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Pollutants: Up in flames

By Janet Raloff 3:13pm, December 2, 2009

NEW ORLEANS Forest fires have the potential to release toxic industrial and agricultural pollutants previously trapped on soil. After glomming onto smoke particles, these chemicals can hitch long-distance rides — sometimes across oceans — before they're grounded again and contaminate some new region, scientists report.

FIRE AWAY Forest fires can bake decades worth of pollutants out of soils and loft them into the air,.
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In the case of pesticides and polychlorinated biphenyls, or PCBs, these pollutants can land in regions where the compounds are now banned — or even in the Arctic, where they were never used.

And with global warming, the frequency of forest fires is projected to increase, according to the most recent report of the Intergovernmental Panel on Climate Change.

“What that means,” concludes Staci Simonich of Oregon State University in Corvallis, one of the new studies’ authors, “is that there’s a growing potential for these persistent organic pollutants, which have been deposited in ecosystems over the decades, to move around.”

Simonich, Susan Genualdi (also of Oregon State) and their colleagues shared their findings last week at the Society of Toxicology and Environmental Chemistry annual meeting in New Orleans.

In one study, they tracked pollutant plumes passing over two air monitoring stations on remote mountains in the Pacific Northwest during several wildfire events in 2003. One especially intense and protracted burn in Siberia scorched nearly 19 million hectares (almost 74,000 square miles). Satellite imaging of smoke plumes and modeling of air mass trajectories allowed the chemists to track the source of pollutants reaching the air samplers from Siberia and elsewhere. Various markers of burned wood, such as levoglucosan and retene, confirmed that certain plumes indeed had wafted from very-distant wildfires.

Although many pesticides were found in air masses passing over the samplers, these analyses indicated that only some — notably dieldrin and alpha-hexachlorocyclohexane (or alpha-HCH) — were correlated with Siberian fires (versus wildfires elsewhere in Asia and the United States).

Further indicting fires as a source of pollutant purging from soils came from dirt that Genualdi collected from opposite sides of a two-lane road in the Deschutes National Forest in Oregon immediately after a 2003 wildfire had swept through.

That road had served as a firebreak. And compared to soils on the unburned side, dirt that had been subjected to a fire’s intense heat lost a minimum of 90 percent of its dieldrin, alpha-HCH, endosulfan sulfate and dacthal. Prior to the burn, these pesticides had constituted some of the highest-concentration pollutants present — with some at 500 to 1,200 parts per billion. PCB values also diminished in fire-exposed soil, although their starting concentrations had been far lower, with only one approaching 100 ppb.

Genualdi uncovered further chemical evidence pointing to some of the revolatilized pesticides as being legacy pollutants — i.e. antiques from use decades earlier.

Most pesticides come in two structural forms, a left- and right-handed version. During manufacturing, each not-quite-identical twin tends to make up about half of the batch. Although their subtle structural difference often renders one twin all or partially inactive, manufacturers find it’s easier not to bother removing the dud. So they sell the chemicals in a 50:50 ratio.

Soil microbes can detect the pesticides’ structural differences and often find one twin considerably less appetizing, Simonich says. So they’ll preferentially degrade the other one. And the longer a pollutant is exposed to these bugs in the environment, the more skewed its ratio of left- to right-handed twins generally will become. Genualdi used analyses of such ratios to spot legacy pollutants.

But the technique is not foolproof. For instance, although the United States banned the long-used termite-killing chlordane in 1988, some chlordane in the air passing over the pollutant samplers that Simonich and Genualdi studied still hosts a roughly 50:50 ratio of left- to right-handed pesticidal twins.

For pollutant plumes entering the western United States from the Pacific, this might indicate that the compound continues to be used in upwind regions of Asia.

But the virtually 50:50 mix is also seen in air coming from some urban U.S. sites. In this case, a more likely explanation for the banned pollutant's presence is that it's offgassing from deposits around homes where the chemical would have been applied decades earlier to vanquish termites — confined spaces that, for any of several reasons, never experienced much microbial degradation.

Citations

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