CMU researcher studies variation in pollutant emissions

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Presto and his team are working to characterize the intra-city variation in pollution emissions such as how emissions vary between the night lull and rush hour traffic, or how roadway pollutants are different than those emitted from coke factories. Credit: Carnegie Mellon University Mechanical Engineering

Cities are known to wear an unfortunate toupee of air pollution. Even with EPA standards and the development of green infrastructure, pollutant emissions are much higher in populous cities than in the sprawling countryside. But though much research has been done into how air pollutant levels vary from city to city and from urban to rural areas, efforts have been rare to characterize the intra-city variation in pollution emissions: for instance, how emissions vary between the night lull and rush hour traffic, or how roadway pollutants are different than those emitted from coke factories.

But Albert Presto, an assistant research professor in the Department of Mechanical Engineering, has been awarded a National Science Foundation grant of $600,000 to do a comprehensive study of the variation in pollutant emissions within one city—starting with Pittsburgh.

"The way the research is designed is to look at different case studies," says Presto. "One case study is near a road, one has an industrial influence and one is an urban to rural transect, where we would start way to the west of the city, drive all the way through the city and go out to the east. It's not that we want to study Pittsburgh to death; the idea is to use Pittsburgh as a sort of laboratory."

At the core of Presto's research is what's called organic aerosol. Fine airborne particulates of 2.5 micrometers or less (PM2.5) are comprised of innumerable different components, and one of its major components—which is made up of thousands of different types of particles in its own right—is organic aerosol, making up approximately 50% of PM2.5 mass.

"Some organic aerosols can be lubricating oil from your car that hit a hot surface and evaporated," says Presto, "and when it got out of the tail pipe it cooled back down and went back to being a particle. Some organic aerosols are molecules that look like sugars. And because there are so many different components of organic aerosol—literally, thousands—we can't measure every single one. We want to broadly classify it: in different areas and at different times, is it more like motor oil, or is it more like these sugars?"

Presto and his team of graduate students will collect data for this research using a combination of both stationary and mobile data. With an established base station taking atmospheric samples year-round, they will also take samples and measurements using the Mobile Air Quality Labs: vans that have been outfitted with sampling equipment so as to take atmospheric readings while driving.

Obtaining such comprehensive, fine-scale characterizations of the organic aerosol compositions in Pittsburgh's air will have promising implications for public health. Knowing the sources of and variation between different types of organic aerosol pollutants will provide an understanding of how different compositions of PM2.5 affect human health differently.

"A lot of the research in air pollution and in PM2.5 in particular is driven by human health," says Presto. "We know that exposure to PM2.5 leads to a lot of different health problems, including a shorter life span. We've known that for a while. But what hasn't necessarily been known, and what people are starting to push on now, is does the composition matter? Is it just how much mass of particles you breathe in, or does it matter if the same mass has a different composition? So those are problems we're going to try to address."

Provided by Carnegie Mellon University Mechanical Engineering