

# Dust Storm Surprise

*Pollution can convert airborne iron into soluble form required for phytoplankton growth.*

A surprising link may exist between ocean fertility and air pollution over land, according to Georgia Institute of Technology research reported earlier this year in the *Journal of Geophysical Research - Atmospheres*. The work provides new insight into the role that ocean fertility plays in the complex cycle involving carbon dioxide and other greenhouse gases in global warming.

When dust storms pass over industrialized areas, they can pick up sulfur dioxide, an acidic trace gas emitted from industrial facilities and power plants. As the dust storms move out over the ocean, the sulfur dioxide they carry lowers the pH (a measure of acidity and alkalinity) level of dust and transforms iron into a soluble form, says lead author Nicholas Meskhidze, a postdoctoral fellow at Georgia Tech's School of Earth and Atmospheric Sciences.

This conversion is important because dissolved iron is a necessary micronutrient for phytoplankton — tiny aquatic plants that serve as food for fish and other organisms, and also reduce carbon dioxide levels in Earth's atmosphere via photosynthesis.

In research funded by the National Science Foundation, Meskhidze studied dust storms under the guidance of Regents Professor William Chameides, co-author of the paper, who recently retired from Georgia Tech.

"I knew that large storms from the Gobi desert could carry iron from the soil to remote regions of the northern Pacific Ocean, facilitating photosynthesis and carbon-dioxide uptake," Meskhidze says. "But I was puzzled because the iron in desert dust is primarily hematite, a mineral that is insoluble in high-pH solutions such as seawater. So it's not readily available to the plankton."

Using data obtained in a flight over the study area, Meskhidze analyzed the chemistry of a dust storm that originated in the Gobi desert and passed over Shanghai before moving onto the northern Pacific Ocean. His discovery: When a high-concentration of sulfur dioxide mixed with the desert dust, it acidified the dust to a pH below 2 — the level needed for mineral iron to convert into a dissolved form that would be available to phytoplankton.

Expanding on this discovery, Meskhidze studied how variations in air pollution and mineral dust affect iron mobilization.

Obtaining in-flight data from two different Gobi-desert storms — one occurring on March 12, 2001, and the other on April 6, 2001 — Meskhidze analyzed the pollution content and then modeled the storms' trajectory and chemical transformation over the northern Pacific Ocean. Using satellite measurements, he determined whether there had been increased growth of phytoplankton in the ocean area where the storms passed.

The results were surprising, he says. Although the April storm was a large one, with three sources of dust colliding and traveling as far as the United States, there was no increased phytoplankton activity. Yet the smaller March storm greatly boosted the production of phytoplankton.

The differing results can be attributed to the concentration of sulfur dioxide existing in dust storms, Meskhidze says. Large storms are highly alkaline because they contain a higher proportion of calcium carbonate. Thus, the amount of sulfur dioxide picked up from pollution is not enough to bring down the pH below 2.

"Although large storms can export vast amounts of mineral dust to the open ocean, the amount of sulfur dioxide required to acidify these large plumes and generate bioavailable iron is about five to 10 times higher than the average springtime concentrations of this pollutant found in industrialized areas of China," Meskhidze explains. "Yet the percentage of soluble iron in small dust storms can be many orders of magnitude higher than large dust storms."

So even though small storms are limited in the amount of dust they transport to the ocean and may not cause large plankton blooms, small storms still produce enough soluble iron to consistently feed phytoplankton and fertilize the ocean. This may be especially important for high-nitrate, low-chlorophyll waters, where phytoplankton production is limited because of a lack of iron.

@ Read more at: [gtresearchnews.gatech.edu/newsrelease/iron.htm](http://gtresearchnews.gatech.edu/newsrelease/iron.htm)

## CONTACTS

**Nicholas Meskhidze**  
at 404-894-1624 or  
[nmeskhidze@eas.gatech.edu](mailto:nmeskhidze@eas.gatech.edu)

**William Chameides**  
at 212-616-1334 or  
[wchameides@environmentaldefense.org](mailto:wchameides@environmentaldefense.org)



*NASA's Terra satellite observed a large dust storm (light brown pixels) blowing over northeastern China toward the Korean peninsula in November 2002. The dust appears to be originating from the Gobi Desert in north central China. Toward the south (bottom center), there is a dense pall of haze and pollution (gray pixels) over much of southeastern China.*

PHOTO COURTESY NASA

BY T.J. BECKER