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Premium

La Nina impacted air quality in India: what a new study says

This is the first time that air quality in Indian cities has been linked to a La Nina event — and indirectly to climate change, which is making El Nino and La Nina more severe.

Written by **Amitabh Sinha** [Follow](#)

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South Mumbai engulfed in smog and haze on December 16, 2022. Mumbai saw unusually poor air quality that winter. (Express Archive)

Monsoon rainfall over India is known to be strongly influenced by El Nino and La Nina events, the alternating warming and cooling of the eastern Pacific Ocean that impacts weather across the world. A new study by Indian researchers has now suggested that even air quality in the country could be influenced by the two weather events.

The study, by researchers at the Bengaluru-based National Institute of Advanced Studies and Pune-based Indian Institute of Tropical Meteorology, has argued that the unusual air quality in some Indian cities in the winter of 2022 could be attributed to the record-breaking spell of La Nina prevailing at that time.

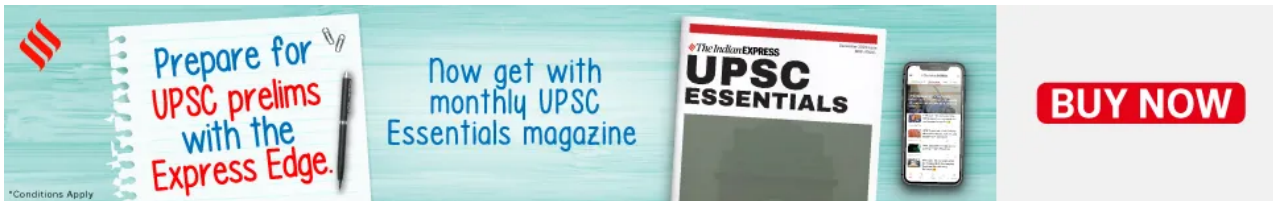
This is the first time that air quality in Indian cities has been linked to a La Nina event — and indirectly to climate change, which is making El Nino and La Nina more severe.

What happened

During October to January, northern Indian cities, particularly Delhi, experience very high concentrations of PM2.5. A variety of meteorological factors — temperature, moisture, heaviness in air, wind speed and direction — play a role in

responsible for transporting pollutants from other regions, particularly those generated by agriculture waste burning in Punjab and Haryana, to Delhi and adjoining areas.

The western and southern parts of the country have always had relatively lower levels of pollution, because of their proximity to oceans.



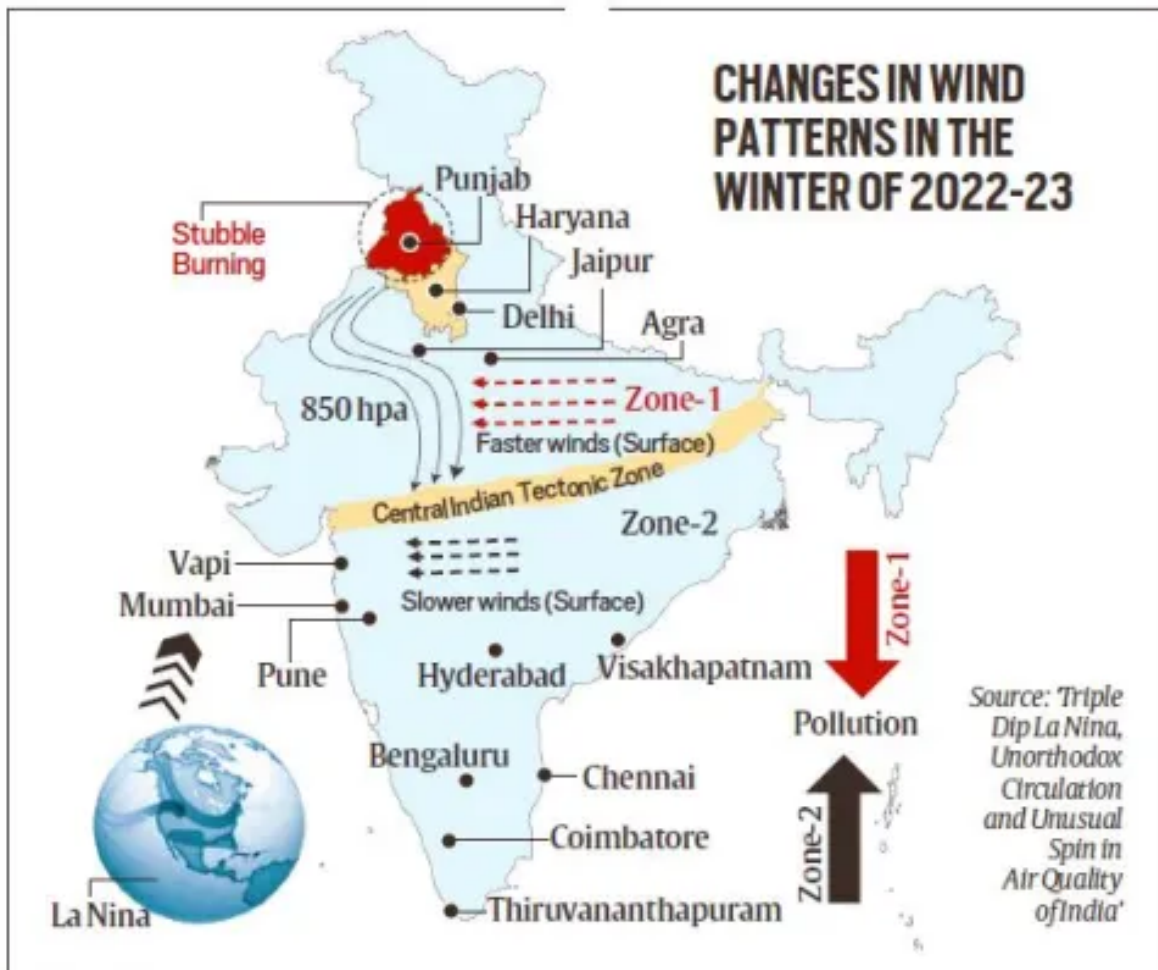
The winter of 2022, however, showed a significant deviation from this normal. Northern Indian cities, including Delhi, were cleaner than usual, while cities in the west and the south, like [Mumbai](#), Bengaluru and [Chennai](#), experienced worse-than-usual air quality.

Read | Why winter of 2022-23 in Delhi was cleaner than usual, but Mumbai saw poor air

The study said PM2.5 concentrations in Ghaziabad that winter saw a reduction of about 33% from normal, while in Noida, the concentration was 28% below normal. Delhi saw a reduction of about 10%. Simultaneously, the concentrations in Mumbai rose by 30%, while Bengaluru registered a 20% rise.

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they found themselves led to the possible effects of La Nina.



Wind direction

The most crucial factor in explaining the anomaly of winter 2022 was a change in the normal wind direction. During this time, wind usually blows in the northwesterly direction: for example, from Punjab towards Delhi and further into the Gangetic plains. This is one of the main reasons why agricultural waste pollutants in Punjab and Haryana flow into Delhi.

In the winter of 2022, however, the wind circulation was in the north-south direction. The pollutants being carried from Punjab and Haryana bypassed Delhi and surrounding areas and flew over Rajasthan and Gujarat to southern regions (see map).

“There was no change in the local sources of emissions in Delhi and Mumbai. But the additional pollutant load from the northern states, which usually lands in Delhi and surrounding areas, moved in a different trajectory and reached peninsular India, some landing in Mumbai as well,” explained Gufran Beig, the lead researcher and one of the leading air pollution experts in the country.

The local circulation of wind near Mumbai also had an anomalous behaviour that year. Wind currents alternate between blowing from the land to the sea every few days. When blowing from the land towards the sea, the winds carry pollutants out of the city. In 2022, however, instead of changing direction every four to five days, the winds persisted in one direction for more than a week or 10 days, leading to greater accumulation of pollutants in Mumbai.

La Nina and climate change

Beig said the wind behaviour in both cases had something to do with the extended La Nina which, by the winter of 2022, had been persisting for an unusually long three years.

“When we used the global air circulation data as a result of La Nina in our computer models, we found the emergence of wind patterns over the Indian region that were very similar to the observed changes. When we ran the models with data from previous years, when a strong La Nina was not present, these anomalous wind patterns disappeared. It showed a strong sensitivity to La Nina conditions,” Beig said.

Beig said not all La Nina events might produce noticeable changes in wind circulation over India. “This one was a particularly strong event. And the impact on air circulation became evident only in the third year of La Nina. So, there may be an accumulative effect,” he said.

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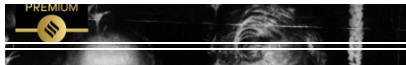
He said it was not yet entirely clear whether El Nino would produce an opposite effect for air quality over India.

The study did add that changes in wind patterns were not the only reasons for the unusual trends in air quality that year. It mentioned local meteorological conditions, unrelated to La Nina, that could also have resulted in the reduction of pollutant concentrations over northern India.

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