Study finds black carbon implicated in global warming

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Increasing the ratio of black carbon to sulfate in the atmosphere increases climate warming, suggests a study conducted by a University of Iowa professor and his colleagues and published in the July 25 issue of the journal *Nature Geoscience*.

Black carbons -- arising from such sources as diesel engine exhaust and cooking fires -- are widely considered a factor in global warming and are an important component of air pollution around the world, according to Greg Carmichael, Karl Kammermeyer Professor of Chemical and Biochemical Engineering in the UI College of Engineering and co-director of the UI's Center for Global and Regional Environmental Research. Sulfates occur in the atmosphere largely as a result of various industrial processes.

Carmichael's colleagues in the study were V. Ramanathan and Y. Feng of Scripps Institution of Oceanography, La Jolla, Calif.; S-C. Yoon and S-W. Kim of Seoul National University, South Korea; and J. J. Schauer of the University of Wisconsin, Madison.

In order to conduct their study, the researchers made ground-level studies of air samples at Cheju Island, South Korea, and then sampled the air at altitudes between 100 and 15,000 feet above the ground using unmanned aircrafts (UAVs).

They found that the amount of solar radiation absorbed increased as the black carbon to sulfate ratio rose. Also, black carbon plumes derived

from fossil fuels were 100 percent more efficient at warming than were plumes arising from biomass burning.

"These results had been indicated by theory but not verified by observations before this work," Carmichael said. "There is currently great interest in developing strategies to reduce black carbon as it offers the opportunity to reduce air pollution and global warming at the same time."

The authors suggest that climate mitigation policies should aim to reduce the ratio of black carbon to sulfate in emissions, as well as the total amount of black carbon released.

In a paper published in May 2008 in *Nature Geoscience*, Carmichael and Ramanathan found that black carbon soot from diesel engine exhaust and cooking fires -- widely used in Asia -- may play a larger role than previously thought in global warming. They said that coal and cow dung-fueled cooking fires in China and India produce about one-third of black carbon; the rest is largely due to diesel exhaust in Europe and other regions relying on diesel transport. The paper also noted that soot and other forms of black carbon could equal up to 60 percent of the current global warming effect of carbon dioxide, the leading greenhouse gas.

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