STM JOURNALS

International Journal of
Climate Conditions

ISSN: 3049-3323
Volume 3, Issue 1, 2026
January–June
DOI (Journal): 10.37591/IJCC

https://journals.stmjournals.com/ijcc

Review IJCC

India's Changing Skies: Unravelling the Rise of Unpredictable Weather Extremes

Pranvi Sharma*

Abstract

India is currently experiencing a significant transformation in its climate system, characterized by rising temperatures, irregular rainfall patterns, and an increasing frequency of extreme weather events. These changes are no longer gradual or isolated but are becoming more visible and impactful across different regions of the country. This study provides a detailed examination of long-term climatic trends in India by analysing temperature variations, monsoon behaviour, and the growing occurrence of extreme events such as heatwaves, floods, and cyclones, with a focus on recent developments up to 2025–2026. The findings indicate that India's climate is shifting from a relatively stable and predictable system to one marked by uncertainty and variability. One of the most notable changes is the rapid increase in temperatures, including a rise in night-time temperatures, which has serious implications for human health and energy consumption. Heatwaves are becoming more intense, frequent, and widespread, while new forms of climate stress, such as combined heat and humidity conditions, are emerging as major risks. At the same time, the monsoon system, which is crucial for India's agriculture and water resources, is becoming increasingly erratic. Rainfall is now more concentrated in short periods, leading to floods, while long dry spells contribute to drought-like conditions. Oceanic factors, such as warming sea temperatures and marine heatwaves, are further influencing these patterns and adding to the complexity of climate behaviour. The study also highlights the wide-ranging socio-economic impacts of these changes, particularly on agriculture, water security, public health, and livelihoods. Vulnerable populations, including farmers and urban poor communities, are facing the greatest challenges. The paper emphasizes that climate change in India has become a continuous and systemic issue, requiring immediate attention. It concludes by stressing the importance of sustainable development, climate-resilient infrastructure, and effective policy measures to reduce risks and build long-term resilience.

Keywords: Climate change, heatwaves, monsoon variability, extreme weather events, urbanization, climate adaptation, India climate trend

INTRODUCTION

India has long been known for its diverse yet relatively stable climate system, largely governed by seasonal cycles and the southwest monsoon. For decades, this predictability has supported agricultural planning, water resource management, and overall economic stability. Farmers have relied on timely rainfall for crop production, while governments and institutions have planned development activities based on expected weather patterns. However, in recent years, this stability has begun to weaken, giving way to increasing uncertainty and variability [1].

The country is now witnessing noticeable changes in its climate behaviour. Seasonal transitions that were once gradual are becoming

***Author for Correspondence**
Pranvi Sharma
E-mail: pranvisharma2101@gmail.com

[1]LLB Student, Department of Law, DELHI METROPOLITAN EDUCATION, NOIDA, Uttar Pradesh, India

Received Date: April 23, 2026
Acceptance Date: May 06, 2026
Published Date: May 06, 2026

Citation: Pranvi Sharma. India's Changing Skies: Unravelling the Rise of Unpredictable Weather Extremes. International Journal of Climate Conditions. 2026; 3(1): 11–18p.

abrupt, with summers arriving earlier and lasting longer, while winters are becoming shorter and less intense. Transitional seasons such as spring and autumn are shrinking, making it difficult to clearly distinguish between different climatic phases. These changes are not just minor variations but indicate a deeper shift in the functioning of India's climate system [2].

One of the most concerning developments is the rise in extreme weather events. Heatwaves, heavy rainfall, floods, cyclones, and lightning strikes are occurring more frequently and affecting larger areas than before. What were once considered rare or unusual events are now becoming more common, sometimes occurring multiple times within a single season. Reports suggest that in recent years, extreme weather conditions have been recorded on a majority of days across different parts of India, highlighting a shift toward continuous climate stress [3].

These changes are being driven by a combination of global and local factors. At the global level, climate change caused by greenhouse gas emissions is altering atmospheric and oceanic systems. At the national and regional levels, factors such as rapid urbanization, deforestation, land-use changes, and environmental degradation are further intensifying the problem. Cities are becoming hotter due to reduced green cover, while natural ecosystems that once helped regulate climate are being weakened [4].

The consequences of these changes are far-reaching. Agriculture is becoming more uncertain, water resources are under pressure, and public health risks are increasing. Economic losses due to climate-related disasters are also rising, affecting both infrastructure and livelihoods. Vulnerable groups, including farmers, daily wage workers, and low-income urban populations, are particularly at risk due to limited access to resources and adaptive capacity.

In this context, it becomes essential to study and understand the changing weather patterns in India. This paper aims to analyze the key trends, identify the underlying causes, and assess the impacts of these changes. By doing so, it seeks to provide insights that can help in developing effective strategies for adaptation and resilience in the face of a rapidly changing climate [5].

RISING TEMPERATURES AND INTENSIFYING HEATWAVES

Long-Term Temperature Trends

India has experienced a statistically significant increase in surface temperatures over the past four decades, consistent with broader global warming trends. Observational datasets indicate a steady rise in both mean and maximum temperatures, with the rate of warming accelerating in recent years [6].

The year 2025 ranked among the warmest years on record in India, with temperature anomalies observed across multiple regions. Notably, there has been a pronounced increase in night-time temperatures, which has critical implications for human health, as it reduces the body's ability to recover from daytime heat stress.(Figure-1)

Long-term projections suggest that:

- The frequency of warm days and nights will increase substantially
- Cold extremes will continue to decline
- Seasonal temperature variability will intensify

These changes are indicative of a systemic shift in India's thermal regime.

Intensification of Heatwaves

Heatwaves have emerged as one of the most significant manifestations of climate change in India.[7] Their characteristics have evolved in several key ways:

- *Increased frequency:* A growing number of regions are experiencing heatwave conditions annually
- *Extended duration:* Heatwaves are lasting longer than in previous decades
- *Expanded geographic coverage:* Areas previously unaffected are now experiencing extreme heat

Recent projections indicate that the number of heatwave days could double by 2030, with further increases expected under high-emission scenarios. This trend is particularly concerning for densely populated regions, where exposure levels are high.(Figure-2)

Emergence of Compound and "Non-Survivable" Heat Events

A critical recent development is the rise of compound heat events, where high temperatures coincide with elevated humidity levels. These conditions significantly increase the wet-bulb temperature, a key indicator of human heat tolerance [8].

Scientific studies published in 2026 suggest that certain regions may approach or exceed thresholds considered dangerous for human survival during extreme events. Such conditions:

- Limit the body's ability to cool through perspiration
- Increase the risk of heatstroke and mortality
- Pose severe challenges to outdoor labour and urban living

These developments underscore the urgent need for adaptive measures in public health and urban planning.

Public Health Implications

The public health consequences of rising temperatures are profound:

- Increased incidence of heat-related illnesses
- Higher mortality rates during extreme heat events
- Reduced labor productivity, particularly in outdoor sectors

A significant proportion of Indian districts are now classified as high-risk zones for heat exposure. Future projections indicate a substantial increase in heat-related mortality, especially in urban centers characterized by high population density and limited green cover [9].

MONSOON VARIABILITY AND RAINFALL EXTREMES

Changing Dynamics of the Monsoon

The Indian monsoon system is undergoing significant changes in both its temporal and spatial characteristics. While total annual rainfall may not show a consistent declining trend, its distribution has become increasingly erratic.

Key observed changes include:

- Reduction in the number of rainy days
- Increase in rainfall intensity per event
- Greater variability in onset and withdrawal dates

These changes have disrupted traditional agricultural calendars and increased the risk of both floods and droughts.

Spatial and Temporal Variability

Rainfall patterns across India are becoming increasingly heterogeneous:

- Some regions are experiencing intense, short-duration rainfall events.

- Others are witnessing prolonged dry spells.

This variability has led to the coexistence of floods and droughts within the same season, often in geographically proximate areas. Such patterns reflect a breakdown in the coherence of large-scale monsoon systems.

Influence of Oceanic Processes

The warming of the Indian Ocean has emerged as a critical factor influencing monsoon behaviour. Marine heatwaves in the Arabian Sea and Bay of Bengal are:

- Enhancing atmospheric moisture content
- Intensifying precipitation events
- Influencing cyclone formation and trajectories

These ocean-atmosphere interactions are contributing to increased unpredictability in monsoon dynamics.

Declining Predictability and Forecast Challenges

The increasing variability of weather systems has reduced the predictability of the monsoon:

- Forecast accuracy is declining at local scales
- Lead times for extreme event warnings are shortening

Additionally, global climatic phenomena such as El Niño are exerting stronger and more complex influences on Indian rainfall patterns. Recent forecasts suggest the possibility of a weaker monsoon in 2026, highlighting the continued uncertainty in seasonal predictions.

ESCALATION OF EXTREME WEATHER EVENTS

Increasing Frequency and Intensity

India has witnessed a substantial rise in the frequency and intensity of extreme weather events, including:

- Heatwaves
- Floods
- Cyclones
- Lightning event

Recent data indicate that extreme weather events are occurring with unprecedented regularity, affecting large parts of the country throughout the year.

Localization and Fragmentation of Events

A notable feature of recent extreme weather events is their increasing localization. Unlike earlier large-scale events, current extremes are often:

- Highly localized
- Short-lived but intense
- Difficult to predict using conventional models

This fragmentation complicates disaster management efforts and increases vulnerability at the community level.

Regional Climate Hotspots

Certain regions are emerging as particularly vulnerable:

- *Himalayan region:* Glacial melt, landslides, flash floods
- *Western Ghats:* Extreme rainfall and ecological sensitivity
- *Coastal areas:* Cyclones and sea-level rise

These hotspots are characterized by high ecological value and significant human dependence, amplifying the risks associated with climate change.

Intensification of Cyclonic Activity

Recent trends indicate:

- Increased cyclone intensity
- Shifts in cyclone formation zones
- Greater unpredictability in cyclone paths

The Arabian Sea, in particular, has shown a rise in cyclone activity, attributed to rising sea surface temperatures.

DRIVERS OF CHANGING WEATHER PATTERNS

Anthropogenic Climate Change

The primary driver of observed changes is the increase in greenhouse gas concentrations, leading to:

- Global warming
- Altered atmospheric circulation
- Increased energy in the climate system

Ocean–Atmosphere Coupling

Interactions between oceanic and atmospheric systems are playing an increasingly important role in shaping weather patterns, particularly in relation to monsoon variability and extreme rainfall events.

Urbanization and Land Use Change

Rapid urban expansion has:

- Increased surface temperatures
- Reduced natural vegetation
- Altered local climatic conditions

The urban heat island effect exacerbates heat stress in cities.

Environmental Degradation

Deforestation, wetland loss, and biodiversity decline have weakened natural climate regulation mechanisms, contributing to increased climatic instability [10].

SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACTS

Agriculture

Climate variability is significantly affecting agricultural productivity:

- Disruption of sowing and harvesting cycles
- Increased crop failure rates
- Greater dependence on irrigation

Water Resources

- Irregular rainfall patterns are impacting water availability:
- Reduced groundwater recharge
- Increased water scarcity in certain regions
- Greater variability in river flows

Public Health

Climate change is emerging as a major public health challenge:

- Heat-related illnesses and mortality
- Spread of vector-borne diseases
- Increased stress on healthcare systems

Economic Impacts

Extreme weather events are imposing significant economic costs:

- Infrastructure damage
- Loss of productivity
- Increased disaster management expenditure

India is among the countries most affected by climate-related economic losses.

Social Vulnerability and Inequality

The impacts of climate change are unevenly distributed:

- Marginalized communities are disproportionately affected
- Rural populations face higher vulnerability
- Urban poor are exposed to heat and flooding risks

EMERGENCY TRENDS IN INDIA'S CLIMATE SYSTEM

Recent research highlights several emerging trends:

- *Shrinking transitional seasons:* Spring and autumn are becoming shorter, with abrupt seasonal shifts.
- *Rise of compound events:* Simultaneous occurrence of multiple hazards (e.g., heat + humidity).
- *Continuous climate exposure:* Extreme weather events are occurring throughout the year.
- *Regional divergence:* Different regions are experiencing distinct climate impacts, increasing complexity in policy responses.(Figure-3)

RESPONSES AND ADAPTATION STRATEGIES

Strengthening Forecasting Systems

- Use of advanced climate models
- Integration of AI and data analytics

Climate-Resilient Agriculture

- Adoption of resilient crop varieties
- Improved irrigation practices

Sustainable Urban Planning

- Expansion of green spaces
- Heat action plans
- Climate-sensitive infrastructure

Disaster Risk Reduction

- Early warning systems
- Community-based adaptation

DATA VISUALISATION AND COMPARATIVE STUDY

Temperature Rise in India (1980–2025)

Description

The graph below illustrates the steady increase in temperature anomaly (°C) in India over the past four decades.

Interpretation

- Temperature has increased by approximately 1.0–1.1°C since 1980
- The rate of warming has accelerated after 2000
- Indicates strong alignment with global warming trends

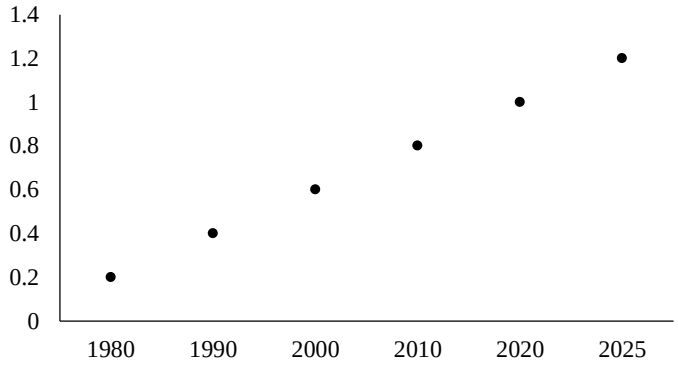

Figure 1. Temperature Anomaly (°C).

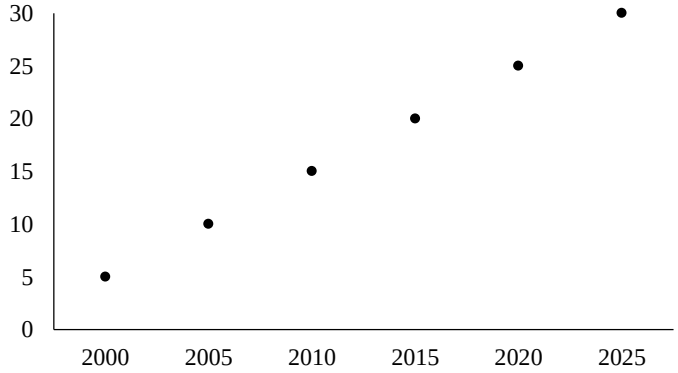

Figure 2. Number of heatwave days.

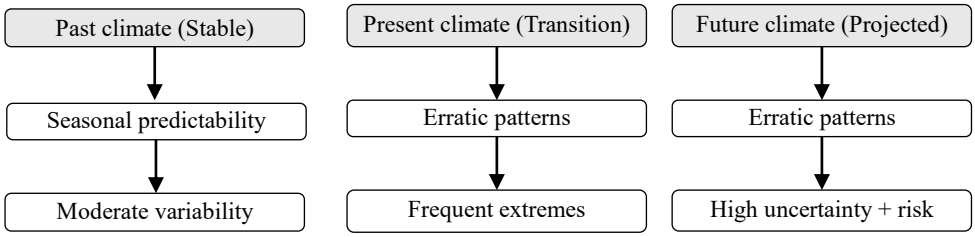

Figure 3. Emerging Trend Visualization (Conceptual Model)

Key Insight

- Heatwave days have increased from ~5 days/year (2000) to ~30 days/year (2025)
- Represents a 5–6 × increase, indicating severe climate stress
- 10.3 Distribution of Extreme Weather Events in India

CONCLUSION

In conclusion, the evidence clearly shows that India's climate is undergoing a significant and ongoing transformation. The traditional patterns of predictable seasons and stable weather conditions

are being replaced by increased variability, uncertainty, and frequent extreme events. Rising temperatures, changing monsoon behavior, and the growing occurrence of heatwaves, floods, and cyclones indicate that climate change is no longer a distant concern but a present reality affecting everyday life.

A key insight from this study is that extreme weather events are no longer isolated or rare. Instead, they are becoming more frequent, intense, and widespread across the country. Heatwaves are lasting longer and affecting new regions, while rainfall patterns are becoming more uneven, often resulting in both floods and droughts within the same season. These shifts highlight a deeper structural change in the climate system, making it more complex and difficult to predict.

The impacts of these changes are widespread and interconnected. Agriculture is becoming increasingly uncertain, with farmers facing unpredictable growing conditions and higher risks of crop failure. Water resources are under pressure due to irregular rainfall and declining groundwater levels. Public health is also being affected, with rising cases of heat-related illnesses and increased vulnerability to climate-sensitive diseases. Economically, the damage caused by extreme weather events is growing, affecting infrastructure, productivity, and livelihoods.

Importantly, the burden of these impacts is not evenly distributed. Vulnerable groups, including rural communities, small farmers, and urban poor populations, are disproportionately affected due to limited resources and adaptive capacity. This highlights the need for inclusive and equitable climate policies.

To address these challenges, there is an urgent need to move from reactive responses to proactive and long-term strategies. Strengthening climate-resilient infrastructure, improving early warning systems, promoting sustainable agricultural practices, and adopting better urban planning are essential steps. In addition, raising public awareness and encouraging community participation can play a crucial role in building resilience.

Ultimately, India's ability to cope with changing weather patterns will depend on timely action, effective governance, and a commitment to sustainable development. By integrating climate considerations into planning and policy-making, the country can reduce risks and work towards a more secure and resilient future.

REFERENCES

1. Intergovernmental Panel on Climate Change. Sixth Assessment Report on Climate Change. Geneva: IPCC; 2023. https://www.ipcc.ch/assessment-report/ar6/
2. Mukhopadhyay B, Chattopadhyay R, Sreejith OP, Ghosh K. The history of climate services in IMD. Mausam. 2025 Jan 16;76(1):163–72.
3. Ministry of Earth Sciences. Climate Change Report India. New Delhi: Government of India; 2024. https://www.moes.gov.in/static/uploads/2025/12/665ee83247969d683e33faf423c2bf41.pdf
4. Anant A. World bank reforms and climate change. Vivekananda International Foundation. 2023. https://www.vifindia.org/article/2023/july/17/world-bank-reforms-and-climate-change
5. Kumar A. United nations environment programme (UNEP). Yearbook of International Environmental Law. 2024;35(1):yvaf054.
6. National Aeronautics and Space Administration. Global Temperature Trends. Washington (DC): NASA; 2025. https://science.nasa.gov/earth/explore/earth-indicators/global-temperature/
7. Dunn R, Blannin J, Gobron N, Miller J, Willett K, Ades M, Adler R, Alexe M, Allan R, Anderson J, Anneville O. Global climate in 2023. Bulletin of the American Meteorological Society. 2024;105(8):S12–55.
8. The Energy and Resources Institute. Climate Change Impacts in India. New Delhi: TERI; 2023.NITI Aayog (2024). Water and Climate Report. https://www.teriin.org/climate

9. World Health Organization. Progress report on climate change, health and environment: a regional framework for action, 2023-2029. World Health Organization. Regional Office for the Eastern Mediterranean; 2025 Sep 29. https://iris.who.int/handle/10665/383930
10. Farah AA, Mohamed MA, Musse OS, Nor BA. The multifaceted impact of climate change on agricultural productivity: A systematic literature review of SCOPUS-indexed studies (2015–2024). Discover Sustainability. 2025 May 13;6(1):397.

