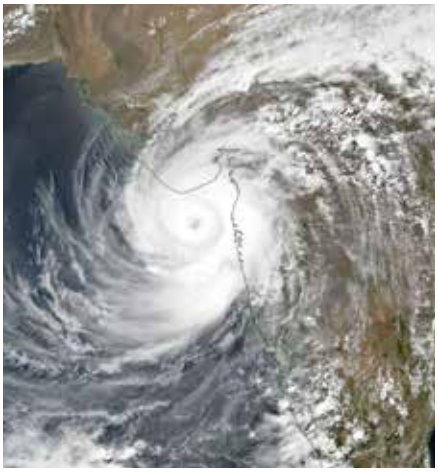
# Cyclone Tauktae Documents a Climate Trend in the Tropics



*Cyclone Tauktae was the strongest cyclone to hit the Indian state of Gujarat in more than 20 years. Credit: NASA*

On 18 May, Cyclone Tauktae hit the coast of Gujarat, a state in western India, with peak wind speeds of about 220 kilometers per hour. Other western states like Maharashtra, Goa, Karnataka, and Kerala and the union territory of Lakshadweep also witnessed heavy rains and storm surges. As of late May, the death toll stood at more than 90.

Cyclone Tauktae documented a startling climate trend, given that the Arabian Sea, with its cooler temperatures, was once considered to be calm relative to the warm and stormy Bay of Bengal on India's eastern coast.

"Unlike Bay of Bengal, the Arabian Sea was not entirely a warm pool until recently. Hence, while Bay of Bengal had two to three cyclones a year, the Arabian Sea had almost none or barely one. Now that is changing due to the rapid warming," said Roxy Mathew Koll, a climate scientist at the Indian Institute of Tropical Meteorology (IITM) and author of several reports released by the Intergovernmental Panel on Climate Change (IPCC).

## Rapid Intensification

Vineet Kumar Singh, a research fellow at IITM, agreed. "We have observed that the Arabian Sea has warmed up by around 1.4°C in the last 40 years in the premonsoon season, which can be attributed to global warming," he said. "We have [also] observed that the intensity and frequency of cyclones in the Arabian Sea [are] increasing."

In fact, according to data from the India Meteorological Department, Cyclone Tauktae marked the first time in 40 years that premonsoon (April–June) cyclones appeared for four consecutive years (2018–2021) in the Arabian Sea.

In addition, "recent cyclones in the Arabian Sea are exhibiting rapid intensification, where they intensify from a weak cyclone to a severe cyclone in a short time," said Koll. An intensification of 55 kilometers per hour in less than 24 hours is defined as rapid intensification.

"Cyclone Tauktae underwent rapid intensification—[it] intensified by 45 knots [83 kilometers per hour] in the 24 hours," Singh explained. He noted that in addition to sea surface temperatures being 1.5°C–2°C higher than normal prior to the genesis of Cyclone Tauktae, "the ocean heat content, which is a proxy of the surface and subsurface combined ocean energy, also was very high."

Singh is the lead author of two papers—one based on Cyclone Fani (bit.ly/fani-study) and another on Cyclone Ockhi (bit.ly/ockhi-study)—that show how warm ocean surface and subsurface conditions are fueling the rapid intensification of cyclones in the northern Indian Ocean.

**"We need to disaster-proof these regions, using both natural and artificial defenses and methods."**

## Warm Ocean Pools

According to IPCC's Fifth Assessment Report, oceans have absorbed more than 93% of excess heat from greenhouse gas emissions since the 1970s. "This is causing ocean temperatures to rise," the report stated.

Such warm temperatures provide conditions conducive to the formation of tropical cyclones. Koll explained how tropical cyclones generally form over warm pools in the ocean, where temperatures are permanently above 28°C. Cyclones draw their energy from the heat and moisture supplied by the warm ocean waters below.

Previous research by Koll noted how the western Indian Ocean has been warming for more than a century, at a rate faster than any other region of the tropical oceans.

## Assessing and Strengthening India's Preparedness

India is reeling under the COVID-19 pandemic; as Cyclone Tauktae struck, the country recorded 259,551 new cases and more than 4,200 deaths. Despite these immense challenges, India did a good job dealing with Cyclone Tauktae, Koll said. He pointed to how weather and ocean agencies forecast the cyclone's impacts well in advance and how disaster response teams and local administrations worked together to evacuate people in time.

As for what India should prepare for in the future, Koll said that "there is a heightened risk on the west coast that we need to assess and work on in terms of adaptation and mitigation. What we need to do first is a risk assessment that can demarcate the regions where the risks of cyclones and other severe weather events are largest. Based on that, we need to disaster-proof these regions, using both natural and artificial defenses and methods."

Coastal mangroves, for instance, are a natural form of floodwater defense in India. According to a 2005 study that analyzed storm protection functions of the Bhitarkanika mangrove ecosystem in the eastern Indian state of Odisha, villages that were located behind mangroves during the 1999 Odisha cyclone suffered less damage than those that did not have mangrove wetlands (bit.ly/mangrove-storms).

Gujarat, the state hardest hit by Cyclone Tauktae, has one of the largest areas of coastal wetlands in the country, and several organizations are developing mangrove restoration programs to help mitigate damage from cyclones and other effects of climate change.

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