Long-term impact of forestry-drained peatlands on forest floor greenhouse gas fluxes and ecosystem carbon balance at a nutrient poor site of boreal Sweden

Tong, Cheuk Hei Marcus[1]*; Nilsson, Mats B[1]; Laudon, Hjalmar[1]; Peichl, Matthias[1]

* Corresponding author: cheuk.hei.tong@slu.se

[1] Department of Forest Ecology and Management, Swedish University of Agricultural Sciences, Umeå, Sweden

Abstract

Recent studies suggest that drainage of boreal peatlands for forestry has significantly altered greenhouse gas (GHG) balance, but its sign and magnitude remain uncertain, making it impossible to provide an accurate accounting of national GHG budgets in Sweden. To fill in the gap in order to meet the national and international climate goals, we evaluate the impacts of drainage and ditch maintenance on carbon (C) and GHG balances of nutrient poor peatland soils in a Swedish drained forest. We produce estimates by comparing the CO2 and CH4 exchanges in a peatland forest drained about a century ago with those at the nearby ICOS Degerö natural undrained peatland. In the drained peatland forest, we have been collecting flux data by manual closed chambers since 2018 in natural and experimental vegetation removal/trenched plots to estimate the various soil and plant associated component fluxes. Tree inventories, tree coring and litterfall production are conducted to estimate the net primary production of the tree layer. In addition, an eddy covariance flux tower was established in spring 2019 for direct measurements of the net ecosystem CO2 and CH4 exchanges. Weirs have been built to quantify the aquatic export via ditch flow from the ecosystem. Together, these data help to understand the C balance of the entire ecosystem and its individual terrestrial and aquatic component fluxes. We then examine how well soil and environmental variables explain temporal and spatial variation in the individual fluxes. Our initial data indicates that peatland drainage altered soil and environmental conditions for vegetation growth and microbial activities, with significant effects on the CO2 and CH4 flux rates.