'Dark' side of air pollution across China poses potential health threat

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Beijing. Credit: Unsplash/CC0 Public Domain

China is a nighttime "hot-spot" for the production of nitrate radicals (PNO_3) that could have a major impact on health-threatening ozone and fine particulates ($PM_{2.5}$) in the atmosphere, a new study reveals.

The country has experienced a rapid increase in nocturnal production of

NO_3, while Europe and the U.S. experienced a decline. Experts believe that this increase will have significant air pollution implications for China and other developing countries such as India.

Current production of NO_3 radicals in eight representative Chinese cities—Beijing, Shanghai, Guangzhou, Chengdu, Xi'an, Jinan, Zhengzhou and Shijiazhuang—are comparable to that in 1990s Los Angeles, but with an overall increasing trend.

Publishing their findings in *Nature Geoscience* today, the international team of researchers—which includes experts from the University of Birmingham—believes that the long-term decreasing trend in the production of NO_3 in Los Angeles offers hope that the level of nocturnal ozone can be reduced while simultaneously reducing nitrogen oxides.

Co-author Professor Zongbo Shi, from the University of Birmingham, commented, "Nitrogen oxides derived from combustion and natural sources are reactive gases that regulate the formation of key air pollutants including both ozone (O_3) and $PM_{2.5}$. Nocturnal oxidation driven by nitrate radicals is an important, but poorly understood, process in atmospheric chemistry—we must understand this better, if we are to formulate effective global pollution mitigation strategies and understand the influence of nitrogen oxides on air quality and climate."

The study shows that, if recent increasing ozone pollution trends continue, nighttime oxidation in China will increase further even if NO_x emissions are reduced. However, based on the trend in Los Angeles since 1980 and global changes since the COVID-19 lockdown, scientists believe that, currently, reducing the emissions of volatile organic compounds (VOC) would simultaneously reduce daytime ozone and nighttime oxidation in China and similar regions.

Night-time NO_3 chemistry influences next-day photochemistry by

removing nitrogen oxides and VOCs—enhancing ozone formation. The production of NO_3 radicals increased significantly in three megacity clusters (North China Plain, Yangtze River Delta and Pearl River Delta), with experts suggesting that the hotspot of NO_3 chemistry persists for the entire year in China.

Given that much lower values of NO_3 radicals in both the Europe and United States have been shown to exert significant impacts on particulate nitrate and organic aerosol formation in those regions, the researchers believe that NO_3 radical chemistry may play a more critical role in atmospheric oxidation and aggravate both O_3 and $PM_{2.5}$ pollution in China in the near future.

Increased O_3 and $PM_{2.5}$ pollution due to nighttime oxidation poses an important challenge in further improving air quality in China, with significant public health implications.

More information: Keding Lu, Increased night-time oxidation over China despite widespread decrease across the globe, *Nature Geoscience* (2023). DOI: 10.1038/s41561-022-01122-x.
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