



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



FDP (Cyclone) NOC Report Dated 29th October, 2019

Time of Issue: 1200 UTC

Synoptic features:

- The Super Cyclonic Storm 'KYARR' over westcentral and adjoining eastcentral & north Arabian Sea moved westnorthwestwards and weakened into an **Extremely Severe Cyclonic Storm (ESCS)** over westcentral & adjoining eastcentral & north Arabian Sea and lay centered at 0300 UTC of today, 29th October 2019, over the same region near Lat. 19.2°N and Long. 63.4°E, about 990 km west of Mumbai (Maharashtra), 1010 km east-northeast of Salalah (Oman) and 500 km east-southeast of Masirah (Oman). It is very likely to move west-northwestwards till 30th October morning, re-curve west-southwestwards thereafter and move towards Gulf of Aden off south Oman-Yemen coasts during subsequent 3 days. It is very likely to weaken into a Very Severe Cyclonic Storm by morning of 30th October and further into a Severe Cyclonic Storm by evening of 31st October.
- Yesterday's Low pressure area over equatorial Indian Ocean (IO) off south Sri Lanka coast became a **Well Marked Low Pressure Area (WML)** at 0300 UTC of today, the 29th October over Comorin area & adjoining equatorial Indian ocean with associated cyclonic circulation extending upto mid-tropospheric levels persists. The system is likely to concentrate into a Depression over Lakshadweep-Maldives areas & adjoining southeast Arabian Sea during next 24 hours. It is likely to move northwestwards across Lakshadweep Islands and intensify into Deep Depression during subsequent 24 hours.

Dynamical and thermodynamical features

Sea Surface Temperature (SST):

SST is 26-28°C over west-central, and adjoining eastcentral AS. It is around 28-30°C over north AS and also over most parts of south AS.

SST is 28 - 30°C over most parts of the BOB.

Tropical Cyclone Heat Potential (TCHP):

TCHP is 110-120 kJ/cm² over west equatorial IO, 100 – 110 kJ/cm² over a small area over southwest AS off Somalia coast. It is < 40 kJ/cm² over entire north, west-central and adjoining southwest AS and along Oman-Yemen and north Somalia coasts.

TCHP is 120-130 kJ/cm² over a small area in southwest BOB and 80-100 kJ/cm² over the rest of the BOB.

Relative Vorticity:

An area of cyclonic relative vorticity at 850 hPa of 300 X10⁻⁶s⁻¹ is seen to the centre of the system.

Cyclonic relative vorticity at 850 hPa of 50 X10⁻⁶s⁻¹ is seen over the area of WML.

Low level Convergence:

Lower level convergence is about 40 x 10⁻⁵s⁻¹ to the south of the ESCS.

Lower level convergence of about 10 x 10⁻⁵s⁻¹ is seen over area of WML.

Upper level Divergence:

A zone of upper level divergence of value 20x10⁻⁵ s⁻¹ is seen over the area of the ESCS and of value 30 x10⁻⁵ s⁻¹ is seen over the area of WML.

Wind Shear:

Wind shear is moderate (20 knots) over the system area. It is low over central and adjoining south AS and also over Comorin area which increases to the north as well as to the south. Wind shear is 05 knots over entire BOB and Andaman Sea.

Wind Shear Tendency:

The wind shear is in decreasing tendency over southwest AS, parts of north AS and also over Comorin area. It is increasing or neutral over the rest of AS. There is increasing wind shear tendency over most parts of the BOB and Andaman Sea.

Upper tropospheric ridge:

The upper tropospheric ridge at 200 hPa runs roughly along 19°N over the north IO.

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

According to 0900 UTC satellite imagery, vortex (Kyarr) over east-central AS & neighbourhood is centered near 18.4N/64.5 E with intensity T 5.5/ C.I 6.0. Eye pattern prevails with ragged eye seen in visible and infrared imagery with eye temperature of -27.0°C. Associated broken low / medium clouds with embedded intense to very intense convection prevails over westcentral and adjoining east-central AS between Lat 18.0°N to 21.0°N and Long 61.5°E to 64.5°E (minimum CTT is minus 88 deg C).

In association with the WML over Comorin area & adjoining equatorial Indian ocean, scattered low to medium clouds with embedded moderate to intense convection prevails over the region.

Bay of Bengal & Andaman Sea:-

According to 0900 UTC satellite imagery, scattered low/medium clouds with embedded intense convection prevails over south BOB, Sri Lanka and Andaman Sea.

Large scale features**M.J.O. Index:**

MJO index is in Phase 3 (eastern Indian Ocean) with amplitude less than 1. It will continue in same phase with reduction in amplitude for 2 more days and enter into Phase 4 (western maritime Continent) with amplitude less than 1.

Storms and Depression over South China Sea/ South Indian Ocean: None over south China Sea and over south Indian Ocean.

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

- (i) Indicates : SuCS over west central AS on 29th, Extremely Severe Cyclonic Storm (ESCS)/ VSCS over west central AS on 30th, SCS over west-central AS on 31st October, CS/DD close to Oman coast on 1st November, and Depression over west-central AS on 2nd November and a WML near Gulf of Aden on 3rd November which becomes less marked by 4th November.
- (ii) Indicates: A Depression over Comorin area on 29th, a CS over Comorin and adjoining Maldives area on 30th October, which is seen to the west of Lakshdweep Islands on 31st. Moving northwestwards, it weakens into a depression over southeast AS and adjoining Lakshadweep area on 1st November, a WML over SE Arabian Sea on 2nd November and a LOPAR on 01st, which becomes less marked the next day.

IMD-GEFS

- (i) Indicates: SCS over westcentral AS on 30th, which becomes a CS over west-central AS off Oman coast on 31st October, weakens into a D/ WML over the same region on 1st November and becomes less marked by 2nd November.
- (ii) Indicates: Depression over Maldives and adjoining Comorin area on 29th October, over southeast AS and adjoining Lakshadweep area on 30th October, which is seen to weaken into a LOPAR on 1st November and becomes less marked on 2nd November.

IMD-WRF

- (i) Indicates: SuCS over central AS on 29th, ESCS/ VSCS over west-central AS and adjoining north Arabian Sea on 30th October and a CS on 31st over WC Arabian Sea close to Oman coast, which becomes a DD over the same area by 01st November.
- (ii) Depression over Comorin and adjoining Maldives on 29th, DD over Maldives and adjoining Lakshadweep area off Kerala coast on 30th October and a CS/ SCS over Lakshadweep area on 31st October, as a depression on 01st November off Karnataka coast.

NCMRWF-NCUM:

- (i) Indicates: ESCS over west-central and adjoining northwest AS on 29th, ESCS/VSCS over west central AS on 30th October, SCS over west central AS close to Oman coast on 31st October, CS on 1st November close to Oman coast and a Depression off Oman coast on 2nd November, and becomes less marked on 2nd.
- (ii) Indicates: Extended low pressure area over Comorin and adjoining Lakshadweep areas on 29th, which on 30th becomes D over southeast AS and adjoining Lakshadweep area. It is seen to move in a west-northwest direction till 3rd November and becomes insignificant by 4th November over WC Arabian Sea.
- (iii) Shows formation of a WML over southeast BOB and adjoining Andaman Sea on 7th November which becomes a depression on 8th over central BoB.

NCMRWF-UM-Regional Model:

- (i) Indicates: SuCS/ ESCS over central and adjoining north AS on 29th and 30th October, which moves westwards.
- (ii) Indicates : Lopar over IO to the south of Comorin area on 29th which becomes a WML on 31st and a D over Lakshadweep and adjoining SE Arabian Sea on 31st October and a CS 01st November over SE Arabian Sea.

NEPS Model:

- (iii) Indicates: SuCS/ ESCS over central and adjoining north AS on 29th and 30th October, which becomes a SCS over west-central AS close to Oman coast on 31st October, a CS on 01st November, a D on 02nd November, which becomes less marked on 03rd.
- (iv) Indicates : Lopar over Lakshadweep and adjoining SE Arabian Sea on 30th, D over SE Arabian Sea on 31st October and 01st November, which moving in a west-northwest direction becomes WML over WC Arabian Sea by 04th November, LOPAR on 05th and becomes less marked on 06th.
- (v) A LOPAR seen to form over SE Bob on 6th November which becomes a D by 8th November.

ECMWF:

- (i)Indicates : SuCS/ESCS over east-central and adjoining west central AS on 29th, VSCS/SCS west-central and adjoining north AS on 30th, Depression over west-central AS off Oman coast on 31st October, which is seen to move in a southwestward direction to become unimportant by on 3rd November.
- (ii) Indicates: Lopar over Comorin area on 29th, D over Comorin and adjoining Lakshadweep area on 31st October, CS over south east AS on 1st November, which is seen to move west-

northwestwards to further intensify into a SCS over westcentral AS on 04th November. It is seen to cross Yemen and adjoining Oman coast on 5th November.

NCEP-GFS :

- (i) Indicates : SuCS/ESCS over west central AS on 29th, SCS over central AS on 30th, CS over west-central AS on 31st October, D over west-central AS off Oman coast on 1st November , WML over west-central AS off Oman coast on 2nd, Lopar off Yemen-Oman coasts on 3rd which becomes less marked on 4th November.
- (ii) Indicates : Lopar over Comorin-Maldives - Lakshadweep areas on 29th & 30th, which becomes less marked thereafter.

ARP-Meteo France :

- (i) Indicates: SCS over west-central AS on 29th, SCS over westcentral AS on 30th October, CS over west-central AS close to Oman coast on 31st October and off Oman coast on 01st November.
- (ii) Indicates: Lopar over Comorin area on 29th, WML over Maldives - Comorin area on 30th, CS over east-central AS and adjoining Lakshadweep area on 31st October and 01st November.

Dynamical statistical models

IMD Genesis Potential Parameter (GPP):

- (i) Significant zone of GPP seen over west-central and adjoining north AS on 29th, west-central AS on 30th, over the same region but diminished on 31st October, reappears over west-central AS on 1st and 2nd November, which becomes less marked on 3rd November.
- (ii) Another significant zone of GPP seen over equatorial IO and adjoining Comorin area on 29th, Comorin and adjoining Maldives area on 30th, over Lakshadweep area, off Kerala coast on 31st October, over southeast AS with lesser areal extension on 1st November, which becomes insignificant on 3rd November over EC Arabian Sea.

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:

- The MJO lies in the phase 3 with amplitude less than 1. It will remain in the same phase during next 2 days and enter into phase 4 with amplitude less than 1 thereafter. The low level relative vorticity is about $300 \times 10^{-5} \text{ sec}^{-1}$ to the southeast of the system centre. The lower level convergence is about $40 \times 10^{-5} \text{ s}^{-1}$ to the southeast of the system centre and the upper level divergence is about $20 \times 10^{-5} \text{ s}^{-1}$ to the southeast of the system centre. The vertical wind shear is moderate (15-20 knots) around the system center. Sea surface temperature to the southwest of the system center over most parts of west central Arabian sea is around 27-28°C while to the north of the system centre, it is warmer (29-30°C). Tropical cyclone heat potential to the west of the system center over westcentral Arabian Sea is 40-50 kJ/cm² while to the east of the system center over eastcentral Arabian Sea, it is 50-70 kJ/cm².

Total precipitable water imageries indicate further reduction in warm air advection and dry air incursion in the western and southern sectors of the system centre. Equatorward outflow is taking place in the upper tropospheric levels. All these environmental, dynamic and thermodynamic conditions indicate gradual weakening of the system.

The upper tropospheric ridge runs along 19°N. The system is being steered by the winds in the western periphery of the anti-cyclone located to the east of the system. As a result, it is continuing to move west-northwestwards slowly being in the COL region. It will come under the influence of the anticyclonic circulation over Arabian peninsula located to the northwest of system by 0000 UTC of 30th October. Subsequently the system is most likely to recurve west-southwestwards and very likely to move towards gulf of Aden off south Oman-Yemen coasts thereafter. Majority of numerical models agree with the above inference

- Majority of the models suggest further intensification of the present Well Marked Low pressure area (WML) over Comorin area & adjoining equatorial Indian ocean on either 30th / 31st October. However, there is wide divergence in the further track and intensity predictions by various models. ECMWF is indicating the system to reach the intensity of SCS by 04th November over westcentral Arabian Sea, while GFS group of modes are not indicating intensification beyond depression stage.

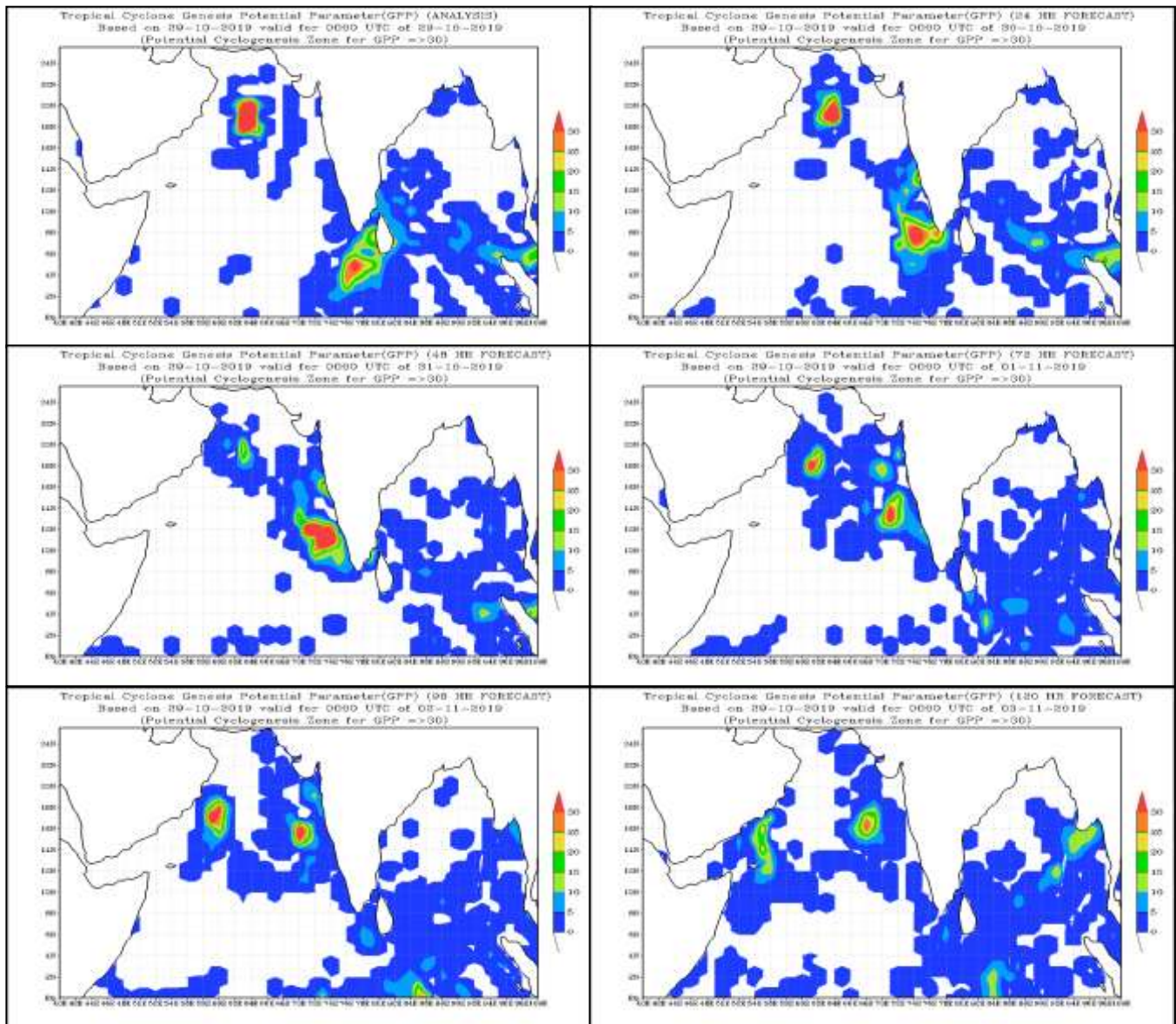
Probability of cyclogenesis over Bay of Bengal and Andaman Sea during next 120 hours:

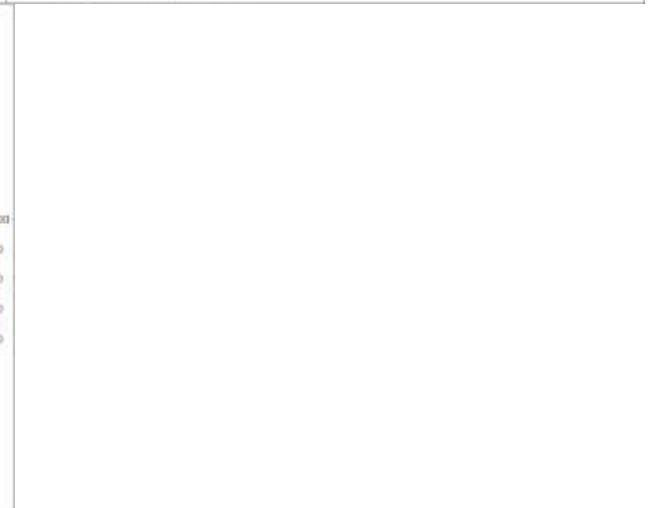
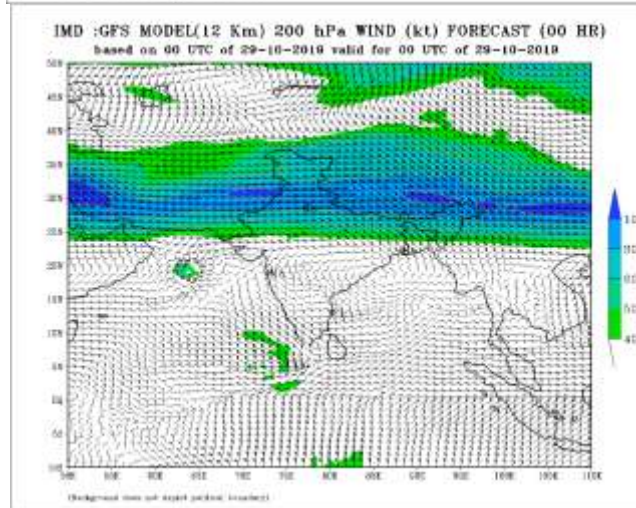
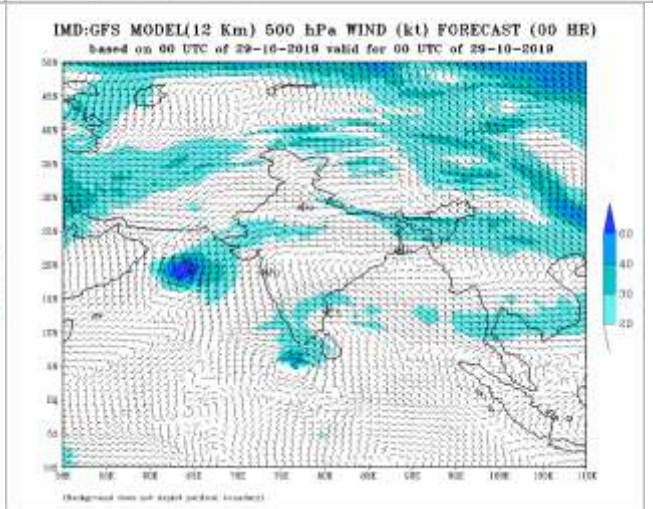
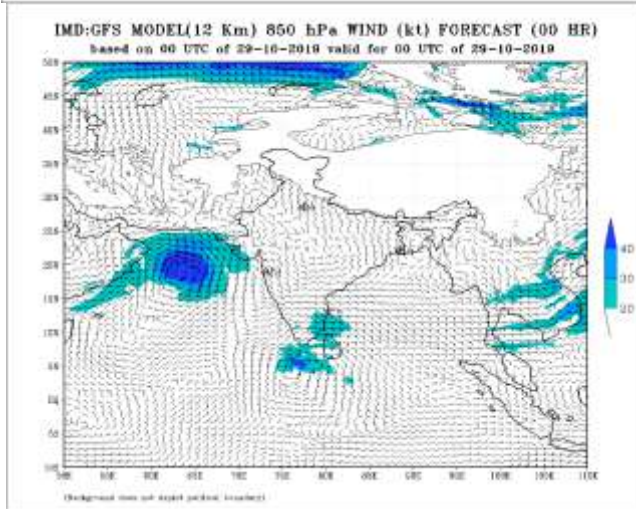
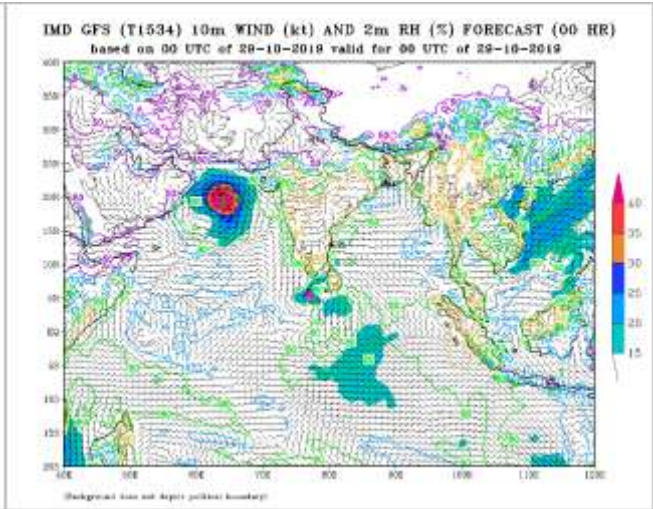
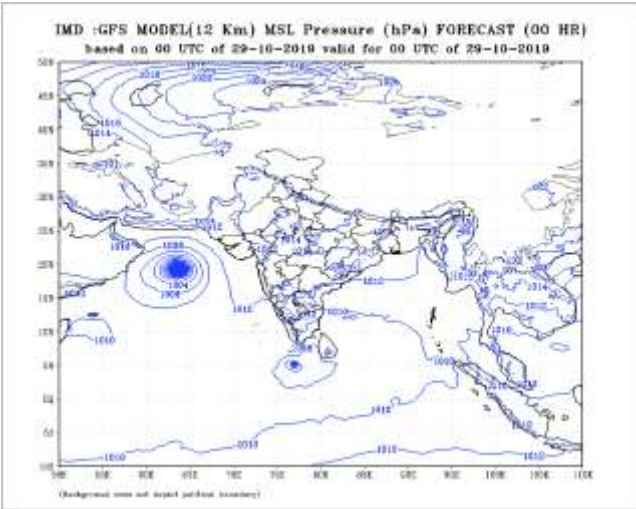
24 HOURS	24-48 HOURS	48-72 HOURS	72-96 HOURS	96-120 HOURS
Nil	Nil	Nil	Nil	Nil

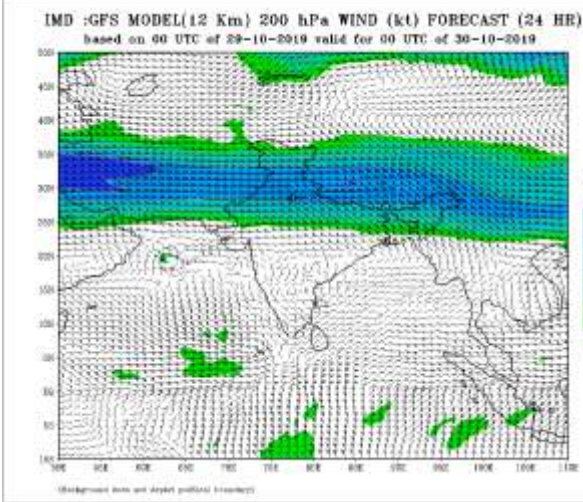
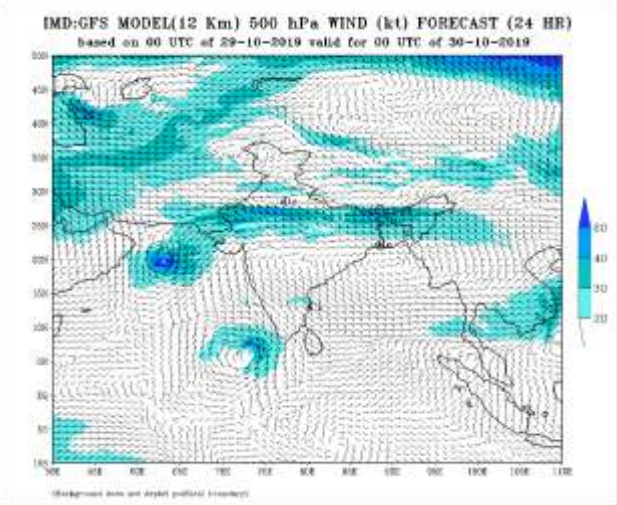
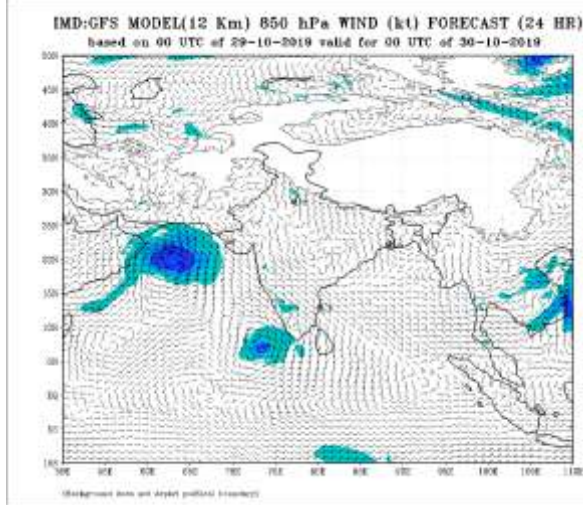
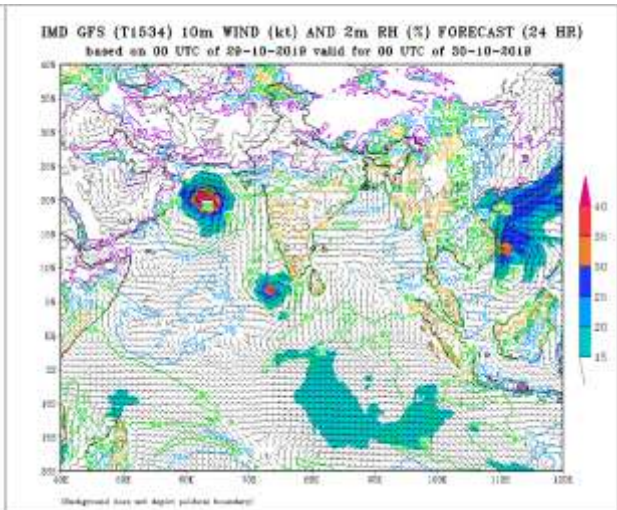
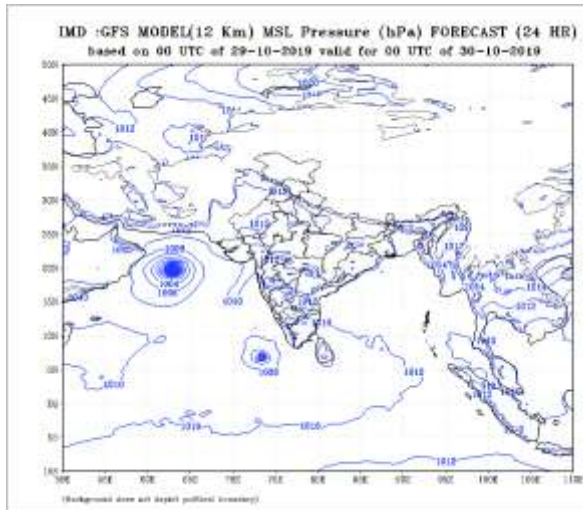
Probability of cyclogenesis over Arabian Sea during next 120 hours:

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

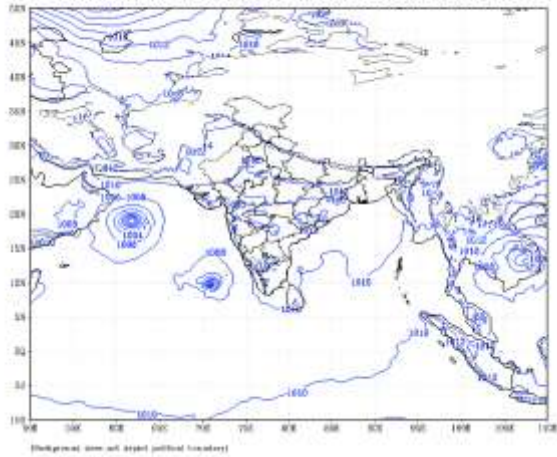
Advisory: IOP for South Tamil Nadu, Kerala and Lakshadweep during 30-31 October 2019.



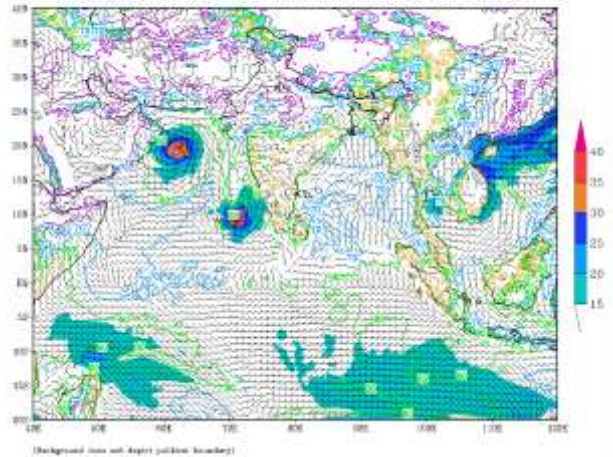




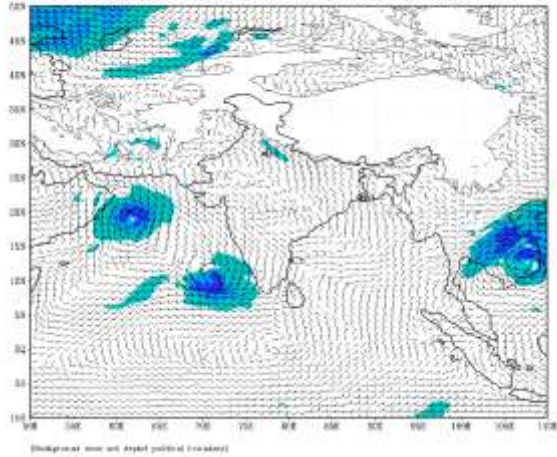
IMD :GFS MODEL(12 Km) MSL Pressure (hPa) FORECAST (48 HR)
 based on 00 UTC of 29-10-2019 valid for 00 UTC of 31-10-2019



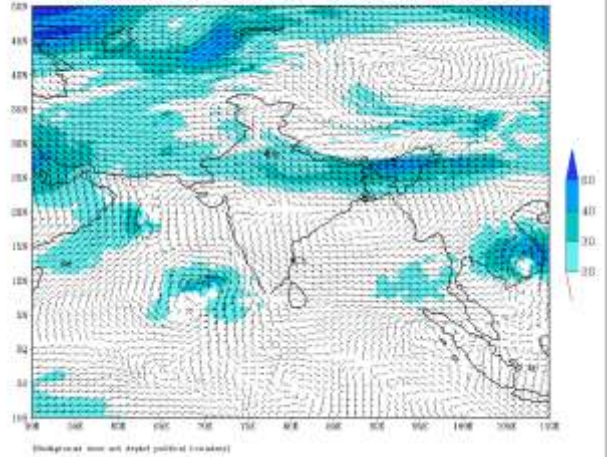
IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (48 HR)
 based on 00 UTC of 29-10-2019 valid for 00 UTC of 31-10-2019



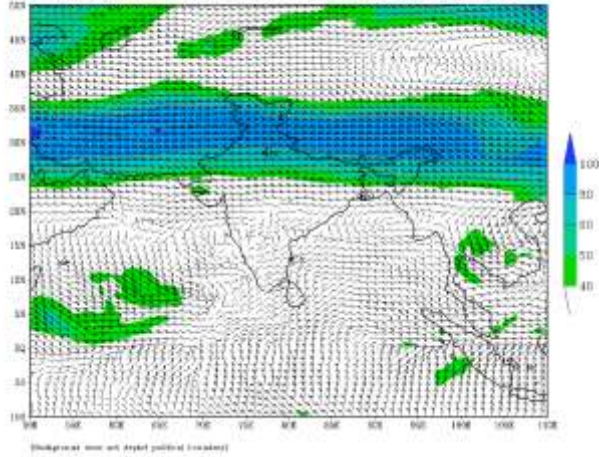
IMD:GFS MODEL(12 Km) 850 hPa WIND (kt) FORECAST (48 HR)
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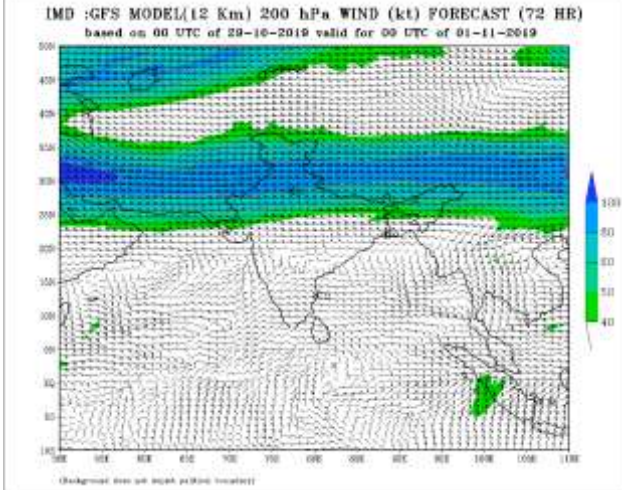
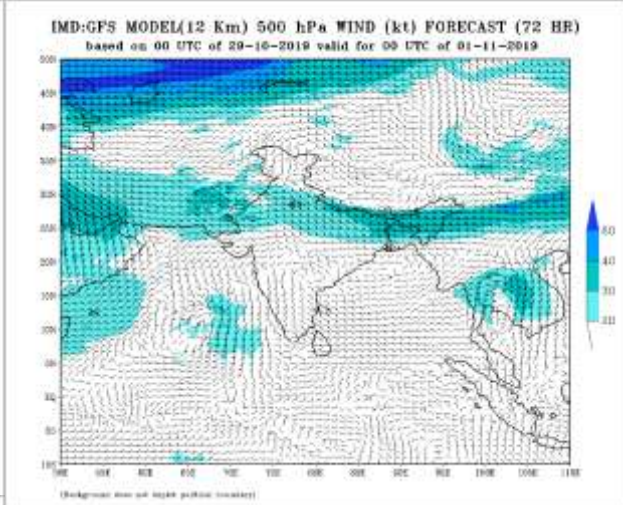
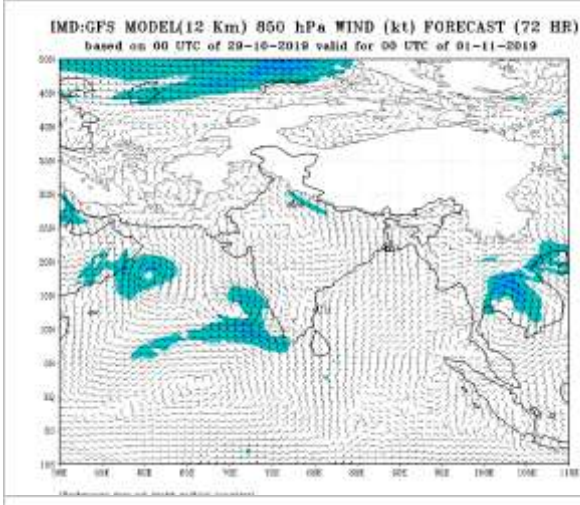
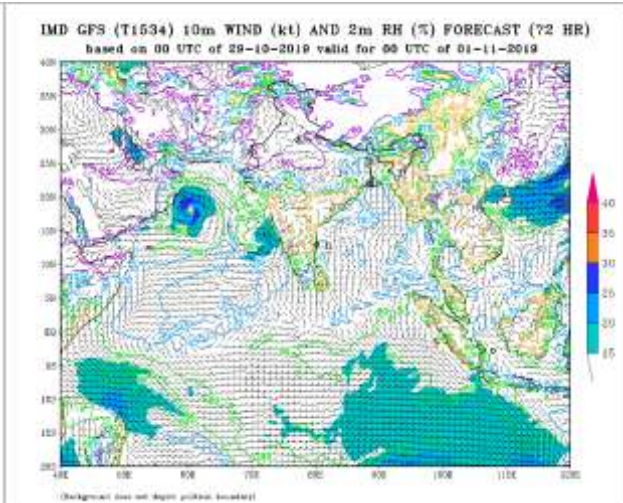
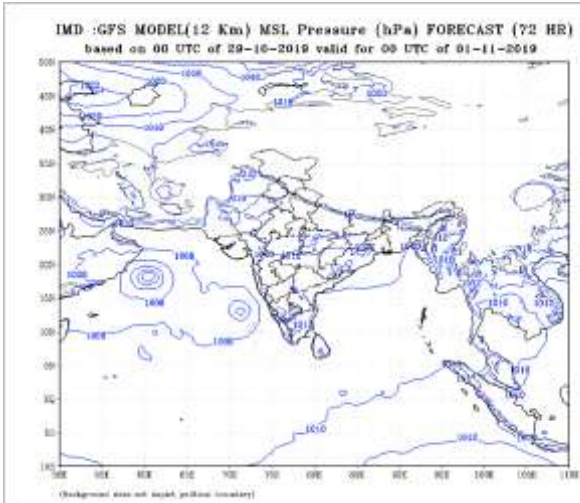


IMD:GFS MODEL(12 Km) 500 hPa WIND (kt) FORECAST (48 HR)
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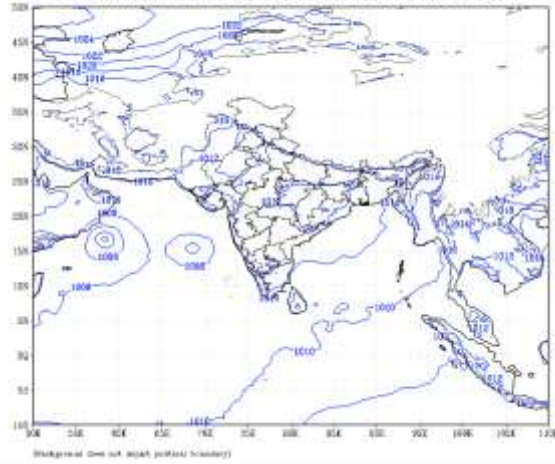


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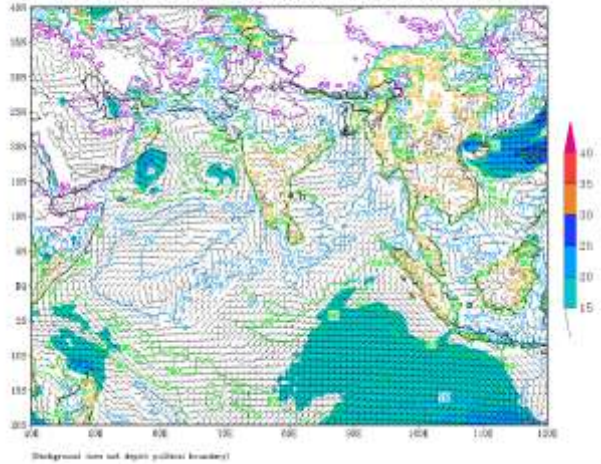




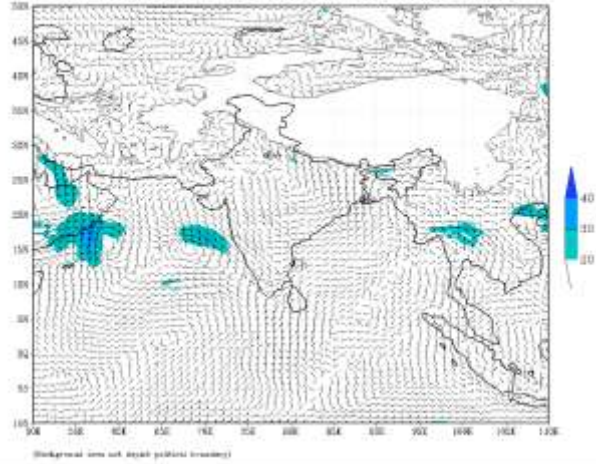
IMD :GFS MODEL(12 Km) MSL Pressure (hPa) FORECAST (96 HR)
based on 00 UTC of 29-10-2019 valid for 00 UTC of 02-11-2019



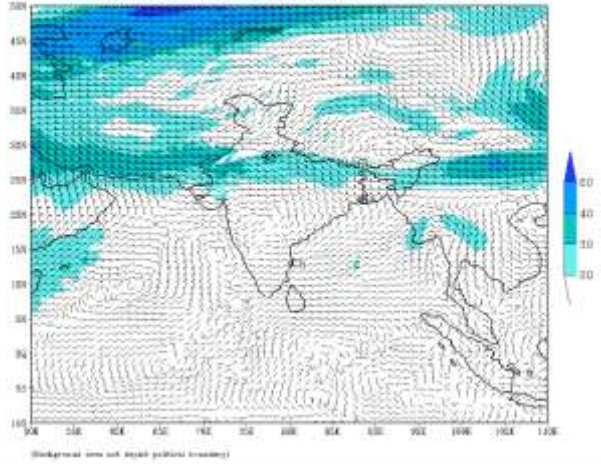
IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (96 HR)
based on 00 UTC of 29-10-2019 valid for 00 UTC of 02-11-2019



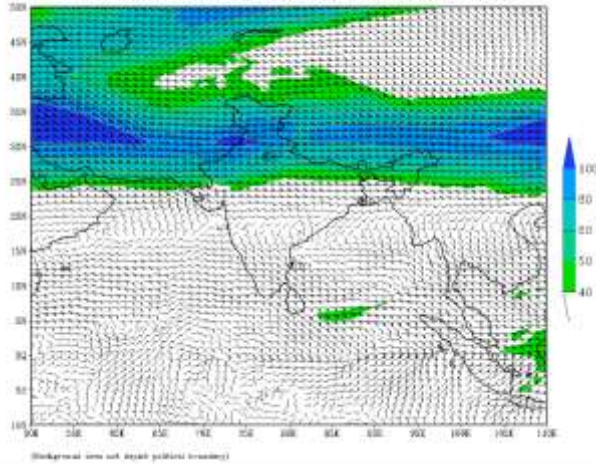
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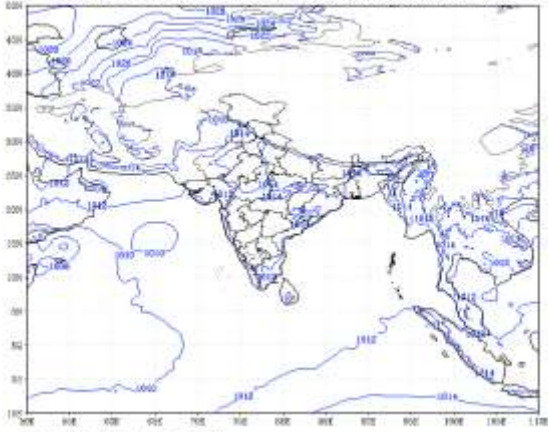
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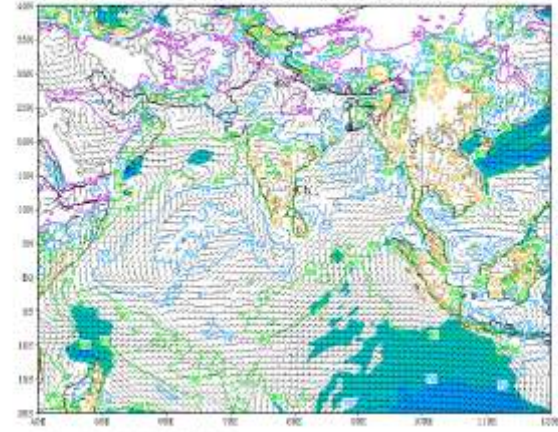


IMD :GFS MODEL(12 Km) MSL Pressure (hPa) FORECAST (120 HR)
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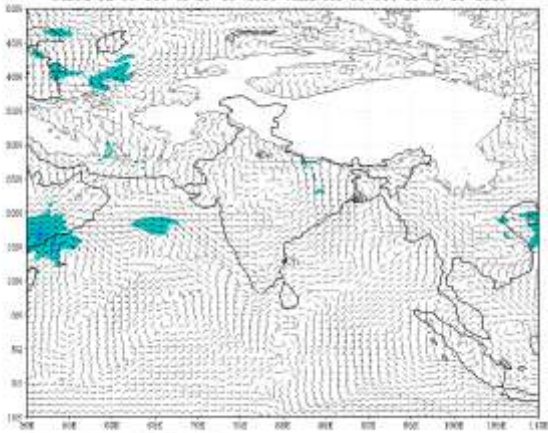
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IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (120 HR)
based on 00 UTC of 29-10-2019 valid for 00 UTC of 03-11-2019



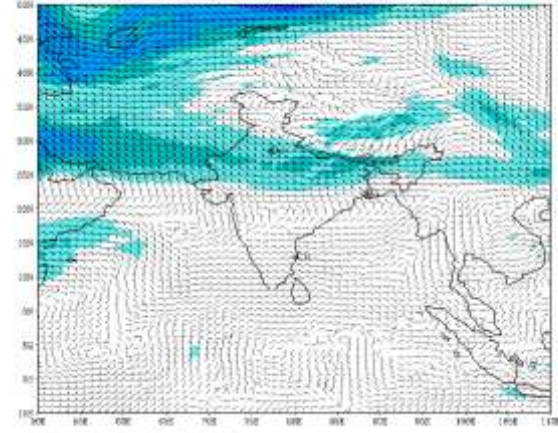
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IMD:GFS MODEL(12 Km) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 29-10-2019 valid for 00 UTC of 03-11-2019



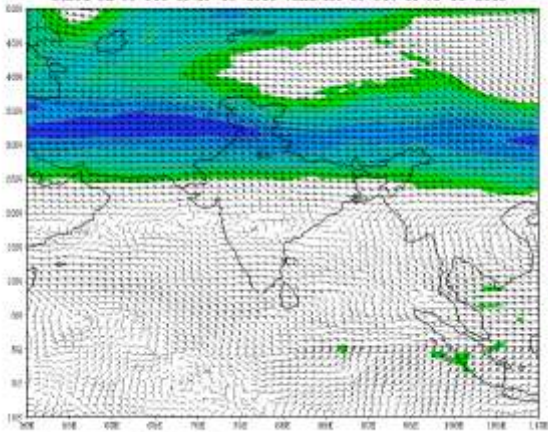
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IMD:GFS MODEL(12 Km) 500 hPa WIND (kt) FORECAST (120 HR)
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(Background does not depict political boundaries)

IMD :GFS MODEL(12 Km) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 29-10-2019 valid for 00 UTC of 03-11-2019



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