ASU researchers use NASA satellites to improve pollution modeling

Detecting pollution, like catching criminals, requires evidence and witnesses; but on the scale of countries, continents and oceans, having enough detectors is easier said than done.

A team of air quality modelers, climatologists and air policy specialists at Arizona State University may soon change that. Under a grant from the Environmental Protection Agency, they have developed a new way to close the gaps in the global pollution dragnet by using NASA satellite data to detect precursors to ozone pollution, also known as smog.

The technique, devised with the aid of health specialists from University of California at Berkeley, uses satellite data to improve ASU's existing computer models of ozone events — filling in the blanks while expanding coverage to much larger areas.

"The satellite data provides information about remote locations," said Rick Van Schoik, director of ASU's North American Center for Transborder Studies. "It gives us data from oceans and about events from other countries with less advanced monitoring capabilities, such as Mexico."

Such information can have vital implications for health, especially in southern Arizona. According to Joe Fernando, a professor in ASU's department of mechanical and aerospace engineering and the environmental fluid dynamics program, who worked on the project, ozone is a key ingredient in urban smog, which affects even healthy adults and presents a special health risk to small children, the elderly and those with lung ailments. It can cause shortness of breath, chest pains, increased risk of infection, aggravation of asthma and significant decreases in lung function. Some studies have linked ozone exposure with death by stroke, premature death among people with severe asthma, cardiac birth defects and reduced lung-function growth in children.

This new satellite-assisted model could allow researchers to see an ozone plume forming and work with communities to head off health effects in advance.

"Before, if there were precursors of an ozone event, we couldn't see them — we just got hit by the pollution," Van Schoik said. "Now, we can watch the event build."

Improved oceanic coverage could also help with monitoring one of the largest sources of pollution along the coasts: oceanic ships, which are covered only by international treaties and are not regulated by the EPA.

Ozone forms when nitrogen oxides and volatile organic hydrocarbons — byproducts of fossil fuel pollution — react with one another in the presence of sunlight and warm temperatures, resulting in a chain reaction. This chain reaction can mean that large amounts of ozone can bloom from even moderate amounts of nitrogen oxides.

Scientists can detect ozone by detecting the absorption of specific wavelengths of light, but they have had to rely on ground data and radiosondes — atmospheric instrumentation bundles sent up on weather balloons — to surmount the large uncertainties associated with the technique.

"This is the reason comparisons were made between low-level ozone direct measurements with those obtained from satellites," said Fernando. "The importance is that the satellite data were used to improve model performance — that this work will lead to better model predictions and hence superior forecasting of ozone and improved health warnings."

The satellites currently provide data every 16 days. Each square, or pixel, of the grid they cover is five by eight kilometers, but Van Schoik said that the resolution would continue to improve.

“NASA has developed tools that are starting to fulfill much of the promise that we hoped for when NASA began engaging in global environmental monitoring,” he said. “With each member of our team adding their own expertise, we are seeing just how powerful that can be.”

Source: Arizona State University