



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



FDP (Cyclone) NOC Report Dated 04th November, 2019

Time of Issue: 1200 UTC

Synoptic features:

- The **Very Severe Cyclonic storm MAHA (Pronounced as M'maha)** over eastcentral Arabian Sea moved westwards, and then west-northwestwards and intensified into an **Extremely severe cyclonic storm (ESCS)** at 0530 hrs IST of today, the 04th November, 2019 over eastcentral and adjoining westcentral Arabian Sea. It and lay centered at 0900 UTC of today, the 04th November, 2019 over eastcentral and adjoining westcentral Arabian Sea near latitude 18.7°N and longitude 64.2°E, about 690 km west-southwest of Veraval (Gujarat), 740 km west-southwest of Diu and 660 km west-southwest of Porbandar. It is very likely to intensify further till 5th November morning and weaken thereafter. It is very likely to move west-northwestwards slowly during next 18 hours, re-curve east-northeastwards and move rapidly thereafter. It is very likely to cross Gujarat coast between Diu and Porbandar as a Cyclonic Storm with a maximum sustained wind speed of 80-90 Km/h gusting to 100 Km/h by early hours of 7th November, 2019.
- Under the influence of the Cyclonic Circulation over north Andaman Sea & adjoining Myanmar Coast a Low Pressure Area has formed over north Andaman Sea at 0000 UTC of today, the 4th November. The associated cyclonic circulation extends upto 5.8 Km above mean sea level. It is very likely to become Well Marked Low Pressure Area during next 12 hours and move west-northwestwards. It is very likely to concentrate into a Depression over eastcentral Bay of Bengal during subsequent 48 hours and intensify further with northwestwards movements.

Dynamical and thermodynamical features

Sea Surface Temperature (SST):

Sea Surface Temperature is around 25-28°C over the area of ESCS Maha and but increases to 28-30°C over north as well as south Arabian Sea.

SST is 28 - 30°C 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/cm² over the system area and also in most parts of central Arabian Sea and north Arabian sea. There is a narrow strip of value 50-70 kJ/cm² off west coast of India. It is around 60-80 kJ/cm² over south Arabian Sea.

TCHP is 100-120 kJ/cm² over a small area in southwest BOB and is 80-100 kJ/cm² over the rest of the BOB.

Relative Vorticity:

Cyclonic relative vorticity at 850 hPa of value 20-30 X10⁻⁶s⁻¹ is seen over north Andaman Sea and adjoining EC BoB.

Cyclonic relative vorticity at 850 hPa of value 200 X10⁻⁶s⁻¹ is seen to the south of the centre of ESCS Maha.

Low level Convergence:

An area of lower level convergence about 10 x 10⁻⁵s⁻¹ is seen over EC BoB and north Andaman Sea.

Lower level convergence of about 10 x 10⁻⁵s⁻¹ around the centre of ESCS Maha.

Upper level Divergence:

Upper level divergence of value 30x10⁻⁵ s⁻¹ is seen over Andaman Sea and adjoining BoB.

Upper level divergence of value 30 x10⁻⁵ s⁻¹ is seen to the southeast of the centre of ESCS Maha.

Wind Shear:

Wind shear is low (05-10 knots) over the area of VSCS Maha and is high over north Arabian Sea.

Wind shear is low to moderate over north Andaman Sea and adjoining EC BoB and also along the east coast of India. It is high elsewhere.

Wind Shear Tendency:

The wind shear tendency is positive over most parts of BoB and Andaman Sea except a small area of north Andaman Sea.

It is negative over most parts of Arabian Sea except for north Arabian Sea and also over a small area in westcentral AS where it is positive.

Upper tropospheric ridge:

The upper tropospheric ridge at 200 hPa runs roughly along 20°N over the Arabian Sea region and is around 15°N over BoB.

Satellite observations based on INSAT imagery:**Arabian Sea:-**

As per the satellite imagery at 0900 UTC of 04th November, 2019, the current intensity of the system (ESCS Maha) is T 5.0. Associated scattered low to medium clouds with embedded intense to very intense convection lies over eastcentral and adjoining westcentral Arabian Sea between Lat 16.5°N to 20.5°N and Long 63.5°E to 66.5°E. The minimum CTT is minus 84°C.

Bay of Bengal & Andaman Sea:-

According to 0900 UTC satellite imagery, a vortex lay over north Andaman sea & neighborhood centered within half degree of 12.6°N/92.8°E with intensity 1.0. Scattered low/medium clouds with embedded intense to very intense convection lies over north Andaman Sea and adjoining eastcentral BoB and Andaman islands in association with a Low Level Circulation (LLC) over the area between Lat 10.5°N to 16.0°N and Long 90.5°E to 94.5°E. The minimum CTT is minus 93°C.

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 0600 UTC on 04 Nov19, Typhoon 24W (Halong) was located near 17.9°N 153.1°E,. Maximum sustained surface winds were estimated at 80 knots. It is expected to move northwestwards and further intensify to 115 knots till 1800 UTC of 05th November and is likely to recurve northeastwards thereafter with gradual weakening.
- b) The area of convection (Invest 90W) located near 13.2°N 114.0°E, at 0600 UTC of 4th approximately 320 NM west-northwest of Puerto Princesa, Philippines. Maximum sustained surface winds are estimated at 18 to 23 knots and has a high potential for intensifying into a cyclonic storm.

NWP Input for FDP Cyclone based on 0000 UTC of today**IMD-GFS T-1534**

- (i) Indicates: The ESCS over west central Arabian Sea on 4th November moves slowly on till 5th November and thereafter it is seen to recurve in a northeast direction with gradual weakening to cross Gujarat coast on in the early hours of 7th as a SCS.

- (ii) The LOPAR on 4th November over north Andaman Sea and adjoining EC BoB becomes a depression on 6th, a CS on 9th. While moving in a northwest direction intensifies into a VSCS/ ESCS over westcentral BoB off north Andhra- south Odisha coasts on 11th. It is seen to cross coast in the later part of 11th.

IMD-GEFS

- (i) Indicates: VSCS over westcentral Arabian Sea on 05th November is seen to move in a northeastward direction to reach close to south Gujarat coast as a CS on 6th, which crosses coast in the late hours of 6th/ early hours of 7th.
- (ii) The WML over north Andaman Sea and adjoining EC BoB becomes a 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. It is seen to cross coast in the later part of 11th.

IMD-WRF

- (i) The ESCS over WC Arabian Sea on 04th and 5th November moves in a NNE direction on 6th and weaken slightly and is seen as a CS on 7th over EC BoB.
- (ii) The LOPAR over Andaman sea and adjoining eastcentral BoB on 4th November, becomes a WML on 5th and a depression on 6th over the same area and a CS on 7th over EC BoB.

NCMRWF-NCUM:

- (i) Indicates: The SCS 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 8th as a very weak system.
- (ii) Shows formation of another LOPAR over eastcentral BOB and adjoining Andaman Sea on 4th/5th November which becomes a depression on 6th 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 November and cross coast.

NCMRWF-UM-Regional Model: Nil

NEPS Model:

- (i) Indicates: The SCS over SE Arabian Sea on 04th November seen to move in a north-northwest direction till 5th. Further on 6th it is seen to recurve in a northeast direction to reach south Gujarat coast on 7th as a depression.
- (ii) Another LOPAR seen to form over north Andaman Sea on 4th which becomes a D over EC BoB on 6th, CS on 7th, and a ESCS on 9th November which crosses Bangladesh coast on 10th.

ECMWF:

- (i) Indicates: ESCS 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 is seen as a CS. 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 on 6th which moves west-northwestward and intensifies into a CS on 7th, which is seen off Odisha- West Bengal coasts as a VSCS on 10th. It weakens thereafter after landfall.

NCEP-GFS:

- (i) Indicates: ESCS on 04th November over EC Arabian Sea moves west-northwestwards till 5th and starts recurving towards north-northeast direction with gradual weakening to cross south Gujarat coast on 7th November as a CS.
- (ii) The LOPAR over EC BoB and adjoining Andaman Sea on 4th becomes a Depression on 07th, and a CS on 9th. It is seen to move north-northeastwards from 10th.

ARP-Meteo France : NIL

Dynamical-statistical models

IMD Genesis Potential Parameter (GPP):

- (i) Significant zone of GPP seen over east-central AS on 04th November which moves northeastward 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 initially and then in a north-northeastward direction and diminishes on 11th November near Myanmar coast.

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 $200 \times 10^{-5} \text{ sec}^{-1}$ near the south of the system centre. The ridge over the system area runs roughly along 18°N . The lower level convergence has decreased and is about $10 \times 10^{-5} \text{ s}^{-1}$ around the system centre and the upper level divergence has increased and is about $40 \times 10^{-5} \text{ s}^{-1}$ southeast of the system center. The vertical wind shear is low (05-10 knots) over the system area and along the forecast track. Sea surface temperature between $25\text{-}27^{\circ}\text{C}$, tropical cyclone heat potential of $20\text{-}40 \text{ kJ/cm}^2$ around the system center.

Under the favourable wind shear environment, a gradual intensification process is likely to continue till 0000 UTC of 5th November. 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 northwest-ward direction. This movement is likely to continue during next 15 hours. Then it is likely to enter into 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 move rapidly and weaken gradually under the influence of increased vertical wind shear and cross south Gujrat coast as a CS in the early hours of 7th. Majority of the numerical models are in agreement with the above analysis

- (A) Most of the models considered are indicating the LOPAR over north Andaman Sea and adjoining Myanmar coast to further intensify into a depression and subsequently into a CS. Most of the global models considered are indicating the system to reach VSCS/ ESCS intensity by 9th/10th November.

Considering the environmental conditions and the model forecasts, it is very likely to become a Well Marked Low Pressure Area during next 12 hours and move west-northwestwards. It is very likely to concentrate into a Depression over eastcentral Bay of Bengal during subsequent 48 hours and intensify further with northwestwards movements. The intensification and movement of the system need to be closely monitored.

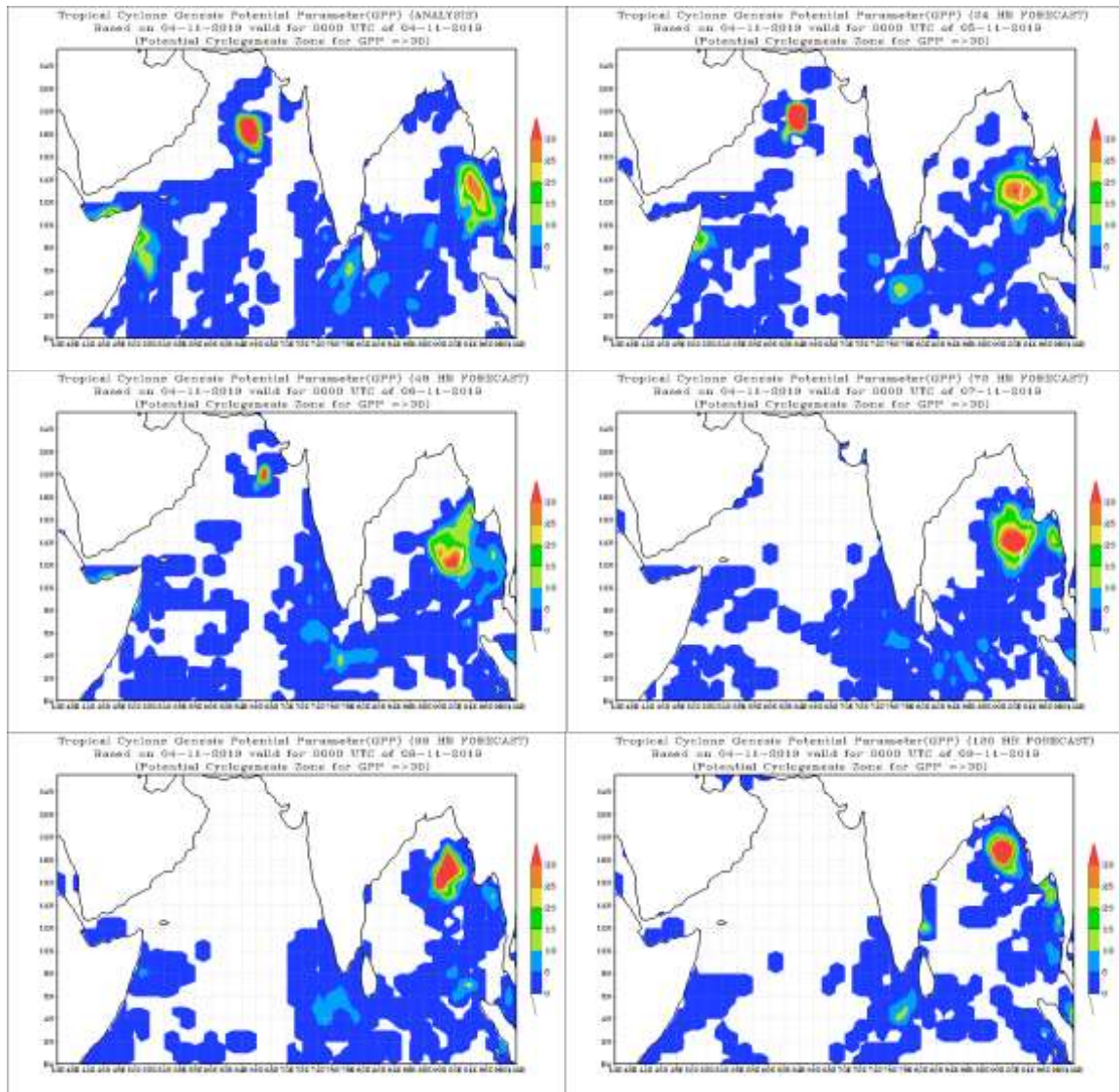
Probability of cyclogenesis over Bay of Bengal and Andaman Sea during next 120 hours:

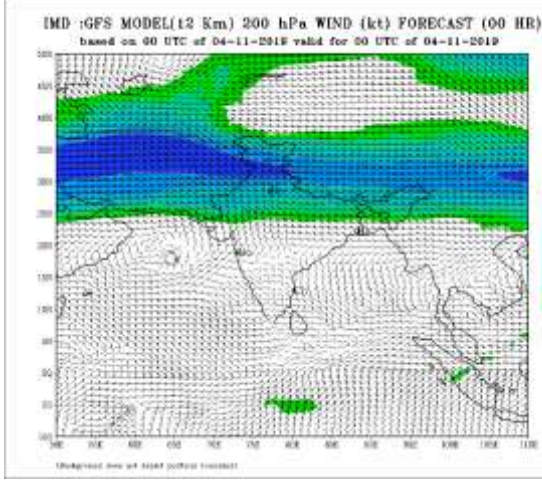
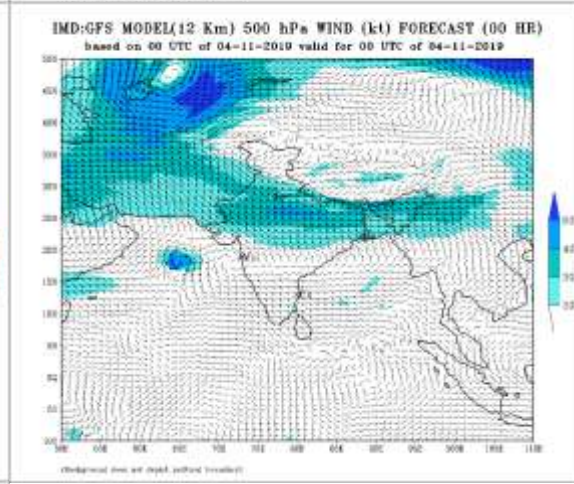
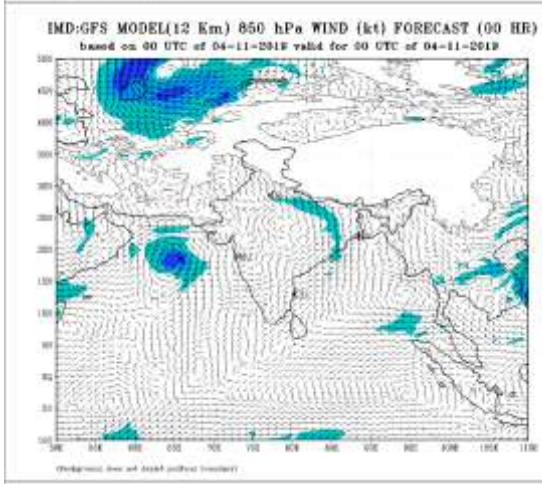
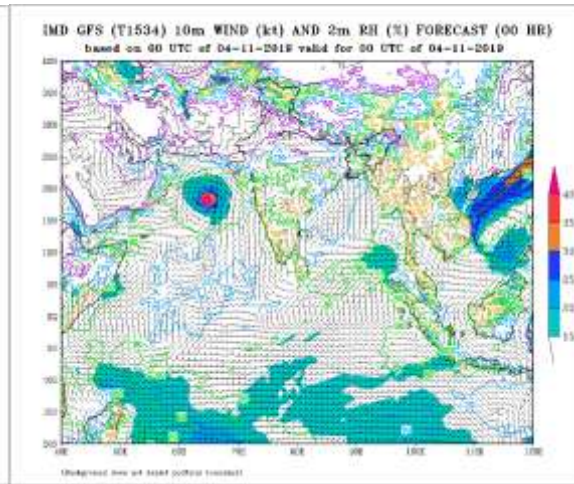
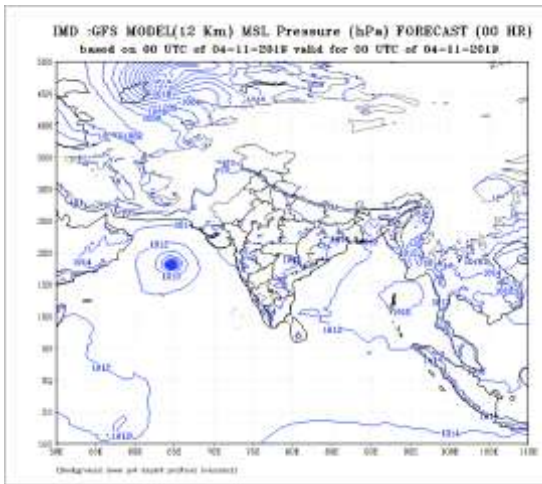
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High	High	-	-	-

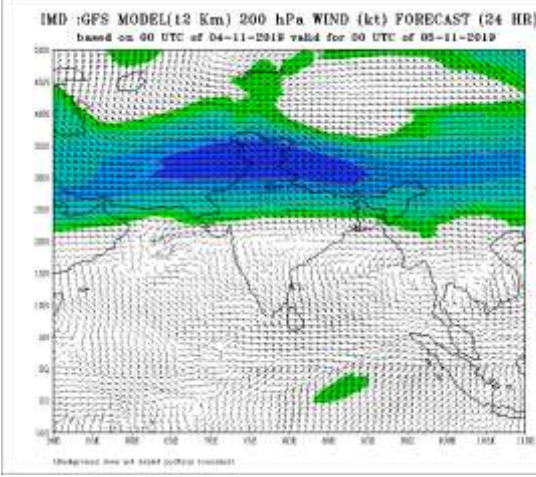
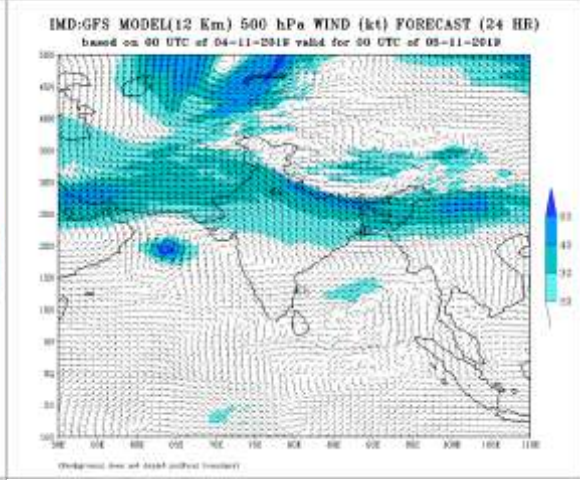
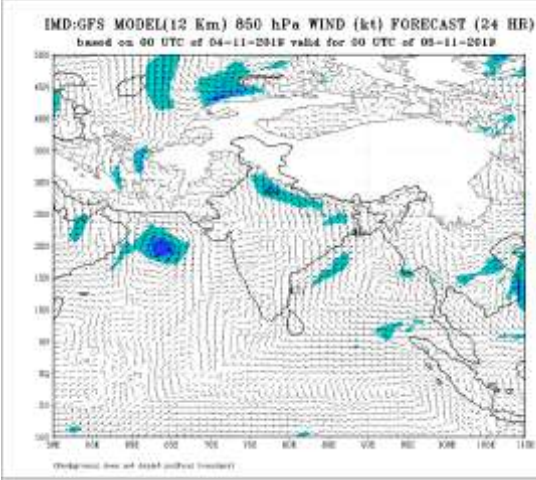
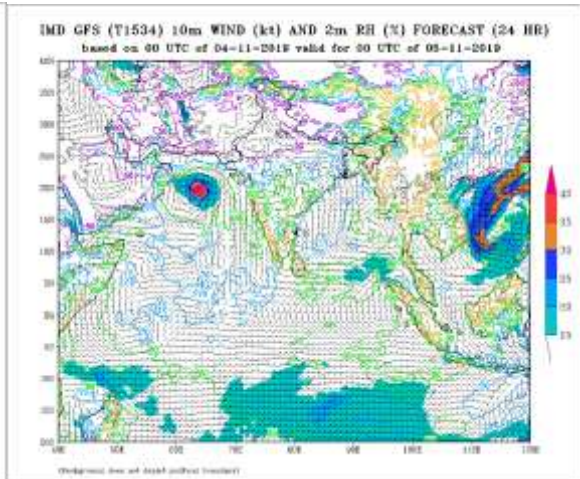
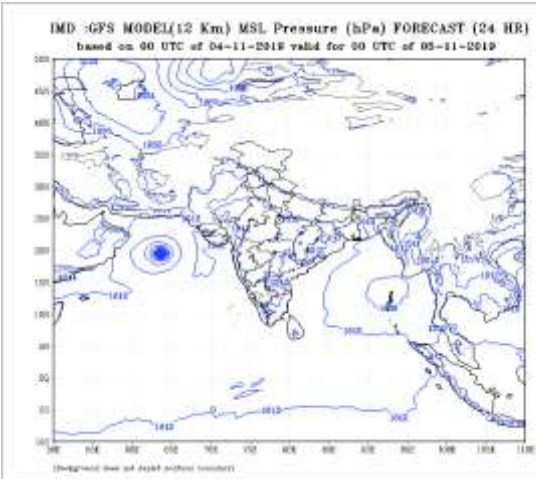
Probability of cyclogenesis over Arabian Sea during next 120 hours:

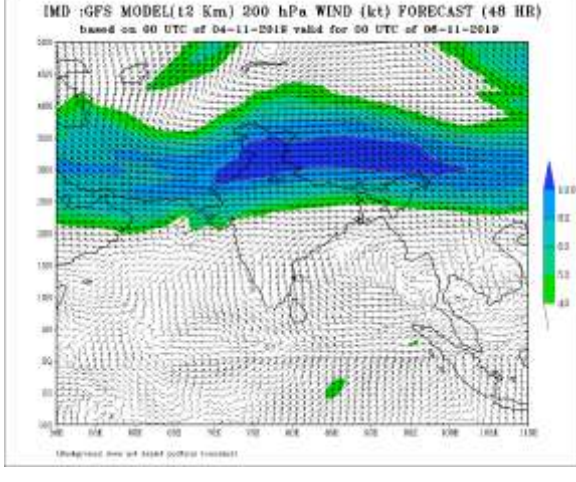
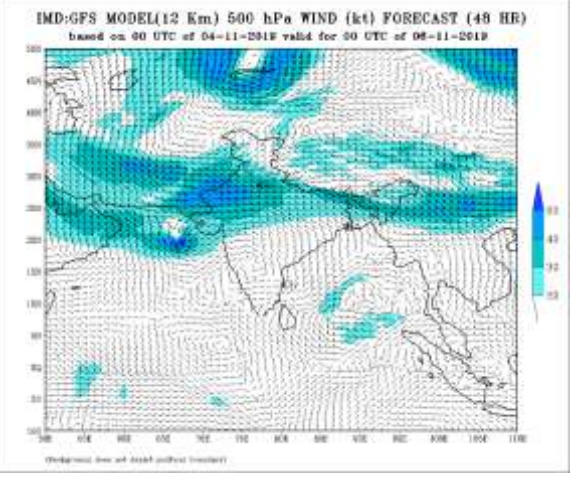
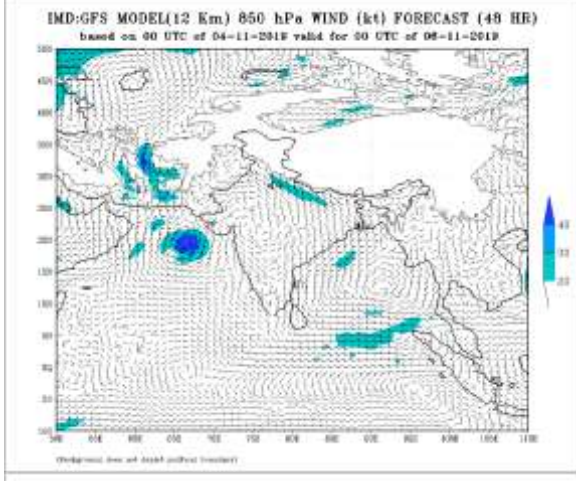
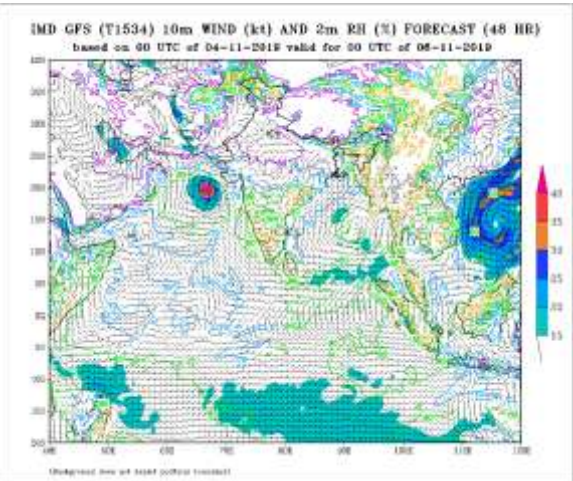
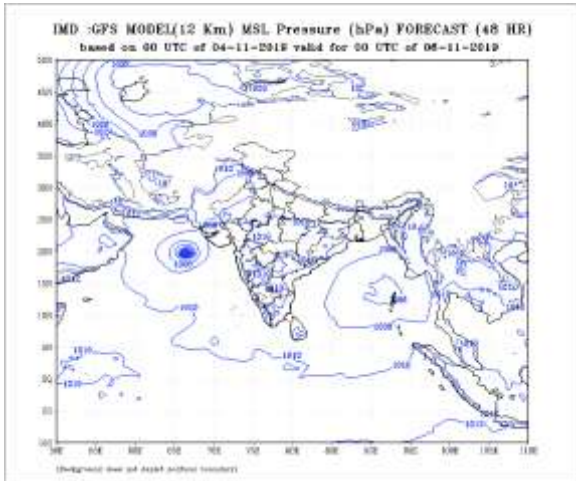
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-	-	-	-	-

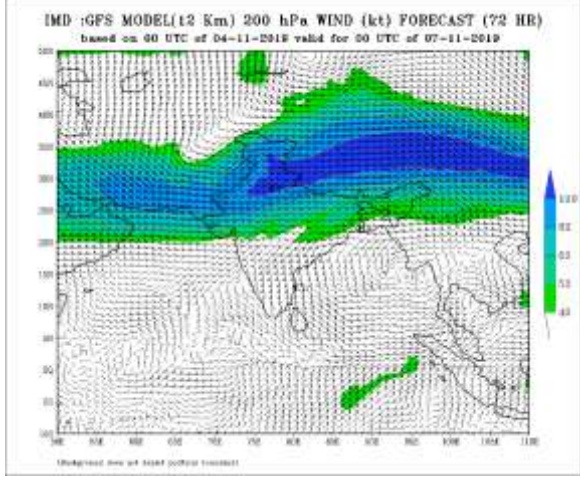
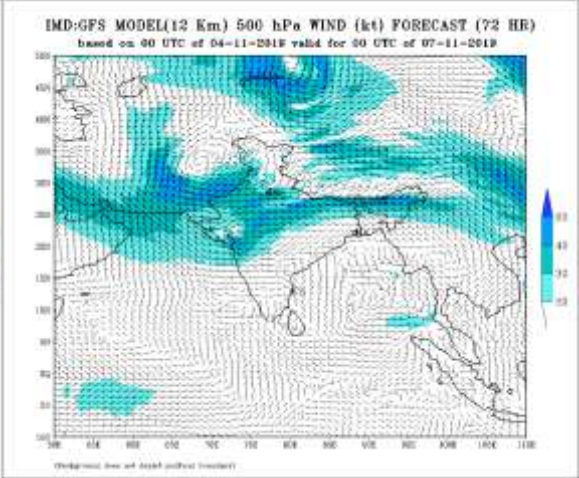
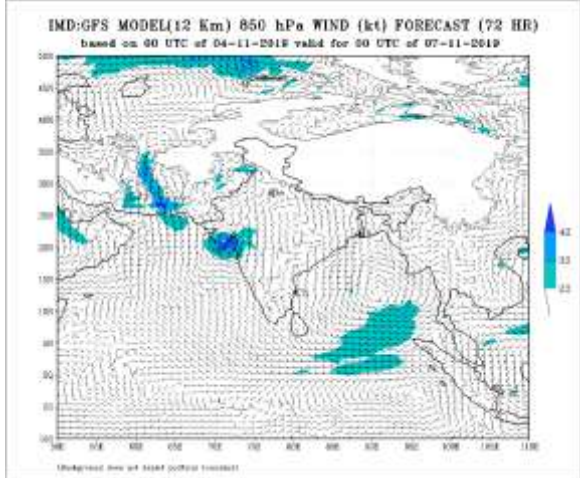
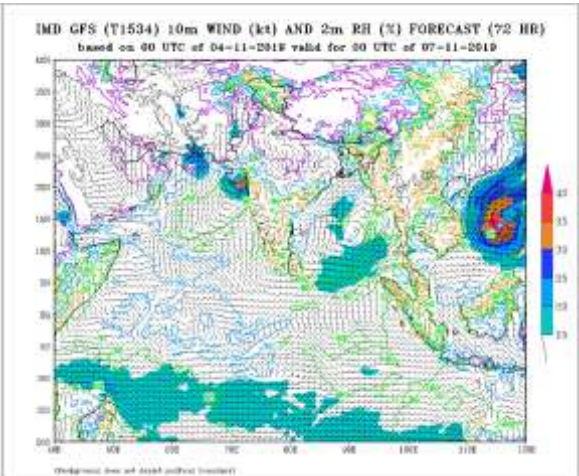
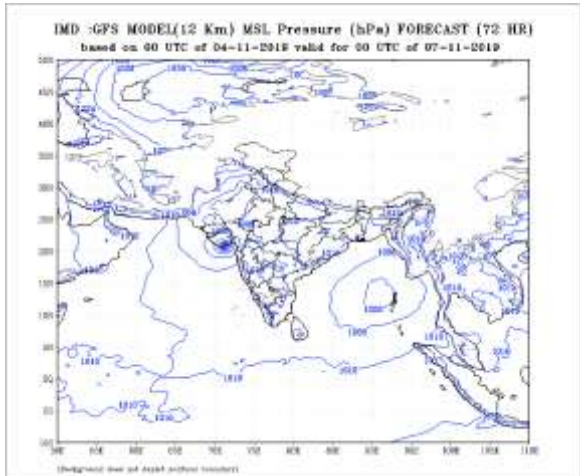
Advisory: IOP for Gujarat coast on 6th and 7th November 2019.



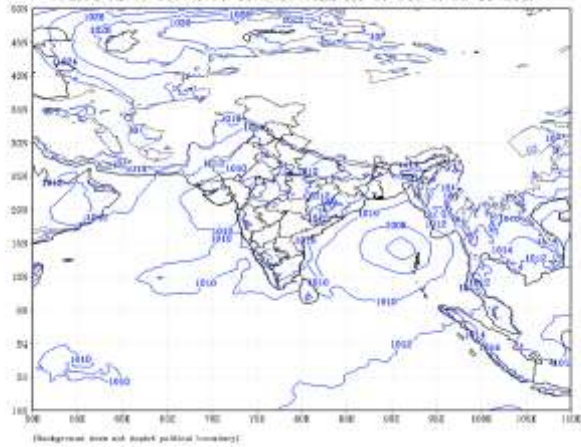




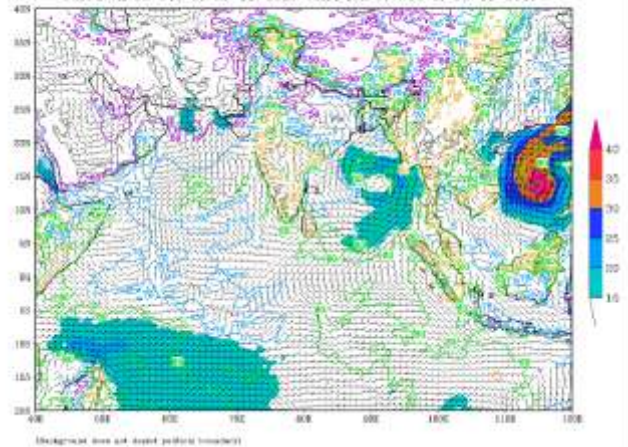




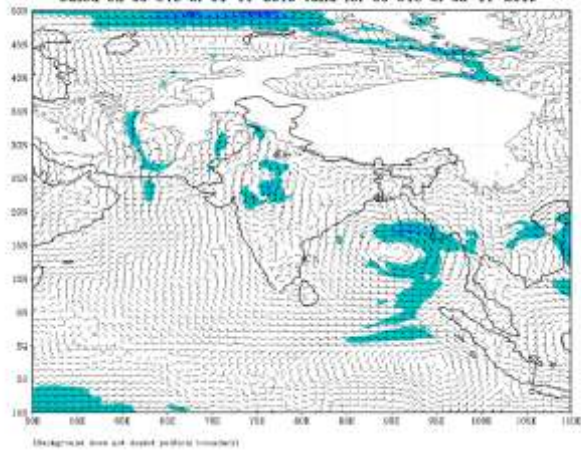
IMD :GFS MODEL(12 Km) MSL Pressure (hPa) FORECAST (96 HR)
based on 00 UTC of 04-11-2019 valid for 00 UTC of 08-11-2019



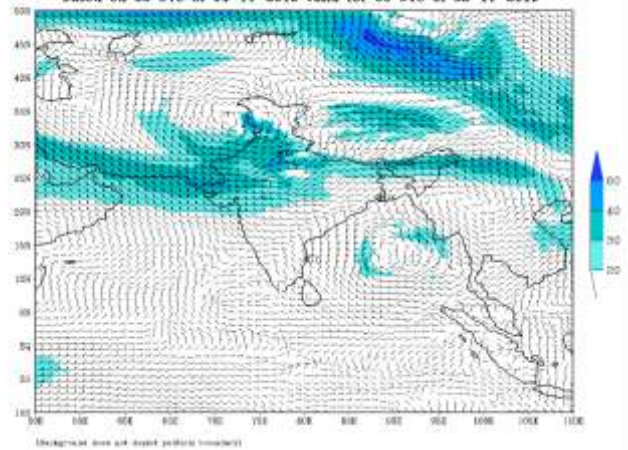
IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (96 HR)
based on 00 UTC of 04-11-2019 valid for 00 UTC of 08-11-2019



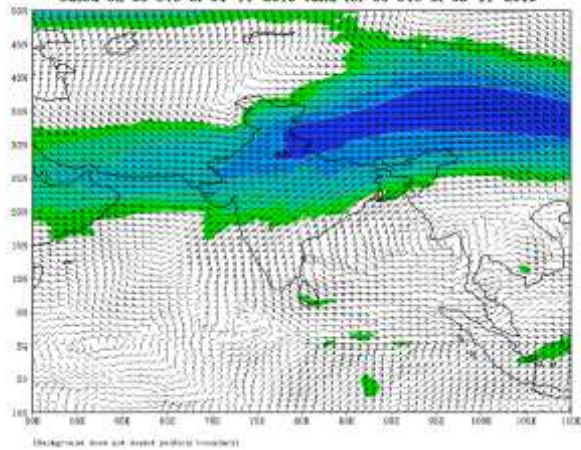
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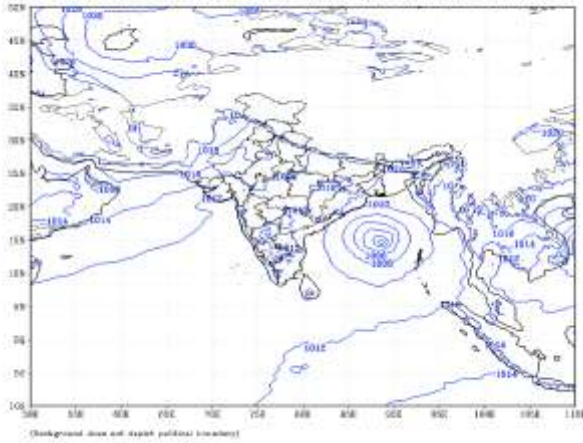
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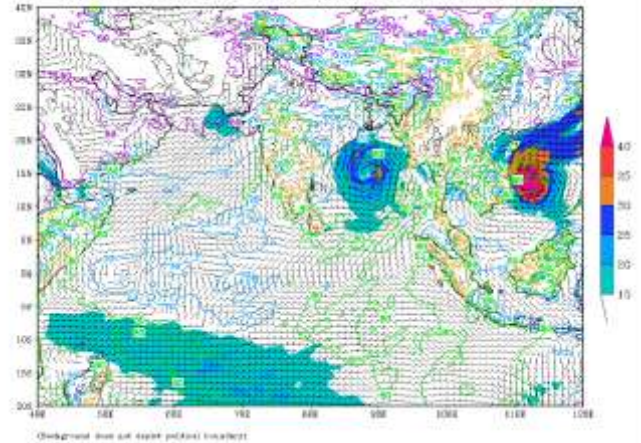
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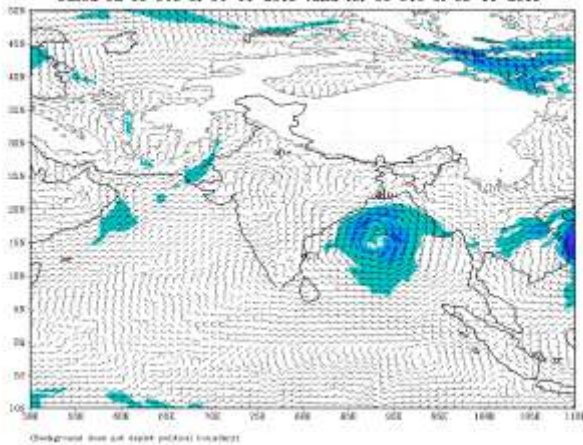
IMD :GFS MODEL(12 Km) MSL Pressure (hPa) FORECAST (120 HR)
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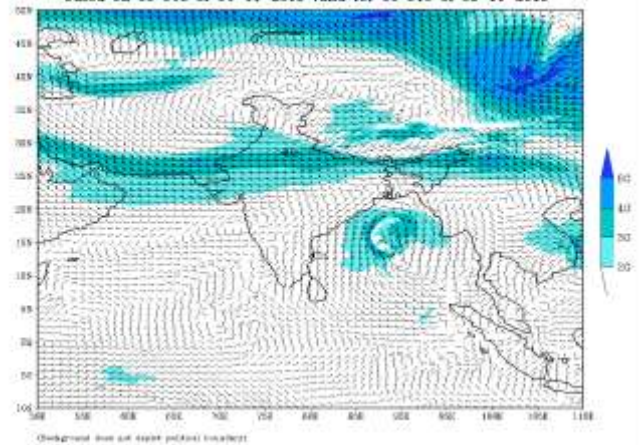
IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (120 HR)
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IMD:GFS MODEL(12 Km) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 04-11-2019 valid for 00 UTC of 09-11-2019



IMD:GFS MODEL(12 Km) 500 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 04-11-2019 valid for 00 UTC of 09-11-2019



IMD :GFS MODEL(12 Km) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 04-11-2019 valid for 00 UTC of 09-11-2019

