

Slowing climate change by targeting gases other than carbon dioxide

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Carbon dioxide remains the undisputed king of recent climate change, but other greenhouse gases measurably contribute to the problem. A new study, conducted by NOAA scientists and published online today in *Nature*, shows that cutting emissions of those other gases could slow changes in climate that are expected in the future.

Discussions with colleagues around the time of the 2009 United Nations' climate conference in Copenhagen inspired three NOAA scientists – Stephen Montzka, Ed Dlugokencky and James Butler of NOAA's Earth System Research Laboratory in Boulder, Colo. – to review the sources of non-carbon dioxide (CO₂) [greenhouse gases](#) and explore the potential climate benefits of cutting their emissions.

Like CO₂, other greenhouse gases trap heat in Earth's atmosphere. Some of these chemicals have shorter lifetimes than CO₂ in the atmosphere. Therefore cutting emissions would quickly reduce their direct radiative forcing – a measure of warming influence.

"We know that recent [climate change](#) is primarily driven by carbon dioxide emitted during fossil-fuel combustion, and we know that this problem is going to be with us a long-time because carbon dioxide is so persistent in the atmosphere," Montzka said. "But lowering emissions of greenhouse gases other than carbon dioxide could lead to some rapid changes for the better."

Scientists know that stabilizing the warming effect of CO₂ in the

atmosphere would require a decrease of about 80 percent in human-caused CO₂ emissions – in part because some of the carbon dioxide emitted today will remain in the atmosphere for thousands of years. In contrast, cutting all long-lived non-CO₂ greenhouse gas emissions by 80 percent could diminish their climate warming effect substantially within a couple of decades. Cutting both CO₂ and non-CO₂ greenhouse gas emissions to this extent could result in a decrease in the total warming effect from these greenhouse gases this century, the new paper shows.

For the new analysis, the researchers considered methane; nitrous oxide; a group of chemicals regulated by an international treaty to protect Earth's ozone layer; and a few other extremely long-lived greenhouse gases currently present at very low concentrations.

The new review paper describes the major human activities responsible for these emissions, and notes that steep cuts (such as 80 percent) would be difficult. Without substantial changes to human behavior, emissions of the non-CO₂ greenhouse gases are expected to continue to increase.

The climate-related benefits of reductions in non-CO₂ greenhouse gases have limits, Montzka and his colleagues showed. Even if all human-related, non-CO₂ greenhouse gas emissions could be eliminated today, it would not be enough to stabilize the warming influence from all greenhouse gases over the next 40 years – unless CO₂ emissions were also cut significantly.

The scientists also noted in the paper the complicated connections between climate and greenhouse gases, some of which are not yet fully understood. The non-CO₂ gases studied have natural sources as well as human emissions, and climate change could amplify or dampen some of those natural processes, Dlugokencky said. Increasingly warm and dry conditions in the Arctic, for example, could thaw permafrost and increase the frequency of wildfires, both of which would send more

methane and carbon dioxide into the atmosphere.

"The long-term necessity of cutting [carbon dioxide](#) emissions shouldn't diminish the effectiveness of short-term action. This paper shows there are other opportunities to influence the trajectory of climate change," Butler said. "Managing emissions of non-carbon dioxide gases is clearly an opportunity to make additional contributions."

Provided by NOAA Headquarters

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