**HEATWAVES AND FLOODS IN CITIES**

645.   MS. S JOTHIMANI:

Will the Minister of EARTH SCIENCES be pleased to state:

(a)   whether it is true that the ICMR–Global South research has projected urban heatwaves and erratic rainfall events to double in cities like Chennai by 2030 and if so, the immediate steps taken/being taken by the Government to mitigate these risks;

(b)   the number of extreme weather events including heatwaves, flash floods and cloudbursts recorded across the Country during the first half of 2025 in comparison with earlier years;

(c)   the status of the Government's efforts to implement "Bharat Forecast System" and urban flood forecasting tools such as C-FLOWS particularly for coastal metros like Chennai; and

(d)   whether enhanced early warning systems and city level decision support platforms are being scaled up in collaboration with IMD and State Governments to improve disaster preparedness and if so, the details thereof?

**ANSWER**
THE MINISTER OF STATE (INDEPENDENT CHARGE) FOR
MINISTRY OF SCIENCE AND TECHNOLOGY
AND EARTH SCIENCES
(DR. JITENDRA SINGH)

(a)   The Government is aware of the earlier reports suggesting that cities like Chennai will face significant rise in heatwave days and extreme rainfall events by 2030. The India Meteorological Department (IMD) continuously monitors extreme weather events such as heatwaves and heavy rainfall across various locations in India, including urban areas, using station and city-based meteorological data. Also, gridded rainfall (25 km resolution) and temperature data (50 km resolution) provided by the IMD are also utilised to track these extreme events. Further, IMD consistently issues timely alerts and forecasts at different time scales to the public and concerned stakeholders. Various steps have been taken to ensure effective dissemination of warnings to vulnerable populations. IMD's weather information, including alerts and warnings to the public, is provided through various platforms:

- Mass Media: Radio/TV, Newspaper network (AM, FM, Community Radio, Private TV), Prasar Bharati, and private broadcasters
- Weekly & Daily Weather Video
- Internet  (email), FTP
- Public Website (mausam.imd.gov.in)
- IMD Apps:  Mausam/Meghdoot/DAMIN/RAIN ALARM
- Social Media: Facebook, X, Instagram, BLOG

    i. X: https://twitter.com/Indiametdept
    ii. Facebook:
       https://www.facebook.com/India.Meteorological.Department/
    iii. Blog: https://imdweather1875.wordpress.com/
    iv. Instagram: https://www.instagram.com/mausam_nwfc
    v. YouTube:
       https://www.youtube.com/channel/UC_qxTReoq07UVARm87CuyQw

(b)    IMD has data on extreme weather events covering heatwaves recorded across the country. However, since the cloud bursts and associated flash flood events are highly localized events, they need a highly dense network of Automatic Rain-Gauges (ARGs) and Automatic Weather Stations (AWSs), and flood Gauges for recording of such highly localised rainfall on a real-time basis. Currently, such rainfall data records for longer periods are not available both in India and as well as world-wide. Further these events mostly occurr in very remote areas over hilly areas of country such as the Himalayas and Western Ghats, which are still data-sparse regions. So there is no study available to find their trends using longer period data. However, IMD has data on heatwave frequencies in terms of meteorological sub-division-wise, across India. Annexure-1 shows their frequency for the period of 2020-2025 (6 years).

(c)    The Bharat Forecast System (BharatFS) is based on the newly implemented Triangular Cubic Octahedral (TCo) dynamical grid, which enables the model to operate at ~ 6 km horizontal resolution. It has improved representation of orography, better filtering, and better conservation properties. With the increase in horizontal resolution, BharatFS can generate distinct forecasts every 6 km. With the improved skill of BharatFS at such a high resolution, the model can provide better guidance for weather predictions and extremes at the district and block levels, which are typically 12 km or more. The BharatFS provides a 10-day forecast of rainfall, temperature, low-pressure genesis, and other critical atmospheric conditions, enabling model guidance in issuing early warnings for multiple sectors.

In 2019, the National Centre for Coastal Research (NCCR) under the Ministry of Earth Sciences (MoES), in collaboration with other MoES institutes and the Tamil Nadu State Government, developed CFLOWS—an urban flood-forecasting system for Chennai. Since then, it is issuing advisory services to the Tamil Nadu State Disaster Department on a regular basis. This tool is also integrated with TNSMART for disaster preparedness. Similar systems are available for Mumbai and Kolkata.

(d)    Yes. MoES has developed advanced early warning systems for severe weather events such as cyclones, heavy rainfall, and other extreme conditions. These systems are supported by a state-of-the-art observation network, including surface and upper-air instruments, Doppler Weather Radars, remote-sensing platforms, and high-resolution dynamical models. The India Meteorological Department, in coordination with other MoES centres and State Governments, has developed an end-to-end GIS-based Decision Support System. This system serves as the front end of the national early-warning framework, enabling timely detection and monitoring of weather hazards and strengthening disaster preparedness across the country, including in urban areas.

IMD has adopted new techniques and technology from time to time to detect, monitor, and provide timely early warnings for the entire country, including urban areas, and cities regularly affected by all types of extreme weather events like cyclones, heavy rainfall, etc., which have devastating impacts on human lives, livelihoods, and infrastructure. IMD has released a "Climate Hazard & Vulnerability Atlas of India", helping States and disaster-management agencies identify hotspots and prepare for extreme weather events, which cause extensive damage and economic, human, and animal losses. The same can be accessed at https://imdpune.gov.in/hazardatlas/abouthazard.html.

IMD has launched seven of its services (Current Weather, Nowcast, City Forecast, Rainfall Information, Tourism Forecast, Warnings, and Cyclone) with the 'UMANG' Mobile App for use by the public. Moreover, IMD developed a mobile App, 'MAUSAM' for weather forecasting, 'Meghdoot' for Agromet advisory dissemination, and 'Damini' for lightning alerts. The Common Alert Protocol (CAP), developed by the National Disaster Management Authority (NDMA), is also being implemented to disseminate warnings and alerts by the IMD. Further, a new Central Sector Scheme, Mission Mausam, has been launched by MoES to make the country 'weather-ready and climate-smart'.

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|
| Assam & Meghalaya | 0 | 0 | 0 | 0 | 1 | 0 |
| N m m t | 0 | 0 | 0 | 0 | 0 | 0 |
| Shwb & Sikkim | 0 | 0 | 1 | 15 | 11 | 1 |
| Gangetic West Bengal | 0 | 3 | 8 | 27 | 31 | 4 |
| Odisha | 0 | 3 | 11 | 24 | 37 | 7 |
| Jharkhand | 0 | 0 | 27 | 16 | 23 | 4 |
| Bihar | 0 | 0 | 13 | 29 | 30 | 4 |
| East U.P. | 2 | 0 | 33 | 11 | 33 | 8 |
| West U.P. | 2 | 2 | 28 | 5 | 32 | 5 |
| Uttarakhand | 0 | 0 | 5 | 0 | 10 | 0 |
| Har. Chd & Delhi | 0 | 2 | 37 | 5 | 30 | 11 |
| Punjab | 0 | 0 | 22 | 3 | 27 | 7 |
| Himachal Pradesh | 0 | 2 | 38 | 0 | 18 | 10 |
| Jammu & kashmir & ladakh | 0 | 0 | 19 | 0 | 11 | 13 |
| West Rajasthan | 5 | 6 | 58 | 3 | 29 | 33 |
| East Rajasthan | 0 | 4 | 28 | 0 | 23 | 21 |
| West Madhya Pradesh | 4 | 2 | 42 | 4 | 24 | 7 |
| East Madhya Pradesh | 0 | 0 | 34 | 13 | 26 | 10 |
| Gujarat region | 0 | 0 | 13 | 1 | 14 | 7 |
| Saurashtra & Kutch | 6 | 12 | 25 | 4 | 16 | 15 |
| Konkan & Goa | 0 | 4 | 2 | 6 | 4 | 1 |
| Madhya Maharashtra | 2 | 0 | 2 | 1 | 8 | 1 |
| Marathwada | 3 | 0 | 0 | 0 | 3 | 3 |
| Vidarbha | 0 | 2 | 18 | 11 | 11 | 8 |
| Chhattisgarh | 2 | 0 | 3 | 12 | 13 | 1 |
| Coastal A.P. & Yanam | 0 | 0 | 0 | 22 | 11 | 0 |
| Telangana | 2 | 0 | 0 | 14 | 12 | 1 |
| Rayalaseema | 0 | 0 | 0 | 1 | 16 | 0 |
| Tamil., Pudu. & Karaikal | 0 | 2 | 0 | 1 | 13 | 0 |
| Coastal Karnataka | 0 | 0 | 0 | 2 | 3 | 0 |
| N. I. Karnataka | 0 | 0 | 0 | 0 | 18 | 0 |
| S. I. Karnataka | 0 | 0 | 0 | 0 | 10 | 0 |
| Kerala & Mahe | 0 | 0 | 0 | 0 | 6 | 0 |

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