

**Fig. 1: Graphical Cyclogenesis over north Indian Ocean during next two weeks**

**I. Environmental features:**

The Madden Julian Oscillation (MJO) index is currently in Phase 5 with an amplitude greater than 1. It is likely to continue to move in phase 5 during week 1 with amplitude becoming less than 1 during the middle of week 1 and more than 1. Thereafter during week 2, it will move across phase 6 with amplitude remaining more than 1. Thus, MJO phase and amplitude is favorable for enhancement of convective activity over the Bay of Bengal during week 1.

The NCICS based forecast indicates MJO wave moving eastwards and is seen over the entire south Arabian Sea (AS), Southern Peninsular India and South Bay of Bengal (BoB) during first half of week 1. Westerly winds (1-3 mps) are also likely over South AS & South Peninsular India and higher winds (5-7 mps) over south BoB along with strong easterly winds (3-5 mps) over North BoB are also seen during the first half of week 1. Over the Eastern parts of India, Rossby waves are also seen propagating westwards during the same period. These features indicate a conducive environment for cyclogenesis over BoB during the first half of week 1. During the later part of the first week, westerly winds (1-3 mps) along with MJO signal are seen over the south and central BoB and Rossby waves are seen over northern parts of India.

During week 2, weak easterly winds (1-2 mps) are indicated over central BoB and westerly wind (3-4 mps) along with Rossby Waves are likely over southeast BoB. These features indicate a favourable environment for development of cyclonic circulation/low pressure area over central BoB during week 2 as well.

Neutral ENSO conditions are currently prevailing with declining EL Nino over central Pacific. Neutral Indian Ocean Dipole conditions are likely to prevail during next 2 weeks. These features are favorable for active Indian Summer Monsoon over the Indian region and may support the development of low pressure systems over BoB.

Considering the existing environmental conditions, the sea surface temperature over the BoB is 28-30°C and SST is around 28-30°C over eastern & northern parts of AS. Sea is colder (SST<26°C) over westcentral AS) & southwest AS. Tropical Cyclone Heat Potential (TCHP) is high (>100 KJ/cm<sup>2</sup>) over westcentral BoB and around 50 KJ/cm<sup>2</sup> over eastcentral, major parts of North BoB. In case of Arabian Sea, it is less than <50 KJ/cm<sup>2</sup> over major parts except over southwest AS and adjoining areas.

## II. Model Guidance:

Most of the models (ECMWF, IMD GFS, NCEP GFS, GEFS, NCUM R, IMD MME) are indicating that the low pressure system over westcentral and adjoining northwest Bay of Bengal off north Andhra Pradesh & south Odisha coasts is likely to move along the east coast of India nearly northwards and become more marked by 6<sup>th</sup> evening over north and adjoining central BoB. Thereafter, the evolution of the system by various models shows different types of forecasts. The GFS groups of models indicate that the system is likely to intensify further and move towards north Odisha and adjoining Gangetic West Bengal coasts during the subsequent 2 days. The maximum intensification is seen over land as it moves west-north-westwards across central India. ECMWF model predicts slight intensification of the system and very slow nearly northward movement to reach Gangetic West Bengal and north Odisha coasts during subsequent 3 days. Thereafter, the model predicts a merger of the well marked low pressure area with another westward migrated low pressure area from northeast India and formation of a depression over north Bihar and neighbourhood. However, all models from 10<sup>th</sup> September onwards have a consensus for a west-northwestward movement of the system across central India.

Therefore, from the forecasts of all numerical models (ECMWF, IMD GEFS, NCUM, UKMO, IMD MME) it is inferred that the existing low pressure area over westcentral & adjoining northwest BoB is likely to move initially northwards and become more marked during the next 24 hours and it has a low probability to become a depression reaching over northwest BoB and adjoining north Odisha-West Bengal coasts during subsequent 2 days. Thereafter, it is likely to maintain its intensity while moving west-northwestwards across east and central India till the beginning of the second week.

The 850 hPa wind field indicates a cyclonic circulation over northwest BoB off Odisha coast in week 1. Even the wind anomaly field in IMD CFS V2 also indicates a cyclonic circulation over the same region in the first week. There is another cyclonic circulation in the wind anomaly over westcentral Arabian Sea in week 1. The model wind forecasts portray a well-established monsoon trough along with an embedded cyclonic circulation over Jharkhand and adjoining interior Odisha & Gangetic West Bengal during 2<sup>nd</sup> week. The anomaly wind field imitates the similar feature in the second week. The model indicates moderate to high (40-80%) probability of formation of cyclogenesis over North BoB with peak values over northwest BoB during week 1. The model also indicated moderate probability (40-60%) over east and adjoining central India during week 2. The ECMWF ensemble forecast Model also indicates moderate to high (40-80%) and low probability (20-30%) of cyclogenesis over North BoB during week 1 and week 2 respectively.

**Legends:** MJO: Madden Julian Oscillation, ERW: Equatorial Rossby Waves, KW: Kelvin Waves, NCICS: North Carolina Institute for Climate Studies (for Equatorial waves Forecast), IMD GFS: India Meteorological Department Global Forecast System, NCUM: National Centre for Medium Range Weather Forecasting Centre (NCMRWF) Unified Model, ECMWF: European Centre for Medium Range Weather Forecasting, ECMF: ECMWF-Ensemble System, ECMM: ECMWF-Ensemble System Bias Corrected, GPP: Genesis Potential Parameter, NCEP GFS: National Centre for Environment Prediction GFS, GEFS: GFS ensemble forecast system, NEPS: NCUM ensemble prediction system, CNCUM: Coupled NCUM, CPC: Climate Prediction Centre, NWS: National Weather Service, INCOIS: Indian National Centre for Ocean Information Services.

## III. Inference:

Considering various environmental conditions and model guidance, it is inferred that:

The existing low pressure area over westcentral & adjoining northwest Bay of Bengal off north Andhra Pradesh & south Odisha coasts is very likely to move slowly northwards and become more marked over northwest Bay of Bengal during next 24 hours and likely to intensify further into a depression over northwest Bay of Bengal and adjoining north Odisha-West Bengal coasts during the subsequent two days. Thereafter, it is likely to maintain its intensity and move west-northwestwards across east and central India till the beginning of the second week.

**IV. Impact Expected over Westcentral & Northwest Bay of Bengal and Eastern & central parts of the country (including Andhra Pradesh, Odisha, Gangetic West Bengal, Chhattisgarh, Jharkhand, Madhya Pradesh and Uttar Pradesh) during week 1**

- Above normal rainfall is likely over eastern & adjoining central parts of the country leading to flooding and inundation.
- Sea condition is likely to be rough over westcentral and northwest Bay of Bengal during week 1.

**V. Action Suggested for stakeholders in Westcentral & Northwest Bay of Bengal and Eastern & central parts of the country (including Andhra Pradesh, Odisha, Gangetic West Bengal, Chhattisgarh, Jharkhand, Madhya Pradesh and Uttar Pradesh) during week 1.**

- Fishermen are advised not to venture into westcentral and northwest BoB during first week.
- Judicious regulation of surface transports including railways and roadways.
- Check for traffic congestion on your route before leaving for your destination.
- Follow any traffic advisories that are issued in this regard.
- Avoid going to areas that face water logging problems often.
- Avoid staying in vulnerable structures.

**VI. Verification of forecast issued during last two weeks:**

**(i) Week 2 updated forecast issued on 24<sup>th</sup> August for the second week (29.08.2024-05.09.2024) indicated**

- (a) the deep depression is likely to continue to move nearly west-southwestwards and emerge into northeast Arabian sea off Saurashtra & Kutch and south Pakistan coasts around 29th August.
- (b) It also indicated likely formation of another cyclonic circulation or low pressure area over the central and adjoining north Bay of Bengal around 29th August.

**(ii) Week 1 forecast issued on 29th August for first week (29.08.2024-05.09.2024) indicated**

- (a) the deep depression over Saurashtra & Kachchh is likely to move west-southwestwards, emerge into northeast Arabian Sea off Kachchh and adjoining Saurashtra & Pakistan coasts and intensify into a Cyclonic Storm on 30th August. Thereafter, it would continue to move nearly west-southwestwards over northeast Arabian Sea away from Indian coast during subsequent 2 days.
- (b) The low pressure area over central and adjoining north Bay of Bengal is likely to move west-northwestwards and become more marked over westcentral and adjoining northwest Bay of Bengal by 30th August. It is likely to move towards north Andhra Pradesh and adjoining south Odisha coasts and intensify into a depression over westcentral and adjoining northwest Bay of Bengal by 1st September.

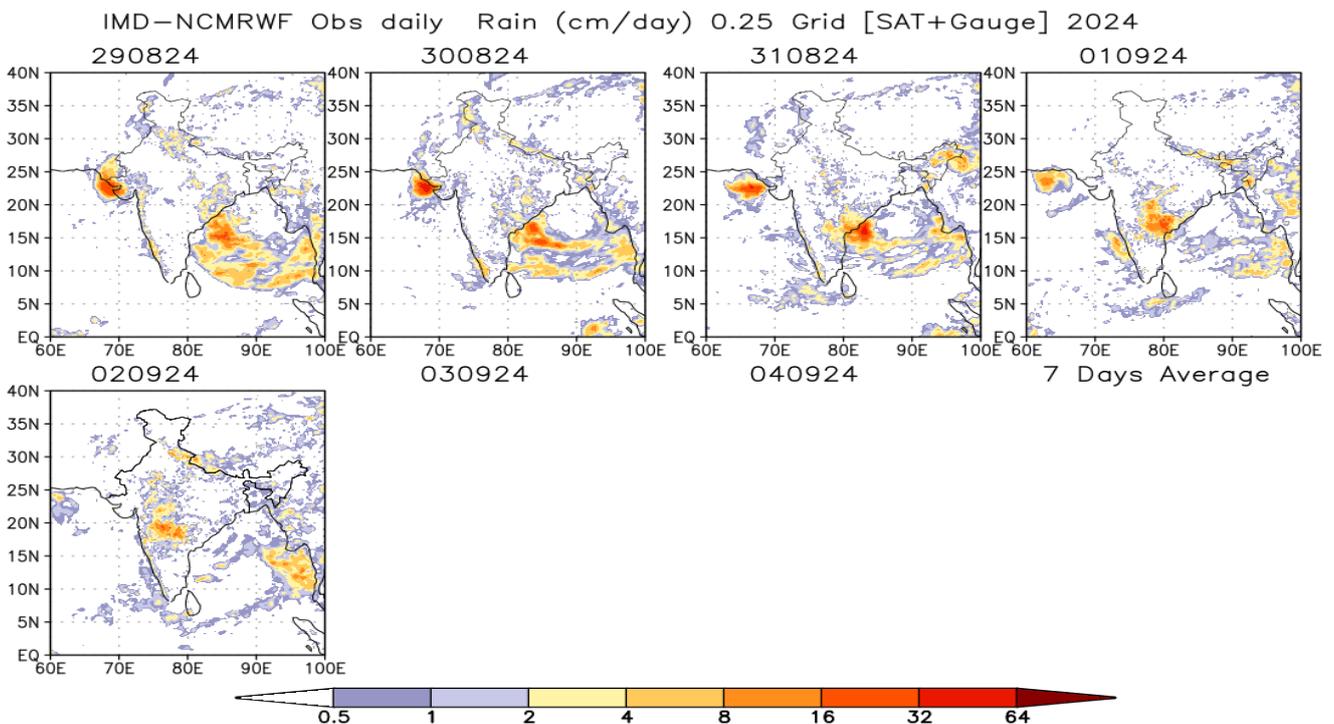
**(iii) Realised:**

- (a)** Deep Depression moved slowly westwards and lay over Saurashtra & Kachchh near latitude 23.7°N and longitude 69.4 °E, 60 km northwest of Bhuj (Gujarat), 80 km northeast of Naliya (Gujarat) and 270 km east-southeast of Karachi (Pakistan) on the morning of 29th August; moved west-southwestwards and lay over Kachchh coast and adjoining areas of Pakistan & Northeast Arabian Sea near latitude 23.5°N and longitude 68.4°E, 145km west-northwest of Bhuj (Gujarat), 50 km west-northeast of Naliya (Gujarat) and 200 km southeast of Karachi (Pakistan) in the morning of 30th August; moved westwards and lay over Kachchh coast and adjoining areas of Pakistan & Northeast Arabian Sea near latitude 23.5°N and longitude 68.2°E, 160 km west of Bhuj (Gujarat), 70 km west-northwest of Naliya (Gujarat) and 190 km east-southeast of Karachi (Pakistan) in the forenoon of 30th August; moved westwards, intensified into a Cyclonic Storm "ASNA" (pronounced as As-Na) and lay over the same region near latitude 23.5°N and longitude 67.9°E, 190 km west-northwest of Bhuj (Gujarat), 100 km west-northwest of Naliya (Gujarat) and 170 km southeast of Karachi (Pakistan) at 1130 hours IST of 30th August; moved westwards and lay over northeast and adjoining northwest Arabian Sea near latitude 23.6°N and longitude 65.3°E, 360 km west of Naliya (Gujarat), 260 km southwest of Karachi (Pakistan), 300 km southeast of Pasni (Pakistan) and 720 km east of Muscat (Oman) in the forenoon of 31st August; moved westwards and lay over central parts of North Arabian Sea near latitude 23.6°N and longitude 64.0°E, 500 km west of Naliya (Gujarat), 190 km

southsoutheast of Pasni (Pakistan), 350 km west-southwest of Karachi (Pakistan) and 580 km east of Muscat (Oman) in the evening of 31st August; moved south-southwestwards, weakened into a Deep Depression and lay over the same region near latitude 22.5°N and longitude 61.8°E, about 200 km east of Ras Al Hadd (Oman) and 380 km east-southeast of Muscat (Oman) in the evening of 01st September; The Deep Depression (Remnant of Cyclonic Storm “ASNA”) over northwest Arabian Sea moved south-southwestwards, weakened into a Depression and lay over the same region near latitude 21.2°N and longitude 61.3°E, about 200 km southeast of Ras Al Hadd (Oman) and 410 km southeast of Muscat (Oman) in the morning of 02nd September; weakened into a Well Marked Low Pressure Area over the northwest Arabian Sea In the forenoon of 02nd September; lay as a Low Pressure Area over westcentral & adjoining northwest Arabian Sea with associated cyclonic circulation extended upto 5.8 km above mean sea level on 3rd September; became less marked and the associated cyclonic circulation lay over Westcentral Arabian Sea off Oman coast and extended upto 3.1 km above mean sea level on 4th September.

(b) Depression over Westcentral Bay of Bengal (31 st August-2 nd September, 2024): Under the influence of the cyclonic circulation over eastcentral Bay of Bengal & neighbourhood, a low pressure area formed over central and adjoining north Bay of Bengal in the morning (0830 hours IST) of the 29th August, 2024. It lay as well marked low pressure area over westcentral & adjoining northwest Bay of Bengal off north Andhra Pradesh & South Odisha coasts in the morning (1130 hours IST) of 30<sup>th</sup> August, 2024. It concentrated into a Depression over the westcentral & adjoining northwest Bay of Bengal off north Andhra Pradesh & South Odisha in the early morning (0530 hours IST) of the 31<sup>st</sup> August, 2024. It moved northwestwards and lay over north Andhra Pradesh coast, close to southwest of Kalingapatnam in midnight (2330 hours IST) on 31st August, 2024. Moving further northwestwards, it crossed north Andhra Pradesh & south Odisha coasts near Kalingapatnam between 0030 and 0230 hrs IST on the 1st September. It moved west-northwestwards and weakened into a Well Marked Low Pressure Area over central parts of Vidarbha and neighbourhood in the evening (1730 hours IST) of the 02 nd September, 2024. It lay as low pressure area over west Vidarbha & neighbourhood in the morning (0830 hours IST) of 3rd September, 2024.

The observed satellite-gauge merged analysis of 24 hours accumulated rainfall from 29<sup>th</sup> August to 4<sup>th</sup> September, 2024 is shown in **Fig. 3**.



**Fig. 3:** NCMRWF-IMD satellite gauge merged data plots of realized 24 hours accumulated rainfall from 29<sup>th</sup> August to 2<sup>nd</sup> September, 2024.