

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



# FDP (Cyclone) NOC Report Dated 03<sup>rd</sup> December, 2019

### Time of Issue: 1200 UTC

## Synoptic features:

- The Well Marked Low pressure area over Southwest Arabian Sea and adjoining Equatorial Indian Ocean concentrated into a depression over southwest Arabian Sea & adjoining equatorial Indian Ocean at 1200 UTC of 2<sup>nd</sup> December. Moving north-northwestwards, it further intensified into a deep depression over southwest Arabian Sea & adjoining equatorial Indian Ocean at 0000 UTC of 3<sup>rd</sup> December. The Deep Depression over southwest Arabian Sea moved north-northwestwards with a speed of 13 Kmph during past 06 hrs and lay centred at 0600 UTC of 03<sup>rd</sup> December, 2019 near latitude 7.2°N and longitude 56.3°E over Southwest Arabian Sea, about 660 km south-southeast of Socotra (Yemen) and 900 km east-southeast of Bosaso (Somalia). It is very likely to intensify into a Cyclonic Storm during next 12 hours. It is very likely to move north-northwestwards for some more time and then recurve west-southwestwards towards Somalia coast during next 04 days.
- The Low Pressure Area over Lakshadweep Area and adjoining Southeast Arabian became a well marked low pressure area over southeast AS and adjoining areas of eastcentral AS & Lakshadweep region at 0300 UTC .

### Dynamical and thermodynamical features

#### Sea Surface Temperature (SST):

Sea Surface Temperature is around 28-29°C over the system area in westcentral Arabian Sea which reduces to 27-28°C to the northwest direction. It increases to 28-30°C over eastcentral and southeast Arabian Sea.

SST is around 26-28°C over most parts of north BoB and adjoining WC BoB. It is between 28 - 30°C over rest BoB with higher values over eastcentral and south BoB.

### Tropical Cyclone Heat Potential (TCHP):

Tropical Cyclone Heat Potential (TCHP) is 20-50 kJ/cm<sup>2</sup> over north Arabian Sea, westcentral, adjoining eastcentral and western parts of southwest Arabian Sea. Over southeast Arabian Sea it is of value 80-100 kJ/cm<sup>2</sup>. There are areas of values more than 100 kJ/cm<sup>2</sup> over southeast Arabian Sea, off Kerala coast & Lakshadweep area and also over equatorial Indian Ocean.

TCHP is around 30-50 kJ/cm<sup>2</sup> over north BoB and adjoining westcentral BoB. It is around 80-90 kJ/cm<sup>2</sup> over rest of the BOB.

### **Relative Vorticity:**

Cyclonic relative vorticity of value 150x10<sup>-5</sup> s-1 seen over the area of the Deep Depression over southwest Arabian Sea. Cyclonic relative vorticity of value 50-60x10<sup>-5</sup> s-1 seen over the area of the WML over southeast Arabian Sea and adjoining Lakshadweep area.

### Low level Convergence:

Positive lower level convergence of value 20x10<sup>-5</sup> s<sup>-1</sup> is seen over the Deep Depression and also over the WML over SE Arabian Sea and adjoining Lakshadweep.

An area of positive lower level convergence of value 5-10x10<sup>-5</sup> s<sup>-1</sup> is seen over southwest BoB to the south of Sri Lanka.

#### Upper level Divergence:

An area of positive upper level divergence of value 5-10x10<sup>-5</sup> s<sup>-1</sup> is seen over southwest BoB and adjoining equatorial Indian Ocean.

Positive upper level divergence of value  $20 \times 10^{-5} \text{ s}^{-1}$  is seen to the northwest of the dcentre of Deep Depression;  $30 \times 10^{-5} \text{ s}^{-1}$  is seen in association with the WML over Southeast Arabian Sea and adjoining Lakshadweep area.

#### Wind Shear:

Wind shear is moderate to high over southwest Arabian Sea and low to moderate over southeast Arabian Sea.

#### Wind Shear Tendency:

The wind shear tendency is negative or neutral over entire BoB.

It is negative or neutral over northeast and adjoining eastcentral Arabian Sea. It is positive over the rest area.

#### Upper tropospheric ridge:

The upper tropospheric ridge at 200 hPa runs roughly along 13°N over BoB and Arabian Sea. **Satellite observations based on INSAT imagery:** 

#### Arabian Sea:-

As per the satellite imagery at 0900 UTC of 3<sup>rd</sup> December, 2019, the intensity of the system over southwest Arabian Sea with intensity T 2.0. Associated broken low to medium clouds with embedded intense to very intense convection lies between latitude 6.0°N to 13.5°N and longitude 52°E to 60.0°E. Minimum Cloud Top Temperature (CTT) is minus 93 deg C.

Intensity of the system over southeast Arabian Sea and adjoining Lakshadweep is T 1.0. Associated broken low/med clouds with embedded intense to very intense convection is seen over area between latitude 8.0°N to 16.0°N long 68.0°E to 75.0°E. Minimum Cloud Top Temperature (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 lies over southwest BoB to the south of 10°N.

#### Large scale features

#### M.J.O. Index:

MJO index is in Phase 1 with amplitude near to 1. It is likely to remain in the same phase for next 3-4 days and move to Phase -2 with increasing amplitude thereafter.

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

### NWP Input for FDP Cyclone based on 0000 UTC of today

#### IMD-GFS T-1534:

- (i) Indicates a CS over southwest Arabian Sea, which moving in a west-northwest direction it is seen crossing north Somali coast in the morning of 6<sup>th</sup> December.
- (ii) The low pressure area over southeast Arabian Sea is seen to become less marked by 4<sup>th</sup> December without any intensification.
- (iii) Another LOPAR forms on 6<sup>th</sup> over southeast Arabian Sea and adjoining equatorial Ocean which moving in a near westward direction becomes a depression over southwest Arabian Sea on 8<sup>th</sup> and into a CS on 9<sup>th</sup> and moves towards Gulf of Aden.

- (i) Indicates a CS over southwest Arabian Sea (AS) which moving west-northwestwards reaches north Somali coast on 6<sup>th</sup> as a depression and becomes less marked thereafter.
- (ii) Other LOPAR over Lakshadweep area and adjoining southeast Arabian Sea moving in a north-northwestwards becomes insignificant on 5<sup>th</sup> December.
- (iii) Another LOPAR forms over equatorial Indian Ocean to the south of southeast Arabian Sea on 6<sup>th</sup> which moves nearly westwards till 9<sup>th</sup> December without much intensification.

#### IMD-WRF:

- (i) Indicates a Deep Depression over southwest Arabian Sea which is seen moving in a westnorthwest direction towards Somali coast till 6<sup>th</sup>.
- (ii) Another LOPAR is seen to form over equatorial Indian Ocean to the south of southwest BoB on 6<sup>th</sup>.

#### NCMRWF-NCUM:

- (i) The CS on 03<sup>rd</sup> December over southwest Arabian Sea further intensify while moving in NNW direction and crosses Somali coast in the morning of 7<sup>th</sup>. It crosses extreme north coast of Somali on 6<sup>th</sup> and weakens thereafter.
- (ii) This model is not indicating a second system over SE Arabian Sea.

**NCMRWF-UM-Regional Model**: Indicates development of no low pressure system for the next 3 days in its domain.

**NEPS Model:** The deep depression over SW Arabian Sea moving northwestwards further intensifies and cross north Somali Coast on 7<sup>th</sup>.

This model is not indicating a second system over SE Arabian Sea.

#### ECMWF:

- (i) The deep depression over southwest Arabian Sea moves nearly westwards weakens into a depression on 5<sup>th</sup> and cross Somali coast in the afternoon of 06<sup>th</sup> December.
- (ii) The other depression over southeast Arabian Sea, moves northwestwards and become unimportant by 6<sup>th</sup>.
- (iii) A third LOPAR forms over southeast Arabian Sea and adjoining equatorial Indian Ocean on 6<sup>th</sup> which moving in westward direction becomes a depression on 7<sup>th</sup>, a CS on 8<sup>th</sup>. It further moves towards Gulf of Aden and weakens into a depression on 10<sup>th</sup> and becomes less marked on 11<sup>th</sup>.

#### NCEP-GFS:

- (i) The deep depression on 03<sup>rd</sup> December over southwest Arabian Sea, moves northwestwards weakens into a depression and cross Somali coast by 6<sup>th</sup> December and weakens thereafter.
- (ii) This model indicates a WML over SE Arabian Sea. It is seen moving nearly northwards without significant intensification and becomes less marked by 5<sup>th</sup>.
- (iii) A third LOPAR is forecast to form over Maldives area on 5<sup>th</sup> which becomes a depression over southwest Arabian Sea on 8<sup>th</sup> and moved westwards and becomes less marked on less marked on 11<sup>th</sup>.

#### ARP-Meteo France :.

#### Dynamical statistical models

#### IMD Genesis Potential Parameter (GPP):

An area of significant zone of GPP is seen over southwest Arabian Sea which is seen to move westwards slowly and crosses Somali coast on 06<sup>th</sup> December. Another significant GPP zone is seen over southeast Arabian Sea and adjoining Lakshadweep which moves in a north-northwest direction and becomes less marked on 05<sup>th</sup> December. A third zone Is seen to develop over southeast Arabian Sea on 6<sup>th</sup> which moving in a near westward direction becomes insignificant by 8<sup>th</sup>.

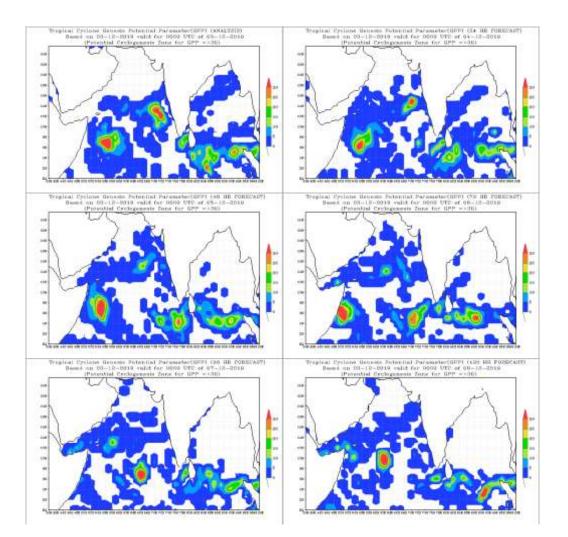
#### IMD NWP products are available at: http://nwp.imd.gov.in/bias/gfsproducts.php http://nwp.imd.gov.in/bias/wrf27pro.php http://www.rsmcnewdelhi.imd.gov.in/NWP\_CYC/Analysis.htm or http://www.rsmcnewdelhi.imd.gov.in/NWP\_CYC/<HH> hrs.htm <HH> are forecast hours i.e. 24, 48, 72 and etc.

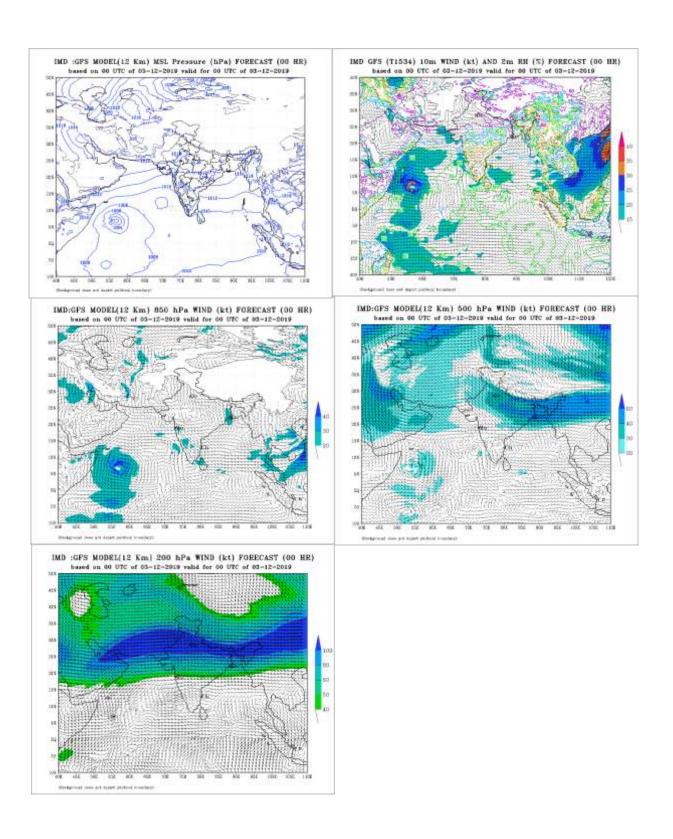
### Summary and Conclusion:

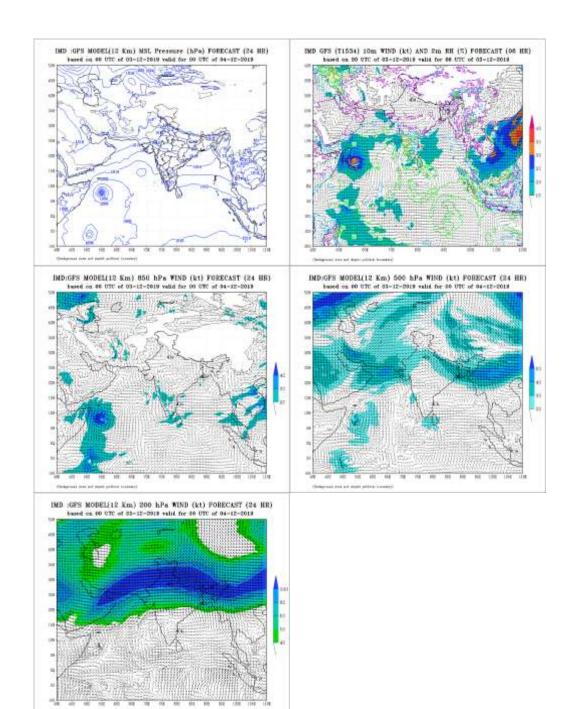
- (i) With regard to the DD over southwest Arabian Sea, total precipitable water vapour imageries indicate warm air advection to the system centre. The low level relative vorticity is 150 x10-5sec-1 to the south of the system centre. Positive vorticity is extending upto 200 hPa level. The lower level convergence is about 30 x10<sup>-5</sup>s<sup>-1</sup> to the northwest of the system center. The upper level divergence is about 40 x10-5s-1 to the northwest of the system center. The vertical wind shear is moderate to high (20-30 knots) over the system area. The upper tropospheric ridge runs along 15° N. Sea surface temperature over the system area is 27-28°C and along the forecast track. Tropical cyclone heat potential is 40-60kJ/cm2 over the system area and decreases to less than 50 kJ/cm2 along the forecast track. As the system is lying in a mostly favourable conditions it is likely to further intensify into a cyclonic storm by 1200 UTC of 03<sup>rd</sup> December. 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 west-northwestwards towards Somalia coast for the next 04 days. Majority of numerical models agree with the above analysis.
- (ii) In respect of the Well Marked Low Pressure Area (WML) over southeast Arabian Sea, the low level relative vorticity is 60-70 x10<sup>-5</sup>sec<sup>-1</sup> around the system area. Positive vorticity is extending upto 500 hPa level. The lower level convergence is about 10-15 x10<sup>-5</sup>s<sup>-1</sup> over Lakshdweep area and the upper level divergence is about 40 x10<sup>-5</sup>s<sup>-1</sup>. The vertical wind shear is low to moderate (10-20 knots) over the system. The upper tropospheric ridge runs along 16° N. Tropical cyclone heat potential is 90-110kJ/cm2 over the region. As system is lying over a very favourable environment, the WML is very likely to intensify into a depression during next 24 hours. Most of the global models are in agreement with the above prognosis.
- (iii) Possible formation and development of the third system over southeast Arabian Sea around 6<sup>th</sup> December needs to be monitored.

#### Advisory: No IOP area for the next 5 days

# Annexure-1

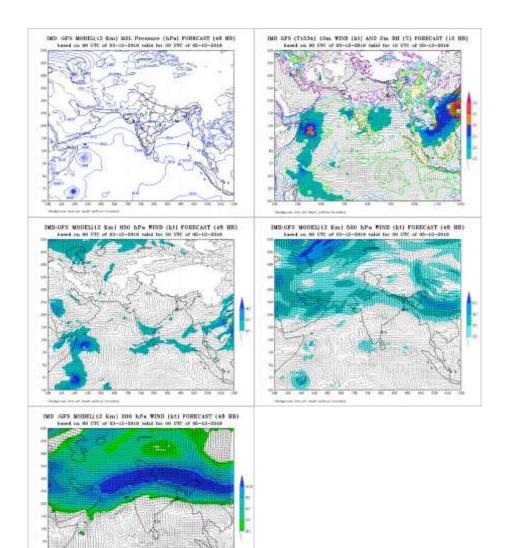


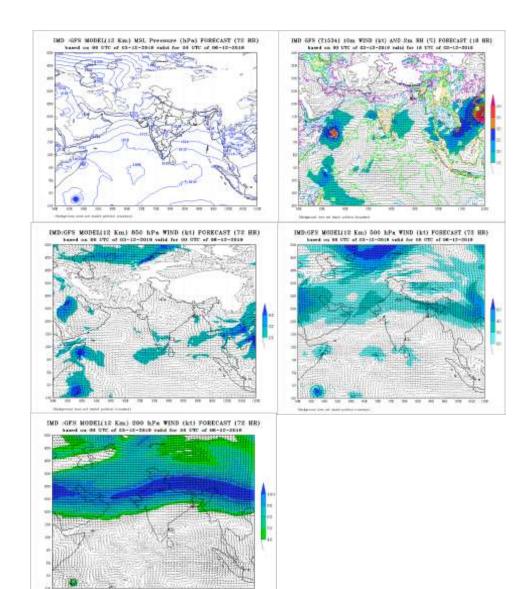


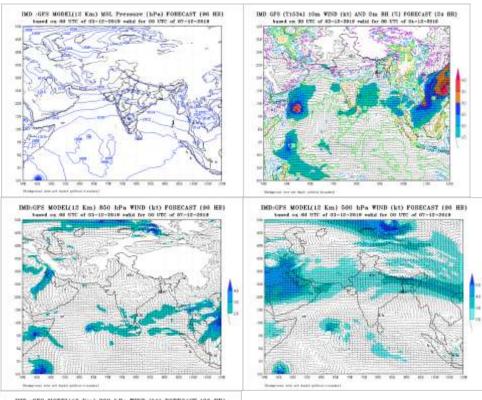


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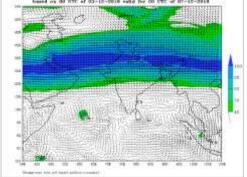
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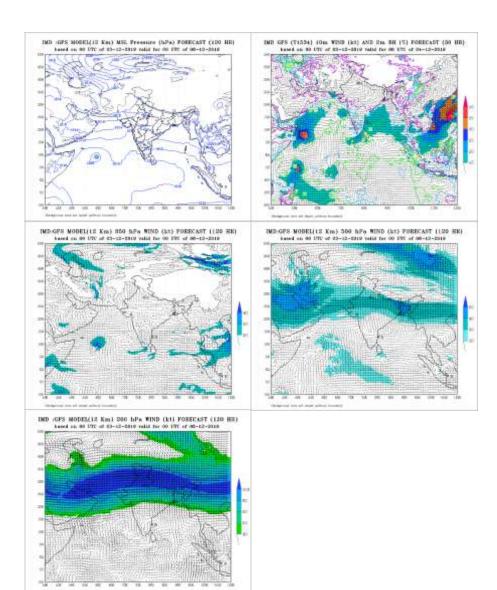






IMD :OFS MODEL(12 Km) 200 hPs WIND (kt) FORECAST (96 HR) based on 00 UTC of 03-12-2018 welld for 00 UTC of 07-15-2018





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