New research finds 1M deaths in 2017 attributable to fossil fuel combustion

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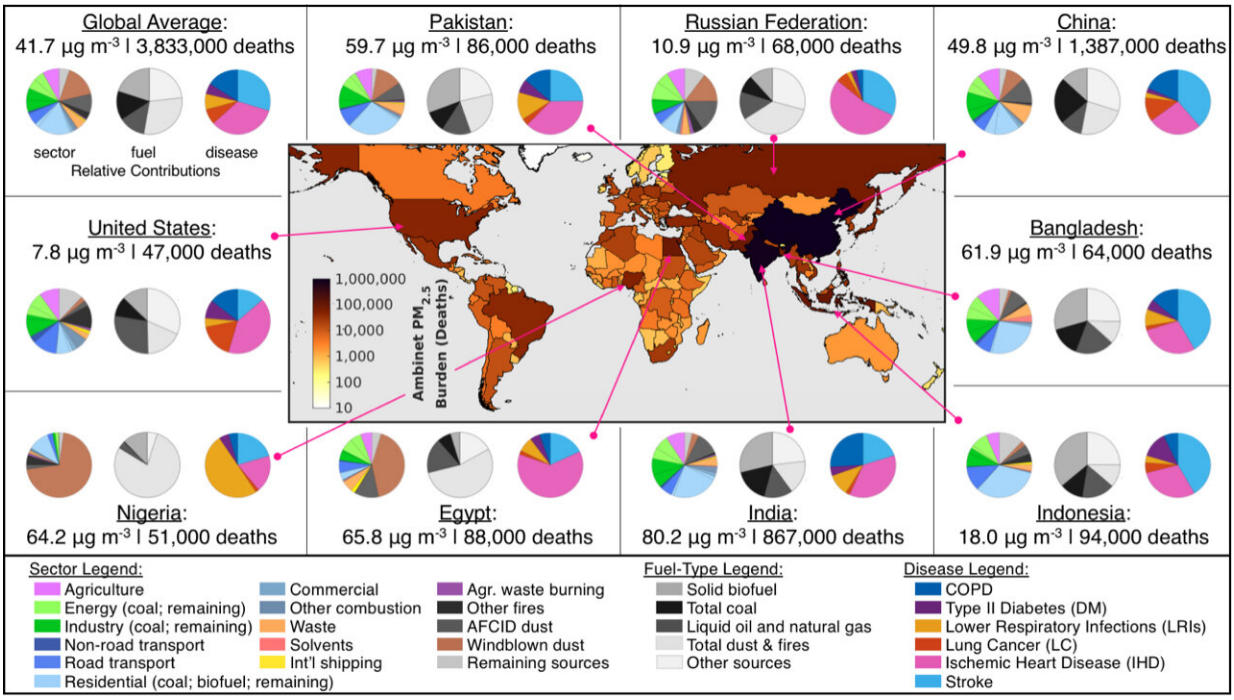

Map: Nationallevel outdoor PM2.5 disease burden in 2017 (from the 2019 Global Burden of Disease concentration-response relationships). Panels: Annual averagepopulation-weighted PM2.5 exposure levels and attributable mortality (rounded to the nearest 1000). (Left pie charts) fractional sectoral source contributions.'Other fires' include deforestation, boreal forest, peat, savannah, and temperate forest fires. 'Remaining sources' include volcanic SO2, lightning NOx, biogenic soil NO, aircraft emissions, and oceanic and biogenic sources. Credit: Lab of Randall Martin

An interdisciplinary group of researchers from across the globe has comprehensively examined the sources and health effects of air pollution—not just on a global scale, but also individually for more than 200 countries.

They found that worldwide, more than one million deaths were attributable to the burning of fossil fuels in 2017. More than half of those deaths were attributable to coal.

Findings and access to their data, which have been made public, were published today in the journal *Nature Communications*.

Pollution is at once a global crisis and a devastatingly personal problem. It is analyzed by satellites, but PM2.5—tiny particles that can infiltrate a person's lungs—can also sicken a person who cooks dinner nightly on a cookstove.

"PM2.5 is the world's leading environmental risk factor for mortality. Our key objective is to understand its sources," said Randall Martin, the Raymond R. Tucker Distinguished Professor in the Department of Energy, Environmental & Chemical Engineering at Washington University in St. Louis.

Martin jointly led the study with Michael Brauer, a professor of public health at the University of British Columbia. They worked with specific datasets and tools from the Institute for Health Metrics and Evaluation at the University of Washington, the Joint Global Change Research Institute at the University of Maryland and Pacific Northwest National Laboratory, as well as other researchers from universities and organizations across the world, amassing a wealth of data, analytical tools and brainpower.

First author Erin McDuffie, a visiting research associate in Martin's lab,

used various computational tools to weave the data together, while also enhancing them. She developed a new global dataset of air pollution emissions, making it the most comprehensive dataset of emissions at the time. McDuffie also brought advances to the GEOS-Chem model, an advanced computational tool used in the Martin lab to model specific aspects of atmospheric chemistry.

With this combination of emissions and modeling, the team was able to tease out different sources of air pollution—everything from energy production to the burning of oil and gas to dust storms.

This study also used new techniques to remote sensing from satellites in order to assess PM2.5 exposure across the globe. The team then incorporated information about the relationship between PM2.5 and health outcomes from the Global Burden of Disease with these exposure estimates to determine the relationships between health and each of the more than 20 distinct pollution sources.

As McDuffie put it: "How many deaths are attributable to exposure to air pollution from specific sources?"

Ultimately, the data reinforced much of what researchers already suspected, particularly on a global scale. It did offer, however, quantitative information in different parts of the world, teasing out which sources are to blame for severe pollution in different areas.

For instance, cookstoves and home-heating are still responsible for the release of particulate matter in many regions throughout Asia and energy generation remains a large polluter on the global scale, McDuffie said.

And natural sources play a role, as well. In West sub-Saharan Africa in 2017, for instance, windblown dust accounted for nearly three quarters of the particulate matter in the atmosphere, compared with the global

rate of just 16 percent. The comparisons in this study are important when it comes to considering mitigation.

"Ultimately, it will be important to consider sources at the subnational scale when developing mitigation strategies for reducing air pollution," McDuffie said.

Martin and McDuffie agreed that, while a takeaway from this work is, simply put, air pollution continues to sicken and kill people, the project also has positive implications.

Although pollution monitoring has been increasing, there are still many areas that do not have the capability. Those that do may not have the tools needed to determine, for instance, how much pollution is a product of local traffic, versus agricultural practices, versus wildfires.

"The good news is that we may be providing some of the first information that these places have about their major sources of pollution," McDuffie said. They may otherwise not have this information readily available to them. "This provides them with a start."

Apples to apples

One unique aspect of this research is its use of the same underlying datasets and methodology to analyze pollution on different spatial scales.

"Previous studies end up having to use different emissions data sets or models all together," said first author Erin McDuffie. In those instances, it is difficult to compare results in one place versus another.

"We can more directly compare results between countries," McDuffie said. "We can even look at pollution sources in places that have implemented some mitigation measures, versus others that haven't to get

a more complete picture of what may or may not be working."

More information: Erin E. McDuffie et al, Source sector and fuel contributions to ambient PM2.5 and attributable mortality across multiple spatial scales, *Nature Communications* (2021). DOI: 10.1038/s41467-021-23853-y

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