

Scientists converge to study ozone, an atmospheric mystery near Lake Michigan

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Lake Michigan shoreline as seen from Sheboygan, Wisconsin. University of Wisconsin–Madison Space Science and Engineering Center (SSEC) researchers have joined an atmospheric study over Sheboygan and other cities along the lake's coast. Credit: SSEC

For several years, air quality managers have identified elevated levels of ozone in the Sheboygan, Wisconsin, area. It remains an atmospheric mystery since high levels of ozone are usually associated with larger cities. It is also an issue of great concern to public health officials because ozone is a known respiratory irritant that poses health threats to vulnerable populations, especially the young and the elderly, and those with breathing problems like asthma.

In an effort to unravel the mystery and understand how pollution moves along the western shoreline of Lake Michigan, University of Wisconsin–Madison Space Science and Engineering Center (SSEC) researchers have joined an atmospheric study over Sheboygan and other cities along the lake's coast.

The goal of the Lake Michigan Ozone Study (LMOS 2017) is to understand how wind currents can transport pollution from one location to

another—especially ozone, which poses human health risks when found near the Earth's surface. The data collected will also be integrated into ozone models used by air quality managers at agencies such as the Environmental Protection Agency (EPA), the Lake Michigan Air Directors Consortium (LADCO), and the Wisconsin Department of Natural Resources.

"We want to help improve these models and better predict when ozone events will happen, and in turn, protect health," says Brad Pierce, a NOAA physical scientist who is stationed at UW–Madison and is leading the LMOS campaign.

The study represents a \$1.3 million multi-agency partnership that includes NASA, the National Science Foundation (NSF), EPA, the National Oceanic and Atmospheric Administration (NOAA), the Electric Power Research Institute (EPRI), and other organizations and universities.

"The plan is to collect data that will give us a comprehensive profile of the atmosphere along the shore of Lake Michigan," says Tim Wagner, SSEC assistant researcher.

Wagner oversees the research efforts for a suite of ground-based instruments, known as the SSEC Portable Atmospheric Research Center, or SPARC. SPARC is a customized, 17-foot trailer equipped with an array of sensitive tools used to measure the atmosphere, many of which were designed and built at SSEC. Data gathered from the SPARC instruments at the study site will help construct a picture of the atmosphere over Sheboygan and surrounding areas through wind and temperature measurements, and help resolve different types of particles like ice, dust and other aerosols.

"By understanding the atmospheric structure, it gives context to the other data that are part of the whole campaign," says Wagner. "It's an important piece of the puzzle to understanding what's

happening up there."

The SPARC team's data will complement NASA measurements already gathered from remote sensing instruments on an aircraft flying in specific patterns over the area—from Zion, Illinois, to Sheboygan—and data from a NOAA research ship equipped with EPA instruments that collected nearshore and offshore measurements. It will also add to ozone measurements collected via automobile by EPA Region 5 and UW–Eau Claire Professor Patricia Cleary.

"Together, the aircraft, ship and land measurements will help build a more complete picture of the atmosphere," Wagner says.

Additionally, EPRI has funded Scientific Aviation to provide measurements from the air along the Lake Michigan coast and NSF has funded the University of Wisconsin, University of Iowa and University of Minnesota to conduct detailed chemical measurements at a ground site in Zion.

The UW–Madison ground team includes Tim Bertram, professor of chemistry, and his graduate students Gordon Novak and Michael Vermeuel. Bertram explains that ozone is commonly found in Earth's atmosphere, where it protects surface dwellers from harmful solar radiation, but it is usually high up and away from people. However, anthropogenic sources—like the burning of fossil fuels—can escalate ozone production to unsafe levels, especially when it forms in cities or densely populated areas.

Ozone is produced by incomplete combustion, which creates what are known as precursor molecules, like nitric oxide, and volatile organic compounds. These are converted into ozone through a sunlight-dependent chemical process. Ozone levels tend to be higher during the summer months because of increased solar intensity.

The EPA is responsible for setting ozone pollution standards nationwide and works with state agencies to monitor air quality conditions. Cities that fail to meet certain air quality standards must undergo a planning process to outline ways of reducing pollutants like ozone. Pierce, who has

studied ozone transport for more than 20 years, says improving models will assist the EPA and cities as they plan for future [air quality](#) needs and requirements.

"The field phase of the 2017 Lake Michigan Ozone Study has been an overwhelming success and we look forward to using the measurements collected during the campaign to help understand why coastal ozone monitors show higher ozone levels than inland, and improve our ability to model [ozone](#) within this complex region," says Pierce.

Provided by University of Wisconsin-Madison

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