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Comparison of a Gas Chromatograph and a Cavity Ringdown Spectrometer for Flux Quantification of Nitrous Oxide, Carbon Dioxide and Methane in Closed Soil Chambers

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The study of the three predominant greenhouse gasses effecting global climate change,CO_2, CH4 and N2O, has become increasingly important in ecological and agricultural soil research. It is essential for current and future atmospheric greenhouse gas budgets to reduce the uncertainty of greenhouse gas soil fluxes in a variety of environments and climates. Traditional soil flux experiments using the closed chamber and discrete sampling for Gas Chromatograph ("GC") analysis cannot sufficiently capture the large temporal variation in soil gas fluxes, which can lead to large errors in ecosystem flux models. Realtime, simultaneous measurement of these gases should provide easier and more comprehensive and precise chamber flux measurements.
We provide a comparison of the GC sampling method to a closed loop, continuous flowsystem coupled with a Picarro G2508 Cavity Ringdown Spectrometer to quantify the flux of CO_2, CH4 and N2O. The Picarro analyzer has a data rate of approximately 6 seconds for allthree gases, which gives a much higher temporal resolution than discrete sampling (performed every 8-15 minutes). This work will compare GC and Picarro G2508 soil flux measurement results from three different soil environments. Details on the system configuration and sampling methodology effects on flux errors will also be discussed. We will show that by reducing the systematic error due to sample preparation for the GC, the continuous flow measurement of the Picarro G2508 field deployable analyzer can significantly increase the measurement precision of respiration rates of N2O, CH4 and CO_2. It is noteworthy that the Picarro analyzer also simultaneously measures the concentration of ammonia (NH3) and water, and these results will also be discussed.