Dust to Dust: A Particularly Lethal Legacy

Particulates—dust-sized air pollutants, including soot and sulfates—inflict much more harm than previously thought, according to a series of new studies. By correlating daily weather, air pollutants and mortality in five U.S. cities, a federal scientist has discovered that nonaccidental death rates tend to rise and fall in near lockstep with daily levels of particulates – but not with other pollutants.

Because the correlation held up even for very low dust levels – in one city, to just 23 percent of the federal limit on particulates – these analyses suggest that as many as 60,000 U.S. residents per year may die from breathing particulates at or below legally allowed levels, says epidemiologist Joel Schwartz of the EPA in Washington, D.C.

Confirmation of the new findings by other researchers would make airborne particulate levels the largest known "involuntary environmental insult" to which Americans are exposed and would strengthen the case for tightening the federal particulate standard, says Schwartz, who described his analyses last week in Arlington, Va., at the annual meeting of the Society for Occupational and Environmental Health.

"I've never thought that [airborne] particles were terribly important by themselves—at least not at these levels," says David V. Bates of the University of British Columbia in Vancouver. But Schwartz's analyses have won him over. Bates says the new studies represent a "tour de force" – one "with tremendous power."

Early last year, Schwartz and Allan H. Marcus of Battelle Memorial Laboratories in Research Triangle Park, N.C., published data on 14 London winters, showing a "likely causal" relationship between daily mortality and daily elevations in so-called "British smoke" – a roughly quantifiable gauge of airborne particulates. They focused on London because the city measures its particulate levels daily. Nearly all U.S. cities measure particulates only every sixth day – too infrequently, Schwartz says, to identify acute changes in mortality.

While analyzing the London data, Schwartz learned that Philadelphia and Steubenville, Ohio, had 10 years' worth of daily particulate readings. He looked at their weather, pollution and daily mortality, and again found a clear, statistically significant association between increased "total suspended particulates" one day and elevated mortality the next.

"Part of the reason nobody found this association before is simply because the statistical techniques required to do the analysis [for small populations or data sets] are quite difficult," says C. Arden Pope, an environmental economist at Brigham Young University in Provo, Utah. Schwartz "is to my knowledge the first to have applied them to mortality and air pollution data," Pope says, "and he did an excellent job."

In 1987, EPA switched from requiring the measurement of all particles suspended in the air to assaying only the respirable fraction – particles with a diameter of 10 microns or less. Schwartz identified two cities that had compiled daily logs of these "PM_{10}" data for roughly a year: St. Louis and Kingston, Tenn. He also correlated the type of daily "visibility" data compiled by airports with every-sixth-day particulate data for Detroit, producing a computed estimate of Detroit's daily particulate levels.

In analyzing the data for these three cities, Schwartz found exactly the same trend identified in London, Steubenville and Philadelphia. Daily particulate pollution correlated with mortality rates, while sulfur dioxide—a gaseous pollutant long suspected of affecting mortality—showed no effect. Moreover, the magnitude of the particulates' effect on mortality proved nearly identical in each U.S. city: a roughly 6 percent increase in deaths for every 100 micrograms of total particulates (or roughly 50 micrograms of PM_{10}) per cubic meter of air.

Such a uniform impact per given change in exposure – in five U.S. cities with vastly different sizes, climates and mixes of air pollutants – argues "very convincingly, both epidemiologically and statistically," that the observed correlations are real, Schwartz asserts.

His Philadelphia data also indicate that people who appeared to succumb to the particulates tended to be elderly and already quite sick, usually with respiratory disease. For every 100 micrograms of particulates per cubic meter of air, Schwartz found that the risk of dying increased by 32 percent from emphysema, 19 percent from other chronic obstructive lung diseases (such as bronchitis and asthma), 12 percent from pneumonia and about 9 percent from cardiovascular disease. Previous studies had linked increases in airborne particulates with children's respiratory symptoms and hospital admissions for bronchitis and asthma (SN: 5/6/89, p.277).

The new findings also suggest that particulates are more toxic than smog ozone, says Bart D. Ostro, chief of air pollution epidemiology at California's Department of Health Services in Berkeley.

But exactly how particulates might contribute to mortality remains unknown. "I have no idea what the mechanism is," says Bates, a chest physician and air pollution epidemiologist. "Nor has anyone else." *– J. Raloff*

A bright spot in Hubble's troubled eye

NASA

Flawed, yes, but the Hubble Space Telescope nonetheless provides the sharpest images of Mars yet taken from Earth's vicinity. It can capture details about 50 kilometers across, compared with the 150-km resolution of ground-based photos.

A seven-member team led by Philip James of the University of Toledo in Ohio now plans periodic Hubble observations for a long-term study of Mars' changing surface and atmosphere, including its occasional global dust storms.

The first image in the series, made Dec. 13 and released last month, shows Syrtis Major Planitia (dark area, middle). Such Martian dark regions appear covered with coarse sand grains about 100 microns across, says Steve Lee of the University of Colorado in Boulder; the lighter surface apparently consists of dust particles no bigger than 1 micron.

The light-blue feature along the picture's upper-right edge represents a "hood" of water ice in the atmosphere above the Martian north pole, extending to a height of 10 kilometers or more. Using ultraviolet filters, the team has also produced what one member calls the first ozone map of Mars.