वार्षिक प्रतिवेदन
ANNUAL REPORT
2025

राष्ट्र सेवा के 150 गौरवपूर्ण वर्ष

150 Glorious Years of Service to the Nation

भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT
पृथ्वी विज्ञान मंत्रालय, भारत सरकार
MInistry of Earth Sciences
Government of India

वार्षिक प्रतिवेदन

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INDIA METEOROLOGICAL DEPARTMENT

(MINISTRY OF EARTH SCIENCES)

(GOVT. OF INDIA)

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INDIA METEOROLOGICAL DEPARTMENT ORGANIZATION CHART

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Minister of State (Independent Charge) of Science & Technology,
Minister of State in the Prime Minister's Office, Minister of State in the Ministry of Personnel, Public Grievanc

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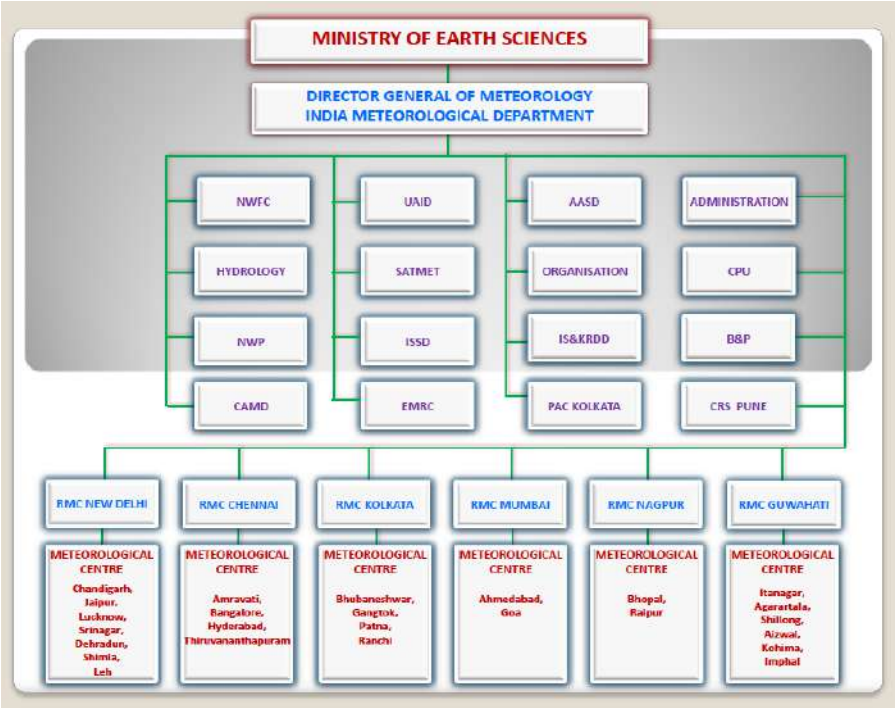
Dr. Mrutyunjay Mohapatra

Director General of Meteorology
India Meteorological Department



NWFC	:	*National Weather Forecasting Centre*	*AASD*	:	*Agromet Advisory Services Division*
Hydrology	:	*Hydromet Division*	*Organisation*	:	*Organisation*
NWP	:	*Numerical Weather Prediction*	*IS&KRDD*	:	*Information Science & Knowledge Resource Development Division*
CAMD	:	*Central Aviation Meteorological Division*	*PAC Kolkata*	:	*Positional Astronomy Centre, Kolkata*
UAID	:	*Upper Air Instruments Division*	*Administration*	:	*Administration*
SATMET	:	*Satellite Meteorology Division*	*CPU*	:	*Central Purchase Unit*
ISSD	:	*Information Systems and Services Division*	*B&P*	:	*Budget & Planning*
EMRC	:	*Environment Monitoring & Research Centre*	*CRS Pune*	:	*Climate Research & Services, Pune*

FOREWORD

It is a great privilege to present the Annual Report of India Meteorological Department (IMD) for the year 2025. The report highlights significant activities of the department during the year. The department has been playing a leading role in the field of Earth and Atmospheric Sciences by providing services in meteorology and allied fields.

During 2025, the IMD progressively strode towards modernization of scientific infrastructure in the fields of meteorological observations, information systems, numerical modelling and weather forecasting. It helped to render better services in areas of disaster management, agriculture, aviation, shipping, fisheries, energy and transport etc. IMD's services of very short range (up to 6 hrs), short range (up to 3-days in advance), medium range (up to 4-10 days in advance), extended range (up to 4 weeks in advance) and long range (monthly and seasonal) forecast alongwith severe weather (cyclones, thunderstorms, heavy rainfall, heat wave, cold wave, fog, etc.) warnings continuously improved to meet the demands of the user agencies, disaster managers, emergency response groups, stakeholders and general public.

IMD celebrated its 150th Foundation Day on 14th & 15th January, 2025. Hon'ble Prime Minister **Shri Narendra Modi Ji** graced this momentous occasion as Chief Guest. **Dr. Jitendra Singh**, Hon'ble Minister, Union Minister of State (Independent Charge) of the Ministry of Earth Sciences and **Prof. Celeste Saulo**, Secretary General, WMO also graced the occasion as guests of honour, at Bharat Mandapam, New Delhi. The Permanent Representatives of various member countries to WMO, representatives from World Bank, United Nations, Heads of various organisations, Chief Secretaries, Secretaries to Govt. of India, Heads of leading organisations, retired and serving employees of IMD and MoES Institutes, representatives of State and Central Government Agencies, R&D and academic institutes, students, teachers and parents of students participated in the function.

At the Foundation Day ceremony of the India Meteorological Department (IMD), the Hon'ble Prime Minister, Narendra Modi, addressed the nation and praised IMD's vital role in advancing India's scientific progress. He highlighted IMD's contributions to disaster management, accurate weather forecasting, and climate resilience, noting its positive impact on agriculture, the blue economy, and other key sectors. He emphasized that scientific progress is meaningful only when it benefits the poorest and reaches every section of society, commending IMD for doing so.

To mitigate the impact of climate change and extreme weather events and strengthen the resilience of the communities, the Hon'ble Prime Minister of India launched the new Central Sector Scheme 'Mission Mausam' on January 14, 2025 with the goal of making Bharat a "Weather-ready and Climate-smart" nation. Mission Mausam aims to enhance weather

monitoring and forecasting across India and surrounding regions by leveraging advanced observational and computing technologies for greater precision and resolution.

Dr. Jitendra Singh, HMoES in his address appreciated IMD and described detailed achievements of IMD including the improvement in forecast accuracy in recent decades and improvement in observation, modeling and communication infrastructure of IMD.

IMD completed 150 glorious years of its establishment on 15th January, 2025. This milestone highlights its enduring commitment to excellence, from predicting the intricate patterns of the monsoon to addressing emerging challenges like climate change. To mark this extraordinary achievement, year-long activities were organized at all offices of IMD.

- Weather Services For Women: A one-day seminar on "Weather Services for Women" was organized on 3rd January, 2025, at Mahika Hall, Ministry of Earth Sciences (MoES), New Delhi.

- Weather And Youth (Way): One-day National workshop on "Weather and Youth (WAY)" was organized at Mahika Hall, Prithvi Bhawan, MoES, New Delhi on 11th January, 2025.

- Run For Mausam: The 'Run for Mausam' event was organised on January 12, 2025 at Jawaharlal Nehru Stadium, New Delhi, bringing together people in support of climate action for a sustainable future.

- National Symposium On 75years of Mausam Journal: One day National Symposium on "Seventy-Five Years of Accomplishment of Mausam: Journal of Meteorology, Hydrology and Geophysics" was organized at Mahika Hall, Prithvi Bhawan, MoES, New Delhi on 13th January, 2025. The scientists in IMD have published 156 research papers in peer reviewed national and International journals during the year 2025.

- The Tableau of India Meteorological Department, Ministry of Earth Sciences made its debut in the Republic Day Parade this year, showcasing the advancements and contributions of the India Meteorological Department since 1875. The Tableau also depicted continued support of the Ministry's scheme for development of weather and climate science and services including "Mission Mausam" recently launched by Hon'ble Prime Minister of India, Shri Narendra Modi Ji.

IMD monitors the climate parameters and provides annual climate statement to the country, WMO and IPCC. The country's annual mean land surface air temperature (25.37°C) in 2025 was +0.28°C higher than the 1991–2020 long-term average, ranking the year as the eighth warmest since records began in 1901.The warmest year on record was 2024, when temperatures across India were 0.65 °C above the long –term average. The decade 2016–2025 emerged as the warmest on record, with a decadal mean annual temperature anomaly (Actual–LPA) of 0.32°C. Over the longer period from 1901 to 2025, the country-averaged annual mean temperature

exhibits a statistically significant increasing trend of 0.68°C per 100 years. During the same period, maximum and minimum temperatures also showed significant warming trends, increasing at rates of 0.89°C and 0.47°C per 100 years, respectively. The all India averaged seasonal mean temperature was above normal during the Winter season (January – February), experienced the highest anomaly on record since 1901 at +1.17°C, Pre-Monsoon season (March – May) was +0.29°C, Southwest Monsoon season (June – September) was +0.09°C and Post-Monsoon season (October- December), with slightly below-normal anomaly of -0.10°C.

The annual rainfall over the country was 110% of Long Period Average (LPA) value for the period 1971-2020.The rainfall during the Southwest Monsoon season was 108% of its LPA. During the period, among the four homogenous regions of the country, South Peninsular, Central India and Northwest India received above normal rainfall (110%, 115% and 127% of its LPA respectively), while East and Northeast India received below normal rainfall (80% of its LPA). During the season, out of 36 meteorological subdivisions, 2 subdivisions received large excess rainfall, 12 subdivisions received excess rainfall, 19 received normal rainfall and the remaining 3 subdivisions received deficient rainfall. Rainfall over homogeneous region of Northwest India (747.9 mm) was highest since 2001 and 6th highest since 1901. Rainfall over homogeneous region of East & Northeast India (1089.9 mm) was 2nd lowest since 1901 and also since 2001.

Finally, I sincerely thank all the employees of IMD for their support and commitment throughout the last year and I look forward to your continued support in our journey towards setting higher levels of excellence. My special thanks to Dr. D. S. Pai, Scientist ‘G’, Dr. V. K. Soni, Scientist ‘G’ and Mr. Sunny Chug, Scientist ‘D’, Information Science & Knowledge Resource Development Division (IS&KRDD) (Formerly Publication Section) and their team in the division for their sincere efforts in compilation, editing and publication of this Annual Report 2025.

Dr. Mrutyunjay Mohapatra
Director General of Meteorology

Document Control Sheet

India Meteorological Department

Ministry of Earth Sciences (MoES)

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14.	Abstract	This report highlights the progress made by the India Meteorological Department during the year 2025. The Department is continuously augmenting its observational, forecasting and information systems to render improved services in areas of agriculture, aviation, shipping, fisheries, environment, water, health, energy, transport etc. To mitigate the impact of climate change and extreme weather events and strengthen the resilience of the communities, the Hon'ble Prime Minister of India launched the new Central Sector Scheme 'Mission Mausam' on January 14, 2025 with the goal of making Bharat a "Weather-ready and Climate-smart" nation. Mission Mausam aims to enhance weather monitoring and forecasting across India and surrounding regions by leveraging advanced observational and computing technologies for greater precision and resolution. The previously approved sub-scheme ACROSS under the PRITHVI scheme was merged with 'Mission Mausam'. India's diverse topography necessitates enhanced radar coverage. To address these gaps and ensure comprehensive weather monitoring, a strategic plan has been proposed to install

Document Control Sheet

India Meteorological Department

Ministry of Earth Sciences (MoES)

		additional radars: The India Meteorological Department (IMD) manages a comprehensive weather radar network in India. This network includes Forty Eight Doppler Weather Radars (DWRs) positioned to monitor weather conditions across the country. Additionally, radar data is integrated from five ISRO radars and six IITM radars, enhancing the overall capability. Recently, two Doppler Weather Radars were commissioned by the India Meteorological Department: a C-Band DWR at Mangaluru, Karnataka, and an X-Band DWR at Jorhat, Assam, strengthening weather monitoring and nowcasting capabilities in coastal and northeastern India. Year 2025 witnessed the formation of 15 cyclonic disturbances (CDs) against normal of 11.2 per year based on the data during the period 1965-2024. It included 11 depressions/deep depressions (maximum sustained wind speed (MSW): 32 – 61 kmph), 2 cyclonic storms (MSW: 62-91 kmph) and 2 severe cyclonic storms (92-117 kmph). All the 4 cyclones had recurving tracks. Out of 4 cyclones, 3 were landfalling cyclones (Montha, Senyar and Ditwah).
15.	Key words	IMD Annual Report 2025, MoES, Publication, Mausam, Weather.

CHAPTER 1

INDIA METEOROLOGICAL DEPARTMENT - OVERVIEW

India Meteorological Department, Ministry of Earth Sciences is the National Meteorological Service of the country and the principal Government agency in all matters relating to Meteorology, Seismology and allied discipline and provides weather and climate services to the public and specialized sectors (Fig. 1).

1.1.1 Mandate

- To take meteorological observations and to provide current and forecast meteorological information for optimum operation of weather-sensitive activities like agriculture, irrigation, shipping, aviation, offshore oil explorations, etc.
- To warn against severe weather phenomena like tropical cyclones, norwesters, duststorms, heavy rains and snow, cold and heat waves, etc., which cause destruction of life and property.
- To provide meteorological statistics required for agriculture, water resource management, industries, oil exploration and other nation-building activities.
- To conduct and promote research in meteorology and allied disciplines.
- To detect and locate earthquakes and to evaluate seismicity in different parts of the country for development projects.

A disastrous tropical cyclone struck Calcutta in 1864 and this was followed by failures of the monsoon rains in 1866 and 1871. In the year 1875, the Government of India established the India Meteorological Department, bringing all meteorological work in the country under a central authority. Mr. H. F. Blanford was appointed Meteorological Reporter to the Government of India.

From a modest beginning in 1875, IMD has progressively expanded its infrastructure for meteorological observations, communications, forecasting and weather services and it has achieved a parallel scientific growth. IMD has always used contemporary technology. In the telegraph age, it made extensive use of weather telegrams for collecting observational data and sending warnings. Later IMD became the first organization in India to have a message switching computer for supporting its global data exchange. One of the first few electronic computers introduced in the country was provided to IMD for scientific applications in meteorology. India was the first developing country in the world to have its own geostationary satellite, INSAT, for continuous weather monitoring of this part of the globe and particularly for cyclone warning. IMD has continuously ventured into new areas of application and service and steadily built upon its infra-structure in its history of 150 years. It has simultaneously nurtured the growth of meteorology and atmospheric science in India. Today, meteorology in India is poised at the threshold of an exciting future.

Fig. 1. Specialized services of IMD

1.1.2. India had some of the oldest meteorological observatories of the world and the first astronomical and meteorological unit started at Madras in 1793. Thus, meteorological observation in India was taken even prior to the establishment of the department in 1875. Since then IMD has achieved many milestones during the period from 1793 to 2025 (Fig. 2).

Fig. 2. IMD milestones during the period from 1793 to 2025

1.1.3. The Director General of Meteorology is the Head of the India Meteorological Department, with headquarters at New Delhi. For the convenience of administrative and technical control, there are 6 Regional Meteorological Centres (RMCs) (Fig.3), with regional headquarters at Mumbai, Chennai, New Delhi, Kolkata, Nagpur and Guwahati. Under the Head of RMCs, there are different operational units such as Meteorological Centres, Forecasting Offices, Agromet. Advisory Centres, Flood Meteorological Offices and Cyclone Detection Radar Stations.

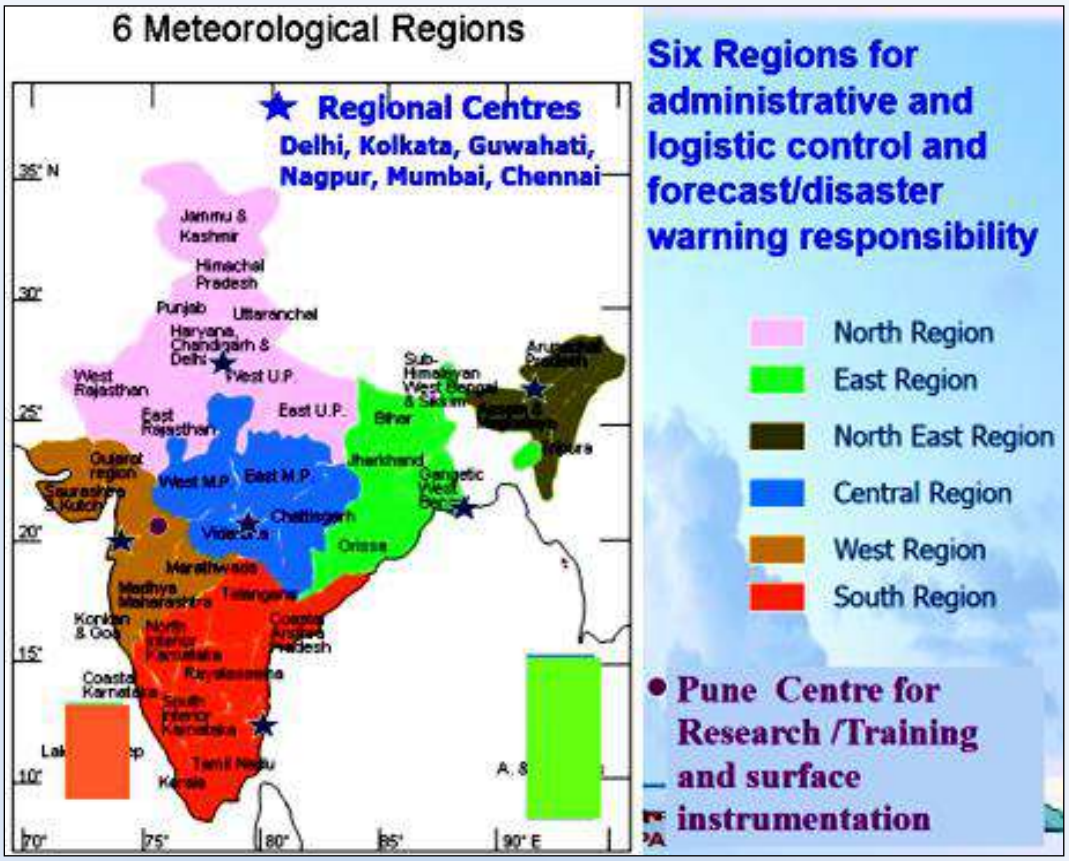


Fig. 3. Six(6) Meteorological regions

1.1.4. IMD completed 150 glorious years of its establishment on 15th January, 2025. This milestone highlights its enduring commitment to excellence, from predicting the intricate patterns of the monsoon to addressing emerging challenges like climate change. To mark this extraordinary achievement, year-long activities were organized at all sub-offices of IMD.

A **commemorative event** was organized on 14th and 15th January 2025 to celebrate the 150th Foundation Day. Hon'ble Prime Minister **Shri Narendra Modi ji** graced the 150th Foundation Day celebrations of IMD on January 14, 2025, at Bharat Mandapam, New Delhi (Fig.4). On this historic occasion, he launched 'Mission Mausam,' an initiative aimed at transforming India into a 'Weather-ready and Climate-smart' nation through advanced weather surveillance technologies, high-resolution atmospheric observations, next-generation radars, satellites, and high-performance computing systems. The Prime Minister also unveiled a commemorative postage stamp and coin, alongside releasing the IMD Vision-2047 document, which outlines a roadmap for weather resilience and climate change adaptation as India prepares to mark 100 years of independence in 2047. The event featured a walk through with the theme "**India's Meteorological Legacy: Harmonizing Ancient Knowledge of Bharat with Modern Scientific Advancements of India - 150 glorious years of India Meteorological Department**". A grand exhibition was also organized at the Bharat Mandapam in which not only IMD but many other organizations also showcased their exhibits to put forth a grand show.

Fig. 4. Address by the Hon'ble Prime Minister of India, Narendra Modi Ji, and release of the *Vision-2047* document of the India Meteorological Department.

1.1.5. A national level stakeholder meeting was convened by the IMD during January 14-15, 2025 at Bharat Mandapam to engage with various sectors on the importance of weather and climate services in improving operational planning, policy-making, and disaster management. The discussion aimed to highlight sector-specific needs for meteorological data and services to strengthen resilience against climate impacts, improve decision-making, and ensure long-term sustainability. The panel discussions were focussed on various sectors namely Transport, Energy, Water, Media, Disaster Risk Reduction, Agriculture, Air Quality and Health.

1.1.6. To create awareness among the public, especially the youth, a '**Run for Mausam**' was organised on the National Youth Day 12th January 2025 at Jawaharlal Nehru Stadium, New Delhi in collaboration with the Sports Authority of India (Fig.5). The event carried the theme of "**Run for Mausam - Every Step Counts for Climate Resilience**" to resonate the purpose of creating awareness. The event sported 5 KM and 10 KM run, with 1,500 participants. Cash prizes were awarded to the first three winners under both categories.

Fig. 5. To create awareness among the public, especially the youth, a 'Run for Mausam' was organised on the National Youth Day 12th January 2025 at Jawaharlal Nehru Stadium

1.1.7. IMD organized a workshop entitled "Weather and Youth (WAY)" on 11th January 2025(Fig.6), aimed at empowering young minds to participate actively in weather and climate-related services. The workshop featured discussions, talks, and collaborative sessions focusing on innovation, education, technology, and community engagement. The Weather and Youth (WAY) web portal, launched during the workshop, serves as a dynamic platform to engage youth in meteorological science and climate awareness.

Fig. 6. Launch of Weather and Youth Portal

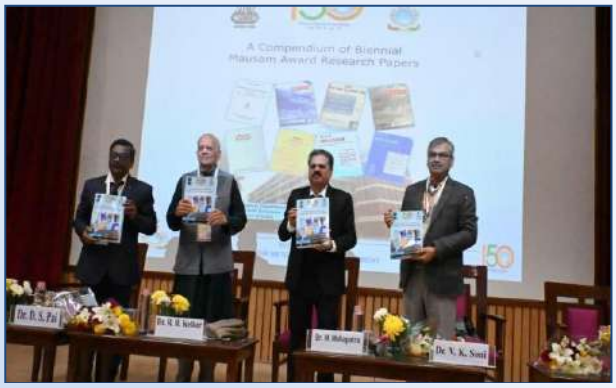


Fig. 7. Release of the 'Compendium of Biennial Mausam Award Papers' at the National Symposium on "Seventy-Five Years of Accomplishment of Mausam"

1.1.8 National Symposium on "**Seventy-Five Years of Accomplishment of Mausam: Journal of Meteorology, Hydrology, and Geophysics**". Along with the celebration of IMDs 150th anniversary, the year 2025 also marked the 75th anniversary of Mausam, the journal that has continuously served as a platform for researchers, scientists, and academicians to share their findings, discoveries, and perspectives (Fig.7).

1.1.9 The celebrations culminated with a magnificent depiction of 'Transformative contribution of IMD to the Meteorology & Society since 1875' at the Republic day-2025 parade in which the Tableau of IMD was displayed (Fig.8). The tableau of IMD, MoES presented a narration of empowerment of the society to save life & property from weather related disasters like the cyclones, thunderstorms, lightning, heat wave, heavy rainfall etc.

Fig. 8. Tableau of IMD in the Republic Day 2025 Parade

1.1.10. In addition to these, IMD also conducted a survey to gather feedback from citizens to improve the accuracy, accessibility, and utility of IMD's weather forecast and other services. The survey was live from 30 Dec 2024 to 15 Feb 2025 with a total of 3253 participants across the country. A Pledge-taking activity was also conducted to support IMD's endeavour – Early Warnings for All.

1.1.11. The annual mean land surface air temperature for the country till November 2025 was +0.29°C above the 1991-2020 average and was the 7th warmest since 1901. The annual maximum and minimum temperature for the country were +0.10°C and +0.49°C, respectively, above the 1991-2020 average till November 2025. The country averaged seasonal mean temperature was above normal during the Winter season (January - February, +1.17°C warmest year since 1901), Pre-monsoon season (March - May, +0.29°C), and Southwest monsoon season (June - September, +0.09°C) was normal(Fig. 9).

The monthly mean temperatures for the country till November were above normal for the six months of the year except May, June, July, October and November, where below normal/near normal with an anomaly of -0.81°C, -0.18°C, -0.01°C, +0.07°C and -0.39°C respectively. The all-India mean temperature during the month of January was the 2nd highest with an anomaly of +0.98°C and February was the highest with an anomaly of +1.36°C since 1901.

The monthly maximum temperature was the 2nd highest (with an anomaly of +1.52°C) and the minimum temperature was the highest (with an anomaly of +1.20°C) for the month of February since 1901. The minimum temperature was the 5th highest during the month of January with an anomaly of +1.04°C since 1901. While the maximum temperature was the 7th lowest (with an anomaly of -1.52°C) and the minimum temperature was the 59th lowest (with an anomaly of -0.10°C) for the month of May since 1901.

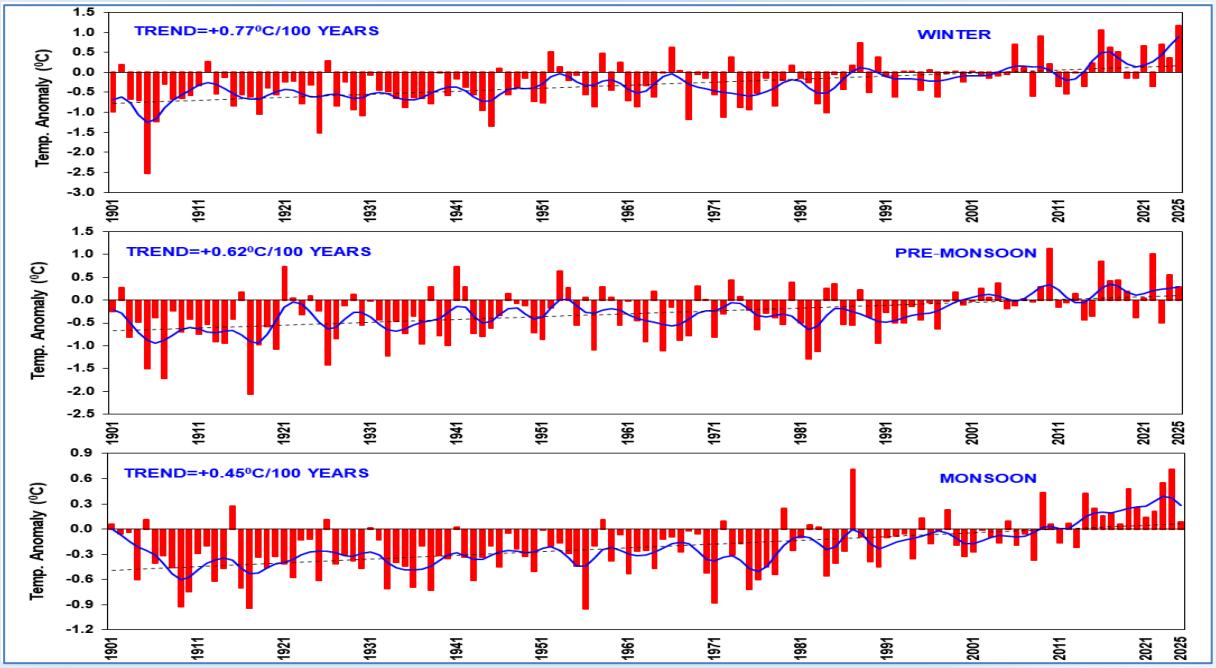


Fig. 9: All India mean temperature anomalies (a) Winter (b) Pre-monsoon (c) SW-monsoon for the period 1901 - 2025 shown as vertical bars. The solid blue curve exhibits sub-decadal time scale variations that have been smoothed with a Binomial Filter (Departures from the 1991 - 2020 average)

1.1.12. The annual rainfall over the country was 110 % of Long Period Average (LPA) value for the period 1971-2020.The rainfall during the Southwest Monsoon season was 108% of its LPA. During the period, among the four homogenous regions of the country, South Peninsular, Central India and Northwest India received above normal rainfall (110%, 115% and 128% of its LPA respectively), while East and Northeast India received below normal rainfall (80% of its LPA). During the season, out of 36 meteorological subdivisions, 2 subdivisions received large excess rainfall, 12 subdivisions received excess rainfall, 19 received normal rainfall and the remaining 3 subdivisions received deficient rainfall. Rainfall over homogeneous region of Northwest India (747.9 mm) was highest since 2001 and 6th highest since 1901. Rainfall over homogeneous region of East & Northeast India (1089.9 mm) was 2nd lowest since 1901 and also since 2001.

1.1.13. Various parts of the country experienced extreme weather events like Extremely Heavy Rainfall, Floods, Landslide, Lightning, Thunderstorm, Heat Wave, etc. which caused more than 2690 deaths, of which more than 1300 were reported due to Lightning and Thunderstorm, Floods, Heavy Rain and Landslides.

1.1.14. Year 2025 witnessed the formation of 15 cyclonic disturbances (CDs) against normal of 11.2 per year based on the data during the period 1965-2024. It included 11 depressions/deep depressions (maximum sustained wind speed (MSW): 32 – 61 kmph), 2 cyclonic storms (MSW: 62-91 kmph) and 2 severe cyclonic storms (92-117 kmph). All the 4 cyclones had recurving tracks. Out of 4 cyclones, 3 were landfalling cyclones (Montha, Senyar and Ditwah).

Following Cyclonic Disturbances (CDs) developed over the North Indian Ocean (NIO) during 2025:

- Depression over the Arabian Sea (24–25 May)
- Deep Depression over Northwest Bay of Bengal off West Bengal–Bangladesh Coasts (29–30 May)
- Depression over Southeast Gangetic West Bengal and Adjoining Bangladesh (14–15 July)
- Depression over Central Parts of North Rajasthan (15 July)
- Depression over Southeast Uttar Pradesh (17–19 July)
- Depression over Northwest Bay of Bengal (25–27 July)
- Depression over Northwest and Adjoining Westcentral Bay of Bengal (18–19 August)
- Land Deep Depression over Southwest Rajasthan and Neighbourhood (06–10 September)
- Depression over Northwest and Adjoining Westcentral Bay of Bengal (26–28 September)
- Deep Depression over Westcentral Bay of Bengal (01–03 October)
- Severe Cyclonic Storm SHAKHTI over Northeast Arabian Sea (01–07 October)
- Depression over Southeast Arabian Sea (22–31 October)
- Severe Cyclonic Storm MONTHA over Westcentral Bay of Bengal (25–29 October)
- Cyclonic Storm “SENYAR” over the Strait of Malacca (25-27 November)
- Cyclone “DITWAH” over Bay of Bengal (27th November – 03rd December)

1.2. Summary of Major achievements in 2025

1.2.1. Union Minister of Earth Sciences, Dr. Jitendra Singh Dedicated Indigenously Developed "The Bharat Forecast System" To the Nation

Hon'ble Union Minister of Earth Sciences, **Dr. Jitendra Singh** dedicated one of the world's first indigenously developed high-resolution weather forecast systems **"the Bharat Forecast System"** to the Nation, enhancing the resolution from 12 km to 6 km, enabling more precise and location-specific forecasts on 26th May, 2025 (Fig. 10.).

Fig. 10. Hon'ble Union Minister of Earth Sciences, Dr. Jitendra Singh dedicated one of the world's first indigenously developed high-resolution weather forecast systems "the Bharat Forecast System" to the Nation

1.2.2. IMD Launches Three Major Initiatives: C-Band Doppler Weather Radars, Solar Power System and Meteorological Museum

Union Minister of State (Independent Charge) for Science & Technology; Minister of State for Earth Sciences; and Minister of State in the Prime Minister's Office, Personnel, Public Grievances, Pensions, Atomic Energy and Space, Dr. Jitendra Singh, on 27th November 2025, inaugurated three major initiatives of the India Meteorological Department (IMD),Fig.11. These included the commissioning of two state-of-the-art Doppler Weather Radars (DWRs) at Raipur and Mangaluru, the launch of a Solar Power System at Mausam Bhawan, and the opening of a Meteorological Museum aimed at promoting weather and climate awareness among students and young learners.

Fig. 11. Hon'ble Union Minister Dr. Jitendra Singh, on 27th November 2025, inaugurated three major initiatives of the India Meteorological Department

1.2.3. Implementation of the Scheme 'Mission Mausam'

To mitigate the impact of climate change and extreme weather events and strengthen the resilience of the communities, the Hon'ble Prime Minister of India launched the new Central Sector Scheme 'Mission Mausam' on January 14, 2025 with the goal of making Bharat a "Weather-ready and Climate-smart" nation. Mission Mausam aims to enhance weather monitoring and forecasting across India and surrounding regions by leveraging advanced observational and computing technologies for greater precision and resolution. The previously approved sub-scheme ACROSS under the PRITHVI scheme was merged with 'Mission Mausam'.

1.2.4. Key IMD activities under 'Mission Mausam' include:

- Commissioning of 53 Doppler Weather Radars
- Establishment of 60 RS/RW stations
- Commissioning of 100 Disdrometers
- Commissioning of 10 Wind profilers
- Commissioning of 25 Microwave Radiometers
- Augmentation of Solar Radiation Monitoring Network- 55 Nos.
- Commissioning of 10 Aerosol / Raman LiDARs
- Procurement of 20 Skyradiometers
- Expansion of BC Aerosol Network (BC, EC/OC)- 25 stations
- Ozonesonde Network (3 India+ Maitri+ Bharati)
- Total Columnar Ozone (TCO3) - 5 Nos.
- Commissioning of mini HPCS, Visualization and Decision Support System
- Collaboration with various agencies and startups for the indigenous development of met instruments / sensors and software and provide useful outputs for enhancing precipitation forecasting, validation of weather forecasting models, and dissemination of information and products
- Establishment of Radar data centre, R&D Labs for Tropical Cyclones, severe weather events, Aviation Meteorology, Mountain weather and Augmentation of Training centre

Implementation of Mission Mausam through installation/commissioning of above major instruments **for which procurement process is undergoing** will lead to **Forecasting** of severe weather Hazards **at** (5x5km) by 2030, **Dynamic Impact based forecasting** & risk based warning for all severe weather, **Last mile connectivity** to meet early warning for all (Early warning to each household 2030, 10-15% improvement in forecast accuracy by 2030 and **Har Har Mausam, Har Ghar Mausam** through improvement of **Mausamgram.**

CHAPTER 2

Weather Summary during 2025

1. Winter Season (January-February)

1.1. Highlights

During the winter season, over the country the mean temperature was the highest (20.54 °C with an anomaly of 1.17 °C) since 1901.Themaximum temperature was the 2nd highest (27.31 °C with an anomaly of 1.22 °C) after the year 2016(27.36 °C) and minimum temperature was the highest (13.76 °C with an anomaly of 1.12 °C) since 1901.

Among the four homogeneous regions, over Central India, the maximum temperature was the highest (30.63 °C with an anomaly of 1.49 °C) and the minimum temperature was the 2nd highest (15.17 °C with an anomaly of 1.42 °C) after the year 2024(15.41 °C) since 1901. Over Northwest India, the minimum temperature was the 3rd highest (8.43 °C with an anomaly of 0.94 °C) after the years 1912(8.63 °C) and 2006 (8.61 °C) and East & Northeast India, it was the highest (12.99 °C with an anomaly of 1.59 °C) since 1901. Over South Peninsular India, the maximum temperature was the 3rdhighest (31.77 °C with an anomaly of 0.59 °C) after the years 2016(31.84 °C) and 2024(31.79 °C) since 1901.

Rainfall realized during the season was 53% of its LPA. Rainfall over the country (20.9 mm) was 8th lowest since 1901 and 4th lowest since 2001.

1.2. Cold wave / Fog conditions:

In January 2025, cold wave conditions were observed for over a smaller area and for only for few days and were mainly confined to Himachal Pradesh (4, 10, 13, 15, 24-29 January), Punjab (9, 25-28 January) and North Rajasthan and adjoining Haryana (10, 26-28 January).

In February 2025, Cold wave/foggy conditions were mostly absent across northern and Indo Gangetic plains during the month.

1.3. Rainfall Features

Rainfall realized during the season was 53% of its LPA. It was 29% of its LPA during January and 70% of its LPA during February. Except both the islands, Arunachal Pradesh, Sub Himalayan West Bengal & Sikkim, Tamilnadu, Puducherry & Karaikal, Rayalaseema and Coastal Karnataka remaining sub divisions received deficient/large deficient or no rainfall.

During the season, out of 36 meteorological subdivisions, 2 received excess rainfall, 5 received normal rainfall, 8 received deficient rainfall, 16 received large deficient rainfall and 5 subdivisions did not receive any rain (Fig.1).

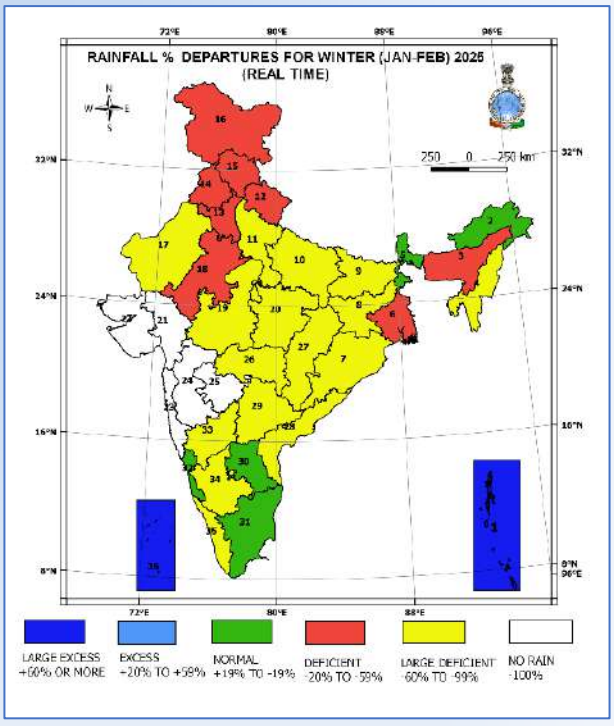


Fig. 1. Sub-division wise rainfall percentage departures for winter (January–February) 2025

Fig. 2(a) shows the spatial pattern of rainfall (mm) received during the winter season. Parts of Arunachal Pradesh, Assam & Meghalaya, Jammu & Kashmir & Ladakh, Uttarakhand, Himachal Pradesh and Andaman & Nicobar Islands received more than 100 mm rainfall.

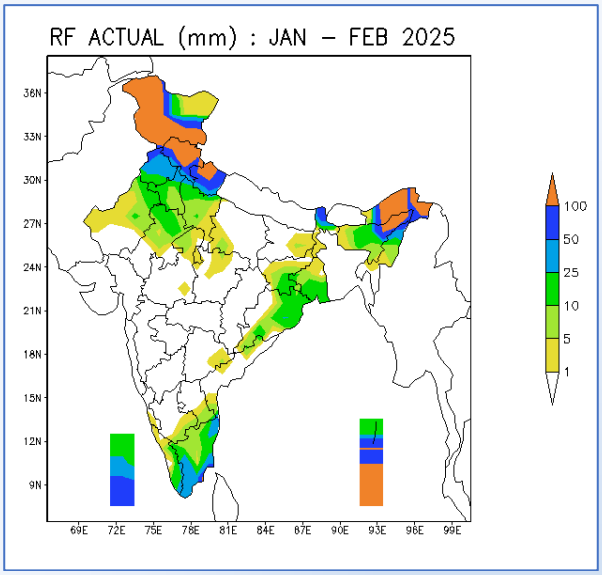


Fig. 2(a) . Seasonal rainfall (mm) for winter (January-February 2025)

Fig. 2(b) shows the spatial pattern of rainfall anomaly (mm) during the winter season.Rainfall anomaly was generally negative over most parts of the country except, extreme east and northeastern partsand both the islands. Rainfall anomaly more than 50 mm was observed over parts of Arunachal Pradesh, Assam & Meghalaya and Andaman &Nicobar Islands. The magnitude of negative rainfall anomaly was more than 50 mm over parts of Jammu & Kashmir & Ladakh, Uttarakhand and Himachal Pradesh.

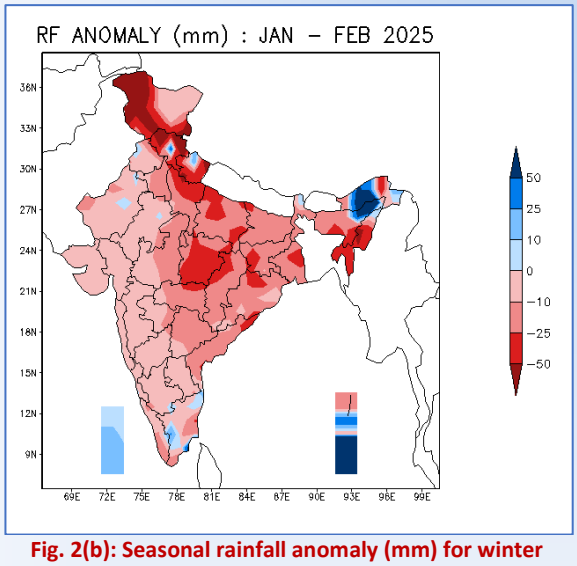


Fig. 2(b): Seasonal rainfall anomaly (mm) for winter (January-February 2025) (based on 1971-2010 nor)

Fig. 3 shows the time series of area weight averaged rainfall over all India and four homogeneous regions for the winter season since 1951. Seasonal rainfall realized over all India was 53 % of its LPA. Rainfall over the country (20.9 mm) was 8th lowest since 1901 and 4th lowest since 2001.

Considering homogeneous region wise it was 11% of its LPA over Central India, 55% of its LPA over South peninsula, 71% of its LPA over East & North East India, and 55% of its LPA over Northwest India. Rainfall over homogeneous region of Central India (1.6 mm) was 4th lowest since 1901 and second lowest since 2001. Rainfall over homogeneous regions of Northwest India (43.4 mm) and South peninsular India (8.7 mm) were 6th lowest and 7th lowest respectively since 2001.

1.4. Standardized Precipitation Index

The Standardized Precipitation Index (SPI) is an index used for measuring drought and is based on only precipitation. This index is negative for drought and positive for wet conditions. As the dry or wet conditions become more severe, the index becomes more negative or positive respectively. Fig. 4(a & b) show the SPI values for the winter season (January-February) 2025 (2 months cumulative) and period from June 2024-February 2025 (nine months cumulative) respectively.

Cumulative SPI values of the past two months indicate extremely wet/severely wet conditions over parts of Assam & Meghalaya, Saurashtra & Kutch and Tamil Nadu while extremely dry/severely dry conditions were observed over parts of Assam & Meghalaya, S.H.West Bengal & Sikkim, Jharkhand, Uttar Pradesh state, Jammu & Kashmir and Ladakh, East Madhya Pradesh and Chhattisgarh.

Cumulative past nine months' SPI values indicate extremely wet/severely wet conditions over parts of Nagaland, Manipur, Mizoram & Tripura, S.H.West Bengal & Sikkim, Odisha, Uttar Pradesh state, Haryana, Chandigarh & Delhi, Rajasthan state, West Madhya Pradesh, Gujarat state, Konkan & Goa, Madhya Maharashtra, Chhattisgarh, Telangana, Tamil Nadu, Coastal Karnataka and South Interior Karnataka while, extremely dry/severely dry conditions were observed over parts of Arunachal Pradesh, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, Jharkhand, Bihar, Uttar Pradesh state, Punjab, Himachal Pradesh, Jammu & Kashmir and Ladakh, Marathawada, Chhattisgarh and Kerala

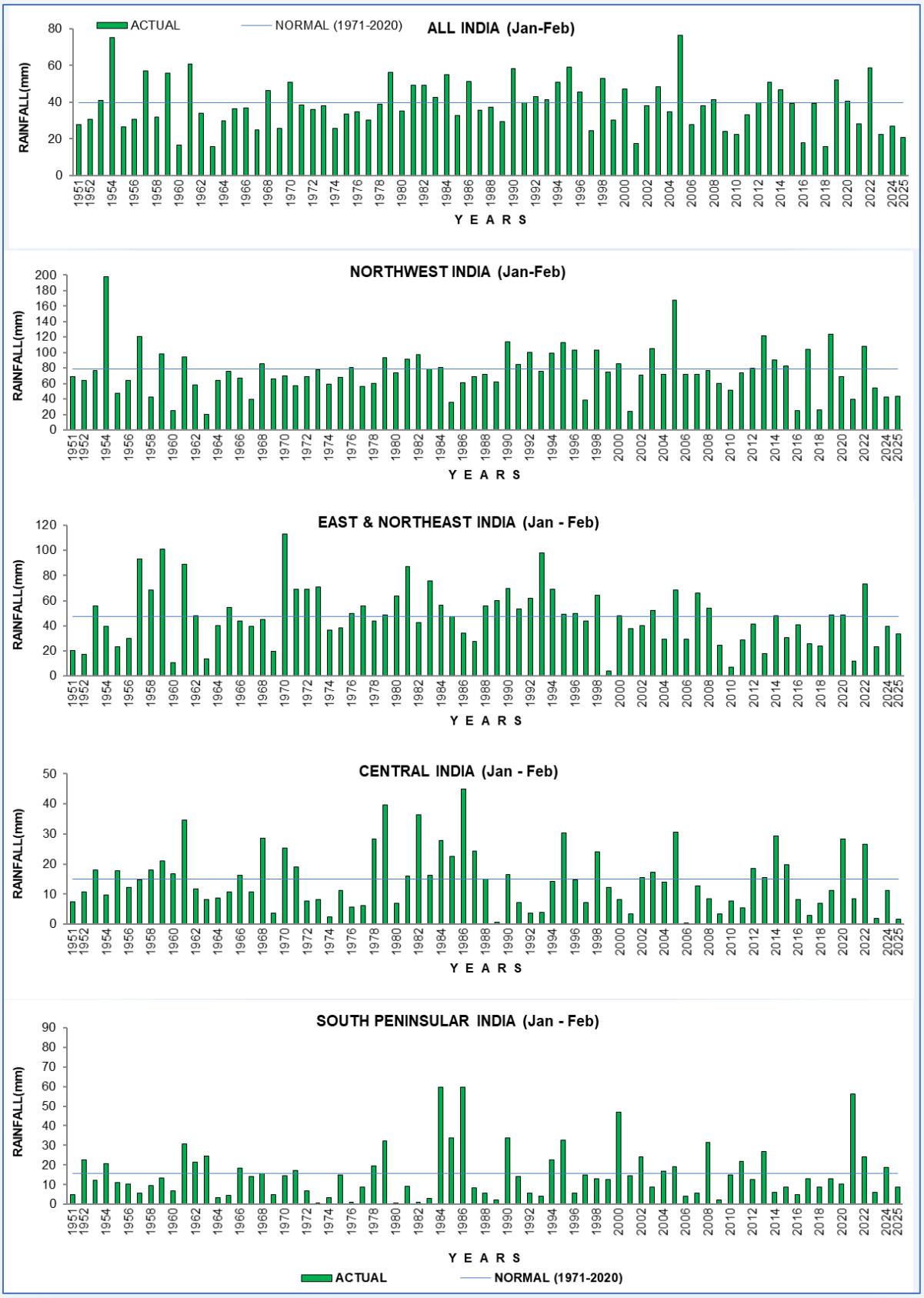
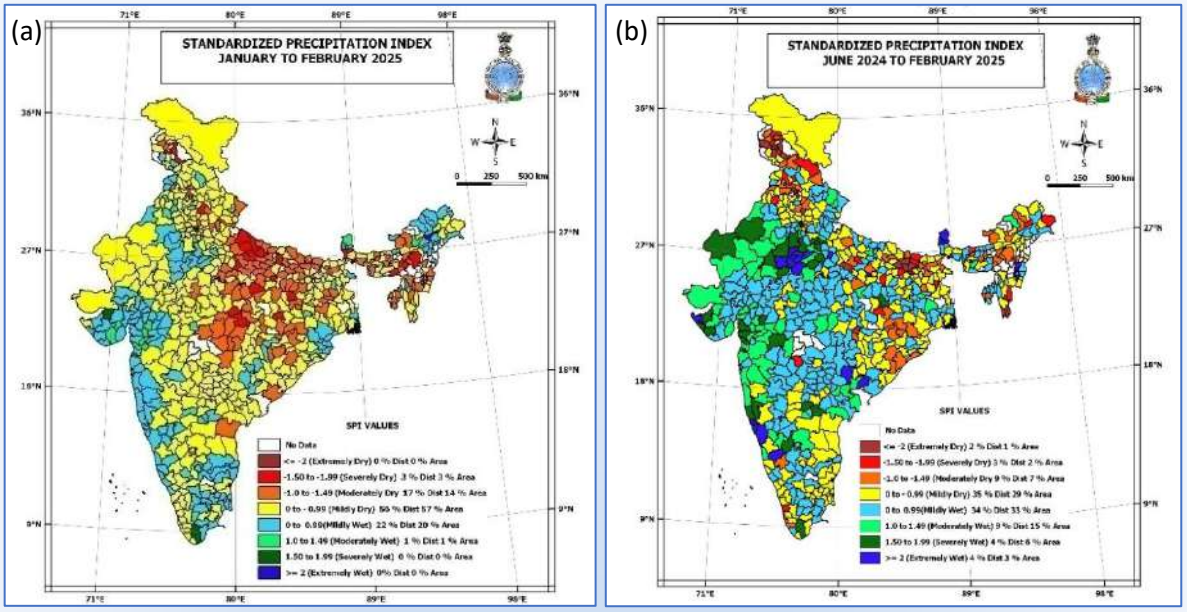


Fig. 3. Time series of area weight averaged rainfall over all India and four homogeneous regions for the winter season (1951 - 2025)



Figs. 4(a&b). Standardized precipitation index (SPI) for (a) January – February (two months) (b) June 2024 – February 2025 (Nine months)

1.5. Outgoing Longwave Radiation (OLR)

OLR anomaly (W/m2) during winter season over the Indian region and neighborhoods is shown in Fig. 5. OLR anomaly was positive over most parts of the country, except extreme parts of Jammu & Kashmir & Ladakh and extreme tip of south peninsula and adjoining North India Ocean. OLR anomaly was ± 10W/m^2.

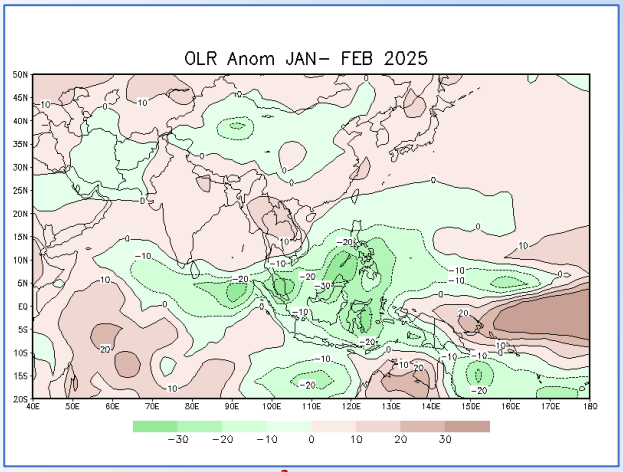


Fig. 5. OLR Anomaly (W/m^2) for winter (January-February) 2025 (Source Data: CDC / NOAA, USA) (based on 1991 - 2020 CLIMATOLOGY)

1.6. Temperature

Mean seasonal maximum and minimum temperature anomalies during winter 2025 are shown in Figs. 6(a) & 6(b) respectively. The maximum temperature was above normal over most parts of the country, except some parts of central India, northeast India and south peninsular India.The maximum temperature anomaly was more than 3 °C over parts of Uttarakhand, Odisha, Jharkhand and Chhattisgarh. The maximum temperature anomaly was more than 2 °C over parts of Jammu, Kashmir & Ladakh, Himachal Pradesh, Uttarakhand, West Rajasthan, Gujarat state, Odisha, Jharkhand, Chhattisgarh, Madhya Maharashtra, Marathawada and Vidarbha.

The minimum temperature was above normal over most parts of the country, except some parts of northwest India, Central India and south peninsular India. The minimum temperature anomaly was more than 2 °C over parts of Punjab, West Rajasthan, Gujarat region, Bihar, Nagaland, Manipur, Mizoram, Tripura, West Madhya Pradesh, Madhya Maharashtra, Marathawada and North Interior Karnataka.

1.7. Percentage of Warm days / Cold nights

Fig. 7(a) & 7(b) show the percentage of days when the maximum (minimum) temperature was more (less) than the 90th (10th) percentile. Over parts of Odisha, Madhya Maharashtra, Marathawada and Lakshdweep maximum temperature was greater than the 90th percentile for more than 50% of the days of the season. For minimum temperature no such significant distribution was observed.

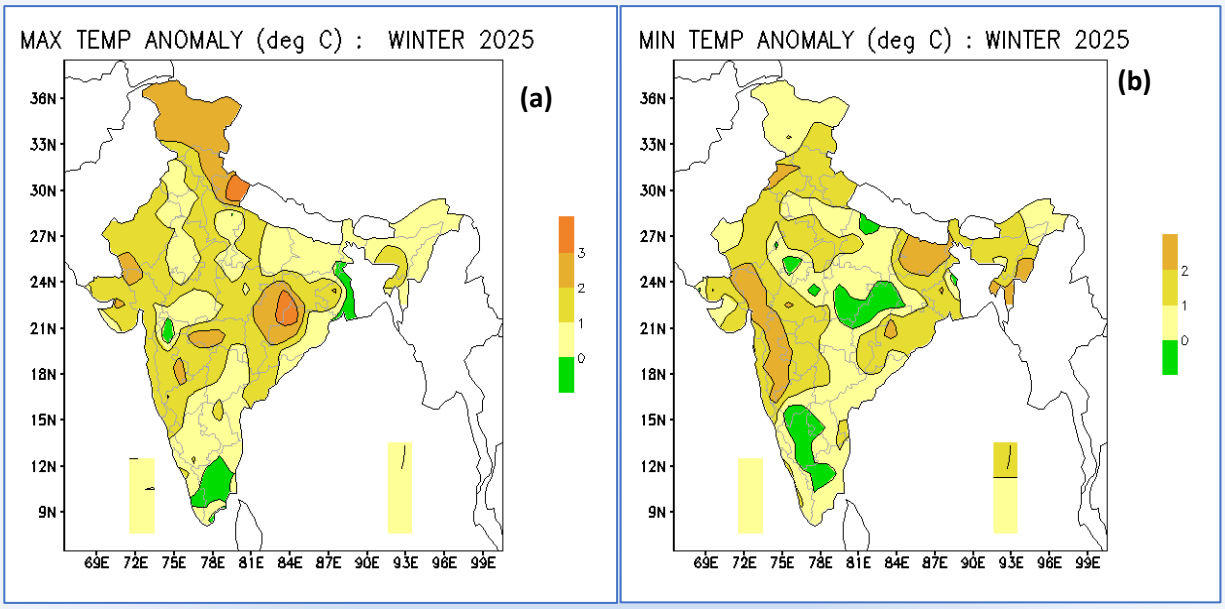


Fig. 6(a&b). Mean seasonal temperature anomalies (°C) for winter (January-February) 2025, (a) Maximum (b) Minimum (Based on 1991-2020 NORMALS)

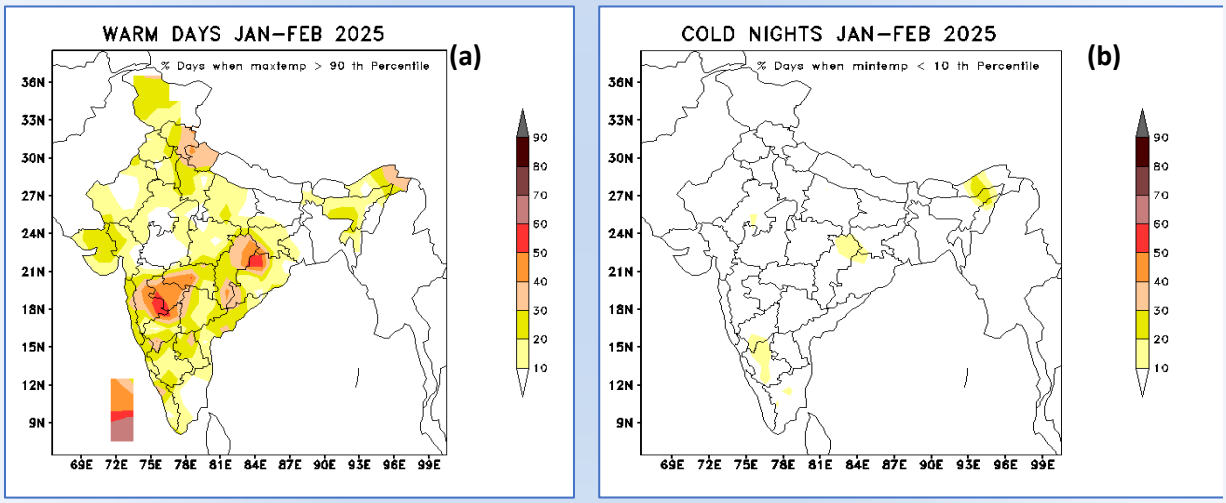


Fig. 7(a&b). (a) Percentage of days when maximum temperature > 90TH percentile (b) Percentage of days when minimum temperature < 10TH percentile

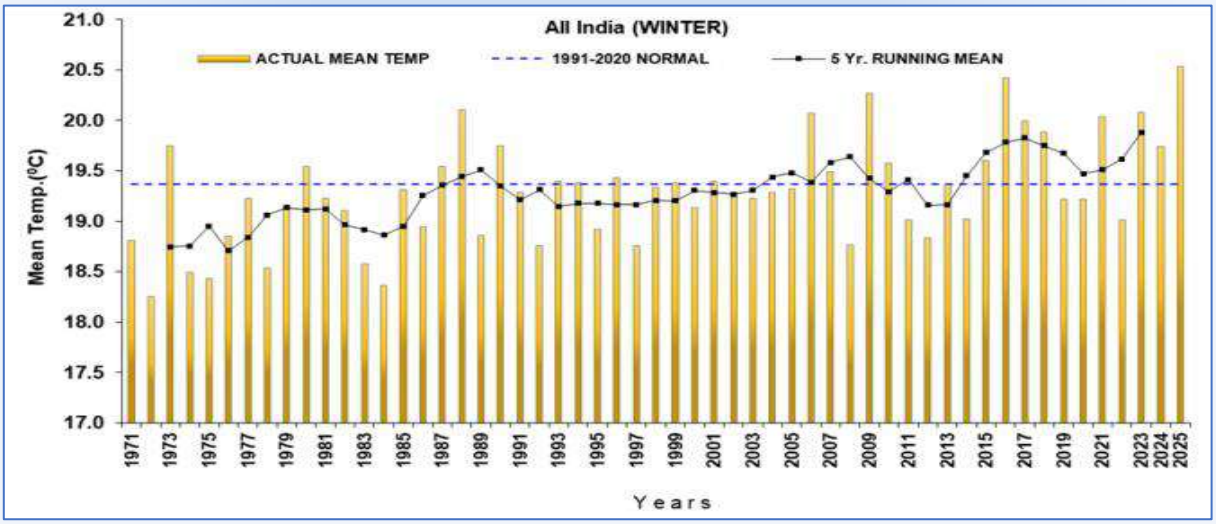
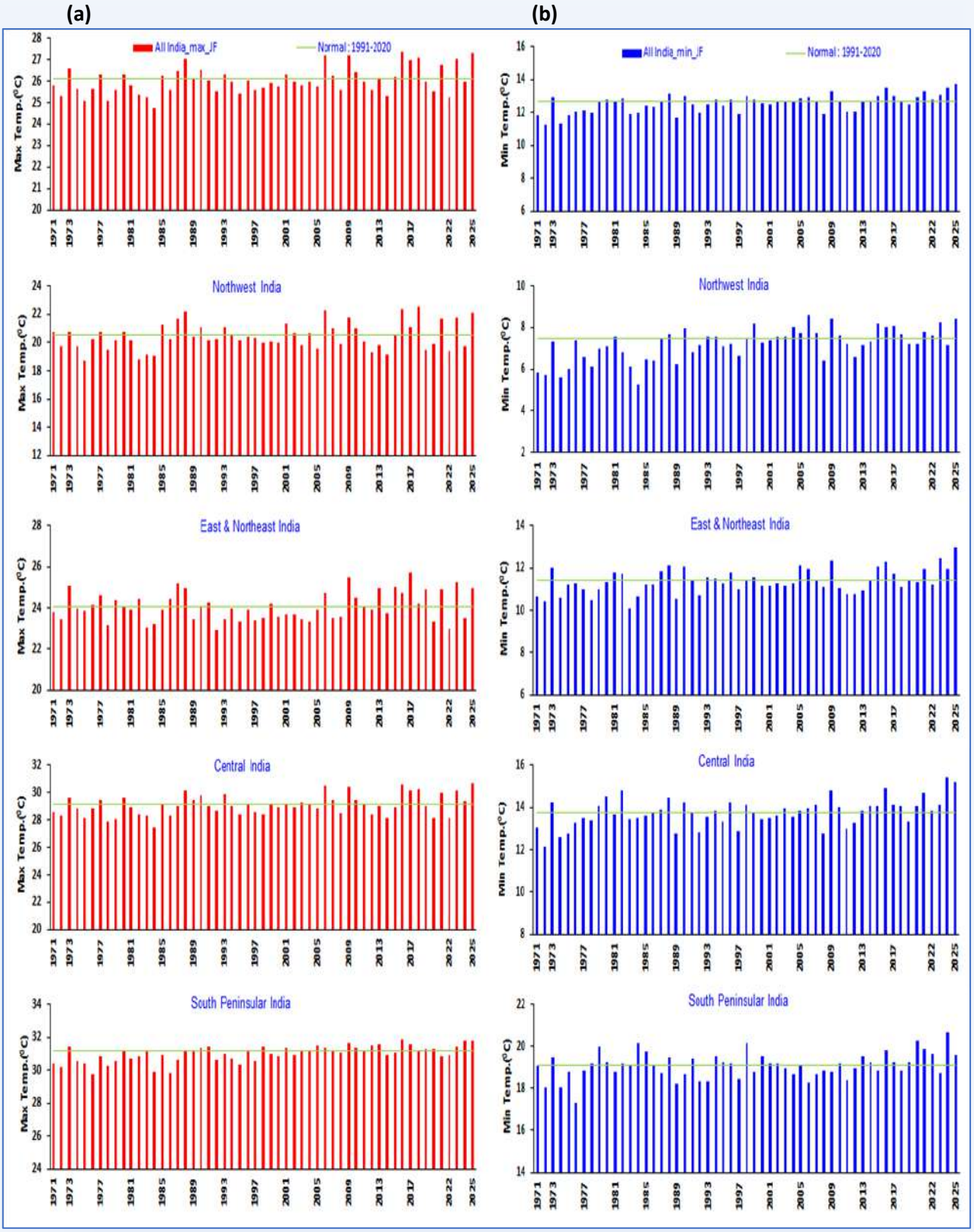


Fig. 8. Time series of mean temperature averaged over India (vertical bars) and five-year running mean (continuous line) for winter season (January-February) (1971-2025)



Figs. 9(a&b). Time series of temperature for the country as a whole and the four homogeneous regions for winter season (January-February) (1971-2025)
(a) maximum (b) minimum

Fig.8 shows the mean temperature for the country as a whole for the winter season since 1971. Five-year moving average values are also shown. The mean temperature for the winter season 2025 was 20.54°C with an anomaly of 1.17oC and the highest since 1901. Among the four homogeneous regions,

the mean temperature over Central India was the highest (22.90 °C with an anomaly of 1.45 °C), East & Northeast India, it was also the highest (18.96 °C with an anomaly of 1.25 °C),Northwest India, it was the 2nd highest (15.26°C with an anomaly of 1.26 °C) after the year 2006(15.42 °C), South Peninsular India, it was the 5th highest (25.69 °C with an anomaly of 0.56 °C) after the years 2024(26.23 °C), 2016(25.83 °C), 1998(25.79 °C) and 2020(25.78 °C) since 1901.

Fig. 9(a) & 9(b) shows the maximum and minimum temperature time series respectively for the country as a whole and the four homogeneous regions during the winter season since 1971. The maximum and minimum temperatures were above normal over all homogeneous areas and the country as a whole. Among the four homogeneous regions, over Central India, the maximum temperature was the highest (30.63 °C with an anomaly of 1.49 °C) and the minimum temperature was the 2nd highest (15.17 °C with an anomaly of 1.42 °C) after the year 2024(15.41 °C) since 1901. Over Northwest India, the minimum temperature was the 3rd highest (8.43 °C with an anomaly of 0.94 °C) after the years 1912(8.63 °C) and 2006(8.61°C) and East & Northeast India, it was the highest (12.99°C with an anomaly of 1.59 °C) since 1901. Over South Peninsular India, the maximum temperature was the 3rdhighest (31.77°C with an anomaly of 0.59 °C) after the years 2016(31.84 °C) and 2024(31.79 °C) since 1901.

Over the country as a whole, maximum temperature was the 2nd highest (27.31 °C with an anomaly of 1.22 °C) after the year 2016(27.36 °C) and minimum temperature was the highest (13.76 °C with an anomaly of 1.12 °C) since 1901.

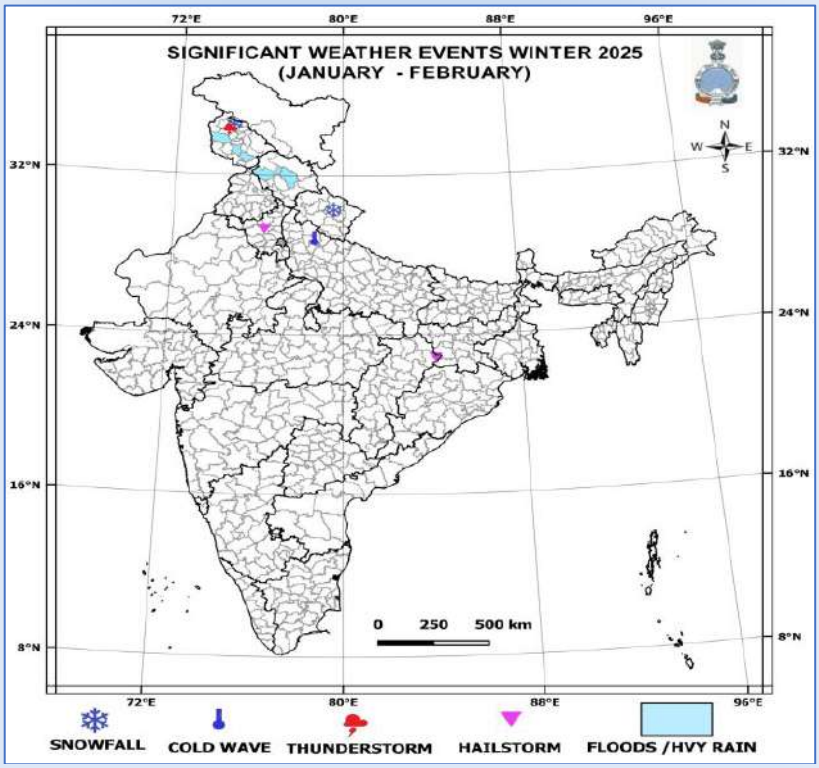


Fig. 10. Deaths due to significant weather events during winter (Jan- Feb) 2025 (Based on real time media report)

1.8. Significant Weather Events for Winter Season (January-February) 2025

During Winter Season, total 19 persons reportedly died and 12 persons injured. The details of causalities given below, which are based on real time media reports. Fig. 10 shows deaths due to significant weather events during Winter Season (January - February) 2025. (Based on real time media reports)

Snowfall: Total 8 persons reportedly died in Chamoli (Uttarakhand) on 28th Feburary during Winter Season, due to Snowfall. While, Bandipora (Jammu and Kashmir) district affected due to Snowfall on 27th February.

Cold Wave: Total 2 persons reportedly died in Moradabad (Uttar Pradesh) on 14th January during Winter Season, Due to Cold Wave.

Thunderstorm: Total 3 persons reported lyinjured, in Baramulla (Jammu and Kashmir) on 27th February during Winter season, because of Thunderstorm.

Heavy Rains, Floods and Landslides: A total of 9 fatalities were reported during the winter season due to heavy rains, floods, and landslides.

Of these, 8 deaths occurred in Poonch, Reasi, and Udhampur districts of Jammu & Kashmir on 27th February, and 1 death was reported from Kangra district of Himachal Pradesh on 28th February.

In addition, 9 persons sustained injuries, including 8 in Poonch, Reasi, and Udhampur districts of Jammu & Kashmir on 27th February, and 1 in Kangra district of Himachal Pradesh on 28th February, due to heavy rains, floods, and landslides.

Hailstorm: Damage to crops, etc. reported in Jashpur (Chhattisgarh), Jind (Haryana) district on 20 February due to Hailstorm.

2. Pre-monsoon Season (March-May)

2.1. Highlights

During the pre-monsoon season, the mean temperature was 28.08 °C over the country with an anomaly of 0.29 °C (17th highest since 1901).

Among the four homogeneous regions, over Northwest India,the maximum temperature was the 10th highest (33.50 °C with an anomaly of 0.97 °C) and the minimum temperature was the 11th highest (18.78 °C with an anomaly of 0.70 °C) since 1901. Over East & Northeast India, the minimum temperature was the 3rd highest (20.81 °C with an anomaly of 0.76 °C) after the years 2022(21.10 °C) and 2024(21.02 °C) since 1901.

Monsoon onset over Kerala was on 24th May, against 1st June (8 days before the normal onset date). Over Mumbai, it advanced on 26th May against the normal date of advancement, 11th June, with a record of 16 days earlier than usual.

Seasonal rainfall realized over all India was 142 % of its LPA. Rainfall over All India (185.8 mm) was the 3rd highest since 1901, after the years 1990 (202.2 mm) and 2015 (185.9 mm).

Rainfall over the homogeneous region of Central India (121.8 mm) and South Peninsular India (274.8 mm) was the highest since 1901.

2.2. Heat Wave Conditions

In March 2025, heat wave conditions were observed mainly over Western India during 10-15 March 2025 and East-Central India during 15-18 March 2025. The above-normal heatwave days

were observed in Gujarat and Odisha; 3-6 days of heat waves were observed in different parts of the subdivisions of these states.

In April 2025, Rajasthan and Gujarat states observed 6-11 heat wave days, and East Madhya Pradesh and Vidarbha observed 4-6 heat wave days. Over East-Central India, Maharashtra and adjoining northern Peninsular India,1-3 days of heat wave were observed.

Rajasthan state, Jammu & Kashmir & and Ladakh observed 6-11 heat wave days in May 2025. East Uttar Pradesh, Haryana, Chandigarh & Delhi, Punjab and East Madhya Pradesh observed 1-3 heat wave days.

Advance of Southwest Monsoon

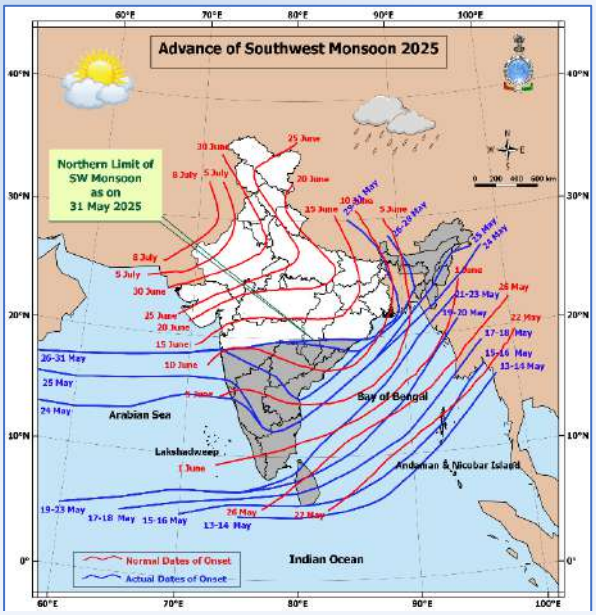


Fig. 11. Advance of southwest monsoon till 31 may 2025

Fig. 11 depicts the isochrones of the advance of the southwest monsoon. Southwest Monsoon advanced into some parts of the South Bay of Bengal, the South Andaman Sea, the Nicobar Islands and some parts of the North Andaman Sea on 13th May, 2025, against the normal date of 19th May. The Northern Limit of Monsoon passed through 5°N/75°E, 5°N/80°E, 6°N/86°E, 8.5°N/90°E, Hut Bay, 13°N/95°E, and 16°N/98°E on 13th May, 2025. It advanced further into some parts of south east Arabian Sea and south Bay of Bengal gradually, it advanced over some more parts of south Arabian Sea, Maldives & Comorin area; South Bay of Bengal; some more parts of central Bay of Bengal and some parts of northeast Bay of Bengal on19th May, 2025; The Northern Limit of Monsoon passed through 5°N/60°E, 6°N/65°E, 7°N/70°E, 7°N/75°E, 8°N/80°E, 10.5°N/85°E, 15°N/90°E, and 21°N/95°E on 19th May, 2025; it remained at this position till 23rd May. The Southwest Monsoon further advanced very rapidly into remaining parts of south Arabian Sea, some parts of west-central& east-central Arabian Sea, entire Lakshadweep area, Kerala, Mahe, some parts of Karnataka, remaining parts of Maldives and Comorin area; many parts of Tamil Nadu, remaining parts of southwest and east-central Bay of Bengal, some parts of west-central and north Bay of Bengal and some parts of Mizoram on 24th May 2025. The Northern Limit of Monsoon passed through 13°N/55°E, 13°N/60°E, 13.5°N/65°E, 15°N/70°E, Karwar, Shimoga, Dharmapuri, Chennai, 15°N/83°E, 18°N/87°E, Saiha, 25°N/96°E, 27°N/98°E on 24th May. Thus, the Southwest Monsoon has set in over Kerala on 24th May 2025, against the normal date of 1st June (8 days before the normal date). By the 26th May it advanced further over more parts of central Arabian Sea, some more parts of Maharashtra including Mumbai, Karnataka including Bengaluru, remaining parts of Tamil Nadu, some parts of Telangana and Andhra Pradesh, some more parts of westcentral & North Bay of Bengal, remaining parts of Mizoram, entire Tripura, Manipur, Nagaland, Arunachal Pradesh, some parts of Assam and Meghalaya, The Northern Limit of Monsoon passed through 17.0°N/55°E, 17.5°N/60°E, 18°N/65°E, 18.5°N/70°E, Mumbai, Pune, Sholapur, Kalaburagi, Mahbubnagar, Kavali, 16.5°N/83°E, 19°N/86°E, 21°N/89°E, Agartala, Golpara and 28.5°N/89°E on 26th May. On 29th May, the Southwest Monsoon advanced into some more parts of Chhattisgarh & Odisha, some more parts of the north Bay of Bengal, the remaining parts of the northeastern states and some parts of Sub-Himalayan West Bengal and entire Sikkim. By 31st May, the Northern Limit of Monsoon passed through 17.0°N/55°E, 17.5°N/60°E, 18°N/65°E, 18.5°N/70°E, Mumbai, Ahilyanagar, Adilabad, Bhawanipatna, Puri, Sandhead Island, 23.5°N/89.5°E, Balurghat, 30°N/85°E.

Monsoon onset over Kerala was on 24th May, against the normal onset date of 1st June (8 days before the expected date and the earliest onset in 17 years after 2009). Over Mumbai, it advanced on 26th May against the expected date of advancement, 11th June, with a record of 16 days earlier than usual.

2.3. Rainfall Features

Rainfall realised during the season was 142% of its LPA. It was 67% of its LPA during March, 99% of its LPA during April and 206% of its LPA during May. During the season, most sub-divisions received large excess/excess/normal rainfall, except some sub-divisions, viz. Arunachal Pradesh, Jammu & Kashmir & Ladakh and Himachal Pradesh. During the season, sub-divisions Konkan & Goa, Madhya Maharashtra, Vidarbha, Coastal Karnataka and North Interior Karnataka received the highest rainfall since 1901.

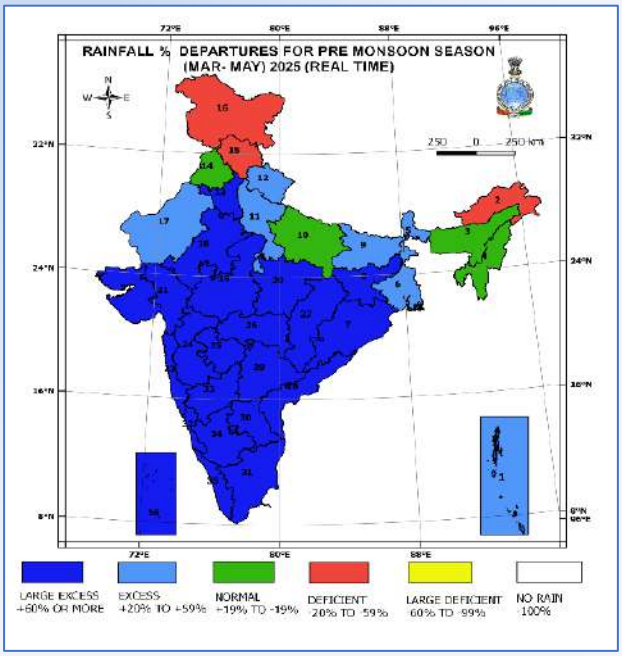


Fig. 12. Sub-Divisionwise rainfall percentage departures for pre-monsoon (March-May) 2025

During the season, out of 36 meteorological subdivisions, 22 received large excess rainfall, 7 received excess rainfall, four received normal rainfall, and three received deficient rainfall. (Fig. 12) shows the subdivision-wise rainfall statistics (mm) for the season.

Fig. 13(a) shows the spatial pattern of rainfall (mm) received during the pre-monsoon season 2025. Parts of Arunachal Pradesh, Assam & Meghalaya, Mizoram & Tripura, Sub-Himalayan West Bengal & Sikkim, Kerala &Mahe, Coastal Karnataka, South Interior Karnataka and Andaman &Nicobar Islandsreceived more than 600 mm of rainfall.

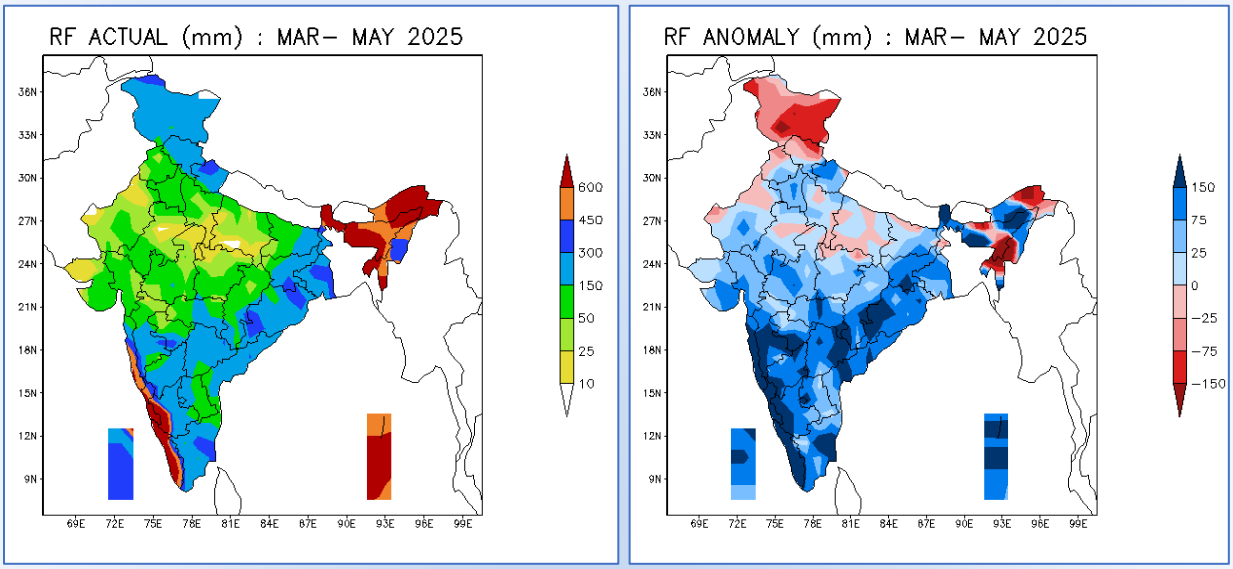


Fig. 13(a&b). (a) Seasonal rainfall for pre-monsoon season (March-May) 2025 and (b) Seasonal Rainfall Anomaly (Mm) Pre-Monsoon Season (March-May) 2025 (Based On 1971-2020 Normals)

Fig. 13(b) shows the spatial pattern of rainfall anomaly (mm) during the pre-monsoon season 2025. Rainfall anomaly was positive over most parts of the country except the northern and northeastern parts. Rainfall anomaly more than 150 mm was observed over parts of Arunachal Pradesh, Assam & Meghalaya, Mizoram, Sub Himalayan West Bengal & Sikkim, Jharkhand, Odisha, Chhattisgarh, Coastal Andhra Pradesh, Telangana, Tamilnadu, Puducherry & Karaikal, Kerala & Mahe, Goa, Maharashtra state, Karnataka state and both the islands. The magnitude of negative rainfall anomaly was more than 150 mm over parts of Arunachal Pradesh, Nagaland, Manipur, Mizoram & Tripura, Assam & Meghalaya and Jammu & Kashmir & Ladakh. Fig. 14 shows the area-weighted rainfall series for the pre-monsoon season over all of India and four homogeneous regions since 1951. The pre-monsoon seasonal rainfall realized over all India was 142 % of its LPA in 2025. Rainfall over All India (185.8 mm) was the 3rd highest since 1901, after the years 1990 (202.2 mm) and 2015 (185.9 mm).

Considering homogeneous region-wise, it was 338% of its LPA over Central India, 227% of its LPA over South peninsula, 101% of its LPA over East & North East India and 87% of its LPA over Northwest India. Rainfall over the homogeneous region of Central India (121.8 mm) and South Peninsular India (274.8 mm) was the highest since 1901.

2.4. Standardized Precipitation Index

The Standardized Precipitation Index (SPI) is used for monitoring drought and is based only on precipitation. This index is negative for dry and positive for wet conditions. The index becomes more negative or positive as the dry or wet conditions become more severe. Fig. 15 (a & b) gives the SPI values for the Pre-Monsoon season 2025 and the period from the past monsoon season, i.e., June 2024-May 2025 (12 months cumulative), respectively.

Cumulative SPI values of the past three months show extremely wet/severely wet conditions over parts of Odisha, Jharkhand, West Uttar Pradesh, Uttarakhand, Haryana, Chandigarh & Delhi, Rajasthan state, West Madhya Pradesh, Gujarat state, Maharashtra state, Goa state, Chhattisgarh, Coastal Andhra Pradesh, Telangana,

Tamil Nadu, Karnataka state and Kerala while, extremely dry/severely dry conditions were observed over parts of Arunachal Pradesh, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, Bihar and East Uttar Pradesh.

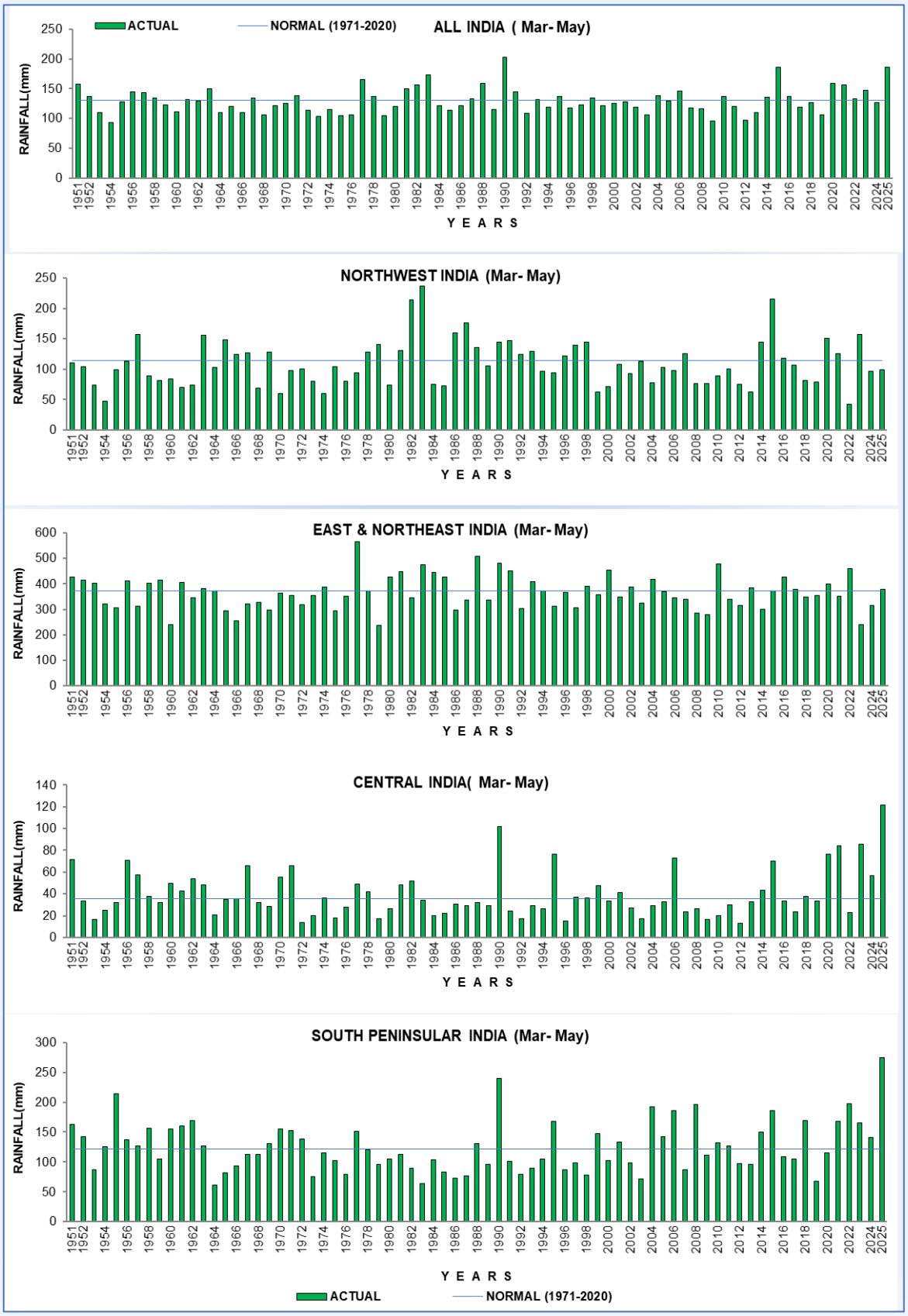
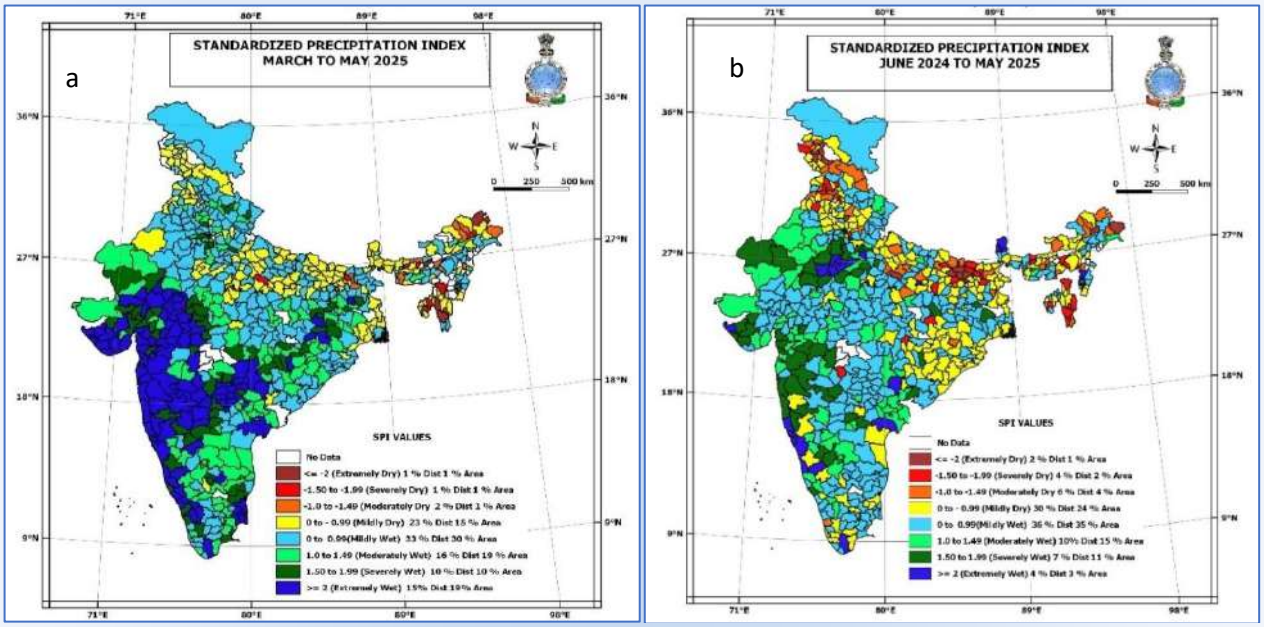


Fig. 14. Time series of area weight averaged rainfall over all India and four homogeneous regions for pre-monsoon season (1951 - 2025)

Cumulative SPI values of the past twelve months indicate that extremely wet/severely wet conditions were observed over parts of Nagaland, Manipur, Mizoram & Tripura, Sub Himalayan West Bengal & Sikkim, Gangetic West Bengal, Odisha, Jharkhand, Uttar Pradesh state, Haryana, Chandigarh & Delhi, Rajasthan state, West Madhya Pradesh, Gujarat state, Maharashtra state, Goa state, Chhattisgarh, Coastal Andhra Pradesh, Telangana, Tamil Nadu, Karnataka state and Kerala while, extremely dry/severely dry conditions were observed over parts of Arunachal Pradesh, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, Bihar, Uttar Pradesh state, Punjab, Himachal Pradesh, Jammu & Kashmir and Ladakh, Marathawada and Chhattisgarh.



Figs. 15(a&b). Standardized Precipitation Index (SPI) For (A) March To May 2025 (three months) (B) June 2024 To May 2025 (Twelve Months)

2.5. Outgoing Longwave Radiation (OLR)

OLR anomaly (W/m2) over the Indian region and neighbourhood is shown in Fig. 16. OLR anomaly was negative over most parts of the country, except parts of the northwestern and northeastern regions. Negative OLR over -20 W/m2 was observed over the extreme south peninsula and adjoining seas.

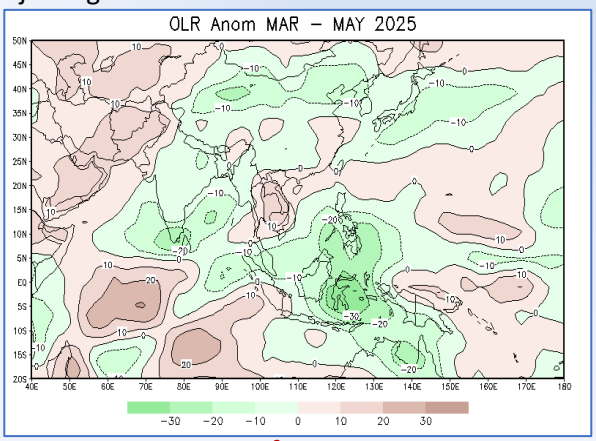


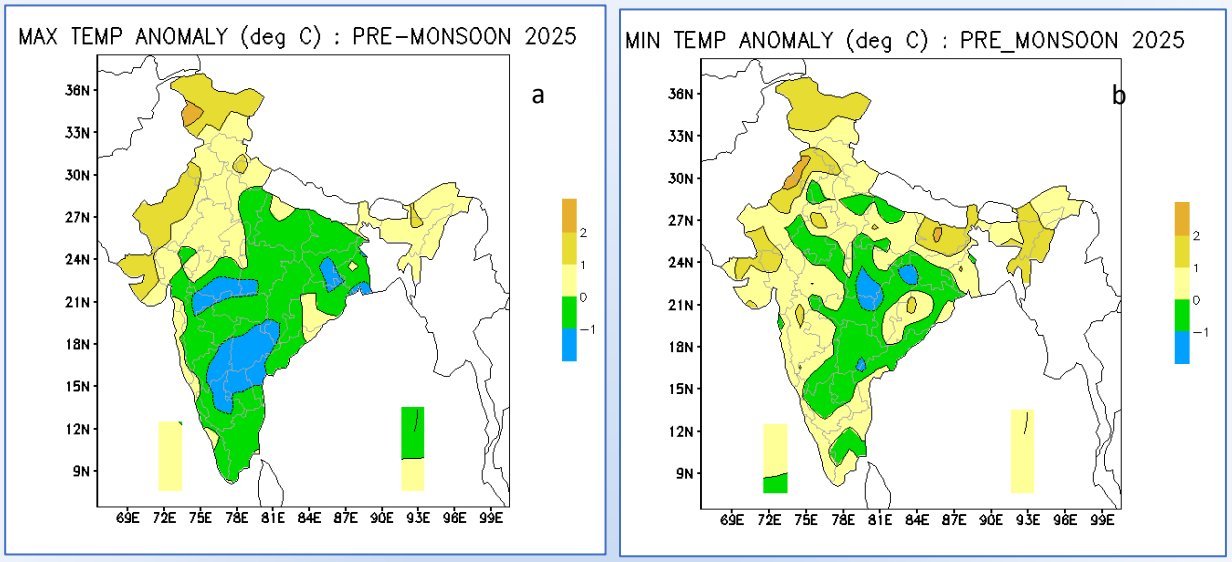
Fig. 16. OLR anomaly (W/M^2) for Pre-Monsoon (March-May) 2025 (SOURCE: CDC / NOAA, USA) (Based on 1991 - 2020 Climatology)

2.6. Temperature

Mean seasonal maximum and minimum temperature anomalies during pre-monsoon 2025 are shown in Figs. 17(a) & 17(b) respectively. The maximum temperature was below or near normal over most parts of the country, except some parts of north India and west India. The maximum temperature anomaly was more than 2 °C over parts of Jammu& Kashmir. The maximum temperature anomaly was less than -1 °C over parts of southern Madhya Pradesh state, north Madhya Maharashtra, Vidarbha, Jharkhand, Gangatic West Bengal, Odisha, Chhattisgarh, Telangana, North Interior Karnataka, South Interior Karnataka and Andhra Pradesh state.

The minimum temperature was above normal in most parts of the country, except some parts of eastern India, central India, southern peninsular India, and Lakshadweep. The minimum temperature anomaly was more than 2 °C over

parts of Punjab, West Rajasthan and Bihar. The minimum temperature anomaly was less than -1 °C over parts of East Madhya Pradesh, Vidarbha, Chhattisgarh, Telangana and Coastal Andhra Pradesh & Yanam.



Figs. 17 (a&b). Mean seasonal temperature anomalies (°C) , for pre-monsoon (march-may) 2025 maximum (b) minimum, (BASED ON 1991-2020 NORMALS)

2.7. Percentage of Warm Days/Cold Nights

Fig. 18(a) & 18(b) show the percentage of days when the maximum (minimum) temperature was more (less) than the 90th (10th) percentile. Over parts of Konkan & Goa and Coastal Karnataka,the maximum temperature was greater than the 90th percentile for more than 40% of the days of the season. For the minimum temperature, no such significant distribution was observed.

Fig.19 shows the mean temperature for the country as a whole for the pre-monsoon season since 1971. Five-year moving average values are also shown. The mean temperature for the pre-monsoon season 2025 was 28.08 °C with an anomaly of 0.29 °C and the 17th highest since 1901. Among the four homogeneous regions, the mean temperature over Northwest India was the 9th highest (26.14 °C with an anomaly of 0.83 °C) and East & Northeast India; it was the 15th highest (26.26 °C with an anomaly of 0.52 °C) since 1901.

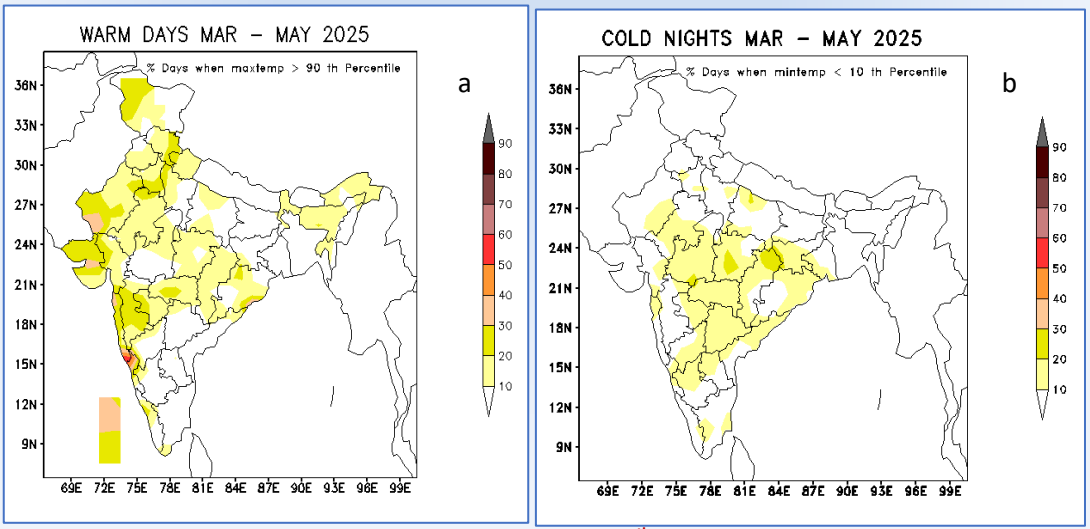


Fig. 18(a&b). (a) Percentage of days when maximum temperature > 90th Percentile; (b) Percentage of days when minimum temperature < 10th percentile

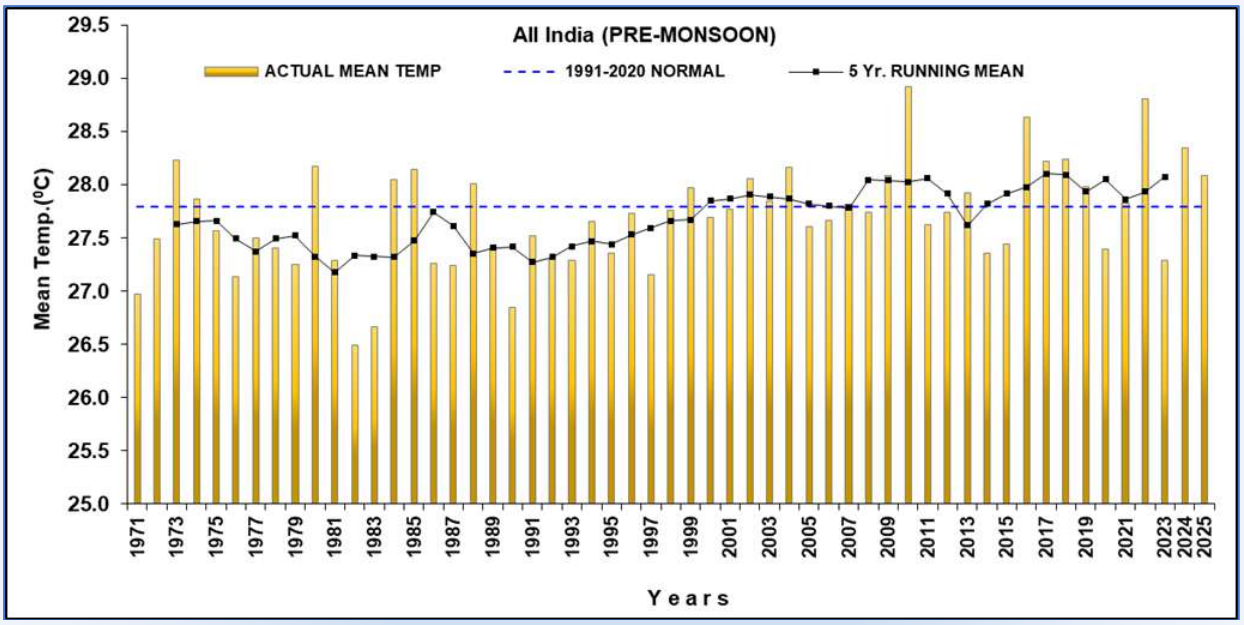


Fig. 19. Time series of mean temperature averaged over india (vertical bars) and five-year running mean (continuous line) for pre-monsoon season {Mar-May (1971-2025)}

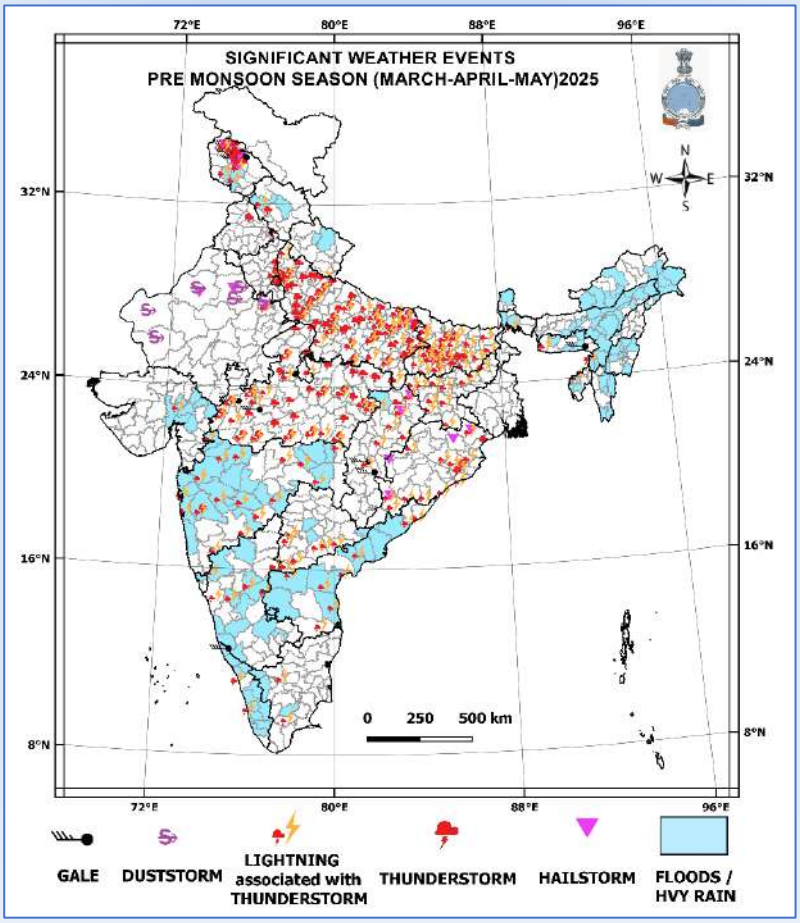


Fig.20. Significant weather events during Pre-Monsoon Season 2025 (Based on real-time media report)

2.8. Low-Pressure Systems

One well-marked low-pressure area formed over the Bay of Bengal from 7 April to 11 April 2025.During May, one depression formed over the Arabian Sea during 24 - 25 May and one deep depression formed over the Bay of Bengal during 29 - 30 May.

2.9. Significant Weather Events for Pre-Monsoon (March-April-May) 2025

During the Pre-Monsoon season, a total of 598 persons reportedly died, more than 300 persons were injured, about 10 persons were missing, and more than 12000 livestock perished. The details of casualties below are based on real-time media reports and other state government agencies.
Fig.20. shows significant weather events during Pre-Monsoon 2025 (Based on real-time media reports).

Lightning associated with thunderstorms: A Total of 289 persons reportedly died, more than 110 persons were injured, and more than 570 livestock perished during the Pre-Monsoon season, because of Lightning associated with thunderstorms.

Thunderstorm: A Total of 179 persons reportedly died, more than 60 persons were injured, and about 125 livestock perished during the Pre-Monsoon season due to thunderstorms.

Heavy Rains, Floods and Landslides: A Total of 122 persons reportedly died, 60 persons were injured, 10 persons were missing, and more than 11350 livestock perished during the pre-monsoon season, because of Heavy Rains, Floods and Landslides.

Gale: A Total of 5 persons reportedly claimed dead, one person injured and three livestock perished during the pre-monsoon season, because of the Gale.

Dust Storm: A Total of 2 persons reportedly died, and one person was injured during the Pre-Monsoon season because of the Dust Storm.

Hailstorm: A Total of one person was reportedly killed, and 67 people were injured during the Pre-Monsoon season because of the Hailstorm.

3. Southwest (SW) Monsoon (June-July-August-September)

3.1. Chief Features

During Monsoon 2025, the mean temperature over the country was 28.10oC with an anomaly of 0.09 °C and the 22nd highest since 1901.Themaximum temperature during Monsoon 2025 was the 48th highest (32.04 °C with an anomaly of -0.17 °C) and the minimum temperature was the 4th highest (24.16°C with an anomaly of 0.35 °C) after the years 2024(24.63°C), 2023(24.33°C) and 2019(24.27 °C) since 1901.

Among the four homogeneous regions, over East & Northeast India the maximum temperature was the 3rd highest (32.12 °C with an anomaly of 0.95 °C) after the years 2024 (32.45 °C), 2023 (32.42 °C) and the minimum temperature was the 4th highest (24.72 °C with an anomaly of 0.54 °C) after the years 2024(25.15 °C), 2023(24.92 °C), 2022(24.79 °C) since 1901. The mean temperature over East & Northeast India was the 4th highest (28.42 °C with an anomaly of 0.75 °C) after the years 2024(28.80 °C), 2023 (28.67 °C) and 2022(28.45 °C) since 1901.Over Northwest India the minimum temperature was the 2nd highest (23.87 °C with an anomaly of 0.60 °C) after the year 2024(24.42 °C) since 1901.

Rainfall over All India (937.2 mm) was 5th highest since 2001 and 38th highest since 1901.Rainfall over homogeneous region of northwest India (747.9 mm) was highest since 2001 and 6th highest since 1901. Rainfall over homogeneous region of east & northeast India (1089.9 mm) was 2nd lowest since 1901 and 2001.

3.2. Onset, Advance and Withdrawal of Southwest Monsoon

Fig. 21(a) depicts the isochrones of the advance of the southwest monsoon and Fig. 21(b) depicts the isochrones of withdrawal of the southwest monsoon (till 30 September).

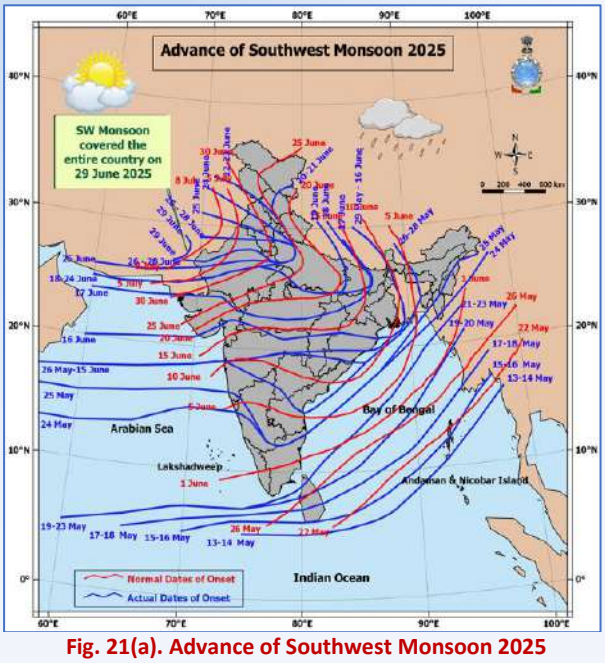


Fig. 21(a). Advance of Southwest Monsoon 2025

Southwest Monsoon advanced into some parts of south Bay of Bengal, south Andaman Sea, Nicobar Islands and some parts of north Andaman Sea on 13thMay, 2025against normal date of 19thMay. Southwest Monsoon set in over Kerala on 24th May 2025, against the normal date of 1stJune (8-days before the normal date).Southwest Monsoon, which had set in over Kerala on 24th Mayfollowed rapid advance till 29th May and covered south India and North East India.By 31st May the Northern Limit of Monsoon passed through 17.0°N/55°E, 17.5°N/60°E, 18°N/65°E, 18.5°N/70°E, Mumbai, Ahilyanagar, Adilabad, Bhawanipatna, Puri, Sandhead Island, 23.5°N/89.5°E, Balurghat, 30°N/85°E.Further progress started on from 16th June. With rapid advance, it covered most parts of the country except some parts of Northwest Rajasthan, West Uttar Pradesh, South Punjab and south Haryana, Delhi by 26th June. SW Monsoon covered the entire country on 29th June 2025, 9 days ahead of its normal date 8th July (Fig. 21a).

The withdrawal of the SW-monsoon 2025 began on 14th September against its normal date of 17th September (Fig. 21 b) .

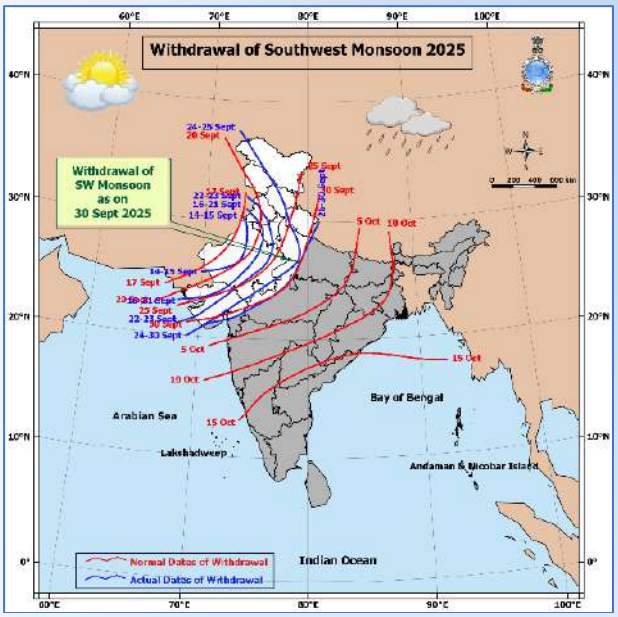


Fig. 21(b). Withdrawal of Southwest Monsoon 2025 (till 30 September)

3.3. Rainfall Features

Most sub-divisions of the country received large excess/excess/normal rainfall, except Arunachal Pradesh, Assam & Meghalaya and Bihar. During the season, out of 36 meteorological subdivisions, 2 sub divisions received large excess rainfall, 12 subdivisions received excess rainfall, 19 received normal rainfall and the remaining 3 subdivisions received deficient rainfall (Fig.22).

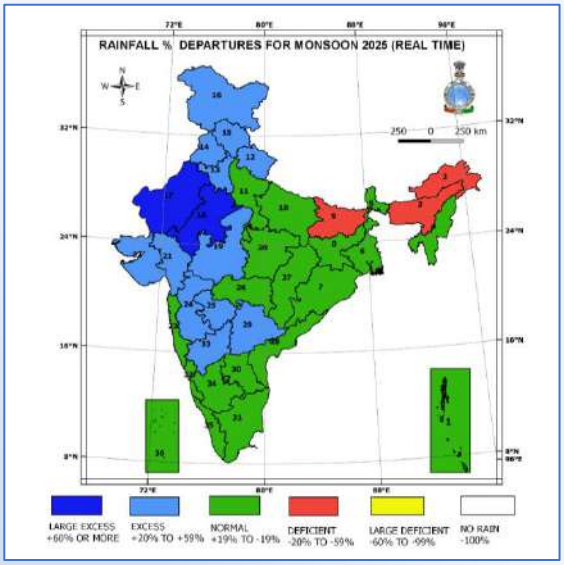


Fig. 22. Sub-divisionwise rainfall percentage departures for the monsoon 2025

Rainfall over East Rajasthan (1010.0 mm) was second highest since 1901. Rainfall over West Rajasthan and North Interior Karnataka (478.0mm, 721.3 mm respectively) was 6th highest since 1901. Rainfall over Assam & Meghalaya (1123.4 mm) was lowest since 1901. Rainfall over Arunachal Pradesh (980.3 mm) was third lowest since 1901.

Fig. 23(a) and 23(b) show the spatial pattern of rainfall received during the season and its anomaly (mm) respectively.

Most parts of northeast India, central India, north-west India, Gujarat Region, East Rajasthan,west coast and Andaman &Nicobar Islandsreceived more than 1000 mm rainfall. Parts of Assam & Meghalaya, Konkan & Goa, Coastal Karnataka, Kerala &Mahe and Andaman & Nicobar Islands received more than 2000 mm of rainfall. Parts of Assam & Meghalaya,Konkan & Goa, Coastal Karnataka and Kerala &Mahereceived more than 3000 mm of rainfall.

Positive rainfall anomaly of more than 300 mm was observed over Jammu & Kashmir & Ladakh, Punjab, Himachal Pradesh, Rajasthan state, Maharashtra state, Chhattisgarh, Telangana, Madhya Pradesh state, Gujarat Region and Andaman &Nicobar Islands. The magnitude of negative rainfall anomaly was more than 300 mm over parts of Arunachal Pradesh, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, Bihar, East Uttar Pradesh, Odisha, Chhattisgarh, West Rajasthan, Kerala and Lakshadweep.

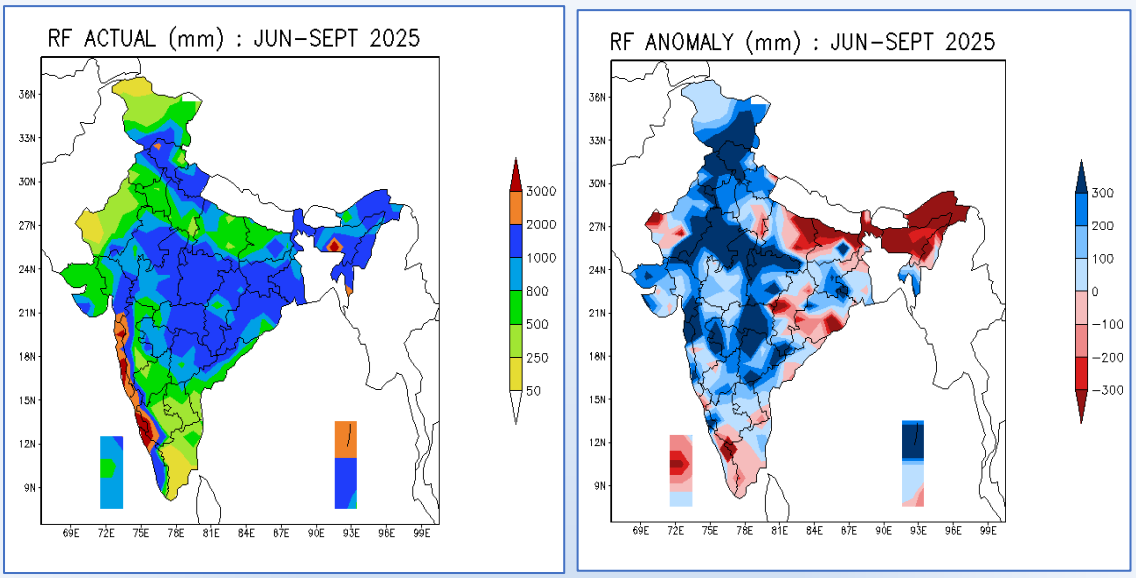


Fig. 23(a &b). (a) Seasonal rainfall (mm) (b). Seasonal rainfall anomaly (mm) (Based on 1971-2020 Normals)

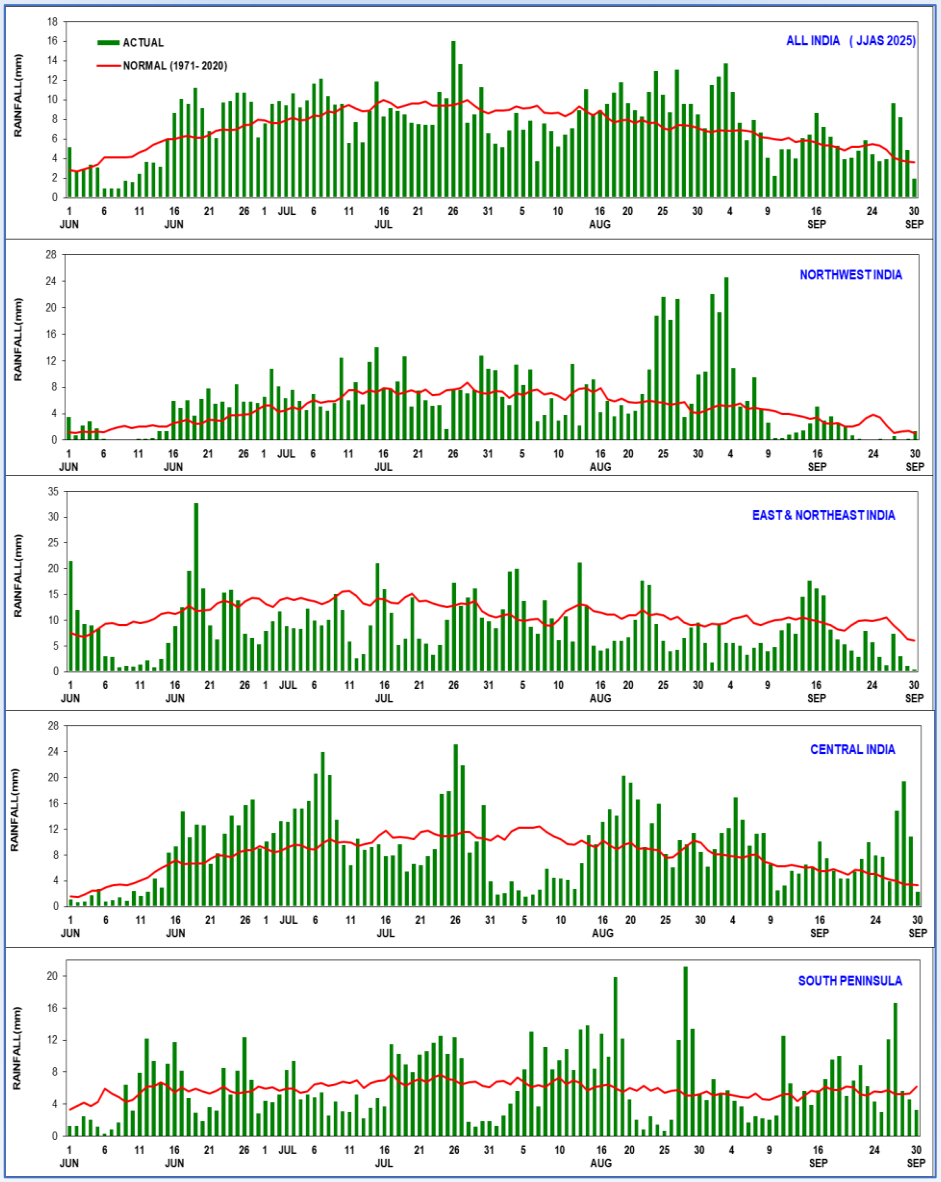


Fig. 24. Daily Area Weight Averaged Rainfall (Mm) And Its Long Term Normal For The Country As A Whole And The Four Homogeneous Regions (1st June – 30th September)

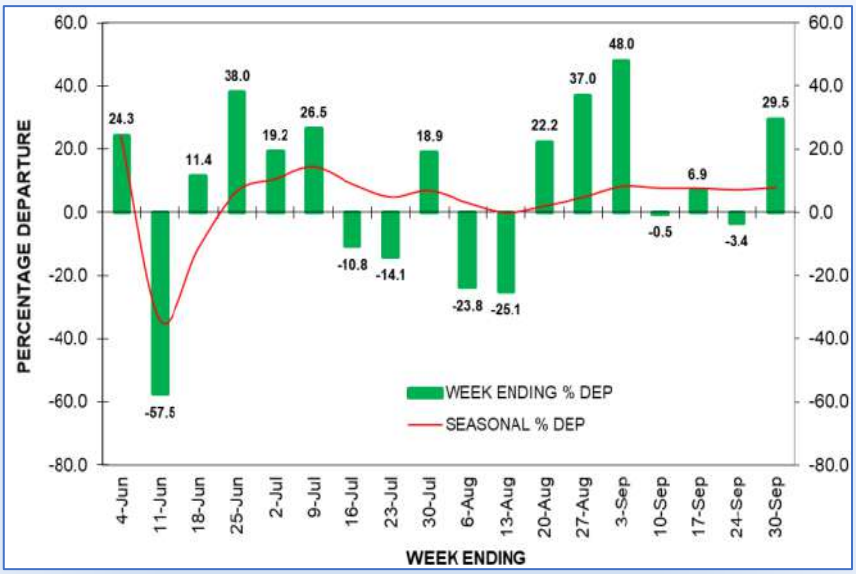
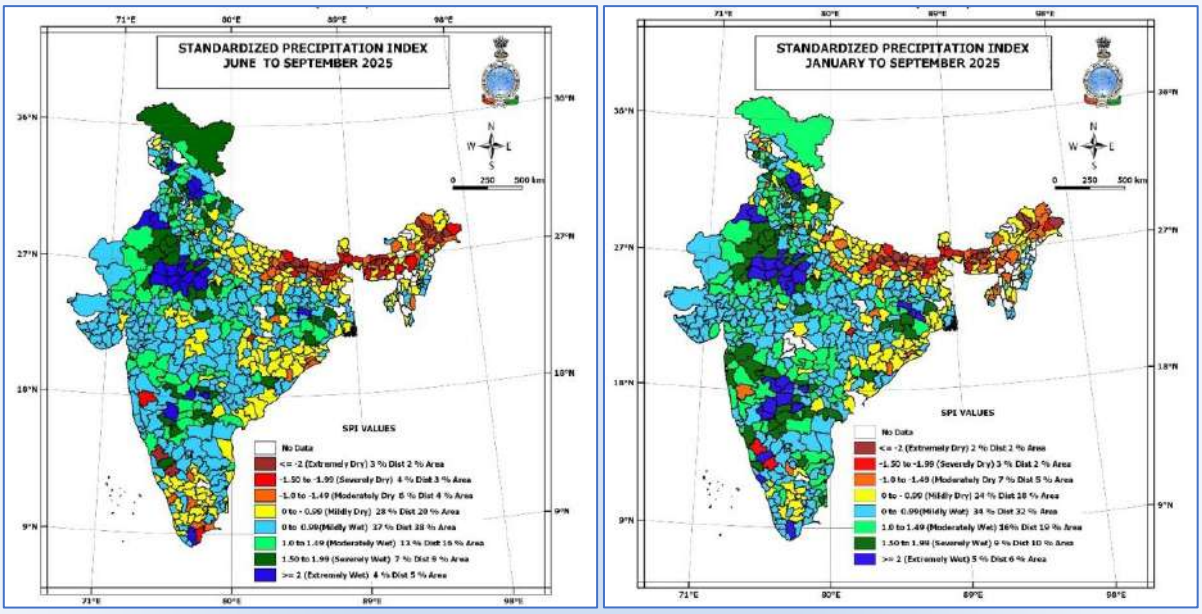


Fig. 25. Week-wise and cumulative percentage departure of area weight averaged rainfall over the country as a whole from June to September 2025

Fig. 26. Time series of area weight averaged rainfall over all India and four homogenous regions for the monsoon season during the period 1951 – 2025

(a) (b)



Figs. 27(a&b). Standardized Precipitation Index (Spi) For (a) Jun – Sep (Four months)(b) JAN- SEP(Nine months)

Cumulative SPI values of the nine months indicate extremely wet/severely wet conditions over parts of Gangetic West Bengal, Odisha, Jharkhand, West Uttar Pradesh, Uttarakhand, Haryana, Chandigarh & Delhi, Punjab, Himachal Pradesh, Jammu & Kashmir and Ladakh , Rajasthan state, Madhya Pradesh state, Konkan & Goa, Madhya Maharashtra, Marathwada, Coastal Andhra Pradesh, Telangana, Tamil Nadu, Karnataka state and Kerala while, extremely dry/severely dry conditions were observed over parts of Arunachal Pradesh, Assam & Meghalaya, S.H.West Bengal & Sikkim, Bihar, East Uttar Pradesh, Chhattisgarh and South Interior Karnataka.

3.5. Outgoing Long Wave Radiation (OLR)

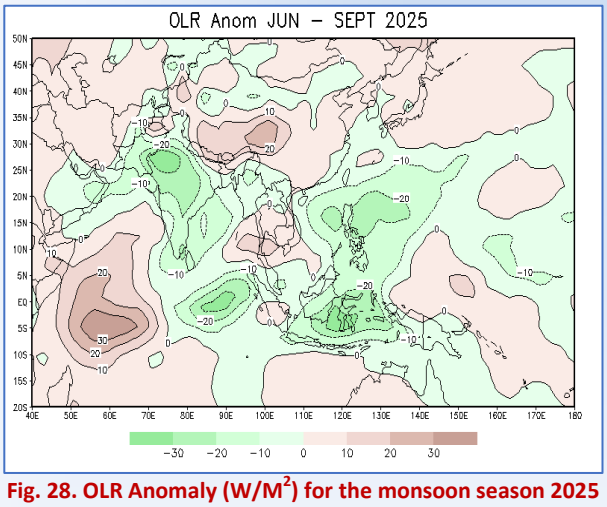


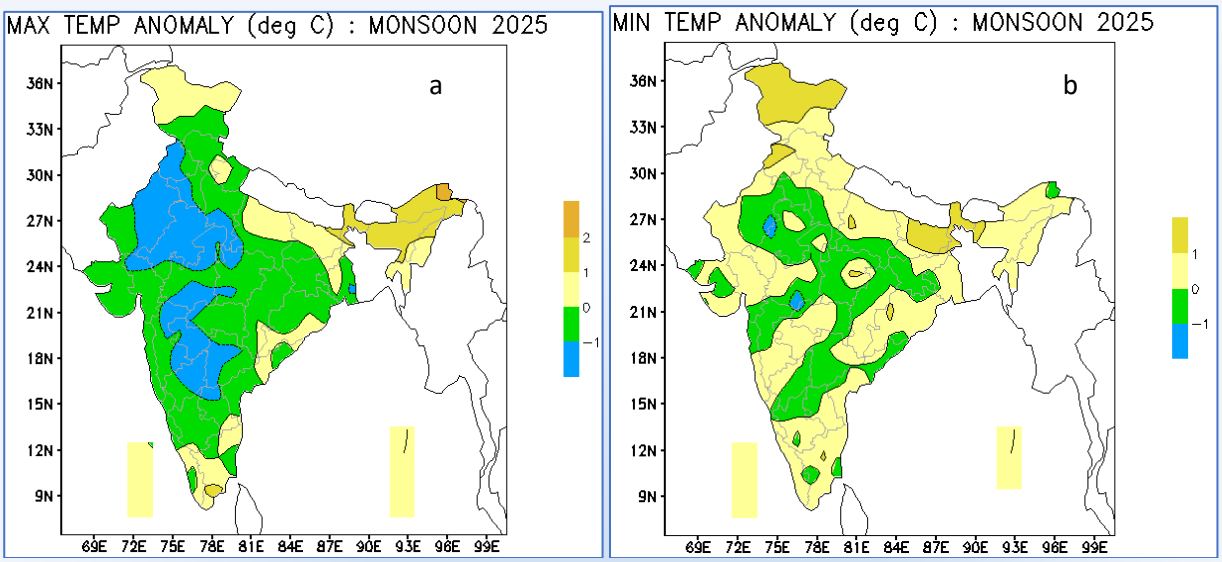
Fig. 28. OLR Anomaly (W/M^2) for the monsoon season 2025 (Data Source: CDC / NOAA, USA) (BASED ON 1991 - 2020 CLIMATOLOGY)

OLR anomaly (W/m2) over the Indian region and neighborhood is shown in Fig. 28. OLR anomaly was negative throughout the country, except extreme northeastern parts. Negative OLR anomaly less than -20 W/m2 was observed over northwestern parts.

3.6. Temperature

The maximum temperature was below normal over most parts of the country, except some parts of east & northeast India, Northwest India, southern South Peninsular India and both the islands (Fig. 29a). Maximum temperature anomaly was more than 1 ^{o}C over parts of Arunachal Pradesh, Assam & Meghalaya, Sub Himalayan West Bengal & Sikkim, Bihar and Tamil Nadu, Puducherry&Karaikal. Maximum temperature anomaly was less than -1 ^{o}C over parts of over parts of Punjab, Rajasthan state, Haryana, Chandigarh & Delhi, southern Uttar Pradesh state, Madhya Pradesh state, Gujarat region, Madhya Maharashtra, Marathwada, Vidarbha, Telangana, North Interior Karnataka, Rayalaseema and Gangatic West Bengal.

The minimum temperature was above normal over most parts of the country, except some parts of northwest India, central India and south peninsular India (Fig.29b). The minimum temperature anomaly was more than 1oC over parts of Jammu, Kashmir & Ladakh, Punjab, East Uttar Pradesh, East Madhya Pradesh, Odisha, Tamil Nadu, Puducherry & Karaikal, Assam state, Bihar and SubHimalayan West Bengal & Sikkim. The minimum temperature anomaly was less than -1oC over parts of central Rajasthan state, West Madhya Pradesh and Vidarbha.



Figs. 29(a&b). Mean seasonal temperature anomalies (°c) for monsoon 2025 Maximum (b) Minimum (based on 1991-2020 normals)

3.7. Low-Pressure Systems

During the season, eighteen low-pressure systems (one Deep Depression, three Depressions, two well-marked low-pressure areas, eight low-pressure areas and one land low-pressure area and three land depressions) were formed. The frequency and place of origin of these low-pressure systems formed over the Indian region during the monsoon season are shown in the table below.

Month / Systems	CS and above	DD	D	WML	LPA	LAND D/DD	LAND LPA	TOTAL
June	**0**	**0**	**0**	**1(BOB)**	**2(BOB),2(AS)**	**0**	**0**	**5**
July	**0**	**0**	**1 (BOB)**	**0**	**1(BOB)**	**3**	**0**	**5**
August	**0**	**0**	**1 (BOB)**	**1(BOB)**	**1(BOB)**	**0**	**1**	**4**
Septemb er	**0**	**1 (BOB)**	**1 (BOB)**	**0**	**2(BOB)**	**0**	**0**	**4**
(AS : Arabian Sea)					**(BOB: Bay of Bengal)**			

3.8. Significant Weather Events for Monsoon Season (June- September) 2025

During Monsoon Season 2025, total 1785 persons reportedly claimed dead, more than 680 persons injured, more than 230 persons missing and more than 15440 livestock perished. The details of causalities given below, which are based on real time media reports and other state government agencies.

Fig. 30 shows deaths due to significant weather events during Monsoon Season (June-July-August-September) 2025. (Based on real time media reports.)

Heavy Rains, Floods, Cloudbursts and Landslides: Total 1082 persons reportedly claimed dead, more than 330 persons injured, more than 230 persons missing and more than 14450 livestock perished during Monsoon season, because of Heavy Rains, Floods, Cloudbursts and Landslides.

Lightning associated with Thunderstorm: Total 669 persons reportedly claimed dead, more than 330 persons injured and about 980 livestock perished, during Monsoon Season, because of Lightning associated with Thunderstorm.

Thunderstorm: Total 9 persons reportedly claimed dead and 2 persons injured during Monsoon season, because of Thunderstorm.

Heat Wave: Total 22 persons reportedly claimed dead because of Heat Wave during Monsoon season.

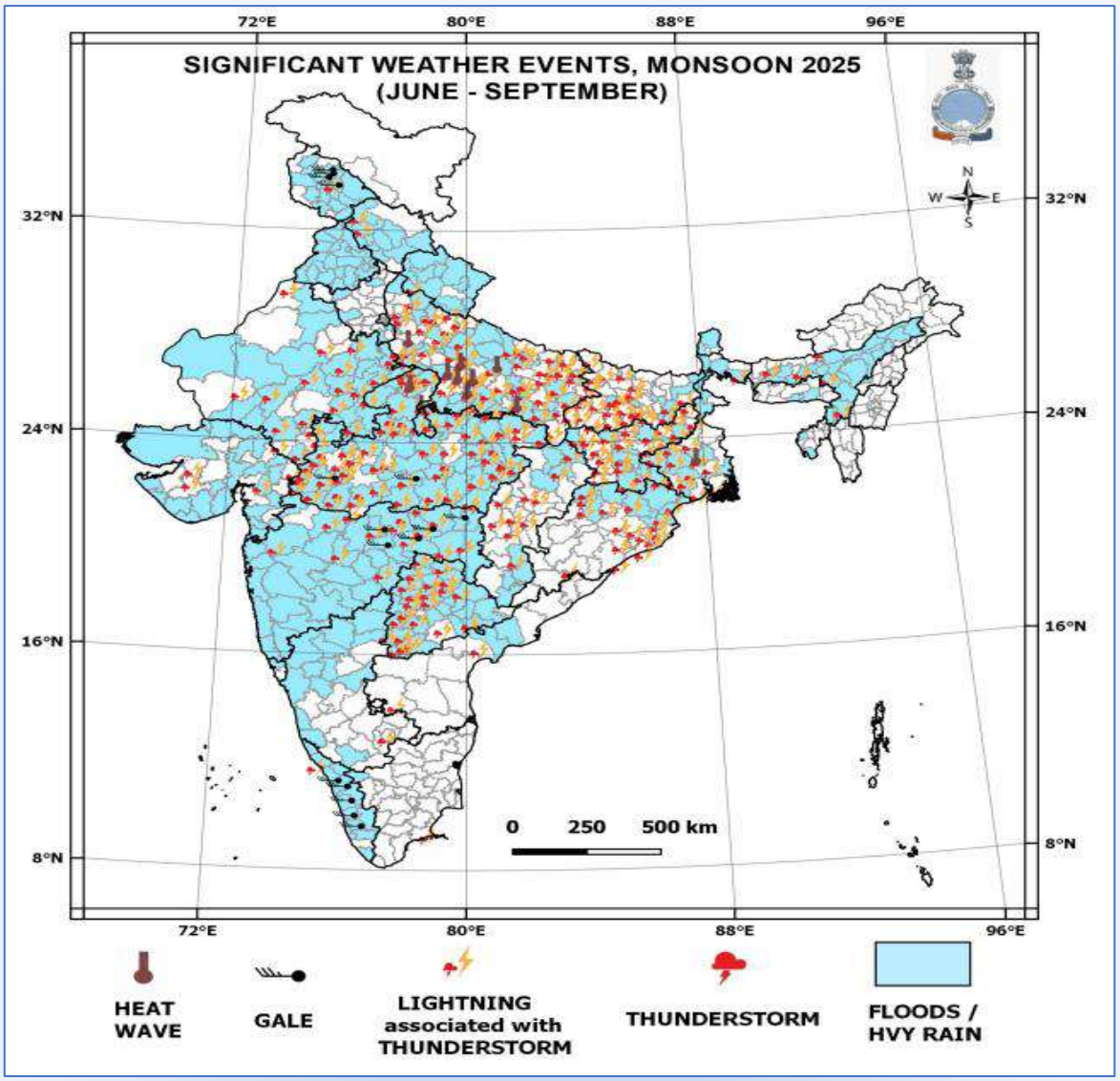


Fig. 30. Significant weather events during the monsoon season 2025 (Based on real time media report)

Gale: Total 3 persons reportedly claimed dead, 5 persons injured and 4 livestock perished because of Gale during Monsoon season.

4. Post-Monsoon Season (Oct-Nov-Dec)

4.1. Highlights

During the Post-Monsoon season, the mean temperature over the country was 22.24 °C with an anomaly of -0.10 °C (34th highest since 1901).

Among the four homogeneous regions, over East & Northeast India, the minimum temperature was the 5th highest (16.72 °C with an anomaly of 0.78 °C) after the years 2024(17.19 °C), 2023(17.12 °C), 1998(16.79 °C) and 1915(16.76 °C) and the mean temperature was the 9th highest (22.04 °C with an anomaly of 0.48 °C) since 1901. Seasonal rainfall realized over the country was 111 % of its LPA.

4.2. Northeast Monsoon Activity

The southwest monsoon withdrew from the entire country on 16th October and northeast monsoon rains commenced over Tamil Nadu, Puducherry &Karaikal, Coastal Andhra Pradesh & Yanam, Rayalaseema, South Interior Karnataka and Kerala & Mahe on the same date Rainfall activity over core region of the South Peninsular India (comprising of 5 subdivisions viz. Coastal Andhra Pradesh & Yanam, Rayalaseema, Tamil Nadu, Puducherry and Kariakal, South Interior Karnataka and Kerala & Mahe) during the season as a whole was 102% of its LPA. It was 143% of its LPA during October, 57% of its LPA during November and 65% of its LPA during December.

4.3. Cold Wave/Foggy conditions

During the season, during November 2025, cold to severe cold wave conditions was observed at isolated pockets over west, central & adjoining east India, mainly over northeast Rajasthan, south Haryana, north Madhya Pradesh, south Uttar Pradesh and north Chhattisgarh during 8 -18 November 2025 and over north interior Maharashtra on 15 and 20 November 2025. Dense Fog cases were highly subdued during the month, with 2-6 days reported from isolated pockets (2-3 Stations) over northern parts of Uttar Pradesh, Odisha, and Himachal Pradesh.

During the season, during December 2025, cold wave was observed over parts of Chhattisgarh, West Madhya Pradesh, Punjab for 8 – 15 days, over parts of Himachal Pradesh, Haryana, Chandigarh & Delhi, Odisha, Telangana, Madhya Maharashtra, Vidarbha, East Madhya Pradesh, Jharkhand, East Uttar Pradesh and North Interior Karnataka for 1- 7 days.

During December 2025, 26 days of dense fog to very dense fog were reported over Odisha especially Rourkela. 15-26 days of dense fog to very dense fog prevailed mainly over Indo Gangetic Plains covering Punjab, Haryana, Uttar Pradesh and Assam, parts of western Himalayan region covering HP and Uttarakhand. Madhya Pradesh and Bihar and Nagaland, Manipur, Mizoram & Tripura reported 10-14 Days of dense fog to very dense fog.

4.4. Rainfall Features

Rainfall realized over the country as a whole during the season was 111% of LPA. During the season,many subdivisions received large excess/excess/normal rainfall except Arunachal Pradesh, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, Uttarakhand, Jammu & Kashmir, Madhya Maharashtra, North Interior Karnataka and Kerala & Mahe. During the season, out of 36 meteorological subdivisions, 11 received large excess rainfall, 8 received excess rainfalls, 9 received normal rainfall and8 received deficient rainfall (Fig. 31).

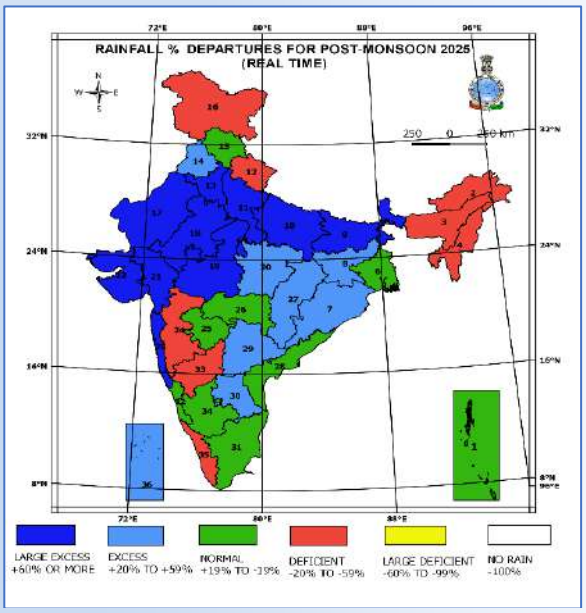


Fig.31. Subdivision wise rainfall percentage departure for Post-Monsoon season 2025

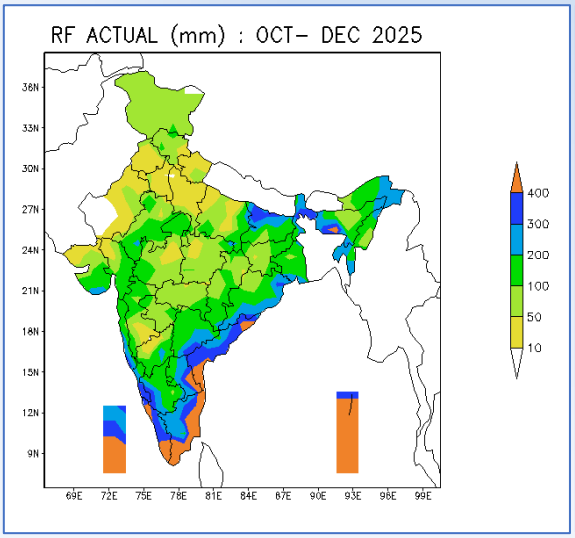


Fig. 32(a). Seasonal rainfall (mm)

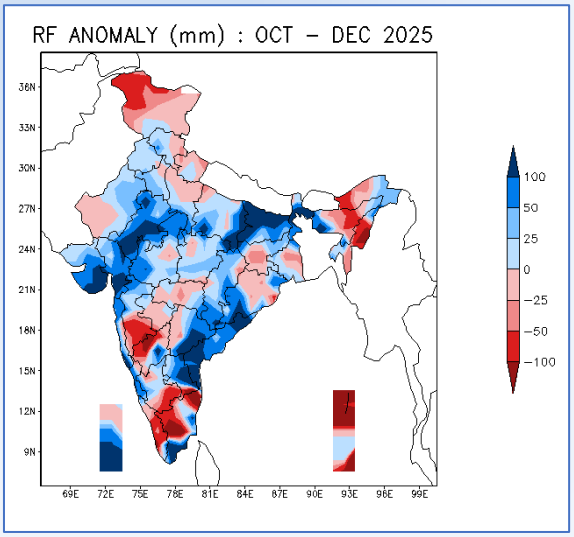


Fig. 32(b). Seasonal rainfall anomaly (mm)

Fig. 32(a) and 32(b) show the spatial pattern of rainfall (mm) received during the season and its anomaly respectively. Parts of Assam & Meghalaya, Coastal Andhra Pradesh, Rayalaseema, Tamilnadu, Puducherry & Karaikal, Kerala & Mahe and both the islands received more than 400 mm of rainfall. Rainfall anomaly was more than 150 mm over parts of Sub Himalayan West Bengal & Sikkim, Bihar, Odisha, Coastal Andhra Pradesh, Telangana, Rayalaseema. Saurashtra & Kutch. East Rajasthan, Tamilnadu, Puducherry &Karaikal and Lakshadweep. Magnitude of negative rainfall anomaly was more than 100 mm over parts of Nagaland, Manipur, Mizoram & Tripura, Tamilnadu, Puducherry &Karaikal, North Interior Karnataka and Andaman &Nicobar Islands.

Fig. 33(a) shows the area weight averaged cumulative weekly rainfall percentage departure during the season for the country as a whole. Cumulative rainfall departure was positive during all the weeks of the season. At the end of the Post-Monsoon season 2025, the rainfall for the country as a whole was 111 % of its LPA. Fig. 33(b) shows the area weight averaged cumulative weekly rainfall percentage departure during the season for the northeast monsoon region of south peninsula. Except first two weeks it was positive till end of the season. At the end of the Post-Monsoon season 2025, the rainfall over the northeast monsoon region of south peninsula was 102 % of its LPA.

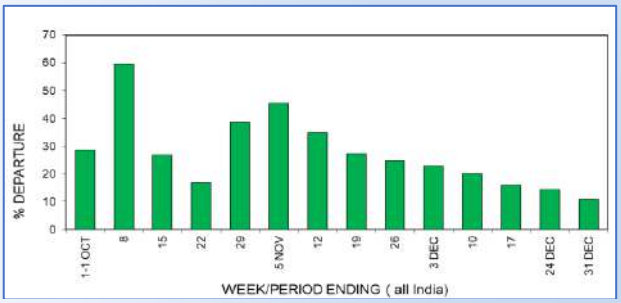


Fig. 33(a). accumulated percentage departure of area weight averaged cumulative rainfall for post-monsoon 2025 (october - december) over the country as a whole

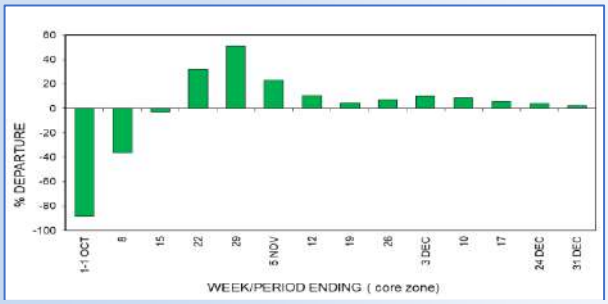


Fig. 33(b). Accumulated percentage departure of area weight averaged cumulative rainfall for post-monsoon (October - December) Over the core zone of Peninsula

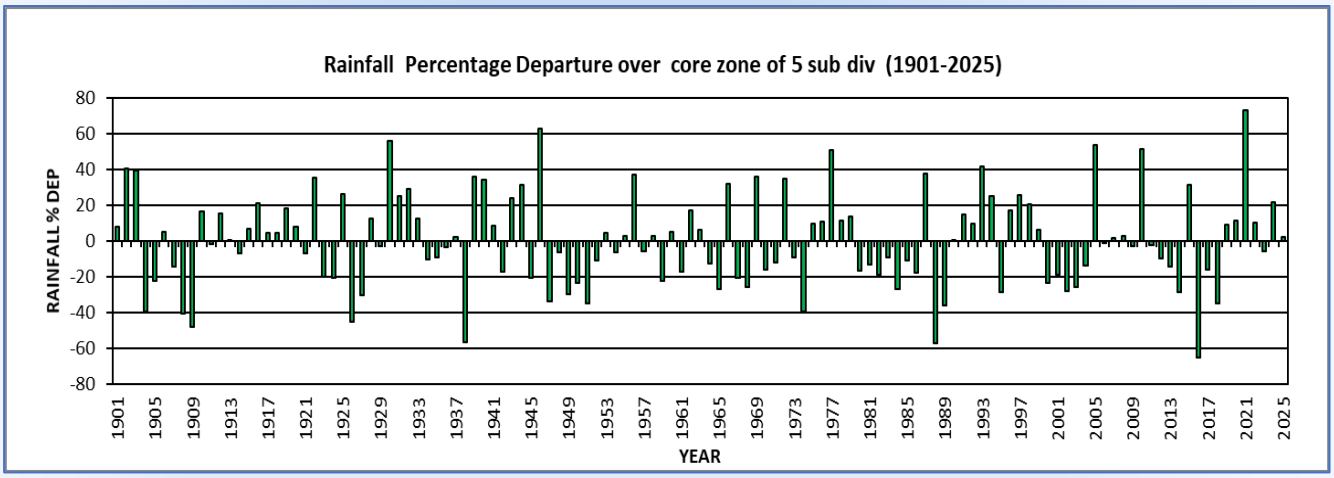


Fig. 33(C). Time series of area weight averaged post - monsoon (October - December) (1901-2025) rainfall over the core zone of Peninsula

Similarly, Fig. 33(c) shows the area weight averaged rainfall percentage departure series for the season since 1901 over the northeast monsoon region of south peninsula.

Fig. 34 shows area weight averaged rainfall series for Post-Monsoon season over all India and four homogeneous regions since 1951. Rainfall realized over the country as a whole was 111% of its LPA during the season. It was 134 % of its LPA over central India, 117% of its LPA over northwest India, 103% of its LPA over south peninsula and 99% if it's LPA over east & northeast India.

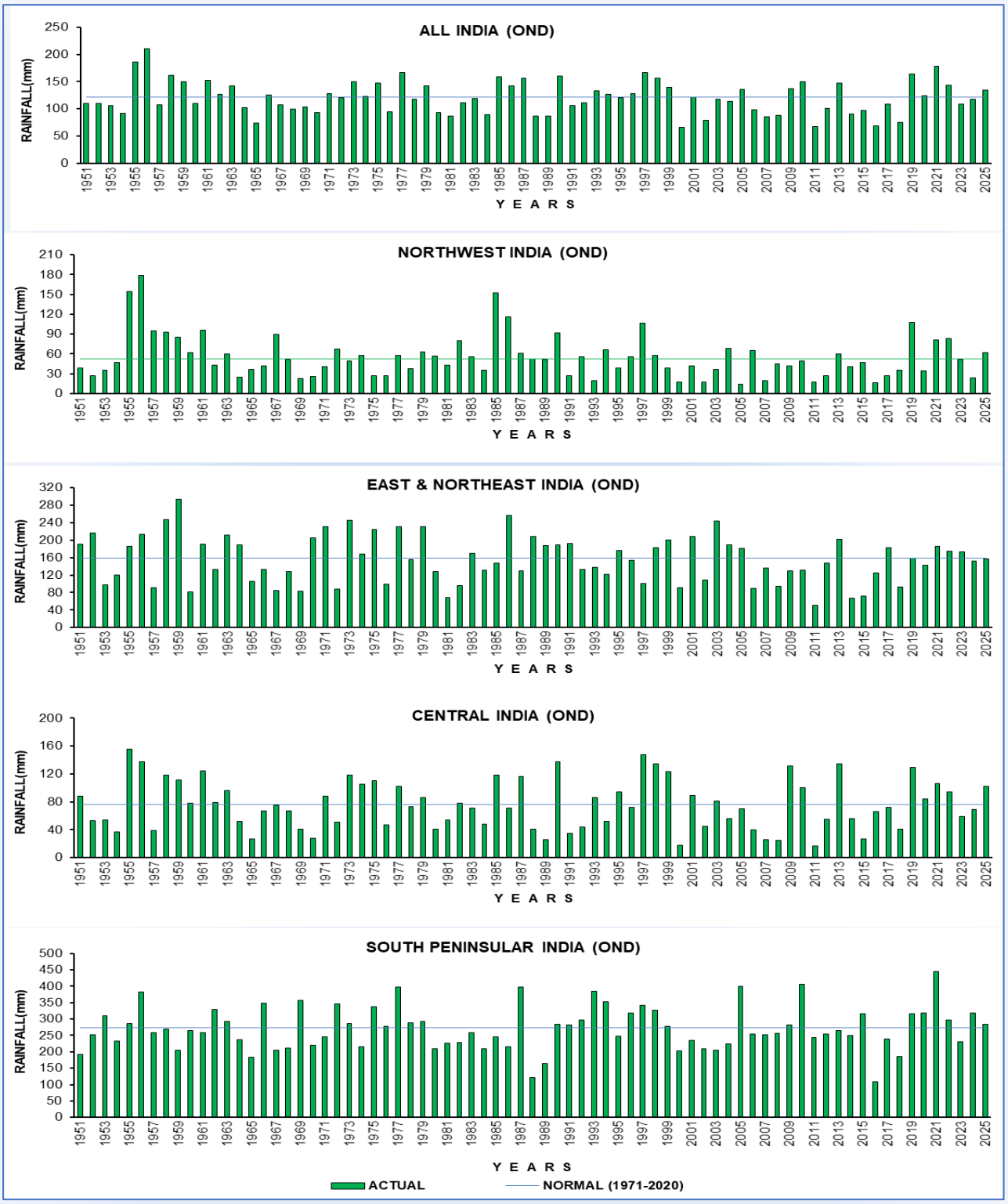


Fig.34. Time series of area weight averaged rainfall over all India and four homogeneous regions for Post - Monsoon season (1951 - 2025)

4.5. Standardized Precipitation Index

The Standardized Precipitation Index (SPI) is an index used for measuring drought and is based only on precipitation. This index is negative for dry and positive for wet conditions. As the dry or wet conditions become more severe, the index becomes more negative or positive. Fig 35 (a & b) give the SPI values for the northeast monsoon season (October to December 2025 i.e. 3 months cumulative) and the year (January-December 2025, i.e.12 months cumulative) respectively.

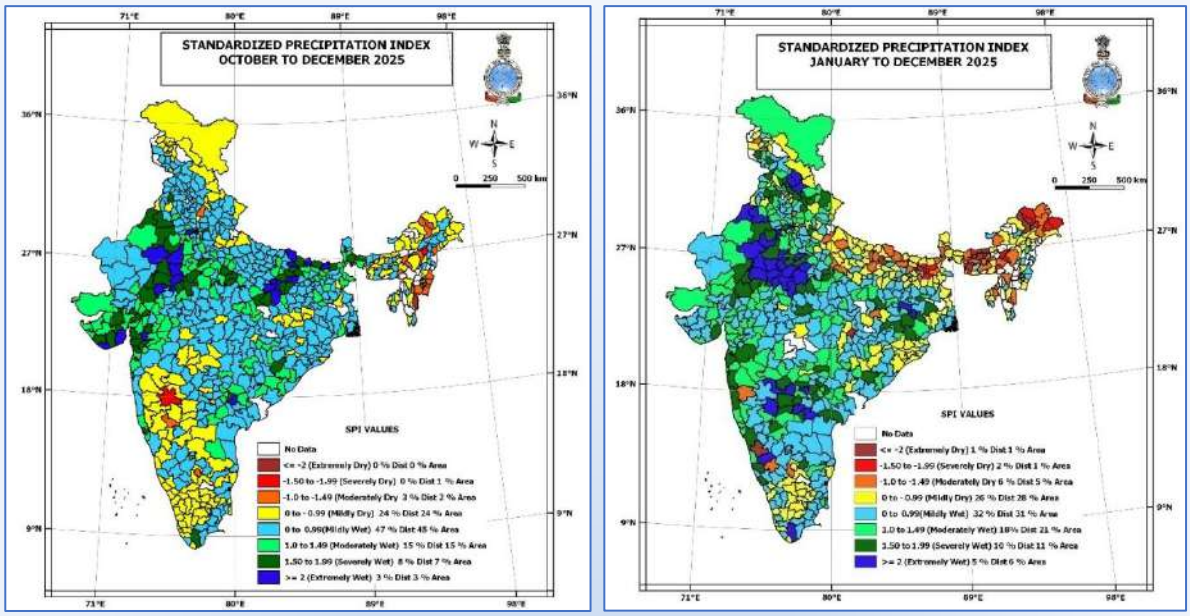


Fig. 35. Standardized precipitation index (SPI) For (a) Oct - Dec 2025 (Three Months) (b) Jan - Dec 2025 (Twelve Months)

Cumulative SPI values of the past three months indicate extremely wet-severely wet conditions over parts of Sub-Himalayan West Bengal & Sikkim, Odisha, Bihar, Uttar Pradesh state, Haryana, Chandigarh & Delhi, Punjab, Rajasthan state, Madhya Pradesh state, Gujarat state, Konkan & Goa, Telangana and Tamil Nadu,while extremely dry-severely dry conditions were observed over parts of Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura and Madhya Maharashtra.

Cumulative SPI values of the twelve months indicate extremely wet/severely wet conditions over parts of Gangetic West Bengal, Odisha, Jharkhand, West Uttar Pradesh, Uttarakhand, Haryana, Chandigarh & Delhi, Punjab, Himachal Pradesh, Jammu & Kashmir and Ladakh, Rajasthan state, West Madhya Pradesh, Gujarat state, Konkan & Goa, Madhya Maharashtra, Marathwada, Chhattisgarh, Coastal Andhra Pradesh, Telangana, Tamil Nadu, Karnataka state and Kerala while, extremely dry/severely dry conditions were observed over parts of Arunachal Pradesh, Assam & Meghalaya, Bihar, East Uttar Pradesh, Chhattisgarh and South Interior Karnataka.

4.6. Outgoing Longwave Radiation (OLR)

OLR anomaly (W/m^2) over the Indian region and neighborhood is shown in Fig. 36. During the season OLR anomaly was negative over entire country and adjoining both the seas. OLR anomaly within normal range within ± 10 W/m2 over most parts of the country and adjoining seas.

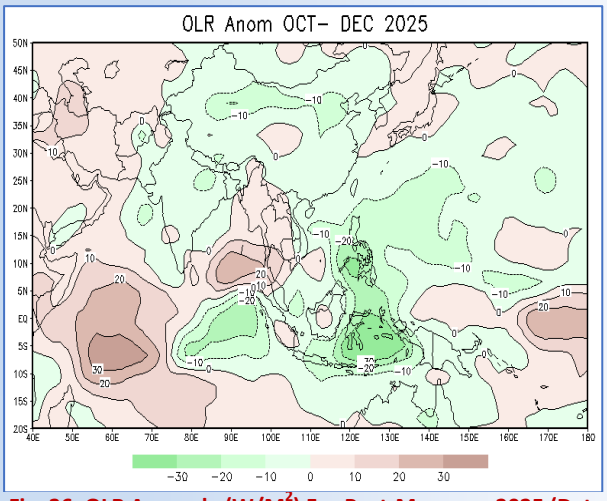
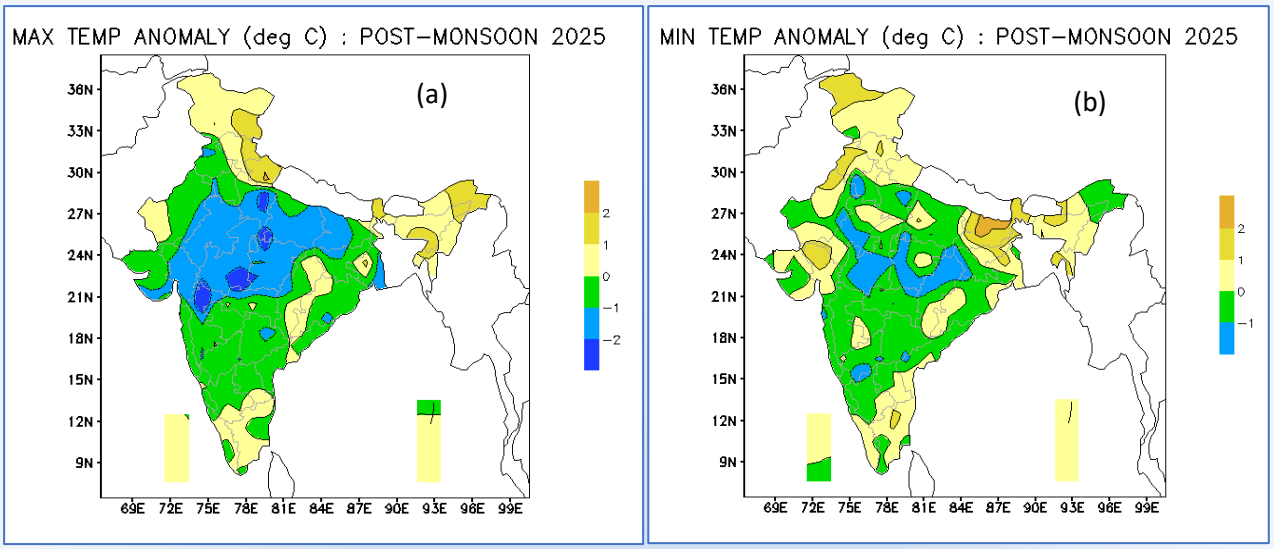


Fig. 36. OLR Anomaly (W/M^2) For Post-Monsoon 2025 (Data Source: Cdc / Noaa, Usa) (Based On 1991 - 2020 Climatology)

4.7. Temperature

Mean seasonal maximum and minimum temperature anomaly is shown in Figs. 37(a) & 37(b) respectively.

The maximum temperature was below or near normal over most parts of the country, except some parts of north India and northeast India. The maximum temperature anomaly was more than 2 °C over parts of Uttarakhand. The maximum temperature anomaly was more than 1 °C over parts of Ladakh, Himachal Pradesh, Uttarakhand, Assam & Meghalaya, Arunachal Pradesh, Mizoram, Tripura and Sikkim state. The maximum temperature anomaly was less than -1 °C over parts of Uttar Pradesh state, Madhya Pradesh state, north Madhya Maharashtra and Vidarbha.



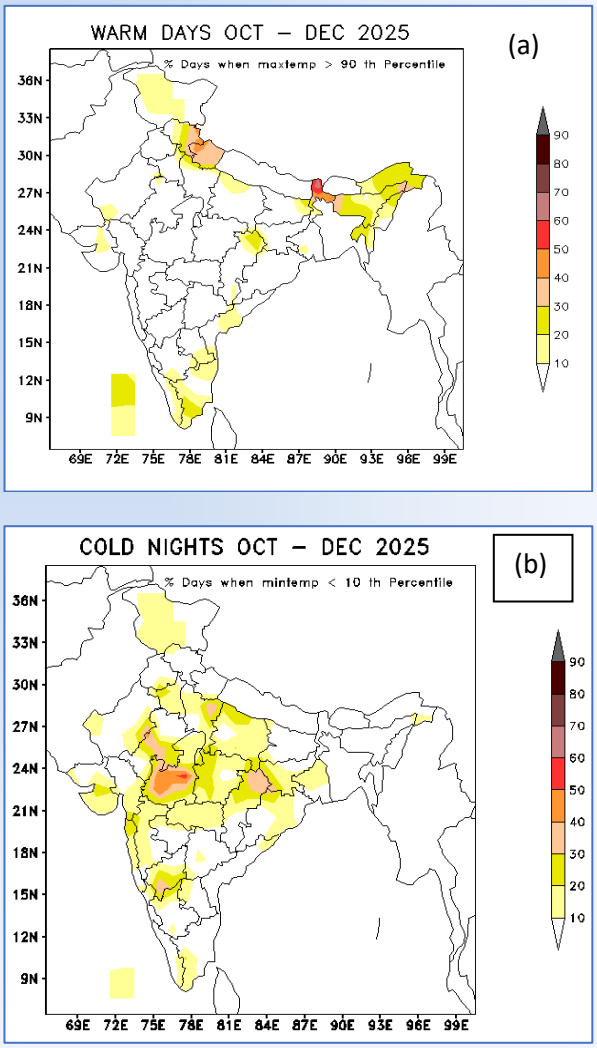
Figs. 37(a&b). Mean seasonal temperature anomalies (°C) for Post-Monsoon 2025 (a) Maximum (b) Minimum (Based On 1991-2020 Normals)

The minimum temperature was below normal in most parts of the country, except some parts of east &northeast India, western central India, southern peninsular India and both the islands. The minimum temperature anomaly was more than 2 °C over parts of Bihar. The minimum temperature anomaly was less than -1 °C over parts of Haryana, Chandigarh & Delhi, Rajasthan state, Uttar Pradesh state, Madhya Pradesh state, Jharkhand, Chhattisgarh, northern Konkan, North Interior Karnataka, South Interior Karnataka, Telangana and Coastal Andhra Pradesh & Yanam.

Fig 38(a) & 38 (b) show the percentage of days when maximum (minimum) temperature was more (less) than 90th (10th) percentile. During the season, over parts of Sub-Himalayan West Bengal & Sikkim and Uttarakhand maximum temperature was greater than 90th percentile for more than 40% of the days. Over parts of West Madhya Pradesh minimum temperature was less than the 10th percentile for more than 40% of the days of the month.

Fig. 39 shows the mean temperature for the country as a whole for the Post-Monsoon season since 1971. Five-year moving average values are also shown. The mean temperature for the Post-Monsoon season 2025 was 22.24 °C with an anomaly of -0.10 °C, ranking it the 34th highest since 1901. Among the four homogeneous regions, the mean temperature over East & Northeast India was the 9th highest (22.04 °C with an anomaly of 0.48 °C) since 1901.

Fig. 38(a) & 46(b) show, the maximum and minimum temperature series, respectively, for the country as a



Figs. 38 (a & b). (a) Percentage of Days When Maximum Temperature > 90th Percentile (b) Percentage of Days When Minimum Temperature <10th Percentile

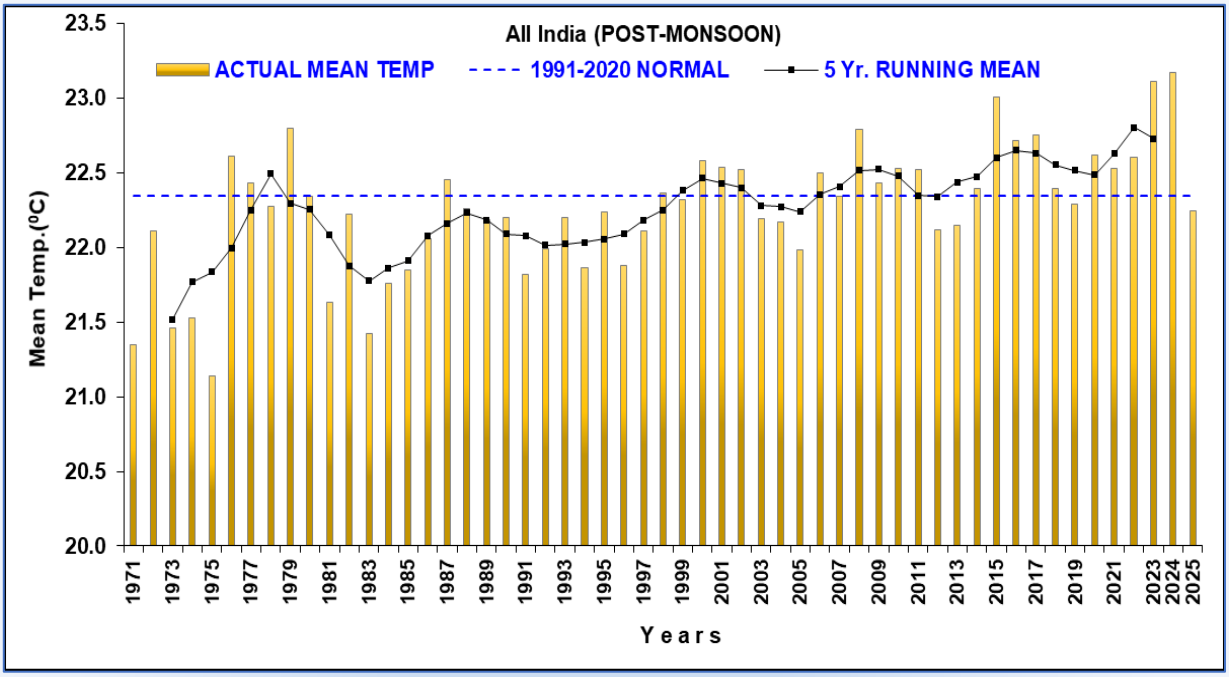


Fig. 39. Time series of mean temperature averaged over India (vertical bars and five-year running mean (continuous line) for the post-monsoon during the period 1971-2025.

whole and the four homogeneous regions during the Post-Monsoon season since 1971. The maximum temperature was below normal over the country as a whole and all the homogeneous regions except East & Northeast India. The minimum temperature was below normal or near normal over the country as a whole and all the homogeneous regions except East & Northeast India. Among the four homogeneous regions, over East & Northeast India, the minimum temperature was the 5th highest (16.72 °C with an anomaly of 0.78 °C) after the years 2024(17.19 °C), 2023(17.12 °C), 1998(16.79 °C) and 1915(16.76 °C) since 1901.

Across the country as a whole, the maximum temperature in Post-Monsoon season 2025 was the 51st highest (28.32 °C with an anomaly of -0.32 °C) and the minimum temperature was the 23rd highest (16.16 °C with an anomaly of 0.12 °C) since 1901.

4.8. Low Pressure Systems

During the Post-Monsoon season, eight low pressure systems (2 SCS, 2 CS, one deep depression, one depression, one well marked low pressure area and one low pressure area) were formed. The frequency and place of origin of these low pressure systems formed over the Indian region during the post monsoon season is shown in the table below.

Month /Systems	CS and above	DD	D	WML	LPA
October	1 (BOB), 1(AS)	1(BOB)	1(AS)		
November	2 (BOB)			1(BOB)	1(BOB)
December	0	0	0	0	0
	(AS : Arabian Sea)		(BOB: Bay of Bengal)		

Fig. 41 shows tracks of these systems formed during season.

4.9. Significant Weather Events for Post Monsoon (October-November-December) 2025

During Post Monsoon season, total 116 persons reportedly claimed dead, more than 35 persons injured, several persons missing and more than 5690 livestock perished. The details of casualties given below, which are based on real time media reports and other state government agencies.

Fig. 42 shows significant weather events during Post Monsoon 2025. (Based on real time media reports.)

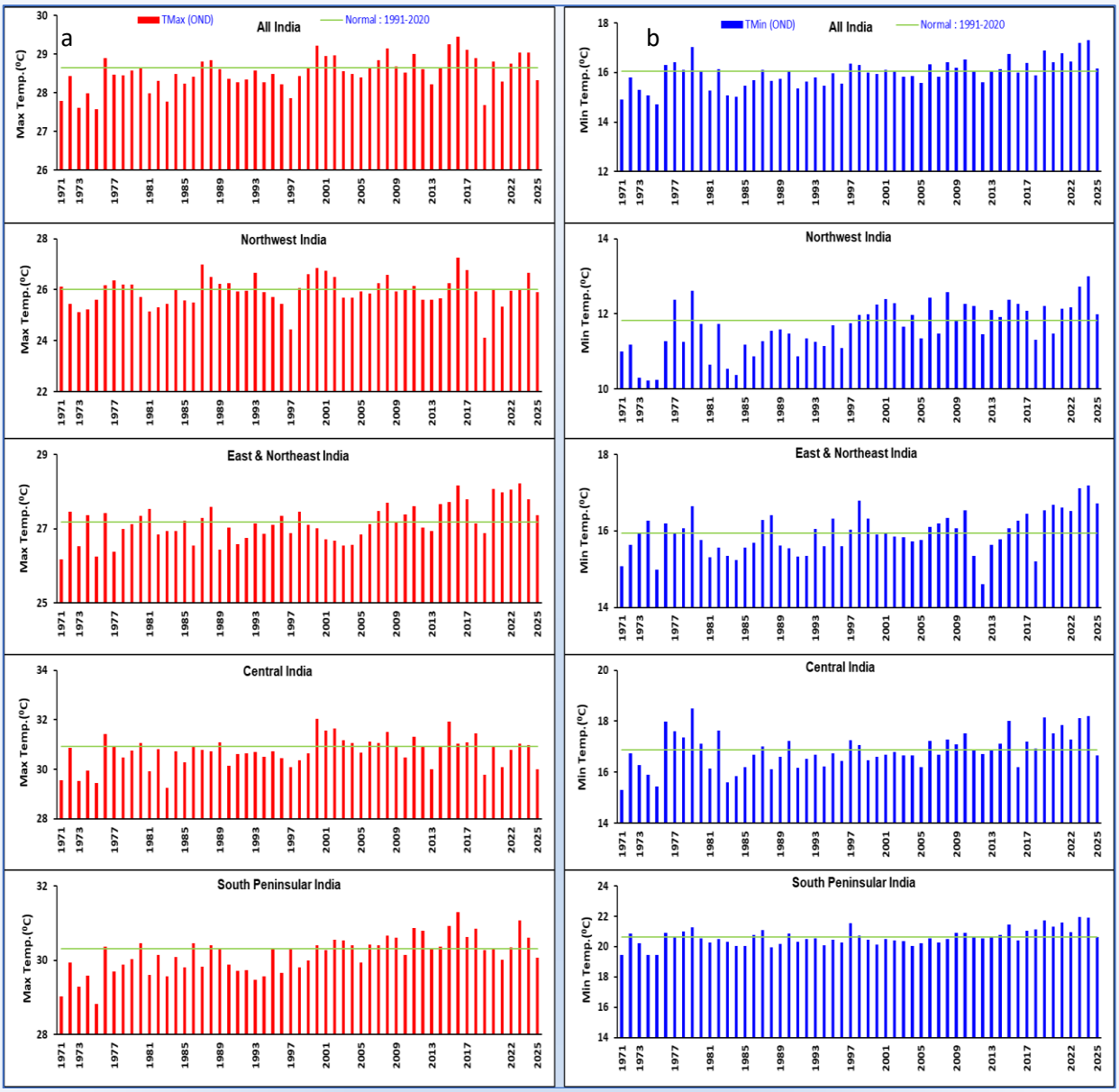


Fig. 40. Time series of temperature for the country as a whole and the four homogeneous regions for post- monsoon season of the period 1971-2025 (a) Maximum (b) Minimum

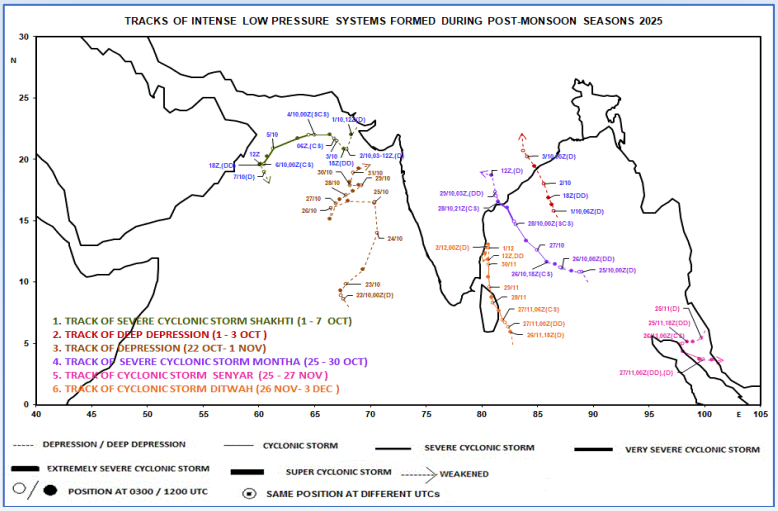


Fig. 41. Tracks of intense low pressure systems formed during post-monsoon season of 2025

Heavy Rains, Floods, Cloudbursts and Landslides: Total 65 persons reportedly claimed dead, more than 20 persons injured, several persons missing and more than 5000 livestock perished during Post Monsoon season, because of Heavy Rains, Floods, Cloudbursts and Landslides.

Lightning associated with Thunderstorm: Total 38 persons reportedly claimed dead, more than 10 persons injured and more than 70 livestock perished during Post Monsoon season, because of Lightning associated with Thunderstorm.

Gale: Total 2 persons reportedly claimed dead and few persons injured during Post Monsoon season, because of Gale.

Cyclonic Storm: Total 11 persons reportedly claimed dead, 3 persons injured and more than 620 livestock perished during Post Monsoon, because of Severe Cyclonic Storm MONTHA and Cyclonic Storm DITWAH.

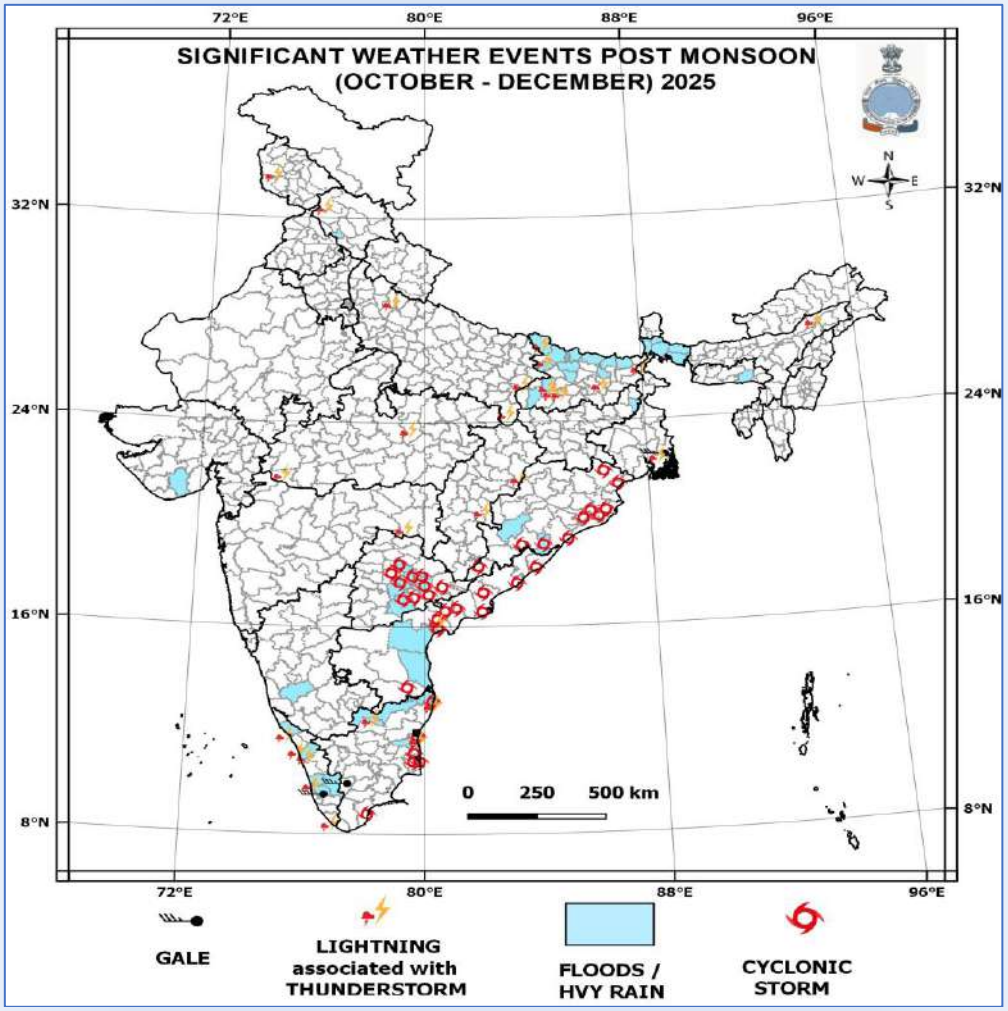


Fig. 42. Significant weather events during post-monsoon season 2025 (based on real time media reports and other state government agencies)

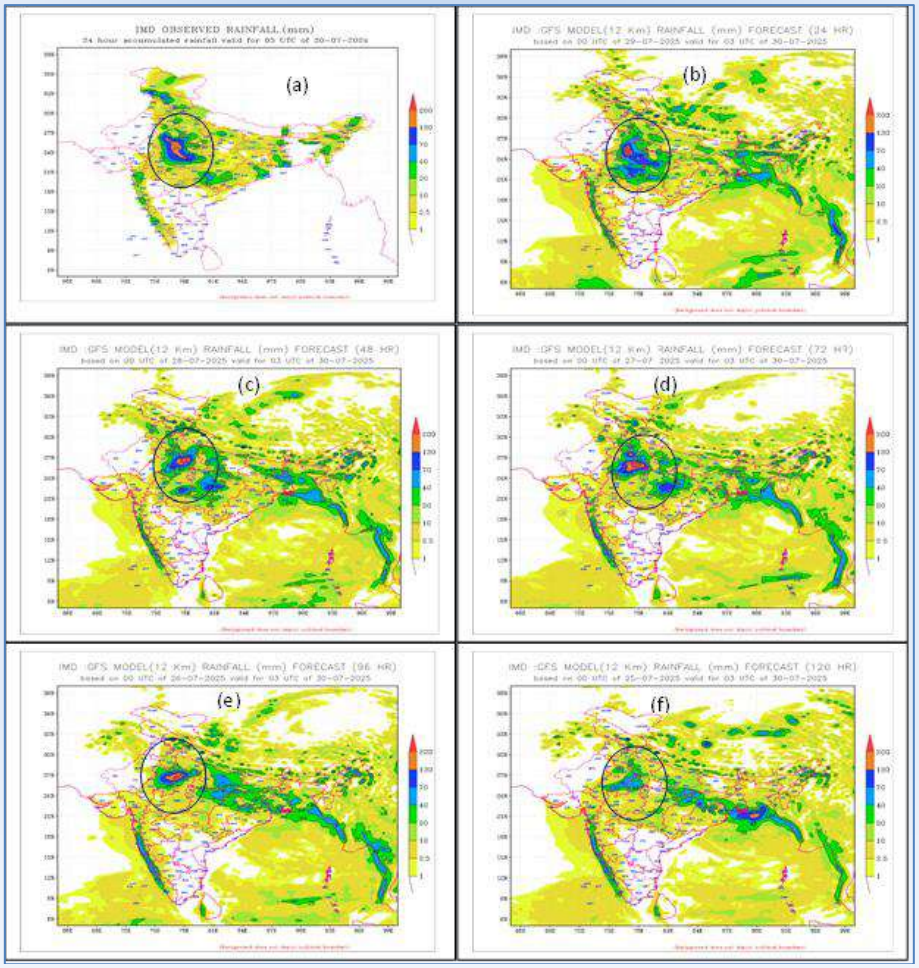
CHAPTER 3

NUMERICAL WEATHER PREDICTION

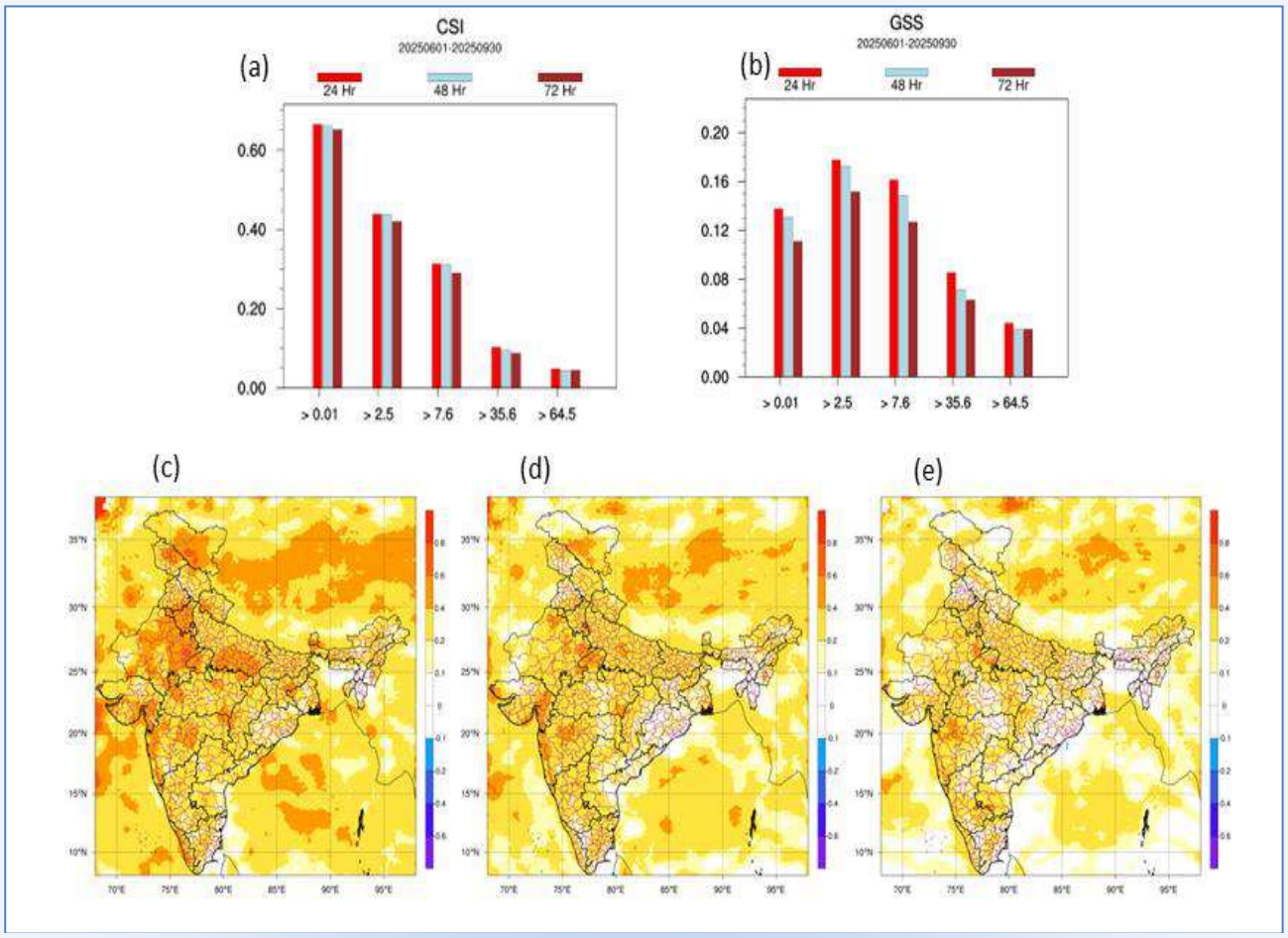
3. Global and Regional Modelling (NWP)

3.1. Global Forecasting System

The Global Forecasting System (GFS T1534L64) model is run operationally at the India Meteorological Department (IMD) four times in a day (0000, 0600, 1200 & 1800 UTC) to give deterministic forecasts in the short to medium range upto 10 days. The forecast model has a resolution of approximately 12 km in horizontal and has 64 levels in the vertical. The initial condition for this GFS model is generated from the four-dimensional (4D) ensemble-variational data assimilation (DA) system (4DEnsVar), building upon the grid point statistical interpolation (GSI)-based hybrid Global Data Assimilation System (GDAS) run on High Performance Computing Systems (HPCS) at the National Center for Medium Range Weather Forecasting (NCMRWF).The real-time GFS T1534L64 model outputs are generated daily at IMD. This 4DEnsVar data assimilation system has capabilities to assimilate various conventional as well as satellite observations, including radiances from different polar orbiting and geostationary satellites. The real-time outputs are made available to operational weather forecasters and various users through the national website of IMD. Fig. 1 shows the forecast and observed heavy rainfall event of 30th July, 2025, during south west monsoon 2025.



Figs. 1(a-f).(a) IMD Observed rainfall for 30th July, 2025 and IMD-GFS forecast for (b) 24 hours, (c) 48hours, (d) 72 hours, (e) 96 hours and (f) 120 hours valid for 30th July, 2025



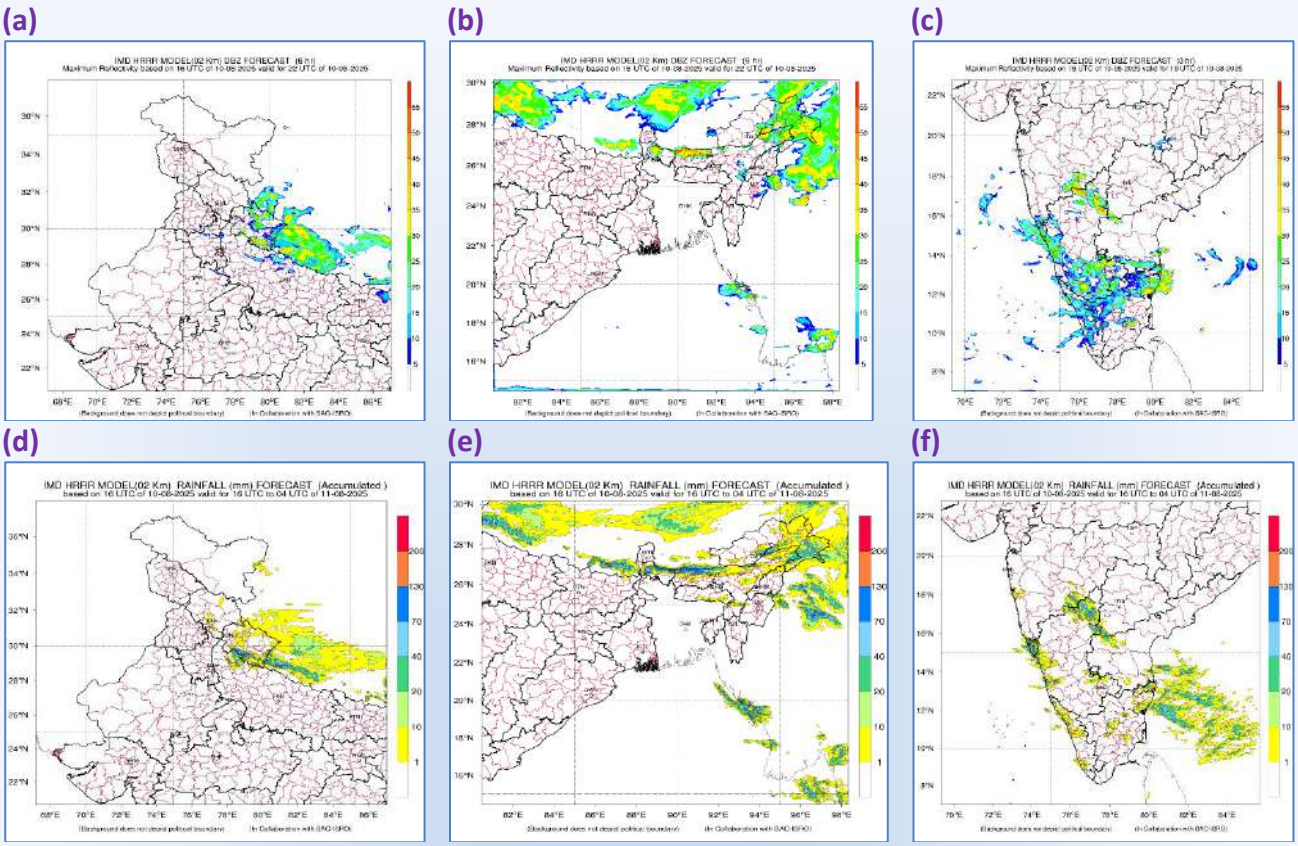
Figs. 2(a-e). (a) Critical Success Index, (b) Gilbert Skill Score & spatial correlation coefficient, averaged over the whole monsoon season for (c) 24 hours forecast, (d) 48 hours forecast, and (e) 72 hours forecast of rainfall

3.2. WRF model

During southwest monsoon season 2025, the WRF model (ARW) delivered three days forecasts at 3 km horizontal resolution four times daily at 0000, 0600, 1200 and 1800 UTC with hourly interval. The data assimilation component, regional GSI (Global Statistical Interpolation) takes global GFS analysis and all other conventional quality-controlled observations as its input and generates mesoscale analysis at 3 km resolution. The model produced forecasts over a domain spanning about 5°S to 41°N in north-south and 49°E to 102°E in east-west directions, respectively. Fig. 2 portrays skill scores viz., (a) critical success index and (b) Gilbert skill scores for different rainfall thresholds, whereas the lower row exhibits the seasonal averaged spatial correlation coefficient for (c) 24 hours, (d) 48 hours and (e) 72 hours rainfall forecasts with observation.

3.3. High Resolution Rapid Refresh (HRRR) MODEL

The HRRR model is based on Weather Research and Forecasting (WRF) Model's ARW core and takes the initial and boundary condition from the IMD-GFS global model. Utilizing the WRF Data Assimilation system (WRF-DA), the RADAR data is assimilated in HRRR model every 10-15 min over a 1-h period. The HRRR is hourly updated, cloud-resolving, convection-allowing atmospheric model, with a horizontal resolution of 2km and provides reflectivity and rainfall forecast for next 12 hours. The HRRR model is run in cyclic mode every hour for three domains covering entire mainland of India viz. North-West Domain, East & North-East Domain and South Peninsular India domain and forecast products are updated on the NWP website every two hours. Some forecast product from the HRRR model is shown in Fig. 3



Figs. 3(a-f).The top panel figures (a,b,c) show the Reflectivity forecast product for North West, South and East & North-East India from HRRR model. The lower panel figures (d,e,f) shoes the rainfall forecast product for North West, South and East & North-East India from HRRR model

3.4. Extended Range Forecasts

A CFSv2 coupled model suite has been developed, implemented, and operationalized in IMD in 2017 to generate operational Extended Range Forecast products for different users. This suite of models are (i) CFSv2 at T382 (≈ 38 km) (ii) CFSv2 at T126 (≈100 km) (iii) GFSbc (bias corrected SSTfrom CFSv2) at T382 and (iv) GFSbc at T126. The Multi-model ensemble (MME) of the above suite is run operationally for 32 days based on every Wednesday initial condition with 4 ensemble members to give forecast for 4 weeks for days 2-8 (week1; Friday to Thursday), days 09-15 (week2; Friday to Thursday), days 16-22 (week3; Friday to Thursday) and days 23-29 (week4; Friday to Thursday). In November 2025 IMD operationalized a new version of ERF system with a multi-physics framework with 18 ensembles with CFS system at T574 resolution up to 15 days forecasts and at T382 resolution beyond 15 days. The observed weekly rainfall departure over India during monsoon 2025, indicating the weak phase in the first half of June, the middle of July, Early August and the second week of September, is shown in Fig. 4. The corresponding weekly rainfall anomalies in the forecast are also shown in Fig. 4. As it is seen from Fig. 4 the model could capture these active

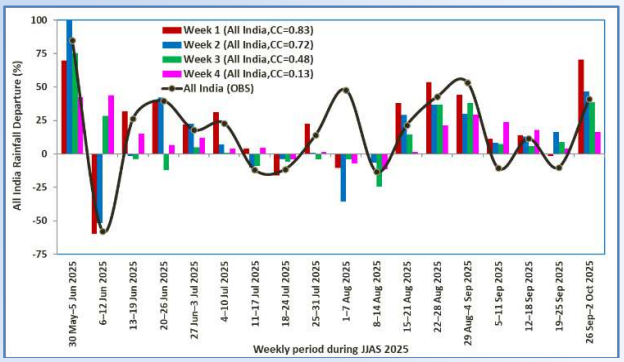
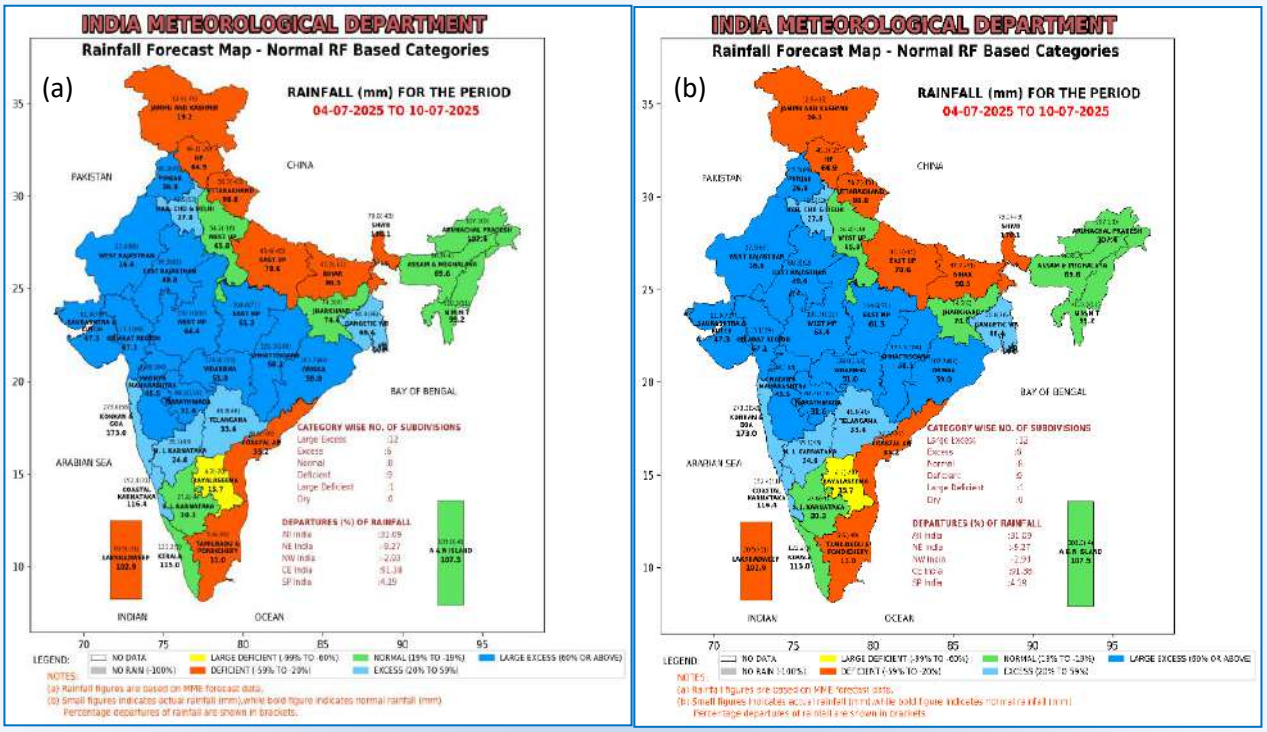


Fig. 4. Weekly observed and forecast rainfall departure during the monsoon season 2025 with 4 weeks lead time

phases of monsoon along with the normal monsoon periods. However, the weak monsoon phase in September was not very well captured, as the model slightly over predicted the actual departure of rainfall. On smaller spatial scales (homogeneous regions and met subdivision levels) the forecast shows useful skill up to two weeks. On met subdivision level, the category forecasts up-to two weeks are being used for agro-advisory purposes.



Figs. 5 (a&b). Met-subdivision wise forecast for target week 04th June - 10th July
(a) week 1 forecast based on 02ndJuly, 2025 IC and (b) week 2 forecats based 25thJune, 2025

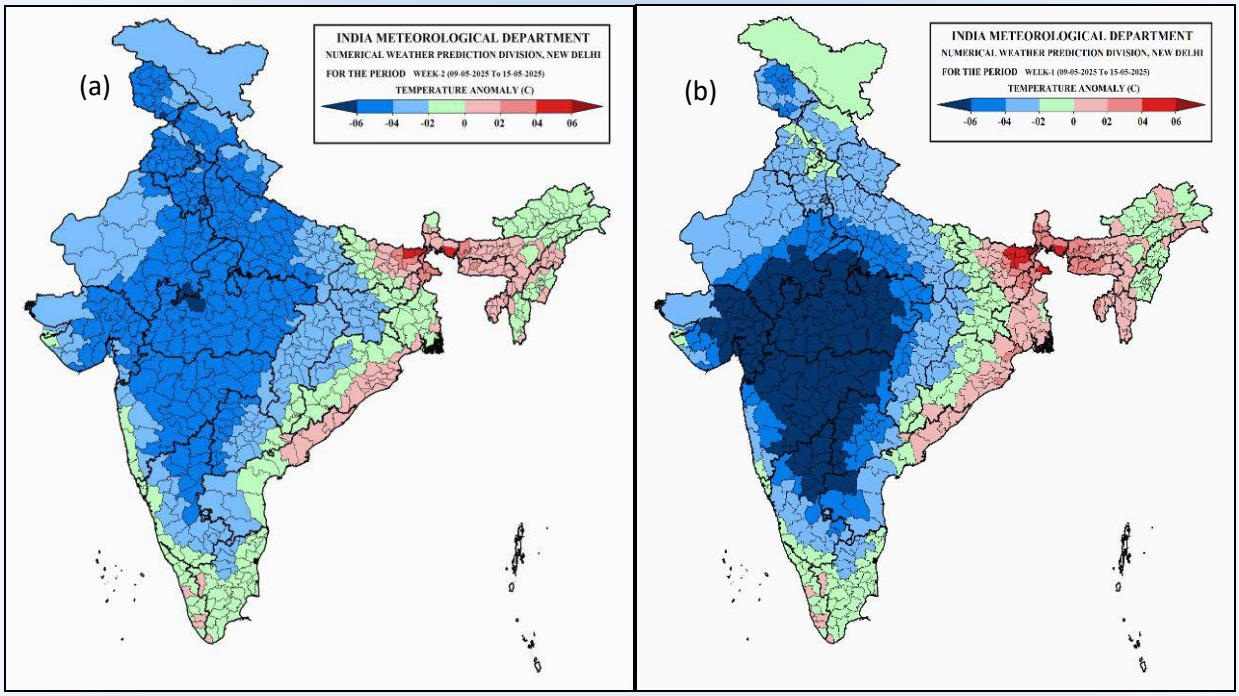


Fig. 6. Shows the District wise maximum temperature anomaly forecast for target week 09th - 15thMay (a) week1 forecast based on IC (30thApril) and (b) week 2 forecast based on IC (7thMay, 2025)

For agromet applications forecast for 36 met subdivisions of India is prepared for two weeks, categorizing the subdivisions as below normal, normal, or above normal categories depending on the rainfall departure during the week. The two-week forecast on the met-subdivision level is widely used for application in Agriculture for farmers' advisory. The active phases of monsoon over NW India for the target weeks of 4th July - 10th July 2025 with two weeks lead time is shown in **Figs. 5 (a&b).**

The transition of monsoon from above normal to below normal is well captured in the extended range forecast, which is being used widely for Agromet advisory purposes.

3.5. Districts level extended range forecast

Experimental ERF products are also being prepared for application in other sectors:-

Agriculture and veterinary sector (The winter frost forecast and extreme low temperature will be used for crop advisory, high temperature for the veterinary sector, like poultry farms, will be used)

Water sector/Disaster management (The ERF forecast of active and break phases of monsoon, heavy rainfall, severe weather like cyclone etc will be generated for application in hydrological models and reservoir operations).

Health sector (indices like heat index, transmission windows for vector-borne diseases, cold wave etc will be generated for services in health sector).

Energy sector (The extreme high and low temperature forecasts products are being generated for potential use in power/energy sector) as shown in the **Fig. 6.**

3.6. Verification of Multi-Model Ensemble (MME) and individual model Forecasts using Observations from Buoys and Ships

The NWP division of IMD generates MME products to support marine weather services. These products are operationally available to forecasters and serve as critical guidance tools for providing forecasts to the marine community. The MME products include computations for 10-meter wind, visibility, weather conditions and sea state.
Forecast data from five global operational models-Global Forecast System (GFS), Global Ensemble Forecast System (GEFS), Japan Meteorological Agency (JMA) model, National Centers for Environmental Prediction (NCEP) model and the National Centre for Medium Range Weather Forecasting (NCMRWF) Unified Model (NCUM)-are utilized daily for up to seven days. Both individual model outputs and MME-based graphical products are generated twice daily, based on 0000 UTC and 1200 UTC data and updated on the IMD website to aid in marine forecasting and bulletin preparation.

The MME forecast wind speeds are visually represented with a color-coded scheme that indicates various wind speed ranges according to the legend. These visualizations extend to a seven-day forecast and are valuable tools for operational forecasters. Observational data are also incorporated with buoy wind speed and direction displayed as blue wind bars and ship observations shown as black wind bars. **Fig.7** provides an example of the Day-1 MME forecast overlaid with real-time buoy and ship observations.

3.7. The real-time verification of individual models for forecasts up to five days is carried out using buoy observations

Forecasts from individual models, generated daily at 0000 UTC and 1200 UTC, are validated against observations from buoys and ships. The figure below provides valuable information for forecasters, serving as a guidance tool to identify and assess biases in the individual models and incorporate value-added adjustments into the final forecasts.

The comparison highlights that individual models exhibit larger errors compared to buoy observations, emphasizing the need for logarithmic correction when comparing model-derived 10m wind speeds. Similarly, models' wind speed data were also validated with respect to the ship observation. The comparison shows that wind speed from the ship observation has a large bias compared to the individual models. The error for 00 UTC-based models versus buoys and ships observation are shown in **Fig. 8**.

3.8. Electric WRF (E-WRF) Operationalization

Recently during March 2022, IMD NWP division has operationally implemented the model EWRF. Presently three different products (Lightning Flash Density, Max Reflectivity and Hourly rainfall) from the Electric-WRF model have been updated in the IMD NWP internal website on the experimental basis for the kind feedback of forecasters. In the E-WRF modelling system, ground-based lightning flash rate has been assimilated for the improvement of the model forecast.

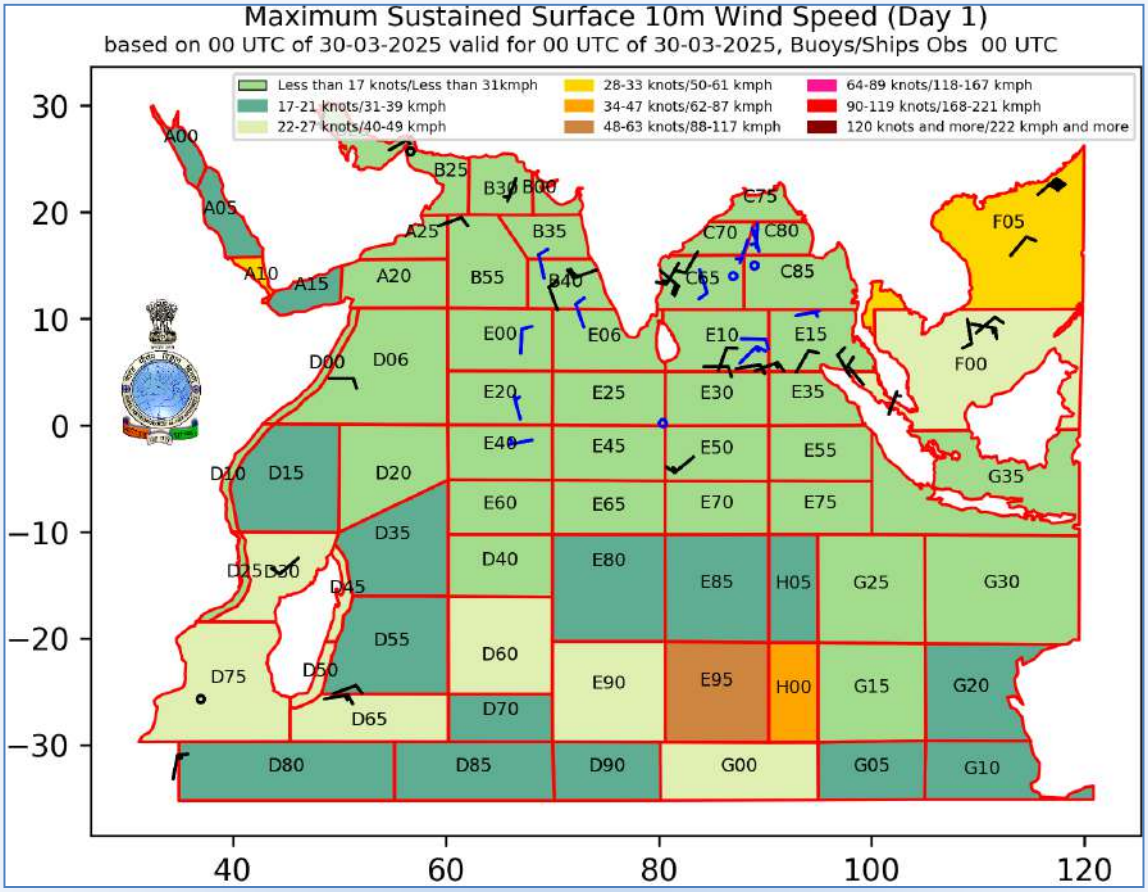
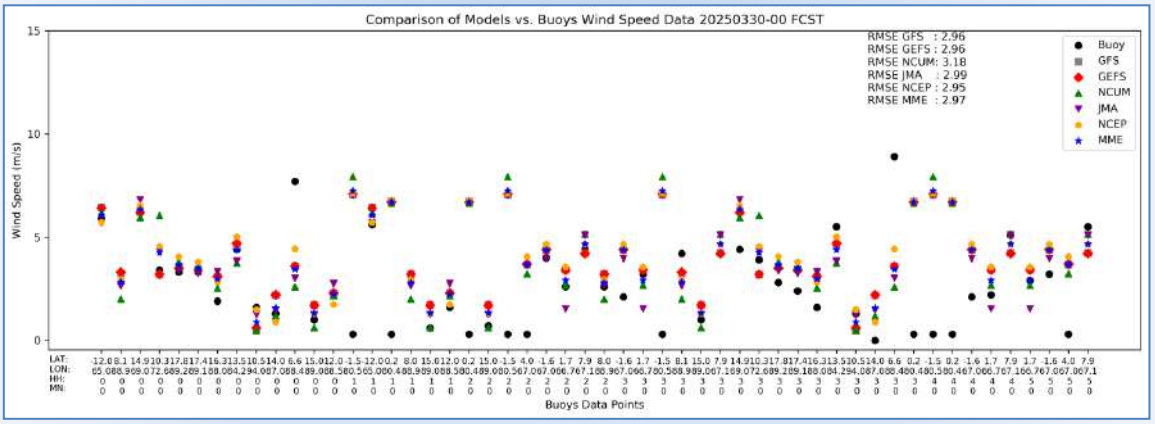


Fig. 7. Extended Fleet Forecast domain including buoys and ships observation for day 1 forecast



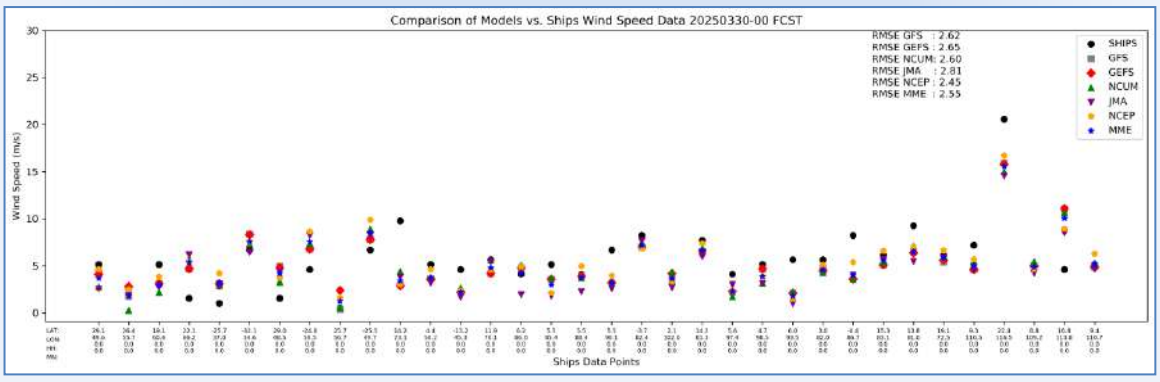


Fig. 8. Root mean Square error of the individual model, MME vs buoys (black dots) and ships (black dots)

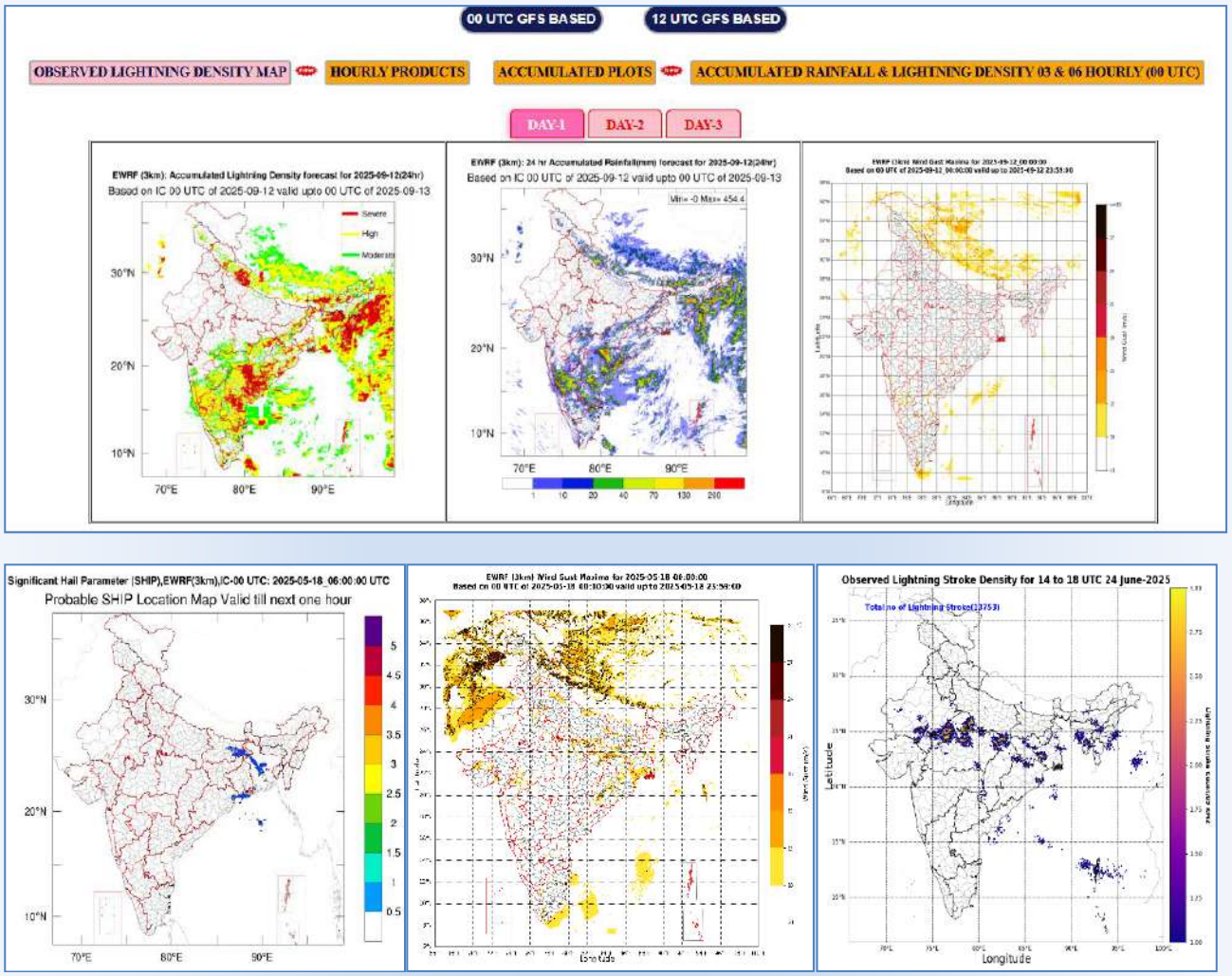


Fig. 9.EWRF simulated (top left to right) Lightning Flash Origin Density, Max Reflectivity, Rainfall and (bottom left to right) Significant Hail Parameter (SHIP), Wind Gustand Observed Lightning density products

The details of these products available in the NWP website (https://nwp.imd.gov.in/) are depicted below. Recently, IMD has extended the model forecast for 72 hours for 0000 UTC run. The 1200 UTC run is still forecasted for next 36 hours. Each run utilizes the latest lightning data assimilation that helps to improve the forecast effectively.

Early Run is based on the 0000 UTC IMD-GFS initial conditions with the validity of the forecast being for 72 hours at hourly intervals. The Early run products will be available on the website around 0500-0530UTC (10:30 to 11:00 IST onward).

Second run is based on the IMD-GFS 1200 UTC initial condition with the validity of the forecast being for 36 hours at hourly intervals. The Third run products will be available on the website around 1730 UTC (11:00 to 1200 IST; midnight).

This Electric WRF model is based on the proper and explicit cloud electrification physics mechanism through which the model generates the electric field over the different grid points of the domain. This electrification mechanism has separate charging and discharging schemes based on different laboratory experiments. In the charging mechanism, Inductive and no-inductive processes have been introduced. Few plots of the products are given below for the understanding of the forecasters **(Fig. 9).**

IMD also introduces district-wise hourly Multi Model Average of lightning count. Presently, we are using EWRF and NCUM-R models for generating the district-wise multi-model average lightning count. On an hourly basis we are generating Multi Model average over all districts of India daily two times 0000 UTC and 1200 UTC based for next 24 hours (Fig. 10). Presently, District wise multi model average is available in the website for 72 hours for all districts of India.The probability of detection (POD) of the individual model and MMA have been evaluated with respect

to IITM and ILDN both the lightning detection networks. The analyses indicated during the pre-monsoon season (MAM) MMA performs best and followed by EWRF and thereafter NCUM-R. We have further checked the other statistics like FAR, CSI etc, which indicated the same observation hold for other statistics as well. In summary, MMA performs best than the individual models. Individual models and MMA perform better over North east, east, Peninsular India and North India. The POD is comparatively lower over west India state like Gujarat, East Rajasthan, West Madhya Pradesh, and Coastal Andhra Pradesh. Average POD (after averaging for all districts of India) for MMA is 0.658 and 0.631 for IITM and ILDN network respectively (Fig.11).

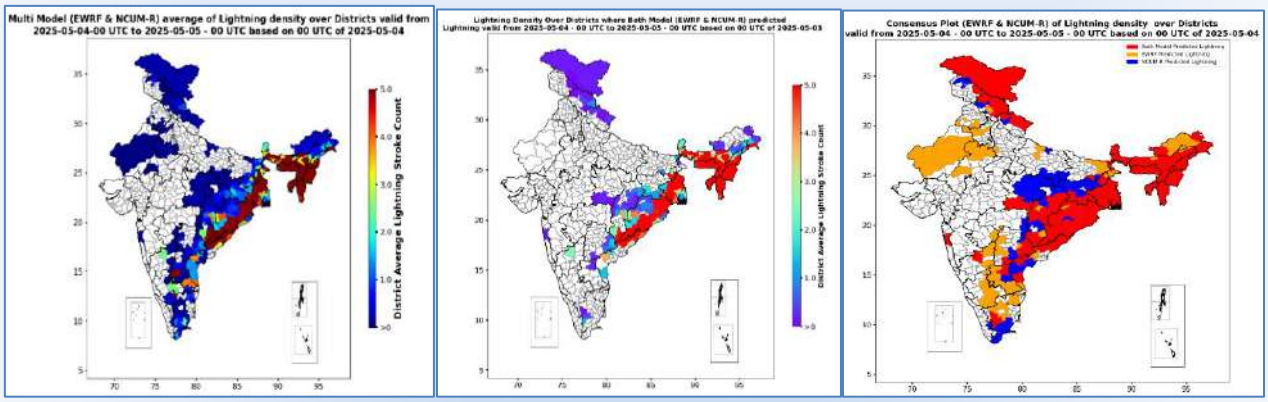


Fig. 10.Multimodel average Lightning count (MMA) over districts of India based on EWRF and NCUM-R model lightning flash count. (left to right) left most plot in Multi model average of lightning count over Districts, middle plot is the consensus plot to show how many models predicted lightning over Districts and right most plot is lightning density over districts where both models indicated lightning

3.9. Multi Model Ensemble Tropical Cyclone Tracker

ECMWF IFS TC Tracker: The European Centre for Medium-Range Weather Forecasts (ECMWF) developed the Integrated Forecasting System (IFS) model for the global numerical weather prediction at medium range timescale and developed Tropical Cyclone Tracker (IFS-TC-Tracker).

The ECMWF IFS-TC-Tracker source code has been modified by the NWP division of IMD, to feed in multi-model global forecasts outputs and made the individual model TC-tracker lines plot along with multi-model-mean and the verifications of TC-Tracker both the visual and statistical outputs are discussed. By using 8 global model (BFS, IMDGFS, NCMRWF-G,ECMWF, NCEP, CMC, NOGAPS, UKMO) and the IFS-TC-Tracker outputs and 1 regional model (NCMRWF-R) tracker outputs have been made over north Indian Ocean, operationally at NWP, IMD. All model outputs are being interpolated to T159 Gaussian Grid horizontal resolution before running the IFS-TC-Tracker. Last 5 years (2021-25) this method is being operationally implemented and made significant improvement in landfall location & time prediction in well advance. Here showed this year one of the Cyclonic Storm named 'DITWAH' during 2025-11-27-00Z to 2025-11-30-12Z over the Bay of Bengal (BoB) has been explored (Fig. 12) & verified (Fig. 13).

The verification of severe cyclonic storm 'DITWAH' (Fig. 13) using 9 TIGGE models and multi-model mean outputs fed into the IFS-TC-Tracker at different forecast lead times (upto138 hours by 6 hourly intervals). In Fig. 13 shows the distance position error (DPE) of the IFS-TC-Tracker outputs of the nine TIGGE models and MM Mean, during different initial conditions from 2025-11-27-00Z and 2025-11-30-12Z at both 0000 and 1200 UTC, and upto 240 hours forecast lead time. The MMEM (blue line) model track error is less than 100 Km at 102 hour lead forecast, but reduced errors less than 55 Km at 72 hours lead forecast, and less than 45 Km at 24 hours lead forecast. The IMD's Operational Forecast error (black line) much less than any of the model forecast at long lead time and better performed than any of the model by utilizing the guidance from the above MMEM especially beyond 36 hours lead forecast, and performed well match along with MMEM for upto 36 hours lead forecast.

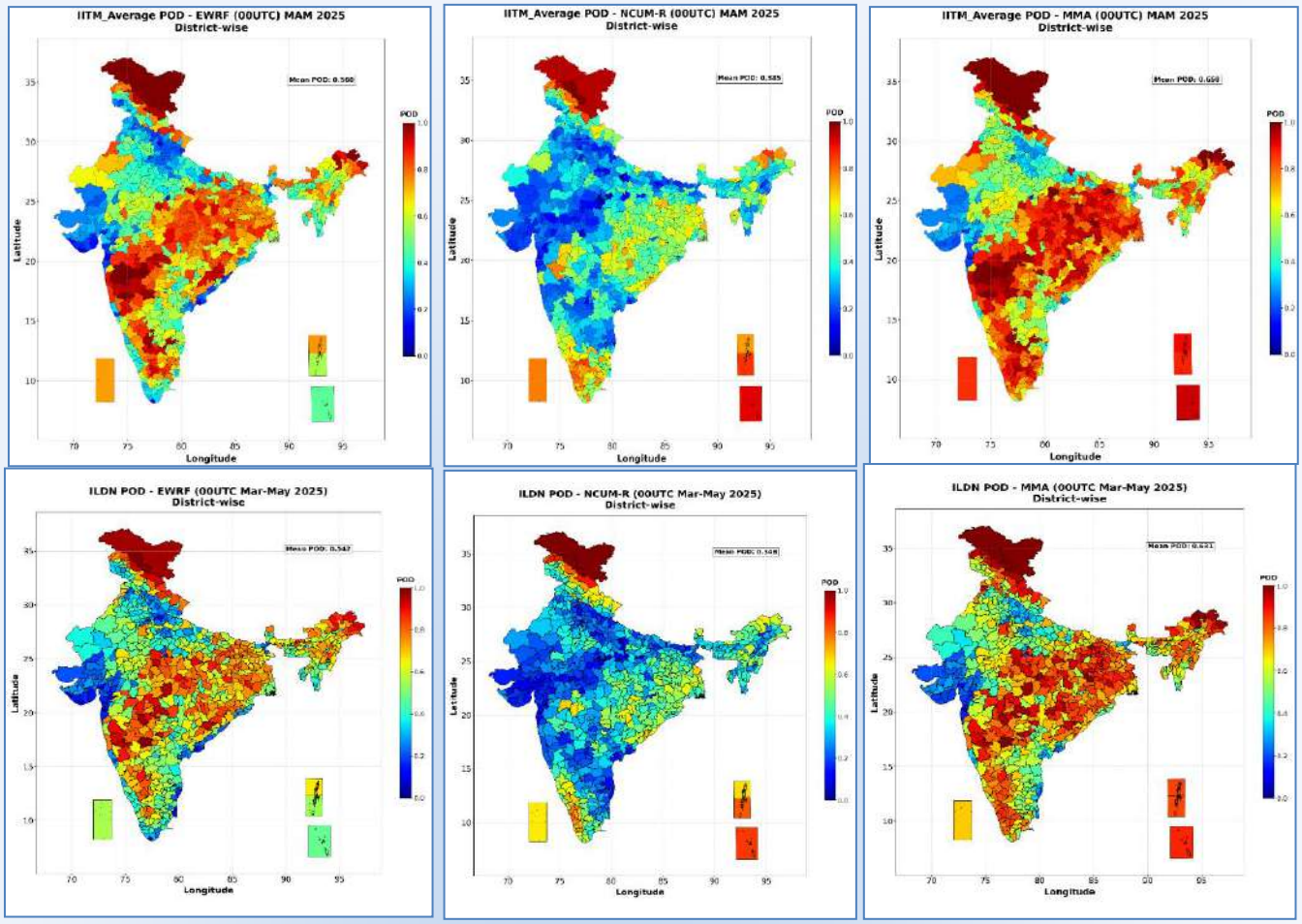


Fig 11. POD of EWRF, NCUM-R, MMA for March, April, May 2025 with respect to IITM and ILDN lightning detection Network

3.10. Dynamic & Interactive Multi Model Meteogram (Mausamgram)

The NWP division jointly with ISSD division, developed, designed and deployed **MausamGram** web portal [Figs. 14(a, b, c)] at NWP division - Post Processing of Multi Model Ensemble (MME) and generated mean of it (MMEM) by using IMDGFS, NCUM-G, ECMWF, NCEP, JMA, NCUM-R, WRF to produce dynamic & interactive meteogram (Fig. 14-b & c) over GIS map (https://meteogram.imd.gov.in/forecaster.html for forecasters use and https://mausamgram.imd.gov.in for public usemobile app, APIs. It provide instant responses for any given location on the GIS map, or search through any location name or Area Pincodes(> 6 Lakhs) or Gram Panchayats Name or GP codes (> 2.5 Lakhs). The multi model mean dynamic meteogram website was released to the public by the Hon'ble Vice President of India, Shri JadgeepDhankhar during 150th IMD FoundationDay Celebration. Released next version of multi models dynamic meteogram along Gram Panchayats location specific forecasts, by the Ministers of MoES and MoPRon for farmers use.

3.11. Generation of MME forecast for Indian cities, districts and meteorological sub-divisions

IMD generates location based as well as area averaged forecast from seven models also its MME in real time for decision support. The NWP model forecasts available with IMD is of different spatial resolution (Table 1).

Seven days of location based forecast of rainfall, maximum temperature, minimum temperature, wind speed, wind direction, relative humidity (at 0300 UTC and 1200 UTC) and cloud cover from each model is generated for Indian cities, followed by MME-mean forecasts have been generated. Currently forecast for 1854 cities are generating. Additionally, meteograms from above models are also generating for these stations.

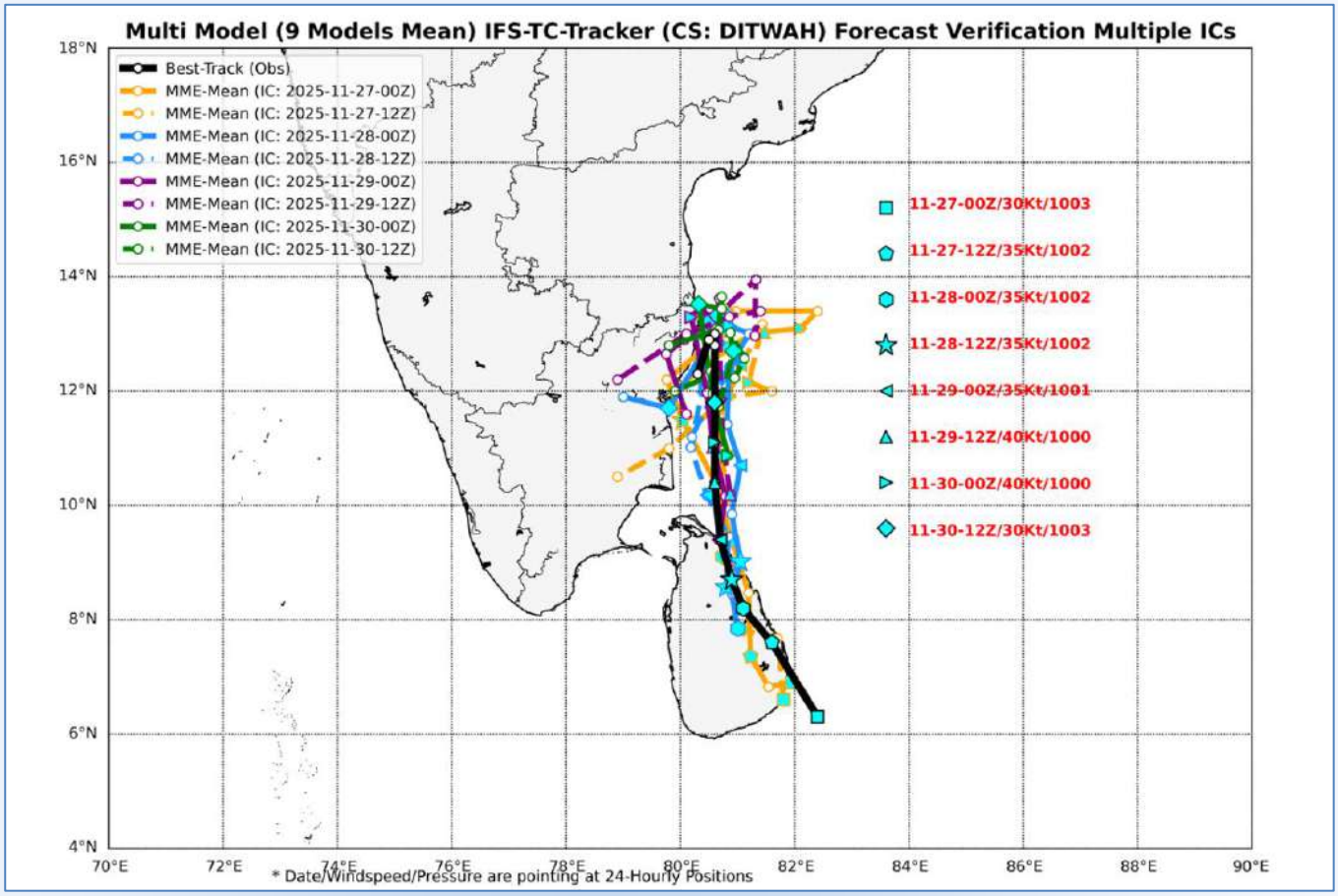


Fig. 12. Real-time production of tropical cyclone tracker outputs verification ('DITWAH' Cyclonic Storm) using ECMWF's IFS-TC-Tracker. The Black line is best track and other color lines indicate different initial conditions forecasts Multi Model Mean. The TC tracker outputs are at 12-hourly intervals which are marked in filled symbols over individual initial conditions Multi Model mean at different lead hours. The best track maximum wind speed in knots and surface mean sea level pressure details are mentioned against respective markers in the figure legend.

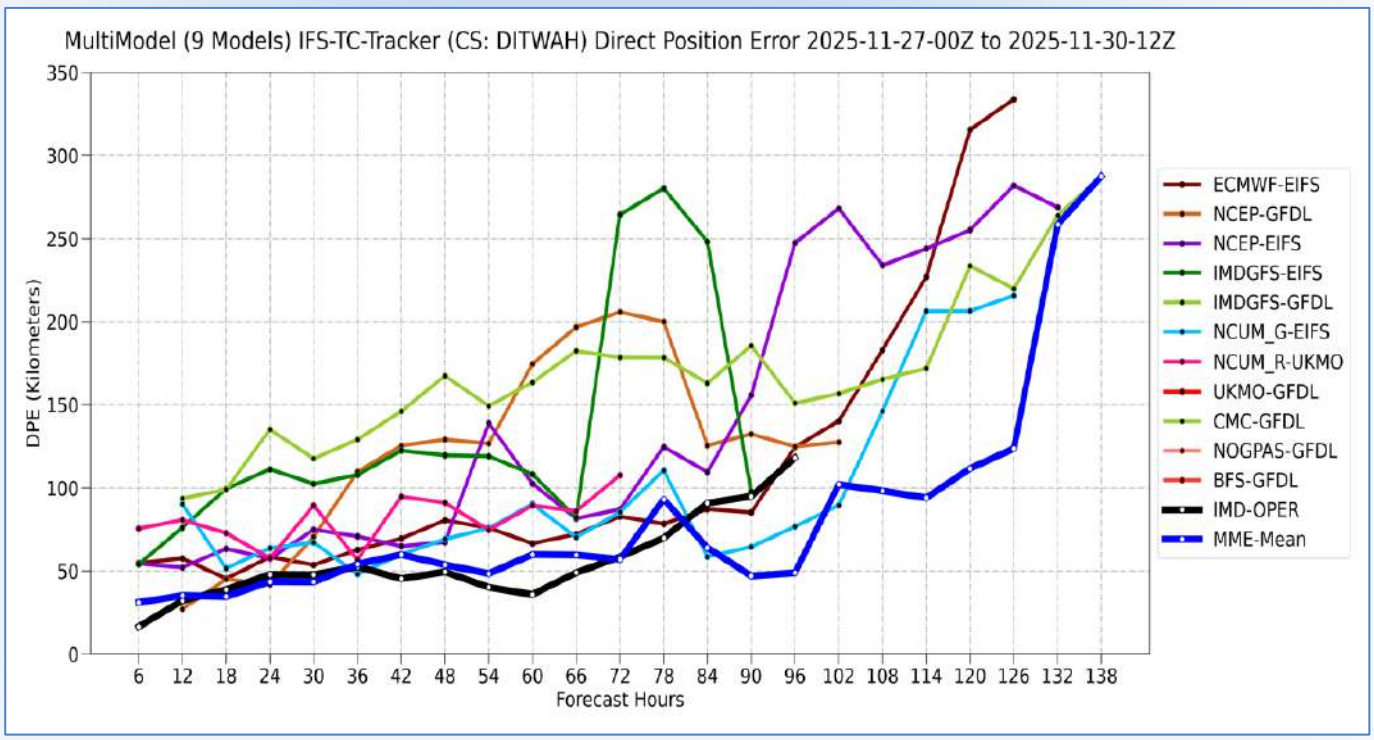


Fig. 13. Verification of DITWAH Cyclonic Storm predicted by the ECMWF IFS-TC-Tracker using 9 TIGGE multi model outputs (shown in multiple colored lines) and Multi Model Mean (shown in thick blue line) during 2025-11-27-00Z to 2025-11-30-12Z. X-axis shows forecast lead hours and Y-axis shows Distance Position Error (DPE) in Kilometers.

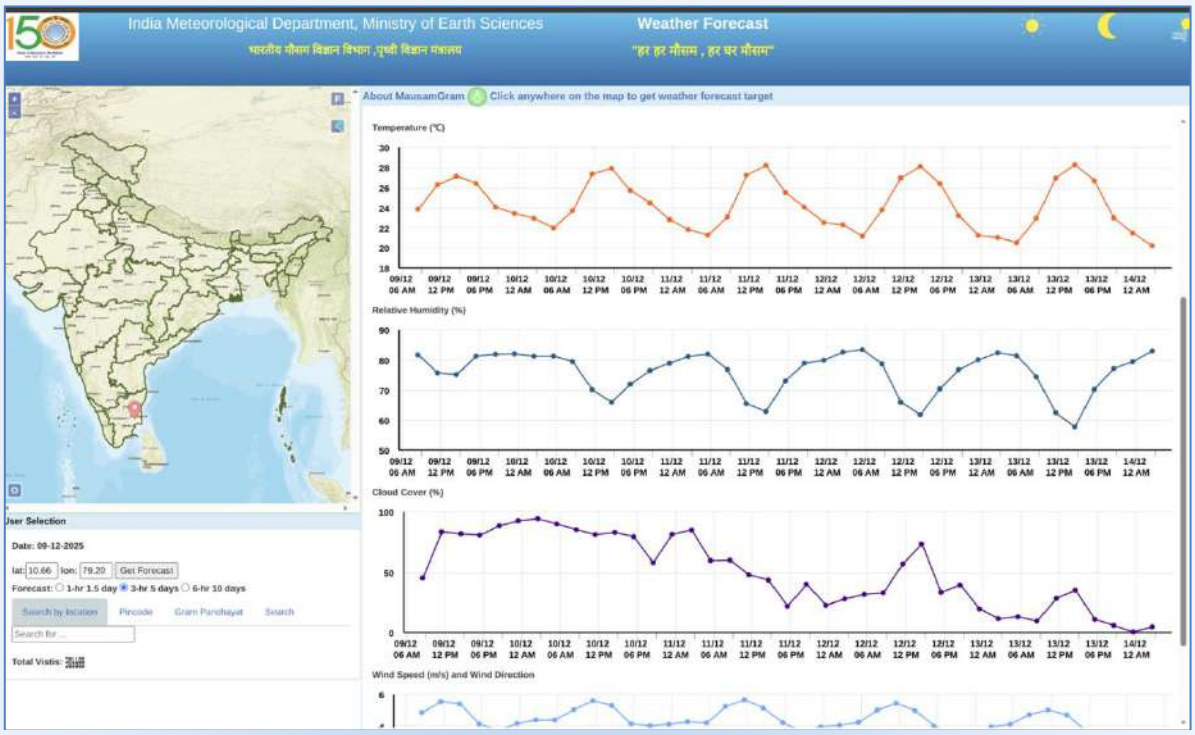


Fig. 14(a). Screenshot of Mausamgram Webpage where multi model ensemble mean generated from 5 global and 2 regional NWP model outputs for public use https://mausamgram.imd.gov.in, where user can click anywhere on the Map (left side) including Ocean, and the corresponding Meteograms are dynamically generated and displayed as interactive meteograms (on right side). User can select or search location or area pincode or Gram Panchayats provided provision at the bottom left panel of the website, and instant response will be generated in interactive graphics over the right side of the interface. Also, the color coded weather warning over the respective districts are marked just above meteogram. Finally, user can download the meteogram as image or csv or pdf.

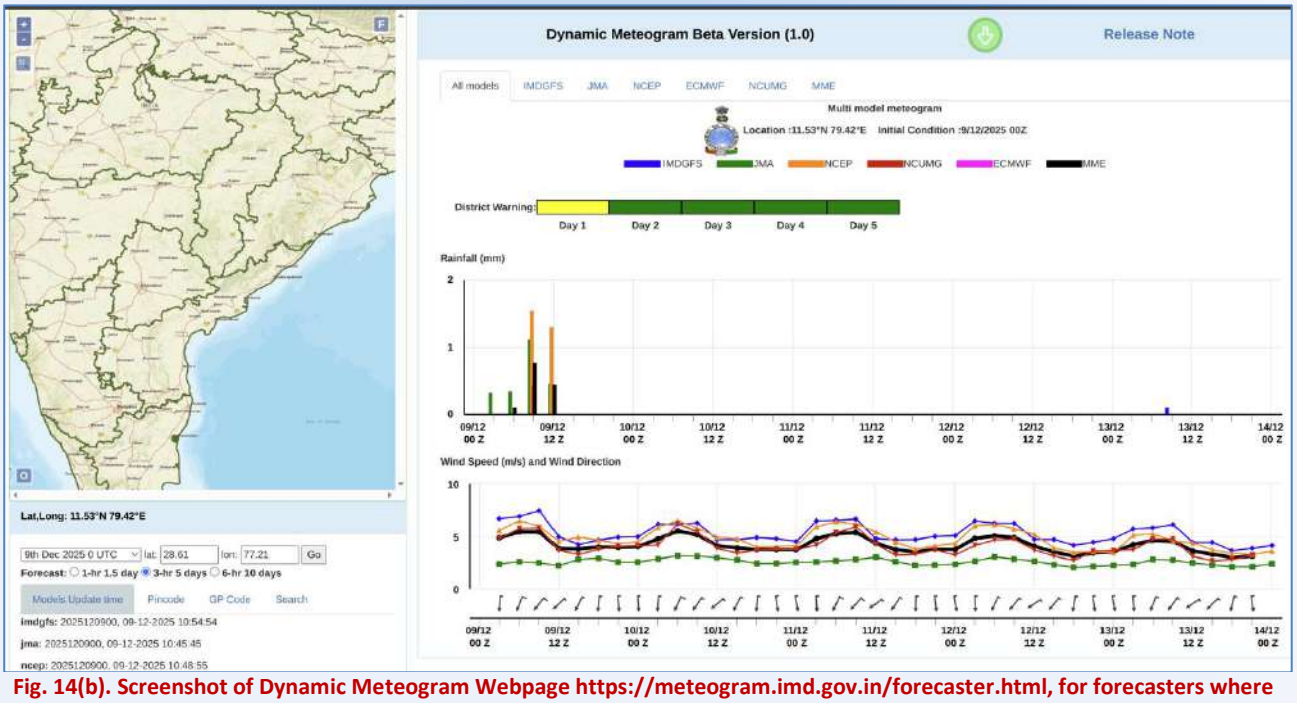


Fig. 14(b). Screenshot of Dynamic Meteogram Webpage https://meteogram.imd.gov.in/forecaster.html, for forecasters where multi model ensemble mean along with individual 5 global and 2 regional NWP model outputs where user can click anywhere on the Map (left side) including Ocean, and the corresponding Meteograms are dynamically generated and displayed as interactive meteograms (on right side). User can select or search location or area pincode or Gram Panchayats provided provision at the bottom left panel of the website, and instant response will be generated in interactive graphics over the right side of the interface. Also, user can download the meteogram as image or csv or pdf.

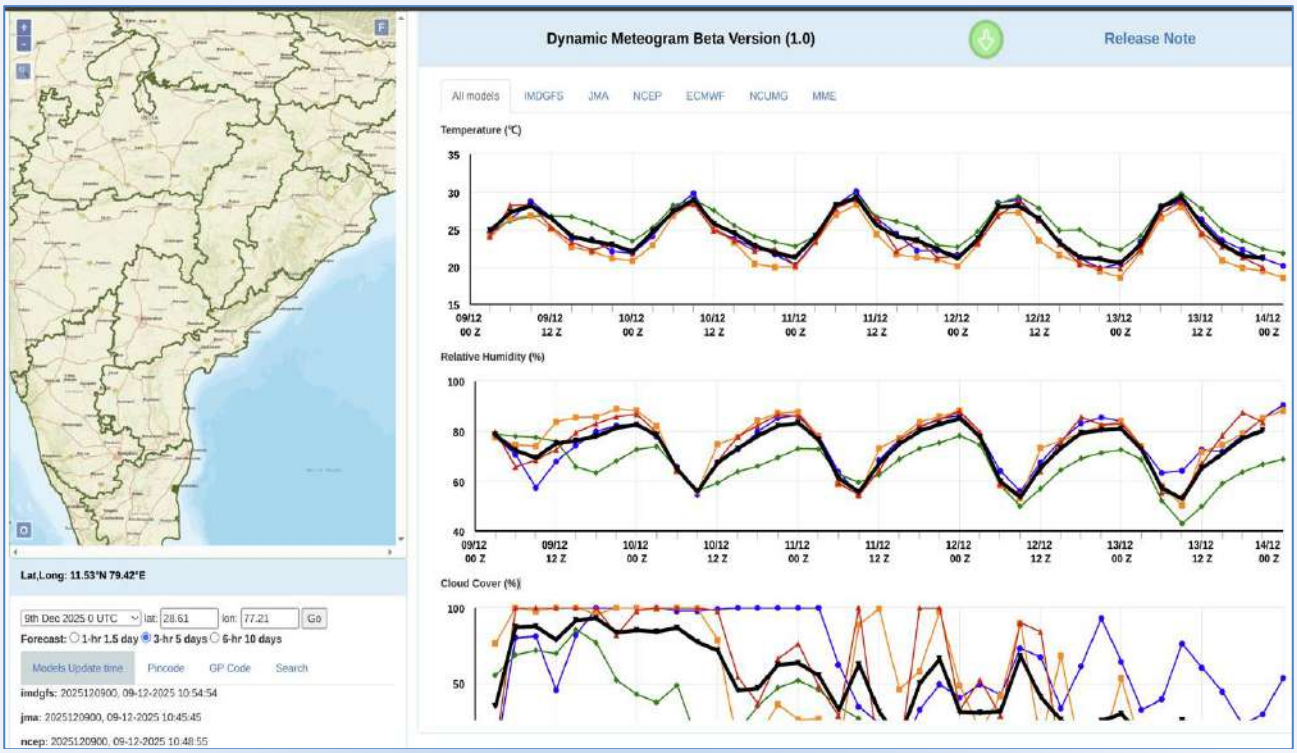


Fig. 14(c). Screenshot of Dynamic Meteogram Webpage same as Fig 14(b), but for extended figure shown for other variables such as Temperature, Relative Humidity, & Cloud Cover.

Table 1
Operational models with their resolutions

	Operation Models	Agency	Resolution (km)
1.	GFS	IMD	12
2.	GEFS	IMD	12
3.	GFS	NCEP	25
4.	UM	NCMRWF	12
5.	GSM	JMA	25
6.	IFS	ECMWF	25
7.	EPS	NCMRWF	12
8.	BharatFS	IMD	6

Area-averaged forecast of rainfall, maximum temperature, minimum temperature, wind speed, wind direction, relative humidity (at 0300 UTC and 1200 UTC), and cloud cover from each model are also generated for Indian districts for next 7 days, followed by MME-mean forecasts have been generated. Currently, forecast over 748 districts are generating in real time. Over these spatial domains, forecast of rainfall distribution also calculated by estimating the percentage of grids reporting a rainfall amount greater than 2.5 mm/day. Similarly, rainfall distribution and intensity forecast are generating for 36 meteorological sub divisions are a decision support to the forecasters. In addition, a heavy rainfall warning system is developed for districts and meteorological sub-divisions based on MME forecast. These forecasts are disseminating to the operational forecasters at RMCs and MCs as a decision support while issuing forecast. These forecasts (as digital values) and figures are also available at NWP division's website.

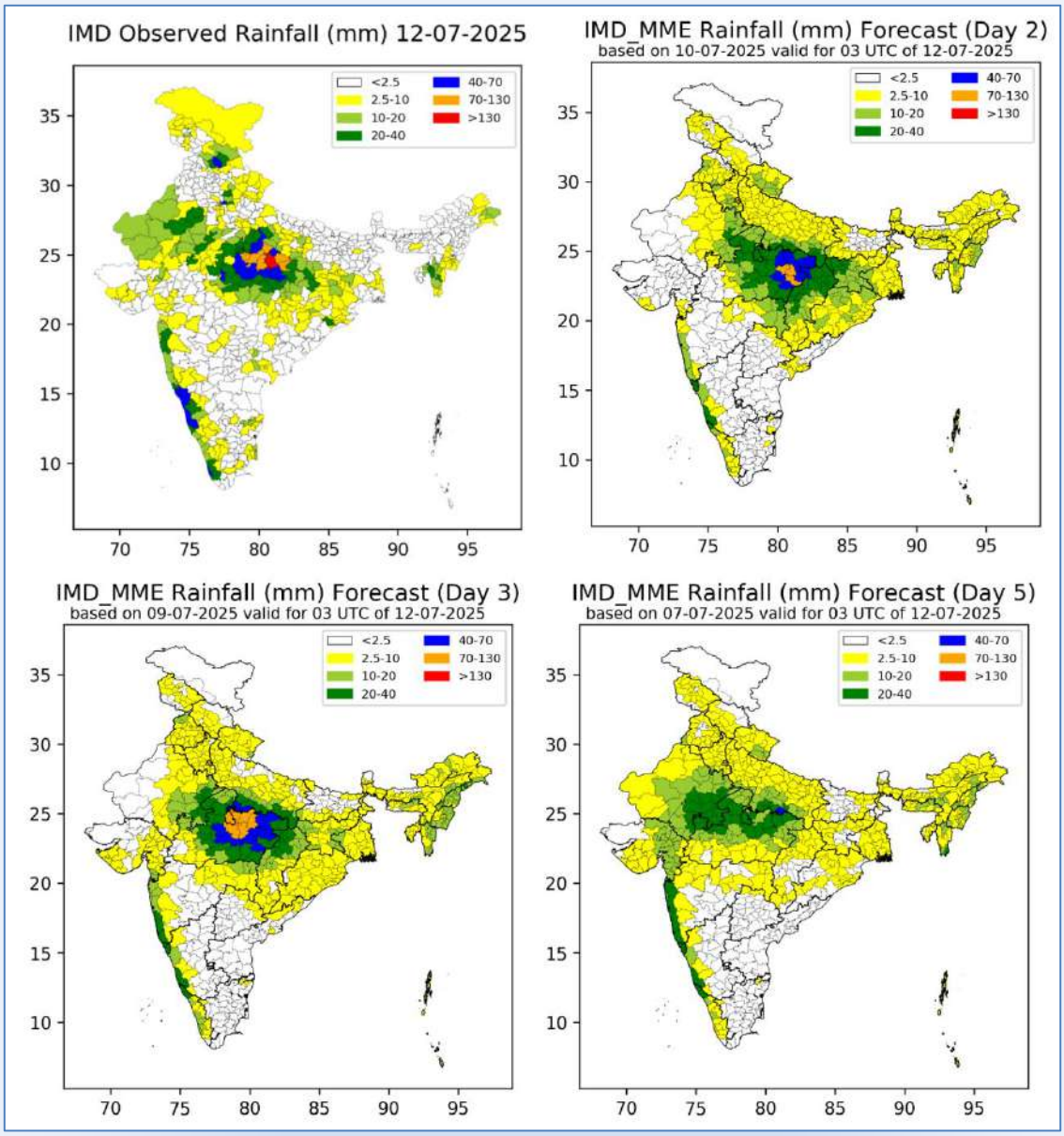


Fig. 15. IMD observed rainfall and MME day 1, day 2and day 3 rainfall forecast for 16thJuly, 2025

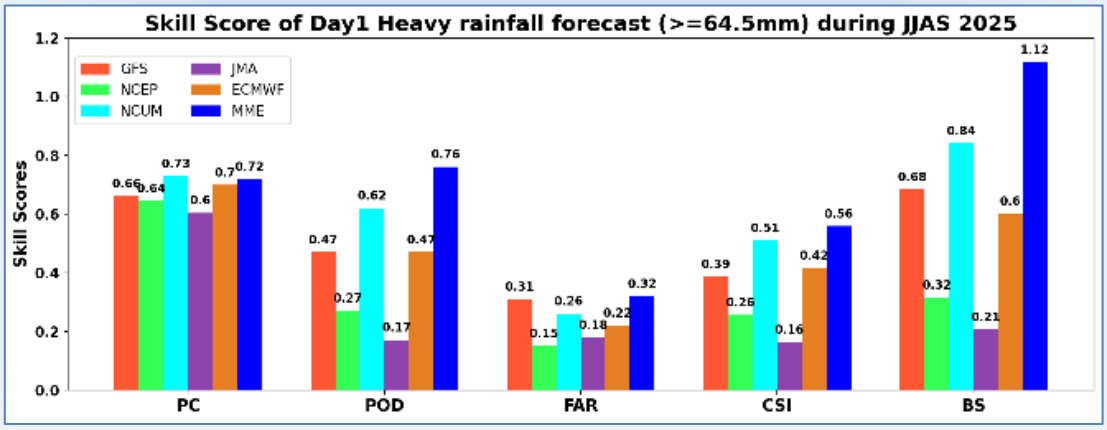


Fig. 16. Percentage correction (PC), Probability of detection, False Alarm Ratio (FAR),Threat Score (TS) of day 1 rainfall forecast against IMD observations for heavy rainfallevents (≥64.5 mm) during 2025 monsoon

An impact-based forecasting tool also developed for heavy rainfall and heavy winds (for marine areas) for the RSMC region using the MME approach. With the help of this forecast, Impact Based Forecast (IBF) is issuing regularly for entire RSMC countries.

The district rainfall forecast from different NWP model and MME are compared against IMD observation during the south-west monsoon 2025. A case study is presented in this report to evaluate the performance of MME forecast qualitatively over Indian districts. In order to assess the performance of MME forecast, a case study during 16th July, 2025 is shown in the fig. 15. The extremely heavy rainfall observed over west coast region of India (Kerala, coastal Karnataka) during 16th July, 2025 is well predicted in MME up to day 5.

Assessment of heavy rainfall warning system at meteorological sub-divisional scale is presented (Fig. 17) in terms of Percentage correction (PC), Probability of detection, False Alarm Ratio (FAR), Threat Score (TS) of heavy rainfall from seven models during monsoon 2025. The performance of the numerical weather prediction models for Day-1 heavy rainfall (≥64.5 mm) during JJAS 2025 shows clear contrasts across verification metrics. In terms of Percentage Correct (PC), all models exhibit reasonably good skill, with NCUM and MME showing the highest PC values, indicating better overall agreement with observations. Among the individual deterministic models, NCUM and ECMWF perform comparably, while JMA shows relatively lower PC.

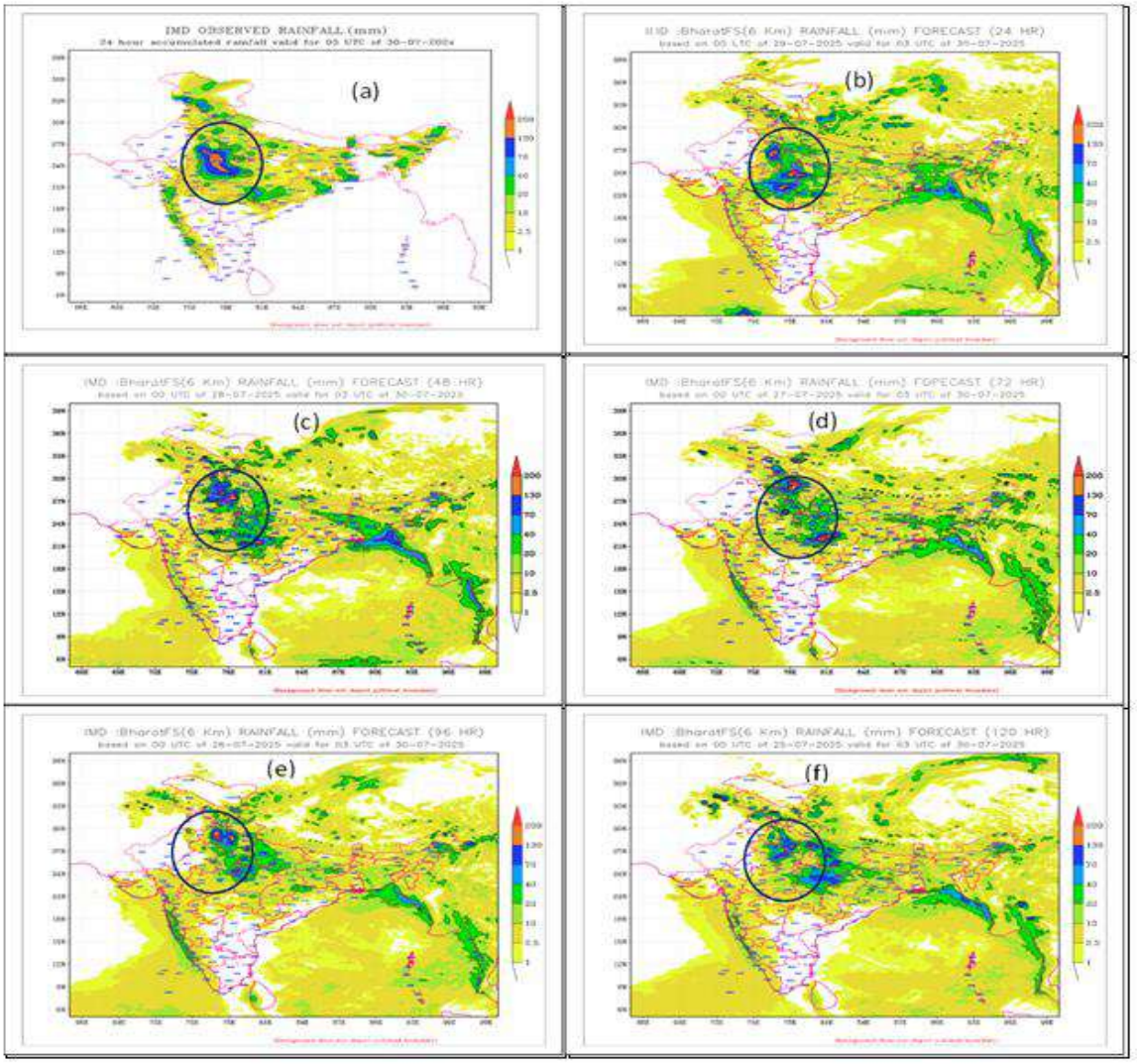
The Probability of Detection (POD) highlights the ability to capture heavy rainfall events. MME demonstrates the highest POD, followed closely by NCUM, indicating superior event detection capability. Among individual models, NCUM outperforms others, whereas JMA and NCEP show comparatively low POD, suggesting missed events.

The False Alarm Ratio (FAR) is lowest for NCEP and JMA, indicating fewer false alarms, while MME and NCUM show slightly higher FAR due to their more aggressive detection of events. This reflects a trade-off between detection and false alarms.

The Bias Score (BS) indicates that MME and NCUM tend to over-forecast heavy rainfall, whereas NCEP and JMA show under-forecasting tendencies. Overall, among individual models, NCUM emerges as the best-performing model, while the MME provides the most balanced and superior overall performance across metrics.

3.12 Bharat Forecast System

Bharat Forecast System (Bharat FS) global model of about 6 km horizontal resolution operationally started using by IMD in 2025 May. The model uses a novel grid structure Triangular Cubical Octahedral grid (TCO) to achieve high-resolution forecasts about size of clusters of Panchayats/ villages. The Bharat Forecast system will significantly enhance predictive capabilities across a wide range of sectors, including public safety, energy, transportation and agriculture. Its high resolution forecast will support timely decision-making, improve preparedness, optimize resource allocation and in critical situations help save human lives. Model is run operationally at India Meteorological Department (IMD) two times in a day (0000, 1200 UTC) to give deterministic forecast in the short to medium range upto 10 days. The initial conditions for this model is generated from the four-dimensional (4D) ensemble-variational data assimilation (DA) system (4DEnsVar) building upon the grid point statistical interpolation (GSI)-based hybrid Global Data Assimilation System (GDAS) run on High Performance Computing Systems (HPCS) at National Center for Medium Range Weather Forecasting (NCMRWF) and converted to TCO grid.The real-time outputs are made available to operational weather forecasters and various users through the national web site of IMD. Fig. 17 shows the forecast and observed heavy rainfall event of 30thJuly, 2025 during south west monsoon 2025.



Figs. 17(a-f). (a) IMD Observed rainfall for 30thJuly, 2025 and Bharat-FS forecast for (b) 24 hours, (c) 48hours, (d) 72 hours, (e) 96 hours and (f) 120 hours valid for 30thJuly, 2025

3.13Artificial Intelligence and Machine Learning:

(a) Pangu weather model

Under the Artificial Intelligence and Machine Learning(AI/ML) initiative in Numerical Weather Prediction (NWP) Division, an AI/ML-based data-driven weather prediction model has been developed. The model used surface variables such as mean sea-level pressure (MSLP), 2-m air temperature (T), wind components (U, V), and temperature (t2m), and wind components, along with upper-air variables including specific humidity (Q) at 13 standard pressure levels (1000, 925, 850, 700, 600, 500, 400, 300, 250, 200, 150, 100, and 50 hPa) for training, testing, and validation. The model has been trained using ERA5 reanalysis data at 0.25° spatial resolution with a 24-hour temporal resolution. The testing and validation of the model have also been carried out using ERA5datasets. Training, testing, and validation have been performed using 00 UTC initial conditions.

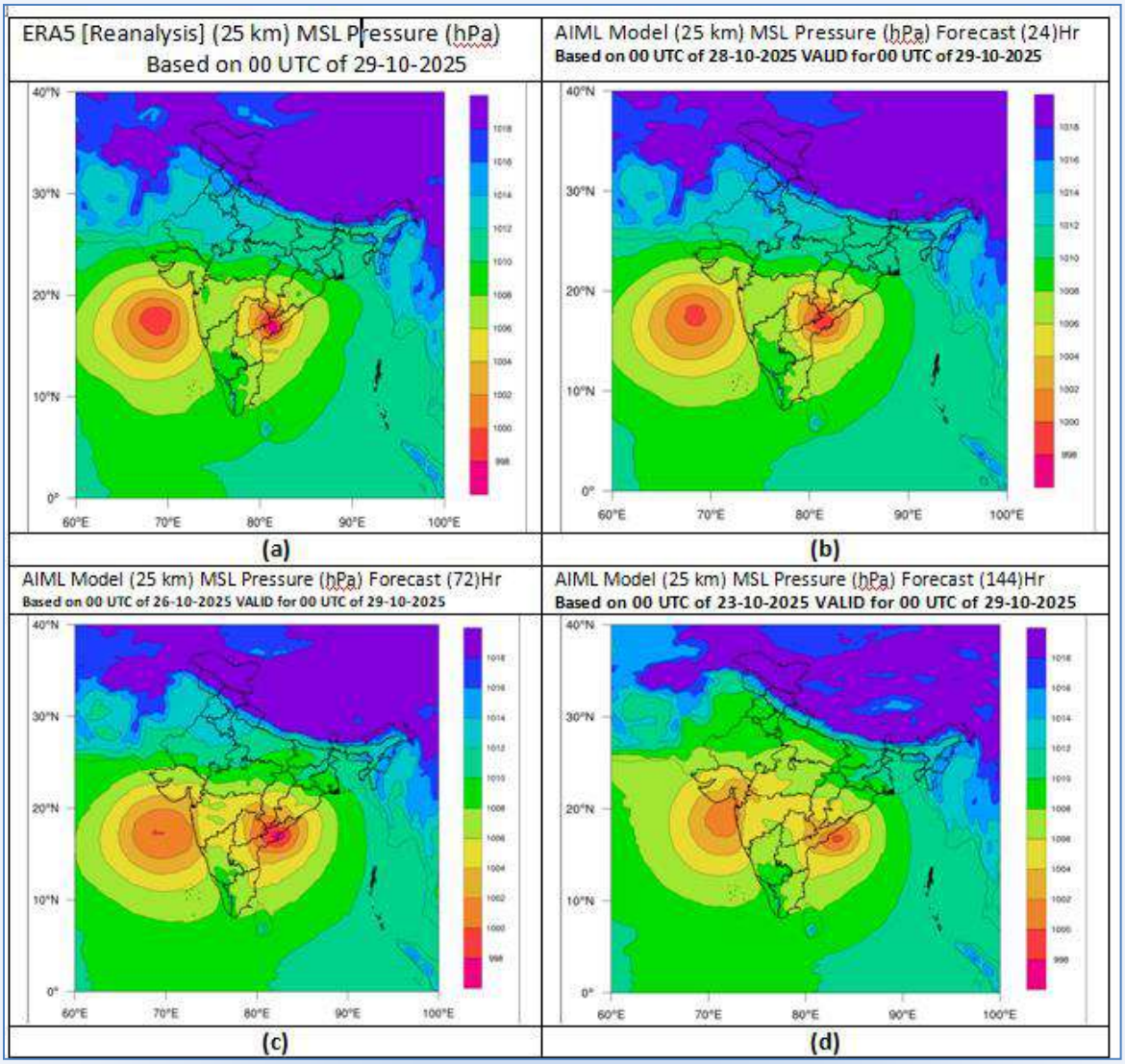


Figure 18. Montha Cyclone MSLP forecasting using AIML Model. (a). MSLP (hPa) based on 00 UTC of 29-10-2025 using ERA5 Reanalysis data. (b). AIML Model (25 km) MSLP (hPa) 24 hour Forecast based on 00 UTC of 28-10-2025 VALID for 00 UTC of 29-10-2025 of ERA5 data.(c). AIML Model (25 km) MSLP (hPa) 72 hour Forecast based on 00 UTC of 26-10-2025 VALID for 00 UTC of 29-10-2025 of ERA5 data. (d). AIML Model (25 km) MSLP (hPa) 144 hour Forecast based on 00 UTC of 23-10-2025 VALID for 00 UTC of 29-10-2025 of ERA5 data

Table 2

Validation results

	Autoregression model	Decision tree model
Probability of detection	0.6	0.76
False alarm	0.1	0.1

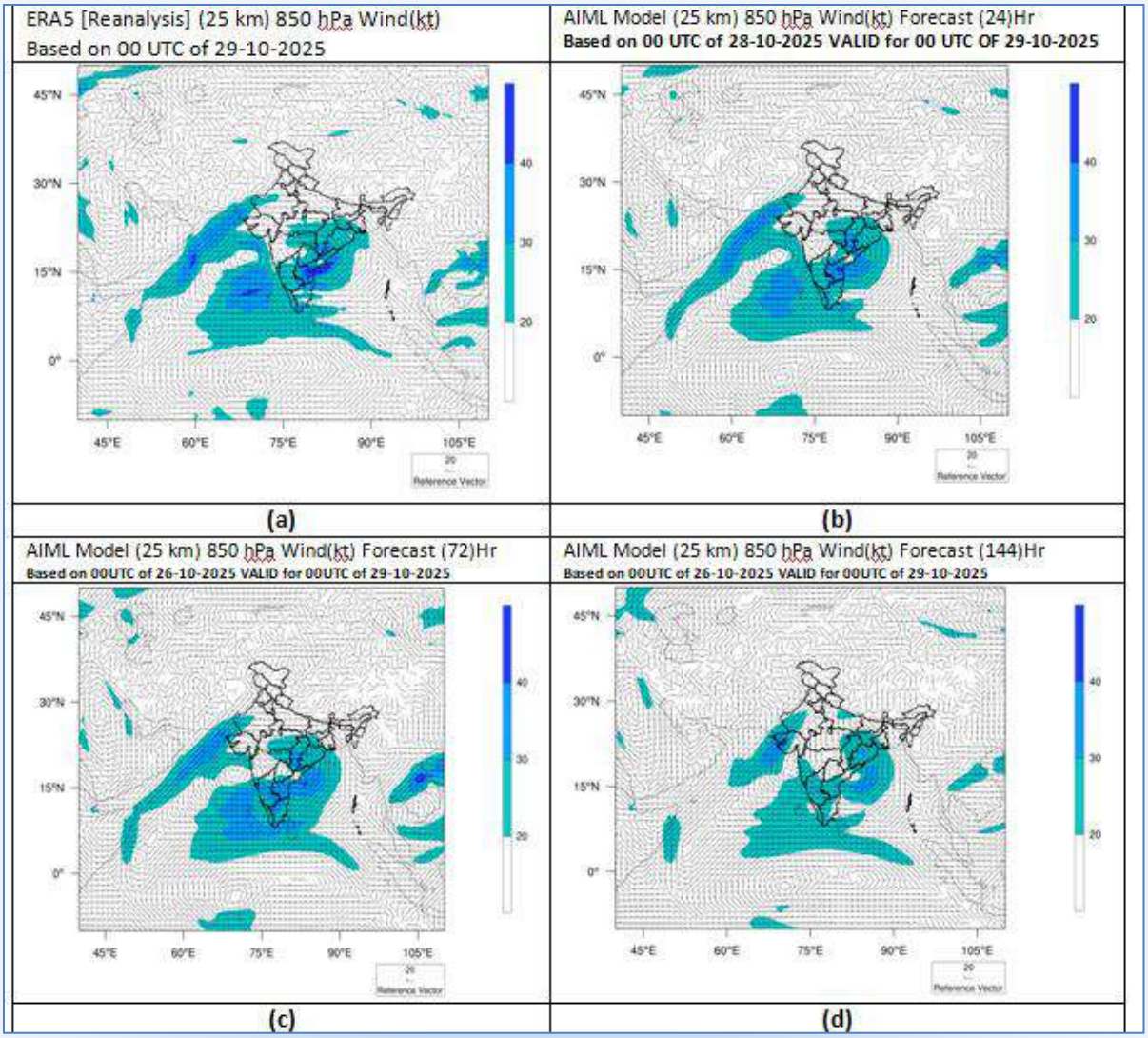


Figure 19. Montha Cyclone wind speed forecasting at 850 (hPa) level using AIML Model. (a). Wind (kt) at 850 (hPa) using ERA5 Reanalysis (25km) based on 00UTC of 29-10-2025. (b). 24 hours Wind (kt) forecast at 850 (hPa) using AIML Model (25 km) based on 00UTC of 28-10-2025 VALID for 00UTC of 29-10-2025 of ERA5 data.(c). 74 hour Wind (kt) forecast at 850 (hPa) using AIML Model (25 km) based on 00UTC of 26-10-2025 VALID for 00UTC of 29-10-2025 of ERA5 data. (d). 144 hour Wind (kt) forecast at 850 (hPa) usingAIML Model (25 km) based on 00UTC of 23-10-2025 VALID for 00UTC of 29-10-2025 of ERA5 data

(b) Development of location specific machine learning model for daily rainfall predictions:

The goal of this work is to develop comprehensive machine learning models based on the local climatological features of some specific cities to improve rainfall forecasting in daily timescale. An attempt is made to develop a machine learning model for predicting daily rainfall in Delhi during the monsoon season. A decision tree is built up in which input variables aretaken as air temperature at 925 hpa, dew point at 700 hPa, wind direction at 925 and 500 hpa at 0UTC. Daily rainfall time series of Safdarjung observatory is classifiedinto low, medium and high category based on the basic statistical properties of the data. For validation purpose, training period is taken as July, August, September months from the year of 2020 to 2022 and forecasting period is July, August, and September months of 2023. Validation results are shown in Table 2.

CHAPTER 4

OBSERVATIONAL NETWORK

One of the mandates of IMD is to take meteorological observations for use by different users. Strengthening of atmospheric observational network and its regular maintenance is absolutely required to sustain and improve skill of weather forecasts. IMD has been augmenting its observing system networks over the past years.

4.1. Upper Air Observational Network

4.1.1. Radiosounding Radiowind (RS/RW) network

The India Meteorological Department (IMD) operates 56 radiosonde/radiowind stations(Fig.1) in its upper-air network as part of the WMO Global Observing System (GOS). These stations measure the vertical profiles of atmospheric parameters such as temperature, pressure, humidity, wind speed, and wind direction using balloon-borne soundings. Radiosonde observations are conducted twice daily at 0000 UTC and 1200 UTC.

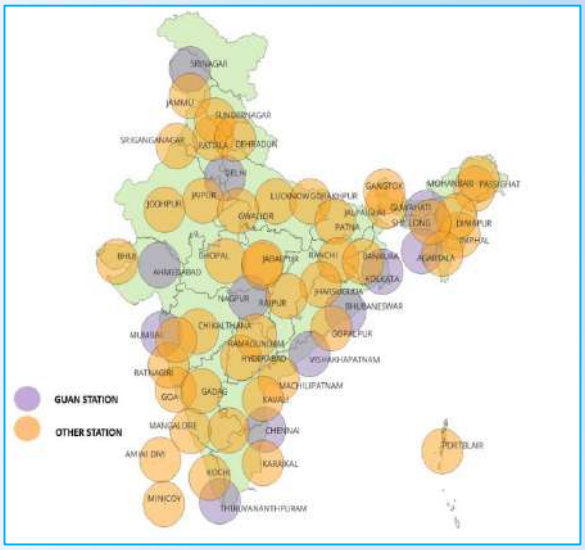


Fig. 1. Existing RS/RW Network of India Meteorological Department

As a subset of the Global Observing System (GOS), the World Meteorological Organization (WMO), in collaboration with the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Environment Programme (UNEP), and the International Council for Science (ICSU), established the Global Climate Observing System (GCOS) in 1992 as an outcome of the Second World Climate Conference. In the upper-air domain of GCOS, with the objective of further improving upper-air data quality, IMD established GUAN-standard radiosonde observations at six Regional Meteorological Centres, namely New Delhi, Mumbai, Kolkata, Chennai, Guwahati, and Nagpur. The performance of these stations was presented at the WMO Technical Conference on Instruments and Methods of Observations (TECO-2016), and a formal request was submitted to the Secretary-General of WMO for their inclusion in the GCOS Upper Air Network (GUAN).Based on their sustained performance, these stations were subsequently included in the WMO-GUAN standard network by the GCOS Secretariat, and their performance indicators have been regularly featured in the summary of NOAA's monthly reports with effect from June 2017. From 2024 onwards, IMD has expanded GUAN-standard radiosonde observations from six to twelve stations, with the additional stations being Srinagar, Ahmedabad, Agartala, Bhubaneshwar, Visakhapatnam, and Thiruvananthapuram. IMD's RS/RW network is shown in the figure. In addition to that, IMD also operates a RS/RW station at Maitri, Antarctica, which conducts regular RS/RW ascents.

4.1.2. Pilot Balloon (PB) Network

IMD operating 63 PB observatories (Fig. 2), which conduct 2 to 4 observations of upper-air wind profiles at 00, 06, 12, and 18 UTC. Traditionally, these PB stations relied on optical theodolites for manual balloon tracking. However, significant progress has been made in transitioning to GPS-based, fully automatic PB systems to improve operational efficiency and observational accuracy.
For this purpose, a GPS-based pilot sonde has been developed and is manufactured in-house at the IMD Workshop. In line with this initiative, 25 stations in the PB network have been upgraded and equipped with GPS-based, fully automatic PB systems. Of these, five stations are equipped with IMD-manufactured systems, namely Jammu,

Jaipur, Jodhpur, Sundernagar, and Dehradun. The remaining 20 stations are equipped with systems procured from Indian manufacturers, namely Aminidivi, Amritsar, Allahabad, Bengaluru, Bhuj, Churu, Deesa, Gaya, Gangtok, Gopalpur, Gwalior, Karaikal, Lucknow, Minicoy, Mohanbari, Port Blair, Raipur, Sri Ganganagar, and Thiruvananthapuram.

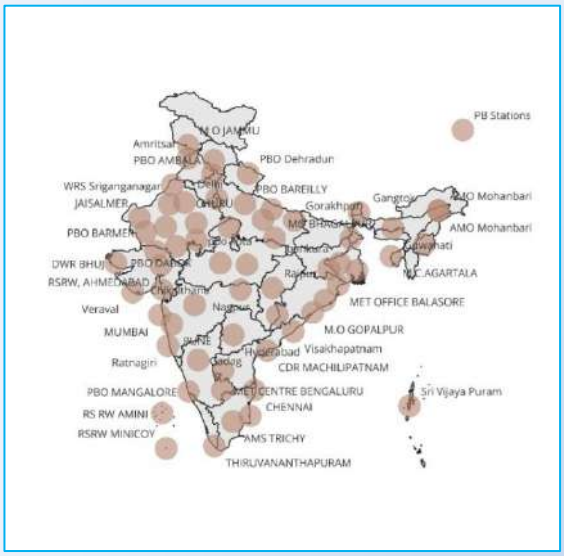


Fig. 2. IMD's Pilotsonde Network

4.1.3. Achievements during the year

(i). Continuation of 12 Nos. of WMO GCOS Upper Air Network (GUAN) standard RS/RW stations at New Delhi, Mumbai, Kolkata, Chennai, Guwahati, Nagpur, Bhubaneswar, Agartala, Srinagar, Visakhapatnam, Thiruvananthapuram and Ahmedabad equipped with GPS based high-quality radiosounding systems. Currently, all 12 GUAN standard radiosondes are operational.

(ii). Sustenance of 25 GPS-based PB Stations in which 5 stations are equipped with IMD manufactured and 20 are outsourced from Indian manufacturers.

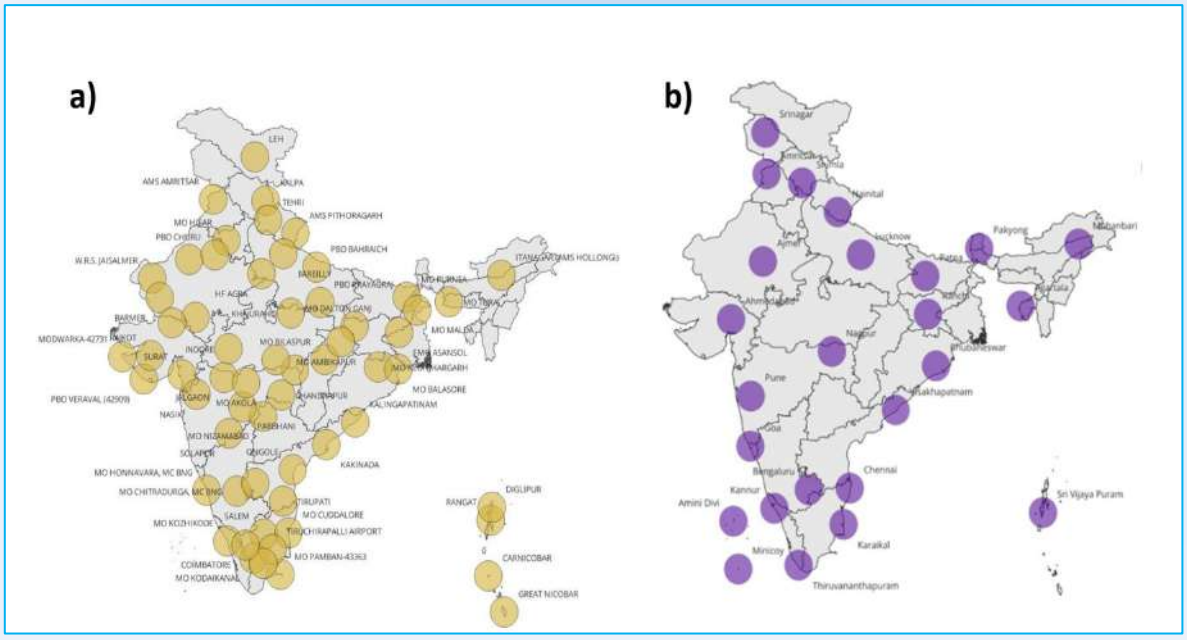
(iii). Provided high-resolution sonde data of IMD land stations on the west and east coast of India in May-June 2025 under the EKAMSAT "Enhancing Knowledge of the Arabian Sea Marine Environment Through Science and Advance Training (EKAMSAT)" programme of MoES.

(iv). For the sustenance of 43 non-GUAN stations, the procurement of 34400 Nos. of GPS radiosondes with compatible ground systems is being processed and supply order issued.

(v). RSRW Kochi and Mohanbari stations are equipped with the SCL (ISRO) Radiosonde System, which is operational.

(vi). Procurement of 06 Nos. of Compact Hydrogen gas generators is under process.

(vii). Testing of 10000 Nos. of Fabricated PCB along with accessories for Indigenous GPS-based PB systems areunder process.



Figs. 3(a&b): (a) the proposed 60 new GPS Radiosonde Stations and (b) the proposed 25 Microwave Radiometer stations of IMD.

(viii). Procurement for establishing 60 new RS/RW stations and 25 Microwave Radiometer stations under Mission Mausam has been initiated, marking a major expansion of atmospheric observation infrastructure.

(ix). The supply order for the 25 Microwave Radiometers has been issued.

The proposed 60 new GPS Radiosondes stations and 25 Microwave Radiometer stations are shown in Figs. 3(a&b).

(x). RS/RW observations have been operational at Maitri, Antarctica, since December 2023. Procurement of 8,000 GPS-based Radiosondes, along with 04 compatible ground systems for Maitri and Bharati stations, is in progress, significantly strengthening polar meteorological capabilities.

(xi). IMD has supported the startup ToSpace in the development of the ToSpace Radiosonde Device by sharing technical knowledge and expertise.

4.2. Surface Observational Networks

Automated weather stations measure all the important surface weather observations These weather stations provide accurate and frequent readings, have low power requirements, and can operate practically anywhere. The weather monitoring system able to provide localized information on the weather conditions. These are very useful during severe weather conditions and current weather data made available to all in real time even at 1 minute interval also.

IMD operates 1,008 Automatic Weather Stations (AWS), 1,382 Automatic Rain Gauge (ARG) stations, 200 Agro-AWS, 5 Automatic Snow Gauge (ASG) stations, 37 High Wind Speed Recorders (HWSR), and 47 Solar Radiation Stations, as depicted in the Figs.(4-11).

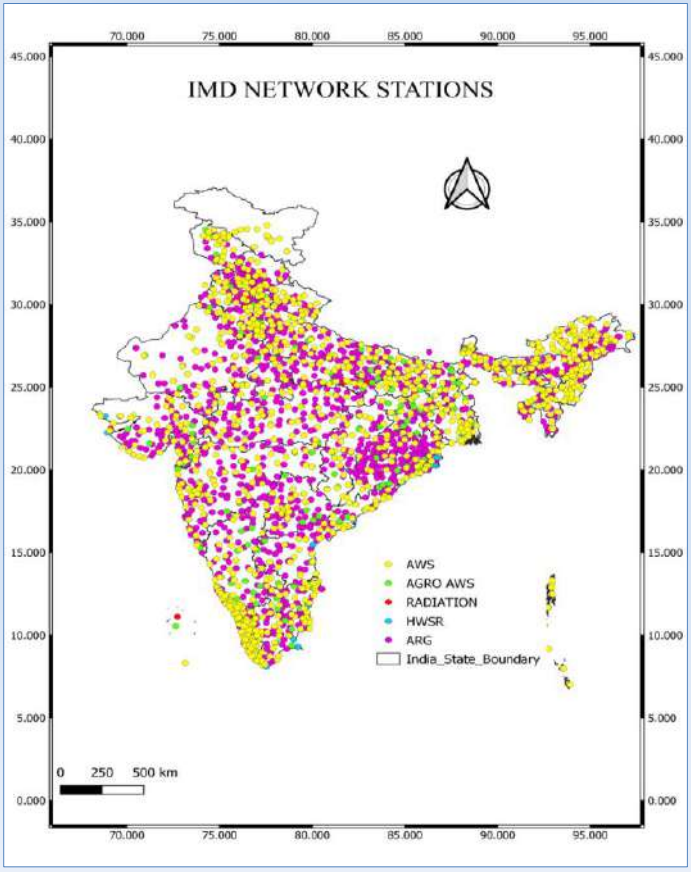


Fig. 4. Observational Network of Stations of the India Meteorological Department (IMD)

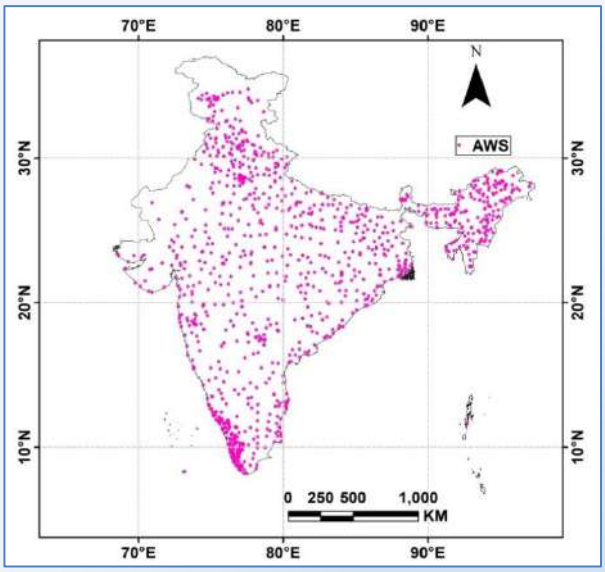


Fig. 5.IMD Automatic Weather Stations (AWS) Network

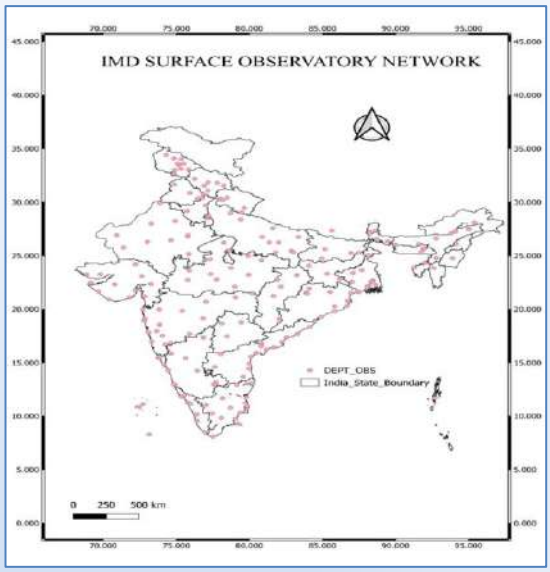


Fig. 8.IMD surface observatory Network

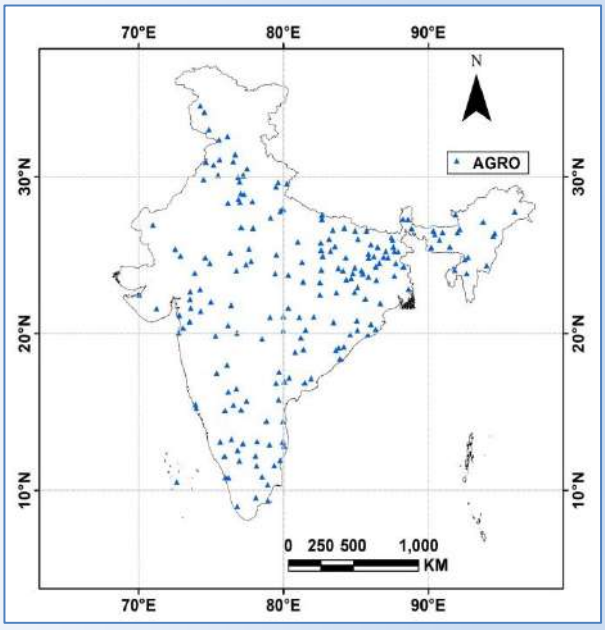


Fig. 6.IMD Agro-AWS Network

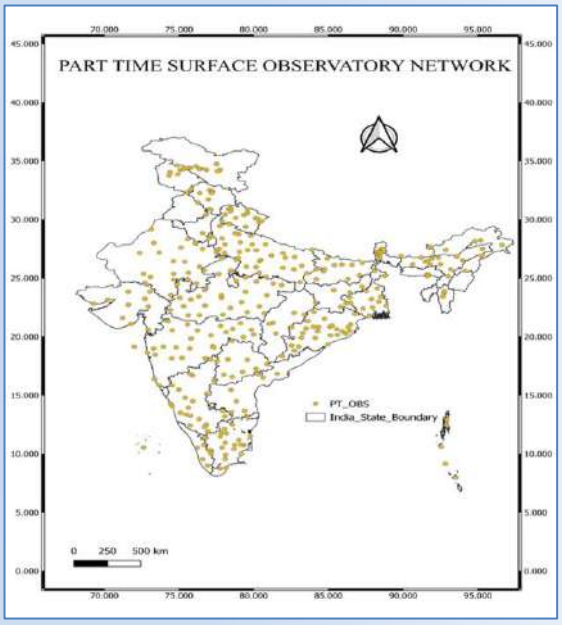


Fig. 9.IMD part time surface observatory Network

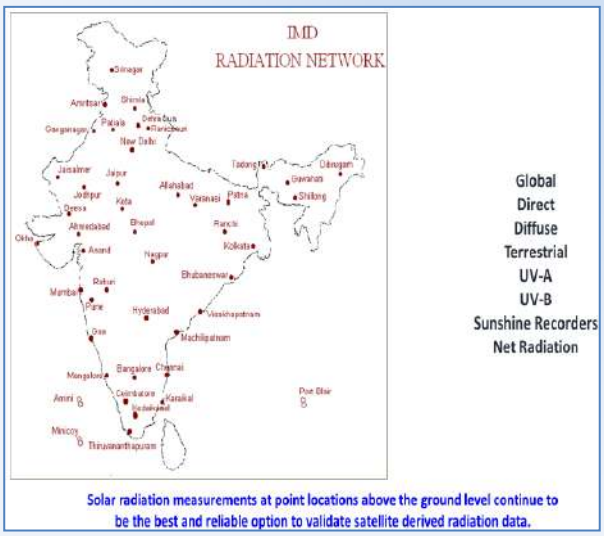


Fig. 7. IMD Radiation Network

Fig. 10. A network of 37 HWSR has been established all over India

The AWS Lab is continuously following up on the upkeep and maintenance of the AWS/ARG network to ensure high-quality data. Preventive maintenance at the AWS site aims to sustain the monsoon and all-season operations, prolong the lifespan of the Automatic Weather Station, and enhance data quality (Figs.(11 & 12).

Fig. 11.AWS SITE: Chintapalle Alluri Sitaramaraju District under MC Amaravati

Fig. 12.ARG SITE: ARG Walhe Purandar, Pune Districts under SID CRS Pune

4.3. Atmospheric Sciences

4.3.1. Environment Monitoring and Research Center (EMRC)

4.3.1.1. Environmental Meteorology Services

IMD conducts monitoring and research related to atmospheric constituents that are capable of forcing change in the climate of the Earth and may cause depletion of the global ozone layer and play key roles in air quality from local to global scales. IMD also provides specific services to Ministry of Environment and Forest & Climate Change and other Government Agencies in the assessment of air pollution impacts. IMD contributes in the field of atmospheric environment to the World Meteorological Organization (WMO) Global Atmosphere Watch (GAW) programme. The main objective of GAW is to provide data and other information on the chemical composition & related physical characteristics of the atmosphere and their trends, required to improve understanding of the behaviour of the atmosphere and its interactions with the oceans and the biosphere.

4.3.1.2. Ozone Monitoring Network

National Ozone Centre of EMRC, IMD is designated as secondary regional ozone centre for Regional Association (RA-II Asia) of World Meteorological Organization. The centre maintains a network of ozone monitoring stations including Maitri and Bharati in Antarctica. The following Ozone components are being monitored at IMD observatories:

- Total Columnar ozone measurement using Dobson and Brewer spectrophotometer. Dobson Spectrophotometer D36 was calibrated and refurbished at Regional Dobson Calibration Center (RDCC) at the Meteorological Observatory Hohenpeissenberg, Germany in 2020. Another Dobson Spectrophotometer D112 was calibrated during WMO International Comparison of Dobson Spectrophotometers (DIC) held at Irene Technical Centre, Pretoria, Gauteng Province, South Africa. Two Brewer Spectrophotometers have been calibrated and refurbished at Canada with the help of WMO.

- Surface Ozone monitoring network using electro-chemical method with IMD make

instrument. Two more stations (Shillong and Ranichauri) have been added in the network and now network comprises total 11 surface monitoring stations including Maitri and Bharati stations.

Precipitation and Particulate Matter Chemistry Monitoring: IMD is monitoring Precipitation Chemistry through a network of eleven stations since 1970s. The rainwater and particulate matter samples collected from these stations are analyzed in Air Pollution Chemistry Laboratory at IMD, Pune which is equipped with Ion-chromatograph, UV-VIS Spectrophotometer, Semi-micro Balance, pH & Conductivity Meter, Ultra-pure Deionized Water Purification System. A new Atomic Absorption Spectrophotometer has been installed in the laboratory. The IMD laboratory participated in Laboratory Inter comparison Study held in the year 2022 and 2023 organized by Quality Assurance/ Science Activity Centre-Americas, one of five QA/SACs operating to ensure data quality and support science activities in the WMO GAW.

Aerosol Monitoring Network: IMD has established Aerosol Monitoring Network covering different geographic regions of India. The Aerosol Monitoring Network consists of following sub-networks:

(i) Sun-Sky radiometer Network: Environment Monitoring and Research Center, India Meteorological Department has established Aerosol Monitoring Network of 20 stations by installing sky radiometer. The network is used to measure optical properties of aerosols such as Aerosol Optical Depth, Single Scattering Albedo, Size Distribution, Phase Function etc.

(ii) Black Carbon Aerosol Monitoring Network: Black Carbon Monitoring Network of 25 stations for measurement of Spectral Aerosol Absorption Coefficient, Equivalent Black Carbon Concentration and bio-mass burning component is operational.

(iii) Multi-wavelength Integrating Nephelometer Network: IMD has established a network for measurement of aerosol scattering coefficient at New Delhi, Ranichauri, Varanasi, Nagpur, Pune, Port Blair, Visakhapatnam, Guwahati, Kolkata, Jodhpur, Bhuj, Thiruvananthpuram.

(iv) Chemical Characterization of Aerosols: High Volume Samplers for collecting PM_{10}, $PM_{2.5}$ and Total Suspended Particulate Matter have been installed at Delhi, Ranichauri, Pune and Varanasi. The filter papers are being analyzed for chemical characterization of aerosols at Air Pollution Section, O/o CRS, IMD, Pune.

4.3.1.3. Air Quality Forecasting and Research

The latest version of Air Quality forecast model "System for integrated modelling of Atmospheric composition (SILAM v5.8)" has been operationalized for Indian region. Hourly air quality forecast for 96 hours of all criteria pollutants (PM_{10}, $PM_{2.5}$, O_3, CO, NO_2, SO_2 and other species) is being generated for the domain 60-100 °E, 0-40 °N. SILAM is coupled with hourly 3-km IMD-WRF meteorological forecasts model. The latest emission inventories CAMS-GLOB v5.3, 0.1-deg supplemented with EDGAR v4.3.2 for coarse and mineral-fine anthropogenic particulate matter, GEIA v1 lightning climatology and MEGAN-MACC biogenic climatology for isoprene and mono-terpene are used in SILAM model. The model is validated with air quality observations available from CPCB. A very high resolution city scale air quality model "ENvironmental information FUsionSERvice (ENFUSER)" has been also operationalized for Delhi. Hourly air quality forecast for 96 hours of all criteria pollutants (PM_{10}, $PM_{2.5}$, O_3, CO, NO_2, SO_2) is generated for the domain (28.362 °N-28.86 °N, 76.901 °E-77.56 °E) at 30m spatial resolution. The model uses and assimilates a large amount of Geographic Information System (GIS) data to describe the modelling area on a high resolution. This includes a detailed description of the road network, buildings, land-use information, high-resolution satellite images, ground elevation, population data, traffic density etc. SILAM and ENFUSER are developed under a collaborative project with Finnish Meteorological Institute.

Further, to strengthen the forecasting services, the Air Quality Early Warning System (AQ-EWS) was developed under the aegis of Ministry of Earth Sciences in 2018, jointly by the scientists of Indian Institute of Tropical Meteorology (IITM), Pune, India Meteorological Department (IMD), National Centre for Medium-Range Weather Forecasting (NCMRWF). IMD issues AQ Early Warning bulletins based on different models. This year the air quality forecast services were extended to other cities. As of now, the services are being provided to 46 cities.

It is now planned to extend the air quality forecast services to all the 131 non-attainment cities of India by 2026-27.

The Early Warning System for air quality over Delhi consists of:

Real-time observations of air quality and other relevant meteorological parameters.

Predictions of air pollutant concentration and air quality index for next 4 days and outlook for further 6 days. Prediction of contribution in air quality from biomass burning and dust is also provided.

Air Quality Bulletin, Warning Messages and Alerts for pollution control authorities and general public.

The system also has a feature whereby user can create possible emission reduction scenario to examine the possible projected improvement in air quality in Delhi for the next five days.

4.3.1.4. Performance Verification of Air Quality Model

Fig. 13 shows the performance diagram summarizing the Success Ratio, POD, bias, and CSI

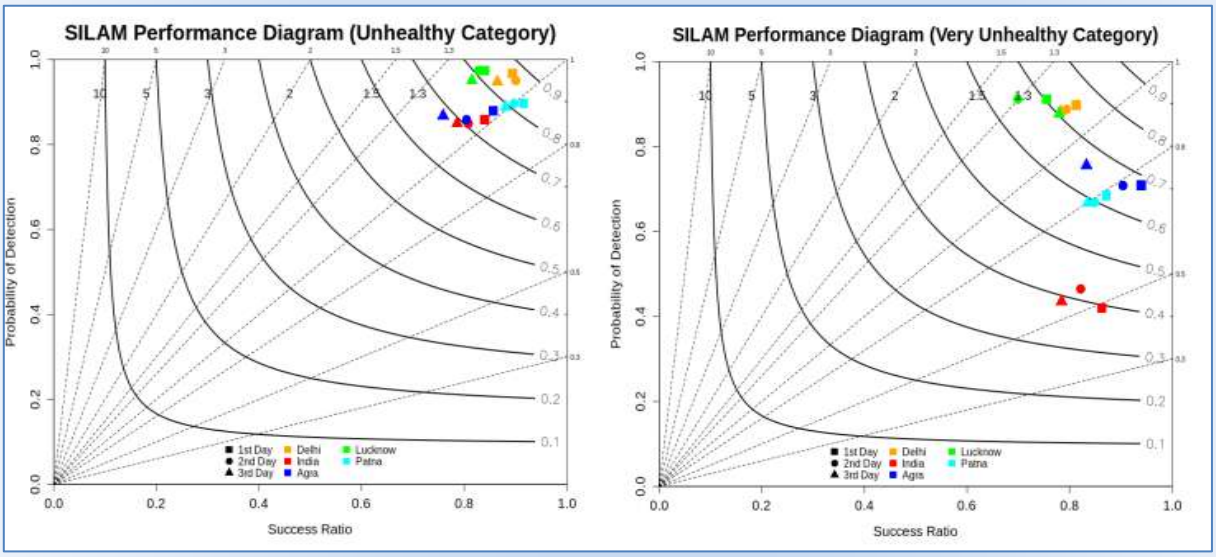


Fig. 13. Performance diagram summarizing the Success Ratio, POD, bias, and CSI skill scores for (a) Unhealthy category and (b) Very Unhealthy category of study periods. The labelled dashed lines represent bias scores, while labelled solid contours represent the CSI values. Appropriate symbols for different cities and days of forecast are present in the figure legends

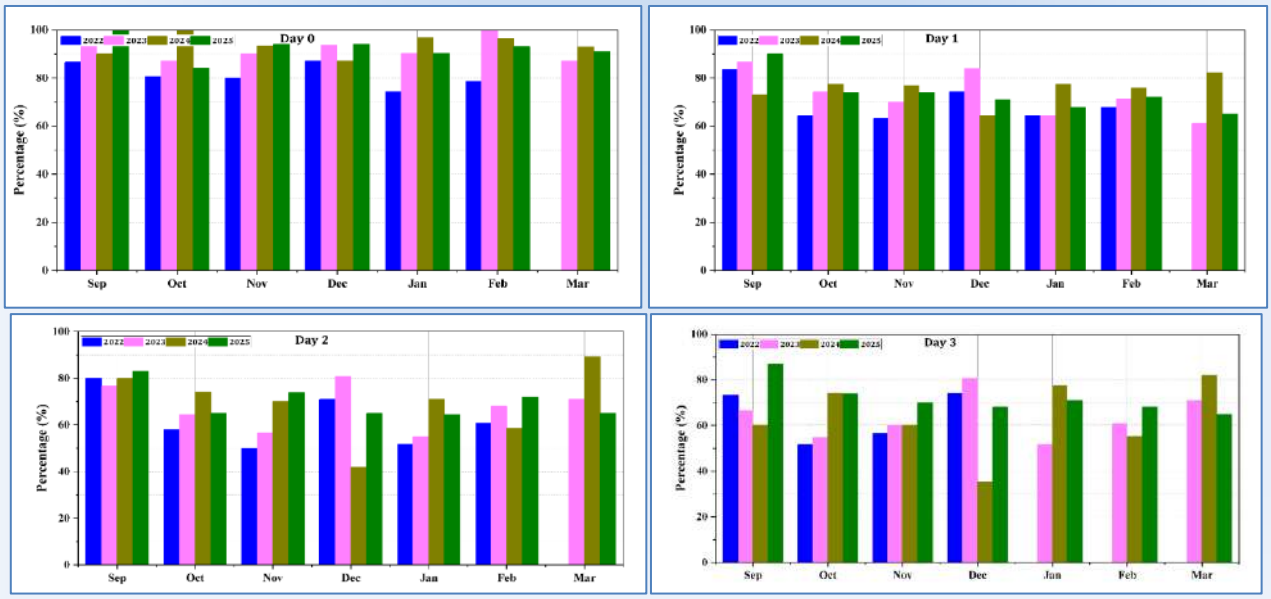


Fig. 14(a).Performance of IMD Air quality forecast bulletin percentage of correct forecast for Good, Satisfactory, Moderate, Poor, Very Poor and Severe categories over Delhi

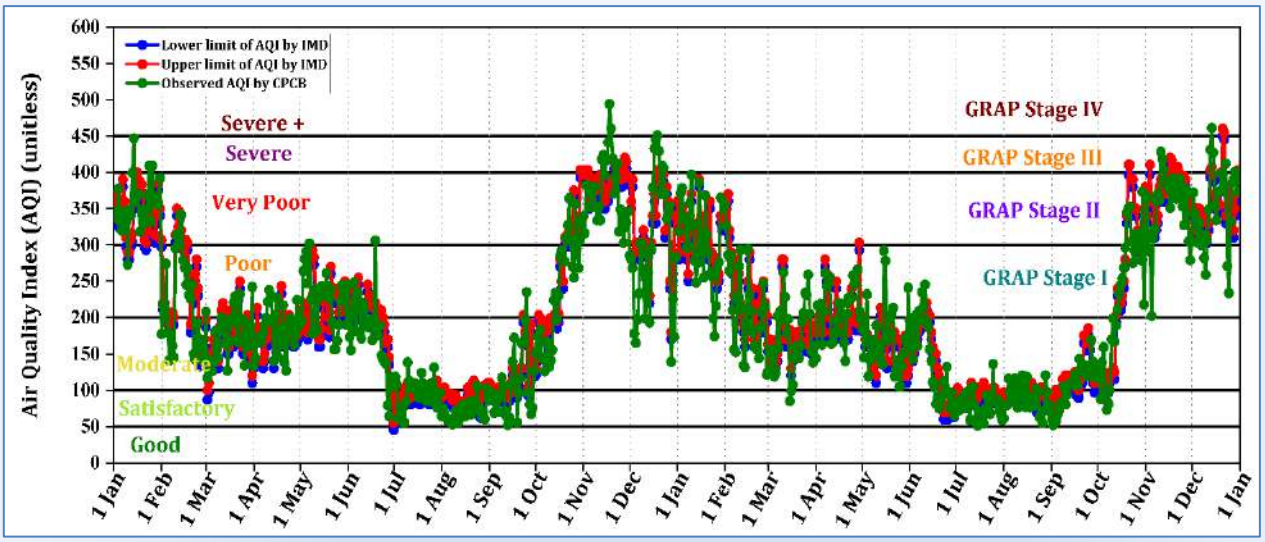


Fig. 14(b). Performance of IMD 3rd day air quality forecast bulletin lower limit AQI (blue) & upper limit AQI (red) by IMD and CPCB observed AQI (green) over Delhi during 2025.

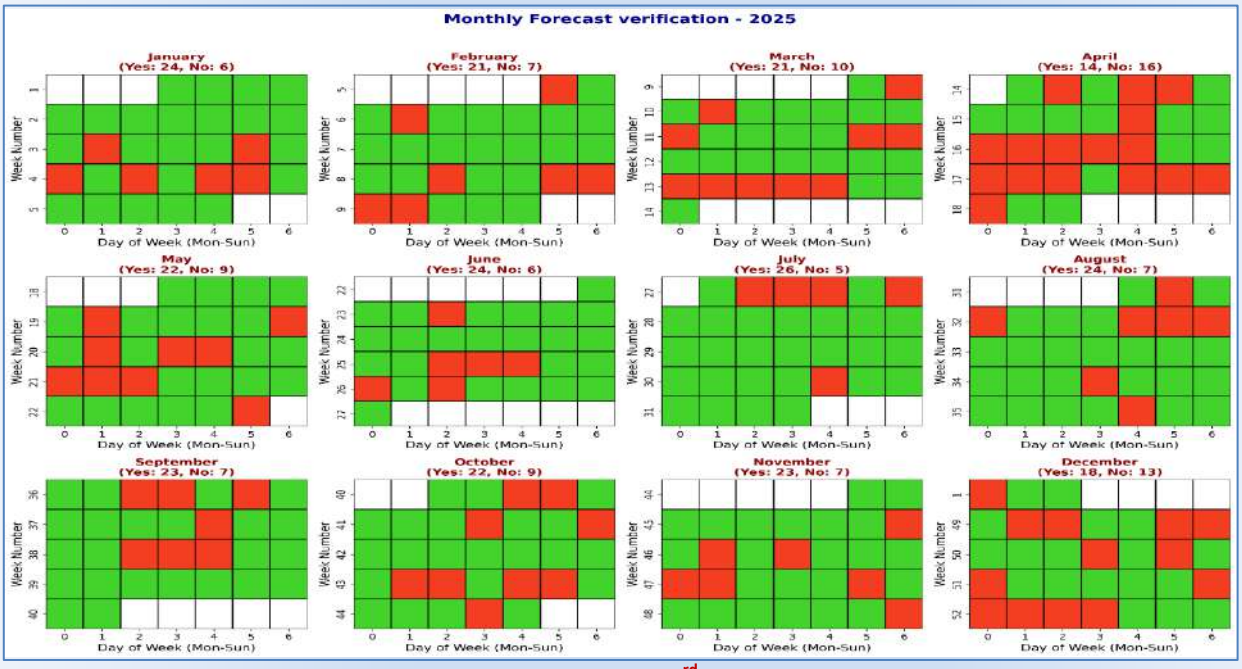


Fig. 14(c).Performance of IMD Air quality forecast of 3rd day bulletin of correct forecast for Good, Satisfactory, Moderate, Poor, Very Poor and Severe categories over Delhi during 2025.

skill scores for (a) Unhealthy category and (b) Very Unhealthy category of study periods. The labelled dashed lines represent bias scores, while labelled solid contours represent the CSI values. Appropriate symbols for different cities and days of forecast are present in the figure legends.

4.3.1.5. Performance of skill of IMD Air Quality Forecast Bulletin for Delhi

Fig. 14(a) shows the performance of IMD Air quality forecast bulletin percentage of correct forecast for Good, Satisfactory, Moderate, Poor, Very Poor and Severe categories over Delhi for last 4 years (2022 to 2026).Fig. 15(b) shows the performance of IMD 3rd day air quality forecast bulletin lower limit AQI (blue) & upper limit AQI (red) by IMD and CPCB observed AQI (green) over Delhi during 2025.Fig. 14(c) shows Performance of IMD Air quality forecast of 3rd day bulletin of correct forecast for Good, Satisfactory, Moderate, Poor, Very Poor and Severe categories over Delhi during 2025.

4.3.1.6: Air quality forecast for major Indian cities

The India Meteorological Department (IMD) has expanded its air quality forecast services to cover

Table 1

Air Quality Forecast for other 47 Indian Cities

		Observed AQI	Air Quality Forecast AQI		
SI.NO.	Indian Cities	28.01.2026	29.01.2026	30.01.2026	31.01.2026
1	Agra (UP)	Moderate	Moderate	Moderate	Moderate
2	Aizawl (Mizoram)	Satisfactory	Satisfactory	Satisfactory	Satisfactory
3	Ahmedabad (Gujarat)	Moderate	Moderate	Moderate	Moderate
4	Amritsar (Punjab)	Satisfactory	Satisfactory	Moderate	Moderate
5	Bengaluru (Karnataka)	Moderate	Moderate	Moderate	Moderate
6	Bhopal (MP)	Moderate	Moderate	Moderate	Moderate
7	Bhiwani (Haryana)		Moderate	Moderate	Poor
8	Bhubaneswar	Moderate	Moderate	Moderate	Moderate
9	Chandigarh (UT)	Satisfactory	Satisfactory	Satisfactory	Moderate
10	Cuttack	Poor	Moderate	Moderate	Moderate
11	Chennai (Tamil Nadu)	Moderate	Moderate	Moderate	moderate
12	Delhi (Delhi)	Poor	Poor	Very Poor	Very Poor
13	Faridabad (Haryana)	Moderate	Moderate	Moderate	Poor
14	Gandhinagar (Gujarat)	Moderate	Moderate	Moderate	Moderate
15	Gaya (Bihar)	Moderate	Moderate	Moderate	Moderate
16	Ghaziabad (UP)	Poor	Poor	Very Poor	Very Poor
17	Gorakhpur (UP)	Satisfactory	Satisfactory	Satisfactory	Moderate
18	Greater Noida (UP)	Moderate	Poor	Very Poor	Very Poor
19	Gurugram (Haryana)	Poor	Poor	Very Poor	Very Poor
20	Guwahati (Assam)	Moderate	Moderate	Moderate	Moderate
21	Gwalior (MP)	Moderate	Moderate	Moderate	Moderate
22	Howrah (WB)	Moderate	Poor	Poor	Moderate
23	Hyderabad (Telangana)	Satisfactory	Satisfactory	Satisfactory	Moderate
24	Indore (MP)	Satisfactory	Satisfactory	Moderate	Moderate
25	Jaipur (Rajasthan)	Poor	Moderate	Moderate	Poor
26	Jodhpur (Rajasthan)	Moderate	Satisfactory	Satisfactory	Moderate
27	Kanpur (UP)	Satisfactory	Satisfactory	Satisfactory	Moderate
28	Kolkata (WB)	Moderate	Poor	Poor	Moderate
29	Kochi (Kerala)		Satisfactory	Satisfactory	Satisfactory
30	Kota (Rajasthan)	Moderate	Poor	Poor	Poor
31	Lucknow (UP)	Satisfactory	Satisfactory	Moderate	Poor
32	Meerut (UP)	Satisfactory	Moderate	Moderate	Poor
33	Mumbai (MH)	Satisfactory	Satisfactory	Satisfactory	Satisfactory
34	Navi Mumbai (MH)	Satisfactory	Satisfactory	Satisfactory	Moderate
35	Nagpur (MH)	Moderate	Moderate	Moderate	Moderate
36	Noida (UP)	Poor	Poor	Very Poor	Very Poor
37	Patna (Bihar)	Moderate	Moderate	Moderate	Moderate
38	Prayagraj (UP)	Satisfactory	Satisfactory	Satisfactory	Moderate
39	Pune (MH)	Moderate	Moderate	Moderate	Moderate
40	Raipur (Chhattisgarh)	Satisfactory	Satisfactory	Moderate	Moderate
41	Rourkela (Odisha)	Moderate	Moderate	Moderate	Moderate
42	Thiru'puram (Kerala)	Satisfactory	Moderate	Moderate	Moderate
43	Tirupati (AP)	Satisfactory	Satisfactory	Satisfactory	Moderate
44	Udaipur (Rajasthan)	Moderate	Moderate	Moderate	Moderate
45	Ujjain (MP)		Moderate	Moderate	Moderate
46	Varanasi (UP)	Satisfactory	Satisfactory	Satisfactory	Moderate
47	Visakhapatnam (AP)	Poor	Poor	Poor	Moderate
		Good	AQI 0-50	Satisfactory	AQI 51-100
		Moderate	AQI 101-200	Poor	201-300
		Very Poor	AQI 301-400	Severe	401-500

47 cities across India. These forecasts provide advance information on air pollution levels, helping citizens, researchers, and policymakers take timely measures to protect public health and manage environmental risks.

The updated air quality bulletins are available on the official IMD website (https://nwp.imd.gov.in/airqualityfc_bulletin_mausam.php) and offer city-specific forecasts, including pollutant levels and related AQI information.

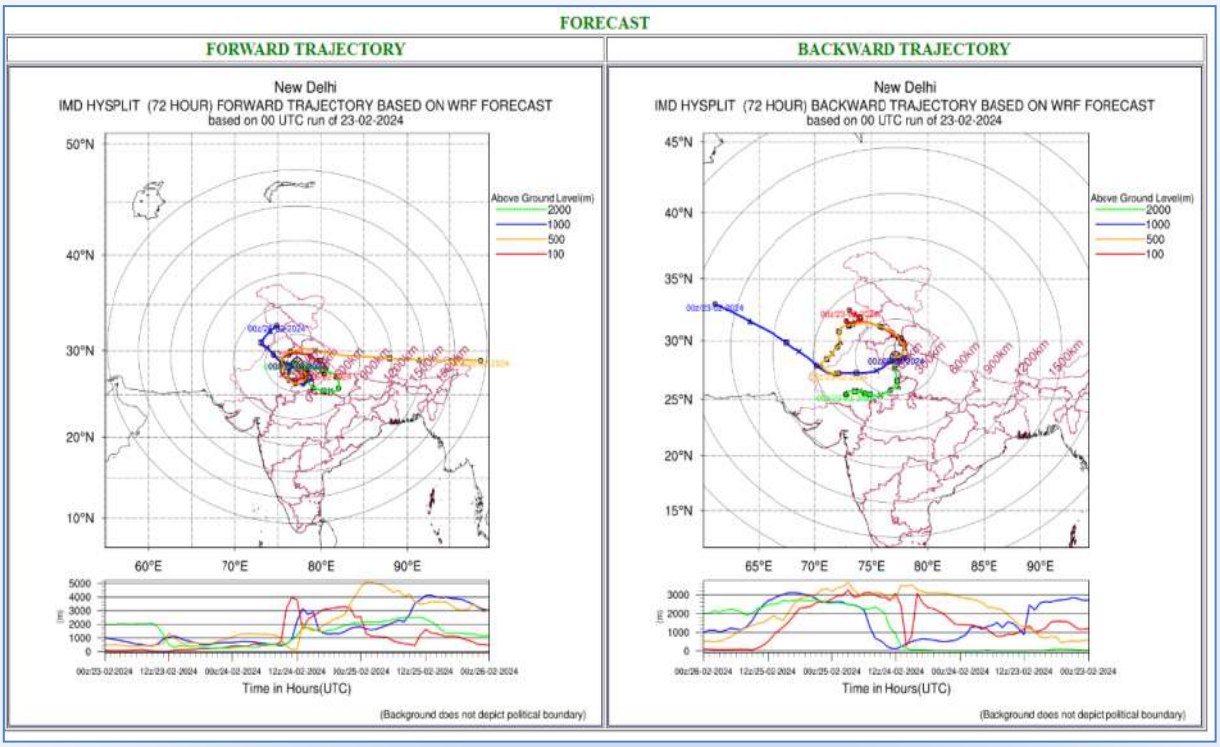


Fig. 15. Air Mass trajectories using IMD-WRF-HYSPLIT model

4.3.1.7. Air Mass Trajectories

Air Mass trajectories using IMD-WRF-HYSPLIT model forecast as well as analysis are available with forward and backward trajectories for 33 cities all over India at 100, 500, 1000 and 2000m for next 24, 48 and 72 hours. Fig. 15 shows the Air Mass trajectories using IMD-WRF-HYSPLIT model.

4.3.2. POLAR METEOROLOGICAL RESEARCH DIVISION (PMRD)

4.3.2.1. Polar Meteorological Research

India Meteorological Department has been an integral part of all the Indian Scientific Expedition to Antarctica (ISEA) since the very first expedition during 1981-82. IMD started meteorological and ozone observations at Maitri station from January, 1990 (from 9thISEA) and are ongoing till date. A meteorological observatory was commissioned in 2015 by IMD at Bharati, another Indian station in Antarctica. The observations vertical profile of ozone is also carried out at Bharati regularly.

Latest version of Polar WRF model has been operationalized to provide day-to-day 72 hours weather forecast at 3 km resolution for the Maitri and Bharati region in the Antarctica. The NWP products are routinely made available on the IMD web site to support of Antarctic Expedition. Two IMD officials each at Maitri and Bharati have proceeded as expedition member of 43 ISEA. Figs. 16 and 17 are showing spatial plot and meteogram respectively.

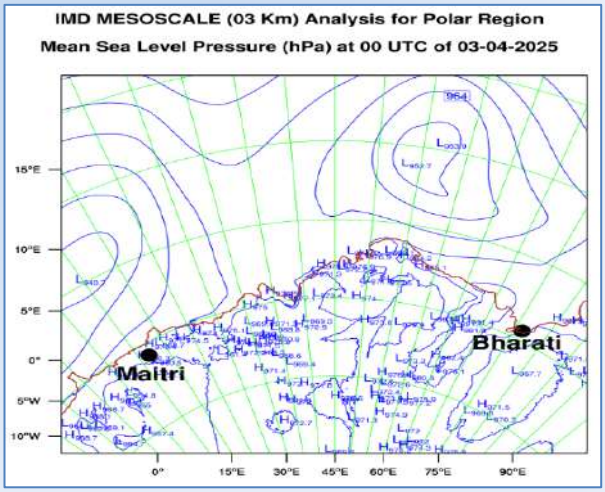


Fig. 16. Spatial plot of mean sea level pressure (hPa) over polar region

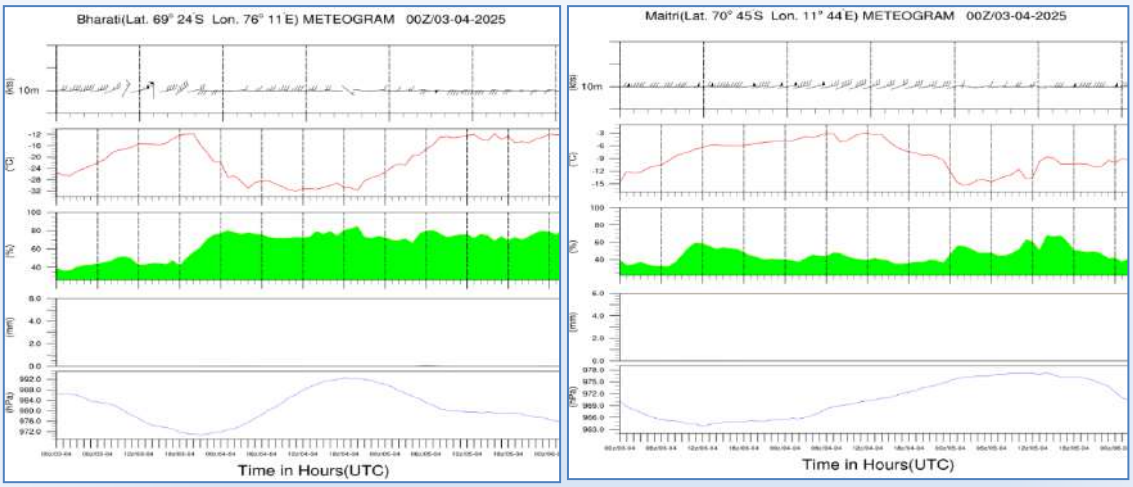


Fig. 17. Meteogram of T2m (oc), RH at 2m (%), Wind (Kts), MSLP (hPa) and Snow (mm) over Bharati and Maitri stations

4.3.3. Urban Meteorological Services

According to the WMO, urban areas experiencing rapid change require Urban Integrated Services that include weather, climate, hydrology, and air quality infrastructure, such as data, observations, and predictions, to support both traditional and emerging urban services. Specialized services have been developed over time for advanced Monitoring, Detection, and Early Warning of severe weather events such as tropical cyclones, thunderstorms, coastal inundation, flooding, air quality issues, health-related concerns, dust storms, heavy rains, snowfall events, cold and heat waves, and more. These services also include climate services for purposes such as building codes, zoning, planning, and design.

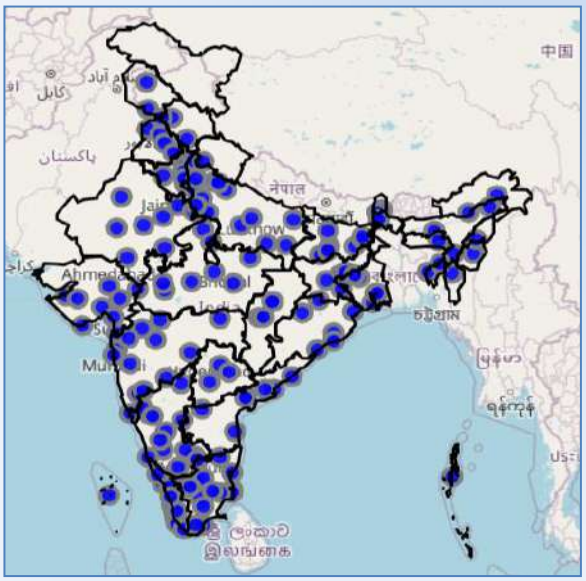


Fig. 18. List of cities covered under IMD UMS

The India Meteorological Department (IMD) has created Urban Meteorological Services for over 150+ urban regions across various city types in India to enhance its Early Warning System (https://internal.imd.gov.in/pages/city_weather_main_mausam.php; Fig. 18). These Urban Integrated Services include the incorporation of detailed urban data observations, urban canopy models, urban vegetation analysis and land use assessment to evaluate exposure, vulnerability, and soil permeability impact on hazards. Additionally, these systems involve ensemble prediction, uncertainty quantification, and a multidisciplinary approach to model initialization.

IMD has prioritized Urban Meteorological Services due to increasing demand. This initiative aims to offer specific severe weather alerts for the capital by leveraging dense observational networks, detailed forecasts, early warning systems for multiple hazards, and climate services that support Sustainable Development Goals. As urban centers, including smart cities and megacities, continue to grow in India, there is a crucial requirement to enhance infrastructure and deliver comprehensive environmental and weather services. The integrated urban meteorological services ensure continuous monitoring and forecasting of hydro-meteorological risks at different levels, including the prediction of:

- Heat waves and cold waves
- Fog
- Cyclone
- Floods
- Drought
- Strong winds and Squalls
- Hailstorms
- Thunderstorms and lightning
- Impact-based warnings for localized convective activities.

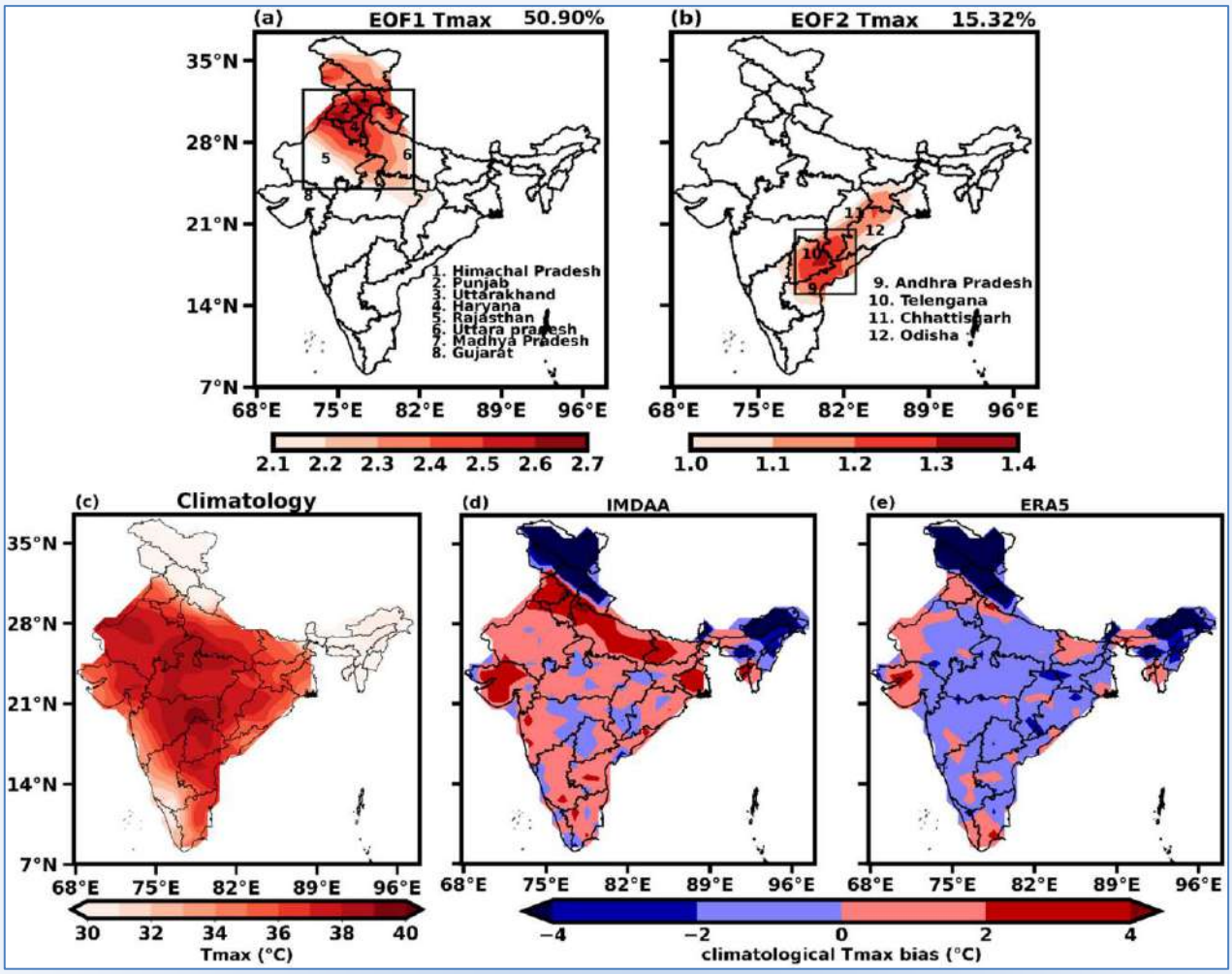


Fig 19. Empirical orthogonal function (EOF) analysis of T max anomalies for March to June (a) first mode and (b) second mode from IMD gridded analysis data, (c) Climatological T max obtained from IMD observational analysis. (d,e) are T max

4.3.3.1. R&D efforts in Urban Meteorological Services

Heatwaves are the most hazardous extreme weather events in India during the pre-monsoon season (March to June), significantly impacting human health and mortality. This research identifies two primary "hotspot" regions through Empirical Orthogonal Function (EOF) analysis(Fig.19): North-central India (NCI), which accounts for 50.9% of temperature variability, and the Southeast coast of India (SECI), accounting for 15.32%. While NCIoften records higher absolute temperatures, SECI frequently experiences higher mortality rates.

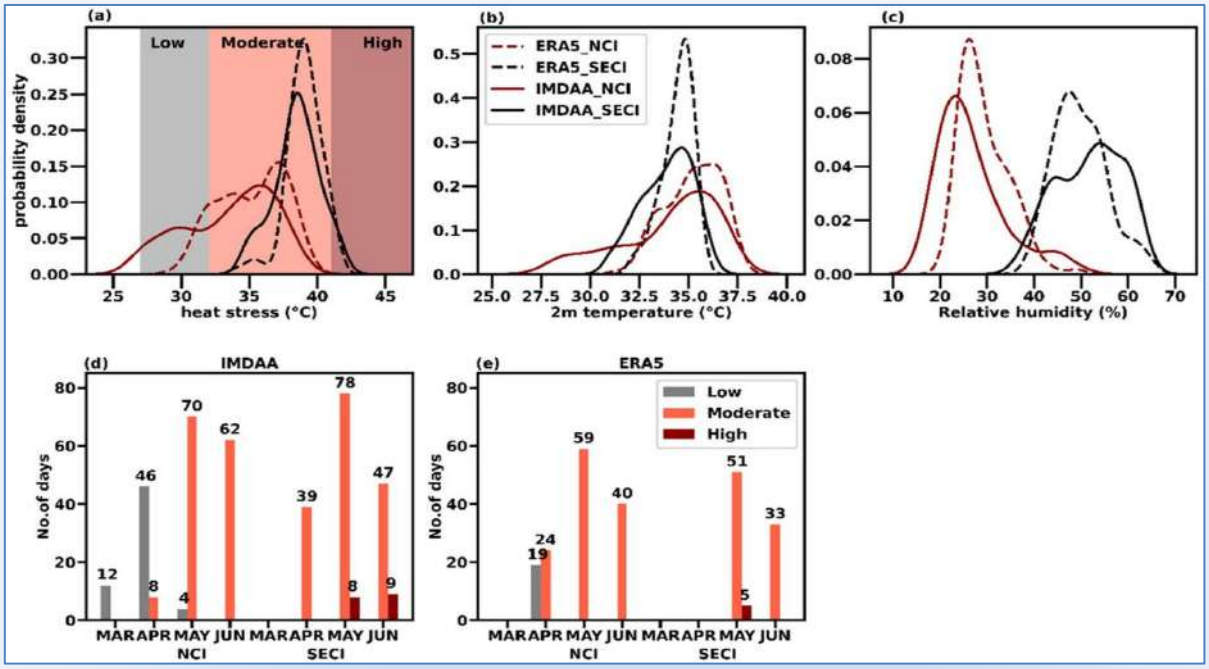
Physical Mechanisms: The "Heat Dome." The study describes different dynamical drivers for each region:

• NCI Dynamics*:* Heatwaves are primarily linked to strong upper-level anomalous anticyclones (at 500–250 hPa). These systems cause subsidence (sinking air), which leads to compressional heating and prevents cloud formation, resulting in high solar insolation and dry conditions.

• *SECI Dynamics:* These events are driven by strong north-westerly winds that advect hot, dry air from the interior, effectively abating the cooling influence of the sea breeze.

• *The Heat Dome:* In both regions, surface heating creates an ascending motion that is trapped in the lower atmosphere (up to ~850 hPa) by the subsidence from upper-level anticyclones. This creates a "heat dome" where high temperatures stagnate.

• *Thermal Discomfort and Mortality:* A major finding is the role of humidity in perceived heat stress, measured by the Heat Index (HI).



Figs. 20(a-e). Kernel density (%) estimation of (a) heat stress (b) daily mean temperature (°C), and (c) relative humidity (%) for NCI (red line) and SECI (black line) regions during heatwave days. Month-wise distribution of heat stress categories from (d) IMDAA

• NCI experiences higher maximum temperatures (31°C–39°C) but low relative humidity (20%–50%).

• SECI has slightly lower temperatures (30°C–37°C) but significantly higher relative humidity (35%–65%) due to maritime winds from the Bay of Bengal.

• Consequently, SECI experiences a "moist heat dome," leading to higher HI values (38°C–39°C) compared to NCI (35°C–36.5°C). This increased heat stress is directly correlated with higher mortality cases, particularly in states like Andhra Pradesh and Telangana.

Figs. 20(a-e) utilizes Kernel Density Estimation (KDE) to compare heat stress, temperature, and humidity across the two primary hotspot regions: North-central India (NCI) and the Southeast coast of India (SECI).The Humidity-Temperature Paradox: While the sources note that NCI generally records actual daily mean temperatures approximately 2°C higher than SECI, the perceived heat stress is significantly lower in NCI. This is due to relative humidity (RH): NCI is characterized by dry conditions (20%–50% RH), whereas SECI experiences nearly twice the humidity (35%–65% RH). Heat Index (HI) Disparity: Because SECI is a "danger zone" where high temperatures coincide with high moisture from the Bay of Bengal, it experiences a "moist heat dome". Figure 21a shows that SECI reaches peak HI values of 38°C–39°C with a high frequency (~30%), while NCI peaks at a lower range of 35°C–36.5°C with less than 15% frequency. Monthly Distribution of Risk: Figures 21d and 21e categorize heat stress into Low (Caution), Moderate (Extreme Caution), and High (Danger) based on National Weather Service (NWS) risk levels.

Figure 21 provides a historical perspective (1992–2020) on how Heat Index (HI) intensity correlates with reported heatwave mortalities across India.

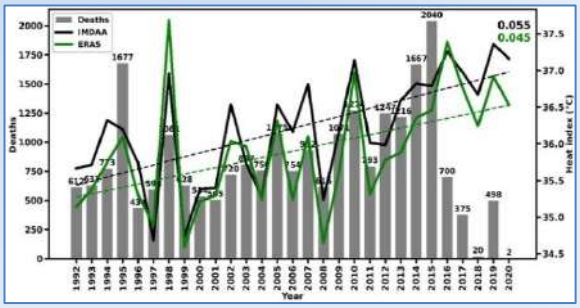


Fig. 21. Year-wise heat wave mortalities (bars) with 95th percentiles of heat index from IMDAA (black) and ERA5 (green) from 1992 to 2020. Mortality source—National Disaster Management Authority (NDMA). The values in the figure indicate the slope values.

• Highest Mortality Years: The data show that years with peak 95th percentile HI values correlate

strongly with mass casualty events. The highest death tolls were recorded in the years as per the following table:

Table 2
Highest No. of death tolls

2015	**2,040 deaths**
1995	1,677 deaths
2014	1,667 deaths

Increasing Heat Stress Trends: Both the IMDAA and ERA5 reanalysis datasets show a statistically significant increasing trend in heat stress. The IMDAA shows a steeper rise at 0.055°C per year, while ERA5 indicates a trend of 0.045°C per year. This upward trajectory highlights an escalating threat to public health. Figure 18 shows that the IMDAA regional reanalysis consistently yields higher (and likely more accurate) heat-stress values than the global ERA5 reanalysis for almost every year in the study period. An important observation in Figure 5 is that despite high heat stress in very recent years (2017–2020), reported mortality has decreased. The sources attribute this success to early warnings, increased public awareness, and robust heatwave mitigation plans implemented by the National Disaster Management Authority (NDMA) and state-level authorities.

The study highlights the superiority of the high-resolution (12 km) IMDAA regional reanalysis over the global ERA5 (25 km) reanalysis. IMDAA captured 202 heatwave days in NCI and 181 in SECI, closely matching observations, while ERA5 significantly underestimated these events by 32% and 42%, respectively. Furthermore, IMDAA accurately captured the negative correlation between soil moisture and temperature, a critical driver of surface sensible heat during heatwaves.

4.3.3.1. R&D on Aerosol and Meteorological Thresholds Affecting Visibility over Delhi

The quantitative assessment of air-pollution-induced visibility impairment is a prevalent concern across the Indian subcontinent, particularly during wintertime fog episodes. In the present study, efforts have been made to identify threshold values of aerosol concentration ($PM_{2.5}$), meteorological variables relative humidity (RH), temperature at 2 m, wind speed at 10 m—and boundary layer height (BLH)associated with shallow, moderate, dense, and very dense fog conditions. Visibility was classified intofive categories: CAT I (550–1000 m) representing shallow fog, CAT II (300–550 m) representing moderate fog, CAT IIIA (175–300 m) and CAT IIIB (50–175 m) representing dense fog, and CAT IIIC (<50 m)representing very dense fog.

A five-year wintertime dataset (December–February) spanning 2018–2023 was used to determine these thresholds using statistical methods. A unique two-way rolling window correlation analysis was performed to examine linear, inverse, and logarithmic relationships between visibility, $PM_{2.5}$, RH, and temperature across different fog categories. Multiple sliding window sizes and step lengths were applied to assess interrelationships based on statistically significant correlation coefficients. Thresholds for wind speed and boundary layer height were derived using a frequency-distribution-based averaging approach. In addition, trajectory analysis was conducted to identify potential source regions contributing to elevated pollution levels during low-visibility events.

Hourly temporal analysis of wintertime visibility revealed persistently poor visibility conditions (<1 km) during early morning hours, particularly between 05:00–08:00 in December and 06:00–08:00 in January and February. Visibility gradually improved during the daytime, with afternoon and evening hours (13:00–17:00) consistently exhibiting better visibility conditions, indicating the influence of boundary layer development and enhanced atmospheric mixing.

Box-plot analysis demonstrated a clear inverse relationship between $PM_{2.5}$ concentrations and visibility over Delhi, with mean pollution levels increasing from approximately 203 µg m^{-3} under CAT I conditions to about 240 µg m^{-3} during CAT IIIC conditions. Meteorological parameters further contributed to visibility impairment. Relative humidity increased from about 89% in CAT I to near saturation (100%) in dense fog categories, enhancing aerosol hygroscopic growth. Wind speed decreased from approximately 1.7 m s^{-1} in CAT I to below 1 m s^{-1} in CAT IIIC, while temperature declined from around 12 °C to 8.5 °C. Simultaneously, BLH reduced from ~139 m to below 50 m, restricting pollutant dispersion and intensifying near-surface aerosol accumulation.

Two-way rolling window correlation analysis revealed category-dependent statistical relationships between aerosols, meteorology, and visibility. For $PM_{2.5}$–RH–visibility interactions, linear and inverse trends were most robust for CAT I, whereas linear and logarithmic relationships best represented $PM_{2.5}$–visibility and RH–visibility associations for the remaining categories. For $PM_{2.5}$–temperature–visibility interactions, linear and inverse relationships consistently described $PM_{2.5}$–visibility dependence, while linear and logarithmic interdependencies were dominant for RH–visibility across all fog categories. Based on these analyses, threshold values for $PM_{2.5}$, RH, temperature, wind speed, and BLH were identified for each fog category. For CAT I, thresholds were $PM_{2.5}$>270 µg m^{-3}, RH >70%, temperature <13 °C, wind speed <1.5 m s^{-1}, and BLH <100 m. Corresponding thresholds for CAT II were $PM_{2.5}$>250 µg m^{-3}, RH >70%, temperature <13 °C, wind speed <1.2 m s^{-1}, and BLH <80 m. For CAT IIIA, thresholds included $PM_{2.5}$>250 µg m^{-3}, RH >70%, temperature <11 °C, calm winds, and BLH <80 m. For CAT IIIB, thresholds were $PM_{2.5}$>220 µg m^{-3}, RH >80%, temperature <11 °C, calm winds, and BLH <70 m, while CAT IIIC was characterized by $PM_{2.5}$>180 µg m^{-3}, RH >90%, temperature <9 °C, calm winds, and BLH <60 m.

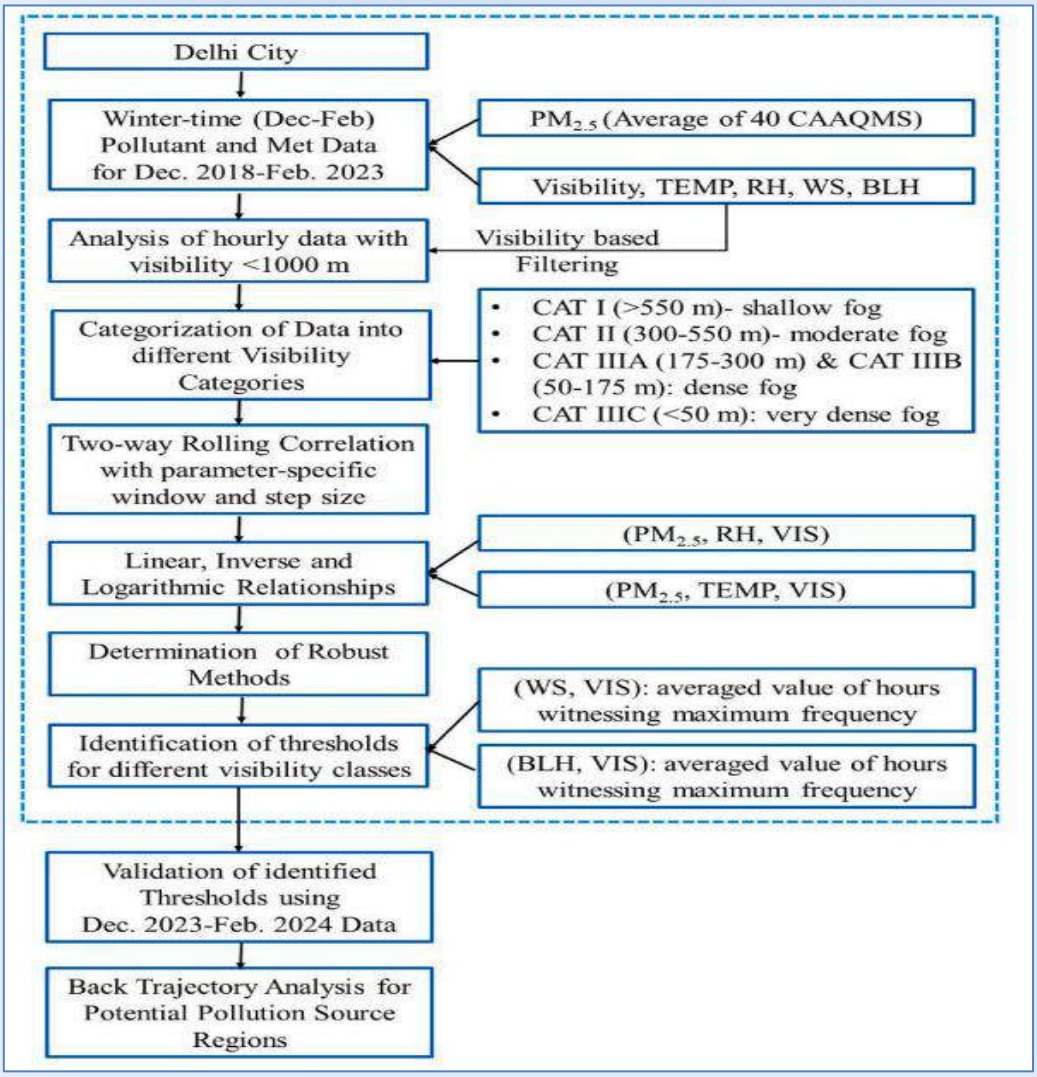


Fig. 22. Flow Chart showing step-wise Methodology adopted for the Present Study.

For CAT I and CAT II, as visibility decreased, the RH threshold remained nearly unchanged, whereas the $PM_{2.5}$ threshold declined. Under extreme fog conditions (CAT IIIA, CAT IIIB, and CAT IIIC), wind speed and BLH emerged as the dominant controlling factors, as the atmosphere approached saturation. The synergistic interaction between aerosols and meteorology became particularly detrimental under these conditions. Additionally, fog droplets exhibited scavenging properties, resulting in a gradual decrease in $PM_{2.5}$ concentration with further reduction in visibility.

The identified thresholds were validated using an independent dataset from December 2023 to February 2024. Threshold compliance was observed for 257 (65%) CAT I events, 116 (77%) CAT II events, 21 (88%) CAT IIIA events, 53 (90%) CAT IIIB events, and 79 (93%) CAT IIIC events, indicating strong applicability of the thresholds, particularly for dense and very dense fog conditions.

Trajectory clustering analysis revealed dominant pollution source regions in the northwestern part of the Asian subcontinent. At lower altitudes (100 m and 500 m), air masses primarily originated from Delhi, Punjab, Haryana, Uttar Pradesh, Jammu & Kashmir, and adjacent regions of Pakistan. At higher altitudes (1000 m and 1500 m), transport was dominated by transboundary regions extending across Pakistan, Afghanistan, and Iran.

Overall, the study indicates a negative relationship between relative humidity and visibility, while wind speed, temperature, and boundary layer height exhibit positive relationships with visibility. Meteorological conditions directly influence particulate pollution through aerosol hygroscopicity, and their combined effect governs wintertime visibility over the study region. For shallow, moderate, and dense fog conditions, aerosol water uptake altered particle size and composition, enhancing scattering efficiency and reducing visibility. As visibility deteriorated further under very dense fog conditions, RH remained nearly constant, wind speeds became calm, and BLH collapsed to near-surface levels (<50 m), forming a vertical lid that trapped pollutants and exacerbated visibility degradation.

The validated thresholds demonstrate their operational utility for future applications, confirming that visibility can be effectively used as a proxy for air quality. The study presents a statistically robust methodology for identifying aerosol–meteorology thresholds that can aid policymakers in predicting fog events and issuing early warnings. These findings can support the formulation of targeted policy interventions and public advisories, while source-specific aerosol characteristics may be linked with the identified thresholds to develop effective, region-specific pollution mitigation strategies.

Table 3
Category-wise identified thresholds for different visibility conditions.

Visibility Category (m)	$PM_{2.5}$, Relative Humidity and Visibility				$PM_{2.5}$, Temperature and Visibility				Wind Speed, Visibility	Boundary Layer, Visibility	Identified Thresholds				
	$(PM_{2.5}$ & $VIS)_{RH}$		$(RH$ & $VIS)_{PM2.5}$		$(PM_{2.5}$ & $VIS)_{TEMP}$		$(TEMP$ & $VIS)_{PM2.5}$		Based on Hours with maximum frequency (m/s)		$PM_{2.5} \pm 50$ ($\mu g/m^3$)	RH (%)	TEMP (°C)	WS (m/s)	MH ± 50 (m)
	Best fit (r value)	$PM_{2.5}$ Bin ($\mu g/m^3$)	Best fit (r value)	RH Bin (%)	Best fit (r value)	$PM_{2.5}$ Bin ($\mu g/m^3$)	Best fit (r value)	TEMP Bin (°C)							
CAT I (>550)	Linear (−0.40), inverse (0.40)	>350	Linear (−0.40), inverse (0.40)	>70	Linear (−0.50), inverse (0.50)	>270	Linear (0.55), logarithmic (0.55)	<13	1.5	85	>270	>70	<13	<1.5	<100
CAT II (300-550)	Linear (−0.45), logarithmic (−0.45)	>330	Linear (−0.60), logarithmic (-0.50)	>70	Linear (−0.50), inverse (0.55)	>250	Linear (0.60), logarithmic (0.55)	<13	1.2	73	>250	>70	<13	<1.2	<80
CAT IIIA (175-300)	Linear (−0.40), logarithmic (−0.40)	>280	Linear (−0.40), logarithmic (-0.35)	>70	Linear (−0.50), inverse (0.50)	>250	Linear (0.55), logarithmic (0.50)	<11	0.8	70	>250	>70	<11	Calm	<80
CAT IIIB (50-175)	Linear (−0.40), logarithmic (−0.40)	>260	Linear (−0.40), logarithmic (-0.40)	>80	Linear (−0.55), inverse (0.55)	>220	Linear (0.60), logarithmic (0.60)	<11	0.8	64	>220	>80	<11	Calm	<70
CAT IIIC (<50)	Linear (−0.40), logarithmic (−0.35)	>210	Inverse (0.35), logarithmic (-0.35)	>90	Linear (−0.60), inverse (0.50)	>180	Linear (0.55), logarithmic (0.50)	<9	0.4	50	>180	>90	<9	Calm	<60

4.4. Radar Observations

4.4.1. India Meteorological Department Doppler Weather Radar Network:

The **India Meteorological Department (IMD)** manages a comprehensive weather radar network in India (Fig. 23). This network includes **Forty Eight**

Doppler Weather Radars (DWRs) positioned to monitor weather conditions across the country. Additionally, radar data is integrated from **five ISRO radars** and **six IITM radars**, enhancing the overall capability.

4.4.2. Distribution of IMD Radars:

1. **S-Band RADARs:** Detect severe weather phenomena such as thunderstorms and cyclones. Installed in Chennai, Kolkata, Machilipatnam, Visakhapatnam, Paradip, Hyderabad, Nagpur, Patna, Lucknow, Patiala, Karaikal, Bhopal, Agartala, Mohanbari, Delhi (Palam), Goa, Bhuj, Mumbai, Cherrapunji and SHAR.

2. **S-Band Polarimetric RADARs:** Provide precise data for severe weather monitoring. Located in Kochi and Gopalpur.

3. **C-Band Polarimetric RADARs:** Differentiate between precipitation types. Installed at Delhi (HQ), Jaipur, Veravali, Raipur and Mangaluru,VSSC Thiruvananthapuram.

4. **X-Band Polarimetric RADARs:** High-resolution short-range monitoring. Installed at Pallikarnai, Ayanagar, Jammu, Kufri, Mukteshwar, Surkanda Devi, Banihal Top, Murari Devi, Jot, Lansdowne and one mobile radar in Leh in the Western & Central Himalayas. Recently, an X-Band DWR has been installed in Jorhat among the 10 X-Band DWRs being installed in the North Eastern region covering the Eastern Himalayan region.

4.4.3. Coastal Radar Coverage:

- **East Coast:** Eight radars at Chennai, Kolkata, Machilipatnam, Visakhapatnam, Paradip, Gopalpur, SHAR and Karaikal.
- **West Coast:** Five radars at Kochi, Goa, Mumbai, Bhuj, and VSSC Thiruvananthapuram.

Recent Additions:

- C-Band DWR at Mangaluru, Karnataka
- X-Band DWR at Jorhat, Assam

4.4.4. Collaboration with ISRO:

- Utilizes data from ISRO radars located at VSSC Thiruvananthapuram (C-Band), Sohra / Cherrapunji (S-Band) and SHAR (Sriharikota S-Band). Also, six DWRs (Solapur (C-Band) & Silkheda, Juhu, Panvel, Kalyan, Vasai & Mahabaleshwar X-Band DWRs) installed and operated by IITM are also being utilized by IMD to enhance weather forecasting capabilities.

This extensive network enhances India's ability to monitor severe weather events, providing vital data for accurate weather forecasting and disaster management. The integration of various radar types ensures comprehensive coverage and precise detection of weather patterns.

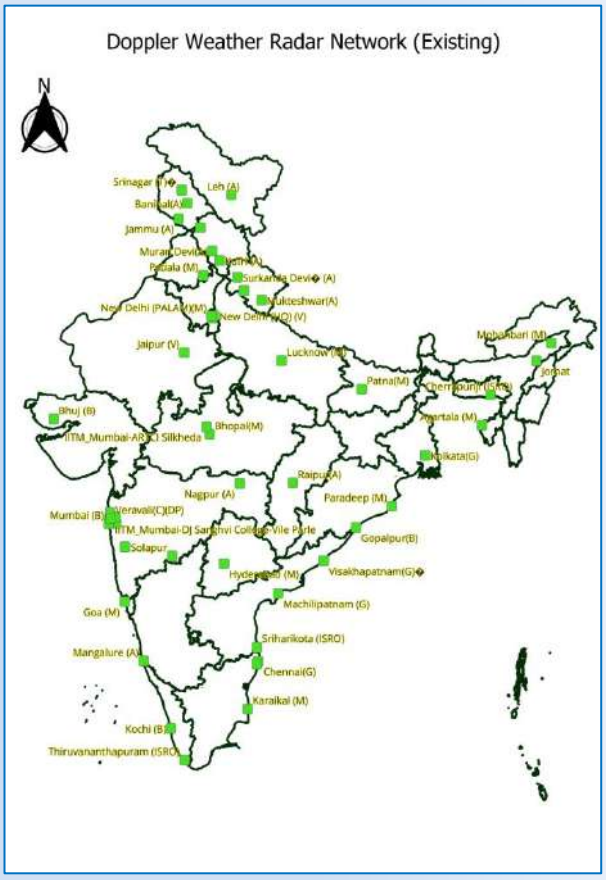


Fig. 23. Existing IMD DWR Network

4.4.5. Addressing Coverage Gaps:

India's diverse topography necessitates enhanced radar coverage. To address these gaps and ensure comprehensive weather monitoring, a strategic plan has been proposed to install additional radars (Fig. 24):

- **S-Band DWRs:** The existing 04 S-Band DWRs on the Eastern Coast are being replaced with the new Klystron based S-Band DWRs. Another 8 S-Band DWRs are proposed to be installed all along the east and west coast of India and Andaman Nicobar Islands.

- **C-Band DWRs:** Installation of 12 radars aimed at improving coverage in the plains, where radar coverage is currently insufficient.Of these, 02 DWRs at Raipur and Mangaluru have been installed and commissioned. DWRs at Sambalpur and Kahilipara (Assam) are expected to be installed and commissioned shortly.

- **X-band DWRs:** Installation of 10 radars to strengthen the network in the northeastern states (Eastern Himalayas). Of these, an X-Band DWR in Jorhat has been installed and commissioned. Another 8 X band DWRs are proposed to be installed at Urban centres throughout India.12 X-Band DWRs including 04 DWRs for GoUP are being installed across the country under 'Urban Meteorology' programme.

- **45 DWRs (20 C-Band and 25 X-Band)** under Mission Mausam are proposed for installation to cover the gap areas throughout the nation.

- **19 Wind Profilers** under Mission Mausam are proposed for installation throughout India.

The proposed layout ensures that these additional radars and wind profilers will be strategically placed to provide enhanced meteorological observation capabilities, especially in regions that are currently under served. This expansion aims to improve real-time weather monitoring and forecasting, thereby bolstering disaster management and preparedness efforts across India.

Strategic Expansion Plan

Following the success of the Integrated Himalayan Meteorological Project, IMD has set an ambitious goal to further expand its radar network:

- **Upgradation of 02 existing DWRs:** Two DWRs namely Kochi & Gopalpur were upgraded through M/s BEL, Bangalore during 2025-26.

- **Installation of 34 Additional DWRs:** By March 2027, IMD plans to install 33 new DWRs across major parts of the country. This will increase the total number of radars in IMD's network to 80, providing more comprehensive coverage. (Fig. 24)

- **Targeted Areas:** The new installations will focus on areas with inadequate radar coverage, including regions prone to severe weather phenomena such as cyclones, thunderstorms, and heavy rainfall.

- **Enhanced Coverage:** This expansion will ensure that even remote and previously underserved areas are included in the radar network, improving the accuracy of weather predictions and providing timely warnings for severe weather events.

By integrating these additional radars into the existing network, IMD aims to enhance its ability to monitor weather patterns in real-time, contributing to improved disaster preparedness and response across the country.

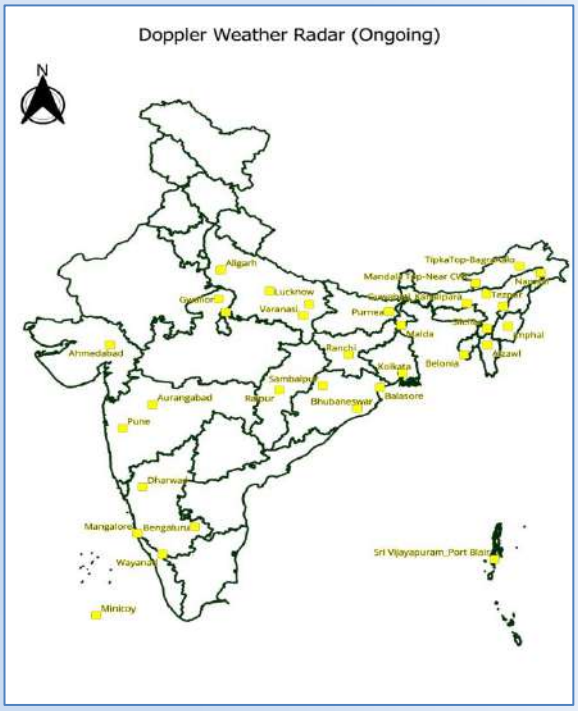


Fig. 24. Ongoing C-Band and X-Band DWRs

4.4.6. Mission Mausam

The **IMD** aims to enhance its radar network under **Mission Mausam** by installing additional **DWRs** (Fig. 25).

X-Band (25 DWRs):

- **Purpose:** High-resolution monitoring for localized weather phenomena and adaptation to complex terrains.

C-Band (20 DWRs):

- **Purpose:** Versatile for various weather applications, effective in

precipitation measurement and useful for hydrological purposes.

S-Band (8 DWRs):

- **Purpose:** Long-range detection, severe weather monitoring and robust performance in various weather conditions.

Proposed Locations:

- **Cyclone-Prone Areas:** To provide early warnings and detailed tracking.

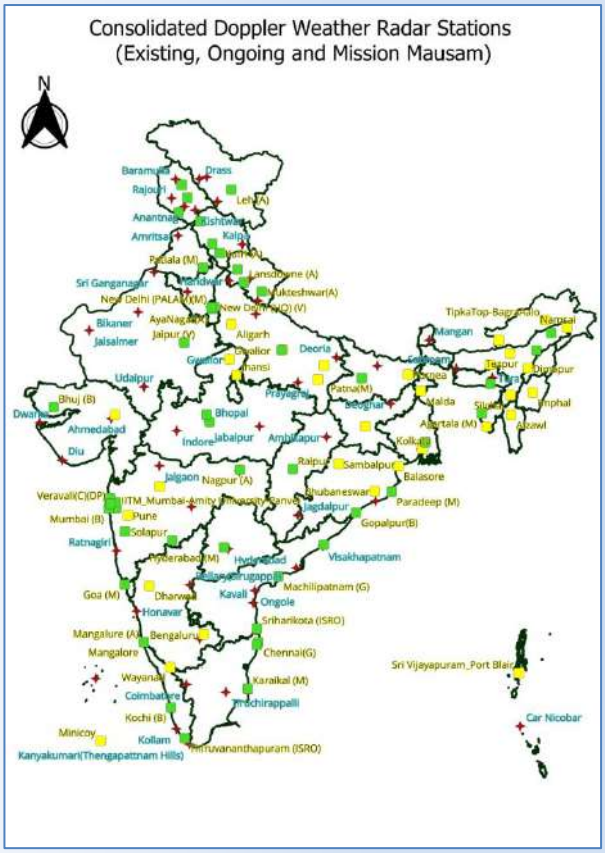


Fig. 25. Proposed DWR network after addition of Mission Mausam DWRs

- **Key Strategic Locations:** To ensure reliable and continuous radar coverage in vulnerable regions.

This initiative aims to improve weather monitoring and forecasting across different regions of India.

4.4.7. Wind Profilers

The IMD has strategically planned to procure wind profilers as part of a collaborative effort under a Memorandum of Understanding (MoU) with ISTRAC, Indian Space Research Organisation (ISRO), Bangalore. This collaboration aims to enhance the accuracy of weather predictions, particularly in tropical regions, where wind profiles are critical for understanding atmospheric dynamics. IMD also planned 10 Nos. of additional wind profiler under Mission Mausam project (Fig. 26).

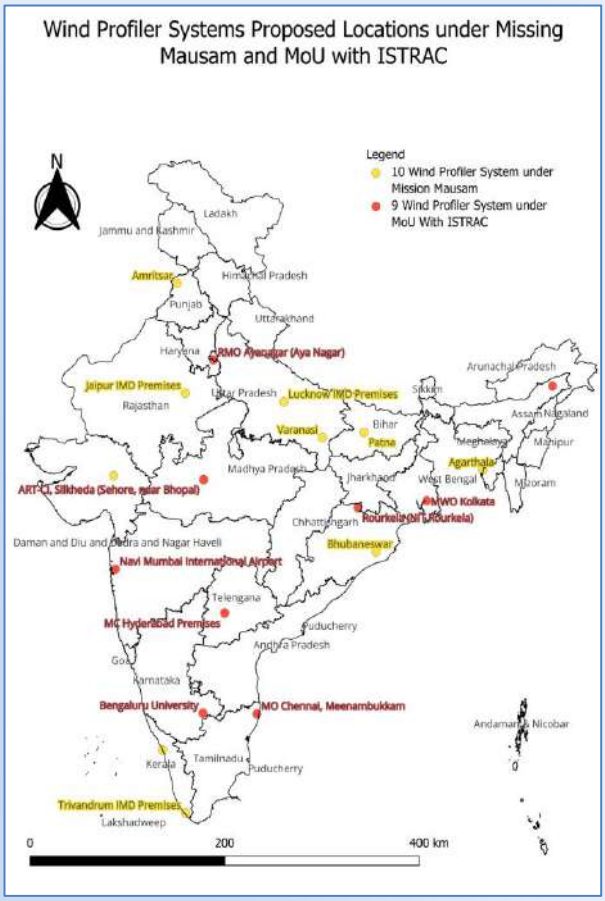


Fig. 26. Proposed Wind Profiler

4.5. Satellite Observations

4.5.1. 1 Low Earth Orbit (LEO) Constellation: Working Group Committee

Recognizing the growing need for more precise weather monitoring and forecasting, and to cater to the urgent requirement for enhancement of observational capabilities of the existing space-based systems, Ministry of Earth Sciences (MoES) and the India Meteorological Department (IMD) have initiated efforts to develop and deploy advanced Hyperspectral and Weather Satellite Solutions.

(i). A Working Group Committee comprising expert members from various organizations was

constituted for the coordination of accurate weather forecasting whose key mandates include:

- Strengthening weather monitoring and forecasting using Hyperspectral Imagers and Microwave Sounders.
- Implementing end-to-end solutions covering satellite development, launch, operations, data collection, analysis, and assimilation into Numerical Weather Prediction (NWP) models.

(ii). Based on the deliberations held during the meeting, the committee emphasized that satellite data forms the backbone for Numerical Weather Prediction (NWP) applications with polar orbiting satellites contributing a significant 80% of the space-based data. While India has a long-standing and committed program utilizing the INSAT series of geostationary satellites for over 40 years, with advanced future plans, the committee noted a current lack of a firm Indian program for launching dedicated Polar orbiting meteorological satellites with advanced payloads. Currently, India relies heavily on data from foreign polar satellites (besides Indian OCEANSAT for ocean surface winds). Given the critical role of polar orbiting satellites in NWP, the committee concluded that it is necessary to start a new Indian program. A proposal for a constellation of four Polar orbiting sun-synchronous satellites, incorporating state-of-the-art payloads like a Hyperspectral Sounder (IR based), an Advanced Microwave Sounder, and GNSS-RO.

(iii). A LEO satellite constellation under PPP framework is under consideration phase. This includes Microwave Atmospheric Sounders and Scatter meters to achieve a high revisit frequency (approximately 1-hour) over the Indian Ocean, which is critical for tracking the rapid intensification of cyclones and diurnal wind variability.

The recommendations arrived at by the committee include:

(i) **Hyperspectral Imager:** A Hyperspectral Imager-VNIR and SWIR at spatial/spectral resolutions of 10 nm/30m and 20 nm/60m respectively for the specified bands.

(ii) **Microwave Atmospheric Sounders:** A constellation of Millimeter-wave temperature and humidity Sounders (similar to the MATHS instrument for Oceansat-3A) from inclined orbits (±350) is recommended for a 1-hour revisit over the Indian subcontinent and Indian Ocean region.

(iii) **Scatterometer:** A standalone Scatterometer mission in an inclined orbit (±350) is recommended to enable 6-hourly revisits over the Indian Ocean region to capture diurnal wind variability. Additionally, a constellation of Scatterometers with GNSS-R in low-inclination is important for frequent (<3 hr) coverage in the tropical region to monitor and track tropical cyclones.

4.5.1.2 Expected Benefits

Operational use of data from above proposed instruments will result in improved initial conditions for models leading to better short range and very short-range weather forecasts particularly for the severe weather caused by the thunderstorms, torrential rain, flood, cyclones and monsoon weather system. Timely availability of operational data from our own polar orbiting satellites will certainly result in issuance of warnings to the users with more lead time as IMD will receive the data with its own receiving the station across the country.

4.5.2. Achievements

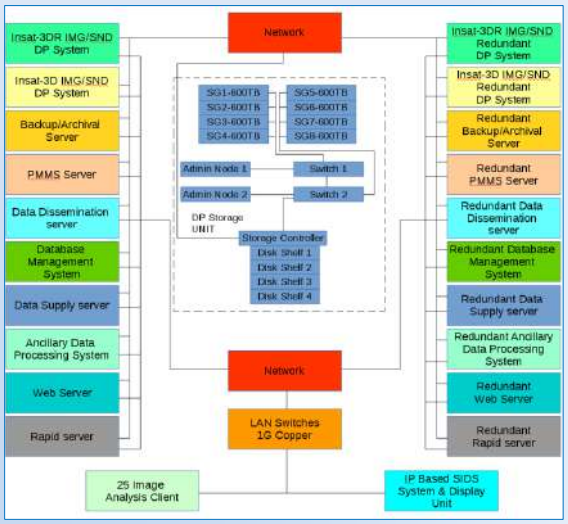
4.5.2.1. Multi-Mission Meteorological Data Receiving and Processing System (MMDRPS)

IMD has established Multi-Mission Meteorological Data Receiving and Processing System (MMDRPS) for INSAT-3DR, INSAT-3DS (Figs. 28 & 29). Three numbers new earth stations have beensetup under MMDRPS Project, which have the capability to receive the data from INSAT-3DR, and INSAT-3DS satellite. MMDRPS systems consist of advanced & latest state of art servers capable to process the complete set of data within 7 minutes after completion of scan along with the storage capacity of order 2.0/2.0PB (Main/Mirror) & 324TB SSD which will facilitate online sharing of processed data for all Indian Meteorological Satellites to the registered users as per IMD data policy through Web-based secured Satellite Data Supply System.

4.5.2 .2 Operational Scan Strategies

The Imager payload of INSAT-3DR and INSAT-3DS(Fig.30) is being used in the staggered mode so that a 15 minutes temporal resolution is achieved. During extreme weather events, the INSAT 3DR imager is used for RAPID scanning. Rapid scan has

Fig. 27.



Figs. (28 & 29). Data receiving, processing, storage and dissemination chain of MMDRPS system

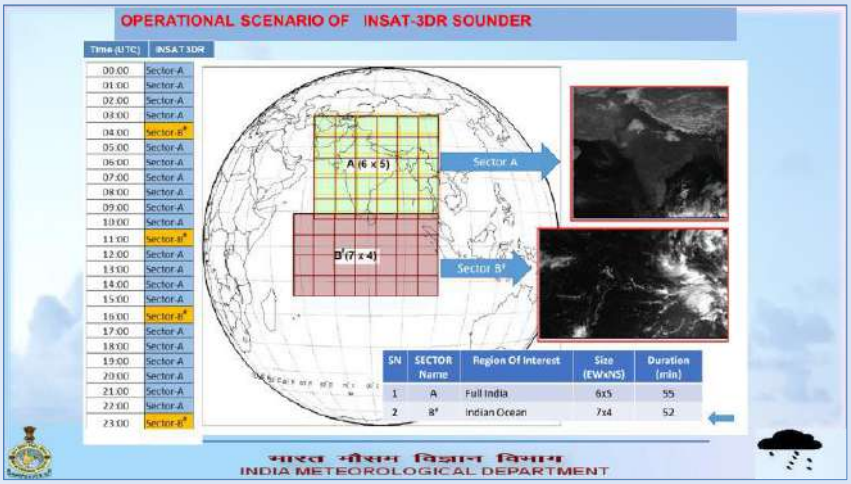


Fig. 30. Scan strategy of INSAT-3DS sounder

been conducted during major cyclonic events like Remal and Dana.

The sounder payload of INSAT-3DR is operated in such a way that India land region sector data is covered up twenty times and the Indian Ocean region data is covered up four times (04, 11, 16 & 23 UTC) on an hourly basis.

4.5.2.3 Operational Products generated from INSAT 3DS Satellite

The products derived from the satellite data include: Cloud images in the Visible, Short wave Infra-red, Mid Infra-red, Thermal Infra-red, Water Vapour Channels; and special enhanced images, Atmospheric Motion Vectors (IR Wind, Water Vapour Winds, MIR/Visible Winds), Sea Surface

temperature, Outgoing Long-wave radiation, Land Surface Temperature (LST),Insolation, Quantitative Precipitation Estimates, Nighttime Fog, Smoke, Fire, Snow Cover, Aerosol Optical Depth, Upper Tropospheric Humidity, Cloud top Temperature, Cloud top Pressure, Temperature & Humidity profiles, Total ozone, Total/Layer Precipitable Water Vapour, Stability Indices.In addition to these, IMD has also started a generation of Wind derived products such as Vorticity (at 850mb,700mb,500mb, 200mb levels), Wind Shear, Mid-level Wind Shear, Shear Tendency, Low-level Convergence, and Upper-Level Divergence using Imager Wind product and NCEP forecast file and T-phi gram at all district locations using Sounder data. All these images and products are disseminated on a real-time basis through a dedicated IMD website. Satellite observed radiances and winds are now being assimilated in NWP models to improve their forecast ability. Satellite images are used in monitoring Cyclones. The intensity and position of cyclones are given to forecasters in real-time using the Dvorak technique. Satellite data and images are also used in monitoring various other significant weather phenomena such as Fog and thunderstorms. Two new types of satellite Imageries IR-1 BT Blended Image & IR-1 BT & Visible Sandwich Image has been made operational which are considered very useful for monitoring Thunderstorm events.

4.5.2.4 Satellite-based cyclone monitoring

During the year 2025, formation of a number of tropical cyclones and depressions including Montha (25th to 30th October 2025) fig. 32, and Ditwah (26th to 03rd December 2025) fig.31, was forecasted by IMD which were monitored with INSAT 3DR and 3DS.

Advanced Dvorak Technique (ADT) software customized for INSAT-3DS was implemented to determine the intensity of Tropical Cyclones. During extreme weather events, INSAT 3DS & 3DR imager was used for Cyclone Monitoring. Sector specific imagery generated during the course of cyclone enabled close watch over the cyclonic stages achieved staggered configuration of the satellites. The imageries during cyclonic events are being disseminated through dedicated web page (http://satmet.imd.gov.in/rapid/rapid_scan.htm).

TABLE 4

INSAT-3DR Total Number of Rapid Scans during cyclonic storms

S.No.	Name ofcyclone	Duration	Total Numberof Rapid Scans
1.	SCS – Detwah	26th Nov to 03th December 2025	572
2.	SCS – Montha	25th to 30th Oct 2025	508

4.5.2.5 Cyclone Detwah Imagery (26th November to 03rd December 2025)

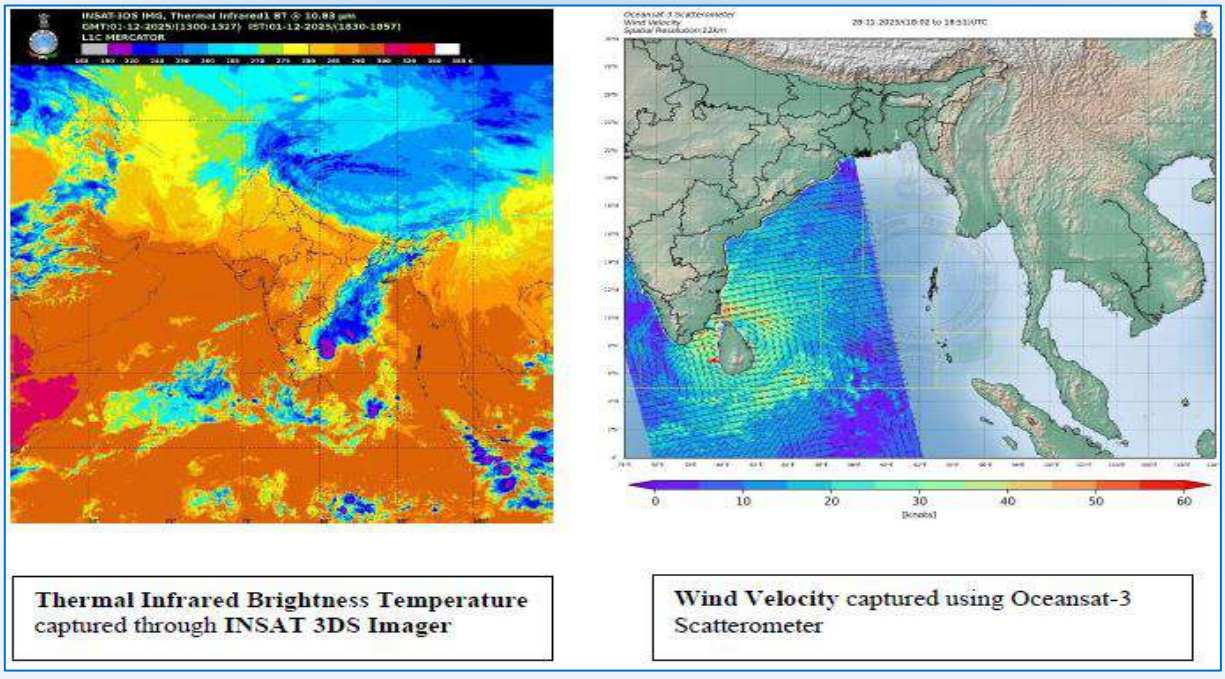


Fig. 31. Cyclone Detwah Imagery (26th to 03rd December 2025)

4.5.2.6 Cyclone Montha Imagery (25th to 30th October 2025)

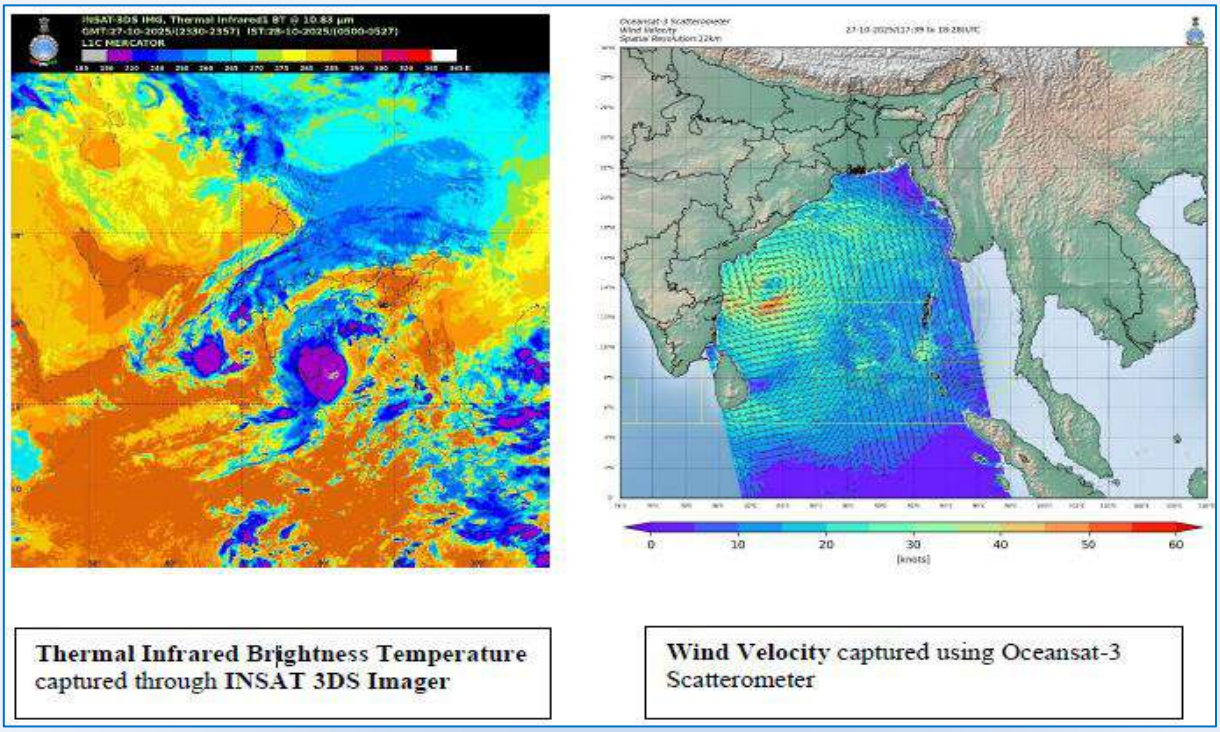


Fig. 32. Cyclone Montha Imagery (25th to 30th October 2025)

4.6. FDP STORM Report – 2024

The STORM program was conceived as a multidisciplinary nationally coordinated research and development programme and has been carried out as a multi-year observational-cum modelling campaign with an objective to build appropriate operational early warning systems for highly damaging severe thunderstorms over various parts of India. In order to develop methods for improving the accuracy of nowcasting of Severe Thunderstorms, Hailstorms, Squalls & other associated phenomenon, India Meteorological Department conducts field experiments over entire country under STORM Forecast Demonstration Project (FDP STORM) during March to June every year. The programme was run as SAARC STORM project prior to 2017.

At the end of every FDP programme, an Annual STORM Report is compiled and published. It contains region wise detailed analysis of observed significant weather events, case studies, verification of Intensive Observation Periods (IOPs) issued during the FDP, as well as verification of 3 hourly Nowcasts issued round the clock throughout the season.

This year also STORM Fields Experiments covered the whole India. The monitoring period was uniform for entire country from 1 March to 30 June, 2025.

Under this project, FDP Bulletins were issued on daily basis with updated one in the evening, if required. The FDP Bulletin consists of four sections:

(i) Current Synoptic situations and satellite current & past 24 hrs observations over India,

(ii) NWP model Guidance from IMD GFS, IMD WRF EWRF, HRRR and NCUM (NCMRWF) Models,

(iii) Radar & Realized Thunderstorm reports of the past 24 hours and

(iv) Intensive Observation Period (IOP) for thunderstorm and rainfall occurrence during next 24 hrs and 24-48 hrs for the meteorological subdivision and summary of the weather of the day.

A total of 122 FDP Bulletins were issued during the STORM Period-2025.

4.6.1. Nowcast Guidance Bulletins

In addition to FDP Bulletins during March to June - 2025, Nowcast Guidance Bulletins containing current Synoptic features and depicting potential areas for Severe Weather (Heavy Rainfall/ Thunderstorm & Associated Phenomenon/Fog) for next 24hours, in text as well as visual form based on 0830 IST observations were issued once a day (updated in the afternoon if needed) throughout the year. These bulletins provide significant guidance to the forecasters working at different RMCs/MCs, in keeping a watch over their areas of responsibility as mentioned in the Guidance Bulletins & issue Nowcast Bulletins accordingly.

4.6.2. Location Specific three hourly Thunderstorm (TS) Nowcast

Nowcasting of Severe Weather (thunderstorms, squalls and hailstorms, heavy rainfall etc.) has benefited from the recent improvement in monitoring & forecasting due to introduction of (i) digital and image information at 10 mins interval from a network of 45 Doppler Weather Radars, (ii) half hourly satellite observations from RAPID Satellite imagery, (iii) dense automatic weather station (AWS) network (iv) better analysis tools in synergy system at forecaster's workstation, (v) Ground based lightning network (vi) availability of mesoscale models and (vii) computational & communication capabilities.

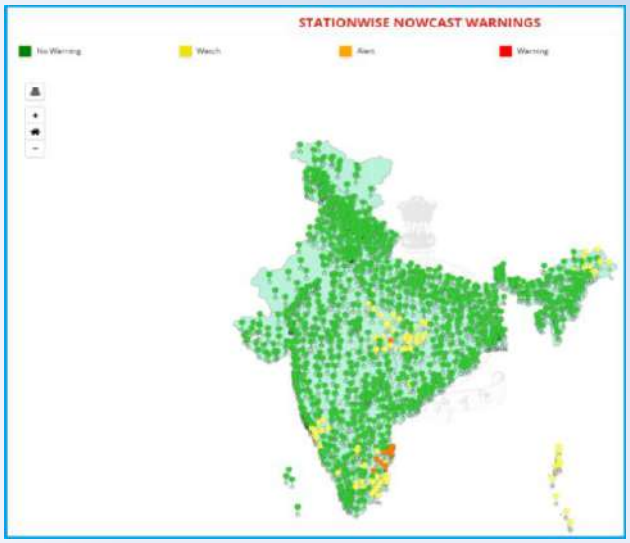


Fig. 33(a).Stationwise Nowcast Warning Page on IMD website Link: https://mausam.imd.gov.in/responsive/stationWiseNowcast.php

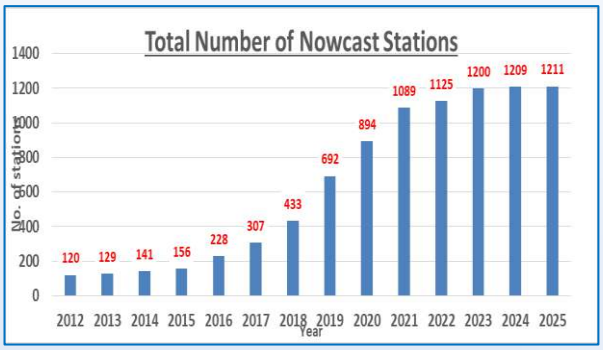


Fig. 33(b). Year-wise cumulative number of stations for three hourly thunderstorm Nowcast

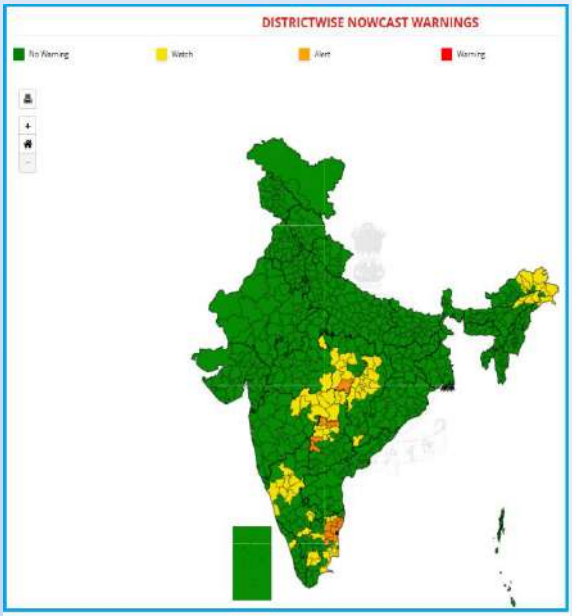


Fig. 33(c).Districtwise Nowcast Warning Web Page on IMD website Link: https://mausam.imd.gov.in/responsive/districtWiseNowcast.php

Thunderstorm nowcast of major towns is uploaded every3 hourly interval utilizing Synoptic Data, Model outputs, Satellite products and finally various Radar outputs by the respective RMCs/MCs/ RWFCs under whose jurisdiction these stations are situated. During the year-2025, 2 new stations were added on All India Nowcast Warning page of IMD website for issuing three hourly thunderstorm nowcast, thereby, increasing the total number of nowcast stations to 1211 (till December, 2025) under 25 Nowcast Centers (RMC/RWFC/MC/CWC). Fig. 33(a) depicts the screen shot of Nowcast Warning Page on IMD website and Fig. 33(b) indicates the year-wise cumulative number of stations added on Nowcast Warning page for three hourly thunderstorm Nowcast. Recently, IMD has started implementing nowcast warning over each and every location of the country based on GIS based polygon mapping system.

i	No weather
ii.	Light rain: < 5 mm/hr
iii.	Light snow < 5cm/hr
iv.	Light Thunderstorms with maximum surface wind speed upto 40 kmph
v.	Slight dust storm: If the wind speed is up to 40 kmph and visibility is less than 1,000 metres but more than 500 meters due to dust
vi	Low cloud to ground Lightning probability (< 30% probability of lightning occurrence)
vii.	Moderate rain: 5-15 mm/hr
viii.	Moderate snow: 5-15 cm/hr
ix.	Moderate Thunderstorms with maximum surface wind speed between 41 – 61 kmph (In gusts).
x.	Moderate dust storm: If the wind speed is between 41- 61 kmph and visibility is between 200 and 500 metres due to dust
xi.	Moderate cloud to ground Lightning probability (30 - 60% probability of lightning occurrence)
xii.	Heavy rain: >15 mm/hr
xiii.	Heavy snow: >15 cm/hr
xiv.	Severe Thunderstorms with maximum surface wind speed between 62 -87 kmph (in gusts).
xv.	Very Severe Thunderstorms with maximum surface wind speed > 87 kmph (in gusts).
xvi.	Thunderstorms with Hail
xvii.	Severe dust storm: If surface wind speed (in gusts) exceeding 61 kmph and visibility is less than 200 metres due to dust
xviii.	High cloud to ground Lightning probability (> 60% probability of lightning occurrence)
xix.	Other warnings (to be filled by the user MC)

Fig. 33(d). Different categories of Nowcast Warnings

In addition to stationwise nowcasting, district level nowcast, which was started in July, 2019 was also issued for all the 748 districts of India [Fig. 33(c)]. Considering the importance and reliability of DWR and satellite based information for nowcast of severe weather, all district headquarters/major towns/tourist places and specific locations within capital cities (under Urban Meteorology and Climate project) in India are to be included for nowcasting of severe weather.

The Stationwise and district wise nowcast is issued for about nineteen categories [Fig. 33(d)] of different kinds based on severity of weather for lightning, thunderstorms, dust storms, hail storms,squalls, rain and snow etc. This nowcast Warning page is available on new as well as old IMD websites.

A new web based Thunderstorm Decision Support System (TDSS) portal has been developed by IMD in 2024 - **'Interactive System for Nowcast Services'**[Fig. 33(e)]. All (i) observational data products including lightning data from IITM & ILDN networks, satellite & radar tools, (ii) mesoscale/

nowcast model products developed by IMD including newly developed nowcast models EWRF & HRRR, NCMRWF and (iii) climatological thermodynamic indices are integrated on this portal for monitoring of thunderstorms and associated phenomena.

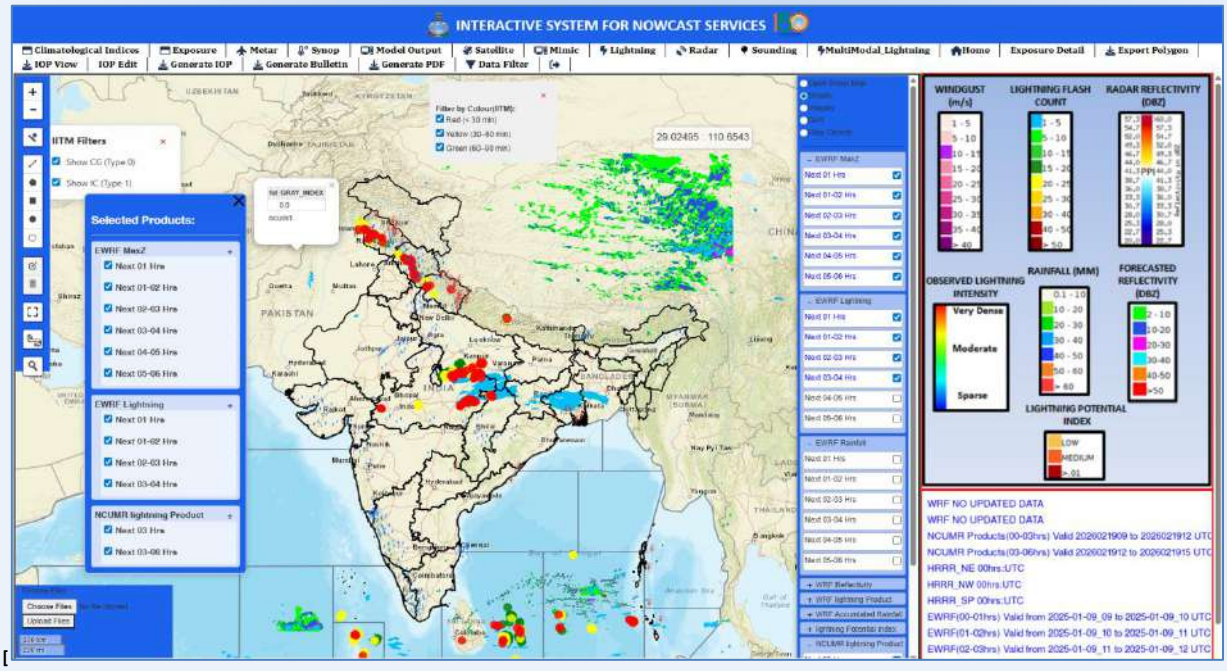


Fig. 33(e). New Portal-Interactive System for Nowcast ServicesLink:http://103.215.208.18/dwr_img/GIS/nowcast.html

This integrated system guides a forecaster /nowcaster in generating impact based colour coded nowcast warnings in an effective way as well as their dissemination to various users and updating on IMD's Nowcast web Page.

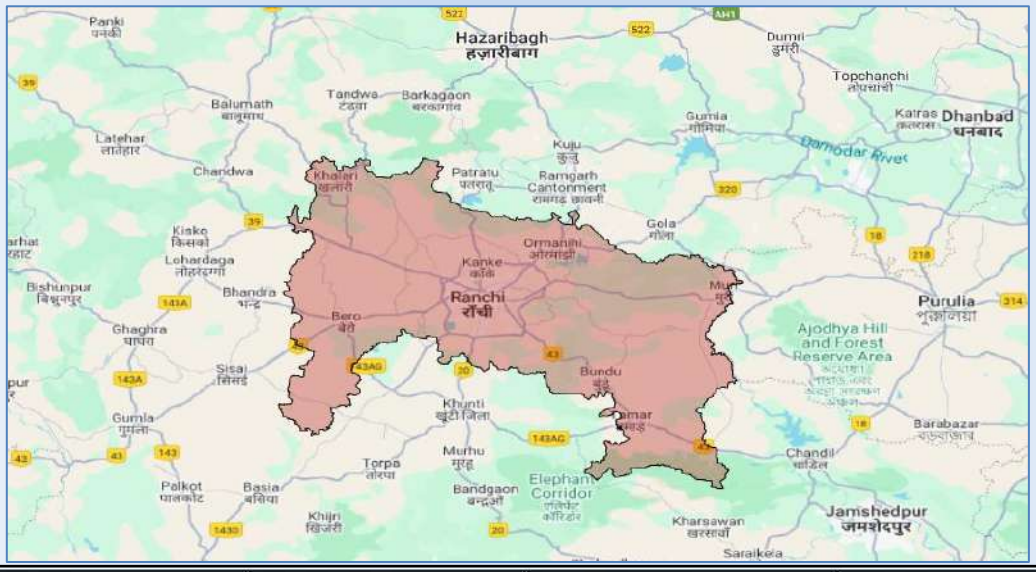
There has simultaneously been a conscious thrust from all Meteorological centres to provide impact based dissemination of warnings of thunderstorms over the Indian region in line with the forecast Circular No. 1/2019 using Common Alert Protocol through SACHET portal [Fig. 33(f)]. Simultaneously, Automated generation of Nowcast Bulletin through the TDSS portal has allowed the penetration of IMD forecasts up to Tehsil level and more [Fig. 33(g)].

(i) FDP Bulletins

The thunderstorm forecasts issued for 24 hours during FDP STORM-2025 were verified with realized thunderstorm data. The month wise evolution of forecast skill during 2025 as indicated by the verification results for thunderstorm forecast are shown in Table 2 and graphically by Fig. 33(h). Fig 33 (h) showcase the verification statistics for 24 hour Severe Weather Advisory for thunderstorms during March to June of 2016-2025 (FDP Season).Fig. 33(i) indicates the evolution of 24 hr Thunderstorm forecast IOP skill during FDP season of 2016 to 2020 and 2021-2025 which shows a significant improvement in all the scores.

TABLE 2
Monthwise verification statistics for three hourly station Nowcasts during FDP-2025

FDPSeason(MarchtoJune)MonthwiseStationNowcastVerification Scores-Countryasawhole					
	RatioScore	POD	FAR	CSI	ETS
March	0.99	0.95	0.35	0.63	0.62
April	0.97	0.93	0.31	0.65	0.63
May	0.94	0.91	0.29	0.66	0.61
June	0.96	0.93	0.21	0.75	0.72
FDP Season	**0.96**	**0.92**	**0.27**	**0.68**	**0.66**



Generated by:	IMD Ranchi	**Entry Date & Time:**	05 Aug 2025, 3:29 PM
Effective Date & Time:	05 Aug 2025, 3:29 PM	**Expiry Date & Time:**	05 Aug 2025, 6:29 PM
Area Description:	Ranchi district of Jharkhand	**Area covered:**	5998.894 Sq. Km (approx.)
Additional Warning Details:	VIEW		
Event Description:	Thunderstorm with Lightning	**Urgency:**	Expected
Severity:	ALERT	**Certainty:**	Very Likely
Message Body:	*Message in English:*	Thunderstorm with Lightning is very likely to occur at a few place s over Ranchi in next 3 hours.	
	Message in Hindi:	अगले 3 घंटों में रांची में कुछ स्थानों पर गरज के साथ बारिश होने की संभावना है। सावधान एवं सतर्क रहें।वज्रपात के दौरान पेड़ के नीचे न रहे।आपदा प्रबंध न प्रभाग रांची झारखंड।	

Fig. 33(f). Common Alert Protocol based warning issued through SACHET portal

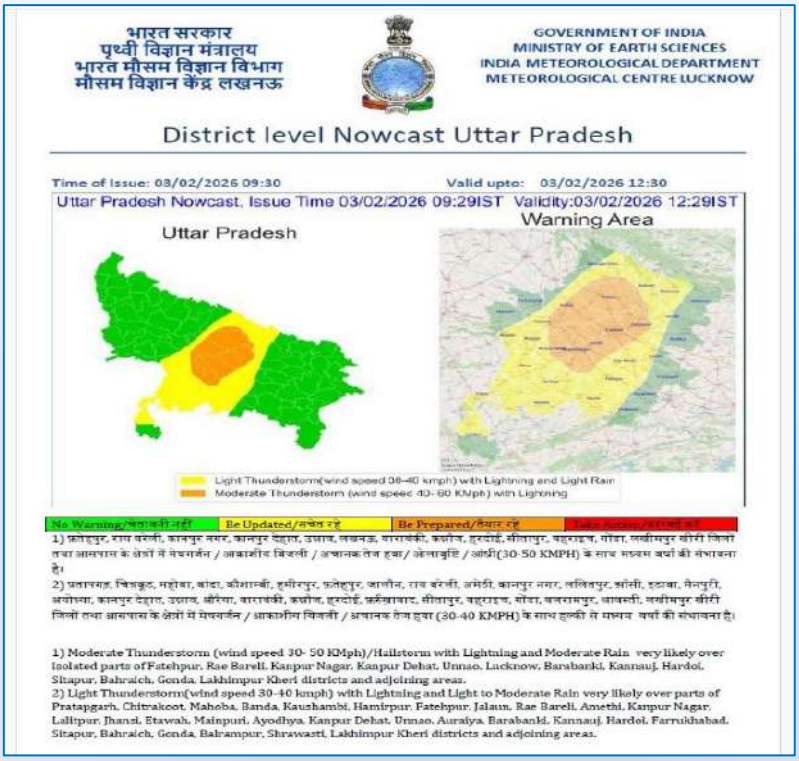


Fig. 33(g). Automatic Nowcast Bulletin generated and issued through TDSS portal

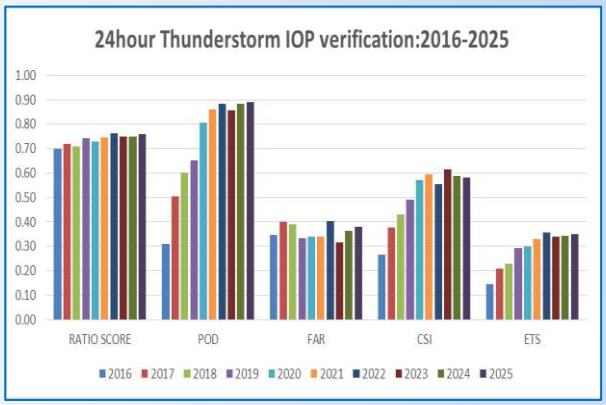


Fig. 33(h). Verification statistics for 24 hour Severe Weather Advisory for thunderstorms during March to June of 2016-2025 (FDP Season)

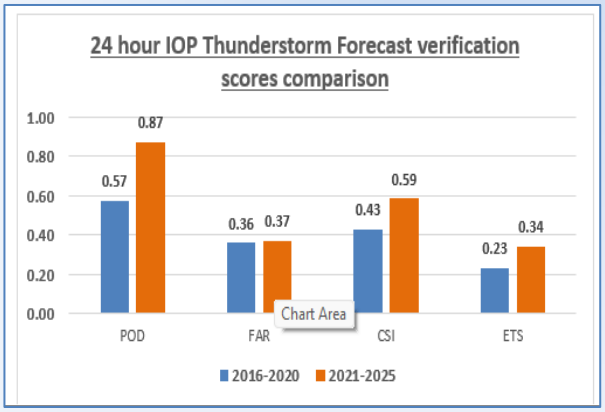


Fig. 33(i). Verification statistics for 24-hour Thunderstorm Forecast for 2016-2020 and 2021-during March to June (FDP Season) of 2021-2025

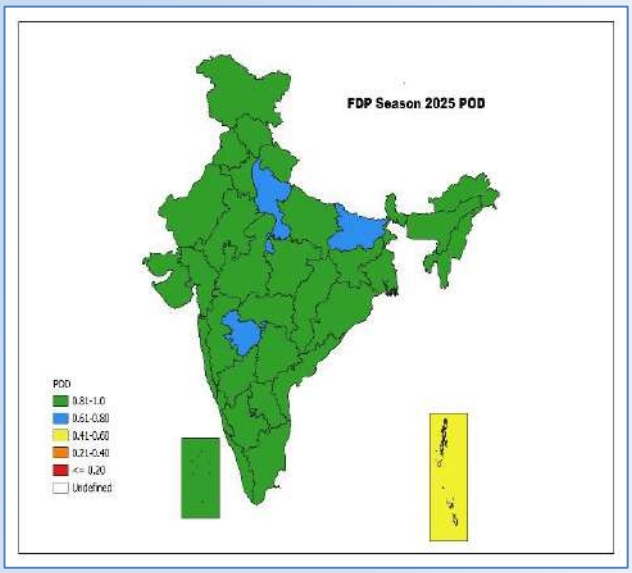


Fig. 33(j). 24 hour thunderstorm forecast verificationresult for the entire FDP season of 2024 – POD score

Figs. 33(j-m) display statewise POD, FAR, CSI and ETS scores of 24 hour IOP of Thunderstorm forecasts. As may be noted, forecastskills are comparatively poorer for the peninsular India and North East Indian Hilly regions.

Fig. 33 (n) indicates the all India POD, FAR, CSI and ETS scores of three hourly TS Nowcasts issued by various RMCs/MCs during FDP STORM (March to June) for the year-2013 to 2025.

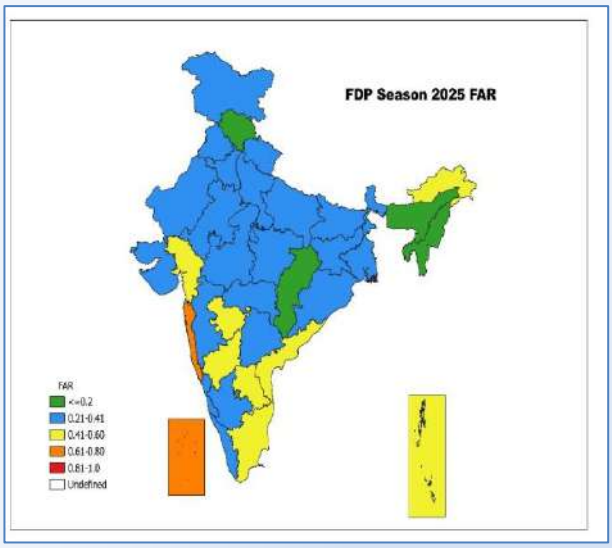
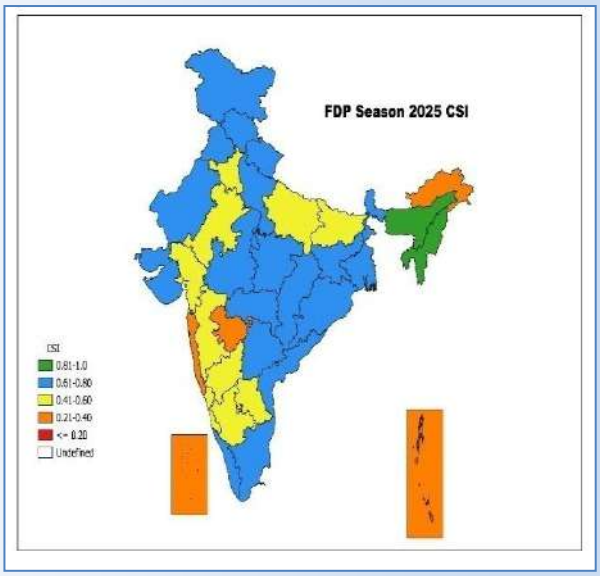


Fig. 33(k). 24 hour thunderstorm forecast verification result for the entire FDP season of 2024 – FAR score



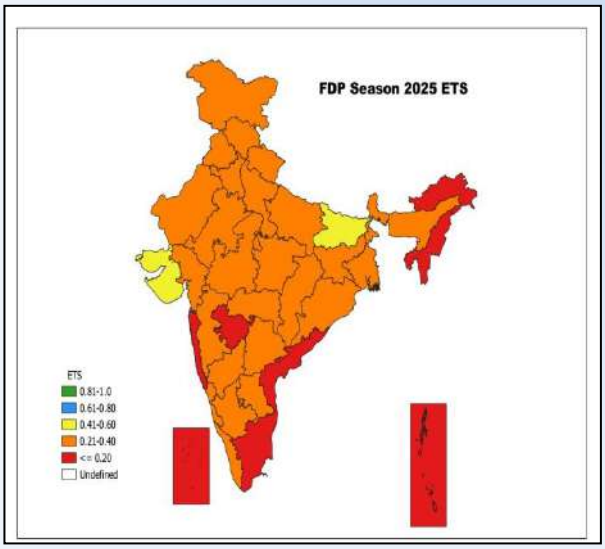


Fig. 33(l). 24 hour thunderstorm forecast verification result for the entire FDP season of 2024 – CSI score

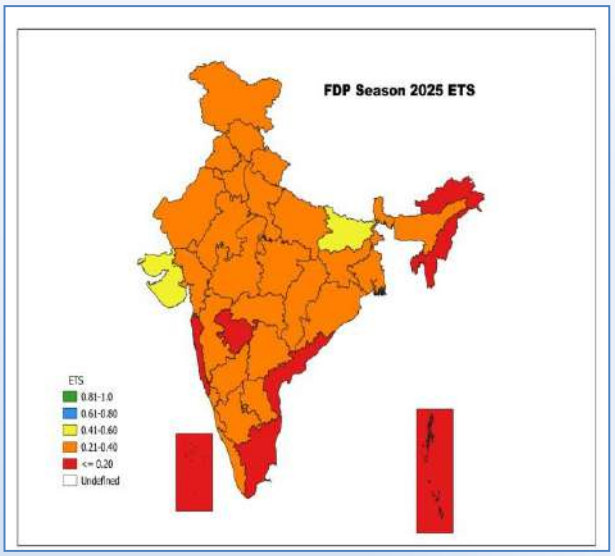


Fig. 33(m). 24 hour thunderstorm forecast verification result for the entire FDP season of 2024 – ETS score

4.6.3. Nowcast Performance during FDP Season 2025

Figs. 33(o to r) display the statewise POD, FAR, CSI and ETS scores of 3 hour Thunderstorm nowcasts.
A detailed STORM Report document, based on thunderstorm activities observed over India during March to June-2025, was prepared by Nowcast Division, NWFC. It contains information on daily weather situation, important weather charts, severe weather events all through the campaign period, case studies and the bulletins issued during the period. Figs. 33(s-y) represent some of the salient features of the FDP STORM Report-2025.

IMD operationally issues district level nowcasts for severe weather for all districts of India round

theclock at three hourly intervals since 2018. The phenomena for which nowcasts are issued include: (a) Thunderstorms and associated weather and (b) rainfall. All these nowcasts are updated every threehours on the IMD website (https://mausam.imd.gov.in/imd_latest/contents/districtwisewarnings.php). The data from the ground-based lightning location network of the Indian Institute of Tropical Meteorology and Indian Air Forcehas been used for verification of the District level Nowcasts. This network currently has 118 sensorsand provides spatial accuracy of about 500 m. The point data for lightning with lat-long coordinatesis provided from the network in near realtime mode to IMD at 15 minute intervals for operational use.

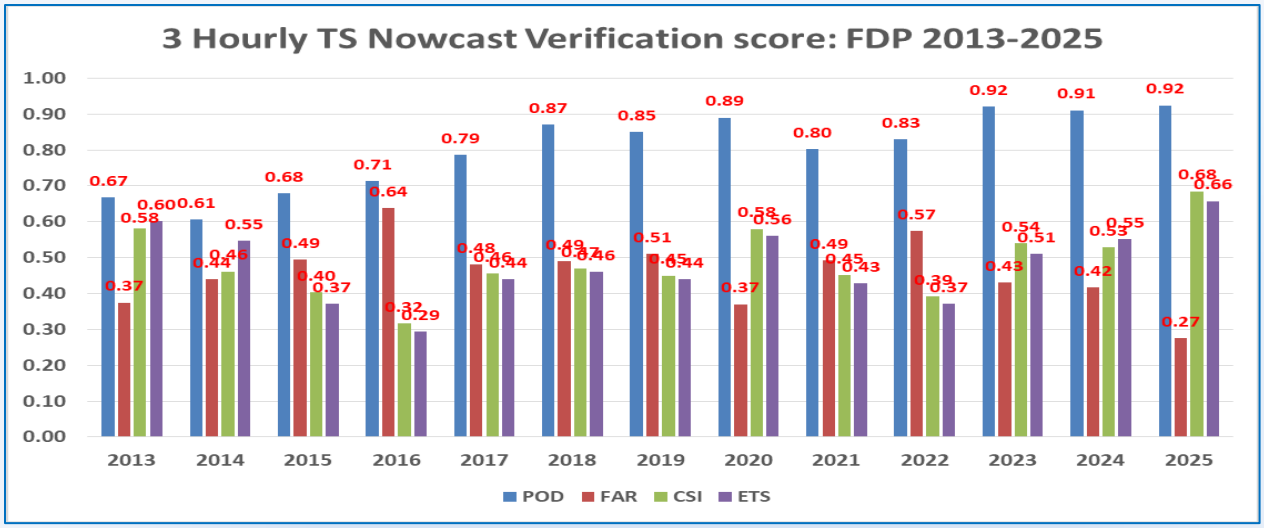


Fig. 33(n). Three hourly thunderstorm nowcast verification result for the entire FDP season of 2016-2024

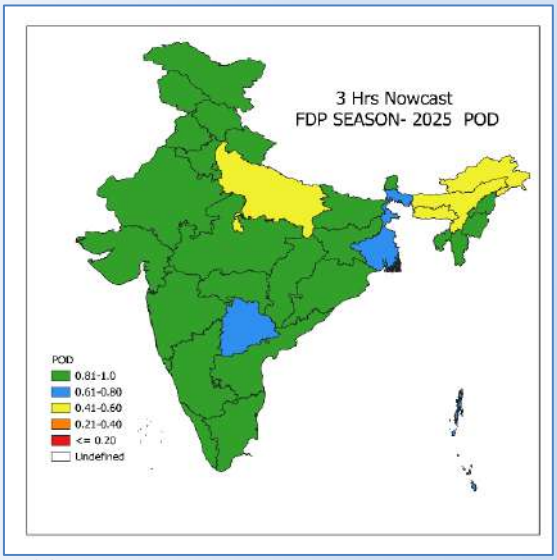


Fig. 33(o). 3 hour thunderstorm forecast verification result forthe FDPseason of 2025 – POD score

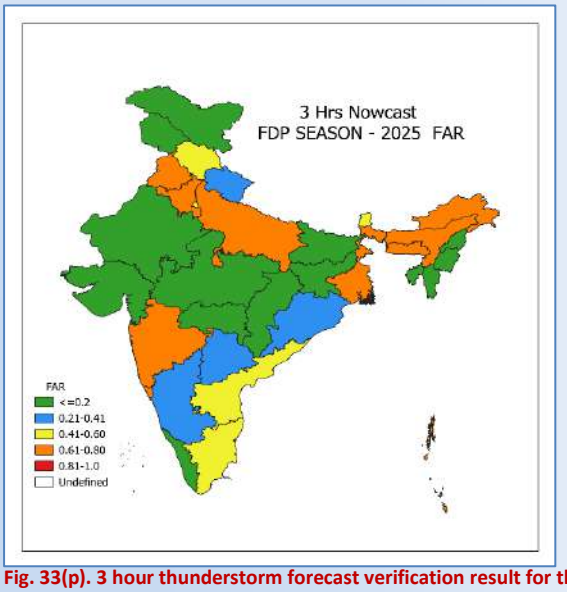


Fig. 33(p). 3 hour thunderstorm forecast verification result for the FDP season of 2025 – FAR score
– POD score

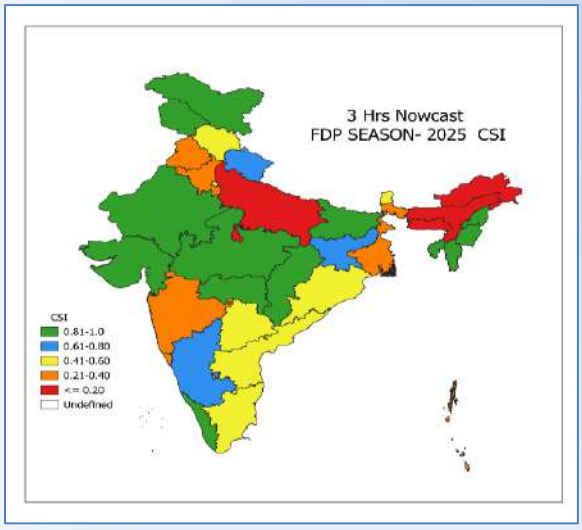


Fig. 33(q). 3 hour thunderstorm nowcast verification result for the FDPseason of 2025– CSI score
– FAR score
– POD score

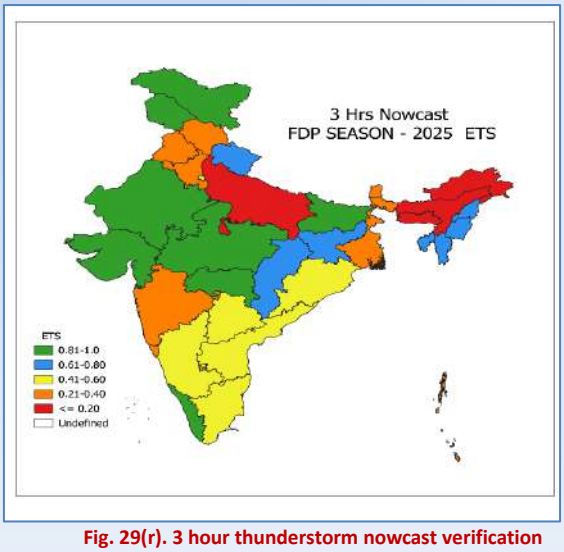


Fig. 29(r). 3 hour thunderstorm nowcast verification result for the FDP season of 2024 – ETS score
– ETS score
– FAR score

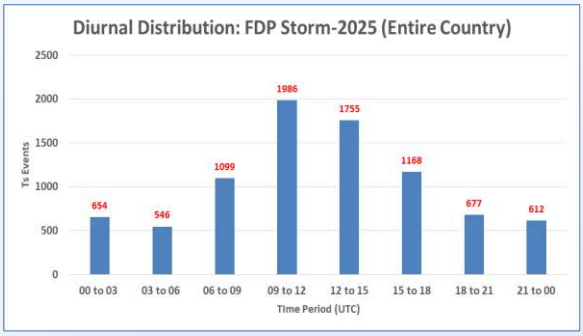


Fig. 33(s). Diurnal distribution of TS events over the country during FDP STORM-2025 CSI score

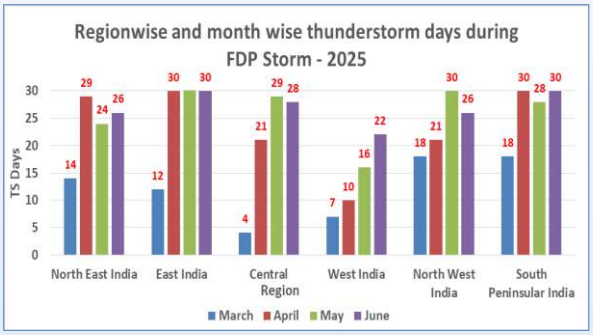


Fig. 33(t). Monthwise distribution of TS days over different regions of India during FDP STORM-2025

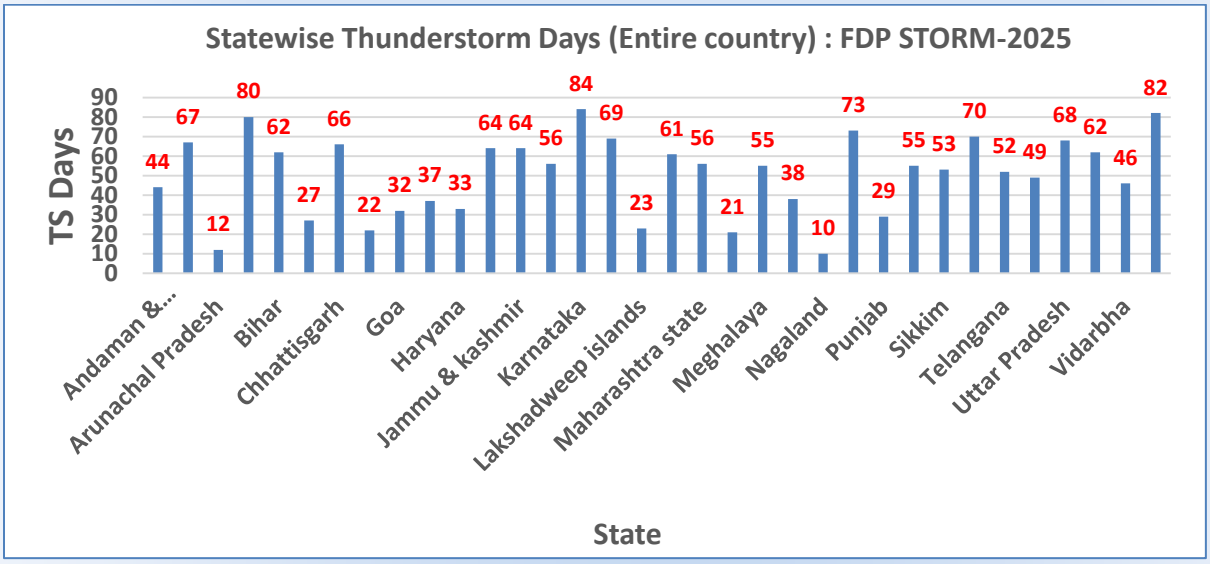


Fig. 33(u). State wise distribution of thunderstorm days over the country during FDP STORM-2025

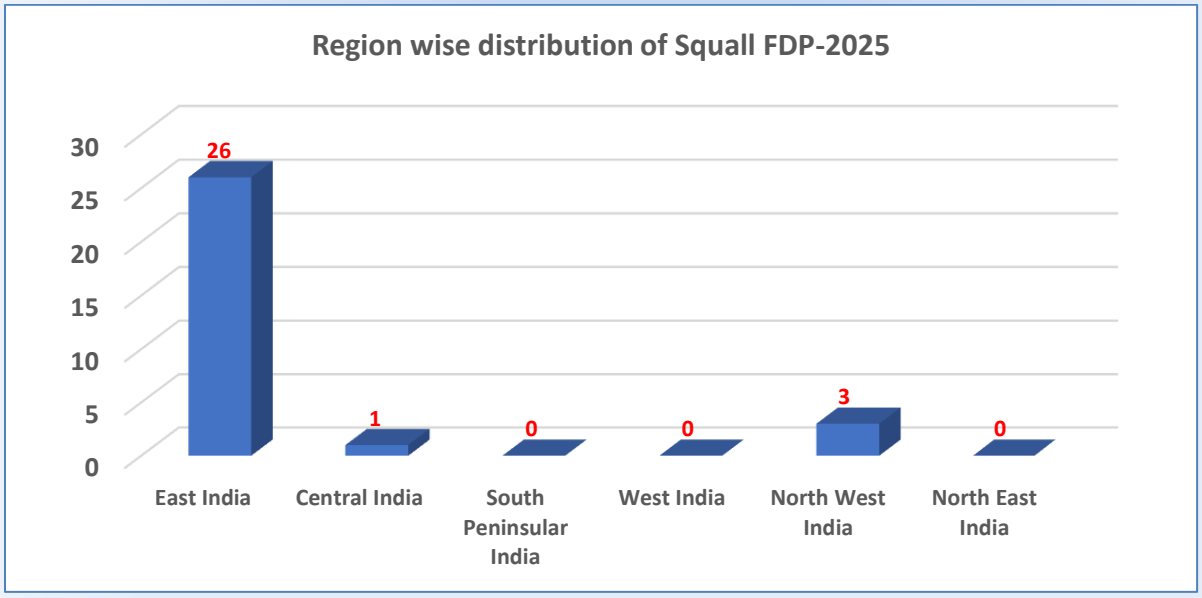


Fig. 33(v). Regionwise Distribution of squall events over the country during entire FDP STORM-2025

4.6.4. New Initiatives undertaken by Nowcast Unit

(i) Automation of district nowcast verification

The point data is geolocated up to the district level using open source "Nominatim Server"software. For verification purposes, a yes-no criterion (2x2 configuration table) is applied foroccurrence-non-occurrence of thunderstorms in each district. All the eleven categories of nowcastsfor thunderstorms and associated weather are considered for verification. A minimum of 2 (two) incidences of lightning occurrence in a district within the validity period of a nowcast is considered occurrence of thunderstorm over that district.

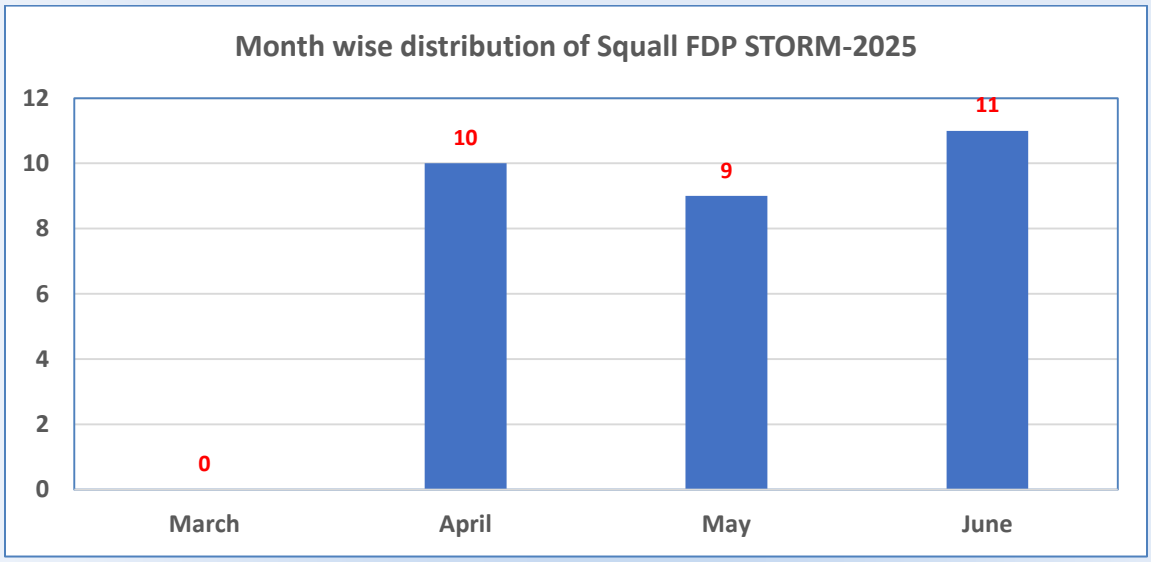


Fig. 33(w). Monthwise distribution of thundersqualls during FDP STORM-2025

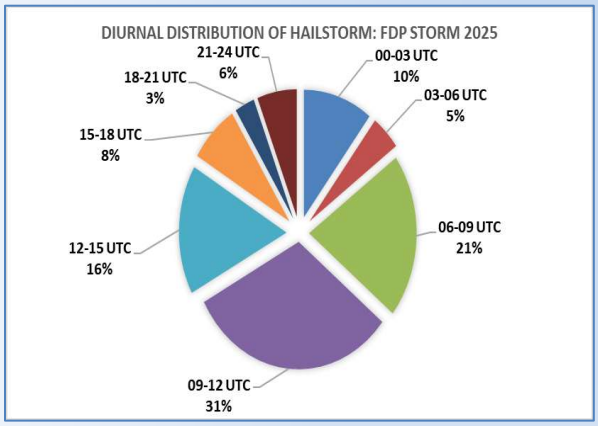


Fig. 33(x). Diurnal distribution of hailstorm events over the country during entire FDP STORM-2025

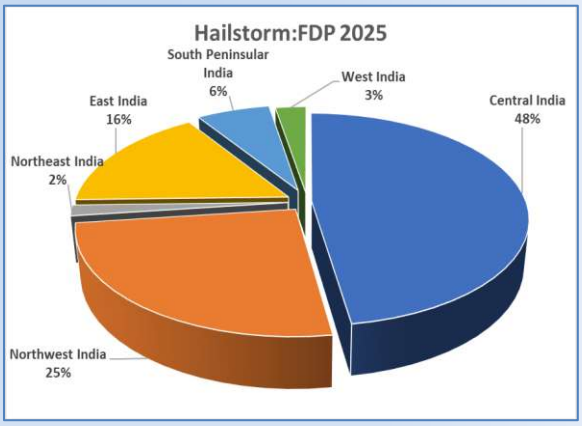


Fig. 33(y). Regionwise distribution of hailstorm events during FDP STORM-2025

The two flashes may occur concurrently or subsequently in time in any part of the district within a period of three hours, i.e., during the validitytime of the nowcast for the district.

Based on both observation and nowcast for thunderstorms (anyone of the eleven categories), the forecast skill scores have been calculated. Figs. 34(y-z, aa-ab) represent the district wise POD, FAR, CST and ETS scores of

3hourly districts nowcast verification forthe month of June2025.

(ii) Crowdsourcing

The term "crowdsourcing" was first coined in 2006 by American journalist Jeff Howe who defined itas "the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and general large) network of people in the form of an open call.

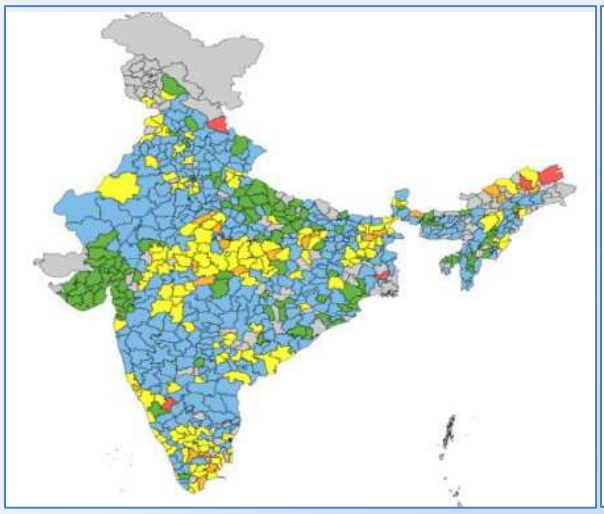


Fig. 34(y). Districtwise POD of 3 hourly district nowcast automatic verification for June 2025

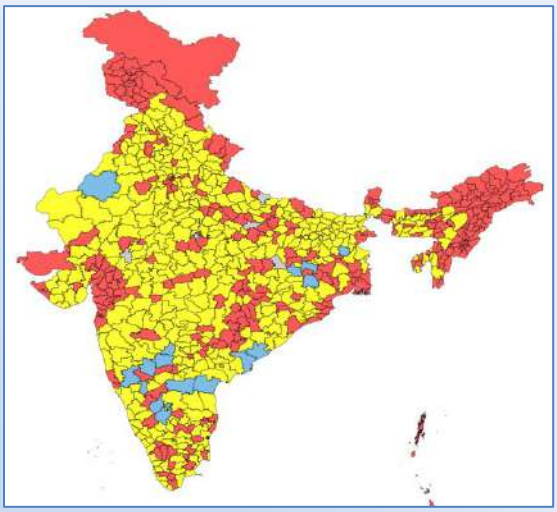


Fig. 34(z). Districtwise FAR of 3 hourly district nowcast automatic verification for June 2025

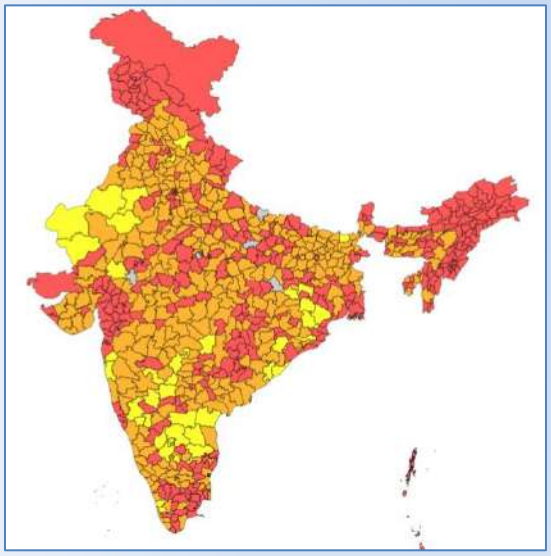


Fig. 34(aa). Districtwise CSI of 3 hourly district nowcast automatic verification for June 2025

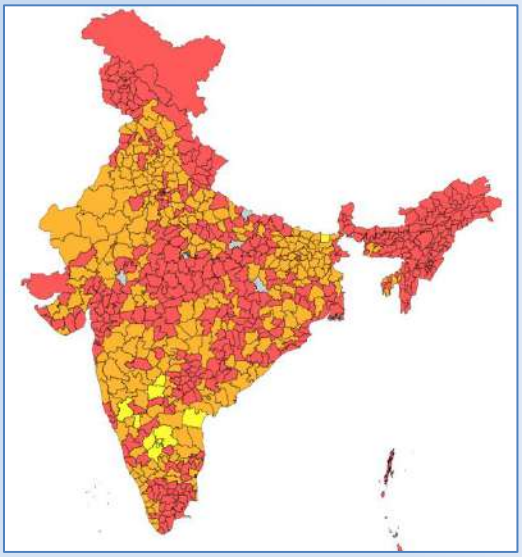


Fig. 34(ab). Districtwise ETS of 3 hourly district nowcast automatic verification for June 2025

In recent years, with the improved understanding of the mesoscale nature of weather systems over Indian region, the constraints of the existing observatory network are sought to be supplemented byother sources of observations. This requirement has been

partly met by remote sensed observationsof weather by radar and satellite based

instruments and the lightning detection network. However,in the absence of validation with ground data, the limitations of each instrument hamper theprocess of forming a clear picture of the weather occurred and its intensity and impact. The lack ofclarity in observations causes uncertainty in forecasts of subsequent weather and its associatedimpact. With the widespread availability of smart phones, information regarding the state of theatmosphere can now be obtained from many non-traditional sources in text, audio and video formfrom sources such as citizen Further, the interface has following features: (i) The reporting interface is without login requirement.(ii) The time of submission will be automatically recorded. (iii) The user machine address and time isautomatically recorded. (iv) scientists, amateur weather stations and sensors, smart devices andsocial-media/web 2.0.

Since 2021, IMD has started an online interface [Figs. 34(ac)] to collect the information of the weatherthat has occurred as well as the associated impact information for six weather events initially, viz.,Rain. Hail, Duststorm, Wind Speed, Thunderstorm/Lightning & Fog. The target weather reportersare (a) Class II, Class III observatories (any observatory not covered under MMR) (b) AMFU, KVKobservatories (c) Railways Station Masters (d) Power discom maintenance staff & (e) General Public.

The user has the facility to record the Location, State, District ofobservation. There is also the facility to add photo or video proof of the event.

Fig. 34(ac). Crowd sourcing weather reporting Interface
Link: https://city.imd.gov.in/citywx/crowd/enter_th_datag.php

CHAPTER 5

WEATHER AND CLIMATE SERVICES OF IMD

5.1. Hydromet Services

5.1.1. Mandate of Hydromet Division

Hydro-meteorological Division is established to fulfill the following mandates with various services being provided to support all stakeholders, Central/State Govt. organizations and other agencies in sector specific applications (Fig. 1).

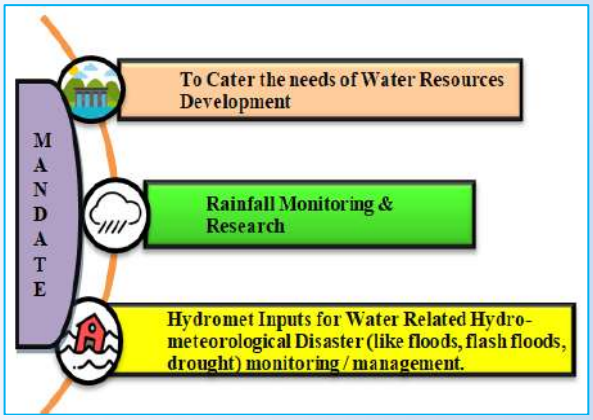


Fig. 1. Mandate of Hydromet Division

5.1.2. Overview of Hydro-meteorological Services of IMD (Fig. 2)

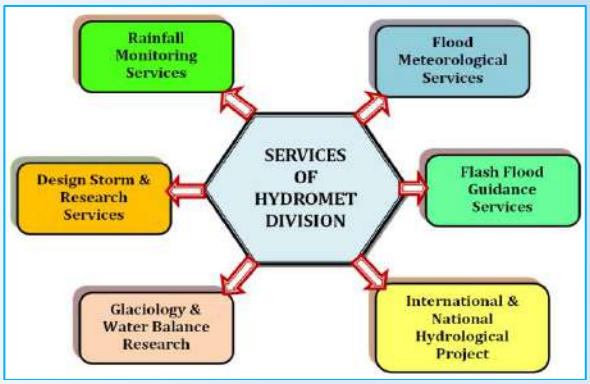


Fig. 2. Services of Hydromet Division

5.1.3. Hydro-meteorological Services of IMD

5.1.3.1. Flood Meteorological Services

The sub-basin wise Quantitative Precipitation Forecasts (QPFs) were issued (daily on operational basis) by 16 FMOs namely Agra, New Delhi, Asansol, Ahmedabad, Bhubaneswar, Guwahati, Jalpaiguri, Hyderabad, Lucknow, Patna, DVC Met Unit Kolkata, Srinagar, Chennai, Thiruvananthapuram, Bengaluru and Shimla during the monsoon season 2025 for their area of jurisdiction from 1st June to 31st October, 2025. However, FMOs Srinagar, Guwahati and Jalpaiguri also provide QPF guidance from 1st May to 31st October 2025 and FMOs Chennai, Thiruvananthapuram and Bengaluru issued QPFs up to 31st December 2025. These operational QPF are provided to the field offices of the Central Water Commission for use in their Flood Forecast Model(Fig. 3).

River Sub-basin-wise Quantitative Precipitation Estimate for Day-1, Day-2 & Day-3 using WRF ARW (3km x 3km) & NCUM-R (4kmx4km), for Day-1 to Day-7 using GFS (12km x 12km), GFS-BC (12kmx12km) & NCUM-G (12kmx12km), River sub basin-wise 7 days Probabilistic QPF based on dynamical model GEFS & NEPS were uploaded in IMD website operationally for 162 river sub-basins(Fig.4). Besides these, Operational forecasters have used the model based QPF generated by different models in Decision Support System (DSS).

During the year 2025, a new FMO is established under MC Shimla i.e. FMO Shimla for the BBMB region with sub-basins Beas, Ranjit Sagar Dam, Upper Satluj and Lower Satluj.

During the year 2025, the number of Sub-basins were increased from 157 to 162 all over India, four sub-basins are formed under FMO Shimla and one sub-basin under FMO Bhubaneswar i.e. Brahmani is bifurcated into two sub-basins: Upper Brahmani and Lower Brahmani.

During the SW Monsoon season 2025, the accuracy within the same category of river sub-basin-wise QPF is 68% in Day-1, 63% in Day-2, 62% in Day-3, 60% in Day-4, 59% in Day-5, 59% in Day-6, and 58 % in Day-7 (Fig. 5). FMO wise performance during the year JJAS 2025 is shown in Fig.6.

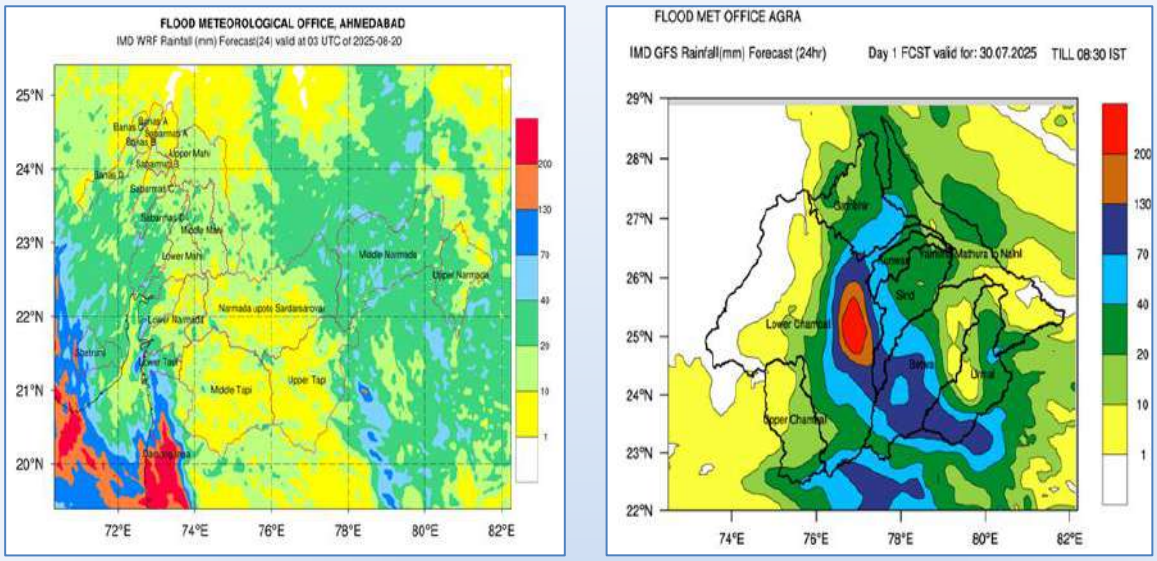
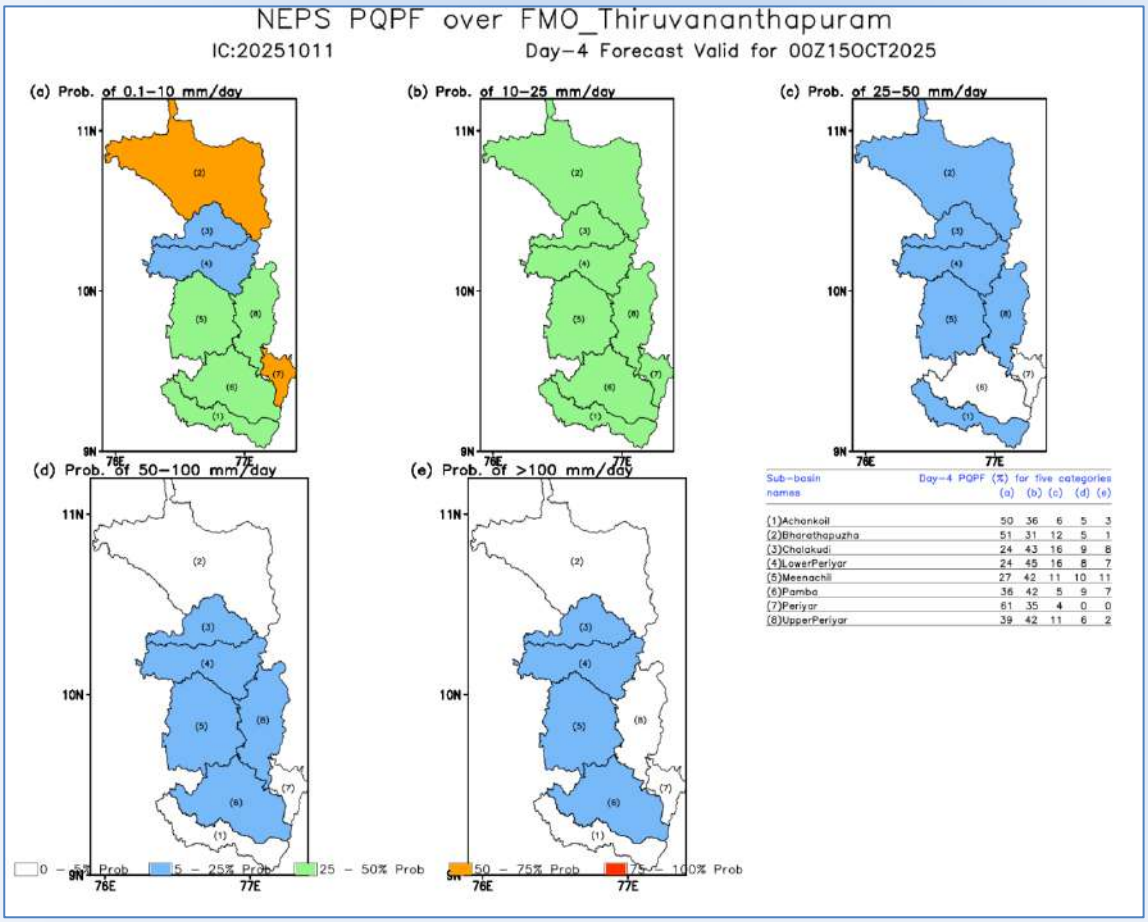


Fig. 3. Spatial distribution of rainfall along with QPF over catchments from different numerical models (WRF and GFS only shown)



Sub-basin names	Day-4 PQPF (%) for five categories (a)	(b)	(c)	(d)	(e)
(1)Achankoil	50	36	6	5	3
(2)Bharathapuzha	51	31	12	5	1
(3)Chalakudi	24	43	16	9	8
(4)LowerPeriyar	24	45	16	8	7
(5)Meenachil	27	42	11	10	11
(6)Pamba	36	42	5	9	7
(7)Periyar	61	35	4	0	0
(8)UpperPeriyar	39	42	11	6	2

Fig. 4. Probabilistic forecast for QPF from NEPS

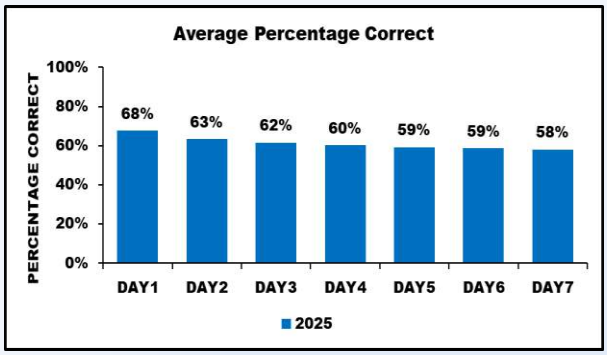


Fig. 5. Average Percentage correct during JJAS 2025 from Day-1 to Day-7

Issuing joint advisories on Flood Status of the country by IMD, CWC and NDRF as suggested by MHA(Fig.7).

Daily monitoring of river sub-basin-wise Severe Flood Situation &high QPF (26-50 mm and above) is provided to Central Agencies (Fig. 8).

River basin Rainfall Map of all sub-basins depicting realised actual rainfall, normal rainfall and corresponding percentage departure from normal,

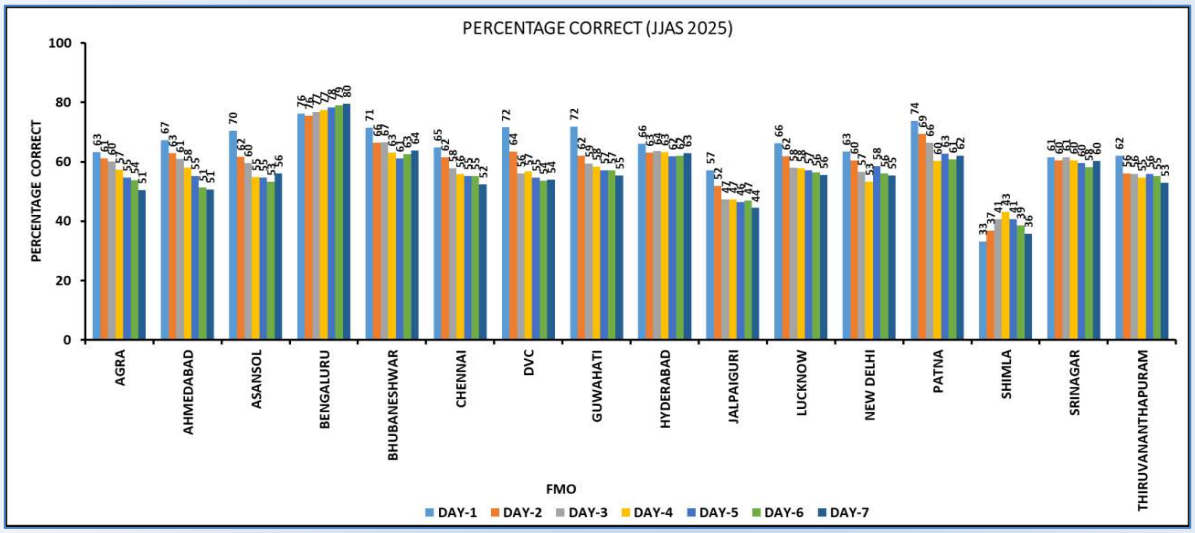


Fig.6. FMO wise performance during the year JJAS 2025

Ministry of Home Affairs

Flood Situation in sub-basins

Date: 10.08.2025

Sl.No.	River/Sub-Basin/Basin	State	Site/District	Rainfall Situation					Remarks/Advisories
				Day 1	Day 2	Day3	Day4	Day5	
1.	Ganga/ Gandak & Others /Ganga	Bihar	Ekchari/Bhagalpur						• Bihar: 10 teams of NDRF available i.e. Supaul-1, Patna- 1, Darbhanga- 01, Nalanda-02, Bhagalpur- 4 & East Champapran-01 and reserve teams are available at BHQ at Patna.
2.	Ganga/Above Ramganga Confluence/Ganga	Uttar Pradesh	Kachhla Bridge/Budaun						• Uttar Pradesh: 15 teams of NDRF available i.e. Varanasi- 3, Lucknow-2, Bareilly- 1, Gorakhpur- 1, Lakhimpur-1, Bijnor-1, Prayagraj- 1, Bahraich- 1, Ballia- 1, Gautam Buddha Nagar- 1, Buland Shahr- 1 Farrukhabad- 1 and reserve teams are available at BHQ at Ghaziabad and Varanasi.
3.	Ichamati/ Bhagirathi and Others/Ganga Basin	West Bengal	Bajitpur/North24 Parganas						• West Bengal: 11 teams of NDRF available i.e. Kolkata -1, Siliguri -1, Alipurduar -1 North 24 Pargana -1, South 24 Pargana -1, East Medinipur -1, Malda -1, Hooghly-2, West Medinipur -1 & Jalpaiguri -1 and reserve teams are available at BHQ at Nadiya.
4.	Ichamati/Bhagirathi and Others/Ganga Basin	West Bengal	Kuthibari/North 24 Parganas						
5.	Desang/Upper Brahmaputra/ Brahmaputra Basin	Assam	Nanglamoraghat/ Sivsagar						• Assam: i. First meeting on flood preparedness was Conducted on 05.03.2025 (through VC) Review meeting on 06.05.2025 & 17.05.2025 (through VC). ii. 11 teams of NDRF available i.e. Cachar -2, Jorhat-1, Bongaigaon-1, Barpeta-1, Guwahati-1, Sonitpur-1, Dibrugarh-2, Shiv sagar-1, Dhemaji-1 and reserve teams are available at BHQ at Guwahati.
6.	Buridehing/Upper Brahmaputra/ Brahmaputra Basin	Assam	Margherita/ Tinsukia						

Fig.7.: Advisory on flood situation

भारत सरकार
भारतमौसमविज्ञानविभाग
पृथ्वी विज्ञान मंत्रालय
जल मौसम विज्ञान प्रभाग
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GOVERNMENT OF INDIA
INDIA METEOROLOGICAL
DEPARTMENT(*Ministry of Earth Sciences*)
Hydromet Division
New Delhi
Phone : 011-24344559/4558
Email :dgmfmu@gmail.com

Dated: 28/09/2025

Sub-basin-wise Real Time Monitoring of Flood Situation and Quantitative Precipitation forecast (QPF) by IMD

Flood Monitoring Offices				Flood Level (CWC)		Quantitative Precipitation Forecast (QPF)																				
						Day-1 (28/09/25)*			Day-2 (29/09/25)*			Day-3 (30/09/25)*			Day-4 (01/10/25)*			Day-5 (02/10/25)*			Day-6 (03/10/25)*			Day-7 (04/10/25)*		
SNo	FMO	Basin	Sub-Basin	Severe Flood	Extreme Flood	26-50mm	51-100mm	>100mm	26-50mm	51-100mm	>100mm	26-50mm	51-100mm	>100mm	26-50mm	51-100mm	>100mm	26-50mm	51-100mm	>100mm	26-50mm	51-100mm	>100mm	26-50mm	51-100mm	>100mm
1	FMO Ahmedabad	SHETRUNJI	Shetrunji				✓		✓																	
2	FMO Ahmedabad	Damanganga	Damanganga					✓	✓																	
3	FMO Ahmedabad	Narmada	Narmada Hoshangabad to Sardar Sarovar			✓																				
4	FMO Ahmedabad	Narmada	Lower Narmada			✓																				
5	FMO Ahmedabad	Tapi	Middle Tapi				✓																			
6	FMO Ahmedabad	Tapi	Lower Tapi				✓																			
7	FMO Asansol	Ajoy	Ajoy																		✓					
8	FMO Asansol	Kangsabati	Kangsabati															✓			✓					
9	FMO Asansol	Mayurakshi	Mayurakshi																		✓					
10	FMO Bengaluru	Krishna	Upper Bhima			✓																				
11	FMO Bengaluru	Krishna	Lower Bhima	✓																						
12	FMO DVC	Damodar	Damodar East																		✓					
13	FMO DVC	Lower Valley	Lower Valley West																		✓					
14	FMO DVC	Lower Valley	Lower Valley South															✓								

Highest Flood Level = HFL
Severe Flood : when the river water level is at or above Danger Level and below HFL.
Extreme Flood : when the river water level is at or above HFL
* Forecast and Warning for any day is valid from 0830 hours IST of day till 0830 hours IST of next day.

Fig. 8.: Subbasin-wise real-time monitoring of flood situation and QPF issued.

is prepared daily, weekly and cumulative and is uploaded on the IMD website daily during JJAS 2025(Fig. 9).

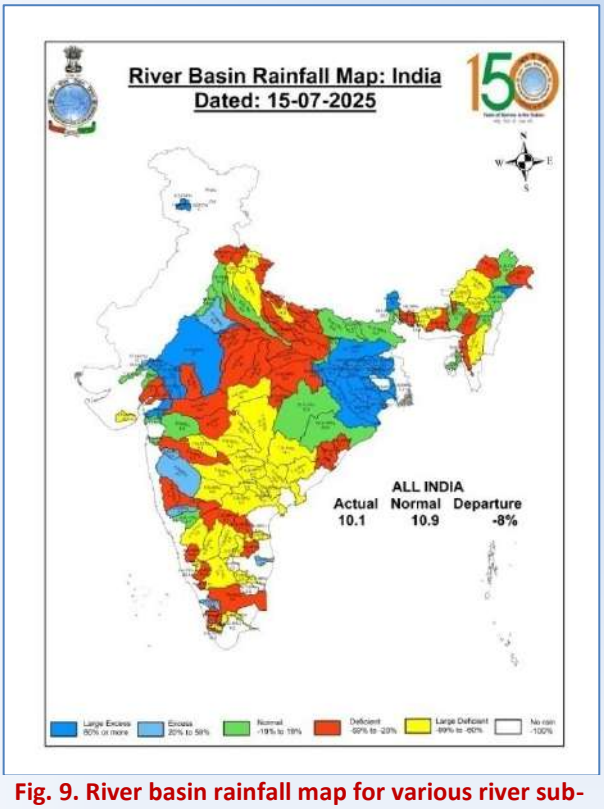


Fig. 9. River basin rainfall map for various river sub-basins (15th July 2025).

5.1.3.2 .Design Storm Unit / Storm Analysis Unit

Design Storm Studies are being conducted to evaluate design storm estimates (rainfall magnitude and time distribution) for various river catchments/ projects in the country, for use as main input for design engineers in estimating design flood for hydraulic structures, irrigation projects, dams etc. on various rivers. This estimation of design values is required for safe and optimum design of storage and spillway capacity. On the request of Central Govt./ State Govt., Private Agencies, design storm values (Standard Project Storm, Probable Maximum Precipitation along with Time Distribution, IDF Curve etc.) are being provided for users as main input. These studies are being carried out on payment basis. The detailed project reports are sent to the project authorities.

5.1.3.3 Rainfall Monitoring Unit

Hydromet Division, India Meteorological Department (IMD), New Delhi has conducted the National level stakeholders meeting on “Weather and Climate Services for Water Sector” as part of its 150 years foundation day celebrations on 15th January, 2025 at the Bharath Mandapam, New

Delhi. The objective of the meeting was to understand the current challenges associated with the rainfall patterns, flash flood predictions and water management under global warming and climate change. This meeting was also aimed at developing an effective liaison with various stake holders at national and state level. The panel discussion started with the opening remarks from the Chair about the challenges associated in the prediction of the extreme rainfall events and droughts over various geographical regions of India associated with different complex topography, and land use patterns. The changes in the water cycle due to the changing climatic conditions make it really difficult for the proper planning and management of the water resources(Fig. 10).

Fig. 10. National level stakeholders meeting on "Weather and Climate Services for Water Sector" as part of its 150 years foundation day celebrations on 15th January, 2025 at the Bharath Mandapam, New Delhi.

5.1.3.4 List of Recommendation's

(i). The density of observations systems such as automatic weather stations and rain gauges over hilly terrain regions are sparse. The Panel recommends installation of observational instruments on the hilly terrains for the proper monitoring of rainfall activity over hilly terrains which could trigger landslides.

(ii). Optimal utilization of water in multipurpose projects like Bhakra Nangal and Beas dams will be useful for other similar multipurpose projects as well in the country. Rainfall received during the monsoon season plays an important for the water management of agriculture land and hydro-electricity. Hence, it is important to know the end of the season rainfall well in advance for proper planning, so that water is not wasted in Spillways. Quantitative precipitation forecast (QPF) for the next 7 days is provided by IMD on a spatial resolution of 25 km. An increase in the spatial resolution of the provided QPF by IMD to be in 5 km by 5 km is necessary, so that the rainfall estimated data in the nearby rivers, Beas and Sutlej don't get overlapped.

(iii). Rainfall prediction from the numerical weather prediction (NWP) models needs to be improved for accurate flash flood alerts. Orography plays an important role in the triggering of extremely heavy rainfall events over hilly regions due to the blocking of moist air; these processes need to be properly captured well in advance by the NWP models on local scale. High resolution NWP model output will be useful for flash flood prediction over hilly regions.

(iv). Lead time plays a critical role in the proper management of the rescue operations for the case of urban flooding events. Hence, it is important to revisit the lead time of short
range forecasts regarding extreme rainfall events and urban flooding.

(v). It is imperative that IMD should use datasets available from other agencies such as CWC and State network. Efforts should be made for sharing of such data in real time by the collecting organisations to IMD. Possibility of entering into MoU with respective organisations by IMD should be explored. IMD should collect all the observed data from various states like Kerala, Tamil Nadu, Telangana, Uttar Pradesh etc and can be included in flash flood prediction system.

(vi). Major Services include Real-time rainfall monitoring and preparation of All India Rainfall statistics on Daily, Weekly, Monthly and Seasonal Basis. An annual Report on All India Rainfall Statistics is published.

(vii). The real time rainfall statistics was prepared for Annual (Jan to Dec) -2025. The rainfall for the country as a whole, for Annual (Jan to Dec) -2025 has been recorded as 1278.2 mm which is 110% of its Long Period Average (LPA) of 1160.0 mm. In all, category wise, 02 Met. Sub-divisions in LARGE EXCESS, 14 Met sub-divisions in EXCESS, 18 Met sub-divisions in NORMAL, 02 in DEFICIENT and none of any Met. Sub-divisions LARGE DEFICIENT, NO RAIN category of rainfall (Fig. 11).

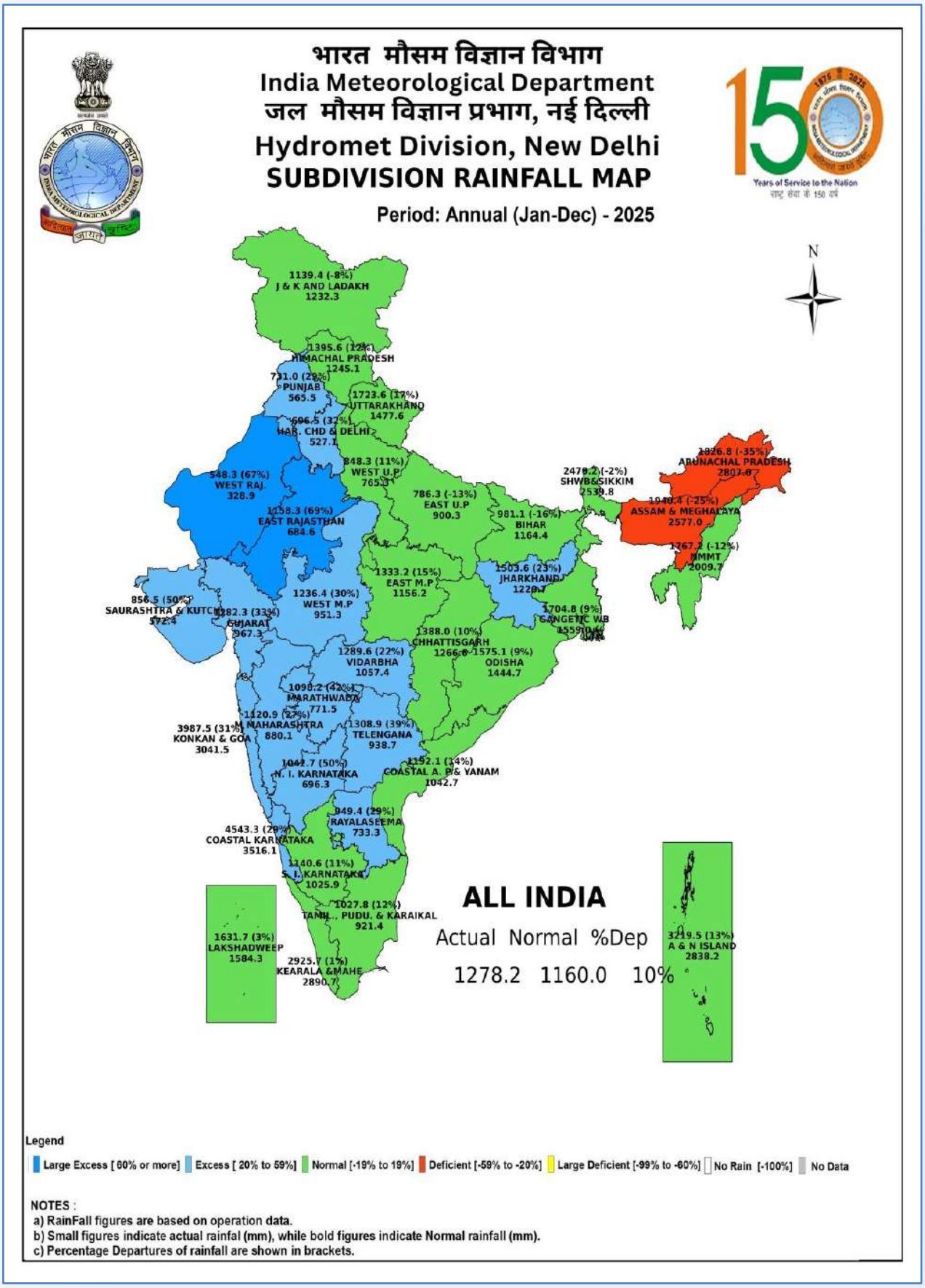


Fig. 11. SUBDIVISION-WISE RAINFALL (MM) DISTRIBUTION

Table 1

SUBDIVISION-WISE RAINFALL (MM) DISTRIBUTION

S. NO.	METEOROLOGICAL SUBDIVISIONS	PERIOD: ANNUAL (JAN-DEC)-2025			
		ACTUAL	NORMAL	% DEP.	CAT.
EAST & NORTH EAST INDIA		1660.1	1946.5	-15%	
1	ARUNACHAL PRADESH	1826.8	2807.0	-35%	D
2	ASSAM & MEGHALAYA	1940.4	2577.0	-25%	D
3	N M M T	1767.2	2009.7	-12%	N
4	SHWB & SIKKIM	2479.2	2539.8	-2%	N
5	GANGETIC WEST BENGAL	1704.8	1559.0	9%	N
6	JHARKHAND	1503.6	1220.7	23%	E
7	BIHAR	981.1	1164.4	-16%	N
NORTH WEST INDIA		952.2	833.3	14%	
1	EAST U.P.	786.3	900.3	-13%	N
2	WEST U.P.	848.3	765.3	11%	N
3	UTTARAKHAND	1723.6	1477.6	17%	N
4	HAR. CHD & DELHI	696.5	527.1	32%	E
5	PUNJAB	731.0	565.5	29%	E
6	HIMACHAL PRADESH	1395.6	1245.1	12%	N
7	J & K AND LADAKH	1139.4	1232.3	-8%	N
8	WEST RAJASTHAN	548.3	328.9	67%	LE
9	EAST RAJASTHAN	1158.3	684.6	69%	LE
CENTRAL INDIA		1350.2	1105.0	22%	
1	ODISHA	1575.1	1444.7	9%	N
2	WEST MADHYA PRADESH	1236.4	951.3	30%	E
3	EAST MADHYA PRADESH	1333.2	1156.2	15%	N
4	GUJARAT REGION	1282.3	967.3	33%	E
5	SAURASHTRA & KUTCH	856.5	572.4	50%	E
6	KONKAN & GOA	3987.5	3041.5	31%	E
7	MADHYA MAHARASHTRA	1120.9	880.1	27%	E
8	MARATHWADA	1098.2	771.5	42%	E
9	VIDARBHA	1289.6	1057.4	22%	E
10	CHHATTISGARH	1388.0	1266.6	10%	N
SOUTH PENINSULA		1355.1	1127.2	20%	
1	A & N ISLAND	3219.5	2838.2	13%	N
2	COASTAL A. P.& YANAM	1192.1	1042.7	14%	N
3	TELANGANA	1308.9	938.7	39%	E
4	RAYALASEEMA	949.4	733.3	29%	E
5	TAMIL., PUDU. & KARAIKAL	1027.8	921.4	12%	N
6	COASTAL KARNATAKA	4543.3	3516.1	29%	E
7	N. I. KARNATAKA	1042.7	696.3	50%	E
8	S. I. KARNATAKA	1140.6	1025.9	11%	N
9	KERALA & MAHE	2925.7	2890.7	1%	N
10	LAKSHADWEEP	1631.7	1584.3	3%	N
COUNTRY AS A WHOLE		1278.2	1160.0	10%	

CATEGORYWISE NO. OF SUBDIVISIONS & % AREA (SUBDIVISIONAL) OF THE COUNTRY

CATEGORY		PERIOD: ANNUAL (JAN-DEC)-2025	
		NO. OF SUBDIVISIONS	SUBDIVISIONAL % AREA OF COUNTRY
LARGE EXCESS		2	10%
EXCESS		14	35%
NORMAL		18	49%
DEFICIENT		2	6%
LARGE DEFICIENT		0	0%
NO RAIN		0	0%

5.1.3.5 New Developments

In a significant technological advancement, Hydromet Division, IMD has launched the India Meteorological Department RAinfall INformation System (IRAINS), with its sub component Block-Wise Rainfall Monitoring Scheme (BRMS), an indigenously developed system that will provide real-time rainfall data for 7,200 administrative blocks across India. This represents a tenfold increase in spatial resolution, greatly enhancing the granularity and usefulness of rainfall data. IMD aims to provide localized observations at block level to full fill the aim of Har Har Mausam, Har Ghar Mausam.

5.1.3.4 Central Hydromet Observatory (CHO) Activities

Awareness of Weather Observations by Central Hydromet Observatory: About 1350 visitors including Officers from Indian Navy, Research Scholars and Professors from Muradabad Institute of Technology MRIIRS Faridabad, SES, JNU Delhi, Department of Geophysics BHU Varanasi and Department of Mathematics Moti Lal Nehru College. Queen's vally School Dwaraka New Delhi, DPMI B-block New Ashok Nagar New Delhi, National Bal Bhawan New Delhi, Nav Bharai Publiic school, TERI School of Advanced Studies New Delhi, Shikshantar School, IMD FTC Training Batch, IMD IMTC Training Batch, Training Batch of Scientistsof IMD. New instruments (SRRG, Thermograph, Hair Hygrograph and Minimum Temperature Thermometer & Maximum Temperature Thermometer were brought from PUNE office and installed at C.H.O. New Delhi.

5.2. Agrometeorological Advisories Services

5.2.1. District Wise Crop Weather Calendar in India: A step towards resilient agriculture-IMD was launched by Dr. Jitendra Singh, Honourable Minister of State (I/C) for Earth Sciences and Science & Technology on the occasion of MoES Foundation Day - 28 July 2025.

The District wise Crop Weather Calendar (CWC) in India is a pioneering and precise agro meteorological tool developed by the India Meteorological Department (IMD), Ministry of Earth Sciences (MoES), in coordination with the Indian Council of Agricultural Research (ICAR), various agricultural universities, and state agencies. Unlike traditional crop calendars that only specify sowing and harvesting windows and seed rates, these CWCs integrate weekly weather data—such as rainfall, temperature, humidity, and wind—with crop phenology and management stages, making them both crop specific and location specific. The CWC serves as a vital tool for farmers, extension workers, and planners by offering week-wise insights into crop phenology, climatic requirements, and the potential impact of adverse weather events such as early/delayed monsoon, wet spell/dry spell, heat waves/cold waves, or unseasonal rains etc. By aligning crop activities with agro-climatic conditions specific to each region, CWCs support timely decision-making and enhance resilience against climate risks. In India, the development of district- and agro-climatic zone-specific CWCs is a step forward in improving preparedness and productivity in agriculture. Furthermore, by integrating real time observations with weather forecast, district level CWCs have evolved into dynamic systems that adapt to current crop stages and upcoming weather variability—significantly enhancing preparedness and reducing weather associated risk in agriculture.

5.2.2. Weather Services under Gramin Krishi Mausam Sewa (GKMS)

(i). Dissemination of Agromet Advisories to the users' community through SMS and IVR technology is being continued in the country through PPP mode and presently reaching to 6.09 million farmers through PPP mode.

(ii). In order to enhance outreach, initiatives have been undertaken to integrate the weather forecast and agromet advisories with the mobile applications and websites of various State Governments and Academic Institutions. Integration has been completed for 24 states viz. Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Kerala, Madhya Pradesh, Meghalaya, Nagaland, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand, Maharashtra, Andhra Pradesh,

Telangana, Arunachal Pradesh, West Bengal, Jharkhand, Mizoram and Tripura.

(iii). The weather forecast and Agromet advisory are being disseminated through mobile apps and websites of various State Govt. (1,56,02,201 no. of farmers), PPP mode (60,96,687no. of farmers) and WhatsApp (18,13,144 no. of farmers).

(iv). Farmers' Awareness Programme (FAPs) was organized at 33 locations during 2025 by Agromet Field Units (AMFUs) and District Agromet Unit (DAMUs). 3057 farmers participated in the programs(Fig. 12).

(v). 27 success stories of utilization of services were uploaded in the Agrimet Division Website.

Fig. 12. Farmers' Awareness Programme on "Climate-Smart Technologies and Practicabilityof Agromet Advisory Services Mobile Applications" was organized under the GKMS Schemeon 13.03.2025 at the Agricultural Research Station (ARS), Kovilpatti

(vi). A YouTube channel named IMD-GKMS was created to showcase various activities being carried out under GKMS scheme. During 2025 around 97 videos under GKMS have been uploaded in the channel.

(vii).To enhance the delivery of Agromet advisories, more than 98 thousand farmers have been added to WhatsApp groups.

5.3. Positional Astronomy Services

The Positional Astronomy Centre, located at Sector V, Saltlake, Kolkata, is the nodal office of the Govt. of India having the responsibility for the preparation of positional astronomy data for scientific applications, as well as for the formulation of the National Calendar used for civic purposes.

Since ancient times, eminent Indian astronomers such as Aryabhata and Bhaskara have made remarkable contributions to the field of astronomy. The positions of stars and planets traditionally guided the observance of religious events, festivals, and rituals, making astronomy an integral part of daily life in India.

In the modern era, almanacs and astronomical ephemerides play an important role in the practical application of astronomy. They provide advance information on significant celestial events

such as solar and lunar eclipses, unusual planetary configurations, the phases of the Moon and so on. In India, such almanacs—popularly known as Panchangs—have been prepared since ancient times. However, the methods used for their calculation differed widely across regions and traditions.

During the post-independence period, nearly 30 different Panchangs were in use across the country, reflecting India's rich and diverse political, cultural, and historical traditions. Each calendar system had its own advantages and limitations. Therefore, there arose a need to adopt a scientific approach and develop a uniform calendar for the entire nation, based on the most accurate modern astronomical data, in the interest of national integration.

In November 1952, the Government of India appointed a seven-member Calendar Reform Committee under the chairmanship of Prof. Meghnad Saha, with late N. C. Lahiri as Member-Secretary, under the Council of Scientific and Industrial Research (CSIR). The committee was tasked with developing a unified National Calendar based on the most accurate modern astronomical data.

The committee recommended the preparation of the Indian Ephemeris and Nautical Almanac using modern astronomical formulae, as well as the National Calendar of India incorporating the timings of Tithis, Nakshatras, Yogas, and festival dates. The Saka Era was chosen as the basis for this calendar.

Thus, the remaining work of the Calendar Reform Committee, along with the preparation of the Indian Ephemeris and Nautical Almanac and the Rashtriya Panchang, was transferred from the Council of Scientific and Industrial Research to the India Meteorological Department on 1 December 1955. This responsibility was assigned to a unit called the Nautical Almanac Unit, functioning under the administrative control of the then Director of the Regional Meteorological Centre, Calcutta.

The unit prepared The Indian Ephemeris and Nautical Almanac for the year 1958, which became its first issue and was published in March 1957. At the same time, the first issue of the Rashtriya Panchang was brought out for the 1879 Saka Era (1957–58 A.D.). In 1979, the title The Indian Ephemeris and Nautical Almanac was changed to Indian Astronomical Ephemeris.

In 1976, the Ramanna Committee, after reviewing the functioning of the Nautical Almanac Unit, recommended its independent status and upgradation of the post of Officer-in Charge of the Unit to the level of Director. These recommendations were subsequently approved by the Council of Meteorology and Atmospheric Sciences (CMAS) of the Government of India.

Accordingly, it was decided to completely separate the Nautical Almanac Unit from the administrative control of the Director, Regional Meteorological Centre, Calcutta, and establish it as an independent centre named the Positional Astronomy Centre (PAC), directly under the control of the Director General of Meteorology, New Delhi. This decision was implemented with effect from 1 December 1979, and the formal inauguration of the Positional Astronomy Centre took place on 26 April 1980.

The Positional Astronomy Centre (PAC), Kolkata, under the India Meteorological Department, is the only national agency responsible for publishing ephemerides containing positional data of celestial objects. The Centre also prepares the National Calendar for civil and religious purposes through the publication of the Rashtriya Panchang in 14 languages. This serves as the official Panchang of the country and provides accurate Panchang data. Additionally, the Centre determines the dates of all-India festivals for various communities, which are used by the Central and State Governments for declaring holidays. Thus, the work carried out by the Centre is unique, and no other organization in the country performs these functions.

5.3.1. Present Activities

- Publication of Indian Astronomical Ephemeris
- Publication of Tables of Sunrise- Sunset, Moonrise-Moonset
- Preparation of Indian National calendar

- Publication of Rashtriya Panchang in 14 languages namely, Hindi, English, Sanskrit, Urdu, Assamese, Bengali, Gujarati, Marathi, Punjabi, Tamil, Telugu, Kannada, Malayalam and Odia.

- Supply data to meets up data requirements of a large number of users including Government organizations, non-Government organizations, astronomers, various panchang makers, general public etc.

- Taking observation on special astronomical events from time to time with the help of its portable telescopes.

5.3.2. Activities during the Year 2025

The 2026 edition of the Indian Astronomical Ephemeris, an annual publication of the Positional Astronomy Centre, is now available in both print and digital formats. This comprehensive resource provides precise positional data for the Sun, Moon, and planets in various astronomical coordinate systems. It also includes the rising and setting times of the Sun and Moon, the mean and apparent positions of bright stars, a calendar of celestial events, information on eclipses and occultations, calendric data, explanatory notes, and other valuable insights into astronomy.

Fig. 13. Inauguration of SAC meeting of PAC Kolkata and Commencement of Refresher Course on Astronomy from 3rd-7th March, 2025

The Rashtriya Panchang for the 1947 Saka Era (2025-26 AD) has been published in 14 languages, available in both print and digital formats. These important publications cater to the daily needs of almanac users, Panchang makers, and other interested readers. The Panchang provides detailed information such as Tithi, Nakshatra, Yoga, and Karana calculated in Indian Standard Time (IST) for the central reference point (82°30′ E, 23°11′ N); lunar months beginning from the ending moment of the New Moon following the traditional luni-solar system; tables of longitudes; the beginning of Lagnas; transits of the Sun, Moon, and planets through different Rasis and Nakshatras; dates of all-India fairs and festivals for all communities; and tables of sunrise, sunset, moonrise, and moonset.

The tables of sunrise and sunset, as well as moonrise and moonset, for the year 2026 has been published in 2025.

The Centre has continued its web-based services by developing electronic editions of the Rashtriya Panchang in 14 languages and the Indian Astronomical Ephemeris. These digital versions are accessible to users through the PAC Kolkata website.

The Centre has prepared monthly star charts and astronomical bulletins for all 12 months of 2025 to provide guidance for observing celestial objects in the night sky. These bulletins include concise explanations of the positions of celestial objects, along with diagrams, which can be used for

practical demonstrations and observation.

The dates of all-India festivals for various communities have been fixed in advance for the year 2026, to facilitate the declaration of holidays by the Government of India and the State Governments. Additionally, the Indian National Calendar, along with the corresponding Gregorian calendar data for 2026–27, has been prepared in advance for the use of various stakeholders.
Advance Panchang data has been prepared and provided to various stakeholders.

PAC Kolkata conducted SAC meeting on 3rd March, 2025 and Commencement of Refresher Course on Astronomy from 3rd-7th March, 2025(Fig. 13,14).

Fig. 14. Participants of SAC meeting and Refresher Course on Astronomy

5.4. Climate Research & Services

5.4.1. The CR&S, IMD Pune, in collaboration with IIT Delhi, developed the high-resolution (~10 km) Precipitation Ensemble Dataset for the Indian Region.

The CR&S, IMD Pune, in collaboration with IIT Delhi, developed the high-resolution (~10 km) Precipitation Ensemble Dataset for the Indian Region. New 0.1 Degree Gridded Rainfall Dataset. Indian Precipitation Ensemble Dataset (IPED) is India's first observation-based ensemble rainfall dataset at a resolution of about 10 kilometres compared to existing 25 km resolution. It has been jointly developed by Climate Research and Services, IMD Pune and the HydroSense Lab at IIT Delhi. It combines IMD's dense rain gauge network with terrain-aided interpolation, incorporating elevation, slope and other aspects to better reflect local conditions. This improves accuracy across plains, valleys, hills and mountains. It removes the uncertainties of rainfall estimates arising due to interpolation, wind effects, gauge types and evaporation, by providing 30 equally likely estimates of rainfall every day.This product will support better hydrological modelling, disaster preparedness, agriculture planning, and climate research—helping stakeholders make more informed, uncertainty-aware decisions.Shared data to NITI Aayog for sharing data for the preparation of Investment Friendliness Index of States.Provided input for BTR-1 report to Ministry of Environment and Forest and Climate Change (MoEF CC).

5.4.2. Operational Long Range Forecast and its Verification

Operational LRF System

India Meteorological Department (IMD) issues operational monthly and seasonal forecasts for the southwest monsoon rainfall. Since 2021, IMD has adopted a new strategy for issuing monthly and seasonal operational forecasts for the southwest monsoon rainfall over the country by modifying the existing two stage forecasting strategy. Schematic diagram (Fig.15) showing various operational forecasts for the southwest monsoon rainfall issued by IMD. The new strategy is based on the existing statistical forecasting system and the newly developed

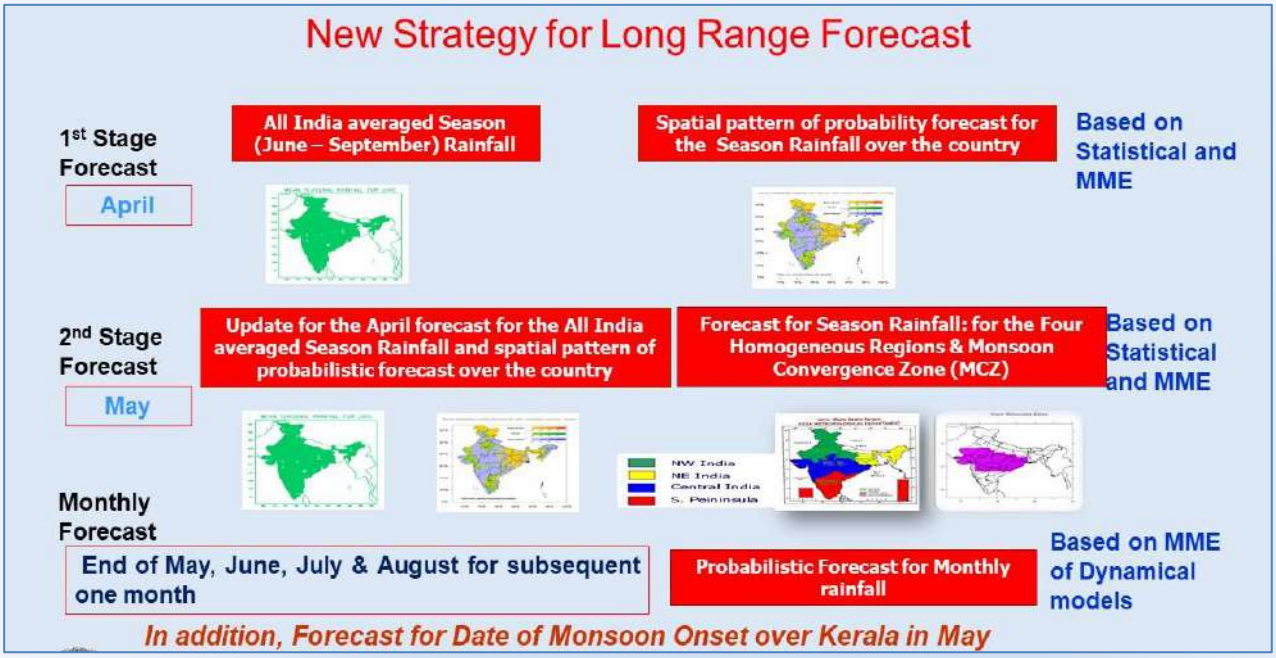


Fig.15: Schematic diagram showing various operational forecasts for the southwest monsoon rainfall issued by IMD

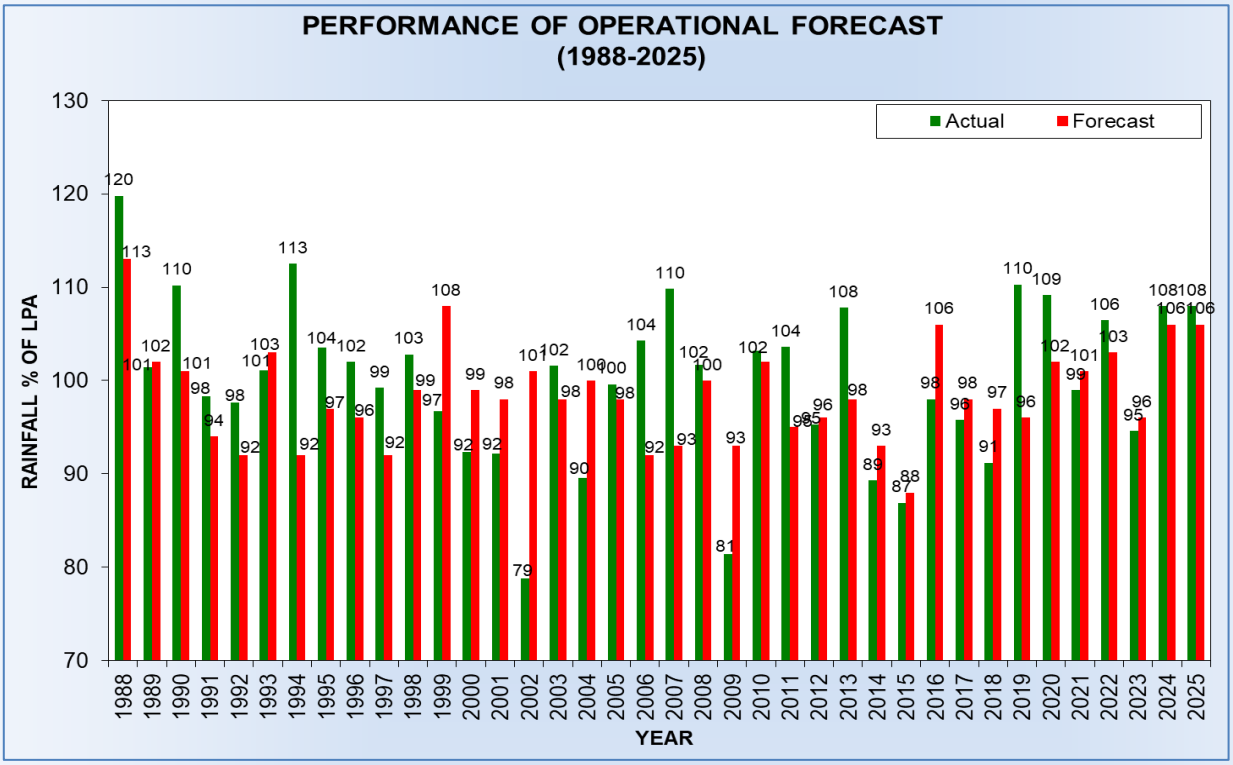


Fig. 16: Performance operational forecast (1988-2025)

Multi-Model Ensemble (MME) based forecasting system. The MME approach uses the coupled global climate models (CGCMs) from different global climate prediction and research centers including IMD's Monsoon Mission Climate Forecasting System (MMCFS) model. The spatial distribution of probabilistic forecasts for tercile categories (above normal, normal and below normal) for the seasonal rainfall (June to September) over the country was also issued at the end of the previous month based on MME approach.

Details of the various long range forecasts issued by IMD and their verification are discussed in this report. Various operational forecasts issued by IMD as shown in table-2 and the Performance operational forecast (1988-2022) is shown in Fig. 16.

Southwest Monsoon Season (June to September, 2025) Rainfall

The forecast for monsoon onset over Kerala for this year was correct, which is the nineteenth consecutive correct forecast for this event except the year 2015 since the commencement of this forecast in 2005. The Forecast date of onset of monsoon over Kerala was 27th May with a model error of ± 4 days and realized date of onset of monsoon over Kerala was 24th May.

Table-3. gives the summary of the various operational long-range forecasts issued for the 2025 Southwest monsoon rainfall along with the realized rainfalls. Table-4. gives performance of monthly Rainfall Forecast during Monsoon 2025. Figs.17(a-j) gives spatial forecast verification plots for seasonal forecasts of 2025.

5.4.3. Verification of Operational Long-Range Forecasts

The first stage forecast for the season (June-September) rainfall over the country as a whole issued in April was 105% of LPA with a model error of ± 5% of LPA. The update issued on 27th May for this forecast was (106% of LPA) with a model error of ± 4% of LPA. The actual season rainfall for the country as a whole was 108% of LPA. Thus the both the forecasts were within forecast limits and therefore the forecast was correct.

Considering the four broad geographical regions of India, the forecasts issued on 27th May**,** the southwest monsoon seasonal (June to September 2025) rainfall is most likely to be above-normal over Central India and South Peninsular India (>106% of LPA), above normal over Northwest India (>108% of LPA) and below normal over Northeast India (<94% of LPA). The southwest monsoon seasonal rainfall over the monsoon core zone consisting of most of the rainfed agriculture areas in the country **was** most likely to be above Normal (>106% of LPA). The actual rainfall over Northwest India, Central India, Northeast India, South Peninsula and Monsoon Core Zone were 27%, 15%, -20%, 10% and 22% of the LPA, respectively. The seasonal forecast issued for homogeneous regions during the season was within the range of the forecast except the Northwest India. All the monthly outlooks were within the forecast limit, except the July. The forecast for the second half of the monsoon season (August –September) for the country as a whole also was in the forecast limit.

TABLE 2

Details of the various long range forecasts issued by IMD

S.N.	Forecast for	Region for which forecast issued	Method/ Model
1	Monthly & Seasonal outlook for rainfall and temperatures during January, February and March 2025	North India consisting of seven meteorological subdivisions (East Uttar Pradesh, West Uttar Pradesh, Uttarakhand, Haryana, Chandigarh & Delhi, Punjab, Himachal Pradesh, Jammu Kashmir & Ladakh)	MME
2	Monthly & Seasonal outlook for rainfall and temperatures during March-April-May 2025 and Heatwave Outlook	Country as a Whole	MME
3	Long Range Forecast for the 2025 Southwest Monsoon (June to September) Season Rainfall	Country as a Whole	Statistical & MME
4	Monthly Outlook for the Temperature and Rainfall during May 2025	Country as a Whole	MME

5	Forecast of the Onset Date of Southwest Monsoon - 2025 over Kerala	Over Kerala	MME
6	Updated Long Range Forecast of Rainfall during Southwest Monsoon Season (June - September), 2025 and Monthly Outlook for Rainfall and Temperature during June 2025	Country as a Whole,	Statistical & MME
7	Forecast outlook for rainfall and temperatures during the month of July 2025 of Southwest monsoon season.	Country as a Whole	MME
8	Forecast outlook for rainfall and temperatures during the month of August and August-September 2025 of Southwest monsoon season.	Country as a Whole	MME
9	Forecast outlook for rainfall and temperatures for the Month of September 2025	Country as a Whole	MME
10	Long Range Forecast of Rainfall during Post-Monsoon Season 2025 and Rainfall and Temperature during October 2025	Country as a Whole & South Peninsular India	MME
11	Salient Features of Monsoon 2025	Country as a Whole	….
12	Monthly Outlook for Rainfall and Temperature for November 2025	Country as a Whole	MME
13	Outlook for the Temperatures during Winter Season (Dec.2025- Feb.2026) and Forecast for the Rainfall and Temperatures during December 2025	Country as a Whole	MME

TABLE 3

Verification of the operational forecast issued for the 2025 southwest monsoon rainfall.
Performance of Long-Range Forecast of Southwest Monsoon 2024

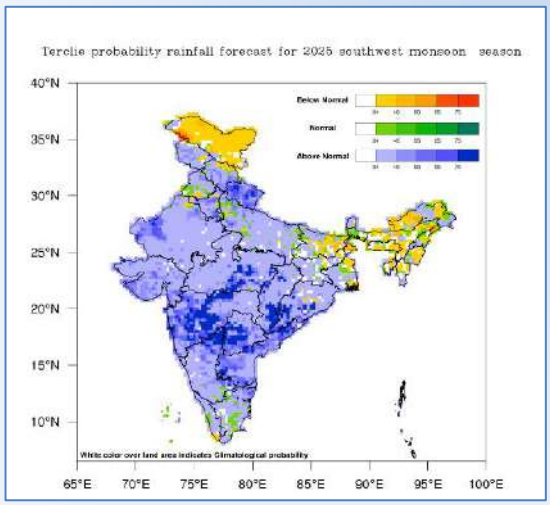
Seasonal Forecast		**Observed**
15 April 2025-1st Stage for Season as a whole	**27th May 2025-2nd stage -**	
◆ The Neutral ENSO condition is likely to continue during the monsoon season. ◆ The Neutral IOD conditions are likely to continue during the southwest monsoon season. ◆ The snow cover areas of northern hemisphere and Eurasia during the last three months (January to March, 2025) were below normal. The winter and spring snow cover extent over Northern Hemisphere as well as Eurasia has in general an inverse relationship with the subsequent Indian summer monsoon	◆ Same ENSO forecast. ◆ A weak negative IOD conditions are likely to develop during the southwest monsoon season. ◆ Quantitatively, the southwest monsoon seasonal rainfall over the country as a whole is likely to be 106% of the Long Period Average (LPA) with a model error of ±4%, indicating that above	◆ Neutral El Nino Southern Oscillation (ENSO) conditions are prevailing over the equatorial Pacific region till September. ◆ IOD remained neutral till July and a weak negative IOD conditions are developed towards the end of the monsoon season. ◆ Rainfall is (108% of LPA).

rainfall. ◆ The southwest monsoon seasonal (June to September) rainfall over the country as a whole during 2025 is most likely to be above normal (>104% of the Long Period Average (LPA)). Quantitatively, the seasonal rainfall over the country as a whole is likely to be 105% of LPA with a model error of ± 5%.	normal rainfall is most likely over the country as a whole during the monsoon season (June to September), 2025.	
31st July -3rd Stage (For 2nd half of Monsoon 2025 (Aug- Sept)		
◆ Neutral El Nino-Southern Oscillation (ENSO) conditions are prevailing over the equatorial Pacific region. These neutral ENSO conditions are likely to continue during remaining part of the monsoon season. ◆ At present, neutral Indian Ocean Dipole (IOD) conditions are observed over the Indian Ocean. These neutral IOD conditions are likely to turn into weak negative IOD conditions at the end of the monsoon season. ◆ Rainfall is most likely to be above normal (>106% of LPA) for Second half of the monsoon season.		◆ Neutral El Nino-Southern Oscillation (ENSO) conditions prevailed. ◆ A weak negative IOD conditions are developed towards the end of the monsoon season. ◆ Above normal Rainfall received for Both 1st half (106% of LPA) & second half (110% of the LPA of the monsoon season 2025.

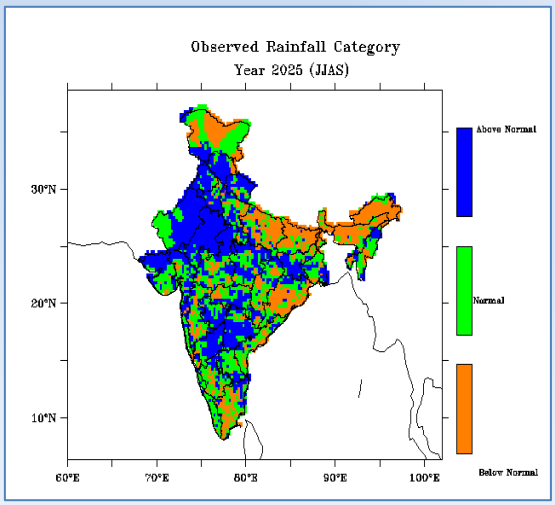
TABLE 4

Performance of monthly Rainfall Forecast during Monsoon 2025.

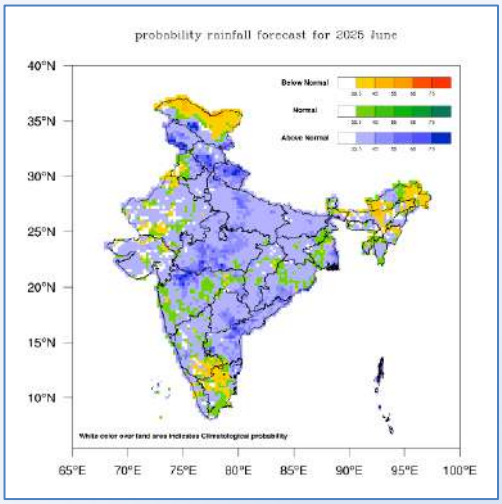
Month	Forecast	Realized
June 2025	Above Normal rainfall (>108% of LPA) is most likely over the country as a whole during June, 2025	109% of LPA
July 2025	Above Normal (>106 % of LPA) is most likely over the country as a whole during July, 2025	105% of LPA
August 2025	Normal ((94 to 106 % of LPA) is most likely over the country as a whole during August, 2025	105% of LPA
September 2025	Above Normal (>109 % of LPA) is most likely over the country as a whole during September, 2025	115% of LPA



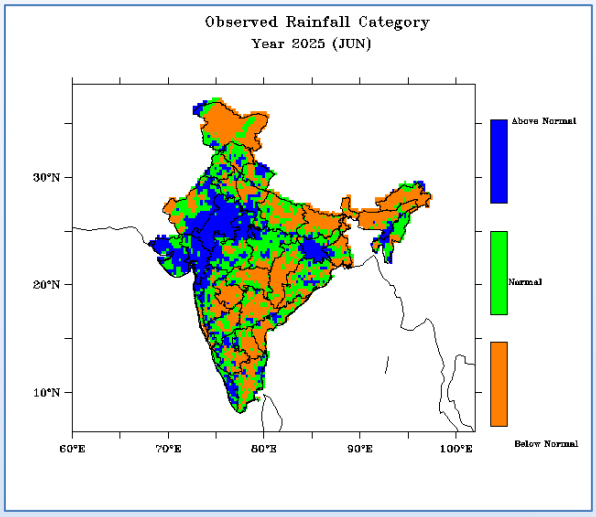
(a) Probabilistic Rainfall Forecast for June to September 2025



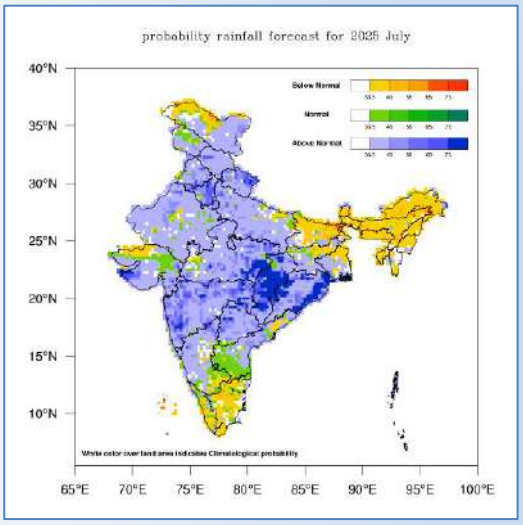
(b) Observed Rainfall Category for June to September 2025



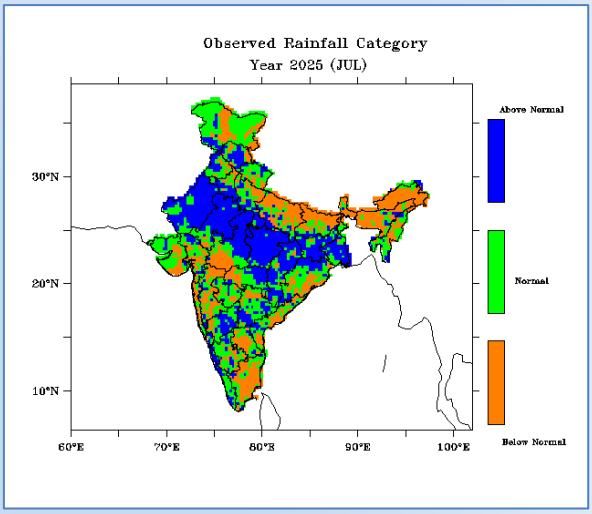
(c) Probabilistic Rainfall Forecast for June 2025



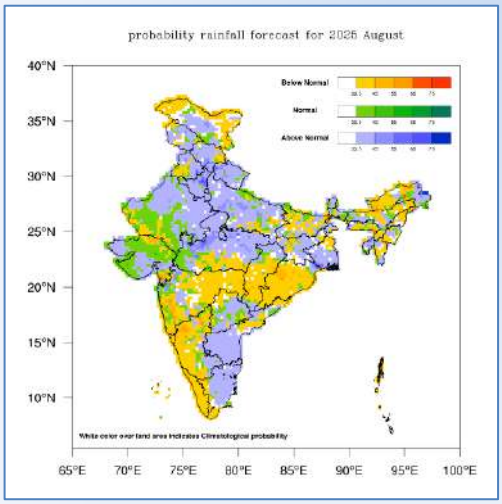
(d) Observed Rainfall Category for June 2025



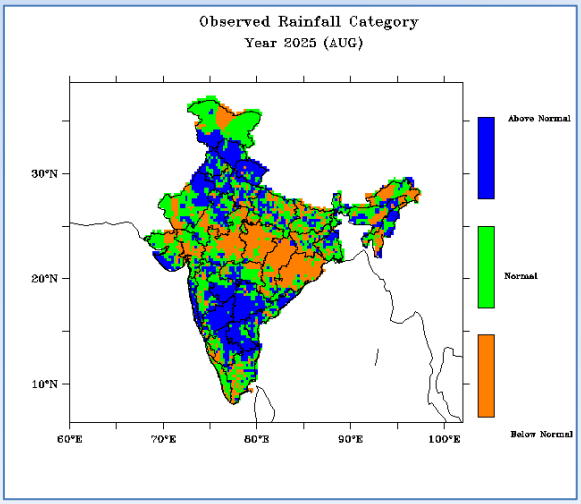
(e) Probabilistic Rainfall Forecast for July 2025



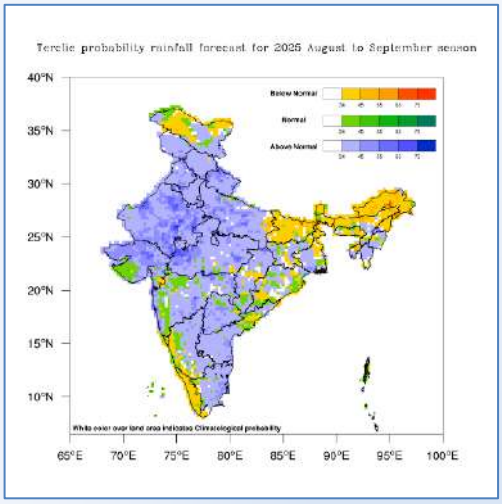
(f) Observed Rainfall Category for July 2025



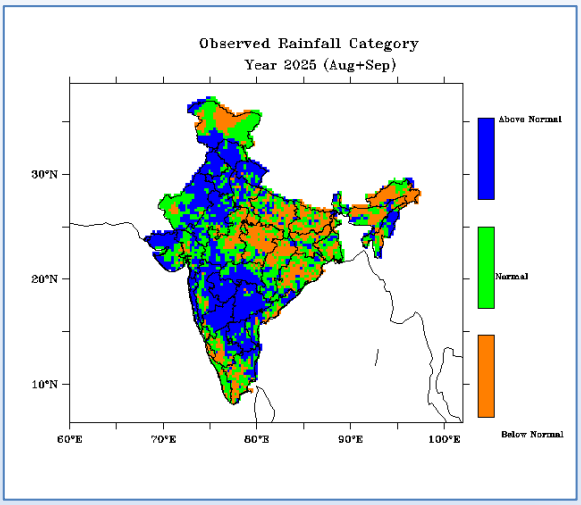
(g) Probabilistic Rainfall Forecast for August 2025



(h) Observed Rainfall Category for August 2025



(i) Probabilistic Rainfall Forecast for August + September 2025



(j) Observed Rainfall Category for August + September 2025

Figs. 17(a-j): Spatial Forecast Verification plots for seasonal forecasts of 2025.

5.4.4. Post Monsoon Season (October to December, 2025) Rainfall

The south Peninsular India consisting of five meteorological subdivisions (Tamil Nadu (Puducherry & Karaikkal), Coastal Andhra Pradesh & Yanam , Rayalaseema, Kerala & Mahe and South Interior Karnatak) receives significant amount of rainfall during the month of December due to northeast monsoon. Utilizing the new strategy of the MME based forecasting system as discussed above, IMD had issued rainfall forecasts for the 2025 northeast monsoon season (October to December (OND)) and for the months of October, November and December.

Seasonal rainfall during October to December (OND) over South Peninsular India consisting of five meteorological subdivisions (Tamil Nadu, Puducherry & Karaikal, Coastal Andhra Pradesh & Yanam, Rayalaseema, Kerala & Mahe, and South Interior Karnataka) is most likely to be above normal (>112% of Long Period Average (LPA)). Most parts of the country are expected to receive normal to above-normal rainfall, except many parts of Northwest India and some parts of extreme south peninsular India and northeast India, where rainfall is likely to be below-normal. Monthly rainfall over the country as a whole during October 2025 is likely to be above normal >115% of LPA. In October 2025, most parts of the country are expected to receive normal to above-normal rainfall. However, some areas in Northwest India and extreme south peninsular India and isolated pockets in the Northeast India, may experience below-normal rainfall.

Fig.18 gives Probability forecast of tercile categories* (below normal, normal, and above normal) of rainfall over India during October to December, 2025 period.

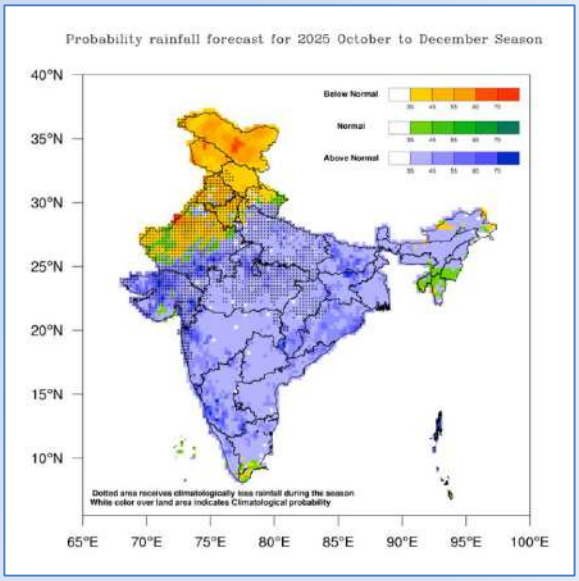


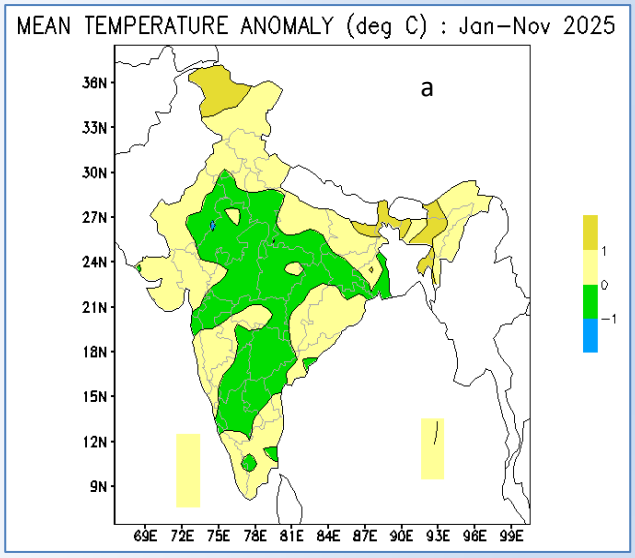
Fig. 18: Probability forecast of rainfall over India during October to December 2025

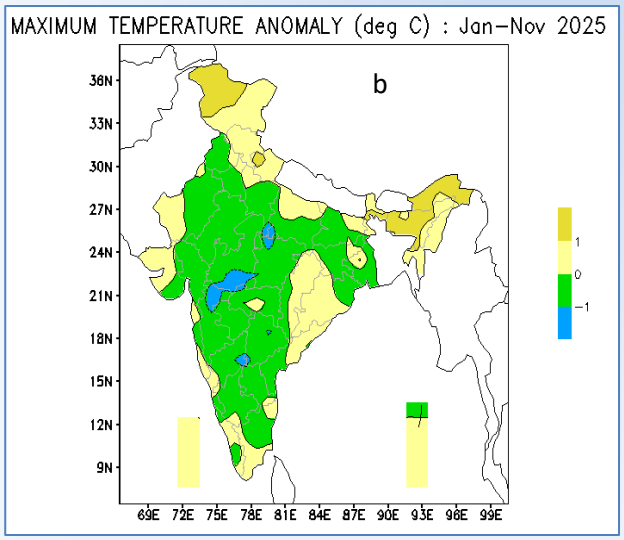
5.4.5. Climate Statement of India for 2025 (til November 2025)

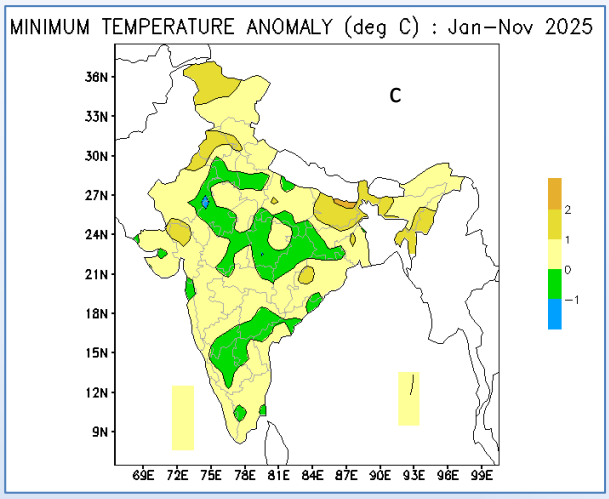
Temperature (till November 2025)

Spatial pattern of annual (Jan-Nov) mean, maximum and minimum temperature anomalies for 2025 (till November 2025) are shown in Figs.

19(a-c). During 2025 (till November 2025), mean, minimum and maximum temperature anomalies over many parts of the country was within 01°C.Mean temperature over parts of Jammu, Kashmir & Ladakh, Bihar, Sub Himalayan West Bengal & Sikkim, Arunachal Pradesh, Assam & Meghalaya and Tripura was above normal by about 1°C.Maximum temperature over parts of Jammu, Kashmir & Ladakh, Uttarakhand, Sub Himalayan West Bengal & Sikkim, Assam & Meghalaya, Arunachal Pradesh and Tripura was above normal by about 1 °C. However, maximum temperature over parts of southern Uttar Pradesh state, Madhya Pradesh state, north Madhya Maharashtra, Telangana and North Interior Karnataka was below normal by about 1 °C.Minimum temperature over parts of Bihar was above normal by about 2 °C, whereas central parts of Rajasthan state was below normal by about 1 °C.





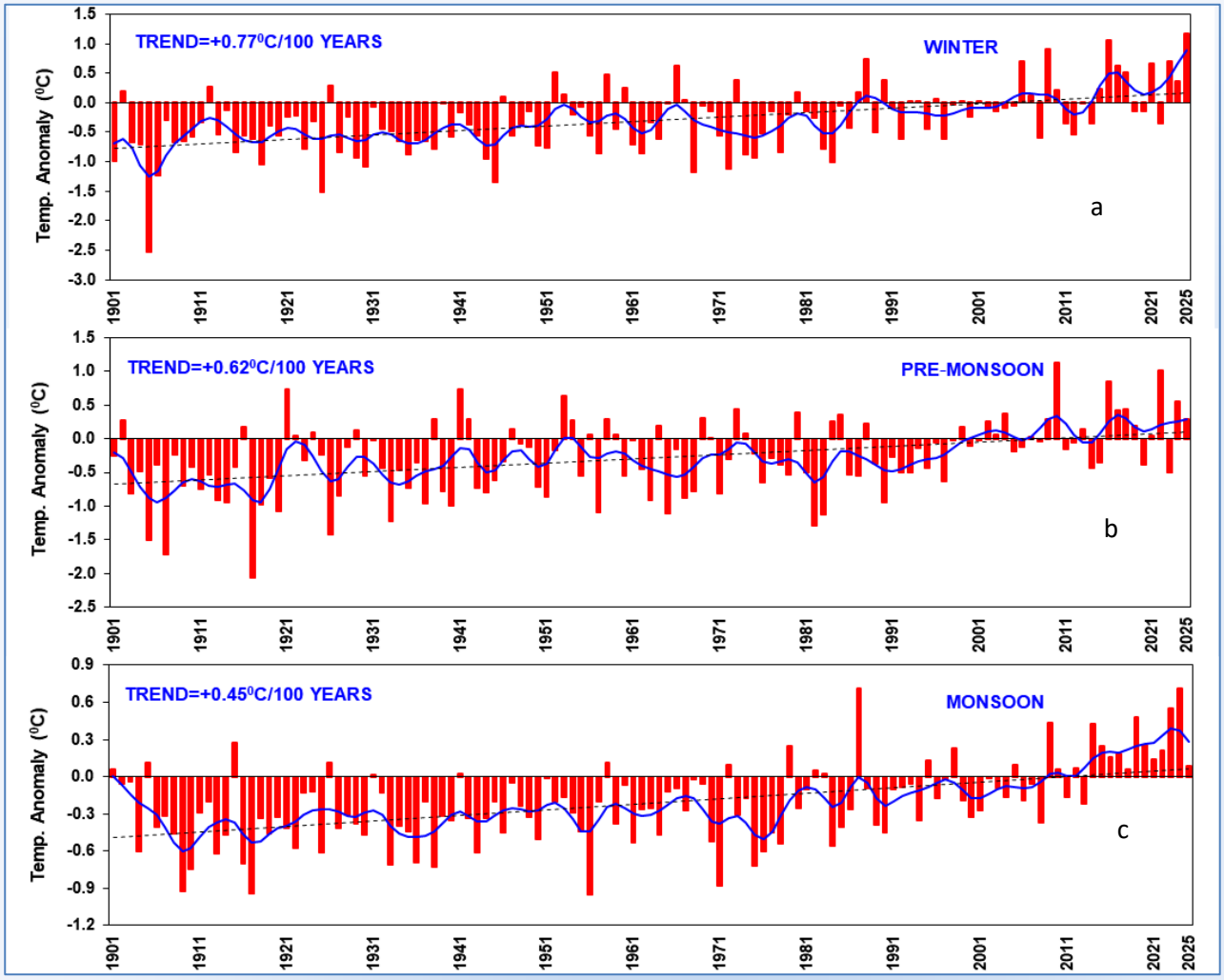


Figs. 19(a-c). Annual temperature anomalies (°C) for 2025 (till Nov2025) (a) Mean temperature (b) Maximum temperature and (c) Minimum temperature. (Based on 1991-2020 Average)

The annual mean land surface air temperature for the country till November 2025 was +0.29°C above the 1991-2020 average and was the 7th warmest since 1901. The annual maximum and minimum temperature for the country were +0.10°C and +0.49°C, respectively, above the 1991-2020 average till November 2025. The country averaged seasonal mean temperature was above normal during the Winter season (January - February, +1.17°C warmest year since 1901), Pre-monsoon season (March - May, +0.29°C), and Southwest monsoon season (June - September, +0.09°C) was normal Figs. 20(a-c).

The monthly mean temperatures for the country till November were above normal for the six months of the year except May, June, July, October and November, where below normal/near normal with an anomaly of -0.81°C, -0.18°C, -0.01°C, +0.07°C and -0.39°C respectively. The all-India mean temperature during the month of January was the 2nd highest with an anomaly of +0.98°C and February was the highest with an anomaly of +1.36°C since 1901.

The monthly maximum temperature was the 2nd highest (with an anomaly of +1.52°C) and the minimum temperature was the highest (with an anomaly of +1.20°C) for the month of February since 1901. The minimum temperature was the 5th highest during the month of January with an



Figs. 20(a-c). All India mean temperature anomalies (a) Winter (b) Pre-monsoon (c) SW-monsoonfor the period 1901 - 2025 shown as vertical bars. The solid blue curve exhibits sub-decadal time scale variations that have been smoothed with a Binomial Filter (Departures from the 1991 - 2020 average)

anomaly of +1.04°C since 1901. While the maximum temperature was the 7th lowest (with an anomaly of -1.52°C) and the minimum temperature was the 59th lowest (with an anomaly of -0.10°C) for the month of May since 1901. It will be updated on January 2026.

5.4.6. Regional Climate Centre (RCC) Activities

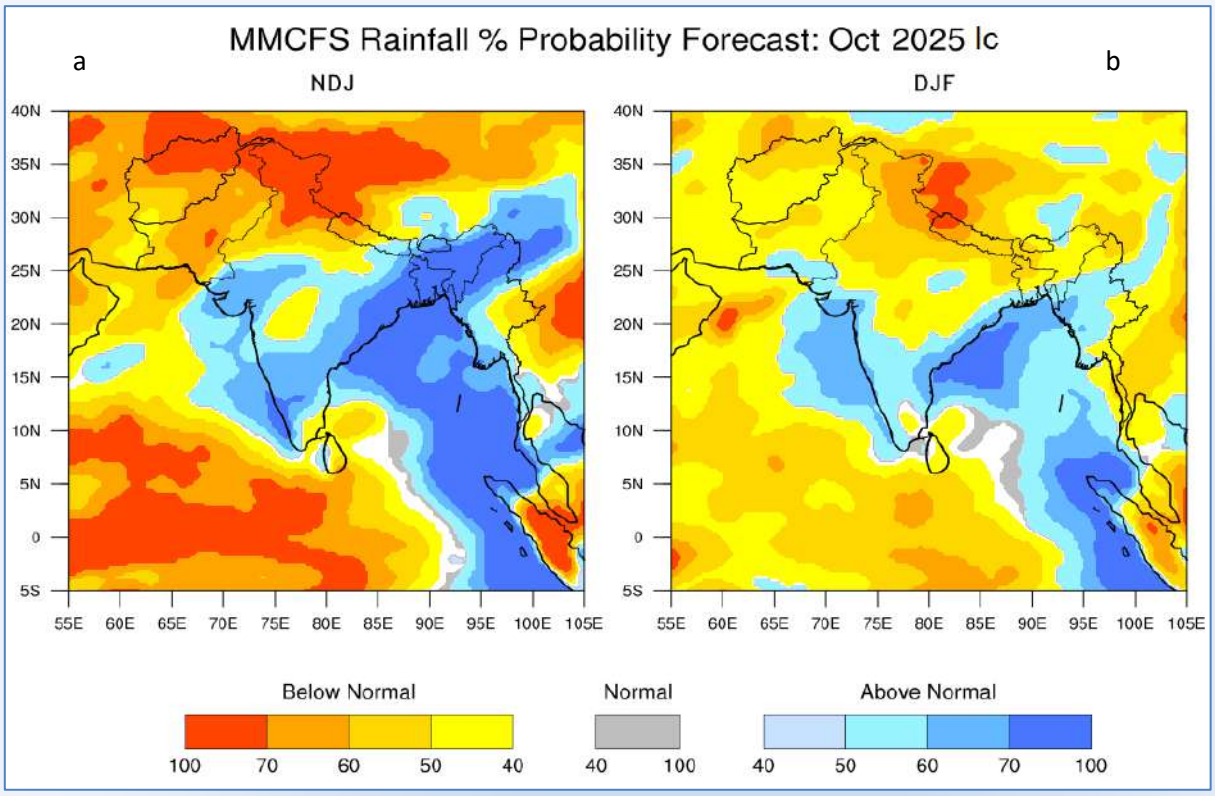
The CRS office of IMD, Pune is also recognized as the WMO Regional Climate Centre (RCC) for south Asia. Presently the MMCFS model is used for the following RCC long range forecasting activities.

(A)Generate global monthly and seasonal (anomaly and probability) forecasts for the temperature and rainfall. This is updated every month.

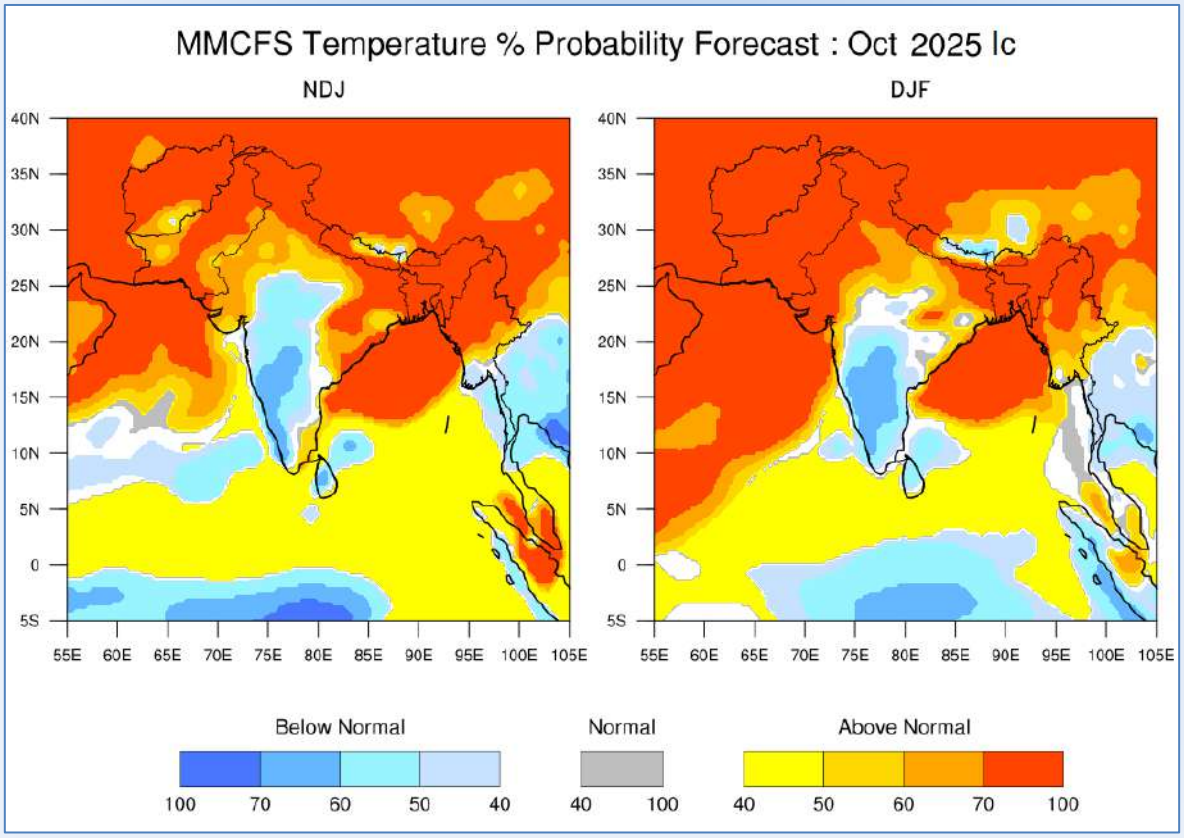
(B) Prepare Seasonal Climate Outlook for rainfall and temperatures over south Asia for the next 2 moving 3-month seasons (total 4 months) with monthly update. The Seasonal probability (%) forecasts of precipitation for (a) NDJ 2025-26 (left) and (b) DJF 2025-26 (right) based on initial conditions of October 2025 is shown in the Figs. 21(a&b).

Similarly, the Seasonal probability (%) forecasts of temperature for (a) NDJ 2025-26 (left) and (b) DJF 2025-26 (right) based on initial conditions of October 2025 is shown in the Figs. 22(a&b).

(C) Prepare ENSO and IOD bulletin every month providing statement on the global SST anomalies and probabilities forecast with emphasis on the



Figs. 21(a&b). Seasonal probability (%) forecasts of precipitation for (a) NDJ 2025-26 (left) and (b) DJF 2025-26 (right) based on initial conditions of October 2025



Figs. 22(a&b). Seasonal probability (%) forecasts of temperature for (a) NDJ 2025-26 (left) and (b) DJF 2025-26 (right) based on initial conditions of October 2025.

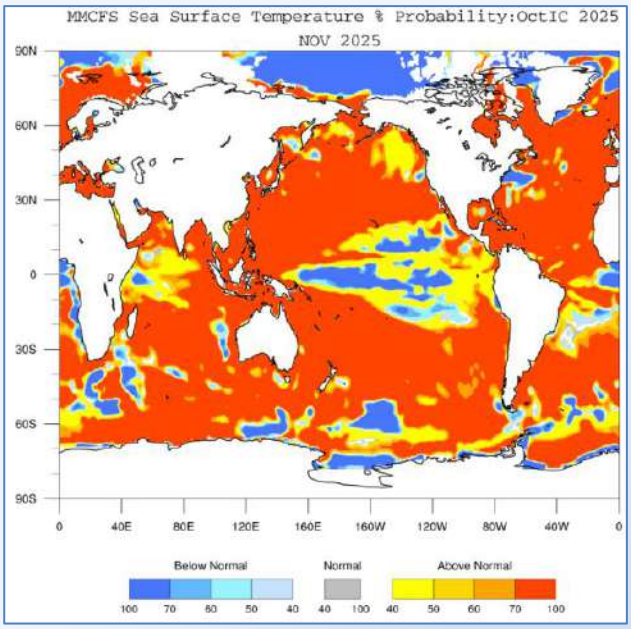


Fig.(23). Gives the Global sea surface temperature probability forecast for the month of November 2025 using the October initial conditions.

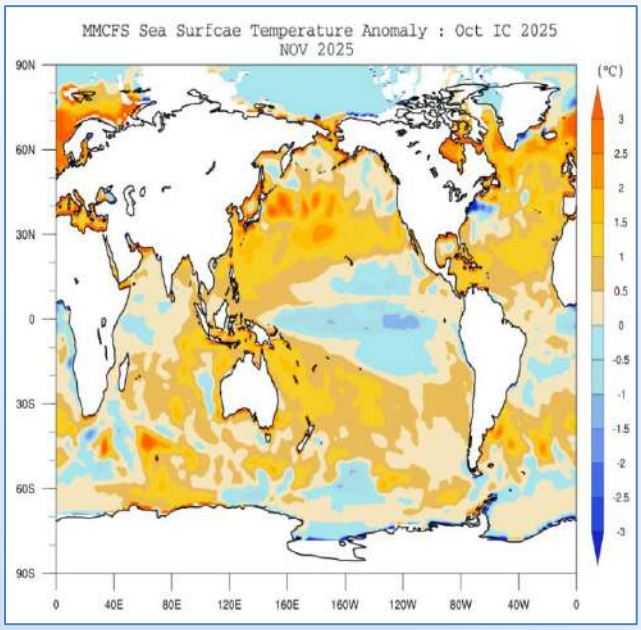


Fig.(24). Gives the Global sea surface temperature anomaly forecast for the month of November 2025 using the October initial conditions.

ENSO and IOD conditions for the next 9 months prepared based with monthly update. Fig.23 gives the Global sea surface temperature probability and Fig.24 gives the Global sea surface temperature anomaly forecast for the month of November 2025 using the October initial conditions.

5.5. Cyclone Monitoring & Prediction

5.5.1. Annual Report on Cyclonic Disturbances during 2025

Year 2025 witnessed the formation of 15 cyclonic disturbances (CDs) against normal of 11.2 per year based on the data during the period 1965-2024. It included 11 depressions/deep depressions (maximum sustained wind speed (MSW): 32 – 61 kmph), 2 cyclonic storms (MSW: 62-91 kmph) and 2 severe cyclonic storms (92-117 kmph). All the 4 cyclones had recurving tracks. Out of 4 cyclones, 3 were landfalling cyclones (Montha, Senyar and Ditwah).

Following Cyclonic Disturbances (CDs) developed over the North Indian Ocean (NIO) during 2025:

1. Depression over the Arabian Sea (24–25 May)
2. Deep Depression over Northwest Bay of Bengal off West Bengal–Bangladesh Coasts (29–30 May)
3. Depression over Southeast Gangetic West Bengal and Adjoining Bangladesh (14–15 July)
4. Depression over Central Parts of North Rajasthan (15 July)
5. Depression over Southeast Uttar Pradesh (17–19 July)
6. Depression over Northwest Bay of Bengal (25–27 July)
7. Depression over Northwest and Adjoining Westcentral Bay of Bengal (18–19 August)
8. Land Deep Depression over Southwest Rajasthan and Neighbourhood (06–10 September)
9. Depression over Northwest and Adjoining Westcentral Bay of Bengal (26–28 September)
10. Deep Depression over Westcentral Bay of Bengal (01–03 October)
11. Severe Cyclonic Storm SHAKHTI over Northeast Arabian Sea (01–07 October)
12. Depression over Southeast Arabian Sea (22–31 October)
13. Severe Cyclonic Storm MONTHA over Westcentral Bay of Bengal (25–29 October)
14. Cyclonic Storm “SENYAR” over the Strait of Malacca (25-27 November)
15. Cyclone “DITWAH” over Bay of Bengal (27th November – 03rd December)

Basin wise, out of the 4 cyclones, 3 developed over the Bay of Bengal (BoB) and 1 over the Arabian Sea (AS) against normal of 3.5 over the BoB and 1 over

the AS based on the data during the period 1965-2024. Season wise, there were 2 CDs during pre-monsoon season (March-May) against normal of 1.4, 7 CDs during monsoon season (June-Sep) against normal of 4.9 and 6 CDs during post-monsoon season (Oct-Dec) against normal of 4.8. Thus, the above normal genesis of CDs during 2025 was mainly during monsoon and post-monsoon seasons.

5.5.2. The salient features of 4 cyclones during 2025 are given below

5.5.2.1. Severe Cyclonic Storm SHAKHTI over Northeast Arabian Sea (01–07 October, 2025)

The severe cyclonic storm "Shakhti" originated from the remnant of a depression that formed over northwest & adjoining westcentral Bay of Bengal on 26thSeptember. It moved across Odisha, Chhattisgarh and Vidarbha and weakened into a well-marked low-pressure area over west Vidarbha and adjoining north Madhya Maharashtra on 28th Sep. It moved across central India and emerged into Gulf of Cambay on 29thSep. It then moved across Gujarat and emerged into northeast Arabian Sea in the morning (0830 hrs IST) of 1stOctober as a well-marked low-pressure area. It intensified into a depression over northeast AS in the evening (1730 hrs IST) of 1st Oct. and into a deep depression in the midnight (2330 hrs IST) of 2ndOct. Thereafter, it exhibited multiple recurvatures & changed its path about 7 times during its life period. It intensified into a Cyclonic Storm over northeast AS in the noon (0600 UTC) of 3rd Oct. and into a severe cyclonic storm over northeast & adjoining northwest AS in the early morning (0000 UTC) of 4th Oct. It reached its peak intensity of 60 kt in the early morning (0000 UTC) of 5th October and maintained its intensity till noon (0600 UTC) of 5th Oct.Thereafter, while moving south-southwestwards, it started weakening from evening (1200 UTC) of 5th October onwards. Subsequently it weakened into a cyclonic storm in the early morning (0000 UTC) of 6th Oct., into a deep depression in the midnight (1800 UTC) of 6th Oct. It moved southeastwards from the midnight of 6th Oct. and weakened into a depression in the noon (0600 UTC) of 7th Oct. and into a well marked low pressure area in the evening (1730 hrs IST) of 7th Oct. over the westcentral AS. The observed track of the system is presented in Fig. 25.

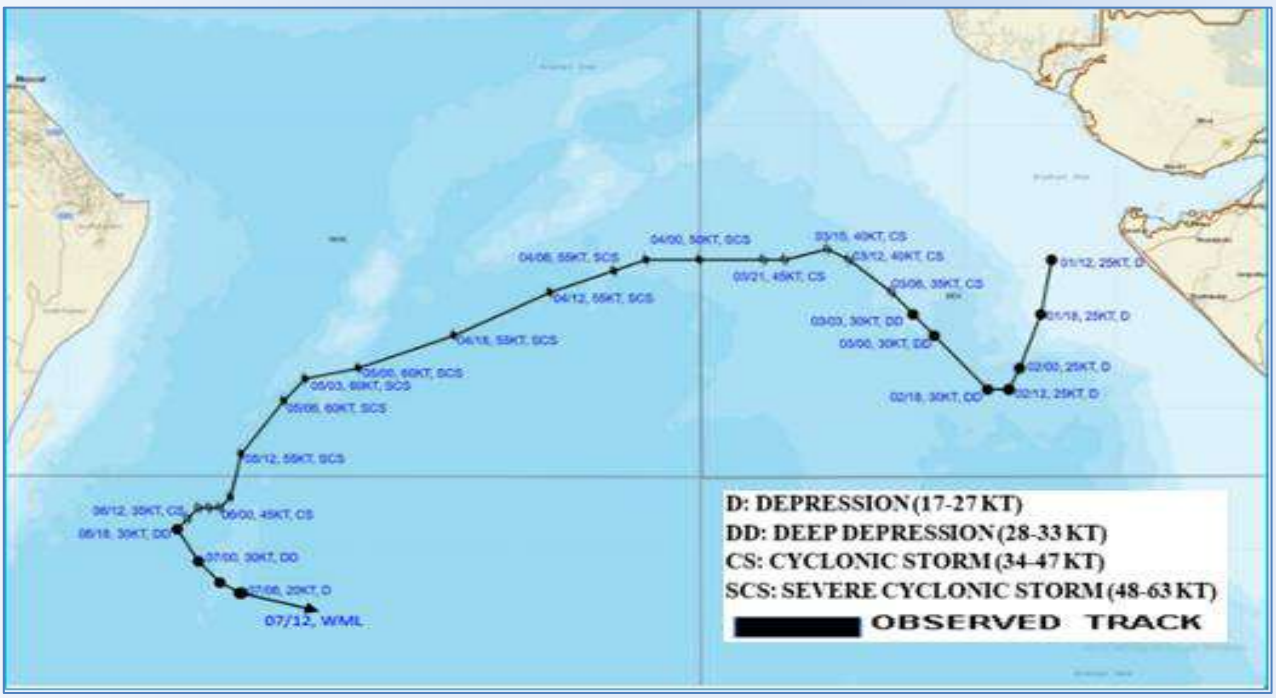


Fig. 25. Observed track of severe cyclonic storm "Shakhti" over the Northeast Arabian Sea (01–07 October, 2025)

Forecast Performance

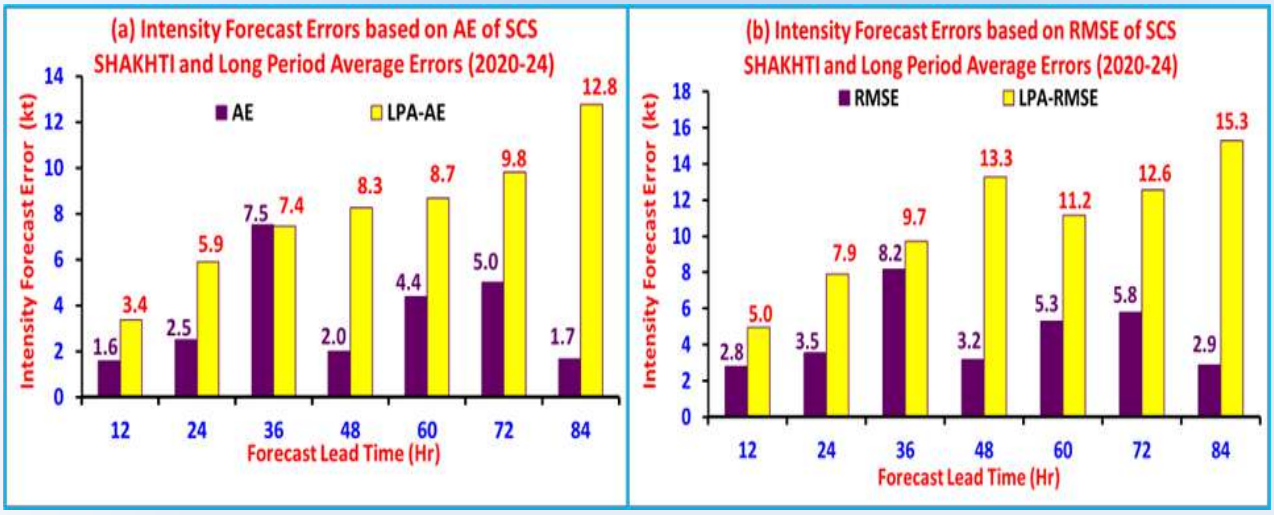
- The extended range outlook issued on 25th Sep. indicated emergence of remnant of depression over northwest & adjoining westcentral Bay of Bengal (BoB) into northeast AS and adjoining South Gujarat with moderate probability of its intensification into a depression around 30th Sep. Actually, it moved across central India and emerged into Gulf of Cambay on 29th Sep. It then moved across Gujarat and emerged into northeast AS on 1st Oct. morning. (about 6 days in advance of formation of depression over northeast AS).
- Regular Tropical Weather Outlooks issued from 28th Sep. onwards, on weakening of the depression into a well marked low pressure area over Vidarbha region, indicated that the remnant would continue to move across North Madhya Maharashtra, south Gujarat and Saurashtra during 28th to 30th September and emerge as a low-pressure area over Northeast Arabian Sea off Gujarat coast by 1st October. Considering the chances of further intensification, continuous monitoring of the system was maintained.

Operational track, intensity and landfall forecast performance

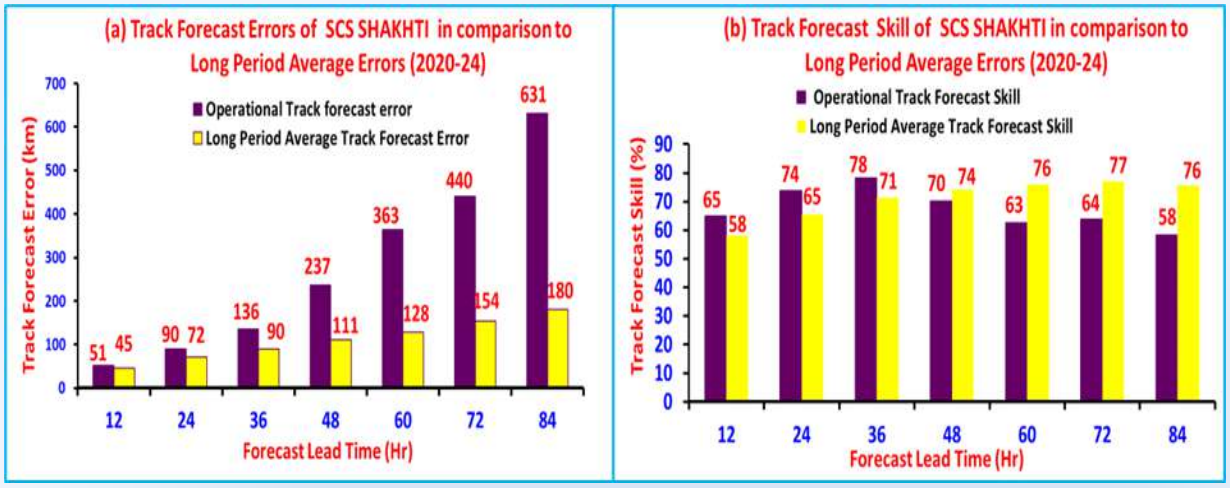
The operational track forecast errors for 24, 48 and 72 hrs lead period were 90, 237 and 440 km against the long period average errors of 72, 111 and 154 km respectively based on the data of 2020-24 (Fig. 26a). The operational track forecast skills compared to climatological & persistence (CLIPER) based forecast for 24, 48 and 72 hours lead period were 74, 70 and 64% against long period average (2020-24) skills of 65, 74 and 77 % respectively (Fig. 26b). For all lead periods, the operational track forecast errors were more the long period average errors (2020-24). However, the skill was comparable to long period average errors for all lead periods. It is mainly attributed to the fact that the Shakhti exhibited multiple recurvatures and the predictability of recurving cyclones is less than that of straight moving cyclones.

The absolute errors (AE) in intensity (wind) forecast for 24, 48 and 72 hrs lead period were 2.5, 2.0 and 5.0 knots against the long period average errors of 5.9, 8.3 and 9.8 knots based on the data of 2020-24 respectively (Fig. 27a). The root mean square errors (RMSE) of intensity (wind) forecast for 24, 48 and 72 hrs lead period were 3.5, 3.2 and 5.8 knots against the long period average errors of 7.9, 13.3 and 12.6 knots based on data of 2020-24 respectively (Fig. 27b). For all lead periods, the operational intensity forecast errors were markedly less than the long period average errors.

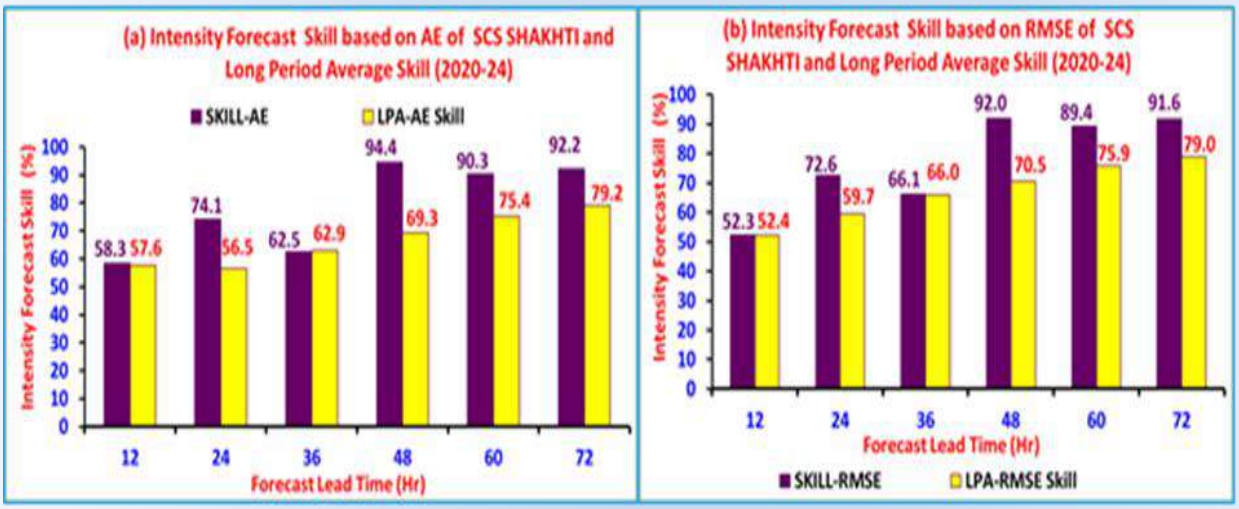
The skills in intensity (wind) forecast for 24, 48 and 72 hrs lead period were 74, 94 and 92 % against the long period average skills of 57, 69 and 79% based on the data of 2020-24 respectively (Fig. 28a). The skills in intensity (wind) forecast based on RMSE for 24, 48 and 72 hrs lead period were 73, 92 and 92 % against the long period average errors of 60, 71 and 79 knots based on the data of 2020-24 respectively (Fig. 28b).



Figs. 26(a&b) :(a) Track forecast errors and (b) skills against Climatology & Persistence (CLIPER) compared to long period average (LPA of 2020-2024) errors & skills respectively



Figs. 27(a&b) :(a) Absolute errors (AE) and (b) Root Mean Square errors (RMSE) in intensity forecast (winds in knots) as compared to long period average (2020-24))



Figs. 28(a&b): Skill (%) in intensity forecast based on (a) Absolute errors (AE) and (b) Root Mean Square errors (RMSE) as compared to long period average (2020-24)

5.5.2.2. Severe cyclonic storm "MONTHA" over Southeast Bay of Bengal (25th – 30th) October, 2025

A low-pressure area formed over southeast BoB in the early morning (0530 hrs IST) of 24th October, 2025. It lay as a well-marked low pressure area over the same region in the evening (1730 hrs IST) of same day, the 24th October, 2025.It concentrated into a depression over the same region in the early morning (0530 hrs IST) of 25th October, 2025. It moved west-northwestwards and intensified into a deep depression over the same region in the early morning (0530 hrs IST) of 26th October. It then moved northwestwards and intensified into the Cyclonic Storm "MONTHA" [Pronunciation: Mon-Tha] in the same midnight (2330 hrs IST) of 26th October, 2025 over southwest & adjoining southeast BoB. Continuing to move further northwestwards, it intensified into a severe cyclonic storm in the early morning (0530 hrs IST) of 28th October, 2025 over westcentral BoB. Thereafter, it moved north-northwestwards till evening (1730 hrs IST) of 28th October. It then suddenly changed the track, moved west-northwestwards and crossed Andhra Pradesh & Yanam coasts between Machilipatnam and Kalingapatnam to the south of Kakinada close to Narsapur near latitude 16.35ºN and longitude 81.70º E during 2330 hrs IST of 28th to 0030 hrs IST of 29th October with maximum sustained wind speed of 90-100 kmph (50 kt) gusting to 110 kmph

(60 kt).Continuing to move further north-northwestwards, it weakened into a cyclonic storm over Coastal Andhra Pradesh in the early hours (0230 hrs IST) of 29th October and into a deep depression over Coastal Andhra Pradesh and adjoining Telangana in the forenoon (0830 hrs IST) of 29th October. Continuing to move north-northwestwards, it weakened into a Depression over south Chhattisgarh & neighbourhood in the evening (1730 hrs IST) of 29th October.Further moving north-northwestwards, it weakened into a Well Marked Low Pressure Area over East Vidarbha and adjoining South Chhattisgarh in the early morning (0530 hrs IST) of 30th October 2025.Observed track of the system is presented inFig. 29.

Forecast performance

IMD provided 1st information about the likely development of low-pressure area over southeast BoB on 9th October (15 days ahead of formation of low pressure area on 24th Oct) and formation of depression on 16th October (about 9 days ahead of formation of depression on 25th Oct).
On 24th October at 1400 hrs IST (about 4.5 days ahead of landfall), IMD issued Pre-genesis (before formation of depression) track and intensity forecasts, indicating movement towards Andhra Pradesh coast and intensification into a cyclonic storm over southwest BoB when the system lay as low-pressure area over southwest BoB on 24th October.

Actually, low pressure area formed over southeast BoB on 24th October, depression over southeast BoB on 25th October, cyclonic storm “MONTHA” over southwest BoB on 27th and severe cyclonic storm on 28th October. Montha crossed Andhra Pradesh and Yanam coasts between Machilipatnam and Kalingapatnam to the south of Kakinada close to Narsapur near latitude 16.35N and longitude 81.70 E during midnight of 28th October (2330 hrs IST of 28th October and 0030 hrs IST of 29th October) with maximum sustained wind speed of 90-100 gusting to 110 kmph.

Operational track, intensity and landfall forecast performance

The operational track forecast errors for 24, 48 and 72 hrs lead period were 68, 63 and 113 km against the long period average errors of 72, 111 and 154 km respectively based on the data of 2020-24 (Fig. 30a). However, the operational track forecast skills compared to climatological & persistence (CLIPER) based forecast for 24, 48 and 72 hours lead period were 39, 54 and 15% against long period average (2020-24) skills of 65, 74, 77 and 78 % respectively (Fig. 30b). For all lead periods, the operational track forecast errors were less than the long period average errors (2020-24).

The absolute errors (AE) in intensity (wind) forecast for 24, 48 and 72 hrs lead period were 2.5, 3.0 and 1.7 knots against the long period average errors of 5.9, 8.3 and 9.8 knots based on the data of 2020-24 respectively (Fig. 31a). The root mean square errors (RMSE) of intensity (wind) forecast for 24, 48 and 72 hrs lead period were 3.5, 5.0 and 2.9 knots against the long period average errors of 7.9, 13.3 and 12.6 knots based on data of 2020-24 respectively (Fig.31b). For all lead periods, the operational intensity forecast errors were markedly less than the long period average errors.
The skills in intensity (wind) forecast for 24, 48 and 72 hrs lead period were 75, 79 and 93 % against the long period average skills of 57, 71 and 77% based on the data of 2020-24 respectively (Fig. 32a). The skills in intensity (wind) forecast for 24, 48 and 72 hrs lead period were 2.5, 3.0 and 1.7 % against the long period average errors of 5.9, 8.3 and 9.8 knots based on the data of 2020-24 respectively (Fig. 32b).

The operational landfall point forecast errors for 24, 48 and 72 hrs lead period were 76, 82 and 120 km respectively against the long period average (LPA) errors of 16, 39 and 70 km based on data of 2020 – 24 (Fig. **33**a). The operational landfall point errors were about 60-70 km higher than long period average errors (2020-24) for different lead periods. It could be mainly attributed to the fact that the system changed its track just before landfall.The operational landfall time forecast errors for 24, 48 and 72 hrs lead period were 3.0, 3.0 and 1.5 hours respectively against the long period average error of 2.9, 4.2 and 7.5 hours respectively based on the data of 2020-24 (Fig. **33**b). The operational landfall time forecast errors were markedly less than the LPA errors for all lead periods.

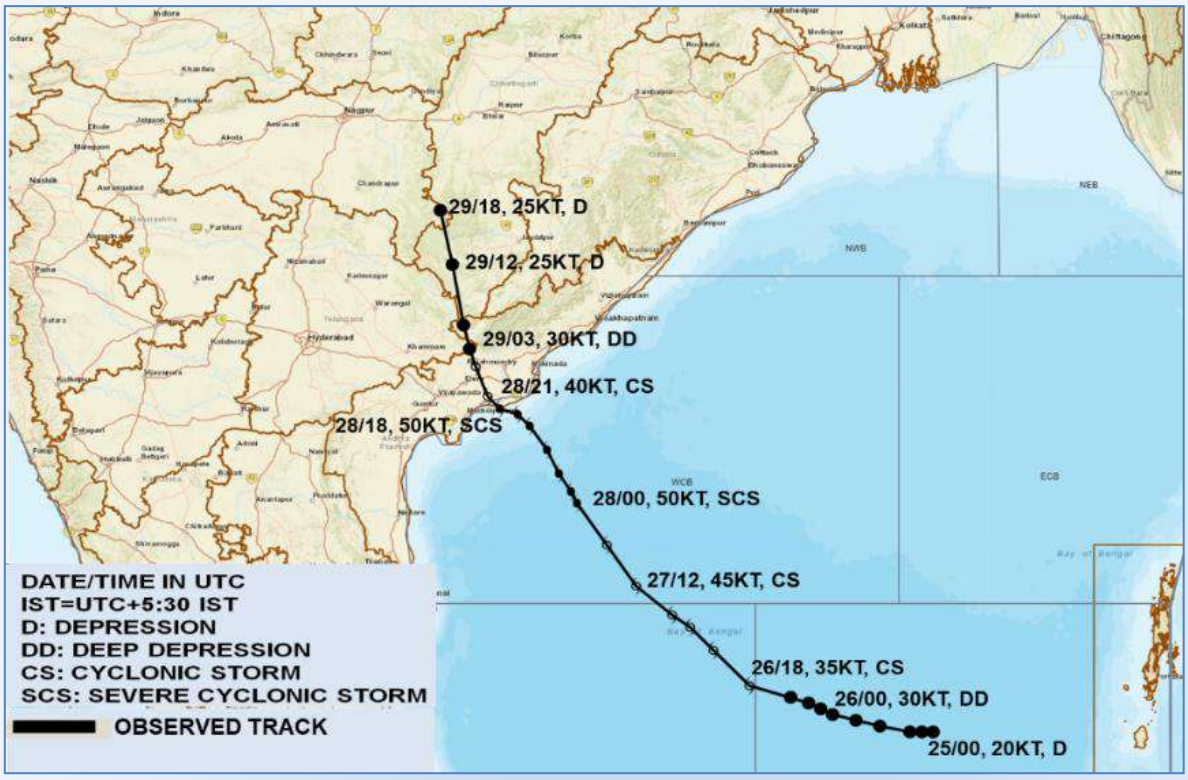
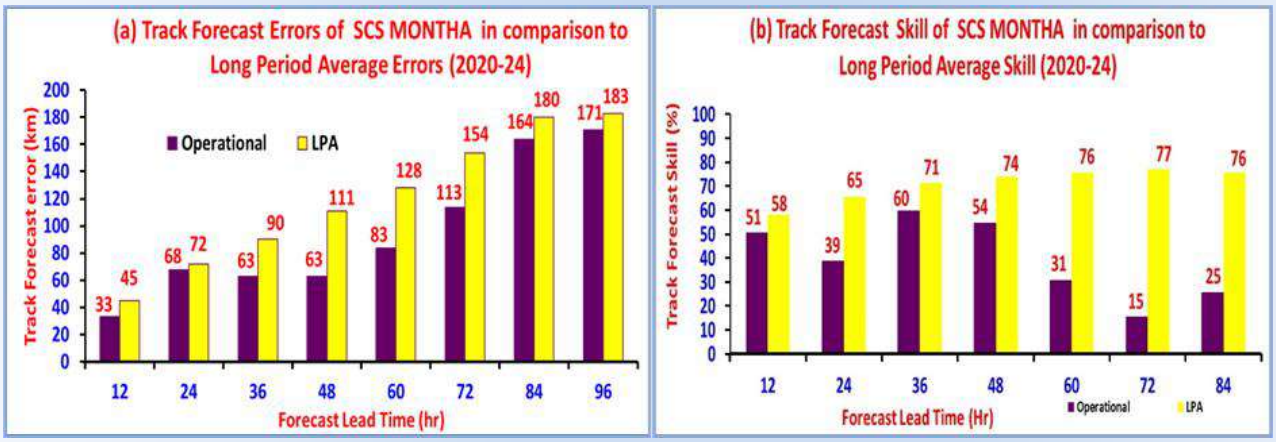
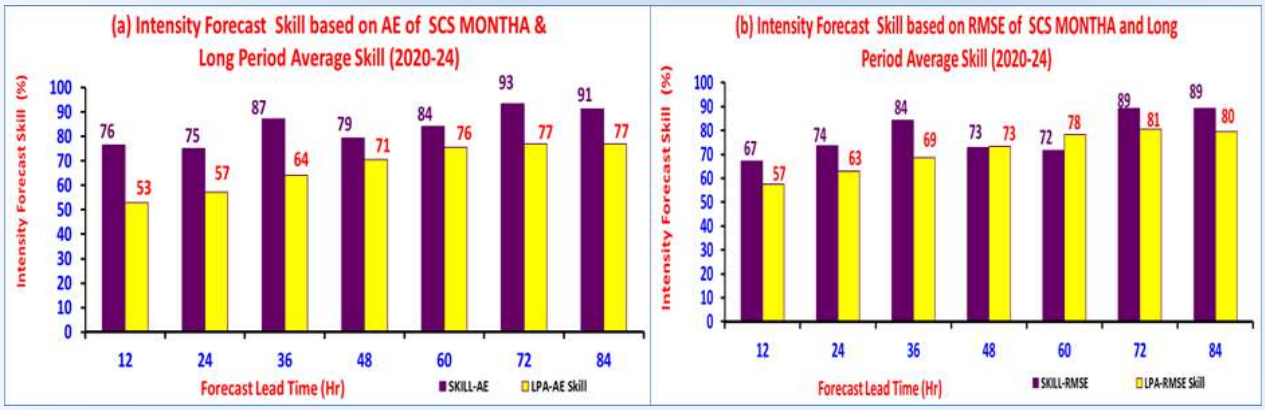


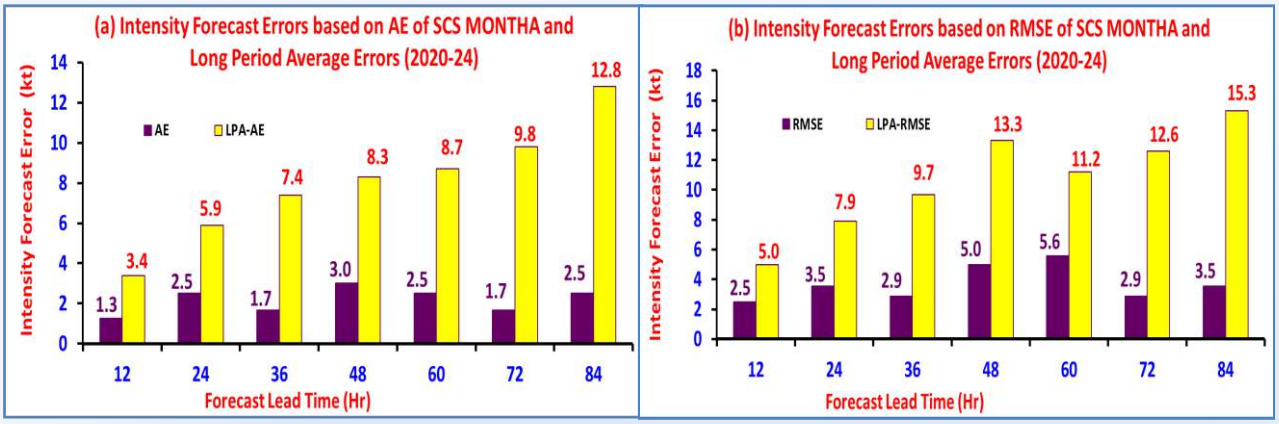
Fig. 29. Observed track of severe cyclonic storm "MONTHA" over southeast Bay of Bengal during 25-30 October, 2025



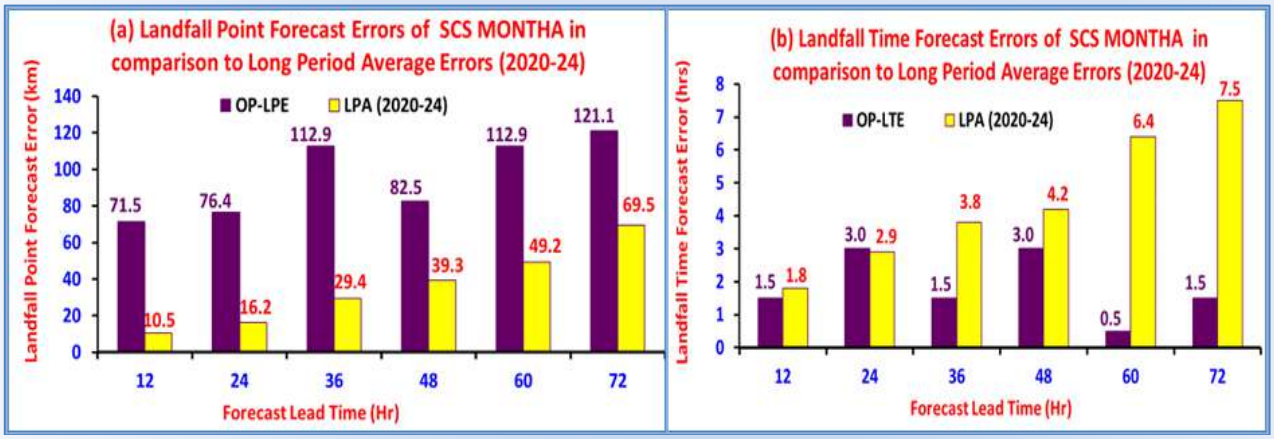
Figs. 30(a&b): (a)Operational track forecast errors and (b) skill compared to long period average during 2020-24



Figs. 31(a&b): (a) Absolute Error (AE) intensity forecast and (b) skill against Persistence forecast compared to long period average (LPA of 2020-24) error & skill respectively based on absolute error (AE)



Figs. 32(a&b): (a) Absolute Error (AE) intensity forecast and (b) skill against Persistence forecast compared to long period average (LPA of 2020-24) error & skill respectively based on absolute error (AE)



Figs. 33(a&b): (a) Operational landfall point and (b) time forecast errors compared to long period average during 2020-24

5.5.2.3. Cyclonic Storm "DITWAH" over the Bay of Bengal (26th November– 03rd December, 2025)

Alow-pressure area formed over Comorin and adjoining Southwest Bay of Bengal (BoB) & Sri Lanka in the early morning (0530 hrs IST) of 25th November, 2025. It lay as well marked low pressure area over southwest Bay of Bengal and adjoining areas of Southeast Sri Lanka & Equatorial Indian Ocean in the early morning (0530 hrs IST) of 26th November, 2025.It concentrated into a depression over southwest BoB and adjoining Sri Lanka in the midnight (2330 hrs. IST) of 26th November, 2025.It moved north-northwestwards and intensified into a deep depression over the same region in the early morning (0530 hours IST) and into the cyclonic storm "DITWAH" over the same region in the noon (1130 hours IST) of 27thNovember. Continuing to move to north-northwestwards, it crossed Sri Lanka coast around noon (between 1130 to 1230 hrs. IST) of 27th November as a Cyclonic Storm with the wind speed of 60 to 70 gusting to 80 kmph.Thereafter, it emerged into southwest BoB and adjoining North Sri Lanka coasts in the early morning (0530 hrs. IST) of 29th November. Thereafter, it moved nearly northwards and intensified slightly by reaching the maximum sustained wind speed of 70-80 gusting to 90 kmph during 0830 hrs. IST of 29th to 0530 hrs. IST of 30th November and lay centered about 50 km east of Chennai.Continuing to moving further northwards over southwest BoB and adjoining Tamil Nadu-Puducherry coast, it lay about 70km east of north Tamil Nadu- Puducherry coast at 0830 hrs. IST of 30th November and about 30km east of Chennai coast at 1130 hrs. IST of 01st December. While moving northwards, it weakened into a deep depression in the evening (1730 hours IST) of 30th November.Then it gradually recurved south-southwestwards & weakened into a depression in the early morning (0530 hrs. IST) of 2nd December with its center about 25 km away from North Tamil Nadu coast and into a well-marked low-pressure area over North Tamil Nadu-Puducherry coasts and neighbourhood in the early morning (0530 hrs IST) of 3rd December.Observed track of the system is given in Fig. 34.

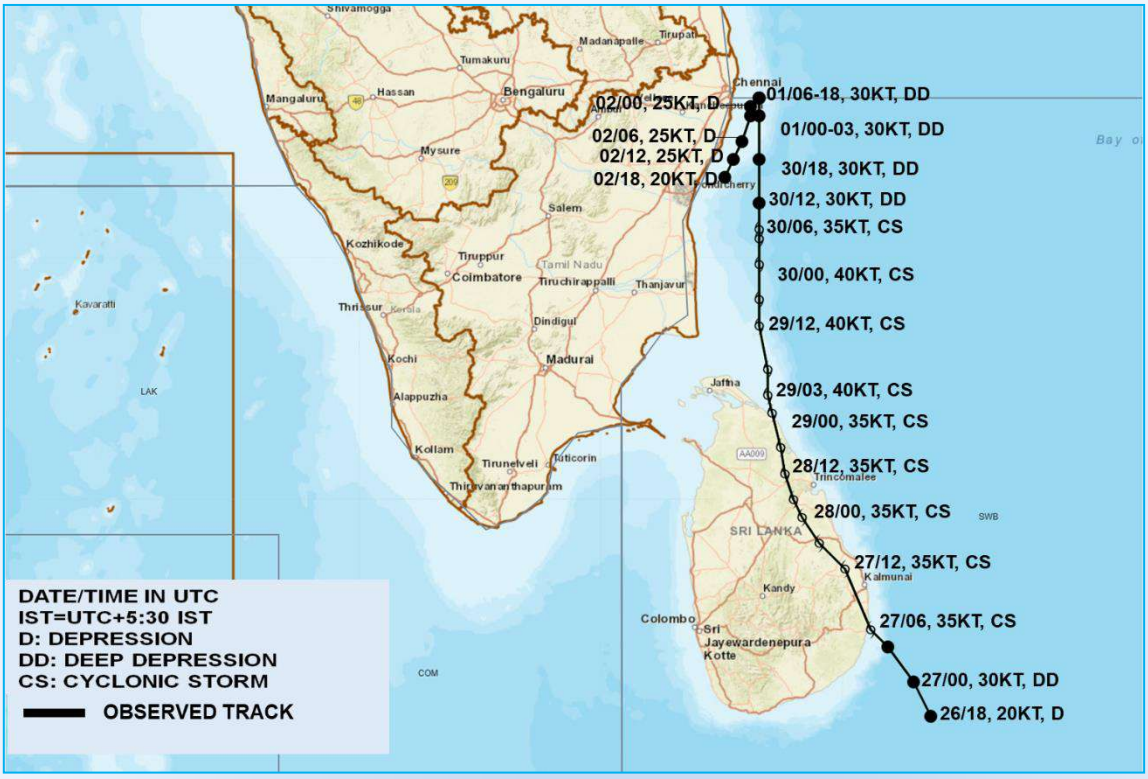


Fig. 34. Observed track of severe cyclonic storm "DITWAH" over Bay of Bengal during 26th November- 03rd December, 2025

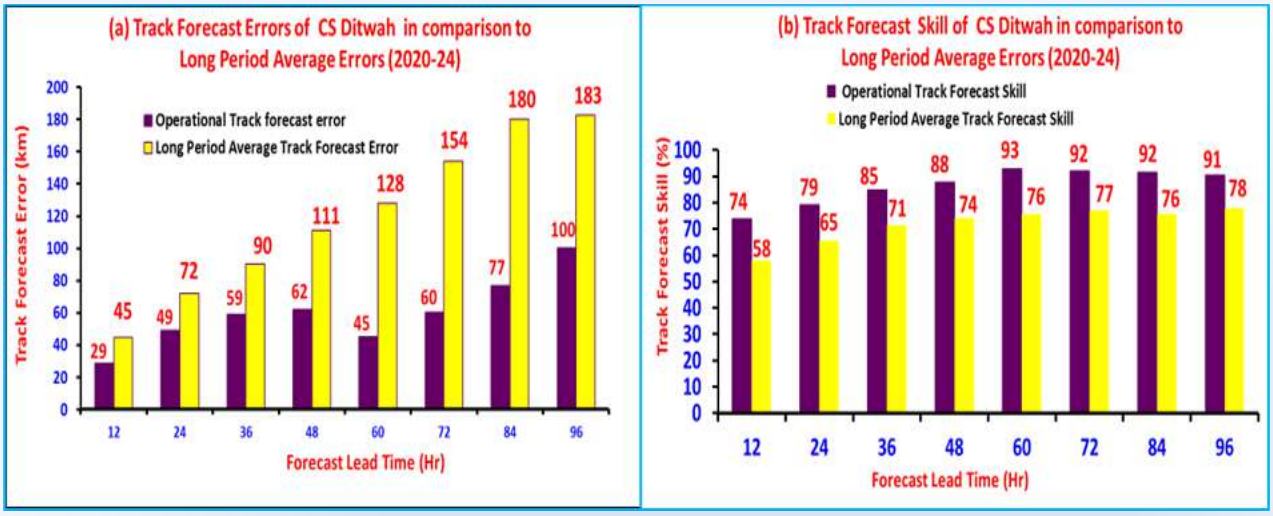
Forecast performance

First information about likely cyclogenesis (formation of Depression) over the BoB was issued on 13th November for 26th November about 13 days ahead of formation of depression. Subsequently, the extended range outlook issued on 20th November (6 days ahead) indicated high (67-100%) probability of cyclogenesis (formation of Depression) over south BoB.

In the tropical weather outlook issued at 1430 hrs. IST of 23rd Nov., it was indicated that a low-pressure area would form over Comorin and adjoining southeast Sri Lanka around 25th Nov. with moderate probability of formation of depression by 25th morning (0830 hrs. IST) and high probability of formation of depression by 26th morning (0830 hrs. IST). Actually, the low-pressure area formed over Comorin & adjoining southeast BoB and Sri Lanka in the early morning (0530 hrs. IST) of 25th Nov.
The same was reiterated in the tropical weather outlook issued at 1430 hrs. IST of 24th Nov.

The tropical weather outlook issued at 1330 hrs. IST of 25th Nov. on formation of low-pressure area over southwest Bay of Bengal and adjoining areas of south Sri Lanka and adjoining Equatorial Indian Ocean indicated north-northwestwards movement and likely intensification onto a well-marked low-pressure area by morning of 26th (0830 hrs. IST) and depression by morning of 27th November (0830 hrs. IST).

Subsequently, the advisory issued in the morning of 26th Nov. (0930 hrs. IST) on formation of well-marked low-pressure area over southwest BoB and adjoining areas of southeast Sri Lanka and Equatorial Indian Ocean predicted that the system would move north-northwestwards and intensify into a depression by morning of 27th Nov. (0830 hrs. IST).
The update issued in the noon of 26th (1230 hrs. IST) indicated the well-marked low-pressure area to intensify into a depression by 27th morning and intensify further thereafter. It was predicted to move north-northwestwards across southwest BoB towards north Tamil Nadu and Puducherry coasts till 29th morning. Actually, it reached southwest BoB and adjoining north Sri Lanka and Tamil Nadu-Puducherry coasts as a cyclonic storm by 29th morning (0830 hrs. IST).



Figs.35(a&b): (a)Track forecast errors and (b) skill against Climatology & Persistence (CLIPER) compared to long period average (LPA of 2020-2024) errors & skill respectively

Actually, low pressure area formed over Comorin on 25th Nov. early morning (0530 hrs. IST), well-marked low-pressure area over southwest BoB and adjoining southeast Sri Lanka on 26th early morning (0530 hrs. IST) and depression over southwest BoB and adjoining Sri Lanka on 26th midnight (2330 hrs. IST), Cyclonic Storm "DITWAH" over southwest BoB and adjoining Sri Lanka in the noon of 27th Nov. (1130 hrs. IST).

The first track and intensity forecast issued in the morning (0930 hrs IST) of 27th Nov., indicated the system to reach peak intensification of 80-90 gusting to 100 kmph over southwest Bay of Bengal and along & off North Tamil Nadu-Puducherry coasts and adjoining North Sri Lanka from early morning of 29th Nov. to early morning of 30th Nov. Actually, Gale wind speed reaching 60 to 70 kmph gusting to 80 kmph was observed over south Sri Lanka on 27th Nov. and 65 to 75 gusting to 85 kmph was observed over central & north Sri Lanka during 27th to 28th Nov. Gale wind speed reaching 70-80 gusting to 90 kmph prevailed over southwest Bay of Bengal and south Tamil Nadu and adjoining north Tamil Nadu-Puducherry & north Sri Lanka during 29th morning to 30th morning.

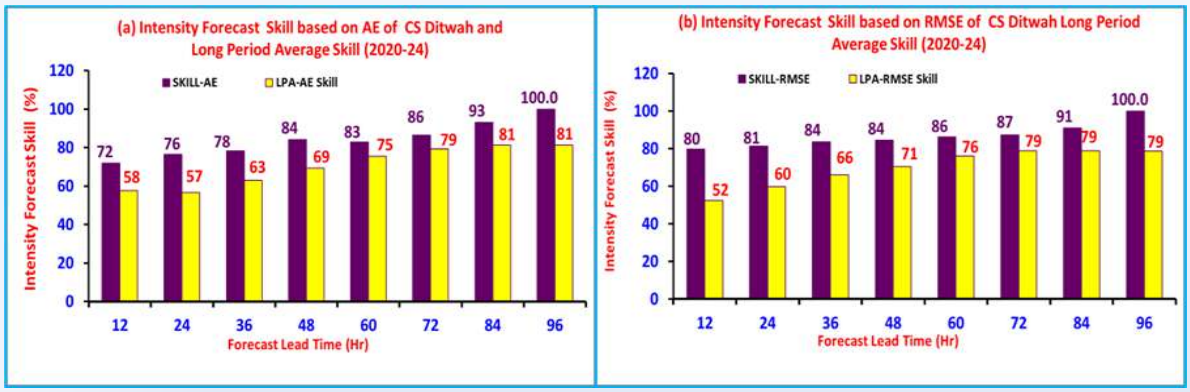
The first track and intensity forecast issued at 1540 hrs. IST of 27th indicated the system to gradually weaken into a deep depression while reaching near Tamil Nadu-Puducherry and adjoining south Andhra Pradesh coast by 01st Dec).

Track, intensity and landfall forecast performance

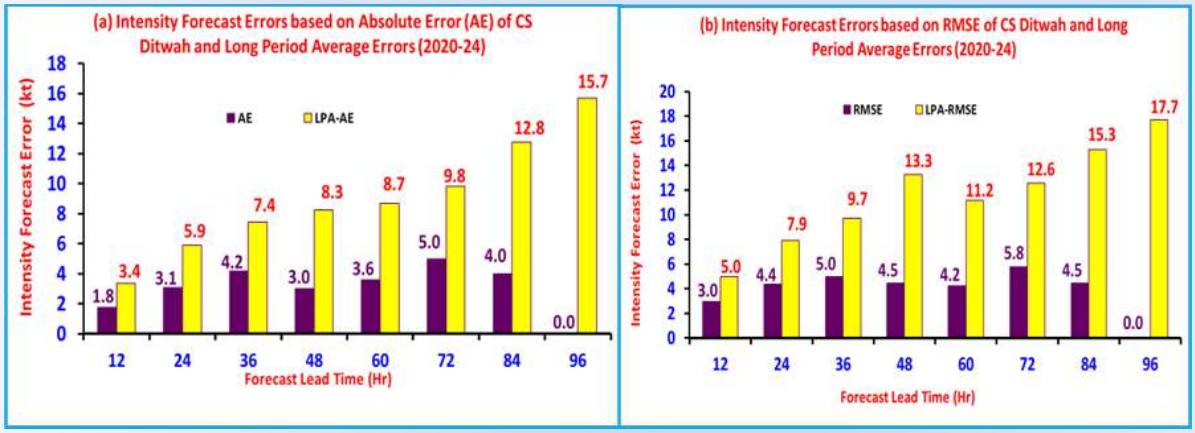
The operational track forecast errors for 24, 48, 72 and 96 hours lead period were 49, 62, 60 and 100 km against long period average (2020-24) of 72, 111, 154 and 183 km respectively (Fig. 35a). The operational track forecast skill compared to climatological & persistence (CLIPER) based forecast for 24, 48, 72 and 96 hours lead period were 79, 88, 92 and 91% against long period average (2020-24) of 65, 74, 77 and 78 % respectively (Fig. 35b,). For all lead periods, the track forecast errors were markedly less than the long period average errors.

The operational intensity forecast absolute errors (AE) for 24, 48, 72, and 96 hours lead period were 3.1, 3.0, 5.0 and zero kt against long period average (2020-24) of 5.9, 8.3, 9.8 and 15.7 kt respectively (Fig. 36a). The operational intensity forecast root mean square errors (RMSE) for 24, 48, 72 and 96 hours lead period were 4.4, 4.5, 5.8 and zero kt against long period average (2020-24) of 7.9, 13.3, 12.6 and 17.7 kt respectively (Fig. 36b). For all lead periods, the intensity forecast errors were markedly less than the long period average errors.

The operational intensity forecast skill based on AE for 24, 48, 72 and 96 hours lead period was 76, 84, 86 and 100% against long period average (2020-24) of 57, 69, 79 and 81% respectively (Fig. 37a). The operational intensity forecast skill based on RMSE for 24, 48, 72 and 96 hours lead period was 81, 84, 86 and 100% against long period average (2020-24) of 60, 71, 79 and 79% respectively (Fig. 37b). For all lead periods, the intensity forecast skills were markedly above the long period average skill.



Figs. 36(a&b): Intensity forecast errors based on (a) AE and (b) RMSE against long period average (LPA of 2020-24) errors respectively.



Figs. 37(a&b): Skill (%) in intensity forecast based on (a) Absolute errors (AE) and (b) Root Mean Square errors (RMSE) as compared to long period average (2020-24)

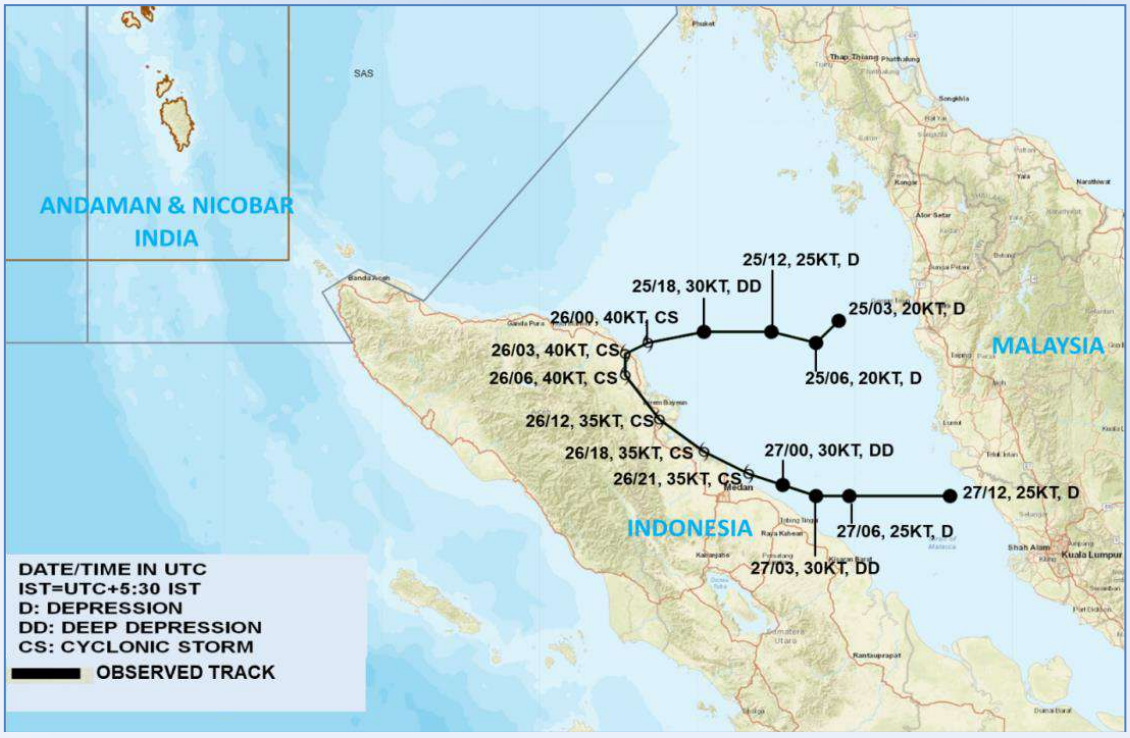


Fig. 38. Observed track of cyclonic storm "Senyar" over Strait of Malacca during 25th to 27th November, 2025

5.5.2.4. Cyclonic Storm "SENYAR" over the Strait of Malacca (25-27 November, 2025)

A low-pressure area developed over Strait of Malacca and adjoining South Andaman Sea in the forenoon (0830 hours IST) of 22nd Nov., 2025. It concentrated into a depression over the Strait of Malacca in the forenoon (0830 hours IST) of 25th Nov.It moved nearly westwards and intensified into a deep depression over Malacca Strait in the midnight (2330 hours IST) of 25th Nov. and into the Cyclonic Storm Senyar over Strait of Malacca and adjoining Northeast Indonesia in the early morning (0530 hours IST) of 26th Nov. while moving west-southwestwards. Continuing to move further west-southwestwards, it crossed Northeast Indonesia near 4.90N/97.750E in the forenoon (during 0830 - 0930 hours IST) of 26th Nov. Thereafter, it gradually recurved southeastwards & emerged back into Malacca Strait in the early hours (0030-0130 hours IST) of 27th Nov. as a cyclonic storm. Thereafter, while moving nearly eastwards, it weakened into a deep depression during early morning (0530 hrs IST) and into a depression around noon (1130 hrs IST) of 27th Nov. over Malacca Strait. Continuing to move eastwards, it maintained the intensity of depression till evening (1730 hrs IST) of 27th Nov. and weakened into a well-marked low pressure area over Malacca Strait and adjoining coastal areas of Malaysia in the midnight (2330 hrs IST) of 27th Nov. Thereafter, it moved across Malaysia into Northwest Pacific & adjoining Equatorial Pacific & weakened gradually. Observed track of the system is given in Fig. 38.

Genesis Forecast

First information about likely cyclogenesis (formation of Depression) over the Bay of Bengal (BoB) during 21st-27th November was issued on 13th November about 12 days ahead of formation of depression over strait of Malacca on 25th November. It indicated likely formation of low pressure area over southeast BoB around 21st Nov. with low probability of formation of depression around 23rd. Subsequently, the extended range outlook issued on 20th November (6 days ahead of genesis of depression) indicated high (67-100%) probability of cyclogenesis (formation of Depression) over south BoB. Thus, the system was monitored with respect to genesis, track, intensity and landfall since 13th Nov. The genesis area was not captured well in the extended range forecast issued by RSMC New Delhi.

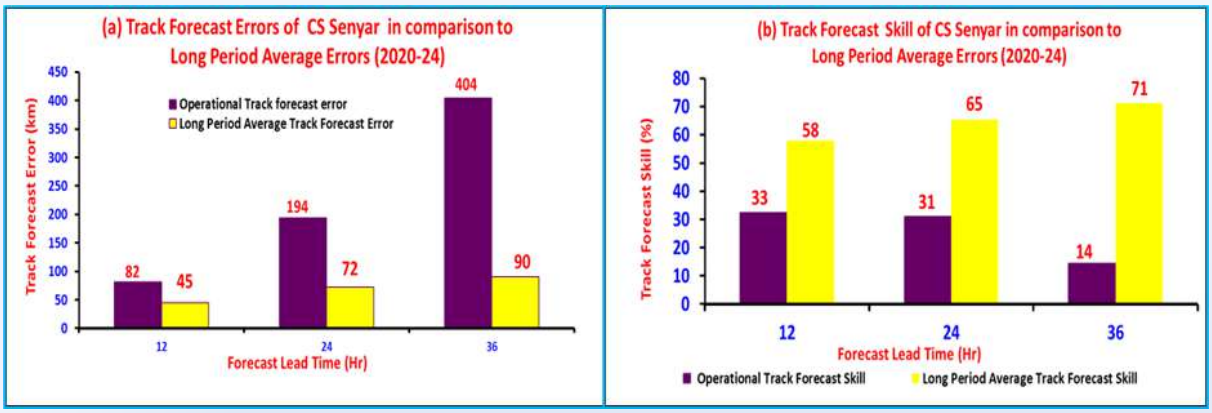
Cyclonic circulation over Strait of Malacca was detected and mentioned in the tropical weather outlook issued at 1130 hrs. IST of 20th Nov. It was indicated that under the influence of cyclonic circulation over Strait of Malacca, a low-pressure area would form over southeast BoB around 22nd Nov. and it was indicated to intensify into a depression with low probability (1-33%) over central parts of South BoB by morning (0830 hours IST) of 24th Nov.

With the formation of low-pressure area over central parts of Strait of Malacca and adjoining South Andaman Sea in the morning (0830 hrs. IST) of 22nd Nov., it was predicted that the system would intensify further into a depression over southeast BoB and adjoining south Andaman Sea around 24th Nov. At that time, the conditions were becoming favorable for formation of an upper air cyclonic circulation over Comorin area as well.

The advisories were further upgraded in the tropical weather outlook issued at 1430 hrs. IST of 24th Nov. indicating likely formation of depression over south Andaman Sea by 25th Nov. and further intensification into a cyclonic storm over south BoB by 27th Nov.

The first Special Tropical Weather Outlook issued at 1330 hours IST of 25th Nov. on formation of depression over Strait of Malacca at 0830 hrs IST indicated the system to move west-northwestwards and intensify further during 25th to 27th Nov.

Thus, in the initial stage till the formation of depression, the area of genesis could not be predicted, as it was displaced to west compared to actual area of genesis over Strait of Malacca.
The subsequent special tropical weather outlook issued at early morning hours (0130 hrs. IST) of 26th Nov on formation of deep depression over Strait of Malacca indicated the system to move west-southwestwards, intensify into a cyclonic storm and cross Indonesia coast as a cyclonic storm in the morning hours (around 0830 hrs IST) of 26th Nov. It was also indicated that the system



Figs. 39(a&b): (a) Track forecast error and (b) skill against Climatology & Persistence (CLIPER) forecast compared to long period average (LPA of 2020-24) errors & skills respectively

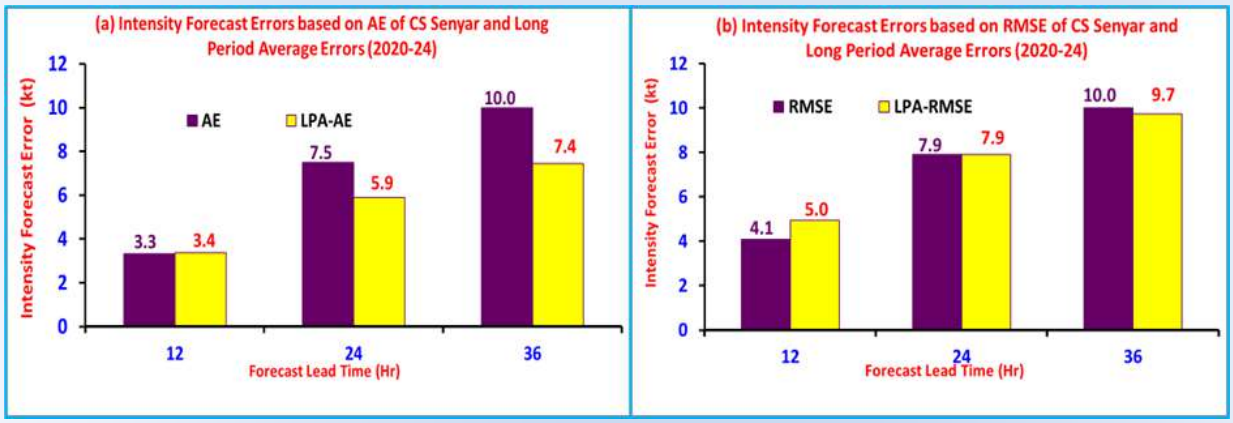


Fig. 40(a&b): Intensity forecast errors based on (a) AE and (b) RMSE against long period average (LPA of 2020-24) errors respectively

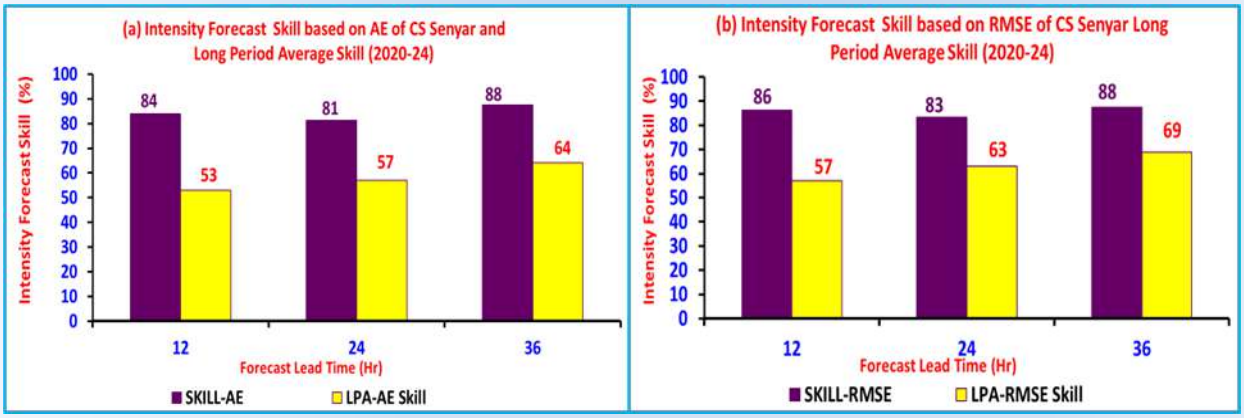


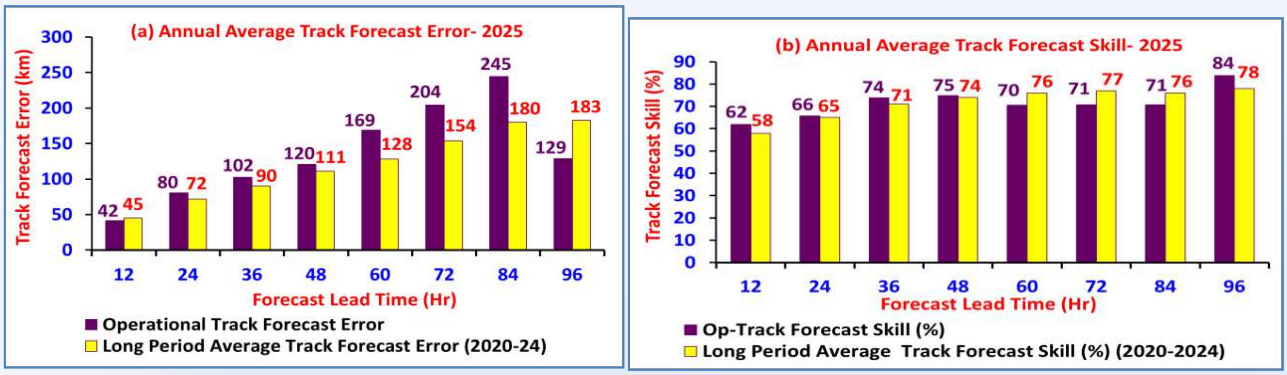
Fig.41(a&b): Intensity forecast skills (%) based on (a) AE and (b) RMSE compared to LPA skills during 2020-24

would recurve east-southeastwards while moving across Indonesia.

First Tropical Cyclone Advisory issued in the morning (0930 hrs IST) of 26th Nov., further reiterated the above forecast.

The system caused extremely heavy rains, flash floods and landslides in Indonesia and Malaysia, as per media reports leading to loss of lives and properties.

Maximum sustained wind speed reaching 70-80 gusting to 90 kmph prevailed over the Strait of Malcca and along & off adjoining Indonesia during 26th morning to 26th evening and 65 to 75 gusting to 85 kmph during 26th evening and 27th morning. The sea condition over Malacca



Figs. 42(a&b): Annual average (a) track forecast error (km) and (b) track forecast skill against the climatology and persistence forecast during 2025 as compared to that during 2020-2024

strait and along & off adjoining Indonesia coast was high on 26th and 27th Nov.

No adverse weather was observed over the Andaman and Nicobar Islands in association with this system, though the sea condition remained rough to very rough.

The operational track and intensity forecast errors were comparatively higher than the long period average errors, as the system exhibited multiple recurvatures and was interacting with other cyclonic vortices over south BoB and the northwest Pacific during its life period.

Operational track, intensity and landfall forecast performance

The operational track forecast errors for 12, 24 and 36 hours lead period were 82, 194 and 404 km against long period average (2020-24) of 45, 72 and 90 km respectively (Fig. 39a). The operational track forecast skill compared to climatological & persistence (CLIPER) based forecast for 12, 24 and 36 hours lead period were 33, 31 and 14 91% against long period average (2020-24) of 58, 65 and 71 % respectively (Fig. 39b).

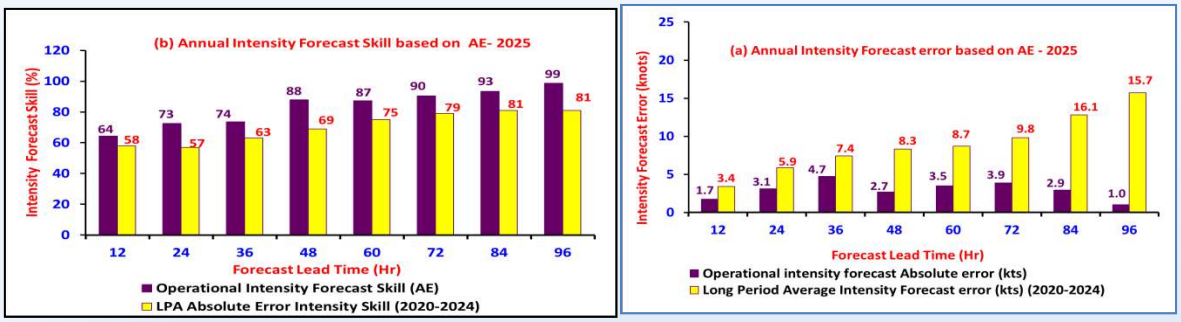
The operational intensity forecast absolute errors (AE) for 12, 24 and 36 hours lead period were 3.3, 7.5 and 10.0 kt against long period average (2020-24) of 3.4, 5.9, and 7.4 kt respectively (Fig. 40a). The operational intensity forecast root mean square errors (RMSE) for 12, 24 and 36 hours lead period were 4.1, 7.9 and 10.0 kt against long period average (2020-24) of 5.0, 7.9 and 9.7 respectively (Fig. 40b). The intensity forecast errors were quite comparable to long period average errors.

However, the operational intensity forecast skill based on AE for 12, 24 and 36 hours lead period was 84, 81 and 88 % against long period average (2020-24) of 58, 57 and 63% respectively (Fig. 41a). The operational intensity forecast skill based on RMSE for 12, 24 and 36 hours lead period was 86, 83 and 88% against long period average (2020-24) of 52, 60 and 66% respectively (Fig. 41b). For all lead periods, the intensity forecast skills were markedly above the long period average skill.

5.5.3.1. Annual Performance of cyclone landfall, track and intensity forecast

The annual average track forecast errors in 2025 have been 80 km, 120 km and 204 km, respectively for 24, 48 and 72 hrs against the past five-years average error of 72, 111 and 154 km based on data of 2020-2024. The errors have been lesser during this year as compared to long period average (LPA) (2020-24), The track forecast skills compared to climatology and persistence forecast have been 66%, 75% and 71% respectively for the 24, 48 and 72 hrs lead period which was also less than long period average of 2020-2024 (65%, 74% & 77% respectively).The annual average track forecast errors and skill during 2025 are presented in Figs. 42(a&b).

The annual average absolute error (AE) in intensity forecast error Figs.43 (a-b) has been 3.1 knots, 2.7 knots and 3.9 knots respectively for 24, 48 and 72 hrs lead period of forecast against the past five-year average of 5.9, 8.3 and 9.8 knots. The skill in terms of AE compared to persistence forecast was 73%, 88% and 90% as compared to long period average (2020-24) of 57%, 69% and 79% for 24, 48 and 72 hours period.



Figs. 43(a&b): Annual average (a) absolute error (AE) in kts and (b) skill in % during 2025 as compared to long period average (LPA) during 2020-2024

The annual average landfall forecast errors for the year 2025 have been 76 km, 82 km and 121 km for 24, 48 and 72 hrs lead period against the past five years average errors of 16 km, 39 km and 70 km during 2020-2024. The landfall time forecast errors have been 3.0, 3.0 and 1.5 hrs for 24, 48 and 72 hrs lead period during 2025 against the average of past five years of 2.9, 4.2 and 7.5 hrs during 20120-2024. The annual average landfall points and time forecast errors are presented in Fig. 44 (a-b).

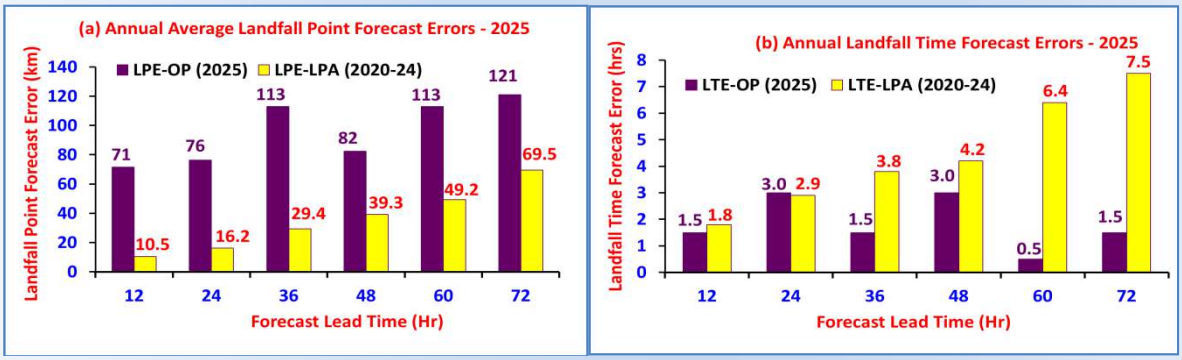
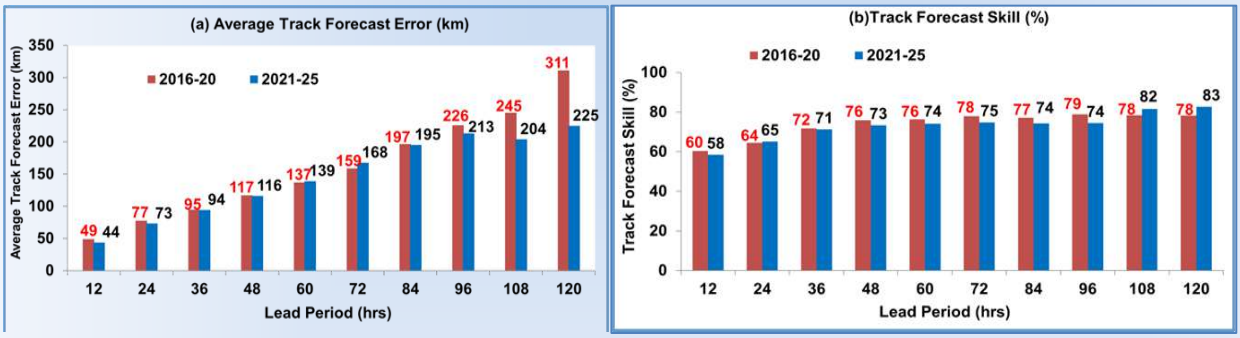


Fig. 44(a&b): Annual average (a) landfall point forecast error (km) and (b) landfall time forecast errors as compared to long period average errors during 2020-2024



Figs. 45(a&b). Comparative Average track forecast (a) error (km) (b) skill (%) during 2020-2024 vis-à-vis 2016-20

The comparative analysis of average intensity forecast error and skill based on AE during 2021-25 and 2016-20 are presented in Figs.46 (a&b). The average intensity forecast error based on AE for 24hrs, 48hrs and 72hrs are 5.3 knots, 7.5 knots and 9.1 knots during 2021-25 against 7.9 knots, 11.4 knots and 14.1 knots during 2016-20. Based on RMSE the intensity forecast errors were 7.9 knots, 13.3 knots and 12.6 knots during 2021-25 against 9.9 knots, 13.8 knots, and 16.7 knots during 2016-20. It can be seen that there has been marginal improvement in intensity forecast during recent five years (2021-25) as compared to previous five years (2016-20).

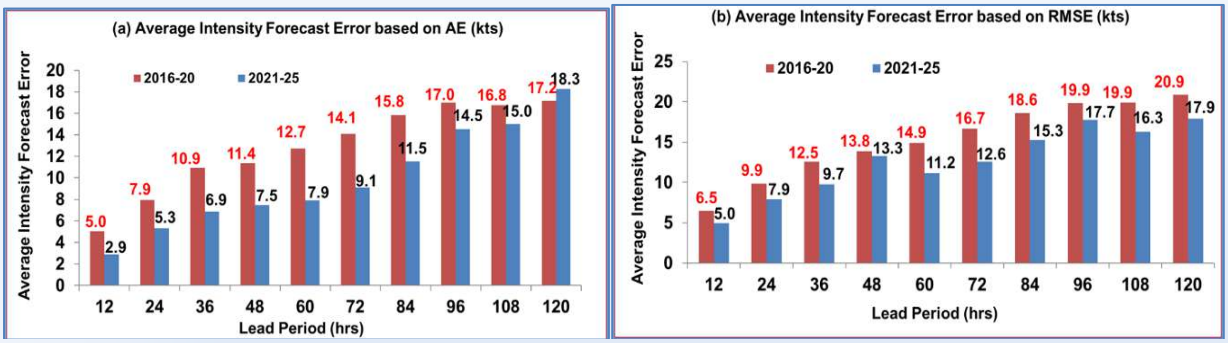
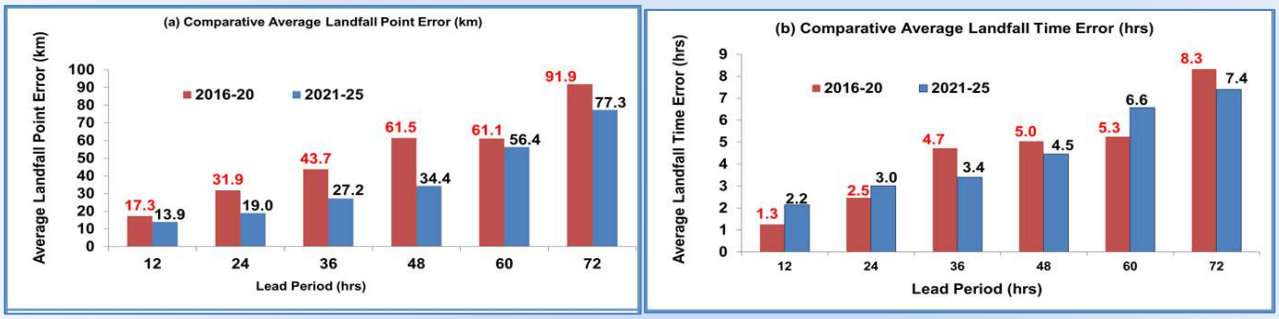
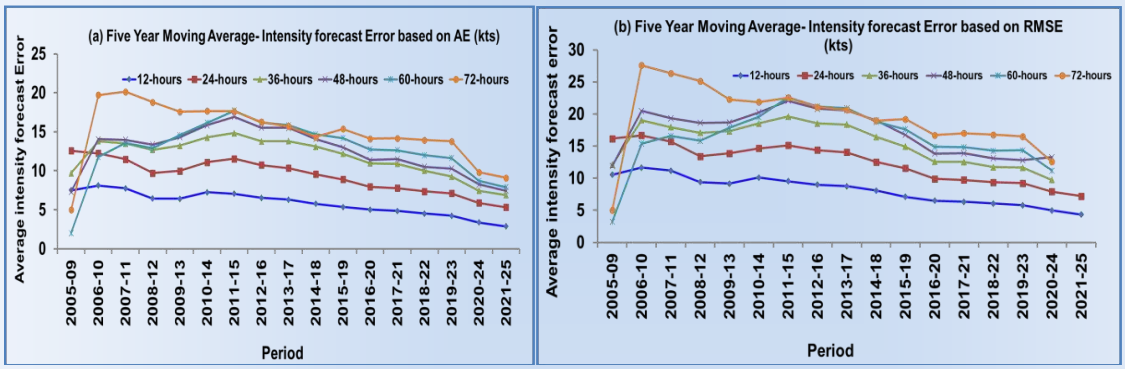


Fig. 46: Comparative average intensity forecast errors (kts) based on (a) absolute error and (b) root mean square errors during 2020-2024 vis-à-vis 2016-20



Figs. 47(a&b). Comparative average landfall (a) point and (b) time forecast errors during 2020-2024 vis-à-vis 2016-20



Figs. 48(a&b): Five Year Moving Average Intensity Forecast skill based on (a) AE and (b) RMSE of RSMC, New Delhi over North Indian Ocean

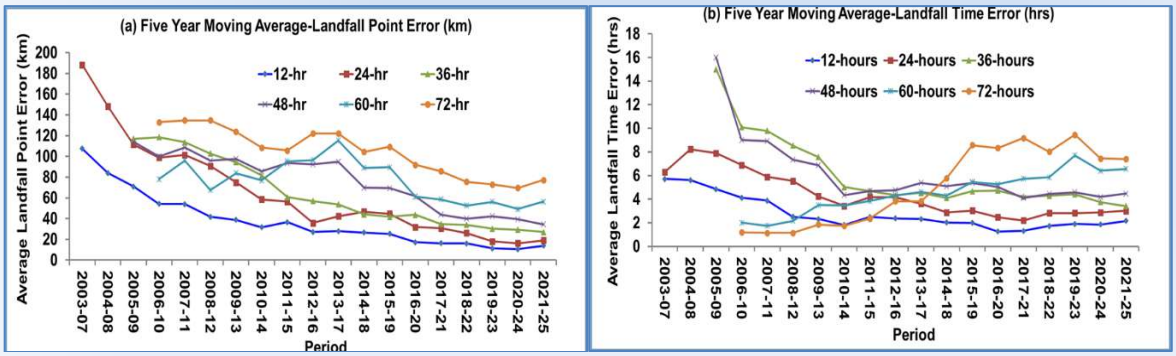


Fig.:49 Five Year Moving Average Errors in (a) Landfall Point (km) and (b) Landfall Time (hrs) of RSMC, New Delhi over north Indian Ocean

The average intensity forecast skill based on AE for 24hrs, 48hrs and 72hrs are 54%, 68% and 78% during 2021-25 against 52%, 72% and 75% during 2016-20. Based on RMSE the intensity forecast skill were 65%, 67% and 83% during 2021-25 against 59%, 69% and 78% during 2016-20. It can be seen that there has been marginal improvement in intensity forecast during recent five years (2021-25) as compared to previous five years (2016-20). Comparative analysis of landfall point error (LPE) and landfall time error (LTE) during 2021-25 vis-à-vis 2016-20 is presented in Figs. 47 (a & b). The LPE for 24, 48 and 72 hrs lead period during 2021-25 were 19.0 km, 34.4 km and 77.3 km against 31.9 km, 61.5 km and 91.9 km respectively during 2016-20 which shows an improvement of 41%, 44% and 16% respectively. The LTEs for 24, 48 and 72 hrs lead period during 2021-25 were 3.0hrs, 4.5hrs & 7.4hrs against 2.5hrs, 5.0hrs & 8.3hrs respectively during 2016-20 registering an improvement of -22% and 12% for 24 and 48 hours lead period respectively.

5.5.3.3. Five Year Moving Average errors and skill over north Indian Ocean

Five year moving average track forecast errors and corresponding skills for different lead periods upto 120 hours are presented in Figs. 48(a&b), indicating consistent decrease in track forecast errors since 2003.

Five year moving average intensity forecast errors and corresponding skills for different lead periods upto 120 hours are presented in Figs. 49(a&b) indicating consistent decrease in intensity forecast errors since 2003.

Five Year Moving Average Errors in (a) Landfall Point (km) and (b) Landfall Time (hrs) of RSMC, New Delhi over north Indian Ocean are presented in Figs.50 (a&b).

5.5.4. New Initiatives

5.5.4.1. New Cone of Uncertainty (COU) wef October, 2025:

The cone of uncertainty (COU) represents the uncertainty in forecast locations based on previous 5 years errors operational track forecast errors. NewCOU values have been introduced from post monsoon season 2025 based on the operational errors during 2020-24. The standard errors (nm) as radius of the circle around the forecast position (lat/long) so as to construct the cone of uncertainty in the track forecast for 00, +06, +12, +18, +24, +36, +48, +60, +72, +84, +96, +108 and +120 hrs lead period have been fixed as 10, 20, 25, 35, 40, 50, 60, 70, 85, 100, 115, 130 and 145 nm respectively since October, 2025. It has led to a reduction of about 10-15% in the uncertainty in forecast locations (Fig. 50).

5.5.4.2. Introduction of Level of confidence in current and predicted location and intensity wef October, 2025

RSMC New Delhi introduced confidence level in current and forecast location & intensity as low, moderate and high wef post monsoon cyclone season 2025. Track and Intensity estimate is based on multiple data sources including satellite, scatterometer, multi-satellite based winds, radar, synoptic, guidance from other centres etc.

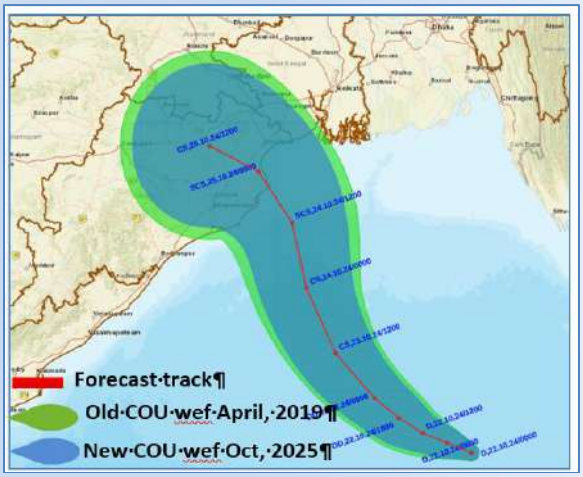


Fig. 50: Comparative COU wef April 2019 and Oct. 2025 alongwith forecast track during cyclone DANA.

Considering the variation in the estimate by different sources, probability or confidence in estimation of intensity and location is decided as given in Table 1 and Table 2 respectively.

IMD updated the Tropical Cyclone Operation Plan (TCP-21) for the North Indian Ocean with inputs from 13 WMO/ESCAP panel member countries in the Bay of Bengal and Arabian Sea region. The same was approved during the 51st session of WMO/ESCAP Panel on Tropical Cyclones held online in May, 2024. The basic purpose of the operational plan is to facilitate the most effective tropical cyclone warning system for the region with existing facilities. In doing so the plan defines the sharing of responsibilities among Panel countries

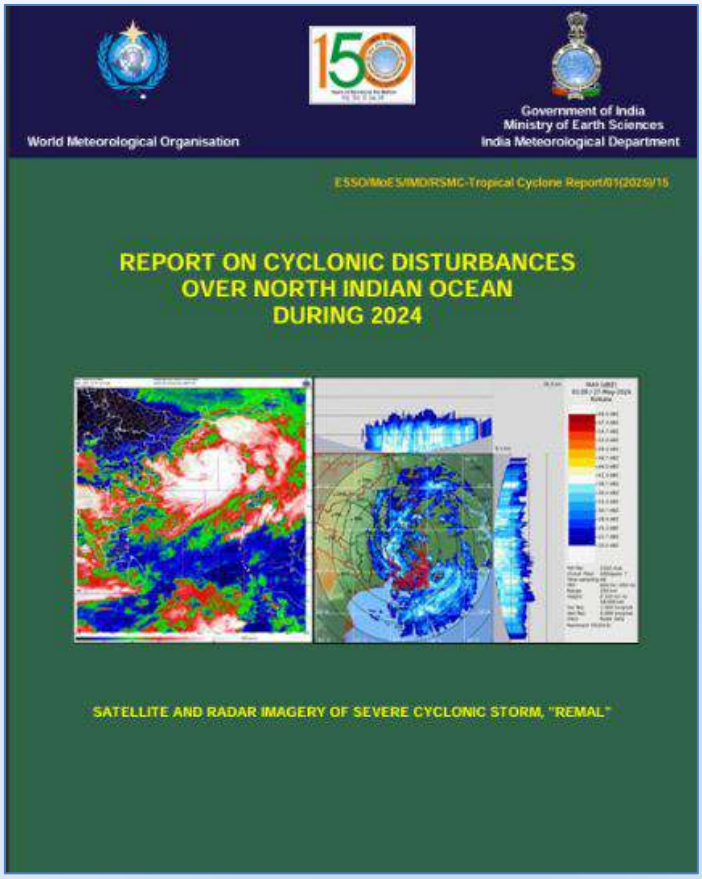


Table 1
Confidence level for estimation of intensity

Range	Confidence Level
<10 kt	High
10-20 kt	Moderate
>20 kt	Low

Table 2
Confidence level for estimation of location corresponding to various lead period

Lead time (hr)	Confidence level		
	Low	Moderate	High
0	>0.5°	0.3° - 0.5°	0.3°
+24	>1.0°	0.5° - 1.0°	0.5°
+48	>1.5°	1.0° - 1.5°	1.0°
+72	>2.0°	1.5° - 2.0°	1.5°
+96	>2.5°	2.0° - 2.5°	2.0°
+120	>3.0	2.5° - 3.0°	2.5°
+144	>3.5°	3.0° - 3.5°	3.0°
+168	>4.5°	4.0° - 4.5°	4.0°

records the coordination and cooperation achieved. The plan records the agreed arrangements for standardization of operational procedures, efficient exchange of various data related to tropical cyclone warnings, issue of cyclone advisories from a central location having the required facilities for this purpose, archival of data and issue of a tropical weather outlook for the benefit of the region. The operational plan contains an explicit formulation of the procedures adopted in the Bay of Bengal and Arabian Sea region for the preparation, distribution and exchange of information and warnings pertaining to tropical cyclones. The plan was uploaded on WMO website and RSMC website.

5.6. Drought Monitoring & Prediction

Drought Monitoring and Prediction is being done using different indices like SPI (Standardized Precipitation Index), AAI (Aridity Anomaly Index) and SPEI Drought monitoring using Aridity Anomaly Index (AAI). The SPI maps are being generated every week as well as every month to identify the regions with prevailing or beginning/ ending of the extremely/ severely/ moderately dry/ wet conditions. The detailed statistics of the

SPI computed for the entire SW monsoon period helps the various state government agencies for initiating drought management. Weekly SPI maps and values is being sent to all the state authorities as demanded by them according to new Drought manual of Ministry of Agriculture.

Weekly Drought monitoring using Standardized Precipitation Evaporation Index (SPEI) is being done.Prediction of one-week advance SPI and AAI maps is being done during SW monsoon and NE monsoon using IMD GFS district rainfall forecast.SPI Forecast maps for one week to four weeks are also being generated using ERFS data.

WORLD METEOROLOGICAL ORGANIZATION
TECHNICAL DOCUMENT

WMO/TD No. 84

TROPICAL CYCLONE
PROGRAMME
Report No. TCP-21

TROPICAL CYCLONE OPERATIONAL PLAN
FOR THE BAY OF BENGAL AND THE ARABIAN SEA

Edition 2025

SECRETARIAT OF THE WORLD METEOROLOGICAL ORGANIZATION
GENEVA SWITZERLAND

CHAPTER 6

CAPACITY BUILDING, PUBLIC AWARENESS & OUTREACH PROGRAMME

6.1. IMPORTANT EVENTS

IMD celebrated its 150th Foundation Day on 14th & 15th January 2025

IMD celebrated its 150thFoundation Day on 14th& 15thJanuary, 2025. Hon'ble Prime Minister**Shri Narendra Modi Ji** graced this momentous occasion as Chief Guest. **Dr. Jitendra Singh**, Hon'ble Minister, Union Minister of State (Independent Charge) of the Ministry of Earth Sciences and **Prof. Celeste Saulo**, Secretary General, WMO also graced the occasion as guests of honour. The Permanent Representatives of various member countries to WMO, representatives from World Bank, United Nations, Heads of various organisations, Chief Secretaries, Secretaries to Govt. of India, Heads of leading organisations, retired and serving employees of IMD and MoES institutes, representatives of state and central government agencies, R&D and academic institutes, students, teachers and parents of studentsparticipated in the function.

India MeteorologicalDepartment (IMD) celebrate its 150th Foundation Day on 14th& 15th January, 2025

Hon'ble Prime Minister of India launched Mission Mausam with an objective to make India a weather ready and climate-smart nation

The main activities of the programme

Hon'ble PM addressed the Nation during the inaugural ceremony of IMD's Foundation Day. In his address to the nation, Hon'ble Prime Minister appreciated the role of IMD in advancing India's scientific progress. He highlighted IMD's contributions to disaster management, weather forecasting and climate resilience. He lauded IMD's growing infrastructure and its positive impact on sectors like agriculture and the blue economy and expressed confidence in India's future role in global meteorological advancements. He appreciated weather forecasting by IMD by quoting various examples. He further said that the achievement of IMD shows scientific progress of the country as the scientific research becomes fruitful only when it benefits the poor people of the society and the service of IMD reached the each section of the society.On this occasion, Hon'ble Prime Ministerlaunched Mission Mausam with an objective to make India a weather ready and climate-smart nation. Mission Mausam is a symbol of India's commitment towards sustainable future and future readiness.

Dr. Mrutyunjay Mohapatra, DG IMD presented the Welcome Address

Hon'ble Prime Minister released the Coffee Table Book showingthe successful journey of 150 years of IMD

Dr. Jitendra Singh, HMoES in his address appreciated IMD and described detailed achievements of IMD including the improvement in forecast accuracy in recent decades and improvement in observation, modeling and communication infrastructure of IMD.

The Honorable Prime Minister of India released customized My Stamp and a Coin commemorating 150 years of IMD

Hon'ble Prime Minister, released the customized My Stamp and a Coin commemorating 150 years of IMD

Prof. Celeste Saulo, Secretary General of WMO also addressed the gathering and appreciated IMD for its role in global arena by providing observation, modeling, communication, forecasting and advisory support to different countries, especially southAsia, southeast Asia, middle East, Bay of Bengal and Arabian sea region.

About 3000 delegates participated in the function. Hon'ble PM interacted with the students who won the prizes in national level Olympiad organised by IMD to commemorate 150 years of IMD.

Visit of Hon'ble Prime Minister to IMD Exhibition Stall

Hon'ble Prime Minister Visited IMD Exhibition Stall

Secretary, MoES; Director General, IMD; Director IITM, Pune and other dignitaries visited exhibitionat Bharat Mandapam

As part of the grand celebration of 150 years of IMD, several workshops were organized by IMD as follows:

Weather services for women

A one-day seminar on "**Weather Services for Women**" was organized on 3rd January, 2025, at Mahika Hall, Ministry of Earth Sciences (MoES), New Delhi. The event aimed to highlight gender considerations in meteorology, promote women's representation in the field, and discuss the impact of climate on women's health and social conditions. The workshop provided a platform for experts, policymakers, and stakeholders to exchange ideas and explore innovative approaches to integrating gender perspectives into weather services.

The workshop was graced by several eminent personalities, including:

Chief Guest	: Dr. Parvinder Maini, Scientific Secretary, Office of the Principal Scientific Adviser, Government of India
Secretary, MoES	: Dr. M. Ravichandaran
DGM, IMD	: Dr. M. Mohapatra
Guest of Honour	: Dr. Swati Basu, Former Scientific Secretary, Office of the Principal Scientific Adviser
	: Smt. Shubha Thakur, Additional Secretary, Department of Agriculture & Farmers Welfare (DoA&FW)

The workshop proceeded with the technical and panel discussion sessions

A one-day seminar on "Weather Services for Women" was organized on 3rd January, 2025, at Mahika Hall, Ministry of Earth Sciences (MoES), New Delhi

Weather and Youth (Way)

One-day National workshop on "**Weather and Youth (WAY)**" was organized at Mahika Hall, PrithviBhawan, MoES, New Delhi on 11th January, 2025. The workshop saw the launch of the interactive 'Weather and Youth' Portal to engage young Indians. It concluded with inspiring IMD Young Scientists' Vision 2047strategies, spotlighting youth in advancing weather & climate services.

One-day National workshop on "Weather and Youth (WAY)" was organized at Mahika Hall, Prithvi Bhawan, MoES, New Delhi on 11th January, 2025

Run For Mausam

The **'Run for Mausam'** event was organised on January 12, 2025 at Jawaharlal Nehru Stadium, New Delhi, bringing together people in support of climate action for a sustainable future.

The event was graced by **Dr. M. Ravichandran**, Secretary, MoES, and **Dr. M. Mohapatra**, DGIMD, this event highlighted the importance of coming together as a society for our nation. Over 750 participants run for Mausam during the event.

The 'Run for Mausam' event was organised on January 12, 2025 at Jawaharlal Nehru Stadium, New Delhi, bringing together people in support of climate action for a sustainable future

National Symposium On 75 Years of Mausam Journal

One day National Symposium on"**Seventy-Five Years of Accomplishment of Mausam: Journal of Meteorology, Hydrology and Geophysics**" was organized at Mahika Hall, PrithviBhawan, MoES, New Delhi on 13th January, 2025. The symposium was inaugurated with the ceremonial lighting of the lamp by esteemed dignitaries **Dr. R. R. Kelkar**, Ex-DG, IMD; **Dr. M. Mohapatra**, DG IMD; **Dr. D. S. Pai**, Sc. 'G' and **Dr. V. K. Soni**, Sc. 'F'.

The event proceeded with technical and panel discussion sessions.

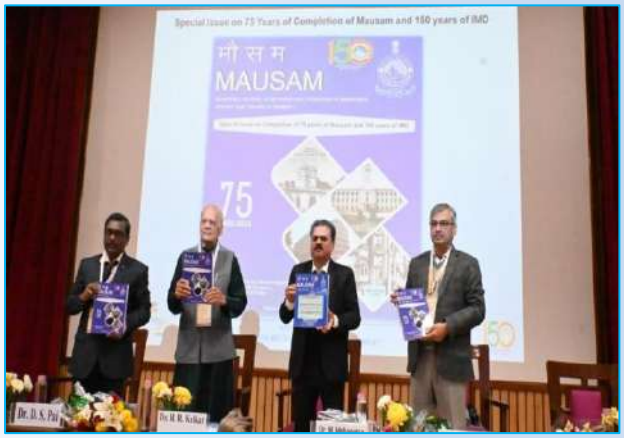
During the occasion, the 31st Biennial Mausam Award was conferred upon Dr. Mrutyunjay Mohapatra, Smt. Monica Sharma, Dr.Sunitha S. Devi, Smt. Bharati S. Sabade and Shri S. V. J. Kumar for their research paper entitled "**Frequency of genesis and landfall of different categories of tropical cyclones over the North Indian Ocean**".

Dr. Mrutyunjay Mohapatrareceving the 31st Biennial Mausam Award

A booklet of all Biennial Mausam Award Papers namely, **Compendium of Biennial Mausam Award Papers** was compiled and launched during the event by **Dr. R. R. Kelkar**.

Compendium of Biennial Mausam Award Papers was launched during the event by Dr. R. R. Kelkar

The **29thspecial issue**, commemorating the completion of 75 years of *Mausam* and 150 years of the India Meteorological Department (IMD) was also launched by the dignitaries present on the dais.Book on abstracts was also released.



The 29th special issue, commemorating the completion of 75 years of Mausam and 150 years of the India Meteorological Department (IMD) was also launched

Celebration Of International Women's Day (IWD)

International Women's Day (IWD) was celebrated on 8th March to honor the remarkable achievements of women across various sectors while also acknowledging the challenges they continue to face. The IWD 2025 campaign theme**,** "**For ALL Women and Girls: Rights, Equality, Empowerment**," highlights the need for collective action to ensure equal rights, power and opportunities for all. This year, the Fit India Mission, under the Sports Authority of India, has planned a week-long celebration from 3rd to 9th March, 2025 to promote fitness, mental well-being, healthy nutrition, and social inclusion. Aligned with the theme "Stronger Her, Healthier Future," the initiative encourages women to prioritize their health and well-being. The official slogan for this campaign is "**Fitness ka dose, Aadha ghanta roz**" reinforcing the importance of daily physical activity.

International Women's Day (IWD) was celebrated on 8th March to honor the remarkable achievements of women across various sectors

As part of these celebrations, **DGM, HQ**, has organized women-centric activities **from 3rd to 7th March, 2025**. All women employees (Regular / Project Staff / Research Students / Housekeeping Staff) posted at DGM, HQ including RMC, New Delhi and NCS participated in the event. Celebration commenced on March 3, 2025, the event empowered women through engaging activities centered on health, fitness, and unity, leading to enthusiastic participation and a strong sense of community wellness.

World Meteorological Day 2025

The India Meteorological Department (IMD) celebrated **World Meteorological Day 2025** on **23rd March 2025** at **Mahika Hall**, Ministry of Earth Sciences, New Delhi, along with its sub-offices across the country.

IMD celebrated World Meteorological Organisation Day 2025 at Mahika Hall, Ministry of Earth Sciences,New Delhi

WMO Day 2025 Celebration at MC Ranchi

WMO Day 2025 Celebration at MWO Kolkata

World Meteorological Day Celebrations CWC Visakhapatnam:

The WMO celebrations commenced from 19th March 2025 with the culmination of the main function on 24 March 2025. The details of the events are as follows:

21 officers from INS Dega visited DWR Visakhapatnam and participated in WMO Day Celebrations on 19 March 2025. They were briefed about the workings of RADAR, Application and other utilities in Meteorology. A video presentation on various aspects of RADAR was shown to the visiting officials.

21 officers from INS Dega visited DWR Visakhapatnam and participated in WMO Day

A radio talk on "WMO DAY, its theme, and various activities and success stories of IMD" was aired on All India Radio, Visakhapatnam. The talk was delivered in Telugu by Shri. S. V. J. Kumar, Met. B and was broadcast on 23rd March 2025.

On this day, an open house exhibition was arranged for public, media and students at CWC and DWR Visakhapatnam. Standees and other displays were arranged for public view. The theme topic of the year "Closing the Early Warning Gap Together" was displayed.

Students and teachers from various schools visited CWC Visakhapatnam

About 100 Students and teachers from various schools visited this office. The officers and staff explained various services provided by the CWC and IMD in order to create awareness amongst the students and the teachers. Special emphasis was made on the early warning services, disaster management, theme topic of the WMO Day and also the students and teachers visited the observatories.

India's Weather and Disaster Preparedness and Roll Out Roadmap For Accurate Forecast

Hon'ble Union Minister of State (Independent Charge) for Science & Technology, Earth Sciences and Minister State for PMO, Department of Atomic Energy, Department of Space, Personnel, Public Grievances &Pensions, **Dr. Jitendra Singh** chaired a high level meeting of India Meteorological Department and other key ministries to review India's weather and disaster preparedness and also to roll out roadmap for accurate forecast on 25th April, 2025. Hon'ble Minister called for expediting expansion of Doppler Weather Radar (DWR) coverage and modernisation of meteorological systems across the country.

Hon'ble Union Minister Dr. Jitendra Singh chaired a high level meeting of India Meteorological Department and other key ministries

3rd Session of the 3rd Pole Climate Forum (TPCF-3) and meeting of the Third Pole Regional Climate Centre Network (TPRCC-Network) Task Team

Dr. M. Ravichandran, Secretary, MoES, delivering Inaugural address in TPCF-3

The World Meteorological Organization (WMO) and the India Meteorological Department (IMD) jointly hosted the 3rd Session of the 3rd Pole Climate Forum (TPCF-3) and meeting of the 3rd Pole Regional Climate Centre Network (TPRCC-Network) Task Team, held at New Delhi during 3rd to5th June,2025.

Participant of the 3rd Pole Regional Climate Centre Network (TPRCC-Network) Task Team meeting, held at New Delhi

Release of publication on 150 years of IMD by AIDMI

India Meteorological Department (IMD) and the All-India Disaster Mitigation Institute (AIDMI) co-hosted a virtual roundtable event entitled "**Celebrating 150 Years of IMD: Frontiers for Early Warning**" This event not only marked a century and a half of IMD's pioneering service in weather forecasting and disaster risk reduction but also celebrated a moment of international pride Dr.Mrutyunjay Mohapatra, Director General of IMD, as the recipient of the United Nations Sasakawa Award-2025 for Disaster Risk Reduction. From accurate cyclone warnings and heavy rainfall alerts to heatwave advisories, IMD has been a cornerstone of India's climate resilience. The roundtable explored how India's early warning systems—built on science, technology, and community outreach—can become more useful to its own people, its neighbours, and the world. A special issue of South Asia disasters. entitled "Celebrating 150 Years of IMD: Frontiers for Early Warning" was launched during the event and shared widely for learning and engagement.

Celebrating 150 Years of IMD: Frontiers for Early Warning

India Meteorological Department organized Pre-Cyclone Exercise Meeting on 04th April, 2025

India Meteorological Department organized Pre-Cyclone Exercise Meeting on 04th April, 2025 in hybrid mode under the Chairmanship of Dr. Mrutyunjay Mohapatra, DG IMD**.** Around 50 officers joined the meeting at Headquarters and 260 participants from different organizations including central level disaster management agencies, state level disaster management (DM) agencies, various Ministries & Departments, IMD's sister organizations and research institutes joined online. The national level DM agencies included representatives from National Disaster Management Authority (NDMA), National disaster Response Force (NDRF) (All field units), Integrated Control Room Emergency Response (ICR-ER) Ministry of Home Affairs (MHA), Indian Navy (IN),

Indian Air Force(IAF), Indian Defense Services, Central Water Commission (CWC), Indian Coast Guard (ICG), Port Authority, Directorate General of Hydrocarbons (DGH),Directorate General of Light House & Light Ships, National Hydrographic Office, All India Radio, Door Darshan, Indian Railways (Punctuality Cell), Ministry of Petroleum & Natural Gas, Ministry of Rural Development, Ministry of Ports, Waterways & Shipping, Ministry of Road, Kandla Port, Transport & Highways, Ministry of Steel, and Ministry of Health & Family Welfare, Department of Atomic Energy etc.

During the meeting IMD informed the participants about the new initiatives primarily the plans of Govt. of India for augmentation of observational network under Mission Mausam, introduction of various products in GIS platform, introduction of multi model ensemble based forecast, customized location specific impact based forecast for various offshore & onshore industries, ports, district Headquarters, Indian Air Force locations, Indian Coast Guard Locations, city forecast for ports, ship route forecast, customized forecast for tourism spots.

DG IMD informed the stakeholders that IMD is committed to provide updated services for the safety of life and property. He also informed the participants that IMD is ready to start customized location specific forecasts for major industries, civilian airports, each district headquarter, each town/city along the coast, route forecast for surface transport and waterways. IMD is all poised to improve the Availability, Accessibility and Actionability of cyclone warning/advisories and solicited feedback from stakeholders for further improvement in services.

Participants of Pre-cyclone exercise meeting on 04thApril, 2025

52nd Session of WMO/ESCAP Panel on Tropical Cyclones (PTC)

52nd Session of WMO/ESCAP Panel on Tropical Cyclones (PTC) was organsied by Qatar Meteorological Department (online) during 28th April-1st May. IMD is hosting PTC Secretariat for the period 2024-27. From IMD, **Dr. M. Mohapatra**, DGM IMD and Secretary PTC, Dr. D R Pattanaik, Scientist-F & Head RSMC New Delhi, Dr.A K Das, Scientist-F & Head CWD, Dr. PLN Murty, Scientist-E & Head MSD, Mrs. Monica Sharma, Scientist-D, CWD and Dr. Amit Bhardwaj, Scientist-C, MSD & NWP participated in the meeting. Dr. M. Mohapatra made various deliberations wrt developments in Meteorology, Hydrology, Disaster Risk Reduction and Training & Research components in the PTC region.

Following technical documents were prepared and presented by IMD Scientists:

- Country Report of India by Dr. D R Pattanaik
- Report on Cyclones during 2024 by Dr. D R Pattanaik
- Annual Cyclone Review 2024 by Dr. D R Pattanaik
- Annual Operating Plan for 2025 by Dr.A K Das
- Coordinated Technical Plan (2024-27) by Dr.A K Das
- Action Taken Report on recommendation of PTC-50 and 51 by Mrs. Monica Sharma
- Tropical Cyclone Operation Plan (TCP-21) by Mrs. Monica Sharma
- Report on constitution & revival of Working Groups on Meteorology, Hydrology, DRR and Training & Research by Mrs. Monica Sharma.
- PTC News Letter by Mrs. Monica Sharma
- Report of 52nd Session of PTC by Mrs. Monica Sharma

India Meteorological Department organized Virtual Press Conference on "Outlook for Rainfall and Temperature for the month of July 2025" on 30th June 2025.

Dr. M. Mohapatra, DG IMD addressed the media virtually. The highlights of the Press Release are presented below:

a)Rainfall over India – Monthly average rainfall over the country as a whole in July 2025 is most likely to be above normal, exceeding 106% of the Long Period Average (LPA). Geographically, most parts of the country are likely to experience normal to above-normal rainfall. However, most parts of Northeast & East India, and many areas of extreme South Peninsular India and some areas of Northwest India, are likely to receive below-normal rainfall.

b)Surface Air Temperature over India – In July 2025, monthly average maximum temperatures are expected to remain normal to below normal in many regions, except northeast India and some areas of the northwest, east and southern peninsula, where they are likely to be above normal. Monthly minimum temperatures are expected to be normal to below normal over many parts of the country. However, above-normal minimum temperatures are likely over northeast India, many parts of southern peninsular India and some parts of northwest, east and central India.

Bb c) Sea Surface Temperature (SST) - Neutral El Niño–Southern Oscillation (ENSO) conditions currently prevail over the equatorial Pacific Ocean. Forecasts from the latest Monsoon Mission Climate Forecast System (MMCFS) and other climate models suggest that these neutral conditions will likely to persist till the end of the monsoon season. Currently, neutral IndianOcean Dipole (IOD) conditions are being observed over the Indian Ocean. The model forecast indicates a possible transition to negative IOD conditions during the coming months.

Dr. M. Mohapatra, DG IMD participated as Guest of Honour during the International Conclave on "Climate Change and Global Warming" organized by Siksha 'O' Anusandhan, Deemed to be University at Bhubaneswar on 10th July, 2025.

Dr. M. Mohapatra, DG IMD during the International Conclave on "Climate Change and Global Warming"

Awareness Program cum Demonstration on Disaster Management

Dr. M. Mohapatra, DG IMD during Awareness Program cum Demonstration on Disaster Management

The India Meteorological Department (IMD) organized an Awareness Program cum Demonstration on Disaster Management by the National Disaster Response Force (NDRF) on 11th September, 2025 at Mahika Hall, MoES, New Delhi. The NDRF team, consisting of 14 members and led by **Dr. Abhishek Pandey**, CMO and **Shri Pramod Kumar**, INSPR (GD) conducted an informative session on disaster management. The program was graced by **Dr. M. Mohapatra**, Director General of Meteorology; **Shri D. Senthil Pandiyan**, (Joint Secretary, MoES);**Dr. Sivananda Damodara Pai**, Scientist-G; **Shri. Santosh Kumar S,** DDG(A); **Dr. S.I. Laskar**, Scientist-F (Head, DMD(IMD)) and other officials from IMD, MoES and NCS.

On 27 September 2025, the Hon'ble Union Ministerof State for Law & Justice, Independent Charge, **Shri Arjun Ram Meghwal**, visited the **Meteorological Centre, Jaipur**, where he toured various sections and held a meeting with senior scientists and officers. During his visit, inspected the DWR and discussed the radar's pivotal role in providing early warning services; Stressed the

importance of promoting research to mitigate climate change impacts, particularly in the Thar Desert region; Planted trees within the office premises as a gesture of environmental commitment and to uplift departmental morale.

Hon'ble Union Minister of State for Law & Justice, Independent Charge, Shri Arjun Ram Meghwal, visited the Meteorological Centre, Jaipur

During the meeting, **Sh. Radheshyam Sharma**, Head MC, Jaipur, discussed on meteorological services provided by MC Jaipur for Rajasthan, affecting the Thar Desert region — such as storms, heat waves, cold waves, heavy rainfall, and lightning.

India Meteorological Department(IMD) organised**National Plastic Reduction Programme** under the "**Swachhata Hi Sewa**" campaign on 3rd October, 2025. On this occasion, Dr. M. Mohapatra, Director General of Meteorology, IMD, addressed the staff of IMD and emphasized the importance of environmental cleanliness and sustainable waste management practices. He urged all officers and employees to actively participate in the campaign by reducing the use of single-use plastics and adopting eco-friendly alternatives in their day-to-day activities.

Dr. M. Mohapatra, DG IMD had been on deputation to WMO Geneva to participate in the Extraordinary Session of the World Meteorological Congress (Cg.- Ext.2025) and Executive Council (EC-Ext. 2025) at WMO, Geneva during 20-24 October, 2025. The major events during his visit include following:

(i) **Mr. António Guterres,** Secretary-General of the United Nations, visited the World Meteorological Organization (WMO) headquarters to engage in an Interactive Dialogue with Members of the World Meteorological Congress on 22nd October, 2025, during the WMO Extraordinary Session of **Congress (Cg-Ext (2025))**. **Dr. M. Mohapatra**, DG, IMD, and 3rd Vice-President of WMO welcomed the UNSG on the dais.

Dr. M. Mohapatra, DGM, IMD, and 3rd Vice-President of WMO welcomed the UNSG on the dais

(ii) During his visit **Dr. Mohapatra** chaired a session on election and appointment procedures, including the WMO Code of Conduct, on 22- 23 October, 2025.

Dr. M. Mohapatra, chaired a session on election and appointment procedures

Dr. Abdulla Al Mandous, President of the World Meteorological Organization (WMO)andPermanent Representative of the United Arab Emirates with WMO, visited theCRS Officeon1st November, 2025 and interacted with the scientists working at the CRS Office.

Dr. Abdulla Al Mandous, visited the CRS Office and interacted with the scientists

A delegation from African Centre for Meteorological Applications (ACMAD) including Director General of ACMAD visited CRS, IMD, Pune on 27th November, 2025 to strengthen the collaboration between ACMOD and MoES in the

field of Climate Service and capacity Development in weather/ climate forecast and had interaction meeting with Senior officials of IMD, Pune at CR&S, IMD, Pune on 28th November, 2025.

Delegation from African Centre for Meteorological Applications (ACMAD)

ESSO REVIEW MEETING AT SHILLONG DURING 18-19 DECEMBER 2025

ESSO Review Meeting Held at Shillong During 18-19 December 2025

MoES hosted the **Earth System Science Organization (ESSO) Review Meeting** at IMD Shillong under the chairmanship of **Dr. M. Ravichandran**, Secretary, MoES, with participation from the Director General of Meteorology and Heads and Directors of MoES institutions. The meeting focused on reviewing progress, identifying scientific & technological gaps, strengthening inter-institutional collaboration, addressing administrative and financial issues, and aligning ESSO's roadmap with India's Vision 2047 across weather, climate, ocean, and earth system sciences.

Curtain Raiser Event of The India International Science Festival (Iisf) -2025

Dr. M. Mohapatra, DG IMD participated in the Curtain Raiser ceremony of India International Science Festival (IISF)-2025 inaugurated by Hon'ble Minister of Earth Sciences Dr Jitendra Singh at National Media Centre, New Delhi on 17th October, 2025.

MC Patna, organized the curtain raiser event of the India International Science Festival (IISF) 2025 on 30th November, 2025, under the national theme "**Science for Prosperity: For a Self-Reliant India**". Students from various schools, with teachers, participated in the event. The objective of the event was to introduce young students to IISF 2025 and make them aware of the opportunities available for participation in national-level scientific activities. **Mr. Ashish Kumar**, Sc. 'D' delivered a lecture on Science-Based Development. He highlighted the important role of the India Meteorological Department (IMD) in strengthening national disaster resilience. Other scientists also gave an introduction to IISF and its objectives, a description of the services provided by IMD, and a special presentation on "**Understanding Weather and Climate Change**".

Curtain Raiser Ceremony for India International Science Festival (IISF) 2025 held at RMC Office Kolkata on 25th November, 2025. **Dr. H. R. Biswas**,Sc. 'F' presided over the event.

Curtain Raiser Ceremony for India International Science Festival (IISF) 2025 held at RMC Office Kolkata, on 25th November, 2025

MC Patna, organized the curtain raiser event2nd December, 2025. **Mr. Jayant Das**, In-charge Training, Data Centre, Water Resource Department, was invited as the chief guest, alongside S**mt. Samanti Sarkar**, Sc. 'F' who presided over the event. An audio-visual

presentation on IISF-2025 was displayed to the students along with an open house exhibition set up for the participating students wherein the officials of Meteorological Centre, Raipur demonstrated the operation and functioning of various instruments and equipment that play an important role in forecasting and gathering weather related information.

Curtain Raiser Programme was arranged by Meteorological Center Ahmedabad on 28 November, 2025. More than 200 school children & teachers from reputed schools attended the Programme followed by media briefing for wide publicity of the IISF-2025.

School children & teachers from reputed schools in MC Ahmedabad

RMC Kolkata participated in the exhibition "ISG-ISRS National Symposium- Geomatics and SpaceInnovations towards Atmanirbhar Bharat: Insights and Frontiers and Annual Conventions" organized by The Indian Society of Geomatics (ISG) and Indian Society of Remote Sensing (ISRS) at IIT Kharagpur Research Park, New Town, Kolkata, during 25–27 November, 2025, represented by **Shri Milan Kanti Das**, Met-A, **Shri Angshuman Kundu**, Met-A.

RMC Kolkata participated in the exhibition, highlighting its key Initiatives and services

Dr. M. Mohapatra, DGM IMD participated in the 11th Edition of India International Science Festival (IISF)-2025 at Panjab University, Panchkula, Haryana on 8th December and Chaired the session "**Strengthening Triple Helix Model-R & D Industry, Academia, Collaborations under Vision Sansad**" during IISF 2025 at Dussehara Ground, Panchkula on 8th December, 2025.

RMC Kolkata has participated in "**20th Science Exhibition cum Environmental Awareness Fair**" (Paribesh Mela) held at Netaji Subhas Maidan, MadhyamgramChowmatha, North 24 Parganas, represented by **Shri Indranil Talukdar**, Met-B, **Shri Sushil Singh**, **Ms. RomitaMarik**, SA, and **Shri Amit Roy**, MTS, from 24- 28 December,2025.

"20th Science Exhibition cum Environmental Awareness Fair" (Paribesh Mela)

Regional Meteorological Centre, Chennai organised Open house and Met exhibition in connection with the 150th Foundation Day of India Meteorological Department on 14th-15th January 2025. About 30 students and general public visited the openhouse and met exhibition at RMC Chennai. New exhibits on milestones of 150-year journey of IMD and activities of RMC Chennai were prepared and displayed in the exhibition

About 30 students and general public visited the openhouse and met exhibition at RMC Chennai.

6.2. SOUTH ASIAN CLIMATE OUTLOOK FORUM (SASCOF) RELATED ACTIVITIES UNDER RCC

Pre-Climate Outlook Forum (Pre-COF) hands-on training workshop in association with 31st South Asian Climate Outlook Forum (SASCOF-31) was organized during 24-26th April 2025 in Sheraton Grand Hotel, Pune. 16 participants (13 off line and 3 online) and 5 resource persons participated the workshop.

IMD hosted a 31st session of South Asia Climate Outlook forum (SASCOF-31) and Climate Service User Forum (CSUF) in collaboration with World Meteorological Organization (WMO), UK Met. Office (UKMO) Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES), Bangkok and **The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)** conducted in Physical mode in Sheraton Grand Hotel, Pune India. Experts from National Meteorological and Hydrological Service (NMHS) from nine south Asian countries, Japan Meteorological Agency (JMA), WMO Lead centre of Multi Model Ensemble, Korea Meteorological administration, South Korea, National Atmospheric and Oceanic Administration (NOAA), USA, UK Met office, UK and other experts from various research institutes participated { Total 88 participants (77 off line and 11 online) and 107 participants (91 off line and 16 online) } in the Forum and discussed outlook for rainfall and temperature during upcoming June to Septemberseason 2025 and summarized that the rainfall during coming summer monsoon season is likely to be above normal. All Class I Officers of IMD Pune participated in the meeting. The meeting Concept Note and Agenda as well as Outlook Statement is available on the RCC Pune Website link below.

Link- http://rcc.imdpune.gov.in/Sascof.html.

Officials during South Asian Climate Outlook Forum (SASCOF)

RMC Kolkata has taken a new initiative for organizing State Level Seasonal Climate Outlook Forum (SLSCOF) for all seasons

RMC Kolkata has taken a new initiative for organizing State Level Seasonal Climate Outlook Forum (SLSCOF) for all seasons, before the ensuing season. It will be basically a knowledge sharing and dialogue platform aimed at presenting the seasonal Climate outlook for West Bengal and fostering pro-active engagement among stakeholders from multiple sectors. The West Bengal State-Level South-West Monsoon Outlook for 2025 was held on 27.05.2025 at RMC Kolkata, Alipore. The event was chaired by Mr. Rajesh Kumar Sinha, Hon'ble Principal Secretary, Disaster Management & Civil Defence department, the Govt. of West Bengal GoWB. The forum featured insightful presentations by leading experts including Dr. D.S. Pai, Scientist 'G', IMD HQ; Dr. O.P. Sreejith, Scientist 'F' CRS IMD Pune; Dr. H.R. Biswas,Scientist'F', RMCKolkata; Dr. N. Chattopadhyay, Ex-DDGM IMD; Dr. G.C. Debnath, Senior Consultant, WBSDMA; other officials of RMC Kolkata and eminent delegates from different sectors i.e. I&WD, DVC, CESC,

Agriculture, ARD Department, GSI. The day-long programme fostered meaningful dialogue among stakeholders under three sessions viz., Seasonal Forecast, Managing Disasters and Resources and Livelihood and Well-being. Dr.SomenathDutta, Scientist'G',presided over the event.

West Bengal State-Level South-West Monsoon Outlook for 2025 held on 27th May, 2025 at RMC Kolkata, Alipore

Regional Climate Centre (RCC) Activities during October to December 2025

The CRS office of IMD, Pune is recognized as the World Meteorological Organization (WMO) **Regional Climate Centre (RCC)** for South Asia. Presently the MMCFS is used for the RCC long range forecasting activities.

Climate Services User Forum (CSUF) associated with **SASCOF-32** for ensuing OND Season (October to December 2025) took place online through video conferencing on 3rd October 2025. The SASCOF-32 session was hosted by Regional Climate Centre (RCC), India Meteorological Department (IMD), Pune in collaboration with World Meteorological Organization (WMO), UK Met. Office (UKMO), Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES), Bangkok and The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and summarized that the rainfall during coming winter season is likely to be normal to above normal.

Dr. M. Mohapatra, DG, IMD during SASCOF- 32 & CSUF Online Session

33rd Session ofSouth Asian Climate Outlook Forum (SASCOF-33): For the ensuing Winter Season (December to February 2025/26) took place online through video conferencing on 27th November, 2025. The **SASCOF-33** session was organized by Regional Climate Centre (RCC), India Meteorological Department (IMD), Pune in collaboration with World Meteorological Organization (WMO), UK Met. Office (UKMO) and Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES), Bangkok and The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). Experts from National Meteorological and Hydrological Service (NMHS) from nine south Asian countries participated in the Forum and discussed the outlook for rainfall and temperature during upcoming Winter season DJF 2025/26.

6.3. MEMORANDUM OF UNDERSTANDING (MOU)

1. Memorandum of Understanding (MoU) between IMD and DST, Government of Mizoram at Aizawl Mizoram

On 24th February, 2025 Government of India through Ministry of Earth Sciences - India Meteorological Department (IMD) & State Government of Mizoram through Directorate of Science & technology, signed MoU in the august presence of Hon'ble CM Pu Lalduhoma and Director General of Meteorology (IMD) Dr. Mrutyunjaya Mohapatra. In MoU, DST will provide space and other necessary support to IMD for setting up Meteorological Centre (State Headquarters) at Science Centre, Berawtlang, Aizawl. IMD will provide meteorological data for climate study and weather services.

2. MoU with National Building Construction Corporation Ltd.

IMD signed a Memorandum of Understanding (MoU) with National Building Construction Corporation Ltd. on 11th March, 2025.

3.MoU with Central Electricity Authority

IMD signed a Memorandum of Understanding with **Central Electricity Authority** to improve coordination and collaboration between both the agencies on 21st March, 2025.

4. A Memorandum of Understanding (MoU) has been signed between India Meteorological Department (IMD) and Kal. io Fed India Private Limited (Kal. io)

On 29th July, 2025. **Dr. R.K. Jenamani** (Scientist-G, IMD) and **Dr. Ravinder Pal Singh** (Chief Executive Officer, Kal. io) signed the MoU on behalf of the two organizations. **Dr. M. Ravichandran** (Secretary, MoES) and **Dr. M. Mohapatra** (DGM. IMD) and officials from Kal. io and IMD were also present at this occasion. The MoU with Kal. io aims to support & guide in designing, developing, provisioning & deploying state of-art technologies, products & solutions such as weather monitoring systems, AI/ML based forecasting algorithms, operational weather intelligence software's, data assimilation technologies and Low Earth Orbit (LEO) satellite data/ atmospheric profiles. This partnership will enhance collaborative research, case studies, technical publications, and project documentation for academic and operational references.

MoU between IMD and Kal. io Fed India Private Limited

5. IMD signed a Memorandum of CSIR-National Aerospace Laboratories (CSIR-NAL)

On 7th August, 2025. The MoU is an addendum to a previous agreement. This collaboration aims to enhance India's weather observation and forecasting capabilities through instrument innovation, algorithm development, and the operational deployment of systems like the Drishti Transmissometer for airports.

DG IMD and Director CSIR-NAL signing the MoU

6. IMD signed an MOU with Central Water Commission

On 14th August, 2025 with an objective to improve data exchange and scientific research between the organisations to strengthen early warning systems for riverine and flash floods.

IMD signed an MOU with Central Water Commission on 14th August, 2025

7. MOU between IMDR and CWC

Shri Rahul Saxena, Scientist - G & Head Hydro Meteorology Division attended the Signing of MOU between IMDR and CWC on 14th August, 2025.

8. IMD signed a memorandum of understanding (MoU) with the Integrated Finance Corporation India Ltd.

IMD signed a memorandum of understanding (MoU) with the Integrated Finance Corporation India Ltd. (IFCI) for enhanced cooperation and collaboration between the two agencies on 10th September, 2025.

MoU between IMD and IFCI

9. Dr. M. Mohapatra, DGM IMD signed an MoU with Chaudhary Charan Singh University

Dr. M. Mohapatra, DGM IMD signed an MoU with Chaudhary Charan Singh University, Meerut for enhanced cooperation in research and development activities on 11th September, 2025.

MoU between IMD and Chaudhary Charan Singh University

10. An MoU was signed between IMD and Asoka University

An MoU was signed between IMD and Asoka **University**, Sonipat, Haryana on 13thSeptember for joint research and development on weather and climate. **Dr. M. Mohapatra**, DGM IMD participated as the Chief Guest in the workshop on AI/ML Methods in Weather and climate Modelling and delivered a lecture at Ashoka University, Sonipat, Haryana on 13th September, 2025.

MoU between IMD and Asoka University

11. MoU Between IMD and ICAR-NIVEDI at the MoES, New Delhi during the Brainstorming and Strategy Workshop

MoU Between IMD and ICAR-NIVEDI at the MoES, New Delhi during the Brainstorming and Strategy Workshop

India Meteorological Department (IMD) and ICAR–National Institute of Veterinary Epidemiology and Disease Informatics (ICAR–NIVEDI) signed a Memorandum of Understanding (MoU) at the Ministry of Earth Sciences, New Delhi, during the Brainstorming and Strategy Workshop on Developing Weather-Driven Advisories for Horticulture, Livestock, Poultry, and Inland Fisheries Sectors held on 16 September, 2025 at Ministry of Earth Sciences, New Delhi. The agreement marks a major step in integrating IMD's climate data into ICAR–NIVEDI's forecasting system (NADRES), aimed at improving the accuracy of livestock disease predictions and enhancing the granularity of advisories from district to block level. This will help in better prediction, prevention & management of livestock diseases, ultimately supporting farmers' income and resilience.

12. Memorandum of Understanding (MoU)between the India Meteorological Department (IMD) and CSIR

A Memorandum of Understanding (MoU) was signed on September 26, 2025, between the India Meteorological Department (IMD) and CSIR–Advanced Materials and Processes Research Institute (AMPRI), Bhopal. The MoU aims to foster collaborative research in meteorology, climate science, atmospheric physics, hydrology, and environmental sustainability, thereby advancing scientific understanding in these critical areas. IMD and CSIR–AMPRI will jointly promote problem-driven collaborations, while also working to strengthen academic and technical capacity in meteorological and climate sciences.

MOU between IMD and CSIR–Advanced Materialsand Processes Research Institute (AMPRI), Bhopal

The India Meteorological Department (IMD) signed Memoranda of Understanding (MoUs) with the following ICAR institutes on 16th September, 2025. The collaboration aims to develop tailored, sector-specific weather advisories for horticulture, dairy,

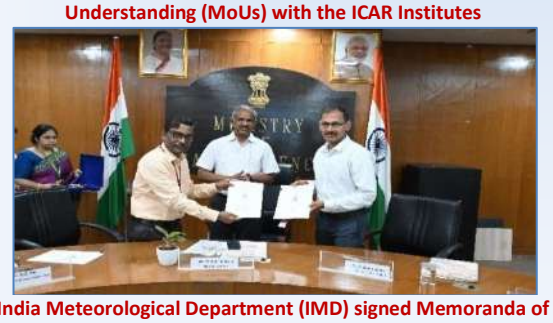
livestock, poultry, and inland fisheries-bringing weather services closer to farmers' needs.

- ICAR–Indian Institute of Horticultural Research (IIHR), Karnataka, India
- ICAR–Central Institute of Freshwater Aquaculture (CIFA), Odisha, India
- ICAR–National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI), Karnataka, India
- ICAR–Directorate of Poultry Research (DPR), Telangana, India
- ICAR–National Dairy Research Institute (NDRI), Haryana, India

India Meteorological Department (IMD) signed Memoranda of Understanding (MoUs) with the ICAR Institutes

India Meteorological Department (IMD) signed Memoranda of Understanding (MoUs) with the ICAR Institutes

India Meteorological Department (IMD) signed Memoranda of Understanding (MoUs) with the ICAR Institutes



India Meteorological Department (IMD) signed Memoranda of Understanding (MoUs) with the ICAR Institutes

13. MOU between IMD and Indian Coast Guard

Indian Coast Guard and **IMD** signed a Memoradumof Understanding for enhanced cooperation and collaboration between the two organisations on 5th December, 2025.

Indian Coast Guard and IMD signed a Memorandum of Understanding

6.4. HUMAN RESOURCE DEVELOPMENT ACTIVITIES

STAKEHOLDER WORKSHOP

Stakeholder workshop hosted by Meteorological Centre Lucknow to commemorate 150 years of the IMD at Jade 2 Hall, Hotel Holiday Inn, Lucknow on 02-01-2025

First Hindi magazine of MC Lucknow "Kshitij" was released by the dignitaries in stakeholder Workshop

Stakeholder workshop hosted by Meteorological Centre Lucknow to commemorate 150 years of the IMD at Jade 2 Hall, Hotel Holiday Inn, Lucknow on

02-01-2025, "The Chief Guest was Shri G. S. Naveen Kumar (IAS), Secretary, Irrigation and water Resources, Government of Uttar Pradesh, Guest of Honour was Dr. Sanjay Singh, Uttar Pradesh Council of Agricultural Research, Government of Uttar Pradesh, Dr. R. K. Jenamani, Scientist-G, IMD New Delhi, Dr. S. D. Kotal, Deputy Director General of Meteorology, RMC New Delhi participated in workshop and Dr. Mrutyunjay Mohapatra, DG IMD, New Delhi participated through Video Conferencing in the workshop. More than 50 participants from key stakeholders' departments including experts and policy makers from Uttar Pradesh participated in the workshop to discuss recent advancements in weather and climate services in Uttar Pradesh. Our First Hindi magazine of MC Lucknow "Kshitij" was released by the dignitaries in stakeholder Workshop.

Dr. Rizwan Ahmed, Sc. 'D' Delivered a lecture on "**Now-casting Services by IMD**" in the workshop organized in collaboration with RMC Nagpur and Nagpur Divisional Commissioner Office on 6th March, 2025.

Dr. Rizwan Ahmed, Sc. 'D' delivered a lecture on "Now-casting Services by IMD"

Dr. M. Mohapatra, DG IMD participated online in the inaugural ceremony of Eighth WMO Workshop on Monsoon at IITM, Pune on 17th March, 2025 and addresses the participants and delivered a talk on Multihazard early warning system in India.

Dr. M. Mohapatra, DG IMD participated in the seminar on Next Generation Aeronautical Weather Services for Military & Civil Operations on the Occasion of World Meteorological Day 2025 at Jaswant Hall, Air Force Station, New Delhi on 19th March, 2025.

WORKSHOPS

Dr Sreekanth T.S., Sc. 'D' and **Dr. Rizwan Ahmed**, Sc. 'D' Participated and presented poster in one day workshop on Radar at 7th Conference on India RADAR Meteorology-Irad-2025 hosted by the India Meteorological Department (IMD) during 05 - 08 January 2025.

Dr Satyaban B Ratna, Sc-E, attended the CLIVAR Climate Dynamics Panel 5th Annual Workshop and presented a talk titled "Asymmetrical Impact of La Niña Evolution on Indian Summer Monsoon Rainfall: Insights from Observations and Model Forecasts" in Lorne, Melbourne, Australia during 24-27 February 2025.

Shri Raja Acharya, Met. 'B'**,** participated in the 13th session of WMO, Ship Observations Team (SOT-13) jointly organized by the WMO, IOC and Ifremer, France during 1-4 April, 2025.

Dr. Praveen Kumar, Scientist 'C', RMC Nagpur delivered a talk on Weather Forecast and Weather Warning Services of RMC Nagpur during the one Day workshop at Niyojan Bhawan, Collectorate office Wardha 0n 3rd April, 2025.

Dr. M. Mohapatra, DG IMD, attended the Inaugural Ceremony of the National Training Workshop on Weather Radar: Theory, Calibration, Maintenance, Data Analysis and Applications (NT-RADAR) (online) held during 7 – 10 April, 2025 at Meghdoot Auditorium at IITM.

Dr. M. Mohapatra, DG IMD, **Dr. D.S. Pai**, Scientist 'G',**Dr. R. K. Jenamani**, Scientist 'G' **and Dr.Kripan Ghosh**, Scientist 'F' participated in Brainstorming Meet on Desert Meteorology organized by M.C. Jaipur on 16thApril, 2025.

Dr.KripanGhosh,Scientist 'F' and **Dr. Ashutosh Kumar Misra**, Scientist 'D', attended "State-Level Kharif Season Planning Workshop" chaired by the Principal Secretary of Agriculture, Government of Maharashtra with senior officials from the Maharashtra Agriculture Department and other stakeholders at Vaikunth Mehta National Institute of Cooperative Management (VAMNICOM), Pune on 8thApril, 2025. Dr.Kripan Ghosh also delivered a talk on "Agromet Advisory Services in India" during the workshop.

RMC Nagpur organized a Stakeholder Meeting (Workshop) on Climate Change and Distaste Management at Divisional Commissioner Amravati, Maharashtra in collaboration with SDMA

Maharashtra. The Workshop was led**Dr. Praveen Kumar,**Scientist 'C'. The representative from different stakeholders of districts from West Vidarbha, attended the session on 23rdApril,2025. Divisional Commissioner and Collector Amravati, Maharashtra co-participated in the Workshop.

Dr. Iyyappan M, Scientist 'F', attended one day workshop on "Harnessing Space-Based Earth Observation and GIS Technologies for Disaster Risk Management" on 23rd May, 2025 at Vigyan Bhavan, New Delhi.

Dr. A.K. Mitra,Scientist'F', was invited as a speaker for the third technical session on "Real-Time GIS and Early Warning Systems for Disaster Risk Reduction" at one day workshop on "Harnessing Space-Based Earth Observation and GIS Technologies for Disaster Risk Management" organized by National Disaster Management Authority (NDMA) on 23rd May, 2025 held at Vigyan Bhavan, New Delhi.

Dr. Asha Latwal, Scientist 'C'attended 3-day workshop on "Climate-informed Flood Prediction and Water Management" led by S2S-AccelNet Team in collaboration with IITM, Pune and IMD, New Delhi at IITM, Pune during 16 - 18 June, 2025.

Shri Thangjalal Lhouvum, Scientist 'D', MCShillong along with **Ms. AldarihunNongkhlaw**, S.A. attended the State Water Informatics Centre (SWIC) stakeholders workshop-cum-meeting at SWIC, Shillong on 19th June, 2025. The meeting discusses ways to collaborate among all weather and water related departments and sharing of meta data in a single state repository.

Dr. B.Geetha, Scientist – E, delivered a scientific lecture in a one-day workshop on the topic "Some dynamical and thermodynamical aspects associated with intensity changes in Tropical Cyclones over the North Indian Ocean" on 20 June 2025 at SRM Institute of Science and Technology, Kattankulathur.

Dr. B. Geetha, Sc-E attended CMDA workshop held on June 23, 2025, at 3 PM in the Fortel, Egmore regarding preparation of Detailed Project Report for "Integrating Blue Green Infrastructure" in Urban Planning for Climate Change Adaptation and Mitigation in Chennai Metropolitan Area with World Bank Assistance with an aim to map and assess the blue-green elements, Climate risks and institutional capacity in CMA; formulation of Blue Green Infrastructure based land use plan with nature-based solutions for CMA and a concept design for a pilot study.

Dr. Satyaban B Ratna, Scientist 'E', participated (Online) in the SAHF Climate Services Workshop held in Bangkok, Thailand, during 24-26 June, 2025.

Dr. D. R. Pattanaik, Scientist 'F' attended the workshop on Mainstreaming Disaster Risk Reduction into Governance: Strategic Synergies with Agencies and participated in the Panel Discussion on "Future Technologies for DRR Moderator" on 25th June, 2025 at NIDM, Delhi.

Shri B. SudarsanPatro, Sc. 'E' Pune conducted a science outreach activity at Cusrow Wadia Institute of Technology Pune, one of the pioneering diploma institutes in Maharashtra, on 6th October, 2025. The session was organized for third-year Electronics and Telecommunication (E&TC) students on the topic "**Advancing Weather Monitoring: Current Trends, Future Innovations, and Embedded System Applications in Automatic Weather Stations**".

Dr. Somenath Dutta, Scientist-G & Head, RMC Kolkata, attended a technical workshop and delivered a talk on "IMD's impact-based rainfall forecasts, and its future advancements in India" organised by Geological Survey of India at Dharitri Building Campus, GN-40, Sector V, Salt Lake, Kolkata, on 18th July, 2025.

Dr. Arvind Kumar, Sc.-D, AASU participated in the "AGRIVISION-2025: 9th National Convention" held on July 26–27, 2025, at the National Agricultural Science Complex (ICAR, Pusa Campus), New Delhi. The theme of the convention was "Empowered Youth – Prosperous Agriculture: Skill, Innovation, and Entrepreneurship."He delivered an Invited talk on the topic "Weather to Wealth: Transforming Agromet Services into Opportunities for Youth-led Agri-Entrepreneurship" on July 27, 2025, and Chaired Technical Session-II held on July 26, 2025.

A Farmers Awareness Program, in collaboration with Agromet Field Unit (AMFU) Ambikapur was organized in online mode on 20thAugust, 2025 to disseminate and spread awareness towards the services being offered by IMD to the farmer

communities in Manendragarh-Chirmiri-Bharatpur, Koriya, Surajpur, Jashpur and Surguja districts. The Workshop was attended by more than 50 individual farmers in the presence of **Smt. Samanti Sarkar,** Head, MC Raipur. The workshop was conducted by **Dr. Gayatri Vani Kanchibhotla**, Scientist-C and **Sh. Yogesh Janghel**, J.R.F. The event involved a doubt clearing session, in which queries of farmers were addressed by the officials of MC Raipur.

Dr. Sanjay O'Neill Shaw, Scientist-F, **Sri C. Amarnath,** Scientist-D, **Sri Anil Chandra Roy**, Meteorologist-A and **Dr. Sudip Kumar Kundu,** RA attended Workshop on YESTECH & WINDS implementation in Assam on 2nd September, 2025.

Dr. Rizwan Ahmed, Scientist-D, AMO Nagpur, delivered an invited talk On 16 September 2025, titled "Assessment of the Impact of Climate Change on the Characteristics of Land-Falling Tropical Cyclones over the North Indian Ocean (NIO)" at a One-Day Workshop on "Importance of Climate Literacy" held at SSM College, Nagpur.

Dr. Rizwan Ahmed, Scientist-D, at One-Day Workshop on "Importance of Climate Literacy"

Dr. Sanjeev Dwivedi, Sc. 'D' attended a Stakeholder Consultation Workshop on "**Assessment of Pest Risks and Gendered Socio-Economic Impacts of Crop Loss in Rice Farming Systems of Odisha**" at Hotel Mayfair, Bhubaneswar organized by CRRI and CABI on 4th November, 2025.

Dr. Divesh Choudhary, Sc. 'D', **Dr. Sourish Bandyopadhyay**, Sc. 'D' and **Dr. Anwesa Bhattacharya**, Sc. 'C' attended virtually a National Training Workshop on '**Nowcasting of High-Impact Weather Events 2025**" from 11- 14 November, 2025.

National Training Workshop on Nowcasting of High-Impact Weather Events 2025 attended by **Sh. Amrit Tirkey,** SO-I, **Sh. Vinod Sharma**, Met-B, **Sh. Akash Sen,** SA and **Sh. Shekhar Jha,** SA, MC Sri Vijaya Puram from 11- 14 November, 2025.

CONFERENCES

CWC/DWR Visakhapatnam participated in Department of Geophysics, Andhra University seminar on "Advance in Geophysics for a sustainable Future: Energy, Environment and Natural Resources" for three days from 17-19 February, 2025. In this event we organized an exhibition and set up a stall to display IMD's services for students and the public. **Shri S.V.J. Kumar**, Met-B presented an oral presentation on "Pervading inland heat waves over the contiguous coastal areas of India."

Seminar on Monsoons – 2024

Under the joint auspices of Regional Meteorological Centre, Chennai and Indian Meteorological Society, Chennai Chapter, a seminar on Monsoons-2024 was conducted on the occasion of National Science Day, the 28th February 2025 (Friday), 14:30 IST at Conference Hall-1, Regional Meteorological Centre, Chennai.
Dr. S. Balachandran, Scientist-G, RMC Chennai delivered a scientific lecture on Review of salient features of Northeast Monsoon 2024. **Dr.B. Amudha,** Scientist-F, RMC Chennai & Chairman IMS Chennai Chapter delivered the Welcome address. Shri P.Senthamarai Kannan, Scientist-F, RMC Chennai delivered a scientific lecture on Review of Regional aspects of Southwest Monsoon 2024.

Dr.S.Balachandran, Scientist-G, RMC Chennai delivered a scientific lecture on Review of salient features of Northeast Monsoon 2024

Dr. Soumi Chakravorty, Scientist -D, delivered an invited online seminar titled "The Impact of Extratropical Atmospheric Variability on El Niño: Contrasting Thermodynamic versus Dynamic Coupling" on 7 April 2025 at the Navigation College, Dalian Maritime University, Liaoning Province, China.

Dr. H.R. Biswas, Scientist 'F', RMC Kolkata, attended HADR Seminar and delivered lecture on Cyclone at Panagarh Military Station on 9th April, 2025.

Dr. M. Mohapatra, DG IMD, **Dr. D.R. Pattanaik**, **Dr. AK Das**, **Dr. PLN Murty** and **Mrs. Monica Sharma** attended MEGHAYAN 2025 organized by Indian Navy at Naval Headquarters to commemorate WMO Day on 14thApril, 2025.

Shri Raja Acharya, Met. 'B', attended ebinaronMonitoring and Warning for sunamis Generated by Volcanoes organizedbytheInter-governmentalOceanographicCommission (UNESCO) on 16th April, 2025.

Dr. A.K. Mitra, Scientist'F', attended the online webinar as Guest of Honor for Golden Jubilee Celebration of Aryabhatta Satellite organized by India Space Week, New Delhi on the occasion of Satellite Technology Day, 19th April, 2025. Dr. Mitra also received a letter of gratitude for taking a lecture in the said event held on 19th April, 2025.

Dr. A. K. Mitra, Scientist'F' attended 25th International TOVS Study Conference (ITSC-25) held during 8-14 May, 2025 at Resort Rio, Goa and presented research paper abstract "Analysis of diurnal nature of spatial variability of Land Surface Temperature in Delhi NCR using Sentinel 3 and INSAT-3D/R satellite data" accepted for Poster Presentation.

Dr. M. Mohapatra, DG IMD delivered the Keynote Address during the inaugural ceremony of the 3-days training programme on Early Warning Systems at NIDM, Rohini on 14th May, 2025.

Dr. M. Mohapatra, DG IMD delivered the Keynote Address

Dr. M. Mohapatra, DG IMD participated in the Annual National Conference 2025 titled "Mitigating Heat Risks: Challenges & Opportunities for India" at India International Centre, New Delhi and delivered a special address on "Climate Risks" on 27th May, 2025. The event was organized by Climate Trends.

Sh. Pradeep Sharma, Sc. 'D' delivered a session in SATCOM training on "Hydro-meteorological Early Warning Services of IMD in India/Gujarat" on 31st May 2025, organized by GIDM & live telecasted on Vande-Gujarat Channel-I, at BISAG-N, Gandhinagar.

Dr. M. Mohapatra, DG IMD delivered a Keynote Address at a brainstorming Session on "Climate Change and Extreme Weather Events" to be held at Vivekananda International Foundation on 18th June, 2025.

Dr. M. Mohapatra, Director General, IMD participated as Panelist during the panel discussion on "Creating R&D ecosystem in India for "Viksit Bharat 2047" during in the global research event C-DAC Tech Verse 2025 on 27th June at the Manekshaw Centre, New Delhi organized by SAMEER, C-DAC, C-MET under MeITY. Dr. Mohapatra underscored the importance of integrating scientific research, technology development, and industrial collaboration to achieve sustainable progress in India's meteorological infrastructure, in alignment with the broader goals of Viksit Bharat 2047. Dr. Mohapatra also visited exhibition.

Dr. M. Mohapatra, DG IMD participated as an esteemed speaker in the 2nd Edition of "The India Climate Summit" organized by The Times Network on 27th June, 2025. The Theme of the event was "The Decisive Decade-Navigating the Tipping Point – recognizing that today's decisions will shape generations to come as we face Earth's Environmental tipping point".

A short online session of South Asian Climate Outlook Forum was held on 30.06.2025 to update 2025 Monsoon Seasonal Outlook. Shri K.C. Sai Krishnan, Scientist - G, Dr.Kripan Ghosh, Scientist - F, Dr. Sreejith O. P., Scientist -F, Dr. Satyaban Rtna, Scientist-E, Smt. Arti Bandgar, Scientist-D, Dr.Sabeerali, Scientist-C, Dr. Rohini P., Scientist-C, Dr. Ashutosh Misra, Scientist-D, attended the session.

Smt. Samanti Sarkar, Scientist-F, along **with Dr. Gayatri Vani Kanchibhotla**, Scientist-C attended the Table Top Exercise (TTEx) organized by State Disaster Management Authority (SDMA) on Flood Disasters in Chhattisgarh On 23rd September, 2025. The event entailed a holistic presentation by Dr. Gayatri Vani Kanchibhotla, Scientist-C, in front of SDMA officials, officials from other state departments and district collectors on meteorological services being provided by IMD for flood preparedness in the state and sharing of valuable inputs by which other stakeholders could benefit from the assistance of IMD in the field of disaster management.

MEETINGS

Dr. V. K. Soni, Scientist 'F', **Dr. D. R. Pattanaik**, Scientist 'F' & **Shri H. S. Sawhney**, Scientist 'E' attended a follow-up meeting held under the co-chairmanship of Secretary (Power) and Secretary (MoES) on 2nd January, 2025 at Prithvi Bhawan to review the progress of implementation of action points emerged during a meeting held on 3rd July, 2024 to discuss the issues related to Renewable Energy Forecasting.

Dr. M. Mohapatra, DG IMD addressed the Inaugural Session of the Stakeholders Meeting at Meteorological Centre, Lucknow on 2nd January online. He also addressed online the similar stakeholders meeting in Bengaluru on 10th January, 2025.

Dr. Ashutosh Misra, Sc. 'D', Dr. Jaya Dhami Parihar, Sc. 'D' and Dr. Asha Latwal, Sc. 'C' attended the popular talks on "**Growth of Indian Seismology since its inception as IMD Seismology unit and Collaborative Research**" by Dr. O. P. Mishra, Director, National Centre for Seismology (NCS), New Delhi on 6th January, 2025 through virtual mode.

Dr. Gargi Rakshit, Sc. 'C' attended the In-person meeting on **Mutual Co-operation and Data Sharing Program for Continuously Operating Reference Stations (CORS)** in Survey of India, Western printing office (Wing), Palam Village Road, New Delhi on 10th January, 2025.

Dr. M. Mohapatra, DG IMD participated in the meeting with Capt. AnubhaRathaur, Shiv Nadar University to explore possibilities of collaboration and internship between two organizations on 20th January.

Dr. M. Mohapatra, DG IMD participated in a meeting with Ms. Livleen K. Kahlon, Senior Fellow and Associate Director at TERI, IHC, on 21st January. The discussion focused on IMD's climate change research and TERI's efforts in structuring climate education within the informal curriculum for middle and senior school students.

Dr. V. K. Soni, Scientist 'F' attended Second Meeting of the Thematic Working Group - Health for National Adaptation Plan (NAP) on 27th January, 2025 at Nirman Bhawan, New Delhi.

Dr. Ashutosh Misra, Sc. 'D' and **Shri J. P. Sabale**, Met-A attended the meeting under the chairmanship of Sugar Commissioner, Maharashtra State "**to discuss impact of excess rainfall during monsoon and high temperatures during post monsoon on sugarcane acreage, production, productivity and sugarcane crushing during 2024-25 season in Maharashtra**" at Sugar Commissionerate Office, SakharSankul, Shivajinagar, Pune on 28th January,2025.

Dr. M. Mohapatra, DG IMD participated in the 83rd Session of the WMO Bureau Meeting (BuR-83) at WMO HQ, Geneva during 5th to 9th February, 2025.

Dr. M. Mohapatra, DG IMD participated in the Meeting with Dr. Ashok Gadgil, IECC's Affiliate and

UC Berkeley's Distinguished Professor Emeritus of Civil and Environmental Engineering and Mr. Piyush Narang, Policy Analyst, University of Berkeley, California on 10th February, 2025.

Dr. M. Mohapatra, DG IMD participated in the "Concluding and Way Forward Session of the RESSUMMIT 2025 - Disaster Management & Infrastructure Resilience in Changing Climate and Environmental Risks Workshop" organized by International Centre for Antimicrobial Resistance Solutions (ICARS) at Greater Noida Extension Centre on 11th February, 2025.

Dr. M. Mohapatra, DG IMD participated in the Visit of BISAG-N team from Ministry of Electronics and Information Technology (MeitY), Electronics Niketan on 13th February, 2025.

Shri ThangjalalLhouvum, Sc. 'D', MC Shillong along with Officer Shri R Pariong, Met-B attended the **UK-India Knowledge Exchange Workshop on AI-based Climate Modelling Centre and Policy Making** on 20th February, 2025 (Thursday) at Vivanta Meghalaya, Shillong.

Shri ThangjalalLhouvum, Sc. 'D' and Shri R Pariong, Met-B MC Shillong

Dr. Kripan Ghosh, attended the "**20th meeting of Project Monitoring and Advisory Committee (PMAC) of IMD**" to monitor the periodic progress of the projects under ACROSS-IMD and to suggest suitable remedial measures for successful implementation of the activities on 25th February, 2025.

Dr. Kripan Ghosh, Head Agrimet Division, Pune, attended meeting with the representatives from WMO and Global Water Partnership to discuss the "Pre-concept note on Integrated Drought Management for South Asia" through virtual mode on 11th March, 2025.

Dr. M. Mohapatra, DG IMD participated in the meeting for development of Urban Flood Risk Management Framework for Ahmedabad, Delhi and Mumbai under the Chairmanship of Union Home Secretary on 12th March.

Dr. M. Mohapatra, DG IMD had meeting with the Director General, Defence Research & Development Organisation (DRDO) on 12th March regarding handing over of Aerosol Radar to IMD. The indigenous LIDAR for measurement of aerosols developed by DRDO was handed over to IMD by DRDO. The aerosol LIDAR is developed by the Indian Research and Development Establishment (IRDE), a constituent Lab of DRDO. The LIDAR system was handed over by Dr. B. K. Das, DG (ECS), DRDO.

The indigenous Lidar for measurement of aerosols developed by DRDO was handed over to IMD by DRDO

Shri Sunny Chug, Sc. 'D', **Dr. S. B. Saha**, Met-B and **Shri C. Chakraborty,** Met-A, MWO Kolkata, attended the Coordination Meeting between IMD and AAI held on 12.03.2025 to implement in-house developed RVR and Met. Parameters display at ATC and AOCC.

Shri Raja Acharya, Met.-B, participated virtually in the 8thWMO International Workshop on Monsoons (IWM-8) organised through hybrid mode at IITM Pune during 17-21st March, 2025.

Dr. Rizwan Ahmed, Sc. 'D' delivered a lecture on Heat waves and Its mitigation at a Maharashtra government-organized workshop focused on Heat wave forecasting, impacts and mitigation and preparedness at Washim, organized by the Maharashtra Government Disaster management Authority on 19th March, 2025.

Dr. Gargi Rakshit, Sc. 'C' attended Survey of India (SOI) one day event AAYAM 2025 "**Empowering Geospatial Solutions: Future-Ready Mapping & Collaboration**" focussed on the evolving landscape of geospatial mapping and drone-enabled surveying, underscoring the pivotal role of geospatial data in national infrastructure development, economic advancement and

governance on 17th March, 2025 at Vivanta by Taj, Dwarka, New Delhi.

Dr. A. K. Mitra, Sc. 'F' attended **GSICS Annual and Executive Panel (EP-25) meeting** hosted by CMA from 17th to 21st March 2025 held in Changchun, Jilin Province, China. The Global Space-based Inter-Calibration System (GSICS) is an international collaborative effort initiated in 2005 by the World Meteorological Organization (WMO) and the Coordination Group for Meteorological Satellites (CGMS) to monitor, improve and harmonize the quality of observations from operational weather and environmental satellites of the Global Observing System (GOS).

Shri Raja Acharya, Met.-B, attended WMO GOOS webinar on monitoring the performance of Voluntary Observing Ships (VOS) and Data Buoy Cooperation Panel (DBCP) platforms held on 18thMarch, 2025.

Dr. Gopi Nath Raha, Sc. 'E', MC Gangtok, attended a meeting with Secretary, Dept of Science and Technology, Govt. of Sikkim regarding augmentation of AWS network in the State of Sikkim, on 19th February, 2025.

Dr. Ashutosh Misra, Sc. 'D', **Dr. Jaya Dhami Parihar**, Sc. 'D' and **Dr. Asha Latwal**, Sc. 'C' attended an interaction meeting with delegates from University of Reading, United Kingdom (UK) and Meteorological Service Singapore (MSS) and officials from IMD, Pune at CR&S, Pune on 20th March, 2025.

Dr. M. Mohapatra, DG IMD participated in the preparatory meeting of World Meteorological Organisation and International Oceanographic Commission (WMO-IOC) Joint Collaborative Board (JCB) meeting on 18th March. It was followed by regular online meeting with all the members on 24th March, 2025 to discuss about the necessity for enhanced collaboration and strategic planning to address pressing oceanic & meteorological challenges and prioritize work areas for further improvements.

Dr. M. Mohapatra, DG IMD participated in the meeting on Heat Wave preparedness and Mitigation Measures convened by National Disaster Management Authority on 20th March, 2025. Dr. Naresh Kumar, Sc. 'F' gave a presentation on Heat Wave monitoring and forecasting by IMD.

Dr. R. K. Giri, Sc. 'F', **Dr. A. K. Mitra**, Sc. 'F' and **Dr. Gargi Rakshit**, Sc. 'C' attended virtual meeting "**Collaboration on Real-Time GNSS Data Processing (IMD & IIT Tirupati)**" with IIT Tirupati on collaboration on real-time processing of GNSS data using GAMIT software on 28th March, 2025.

Sri. K.N Mohan, Sc-G of RMC Guwahati and Dr. S.O. Shaw, Sc-F attended Review meeting of the Inception Report submitted by the Consultancy Service provider for 15 Master Plans organized by Brahmaputra Board on 26th March, 2025.

Dr. M. Mohapatra, DG IMD, attended 38th ICAR-CIFA Annual Day function as Chief Guest at Kausalyaganga, Bhubaneswar on 01st April, 2025.

Shri Uday K. Shende, Scientist 'F', participated in the online meeting of the Ship Observation Team (SOT-13) under the World Meteorological Organization (WMO), held on 1st April, 2025.

Shri. Ashish Kumar, Scientist 'D', attended a meeting held in hybrid mode on 4th April, 2025 at MoES to review the status of Mission Mausam projects status under the chairmanship of **Dr M. Ravichandran**, Secretary, MoES. **Dr. M Mohapatra**, DGM-IMD, **Sh. Chetan Prakash Jain**, JS&FA, MoES, **Dr. D S Pai**, Program Head (Mission Mausam), **Sh. Santosh Kumar**, DDG(Admin), **Sh. K D Meena,** Controller of Accounts, Project Directors and Deputy Project Directors of Mission Mausam, Scientists from CPU, B&P and Heads from RMCs/MCs/CRS, Pune participated in the meeting.

Dr. M. Mohapatra, DG IMD participated online in the Meeting of the next session of the Technical Coordination Committee (TCC) at WMO, Geneva from 7-11 April, 2025.

Shri Surjay Lama, SO-I and **Shri Atanu Sarkar,** Met-B, MC Gangtok, participated in a meeting with Secretary, Horticulture Department and Secretary, Agriculture Department, Govt of Sikkim on 16th April, 2025 for integration of IMD Weather Forecast and Agro Meteorological Services with Sikkim State Government IT Platforms and further requested him to provide Agro Advisory for preparation of AAS Bulletin from this office.

Dr. M. Mohapatra, DG IMD, **Shri R. K. Jenamani, Scientist-G** and **Shri Rahul Saxena, Scientist-G** participated in the Meeting to review the implementation of directions given by Hon'ble

Home Minister during Flood Preparedness Review Meetings held in the year 2020, 2021, 2022, 2023 and 2024 under the chairmanship of Union Home Secretary at MHA, North Block, New Delhi on 28th April, 2025.

Dr. R. K. Giri,Scientist'F', **Dr. A.K. Mitra**, Scientist'F' and **Dr. Gargi Rakshit**, Scientist 'C', attended meeting with **Prof. Toru Terao** Faculty of Education, Kagawa University Japan to discuss on Real-time IPWV processing using RTKLIB for multiple GNSS stations on the IMD server and exploring the possibility of deriving IPWV from Trimble stations using RTKLIB at GNSS, Satmet Building, IMD on 30th April, 2025.

Meeting regarding preparation of draft **Andaman and Nicobar Disaster Management Plan-2025** held under the chairmanship of Chief Secretary, A&N Islands held on 2nd May, 2025 was attended by Shri S.P. Singh, Sc-D, MC Sri Vijaya Puram.

Dr. O. P. Sreejith,Scientist 'F', has attended eighth meeting (online) on 5th May, 2025, ninth meeting (online) on 26th May, 2025 and tenth meeting (online) on 29th May, 2025from 03:00 pm to 04:00 pm under the chairmanship of Dr.Preveen Kumar, ScientistG, NCMRWF regarding preparing the RFP document titled "For Procurement of Supply, Installation, Integration & Maintenance of Computational Infrastructure and HighPerformance Computing (HPC) Solutions at India Meteorological Department – Turnkey Job".

Dr. Kuldeep Srivastava, Scientist 'F' attended meeting regarding Regional Session for National Focal Points on Radio Frequency Matters in the Asia-Pacific Region on 13th May, 2025 in online mode and made a presentation on IMD activities in this regard.

Dr. R.K. Giri, Scientist 'F', along with Hon'ble MoES (I/C) for Earth Sciences, PS to MoES and Secretary, MoES participated in 17th RIMES Council Meeting and 4th Ministerial Conference held in Colombo, Sri Lanka from 7-9 May, 2025.

Meeting to discuss **"climatic and weather conditions in Pune and surrounding are**a" for review "Bio Diversity Park reservation and Hill Top Hill Slope zone" in PMC and PMRDA area under the chairmanship of Shri. Ramanath Jha, Former Collector and Deputy Director, Municipal Administration, Ahmednagar, Municipal Commissioner, Pune and Metropolitan Commissioner, MMRDA at CR&S, IMD, Pune on 13th May, 2025.

Dr. Ashutosh Misra, Scientist 'D', **Dr. Jaya Dhami Parihar,** Scientist 'D' and **Dr. Asha Latwal,** Scientist 'C', attended the online meeting on "Kharif Season 2025-Contingency Crop Planning" under the chairmanship of Commissioner (Agriculture) with senior officials from ICAR-CRIDA Hyderabad, Maharashtra State Government, State Agricultural Universities and ICAR institutes *etc*. on 14th May, 2025.

Dr. Ashutosh Misra, Scientist 'D' attended, "PradhanmantriFasalBimaYojna (PMFBY) State level Crop Insurance co-ordination Committee Meeting (SLCCCI)" under the chairmanship of Chief Secretary (Agriculture) with senior officers from Maharashtra State Government, RBI, NABARD, insurance companies etc. through virtual mode on 15th May, 2025 and (ii) Online State Level Crop Insurance Coordination Committee Meeting on Pradhanmantri Fasal Bima Yojna (PMFBY) chaired by Chief Secretary, Government of Maharashtra on 17th June, 2025.

A two-day Regional Level Coordination Meeting of all heads of **MCs / DWR / MWO / FMOs** and different divisional heads under RMC Kolkata held during 15.05.2025-16.05.2025 at RMC Office Kolkata under Chairmanship of Dr.Somenath Dutta, Scientist 'G'.

The meeting was held broadly in two sessions focusing on technical and operational matters on Day-1 (15.05.2025) and General administration and works matter on Day-2 (16.05.2025). Dr. H.R. Biswas, Scientist 'F' welcomed all participants in the meeting on behalf of Head, RMC Kolkata and highlighted about the meeting purpose and objectives in brief.

Regional Level Coordination Meeting of all heads of MCs / DWR / MWO / FMOs and different divisional heads under RMC Kolkata

Dr. A.K. Mitra, Scientist-F, attended first and Second meeting of Joint Working Group (JWG) for the Space-Based Disaster Management Requirement of MHA at Tapovan, National Disaster Management Authority, New Delhi on 30th April, and 19th May, 2025.

Sh. Pradeep Sharma, Scientist-D and Sh. N. V. Patel, Met-B attended Pre-Monsoon Inter–State Meetings on "Flood Forecasting Arrangements Monsoon-2025" for Tapi, Lower Narmada and Daman Ganga Basins and Sabarati, Banas and Mahi &Setrunji river basins on 21st May 2025 at Narmada-Tapi Bhawan Central Water Commission, Gandhinagar.

Dr. Ashutosh Misra,Scientist 'D', **Dr. Jaya Dhami Parihar**, Scientist 'D' and **Dr. Asha Latwal**, Scientist 'C' attended the online meeting with various AMFUs and RMCs/MCs regarding "Quality and Timeliness of AAS Bulletins under GKMS" on 21-22 May, 2025.

The State Disaster Management Authority (SDMA) under the Department of Revenue and Disaster Management, Govt. of Chhattisgarh held a southwest monsoon 2025 preparedness meeting on 30.05.2025 constituted under the chairmanship of Additional Chief Secretary Forest and Climate Change, **Ms. Rich Sarma**. The meeting was attended by **Smt. Samanti Sarkar,** Scientist 'F' & **Dr. Gayatri Vani Kanchibhotla**, Scientist 'C', In-Charge State Weather Forecasting Services. Inputs of Long Range Forecast of SW Monsoon 2025 along with meteorological terms and services were briefed. Also the timely dissemination of CAPSACHET messages was discussed with focus on orange and red alerts.

Shri.R.Pariong, Met. 'B' and **Ms.Evakordor Jyrwa** Project Scientist-I attended the online meeting Strengthening Dissemination of Agromet Advisory Services under Gramin Krishi Mausam Sewa (GKMS) regarding collection of more Farmers data to be included in Agromet WhatsApp group on 2nd June, 2025.

Dr.Manorama Mohanty, Scientist 'F', attended Disaster Management Exercise (DMEx-2025) Meeting, held at OSDMA, Rajiv Bhavan, Bhubaneswar, to carry out Dummy Exercise for District Level (Table Top Exercise) and Block Level (Table Top Exercise) in connection with Cyclone/Associated Storm Surge/ Heavy Rainfall/ Landslide, on 6thJune, 2025.

Dr.Trisanu Banik, Scientist 'D' attended a meeting as a member of Technical Evaluation Committee (TAC) under NLRMP Project with NDMA along with various other states representative of India for evaluating the PPR of individual states under the Chairmanship of Shri Krishna S. Vatsa, Member, NDMA on 10th June, 2025.

Dr.Kripan Ghosh, Scientist 'F', **Dr. Jaya Dhami Parihar**, Scientist 'D' and **Dr. Asha Latwal**, Scientist 'C' attended virtual roundtable on "Celebrating 150 Years of IMD: Frontiers for Early Warning" jointly organised by IMD, New Delhi and the All India Disaster Mitigation Institute (AIDMI), Ahmedabad, Gujarat on 11th June, 2025.

Dr. M Mohapatra, DG IMD attended meeting with Mr. Stephen Hodgson regarding Assessing the legal and institutional framework for the provision of meteorological services in South Asia through video conferencing on 12th June, 2025.

Dr. Sreejith O.P. and **Dr. Rohini P.** participated in the S2S–AccelNetWorkshop:"Climate-Informed Flood Prediction and Water Management", hosted by the S2S AccelNet team in collaboration with the Indian Institute of Tropical Meteorology(IITM) and the India Meteorological Department (IMD). The workshop was held from June 16–18, 2025, at IITM, Pune.

Union Minister of State (Independent Charge) for Science and Technology and Earth Sciences, Dr. Jitendra Singh,

Union Minister of State (Independent Charge) for Science and Technology and Earth Sciences, Dr.

Jitendra Singh, convened a high-level review meeting with prominent scientific institutions from the Northeast at the Deputy Commissioner's Conference Hall on 17th June 2025. Sri K.N. Mohan, Scientist-G and Head, Regional Meteorological Centre, Guwahati, Dr. Sanjay O'Neill Shaw, Scientist-F, Sri C. Amarnath, Scientist-D and Sri Nalnish KumarChaoudhary, Scientist-D and Head, Meteorological Centre, Kohima attended the meeting.

Dr.Trisanu Banik, Scientist 'D' attended a meeting with Uttar Pradesh Relief Commissioner, Government of Uttar Pradesh concerning the establishment of a Lightning Detection Network and Electric Field Monitor in the state on 19thJune, 2025.

Shri. Sunny Chug, Scientist 'D' and Shri I. Talukdar, Met. 'B', MWO Kolkata, attended the initial Preparatory Meeting for Full Scale Mock Exercise for Aircraft Accident conducted by AAI Kolkata on 20thJune, 2025.

Dr. Arvind Kumar, Scientist-D organized a meeting on 20th June 2025 at 1200 hrs IST 8 at RMC Chennai for the Integration of IMD Services with State Government Portals and Strengthening Farmer Outreach in Tamil Nadu, Puducherry, and Karaikal. The meeting was attended by Shri Ravichandran, Deputy Director of Agriculture (IT), Government of Tamil Nadu; Shri S. Karthik, Agricultural Officer, Department of Agriculture, Government of Tamil Nadu; Dr. B. Amudha, Scientist-F & Head, RMC Chennai; and Dr. Arvind Kumar, Scientist-D & Officer-in-Charge, Agromet Advisory Services Unit (AASU), RMC Chennai

Dr. M. Mohapatra, DG IMD alongwith experts from IMD attended meeting with experts from Bureau of Indian Standards including Dr. Prem Krishna, Chairperson, Cyclone Resistant Structures Sectional Committee; Dr. P. Hari Krishna, CSIR-Structural Engineering Research Centre, Chennai; Dr. S. Arunachalam, Jaypee University of Engineering and Technology, Guna; Dr. Manoj Kumar Rajak, Bureau of Indian Standards on 23rd June, 2025.

Dr. O. P. Sreejith, Scientist'F', attended an Online meeting on 23 June 2025 organised by WMO for the Launch of the State of the Climate in Asia 2024 Report, and presented the report as a Lead Author. Dr.Satyaban B Ratna, Scientist 'E' also attended the meeting.

Shri Uday K. Shende,Scientist 'F', participated in the online meeting organized by the World Meteorological Organization (WMO) under the Climate Risk and Adaptation Partnership (Climate RAP) on 23rd June 2025 Shri Uday K. Shende, Scientist 'F', participated in the online meeting organized by the World Meteorological Organization (WMO) under the Climate Risk and Adaptation Partnership (Climate RAP) on 23rd June, 2025.

Shri ThangjalalLhouvum, Scientist 'D', MC Shillong attended the First Half-yearly meeting of the Nagar Rajbhasha Implementation Committee (Office-1) Shillong Meeting on 23rdJune, 2025.

Shri Abhimanyu Chauhan, Sc. 'C' attended Technical Verification Committee Meeting under the Project 'Digital Monitoring of Agriculture, Crop Acreage and Production Estimation for Gujarat State Using Remote Sensing, GIS and Other Technologies' on 24th June, 2025 at Krushi Bhavan, Gandhinagar.

The Department of Agriculture Development, Farmers' Welfare and Biotechnology, Govt. of Chhattisgarh organized a meeting of the State Level Crop Insurance Coordination Committee (SLCCCI) on 23.06.2025 to review and discuss key aspects of the Pradhan Mantri FasalBima Yojana (PMFBY) for the Kharif and Rabi seasons 2024–25 and 2025–26. Additionally, under the Revised Weather-Based Crop Insurance Scheme (RWBCIS), discussions were held on the establishment of automated weather stations under the WINDS framework. The meeting was attended by **Smt. Samanti Sarkar**, Scientist 'F' & **Dr. Gayatri Vani Kanchibhotla,** Scientist 'C'.

Dr. A.K. Mitra, Scientist 'F', member, attended VLMG Eastern Group Meeting and presented IMD proposal to establish a new VLab Centre of Excellence in New Delhi on 24th June, 2025. Shri Chinmay R Khadke, Sc-D was also present during the meeting.

Dr Sankar Nath,Scientist'F', **Mr. Prashant Bansal**, Scientist 'D', and **Dr.TrisanuBanik**, Scientist 'D' attended a CAP meeting in NDMA Bhawan, New Delhi related to direct dissemination of CAP alerts on 24th June, 2025.

Dr. A.K. Mitra,Scientist'F', attended fourth meeting of Joint Working Group (JWG) and submitted TOR in r/o IMD for the Space-Based Disaster Management Requirement of MHA as a member organized by National Disaster Management Authority, New Delhi on 26thJune, 2025.

IMD team attended Joint Systematic Observations Financing Facilities (SOFF) & Hydro Meteorological and Environment Industry (HMEI) session for SOFF peer advisors and implementing entities on 26th June 2025. **Shri K. C. Sai Krishnan, Ms. Ranju Madan, Shri K.N. Mohan, Dr. R. K. Giri and Shri Manish Ratnakar** attended the meeting.

Dr. Arvind Kumar, Sc.-D, AASU attended an online meeting on 1st July 2025 (via Google Meet) regarding the "Follow-up Discussion on Automation and API-based Data Integration of Agromet Advisory Services (AAS) with the 'Uzhavar' App" in collaboration with the Department of Agriculture, Government of Tamil Nadu and IMD HQ. Key discussions included the technical framework for API integration, enhancement of Agromet Advisory dissemination via the 'Uzhavar' App and WhatsApp groups, and action points for implementation. This initiative aims to strengthen last-mile connectivity of weather and agromet services to farmers across Tamil Nadu.

Dr. B. Amudha, Scientist-F, RMC-Chennai, participated in a Video Conference Meeting conducted by Head quarters on 02.07.2025 at 3 pm along with officials of Govt. of Tamilnadu in connection with procurement of 2 Nos. of Doppler Weather Radar for installation at Yercaud and Ramanathapuram.

Shri Parmod Kumar, Scientist-D chaired the first meeting of the committee formed for development of IMD PRONATTI - a package of promotion and confirmation through METNET on 9th July, 2025. In the meeting discussion was held to create a workflow and SOP.

Dr. Kripan Ghosh, Scientist F & Head Agrimet Division, **Dr. Ashutosh Misra**, Scientist-D and **Dr. Asha Latwal**, Scientist-C attended Meeting with Lieutenant General Shri YogendraDimri (Retd.), Vice Chairperson, Uttar Pradesh State Disaster Management Authority (UPSDMA) at CR&S, IMD, Pune on 4th July, 2025 and Online meeting to discuss "Integration of IMD Services (Weather forecast and Agrometeorological Advisory Services) with State Government website / web portal / mobile apps" under the chairmanship of Director, Agriculture & Farmers' Welfare Department, Government of Mizoram with senior officials from Directorate of Agriculture & Farmers' Welfare, Government of Mizoram, ICAR-Mizoram Centre, Kolasib and IMD, New Delhi on 10th July, 2025.

Dr. Satyaban B Ratna, Scientist-E, as a member of the CLIVAR CDP, participated in (Online) the CD Dr. Satyaban B Ratna, Scientist-E, attended the first meeting of the WMO Task Team on National Framework for Climate Services (TT-NFCS) organized by WMO on 9 July, 2025.

Dr. O. P. Sreejith Scentist-F attended "International Conclave on "Climate Change and Global Warming – Problems & Prospects," organized by Siksha 'O' Anusandhan Deemed to be University, Bhubaneswar on 10–11 July 2025 and gave presentation on "Climate change observation and climate service over Indian Region".

Shri Rahul Saxena, Scientist 'G' & Head Hydro Meteorology Division attended the WMO- PMC Meet in view of releasing of US AID Funds to WMO for GFFGS and EWS-F on 16 July, 2025.

Sri K.N. Mohan, Scientist-G, **Dr. Sanjay O'Neill Shaw**, Scientist-F, **Shri Sunit Das,** Scientist-F &**Shri C. Amarnath**, Scientist-D attended a meeting called by Dr. HimantaBiswaSarma, Chief Minister of Assam on 17 July, 2025 to discuss about deficient rainfall in Assam. The meeting was also attended by Sri Ravi Kota, IAS, Chief Secretary, Assam, SmtArunaRajoria, IAS, Commissioner & Secretary to the Govt. of Assam & other senior officials of Dept. of Agriculture and Horticulture, Govt of Assam.

Dr. M. Mohapatra, DGM IMD participated in the 5th Scientific Steering Committee (SSC) meeting of Monsoon Mission-III at IITM Pune online during 21st – 22nd July, 2025.

Dr. Satyaban B Ratna, Scientist-E, attended the VC Meeting on Data Sharing with PM Gatishakti on 23 July, 2025 and Online meeting with Christ University (Lavasa Pune) to discuss the internship aspects of their students, on 24th July, 2025.

Dr. M. Mohapatra, DGM IMD participated in the review meeting for the Mitigation Project on

Lightning Safety (MPLS) under the Chairmanship of Union Home Secretary at Common Central Secretariat III Conference Hall on 24th July.

The officials from the **Central Water and Power Research Station** (CWPRS), Khadakwasla, Pune, had a meeting with **Shri K.C. Sai Krishnan**, Scientist G & Head, CR&S, Pune, **Dr. O. P. Sreejith**, Scientist F**, Dr. SatyabanBishoyiRatna**, Scientist-E and **Smt. Arti Bandgar**, Scientist -D and other IMD scientists on 1st August 2025 to discuss collaboration with IMD for research and development activities in the concerned sectors.

Dr. M. Mohapatra, DG IMD participated in the inaugural; Session of the DBCP-INCOIS Training Workshop on Ocean Observations for Operational Services in the Indian Ocean on 5th August.

Dr. B. Amudha, Scientist-F, RMC-Chennai, on 6th August 2025, attended a meeting with Smt. Sigy Thomas Vaidhyan, IAS, Commissioner (Disaster Management), Tamil Nadu State Disaster Management Authority (TNSDMA), Chepauk, Chennai – 600 005, requesting for support of Government of Tamil Nadu / TNDRA support to identify suitable site for New Radar Installations at Kanyakumari, Thiruchirapalli and Coimbatore under Mission Mausam Radar installation.

Dr. M. Mohapatra, DG IMD participated in the 4th Consultative Meeting on "Ease of Doing Research & Development (R & D) under the Chairmanship of **Dr. V. K. Saraswat**, Hon'ble Member, Niti Aayog on 6th August, 2025. He also chaired a Technical Session on "Strengthening R & D Ecosystems – Funding, Infrastructure and Regulatory Framework" during the meeting.

A team of disaster management officers from the Govt. of Tamil Nadu visited IMD on 8th August, 2025 to discuss about various issues w.r.t. data sharing and access to APIs of various severe weather phenomena.

Dr. B. Amudha, Scientist-F, RMC Chennai, attended a meeting through VC on 14.08.2025, arranged by Surface Instruments Division, CRS, Pune, regarding 2nd phase of installation of Agro AWS – Status of NOCs of 101 Agro AWS installations (IInd Phase) under 330 Agro AWS Project.

Dr. M. Mohapatra, DGM IMD participated in the Inaugural Session of the National Meet 2025 (NM2.0): Leveraging Space Technology and Applications for Viksit Bharat 2047 at Bharat Mandapam.

Dr. M. Mohapatra, DGM IMD participated in the National workshop "Enhancing Coastal Risk Resilience" and presented an Invited Talk on Emerging Cyclone trends during 1st Technical Session on 22nd August.

Dr. M. Mohapatra, DG IMD attended Inspection Committee meeting of Parliamentary Committee for implementation of Hindi language at Meteorological Centre, Gangtok, Siliguri on 25th August and Flood Meteorological Office (FMO), Asansol at Kolkata on 28th August. Dr. Mohapatra also visited FMO Jalpaiguri on 25th August, 2025.

Dr. M. Mohapatra, DGM IMD participated in the meeting of the National Executive Committee (NEC) to review the restoration of services/infrastructure and relief measures in the flood affected regions of the Union Territory of Jammu & Kashmir on 3rd September, 2025.

Dr. M. Mohapatra, DGM IMD participated in the meeting at PM Office for discussion on increase in the frequency of disasters in hilly areas, under the Chairmanship of **Sh. Tarun Kapoor**, Advisor to Hon'ble Prime Minister on 6th September, 2025.

Dr. M. Mohapatra, DGM IMD chaired the meeting with**CMDE Mr. Abhinav Bharve**, DNOM, Indian Navy and his team on 12th September, 2025 during their visit to IMD, to enhance further collaboration between the two agencies w.r.t. integration of various guidance products in the Panorama DSS developed by Indian Navy.

On 26th August, 2025, a hybrid review meeting was chaired by **Smt. Ranju Madan**, Scientist-G and Head, Surface Instrument Division, CRS IMD Pune. The meeting brought together officials from IMD, CSIR institutes, defenceorganisations, DGCA, and industry representatives, with active participation from BIS. Discussions focused on the standardisation of meteorological instruments, followed by a visit to the CRS IMD Surface Instrumentation Division labs at Shivajinagar, Pune.

Participants of hybrid review meeting at Surface Instrument Division, CRS Pune.

Dr. Satyaban Bishoyi Ratna, Scientist - E, as a CLIVAR member, attended the "Pan-CLIVAR Meeting 2025 & CLIVAR Symposium: Bridging Science and Society in Southeast Asia and Beyond" at Bali, Indonesia, during 22-26 September, 2025.

Captain A. Vidyasagar, Head IMAC, Indian Navy visited IMD on for familiarisation on the **Decision Support System** of IMD for weather forecasting on 10th October. **Dr. M. Mohapatra**, DG IMD chaired the meeting.

Dr. Ashutosh Misra, Sc. 'E', attended an online meeting under the chairmanship of Commissioner of Agriculture, Maharashtra regarding "**The WINDS project implementation**" with officials from Maharashtra State Agriculture Department and Agriculture Universities on 14th October, 2025.

Dr. Manorama Mohanty, Sc. 'F', MC Bhubaneswar attended review meeting with Hon'ble Minister, Revenue and Disaster Management and with Special Relief Commissioner, Revenue and Disaster Management regarding preparedness for ensuing Cyclone system over Bay of Bengal through OSWAN VC from the SEOC Conference Hall, Bhubaneswar on 25th and 26th October, 2025 respectively.

Dr. M. Mohapatra, DG, IMD participated in the Joint Collaborative Board of WMO and Intergovernmental Oceanographic Commission (IOC), **Annual Review Meeting-2025** on 27-28 October through video conferencing.

Dr. R. K. Giri, Sc. 'F' virtually attended the International Conference Steering Committee (ICSC) Meeting, **Asia-Oceania Meteorological Satellites Users' Conference (AOMSUC-15)** on 28th October, 2025.

Regional Meteorological Center (RMC) Chennai conducted "**Regional Northeast Monsoon Forum for Southern States**" on 7th November 2025 in collaboration with the World Food Program (WFP), and State government Tamil Nadu. **Dr. O. P. Sreejith**, Sc. 'F' attended the meeting and gave presentation on "**Review of the climate for States in South India**".

Dr. M. Mohapatra, DG, IMD participated in the review meeting chaired by Home Secretary to normalize the responsibilities especially with regard to cloudburst, flooding with Western Himalayas and Northeast States at PM Office, South Block on 14th November, 2025.

Dr. M. Mohapatra, DGM IMD participated in the **Regional Expert Group Meeting (ReG)** of the APDIM at Vigyan Bhawan New Delhi and made a presentation on **Multi Hazard Analytics and Impact-Based Forecasting for Inclusive Risk Data Governance** on 20th November, 2025.

Dr. M. Mohapatra, DG, IMD participated in the joint meeting of the Secretary Ministry of Agriculture & Farmers Welfare with Secretary, Ministry of Earth Sciences and Secretary, Department of Space to discuss the feasibility of AI-based weather advisories and farm-level yield estimation at Room No. 142, Krishi Bhawan, New Delhi on 2nd December, 2025.

Dr. M. Mohapatra,DG, IMD participated in the inception meeting between the delegation from ASEAN Humanitarian Assistance Centre (AHA Centre) and officials from Indian Stakeholders at ICR-ER Conference Hall, 4th Floor, NDCC-II Building, Jai Singh Road, MHA on 4th December, 2025.

Thereafter the team visited IMD**. Mrs. Monica Sharma,** Sc. 'E' gave a presentation on the international responsibilities of IMD.

A meeting on Stakeholders Consultation on Condition Assessment & Management Plan (CAMP) for Mahanadi river basin & State Specific Action Plan (SSAP) for water was held on 4th December, 2025. The meeting was attended by **Ms. Samanti Sarkar**, Sc. 'F', and **Dr. Gayatri Vani Kanchibhotla**, Sc. 'C'. IMD being key stakeholder, inputs on climatology of the region and extreme weather events were discussed. The stake holders were also informed of the services being provided by the

office of MC Raipur and our intention to work closely with other departments towards a common goal.

Dr. M. Mohapatra, DG, IMD participated in the Joint Collaborative Board (JCB) meeting of World Meteorological Organisation (WMO) and Intergovernmental Oceanographic Commission (IOC)Meeting through VC on 9th December, 2025.

Mrs. Monica Sharma, Sc. 'E' made a presentation on "National collaboration between Ocean & Meteorological Agencies for Services and Capacity Development: A Success Story in India" during the meeting.

Dr. A. K. Mitra, Sc. 'F' attended the **ESSO Council Meeting** held in Guwahati on 19-20 December, 2025. The meeting focused on New activities/programs included in the next Financial Cycle (2026-2031) pertaining to innovation and technology development, Programs on Science, Technology and Innovation-based entrepreneurship, promotion of start-ups, location-specific technologies for sustainable livelihoods, women's empowerment, and advancement of gender parity and pending administrative and financial matters.

Dr. R.K. Giri, Sc. 'F' attended a meeting organized by NitiAyog regarding evaluation of the High Performance Computing (HPC) and Multi-Mission Data Receiving and Processing System (MMDRPS) held at Niti Bhawan, New Delhi on 15th December, 2025.

Dr. M. Mohapatra, DG IMD, participated as a panellist in the National Conference on "**Digital India Land Record Modernization Program (DILRMP) & Disaster Management**" organized by Government of Gujarat in collaboration with Department Land Resources, Ministry of Rural Development, Govt. of India and GSDMA, Gujarat on 3rd October, 2025.

Shri Rahul Saxena, Sc. 'G' attended Regional Policy Dialogue on Flood Emergency Response organised at Thailand, Bangkok on 13 -16 October, 2025.

Dr. M. Mohapatra, DG, IMD, participated in the inaugural ceremony of the Emerging Science, Technology & Innovation Conclave (ESTIC-2025) organized by DST at Bharat Mandapam, Pragati Maidan with the vision "**Pioneering Sustainable Innovation, Technological Advancement and Empowerment**" for "**Viksit Bharat 2047**" on 3rd November, 2025.

Dr. M. Mohapatra, DG, IMD participated in the Valedictory session of **South Asian Institute for Advanced Research and Development (SAIARD) International River Congress**, at India International Centre on 6th November, 2025.

International Tropical Meteorology Symposium (INTROMET-2025) on "**Advances in Tropical Weather, Ocean, and Monsoon Climate Research for a Sustainable Future**" was organised during 18-20 November 2025 at IITM, Pune in which Scientists from IMD participated and presented.

Dr. S. I. Laskar, Sc. 'F', participated International Symposium on Tropical Meteorology (INTROMET-2025), organized by the Indian Meteorological Society at the Indian Institute of Tropical Meteorology (IITM), Pune during 18-20 November, 2025 on the theme "**Advances in Tropical Weather, Ocean, and Monsoon Climate Research for a Sustainable Future**" as a Convenor of National Organizing Committee and Chair a Technical session on the topic "**Weather & Climate Science for Sustainable Agriculture**". **Dr. Kripan Ghosh,** Sc. 'F' delivered an invited lecture on "**Science to Services: Agromet Advisory Services for Climate-Resilient Agriculture**" during the workshop on 20th November, 2025. **Dr. Gargi Rakshit,** Sc. 'C' delivered an oral presentation at the symposium. **Sh. Pradeep Sharma**, Sc. 'D' also presented his paper. **Dr. Sudeep KumarB.L.** Sc. 'D', presented a poster on the topic "**Understanding the long-term trends in thermodynamic instability indices and their optimum values for thunderstorm prediction over India**".

Dr. M. Mohapatra, DG, IMD participated in the Session 2 entitled Technology-enhanced Surveillance, Panel Discussion 3 in the One Health Mission Workshop to be held at Bharat Mandapam, New Delhi on 20th November, 2025.

IMD organized a Brainstorming Session on "Cloudburst Events: Challenges in its Monitoring & Forecasting and Way Forward" at New Delhi on 28th November, 2025.

Dr. M. Mohapatra, DG, IMD participated in the **4th Session of the Third Pole Climate Forum (TPCF-4)** through VC on 1st December, 2025.

Dr. Manorama Mohanty, Sc. 'F', **Dr. Gopi Nath Raha**, Sc. 'F', **Shri Ashis Kumar**, Sc. 'D', and **Shri S. P. Singh**, Sc. 'D' attended the **Brainstorming Session on Aviation Meteorological Services** at Ministry of Earth Science, New Delhi, on 15th December, 2025.

Dr. A.K. Mitra, Sc. 'F' attended the 2nd National Conference on **Geospatial Education** on 5th December, 2025 organised by Delhi Technological University, Delhi. The conference aimed to **establish a national platform for dialogue and collaboration among Government, Academia, and Industry on key issues shaping India's Geospatial Education landscape in its journey towards Global Geospatial Leader**.

Dr. M. Mohapatra, DG IMD participated in the 7th International Conference on India Radar Meteorology iRADat Indian Institute of Geomagnetism at Navi Mumbai on 6th January, 2025.

Ms. Vijeta, Scientific Assistant, represented the Regional Meteorological Center Nagpur in the National Hindi Scientific Seminar on the topic of "**Uninterrupted Weather Forecasting and Applications**" organized by the National Centre for Medium Range Weather Forecasting Center (NCMRWF) on 24 - 25 March 2025. Ms. Vijeta presented on the application of machine learning and artificial intelligence in weather forecasting.

Dr. Ashok Kumar Das, Sc-F & Head, Met Centre Ahmedabad attended the 'One-day Brainstorming Session' to discuss the current gaps and requirements of future satellite sensors, data and applications, to cater to India's future research and operational requirements held on 4th July 2025 at SAC, ISRO Ahmedabad.

Dr. Manorama Mohanty, Scientist-F, MC Bhubaneswar, attended a seminar on World Nature Conservation Day 2025 on 26 July, 2025, hosted by Science for Common People Society (SCOPES) in collaboration with India Meteorological Society – Bhubaneswar Chapter and Trident Academy of Technology at Trident Academy of Technology and delivered a lecture on 'The Role of Weather Awareness in Mitigating Extreme Climate Events'.

A Brainstorming Committee meet on Desert Meteorology & Climate Change at Central University of Rajasthan was held on 20th August 2025 at Central University of Rajasthan, Kishangarh, Ajmer under the chairmanship of **Dr. L. S Rathore**, EX-DGM IMD. **Prof. Anand Bhalerao**, Vice-Chancellor, Central University of Rajasthan, Ajmer, **Dr. D. S. Pai**, Scientist-G, IMD New Delhi, **Sh. Radheshyam Sharma**, Head MC Jaipur, **Dr. Swagata Payra**, Prof, BIT Mesra, **Sh. Nitin,** Lt. Col., South West Command, Indian Army, Sh. Himanshu Sharma, Scientist-D, MC Jaipur and senior officers and faculties were participated.

A Brainstorming Committee meet on Desert Meteorology & Climate Change at Central University of Rajasthan

Dr. M. Mohapatra, DG IMD participated in the Inaugural Session of the Science Conclave on "Science & Technology Frontiers for Swarnandhra and Viksit Bharat – 2047 at Andhra University and delivered the Padma Bhushan Dr. P.Koteswaram Memorial Lecture during the event on 5th September, 2024.

Dr. M. Mohapatra, DG IMD participated in the Advisory Committee Meeting of the Fourth National Conference on Polar Sciences (NCPS-2025) at National Centre for Polar & Ocean Research (NCPOR), Goa on 16th September, 2025.

The Fourth National Conference on Polar Sciences (NCPS-2025)

Dr. M. Mohapatra, DG IMD participated online as the Chief Guest during the Valedictory Session on Vaksana 2025, 6th International Confrence on Climate Smart Agriculture Impact and Adoption Stategiesorganised by Shri Vaishnav Instititue of

Agriculture, Shri Vishnav Vidyapeeth Vishwavidyalaya, Indore on 19th September.

On **29 September 2025**, a Brainstorming Committee Meeting on Desert Meteorology & Climate Change was jointly organized by the Meteorological Centre, Jaipur, and Bikaner Technical University, Bikaner, at Swami Keshwanand Rajasthan Agricultural University, Bikaner.

Brainstorming Committee Meeting on Desert Meteorology & Climate Change was jointly organized by the Meteorological Centre, Jaipur, and Bikaner Technical University, Bikaner,

The meeting was chaired by **Dr. L. S. Rathore** (Ex-DGM, IMD), and had prominent participants including Professor Akhil Ranjan Garg (VC, BTU & SKRAU, Bikaner), **Dr. D. S. Pai** (Scientist-G, IMD, New Delhi), **Shri Radheshyam Sharma** (Head, Meteorological Centre, Jaipur), **Dr.O. P. Yadav** (Ex-Director, CAZRI), along with other committee officers and domain experts from various institutions.

TRAININGS

MTI Pashan Pune conducting regular courses for capacity building for trainees at various levels and with respect to the departmental requirement in view.

- Modular training wherein Multi-tasking staff are trained for recoding the primary surface observations with a brief view on meteorology of atmosphere an introduction to the climatology of India and its topographical situations.
- Integrated Meteorological Training Course: In this course the mid-level employees from IMD and other departs are trained for recording all kinds of observations, analysis as per the ICAO standardization to meet the aviation and forecasting requirements of the department.
- Forecasters Training course: This is an advanced meteorology course which further enhances the understanding to applied meteorology and enables the senior experienced officials to issue forecasting
- Direct Recruited Scientists Training Course (DRSTC): This course was designed specially to train Directly recruited IMD's Scientists (C, D, E) with operational forecasting, tools and techniques.
- Advanced Meteorological Training course: Group A officers from Indian Navy, Coast Guard and international participants
- Customized Basic Observations on Meteorology Training Course was conducted from 27.10.2025 to 01.11.2025 for 10 Officials from Maldives Met. Services.

RMC Chennai conducted: (i) The Integrated Meteorological Training Course (IMTC) Batch No. 19, 20 and 21 for new Scientific Assistants (SAs) were conducted during 2025.

(ii) The Forecaster's Training Course (FTC) Batch No. 199, 200 and 201 was conducted during 2025.

(iii) A 15-day Familiarisation Training program for newly joined SAs was conducted during February 2025.

Aerodrome Meteorological Office Nagpur, DBAI Airport, Nagpur organized Familiarization course in Aviation Meteorology on 6/7th Feb, 2025.

The Aerodrome Meteorological Office (AMO), Nagpur, in collaboration with the Regional Meteorological Centre (RMC), Nagpur, successfully conducted a two-day training workshop on aviation (6-7th Feb, 2025) meteorological services for officers and staff from 22 airports, with a total participation of over 100 meteorologists across Madhya Pradesh, Chhattisgarh, and Vidarbha. The primary objective of this training was to enhance the competency of meteorologists and scientists, ensuring improved aviation safety and operational efficiency. The workshop was led by key organizers and experts, including **Dr. R. Balasubramania**n, Sc. 'F', RMC Nagpur and **Dr. Rizwan Ahmed** Sc. 'D', who played pivotal roles in the training sessions. In addition to participants from Madhya Pradesh, Chhattisgarh, and Vidarbha, officers from RMC Kolkata, RMC Chennai, the Airport Authority of India (AAI) Nagpur, and ICAR Nagpur also attended the workshop. Their participation fostered inter-regional collaboration and facilitated the exchange of expertise, further strengthening aviation meteorology practices across different regions.

Shri Chinmay R. Khadke, Sc. 'D' and **Shri Gargi Rakshit**, Sc. 'C' attended the training on INSAT-3DS MMDRPS system training at Space Application Centre (SAC), Ahmedabad during 12th to 19th February, 2025.

Sat. Met. Division IMDconducted the joint Cal/Val campaign with SAC (ISRO), Ahmedabad as Project Director for Calibration/ Validation of INSAT-3DR and newly launched satellite INSAT-3DS at Bhuj, Gujarat during 3rd to 6thMarch, 2025.

ICITC organized 15th batch of the Advanced Training Course in Meteorological Instrumentation & Information Systems (MI&IS) for the period of 01.04.2025- 26.09.2025. This six-month program is certified by the World Meteorological Organization (WMO) and is recognized as equivalent to the BIP-M qualification.

Training on Basic Meteorology, Installation, maintenance of Meteorological instruments, Data archival and analysis was organized for the officials of Department of Soil and Water Conservation, Govt. of Nagaland at Regional Meteorological Centre, LGBI Airport, Guwahati from 8th–9th April 2025.

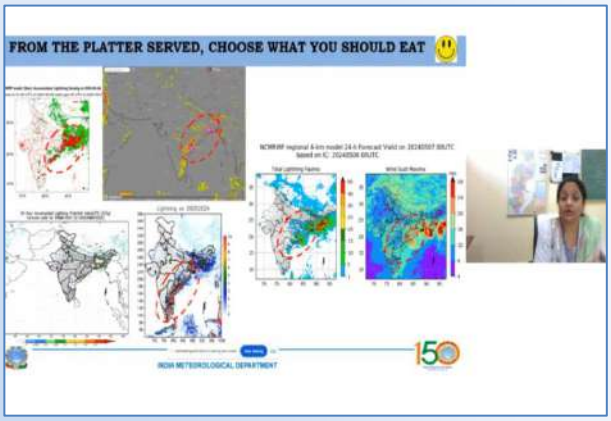
Dr. Kuldeep Srivastava, Scientist 'F' has completed a training course on Annual Performance Appraisal Report (APAR) provided by the Institute of Secretariat Training and Management on 15th April, 2025 through Karmayogi portal.

Office wise Online Training on DAK/Receipts of eOffice for all IMD officials is organised during 21 - 29April, 2025.

A five-day online short-term refresher course on the fundamentals of Python, organized by ICITC, during the period of 21-25 April, 2025.The training delivered to 179 IMD trainees, including two international participants.

2nd All-India Familiarization Training Course on Thunderstorm Monitoring for Aviation SafetyfromApril 21–22, 2025.

The Aerodrome Meteorological Office (AMO), Nagpur, in collaboration with the IMS Chapters of Nagpur, Bhopal, and Raipur, successfully organized the 2nd All-India Familiarization Training Course on Thunderstorm Monitoring for Aviation Safety from April 21-22, 2025, through an online platform. This specialized training programme aimed to enhance the operational capabilities of aviation meteorologists by equipping them with advanced skills and knowledge essential for monitoring, forecasting, and managing the risks associated with thunderstorms—one of the most critical weather hazards affecting flight operations, air traffic management and airport safety.



Office (AMO) Nagpur, DBAI Airport, Nagpur organized Familiarization course thunderstorm monitoring for the aviation safety, April 21-22 2025 for all airports.

Pre-Climate Outlook Forum (Pre-COF) hands-on training workshop in association with 31st South Asian Climate Outlook Forum (SASCOF-31) was organized during 24-26th April 2025 in Sheraton Grand Hotel, Pune. 16 participants (13 off line and 3 online) and 5 resource persons participated the workshop.

A **"Refresher Training Programme"** for SAGARMITRAs' under the state plan scheme for the year 2025-2026 at BWTC Campus Paradeep organized by Principal Brackish Water Training Centre (BWTC), was attended by Shri R.K. Mohapatra, Met-B, on 02.05.2025, 17.05.2025, and by Shri S. Mallick, Met-B on 01.05.2025 (atFTIBalugaon) 06.05.2025 and 14.05.2025, and by Shri Sapan Kumar Das, SO-I on 20.05.2025.

Four-weeks summer placement course has been organized by Agrimet Division, IMD, Pune during 5 - 30 May, 2025. B.Tech (Agril. Engineering) students from various universities of Maharashtra has participated in the said course. Scientists of the division delivered lectures on following topics during the course: 'Introduction to Agricultural Meteorology', 'Crop weather relationship', Application of Weather forecasting to Agriculture' and 'Basics of Crop weather modelling' - by **Dr.**

Ashutosh Kumar Misra, Scientist'D'.'Weather Hazards and Agriculture' and 'Operational Activities of Agricultural Meteorology Division' – by**Dr. Jaya Dhami Parihar**, Scientist'D', Agromet Advisory services', 'Evaporation and Evapotranspiration' and 'Basics of Remote Sensing and its applications in Agriculture' - by **Dr. Asha Latwal**, Scientist'C'.

A five-day online short-term refresher course on **the Airport Met Instruments**, organized by ICITC during the period of 23-27June, 2025.The training delivered to 211 IMD trainees, including seven (07) international participants.

Dr. O. P. Sreejith, Scientist'F' attended a training workshop S2S Accelnet workshop, jointly conducted by IITM, IMD and North Carolina State University, USA at IITM from June 16-18 for seasonal and sub-seasonal forecast application for hydrology and agriculture sector and gave presentation of "Seasonal Forecast Activities of IMD".

Training courses viz. Advanced Meteorological Training Course (AMTC), Forecasters' Training Course (FTC), Integrated Met Training Course (IMTC), Direct Recruited Scientists Training Course (DRSTC), Modular Training Course (MTC) are imparted to officials & other departments on regular basis under Capacity Building.

IMD organised 21st WMO's TC Forecasters Training 2023 during 14-25 July, 2025: Regional Specialised Meteorological Centre (RSMC), New Delhi, IMD organised 21st WMO's TC Forecasters Training 2023 during 14-25 July, 2025 in hybrid mode. IMD has been regularly organizing this training since 2005. This year there were 8 international participants from Thailand, Myanmar, Sri Lanka, Saudi Arabia and Qatar and 35 national participants from various sub-offices of IMD.

The training aimed at building capacity of the TC forecasters in the region by understanding the latest developments in observations, monitoring, modeling, prediction and early warning services of TCs over the Bay of Bengal (BoB) and the Arabian Sea (AS) and carrying out the case studies as practical examples in these aspects. The training included resource persons from IMD, UN-ESCAP, RSMC Tokyo and National Centre for Medium Range Weather Forecasting (NCMRWF).

IMD organised 21st WMO's TC Forecasters Training 2023 during 14-25 July, 2025 at New Delhi

Dr. Mohapatra, Director General of Meteorology, IMD and 3rd Vice President of WMO also took lectures on practical aspects of monitoring & prediction and management of cyclones with disaster managers. In his inaugural address on 14th July, Dr. Mohapatra, DGM IMD highlighted various advancements in the early warning system of TCs adopted by IMD that has enabled disaster managers and general public to minimise the loss of lives due to cyclones to double digit in recent years not only in India but also in 13 PTC member countries.

He expressed IMD's continued commitment to support member countries in developing their own Decision Support Systems (DSS) to enhance region-specific forecasting and disaster management capabilities. He also underscored the importance of capacity building, collaborative research and development, and one-to-one interaction among member countries to strengthen regional preparedness and resilience, especially in the context of a changing climate. On 25th July, an assessment test was conducted and successful participants were given certificates.

A five-day online short-term refresher course on the RADAR organized by ICITC, is concluded on 25th July, 2025. The training is being delivered to 137 IMD trainees, including one international participant.

An online training session on **DAK/Receipts for the newly created eOffice** CRU users was conducted on 4th August, 2025.

A Short-Term Refresher Course was conducted from 18.08.2025 to 22nd August, 2025(1500 – 1800 Hrs IST), wherein 82 participants were nominated from all IMD offices under RMCs/MCs. The course was delivered by eight faculty members, and on the concluding day, a Questionnaire was attempted by the participants.

A Short Term Refresher Course on "NETWORKING" was conducted during 22nd August, 2025 to 26th September,2025 , wherein 84 participants were nominated from all IMD offices under RMCs/MCs including one Foreign participant from Cameroon. The course was delivered by Five faculty members (**Dr.SankarNath**, Scientist-F; **Mr. Amul Batra**, Scientist -E; **Mr. Dinesh Kumar,** Met-B; **Mr.Ashish Kumar**, Scientist -D; **Sh. Arka Deb Banerjee**, Scientist -D) and on the concluding day, a Questionnaire was attempted by the participants.

MASTER TRAINING/ KARMYOGI COACH (MT/KC) TRAINING PROGRAM, 15-17 SEPTEMBER 2025

Under the Mission Karmayogi initiative, the India Meteorological Department (IMD), Ministry of Earth Sciences (MoES) organized a three-day Master Trainer/Karmayogi Coach (MT/KC) Training Program for officials from 15–17 September, 2025. The program marks a significant step towards realizing the vision of *Viksit Bharat*.

The inaugural session was graced by **Dr. M. Ravichandran, Secretary,** MoES, **Dr. M. Mohapatra**, Director General of Meteorology, IMD, and **Dr. D. S. Pai**, Program Head. The training was led by two Lead Trainers — **Dr. A. K. Mitra,** Scientist-F, IMD, and **Dr. Pramit D. Burman**, Scientist-D, IITM — and attended by 35 participants from various MoES institutions.

This initiative aims to empower government officials with the spirit of service and leadership, transforming them into Karmayogi Coaches who will in turn train others, thereby enhancing public service delivery across the nation.

Master Trainer Karmayogi Coach Training Program

1-Day RashtriyaKarmayogi Training Program by the Master Trainers at RMC Kolkata on 25th September, 2025

On 5th May, 2025 with the initiation of an intensive 5-day Lead Trainer (LT) training program. These LTs have trained the Master Trainers (MTs)/Karmayogi Coaches (KCs). The trained Master Trainers/Karmayogi Coaches (MTs/KCs) are now entrusted with the responsibility of conducting the 1-day **RashtriyaKarmayogi** training at their respective institutes/centres. **Shri Sunny Chug**, Scientist-D, and **Shri Trideep Biswas**, Met.-A, are among the designated Master Trainers. The objective of this initiative is to reawaken the spirit of SevaBhaav—a deep commitment to selfless public service—in the professional conduct and responsibilities of the employees. By embedding this core value into day-to-day functioning, the program aims to bring about a transformational shift in the delivery of public service.

1-Day RashtriyaKarmayogi Training Program by the Master Trainers at RMC Kolkata on 25th September, 2025

"As part of the 12-day Training Programme on Disaster Management for the 102 Battalion Rapid Action Force held at VeermataJijabai Bhosale Botanical Garden & Zoo, 2nd Floor, Penguin Building, Dr. Babasaheb Ambedkar Road, Byculla (East), Mumbai – 400 027, **Smt. Shubhangi A. Bhute,** Scientist 'F', delivered a lecture on 'Climate Change' on 16th June, 2025.

Smt. Shubhangi A. Bhute, Scientist 'F', delivered a lecture on 'Climate Change' on 16th June, 2025."

AWS & Radiation Lab, SID Pashan, conducted a training Program on meteorological instrument familiarisation for officials of the Central Water Commission On 25 August, 2025.

Mr. Prashant Bansal, Scientist-D, Shri Himanshu Gupta, SA, Shri Pankaj Jhaharia, SA, ISSD attended Onsite Training on Cybersecurity in RashtriyaRaksha University, Gandhinagar from 25th August 2025 to 1st Sept 2025.

Official from CRS IMD Pune participated in the 3-day Master Trainer Karmayogi Coach capacity-building training Program held at IITM Pune from 1st to 3rd September 2025.

Master Trainer Karmayogi Coach capacity-building training Program held at IITM Pune

AWS & Radiation Lab, SID Pashan, conducted an Instrument Familiarization Training Program for the 45th Indian Scientific Expedition to Antarctica, including IMD Maitri–Bharati expedition members On 4th September, 2025.

Members of the 45th Indian Scientific Expedition to Antarctica, including IMD Maitri–Bharati expedition

WMO Information System (WIS) 2.0 Training Workshop in Guangzhou (China) from 15 to 19 September 2025 (05 Days) was attended by **Dr. Sankar Nath**, Scientist-F and **Shri Trilok Singh**, Met. B from ISSD, IMD, New Delhi.

Training Program on Aviation Meteorological Instruments: A Technical Deep Dive organized by MWO Kolkata

A comprehensive training program on Airport Meteorological Instruments (AMI) and aviation weather reporting was successfully conducted byMeteorological Watch Office, Kolkata at PBO Building, Dum Dum from 17-09-2025 to 19-09-2025. Designed to enhance operational proficiency and technical expertise, the program brought together 16 meteorological professionals form two (02) Aerodrome Meteorological Offices (AMOs) & eleven (11) Aeronautical Meteorological Stations (AMSs) which are under administrative control of RMC Kolkatafor an intensive blend of theoretical instruction and hands-on experience.

A highlight of the program was the in-depth focus on METAR/SPECI reporting standards. **Shri Chiranjit Chakraborty,** Met. 'A',presented a live demo of the newly developed MDSS system that presently collecting meteorological data from various stations of all over the India**. Shri Indranil Talukdar,** Met. 'A', conducted a critical session addressing common reporting errors, emphasizing alignment with ICAO Annex 3 and WMO protocols. This reinforced the importance of accuracy and consistency in aviation meteorological observations.

Participants also engaged in practical runway visits, calibrating and testing key sensors such as wind speed& direction, temperature, dew point, pressure, and visibility/RVR instruments. These field exercises provided valuable exposure to real-time diagnostics and reinforced classroom learning.

Training Program on Aviation Meteorological Instruments: A Technical Deep Dive organized by MWO Kolkata

Dr. Praveen Kumar, Sc. 'C' and **Shri AvinashTarodekar**, Met. 'B' both, as Master Trainers from RMC, Nagpur conducted 1-Day RashtriyaKarmayogi Training Program at RMC Nagpur in the capacity of 77 Officials each on 3rd October, 2025, 14th October, 2025 & 17th December, 2025 respectively.

Official from RMC Nagpur, participated in RashtriyaKarmyogi Program

Customized Basic Observation Course on Meteorology was inaugurated under the chairmanship of **Dr. Suryachandra Rao,** Director, IITM on 27th October, 2025 at MTI, which was attended by senior officers of IMD Pune. The training commenced from 27th October, 2025 with 10 Maldives participants and concluded on 1st November, 2025.

Meteorological Instrument Familiarization Training was conducted for eight naval officers from the School of Naval Oceanography and Meteorology, Kochi, during their visit to the AWS Lab, IMD Pune, on 29th October 2025 and for the Maldives Met trainee officers during their visit to the SID Pashan Laboratory, IMD Pune, on 31st October 2025. Proud moment for IMD—sharing expertise, fostering learning, and building future meteorologists. Strengthening collaboration between science and Defence for better weather preparedness.

Naval officers from the School of Naval Oceanography and Meteorology,Kochi, during their visit to AWS Lab, IMD Pune

Maldives Met trainee officers during their visit to the SID Pashan Laboratory, IMD Pune

Regional SAR Exercise and training by Coast Guard attended by **Sh. O.K. Priyadarshi**, Met. 'A' and **Sh. Akash Sen**, S. A. on 27-28 November, 2025.

In-Person Radiation Training Programme for all 47 Solar Radiation Stations (SRS) conducted at Central Radiation Laboratory, Pune in two batches during 2-4 December 2025, and 9–11, December 2025.

In-Person Radiation Training Programme at Central Radiation Laboratory, Pune

LECTURES

Smt. Bharati S. Sabade, Sc-D, CWC Visakhapatnam delivered a lecture to students of Department of Maritime Management, Ahmadabad, Gujarat on 5th February, 2025 at CWC Office conference hall.

Dr. Sanjay O'Neill Shaw, Scientist-F of RMC Guwahati delivered lecture on the topic- "Role of IMD in Disaster Risk Reduction dtd 13th Feburary, 2025 – UGC Malaviya Mission Teacher Training Centre, Patna University Refresher Course in Disaster Management.

Shri K.V.S. Srinivas, SO-I, delivered a lecture in APHRDI on "Early Warning Systems and Emergency Communication Systems" on 19th and 20th February 2025 to State Govt Officials at APHRDI, Regional Centre, Visakhapatnam.

Dr. M. Mohapatra, DG IMD delivered an online lecture on "**Space Technology for Combating Meteorological Disasters**" during the Webinar

supported by International Society for Photogrammetry and Remote Sensing Students Consortium (ISPRS) for the WG V/4 and organized by North Eastern Space Applications Centre, Dubai on 20th March, 2025.

Dr. M. Mohapatra, DG IMD delivered Institute lecture at IIT Bombay on IMD's Glorious 150 years on 26th March, 2025.

Dr.Somenath Dutta, Scientist 'G'& Head, RMC Kolkata, delivered a lecture on 'Use of Balloons in Meteorology' at Indian Centre for Space Physics, Kolkata, on 2nd April, 2025.

Dr.ManoramaMohanty, Scientist 'F', visited Gopabandhu Academy of Administration (GAA) and delivered a lecture on "Impact Based Forecasting and Warning Dissemination" to OAS Probationers (Dr-2022 batch), on 4th April, 2025.

CWC_VIZAG: Pre-Cyclone Lectures were conducted on 08.04.2025 & 09.04.2025 as part of Pre- Cyclone Exercises. All user-agencies were informed about the Pre-Cyclone action. Staff & Officers also attended the lectures and orientation classes conducted by the CWD, New Delhi during the first week of April, 2025.

Dr. Soumi Chakravorty, Scientist 'D', gave an invited lecture series (online) on "General Circulation of the Ocean and Atmosphere and Recent Climate Extremes" from 7-10 April, 2025 at the Navigation College, Dalian Maritime University, Liaoning Province, China.

Dr. O. P.Sreejith, Scientist 'F' delivered a lecture on " Long Range forecasting of ISMR: Present modalities & challenges lecture on " Long Range forecasting of ISMR: Present modalities & challenges:" for trainees of Advanced Training for Met Officers (ATMOS) at Air Force Academy, Hyderabad (offline) on 16thApril, 2025.

Dr. G. P. Singh, Met. 'A' delivered a lecture to participants of the Familiarization Course on thunderstorm monitoring to enhance Aviation safety, at RMC Nagpur on 22nd April, 2025.

Dr. Satyaban B Ratna, Scientist 'E', delivered a lecture titled "IMD Products for Flood Forecasting: Tools, Applications, and Demonstration" at the National Water Academy (NWA), Pune, on 2nd May, 2025.

Dr. H.R. Biswas, Scientist 'F', RMC Kolkata, attended and delivered lecture in Eastern Region Committee for disaster management in power sector held at ERPC Kolkata, on 9th May, 2025.

Dr. Ashok Kumar Das, Sc. 'F' Met Centre Ahmedabad delivered a invited lecture on topic "Weather Forecasting and Warning Services": Heat Wave & Long Range Forecast for SW Monsoon 2025" on 14 May organized by IMS Ahmedabad at Vikram Hall, SAC, ISRO Ahmedabad. Shri Ramashray Yadav, Sci.-D is also attended the session.

Dr. Ashok Kumar Das, Sc. 'F' Met Centre Ahmedabad delivered a lecture on topic "Weather Forecasting and Warning Services: Heat Wave" in the meeting and Interactive Knowledge Sharing Session related to Heat Action Plan for Rajkot in the Virtual learning session from IMD on 28 May organized by ICLEI South Asia with the visiting officials of Nairobi at Rajkot, Gujarat.

Dr. Ashutosh Kumar Misra, Scientist 'D', participated in Joint Agresco-2025 and delivered a lecture on "Southwest monsoon 2024 and activities under GKMS in Maharashtra" at Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani, Maharashtra on 29th May, 2025.

Dr. Satyaban B Ratna, Scientist-E, delivered a lecture on "Hazard and Vulnerability Atlas of IMD"at the RSMC 21st Tropical Cyclone Forecasters Training on 14th July, 2025.

Dr. Rizwan Ahmed, Scientist-D, AMO Nagpur delivered a lecture on "Satellite Applications in Weather and Climate" at RMC Nagpur on 28 July, 2025 for senior officers from the Central Water Commission and the India Meteorological Department, Nagpur.

Ranjan Phukan, Scientist-D delivered an online lecture on 30 August 2025 in the Refresher Programme on Application of AI in Science, Technology, Engineering, Mathematics and Business (STEMB), organised by Assam University, Silchar and UGC-MMTTC, on the topic "Weather and Climate Services: Opportunities with AI/ML".

Dr. M. Mohapatra, DGM IMD delivered online the guest lecture on Geo-spatial applications in weather and climate services in the National Seminar on Geospatial Technologies for environmental issues organized at Andhra University on 20th September, 2025.

Smt. Bharati S. Sabade, Sc-D, Head CWC Visakhapatnam delivered a lecture in APHRDI on "Early Warning Systems and Emergency Communication Systems" on 25th September, 2025 to State Govt. Officials at APHRDI, Regional Centre, Visakhapatnam.

Shri S.V.J. Kumar, Met-B, CWC VSK delivered a lecture at APHRDI on "Impact of Severe Weather Events and Disaster Management" on 25th September, 2025 to State Govt. Officials at APHRDI, Regional Centre, Visakhapatnam.

Dr. Sudeep Kumar B.L. & Dr. S.D. Sanap participated in the meeting with CWPRS (Central Water and Power Research Station) on 1st August and delivered a lecture on overview of CR & S, Pune, to faculty and students of Christ University, Bengaluru on 30th August, 2025.

Dr. H.R. Biswas, Sc. 'F' delivered a lecture on the subject "**From Forecast to Field: Leveraging IMD Alerts for Worker Safety in Organized and Unorganized Sectors**" in the "**Strategic Workshop on Workers' Safety and Health in Changing Climate**" at All India Institute of Hygiene and Public Health, Bidhan Nagar Campus, Kolkata on 9th October, 2025.

Dr. Ashok Kumar Das, Sc. 'F' delivered a lecture on **'SEA AREA BULLETIN'** in the **'Pre-cyclone season familiarization training for forecasters'** during 15-16 October, 2025 and **Shri Ramashray Yadav**, Sc. 'D' and **Shri Pradeep Sharma**, Sc. 'D' and CWC staff attended the meeting (Hybrid Mode).

Sh. Uday K. Shende, Sc. 'F', was nominated as a course coordinator faculty for "**Surface Instruments Refresher Course**" by ICITC, HQ, New Delhi for the session held from 27-31 October, 2025. In this course lectures were delivered by **Sh. Uday K. Shende**, Sc. 'F' and **Ms. Shahenaz Mulla**, Met. 'B' covering installation, operation and routine maintenance of key surface instruments.

Dr. Ashutosh Misra, Sc. 'E' delivered a lecture on "**Agromet Advisory Services in India and Impact-Based Forecasting for Agriculture**" Maldives trainees of "**Customized Basic observation Course**" organised by MTI, Pashan, Pune on 29th October, 2025.

Dr. Jaya Dhami Parihar, Sc. 'D' delivered a lecture on "**Operational activities of Agrimet Division**" to final year B.Sc. (Hons.) Agriculture students of Institute of Agriculture Research & Technology (IART), NMV University, Tamil Nadu on 29th October, 2025.

Dr. H.R. Biswas, Sc. 'F' delivered a lecture on "**Basic Meteorology & Marine Weather Services**" in the training on Level-1 AtoN Manager course at MNTI, Kolkata, on 29th October, 2025.

As an integral part of their FDP on 'Empowering Environmental Stewardship' (Sustainability as a tool for risk reduction), the faculty members of the AU Department of Environmental Sciences visited CWC VSK on 30.10.2025. Smt. Bharati S. Sabade, Sc-D, Head, CWC Visakhapatnam delivered a lecture to faculty of Andhra University in the conference hall of this Office. Shri. R. P. Patnaik, Met-B, Shri G. V. Dora, Met-A, Smt. B. Sri Devi, Met-A and Shri D. Harish, SA explained various services rendered by the CWC and the IMD.

Dr. Rizwan Ahmed, Sc. 'D' presented talk on the "**Climate change & LFTCs**" during the International Symposium on Tropical Meteorology (INTROMET-2025). **Dr. S.D. Sanap**, Sc. 'D' also delivered a talk on the, "**Spring time dipole in the heat wave pattern over the Indian region**" at the event and evaluated the posters at the INTROMET for the award of the best poster.

Ms. Anahit Hovsepyan, WMO official visited CRS Pune office and delivered lecture on "**World Meteorological Organization's Perspectives on Climate Services**" on 21st November, 2025 at Map Discussion Hall, CRS Pune.

Dr. Manorama Mohanty, Sc. 'F', M.C Bhubaneswar joined ATAL Online Faculty Development Programme and delivered a lecture on "**Weather Forecasting, Climate Variability Impacts and Remedies**" On 27th November,2025.

TALK/ WEBINAR

A popular talk on "**Climate Change and the Mirage of Sustainable Development**" by **Prof. B. N.**

Goswami, was organized in hybrid mode at RMC Guwahati on 2nd Jan, 2025.

A scientific talk on the topic "IMD's role in forecasting of landslides in North Bengal region" was given by **Dr. Saibal Ghosh,** DG, GSI at Akash Mancho, RMC Office, Alipore, Kolkata, on 14th January, 2025.

Dr. Kripan Ghosh, Sc. 'F', **Dr. Ashutosh Misra**, Sc. 'D', **Dr. Jaya Dhami Parihar**, Sc. 'D' and **Dr. Asha Latwal**, Sc. C attended the invited talk on "**Climate Change Threat to Society : Solution for Natural Hazards**" by Dr. ManojKhare, Sc. 'G' and HoD, HPC-ESEG Group, CDAC, Pune, as a part of celebration of 150 Years' Service of IMD to the Nation at CR&S, IMD, Pune on 14th January, 2025.

Dr. Rizwan Ahmed, Sc. 'D' delivered an Invited Talk in a one-day workshop organized by RNTU university Bhopal and IMS Chapter Bhopal on "**Satellite Application in weather & climate**" 24 January, 2025.

Dr. Soumi Chakravorty and **Dr. Ananya Karmakar** attended a webinar on "**Climate change, health and outdoor workers in urban Vietnam : linking vulnerability, extreme weather and policy**" on 27th January, 2025.

Dr. Satyaban B. Ratna, Sc. 'E', delivered an expert talk titled "**Unlocking the Potential of Climate Services : Informing Decision-Making for a Resilient Future**" on 6th February, 2025, as part of the ATAL Online Faculty Development Programme (FDP) on "**Leveraging Artificial Intelligence for Climate and Sustainability**", organized by K. J. Somaiya Institute of Technology, Mumbai.

Dr. Arvind Kumar, Scientist-D, delivered an invited talk on "The Importance of Weather Forecasting for Sustainable Agriculture" at IIT Roorkee on February 8, 2025.

Dr. Arvind Kumar, Scientist-D, delivered a talk in Hindi on "Agrometeorological Advisory Services: A Holistic Approach for Farmers' Empowerment" at RMC Chennai on 27 February, 2025.' translate in Hindi.

Dr Satyaban B Ratna, Sc-E, visited the Bureau of Meteorology, Melbourne, Australia, and delivered a visiting talk titled "Interannual Variability of the Indian Summer Monsoon: Teleconnections with Large-Scale Climate Modes and Operational Perspectives from IMD" on 28 February, 2025.

"Diploma in Safety & Disaster Management" for Defence Personnel: 35 personnel from the three Defence forces had visited this office (CWC Visakhapatnam) on 06.03.2025. **Sri. S.V.J. Kumar**, Met-B addressed the team of Defence personnel and delivered a talk on, "The role of Early Warning Systems in Disaster management" and also explained observational tools, methods and forecasting insights.

Dr. M. Mohapatra, DG IMD delivered an invited talk (online mode) on "**Research to Operation and Operations to Services: transitions and Communications**" during Eighth WMO Workshop on Monsoon at IITM, Pune on 21st March, 2025.

Dr. M. Mohapatra, DG IMD participated as Chief Guest during the WMO Day 2025 celebrations organized by South Asian Meteorological Association (SAMA) and Humanitarian Observatory Initiative of South Asia (HOISA) through VC on 23rd March, 2025 and gave an online talk on Bridging the early warning gap together.

Dr. M. Mohapatra, DGM IMD participated as Chief Guest in the WMO Day celebrations organised by NPL

Shri. S.V.J. Kumar, Met-B delivered a Radio Talk on "Significance of world Meteorological Day and its theme: Closing the Early Warnings Gap Together" over All India Radio, Visakhapatnam. The vernacular Talk in Telugu was aired by AIR on 23rd March, 2025.

Dr. M. Mohapatra, DG IMD participated as Chief Guest in the WMO Day celebrations organised by National Physical Laboratory, Council for Scientific and Industrial Research (NPL-CSIR) on 24th March, 2025 and gave a talk on Bridging the early warning gap together.

Sh. Bikram Singh, Scientist 'F', was invited by Uttarakhand State Council for Science and Technology (UCOST), Department of IT, Suraj and Science Technology, Govt. of Uttarakhand to deliver a talk on Earth Day at Vigyan Dham, Dehradun and Sh. Bikram Singh, participated in the said program on 22nd April, 2025 and delivered a talk on "Weather and Climate with reference to Dehradun".

Ms. Tanu Sharma, SRF, attended the EGU2025 in Austria, Vienna, from 27th April to 2nd May 2025& made a poster presentation (EGU25-651, x5.123) on "Influence of Tropical Ocean Basins on the Interannual Variability of Indian Summer Monsoon Rainfall during three recent epochs".ByTanu Sharma, Satyaban B. Ratna, Ingo Ritcher, D.S. Pai (2025). at EGU25 Conference, under the session CL2.2

Dr. Satyaban B Ratna, Scientist 'E', attended the SASCOF31 and CSUF and delivered a talk on "Strengthening Hydrometeorological Services in South Asia: Role of Climate Applications and User Interface" in Pune during 28-30 April. 2025.

Dr. Rizwan Ahmed, Scientist 'D' delivered an Invited talk on weather services by IMD in a lecture organised by the Vigyan Bharati- NAGPUR on 10th May, 2025 at Dada RamchandBakhru Sindhu Mahavidyalay, Panchpaoli, Nagpur&delivered a session on **"Satellite Applications in Aviation Services"** highlighted the operational use of INSAT satellite data in real-time weather monitoring and forecasting, emphasizing its critical role in aviation safety and meteorological services for engineering college interns from Nagpur, Maharashtra, during 13–15 May, 2025.

Dr.ArulalanT, Scientist 'C', delivered a talk titled "Forecasting and Early Warning: Making Climate Intelligence Work for All" in the online webinar titled "Policy, Forecasting, and Early Action: Strengthening Heat wave Governance and Preparedness" on 13th June, 2025, organized by NIDM and Sphere India Academy.

Smt Arti Bandgar, Scientist 'D' has presented an invited talk on Climate Change, Sustainability and Conservation for International Yoga Day Celebration Program Series held at Regional Ayurvedic Research Institute (RARI) - Central Council for Research in Ayurvedic Sciences (CCRAS) on 17th June, 2025 at Pune.

Dr. Manorama Mohanty, Scientist 'F', was invited by Veterinary Officers' Training Institute, Bhubaneswar to join as resource person for taking session during programme for Veterinary Officers on "Disaster Management in collaboration with OSDMA" and delivered a Short Talk On 21stJune, 2025.

Smt Arti Bandgar, Scientist'D' delivered an invited talk on Effects of Climate Change in Local Marathi Language at Pune Mahila Mandal, Rasta Peth Branch of All India Women's Conference held on 26th June, 2025 at Agarkar girls High School, Pune.

B. Sudarsan Patro, Scientist-D, was invited to deliver a talk at COEP Technological University, Pune, on the topic "5G Applications in the Meteorological Domain" on 1st July 2025. He was accompanied by **Shri Divyesh Deshpande** (JRF) and **Shri Aman** (S.A.) for sessions on AWS equipment familiarisation, instrumentation, and conducting a science outreach Program.

Dr. Ananya Karmakar, Scientist -C, delivered a talk entitled "Climate Application on different sectors in India Meteorological Department" in International Citizen Science Conclave on 5thJuly, 2025 by Pune Knowledge Cluster.

Ms. Neha Rani, Scientific Assistant, delivered a research talk on 4 July, 2025 as part of the RiSE@CRS activities. The talk was based on the recently published research paper titled "Asymmetrical Impact of El Niño to La Niña Transition in the Tropical Pacific Basin on Hot Extremes over India" authored by Lekshmi, S., Rani, N., Chattopadhyay, R., Ratna, S. B.,andPai, D. S., and published in Atmosphere-Ocean, 63(3), 201–222 (2025) . https://doi.org/10.1080/ 07055900 .2025.2513307.

Dr. M. Mohapatra, DG IMD presented a talk on the award-winning e-Governance initiative, entitled Multi-Hazard Early Warning System which gor national award for the year 2925 under the category of "Excellence in Central Level Initiative in Government Process Re-engineering by use of technology for Digital Transformation" in the inaugural webinar of the NeGW 2025-26 series organized by Department of Administrative

Reforms and Public Grievances, New Delhi on 22nd July, 2025.

B. SudarsanPatro, Scientist-D, was invited to deliver an expert talk on "Impact of Forest Conservation on Biodiversity and Climate Resilience" during Van Mahotsav Week at DAV Public School, PPL Township, Paradeep, on 4th July 2025 at 11:30 AM.

B. SudarsanPatro, Scientist-D at DAV Public School deliver a talk

Dr. Kripan Ghosh, Scientist F & Head Agrimet Division, **Dr. Ashutosh Misra,** Scientist - D and **Dr. Asha Latwal,** Scientist- C attended an online talk on "Control of Single Use Plastic" delivered by **Dr. V. K. Soni,** Scientist-F as part of "Swachhata Pakhwada-2025" on 11th July, 2025.

Dr. Kripan Ghosh, Scientist - F & Head Agrimet Division, **Dr. Ashutosh Misra**, Scientist -D, **Dr. Jaya Dhami Parihar**, Scientist-D and **Dr. Asha Latwal**, Scientist - C attended an online talk on "Benchmarking and Deploying AI-driven Forecasts of Regional-scale Indian Monsoon Onset" delivered by **Prof. William R. Boos,** University of California, Berkeley, United States and **Prof. PedramHassanzadeh,** University of Chicago, Illinois, United States on 6th August, 2025.

Dr. B. Amudha, Scientist-F, RMC Chennai participated in a Seminar and delivered a talk on "Climate Change and It's impact: An urgent need for Change" organized by Don Bosco Arts & Science College, Kilpauk, Chennai-10, on 25th August, 2025.

Dr. H.R. Biswas, Sc. 'F' delivered speech on "**Weather Climate and Energy Conservation**" on the occasion of Energy Conservation Day in All India Radio, on 14th December, 2025.

6.5. AWARENESS PROGRAM

MC Shillong Office Celebrated Earth Day by organising various activities such as Drawing competition, Quiz competition, Human Chain event and Tree Plantation event on the 22nd April 2025 with the Theme: "This is OUR POWER, OUR PLANET - Renewable Energy" with enthusiastic participation from Lady Keane College, Bormanik College, and Ram Krishna Mission School, Mylliem.

Earth Day Celebrated at MC Shillong Office

A science outreach program and practical demonstration of meteorological instruments were conducted for 15 naval officers from the School of Naval Oceanology and Meteorology, KochiOn 30th May, 2025.

15 naval officers from the School of Naval Oceanology and Meteorology, Kochi

RMC Nagpur conducted Farmer Awareness Program at three different Villages of Wardha District of Maharashtra, on 5th June 2025. During this awareness program, about 150 farmers took participate and they were briefed by **Dr. Praveen Kumar**, Scientist'C', about IMD services related to Agro-advisory and weather forecast and Warning services of IMD. The status of Monsoon and Long Range Forecast also elaborated for their application to Agriculture practices.

Farmer Awareness ProgramatRMC NagpurofWardha District of Maharashtra, on 05th June, 2025

International Yoga Day was celebrated at MC Bhubaneswar on 21st June, 2025.

International Yoga Day was celebrated at MC Bhubaneswar

CWC Officers and Staff Members participated in the "Yogandhra" event (which is a Guinness Book Record with 3 Lakhs participants) in connection with International Day of Yoga, 2025.Yoga exercises were performed by Officers & Staff members at CWC & DWR Visakhapatnam on 21st June, 2025.

Dr. M. Mohapatra, DGM, IMD participated as the Chief Guest during the online Valedictory Session of the Course "Spatial Analytical Tools for Advanced Academic organized by Dr. Rashmi Singh, Miranda House, University of Delhi on 18th July, 2025.

Shri K.C. Sai Krishnan, Scientist- G and Head, Climate Research & Services (CR&S), Pune, inaugurated an inter-office 'Self-Composed Hindi Poetry Recitation Competition' organized on 29th July, 2025 under the aegis of the Town Official Language Implementation Committee (Office-2), Maharashtra, Pune. The event was held at the Office of the Head, Climate Research & Services.

Human Chain formation pledging to propagate cleanliness: On the occasion of Swachhata Hi Sewa 2025 Campaign, a swachhata pledge was taken by the officials of MC Raipur under the leadership of Smt. Samanti Sarkar, Head, MC Raipur followed by the formation of a human chain signifying togetherness in propagating the message of cleanliness.

Human Chain formation pledging to propagate cleanliness MC Raipur

AWS & Radiation Lab, SID Pashan observed SwachhataPakhwada from 1st to 15th July, 2025 with a series of activities including cleaning drives for Met. Instruments, Calibration Laboratory, training programs, office, PC, store, and lab cleaning, as well as plantation drives.

SwachhataPakhwada at AWS & Radiation Lab, SID Pashan

Plantation drives at, SID Pashan

National Plastic Pollution Reduction Campaign 5.0 at CWC Vsk: As part of the annual SHS campaign, officers and staff of CWC Vskparticipated in the National Plastic Pollution Reduction Campaign 5.0 at this office during the 1st week of October 2025. Several activities were conducted. Special campaign was launched by the team to spread awareness to reduce use of plastic. Littered plastic bottles, stray polythene covers and broken plastic items were collected from the office surroundings to dispose at the garbage collection point of the GVMC. Staff and officers attended a talk delivered by Dr. V. K. Soni, Sc-F on the National Plastic Pollution Reduction Campaign-5 on Dt.03.10.2025 through video conference.

National Plastic Pollution Reduction Campaign 5.0 at CWC Vsk

Dr. HabiburRahaman Biswas, Sc. 'F' administered the celebration of SamvidhanDiwas (Constitution Day) with reading of the Preamble to the

constitution at RMC Kolkata, on 26th November, 2025. SamvidhanDiwas was also celebrated at MWO Kolkata and other sub offices.

SamvidhanDiwas (Constitution Day) was celebrated on 26th November, 2025 at all IMD offices

SamvidhanDiwas (Constitution Day) was celebrated on 26th November, 2025 at all IMD offices

VISITORS

Prof. Petteri Taalas, Director General, Finnish Meteorological Institute (Former Secretary General, WMO) visited MoES on 5th March, 2025 and had a meeting with Secretary, MoES, DGM, and other senior officers of IMD. Dr. **Petteri Taalas also delivered a popular lecture on "Activities".**

Prof. Petteri Taalas, Director General, Finnish Meteorological Institute (Former Secretary General, WMO) visited MoES and IMD

165 Students from VPMP Polytechnic College, Ahmedabad visited Met Centre Ahmedabad for industrial visit on 07-01-25 & 09-01-2025.

200 Students of PDEU University (ECE Department) visited Met Centre Ahmedabad on 5th & 6th February, 2025.

200 Students of PDEU University (ECE Department) visited Met Centre Ahmedabad

Students for Shyam Bhumi High School visited Regional Meteorological Centre Guwahati on 28th February, 2025.

Students for Shyam Bhumi High School visited Regional Meteorological Centre Guwahati

Hon'ble Minister, Ministry of Science & Technology and Ministry of Earth Sciences **Dr. Jitendra Singh** visited IMD on 17th March, 2025 to review the progress on implementation of Mission MAUSAM. Science outreach program was conducted on 24th March, 2025, WMO Day celebration at CRS Pune, featuring an AWS and Radiation lab stalls. Students and professors visiting CRS Pune were provided with explanations and demonstrations.

Science outreach program was conducted on 24th March, 2025 WMO Day celebration at CRS Pune

12 students from IAHR institute visited Met Centre Lucknow on 24.03.2025 on the occasion of WMO day

80 Nos of Students along with 4 faculty members from Manav Rachna International Institute of Research and studies, Faridabad visited Sat. Met. Division for educational visit on 27th and 28th March, 2025.

On May 14, 2025, science outreach activities were conducted during the visit of B.Tech (Agricultural Engineering) students and faculty, who visited the AWS and Radiation Lab at Pashan to attend a lecture and practical demonstration of Met. Instrumentations.

B.Tech (Agricultural Engineering) students and faculty, who visited the AWS and Radiation Lab at Pashan

Around 30 students along with 4 Faculty members from North Eastern Hill University (NEHU), Department of Geology visited MC Shillongon 17th May, 2025.

Student of North Eastern Hill University

Almost 60 students and faculty members of **Vidyasagar University, Midnapore** visited FMO Jalpaiguri on 02.06.2025. They had been demonstrated the usefulness and functioning of all Surface Meteorological instruments.

Under IMD outreach program students and faculties from Himalayan Institute of Medical Sciences, Dehradun, Manava Bharati India International School, Dehradun, Army Public School Miran Sahib, Jammu & Kashmir &Chattisgarh Degree college, Raipur were allowed to visit Meteorological Centre Dehradun premises on 28.04.25, 23.04.25, 21.05.25 & 13.06.25 respectively. Sh. BhaumikIndrawal, Met-A, Sh. Ankit Sharma, Met-A & Sh. Anurag Negi, SA showed the students the activities of weather forecasting section and Sh. Akash Chandra, Met-A & Sh. Ashish Mehar, SA briefed them about RS/RW observation & surface met. Observatory.

Students from various schools and colleges visiting MC Dehradun

Dr. B. Amudha, Scientist-F, RMC Chennai, interacted with the students of Science India Forum (SIF), VijnanaBharathi (VIBHA), Vidyarthi Vigyan Manthan, Tamilnadu, who visited the Regional Meteorological Centre-Chennai on 08th July 2025, as part of their learning process.

The **officers of Indian Air Force** assigned with **Anti Naxal Task Force** in Chhattisgarh State visited the Meteorological Centre, Raipur on 17 July 2025 and were briefed on the state weather forecasting services and observational facilities by the officials of MC Raipur. The officers were provided with valuable insights into various weather phenomena and were explained by the officials about the methodologies and processes involved in state-level weather forecasting which may result to be helpful in their line of profession.

The officers of Indian Air Force visited MC Raipur

20 students along with 2 faculty members from **GEMS Genesis International School, Ahmedabad** visited M.C. Ahmedabad for educational purpose on 5thAugust 2025.

Students from GEMS Genesis International School, Ahmedabad

Students from the department. of Civil Engineering, Girijananda University, Guwahati visited Regional Meteorological Centre, Guwahati on 4th September, 2025.

Students from the department. of Civil Engineering, Girijananda University, Guwahati

Medical students from Sri Balaji Institute of Medical Sciences visited the Meteorological Centre, Raipur on 9 Sep 2025. During their visit, they were given an overview of the Centre's operations and were introduced to a range of meteorological instruments used in weather observations and data collection. The students also gained valuable insights into various weather phenomena and were explained by the officers about the methodologies and processes involved in state-level weather forecasting.

Medical students from Sri Balaji Institute of Medical Sciences visited the Meteorological Centre, Raipur

Science outreach Program was conductedat AWS & Radiation Lab, IMD's Pashancampus for 76 Civil Engineering students and professors from PCCOE, Pune, **On 12 September, 2025**. The visit included the AWS & Radiation Lab, offering exposure to meteorological instruments, polar observations, and IMD's role in national weather services. Students were sensitised to sustainable development and SDGs, while also receiving guidance on career opportunities in Weather & Climate Science.

15 students along with 2 faculty members from Anand Agriculture University visited M.C. Ahmedabad for educational purpose on 19th September, 2025.

Students from Anand Agriculture University

Dr. R. K. Giri, Sc. 'F', briefed Navy officials on the various activities and functions of the SATMET Division on 4th November, 2025.

Commodore Abhinav Barve from Indian Navy, Naval Oceanology and Meteorology, New Delhi visited the CRS, IMD, Pune office on 19th November, 2025 to strengthen the collaboration between Indian Navy and IMD in the field of instrumentation, capacity building and climate service.

Regional Meteorological Centre, Chennai 150 years of IMD foundation day was celebrated in CWC Visakhapatnam Office & open house Exhibition, Drawing Competition, Essay Writing Competition, walk for Weather, Kollam, Plantation were conducted and prizes were distributed to the winners. 100 school students from different schools participated in the competitions. 25 Teachers from different schools visited this office, the programs were conducted during 10.01.2025 to 15.01.2025. And invited press reporters, public & briefed about the services rendered by IMD & CWC Visakhapatnam.

Students and General public visited the open house and met exhibition at RMC Chennai.

20 students from various Engineering colleges visited on 26th June 2025 at DWR Chennai.

Around 45 students of P.R. Government Degree College, Kakinada visited this office (DWR VSK) on 27th March, 2025.Shri K. V. S. Srinivas, S.O-I, Officer-In-Charge of DWR gave a presentation about IMD and working principles of Doppler Weather Radar and its importance in Now casting & cyclone tracking.

Around 31 students of Welfare institute of Science Technology & Management, Pinagadili visited this office (DWR Visakhapatnam) on 2nd April,2025. Shri K. V. S Srinivas, S.O-I, Officer-In-Charge of DWR gave a presentation about IMD and working principles of Doppler Weather Radar and its importance in Now casting & cyclone tracking. and Shri I. Sai Deepak SA explained Working of Radar.

Around 32 students of Welfare institute of Science Technology& Management, Pinagadili visited this office (DWR Visakhapatnam) on 03nd April, 2025.Shri K. V. S Srinivas, S.O-I, Officer-In-Charge of DWR gave a presentation about IMD and working principles of Doppler Weather Radar and its importance in Now casting & cyclone tracking. and Shri N. Saikiran SA Explained Working of Radar.

Around 48 students of Dadi institute of Science Technology, Anakapalli visited this office (DWR Visakhapatnam) on 16th April, 2025.Shri K. V. S. Srinivas, S.O-I, Officer-In-Charge of DWR gave a presentation about IMD and working principles of Doppler Weather Radar and its importance in Now casting & cyclone tracking. and Shri G. Mahesh Met-A Explained Working of Radar.

Student and teacher of different School

Central Hydromet Observatory (CHO) Activities

Awareness of Weather Observations by Central Hydromet Observatory: About 1350 visitors including Officers from Indian Navy, Research Scholars and Professors from Muradabad Institute of Technology MRIIRS Faridabad, SES, JNU Delhi, Department of Geophysics BHU Varanasi and Department of Mathematics Moti Lal Nehru College. Queen's vally School Dwaraka New Delhi, DPMI B-block New Ashok Nagar New Delhi, National Bal Bhawan New Delhi, Nav BharaiPubliic school, TERI School of Advanced Studies New Delhi, Shikshantar School, IMD FTC Training Batch, IMD IMTC Training Batch, Training Batch of Scientistsof IMD. New instruments (SRRG, Thermograph, Hair Hygrograph and Minimum Temperature Thermometer & Maximum Temperature Thermometer were brought from PUNE office and installed at C.H.O. New Delhi.

Visitors from Various Institutes at Central Hydromet Observatory (CHO),New Delhi

Visitors from Various Institutes at Central Hydromet Observatory (CHO),New Delhi

CHAPTER 7

RESEARCH PUBLICATIONS

7.1. Research contributions

Twenty one (21) research articles have been published in *MAUSAM* (Vol. **76**, No. 1), January, 2024 issue.

Twenty four (24) research articles have been published in *MAUSAM* (Vol. **76**, No. 2), April, 2025 issue.

Twenty two (22) research papers got published in Quarterly Journal '*MAUSAM*' (Vol.**76**, No.3), July, 2025 issue.

Twenty two (22) research papers got published in Quarterly Journal '*MAUSAM*' (Vol.**76**, No.4), October issue.

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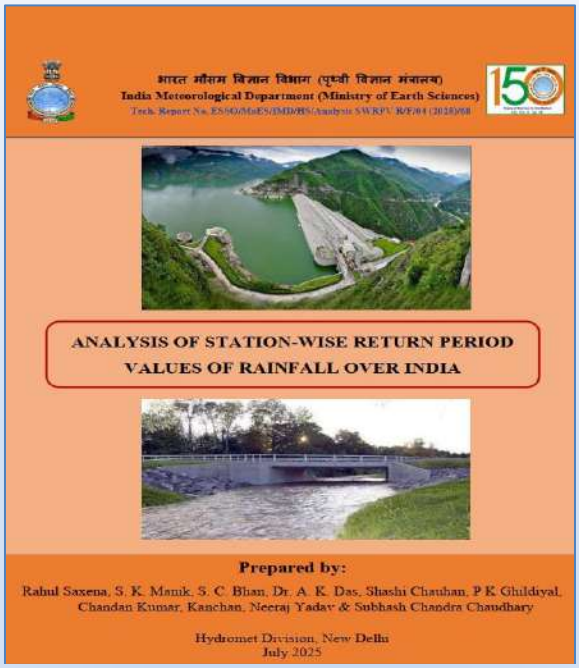
Other Publications:

1. Published the Technical Report entitled "Design Storm Studies undertaken during 2024" and uploaded in IMD website during the month of July 2025.

2. Published the Technical Report entitled “Analysis of Station-wise Return Period Values of Rainfall over India” and uploaded in IMD website in the month of July 2025.



CHAPTER 8

FINANCIAL RESOURCES AND MANAGEMENT PROCESS

8.1. Budget Outlay for approved schemes of IMD

IMD receives its budget allocation under two categories namely, budget for implementation of Central Sector schemes and budget for Establishment related expenditure. Budget Estimates (B.E.) during Financial Year 2025-26 are as follows:

Budget Estimates 2025-26 (Rs. in Crores)

Central Sector Schemes	Establishment	Total
622.52	633.06	1255.58

8.2. Expenditure incurred during FY 2024-25

Expenditure during FY 2024-25 (Rs. in Crores)

Central Sector Schemes	Establishment	Total
259.0	590.87	849.87

8.3. Implementation of the Scheme ‘Mission Mausam’

To mitigate the impact of climate change and extreme weather events and strengthen the resilience of the communities, the Hon'ble Prime Minister of India launched the new Central Sector Scheme 'Mission Mausam' on January 14, 2025 with the goal of making Bharat a "Weather-ready and Climate-smart" nation. Mission Mausam aims to enhance weather monitoring and forecasting across India and surrounding regions by leveraging advanced observational and computing technologies for greater precision and resolution. The previously approved sub-scheme ACROSS under the PRITHVI scheme was merged with ‘Mission Mausam’.

Key IMD activities under ‘Mission Mausam’ include:

- Commissioning of 53 Doppler Weather Radars
- Establishment of 60 RS/RW stations
- Commissioning of 100 Disdrometers
- Commissioning of 10 Wind profilers

- Commissioning of 25 Microwave Radiometers
- Augmentation of Solar Radiation Monitoring Network- 55 Nos.
- Commissioning of 10 Aerosol / Raman LiDARs
- Procurement of 20 Skyradiometers
- Expansion of BC Aerosol Network (BC, EC/OC)- 25 stations
- Ozonesonde Network (3 India+ Maitri+ Bharati)
- Total Columnar Ozone (TCO3) - 5 Nos.
- Commissioning of mini HPCS, Visualization and Decision Support System
- Collaboration with various agencies and startups for the indigenous development of met instruments / sensors and software and provide useful outputs for enhancing precipitation forecasting, validation of weather forecasting models, and dissemination of information and products
- Establishment of Radar data centre, R&D Labs for Tropical Cyclones, severe weather events, Aviation Meteorology, Mountain weather and Augmentation of Training centre

Implementation of Mission Mausam through installation/commissioning of above major instruments **for which procurement process is undergoing** will lead to **Forecasting** of severe weather Hazards **at** (5x5km) by 2030, **Dynamic Impact based forecasting** & risk based warning for all severe weather, **Last mile connectivity** to meet early warning for all (Early warning to each household 2030, 10-15% improvement in forecast accuracy by 2030 and **HarHarMausam, HarGharMausam**through improvement of **Mausamgram.**

8.4. REVENUE GENERATED DURING THE YEAR 2025

Sale of Meteorological Data

RCs/MCs	Total revenue received by sale of meteorological data during the month (Amount in Rupees)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DGM, New Delhi												
DGM SATMET	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
DGM HYDROLOGY	4,75,988	5,98,118	2,81,784	NIL	2,57,216	NIL	NIL	NIL	4,40,588	62,658	3,02,174	NIL
DGM (Publication)	Nil	24600	25225	7825	450	5125	4000	NIL	4000	Nil	6000	24000
RMC, New Delhi												
New Delhi	3101	8356	9782	11900	38993	8446	17001	12684	15256	10187	5350	5579
Jaipur	1584	27675	11457	3472	5428	18880	40296	8868	14795	20369	27360	12297
Lucknow	26479	6788	3541	4502	8772	9322	12915	8290	17996	13019	3658	32171
Srinagar	3101	8356	9782	11900	38993	8446	17001	12684	15256	10187	5350	5579
Chandigarh	9591	1805	1770	11293	5310	0	6545	24114	6637	22691	3776	0

Shimla	2421	369	217	255	539	3510	3074	5816	29655	2781	2103	375
Dehradun	3691	5247	31865	15150	6779	1770	17230	15515	26317	11433	9995	23167
RMC, Mumbai												
Mumbai	22550	13666	12368	16230	67773	26600	82334	36954	12171	16481	17232	24355
RMC, Nagpur												
Nagpur	NA	NA	NA	64964	32869	73082	76755	109299	32222	154149	68019	41697
Bhopal	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
RMC, Kolkata												
RMC Kolkata	9291	70438	31882	25212	85240	29946	14496	51544	25883	32899	57121	15471
PAC Kolkata	1350	12971	6450	32833	27880	2925	8530	900	53756	Nil	16327	14850
Patna	2383	13262	4328	0	2011	17019	24735	1770	1770	2756	7538	11059
Bhubaneswar	10543	48382	44312	12969	15169	8551	48944	27378	4717	25535	25996	11146
Gangtok	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Ranchi	5310	3941	0	3540	23669	10681	4970	5953	29878	6353	5479	9986
RMC, Guwahati												
Guwahati	22,609	10,478-	1, 13,262	37,455	21,461	96,977	54,073	39,532	25,015	64,448	25,665	11,397
RMC, Chennai												
Chennai	22298	31240	38552	10561	30453	11553	74627	23092	24,914	20832	21144	1303
Thiruvananthapuram	15930	7468	12098	8391	21998	20589	9171	14036	6,214	9112	12731	14099
Hyderabad	28622	15850	17172	38822	41936	42856	28463	6630	32,998	22581	NIL	2,342
Bangalore	90622	60772	82707	119938	152091	99033	177463	75993	100,976	162231	51914	76,706
ACWC Chennai	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
CWC Visakhapatnam	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Pune	INR 84, 71,432											

CHAPTER 9

राजभाषा नीति का कार्यांवयन

संसदीय राजभाषा समिति द्वारा निरीक्षण

माननीय संसदीय समिति की दूसरी उपसमिति द्वारा किए गए राजभाषायी निरीक्षण:

संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा दिनांक 06.01.2025 को प्रादेशिक मौसम केंद्र- चेन्नै का पुदुचेरीमेंनिरीक्षण किया गया। निरीक्षण के दौरान मुख्यालय से श्री राहुल सक्सेना, वैज्ञानिक 'जी', और श्रीमती सरिता जोशी, उपनिदेशक (रा.भा.), उपस्थित रहे। श्री सचिन कादयान, कनिष्ठ अनुवाद अधिकारी निरीक्षण में सहयोग के लिए उपस्थित रहे। निरीक्षण सफल एवं संतोषजनक रहा।

संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा दिनांक 10.01.2025 को मौसम केंद्र- तिरूवनंतपुरम का तिरूवनंतपुरम निरीक्षण किया गया। निरीक्षण के दौरान मुख्यालय से श्रीमती रंजू मदान, वैज्ञानिक 'एफ', श्रीमती सरिता जोशी, उपनिदेशक (रा.भा.) उपस्थित रहे। श्री सचिन कादयान, कनिष्ठ अनुवाद अधिकारी निरीक्षण में सहयोग के लिए उपस्थित रहे। निरीक्षण सफल एवं संतोषजनक रहा।

संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा को मौसम केंद्र- तिरूवनंतपुरम का राजभाषायी निरीक्षण

संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा उपसमिति द्वारा मौसम विज्ञान केंद्र- चंडीगढ़ का शिमला में दिनांक 24.02.2025 को निरीक्षण किया गया। निरीक्षण के दौरान मुख्यालय से श्री राहुल सक्सेना, वैज्ञानिक 'जी', और श्रीमती सरिता जोशी, उपनिदेशक (रा.भा.), उपस्थित रहे। सुश्री गुंजन त्यागी, कनिष्ठ अनुवाद अधिकारी निरीक्षण में सहयोग के लिए उपस्थित रहे। निरीक्षण सफल एवं संतोषजनक रहा।

संसदीय राजभाषा दूसरी उपसमिति द्वारा मौसम विज्ञान केंद्र- चंडीगढ़ का राजभाषायी निरीक्षण

संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा दिनांक 22.4.2025 को मौसम कार्यालय- सांताक्रुज मुंबई का मुंबई में निरीक्षण किया गया। निरीक्षण के दौरान मुख्यालय से श्री राहुल सक्सेना, वैज्ञानिक 'जी', श्रीमती अंजना मन्हास, प्रशासनिक अधिकारी-।।, राजभाषा संपर्क अधिकारीउपस्थित रहे। सुश्री गुंजन त्यागी, कनिष्ठ अनुवाद अधिकारी निरीक्षण में सहयोग के लिए उपस्थित रहे। निरीक्षण सफल एवं संतोषजनक रहा।

संसदीय राजभाषा दूसरी उपसमिति द्वारा मौसम कार्यालय- सांताक्रुज मुंबई का राजभाषायी निरीक्षण

संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा दिनांक 22.04.2025 को मौसम कार्यालय- सोलापुर का

निरीक्षण किया गया। निरीक्षण में मुख्यालय से श्री राहुल सक्सेना, वैज्ञानिक- 'जी', श्रीमती अंजना मन्हास, प्रशासनिक अधिकारी-।।/राजभाषा संपर्क अधिकारी, उपस्थित रहीं। सुश्री गुंजन त्यागी, कनिष्ठ अनुवाद अधिकारी सहयोग के लिए उपस्थित रही। निरीक्षण सफल एवं संतोषजनक रहा।

संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा दिनांक 22.04.2025 को मौसम कार्यालय- सोलापुर का निरीक्षण

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति दिनांक 26.05.2025 को मौसम केंद्र, अगरतला का राजभाषायी निरीक्षण किया गया। जिसमें मुख्यालय से श्री राहुल सक्सेना, वैज्ञानिक- 'जी' औरश्रीमती अंजना मन्हास, प्रशासनिक अधिकारी-।।/राजभाषा संपर्क अधिकारीने भाग लिया। सुश्री गुंजन त्यागी, कनिष्ठ अनुवाद अधिकारी सहयोग के लिए उपस्थित रहीं। निरीक्षण सफल एवं संतोषजनक रहा।

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा मौसम केंद्र, अगरतला का राजभाषायी निरीक्षण

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति दिनांक 28.05.2025 को मौसम केंद्र, शिलांग का निरीक्षण किया गया। निरीक्षण में मुख्यालय से डॉ. डी. आर. पटनायक, वैज्ञानिक- 'जी', एवं श्रीमती अंजना मन्हास, प्रशासनिक अधिकारी-।।/ राजभाषा संपर्क अधिकारीशामिल रही। सुश्री गुंजन त्यागी, कनिष्ठ अनुवाद अधिकारी सहयोग के लिए उपस्थित रहीं। निरीक्षण सफल एवं संतोषजनक रहा।

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा मौसम केंद्र, शिलांग का निरीक्षण

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा दिनांक 25.06.2025 को प्रोदशिक मौसम केंद्र, नई दिल्ली का राजभाषायी निरीक्षण किया गया। निरीक्षण में मुख्यालय से महानिदेशक महोदयडॉ. मृत्युंजय महापात्र और श्रीमती अंजना मन्हास, प्रशासनिक अधिकारी-।। ने भाग लिया। सुश्री गंजन त्यागी, कनिष्ठ अनुवाद अधिकारी सहयोग के लिए उपस्थित रहीं।

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा प्रोदशिक मौसम केंद्र, नई दिल्ली का राजभाषायी निरीक्षण

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति दिनांक 04.07.2025 को मौसम कार्यालय, इंदौर का राजभाषायी निरीक्षण किया गया। जिसमें मुख्यालय से श्री राहुल सक्सेना, वैज्ञानिक 'जी' और श्रीमती अंजना मन्हास प्रशासनिक अधिकारी-।।ने भाग लिया। निरीक्षण सफल एवं संतोषजनक रहा। श्री सचिन कादयान कनिष्ठ अनुवाद अधिकारी भी सहयोग के लिए उपस्थित रहे।

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा प्रोदशिक मौसम केंद्र इंदौर का राजभाषायी निरीक्षण

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति दिनांक 25.08.2025 को मौसम केंद्र, गंगटोक का निरीक्षण किया गया जिसमें मुख्यालय से महानिदेशक मृत्युंजय महापात्र, श्रीमती अंजना मन्हास, प्रशासनिक अधिकारी-।।/ राजभाषा संपर्क अधिकारी उपस्थित रहीं। सहयोग के लिए श्री सचिन कादयान, कनिष्ठ अनुवाद अधिकारी उपस्थित रहे। निरीक्षण संतोषजनक रहा।

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा मौसम केंद्र गंगटोक का निरीक्षण

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति दिनांक 28.08.2025 को बाढ मौसम कार्यालय, आसनसोन का निरीक्षण किया गया जिसमें मुख्यालय से महानिदेशक मृत्युंजय महापात्र, श्रीमती अंजना मन्हास, प्रशासनिक अधिकारी-।।/ राजभाषा संपर्क अधिकारी उपस्थित रहीं। सहयोग के लिए श्री सचिन कादयान, कनिष्ठ अनुवाद अधिकारी उपस्थित रहे। निरीक्षण संतोषजनक रहा।

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा बाढ मौसम कार्यालय, आसनसोन का निरीक्षण

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा दिनांक 21.11.2025 को हवाई अड्डा मौसम स्टेशन - चेन्नै का तिरूपतिमेंनिरीक्षण किया गया। मुख्यालय से महानिदेशक, मृत्युंजय महापात्र 'जी', और श्रीमती अंजना मन्हास, प्रशासनिक अधिकारी-।। राजभाषा/ संपर्क अधिकारी तथा श्री सचिन कादयान, कनिष्ठ अनुवाद अधिकारी ने भाग लिया। निरीक्षण असफल असंतोषजनक रहा।

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा दिनांक 29.12.2025 को मौसम केंद्र- रायपुर का रायपुर में राजभाषायी निरीक्षण किया गया जिसमें मुख्यालय से डॉ. मृत्युंजय महापात्र, महानिदेशक, श्रीमती अंजना मन्हास, प्रशासनिक अधिकारी-।।/ राजभाषा संपर्क अधिकारी ने भाग लिया।सहयोग के लिए श्री सचिन कादयान, कनिष्ठ अनुवाद अधिकारी उपस्थित रहे।निरीक्षण सफल व संतोषजनक रहा।

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा मौसम केंद्र रायपुर का निरीक्षण

बैठकें

दिनांक 31.12.2025 को पृथ्वी विज्ञान मंत्रालय द्वारा आयोजित संयुक्त हिंदी सलाहकार समिति की प्रथम बैठक आयोजित गई जिसकी अध्यक्षता माननीय मंत्री महोदय श्री जीतेन्द्र सिंह द्वारा की गई। बैठक् में भारत मौसम विज्ञान विभाग के कार्यकारी महानिदेशक महोदय श्री आर. के. जैनामनी, वैज्ञानिक 'जी', श्रीमती अंजना मन्हास, प्रशासनिक अधिकारी-।।/ राजभाषा संपर्क अधिकारी तथा श्री सचिन कादयान, कनिष्ठ अनुवाद अधिकारी ने भाग लिया।

प्रोत्साहन योजनाएं

सरकारी कामकाज मूलरूप से हिंदी में करने की प्रोत्साहन योजना 2025-26 से संबंधित पत्र जारी किया गया एवं मेटनेट पर अपलोड किया गया।

प्रादेशिक मौसम केंद्र, गुवाहाटी के 14 कार्मिकों को हिंदी शिक्षण योजना के अंतर्गत जुलाई नवम्बर 2024 में आयोजित हिंदीप्राज्ञ/ प्रवीण, पारंगत परीक्षा उत्तीर्ण करने पर कुल 89,200/-रू. (नवासी हजार दो सौ रूपये) की राशि नकद पुरस्कार के रूप में स्वीकृत की गई है।

प्रादेशिक मौसम केंद्र- गुवाहाटी में कार्यरत 14 कार्मिक को हिंदी शिक्षण योजना के अंतर्गत हिंदी टंकण/ हिंदी पारंगत परीक्षा उत्तीर्ण करने पर कुल 1,24,800/-रू. की नकद पुरस्कार राशि का स्वीकृति पत्र जारी किया गया।

प्रादेशिक मौसम केंद्र- कोलकाता के 11 कार्मिकों तथा जलवायु अनुसंधान एव सेवाएँ- पुणे के 18 कार्मिकों के लिए हिंदी शिक्षण योजना के अंतर्गत नकद राशि का स्वीकृति पत्र जारी किया गया।

प्रादेशिक मौसम केंद्र- चेन्नै में कार्यरत 31 कार्मिकों को हिंदी शिक्षण योजना के अंतर्गत हिंदी 'पारंगत' परीक्षा उत्तीर्ण करने पर 2,83,000/- रू. की नकद पुरस्कार राशि का स्वीकृति पत्र जारी किया गया।

वर्ष 2024-2025 में सरकारी कामकाज मूलरूप से हिंदी में करने की प्रोत्साहन योजना के अंतर्गत विभाग के 10 कार्मिकों को पुरस्कार तथा प्रमाण पत्र प्रदान हेतु स्वीकृति पत्र जारी किए गए।

प्रकाशन

भारत मंडपम में आयोजित भारत मौसम विज्ञान विभाग के 150वें स्थापना दिवस समारोह के अवसर पर 'मौसम मंजूषा' के 40वें संस्करण का विमोचन महानिदेशक महोदय और मंचासीन अधिकारियों द्वारा किया गया।

हिंदी दिवस समारोह

मुख्यालय में हिंदी माह/ हिंदी दिवस-2025 समारोह दिनांक 26.09.2025 को मुख्यालय तथा प्रादेशिक मौसम केंद्र-नई दिल्ली द्वारा संयुक्त रूप से आयोजित किया गया। समारोह की अध्यक्षता महानिदेशक महोदय ने की। समारोह के मुख्य अतिथि नवगीतकार डॉ. राधेश्याम बंधु रहे।

मुख्यालय द्वारा हिंदी माह/ हिंदी दिवस-2025 के दौरान आयोजित की गई 06 प्रतियोगिताओं के 30 विजेताओं को कार्यकारी महानिदेशक महोदय के करकमलों से प्रमाण पत्र प्रदान किए गए।

राजभाषा हिंदी में सर्वश्रेष्ठ कार्य करने हेतु वर्ष 2024-2025 के लिए राजभाषा चलशील्ड कृषि सलाहकार सेवाएँ प्रभाग को प्रदान की गई।

मुख्यालय में कार्यरत 02 कार्मिकों को तथा प्रादेशिक मौसम केंद्र- नई दिल्ली में कार्यरत 03 कार्मिक को सरकारी कामकाज मूलरूप से हिंदी में करने की प्रोत्साहन योजना 2024-2025 के अंतर्गत प्रमाण पत्र प्रदान किए गए।

हिंदी दिवस समारोह में कार्मिकों द्वारा सांस्कृति कार्यक्रम बड़े उत्साह-उल्लास द्वारा प्रस्तुत किया गया।

CHAPTER 10

STATUS OF SC/ST/OBC AS ON 01.12.2025

(i) Status of SC/ST/OBC as on 01.12.2025 (Group wise)

	Representation of SCs / STs/ OBCs as on 1.12.2025				Appointments by Promotion during the calendar year		
Groups	No. of Employees	SCs	STs	OBCs	SCs	STs	Total
Group A	286	46	34	63	4	3	31
Group B (Gaz.)	1455	223	101	389	25	11	121
Group B (Non- Gaz.)	1672	249	147	612	3	1	13
Group C	946	223	99	230	7	4	29
TOTAL	4359	741	381	1294	39	19	194

(ii) Status of SC/ST/OBC as on 01.12.2025 (Pay Scale Wise)

	Representation of SCs / STs / OBCs				Appointments by promotion during the calendar year		
Pay Scale in Rs.	No. of Employees	SCs	STs	OBCs	SCs	STs	Total
PB-3 + GP 5400	0	0	0	0	0	0	0
PB-3 + GP 6600	91	20	22	4	0	0	0
PB-3 + GP 7600	110	15	5	35	3	1	16
PB-4 + GP 8700	21	1	1	6	0	0	5
PB-4 + GP 8900	53	10	5	18	1	1	7
PB-4 + GP 10000	10	0	1	0	0	1	3
75500-80000	1	0	0	0	0	0	0
TOTAL	286	46	34	63	4	3	31

CHAPTER 11

MISCELLENEOUS

11.1. Honours and Awards

IMD Awards

Best Employees Awards for the year 2025 on the occasion of IMD Foundation Day

S. No.	Category	Name of the officials & designation	Office/Division/Place of posting
1.	Group 'A' Officer (Certificate of Merit)	Dr. Akhil Srivastava, Sc. D	DGM HQ-NWFC
2.	Group B Officer (Gazetted-Scientific)	Sh. Zeeshan Hashmi, Met.A	(CATC Bamraulli)
3.	Group B Officer (Non-Gazetted-Scientific)	Sh. Sachin Bhardwaj, S.A Ms. Akanksha Sharma, S.A	(DGM HQ-Rectt. Cell) (MC Dehradun)
4.	Group B officer (Non-Gazetted-Non-Scientific)	Sh. Deepak Kumar, Assistant, Sh. Harpreet Singh, Steno-II	DGM HQ-E-II Attached with MOES
5.	Group C Staff	Sh. Gaurav, UDC Sh. Sunil P. Dhawale, MTS	DGM HQ-GS Bills RMC Nagpur
6.	DRM/Safai Worker	Sh. Anand Kumar Jha Sh. Shyam Ms. Gita Rani Biswas	DGM HQ (Budget & Planning) DGM HQ (DGM Sectt.) PAC Kolkata
7.	Project Scientist/ Research Associate	Dr. V. Guhan, Project Scientist	MC Hyderabad

Team Award Categories

S.No.	Category	Awarded to
1.	Development Initiative (Team Award)	Decision Support System (DSS) Team
2.	Research Publication(Team Award)	Singh, A.K.; **Singh, S.K.**; Srivsastava, P., **Jain, A.**, 2025, "Angstrom-Prescott, Artificial and Convolutional neural network radiation model over North India", EARTH SCIENCE INFORMATICS, 18,1. DOI10.1007/s12145-024-01618-7

Institutional/ Functional Award Categories

1.	**Best RMC/MC**	**MC Agartala**
2.	Best Operational Meteorological Office (AMO/MWO/AMS)	AMO Nagpur
3.	Best Doppler Weather Radar(DWR) Station	DWR Kolkata
4.	Best Meteorological Observatory(MO)	TMO Kupwara
5.	Best RS/RW Unit	RS/RW Visakhapatnam
6.	Best Radiation Unit	Radiation Unit Mangalore

IMD feels proud to announce that its employees participated in Inter Ministry Music, Dance and Short Play Competition 2025-26 organized by Central Civil Services Cultural & Sports Board (CCSCSB) (DoPT) and the following officials won medals:

Name of event	Name of winners	Position/Medal acquired
Short Play	Sh. S. S. Negi	Best Production – **Silver**
	Sh. RadheyShyam	Best Actor & Direction – **Gold & Silver**
	Ms. Kanchan	Best Actress (Supporting Role) – **Gold**
	Ms. Vandana	Best Actress – **Bronze**
	Ms. Jayitri Sen	Best Child Actor – **Bronze**
	Ms. Anjali Rawat	**3rd Prize (Bronze)**

ACHIEVEMENTS /APPRECIATIONS /AWARDS RECEIVED

AWARDS

American Meteorological Society conferred the Scientific and Technological Activities Commission Outstanding Service Award, 2025 upon Dr. Mrutyunjay Mohapatra

American Meteorological Society conferred the Scientific and Technological Activities Commission Outstanding Service Award, 2025 upon **Dr. Mrutyunjay Mohapatra** for enhancing tropical cyclone prediction and warning systems in the Indian Ocean region through exceptional leadership and services.

Dr. Somnath Mahato, Project Sc-III at IMD, received IEEE Young Professional of Year award on 11th January, 2025 at Pune.

Prananath College, Khordha, Odisha conferred the PrananathSamman upon **Dr. M. Mohapatra**, DG IMD in recognition to his outstanding contributions and achievements in the field of weather monitoring and forecasting on 28thJanuary.

Prananath College, Khordha, Odisha conferred the PrananathSamman upon Dr. M. Mohapatra, DG IMD

Dr. M. Mohanty, Sc. 'F', MC Bhubaneswar was awarded with Odisha Women Award by Evergreen Forum at Odisha Women's Conclave2024-2025, Jaydev Bhawan, Bhubaneswar, on 27.01.2025.

31stBiennial Mausam Award was conferred upon **Dr. Mrutyunjay Mohapatra**, **Mrs. Monica Sharma, Mrs. Sunitha Devi, Mr. S.V.J. Kumar and Mrs. Bharati Sabadefor** the best research paper published in journal Mausam entitled "Frequency of Genesis and Landfall of different categories of tropical cyclones over the North Indian Ocean during the biennial period of 2020-2021.

RadhanathSikdar Institute of Geospatial Science and Technology (RSGIGST) conferred "**Sir RadhanathSikdar Memorial Award 2025**" upon **Dr. Mrutyunjay Mohapatra**, DG IMD at the GEOSPATIA 2025. The event was organised by the Anthropological Survey of India, Kolkata on 14th February, 2025.

RSGIGST, conferred "Sir RadhanathSikdar Memorial Award 2025" upon Dr. Mrutyunjay Mohapatra, DG IMD at the GEOSPATIA 2025

Hon'ble Chief Minister of Odisha **Shri Mohan Charan Majhi**honored**Dr. M. Mohapatra**, DG IMD with **Ekamra Shree Award-2025** for his outstanding contribution to the field of Science and early warning services during the function organised by EkamraSanskrutikaPrakashani on the eve of Mahashivratri at Lingaraj Temple, Bhubaneswar, Odisha on 26th February, 2025.

Hon'ble Chief Minister of Odisha Shri Mohan Charan Majhi honoured Dr. M. Mohapatra, DG IMD with Ekamra Shree Award-2025

Ms. Gitanjali Maraskole, Scientific Assistant won All India first (1st) prize in Chess (women) competition during 15th IMD All India sports meet 17-20 February, 2025 at Pune (India).

Tanu Sharma, S.R.F(MRFP) got **Dr. S.K. Ghosh Memorial Young Scientist Award-2025** second prize, organized by the Indian Meteorological Society (IMS), Kolkata Chapter on WMO day celebration (held on 24th March 2025) at Regional Meteorological Centre (RMC) Kolkata for her published research paper.

Smt. NilimaNinawe, Met-B and **Smt. SanyogitaMeshram**, UDC won All India 2nd prize in Carrom (women) competition during 15th IMD All India sports meet 17-20 February, 2025.

India Meteorological Department (IMD) received the National Award for e-Governance 2025 for its exemplary efforts in leveraging technology for digital transformation and public service delivery through the Multi-Hazard Early Warning Decision Support System. The IMD team was led by **Dr. M. Mohapatra**, DGM, and the key contributors were Mr. Anshul Chouhan (Scientist D), Dr. M. T. Bushair (Scientist D), and Ms. Suman Gurjar (Scientist E), along with other team members.

Hon'ble Union Minister Dr. Jitendra Singh, conferring the National Award on Dr. M. Mohapatra, DG IMD and DSS Team including Mr. Anshul Chauhan, Scientist-C, Mrs Suman Gurjar, Scientist-D and Dr. M.T. Bushair, Scientist-D

United Nations Office for Disaster Risk Reduction (UNDRR) organized 8th Session of Global Platform for Disaster Risk Reduction (GP-DRR) and Sasakawa Award – 2025 Ceremony during 3 – 6 June, 2025.

Sasakawa Award established in 1986 with the support of The Nippon Foundation, the United Nations Sasakawa Award is the most prestigious international recognition in the field of disaster risk reduction. **Dr.Mrutyunjay Mohapatra,** Director General, India Meteorological Department (DG IMD) received United Nations Sasakawa Award-2025 for Disaster Risk Reduction. The theme for 2025, "**Connecting science to people: Democratizing access to innovation and technology for disaster-resilient communities**," underscores the significance ofDr. Mohapatra's groundbreaking work in minimizing deaths due to any cyclone over the north Indian Ocean region, not only in India, but also in 13 WMO/ESCAP Panel member countries bordering the Bay of Bengal and the Arabian Sea.

Mr. Kamal Kishore, Secretary General, Special Representative of the United Nations Secretary-General for Disaster Risk Reduction, and Head of UNDRR presenting the Sasakawa Award to Dr.Mrutyunjay Mohapatra, Director General of Meteorology, India Meteorological Department

Dr. Mohapatra presenting Thanksgiving speech for the honour

Dr. M. Mohapatra, Director General of Meteorology, IMD, was awarded **the Sir Gilbert Walker Gold Medal Award by Indian Meteorological Society (IMS)** for his exceptional contributions to science & technology, research & innovation and their applications in weather forecasting and severe weather warnings, especially with respect to cyclones and monsoonal low-pressure systems.

Dr. Mrutyunjay Mohapatra,Director General of Meteorology, India Meteorological Department, receives Sir Gilbert Walker Award-2025

WMO Certificate of Appreciation: Dr. Kuldeep Srivastava, Scientist 'F', received recognition for services to WMO Regional Association II (Asia) during the intersessional period of the 17th Session (RA II-17).

Young Scientist Award – iRAD 2025: Mr. Amit Kumar, Scientist-D, was conferred the Young Scientist Award at the 7th Conference on Indian Radar Meteorology (iRAD 2025).

MC Chandigarh won First Prize from TOLIC Chandigarh for the year 2024-25 on 03/02/2026 for doing commendable work in Rajbhasha.

On 19th December 2025, at the 85th meeting of the Urban Official Language Implementation Committee held in Ahmedabad, the MC Ahmedabad was awarded the First Prize for outstanding performance in the implementation of the Official Language for the year 2024-25.

MC Ranchi was awarded the Second Prize for excellent implementation of the Union Government's Official Language Policy within the jurisdiction of the Regional Implementation Office (Eastern Region).

ISO 9001:2015 Certification – AMO Nagpur: On 4 August 2025, the Aerodrome Meteorological Office (AMO), Nagpur, became the first among 18 AMOs under IMD to receive the ISO 9001:2015 Quality Management Certification, reinforcing excellence in aviation meteorological services.

MC Srinagar received an appreciation letter from the Hon'ble Lieutenant Governor, Union Territory of Jammu & Kashmir, regarding the safe and smooth conduct of Shri Amarnath Ji Yatra 2025.

MC Patna, received an Appreciation Certificate from the Asian Development Research Institute (ADRI), Patna, for providing weather forecasting services to farmers in Bihar.

MC Thiruvananthapuram received an appreciation letter from the Flag Officer Commanding-in-Chief, Southern Naval Command, for the exceptional meteorological support provided during the recent OP-DEMO 25 conducted at Thiruvananthapuram.

MC Bengaluru received an appreciation letter from the Karnataka State Natural Disaster Monitoring Centre (KSNDMC) for providing timely forecasts on Rainfall, Cyclogenesis, Cold Waves, Heat Waves, and other significant weather phenomena, which aided them in early response and preparedness measures.

AMO Bengaluru (Devanahalli) received an appreciation letter from the Airport Authority of India, Devanahalli, Bengaluru, for timely, accurate and dependable meteorological observations, forecasts, and briefings, which played a crucial role in ensuring the safety, efficiency, and smooth conduct of aviation operations.

MC Agartala received an appreciation letter from the AAI, MBB Airport Agartala for its continued dedication and professional support in delivering high-quality Aviation Meteorological Services through the Aerodrome Meteorological Office (AMO) Agartala, under its administrative control.

APPRECIATIONS

Shri K. N. Mohan, Sc. 'G' was facilitated by **Lt. Gen. Rajiv Kumar Sahni**, Indian Army for installation of Automatic Weather Stations in Arunachal Pradesh.

RMC Guwahati established its stall in National Conference AGMET- 2025 on Frontier Technologies for weather & climate based decisions in Agriculture and Allied Sectors during 13-15 February 2025 at Assam Agricultural University, Jorhat and won the best stall award.

RMC Guwahati won the best stall award at Assam Agricultural University, Jorhat

WMO has Presented Certificate of Appreciation For Services to the World Meteorological Organization and particularly to the WMO Regional Association II (Asia) to Dr. Kuldeep Srivastava, Scientist 'F' in recognition of his valuable contribution during the intersessional period of the Seventeenth Session of Regional Association II (Ra II-17).

AMO Nagpur Achieves Prestigious ISO 9001:2015 Certification: On 4 August, 2025, the Aerodrome Meteorological Office (AMO), Nagpur, became **the first among 18 AMOs under the India Meteorological Department** to receive the **ISO 9001:2015 Quality Management Certification**.

AMO, RMC Nagpur, Achieve Prestigious ISO 9001:2015 Quality Management System Certification

RMC Guwahati received "**Certificate of Appreciation**" for successfully organizing various activities commemorating 150 years of IMD's service to the nation.

Certificate of Appreciation to RMC Guwahati

This certification places AMO Nagpur at the forefront of aviation meteorological services in India, reinforcing its commitment to global standards of quality, consistency and service excellence.

Shri B. SudarsanPatro, Sc. 'E' received a Certificate of Appreciation from the Journal of Agro-meteorology, Association of Agrometeorologists, Anand, Gujarat, India and Dept. of Computer Science& Engineering, ABV-IIIT, Gwalior in recognition of his outstanding contribution in peer reviewing research articles towards the quality of publication of the Journal of Agrometeorology and IEEE International Conference on Recent Advancement in Computing and Systems during 2025 respectively. He alsoreceived a certificate of appreciation from the head of the institute for conducting a science outreach activity at Kalam Institute of Technology, Odisha, on 7th November 2025.

Shri B. SudarsanPatro, Scientist-E, IMD Pune, received a certificate of appreciation

11.2. Media Interaction/Outreach Programme

Updated Long-Range Forecast for Southwest Monsoon Rainfall 2025

(i) **IMD organized Press Conference** on the updated Long-Range Forecast for Southwest Monsoon Rainfall 2025 at Mahika Hall, MoES on 27th May 2025. The highlights of the Press Release are presented below:

a) Quantitatively, the southwest monsoon seasonal rainfall over the country as a whole is likely to be 106% of the Long Period Average (LPA) with a model error of ±4%, indicating that above normal rainfall is most likely over the country as a whole during the monsoon season (June to September), 2025.

b) The southwest monsoon seasonal (June to September, 2025) rainfall is most likely to be above normal over Central India and South Peninsular India (>106% of LPA), normal over Northwest India (92-108% of LPA) and below normal over Northeast India (106% of LPA).

c) The southwest monsoon seasonal rainfall over the Monsoon Core Zone (MCZ) consisting of most of the rainfed agriculture areas in the country is most likely to be above normal (>106% of LPA).

d) During June to September 2025, normal to above normal rainfall is very likely over most parts of the country except some areas of Northwest and East India and many areas of Northeast India where below normal rainfall is very likely.

e) The average rainfall for the country as a whole during June 2025 is most likely to be above normal (>108% of the Long Period Average (LPA)).

f) During June 2025, Normal to above normal monthly rainfall is very likely over most parts of the country, except some southern parts of peninsular India and parts of Northwest and Northeast India, where below normal rainfall is likely.

g) In June 2025, normal to below normal monthly maximum temperatures are likely over most parts of the country, except many regions of the Northwest India and Northeast India, where above normal temperatures are very likely. Above-normal monthly minimum temperatures are likely across most parts of the country, except some parts of Central India and adjoining south Peninsula where, where normal to below-normal minimum temperatures are very likely.

h) Currently, neutral El Nino-Southern Oscillation (ENSO) conditions are prevailing over the equatorial Pacific region. The latest Monsoon Mission Climate Forecast System (MMCFS) as well as other climate model forecasts indicate that the neutral ENSO conditions are likely to continue during the monsoon season.

i) At present, neutral Indian Ocean Dipole (IOD) conditions are observed over the Indian Ocean. The latest MMCFS forecast indicates that weak negative IOD conditions are likely to develop during the southwest monsoon season.
Detailed Press Release is available at:
https://internal.imd.gov.in/press_release/20250527_pr_4008.pdf

An Interview on "Career research & Achievements in the area of Meteorology" by Dr. B Amudha,Scientist-F & Head (Addl. Charge), RMC Chennai was broadcasted by 101.4 AIR Chennai FM (FM Rainbow Chennai) on 24th March2025at 13:10 hrsIST.

A talk on "World Meteorological Day (WMD) & Evolution of India Meteorological Department (IMD)", by Dr. B Geetha,Scientist- D, RMC Chennai was broadcasted by 101.4 AIR Chennai FM (FM Rainbow Chennai) on 23rd March2025at 20:30 hrsIST.

Officials from 'Climate Monitoring & Prediction Group' and 'Agrimet Division' participated in the "Krishidarshan & Amachi Mati Amachi Manse" programme of DD Sahyadri (Marathi Channel) on 4 occasions for discussion on various relevant topics as:
"Agro Advisory for Rabi Crops" broadcasted on 10.01.2025
"Monsoon 2025 and Kharif Planning" broadcasted on 20.06.2025
"Monsoon present Situation and Forecast" broadcasted on 08.08.2025
"Post Monsoon Forecast and Rabi Planning" broadcasted on 10.10.2025

Officials from Agrimet Division, IMD, Pune participated in the programme "हवामानाचा

साप्ताहिक अंदाज व कृषि तज्ञांचा सल्ला" organised by 'Lokmat' (a Marathi news channel) for Maharashtra being posted in facebook channel of Lokmat on every Friday.

Participation of Officials from the Division in the programme "हवामानाचा साप्ताहिक अंदाज व कृषि तज्ञांचा सल्ला" organised by Lokmat'

Scientists from Agrimet Division delivered TV bytes on weather based Agromet Advisories in DD Kisan Channel which are being telecasted every Tuesday and Friday in Mausam Khabar Programme.

Three Scientist from Agrimet Division delivering biweekly video bytes (every Tuesday and Friday) on weather based Agromet Advisories for 'Mausam Khabar' Programme of DD Kisan Channel

Dissemination of agromet advisories to the farmers through various multi channels system like All India Radio (AIR) and Doordarshan, private TV and radio channels, newspaper and internet, SMS, social media etc. is being carried out on wider scale. Under Public Private Partnership (PPP) mode, Reliance Foundation, Kisan Sanchar etc. are also disseminating agromet advisories through SMS to the farming community. In addition, number of AMFUs have been sending agromet advisories through SMS in collaboration with Agricultural Technology Management Agency (ATMA).

To enhance outreach, initiatives have been undertaken to integrate the weather forecast and agromet advisories with the mobile applications and websites of various State Governments and Academic Institutions. Integration has been completed for 24 states viz. Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Kerala, Madhya Pradesh, Meghalaya, Nagaland, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand, Maharashtra, Andhra Pradesh, Telangana, Arunachal Pradesh, West Bengal, Jharkhand, Mizoram and Tripura.

The weather forecast and Agromet advisory are being disseminated through mobile apps and websites of various State Govt. (1,56,02,201 no. of farmers), PPP mode (61,63,324 no. of farmers) and WhatsApp (no. of 18,13,144 farmers).

11.3. New Projects/Schemes/Programmes Approved/Initiated

Infrastructure Development & Installations: Hon'ble MoS (I/C), MoES, **Dr. Jitendra Singh** Inaugurates 3 Major Initiatives of India Meteorological Department (IMD), Two New C-Band Doppler Weather Radars, Solar Panel System & Meteorological Museum.

Dr. Jitendra Singh Inaugurates 3 Major Initiatives of India Meteorological Department (IMD), Two New C-Band Doppler Weather Radars, Solar Panel System & Meteorological Museum

Hon'ble MoS (I/C), MoES, Dr Jitendra Singh on 27th November, 2025 inaugurated the Museum of Meteorological Instruments and a new Solar Panel system at the Mausam Bhawan Complex, New Delhi.

Developed by the India Meteorological Department under the Ministry of Earth Sciences Government of India the museum showcases India's rich meteorological heritage through historic and modern weather instruments used across the country.

During the event, Doppler Weather Radars at Raipur and Mangaluru were also inaugurated;

further strengthening India's weather monitoring, forecasting accuracy, and disaster preparedness.

The ceremony was graced by Dr. M. Ravichandran, Secretary, MoES, and Dr. Mrutyunjay Mohapatra, Director General, IMD.

These initiatives collectively mark another significant milestone in advancing India's capabilities in climate services, scientific outreach, and public weather awareness.
Dr. Jitendra Singh emphasised that Doppler Weather Radars are among the most visible and impactful components of weather infrastructure, valued by the public, disaster managers, and policymakers alike. He underlined that weather radars do not recognise administrative boundaries and therefore serve multiple states and regions simultaneously. The radar located in one state, he said, must be understood as a regional asset designed to protect lives and property across its entire coverage span.

A Dual Polarized, Solid-State Power Amplifier-based C-Band Doppler Weather Radar has been installed at Indira Gandhi Krishi Vishwavidyalaya, Raipur—the first such radar in Chhattisgarh. With a 250-km radial coverage, it can detect monsoon depressions, low-pressure systems, heavy rainfall, thunderstorms, lightning, hailstorms, squalls, and turbulence.Its observational reach extends over Chhattisgarh, interior Odisha, eastern Madhya Pradesh, southwest Jharkhand, and southern parts of East Uttar Pradesh, filling a long-standing data gap and significantly improving IMD's prediction capabilities in these regions.

The second Dual Polarized C-Band Doppler Weather Radar, installed at IMD's RS/RW Office in Shakthi Nagar, Mangaluru, will provide advanced monitoring of severe weather systems including cyclones, thunderstorms, squalls, heavy rainfall, lightning, hailstorms, and turbulence.With 250 km coverage, the radar will monitor the Arabian Sea adjoining Karnataka, areas of Goa and South Konkan, northern Lakshadweep, and land regions of Karnataka, Kerala, Goa, and South Maharashtra.This is Karnataka's first IMD radar, and will be crucial for nowcasting and short-range forecasting, strengthening disaster preparedness along the west coast.Both radars have been indigenously developed under the 'Make in India' initiative.

The Minister also inaugurated a newly developed Meteorological Museum, designed to inspire students, researchers, and the youth by showcasing IMD's journey over 150 years. The museum features historic weather instruments, upper-air observational systems, communication tools, radar, and satellite components, and offers audio-visual facilities for interactive learning. Dr. Jitendra Singh encouraged IMD to conduct structured educational tours for school and college students, calling the museum a "**journey down a century of scientific evolution**".

In alignment with India's clean energy mission, IMD has installed a 771 kWp solar power system across the Mausam Bhawan Complex, comprising 1,315 solar panels installed through NBCC. Dr. Singh said the initiative supports national goals under the PM Surya GharMuft Bijli Yojana, contributes to India's net-zero commitments, and sets a model for other government buildings.He noted that generated power is expected to exceed IMD's consumption needs and can be fed back to the grid, enabling both environmental and economic gains.

Speaking on the occasion, Secretary, Ministry of Earth Sciences, Dr. M. Ravichandran said that IMD has now achieved over 50% radar coverage, and is planning additional radars, including urban radars in Delhi, Chennai, Mumbai, and Kolkata, and advanced phased-array radars for the Himalayan states of Jammu & Kashmir, Uttarakhand, and Himachal Pradesh.

On January 2, 2025 **MAHAKUMBHA MELA-2025** Weather Webpage and Automatic Weather Observing System (AWOS) was inaugurated by Chief Guest **Shri G.S Naveen Kumar** (IAS) in Stakeholder workshop hosted by Meteorological Centre Lucknow. Dedicated daily Weather Page bulletin issues for Kumbh Mela 2025.
PWD system was installed at Khushinagar airport in Feb 2025.

Director General, IMD, Dr. Mrutyunjay Mohapatra underlined that IMD's commitment to enhancing observational, modelling, forecasting, and learning systems, and expressed gratitude for the Minister's continuous guidance and support. Dr. Jitendra Singh concluded that today's launches represent IMD's contribution to India's pursuit of Viksit Bharat @2047, combining traditional knowledge with modern technology, expanding disaster

preparedness, and advancing the country's commitment to clean energy. He commended IMD for emerging as a "**Vishwa Bandhu**" by supporting neighbouring countries through weather services and disaster advisory systems.

Dedicated Webpage for Kumbh Mela 2025

New 04 AWS and 01 LED Display were installed at Kumbh Mela Prayagraj for providing the Current Weather Forecast (24×7) for pilgrim at Kumbh Mela 2025.
2000 ARG and 450 AWS have been set up by MC Lucknow for Uttar Pradesh AWS Project.

27 AWS has been Set Up by MC Lucknow under 400 AWS project.

DGM has approved the proposed establishment of a new Meteorological Office at Tura proposed by MC Shillong as follow up action from the State Level IMD Stakeholders Workshop at Shillong in commemoration of IMD 150 years celebration.

Secretary, MoES has approved the proposed establishment Manual Climatological Observatory and Educational Centre at Mawsynram; World's Wettest Place as per MC Shillong proposal.

FMO Jalpaiguri, out of 60 ORGs initiated in the previous quarter, 45 are successfully installed at different Schools, Colleges and Tea Gardens located in SHWB under the flagship Programme of Augmentation of Observatories during 150 years of IMD.

Foundation stone for installation of X-Band Doppler Weather Radar was laid by Sri Keshab Mahanta, Hon. Minister of Science, Tech. & Climate Change, Disaster Management etc. Govt. of Assam of 13.02.2025 in presence of **Shri K.N. Mohan**, Sc. 'G'& Head RMC Guwahati and other dignitaries.

Foundation stone for installation of X-Band Doppler Weather Radar was laid by Sri Keshab Mahanta, Hon. Minister of Science, Tech. & Climate Change, Disaster Management etc. Govt. of Assam

A new Class - I Observatory at AMS Dimapur :

A new class-I Surface Observatory has been established at AMS Dimapur for observing various parameters like Dry Bulb Temperature, Wet Bulb Temperature, Relative Humidity, Maximum and minimum temperature, Wind Direction, Wind Speed, cumulative rainfall measurement, etc. The above surface observatory is operational w.e.f 01.03.2025.

A new Class - I Observatory at AMS Dimapur

A tour to Indian Institute of Astro Physics / Kodaikanal Solar Observatory Kodaikanal was undertaken by **Dr. (Smt.) B. Amudha**, Sc.-F, **Shri Mohd. Kasim,** Met-B and **Shri S. Johnson**, Met-A from 01.07.2025 to 03.07.2025 towards site selection for establishment of newly proposed RS/RW upper air observatory under Mission Mausam project.

Regional Severe Local Storm Laboratory

An advanced level Computer Workstation based Research Laboratory named "Regional Severe Local Storm Laboratory" has been inaugurated dated 28.08.2025 by Dr. Mrutyunjay Mohapatra, DGM in presence of Dr. Somenath Dutta, Sc-G & Head, RMC Kolkata, Dr. H.R. Biswas, Sc-F & Head, RWFC Kolkata, along with other officers at RMC Kolkata.

The lab is equipped with one high power Workstation computer along with five high specification computers and conferencing facility, along with provision for additional 18 high specification computers and digital display systems.

The proposed laboratory is aimed at improvising the accuracy of weather forecasting, especially for severe local thunderstorms / lightning in a precise manner, machine learning / deep learning for more accurate forecast in spatial and temporal scale, meso-scale NWP modelling to simulate various atmospheric condition, model-generated new products, large data processing and associated research. The lab would not only empower researchers and students with the tools and experience to understand and work in the field of meteorology, but also contribute to the development of meteorological expertise in Eastern India where extreme weather events such as severe local thunderstorms, cyclones, and heavy rainfall are very common.

"Regional Severe Local Storm Laboratory" has been inaugurated dated 28.08.2025 by Dr. Mrutyunjay Mohapatra, DGM

Meteorological Data Submission System (MDSS) and Message Handling & Switching System (MHSS)

On approval of DGM, implementation (Phase 1) of the newly developed Meteorological Data Submission System (MDSS) and Message Handling & Switching System (MHSS) that is designed and developed by the officials of Automation Unit, MWOKolkata under the guidance of **Dr. G.K. Das**, Sc-F & Head, AMO Kolkata and **Shri Sunny Chug**, Sc-D, has been started. The Meteorological Data Submission System (MDSS) has been developed and designed by **Shri Chiranjit Chakraborty**, Met-A. The Message Handling & Switching System (MHSS) has been developed and designed by **Shri RajdipSaha**, SA, and the Documentation, necessary checking and preparation of SOP for using MDSS have been done by **Shri Sourav Pan**, SA.

A patent application (Patent Application no 202521022824) for the in house developed Rain gauge was submitted in March 2025. **Dr. Shijo Zacharia**, **Shri. K. S. Hosalikar**, **Dr.M. Mohapatra**, **Shri. Manish R Ranalkar, Shri. AnjithAnjan, Shri. U K Shende, Shri. K. N. Mohan** are the inventors. It is installed at CAgMO Surface Observatory on experimental basis and interfaced with host computer in the observatory on 27 September, 2025.

In house developed Rain gauge installed at CAgMO Surface Observatory on experimental basis

A novel barometric pressure sensor is designed and developed at IMD Pune. An in-principle approval received to process the patent application for the developed product. **Dr. Shijo Zacharia**, **Shri. K. C. Sai Krishnan** and **Ms. Ranju Madan** are the inventors. The evaluation of the product is progressing at SID, IMD Pune.

A novel Air Temperature sensor is designed and developed at IMD Pune. An in-principle approval received to process the patent application for the product. **Dr. Shijo Zacharia**, **Shri. K. C. Sai Krishnan, Ms. Ranju Madan and Shri. AnjitAnjan** are the inventors. The evaluation of the product is progressing at SID, IMD Pune.

Replacement of Mercury barometers at Surface Observatories was initiated. A prototype system was designed and undergoing filed experiment at CAgMO Surface Observatory from 29 September 2025. The system generates Synop in auto and manual modes.

Union Minister of State (Independent Charge) for Science & Technology; Minister of State for Earth Sciences; and Minister of State in the Prime Minister's Office, Personnel, Public Grievances,

Pensions, Atomic Energy and Space, **Dr. Jitendra Singh**, on **27th November 2025**, inaugurated **three major initiatives of the India Meteorological Department (IMD)**. These included the commissioning of **two state-of-the-art Doppler Weather Radars (DWRs)** at **Raipur and Mangaluru**, the launch of a **Solar Power System at Mausam Bhawan**, and the opening of a **Meteorological Museum** aimed at promoting weather and climate awareness among students and young learners.

Hon'ble Union Minister Dr. Jitendra Singh, on 27th November 2025, inaugurated three major initiatives of the IndiaMeteorological Department

Completed installation of Two DCWIS and five RVR systems at Navi Mumbai airport in September 2025.

Installation of Two DCWIS and five RVR systems at Navi Mumbai airport

IITM Pune installed Ceilometer at CWC Vsk under Mission Mausam project on 7th November, 2025.

SERVICES

DGM IMD has inaugurated METNET Video Help Desk on January 01, 2025, "Now you may address your issues and queries LIVE by visiting CONTACT METNET -> CONNECT NOW on METNET home page. This Video Help Desk can also be used for queries related to eOffice and e-HRMS.

DGM IMD has inaugurated METNET Video Help Desk

Farmers' Awareness Programmes

During the quarter 5 Farmers awareness programmes (FAPs) were organized across the country.

FAP conducted by AMFU, Mahisapat at Kalaspur Village, Kankada-Had Block, Dhenkanal District, Odisha Uttarakhand on 12th February, 2025

FAP conducted by AMFU, Gosaigaon at Mankachar Village, South-Salmara Block, South SalmaraMancachar District, Assam on 21st February, 2025

"IMD ATITHI - An Online Guest House Booking System" facility has been extended to the IMD retired employee's w.e.f. 01.04.2025.

IMD BAMS - 2 Budget Heads of **MISSION MAUSAM** added on 17.04.2025 in consultation with the DGM (B&P) Section.

Under Port Meteorological services 4 ship barometers brought to IS, RMC Chennai (4 Indian ships which includes 1 coast guard ship) were compared and necessary certificates issued in the month of July.

The Met instruments (Thermometers (06 nos.) and Psychrometers (02 nos.) brought from **Indian Naval Air Squadron (INAS-313),** Chennai were compared and necessary certificate issued in the month of July.

On 18-26 June 2025, ensuring the safety of the public, pilgrims, and a smooth yatra is a key objective of IMD. To support this, IMD provides critical weather services across the nation, including to the Indian Army, Navy, Air Force, NDMA, and SDMAs, even in challenging and remote terrains. As part of this commitment, automatic weather stations have been installed along the Shri Amarnath Ji Yatra 2025 route by AWS Lab and MC Srinagar.

Automatic weather stations have been installed along the Shri Amarnath Ji Yatra 2025 route by AWS Lab and MC Srinagar.

RMC Chennai conducted Pre-cyclone orientation exercise on 07.10.2025 and 08.10.2025. Officers delivered lectures on various bulletins. As part of the pre-cyclone exercise, contact details of Disaster Managers, stakeholder organizations and service providers were updated. Letters were sent to APEPDCL, CPWD, Police Communication, Ports, AIRs, BSNL and other organizations to provide seamless and uninterrupted services to this office during cyclones.

11.4. ADDRESSES OF VARIOUS REGIONAL METEOROLOGICAL CENTRES & METEOROLOGICAL CENTRES

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भारत मौसम विज्ञान विभाग

INDIA METEOROLOGICAL DEPARTMENT

पृथ्वी विज्ञान मंत्रालय, भारत सरकार

Ministry of Earth Sciences, Govt. of India