Breathing is going to get tougher as hotter temps mean more air pollution, says study

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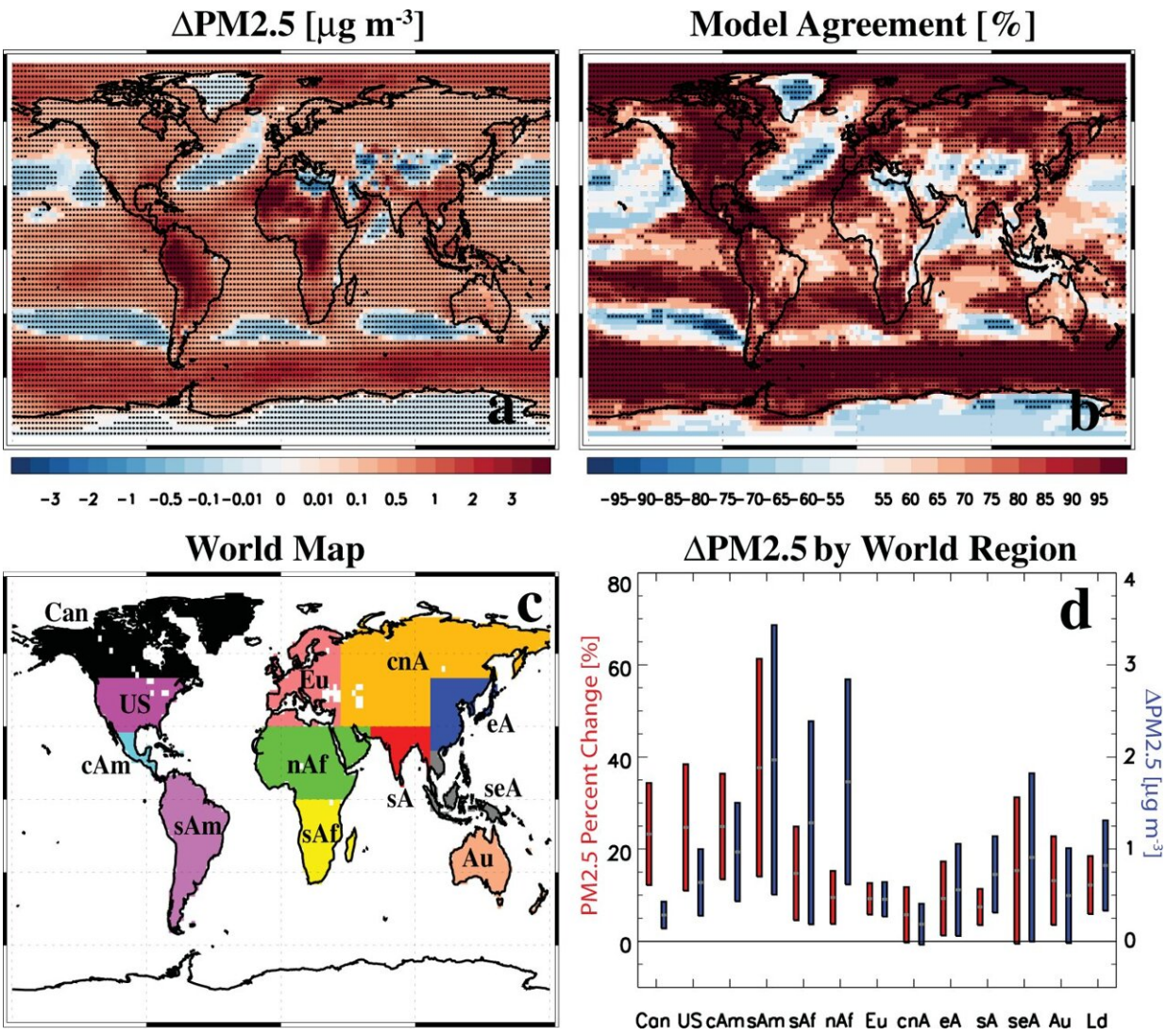

$PM_{2.5}$ response to GHG-induced warming. **a** Multi-model mean annual mean $PM_{2.5}$ response [μg m^{-3}]; **b** model agreement on the sign of the $PM_{2.5}$ response [%]; **c** 12 world regions; and **d** absolute [μg m^{-3}] and relative [%] $PM_{2.5}$ response

by world region. Dots in **a** represent a significant response at the 90% confidence level based on a two-tailed pooled *t*-test. Red (blue) colors in **b** indicate model agreement on a $PM_{2.5}$ increase (decrease). Dots in **b** represent a significant model agreement at the 90% confidence level based on a two-tailed binomial test. Bar center (gray horizontal line) in **d** shows the multi-model mean response and bar length represents the 90% confidence interval estimated as $1.65\times\sigma/\sqrt{n_m}$, where σ is the standard deviation across models and n_m is the number of models. The following abbreviations are used: Canada (Can; black), United States (US; magenta), Central America (cAm; sky blue), South America (sAm; purple), south Africa (sAf; yellow), north Africa (nAf; green), Europe (Eu; pink), central and north Asia (cnA; orange), east Asia (eA; navy), south Asia (sA; red), southeast Asia (seA; gray), and Australia (Au; beige). The average over these 12 land regions is abbreviated as “Ld". Credit: *Communications Earth & Environment* (2023). DOI: 10.1038/s43247-023-00688-7

Not all pollution comes from people. When global temperatures increase by 4°C, harmful plant emissions and dust will also increase by as much as 14%, according to new UC Riverside research.

The research does not account for a simultaneous increase in human-made sources of air pollution, which has already been predicted by other studies.

"We are not looking at human emissions of air pollution, because we can change what we emit," said James Gomez, UCR doctoral student and lead author of the study. "We can switch to electric cars. But that may not change air pollution from plants or dust."

Details of the degradation in future air quality from these natural sources have now been published in the journal *Communications Earth & Environment*. About two-thirds of the future pollution is predicted to

come from plants.

All plants produce chemicals called biogenic volatile organic compounds, or BVOCs. "The smell of a just-mowed lawn, or the sweetness of a ripe strawberry, those are BVOCs. Plants are constantly emitting them," Gomez said.

On their own, BVOCs are benign. However, once they react with oxygen, they produce organic aerosols. As they're inhaled, these aerosols can cause infant mortality and childhood asthma, as well as heart disease and lung cancer in adults.

There are two reasons plants increase BVOC production: increases in atmospheric carbon dioxide and increases in temperatures. Both of these factors are projected to continue increasing.

To be clear, growing plants is a net positive for the environment. They reduce the amount of carbon dioxide in the atmosphere, which helps control global warming. BVOCs from small gardens will not harm people.

"Your lawn, for example, won't produce enough BVOCs to make you sick," Gomez explained. "It's the large-scale increase in carbon dioxide that contributes to the biosphere increasing BVOCs, and then organic aerosols."

The second-largest contributor to future air pollution is likely to be dust from the Saharan desert. "In our models, an increase in winds is projected to loft more dust into the atmosphere," said Robert Allen, associate professor of Earth and Planetary Sciences at UCR and co-author of the study.

As the climate warms, increased Saharan dust is likely to get blown

around the globe, with higher levels of dust in Africa, the eastern U.S., and the Caribbean. Dust over Northern Africa, including the Sahel and the Sahara, is likely to increase due to more intense West African monsoons.

Both organic aerosols and dust, as well as sea salt, black carbon, and sulfate, fall into a category of airborne pollutants known as $PM_{2.5}$, because they have a diameter of 2.5 micrometers or less. The increase in naturally sourced $PM_{2.5}$ pollution increased, in this study, in direct proportion to CO_2 levels.

"The more we increase CO_2, the more $PM_{2.5}$ we see being put into the atmosphere, and the inverse is also true. The more we reduce, the better the air quality gets," Gomez said.

For example, if the climate warms only 2°C, the study found only a 7% increase in $PM_{2.5}$. All of these results only apply to changes found in air quality over land, as the study is focused on human health impacts.

The researchers hope the potential to improve air quality will inspire swift and decisive action to decrease CO_2 emissions. Without it, temperatures may increase 4°C by the end of this century, though it's possible for the increase to happen sooner.

Gomez warns that CO_2 emissions will have to decrease sharply to have a positive effect on future air quality.

"The results of this experiment may even be a bit conservative because we did not include climate-dependent changes in wildfire emissions as a factor," Gomez said. "In the future, make sure you get an air purifier."

More information: James Gomez et al, The projected future degradation in air quality is caused by more abundant natural aerosols in

a warmer world, *Communications Earth & Environment* (2023). DOI: 10.1038/s43247-023-00688-7

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