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

FDP (Cyclone) NOC Report Dated 03rd November, 2019

Time of Issue: 1200 UTC

Synoptic features:

- The Depression over westcentral & adjoining southwest Arabian Sea moved west-southwestwards weaken into a Well Marked Low Pressure Area and lay centred at 1800 UTC of 2nd November, 2019 over westcentral and adjoining southwest Arabian Sea off north Somalia coast. It is very likely to move west-southwestwards towards Somalia coast
- The **Severe Cyclonic storm MAHA** (**Pronounced as M'maha**) over eastcentral Arabian Sea moved westwards, intensified into a **Very Severe Cyclonic storm** and lay centered at 0900 UTC of today, the 03rd November, 2019 over eastcentral Arabian Sea near latitude 17.6°N and longitude 65.9°E, about 590 km west-southwest of Veraval (Gujarat), 630 km west-southwest of Diu and 590 km southwest of Porbandar. It is very likely to move west-northwestwards slowly till 04th November, re-curve east-northeastwards and move rapidly thereafter and weaken gradually from 05th November onwards. It is very likely to cross Gujarat coast between Diu and Dwarka as a Severe Cyclonic Storm with a maximum sustained wind speed of 100-110 Kmph gusting to 120 Kmph around mid-night of 6th November/ early hours of 7th November, 2019.
- The Cyclonic Circulation over Gulf of Thailand & neighbourhood now lies over north Andaman Sea & adjoining Myanmar Coast and extends upto 5.8 Km above mean sea level. Under its influence, a Low Pressure Area is likely to form over north Andaman Sea during next 24 hours. It is very likely to move west-northwestwards, concentrate into a Depression over eastcentral Bay of Bengal during subsequent 2-3 days and intensify further with northwestwards movements subsequently.

Dynamical and thermodynamical features

Sea Surface Temperature (SST):

Sea Surface Temperature is around 26-28°C over the area of SCS Maha and but increases to 28-30°C over northeast Arabian Sea and along Gujrat- Maharshtra coasts.

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 the system area and also in westcentral Arabian Sea most parts of east central and north Arabian sea. There is a narrow strip of value 50-70 kJ/cm^2 off Gujarat coast.

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

Relative Vorticity:

Cyclonic relative vorticity at 850 hPa of value 20-30 X10^{-6}s-1 is seen over north Andaman Sea

Cyclonic relative vorticity at 850 hPa of value 200 X10^{-6}s-1 is seen to the south of the centre of VSCS Maha.

Low level Convergence:

Small areas of Lower level convergence about 5 x 10^{-5}s^{-1} are seen over SW BoB off east Sri Lanka coast and also over Andaman Sea.

Lower level convergence of about 20 x 10^{-5}s^{-1} to the south of the centre of VSCS Maha.

Upper level Divergence:

Upper level divergence of value 20-30x10^{-5} s-1 is seen over equatorial Indian Ocean and adjoin south BoB.

Upper level divergence of value 20 x10^{-5} s-1 is seen to the east of the centre of VSCS Maha.

Wind Shear:
Wind shear is low (05-10 knots) over the area of VSCS Maha.

Wind shear is low to moderate over most parts of BOB and Andaman Sea. It is high over extreme north and south BoB.

Wind Shear Tendency:
The wind shear tendency is positive over most parts of BoB and Andaman Seam except a small area of southwest BOB and also of north Andaman Sea.
It is negative over most parts of Arabian Sea except for a small area in westcentral AS where it is positive.

Upper tropospheric ridge:
The upper tropospheric ridge at 200 hPa runs roughly along 18°N over the region of the SCS Maha and is around 19°N over BoB.

Satellite observations based on INSAT imagery:

Arabian Sea:-

As per the satellite imagery at 0900 UTC of 03rd November, 2019, the current intensity of the system (SCS Maha) is T 4.0. Associated scattered low to medium clouds with embedded intense to very intense convection lies over eastcentral Arabian Sea between Lat 15.8^0N to 21.0^0N and Long 64.5^0E to 68.0^0E. The minimum CTT is minus 93^0C.

Bay of Bengal & Andaman Sea:-

According to 0900 UTC satellite imagery, scattered low/medium clouds with embedded isolated moderate to intense convection prevails over north Andaman Sea in association with a Low Level Circulation (LLC) over the area.

Large scale features

M.J.O. Index:
MJO index is in Phase 5 with amplitude more than 1. It is likely to remain there till 6th November and enter into phase 6 thereafter.

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

(a) At 0000 UTC on 03 Nov19, Tropical Storm 24W (Halong) was located near 14.8°N 155.4°E, approximately 614 NM east of Andersen AFB, Guam, and had tracked northwestward at 15 knots over the past six hours. Maximum sustained surface winds were estimated at 40 knots gusting to 50 knots. It is expected to move northwestwards till 0600 UTC of 05th November and is likely to recurve northeastwards thereafter with gradual weakening.

(b) The area of convection (Invest 90W) previously located near 12.3°N 112.4°E is now located near 13.2°N 114.0°E, approximately 380 NM east-southeast of Da Nang, Vietnam. Upper level Analysis indicates a marginally favorable environment for development of the system. Maximum sustained surface winds are estimated at 10 to 15 knots. Minimum sea level pressure is estimated to be around 1004 hPa.

NWP Input for FDP Cyclone based on 0000 UTC of today

IMD-GFS T-1534

(i) Indicates: The VSCS over SE Arabian Sea on 3rd November moves north-northwestwards to reach westcentral BoB on 5th November. Thereafter it is seen to move in a northeast direction to cross Gujarat coast on in the early hours of 7th as a VSCS and weakens thereafter.

(ii) Another LOPAR is seen on 3rd November over north Andaman Sea and adjoining EC BoB, which becomes a depression on 9th, a CS on 10th. While moving in a northwest direction intensifies into a VSCS over westcentral BoB on 10th and crosses north Andhra coast in the night of 10th.

IMD-GEFS

(i) Indicates: VSCS over northern parts of central Arabian Sea on 04th November is seen to move north-northwestward till 5th November recurves in a northeastward to reach close to south Gujarat coast as a SCS/CS on 6th, which crosses coast in the late hours of 6th/ early hours of 7th.

(ii) Another LOPAR forms on 4th November over north Andaman Sea and adjoining EC BoB which becomes a WML on 6th, Depression over EC BoB on 8th and a CS on 9th November, which intensifies further while moving northwestwards to reach north Andhra Pradesh coast on 11th.

IMD-WRF

(i) The SCS over EC Arabian Sea on 03rd November moves in a NNW direction till 5th November to reach central Arabian Sea, which is seen to weaken slightly on 6th as it recurves.

(ii) Another LOPAR seen over Andaman sea and adjoining eastcentral BoB on 4th November, which becomes a WML on 5th and a depression on 6th over the same area.

NCMRWF-NCUM:

(i) Indicates: The CS over SE Arabian Sea is seen to move in a west-northwest direction to reach WC Arabian Sea on 5th November. It is then seen to recurve from 6th November onwards in a northeast direction to reach south Gujarat coast on 7th as a depression.

(ii) Shows formation of another LOPAR over eastcentral BOB and adjoining Andaman Sea on 4th/5th November which becomes a depression on 7th over eastcentral BoB. Thereafter it is seen to move in a north-northeastward direction and further intensify to reach Bangladesh coast as a ESCS on 10th / 11th November.

NCMRWF-UM-Regional Model: Nil

NEPS Model:

(i) Indicates: The CS over SE Arabian Sea on 03rd November while moving in a north-northwest direction becomes VSCS over WC Arabian Sea. Further on 6th it is seen to recurve in a northeast direction from 6th onwards to cross south Gujarat coast on 7th.

(ii) Another LOPAR seen to form over north Andaman Sea on 4th which becomes a D over EC BoB on 5th, CS on 7th, and a ESCS on 9th November which crosses Bangladesh coast on 11th.

ECMWF:

(i) Indicates: SCS over eastcentral Arabian Sea moves north-northwestward with intensification till 05th November to reach western parts of EC Arabian Sea and adjoining northeast AS. It then recurves and moves north-northeastwards from 6th and starts weakening. It is seen as a depression over EC and adjoining NE Arabian Sea on 7th and becomes less marked on 8th over sea.

(iv) Another LOPAR is seen over north Andaman Sea and adjoining EC BoB on 04th, which becomes a Depression 7th which moves west-northwestward and intensifies into a CS on 9th, which is seen off Odisha- West Bengal coasts as a CS on 12th.

NCEP-GFS:

(i) Indicates: VSCS on 04th November over EC Arabian Sea moves west-northwestwards till 5th and starts recurving towards north-northeast direction to cross south Gujrat coast in the evening of 6th November.

(ii) Another LOPAR forms over EC BoB on 4th/5th which becomes a Depression on 08th, and a CS on 9th. It is seen to move northwestwards to reach WC BoB off Odisha coast on 11th. It is seen to weaken over the area gradually.

ARP-Meteo France : NIL

Dynamical statistical models
IMD Genesis Potential Parameter (GPP):

(i) Significant zone of GPP seen over east-central AS on 03rd November which moves northwestward till 5th and is seen over northeast AS diminished in area on 6th and becomes less marked on 7th November.

(ii) Another significant zone of GPP seen over EC BoB on 6th November, seen to move in north-northwest direction till 11th November.

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 is about 200 $x10^{-5}$ sec^{-1} to the south of the system centre. The ridge over the system area runs roughly along 18^0 N. The lower level convergence is about 20 $x10^{-5}$ s^{-1} to the southwest of the system centre and the upper level divergence is about 20 $x10^{-5}$ s^{-1} over the system area. The vertical wind shear is low (05-10 knots) over the system area and along the forecast track. Sea surface temperature between 26-28°C, tropical cyclone heat potential of 20-40 kJ/cm^2 around the system center.

(B) Presently, an anticyclone is located to the northeast of the system and the system is being steered by the southern periphery winds, it is moving in west-northwest direction. This movement is likely to continue till 4th November. Then it is likely to enter in to COL region, move nearly northwards for a brief period and likely to come under the influence of an approaching mid-latitude westerly trough from 5th November. As a result the system is very likely to re-curve east-northeastwards from 5th November. During this period, the system is likely to weaken gradually under the influence of increased vertical wind shear. Majority of the numerical models are in agreement with the above analysis.

(C) Most of the models considered are indicating the development of a LOPAR over BoB around 4th November, which is forecast to further intensify into a depression and subsequently into a CS. The development of the LOPAR and its possible intensification needs to be closely monitored.

Probability of cyclogenesis over Bay of Bengal and Andaman Sea during next 120 hours:

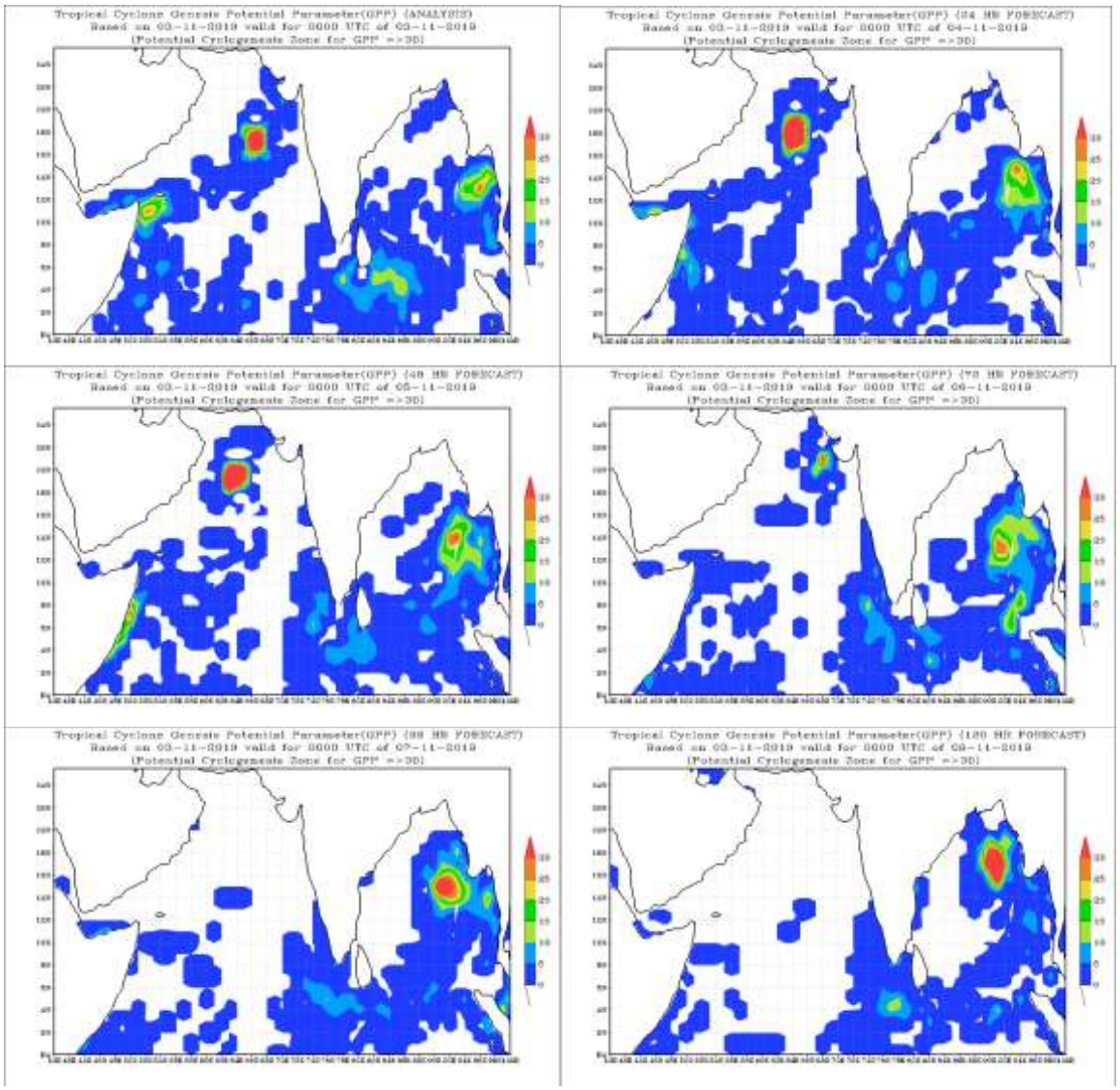
24 HOURS	24-48 HOURS	48-72 HOURS	72-96 HOURS	96-120 HOURS
Nil	Nil	Nil	Low	Medium

Probability of cyclogenesis over Arabian Sea during next 120 hours:

24 HOURS	24-48 HOURS	48-72 HOURS	72-96 HOURS	96-120 HOURS
-	-	-	-	-

Advisory: IOP for Gujarat coast on 6th and 7th November 2019.

Annexure-1


Tropical Cyclone Genesis Potential Parameter(GPP) (ANALYSIS)
Based on 03-11-2019 valid for 0000 UTC of 03-11-2019
(Potential Cyclogenesis Zone for GPP =>30)
Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 03-11-2019 valid for 0000 UTC of 04-11-2019
(Potential Cyclogenesis Zone for GPP =>30)
Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 03-11-2019 valid for 0000 UTC of 05-11-2019
(Potential Cyclogenesis Zone for GPP =>30)
Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 03-11-2019 valid for 0000 UTC of 06-11-2019
(Potential Cyclogenesis Zone for GPP =>30)
Tropical Cyclone Genesis Potential Parameter(GPP) (96 HR FORECAST)
Based on 03-11-2019 valid for 0000 UTC of 07-11-2019
(Potential Cyclogenesis Zone for GPP =>30)
Tropical Cyclone Genesis Potential Parameter(GPP) (120 HR FORECAST)
Based on 03-11-2019 valid for 0000 UTC of 08-11-2019
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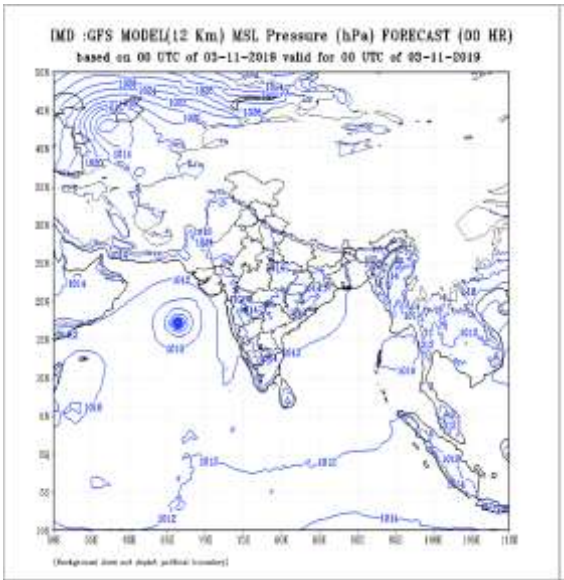
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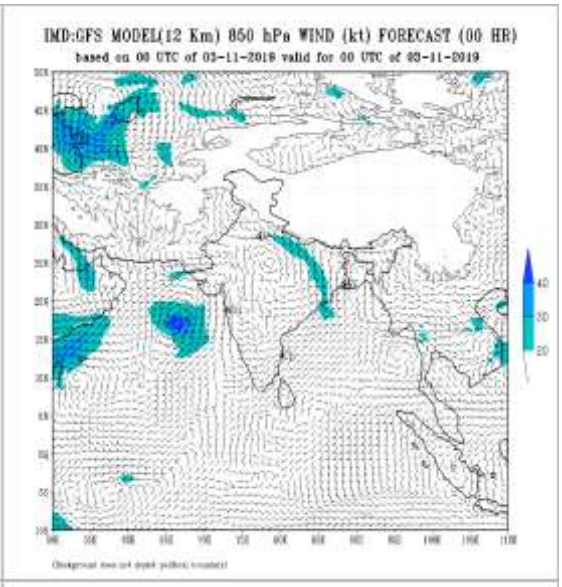
based on 00 UTC of 03-11-2018 valid for 00 UTC of 03-11-2018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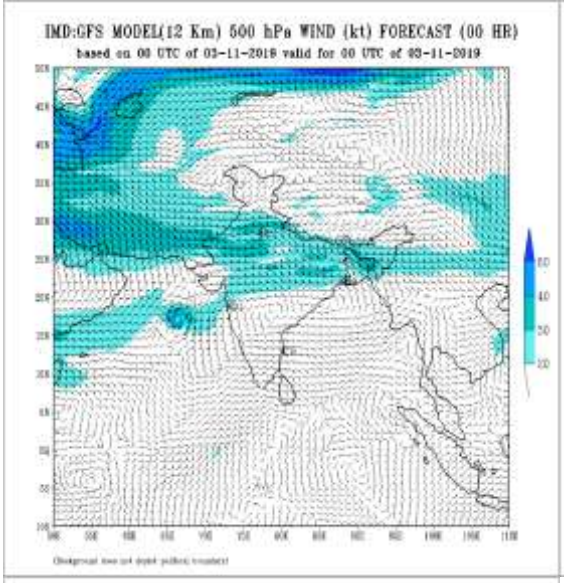
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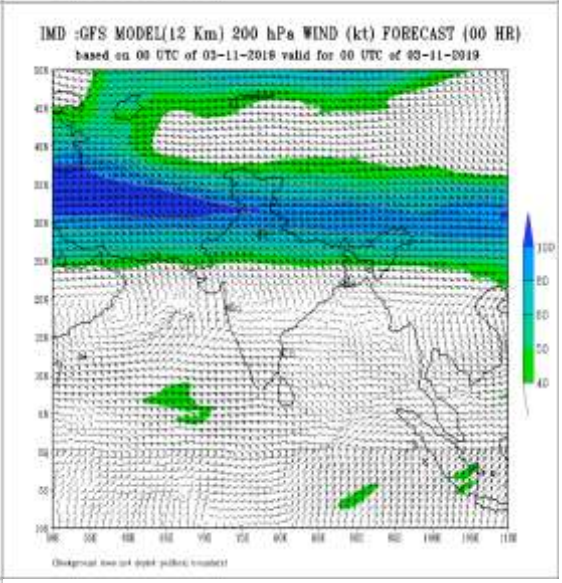
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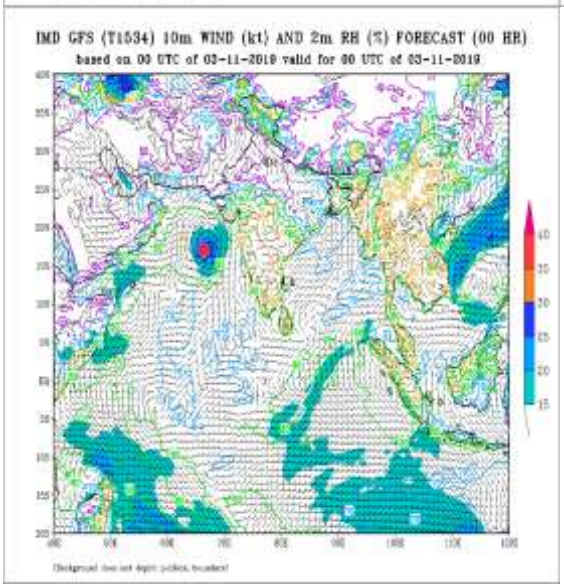
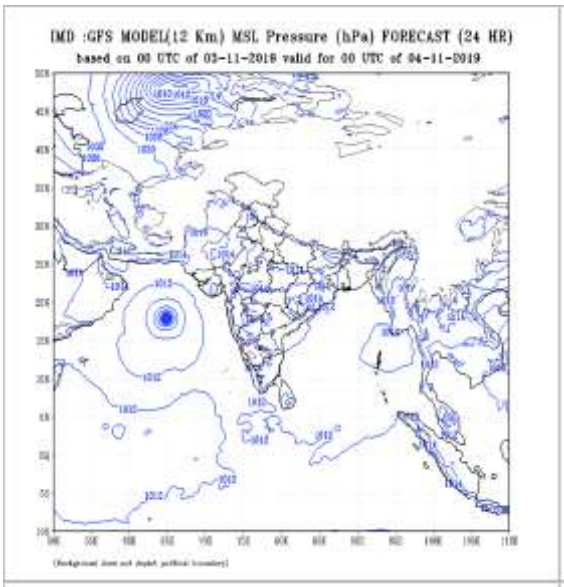

IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (00 HR)
based on 00 UTC of 03-11-2018 valid for 00 UTC of 03-11-2018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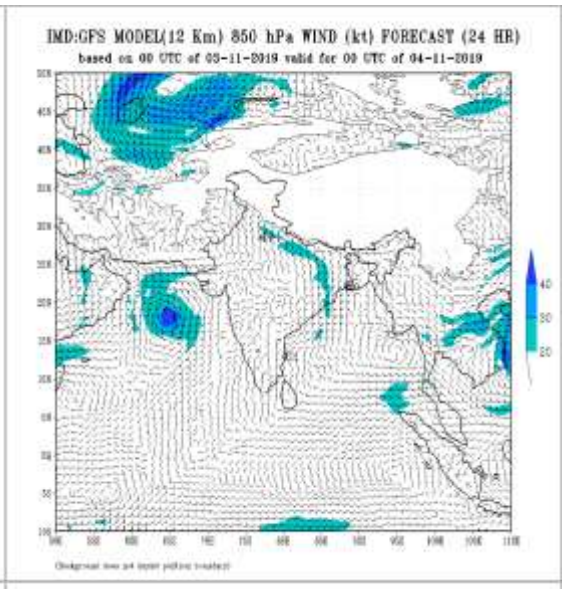
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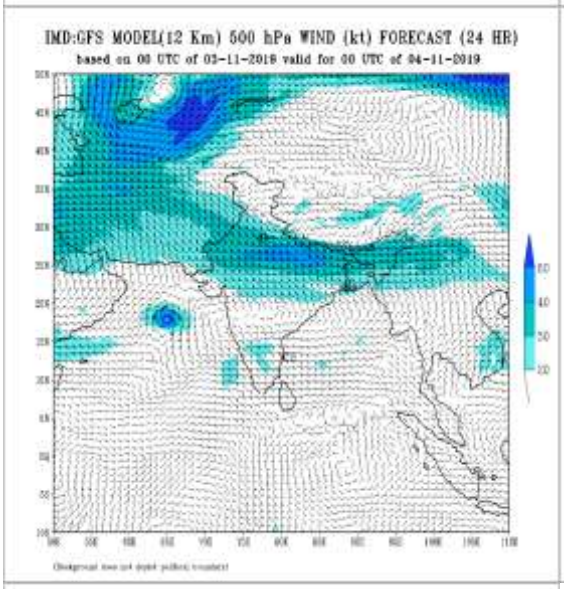
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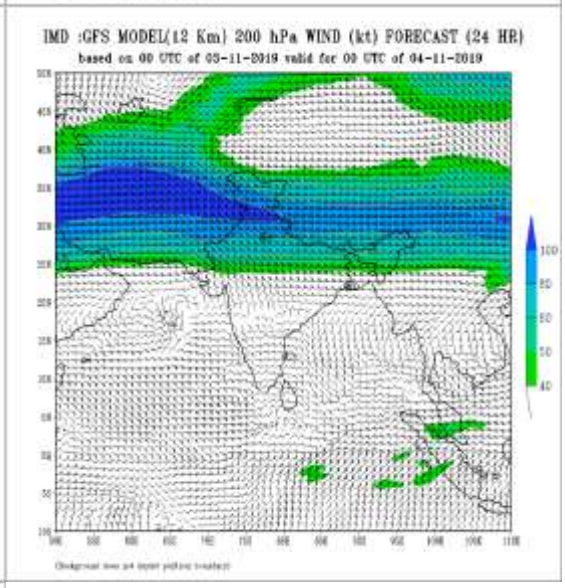
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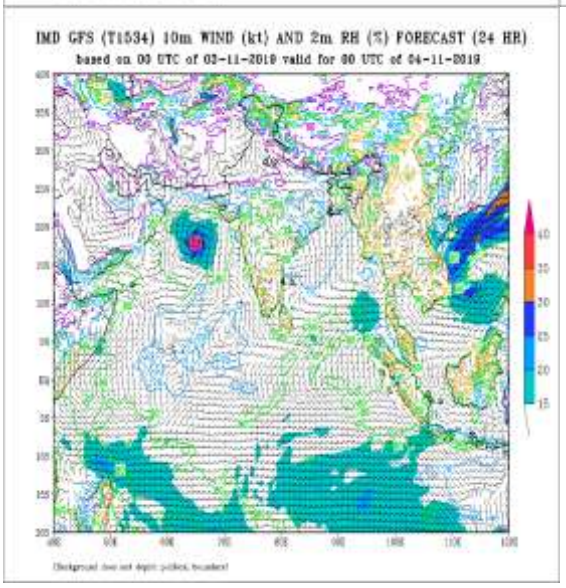
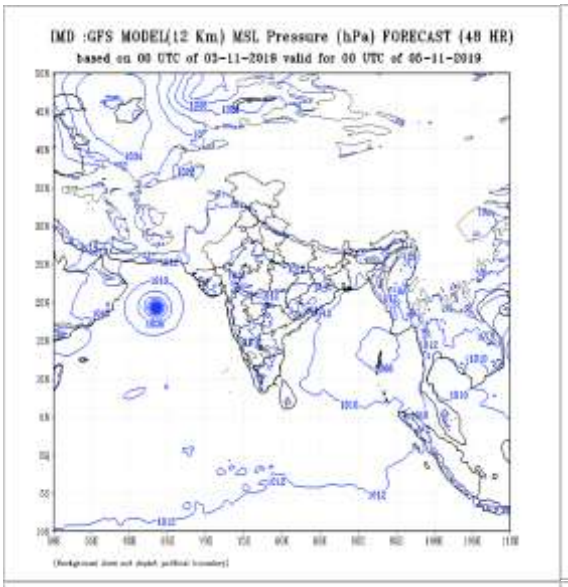

IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (24 HR)
based on 00 UTC of 03-11-2019 valid for 00 UTC of 04-11-2019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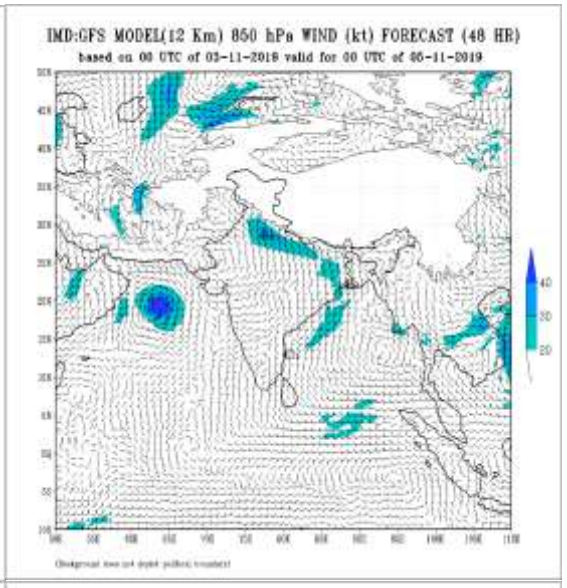
based on 00 UTC of 03-11-2018 valid for 00 UTC of 05-11-2018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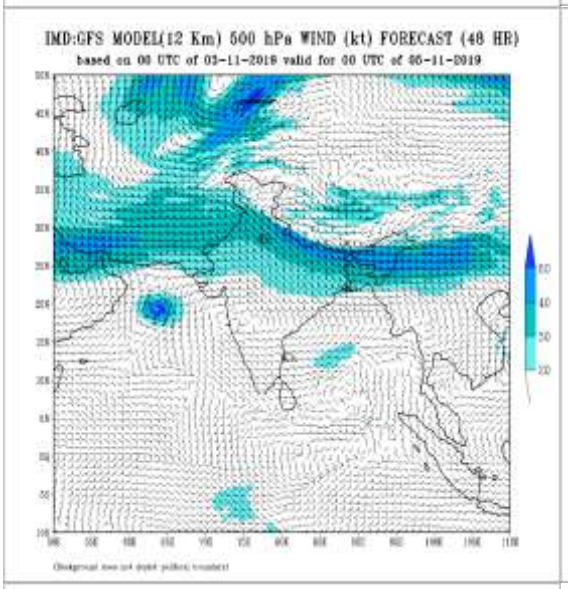
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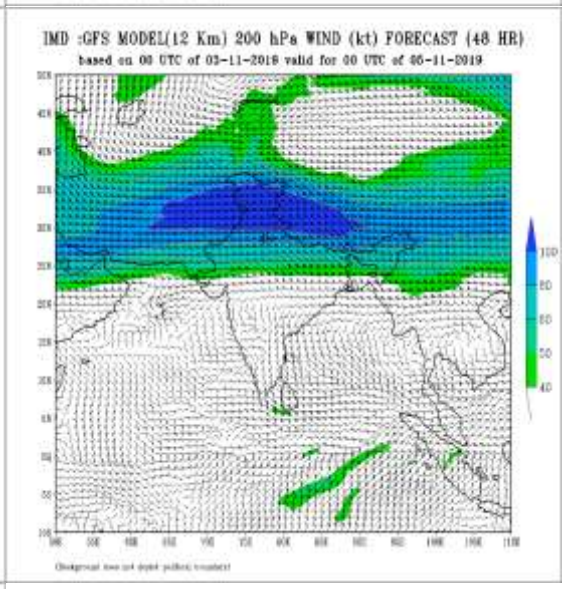
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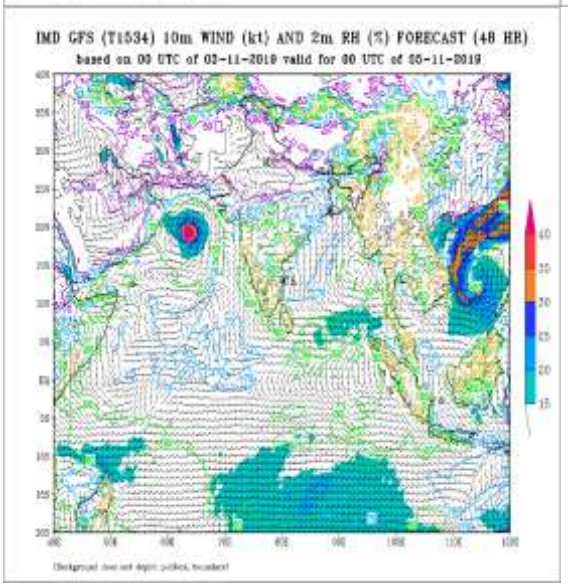
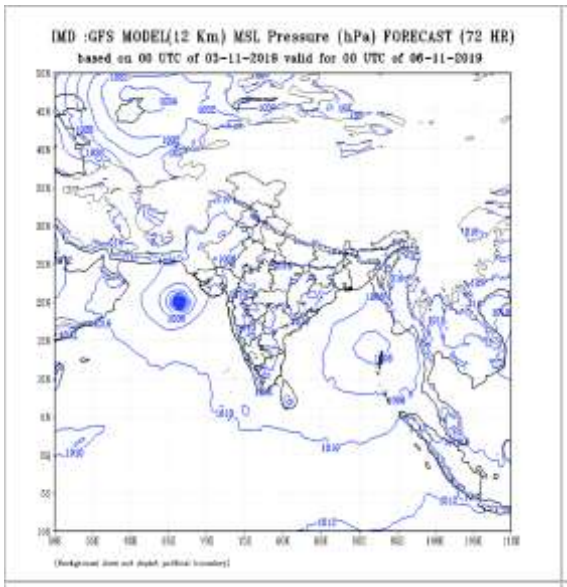

IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (48 HR)
based on 00 UTC of 03-11-2018 valid for 00 UTC of 05-11-2018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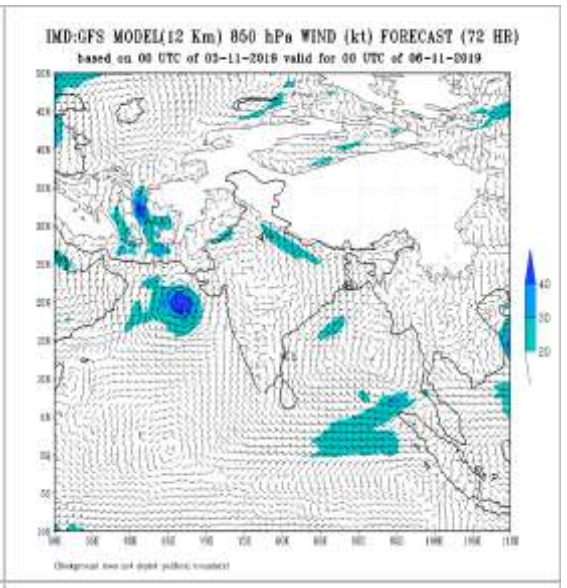
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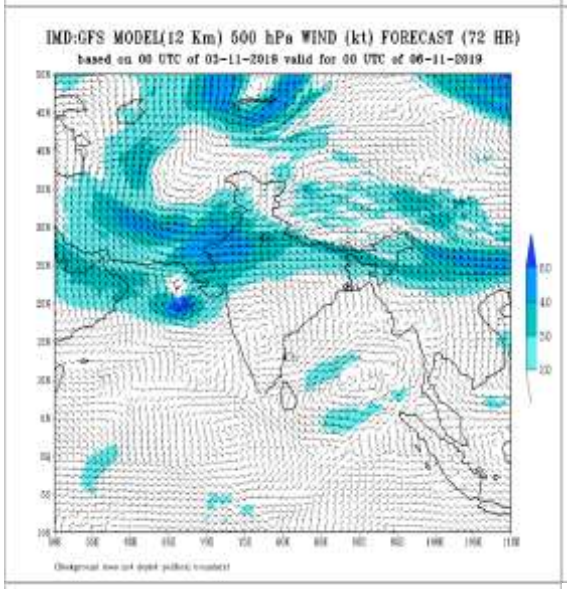
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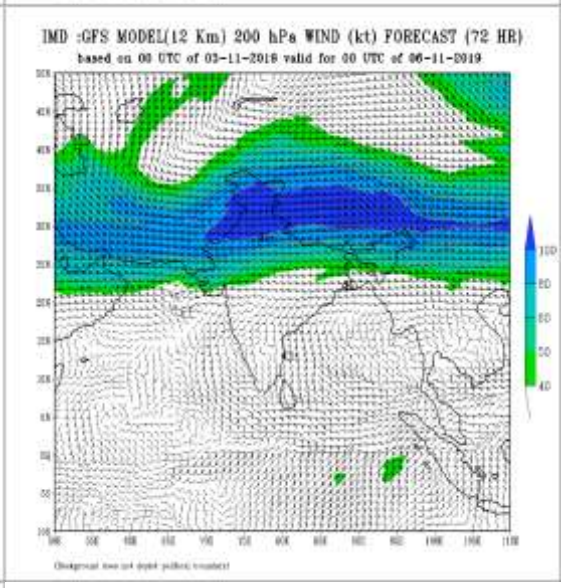
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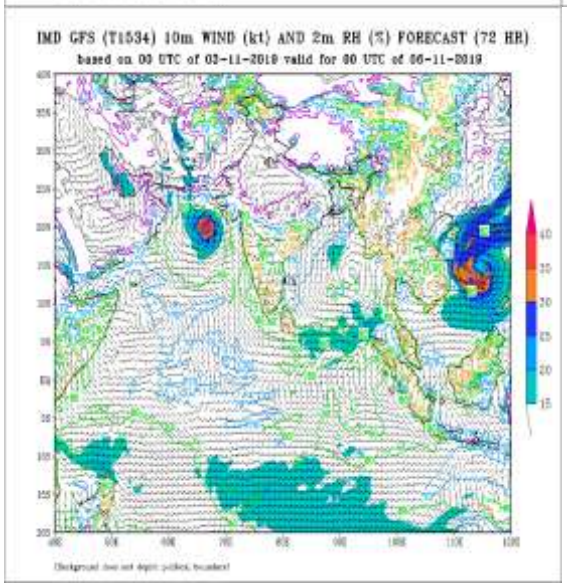
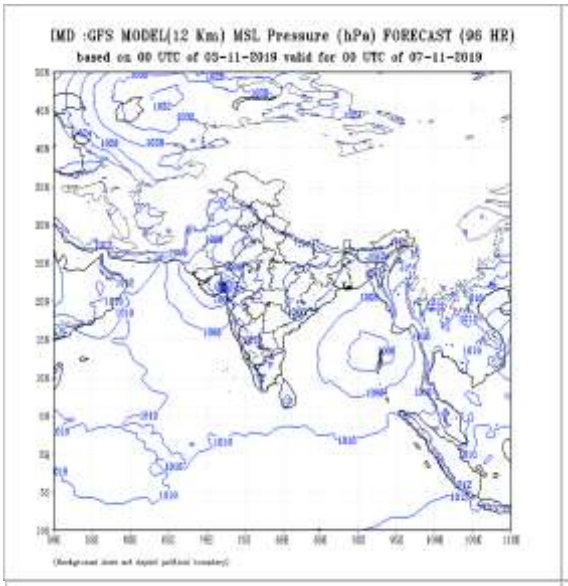

IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (72 HR)
based on 00 UTC of 03-11-2018 valid for 00 UTC of 06-11-2018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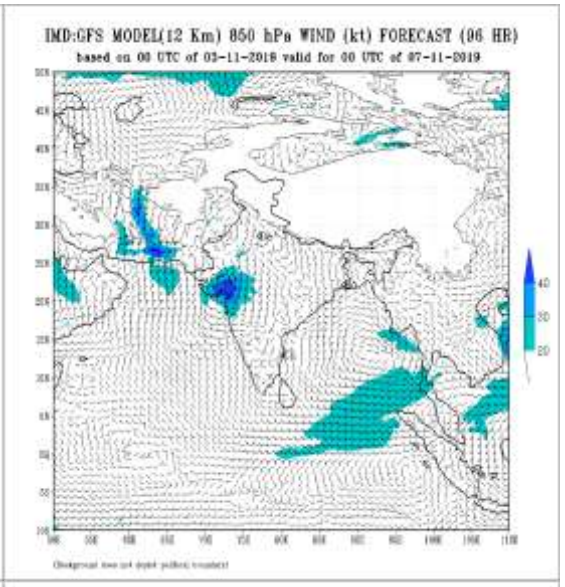
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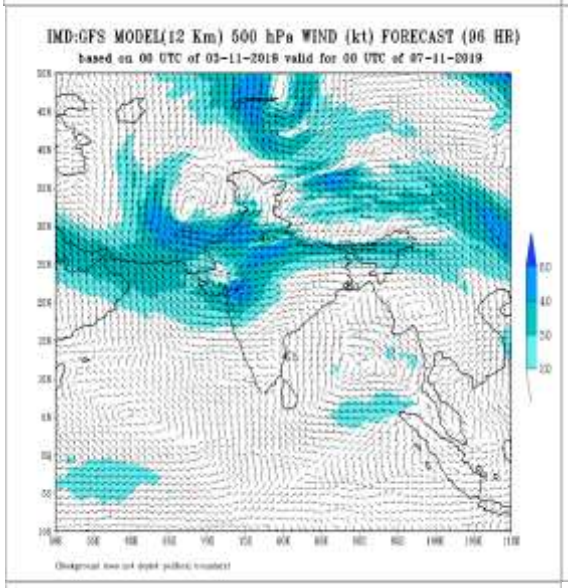
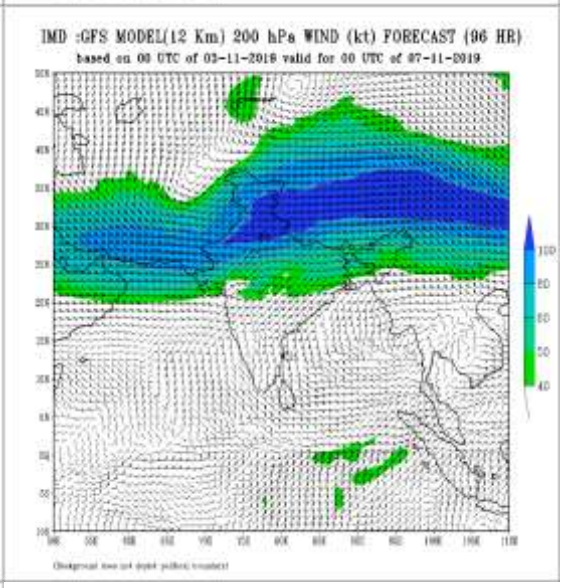
based on 00 UTC of 03-11-2018 valid for 00 UTC of 07-11-2018


IMD:GFS MODEL(12 Km) 500 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 03-11-2018 valid for 00 UTC of 07-11-2018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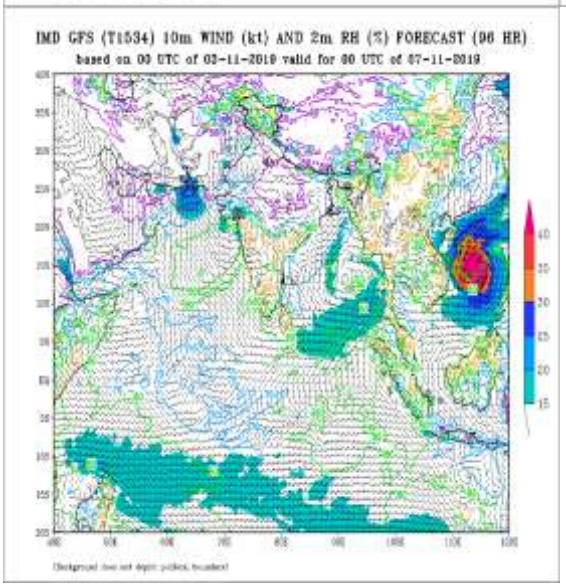
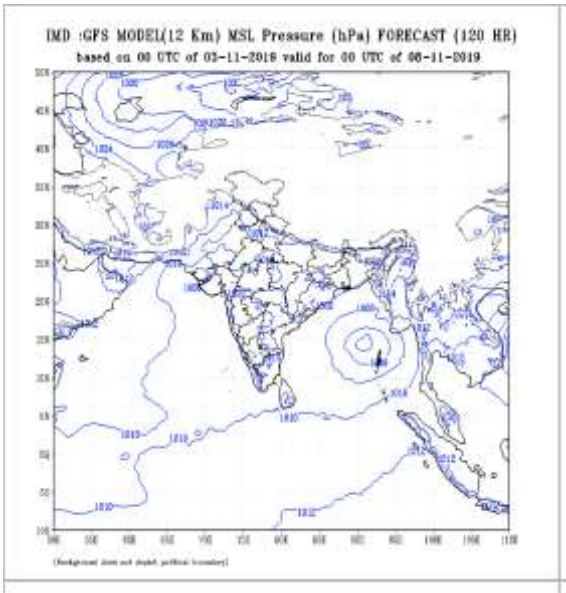
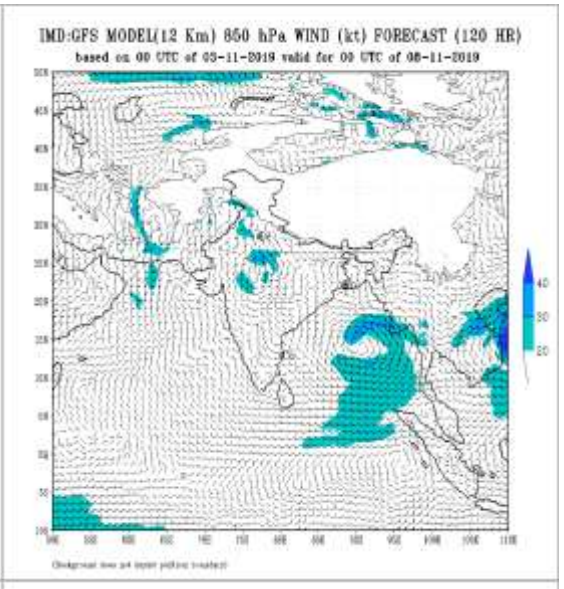
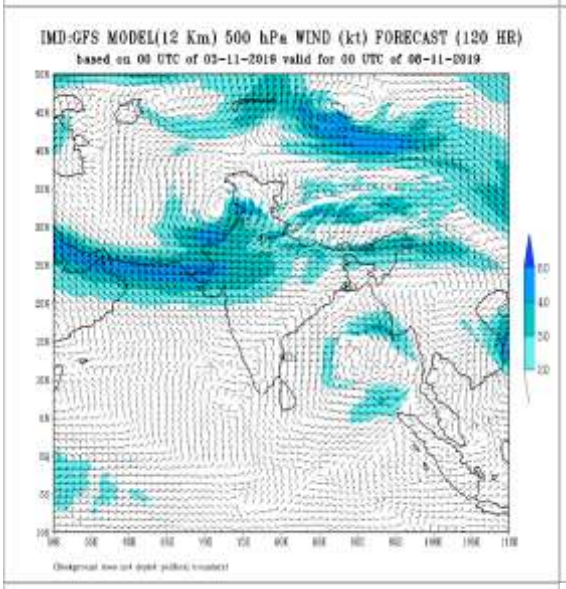
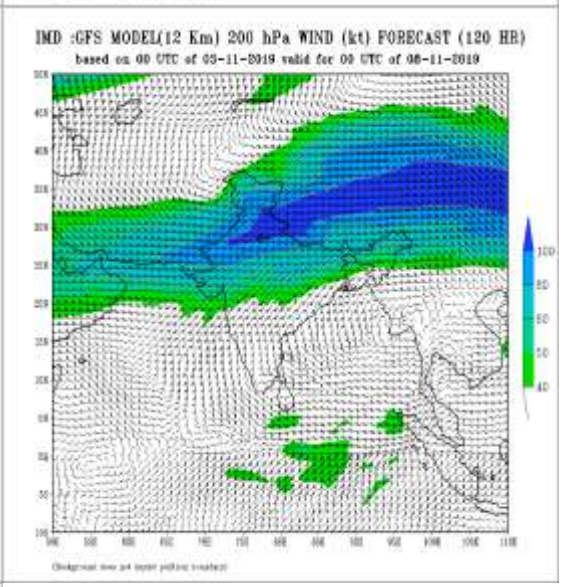
based on 00 UTC of 03-11-2018 valid for 00 UTC of 07-11-2018

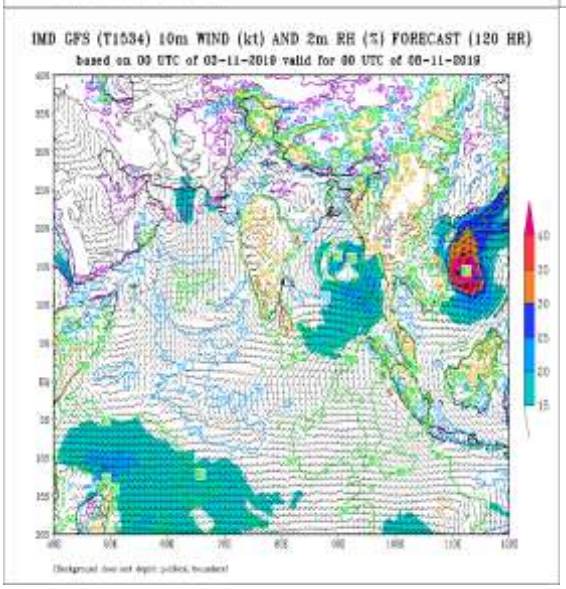

IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (96 HR)
based on 00 UTC of 03-11-2018 valid for 00 UTC of 07-11-2018


IMD :GFS MODEL(12 Km) MSL Pressure (hPa) FORECAST (120 HR)
based on 00 UTC of 03-11-2019 valid for 00 UTC of 08-11-2019


IMD:GFS MODEL(12 Km) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 03-11-2019 valid for 00 UTC of 08-11-2019


IMD:GFS MODEL(12 Km) 500 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 03-11-2019 valid for 00 UTC of 08-11-2019


IMD :GFS MODEL(12 Km) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 03-11-2019 valid for 00 UTC of 08-11-2019


IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (120 HR)
based on 00 UTC of 03-11-2019 valid for 00 UTC of 08-11-2019