El Niño & Drought

Why in News

In a recent study by **Indian Institute of Science's** (IISc) **Centre for Atmospheric and Oceanic Sciences** (CAOS), it has been found that **El Niño** was **not the only cause for droughts** during the Summer **Monsoon** in the Indian Subcontinent.

- **El Niño** is a recurring climate event during which **abnormally warm equatorial Pacific waters pull moisture-laden clouds** away from the **Indian subcontinent.**
- It is the usual **suspect** for **failing Indian summer monsoons** between **June and September.**

Key Points

- **Findings of the Study:**
  - 43% of the droughts that occurred during the Indian summer monsoon season in the past century may have been driven by **atmospheric disturbances** from the **North Atlantic region.**
    - These **droughts** that India faced occurred during years **when El Niño was absent.**
- **Cause of these Drought:**
  - Sudden and steep drop in rainfall in late August that was linked to an **atmospheric disturbance in the mid-latitude region over the North Atlantic Ocean,** creating a **pattern of atmospheric currents** that move over the indian subcontinent and **"derail" the monsoon.**

- **Change in Drought Pattern:**
  - **El Niño year drought:**

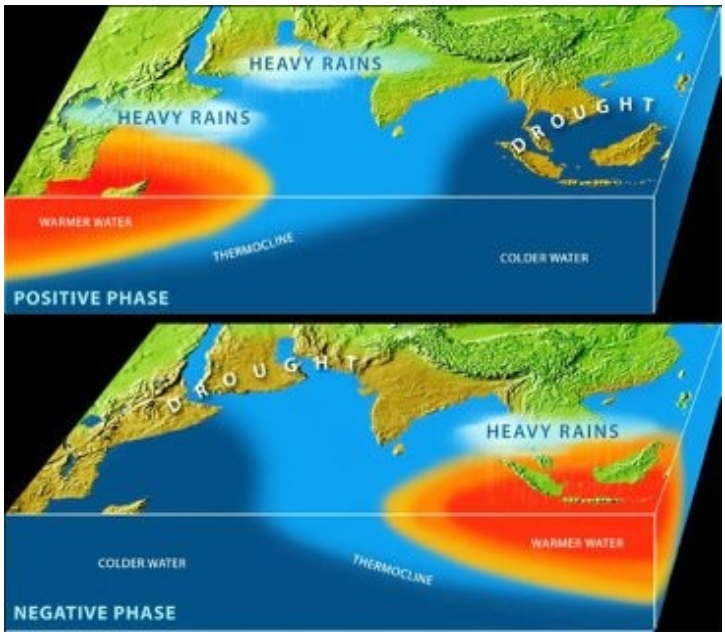
    The **rainfall deficit** begins **mid-June** and spreads throughout the country.
  - **Normal year Drought Condition:**
    - There is normal rainfall during the monsoon season but a **sudden and steep decline was observed in August.**
    - **Causes for this August decline:**
      - An unusual **atmospheric disturbance** in the **mid-latitudes**

        The middle latitudes are spatial regions on Earth **located between the latitudes 23° and 66° north.**
      - The disturbance emerges from **winds in the upper atmosphere** interacting with a **cyclonic circulation** above abnormally **cold North Atlantic waters.**

        The resulting wave of air currents, called **a Rossby wave, moves from the North Atlantic** towards the **Tibetan plateau** and **hits the Indian subcontinent** around **mid-August, suppressing rainfall and causing drought-like conditions.**

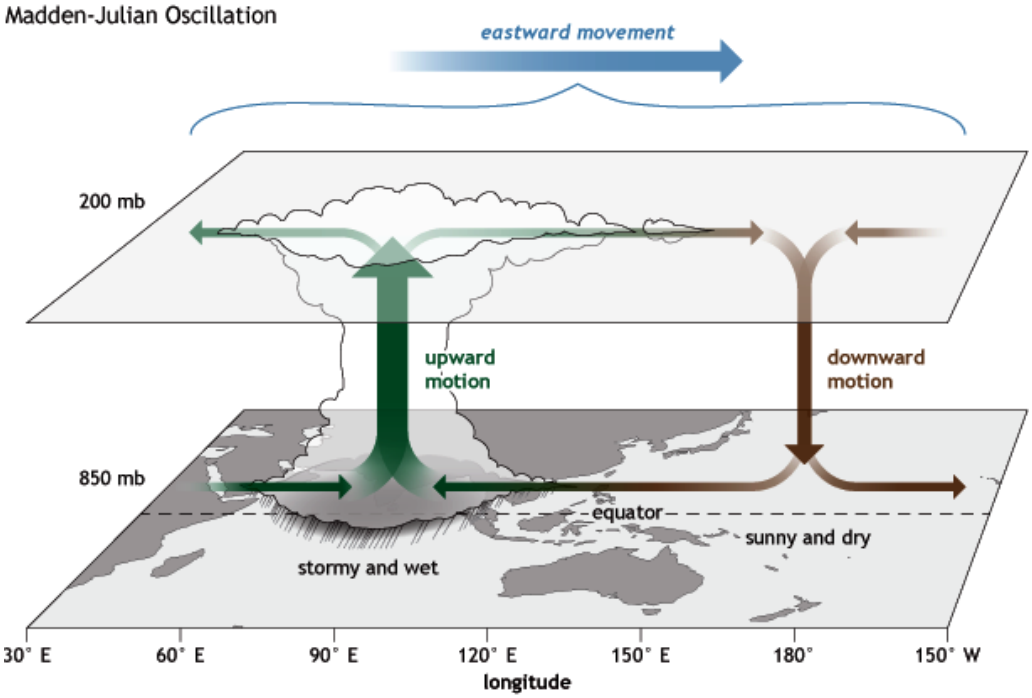
Other Atmospheric Circulations that Impact Monsoon

- **Indian Ocean Dipole:**
  - The Indian Ocean Dipole (IOD) is defined by the **difference in sea surface temperature between two areas** (or poles, hence a dipole) – a western pole in the **Arabian Sea** (western Indian Ocean) and an **eastern pole** in the eastern Indian Ocean **south of Indonesia.**
  - IOD develops in the equatorial region of Indian Ocean **from April to May** peaking in October.
  - With a **positive IOD** winds over the Indian Ocean blow from east to west (from Bay of Bengal towards Arabian Sea). This results in the **Arabian Sea** (western Indian Ocean near African Coast) being much **warmer and eastern Indian Ocean around Indonesia becoming colder and dry.**
  - In the **negative dipole** year (negative IOD), **reverse happens** making Indonesia much warmer and rainier.



  - **Indian Ocean Dipole effect:**
    - It was demonstrated that a **positive IOD index** often negated the effect of El Nino, resulting in increased Monsoon rains in several El Nino years like the 1983, 1994 and 1997.
    - Two poles of the IOD – the **eastern pole** (around Indonesia) and the **western pole** (off the African coast) were independently and cumulatively affecting the quantity of rains for the Monsoon in the Indian subcontinent.
  - Impact of IOD on **Cyclogenesis** in Northern Indian Ocean:
    - Positive IOD (Arabian Sea warmer than Bay of Bengal) results in **more cyclones than usual in Arabian Sea.**
    - Negative IOD results in **stronger than usual <u>Tropical Cyclones</u>** in the Bay of Bengal. Cyclonic activity in Arabian Sea is **suppressed.**

- **Madden-Julian Oscillation, or MJO**
  - The Madden–Julian Oscillation (MJO), is an eastward **moving band of rain clouds** that travels around the globe spanning 12,000–20,000 km across the tropical oceans returning to its initial starting point in 30 to 60 days.
  - In its journey, it interacts with **surface waters** of the Indo-Pacific ocean, the **largest pool of warm water in the globe.**



  - The MJO consists of two parts, or phases: one is the **enhanced rainfall** (or convective) phase and the other is the **suppressed rainfall phase.**
  - Strong MJO activity often **dissects the planet into halves:**

    One half within the **enhanced convective phase** and the other half in **the suppressed convective phase.** These two phases produce opposite changes in clouds and rainfall and this entire dipole propagates eastward.
- **Effects of MJO on global weather phenomenon:**
  - It can modulate the **timing and strength of monsoons.**
  - It **Influences tropical cyclone** numbers and strength in nearly all ocean basins.
  - It can result in **jet stream changes** that can lead to cold air outbreaks, extreme heat events, and flooding rains over the United States and North America.

Source:TOI