



PRESS RELEASE

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INDIA METEOROLOGICAL DEPARTMENT MINISTRY OF EARTH SCIENCES

Long Range Forecast Update for 2011 Southwest Monsoon Rainfall

1. Background

As per the present operational long range forecasting system, India Meteorological Department (IMD) issues the operational long range forecast for nation-wide (country as a whole) southwest monsoon season (June-September) rainfall in two stages. The first stage forecast is issued in April based on data up to March and the second stage or update forecast is issued in June based on data up to May. In the second stage, along with update for the April forecast, forecasts for the monthly rainfall for July & August over the country as a whole and the season rainfall over four geographical regions of the country are also issued. Similarly forecast for the nation-wide rainfall during the second half of the season (August to September) is issued in July and that for the nation-wide rainfall for the month of September is issued in August.

This year, the first stage forecast for the nation-wide season rainfall was issued on 19th April. The summary of the first stage forecast is given below.

“IMD’s long range forecast for the 2011 south-west monsoon season (June to September) is that the rainfall for the country as a whole is most likely to be Normal (96-104% of Long Period Average (LPA)). There is very low probability for season rainfall to be deficient (below 90% of LPA) or excess (above 110% of LPA). Quantitatively, monsoon season rainfall is likely to be 98% of the LPA with a model error of $\pm 5\%$. The LPA of the season rainfall over the country as a whole for the period 1951-2000 is 89 cm.”

2. The Operational Forecasts Issued In June

IMD is now ready with the following forecasts:

- Updated quantitative and probabilistic forecasts for the Southwest Monsoon season rainfall for the country as a whole using a 6-parameter Ensemble Forecasting System.
- Quantitative forecast for the monthly rainfall for July & August over the country as a whole using separate Principal Component Regression Models.
- Quantitative forecasts for the season rainfall for the 4 broad geographical regions of India (NW India, NE India, Central India and South Peninsula)

using separate Multiple Regression Models. The list of states included in each of these four geographical regions is given below.

Northwest India:– Jammu and Kashmir, Himachal Pradesh, Punjab, Rajasthan, Haryana, Chandigarh, Delhi, Uttaranchal and Uttar Pradesh.

Northeast India:– Arunachal Pradesh, Meghalaya, Assam, Nagaland, Manipur, Mizoram, Tripura, Sikkim, West Bengal, Bihar and Jharkhand.

Central India: – Gujarat State, Madhya Pradesh, Chattisgarh, Maharashtra, Goa and Orissa.

South Peninsula:– Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, Lakshadweep and Andaman and Nicobar Islands.

The long period average (LPA) and coefficient of variation of monthly and season rainfall over various regions based on the 1951-2000 data are given below:

Region	LPA (mm)	Coefficient of Variation (%)
Season (June to September) Rainfall		
All India	887.5	10.7
Northwest India	615.0	18.9
Central India	975.5	15.0
Northeast India	1438.3	12.6
South Peninsula	715.5	15.3
Monthly Rainfall		
All India (July)	289.2	12.7
All India (August)	261.3	14.2

3. 6-Parameters Used in the Ensemble Forecasting System

The 6 predictors used in the ensemble forecasting system for the update forecast for the southwest monsoon season (June-September) rainfall over the country as a whole are: North Atlantic Sea Surface Temperature (December + January), Equatorial SE Indian Ocean Sea Surface Temperature (February + March), East Asia Mean Sea Level Pressure (February + March), Central Pacific (Nino 3.4) Sea Surface Temperature Tendency (March to May - December to February), North Atlantic Mean Sea Level Pressure (May) and North Central Pacific Zonal Wind at 850hPa (May).

The 6-parameter ensemble statistical forecasting system was also used to prepare probability forecasts for five pre-defined rainfall categories. These are deficient (less than 90% of LPA), below normal (90-96% of LPA), normal (96-104% of LPA), above normal (104-110% of LPA) and excess (above 110% of LPA). The forecasted probabilities for the 2011 southwest monsoon season based on this

system in percentage for the above 5 categories are 19%, 37%, 37%, 6% and 1% respectively.

4. Experimental Forecasts

An experimental forecast for the 2011 southwest monsoon rainfall was generated using IMD's dynamical ensemble forecast system (Seasonal Forecast model of the Experimental Climate Prediction Centre (ECPC), USA). The ensemble forecast was computed as the ensemble average of 10 member forecasts with forecasted sea surface temperatures (SST) as boundary SST forcing.

In addition, IMD has taken into account the experimental forecasts prepared by the national institutes like Indian Institute of Tropical Meteorology, Pune, Indian Institute of Science, Bangalore, Space Applications Centre, Ahmedabad, National Aerospace Laboratories, Bangalore, Centre for Mathematical Modelling and Computer Simulation, Bangalore, National Centre for Medium Range Weather Forecasting, Noida and Center for Development of Advanced Computing, Pune. Operational/experimental forecasts prepared by international institutes like the National Centers for Environmental Prediction, USA, International Research Institute for Climate and Society, USA, Meteorological Office, UK, the European Center for Medium Range Weather Forecasts, UK, the Experimental Climate Prediction Center, USA, and World Meteorological Organization's Lead Centre for Long Range Forecasting - Multi-Model Ensemble were also taken into account.

The experimental forecasts show large divergence (from deficient to excess rainfall) with dynamical models particularly coupled models indicating normal to excess rainfall.

5. Onset and Advance of Monsoon 2011

This year, setting in of southwest monsoon over Andaman Sea was delayed by about 10 days. However, it set over Kerala 3 days before its normal date of 1st June. Monsoon set in over most parts of South Arabian Sea, Kerala, some parts of Tamil Nadu, south Bay of Bengal and South Andaman Sea on 29th May 2011. Due to strengthening of cross-equatorial flow over Arabian Sea and the northward movement of a vortex in the form of an upper air cyclonic circulation along the trough off the west coast, monsoon further advanced rapidly and covered entire Kerala, Tamil Nadu and Goa, most parts of Karnataka and some parts of south Andhra Pradesh by 5th June. However, during 6th – 10th June, there was a short hiatus in the further advance of monsoon along the west coast. On the other hand, the eastern branch of monsoon advanced over some more parts of Bay of Bengal and northeastern states, with a delay of nearly 5 days. By 13th June, associated with the formation of a Depression over north Bay of Bengal, the monsoon advanced into some more parts of Arabian Sea, parts of Saurashtra and most parts of the Bay of Bengal and parts of coastal Andhra Pradesh and coastal Orissa. On 15th June, monsoon further advanced over some more parts of Maharashtra, most parts of Telangana and Orissa, remaining parts of coastal Andhra Pradesh, Bay of Bengal, West Bengal and some parts of Chhattisgarh, Jharkhand and Bihar.

As on 20th June 2011, the northern limit of monsoon (NLM) passes through 22.0°N/60.0°E, Porbandar, Veraval, Dahanu, Nasik, Adilabad, Nagpur, Jabalpur, Khajuraho, Kanpur, Shahjahanpur, Mukteshwar and 31.0°N/ 80.0°E.

The cumulated seasonal rainfall over the country as a whole during the period 1-20th June is 111% of LPA.

6. Conditions over the equatorial Pacific and Indian Oceans

The moderate to strong La Nina conditions that prevailed in the equatorial Pacific during mid-August 2010 to early February 2011 weakened during subsequent months and dissipated to neutral conditions around mid-May 2011. The latest forecasts from a majority of the dynamical and statistical models indicate strong probability for the present ENSO-neutral conditions to continue during the current monsoon season and the remaining part of 2011.

It is important to note that in addition to El Niño and La Niña events, other factors such as the Indian Ocean Sea surface temperatures (SSTs) have also significant influence on India monsoon. However, the latest forecasts do not suggest development of either a positive or a negative Indian Ocean Dipole event during the 2011 monsoon season. In the absence of strong monsoon forcing from both Pacific and Indian Oceans, intraseasonal variation may become more crucial during this southwest monsoon season and lead to increased uncertainty in the monsoon forecasts.

7. Summary of the Update Forecasts for 2011 Southwest Monsoon Rainfall

i) Southwest Monsoon Season Rainfall

Rainfall over the country as a whole for the 2011 southwest monsoon season (June to September) is most likely to be below normal (90-96% of LPA).

Quantitatively, monsoon season rainfall for the country as a whole is likely to be 95% of the long period average with a model error of $\pm 4\%$. The Long period average rainfall over the country as a whole for the period 1951-2000 is 89 cm.

ii) Monthly (July & August) Rainfall

Rainfall over the country as a whole in the month of July 2011 is likely to be 93% of its LPA and that in the month of August is likely to be 94% of LPA both with a model error of $\pm 9\%$.

iii) Rainfall over Broad Geographical Regions

Over the four broad geographical regions of the country, rainfall for the 2011 Southwest Monsoon Season is likely to be 97% of its LPA over North-West India, 95% of its LPA over North-East India, 95% of its LPA over Central India and 94% of its LPA over South Peninsula, all with a model error of $\pm 8\%$.