

# China's war on particulate air pollution is causing more severe ozone pollution

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In early 2013, the Chinese government declared a war on air pollution and began instituting stringent policies to regulate the emissions of fine particulate matter, a pollutant known as PM 2.5. Cities restricted the

number of cars on the road, coal-fired power plants reduced emissions or were shuttered and replaced with natural gas. Over the course of five years, PM 2.5 concentrations in eastern China have fallen nearly 40 percent.

The number of air quality monitoring stations across the country has grown to over 1,000, collecting unprecedented amounts of environmental data. Sifting through that data, researchers from the John A. Paulson School of Engineering and Applied Sciences (SEAS) and the Nanjing University of Information Science & Technology (NUIST), found something surprising: While PM 2.5 pollution is falling, harmful ground-level [ozone](#) pollution is on the rise, especially in [large cities](#).

As it turns out, when it comes to the war on [air pollution](#), chemistry is a formidable foe.

Ozone is the main ingredient in smog and has been studied since it began choking cities in the U.S. in the early 1950s. Ozone is formed through a series of chemical reactions, starting with the oxidation of volatile organic compounds (VOCs). This reaction forms chemical radicals, which drives reactions among oxides of nitrogen (NO<sub>x</sub>) and VOCs to produce ozone in the presence of sunlight. Both NO<sub>x</sub> and VOCs are emitted from fossil fuel combustion, and VOCs can also be emitted from industrial sources.

The researchers from SEAS and NUIST found that [particulate matter](#) acts like a sponge for the radicals needed to generate ozone pollution, sucking them up and preventing them from producing ozone.

"There was so much particulate matter in Chinese cities that it stunted the ozone production," said Daniel Jacob, the Vasco McCoy Family Professor of Atmospheric Chemistry and Environmental Engineering, and co-corresponding author of the study.

But the rapid reduction of PM 2.5 dramatically altered the chemistry of the atmosphere, leaving more radicals available to produce ozone.

"We haven't observed this happening anywhere else because no other country has moved this quickly to reduce particulate matter emissions," said Jacob. "It took China four years to do what took 30 years in the U.S."

Despite this rapid reduction, China still has a long way to go to meet its air quality goals.

"As PM 2.5 levels continue to fall, ozone is going to keep getting worse," said Ke Li, a postdoctoral fellow at SEAS and first author of the study. "Results from this study suggest that extra efforts are needed to reduce NO<sub>x</sub> and VOC emissions in order to stem the tide of ozone [pollution](#)," said Hong Liao at NUIST who is the co-corresponding author of this work.

**More information:** Ke Li et al. Anthropogenic drivers of 2013–2017 trends in summer surface ozone in China, *Proceedings of the National Academy of Sciences* (2019). [DOI: 10.1073/pnas.1812168116](https://doi.org/10.1073/pnas.1812168116)

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