Could US wildfires be contributing to heart disease?

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The destructive force of wildfires in the U.S. is well documented. Every year, on both the east and west coasts of the country, and due to both environmental and man-made factors, fires rage, and homes and habitats are destroyed. But beyond the obvious dangers, these fires cause other, more invisible damages. Certain nanoscale particles in the atmosphere known as organic aerosols—particles released when organic materials like trees and other plant matter are burned—have been linked to an increased risk of heart disease, and even death.

These particles don't just pose a threat to the region where the fire burns. Until now, most models of atmospheric particle movement have made certain assumptions about how these organic aerosols will affect human health based on how they react with the atmosphere. But in their recent paper published in *Atmospheric Environment*, authors Spyros Pandis, professor of chemical engineering; Allen Robinson, head and professor of mechanical engineering; and Laura Posner, chemical engineering Ph.D. alumna, are challenging those assumptions, and revealing just how dangerous organic aerosol emissions can be.

"Biomass burning is a major global source of organic aerosols," the authors write in the paper. "Biomass burning organic aerosol can contribute significantly to organic aerosol concentrations both locally and far downwind of fires."

Traditionally, organic aerosols are divided into two categories, based on how they enter the atmosphere: primary organic aerosol (POA), and secondary organic aerosol (SOA). POA is directly emitted into the atmosphere as particles, while SOA is formed when some of the products of volatile organic compound oxidation condense in the atmosphere. Current chemical transport models, which track the movement of particles in the air, focus on POA emissions from fires, but neglect those from SOA.

Because of this assumption, these chemical transport models only account for the damages caused by POA, which are mostly in the burn's immediate vicinity—the local area around the fire. This new research suggests, however, that only taking POA into account is only telling half the story—and that the effects of SOA can pose a threat to the health of people much further from the fire's source.

The team used a three-dimensional transport model to understand how much these emissions from wildfires contributed to the total organic aerosol concentrations in the continental U.S. for three representative months during spring, summer, and fall. The model showed that while POA remained the most severe contributor to organic aerosol concentrations near the burned area, incorporating SOA into those measurements made the transport model much more accurate when compared to the observed levels of organic aerosol than other predictive models—at least for the spring and summer. In the fall, on the other hand, the model had a tendency to over predict the levels of organic aerosol, suggesting a correlation between the temperature and the proliferation of these emissions.

"Atmospheric chemistry acts as a booster," says Pandis, "producing additional particulate matter as the plume moves away from the fire one or two days later. The effects, of course, get smaller as one gets away from the fire, but it can remain significant up to six hundred miles away—even if it's no longer visible as thick smoke. This enhancement is stronger during warm sunny days."

The authors hope that this research will help expand the public's understanding of the severity of these wildfires and the importance of limiting them in the future, just as we try to limit other sources of harmful emissions.

"The evidence suggests that these emissions are just as bad for our health as that of other combustion sources, such as vehicle and industrial emissions," says Pandis. "The emissions from wildfires contain thousands of complex organic compounds, some of them carcinogenic."

More information: Laura N. Posner et al. Simulation of fresh and chemically-aged biomass burning organic aerosol, *Atmospheric Environment* (2018). DOI: 10.1016/j.atmosenv.2018.09.055

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