



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



FDP (Cyclone) NOC Report Dated 05th November, 2019

Time of Issue: 1200 UTC

Synoptic features:

- The **Extremely severe cyclonic storm (ESCS) MAHA (Pronounced as M'maha)** weakened into a **Very severe cyclonic storm** at 0300 UTC of 5th November and lay centered at 0900 UTC of 05th November, 2019 over westcentral and adjoining eastcentral Arabian Sea near latitude 19.8°N and longitude 63.8°E, about 640 km west-southwest of Porbandar (Gujarat), 690 km west-southwest of Veraval (Gujarat) and 750 km west-southwest of Diu. It is very likely to move east-northeastwards with rapid weakening. It is very likely to cross Gujarat coast around Diu as a Cyclonic Storm with a maximum sustained wind speed of 70-80 Kmph gusting to 90 Kmph around morning hours of 7th November, 2019
- The Low Pressure Area over north Andaman Sea became a Well Marked Low Pressure Area (WML) at 1200 UTC of 4th November. It concentrated into a **Depression** at 0000 UTC of 5th over eastcentral and adjoining southeast BoB and Andaman sea and lay centred at 0900 UTC of 5th November 2019, over eastcentral & adjoining southeast Bay of Bengal and North Andaman Sea, near Lat.13.1°N and Long. 90.4°E, about 270 km west-northwest of Maya Bandar (Andaman Islands), about 890 km south-southeast of Paradip (Odisha), 980 km south-southeast of Sagar islands (West Bengal) and 990 km south-southwest of Khepupara (Bangla Desh). It is very likely to intensify into a Deep Depression during next 12 hours and into a Cyclonic Storm during the subsequent 24 hours. It is very likely to move west-northwestwards initially and then north-northwestwards, towards West Bengal & adjoining north Odisha and Bangladesh coasts.

Dynamical and thermodynamical features

Sea Surface Temperature (SST):

Sea Surface Temperature is around 25-28°C over the area of VSCS Maha but increases to 28-29°C along the forecast track.

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 50-60 X10⁻⁶s⁻¹ is seen over EC BoB and adjoining north Andaman Sea.

Cyclonic relative vorticity at 850 hPa of value 150 X10⁻⁶s⁻¹ is seen to the south of the centre of VSCS Maha.

Low level Convergence:

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

Lower level convergence of about 20 x 10⁻⁵s⁻¹ around the centre of VSCS Maha.

Upper level Divergence:

Upper level divergence of value 20x10⁻⁵ s⁻¹ is seen over EC and adjoining SE BoB.

Upper level divergence of value 20 x10⁻⁵ s⁻¹ is seen to the southeast of the centre of VSCS Maha.

Wind Shear:

Wind shear is low (05-10 knots) over the area of VSCS Maha and central and south Arabian Sea. It is high over north Arabian Sea where the system is forecast to move.

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 western parts of southwest and westcentral BoB. It is negative or neutral elsewhere.

It is positive over north 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 05th November, 2019, the current intensity of the system (VSCS Maha) is T 4.5/5.0. Associated scattered low to medium clouds with embedded intense to very intense convection lies over westcentral and adjoining eastcentral Arabian Sea and north Arabian Sea between Lat 18.5^oN to 22.5^oN and Long 62.5^oE to 66.0^oE. The minimum CTT is minus 83^oC.

Bay of Bengal & Andaman Sea:-

According to 0900 UTC satellite imagery, a vortex lay centered within half degree of 13.1^oN/90.4^oE with intensity T1.5. Associated scattered low/medium clouds with embedded intense to very intense convection lies over eastcentral and adjoining southeast BoB between Lat 11.0^oN to 16.0^oN and Long 85.0^oE to 92.0^oE. The minimum CTT is minus 93^oC.

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 05 Nov 2019, Super Typhoon "Halong" was located near 19.6°N 153.3°E, approximately 427 nm northeast of Tinian. It moved northwestward at 08 knots over the past six hours. Maximum sustained surface winds were estimated at 130 knots. It is expected to move northwestwards and further intensify to 155 knots till 1800 UTC of 05th November and is likely to recurve northeastwards thereafter with gradual weakening.

b) The area of convection (Invest 90W) is now located near 14.0°N 115.6°E, approximately 315nm west of Manila, Philippines. It is expected that the system will remain quasi-stationary while strengthening, and continue on a westward track after 72 hours. Maximum sustained surface winds are estimated at 18 to 23 knots. Minimum sea level pressure is estimated to be near 1005 hPa. The potential for the development of a significant tropical cyclone within the next 24 hours remains high.

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

- (i) The ESCS over west central Arabian Sea on 5th November moves in a northeast direction with gradual weakening to cross Gujarat coast in the early hours of 7th as a CS.

- (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) SCS over eastcentral Arabian Sea on 06th November is seen to move in a northeastward direction with gradual weakening to reach close to south Gujarat coast as a CS on 7th, which crosses coast in the forenoon of 7th and becomes less marked thereafter.
- (ii) The Depression over EC BoB on 6th becomes a CS over EC BoB on 8th November, which intensifies further while moving northwestwards to reach Odisha –West Bengal coasts on 9th. It is seen to recurve northeastwards with gradual weakening thereafter.

IMD-WRF

- (i) The ESCS over WC Arabian Sea on 5th November moves in a nearly eastward direction on 6th and weaken slightly and is seen as a CS on 7th over EC BoB off south Gujarat coast.
- (ii) The depression over eastcentral BoB and adjoining Andaman sea and southeast BoB on 5th becomes a deep depression on 6th over the same area and a CS on 7th over EC BoB. It is seen as a ESCS on 8th over WC BoB.

NCMRWF-NCUM:

- (i) Indicates: The CS over WC Arabian Sea on 5th November is seen to move in a nearly eastward direction from 6th November onwards with gradual weakening and is seen as a WML on 8th over northern parts of eastcentral Arabian sea close to south Gujarat coast. It is seen to weaken further over sea without landfall.
- (ii) The WML over eastcentral BOB and adjoining Andaman Sea on 5th November becomes a depression on 7th over eastcentral BoB and a CS on 8th. 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:

- (i) The CS over central Arabian sea is seen to move east-northeastwards with gradual weakening and is seen to cross south Gujrat coast as a very weak system on 8th.
- (ii) The LOPAR over EC BoB becomes a Depression on 6th and a CS on 7th. It is seen to intensify further while moving in a northwest direction.

NEPS Model:

- (i) The SCS over WC Arabian Sea on 05th November seen to move in an east-northeast direction to reach close south Gujarat coast on 7th as a depression. It further weakens and is seen as a WML over the same area on 9th.
- (ii) The WML over EC BoB and adjoining north Andaman Sea on 5th becomes a D over EC BoB on 6th, CS on 7th, and a ESCS on 9th November while moving north-northeastwards which crosses Bangladesh coast on 10th.

ECMWF:

- (i) The VSCS over westcentral Arabian Sea on 5th moves north-northeastwards with rapid weakening and is seen as a CS on 6th. It is seen as a depression over EC and adjoining NE Arabian Sea on 7th and becomes a LOPAR on 8th.
- (iv) The LOPAR over EC BoB and adjoining Andaman Sea on 05th, becomes a Depression on 6th over the same area which moves west-northwestward and intensifies into a CS on 7th. It is seen off Odisha coast as a VSCS on 10th. It weakens thereafter while recurving in a northeast direction thereafter.

NCEP-GFS:

- (i) Indicates: The SCS over WC Arabian Sea on 5th and starts moving towards east-northeast direction with gradual weakening and is seen close to south Gujrat coast as a depression on 7th November which is seen as a LOPAR over Gujarat on 8th.
- (ii) The D over EC BoB and adjoining Andaman Sea on 5th November becomes a Deep Depression on 06th, and a CS on 7th and a SCS on 8th over central BoB. It is seen to move

north-northeastwards and starts weakening from 11th and is seen as a depression over westcentral BoB off Odisha coast on 13th.

ARP-Meteo France : NIL

Dynamical statistical models

IMD Genesis Potential Parameter (GPP):

- (i) The significant zone of GPP seen over east-central AS on 05th November becomes insignificant on 7th November.
- (ii) Another significant zone of GPP seen over EC BoB on 5th November, is seen to move in north-northwest direction till 9th to reach northern parts of central BoB.

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 $150 \times 10^{-5} \text{ sec}^{-1}$ near the southwest of the centre of VSCS Maha. The ridge runs roughly along 19°N over the system area. The lower level convergence is about $30 \times 10^{-5} \text{ s}^{-1}$ around the system centre and the upper level divergence is about $20 \times 10^{-5} \text{ s}^{-1}$ to southeast of the system center. The vertical wind shear is 15-20 knots over the system area and 20-25 knots along the forecast track. Sea surface temperature is around $24\text{-}26^{\circ}\text{C}$ to the north of the system center and tropical cyclone heat potential is about $20\text{-}40 \text{ kJ/cm}^2$ around the system center.

As the system is situated to the north of the col region, the system is very likely to move rapidly east-northeastwards under the influence of mid-latitude westerlies. During this period the system is also likely to weaken under the influence of increased vertical wind shear along the forecast track cross Gujarat coast around Diu as a cyclonic storm with a maximum sustained wind speed of 70-80 kmph gusting to 90 kmph around 0300 UTC of 7th November, 2019. Majority of the numerical models are in agreement with the above analysis.

- B)** The low level relative vorticity is about $70 \times 10^{-5} \text{ sec}^{-1}$ to the south of the centre of the depression over BoB. The lower level convergence is about $10 \times 10^{-5} \text{ s}^{-1}$ around the system centre and the upper level divergence is about $20 \times 10^{-5} \text{ s}^{-1}$ to the southwest of the system center. The vertical wind shear is 10-15 knots over the system area and along the forecast track. The ridge roughly along 15°N runs and is to the north of the system area. Tropical cyclone heat potential of $60\text{-}85 \text{ kJ/cm}^2$ around the system center. Sea surface temperature between $29\text{-}30^{\circ}\text{C}$ around the system. The moderate shear in the atmosphere and high SST over ocean is supporting the gradual intensification of the system into a Deep Depression during next 12 hours and into a Cyclonic Storm during the subsequent 24 hours. Initially, as the system is shallow, it is likely to move westward and thereafter due to weak steering flow the system will move slowly north-northwestwards. Majority of the NWP models are in agreement with the above analysis.

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













