Geoengineering takes a ride in the shipping lanes

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Phil Rasch studies atmospheric sciences at Pacific Northwest National Laboratory in Richland, Wash. Credit: PNNL

Ships blowing off steam are helping researchers understand how manmade particles might be useful against global warming. New results from modeling clouds like those seen in shipping lanes reveal the complex interplay between aerosols, the prevailing weather and even the time of day the aerosol particles hit the air, according to research presented Saturday morning at the American Association for the Advancement of Science's annual meeting.

"We've seen ship tracks affect the reflectivity of clouds," said Phil Rasch, chief climate scientist at the Department of Energy's Pacific Northwest National Laboratory in Richland, Wash. "We want to know if we can do the same thing when we want to, on purpose, and how that might be helpful in countering some of the effects of global warming.

"We decided to see how the reflectivity of clouds is influenced by particles in a very detailed model that treats clouds much more realistically than we are able to do in a typical climate model."

Reflecting sunlight back into space prevents that energy from hitting Earth's surface. So brighter clouds could have an overall cooling effect compared to darker ones.

A handful of research groups in the US are exploring geoengineering, or the intentional modification of Earth's climate, in hopes of developing tools that might be used to lower global temperatures if atmospheric greenhouse gases reach levels that might produce disastrous climate change.

Previous work analyzing clouds in shipping lanes showed that large ships spewing tiny particles into the sky change the characteristics of clouds. More aerosol particles -- tiny natural or manmade bits of dirt, water and gas, such as from pollution -- increase the number of droplets in clouds and make each droplet smaller. This reflects more sunlight from the surface, and the clouds appear brighter.

But the previous work revealed that some parts of the clouds above shipping lanes became brighter and other parts darker, suggesting that using aerosols to increase cloud reflectivity will be more complex than simply adding more.

"Do the brighter and darker parts cancel each other out?" asked Rasch.

To find out, the group performed some exploratory computer simulations to determine the net effect of increased aerosols. His team simulated three ships chugging along in a 93-mile by 37-mile block of the Pacific Ocean a few hundred miles southwest of Los Angeles.

The team showed that introducing additional particles into the model near the surface -- as proposed for geoengineering -- would make the clouds significantly more reflective than they would otherwise be, in certain situations. They found that if the clouds were already drizzling then the new particles would not brighten them very effectively.

Rasch will discuss other cloud, weather and climate characteristics affected by aerosols, such as how long the brighter clouds last, whether they burn off when the sun comes up, and what happens when they finally rain. The team is also using the simulations to test when the best time to spray seawater using the simulations is -- in the morning, late afternoon or perhaps all night long.

Although ship tracks are helping researchers explore geoengineering methods, the real plans won't use polluting aerosols from ships. Instead, Rasch and others suggest that ocean vessels could spray seawater aerosols into the sky to brighten clouds. But many questions remain about how effective, predictable and safe such methods might be.

Rasch will also discuss results from a Community Climate System Model study. He and colleagues simulated what happens to the global climate as aerosol concentrations rise. The work, published December 2009 in Environmental Research Letters, showed increasing aerosols in the ocean air can either increase the amount of sea ice to previous levels, restore precipitation, or reduce temperatures, but not all at the same time.

Provided by Pacific Northwest National Laboratory