## WESTERN DISTURBANCE: GEOGRAPHY

**NEWS:** Storm in Delhi, floods in hill states: Impact of climate change-induced changing patterns of Western Disturbances

## WHAT'S IN THE NEWS?

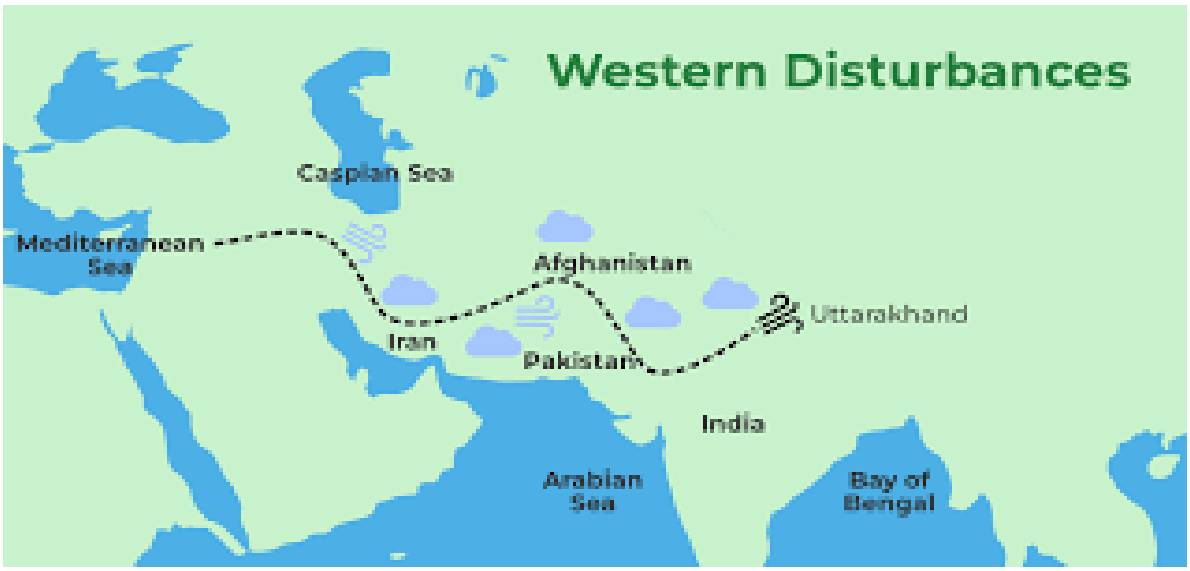
Western Disturbances, once limited to winter, are now more frequent and intense due to climate change, bringing unseasonal rain, floods, and disruptions to agriculture and monsoon patterns. Their shifting behavior highlights the urgent need for climate-adaptive planning and disaster preparedness in India.

### Context: Recent Impact of Western Disturbances (WDs) in India

- In **March–April 2025**, Delhi and surrounding regions experienced **heavy rainfall and strong winds** due to a **Western Disturbance**.
- The event caused **flight disruptions**, **waterlogging**, and extreme weather conditions.
- **Himachal Pradesh, Uttarakhand, and Jammu & Kashmir** faced **flash floods and landslides** during intense WDs.
- Experts link this rising intensity and frequency of WDs to **climate change and global warming**.

### What are Western Disturbances?

- **Definition**: WDs are **extra-tropical low-pressure weather systems** originating in the **Mediterranean region**.
- **Movement**: Carried eastward by the **Subtropical Westerly Jet Stream (SWJ)** towards the **Indian subcontinent**.
- **Seasonality**: Traditionally active during **winter months (Dec–Feb)** but now increasingly seen in **spring and early summer**.
- **Moisture Content**: Unlike monsoons, WDs carry **moisture in the upper troposphere**.
- **Impact Zone**: Affect **northwest India** and the **western Himalayan region**.




**Significance and Impact of Western Disturbances**

**1. Weather and Climate Regulation**

- Bring **winter rain to northwestern India**, especially Punjab, Haryana, Delhi, and western UP.
- Trigger **cold waves, fog, and sudden temperature drops** during winter.
- Increasingly cause **unseasonal extreme weather events** beyond winter months.

**2. Agricultural Importance**

- Vital for the **rabi crop cycle**, especially for **wheat**, by maintaining soil moisture and temperature.
- Provide **pre-sowing rainfall** and **reduce irrigation dependence**.
- However, **excessive or unseasonal rains** due to intense WDs can **damage standing crops**, delay sowing, and affect yield.

**3. Hailstorms and Crop Loss**

- Strong WDs can bring **hailstorms**, damaging orchards, vegetables, and delicate flowering crops.
- Affect states like **Himachal Pradesh, Maharashtra, and Punjab**.

**4. Glacier and River System Maintenance**

- WD-induced snowfall feeds **Himalayan glaciers**, helping maintain **perennial flow in rivers** like the **Ganga, Yamuna, and Indus** during dry seasons.

**5. Groundwater and Water Storage**

- Snowmelt and rainfall from WDs **recharge groundwater**, **fill reservoirs**, and support **irrigation systems**.
- Intense events, however, lead to **floods, landslides**, and **urban drainage stress**.

**Changing Patterns of Western Disturbances**

**1. Seasonal Shift**

- WDs are now active in **pre-monsoon months** — **May, June, July**, beyond their traditional winter occurrence.

**2. Geographical Expansion**

- Their impact has spread from **northwest Himalayas** to include **central and eastern Himalayan regions**.

**3. Increase in Intensity and Frequency**

- WDs are now more **intense, widespread, and erratic**, contributing to **extreme rainfall and flooding**.

**4. Interference with Monsoon Patterns**

- Their pre-monsoon presence **delays monsoon onset** and **distorts agricultural calendars**.

**Factors Behind Changing Western Disturbance Patterns**

**1. Global Warming**

- Rising temperatures have **intensified jet streams**, making WDs **stronger and more persistent**.

**2. Arabian Sea Warming**

- **Sea Surface Temperatures (SSTs)** in the Arabian Sea have increased by **1.2–1.4°C**.
- This adds **more moisture** to WDs, enhancing rainfall and extending their seasonal activity.

**3. Enhanced Jet Stream Activity**

- A **stronger upper atmosphere** and broader **jet stream** enable WDs to **travel further** and **linger longer**.

**4. Shifting Tracks**

- Traditional west-to-east movement is now **more meridional** (north-south), increasing **unpredictability**.

**5. Delayed Jet Stream Retreat**

- Slow retreat of SWJ leads to **overlap between WDs and monsoon**, heightening risks of **weather extremes**.

**6. Continuous Moisture Supply**

- WDs now draw moisture from **Mediterranean, Caspian, and Arabian Seas**, making them **active year-round**.

**Western Disturbances vs Southwest Monsoon (Comparison Table)**

| Aspect | Western Disturbances | Southwest Monsoon |
|---|---|---|
| **Definition** | Extra-tropical low-pressure systems | Tropical seasonal wind system |
| **Origin** | Mediterranean region | Indian Ocean differential heating |
| **Season** | Winter (Dec–Feb); now pre-monsoon too | Summer (June–Sept); retreat in Oct–Nov |
| **System Type** | Mid-latitude low-pressure | Tropical monsoon system |
| **Moisture Source** | Mediterranean, Caspian Sea, Arabian Sea | Indian Ocean and Bay of Bengal |
| **Main Impact Area** | Northwest India, western Himalayas | Pan-India: central, coastal, and northeast India |
| **Phenomena** | Snowfall, rain, fog, cold waves, hailstorms | Heavy rainfall, floods, soil erosion |
| **Key Influences** | Subtropical Westerly Jet Stream (SWJ) | ITCZ, SSTs, Tibetan heating, Jet Streams |

**Conclusion**

- **Western Disturbances are crucial for India's winter ecology and agriculture**, but their **increasing intensity, frequency, and unpredictability** signal **climate change impacts**.
- Their interference with **monsoonal patterns**, **cropping cycles**, and **disaster risks** calls for urgent **scientific monitoring and policy adaptation**.
- India must invest in:
    - **Early warning systems**,
    - **Climate-resilient cropping**,
    - **Integrated water and flood management**,
    - **Inter-agency cooperation** for mitigation and response.

**Source:** **https://indianexpress.com/article/explained/explained-climate/climate-change-western-disturbances-9979222/**