Science News

Study: Sea Salt Seasons Chemical Brew That Destroys Arctic Ozone

ScienceDaily (Jan. 19, 2001) —

WEST LAFAYETTE, Ind. — Sunlight, snow and sea salt are sometimes used to illustrate Nature at its best. But new scientific evidence shows that, when combined, these forces may provide a potent mixture for destroying ozone.

See also:

Matter & Energy
- Chemistry
- Inorganic Chemistry
- Organic Chemistry

Earth & Climate
- Air Quality
- Ozone Holes
- Atmosphere

Reference
- Ozone layer
- Atmospheric chemistry
- Ozone depletion
- Tropospheric ozone

Purdue University researchers, working with researchers from the University of California, Irvine and Battelle, have found that two chemicals found in sea salt may serve as precursors to initiate a series of chemical events that destroy ozone in the Arctic troposphere, the lowest part of the atmosphere.

The findings, published in the Jan. 19 issue of the scientific journal Science, describe the role that bromine and chlorine play in a complex series of chemical reactions that occur each spring when, after several months of darkness, sunlight interacts with the snow in the Arctic region.

The study traces the source of those chemical precursors to the salty minerals found in sea water that is carried into the snowpack in the form of tiny salt particles by wind and waves.

"Bromine and chlorine have long been suspected as major players in this series of chemical events, but the source of these chemicals was unknown," says Paul Shepson, professor of atmospheric chemistry at Purdue. "Our findings indicate that this near-surface ozone depletion in the Arctic is a naturally

Related Stories

Ozone Levels In Southern California Smog May Be Higher Than Current Air Quality Models Predict (Feb. 11, 2003) — Current air-quality models used for predicting air pollution may be underestimating ozone levels in Southern California by as much as 10% of the national one-hour ozone standard, a UC Irvine study ... > *read more*

UC Irvine Researchers Discover How Airborne Sea Salt Particles May Influence Air Pollution Levels (Apr. 18, 2000) — UC Irvine researchers who study the chemistry of ocean/air interactions have discovered how airborne sea salt particles may be involved in helping to determine the levels of ... > *read more*

New Clues To Ozone Depletion (Jul. 27, 2007) — Large quantities of ozone-depleting chemicals have been discovered in the Antarctic atmosphere. A team of atmospheric chemists carried out an 18-month study of the make-up of the lowest part of the ... > *read more*

Sea Salt Inhibits Global Warming (Feb. 23, 2005) — Scientists at The University of Manchester are examining a novel idea for delaying the effects of climate change using a combination of clouds and sea ... > *read more*

Study Links 'Smog' To Arctic Warming (Mar. 19, 2006) — In a global assessment of the impact of ozone on climate warming, scientists at the NASA Goddard Institute for Space Studies, New York, evaluated how ozone in the lowest part of the atmosphere ... > *read more*

quarters of the earth's surface is covered by ocean, we've uncovered a process we need to understand much better in terms of our ability to model ozone in the atmosphere."

Current models don't take these interactions into account because scientists are only beginning to recognize and document the role that snow and sea salt play in atmospheric chemistry. In 1986, scientists observed that, at polar sunrise, which occurs in March or April after several months of complete darkness, ozone in a thin layer of air over the Arctic ocean is completely removed. "This was a big surprise to us, and it indicated that our understanding of atmospheric ozone, and the factors that lead to its production and depletion, is poor," Shepson says.

Since then, scientists have found evidence that a number of chemicals that lay dormant in the snow can interact with sunlight to produce chemical "pollutants" — such as nitric oxide, nitrogen dioxide, formaldehyde and bromine — that impact the composition of the atmosphere.

Last year, Shepson and colleague Jan Bottenheim of Environment Canada led a research group to the Canadian Arctic to measure levels of bromine and chlorine in the snowpacks, and analyze how sunlight interacts with these chemicals during the polar sunrise.

From a research site at the Canadian Forces base at Alert, Canada, the group measured levels of bromine and chlorine in the snow and air over a two-month period, beginning in early February. The bromine and chlorine measurements were conducted under the leadership of Chet Spicer of Battelle-Columbus, and Barbara Finlayson-Pitts of the University of California, Irvine.

The measurements show that in mid-March, when the sun began to rise over the Arctic region, these elements increased in the air while decreasing in the snow.

Because molecular bromine is short-lived in the atmosphere and can't be transported very far, Shepson and co-workers began looking for sources of bromine from the local environment. "Sea salt is the only source of bromine in the Arctic," he says.

Bromine and chlorine also play a role in destroying ozone in the upper atmosphere over the Arctic and Antarctic, but in those cases the sources of bromine and chloride come primarily from human-derived pollutants, Shepson says.

Though the study indicates that ozone-depletion is a naturally occurring process in the Arctic, the findings suggest that mixtures of snow and salt on roads in urban areas may also affect air quality, Shepson says.

predictions, but there could be a variety of chemical interactions that occur in urban, road-salted environments that we need to understand." Shepson's studies at Purdue are funded by the National Science Foundation.

Adapted from materials provided by Purdue University.