

## Untimely rain linked to air pollution?

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[Badri Chatterjee](#)



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The unusual weather in the city this year, including unseasonal rain caused by two rare November cyclones, could be linked to air pollution and resultant global warming, according to a report by climate research group Climate Trends.

Delhi-based Climate Trends analysed six national and international climate studies and found that air pollution may be strengthening post-monsoon cyclones in the Arabian Sea. This year, Mumbai witnessed a number of record-breaking rainfall events due to an unusual increase in the frequency of pre- and post-monsoon tropical cyclones. Cyclone Vayu in June delayed the onset of the southwest monsoon, but subsequently led to extremely heavy rain in June and July. Cyclone Hikka delayed the withdrawal of the season. Cyclones Kyarr and Maha, between October and November, caused rains to continue in November and formed an extremely rare weather event, according to the India Meteorological Department (IMD).

In its report, Climate Trends quoted Amato Evan, associate professor (climate, atmospheric science and physical oceanography), Scripps Institution of Oceanography, University of California, San Diego, USA, who had authored a paper in 2011 on cyclones in the Arabian Sea. “Air pollution may be increasing the strength of tropical cyclones in the Arabian Sea by reducing the vertical wind shear (rapid changes in wind speed combined with direction or height of moving winds). Our research found this to be the case for pre-monsoon storms and

we speculated that this also could be true in the post-monsoon season as well. Given the current and alarming amount of emissions, it may be time to revisit this hypothesis.”

The report also looked at studies published in peer-reviewed journal *Nature Climate*, in 2012 and 2017, which predicted a 46% increase in powerful tropical cyclones in the Arabian Sea this century if greenhouse gas emissions continue to rise, particularly during peak monsoon season.

Additionally, the study published last month by the United Nations Intergovernmental Panel on Climate Change (IPCC) in its Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC) confirmed coastal habitats are at critical risk with increased probability of cyclones in the Arabian Sea. Earlier this month, a more detailed report using satellite maps by Climate Central concluded that coastal cities like Mumbai could be partially inundated by 2050. “Increase in extreme weather events witnessed for almost five months in Mumbai is already an indicator of this changing climate scenario, and new climate-resilient technology needs to be adopted,” said Anjal Prakash, coordinating lead author, SROCC and associate professor, regional water studies, TERI School of Advanced Studies.

Researchers from India have found a connection between the frequency of cyclones and rapidly warming oceans. “As tropical cyclones primarily draw their energy from evaporation at the ocean surface, the surface temperature and ocean heat content has strong control over their intensity,” said Dr Roxy Mathew Koll, climate scientist, Indian Institute of Tropical Meteorology, Pune. Professor V Vinoj from Indian Institute of Technology (IIT) Bhubaneswar said, “The gradual rise in sea-level due to climate change, coupled with increasing frequency and intensity of cyclones are making our coastal cities more vulnerable.”

Dr Koll said the first extremely severe post-monsoon cyclone in the Arabian Sea was in 2014, with Cyclone Nilofar. “This year, we had Kyarr and Maha. In fact, Kyarr is the first super cyclone (strongest, above extremely severe cyclone) to be recorded in the Arabian Sea in the post-monsoon season. With a rapidly warming Indian Ocean, these severe cyclones are projected to increase in number and we cannot neglect the possibility of these cyclones making landfall over the west coast of India,” said Dr Koll.