

Decoding the Early Monsoon

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Decoding the Early Monsoon: Atmospheric and Oceanic Influences in 2025

Context

The southwest monsoon is crucial for India, as it accounts for over 70% of the country's annual rainfall and sustains its agriculture-dependent economy. Its timely onset and progression affect Kharif crop production, water availability, and the overall economic outlook. The India Meteorological Department (IMD) officially declared the onset of the 2025 southwest monsoon over Kerala on May 24, which is eight days earlier than the normal date of June 1. This early onset signals the beginning of the June-September monsoon season.

Monsoon Onset Declaration: Criteria and Procedure

The IMD uses specific meteorological parameters to declare the onset of the southwest monsoon, typically after May 10 each year.

Key Criteria for Onset

1. Rainfall Criterion

At least 60% of 14 designated stations in southern India (e.g., Thiruvananthapuram, Kochi, Mangaluru) must report ≥2.5 mm rainfall for two consecutive days.

2. Wind Field Condition

• Dominance of **westerly winds** up to the **600 hPa pressure level**.

 $\circ\,$ Wind speed at $925\ hPa$ should be between $15\text{--}20\ knots$ (27-37 km/h).

3. Outgoing Longwave Radiation (OLR)

 $\circ~$ OLR values should be $below~200~W/m^2,$ indicating high cloud cover and active convection.

4. Final Declaration

• IMD declares monsoon onset on the second day after all conditions are fulfilled.



This widespread coverage highlights a strong and early start to the season.

Why Did Monsoon Arrive Early in 2025?

The early onset was influenced by **favourable oceanic and atmospheric conditions**:

1. Low-Pressure Systems and Trough Formation

• A low-pressure area over the Arabian Sea and a trough over Vidarbha enhanced moisture inflow and triggered strong convection, hastening monsoon arrival.

- 2. Madden-Julian Oscillation (MJO)
 - MJO is an **eastward-moving ocean-atmosphere phenomenon**.
 - Involves disturbances in clouds, winds, and pressure.
 - Travels around the globe in **30-60 days** at **4-8 m/s**.
 - In a favourable phase, it enhances monsoon rainfall over India.
- **3. Mascarene High**
 - A high-pressure zone near the Mascarene Islands (south Indian Ocean).
 - Affects the strength of monsoon winds, especially over India's west coast.
 - Strong Mascarene High results in heavier rainfall in coastal areas.
- 4. Increased Convective Activity
 - Vertical movement of heat and moisture in the atmosphere enhances rainfall potential.
 - Example: A convective system over Haryana moved to Delhi, causing rainfall.
- 5. Somali Jet Stream
 - A cross-equatorial low-level jet originating near Mauritius and Madagascar.
 - Strengthens by May, reaching India's west coast via the Arabian Sea.
 - Plays a vital role in enhancing monsoon winds and moisture transport.
- 6. Heat Low and Moisture Suction Effect
 - A heat low develops over Pakistan and northwest India due to summer heating.
 - Acts as a **suction pump**, drawing in **moist air** from the Arabian Sea.

- Intensifies rainfall over central and northern India.
- 7. Monsoon Trough Dynamics
 - The monsoon trough is an elongated low-pressure area from northwest India to north Bay of Bengal.

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- Its oscillating position governs rainfall distribution across the monsoon zone.
- 8. Monsoon Onset Vortex
 - A cyclonic system in the southeastern Arabian Sea.
 - Triggers initial burst of monsoon over Kerala and nearby regions.