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Biogeosciences Discussions

Interactive comment on "Greenhouse gas and energy fluxes in a boreal peatland forest after clearcutting" *by* Mika Korkiakoski et al.

Anonymous Referee #1

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General Comments: The study investigated all three main GHG gases (CO2, CH4 and N2O) and heat fluxes after a clear cut on a moderately drained boreal organic soil. The authors used a combination of eddy-covariance and chamber method for flux determination. Studies determining the effect on GHG after clear cut exits for mineral soil, but not for organic soil. Details are nicely discussed.

My main concern is the experimental design of the study. The paper is based on two years of CO2 measurement after the clear cut. Reference data (fluxes before the clear cut) are missing, although it is stated in the paper, that one year measurement of CO2 fluxes before the clear cut exits. These data are not published (p.11 ll.24-25). However the main conclusion (clearcutting turned boreal forest from neutral to C source) is based on these unavailable data. In view of the generally large interannual

variability of carbon balances on organic soil, the main conclusion is weakly supported. Interannual variability is not even discussed within the paper, although the first year after clear cutting is drier and warmer than the following. Without a control site including GHG measurements it is difficult to figure out the influence of the clear cut and "normal" annual variability. It exits a control plot of a reference site, but only data of water table and soil temperature is included. There is a second EC tower, measuring above the canopy (p.4 l.27). It is not clear whether GHG flux data exits and could be used as reference. There are data from chamber measurement from the year before the clear cut (starting during mid-summer 2015). Without a reference-control site and only a very short time series before the clear cut (even not a full year) for CH4 and N2O, data interpretation is very difficult and weak. The weather conditions in 2015 are not discussed.

I would suggest including these data (CO2 balances before clear cut and GHG of reference/control site after clear cut) in order to get a complete dataset instead of publishing a partial data set with weakly supported main conclusion. In addition I would suggest to include basic information about soil properties and to check the paper for consistent data sets. See comments below.

I miss a discussion about the system boundaries regarding source/sink function of forests. Is the assumed sink or neutral function of the forest due to accumulation of wood? Is the source function after the clear cut due to enhanced mineralisation of logging residues (which caused the former c sink/neutral)? What's about the peat mineralisation before and after clear cutting? GHG warming potential depending on the system boundary and source/sink function may change including C export from harvest. See also (Biogeosciences, 15, 3603–3624, 2018). Hommeltenberg et al. (2014, Biogeosciences, 11, 3477–3493, 2014) stated that a forested bog was a strong carbon sink based on EC measurement – however estimation of long term carbon loss rate since drainage indicated a carbon source of the site. I would extend the discussion on clear cuts effects on GHG balances with the focus on soil type (mineral vs organic)

p 13 L21 ff. How is the carbon balance in boreal forest on mineral soils? Perhaps it is possible to get an estimation of peat carbon mineralisation after clear cutting?

Information about soil properties are missing. The only information included is the peat type (nutrient-rich peatland). Information about soil organic carbon content, storage, C/N ratio and bulk density before and after the clear cut (or of the control site) would be valuable in order to compare these results with other organic soils sites. The use of heavy machinery (p4 L2-3) could lead to soil compaction, which could lead to a higher water table (depending on the reference point of water table measurement). Please include basic soil properties and an estimation peat thickness (reference and clear cut or before and after clearcutting).

Soil T data is not consistent in Figures. Compare Figure 2. Soil T at 5 cm depth is warmer in winter time than in summer time compared to other soil depth temperature and has the lowest annual variation (perhaps data of 30 cm depth?). In Figure S3 clear cut temperature in winter 2017 is 0°C without any variation. In Figure 2 all T soil depth are below 0°C in winter 2017. In addition there seems different sensibility of temperature sensors during the year, especially at the end of 2017 there seems temperature drops of 0.5 °C. Please clarify. Please use same axis label to be able to compare the same time periods. I would like to have the time mark of clear cut in all Figures (similar to Figure 2). Figure 5 shows all accepted night-time vs T air. Below 10°C there are very few points, below 7°C no points. However, T air seemed to be below 5°C for several months (Figure 2). The soil temperature (5cm) is below 5°C (Figure 9). How does this fit together? Does this mean that the data in Figure S2 during winter 2016/ 2017 are daytime data? In the paper is stated that data coverage is 30% after selection (p.5 l.21). Could you please add the night-time and daytime coverage (per month) of EC data?. Is the uncertainty of NEE due to uneven distribution of day-time and night-time coverage during gap-filling considered? How does Figure 9 fit to Figure 5a?

Additional comments. I wonder why CO2 fluxes from chamber measurements are

related to T soil, while EC CO2 night-time fluxes are related to T air and why T air is used in gap filling procedure. Please Comment.

The addition of annual cumulative footprint contributions in Figure 1 would help to evaluate the chosen suitable wind direction. Please add the used wind direction.

I would appreciate a table including warming potential of all GHG gasses.

Figure 3: Please include water table of control site.

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