Geophysical Research Abstracts
Vol. 20, EGU2018-12014, 2018
EGU General Assembly 2018

The effect of partial harvesting and clearcutting on CO_2, CH4 and N2O balances in a drained peatland forest

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Drained peatland forests represent 20% of the forest surface area in Finland of which one third has nutrient-rich soil. The purpose of the drainage is to enhance tree growth by lowering the water table level (WTL) which improves oxygen availability for the tree roots. The nutrient-rich drained peatlands are a major source of carbon dioxide (CO_2) due to the decomposition of oxic peat layer. On the other hand, a well-drained peatland is typically a small methane (CH4) sink. Peatland forests in Finland are widely reaching harvesting age and the method used for the harvesting may have a significant impact on the greenhouse gas (GHG) balances. Nowadays, the most common method of forest management in Finland is rotation forestry including clearcutting and forest regeneration, but clearcutting is known to increase CH4 emissions and greatly change the soil hydrology.

Our aim was to study to what extent the adverse environmental impacts of peatland forestry could be reduced by making a partial harvesting instead of clearcutting. The experiment was conducted at a nutrient-rich peatland forest (Lettosuo, Tammela in southern Finland) which was originally drained in 1969. At the partial harvest plot, ca. 75% of the tree biomass was removed in spring 2016. In addition, we 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.

The effect of partial and full harvests and the subsequent moderate or more dramatic WTL rise on GHG fluxes and evapotranspiration were studied using the data collected with the eddy covariance method before (2009–2015) and after (2016–) the partial and full harvests. In addition, manual and automatic chambers were used to measure GHG exchange at the forest floor. To have “a calibration year”, we started to measure most of these variables already in spring 2015.

The preliminary results show that the WTL at the partial harvest rose less than at the clear-cut (12 cm vs. 22 cm) as compared to the control. Also, on the ecosystem level, the CO_2 balance was changed from neutral into a CO_2 source in both the clear-cut and the partial harvest. However, the net CO_2 emission at the clear-cut was about five times larger than at the partial harvest plot. CH4 sink decreased about 35% at the partial harvest while the clear-cut turned into a small source of CH4. In addition, initial results indicate that while the nitrogen oxide (N2O) fluxes were both spatially and temporally highly variable, they were, however, not changed significantly due to partial harvest. On the other hand, the N2O emissions at the clear-cut increased significantly.