INDIA'S 2025 MONSOON FORCAST: GEOGRAPHY

NEWS: El Niño or La Niña? Anomalous temperature pattern keeps confusion alive

WHAT'S IN THE NEWS?

India is facing uncertainty about the 2025 monsoon forecast due to unusual shifts in Sea Surface Temperature patterns and mixed predictions for El Niño or La Niña. The unpredictability poses challenges for agriculture, water management, and disaster preparedness, emphasizing the need for accurate climate forecasting.

India's 2025 Summer Monsoon Forecast and Climate Concerns

- **Importance of the Monsoon Forecast for 2025**:

  - **India's economy and agricultural sector** heavily depend on the **summer monsoon**, as it supplies around **70% of the annual rainfall**, crucial for **irrigation** and **water supply** in many regions. The **2025 monsoon forecast** is especially important because it will determine the amount of rainfall for agriculture, affecting the yields of **crops like rice, wheat, and pulses** that are vital for food security.

  - The forecast for **2025** is also crucial for government planning and policymaking related to **water management**, **disaster preparedness**, and **economic growth**. It also raises concerns regarding the possibility of either an **El Niño** or **La Niña** year, as both climatic phenomena influence **rainfall distribution** across the country and have profound implications for agriculture.

Unexpected Sea Surface Temperature (SST) Patterns:

- The **Sea Surface Temperature (SST)** patterns in the **tropical Pacific Ocean** have been evolving unusually since **early 2024**, showing significant deviations from typical trends observed in previous years. SST is a critical factor influencing the **El Niño-Southern Oscillation (ENSO)** phenomenon, which governs the climate conditions in large parts of the world, including India.

- **El Niño** is typically associated with **deficient monsoon rainfall** in India, which can lead to **droughts** and poor agricultural output. On the other hand, **La Niña** is often linked with **above-average rainfall** in India, beneficial for agriculture and water resources.

- Initially, the climate models predicted a **strong La Niña** event for late **2024**, which would have been expected to bring **abundant rainfall**. However, SST anomalies began shifting in an unexpected direction, further complicating the predictions for 2025. Instead of cooling in the far eastern Pacific, which is characteristic of **La Niña**, **warm SST anomalies** appeared in the region, while **cold SST anomalies** shifted westward, deviating from the typical **El Niño** or **La Niña** patterns.

Role of Climate Variability in ENSO Transition:

- The shift in SST patterns in early 2024 could be partly explained by the influence of **ENSO Transition Mode (ETM)**, a **natural climate variability factor**. The **ETM** refers to the natural climatic fluctuations in the Pacific Ocean, which can influence the development and intensity of **El Niño** and **La Niña** events.

- The presence of **ETM** might have **prevented La Niña** from emerging in 2024, even though earlier predictions suggested a strong La Niña event. This shift is indicative of the increasing complexity of global weather systems, as multiple climate factors now interact in unpredictable ways, making it harder to forecast ENSO transitions accurately.

Uncertain Climate Predictions for 2025:

- **Climate models** for **2025** remain mixed and uncertain, with varying predictions for the year's monsoon conditions:

    - Some models predict the formation of **La Niña**, suggesting a **favorable monsoon** with **above-average rainfall**.

    - Others predict a **neutral ENSO year**, meaning the monsoon may neither be overly wet nor dry, leading to **uncertain** outcomes for agricultural productivity.

    - A few models suggest the possibility of a **strong El Niño** in 2025, which could lead to **deficient monsoon rainfall**, potentially resulting in drought conditions, particularly in **central and northern India**.

- The **2023 monsoon** was **normal** despite the presence of a **strong El Niño** because the **Indian Ocean Dipole (IOD)** played a **mitigating role**. The IOD, a sea surface temperature anomaly in the Indian Ocean, can either amplify or dampen the effects of ENSO on the Indian monsoon. In 2023, a positive IOD helped **offset** the typical negative impacts of El Niño, allowing for a more **balanced monsoon**.

Challenges in Forecasting and Climate Change Impact:

- Over the past few decades, the **relationship between ENSO** and the **Indian monsoon** has changed, making it more difficult to predict the monsoon's behavior accurately. **Climate change** has added a layer of unpredictability to this relationship, as **record-high global temperatures** have altered the dynamics of both **oceanic and atmospheric patterns** that influence rainfall.

- Climate models are increasingly struggling to account for **mid-latitude climate changes**, such as shifts in the **jet stream** and alterations in **ocean currents**, which further complicate the forecasting of monsoon timing, intensity, and distribution.

- **Pre-monsoon cyclones**, which have been occurring with increasing frequency, are another factor influencing the **onset and progression** of the monsoon season. These

cyclones can disrupt the normal monsoon flow, delay its arrival, or result in sudden, intense rainfall bursts.
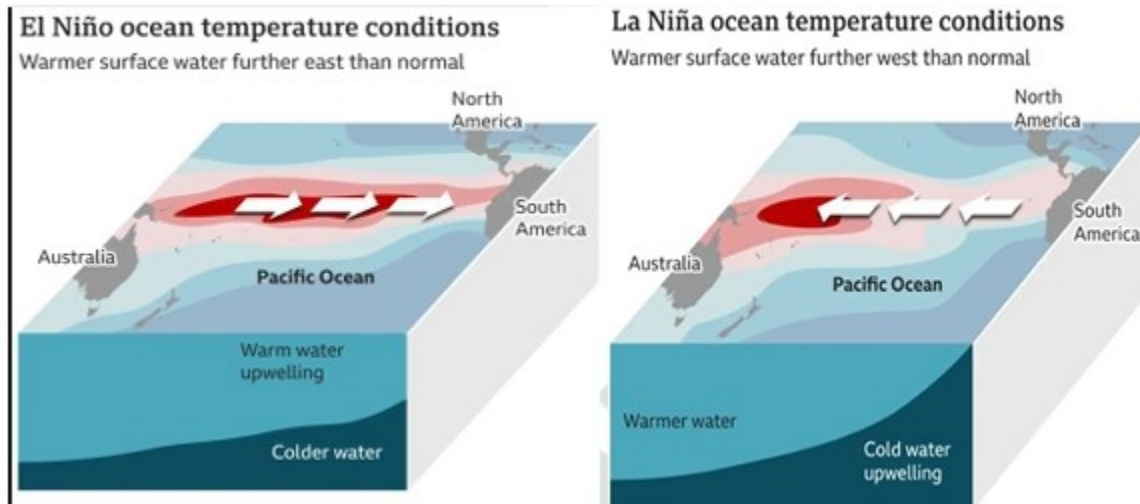
Implications for India:

- Farmers in India, who rely heavily on the **monsoon** for irrigation, face significant uncertainty regarding their **crop yields** due to unpredictable weather patterns. The lack of certainty around the **2025 monsoon** forecast could hinder farmers' ability to plan, affecting crop production and food security.

- The **State and Union governments** depend on accurate **monsoon forecasts** to manage **water resources**, plan for **droughts** or **floods**, and provide assistance to affected populations. Inaccurate predictions could lead to inadequate preparedness, exacerbating the impact of extreme weather events.

- **Climate scientists** and the **India Meteorological Department (IMD)** are working to improve the **reliability** and **accuracy** of monsoon forecasts, using advanced technologies like **satellite data**, **climate models**, and **historical data** to predict future climate events with greater precision.

- Early **heat waves** in **2025** have already raised concerns about extreme weather patterns. Such heat waves can significantly affect **agriculture**, public health, and **energy consumption**, making it all the more important to have accurate climate predictions to anticipate and mitigate their effects.

Conclusion:

- The uncertainty surrounding the **2025 monsoon** forecast and the possibility of either **El Niño** or **La Niña** events presents significant challenges for **India's agriculture**, **water management**, and **economic planning**. The increasing **complexity** of climate systems, exacerbated by **climate change**, makes it more difficult to predict monsoon patterns with certainty.

- Reliable forecasts are critical for **farmers** to manage crop production, for governments to plan **water resource management**, and for disaster preparedness. Improved forecasting methods will be key to minimizing the adverse impacts of extreme weather events and ensuring **food security** and **sustainable development** in the face of climate uncertainties.

El Niño: El Niño is a climate phenomenon characterized by the warming of Sea Surface Temperatures (SST) in the central and eastern tropical Pacific Ocean. This warming disrupts normal weather patterns, often leading to **droughts** in some regions and **heavy rainfall** in others, including **India's monsoon**, which is typically affected by a weakened or delayed monsoon.

La Niña: La Niña is the opposite of El Niño, marked by the cooling of Sea Surface Temperatures in the central and eastern tropical Pacific Ocean. This cooling leads to the strengthening of the **trade winds**, resulting in **above-average rainfall** in parts of Asia and **Australia**, while India often experiences a **stronger monsoon**.

ENSO (El Niño-Southern Oscillation): ENSO is a climate pattern that refers to the cyclical warming (El Niño) and cooling (La Niña) of Sea Surface Temperatures in the tropical Pacific Ocean, along with atmospheric changes. ENSO influences global weather patterns, including **precipitation**, **temperature**, and **storm activity**.

Indian Ocean Dipole (IOD): The **Indian Ocean Dipole** is a climate phenomenon that involves the difference in Sea Surface Temperatures between the **western** and **eastern** parts of the Indian Ocean. A positive IOD occurs when the western Indian Ocean is warmer than the eastern part, leading to enhanced rainfall over **India** and **East Africa**. A negative IOD leads to **drought** conditions in **India** and can suppress the monsoon.

Source: https://www.thehindu.com/sci-tech/energy-and-environment/el-nino-or-la-nina-anomalous-sea-surface-temperature-patterns-confusion/article69337873.ece