Asian pollutants found atop Mount Bachelor

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Professor Dan Jaffe holds a 1-inch disk that collects tiny particles of dust extracted from the atmosphere in a frigid shelter at the top of Mount Bachelor.

Links

Jaffe Research Group:
http://research.uwb.edu/jaffegroup/modules/news

Simonich Lab:
http://emt.oregonstate.edu/simonich

MOUNT BACHELOR SUMMIT -- In a frigid shelter at the top of Mount Bachelor, Dan Jaffe brushed the snow from a rough plywood table, laid out a clean tissue, and unscrewed a stainless steel fitting from one of his scientific instruments.

The University of Washington-Bothell professor of atmospheric and environmental chemistry removed a 1-inch disk with a hole in the center. There, on a shiny film of grease, five dull black dots made up of tiny soot particles appeared. He passed it around for the graduate students to see.

"Some of those particles," he said, "came from Asia."

At 9,000 feet at the crest of the Cascade Range, the air is some of the cleanest to be found anywhere in the United States. But each breath -- especially in the spring -- can suck in tiny amounts of pollution from China and elsewhere in Asia. Soot, dust and chemicals come from coal-fired power plants, cars and trucks, forest fires, desert dust storms and even wood cooking fires.

China now emits more carbon dioxide -- the atmospheric pollutant that is primarily responsible for global warming -- than any other nation. But scientists working on mountaintops, with computer models and with aircraft stuffed with instruments are also worried about the effects of these lesser-known pollutants here.

"One might think of these sources as small in terms of their contribution. But it's a contribution on top of what we already have," said John Spengler, professor of environmental health and human habitation at the Harvard School of Public Health.

The U.S. Environmental Protection Agency recognizes that air pollution travels great distances, said Bill Wehrum, EPA's acting assistant administrator for air and radiation.

What is not known, he said, "is how much pollution is moving over those distances, how much real impact it is having on public health downwind in the environment.

"The Europeans are asking that question about emissions from the United States. Asians are asking that question about emissions from Europe. And the United States is asking that question about emissions from Asia."

Early studies

In 1994, Jaffe was in Oslo, Norway, on sabbatical when he came across a computer model that indicated that pollutants in the Arctic were coming from China.

Back in the States, he secured a grant from the National Science Foundation to measure them. His first observatory was on Cheeka Peak, a 1,598-foot mountain on the tip of Washington's rainy Olympic Peninsula about 120 miles west of his home in Seattle.

In 1999, Jaffe took instruments to higher altitudes in airplanes flying off Washington and California. They found more pollution, particularly between 6,000 feet and 20,000 feet.

That led him in 2004 to the 9,000-foot summit of Mount Bachelor, a ski resort in the Cascade Range of Central Oregon, and to its ski lift house.

Hooded air intakes handcrafted from sheet metal lead to tiny rooms packed with instruments that measure carbon monoxide, ozone, mercury, soot and radon. Jaffe can read the instruments on his office computer, but must visit the site every few months to keep things running.

Since 2000, satellites have been able to watch dust, soot, ozone and nitrous oxides as they are blown across the Pacific at high altitudes. The dust and soot are visible. The gases show up in refracted wavelengths of light bouncing back to the satellites.

"By looking at the ratios of different pollutants, particularly carbon monoxide and mercury, we can actually say the ratio of these pollutants we are seeing here at Mount Bachelor matches the ratio of pollutants coming right out of China," Jaffe said.

"This is, in effect, a fingerprint -- a chemical fingerprint. When we see all these indicators, meteorological data, the satellite data, the pollutants fingerprint, we can be very confident these are pollutants coming across from Asia."

Staci Simonich, an assistant professor at Oregon State, also has instruments on top of Mount Bachelor. She and her graduate students are looking for things such as pesticides and PCBs, an industrial chemical outlawed in this country that causes cancer. The toxins attach to their own favorite sizes of dust and soot.

While levels are very low, "it's only going to increase from everything we know about the use of energy in those countries," Simonich said.

The spring offers prime conditions for pollution to travel from China to the United States. That's when a low pressure area forms over the east China Sea or the Sea of Japan, combined with a cold front that kicks the pollutants up into the free troposphere, the clear air above the haze you see when you take off in an airplane. The prevailing winds send the pollutants straight across to the United States.

In 2003, Jaffe and Dave Parrish of the National Oceanographic and Atmospheric Administration published a paper that found an increase in ozone over the Pacific of 10 parts per billion in 18 years.

"That's a fairly significant rate in that background air is only about 40 parts per billion and the standard is 80 parts per billion," Jaffe said. "That is going to make it harder for us to meet our own air quality standards."

And those standards likely will get tougher. On June 21, the EPA proposed lower limits for ground-level ozone, the principal component of smog, saying the current standards don't protect the public health.

Daniel Jacob, professor of atmospheric chemistry and environmental engineering at Harvard

University, says that Asian emissions are growing 5 percent to 10 percent per year, and the trend is likely to continue through the next decade. He manages the GEOS-Chem computer model, developed by scientists around the world to study the effects of global emissions on U.S. air quality.

"The cars and factories we have in the United States are among the cleanest in the world, and it's difficult to make them cleaner," Jacob said. "So the question is whether we should maybe invest some basic air pollution controls in China as a more cost-effective way of dealing with some of the pollution problems we have."

The United States and the Natural Resources Defense Council, an environmental group, are working with China to increase the efficiency of energy production and boost conservation. Premier Wen Jiabao has pledged to reduce energy use against gross domestic product by 20 percent by 2010. Last year energy use fell by only 1.2 percent, short of the first phase goal of 4 percent.

Barbara Finamore, who heads NRDC's China program, said the United States has an obligation to help: "The U.S. has outsourced much of its manufacturing to China and therefore outsourced the pollution inherent in that manufacturing, and that is what is coming back to haunt us."

But it is a tremendous challenge.

"Literally, there are millions of Chinese people who don't have cookstoves who actually cook on an open fire in the home they have," EPA Administrator Stephen L. Johnson said.

China uses twice as much energy per unit of gross domestic product as the world average and 10 times more than Japan, the world leader in efficiency. And more than half of the 800,000 deaths each year as a result of urban air pollution occur in China, according to the World Health Organization.

Meanwhile, China is expected to build 140 new coal-fired power plants during the next three years, and each one will last 30 to 70 years, Johnson said. "So what they do today will have a lasting legacy."

Effect on weather

While Jaffe is focused on pollution at mountaintop elevations, Veerabhadran Ramanathan, director of the Center for Clouds, Chemistry and Climate at the Scripps Institution of Oceanography in La Jolla, Calif., is looking higher.

He and Jeff Stith of the National Center for Atmospheric Research lead an international research team that is looking at dust and particulates blowing across the Pacific at up to 30,000 feet.

A Gulfstream-V jet jammed with scientific instruments scoops up air samples and analyzes them. The jet flies between Japan, Hawaii and Alaska, climbing from near the ocean's surface to 50,000 feet, constructing a profile of the layers of dust.

"For the first time we are following the dust," said Ramanathan. "Literally we are baby-sitting it all the way from Japan across the Pacific Ocean into North America."

Ramanathan is primarily interested in the weather and global warming ramifications of soot and dust. A study published this year in the Proceedings of the National Academy of Sciences, based on computer models, found that tiny particles from Asia are helping to produce stronger

and more frequent storms over the Pacific.

It comes back to the idea that the individual droplets of water vapor that make up clouds need a nucleus to form. Nature has always provided dust and soot from forest fires and dust storms in Mongolia; now combustion from cars and trucks, coal-fired power plants and millions of cooking fires are providing more.

At the same time, "by sheer dumb luck" pollution actually has helped reduce global warming by helping to form low-elevation clouds made of water vapor that reflect sunlight and heat back into space, said Ramanathan.

But when those tiny particles of soot rise to 25,000 feet, they help form clouds made of ice. Instead of reflecting sunlight, they act like another blanket on a cold winter night, trapping the heat of the earth.

Based on earlier measurements, 25 million kilograms to 30 million kilograms of soot floats over the Pacific, and about 75 percent of that is from Asia, said Ramanathan.

"At one point in the middle of the Pacific it looked like a wall of dust," said Ramanathan. "That's when I started to imagine it was like Genghis Khan. If he were to invade he would come behind this wall of dust.

"But we are ready for him thanks to this aircraft. We can measure it."

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