Ministry of Earth Sciences
India Meteorological Department
Cyclone Warning Division, New Delhi

FDP (Cyclone) NOC Report Dated 07th November, 2019

Time of Issue: 1200 UTC

Synoptic features:

- The Very severe cyclonic storm (ESCS) MAHA (Pronounced as M'maha) over westcentral and adjoining eastcentral Arabian Sea moved nearly eastwards and weakened into a **Severe Cyclonic Storm (SCS)** over the same area at 0000 UTC of 6th. It lay centered at 0900 UTC of today, the 06th November, 2019 over eastcentral & adjoining northeast Arabian Sea near latitude 19.6°N and longitude 67.1°E, about 350 km west-southwest of Porbandar (Gujarat), 370 km west-southwest of Veraval (Gujarat) and 420 km west-southwest of Diu. It is very likely to move nearly eastwards, weaken into a Cyclonic Storm during next 12 hours. Thereafter it is likely to move east-northeastwards, weaken further into a Deep Depression by morning of tomorrow, the 7th November over northeast and adjoining eastcentral Arabian Sea. It is very likely to skirt Saurashtra coast and lie centered about 40 kilometers south of Diu around noon of 7th November as a deep depression. Continuing to move east-northeastwards, it would further weaken into a depression by tomorrow evening.
- The Depression over eastcentral and adjoining southeast BoB and adjoining Andaman sea intensified into a **Deep Depression** over eastcentral and adjoining southeast BoB remained practically stationary and lay centred at 0900 UTC of today, the 6th November 2019, over eastcentral & adjoining southeast Bay of Bengal, near Lat.13.4°N and Long. 89.3°E, about 390 km west-northwest of Maya Bandar (Andaman Islands), about 810 km south-southeast of Paradip (Odisha), 920 km south-southeast of Sagar Islands (West Bengal) and 960 km south-southwest of Khepupara (Bangladesh) . It is very likely to intensify into a Cyclonic Storm during next 12 hours and into a Severe Cyclonic Storm during the subsequent 24 hours. It is very likely to move northwestwards for some time and then north-northwestwards towards West Bengal and Bangladesh coasts.

Dynamical and thermodynamical features

Sea Surface Temperature (SST):

Sea Surface Temperature is around 25-26°C over a small area in Arabian Sea roughly along 20° N which increases to 28-30°C over north Arabian Sea and south Arabian Sea.

SST is 28 - 30ºC over most parts of the BOB with higher values over central BoB.

Tropical Cyclone Heat Potential (TCHP):

Tropical Cyclone Heat Potential (TCHP) is 20-40 kJ/cm^2 over most parts of central Arabian Sea and north Arabian sea. There is a narrow strip of value 50-70 kJ/cm^2 off west coast of India. It is around 80-100 kJ/cm^2 over south Arabian Sea.

TCHP is 100-120 kJ/cm^2 over a small area in southwest BOB and is 80-100 kJ/cm^2 over the system area and also over rest of the BOB.

Relative Vorticity:

Cyclonic relative vorticity at 850 hPa of value 150 X10^{-6}s-1 is seen to the south of the centre of Cyclonic Storm Bul bul over EC BoB.

Cyclonic relative vorticity at 850 hPa of value 50-70 X10^{-6}s-1 is seen over the area of depression in Arabian Sea.

Low level Convergence:

An area of lower level convergence about 30 x 10^{-5}s^{-1} is seen to the southwest of the centre of CS Bul bul over EC BoB.

Lower level convergence of about 5 x 10^{-5}s^{-1} over the depression area over Arabian Sea.

Upper level Divergence:

Upper level divergence of value 30x10^{-5} s-1 to the northwest of CS Bul bul over EC SE BoB.

There is no area of positive upper level divergence over Arabian Sea.

Wind Shear:
Wind shear is high over north Arabian Sea and adjoining central Arabian Sea. It is low to moderate over the rest AS.

Wind shear is low to moderate over north Andaman Sea. It is high elsewhere.

Wind Shear Tendency:
The wind shear tendency is negative over Andaman Sea and EC BoB and adjoining southeast BoB. It is positive or neutral elsewhere.
It is negative over southeast Arabian Sea. It is positive or neutral over rest Arabian Sea.

Upper tropospheric ridge:
The upper tropospheric ridge at 200 hPa runs roughly along 18°N over BoB.

Satellite observations based on INSAT imagery:

Arabian Sea:-

As per the satellite imagery at 0900 UTC of 07th November, 2019, the current intensity of the system is T 1.0/1.5. Associated broken low to medium clouds with embedded moderate to intense convection lies over northeast Arabian Sea and adjoining Gulf of Cambay and south Gujarat between Lat 20.5^{0}N to 22.5^{0}N and Long 71.5^{0}E to 73.0^{0}E. The minimum CTT is minus 61^{0}C.

Bay of Bengal & Andaman Sea:-

According to 0900 UTC satellite imagery, the intensity of the system (CS Bul bul) is T3.0. Associated broken low/medium clouds with embedded intense to very intense convection lies over eastcentral and adjoining westcentral BoB between Lat 12.0^{0}N to 21.0^{0}N and Long 84.5^{0}E to 92.0^{0}E. The minimum CTT is minus 93^{0}C.

Large scale features

M.J.O. Index:
MJO index is in Phase 6 with amplitude more than 1. It is likely to remain there for next 2 days and move to phase 7 thereafter.

Storms and Depression over South China Sea/ South Indian Ocean:

a) At 0600 UTC on 07 Nov 2019, Typhoon "Halong" was located near 23.3°N 151.6°E, approximately 142 NM west-southwest of Minami Tori Shima. Maximum sustained surface winds were estimated at 90 knots. It is expected to move northeastwards and then north-northeastwards with gradual weakening to become a Tropical Cyclone by 0600 UTC on 9th.

b) The Tropical Storm "NAKRI" is located at 0600 UTC of 07th near 13.3°N 117.3°E, approximately 547 NM east-southeast of Da Nang, Vietnam. Maximum sustained surface winds were estimated at 50 knots. It is expected that the system is likely to move nearly westwards with marginal intensification and cross Vietnam coast around 13.2^0 N by1800 UTC on 11th November as a cyclonic storm.

NWP Input for FDP Cyclone based on 0000 UTC of today

IMD-GFS T-1534

(i) The depression on 7th over eastcentral and adjoining northeast Arabian sea off south Gujarat- north Maharashtra coasts becomes a LOPAR on 8th and becomes less marked thereafter.

(ii) The CS on 7th over EC BoB while moving in a north-northwest direction becomes a VSCS/ ESCS during 8th- 9th. Further it is seen off West Bengal coast on 10th and crosses coast in the night of 10th.

IMD-GEFS

(i) The depression over eastcentral Arabian Sea on 07th November is seen close to south Gujarat coast as a LOPAR on 8th, which becomes less marked thereafter.

(ii) The CS over EC BoB on 7th November, which intensifies further while moving northwestwards to reach Odisha –West Bengal coasts on 9th as a VSCS/ESCS It is seen to recurve northeastwards with gradual weakening thereafter.

IMD-WRF

(i) The depression on 7th over EC Arabian Sea off south Gujarat coast becomes less marked on 9th off Maharashtra coast.

(ii) The CS over eastcentral BoB on 7th while moving in a north-northwest direction intensifies and is seen as a ESCS on 9th over WC BoB off Odisha coast, which crosses coast in the night of 10th.

NCMRWF-NCUM:

(i) Indicates: The depression on 7th over northern parts of eastcentral Arabian sea close to south Gujarat coast is seen to weaken further over sea without making landfall.

(ii) The CS over eastcentral BOB on 7th November is seen to move in a north-northwest direction and intensify further to reach Odisha coast as a ESCS on 10th November. It further moves east-northeastward with gradual weakening without making landfall till 13th.

NCMRWF-UM-Regional Model:

(i) The CS over central Arabian sea is seen to move east-northeastwards with gradual weakening and is seen to cross south Gujrat coast as a very weak system on 8th.

(ii) The WML over EC BoB becomes a D on 8th, CS on 9th and crosses North Andhra Pradesh-South Odisha coast on 10th.

NEPS Model:

(i) The Depression over EC Arabian Sea on 07th November seen to move in an east-northeast direction and weaken gradually and becomes less marked by 10th over sea.

(ii) The CS over EC BoB becomes a ESCS on 9th off Odisha coast. It is seen to move in a northeast direction and weaken gradually without making landfall.

ECMWF:

(i) The depression over EC and adjoining NE Arabian Sea off Saurashtra coast on 8th becomes less marked on 9th.

(ii) The CS over EC BoB on 7th intensifies into SCS on 8th. Moving in a northwest direction it is seen off Odisha coast as a SCS on 9th. It then recurves in a northeast direction with gradual weakening and is seen as a Depression on 12th which becomes less marked on 13th WC BoB.

NCEP-GFS:

(i) Indicates: The Depression seen close to south Gujrat coast on 7th becomes less marked on 9th November over sea.

(ii) The CS over EC BoB on 7th November becomes a SCS on 8th over central BoB. It is seen to move north-northwestwards to reach Odisha coast on 09th, off West Bengal- Bangladesh coasts on 10th as SCS and is seen to cross coast same day and weaken thereafter.

ARP-Meteo France : NIL

Dynamical statistical models

IMD Genesis Potential Parameter (GPP):

(i) The significant zone of GPP seen over EC BoB on 7th November, is seen to move in north-northwest direction till 10th to reach north BoB off West Bengal-Bangladesh coasts crosses coast on 11th.

IMD NWP products are available at:

http://nwp.imd.gov.in/bias/gfsproducts.php

http://nwp.imd.gov.in/bias/wrf27pro.php
http://www.rsmcnewdelhi.imd.gov.in/NWP_CYC/Analysis.htm or
http://www.rsmcnewdelhi.imd.gov.in/NWP_CYC/<HH> hrs.htm
<HH> are forecast hours i.e. 24, 48, 72 and etc.

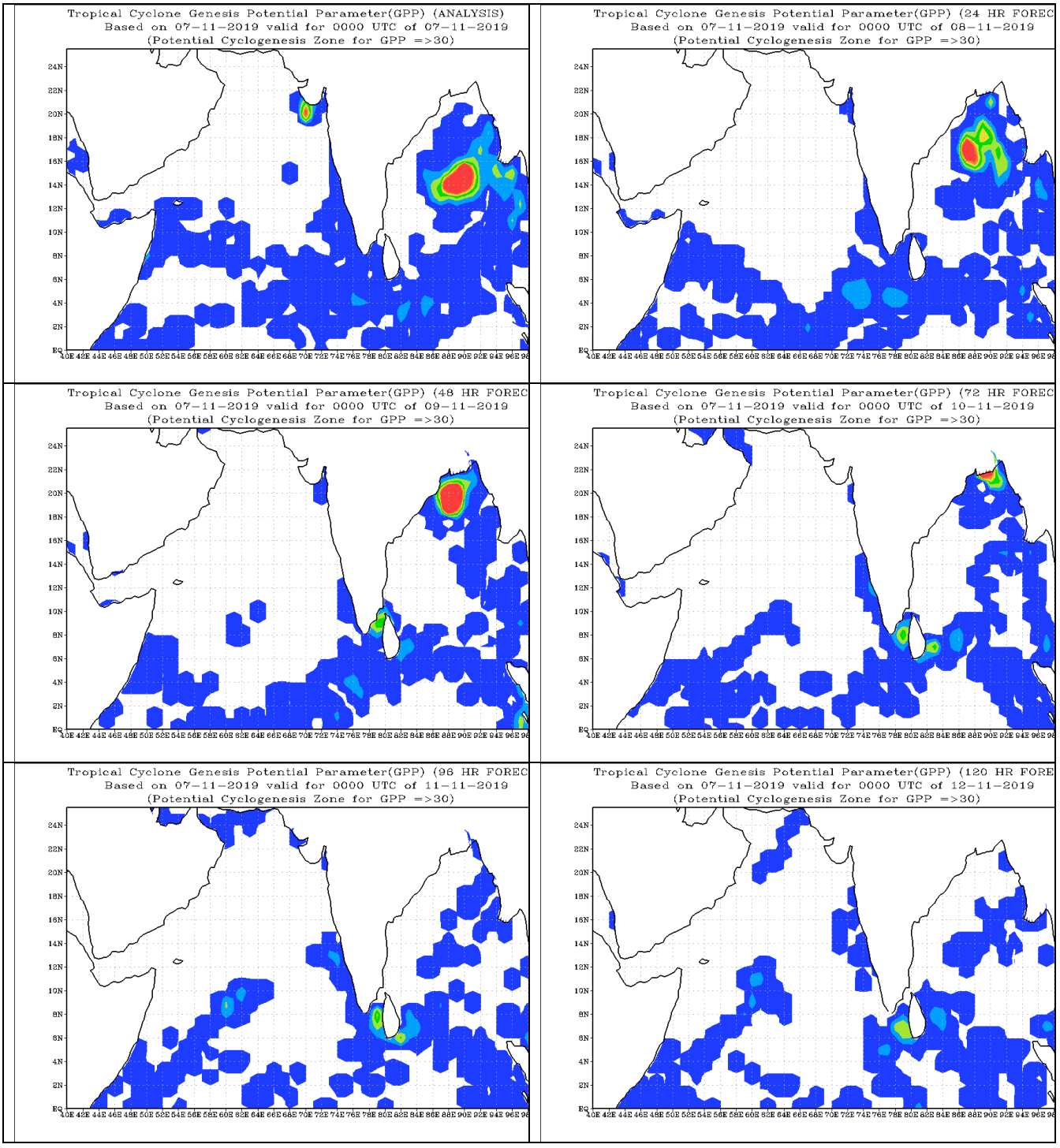
Summary and Conclusion:

A) The low level relative vorticity has increased and is about 200 $x10^{-5}$ sec^{-1} to the south of the centre of CS Bul bul in EC BoB. The lower level convergence has decreased and is about 20 $x10^{-5}$ s^{-1} close to the system centre and the upper level divergence has increased and is about 40 $x10^{-5}$ s^{-1} to the northwest of the system center. The vertical wind shear is 15-20 knots over the system area and is about 20-25 knots to the west of the system centre. The ridge runs roughly along 17°N over Bay of Bengal region. Tropical cyclone heat potential of 80-110 kJ/cm^2 around the system center. Sea surface temperature between 29-30°C around the system. The enhanced upper level divergence, moderate vertical wind shear and high SST over ocean is supporting the gradual intensification of the system. It is very likely to move northwestwards along the western peripherial winds of the anticyclone located to the east of the system for some more time and thereafter will move slowly north-northwestwards and then re-curve northeastwards. Majority of the NWP models are in agreement with the above analysis.

B) The low level relative vorticity is about 50-80 $x10^{-5}$ sec^{-1} to the south of the centre of the depression over EC Arabian Sea. The ridge runs roughly along 19°N over the system area. The lower level convergence is about 05$x10^{-5}$ s^{-1} in the southwest sector. The vertical wind shear is 30-35 knots over the system area and along the forecast track. Sea surface temperature is between 28-29°C to the southwest of the system center and tropical cyclone heat potential of 20-40 kJ/cm^2 is around the system center. The system is moving eastwards under the influence of mid-latitude westerlies. Also the system has weakened under the influence of unfavourable vertical wind shear environment. Since this condition is very likely to continue along the forecast track, further weakening is anticipated during next 06 hours. Majority of the numerical models are in agreement with the above analysis

Advisory: IOP for North Odisha- West Bengal coasts on 9th and 10th November 2019.

Annexure-1


Tropical Cyclone Genesis Potential Parameter(GPP) (ANALYSIS)
Based on 07-11-2019 valid for 0000 UTC of 07-11-2019
(Potential Cyclogenesis Zone for GPP =>30)
Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FOREC
Based on 07-11-2019 valid for 0000 UTC of 08-11-2019
(Potential Cyclogenesis Zone for GPP =>30)
Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FOREC
Based on 07-11-2019 valid for 0000 UTC of 09-11-2019
(Potential Cyclogenesis Zone for GPP =>30)
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Based on 07-11-2019 valid for 0000 UTC of 10-11-2019
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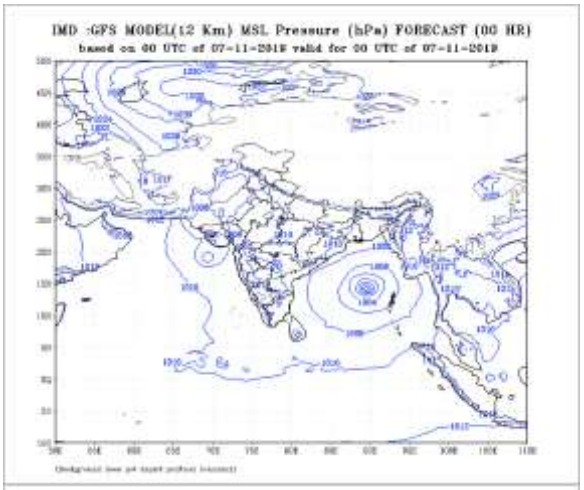
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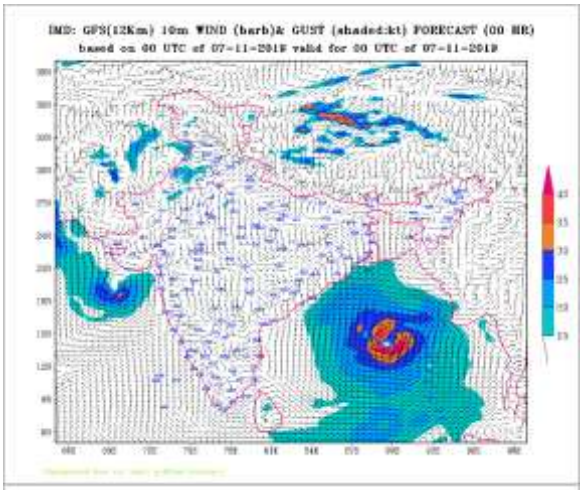
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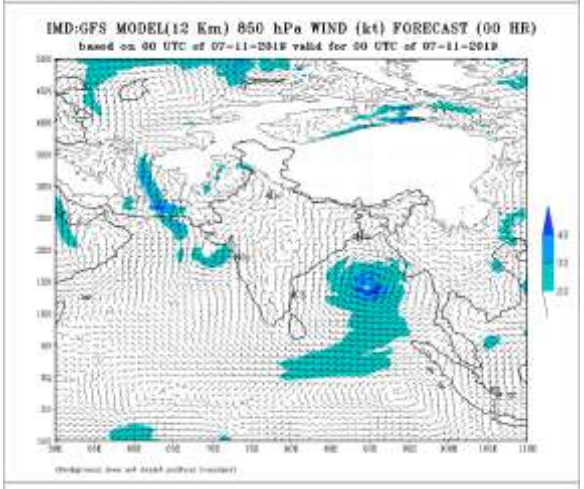
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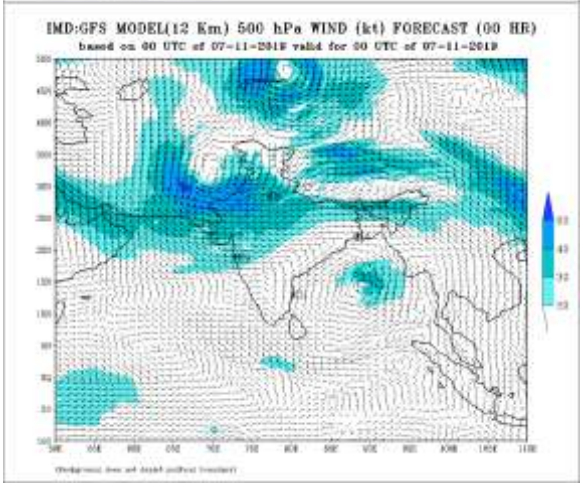
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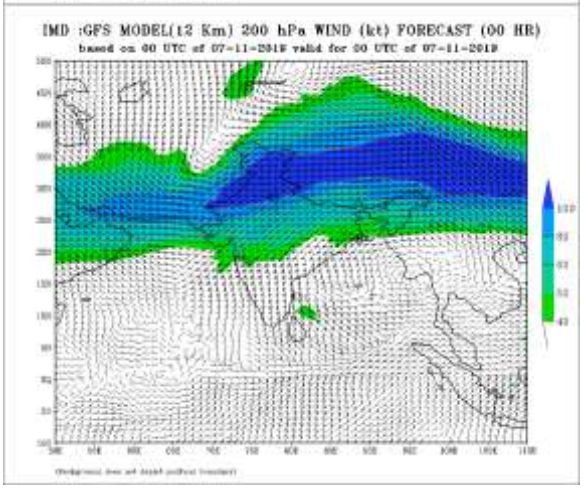
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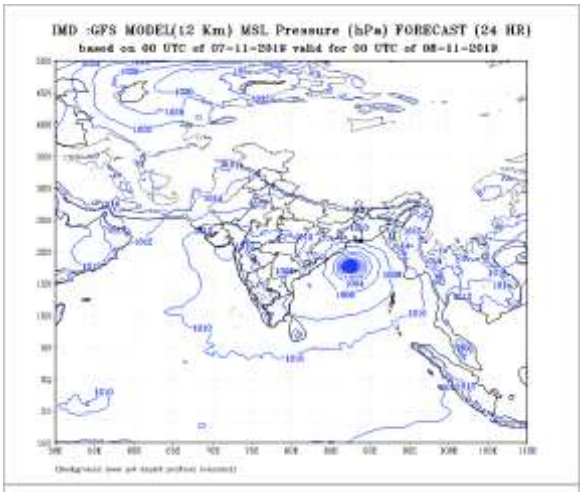
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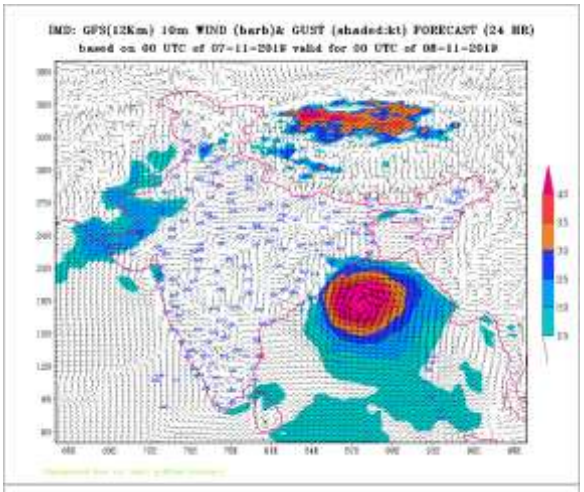
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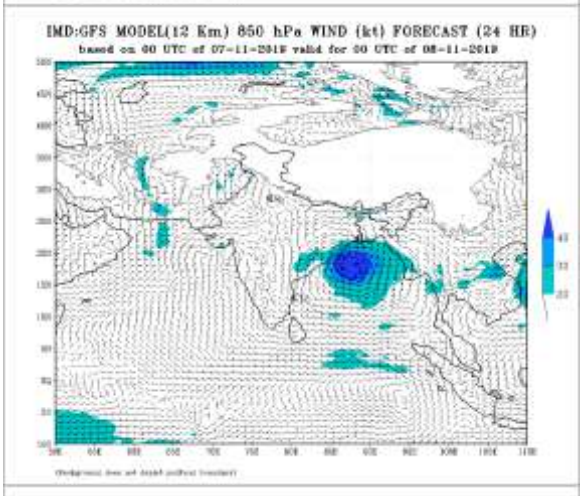
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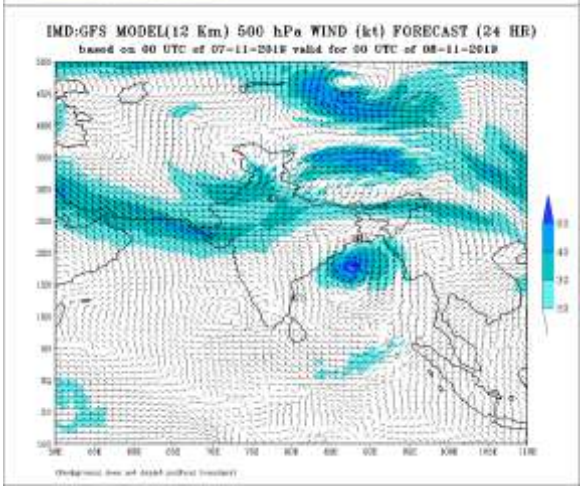
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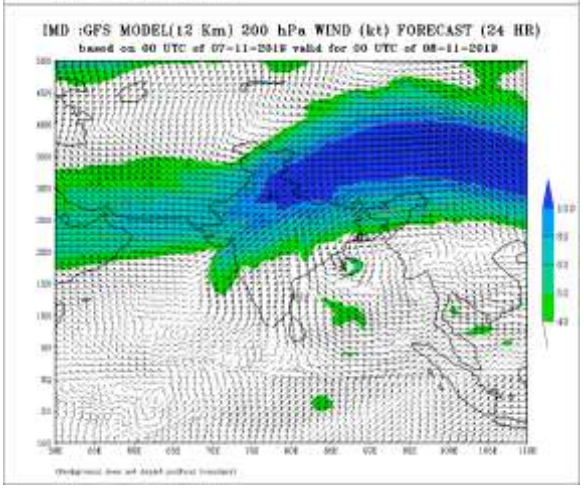
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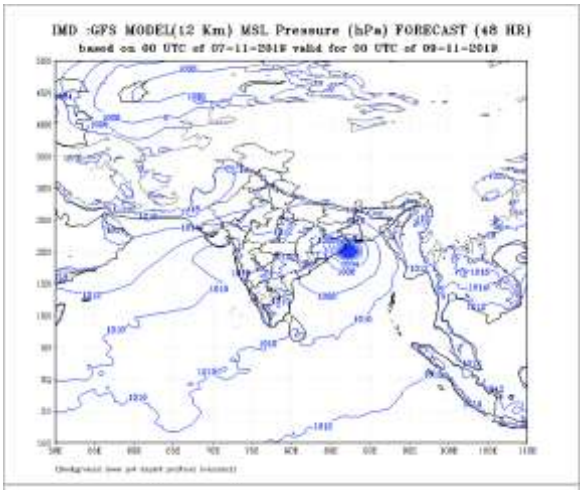
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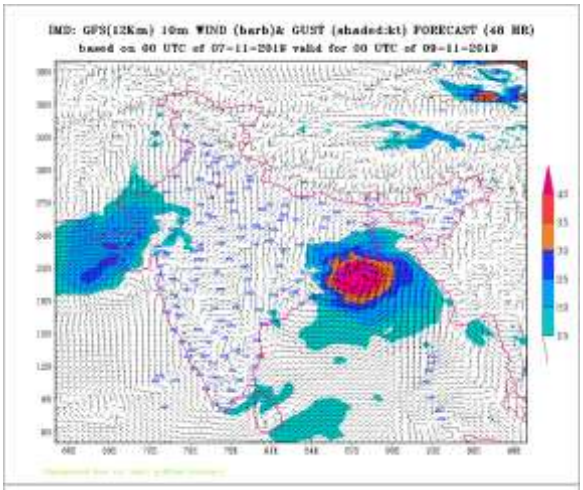
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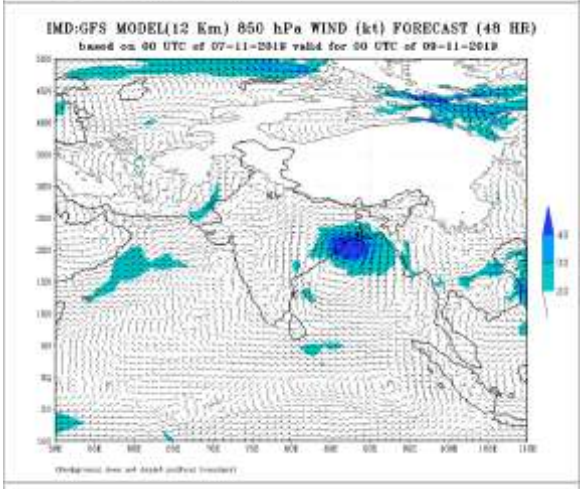
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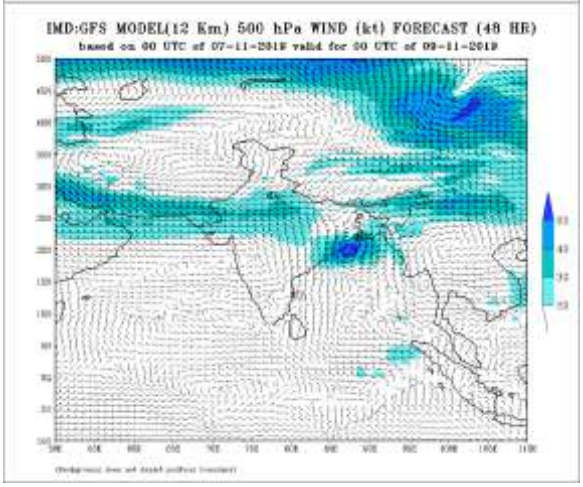
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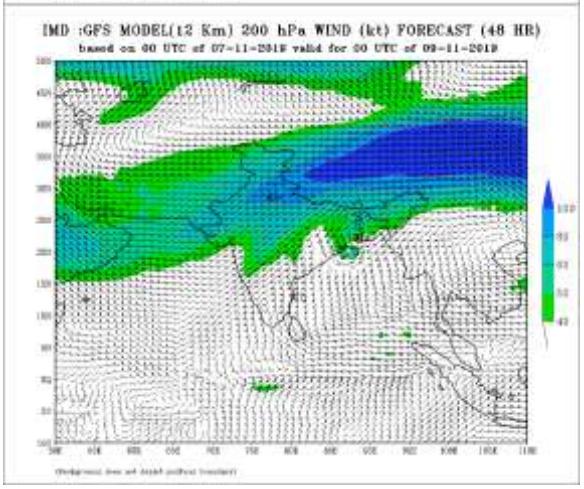
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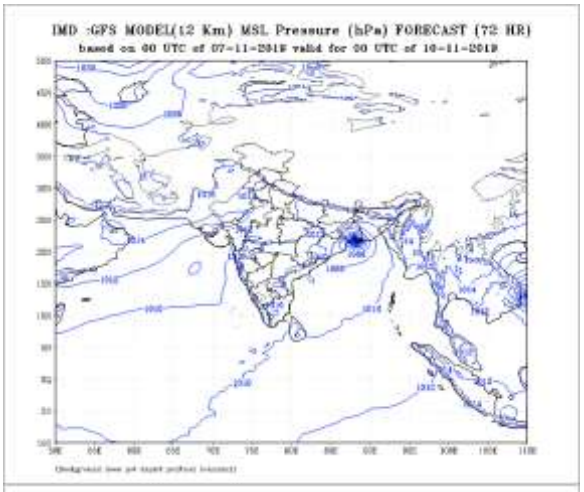
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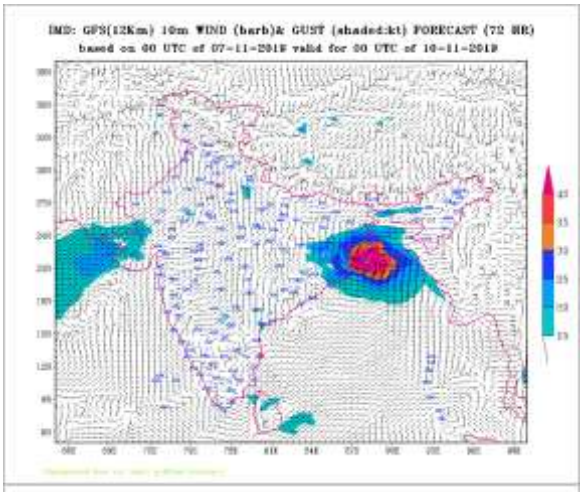
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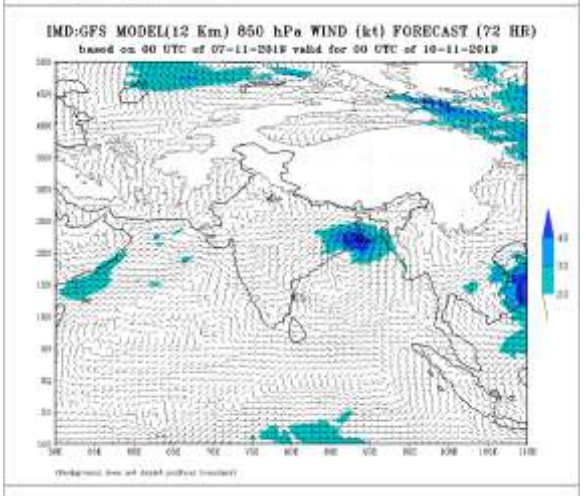
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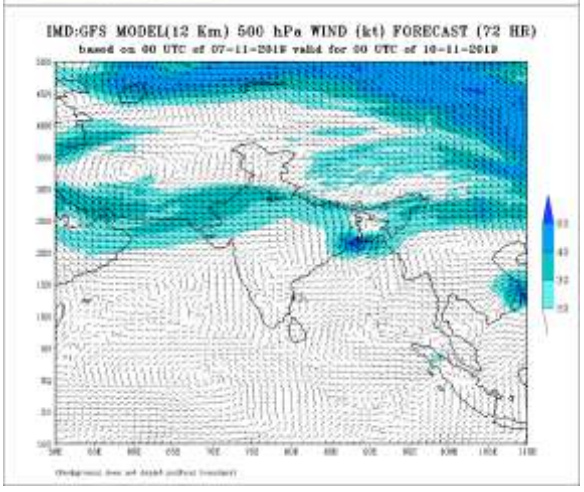
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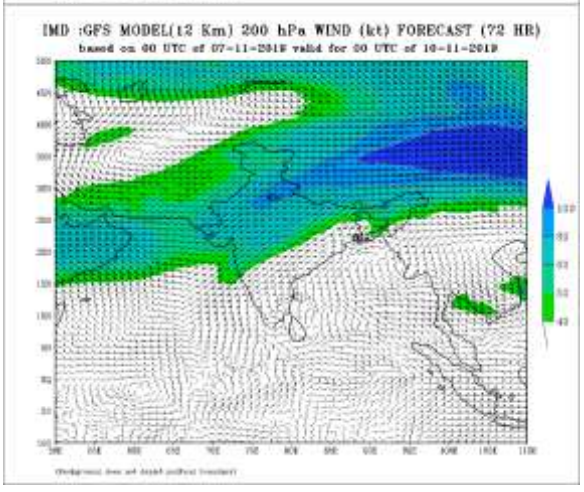
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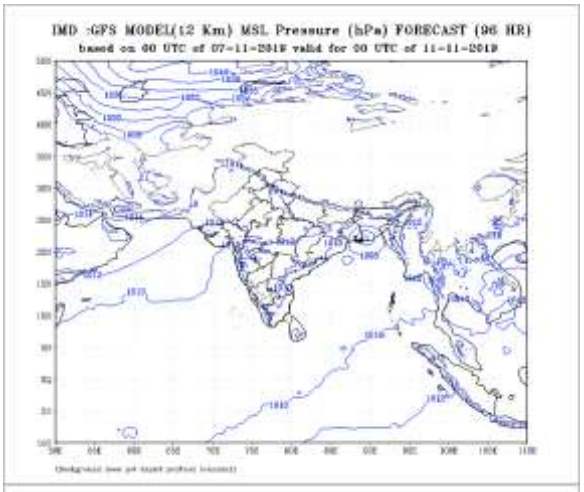
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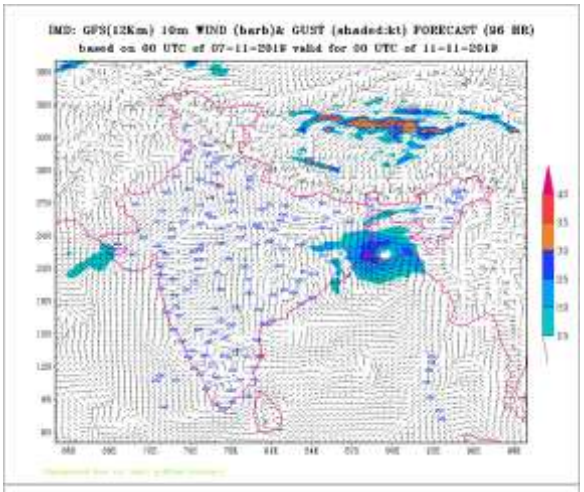
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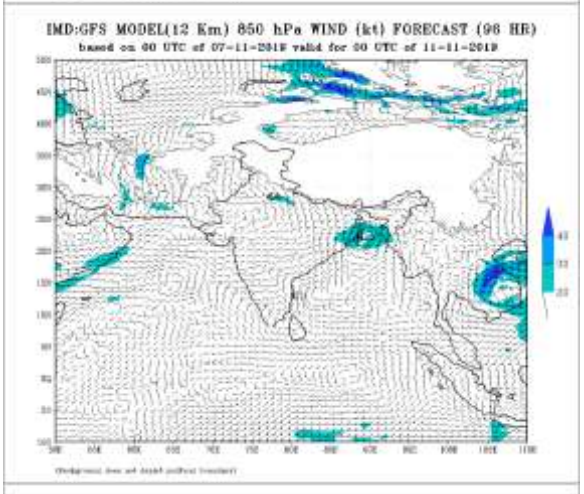
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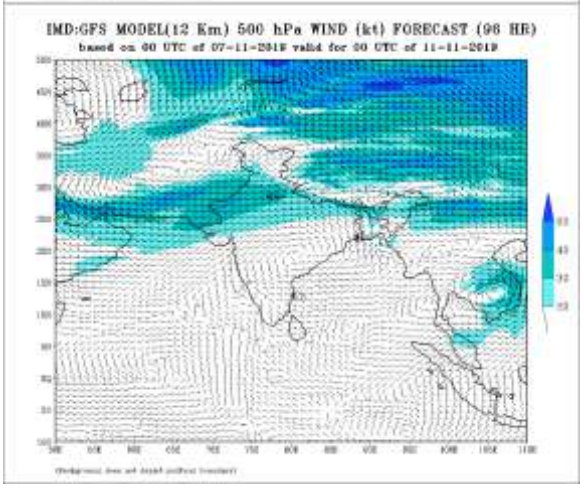
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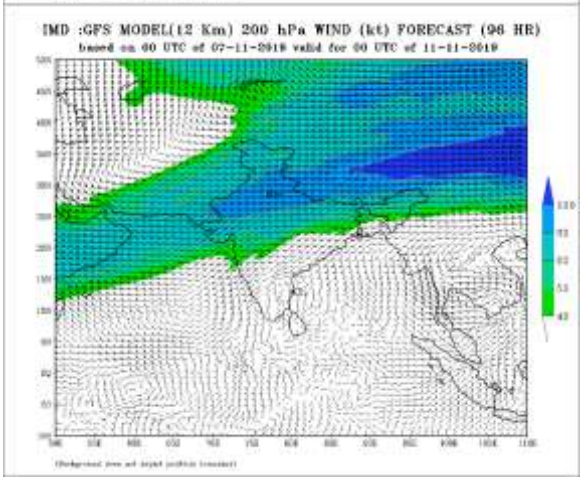
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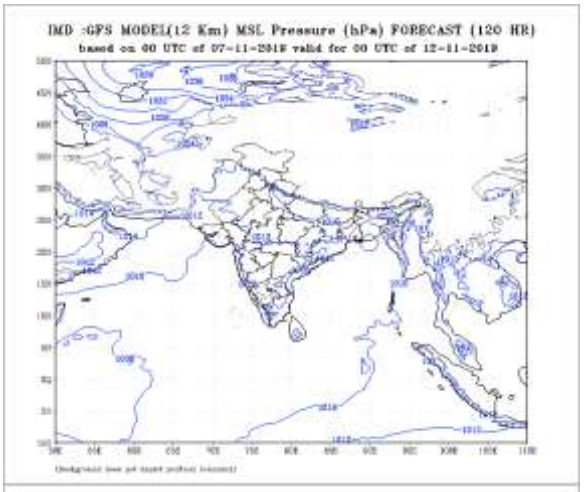
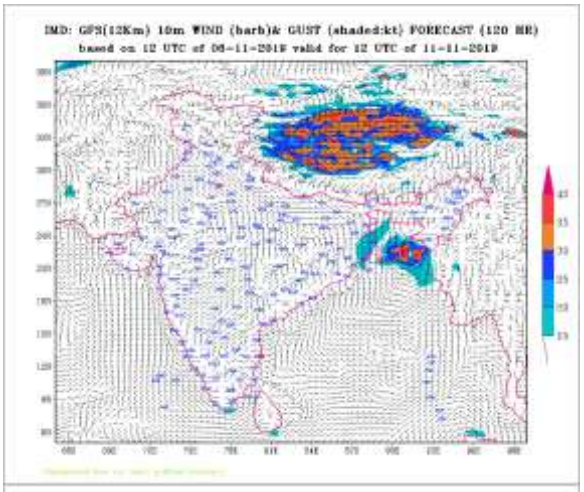
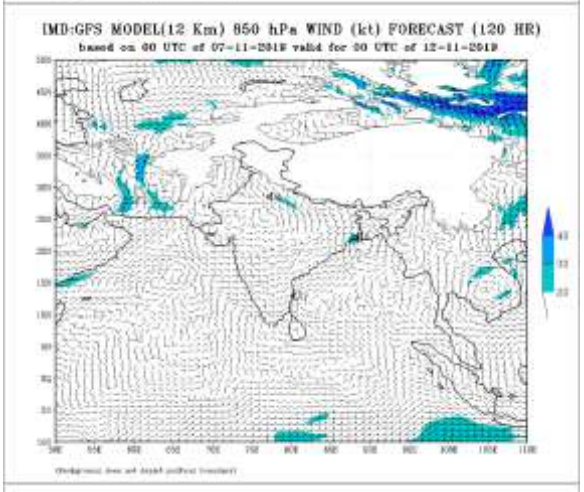
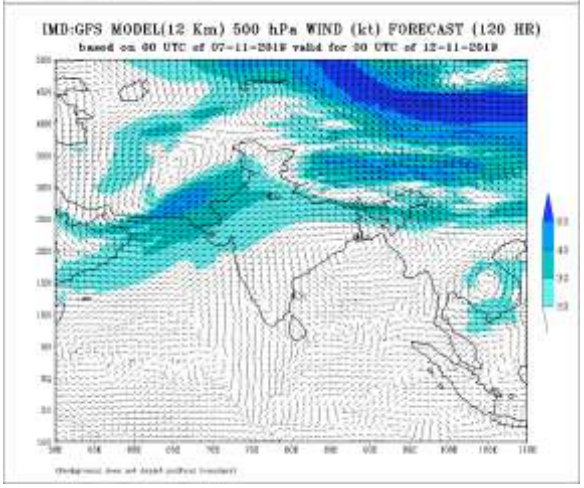
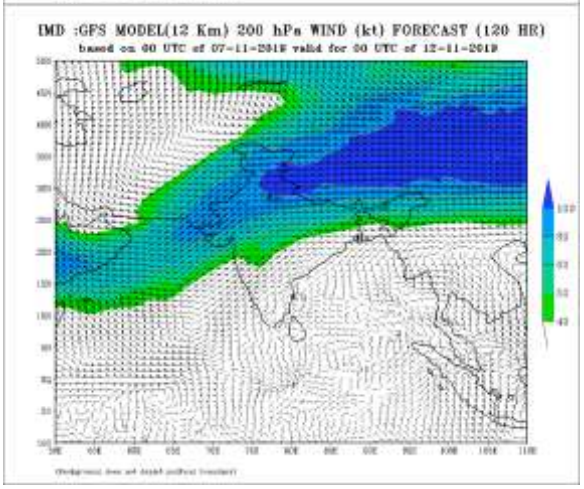
based on 00 UTC of 07-11-2018 valid for 00 UTC of 11-11-2018


IMD :GPS MODEL(12 Km) MSL Pressure (hPa) FORECAST (120 HR)
based on 00 UTC of 07-11-2018 valid for 00 UTC of 12-11-2018


IMD: GFS(12Km) 10m WIND (barb)& GUST (shaded:kt) FORECAST (120 HR)
based on 12 UTC of 06-11-2018 valid for 12 UTC of 11-11-2018


IMD:GFS MODEL(12 Km) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 07-11-2018 valid for 00 UTC of 12-11-2018


IMD:GFS MODEL(12 Km) 500 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 07-11-2018 valid for 00 UTC of 12-11-2018


IMD :GPS MODEL(12 Km) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 07-11-2018 valid for 00 UTC of 12-11-2018