New monitoring system clarifies murky atmospheric questions

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A new technique to measure CO2 and trace gas emissions may be of help in monitoring greenhouse gases. Credit: National Park Service

A University of Colorado Boulder-led team has developed a new monitoring system to analyze and compare emissions from man-made fossil fuels and trace gases in the atmosphere, a technique that likely could be used to monitor the effectiveness of measures regulating greenhouse gases.

The research team looked at atmospheric gas measurements taken every two weeks from aircraft over a six-year period over the northeast United States to collect samples of CO2 and other environmentally important gases. Their method allowed them to separate CO2 derived from fossil fuels from CO2 being emitted by biological sources like plant respiration , said CU-Boulder Senior Research Associate Scott Lehman, who led the

study with CU-Boulder Research Associate John Miller.

The separation was made possible by the fact that CO2 released from the burning of fossil fuels like coal, oil and gas has no carbon-14, since the half-life of that carbon radio isotope is about 5,700 years -- far less than the age of fossil fuels, which are millions of years old. In contrast, CO2 emitted from biological sources on Earth like plants is relatively rich in carbon-14 and the difference can be pinpointed by atmospheric scientists, said Lehman of CU's Institute of Arctic and Alpine Research.

The team also measured concentrations of 22 other atmospheric gases tied to human activities as part of the study, said Miller of the CU-headquartered Cooperative Institute for Research in Environmental Sciences. The diverse set of gases impact climate change, air quality and the recovery of the ozone layer, but their emissions are poorly understood. The authors used the ratio between the concentration level of each gas in the atmosphere and that of fossil fuel-derived CO2 to estimate the emission rates of the individual gases, said Miller.

In the long run, measuring carbon-14 in the atmosphere offers the possibility to directly measure country and state emissions of fossil fuel CO2, said Miller. The technique would be an improvement over traditional, "accounting-based" methods of estimating emission rates of CO2 and other gases, which generally rely on reports from particular countries or regions regarding the use of coal, oil and natural gas, he said.

"While the accounting-based approach is probably accurate at global scales, the uncertainties rise for smaller-scale regions," said Miller, also a scientist at the National Oceanic and Atmospheric Administration's Earth System Research Laboratory in Boulder. "And as CO2 emissions targets become more widespread, there may be a greater temptation to underreport. But we'll be able to see through that."

A paper on the subject was published in the April 19 issue of the *Journal of Geophysical Research: Atmospheres,* published by the American Geophysical Union. Co-authors include Stephen Montzka and Ed Dlugokencky of NOAA, Colm Sweeney, Benjamin Miller, Anna Karion, Jocelyn Turnbull and Pieter Tans of NOAA and CIRES, Chad Wolak of CU's INSTAAR and John Southton of the University of California, Irvine.

One surprise in the study was that the researchers detected continued emissions of methyl chloroform and several other gases banned from production in the United States. Such observations emphasize the importance of independent monitoring, since the detection of such emissions could be overlooked by the widely used accounting-based estimation techniques, said Montzka.

The atmospheric air samples were taken every two weeks for six years by aircraft off the coastlines of Cape May, N.J., and Portsmouth, N.H.

Fossil fuel emissions have driven Earth's atmospheric CO2 from concentrations of about 280 parts per million in the early 1800s to about 390 parts per million today, said Miller. The vast majority of climate scientists believe higher concentrations of the greenhouse gas CO2 in Earth's atmosphere are directly leading to rising temperatures on the planet.

"We think the approach offered by this study can increase the accuracy of emissions detection and verification for fossil fuel combustion and a host of other man-made gases," said Lehman. He said the approach of using carbon-14 has been supported by the National Academy of Sciences and could be an invaluable tool for monitoring greenhouse gases by federal agencies like NOAA.

Unfortunately, NOAA's greenhouse gas monitoring program has been

cut back by Congress in recent years, said Lehman. "Even if we lack the will to regulate emissions, the public has a right to know what is happening to our atmosphere. Sticking our heads in the sand is not a sound strategy," he said.

Provided by University of Colorado at Boulder