Department of Botany Seminar

Tales from the Honeymoon Stage of a New Photosynthesis Tracer

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Abstract:

Numerous approaches have been used to place quantitative constraints on the size of the terrestrial carbon sink. These varied techniques produce widely disparate estimates of how much carbon ecosystems assimilate from photosynthesis, which hinders the ability to provide a benchmark by which to assess the performance of earth system models. Here I will discuss recent efforts to use an atmospheric trace gas, carbonyl sulfide, to develop a new proxy for the uptake of carbon by terrestrial vegetation. Carbonyl sulfide diffuses into plants through stomata following the same pathway as carbon dioxide and is quickly consumed by a hydrolysis reaction in the plant's mesophyll. The rate that the gas is consumed is thus tightly controlled by stomatal conductance. However, unlike carbon dioxide, there is not retroflux of this gas back out of ecosystems (such as respiration), which means variations in its atmospheric concentration or fluxes can be linked in a direct way to ecosystem productivity. A number of recent studies will be discussed showing how carbonyl sulfide can provide estimates of ecosystem photosynthesis at the site, regional and even global scales. Recent studies on carbonyl sulfide concentrations in bubbles from ice cores even suggest the gas can be used as a proxy for historic variations in terrestrial ecosystem productivity to test theories about how vegetation has responded to past changes in temperature and carbon dioxide concentration. This exciting new tracer is in a honeymoon stage with new findings rolling out weekly, but to be balanced I also will discuss some of the challenges to its utility that are beginning to emerge.

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