Climate Change Projections for India (2021 -2040)

Azim Premji University today unveiled a new climate data set for India that offers critical insights into how climate change will impact the country over the next two decades. These projections reveal key information about India's climate, detailing how extreme weather events -- like heat waves, droughts, and intense rainfall -- could affect communities, agriculture, and natural resources.

Why are these projections important?

Climate projections are essential for actionable change. The report will help stakeholders ranging from government officials and policy makers take immediate and effective actions and help educators and non-governmental organizations understand and prepare for the impact of climate change. By enabling stakeholders to assess regional risks more precisely, this data empowers local authorities, policymakers, and community leaders to develop targeted strategies to safeguard lives and livelihoods.

The two scenarios

The projections examine two IPCC (Intergovernmental Panel on Climate Change) scenarios: **SSP2-4.5** (moderate emissions and adaptation) and **SSP5-8.5** (high emissions with heavy fossil fuel reliance). In other words, the "Middle of the Road" emission scenario assumes that society will take moderate steps to reduce emissions and adapt to climate change which will lead to moderate effects in the future. The "Fossil-Fueled Development" emission scenario presumes that society will continue to rely heavily on fossil fuels for energy, leading to a future with very high emissions and severe impacts. These scenarios offer a framework for understanding potential climate outcomes and their impacts on India.

What does the report say?

India is one of the global hotspots for climate change. With the majority of the population relying on agriculture and natural resources for survival, coupled with a high population density, they are acutely vulnerable to the impacts of climate change.

From 1986-2015, India's annual mean, maximum and minimum temperatures have shown substantial warming trends during the pre-monsoon season (March-April-May). The frequency of heat extremes in India has increased between 1950-2015, and warming has occurred over the past three decades at an accelerated rate.

Changes in the monsoonal rainfall pattern will significantly impact the country's agrarian economy and food security. Droughts and floods are also projected to increase, as per the climate model data, which will have a deleterious impact on the economy, health, and food supply of the people. There is also a noticeable increase in the frequency of post-monsoon cyclonic storms, causing severe consequences on the coastal communities.

Key findings: Changes in temperature patterns (2021-2040)

- The average annual maximum temperature will experience an increase of 1.5 degrees Celsius by 2057 under the "Middle of the Road" emission scenario. The more extreme "Fossil-Fueled Development" emission scenario predicts this temperature rise will occur a decade earlier, by 2047.

- India's average summer maximum temperature will have a 1.5-degree Celsius increase by 2043, according to the "Middle of the Road" emission scenario and by 2041 for the "Fossil-Fueled Development" emission scenario.

Under the low emission scenario i.e. SSP2-4.5:

- 196 districts in India will experience a summer maximum temperature increase of at least one degree,with 70 districts projected to experience a similar annual maximum temperature change. The highest change is expected in Leh at 1.6 degrees Celsius for both summer and annual maximum temperatures.

- The winter minimum temperature is projected to change by 1.5 degree Celsius or more for 139 districtsand 611 districts will see a 1 degree Celsius or more temperature change.

Under high emission scenario i.e. SSP5-8.5:

- 249 districts will experience an annual maximum temperature change of one degree Celsius or more and 16 districts, mostly in the Himalayan states, are projected to experience an annual maximum tempchange by 1.5 degree Celsius or more with the highest being at Leh at 1.8 degree Celsius.
- 517 districts will experience a summer maximum temperature change of one degree Celsius or more and 17 districts will experience a summer maximum temperature change of 1.5 degree Celsius or morewith the highest being at Leh at 1.7 degree Celsius.
- The winter minimum temperature is projected to change by 1.5 degree Celsius or more in 162 districtswith the highest with 2.2 degree Celsius in Anjaw district in Arunachal Pradesh.
- Under both the scenarios, 24 - 25 districts spread across the coastal states and eastern Himalayas will experience more than 31-degree Celsius summer wetbulb temperature posing serious threats to human health.

Key findings: Change in precipitation patterns (2021-2040)

Indian agriculture is highly dependent on the monsoons, which account for 70% of the country's precipitation. As a result, monsoons play a crucial role in determining India's agricultural yield. With half ofthe country's population employed in the agricultural sector, which contributes 15% to the Indian economy, any change in precipitation patterns can have a significant impact. The majority of the states andunion territories in India receive rainfall from the southwest monsoon, making it a crucial factor for the country's agricultural sector. Our district level analysis highlights the following:

- In general, the western part of India will experience a significant increase in precipitation, compared tomost of the eastern and north-eastern parts of the country.

- Arid states such as Gujarat and Rajasthan exhibit a higher annual precipitation ranging from 20 to 40%under SSP2-4.5 and a 20 to 50 % change under SSP5-8.5.

- The entire stretch of the Indian Himalayas from Kashmir to Arunachal Pradesh will experience a deficit precipitation during the northeast monsoon, the highest being in the Upper Subansiri district of Arunachal Pradesh with a 13 percent rainfall deficit followed by 12 percent rainfall deficit in the North Sikkim district under SSP2-4.5 scenario. Under the SSP5-8.5 scenario, the condition worsens with NorthSikkim and Tawang districts seeing upto 15% deficit in rainfall.

- The southwest monsoon will see a shift from east to west with the normally drier western states experiencing higher precipitation. In the low emission scenario Devbhumi Dwarka district in Gujarat will see a 37% increase in precipitation while East Kameng district in Arunachal Pradesh is projected to seea 3 percent deficit rainfall.

- The northeast monsoon shows a rather grim picture where a major part of the country will experience a decrease in precipitation in the Indian Himalayas. On the other hand, the western and south western

  states like Gujarat, Rajasthan, Karnataka and parts of Uttar Pradesh, Madhya Pradesh, including parts of Ladakh, will experience an increase in precipitation of 20 to 60%, with the highest being in Gujarat (50 to 60%).

- Increased heavy precipitation events in higher altitude states like Ladakh, Arunachal Pradesh, Meghalayas and the Western ghats will result in detrimental consequences like accelerated snowmelt and potential climate-induced calamities like landslides. Higher precipitation in these areas will cause havoc to horticulture practices, as well as cause negative impacts on the local economy.

What do these projections on precipitation patterns mean?

- The states of Gujarat, Rajasthan, and Ladakh are likely to experience severe flooding due to a notable rise in annual precipitation. Additionally, the increased soil erosion from precipitation will decrease soil fertility and agricultural productivity. Increased precipitation in higher altitude states like Ladakh will trigger worrying scenarios of climate-induced disasters like landslides and flooding that can cause significant loss of traditional mud houses of rural populations, posing a threat to their lives.

- Drought-like scenarios in parts of the northeastern states such as Assam and Arunachal Pradesh will strain agriculture and threaten the livelihoods of the communities relying on traditional rain-fed farming.

- The significant variation in precipitation levels during the southwest monsoon season, will cause added strain on agriculture, increasing the likelihood of disasters such as floods and droughts. This, in turn, can severely impact human health, as the increase in vector-borne diseases may become a significant concern.

- The projected increase in rainfall can cause devastation in the form of increased floods, soil erosion, agricultural loss and climate-triggered drastic events such as landslides, flooding and heavy loss to traditional housing and thus have a concerning impact on the communities living in remote areas suchas Ladakh.

- The drought-like conditions in the northern, central and northeastern states can potentially damage the farm produce stressing rural communities as they rely on traditional agriculture practices.
  The data set uses high-resolution data at a scale of 25 by 25 km to provide a detailed look at how India's climate is projected to change. It will be accessible to everyone through interactive web-based platforms, making it easy to use this information for a variety of purposes. Individual reports will be available for each state and union territory of India, with data aggregated to the district level. You will find the full report in the link below: https://azimpremjiuniversity.edu.in/navigating-indias-climate-future

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