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Measurement of N2O and CH4 soil fluxes from garden, agricultural and natural soils using both closed and open chamber systems coupled with high-precision CRDS analyzer

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Studying the emission and uptake of greenhouse gases from soil is essential for understanding, adapting to and ultimately mitigating the effects of climate change. To-date, majority of such studies have been focused on carbon dioxide (CO_2) , however, in 2006 the EPA estimated that "Agricultural activities currently generate the largest share, 63 percent, of the world's anthropogenic non-carbon dioxide (non-CO_2) emissions (84 percent of nitrous oxide [N2O] and 52 percent of methane[CH4]), and make up roughly 15 percent of all anthropogenic greenhouse gas emissions" (Prentice et al., 2001). Therefore, enabling accurate N2O and CH4 flux measurements in the field are clearly critical to our ability to better constrain carbon and nitrogen budgets, characterize soil sensitivities, agricultural practices, and microbial processes like denitrification and nitrification. To aide in these studies, Picarro has developed a new analyzer based on its proven, NIR technology platform, which is capable of measuring both N2O and CH4 down to ppb levels in a single, field-deployable analyzer. This analyzer measures N2O with a 1-sigma, precision of 3.5 ppb and CH4 with a 1-sigma precision of 3ppb on a 5 minute average. The instrument also has extremely low drift to enable accurate measurements with infrequent calibrations. The data rate of the analyzer is on the order of 5 seconds in order to capture fast, episodic emission events. One of the keys to making accurate CRDS measurements is to thoroughly characterize and correct for spectral interfering species. This is especially important for closed system soil chambers used on agricultural soils where a variety of soil amendments may be applied and gases not usually present in ambient air could concentrate to high levels. In this work, we present the results of analyzer interference testing and corrections completed for the interference of carbon dioxide, methane, ammonia, ethane, ethylene, acetylene, and water on N2O. In addition, we will present the results of testing done with the analyzer attached to both closed and open chamber systems to quantify fluxes of N2O and CH4 from active soil samples. The soil samples were collected by the University of Iowa from soil test sites used for studying the application of biochar as a soil amendment. Results will compare the two chamber methodologies and results from several soil sample types, garden, agricultural and natural. Preliminary results from laboratory measurements of soil core samples taken from a garden soil sample using the closed-system chamber method show N2O emission to be on the order of 5.67 x 10-2 μg/cm3*hr, which is in good agreement with the open-system chamber method tested on the same soil sample, which yielded fluxes of 6.01 x 10-2 μg/cm3*hr . Additional work presented will verify these initial results and will be compared to literature such as Hutchinsion and Livingston 1993 assessment of the bias of different chamber flux methodologies.