# World-first study into global daily air pollution shows almost nowhere on Earth is safe

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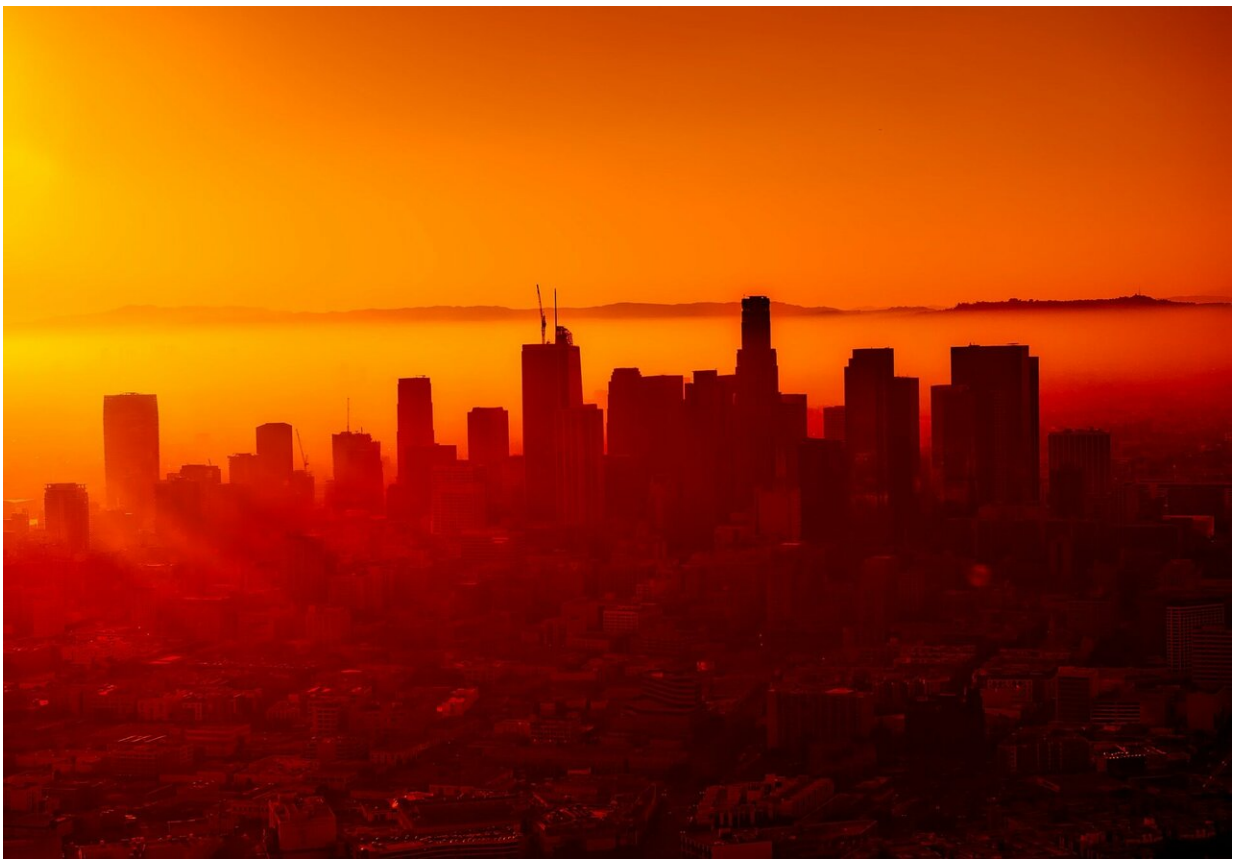

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In a world-first study of daily ambient fine particulate matter ($PM_{2.5}$)

across the globe, a Monash University study has found that only 0.18% of the global land area and 0.001% of the global population are exposed to levels of $PM_{2.5}$—the world's leading environmental health risk factor—below levels of safety recommended by World Health Organization (WHO).

Importantly, while daily levels have reduced in Europe and North America in the two decades to 2019, levels have increased Southern Asia, Australia, New Zealand, Latin America and the Caribbean, with more than 70% of days globally seeing levels above what is safe.

A lack of pollution monitoring stations globally for air pollution has meant a lack of data on local, national, regional and global $PM_{2.5}$ exposure. Now this study, led by Professor Yuming Guo, from the Monash University School of Public Health and Preventive Medicine in Melbourne, Australia, and published in *The Lancet Planetary Health*, has provided a map of how $PM_{2.5}$ has changed across the globe in the past decades

The research team utilized traditional air quality monitoring observations, satellite-based meteorological and air pollution detectors, statistical and machine learning methods to more accurately assess $PM_{2.5}$ concentrations globally, according to Professor Guo.

"In this study, we used an innovative machine learning approach to integrate multiple meteorological and geological information to estimate the global surface-level daily $PM_{2.5}$ concentrations at a high spatial resolution of approximately 10km ×10km for global grid cells in 2000-2019, focusing on areas above 15 $\mu g/m^3$, which is considered the safe limit by WHO (the threshold is still arguable)," he said.

The study reveals that annual $PM_{2.5}$ concentration and high $PM_{2.5}$ exposed days in Europe and northern America decreased over the two

decades of the study—whereas exposures increased in southern Asia, Australia and New Zealand, and Latin America and the Caribbean.

In addition, the study found that:

- Despite a slight decrease in high $PM_{2.5}$ exposed days globally, by 2019 more than 70% of days still had $PM_{2.5}$ concentrations higher than 15 $\mu g/m^3$.
- In southern Asia and eastern Asia, more than 90% of days had daily $PM_{2.5}$ concentrations higher than 15 $\mu g/m^3$.
- Australia and New Zealand had a marked increase in the number of days with high $PM_{2.5}$ concentrations in 2019.
- Globally, the annual average $PM_{2.5}$ from 2000 to 2019 was 32.8 $\mu g/m^3$.
- The highest $PM_{2.5}$ concentrations were distributed in the regions of Eastern Asia (50.0 $\mu g/m^3$) and Southern Asia (37.2 $\mu g/m^3$), followed by northern Africa (30.1 $\mu g/m^3$).
- Australia and New Zealand (8.5 $\mu g/m^3$), other regions in Oceania (12.6 $\mu g/m^3$), and southern America (15.6 $\mu g/m^3$) had the lowest annual $PM_{2.5}$ concentrations.
- Based on the new 2021 WHO guideline limit, only 0.18% of the global land area and 0.001% of the global population were exposed to an annual exposure lower than this guideline limit (annual average of 5 $\mu g/m^3$) in 2019.

According to Professor Guo, the unsafe $PM_{2.5}$ concentrations also show different seasonal patterns that "included Northeast China and North India during their winter months (December, January, and February), whereas eastern areas in northern America had high $PM_{2.5}$ in its summer months (June, July, and August)," he said. "We also recorded relatively high $PM_{2.5}$ air pollution in August and September in South America and from June to September in sub-Saharan Africa."

He added that the study is important because "It provides a deep understanding of the current state of outdoor air pollution and its impacts on human health. With this information, policymakers, public health officials, and researchers can better assess the short-term and long-term health effects of air pollution and develop air pollution mitigation strategies."

**More information:** Global estimates of daily ambient fine particulate matter concentrations and unequal spatiotemporal distribution of population exposure: a machine learning modelling study, *The Lancet Planetary Health* (2023). DOI: 10.1016/S2542-5196(23)00008-6

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