

## EARLY MONSOON ONSET IN INDIA: GEOGRAPHY

**NEWS:** How the Madden-Julian Oscillation helped trigger the early onset of the monsoon

### WHAT'S IN THE NEWS?

The Southwest Monsoon arrived early over Kerala on May 24, 2025—eight days ahead of schedule—due to factors like active MJO, strong Somali Jet, reduced Himalayan snow, and warmer sea surface temperatures. While it benefits agriculture and water resources, early onset can cause planning disruptions and climate variability concerns.

### Southwest Monsoon 2025: Early Onset Over Kerala

- **Date of Onset:** May 24, 2025 – **8 days ahead** of the normal onset date of **June 1**
- **Significance:** This was the **earliest monsoon onset since 2009**
- **Declared By:** Indian Meteorological Department (IMD)
- **Seasonal Forecast:** IMD predicted **106% of Long Period Average (LPA)** – indicating **above-normal monsoon rainfall**

### Understanding Monsoon Onset

- **Definition:** The **onset of monsoon** is declared when **southwest winds**, increased humidity, **rainfall thresholds**, and cloud formations are observed over **Kerala**.
- **Northern Limit of Monsoon (NLM):** An **imaginary line** that tracks monsoon progression across India.

### Climatic and Meteorological Factors Behind the Early Onset

#### 1. Active Madden-Julian Oscillation (MJO)

- MJO was in **Phase 4** with amplitude  $>1$
- Enhanced **convection and cloud formation** in Indian Ocean
- Played a critical role in advancing the monsoon front

#### 2. Strong Somali Jet and Cross-Equatorial Flow

- High-speed **moisture-laden winds** from southern hemisphere
- Entered **Arabian Sea**, intensifying monsoon currents

#### 3. Pre-Monsoon Heat Low Over Arabian Region

- Low-pressure over **Pakistan** and surrounding areas
- Acted as a **suction pump** for monsoon moisture

#### 4. Enhanced Mascarene High

- High-pressure system over **southwest Indian Ocean** (Mascarene Islands)
- Strengthened **southwesterly monsoon winds**

## 5. Reduced Himalayan Snow Cover

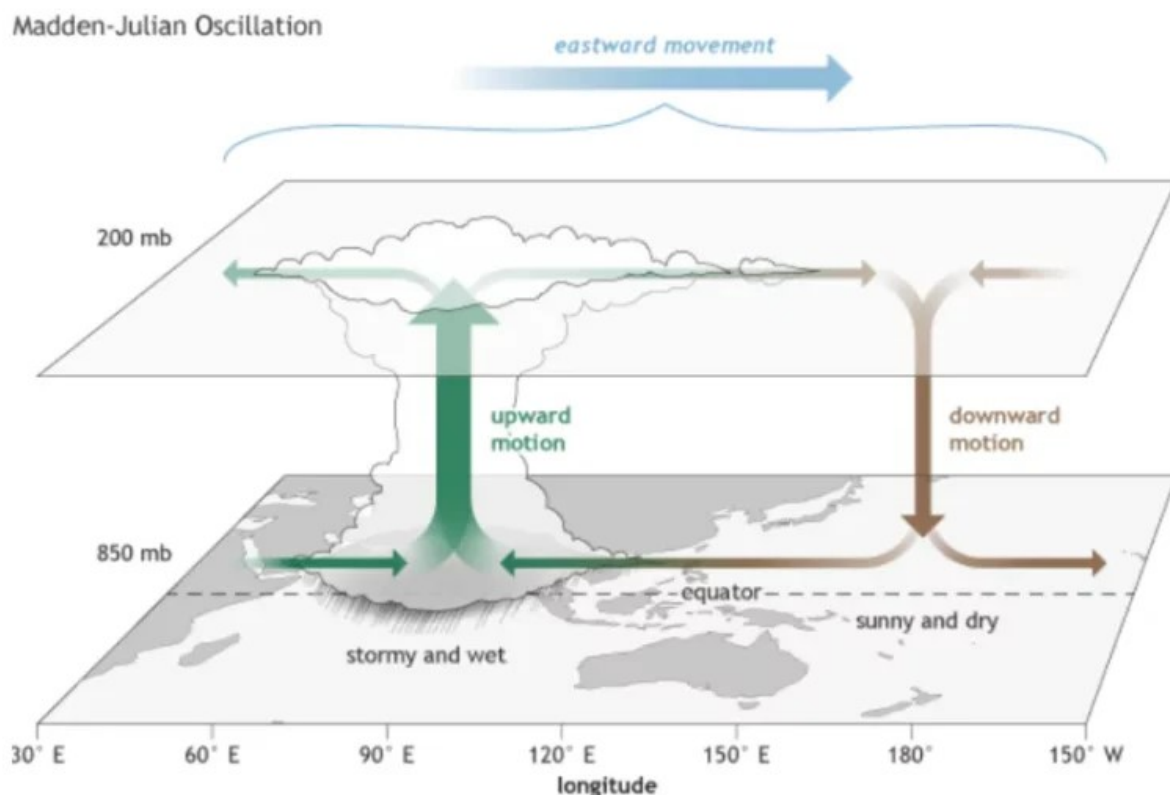
- Warmer subcontinent due to **low snow** in March–April
- Boosted **land-sea thermal contrast**, aiding low-pressure formation

## 6. Neutral ENSO and IOD Conditions

- Neither **El Niño** nor **La Niña** present – **stable monsoon environment**
- IOD (Indian Ocean Dipole) remained **neutral**, allowing regular monsoon patterns

## 7. Warmer Sea Surface Temperatures (SSTs)

- SSTs in the **Arabian Sea and Bay of Bengal** were above normal
- **Enhanced latent heat** release increased rainfall intensity



## Geophysical Phenomena Linked to Monsoon Formation

### 1. Inter-Tropical Convergence Zone (ITCZ)

- Moves northwards in summer over **Ganga plains**
- Forms **monsoon trough** aiding rainfall over core monsoon zone

## 2. Tibetan Plateau Heating

- Causes **strong vertical air currents**
- Generates **high-altitude low pressure** pulling in monsoon winds

## 3. Jet Streams

- **Westerly Jet Stream** moves north of Himalayas in summer
- **Tropical Easterly Jet Stream** dominates Indian peninsula during monsoon

## 4. Southern Oscillation (SO)

- Reversal of pressure between **Tahiti and Darwin**
- Linked to monsoon strength and variability

## Climate Change Influence on Early Monsoon

- **Accelerated Land Heating:** Intensifies **low pressure** over India
- **Declining Snow Cover:** Speeds up **subcontinental heating**
- **Rising SSTs:** Boosts **convection and early cloud band formation**
- **Frequent MJO Events:** Linked to **warming oceans**, influencing intra-seasonal rainfall
- **Stronger Jet Streams:** Altered wind patterns favor **early monsoon onset**

## Impacts of Early Monsoon Onset

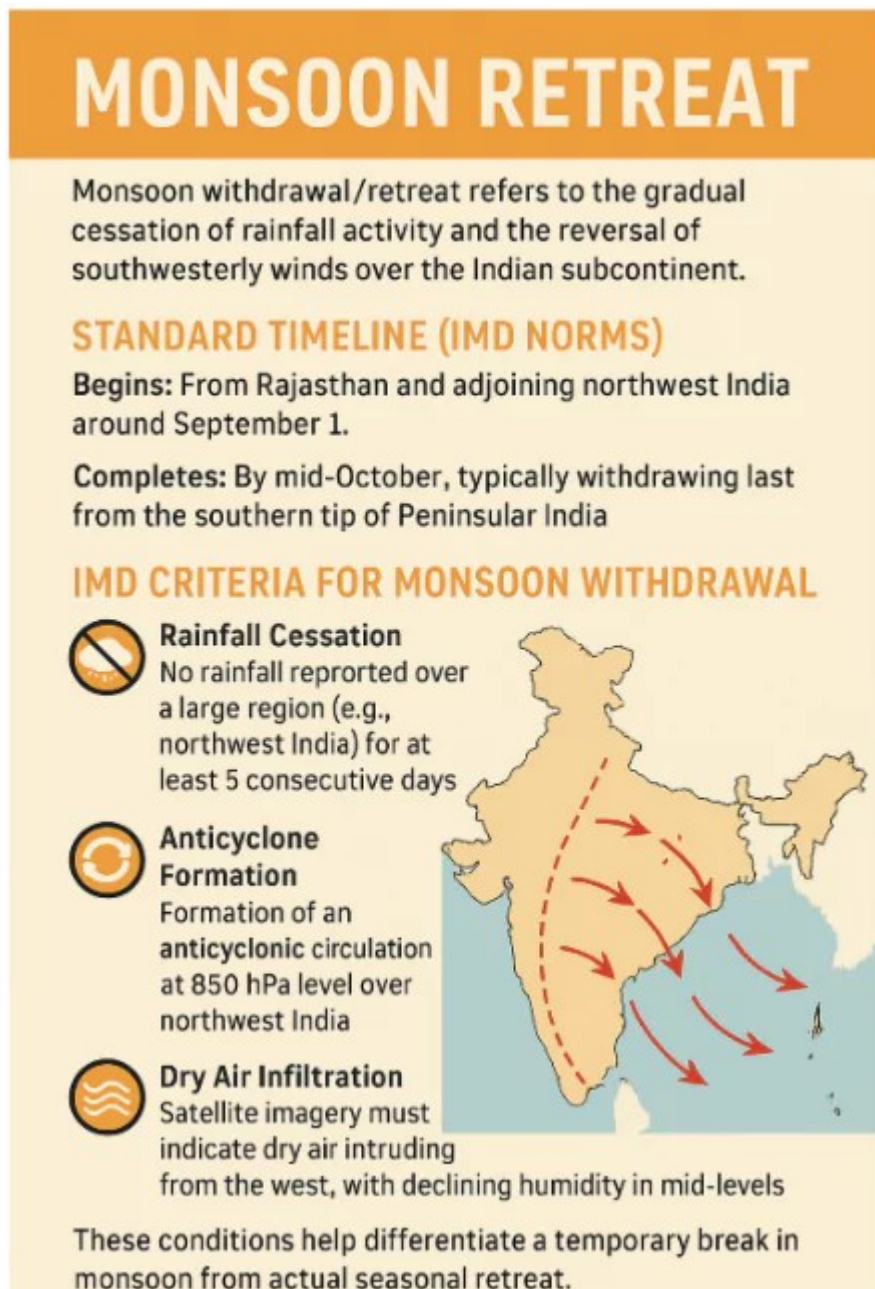
### Positive Impacts:

- **Timely Sowing:** Supports early planting of **Kharif crops** (rice, pulses, cotton)
- **Groundwater Recharge:** Improves **soil moisture** and **irrigation readiness**
- **Heatwave Relief:** Lowers **temperature extremes** and power demand
- **Reservoir Filling:** Early rains help **hydropower generation** and **water storage**

### Negative Impacts:

- **Agronomic Mismatch:** Early sowing followed by a **rainfall break** may damage crops
- **Flood Risk:** Sudden heavy rain over **dry soil** causes **flash floods**
- **Planning Challenges:** Complicates **agricultural advisories** and **dam operations**

- **Cultural Disruption:** Mismatches **traditional sowing calendars** in rural areas



## Technological Tools Supporting Monsoon Forecasting

### 1. Satellites

- **INSAT-3D/3DR, Megha-Tropiques** for real-time **cloud, rainfall, wind** monitoring

### 2. Ocean Observations

- **Argo Floats:** Measure ocean **temperature and salinity**
- **OMNI Buoys:** Real-time monitoring of **currents, temperature, conductivity**

- **Moored Buoys:** Provide **navigation and meteorological data**

### 3. Doppler Weather Radars (DWRs)

- Track **cyclones, thunderstorms, and rainfall bands**
- IMD operates **37+ radars** across the country

### 4. Supercomputers

- **Mihir (6.8 PFLOPS)** and **Pratyush (4 PFLOPS)** simulate monsoon models
- Used for **real-time monsoon forecasting and seasonal analysis**

## Government Initiatives for Monsoon Management

### 1. National Monsoon Mission (NMM)

- Launched in **2012** by the **Ministry of Earth Sciences (MoES)**
- Develops **dynamical models** for short-, medium-, and long-term monsoon prediction

### 2. Mission Mausam (2025)

- Aims to **upgrade weather prediction infrastructure**
- Focuses on **extreme weather preparedness and climate adaptation**

### 3. Farmer-Centric Schemes

- **PM Fasal Bima Yojana (PMFBY):** Crop insurance for **weather-related damage**
- **PM Krishi Sinchayee Yojana (PMKSY):** Enhances **irrigation access**
- **PM-KISAN:** Income support for small farmers

### 4. Water & Disaster Management

- **NDMA & SDRF:** Handle **floods and cyclone emergencies**
- **Jal Shakti Abhiyan & Atal Bhujal Yojana:** Promote **groundwater recharge and efficient use**

## Conclusion

The early arrival of the **2025 Southwest Monsoon**, driven by a combination of **favorable oceanic, atmospheric, and climatic conditions**, marks both a scientific challenge and a policy opportunity. With **climate change intensifying variability**, India's preparedness through **advanced forecasting, resilient agriculture, and inter-sectoral coordination** is crucial for ensuring sustainable development and disaster resilience.

Source: <https://indianexpress.com/article/explained/explained-climate/this-word-means-madden-julian-oscillation-10032866/>