EGU General Assembly 2022

EGU22-837
https://doi.org/10.5194/egusphere-egu22-837
EGU General Assembly 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Predicting the methane flux from a north boreal fen using redox potential as an additional parameter

Markku Koskinen[1], Hanna Finné[2], Tarmo Virtanen[2], Annalea Lohila[3,4], Raija Laiho[5], Tuomas Laurila[4], and Mika Aurela[4]

[1]University of Helsinki, Environmental Soil Science, Helsinki, Finland (markku.koskinen@helsinki.fi)
[2]Ecosystems and Environment Research Programme, Faculty of Biological and Environmental Sciences, and Helsinki Institute of Sustainability Science (HELSUS), University of Helsinki, Helsinki, Finland
[3]INAR Institute for Atmospheric and Earth System Research/Physics, University of Helsinki, FInland
[4]Finnish Meteorological Institute, Greenhouse Gases Research Group, Helsinki, Finland
[5]Natural Resources Institute Finland, Helsinki, Finland

Continuous in-situ measurement of reduction-oxidation (redox) potential is an emerging tool for analysing ecosystem biochemical status. Redox processes are intrinsically linked to methane (CH4) production and consumption in soils. Under highly reducing conditions, acetate and carbon dioxide (CO2) are reduced into CH4, while at less reducing conditions, CH4 is readily oxidised into CO2. These oxidation processes do not necessarily require oxygen; other electron acceptors such as nitrate (NO3-) and iron can also be used by microbes. The prevalence of different electron acceptors and donors is reflected in the redox potential of the soil solution which can be measured. Thus measurements of soil redox potential could in principle be used for predicting CH4 flux.

We measured soil redox potential continuously at 4 depths between 5 and 40 cm over one growing season on nine measurement plots on three different microsites (flark, lawn and string), in a north boreal flark fen, while concurrently measuring CO2 and CH4 flux of the same plots using the manual chamber method. Flux measurements were conducted five to seven times per week from late June to late September, 2019. Along with the redox potential, water table level (WTL), air and soil temperature (Tair, Tsoil) and several vegetation characteristics were measured.

Tsoil was found to be the major control of the momentary CH4 flux, but after standardizing the flux to 10 C using the Lloyd-Taylor equation, including the soil redox potential was found to significantly ($p < 0.001$) improve the prediction of the flux over a model incorporating only WTL and momentary Tsoil.

This is an initial step towards inclusion of redox potential as a continuous variable describing the processes active in the soil into CH4 production/consumption models.