



Driving Up Air Pollution

Air pollution causes the premature deaths of an estimated seven million people each year, and it makes life worse for all of us. People with asthma can experience chest tightness, coughing or wheezing, and difficulty breathing when triggered by air pollution. One major source is gas- and diesel-powered cars and trucks, which emit “ultrafine” particles less than 0.1 micrometers across.



That’s about the width of the virus that causes COVID-19—so tiny that these particles are not currently regulated by the US Environmental Protection Agency. Yet ultrafine particles can easily enter your lungs and be absorbed into your bloodstream, causing health issues such as an asthma attack or even neurodegenerative diseases. Mathematics can help us understand the extent of the problem and how to solve it.

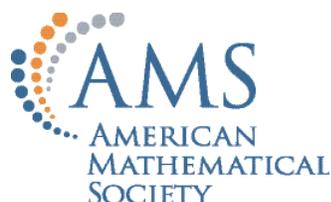
Researchers built a “reaction-diffusion” mathematical model using partial differential equations that describe how pollutants grow in the environment (reaction) and spread through the air (diffusion), combined with techniques from epidemiological models that describe asthma attacks. The model takes into consideration factors such as the gasoline burning rate, travel time, and urban versus rural traffic, all based on real-world measurements. When they crunched the numbers, the mathematicians found a threshold quantity below which vehicle emissions would be much less likely to trigger asthma episodes in the asthmatic population. Based on this research, adding particle filters to gas-powered vehicles and shifting to more electric vehicles would help make the air safer for everyone to breathe.

For More Information: “On the spread of ultrafine particulate matter: A mathematical model for motor vehicle emissions and their effects as an asthma trigger,” M. N. Rosado-Pérez and K. Ríos-Soto, *International Journal of Biomathematics* 15(1), 2022.

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