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Atmospheric Aerosols Found to Brighten Clouds

BY GENE TULMAN
Statesman Editor

Atmospheric scientists at the U.S. Department of Energy's Brookhaven National Laboratory (BNL) and Purdue University used model calculations to demonstrate how the microscopic aerosol particles from industrial processes increase the brightness of clouds, resulting in greater reflection of sunlight and cooling the Earth's climate. This work may explain the implications of the greenhouse effect, a global warming phenomenon.

The research team has combined satellite measurements of cloud brightness, water content and other variables with model calculations of atmospheric aerosols to study the brightening effect.

Scientists have long known about the brightening effect, claiming that it should be accounted for in assessing the magnitude of global climate change in the world.

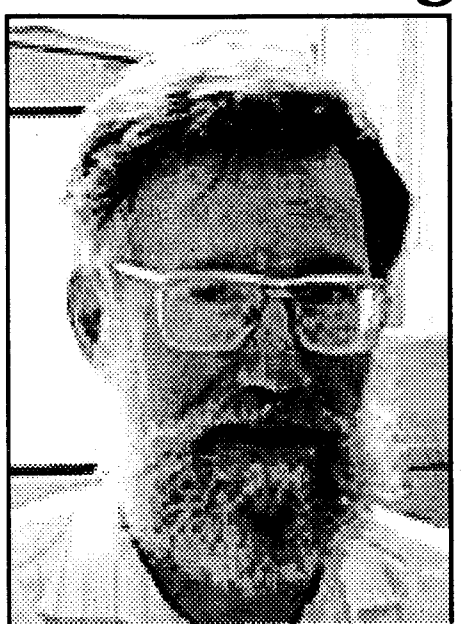
"We're not saying that aerosols can counteract the greenhouse effect, but rather that we need to know how much of a cooling effect they have so we have a clearer picture of the greenhouse effect," Stephen Schwartz, atmospheric chemist and lead researcher, said. "To whatever extent aerosols are offsetting greenhouse warming, then the offset is the unseen part of the greenhouse 'iceberg."

It is difficult to measure the effect of aerosols because of the lack of knowledge of their concentration. Aerosols commonly result from emissions by fossil-fuel-burning power plants and various other industrial processes, and are typically found in the lowest three to four kilometers above Earth's surface, precipitating out of the atmosphere in about a week.

"Because of this short residence time, aerosols are highly variable as a function of location and time, which makes it tough to measure their concentrations on a global scale," Schwartz said.

The Brookhaven-Purdue team identified two one-week episodes during April 1987 when the modeled concentration of sulfate aerosol over the North Atlantic Ocean (far from any local sources of aerosol emissions) increased significantly and then decreased over the course of each week. These large variations in aerosol concentration and the fact that there were no high-atmosphere (obscuring) clouds during these events made them ideal episodes for studying the effect of aerosols on cloud brightening.

The next obstacle was to get the data on cloud brightness for that area over the same time period. For this, the scientists retrieved satellite measurements of radiance (how much light the clouds reflect) and optical depth (a value related to how much light is transmitted through the cloud), and used these measurements to calculate the size of the cloud droplets and the liquid water path (the amount of liquid water in the cloud).



Courtesy of www.bnl.gov

Stephen Schwartz is researching the effects of aerosols on the atmosphere.

Researchers were also able to analyze how these variables were interrelated.

The findings show that, for a given liquid water path, cloud reflectivity was, as expected, higher on the days with higher aerosol content than on the days with lower aerosol levels.

"If the effect is as widespread as we think it is, it would produce quite a substantial cooling effect on climate," Schwartz said. "This new study provides a method of quantifying the phenomenon globally over the past 15 years ...Once this is done, we will have a much better idea of the true magnitude of the greenhouse effect."

Schwartz speculated about the concept of deliberately using aerosols to offset the greenhouse effect, concluding that such utility would not be practical in the long run.

"This is an attractive thought, but it cannot work in the long run — because aerosols are so short-lived in the atmosphere, whereas greenhouse gases accumulate over time," he said. "An ever increasing amount of aerosols would be required. We'd never solve the long-term problem."

The research team acknowledged that their results are based on model calculations rather than observations, and that these model calculations are somewhat uncertain. According to Schwartz, one key to assessing the overall impact of aerosols will be further development of the satellite-based measurements.