



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



FDP (Cyclone) NOC Report Dated 24th October, 2019

Time of Issue: 1200 UTC

Synoptic features:

- The Well Marked Low Pressure Area (WML) over east-central Arabian Sea and neighbourhood concentrated into a **Depression (D)** over eastcentral Arabian Sea and lay centred at 0300 UTC of today, the 24th October, 2019 near latitude 15.4°N and longitude 70.4°E, about 360 km west-southwest of Ratnagiri (Maharashtra), 490 km southwest of Mumbai (Maharashtra) and 1750 km east-southeast of Salalah (Oman). It is very likely to intensify further into a deep depression during next 12 hours and into a cyclonic storm during subsequent 12 hours. It is very likely to move east-northeastwards till 25th October evening. Then it is very likely to re-curve and move nearly westwards towards south Oman and adjoining Yemen coast with gradual intensification during subsequent 72 hours.
- The other **WML** over west-central Bay of Bengal Andhra Pradesh coast has moved inland.

Dynamical and thermodynamical features

Surface Temperature (SST):

SST is 29-30°C over east-central & southeast Arabian Sea (AS) and Gulf of Oman, except over a small pocket over southeast AS off south Kerala coast where it is 26- 27°C, 28-29°C over rest AS, except over west central & southwest AS off Oman and Somalia coasts where it is 26-27°C.

SST is 30 - 32°C over north and adjoining east-central Bay of Bengal (BOB) & Myanmar coast and 29- 30°C over the rest of BOB.

Tropical Cyclone Heat Potential (TCHP):

TCHP is 80-100 kJ/cm² over southeast & adjoining central AS, 100-110 kJ/cm² over west equatorial Indian Ocean (IO). It is < 40 kJ/cm² over most parts of north & west-central AS and Oman – Yemen coasts.

TCHP is 110-130 kJ/cm² over west-central & southwest BOB, 100-110 kJ/cm² over north Andaman Sea and east-central BOB and 60-80 kJ/cm² elsewhere over the BOB.

Relative Vorticity:

An area of cyclonic relative vorticity at 850 hPa of 200 X10⁻⁶s⁻¹ is seen over east-central AS around the Depression centre.

Cyclonic relative vorticity at 850 hPa is neutral over most parts of BOB and is anti-cyclonic over northeast & east-central BOB.

Low level Convergence:

Lower level convergence is about 10 – 20 x 10⁻⁵s⁻¹ over east-central AS to the southwest of the D centre.

Lower level convergence of about 10-15 x 10⁻⁵s⁻¹ is seen over northwest BOB and 10 x 10⁻⁵s⁻¹ over east equatorial Indian Ocean (IO).

Upper level Divergence:

A zone of upper level divergence of 20 - 30x10⁻⁵ s⁻¹ is seen over southeast and adjoining east-central AS, to the southwest of the D centre.

Upper level divergence of 10 - 20x10⁻⁵ s⁻¹ is seen over major parts of BOB except over Andaman Sea where upper level convergence is prevailing.

Wind Shear:

Wind shear is 20-30 knots over east-central AS, over the centre of the D and reduces to its east becoming 10-20 knots.

Wind shear is 05-10 knots over north, east-central and southeast BOB & Andaman Sea and 25-30 knots over west-central and southwest BOB.

Wind Shear Tendency:

The wind shear is in increasing tendency over east- central and southeast AS.

It is increasing over central BOB .

Upper tropospheric ridge:

The upper tropospheric ridge at 200 hPa runs roughly along 15°N over the AS and along 17°N over the BOB.

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

According to 0900 UTC satellite imagery, vortex over east-central Arabian Sea & neighbourhood lay centered within half a deg of Lat. 15.5N/70.6E with Intensity T1.5. Associated broken low/medium clouds with embedded intense to very intense convection prevails over east-central and adjoining southeast Arabian Sea between Lat. 11.0N & 18.0N and Long 66.5E & 73.0E (minimum CTT is minus 93 deg C).

Bay of Bengal & Andaman Sea:-

According to 0900 UTC satellite imagery, scattered low/medium clouds with embedded intense to very intense convection prevails over northwest, west-central and adjoining southwest BOB and parts of southeast BOB & south Andaman Sea.

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

MJO index is in Phase 2 (western Indian Ocean) with amplitude more than 1. It will continue in same phase with gradual reduction in amplitude for next 4 days.

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

Typhoon 22W "Bualoi" is currently located over Pacific Ocean.

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

- (i) Indicates : Severe Cyclonic Storm (SCS) over east-central AS on 24th, Very Severe Cyclonic Storm (VSCS) / Extremely SCS (ESCS) over east-central AS on 25th, ESCS over east-central AS away from Maharashtra coasts on 26th, ESCS over central AS on 27th, ESCS over west-central AS on 28th, ESCS over west-central AS, close to south Oman – Yemen coasts on 29th, ESCS over west-central AS over Gulf of Oman, close to Yemen coast on 30th and moving away westwards and dissipation on 31st Oct.
- (ii) Indicates: D over east equatorial IO and adjoining southeast BOB on 26th, WML over southwest AS and adjoining equatorial IO on 27th, a fresh Low pressure area (Lopar) over Lakshadweep area and adjoining southeast AS on 31st October, WML over south &

adjoining central AS on 1st November and Lopar over west-central and adjoining southwest AS on 2nd & 3rd November.

- (iii) It also indicates the formation of a D over Gulf of Siam on 1st November, its emergence into Andaman Sea as a CS on 2nd & further intensification on 3rd November.

IMD-GEFS

- (i) Indicates : SCS over east-central AS off Maharashtra coast on 24th, VSCS over east central AS off Maharashtra coast on 25th, VSCS over east-central AS moving away from Maharashtra coast on 26th, VSCS over east-central & adjoining west-central AS on 27th, VSCS over west-central AS on 28th, VSCS over west-central AS , off Oman coast on 29th, SCS over west-central AS close to south Oman – Yemen coasts on 30th and west-central AS off Yemen coast on 31st October.
- (ii) Indicates: Lopar over southwest BOB off Andhra Pradesh coast on 27th, its westward movement and weakening on 28th, trough of low Lakshadweep – Maldives area on 29th, trough of low over Lakshadweep area off Kerala coast on 30th, Lopar over southeast AS and adjoining Lakshadweep area on 31st October. It also indicates a Lopar over Gulf of Siam on 1st November.

IMD-WRF

- (i) Indicates: SCS over east-central AS on 24th, VSCS over east-central AS off south Maharashtra - Goa coasts on 25th, ESCS over east-central AS away from Maharashtra on 26th and ESCS over -central AS on 27th October.

NCMRWF-NCUM:

- (i) Indicates : SCS over east central AS on 24th, VSCS over east central AS off Maharashtra – Goa coasts on 25th, ESCS over the east central AS off south Maharashtra coast on 26th, ESCS over east central As away from Maharashtra coast on 27th, ESCS over central AS on 28th, ESCS over west central AS on 29th, ESCS over west central AS, off Oman coast on 30th, ESCS over west central AS close to Oman coast on 31st October, CS over Gulf of Oman on 1st November.
- (ii) Indicates : Trough of low over Lakshadweep – Maldives area on 30th & 31st October, trough of low over southeast & adjoining east-central AS on 1st November and D over central AS on 2nd November.
- (iii) It also indicates a CS over south China Sea on 31st October & 1st November an its crossing Thailand coast on 2nd November.

NCMRWF-UM-Regional Model:

- (i) Indicates : SCS over east-central AS on 24th, VSCS over east-central AS off south Maharashtra coast on 25th, ESCS over east-central AS away from maharashtra coast on 26th, ESCS over central AS on 27th October.

NEPS Model:

- (i)Indicates : SCS over east central AS on 24th, VSCS over east-central AS off Maharashtra Coast on 25th& 26th, ESCS over east-central AS away from Maharashtra coast on 27th, ESCS over central AS on 28th, ESCS over west-central AS on 29th, ESCS over west-central AS off Oman coast on 30th, SCS over west-central AS off Oman coast on 31st October, CS over Gulf of Oman, close to Yemen coast on 1st November.

ECMWF:

- (ii) Indicates : CS over east-central AS on 24th, SCS over east-central AS off Maharashtra coast on 25th, SCS over east-central AS away from Maharashtra coast on 26th, VSCS

over east central AS on 27th, VSCS over central AS on 28th, VSCS over west central AS on 29th & 30th, SCS over west-central AS off south Oman coast on 31st October, Deep Depression (DD) over the same region on 1st November, D over Gulf of Oman, on 2nd November.

NCEP-GFS :

- (i) Indicates : SCS over east central AS on 25th & 26th, SCS over east central & adjoining west central AS on 27th, SCS over central AS on 28th, SCS over west-central AS off Oman coast on 29th, CS over Gulf of Oman close to south Oman – Yemen coasts on 30th DD over Gulf of Oman on 31st October.

ARP-Meteo France : Not analysed

Dynamical statistical models

IMD Genesis Potential Parameter (GPP):

- (i) Significant zone of (elliptical) GPP seen over east central AS on 24th, & 25th, over east-central AS away from south Maharashtra coast on 26th, central AS on 27th, west-central AS on 28th, west central AS off Oman coast on 29th, west central AS off Oman-Yemen coasts on 30th and west central AS off Yemen coast on 31st October.
- (ii) Significant zone of GPP seen over east equatorial IO and adjoining southwest BOB on 26th & 27th, east equatorial IO and adjoining southwest BOB off Sri Lanka coast and another over south Andaman Sea on 28th, southwest BOB off Tamil Nadu coast on 30th, southeast AS off north Kerala- Karnataka coasts on 31st October and a circular zone over southeast AS off Karnataka coast on 31st October. .

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:

Arabian Sea:

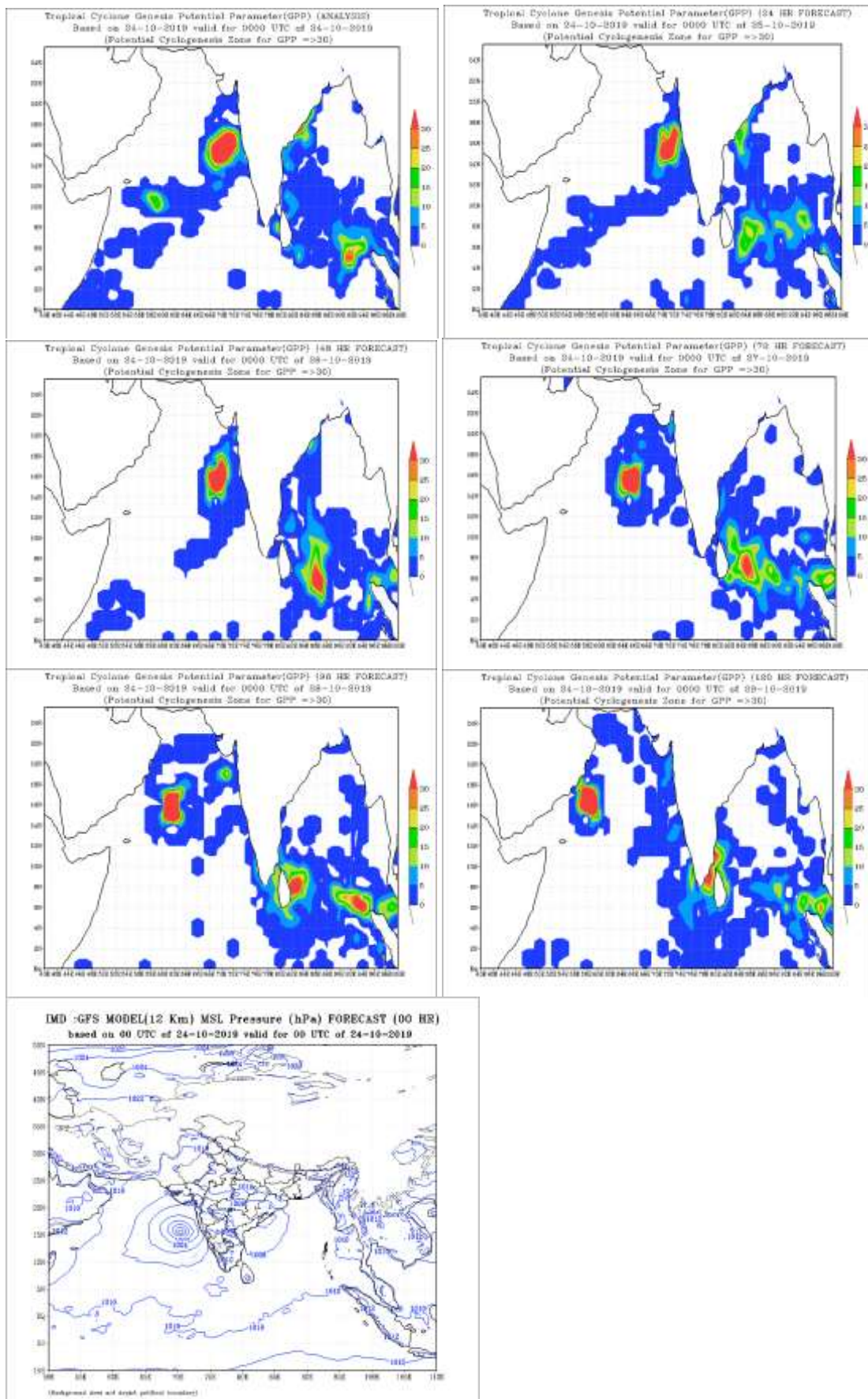
The depression over east central Arabian Sea is very likely to intensify into a deep depression during next 12 hours and into a cyclonic storm during subsequent 12 hours. It is very likely to move east northeastwards till 25th October evening. Then it is very likely to recurve and move nearly westwards towards south Oman and adjoining Yemen coasts with gradual intensification during subsequent 72 hours.

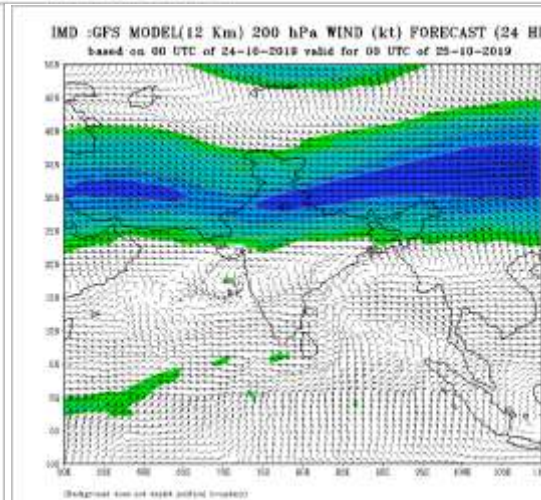
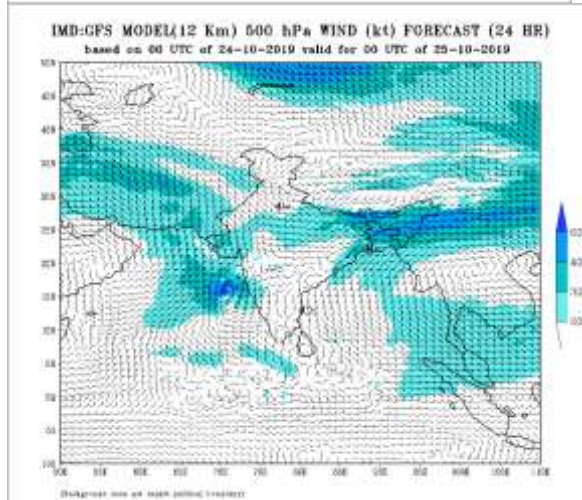
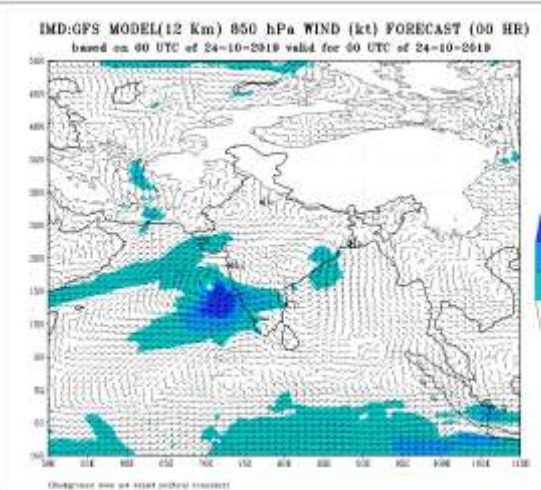
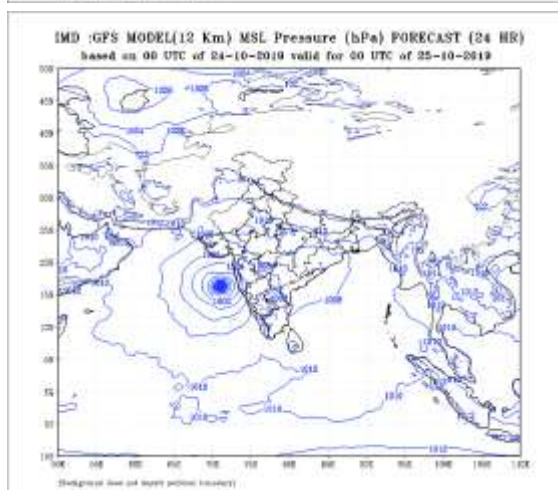
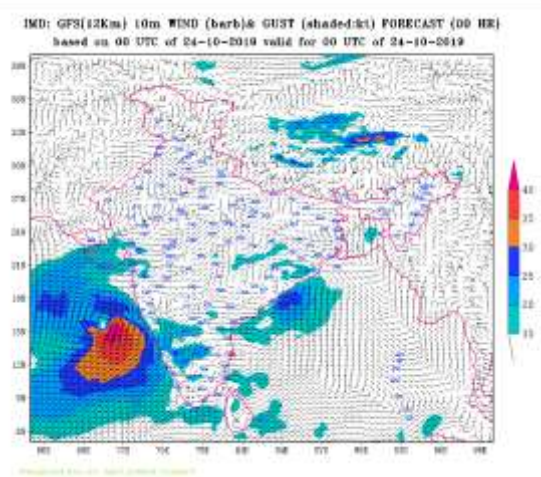
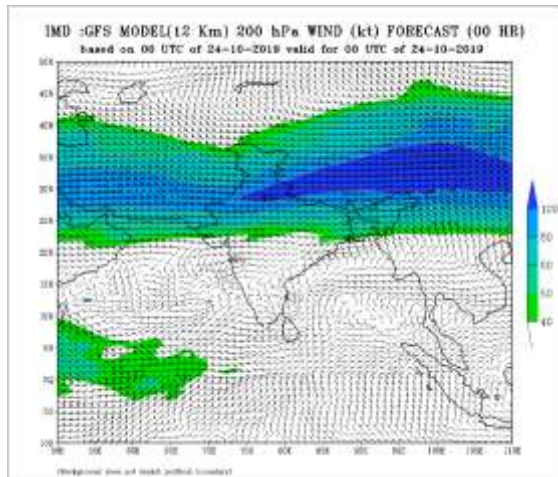
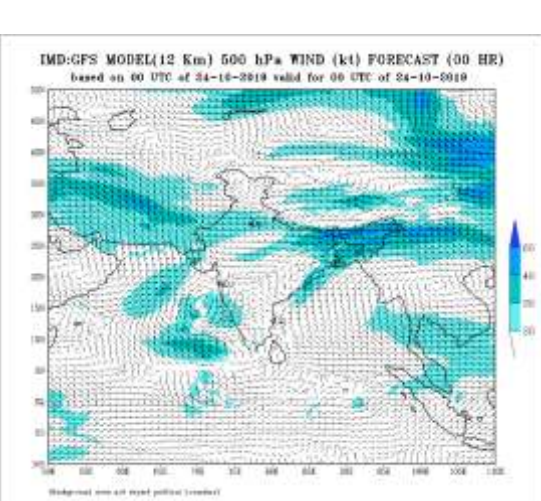
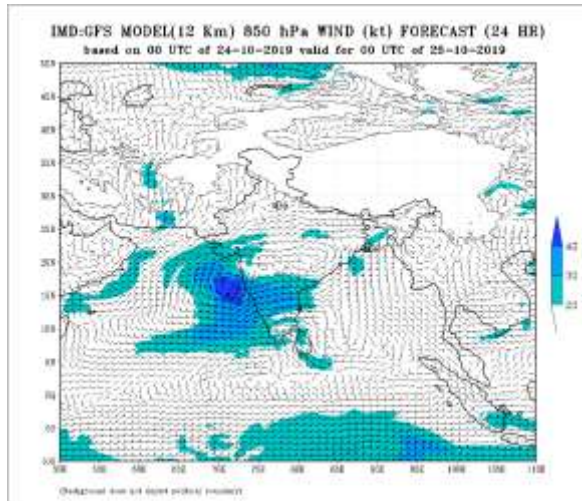
The MJO lies in the phase 2 with amplitude greater than 1. It will remain in the same phase during next 4 days. Considering the environmental conditions, total precipitable water imageries indicate warm air advection to the system centre. the low level relative vorticity increased in past 24 hours and is $150 \times 10^{-5} \text{sec}^{-1}$ around the system centre. positive vorticity is extending upto 200 hPa level. The lower level convergence is about $20 \times 10^{-5} \text{s}^{-1}$ south of the system center. The upper level divergence is about $30 \times 10^{-5} \text{s}^{-1}$ to the southwest of the system center. The vertical wind shear is moderate (15-20 knots) over the system. the upper tropospheric ridge runs along 18° n. sea surface temperature over most parts of eastcentral Arabian sea is 29-30°C and tropical cyclone heat potential is 80 kJ/cm² over the region thereby favoring further intensification.

As the system lies to the south of upper tropospheric ridge and is being steered by middle and

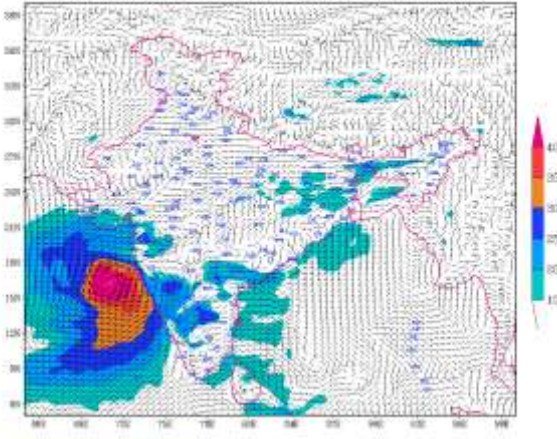
upper tropospheric winds, it is very likely to move east-northeastwards till 25th evening under the influence of mid-latitude westerly trough at middle and upper-tropospheric levels. From 25th evening the steering flow is expected to change with the above trough becoming insignificant. Majority of numerical models including ECMWF, NCMRWF unified models (NCUM), NCMRWF ensemble prediction system (NEPS), IMD global forecast system (GFS), NCEP GFS, global ensemble forecasting system (GEFS) agree with the above inference.

Advisory: (i) IOP for Maharashtra- Goa- Karnataka coasts on 24th & 25th October.

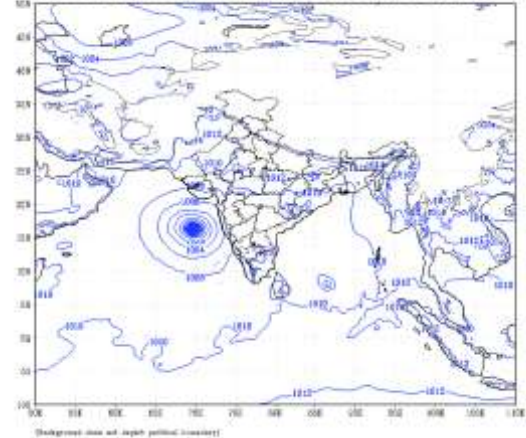




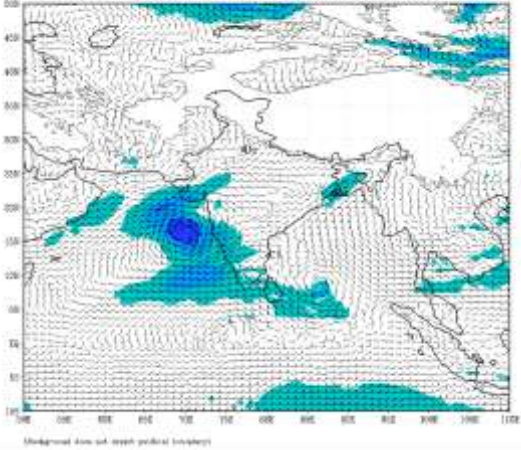
IMD: GFS(12Km) 10m WIND (barb)& GUST (shaded:kt) FORECAST (24 HR)
based on 00 UTC of 24-10-2019 valid for 00 UTC of 25-10-2019



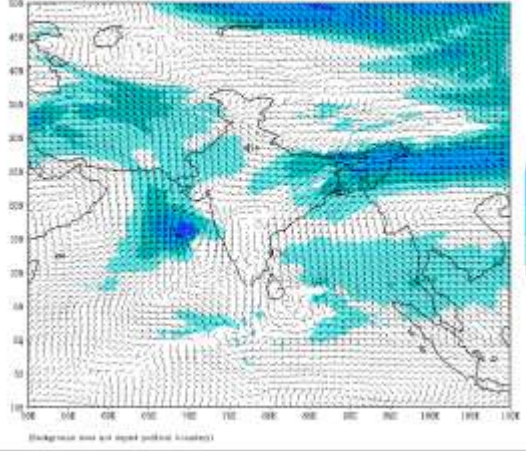
IMD :GFS MODEL(12 Km) MSL Pressure (hPa) FORECAST (48 HR)
based on 00 UTC of 24-10-2019 valid for 00 UTC of 26-10-2019



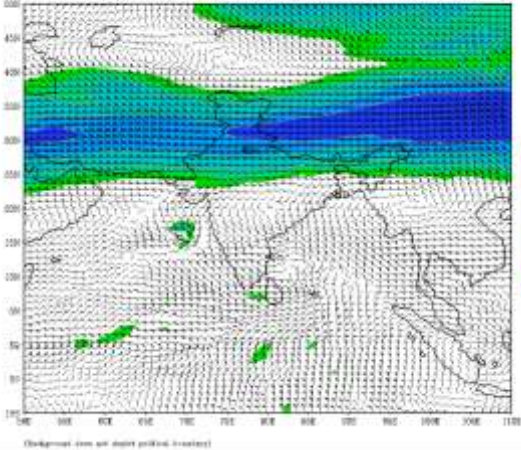
IMD:GFS MODEL(12 Km) 850 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 24-10-2019 valid for 00 UTC of 26-10-2019



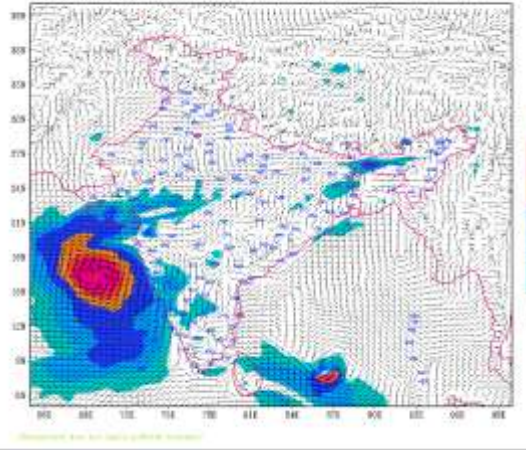
IMD:GFS MODEL(12 Km) 500 hPa WIND (kt) FORECAST (48 HR)
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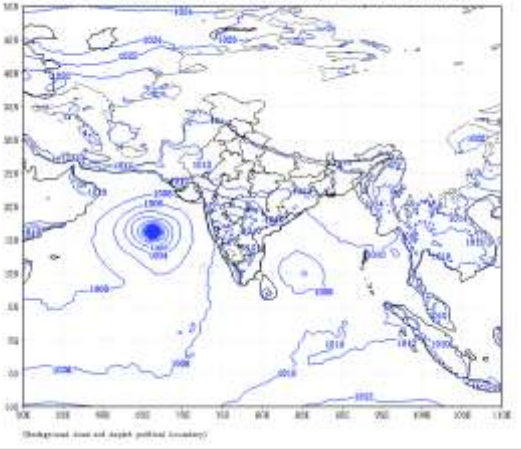
IMD :GFS MODEL(12 Km) 200 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 24-10-2019 valid for 00 UTC of 26-10-2019



IMD: GFS(12Km) 10m WIND (barb)& GUST (shaded:kt) FORECAST (48 HR)
based on 00 UTC of 24-10-2019 valid for 00 UTC of 26-10-2019



IMD :GFS MODEL(12 Km) MSL Pressure (hPa) FORECAST (72 HR)
based on 00 UTC of 24-10-2019 valid for 00 UTC of 27-10-2019



IMD:GFS MODEL(12 Km) 850 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 24-10-2019 valid for 00 UTC of 27-10-2019

