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Scientists Find New Dangers in Tiny but Pervasive Particles in Air Pollution

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Fine atmospheric particles — smaller than one-thirtieth of the diameter of a human hair — were identified more than 20 years ago as the most lethal of the widely dispersed air pollutants in the United States. Linked to both heart and lung disease, they kill an estimated 50,000 Americans each year. But more recently, scientists have been puzzled to learn that a subset of these particles, called secondary organic aerosols, has a greater total mass, and is thus more dangerous, than previously understood.

A batch of new scientific findings is helping sort out the discrepancy, including, most recently, a study led by scientists at the University of California, Irvine, and the Pacific Northwest National Laboratory in Richland, Wash., that is scheduled to be released on Tuesday. It indicates that the compounds' persistence in the atmosphere was under-represented in older scientific models. "If the authors' analysis is correct, the public is now facing a false sense of security in knowing whether the air they breathe is indeed safe," said Bill Becker, of the National Association of Clean Air Agencies.

Taken together, the findings of the new study and of a handful of others published in the past two years could mean that two decades' worth of pollution-control strategies — focused on keeping tiny particles from escaping into the atmosphere — have addressed only part of the problem.

Scientists and regulators say that new models, strategies and technologies would be needed to address the secondary organic aerosol particles, which are formed not during combustion but later, in the wake of interactions between pollutants and natural chemical compounds.

Paul Shepson, a professor of analytical and atmospheric chemistry at Purdue University and one of the reviewers of the Irvine paper, called it "highly significant in scientific terms," adding that current models of fine particulates "grossly underpredict" their density, "sometimes by as much as a factor of 10."

A former regulator agreed. "There's no doubt this is important stuff," said Jeffrey R. Holmstead, who ran the Environmental Protection Agency's air and radiation program during the administration of President George W. Bush. "It may be harder than we thought" to clean the fine particles out of the air and protect public health, he said, "but if we really know what's causing it, we can focus our efforts more."

Mr. Holmstead added that the findings could significantly affect the future design and implementation of air-pollution control strategies and that regulators would have to rethink the models that inform air quality rules.

This new information has scientists questioning whether climate change modeling should be adjusted as well. The E.P.A. has announced that it is reassessing the national ambient air quality standards for fine particulates,

which were last set in 2006 at levels higher than the agency's staff and scientific advisers had recommended. The agency's most recent data show that airborne particles decreased 27 percent from 2000 to 2010.

A spokeswoman for the E.P.A. said the agency usually declined to comment on individual studies, preferring to incorporate them into its larger analyses during the rulemaking process.

The Irvine study of the formation of secondary compounds in the atmosphere, which will be published in the Proceedings of the National Academy of Science, upends previous assumptions about the fate of the byproducts of the pollution from internal-combustion engines. These gaseous byproducts were thought to incorporate themselves into tiny airborne drops of liquid that would then dissipate quickly as the drops evaporated.

The new study finds instead that they attach themselves more tightly to airborne organic particles, creating tiny tar balls that evaporate more slowly and persist longer than anyone had thought. E.P.A. models built on these assumptions now appear to understate the total amount of fine particles, according to Barbara J. Finlayson-Pitts, a professor at Irvine and one of the study's authors.

"If you're going to use models in a predictive sense, you need to make sure they are getting the right answer for the right reasons," she said. "Right now most models are not getting the right answer."

Allen Robinson, a professor of engineering and public policy at Carnegie Mellon University, focuses his work on fine particulates and their regulation. "We haven't been trying to control a lot of the organics," he said of the subset of particles that is the subject of the new findings.

Emissions of coal-fired power plants do not play a role in the formation of these organic particles, several scientists said, but they do come into play in the formation of sulfide-based particles.