

**Earth System Science Organization (ESSO)
Ministry of Earth Sciences (MoES)
INDIA METEOROLOGICAL DEPARTMENT**

**Long Range Forecast
For the 2014 Southwest Monsoon Season Rainfall**

1. Background

ESSO-India Meteorological Department (IMD) issues various monthly and seasonal operational forecasts for rainfall during the southwest monsoon season. Operational models are critically reviewed regularly and further improved through in-house research activities. Operational forecasts for the southwest monsoon season (June – September) rainfall are issued in two stages. The first stage forecast is issued in April and the second stage forecast is issued in June.

The ESSO-IMD's Ensemble Statistical Forecasting system for the April forecast uses the following 5 predictors.

S. No	Predictor	Period
1	The Sea Surface Temperature (SST) Gradient between North Atlantic and North Pacific	December + January
2	Equatorial South Indian Ocean SST	February + March
3	East Asia Mean Sea Level Pressure	February + March
4	Northwest Europe Land Surface Air Temperature	January
5	Equatorial Pacific Warm Water Volume	February + March

2. Sea Surface Temperature (SST) Conditions in the equatorial Pacific & Indian Oceans

The ENSO conditions in the equatorial Pacific continues to be neutral. However, the sub surface temperatures in the tropical Pacific have warmed to the levels generally observed prior to an El Nino event. Latest forecast from a majority of the models also indicate warming trend in the sea surface temperatures over the equatorial Pacific reaching to El Nino level during the southwest monsoon season with a probability of around 60%.

In addition to the ENSO conditions over Pacific, other factors such as the Indian Ocean SSTs have also some influence on Indian monsoon. Currently near neutral Indian Ocean Dipole (IOD) conditions are prevailing over equatorial Indian Ocean. Based on the recent forecasts from some coupled models, it is expected that neutral IOD conditions are likely to continue till the end of southwest monsoon season. As the extreme sea surface temperature conditions over Pacific and Indian Oceans particularly ENSO conditions over Pacific (El Nino or La Nina) are known to have strong influence on the Indian summer monsoon, IMD is carefully monitoring the sea surface conditions over Pacific and Indian oceans.

3. Experimental Coupled Dynamical Model Forecasting System

3.1. Monsoon Mission Model

The ESSO-Indian Institute of Tropical Meteorology (IITM), Pune is coordinating and working along with different climate research centers from India and abroad on the development of a coupled model for the forecasting of Indian summer monsoon rainfall under ESSO's Monsoon Mission project. The latest high resolution research version of the Coupled Forecasting System (CFS) originally developed by the National Centers for Environmental Prediction (NCEP), USA has been implemented at the ESSO-IITM. This model was used to generate the experimental update forecast for the 2014 southwest Monsoon season rainfall using the February initial conditions. The model has moderate skill.

The experimental forecast based on the coupled dynamical model forecasting system suggest that the monsoon rainfall during the 2014 monsoon season (June to September) averaged over the country as a whole is likely to be 96% \pm 5% of long period model average (LPMA). The experimental five category probability forecasts for the 2014 monsoon season rainfall over the country as a whole using the experimental dynamical prediction system are 33% (deficient), 20% (below normal), 24% (normal), 6% (above normal) and 17% (excess).

3.2. ESSO-IMD Seasonal Forecast Model (SFM)

Since 2004, IMD has been generating experimental dynamical ensemble forecast for the southwest monsoon rainfall using the seasonal forecast model (SFM) of the Experimental Climate Prediction Center (ECPC), USA. The global sea surface temperature (SST) forecasts from NCEP coupled forecasting system (CFS) version 2 model was used as boundary forcing for the SFM model. The model show moderate skill. For computing the ensemble forecast, ten ensemble member forecasts were generated using the initial conditions of first 10 days of April, 2014.

The experimental ensemble forecast based on IMD SFM indicates that the rainfall during the 2014 monsoon season (June to September) averaged over the country as a whole is likely to be 88% \pm 5% of long period average (LPA).

4. Summary of the ESSO-IMD's Operational long range Forecast for the 2014 Southwest monsoon rainfall

(a) Quantitatively, the monsoon seasonal rainfall is likely to be 95% of the Long Period Average (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.

(b) The 5 category probability forecasts for the Seasonal (June to September) rainfall over the country as a whole is given below:

Category	Rainfall Range (% of LPA)	Forecast Probability (%)	Climatological Probability (%)
Deficient	< 90	23	16
Below Normal	90 - 96	33	17
Normal	96 - 104	35	33
Above Normal	104 - 110	8	16
Excess	> 110	1	17

ESSO-IMD will issue the update forecasts in June, 2014 as a part of the second stage forecast. Along with the update forecast, separate forecasts for the monthly (July and August) rainfall over the country as a whole and seasonal (June-September) rainfall over the four geographical regions of India will also be issued.