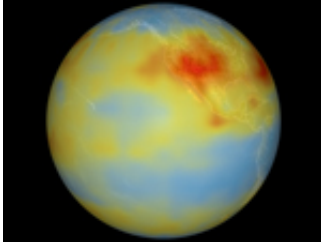


Corralling the carbon cycle

November 13 2008



NASA's Atmospheric Infrared Sounder (AIRS) instrument on the Aqua spacecraft is used to observe carbon dioxide in the atmospheric. This image shows CO₂ over the United States in July 2003. High concentrations of the greenhouse gas are red, while low concentrations are blue. Image courtesy NASA

(PhysOrg.com) -- Scientists may have overcome a major hurdle to calculating how much carbon dioxide (CO₂) is absorbed and released by plants, vital information for understanding how the biosphere responds to stress and for determining the amount of carbon that can be safely emitted by human activities. The problem is that ecosystems simultaneously take up and release CO₂. The key finding is that the compound carbonyl sulfide, which plants consume in tandem with CO₂, can be used to quantify gas flow into the plants during photosynthesis. The research is published in the November 14, issue of *Science*.

“In photosynthesis, plants ‘breathe’ in carbon dioxide from the atmosphere and, with sunlight energy, convert it and water into food and oxygen, which they then ‘exhale,’” explained co-author Joe Berry from the

Carnegie Institution's Department of Global Ecology. "In ecosystems, plants and other organisms respire producing carbon dioxide. We can measure the net change in CO₂, but we do not have an accurate way to measure how much is going in or out and how this is affected by climate. Understanding this photosynthesis-climate feedback riddle is key to understanding how climate change may affect the natural processes that are a sink for human-made carbon emissions."

Previous laboratory research showed that carbonyl sulfide is taken up in step with photosynthesis. But unlike CO₂, there is no emission of carbonyl sulfide from plants.

The researchers compared atmospheric measurements of carbonyl sulfide over North America during the growing season with two simulations of an atmospheric transport model. The airborne observations, from the Intercontinental Chemical Transport Experiment-North America, also measured CO₂. They combined that data with results from laboratory experiments that looked at gas exchange at the leaf level.

"We've always looked at the total change in CO₂, but now we can look for the influence of photosynthesis on this total change," remarked lead author Elliott Campbell a former Carnegie postdoctoral researcher, currently at UC Merced. "Our approach, based on the relation of carbonyl sulfide to photosynthesis, gives us this unique ability."

With the new inputs, the researchers ran their simulations, which consider plant uptake, soil and ocean absorption, human-made emissions and how the gases flow through these systems. The simulations showed that the magnitude of the plant uptake was much larger than other sources and sinks at a continental scale during the growing season, which is important for using the compound to trace photosynthesis.

“The intriguing outcome of this study is that an inverse analysis of the atmospheric carbonyl sulfide measurements may be used to quantify the carbon released during plant respiration,” remarked Berry. “That key missing piece has been a thorn in the side of carbon-cycle research for years.”

Provided by Carnegie Institution

Citation: Corralling the carbon cycle (2008, November 13) retrieved 10 April 2024 from <https://phys.org/news/2008-11-corralling-carbon.html>

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