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A new chamber method for the simultaneous determination of δ^{13}C and δ^{18}O in soil derived CO_2

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Stable carbon (C) isotopes have been instrumental in constraining current estimates of the terrestrial C balance. Recently, Wingate et al. (2010; *Global Change Biology*, **16**, 3048-3064) have shown a strong disequilibrium in δ^{18}O between leaf and soil derived CO_2, raising hopes that different respiratory sources (e.g. plant vs. soil) can be distinguished using the atmospheric abundance of $CO^{18}O$ at larger spatial scales. However, uncertainty remains about the role of carbonic anhydrase (CA), an enzyme that efficiently catalyzes the exchange of O during CO_2 hydration in soils. The activity of CA determines the degree to which soil derived CO_2 carries the isotopic signature of soil surface water (e.g. in the litter layer). Experimental work is needed to clarify this exchange of ^{18}O in the soil, and the potential to identify root and rhizosphere-derived CO_2 using ^{18}O.

In order to constrain ecosystem C exchange estimates on the basis of ^{18}O abundance in atmospheric CO_2, we now require new measuring systems that allow simultaneous capture of δ^{18}O and δ^{13}C signatures of soil derived CO_2. To date, many laser absorption methodologies require considerable electric power and frequent calibration. However, a new generation of analysers based on a cavity enhanced laser absorption spectroscopy technique has recently become available and has considerable potential to deliver fast isotopic measurements with dramatically reduced power consumption and calibration requirements. We present first results from a new analytical set-up based on such a fast isotope analyser (model CCIA-36*d*, Los Gatos Research) coupled to a dynamic soil chamber. We use the changes in isotopic abundance (of both ^{13}C and ^{18}O) as CO_2 concentrations build up during chamber closure to determine soil $^{13}CO_2$ and $CO^{18}O$ fluxes. Using a series of replicated soil microcosms, we assess the role of (1) rooted vs. un-rooted soil, (2) simulated rain events, and (3) soil warming on the δ^{18}O and δ^{13}C signatures of soil derived CO_2.