



INDIA METEOROLOGICAL DEPARTMENT

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

**Pilot Phase - 2011
Project Implementation Plan**

1. Introduction

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.-30 Nov. 2011. 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 like previous years.

2. 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: e-mail cwdhq2008@gmail.com, Phone no. 011-24652484, 24631913 Mobile: 9868623475, Fax No. 011-24623220).

3. Field Operational Centre (FOC):

The FOC, Chennai will work in unison with the NOC coordinating all activities of every institution during the IOP.(Temporary contact:yearaj@gmail.com, Phone No. 044-28276752, Fax No. 044-28276752).

4. Multi institutional initiative

The institutions involved in the programme 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) INCOAR
- 12) NPOL
- 13) DRDO

5. Targeted FDP Requirements for the Pilot FDP Campaign of October-November 2011

5.1. Observational program:-

(I)AWS:

Operational meso-scale AWS and ARG network of IMD is given in table below.

State & Union Territory	Installed AWS	Installed ARG Stations
Andhra Pradesh	22	-
Arunachal Pradesh	-	-
Assam	25	-
Bihar	28	-

State & Union Territory	Installed AWS	Installed ARG Stations
Chhattisgarh	18	-
Goa	1	5
Gujarat	26	65
Haryana	25	-
Himachal Pradesh	22	27
Jammu and Kashmir	14	-
Jharkhand	14	-
Karnataka	21	-
Kerala	10	-
Madhya Pradesh	48	12
Maharashtra	36	70
Manipur	-	-
Meghalaya	7	-
Mizoram	8	-
Nagaland	-	-
Orissa	30	177
Punjab	24	-
Rajasthan	35	-
Sikkim	3	-
Tamil Nadu	17	-
Tripura	4	-
Uttar Pradesh	45	99
Uttarakhand	12	-
West Bengal	17	-
Chandigarh	1	-
Daman and Diu	1	1
Delhi	10	-
<i>Total</i>	<i>524</i>	<i>456</i>

The locations of the stations are shown in **Fig.1**.

- DDGM(SI), Pune will ensure the transmission of data from AWS stations along east coast of India and additional 14 in the Northeast to DDGM(Telecom) Delhi in GTS mobile synop format. DDGM(SI) will submit status report by 10th October 2011 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**).
- SAC Ahmedabad to intimate DDGM(Sat. Met) to make arrangements to download ISRO AWS data and relay it to NOC for operational and NWP application.
- 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 10th October 2011.

- Real time collection of AWS data over NE India
- 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 first week of October. The data will be transmitted through AMSS of respective RMC FOC shall coordinate the exercise

(II) Synop

- Synoptic observatories of IMD network (**Fig.3** and **Fig.4**) over the peninsular/east India under the RMCs of Chennai, 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 National Operational Centre and Field Operation centres. 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 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 made.
- 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 12 HWSRs along the coast of India in the operational conditions as mentioned below.

Digha	: West Bengal
Balasore	: Odisha
Paradip	: Odisha
Puri	: Odisha
Gopalpur	: Odisha
Visakhapatnam	: AndhraPradesh
Machilipatnam	: AndhraPradesh
Nellore	: AndhraPradesh
Chennai	: Tamil Nadu
Mumbai	: Maharashtra
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.

(V) Upper air:

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

- Upper air RS/RW data from IMD stations (Guwahati, Kolkata, Portblair, Bhubaneswar, Visakhapatnam, Machilipatnam, Hyderabad, Chennai, Karaikal, Minicoy/Amini Divi, Thiruvananthapuram) will be collected 12hrly for normal days of FDP period. However, during the IOP phase of FDP, 6hrly 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 10th October 2011.
- Additional GPS Sonde soundings will be taken at Balasore, Gopalpur, Kalingapatnam, Ongole/Bapatla and Pamban with the support of ISRO. RMC, Kolkata and RMC, Chennai will immediately relocate the receivers from STORM stations.
- DDGM, Chennai shall liaise with VSSC, Thiruvananthapuram to ensure commissioning of equipment along with training to IMD staff to operate during the IOP phase of FDP. DDGM, Kolkata to 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. O/O of DDGM (UI) shall liaise with DNOM and ensure real time data transfer for the FDP period.
- Upper air data from GPS Sonde network of ISRO at Gadanki, SHAR, Arakkonam, Kochi etc. shall become available through E-Mail for the IOP Phase of FDP as intimated by the FOC. DDGM, Chennai shall liaise with VSSC, Thiruvananthapuram to ensure commissioning of equipment along with training to IMD staff to operate during the IOP phase .
- ITR, Chandipur (DRDO) will be requested to operate GPS sonde flights for the IOP phase of FDP. Director MC Bhubaneswar shall liaise with ITR for organizing necessary logistics to receive upper air data.
- Due arrangements are to be made by DDGM (UI) to receive all available Pilot Balloon data sets for the FDP 2011 period.
- Arrangements have to be made by Project Director (Instrumentation) to collect pilot balloon data from IAF. In case of becoming dark by 12UTC, IAF be advised to take the Pilot ascent by 11UTC. Daily flight level winds as collected by IAF flights between Carnicobar and Tambaram are also to be received for FDP 2011 period. Project Director (Instrumentation) shall liaison with IAF to receive GTS coded data.
- NWP Division of IMD shall ensure the synchronization of data formats and collection at the NWFC/Telecom 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 coastal DWRs with uniform storm scanning strategy will be ensured prior to the FDP-2011. DDGM(UI) shall make due arrangements to receive the DWR data in real time to DDGM (NWP) for the FDP 2011.
- The mosaic products (**Fig.6**) will be available to NOC and FOC in addition to previous products as mentioned below.

- MAX(Z) Product
- Plan Position Indicator(Z)
- Plan Position Indicator(Z)-Close Range
- Volume Velocity Processing(2)
- Plan Position Indicator(V)
- Surface Rainfall Intensity
- Precipitation Accumulation (PAC) 24 hrs at 0300 UTC
- A detailed DWR bulletin catering to the needs of cyclone monitoring will be issued by concerned DWR station during FDP-2011.

(VII) Sagar Kanya Cruise

- There will be no cruise observations during FDP-2011

(VIII) 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 2011 period.
- A special bulletin catering to the need of cyclone monitoring will be issued during FDP-2011

5.2. Telecommunication

- DDG(ISSD) shall take all necessary steps so as receive the observational data at the National Operations Centre (NOC) and field operations center (FOC) from all identified sources from FDP partners, Defence and the regional countries (Bangladesh, Myanmar, Malaysia, Thailand and Indonesia, Sri Lanka) in real time.
- ISSD and NWP division shall continuously monitor the data reception and ensure the timely data reception and onward transmission of data to NWP Division and NCMRWF throughout the FDP 2011 period.
- ISSD, IMD shall establish FDP Web Page on IMD. The existing FDP e-mail group may 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.

5.3. NWP analysis and prediction

- NWP Division shall make all necessary arrangements for the generation of global and regional analyses fields by using special FDP 2011 data at 4 analysis times (00, 06, 12, 18 UTC) for the whole of FDP 2011 period. Arrangements are also to be made to keep FDP 2011 analyses fields and forecast boundary fields up to 72hrs on ftp servers of NCMRWF and IMD for their utilization by FDP partners in India. Efforts will be made to bring out the Model forecast within three hours of the observation time.
- NWP Division, IMD shall workout arrangements to provide analyses fields of JMA, ECMWF and UKMO as well on the ftp servers at NCMRWF and IMD for the FDP 2011 period.

5.4. 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.

5.5. FDP Operation Centre

A National FDP Operations Center at NWFC will function during FDP-2011 and a FDP Weather Monitoring and Advisory Group is constituted to identify the IOP phases during FDP 2011 period.

FDP Weather Monitoring and Advisory Group(WMAG)

1. DGM Chairman
 2. All members of FDP Project Team
 3. DDGM (Satmet), DDGM (DM), DDGM(S), DDGM (UI), Scientist-E (S)
 4. Head ,NCMRWF
 5. Prof. U.C. Mohanty
 6. Shri D.R. Sikka
 7. Representatives from IAF, Indian Navy.
- The WMAG shall meet thrice a week (Monday, Wednesday and Friday) at 1500 hrs during the period 15 Oct.- 30 Nov., 2011 at NWFC to review the FDP activity regularly and decide on IOP declaration.
 - However, the daily report will be prepared by NOC like previous years and disseminated through FDP google group and the FDP website by 1730 hrs IST.
 - For preparation of daily report, inputs will be provided by FOC, Chennai, NWP and satellite divisions of IMD, The final consolidated report will be prepared by the synoptic expert on duty.
 - The presentations will be made only on Monday, Wednesday and Friday by various groups.
 - During IOP phase, input will also be provided by various NWP groups involved in the FDP for inclusion in the report.

5.6. Implementation Strategy

- Preparatory Phase for the FDP Pilot 2011: 1-15 October 2011
(Actions to be completed as mentioned above)
- FDP-2011 Field Phase: 15 October to 30 November
(Actions to be completed as mentioned above)
- IOP Phase: Identified by the NOC at NWFC in consultation with the Weather Monitoring and Advisory Group
- NOC: The NOC 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.
- FOC: Cyclone Warning Research Center 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 2011 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 centers.

5.7. Post Experiment Phase :

- Preparation of weather summary data CD will be carried out by the project management team and NWP group of IMD.
- 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.

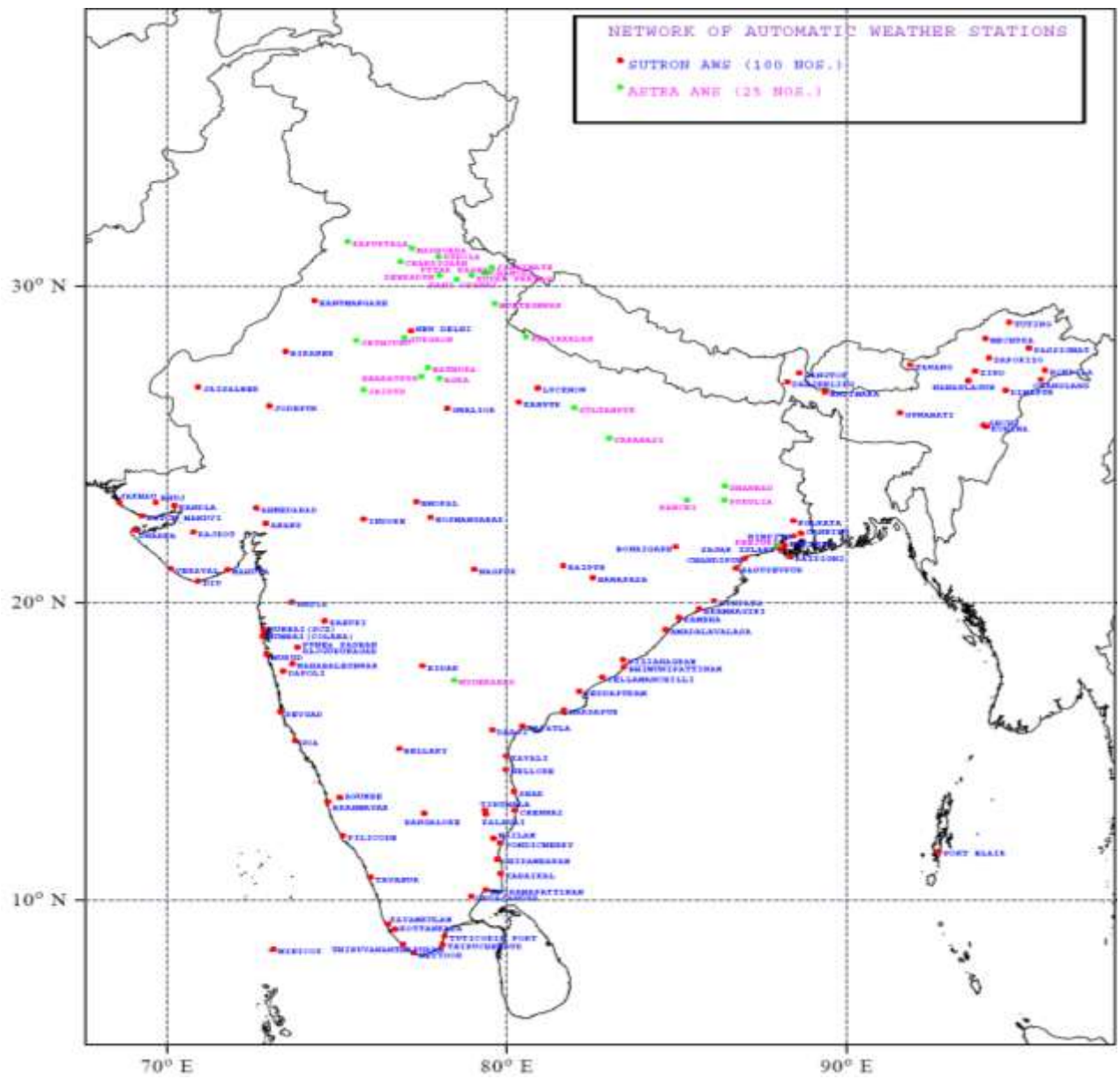


Fig.1(a). Old 125 AWS network of IMD

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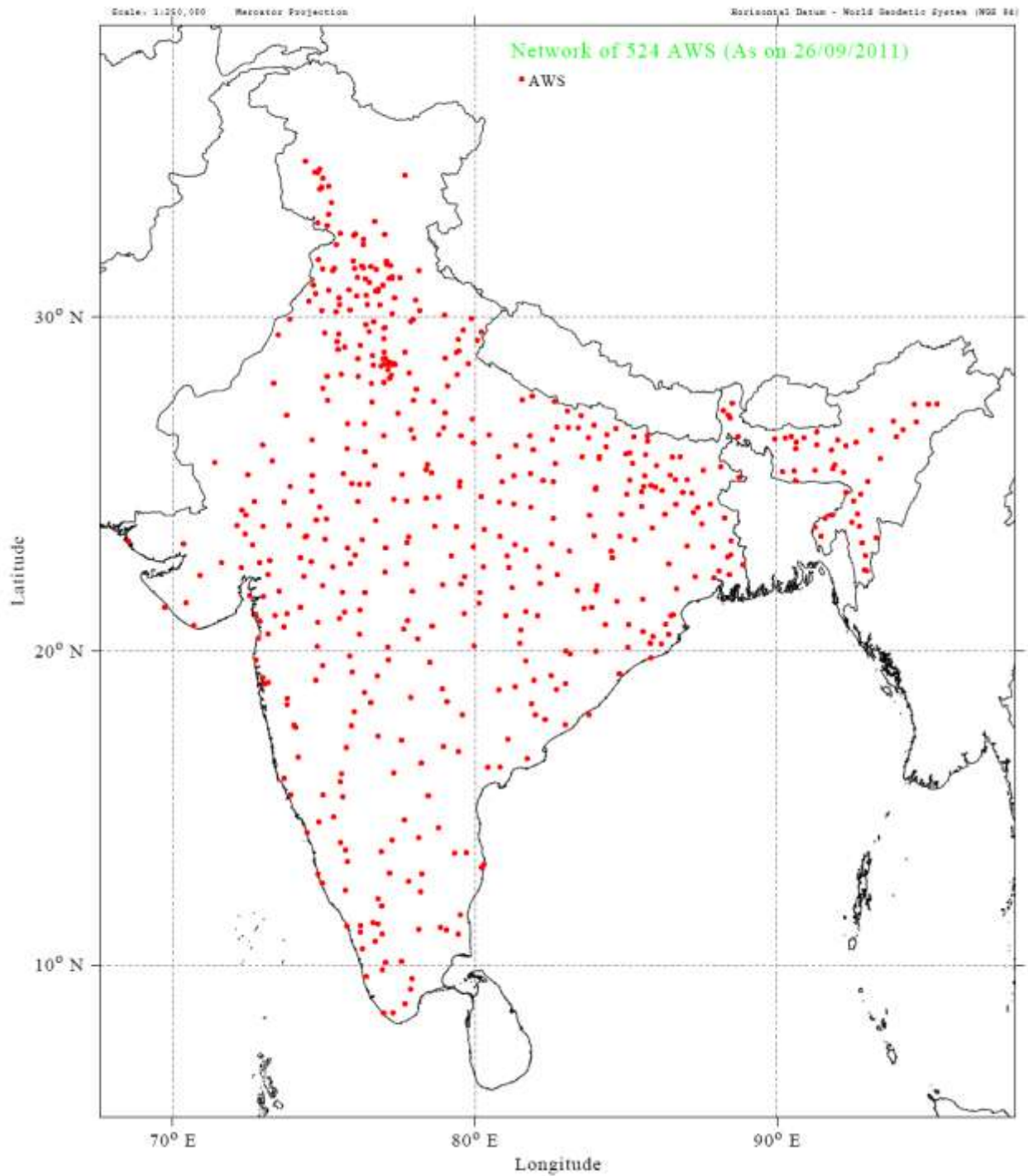


Fig.1(b). New AWS network of IMD as on 30th September 2011

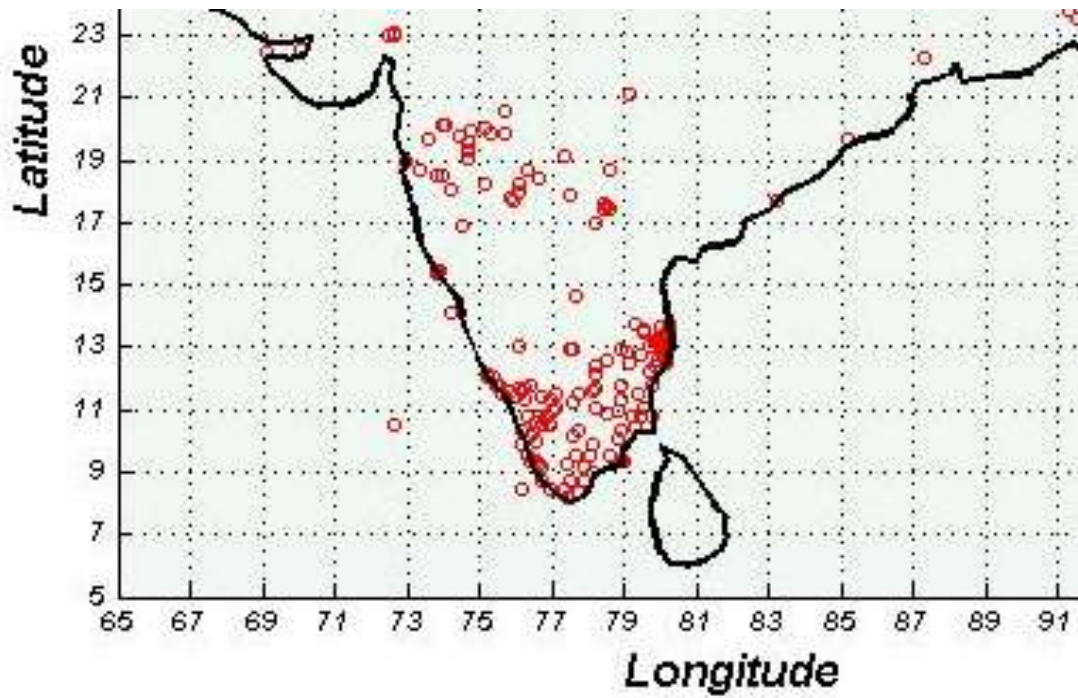


Fig.2. ISRO AWS stations under PRWONAM project.

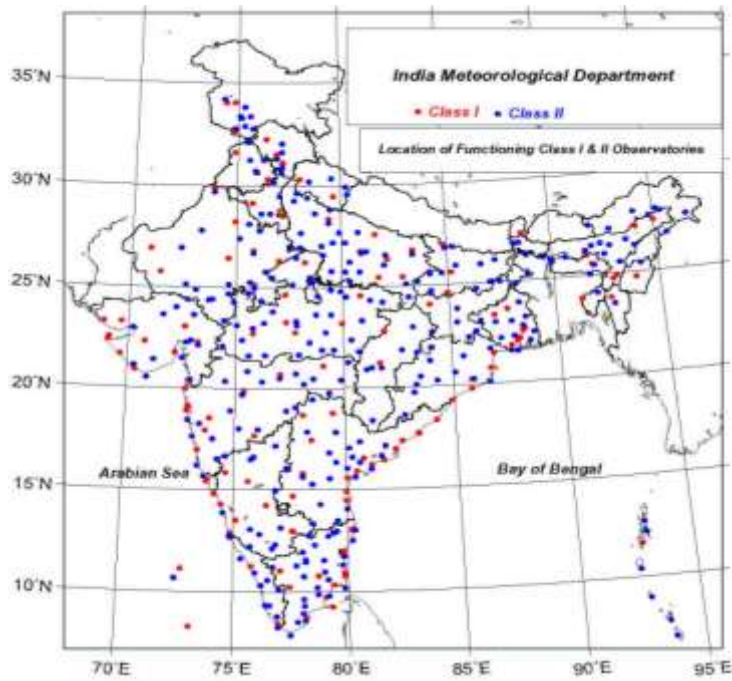


Fig.3. Synoptic stations of IMD

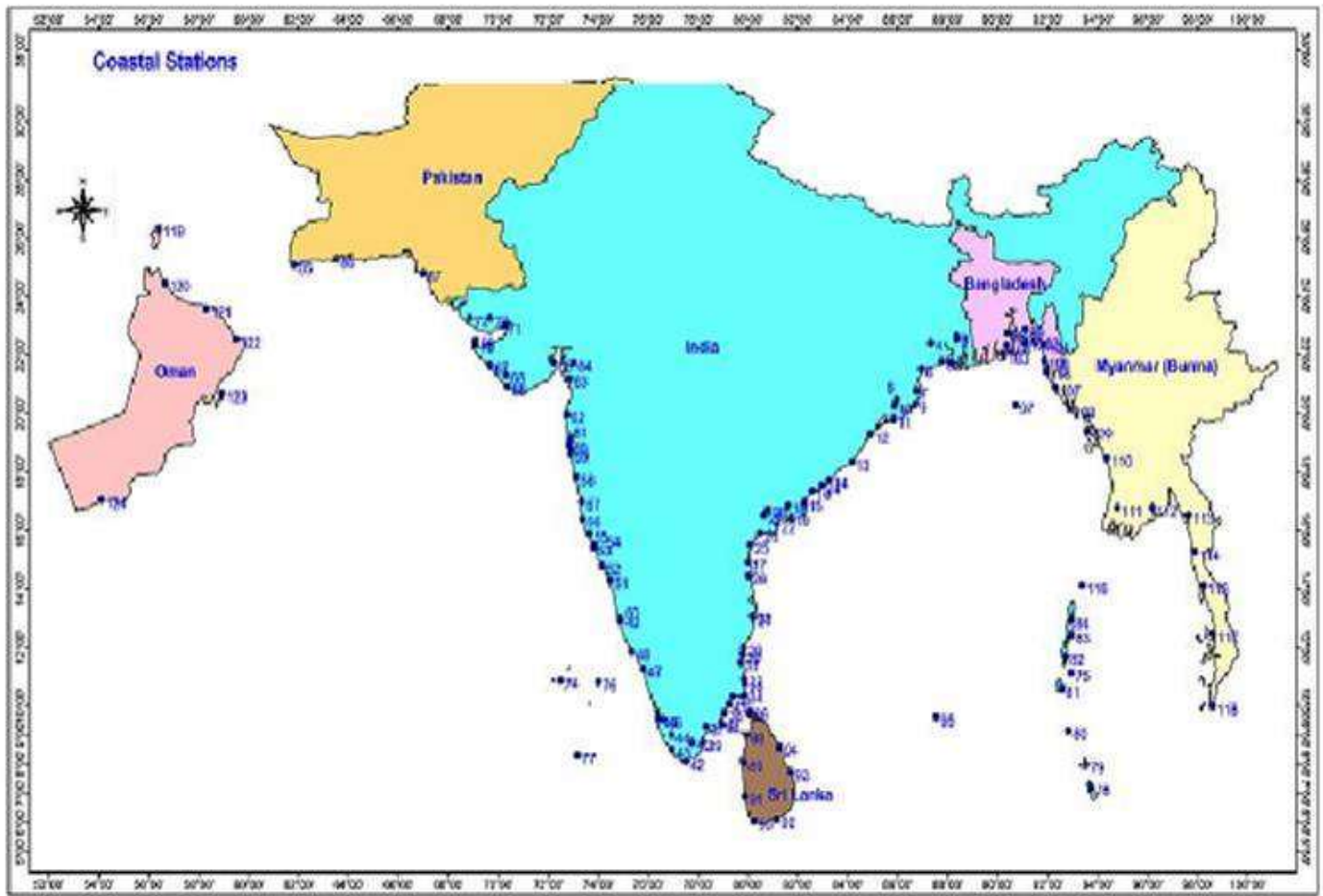


Fig.4. Coastal synoptic stations

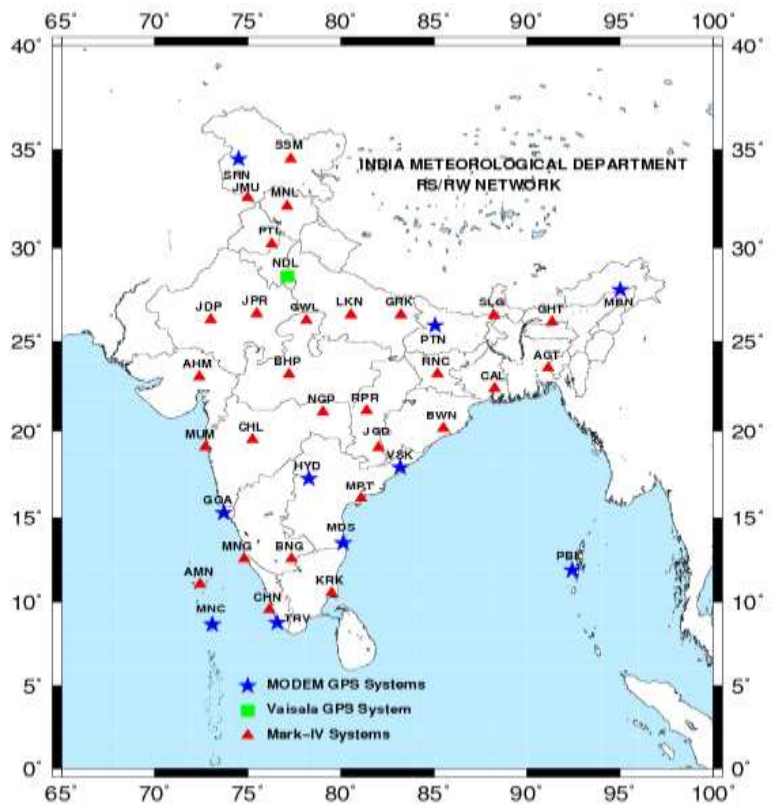
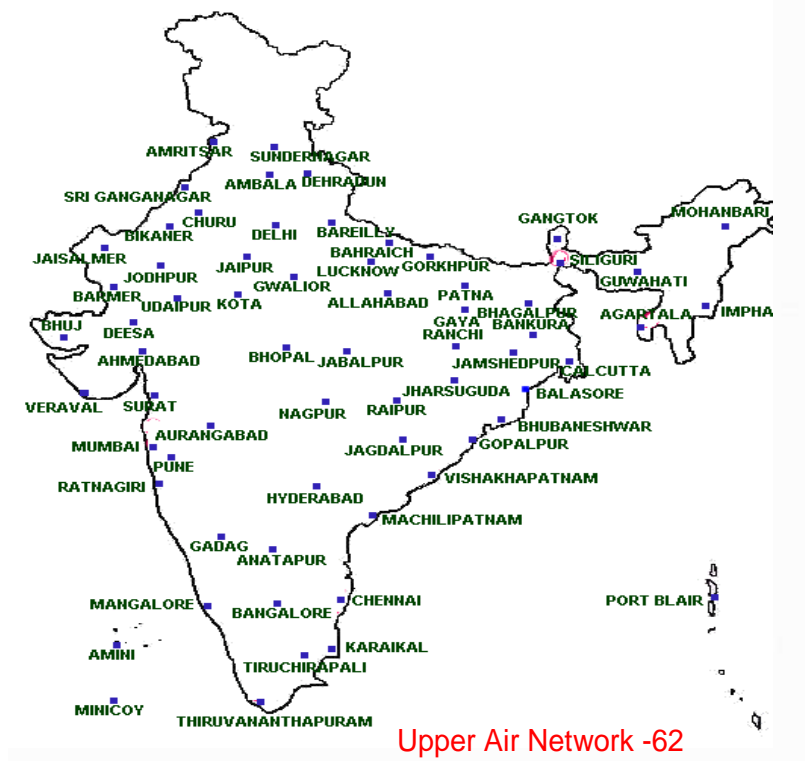


Fig.5. The pilot balloon and RS/RW network of IMD

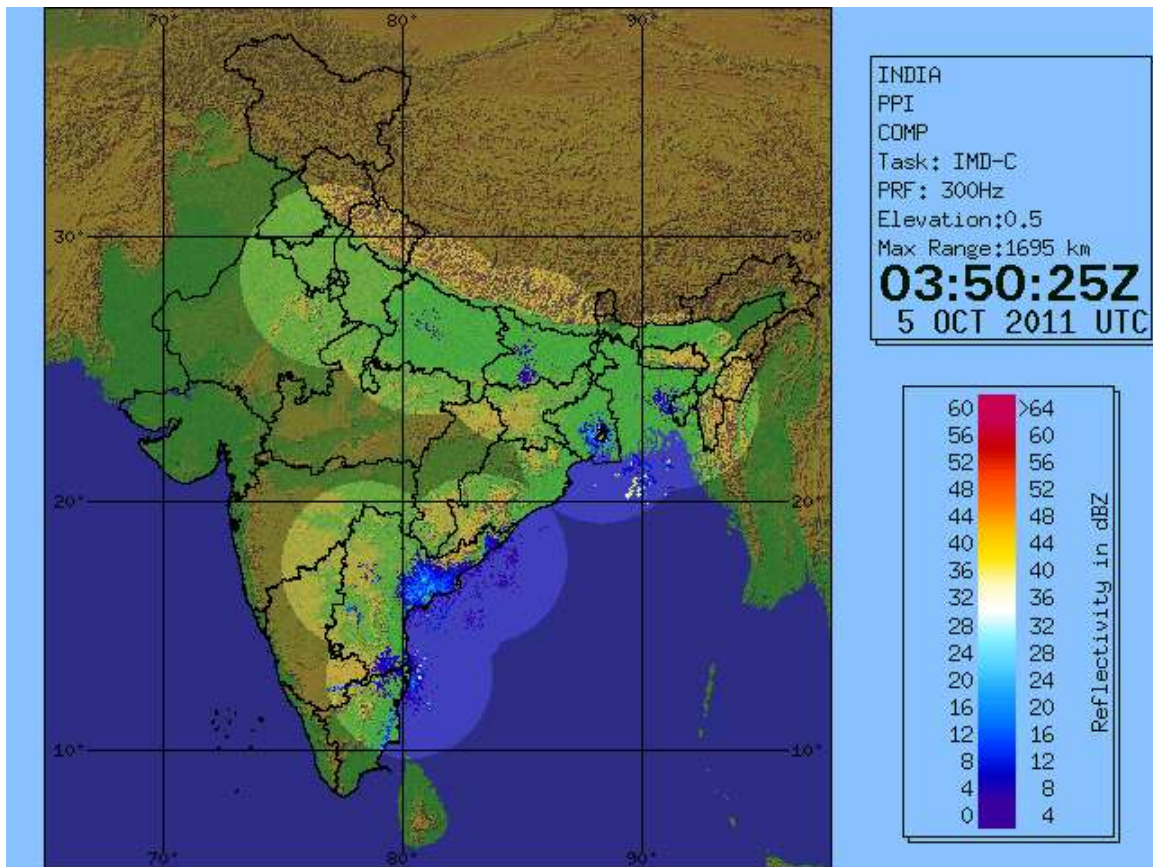


Fig.6. Mosaic product with DWR Network of IMD

Table 1. List of East Coast stations in India

Station	Index	Latitude	Longitude	Class	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
Kolkata(Alipore)	42807	22 32N	88 20E	I	X	X	X	X	X	X	X	X
Kolkata(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

Bubaneswar	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	IO	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 3. List of Co-operative Cyclone Reporting Network of Stations

SN	Station	District
Andhra Pradesh		
1	Palasa	Srikakulam
2	Sompeta	Srikakulam
3	Anakapalli	Vishakapatnam
4	Rajamundry	East Godavari
5	Yanam	East Godavari
6	Razaole	East Godavari
7	Eluru	West Godavari
8	Challapalli	Krishna
9	Avani Gadda	Krishna
10	Nagayalanka	Krishna
11	Bantimalli	Krishna
12	Kothapatnam	Prakasam
13	Narasapuram	Nellore
Odisha		
1	Bhogral	Balasore
2	Basta	Balasore
3	Bhadrak	Balasore
4	Bansara	Balasore
5	Rajkanika	Cuttack
6	Aul	Cuttack
7	Rajnagar	Cuttack
8	Kendrapara	Cuttack
9	Mahakalpara	Cuttack
10	Jagatsingpur	Cuttack
11	Ersama	Cuttack
12	Nimapara	Puri
13	Brahmagiri	Puri
14	Krishnaprasad	Puri
15	Chatrapur	Ganjam
16	Berhampur	Ganjam