Geophysical Research Abstracts
Vol. 18, EGU2016-15482, 2016
EGU General Assembly 2016

High temporal resolution ecosystem CH4, CO_2 and H_2O flux data measured with a novel chamber technique

Klaus Steenberg Larsen and Jesper Riis Christiansen

Dept. Geosciences and Natural Resource Management, University of Copenhagen, Copenhagen, Denmark (ksl@ign.ku.dk)

Soil-atmosphere exchange of greenhouse gases (GHGs) is commonly measured with closed static chambers (Pihlatie et al., 2013) with off-site gas chromatographic (GC) analysis for CH4 and N2O. Static chambers are widely used to observe in detail the effect of experimental manipulations, like climate change experiments, on GHG exchange (e.g. Carter et al., 2012).
However, the low sensitivity of GC systems necessitates long measurement times and manual sampling, which increases the disturbance of the exchange of GHGs and leads to potential underestimation of fluxes (Christiansen et al., 2011; Creelman et al., 2013). The recent emergence of field proof infrared lasers using cavity ring-down spectroscopy (CRDS) have increased frequency and precision of concentration measurements and enabled better estimates of GHG fluxes (Christiansen et al., 2015) due to shorter chamber enclosure times. This minimizes the negative impact of the chamber enclosure on the soil-atmosphere gas exchange rate.
Secondly, an integral aspect of understanding GHG exchange in terrestrial ecosystem is to achieve high temporal coverage. This is needed to capture the often dynamic behavior where fluxes can change rapidly over the course of days or even a few hours in response to e.g. rain events. Consequently, low temporal coverage in measurements of GHG exchange have in many past investigations led to highly uncertain annual budgets which severely limits our understanding of the ecosystem processes interacting with the climate system through GHG exchange.
Real-time field measurements at high temporal resolution are needed to obtain a much more detailed understanding of the processes governing ecosystem CH4 exchange as well as for better predicting the effects of climate and environmental changes.
We combined a state-of-the-art field applicable CH4 sensor (Los Gatos UGGA) with a newly developed ecosystem-level automatic chamber controlled by a LI-COR 8100/8150 system. The chamber is capable of switching automatically between transparent and darkened mode enabling for separation of light-sensitive and light-indifferent processes in chambers. In a pilot study we measured hourly fluxes of CO_2, H_2O and CH4 continuously for two weeks in Danish Calluna vulgaris (common heather) heathland (Larsen et al. 2011).
We will present an analysis of the novel, high-frequency data of CH4 fluxes under light and dark conditions, assess the advantages and limitations of the experimental setup and recommend future improvements of the technology involved.

References:
Carter, M.S., Larsen, K.S., et al. 2012. Synthesizing greenhouse gas fluxes across nine European peatlands and shrublands: responses to climatic and environmental changes. Biogeosciences 3739–3755.
Christiansen, J.R., Korhonen, J.F.J., et al. 2011. Assessing the effects of chamber placement, manual sampling and headspace mixing on CH4 fluxes in a laboratory experiment. Plant and Soil 343, 171–185.
Christiansen, J.R., Outhwaite, J., et al. 2015. Comparison of CO_2, CH4 and N2O soil-atmosphere exchange measured in static chambers with cavity ring-down spectroscopy and gas chromatography. Agricultural and Forest Meteorology 211-212, 48–57.
Creelman, C., Nickerson, N., Risk, D., 2013. Quantifying Lateral Diffusion Error in Soil Carbon Dioxide Respiration Estimates using Numerical Modeling. Soil Science Society of America Journal 77, 699–708.
Larsen, K.S., Andresen, L.C., et al. 2011. Reduced N cycling in response to elevated CO_2, warming, and drought in a Danish heathland: Synthesizing results of the CLIMAITE project after two years of treatments. Global Change Biology 17, 1884–1899.
Pihlatie, M.K., Christiansen, J.R., et al. 2013. Comparison of static chambers to measure CH4 emissions from soils. Agricultural and Forest Meteorology 171-172, 124–136.