# Science News



# Atmospheric Compound Is Double-edged Sword In Climate Change

ScienceDaily (Dec. 10, 2003) — SAN FRANCISCO – Recent studies suggest that an atmospheric compound derived primarily from coal combustion may have contradictory effects on the earth's climate.

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Under many conditions, sulfuric acid may cool the earth's atmosphere. Sulfuric acid particles seem to scatter ultraviolet light back into space before it has a change to enter the troposphere – the bottom layer of earth's atmosphere. But if conditions are right, this same chemical can warm the earth by combining with other compounds in the atmosphere to form clouds.

Researchers at Ohio State University looked at the interaction of sulfuric acid and methanol and what the compounds' combined effect might mean to global climate change. Both compounds are usually found in aerosol form in the upper atmosphere.

Scientists believe that methanol comes primarily from natural sources, such as oceans, forests and the decay of organic matter. While there are a few natural sources for sulfuric acid, such as volcanoes and marine sea spray, its precursor – sulfur dioxide – comes mainly from the burning of coal. In the atmosphere, sulfur dioxide is oxidized primarily by atmospheric moisture, resulting in sulfuric acid.

Sulfuric acid molecules in atmospheric aerosols can act as sort of a force field by reflecting light and heat back into space, said Heather Allen, a study co-author and an assistant professor of chemistry at Ohio State. This reflection contributes to a cooling effect on the earth. Methanol by itself doesn't really have an effect on climate change.

But when the two molecules get together – about 5 to 10 percent of the methanol in the atmospheric aerosols reacts with sulfuric acid – they form methyl sulfate. Methyl sulfate is less volatile than methanol, meaning there's less chance that methyl sulfate will evaporate or be vaporized.

And while it seems like a relatively small amount of methanol gets converted to methyl sulfate, it's still enough to have an impact on global climate change, Allen said.

She and colleague Lisa Van Loon, a doctoral student in chemistry at Ohio State, found that methyl sulfate's stability provides a springboard for cloud formation – water droplets collect on the stable molecules and eventually form clouds. Instead of causing light and heat to bounce back into space, most clouds create a warming effect by trapping light and heat in the atmosphere.

Van Loon presented the findings December 12 at the fall meeting of the American

Geophysical Union in San Francisco.

The researchers used a laboratory technique called Raman spectroscopy to analyze the behavior of methanol, sulfuric acid and methyl sulfate. They focused a beam of laser light onto a sample of each substance in order to analyze differences in the bonds that hold the molecules together. The frequencies of the resulting wavelengths told the researchers how the compounds behaved, and also how methanol and sulfuric acid interacted. From this information, they could determine what each compound might do in the atmosphere.

The researchers found that sulfuric acid combines with a small amount of methanol–essentially starting points for cloud formation.

But the conditions must be right in order to create methyl sulfate, Allen said.

"The atmospheric chemistry community is trying to understand what conditions let these atmospheric particles combine, or cause them to stay aerosol-sized," Allen said, adding that cloud particles are about three times the size of aerosol particles.

The interaction between sulfuric acid and methanol affects global climate change and the aerosol picture, Allen said.

"Right now these aerosols are probably helping to slow down the human-induced warming effect on the earth, but it's a complicated balance that we're struggling to fully understand," she said. "We certainly know that the earth is warming at a rate that isn't totally natural. It's the warming rate that we're more concerned about.

"More aerosols emitted into the atmosphere may lead to cooling," Allen continued. "But if these aerosols are able to combine with other compounds and ultimately form clouds, it could have a warming effect. There's a complex balance between warming and cooling."

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*Adapted from materials provided by Ohio State University.*

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