Geophysical Research Abstracts
Vol. 19, EGU2017-16877, 2017
EGU General Assembly 2017

Greenhouse gas fluxes and carbon leaching before and after partial harvesting and clearcutting in a drained peatland forest

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The most common method of forest management in Finland is rotation forestry including clearcutting and forest regeneration. Typical clearcutting involves removing stem wood and leaving logging residues (foliage, branches, stumps, and roots) on the site. After clearcutting of a peatland forest, water table level (WTL) rises due to ceased interception and transpiration of trees. Due to the elevated WTL, the thickness of the oxic peat layer and peat mass susceptible to aerobic decomposition decrease, and consequently, carbon dioxide (CO_2) emissions from the 'old' peat are expected to decrease. On the other hand, conditions for methane (CH4) producing microbes will be more favorable and methane oxidation may decrease, which together may increase emissions of CH4 to the atmosphere. Also, nitrogen oxide (N2O) emissions are expected to increase due to the enhancing effect of logging residues on nitrification and denitrification processes. Due to the rising WTL, the leaching of dissolved organic carbon (DOC) may temporarily increase.

In our project, we aim to reduce the adverse environmental impacts of peatland forestry by conducting a partial harvesting instead of clearcutting to regenerate our study forest (Lettosuo, Tammela in southern Finland). Ca. 3/4 of the tree biomass was removed in spring 2016. With this, we hope to achieve a moderate (about 20 cm) rise in the WTL from the original –50 cm level. This should eventually decrease CO_2 emissions but not significantly increase CH4 emissions nor DOC leaching.

The effect of harvest and the moderate WTL rise on greenhouse gas (GHG) fluxes and evapotranspiration are studied using the data collected with the eddy covariance method before (2009–2015) and after (2016–) the harvest. We also retained an uncut control and set up a clear-cut plot at the site to compare the impacts of different management practices on site conditions, soil GHG fluxes and C and N leaching. The impact of logging residues on GHG fluxes are also studied with manual chambers. To have "a calibration year", we started to measure most of these variables already in spring 2015.

In this presentation, we will show the GHG and aquatic carbon fluxes before and after the logging and discuss the most important short-term implications of logging on GHG fluxes as well as on meteorology.