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First nationwide ultrafine particle study paves the way for understanding health effects

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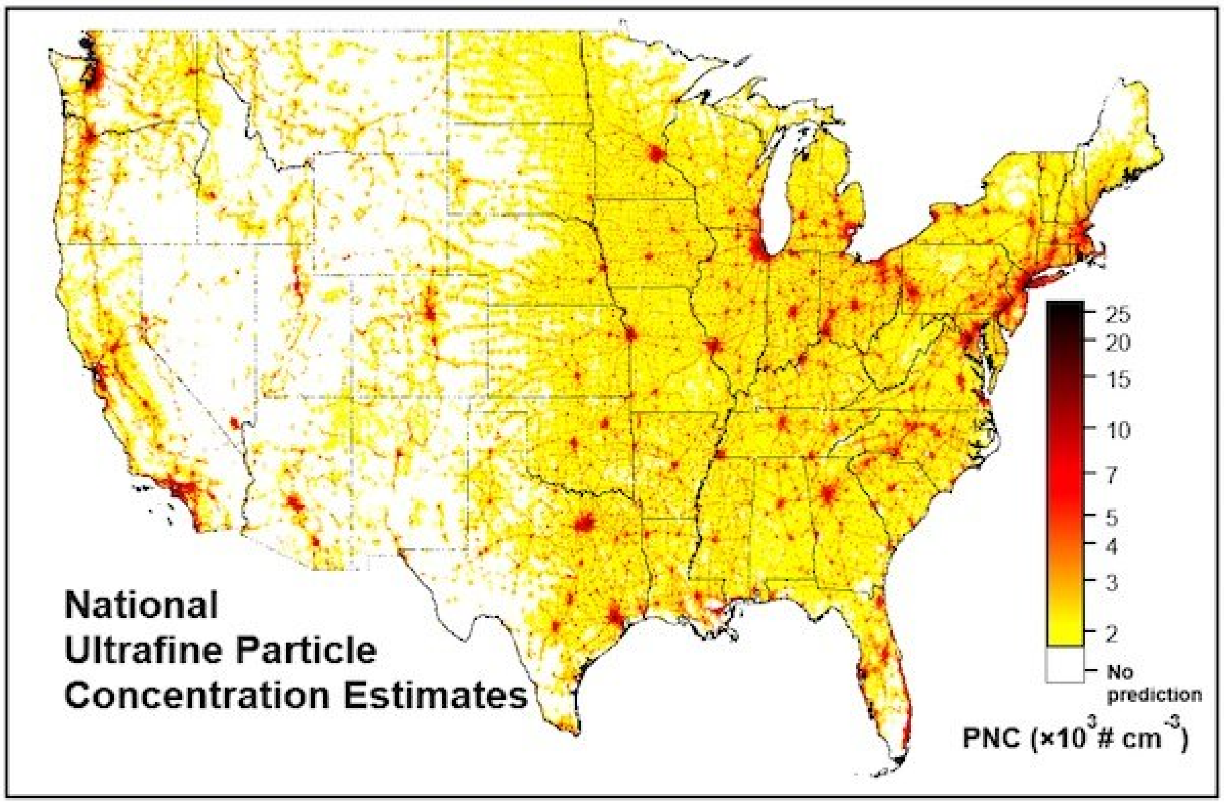

Studies on the health effects of ultrafine particles (UFP) have been inconclusive and inconsistent due to the lack of a national-scale UFP study. A collaborative research team is working to change that. Credit: College of Engineering, Carnegie Mellon University

It is widely known that air quality contributes to health conditions thanks to nationwide studies of particulate matter (PM). However, there is growing evidence that the most toxic particles are ultrafine particles (UFP), those smaller than 1/50th the diameter of a human hair. Studies on the health effects of ultrafine particles have been inconclusive and inconsistent due to the lack of a national-scale UFP study, but a team led by Carnegie Mellon University professors Albert Presto and Allen Robinson, postdoctoral researcher Provat Saha, and collaborators from the University of Washington and Virginia Tech, worked to change that.

As part of the Center for Air Climate and Energy Solutions (CACES), the team developed the first national model estimate for airborne ultrafine particle concentrations. The model will ultimately lead to a better understanding of UFP effects on health, and could one day impact air pollution policy. The findings were published in *Environmental Science and Technology.*

The center's initial project was focused on figuring out how to measure air pollution at high spatial and temporal resolutions. After successfully completing studies at local levels, the team recognized that most American cities share similarities—people buy the same cars and stop to eat at the same fast-food restaurants—so the researchers developed a national estimate.

The team analyzed a national particle number concentration (PNC) dataset that consisted of fixed-site measurements from 19 urban locations, 15 rural locations and four near airport locations. The team also used their mobile laboratory to gather spatially dense data—the number of ultrafine particles in any given area (PNC) and the mass of those particles ($PM_{2.5}$) from Pittsburgh, Pa., Oakland, Calif., and Baltimore, Md.

With this data, the team created a land-use regression model—a statistical model that uses land-use, such as traffic on roadways—to predict concentrations in locations where they didn't have measurements. They concluded that the average urban PNC is roughly three times larger than the rural PNC. PNC peaks in downtown and commercial areas indicating that local sources, including traffic and commercial cooking, drive this variation. Additionally, they found that PNC and $PM_{2.5}$ are moderately correlated at the city scale but uncorrelated nationally. This indicates that moving forward, epidemiologists studying the health effects of UFP should concentrate on effects of PNC versus those of $PM_{2.5}$.

Current U.S. pollution regulations target $PM_{2.5}$ but not PNC. Because PNC was found to be strongly related to traffic and urban air pollution, and its intra-city distribution was different from $PM_{2.5}$, perhaps targeting $PM_{2.5}$ is not enough to reduce PNC. Regulations will likely need to focus specifically on PNC in order to reduce concentrations.

With this, the team's research on PNC and $PM_{2.5}$ is just beginning. They will be building on this study to analyze $PM_{2.5}$ based on sources, such as traffic and commercial cooking. They plan to then unfold the results of both studies to tell the environmental justice story that lays beneath them.

More information: Provat K. Saha et al, High-Spatial-Resolution Estimates of Ultrafine Particle Concentrations across the Continental United States, *Environmental Science & Technology* (2021). DOI: 10.1021/acs.est.1c03237

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