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Researchers Cite Near-Term Control Strategies for Global Warming

Studies call for limiting soot, methane and land surface changes

By James Fuller
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Washington – While many scientists and policy makers have focused on how heat-trapping greenhouse gases such as carbon dioxide are altering the global climate, several new studies report that both air pollution and global warming could be significantly reduced by controlling emissions of methane gas and black carbon soot, and limiting activities like urban sprawl and deforestation that cause land surface changes.

Reports by the National Aeronautics and Space Administration (NASA), Georgia Institute of Technology, Harvard University and the Argonne National Laboratory suggest that the reduction of methane emissions and soot could yield a major near-term success story in the battle against global warming, providing time to work on technologies to reduce future carbon dioxide emissions.

And a new international study argues that human-caused land surface changes in places like North America, Europe and southeast Asia redistribute heat in the atmosphere both regionally and globally, and may actually have a greater impact on climate than do all greenhouse gases released by human activities.

Researchers have shown that global warming in recent decades has probably been caused by carbon dioxide from the burning of fossil fuels like coal, oil and gas, but also by other greenhouse gases such as methane and tropospheric ozone -- a principal ingredient of smog -- and by soot particles .

In a paper appearing in a recent issue of the journal Science, researchers said that dark soot particles -- a product of incomplete combustion -- absorb sunlight, heating the air and reducing the amount of sunlight reaching the ground. As soot heats the lower atmosphere in one region of the world, some of this warm air can get transported to other regions of the world, causing surface warming in distant locations.

Diesel-powered trucks and buses are primary sources of airborne soot in the United States. But even larger amounts of soot occur in developing countries like China and India, where much of household cooking and heating is fueled with wood, crop and animal wastes and coal, at a low temperature that does not allow for complete combustion.

The authors of the Science study -- James Hansen of NASA's Goddard Institute of Space Studies and Surabi Menon of Columbia University -- also found that black carbon soot can alter large-scale atmospheric circulation and the hydrologic cycle of a region. Using Goddard's climate computer model and aerosol data from 46 ground stations in China, the researchers found that the effect of increased amounts of soot over southern China created a "clear tendency" for flooding in that region, and for drought in northern China.

They believe this happens because the black carbon aerosols in southern China soak up the sun's rays, heating up the atmosphere. The heated air rises and creates rain clouds. The rising air is balanced by an increase in sinking air in northern China. When air sinks, clouds and rain cannot form, creating dry conditions.

In a separate article in Science, researchers at the Georgia Institute of Technology said the new findings identifying soot as a warming agent could point toward a better near-term control strategy for global warming than attempts to reduce carbon dioxide emissions.

"As we've learned more about the amount of black carbon emitted by countries like China and India, it appears now that soot could have important climate effects, and that those effects may be almost as much as those of carbon dioxide," said Michael Bergin, assistant professor at Georgia Tech's School of Earth and Atmospheric Sciences.

Bergin also said that it could take only weeks or months to remove soot particles from the atmosphere, while carbon dioxide can linger for hundreds of years.

"Carbon dioxide is not easily removed from the atmosphere," he said in an interview. "It's not very soluble in water, it's not rained out very easily, and there's not a lot of chemical reaction to make it go away. But the soot particles in the atmosphere -- they deposit out, they drop out and they are also removed by rain very efficiently."

He added, however, that little is known about the worldwide impact of soot emissions or even how best to measure them, and that better computer models are needed to determine how the particles affect global climate change. He said if it is found that soot emissions do in fact play a large role in global warming, that could shift increased responsibility for curbing climate changing pollution to developing countries like China and India.

Another study, in the October issue of "Geophysical Research Letters," says both air pollution and global warming could be reduced by controlling emissions of methane gas.

The study, by researchers at Harvard, Argonne National Laboratory and the U.S. Environmental Protection Agency, says that methane is directly linked to the production of ozone smog in the atmosphere, and that both methane and ozone are greenhouse gases linked to global warming.

Sources of methane include cattle herds, rice cultivation and industrial production. Scientists report that technologies are currently within reach that would reduce global air pollutants like methane in ways that are cheaper and faster than reducing carbon dioxide.

Research funded by grants from NASA and the National Science Foundation found that human-caused land surface changes resulting from urban sprawl, deforestation and reforestation, and irrigation and other agricultural practices strongly affect regional surface temperatures, precipitation and large-scale atmospheric circulation.

"Our work suggests that the impacts of human-caused land cover changes on climate are at least as important, and quite possibly more important than those of carbon dioxide," said Roger Pielke, an atmospheric scientist at Colorado State University and lead author of the study. "Through land cover changes over the last 300 years, we may have already altered the climate more than would occur from the radiative effect of a doubling of carbon dioxide."

As an example of how land cover changes can affect climate, the study says that if a rainforest is removed and replaced with crops, there is less transpiration, or evaporation of water from leaves. Less transpiration leads to warmer temperatures in that area. On the other hand, if farmland is irrigated, more water is transpired and also evaporated from moist soils, which cools and moistens the atmosphere, and can contribute to precipitation and cloudiness.

The study, published in a recent issue of the Philosophical Transactions of the Royal Society of London, also proposes a new method for measuring the impacts of both greenhouse gases and land cover changes in terms of the redistribution of heat over land and in the atmosphere. Using a single unit of measurement may open the door to future work that more accurately represents human-caused climate change.

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