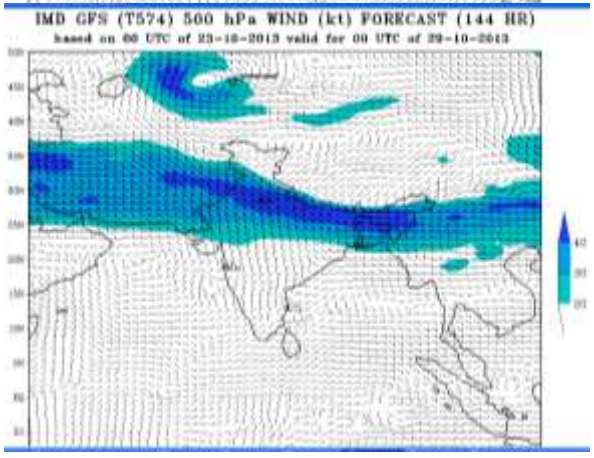

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 24-10-2013

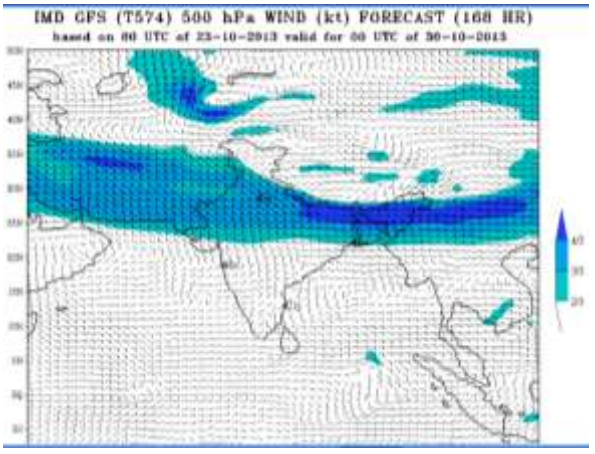

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 25-10-2013

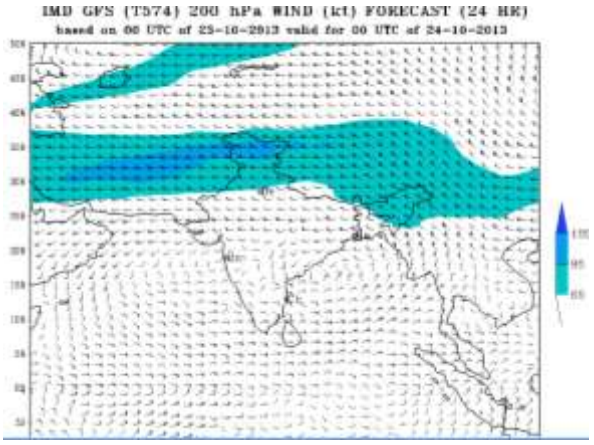

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 26-10-2013

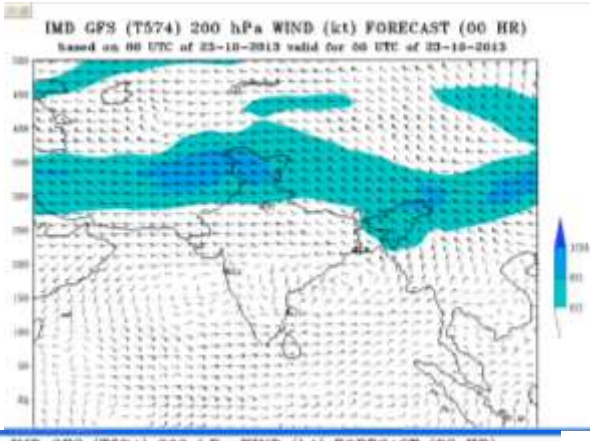

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 27-10-2013

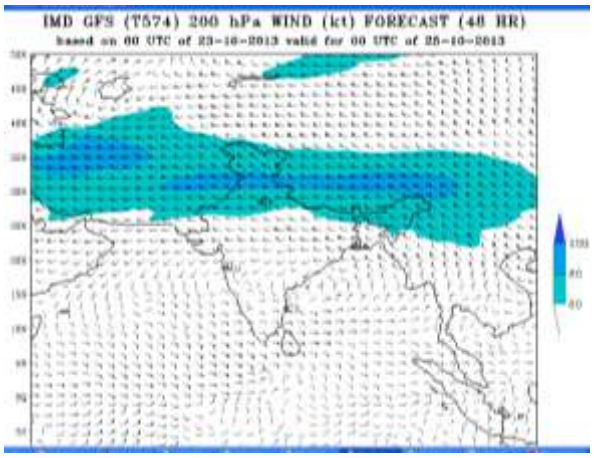

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 28-10-2013

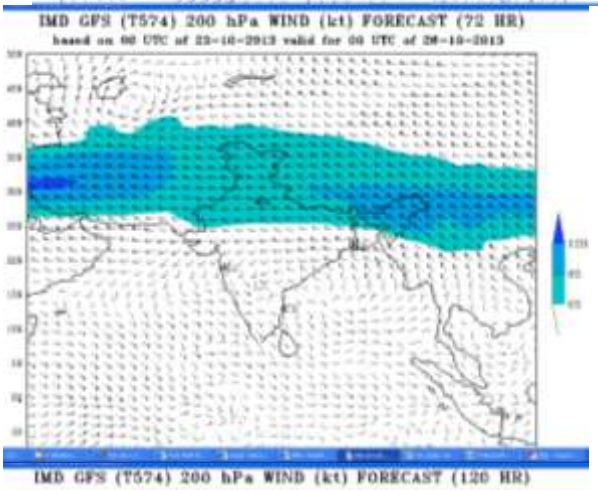

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 29-10-2013

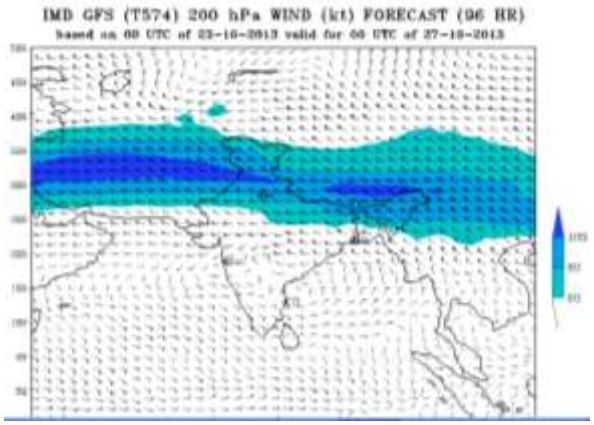

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 30-10-2013

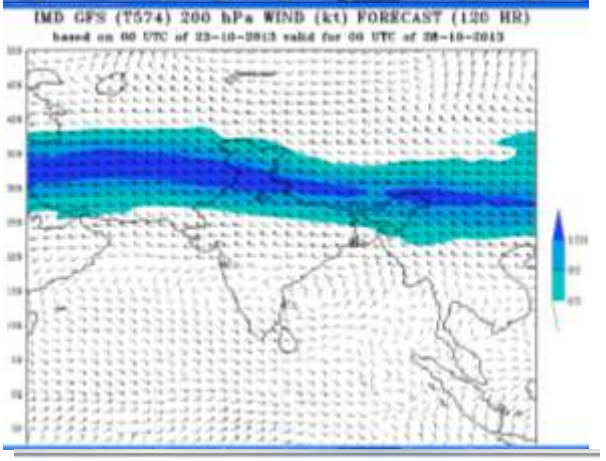

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 24-10-2013

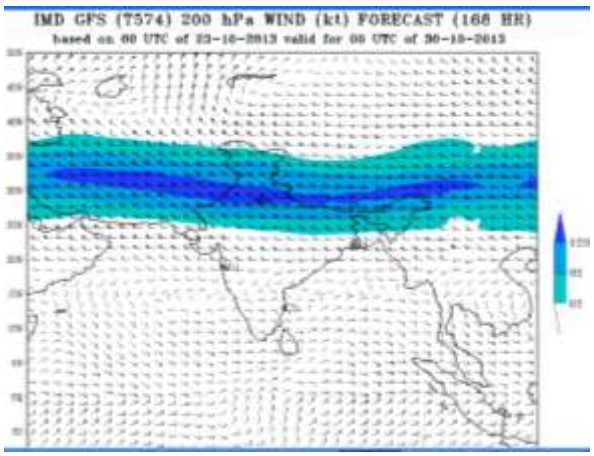

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 23-10-2013

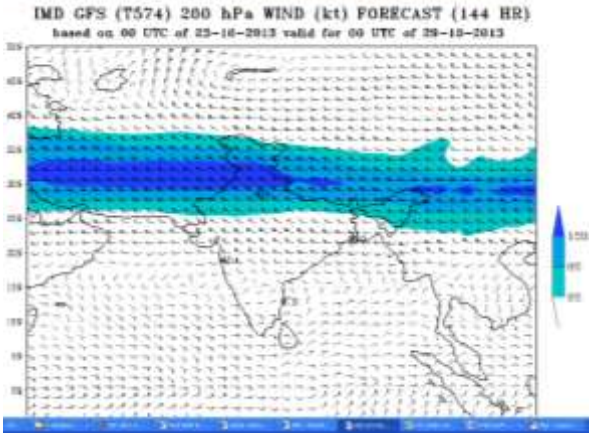

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 25-10-2013

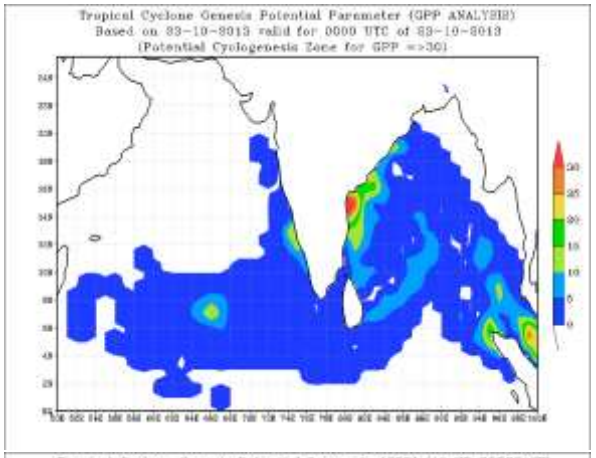

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 26-10-2013

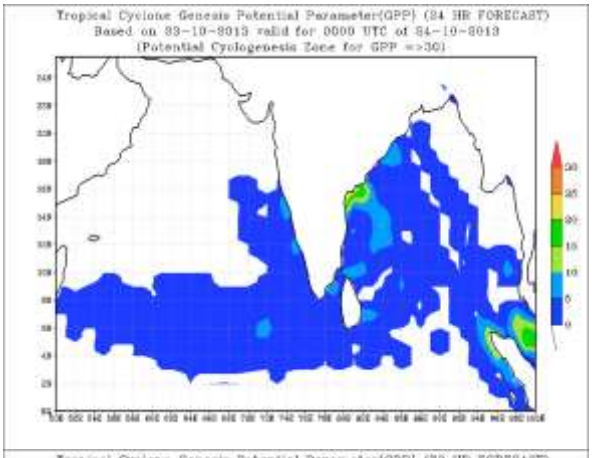

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 27-10-2013

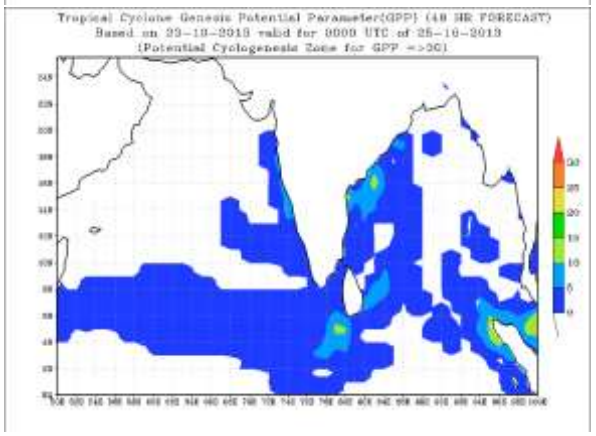

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 28-10-2013

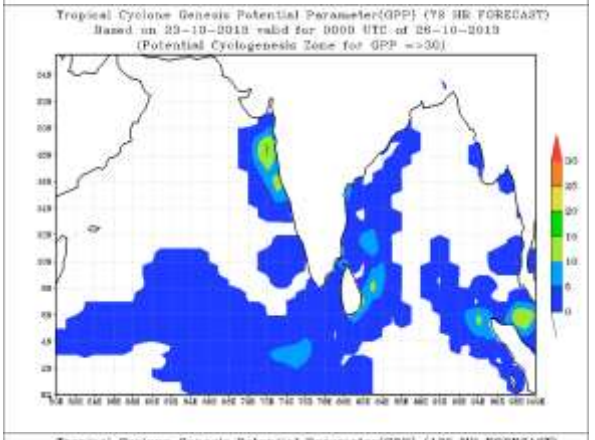

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 30-10-2013

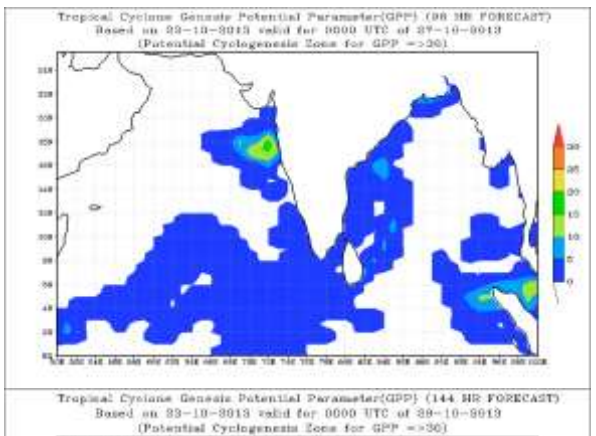

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 23-10-2013 valid for 00 UTC of 29-10-2013

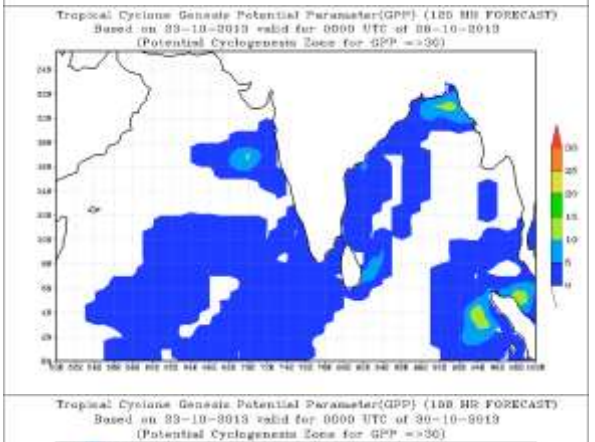

Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 23-10-2013 valid for 0000 UTC of 23-10-2013
(Potential Cyclogenesis Zone for GPP =>30)

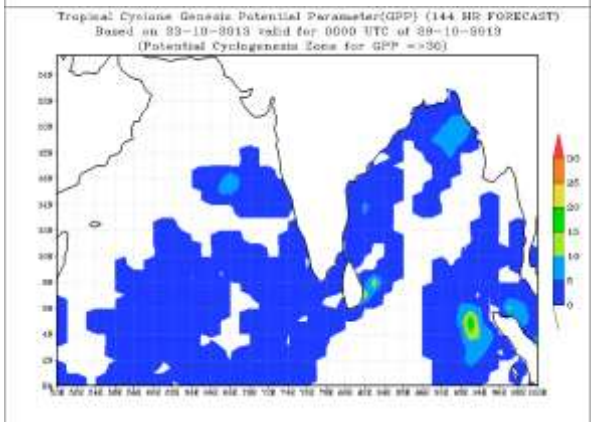

Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 23-10-2013 valid for 0000 UTC of 24-10-2013
(Potential Cyclogenesis Zone for GPP =>30)

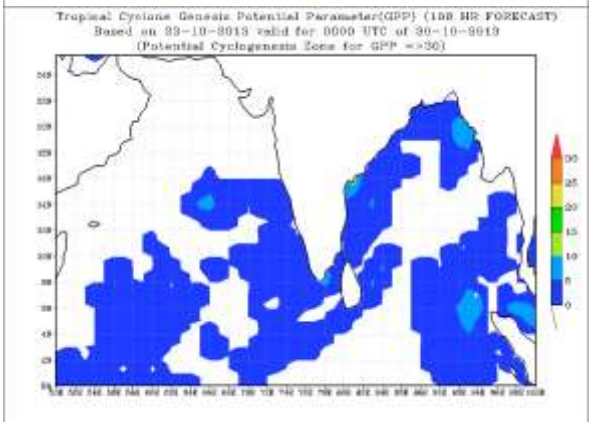

Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 23-10-2013 valid for 0000 UTC of 25-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 23-10-2013 valid for 0000 UTC of 26-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (96 HR FORECAST)
Based on 23-10-2013 valid for 0000 UTC of 27-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (120 HR FORECAST)
Based on 23-10-2013 valid for 0000 UTC of 28-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (144 HR FORECAST)
Based on 23-10-2013 valid for 0000 UTC of 29-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (168 HR FORECAST)
Based on 23-10-2013 valid for 0000 UTC of 30-10-2013
(Potential Cyclogenesis Zone for GPP =>30)

FDP (Cyclone) NOC Report Dated 24 October, 2013

Synoptic features based on 0300 UTC:

- The northeast Monsoon has been vigorous over coastal Andhra Pradesh and active over Rayalaseema and south interior Karnataka**.**

- The well marked low pressure area over south coastal Andhra Pradesh Adjoining west central Bay of Bengal and neighbourhood lies over Telengana and adjoining coastal Andhra Pradesh and Rayalaseema. Associated cyclonic circulation extends upto 7.6 kms a.s.l.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST around 29-32^{0}C over Bay of Bengal warmer towards north Tamilnadu and south Andhra Pradesh coast.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over southwest Bay of Bengal, north Bay and Gulf of Martaban. It is 50-110 KJ cm^{-2} over rest Bay except equatorial region where it is 80-120 KJ cm^{-2}.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over south and west central Bay of Bengal. It is negative over the rest part of Bay of Bengal.

Convergence:

- Lower level convergence is of the order of 5-15*10^{-5} s^{-1} over southwest and west central Bay of Bengal.

Divergence:

- Upper air positive divergence is of the order 5-20*10^{-5} s^{-1} over southwest and westcentral Bay of Bengal . It is negative order -5*10^{-5} s^{-1}10 over rest bay.

Wind Shear:

- Wind Shear is 10-20 knots over southwest Bay of Bengal

Wind Shear Tendency:

- Shear Tendency is increasing over southwest and north Bay of Bengal and decreasing over central Bay.

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 19°N.

M.J.O. Index:

- Located in phase 1 with amplitude more than 1.0.
- Dynamical forecast:- MJO may continue in phase 1 with amplitude more than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 240900 UTC

- Broken low/medium clouds with embedded moderate to intense convection over Bay north of Lat 9.5N. Scattered low/medium clouds with embedded isolated weak to moderate convection over rest Bay & Andaman Sea
- Broken low/medium clouds with embedded isolated moderate to intense convection over south east Arabian Sea off Kerala coast.

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 24 October 2013 shows a LOW pressure area over Coastal Andhra Pradesh and adjoining Telangana and Rayalaseema. Model forecasts show that the system likely to move in west-northwestwards with slight intensification during next 48hr and seen over central part of Maharashtra on 26th. Further the system re-curved and moved in northeastwards direction in subsequent 1 day

and in eastwards direction during subsequent 3 days and seen as a cycer over the Coastal Andhra Pradesh region and adjoining Bay of Bengal on 30th. The analysis and forecasts for 24h to 168 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.

- **IMD-WRF** model analysis of 0000 UTC of 24 October 2013 shows a LOW over Coastal Andhra Pradesh and adjoining Telangana and Rayalaseema. Forecasts show slight intensification and northwestwards movement and seen over Mumbai region and adjoining Arabian Sea.
  (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
- **JMA** : Model show that a Low pressure area lies over south AP and adjoining Rayalaseema and Telangana on 24th and it would practically stationary on 25th. The system would be weaken over NIK adjoining Maharashtra on 26th October 2013.
- **ECMWF:** Model shows that WML lies over south coastal AP and adjoining west central Bay on 24th, it would move northwest ward and weaken as low pressure area lay over Telangana and adjoining area. The system would oscillate during next two days.
- **METEOFRANCE-ARP:** Model show that a Low pressure area lies over south coastal AP and adjoining Rayalaseema and Telangana on 24th and it would practically stationary on 25th. The system would be weaken over SIK adjoining area on 26th October 2013. This model also suggests the formation of another low pressure area over east central Arabian sea on 25th and it would continue till 27th October 2013.
- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 24 October 2013 suggests development of a cyclogenesis zone of very small area over CAP on 24 October 2013. GPP charts for analysis and forecasts for 24h to 168 h are shown in **Annexure II**.

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- The well marked low pressure area over Telengana and adjoining areas of coastal Andhra Pradesh and Rayalaseema is likely to move northwest wards towards NIK and adjoining Maharashtra coast.
- After moving across south peninsula, it is likely to emerge into east-central Arabian Sea off north Karnataka-south Konkan coast by 26th/27th October 2013. The system would not intensified further.

Advisory:

- **No IOP during next 4 days.**

Annexure-I

Data Statistics over RMC Chennai Region

No of Synop data

Date→																
UTC→	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**12**	**13**	**22**	**17**	**15**	**20**	**16**	**16**	**20**	**14**	**16**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

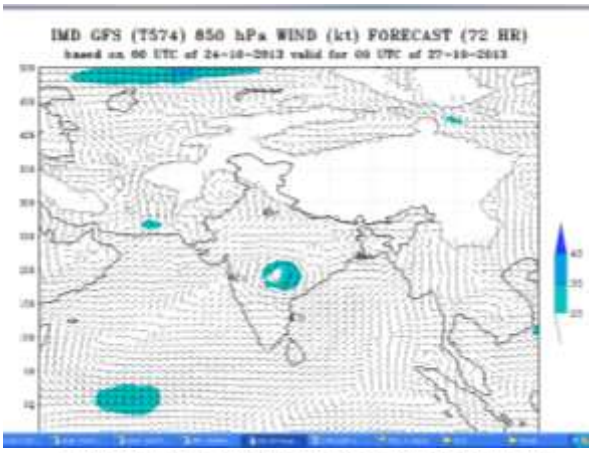
00Z /23.10.2013 : 6
No. of Ascents reaching 250 hPa level =4
MISDA : 2

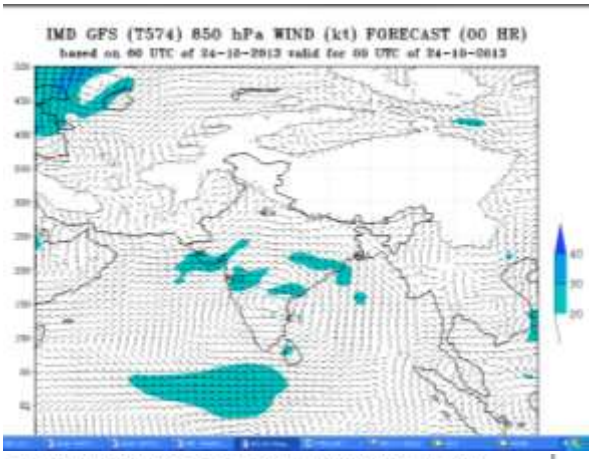
12Z /23.10.2013 : 3
No. of Ascents reaching 250 hPa level =3
MISDA : 5

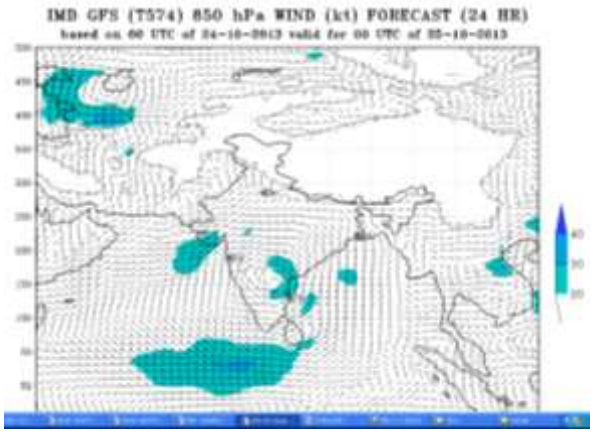
No. of PILOT Ascents:

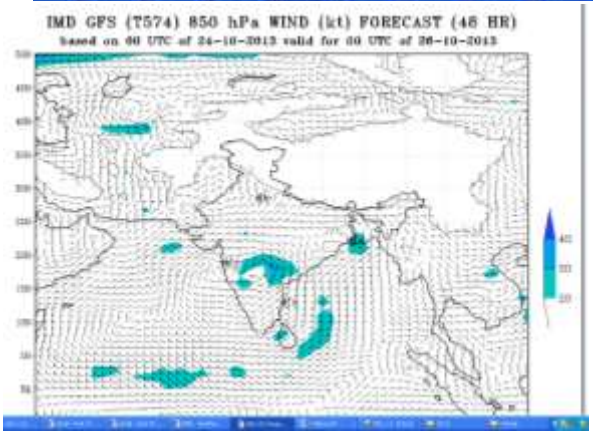
23.10.2013	
06Z	18Z
3	1

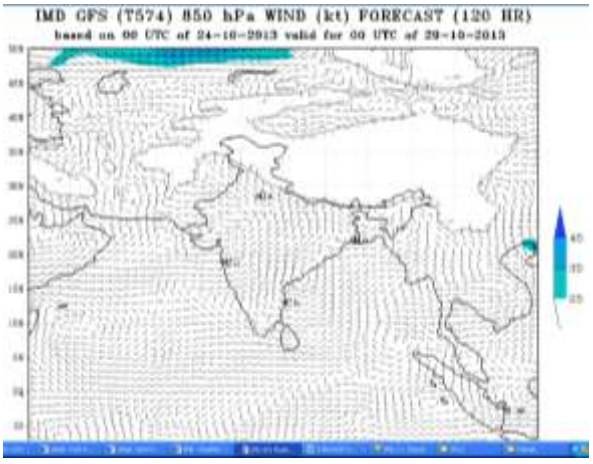
Annexure-II

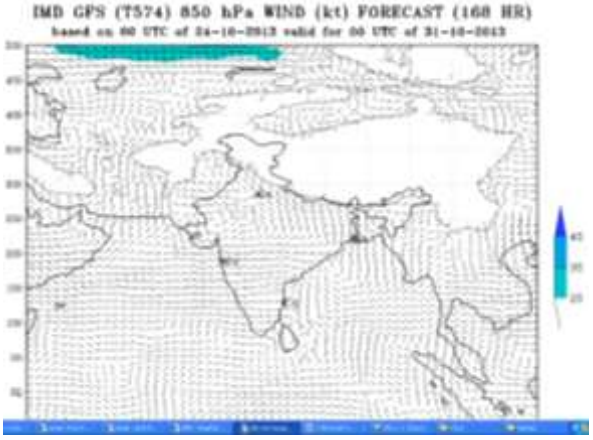

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)

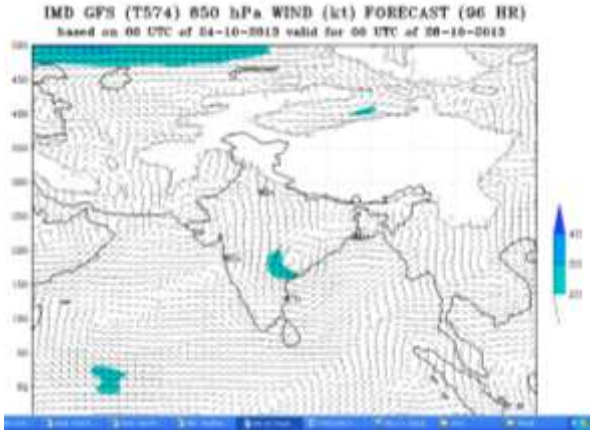

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)

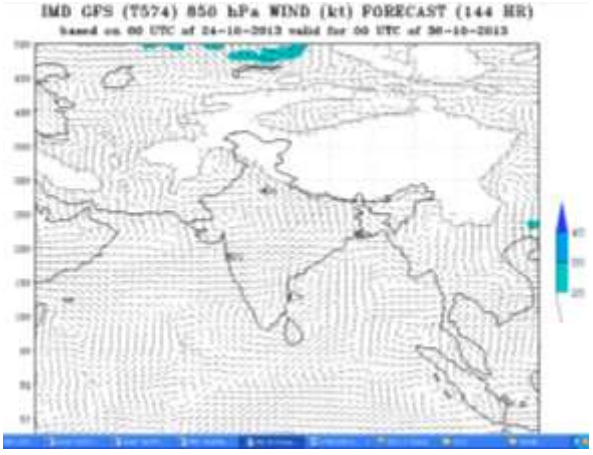

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)

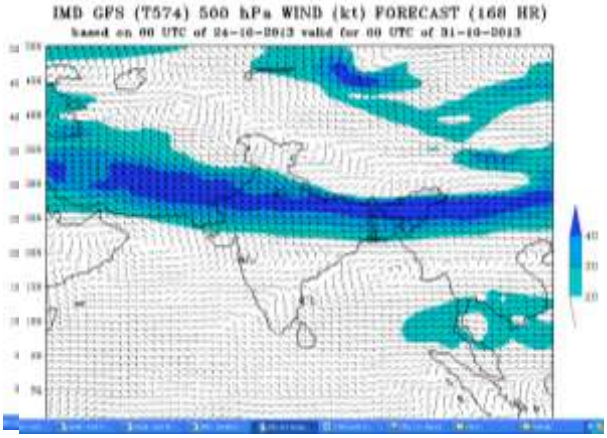

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)

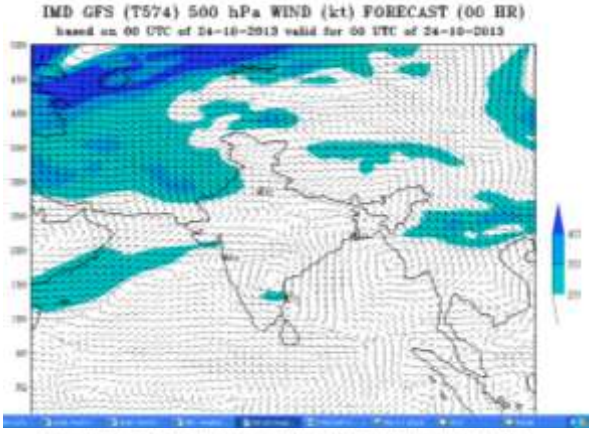

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (120 HR)

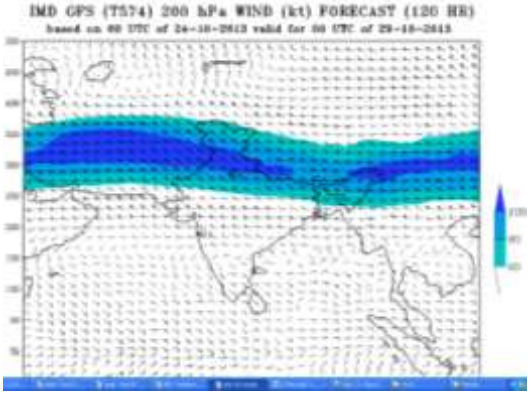

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (168 HR)

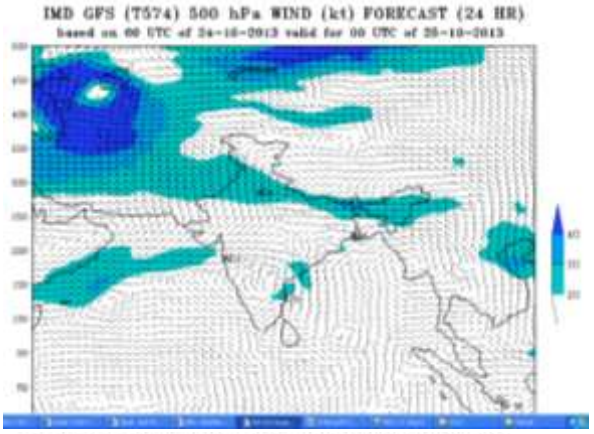

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (96 HR)

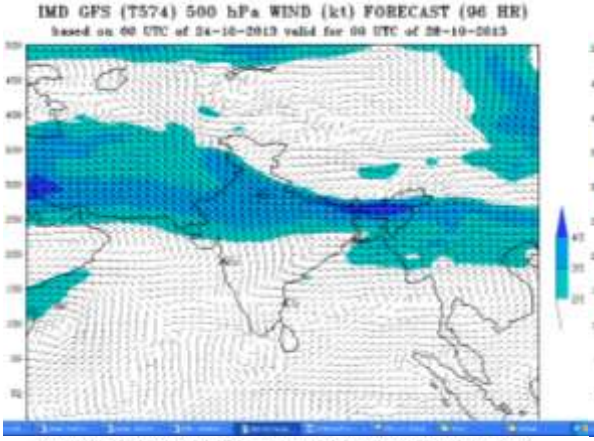

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (144 HR)

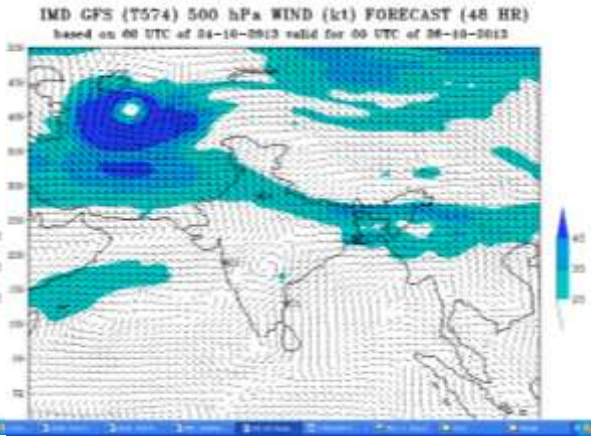

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 24-10-2013 valid for 00 UTC of 31-10-2013

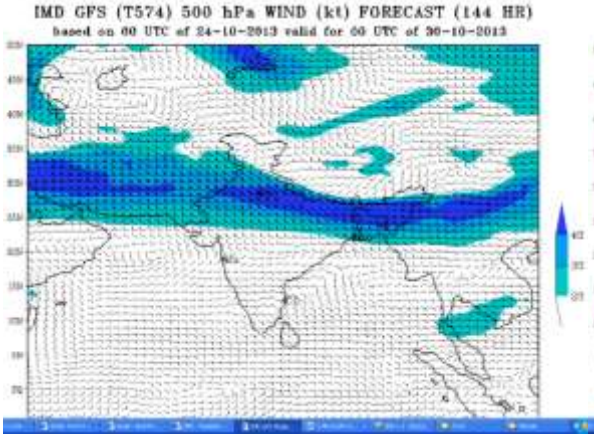

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 24-10-2013 valid for 00 UTC of 24-10-2013

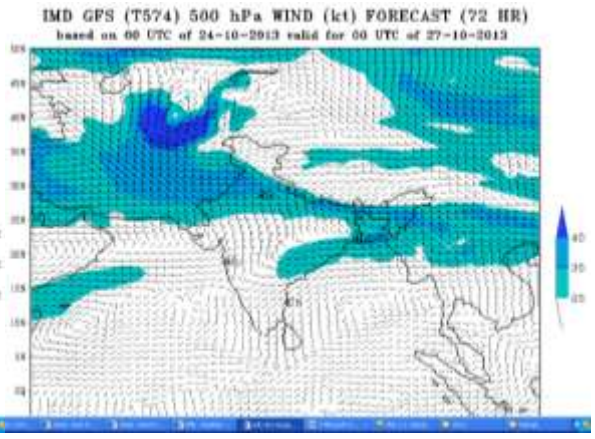

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 24-10-2013 valid for 00 UTC of 29-10-2013

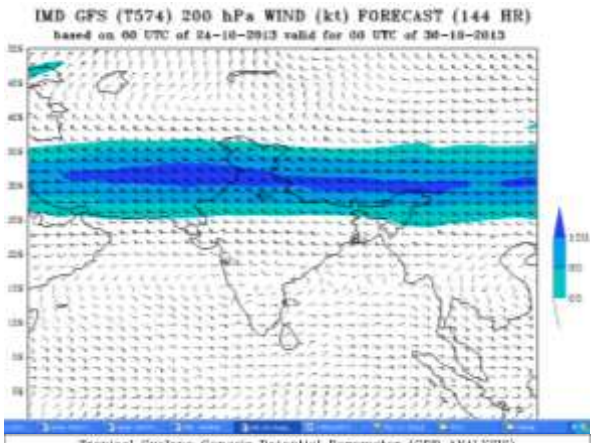

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 24-10-2013 valid for 00 UTC of 25-10-2013

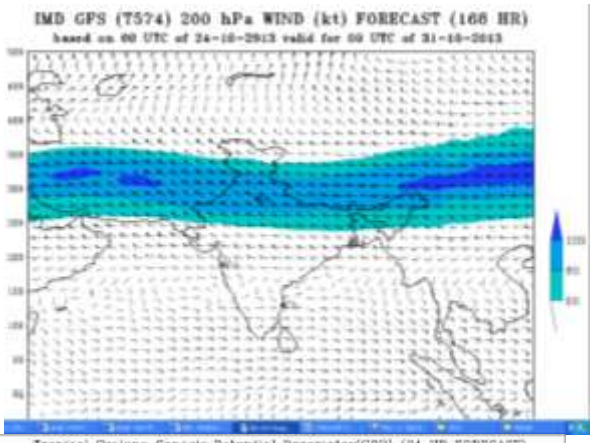

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 24-10-2013 valid for 00 UTC of 28-10-2013

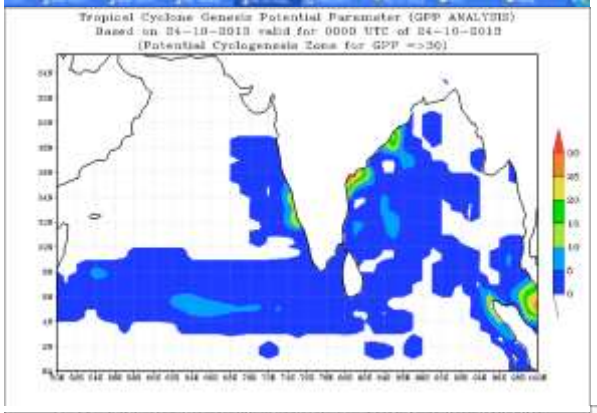

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 24-10-2013 valid for 00 UTC of 26-10-2013

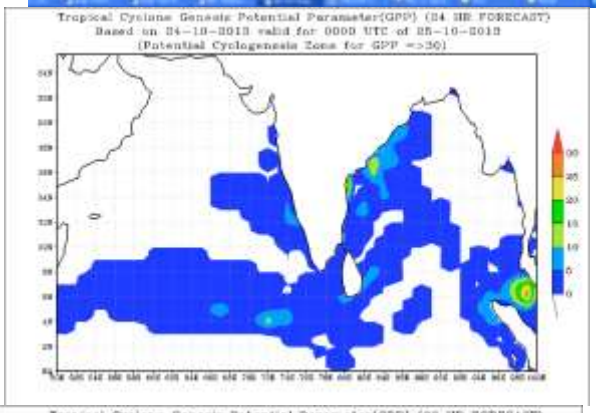

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 24-10-2013 valid for 00 UTC of 30-10-2013

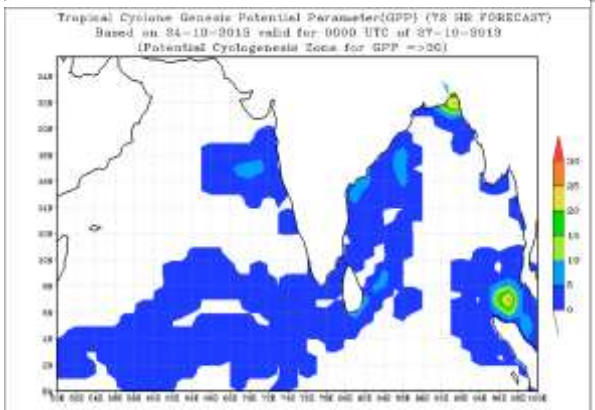

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 24-10-2013 valid for 00 UTC of 27-10-2013

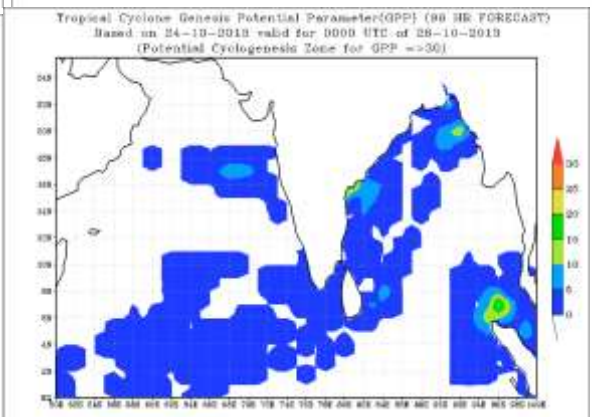

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 24-10-2013 valid for 00 UTC of 30-10-2013

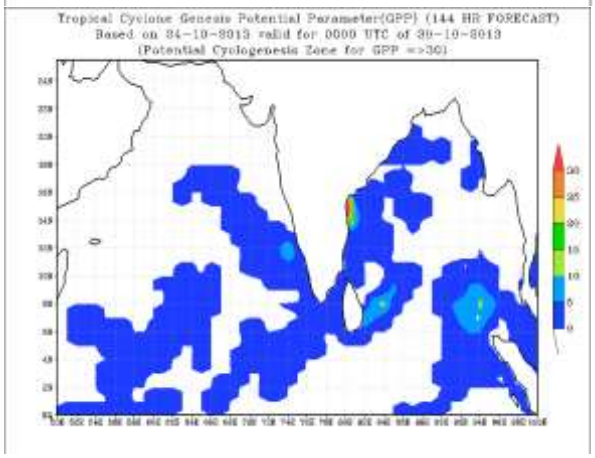

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 24-10-2013 valid for 00 UTC of 31-10-2013

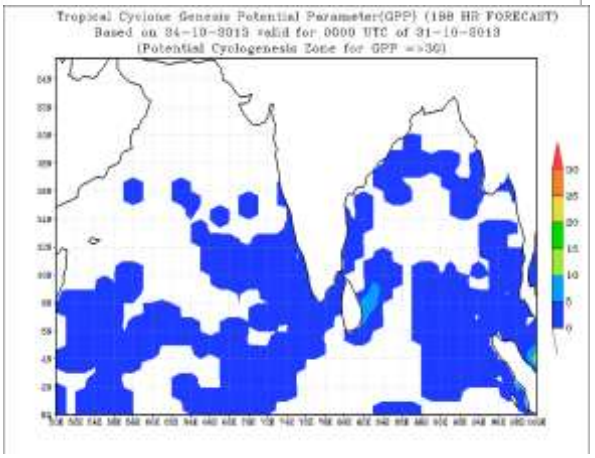

Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 24-10-2013 valid for 0000 UTC of 24-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 24-10-2013 valid for 0000 UTC of 25-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 24-10-2013 valid for 0000 UTC of 27-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (96 HR FORECAST)
Based on 24-10-2013 valid for 0000 UTC of 28-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (144 HR FORECAST)
Based on 24-10-2013 valid for 0000 UTC of 30-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (168 HR FORECAST)
Based on 24-10-2013 valid for 0000 UTC of 31-10-2013
(Potential Cyclogenesis Zone for GPP =>30)

FDP (Cyclone) NOC Report Dated 25 October, 2013

Synoptic features based on 0300 UTC:

- The northeast Monsoon has been vigorous over coastal Andhra Pradesh and active over Rayalaseema and Kerala.
- The well marked low pressure area over Telengana and adjoining areas of coastal Andhra Pradesh and Rayalaseema persists. Associated cyclonic circulation extends upto 5.8 kms a.s.l.
- A trough in easterlies extending upto 3.1 kms a.s.l. runs from the well marked Low pressure area to Assam & Meghalaya across Odisha and Gangetic West Bengal.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST around 27-31^{0}C over Bay of Bengal warmer towards north Tamilnadu and south Andhra Pradesh coast.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over North, southwest Bay of Bengal and Gulf of Martaban. It is 50-100 KJ cm^{-2} over rest Bay of Bengal except equatorial region where it is 80-120 KJ cm^{-2}.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over southwest and west central Bay of Bengal. It is negative over the rest part of Bay of Bengal.

Convergence:

- Lower level convergence is of the order of 5-15*10^{-5} s^{-1} over southwest, west central and North Bay of Bengal.

Divergence:

- Upper air positive divergence is of the order 5-20*10^{-5} s^{-1} over north and westcentral Bay of Bengal . It is negative order -5*10^{-5} s^{-1} over Southeast and Andaman sea.

Wind Shear:

- Wind Shear is 20-30 knots over south and central Bay of Bengal

Wind Shear Tendency:

- Shear Tendency is increasing over westcentral Bay of Bengal and decreasing over southwest Bay.

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 18°N.

M.J.O. Index:

- Located in phase 1 with amplitude more than 1.0.
- Dynamical forecast:- MJO may continue in phase 1 with amplitude more than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 250900 UTC

- Broken low/medium clouds with embedded moderate to intense convection over Northwest Bay and Westcentral Bay. Scattered low/medium clouds with embedded isolated weak to moderate convection over rest Bay & Andaman Sea
- Broken low/medium clouds with embedded isolated moderate to intense convection over south east Arabian Sea off Karnataka - Kerala coast.

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 25 October 2013 shows a LOW pressure area over Coastal Andhra Pradesh and adjoining Telengana and Rayalaseema. Model forecasts show that the system likely to move in north-northwestwards during next 24hrs and further move northeastwards in subsequent 24hrs and seen over Chhattisgarh and adjoining western Orissa on 27th. Further the system is seen as northeast-southwest

oriented trough over coastal Andhra Pradesh and Orissa on 28th. From 29 to 30 the trough is seen as a cyclonic circulation over Bay of Bengal off coastal Andhra Pradesh coast, which drifted little southward and seen over north coastal part of Tamil Nadu on 31st. The analysis and forecasts for 24h to 168 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.

- **IMD-WRF** model analysis of 0000 UTC of 25 October 2013 shows a LOW over Coastal Andhra Pradesh and adjoining Telengana and Rayalaseema. Forecasts show northwestwards movement during next 48 hrs and is seen over Maharashtra towards southeast part of Mumbai on 27th. The system is extended eastward over the land region on 28th.
  (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
- **JMA** : Model show that a Low pressure area lies over CAP and adjoining Rayalaseema and Telengana on 25th and it would move northwest ward and lay over Telengana, Rayalaseema and adjoining NIK on 26th. The system would be over Telengana on 27th and weaken gradually on 28th October 2013.
- **ECMWF:** Model shows that WML lies over south coastal AP and adjoining west central Bay on 25th, it would move northwest ward and weaken as low pressure area lay over Telengana and adjoining area. The system would move northeast wards and lay over Telengana and adjoining Chhattisgarh on 27th and weaken gradually on 28th October 2013.
- **METEOFRANCE-ARP:** Model show that a well marked Low pressure area lies over coastal AP and adjoining Rayalaseema and Telengana on 25th and it would weaken as low pressure area and lay over Telengana, CAP and adjoining South Chhattisgarh on 26th. The system would lay over Vidarbha, Chhattisgarh and adjoining Telengana on 27th and weaken gradually on 28th October 2013.
- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 25 October 2013 suggests development of a cyclogenesis zone of very small area over CAP on 25 October 2013. The GPP value shows cyclogenesis zone over Bay of Bengal close to Orissa and CAP coast on day 3 (28th October) . The GPP charts for analysis and forecasts for 24h to 168 h are shown in **Annexure II**.
  (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- The well marked low pressure area over Telengana and adjoining areas of coastal Andhra Pradesh and Rayalaseema is likely to move initially north-northwestwards and then it would move northeastwards across south Chhattisgarh and coastal Odisha. The system would weaken gradually after 48 hrs.

Advisory:

- **No IOP during next 4 days.**

Annexure-1

No of Synop data

Date→	**24.10.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

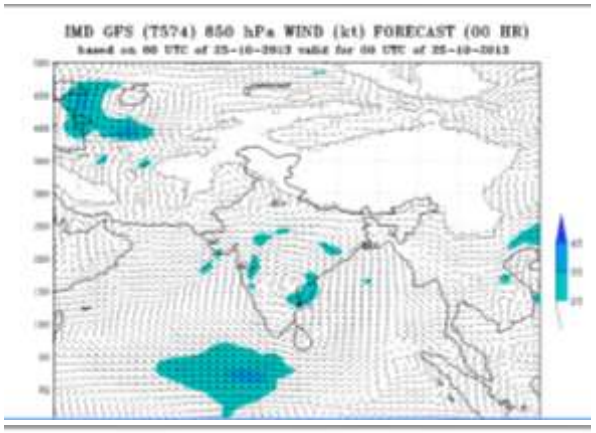
00Z /24.10.2013 : 5
No. of Ascents reaching 250 hPa level =4
MISDA : 3

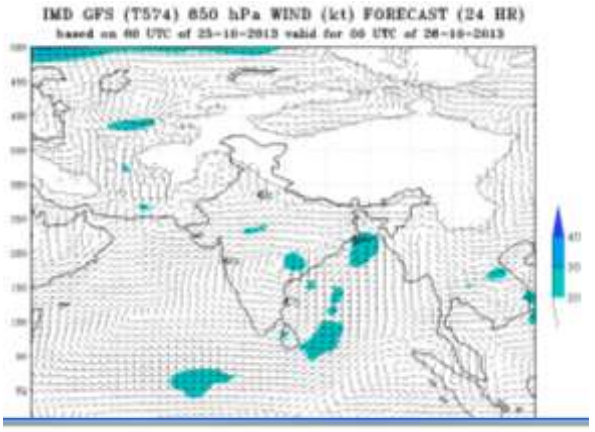
12Z /24.10.2013 : 4
No. of Ascents reaching 250 hPa level =4
MISDA : 4

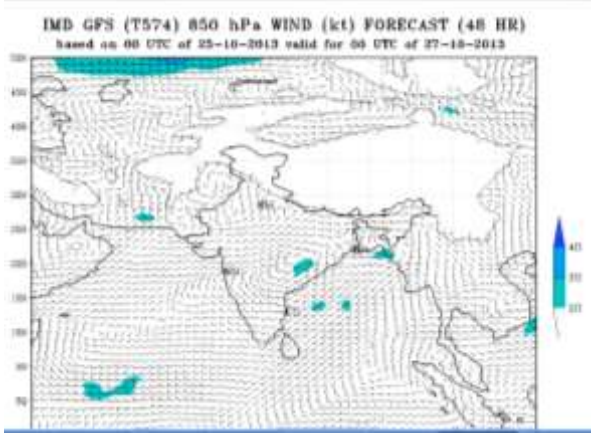
No. of PILOT Ascents:

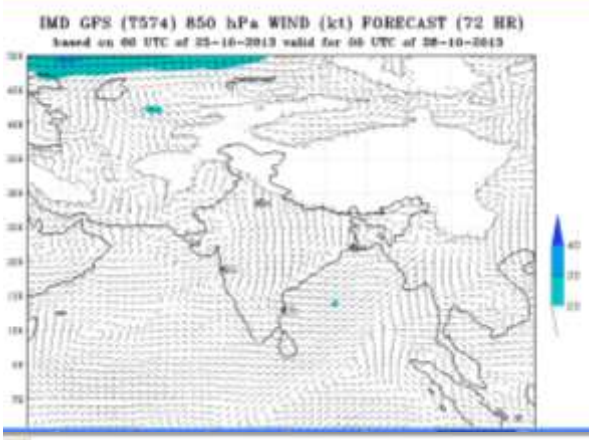
24.10.2013	
06Z	18Z
1	0

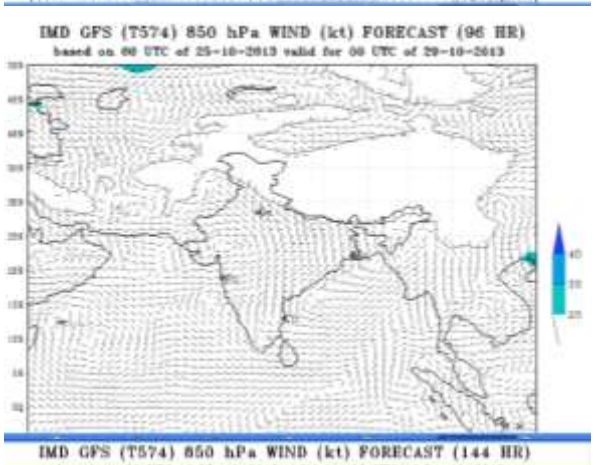
Annexure-II

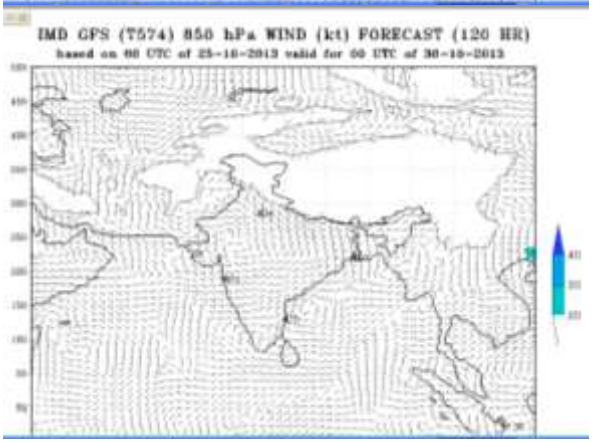

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)

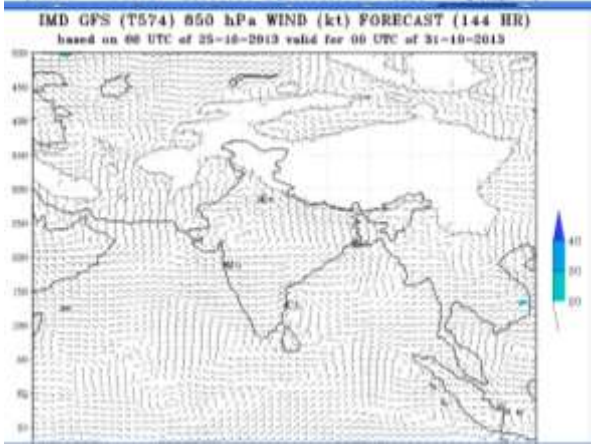

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)

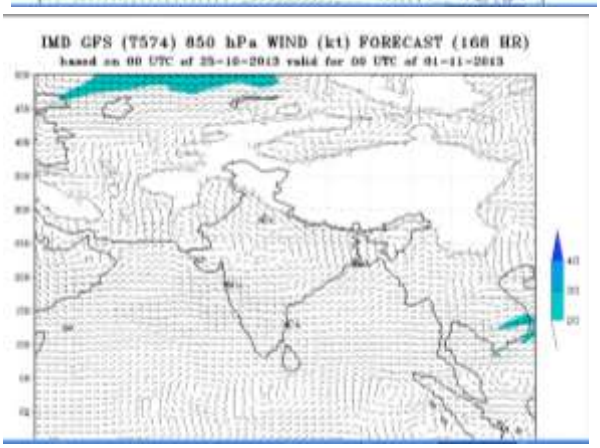

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)

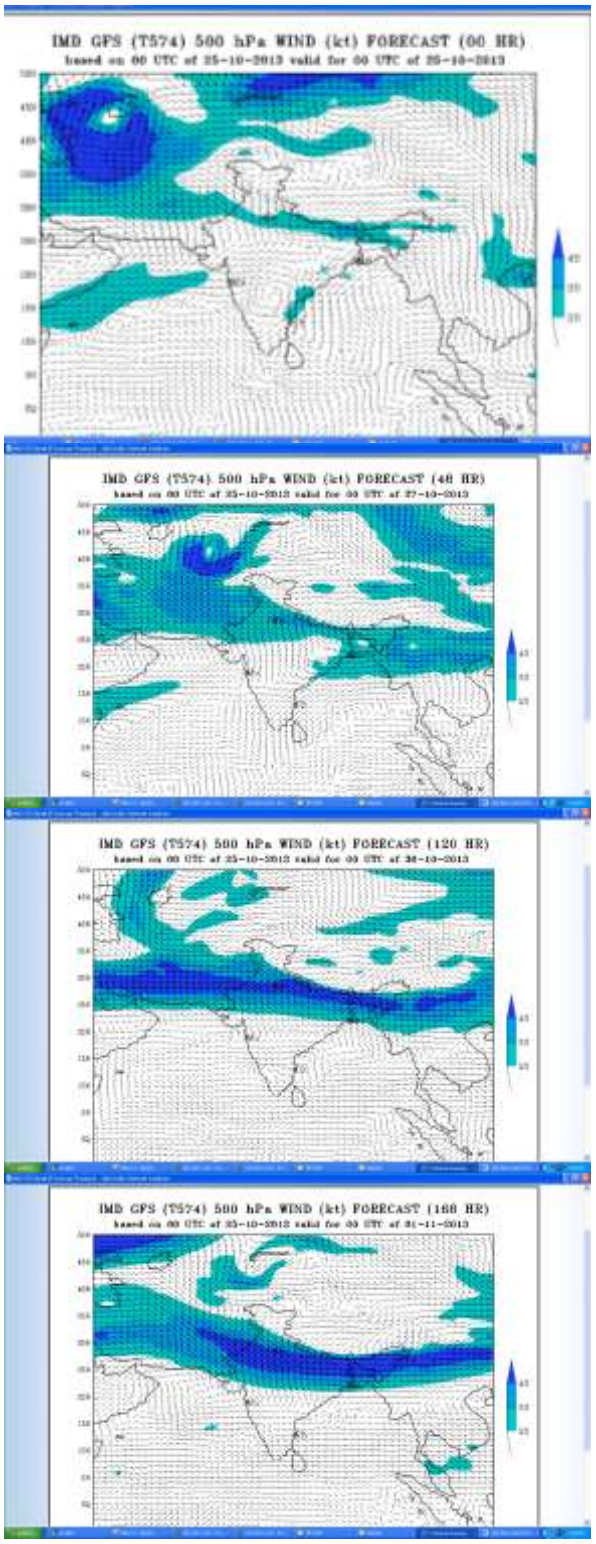

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)

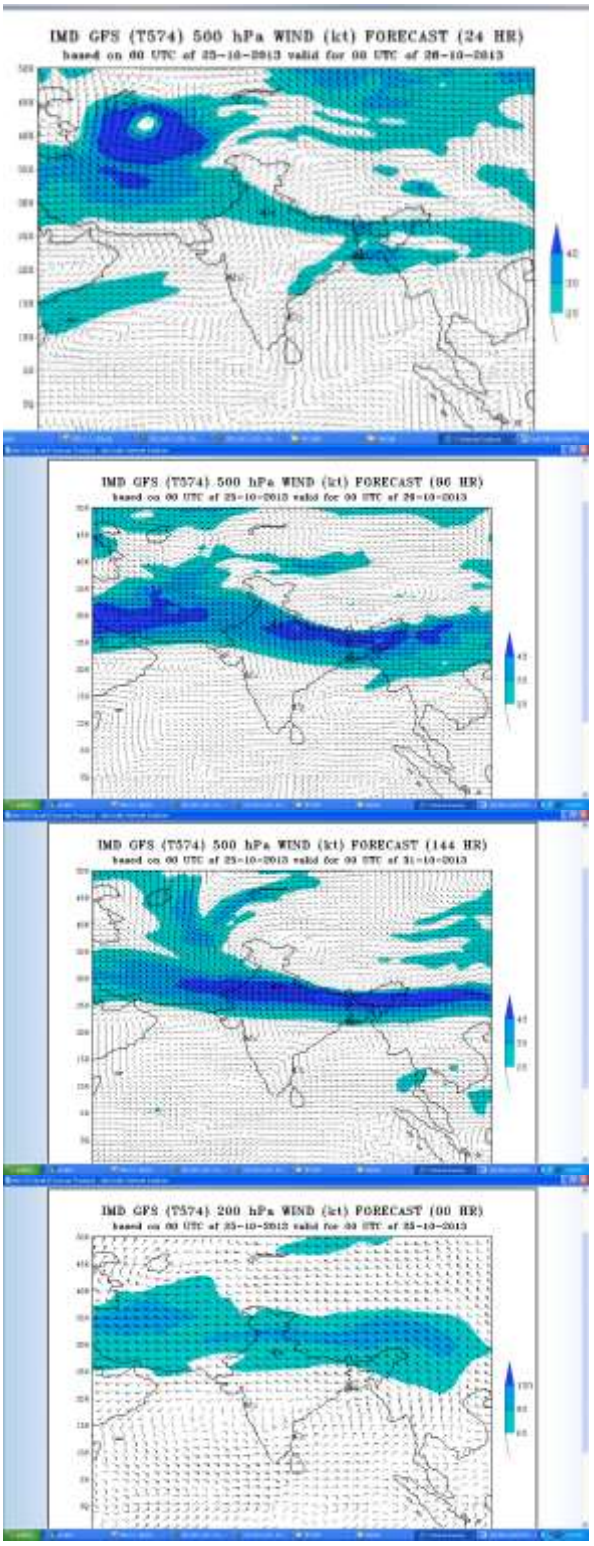

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (96 HR)


IMD GFS (T574) 850 hPa WIND (kt) FORECAST (120 HR)


IMD GFS (T574) 850 hPa WIND (kt) FORECAST (144 HR)


IMD GFS (T574) 850 hPa WIND (kt) FORECAST (168 HR)


IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 25-10-2013 valid for 00 UTC of 25-10-2013


IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 25-10-2013 valid for 00 UTC of 26-10-2013

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 25-10-2013 valid for 00 UTC of 27-10-2013

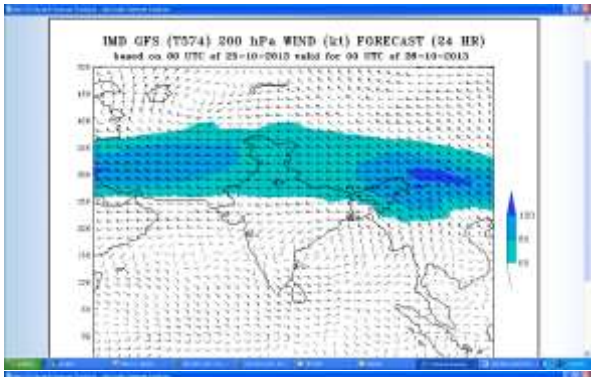
IMD GFS (T574) 500 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 25-10-2013 valid for 00 UTC of 29-10-2013

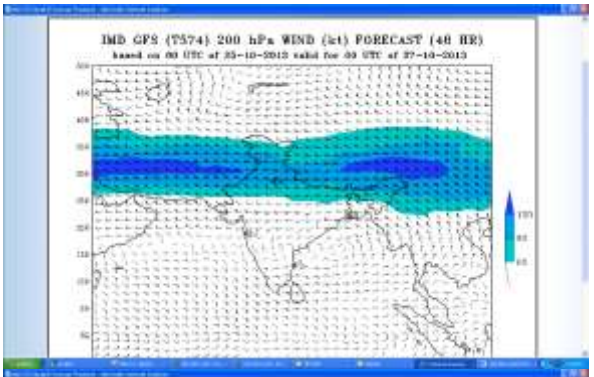
IMD GFS (T574) 500 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 25-10-2013 valid for 00 UTC of 30-10-2013

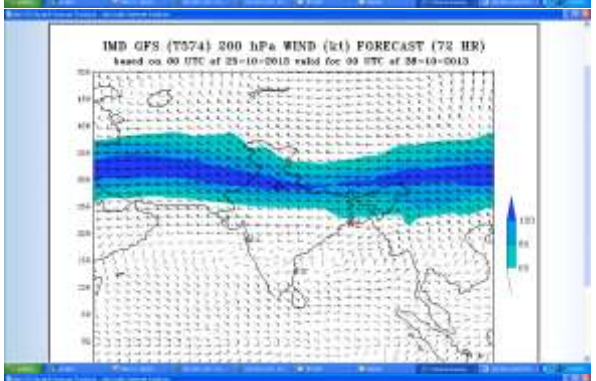
IMD GFS (T574) 500 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 25-10-2013 valid for 00 UTC of 31-10-2013

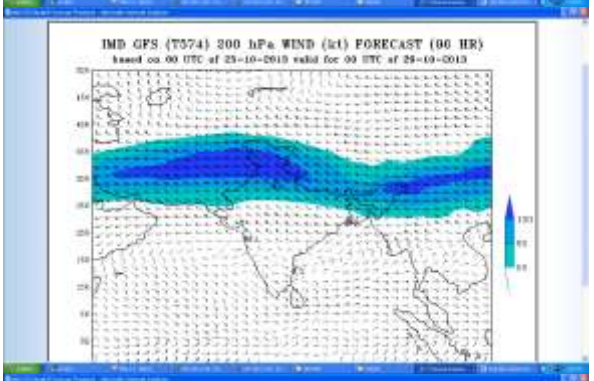
IMD GFS (T574) 500 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 25-10-2013 valid for 00 UTC of 01-11-2013

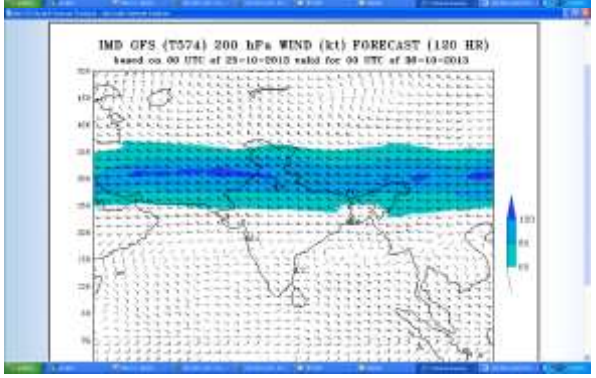
IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 25-10-2013 valid for 00 UTC of 25-10-2013

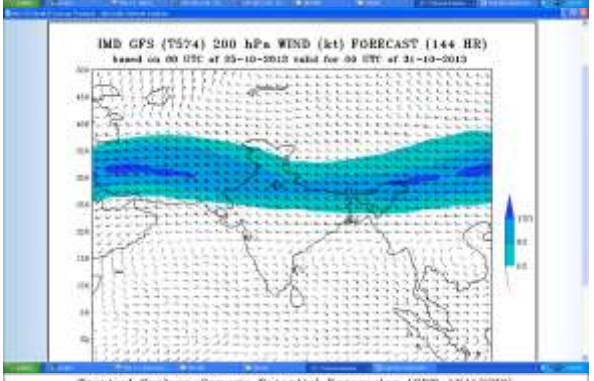

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)

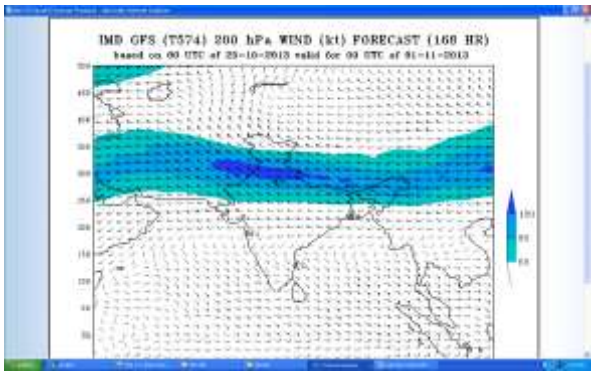

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)

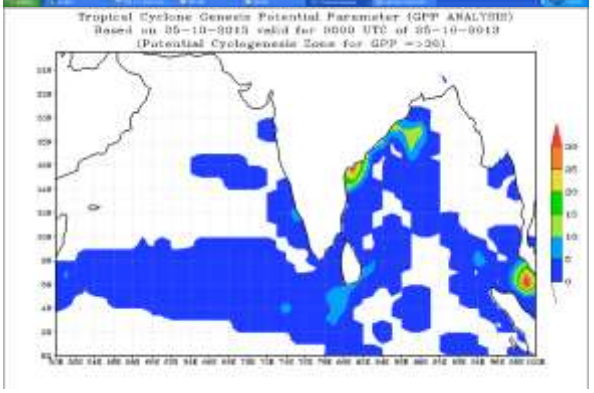

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)

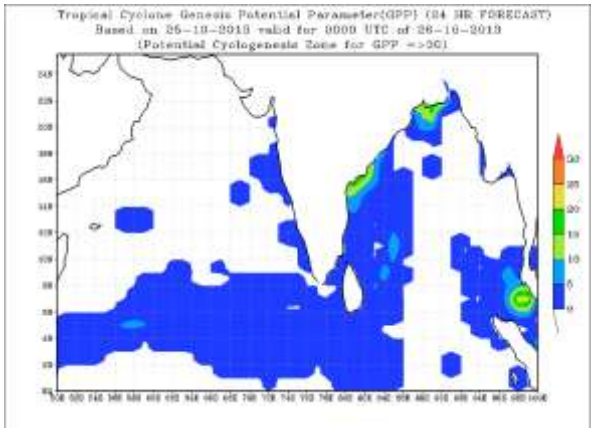

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (96 HR)

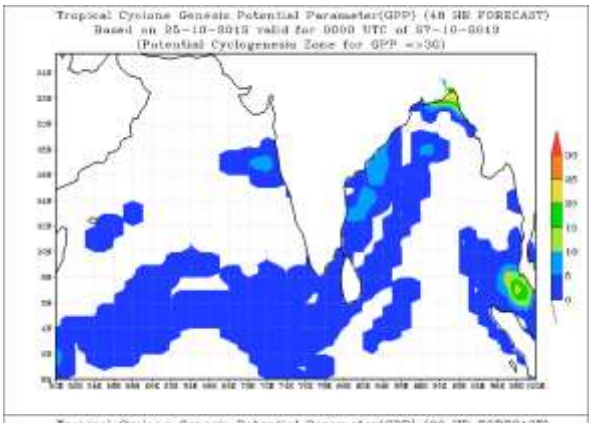

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (120 HR)

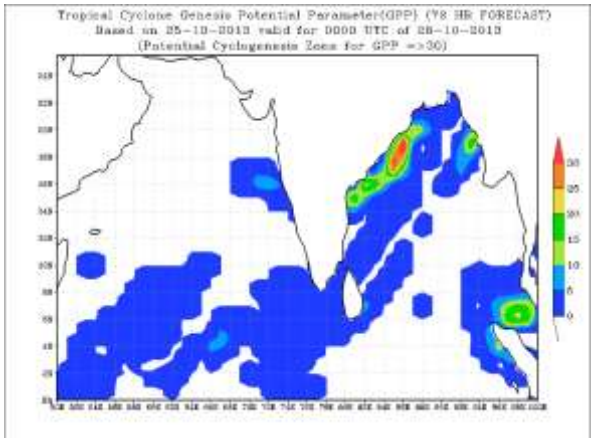

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (144 HR)

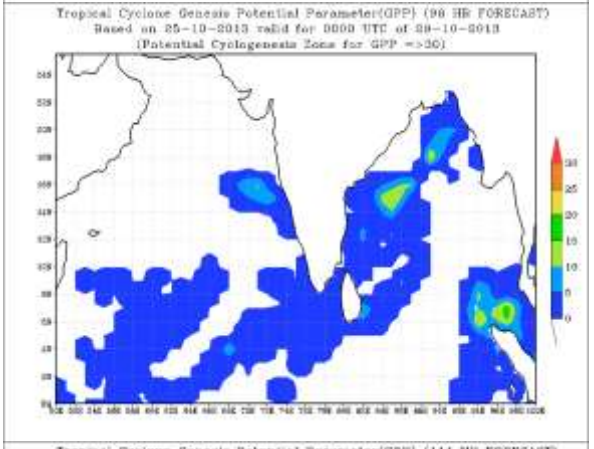

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (168 HR)

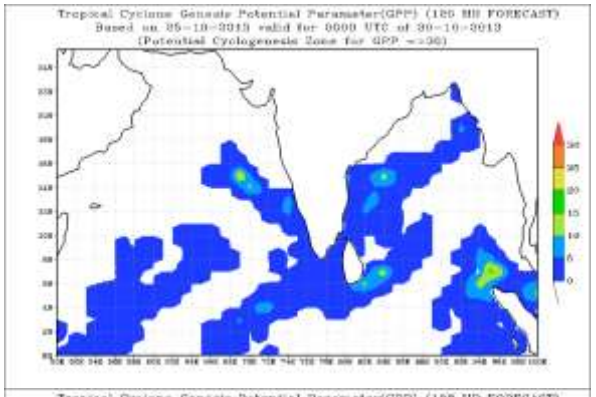

Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 05-10-2013 valid for 0000 UTC of 25-10-2013
(Potential Cyclogenesis Zone for GPP >=20)

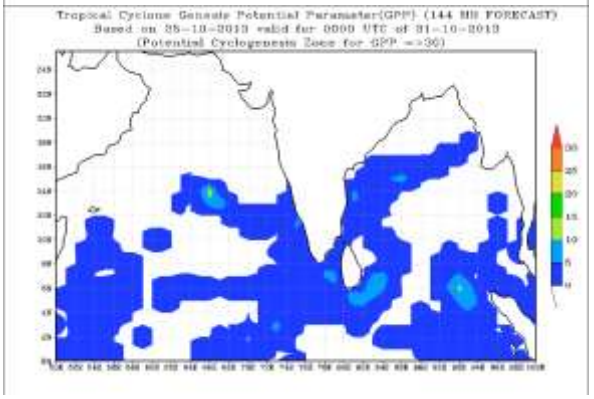

Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 25-10-2013 valid for 0000 UTC of 26-10-2013
(Potential Cyclogenesis Zone for GPP =>30)

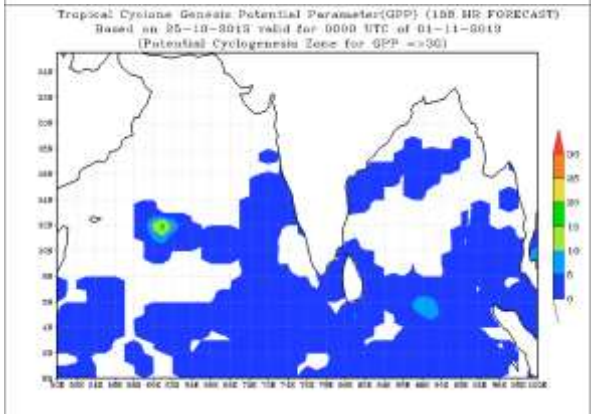

Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 25-10-2013 valid for 0000 UTC of 27-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 25-10-2013 valid for 0000 UTC of 28-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (96 HR FORECAST)
Based on 25-10-2013 valid for 0000 UTC of 29-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (120 HR FORECAST)
Based on 25-10-2013 valid for 0000 UTC of 30-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (144 HR FORECAST)
Based on 25-10-2013 valid for 0000 UTC of 31-10-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (168 HR FORECAST)
Based on 25-10-2013 valid for 0000 UTC of 01-11-2013
(Potential Cyclogenesis Zone for GPP =>30)

FDP (Cyclone) NOC Report Dated 26 October, 2013

Synoptic features based on 0300 UTC:

- The northeast Monsoon has been vigorous over coastal Andhra Pradesh and Rayalaseema**.**
- The well marked low pressure area over Telangana and adjoining areas of Coastal Andhra Pradesh and Rayalaseema now lies as a low pressure area over Telangana and neighbourhood. Associated cyclonic circulation extends upto mid tropospheric levels.
- Yesterday's trough in easterlies now lies as a wind discontinuity from Assam & Meghalaya to south Tamil Nadu across Gangetic West Bengal, Odisha and interior Andhra Pradesh and extends upto 3.1 kms a.s.l.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST around 27-31^{0}C over Bay of Bengal warmer towards north Tamilnadu south Andhra Pradesh coast and North Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over North, southwest Bay of Bengal and Gulf of Martaban. It is 50-100 KJ cm^{-2} over rest Bay of Bengal except equatorial region where it is 80-120 KJ cm^{-2}.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over Northwest, southwest and west central Bay of Bengal. It is negative over the rest part of Bay of Bengal.

Convergence:

- Lower level convergence is of the order of 5-20*10^{-5} s^{-1} over south, west central and North Bay of Bengal.

Divergence:

- Upper air positive divergence is of the order 5-20*10^{-5} s^{-1} over north and westcentral Bay of Bengal . It is negative order -5*10^{-5} s^{-1} over Southwest and Andaman sea.

Wind Shear:

- Wind Shear is 20-30 knots over south and central Bay of Bengal

Wind Shear Tendency:

- Shear Tendency is decreasing over North, westcentral, southwest Bay of Bengal and Andaman sea.

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 15°N.

M.J.O. Index:

- Located in phase 1 with amplitude more than 1.0.
- Dynamical forecast:- MJO may continue in phase 1 with amplitude more than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 260900 UTC

- Broken low/medium clouds with embedded moderate to intense convection over North Bay North of Lat 18°N and Westcentral Bay Southeast Andaman sea. Scattered low/medium clouds with embedded isolated weak to moderate convection over rest central Bay rest south Andaman Sea North Arakan Coast.
- Broken low/medium clouds with embedded isolated weak to moderate convection over south east Arabian Sea.

NWP Analysis

(Due to Technical problem GFS and WRF model data for 0000 UTC on 26th October 2013 is not available.)

- IMD-GFS : Due to Technical problem GFS model data for 0000 UTC on 26th October 2013 is not available.
- IMD-WRF : Due to Technical problem WRF model data for 0000 UTC on 26th October 2013 is not available.
- **ECMWF:** Model shows that Low pressure area lies over Telengana and adjoining north coastal AP on 26th, it would move north-northeast ward and lay over Orissa and adjoining North CAP on 27th and 28th. The system would move northeast wards and would emerge into westcentral Bay of Bengal on 29th October 2013 and weaken gradually.
- **METEOFRANCE -ARP:** Model show that a Low pressure area lies over Telengana an**d** adjoining coastal AP on 2^{6th} and it would slightly move northeast ward and lay over CAP and adjoining Telengana on 2^{7th}. It would move further northeast ward and lay over coastal AP and adjoining Orissa coast on 2^{8th} and weaken further on 2^{9th} October 2013**.**
- Genesis Potential Parameter (GPP): Due to Technical problem GFS model data for 0000 UTC on 26th October 2013 is not available

Summary and Conclusion:

- The low pressure area over Telengana and adjoining Vidarbha and south Chhattisgarh is likely to move northeastwards across south Chhattisgarh and coastal Odisha. The system would emerge into west central Bay of Bengal and weaken gradually after 48 hrs.

Advisory:

- **No IOP during next 4 days.**

Annexure-1

No of Synop data

Date→				**25.10.2013**				
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**21**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /25.10.2013 : 6
No. of Ascents reaching 250 hPa level =5
MISDA : 2

12Z /25.10.2013 : 4
No. of Ascents reaching 250 hPa level =4
MISDA : 4

No. of PILOT Ascents:

25.10.2013	
06Z	18Z
4	3

FDP (Cyclone) NOC Report Dated 27 October, 2013

Synoptic features based on 0300 UTC:

- The northeast Monsoon has been vigorous over coastal Andhra Pradesh.
- The low pressure area over Telangana and neighbourhood now lies over north coastal Andhra Pradesh and neighbourhood. Associated circulation extends upto mid tropospheric levels.
- The wind discontinuity now runs from Tripura to north Tamil Nadu across Gangetic West Bengal, Odisha and centre of low pressure area and extends upto 3.1 kms a.s.l.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST around 27-31^{0}C over Bay of Bengal warmer towards north Tamilnadu south Andhra Pradesh coast and North Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over North, southwest Bay of Bengal and Gulf of Martaban. It is 50-100 KJ cm^{-2} over rest Bay of Bengal except equatorial region where it is 80-120 KJ cm^{-2}.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over Northwest, southwest and west central Bay of Bengal. It is negative over the rest part of Bay of Bengal.

Convergence:

- Lower level convergence is of the order of 5-20*10^{-5} s^{-1} over, central and North Bay of Bengal.

Divergence:

- Upper air positive divergence is of the order 5-20*10^{-5} s^{-1} over north and central Bay of Bengal . It is negative order -5*10^{-5} s^{-1} over Southwest Bay of Bengal and Andaman sea.

Wind Shear:

- Wind Shear is 20-30 knots over south and central Bay of Bengal

Wind Shear Tendency:

- Shear Tendency is decreasing over North, westcentral, southwest Bay of Bengal and Andaman sea.

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 17°N.

M.J.O. Index:

- Located in phase 8 with amplitude less than 1.0.
- Dynamical forecast:- MJO may move to phase 1 with amplitude less than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 270900 UTC

- Broken low/medium clouds with embedded moderate to intense convection over central and adjoining North Bay North of Lat 16°N and central part of rest Bay over area between latitude 12.00N to 13.00N longitude 85.00 to 92.00E, south Andaman Sea. Scattered low/medium clouds with embedded isolated weak to moderate convection over rest south & adjoining central Bay extending up to Arakan coast.
- Broken low/medium clouds with embedded isolated weak to moderate convection over south east Arabian Sea and off Konkan coast..

NWP Analysis

(Due to Technical problem GFS and WRF model data for 0000 UTC on 27th October 2013 is not available.)

- **IMD-GFS** : Due to Technical problem GFS model data for 0000 UTC on 27th October 2013 is not available.
- **IMD-WRF** : Due to Technical problem WRF model data for 0000 UTC on 27th October 2013 is not available.
- **ECMWF:** Model shows that Low pressure area lies over north coastal Andhra Pradesh and neighbourhood. The system would emerge into westcentral Bay of Bengal within next 48 hours, persist till 31st October 2013 over westcentral Bay and adjoining areas and become less marked thereafter.
- **METEOFRANCE -ARP:** Model show that a Low pressure area lies over north coastal coastal AP on 27th October 2013. And it would emerge to west central Bay of Bengal on 28th and lay over west central Bay and till 30th October 2013.
- **Genesis Potential Parameter (GPP**. GPP charts for analysis and forecasts for 24h to 168 h are shown in **Annexure II**.
-

Summary and Conclusion:

- The low pressure area over north coastal Andhra Pradesh and neighbourhood would emerge into west central Bay of Bengal within next 48 hours and weaken gradually.

Advisory:

- **Models show no intensification of the system. Hence No IOP during next 4 days.**

Annexure-I

No of Synop data

Date→	**26.10.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

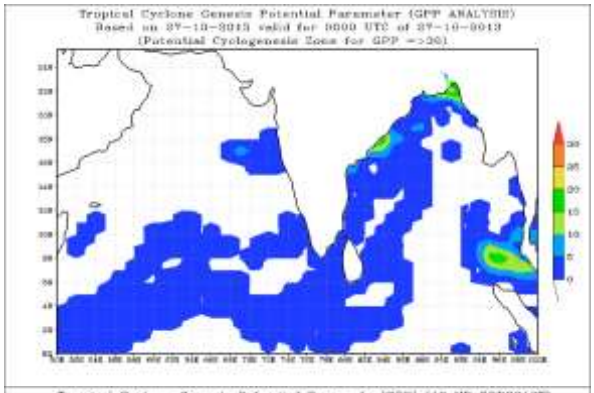
No. of RS/RW Ascents

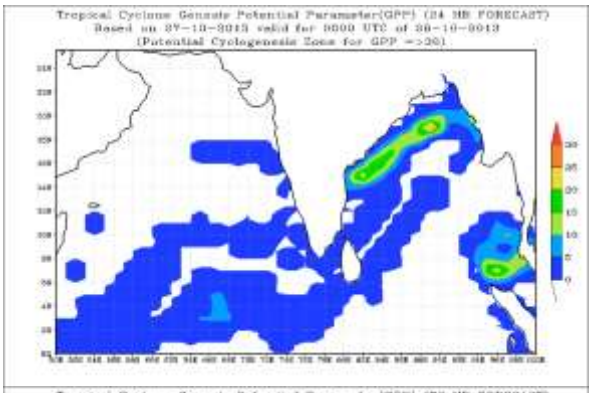
00Z /26.10.2013 : 5
No. of Ascents reaching 250 hPa level =5
MISDA : 3
12Z /26.10.2013 : 4
No. of Ascents reaching 250 hPa level =4
MISDA : 4

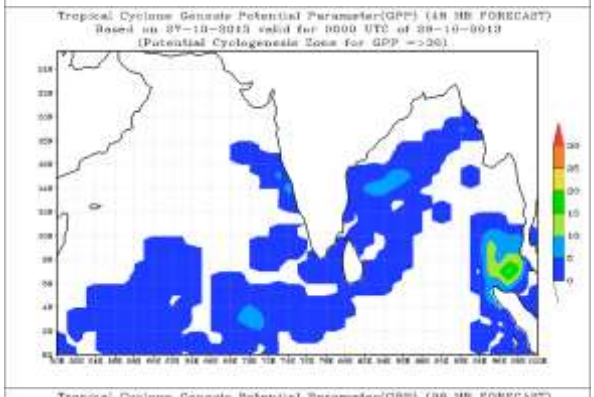
No. of PILOT Ascents:

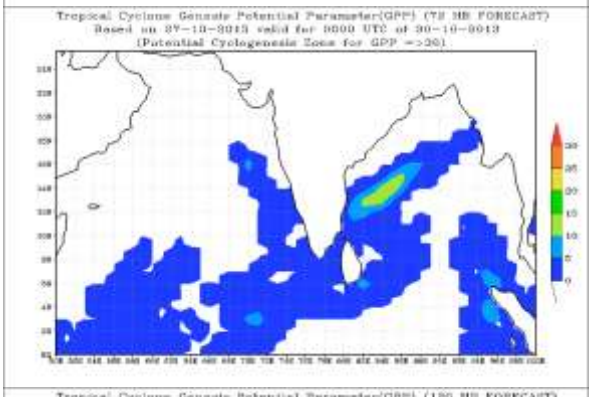
26.10.2013	
06Z	18Z
4	4

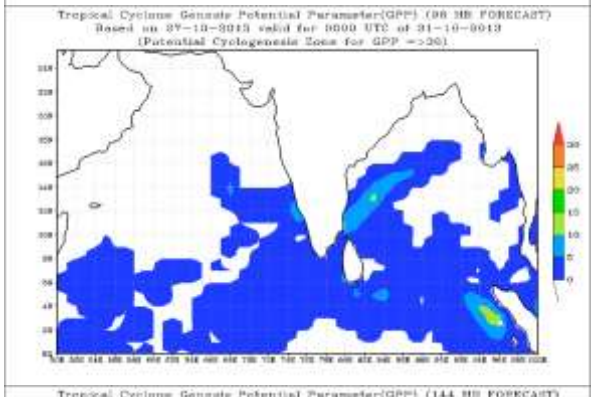
Annexure-II

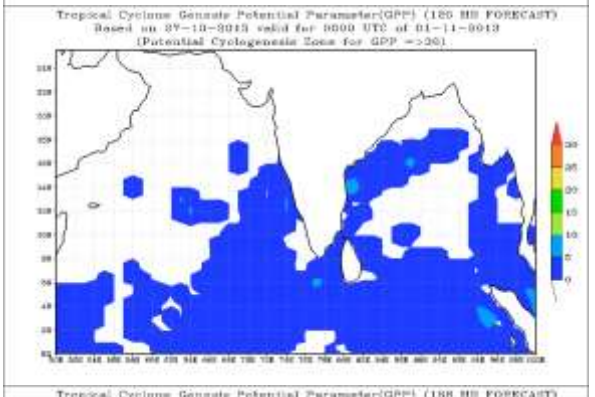

Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 27-10-2013 valid for 0000 UTC of 27-10-2013
(Potential Cyclogenesis Zone for GPP =>26)

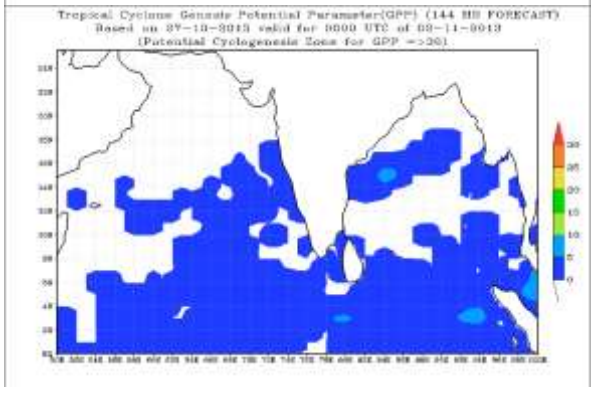

Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 27-10-2013 valid for 0000 UTC of 28-10-2013
(Potential Cyclogenesis Zone for GPP =>26)

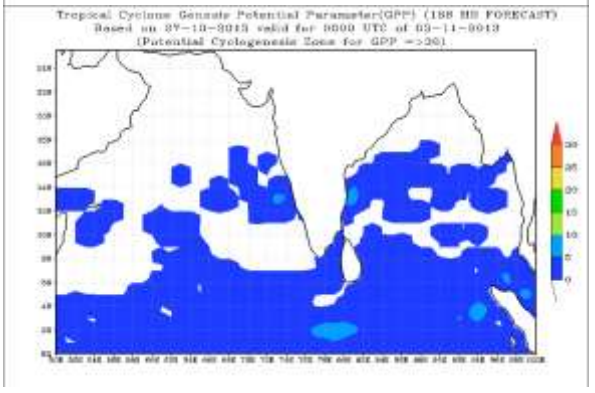

Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 27-10-2013 valid for 0000 UTC of 29-10-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 27-10-2013 valid for 0000 UTC of 30-10-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (96 HR FORECAST)
Based on 27-10-2013 valid for 0000 UTC of 31-10-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (120 HR FORECAST)
Based on 27-10-2013 valid for 0000 UTC of 01-11-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (144 HR FORECAST)
Based on 27-10-2013 valid for 0000 UTC of 02-11-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (168 HR FORECAST)
Based on 27-10-2013 valid for 0000 UTC of 03-11-2013
(Potential Cyclogenesis Zone for GPP =>26)

FDP (Cyclone) NOC Report Dated 28 October, 2013

Synoptic features based on 0300 UTC:

- The low pressure area over north coastal Andhra Pradesh and neighbourhood became less marked yesterday evening. However, the associated cyclonic circulation persisted and now lies over west central Bay of Bengal off Andhra Pradesh coast extending upto 1.5 kms a.s.l.
- The wind discontinuity now runs from Mizoram to west central Bay of Bengal across north Bay of Bengal and extends upto 1.5 kms a.s.l.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 27-31^{0}C over Bay of Bengal ,warmer over South, east central and northeast Bay of Bengal.

- **Ocean thermal energy:**
- It is less than 50 KJ cm^{-2} over western part of the Bay of Bengal except some area of southwest Bay and eastern part of Srilanka coast where it is higher. It is also less than 50 KJ cm^{-2} over gulf of Martaban. It is 50-100 KJ cm^{-2} over rest Bay of Bengal except equatorial region where it is 100-120 KJ cm^{-2}.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over southwest and westcentral Bay of Bengal. It is negative over the rest part of Bay of Bengal.

Convergence:

- Lower level convergence is of the order of 5-10*10^{-5} s^{-1} over east central and adjoining west central & southeast Bay of Bengal.

Divergence:

- Upper air positive divergence is of the order 5-10*10^{-5} s^{-1} over eastcentral Bay of Bengal and of the order 5*10^{-5} s^{-1} over Tamilnadu coast. It is negative of the order of -5*10^{-5} s^{-1} over South Bay of Bengal.

Wind Shear:

- Wind Shear is 5-20 knots over central Bay and 20-40 knots over rest Bay of Bengal

Wind Shear Tendency:

- Shear Tendency is increasing over north and south Bay of Bengal and decreasing over central Bay of Bengal and Andaman Sea.

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 15°N.

M.J.O. Index:

- Located in phase 8 with amplitude more than 1.0.
- Dynamical forecast:- MJO may move to phase 1 with amplitude less than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 280900 UTC

- Broken low/medium clouds with embedded moderate to intense convection over area between Lat 15°N to 20.0^0 west of longitude 89.0^{0}E in association with low level circulation over the area. Broken low/medium clouds with embedded moderate to intense convection over rest Bay between latitude 10.0^{0}N to a5.0^{0}N and between latitude north of 15.0^{0}N east of longitude 89.0^{0}E, gulf of Martaban and Andaman Sea.
- Broken low/medium clouds with embedded moderate to intense convection over south Arabian Sea adjoining Indian Ocean between latitude 3.5^{0}N to 7.5^{0}N longitude 66.0^{0}E to 73.0^{0}E.

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 28 October 2013 shows a northeast-southwest oriented trough over Coastal Andhra Pradesh and Orissa coasts. Model forecasts show that the northeast-southwest oriented trough to persists for 2 more days and seen southeast off Orissa and Coastal Andhra Pradesh coast on 29th and 30th October, 2013. On 30th the forecast also indicates a feeble cyclonic circulation southwest off Kerala coast. On subsequent days there is no indication of any system near the coast. The analysis and forecasts for 24h to 168 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.

• WRF model run is not yet completed.
(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **ECMWF:** Model shows that Low pressure area has become less marked.
- **METEOFRANCE -ARP:** Model shows that the Low pressure area persists over north coastal coastal AP on 28th October 2013 and it weakens after 24 hours.
- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 28 October 2013 suggests development of a very weak cyclogenesis zone over the Bay of Bengal southeast off Orissa and coastal Andhra Pradesh coast in the analysis chart on 28. The weak cyclogenesis zone is also seen over Andaman region on 28 and 29. However, in the forecast fields it is not significant during subsequent days. The GPP charts for analysis and forecasts for 24h to 168 h are shown in **Annexure II**.
- (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- The low pressure area over north coastal Andhra Pradesh and neighbourhood now lies as a upper air cyclonic circulation over west central Bay of Bengal off Andhra Pradesh coast extending upto 1.5 kms a.s.l

Advisory:

- **Models show no intensification of the system. Hence No IOP during next 4 days.**

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	27/12	**28/00**	**28/03**
India	39	26	37
Coastal stations			
WB	7	3	6
Odisha	6	5	6
AP	12	10	10
Tamil Nadu	8	7	9
Puducherry	0	0	0
A & N	6	1	6
Bangladesh	6/11	9/11	9/11
Myanmar	5/11	0/11	5/11
Thailand	3/3	3/3	3/3
Srilanka	6/9	7/9	6/9

- **RS/RW** (12Z) of 27/10/2013 09/39
- **No. of Ascents reaching 250 hPa levels:8, MISDA:-30**

- **RS/RW** (00Z) of 28/10/2013 24/39
- **No. of Ascents reaching 250 hPa levels:18 , MISDA:15**

No. of PILOT Ascents

27/12Z	28/00Z
00/37	00/34

Buoy Data

27/12Z	28/00Z	28/03Z
5	5	4

Data Statistics over RMC Chennai Region

No of Synop data

Date→	**27.10.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**21**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /27.10.2013 : 5

No. of Ascents reaching 250 hPa level =4

MISDA : 3

12Z /27.10.2013 : 4

No. of Ascents reaching 250 hPa level =4

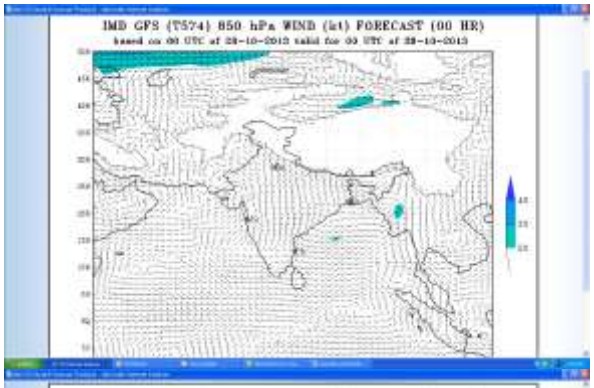
MISDA : 4

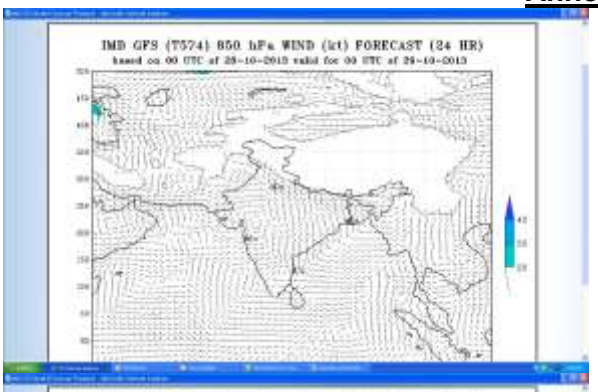
No. of PILOT Ascents:

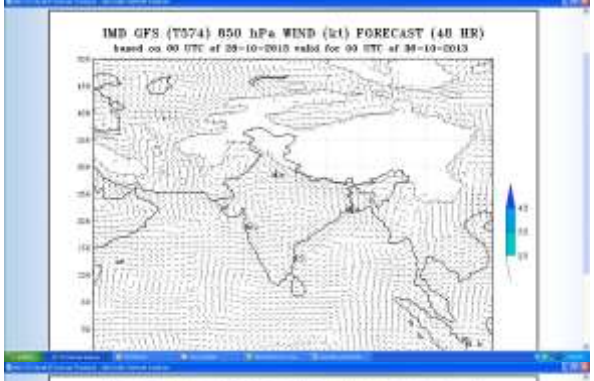
27.10.2013

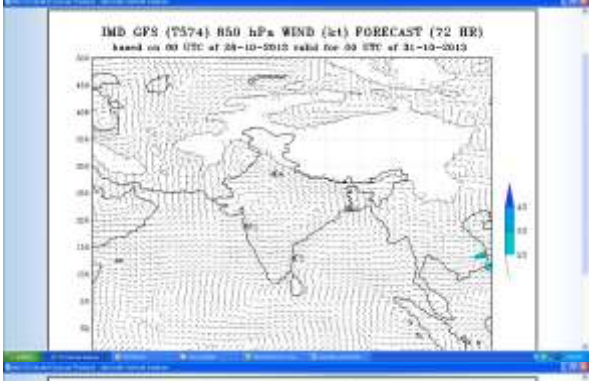
06Z	18Z
0	4

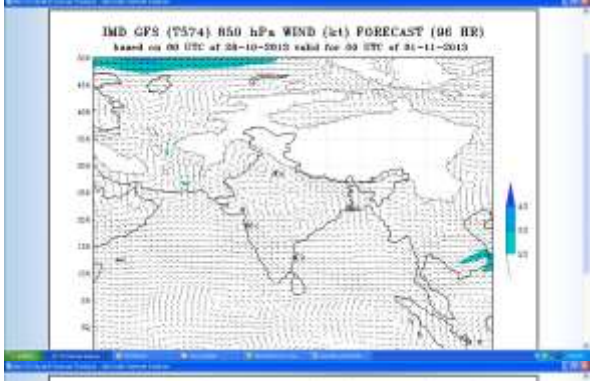
Annexure-II

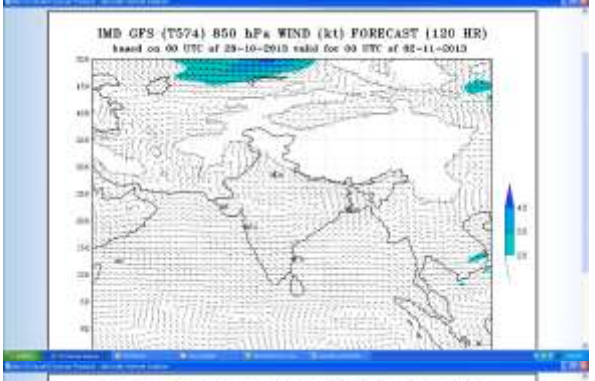

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)

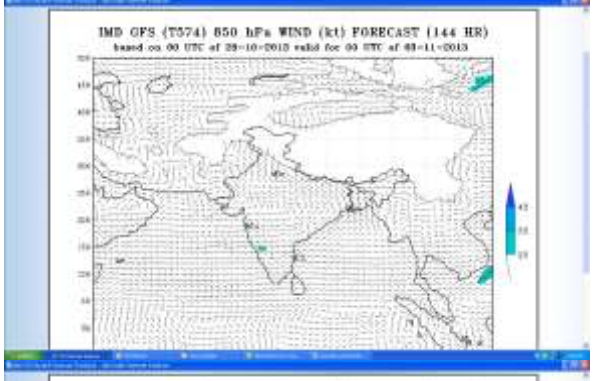

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)

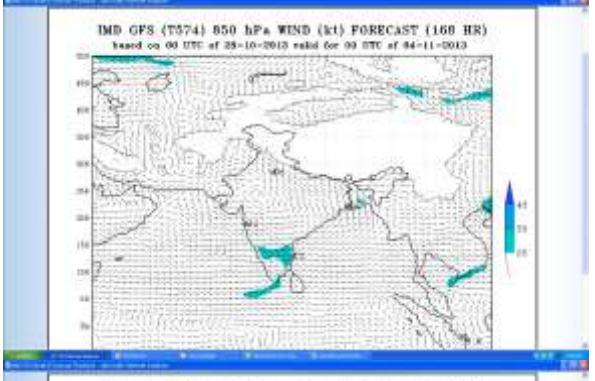

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)

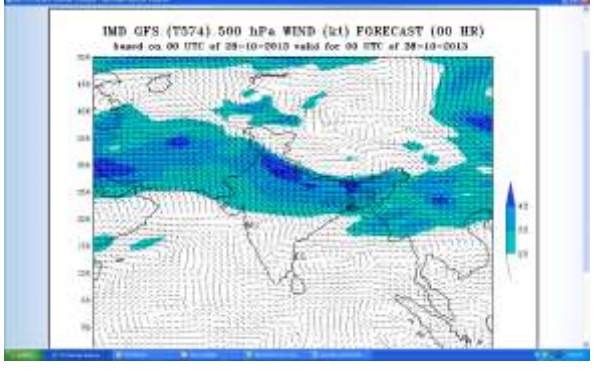

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)

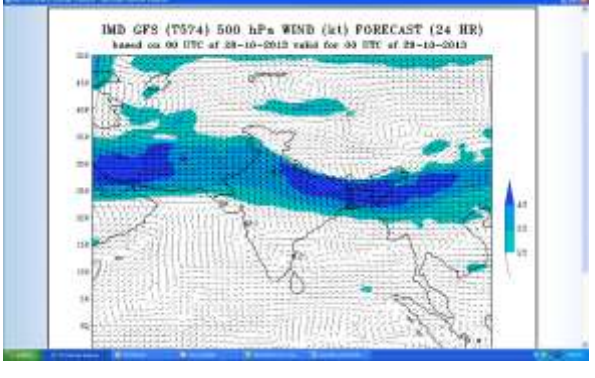

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (96 HR)

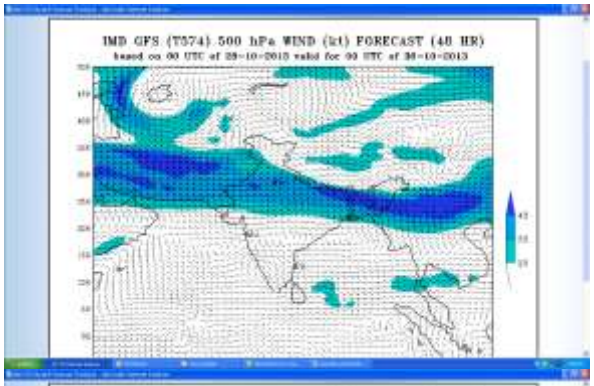

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (120 HR)

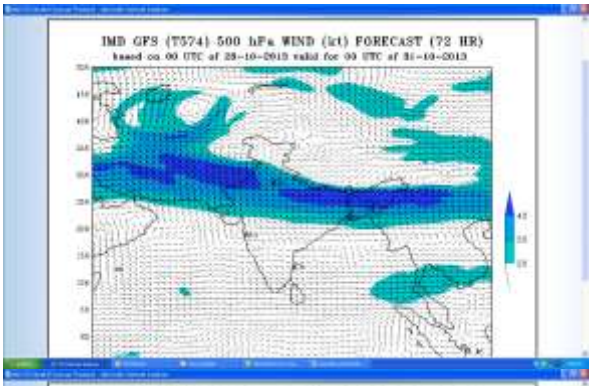

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (144 HR)

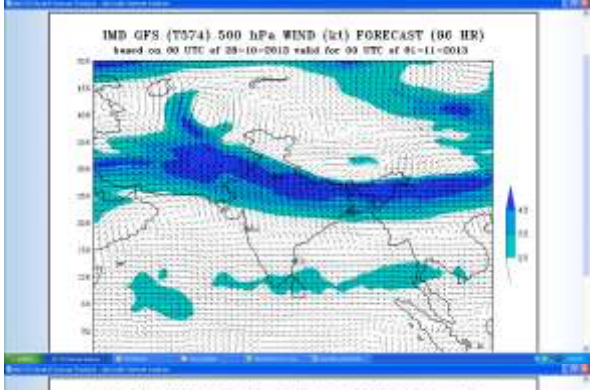

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (168 HR)

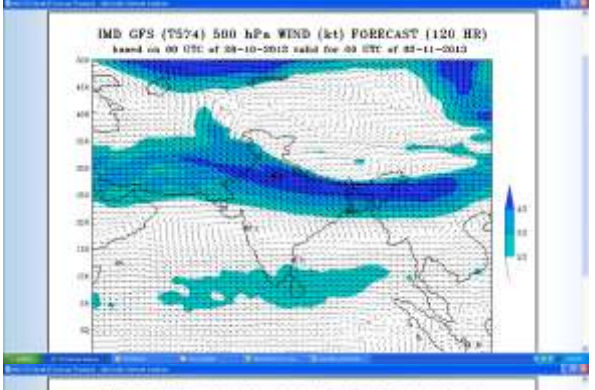

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)

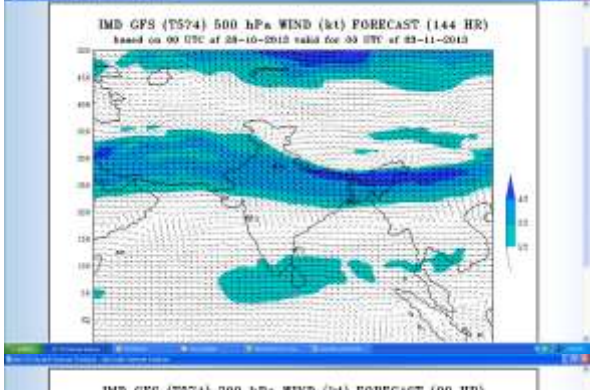

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)

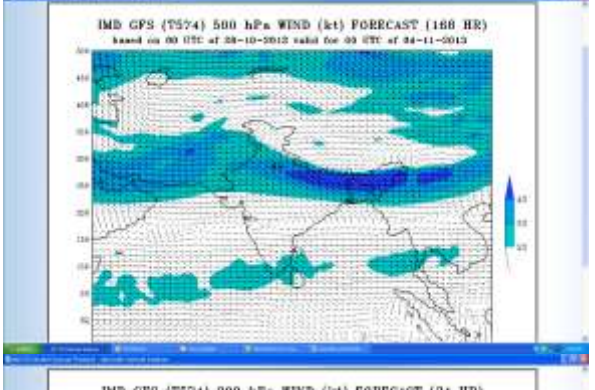

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)

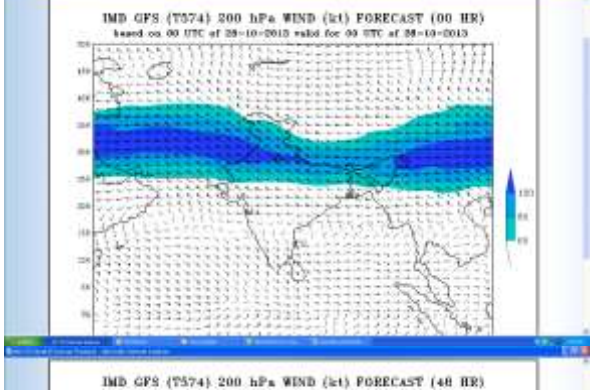

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)

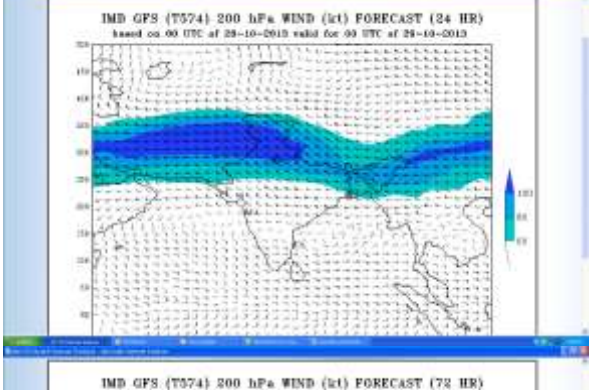

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (96 HR)

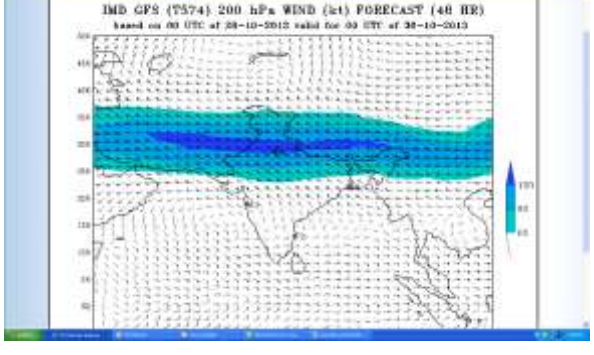

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (120 HR)

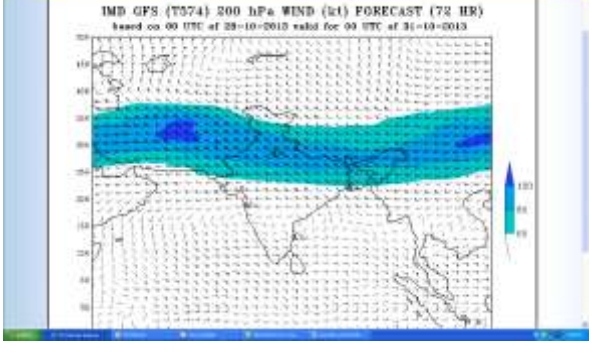

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (144 HR)

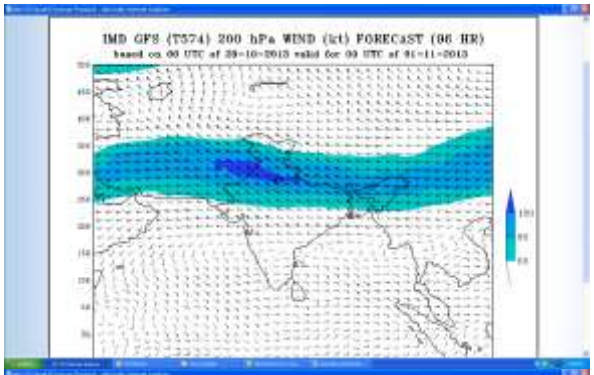

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (168 HR)

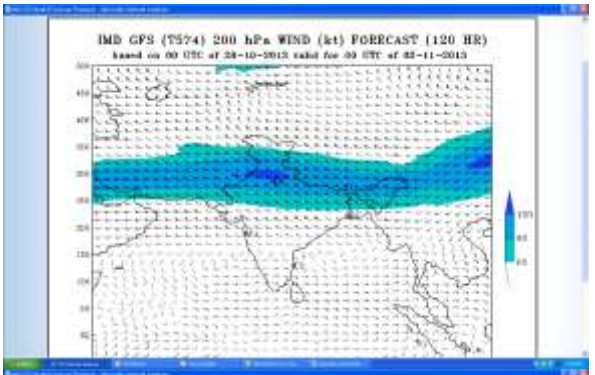

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)

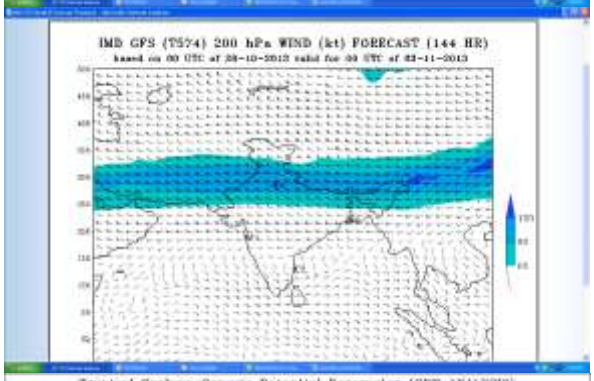

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)

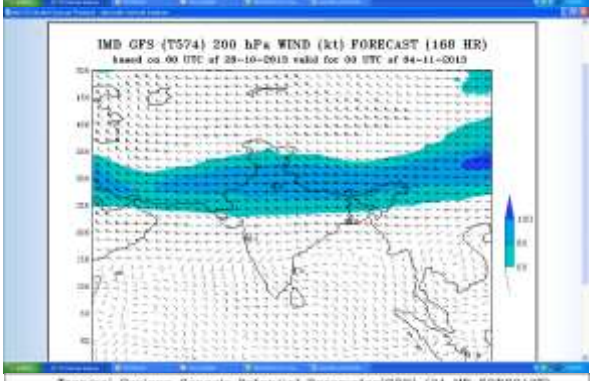

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)

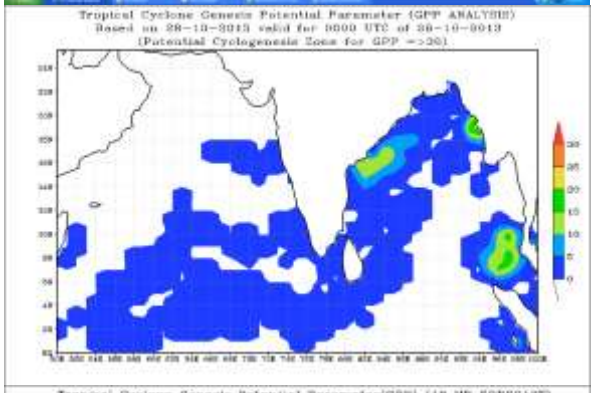

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)

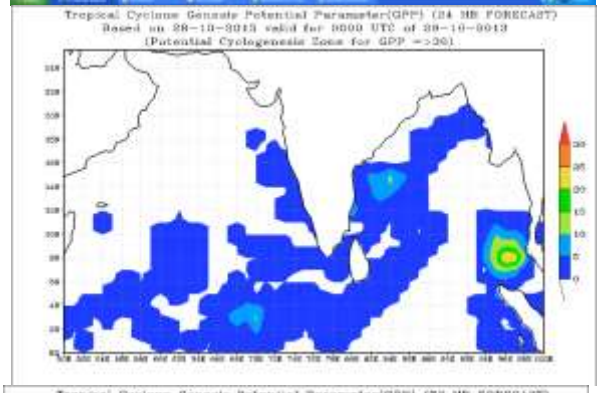

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (96 HR)

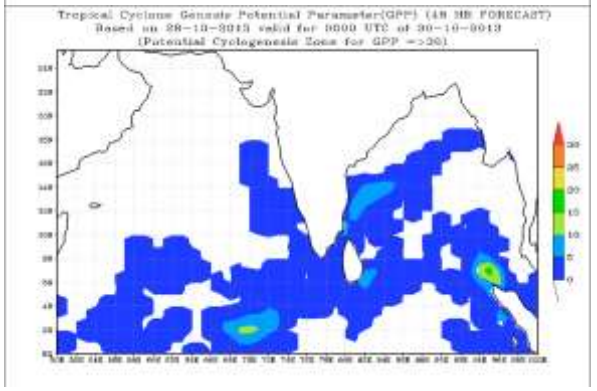

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (120 HR)

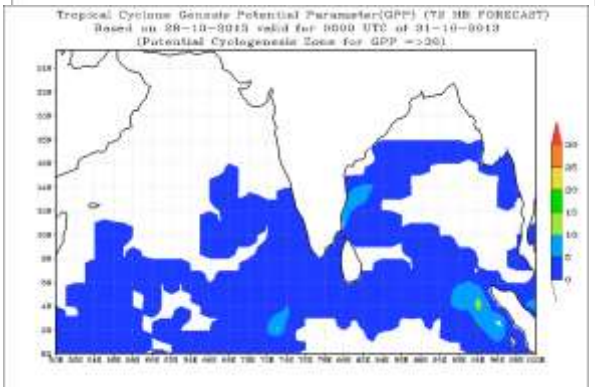

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (144 HR)

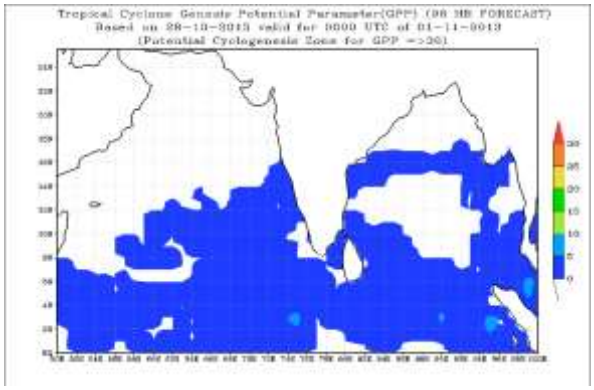

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (168 HR)

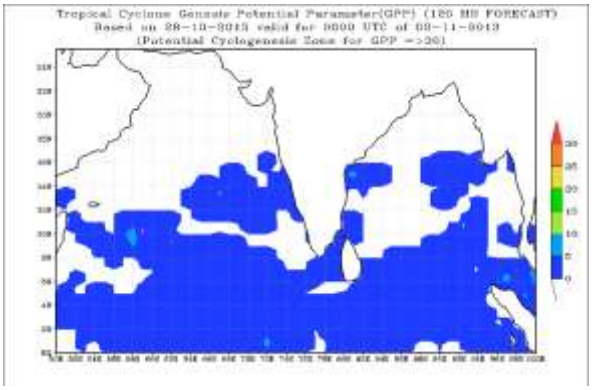

Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)

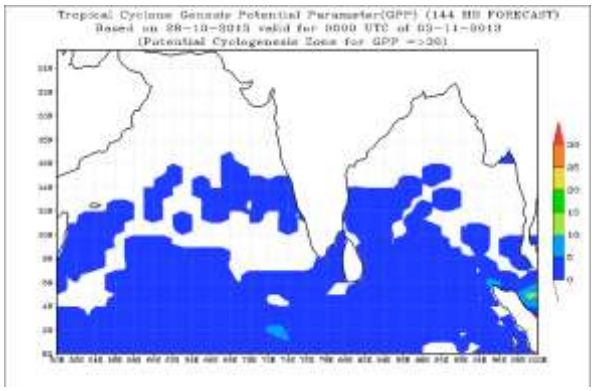

Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)

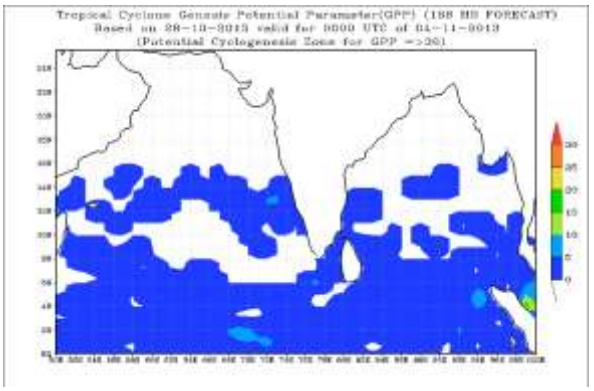

Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)


Tropical Cyclone Genesis Potential Parameter(GPP) (96 HR FORECAST)
Based on 28-10-2013 valid for 0000 UTC of 01-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (120 HR FORECAST)
Based on 28-10-2013 valid for 0000 UTC of 02-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (144 HR FORECAST)
Based on 28-10-2013 valid for 0000 UTC of 03-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (168 HR FORECAST)
Based on 28-10-2013 valid for 0000 UTC of 04-11-2013
(Potential Cyclogenesis Zone for GPP =>20)

FDP (Cyclone) NOC Report Dated 29 October, 2013

Synoptic features based on 0300 UTC:

- The cyclonic circulation extending upto 1.5 kms a.s.l. over west central Bay of Bengal off Andhra Pradesh coast now lies over west central Bay of Bengal and neighbourhood.
- The wind discontinuity now lies as a trough in westerlies from Sub-Himalayan West Bengal & Sikkim to north Bay of Bengal and extends upto 3.1 kms a.s.l.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 27-31^{0}C over Bay of Bengal ,warmer over southheast Bay of Bengal and Andaman Sea.
- **Ocean thermal energy:**
- It is less than 50 KJ cm^{-2} over most part of Bay of Bengal except some area of southwest Bay, northeast Bay, south BaY where it is is 50-100 KJ cm^{-2}. It is also less than 50 KJ cm^{-2} over gulf of Martaban. It is 100-120 KJ cm^2 equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over southwest and westcentral Bay and north Bay except the areas close to Indian coast and Bangladesh coast. It is negative over the rest part of Bay of Bengal and Andaman Sea.

Convergence:

- Lower level convergence is of the order of 5-10*10^{-5} s^{-1} over east central Bay of Bengal.

Divergence:

- Upper air positive divergence is of the order 5-10*10^{-5} s^{-1} over south west and eastcentral Bay of Bengal. It is negative of the order of -5*10^{-5} s^{-1} over rest Bay of Bengal.

Wind Shear:

- Wind Shear is 5-10 knots over central Bay and 20-40 knots over rest Bay of Bengal

Wind Shear Tendency:

- Shear Tendency is increasing over north and south Bay of Bengal and decreasing over central Bay of Bengal and Andaman Sea.

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 14.5°N.

M.J.O. Index:

- Located in phase 8 with amplitude more than 1.0.
- Dynamical forecast:- MJO may move in phase 8 with amplitude more than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 290900 UTC

- Broken low/medium clouds with embedded isolated moderate to intense convection over area between Lat 12°N to 20.0^0 longitude 83.0^{0}E to 89.0^{0}E in association with feeble low level circulation over the area. Broken low/medium clouds with embedded moderate to intense convection over rest Bay between latitude 9.0^{0}N to 20.5^{0}N east of longitude 90.0^{0}E and Andaman Sea.
- Broken low/medium clouds with embedded weak to moderate convection over Arabian Sea between latitude 15.0^{0}N to 17.0^{0}N longitude 68.0^{0}E to 70.0^{0}E.

NWP Analysis

• **IMD-GFS** model analysis of 0000 UTC of 29 October 2013 shows a northeast-southwest oriented trough in the low levels (upto 850 hPa) over the Bay of Bengal parallel to the east coast of India extending from Coastal Orissa to Tamil Nadu coast. This is likely to persist for the next 24 hours. Feeble troughing is observed in the easterlies off the west coast of peninsular India in the low levels (925 hPa and below) extending from a low pressure area off the coast of South Karnataka. Likely to decrease in intensity in the next 48 hours. Under the influence of active easterly wave over south India, scattered rainfall is likely to persist over south peninsular India over the next 2-3 days mostly over the west coast of India, likely to increase in intensity and spread from day 3 onwards especially over the east peninsular coast of India.

The analysis and forecasts for 24h to 72 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.

• **IMD-WRF** model analysis field of 0000 UTC of 29 October 2013 shows a similar northeast-southwest oriented trough in the low levels (upto 850 hPa) over the Bay of Bengal parallel to the east coast of India extending from Coastal Orissa to Tamil Nadu coasts. The wind strength off the east peninsular coast is likely to increase day 2 onwards, increasing the rainfall over the region. A trough (extending upto 700 hPa) is seen off the west coast of India. The trough decreases in intensity day 3 onwards, when the rainfall over the west coast decreases.
(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **ECMWF:** Model shows that Low pressure area has become less marked.
- **METEOFRANCE -ARP:** Model shows that the a Low pressure area lies over westcentral Bay of Bengal on 29th October 2013 and it would weakens after 24 hours.
- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 29 October 2013 suggests development of a very weak cyclogenesis zone over the Bay of Bengal southeast off Orissa and coastal Andhra Pradesh coast in the analysis chart on 289 October. There is no indication of potential cyclogenesis over the region in the next 4-5 days. The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**.
(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- The cyclonic circulation over west central Bay of Bengal off Andhra Pradesh coast now lies over west central Bay of Bengal and neighbourhood. It would not intensify further during next 4 days.

Advisory:

- **Models show no intensification of the system. Hence No IOP during next 4 days.**

Annexure-I

Status of Observation system:

Synoptic observation:

Region	Date/Time (UTC)		
	28/12	**29/00**	**29/03**
India	26/51	18/32	30/51
Coastal stations			
WB	4/9	4/4	6/9
Odisha	5/7	4/5	4/7
AP	6/14	6/13	7/14
Tamil Nadu	5/12	2/7	5/12
Puducherry	1/2	1/2	1/2
A & N	5/7	1/1	7/7
Bangladesh	7/11	7/11	10/11
Myanmar	7/11	10/11	8/11
Thailand	3/3	3/3	3/3
Srilanka	6/9	7/9	7/9

RS/RW (12Z) of 28/10/2013 14/39

- **No. of Ascents reaching 250 hPa levels:14, MISDA:-25**
- **RS/RW** (00Z) of 29/10/2013 23/39
- **No. of Ascents reaching 250 hPa levels:18 , MISDA:16**

No. of PILOT Ascents

28/12Z	29/00Z
22/37	21/34

Buoy Data

28/12Z	29/00Z	29/03Z
3	2	4

Data Statistics over RMC Chennai Region

No of Synop data

Date→	**28.10.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /28.10.2013 : 6

No. of Ascents reaching 250 hPa level =6

MISDA : 2

12Z /28.10.2013 : 5

No. of Ascents reaching 250 hPa level =5

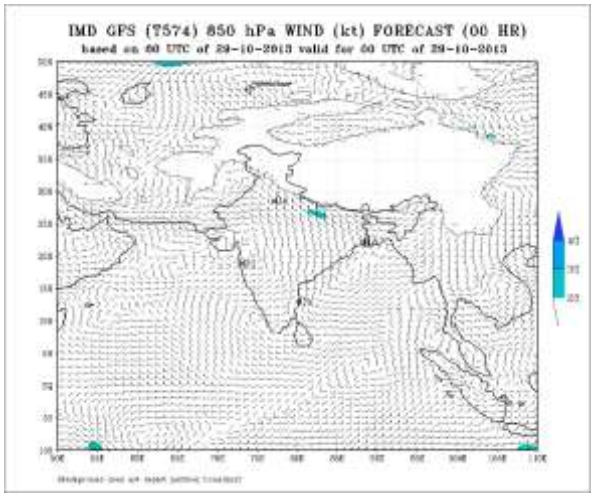
MIDA : 3

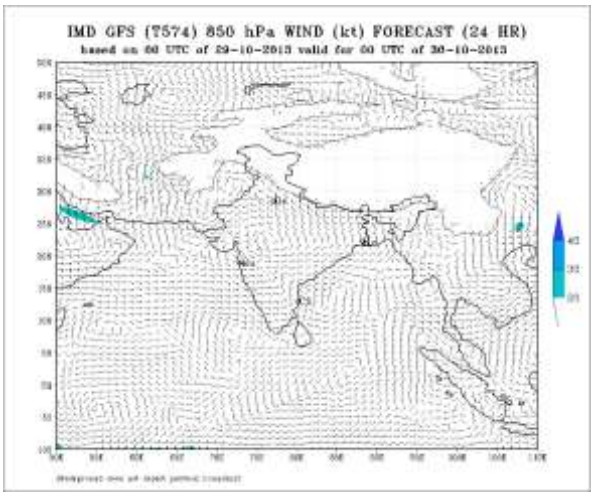
No. of PILOT Ascents:

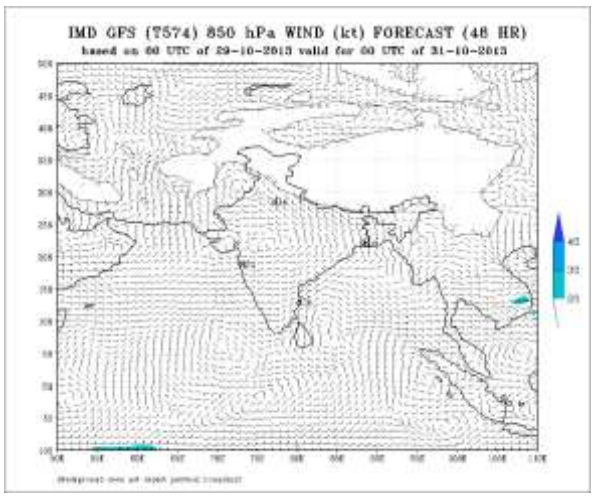
28.10.2013

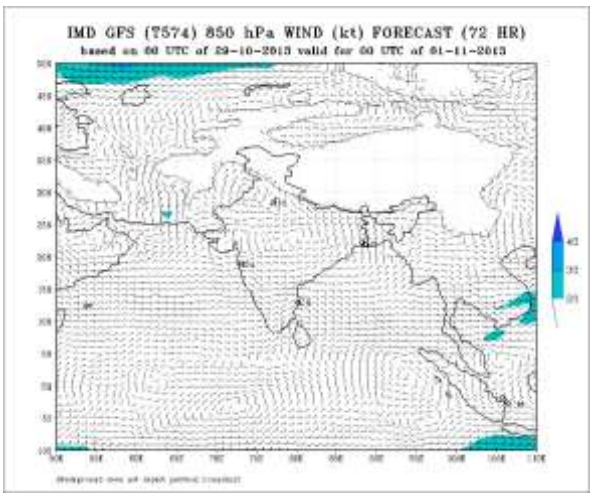
06Z	18Z
4	5

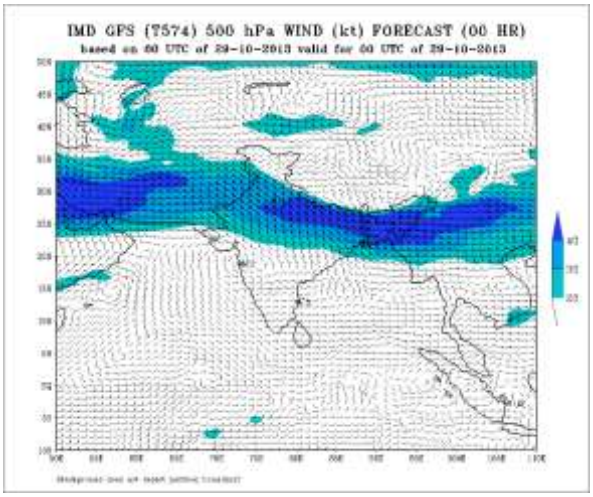
Annexure-II

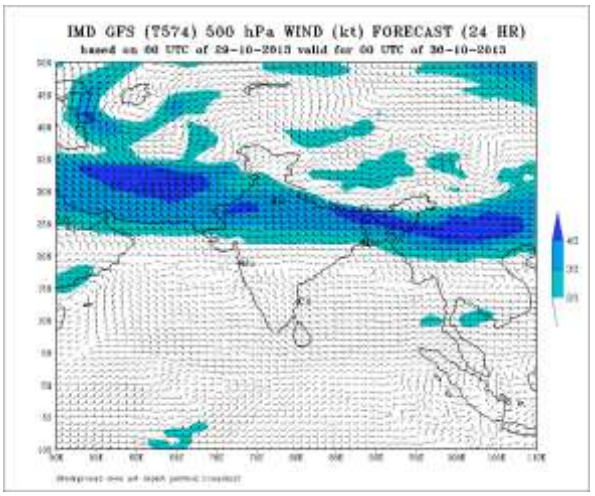

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 29-10-2013 valid for 00 UTC of 29-10-2013

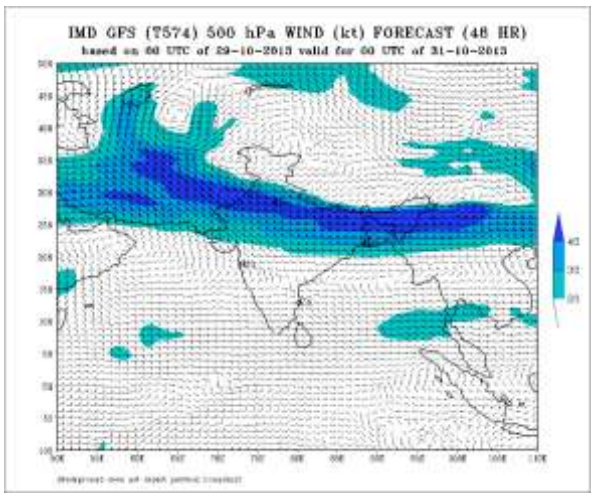

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 29-10-2013 valid for 00 UTC of 30-10-2013

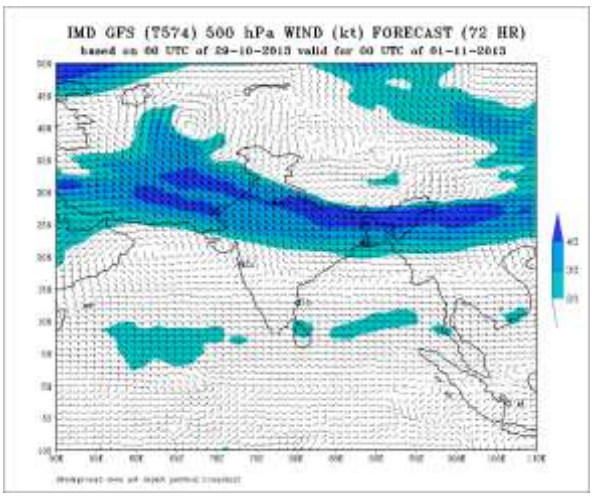

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 29-10-2013 valid for 00 UTC of 31-10-2013

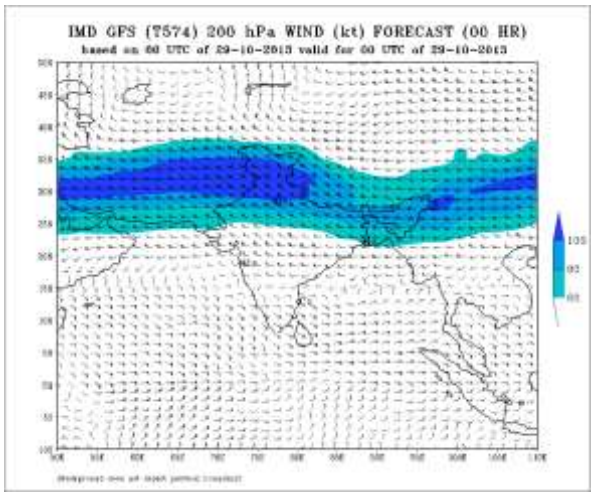

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 29-10-2013 valid for 00 UTC of 01-11-2013

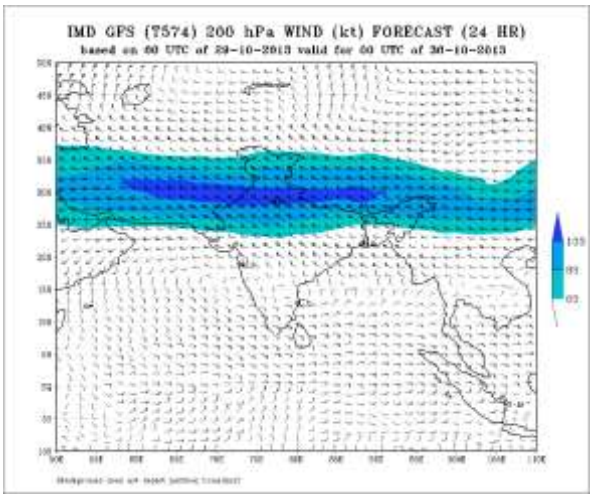

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 29-10-2013 valid for 00 UTC of 29-10-2013

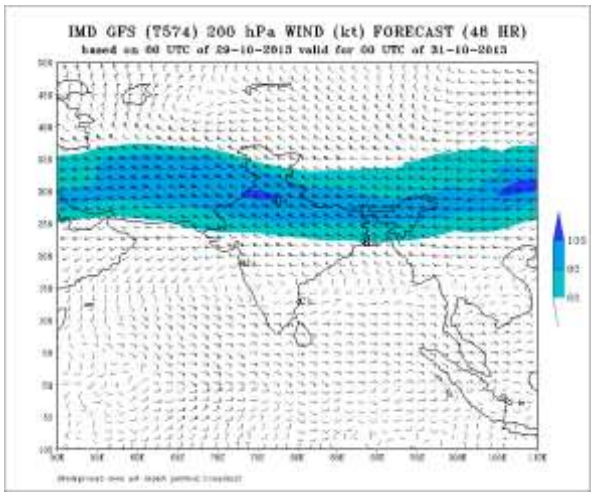

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 29-10-2013 valid for 00 UTC of 30-10-2013

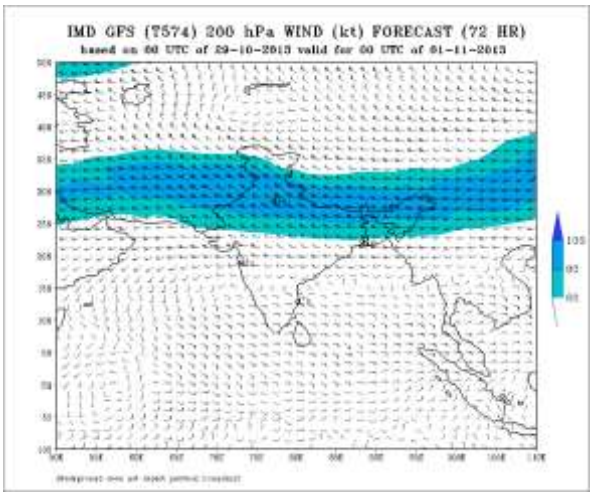

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 29-10-2015 valid for 00 UTC of 31-10-2015

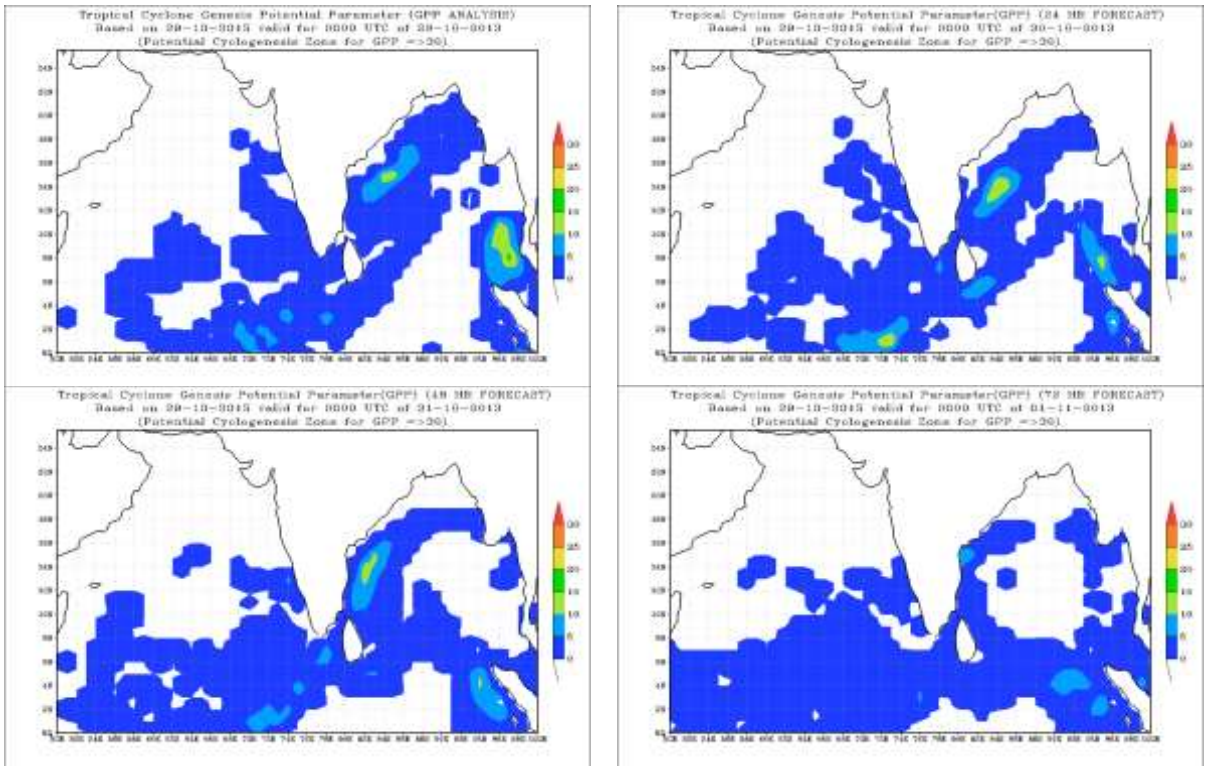

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 29-10-2015 valid for 00 UTC of 01-11-2015


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 29-10-2015 valid for 00 UTC of 29-10-2015


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 29-10-2015 valid for 00 UTC of 30-10-2015


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 29-10-2015 valid for 00 UTC of 31-10-2015


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 29-10-2015 valid for 00 UTC of 01-11-2015



FDP (Cyclone) NOC Report Dated 30 October, 2013

Synoptic features based on 0300 UTC:

- The cyclonic circulation over west central Bay of Bengal and neighbourhood persists and extends upto 0.9 km a.s.l.
- The trough in westerlies from Sub-Himalayan West Bengal & Sikkim to north Bay of Bengal now lies as a cyclonic circulation over Assam & Meghalaya and extends upto1.5 kms a.s.l.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 27-31^{0}C over Bay of Bengal , warmer over southeast Bay of Bengal, Andaman Sea and east coast of Srilanka.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over western part of Bay of Bengal, central part of south Bay of Bengal and gulf of Martaban except some area of southwest Bay, northwest Bay, where it is 50-100 KJ cm^{-2}.It is 50-100 KJ cm^{-2} over rest Bay except equatorial region where it is 100-120 KJ cm^2.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over southwest, central part of central Bay and southeast Bay of Bengal It is negative over the rest part of Bay of Bengal and Andaman Sea.

Convergence:

- Lower level convergence is of the order of $5*10^{-5}$ s^{-1} over southwest Bay and west central Bay of Bengal

Divergence:

- It is negative of the order of $-5*10^{-5}$ s^{-1} over southeast Bay.

Wind Shear:

- Wind Shear is 5-10 knots over southwest Bay and 20-40 knots over rest Bay of Bengal.

Wind Shear Tendency:

- Shear Tendency is increasing over central Bay of Bengal and decreasing over rest Bay of Bengal and Andaman Sea.

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 14.0°N.

M.J.O. Index:

- Located in phase 8 with amplitude more than 1.0.
- Dynamical forecast:- MJO may move in phase 8 with amplitude more than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 300900 UTC

- Scattered low/medium clouds with embedded isolated weak convection over area between Lat 11°N to 17.0^{0}N longitude 82.0^{0}E to 88.0^{0}E in association with feeble low level circulation over the area. Scattered low/medium cloud with embedded isolated weak to moderate convection over southwest Bay and west central Andaman Sea.
  .
- Broken low/medium clouds with embedded weak to moderate convection over southeast Arabian Sea.

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 30 October 2013 shows a northeast-southwest oriented trough in the low levels (upto 700 hPa) over the Bay of Bengal parallel to the east coast of India extending from Coastal Orissa to Tamil Nadu coast. This is likely to intensify in the next 24 hours and will persist for the next 48 hours. Troughing is also observed in the easterlies off the west coast of peninsular India in the low levels (850 hPa and below), extending from a low pressure area off the coast of Kerala. Likely to decrease in intensity in the next 48 hours. Under the influence of active easterly wave over south India, scattered rainfall is likely to persist over south peninsular India over the next 2-3 days mostly over the west coast of India, likely to increase in intensity and spread from day 2 onwards especially over the east peninsular coast of India. -The analysis and forecasts for 24h to 72 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.

- **IMD-WRF** model analysis field of 0000 UTC of 30 October 2013 shows a similar northeast-southwest oriented trough in the low levels (upto 700 hPa) over the Bay of Bengal parallel to the east coast of India extending from Coastal Orissa to Tamil Nadu coasts and another trough along the west coast. Rainfall on day 1 is mostly along the south west peninsular coast, which decreases thereafter. As the wind strength off the east peninsular coast is likely to increase day 2 onwards, rainfall simultaneously increases over the region day 3 onwards.

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm

- **ECMWF:** Model shows no cyclogenesis over Bay of Bengal and Arabian Sea during next 4-5 days.
- **METEOFRANCE -ARP:** Model shows that the a feeble Low pressure area lies over westcentral Bay of Bengal on 30th October 2013 and it would weaken after 24 hours.

Genesis Potential Parameter (GPP): Model forecast of GPP based on 0000 UTC of 30 October 2013 indicates no chances of cyclogenesis in the seas surrounding the Indian

subcontinent. The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**.

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm

Summary and Conclusion:

- A cyclonic circulation lies over west central Bay of Bengal and neighbourhood extends upto 0.9 km a.s.l.. It would weaken during next 24 hrs .

Advisory:

- Model shows no cyclogenesis over Bay of Bengal and Arabian Sea during next 4-5 days. Hence No IOP during next 4 days.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	29/12	**30/00**	**30/03**
India	36/51	29/32	36/51
Coastal stations			
WB	6/9	4/4	5/9
Odisha	6/7	5/5	6/7
AP	9/14	10/13	9/14
Tamil Nadu	7/12	7/7	8/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	9/11	9/11	10/11
Myanmar	1/11	9/11	8/11
Thailand	3/3	3/3	3/3
Srilanka	6/9	7/9	7/9

- **RS/RW** (12Z) of 29/10/2013 13/39
- **No. of Ascents reaching 250 hPa levels:13, MISDA:-26**

- **RS/RW** (00Z) of 30/10/2013 22/39
- **No. of Ascents reaching 250 hPa levels:13 , MISDA:17**

No. of PILOT Ascents

29/12Z	30/00Z
24/37	22/34

Buoy Data

29/12Z	30/00Z	30/03Z
8	8	8

Data Statistics over RMC Chennai Region

No of Synop data

Date→	**29.10.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /29.10.2013 : 6

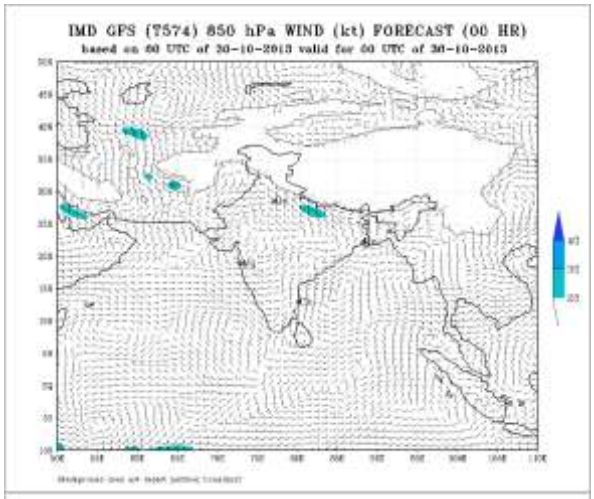
No. of Ascents reaching 250 hPa level =5

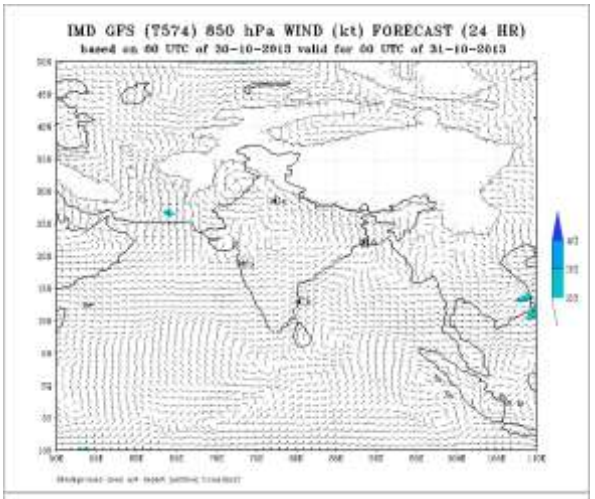
MISDA : 2
12Z /29.10.2013 : 5
No. of Ascents reaching 250 hPa level =5
MISDA : 3
No. of PILOT Ascents:

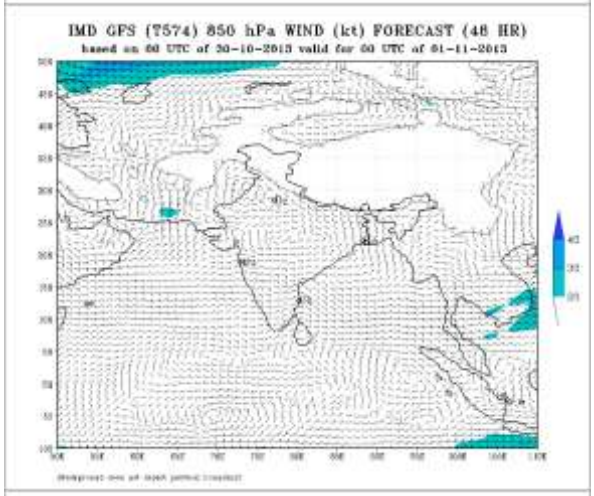
29.10.2013

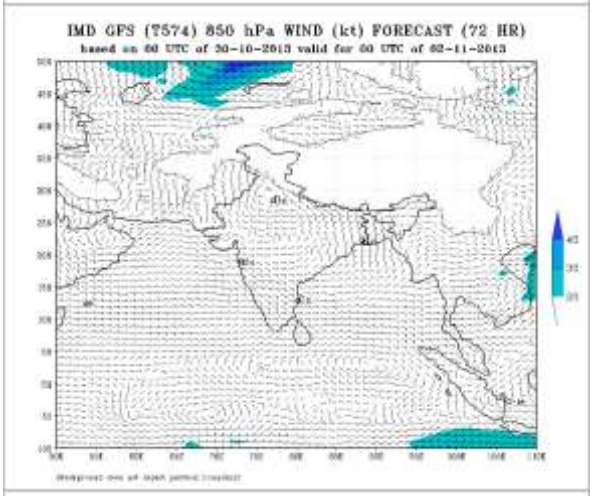
06Z	18Z
5	3

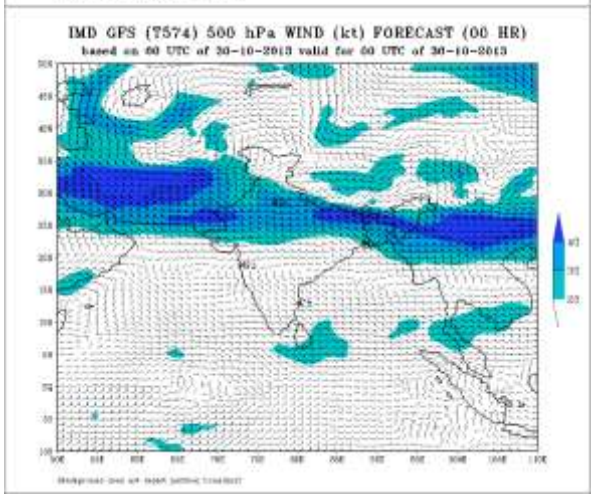
Annexure-II

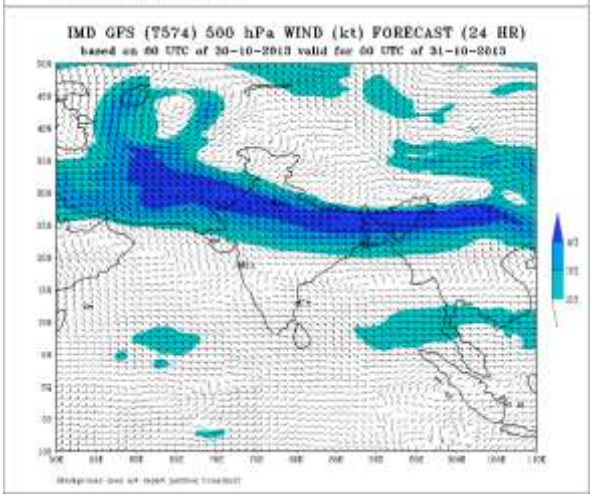

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 30-10-2013 valid for 00 UTC of 30-10-2013

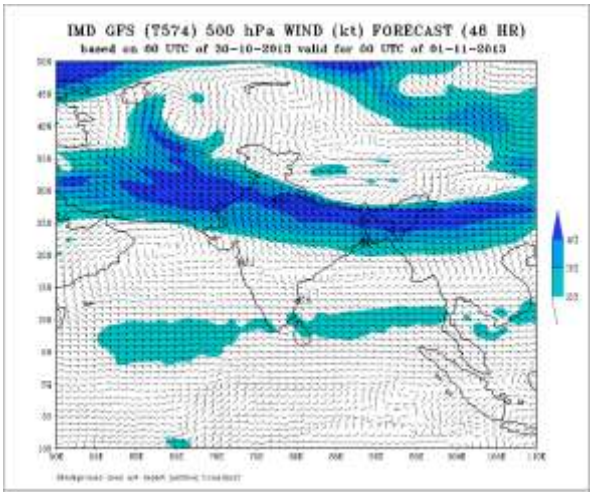

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 30-10-2013 valid for 00 UTC of 31-10-2013

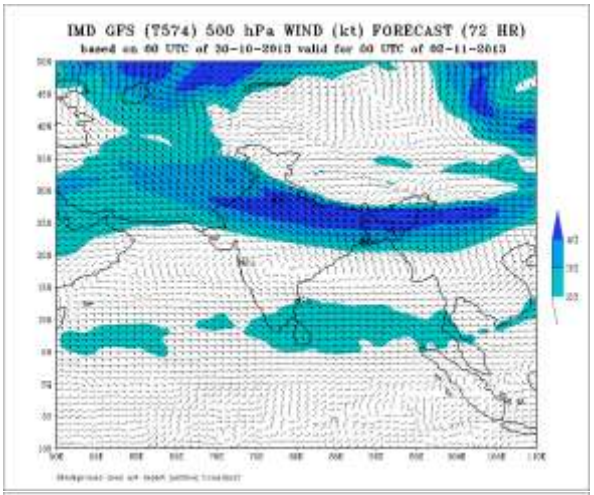

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 30-10-2013 valid for 00 UTC of 01-11-2013

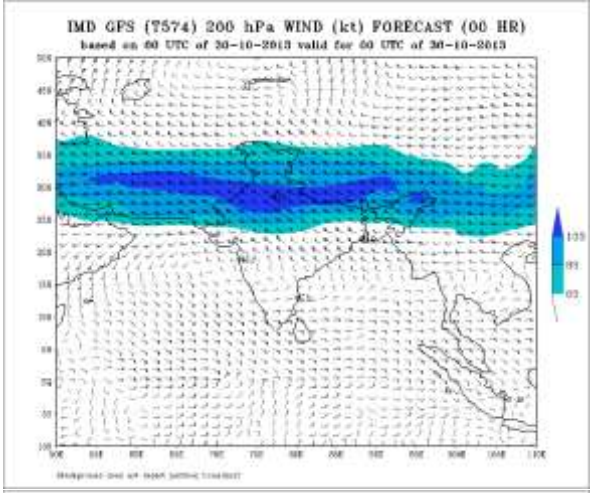

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 30-10-2013 valid for 00 UTC of 02-11-2013

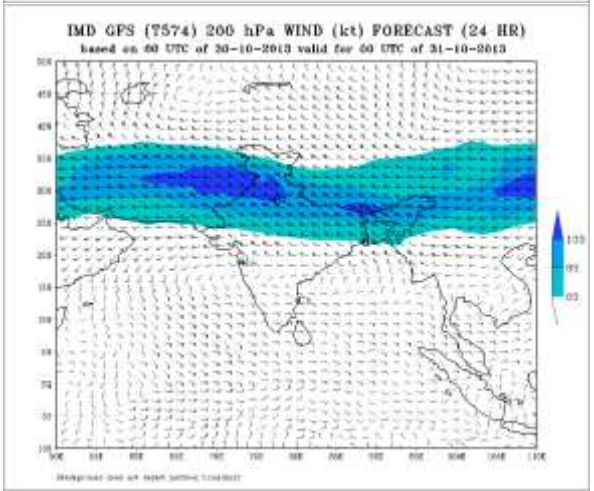

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 30-10-2013 valid for 00 UTC of 30-10-2013

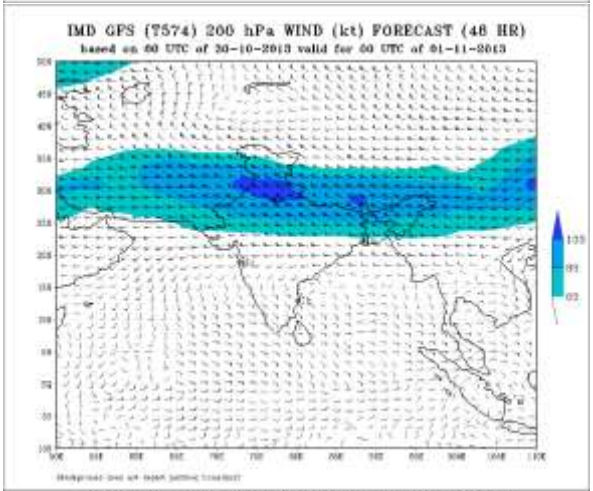

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 30-10-2013 valid for 00 UTC of 31-10-2013

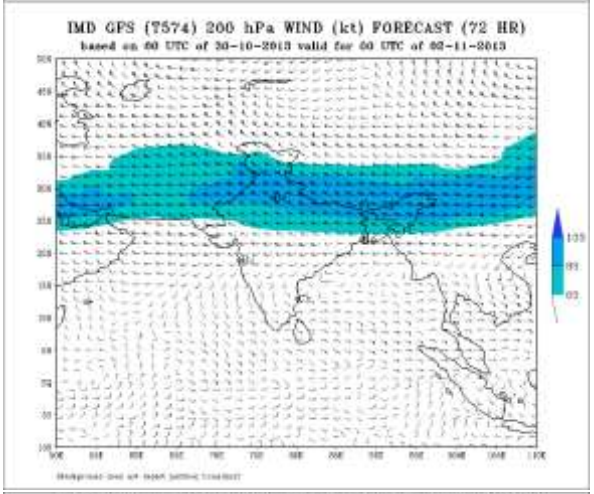

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 30-10-2013 valid for 00 UTC of 01-11-2013

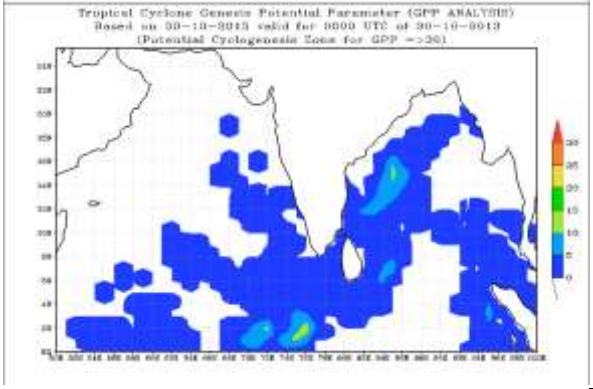

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 30-10-2013 valid for 00 UTC of 02-11-2013

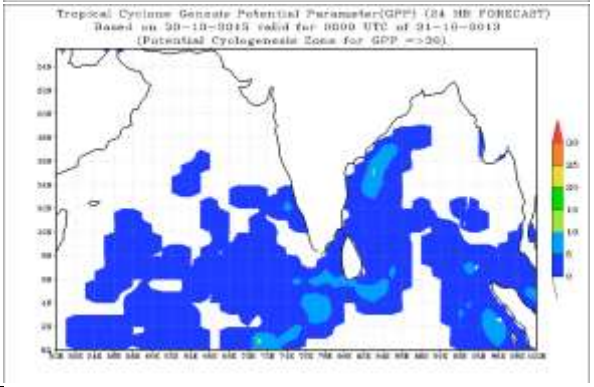

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 30-10-2013 valid for 00 UTC of 30-10-2013

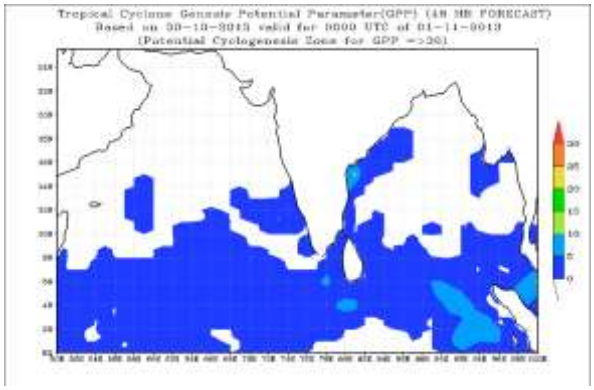

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 30-10-2013 valid for 00 UTC of 31-10-2013

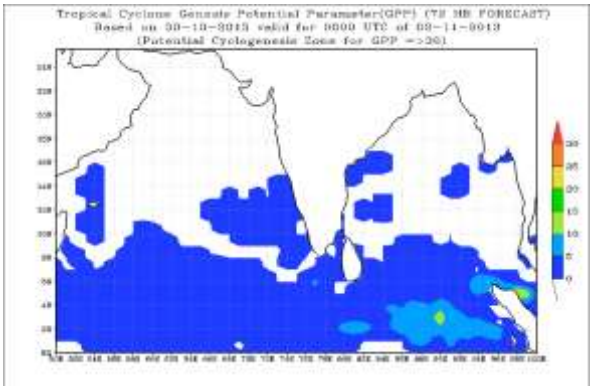

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 30-10-2013 valid for 00 UTC of 01-11-2013


IMD GPS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 30-10-2013 valid for 00 UTC of 02-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 30-10-2013 valid for 0000 UTC of 30-10-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 30-10-2013 valid for 0000 UTC of 31-10-2013
(Potential Cyclogenesis Zone for GPP =>20)





FDP (Cyclone) NOC Report Dated 31 October, 2013

Synoptic features based on 0300 UTC:

- A trough in lower level easterlies runs from southwest Bay of Bengal to west central Bay of Bengal.
- The cyclonic circulation over west central Bay of Bengal and neighbourhood has become less marked.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-31^{0}C over Bay of Bengal, warmer over south Bay of Bengal and Andaman Sea.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over southwest, westcentral and north Bay of Bengal and gulf of Martaban. It is 50-90 KJ cm^{-2} over rest Bay except equatorial region where it is 100-120 KJ cm^2.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over southwest, westcentral and north east Bay of Bengal It is negative over the rest part of Bay of Bengal and Andaman Sea.

Convergence:

- Lower level convergence is negative of the order of -5*10^{-5} s^{-1} over southeast Bay and positive of the order of 5*10^{-5} s^{-1} over rest Bay of Bengal and Andaman sea

Divergence:

- It is positive of the order of 5*10^{-5} s^{-1} over Bay of Bengal and negative of the order of -5*10^{-5} s^{-1} over Andaman sea.

Wind Shear:

- Wind Shear is 5-20 knots over south and central Bay and 20-50 knots over North Bay of Bengal.

Wind Shear Tendency:

- Shear Tendency is increasing over westcentral Bay of Bengal and decreasing over rest Bay of Bengal and Andaman Sea.

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 15.0°N.

M.J.O. Index:

- Located in phase 8 with amplitude more than 1.0.
- Dynamical forecast:- MJO may move from phase 8 to phase 1 with amplitude more than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 310900 UTC

- Broken low/medium clouds with embedded moderate to intense convection over central Bay of Bengal. Scattered low/medium cloud with embedded isolated weak to moderate convection over south Andaman Sea.
  .
- Scattered low/medium clouds with embedded weak to moderate convection over Arabian Sea between Lat 13.5°N to 18.5°N Long 61.0°E to 64.0°E.

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 31 October 2013 shows a northeast-southwest oriented trough in the low levels (upto 700 hPa) over the Bay of Bengal parallel to the east coast of India extending from Coastal Orissa to Tamil Nadu coast. This is likely to persist for the next 24 hours. Troughing is also observed in the easterlies off the west coast of peninsular India in the low levels (850 hPa and below), extending from a low pressure area off the coast of Kerala. Likely to decrease in intensity in the next 48 hours. Under the influence of the active easterly wave over south India, scattered heavy rainfall is likely to persist over south west peninsular India over the next 24 hours, likely to increase in intensity and spread from day 2 onwards especially over the entire south peninsular India. Rainfall is likely to persist over the region on day 4 and 5 also.
  The analysis and forecasts for 24h to 72 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.

- **IMD-WRF** model of 0000 UTC of 31 October 2013 did not run.
  (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
- **ECMWF:** Model shows no cyclogenesis over Bay of Bengal and Arabian Sea during next 4-5 days.

- **METEOFRANCE -ARP:** Model shows that no cyclogenesis seen over bay of Bengal and Arabian sea during next three days.
- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 31 October 2013 indicates there is a zone of strong probability of cyclogenesis off the east-coast of India (16 N and 84 E). This is, in all likelihood, a false alarm. The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**.

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- A trough in lower level easterlies runs from southwest Bay of Bengal to west central Bay of Bengal.

Advisory:

- Model shows no cyclogenesis over Bay of Bengal and Arabian Sea during next 4-5 days. Hence No IOP during next 4 days.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	30/12	**31/00**	**31/03**
India	36/51	29/32	36/51
Coastal stations			
WB	6/9	3/4	6/9
Odisha	6/7	5/5	6/7
AP	13/14	12/13	13/14
Tamil Nadu	7/12	7/7	8/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	11/11	11/11	10/11
Myanmar	9/11	8/11	9/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	8/9	8/9

RS/RW (12Z) of 30/10/2013 13/39

- **No. of Ascents reaching 250 hPa levels:13, MISDA:-26**
- **RS/RW** (00Z) of 31/10/2013 22/39
- **No. of Ascents reaching 250 hPa levels:13 , MISDA:17**

No. of PILOT Ascents

30/12Z	**31/00Z**
24/37	22/34

Buoy Data

30/12Z	**31/00Z**	**31/03Z**
8	8	8

Data Statistics over RMC Chennai Region
No of Synop data

Date→	**30.10.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

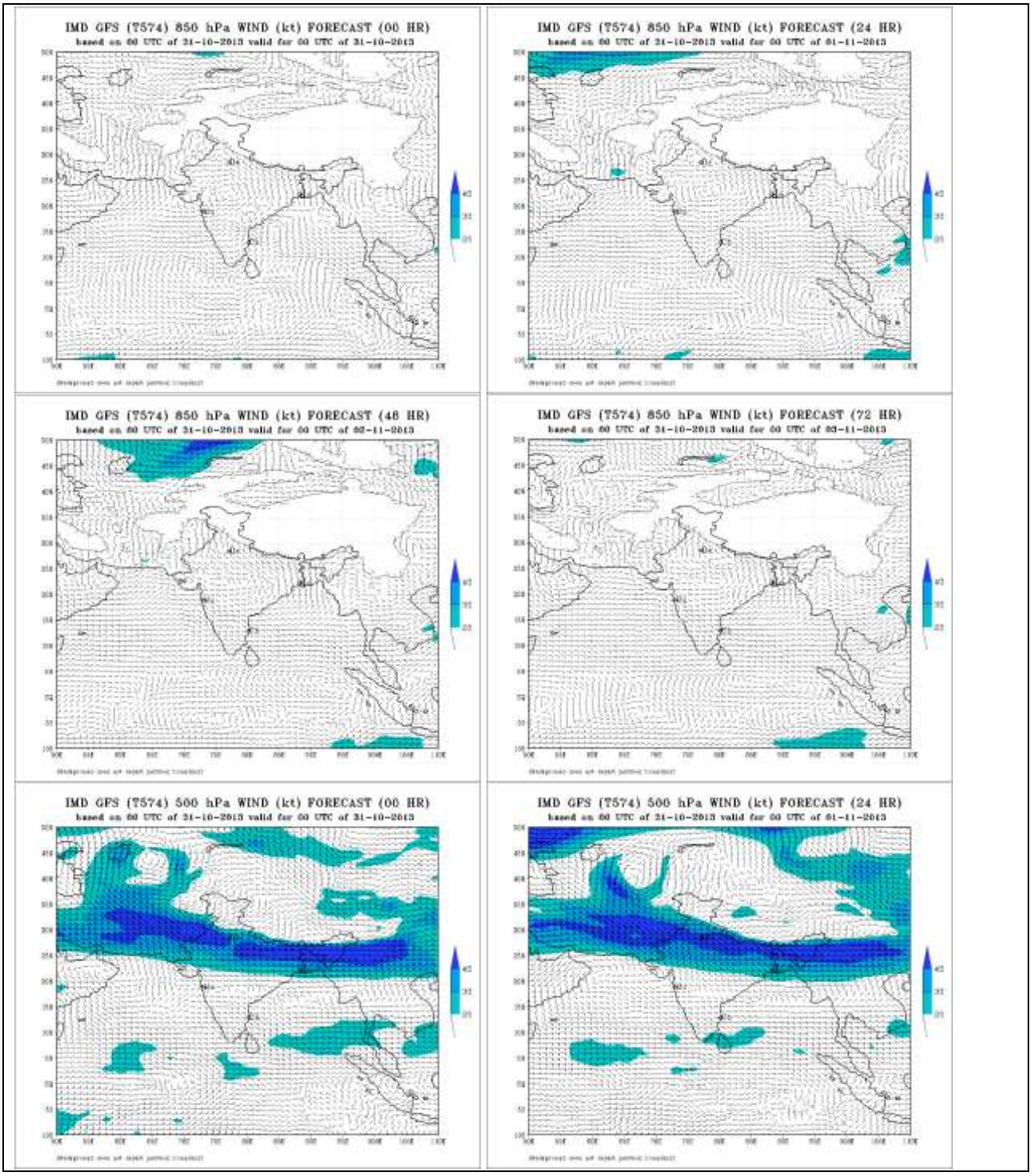
00Z /30.10.2013 : 6
No. of Ascents reaching 250 hPa level =6
MISDA : 2

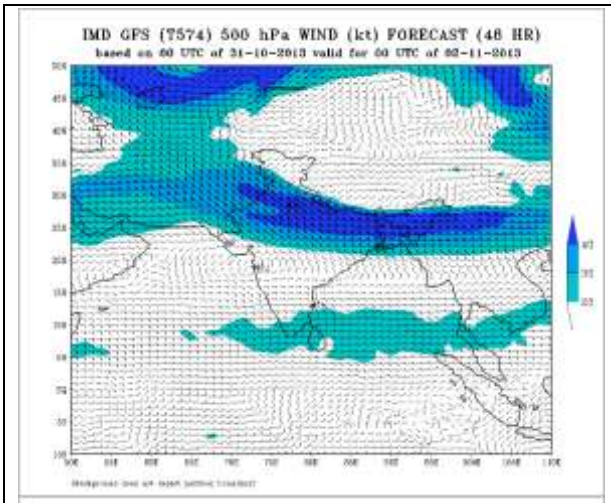
12Z /30.10.2013 : 4
No. of Ascents reaching 250 hPa level =4
MISDA : 4

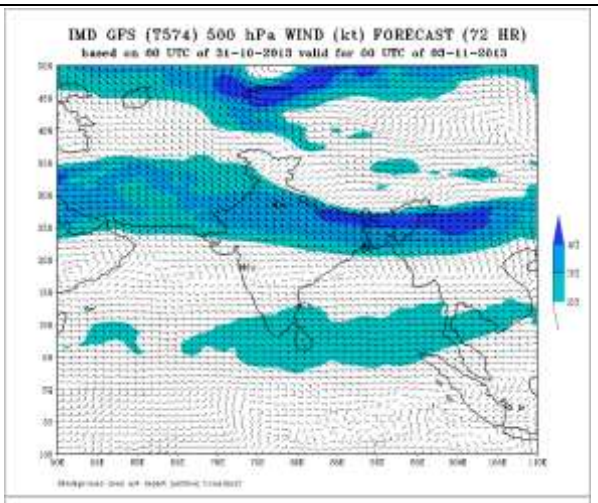
No. of PILOT Ascents:

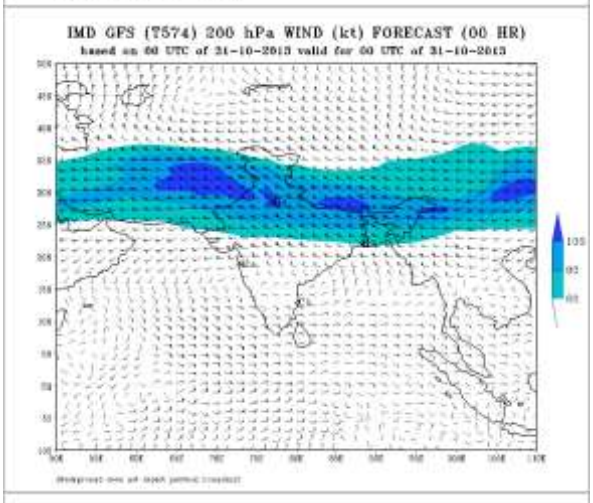
30.10.2013	
06Z	18Z
6	6

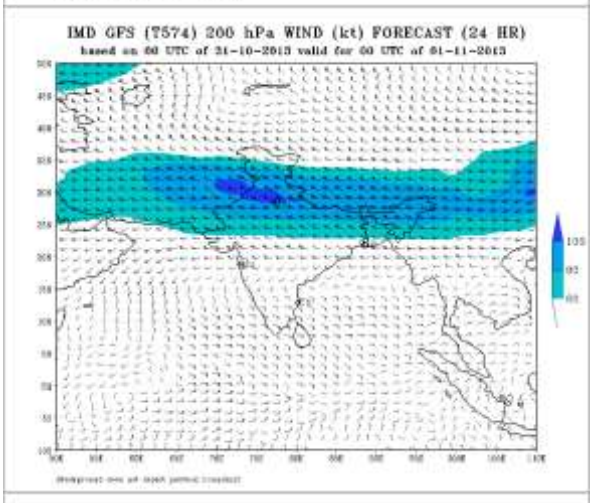
Annexure-II

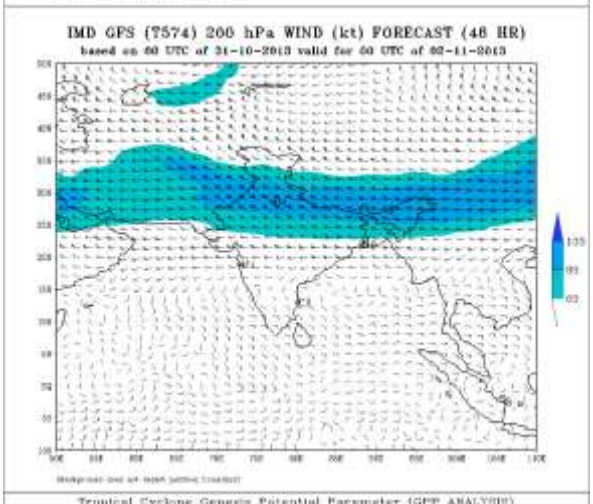

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 31-10-2013 valid for 00 UTC of 31-10-2013
IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 31-10-2013 valid for 00 UTC of 01-11-2013
IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 31-10-2013 valid for 00 UTC of 02-11-2013
IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 31-10-2013 valid for 00 UTC of 03-11-2013
IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 31-10-2013 valid for 00 UTC of 31-10-2013
IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 31-10-2013 valid for 00 UTC of 01-11-2013

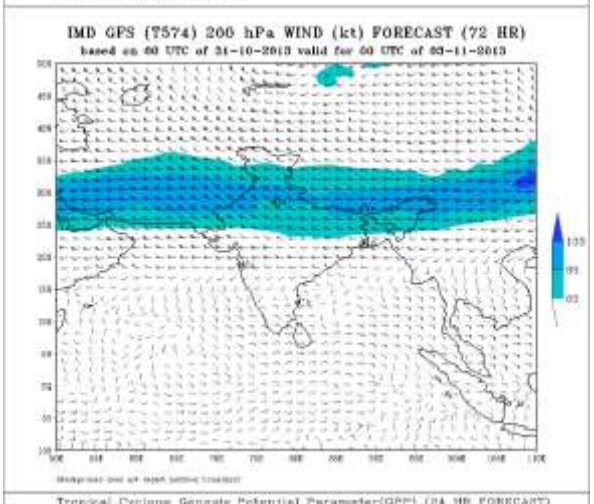

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 31-10-2013 valid for 00 UTC of 02-11-2013

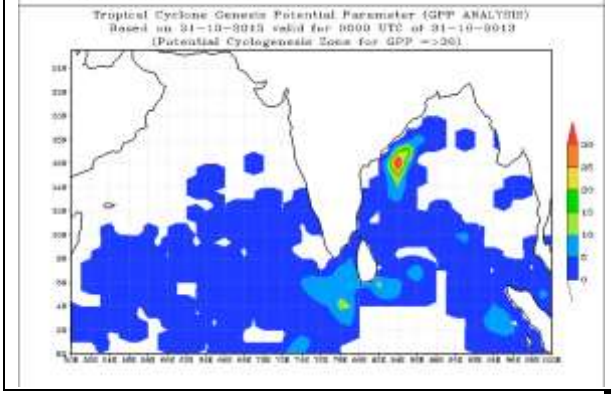

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 31-10-2013 valid for 00 UTC of 03-11-2013

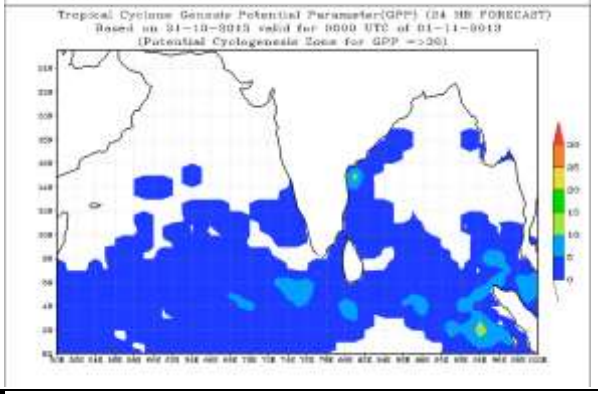

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 31-10-2013 valid for 00 UTC of 31-10-2013

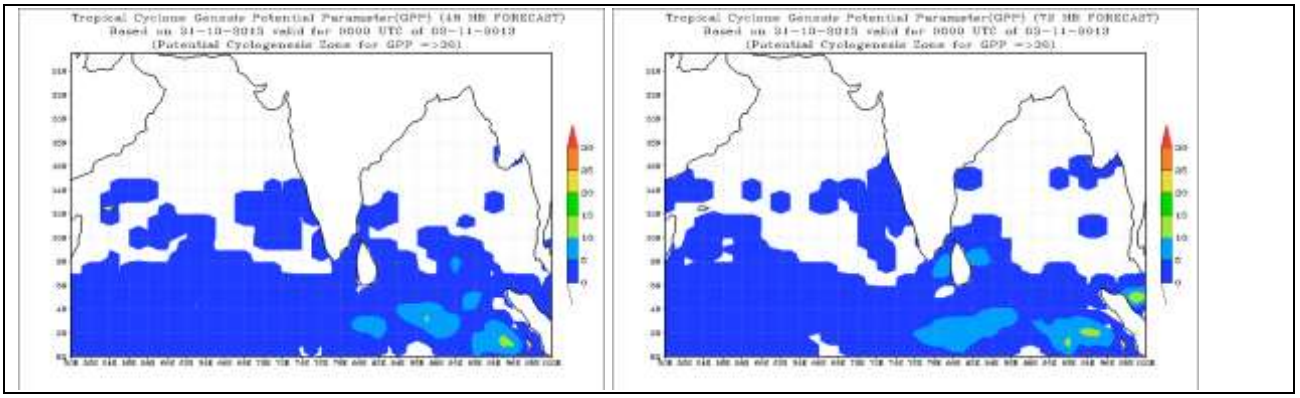

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 31-10-2013 valid for 00 UTC of 01-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 31-10-2013 valid for 00 UTC of 02-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 31-10-2013 valid for 00 UTC of 03-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 31-10-2013 valid for 0000 UTC of 31-10-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 31-10-2013 valid for 0000 UTC of 01-11-2013
(Potential Cyclogenesis Zone for GPP =>20)



FDP (Cyclone) NOC Report Dated 01 November, 2013

Synoptic features based on 0300 UTC:

- The trough in lower level easterlies now extends from southwest Bay of Bengal to west central Bay of Bengal off Tamil Nadu - Andhra Pradesh coasts.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-30^{0}C over Bay of Bengal , warmer over south Bay of Bengal and Andaman Sea.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over southwest, westcentral and north Bay of Bengal and gulf of Martaban. It is 50-90 KJ cm^{-2} over rest Bay except equatorial region where it is 90-120 KJ cm^2.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over a small portion of southwest, westcentral Bay of Bengal It is negative over the rest part of Bay of Bengal and Andaman Sea.

Convergence:

- Lower level convergence is positive of the order of 5*10^{-5} s^{-1} over Bay of Bengal and Andaman sea

Divergence:

- It is negative of the order of -5*10^{-5} s^{-1} over central and south Bay of Bengal and positive of the order of 5*10^{-5} s^{-1} over rest Bay of Bengal and Andaman sea.

Wind Shear:

- Wind Shear is 5-20 knots over south and westcentral Bay and Andaman sea and 20-50 knots over North Bay of Bengal.

Wind Shear Tendency:

- Shear Tendency is decreasing over central and south Bay of Bengal and increasing over rest Bay of Bengal and Andaman Sea.

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 16.0°N.

M.J.O. Index:

- Located in phase 8 with amplitude more than 1.0.
- Dynamical forecast:- MJO may move from phase 8 to phase 1 with amplitude more than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 010900 UTC

- Scattered low/medium clouds with embedded isolated weak to moderate convection over westcentral Bay of Bengal.
  .
- Scattered low/medium clouds with embedded isolated weak convection over Arabian Sea off Kerala coast and south Arabian sea.

NWP Analysis

• **IMD-GFS** model analysis of 0000 UTC of 01 November 2013 shows a northeast-southwest oriented trough in the low levels (upto 700 hPa) over the Bay of Bengal parallel to the east coast of India extending from Coastal Orissa to Tamil Nadu coast. This is likely to persist for the next 48 hours. Troughing is also observed in the easterlies off the west coast of peninsular India in the low levels (850 hPa and below), along the west peninsular coast of India. The trough is likely to decrease in intensity in the next 24 hours. Under the influence of the active easterly wave over south India, scattered moderate rainfall is likely to persist over south peninsular India over the next 24 hours, likely to increase in intensity and spread on day 2 over the west coast before decreasing there and increasing in spread and intensity over the south east peninsular coast on day 3 onwards.

The analysis and forecasts for 24h to 72 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.

• **IMD-WRF** model of 0000 UTC of 01 November 2013 also shows the two troughs along the east and west peninsular coasts. However, unlike the GFS forecast, rainfall amount decreases on the west peninsular coast from day 2 onwards and increases over the east peninsular coast.

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **ECMWF:** Model shows no cyclogenesis over Bay of Bengal and Arabian Sea during next 4-5 days.

- **METEOFRANCE -ARP:** Model shows that no cyclogenesis seen over bay of Bengal and Arabian sea during next three days.
- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 01 November 2013 indicates there is probability of cyclogenesis in the seas off the coast of India. This is, in all likelihood, a false alarm. The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**.
  (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- The trough in lower level easterlies extends from southwest Bay of Bengal to west central Bay of Bengal off Tamil Nadu - Andhra Pradesh coasts.

Advisory:

- Model shows no cyclogenesis over Bay of Bengal and Arabian Sea during next 4-5 days. Hence No IOP during next 4 days.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	30/12	**31/00**	**31/03**
India	35/51	31/32	40/51
Coastal stations			
WB	6/9	5/9	6/9
Odisha	6/7	5/5	6/7
AP	13/13	12/13	13/13
Tamil Nadu	8/12	7/7	10/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	11/11	11/11	10/11
Myanmar	10/11	10/11	10/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	8/9	8/9

RS/RW (12Z) of 31/10/2013 14/39

- **No. of Ascents reaching 250 hPa levels:13, MISDA:-26**
- **RS/RW** (00Z) of 01/11/2013 22/39
- **No. of Ascents reaching 250 hPa levels:13 , MISDA:17**

No. of PILOT Ascents

31/12Z	01/00Z
24/37	22/34

Buoy Data

31/12Z	01/00Z	01/03Z
8	8	8

Data Statistics over RMC Chennai Region
No of Synop data

Date→	**31.10.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

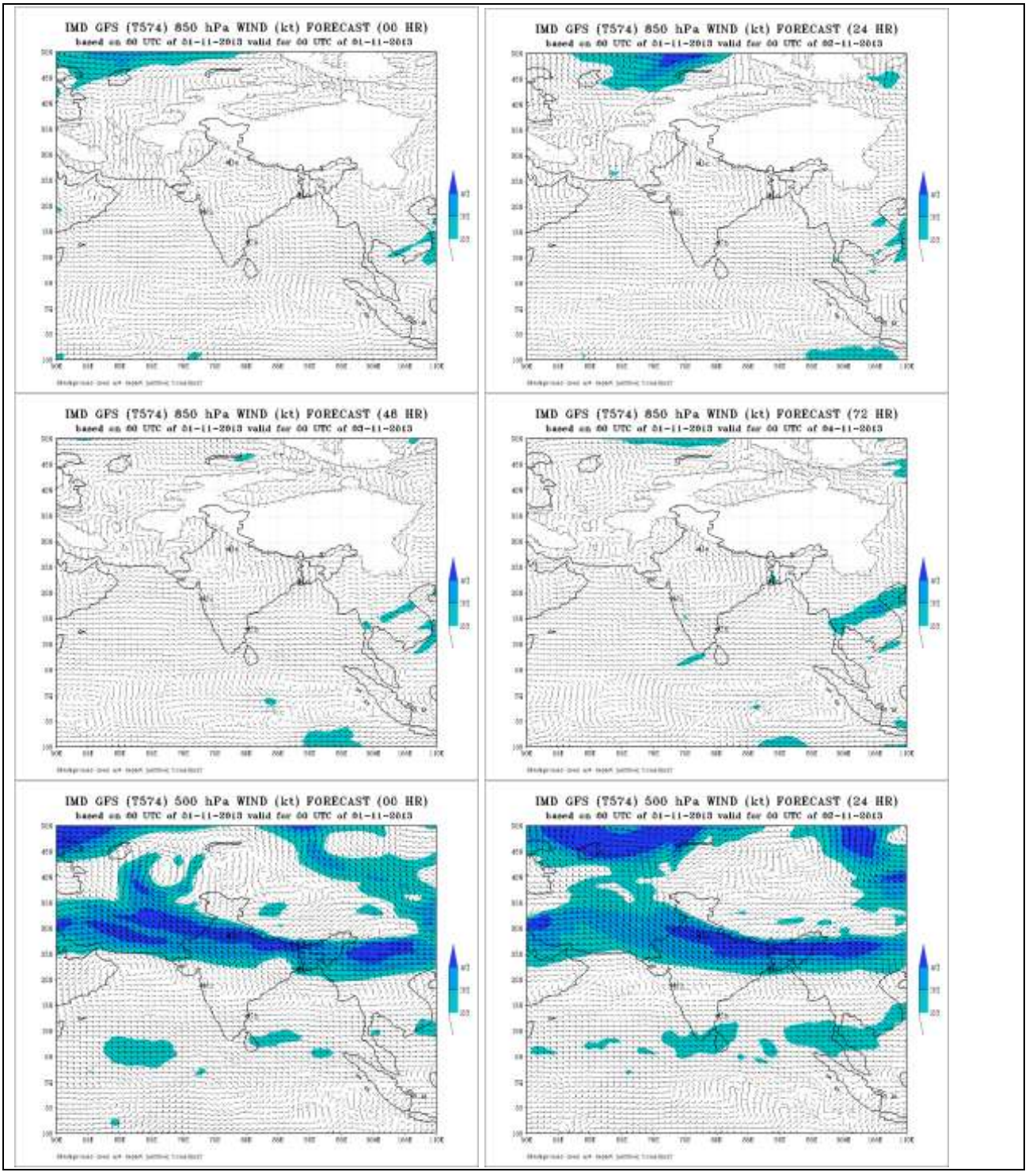
00Z /31.10.2013 : 5
No. of Ascents reaching 250 hPa level =5
MISDA : 3

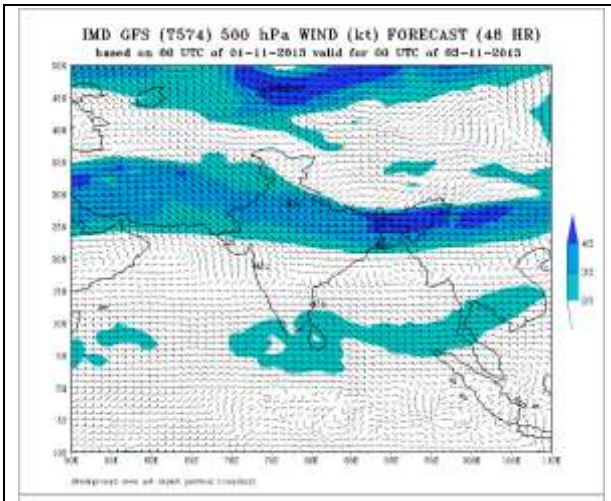
12Z /31.10.2013 : 4
No. of Ascents reaching 250 hPa level =4
MISDA : 4

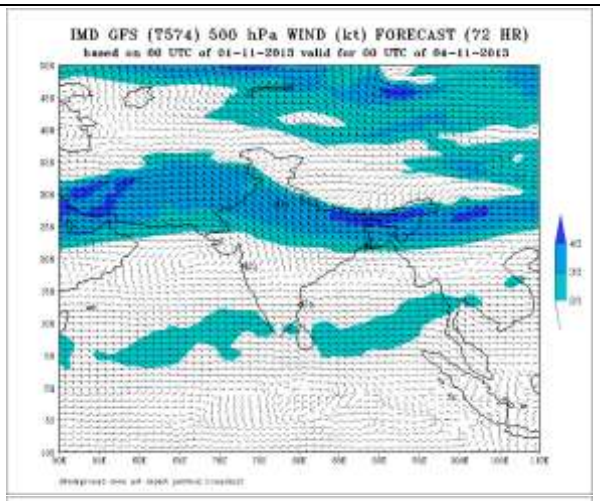
No. of PILOT Ascents:

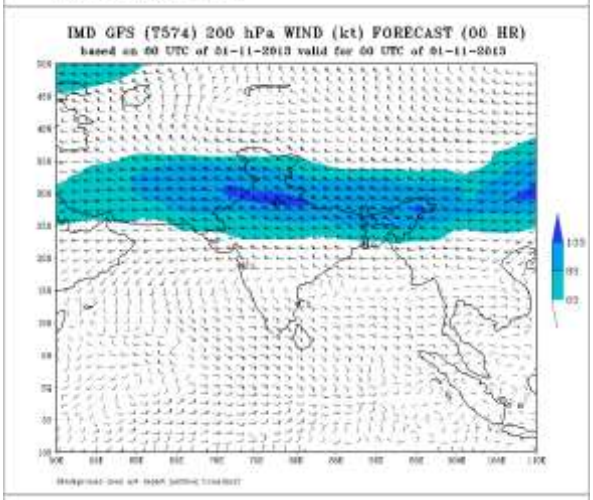
31.10.2013	
06Z	18Z
6	5

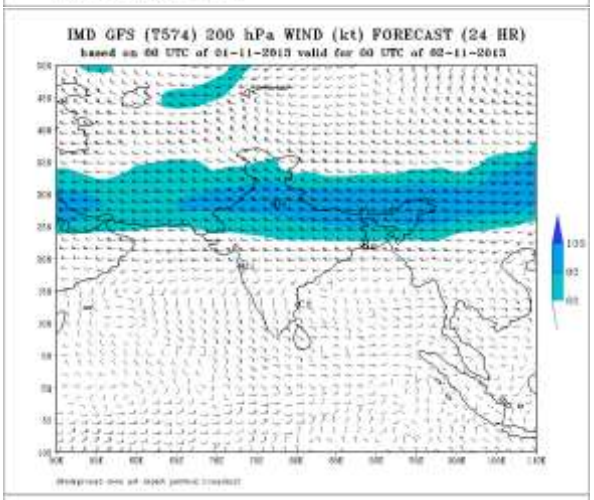
Annexure-II

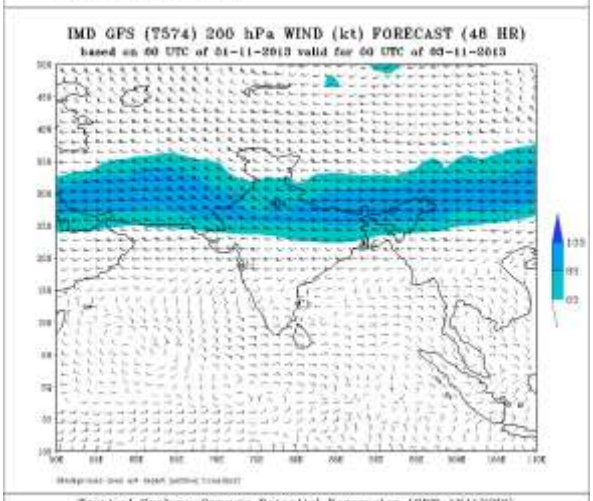

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
IMD GPS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
IMD GPS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
IMD GPS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
IMD GPS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
IMD GPS (T574) 500 hPa WIND (kt) FORECAST (24 HR)

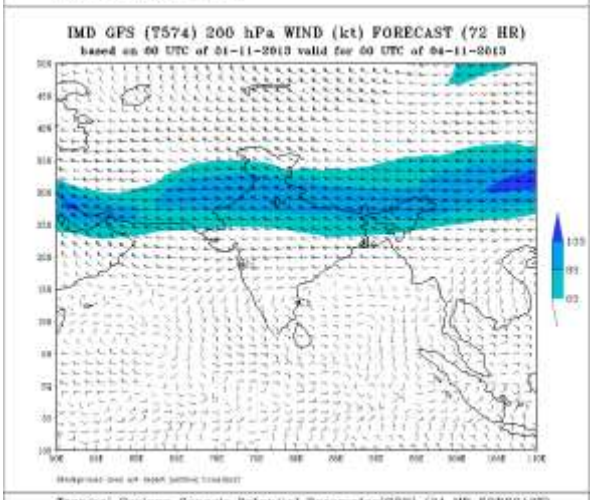

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 01-11-2013 valid for 00 UTC of 03-11-2013

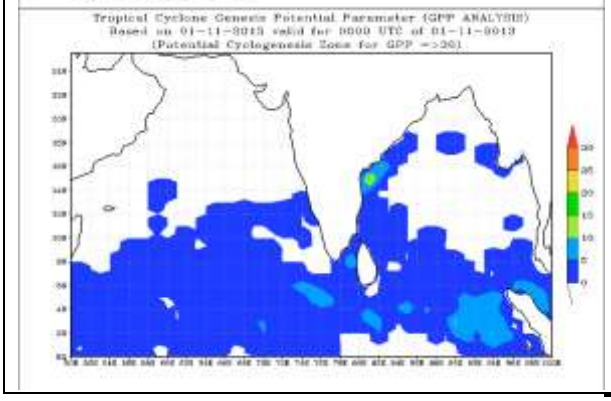

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 01-11-2013 valid for 00 UTC of 04-11-2013

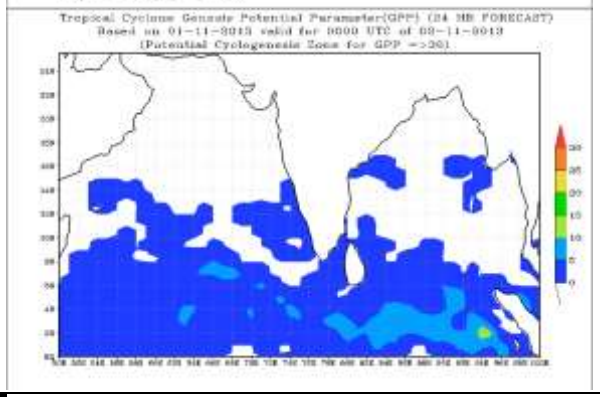

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 01-11-2013 valid for 00 UTC of 01-11-2013

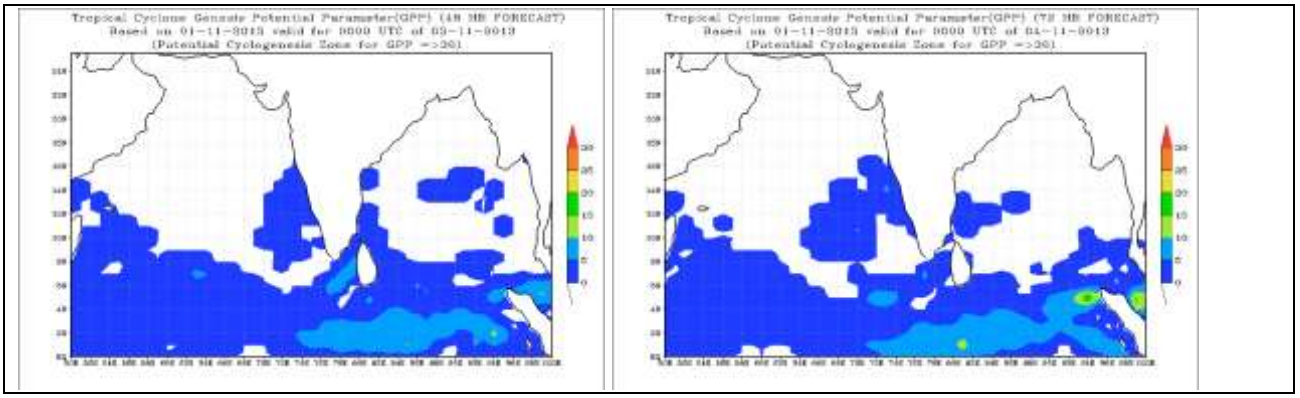

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 01-11-2013 valid for 00 UTC of 02-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 01-11-2013 valid for 00 UTC of 03-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 01-11-2013 valid for 00 UTC of 04-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 01-11-2013 valid for 0000 UTC of 01-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 01-11-2013 valid for 0000 UTC of 02-11-2013
(Potential Cyclogenesis Zone for GPP =>20)



FDP (Cyclone) NOC Report Dated 02 November, 2013

Synoptic features based on 0300 UTC:

- The trough in lower level easterlies from southwest Bay of Bengal to west central Bay of Bengal off Tamil Nadu - Andhra Pradesh coasts now extends from southwest Bay of Bengal and adjoining coastal areas of Tamil Nadu to west central Bay of Bengal and adjoining coastal Andhra Pradesh.
- A cyclonic circulation extending upto 0.9 km a.s.l. lies over Lakshadweep area and neighbourhood.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-30^{0}C over Bay of Bengal , warmer over south Bay of Bengal and Andaman Sea.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over southwest, westcentral and North Bay of Bengal and gulf of Martaban. It is 50-90 KJ cm^{-2} over rest Bay except equatorial region where it is 90-120 KJ cm^2.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over a small portion of westcentral, Andaman sea, northeast Bay of Bengal and gulf of Martaban. It is negative over the rest part of Bay of Bengal.

Convergence:

- Lower level convergence is negative of the order of -5*10^{-5} s^{-1} over central Bay of Bengal and positive of the order of 5*10^{-5} s^{-1} over rest Bay of Bengal and Andaman sea

Divergence:

- It is positive of the order of 5*10^{-5} s^{-1} over Bay of Bengal and Andaman sea.

Wind Shear:

- Wind Shear is 5-20 knots over south Bay, central Bay and Andaman sea and 30-50 knots over North Bay of Bengal.

Wind Shear Tendency:

- Shear Tendency is decreasing over southeast Bay of Bengal and increasing over rest Bay of Bengal and Andaman Sea.

Upper tropospheric ridge:

- The upper tropospheric **ridge** line at 200 hPa passes through lat 14.0°N.

M.J.O. Index:

- Located in phase 1 with amplitude more than 1.0.
- Dynamical forecast:- MJO may continue in phase 1 with amplitude more than 1.0 during next 4-5 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 020600 UTC

- Broken low/medium clouds with embedded Moderate to intense convection over south Bay south of lat 10.0°N west of long 90.0°E and Andman Sea.

- Scattered low/medium clouds with embedded moderate to intense convection over southeast Arabian Sea off Kerala coast.

NWP Analysis

• **IMD-GFS** model analysis of 0000 UTC of 02 November 2013 shows a northeast-southwest oriented trough in the low levels (upto 925 hPa) over the Bay of Bengal parallel to the east coast of India extending from Coastal Andhra Pradesh to Tamil Nadu coast. This is likely to persist for the next 48 hours. Weak trough is also observed in the easterlies off the west coast of peninsular India in the low levels (850 hPa and below), along the west peninsular coast of India. The trough is likely to decrease in intensity in the next 24 hours. Under the influence of the active easterly wave over south India, scattered moderate rainfall is likely to persist over south peninsular India over the next 24 hours, likely to increase in spread on day 2 onwards over the south east peninsular coast.

The analysis and forecasts for 24h to 72 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.

• **IMD-WRF** model of 0000 UTC of 02 November 2013 also shows the two troughs along the east and west peninsular coasts. Under the influence of the active easterly wave, moderate scattered rainfall is likely over south peninsular India on day 1. Similar to the GFS forecast, rainfall amount decreases on the west peninsular coast from day 2 onwards and increases over the east peninsular coast.

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **ECMWF:** Model shows no cyclogenesis over Bay of Bengal and Arabian Sea during next 4-5 days.

- **METEOFRANCE -ARP:** Model shows that no cyclogenesis seen over bay of Bengal and Arabian sea during next three days.
- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 02 November 2013 indicates there is no probability of cyclogenesis in the Arabian Sea and Bay of Bengal. The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**.

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- The trough in lower level easterlies extends from southwest Bay of Bengal and adjoining coastal areas of Tamil Nadu to west central Bay of Bengal and adjoining coastal Andhra Pradesh.
- A cyclonic circulation extending upto 0.9 km a.s.l. lies over Lakshadweep area and neighbourhood.

Advisory:

- Model shows no cyclogenesis over Bay of Bengal and Arabian Sea during next 4-5 days. Hence No IOP during next 4 days.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	01/12	**02/00**	**02/03**
India	36/51	30/32	42/51
Coastal stations			
WB	6/9	5/9	6/9
Odisha	6/7	5/5	6/7
AP	13/13	12/13	13/13
Tamil Nadu	9/12	7/7	10/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	11/11	11/11	10/11
Myanmar	10/11	10/11	10/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	8/9	8/9

RS/RW (12Z) of 01/11/2013 14/39

- **No. of Ascents reaching 250 hPa levels:13, MISDA:-26**
- **RS/RW** (00Z) of 02/11/2013 22/39
- **No. of Ascents reaching 250 hPa levels:13 , MISDA:17**

No. of PILOT Ascents

01/12Z	**02/00Z**
24/37	22/34

Buoy Data

01/12Z	**02/00Z**	**02/03Z**
8	8	8

Data Statistics over RMC Chennai Region
No of Synop data

Date→	**01.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**19**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

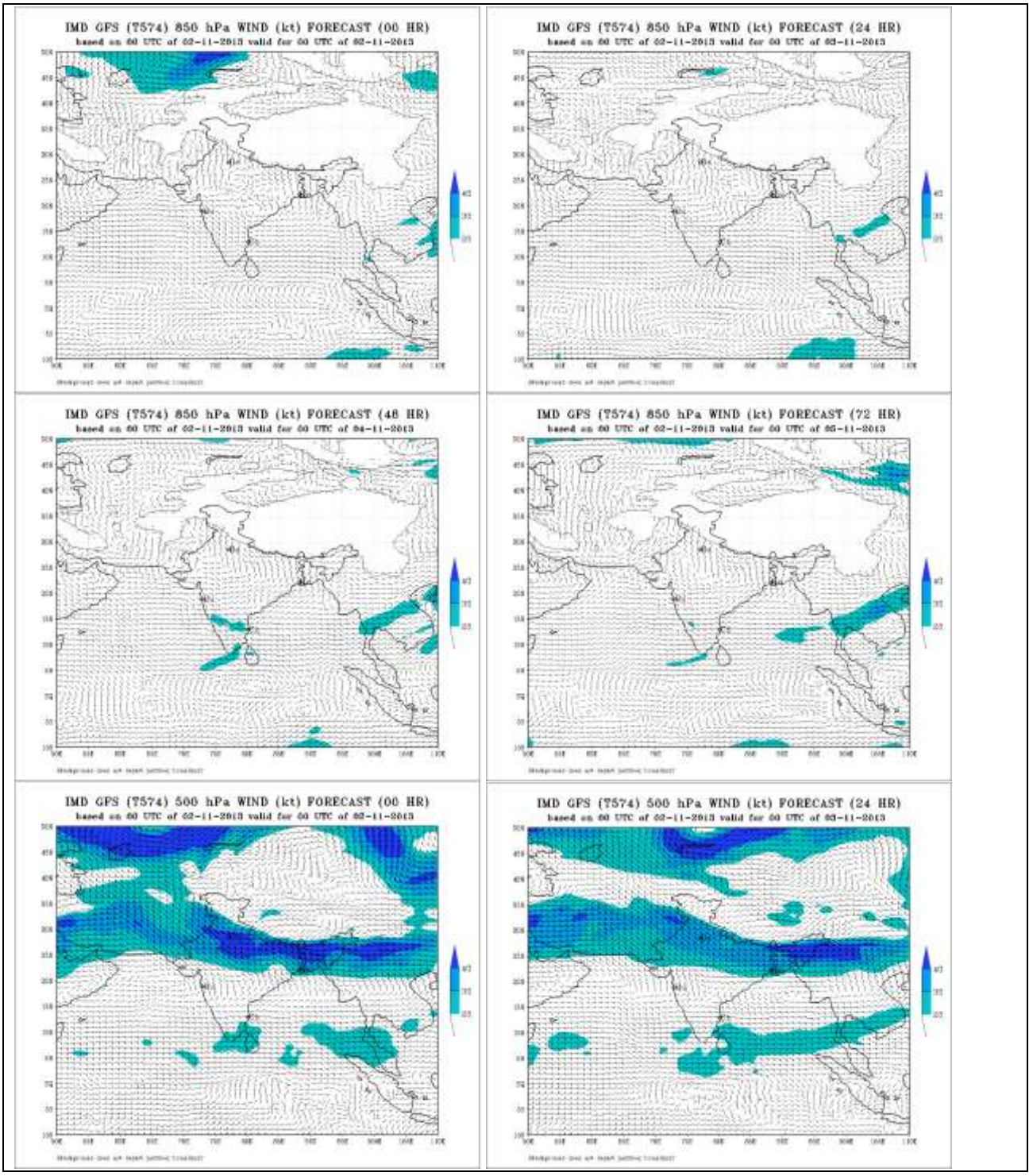
00Z /01.11.2013 : 6
No. of Ascents reaching 250 hPa level =5
MISDA : 2

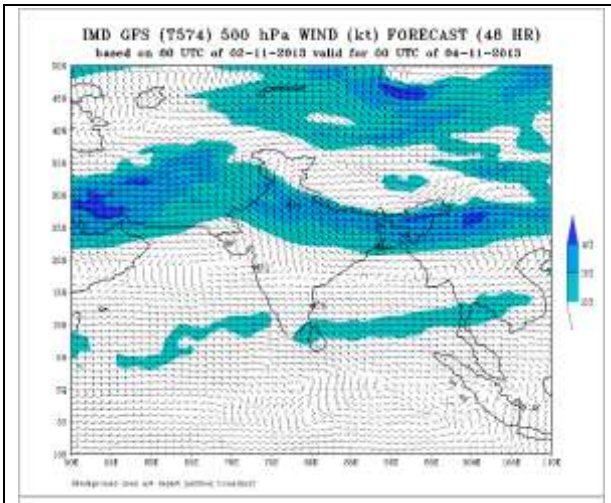
12Z /01.11.2013 : 4
No. of Ascents reaching 250 hPa level =4
MISDA : 4

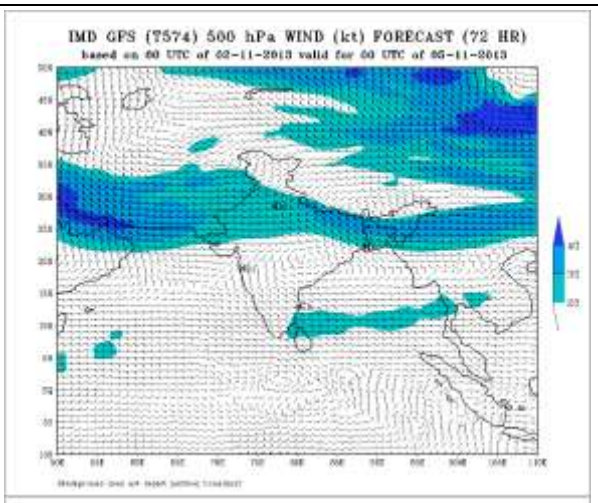
No. of PILOT Ascents:

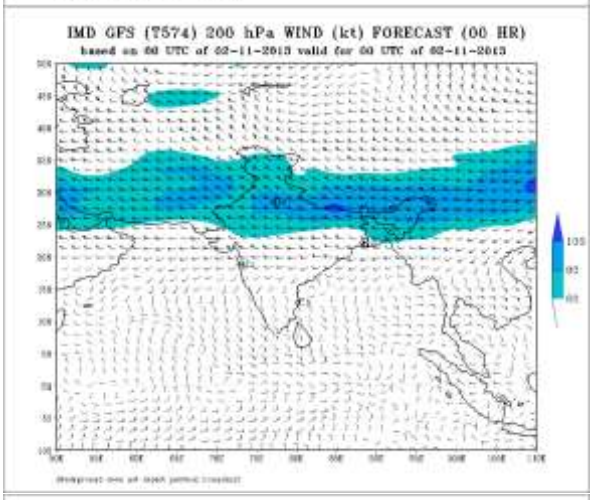
01.11.2013	
06Z	18Z
4	5

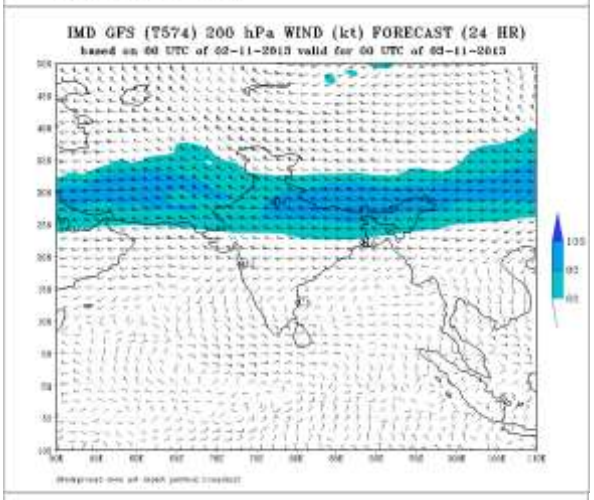
Annexure-II

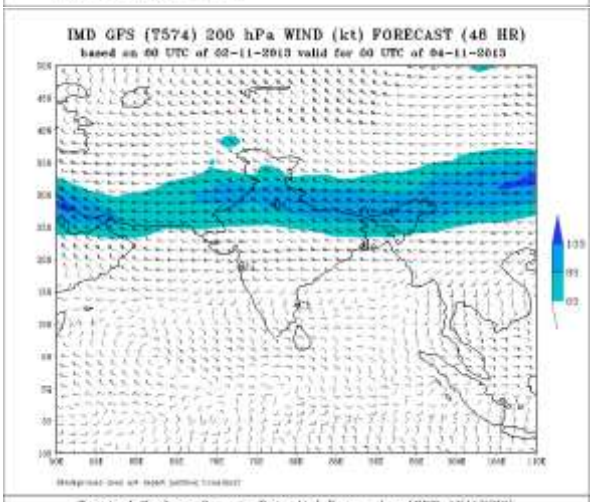

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)

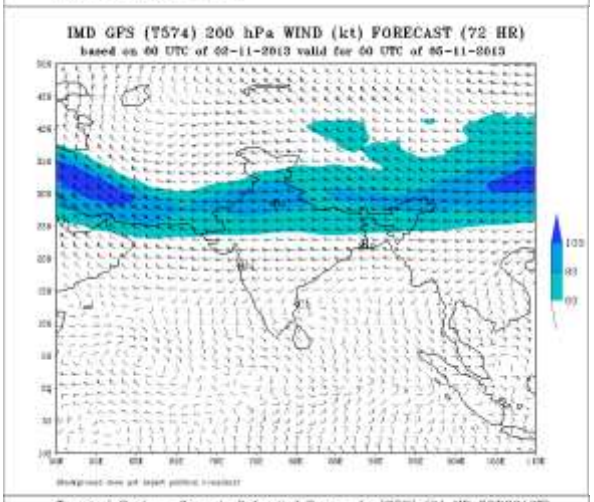

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 02-11-2013 valid for 00 UTC of 04-11-2013

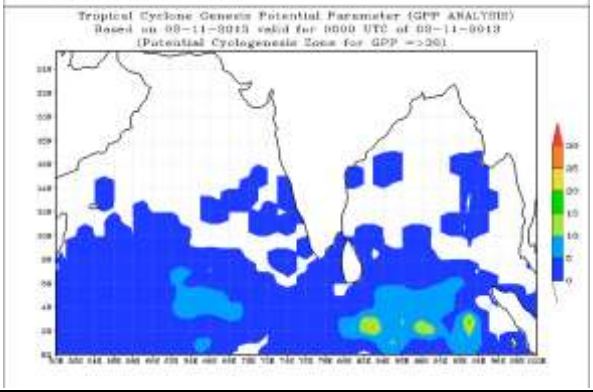

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 02-11-2013 valid for 00 UTC of 05-11-2013

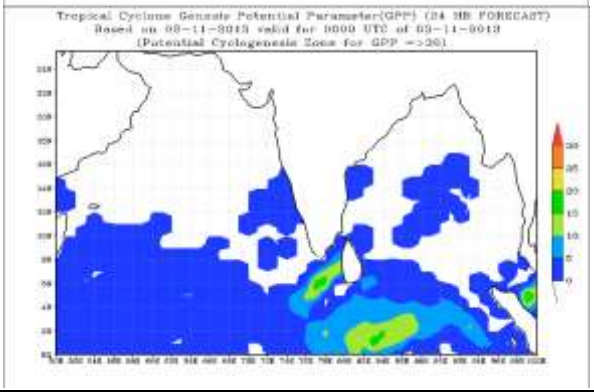

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 02-11-2013 valid for 00 UTC of 02-11-2013

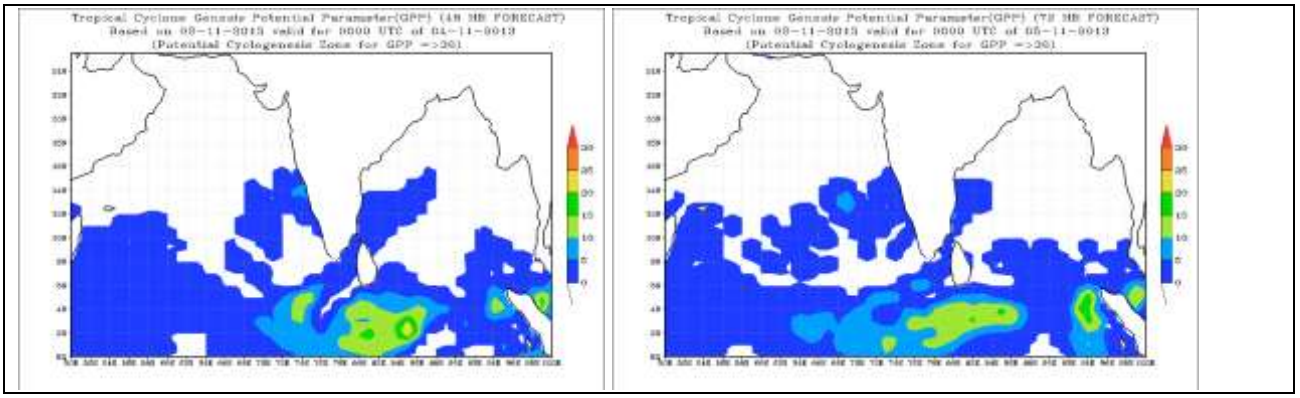

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 02-11-2013 valid for 00 UTC of 03-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 02-11-2013 valid for 00 UTC of 04-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 02-11-2013 valid for 00 UTC of 05-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 00-11-2013 valid for 0000 UTC of 00-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 00-11-2013 valid for 0000 UTC of 03-11-2013
(Potential Cyclogenesis Zone for GPP =>20)



FDP (Cyclone) NOC Report Dated 03 November, 2013

Synoptic features based on 0300 UTC:

- The trough in lower level easterlies from southwest Bay of Bengal and adjoining coastal areas of Tamil Nadu to west central Bay of Bengal and adjoining coastal Andhra Pradesh now extends from Comorin area to west central Bay of Bengal across southwest Bay of Bengal.
- The cyclonic circulation over Lakshadweep area and neighbourhood now lies as a trough in the lower level easterlies from Lakshadweep area to east central Arabian Sea.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-30^{0}C over Bay of Bengal, warmer over south Bay of Bengal and Andaman Sea.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over southwest, westcentral and North Bay of Bengal and gulf of Martaban. It is 50-90 KJ cm^{-2} over rest Bay except equatorial region where it is 90-120 KJ cm^2.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over a small portion of westcentral, Andaman sea, northeast Bay of Bengal and equatorial region. It is negative over the rest part of Bay of Bengal.

Convergence:

- Lower level convergence is positive of the order of 5*10^{-5} s^{-1} over southwest Bay and negative of the order of -5*10^{-5} s^{-1} north Andaman Sea.

Divergence:

- It is negative of the order of 5*10^{-5} s^{-1} over north Andaman sea.

Wind Shear:

- Wind Shear is 5-10 knots over south Bay and Andaman sea and 20-40 knots over North Bay ans central Bay of Bengal.

Wind Shear Tendency:

- Shear Tendency is increasing over southeast Bay of Bengal and decreasing over rest Bay of Bengal and Andaman Sea.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 13.0°N.

M.J.O. Index:

- Located in phase 1 with amplitude more than 1.0.

- Dynamical forecast:- MJO may move to phase 2 with amplitude less than 1.0 during next 4-5 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 030900 UTC

- Scattered low/medium clouds with embedded isolated weak to moderate convection over west central Bay of Bengal and south Andaman Sea.

- Broken low/medium clouds with embedded moderate to intense convection over southeast Arabian.

NWP Analysis

• **IMD-GFS** model analysis of 0000 UTC of 03 November 2013 shows a north-east to south-west oriented trough off the east coast of India extending from coastal Andhra Pradesh to coastal Tamil Nadu. The trough is likely to decrease in intensity over the next 2-3 days. Under the effect of the active easterly wave, scattered moderate rainfall is likely to occur along the east coast of India. The rainfall is likely to increase in intensity on day 2 before decreasing thereafter. However model suggest that a low pressure area is likely to emerge in the Andaman Sea around 9th November 2013. The analysis and forecasts for 24h to 96 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.

• **IMD-WRF** model analysis of 0000 UTC of 03 November 2013 also shows a trough off the east coast of India. However, unlike the GFS forecast, fairly widespread light rainfall is seen all over the south peninsula. Rainfall on day 1. Rainfall is likely to shift to over the east peninsular coast and increase in intensity on day 2 onwards..

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **ECMWF:** Model shows no cyclogenesis over Bay of Bengal and Arabian Sea during next 4-5 days.

- **METEOFRANCE -ARP:** Model shows that no cyclogenesis seen over bay of Bengal and Arabian sea during next three days.
- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 03 November 2013 indicates there is no likelihood of cyclogenesis in the seas around the Indian peninsula over the next three days. However on day 4 onwards there is a probable region of cyclogenesis centred at 5N, 70 E. The zone is likely to move in a west-northwesterly direction over the next few days. GPP charts for analysis and forecasts for 24h to 96 h are shown in **Annexure II**.
- (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- IMD-GFS model suggests that a low pressure area is likely to emerge in the Andaman Sea around 9th November 2013.

Advisory:

- No IOP during next 4 days.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	02/12	03/00	03/03
India	37/51	31/32	42/51
Coastal stations			
WB	6/9	5/9	6/9
Odisha	6/7	5/5	6/7
AP	13/13	12/13	13/13
Tamil Nadu	9/12	7/7	10/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	11/11	11/11	10/11
Myanmar	10/11	10/11	10/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	8/9	8/9

RS/RW (12Z) of 02/11/2013 13/39

- **No. of Ascents reaching 250 hPa levels:13, MISDA: 26**
- **RS/RW** (00Z) of 03/11/2013 22/39
- **No. of Ascents reaching 250 hPa levels:18 , MISDA:17**

No. of PILOT Ascents

02/12Z	03/00Z
25/37	17/34

Buoy Data

02/12Z	03/00Z	03/03Z
10	9	10

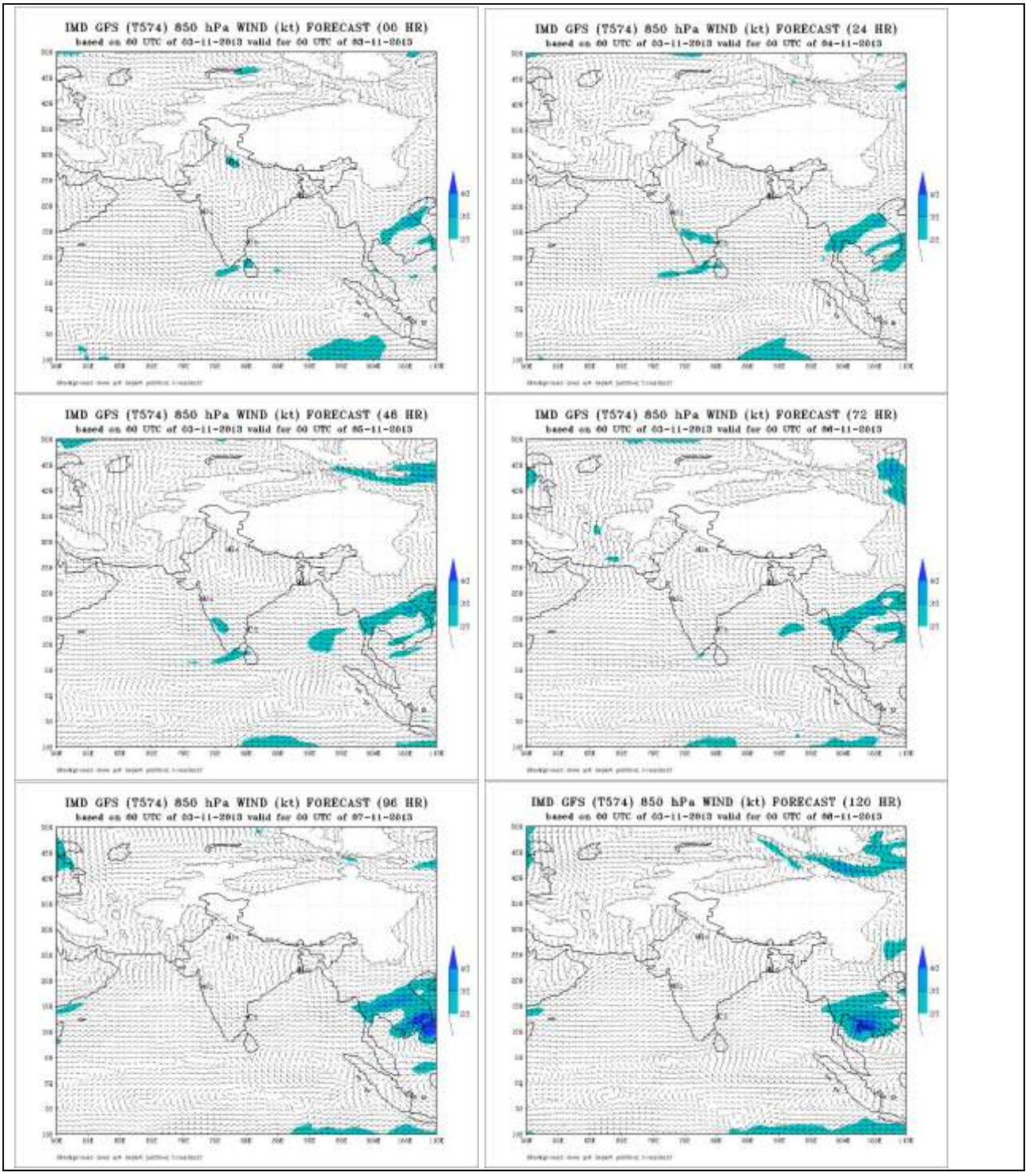
Data Statistics over RMC Chennai Region
No of Synop data

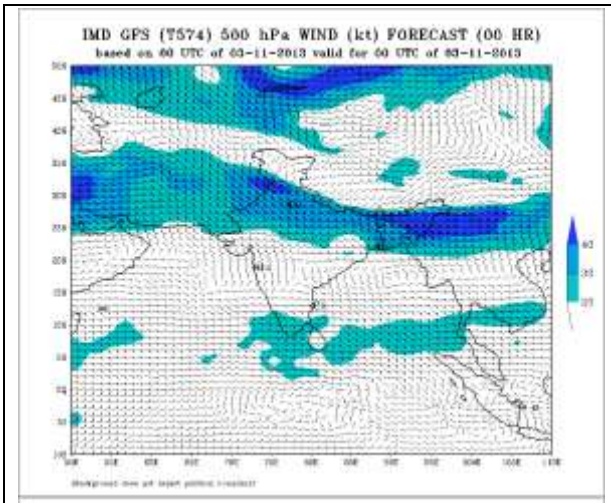
Date→	**02.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

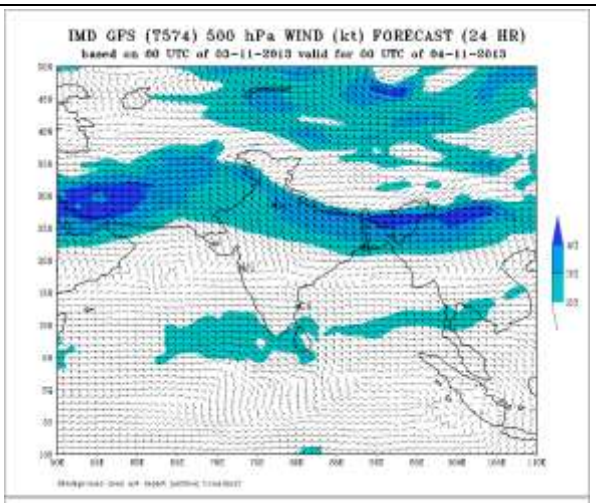
No. of RS/RW Ascents
00Z /02.11.2013 : 6
No. of Ascents reaching 250 hPa level =6
MISDA : 2
12Z /02.11.2013 : 2
No. of Ascents reaching 250 hPa level =2
MISDA : 6
No. of PILOT Ascents:

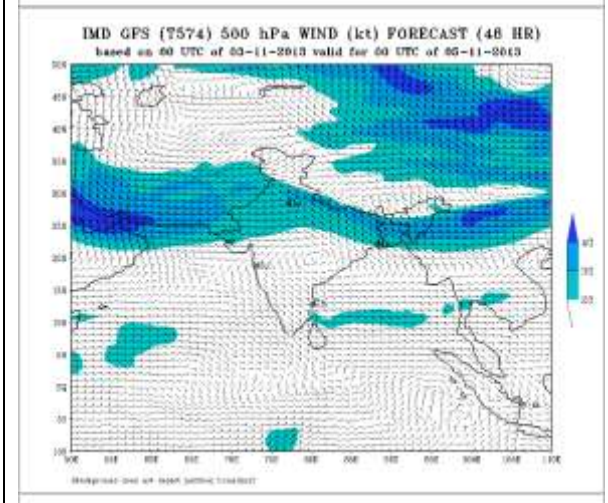
02.11.2013	
06Z	18Z
4	4

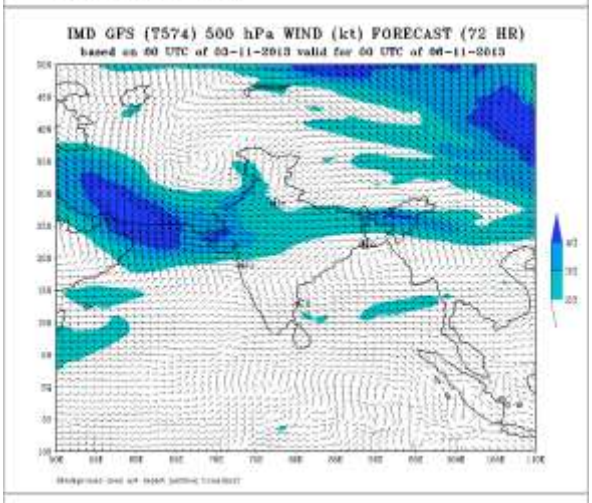
Annexure-II

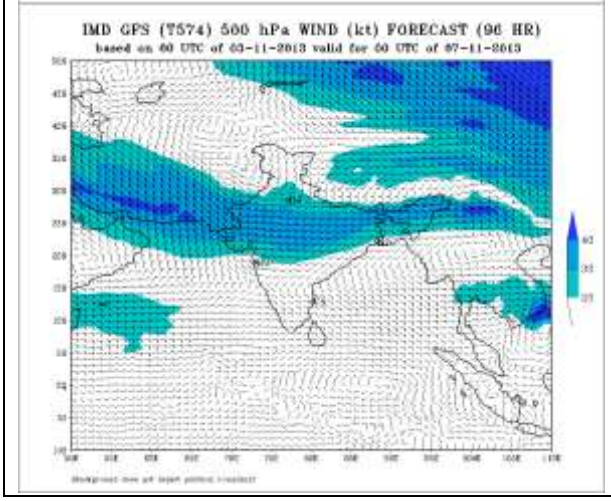

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 03-11-2013
IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 04-11-2013
IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 05-11-2013
IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 06-11-2013
IMD GFS (T574) 850 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 07-11-2013
IMD GFS (T574) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 08-11-2013

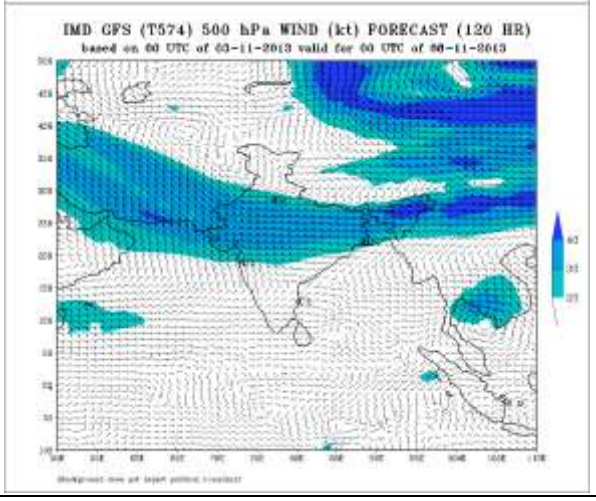

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 03-11-2013

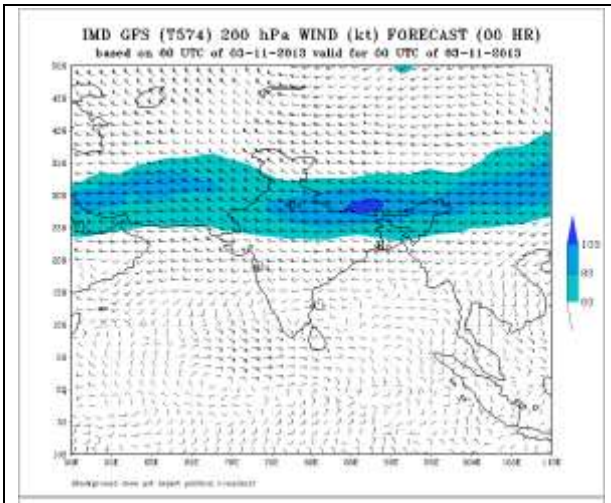

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 04-11-2013

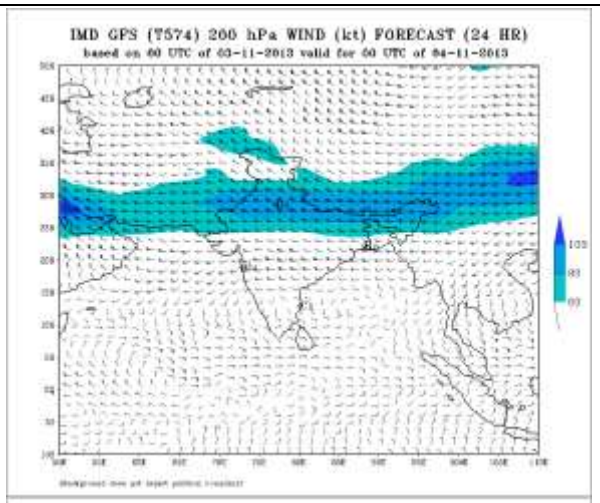

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 05-11-2013

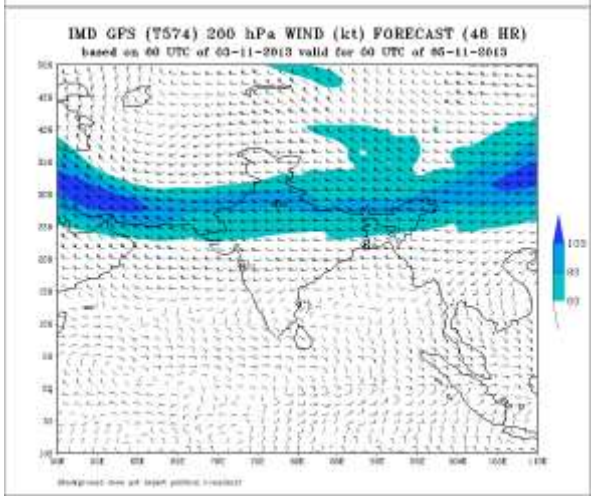

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 06-11-2013

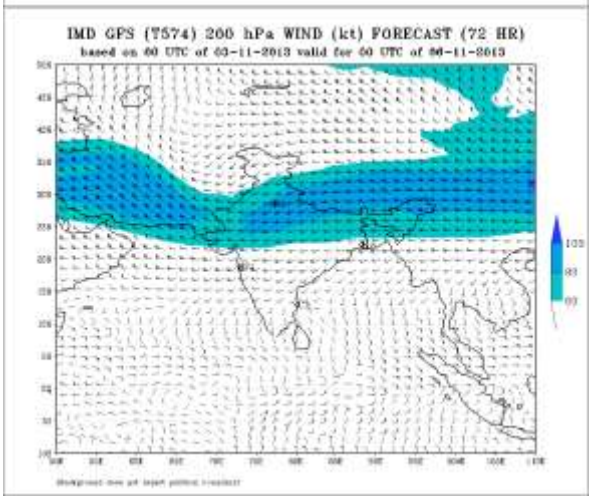

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 07-11-2013

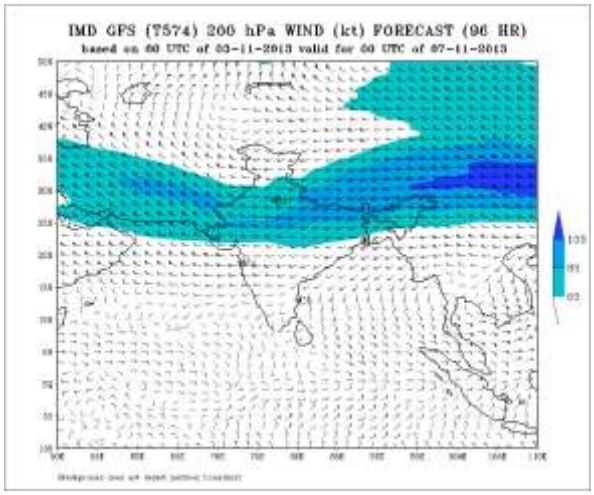

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 08-11-2013

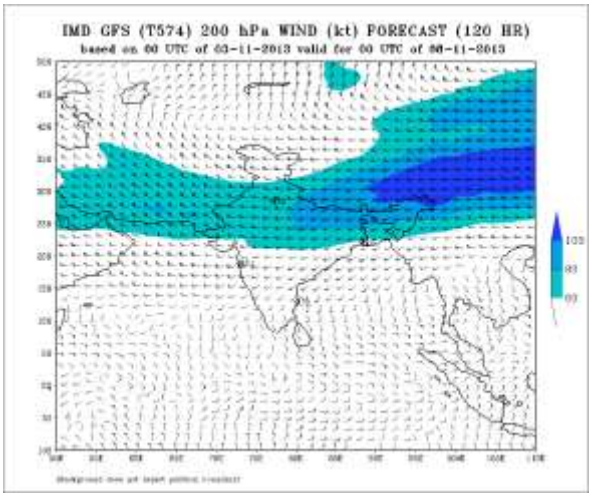

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 03-11-2013

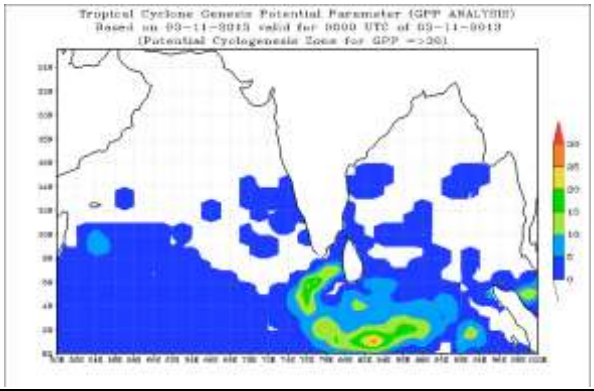

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 04-11-2013

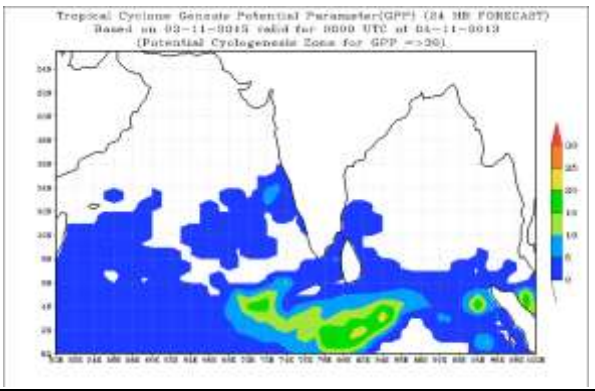

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 05-11-2013

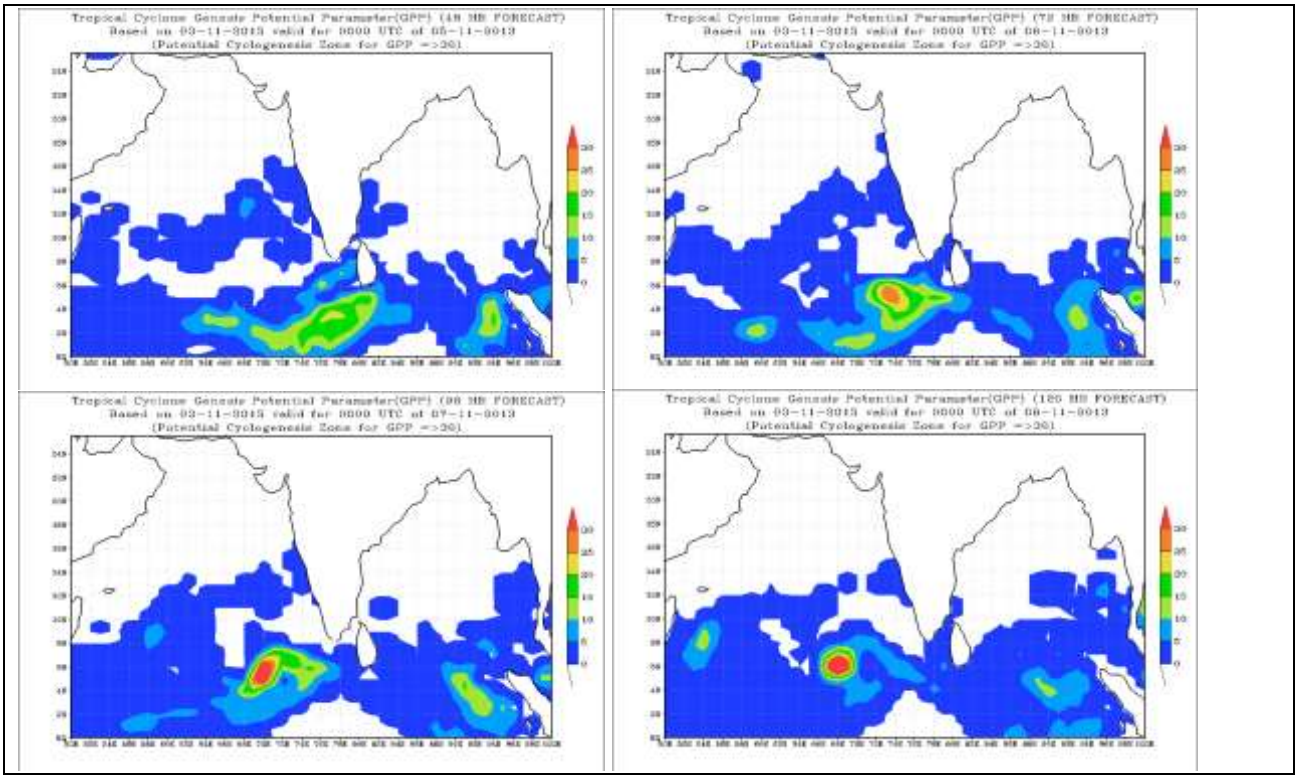

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 06-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 07-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 03-11-2013 valid for 00 UTC of 08-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 03-11-2013 valid for 0000 UTC of 03-11-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 03-11-2013 valid for 0000 UTC of 04-11-2013
(Potential Cyclogenesis Zone for GPP =>26)



FDP (Cyclone) NOC Report Dated 04 November, 2013

Synoptic features based on 0300 UTC:

- The trough in the lower level easterlies from Lakshadweep area to east central Arabian Sea now lies as a trough of low at mean sea level from Lakshadweep–Maldives areas to east central Arabian Sea.
- Yesterday's trough in the lower level easterlies from Comorin area to west central Bay of Bengal moved westwards and merged with the above trough of low.
- Another trough of low at mean sea level extends from southwest Bay of Bengal to west central Bay of Bengal along Sri Lanka-Tamil Nadu coasts.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-30^{0}C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over southwest, westcentral except Tamilnadu and Andhra Pradesh coast and North Bay of Bengal . It is 50-90 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over a small portion of, northeast Bay of Bengal, Andaman sea and equatorial region. It is negative over the rest part of Bay of Bengal.

Convergence:

- Lower level convergence is positive of the order of 5*10^{-5} s^{-1} over southwest Bay, commorin area and south of Andaman Sea.

Divergence:

- It is positive of the order 5-10*10^{-5} s^{-1}over commorin area and south of Andaman sea. It is negative of the order of -5*10^{-5} s^{-1} over south Bay and west central Bay of Bengal.

Wind Shear:

- Wind Shear is 5-10 knots over south Bay and Andaman sea and 20-40 knots over North Bay of Bengal.

Wind Shear Tendency:

- Shear Tendency is increasing over Andaman Sea and adjoining south east Bay of Bengal and decreasing near Equatorial region.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 16.0°N to the north of Andaman Sea and it tilts southwards towards western longitude.

M.J.O. Index:

- Located in phase 1 with amplitude more than 1.0.
- Dynamical forecast:- MJO index may move from phase 1 to Phase 2 with decreasing amplitude around 6 Nov.

System over South China Sea:

- A Tropical Depression is located in South China Sea near 10.0 N and 125.0E at 0600 UTC of today. NWP models indicate the system to move west northwestwards and emerge into Andaman Sea (12.0N and 97.0E) at 00 UTC of 9 Nov as a low pressure area which will further concentrate into a depression on 10 Nov over the same area.

Status of observational system:

- Details of the status of observational system are given in **Annexure-I**.

Satellite:

- Inference based on INSAT imagery of 040900 UTC
- Scattered low/medium clouds with embedded isolated moderate to intense convection over south Andaman Sea.

- Broken low/medium clouds with embedded moderate to intense convection over southeast Arabian Sea south of lat 15.0^0N east of long. 60.5^0E and southwest Arabian Sea.

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 04 November 2013 shows mild trough in the lower levels (upto 925 hPa) off the southeast peninsular coast of India. The trough is likely to decrease in intensity over the next 2-3 days. Under the influence of the active easterly wave over south India, scattered moderate rainfall is likely to persist over south east peninsular India over the next 24 hours, likely to decrease in intensity and spread over the subsequent two days. Rainfall ceases over south peninsular India from day 3 onwards.

The analysis and forecasts for 24h to 72 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.

- **IMD-WRF** model of 0000 UTC of 04 November 2013 also shows the rainfall distribution similar to GFS output.

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **ECMWF:** Model shows no cyclogenesis over Bay of Bengal and Arabian Sea during next 4-5 days.
- **METEOFRANCE -ARP:** Model shows no cyclogenesis over Bay of Bengal during next three days.
- **JMA:** Model in its 84 hr forecast available at IMD does not show cyclogenesis off Thailand coast.

- **UKMO:** Model shows emergence of the circulation over Andaman sea on 9 November.
- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of 04 November 2013 indicates there is no probability of cyclogenesis in the seas off the coast of India. A region of high GPP is seen south of Kerala coast centred at 5N, 68E on day 3. The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

A Tropical Depression is located in South China Sea near 10.0 N and 125.0E at 0600 UTC of today .NWP models indicate the system to move west northwestwards and emerge into Andaman sea (12.0N and 97.0E) at 00 UTC of 9 Nov as a low pressure area which will further concentrate into a depression on 10 Nov over the same area.

Advisory:

- No IOP during next 3 days.

Annexure-I

Status of Observation system:

Synoptic observation:

Region	Date/Time (UTC)		
	03/12	04/00	04/03
India	40/51	31/32	42/51
Coastal stations			
WB	6/9	5/9	6/9
Odisha	6/7	5/5	6/7
AP	13/13	12/13	13/13
Tamil Nadu	9/12	7/7	10/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	11/11	11/11	10/11
Myanmar	10/11	10/11	10/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	8/9	8/9

RS/RW (12Z) of 03/11/2013 13/39

- **No. of Ascents reaching 250 hPa levels:12, MISDA: 26**
- **RS/RW** (00Z) of 04/11/2013 22/39
- **No. of Ascents reaching 250 hPa levels:18 , MISDA:17**

No. of PILOT Ascents

03/12Z	04/00Z
25/37	17/34

Buoy Data

03/12Z	04/00Z	04/03Z
10	9	10

Data Statistics over RMC Chennai Region

No of Synop data

Date→				**03.11.2013**				
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /03.11.2013 : 6

No. of Ascents reaching 250 hPa level =4

MISDA : 2

12Z /03.11.2013 : 2

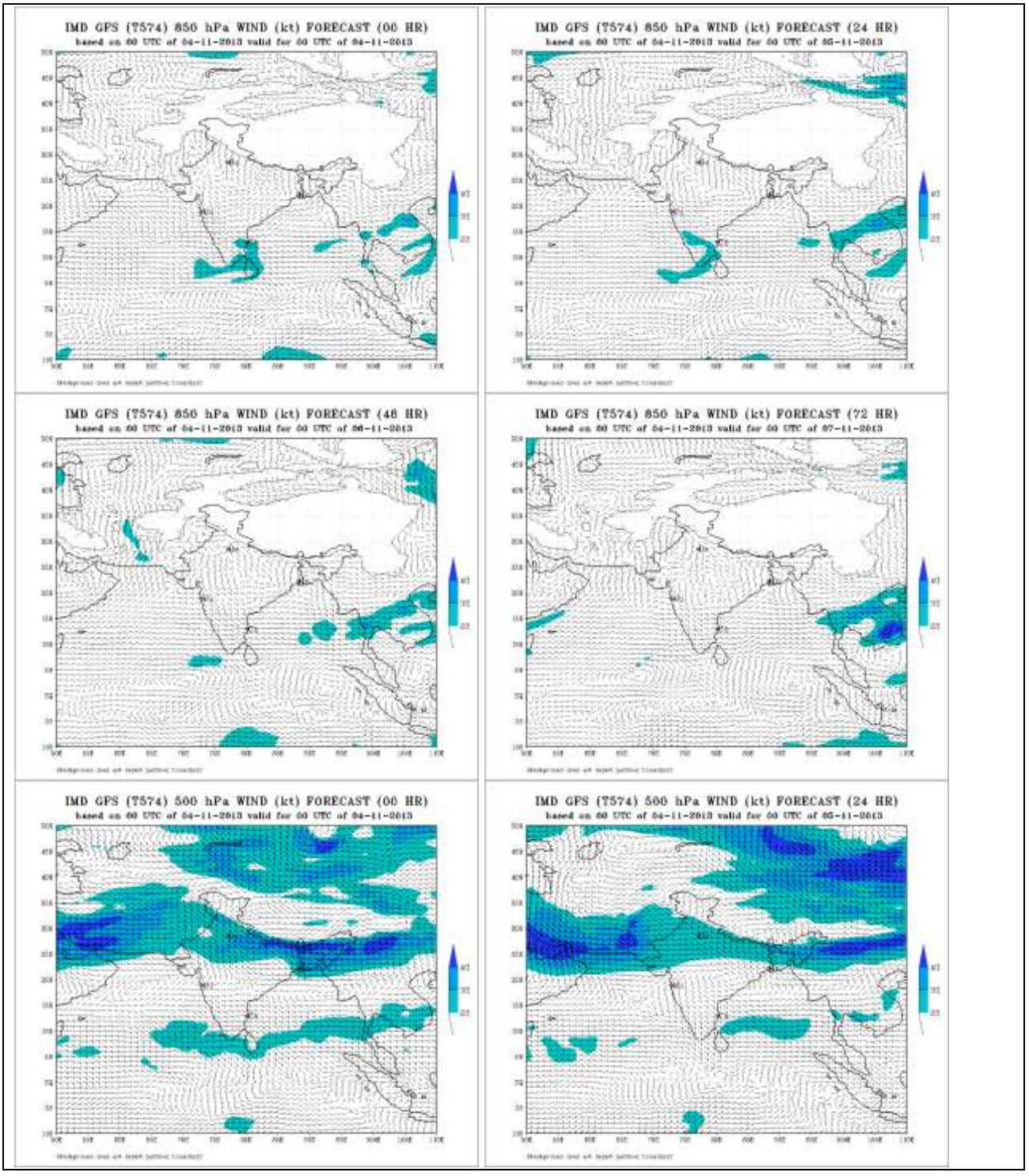
No. of Ascents reaching 250 hPa level =2

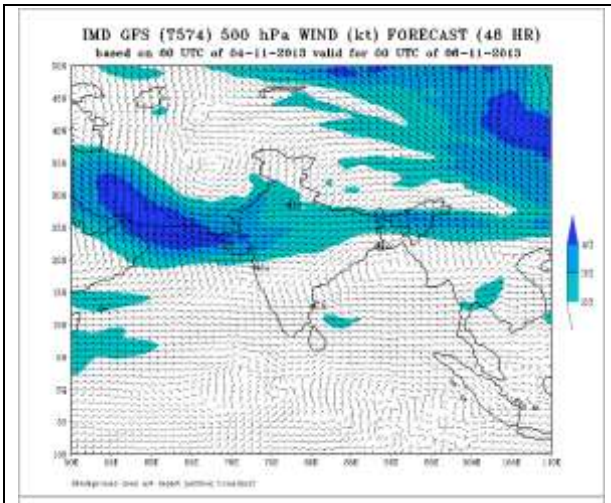
MISDA : 6

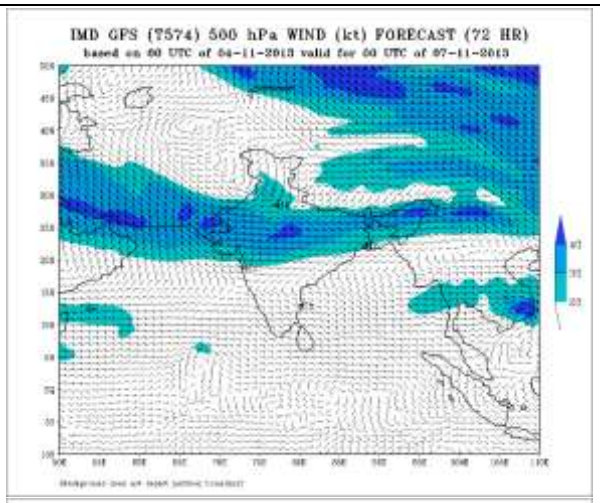
No. of PILOT Ascents:

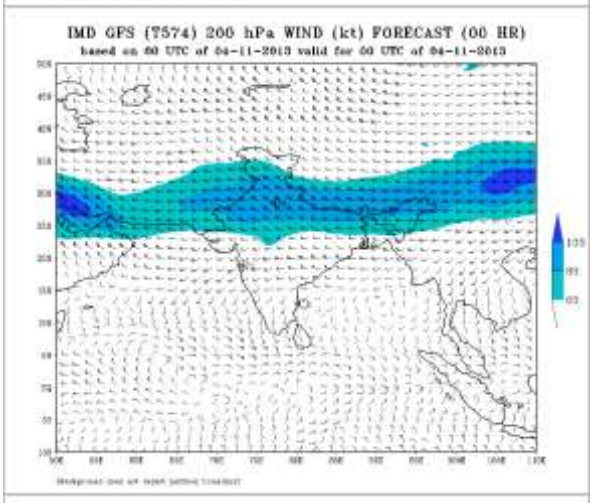
03.11.2013	
06Z	18Z
3	3

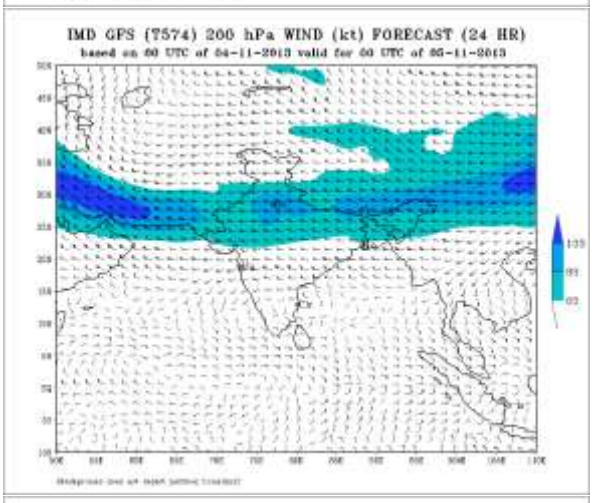
Annexure-II

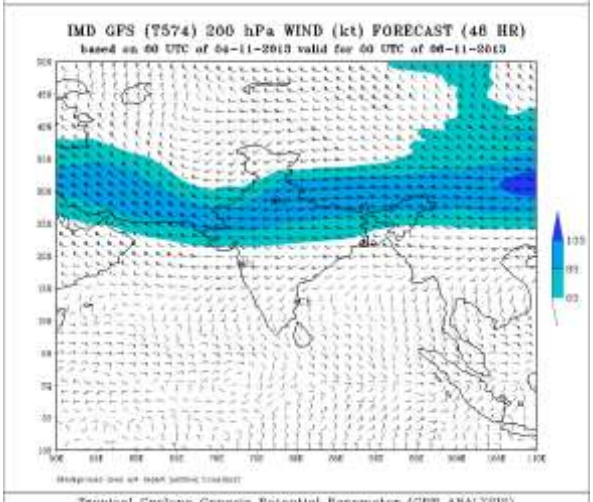

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 04-11-2013 valid for 00 UTC of 04-11-2013
IMD GPS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 04-11-2013 valid for 00 UTC of 05-11-2013
IMD GPS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 04-11-2013 valid for 00 UTC of 06-11-2013
IMD GPS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 04-11-2013 valid for 00 UTC of 07-11-2013
IMD GPS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 04-11-2013 valid for 00 UTC of 04-11-2013
IMD GPS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 04-11-2013 valid for 00 UTC of 05-11-2013

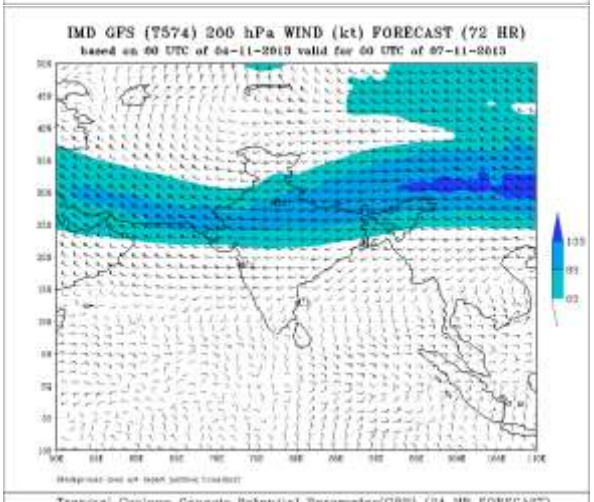

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 04-11-2013 valid for 00 UTC of 06-11-2013

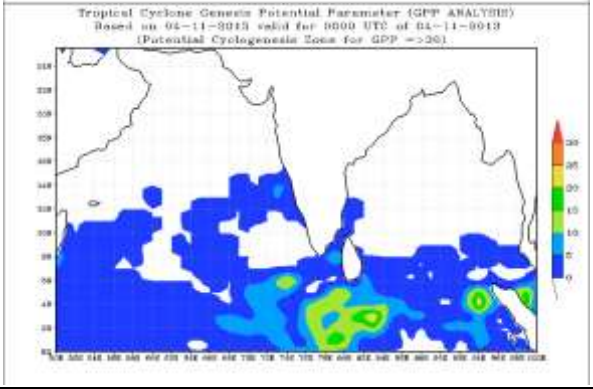

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 04-11-2013 valid for 00 UTC of 07-11-2013

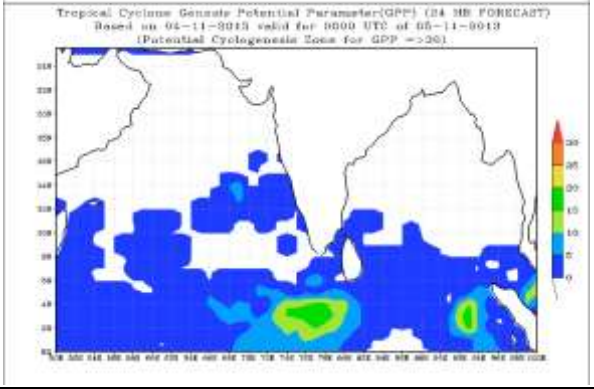

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 04-11-2013 valid for 00 UTC of 04-11-2013

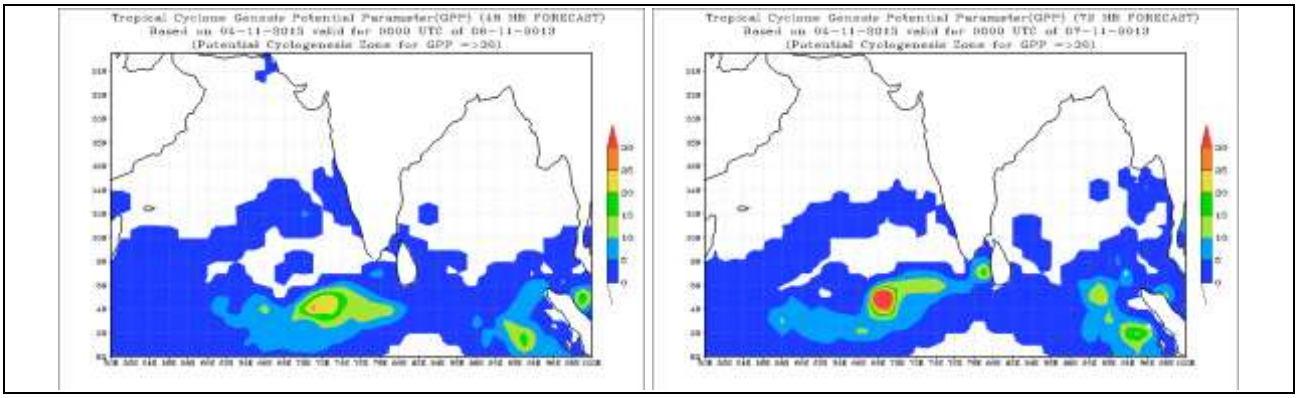

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 04-11-2013 valid for 00 UTC of 05-11-2013


IMD GPS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 04-11-2013 valid for 00 UTC of 06-11-2013


IMD GPS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 04-11-2013 valid for 00 UTC of 07-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 04-11-2013 valid for 0000 UTC of 04-11-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 04-11-2013 valid for 0000 UTC of 05-11-2013
(Potential Cyclogenesis Zone for GPP =>26)



FDP (Cyclone) NOC Report Dated 05 November, 2013

Synoptic features based on 0300 UTC:

- The trough of low at mean sea level from Lakshadweep–Maldives areas to east central Arabian Sea persists.
- The other trough of low at mean sea level from southwest Bay of Bengal to west central Bay of Bengal along Sri Lanka-Tamil Nadu coasts now extends from Comorians areas to southwest Bay of Bengal.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-31^{0}C over Bay of Bengal.
- **Ocean thermal energy:**
- It is less than 50 KJ cm^{-2} over southwest, westcentral and North Bay of Bengal . It is 50-90 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over northeast Bay of Bengal, south Andaman Sea and equatorial region. It is negative over the rest part of Bay of Bengal and Andaman Sea.

Convergence:

- Lower level convergence is negative of the order of 5*10^{-5} s^{-1} over Bay of Bengal, commorian area and Andaman Sea.

Divergence:

- It is negative of the order 5-10*10^{-5} s^{-1}over south east Bay of Bengal and south of Andaman sea .

Wind Shear:

- Wind Shear is 10-20 knots over south and west central Bay and more than 20 knots over North Bay of Bengal.

Wind Shear Tendency:

- Shear Tendency shows no significant change.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 16.0°N to the north of Andaman Sea and it tilts southwards towards western longitude.

M.J.O. Index:

- Located in phase 1 with amplitude more than 1.0.
- Dynamical forecast:- MJO index may move from phase 1 to Phase 2 with decreasing amplitude less than 1.0 around 6 Nov.

System over South China Sea:

A Tropical Depression is located in South China Sea near 10.5 N and 117.0E at 0600 UTC of today. NWP models indicate the system to move west northwestwards and emerge into Andaman Sea (12.0N and 97.0E) at 00 UTC of 9 Nov as a low pressure area which will further concentrate into a depression on 10 Nov over east central Bay.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 050900 UTC

- Scattered low/medium clouds with embedded isolated weak to moderate convection over south Bay between lat 12.0°N to 13.0°N long 85.0°E to 87.0°E south Andaman Sea.
- Scattered low/medium clouds with embedded isolated weak to moderate convection over rest southwest Arabian Sea. Scattered medium/high clouds over central Arabian Sea.

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 05 November 2013 shows a trough of low pressure area (easterly wave) in the lower levels (upto 925 hPa) off the southeast peninsular coast of India. The trough is likely to decrease in intensity over the next 2-3 days. Under the influence of the active ***easterly wave over south India***, scattered to moderate rainfall is likely to persist over south peninsular India ,particularly in Tamilnadu over the next 24 -48 hours, and likely to decrease in intensity and spread over the subsequent two days. Rainfall ceases over south peninsular India from day 3 onwards.
- GFS Analysis also shows a trough of low pressure in the low level (925 hPa) from Lakshadweep Maldives to East-central Arabian Sea.
- The analysis and forecasts of GFS model for 24h to 72 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.

• **IMD-WRF** model of 0000 UTC of 05 November 2013 also shows the rainfall and wind distribution similar to GFS output.

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **ECMWF:** Model shows formation of a low pressure area on 9 nov becomimg Depression on 11 nov over EC bay. It is expected to weaken again into low on 13 nov ,while moving westwards towards north Tamil Nadu, south Andhrta Pradesh coast upto 14 nov and become less marked over sea on 15 Nov.
- **METEOFRANCE -ARP:** Model shows no cyclogenesis over Bay of Bengal during next three days.
- **JMA:** Model in its 84 hr forecast available at IMD does not show cyclogenesis off Thailand coast.
- **UKMO:** Model shows emergence of the circulation/trough over Andaman sea on 9 November which will move westwards towards north Tamil Nadu, south Andhrta Pradesh coast .
- **GEFS (NCMRWF)**: Models show formation of low on 9 Nov, becoming well marked on 11 Nov,weakening into a low on 13 Nov. And lies off North Tamil Nadu coast on 15 Nov
- **Genesis Potential Parameter (GPP) of IMD:** Model forecast of GPP based on 0000 UTC of **05 November 2013** indicates there is a **probability of cyclogenesis over Andaman Sea on 9 Nov.** A region of high GPP is seen over SE Arabian Sea (off south of Kerala coast) centered at 7N, 67E on day 3. The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**
- **Genesis Potential Parameter (GPP) of SAC Ahmedabad**: They suggest genesis around 9 Nov over Andaman Sea.
- **CFAN Model based on ECMWF**: The model suggests genesis around 9 Nov, further extended range forecast of this model indicates west- north-west movement towards north Tamil Nadu coast**.**

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

A Tropical Depression is located in South China Sea near 10.5 N and 117.0E at 0600 UTC of today. NWP models indicate the system to move west northwestwards and emerge into Andaman Sea (12.0N and 97.0E) at 00 UTC of 9 Nov as a low pressure area which will further concentrate into a depression on 10 Nov over east central Bay. There is divergence in the model guidance with respect to track and intensity ,most of the global models predict maximum intensity upto a Deep depression in their seven day forecast. Some models (ECMWF,GEFS,NCMRWF)

also suggest weakening of the system as it comes closer to the North Tamil Nadu-south Andhra coast With respect to track it varies from north Tamil Nadu to south Andhra coast.

- The Genesis over SE Arabian Sea (off south of Kerala coast) based on IMD GPP may be watched as per the current synoptic analysis.

Advisory:

- No IOP during next 3 days.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	04/12	**05/00**	**05/03**
India	40/51	31/32	42/51
Coastal stations			
WB	6/9	5/9	6/9
Odisha	6/7	5/5	6/7
AP	13/13	12/13	13/13
Tamil Nadu	9/12	7/7	10/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	11/11	11/11	10/11
Myanmar	10/11	10/11	10/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	8/9	8/9

RS/RW (12Z) of 04/11/2013 13/39

- **No. of Ascents reaching 250 hPa levels:12, MISDA: 26**
- **RS/RW** (00Z) of 05/11/2013 24/39
- **No. of Ascents reaching 250 hPa levels:18 , MISDA:1**

No. of PILOT Ascents

04/12Z	05/00Z
25/37	25/39

Buoy Data

04/12Z	05/00Z	05/03Z
10	9	10

Data Statistics over RMC Chennai Region

No of Synop data

Date→	**04.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /04.11.2013 : 5

No. of Ascents reaching 250 hPa level =5

MISDA : 3

12Z /04.11.2013 : 5

No. of Ascents reaching 250 hPa level =5

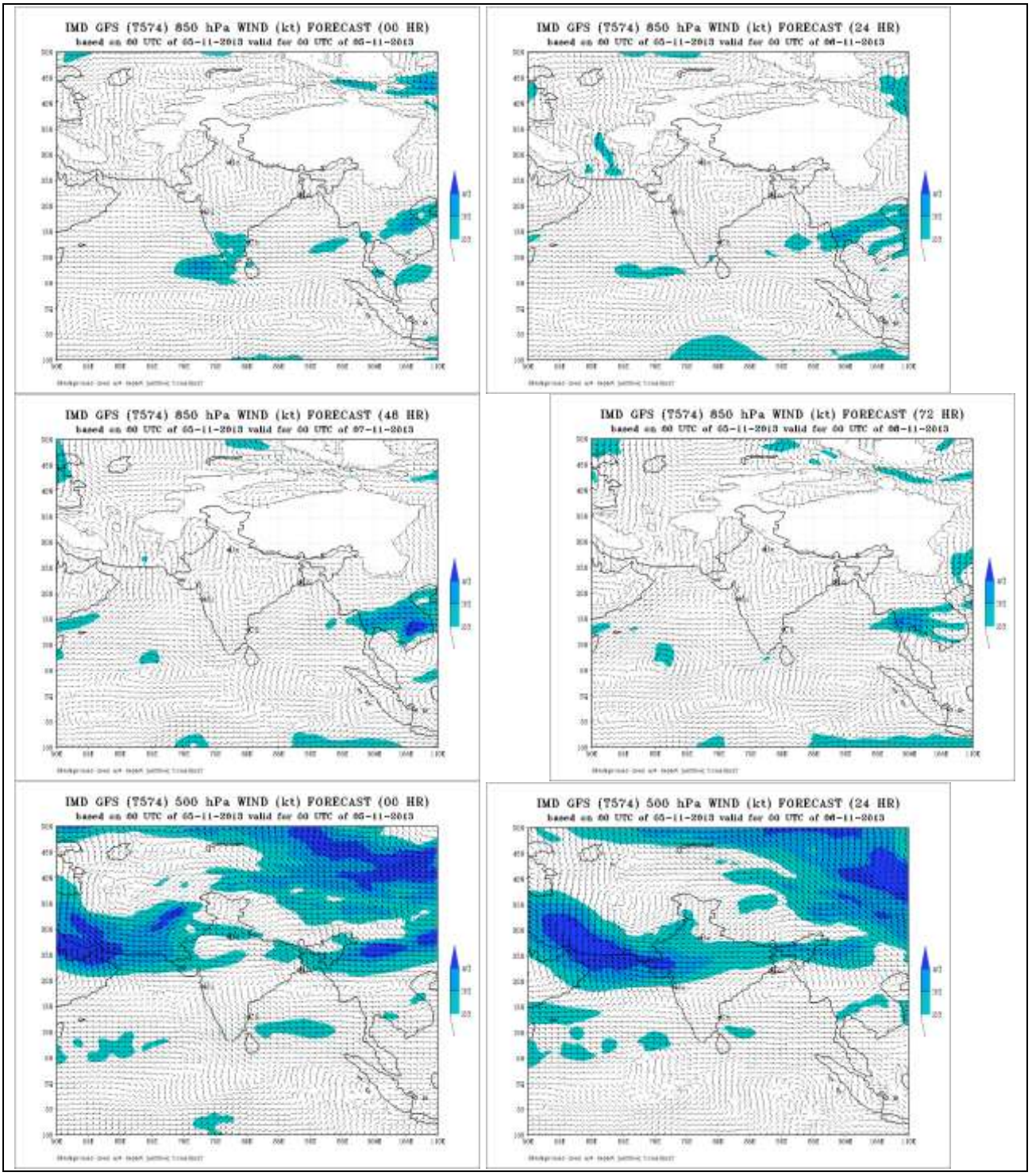
MISDA : 3

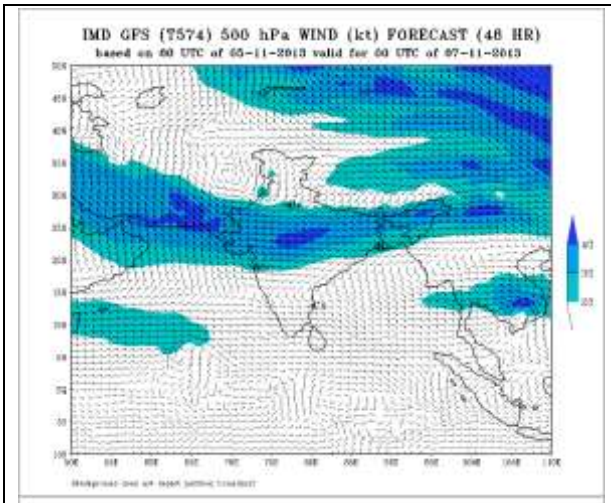
No. of PILOT Ascents:

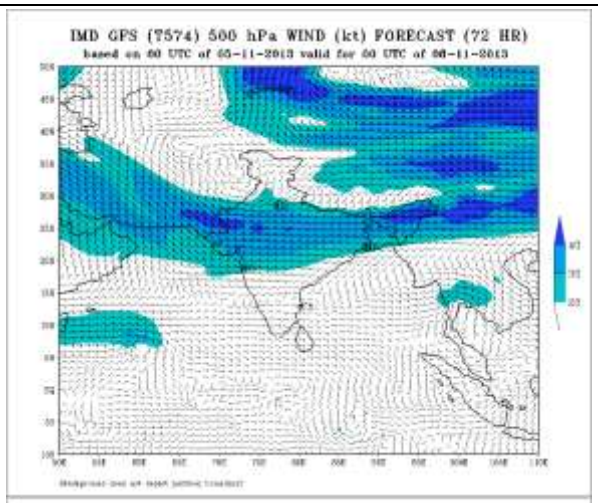
04.11.2013

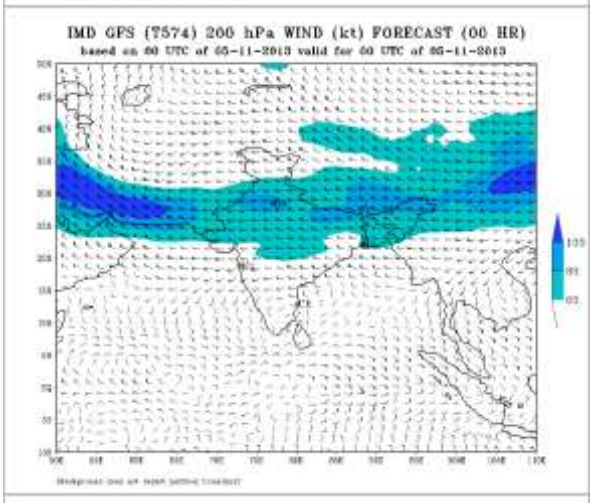
06Z	18Z
2	3

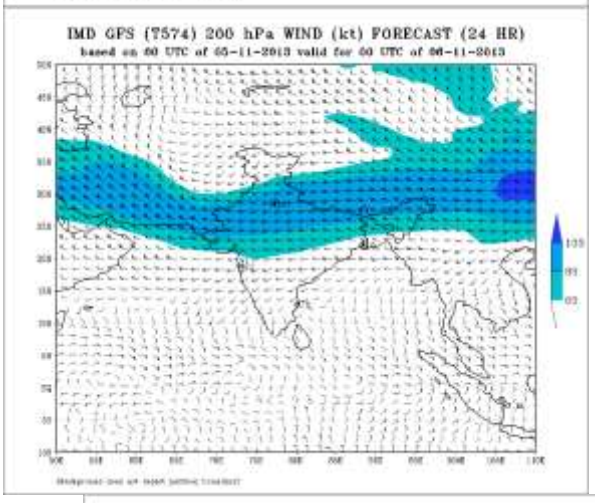
Annexure-II

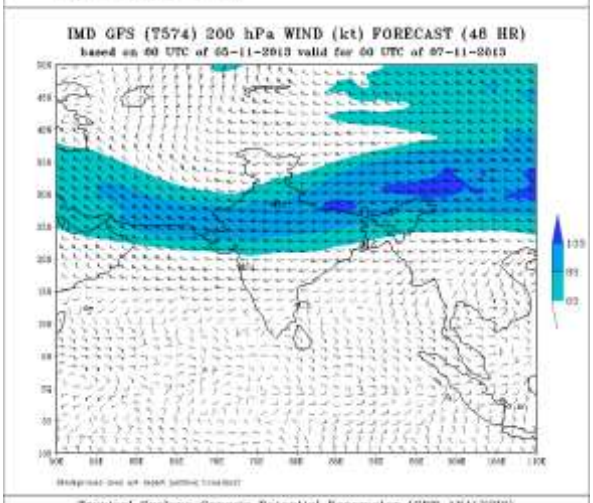

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 05-11-2013 valid for 00 UTC of 05-11-2013
IMD GPS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 05-11-2013 valid for 00 UTC of 06-11-2013
IMD GPS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 05-11-2013 valid for 00 UTC of 07-11-2013
IMD GPS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 05-11-2013 valid for 00 UTC of 08-11-2013
IMD GPS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 05-11-2013 valid for 00 UTC of 05-11-2013
IMD GPS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 05-11-2013 valid for 00 UTC of 06-11-2013

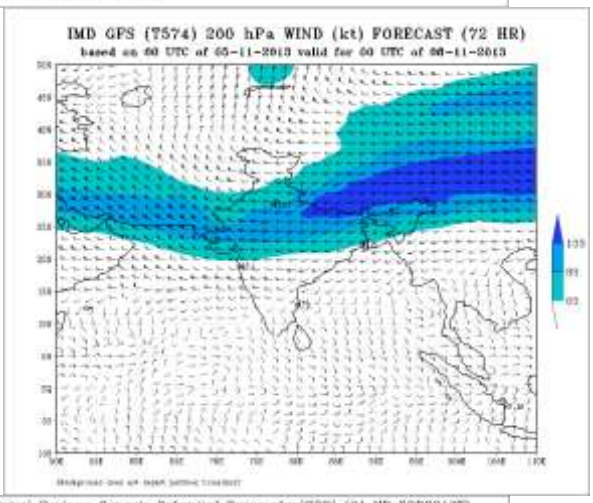

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 05-11-2013 valid for 00 UTC of 07-11-2013

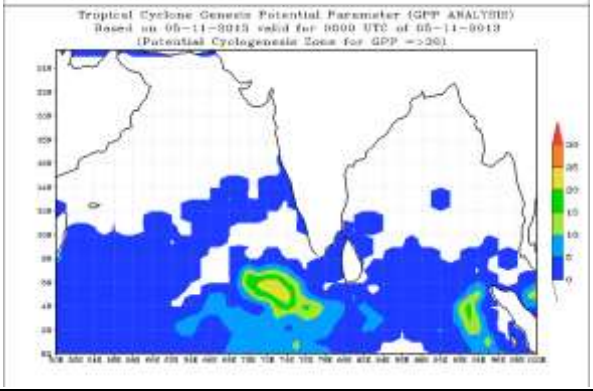

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 05-11-2013 valid for 00 UTC of 08-11-2013

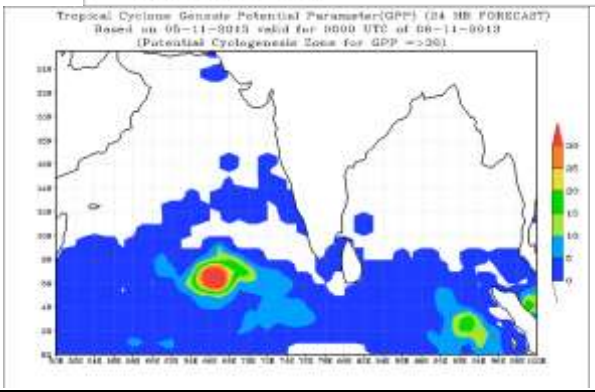

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 05-11-2013 valid for 00 UTC of 05-11-2013

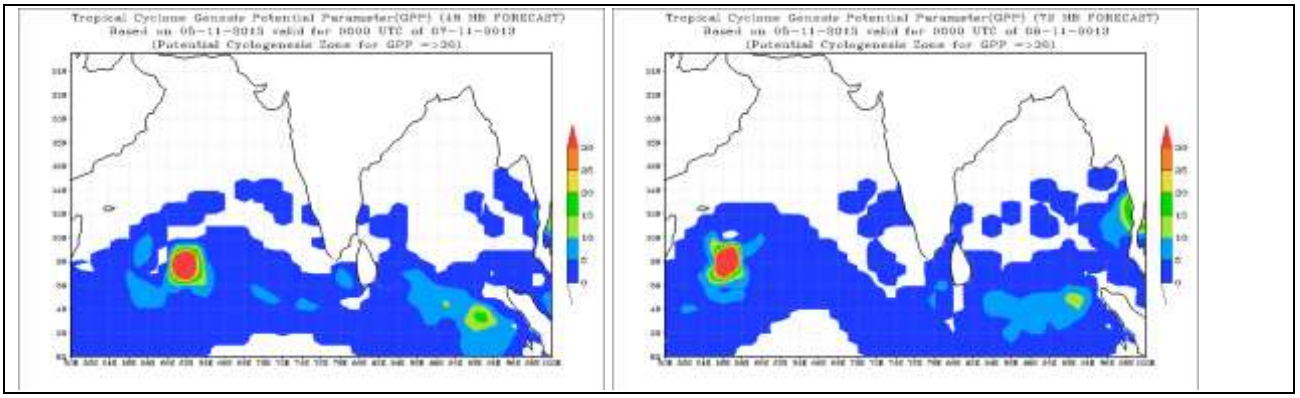

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 05-11-2013 valid for 00 UTC of 06-11-2013


IMD GPS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 05-11-2013 valid for 00 UTC of 07-11-2013


IMD GPS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 05-11-2013 valid for 00 UTC of 08-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 05-11-2013 valid for 0000 UTC of 05-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 05-11-2013 valid for 0000 UTC of 06-11-2013
(Potential Cyclogenesis Zone for GPP =>20)



FDP (Cyclone) NOC Report Dated 06 November, 2013

Synoptic features based on 0300 UTC:

- The trough of low at mean sea level from Lakshadweep–Maldives areas to east central Arabian Sea moved westwards and organised into a low pressure area over southeast Arabian Sea in the morning and is well marked at 1430 hrs IST of today. Associated cyclonic circulation extends upto mid tropospheric levels.
- The trough of low at mean sea level from Commorin areas to southwest Bay of Bengal persists.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-31^{0}C over north Andaman Sea and adjoining Bay of Bengal. It is also 28-31^{0}C over southeast Arabian Sea.
- **Ocean thermal energy:**
- It is less than 50 KJ cm^{-2} over southwest, westcentral and North Bay of Bengal . It is 50-90 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2. It is about 80-100 KJ cm^{-2} over southeast Arabian Sea and adjoining southwest Arabian Sea.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over head Bay of Bengal, south Andaman Sea and equatorial region. It is negative over the rest part of Bay of Bengal and Andaman Sea. It is positive 40-50 10^{-5} s^{-1} to the south of the well marked low pressure area over southeast Arabian Sea.

Convergence:

- Lower level convergence is negative of the order of -5*10^{-5} s^{-1} over some parts southeast Bay and adjoining east central Bay of Bengal adjacent to Bay islands. It is positive over southern part of southeast Bay and of the order 10*10^{-5} s^{-1}. It is about 10*10^{-5} s^{-1} over southeast Arabian Sea in association with WML.

Divergence:

- It is positive of the order 5-10*10^{-5} s^{-1}over south east Bay of Bengal and adjoining south of Andaman sea. It is negative over rest Bay of Bengal. It is about 20*10^{-5} s^{-1} over southeast Arabian Sea in association with WML

Wind Shear:

- Wind Shear is 10 knots over southwest Bay and more than 20 knots over North Bay of Bengal and around 10 knots near WML over Arabian Sea

Wind Shear Tendency:

- Shear Tendency is increasing over southeast Bay & adjoining south Andaman Sea and west central Bay of Bengal. No change elsewhere. Also there is no significant change over southeast Arabian Sea around WML.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 13.0°N over Andaman Sea region. It tilts southward towards western longitude and runs roughly along 10^0N over southeast Arabian Sea.

M.J.O. Index:

- Located in phase 1 with amplitude more than 1.0.
- Dynamical forecast:- MJO index may move from phase 1 to Phase 2 with decreasing amplitude (less than 1.0) within next 3 days.

System over South China Sea:

A Tropical Depression is located in South China Sea near 11.6 N and 110.0E at 0600 UTC of today. NWP models indicate the system to move west northwestwards and emerge into Andaman Sea (12.0N and 97.0E) at 00 UTC of 9 Nov as a low pressure area.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 060900 UTC

- Scattered low/medium clouds with embedded isolated moderate to intense convection over south Andaman Sea.

- Vortex centred within a half a degree of 7.0N/67.50E. Intensity T1.0 Associated broken low/medium clouds with embedded moderate to intense convection over south Arabian Sea adjoining Indian Ocean between lat. 4.0^0N to 9.0^0N long. 61.5^0E to 70.0^0E. Scattered low/medium clouds with embedded moderate to intense convection over rest southwest Arabian Sea.

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 06 November 2013 shows a trough of low pressure area /low level cyc circulation (easterly waves) in the lower levels (upto 925 hPa) over southeast Arabian Sea and adjoining Maldives area. This low pressure area may move westwards and become well marked during next 24 hours.
  GFS Analysis also shows a trough of low in the low level from Commorin areas to southwest Bay of Bengal. Model 72 hour Forecast shows a low pressure area over Andaman sea around **9th Nov 2013** and also shows that the system may intensify further and move westwards. The maximum intensity may be upto well marked low pressure area. The analysis and forecasts of GFS model for 24h to 72 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.
- **IMD-WRF** model of 0000 UTC of 05 November 2013 also shows features similar to GFS output.
- **ECMWF:** Model shows formation of a low pressure area on 9 Nov becomimg well marked low on 11 Nov over EC bay. It is expected to weaken again into low on 14 Nov over southwest Bay off north Tamil Nadu, south Andhra Pradesh coast .
  It also shows a Low only over southeast Arabian Sea, which will move westwards.

- **METEOFRANCE -ARP:** Model shows low over Andaman Sea on 9 Nov.
  It also shows a low over southeast Arabian Sea which will move west-northwestwards during next 72 hrs.
- **JMA:** Model shows low over Andaman Sea on 9 Nov.

It also shows a low over southeast Arabian Sea which will move west-northwestwards during next 48 hrs and become less marked on 9 Novemebr.

- **UKMO (05/00 UTC):** Model shows emergence of the circulation/trough over Andaman sea on 9 November which will move westwards towards north Tamil Nadu, south Andhrta Pradesh coast .
  It shows a low over southeast Arabian Sea at 00 UTC of 10 Nov. It would intensify into a Depression/deep depression at 00 UTC of 11 Nov and a cyclonic storm at 00 UTC of 12 Nov.
- **GEFS (NCMRWF)**: Models show formation of low on 9 Nov, becoming well marked on 11 Nov,weakening into a low on 13 Nov. It will lie off North Tamil Nadu coast on 15 Nov.
  A low may form over southeast Arabian Sea on 8 Nov. It would move west-northwestwards upto 10 Nov and become less marked on 11 Nov over southwest Arabian sea.

- **Genesis Potential Parameter (GPP):** Model forecast of GPP based on 0000 UTC of **06 November 2013** indicates there is a probability of cyclogenesis over east central BOB
  A region of high GPP is seen over SE Arabian Sea (off south of Kerala coast) centered at 05N, 68E on 8 Nov. This is likely to move westwards. The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**.

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

A Tropical Depression is located in South China Sea near 11.6 N and 110.0 E at 0600 UTC of today. NWP models indicate the system to move west northwestwards and emerge into Andaman Sea (12.0N and 97.0E) at 00 UTC of 9 Nov as a low pressure area. Most of the global models predict maximum intensity upto a well marked low pressure area or marginal depression in their seven day forecast. Some models (ECMWF,GEFS,NCMRWF) also suggest weakening of the system as it comes closer to the North Tamil Nadu-south Andhra coast. With respect to track it varies from north Tamil Nadu to south Andhra coast.

Based on the current synoptic and diagnostics analysis and NWP guidance, a low may form over Andaman Sea on 9 the November. It needs to be watched for its further intensification and movement.

- The well marked low pressure area over southeast Arabian Sea may concentrate into a Depression during next 48 hrs while moving west-northwestwards.

Advisory:

- No IOP during next 3 days.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	05/12	**06/00**	**06/03**
India	40/51	31/32	42/51
Coastal stations			
WB	7/9	3/4	7/9
Odisha	6/7	5/5	6/7
AP	10/14	11/13	11/14
Tamil Nadu	10/12	7/7	9/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	5/11	8/11	9/11
Myanmar	10/11	9/11	9/11
Thailand	3/3	3/3	3/3
Srilanka	0/9	7/9	7/9

RS/RW (12Z) of 05/11/2013 13/39

- **No. of Ascents reaching 250 hPa levels:12, MISDA: 26**
- **RS/RW** (00Z) of 06/11/2013 24/39
- **No. of Ascents reaching 250 hPa levels:18 , MISDA:1**

No. of PILOT Ascents

05/12Z	06/00Z
25/37	25/39

Buoy Data

05/12Z	06/00Z	06/03Z
10	9	10

Data Statistics over RMC Chennai Region

No of Synop data

Date→	**05.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

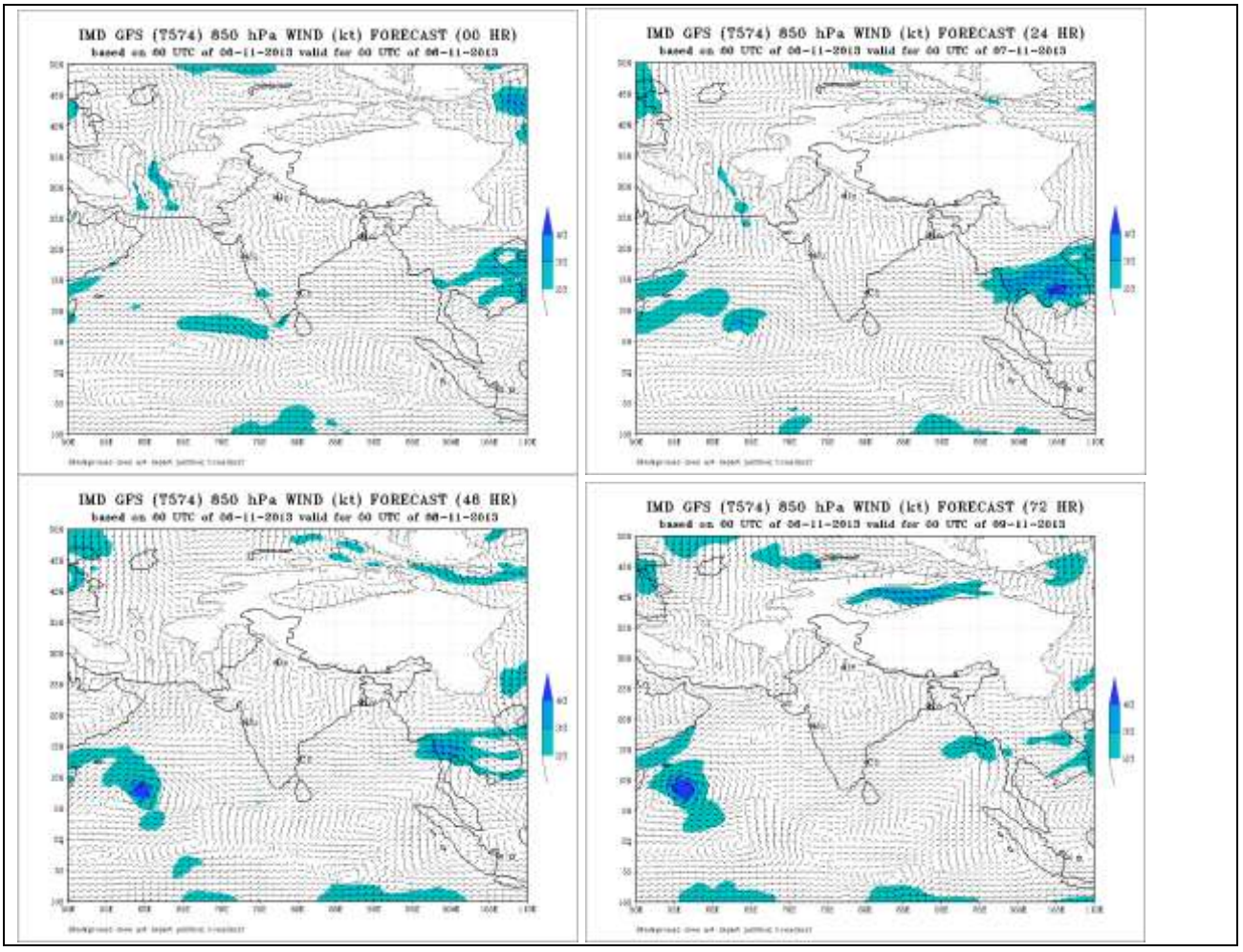
No. of RS/RW Ascents
00Z /05.11.2013 : 5
No. of Ascents reaching 250 hPa level =4
MISDA : 3
12Z /05.11.2013 : 5
No. of Ascents reaching 250 hPa level =5
MISDA : 3

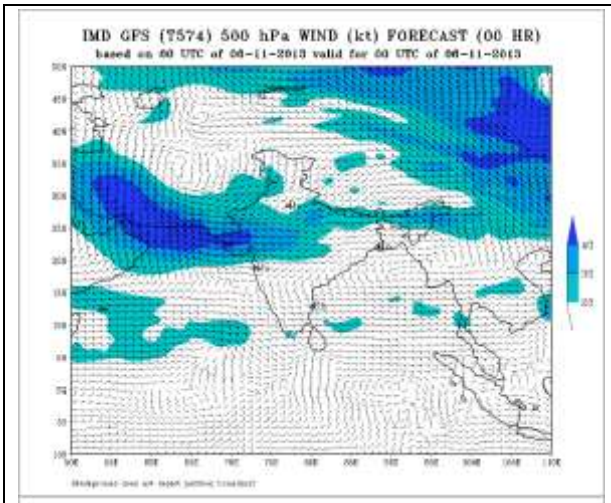
No. of PILOT Ascents:

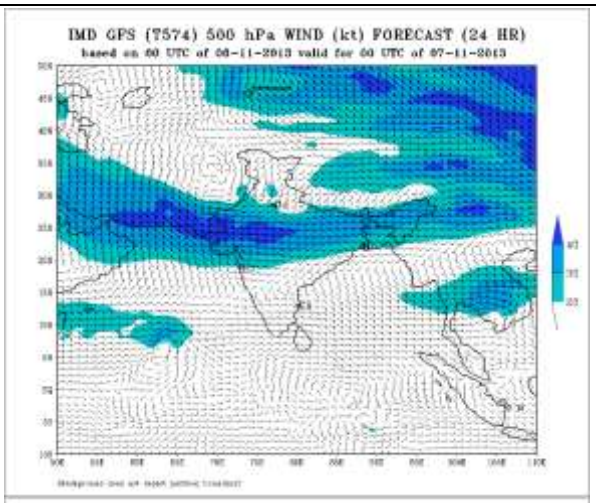
05.11.2013

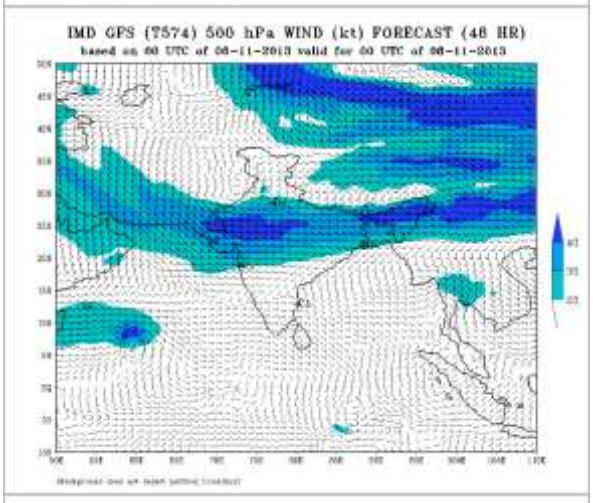
06Z	18Z
4	2

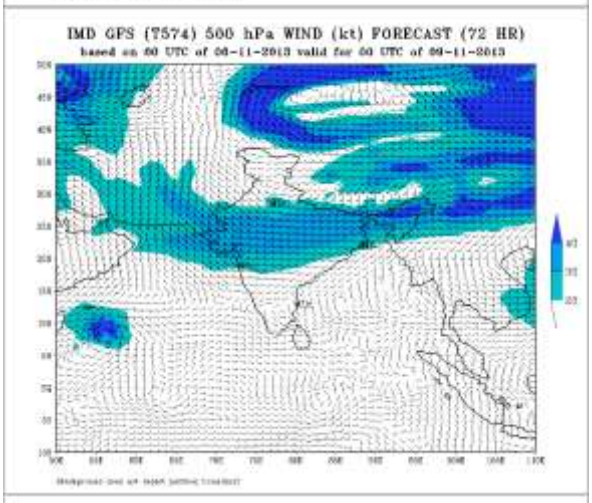
Annexure-II

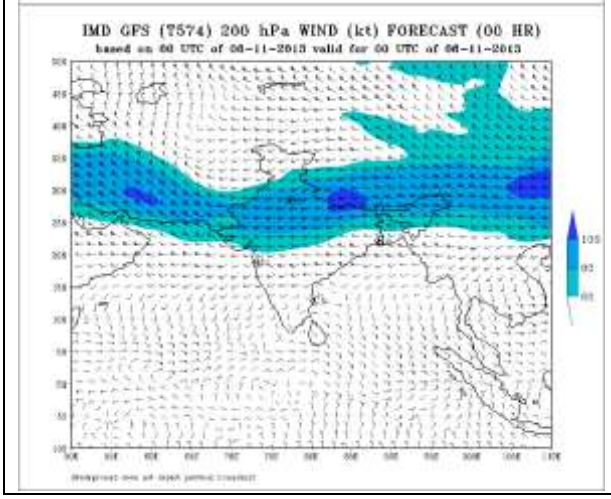

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)

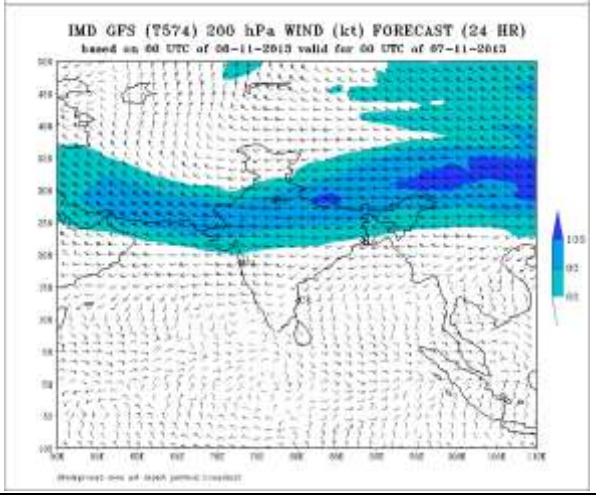

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 06-11-2013 valid for 00 UTC of 06-11-2013

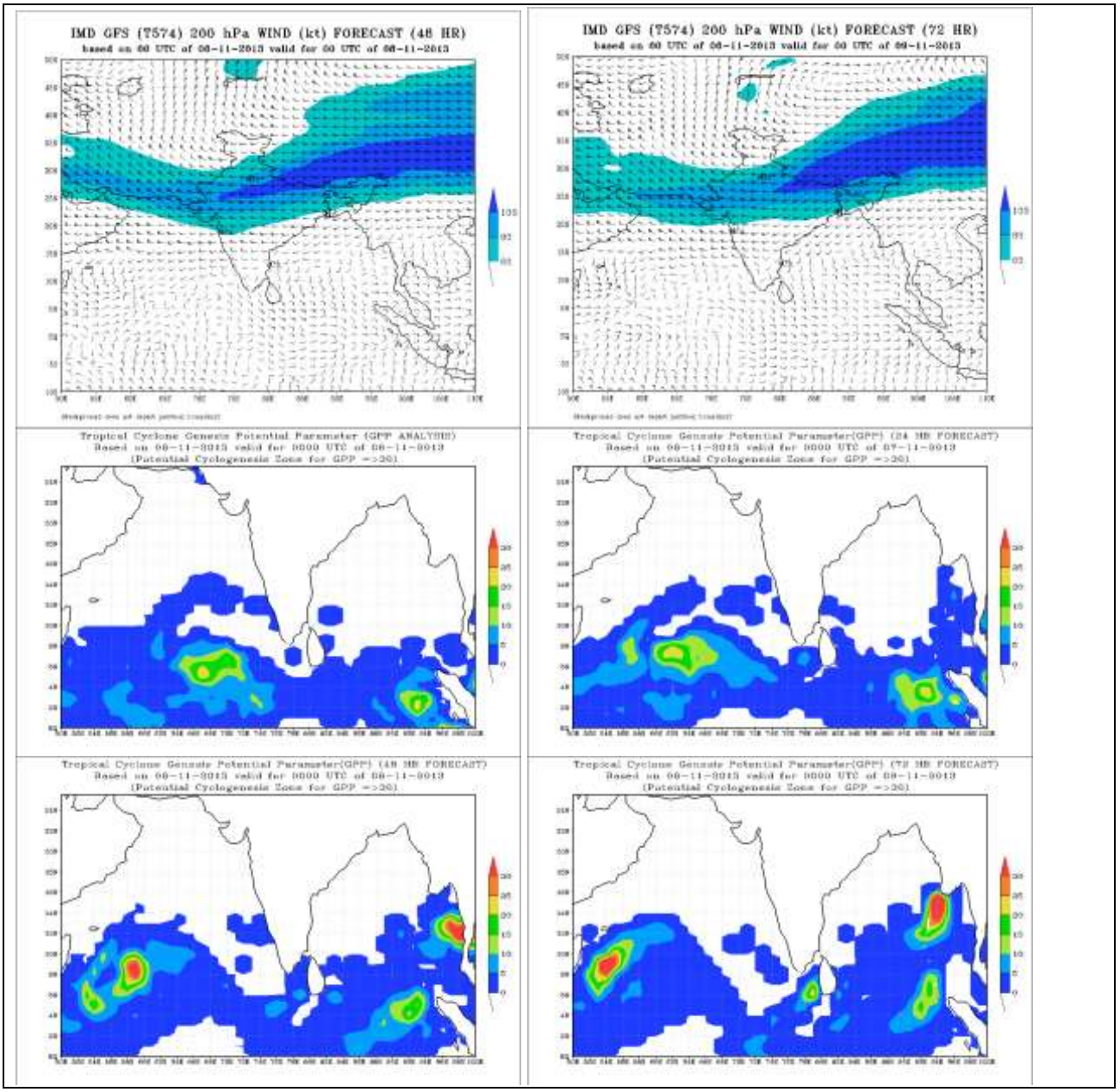

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 06-11-2013 valid for 00 UTC of 07-11-2013


IMD GPS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 06-11-2013 valid for 00 UTC of 08-11-2013


IMD GPS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 06-11-2013 valid for 00 UTC of 09-11-2013


IMD GPS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 06-11-2013 valid for 00 UTC of 06-11-2013


IMD GPS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 06-11-2013 valid for 00 UTC of 07-11-2013


IMD GPS (7574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 08-11-2013 valid for 00 UTC of 08-11-2013
IMD GPS (7574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 08-11-2013 valid for 00 UTC of 08-11-2013
Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 08-11-2013 valid for 0000 UTC of 08-11-2013
(Potential Cyclogenesis Zone for GPP =>26)
Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 08-11-2013 valid for 0000 UTC of 09-11-2013
(Potential Cyclogenesis Zone for GPP =>26)
Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 08-11-2013 valid for 0000 UTC of 10-11-2013
(Potential Cyclogenesis Zone for GPP =>26)
Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 08-11-2013 valid for 0000 UTC of 11-11-2013
(Potential Cyclogenesis Zone for GPP =>26)

FDP (Cyclone) NOC Report Dated 07 November, 2013

Synoptic features based on 0300 UTC:

- The well marked low pressure area over southeast Arabian Sea now lies over southeast and adjoining southwest Arabian Sea. Associated cyclonic circulation extends upto mid tropospheric levels. System may move west-north west wards and concentrate into a Depression during next 24 hours.
- A trough of low at mean sea level runs from southeast Bay of Bengal to east central Bay of Bengal.
- The trough of low at mean sea level from Comorin area to southwest Bay of Bengal has become less marked..

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-30^{0}C over north Andaman Sea and adjoining Bay of Bengal. It is also 29-31^{0}C over southeast Arabian Sea.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over southwest, westcentral and North Bay of Bengal . It is 50-90 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2. It is about 80-90 KJ cm^{-2} over southeast Arabian Sea and adjoining southwest Arabian Sea.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over head Bay of Bengal, south Andaman Sea and equatorial region. It is negative over the rest part of Bay of Bengal and Andaman Sea. It is positive 40-50 10^{-5} s^{-1} to the south of the well marked low pressure area over southeast Arabian Sea.

Convergence:

- Lower level convergence is negative of the order of -5*10^{-5} s^{-1} over north Andaman sea, west central and South East Arabian Sea. It is positive over southern part of southwest Bay and of the order 5-10*10^{-5} s^{-1}. It is 5-10*10^{-5} s^{-1} over north and southwest Arabian Sea in association with WML.

Divergence:

- It is positive of the order 5-10*10^{-5} s^{-1}over Andaman sea, 5-20*10^{-5} over central Arabian sea and 5-20 southwest of Andaman sea. It is negative of the order 5*10^{-5} s^{-1} over central Bay of Bengal, southeast and northwest Arabian sea.

Wind Shear:

- **W**ind Shear is 10 knots over southeast Bay and more than 20 knots over central and North Bay of Bengal and around 10 knots near WML over Arabian Sea

Wind Shear Tendency:

- Shear Tendency is increasing over southwest Bay. It is negative over southwest Bay and Andaman Sea. It is also negative over South east and central Arabian Sea around WML.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 13.0°N over Andaman Sea region. It tilts southward towards western longitude and runs roughly along 10^{0}N over southeast Arabian Sea.

M.J.O. Index: (Based on 5th Nov)

- Located in phase 1 with amplitude more than 1.0.
- Dynamical forecast:- MJO index may move from phase 1 to Phase 2 with decreasing amplitude (less than 1.0) within next 3 days.

System over South China Sea:

A Tropical Depression is located in South China Sea near 11.6 N and 110.0E at 0600 UTC of today. NWP models indicate the system to move west northwestwards and emerge into Andaman Sea (12.0N and 97.0E) at 00 UTC of 9 Nov as a low pressure area.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 070900 UTC

- Scattered low/medium clouds with embedded moderate to intense convection over south Bay south of lat 9.0°N Andaman Sea. Scattered low/medium clouds with embedded isolated weak to moderate convection over rest Bay.

- Vortex over Arabian sea centred within half a deg of 8.0N/60.5E.intensity T 1.0 associated broken low/medium cloud with embedded moderate to intense convection over area between lat. 6.0^0N to 11.0^0N long. 56.0^0E to 65.0^0E. Scattered low/medium clouds with embedded moderate to intense convection over south Arabian sea between lat. 5.0^0N to 14.0^0N long. 53.0^0E to 68.0^0E and southeast Arabian sea

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 07November2013 shows a trough of low pressure area / low level cyclonic circulation (easterly waves) in the lower levels (upto 850 hPa) over southeast Arabian Sea centered at **07N, 62E**. This low pressure area may move westwards and become well marked during next 24 hours.
- Model 48 hour Forecast shows a low pressure area over Andaman sea around **9th Nov 2013** and also shows that the system may intensify further and move south-westwards.
- The analysis and forecasts of GFS model for 24h to 72 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.

- **IMD-WRF** model of 0000 UTC of 07 November 2013 also shows similar pattern.

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **ECMWF:** Model shows formation of a low pressure area on 9 Nov becoming well marked low on 12 Nov over EC bay. It is expected to intensify on 13th Nov again weaken into low on 14 Nov over southwest Bay off north Tamil Nadu, south Andhra Pradesh coast.
  It also shows a Low only over southeast Arabian Sea, which will move west-northwest wards next 2 days.

- **METEOFRANCE -ARP:** Model shows formation of a low pressure area over Andaman Sea on 8 Nov and continue as a low over south Bay of Bengal during next 3 days.
  It also shows a low over southeast Arabian Sea which will move west-northwestwards and intensify into a depression on 9th Nov and further intensify as cyclonic storm on 10th Nov.
- **JMA:** Model shows low over Andaman Sea on 9 Nov it will move as a low west north west wards till 10th Nov.
  It doest not show as low over southeast Arabian Sea till 9 Nov and depicts a low on 10 November.
- **UKMO (05/00 UTC):** Model shows emergence of the circulation/trough over Andaman sea on 9 November which will move westwards towards north Tamil Nadu, south Andhrta Pradesh coast .

It shows a low over southeast Arabian Sea at 00 UTC of 7 Nov. It would intensify into a Depression at 00 UTC of 10 Nov and a cyclonic storm at 00 UTC of 11 Nov. It will cross Somalia coast and adjoining Gulf of Aden on 12 evening.

- **GEFS (NCMRWF)**: Models show formation of low on 9 Nov, becoming less marked on 14 Nov over southwest Bay off Tamil Nadu coast.
  A low formed over southeast Arabian Sea on 7 Nov. It would become well marked on 8 Nov and move west-northwestwards and then westwards and intensify into a depression on 10 Nov. It would cross Somalia coast as a low on 11th evening.
- **Genesis Potential Parameter (GPP)** forecast based on 0000 UTC of **07 November 2013** indicates there is a probability of cyclogenesis over east central BOB on 09th Nov and move south-westwards .

- A region of high GPP is seen today (07Nov) over SE Arabian Sea centered at **07N, 62E**. This system is likely to move westwards. The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**.

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Genesis prediction model of SAC-ISRO Ahmedabad also shows cyclogenesis over EC Bay on 10th November.
SHAR model based on ECMWF EPS suggests cyclogenesis over EC Bay around 10th. However, it suggests that it would cross TN coast as a deep depression on 14th November

Summary and Conclusion:
A Tropical low is located in South China Sea off Thailand 0600 UTC of today. NWP models indicate the system to move west northwestwards and emerge into Andaman Sea at 00 UTC of 9 Nov as a low pressure area. Most of the global models predict maximum intensity upto a well marked low pressure area or marginal depression in their seven day forecast. Some models (ECMWF,GEFS,NCMRWF) also suggest weakening of the system as it comes closer to the North Tamil Nadu-south Andhra coast. With respect to track it varies from north Tamil Nadu to south Andhra coast.
Based on the current synoptic and diagnostics analysis and NWP guidance, a low may form over Andaman Sea on 9 the November. It needs to be watched for its further intensification and movement.

- The well marked low pressure area over southeast Arabian Sea may concentrate into a Depression during next 24 hrs while moving west-northwestwards. It may cross Somalia coast as a Depression by evening of 11 November.

Advisory:

- No IOP during next 3 days.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	06/12	**07/00**	**07/03**
India	40/51	31/32	42/51
Coastal stations			
WB	7/9	3/4	7/9
Odisha	6/7	5/5	6/7
AP	10/14	11/13	11/14
Tamil Nadu	10/12	7/7	9/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	5/11	8/11	9/11
Myanmar	10/11	9/11	9/11
Thailand	3/3	3/3	3/3
Srilanka	0/9	7/9	7/9

RS/RW (12Z) of 06/11/2013 13/39

- **No. of Ascents reaching 250 hPa levels:12, MISDA: 26**
- **RS/RW** (00Z) of 07/11/2013 24/39
- **No. of Ascents reaching 250 hPa levels:18 , MISDA:1**

No. of PILOT Ascents

06/12Z	07/00Z
25/37	25/39

Buoy Data

06/12Z	07/00Z	07/03Z
10	9	10

Data Statistics over RMC Chennai Region

No of Synop data

Date→	**06.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

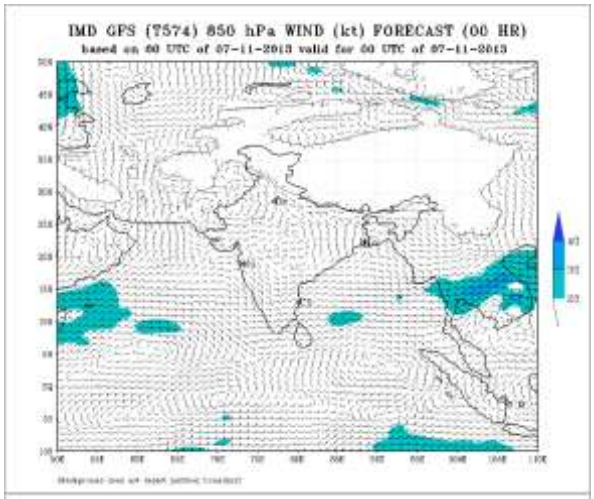
00Z /06.11.2013 : 5
No. of Ascents reaching 250 hPa level =5
MISDA : 3

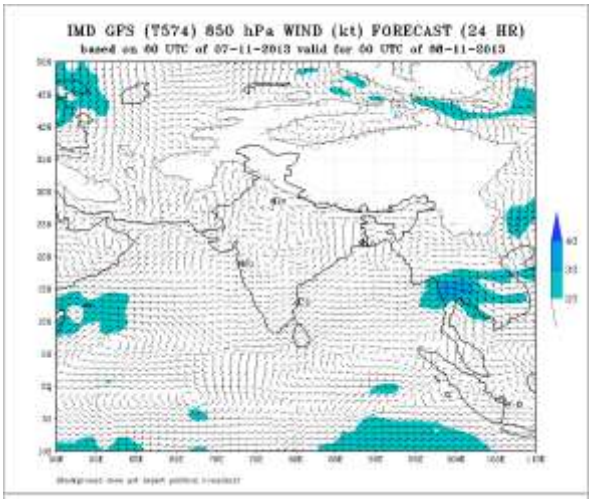
12Z /06.11.2013 : 4
No. of Ascents reaching 250 hPa level =4
MISDA : 4

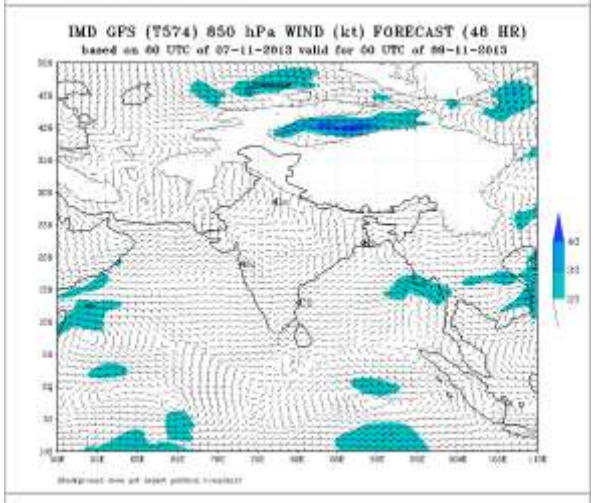
No. of PILOT Ascents:

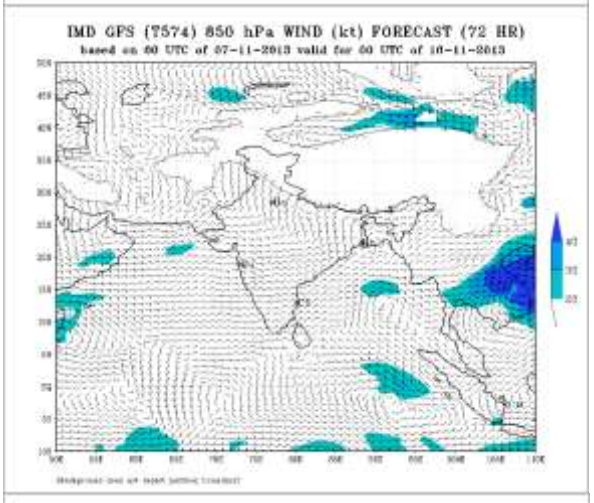
06.11.2013	
06Z	18Z
6	6

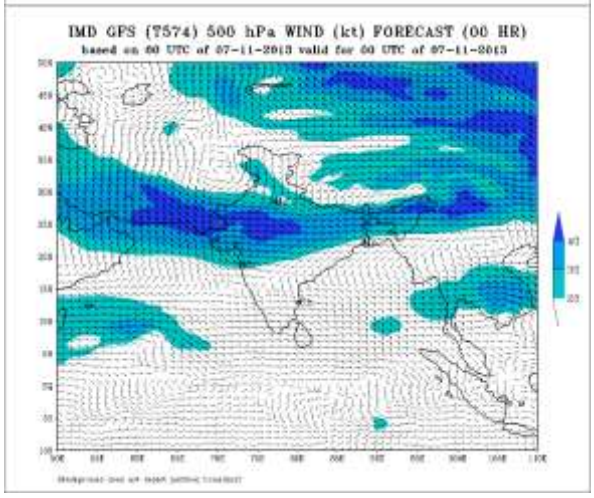
Annexure-II

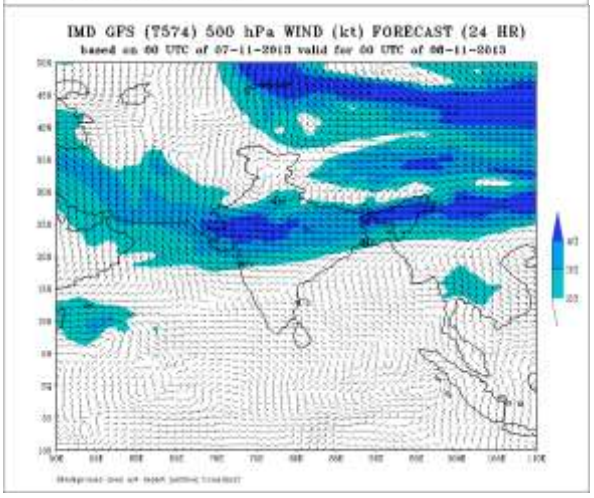

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 07-11-2013 valid for 00 UTC of 07-11-2013

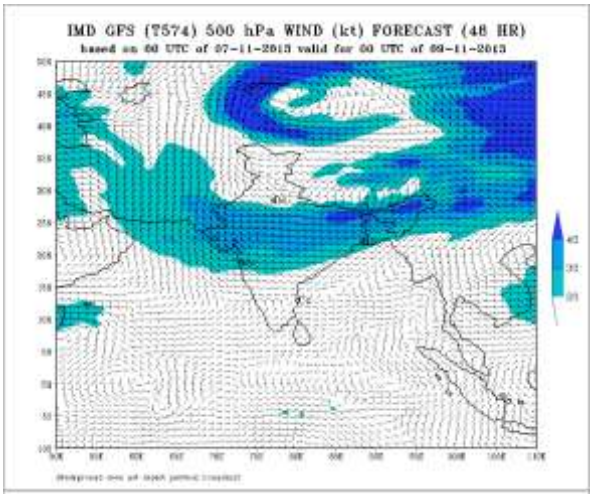

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 07-11-2013 valid for 00 UTC of 08-11-2013

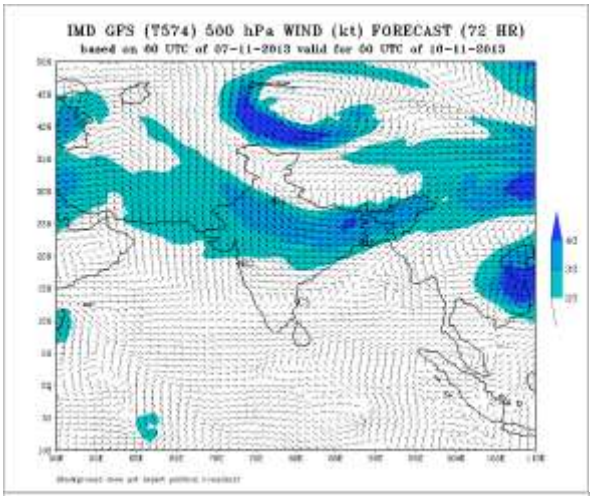

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 07-11-2013 valid for 00 UTC of 09-11-2013

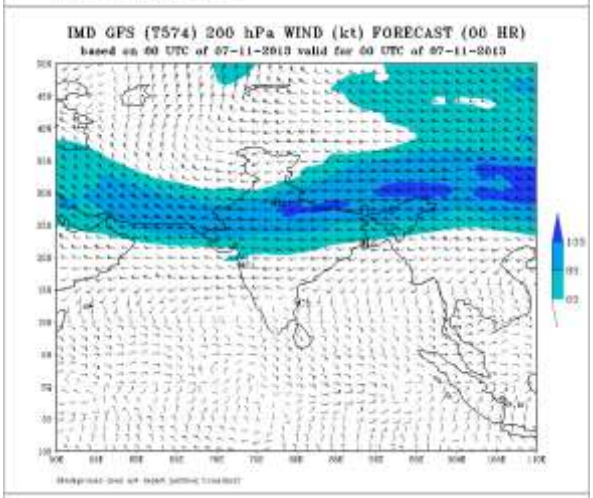

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 07-11-2013 valid for 00 UTC of 10-11-2013

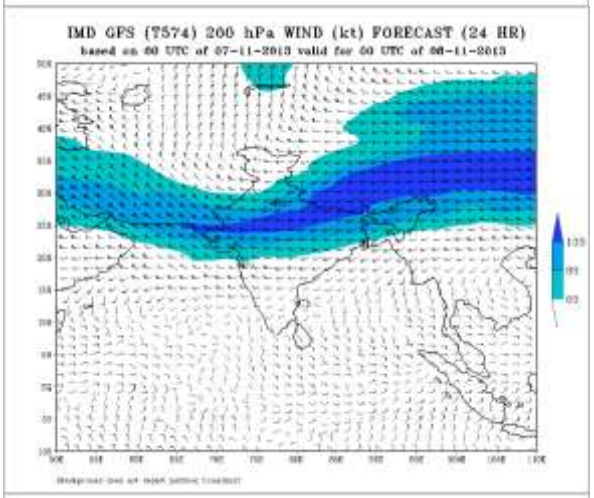

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 07-11-2013 valid for 00 UTC of 07-11-2013

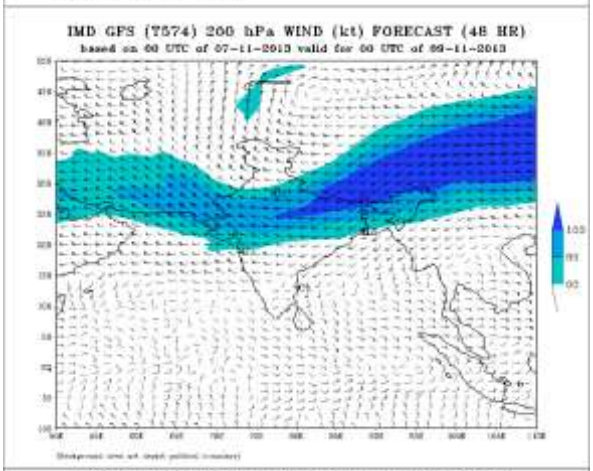

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 07-11-2013 valid for 00 UTC of 08-11-2013

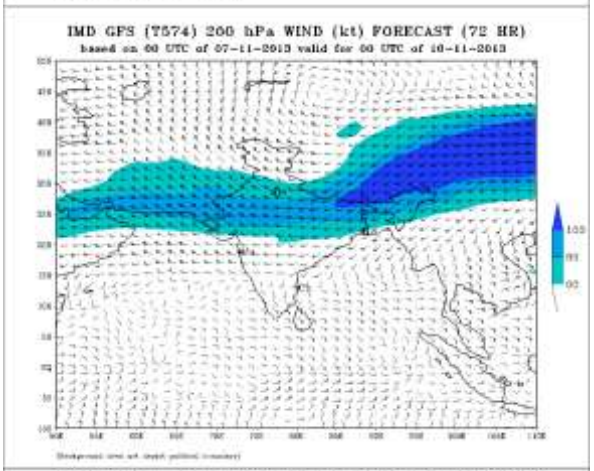

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 07-11-2013 valid for 00 UTC of 09-11-2013

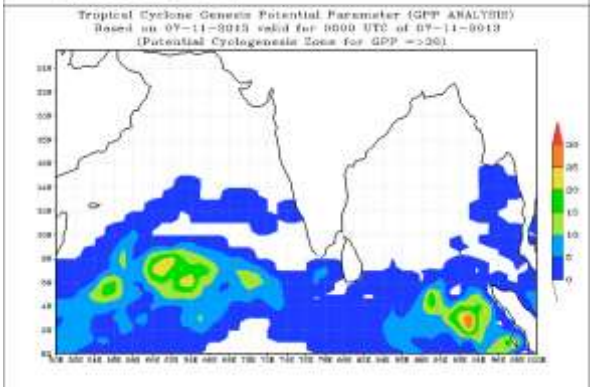

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 07-11-2013 valid for 00 UTC of 10-11-2013

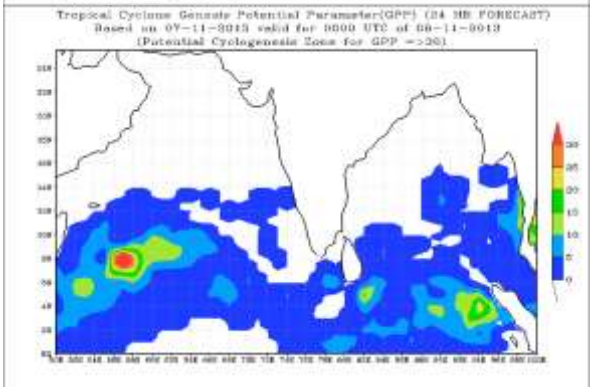

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 07-11-2013 valid for 00 UTC of 07-11-2013

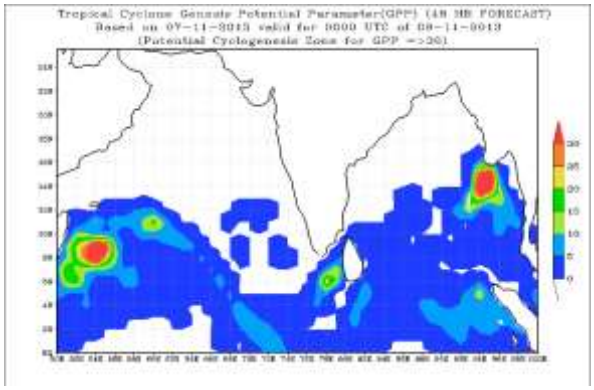

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 07-11-2013 valid for 00 UTC of 08-11-2013

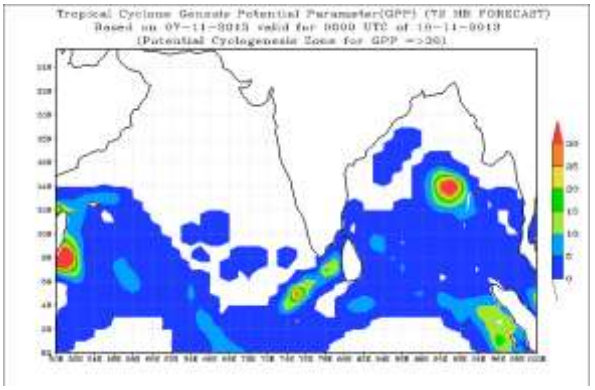

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 07-11-2013 valid for 00 UTC of 09-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 07-11-2013 valid for 00 UTC of 10-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 07-11-2013 valid for 0000 UTC of 07-11-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 07-11-2013 valid for 0000 UTC of 08-11-2013
(Potential Cyclogenesis Zone for GPP =>26)





FDP (Cyclone) NOC Report Dated 08 November, 2013

Synoptic features based on 0300 UTC:

- A low pressure area lies over Tenasserim coast and neighbourhood. Associated cyclonic circulation extends upto 3.6 kms a.s.l. System would emerge into Andaman Sea during next 24 hours and may become well marked.
- The well marked low pressure area over southwest and adjoining southeast Arabian Sea concentrated into a depression and lay centred at 0600 UTC of today over southwest Arabian Sea near lat.8.0^{0}N and 56.5^{0}E. The system would intensify into a deep depression during next 24 hrs would move west-northwestwards and cross Somalia coast between lat. 8^{0}N and 10^{0}N by 10th October evening.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-29^{0}C over Bay of Bengal. It is also 28-29^{0}C over southwest Arabian Sea around system centre. It is colder towards Somalia coast.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north and south west Bay of Bengal. It is 50-90 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2. It is about 80-100 KJ cm^{-2} over southwest Arabian Sea around system centre and less than 50 KJ cm^{-2} near Somalia coast.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over north Bay of Bengal, Andaman Sea and equatorial region. It is negative over the rest part of Bay of Bengal. It is positive 60-80 10^{-5} s^{-1} around the Depression centre over Arabian Sea.

Convergence:

- Lower level convergence is positive of the order of 5*10^{-5} s^{-1} over north Andaman sea and of the order of 5-10*10^{-5} s^{-1}over southwest Bay of Bengal off Srilanka coast and negative over Tamilnadu coast & north Bay of Bengal. It is 5-10*10^{-5} s^{-1} around the Depression over Arabian Sea.

Divergence:

- It is positive of the order 5*10^{-5} s^{-1}over south west Bay of Bengal and 5-10*10^{-5} s^{-1} over Andaman sea. It is also positive over southwest Arabian Sea of the order 5-30*10^{-5} near system centre.

Wind Shear:

- **W**ind Shear is 10 knots over southwest Bay and Andaman sea and more than 20 knots over central and North Bay of Bengal. It is around 10 knots near depression over Arabian Sea

Wind Shear Tendency:

- Shear Tendency is increasing over southeast Bay and south Andaman Sea. It is negative over southwest Bay. It is positive near the depression centre and negative to the northeast of the system centre in Arabian Sea.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 15.0°N over Andaman Sea region. It tilts southward towards western longitude and runs roughly along 12^0N over west Arabian Sea.

M.J.O. Index: (Based on 6th Nov)

- Located in phase 2 with amplitude more than 1.0.
- Dynamical forecast:- MJO index may continue in phase 2 with decreasing amplitude within next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 080900 UTC

- Scattered low/medium clouds with embedded moderate to intense convection over north Andaman Sea. Scattered low/medium clouds with embedded isolated weak convection over south and eastcentral Bay.
- Vortex over Arabian Sea centred 8.0^0N/55.5E.intensity T 1.5. Associated broken low/medium cloud with embedded intense to very convection over the area between lat. 6.0^0N to 13.0^0N and long. 50.0^0E to 60.0^0E

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 08November2013 shows a low pressure area over southwest Arabian Sea. This low pressure area may concentrate into a Depression during next 24 hours and move westwards.
- 24 hour Forecast shows a low pressure area over Andaman sea around 9th Nov 2013 and also shows that the system may intensify further and move south-westwards towards Sri Lanka.
- The analysis and forecasts of GFS model for 24h to 72 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure II**.
- **IMD-WRF** model of 0000 UTC of 08 November 2013 also shows similar pattern as that of GFS. (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
- **ECMWF:** Model shows formation of a low pressure area on 9 Nov becoming depression on 11 Nov over EC bay. It is expected to move west-southwestward and cross Tamil Nadu coast on 15th November.
  It also shows a Low only over southwest Arabian Sea, which will move west-northwestwards next 3 days.
- **METEOFRANCE -ARP:** Model shows formation of a low pressure area over Tenasserim coast on 8 Nov. It would continue as a low and move west-northwestwards towards Tamil Nadu coast during next 3 days.
  It also shows a low over southwest Arabian Sea which will move west-northwestwards and intensify into a depression on 9th Nov and further intensify as cyclonic storm on 10th Nov and cross coast by 11th morning.
- **JMA:** Model shows low over Andaman Sea on 9 Nov it will move as a low west-north westwards till 12th Nov.
  It shows low over southwest Arabian Sea at 08/0000UTC and it would move towards Somalia coast in next 72 hrs.

- **UKMO (07/00 UTC):** Model shows emergence of the circulation/trough over Andaman sea on 9 November which will move westwards towards north Tamil Nadu, south Andhrta Pradesh coast by 15th November.
  It shows a low over southwest Arabian Sea at 00 UTC of 8 Nov. It would intensify into a Depression at 00 UTC of 10 Nov and a cyclonic storm at 00 UTC of 11 Nov. It will cross Somalia coast and adjoining Gulf of Aden on 11th morning.
- **GEFS (NCMRWF)**: Models show formation of low on 9 Nov over Andaman Sea, becoming less marked on 14 Nov over southwest Bay off Tamil Nadu coast.
  A low lies lies over southwest Arabian Sea on 8 Nov. It would become well marked on 8 Nov and move west-northwestwards and then westwards and intensify into a depression on 10 Nov. It would cross Somalia coast as a low on 11th morning.
- **Genesis Potential Parameter (GPP)** forecast based on 0000 UTC of **08 November 2013** indicates there is a probability of cyclogenesis over Andaman Sea on 09th Nov

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Genesis prediction model of SAC-ISRO Ahmedabad also shows cyclogenesis over EC Bay on 10th November.
SHAR model based on ECMWF EPS suggests cyclogenesis over EC Bay around 10th. However, it suggests that it would cross TN coast as a depression on 15th November

Summary and Conclusion:

- The low pressure area lies over Tenasserim coast would emerge into Andaman Sea by 9th November and may become well marked.
- The depression centred at 0600 UTC of today over southwest Arabian Sea near lat.8.0^{0}N and 56.5^{0}E would intensify into a deep depression during next 24 hrs. It would move westwards and cross Somalia coast between lat. 7^{0}N and 9^{0}N by 10th October evening.

Advisory:

- No IOP during next 3 days.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	07/12	**08/00**	**08/03**
India	39/51	30/32	40/51
Coastal stations			
WB	7/9	3/4	7/9
Odisha	6/7	5/5	6/7
AP	10/14	11/13	11/14
Tamil Nadu	10/12	7/7	9/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	5/11	8/11	9/11
Myanmar	10/11	9/11	9/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	7/9	7/9

RS/RW (12Z) of 07/11/2013 01/39

- **No. of Ascents reaching 250 hPa levels:01, MISDA: 38**

- **RS/RW** (00Z) of 08/11/2013 24/39
- **No. of Ascents reaching 250 hPa levels:18 , MISDA:15**

No. of PILOT Ascents

07/12Z	08/00Z
24/37	18/34

Buoy Data

07/12Z	08/00Z	08/03Z
10	9	10

Data Statistics over RMC Chennai Region

No of Synop data

Date→				**07.11.2013**				
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

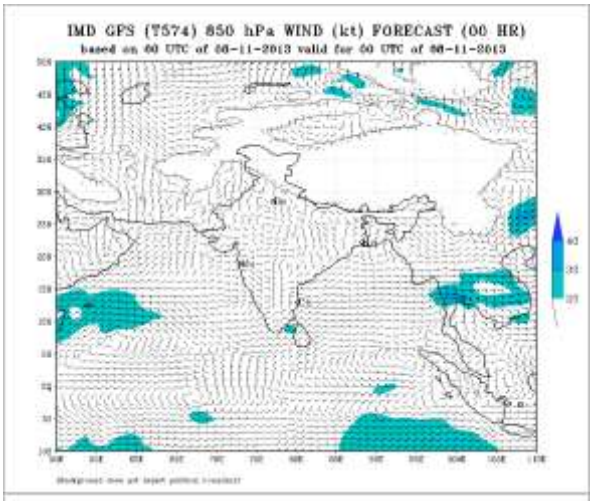
00Z /07.11.2013 : 6
No. of Ascents reaching 250 hPa level =5
MISDA : 2
12Z /07.11.2013 : 5
No. of Ascents reaching 250 hPa level =5
MISDA : 3

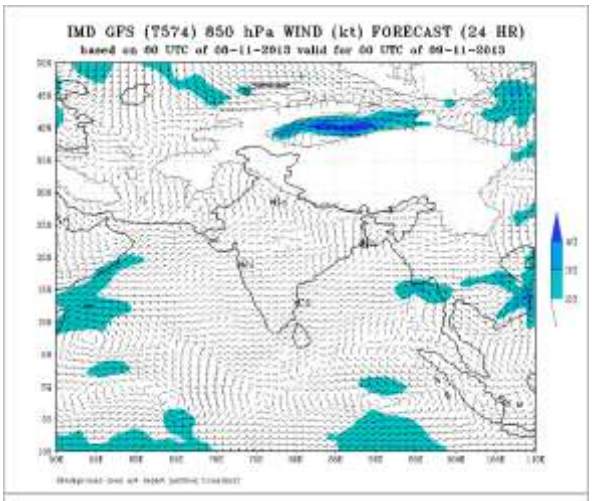
No. of PILOT Ascents:

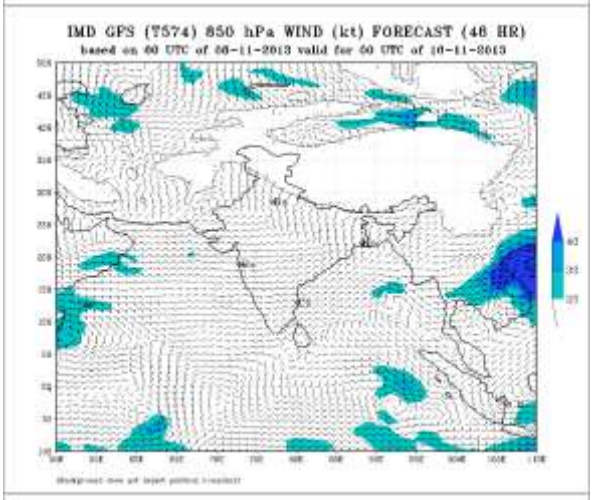
07.11.2013

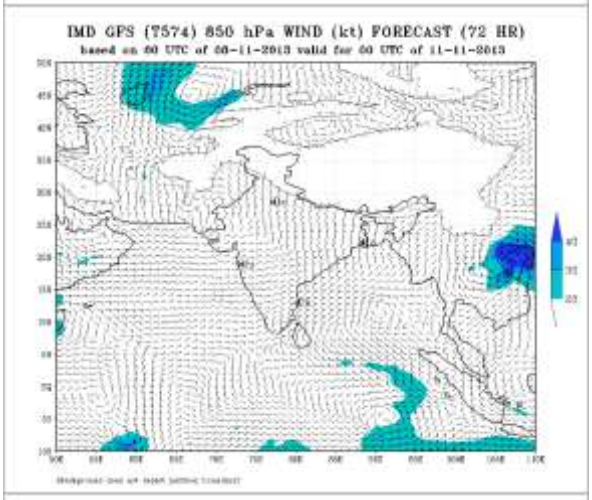
06Z	18Z
6	7

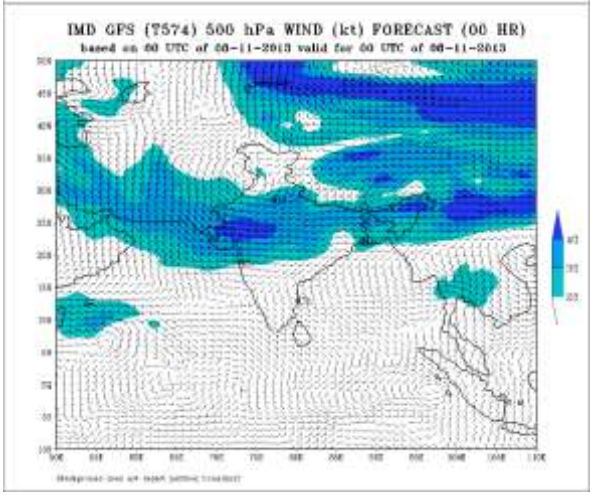
Annexure-II

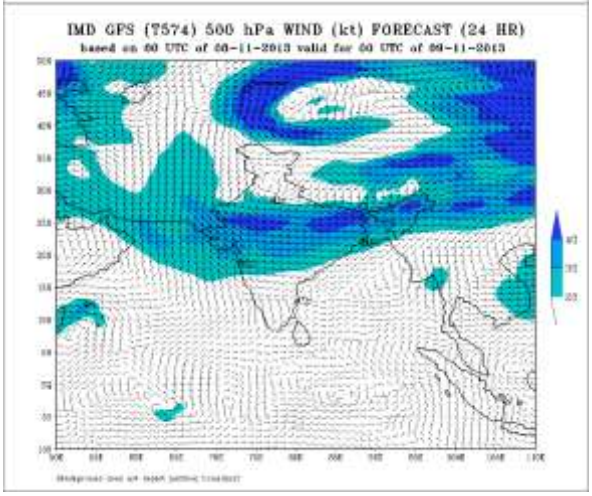

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 08-11-2013 valid for 00 UTC of 08-11-2013

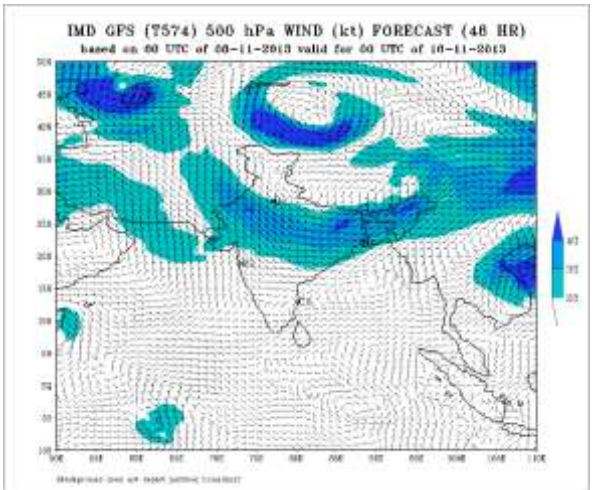

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 08-11-2013 valid for 00 UTC of 09-11-2013

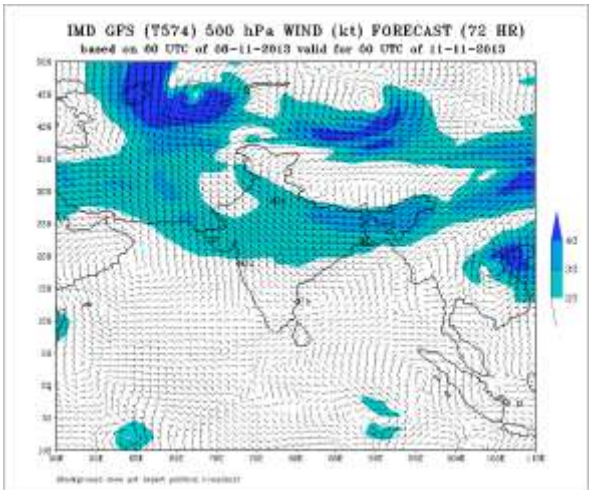

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 08-11-2013 valid for 00 UTC of 10-11-2013

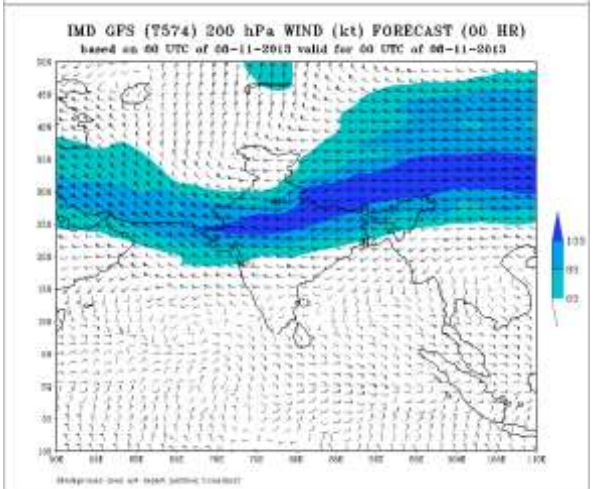

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 08-11-2013 valid for 00 UTC of 11-11-2013

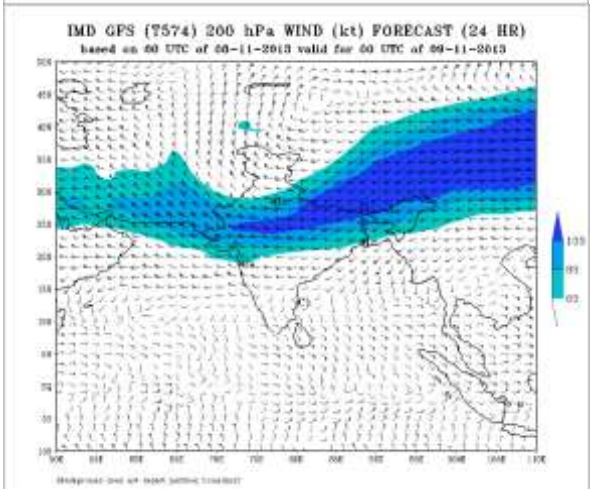

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 08-11-2013 valid for 00 UTC of 08-11-2013

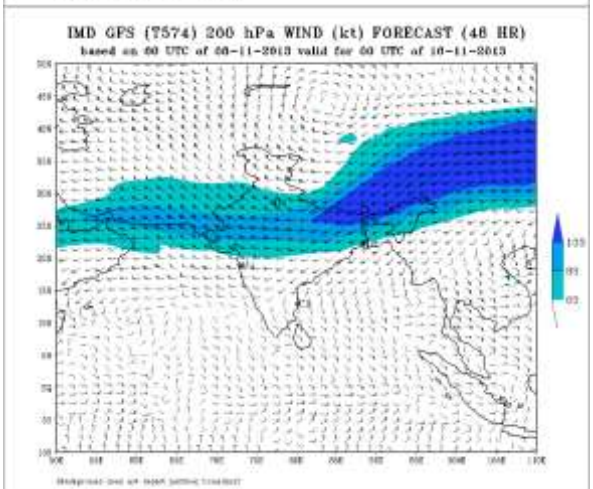

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 08-11-2013 valid for 00 UTC of 09-11-2013

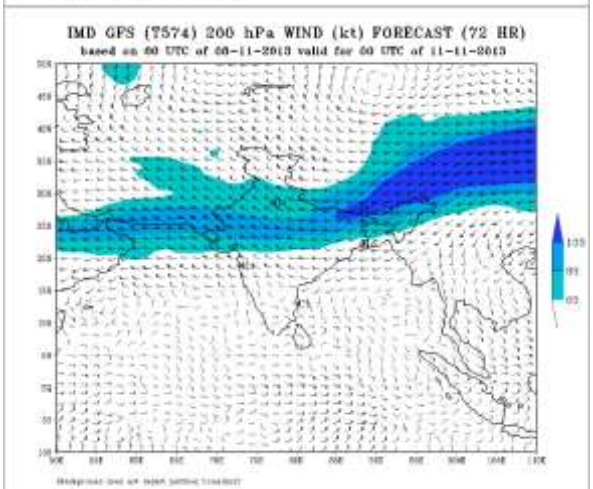

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 08-11-2013 valid for 00 UTC of 10-11-2013

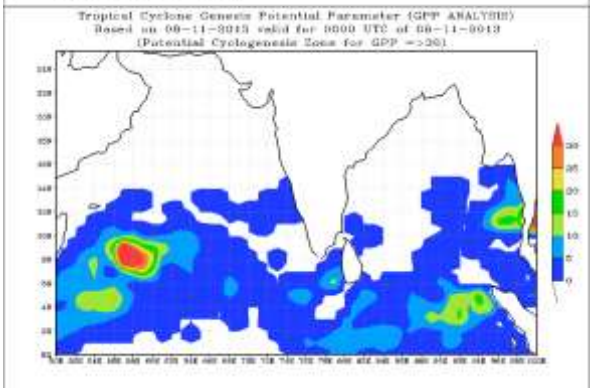

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 08-11-2013 valid for 00 UTC of 11-11-2013

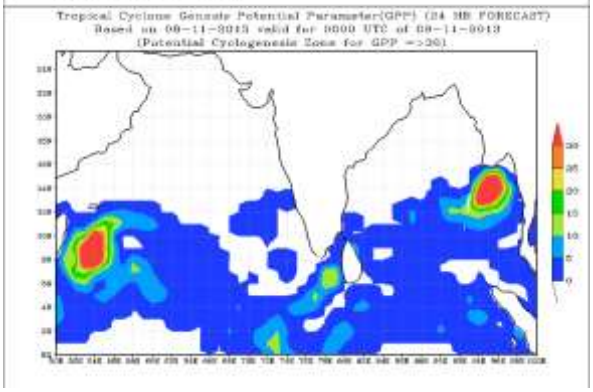

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 08-11-2013 valid for 00 UTC of 08-11-2013

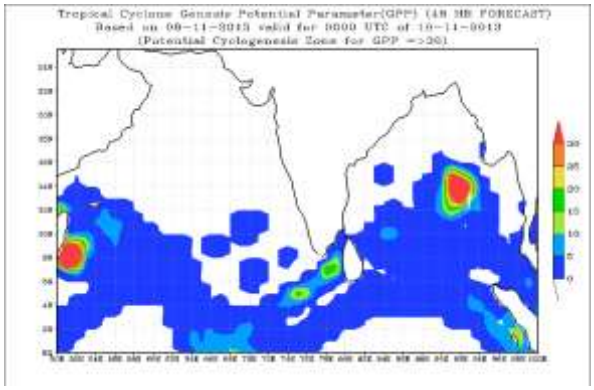

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 08-11-2013 valid for 00 UTC of 09-11-2013

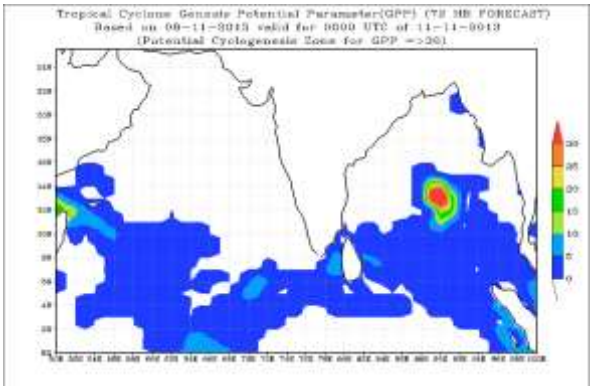

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 08-11-2013 valid for 00 UTC of 10-11-2013


IMD GPS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 08-11-2013 valid for 00 UTC of 11-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 08-11-2013 valid for 0000 UTC of 08-11-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 08-11-2013 valid for 0000 UTC of 09-11-2013
(Potential Cyclogenesis Zone for GPP =>26)





FDP (Cyclone) NOC Report Dated 09 November, 2013

Synoptic features based on 0300 UTC:

- Yesterday's depression over southwest Arabian Sea moved westwards, intensified into a deep depression in the early morning of today. I continued to move westwards and lay centred at 0300 UTC of today, the 9th November 2013, near lat. 8.0° N and Long. 52.5° E, about 390 kms south southeast of Ras Binnah (Somalia). It would move nearly westwards and cross Somalia coast around evening of 10th November.
- The low pressure area over Tenasserim coast and neighbourhood lay over north Andaman Sea and neighbourhood. Associated cyclonic circulation extends upto mid tropospheric levels. System would become well marked during next 24 hours.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-29^{0}C over Bay of Bengal. It is also 28-29^{0}C over southwest Arabian Sea around system centre. It is colder towards Somalia coast.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north and south west Bay of Bengal. It is 50-90 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2. It is about 80-100 KJ cm^{-2} over southwest Arabian Sea around system centre and less than 50 KJ cm^{-2} near Somalia coast.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over north Bay of Bengal, and equatorial region. It is negative over the rest part of Central Bay of Bengal. It is positive 60-80 10^{-5} s^{-1} around the Depression centre over Arabian Sea and around the low pressure area over north Andaman Sea and neighbourhood.

Convergence:

- Lower level convergence is positive of the order of 5-10*10^{-5} s^{-1} over north Andaman sea around the low pressure area and of the order of 5*10^{-5} s^{-1}over central and south Bay of Bengal. It is 5-20*10^{-5} s^{-1} around the Depression over Arabian Sea.

Divergence:

- It is positive of the order of 5-10*10^{-5} s^{-1} over Andaman sea around the low and 5*10^{-5} s^{-1}over central Bay of Bengal and negative of the order of -5*10^{-5} s^{-1} over south Bay of Bengal. It is also positive over southwest Arabian Sea of the order 5-30*10^{-5} near system centre.

Wind Shear:

- **W**ind Shear is 20 knots over south Bay and Andaman sea and more than 20 knots over central and North Bay of Bengal. It is around 10-20 knots near deep depression over Arabian Sea

Wind Shear Tendency:

- Shear Tendency is increasing over southeast Bay and Andaman Sea. No significant change near the deep depression centre in Arabian Sea.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 13.0°N over Andaman Sea region. It tilts southward towards western longitude and runs roughly along 12^0N over west Arabian Sea.

M.J.O. Index: (Based on 6th Nov)

- Located in phase 2 with amplitude more than 1.0.
- Dynamical forecast:- MJO index may move in phase 2 and 3 with amplitude less than 1.0 during next 2 days and again going to phase 1.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 090900 UTC

- Vortex over southwest Arabian sea centered near 8.0°N/52.1°E with intensity T2.0. Associated broken low medium clouds with embedded intense to very intense convection over Arabian Sea between lat. 6.0^0N to 12.0^0N and long. 52.5^0E to Somalia coast.
- Another vortex over north Andaman sea cantered within half a Degree near 14.0°N/95.5°E with intensity T1.0. Associated broken low medium clouds with embedded moderate to intense convection over north Andaman sea.

NWP Analysis

- **IMD-GFS** model analysis of 0000 UTC of 09 November2013 shows a low pressure area over southwest Arabian Sea. This low pressure area may concentrate into a Depression during next 24 hours and move southwestwards.
- The low pressure area over Andaman sea would move west-southwestwards with maximum intensity of depression and reach Sri Lanka coast by 15th November
- **IMD-WRF** model of 0000 UTC of 09 November 2013 also shows similar pattern as that of GFS. (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
- **ECMWF:** Model shows formation of a low pressure area on 9 Nov becoming depression on 11 Nov over EC bay. It is expected to move west-southwestward upto 12th. It would then move west-northwestwards, intensify into a cyclonic storm and cross south AP and adjoining north Tamil Nadu coast on 15th November as a cyclonic storm.
  It also shows a Low only over southwest Arabian Sea, which will move west-northwestwards and cross Somalia coast around morning of 11th November.

- **METEOFRANCE -ARP:** Model shows formation of a low pressure area over north Andaman sea on 9 Nov. It would continue as a low and move west-southwestwards towards Tamil Nadu coast during next 3 days.
  It also shows a depression over southwest Arabian Sea which will move west-northwestwards and intensify into a cyclonic storm on 10th Nov and cross Somalia coast by 11th morning.
- **JMA:** Model shows low over Andaman Sea on 9 Nov it will move as a low west-southwestwards till 12th Nov.
  It shows low over southwest Arabian Sea at 09/0000UTC and it does not show landfall and weakens the system over sea in next 72 hrs.

- **UKMO (09/00 UTC):** Model shows the low over Andaman sea on 9 November which will move west-northwestwards towards north Andhrta Pradesh coast by 15th November. However, it intensifies on first two days and then gradually weakens over the sea.
  It shows a low over southwest Arabian Sea at 00 UTC of 9 Nov. It would intensify into a deep Depression at 00 UTC of 10 Nov and a cyclonic storm at 00 UTC of 11 Nov. It will cross Somalia coast near Ras Binah and adjoining Gulf of Aden on 12th morning.
- **GEFS (NCMRWF)**: Models show formation of low on 9 Nov over Andaman Sea. It would move west-southwestwards and become less marked on 13 Nov over southwest Bay.
  A low lies over southwest Arabian Sea on 9 Nov. It would move west-southwestwards and then west-northwestwards and cross Somalia coast as a low on 10th evening.
- **Genesis Potential Parameter of IMD**
  Analysis and forecasts of Genesis Potential Parameter (GPP) based on 0000 UTC of 09 November 2013 indicate that the Low Pressure Area over the North Andaman Sea is unlikely to intensify into a tropical cyclone during next 84 hours.
  Analysis and forecasts of Genesis Potential Parameter (GPP) based on 0000 UTC of 09 November 2013 indicate that the Deep Depression over the South-west Arabian Sea has potential to intensify into a tropical cyclone.

(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

SHAR model based on ECMWF EPS suggests cyclogenesis over EC Bay around 10th. However, it suggests that it would cross TN coast as a depression on 15th November
Low pressure area lies over North Andaman Sea near 13.3 N & 95.1 E. System will emerge in Central Bay of Bengal as a well marked low during next 12 hours. Probability for intensification in to TC is moderate (60%). System may become depression on 12th Nov and subsequently will become Deep depression on 13th night/14th Nov.
ECMWF ensemble track forecasts shows, System may track initially South Westward direction and further Westward, landfall between North coastal Tamilnadu and extreme South Coastal Andhra near Chennai (with 60% probability) on 15th Nov

Summary and Conclusion:

- The low pressure area over north Andaman Sea may become well marked during next 24 hrs. Subsequently it would move west-southwestwards and intensify into maximum intensity of deep depression and reach north Tamil Nadu and adjoining south AP coast by 15th November.
- The deep depression centred at 0600 UTC of today over southwest Arabian Sea near lat.8.0^{0}N and 52.5^{0}E would move nearly westwards and cross Somalia coast between lat. 7.5^{0}N and 8.5^{0}N by 10th October evening.

Advisory:

- Possible intensification of low over Bay of Bengal to be watched.
- Intense observation may be taken over Andaman and Nicobar for 10 and 11 November
- IOP may be considered for Tamil Nadu and Andhra Pradesh coast during 12-15 November.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	08/12	**09/00**	**09/03**
India	39/51	30/32	40/51
Coastal stations			
WB	7/9	3/4	7/9
Odisha	6/7	5/5	6/7
AP	10/14	11/13	11/14
Tamil Nadu	10/12	7/7	9/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	5/11	8/11	9/11
Myanmar	10/11	9/11	9/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	7/9	7/9

RS/RW (12Z) of 08/11/2013 01/39

- **No. of Ascents reaching 250 hPa levels:01, MISDA: 38**

- **RS/RW** (00Z) of 09/11/2013 24/39
- **No. of Ascents reaching 250 hPa levels:18 , MISDA:15**

No. of PILOT Ascents

08/12Z	09/00Z
24/37	18/34

Buoy Data

08/12Z	09/00Z	09/03Z
10	9	10

Data Statistics over RMC Chennai Region

No of Synop data

Date→	**08.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

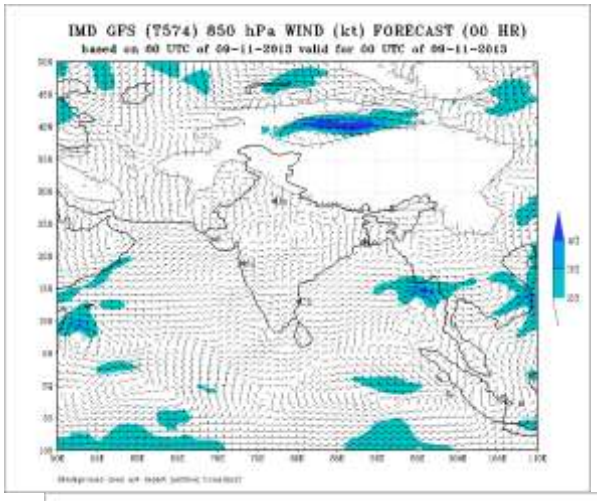
No. of RS/RW Ascents

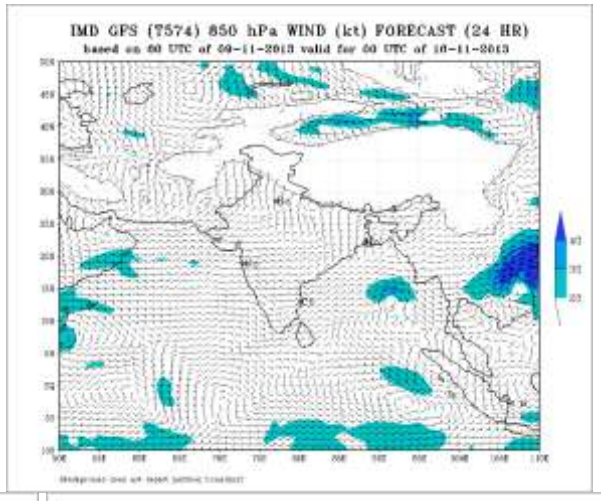
00Z /08.11.2013 : 6
No. of Ascents reaching 250 hPa level =5
MISDA : 2
12Z /08.11.2013 : 5
No. of Ascents reaching 250 hPa level =5
MISDA : 3

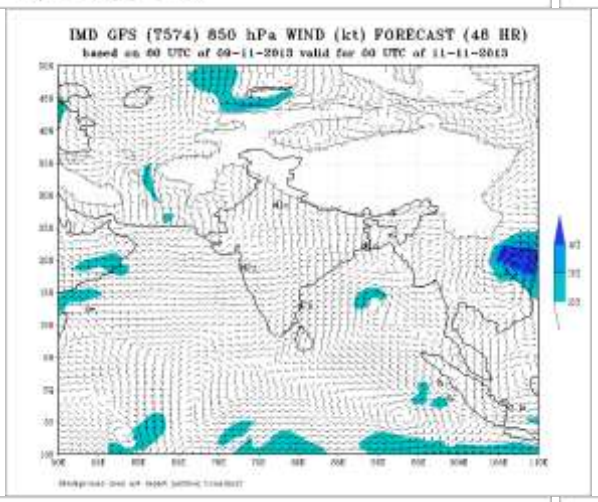
No. of PILOT Ascents:
08.11.2013

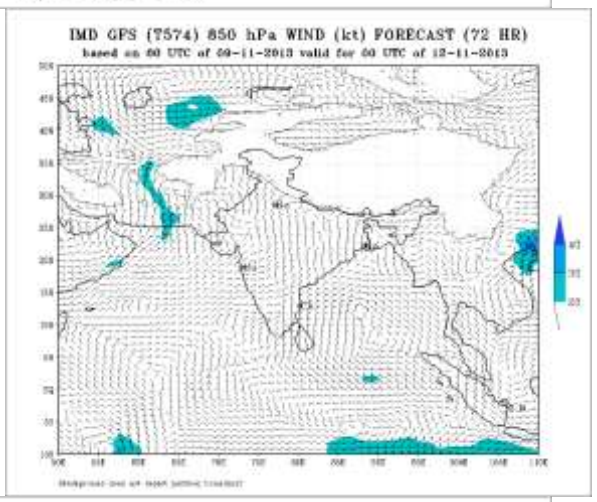
06Z	18Z
7	7

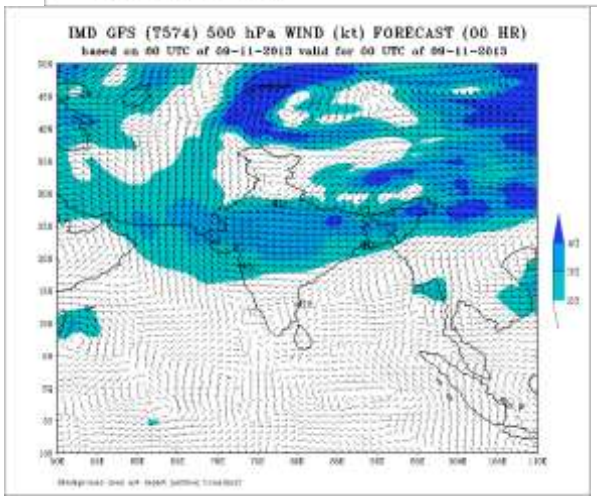
Annexure-II

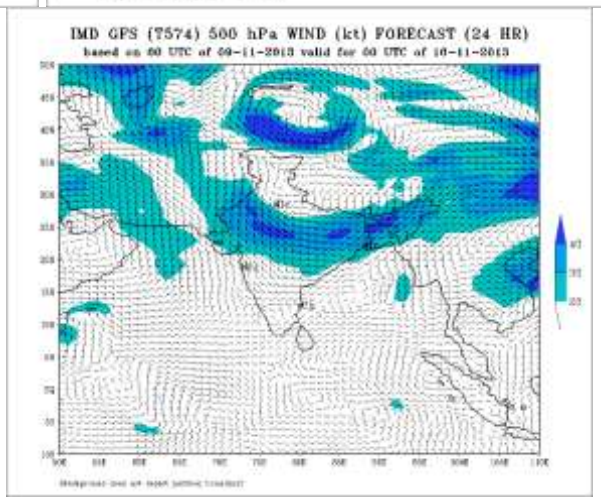

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 09-11-2013 valid for 00 UTC of 09-11-2013

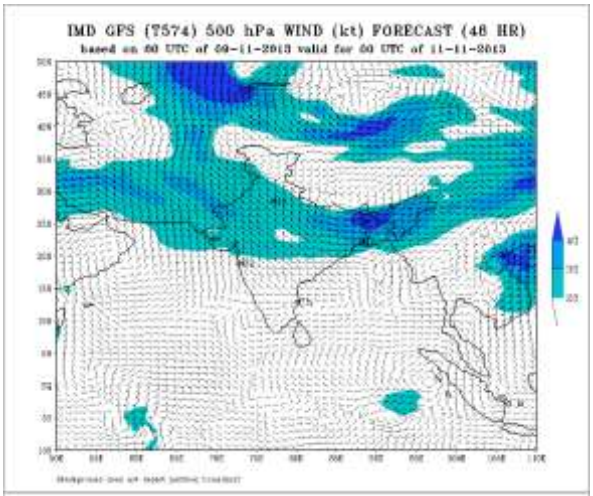

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 09-11-2013 valid for 00 UTC of 10-11-2013

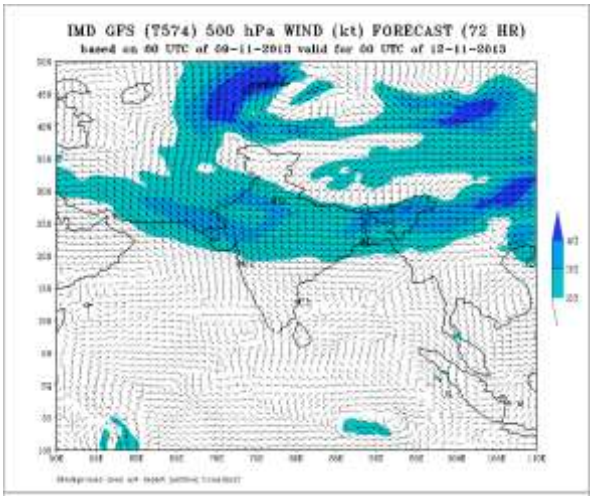

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 09-11-2013 valid for 00 UTC of 11-11-2013

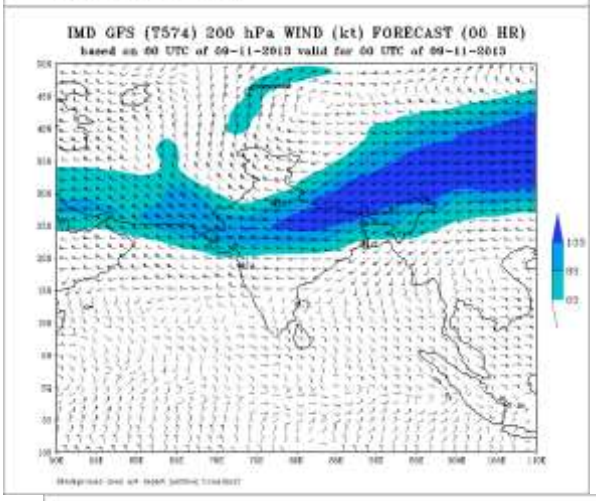

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 09-11-2013 valid for 00 UTC of 12-11-2013

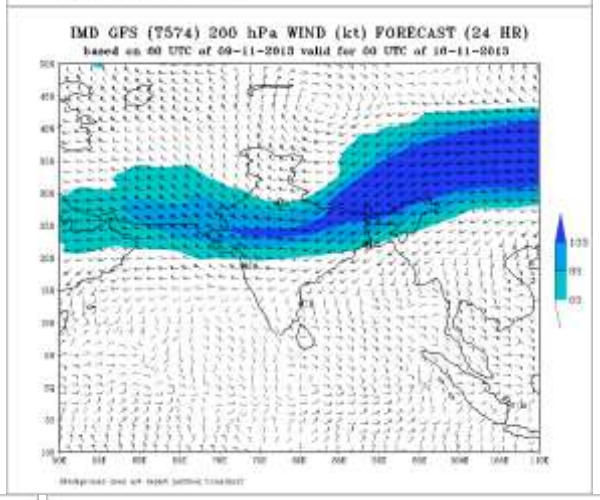

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 09-11-2013 valid for 00 UTC of 09-11-2013

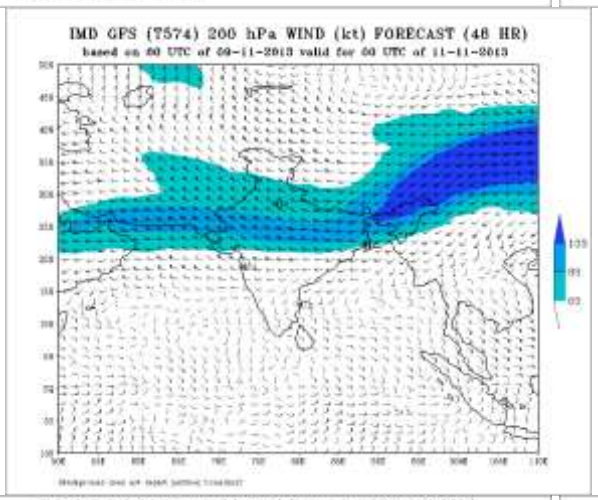

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 09-11-2013 valid for 00 UTC of 10-11-2013

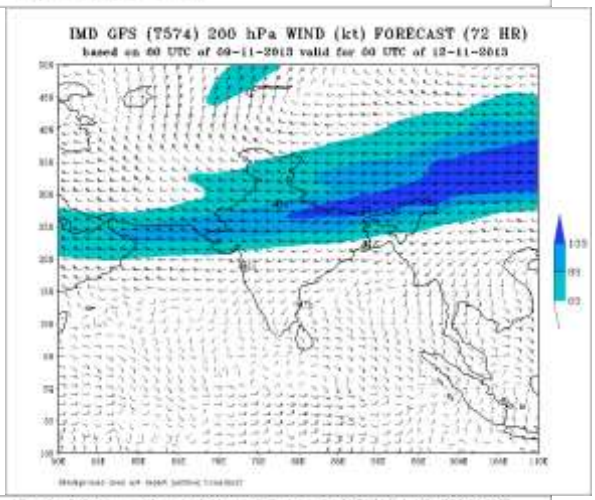

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 09-11-2013 valid for 00 UTC of 11-11-2013

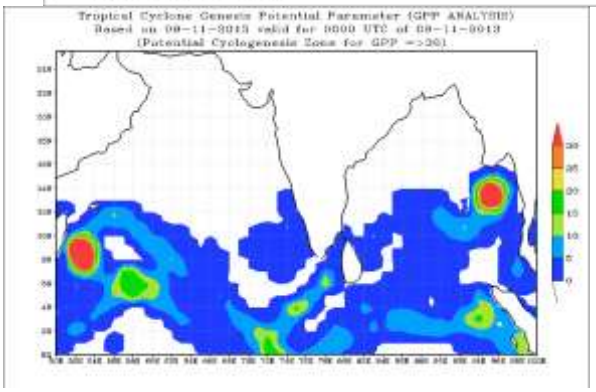

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 09-11-2013 valid for 00 UTC of 12-11-2013

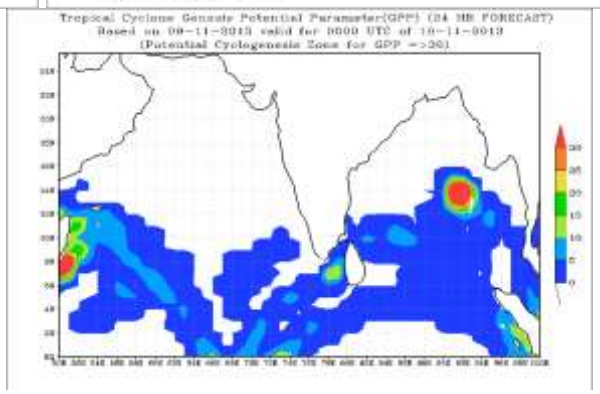

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 09-11-2013 valid for 00 UTC of 09-11-2013

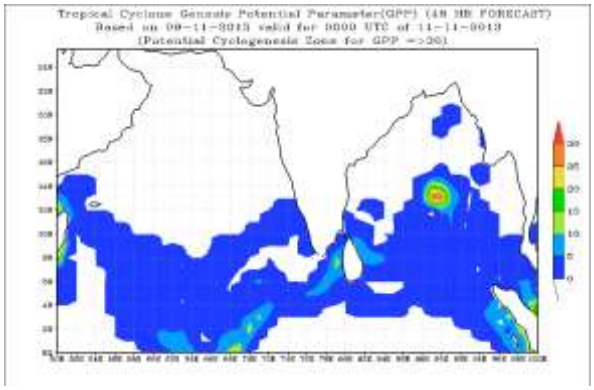

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 09-11-2013 valid for 00 UTC of 10-11-2013

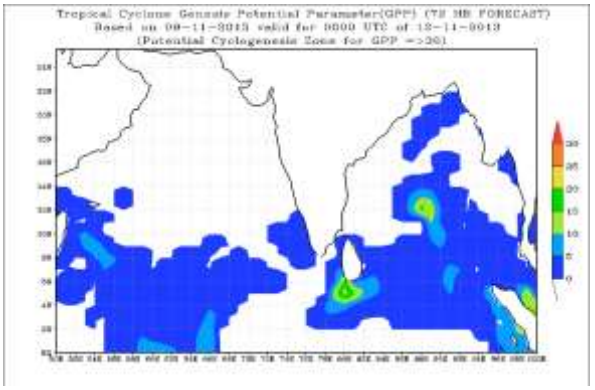

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 09-11-2013 valid for 00 UTC of 11-11-2013


IMD GPS (7574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 09-11-2013 valid for 00 UTC of 12-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 09-11-2013 valid for 0000 UTC of 09-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 09-11-2013 valid for 0000 UTC of 10-11-2013
(Potential Cyclogenesis Zone for GPP =>20)





FDP (Cyclone) NOC Report Dated10 November, 2013

Synoptic features based on 0300 UTC:

- The Deep Depression over southwest Arabian Sea moved westwards and lay centred at 1200 UTC of yesterday, the 9th November 2013 within half a deg. of Lat. 8.0° N and Long. 51.5° E. It moved slowly westwards and lies centred at 0300 UTC of today, the 10th November 2013, within half a deg. of Lat. 8.0° N and Long. 51.0° E, about 350 kms south of Ras Binnah (Somalia). The system would move slowly west-northwestwards and cross Somalia coast during the early hours of 11th November.
- The low pressure area over north Andaman Sea and neighbourhood now lies over southeast Bay of Bengal and neighbourhood. Associated cyclonic circulation extends upto 4.5 kms a.s.l. System would become well marked during next 24 hours

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-29^{0}C over Bay of Bengal. It is also 28^{0}C over southwest Arabian Sea around system centre. It is colder towards Somalia coast.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north, west Central and south west Bay of Bengal. It is 50-90 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2. It is about 80-100 KJ cm^{-2} over southwest Arabian Sea around system centre and less than 50 KJ cm^{-2} near Somalia coast & North Arabian.Sea.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over north Bay of Bengal, and equatorial region. It is negative over the rest part of Central Bay of Bengal. It is positive, 150 10^{-5} s^{-1} around the Deep Depression centre over Arabian Sea and 60-80 10^{-5} s^{-1} around the low pressure area over southeast Bay and neighbourhood.

Convergence:

- Lower level convergence is positive of the order of 5-10*10^{-5} s^{-1} over the low pressure area and over southwest Bay of Bengal. It is negative of the order of -5-10*10^{-5} s^{-1} over north Bay of Bengal. It is 20*10^{-5} s^{-1} around the Deep Depression over Arabian Sea.

Divergence:

- It is positive of the order of 5-10*10^{-5} s^{-1} around the low and 5*10^{-5} s^{-1}over southwest Bay of Bengal and negative of the order of -5*10^{-5} s^{-1} over south Bay of Bengal. It is also positive over southwest Arabian Sea of the order 20*10^{-5} around system centre.

Wind Shear:

- **W**ind Shear is 5-10 knots over Andaman sea, 10 knots over southwest Bay of Bengal and more than 20 knots over central and North Bay of Bengal. It is around 10-20 knots around deep depression over Arabian Sea

Wind Shear Tendency:

- Shear Tendency is decreasing creasing over Andaman Sea and increasing over southeast Bay of Bengal. No significant change near the deep depression centre in Arabian Sea.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 13.0°N over bay of Bengal region and runs roughly along 14^0N over west Arabian Sea near Deep Depression region.

M.J.O. Index: (Based on 9th Nov)

- Located in phase 2 with amplitude more than 1.0.
- Dynamical forecast:- MJO index may move in phase 3 with amplitude less than 1.0 during next 2 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 100900 UTC

- Vortex over southwest Arabian sea centered lies near 8.0°N/51.0°E with intensity T2.0.Centre is more clear in visible imagery Associated broken low medium clouds with embedded intense to very intense convection over Arabian Sea between lat. 5.0^0N to 10.0^0N west of long. 53.0^0E and Somalia coast.
- Another vortex over north Andaman sea and adjoining southeast Bay of Bengal cantered within half a Degree near 13.0°N/93.0°E with intensity T1.0. Associated broken low medium clouds with embedded moderate to intense convection over Bay of Bengal between lat. 11.0^0N to $17.0^{0.}$ and long. 88.0^0E to 93.0^0E

NWP Analysis

- IMD-GFS model analysis of 0000 UTC of 10 November2013 shows a low/ low level circulation in the lower levels (upto 850 hPa) over southwest Arabian Sea centered at 07N, 51E. This system may move westwards towards Somali coast during next 24 hours.
- It also shows a low pressure area over southeast Bay of Bengal and neighborhood and associated cyclonic circulation extends up to 500 hPa. Model forecast shows that the system may move south-westwards towards without intensification.
- The analysis and forecasts of GFS model for 24h to 72 h of 850 hPa, 500 hPa and 200 hPa wind are given in Annexure-II.
- IMD-WRF model of 0000 UTC of 10 November 2013 also shows similar pattern. (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
- **ECMWF:** Model shows formation of a low pressure area on 10 Nov becoming depression on 11 Nov over southeast Bay. It is expected to move west-southwestward upto 12th. It would then move west-northwestwards as a depression and cross south AP and adjoining north Tamil Nadu coast on 16th November.
  It also shows a depression over southwest Arabian Sea, which will move west-northwestwards and cross Somalia coast around morning of 11th November.
- **METEOFRANCE -ARP:** Model shows a low pressure area over southeast Bay on 10 Nov. It would intensify into a depression on 11 November and move initially southwestwards and then westwards during next 72 hrs
  It also shows a deep depression over southwest Arabian Sea which will move west-northwestwards and weaken gradually over the sea during next 72 hrs
- **JMA:** Model shows low over southeast Bay on 10 Nov. It will move as a low west-southwestwards till 13th Nov.
  It shows low over southwest Arabian Sea at 10/0000UTC and it does not show landfall and weakens the system over sea in next 72 hrs, while moving west-southwestwards.

- **UKMO (09/00 UTC):** Model shows the low over Andaman sea on 9 November which will move west-northwestwards towards north Andhrta Pradesh coast by 15th November. However, it intensifies on first two days and then gradually weakens over the sea.
  It shows a low over southwest Arabian Sea at 00 UTC of 9 Nov. It would intensify into a deep Depression at 00 UTC of 10 Nov and a cyclonic storm at 00 UTC of 11 Nov. It will cross Somalia coast near Ras Binah and adjoining Gulf of Aden on 12th morning.
- **GEFS (NCMRWF)**: Models show low on 10 Nov over southeast Bay. It would move west-southwestwards and become less marked on 12 Nov over southwest Bay. It showa formation of a depression over southeast Bay on 17 November, which will move west-northwestwards and lie near AP coast on 20 November.
  A low lies over southwest Arabian Sea on 10 Nov. It would move west-northwestwards and lie over Somalia on 11 morning.
- Analysis and forecasts of Genesis Potential Parameter (GPP) of IMD based on 0000 UTC of 10 November 2013 evaluated for the Deep Depression over the South-west Arabian Sea indicate that the GPP values are marginally above the threshold value, however considering the proximity to coast and land friction the system is unlikely to intensify further into a tropical cyclone.
- Analysis and forecasts of Genesis Potential Parameter (GPP) based on 0000 UTC of 10 November 2013 evaluated for the Well Marked Low Pressure Area over the southeast Bay indicate that the system is unlikely to intensify into a tropical cyclone during next 24 hours. However, the potential for intensification would marginally increase after 36 hours and gradually decrease after 72 hours.
- The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)
  SHAR model based on ECMWF EPS suggests Probability for intensification in to TC is High (60%) on 14th Nov. System may become depression on 12th Nov.ECMWF deterministic and ensemble track forecasts, System may track initially South Westward direction and further Westward, landfall between Extreme North coastal Tamilnadu and South Coastal Andhra between Chennai and Nellore (with 70% probability) on 16th Nov
  SAC-ISRO, Ahmedabad model also shows similar prediction of cyclogenesis

Summary and Conclusion:

- The low pressure area over southeast Bay may become well marked during next 24 hrs. Subsequently it would move west-southwestwards and intensify into a depression on 12th and reach north Tamil Nadu and adjoining south AP coast by 15th / 16th November.
- The deep depression centred at 0600 UTC of today over southwest Arabian Sea near lat.8.0^{0}N and 52.5^{0}E would move slowly west-northwestwards and cross Somalia coast near 8.2^{0}N around early morning of 11th November.

Advisory:

- Possible intensification of low over Bay of Bengal to be watched.
- Intense observation may be taken over Andaman and Nicobar for 10 and 11 November
- IOP may be considered for Tamil Nadu and Andhra Pradesh coast during 12-16 November.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	09/12	**10/00**	**10/03**
India	39/51	30/32	40/51
Coastal stations			
WB	6/9	3/4	6/9
Odisha	6/7	5/5	6/7
AP	11/14	11/13	11/14
Tamil Nadu	8/12	7/7	8/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	9/11	10/11	8/11
Myanmar	10/11	9/11	9/11
Thailand	3/3	3/3	3/3
Srilanka	7/9	6/9	7/9

RS/RW (12Z) of 09/11/2013 01/39

- **No. of Ascents reaching 250 hPa levels:02, MISDA: 36**
- **RS/RW** (00Z) of 10/11/2013 22/39
- **No. of Ascents reaching 250 hPa levels:22 , MISDA:17**

No. of PILOT Ascents

09/12Z	**10/00Z**
32/37	19/34

Buoy Data

09/12Z	**10/00Z**	**10/03Z**
8	7	8

Data Statistics over RMC Chennai Region

No of Synop data

Date→	**09.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /09.11.2013 : 6

No. of Ascents reaching 250 hPa level =6 **MISDA : 2**

12Z /09.11.2013 : 1

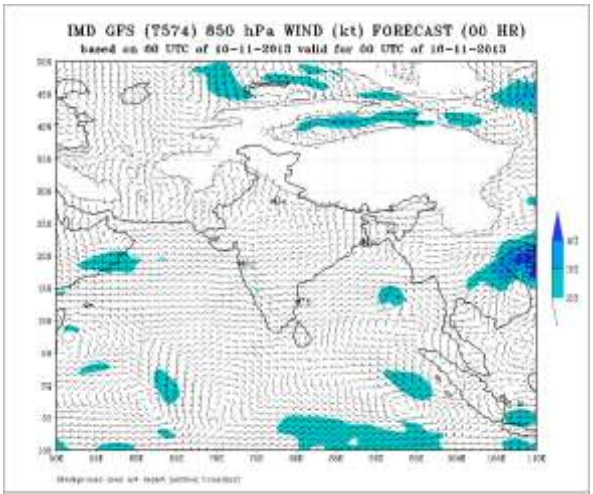
No. of Ascents reaching 250 hPa level =1 **MISDA : 7**

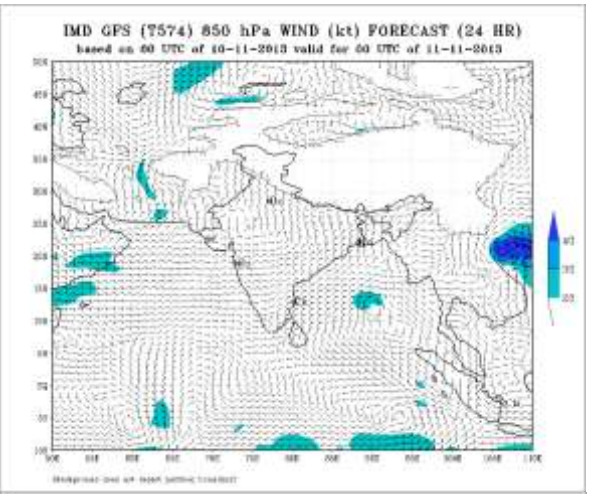
No. of PILOT Ascents:

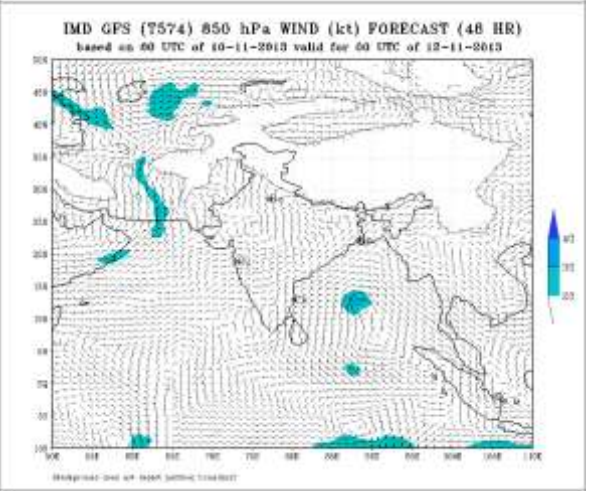
09.11.2013

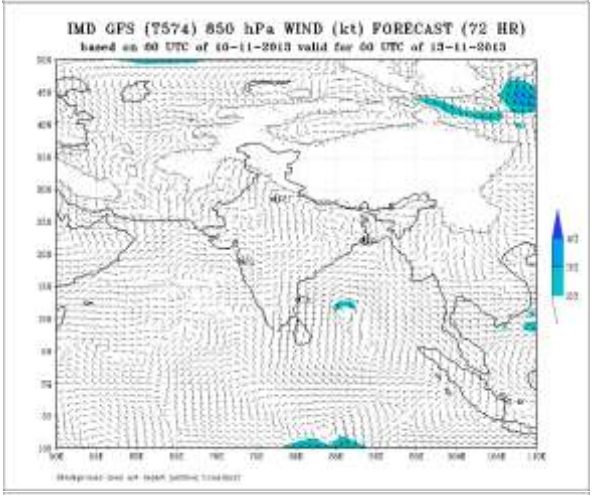
06Z	18Z
6	6

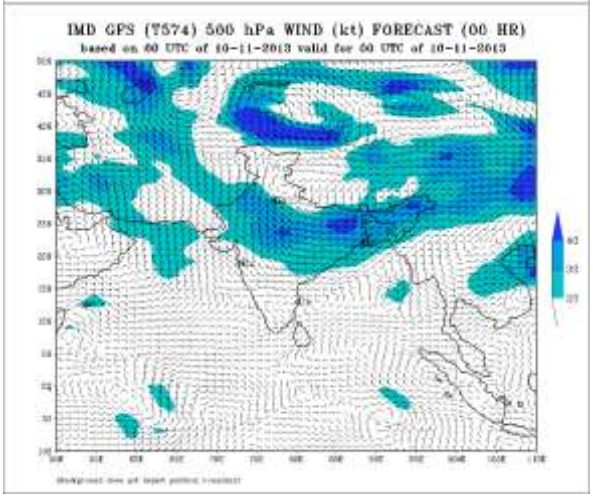
Annexure-II

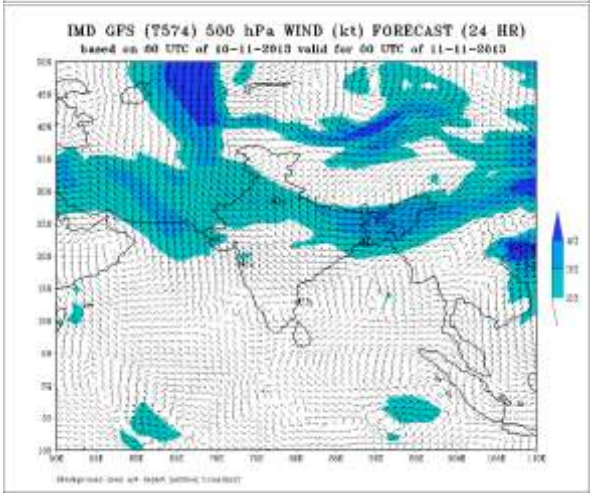

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 10-11-2013 valid for 00 UTC of 10-11-2013

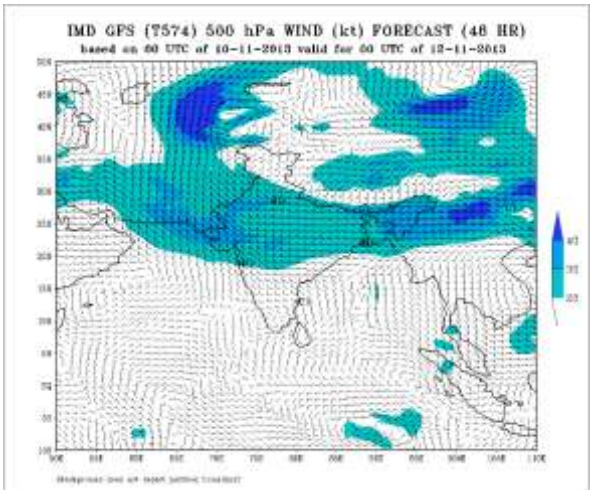

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 10-11-2013 valid for 00 UTC of 11-11-2013

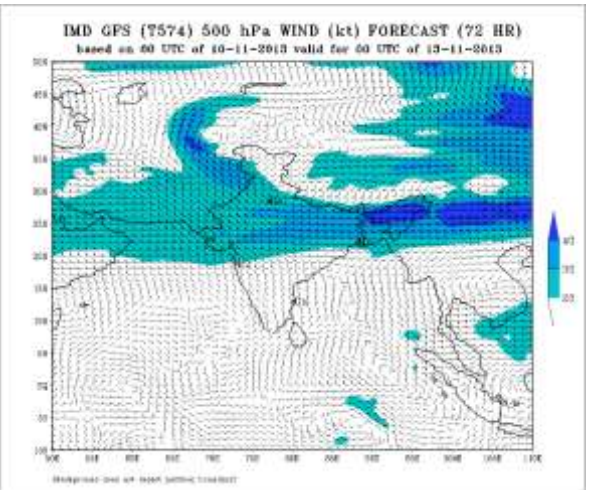

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 10-11-2013 valid for 00 UTC of 12-11-2013

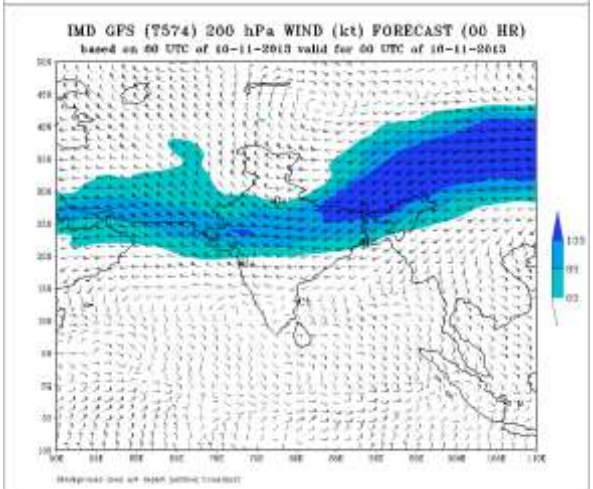

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 10-11-2013 valid for 00 UTC of 13-11-2013

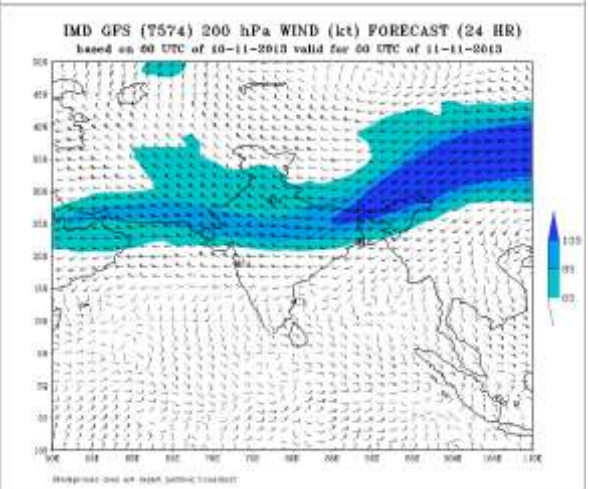

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 10-11-2013 valid for 00 UTC of 10-11-2013

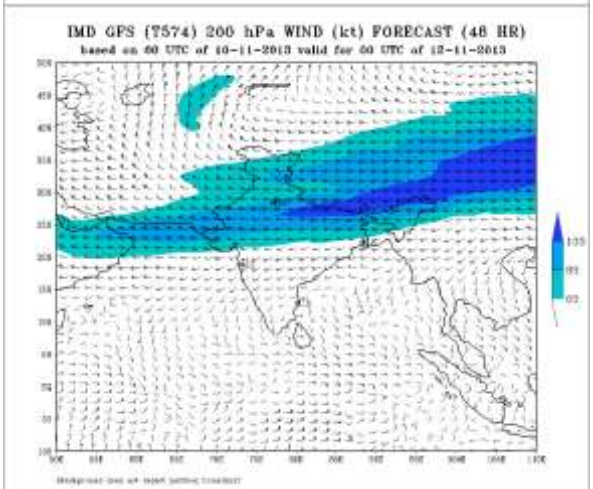

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 10-11-2013 valid for 00 UTC of 11-11-2013

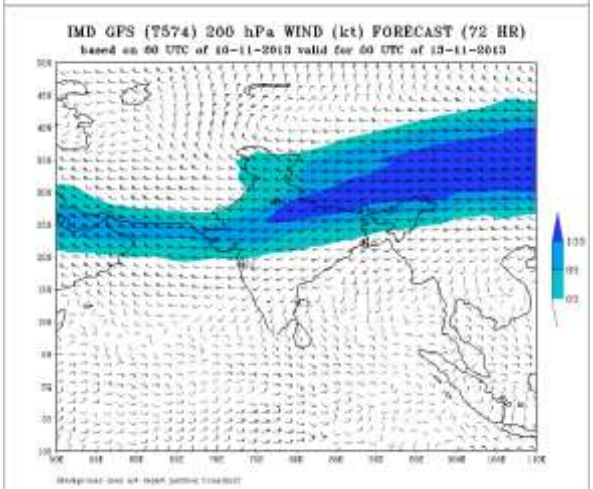

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 10-11-2013 valid for 00 UTC of 12-11-2013

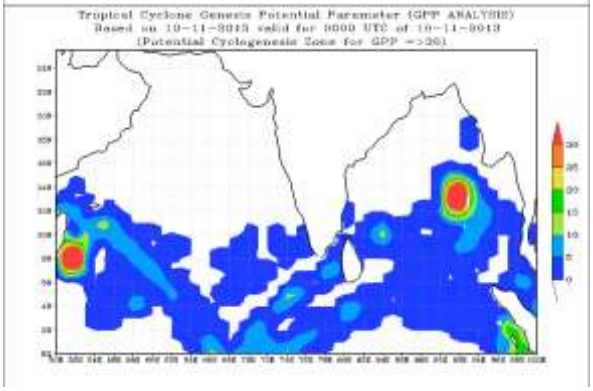

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 10-11-2013 valid for 00 UTC of 13-11-2013

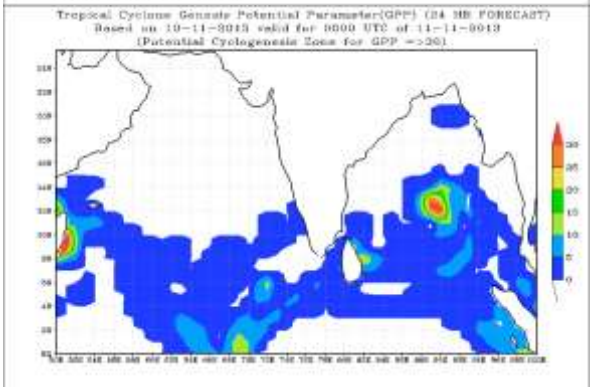

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 10-11-2013 valid for 00 UTC of 10-11-2013

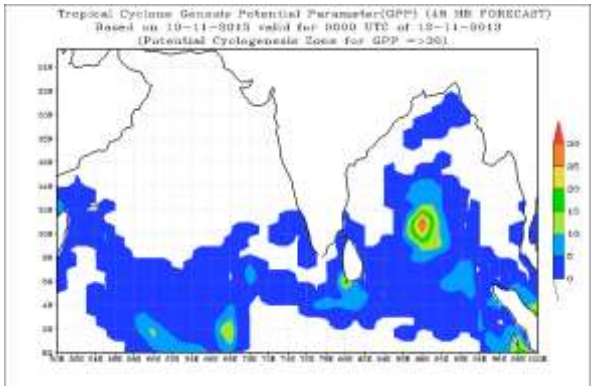

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 10-11-2013 valid for 00 UTC of 11-11-2013

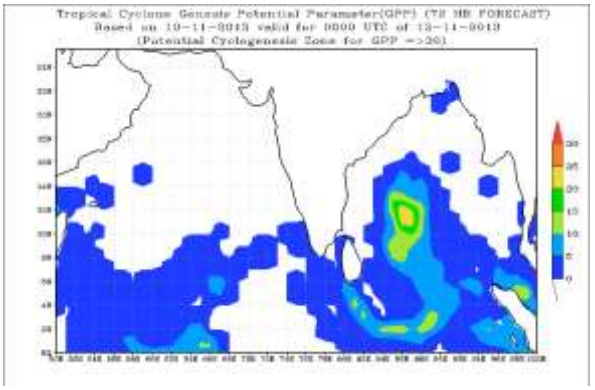

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 10-11-2013 valid for 00 UTC of 12-11-2013


IMD GPS (7574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 10-11-2013 valid for 00 UTC of 13-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 10-11-2013 valid for 0000 UTC of 10-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 10-11-2013 valid for 0000 UTC of 11-11-2013
(Potential Cyclogenesis Zone for GPP =>20)





FDP (Cyclone) NOC Report Dated11 November, 2013

Synoptic features based on 0300 UTC:

- The low pressure area over southeast Bay of Bengal and neighbourhood now lies as a well marked low pressure area over the same region. Associated cyclonic circulation extends upto mid tropospheric levels. System would concentrate into a Depression during next 24 hours
- The Deep Depression over southwest Arabian moved westnorthwestwards and crossed Somalia coast near Lat. 8.2° N between 2300 UTC of yesterday, the 10th November and 0000 UTC of today, the 11th November. It lay as a deep depression at 0300 UTC of today, the 11th November 2013 over coastal Somalia, near Lat 8.2° N and Long. 49.6° E. The system would move westnorthwestwards and weaken gradually into a Depression during next 12 hours.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-29^{0}C over Bay of Bengal. It is also 28^{0}C over southwest Arabian Sea around system centre. It is colder towards Somalia coast.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north, west Central and south west Bay of Bengal. It is 50-90 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2. It is about 80-100 KJ cm^{-2} over southwest Arabian Sea around system centre and less than 50 KJ cm^{-2} near Somalia coast & North Arabian.Sea.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over southeast Bay of Bengal and of the order, 80-100 10^{-5} s^{-1} to the southwest of the Well marked low pressure area. It is also positive over north Bay of Bengal. and equatorial region. It is negative over the rest part of Central Bay of Bengal.

Convergence:

- Lower level convergence is positive of the order of $5*10^{-5}$ s^{-1} over the low pressure area and of the order of $-5\text{-}10*10^{-5}$ s^{-1}. over southwest Bay of Bengal. It is negative over north Bay of Bengal

Divergence:

- It is positive of the order of $10\text{-}30*10^{-5}$ s^{-1} around the low and $5\text{-}10*10^{-5}$ s^{-1}over cntral part of south Bay and central Bay of Bengal. It is negative over west central Bay of the order of $-5*10^{-5}$ s^{-1}

Wind Shear:

- **W**ind Shear is 5-10 knots over Andaman sea, southeast Bay of Bengal and over the Well Marked Low., 20 knots over southwest Bay of Bengal and more than 20 knots over central and North Bay of Bengal.
- **Wind Shear Tendency:**
  - Shear Tendency is decreasing creasing over Andaman Sea, southeast Bay and Over the Wellmarked Low pressure area. and increasing over central part of south Bay No significant change over the the rest Bay
  - **Upper tropospheric ridge**:
- The upper tropospheric ridge line at 200 hPa passes through lat 16.0°N over Bay of Bengal region.

M.J.O. Index: (Based on 9th Nov)

- Located in phase 3 with amplitude more than 1.0.
- Dynamical forecast:- MJO index may move in phase 3 to 2 with amplitude less than 1.0 during next 2 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 110900 UTC

- Vortex over Somali coast and neighbourhood centred near lat.9.1^{0}N and long.49.0^{0}E over land.
- Another vortex over southeast Bay and adjoining eastcentral Bay centred within half a degree of lat.11.3^0 and long 90.0^{0}E. Intensity T1.0Associated broken low medium clouds with embedded moderate to intense convection over Bay of Bengal between lat. 8.0^{0}N and 15.0$^{0.}$ and long. 85.5^{0}E to 92.5^{0}E. Wind shear in this area around 5 to 10 kts and shear tendency is negative around minus 10 to minus 20 kts

NWP Analysis

- **IMD-GFS model** analysis of 0000 UTC of 11th November 2013 shows a well marked low pressure area over south central Bay of Bengal and associated cyclonic circulation extends upto (700 hPa) mid tropospheric levels. Model 24 -72 hour forecast shows that this system would concentrate into a depression and move south westwards till 13th and later, it would move northwestwards till 16th upto south coastal AP and become less marked on 17th

- The analysis and forecasts of GFS model for 24h to 72 h of 850 hPa, 500 hPa and 200 hPa wind are given in **Annexure I**l

- **IMD-WRF** model of 0000 UTC of 11 November 2013 also shows the similar pattern as that of GFS.
- (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **ECMWF:** Model shows an Well Marked Low Pressure Area lies over southeast Bay of Bengal on 11th Nov becoming Depression on 12th Nov over southwest Bay. It is expected to move west-northwestward as Depression till 16th Nov and crossed north Tamilnadu-South A.P. coast night of 16th November and weaken as low.on 17th November.

- **METEOFRANCE -ARP:** Model shows a low pressure area over southeast Bay on 11 Nov. becoming Depression on 12th It would move west-southwestwards during next 24 hrs hrs. The system would intensify as Cyclonic Storm on over SW Bay of Bengal on 14th November.

- **JMA:** Model shows a low over southeast Bay on 11 Nov. It will move as a low west-southwestwards till 14th Nov.
- **UKMO:** Model shows the low over southeast Bay of Bengal on 11November which would intensify as WML on 12th Nov and Depession on 14th Nov and Deep Depression on 15th Nov.. It would move west-northwestwards towards south Andhrta Pradesh coast by 17th November as Depression.
- **GFS (NCMRWF)** Models show a low on 11 Nov over southeast Bay. It would move west-southwestwards and become WML 12th & 13th Nov over southwest Bay. The WML further intensify into Depression on 14 Nov and Deep Depressionon 15th Nov over Southwest Bay. which will move west-southwestwards and crossed Tamilnadu coast near 10 degree north
- **Genesis Potential Parameter (GPP)** forecast based on 0000 UTC of **11 November 2013** indicates that there is a region of high GPP over south central BOB centered at 12N/88E. This may intensify further and move southwestwards.

- The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

SHAR model based on ECMWF EPS : Low pressure area lies over South East Bay of Bengal near 11.8N & 89.5E situated West of Andaman Islands. System will become a well marked low during next 12 hours. System may become depression on 12th night/ 13th Nov. Probability for intensification in to TC is High (60%) on 15th Nov.
ECMWF deterministic and ensemble track forecasts, System may track initially South Westward direction up to 12th Nov and further Westward, landfall between Extreme North coastal Tamilnadu and South Coastal Andhra between Chennai and Nellore (with 70% probability) on 16th Nov morning
SAC-ISRO, Ahmedabad Scorpio model also shows similar prediction of cyclogenesis in Bay of Bengal near 11.75^0N and 91.75^0E.
Another model of SAC ISRO suggests that there is HIGH chance of developing a system west of Andaman in 1-2 days. Model ensembles DO NOT indicate a very strong intensity for this system in future. The maximum expected intensity for this system is of cyclonic storm (35-40 kt).
Summary and Conclusion:

- A well marked low pressure area lies over southeast Bay of Bengal and neighbourhood. Associated cyclonic circulation extends upto mid tropospheric levels. System would concentrate into a Depression during next 24 hours
- Subsequently it would move west-southwestwards and intensify into a Deep Depression on 13th and reach north Tamil Nadu and adjoining south AP coast by 16th November.
- The Deep Depression over southwest Arabian crossed Somalia coast near lat. 8.2.^{0}N and long. 50.0^{0}E between 2300 UTC of 10th and 0000 UTC of 11th Nov. It lay at 0300 UTC of today, the 11th November 2013 over coastal Somalia, near Lat 8.2° N and Long. 49.6° E. The system would move westnorthwestwards and weaken gradually into a low during next 24 hours.

Advisory:

- IOP may be considered for Tamil Nadu and Andhra Pradesh coast during 12-16 November.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	10/12	**11/00**	**11/03**
India	33/51	28/32	33/51
Coastal stations			
WB	6/9	3/4	6/9
Odisha	6/7	5/5	6/7
AP	11/14	10/13	11/14
Tamil Nadu	8/12	7/7	8/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	7/11	6/11	7/11
Myanmar	10/11	10/11	1/11
Thailand	3/3	3/3	3/3
Srilanka	7/9	6/9	7/9

RS/RW (12Z) of 10/11/2013 04/39

- **No. of Ascents reaching 250 hPa levels:04, MISDA: 35**
- **RS/RW** (00Z) of 11/11/2013 24/39
- **No. of Ascents reaching 250 hPa levels:19 , MISDA:15**

No. of PILOT Ascents

10/12Z	**11/00Z**
29/37	21/34

Buoy Data

10/12Z	**11/00Z**	**11/03Z**
9	8	7

Data Statistics over RMC Chennai Region
No of Synop data

Date→	**10.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

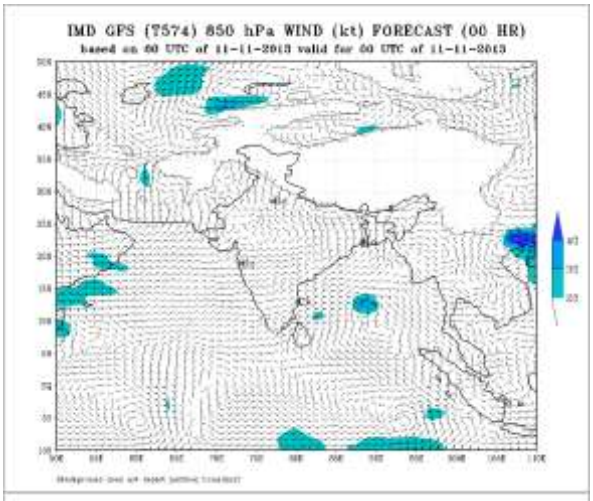
No. of RS/RW Ascents
00Z /10.11.2013 : 5
No. of Ascents reaching 250 hPa level =5
MISDA : 3
12Z /10.11.2013 : 1
No. of Ascents reaching 250 hPa level =1
MISDA : 7

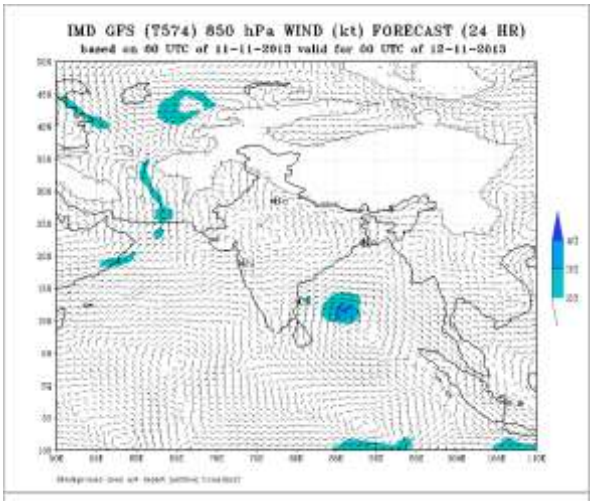
No. of PILOT Ascents:

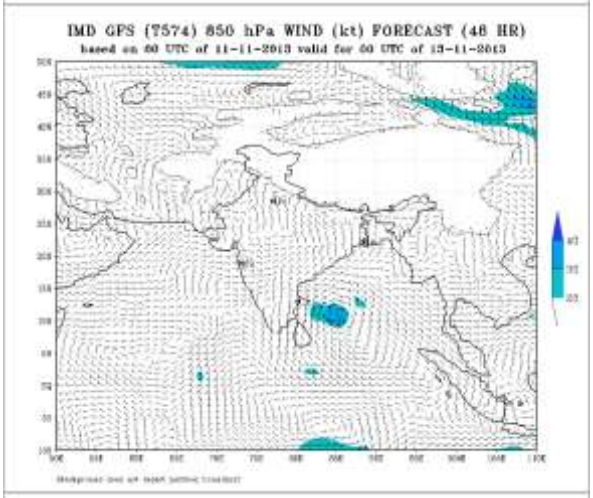
10.11.2013

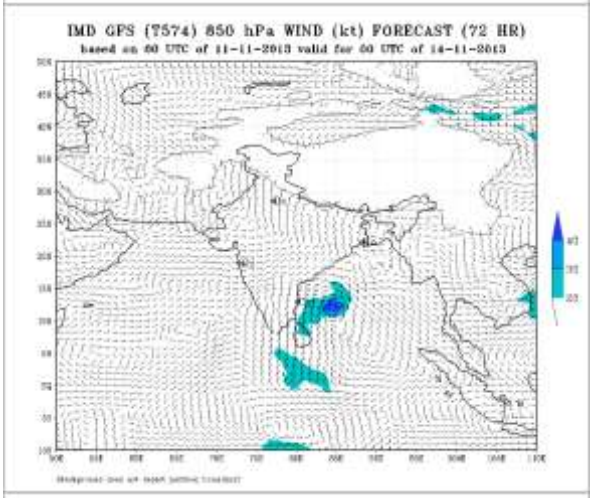
06Z	18Z
5	6

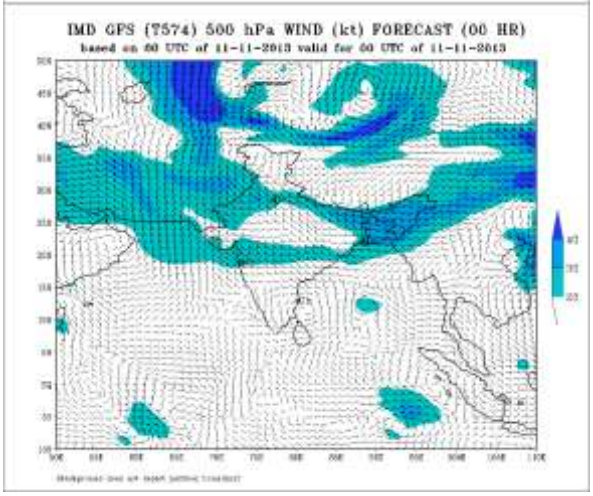
Annexure-I I

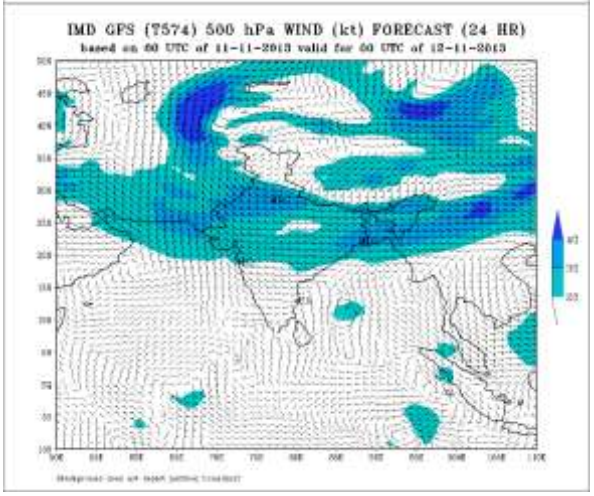

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 11-11-2013 valid for 00 UTC of 11-11-2013

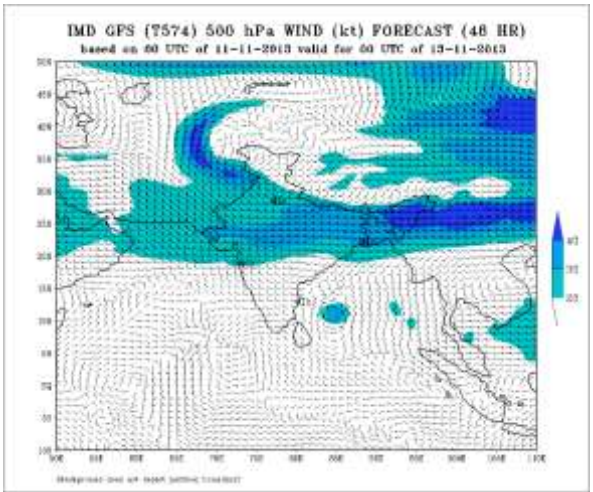

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 11-11-2013 valid for 00 UTC of 12-11-2013

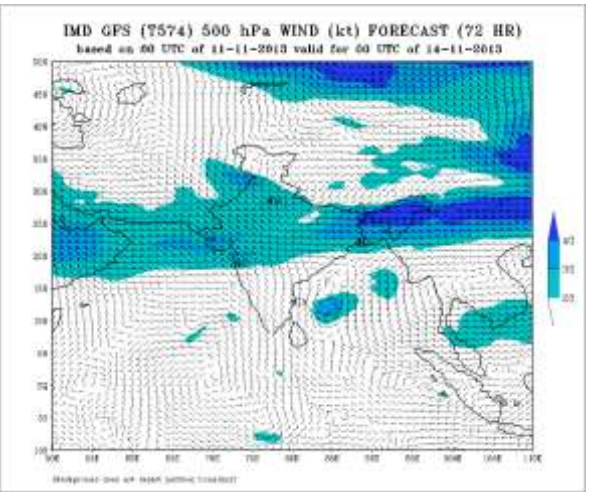

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 11-11-2013 valid for 00 UTC of 13-11-2013

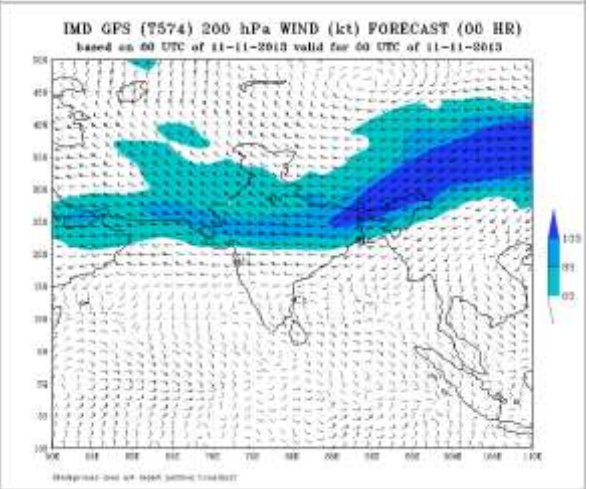

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 11-11-2013 valid for 00 UTC of 14-11-2013

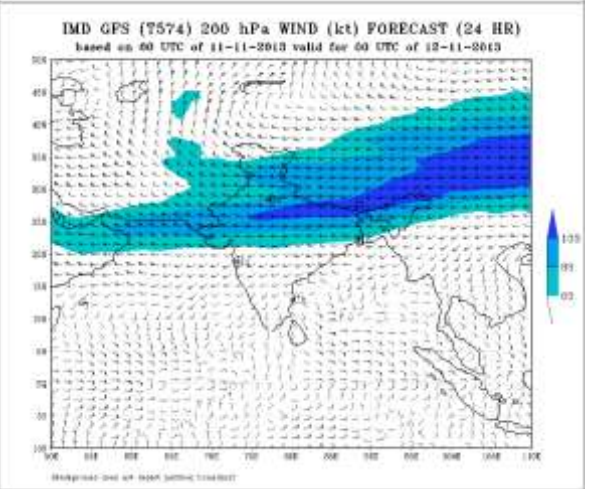

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 11-11-2013 valid for 00 UTC of 11-11-2013

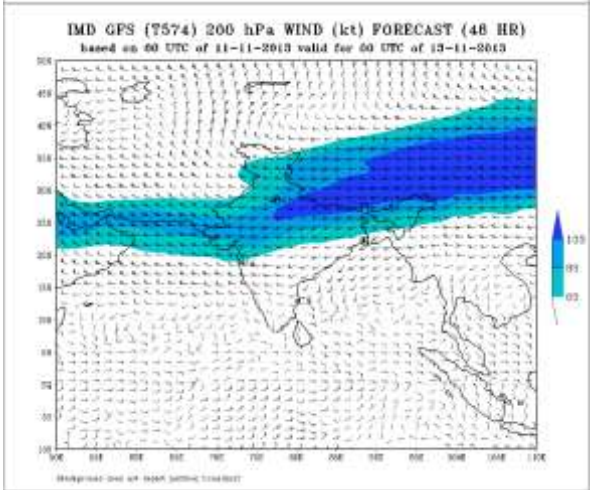

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 11-11-2013 valid for 00 UTC of 12-11-2013

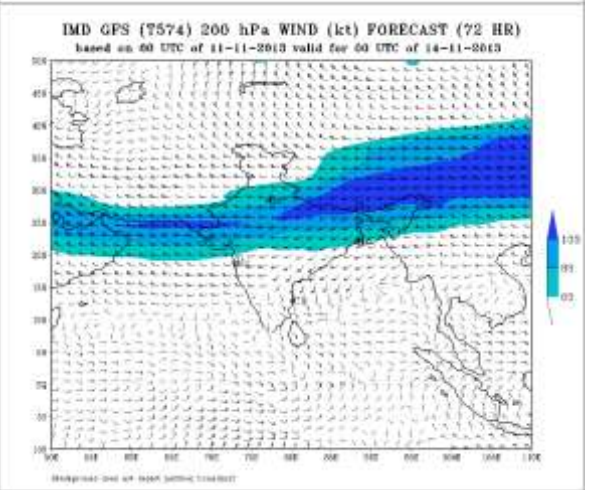

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 11-11-2013 valid for 00 UTC of 13-11-2013

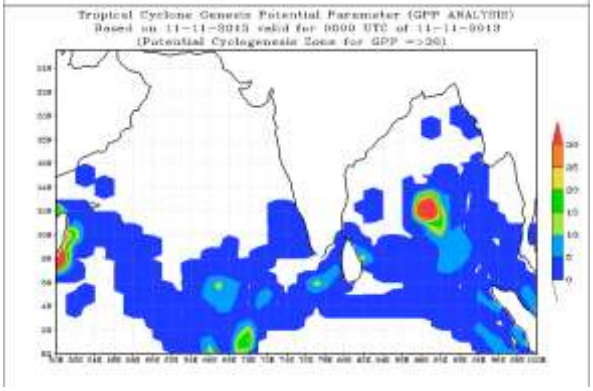

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 11-11-2013 valid for 00 UTC of 14-11-2013

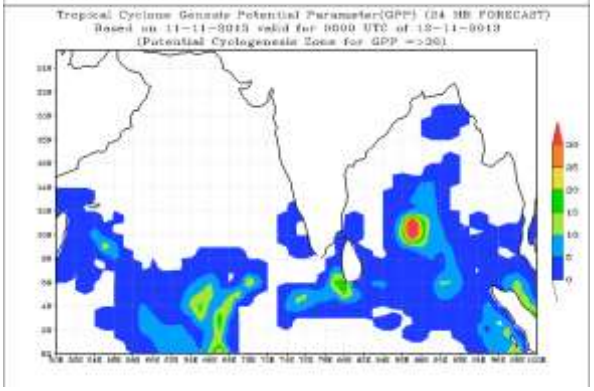

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 11-11-2013 valid for 00 UTC of 11-11-2013

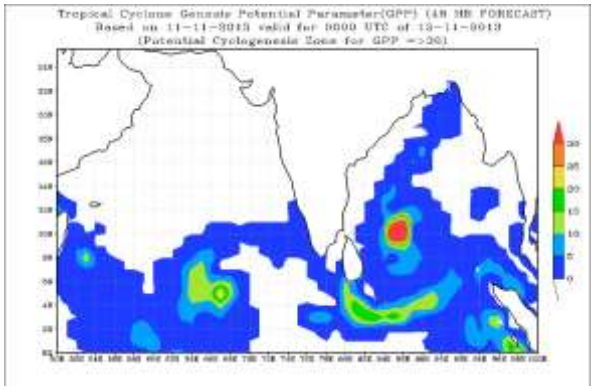

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 11-11-2013 valid for 00 UTC of 12-11-2013

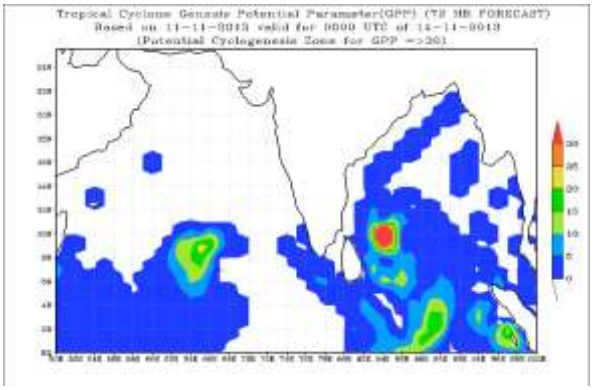

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 11-11-2013 valid for 00 UTC of 13-11-2013


IMD GPS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 11-11-2013 valid for 00 UTC of 14-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 11-11-2013 valid for 0000 UTC of 11-11-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 11-11-2013 valid for 0000 UTC of 12-11-2013
(Potential Cyclogenesis Zone for GPP =>26)





FDP (Cyclone) NOC Report Dated12 November, 2013

Synoptic features based on 0300 UTC:

- The well marked low pressure area over southeast Bay of Bengal and neighbourhood persists. Associated cyclonic circulation extends upto mid tropospheric levels. System would concentrate into a Depression by tomorrow.
- A cyclonic circulation extending upto 2.1 kms a.s.l. lies over Lakshadweep area and neighbourhood.
- The **Deep Depression** over coastal Somalia moved west-northwestwards and weakened into a Depression at 0600 UTC of yesterday. It further weakened into a well marked low pressure area over Somalia and neighbourhood, yesterday evening.
- The feeble western disturbance as an upper air cyclonic circulation extending upto mid tropospheric levels over north Pakistan and neighbourhood now lies over northern parts of Jammu & Kashmir and neighbourhood. System would move eastnortheastwards

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-29^{0}C over Bay of Bengal. It is also 28^{0}C over southwest Arabian Sea around system centre. It is colder towards Somalia coast.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north, west central and south west Bay of Bengal. It is 50-90 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2. It is about 80-100 KJ cm^{-2} over southwest Arabian Sea around system centre and less than 50 KJ cm^{-2} near Somalia coast & North Arabian.Sea.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over southeast Bay of Bengal and of the order , 80-100 10^{-5} s^{-1} to the southwest of the Well marked low pressure area. It is also positive over north Bay of Bengal. and equatorial region. It is negative over the rest part of Central Bay of Bengal.

Convergence:

- Lower level convergence is positive of the order of $5*10^{-5}$ s^{-1} over the low pressure area and of the order of $-5\text{-}10*10^{-5}$ s^{-1}. over southwest Bay of Bengal. It is negative over north Bay of Bengal

Divergence:

- It is positive of the order of 10-30*10^{-5} s^{-1} around the low and 5-10*10^{-5} s^{-1}over cntral part of south Bay and central Bay of Bengal. It is negative over west central Bay of the order of -5*10^{-5} s^{-1}

Wind Shear:

- **W**ind Shear is 5-10 knots over Andaman sea, southeast Bay of Bengal and over the Well Marked Low., 20 knots over southwest Bay of Bengal and more than 20 knots over central and North Bay of Bengal.

Wind Shear Tendency:

Shear Tendency is decreasing creasing over Andaman Sea, southeast Bay and Over the Wellmarked Low pressure area and increasing over central part of south Bay No significant change over the the rest Bay

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 16.0°N over Bay of Bengal region.

M.J.O. Index: (Based on 9th Nov)

- Located in phase 3 with amplitude more than 1.0.
- Dynamical forecast:- MJO index may move in phase 3 to 2 with amplitude less than 1.0 during next 2 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 110900 UTC

- Vortex over southeast adjoining central bay centered within half a deg of 11.5n/87.0e (.) Intensityt1.0 (.) Asstd bkn low/med clouds with embdd mod to int convtn over bay bet lat 8.5n to 15.5n long 83.0e to 90.0e (.)
- Bkn m/layered clouds over j&k hp n utrknd tibet adj china over area bet lat 37.0n to 40.0n long 70.0e to 81.0e in assw wd over the area (.)

NWP Analysis

- IMD-GFS model analysis of 0000 UTC of 12th November 2013 shows a well marked low pressure area over south central Bay of Bengal with approximate center at 87.5 ^{o} E and 11.0 ^{o} N. The associated cyclonic circulation extends up to mid tropospheric levels (500 hPa). The core of jet in upper air westerly lies around 25^{o} N latitude over north-west India and further north over north-east India.
- GFS forecasts predict that the well-marked low over Bay of Bengal intensifies further in to a depression during next 24 hours. Day 2 forecast does not show any further intensification of the system.
- The analysis and forecast charts of GFS model for 24h to 72 h of MSLP, 850 hPa, 500 hPa and 200 hPa winds are given in **Annexure II**.

- **IMD-WRF** model of 0000 UTC of 12 November 2013 also shows the rainfall and wind distribution similar to GFS output. (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **Genesis Potential Parameter (GPP)** forecast based on 0000 UTC of **12 November 2013** indicates that there is a region of high GPP over south central BOB centered at 11^{o} N/87.5^{o} E. This may persists and move southwestwards.

- The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

- **SHAR model based on ECMWF EPS** : Low pressure area lies over South East Bay of Bengal near 11.8N & 89.5E situated West of Andaman Islands. System will become a well marked low during next 12 hours. System may become depression on 12th night/ 13th Nov. Probability for intensification in to TC is High (60%) on 15th Nov.
- ECMWF deterministic and ensemble track forecasts, System may track initially South Westward direction up to 12th Nov and further Westward, landfall between Extreme North coastal Tamilnadu and South Coastal Andhra between Chennai and Nellore (with 70% probability) on 16th Nov morning
- **SAC-ISRO, Ahmedabad** Scorpio model also shows similar prediction of cyclogenesis in Bay of Bengal near 11.75^0N and 91.75^0E.
- Another model of SAC ISRO suggests that there is HIGH chance of developing a system west of Andaman in 1-2 days. Model ensembles DO NOT indicate a very strong intensity for this system in future. The maximum expected intensity for this system is of cyclonic storm (35-40 kt).

Summary and Conclusion:

- A well marked low pressure area lies over southeast Bay of Bengal and neighbourhood. Associated cyclonic circulation extends upto mid tropospheric levels. System would concentrate into a Depression during next 24 hours
- Subsequently it would move west-southwestwards and intensify into a Deep Depression on 13th and reach north Tamil Nadu and adjoining south AP coast by 16th November.
- The Deep Depression over southwest Arabian crossed Somalia coast near lat. 8.2.^{0}N and long. 50.0^0E between 2300 UTC of 10th and 0000 UTC of 11th Nov. It lay at 0300 UTC of today, the 11th November 2013 over coastal Somalia, near Lat 8.2° N and Long. 49.6° E. The system would move westnorthwestwards and weaken gradually into a low during next 24 hours.

Advisory:

- IOP may be considered for Tamil Nadu and Andhra Pradesh coast during 12-16 November.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	11/12	**12/00**	**12/03**
India	33/51	28/32	33/51
Coastal stations			
WB	6/9	3/4	6/9
Odisha	6/7	5/5	6/7
AP	11/14	10/13	11/14
Tamil Nadu	8/12	7/7	8/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	7/11	6/11	7/11
Myanmar	10/11	10/11	1/11
Thailand	3/3	3/3	3/3
Srilanka	7/9	6/9	7/9

RS/RW (12Z) of 11/11/2013 04/39

- **No. of Ascents reaching 250 hPa levels:04, MISDA: 35**
- **RS/RW** (00Z) of 12/11/2013 24/39
- **No. of Ascents reaching 250 hPa levels:19 , MISDA:15**

No. of PILOT Ascents

11/12Z	**12/00Z**
29/37	21/34

Buoy Data

11/12Z	**12/00Z**	**12/03Z**
9	8	7

Data Statistics over RMC Chennai Region

No. of Synop data

Date→	**11.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /11.11.2013 : 6

No. of Ascents reaching 250 hPa level =5

MISDA : 2

12Z /11.11.2013 : 1

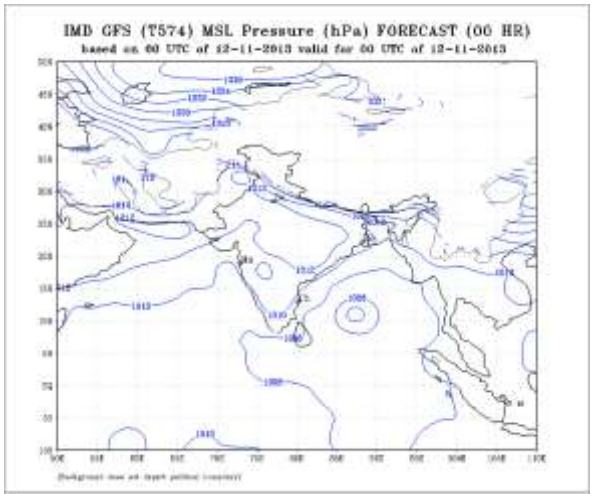
No. of Ascents reaching 250 hPa level =1

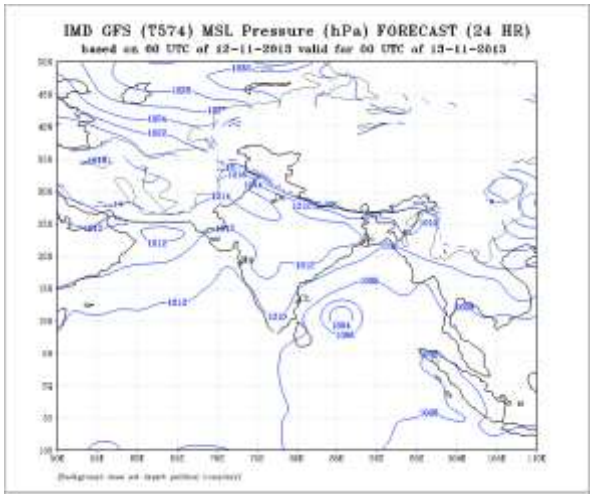
MISDA : 7

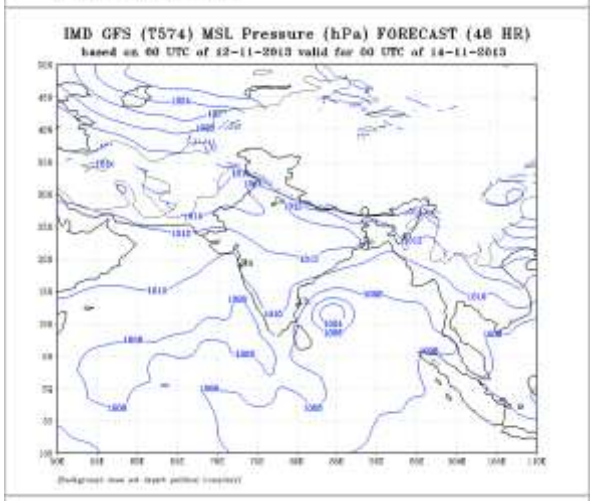
No. of PILOT Ascents:

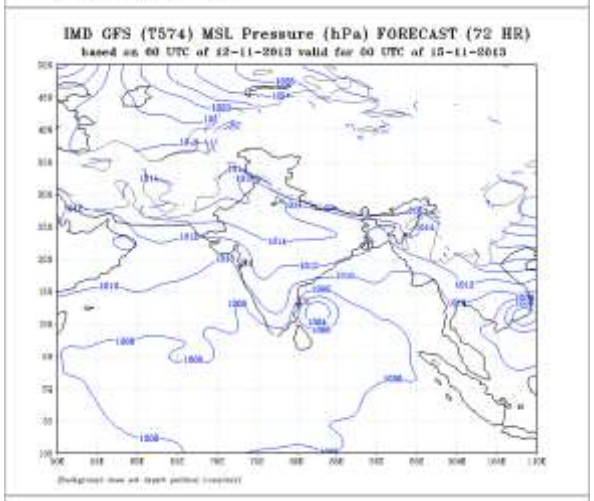
11.11.2013	
06Z	18Z
7	7

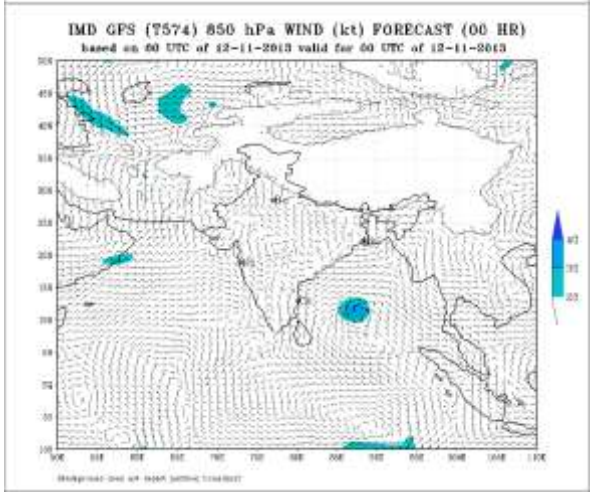
Annexure-II

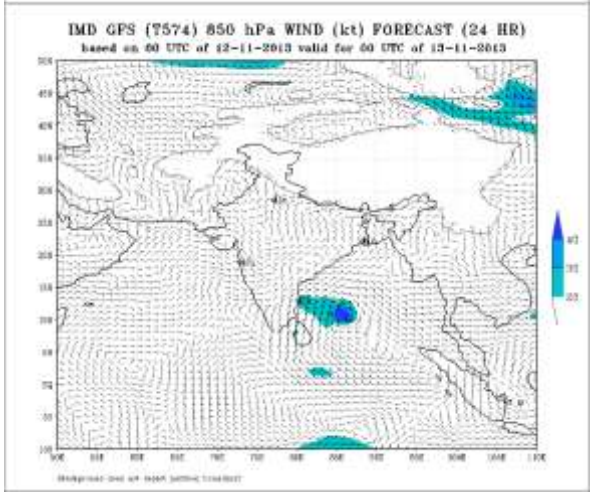

IMD GFS (T574) MSL Pressure (hPa) FORECAST (00 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 12-11-2013

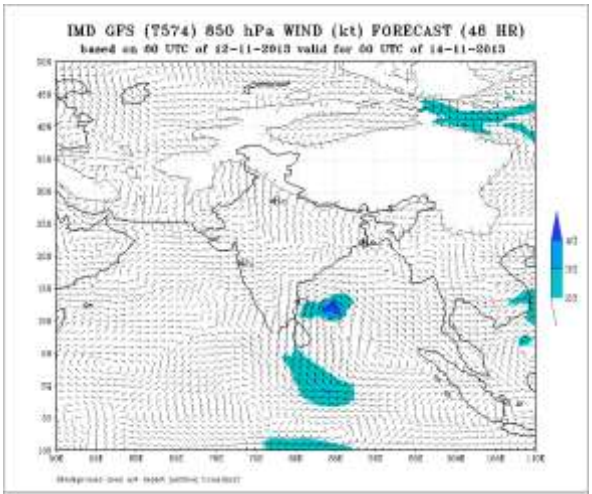

IMD GFS (T574) MSL Pressure (hPa) FORECAST (24 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 13-11-2013

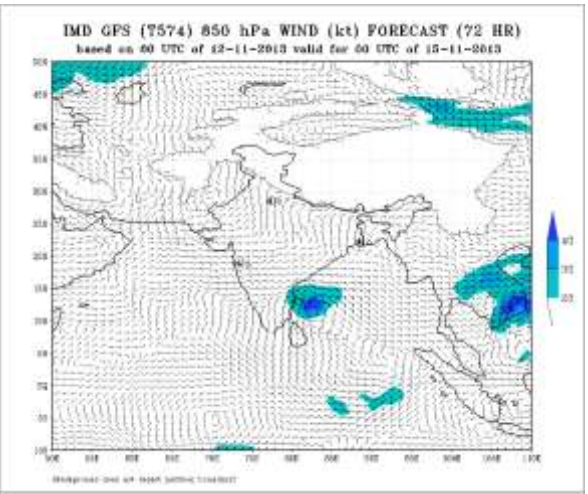

IMD GFS (T574) MSL Pressure (hPa) FORECAST (48 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 14-11-2013

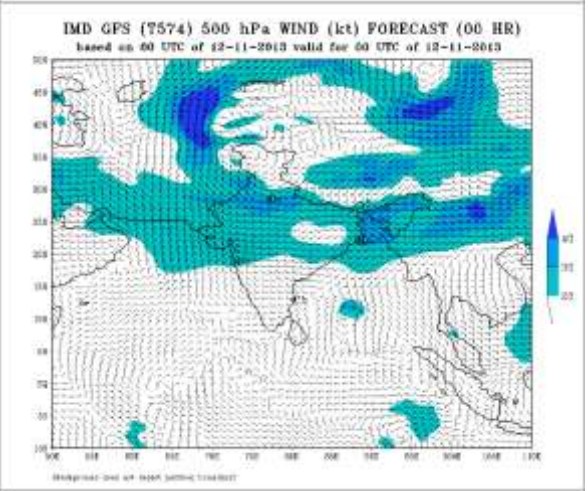

IMD GFS (T574) MSL Pressure (hPa) FORECAST (72 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 15-11-2013

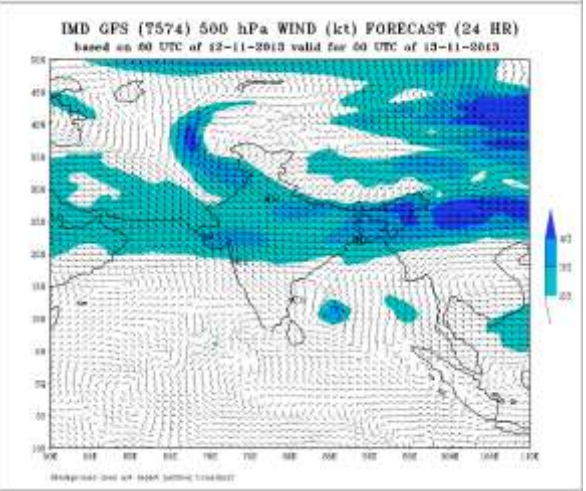

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 12-11-2013

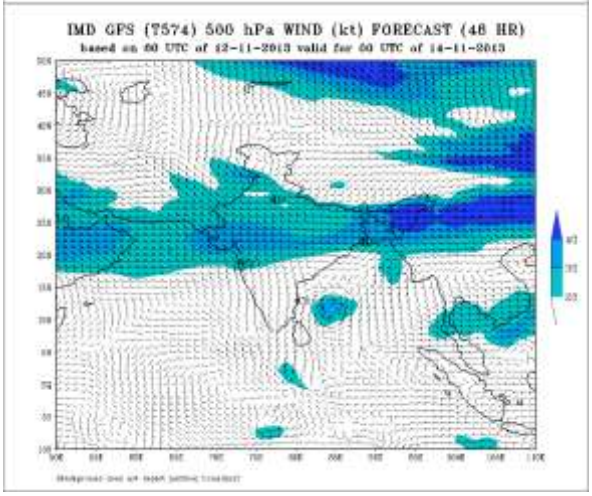

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 13-11-2013

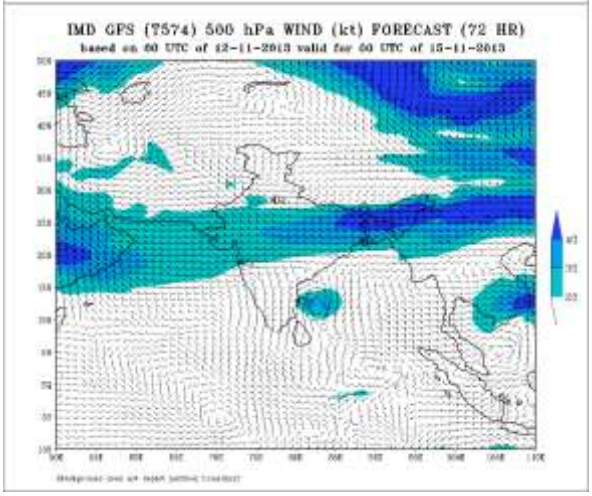

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 14-11-2013

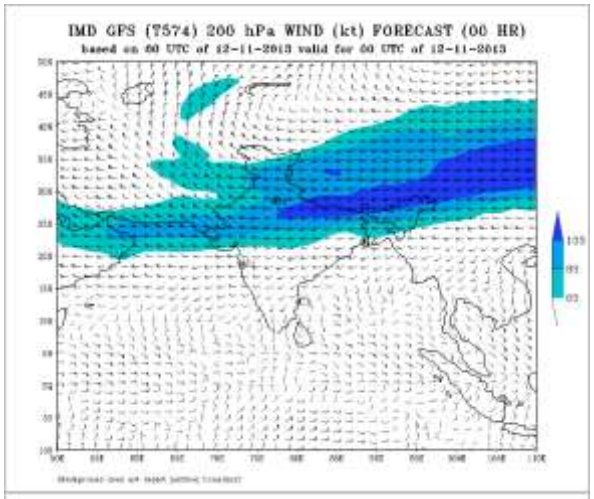

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 15-11-2013

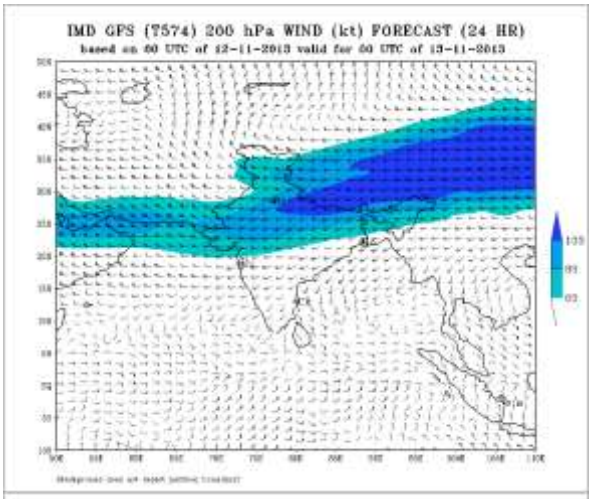

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 12-11-2013

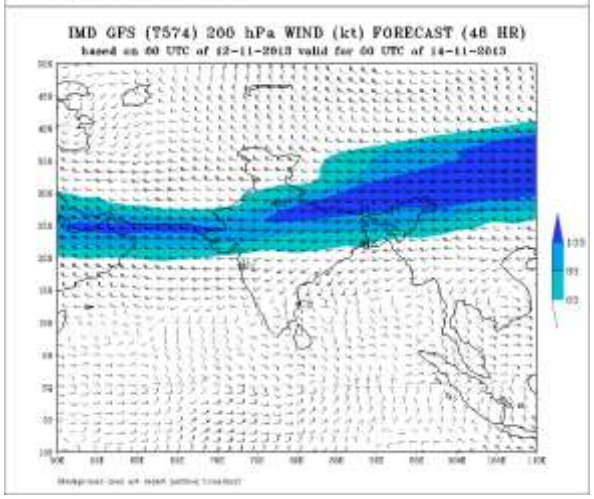

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 13-11-2013

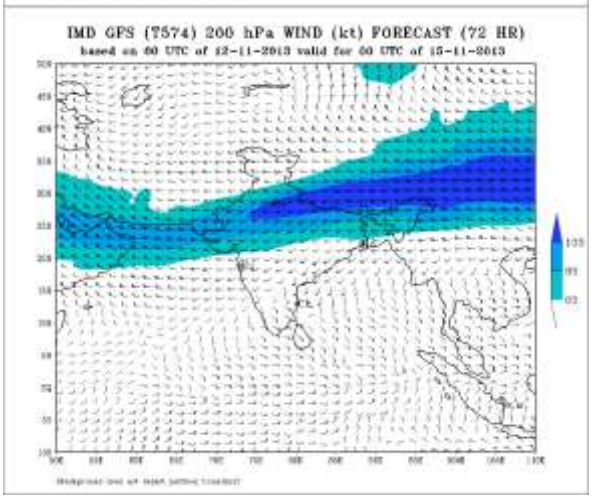

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 14-11-2013

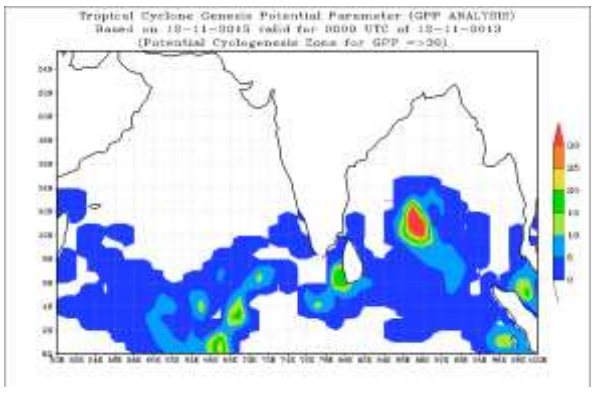

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 15-11-2013

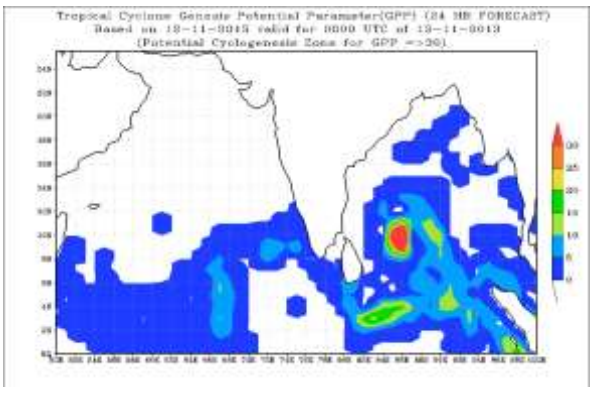

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 12-11-2013

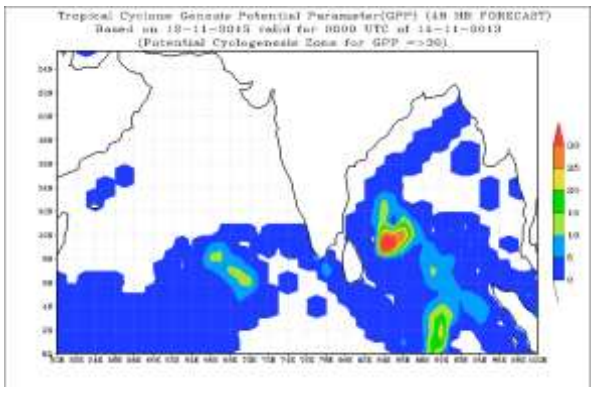

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 13-11-2013

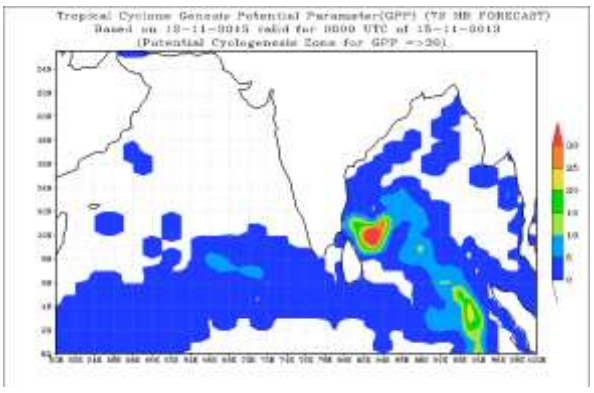

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 14-11-2013


IMD GPS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 12-11-2013 valid for 00 UTC of 15-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 12-11-2013 valid for 0000 UTC of 12-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 12-11-2013 valid for 0000 UTC of 13-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 12-11-2013 valid for 0000 UTC of 14-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 12-11-2013 valid for 0000 UTC of 15-11-2013
(Potential Cyclogenesis Zone for GPP =>20)

FDP (Cyclone) NOC Report Dated13 November, 2013

Synoptic features

- The northeast Monsoon has been vigorous over Kerala.
- The well marked low pressure area over southeast Bay of Bengal and neighbourhood has concentrated into a **Depression** over southwest and adjoining southeast Bay of Bengal and lay centred at 0000 UTC of today, the 13th November 2013 within half a degree of Lat. 11.5° N and Long. 86.5° E, about 700 kms east-southeast of Chennai. It moved westwards and lies centred at 0300 UTC of today, the 13th November 2013 within half a degree of Lat. 11.5° N and Long. 86.0° E, about 650 kms east-southeast of Chennai, 730 kms east-southeast of Nellore and 680 kms east-northeast of Nagapattinam. The system would move westwards for some more time and then west-northwestwards, intensify into a Deep depression and cross north Tamil Nadu coast between Nagapattinam and Chennai by 15th November night or morning of 16th November 2013.
- The cyclonic circulation over Lakshadweep area and neighbourhood persists and now extends upto 0.9 km a.s.l.
- The feeble western disturbance as an upper air cyclonic circulation extending upto mid tropospheric levels over northern parts of Jammu & Kashmir and neighbourhood persists. System would move eastnortheastwards.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-30^{0}C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north, west Central and south west Bay of Bengal. It is 50-90 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2. It is about 80-100 KJ cm^{-2} over southwest Arabian Sea around system centre and less than 50 KJ cm^{-2} near Somalia coast & North Arabian.Sea.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over south Bay of Bengal and of the order , 80-120 10^{-5} s^{-1} around the sytem centre . It is also positive over north east Bay of Bengal. and equatorial region. It is negative over the rest part of Central Bay of Bengal.

Convergence:

- Lower level convergence is positive of the order of 5-15 *10^{-5} s^{-1} around the system centre. It is negative over north Andaman Sea.

Divergence:

- It is positive of the order of 10-30*10^{-5} s^{-1} around the system centre and of the order of 10-30*10^{-5} s^{-1} over westcentral and adjoining southwest & northwest Bay of Bengal. It is negative over north Andaman Sea and adjoining east central Bay of Bengal of the order of -5*10^{-5} s^{-1}

Wind Shear:

- **W**ind Shear is 20-30 knots around the system centre and more than 30 knots over central and North Bay of Bengal.

Wind Shear Tendency:

Shear Tendency is increasing over Bay of Bengal except southern part of south Bay of Bengal and adjoining equatorial region

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 15.0°N over Bay of Bengal region.

M.J.O. Index: (Based on 9th Nov)

- Located in phase 3 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may move in phase 3 to 2 with amplitude less than 1.0 during next 2 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 130900 UTC

Vortex over south and adjoining central Bay centred near lat.11.5^{0}N and long.86.0^{0}E. Intensity T1.5. Minimum CTT minus 78 degree Celsius. Associated broken low/medium clouds with embedded intense to very intense convection seen over Bay of Bengal between lat. 10.0^{0}N to 16.5^{0}N and long. 82.5^0 to 88.5^{0}E.

NWP Analysis

- IMD-GFS model analysis of 0000 UTC of 13th November 2013 shows a well marked low pressure area over south central Bay of Bengal with approximate center at 11.0 ^{o} N and 86.0 ^{o} E. The associated cyclonic circulation extends up to mid tropospheric levels (500 hPa). The trough in upper-air westerly now situating over Afghanistan is approaching over NW India and divergence is persisting over North India with its maximum over North East India.
- GFS forecasts predict that the well-marked low over Bay of Bengal persists further during next 24 hours. Day 2 forecast does not show any further intensification of the system.
- The analysis and forecast charts of GFS model for 24h to 72 h of MSLP, 850 hPa, 500 hPa and 200 hPa winds are given in **Annexure II**.

- **IMD-WRF** model of 0000 UTC of 13 November 2013 also shows the rainfall and wind distribution show that the system will not intensify into a cyclonic storm in next 48 hours and move southwest direction towards Sri Lanka. (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
- **Genesis Potential Parameter (GPP)** forecast based on 0000 UTC of **13 November 2013** indicates that there is a region of high GPP over south central BOB centered at 11^o N/86^o E. This may persists and move northwestward during next 24 hours and weaken further in 48 hours.
- The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

SHAR model based on ECMWF EPS : Low pressure area lies over South East Bay of Bengal near 11.8N & 89.5E situated West of Andaman Islands. System will become a well marked low during next 12 hours. System may become depression on 12th night/ 13th Nov. Probability for intensification in to TC is High (60%) on 15th Nov.

ECMWF deterministic and ensemble track forecasts, System may track initially South Westward direction up to 12th Nov and further Westward, landfall between Extreme North coastal Tamilnadu and South Coastal Andhra between Chennai and Nellore (with 70% probability) on 16th Nov morning

SAC-ISRO, Ahmedabad Scorpio model also shows similar prediction of cyclogenesis in Bay of Bengal near 11.75^{0}N and 91.75^{0}E.

Another model of SAC ISRO suggests that there is HIGH chance of developing a system west of Andaman in 1-2 days. Model ensembles DO NOT indicate a very strong intensity for this system in future. The maximum expected intensity for this system is of cyclonic storm (35-40 kt).

Summary and Conclusion:

- A well marked low pressure area lies over southeast Bay of Bengal and neighbourhood. Associated cyclonic circulation extends upto mid tropospheric levels. System would concentrate into a Depression during next 24 hours
- Subsequently it would move west-southwestwards and intensify into a Deep Depression on 13th and reach north Tamil Nadu and adjoining south AP coast by 16th November.
- The Deep Depression over southwest Arabian crossed Somalia coast near lat. 8.2.^{0}N and long. 50.0^{0}E between 2300 UTC of 10th and 0000 UTC of 11th Nov. It lay at 0300 UTC of today, the 11th November 2013 over coastal Somalia, near Lat 8.2° N and Long. 49.6° E. The system would move westnorthwestwards and weaken gradually into a low during next 24 hours.

Advisory:

- IOP may be considered for Tamil Nadu and Andhra Pradesh coast during 12-16 November.

Annexure-I

Synoptic observation:

Region	**Date/Time (UTC)**		
	12/12	**13/00**	**13/03**
India	33/51	28/32	33/51
Coastal stations			
WB	6/9	3/4	6/9
Odisha	6/7	5/5	6/7
AP	11/14	10/13	11/14
Tamil Nadu	8/12	7/7	8/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	7/11	6/11	7/11
Myanmar	10/11	10/11	1/11
Thailand	3/3	3/3	3/3
Srilanka	7/9	6/9	7/9

RS/RW (12Z) of 12/11/2013 04/39

- **No. of Ascents reaching 250 hPa levels:04, MISDA: 35**
- **RS/RW** (00Z) of 13/11/2013 24/39
- **No. of Ascents reaching 250 hPa levels:19 , MISDA:15**

No. of PILOT Ascents

12/12Z	**13/00Z**
29/37	21/34

Buoy Data

12/12Z	**13/00Z**	**13/03Z**
9	8	7

Data Statistics over RMC Chennai Region

No. of Synop data

Date→	**12.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /12.11.2013 : 4

No. of Ascents reaching 250 hPa level =4

MISDA : 4

12Z /12.11.2013 : Nil

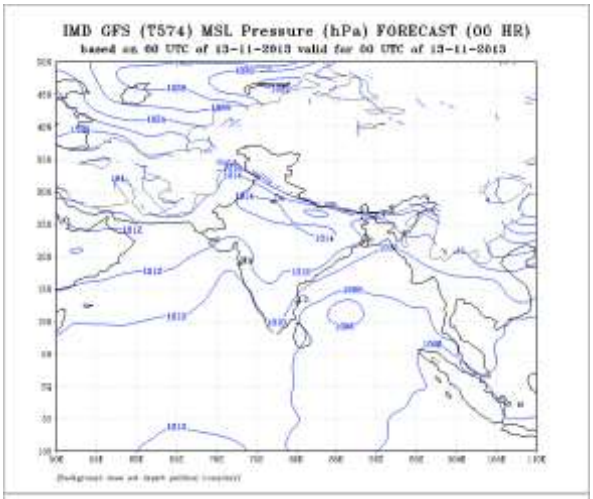
No. of Ascents reaching 250 hPa level =Nil

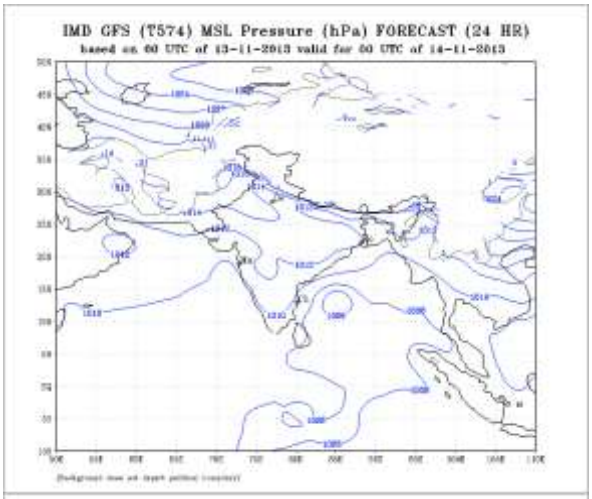
MISDA : 8

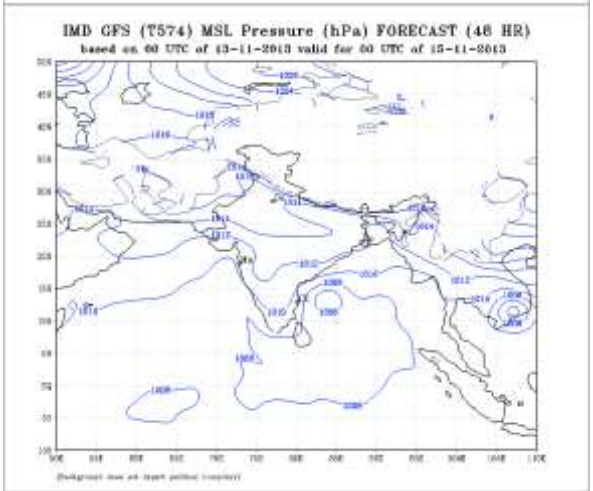
No. of PILOT Ascents:

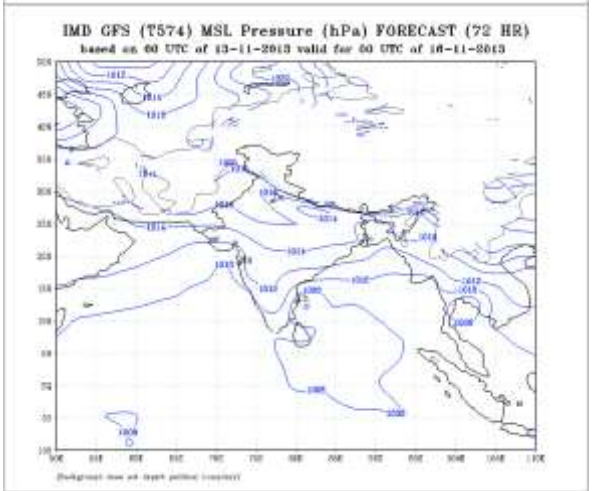
12.11.2013	
06Z	18Z
4	5

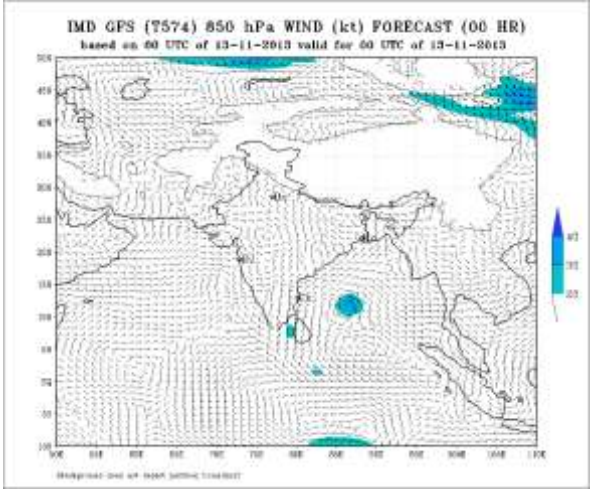
Annexure-II

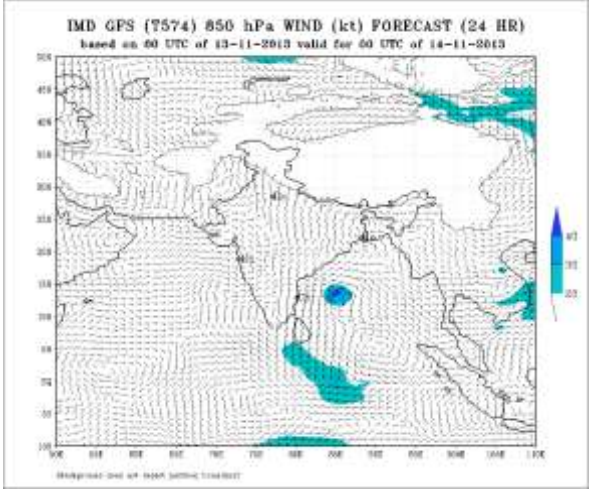

IMD GFS (T574) MSL Pressure (hPa) FORECAST (00 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 13-11-2013

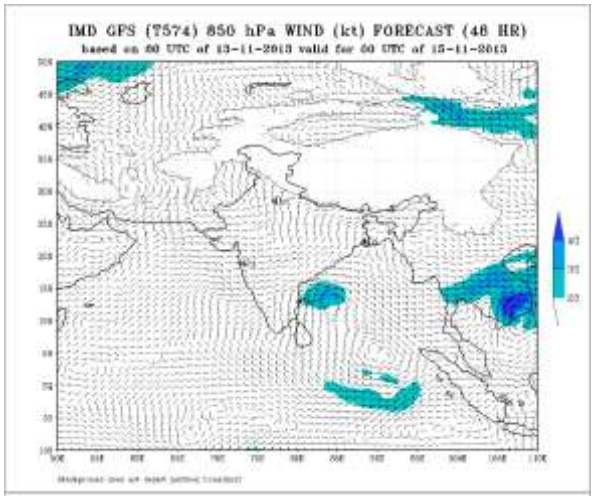

IMD GFS (T574) MSL Pressure (hPa) FORECAST (24 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 14-11-2013

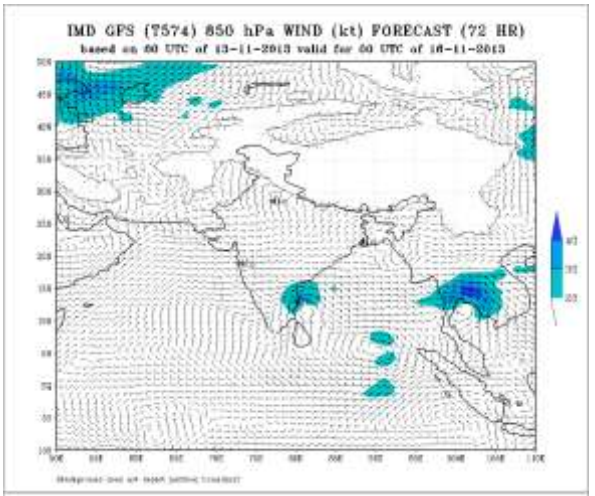

IMD GFS (T574) MSL Pressure (hPa) FORECAST (48 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 15-11-2013

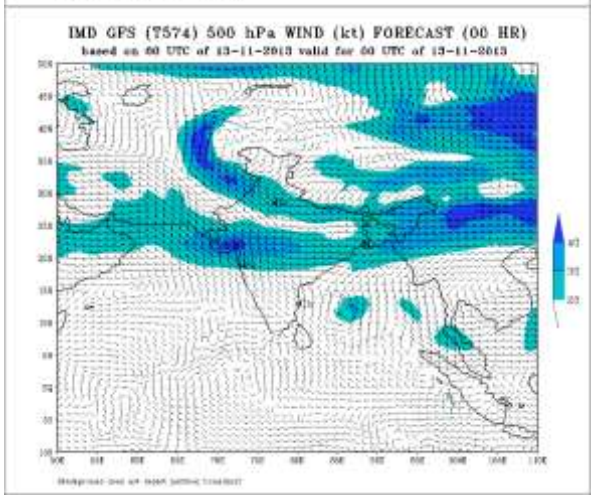

IMD GFS (T574) MSL Pressure (hPa) FORECAST (72 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 16-11-2013

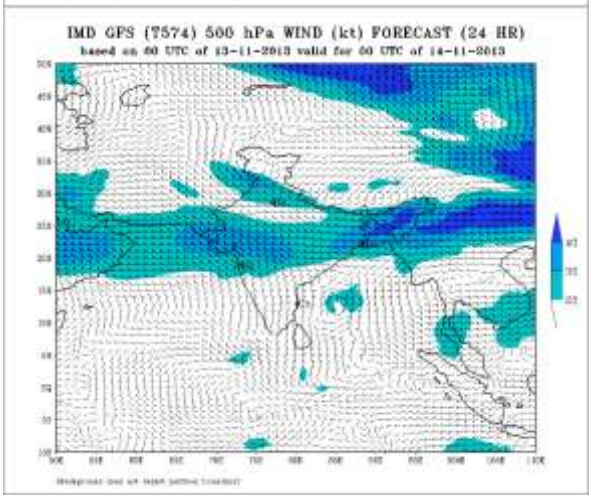

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 13-11-2013

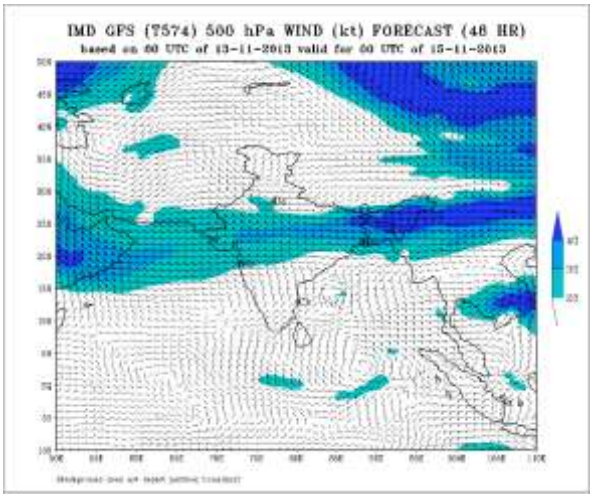

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 14-11-2013

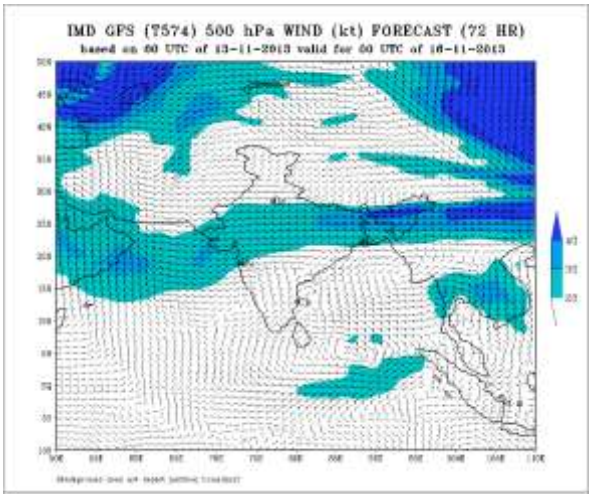

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 15-11-2013

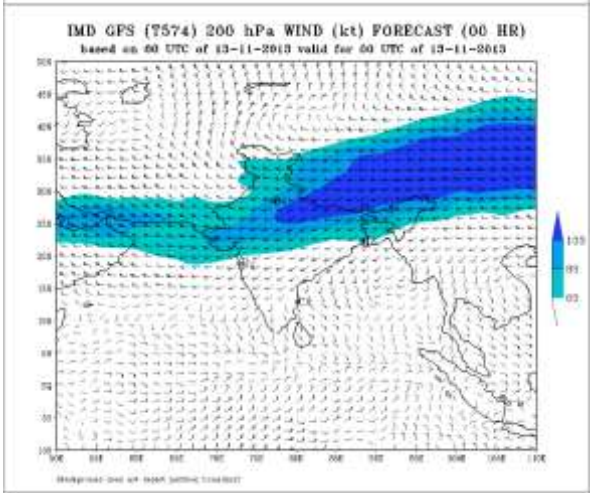

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 16-11-2013

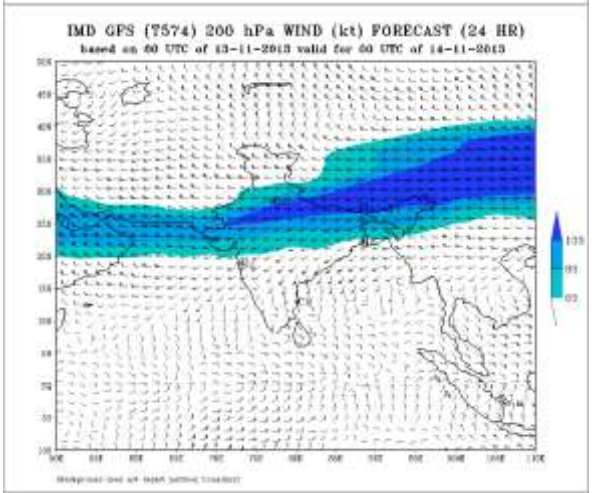

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 13-11-2013

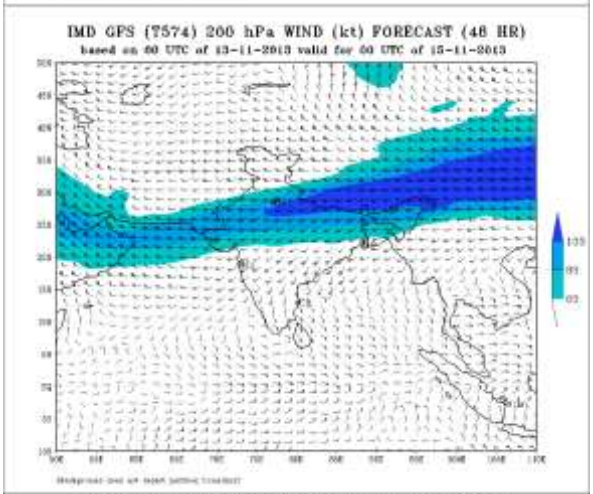

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 14-11-2013

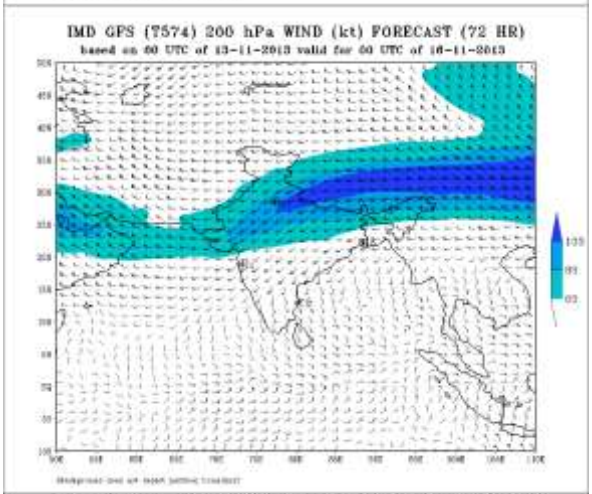

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 15-11-2013

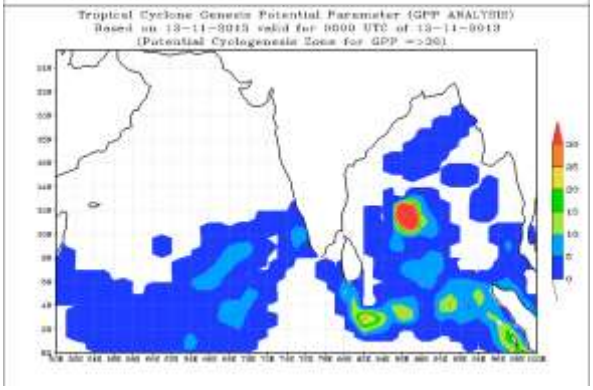

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 16-11-2013

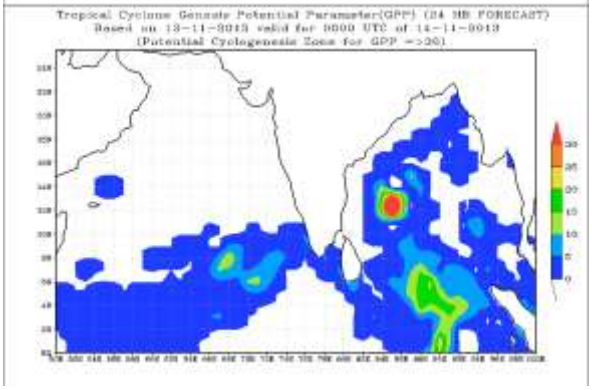

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 13-11-2013

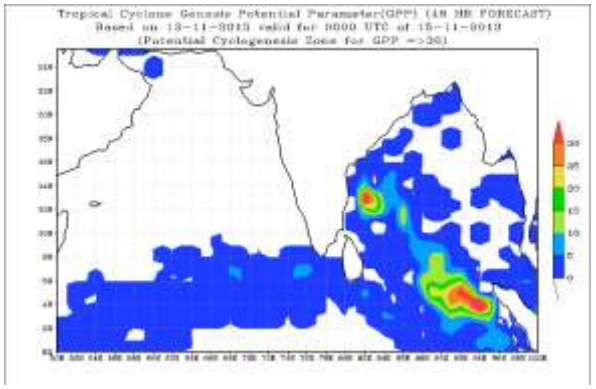

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 14-11-2013

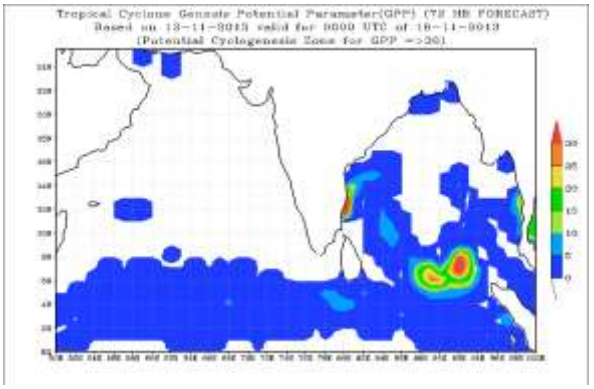

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 15-11-2013


IMD GPS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 13-11-2013 valid for 00 UTC of 16-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 13-11-2013 valid for 0000 UTC of 13-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 13-11-2013 valid for 0000 UTC of 14-11-2013
(Potential Cyclogenesis Zone for GPP =>20)





FDP (Cyclone) NOC Report Dated14 November, 2013

Synoptic features based on 0300 UTC:

- The Depression over southwest and adjoining southeast Bay of Bengal remained practically stationary and lay centred at 1200 UTC of yesterday, the 13th November 2013 within half a degree of Lat. 11.5° N and Long. 86.0° E, about 650 kms east-southeast of Chennai. It moved westwards and lies centred at 0300 UTC of today, the 14th November 2013 within half a degree of Lat. 11.5° N and Long. 85.0°E, about 550 km east-southeast of Chennai, 630 km east-southeast of Nellore and 570 km east-northeast of Nagapattinam. The system would continue to move nearly westwards, may intensify into a Deep depression and cross north Tamil Nadu coast near Nagapattinam around 16th November 2013 evening.
- The cyclonic circulation over Lakshadweep area and neighbourhood persists and extends upto 2.1 kms a.s.l.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-30^{0}C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north, west Central and south west Bay of Bengal. It is 50-90 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over south Bay of Bengal and of the order , 80-120 10^{-5} s^{-1} around the system centre . It is also positive over north east Bay of Bengal. and equatorial region. It is negative over North West Bay, west central Bay and Andaman sea.

Convergence:

- Lower level convergence is positive of the order of 5-15 *10^{-5} s^{-1} around the system centre and it is of the order of 5*10^{-5} s^{-1} over rest of the Bay.

Divergence:

- It is positive of the order of 10-20*10^{-5} s^{-1} around the system centre and of the order of 5*10^{-5} s^{-1} over central & north Bay. It is negative over Andaman Sea of the order of -5*10^{-5} s^{-1} .

Wind Shear:

- **W**ind Shear is 10-30 knots over south west Bay & west central Bay around the system. It is more than 30 knots over North Bay of Bengal.

Wind Shear Tendency:

Shear Tendency is decreasing over west central and adjoining southwest Bay of Bengal. It is also decreasing over north Bay and Andaman Sea. It is increasing over equatorial region.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 14.0°N over Bay of Bengal region.

M.J.O. Index: (Based on 9th Nov)

- Located in phase 3 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may move in phase 3 to 2 with amplitude less than 1.0 during next 2 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 140900 UTC

Vortex over south and adjoining central Bay centred near lat.11.0^{0}N and long.85.0^{0}E. Intensity T1.5. Minimum CTT around -72°C. Associated broken low/medium clouds with embedded intense to very intense convection seen over Bay of Bengal between lat. 10.0^{0}N to 16.0^{0}N and long. 81.5^0 to 86.5^{0}E.

NWP Analysis

- IMD-GFS model analysis of 0000 UTC of 14th November 2013 shows the low pressure system over southwest Bay of Bengal with approximate center at 11^o N and 85^o E. The associated cyclonic circulation extends up to mid tropospheric levels (500 hPa). As, a trough in upper-air westerly is passing over Jammu and Kashmir, divergence is persisting over north-northeast India. The system is far away from the influence of upper-air trough in westerly.
- GFS forecasts predict that the depression over southwest Bay of Bengal move westward during next 24 hours. The system does not show any further intensification and crosses Tamil Nadu coast on Day 2 forecast.
- The analysis and forecast charts of GFS model for 24h to 72 h of MSLP, 850 hPa, 500 hPa and 200 hPa winds are given in **Annexure II**.
- The weather charts of **IMD-WRF** model based on 0000 UTC of 14 November 2013 also show that the depression will move westward direction crosses over south Tamil Nadu coast and adjoining Sri Lanka.
  (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
  ECMWF: Model shows a Low Pressure Area lies over southwest Bay of Bengal on 14th Nov. It is expected to move west-northwestward as low pressure area and cross Tamil Nadu coast on 1200UTC of 16th November and weaken further.
- **METEOFRANCE -ARP:** Model shows a low pressure area over southwest Bay on 14 Nov. It would move west-southwestwards during next 72 hrs and crossed Srilanka coast on 1200 UTC of 16th November.
- **JMA:** Model shows a low over southwest Bay on 14th Nov. It would move west-southwest wards and crossed Srilanka coast around 1200UTC of 16 November.
- **UKMO (13/00UTC):** Model shows a depression lay over southwest Bay of Bengal on 14th November. It would move initially westward till 16th Nov then west-northwestwards and cross south Andhra Pradesh coast by 18th November as Depression.

- **GFS (NCMRWF)** Models show a depression lay over southwest Bay on 14th Nov. It would move west-northwestwards direction and cross near Chennai on 16th Nov around 1200 UTC as a depression.
- **Genesis Potential Parameter (GPP)** forecast based on 0000 UTC of **14 November 2013** indicates that there is a region of high GPP over south central BOB centered at 11° N/85° E. This may persists and move westward during next 24 hours and further west over Tamil Nadu coast in 48 hours. An area of moderate GPP emerges over south Andaman Sea and adjoining area in 72 hour forecast.
- The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

SHAR model based on ECMWF EPS :
Depression over South West BoB persists and moving slowly West South West direction The area of convection located near 11.0N & 83.8E, approximately 400 km SouthEast of Chennai. Past 12 hrs tracked West South West direction Upper air analysis shows, system pulling dry air from the land. So further intensification probability is low.

ECMWF deterministic and ensemble track forecasts, System may slowly track Westward direction. Expected landfall between Central Coastal Tamil Nadu between Nagapattinam and Pondicherry on 16th Nov evening/night as a widespread low.

SAC-ISRO, Ahmedabad
Cyclogenesis summary is as follows
(1) The system has not yet developed into a cyclone, but its probability for development is still high.
(2) There is about 70% probability that the system center will pass within 200 km from SHAR.

(3) There is 90% probability that the system will be weak (low to depressions stage) at the time of landfall.

Summary and Conclusion:

The depression over southwest and adjoining southeast Bay of Bengal moved southwestwards and lay centred at 1730 hrs IST of today, the 14th November 2013 near latitude 10.5°N and longitude 84.5°E, about 650 km southeast of Chennai, 620 km east-southeast of Nagapattinam. The system would move west-southwestwards for some more time and then west-northwestwards and cross north Tamil Nadu coast near Nagapattinam around 16th November 2013 evening.

Advisory:

- IOP will continue for Tamil Nadu and Andhra Pradesh coast during till 16 November.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	13/12	**14/00**	**14/03**
India	41/51	31/32	38/51
Coastal stations			
WB	4/9	2/9	4/9
Odisha	6/7	5/7	6/7
AP	7/13	7/13	7/13
Tamil Nadu	4/12	4/7	5/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	6/7
Bangladesh	9/11	08/11	07/11
Myanmar	9/11	9/11	9/11
Thailand	3/3	3/3	3/3
Srilanka	5/9	6/9	7/9

RS/RW (12Z) of 13/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:0, MISDA: --**
- **RS/RW** (00Z) of 14/11/2013 20/39
- **No. of Ascents reaching 250 hPa levels:15 , MISDA:-**

No. of PILOT Ascents

13/12Z	**14/00Z**
22/37	24/34

Buoy Data

13/12Z	**14/00Z**	**14/03Z**
5	5	5

Data Statistics over RMC Chennai Region

No. of Synop data

Date→				**13.11.2013**				
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /13.11.2013 : 6

No. of Ascents reaching 250 hPa level =4

MISDA : 2

12Z /13.11.2013 : Nil

No. of Ascents reaching 250 hPa level =Nil

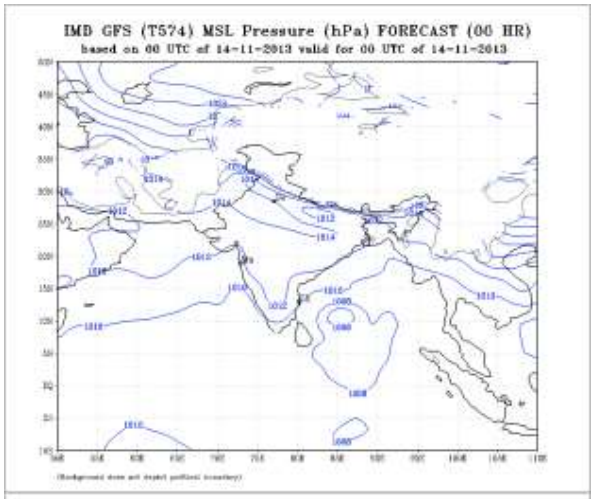
MISDA : 8

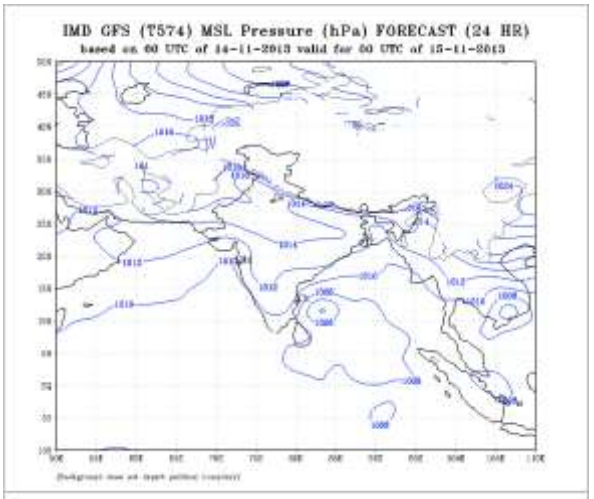
No. of PILOT Ascents:

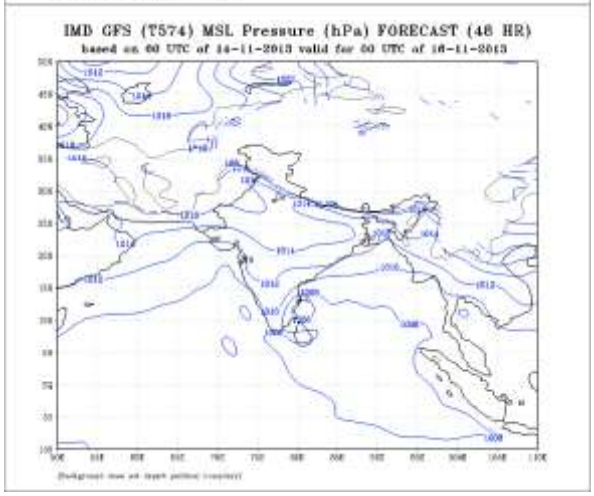
13.11.2013

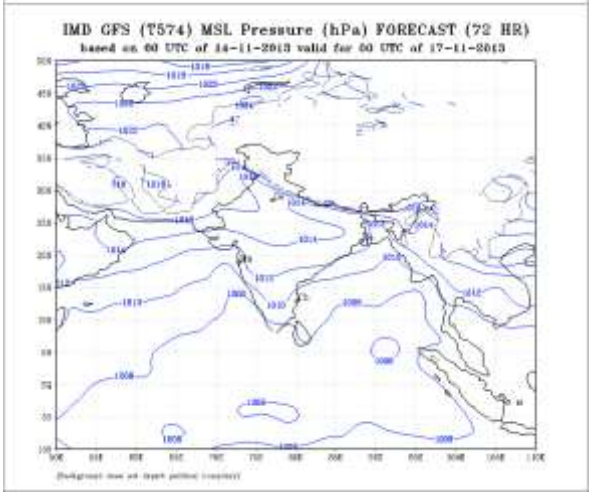
06Z	18Z
5	4

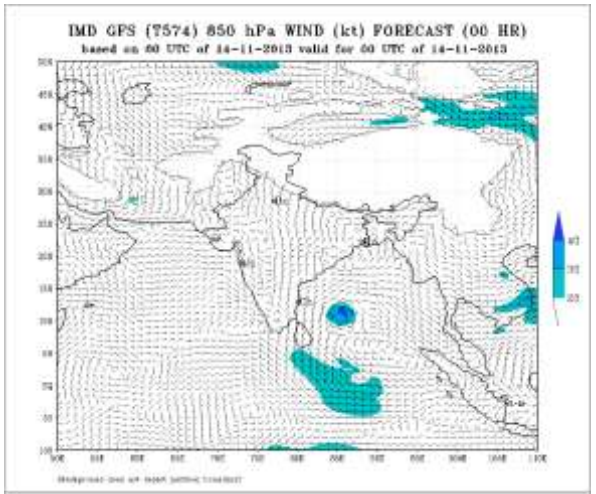
Annexure-II

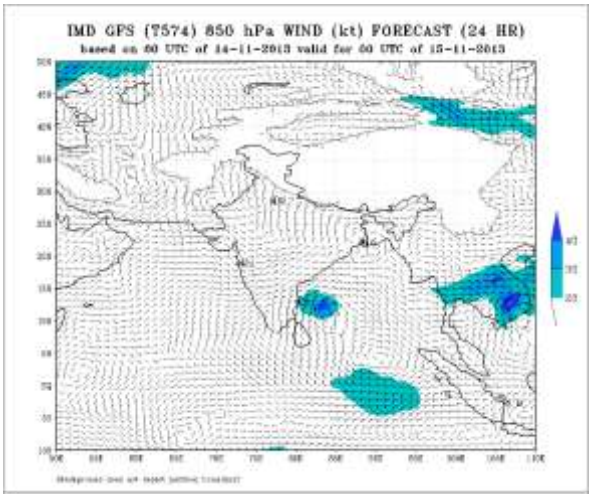

IMD GFS (T574) MSL Pressure (hPa) FORECAST (00 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 14-11-2013

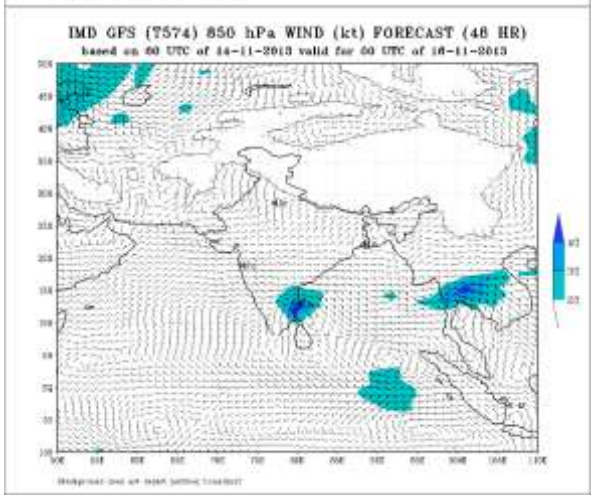

IMD GFS (T574) MSL Pressure (hPa) FORECAST (24 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 15-11-2013

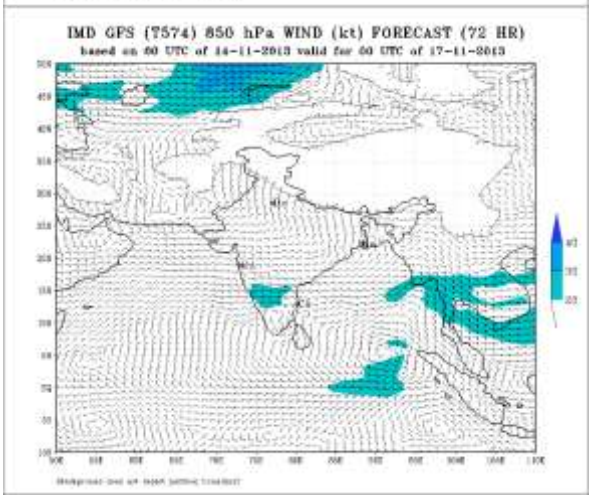

IMD GFS (T574) MSL Pressure (hPa) FORECAST (48 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 16-11-2013

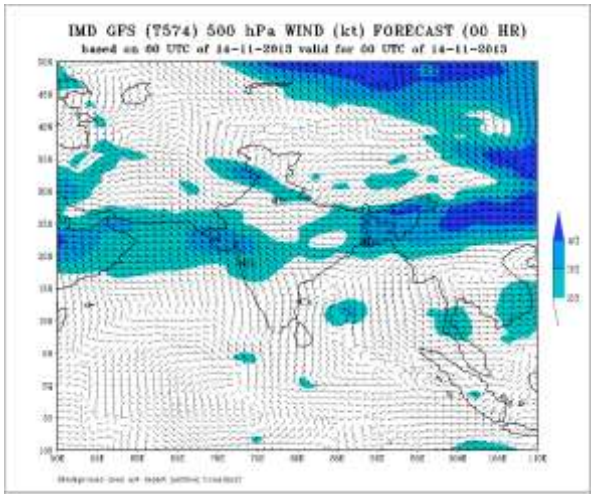

IMD GFS (T574) MSL Pressure (hPa) FORECAST (72 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 17-11-2013

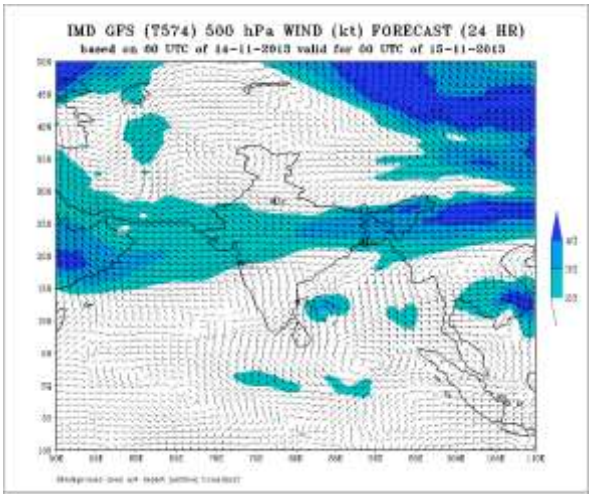

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 14-11-2013

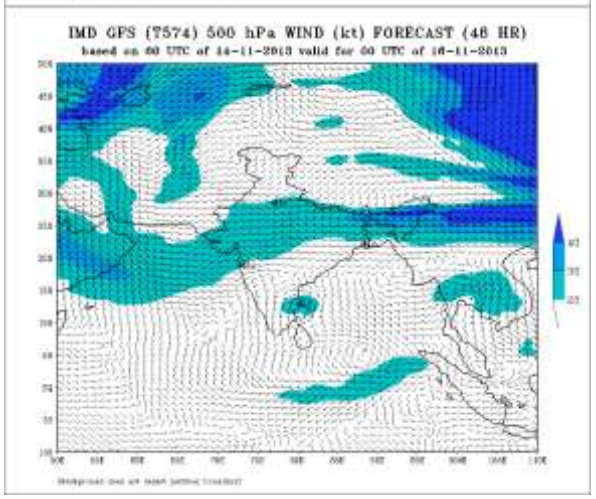

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 15-11-2013

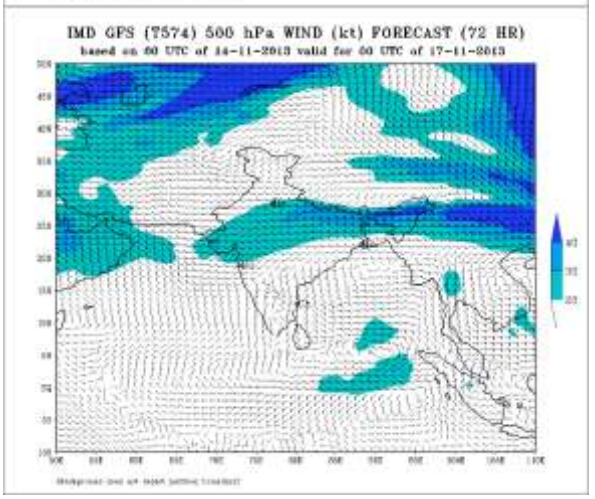

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 16-11-2013

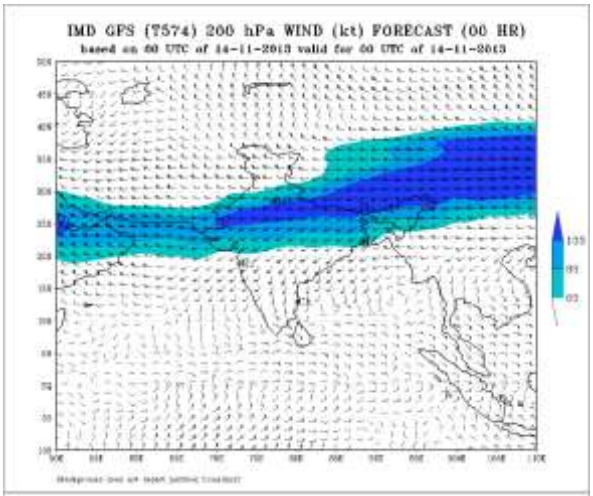

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 17-11-2013

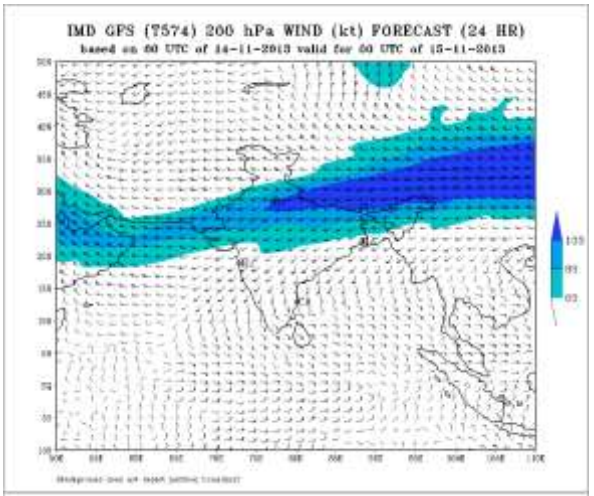

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 14-11-2013

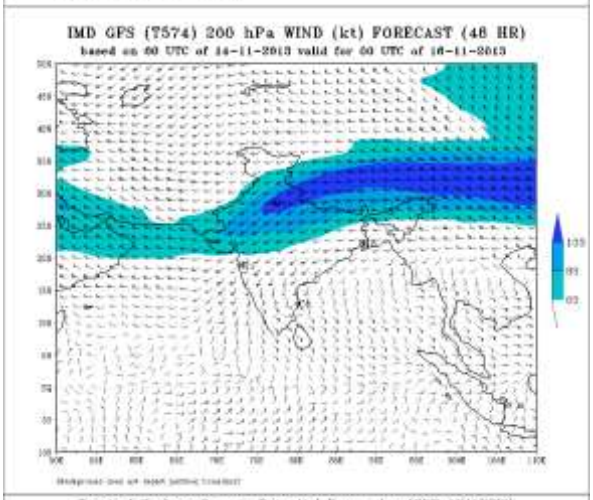

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 15-11-2013

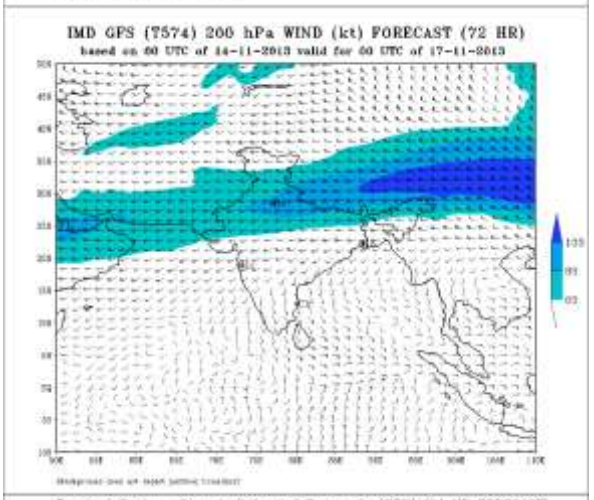

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 16-11-2013

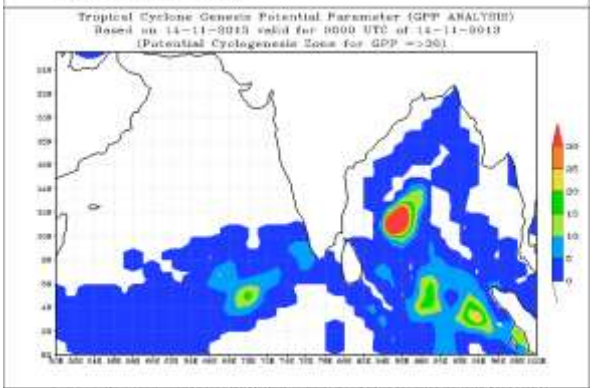

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 17-11-2013

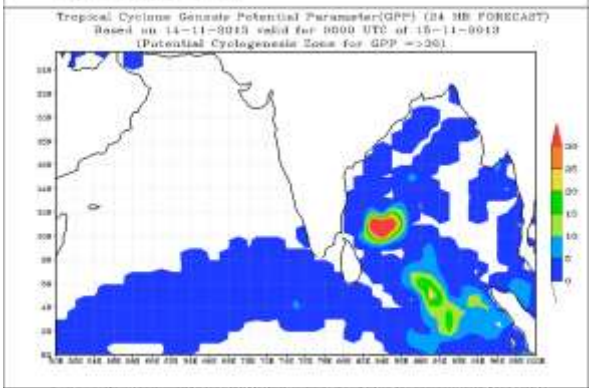

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 14-11-2013

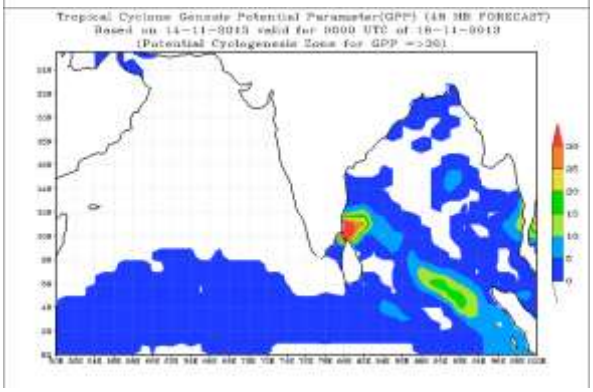

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 15-11-2013

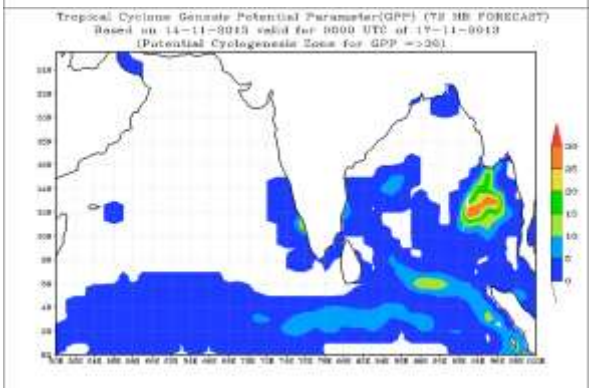

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 16-11-2013


IMD GPS (7574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 14-11-2013 valid for 00 UTC of 17-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 14-11-2013 valid for 0000 UTC of 14-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 14-11-2013 valid for 0000 UTC of 15-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 14-11-2013 valid for 0000 UTC of 16-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 14-11-2013 valid for 0000 UTC of 17-11-2013
(Potential Cyclogenesis Zone for GPP =>20)

FDP (Cyclone) NOC Report Dated 15th November, 2013

Synoptic features based on 0300 UTC:

- The Depression over southwest and adjoining southeast Bay of Bengal moved southwestwards and lay centred at 1200 UTC of yesterday, the 14th November 2013 within half a degree of Lat. 10.5° N and Long. 84.5° E, about 650 kms southeast of Chennai. It moved southwestwards and lay centred at 0300 UTC of 15th November 2013 over southwest Bay of Bengal within half a degree of Lat. 9.5° N and Long. 83.5° E, about 530 kms southeast of Chennai and 420 kms east-southeast of Nagapattinam. The system would move west-northwestwards and cross north Tamil Nadu coast near Nagapattinam around 16th November 2013 evening.
- The cyclonic circulation extending upto 2.1 kms a.s.l. over Lakshadweep area and neighbourhood persists.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-30^{0}C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north and west Central Bay of Bengal. It is 50-90 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over south Bay of Bengal and of the order 80-120 10^{-5} s^{-1} around the system centre . It is also positive over north Andaman sea and equatorial region. It is negative over North West Bay, west central Bay.

Convergence:

- Lower level convergence is positive of the order of 5-15 *10^{-5} s^{-1} around the system centre and it is of the order of 5*10^{-5} s^{-1} over rest of the Bay.

Divergence:

- It is positive of the order of 5-20*10^{-5} s^{-1} around the system centre and of the order of 5*10^{-5} s^{-1} over central & north Bay & Andaman Sea.

Wind Shear:

- **W**ind Shear is 20-30 knots over south west Bay & west central Bay around the system. It is more than 30 knots over North Bay of Bengal.

Wind Shear Tendency:

Shear Tendency is decreasing over south and central Bay of Bengal. It is increasing over Andaman Sea.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 14.0°N over Bay of Bengal region.

M.J.O. Index: (Based on 9th Nov)

- Located in phase 2 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may move in phase 2 to 1 with amplitude less than 1.0 during next 2 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 150900 UTC

Vortex over southwest Bay centred near lat.09.5^{0}N and long.83.2^{0}E. Intensity T1.5. Minimum CTT around -76°C. Associated broken low/medium clouds with embedded intense to very intense convection seen over Bay of Bengal between lat. 08.0^{0}N to 15.0^{0}N and long. 80.0^0 to 83.5^{0}E near North Srilanka.

NWP Analysis

- IMD-GFS model analysis of 0000 UTC of 15th November 2013 shows the depression over southwest Bay of Bengal with approximate center at 9.5° N and 83.5° E. The associated cyclonic circulation extends up to mid tropospheric levels (500 hPa) with gradual weakening with height.
- GFS forecasts predict that the depression over southwest Bay of Bengal move westward during next 48 hours. The system does not show any further intensification and crosses over south Tamil Nadu coast and adjoining Sri Lanka on Day 2 forecast.
- The analysis and forecast charts of GFS model for 24h to 72 h of MSLP, 850 hPa, 500 hPa and 200 hPa winds are given in **Annexure II**.
- The weather charts of **IMD-WRF** model based on 0000 UTC of 15th November 2013 also show that the depression will move westward direction crosses over south Tamil Nadu coast and adjoining Sri Lanka in 48 hours.
  (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
- **ECMWF:** Model shows a Low Pressure Area lies over southwest Bay of Bengalon 15th Nov. It is expected to move west-northwestward as low pressure area and cross Tamil Nadu coast on 1200UTC of 16th November near 10.5°N and weaken further.
- **METEOFRANCE -ARP:** Model shows a low pressure area over southwest Bay on 15th Nov. It would move westwards and crossed Sri Lanka coast on 1200 UTC of 16th November.
- **JMA:** Model shows a low(8.0°N/84.5°E) over southwest Bay on 15th Nov. It would move west-northwest wards and cross Sri Lanka coast around 1200UTC of 16th November.
- **UKMO (14/00UTC):** Model shows a low pressure area lay over southwest Bay of Bengal on 15th November. It would move west-northwestward and cross south of Chennai coast by 18th November morning.
- **GFS (NCMRWF):** Models show a depression lies over southwest Bay on 15th Nov. It would move westwards direction and cross Tamil Nadu on 17th Nov morning as a depression.
- **Genesis Potential Parameter (GPP)** forecast based on 0000 UTC of **15th November 2013** indicates that there is a region of high GPP over southwest BOB centered at 09.5° N/84° E. This may persistently move westward over Sri Lanka in 24 hours and disappears over southern tip of Indian Peninsula in 48 hours. The same area of GPP again emerges over Arabian Sea in 72 hour forecast. An area of moderate GPP appears over south Andaman Sea and adjoining area in 48 hour forecast which intensifies and moves westward over central BOB in 72 hour.
- The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)
- **SHAR model based on ECMWF EPS** :
  Depression over South West Bay of Bengal persists and moving slowly west-southwest direction with slight intensification. Expected landfall between central Coastal Tamil Nadu near South of Nagapattinam on 16th Nov Morning / Afternoon as a low pressure.

SAC-ISRO, Ahmedabad

(1) The system will move mostly in westward direction.
(2) Probability of this system developing into a tropical cyclone is very rare.

Summary and Conclusion:

- The depression would move initially westwards then west-northwestwards and cross Tamil Nadu coast near Nagapattinam around 16th November 2013 evening.

Advisory:

- IOP will continue for Tamil Nadu and Andhra Pradesh coast during till 17 November.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	14/12	**15/00**	**15/03**
India	41/51	31/32	38/51
Coastal stations			
WB	4/9	2/9	5/9
Odisha	6/7	4/7	6/7
AP	7/13	10/13	10/13
Tamil Nadu	4/12	6/7	9/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/1	4/7
Bangladesh	10/11	10/11	09/11
Myanmar	9/11	9/11	7/11
Thailand	3/3	3/3	2/3
Srilanka	7/9	9/9	10/9

RS/RW (12Z) of 14/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:0, MISDA: --**
- **RS/RW** (00Z) of 15/11/2013 19/39
- **No. of Ascents reaching 250 hPa levels:15 , MISDA:-**

No. of PILOT Ascents

14/12Z	**15/00Z**
22/37	24/34

Buoy Data

14/12Z	**15/00Z**	**15/03Z**
5	5	5

Data Statistics over RMC Chennai Region

No of Synop data (Chennai Region:Coasts of AP & TN:-

Hourly Special observations from 14.11.2013/1200 UTC)

Date→	**14.11.2013**							
UTC→	**00**	**01**	**02**	**03**	**04**	**05**	**06**	**07**
No. of obs→	**20**	**--**	**--**	**22**	**--**	**--**	**20**	**--**
UTC→	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**
No. of obs→	**--**	**20**	**--**	**--**	**22**	**5**	**7**	**20**
UTC→	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
No. of obs→	**8**	**7**	**20**	**7**	**8**	**20**	**8**	**5**

No. of RS/RW Ascents

00Z /14.11.2013 : 6

No. of Ascents reaching 250 hPa level =4

MISDA : 2

12Z /14.11.2013 : Nil

No. of Ascents reaching 250 hPa level =Nil

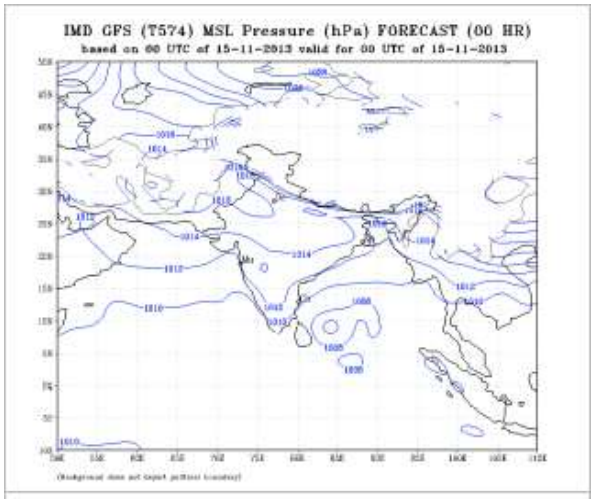
MISDA : 8

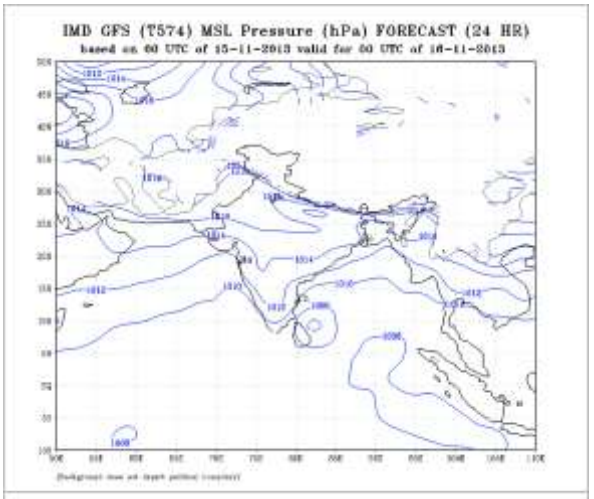
No. of PILOT Ascents:

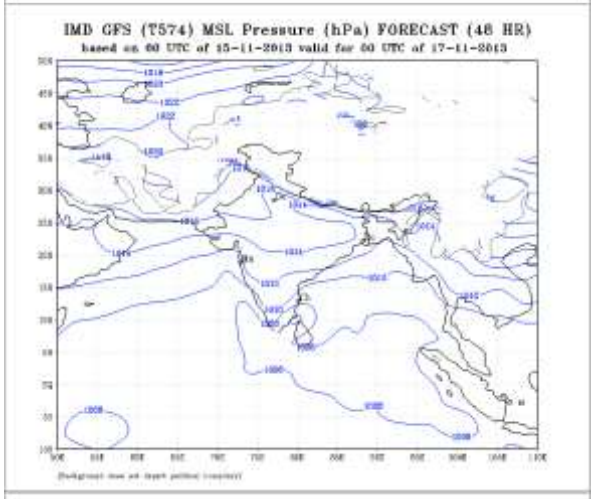
14.11.2013

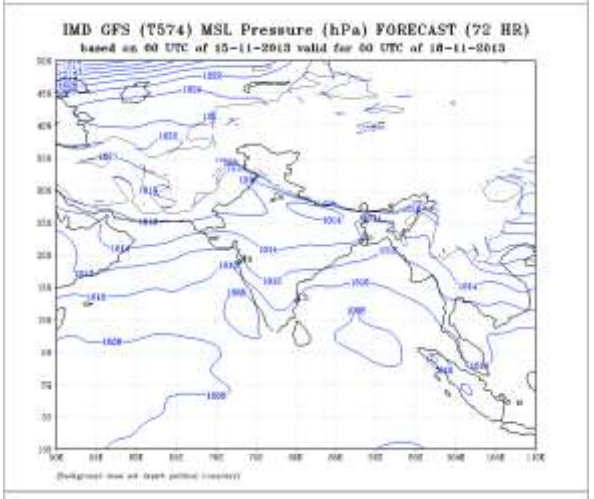
06Z	**18Z**
5	**6**

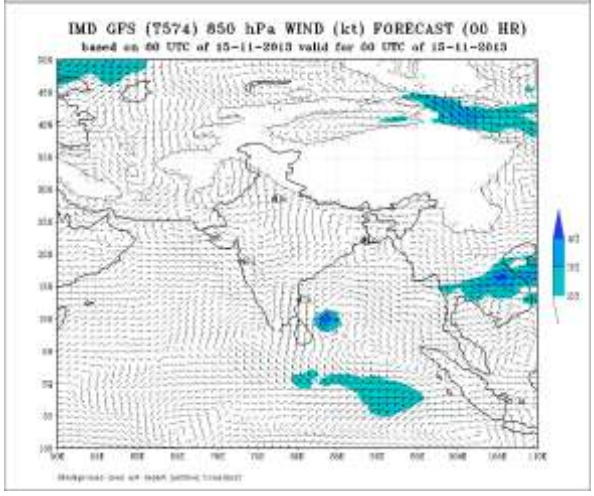
Annexure-II

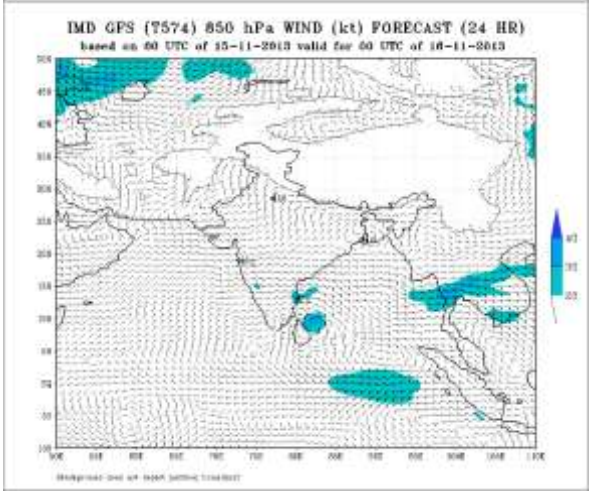

IMD GFS (T574) MSL Pressure (hPa) FORECAST (00 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 15-11-2013

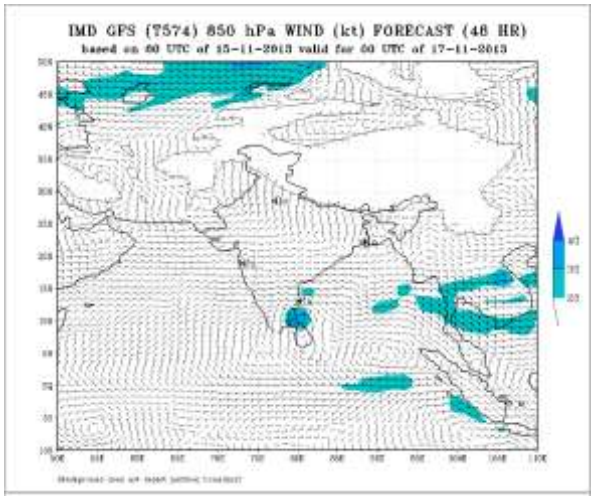

IMD GFS (T574) MSL Pressure (hPa) FORECAST (24 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 16-11-2013

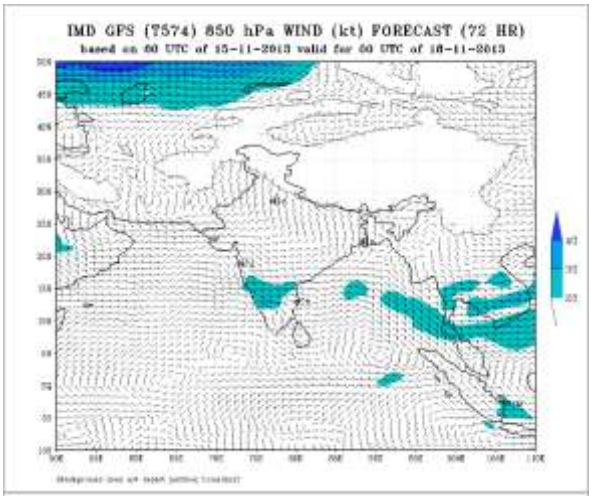

IMD GFS (T574) MSL Pressure (hPa) FORECAST (48 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 17-11-2013

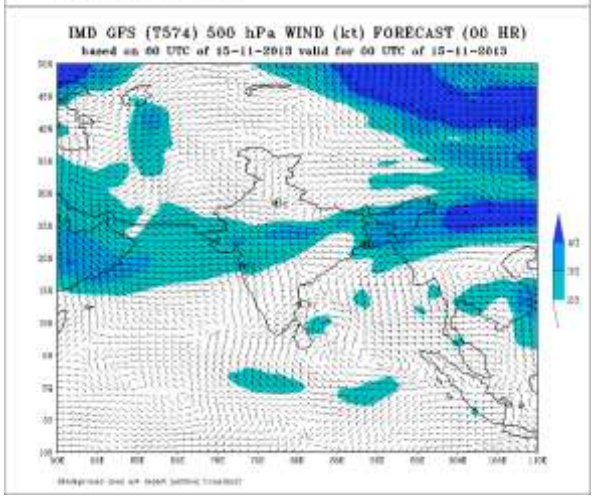

IMD GFS (T574) MSL Pressure (hPa) FORECAST (72 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 18-11-2013

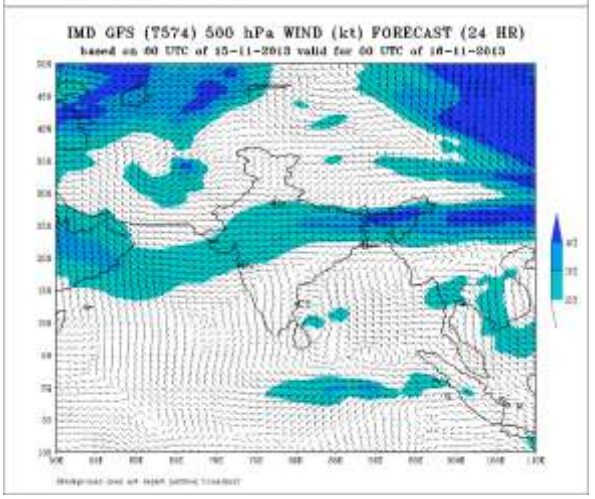

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 15-11-2013

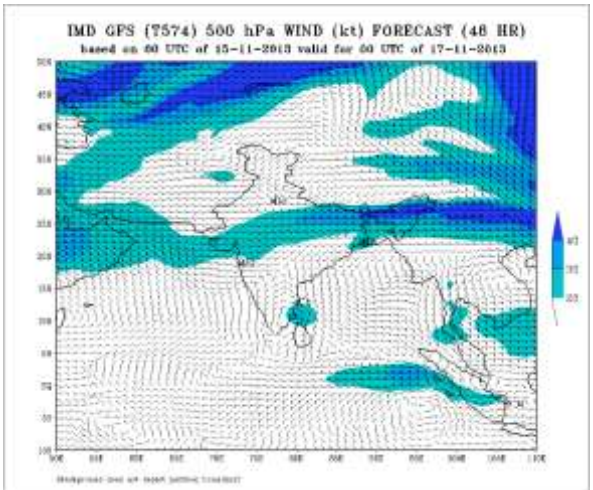

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 16-11-2013

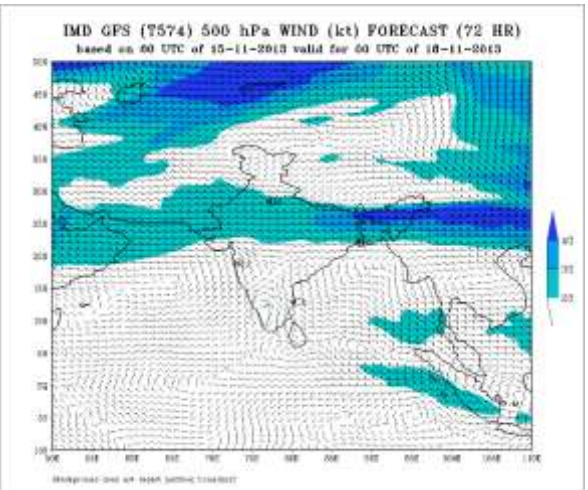

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 17-11-2013

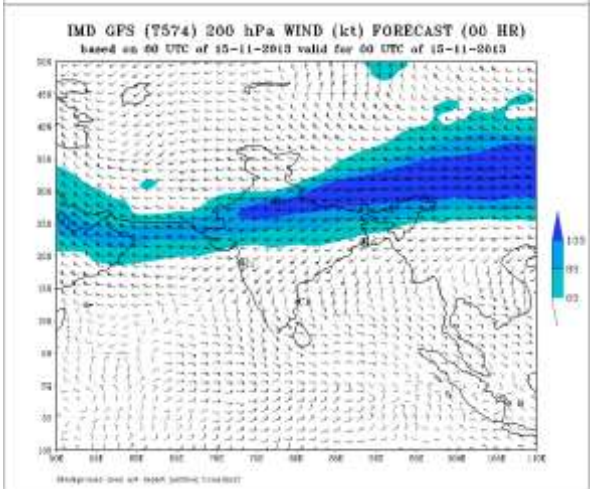

IMD GPS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 18-11-2013

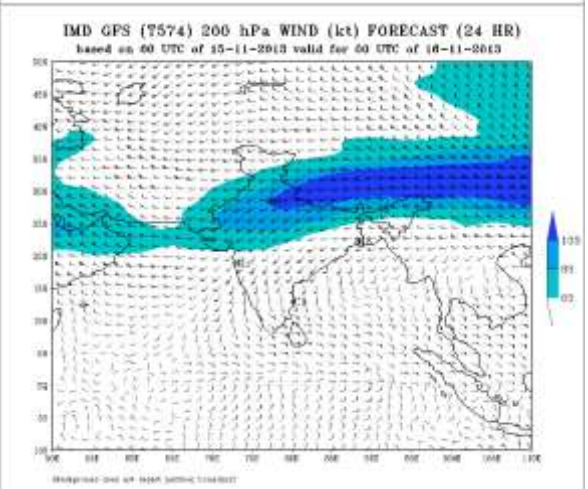

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 15-11-2013

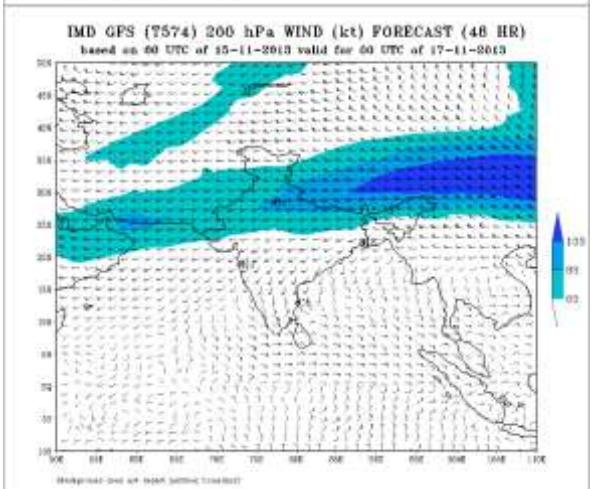

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 16-11-2013

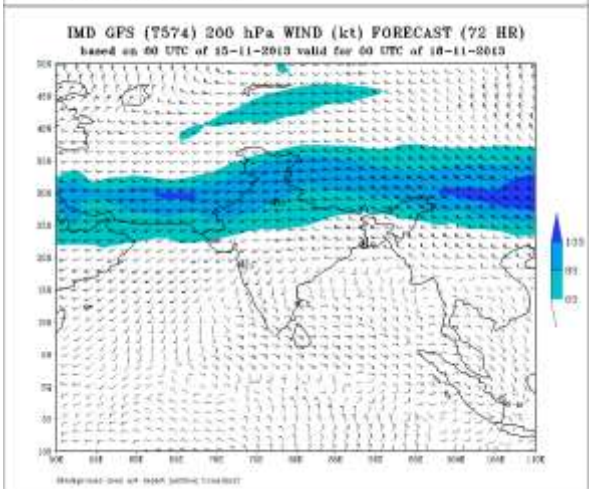

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 17-11-2013

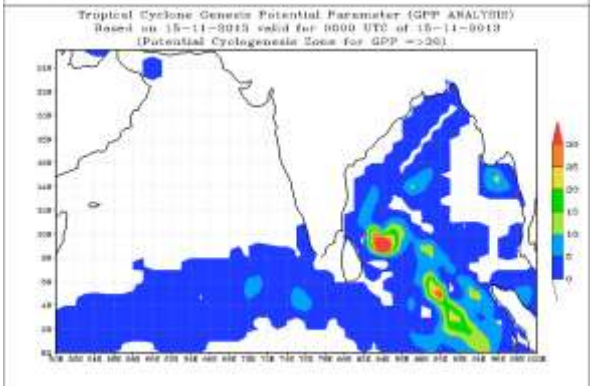

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 18-11-2013

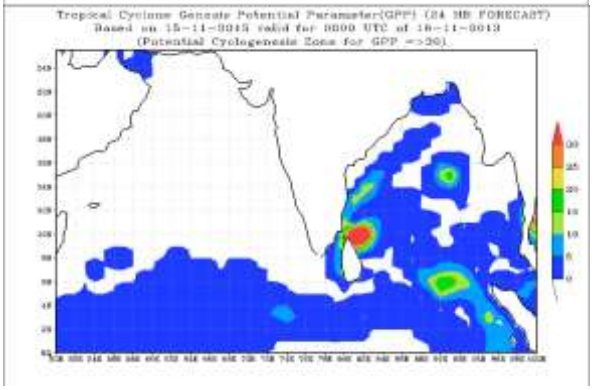

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 15-11-2013

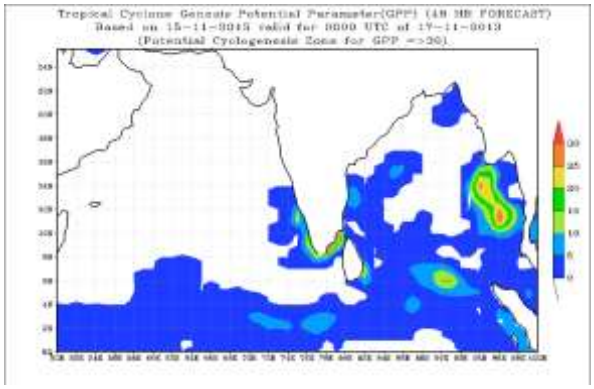

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 16-11-2013

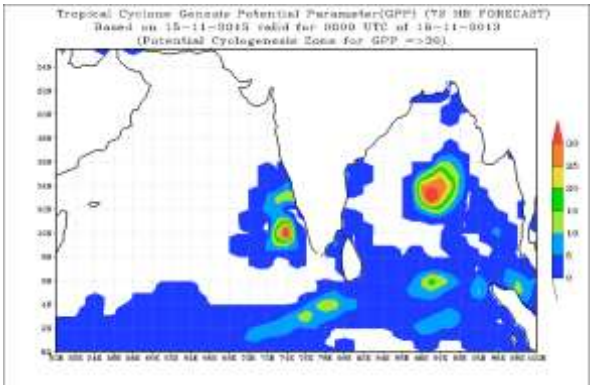

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 17-11-2013


IMD GPS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 15-11-2013 valid for 00 UTC of 18-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 15-11-2013 valid for 0000 UTC of 15-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 15-11-2013 valid for 0000 UTC of 16-11-2013
(Potential Cyclogenesis Zone for GPP =>20)





FDP (Cyclone) NOC Report Dated 16th November, 2013

Synoptic features based on 0300 UTC:

- The Depression over southwest Bay of Bengal moved westwards and lay centred at 1200 UTC of yesterday, the 15th November 2013 within half a degree of Lat. 9.5° N and Long. 83.0° E, about 490 kms southeast of Chennai. It further moved west-northwestwards and lies centred at 0300 UTC of today, the 16th November 2013 within half a degree of Lat. 11.0° N and Long. 80.5° E, about 75 kms east of Nagapattinam and 220 kms south-southeast of Chennai. The system would move west-northwestwards and cross north Tamil Nadu coast close to north of Nagapattinam around 16th November 2013 evening.
- The cyclonic circulation extending upto 2.1 kms a.s.l. over Lakshadweep area and neighbourhood persists.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-30^{0}C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north and west Central Bay of Bengal. It is 50-90 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over south Bay of Bengal, north Andaman sea and equatorial region. It is negative over rest Bay of Bengal.

Convergence:

- Lower level convergence is positive of the order of 5-10 *10^{-5} s^{-1} over southwest and west central Bay of Bengal and it is of the order of 5*10^{-5} s^{-1} over Andaman sea.

Divergence:

- It is positive of the order of 5-10*10^{-5} s^{-1} over westcentral Bay and adjoining southwest Bay off Tamil Nadu coast.

Wind Shear:

- **W**ind Shear is 10-20 knots over south west Bay & west central Bay . It is more than 30 knots over North Bay of Bengal.

Wind Shear Tendency:

Shear Tendency is decreasing over south and central Bay of Bengal. It is increasing over Andaman Sea.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 15.0°N over Bay of Bengal region.

M.J.O. Index: (Based on 9th Nov)

- Located in phase 2 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may move in phase 2 to 1 with amplitude less than 1.0 during next 2 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 160900 UTC

Vortex over southwest Bay which crossed over land at 0800 UTC of 16th November near lat.11.0^{0}N and long.79.6^{0}E with Intensity T1.5. Minimum CTT around -59°C. Associated broken low/medium clouds with embedded intense convection seen over north Tamil Nadu, south interior Karnataka coastal Andhra Pradesh and adjoining Rayalaseema between lat. 10.0^{0}N to 13.0^{0}N and west of long. 80.0$^{0.}$

NWP Analysis

- IMD-GFS model analysis of 0000 UTC of 16th November 2013 shows the depression over southwest Bay of Bengal with approximate center at 11^o N and 80.5^o E. The associated cyclonic circulation extends up to mid tropospheric levels (500 hPa).
- GFS forecasts predict that the depression over southwest Bay of Bengal weakens and move westward crossing over south Tamil Nadu coast during next 24 hours. A prominent trough in easterly persisting at lower levels (below 500 hPa) moves westward from central BOB to southwest BOB in 72 hours.
- The analysis and forecast charts of GFS model for 24h to 72 h of MSLP, 850 hPa, 500 hPa and 200 hPa winds are given in **Annexure II**.
- The weather charts of **IMD-WRF** model based on 0000 UTC of 16th November 2013 also shows that the depression will move westward direction crosses over south Tamil Nadu coast in 24 hours.
  (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
- **ECMWF:** Model shows there is no cyclogenesis over Bay of Bengal during next 04-05 days.
- **METEOFRANCE -ARP:** Model is not showing any cyclogenesis during next 03 days.
- **JMA:** Model is not showing any cyclogenesis during next 03 days.
- **UKMO (15/00UTC):** Model does not predict any cyclogenesis over Bay of Bengal during next 04-05 days.
- **GFS (NCMRWF):** Models shows formation a low pressure area over south Andaman sea on 20th November.
- **Genesis Potential Parameter (GPP)** forecast based on 0000 UTC of **16th November 2013** indicates that there is a region of high GPP associated with the depression over southwest BOB centered at 11^o N/80.5^o E This move westward in 24 hours and disappears over southern tip of Indian Peninsula. In 48 hours, an zone of moderate GPP appearing over south Andaman Sea and adjoining area intensifies and moves westward over central BOB and moves further westward in 72 hour.
- The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**.
  (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- The Depression over southwest Bay of Bengal moved westwards and crossed Tamil Nadu coast near Nagapattinam (43147) between 0700 and 0800 UTC and lay centred at 0900 UTC of today, the 16th November 2013 near latitude 11.0^{0}N and longitude 79.5^{0}E, about 40 km west of Nagapattinam (43147). The system would move west-northwestwards and weaken gradually into a well marked low pressure area during next 24hrs.
- There would not be any cyclogenesis over Bay of Bengal during next 04-05 days.

Advisory: No IOP during next 04-05 days.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	15/12	**16/00**	**16/03**
India	41/51	31/32	38/51
Coastal stations			
WB	5/9	3/9	5/9
Odisha	6/7	5/7	6/7
AP	8/13	11/13	12/13
Tamil Nadu	4/12	6/7	9/12
Puducherry	2/2	2/2	2/2
A & N	6/7	7/7	7/7
Bangladesh	05/11	10/11	09/11
Myanmar	8/11	0/11	6/11
Thailand	3/3	3/3	2/3
Srilanka	8/9	8/9	8/9

RS/RW (12Z) of 15/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:0, MISDA: -**
- **RS/RW** (00Z) of 16/11/2013 19/39
- **No. of Ascents reaching 250 hPa levels:15 , MISDA:-**

No. of PILOT Ascents

15/12Z	**16/00Z**
22/37	24/34

Buoy Data

15/12Z	**16/00Z**	**16/03Z**
11	8	9

Data Statistics over RMC Chennai Region

No of Synop data (Chennai Region:Coasts of AP & TN:- Hourly Special observations from 14.11.2013/1200 UTC)

Date→				**15.11.2013**				
UTC→	**00**	**01**	**02**	**03**	**04**	**05**	**06**	**07**
No. of obs→	**20**	**07**	**06**	**22**	**05**	**06-**	**20**	**07**
UTC→	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**
No. of obs→	**10**	**20**	**09**	**07**	**22**	**08**	**06**	**20**
UTC→	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
No. of obs→	**08**	**07**	**20**	**07**	**08**	**20**	**09**	**07**

No. of RS/RW Ascents

00Z /15.11.2013 : 6

No. of Ascents reaching 250 hPa level =6

MISDA : 2

12Z /15.11.2013 : Nil

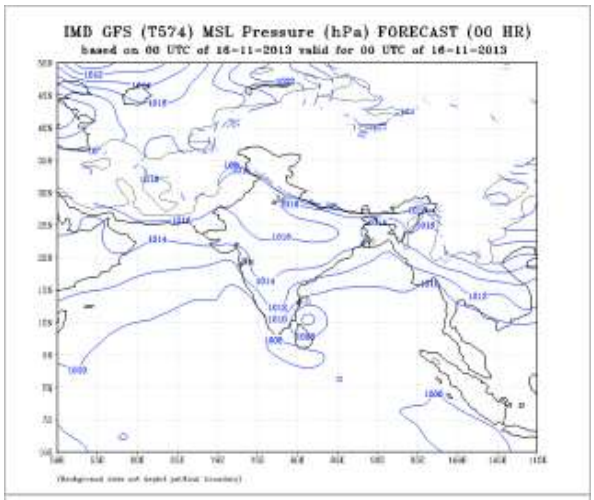
No. of Ascents reaching 250 hPa level =Nil

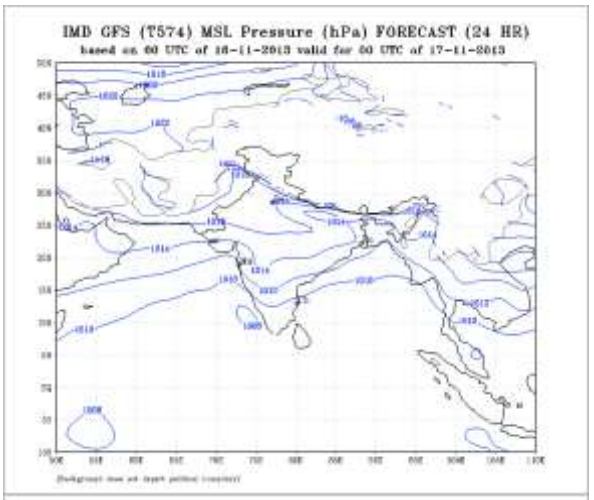
MISDA : 8

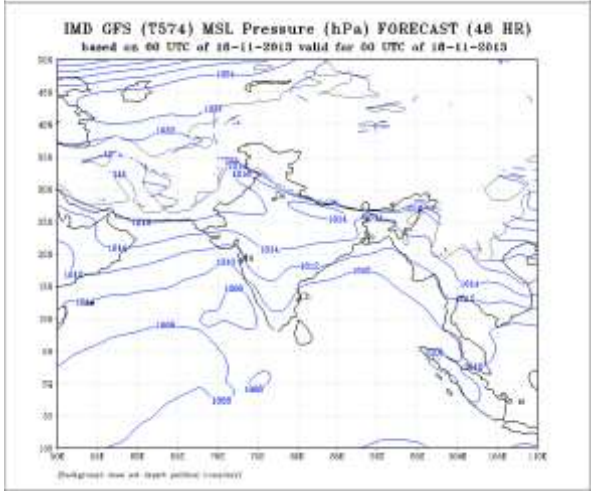
No. of PILOT Ascents:

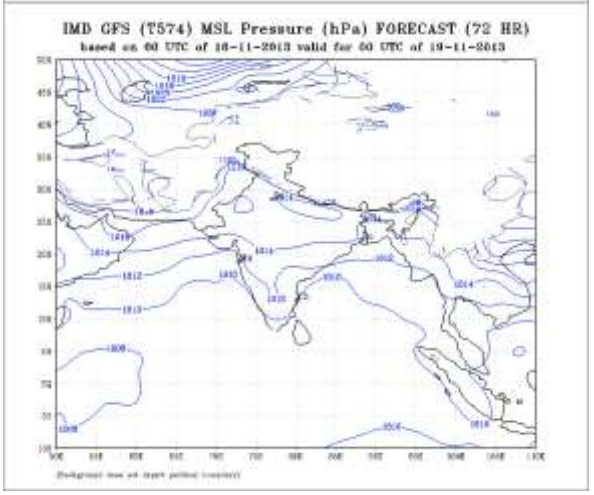
15.11.2013	
06Z	**18Z**
6	**6**

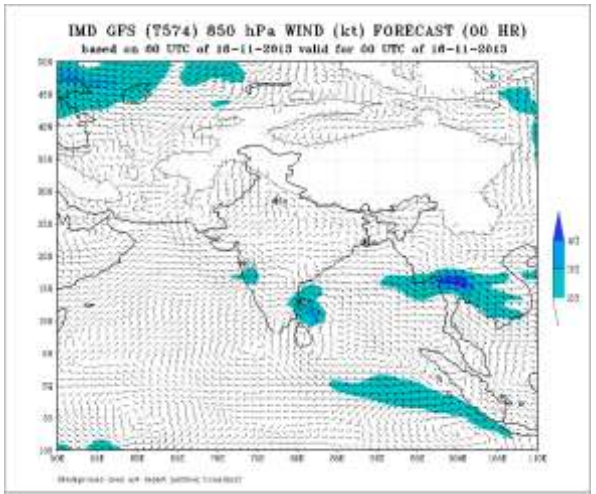
Annexure-II

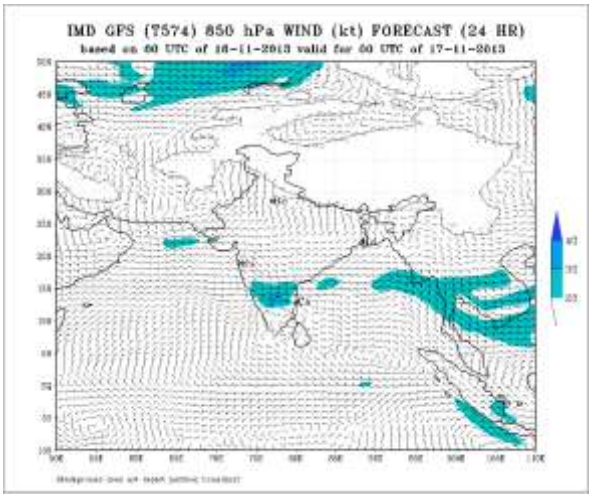

IMD GFS (T574) MSL Pressure (hPa) FORECAST (00 HR)
based on 00 UTC of 16-11-2013 valid for 00 UTC of 16-11-2013

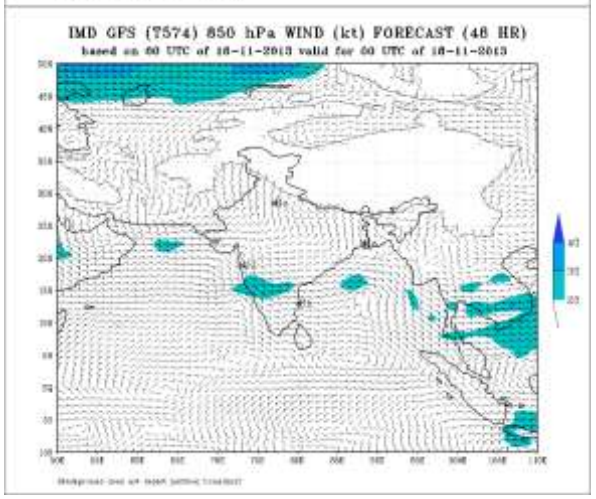

IMD GFS (T574) MSL Pressure (hPa) FORECAST (24 HR)
based on 00 UTC of 16-11-2013 valid for 00 UTC of 17-11-2013

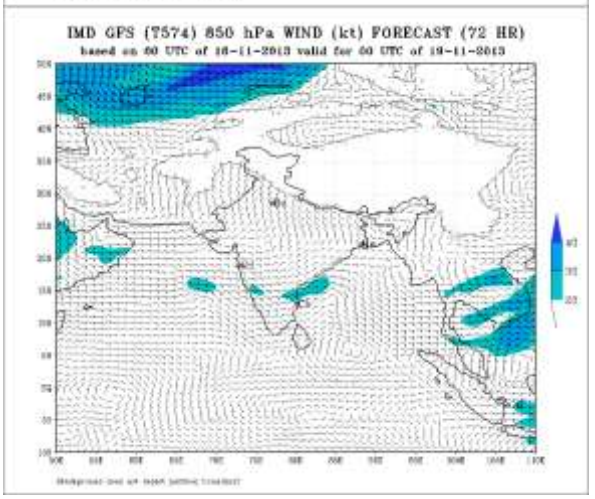

IMD GFS (T574) MSL Pressure (hPa) FORECAST (48 HR)
based on 00 UTC of 16-11-2013 valid for 00 UTC of 18-11-2013

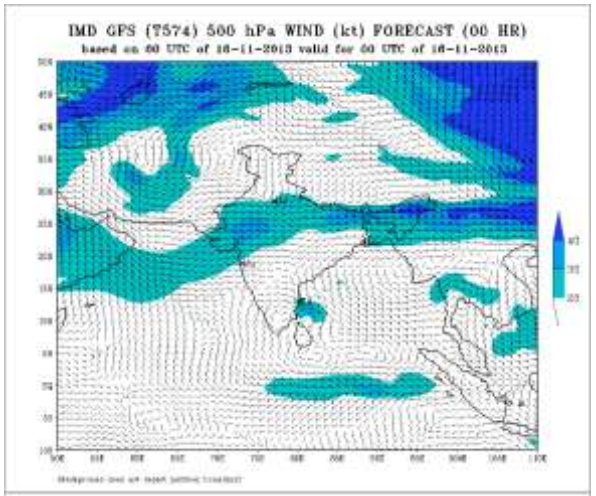

IMD GFS (T574) MSL Pressure (hPa) FORECAST (72 HR)
based on 00 UTC of 16-11-2013 valid for 00 UTC of 19-11-2013

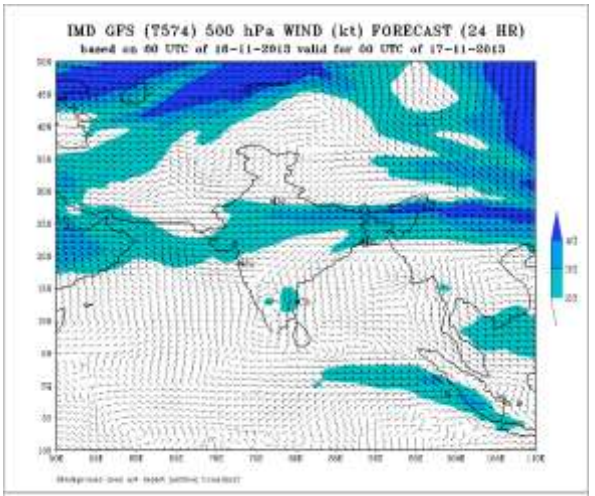

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 16-11-2013 valid for 00 UTC of 16-11-2013

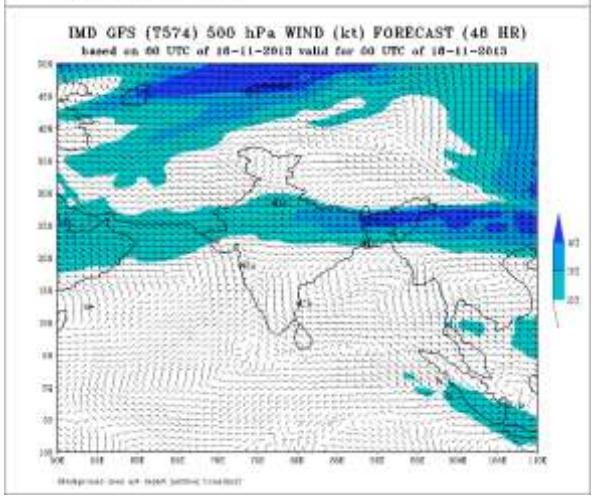

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 16-11-2013 valid for 00 UTC of 17-11-2013

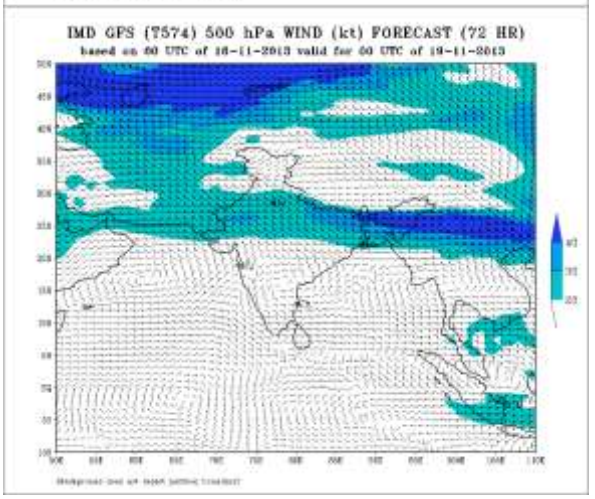

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 16-11-2013 valid for 00 UTC of 18-11-2013

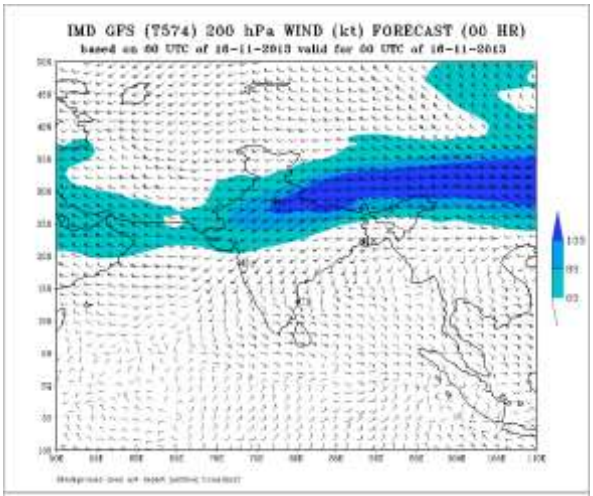

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 16-11-2013 valid for 00 UTC of 19-11-2013

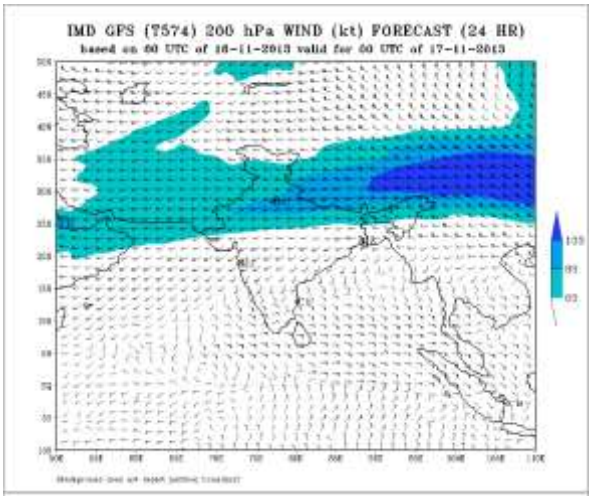

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 16-11-2013 valid for 00 UTC of 16-11-2013

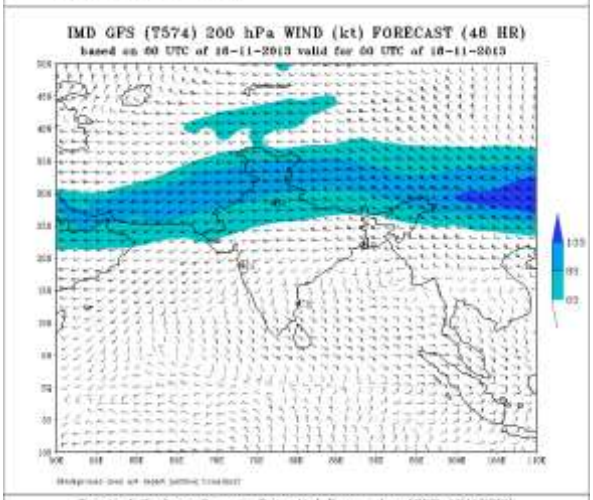

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 16-11-2013 valid for 00 UTC of 17-11-2013

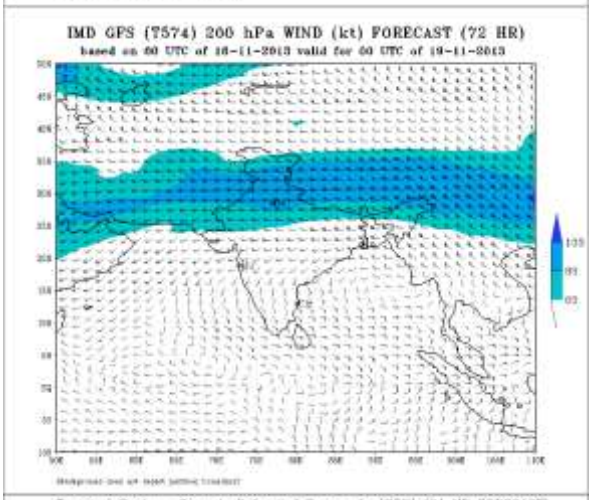

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 16-11-2013 valid for 00 UTC of 18-11-2013

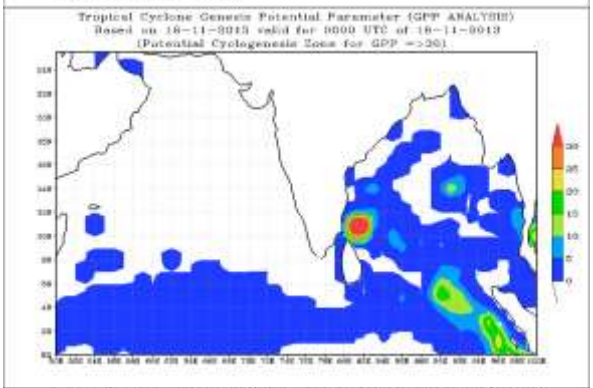

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 16-11-2013 valid for 00 UTC of 19-11-2013

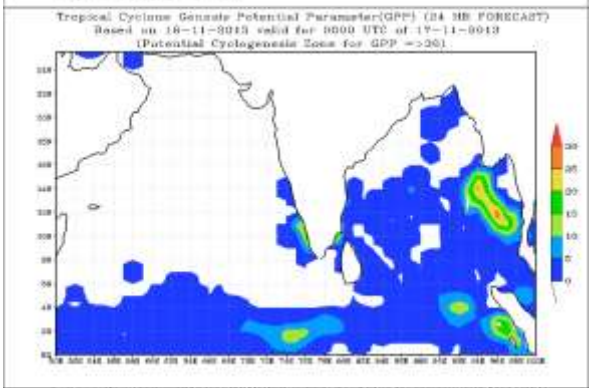

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 18-11-2013

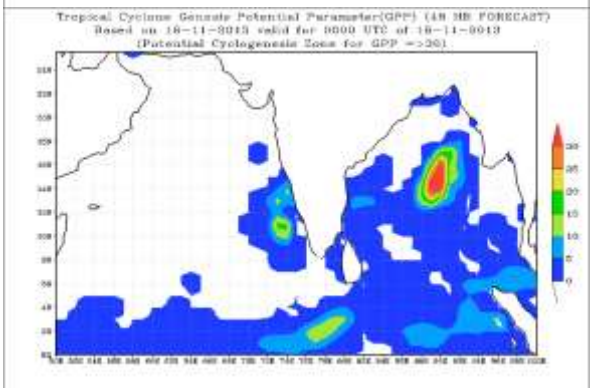

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 17-11-2013

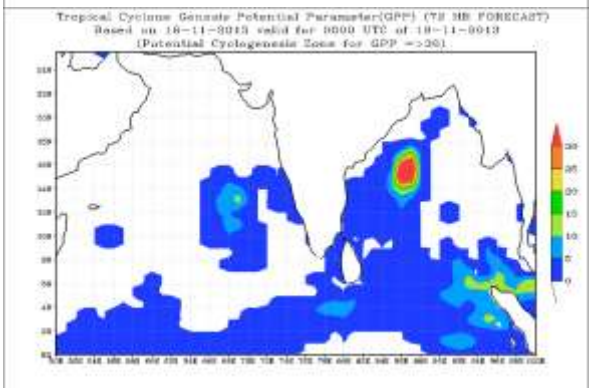

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 16-11-2013


IMD GPS (7574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 19-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 18-11-2013 valid for 0000 UTC of 18-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 18-11-2013 valid for 0000 UTC of 19-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 18-11-2013 valid for 0000 UTC of 18-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 18-11-2013 valid for 0000 UTC of 18-11-2013
(Potential Cyclogenesis Zone for GPP =>20)

FDP (Cyclone) NOC Report Dated 17th November, 2013

Synoptic features based on 0300 UTC:

- Yesterday's depression over Tamil Nadu weakened into a well Marked Low pressure area at 0530 hrs IST of today, 17th November 2013 over north interior Tamil Nadu and neighbourhood. Now it lies as a low pressure area over Lakshadweep & neighbourhood.
- The cyclonic circulation over Lakshadweep area and neighbourhood has merged with the above system.
- A trough at mean sea level lies over Andaman Sea..

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-30^{0}C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north, west central and southwest Bay of Bengal. It is 50-90 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive over south Bay of Bengal, Andaman sea & adjoing southeast Bay of Bengal and equatorial region. It is negative over rest Bay of Bengal.

Convergence:

- Lower level convergence is positive of the order of 5-10 *10^{-5} s^{-1} over southwest Bay of Bengal and Andaman sea.

Divergence:

- It is positive and of the order of 5-10*10^{-5} s^{-1} over southwest Bay, Andaman and adjoining southeast Bay of Bengal

Wind Shear:

- **W**ind Shear is 5-10 knots over southwest Bay of Bengal and 10-20 knots over Andaman Sea and adjoining southeast Bay of Bengal. It is more than 20 knots over North Bay of Bengal.

Wind Shear Tendency:

- Shear Tendency is decreasing over southwest Bay of Bengal and Andaman Sea. It is increasing over southeast Bay and adjoining central Bay of Bengal.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 18.0°N over Bay of Bengal region.

M.J.O. Index: (Based on 15th Nov)

- Located in phase 2 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may move in phase 2 to 1 with amplitude less than 1.0 during next 2 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 170900 UTC

Broken low/medium clouds with embedded moderate to intense convection seen over south Bay & east central Bay south of latitude 17.0N and Andaman Sea

NWP Analysis

- IMD-GFS model analysis of 0000 UTC of 17th November 2013 shows low pressure system from southwest Bay of Bengal crossed Tamil Nadu Coast and emerges as a prominent trough in easterly over Kerala coast, Lakshadweep and adjoining Arabian Sea. The associated cyclonic circulation extends up to mid tropospheric levels (500 hPa). The jet core in upper-air (around 200 hPa) westerly has been shifted towards north and weakens compared to yesterday's situation.
- GFS forecasts predict that a prominent trough in easterly persisting at lower levels (below 500 hPa) moves westward over central BOB in 24 hours which intensifies further with westward movement over southwest BOB in 48 hours. In day 3 forecast it approaches Indian coast near south Andhra Pradesh coast and adjoining north Tamil Nadu.
- The analysis and forecast charts of GFS model for 24h to 72 h of MSLP, 850 hPa, 500 hPa and 200 hPa winds are given in **Annexure II**.
- The weather charts of **IMD-WRF** model based on 0000 UTC of 17th November 2013 also shows that the low pressure system from BOB crossed south Tamil Nadu coast and emerges over Kerala coast as a prominent trough in easterly during 24 hours. Another prominent trough over south central BOB in day 1 move westward over southwest BOB in day 2. It moves quickly westward associated with easterly waves over southern tip of peninsular India in 72 hours.
  (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
- **ECMWF:** Model shows there is no cyclogenesis over Bay of Bengal during next 04-05 days.
- **Genesis Potential Parameter (GPP)** forecast based on 0000 UTC of **17th November 2013** indicates that there is no region of high GPP over BOB except a moderate GPP zone over Andaman Sea and adjoining area. It intensifies and moves westward over central BOB and moves further westward in 48 and 72 hours consecutively.
- The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- The low pressure area over Lakshadweep area & neighbourhood needs to be watched for further intensification.
- No cyclogenesis is likely to occur during next 3 days

Advisory:

- No IOP during next 3 days.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	16/12	**17/00**	**17/03**
India	37/51	30/32	38/51
Coastal stations			
WB	4/9	6/9	5/9
Odisha	6/7	5/7	6/7
AP	11/13	10/13	11/13
Tamil Nadu	8/12	6/7	8/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/7	6/7
Bangladesh	11/11	11/11	11/11
Myanmar	8/11	8/11	8/11
Thailand	3/3	3/3	3/3
Srilanka	6/9	7/9	6/9

RS/RW (12Z) of 16/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:2, MISDA: -37**
- **RS/RW** (00Z) of 17/11/2013 22/39
- **No. of Ascents reaching 250 hPa levels:15 , MISDA:-17**

No. of PILOT Ascents

16/12Z	**17/00Z**
22/37	24/34

Buoy Data

16/12Z	**17/00Z**	**17/03Z**
9	10	9

Data Statistics over RMC Chennai Region

No of Synop data (Chennai Region:Coasts of AP & TN:-
Hourly Special observations from 14.11.2013/1200 UTC)

Date→	**16.11.2013**							
UTC→	**00**	**01**	**02**	**03**	**04**	**05**	**06**	**07**
No. of obs→	**20**	**09**	**08**	**21**	**11**	**09**	**20**	**12**
UTC→	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**
No. of obs→	**12**	**20**	**05**	**--**	**22**	**--**	**--**	**20**
UTC→	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
No. of obs→	**--**	**--**	**20**	**--**	**--**	**20**	**--**	**--**

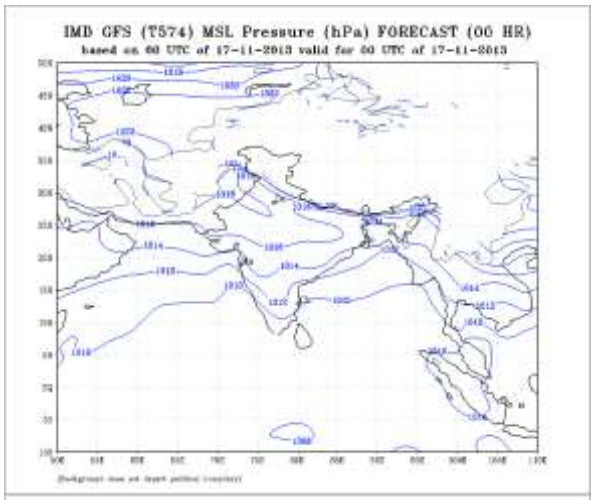
No. of RS/RW Ascents

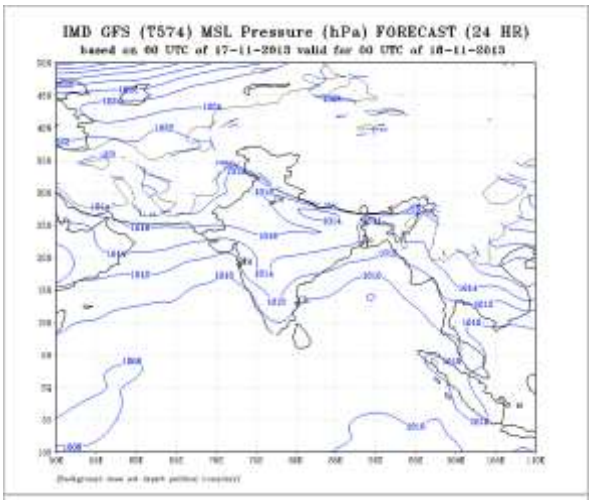
00Z /16.11.2013 : 5
No. of Ascents reaching 250 hPa level =5
MISDA : 3
12Z /16.11.2013 : Nil
No. of Ascents reaching 250 hPa level =Nil
MISDA : 8

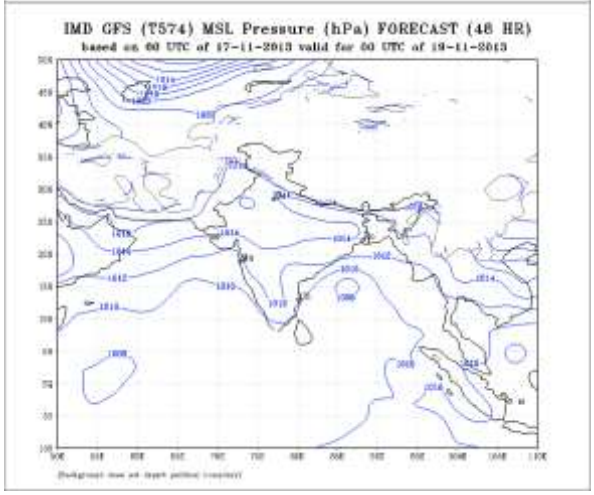
No. of PILOT Ascents:

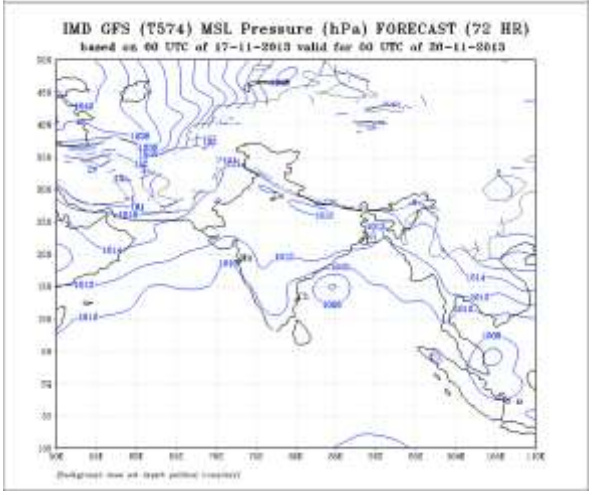
16.11.2013	
06Z	**18Z**
5	**4**

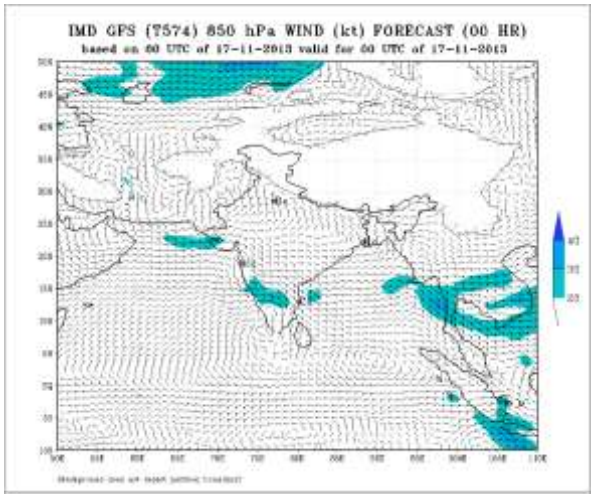
Annexure-II

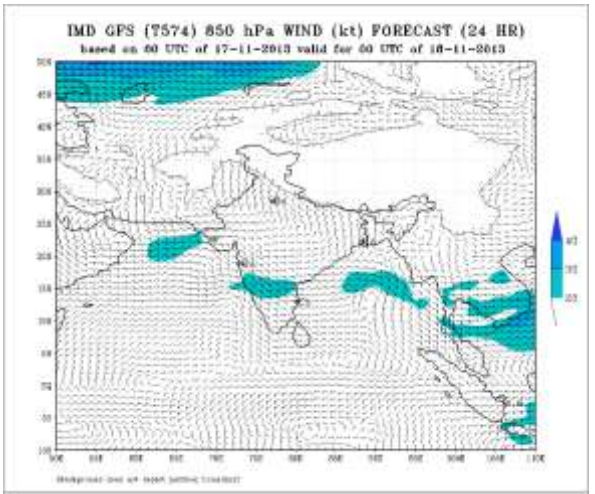

IMD GFS (T574) MSL Pressure (hPa) FORECAST (00 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 17-11-2013

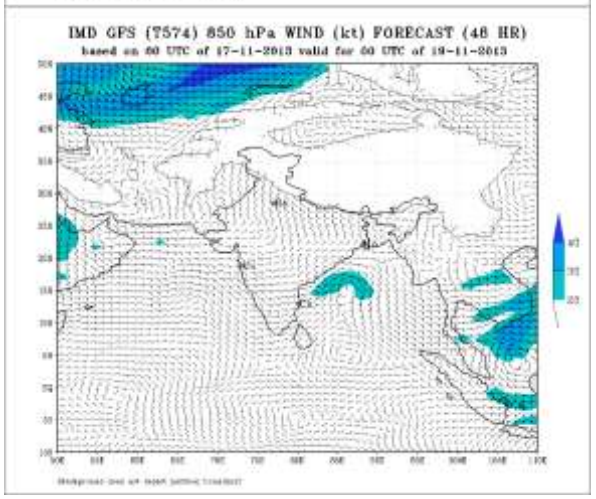

IMD GFS (T574) MSL Pressure (hPa) FORECAST (24 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 18-11-2013

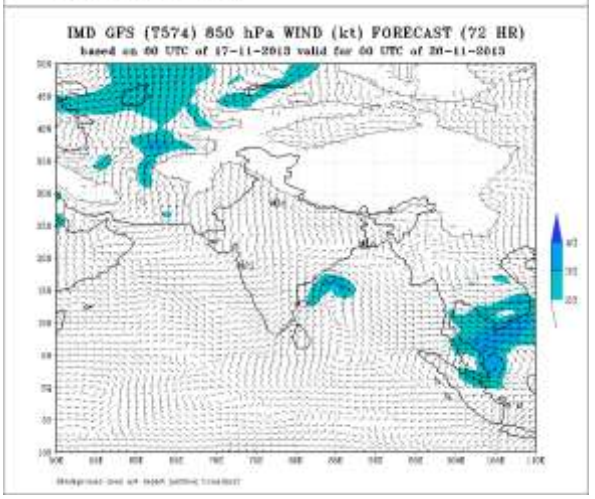

IMD GFS (T574) MSL Pressure (hPa) FORECAST (48 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 19-11-2013

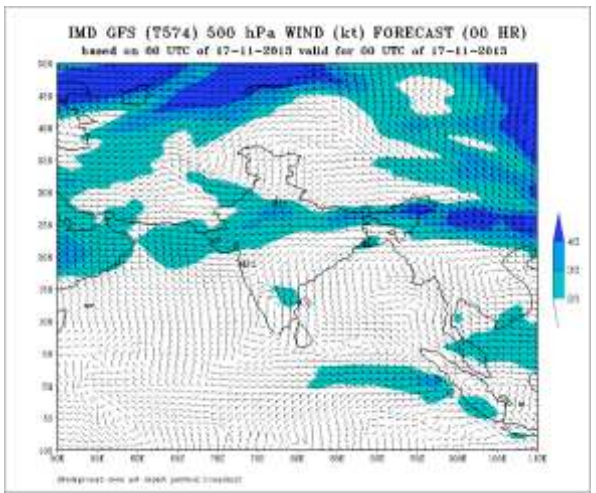

IMD GFS (T574) MSL Pressure (hPa) FORECAST (72 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 20-11-2013

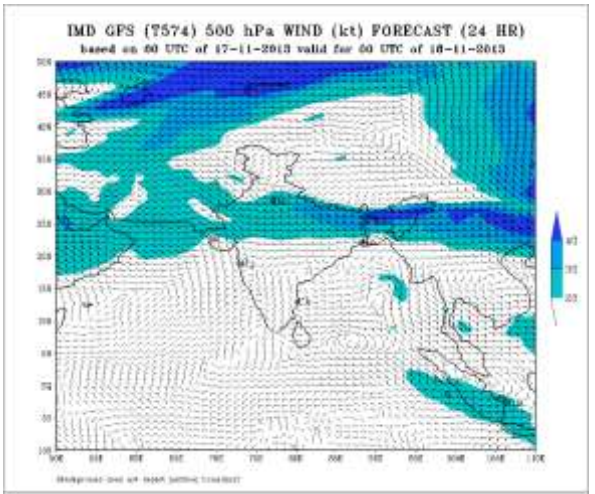

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 17-11-2013

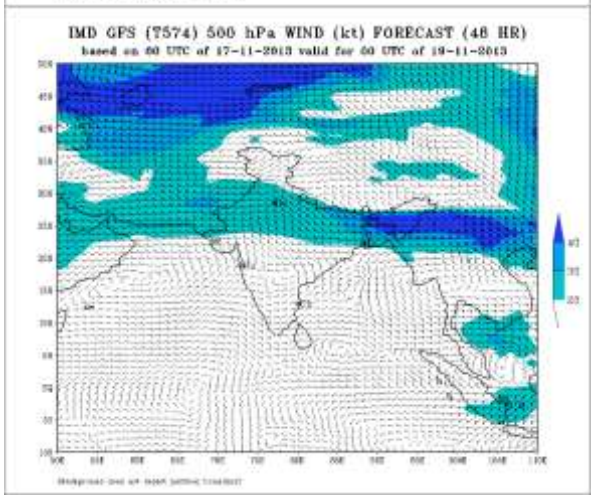

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 18-11-2013

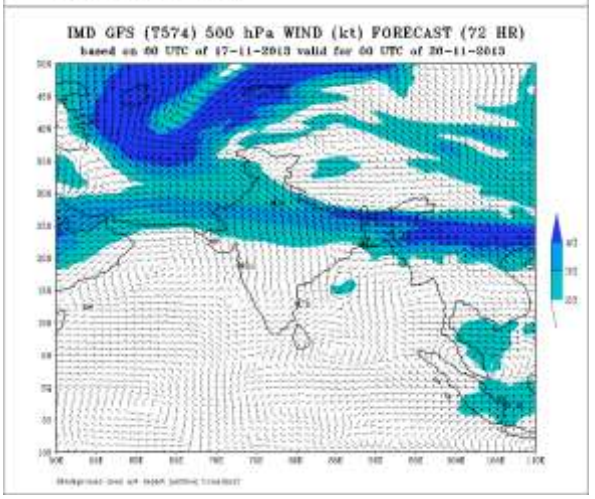

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 19-11-2013

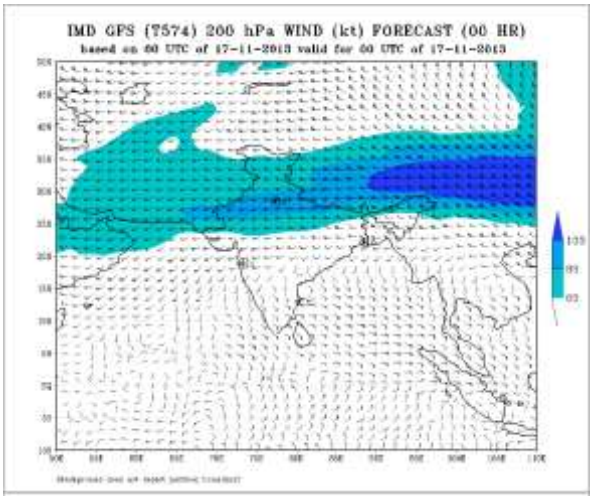

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 20-11-2013

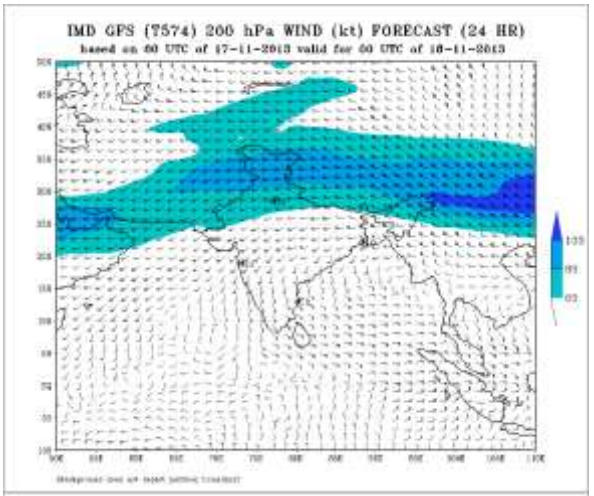

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 17-11-2013

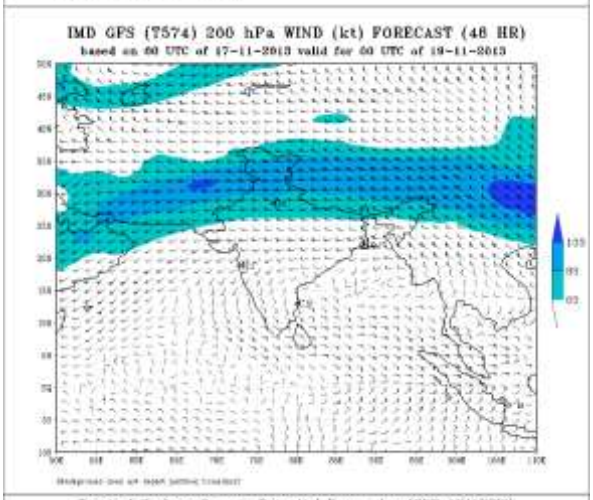

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 18-11-2013

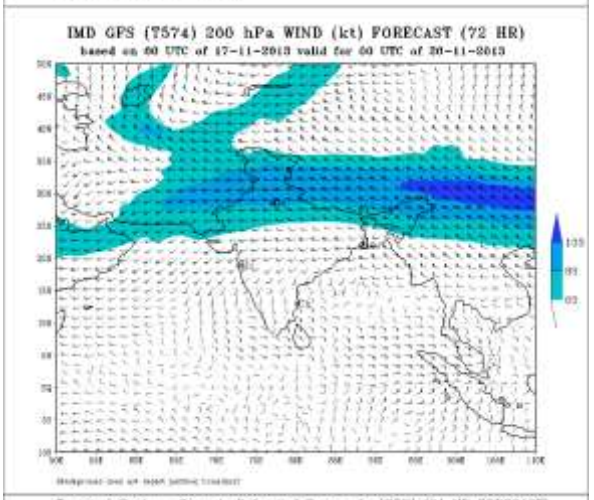

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 19-11-2013

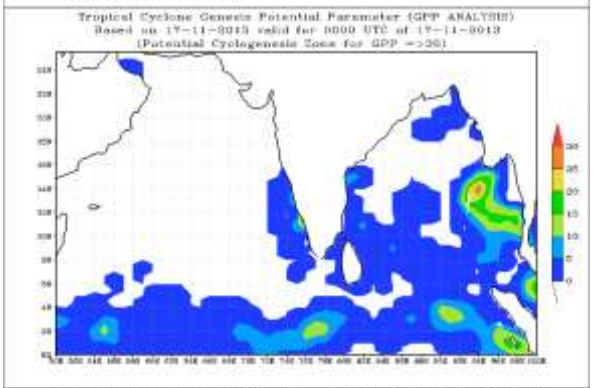

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 20-11-2013

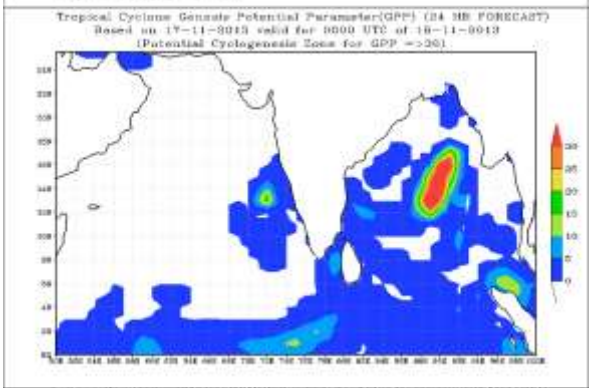

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 17-11-2013

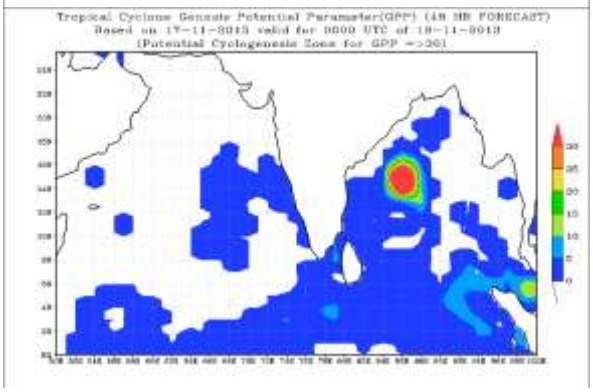

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 18-11-2013

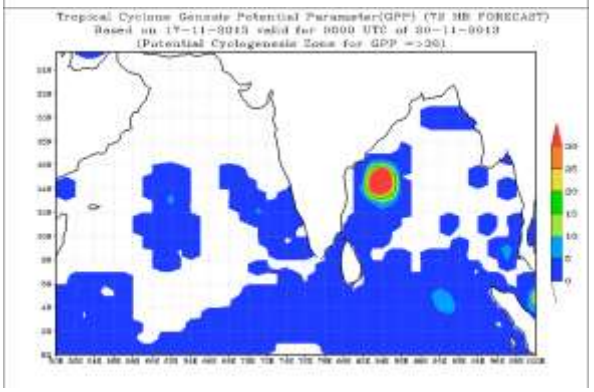

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 19-11-2013


IMD GPS (7574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 17-11-2013 valid for 00 UTC of 20-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 17-11-2013 valid for 0000 UTC of 17-11-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 17-11-2013 valid for 0000 UTC of 18-11-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 17-11-2013 valid for 0000 UTC of 19-11-2013
(Potential Cyclogenesis Zone for GPP =>26)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 17-11-2013 valid for 0000 UTC of 20-11-2013
(Potential Cyclogenesis Zone for GPP =>26)

FDP (Cyclone) NOC Report Dated 18th November, 2013

Synoptic features based on 0300 UTC:

- The trough of low at mean sea level over Andaman Sea now lies as a low pressure area over southeast and adjoining central Bay of Bengal. Associated cyclonic circulation extends upto mid tropospheric levels.
- The low pressure area over Lakshadweep area and adjoining Kerala has become less marked. However, the associated cyclonic circulation extends upto mid tropospheric levels over southeast and adjoining east central Arabian Sea.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-30^{0}C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north, west central and southwest Bay of Bengal. It is 50-80 KJ cm^{-2} over rest Bay except equatorial region and adjoining sea area where it is 90-120 KJ cm^2.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive (about 80 * $10^{-5}s^{-1}$) over Southeast and adjoining central bay around the well marked low pressure area. It is also positive over northeast and southwest Bay of Bengal. It is negative over the rest Bay of Bengal**.**

Convergence:

- Lower level convergence is positive of the order of 5-10 *10^{-5} s^{-1} over southeast and east central Bay of Bengal and of the order of 5 *10^{-5} s^{-1} over Andaman sea.

Divergence:

- It is positive and of the order of 10-20*10^{-5} s^{-1} over eastcentral and southeast Bay and negative over southwest Bay of Bengal and Andaman Sea.

Wind Shear:

- **W**ind Shear is 10-20 knots over central Bay of Bengal. It is more than 20 knots over North and South Bay of Bengal.

Wind Shear Tendency:

Shear Tendency is decreasing over eastcentral Bay of Bengal and south Andaman Sea . It is increasing over rest Bay and north Andaman Sea.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 16.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 2 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may move in phase 2 to 1 with amplitude less than 1.0 during next 2 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 160900 UTC

Vortex over east central Bay centred within half a deg of 13.5N/89.0E with Intensity T1.0. Associated broken low/medium clouds with embedded moderated to intense convection over eastcentral adjoining southeast Bay between Lat. 11.0N to 17.0N long 84.5E to 91.0E.

NWP Analysis

- IMD-GFS model analysis of 00 UTC of 18th November 2013 shows a prominent low over eastcentral bay. It moves northwestwards and bomes a depression on 20 November over west central Bay. It then weakenes into a lon on 21st and on 22nd it moves southwestwards off south AP coast.
- It predicts another cyclone on 22 November developing over south Andaman Sea. It would move northwestwards and further intensify into a severe cyclone by 25 Nov near TN coast.
- The analysis and forecast charts of GFS model for 24h to 72 h of mslp, 850 hpa, 500 hpa and 200 hpa winds are given in **ANNEXURE II**.
- The weather charts of **IMD-WRF** model based on 00UTC of 18th November 2013 also shows similar pattern in its 3 day forecast.
  (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **ECMWF:** Model shows that a low pressure area over eastcentral Bay of Bengal on 18th November. It would move west-northwestwards during next two days then west-southwestwards and reach north Tamilnadu on 22nd November. The model is not showing any intensification.
- **UKMO:** (17/00) **:** Model shows that a low pressure area over eastcentral Bay of Bengal on 18th November . It would move west-northwestwards during next two days then west-southwestwards and reach north Tamilnadu on 22nd November.
- **GFS** (NCMRWF) : Model shows that a low pressure area over eastcentral Bay of Bengal on 18th November. The system is likely to move west-nothwestward and cross south A.P. coast on 22nd November as low pressure area.
- **Genesis Potential Parameter (GPP)** forecast based on 00 UTC of **18th November 2013** indicates that there is a region of high GPP over BOB center around 13.5° N and 89° E. It persists and moves westward over west central BOB in 24 hours and moves further westward in 48 and 72 hours to reach south Andhra Pradesh coast and adjoining north Tamil Nadu.
- The GPP charts for analysis and forecasts for 24h to 72 h are shown in **Annexure II**. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and Conclusion:

- The low pressure area over southeast and adjoining east central Bay of Bengal would move northwestwards and may intensify into a depression during next 48 hours.

Advisory:

- IOP may be considered for Andhra Pradesh and north Tamil Nadu coasts during 20-22 November 2013.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	17/12	**18/00**	**18/03**
India	37/51	30/32	38/51
Coastal stations			
WB	6/9	6/9	7/9
Odisha	6/7	5/7	5/7
AP	6/14	6/13	6/13
Tamil Nadu	7/12	6/7	7/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/7	6/7
Bangladesh	6/11	8/11	7/11
Myanmar	10/11	9/11	9/11
Thailand	3/3	3/3	3/3
Srilanka	6/9	7/9	6/9

RS/RW (12Z) of 17/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:2, MISDA: -37**
- **RS/RW** (00Z) of 18/11/2013 22/39
- **No. of Ascents reaching 250 hPa levels:15 , MISDA:-17**

No. of PILOT Ascents

17/12Z	18/00Z
22/37	24/34

Buoy Data

17/12Z	18/00Z	18/03Z
8	9	8

Data Statistics over RMC Chennai Region

No. of Synop data

Date→	**17.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /17.11.2013 : 5

No. of Ascents reaching 250 hPa level =5

MISDA : 3

12Z /17.11.2013 : 0

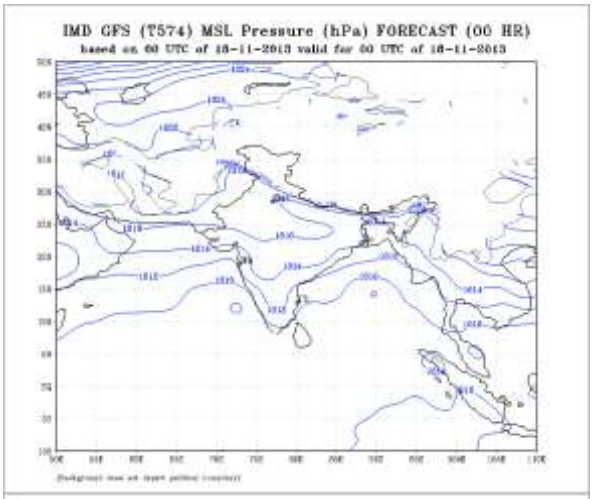
No. of Ascents reaching 250 hPa level =--

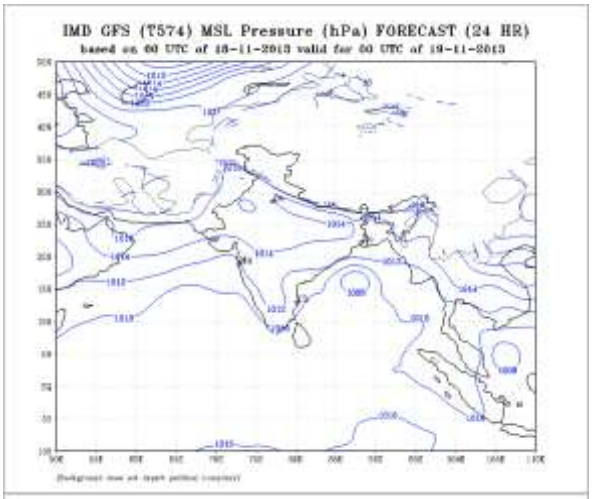
MISDA : 8

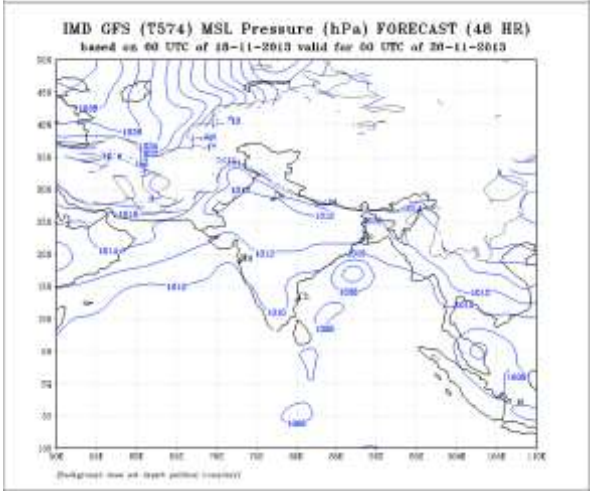
No. of PILOT Ascents:
17.11.2013

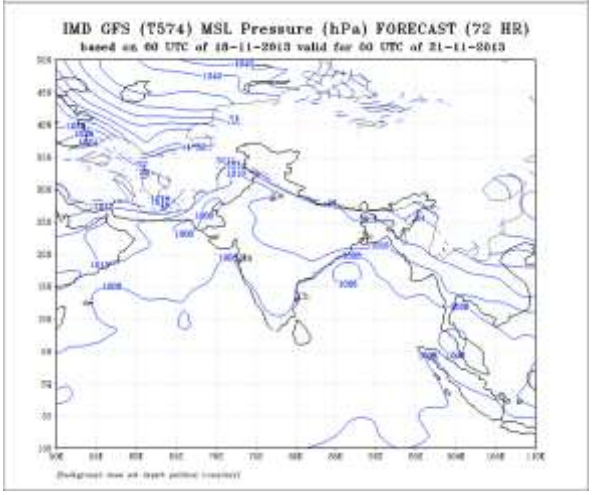
06Z	18Z
6	5

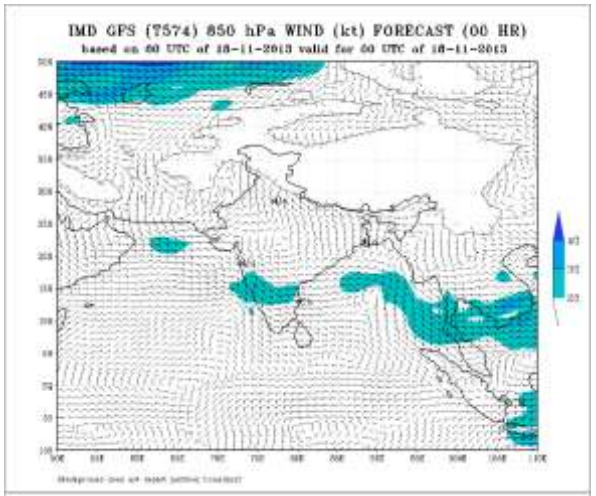
Annexure-II

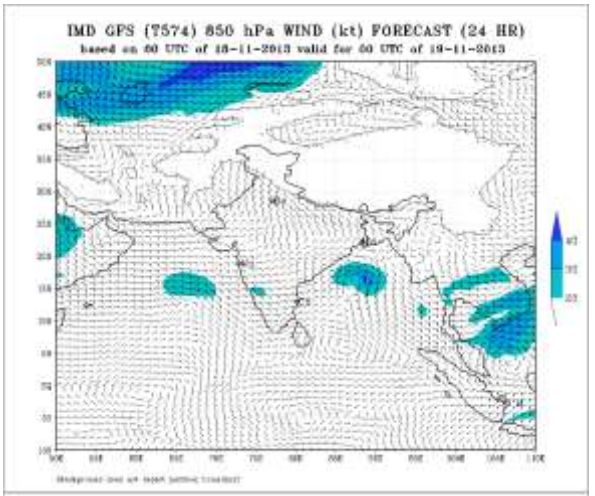

IMD GFS (T574) MSL Pressure (hPa) FORECAST (00 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 18-11-2013

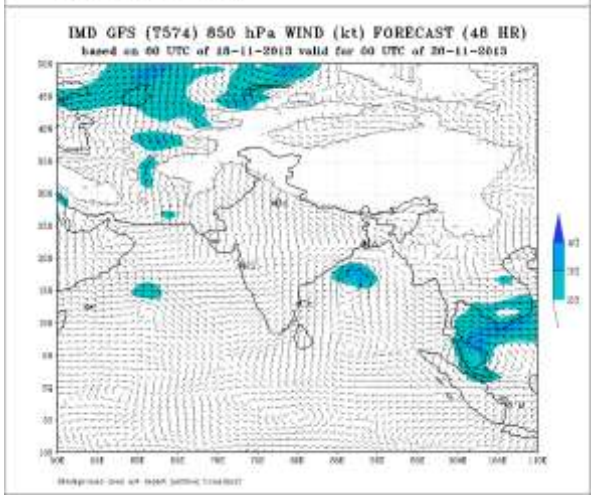

IMD GFS (T574) MSL Pressure (hPa) FORECAST (24 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 19-11-2013

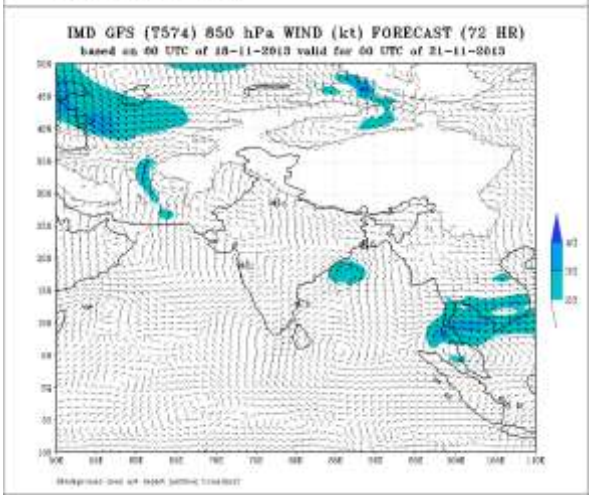

IMD GFS (T574) MSL Pressure (hPa) FORECAST (48 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 20-11-2013

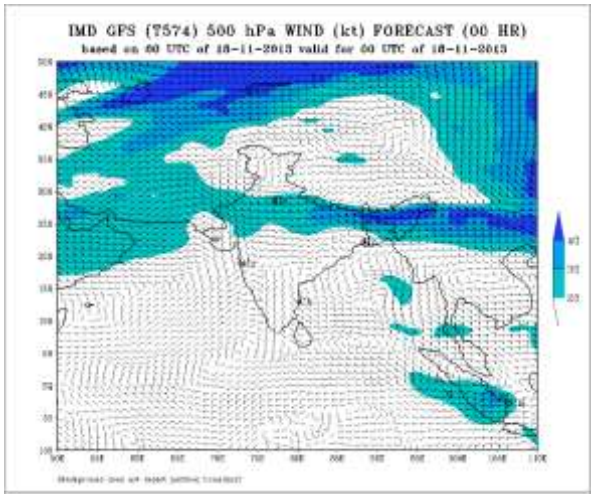

IMD GFS (T574) MSL Pressure (hPa) FORECAST (72 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 21-11-2013

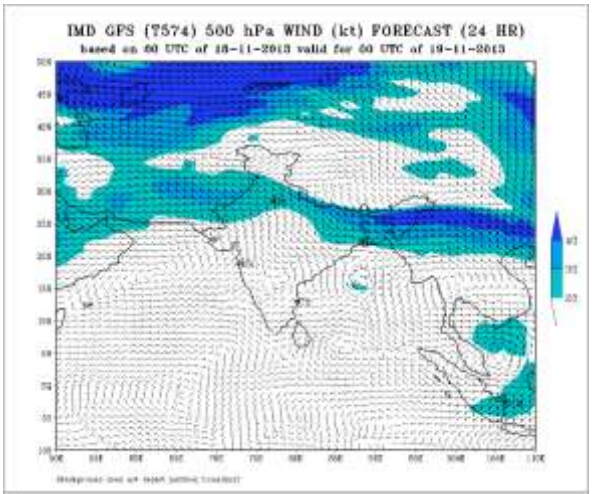

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 18-11-2013

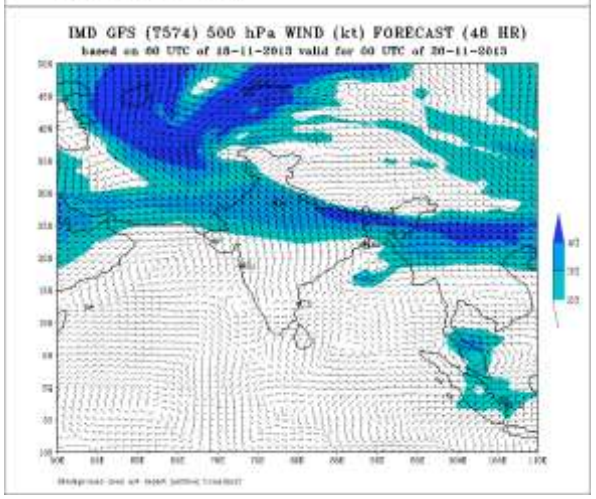

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 19-11-2013

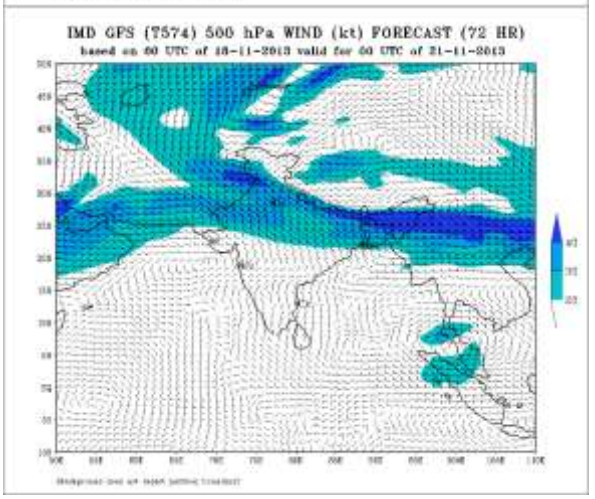

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 20-11-2013

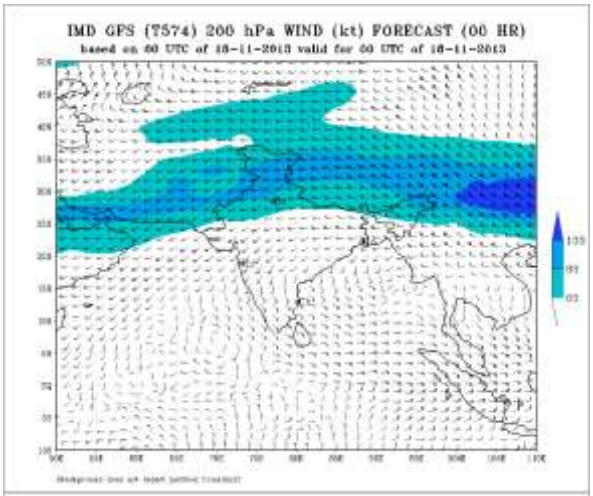

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 21-11-2013

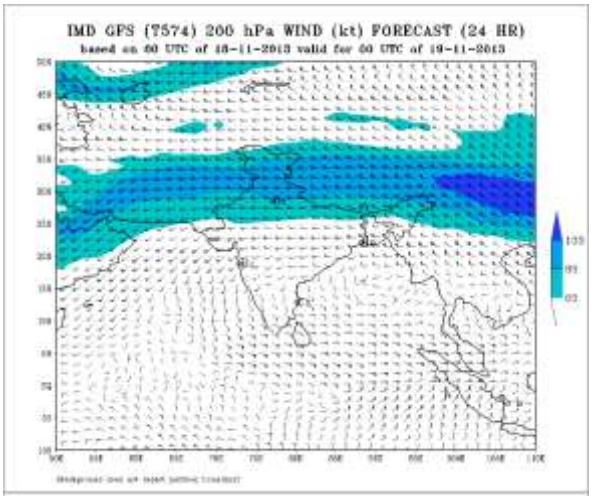

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 18-11-2013

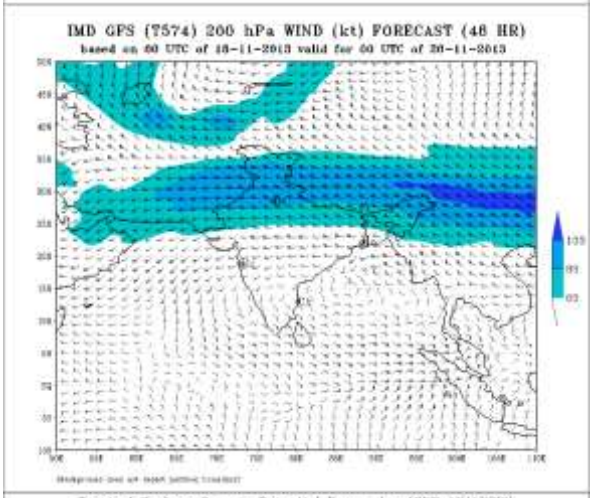

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 19-11-2013

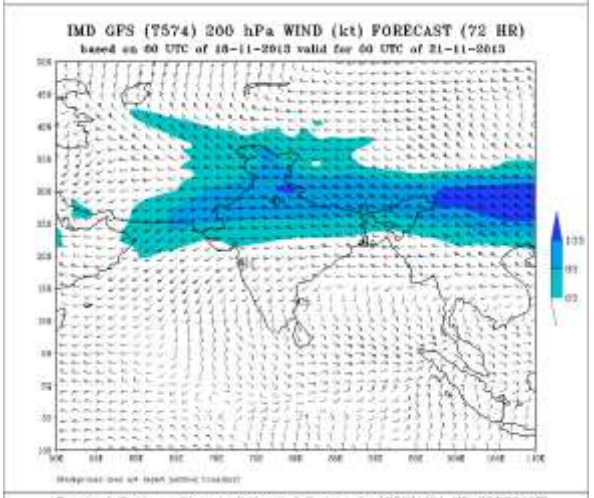

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 20-11-2013

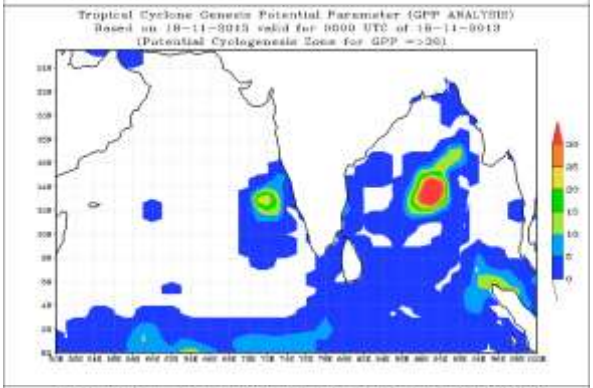

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 21-11-2013

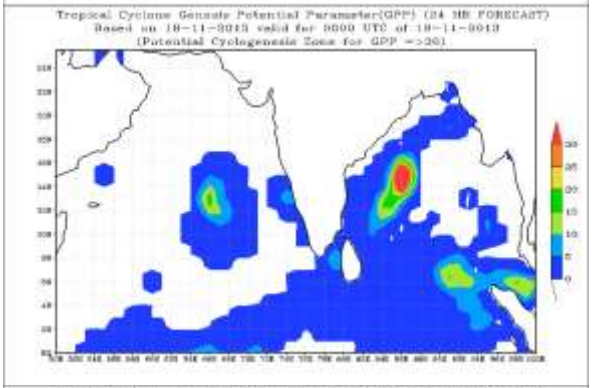

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 18-11-2013

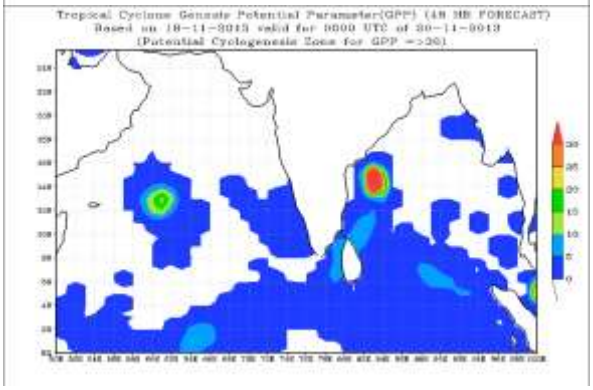

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 19-11-2013

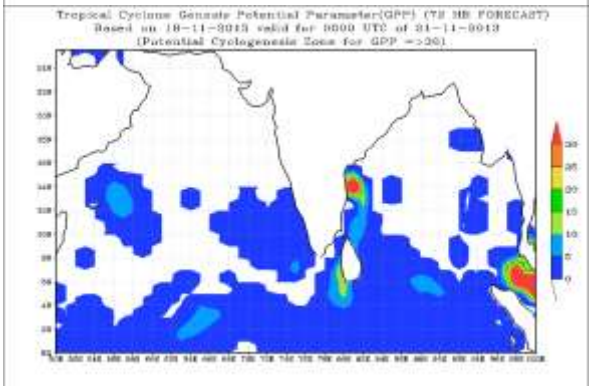

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 20-11-2013


IMD GPS (7574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 18-11-2013 valid for 00 UTC of 21-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 18-11-2013 valid for 0000 UTC of 18-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 18-11-2013 valid for 0000 UTC of 19-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 18-11-2013 valid for 0000 UTC of 20-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 18-11-2013 valid for 0000 UTC of 21-11-2013
(Potential Cyclogenesis Zone for GPP =>20)

FDP (Cyclone) NOC Report Dated 19th November, 2013

Synoptic features based on 0300 UTC:

- The low pressure area over southeast and adjoining central Bay of Bengal rapidly concentrated into a Depression over westcentral Bay of Bengal and lay centred at 0000 UTC of today, the 19th November 2013 near Lat. 14.5ºN and Long 86.5ºE, 500 kms southeast of Vishakhapatnam. It moved westwards and centred at 0300 UTC of today, the 19th November 2013 near Lat.14.5° E and Long. 86.0° N, and at 0600 UTC near lat.14.5^0N & long.85.5^0E. The system would move west-northwestwards, intensify into a Deep Depression and cross north Tamil Nadu and south Andhra Pradesh coast between Chennai and Ongole around night of 21st November 2013
- The cyclonic circulation extending upto mid tropospheric levels over southeast and adjoining east central Arabian Sea persists.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-30^0C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north. It is 50-80 KJ cm^{-2} over west central and adjoining Southwest Bay of Bengal. It is 90-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive (about 80 * $10^{-5}s^{-1}$) over westcentral Bay and adjoining southwest Bay around the depression. It is negative over eastcentral , southeast Bay of Bengal and Andaman Sea.

Convergence:

- Lower level convergence is positive of the order of 10-15 *10^{-5} s^{-1} over westcentral Bay of Bengal and of the order of 5 *10^{-5} s^{-1} over Andaman sea.

Divergence:

- It is positive of the order of 10-20*10^{-5} s^{-1} over westcentral Bay and of the order of 5*10^{-5} s^{-1} over Andaman Sea. It is negative over southwest Bay of Bengal.

Wind Shear:

- **W**ind Shear is 10-20 knots over central Bay of Bengal. It is more than 20 knots over North and South Bay of Bengal. It is 5-10 knots over Andaman Sea.

Wind Shear Tendency:

Shear Tendency is increasing over the system and decreasing towards north and south of the system.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 16.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 1 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may move in phase 1 to 2 with amplitude less than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 190900 UTC

Vortex over central Bay of Bengal centred near 15.0^0N/85.3^0E. Intensity T1.5. Associated broken low/medium cloud embedded with moderate to intense convection seen over Bay of Bengal between latitude 13.0^0N &18.0^0E, longitude 83.0^0E & 90.0^0E.

Broken low/medium cloud embedded with moderate to intense convection seen over Arabian Sea between latitude 10.0^0N &14.0^0E, longitude 62.0^0E & 66.0^0E in association with low level circulation over the area.

NWP Analysis

- IMD-GFS model analysis of 00 UTC of 19th November 2013 shows a well-marked low over west central BOB centered at 15°N and 86°E. The associated cyclonic circulation extends up to mid-tropospheric levels (up to 500 hPa). GFS forecasts predict that well-marked low and associated cyclonic circulation in lower troposphere intensifies into a depression and moves west-northwestward over west central BOB in 24 hours. The system westward movement continues over in day 2 and in day 3 forecast it approaches Indian coast near Andhra Pradesh coast.
- A new low pressure area emerges in south Andaman Sea in day 3 forecast.
- The analysis and forecast charts of GFS model for 24 hr to 72 hr of MSLP, 850 hPa, 500 hPa and 200 hPa winds are given in **Annexure II**.
- The weather charts of **IMD-WRF** model based on 00 UTC of 19th November 2013 also show that the well-marked low over south central BOB intensifies into a depression during next 24 hours and moves westward and crosses over Andhra Pradesh coast in 48 hours.
- **ECMWF:** Model shows that a low pressure area over westcentral Bay of Bengal on 19th November. It would intensify into depression on 20th November 2013 and move west-northwestwards during next two days and cross Andhra Pradesh coast on 22nd .
- **ARP:** Model shows that a low pressure area lay over westcentral Bay of Bengal on 19th November 2013. The system would intensify into a depression on 20th.The depression would move initially westwards then west-southwestwards and cross north Tamil Nadu coast around 0600 UTC of 21st.
- **JMA:** Model shows that a low pressure area lay over westcentral Bay of Bengal on 19th November 2013. It would move west-southwest and cross south Tamil Nadu coast on 21st. This model is not showing any intensification.
- **UKMO:** (18/00) **:** Model is not assimilating the system.
- **GFS** (NCMRWF): Model shows that a low pressure area over westcentral Bay of Bengal on 19th November. The system is likely to move west-nothwestward and cross south A.P. coast on 22nd November as low pressure area.
- This model is showing another cyclogenesis as depression on 22nd November over south Andaman Sea. It is also showing intensification as cyclonic storm on 23rd. It needs to be watched.
- **Genesis Potential Parameter (GPP)** forecast based on 00 UTC of **19th November 2013** indicates that there is a region of high GPP over west central BOB center around 14.5° N and 86° E. It persists and moves west-northwestward in 24 hours and moves further westward in 48 hours. In 72 hours the high GPP zone shrinks and reaches south Andhra Pradesh coast and adjoining area.
- A new zone of high GPP emerges from south Andaman Sea in day 3 forecasts.
- The GPP charts for analysis and forecasts for 24 hr to 72 hr are shown in **Annexure II**.
- (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and conclusion:

- A Depression over westcentral Bay of Bengal and lay centred at 0600 UTC near lat.14.5^0N & long.85.5^0E. The system would move west-northwestwards, intensify into a Deep Depression and cross north Tamil Nadu and south Andhra Pradesh coast between Chennai and Ongole around night of 21st November 2013

Advisory:

- IOP will continue for Andhra Pradesh and north Tamil Nadu coasts during 20-22 November 2013.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	18/12	**19/00**	**19/03**
India	36/51	25/33	36/51
Coastal stations			
WB	6/9	2/9	6/9
Odisha	5/7	4/5	6/7
AP	11/14	10/13	10/14
Tamil Nadu	7/12	6/7	8/12
Puducherry	2/2	2/2	2/2
A & N	5/7	1/7	4/7
Bangladesh	11/11	8/11	11/11
Myanmar	9/11	10/11	10/11
Thailand	3/3	3/3	3/3
Srilanka	7/9	7/9	7/9

RS/RW (12Z) of 18/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:2, MISDA: -37**
- **RS/RW** (00Z) of 19/11/2013 22/39
- **No. of Ascents reaching 250 hPa levels:13 , MISDA:-17**

No. of PILOT Ascents

18/12Z	19/00Z
24/37	22/34

Buoy Data

18/12Z	19/00Z	19/03Z
8	8	8

Data Statistics over RMC Chennai Region

No. of Synop data

Date→	**18.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /18.11.2013 : 5 MISDA : 3

No. of Ascents reaching 250 hPa level =5

12Z /18.11.2013 : 0 MISDA : 8

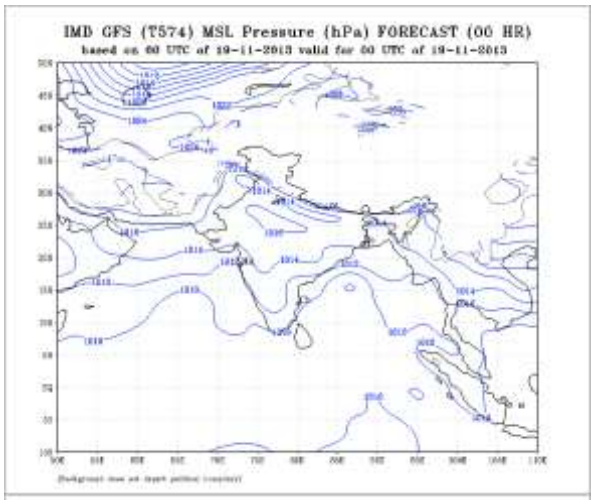
No. of Ascents reaching 250 hPa level =--

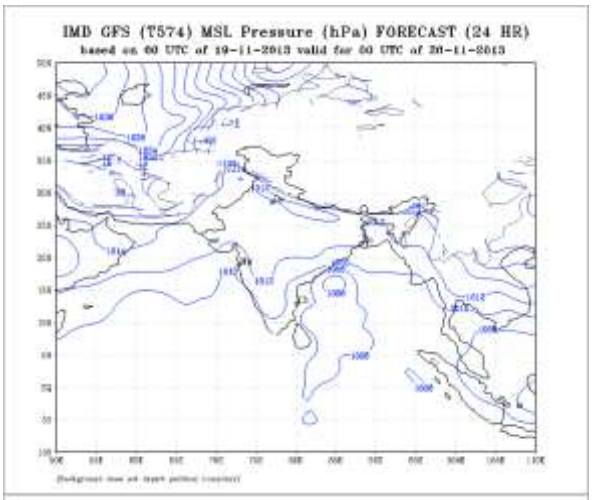
No. of PILOT Ascents:

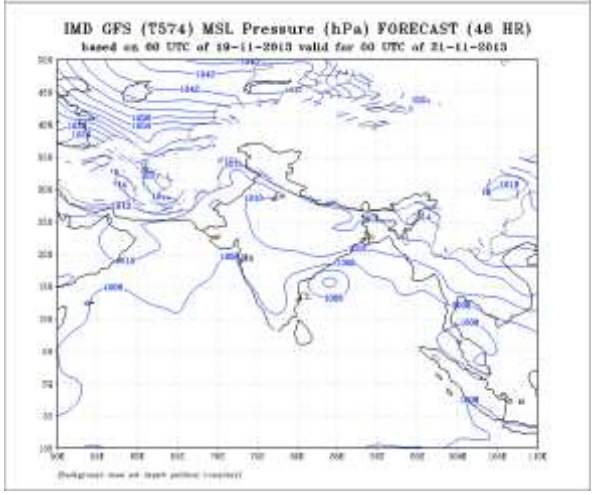
18.11.2013

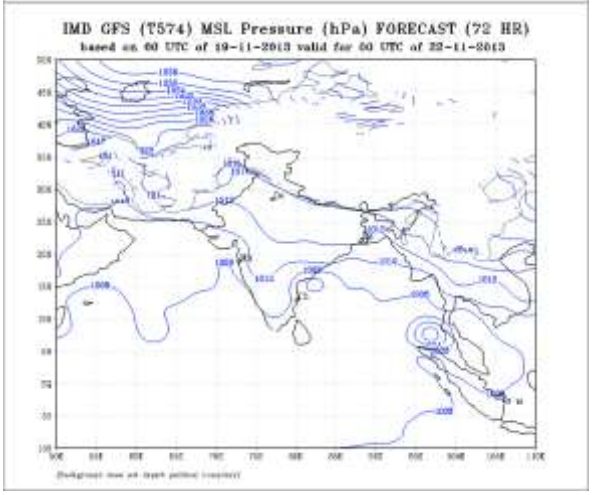
06Z	18Z
3	6

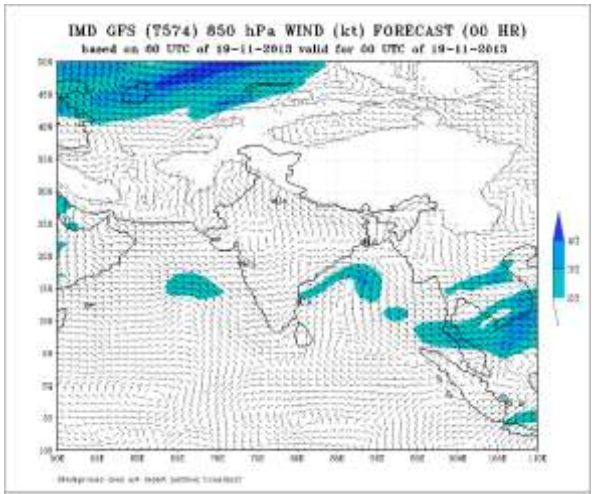
Annexure-II

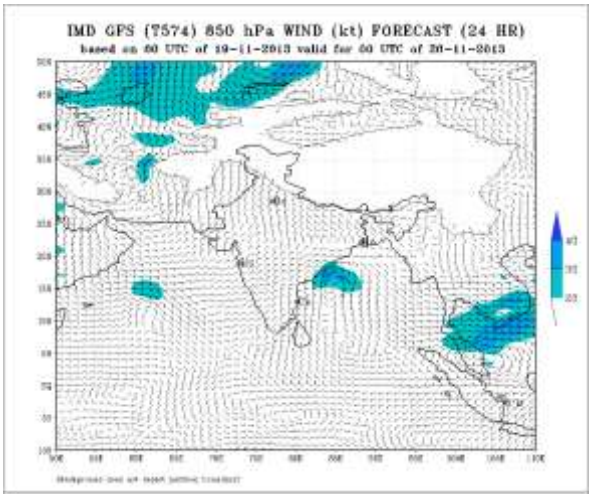

IMD GFS (T574) MSL Pressure (hPa) FORECAST (00 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 19-11-2013

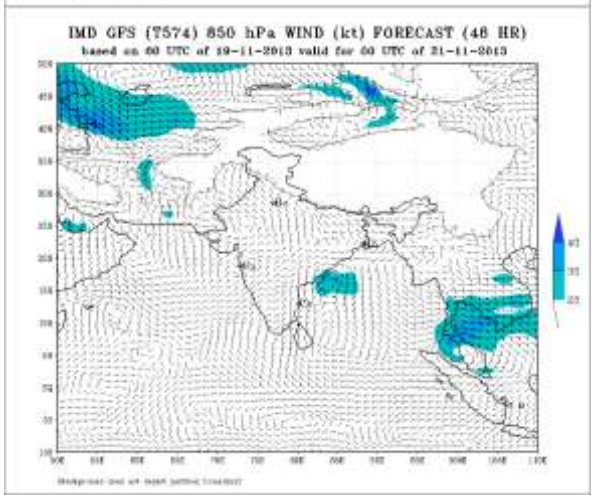

IMD GFS (T574) MSL Pressure (hPa) FORECAST (24 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 20-11-2013

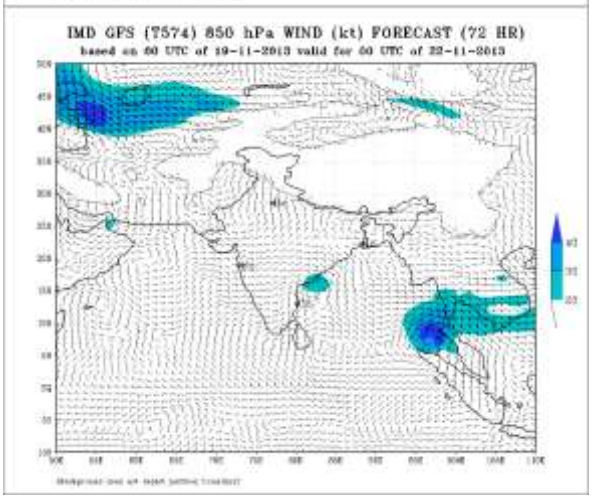

IMD GFS (T574) MSL Pressure (hPa) FORECAST (48 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 21-11-2013

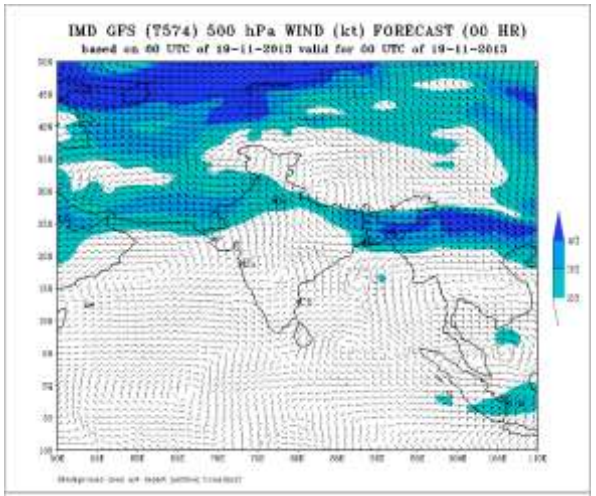

IMD GFS (T574) MSL Pressure (hPa) FORECAST (72 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 22-11-2013

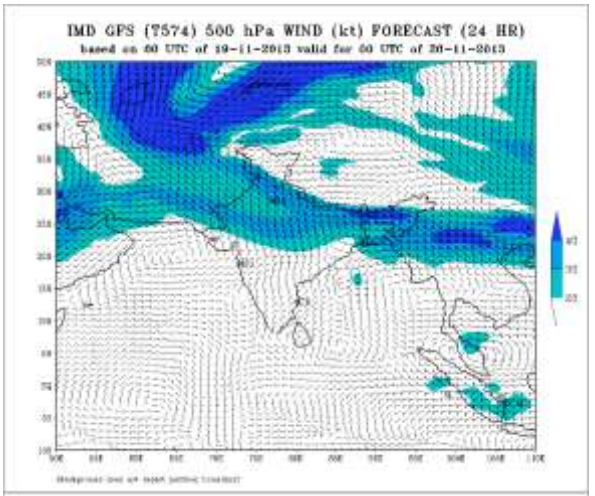

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 19-11-2013

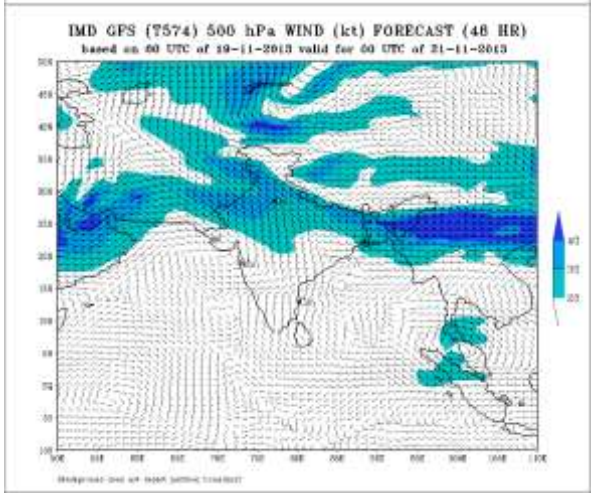

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 20-11-2013

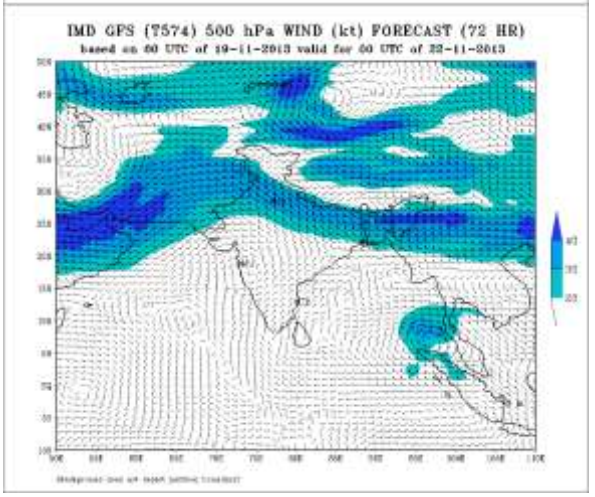

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 21-11-2013

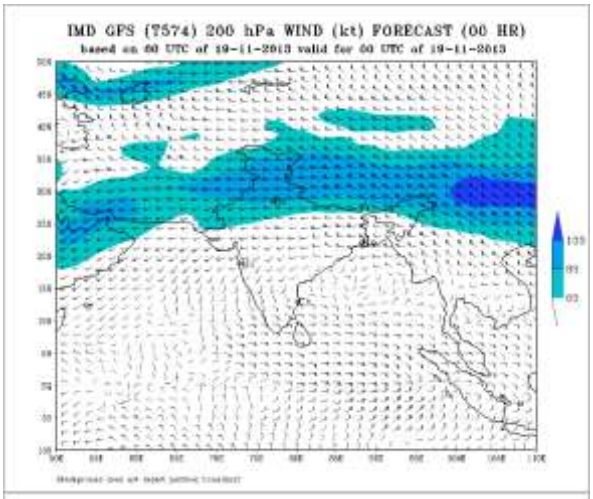

IMD GPS (7574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 22-11-2013

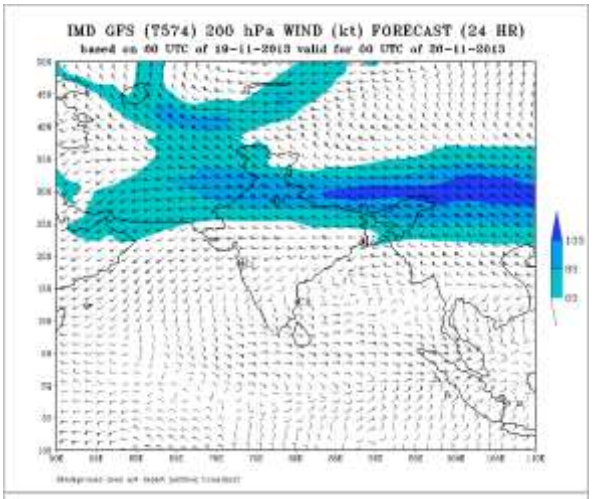

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 19-11-2013

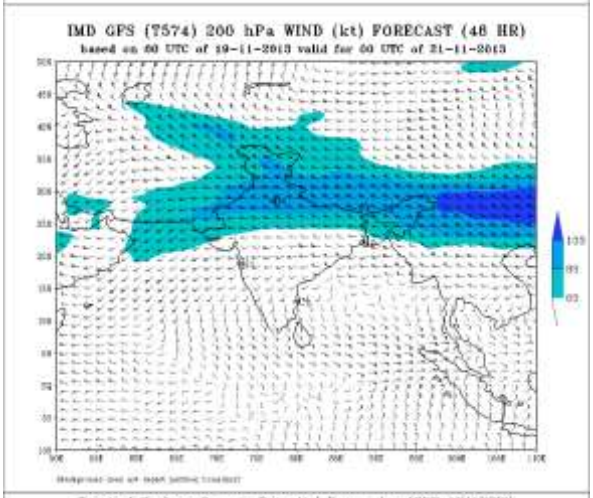

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 20-11-2013

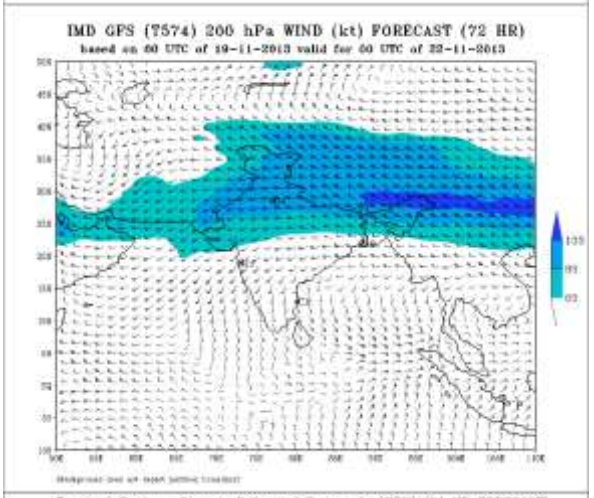

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 21-11-2013

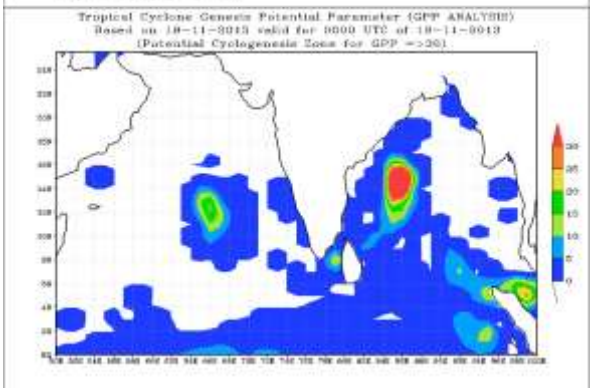

IMD GPS (7574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 22-11-2013

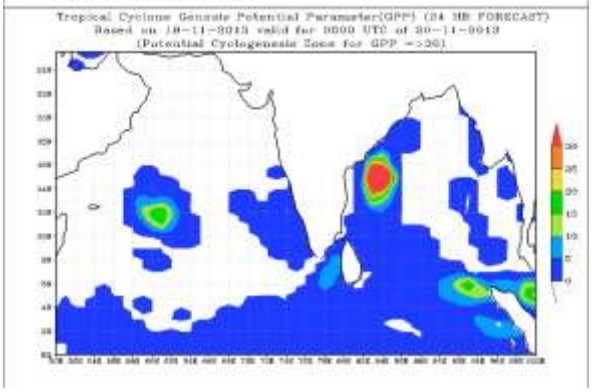

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 19-11-2013

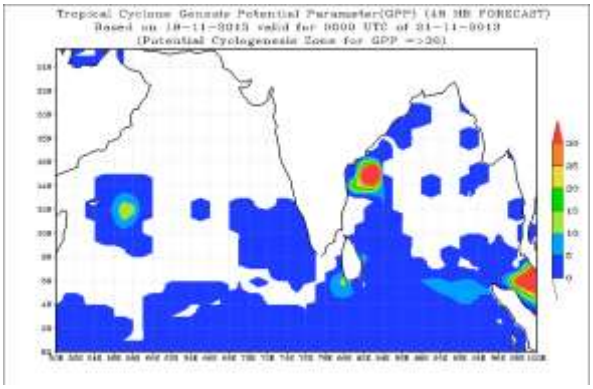

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 20-11-2013

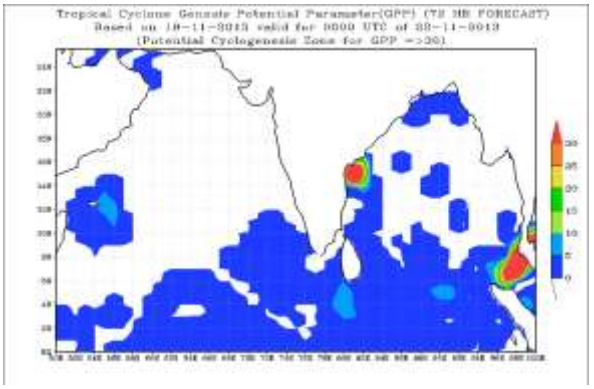

IMD GPS (7574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 21-11-2013


IMD GPS (7574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 19-11-2013 valid for 00 UTC of 22-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 18-11-2013 valid for 0000 UTC of 18-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 18-11-2013 valid for 0000 UTC of 20-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 18-11-2013 valid for 0000 UTC of 21-11-2013
(Potential Cyclogenesis Zone for GPP =>20)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 18-11-2013 valid for 0000 UTC of 22-11-2013
(Potential Cyclogenesis Zone for GPP =>20)

FDP (Cyclone) NOC Report Dated 20th November, 2013

Synoptic features based on 0300 UTC:

- The **Depression** over westcentral Bay of Bengal moved northwestwards and lay centred at 1200 UTC of yesterday, the 19th November 2013 within half a degree of Lat. 15.0º N and Long 85.0º E, about 350 kms south-southeast of Vishakhapatnam. It remained practically stationary, intensified into a **Deep Depression** and lay centred at 1500 UTC of yesterday, the 19th November 2013 within half a degree ofLat. 15.0º N and Long 85.0º E, about 350 kms south-southeast of Vishakhapatnam. It moved westwards and intensified into a **Cyclonic Storm (Helen)** and lay centred at 0300 UTC of today, the 20th November 2013 within half a degree of Lat.15.0° Nand Long. 84.0° E, about 460 kms east-northeast of Chennai, 430 kms east of Kavali, 330 kms east-southeast of Machilipatnam and 310 kms south-southeast of Vishakhapatnam. The system would further intensify into a **Severe Cyclonic Storm** during next 24 hours. It would move west-northwestwards for some time, then westsouthwestwards and cross south Andhra Pradesh coast between Sriharikota and Ongole, close to Kavali during the night of 21st November 2013.
- A cyclonic circulation extending upto 1.5 kms a.s.l. lies over Comorin area and neighbourhood.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 27-30^{0}C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay and along the east coast of India. It is 50-80 KJ cm^{-2} over eastern portion west central and adjoining southwest and east central Bay of Bengal. It is 90-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive (about 100 * $10^{-5}s^{-1}$) over westcentral Bay around the Cyconic Storm and also positive(about 25 * $10^{-5}s^{-1}$) over southwest Bay. It is negative over eastcentral , southeast Bay of Bengal and Andaman Sea.
-

Convergence:

- Lower level convergence is positive of the order of 10-15 *10^{-5} s^{-1} over westcentral Bay of Bengal . It is negative over northeast Bay of Bengal.

Divergence:

- It is positive of the order of 10-30*10^{-5} s^{-1} over westcentral Bay.It is also positive of the order of 5-10*10^{-5} s^{-1} over South Andaman Sea.

Wind Shear:

- **W**ind Shear is 10-20 knots over central Bay of Bengal. It is more than 20 knots over North Bay . It is 5-10 knots over South Bay of Bengal and Andaman Sea.

Wind Shear Tendency:

Shear Tendency is decreasing over the system and increasing towards north of the system.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 16.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 1 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may move in phase 1 to 2 with amplitude less than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 200900 UTC

- Vortex over westcentral Bay of Bengal centred near 15.2^{0}N/84.0^{0}E. Intensity T2.5. Associated broken low/medium cloud embedded with intence to very intense convection seen over Bay of Bengal between latitude 14.0^{0}N &19.0^{0}E, longitude 82.0^{0}E & 86.0^{0}E.
- Broken low/medium cloud embedded with moderate to intense convection seen over Arabian Sea between latitude 10.0^{0}N &14.5^{0}E, longitude 57.0^{0}E & 63.0^{0}E in association with low level circulation over the area.

NWP Analysis

IMD-GFS model analysis of 0000 UTC of 20th November 2013 shows a Cyclonic storm over west central Bay of Bengal centered at latitude 15.0^{o}N and longitude 84.0^{o}E. GFST574 model forecasts show the movement of the system towards west-southwestward direction and cross south Andhra Pradesh coast during next 48 hours.

- GFST574 model forecasts show that another low pressure area likely to form over south Andaman Sea and adjoining areas during next 48 hours.
- The charts of GFST574 model wind analysis and forecast for 24 hr to 72 hr based on 0000UTC of 20th November, 2013 at the levels 850 hPa, 500 hPa and 200 hPa are given in **Annexure II**.
  (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

- The analysis of weather charts of IMD-WRF model based on 00 UTC of 20th November 2013 also show a Cyclonic storm over west central Bay of Bengal centered at latitude 15.0^{o}N and longitude 84.0^{o}E. The model forecasts show that the system likely to move in a westward direction and cross south Andhra Pradesh coast during next 48 hours.
- **ECMWF:** Model shows that a Depression over westcentral Bay of Bengal on 20th November. It would intensify into depression on 21th November 2013 and move west-northwestwards during next two days and cross South Andhra Pradesh coast on 23rd Nov.
- **ARP:** Model shows that a Depression lies over westcentral Bay of Bengal on 20th November 2013. The system would intensify into a Cyclonic Storm on 21th.The depression would move southwestwards then west-northwestwards and cross around 00 UTC of 22nd Nov over south A.P.
- **JMA:** Model shows that a low pressure area lay over southwest Bay of Bengal on 20th November 2013. It would move west-southwest and cross south Tamil Nadu coast on 21st around 0600 UTC. This model is not showing any intensification.
- **UKMO:** (19/00) **:** Model shows that a Depression over westcentral Bay of Bengal on 20th November. It would move west-southwestwards during next two days and cross South Tamilnadu coast on 23rd Nov.
- **GFS** (NCMRWF)**:** Model shows that a Depression lies over westcentral Bay of Bengal on 20th November. The system would intensify into Cyclonic Storm on 21st and move westward and cross south A.P. coast on 23rd November as Cyclonic Storm.
- This model is also showing another cyclogenesis as depression on 22nd November over south Andaman Sea. It is also showing intensification as cyclonic storm on 23rd. It needs to be watched.

- **Genesis Potential Parameter (GPP)** analysis and forecast based on 0000UTC of 20th November 2013 indicate that there is a region of high GPP over west central Bay of Bengal centered around latitude 15.0° N and longitude 84.0°E. The region of high GPP likely to move in a west-northwestward direction during next 48 hours and reaches south Andhra Pradesh coast and adjoining areas.
- **Genesis Potential Parameter (GPP)** forecasts show a region of high GPP over south Andaman Sea and adjoining areas during next 24 hours which moves North West ward direction during next 72 hours.
- The analysis of GPP charts and forecasts for 24 hr to 72 hr are shown in **Annexure II**. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and conclusion:

The cyclonic storm 'HELEN' over westcentral Bay of Bengal remained practically stationary and lay centred at 1430 hrs IST of today, the 20th November 2013 near latitude 15.2°N and longitude 84.0°E, about 470 km east-northeast of Chennai, 430 km east of Kavali, 320 km east-southeast of Machillipatnam and 290 km south-southeast of Vishakhapatnam. The system would further intensify into a severe cyclonic storm during next 24 hrs. It would move west-northwestwards for some time, then west-southwestward and cross south Andhra Pradesh coast between Nellore and Machillipatnam, close to Ongole around morning of 22nd November 2013.

Advisory:

- IOP will continue for Andhra Pradesh and north Tamil Nadu coasts during 21-22 November 2013.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	18/12	**19/00**	**19/03**
India	36/51	25/33	36/51
Coastal stations			
WB	5/9	4/9	6/9
Odisha	5/7	4/5	6/7
AP	10/14	10/13	10/14
Tamil Nadu	8/12	6/7	8/12
Puducherry	2/2	2/2	2/2
A & N	5/7	3/7	4/7
Bangladesh	7/11	8/11	11/11
Myanmar	9/11	9/11	10/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	7/9	7/9

RS/RW (12Z) of 19/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:2, MISDA: -37**
- **RS/RW** (00Z) of 20/11/2013 21/39
- **No. of Ascents reaching 250 hPa levels:13 , MISDA:-17**

No. of PILOT Ascents

19/12Z	**20/00Z**
26/37	22/34

Buoy Data

19/12Z	**20/00Z**	**20/03Z**
8	9	8

Data Statistics over RMC Chennai Region

No. of Synop data

Date→	**19.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /19.11.2013 : 5

No. of Ascents reaching 250 hPa level =5

MISDA : 3

12Z /19.11.2013 : 0

No. of Ascents reaching 250 hPa level =--

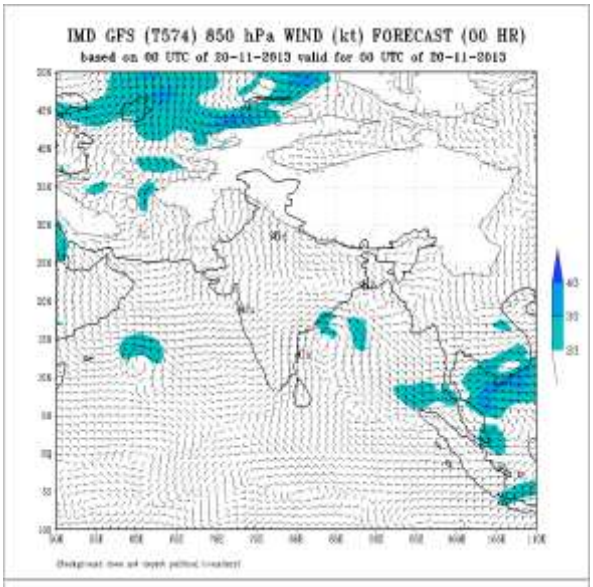
MISDA : 8

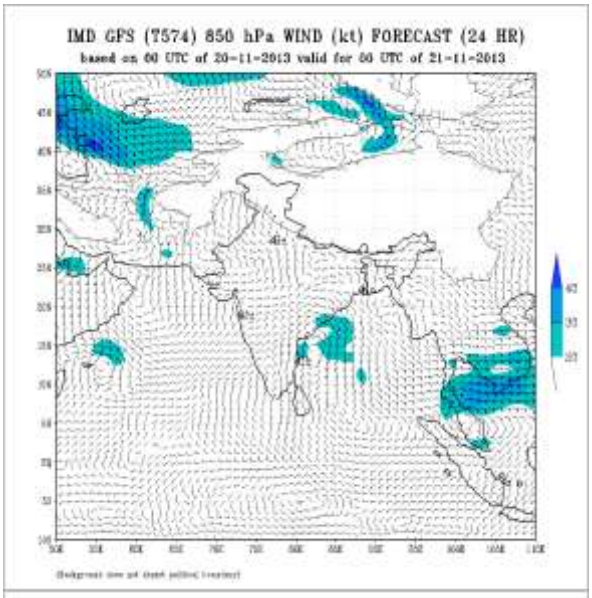
No. of PILOT Ascents:

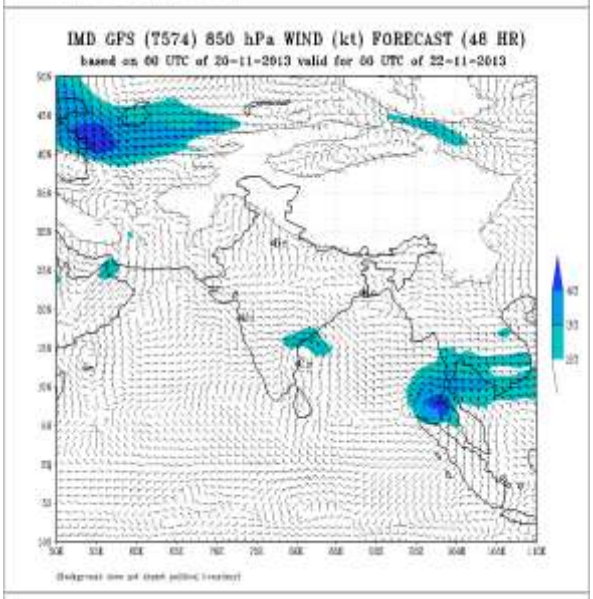
19.11.2013

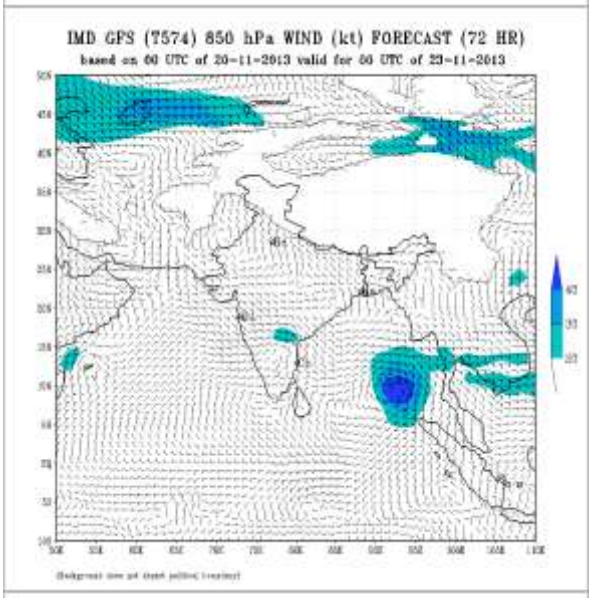
06Z	18Z
5	4

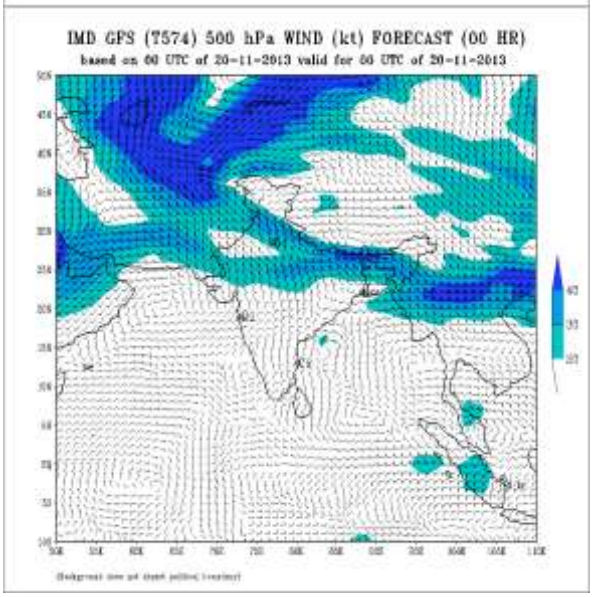
Annexure-II

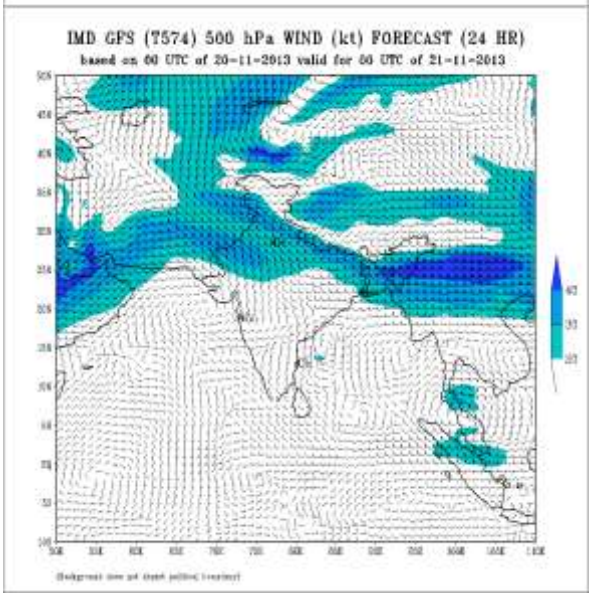

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 20-11-2013 valid for 00 UTC of 20-11-2013

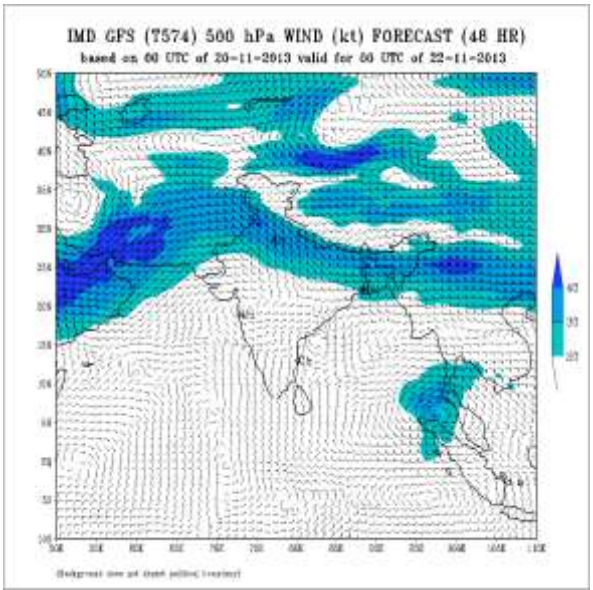

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 20-11-2013 valid for 00 UTC of 21-11-2013

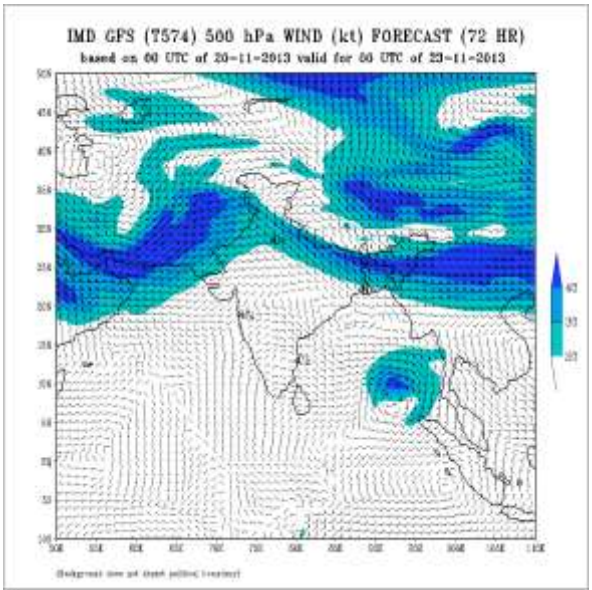

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 20-11-2013 valid for 00 UTC of 22-11-2013

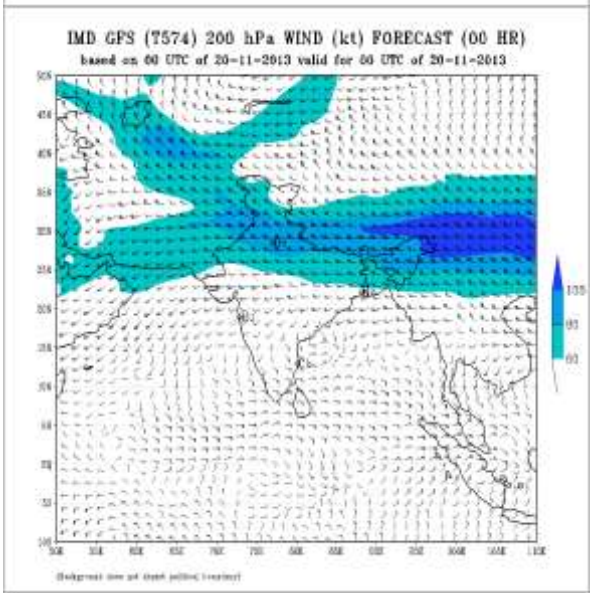

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 20-11-2013 valid for 00 UTC of 23-11-2013

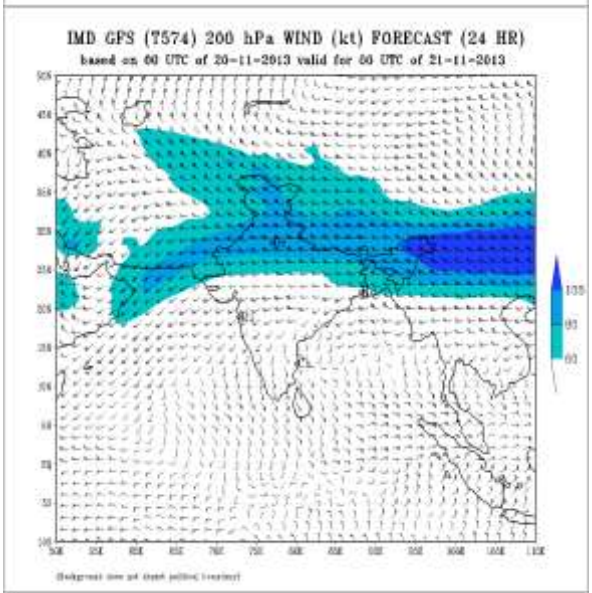

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 20-11-2013 valid for 00 UTC of 20-11-2013

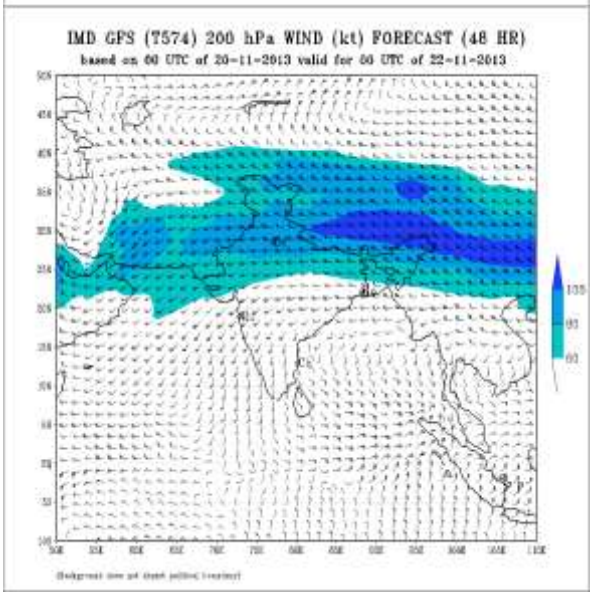

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 20-11-2013 valid for 00 UTC of 21-11-2013

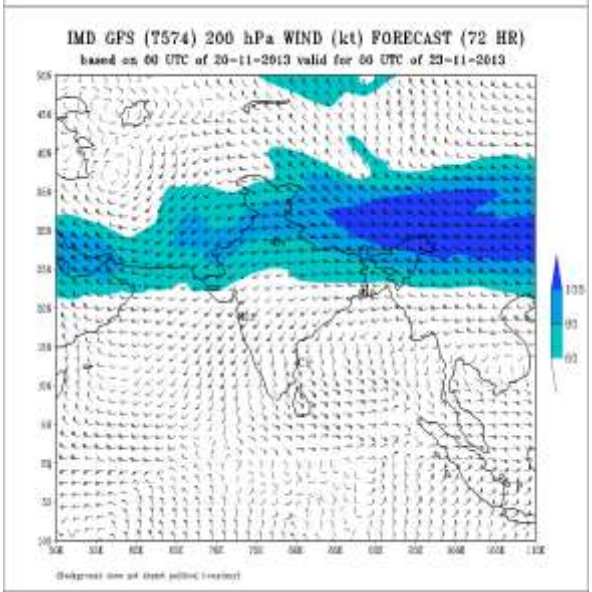

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 20-11-2013 valid for 00 UTC of 22-11-2013

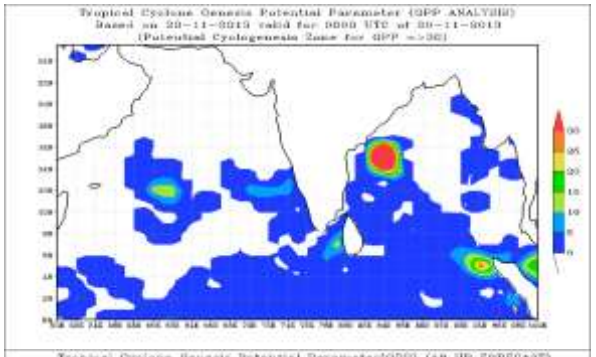

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 20-11-2013 valid for 00 UTC of 23-11-2013

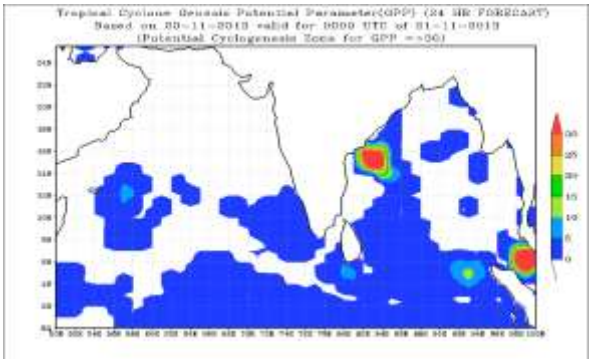

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 20-11-2013 valid for 00 UTC of 20-11-2013

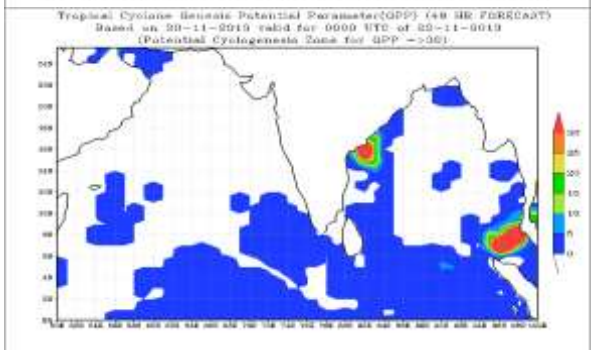

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 20-11-2013 valid for 00 UTC of 21-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 20-11-2013 valid for 00 UTC of 22-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 20-11-2013 valid for 00 UTC of 23-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 30-11-2019 valid for 0000 UTC of 30-11-2019
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 30-11-2019 valid for 0000 UTC of 01-11-2019
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 30-11-2019 valid for 0000 UTC of 02-11-2019
(Potential Cyclogenesis Zone for GPP =>30)

FDP (Cyclone) NOC Report Dated 21th November, 2013

Synoptic features based on 0300 UTC:

- The **Cyclonic Storm (Helen)** over westcentral Bay of Bengal moved slightly northwestwards and lay centred at 1200 UTC of yesterday, the 20th November 2013 near Lat. 15.3º N and Long 83.9º E, about 280 kms south-southeast of Vishakhapatnam. It moved west-northwestwards and intensified into a **Severe Cyclonic Storm (Helen)** and lay centred at 0000 UTC of today, the 21st November 2013 near Lat.15.6° N and Long. 83.5° E, about 230 kms south-southeast of Vishakhapatnam. Further moving northwestwards, it lies centred at 0300 UTC of today, the 21st November 2013 near **Lat. 15.8° N and Long. 83.4° E**, about 240 kms east-southeast of Machilipatnam, 350 kms east-northeast of Ongole and 210 kms south-southeast of Vishakhapatnam.
- A low pressure area lies over Sumatra coast and neighbourhood. Associatedcyclonic circulation extends upto mid tropospheric levels.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 27-30^{0}C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay and along the east coast of India. It is 50-80 KJ cm^{-2} over eastern portion west central and adjoining southwest and east central Bay of Bengal. It is 90-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive (more than 100 * $10^{-5}s^{-1}$) over westcentral Bay around the Severe Cyconic Storm and also positive(about 25 * $10^{-5}s^{-1}$) over southwest Bay. It is negative over north,eastcentral , southeast Bay of Bengal and Andaman Sea.

Convergence:

- Lower level convergence is positive of the order of 10-20 *10^{-5} s^{-1} over westcentral Bay of Bengal . It is also positive over Andaman Sea.

Divergence:

- It is positive of the order of 10-20*10^{-5} s^{-1} over westcentral Bay.It is also positive of the order of 5-20*10^{-5} s^{-1} over South Andaman Sea.

Wind Shear:

- **W**ind Shear is 10-20 knots over central Bay of Bengal. It is more than 20 knots over North Bay . It is 5-10 knots over South Bay of Bengal and Andaman Sea.

Wind Shear Tendency:

Shear Tendency is decreasing over the system and adjoining southwest Bay of Bengal. It increasing over Andaman Sea.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 17.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 1 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may move in phase 1 to 2 with amplitude less than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 210900 UTC

- Vortex over westcentral Bay of Bengal centred near 16.1^{0}N/83.2^{0}E. Intensity T3.5. Associated broken low/medium cloud embedded with intense to very intense convection seen over Bay of Bengal between latitude 15.0^{0}N &18.0^{0}E, longitude 82.0^{0}E & 85.0^{0}E. Minimum cloud top temperature – 77 ^{0}C.
- Broken low/medium cloud embedded with moderate to intense convection seen over Arabian Sea between latitude 10.0^{0}N &13.5^{0}E, longitude 55.0^{0}E & 58.0^{0}E in association with low level circulation over the area.

NWP Analysis

- IMD-GFS(T574) model analysis based on 0000 UTC of 21st November 2013 shows the **Cyclonic storm** over west central Bay of Bengal centered near latitude 15.8°N and longitude 83.4°E. The model forecasts show the movement of the system towards west-southwestward direction during next 48 hours.

- GFST574 model forecasts show that **another low pressure area** likely to emerge over south Andaman Sea and adjoining areas during next 24 hours. The system likely to move in a northwestward direction with increase in intensity during next 72 hours.
- The charts of GFST574 model wind analysis and forecast for 24 hr to 72 hr based on 0000UTC of 21st November, 2013 at the levels 850 hPa, 500 hPa and 200 hPa are given in **Annexure II**.
- The analysis of weather charts of IMD-WRF model based on 0000 UTC of 21st November 2013 also show a Cyclonic storm over west central Bay of Bengal centered at latitude 15.8^{o}N and longitude 83.4^{o}E.

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **ECMWF:** Model shows that a Cyclonic Storm over westcentral Bay of Bengal on 21st November. It would move westwards and crossed Andhra Pradesh coast on 22rd Nov. Model is also showing another low presuure area on 24th Nov over Andman Sea.It is likely to intensify and move northwest direction .It needs to be watched.
- **ARP:** Model shows that a Depression lies over westcentral Bay of Bengal on 21st November 2013. The system would weaken and move west-northwestwards and cross around 00 UTC of 22nd Nov over A.P. coast. This model is also the formation of another Low over south Andaman Sea on 23rd Nov and further intensification.
- **JMA:** Model shows that a low pressure area lay over southwest Bay of Bengal on 21st November 2013. It would move westwards and cross south Tamil Nadu coast on 22nd Nov. This model is not showing any intensification. JMA model is also showing formation of another LOW over south Andaman Sea on 23rd Nov.
- **UKMO:** (20/00) **:** Model shows that a Depression over westcentral Bay of Bengal on 21st November. It would move west-southwestwards during and cross South Tamilnadu coast on 22nd Nov. This model is also showing formation of another LOW on 24 Nov over north Andaman Sea .It would intensify and move west-northwest wards.
- **GFS** (NCMRWF)**:** Model shows that a Cyclonic Storm lies over westcentral Bay of Bengal on 21st November. The system would move westward and cross A.P. coast on 22 November. This model is also showing formation another LOW on 24 Nov over north Andaman Sea .It would intensify and move west-northwest wards.

- **Genesis Potential Parameter (GPP)** analysis and forecast based on 0000 UTC of 21st November 2013 indicate that there is a region of high GPP over west central Bay of Bengal centered around latitude 15.8^o N and longitude 83.4^{o}E. The region of high GPP likely to move in a westward direction during next 48 hours and reaches south Andhra Pradesh coast and adjoining areas.

- **Genesis Potential Parameter (GPP)** forecasts show a region of high GPP over south Andaman Sea and adjoining areas during next 24 hours which moves North West ward direction during next 72 hours.
- The analysis of GPP charts and forecasts for 24 hr to 72 hr are shown in **Annexure II**. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and conclusion:

- The severe cyclonic storm 'HELEN' over westcentral Bay of Bengal moved slightly west-northwestwards and lay centred at 1430 hrs IST of today, the 21st November 2013 near latitude 16.0^0N and longitude 83.1^0E about 210 km east-southeast of Machillipatnam, 320 km east-northeast of Ongole and 190 km south-southeast of Vishakhapatnam. It would move westnorthwestwards slowly for some time, then westward and cross Andhra Pradesh coast near Machillipatnam around afternoon/evening of 22nd November 2013.
- Another low pressure area formed over Sumatra coast would move northwestwards and emerge into south Andaman Sea on 22nd and may intensify into a depression on 23rd. It needs to be watched.

Advisory:

- IOP will continue for Andhra Pradesh and north Tamil Nadu coasts till 22nd November 2013.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	20/12	**21/00**	**21/03**
India	33/51	26/33	32/51
Coastal stations			
WB	5/9	3/9	4/9
Odisha	5/7	4/5	5/7
AP	9/14	8/13	8/14
Tamil Nadu	7/12	6/7	7/12
Puducherry	2/2	2/2	2/2
A & N	5/7	3/7	6/7
Bangladesh	7/11	8/11	10/11
Myanmar	8/11	9/11	9/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	9/9	9/9

RS/RW (12Z) of 20/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:2, MISDA: -37**
- **RS/RW** (00Z) of 21/11/2013 22/39
- **No. of Ascents reaching 250 hPa levels:14 , MISDA:-16**

No. of PILOT Ascents

20/12Z	**21/00Z**
26/37	22/34

Buoy Data

20/12Z	**21/00Z**	**21/03Z**
8	9	8

Data Statistics over RMC Chennai Region

No. of Synop data

date→	**20.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**21**	**20**	**20**	**20**

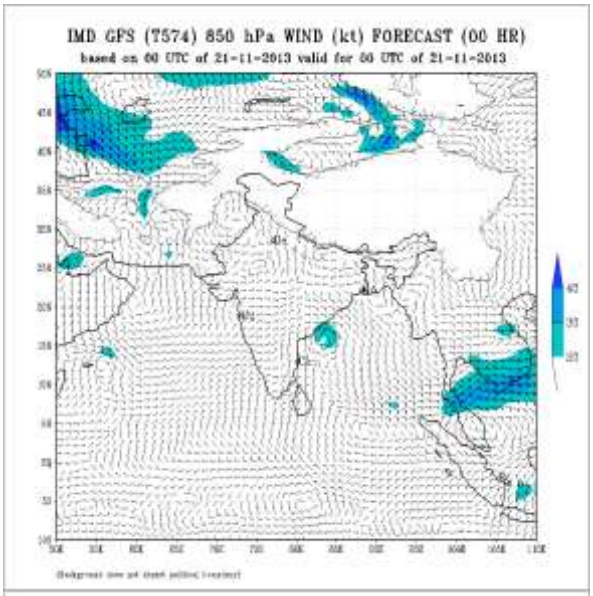
No. of RS/RW Ascents

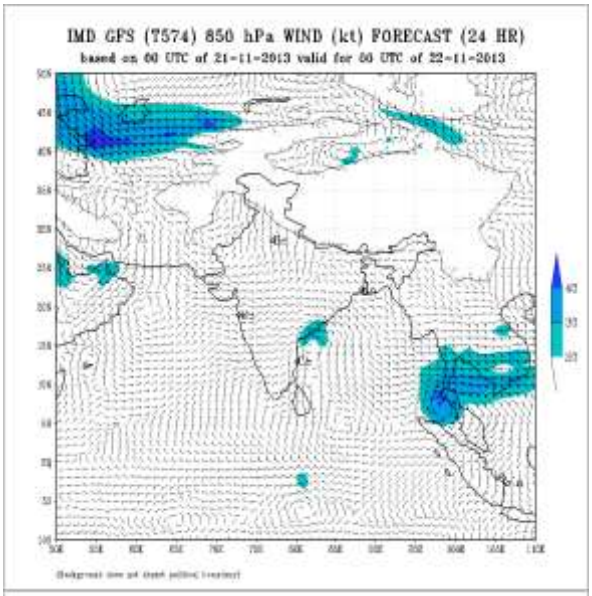
00Z /20.11.2013 : 5
No. of Ascents reaching 250 hPa level =5
MISDA : 3
12Z /20.11.2013 : 0
No. of Ascents reaching 250 hPa level =--
MISDA : 8

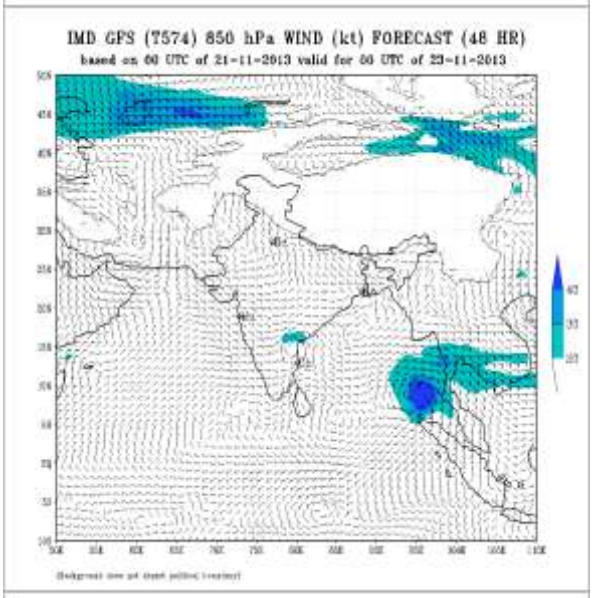
No. of PILOT Ascents:
20.11.2013

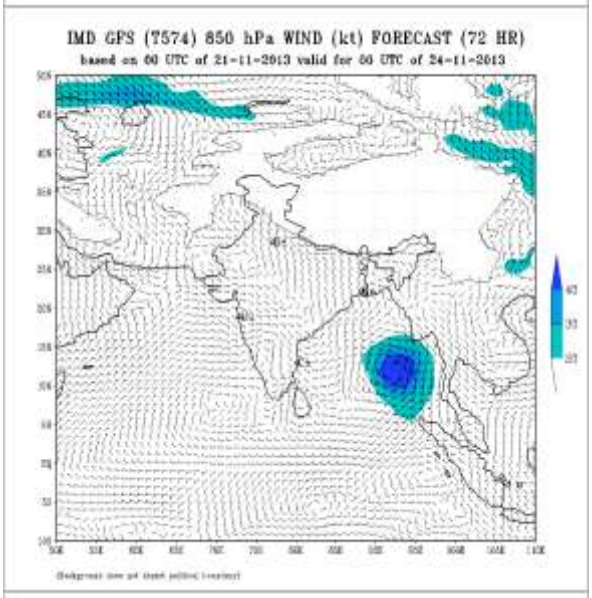
06Z	18Z
5	5

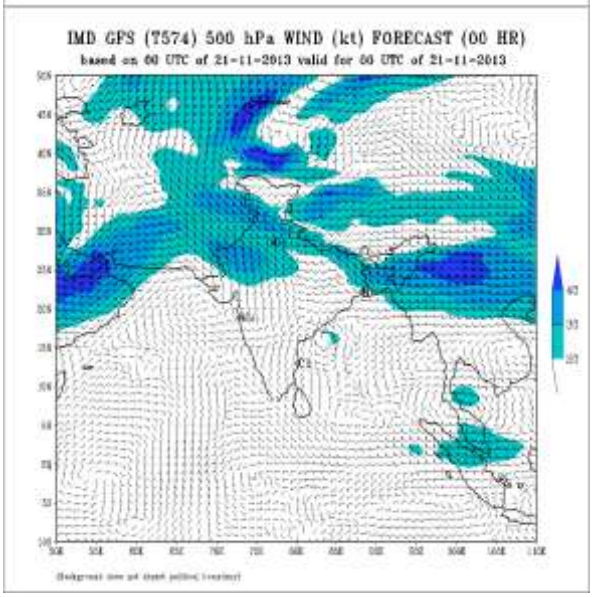
Annexure-II

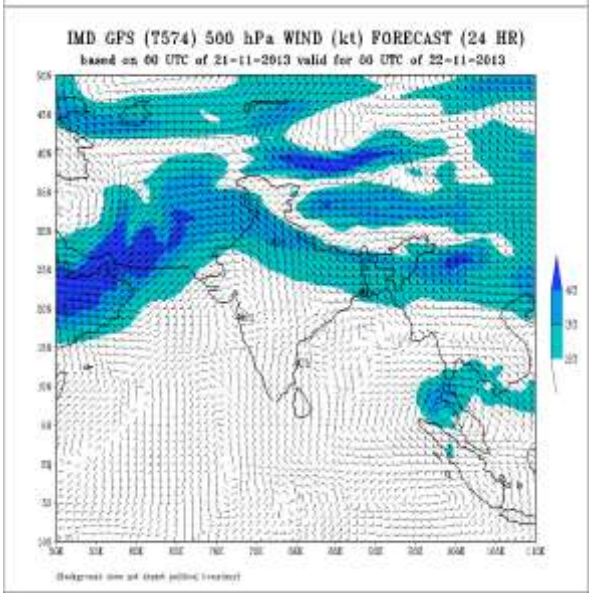

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 21-11-2013 valid for 00 UTC of 21-11-2013

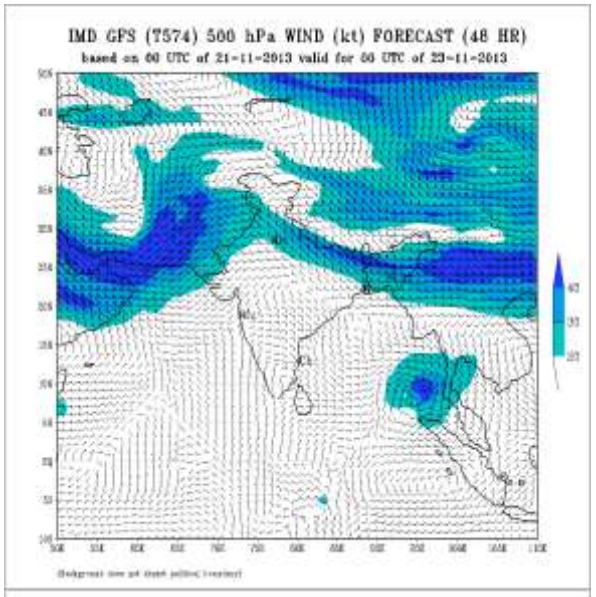

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 21-11-2013 valid for 00 UTC of 22-11-2013

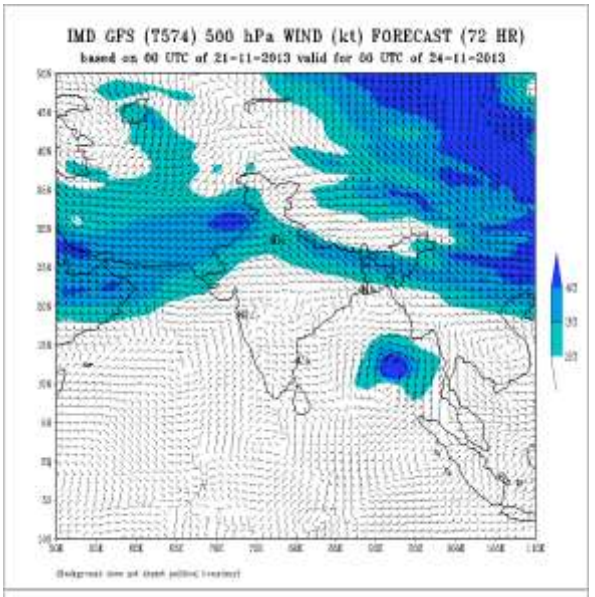

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 21-11-2013 valid for 00 UTC of 23-11-2013

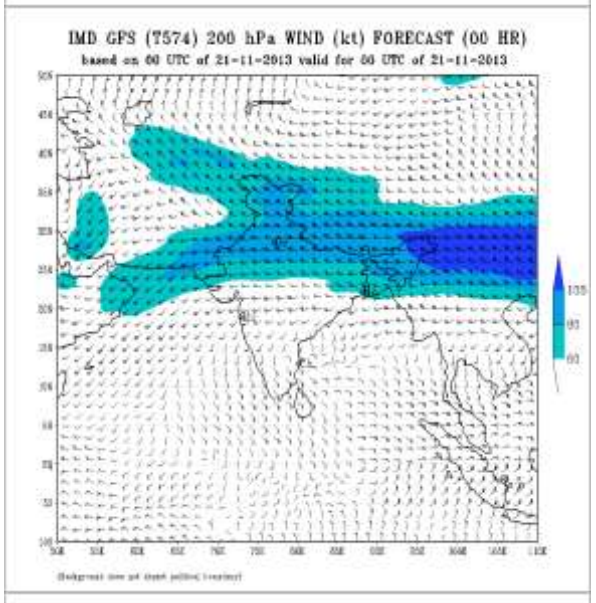

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 21-11-2013 valid for 00 UTC of 24-11-2013

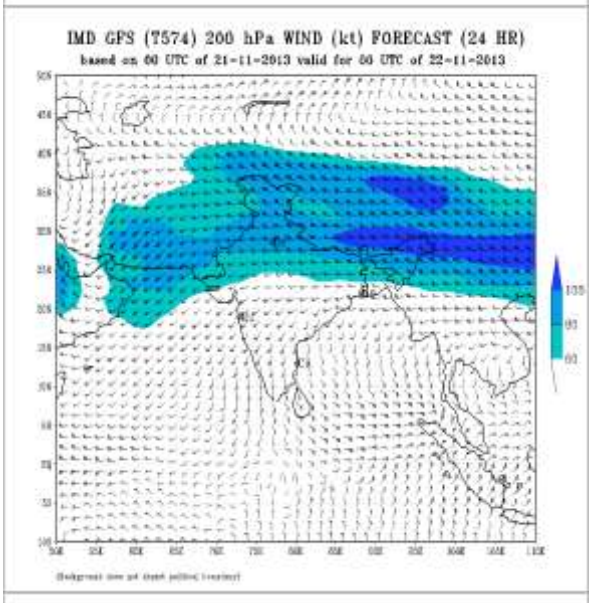

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 21-11-2013 valid for 00 UTC of 21-11-2013

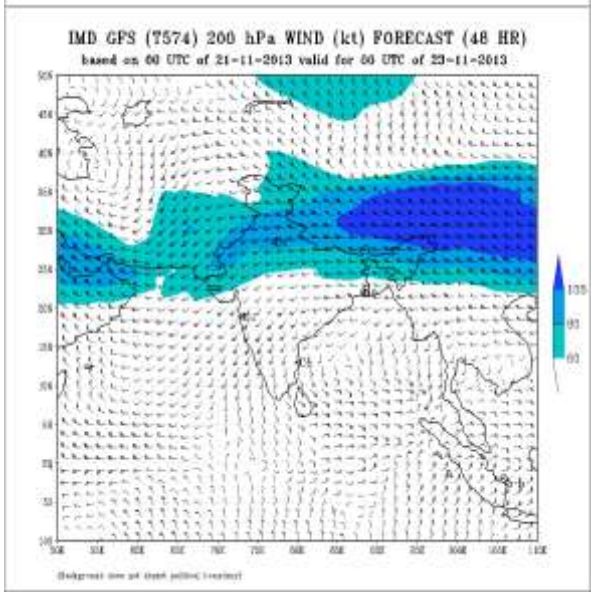

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 21-11-2013 valid for 00 UTC of 22-11-2013

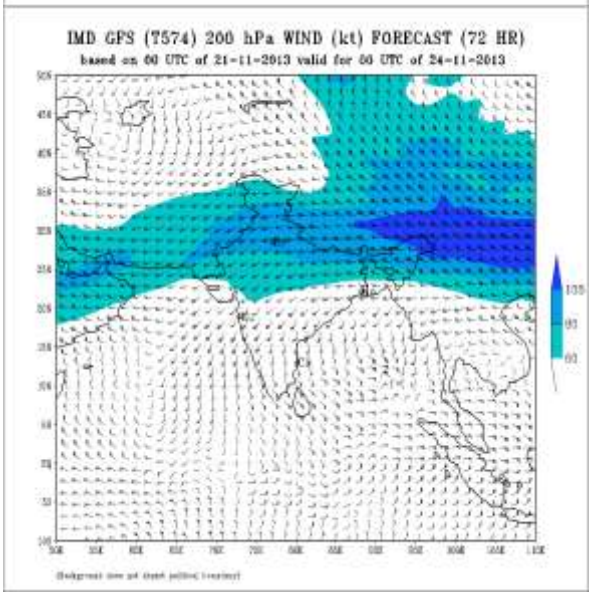

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 21-11-2013 valid for 00 UTC of 23-11-2013

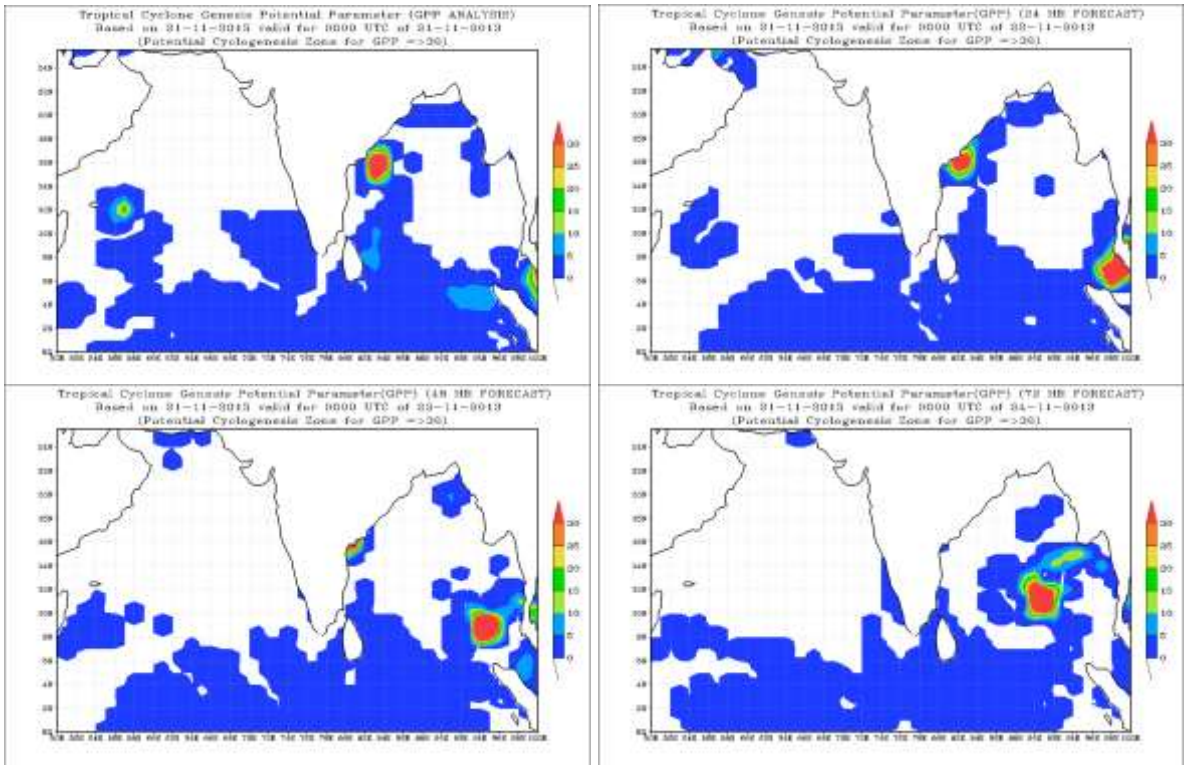

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 21-11-2013 valid for 00 UTC of 24-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 21-11-2013 valid for 00 UTC of 21-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 21-11-2013 valid for 00 UTC of 22-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 21-11-2013 valid for 00 UTC of 23-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 21-11-2013 valid for 00 UTC of 24-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 31-11-2015 valid for 0000 UTC of 31-11-2015
(Potential Cyclogenesis Zone for GPP =>20)
Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 31-11-2015 valid for 0000 UTC of 32-11-2015
(Potential Cyclogenesis Zone for GPP =>20)
Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 31-11-2015 valid for 0000 UTC of 33-11-2015
(Potential Cyclogenesis Zone for GPP =>20)
Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 31-11-2015 valid for 0000 UTC of 34-11-2015
(Potential Cyclogenesis Zone for GPP =>20)

FDP (Cyclone) NOC Report Dated 22th November, 2013

Synoptic features based on 0300 UTC:

- The **Severe Cyclonic Storm 'HELEN'** over westcentral Bay of Bengal moved slightly westwards and lay centred at 0830 hours IST of today,22nd November, 2013 near latitude 16.2°N and longitude 81.7°E, about 025 km south of Narsapur and 060 km east of Machilipatnam. The severe cyclonic storm 'HELEN' over westcentral Bay of Bengal moved slightly westwards and lay centred at 1130 hrs IST the 22nd November 2013 near latitude 16.2^0N and longitude 81.3^0E very close to Andhra Pradesh coast (about 15 km east of Machillipatnam).
- A low pressure area lies over Sumatra and adjoining areas of south Andaman Sea with associated cyclonic circulation extending upto midtropospheric levels.
- An upper air circulation lies over Lakshadweep and neighbourhood in lower levels.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 27-30^0C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay and along the east coast of India. It is 50-80 KJ cm^{-2} over eastcentral ,southeast Bay of Bengal and Andman Sea. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive (more than 80 * $10^{-5}s^{-1}$) over westcentral Bay around the Cyconic Storm and also positive(about 50 * $10^{-5}s^{-1}$) over Sumatra coast near to another system. It is negative over rest Bay of Bengal and Andaman Sea.

Convergence:

- Lower level convergence is positive of the order of 10-20 *10^{-5} s^{-1} over westcentral Bay of Bengal near to system . It is also positive over Andaman Sea.

Divergence:

- It is positive of the order of 10-20*10^{-5} s^{-1} over westcentral Bay. It is also positive of the order of 5-10*10^{-5} s^{-1} over South Andaman Sea.

Wind Shear:

- **W**ind Shear is 5-10 knots over central Bay of Bengal and north Andman Sea. It is more than 20 knots over North and South Bay of Bengal and south Andaman Sea.

Wind Shear Tendency:

Shear Tendency is decreasing over the system and adjoining southwest Bay of Bengal. It increasing over Andaman Sea.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 17.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 2 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may move in phase 2 to 3 with amplitude less than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 220900 UTC

- Vortex over central parts of coastal A.P. centred near 16.0^0N/81.0^0E over the land . Associated broken low/medium cloud embedded with moderate to intense convection

seen over north coastal A.P. extending up to Chhattisgarh and west central Bay between latitude 15.0^{0}N &18.5^{0}E, longitude west of 85.5^{0}E.

- Broken low/medium cloud embedded with moderate to intense convection seen over south Andaman Sea adjoining Thailand in association with low level circulation over the area.

NWP Analysis

- IMD-GFST574 model analysis based on 0000 UTC of 22nd November 2013 shows the **Cyclonic storm** over west central Bay of Bengal centered near latitude 16.2°N and longitude 81.7°E. The model forecasts show the movement of the system towards westward direction during next 24 hours.

- GFST574 model analysis shows a low pressure area over south Andaman Sea and adjoining areas. GFST574 model forecasts show the movement of the system in a northwestward direction with increase in intensity during next 72 hours.
- The charts of GFST574 model wind analysis and forecast for 24 hr to 72 hr based on 0000UTC of 22nd November, 2013 at the levels 850 hPa, 500 hPa and 200 hPa are given in **Annexure II**.
- The analysis of weather charts of IMD-WRF model based on 0000 UTC of 22nd November 2013 also show a Cyclonic storm over west central Bay of Bengal centered near latitude 16.2°N and longitude 81.7°E

(http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **ECMWF:** Model shows that a Cyclonic crossed over Andhra Pradesh coast on 22rd Nov (Near 16.5 N/81.5).
  Model is also showing another low presuure area on 23th Nov over South Andman Sea. It is likely to intensify and move northwest direction .It needs to be watched.
- **ARP: :** Model shows that a LOPAR crossed over Andhra Pradesh coast on 22rd Nov (Near 16.0 N/81.51. This model is also the formation of another Low over south Andaman Sea on 23rd Nov and further intensification with north-westwards movement.
- **JMA:** Model showing formation of a LOW over south Andaman Sea on 23rd Nov.It would intensify and move north-westwards during next 72 hrs.
- **UKMO:** (20/00) **:** Model shows that systems would cross near 16.0 N/ 80.5 E on 23rd Nov.
  This model is also showing formation of another Depression on 24 Nov over north Andaman Sea .It would intensify and move west-northwest wards.
- **GEFS** (NCMRWF)**:** Model shows that a Depression would form on 23 Nov over north Andaman Sea .It would intensify and move west-northwest wards during next 3-4 days. This model is showing fast intensification.

Genesis Potential Parameter (GPP:

- **Genesis Potential Parameter (GPP)** analysis and forecast based on 0000 UTC of 22nd November 2013 indicate that there is a region of high GPP over west central Bay of Bengal centered around latitude 16.0^o N and longitude 82.0^{o}E. The region of high GPP likely to move in a westward direction during next 24 hours.
- **Genesis Potential Parameter (GPP)** analysis based on 0000 UTC of 22nd November 2013 shows a region of high GPP over south Andaman Sea and adjoining areas. **Genesis Potential Parameter (GPP)** forecasts based on 0000 UTC of 22nd November 2013 show the region of high GPP likely to move in a North West ward direction during next 72 hours.
- The analysis of GPP charts and forecasts for 24 hr to 72 hr are shown in (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and conclusion:

- The severe cyclonic storm ‘HELEN’ over westcentral Bay of Bengal moved slightly westwards and lay centred at 1130 hrs IST the 22nd November 2013 near latitude 16.2^{0}N and longitude 81.3^{0}E very close to Andhra Pradesh coast (about 15 km east of Machillipatnam). The System HELEN moved westwards and crossed A.P. coast near close to south Machillipatnam near lat. 16.1 N and Long. 81.2 between 13:30 and 14:30 hrs of IST of todat 22 November 2013 as Cyclonic Storm with wind speed 80-90 km/h.
- Another low pressure area formed over Sumatra coast would move northwestwards and emerge into south Andaman Sea on 23rd and may intensify into a depression on 24th. It needs to be watched.

Advisory:

- IOP declared for Andaman Sea 23-25 November 2013.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	21/12	**22/00**	**22/03**
India	29/51	26/33	30/51
Coastal stations			
WB	4/9	3/9	3/9
Odisha	4/7	4/5	4/7
AP	7/14	8/13	8/14
Tamil Nadu	6/12	8/7	8/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/7	5/7
Bangladesh	7/11	8/11	8/11
Myanmar	8/11	7/11	8/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	9/9	8/9

RS/RW (12Z) of 21/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:2, MISDA: -35**
- **RS/RW** (00Z) of 22/11/2013 23/39
- **No. of Ascents reaching 250 hPa levels:16 , MISDA:-14**

No. of PILOT Ascents

21/12Z	**22/00Z**
23/37	21/34

Buoy Data

21/12Z	**22/00Z**	**22/03Z**
9	9	8

Data Statistics over RMC Chennai Region

No. of Synop data

Date→	**21.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**02**	**19**	**19**

No. of RS/RW Ascents

00Z /21.11.2013 : 5

No. of Ascents reaching 250 hPa level =5

MISDA : 3

12Z /21.11.2013 : 0

No. of Ascents reaching 250 hPa level =--

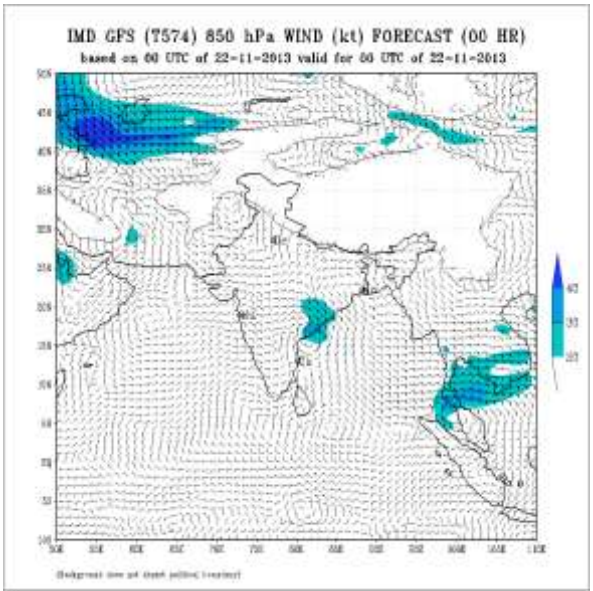
MISDA : 8

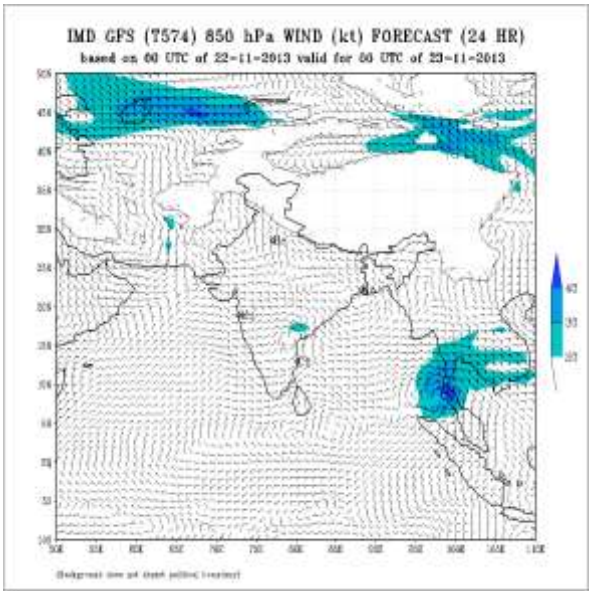
No. of PILOT Ascents:

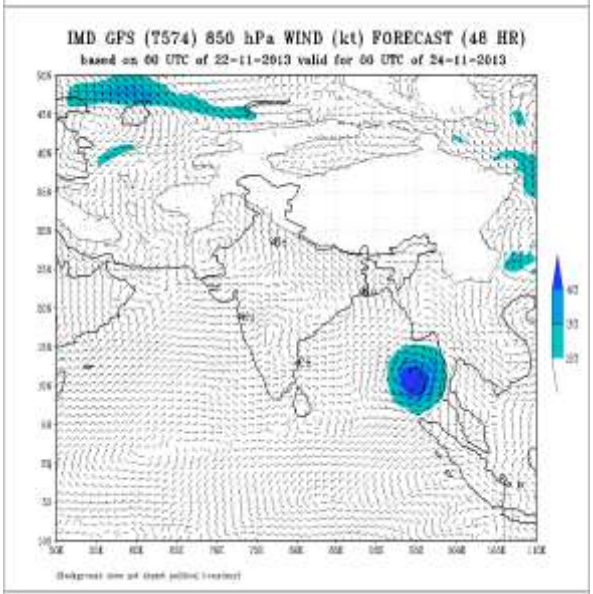
21.11.2013

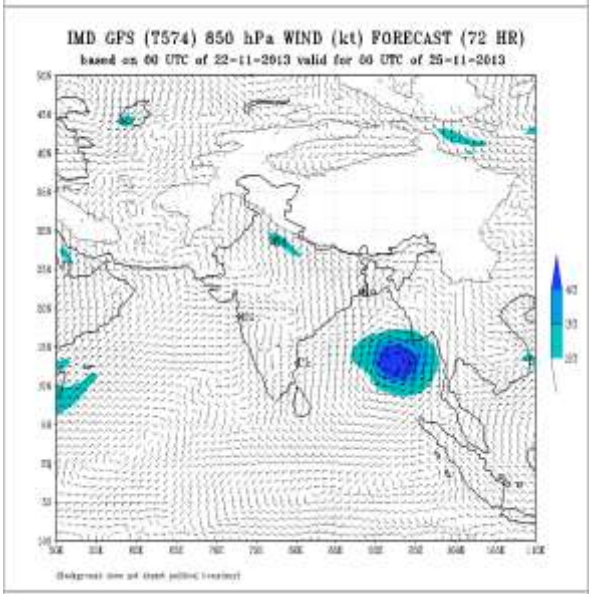
06Z	18Z
6	0

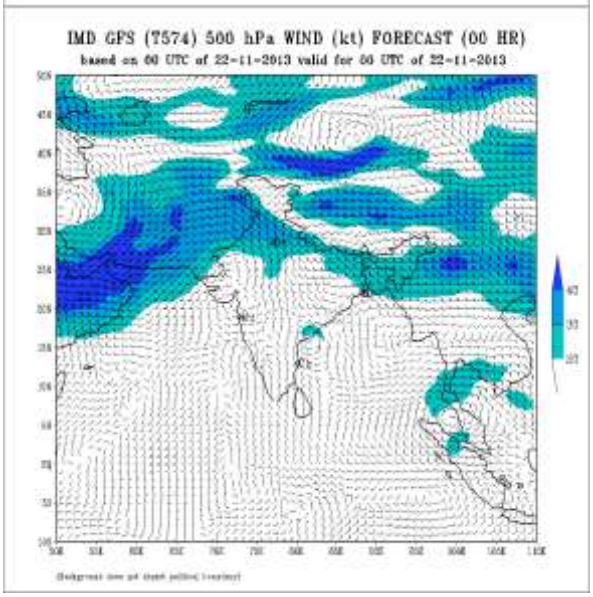
Annexure-II

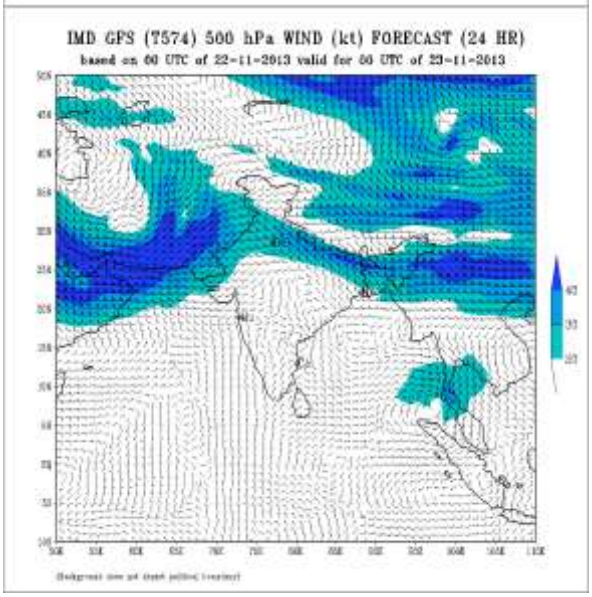

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 22-11-2013 valid for 00 UTC of 22-11-2013

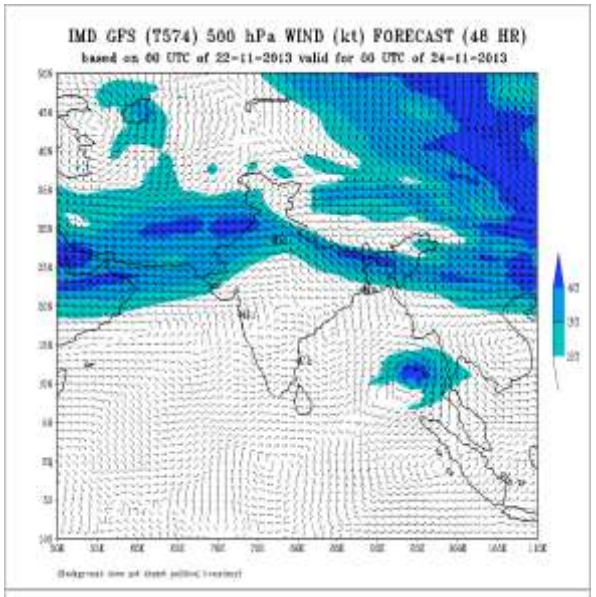

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 22-11-2013 valid for 00 UTC of 23-11-2013

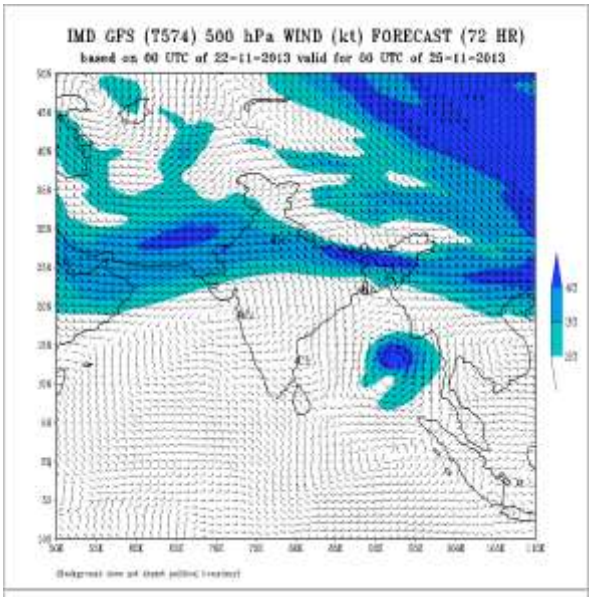

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 22-11-2013 valid for 00 UTC of 24-11-2013

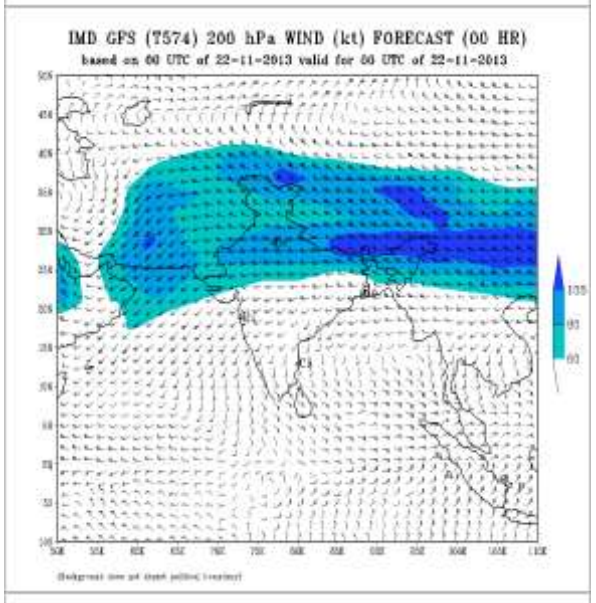

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 22-11-2013 valid for 00 UTC of 25-11-2013

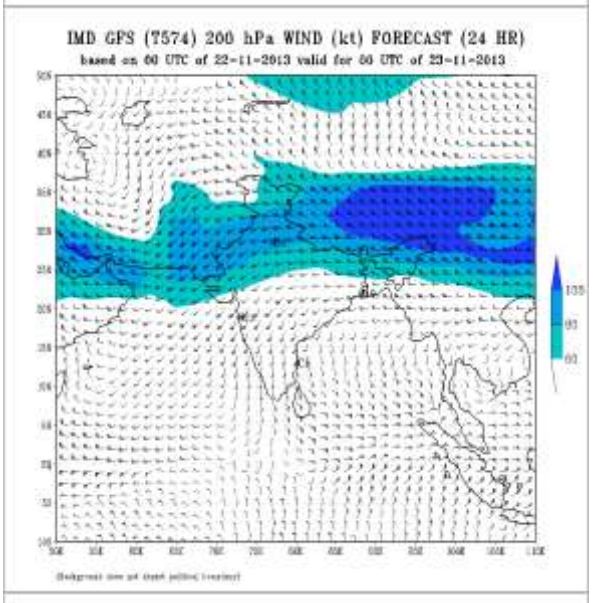

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 22-11-2013 valid for 00 UTC of 22-11-2013

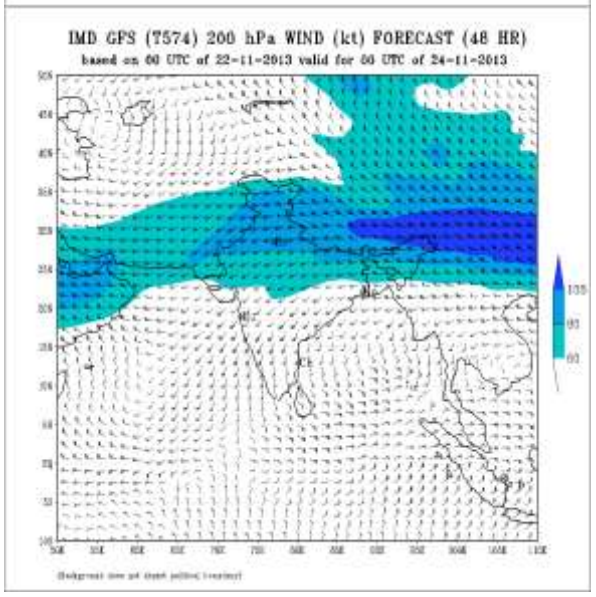

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 22-11-2013 valid for 00 UTC of 23-11-2013

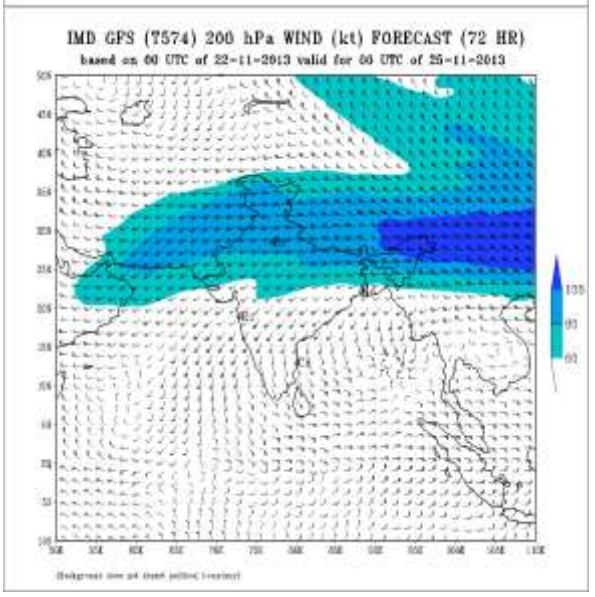

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 22-11-2013 valid for 00 UTC of 24-11-2013

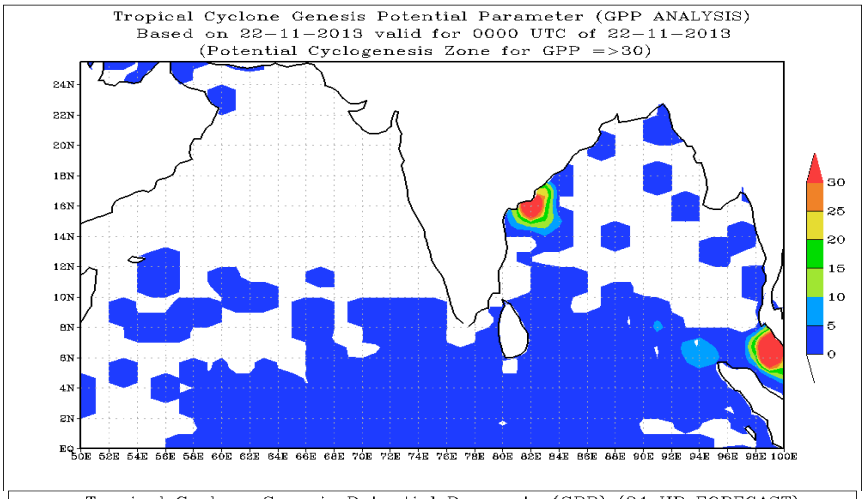

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 22-11-2013 valid for 00 UTC of 25-11-2013

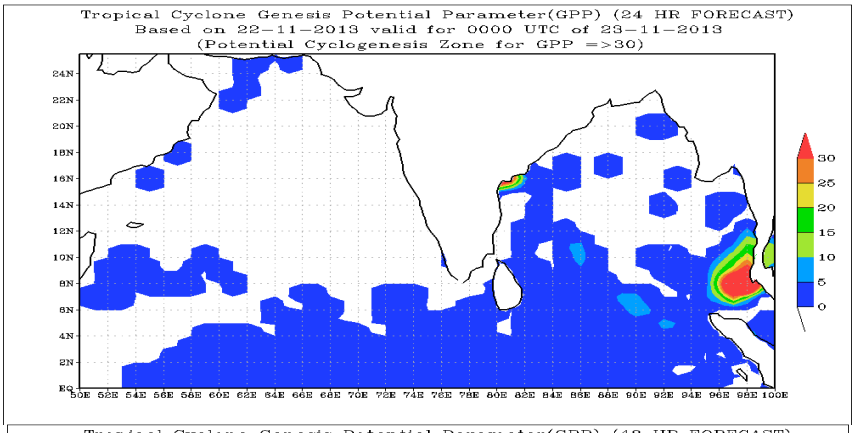

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 22-11-2013 valid for 00 UTC of 22-11-2013

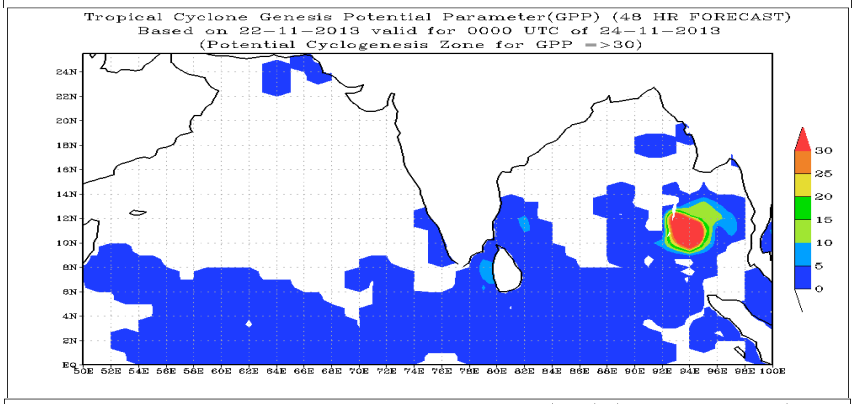

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 22-11-2013 valid for 00 UTC of 23-11-2013

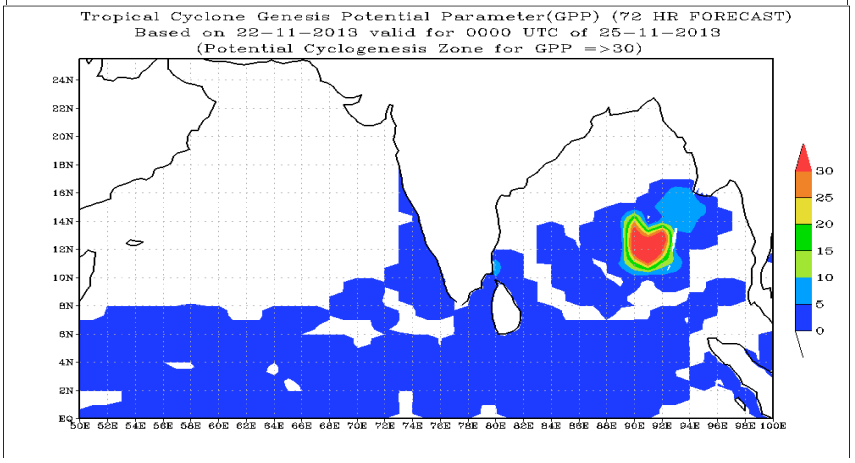

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 22-11-2013 valid for 00 UTC of 24-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 22-11-2013 valid for 00 UTC of 25-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 22-11-2013 valid for 0000 UTC of 22-11-2013
(Potential Cyclogenesis Zone for GPP =>30)
30
25
20
15
10
5
0


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 22-11-2013 valid for 0000 UTC of 23-11-2013
(Potential Cyclogenesis Zone for GPP =>30)
30
25
20
15
10
5
0


Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 22-11-2013 valid for 0000 UTC of 24-11-2013
(Potential Cyclogenesis Zone for GPP =>30)
30
25
20
15
10
5
0


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 22-11-2013 valid for 0000 UTC of 25-11-2013
(Potential Cyclogenesis Zone for GPP =>30)
30
25
20
15
10
5
0

FDP (Cyclone) NOC Report Dated 23 November, 2013

Synoptic features based on 0300 UTC:

- The low pressure area over south Andaman sea & neighbourhood has concentrate into a **well marked low pressure area**. Associated upper air cyclonic circulation extends up to mid tropospheric levels.
- The upper air cyclonic circulation over Lakshadweep and neighbourhood in lower levels persists.

Environmental features based on 0300 UTC of today: Sea

Surface Temperature:

- SST is around 27-30^{0}C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay and along the east coast of India. It is 50-80 KJ cm^{-2} over east central, southeast Bay of Bengal and Andaman Sea. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive (more than 80 * $10^{-5}s^{-1}$) over South Andaman Sea around WML. It is negative over rest Bay of Bengal.

Convergence:

- Lower level convergence is positive of the order of 10-20 *10^{-5} s^{-1} over Andaman Sea.

Divergence:

- It is positive of the order of 10-20*10^{-5} s^{-1} over Andaman Sea and adjoining SE Bay of Bengal.

Wind Shear:

- Wind Shear is 10-20 knots Andman Sea and central Bay of Bengal. It is more than 20 knots over North and South Bay of Bengal .

Wind Shear Tendency:

Shear Tendency is increasing over central, southeast Bay of Bengal and Andaman Sea.

Upper tropospheric ridge:

The upper tropospheric ridge line at 200 hPa passes through lat 17.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 2 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may move in phase 2 to 3 with amplitude less than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 230900 UTC

- Vortex over Andman Sea and neighbourhood centred with half a degree of Lat. **8.0N** Long. **97.3E .** Intensity **T 1.0 .** Associated broken low/medium cloud embedded with intence to very intense convection seen over south Andaman Sea adjoining Tenaserim coast .

NWP Analysis

- GFST574 model analysis shows a **low pressure area** over south Andaman Sea and adjoining areas. GFST574 model forecasts show the movement of the system in a northwestward direction with increase in intensity during next 72 hours.
- The charts of GFST574 model wind analysis and forecast for 24 hr to 72 hr based on 0000UTC of 23rd November, 2013 at the levels 850 hPa, 500 hPa and 200 hPa are given in Annexure-II.
- The analysis and forecast of weather charts of IMD-WRF model based On 0000 UTC of 23 November 2013 show a law pressure area over coastal Andhra Pradesh which may become less marked during next 24 hours. The model analysis and forecast also show another law pressure area over south Andaman Sea and adjoining areas which may move in a northwestward direction with increase in intensity during next 72 hours. (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)

- **ECMWF:** Model is show that a low presuure area on 23th Nov over South Andman Sea. It is likely to intensify as Depression during next 24 hrs and move northwest direction. Model is showing further intensification.
- **ARP: :** This model shows a Low over south Andaman Sea on 23rd Nov and further intensification with north-westwards movement.
- **JMA:** Model show that a LOW over south Andaman Sea on 23rd Nov. It would intensify and move north-westwards during next 72 hrs.
- **UKMO:** (22/00) **:** This model shows that a Low over south Andaman Sea on 23 Nov and intensify as depression on 24 Nov .It would intensify and move west-northwest wards become CS on 25 Nov.
- **GEFS** (NCMRWF)**:** Model shows that a Depression on 23 Nov over south Andaman Sea .It would intensify and move west-northwest wards during next 3-4 days. This model is showing fast intensification.

Genesis Potential Parameter (GPP:

- **Genesis Potential Parameter (GPP)** analysis based on 0000 UTC of 23rd November 2013 shows a region of high GPP over south Andaman Sea and adjoining areas. **Genesis Potential Parameter (GPP)** forecasts based on 0000 UTC of 23rd November 2013 show the region of high GPP likely to move in a North West ward direction during next 72 hours.
- The analysis of GPP charts and forecasts for 24 hr to 72 hr are shown in **Annexure II**. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and conclusion:

- The low pressure area over south Andaman sea & neighbourhood has become **well marked**. Associated upper air cyclonic circulation extends upto mid tropospheric levels. It would intensify into a depression during next 12 hours and further intensify thereafter into a cyclonic storm in subsequent 48 hrs.

Advisory:

- IOP to continue for Andaman Sea 23-25 November 2013.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	22/12	**23/00**	**23/03**
India	24/51	26/33	30/51
Coastal stations			
WB	3/9	3/9	3/9
Odisha	7/7	6/7	7/7
AP	8/14	8/13	8/14
Tamil Nadu	6/12	8/7	8/12
Puducherry	2/2	2/2	2/2
A & N	6/7	6/7	6/7
Bangladesh	7/11	7/11	8/11
Myanmar	8/11	7/11	8/11
Thailand	3/3	3/3	3/3
Srilanka	9/9	9/9	8/9

RS/RW (12Z) of 22/11/2013 1/39

No. of Ascents reaching 250 hPa levels:1, MISDA: -35
RS/RW (00Z) of 23/11/2013 20/39

No. of Ascents reaching 250 hPa levels:12 , MISDA:-14

No. of PILOT Ascents

22/12Z	**23/00Z**
2/37	24/34

Buoy Data

22/12Z	**23/00Z**	**23/03Z**
9	6	8

Data Statistics over RMC Chennai Region

No. of Synop data

Date→	**22.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

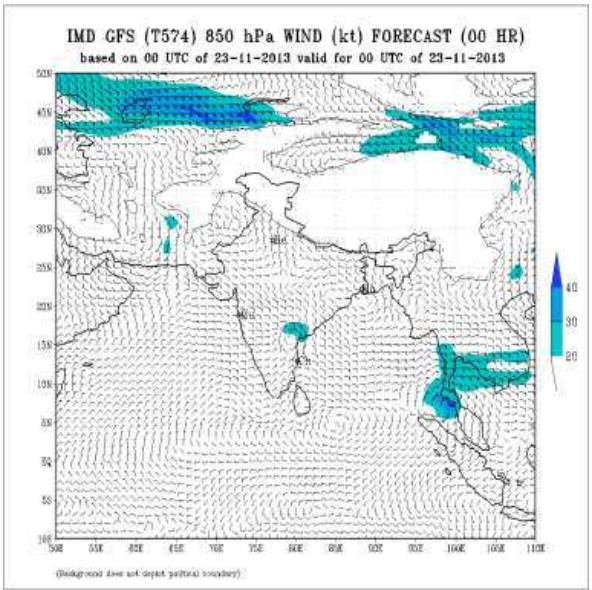
No. of RS/RW Ascents

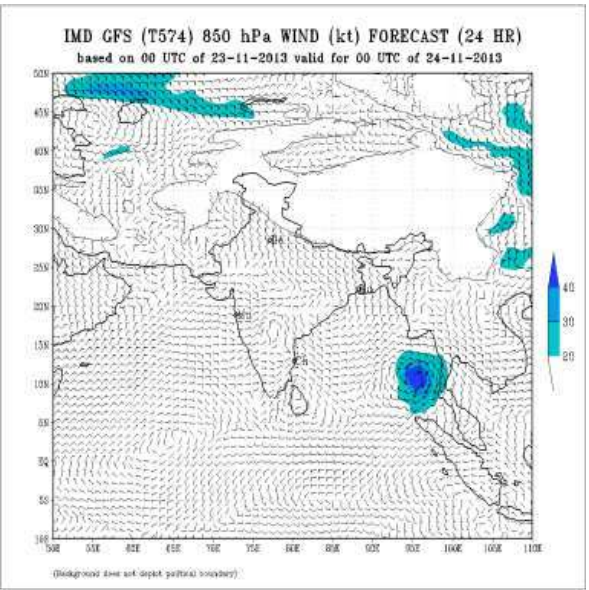
00Z /22.11.2013 : 5
No. of Ascents reaching 250 hPa level =5 **MISDA : 3**
12Z /22.11.2013 : 0
No. of Ascents reaching 250 hPa level =-- **MISDA : 8**

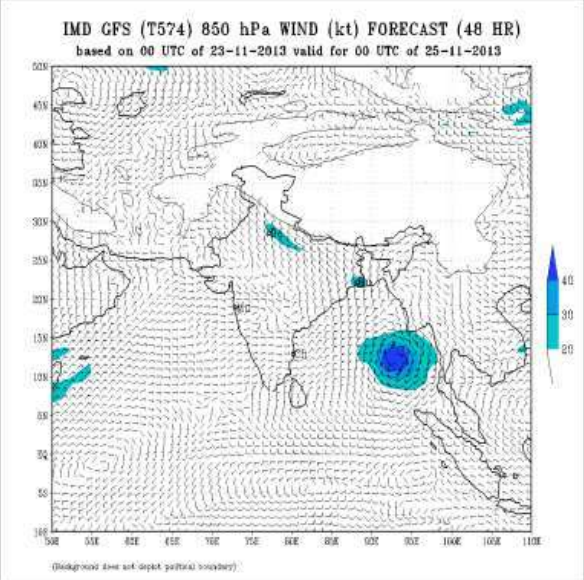
No. of PILOT Ascents:

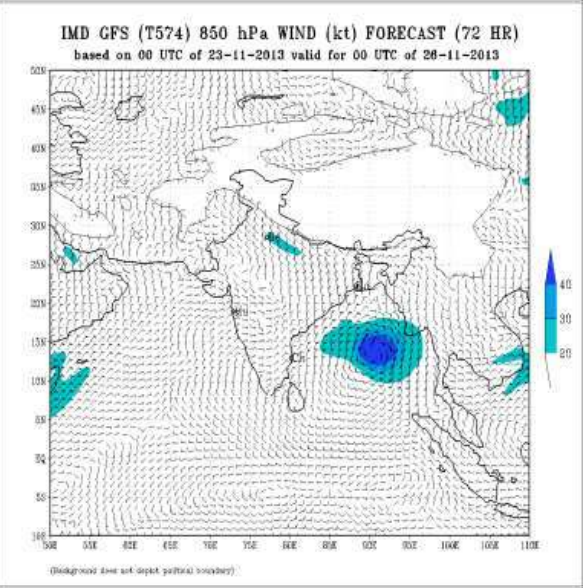
22.11.2013	
06Z	18Z
6	5

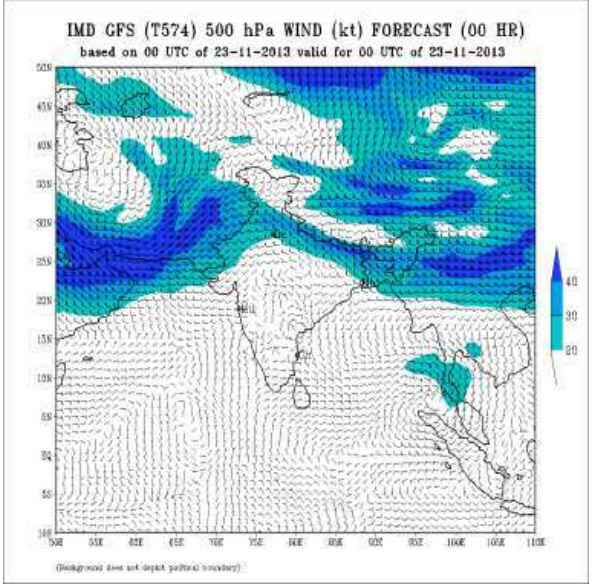
Annexure-II

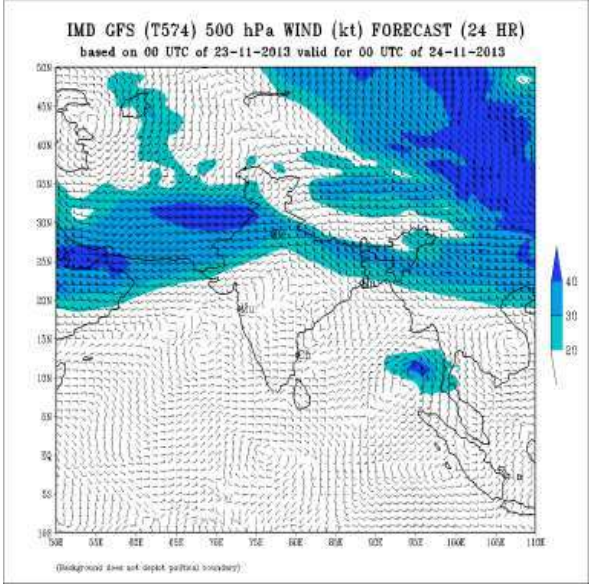

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 23-11-2013 valid for 00 UTC of 23-11-2013

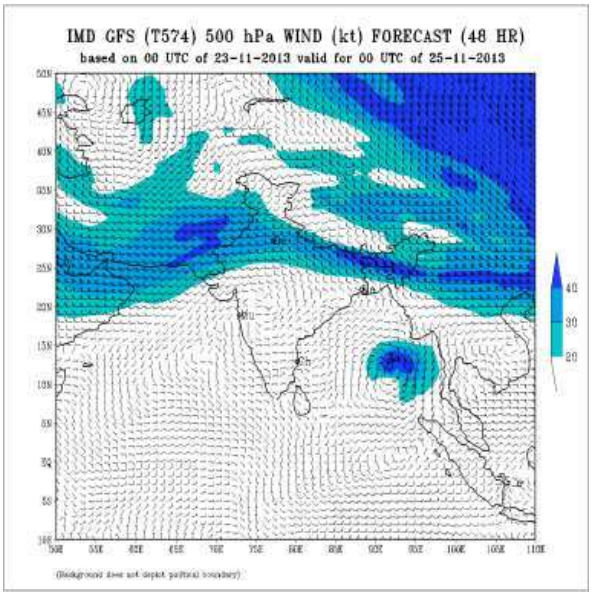

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 23-11-2013 valid for 00 UTC of 24-11-2013

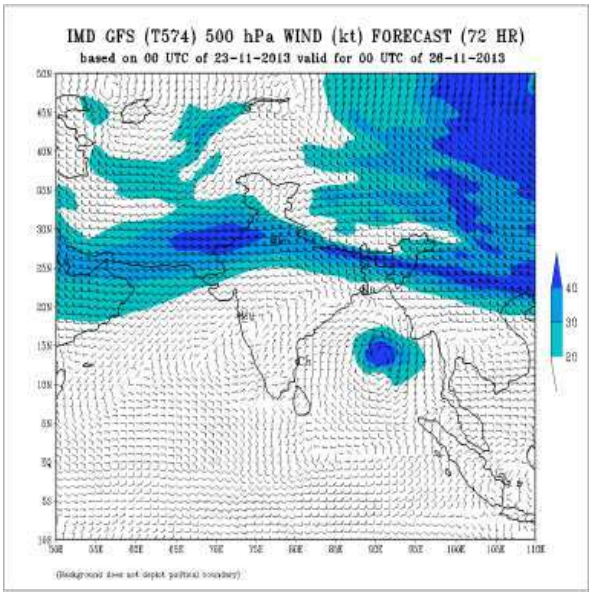

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 23-11-2013 valid for 00 UTC of 25-11-2013

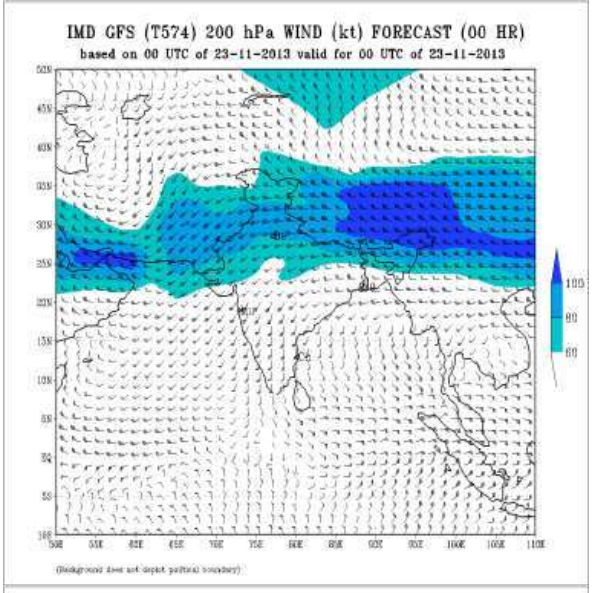

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 23-11-2013 valid for 00 UTC of 26-11-2013

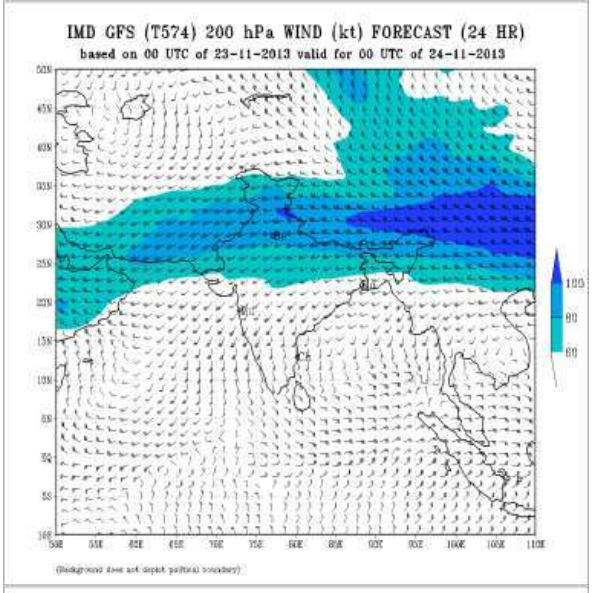

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 23-11-2013 valid for 00 UTC of 23-11-2013

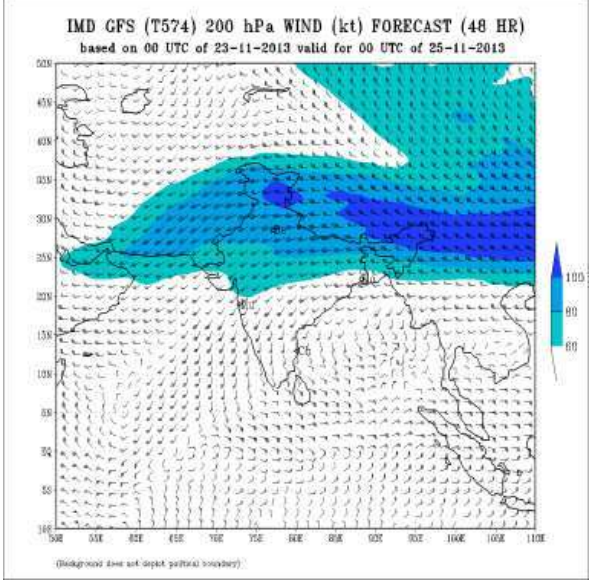

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 23-11-2013 valid for 00 UTC of 24-11-2013

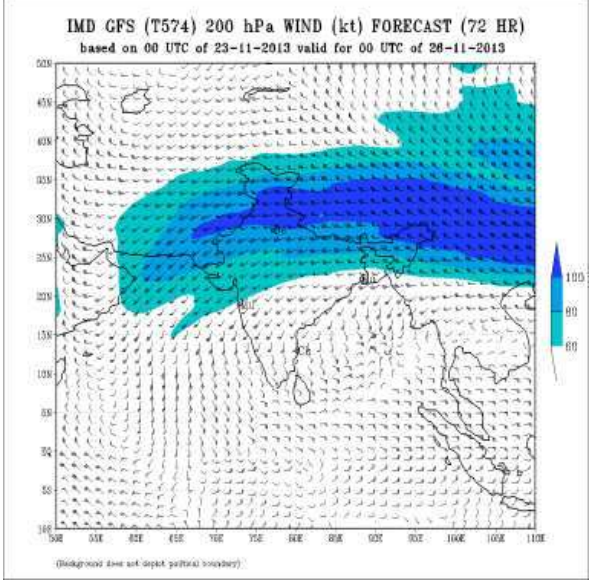

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 23-11-2013 valid for 00 UTC of 25-11-2013

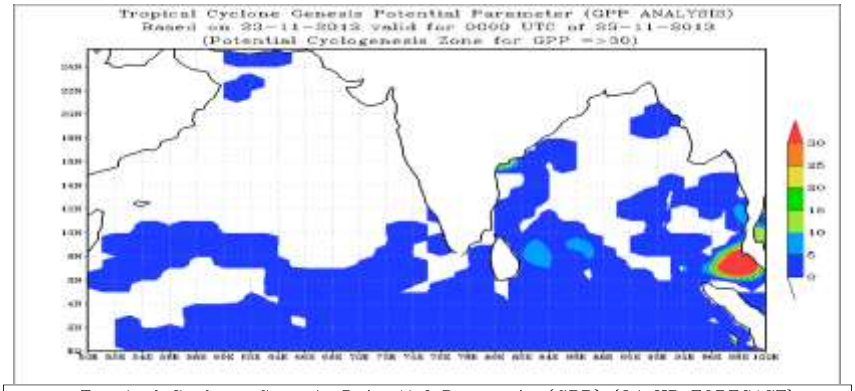

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 23-11-2013 valid for 00 UTC of 26-11-2013

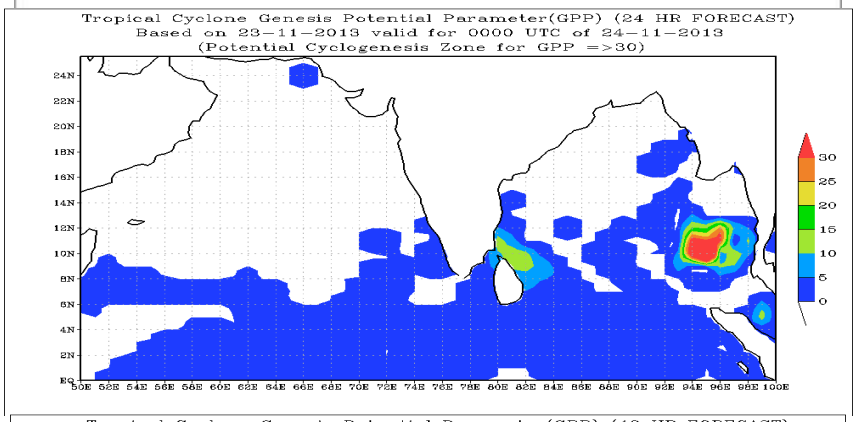

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 23-11-2013 valid for 00 UTC of 23-11-2013

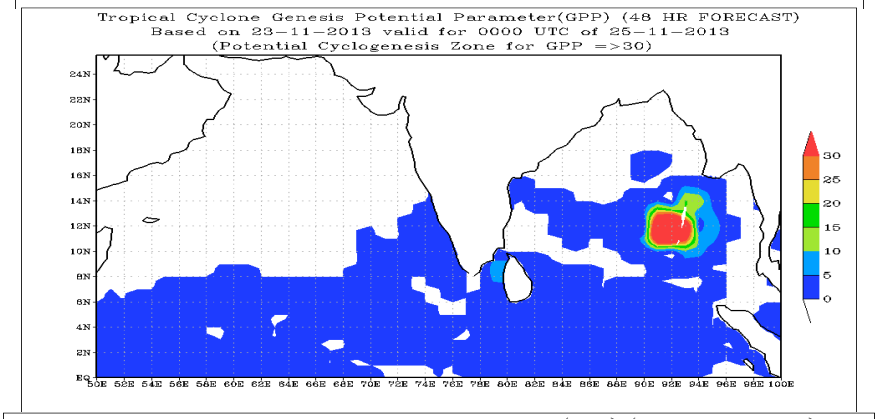

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 23-11-2013 valid for 00 UTC of 24-11-2013

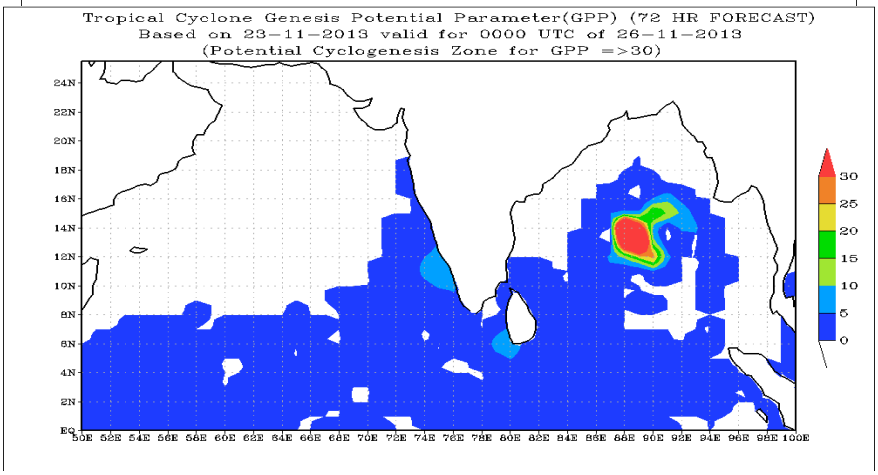

IMD GFS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 23-11-2013 valid for 00 UTC of 25-11-2013


IMD GFS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 23-11-2013 valid for 00 UTC of 26-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 23-11-2013 valid for 0000 UTC of 23-11-2013
(Potential Cyclogenesis Zone for GPP =>30)
30
25
20
15
10
5
0


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 23-11-2013 valid for 0000 UTC of 24-11-2013
(Potential Cyclogenesis Zone for GPP =>30)
30
25
20
15
10
5
0


Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 23-11-2013 valid for 0000 UTC of 25-11-2013
(Potential Cyclogenesis Zone for GPP =>30)
30
25
20
15
10
5
0


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 23-11-2013 valid for 0000 UTC of 26-11-2013
(Potential Cyclogenesis Zone for GPP =>30)
30
25
20
15
10
5
0

FDP (Cyclone) NOC Report Dated 24th November, 2013

Synoptic features based on 0300 UTC:

- The well marked low pressure area over Andaman Sea intensified into a depression in the evening of yesterday and further intensified into a cyclonic storm in the morning of today. It is located near 11.0^0N and 93.5^0E at 1200 UTC of 24 Nov 2013.
- The upper air cyclonic circulation over Lakshadweep and neighbourhood in lower levels persists.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 27-30^0C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay and along the east coast of India. It is 50-80 KJ cm^{-2} over eastcentral ,southeast Bay of Bengal and Andman Sea. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive (more than 80 * $10^{-5}s^{-1}$) over South Andman Sea around WML. It is negative over rest Bay of Bengal.

Convergence:

- Lower level convergence is positive of the order of 10-20 *10^{-5} s^{-1} over Andaman Sea.

Divergence:

- It is positive of the order of 10-20*10^{-5} s^{-1} over Andaman Sea and adjoining SE Bay of Bengal.

Wind Shear:

- **W**ind Shear is 10-20 knots Andman Sea and central Bay of Bengal. It is more than 20 knots over North and South Bay of Bengal .

Wind Shear Tendency:

Shear Tendency is increasing over central, southeast Bay of Bengal and Andaman Sea.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 17.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 2 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may move in phase 2 to 3 with amplitude less than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 240900 UTC

- Vortex over Andman Sea and neighbourhood centred with half a degee of Lat. 8.0N Long. 97.3E . Intensity T 1.0 . Associated broken low/medium cloud embedded with intence to very intense convection seen over south Andaman Sea adjoining Tenaserim coast.

NWP Analysis

- IMD-GFST574 model analysis based on 0000 UTC of 24th November 2013 shows a **Cyclonic storm** over Andaman Sea centered near latitude 10.0°N and longitude 95.0°E. GFST574 model forecasts show the movement of the system in a northwestward direction during next 72 hours.
- The analysis chats of mean sea level pressure and wind at the levels 850 hPa, 500 hPa and 200 hPa of the model GFST574 based on 0000UTC of 24th November, 2013 and their 24 to 72 hour forecasts are given in **Annexure I**.
- The analysis and forecast of weather charts of IMD-WRF model based on 0000 UTC of 24th November 2013 also show a Cyclonic storm over Andaman Sea centered near latitude 10.0°N and longitude 95.0°E which may move in a northwestward direction during next 72 hours.
  (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
- **Genesis Potential Parameter (GPP)** analysis based on 0000 UTC of 24th November 2013 shows a region of high GPP over Andaman Sea and adjoining areas. **Genesis Potential Parameter (GPP)** forecasts based on 0000 UTC of 24th November 2013 show the region of high GPP likely to move in a North West ward direction during next 72 hours.
- The analysis of GPP charts and forecasts for 24 hr to 72 hr are shown in **Annexure II**. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

- **ECMWF:** Model is show that a low presuure area on 23th Nov over South Andman Sea. It is likely to intensify as Depression during next 24 hrs and move northwest direction. Model is showing further intensification.
- **ARP: :** This model shows a Low over south Andaman Sea on 23rd Nov and further intensification with north-westwards movement.
- **JMA:** Model show that a LOW over south Andaman Sea on 23rd Nov. It would intensify and move north-westwards during next 72 hrs.
- **UKMO:** (22/00) **:** This model shows that a Low over south Andaman Sea on 23 Nov and intensify as depression on 24 Nov .It would intensify and move west-northwest wards become CS on 25 Nov.
- **GEFS** (NCMRWF)**:** Model shows that a Depression on 23 Nov over south Andaman Sea .It would intensify and move west-northwest wards during next 3-4 days. This model is showing fast intensification.

Genesis Potential Parameter (GPP:

- **Genesis Potential Parameter (GPP)** analysis based on 0000 UTC of 24th November 2013 shows a region of high GPP over south Andaman Sea and adjoining areas. **Genesis Potential Parameter (GPP)** forecasts based on 0000 UTC of 24th November 2013 show the region of high GPP likely to move in a North West ward direction during next 72 hours.
- The analysis of GPP charts and forecasts for 24 hr to 72 hr are shown in **Annexure II**. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and conclusion:

- The cyclonic storm would cross A & N Islands near Port Blair and continue to move west northwestwards and cross AP coast between Machillipatnam and Kalingapatnam, near Kakinada around noon of 28 November as a very severe cyclonic storm with wind speed of 170-180 kmph gusting to 200 kmph.

Advisory:

- IOP to continue for Andaman Sea 24-28 November 2013 for Andhra Pradesh, south Odisha coast.
- IOP to continue for A & N Island till 25th November 2013.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	23/12	**2400**	**24/03**
India	30/51	28/33	34/51
Coastal stations			
WB	3/9	3/9	4/9
Odisha	5/7	4/7	5/7
AP	9/14	9/13	9/14
Tamil Nadu	6/12	7/7	8/12
Puducherry	2/2	2/2	2/2
A & N	5/7	3/7	6/7
Bangladesh	7/11	7/11	8/11
Myanmar	8/11	8/11	8/11
Thailand	3/3	3/3	3/3
Srilanka	7/9	6/9	7/9

RS/RW (12Z) of 23/11/2013 3/39

- **No. of Ascents reaching 250 hPa levels:1, MISDA: -35**
- **RS/RW** (00Z) of 24/11/2013 17/39
- **No. of Ascents reaching 250 hPa levels:17 , MISDA:-14**

No. of PILOT Ascents

23/12Z	**24/00Z**
2/37	26/34

Buoy Data

23/12Z	**24/00Z**	**24/03Z**
9	6	8

Data Statistics over RMC Chennai Region

No. of Synop data

Date→	**23.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coastsof AP & TN)	**20**	**21**	**20**	**19**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /23.11.2013 : 5

No. of Ascents reaching 250 hPa level =5

MISDA : 3

12Z /23.11.2013 : 0

No. of Ascents reaching 250 hPa level =--

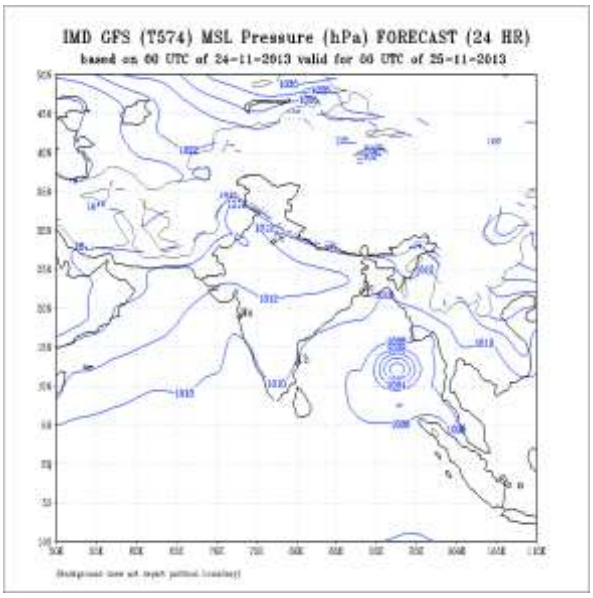
MISDA : 8

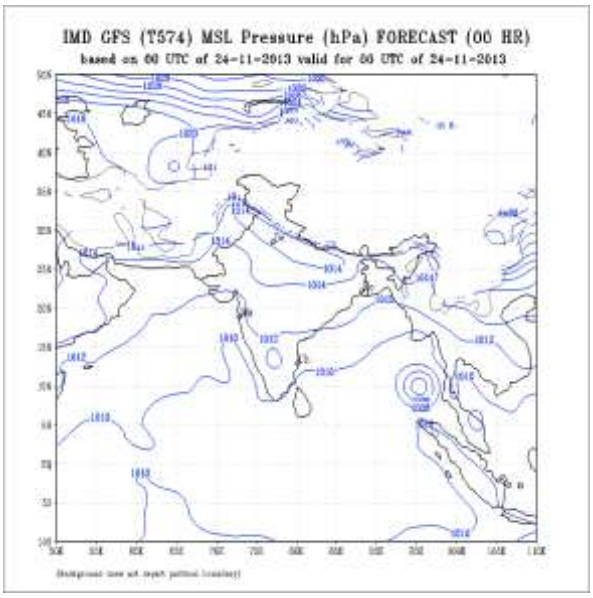
No. of PILOT Ascents:

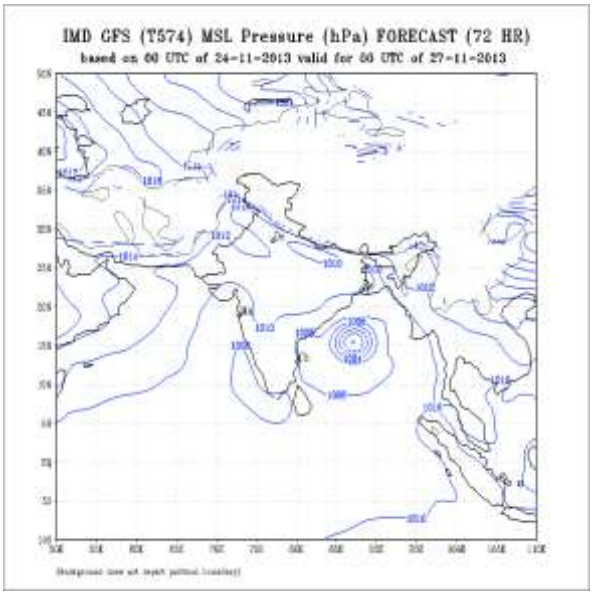
23.11.2013

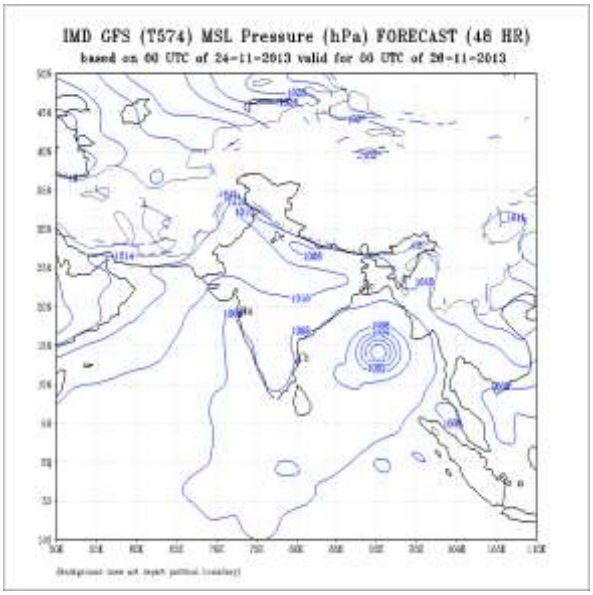
06Z	18Z
5	3

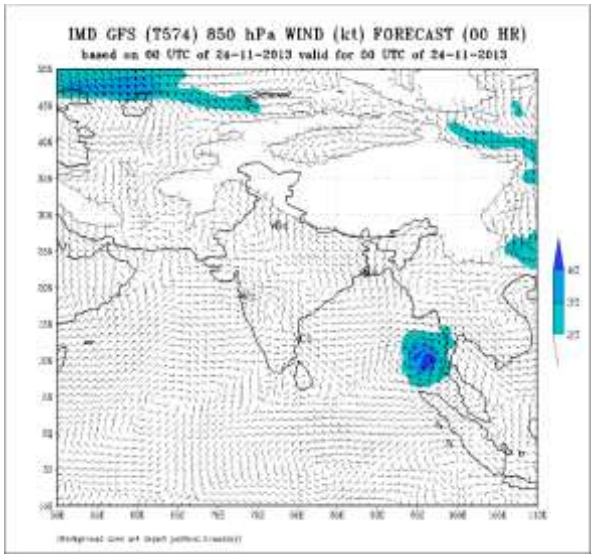
Annexure-II

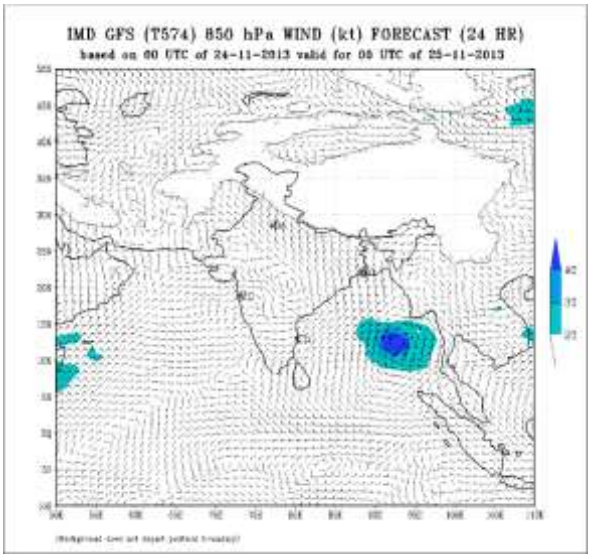

IMD GFS (T574) MSL Pressure (hPa) FORECAST (24 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 25-11-2013

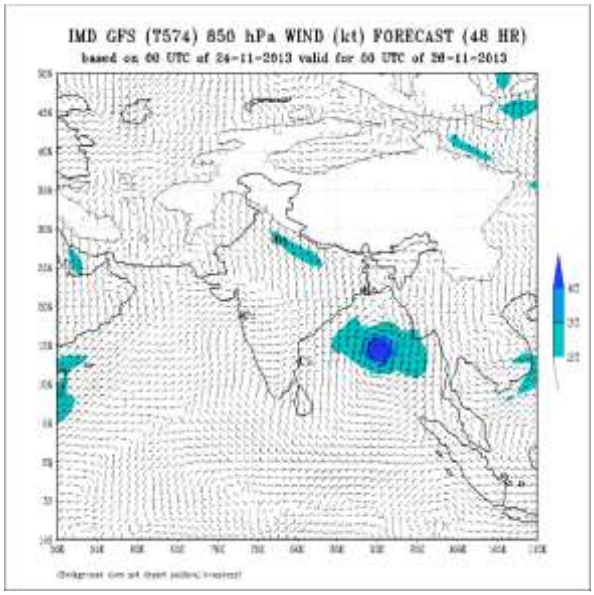

IMD GFS (T574) MSL Pressure (hPa) FORECAST (00 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 24-11-2013

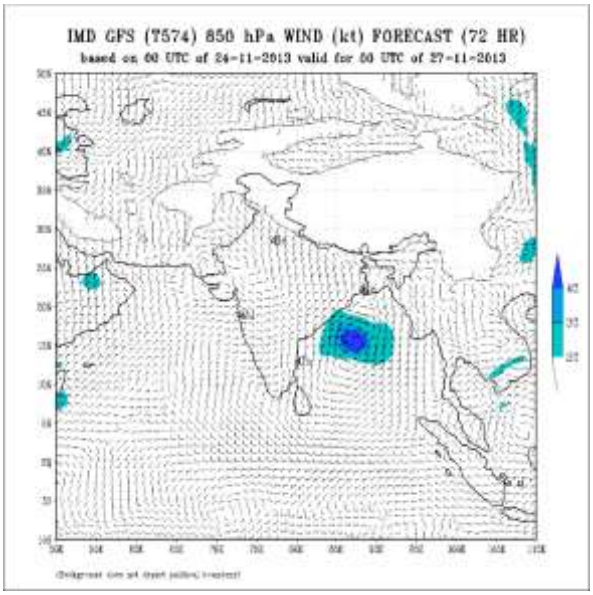

IMD GFS (T574) MSL Pressure (hPa) FORECAST (72 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 27-11-2013

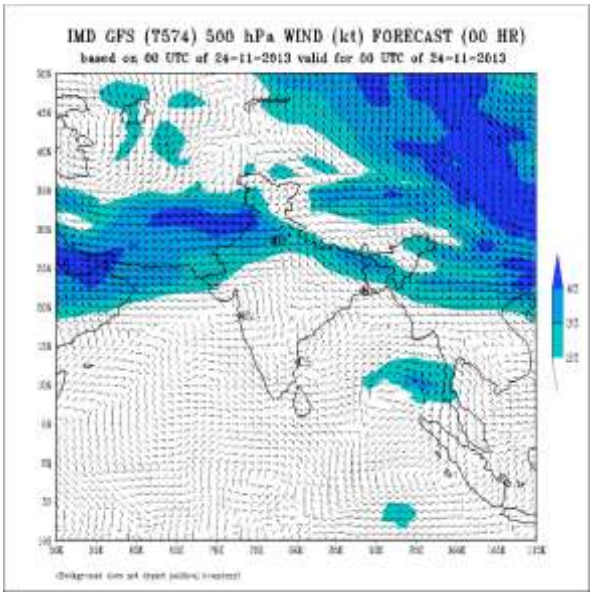

IMD GFS (T574) MSL Pressure (hPa) FORECAST (48 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 26-11-2013

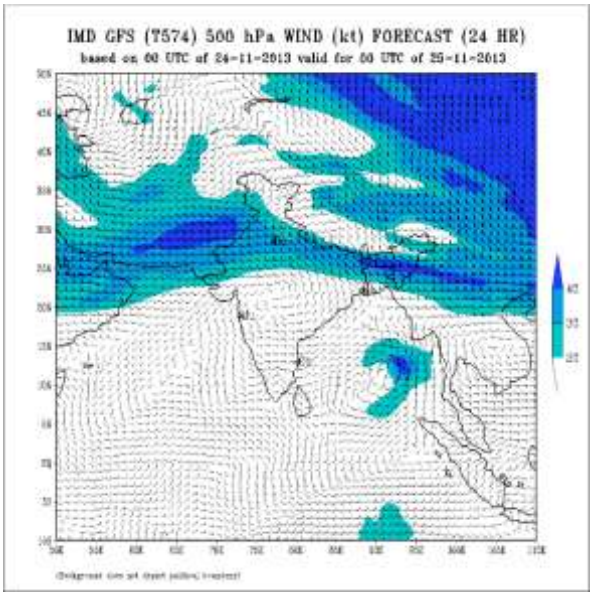

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 24-11-2013

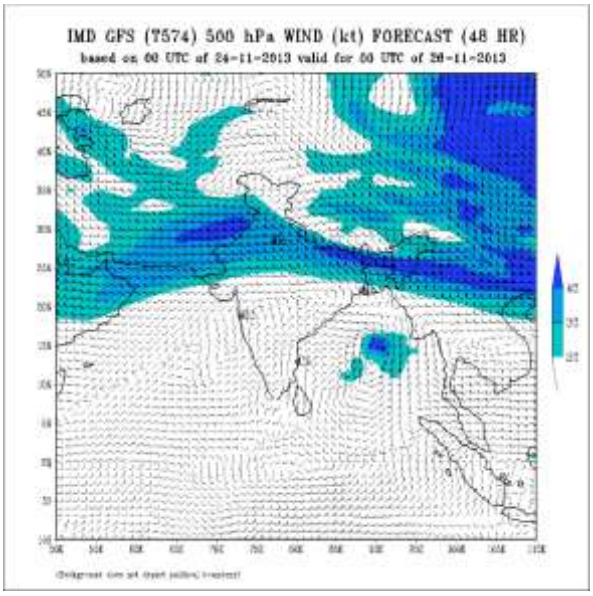

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 25-11-2013

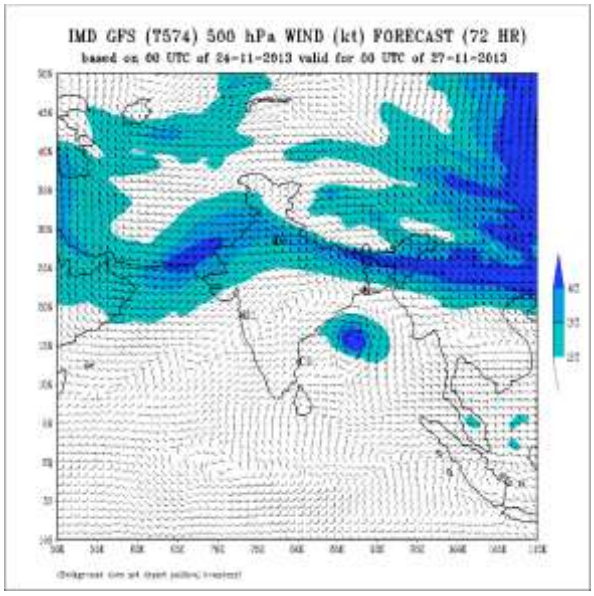

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 26-11-2013

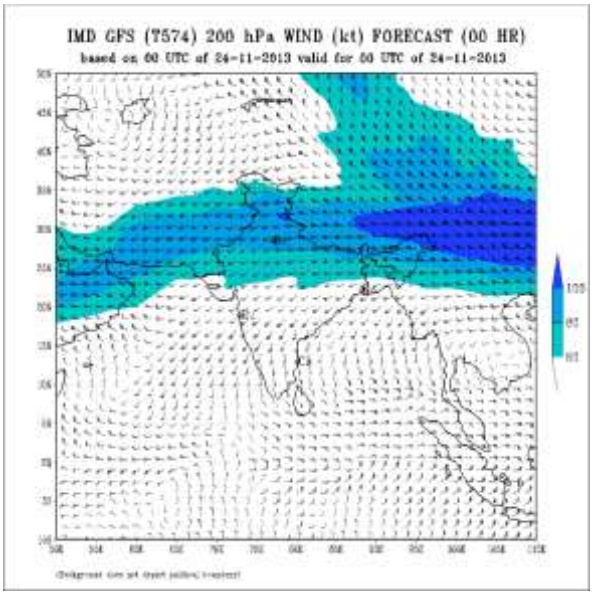

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 27-11-2013

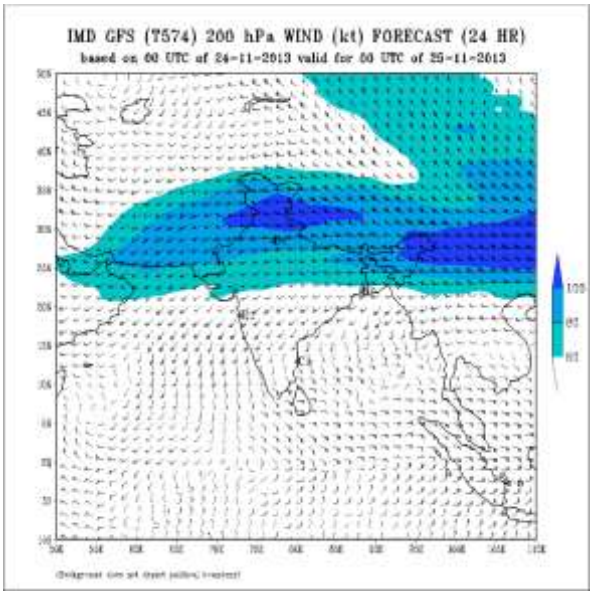

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 24-11-2013

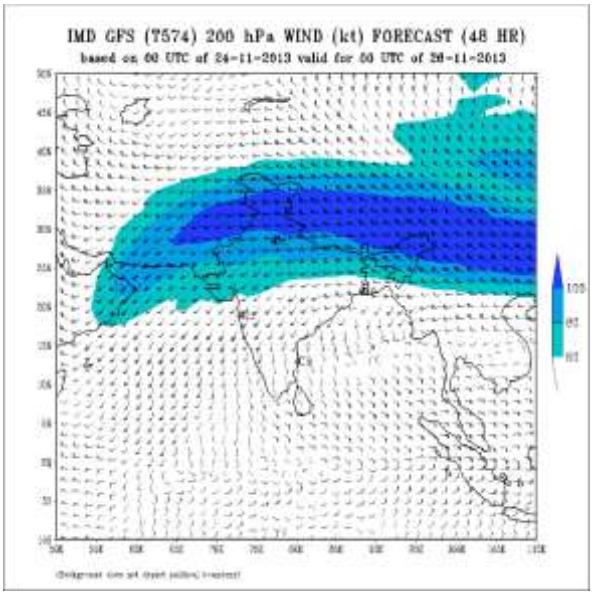

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 25-11-2013

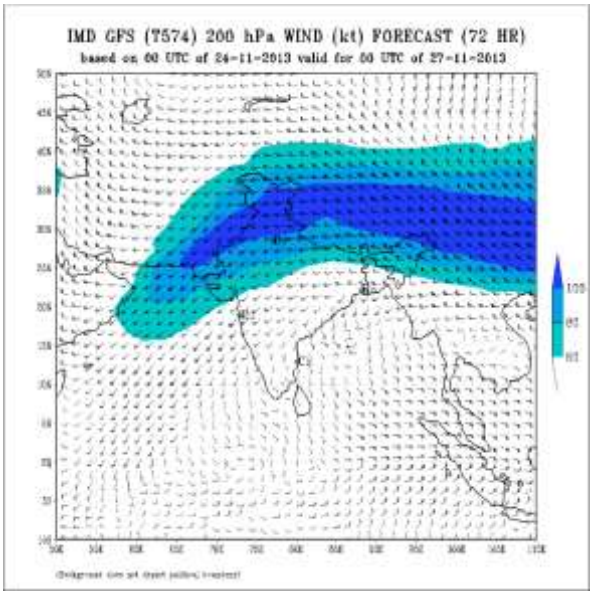

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 26-11-2013

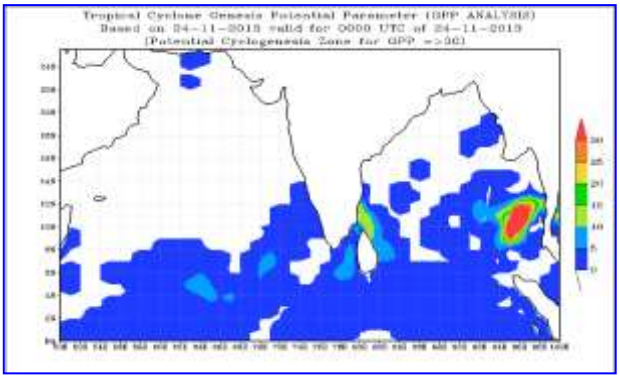

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 27-11-2013

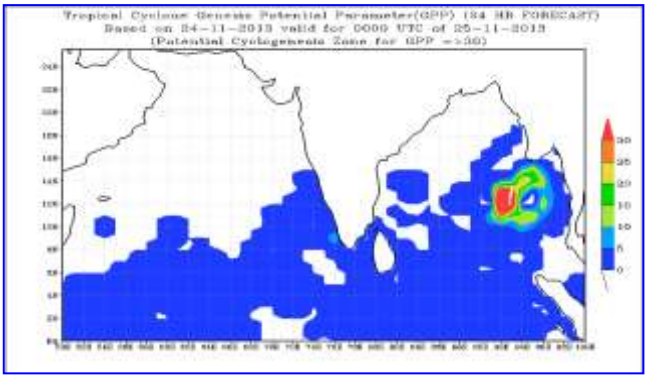

IMD GFS (7574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 24-11-2013

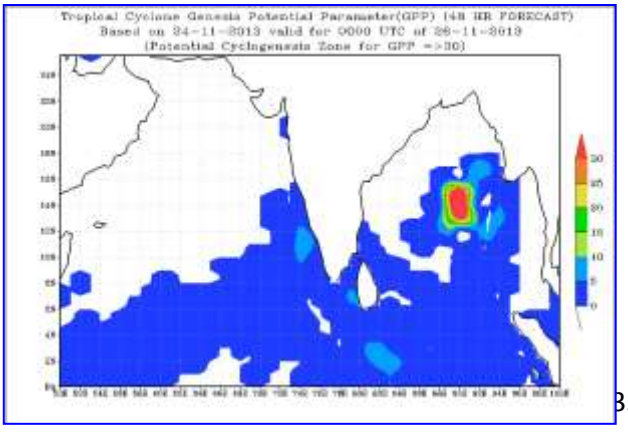

IMD GFS (7574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 25-11-2013

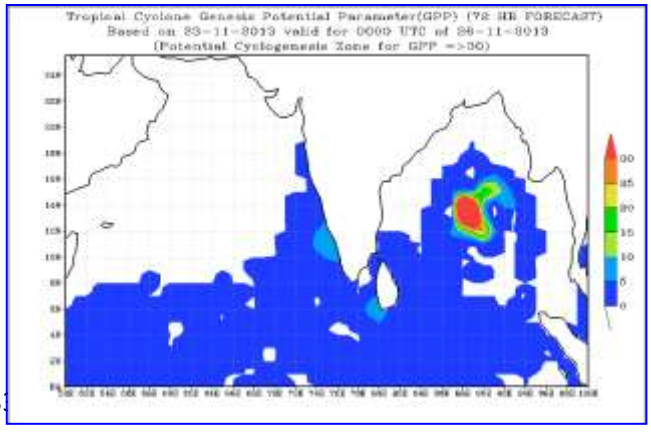

IMD GFS (7574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 26-11-2013


IMD GFS (7574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 24-11-2013 valid for 00 UTC of 27-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 24-11-2013 valid for 0000 UTC of 24-11-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 24-11-2013 valid for 0000 UTC of 25-11-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 24-11-2013 valid for 0000 UTC of 26-11-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 24-11-2013 valid for 0000 UTC of 27-11-2013
(Potential Cyclogenesis Zone for GPP =>30)

FDP (Cyclone) NOC Report Dated 25 November, 2013

Synoptic features based on 0300 UTC:

- The Cyclonic Storm **Lehar** over Andaman Sea moved west-northwestwards and lay centred at 1200 UTC of yesterday, the 24th November 2013, within half a degree of Lat.11.0° N and Long. 93.5° E, about 120 kms east-southeast of Port Blair. It moved northwestwards and intensified into a Severe Cyclonic Storm 'Lehar' cossed Andaman and Nicobar Islands, close to Port Blair in the early morning and lay centred at 0000 UTC of today, the 25th November 2013 over southeast Bay of Bengal within half a degree of Lat. 12.0° N and Long. 92.5° E, close to Port Blair 1300 kms east-southeast of Machilipatnam . It further moved west-northwestwards and lies centred at 0300 UTC of today, the 25th November 2013 over southeast Bay of Bengal within half a degree of Lat. 12.0° N and Long. 92.0° E. It further moved westward and lay centred at 0900 UTC of 25th November 2013 near Lat. 12.0° N and Long. 91.5° E . The system would intensify further gradually into a very severe cyclonic storm and would move west-northwestwards and cross Andhra Pradesh coast between Machillipatnam and Kalingapatnam near Kakinada around 28th November noon.
- A trough at mean sea level extends from south Tamil Nadu to south Madhya Maharashtra with an embedded cyclonic circulation over north interior Karnataka and adjoining south Madhya Maharashtra.
- The cyclonic circulation extending upto 2.1 kms a.s.l. over south Tamil Nadu and neighbourhood now lies over south Tamil Nadu and adjoining Comorin area
- The upper air cyclonic circulation over Lakshadweep area and neighbourhood has become less marked.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 28-29^{0}C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay and along the east coast of India. It is 50-80 KJ cm^{-2} over eastcentral ,southeast Bay of Bengal and Andman Sea. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive (more than 1000 * 10^{-5}s^{-1}) around the severe cyclonic storm and it is it is more than 150* 10-5s-1 to the southeast of the system

Convergence:

- Lower level convergence is positive of the order of 10-15 *10^{-5} s^{-1} to the northeast of the system Andaman Sea.

Divergence:

- It is positive of the order of 10-30*10^{-5} s^{-1} around the system.

Wind Shear:

Wind Shear is 10-20 knots over the system centre. It is more than 20-40 knots over North and South Bay of Bengal .

Wind Shear Tendency:

Shear Tendency is decreasing to the northeast of the system.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 15.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 3 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 3 with amplitude less than 1.0 during next 4-5 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 250900 UTC

- Vortex over southeast and adjoining eastcentral Bay of Bengal cetred Lat. 12.^{0}N Long. 91.9^{0}E **.** Intensity T 3.5 **.** Associated broken low/medium cloud embedded with intence to very intense convection seen over the area between 9.0^{0}N to 18.0^{0}N and Long. 88.0^{0}E to 95.0^{0}E &Andaman Sea.

NWP Analysis

- IMD-GFST574 model analysis based on 0000 UTC of 25th November 2013 shows a Severe Cyclonic storm over southeast Bay of Bengal centered near Latitude 12.0°N and Longitude 92.0°E. GFST574 model forecasts show the movement of the system in west-northwestward direction during next 72 hours.

- The analysis charts of wind at the levels 850 hPa, 500 hPa and 200 hPa of the model GFST574 based on 0000 UTC of 25th November, 2013 and their 24 to 72 hour forecasts are given in Annexure II.

- The analysis and forecast of weather charts of IMD-WRF model based on 0000 UTC of 25th November 2013 also show a Severe Cyclonic storm over southeast Bay of Bengal centered near Latitude 12.0°N and Longitude 92.0°E which may move in west-northwestward direction during next 72 hours.

  (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
- Genesis Potential Parameter (GPP) analysis based on 0000 UTC of 25th November 2013 shows a region of high GPP over southeast Bay of Bengal and adjoining areas. Genesis Potential Parameter (GPP) forecasts based on 0000 UTC of 25th November 2013 show the region of high GPP likely to move in a North West ward direction during next 72 hours.
- The analysis of GPP charts and forecasts for 24 hr to 72 hr are shown in Annexure II.
- (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Genesis Potential Parameter (GPP):

- Genesis Potential Parameter (GPP) analysis based on 0000 UTC of 24th November 2013 shows a region of high GPP over south Andaman Sea and adjoining areas. Genesis Potential Parameter (GPP) forecasts based on 0000 UTC of 24th November 2013 show the region of high GPP likely to move in a North West ward direction during next 72 hours.
- The analysis of GPP charts and forecasts for 24 hr to 72 hr are shown in Annexure II. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and conclusion:

- The severe cyclonic storm **LEHAR** would intensify further gradually into a very severe cyclonic storm and would move west-northwestwards and cross Andhra Pradesh coast between Machillipatnam and Kalingapatnam near Kakinada around 28th November noon.

Advisory:

- IOP to continue for 25-28 November 2013 for Andhra Pradesh, south Odisha coast.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	24/12	**2500**	**25/03**
India	30/51	28/33	34/51
Coastal stations			
WB	6/9	3/9	6/9
Odisha	6/7	5/6	6/7
AP	1214	12/13	12/14
Tamil Nadu	9/12	7/7	8/12
Puducherry	2/2	2/2	2/2
A & N	5/7	1/7	6/7
Bangladesh	10/11	8/11	10/11
Myanmar	7/11	7/11	6/11
Thailand	3/3	3/3	3/3
Srilanka	7/9	6/9	7/9

RS/RW (12Z) of 24/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:2, MISDA: -35**
- **RS/RW** (00Z) of 25/11/2013 22/39
- **No. of Ascents reaching 250 hPa levels:17 , MISDA:-17**

No. of PILOT Ascents

24/12Z	**25/00Z**
24/37	11/34

Buoy Data

24/12Z	**25/00Z**	**25/03Z**
8	9	8

Data Statistics over RMC Chennai Region

No. of Synop data

Date→	24.11.2013							
UTC→	00	03	06	09	12	15	18	21
Chennai Region (Coasts of AP & TN)	20	22	20	20	22	20	20	20

No. of RS/RW Ascents

00Z /24.11.2013 : 4

No. of Ascents reaching 250 hPa level = 4

MISDA : 4

12Z /24.11.2013 : 0

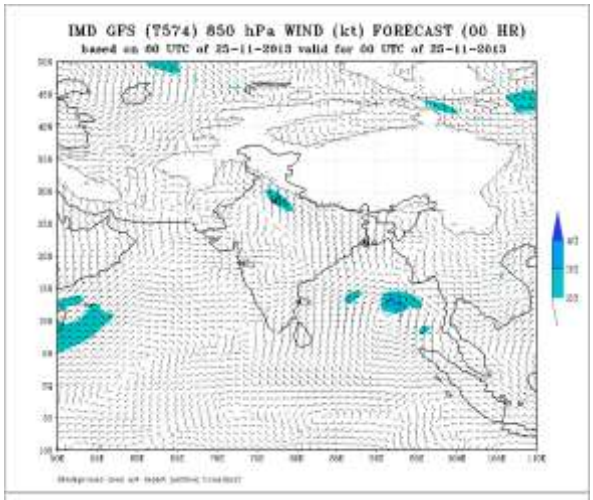
No. of Ascents reaching 250 hPa level =--

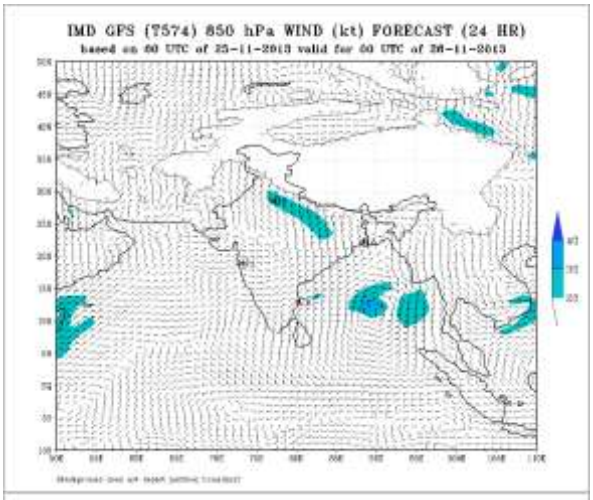
MISDA : 8

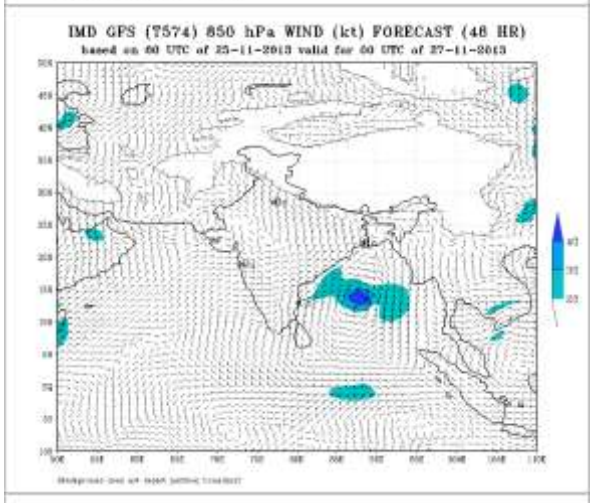
No. of PILOT Ascents:

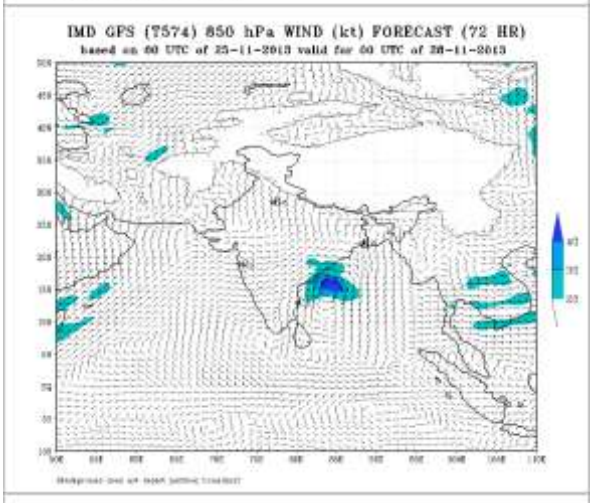
24.11.2013	
06Z	18Z
7	3

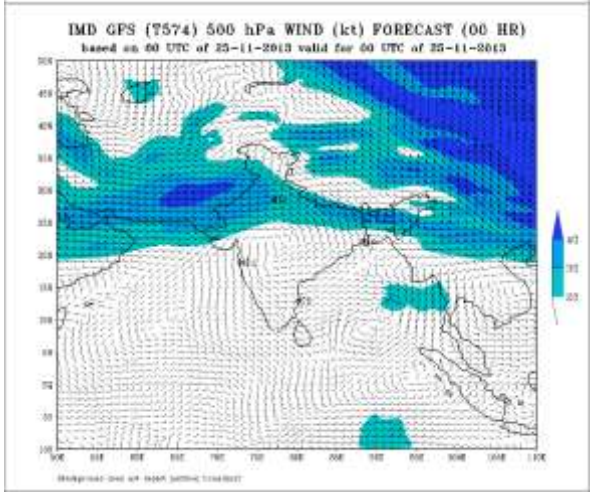
Annexure-II

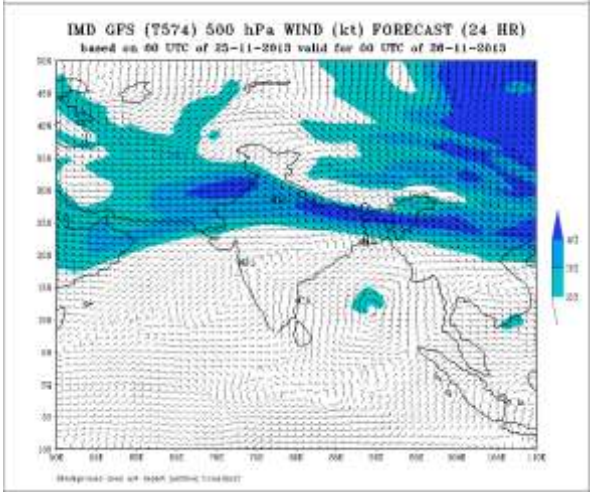

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 25-11-2013 valid for 00 UTC of 25-11-2013

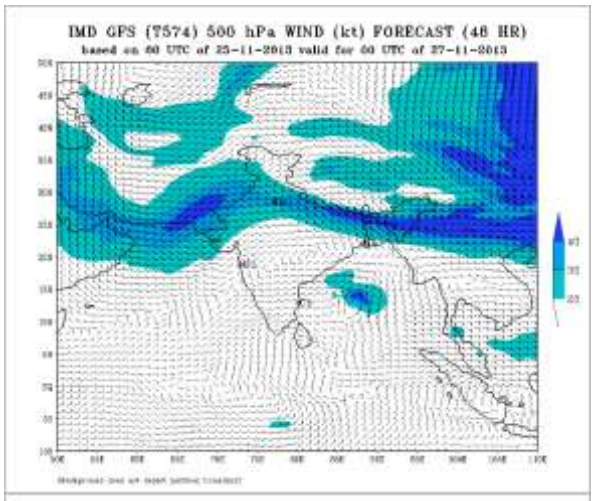

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 25-11-2013 valid for 00 UTC of 26-11-2013

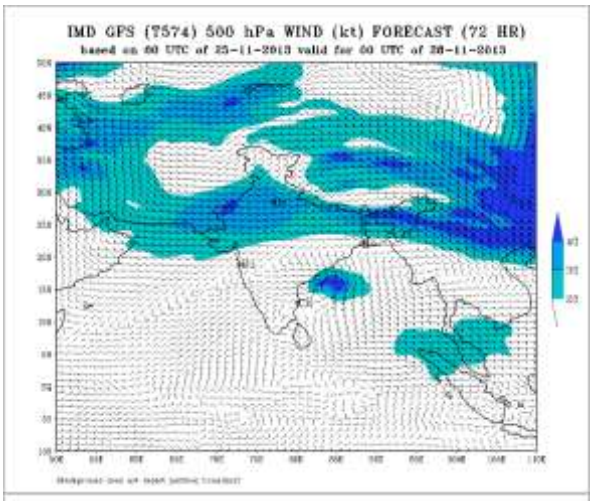

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 25-11-2013 valid for 00 UTC of 27-11-2013

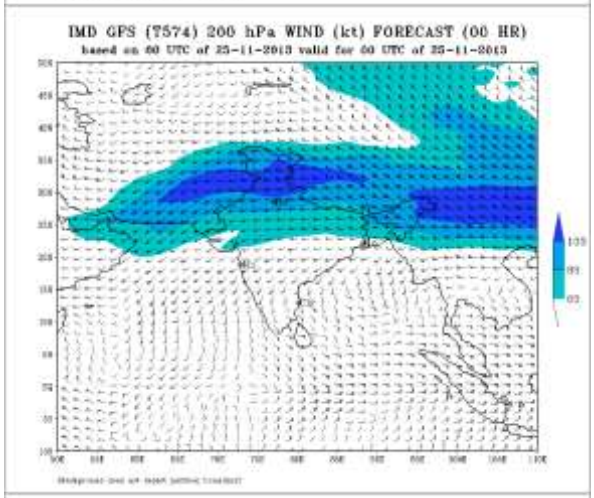

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 25-11-2013 valid for 00 UTC of 28-11-2013

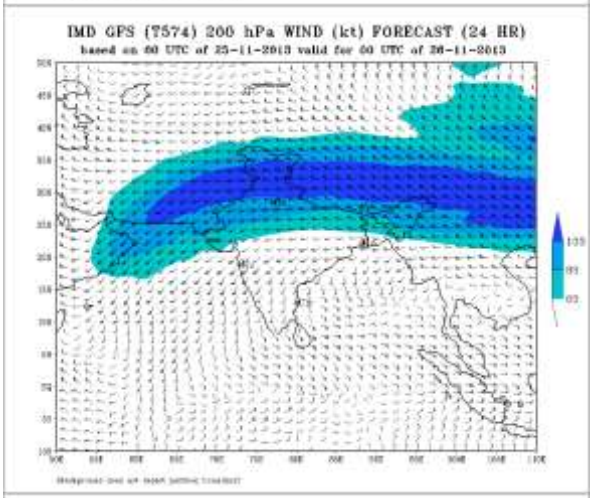

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 25-11-2013 valid for 00 UTC of 25-11-2013

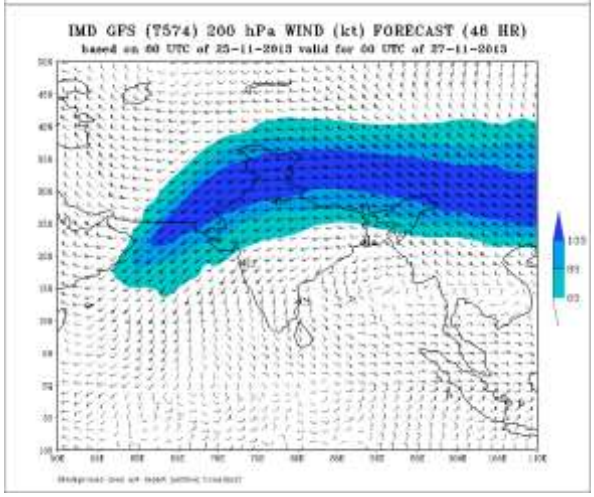

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 25-11-2013 valid for 00 UTC of 26-11-2013

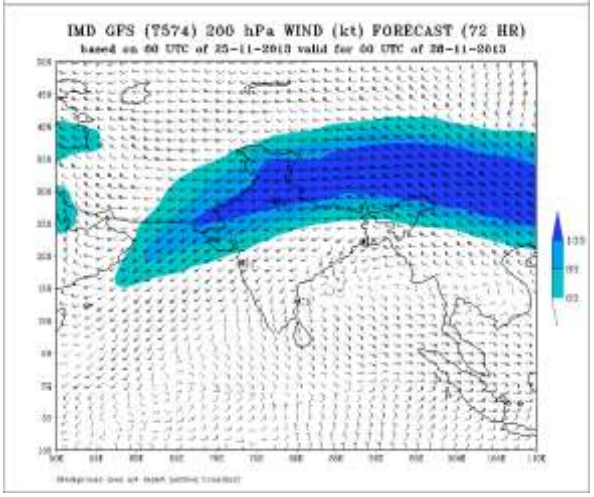

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 25-11-2013 valid for 00 UTC of 27-11-2013

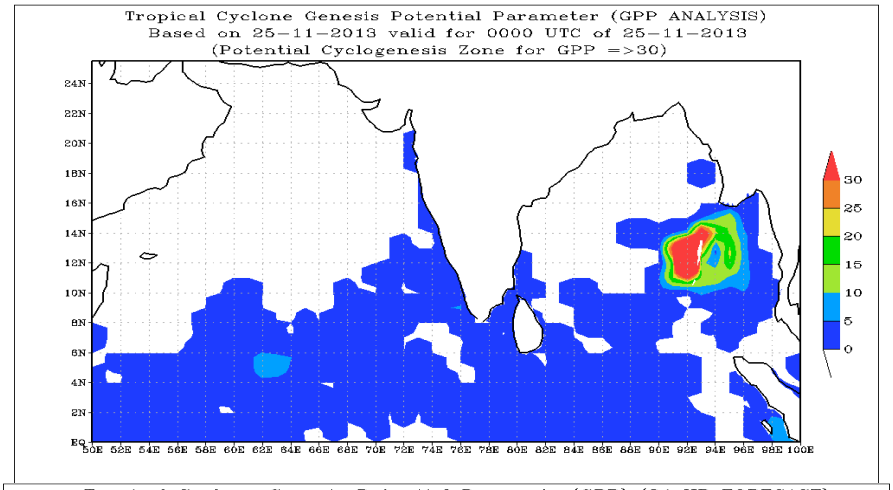

IMD GPS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 25-11-2013 valid for 00 UTC of 28-11-2013

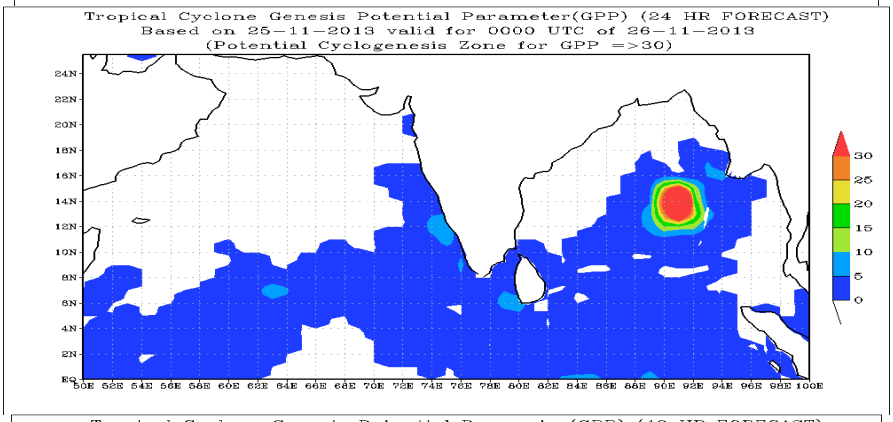

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 25-11-2013 valid for 00 UTC of 25-11-2013

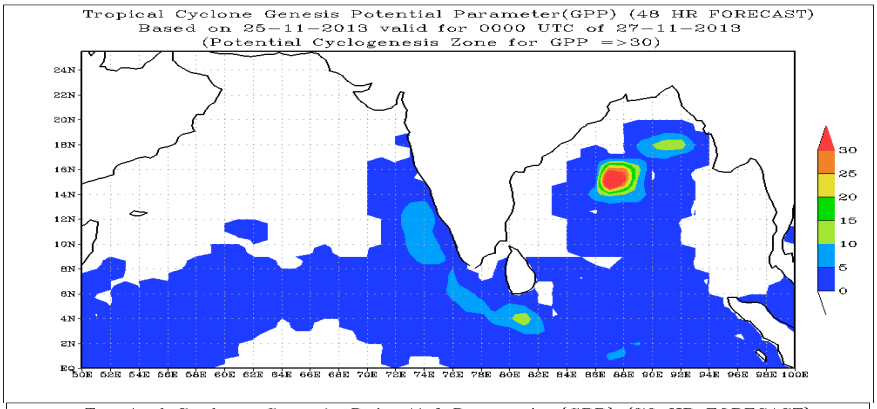

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 25-11-2013 valid for 00 UTC of 26-11-2013

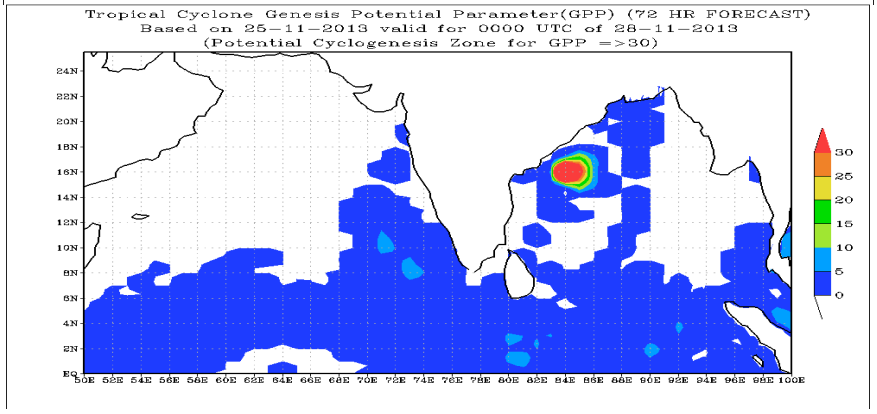

IMD GPS (T574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 25-11-2013 valid for 00 UTC of 27-11-2013


IMD GPS (T574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 25-11-2013 valid for 00 UTC of 28-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 25-11-2013 valid for 0000 UTC of 25-11-2013
(Potential Cyclogenesis Zone for GPP =>30)
30
25
20
15
10
5
0


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 25-11-2013 valid for 0000 UTC of 26-11-2013
(Potential Cyclogenesis Zone for GPP =>30)
30
25
20
15
10
5
0


Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 25-11-2013 valid for 0000 UTC of 27-11-2013
(Potential Cyclogenesis Zone for GPP =>30)
30
25
20
15
10
5
0


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 25-11-2013 valid for 0000 UTC of 28-11-2013
(Potential Cyclogenesis Zone for GPP =>30)
30
25
20
15
10
5
0

FDP (Cyclone) NOC Report Dated 26 November, 2013

Synoptic features based on 0300 UTC:

- The **Severe Cyclonic Storm 'Lehar'** over southeast Bay of Bengal moved northwestwards and lay centred at 1200 UTC of yesterday, the 25th November 2013 over southeast Bay of Bengal within half a degree of Lat. 12.5° N and Long. 91.0° E,about 200 kms west-northwest of Port Blair, 1100 kms east-southeast of Machilipatnam. It remained practically stationary and intensified into a **Very SevereCyclonic Storm 'Lehar'**, lay centred at 2100 UTC of yesterday, the 25th November2013 over southeast Bay of Bengal. It moved westwards and lies centred at 0300 UTC of today, the 26th November 2013 over southeast Bay of Bengal within half a degree of Lat. 12.5° N and Long. 90.0° E, about 300 kms west-northwest of Port Blair, 1030 kms east- southeast of Machilipatnam, 970 kms east-southeast of Kakinada and 900 kms southeast of Kalingapatnam. It moved further west-northwestward lay centred at 0900 UTC of 26 over southeast Bay and adjoining west central Bay of Bengal near Lat. 13.0^0N and Long. 89.0^0E, about 850 km east-southeast of Kakinada. The system would intensify further and move west- northwestwards and cross Andhra Pradesh coast between Machilipatnam and Kalingapatnam near Kakinada around 28th November noon.
- The cyclonic circulation extending upto 2.1 kms a.s.l. over south Tamil Nadu and adjoining Comorin area now lies over Comorin and adjoining Lakshadweep area.
- The trough at mean sea level from south Tamil Nadu to south Madhya Maharashtranow extends from the above cyclonic circulation to south Konkan & Goa acrossKarnataka.

Environmental features based on 0300 UTC of today: Sea Surface Temperature:

- SST is around 28-29^0C over Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay and along the east coast of India. It is 50-80 KJ cm^{-2} over eastcentral ,southeast Bay of Bengal and Andman Sea. It is 80-120 KJ cm^{-2} over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive (more than 100 * $10^{-5}s^{-1}$) around the severe cyclonic storm and it is it is more than 150* 10-5s-1 to the southeast of the system

Convergence:

- Lower level convergence is positive of the order of 5 *10^{-5} s^{-1} to the northeast of the system and Andaman Sea.

Divergence:

- It is positive of the order of 5-10*10^{-5} s^{-1} to the northeast of the system.

Wind Shear:

- Wind Shear is 5-10 knots over the system centre. It is more than 20-40 knots over North and South Bay of Bengal .

Wind Shear Tendency:

- Shear Tendency is decreasing over central Bay and north of the syste system.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 16.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 4 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 4 & 5 with amplitude less than 1.0 during next 4 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 260900 UTC

- Vortex over southeast and adjoining eastcentral Bay of Bengal cetred Lat. 12.7^0N **&** Long. 88.9^0E **.** Intensity T4.0 **.** Associated broken low/medium cloud embedded with intence to very intense convection seen over the area between 10.0^0N to 16.0^0N and Long. 86.0^0E to 91.5^0E.

NWP Analysis

- IMD-GFST574 model forecasts based on 0000 UTC of 26th November 2013 shows west-northwestward movement of the cyclone LEHAR during next 72 hours.
- The analysis charts of wind at the levels 850 hPa, 500 hPa and 200 hPa of the model GFST574 based on 0000 UTC of 26th November, 2013 and their 24 to 72 hour forecasts are given in Annexure II.
- IMD-WRF model forecasts based on 0000 UTC of 26th November 2013 shows west-northwestward movement of the cyclone LEHAR during next 72 hours. (http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)• Genesis Potential Parameter (GPP) analysis based on 0000 UTC of 26th November 2013 shows a region of high GPP over southeast Bay of Bengal in associated with the cyclone LEHAR. Genesis Potential Parameter (GPP) forecasts based on 0000 UTC of 26th November 2013 show the region of high GPP likely to move in a North West ward direction during next 72 hours.
- The analysis of GPP charts and forecasts for 24 hr to 72 hr are shown in Annexure II. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Track prediction by MME:

- Track prediction by MME suggests that the tropical cyclone LEHAR over the Bay of Bengal would move in a west-northwestward direction and cross Andhra Pradesh coast between Ongole and Machilipatnam at about 2000 UTC of 28 November 2013.

Intensity prediction by SCIP model:

- Intensity prediction by SCIP model suggests that the tropical cyclone LEHAR over the Bay of Bengal is unlikely to intensify further.
- Probability of Rapid Intensification (intensity increase by 30 kts or more) during next 24 hours: VERY LOW (9.4 %).
- The track forecast by MME, intensity prediction by SCIP and probability of rapid intensification is shown in Annexure II. (http://www.imd.gov.in/section/nhac/dynamic/MME_TRACK_INTENSITY.htm)

Summary and conclusion:

- The very severe cyclonic storm LEHAR lay centred at 0900 UTC of 26th November 2013 over southeast Bay and adjoining west central Bay of Bengal near Lat. 13.0^0N and long. 89.0^0E, about 850 km east-southeast of Kakinada. The system would intensify further and moved west-northwestwards and cross Andhra Pradesh coast between Machilipatnam and Kalingapatnam near Kakinada around 28th November noon.

Advisory:

- IOP to continue for 26-28 November 2013 for Andhra Pradesh, south Odisha coast.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	25/12	**26/00**	**26/03**
India	39/51	32/33	38/51
Coastal stations			
WB	6/9	3/9	6/9
Odisha	6/7	5/6	6/7
AP	1214	12/13	12/14
Tamil Nadu	8/12	7/7	8/12
Puducherry	2/2	2/2	2/2
A & N	5/7	1/7	6/7
Bangladesh	10/11	7/11	10/11
Myanmar	9/11	8/11	8/11
Thailand	3/3	3/3	3/3
Srilanka	7/9	7/9	7/9

RS/RW (12Z) of 25/11/2013 1/39

- **No. of Ascents reaching 250 hPa levels:1, MISDA: -38**
- **RS/RW** (00Z) of 26/11/2013 18/39
- **No. of Ascents reaching 250 hPa levels:17 , MISDA:-21**

No. of PILOT Ascents

25/12Z	**26/00Z**
31/37	18/34

Buoy Data

25/12Z	**26/00Z**	**26/03Z**
8	7	8

Data Statistics over RMC Chennai Region

No. of Synop data

Date→	**25.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coastsof AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /25.11.2013 : 5

No. of Ascents reaching 250 hPa level =5

MISDA : 3

12Z /25.11.2013 : 0

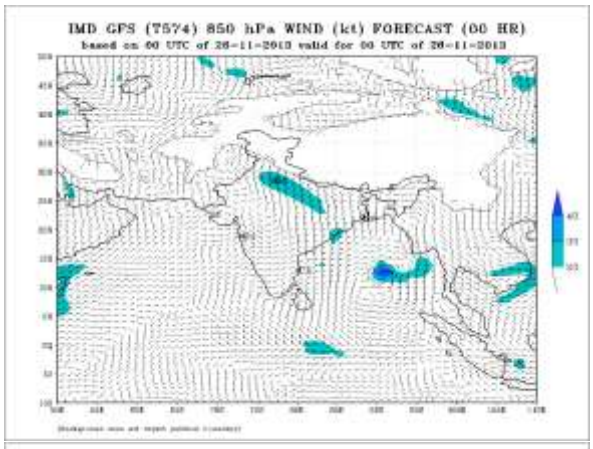
No. of Ascents reaching 250 hPa level =--

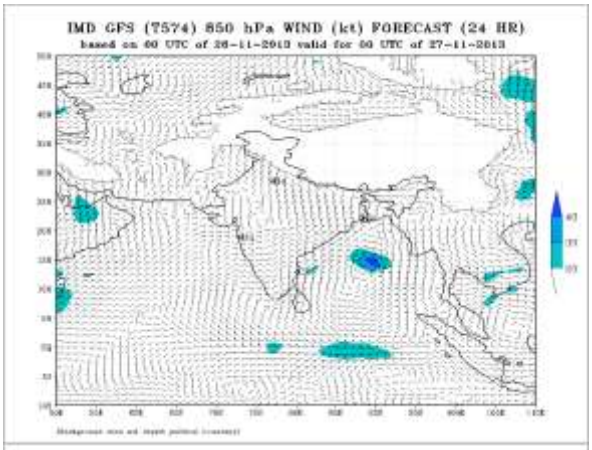
MISDA : 8

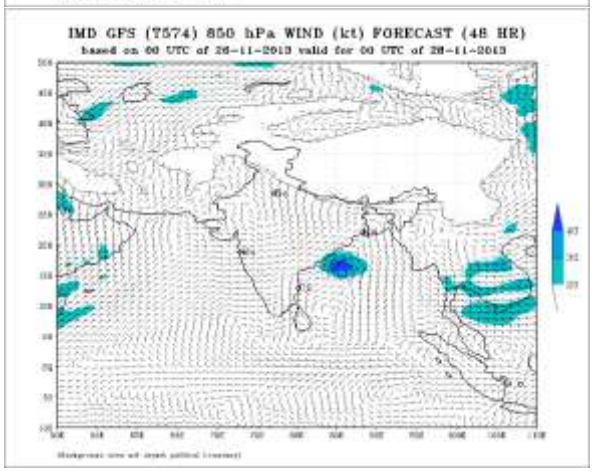
No. of PILOT Ascents:

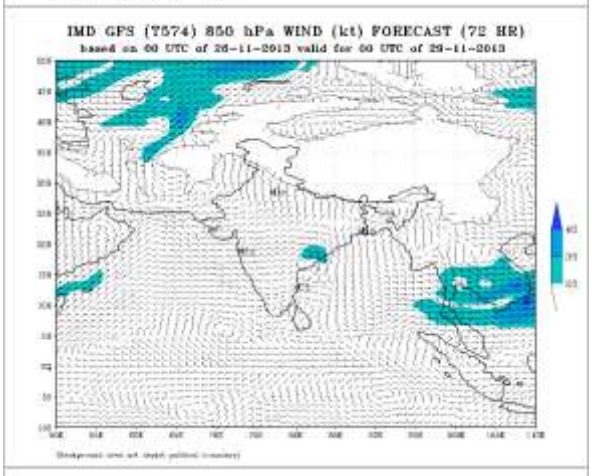
25.11.2013	
06Z	18Z
7	5

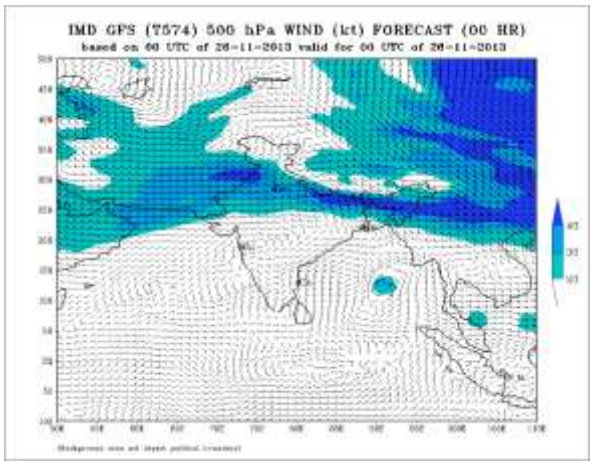
Annexure-II

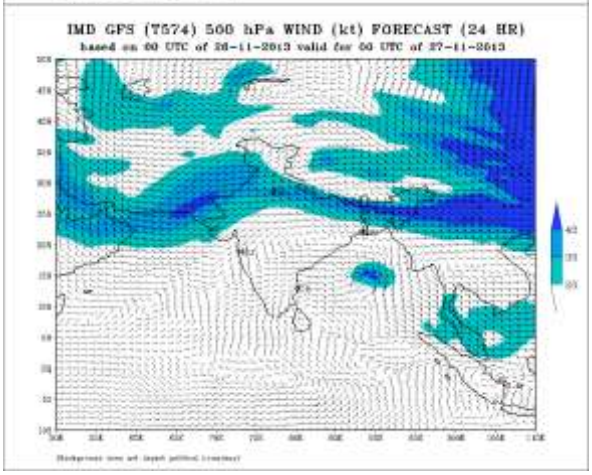

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 26-11-2013 valid for 00 UTC of 26-11-2013

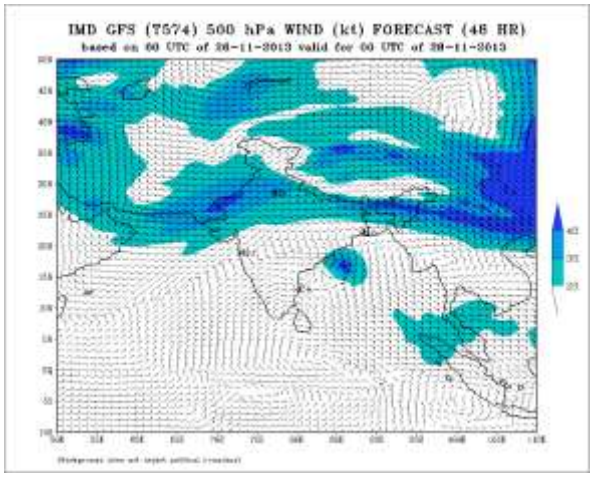

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 26-11-2013 valid for 00 UTC of 27-11-2013

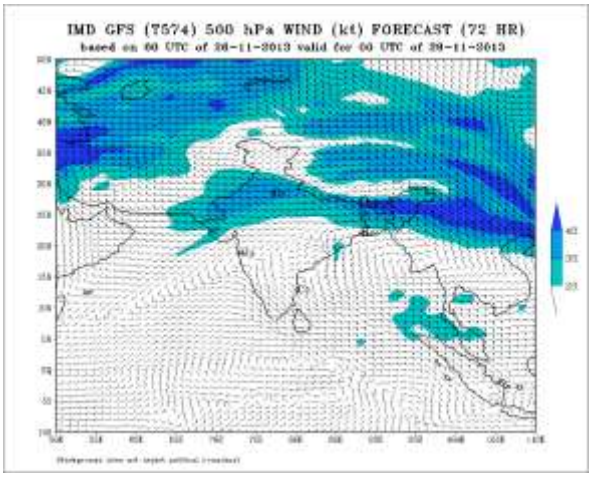

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 26-11-2013 valid for 00 UTC of 28-11-2013

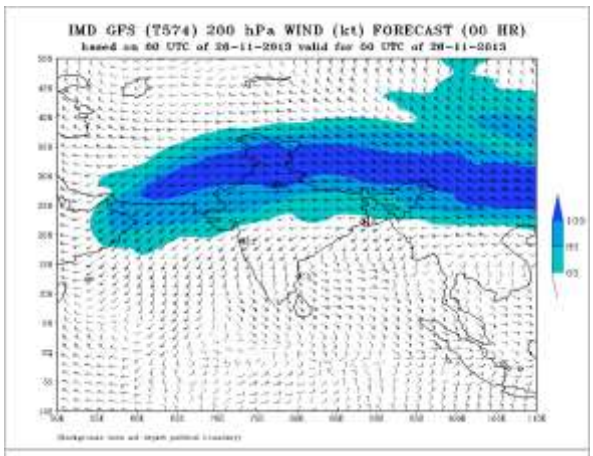

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 26-11-2013 valid for 00 UTC of 29-11-2013

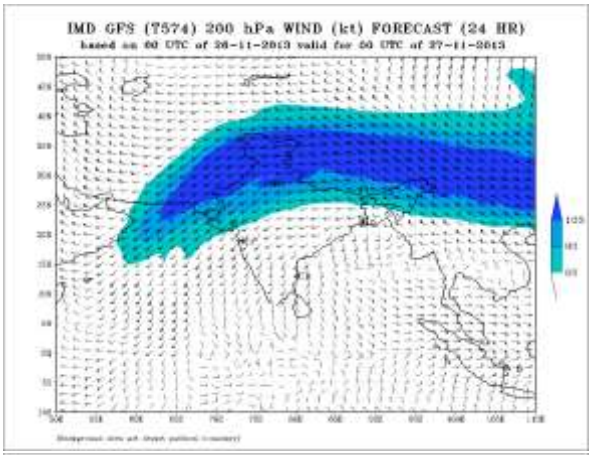

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 26-11-2013 valid for 00 UTC of 26-11-2013

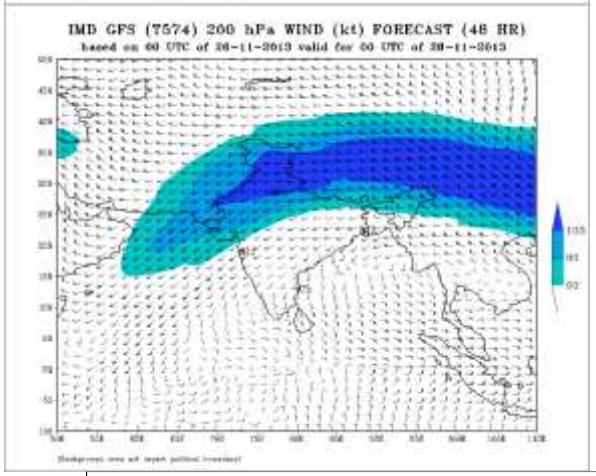

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 26-11-2013 valid for 00 UTC of 27-11-2013

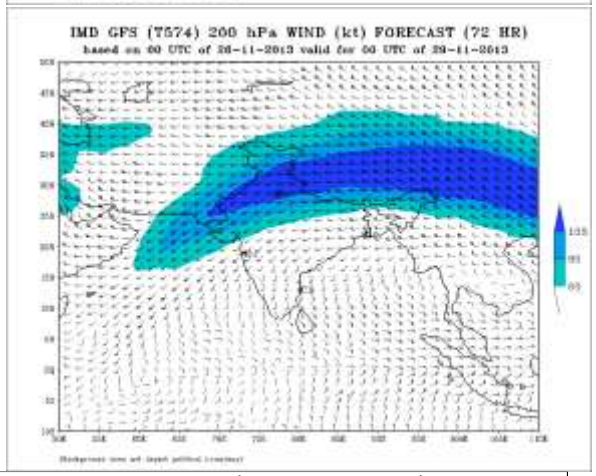

IMD GFS (7574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 26-11-2013 valid for 00 UTC of 28-11-2013

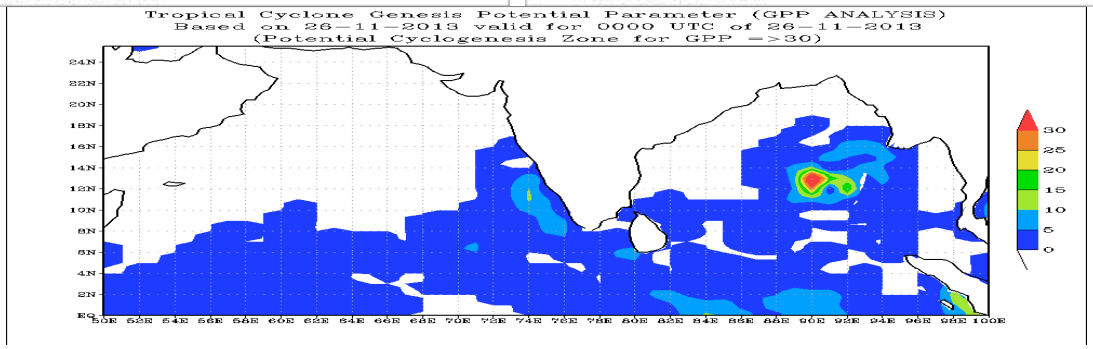

IMD GFS (7574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 26-11-2013 valid for 00 UTC of 29-11-2013

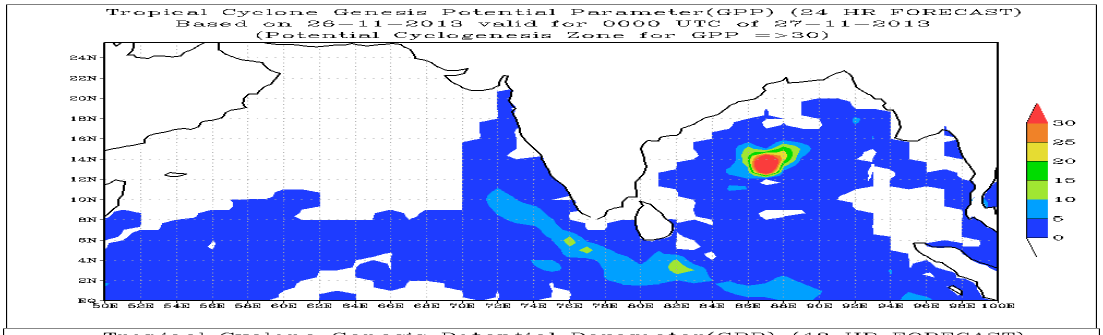

IMD GFS (7574) 200 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 26-11-2013 valid for 00 UTC of 26-11-2013

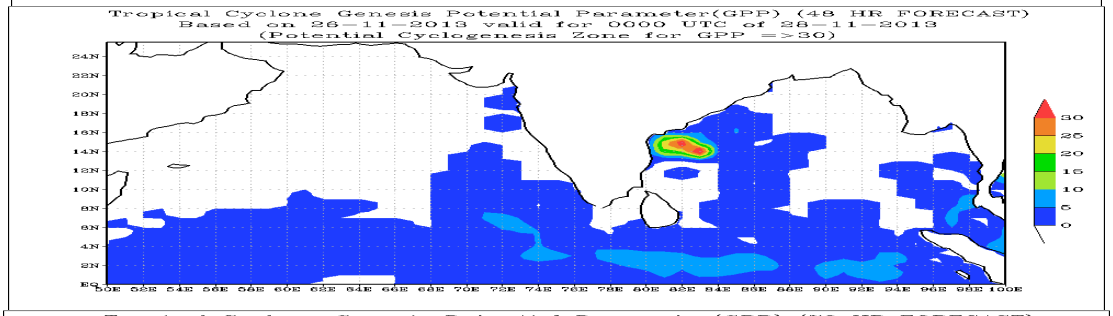

IMD GFS (7574) 200 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 26-11-2013 valid for 00 UTC of 27-11-2013

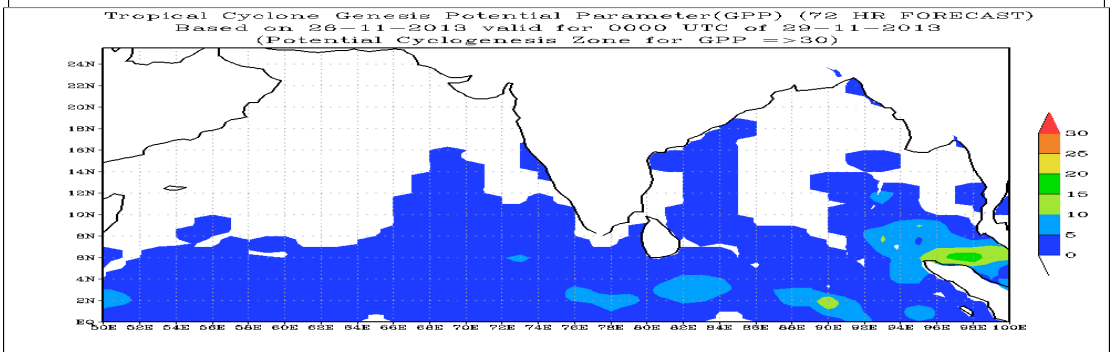

IMD GFS (7574) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 26-11-2013 valid for 00 UTC of 28-11-2013


IMD GFS (7574) 200 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 26-11-2013 valid for 00 UTC of 29-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 26-11-2013 valid for 0000 UTC of 26-11-2013
(Potential Cyclogenesis Zone for GPP =>30)
30
25
20
15
10
5
0



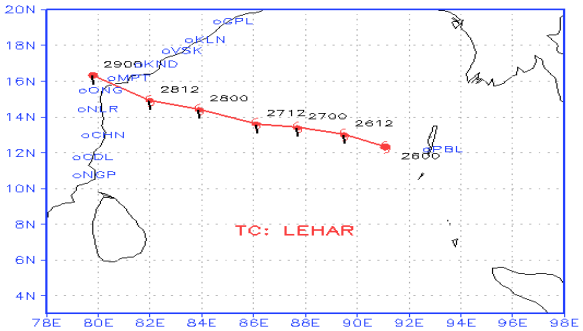




TRACK PREDICTION BY IMD MULTIMODEL ENSEMBLE(MME)
based on 00 UTC of 26-11-2013

TRACK PREDICTION BY IMD MME based on 00 UTC of 26-11-2013

FORECAST HOUR	LAT	LON
2013112600	12.3	91.1
2013112612	13.0	89.5
2013112700	13.4	87.7
2013112712	13.6	86.1
2013112800	14.4	83.9
2013112812	14.9	82.0
2013112900	16.3	79.8



INTENSITY PREDICTION BY IMD SCIP MODEL based on 00 UTC of 26-11-2013

FORECAST HOUR	INTENSITY
2013112600	65 kts
2013112612	66 kts
2013112700	70 kts
2013112712	70 kts
2013112800	72 kts
2013112812	69 kts

Probability of Rapid Intensification(RI)(Intensity increase by 30 kts or more in next 24 hr)=9.4%
INFERENCE: RI probability VERY LOW

FDP (Cyclone) NOC Report Dated 27th November, 2013

Synoptic features based on 0300 UTC:

- The **Very Severe Cyclonic Storm 'Lehar'** over southeast Bay of Bengal moved west-northwestwards and lay centred at 1200 UTC of yesterday, the 26th November 2013 over southeast and adjoining central Bay of Bengal within half a degree of Lat.13.0° N and Long. 88.5° E, about 480 kms west-northwest of Port Blair, 860 kms east-southeast of Machilipatnam. It moved west-northwestwards and lay centred at 0300 UTC of today, the 27th November 2013 over the west central and adjoining south Bay of Bengal within half a degree of Lat. 13.5° N and Long. 86.5° E, about 650 kms east-southeast of Machilipatnam and 600 kms east-southeast of Kakinada. It moved further west-northwestward lay centred at 0900 UTC of 27th November 2013 near latitude 14.0^0N & longitude 85.5^0E, about 520 km east southeast of Machilipatnam and 470 km southeast of Kakinada.The system would move west-northwestwards, weaken gradually and cross Andhra Pradesh coast near Machilipatnam as a cyclonic storm around 28 November afternoon.
- The cyclonic circulation over Comorin and adjoining Lakshadweep area now lies as a trough in lower levels extending from Lakshadweep area to south Konkan-Goa.·

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-28^0C over north Bay, and westcentral Bay of Bengal and some parts of Andaman sea. It is 28-30^0C over rest Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay and along the east coast of India. It is 50-80 KJ cm^{-2} over eastcentral ,southeast Bay of Bengal and Andman Sea. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive (100-150 * $10^{-5}s^{-1}$) around the very severe cyclonic storm.

Convergence:

- Lower level convergence is decreasing around the system centre.

Divergence:

- It is positive of the order of 5-10*10^{-5} s^{-1} to the north of the system.

Wind Shear:

- **W**ind Shear is 10-20 knots over the system centre. It is more than 20-40 knots over North and South Bay of Bengal.

Wind Shear Tendency:

Shear Tendency is decreasing around the system centre.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 17.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 5 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 5 & 6 with amplitude less than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 270900 UTC

- Vortex over westcentral and adjoining eastcentral Bay of Bengal has weakened and centred near Lat. 14.2^{0}N **&** Long. 85.5^{0}E**.** Intensity T3.5/CI4.0**.** Associated broken low/medium cloud embedded with intense to very intense convection seen over the area between 10.0^{0}N to 17.0^{0}N and Long. 81.0^{0}E to 88.0^{0}E.

NWP Analysis:

- IMD-GFST574 model forecasts based on 0000 UTC of 27th November 2013 shows west-northwestward movement of the cyclone LEHAR during next 48 hours.

- The analysis charts of wind at the levels 850 hPa of the model GFST574 based on 0000 UTC of 27th November, 2013 and their 24 to 48 hour forecasts are given in Annexure II.

- IMD-WRF model forecasts based on 0000 UTC of 27th November 2013 shows west-northwestward movement of the cyclone LEHAR during next 36 hours.

  (available at: http://www.imd.gov.in/section/nhac/dynamic/welcome.htm)
- Genesis Potential Parameter (GPP) analysis based on 0000 UTC of 27h November 2013 shows a region of high GPP over the west central Bay of Bengal in associated with the cyclone LEHAR. Genesis Potential Parameter (GPP) forecasts based on 0000 UTC of 27th November 2013 show the region of high GPP likely to move in a North West ward direction during next 48 hours.
- The analysis of GPP charts and forecasts for 24 hr to 48 hr are shown in Annexure II.

  (available at: http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Track prediction by MME:

- Track prediction by MME suggests that the tropical cyclone LEHAR over the Bay of Bengal would move in a west-northwestward direction and cross Andhra Pradesh coast between Nellore and Ongole at about 1800 UTC of 28 November 2013.

Intensity prediction by SCIP model:

- Intensity prediction by SCIP model suggests that the tropical cyclone LEHAR over the Bay of Bengal is unlikely to intensify further.
- Probability of Rapid Intensification (intensity increase by 30 kts or more) during next 24 hours: VERY LOW (9.4 %).
- The track forecast by MME, intensity prediction by SCIP and probability of rapid intensification is shown in Annexure II.

(http://www.imd.gov.in/section/nhac/dynamic/MME_TRACK_INTENSITY.htm)

Summary and conclusion:

- The very severe cyclonic storm LEHAR lay centred at 0900 UTC of 27th November 2013 near latitude 14.0^{0}N & longitude 85.5^{0}E, about 520 km east southeast of Machilipatnam and 470 km southeast of Kakinada.The system would move west-northwestwards, weaken gradually and cross Andhra Pradesh coast near Machilipatnam as a cyclonic storm around 28 November afternoon.

Advisory:

- IOP to continue for 27-28 November 2013 for Andhra Pradesh, south Odisha coast.
-

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	26/12	**27/00**	**27/03**
India	35/51	30/33	37/51
Coastal stations			
WB	6/9	3/9	6/9
Odisha	4/7	5/6	5/7
AP	1214	12/13	12/14
Tamil Nadu	6/12	7/7	7/12
Puducherry	2/2	2/2	2/2
A & N	5/7	1/7	5/7
Bangladesh	8/11	7/11	8/11
Myanmar	9/11	8/11	8/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	7/9	7/9

RS/RW (12Z) of 26/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:1, MISDA: -38**
- **RS/RW** (00Z) of 27/11/2013 12/39
- **No. of Ascents reaching 250 hPa levels:12 , MISDA:-27**

No. of PILOT Ascents

26/12Z	**27/00Z**
30/37	16/34

Buoy Data

26/12Z	**27/00Z**	**27/03Z**
7	7	6

Data Statistics over RMC Chennai Region

No. of Synop data

Date→	**26.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coastsof AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /26.11.2013 : 4

No. of Ascents reaching 260 hPa level = 3

MISDA : 4

12Z /26.11.2013 : 0

No. of Ascents reaching 260 hPa level =--

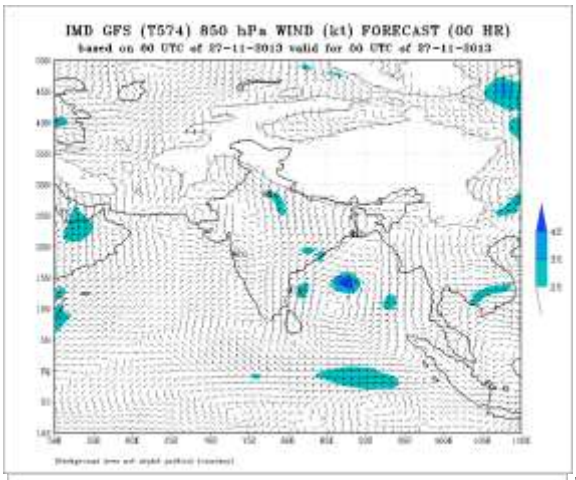
MISDA : 8

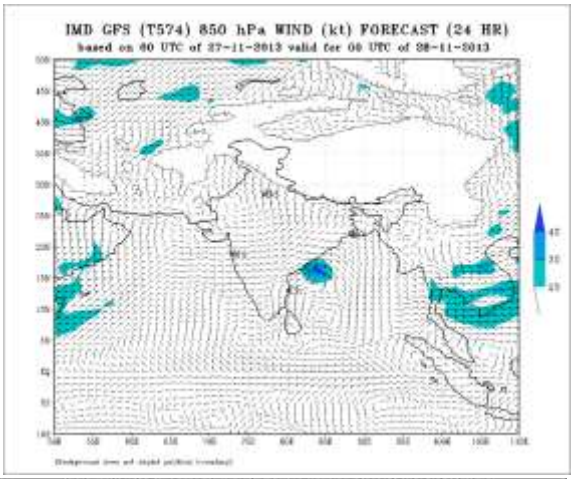
No. of PILOT Ascents:

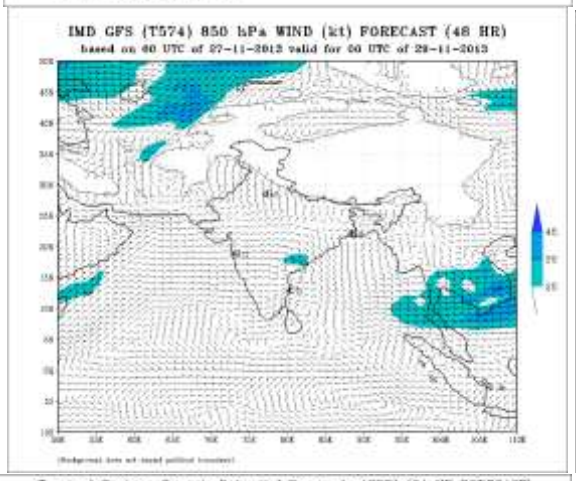
26.11.2013

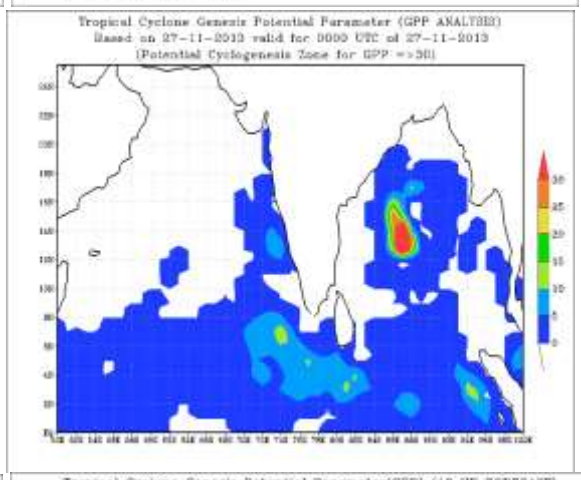
06Z	18Z
7	6

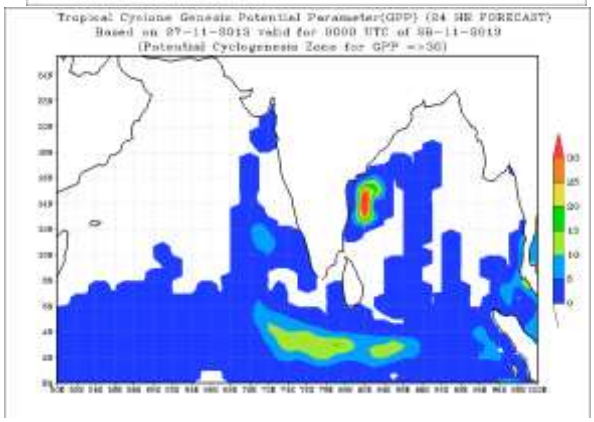
Annexure-II

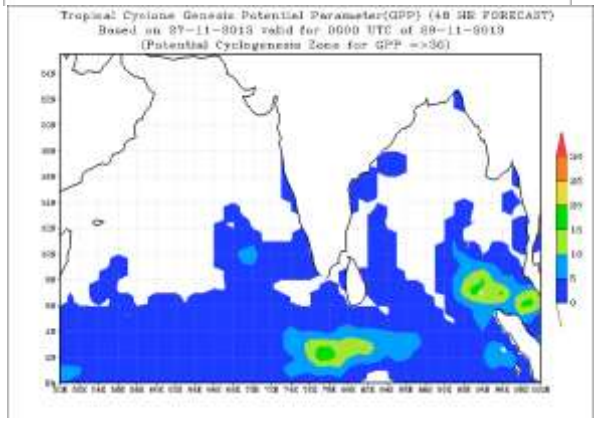

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 27-11-2013 valid for 00 UTC of 27-11-2013

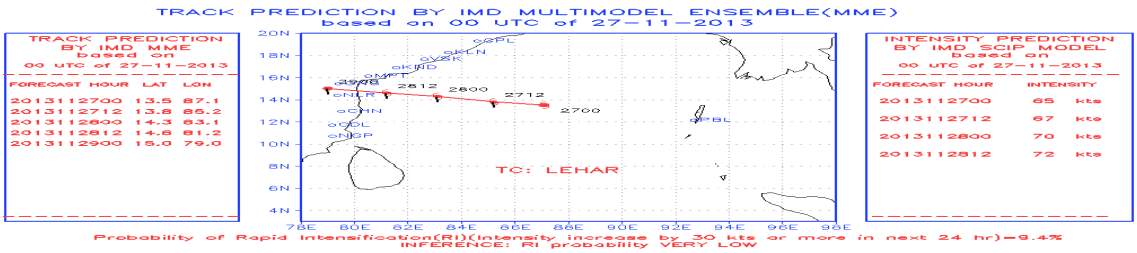

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 27-11-2013 valid for 00 UTC of 28-11-2013


IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 27-11-2013 valid for 00 UTC of 29-11-2013


Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 27-11-2013 valid for 0000 UTC of 27-11-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 27-11-2013 valid for 0000 UTC of 28-11-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 27-11-2013 valid for 0000 UTC of 29-11-2013
(Potential Cyclogenesis Zone for GPP =>30)


TRACK PREDICTION BY IMD MULTIMODEL ENSEMBLE(MME)
based on 00 UTC of 27-11-2013
TRACK PREDICTION BY IMD MME based on 00 UTC of 27-11-2013
FORECAST HOUR LAT LON
20131127 00 13.5 87.1
20131127 12 13.8 85.2
20131128 00 14.3 83.1
20131128 12 14.8 81.2
20131129 00 15.0 79.0
INTENSITY PREDICTION BY IMD SCIP MODEL based on 00 UTC of 27-11-2013
FORECAST HOUR INTENSITY
20131127 00 65 kts
20131127 12 67 kts
20131128 00 70 kts
20131128 12 72 kts
TC: LEHAR
Probability of Rapid Intensification(RI)(Intensity increase by 30 kts or more in next 24 hr)=9.4%
INFERENCE: RI probability VERY LOW

FDP (Cyclone) NOC Report Dated 28 November, 2013

Synoptic features based on 0300 UTC:

- The **Severe Cyclonic Storm 'Lehar'** over southeast Bay of Bengal moved further west-northwestward lay centred at 1200 UTC of 27th November 2013 near latitude 14.5^{0}N & longitude 85.0^{0}E, about 450 km east southeast of Machilipatnam and 400 km southeast of Kakinada. The System weakened into a cyclonic storm and lay centred at 1800 UTC of 27th November 2013 over the westcentral Bay of Bengal near latitude 15.0^0 N and longitude 84.0^0 E, about 330 km east-southeast of Machillipatnam and 280 km southeast of Kakinada. The system further weaken as Deep Depression over westcentral Bay of Bengal moved west-northwestwards with a speed of 20 kmph during past six hrs and lay centred at 0830 hours IST of today, the 28th November 2013 over the westcentral Bay of Bengal near latitude 15.7^0 N and longitude 81.7^0 E, about 80 km east-southeast of Machillipatnam. It would move west-northwestwards, weaken further and cross Andhra Pradesh coast near Machillipatnam by today, the 28th November afternoon.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-28^{0}C over north Bay, and westcentral Bay of Bengal and some parts of Andaman sea. It is 28-30^{0}C over rest Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay and along the east coast of India. It is 50-80 KJ cm^{-2} over eastcentral ,southeast Bay of Bengal and Andman Sea. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive (80-120 * 10^{-5}s^{-1}) around the System.

Convergence:

- Lower level convergence is decreasing around the system centre.

Divergence:

- It is positive of the order of 5-10*10^{-5} s^{-1} to the north of the system.

Wind Shear:

- **W**ind Shear is 10-20 knots over the system centre. It is more than 20-40 knots over North and South Bay of Bengal.

Wind Shear Tendency:

Shear Tendency is decreasing around the system centre.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 17.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 5 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 5 & 6 with amplitude less than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 280300 UTC

- Vortex over westcentral Bay of Bengal has weakened and centred near Lat. 15.7^{0}N **&** Long. 81.7^{0}E**.** Intensity T2.0**.** Associated broken low/medium cloud embedded with intense to very intense convection seen over the area between 11.0^{0}N to 18.0^{0}N and Long. 80.0^{0}E to 86.0^{0}E.

NWP Analysis:

- IMD-GFST574 model forecasts based on 0000 UTC of 28th November 2013 shows west-northwestward movement and decreasing tendency of the cyclone LEHAR during next 48 hours.
- Genesis Potential Parameter (GPP) analysis based on 0000 UTC of 28h November 2013 shows a region of high GPP over the west central Bay of Bengal likely to move in a North West ward direction and decreasing during next 48 hours.

Summary and conclusion:

- The Depression over coastal Andhra Pradesh moved west-northwestwards and lay centred at 1730 hours IST of today, the 28th November 2013 over coastal Andhra Pradesh near latitude 16.0^0 N and longitude 80.8^0 E about 50 km southwest of Machillipatnam. It would move west-northwestwards and weaken further into a well marked low pressure area during next 06 hours.

Advisory:

- IOP to continue for 28-29 November 2013 for Andhra Pradesh coast.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	27/12	**28/00**	**28/03**
India	35/51	30/33	37/51
Coastal stations			
WB	6/9	3/9	6/9
Odisha	4/7	5/6	5/7
AP	1214	12/13	12/14
Tamil Nadu	6/12	7/7	7/12
Puducherry	2/2	2/2	2/2
A & N	5/7	1/7	5/7
Bangladesh	811	7/11	8/11
Myanmar	9/11	8/11	8/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	7/9	7/9

RS/RW (12Z) of 27/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:1, MISDA: -37**
- **RS/RW** (00Z) of 28/11/2013 12/39
- **No. of Ascents reaching 250 hPa levels:12 , MISDA:-27**

No. of PILOT Ascents

27/12Z	**28/00Z**
30/37	16/34

Buoy Data

27/12Z	**28/00Z**	**28/03Z**
7	7	6

Data Statistics over RMC Chennai Region

No. of Synop data

Date→	**27.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /27.11.2013 : 4

No. of Ascents reaching 260 hPa level = 3

MISDA : 4

12Z /27.11.2013 : 0

No. of Ascents reaching 260 hPa level =--

MISDA : 8

No. of PILOT Ascents:

27.11.2013

06Z	18Z
7	6

FDP (Cyclone) NOC Report Dated 29th November, 2013

Synoptic features based on 0300 UTC:

- The Deep Depression over the west central Bay of Bengal moved northwest wards, weakened into a Depression and crossed Andhra Pradesh coast near Lat. 15.9° N and Long. 81.1° E, close to south of Machilipatnam around 0830 UTC of yesterday, the 28th November 2013. It moved west-northwest wards and lay centred at 1200 UTC of yesterday, the 28th November 2013 over coastal Andhra Pradesh near Lat. 16.0° N and Long. 80.8° E, about 50 kms southwest of Machilipatnam. It further weakened and lay as a well marked low pressure area over coastal Andhra Pradesh and adjoining Telangana at 1800 UTC of yesterday night. It now lies as a low pressure area over Telangana and neighbourhood.
- A trough of low at mean sea level lies over southeast Bay of Bengal and adjoining Andaman Sea.
- The cyclonic circulation over Lakshadweep area and neighbourhood persists and extends upto 1.5 kms a.s.l.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-28^{0}C over north Bay, and westcentral Bay of Bengal and some parts of Andaman sea. It is 28-30^{0}C over rest Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay,West Central Bay of Bengal and along the east coast of India. It is 50-80 KJ cm^{-2} over eastcentral ,southeast Bay of Bengal and Andman Sea. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is negative vorticity over bay and Andaman sea.

Convergence:

- Lower level convergence is positive of order 5-10*10^{-5} s^{-1} south Andaman sea and negative over 5*10^{-5} s^{-1} over north Andaman sea.

Divergence:

- It is positive of the order of 5-10*10^{-5} s^{-1} south Andaman sea and central bay of Bengal. And negative of order of 5-10*10^{-5} s^{-1} over westcentral bay of Bengal.

Wind Shear:

- **W**ind Shear is 10-20 knots over bay of Bengal and less than 20 over Andaman sea.

Wind Shear Tendency:

Shear Tendency is increasing over west central and north Andaman sea and decreasing over south east bay and south Andaman sea.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 13.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 5 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 5 & 6 with amplitude less than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 290900 UTC

Broken low medium clouds with embedded moderate to intense convection over rest south Bay of Bengal Andaman sea Tenesserim coast. Scattered low/medium clouds with embedded

isolated weak to moderate convection over southeast Arabian sea between lat 8.0°N to 12.0°N long 63.0°E to 69.0°E and also off Kerala Karnataka coast.

NWP Analysis:

Most of the models are showing no cyclogenesis for next 3 days.

Summary and conclusion:

- The trough and associated convection over Andaman Sea and adjoining area needs to be watched.

Advisory:

- No IOP to continue for next 3 days.

Annexure-I

Synoptic observation:

Region	Date/Time (UTC)		
	28/12	**29/00**	**29/03**
India	35/51	30/33	37/51
Coastal stations			
WB	6/9	3/9	6/9
Odisha	4/7	5/6	5/7
AP	1214	12/13	12/14
Tamil Nadu	6/12	7/7	7/12
Puducherry	2/2	2/2	2/2
A & N	5/7	1/7	5/7
Bangladesh	811	7/11	8/11
Myanmar	9/11	8/11	8/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	7/9	7/9

RS/RW (12Z) of 28/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:1, MISDA: -38**
- **RS/RW** (00Z) of 29/11/2013 12/39
- **No. of Ascents reaching 250 hPa levels:12 , MISDA:-27**

No. of PILOT Ascents

28/12Z	**29/00Z**
30/37	16/34

Buoy Data

28/12Z	**29/00Z**	**29/03Z**
7	7	6

Data Statistics over RMC Chennai Region

No. of Synop data

Date→	**28.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**19**	**20**	**20**

No. of RS/RW Ascents

00Z /28.11.2013 : 5

No. of Ascents reaching 280 hPa level = 5

MISDA : 3

12Z /28.11.2013 : 0

No. of Ascents reaching 280 hPa level =--

MISDA : 8

No. of PILOT Ascents:

28.11.2013

06Z	18Z
1	7

FDP (Cyclone) NOC Report Dated 30th November, 2013

Synoptic features based on 0300 UTC:

- The trough of low at mean sea level over southeast Bay of Bengal and adjoining Andaman Sea now lies over southeast Bay of Bengal and neighbourhood.
- Another trough of low at mean sea level lies over southwest Bay of Bengal extending from Sri Lanka to north Tamil Nadu coast.
- The cyclonic circulation extending upto 1.5 kms a.s.l. over Lakshadweep area and neighbourhood persists.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-28^{0}C over north Bay, and westcentral Bay of Bengal and some parts of Andaman sea. It is 28-30^{0}C over rest Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay,West Central Bay of Bengal and Andman Sea and along the east coast of India. It is 50-80 KJ cm^{-2} over eastcentral ,southeast Bay of Bengal. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is negative vorticity over bay and Andaman sea. and positive over the north bay of Bengal

Convergence:

- Lower level convergence is positive of order 5-10*10^{-5} s^{-1} south west bay of Bengal.

Divergence:

- It is positive of the order of 5-20*10^{-5} s^{-1} over south bay of Bengal and south Andaman sea, negative of order of 5-10*10^{-5} s^{-1} over westcentral bay of Bengal.

Wind Shear:

- **W**ind Shear is 20 knots over Central bay of Bengal adjoining Andaman sea and more than 20 over north bay of Bengal.

Wind Shear Tendency:

Shear Tendency is increasing over central and adjoining Andaman sea and decreasing over west central and south bay.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 13.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 5 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 5 & 6 with amplitude less than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 300900 UTC

Broken low medium clouds with embedded moderate to intense convection over rest south Bay of Bengal and south Andaman sea. Scattered low/medium clouds with embedded isolated weak to moderate convection over southeast Arabian sea between lat 6.5°N to 12.0°N long 58.0°E to 67.0°E.

NWP Analysis:

GFS:

- This model indicates that a low pressure area formed at 0000z of 02nd Dec 2013 and it would be developed into a depression on 03rd and weaken as a low on 4th of December 2013.

ECMWF:

- This model indicates no cyclogenesis for next three days.

Meteofrance:

- This model indicates that a low pressure area formed at 0000z of 02nd Dec 2013 and it would be developed into a depression on 03rd .

Unified model :

- This model indicates no cyclogenesis for next three days

Summary and conclusion:

- The trough of low pressure area lies over southeast bay of Bengal. A low pressure area would develop into central parts of south bay of Bengal during next 24 hours it may further intensify into a depression during subsequent 24 hours over southwest bay of Bengal.

Advisory:

- IOP will be watched for east coast of Srilanka and Tamilnadu coast during 1 to 3rd December 2013.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	29/12	**30/00**	**30/03**
India	35/51	30/33	37/51
Coastal stations			
WB	6/9	3/9	6/9
Odisha	4/7	5/6	5/7
AP	1214	12/13	12/14
Tamil Nadu	6/12	7/7	7/12
Puducherry	2/2	2/2	2/2
A & N	5/7	1/7	5/7
Bangladesh	811	7/11	8/11
Myanmar	9/11	8/11	8/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	7/9	7/9

RS/RW (12Z) of 29/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:1, MISDA: -38**
- **RS/RW** (00Z) of 30/11/2013 12/39
- **No. of Ascents reaching 250 hPa levels:12 , MISDA:-27**

No. of PILOT Ascents

29/12Z	**30/00Z**
30/37	16/34

Buoy Data

29/12Z	**30/00Z**	**30/03Z**
7	7	6

Data Statistics over RMC Chennai Region

No. of Synop data

Date→	**29.11.2013**							
UTC→	**00**	**03**	**06**	**09**	**12**	**15**	**18**	**21**
Chennai Region (Coasts of AP & TN)	**20**	**22**	**20**	**20**	**22**	**20**	**20**	**20**

No. of RS/RW Ascents

00Z /29.11.2013 : 5
No. of Ascents reaching 290 hPa level = 5
MISDA : 3
12Z /29.11.2013 : 0
No. of Ascents reaching 290 hPa level =--
MISDA : 8

No. of PILOT Ascents:
29.11.2013

06Z	18Z
4	5

FDP (Cyclone) NOC Report Dated 1st December, 2013

Synoptic features based on 0300 UTC:

- Under the influence of the trough of low at mean sea level over southeast Bay of Bengal and neighbourhood, a low pressure area has formed over the same area. Associated cyclonic circulation extends upto mid tropospheric levels. System would become more marked during next 48 hours.
- The trough of low at mean sea level over southwest Bay of Bengal extending from Sri Lanka to north Tamil Nadu coasts persists.
- The cyclonic circulation over Lakshadweep area and neighbourhood has become less marked.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-28^{0}C over north Bay, and westcentral Bay of Bengal and some parts of Andaman sea. It is 28-30^{0}C over rest Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay,West Central Bay of Bengal and Andaman Sea and along the east coast of India. It is 50-80 KJ cm^{-2} over eastcentral, southeast Bay of Bengal. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is negative vorticity over bay and Andaman sea. and positive over the north bay of Bengal

Convergence:

- Lower level convergence is positive of order 5-10*10^{-5} s^{-1} south west bay of Bengal.

Divergence:

- It is positive of the order of 5-20*10^{-5} s^{-1} over south bay of Bengal and south Andaman sea, negative of order of 5-10*10^{-5} s^{-1} over westcentral bay of Bengal.

Wind Shear:

- **W**ind Shear is 20 knots over Central bay of Bengal adjoining Andaman sea and more than 20 over north bay of Bengal.

Wind Shear Tendency:

Shear Tendency is increasing over central and adjoining Andaman sea and decreasing over west central and south bay.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 13.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 5 with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 5 & 6 with amplitude less than 1.0 during next 3 days.

Satellite:

Inference based on INSAT imagery of 010900 UTC

Broken loe/medium clouds with embedded moderate to intense convection seen over south Bay between lat. 5.0^{0}N to 13.0^{0}N and longitude 82.0^{0}E to 92.0^{0}E in association with low level circulation over the area.

NWP Analysis:

GFS: Model indicates that a low pressure area over southeast Bay of Bengal and neighbourhood would become well marked low pressure area over central parts of south Bay of Bengal on 2nd December and may intensify further and may become a depression over southwest Bay of Bengal on 3rd December, 2013. Model also indicates that the system may shift towards north along coastal areas Tamilnadu and adjoining southwest Bay of Bengal.

ECMWF: Model also indicates that a low pressure area over southeast Bay of Bengal and neighbourhood would become well marked low pressure area over central parts of south Bay of Bengal on 2nd December and may intensify further and may become a depression over southwest Bay of Bengal on 3rd December, 2013.

Summary and conclusion:

- The low pressure area over southeast Bay of Bengal and neighbourhood would become well marked low pressure area on 2nd December and may become depression on 3rd December 2013 over southwest Bay of Bengal and neighbourhood.

Advisory:

- IOP may be continued during the period 2-4 December 2013 for east coast of Srilanka and Tamilnadu coast.

FDP (Cyclone) NOC Report Dated 02nd December, 2013

Synoptic features based on 0300 UTC:

- The low pressure area over southeast Bay of Bengal and neighbourhood now lies as a well marked low pressure area over southwest & adjoining southeast Bay of Bengal. Associated cyclonic circulation extends upto mid tropospheric levels. System may concentrate into a Depression during next 24 hours.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-29^{0}C over north Bay, and westcentral Bay of Bengal and some parts of Andaman sea. It is 29-30^{0}C over rest Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay,West Central Bay of Bengal and along the east coast of India. It is 50-80 KJ cm^{-2} over eastcentral ,southeast Bay of Bengal and Andman Sea. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is negative vorticity over bay and Andaman sea.

Convergence:

- Lower level convergence is positive of order 5-30*10^{-5} s^{-1} south west bay of Bengal and negative over 5-10*10^{-5} s^{-1} over west central bay.

Divergence:

- It is positive of the order of 5-30*10^{-5} s^{-1} over south of west central bay of Bengal.. And negative of order of 5-10*10^{-5} s^{-1} over southeast bay of Bengal and adjoining south Andaman sea central bay of Bengal.

Wind Shear:

- **W**ind Shear is 10-20 knots over south bay of Bengal and Andaman sea and more than 20 over west central bay and north bay of Bengal.

Wind Shear Tendency:

Shear Tendency is increasing over west central and south west bay of Bengal and decreasing over south east bay and south Andaman sea.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 14.0°N over Bay of Bengal region.

M.J.O. Index:

- Located with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 2 &3 with amplitude more than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:
Inference based on INSAT imagery of 020900 UTC

Broken low medium clouds with embedded moderate to intense convection over rest southeast Bay of Bengal south of Lat 9.0°N.

Broken low/medium clouds with embedded moderate to intense convection over southeast Arabian sea between lat 5.0°N to 12.5°N east of long 60.5°E and Comorian region.

NWP Analysis:
GFS: This model indicates a low pressure area formed on 2nd and intensified into a depression on 3rd moving northwards with further intensification as tropical cyclone on 5th and take recurve on 09th December 2013.

Meteofrance This model indicates that a low pressure are formed on 2nd and intensified into a depression on 3rd moving northwards and it would intensify further as a tropical cyclone on 5th December.

ECMWF This model indicates a low pressure area will be formed on 5th December and it would intensify as a tropical cyclone on 09th December.

Unified Model This model indicates a low pressure area will be formed on 03rd December moving initially northwards and then move northeastwards. It would intensify further as tropical cyclone on 5th December onwards.

GPP indicates that the low pressure system over the south Bay of Bengal has potential to intensify into a tropical cyclone.

Summary and conclusion:

- Well marked low pressure area over south Bay of Bengal may concentrate into a depression during next 24 hrs and further intensify into a cyclone during subsequent 72 hrs. It would move slowly northwestwards initially.

Advisory:

- IOP will continue for Tamil Nadu, Puducherry and east coast of Sri Lanka for 3-6 December 2013.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	01/12	**02/00**	**02/03**
India	35/51	30/33	37/51
Coastal stations			
WB	6/9	3/9	6/9
Odisha	4/7	5/6	5/7
AP	1214	12/13	12/14
Tamil Nadu	6/12	7/7	7/12
Puducherry	2/2	2/2	2/2
A & N	5/7	1/7	5/7
Bangladesh	811	7/11	8/11
Myanmar	9/11	8/11	8/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	7/9	7/9

RS/RW (12Z) of 01/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:1, MISDA: -38**
- **RS/RW** (00Z) of 02/11/2013 12/39
- **No. of Ascents reaching 250 hPa levels:12 , MISDA:-27**

No. of PILOT Ascents

01/12Z	**02/00Z**
30/37	16/34

Buoy Data

01/12Z	**02/00Z**	**02/03Z**
7	7	6

FDP (Cyclone) NOC Report Dated 03rd December, 2013

Synoptic features based on 0300 UTC:

- The well-marked low pressure area over southwest & adjoining southeast Bay of Bengal now lies over southwest Bay of Bengal. Associated cyclonic circulation extends up to mid tropospheric levels.
- The northeast Monsoon has been active over Tamil Nadu.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-29^{0}C over north Bay, and westcentral Bay of Bengal and some parts of Andaman Sea. It is 29-30^{0}C over southwest Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay, West Central Bay of Bengal and along the east coast of India. It is 50-80 KJ cm^{-2} over east central, southwest Bay of Bengal and Andaman Sea. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is negative vorticity over Bay and Andaman sea, and positive vorticity over north bay and adjoining west central and central bay of Bengal. It is about 100-120 * 10^{-5}s^{-1} over southwest Bay of Bengal.

Convergence:

- Lower level convergence is negative over 5-20*10^{-5} s^{-1} over west central and southwest bay of Bengal.

Divergence:

- It is positive of the order of 5-10*10^{-5} s^{-1} over central Bay of Bengal, about 20*10^{-5} s^{-1} and negative of order of 5*10^{-5} s^{-1} over northeast Bay of Bengal and adjoining north Andaman sea.

Wind Shear:

- **W**ind Shear is 10-20 knots over south west bay of Bengal and south Andaman sea, 15-25 knots over southwest Bay and more than 20 over rest bay of Bengal.

Wind Shear Tendency:

Shear Tendency is decreasing over central and south east bay of Bengal and increasing over rest bay of Bengal and Andaman sea.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 14.0°N over Bay of Bengal region.

M.J.O. Index:

- Located with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 2 with amplitude more than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:
Inference based on INSAT imagery of 030900 UTC

Broken low medium clouds with embedded moderate to intense convection over rest south Bay of Bengal and south Andaman Sea. Scattered low/medium clouds with embedded isolated weak to moderate convection over east central Bay of Bengal.

Broken low/medium clouds with embedded isolated weak to moderate convection over south Arabian sea between lat 5.0°N to 10.5°N east of long 59.5°E.

NWP Analysis:
IMD-GFS model indicates the low pressure area over the southwest Bay of Bengal is likely to intensify into a Depression on 4 December and into Cyclonic Storm on 6 December and moves towards north initially and recurve towards north-eastwards from 8 December 2013. (http://www.imd.gov.in/section/nhac/dynamic/nwp/welcome.htm)
IMD-WRF model indicates the low pressure area over the southwest Bay of Bengal is likely to intensify into a Depression on 4 December and moves towards west during next 3 days. (http://www.imd.gov.in/section/nhac/dynamic/nwp/welcome.htm)
GFS: This model indicates a well-marked low pressure area on 3rd and intensified into a depression on 4th moving northwards with further intensification as tropical cyclone on 6th and take recurve on 09th December 2013.
Meteofrance This model indicates that a well-marked low pressure area on 3rd and intensified into a depression on 4th further intensified into moving northwards and it would intensify further as a tropical cyclone on 6th December.
ECMWF This model indicates a low pressure area will be formed on 6th December and it would intensify as a tropical cyclone on 10th December.
Unified Model This model indicates a well-marked low pressure area on 03rd will be intensified as a tropical cyclone on 5th moving initially northwards and then move east northeastwards as severe cyclonic storm on 8th December onwards.
JMA This model indicates a well-marked low pressure area will be on 4th intensified into a deep depression on 6th .

Genesis Potential Parameter (GPP):
(a) The **grid point analysis** and forecasts of GPP indicate a favourable zone for cyclogenesis over the southwest Bay of Bengal and is likely to organise further during next 7 days. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)
(b) The analysis and forecasts of **area average GPP** indicate that the low pressure system over the south Bay of Bengal has potential to intensify into a tropical cyclone. (http://www.imd.gov.in/section/nhac/dynamic/gpp.pdf

Summary and conclusion:

- Well marked low pressure area over south Bay of Bengal may concentrate into a depression during next 24 hrs and further intensify into a cyclone during subsequent 72 hrs. It would move slowly northwestwards initially.

Advisory:

- IOP will continue for Tamil Nadu, Puducherry and east coast of Sri Lanka for 4-7 December 2013.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	02/12	**03/00**	**03/03**
India	35/51	30/33	37/51
Coastal stations			
WB	6/9	3/9	6/9
Odisha	4/7	5/6	5/7
AP	1214	12/13	12/14
Tamil Nadu	6/12	7/7	7/12
Puducherry	2/2	2/2	2/2
A & N	5/7	1/7	5/7
Bangladesh	811	7/11	8/11
Myanmar	9/11	8/11	8/11
Thailand	3/3	3/3	3/3
Srilanka	8/9	7/9	7/9

RS/RW (12Z) of 02/11/2013 2/39

- **No. of Ascents reaching 250 hPa levels:1, MISDA: -38**
- **RS/RW** (00Z) of 03/11/2013 12/39
- **No. of Ascents reaching 250 hPa levels:12 , MISDA:-27**

No. of PILOT Ascents

02/12Z	**03/00Z**
30/37	16/34

Buoy Data

02/12Z	**03/00Z**	**03/03Z**
7	7	6

FDP (Cyclone) NOC Report Dated 4th December, 2013

Synoptic features based on 0300 UTC:

- The well marked low pressure area over southwest Bay of Bengal persists. Associated cyclonic circulation extends upto mid tropospheric levels System may concentrate into a Depression by tomorrow
- The trough of low at mean sea level from Lakshadweep area to north Maharashtra coast persists

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-29^{0}C over north Bay, and westcentral Bay of Bengal and some parts of Andaman Sea. It is 29-30^{0}C over southwest Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay, West Central Bay of Bengal and along the east coast of India. It is 50-80 KJ cm^{-2} over east central, southwest Bay of Bengal and Andaman Sea. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is negative over Bay and some parts of Andaman Sea, and positive vorticity over North Bay and adjoining central Bay of Bengal. It is positive of about 100-120 * 10^{-5}s^{-1} over southwest Bay of Bengal.

Convergence:

- Lower level convergence is negative over 10-20*10^{-5} s^{-1} over southwest Bay of Bengal.

Divergence:

- It is positive of the order of 5-20*10^{-5} s^{-1} over southwest Bay and about 5-10*10^{-5} s^{-1} over southeast Bay and negative of order of 5*10^{-5} s^{-1} over north Andaman sea & adjoining southeast Bay and Andhra Pradesh coast. .

Wind Shear:

- **W**ind Shear is 5-20 knots over south Bay of Bengal and south Andaman sea. It is more than 20 knots over rest Bay of Bengal.

Wind Shear Tendency:

Shear Tendency is decreasing over south Bay of Bengal & south Andaman Sea. It is increasing over rest Bay of Bengal and north Andaman sea.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 12.0°N over Bay of Bengal region.

M.J.O. Index:

- Located with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 2 with amplitude more than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 040900 UTC

Vortex over southwest Bay centred within half a deg of latitude 8.0^{0}N and longitude 83.0^{0}E. Intensity T1.0. Associated broken low/med clouds with embedded mod to intense convection over south Bay between latitude 5.0^{0}N to 12.5^{0}N west of longitude 89.0^{0}E & Srilanka

NWP Analysis:

IMD-GFS model indicates the low pressure area over the southwest Bay of Bengal is likely to intensify into a Deep Depression at 0000 UTC of 5 December and into Cyclonic Storm at 1200 UTC of 5 December and further intensification during next 6 days. The system is likely to move towards northwest direction slowly and cross Tamil Nadu cost near Chennai on 11 December 2013. (http://www.imd.gov.in/section/nhac/dynamic/nwp/welcome.htm)
IMD-WRF model indicates the low pressure area over the southwest Bay of Bengal is likely to intensify into a Cyclonic Storm on 5 December and moves towards northwest direction during next 2 days and towards west thereafter. (http://www.imd.gov.in/section/nhac/dynamic/nwp/welcome.htm)
ARP model indicates that the low pressure over south west Bay is likely to intensify into depression on 5th and a cyclonic storm on 6th December and moves towards northwest
ECMWF: model indicates the low pressure area over southwest Bay is likely to intensify into a depression on 5th & continue as depression till 7th . it is likely to intensify further into a cyclonic storm on 8th December 2013. It remains almost stationary or slightly northward initially and then northeastwards in the region and weakens gradually from 10th December onwards.
Unified Model This model indicates a well-marked low pressure area on 04th, will be intensified as a depression on 5th and cyclone on 7th moving initially northwards and then move east-northeastwards as severe cyclonic storm on 8th December. It would gradually weaken from 9th December onwards.
JMA: model indicates that low pressure area in the southwest Bay will intensify into a depression on 5th, deep depression on 6th and cyclonic storm on 7th December.
Genesis Potential Parameter (GPP): The **grid point analysis** and forecasts of GPP indicate a favourable zone for cyclogenesis over the southwest Bay of Bengal and is likely to organise further during next 7 days. (http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and conclusion:

- Well marked low pressure area over south Bay of Bengal would concentrate into a depression during next 24 hrs and further intensify into a cyclone during subsequent 48 hrs. It would move slowly northwestwards initially.

Advisory:

- IOP will continue for Tamil Nadu, Puducherry and east coast of Sri Lanka for 4-9 December 2013.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	03/12	**04/00**	**04/03**
India	35/51	30/33	37/51
Coastal stations			
WB	6/9	3/4	6/9
Odisha	6/7	5/5	6/7
AP	12/14	12/13	12/14
Tamil Nadu	8/12	7/7	8/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/7	6/7
Bangladesh	10/11	6/11	8/11
Myanmar	8/11	7/11	7/11
Thailand	3/3	3/3	3/3
Srilanka	7/9	7/9	7/9

RS/RW (12Z) of 03/11/2013 1/39

- **No. of Ascents reaching 250 hPa levels:1, MISDA: -38**
- **RS/RW** (00Z) of 04/11/2013 19/39
- **No. of Ascents reaching 250 hPa levels:20 , MISDA:-20**

No. of PILOT Ascents

03/12Z	**04/00Z**
25/37	18/34

Buoy Data

03/12Z	**04/00Z**	**04/03Z**
8	7	8

FDP (Cyclone) NOC Report Dated 5th December, 2013

Synoptic features based on 0300 UTC:

- The well-marked low pressure area over southwest Bay of Bengal persists. Associated cyclonic circulation extends up to mid tropospheric levels. System may concentrate into a Depression by tomorrow.
- The trough of low at mean sea level from Lakshadweep area to north Maharashtra coast now extends up to south Maharashtra coast.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-29^{0}C over Bay of Bengal. Lower temperatures towards north and higher temperatures towards south.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay, West Central Bay of Bengal and along the east coast of India. It is 50-80 KJ cm^{-2} over east central, southwest Bay of Bengal and Andaman Sea. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive of about 50-120 * $10^{-5}s^{-1}$ over southwest Bay of Bengal. It is negative over central Bay and Andaman Sea

Convergence:

- Lower level convergence is positive over 10-20*10^{-5} s^{-1} over south Bay of Bengal.

Divergence:

- It is positive of the order of 5-20*10^{-5} s^{-1} over south Bay of Bengal and negative of order of 5*10^{-5} s^{-1} over north Andaman sea.

Wind Shear:

- **W**ind Shear is 5-30 knots over south Bay of Bengal and south Andaman sea. It is more than 20 knots over rest Bay of Bengal.

Wind Shear Tendency:

Shear Tendency is increasing over southwest Bay of Bengal.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 10.0°N over Bay of Bengal region.

M.J.O. Index:

- Located with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 3 with amplitude more than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 050900 UTC

Vortex over southwest Bay centred within half a deg of latitude 9.0^{0}N and longitude 83.8^{0}E. Intensity T1.0. Associated broken low/med clouds with embedded intense to very intense convection over south Bay between latitude 5.0^{0}N to 12.5^{0}N and longitude 81.5°E to 88.0^{0}E & East Srilanka

NWP Analysis:

IMD-GFS model indicates the low pressure area over the southwest Bay of Bengal is likely to intensify into a Depression at 0000 UTC of 6 December and into Cyclonic Storm at 1200 UTC of

6th December and further intensification during next 72 hours. The system is likely to move towards northward direction slowly and recurve north north east wards on 9th December 2013.

IMD-WRF model indicates the well-marked low pressure area over the southwest Bay of Bengal on 5th is likely to intensify into a depression on 6th and Cyclonic Storm on 7th December and moves northwest wards and cross Srilanka coast on 8th December 2013.

ARP model indicates that the low pressure over south west Bay is likely to intensify into depression on 6th and a cyclonic storm on 7th December and moves initially towards north.

ECMWF: model indicates the well marked low pressure area over southwest Bay is likely to intensify into a depression on 6th and intensify as cyclonic storm on 7th and move northward till 9th , then move east north east wards till 12th December. System would weaken when it cross lat 15°N.

Unified Model This model indicates a well-marked low pressure area on 05th, will be intensified as a depression on 6th and cyclone on 7th moving initially northwards and then move east-northeastwards as severe cyclonic storm till 11th December over the ocean.

JMA: model indicates that low pressure area in the southwest Bay will intensify into a depression on 6th, and cross Srilanka coast on 7th December.

Genesis Potential Parameter (GPP): Analysis and forecasts of Genesis Potential Parameter (GPP) based on 0000 UTC of 05 December 2013 evaluated for the Low pressure System over the southwest Bay of Bengal indicate that the system has potential to intensify into a Tropical Cyclone.

Summary and conclusion:

- Well marked low pressure area over south Bay of Bengal would concentrate into a depression during next 24 hrs and further intensify into a cyclone during subsequent 48 hrs. It would move slowly north wards initially.

Advisory:

- IOP will continue for Tamil Nadu, Puducherry and east coast of Sri Lanka for 5-9 December 2013.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	04/12	**05/00**	**05/03**
India	35/51	30/33	37/51
Coastal stations			
WB	6/9	3/4	6/9
Odisha	6/7	5/5	6/7
AP	12/14	12/13	12/14
Tamil Nadu	8/12	7/7	8/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/7	6/7
Bangladesh	10/11	6/11	8/11
Myanmar	8/11	7/11	7/11
Thailand	3/3	3/3	3/3
Srilanka	7/9	7/9	7/9

RS/RW (12Z) of 04/11/2013 1/39

- **No. of Ascents reaching 250 hPa levels:1, MISDA: -38**
- **RS/RW** (00Z) of 05/11/2013 19/39
- **No. of Ascents reaching 250 hPa levels:20 , MISDA:-20**
-

No. of PILOT Ascents

04/12Z	**05/00Z**
25/37	18/34

Buoy Data

04/12Z	**05/00Z**	**05/03Z**
8	7	8

FDP (Cyclone) NOC Report Dated 6th December, 2013

Synoptic features based on 0300 UTC:

- The well-marked low pressure area over southwest Bay of Bengal has concentrated into a Depression over the same area and now lies centred at 0300 UTC of today, the 6th December 2013 within half a degree of Lat. 10.0° N and Long. 84.0° E, about 530 kms southeast of Chennai and 350 kms northeast of Trincomalee (Sri Lanka). It would intensify further into a Deep Depression during next 24 hours and subsequently into a Cyclonic Storm. It would move nearly northwards slowly during next 48 hours and then recurve north-northeastwards.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-28^{0}C over Bay of Bengal. Lower temperatures over north and central Bay of Bengal higher temperatures over Andaman sea and south Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay, West Central Bay of Bengal. It is 50-80 KJ cm^{-2} over east central, southwest Bay of Bengal and Andaman Sea. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive of about 50-120 * $10^{-5}s^{-1}$ over southwest Bay of Bengal around the system. It is negative over rest of the Bay of Bengal and Andaman Sea

Convergence:

- Lower level convergence is positive over 10-40*10^{-5} s^{-1} over south Bay of Bengal around the system. It is negative of order of 5*10^{-5} s^{-1} over west central Bay of Bengal and north Andaman Sea.

Divergence:

- It is positive of the order of 5-30*10^{-5} s^{-1} over south and west central Bay of Bengal and negative of order of 5*10^{-5} s^{-1} over south Andaman sea.

Wind Shear:

- **W**ind Shear is 5-20 knots over south Bay of Bengal and south Andaman sea. It is more than 20 knots over rest Bay of Bengal.

Wind Shear Tendency:

Shear Tendency is decreasing over southwest and west central Bay of Bengal.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 10.0°N over Bay of Bengal region.

M.J.O. Index:

- Located with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 3 with amplitude more than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 060900 UTC

Vortex over southwest Bay centred near latitude 10.1° and longitude 83.8^{0}E. intensity T1.5. Associated broken low/med clouds with embedded intense to very intense convection over south Bay between latitude 5.0^{0}N to 16.0^{0}N and longitude 80.0°E to 90.0^{0}E.

NWP Analysis:

IMD-GFS model indicates the low pressure area over the southwest Bay of Bengal is likely to intensify into a Cyclonic Storm during next 24 hr and further intensification during next 4 days. The system is likely to move towards northward direction.
(http://www.imd.gov.in/section/nhac/dynamic/nwp/welcome.htm)
IMD-WRF model indicates the low pressure area over the southwest Bay of Bengal is likely to intensify into a Cyclonic Storm during next 24 hr and moves towards west during next 72 hours.
(http://www.imd.gov.in/section/nhac/dynamic/nwp/welcome.htm)

ARP model indicates that the Depression over south west Bay on 6th is likely to intensify into a cyclonic storm on 7th December and move towards northward during next 3 days.
ECMWF: model indicates the Depression over southwest Bay on 6th is likely to intensify into a cyclonic storm on 7th and move northward till 10th , then move east north east wards till 12th December. System would weaken when it cross lat 13°N over the ocean.
Unified Model indicates a depression on 06th, will be intensified as a cyclonic storm on 7th and as a severe cyclonic storm on 09th December. It would move northwards during next 3-4 days.
JMA: model shows that depression over southwest Bay on 6th and it would intensify into a cyclonic storm on 7th, and cross north Srilanka coast on 9th December.
Genesis Potential Parameter (GPP):
The **grid point analysis** and forecasts of GPP indicate a favourable zone for cyclogenesis over the southwest Bay of Bengal and is likely to organise further during next 5 days and disorganise thereafter.
(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)
Summary and conclusion:

- The Depression over southwest Bay of Bengal would concentrate into a Deep Depression during next 24 hrs and further intensify into a cyclonic storm during subsequent 48 hrs. It would move slowly northwards initially.

Advisory:

- IOP will continue for Tamil Nadu, Puducherry and east coast of Sri Lanka for 7-10 December 2013.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	05/12	**06/00**	**06/03**
India	35/51	30/33	37/51
Coastal stations			
WB	6/9	3/4	6/9
Odisha	6/7	5/5	6/7
AP	12/14	12/13	12/14
Tamil Nadu	8/12	7/7	8/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/7	6/7
Bangladesh	10/11	6/11	8/11
Myanmar	8/11	7/11	7/11
Thailand	3/3	3/3	3/3
Srilanka	7/9	7/9	7/9

RS/RW (12Z) of 05/11/2013 1/39

- **No. of Ascents reaching 250 hPa levels:1, MISDA: -38**
- **RS/RW** (00Z) of 06/11/2013 19/39
- **No. of Ascents reaching 250 hPa levels:20 , MISDA:-20**

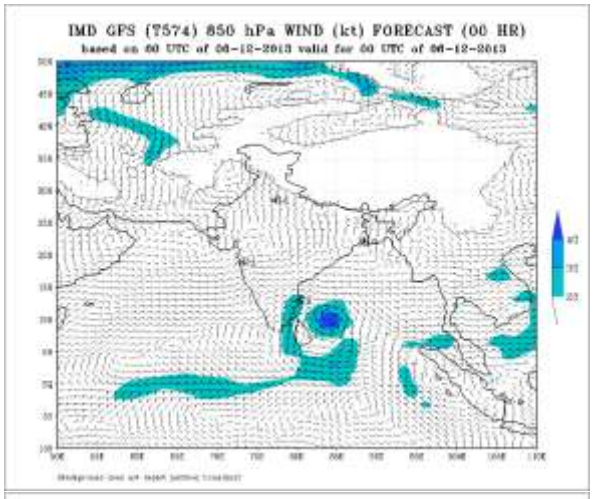
No. of PILOT Ascents

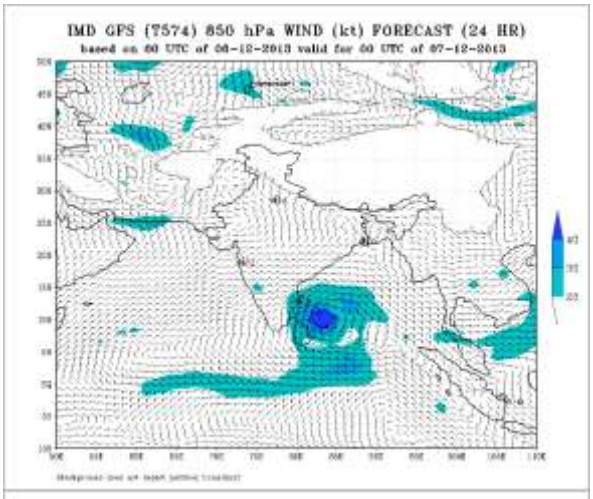
05/12Z	**06/00Z**
25/37	18/34

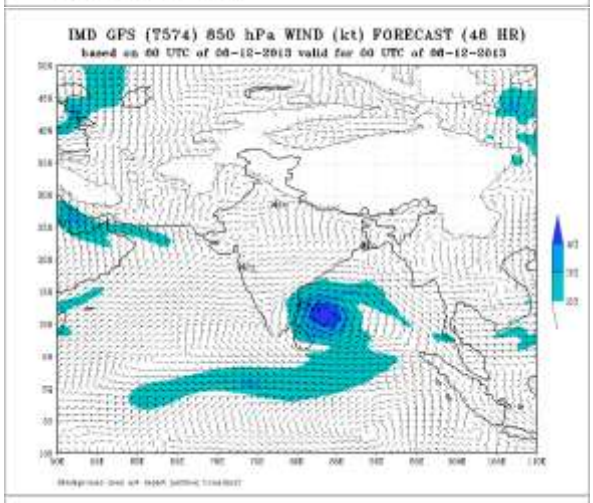
Buoy Data

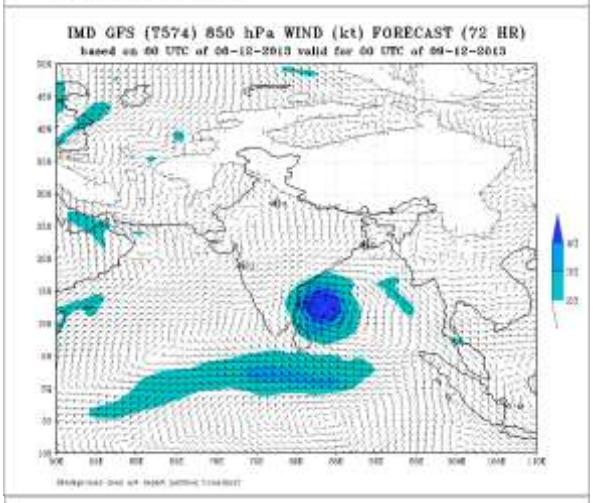
05/12Z	**06/00Z**	**06/03Z**
8	7	8

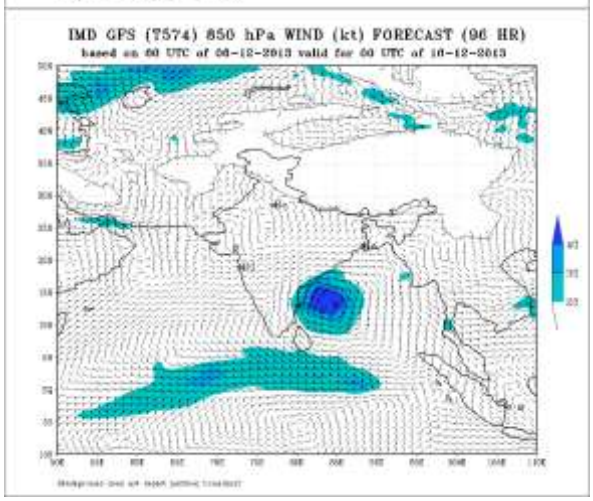
Annexure-II

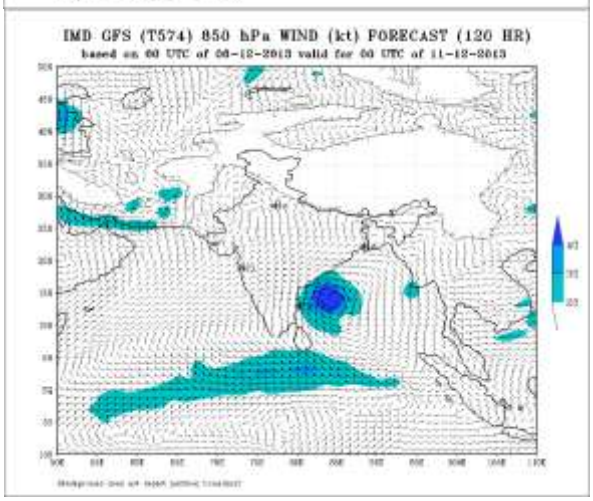

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 06-12-2013 valid for 00 UTC of 06-12-2013

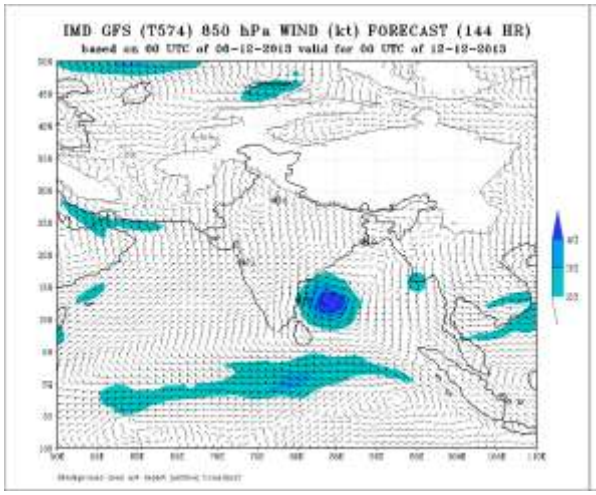

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 06-12-2013 valid for 00 UTC of 07-12-2013

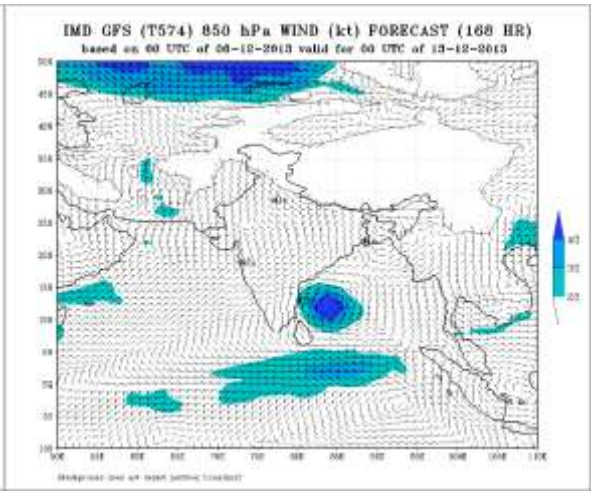

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 06-12-2013 valid for 00 UTC of 08-12-2013

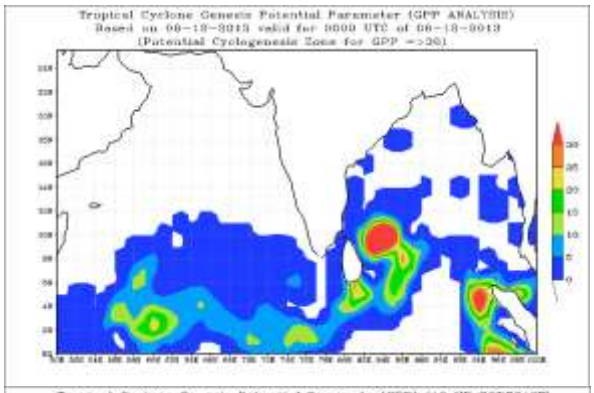

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 06-12-2013 valid for 00 UTC of 09-12-2013

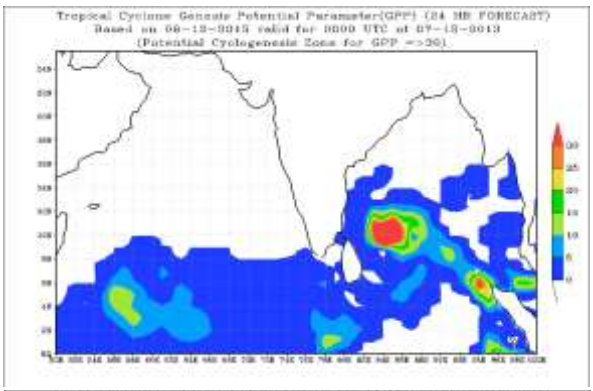

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 06-12-2013 valid for 00 UTC of 10-12-2013

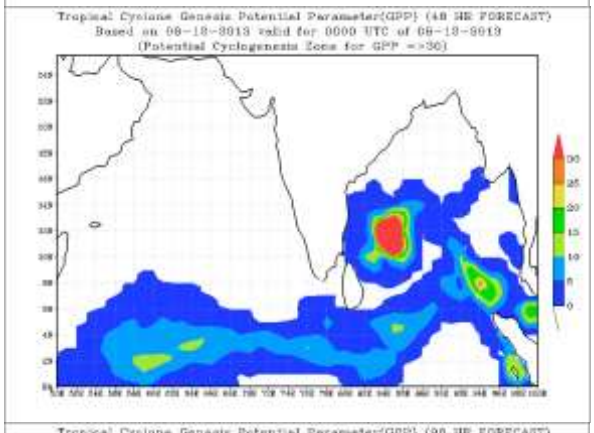

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 06-12-2013 valid for 00 UTC of 11-12-2013

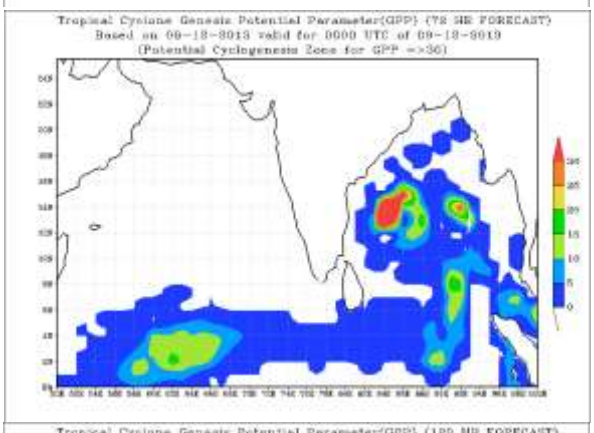

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 08-12-2013 valid for 00 UTC of 12-12-2013

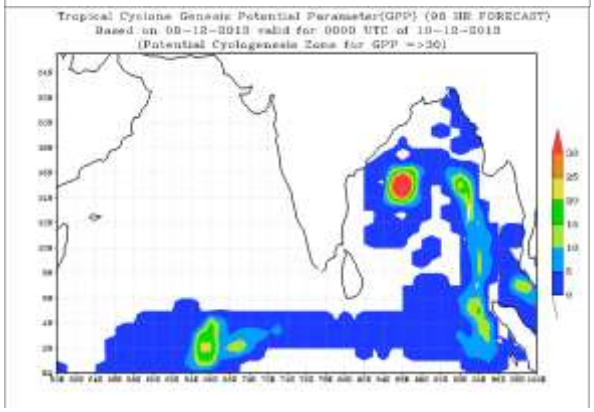

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 08-12-2013 valid for 00 UTC of 13-12-2013

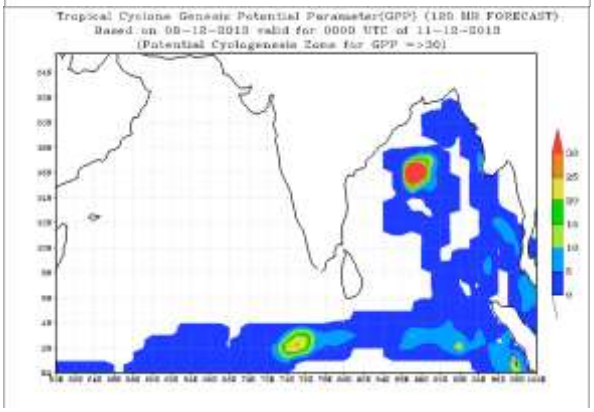

Tropical Cyclone Genesis Potential Parameter (GPP ANALYSIS)
Based on 08-12-2013 valid for 0000 UTC of 08-12-2013
(Potential Cyclogenesis Zone for GPP =>30)

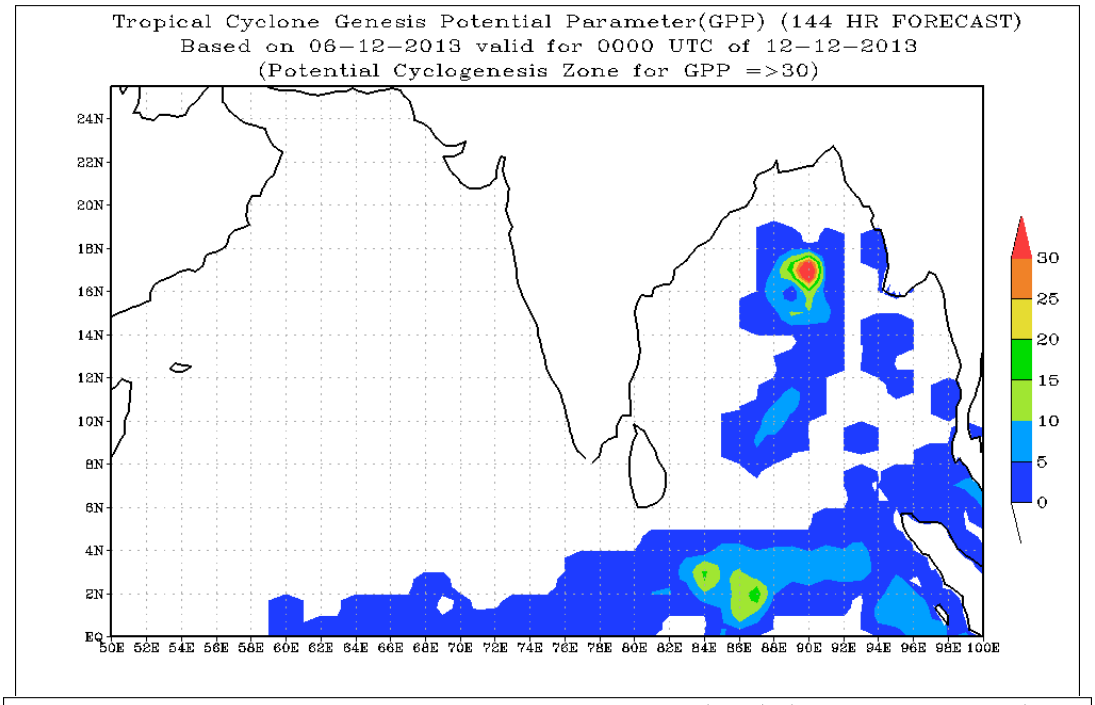

Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 08-12-2013 valid for 0000 UTC of 09-12-2013
(Potential Cyclogenesis Zone for GPP =>30)

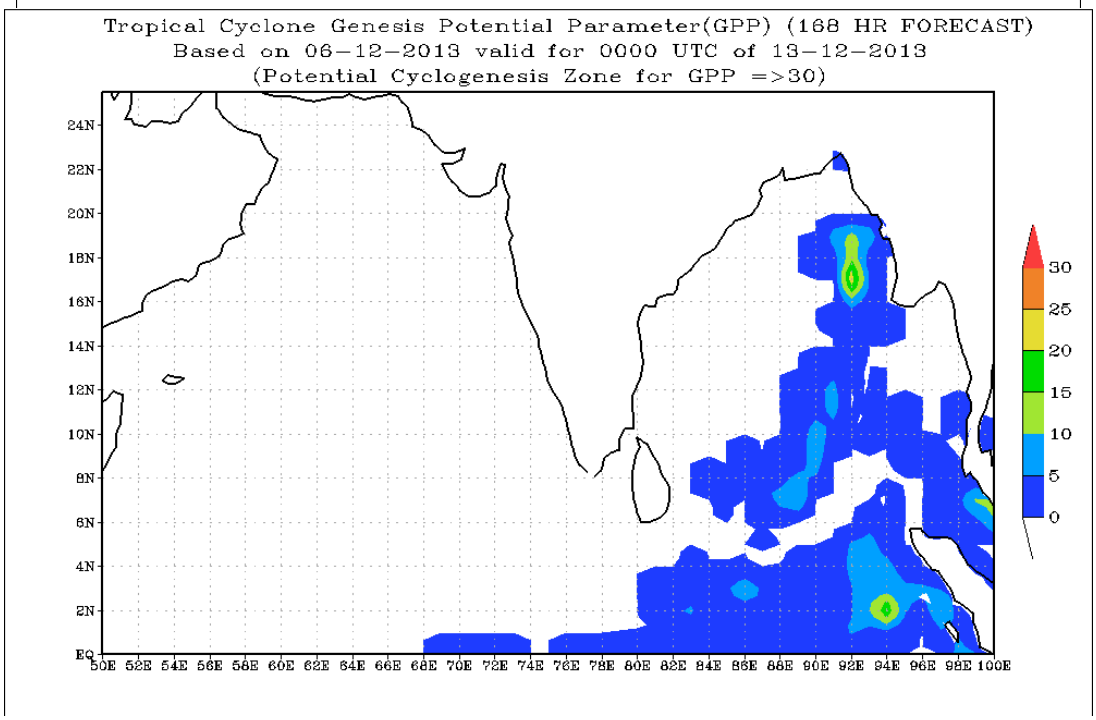

Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 08-12-2013 valid for 0000 UTC of 10-12-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 08-12-2013 valid for 0000 UTC of 11-12-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (96 HR FORECAST)
Based on 08-12-2013 valid for 0000 UTC of 12-12-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (120 HR FORECAST)
Based on 08-12-2013 valid for 0000 UTC of 13-12-2013
(Potential Cyclogenesis Zone for GPP =>30)


Tropical Cyclone Genesis Potential Parameter(GPP) (144 HR FORECAST)
Based on 06-12-2013 valid for 0000 UTC of 12-12-2013
(Potential Cyclogenesis Zone for GPP =>30)
24N
22N
20N
18N
16N
14N
12N
10N
8N
6N
4N
2N
EQ
50E 52E 54E 56E 58E 60E 62E 64E 66E 68E 70E 72E 74E 76E 78E 80E 82E 84E 86E 88E 90E 92E 94E 96E 98E 100E
30
25
20
15
10
5
0


Tropical Cyclone Genesis Potential Parameter(GPP) (168 HR FORECAST)
Based on 06-12-2013 valid for 0000 UTC of 13-12-2013
(Potential Cyclogenesis Zone for GPP =>30)
24N
22N
20N
18N
16N
14N
12N
10N
8N
6N
4N
2N
EQ
50E 52E 54E 56E 58E 60E 62E 64E 66E 68E 70E 72E 74E 76E 78E 80E 82E 84E 86E 88E 90E 92E 94E 96E 98E 100E
30
25
20
15
10
5
0

FDP (Cyclone) NOC Report Dated 7th December, 2013

Synoptic features based on 0300 UTC:

- The Depression over southwest Bay of Bengal remained practically stationary and lay centred at 1200 UTC of yesterday, the 6th December 2013 within half a degree of Lat. 10.0° N and Long. 84.0° E, about 530 kms southeast of Chennai and 350 kms northeast of Trincomalee (Sri Lanka). It further intensified into a Deep Depression at 1800 UTC of yesterday the 6th December 2013 and lay centred over the same region. It moved northwards and intensified into a Cyclonic Storm 'MADI' and lay centred at 0000 UTC of today, the 7th December 2013 over southwest Bay of Bengal within half a degree of Lat. 10.5° N and Long. 84.0° E, about 500 kms southeast of Chennai and 370 kms northeast of Trincomalee (Sri Lanka). It remained practically stationary and lies centred at 0300 UTC of today, the 7th December 2013 within half a degree of Lat. 10.5° N and Long. 84.0° E, over the same region. It would intensify further into a Severe Cyclonic Storm during next 24 hours. It would move nearly northwards very slowly during next 48 hours and then recurve north-northeastwards

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-28^{0}C over Bay of Bengal. Lower temperatures over north and central Bay of Bengal higher temperatures over Andaman sea and south Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay, West Central Bay of Bengal. It is 50-80 KJ cm^{-2} over east central, southwest Bay of Bengal and Andaman Sea. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive of about 50-150 * $10^{-5}s^{-1}$ over southwest Bay of Bengal around the system. It is negative over rest of the Bay of Bengal and Andaman Sea

Convergence:

- Lower level convergence is positive over 10-30*10^{-5} s^{-1} over south Bay of Bengal around the system and west central Bay of Bengal.

Divergence:

- It is positive of the order of 5-30*10^{-5} s^{-1} over southwest adjoining central Bay of Bengal and negative of order of 5*10^{-5} s^{-1} over southeast bay and sourth Andaman sea.

Wind Shear:

- **W**ind Shear is 10-20 knots over south Bay of Bengal and south Andaman sea. It is more than 20 knots over rest Bay of Bengal.

Wind Shear Tendency:

Shear Tendency is decreasing over southwest and increasing over central Bay of Bengal.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 10.0°N over Bay of Bengal region.

M.J.O. Index:

- Located with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 3 with amplitude more than 1.0 during next 3 days.

Status of observational system:

Details of the status of observational system are given in **Annexure-I**.

Satellite:

Inference based on INSAT imagery of 070900 UTC

Vortex (MADI) over southwest Bay centred near latitude 10.5° and longitude 84.3^{0}E. intensity T3.5. Associated broken low/med clouds with embedded intense to very intense convection over south Bay between latitude 6.0^{0}N to 18.0^{0}N and longitude 80.0°E to 89.0^{0}E.

NWP Analysis:

IMD-GFS model indicates the cyclonic storm over the southwest Bay of Bengal on 7th is likely to intensify into a severe Cyclonic Storm during next 24 hr and further intensification during next 48 hour. The system is likely to move towards northward direction.
(http://www.imd.gov.in/section/nhac/dynamic/nwp/welcome.htm)

ARP model indicates that the cyclonic storm over south west Bay on 7th is likely to intensify into a severe cyclonic storm on 8th December and very severe cyclonic storm on 9th and move towards north-northeast ward during next 3 days.

ECMWF: model indicates the cyclonic storm over southwest Bay on 7th is likely to intensify into a severe cyclonic storm on 8th and move northward till 11th , then move southwest wards on 12th December. System would weaken as depression, when it close to Tamilnadu coast.

Unified Model indicates a cyclonic storm on 7th, will be intensified as a severe cyclonic storm on 8th. It would move very slow northwards till 11th and weaken as a depression.

Genesis Potential Parameter (GPP): The **grid point analysis** and forecasts of GPP indicate a favourable zone for cyclogenesis over the southwest Bay of Bengal and is likely to organise further during next 3 days and disorganise thereafter.
(http://www.imd.gov.in/section/nhac/dynamic/Analysis.htm)

Summary and conclusion:

- The cyclonic storm, **MADI** over southwest Bay of Bengal remained practically stationary, intensified into a severe cyclonic storm and lay centred at 1430 hours IST of 07 December 2013 over southwest Bay of Bengal near latitude 10.5^0 N and longitude 84.0^0 E, about 500 km southeast of Chennai and 370 km northeast of Trincomalee (Sri Lanka) . It would intensify further into a very severe cyclonic storm during next 24 hours. It would move nearly northwards very slowly during next 48 hrs and then recurve north-northeastwards.

Advisory:

- IOP will continue for Tamil Nadu, Puducherry and east coast of Sri Lanka for 8-11 December 2013.

Annexure-I

Status of Observation system:
Synoptic observation:

Region	Date/Time (UTC)		
	06/12	**07/00**	**07/03**
India	34/51	31/33	38/51
Coastal stations			
WB	6/9	3/4	6/9
Odisha	6/7	5/5	6/7
AP	12/14	12/13	12/14
Tamil Nadu	8/12	7/7	8/12
Puducherry	2/2	2/2	2/2
A & N	6/7	1/7	6/7
Bangladesh	10/11	6/11	8/11
Myanmar	8/11	7/11	7/11
Thailand	3/3	3/3	3/3
Srilanka	7/9	7/9	7/9

RS/RW (12Z) of 06/11/2013 1/39

- **No. of Ascents reaching 250 hPa levels:1, MISDA: -38**
- **RS/RW** (00Z) of 07/11/2013 19/39
- **No. of Ascents reaching 250 hPa levels:20 , MISDA:-20**

No. of PILOT Ascents

06/12Z	**07/00Z**
25/37	18/34

Buoy Data

06/12Z	**07/00Z**	**07/03Z**
8	7	8

FDP (Cyclone) NOC Report Dated 8th December, 2013

Synoptic features based on 0300 UTC:

- The Cyclonic Storm 'MADI' over southwest Bay of Bengal remained practically stationary, intensified into a Severe Cyclonic Storm and lay centred at 0900 UTC of yesterday, the 07th December 2013 over the same region within half a degree of Lat.10.5°N and Long.84.0°E.It moved northeastwards and lay centred at 1200 UTC of yesterday evening over southwest Bay of Bengal within half a degree of Lat.11.0°N and Long.84.5°E, about 520 kms east-southeast of Chennai and 440 kms north east of Trincomalee (Sri Lanka).It further moved northwards and lay centred at 0300 UTC of today, the 8th December 2013 over southwest and adjoining west central Bay of Bengal within half a degree of Lat.12.0°N and Long.84.6°E, about 490 kms east-outheast of Chennai and 530 kms northeast of Trincomalee (Sri Lanka). It moved slightly north-northeast ward intensified into a Very severe cyclonic storm and lay centred at 0600 UTC near lat. 12.3^0N and long.84.7^0 E it further moved northward and lay centred at 0900 UTC of 8th December near lat.12.6^0N and long.84.7^0E about 490 kms east-southeast of Chennai and 580 kms northeast of Trincomalee. It would move slightly northwards slowly for some more time.
- The trough of low at mean sea level from Lakshadweep area to south Maharashtra coast persists
- A cyclonic circulation extending upto 3.1 kms a.s.l. lies over Lakshadweep area

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around 26-28^0C over Bay of Bengal. Lower temperatures over north and central Bay of Bengal higher temperatures over Andaman sea and south Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay, West Central Bay of Bengal. It is 50-80 KJ cm^{-2} over east central, southwest Bay of Bengal and Andaman Sea. It is 80-120 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive of about 50-150 * $10^{-5}s^{-1}$ over southwest Bay of Bengal around the system. It is negative over rest of the Bay of Bengal and Andaman Sea.

Convergence:

- Lower level convergence is positive over 10-30*10^{-5} s^{-1} over south Bay of Bengal around the system and west central Bay of Bengal.

Divergence:

- It is positive of the order of 5-30*10^{-5} s^{-1} over southwest adjoining central Bay of Bengal and negative of order of 5*10^{-5} s^{-1} over southeast bay and sourth Andaman sea.

Wind Shear:

- **W**ind Shear is 10-20 knots over south Bay of Bengal and south Andaman sea. It is more than 20 knots over rest Bay of Bengal.

Wind Shear Tendency:

Shear Tendency is decreasing over southwest and increasing over central Bay of Bengal.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 10.0°N over Bay of Bengal region.

M.J.O. Index:

- Located with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 3 with amplitude more than 1.0 during next 3 days.

Status of observational system:

Satellite:

Inference based on INSAT imagery of 080900 UTC

Vortex (MADI) over southwest Bay has further intensified and now centred near latitude 12.6° and longitude 84.7^{0}E. intensity T4.0. Associated broken low/med clouds with embedded intense to very intense convection over Bay between latitude 10.0^{0}N to 18.0^{0}N and longitude 80.0°E to 88.0^{0}E.

NWP Analysis:

Most of the models suggest that the system would move slightly northeastwards for next 48 hours then southwestwards and weaken gradually.

Summary and conclusion:

I The severe cyclonic storm '**MADI'** over southwest Bay of Bengal intensified into very severe cyclonic storm, moved north-northeast wards and lay centred at 0900 UTC of 8th December 2013 over southwest and adjoining westcentral Bay of Bengal near latitude 12.6^{0}N and longitude 84.7^0 E, about 490 km east-southeast of Chennai and 580 km northeast of Trincomalee. it would move slightly northwards slowly for some more time.

Advisory:

- IOP will continue for Tamil Nadu, Puducherry and east coast of Sri Lanka for 9-11 December 2013.

FDP (Cyclone) NOC Report Dated 9th December, 2013

Synoptic features based on 0300 UTC:

- The very severe cyclonic storm '**MADI'** over westcentral and adjoining southwest Bay of Bengal remained practically stationary and lay centred at 0830 hours IST of 9th December 2013 over westcentral and adjoining southwest Bay of Bengal near latitude 14.0^0 N and longitude 84.7^0 E, about 500 km east-northeast of Chennai and 710 km north-northeast of Trincomalee (Sri Lanka). It would weaken gradually and move nearly northwards slowly for 12 hrs and then recurve southwestward.

Environmental features based on 0300 UTC of today:

Sea Surface Temperature:

- SST is around $26\text{-}28^0$C over Bay of Bengal. Lower temperatures over north and central Bay of Bengal higher temperatures over Andaman sea and south Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay, West Central and Southwest Bay. It is 50-80 KJ cm^{-2} over east central Bay of Bengal and Andaman Sea. It is 80-100 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive of about $50\text{-}150*10^{-5}s^{-1}$ over southwest and westcentral Bay of Bengal around the system. It is negative over rest of the Bay of Bengal and Andaman Sea.

Convergence:

- Lower level convergence is positive over $05\text{-}15*10^{-5}$ s^{-1} over westcentral and adjoining southwest Bay of Bengal around the system .

Divergence:

- It is positive of the order of $10\text{-}30*10^{-5}$ s^{-1} over westcentral bay around the system. and negative of order of $5*10^{-5}$ s^{-1} over southwest bay of Bengal..

Wind Shear:

- **W**ind Shear is 20-30 knots over westcentral Bay of Bengal around the system. It is more than 30 knots over the north of the system and less than 20 knots over south of the system.

Wind Shear Tendency:

Shear Tendency is decreasing over central bay and increasing over southwest Bay of Bengal.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 11.0°N over Bay of Bengal region.

M.J.O. Index:

- Located with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 3 with amplitude more than 1.0 during next 3 days.

Satellite:

Inference based on INSAT imagery of 090900 UTC
Vortex (MADI) over westcentral bay has centred near latitude 14.4° and longitude 84.7^{0}E. intensity T4.0. Associated broken low/med clouds with embedded intense to very intense convection over Bay between latitude 11.0^{0}N to 18.0^{0}N and longitude 82.0°E to 87.0^{0}E.

NWP Analysis:
Most of the models suggest that the system would move slightly northwards for next 24 hours then southwestwards and weaken gradually.

Summary and conclusion:

The very severe cyclonic storm '**MADI'** over westcentral and adjoining southwest Bay of Bengal moved slightly northwards and lay centred at 1430 hours IST of 9th December 2013 over westcentral and adjoining southwest Bay of Bengal near latitude 14.4^0 N and longitude 84.7^0 E, about 510 km east-northeast of Chennai and 750 km north-northeast of Trincomalee (Sri Lanka). It would weaken gradually and move nearly northwards slowly for some more time and then recurve southwestward.

Advisory:

- IOP will continue for Tamil Nadu, Puducherry and east coast of Sri Lanka for 10-12 December 2013.

FDP (Cyclone) NOC Report Dated10th December, 2013

Synoptic features based on 0300 UTC:

- The severe cyclonic storm '**MADI'** over westcentral & adjoining southwest Bay of Bengal moved northeastwards during past six hours and lay centred at 0830 hours IST of today, the 10th December 2013 over westcentral & adjoining southwest Bay of Bengal near lat.15.3^0 N and long. 85.3^0 E, about 600 km east-northeast of Chennai and 860 km north-northeast of Trincomalee (Sri Lanka). It would move nearly northwards slowly for some time and then recurve southwestwards and weaken gradually.

Environmental features based on 0900 UTC of today:

Sea Surface Temperature:

- SST is around 26-28^{0}C over Bay of Bengal. Lower temperatures over north and central Bay of Bengal higher temperatures over Andaman sea and south Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay, West Central and Southwest Bay. It is 50-80 KJ cm^{-2} over east central Bay of Bengal and Andaman Sea. It is 80-100 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive of about 50-150*10^{-5}s^{-1} over westcentral Bay of Bengal around the system. It is negative over north and northeast Bay of Bengal and Andaman Sea.

Convergence:

- Lower level convergence is positive over 05-10*10^{-5} s^{-1} over westcentral and adjoining southwest Bay of Bengal around the system .

Divergence:

- It is positive of the order of 10-20*10^{-5} s^{-1} over westcentral bay around the system. and negative of order of 5*10^{-5} s^{-1} over southwest bay of Bengal..

Wind Shear:

- **W**ind Shear is 10-40 knots over westcentral Bay of Bengal around the system. It is more than 30 knots over the north of the system and less than 20 knots over south of the system.

Wind Shear Tendency:

Shear Tendency is decreasing over central bay and increasing over southwest Bay of Bengal.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 12.0°N over Bay of Bengal region.

M.J.O. Index:

- Located with amplitude less than 1.0.
- Dynamical forecast:- MJO index may continue in phase 3 with amplitude more than 1.0 during next 3 days.

Satellite:

Inference based on INSAT imagery of 100900 UTC

Vortex (MADI) over westcentral bay has centred near latitude 15.7° and longitude 85.3^{0}E. intensity T4.0. Associated broken low/med clouds with embedded intense to very intense convection over Bay between latitude 14.0^{0}N to 20.0^{0}N and longitude 82.0°E to 87.0^{0}E.

NWP Analysis:
Most of the models suggest that the system would move slightly northwards then southwestwards and weaken gradually.

Summary and conclusion:

- The severe cyclonic storm '**MADI'** over westcentral & adjoining southwest Bay of Bengal moved slightly northwards during past six hours and lay centred at 1430 hours IST of today, the 10th December 2013 over westcentral Bay of Bengal near lat.15.7^0 N and long. 85.3^0 E, about 450 km east-southeast.of Machillipatnam, 630 km northeast of Chennai and 900 km north-northeast of Trincomalee (Sri Lanka). It would move nearly northwards slowly for some time and then recurve southwestwards and weaken gradually.

Advisory:

- IOP will continue for Tamil Nadu, Puducherry and east coast of Sri Lanka for 11-13 December 2013.

FDP (Cyclone) NOC Report Dated11th December, 2013

Synoptic features based on 0300 UTC:

- The **Severe Cyclonic Storm 'MADI'** over west central Bay of Bengal moved southwestwards and lay centred at 1200 UTC of yesterday, the 10th December 2013 over west central Bay of Bengal, near Lat. 15.4° N and Long. 85.0° E. It further moved southwestwards, weakened into a **Cyclonic Storm 'MADI'** and lay centred at 2100 UTC of yesterday, the 10th December 2013 over the same area, near Lat. 14.6°N and Long. 84.6° E, about 400 kms east-southeast of Machilipatnam, 500 kms northeast of Chennai and 750 kms north northeast of Trincomalee (Sri Lanka). It further moved southwestwards, weakened into a **Deep Depression** and lies centred at 0300 UTC of today, the 11th December 2013, over west central Bay of Bengal, near Lat. 14.0° N and Long. 83.8° E, about 380 kms southeast of Machilipatnam, 400 kms east northeast of Chennai and 660 kms north northeast of Trincomalee (Sri Lanka). It would move further southwestwards and weaken into a Depression during next 12 hours.

Environmental features based on 0900 UTC of today:

Sea Surface Temperature:

- SST is around 26-28^{0}C over Bay of Bengal. Lower temperatures over north and central Bay of Bengal higher temperatures over Andaman sea and south Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north Bay, West Central and Southwest Bay. It is 50-80 KJ cm^{-2} over east central Bay of Bengal and Andaman Sea. It is 80-100 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive of about 50-150*10^{-5}s^{-1} over westcentral Bay of Bengal around the system. It is negative over north and northeast Bay of Bengal and Andaman Sea.

Convergence:

- Lower level convergence is positive over 05-10*10^{-5} s^{-1} over westcentral and adjoining southwest Bay of Bengal around the system .

Divergence:

- It is positive of the order of 10-20*10^{-5} s^{-1} over westcentral bay around the system. and negative of order of 5*10^{-5} s^{-1} over southwest bay of Bengal..

Wind Shear:

- **W**ind Shear is 10-40 knots over westcentral Bay of Bengal around the system. It is more than 30 knots over the north of the system and less than 20 knots over south of the system.

Wind Shear Tendency:

- shear tendency is decreasing over central bay and increasing southwest Bay of Bengal.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 12.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 3 with amplitude more than 1.0.
- Dynamical forecast:- MJO index may continue in phase 3 with amplitude more than 1.0 during next 3 days.

Status of observational system:

NWP Analysis:
Most of the models suggest that the system would move southwestwards then and weaken gradually.

Satellite bulletin based on 0900 UTC of 12th Decmber 2013

- Vortex (madi) over southwest bay centred near lat 13.3n/83.3e (.) Intensity T2.0/C.I 2.5 (.) Associated broken low/med clouds with embedded isolated moderate to intense convection over Bay between lat 11.5°N to 16.0°N long 81.0° E to 85.5° E (.)

Summary and conclusion:

- The Deep Depression '**MADI'** over westcentral & adjoining southwest Bay of Bengal moved slightly southwest during past six hours and lay centred at 1730 hours IST of today, the 11th December 2013 over westcentral Bay of Bengal near lat.13.3^0 N and long. 83.3^0 E, about 400 km southeast.of Machillipatnam, 340 km east-northeast of Chennai and 570 km north-northeast of Trincomalee (Sri Lanka). It would move southwestwards and weaken gradually and cross Tamilnadu coast as a **Well Marked Low** by night of 12th December 2013.

Advisory:

- IOP will continue till 12th December 2013.

FDP (Cyclone) NOC Report Dated12th December, 2013

Synoptic features based on 0300 UTC:

The Deep Depression over west central Bay of Bengal moved slightly southwestwards and lay centred at 0900 UTC of yesterday, the 11th December 2013 over west central and adjoining southwest Bay of Bengal. It moved south southwestwards and lay centred at 1200 UTC of yesterday, the 11th December 2013 over the same area, near Lat. 13.3° N and Long. 83.3° E. It further moved southwestwards, weakened into a Depression and lay centred at 1800 UTC of yesterday, the 11th December 2013 over southwest Bay of Bengal, near Lat. 12.9° N and Long. 82.7° E. It moved southwestwards, weakened into a well marked low pressure area over southwest Bay of Bengal, at 0000 UTC of today, the 12th December 2013. It further moved southwestwards and now lies over southwest Bay of Bengal off north Tamil Nadu coast. Associated cyclonic circulation extends upto mid tropospheric levels. ·

Environmental features based on 0900 UTC of today:

Sea Surface Temperature:

- SST is around 26-28^{0}C over Bay of Bengal. Lower temperatures over north and central Bay of Bengal higher temperatures over Andaman sea and south Bay of Bengal.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over north, Central and Southwest Bay of Bengal. It is 80-100 KJ cm^2 over equatorial region.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive of about 50-120*10^{-5}s^{-1} over southwest Bay of Bengal around the system. It is negative over north and northeast Bay of Bengal and Andaman Sea.

Convergence:

- Lower level convergence is positive over 05-10*10^{-5} s^{-1} over southwest Bay of Bengal around the system .

Divergence:

- It is positive of the order of 5-10*10^{-5} s^{-1} around the system. and negative towards south of the system...

Wind Shear:

- **W**ind Shear is 10 knots over southwest Bay of Bengal around the system. It is more than 20 knots over the north and south of the system.

Wind Shear Tendency:

- shear tendency is increasing over central bay and decreasing over southwest Bay of Bengal.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 12.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 3 with amplitude more than 1.0.
- Dynamical forecast:- MJO index may continue in phase 3 with amplitude more than 1.0 during next 3 days.

NWP Analysis:

Most of the models suggest that the system would move southwestwards then and weaken gradually.

Satellite bulletin based on 1000 UTC of 12th Decmber 2013

- Vortex (madi) over southwest bay centred near lat10.7N/80.6 E Intensity T1.5 Associated broken low/med clouds with embedded isolated moderate to intense convection over Bay between lat 8.0°N to 13.0°N west of long 82.0E coastal Tamilnadu extending up to north SriLanka.

Summary and conclusion:

Latest Satellite imagery and coastal & RADAR observations indicate that the well marked low pressure area lay as depression at 1430 hrs IST of today, the 12th December over southwest Bay of Bengal near lat. 10.7°N and long. 80.7°E, about 90 km southeast of Nagapattinam. It would move southwestwards and cross Tamil Nadu coast between Nagapattinam and Tondi tonight.

Advisory:

- IOP will continue till 13th December 2013.

FDP (Cyclone) NOC Report Dated13th December, 2013

Synoptic features based on 0300 UTC:

- The depression over southwest Bay of Bengal, moved west-southwestwards and crossed Tamil Nadu coast, close to Vedaranyam around 1330 UTC of yesterday, the 12th December 2013. It then emerged into Palk Strait at 1500 UTC of yesterday, moved west-southwestwards and crossed again Tamil Nadu coast, near Tondi around 1700 UTC of yesterday, the 12th December 2013 and lay centred at 1800 UTC of the 12th December 2013 near Lat. 10.0° N and Long. 78.5° E, about 50 kms northeast of Maduarai. It continued to move west-southwestwards and weakened into a well marked low pressure area over southeast Arabian Sea and adjoining Kerala at 0000 UTC of today, the 13th December 2013. It lay as a low pressure area over Lakshadweep area and neighborhood, at 0300 UTC of today, the 13th December 2013.
- A cyclonic circulation extending upto 3.1 kms a.s.l. lies over south Andaman Sea and neighbourhood.

Environmental features based on 0900 UTC of today:

Sea Surface Temperature:

- SST is around below 20°C over Bay of Bengal and Andaman Sea.

Ocean thermal energy:

- It is less than 50 KJ cm^{-2} over Bay of Bengal and Andaman Sea.

Relative Vorticity:

- Relative vorticity at 850 hPa is positive of about $0\text{-}30*10^{-5}s^{-1}$ over southwest Bay of Bengal and Andaman Sea

Convergence:

- Lower level convergence is positive over $05\text{-}10*10^{-5}$ s^{-1} over southeast Bay of Bengal and south Andaman sea .

Divergence:

- It is positive of the order of $5*10^{-5}$ s^{-1} over southeast Bay of Bengal and negative over west central and northwest Bay of Bengal.

Wind Shear:

- **W**ind Shear is 5-10 knots over south Bay of Bengal. It is more than 20 knots rest Bay of Bengal.

Wind Shear Tendency:

- shear tendency is increasing over Bay of Bengal and Andaman sea, and decreasing over southeast Bay of Bengal.

Upper tropospheric ridge:

- The upper tropospheric ridge line at 200 hPa passes through lat 12.0°N over Bay of Bengal region.

M.J.O. Index:

- Located in phase 3 with amplitude more than 1.0.
- Dynamical forecast:- MJO index may continue in phase 3 with amplitude more than 1.0 during next 3 days.

NWP Analysis:

Most of the models indicate no Cyclogenesis over Indian ocean.

Satellite bulletin based on 0900 UTC of 13th December 2013

- Broken low/med clouds with embedded moderate to intense convection over southeast Arabian Sea adjoining Kerala adjoining Tamil Nadu in association with Vortex (MADI) centred within a half degree of lat 8.8°N and long 75.0E.

Summary and conclusion:

- The low pressure area over southeast Arabian Sea and adjoining Kerala would move westwards and weaken gradually.

Advisory:

- No IOP.

This is the last bulletin for FDP programme of 2013.

CHAPTER-VI

Lessons learnt from FDP-2013

IOP was declared for 31 days including 7 days during depression over the Bay of Bengal (13-17 Nov.2013), 6 days during the severe cyclonic strom(SCS), Helen over the Bay of Bengal (19-23 Nov.2013), 5 days during very severe cyclonic storm(VSCS), Lehar over the Bay of Bengal (23-28 Nov2013) and 13 days during very severe cyclonic storm(VSCS), Madi over the Bay of Bengal (06-13 Dec.2013). SST observations and ocean thermal energy showed favorable conditions for genesis as it crossed the limit of 50KJ/cm^{-2} over the Bay of Bengal for a number of days. Further intensification takes place when ocean thermal energy .100 KJ/cm^2. The system weakens if it is less than 50 KJ/cm^2 in most cases though not inall cases. It indicates that ocean thermal energy is not the only factor intensification/weakening

1. There is constraint in finding centre of the storm during night. Microwave imagery is very useful to monitor intensity and location of cyclonic disturbance for analysing characteristics of cloud cluster evolution and dissipation and brightness temperature structure around the centre of the system. There is a need to make arrangement to ensure availability of all polar satellite products during cyclonic disturbance over NIO. As such arrangement may be made to provide centre of cyclonic storm during night using microwave imageries along with T No which will be highly helpful. Officers/staff can be traiThe technique should be develpedned for fixing T.No in microwave imagery.
2. Buoy data were very usefull for validating the scratteromery wind and intensity examination thouth they were scanty. Buoy observation is highly informative for synoptic analyses and ocean surface wind information. As such number of buoy may be enhanced from existing 12 buoys over entire north Indian Ocean.
3. Structure DWR bulletins were received from CDR Visakhapatanam and could not be so ontained from Machilipatnam dueto manpower problem. Trained manpower should be available in CDR stations during cyclone period. Coastal Automatic Weather Station observation and Dopplar data were very useful in facilitating early warning of landfall.
4. Diurnal cycle of convection do influence cyclonic disturbance and hence this aspect is required to be monitored and examined in detail. Satellite division of IMD and other may carry out studies on these aspects.
5. Conventional ship observations under IVOF scheme are very less. Only a few ship observations were received during cyclonic disturbance period. Hence deployment of Sagar Kanya or Sagar Nidhi cruise could have been very useful for cyclone forecast. Inspite of several attempts it could not be organized during 2013. Attempt should be made for future campaign.
6. Due to huge number of hits, the IMD website could not be accessed by general public and disaster managers. Necessary arrangements need to be done to avoid such failures in future. However the newly launched RSMC, New Delhi website(www.rsmcnewdelhi.imd.gov.in) may be able to address this problem.

7. Structured satellite bulletins like that issued by other international centres would be very helpful for better utilization of statellite advisories. Satmet division of IMD should issue such bulletin
8. Intensity forecast especially rapid weakening before landfall is still challenging. R&D group should make coordinated effort to develop a technique for forecasting rapid weakening of TC.
9. Inspite of several attempts, aircraft recorraissance which is one of the key objectives of FDP could not be carried out so far. MoES and IMD however should continue their efforts to achieve this objective in 12th five year plan.
10. As Oceansat-II has been defunc ISRO should plan for its replacement as sea surface wind for such satellite is very useful over the data sparse NIO region.
11. Based on the campaign conducted so far the NWP groups should bring out the limitation and capabilities of various models used operationally based on critical assessment of their performance.
12. In view velopment in recent years in ensemble prediction, attempts should be made to create dynamical cone of uncertainty location specific probability of precipitation, strong wind and stom surge/coastal inundation.

CHAPTER-VII

Summary and Conclusions

The Pilot Phase of FDP on landfalling cyclones over the Bay of Bengal was conducted during 15th October to 13th December, 2013 as per the implementation plan. IOP was declared for 31 days in view of Depression over the Bay of Bengal (13-17 Nov.2013) 7 days. The Severe Cyclonic Strom over the Bay of Bengal Helen (19-23 Nov.2013) 6 days, Very Severe cyclonic storm over the Bay of Bengal Lehar (23-28 Nov2013) 5 days and Very Severe cyclonic storm over the Bay of Bengal Madi (06-13 Dec.2013) 13 days.The daily bulletin was prepared during the period and circulated to all concerned. The NOC meeting was held thrice a week, viz. Monday, Wednesday & Friday.

The FDP helped in continuous monitoring of environmental conditions for cyclogenesis. Further, intense observation during IOP helped in better monitoring and prediction of cyclonic disturbances. The additional data collected during FDP 2013 included the data collected from ACWC/CWCs, Enhanced AWS network of the coast, twelve activated buoy observations from the Bay of Bengal and Arabian Sea, Oceansat-II observations and microwave imagery products. The Tropical Cyclone module installed in Synergie System was also used for monitoring and prediction of cyclone.

As a result of above, the cyclone track forecast errors reduced in 2013 compared to previous FDP campaign. It helped in refining the Standard Operation Procedure and strengthening the multi-institutional mechanism.

Various lessons were also learnt from the FDP campaign 2013as mentioned in previous chapter, it will further help in improving the campaign in future. To mention a few, we should have:

- better availability of consumables and other logistic support for the coastal surface and upper air observatories to ensure good collection of data,
- improved buoy network
- replacement of Oceansat-II for sea surface wind
- threshold values of various NWP products for genesis, intensification and movement
- structured satellite bulletins as issued by other international centres giving reason for fixation of a T number.
- DWR data with uniform scanning strategy for mosaicing and NWP modeling.
- Critical assessement of NWP models for track and intensity prediction.

Acknowledgements

The authors are thankful to Satellite Meteorology Division, NWP Division, Radar Division, DDGM RMC Kolkata/ Chennai, Director ACWC Kolkata/ Chennai, Director CWC Bhubaneswar/ Vishakhapatnam, DWR Chennai/ SHAR/ Machhilipatnam/ Vishakhapatnam/ Kolkata and CDR Paradip for their significant contribution. We are also thankful to Indian Space Research Organisation, National Centre for Medium Range Weather Forecasting, Indian Air Force, Indian Navy, Indian Institute of Technology- Delhi & Bhubaneswar, Indian National Centre for Ocean Information Services and National Institute of Ocean Technology for their valuable inputs. We thank Mr. R.P. Sharma, Mr. D.P. Nayak, Mr. V. Vijay Kumar, Mr. R.G. Bali, Mr. Astikar, Mr. A.K. Das and Mrs. Monica Sharma of Cyclone Warning Division for their valuable contribution to bring out this report on “Pilot Phase of Forecast Demonstration Project on landfalling cyclones over the Bay of Bengal-2013”.