Fine-tuning air pollution models

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Urban air pollution doesn't equally affect all residents. Credit: SreeBot/Wikimedia Commons, CC BY 3.0

Air pollution doesn't affect everybody the same way. And in a new study, researchers developed a method to improve estimates of how, within cities, different communities are exposed to fine particulate

matter ($PM_{2.5}$).

Globally, $PM_{2.5}$ is estimated to cause 4.7 million premature deaths each year, and in the United States, communities of color face the most intense exposure to the chemicals. To estimate levels of exposure to air pollution, the Intervention Model for Air Pollution (InMAP) estimates air quality with fine spatial resolution, especially in densely populated areas. Because the model can assess differences in pollution exposure within cities, it can be useful in designing policies that include environmental justice.

However, InMAP overestimates and underestimates specific $PM_{2.5}$ chemicals: It underestimates particulate sulfate and overestimates particulate ammonium. In a new study, Gallagher and colleagues develop a method to correct those biases.

The researchers developed bias correction factors, or scaling factors, for InMAP using measurements of different $PM_{2.5}$ chemicals. They used pollution monitoring data collected on the ground by the U.S. EPA and satellite data processed by Washington University in St. Louis. Comparing InMAP's predictions with these data sources allowed them to gauge and correct for errors.

The authors tested how InMAP with and without scaling factors performed using an established goal of 10% error in its predictions. Without the scaling factors, InMAP underestimated or overestimated $PM_{2.5}$ concentrations by greater than 10%. Introducing city-specific scaling factors, however, improved model fit and reduced the error below the 10% threshold. In addition, the authors found that their method was most effective in the densest population areas of cities.

The authors published all scaling factors for public use and recommend they be used when researching how air pollution differs across race,

ethnicity, income, and other demographic traits.

More information: Ciaran L. Gallagher et al, Combining Satellite-Derived PM 2.5 Data and a Reduced-Form Air Quality Model to Support Air Quality Analysis in US Cities, *GeoHealth* (2023). DOI: 10.1029/2023GH000788

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