marine influences on the fog communities were noticeable as far as 50 kilometers from the coast.

Due to the water content in fog, microbes can survive there for longer periods than they can in dry aerosols. The researchers observed differences between pre- and postfog aerosol communities that suggest fog events can have a significant impact on microbial aerosol diversity and composition, and as colead author M. Elias Dueker of Bard College notes, this indicates that "fog itself is a novel, living ecosystem" that can introduce greater amounts and a broader assortment of microbes than dry air to a particular land area.

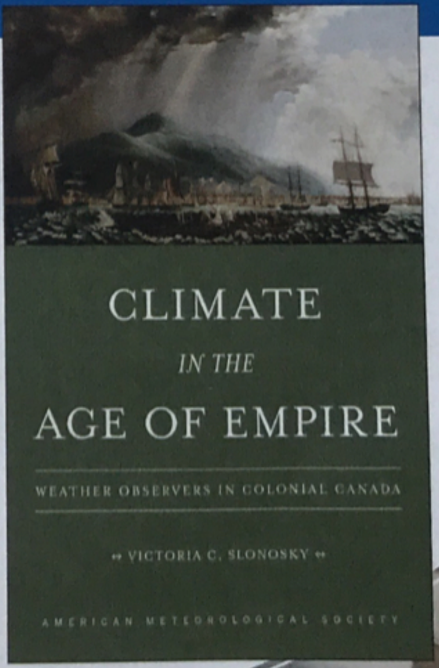
"When fog rolls in, it can shift the composition of terrestrial airborne microbial communities," Dueker says. "And in a fascinating twist, on the journey from the ocean to the land, microbes not only survive, but change during transport."

In both Maine and Namibia, the studied fog contained suspected plant pathogens as well as known microbes that can cause respiratory problems in humans, and the researchers believe that the introduction of these pathogens into urban fog could "[increase] their threat to people, plants, and other animals," Dueker says. In the future, the research team hopes to create models to forecast unhealthy fog events. [SOURCE: Cary Institute of Ecosystem Studies]

WHY ARE U.S. WINTER AIR POLLUTION REDUCTIONS LESS THAN IN SUMMER?

Summertime air pollution levels in the United States have declined significantly over the past 10 years, but those reductions haven't kept pace in winter. A new study published in the *Proceedings of the National Academy of Sciences* explains the discrepancy by focusing on differences between summer and winter air chemistry.

The study looked at two kinds of particulates that are harmful to human health: sulfates, which come from sulfur dioxide, and nitrates, which originate from nitrogen oxides. In the eastern United States, summertime levels of these particulates decreased by about one-third between 2007 and 2015, but winter levels only declined by half that amount. To investigate the reason for this disparity, researchers looked at observations taken during the Wintertime Investigation of Transport, Emissions and Reactivity (WINTER) campaign, in which aircraft flew through pollution plumes over a number of eastern and midwestern U.S. cities during a six-week span in the winter of 2015. They also utilized ground-based observations and a chemical transport model.



During summertime, some sulfur dioxide and nitrogen oxide emissions remain in a gas phase and subsequently are either broken down by sunlight or deposited on land, with the rest becoming nitrates and sulfates. This means that particulate levels decrease in correlation with the levels of these primary emissions. But the new study uncovered different dynamics in winter, when colder temperatures and less sunlight cause more emissions to develop in a liquid phase, either on the surfaces of particulates or clouds. In this phase, the decrease in primary emissions enhances the efficiency of the conversion of sulfur dioxide to sulfate due to the availability of more oxidants. As sulfate amounts decrease though, due to less sulfur dioxide for production, the particulates overall become less acidic, which enhances the conversion of nitrogen oxide into nitrates. As a result of this feedback effect, and despite governmental regulations having caused an accelerated decrease in the levels of primary emissions, joint particulate levels have declined at a slower rate.

"It's not that the reductions aren't working," explains lead author Viral Shah, formerly at the University of Washington and now at Harvard University. "It's just that the reductions have a canceling effect, and the canceling effect has a set strength."

The researchers believe this trend will continue in the eastern United States and other cold climates unless further reductions of both sulfur and nitrogen oxides are enacted.

"Once the reductions become larger than the canceling effect, then winter will start behaving more like summer," Shah says. [Source: University of Washington]

STUDY QUANTIFIES METHANE'S SHORTWAVE RADIATIVE IMPACTS

Along with absorbing heat (longwave radiation) emitted to space from Earth's atmosphere, atmospheric methane also absorbs solar energy, or shortwave radiation, in a process known as radiative forcing, and converts that energy into heat; this combination makes methane about 84 times more potent at warming the atmosphere than carbon dioxide in the first two decades after it is released. But the complex configuration of methane makes t difficult to accurately measure ts absorption capabilities in the aboratory, so a group of scientists recently looked to other planets o help them quantify methane's shortwave radiative impact on Earth. They discovered that clouds and bright surfaces influence methane absorption of solar energy on Earth. Their research was pubished in *Science Advances.*

In the atmospheres of Jupiter and Saturn's largest moon, Titan, methane concentrations are more han 1,000 times greater than those n Earth, which facilitates acurate occultation measurements f methane absorption properes. Researchers in the new study ooked at data taken from previous observations of those two bodies and found that radiative forcing estimates from those data corresponded with the incomplete laboratory data of methane absorption on Earth. This indicates that current spectroscopy techniques are suitable for calculating methane radiative forcing on Earth in both past climate analyses and future predictions, and are not underestimating methane effects, as had prevously been suspected. Supported by this result, the team made the frst-ever global calculations of radiative forcing by methane using realistic atmospheric and boundary conditions.

Their work showed that such forcing is not spatially uniform, and features significant regional patterns. For example, localized methane forcing in low-latitude desert areas, such as the Saharan Desert and the Arabian Peninsula, is 10 times the global annualized forcing because of the bright, exposed surfaces in those regions that reflect sunlight and enhance methane's absorption capabilities.

A similar effect was found for methane that was overlying cloud cover; in those conditions, the study revealed forcing that was as much as three times greater than in the rest of the world. This was especially prominent with oceanic stratus clouds west of southern Africa and both North and South America, as well as with cloud systems in the intertropical convergence zone. High clouds in the upper levels of the atmosphere that block incoming solar radiation can lower methane's forcing compared to a lack of upper-air clouds. But the study finds that the enhancement of methane prevails on nearly 90% of Earth's surface.

The research "represents the importance of taking into consideration what impact methane and other greenhouse gases are having not just in general, but with regional certainty," notes lead author William Collins of the Lawrence Berkeley National Laboratory, and the researchers hope their findings can be used to better understand both the susceptibility of different global regions to a warming climate as well as the differing greenhouse effect potencies of carbon dioxide and methane. [Source: Department of Energy/Lawrence Berkeley National Laboratory]