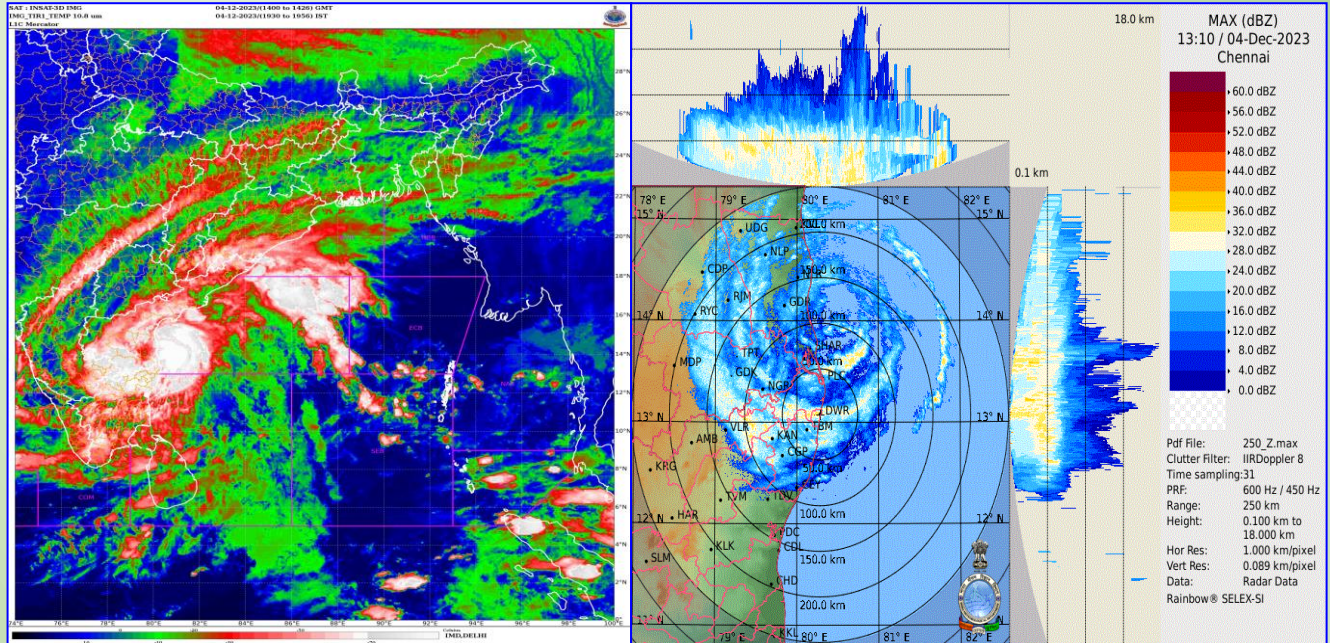# Severe Cyclonic Storm "MICHAUNG" over the Bay of Bengal (1st-6th December, 2023): A Report



**Typical (a) enhanced color imagery from INSAT 3D(R) at 1930 hrs IST/ 1400 UTC and (b) reflectivity imagery from Doppler Weather Radar, Chennai at 1840 hrs IST/1310 UTC of 4th December, 2023 during life cycle of severe cyclonic storm "MICHAUNG"**

**Cyclone Warning Division
India Meteorological Department
New Delhi
December, 2023**

# Severe Cyclonic Storm "MICHAUNG" over the Bay of Bengal (1st-6th December, 2023): A Report

## 1. Life History of "MICHAUNG":

➤ A cyclonic circulation emerged into South Andaman Sea and adjoining South Thailand in the morning (0830 hours IST /0300 UTC) of 26th November.

➤ Under its influence, a **low pressure area** formed over South Andaman Sea & adjoining Malacca Strait in the early morning (0530 hours IST/0000 UTC) of the 27th November.

➤ It lay as a **Well Marked Low Pressure** area over Southeast Bay of Bengal & adjoining South Andaman Sea in the early morning (0530 hours IST/0000 UTC) of the 29th November.

➤ Moving westwards, it concentrated into a **Depression** over Southeast & adjoining Southwest Bay of Bengal in the early morning (0530 hours IST/0000 UTC) of the 1st December, 2023. It moved west-northwestwards and intensified into a **Deep Depression** over Southwest Bay of Bengal in the early morning (0530 hours IST/0000 UTC) of the 2nd December, 2023.

➤ Moving in the same direction, it intensified into a **Cyclonic Storm "MICHAUNG" (pronounced as MIGJAUM)** over the southwest Bay of Bengal in the early morning (0530 hours IST/ 0000 UTC) of the 3rd December, 2023.

➤ It then moved northwestwards and intensified into a **Severe Cyclonic Storm** over the Westcentral & adjoining Southwest Bay of Bengal off south Andhra Pradesh and adjoining north Tamil Nadu coasts in the forenoon (0830 hours IST/ 0300 UTC) of the 4th December.

➤ Thereafter, it moved nearly northwards almost parallel and close to south Andhra Pradesh coast and crossed south Andhra Pradesh coast between Nellore and Machilipatnam, close to south of Bapatla during 1230 to 1430 hours IST (0700-0900 UTC) of the 5th December 2023 as a **Severe Cyclonic Storm** with maximum sustained wind speed of **90-100 kmph gusting to 110 kmph.**

➤ After the landfall, it continued to moved nearly northward and weakened into a Cyclonic Storm and lay centred at 1530 hrs IST/ 1000 UTC of 5th December over south coastal Andhra Pradesh, about 15 km west of Bapatla.

➤ It then moved north-northeastwards and weakened into a Deep Depression around mid-night (2330 IST/ 1800 UTC) of 5th December over coastal Andhra Pradesh and further into a Depression over northeast Telangana and adjoining areas of south Chhattisgarh, south Odisha and coastal Andhra Pradesh in the early morning (0530 IST/ 0000 UTC) of 6th December. It weakened into a well marked low pressure area over the same region in the forenoon (0830 IST/ 0300 UTC) of 6th December. It weakened into an upper air cyclonic circulation over Odisha in the morning of 7th December and became less marked on 8th December.

➤ The observed track of the system is presented in **Fig. 1**. The best track parameters associated with the system are presented in Table 1.

## 2. Salient Features

**(i)** It was the sixth cyclone with maximum sustained wind speed (MSW) of ≥ 34 knots( ≥ 62 kmph)) over the North Indian Ocean (NIO) during 2023. During last 33 years (1990-2022) about 13 cyclones developed over the Bay of Bengal (BoB) in the month of December. Out of these 9 crossed Tamil Nadu & Puducherry coast, 2 Andhra Pradesh coast, 1

Bangladesh coast and remaining 1 weakened over sea (**Fig. 2a**). Out of these 13 cyclones, 9 were severe cyclones (≥48 knots) **(Fig. 2b).** Thus climatologically, maximum number of cyclones (about 85%) in the month of December cross either Andhra Pradesh or Tamil Nadu & Puducherry coasts. 70 % of the cyclones in December become severe.

**(ii) Slow movement and associated adverse weather:**

During the passage of the cyclone 'Michaung' along & off north coastal Tamilnadu and south Coastal Andhra Pradesh, during the period from 2330 hours IST of 3rd to 2030 hours IST of 04th December (1800 UTC of 3rd to 1500 UTC of 04th), the system moved very slowly (with a speed of 8-10 kmph) along & off the coast of north Tamil Nadu (north of Chennai) and south coastal Andhra Pradesh (till landfall). The six hourly average translational speed of "MICHAUNG" was 10.1 kmph against the normal of 17.6 kmph for severe cyclonic storm category over the BoB during post monsoon season    (**Fig.3a)**. During this period, the system was in its intensification phase as well from Cyclonic Storm (CS) to Severe Cyclonic Storm (SCS).

**(iii) Maximum sustained wind speed and estimated central pressure:**

No rapid intensification/weakening was observed during the life cycle of Michaung. The system reached it's peak intensity of 55 knots (100-110 kmph) at 1200 UTC (1730 IST) of 4th December with estimated central pressure of 986 hPa and pressure drop of about 16 hPa. Thereafter, it weakened slightly at 1800 UTC of 4th December, as it entered into an area of slightly less sea surface temperature. However, ocean thermal energy continued to be 70-80 KJ/cm$^2$ and thus system maintained it's intensity and crossed Andhra Pradesh coast near Bapatla with MSW of 50 knots(90-100 kmph) (**Fig. 3b**).

**(iv) Recurving track:**

The track of cyclone, Michaung recurved twice in its life period. Initially, it recurved from west-northwestward movement to northwestwards around evening (1730 hours IST/1200 UTC) of 2nd December. Another recurvature took place when it changed the track from northwestward to north-northwest/northward from 4th December evening (**Fig. 3a**).

**(v) Very close movement along the coast:**

Michaung moved almost parallel and very close to Andhra Pradesh and adjoining north Tamil Nadu coasts from 4th forenoon (0830 hrs IST/0300 UTC) till landfall around 1330 hrs IST/0800 UTC of 5th December. It lay 90 km east of Chennai at 0830 IST of 4th Dec, 30 km east of Nellore at 2330 hrs IST of 4th Dec, 20 km east of Kavali at 0530 hrs of 5th Dec,  20 km east of Ongole at 1130 hrs IST, 15 km southwest of Bapatla at 1430 hrs IST of 5th Dec (**Fig.1**).

**(vi) Total Track length:**

The total track length of "MICHAUNG" was 1150 km against the normal of 1680 km during post-monsoon season over BoB during 1990-2020. Thus it was shorter in length by about 500 km.

**(vii) Total Life Period:**

The total life period (D to D) of "MICHAUNG" was 5 days & 03 hours against the normal of 4 days & 1 hours for SCS category over the BoB in post monsoon season during the period 1990-2013. Thus life period was slightly longer.

**(viii)  Accumulated Cyclone Energy and Power Dissipation Index:**

The Velocity Flux, Accumulated Cyclone Energy, ACE (a measure of damage potential) and Power Dissipation Index, PDI (a measure of loss) were $4.6 \times 10^2$ knots, $2.1 \times 10^4$ knots$^2$ and $0.99 \times 10^6$ knots$^3$ respectively against normal of $3.88 \times 10^2$ knots, $1.83 \times 10^4$ knots$^2$ and $0.90 \times 10^6$ knots$^3$ for SCS category over the BoB for post monsoon season during the period 1990-2020. Thus its ACE and PDI were near normal.

**(ix)  Extremely heavy rainfall and flood due to cyclone, Michaung**

The cyclone "MICHAUNG" caused, torrential rains and gale force winds over coastal districts of North Tamil Nadu and South Andhra Pradesh. Especially it caused flood over Chennai city. In past, Tamil Nadu has witnessed similar torrential rains and hence flood due to cyclonic disturbances. Details of very heavy rainfall (≥12 cm) since 1976 over the region are given in Annexure-1.

**Table1: Best track positions and other parameters of the Severe Cyclonic Storm "MICHAUNG" over BoB during 1st – 6th December, 2023**

| Date | Time (UTC) | Centre lat.⁰ N/ long. ⁰ E | | C.I. NO. | Estimated Central Pressure (hPa) | Estimated Maximum Sustained Surface Wind (MSW (kt) | Estimated Pressure drop at the Centre (hPa) | Grade |
|---|---|---|---|---|---|---|---|---|
| 01.12.23 | 0000 | 9.1 | 86.4 | 1.5 | 1002 | 20 | 3 | D |
| | 0300 | 9.3 | 86.2 | 1.5 | 1002 | 20 | 3 | D |
| | 0600 | 9.5 | 86.0 | 1.5 | 1002 | 25 | 3 | D |
| | 1200 | 10.0 | 85.7 | 1.5 | 1001 | 25 | 3 | D |
| | 1800 | 10.3 | 85.1 | 1.5 | 1000 | 25 | 4 | D |
| 02.12.23 | 0000 | 10.5 | 84.1 | 2.0 | 998 | 30 | 5 | DD |
| | 0300 | 10.6 | 83.6 | 2.0 | 997 | 30 | 5 | DD |
| | 0600 | 10.7 | 83.2 | 2.0 | 997 | 30 | 5 | DD |
| | 1200 | 10.9 | 83.1 | 2.0 | 997 | 30 | 5 | DD |
| | 1800 | 11.1 | 82.7 | 2.0 | 996 | 30 | 6 | DD |
| 03.12.23 | 0000 | 11.4 | 82.5 | 2.5 | 995 | 35 | 7 | CS |
| | 0300 | 11.5 | 82.4 | 2.5 | 995 | 35 | 7 | CS |
| | 0600 | 11.8 | 82.2 | 2.5 | 995 | 35 | 7 | CS |
| | 0900 | 12.0 | 82.1 | 2.5 | 995 | 35 | 7 | CS |
| | 1200 | 12.2 | 82.0 | 2.5 | 995 | 35 | 7 | CS |
| | 1500 | 12.4 | 81.9 | 2.5 | 994 | 40 | 8 | CS |
| | 1800 | 12.8 | 81.6 | 3.0 | 992 | 45 | 10 | CS |
| | 2100 | 13.0 | 81.4 | 3.0 | 992 | 45 | 10 | CS |
| 04.12.23 | 0000 | 13.1 | 81.2 | 3.0 | 992 | 45 | 10 | CS |
| | 0300 | 13.3 | 81.0 | 3.0 | 988 | 50 | 14 | SCS |
| | 0600 | 13.5 | 80.8 | 3.0 | 988 | 50 | 14 | SCS |
| | 0900 | 13.7 | 80.7 | 3.0 | 988 | 50 | 14 | SCS |
| | 1200 | 14.0 | 80.5 | 3.5 | 986 | 55 | 16 | SCS |
| | 1500 | 14.3 | 80.4 | 3.5 | 986 | 55 | 16 | SCS |
| | 1800 | 14.5 | 80.3 | 3.5 | 988 | 50 | 14 | SCS |
| | 2100 | 14.7 | 80.2 | 3.5 | 988 | 50 | 14 | SCS |

| | 0000 | 14.9 | 80.2 | 3.5 | 988 | 50 | 14 | SCS |
|---|---|---|---|---|---|---|---|---|
| | 0300 | 15.2 | 80.2 | 3.5 | 988 | 50 | 14 | SCS |
| | 0600 | 15.5 | 80.3 | 3.0 | 988 | 50 | 14 | SCS |
| 05.12.23 | Crossed South Andhra Pradesh coast close to south of Bapatla during 0700-0900 UTC (1230-1430 IST) of 05th December near Lat 15.7 deg. N and Lon 80.3 deg. E as a severe Cyclonic Storm with the maximum sustained wind speed of 50 knots (90-100 kmph gusting to 110 kmph) | | | | | | | |
| | 0900 | 15.8 | 80.3 | - | 990 | 50 | 12 | SCS |
| | 1200 | 16.0 | 80.3 | - | 996 | 40 | 8 | CS |
| | 1500 | 16.4 | 80.4 | - | 998 | 35 | 7 | CS |
| | 1800 | 16.8 | 80.4 | - | 1000 | 30 | 6 | DD |
| 06.12.23 | 0000 | 17.4 | 80.5 | - | 1004 | 20 | 3 | D |
| | 0300 | Weakened into a well marked low Pressure area (WML) over Northeast Telangana | | | | | | WML |

Maximum sustained wind speed in knots (kt), 1 kt = 1.85 kmph, D: Depression, DD: Deep depression, CS: Cyclonic storm, ECP: Estimated Central Pressure, C.I. No.: Current Intensity No., ∆P: Pressure drop at centre, Kt: Knots, 1 kt= 1.85 kmph

## 3. Monitoring of SCS, "Michaung"

The cyclone was monitored with the help of available satellite observations from INSAT 3D and 3DR, SCAT SAT, ASCAT, microwave imageries and available ships, buoy observations, Doppler Weather Radar Chennai & Machilipatnam and coastal observations in the region. Various global models and dynamical-statistical models run by Ministry of Earth Sciences (MoES) institutions including IMD, NCMRWF, IITM & INCOIS and guidance from models from various international agencies under bilateral arrangement and cyclone specific Hurricane Weather Research Forecast (HWRF) model were utilized to predict the genesis, track, landfall and intensity of the cyclone as well as associated severe weather. The forecasts were mainly based on multi-model ensemble technique developed by IMD. An indigenously developed digitized forecasting system of IMD was utilized for analysis and comparison of various observations and numerical weather prediction models guidance, decision making process and warning products generation. Typical imageries from INSAT 3D (R) and DWR Chennai are presented in **Fig.5**.

## 4. Operational Forecast Performance:

### i) Pre-Genesis Forecast performance

❖ India Meteorological Department (IMD) maintained round the clock watch over the north Indian Ocean and the cyclone was monitored since 16th November, about 15 days prior to formation of depression on 1st December and 19 days prior to the landfall of system over Andhra Pradesh coast. The information about the system was first released in the weekly extended range outlook issued by IMD on 16th November (**Fig. 4a**), indicating formation of depression over southeast BoB around 30th November during the week 2 (24-30 November).

❖ Further, the extended range outlook issued on 23rd November (**Fig. 4b**), indicated formation of depression over southwest BoB around 30th November and it's movement towards Andhra Pradesh coast with high confidence (76-100%) (about 8 days ahead of formation of depression and 12 days ahead of landfall over Andhra Pradesh).

- Daily tropical weather outlook issued since 22nd November indicated high probability of formation of depression during 29th-30th November. The daily report under Tropical Cyclone Forecasting Programme (TCFP) for North Indian Ocean issued on 21st Nov., also indicated likely formation of depression around 29th-30th November. Since 21st November onwards, the system was continuously monitored and discussed in TCFP report. This report is a brief synopsis of environmental & cloud features and model guidance along with a brief summary and cyclogenesis probability.

- **Pre-genesis track & intensity and structure forecast:**
  On formation of low pressure area over South Andaman Sea on 27th November, pre-genesis track & intensity forecast was issued indicating movement of depression towards westcentral BoB on 1st December (about 4 days ahead of formation of depression). It was also indicated on 27th November itself that the system will intensify into a cyclonic storm.

**ii) Operational track, intensity and landfall forecast performance**

(a) On formation of depression in the early morning of 1st December, the track and intensity forecast issued at 1000 hrs IST of 1st December (about 4 days ahead of landfall on 5th December), indicated the system to move very close to South Andhra Pradesh coast since 4th December evening (1730 hours IST) and system to cross coast between Nellore and Machilipatnam, close to Bapatla around noon (during 1230-1330 hours IST) of 5th December as a cyclonic storm with wind speed of 70-80 kmph gusting to 90 kmph. The forecast issued at 1130 hours IST of 3rd December indicated the system to cross coast near Bapatla as a severe cyclonic storm with wind speed of 90-100 kmph gusting 110 kmph

(b) Subsequently all forecasts were continued consistently without any significant change. Typical observed and forecast tracks alongwith cone of uncertainty and wind distribution are presented in **Fig. 6.**

Actually, a low pressure area lay over South Andaman Sea on 27th November. It moved west-northwestwards and intensified into a depression over southeast BoB in the early morning (0530 hours IST) of 1st December, into a deep depression in the early morning (0530 hours IST) of 2nd December, into the cyclonic storm "Michaung" in the early morning (0530 hours IST) of 3rd December and into a severe cyclonic storm in the noon (1130 hours IST) of 4th December. It crossed Andhra Pradesh coast between Nellore and Machilipatnam, close to south of Bapatla during 1230-1430 hours IST, as a severe cyclonic storm with wind speed of 90-100 kmph gusting 110 kmph.

(c) The track forecast errors for 12, 24, 48, 72 and 96 hrs lead period were 44, 59, 73, 73  and 93 km respectively against the long period average (LPA) errors (2018-22) of 46, 74, 112, 153 and  208 km respectively (**Fig. 7a**). The track forecast skill for 12, 24, 48, 72 and 96 hrs lead period was 75, 77, 84, 84 and 89 km respectively against the long period average (LPA) errors (2018-22) of 61, 65, 77, 78, and 80 % respectively (**Fig. 7b**). The operational track forecast errors were less than the LPA errors for all lead periods and the operational track forecast skill was better than  the LPA skill for all lead periods.

(d) The absolute error (AE) of intensity (wind) forecast for 12, 24, 48 and 72 hrs lead period were 1.1, 1.8, 4.6 and 5.6 knots against the LPA errors of 4.5, 7.4, 10.5 and 14.0 knots during 2018-22 respectively (**Fig.8a**). The skill in intensity forecast based on AE for 12, 24, 48 and 72 hrs lead period was 83, 85, 78 and 71% against the LPA skill of 43, 55, 74 and

77% during 2018-22 respectively (**Fig.8b**). For all lead periods, the operational intensity forecast errors and skill were better than the LPA.

(e) The root mean square error (RMSE) of intensity (wind) forecast for 12, 24, 48 and 72 hrs lead period were 2.3, 3.0, 5.5 and 5.8 knots against the LPA errors of 6.0, 9.3, 13.1 and 16.8 knots during 2018-22 respectively (**Fig.9a**). The skill in intensity forecast based on RMSE for 12, 24, 48 and 72 hrs lead period was 71, 80, 80 and 76% against the LPA skill of 53, 42, 61 and 73% during 2018-22 respectively (**Fig.9b**).

(f) The landfall point forecast errors for 24, 48, 72 and 96 hrs lead period were 15.6, 18.7, 54.2 and 29.3 km respectively against the LPA errors (2018-22) of 26.2, 39.9, 75.7 and 59.9 km during 2018-22 respectively (**Fig.10a**). Considering the eye diameter to be about 50 km, there was almost **zero landfall point forecast errors for all lead periods.**

(g) The landfall time forecast errors for 24, 48, 72 and 96 hrs lead period were 2.0, **4.0, 5.0** and 2.0 hours respectively against the LPA errors (2018-22) of 2.8, 4.5, 8.0 and 8.5 hours during 2018-22 respectively (**Fig.10b**). **For all lead periods, the landfall time errors were appreciably less than LPA errors.**

**Thus, the cyclone track, intensity and landfall point and time were correctly predicted with reasonable lead period (about 4 days in advance), which helped the disaster managers to take response actions for minimising loss of lives and properties.**

**7. Warnings and advisories issued**

**Bulletins issued by Cyclone Warning Division, New Delhi**

- **Track, intensity and landfall forecast:** IMD continuously monitored, predicted and issued bulletins containing track, intensity, and landfall forecast for +06, +12, +18, +24, +36 and +48…+72 hours and upto     +120 hrs lead period commencing from 27th November  and 1st December respectively till the system weakened into a low pressure area. The above forecasts were issued from the stage of low pressure area along with the cone of uncertainty in the track forecast once daily, five times a day during depression and every three hourly during the cyclone period.
- **Cyclone structure forecast for shipping and coastal hazard management:** The radius of maximum wind and radii of MSW ≥28, ≥34, ≥50 and ≥64 knots wind in four quadrants of cyclone was issued alongwith cone graphics, commencing from 27th November.
- **Four stage warnings:**

**Pre-cyclone Watch (Yellow message):**
Pre-cyclone Watch for Andhra Pradesh and North Tamil Nadu-Puducherry coasts was issued at 1000 hours IST (0430 UTC) of 1st December, on formation of Depression (about 98 hours prior to landfall)

**Cyclone Alert (Orange message):**
Cyclone Alert for Andhra Pradesh and North Tamil Nadu-Puducherry coasts was issued at 1240 hours IST (0710 UTC) of 2nd December at the stage of deep depression (about 73 hours prior to landfall)

**Cyclone Warning (Red message):**
**Cyclone warning** for Andhra Pradesh and North Tamil Nadu-Puducherry coasts was issued at 0830 hours IST (0300 UTC) of 3rd December at cyclonic storm stage (about 53 hours prior to landfall).

**Post landfall outlook (Red message):**
Post landfall Outlook for interior districts of Andhra Pradesh and adjoining Telangana was issued at 0230 hours IST of 5th December (2100 UTC of 4th December) indicating the system to maintain the intensity of cyclonic storm till 2030 hours IST (1500 UTC) of 5th December.

- **Adverse weather warning bulletins:** The tropical cyclone forecasts alongwith expected adverse weather like heavy rainfall, gale wind, state of sea and storm surge for Bay of Bengal, states of North Tamil Nadu, Puducherry, Andhra Pradesh, Odisha, Telangana, Andaman & Nicobar Islands were issued with every six/three hourly update to central, state and district level disaster management agencies including Ministry of Home Affairs (MHA), National Disaster Response Force (NDRF), National Disaster Management Agency (NDMA) for all concerned states along the east coast of India including Andaman & Nicobar Islands, Tamil Nadu, Puducherry, Andhra Pradesh, Odisha and Telangana. The bulletins also contained the suggested action for disaster managers and general public in particular for fishermen, ports and off & along shore activities. These bulletins were also issued to Defence including Indian Navy & Indian Air Force, NDRF, Indian Coast Guard, ports, Shipping, fishery, Railways, surface transport and aviation authorities. For cyclone "Michaung" the advisories for winds & sea condition for fishermen over Bay of Bengal were also provided to WMO and WMO/ESCAP PTC member countries including Bangladesh and Myanmar.

**Wind warning**
The wind warning for different states like Tamil Nadu, Puducherry, Andhra Pradesh, Odisha were issued at district level 4 days in advance

**Storm surge warning:**
Storm surge of height about 1.0-1.5 m that would inundate low lying areas of south coastal Andhra Pradesh at the time of landfall was given by IMD since 1430 hours IST of 1st December (4 days ahead of landfall).

**Heavy rainfall warning**
The extremely heavy rainfall that occurred over Tamil Nadu, Andhra Pradesh and Telangana and the heavy rainfall that occurred over Odisha and Chhattisgarh were well predicted in advance and warnings were issued at district level to public and state/central level disaster managers 4 days in advance.

**Hazard, impact and risk based warning.**
Based on Web-Dynamic Composite Risk Atlads (DCRA) developed by NDMA, IMD and other central and state organisations, the impact based forecast and risk based warnings were provided in GIS platform. Also it was included in the forecast bulletins issued by IMD.
- **Warning graphics:** The graphical display of the observed and forecast track with cone of uncertainty and the wind forecast for different quadrants were disseminated by email and uploaded in the RSMC, New Delhi website (http://rsmcnewdelhi.imd.gov.in/) regularly. The adverse weather warnings related to fishermen were also presented in graphics alongwith colour codes in the website.

- **Warnings and advisories through social media:** Daily updates (every three hourly or whenever there was any significant change in intensity/track/landfall) were uploaded on Facebook and Twitter during the life period of the system since the development of low pressure area.
- **Press Conference, Press release and Media briefing:** Press and electronic media were given daily updates since inception of system through press release, e-mail, website, video capsule by DGM and SMS.
- **Warning and advisory for marine community:** The three/six hourly Global Maritime Distress Safety System (GMDSS) bulletins were issued by the Marine Weather Services Division at New Delhi and bulletins for maritime interest were issued by Area Cyclone Warning Centres of IMD at Chennai & Kolkata, Cyclone Warning Centres at Bhubaneswar and Visakhapatnam for coastal and high sea shipping community.
- **Fishermen Warning:** Regular warnings for fishermen in Bay of Bengal and Andaman Sea were issued since 22nd November.
- **Advisory for international Civil Aviation:** The Tropical Cyclone Advisory Centre (TCAC) bulletin for International Civil Aviation were issued every six hourly to all meteorological watch offices in Asia Pacific region for issue of significant meteorological information (SIGMET) by Meteorological Watch Offices. It was also sent to Aviation Disaster Risk Reduction (ADRR) centre of WMO at Hong Kong.
- **Diagnostic and prognostic features of cyclone:** The prognostics and diagnostics of the systems were described in the RSMC bulletins and report under Tropical Cyclone Forecasting Programme since 22nd November.
- **Director General of Meteorology** addressed media through press conference on 1st December. Short video capsule on the status of Michaung was also issued by DG IMD for all stakeholders. On the day of landfall, DG IMD briefed print and electronic media every hourly.
- **Briefings by Director General of Meteorology to Senior Government Officials:**

The NCMC meeting was held under the chairmanship of Cabinet Secretary on 1st and 3rd December based on the cyclone warnings issued by IMD to review the preparedness and follow up actions. The meeting was attended by Home Secretary, Chief Secretary of Tamil Nadu, Puducherry, Andhra Pradesh and Odisha among others. DG, IMD made the presentation on current status and forecast/Warnings issues as well as damage expected and suggested actions.

Statistics of bulletins issued by Cyclone Warning Division, RSMC New Delhi and different offices are given in Table 2-3.

**Table 2: Bulletins issued by Cyclone Warning Division, New Delhi**

| S. No. | Bulletin type | No. Of Bulletins | Issued to |
|---|---|---|---|
| 1 | (A)National Bulletin<br><br>(B) Special Message | 34<br><br><br>4 | 1. IMD's website, RSMC New Delhi website<br>2. FAX and e-mail to Control Room Ministry of Home Affairs & National Disaster Management Authority, Cabinet Secretariat, Ministry of Science & Technology, Secretary MOES, Headquarter Integrated Defence Staff, Director General Doordarshan, All India Radio, PIB MOES, UNI, DG National Disaster Response Force, Director, Punctuality, Indian Railways, Chief Secretary: Government of North Tamil Nadu, Puducherry, Andhra |

| | | | Pradesh, Odisha, Telangana, Andaman & Nicobar Islands |
|---|---|---|---|
| 2 | RSMC Bulletin | 45 | 1. IMD's website<br>2. WMO/ESCAP member countries through GTS and E-mail. |
| 3 | GMDSS Bulletins | 22 | 1. IMD website, RSMC New Delhi website<br>2. Transmitted through WMO Information System (WIS) to Joint WMO/IOC Technical Commission for Ocean and Marine Meteorology (JCOMM) |
| 4 | Tropical Cyclone Advisory Centre Bulletin | 15 | 1. Met Watch offices in Asia Pacific regions and middle east through GTS to issue Significant Meteorological information for International Civil Aviation<br>2. WMO's Aviation Disaster Risk Reduction (ADRR), Hong Kong through ftp<br>3. RSMC website |
| 5 | Tropical Cyclone Vital Statistics | 15 | Modelling group of IMD, National Centre for Medium Range Weather Forecasting Centre (NCMRWF), Indian National Centre for Ocean Information Services (INCOIS), Indian Institute of Technology (IIT) Delhi, IIT Bhubaneswar etc. |
| 6 | Warnings through SMS | 68,10,699 | **6969** SMS to disaster managers at national level and concerned states (every time when there was change in track, intensity and landfall characteristics)<br>**7.7 lakhs** (7,72,208) to General Public and disaster manages along the east coast of India by IMD Headquarters<br>**60 Lakhs** (60,00,884) to Farmers in the states of Andhra Pradesh, Tamilnadu and Odisha<br>**30,638** to fishermen through INCOIS network |
| 7 | Warnings through Social Media | Daily | Cyclone Warnings were uploaded on Social networking sites (Facebook and Tweeter) since inception to weakening of system (every time when there was change in track, intensity and landfall characteristics). |
| 8 | Press Release | 6 | Disaster Managers, Media persons by email and uploaded on website |
| 9 | Press Briefings | Daily | Regular & frequent briefing daily during 1st-4th December and hourly on 5th December |
| 10 | Hourly Bulletins | 19 | 1. IMD's website, RSMC New Delhi website<br>2. FAX and e-mail to Control Room Ministry of Home Affairs & National Disaster Management Authority, Cabinet Secretariat, Ministry of Science & Technology, Secretary MOES, Headquarter Integrated Defence Staff, Director General Doordarshan, All India Radio, PIB MOES, UNI, DG National Disaster Response Force, Director, Punctuality, Indian Railways, Chief Secretary: Government of North Tamil Nadu, Puducherry, Andhra Pradesh, Odisha, Telangana, Andaman & Nicobar Islands |

**Table 3: Statistics of SMS issued by Area Cyclone Warning Centre (ACWC) Chennai (CHN) & Kolkata (Kol), Cyclone Warning Centre (CWC) Bhubaneswar (BBN), Visakhapatnam (VZG), Meteorological Centre Amaravati (MC AMR) and Meteorological Office Port Blair (MO PB)**

| S.No. | Type of Bulletin | ACWC CHN | ACWC KOL | CWC BBN | CWC VZK | MC AMR | MO PB |
|---|---|---|---|---|---|---|---|
| 1. | Sea Area Bulletins | - | 28 | - | - | - | - |
| 2. | Coastal Weather Bulletins | 12 | 28 | 20 | 24 | 24 | 02 |
| 3. | Fishermen Warnings issued | 20 | A&N-18 | 41 | 24 | 10 | 09 |
| 4. | Port Warnings | 10 | WB-20 A&N-20 | 22 | 13 | - | 05 |
| 5. | Heavy Rainfall Warning | 20 | | 8 | 05 | 10 | 06 |
| 6. | Gale Wind Warning | 20 | - | - | 02 | 10 | 00 |
| 7. | Storm Surge Warning | NIL | - | - | 20 | 10 | 00 |
| 8. | Information & Warning issued to State Government and other Agencies | 20 | 7 | 33 | 47 | 10 | 34 |
| 9. | SMS/CAP(SACHET) | NIL | - | - | 10.39 crores | 5.46 crores | 09 |
| 10. | No. of Press releases | 17 | - | 9 | 29 | 5 | 00 |
| 11. | No. of impact based warnings for | 08 | - | 30 | 74 | 10 | 00 |
| 12. | No. of whatsapp messages | **10879** | **77000** | **89,559** | **10,314** | **3,55,44,75** | **20 groups** |
| 13. | No. of updates on facebook | 145 | 7 | 124 | 4 | 54 | 00 |
| 14. | No. of updates on tweeter , Instagram | 145 | 7 | 115 and 62 | 4 | 108 | 00 |
| 15. | No. video released | 11 | 2 | 27 | 4 | | |

## 8. Realized Weather

### 8.1. Realised rainfall

It caused heavy rainfall over Nicobar Islands, Tamil Nadu, Andhra Pradesh, Odisha, Jharkhand, Gangetic West Bengal, Telangana and Mizoram

24 hours accumulated realized heavy rainfall (≥7cm) ending at 0830 hours IST of date:

**27th Nov, 2023**:

**Andaman & Nicobar Islands**: Car Nicobar 8

**3rd Dec, 2023**:

**Tamil Nadu & Puducherry:** Pallipattu 15; Uthukottai 13; Thenkasi 11; Zone 12 Alandhur & Ponneri 10 each; Tiruttani, Avadi & Wallajah 9 each; Meenambakkam , Anna University, Zone 12

Meenambakkam, Alandur, Chennai(AP), Zone 14 Perungudi, Oothu, Shencottah, Tiruvallur, Anna University, Zone 12 D156 Mugalivakkam & Thamaraipakkam 8 each; Zone 11 Valasaravakkam, Gundar Dam, Zone 10 Kodambakkam, Zone 14 U41 Perungudi, Nalumukku, Cholavaram, Tambaram, Zone 13 U39 Adyar, Zone 09 Ice House, Papanasam, VIT_Chennai, MGR Nagar, Zone 09 Teynampet & Kakkachi 7 each;

**Rayalaseema:** Thottambedu 15, Srikalahasti 14, Tirupati Aero 13, Satyavedu 10, Nagari & Tada 9 each, Sullurpeta, Gudur 8 each;

**Coastal Andhra Pradesh**: Nellore 7

**4th Dec, 2023**:

**Raylaseema**: Sullurpeta 20; Tada 19; Gudur 14; Srikalahasti, Thottambedu & Satyavedu 13 each; Nagari 12, Tirupati Aero 7;

Coastal Andhra Pradesh : Nellore 19;

**Tamilnadu, Puducherry & Karaikal**: Zone 14 Perungudi 29; Avadi 28; Alandur & Chennai (AP) 25 each; Zone 13 Adyar, Meenambakkam AWS, Zone 12 Meenambakkam, Chennai (N), Puzhal & Cholavaram 23 each; Mahabalipuram, MGR Nagar, Zone 10 Kodambakkam & CD Hospital Tondiarpet 22 each; Zone 11 Valasaravakkam, Zone 15 Sholinganallur, DGP Office, Pallikaranai, Chennai (N), Anna University & Ponneri 21 each; Zone 03 Puzhal, Perambur, Zone 09 Ice House & Red Hills 20 each; Ayanavaram Taluk Office, Taramani, Satyabama Uty, Anna Nagar & VIT_Chennai 19 each, Chennai Collector Office, Sholinganallur), Zone 09 Teynampet, Zone 08 Malar Colony, Ambattur, Anna University, Valasaravakkam, Good Will School Villivakkam, YMCA Nandnam, KVK Kattukuppam, Thamaraipakkam & Kodambakkam 18 each; Gummidipoondi, Tambaram, Ambathur-2 & Kelambakkam 17 each; Zone 06 T.V.K Nagar, Zone 04 Tondiarpet, Chembarapakkam, Teynampet, Tiruvallur, Zone 01 Kathivakkam, ThiruViKa Nagar & Zone 03 Madhavaram 16 each & Uthukottai, Zone 08 Anna Nagar, Sholinganallur, Tirur KVK, Zone 06 Kolathur, Tondairpet, Zone 14 Perungudi & Ennore 15 each, Zone 07 Ambattur, Zone 13 Adyar Eco Park, Zone 05 GCC, Poonamallee, Thirukalukundram, Zone 12 Alandhur & Koratur 14 each; Sriperumbudur, Thirupporur, Zone 02 Manali, Zone U39 Adyar & Chembarabakkam 13 each; Mugalivakkam, Kundrathur, Chengalpattu, Zone 15 Uthandi, Royapuram & Zone 07 U18 D81 Vanagaram 12 each; Zone 05 Royapuram & Zone U32 Maduravoyal 11 each; Poondi & Tiruttani 10 each; Thiruvottiyur, Maduranthagam, Thiruvalangadu, Kancheepuram, Uthiramerur & Cheyyur 9 each; Walajabad, Minnal, Arakonam & Marakkanam 8 each; Thiruvottiyur 7

**5th Dec, 2023**:

**Tamil Nadu**: Poonamallee 34; Avadi 28; KVK Kattukuppam 27; Chennai (N), Chennai(N) AWS & Tambaram 24 each & Mahabalipuram & Zone 09 Ice House 22 each; Royapuram, Zone 13 Adyar, ThiruViKa Nagar, Zone 05 GCC, Zone 10 Kodambakkam & Chembarapakkam_Rev 21 each; Zone 15 Sholinganallur, Taramani, Meenambakkam, Chennai (AP), Kundrathur, Thamaraipakkam, Kodambakkam & Tirur KVK 19 each, Teynampet, Valasaravakkam, Tiruvallur, Anna University & Zone 11 Valasaravakkam 18 each, Uthukottai, NIOT_Pallikaranai, Ponneri, Sriperumbudur & Koratur 17 each; Kelambakkam 16; Cholavaram 15; Thiruvalangadu, Poondi, Alandur & Thirupporur 14 each; Red Hills 13; Zone Alandhur, Tiruttani, Gummidipoondi & Chembarabakkam_CMWSSB 12 each; Thirukalukundram, Pechiparai & Zone 05 Royapuram 11 each; Minnal & Zone 04 Tondiarpet 10 each; Chengalpattu, Zone 12 D156 Mugalivakkam, Wallajah, Perunchani Dam & Tiruttani PTO 9 each; Zone 03 Puzhal, Puthan Dam, Panapakkam

& Zone 09 Teynampet 8 each, R.K.Pet, Walajabad, Pallipattu, Vembakkam, Sholingur & Kuzhithurai 7 each;

**Coastal Andhra Pradesh**: Bapatla 22; Nellore 22; Rapur 21; Atmakur 19; Amalapuram, Addanki & Karamchedu 17 each; Masulipatnam Cdr 16; Kavali 15; Avanigada & Vinjamur 14 each, Udayagiri 13; Ongole 12; Repalle & Kandukur 11 each; Konakanamitla, Gudivada, Santhamaguluru 9 each; Tenali, Kakinada & Yanam 8 each, Marripudi, Veligandla, Mundlamuru, Guntur, Seetharamapuram, Tanuku, Vijayawada & Peddapuram 7 each;

**Raylaseema:** Gudur 28; Srikalahasti 24 & Kodur 24 each; Thottambedu, Sullurpeta & Penagaluru 23 each; Tadapati 20; Venkatagiri 18; Satyavedu 14; Nagari & Tirupati Aero 13 each; Rajampet 12; Atlur 9; Badvel 8; Gurramkonda, Kalakada, Sambepalle, Royachoti, Pakala, Pullampeta, Chinnamandem & Cuddapah 7 each

**6th Dec, 2023:**
**Telangana:** Aswaraopeta 34; Palawancha 25; Chandrugonda 23; Kothagudem 22; Julurpad & Mulakalapalle 20 each, Aswapuram 19; Burgampadu 18 & Bhadrachalam 18 each; Sathupalle 16; Tekulapalle 15; Madhira & Enkuru 14 each; Bonakal 13; Manuguru & Wyra Kvk 12 each; Pinapaka & Thollada 10 each; Konijerla 9; Gundala 8; Venkatapur, Chinthakam & Yellandu 7 each;

**Coastal Andhra Pradesh:** Bhimadole 24; Kukunoor 22; Narsapuram 21 & Chintalapudi 21; Narsipatnam, Bheemavaram & Koyyalagudem 20 each; Amalapuram, Anakapalle, Kunavaram & Yelamanchili 19 each; Sattenapalle & Palakoderu 18 each; Tanuku 17; Kaikalur, Prathipadu, Santhamaguluru & Polavaram 16 each; Chodavaram, Visakhapatnam, Denkada & Chintur 15 each; Tadepalligudem, Darsi & Kakinada 14 each; Anakapalle, Velairpad, Srungavarapukota & Tiruvuru 13 each; Tuni, Chintapalle, Mentada, Paderu & Nuzvid 12 each; Nandigama, Eluru, Vararamachandrapur, Guntur, Bondapalle, Gajapathinagaram, Vepada & Amaravati 11 each; Vizianagaram, Bheemunipatnam, Mangalagiri, Piduguralla, Araku Valley & Yanam 10 each; Pusapatirega, Peddapuram, Addanki, Gantyada, Mundlamuru & Lam 9 each; Podili, Atchampet, Vijayawada, Garividi & Ranastalam 8 each; Nellimarla, Jangamaheswarapuram, Cheepurupalle, Visakhapatnam & Gudivada 7 each;

**Tamil Nadu**: Virudunagar, Ponnamaravathi, Natham, Singampunari, Sathiar, Arimalam 7 each;
**Odisha:** Pottangi 11; Similiguda 9; Koraput 7.

**7th Dec.:**
**Coastal Andhra Pradesh**: Yelamanchili (dist Anakapalli) 7, Chodavaram (dist Anakapalli) 7, Araku Valley (dist Alluri Sitharamaraju)-7
**Gangetic west Bengal**: Phulberia-7,
Jharkhand: Kharsema-7

**8th Dec.:**
**Mizoram**: Champhai-8, Lengpui-8, Serchip-7, Lenglui-7
**Gangetic West Bengal**: Burdwan-7

**8.2. Realised wind**
Realised wind reported at different stations of **Andhra Pradesh**:
  ❖ Krishnapatnam Port reported 103 kmph gusting to 115 kmph on 4th December, 2023
  ❖ MO Bapatla reported $140^0$/38kt (75 kmph) at 1430 hours IST on 05th December 2023

❖ Kavali High Wind Speed Recorder reported $270^0/36$kts (70 kmph) at 1644 hours IST of 04th December 2023

Realised wind reported at different stations of **Tamil Nadu:**

❖ High Wind Speed Recorder at Chennai (NBK) recorded wind speed of about 75 kmph (40-45 knots) in gusts during early hours to noon of 04th December 2023.

❖ NBK Anemograph recorded wind speed of 60-70 kmph in gusts during this period

❖ MBK recorded wind speed of 80-90 kmph in gusts during this period

❖ NBK AWS 30 kt (56 kmph) on 04th / 14:15 IST

❖ MBK AWS 37 kt (68 kmph) on 04th / 10:30 IST

❖ Ennore AWS recorded 43 knots (80 kmph) on 04th /19:45 IST (75 kmph) in gusts

AWS: Automatic Weather Station, MBK: Meenambakkam, NBK: Nungambakkam

Estimated wind speed realised during cyclone Michaung is presented in **Fig. 11**.

## 8.3. Realised storm surge
Storm surge of height 1.0-1.5 m was realised over low lying areas of south coastal Andhra Pradesh (maximum over Krishna and Bapatla districts) at the time of landfall.

## 9. Damage report
As per media reports, 17 persons were killed in various incidents associated with "Michaung" in Tamil Nadu and two in Andhra Pradesh. More than 41,000 people were evacuated and temporarily relocated, including 32,158 in Tamil Nadu and 9,500 in Andhra Pradesh. Schools and offices were closed due to heavy rains and flooding in Chennai. In Andhra Pradesh, crop damage and losses were reported due to the flooding of fields. The damage photographs from Tamil Nadu and Andhra Pradesh are presented in **Fig. 12 and 13 respectively**.

## 10. Acknowledgements:
India Meteorological Department (IMD) and RSMC New Delhi duly acknowledge contribution from WMO and WMO/ESCAP member countries including Sri Lanka, Bangladesh and Myanmar for observational data. The contribution from RSMC Tokyo is also duly acknowledged for sharing the expected migration of cyclonic circulation into Andaman Sea. The contribution from all the stake holders and disaster management agencies who contributed to the successful monitoring, prediction and early warning service of SCS MICHAUNG is also duly acknowledged. We acknowledge the contribution of all sister organisations of Ministry of Earth Sciences including National Centre for Medium Range Weather Forecasting Centre (NCMRWF), Indian National Centre for Ocean Information Services (INCOIS), National Institute of Ocean Technology (NIOT), Indian Institute of Tropical Meteorology (IITM) Pune. The support from various Divisions/Sections of IMD including Area Cyclone Warning Centre (ACWC) Chennai & Kolkata, Cyclone Warning Centres Bhubaneswar, Visakhapatnam, Meteorological Centre Amaravati and Meteorological Office Port Blair. The contribution from Numerical Weather Prediction Division, Satellite and Radar Division, Surface & Upper Air Instruments Divisions, Agromet Advisory Division, Information System and Services Division and Cyclone Warning Divison at IMD is also duly acknowledged.
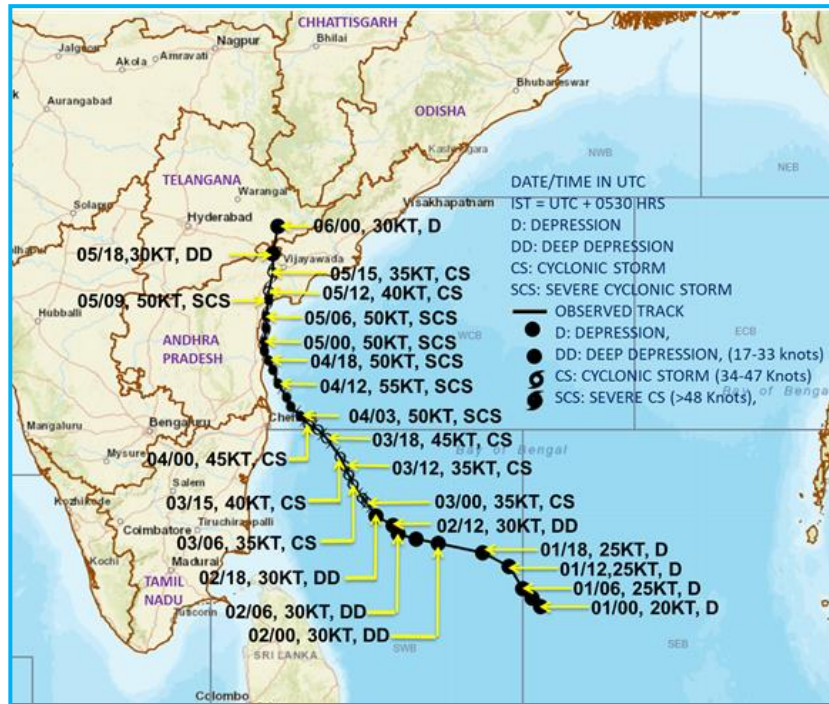
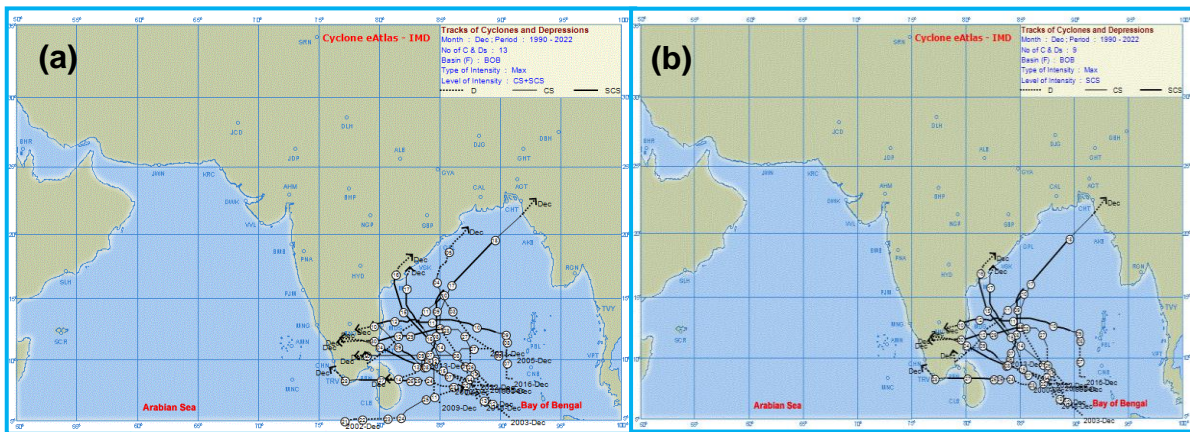**Fig. 1: Observed track of severe cyclonic storm "Michaung" over the Bay of Bengal during 1ˢᵗ-6ᵗʰ December**



**Fig. 2: Tracks of (a) cyclones (maximum sustained wind speed ≥34 knots) and (b) severe cyclones (MSW ≥48 knots) in the month of December during 1990-2022**
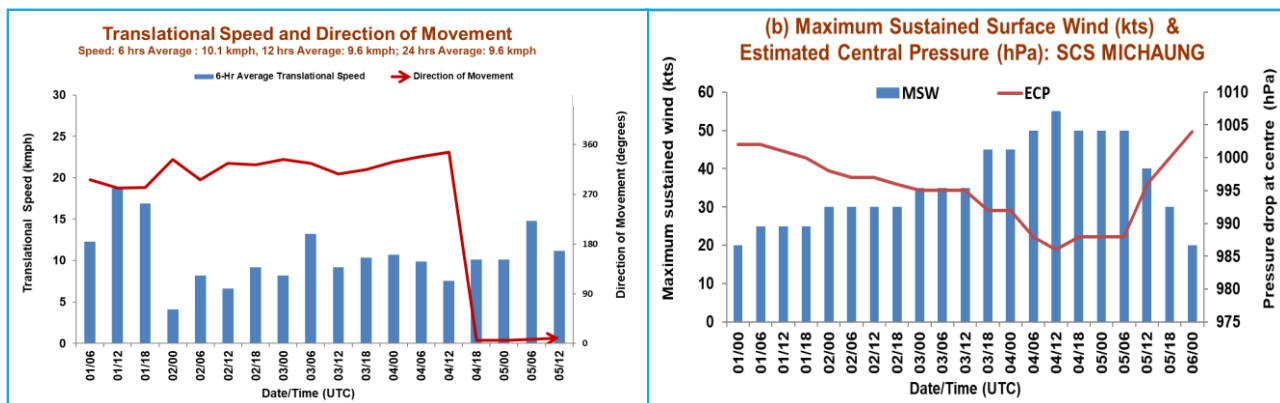


**Fig. 3: (a) 6 hourly average translational speed and (b) maximum sustained wind speed & estimated central pressure during life cycle of Michaung**
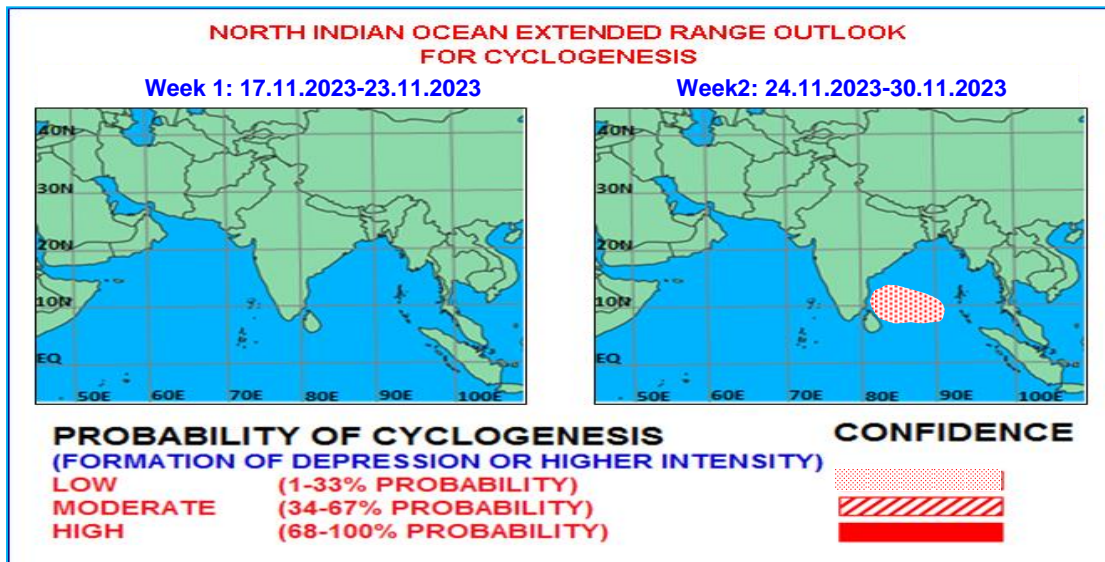
**Fig. 4(a): Weekly extended range outlook issued by IMD on 16th November about 15 days prior to formation of depression on 1st December and 19 days prior to the landfall of system over south Andhra Pradesh coast indicating formation of depression over southwest BoB during the week 2**
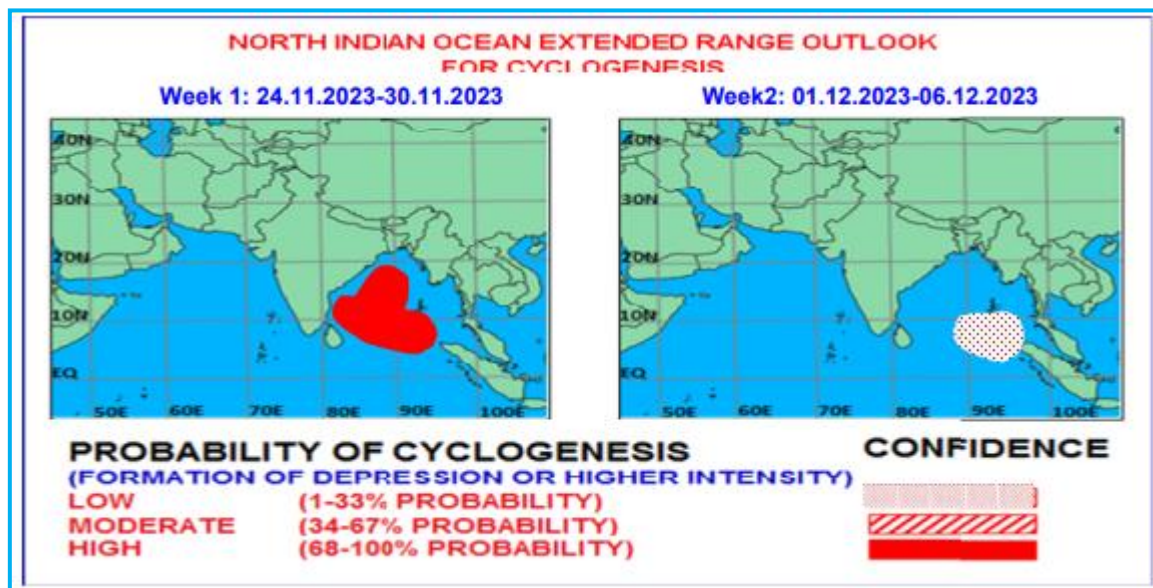


**Fig. 4 (b): Weekly extended range outlook issued by IMD on 23rd November about 8 days prior to formation of depression on 1st December and 12 days prior to the landfall of system over south Andhra Pradesh coast indicating formation of depression over southwest BoB during the week 1 and movement towards South Andhra Pradesh coast alongwith northeastwards recurvature.**

15
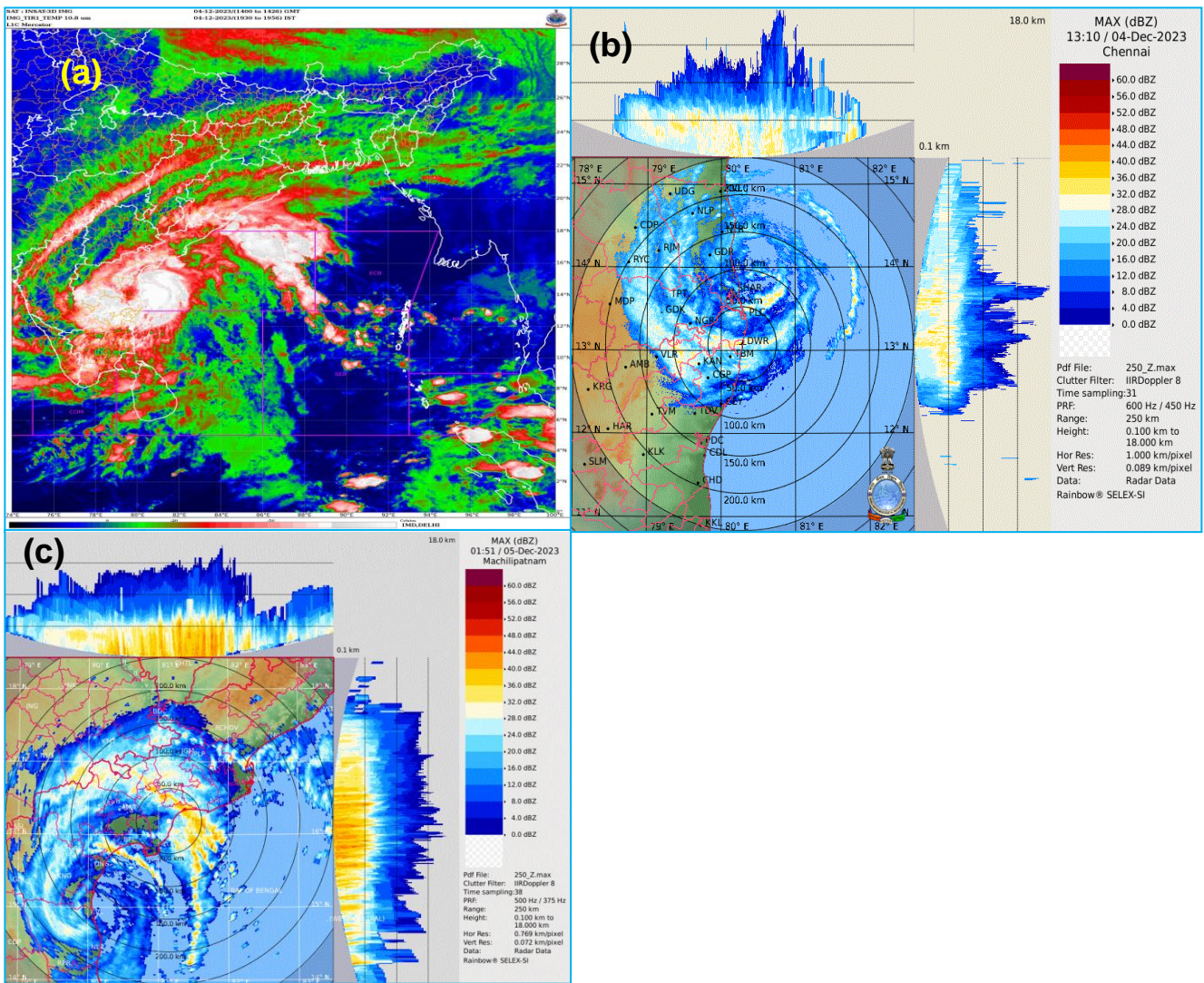
**Fig. 5:** Typical (a) enhanced color imagery from INSAT 3D(R) at 1930 hrs IST/ 1400 UTC, (b)  reflectivity imagery from DWR,  Chennai at 1840 hrs IST/1310 UTC and (c) DWR Machilipatnam at 0720 hours IST/0151 UTC of 5th December, 2023 during life cycle of severe cyclonic storm "MICHAUNG"
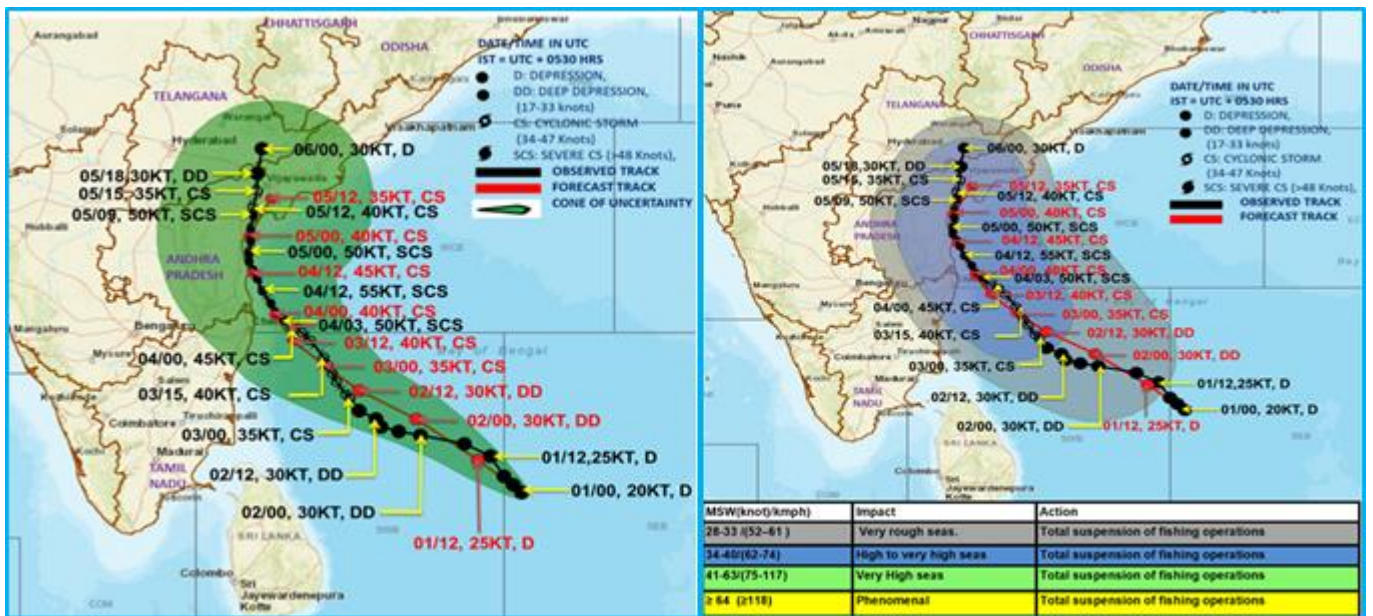


**Fig. 6: Observed track and forecast track & intensity issued based on 0000 UTC observation of 1st December (at the stage of depression) about 4 days and 6 hours ahead of landfall**
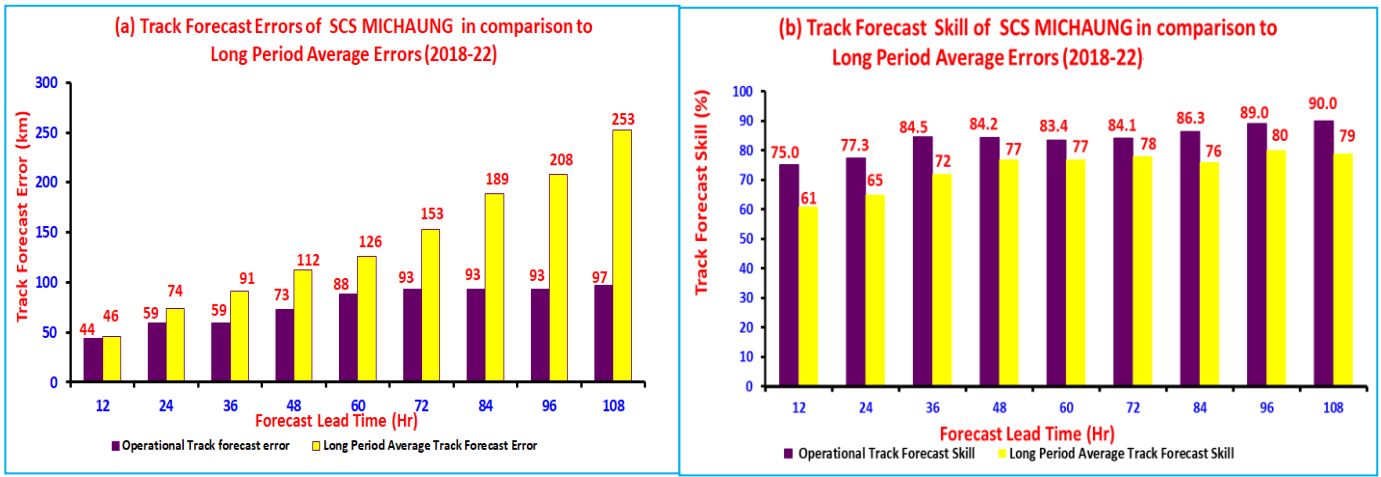
Fig. 7: (a) Track forecast errors and (b) skill against the long period average (LPA) errors (2018-22)
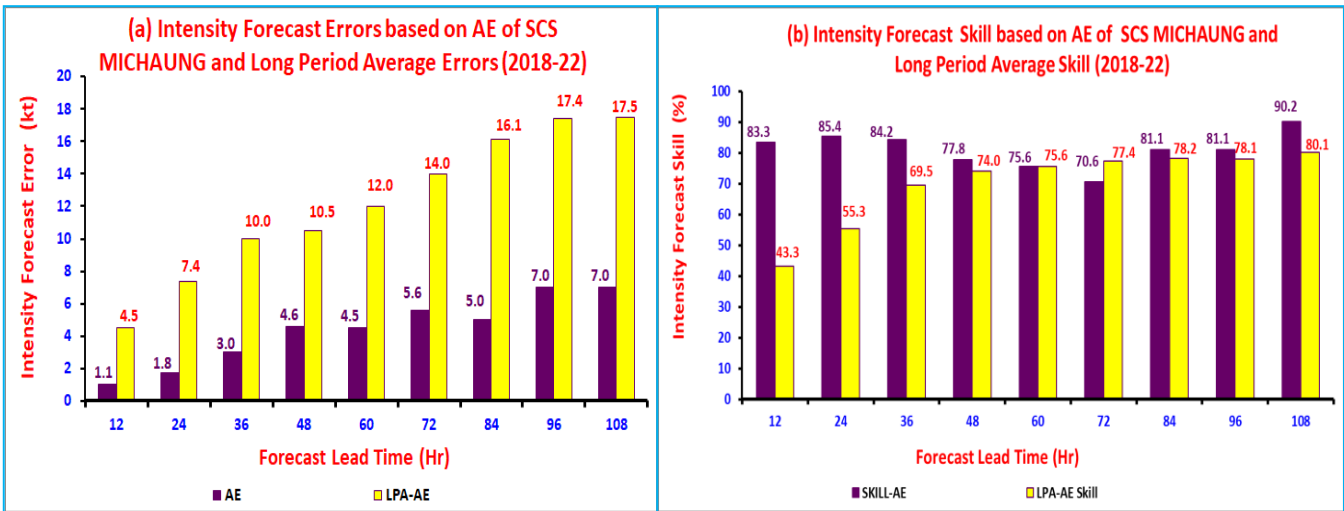


Fig. 8: (a) Intensity forecast errors (AE) and (b) skill against the long period average (LPA) errors (2018-22).
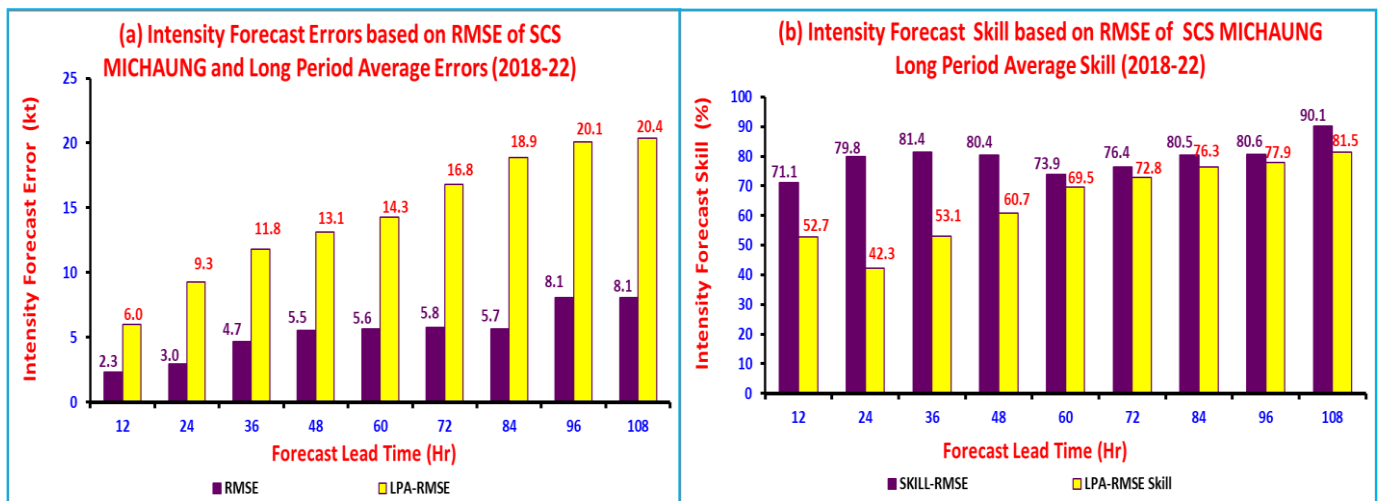


Fig. 9: (a) Intensity forecast errors (RMSE) and (b) skill against the long period average (LPA) errors (2018-22)
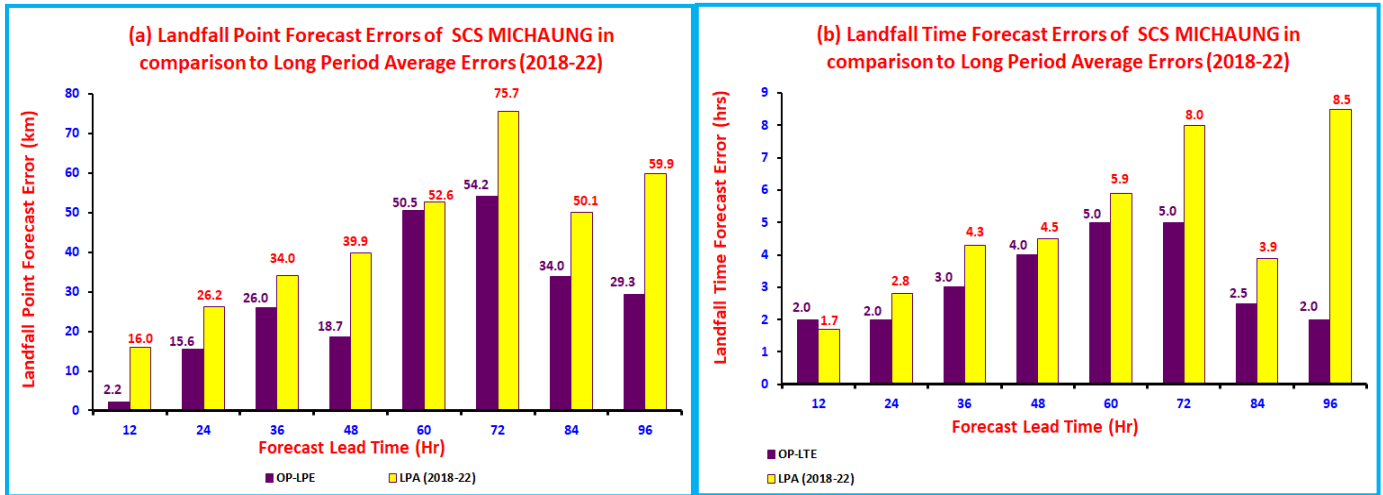
17

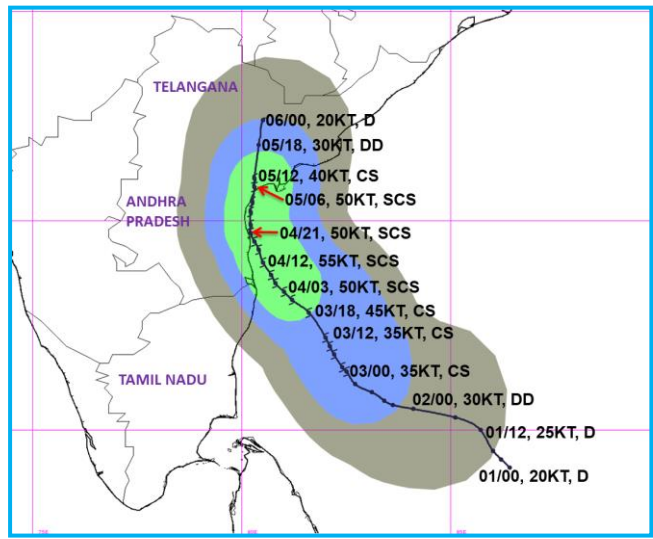**Fig. 10: (a) Landfall point and (b) time error against the long period average (LPA) errors (2018-22)**



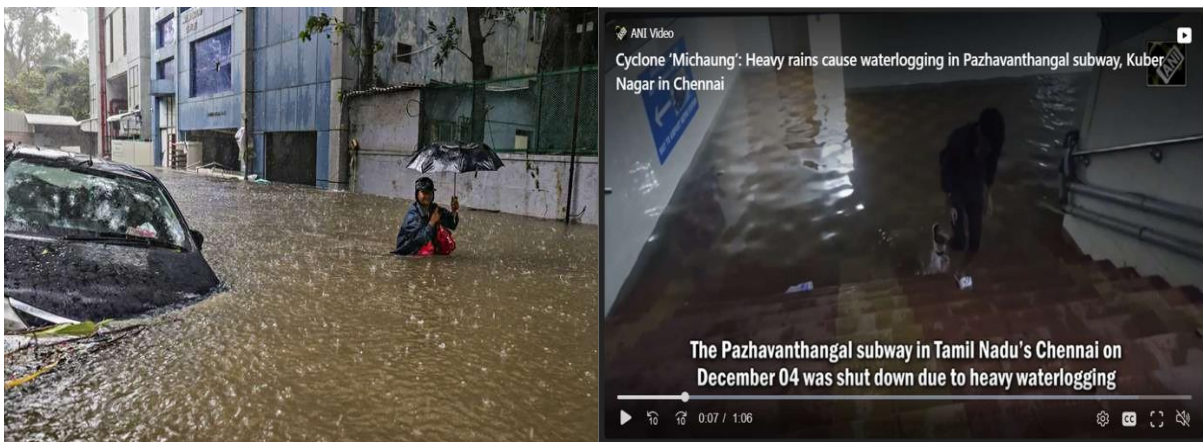**Fig. 11: Estimated maximum sustained wind during the life cycle of SCS Michaung**



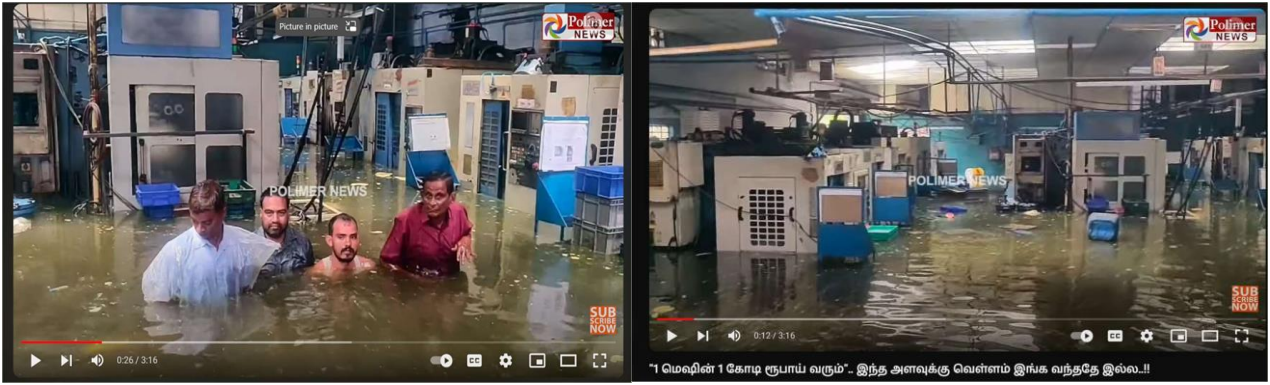**Fig. 12: Submerged cars in flooded Chennai**

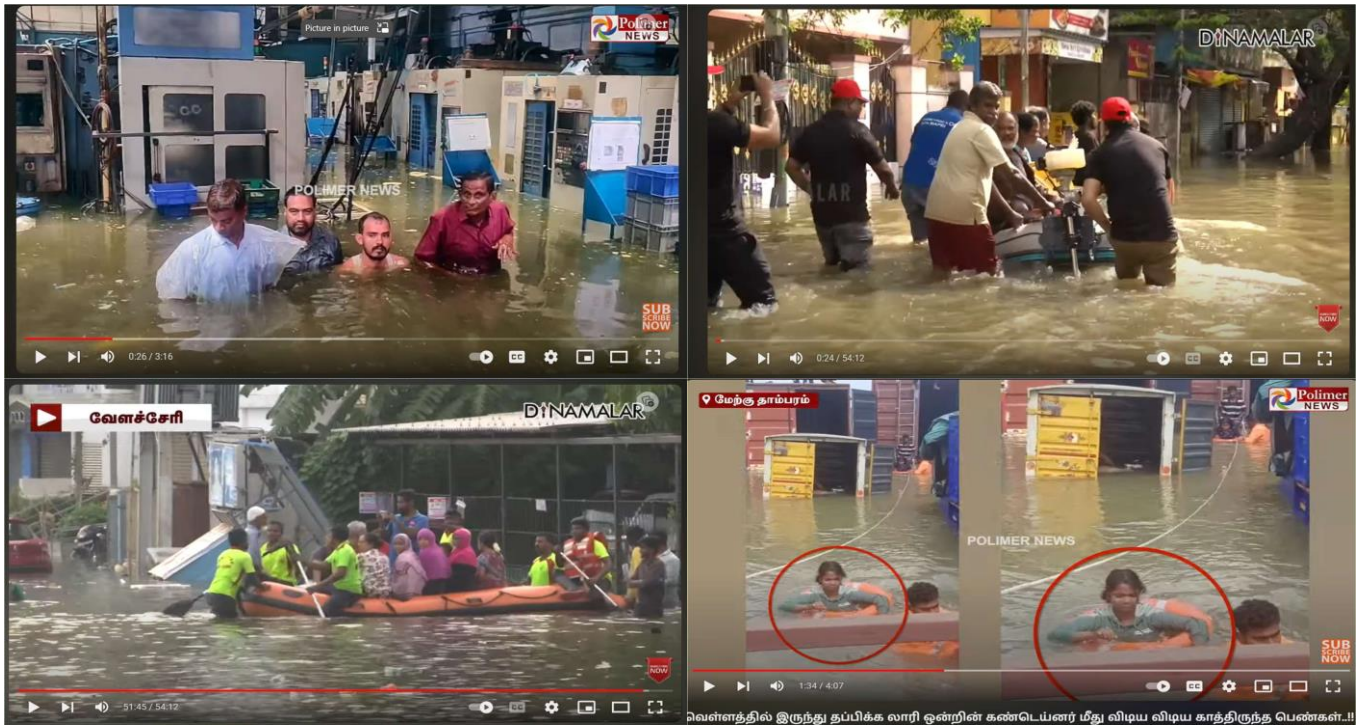**Fig. 12 contd: Flooded factories and houses in Chennai**


**Fig. 12 contd: Rescue workers in Velachery and Tambrahm**


**Fig. 13: Water logging in Visakhapatnam and Machilipatnam**

బందరు మండలం పొట్లపాలెంలో అధికారులకు పంట చూపుతున్న రైతులు

మచిలీపట్నం: జాతీయ రహదారి పక్కన పొలంలో పనలు

గూడూరు మండలం మల్లవోలులో ..

బుద్దాలపాలెంలో..

భాస్కరపురం: మెడికల్ కళాశాల పక్కనే..

చిన్నాపురం: ఉధృతంగా ప్రవహిస్తున్న గుండేరు

**Fig. 13 contd: Damaged crops in Machilipatnam and Krishna District**



**Fig. 13 contd.: Prakasam District (Damage to Banana trees)**

**Fig. 14: Damaged crops in Malkangiri district of Odisha**

Table 1. Significant rainfall (≥12 cm) realised over Tamil Nadu in association with various past cyclonic disturbances over the Bay of Bengal is presented in table below.

| S.NO | Period | Crossing Point | Rainfall (cm) over Chennai, Chengalpattu, Kancheepuram & Thiruvallur districts |
|---|---|---|---|
| 1 | Cyclonic Storm (22-29 Oct 1976) | Weakened off Coast | **25.11.1976**: Chennai 45 , Chennai AP 35 |
| 2 | Severe Cyclonic Storm (16-21 Oct 1982) | Sriharikota | **19.10.1982**: Chennai 12, Chennai AP 11 |
| 3 | Severe Cyclonic Storm (09-14 Nov 1984) | Sriharikota | **12.11.1984**: Chennai AP 12 ;   **13.11.1984**: Chennai 25, |
| 4 | Very Severe Cyclonic Storm (27 NOV - 06 Dec 1996) | Chennai-Puducherry | **07.12.1996**: Thiruvallur 13, Kancheepuram 11 |
| 5 | Deep Depression (26-29 Oct 2005) | Ongole | **28 Oct 2005** : Tiruvallur 27, Redhills 24, Ponneri 20, Chennai 16, Tambaram 13. |
| 6 | Cyclonic Storm Baaz (28 Nov-2 Dec 2005) | Weakened OFF North tamil Nadu-South Andhra Pradesh coast | **03.12.2005**: Tambrham 31, Chennai AP 28, Thiruvallur & Chennai city 23 each,  Arakonam 21, Sri Perumbuthur 18,  Chengalpattu & Red Hills 15 each, Tiruttani 14, Poondi 13, Ponneri 11. |
| 7 | Cyclonic Storm Ogni (28-30 Oct 2006) | Ongole-Bapatla | **29.10.2006**: Chennai 19, Tiruvallur 18, Red  Hills 13 |
| 8 | Severe Cyclonic Storm Laila (17-21 May 2010) | Bapatla | **20.05.2010**: Ponneri 17, Cholavaram 13, Chennai, |
| 9 | Severe Cyclonic Storm Nilam (28 Oct-02 Nov 2012) | Mahabalipuram | **31 .10.2012**:  Mahabalipuram 13 |
| 10 | Cyclonic Storm Roanu (17-22 May 2016) | Bangladesh | **18.05.2016**: Kelambakkam 23, Ponneri 15, Mahabalipuram and  Satyabama Uty ARG 14 each, Chembarabakkam and  Chennai AP 12 each, |
| 11 | Very Severe Cyclonic Storm Vardah (06-13 Dec 2016) | Chennai | **13.12.2016**: Satyabhama University (Kancheepuram)-38, Kattukuppam (Kancheepuram)-34, Kancheepuram (Kancheepuram)-28,  Poonamallee (Tiruvallur)-22, Chembarabakkam (Tiruvallur)-21, Meenambakkam-20 Sriperumbudur (Kancheepuram)-17, Chembarambakkam (Tiruvallur)-16, Tambaram (Kancheepuram)-14, Nungampakam-12 |
| 12 | Very Severe Cyclonic Storm Nivar (22-27 Nov 2020) | Puducherry | **25.11.2020**: : Chennai (Nungambakkam) 16,  Anna University, Chennai  (Meenambakkam) & Sholinganallur 15 each,  Taramani, Anna University, DGP Office & MGR Nagar 14, Mahabalipuram, Alandur,  Hindusthan University, Puzhal & Chembarambakkam 12 each,      **26.11.2020**: Tambaram (Chengalpattu district)  31 cm,  Chennai Mylapore (DGP office)  26 cm, Sholinganallur (Chennai district) 22 cm,  Thamaraipakkam 19,  Pallipattu 17, Cholavaram 16,  Poonamallee, Ambathur, Tiruvallur, Mahabalipuram & Gummidipoondi 15 each, Tindivanam, Maduranthagam, Chembarabakkam, Anna University 14 each, MGR Nagar, Kancheepuram, Alandur,  Red Hills,  Chengalpattu, Tiruttani  13 each, Poondi,  Koratur 12 each, Chennai Airport, |

| | | | Poonamalle, Thirukalukundram, Sriperumbudur 11 each, |
|---|---|---|---|
| 13 | Depression (10-12 Nov 2021) | Chennai | **11.11.2021**: Tambaram (dist Chengalpattu) 23 cm, Cholavaram (dist Tiruvallur) 22 cm, EnnoreAWS (dist Tiruvallur) 21 cm, Gummidipoonai & Red Hills 18 each, Mahabalipuram & Perambur 17 each, Nungambakkam 16, Ambathur & Thomaraipakkam, MGR Nagar 15 each, Chembarabakkam, Meenambakkam, Taramani, Anna University & Chennai 14 each, Ponneri 13, Kelabakkam, Satyabama, Thirupporur, Poonamallee 12 each, |
| 16 | Cyclonic Storm Mandous (06-10 Dec 2022) | Mahabalipuram | **10.12.2022**: Vembakkam 25, Minnal & Panapakkam 20 each, Kancheepuram 19, Cheyyar 18, Avadi 17, Tiruttani & KVK Kattukuppam Agro 16 each, Ayanavaram Taluk Office & Kundrathur 15 each, Arakonam, Uthiramerur & Perambur 14 each, Gummidipoondi, Tambaram, Sriperumbudur, Mahabalipuram, Cholavaram, Pallipattu, MGR Nagar, Alandur & Uthukottai 13 each, Ambathur, Red Hills, Chengalpattu, Koratur, Chennai 12 each |