

AQAST Spotlight: Arlene Fiore & U.S. EPA

U.S. Air Pollution: Domestic or Imported?

By Ben Kaldunski & Tracey Holloway

The Environmental Protection Agency (EPA) is charged with keeping air healthy across the U.S., but what happens when air pollution flows in across our borders? Identifying the sources of pollution is a critical step in designing strategies to ensure that our air stays clean. Of course, airborne chemicals do not pass through customs, or carry import/export labels. Instead, scientists must use advanced computer models of air pollution chemistry and transport combined with detective work to piece together the evidence from the available measurements to determine how other countries are affecting domestic air quality in the U.S.

Although our lungs can't distinguish local from foreign air pollution, it is essential that policy makers know the difference. Otherwise, air quality managers risk setting unattainable limits, or regulating the wrong sources of emissions. This issue is particularly significant for ground-level ozone, because the EPA is currently developing a tighter national standard and "background" sources play a major role in the U.S. ground-level ozone budget. Background ozone is defined by EPA as pollution that is formed from sources beyond the control of U.S. air quality managers. Major sources of background ozone include global methane emissions, transport from foreign countries and natural sources like wildfires and lightning.

Arlene Fiore, Associate Professor at Columbia University and a member of NASA's Air Quality Applied Sciences Team (AQAST), is one of the leading experts on the attribution of U.S. air pollution to domestic versus foreign sources. Although Fiore has been working with the EPA on this important topic for years, her involvement in AQAST has advanced her engagement with air quality managers, especially Pat Dolwick, a scientist in EPA's Office of Air Quality Planning and Standards, and Gail Tonnesen, a member of EPA's Air Quality Modeling Group at the agency's Region 8 office in Denver. "The work Arlene has done to compare modeling practices has helped us better understand the reasons why model estimates of background ozone can differ," said Dolwick, who has collaborated with Fiore on research to support federal ozone designations and pollution mitigation plans.

"A high level of background ozone implies that an area cannot attain the federal standards using traditional control methods," Fiore said. "Unlike particulate pollution, we have no way to identify where an ozone molecule came from." This is why scientists need to use models to predict seasonal and geographical variations in background ozone. Fiore's research team at Columbia uses advanced global models of atmospheric chemistry, which are evaluated against a wide range of measurement data from ground instruments and satellites, to quantify how different sources contribute to U.S. inflow. In particular, she examines how changing regional and global emissions will affect U.S. ozone levels, taking into account climate change and variability over several decades.



Dr. Fiore's research has helped EPA improve modeling capabilities to produce more accurate estimates of background ozone (Image from Columbia University).



EPA's Pat Dolwick has worked with Dr. Fiore on several AQAST research projects. The collaboration with AQAST has aligned research projects with the most pressing needs at EPA and state level air quality management agencies (Image from EPA).

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“We have leveraged a lot of Arlene’s work in characterizing background ozone,” Dolwick said. “Her work has been incorporated in several of our scientific and technical support documents for the proposed ozone standard revisions.” EPA is expected to issue new ozone standards in October 2015.

The long-term goal of Fiore’s efforts is to identify chemical indicators that could serve as “tracers” for background ozone. These tracers could be measured by satellites, or ground-based instruments, instead of relying heavily on imperfect computer models. Fiore explained that already, satellite measurements of carbon monoxide and nitrogen dioxide (a major ingredient that leads to ozone formation) have helped researchers compare simulations from air quality models against observed conditions. Gail Tonnesen, from EPA Region 8, said satellite measurements of formaldehyde also hold potential for tracking background ozone. “It is an evolving process,” Tonnesen said. “The current generation of instruments cannot provide the high resolution required to monitor ozone for compliance with the federal standards.”

The next generation of ozone monitoring instruments, mounted to geostationary satellites, could provide EPA with a powerful new set of tools for ozone background checks. The Tropospheric Emissions Monitoring of Pollution (TEMPO) instrument, which will be launched into geostationary orbit above North America later this decade, could provide hourly measurements of ozone and other pollutants. Current satellite instruments, which only pass over the U.S. once per day, can only provide a brief snapshot of pollution. “We are trying to extract as much information as possible from existing instruments, while figuring out ways to best utilize the next generation of satellite instruments,” Fiore said.

Fiore cites “constant two-way interactions” as essential to succeeding in this type of policy-relevant science. “I have found it really useful,” Fiore said. “I’ve learned from Pat and Gail how to present research findings in ways that are more digestible to policy makers.” Dolwick also praised the partnership and support provided by collaborations with AQAST. “We really appreciate the frequency with which they check in with the air quality planning community,” Dolwick said. Tonnesen also cited AQAST’s communication and outreach efforts as a major reason for successful collaboration. “It has been extremely valuable for us to align research initiatives with air quality management needs,” he said.



Dr. Fiore’s collaboration with EPA researchers Pat Dolwick and Gail Tonnesen has helped the agency refine air quality models that are used to estimate levels of background ozone in remote areas, such as the Rocky Mountains (shown above). While EPA and state-level air quality managers largely rely on air quality models to quantify background ozone, AQAST research efforts could result in the use of satellite measurements and other remote sensing techniques to provide more accurate and frequent data for a variety of air quality applications (Image from the U.S. National Parks Service).