Removing sulfur from jet fuel cools climate: study

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A Yale study examining the impact of aviation on climate change found that removing sulfur from jet fuel cools the atmosphere. The study was published in the October 22 issue of *Geophysical Research Letters*.

"Aviation is really important to the global economy. We better understand what it's doing to climate because it's the fastest growing fossil fuel-burning sector and there is no alternative to air travel in many circumstances. Emissions are projected to increase substantially in the next two decades—by a factor of two—whereas projections for other sectors are expected to decrease," said Nadine Unger, the study's author and assistant professor of climate science at the Yale School of Forestry & Environmental Studies.

Particles of sulfate, formed by burning sulfur-laden jet fuel, act like tiny mirrors that scatter solar radiation back into space. When sulfur is removed from the fuel, warming occurs but it's offset by the cooling effect of nitrate that forms from nitrogen oxides in jet exhaust. The result is that desulfurization of jet fuel has a small, net cooling effect.

In 2006 the United States introduced an ultralow sulfur standard for highway diesel, and the Federal Aviation Administration (FAA) is interested in desulfurized jet fuel for its potential to improve air quality around airports. Aircraft exhaust particles lodge in the lungs and cause respiratory and cardiovascular illness. In 2006 there were more than 31 million flights across the globe, according to an FAA emissions inventory.

"It's a win-win situation, because the sulfate can be taken out of the fuel to improve air quality around airports and, at the same time, it's not going to have a detrimental impact on global warming," she said.

Unger used a global-scale model that assessed the impact of reducing the amount of sulfur in jet fuel from 600 milligrams per kilogram of fuel to 15 milligrams per kilogram, which is the level targeted by the U.S. Department of Transportation.

The study also simulated the full impacts of aviation emissions, such as ozone, methane, carbon dioxide, sulfate and contrails—those ribbons of clouds that appear in the wake of a jet—whereas previous studies examined each chemical effect only in isolation.

"In this study we tried to put everything together so that we account for interactions between those different chemical effects," said Unger. "We find that only a third of the climate impact from aviation can be attributed to carbon dioxide."

Unger also ran a simulation of aviation emissions at the Earth's surface and found that the climate impact is four times greater because the emissions occur at altitude in the upper atmosphere.

"The chemical production of ozone is greater in the upper troposphere and its radiative efficiency is greater," she said. "It's a stronger greenhouse gas when it's higher up in the troposphere, which is exactly where aviation is making it."

More information: The paper, "Global Climate Impact of Civil Aviation for Standard and Desulferized Jet Fuel," can be found at www.agu.org/journals/gl/gl1120/2011GL049289/

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