

China blamed for U.S. ozone

Western states caught between rising background levels and more stringent federal limits

By Eric Hand

On 10 August 2012, temperatures rose above 40°C in the San Joaquin Valley, a natural bowl in California's mid-section. The blistering heat, along with trapped air pollution, was perfect for the production of ozone, an oxygen molecule that corrodes the lungs. By the afternoon, an air quality monitor in Fresno signaled that the region was in violation of one of the legal limits set by the U.S. Clean Air Act and enforced by the Environmental Protection Agency (EPA). Combined with other violations, the event meant that the region would have to pay an annual \$29 million fine.

In May, however, regional air quality officials petitioned EPA to let them off the hook for that bad ozone day. Their excuse? It was China's fault. That August day, on a rural ridge top 168 kilometers to the west of Fresno, a sensor had picked up high levels of background ozone wafting in from the Pacific, presumably all the way from East Asia, where ozone-creating emissions are booming. The petition argued that about 10% of the ozone pollution on that day—more than enough to put the San Joaquin Valley over the limit—came from abroad.

The petition is the first time a U.S. region or state has pointed the finger at China for ozone pollution, says Seyed Sadredin, the executive director of the San Joaquin Valley Air Pollution Control District in Fresno. But as background ozone levels rise and federal standards tighten, it will not be the last, especially in high-altitude western states. "This is not just going to be a San Joaquin Valley problem," Sadredin predicts.

On 29 August, citing the latest health research, EPA staff recommended that the agency lower the ozone limit from the current 75 parts per billion to somewhere between 60 to 70 parts per billion. For areas with high background ozone levels, that leaves "very little wiggle room," says Owen Cooper, an atmospheric scientist at the Cooperative Institute for Research in Environmental Sciences in Boulder, Colorado.

Given the squeeze, the Clean Air Act needs to evolve to reflect pollution blowing across borders, contends Daniel Jacob, an atmospheric chemist at Harvard University. "It's really important that we start to take our

air quality policies beyond the state and national level and start to think about air quality on an international level."

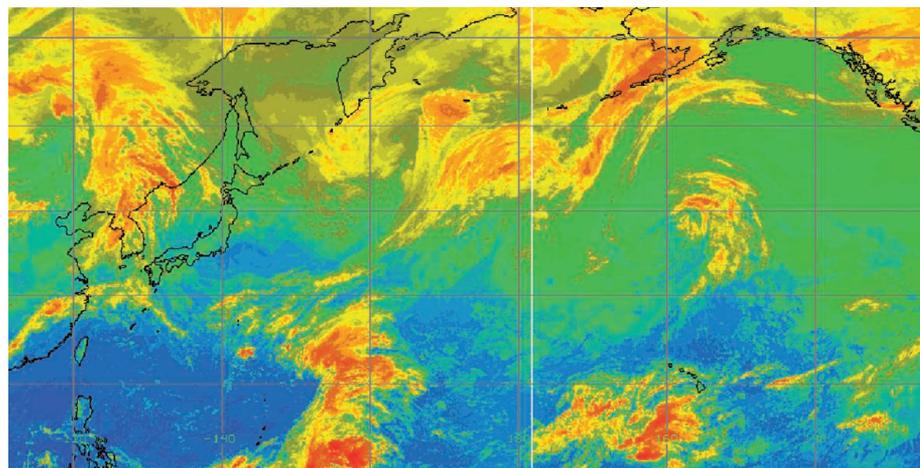
Ozone levels in the United States and Europe have dropped significantly in recent decades as clean air policies cut pollution from cars and power plants. Not so in fast-developing China, where levels of nitrogen oxides—key ozone precursors—have more than doubled between 1995 and 2010, according to a study published in October 2013 in *Atmospheric Chemistry and Physics*.

And this pollution moves. Studies have found that both the nitrogen oxides and locally produced ozone can survive in the atmosphere for days, if not weeks. During this time, the pollution can travel across the Pacific in a Northern Hemisphere "conveyor belt" of westerly winds several kilometers up. The U.S. mountain west lies right in their

Dan Jaffe, an atmospheric chemist at the University of Washington, Bothell, who in June published a study online charting the rise of background ozone at a remote site atop Mount Bachelor in Oregon. "Traditionally cities only worry in summer," when hot weather promotes ozone formation.

Tracing background ozone to a specific source is a challenge. Not all is humanmade: Forest fires and soil emissions contribute, and weather events can allow ozone from the stratosphere to mix with the lower atmosphere. In fact, in May, EPA granted the state of Wyoming a first-ever exemption for an ozone violation because of a stratospheric intrusion event. Climate change is another factor, because rising temperatures can enhance ozone production.

But it is clear that emissions from overseas lead to a significant part of the background, even if "things really get muddled when you try to get down to which city contributed what," Cooper says. In Europe, ozone pollution blowing from North America or even China is a major factor in rising background levels, notes Paul Monks, an atmospheric chemist at the University of Leicester and chair of the United Kingdom's Air Quality Expert Group. "The benefits of emission con-



In a satellite map, storm systems march across the Pacific, driven by winds that also carry pollutants.

path—and because of its altitude it also gets doses of ozone from the stratosphere, where the "good" ozone that protects Earth from ultraviolet light is made naturally.

Over the past 15 years, the western United States has experienced an overall rise in springtime background ozone of nearly a half a part per billion per year at altitudes of between 3 and 8 kilometers, according to one recent analysis of balloon and aircraft measurements. The background trends are more significant in the springtime, when conveyor belt winds from East Asia are strong and direct. "As the standard goes down, spring is going to become more important," says

controls could be significantly counterbalanced by increasing background ozone levels," he says. "It's the elephant in the room."

Sadredin is already grappling with that elephant. If EPA accepts his arguments, taxpayers in his district will stop having to pay the annual penalty. But he worries about meeting future standards. Already, there are hundreds of regulations on the books to control ozone-generating pollution—rules that govern everything from bakery ovens to brandy aging. Sadredin is running out of regulatory room. "We're down to regulating people's barbecues and hairsprays," he says. ■