

Seasonal and inter-annual variation in ecosystem scale methane emission from a boreal fen

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Northern wetlands are one of the major sources of atmospheric methane. We have measured ecosystem scale methane emissions from a boreal fen continuously since 2005. The site is an oligotrophic fen in boreal vegetation zone situated in Siikaneva wetland complex in Southern Finland. The mean annual temperature in the area is 3.3°C and total annual precipitation 710 mm.

We have conducted the methane emission measurements by the eddy covariance method. Additionally we have measured fluxes of carbon dioxide, water vapor, and sensible heat together with a suite of other environmental parameters. We have analyzed this data alongside with a model run with University of Helsinki methane model.

The measured fluxes show generally highest methane emission in late summers coinciding with the highest temperatures in saturated peat zone. During winters the fluxes show small but detectable emission despite the snow and ice cover on the fen. More than 90% of the annual methane emission occurs in snow-free period.

The methane emission and peat temperature are connected in exponential manner in seasonal scales, but methane emission does not show the expected behavior with water table. The lack of water table position dependence also contrasts with the spatial variation across microtopography. There is no systematic variation in sub-diurnal time scale. The general seasonal cycle in methane emission is captured well with the methane model. We will show how well the model reproduces the temperature and water table position dependencies observed.

The annual methane emission is typically around 10 gC m⁻². This is a significant part of the total carbon exchange between the fen and the atmosphere and about twice the estimated carbon loss by leaching from the fen area. The inter-annual variability in the methane emission is modest. The June-September methane emissions from different years, comprising most of the annual emission, correlates positively with peat temperature, but not with water table position.