

**GOVERNMENT OF INDIA  
MINISTRY OF EARTH SCIENCES  
LOK SABHA  
UNSTARRED QUESTION NO. 2468  
TO BE ANSWERED ON WEDNESDAY, 16<sup>TH</sup> MARCH, 2022**

**PREDICTIONS OF HEAVY RAINS**

2468. SHRI MADDILA GURUMOORTHY:  
SHRI KURUVA GORANTLA MADHAV:  
DR. SANJEEV KUMAR SINGARI:  
SHRI P.V. MIDHUN REDDY:  
SHRI ADALA PRABHAKARA REDDY:

Will the Minister of EARTH SCIENCES be pleased to state:

- (a) whether India Meteorological Department(IMD) estimate of monsoon in Andhra Pradesh has been accurate during the current year and if so, the details thereof;
- (b) whether the Government has identified the reasons for heavy rains, if so, the details thereof; and
- (c) whether any scientific advances have been made in regard to making accurate predictions 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) Yes Sir. India Meteorological Department (IMD) issued forecast for south west monsoon seasonal rainfall (1<sup>st</sup> Stage) on 16<sup>th</sup> April 2021 (Figure 1a) and its update was given on 1<sup>st</sup> June 2021 (Figure 1b). The observed rainfall distribution during 2021 Southwest monsoon season is given in Figure 1c. The sub-divisional distribution of Monsoon Seasonal Rainfall 2021 for the country is given in Figure 1d additionally.

From the figures (Figure 1a and Figure 1b), it is found that the above normal monsoon seasonal rainfall was predicted for most parts of Andhra Pradesh.

From the observed rainfall distribution given in Figure 1c, it is found that most parts of Andhra Pradesh received above normal rainfall during 2021 which is further ascertained by the sub-divisional monsoon seasonal rainfall distribution map given in Figure 1d for the year 2021. As per this map, the percentage departure of seasonal rainfall of Andhra Pradesh against the normal is +20 which comes under above normal (excess) category.

- (b) The heavy rains received over South Peninsula and adjacent Central India during the Southwest monsoon season 2021 was mainly associated with passage of Low Pressure Systems during the season. During the 2021 SW monsoon Season, a total number of 13 Low Pressure Systems formed and majority of the systems formed over Bay of Bengal moved west-northwestwards causing intense rainfall activity over Central and Peninsular India.

Number of Low pressure System (LPS) including Low (L), Well Marked Low (WML), Depression (D), Deep Depression (DD), Cyclonic Storm (CS) and number of LPS days in monsoon 2021 are given below :

Systems / Month	Cyclonic-storm¶	Deep Depression	Depression	Well-marked low-pressure area	Low-pressure area
June	0	0	0	0	1
July	0	0	0	1	2
August	0	0	0	0	2
Sept.	1	1	1	2	1

- (c) IMD regularly reviews the operational long range forecasting system to improve it through in house research activities & collaboration with various climate research institutions in the country. The operational statistical models are mainly improved by implementing the latest state of the art statistical forecasting techniques and by using better predictors. Similarly, Ministry of Earth Sciences (MoES) has launched National Monsoon Mission (NMM) with a vision to develop state-of-the-art dynamical prediction system for the monsoon rainfall in different time scales. IMD used Monsoon Mission Climate Forecast System (MMCFS) model for preparing operational forecasts since 2018 monsoon season.

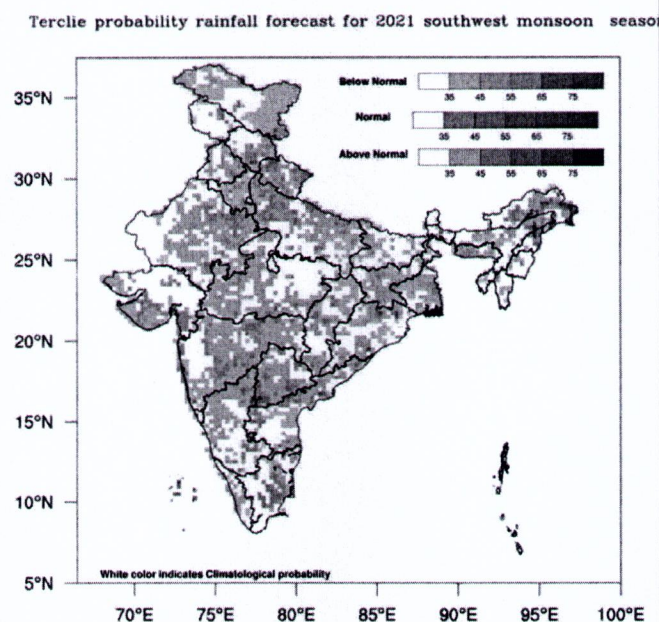
This year, IMD has implemented a new strategy for issuing monthly and seasonal operational forecasts for the southwest monsoon rainfall over the country by modifying the existing two state forecasting strategy. The new strategy uses the existing statistical forecasting system to generate these forecasts along with a newly developed Multi-Model Ensemble (MME) forecasting system based on coupled global climate models (CGCMs) from different global climate prediction and research centers including IMD's Monsoon Mission CFS (MMCFS) model.

IMD is effectively functioning in the country maintaining accurate weather monitoring and forecasting of all the weather based natural disasters. During the past few years, IMD has been continuously improving weather prediction services in terms of accuracy, lead time and associated impact.

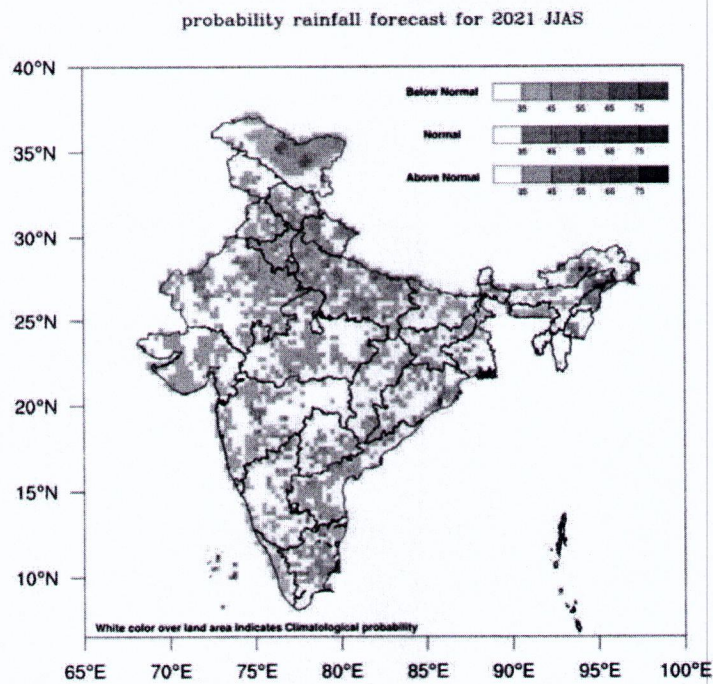
For this purpose, IMD follows a seamless forecasting strategy. The long-range forecasts (for the whole season) issued are being followed with extended range forecast issued on every Thursday with a validity period of four weeks. To follow up the extended range forecast, IMD issues short to medium range forecast and warnings at 36 meteorological sub-divisions levels daily four times valid up to next five days with an outlook for subsequent two days. The short to medium range forecast and warning at district and station level are issued with a validity of next five days and are updated twice a day. The short to medium range forecast is followed by very short range forecast of severe weather up to three hours (nowcast) for all the districts and 1089 cities and towns. These nowcasts are updated every three hours.

IMD started issuing Impact Based Forecast (IBF) recently which give details of what the weather will do rather than what the weather will be. It contains the details of impacts expected from the severe weather elements and guidelines to general public about do's and don'ts while getting exposed to severe weather. These guidelines are finalised in collaboration with National Disaster Management Authority (NDMA) and is already implemented successfully for cyclone, heat wave, thunderstorm and heavy rainfall. Work is in progress to implement the same for other severe weather elements.

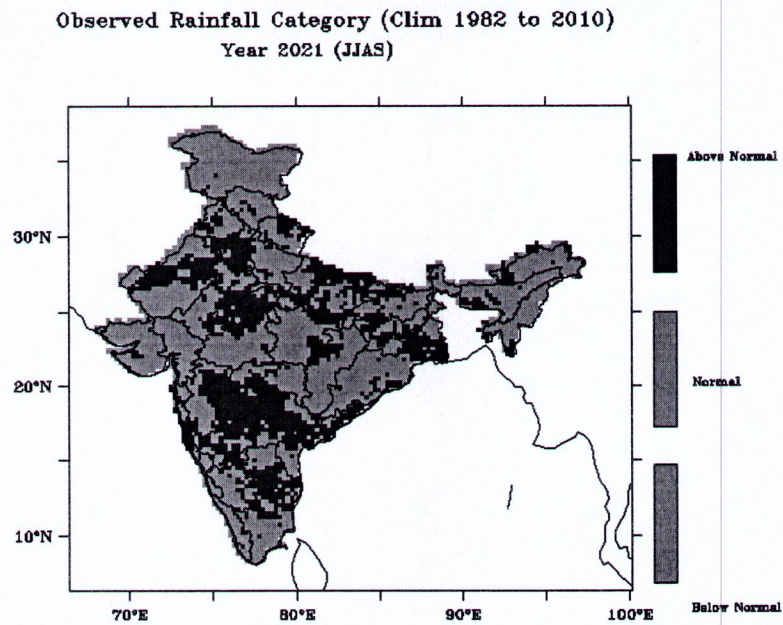
The weather forecast accuracy is verified by IMD and errors and skill scores are calculated seasonwise and annually. The heavy rainfall warning skill for the year 2021 and its comparison with the period 2002-20 are given in the Figure 2. From the figure, it is found that Probability of Detection (POD) for heavy rainfall warning with 24 hr lead period is 74% in 2021, which has improved by 51% in year 2021 as compared to their skill between 2002-20. False Alarm Rate (FAR) and Missing Rate (MR) are 26% in 2021, which has improved by 21% & 53% respectively in year 2021 as compared to their skill between 2002-20.



**Fig 1a.** Probability forecast of tercile categories normal) for the seasonal rainfall over India during the 2021 southwest monsoon season (June-September). The figure illustrates the most likely categories as well as their probabilities. The white shaded areas represent climatological probabilities.



**Fig 1b.** Updated Probability forecast for the seasonal rainfall over India during the 2021 southwest monsoon season (June - September). The figure illustrates the most likely categories as well as their probabilities.



**Fig 1c.** Observed rainfall distribution during 2021 Southwest monsoon (June to September) season expressed as grid point rainfall tercile categories.

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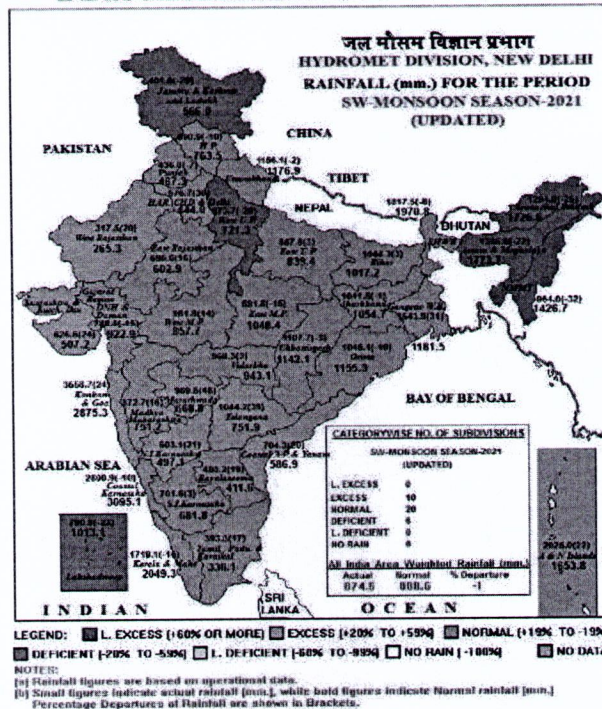


Fig 1d. The sub-divisional distribution of Monsoon Seasonal Rainfall 2021.

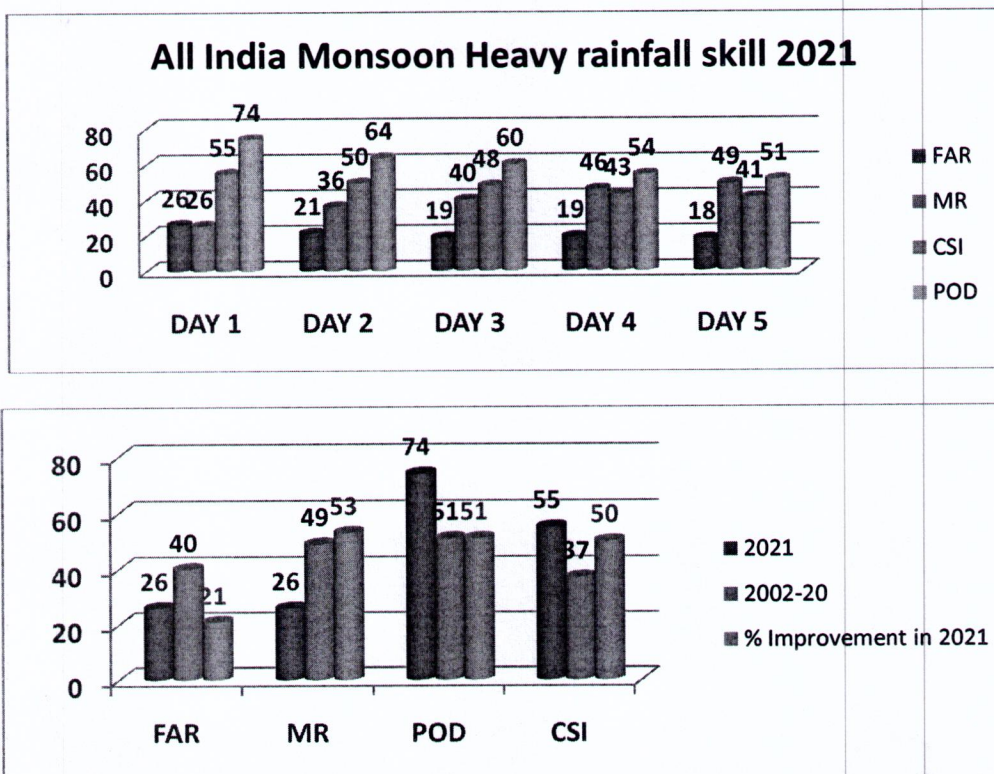


Fig. 2: Heavy rainfall warning skill during 2021(FAR (False Alarm Rate), MR(Missing Rate), PoD (Probability of Detection) and CSI (Critical Success Index).IMD has high skill for heavy rainfall warning upto Day 5 as POD for Day 5 is more than 50%.