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A Portable, Low-Power Analyzer and Automated Soil Flux Chamber System for Measuring Wetland GHG Emissions

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Preservation and restoration of wetlands has the potential to help sequester large amounts of carbon due to the naturally high primary productivity and slow turnover of stored soil carbon. However, the anoxic environmental conditions present in wetland soils are also the largest natural contributor to global methane emissions. While it is well known that wetlands are net carbon sinks over long time scales, given the high global warming potential of methane, the short-term balances between C uptake and storage and loss as CO_2 and CH4 need to be carefully considered when evaluating the climate effects of land-use change.

It is relatively difficult to measure methane emissions from wetlands with currently available techniques given the temporally and spatially sporadic nature of the processes involved (methanogenesis, methane oxidation, ebullition, etc.). For example, using manual soil flux chambers can often only capture a portion of either the spatial or temporal variability, and often have other disadvantages associated with soil atmosphere disturbance during deployment in these relatively compressible wetland soils. Automated chamber systems offer the advantage of collecting high-resolution time series of gaseous fluxes while reducing some human and method induced biases. Additionally, new laser-based analyzers that can be used in situ alongside automated chambers offer a greater minimum detectable flux than can be achieved using alternative methods such as Gas Chromatography.

Until recently these types of automated measurements were limited to areas that had good power coverage, as laser based systems were power intensive and could not easily be supplemented with power from field-available sources such as solar. Recent advances in laser technology has reduced the power needed and made these systems less power intensive and more field portable in the process. Here we present data using an automated chamber system coupled to a portable laser based greenhouse gas analyzer (Picarro G4301). We will present on the methodological and field deployment benefits of the system with a strong emphasis on the enhanced minimum detectable flux limits offered by this fully automated design. These advantages will be demonstrated through two deployments of the system in wetland and peatland ecosystems in Nova Scotia, Canada.