

Climate of India

India experiences a tropical monsoon climate, largely influenced by the monsoon winds. The country's geographical features and relief patterns significantly affect its climate, resulting in diverse weather conditions across different regions. Generally, India has hot summers and dry winters, typical of a tropical monsoon climate.

The Role of the Himalayas

The Himalayas play a critical role in shaping India's climate by protecting northern India from the cold winds of Central Asia. Without this barrier, the Indian plains would experience harsh, freezing winters. Additionally, the presence of the Himalayas gives northern India a continental climate characterized by hot summers, cold winters, and minimal rainfall.

Regional Climate Variations

Given India's vast size and geographic diversity, there are significant regional climate variations:

- **Temperature:** In June, Barmer (Rajasthan) can reach 48–50°C, while Pahalgam (Kashmir) enjoys a mild 22°C.
- **Humidity:** Kerala has a tropical climate with warm, moist air, while Punjab experiences extremes of heat in summer and severe cold in winter.
- **Winter Temperatures:** Kerala's winter temperatures range between 20–22°C, while Kargil can drop below –40°C.
- **Day-Night Temperature Difference:** The diurnal range is small in Kerala (7–8°C) but high in the Thar Desert, with differences of 25–30°C.
- **Precipitation:** Rainfall varies widely, from the heavy 1,100 cm received by Mawsynram and Cherrapunji (Meghalaya) to the scant 9 cm in Jaisalmer (Rajasthan).
- **Monsoon Patterns:** Most regions receive rainfall from June to September, while Tamil Nadu's coastal areas experience winter rains.

Key Factors Affecting India's Climate

1. The Himalayas

- Protect northern India from cold winds.
- Trap rain-bearing winds, causing rainfall in northern plains.
- Central Asia remains dry as it lies in the rain shadow region of the Himalayas.

2. Monsoon Winds

- **Southwest Monsoon (June–September):** Brings rain to most parts of India.
- **Northeast Monsoon (October–December):** Causes rainfall in Tamil Nadu.

3. Latitude

- The Tropic of Cancer divides India into two zones: the northern temperate zone and the southern tropical zone.
- Northern India experiences extreme weather, while the southern region remains warm throughout the year.

4. Relief Features

- Areas on the windward side of the Western Ghats receive heavy rainfall, while the leeward side remains dry.
- The Aravalli Range fails to block monsoon winds, making Rajasthan arid.
- Hills in southern Assam cause heavy rainfall in the region.

5. Altitude

- Temperature decreases with elevation (1°C for every 166 m rise).
- Hill stations like Ooty are cooler than nearby plains.

6. Surrounding Seas

- Coastal regions enjoy moderate maritime climates due to proximity to the sea.

7. Western Disturbances

- These bring winter rain and snowfall to parts of northern India.

8. Distance from the Sea

- Interior regions experience extreme temperatures due to the absence of a moderating maritime influence.

Mechanism of the Monsoons

Monsoons result from the differential heating of land and sea, leading to distinct summer and winter wind patterns.

Summer Monsoon

- During summer, the land heats quickly, creating a low-pressure zone, while the surrounding sea remains cooler.



- Winds move from high-pressure areas over the sea to low-pressure areas over land, bringing rain.
- Known as the **southwest monsoon**, these winds dominate from June to September.

Winter Monsoon

- In winter, the land cools while the sea remains warm, reversing the pressure zones.
- Winds blow from land to sea, resulting in dry weather, except in Tamil Nadu, where they bring rainfall after picking up moisture from the Bay of Bengal.
- These winds are known as **northeast monsoon winds**.

Rainfall Patterns

- Most rainfall occurs between July and September.
- Orographic rainfall dominates, with windward regions receiving heavy rain and leeward areas remaining dry.
- Rainfall distribution is uneven, causing both floods and droughts in different regions.

Seasonal Climate in India

India's climate is divided into four distinct seasons:

1. Hot Dry Summer (March–May)

- Temperatures peak in northwestern India, reaching up to 48°C.
- South India experiences milder summers due to the sea's moderating influence.
- **Loo winds**—hot, dry winds—blow across northern India.
- **Kalbaisakhi thunderstorms** in West Bengal and **mango showers** in Kerala and Karnataka help with early crop ripening.

2. Southwest Monsoon (June–September)

- Low-pressure systems attract moisture-laden winds from the Indian Ocean.
- Rainfall is accompanied by thunder and lightning.
- The monsoon divides into two branches:
 - **Arabian Sea Branch:** Causes heavy rainfall on the windward side of the Western Ghats.
 - **Bay of Bengal Branch:** Brings rain to northeastern India, including Mawsynram and Cherrapunji.

3. Retreating Monsoon (October–November)

- The monsoon winds withdraw, causing clear skies and rising temperatures (October heat).

- Cyclonic depressions in the Bay of Bengal bring rain to Tamil Nadu and Andhra Pradesh.

4. Cold Season (December–February)

- Northern India experiences cold weather, while southern India remains warmer.
- Western disturbances bring occasional rain to the north.
- Temperatures vary significantly, with Thiruvananthapuram at 31°C and Varanasi at 16°C.

Distribution of Rainfall

Heavy Rainfall (Above 200 cm)

- Western Ghats slopes, Meghalaya Hills, southern slopes of the Eastern Himalayas, and parts of West Bengal.

Moderate Rainfall (100–200 cm)

- Middle Ganga Valley, southern Tamil Nadu, northern Andhra Pradesh, and parts of Maharashtra and Odisha.

Low Rainfall (50–100 cm)

- Deccan Plateau regions, eastern Rajasthan, Punjab, Haryana, and Kashmir.

Scanty Rainfall (Below 50 cm)

- Western Rajasthan, southern Punjab, and the northern parts of Kashmir.

Conclusion

Several factors, including geography, altitude, and the influence of monsoon winds shape India's diverse climate. Understanding these patterns is crucial for the country's agriculture, water management, and disaster preparedness.