

# North Atlantic Ocean a visible contributor to Indian summer monsoon rainfall

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## ABSTRACT

Moisture feeding from North Atlantic Ocean saves summer monsoon rainfall over India also during El-Nino, El Nino-Southern Oscillation (ENSO) and Indian Ocean Dipole neutral conditions if cyclonic circulation/flow is observed along North African coast having minimum latitudinal width of 5° south of 25°N during south west monsoon season. Southern Hemisphere Zonal Westerlies Activity Index (SHZWAI), which had been prepared on the basis of (i) combination of High and Low located along 40°S between 40°W-120°E at 850 hPa geo-potential height or vector wind anomaly fields, (ii) a continuous negative anomaly (Low) from 40°S-30°N along 90°E, (iii) a region of negative anomalies lying to the north of positive anomalies (High) along 40°S, (iv) a continuous High from 80°W-150°W or 120°W-170°E, (v) a continuous Low from 80°W-150°W or 120°W-170°E, and (vi) Cyclonic circulation/trough over Arabian Sea in the anomaly of 850 hPa vector wind observed during April-May of the ensuing monsoon year, has been modified for the quantitative forecast of All India Monsoon Rainfall. By considering cyclonic flow and anti cyclonic flow along North African coast up to 25°N over the North Atlantic Ocean during April-May for the period of 50 years (1948-1997), a methodology has been developed for modifying the quantitative forecast of All India Monsoon Rainfall with modified Southern Hemisphere Zonal Westerlies Activity Index. Reanalysed NCEP/NCAR (National Centres for Environmental Prediction/National Centre for Atmospheric Research) data of geo-potential height, vector wind fields and relative humidity at 850 hPa geo-potential height and Sea Surface Temperature of North Atlantic Ocean up to 20°N for the period 1948-2025, have been used in the study. It has been shown that composite anomaly field of vector wind/relative humidity at 850 hPa level for the period April-May from the region bounded by 60°W-100°E and equator to 30°N, are helpful in identifying the conditions that are related to inter-annual variability in All India Monsoon Rainfall.

**Key words:** Southwest monsoon, North Atlantic Ocean, West coast of North Africa, Vector wind anomaly, Quantitative forecast, Cyclonic flow

## INTRODUCTION

Popularity of Long Range Forecast for southwest monsoon rainfall is increasing day by day as people from all walks of life know that a normal rainfall is the life line of our country. As ground water is depleting gradually, deficient rainfall in any parts of our country, creates biggest problem in availability of drinking water not only in cities and towns but also in villages besides affecting agriculture produce and general health of the people due to rise in temperature. Kumar and Satya Kumar (2021) had prepared real time long range forecast of All India Monsoon Rainfall. During 2024 southwest monsoon season, La-Nina conditions were expected from August-September months, but this did not happen till the month of December 2024. Average Sea Surface Temperature for Nino 3.4 was observed as -0.4°C for the combined months of October-November-December (NOAA, 2025). El Nino-Southern Oscillation (ENSO) neutral conditions are present and so was the condition of Indian Ocean Dipole. Even then monsoon rainfall for the monsoon season 2024 (June to September) over the country was recorded as 108% (above normal) of the Long Period Average. During EL-Nino years 1953 (109.9%), 1957 (97.6%), 1958 (109.8%) and 1997 (102.2%) normal/above normal rainfall had been recorded and during La Nina years 1974 (88%) and 1985 (92.9%) deficient and below normal rainfall had been recorded respectively (E-Mausam).

The observed analysis revealed that despite the presence of the same climate drivers, El- Nino and positive Indian Ocean Dipole, in 1997 and 2015, 1997 was a normal monsoon year, whereas 2015 was a below normal monsoon year (86.0%) for the Indian region (Ratna et al., 2024). There are years in which dipole mode events coincide with the strong ENSO events as in 1972 or 1997 (Saji et al., 1999). 1972 was a deficient monsoon year. Attempts have been made to look out for an atmospheric condition, which may further improve the real time Long Range Forecast of All India Monsoon Rainfall prepared by Kumar and Satya Kumar (2021). They had shown that composite anomaly field of geo-potential height/vector wind at 850/700 hPa level for the period April-May from the region bounded by 40°W-140°E/80°W-150°W-170°E and 40°S-30°N, are helpful in identifying the circulation features that are related to inter-annual variability in All India Monsoon Rainfall. The features identified were: (i) a pair of positive and negative anomalies along 40°S latitude, (ii) continuous negative anomalies from 40°S to 30°N, (iii) region of negative anomalies lying to the north of positive anomalies along 40°S, (vi) cyclonic circulation/trough over Arabian Sea, and (v) positive/negative anomalies between 80°W-150°W-170°E/40°S. The semi-permanent subtropical anticyclone over North Atlantic Ocean basin, commonly referred as the “Azores” or the “Bermuda High”, has a major influence on the weather and climate over the eastern United States,