



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



FDP (Cyclone) NOC Report Dated 03rd 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 2nd December. Moving north-northwestwards, it further intensified into a deep depression over southwest Arabian Sea & adjoining equatorial Indian Ocean at 0000 UTC of 3rd December. The Deep Depression over southwest Arabian Sea moved north-northwestwards with a speed of 13 Km/h during past 06 hrs and lay centred at 0600 UTC of 03rd 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/cm² 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/cm². There are areas of values more than 100 kJ/cm² over southeast Arabian Sea, off Kerala coast & Lakshadweep area and also over equatorial Indian Ocean.

TCHP is around 30-50 kJ/cm² over north BoB and adjoining westcentral BoB. It is around 80-90 kJ/cm² over rest of the BOB.

Relative Vorticity:

Cyclonic relative vorticity of value $150 \times 10^{-5} \text{ s}^{-1}$ seen over the area of the Deep Depression over southwest Arabian Sea. Cyclonic relative vorticity of value $50-60 \times 10^{-5} \text{ s}^{-1}$ seen over the area of the WML over southeast Arabian Sea and adjoining Lakshadweep area.

Low level Convergence:

Positive lower level convergence of value $20 \times 10^{-5} \text{ s}^{-1}$ 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 $5-10 \times 10^{-5} \text{ s}^{-1}$ is seen over southwest BoB to the south of Sri Lanka.

Upper level Divergence:

An area of positive upper level divergence of value $5-10 \times 10^{-5} \text{ s}^{-1}$ 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 centre 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 3rd 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 6th December.
- (ii) The low pressure area over southeast Arabian Sea is seen to become less marked by 4th December without any intensification.
- (iii) Another LOPAR forms on 6th over southeast Arabian Sea and adjoining equatorial Ocean which moving in a near westward direction becomes a depression over southwest Arabian Sea on 8th and into a CS on 9th and moves towards Gulf of Aden.

IMD-GEFS:

- (i) Indicates a CS over southwest Arabian Sea (AS) which moving west-northwestwards reaches north Somali coast on 6th 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 5th December.
- (iii) Another LOPAR forms over equatorial Indian Ocean to the south of southeast Arabian Sea on 6th which moves nearly westwards till 9th December without much intensification.

IMD-WRF:

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

NCMRWF-NCUM:

- (i) The CS on 03rd December over southwest Arabian Sea further intensify while moving in NNW direction and crosses Somali coast in the morning of 7th. It crosses extreme north coast of Somali on 6th 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 7th.

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

NCEP-GFS:

- (i) The deep depression on 03rd December over southwest Arabian Sea, moves northwestwards weakens into a depression and cross Somali coast by 6th 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 5th.
- (iii) A third LOPAR is forecast to form over Maldives area on 5th which becomes a depression over southwest Arabian Sea on 8th and moved westwards and becomes less marked on 11th.

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 06th 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 05th December. A third zone is seen to develop over southeast Arabian Sea on 6th which moving in a near westward direction becomes insignificant by 8th.

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 $150 \times 10^{-5} \text{sec}^{-1}$ to the south of the system centre. Positive vorticity is extending upto 200 hPa level. The lower level convergence is about $30 \times 10^{-5} \text{s}^{-1}$ to the northwest of the system center. The upper level divergence is about $40 \times 10^{-5} \text{s}^{-1}$ 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 $27-28^\circ \text{C}$ and along the forecast track. Tropical cyclone heat potential is $40-60 \text{kJ/cm}^2$ over the system area and decreases to less than 50kJ/cm^2 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 03rd 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 $60-70 \times 10^{-5} \text{sec}^{-1}$ around the system area. Positive vorticity is extending upto 500 hPa level. The lower level convergence is about $10-15 \times 10^{-5} \text{s}^{-1}$ over Lakshdweep area and the upper level divergence is about $40 \times 10^{-5} \text{s}^{-1}$. 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 $90-110 \text{kJ/cm}^2$ 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 6th December needs to be monitored.

Advisory: No IOP area for the next 5 days













