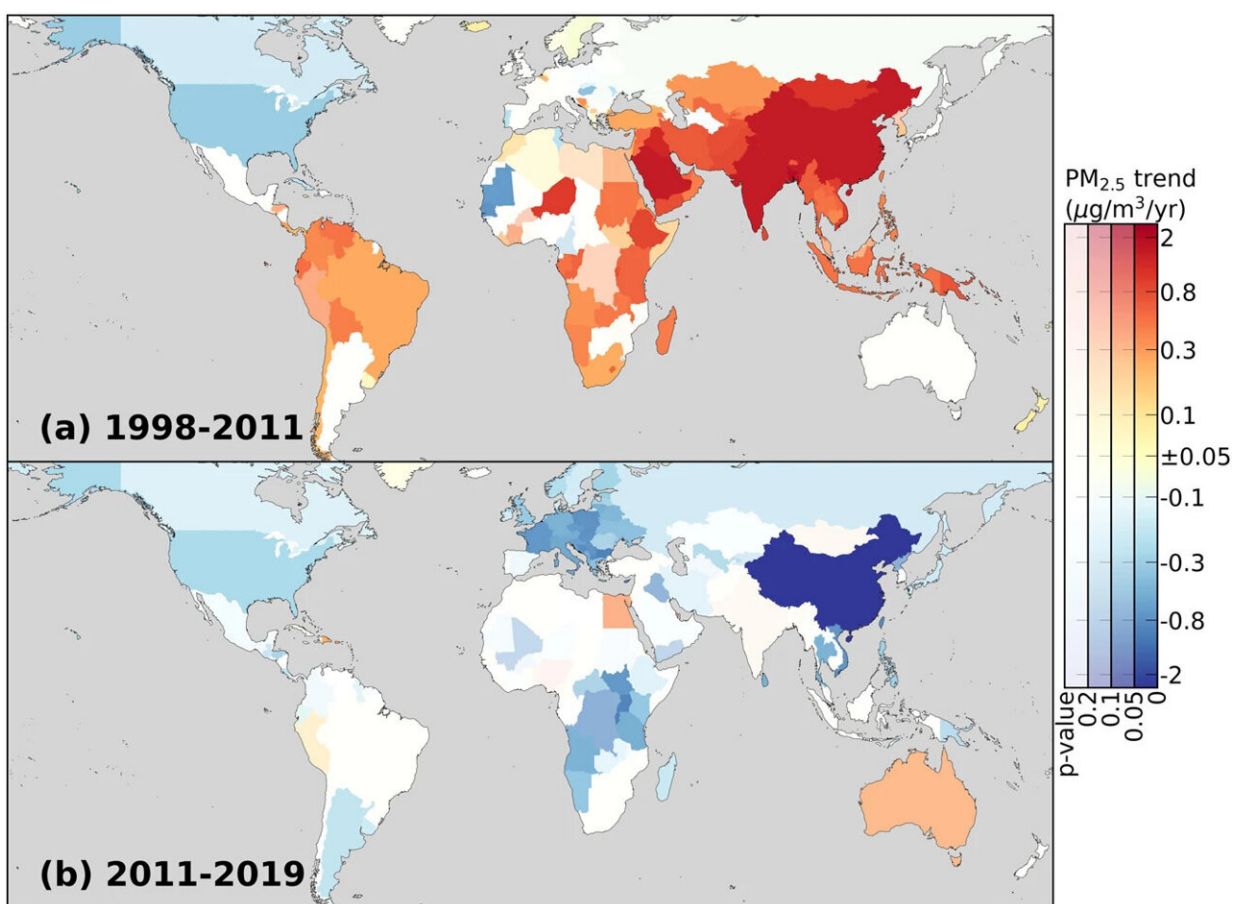


World can now breathe easier but further mitigation still needed, air pollution study finds

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Randall Martin and Chi Li found a general reversal of trends in PM_{2.5} air pollution around the world. These maps show trends in population-weighted PM_{2.5} for 204 territories from 1998-2011 and 2011-2019. Credit: Martin lab, Washington University in St. Louis

Ambient fine particulate matter (PM_{2.5}) is the world's leading environmental health risk factor. At only 2.5 micrometers or smaller, these particles are small enough to be inhaled and cause respiratory problems, such as asthma and bronchitis, and cardiovascular issues, including heart attacks and high blood pressure. For children, PM_{2.5} can cause lifelong developmental issues, and for the general population, PM_{2.5} is associated with premature death.

To ameliorate these wide-ranging negative impacts resulting from exposure to PM_{2.5}, which is produced largely through traditional energy sources such as burning [fossil fuels](#) or wood, several countries have taken steps to reduce exposure to PM_{2.5}. But how effective have these mitigation efforts been, and what region or regions are most responsible for driving global PM_{2.5} reduction?

Researchers working with Randall Martin, the Raymond R. Tucker Distinguished Professor in the McKelvey School of Engineering at Washington University in St. Louis, examined PM_{2.5} data from 1998–2019 to find out.

"The importance of PM_{2.5} as a leading risk factor for [human health](#) motivates assessment of its long-term changes," Martin said. "We sought to analyze our satellite-derived PM_{2.5} estimates for insight into global and regional changes in PM_{2.5} exposure and its health effects."

The team's analysis, published in [Nature Communications](#), showed that global, population-weighted PM_{2.5} exposure, related to both [pollution levels](#) and [population size](#), increased from 1998 to a peak in 2011, then decreased steadily from 2011 to 2019, largely driven by exposure reduction in China and slower growth in other regions.

"Before this work, there was a knowledge gap regarding quantitative local/regional contributions to global population exposure to PM_{2.5} and

its changes," said Chi Li, first author on the study and a staff scientist in Martin's research group. "We developed a new regional decomposition approach that jointly considered pollution level and population size, and from that we depicted the first-ever time series of regional contributions to global PM_{2.5} air pollution."

Li found that many regions have exhibited decreasing exposure since 2011, including continuous reductions in North America and western Europe. He described recent emerging decreases in China as particularly striking.

"Rigorous air quality management in China, which has been most pronounced since 2013, turned out to be the biggest contributor to this global reversal," Li said. "More than 90% of the reduction of global mean exposure from 2011 to 2019 is from China, according to our regional attribution. This result was astonishing when it was derived, but it could be explained well by the rapid reduction of PM_{2.5} concentrations due to China's mitigation efforts, which benefit nearly one-fifth of the global population."

Benefits from PM_{2.5} exposure reduction include 1.1 million fewer premature deaths in China alone between 2011 and 2019, as well as improved health more generally. Future interventions to reduce PM_{2.5} exposure will have even greater impacts for an aging and growing global population, Li said.

"By combining PM_{2.5} data with health data and exposure-response models, we also revealed that despite the recent sustained reduction of global PM_{2.5} pollution, population aging and growth are now the main challenges in alleviating PM_{2.5} health impacts," Li said. "Reducing the same amount of PM_{2.5} now will have stronger health benefits than it would have 20 years ago, a globally prevalent phenomenon highlighted in our study."

The team calculated that in 2019, there were still millions of premature deaths worldwide that could be attributed to PM_{2.5}, highlighting the urgent need for continued reduction to PM_{2.5} exposure. Careful monitoring, especially in regions that are currently poorly monitored but highly populated, including South Asia and the Middle East, will be critical to ongoing improvements in air quality and to evaluate the effectiveness of mitigation efforts, Martin said.

"There is need to continue to sustain and develop global monitoring capabilities for PM_{2.5} both from satellite, but also from ground-based measurements," Martin said. "The successes in PM_{2.5} reductions serve to demonstrate the benefits of PM_{2.5} [mitigation efforts](#), and to motivate further mitigation."

More information: Chi Li et al, Reversal of trends in global fine particulate matter air pollution, *Nature Communications* (2023). [DOI: 10.1038/s41467-023-41086-z](https://doi.org/10.1038/s41467-023-41086-z)

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