

Interactive comment on “Greenhouse gas fluxes in a drained peatland forest during spring frost-thaw event” by M. K. Pihlatie et al.

Anonymous Referee #2

Received and published: 20 January 2010

Pihlatie et al. present the results of measuring the CO₂, CH₄ and N₂O exchange from a drained peatland forest. The measurements were performed during the spring and during the first month air temperature was often below zero during night but above zero during the day. The number of articles that deal with flux measurements of three greenhouse gases is still rather limited and makes this article very interesting. The relevance of the article is further increased by the aspect that they made use of 3 different methods for measuring the fluxes from both the forest floor and the forest canopy. Besides eddy covariance measurements below and above the canopy, automatic chamber and manual chamber measurements are presented, compared and discussed. The technical description of the chamber methods and analysis is absolute sufficient, but both for the details and for the analysis of eddy covariance methods they refer to other articles and manuscripts.

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The manuscript presents the experimental setup. Results are described and presented in 5 figures. The figures are sufficient clear although some figures are rather small. The authors should present more about the soil temperatures regarding the title of the manuscript. They describe that soil temperatures were measured and different depths and locations, but present only one soil temperature curve. It is unclear if this an average of all soil temperature measurements. The presented soil temperature in figures 2A and 3C are actually never below zero, so my main comment is if you can actually consider the soil frozen during the measurements. Air temperature is below zero during the nights, which implicates frost-thaw events in the very top of the litter-layer. It should already be mentioned in the abstract as well as in the introduction that the frost-thaw events are short events on daily scale and not longer periods with deep soil. This might also be the reason why actually no real effect of frost-thaw was detected and I suggest reconsidering the title of the manuscript.

Further comments:

Introducton Line 17-19 Drained peatlands. ...soils : please clarify! Do you want to say that drained peatlands which have been used for agriculture first and then planted with trees have emissions in the same order of magnitude as drained peatlands which are still used for agriculture. Is a drained peatland with forest not cultivated?

Material and Methods 2.1 Site description: Please give the tree density and/or the leaf area index of the forest. This will give the reading an idea how dense is the forest. Page 6115 line 6: The site was drained for the first time in 1971. This implies that the site was drained more often. Please specify if the drainage ditches were deepened or maintained. In the final section of this page the well-decomposed peat is up to 2.5 m deep although the average (?) water tables was lowered to 40 cm depth. Any indication how deep the average water table was before drainage. Can you say anything about fluctuations in the water table during the season and year? 2.2 Flux measurements Page 6117 line 11: change 'enclosure' to 'closure'. Is 48 min per chamber the time for one measurement or is it really the time that a chamber was closed? In that case it is

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important to mention when the readings of concentrations were taken during those 48 minutes. Page 6117 line: what was the volume of the manual chamber.

2.3 Soil measurements Page 6118 line 20-26: Please specify if soil water content and soil temperatures were also measured at depths given below the litter-layer or below the surface.

2.4 Data analysis Page 6119 line 16: Which pressure and temperature data were used to correct the flux rates.

3 Results; environmental conditions Page 6120 line 26 Is the line for air temperature in figure 2A an average? 27 $\bar{E}ZC$ is not shown in figure 2. Please clarify. Page 6121 lines 4-6: I cannot see clearly from figure 2A that the soil temperature becomes below zero. If you have measurements of the temperature in the litter layer please show them.

3.3 Fluxes Page 6122 line 24-28: what do you mean exactly? The negative correlation between flux with soil moisture and water table depth was not significant for EC-based sub canopy measurements. But was it not significant due to the negative correlation between soil moisture and water table with soil and air temperature or was the negative correlation of the flux with soil water and water table due to the negative correlation between soil moisture and water table with soil and air temperature. In other words; where is 'this' in line 27 referring to?

Discussion 4.1 CO₂ fluxes Page 6125 lines 17-24. This is why I consider change of the title: here you are actually suggesting that the freezing-thawing is only in the air and the very top of the litter layer and soil temperatures are not below zero.

4.2 CH₄ fluxes Page 6127 line 14 and Page 6128 line 25. Here I get confused regarding the different figures, please see over them again and use the same unit. For the site Kalevansuo you take 34 $\mu\text{g CH}_4\text{-C m}^{-2}\text{h}^{-1}$ from Minkkinen et al, which is extrapolated to a year 3.2 kg CH₄-C ha⁻¹. In the next line you write 1.95 kg CH₄ as average. I assume here CH₄-C. However, on line 25, page 6128 you give an uptake of 0.9 kg

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CH₄-C ha⁻¹yr⁻¹ for the site with a comparison to Minkkinen again with 2 kg CH₄-C ha⁻¹yr⁻¹. Is the 3.2 kg for the year 2007 and 2 kg for 2004-2005? Could you also describe briefly how the extrapolation was done in case the measurements did not cover the full year? What did you use to extrapolate?

General comments Page 6115 line 4: change 'was' to 'is'. Page 6115 line 10: consider to take away – before the 40 cm, as you write already that it is 'down to' 'from the surface' Page 6116 line 2: remove comma in 27 June, 2007 Page 6116 line 13: suggest changing 'which has'to' 'with' Page 6116 Line 17: explain 'NEE'. You are introducing all abbreviations except this one Page 6116 Line 18: 'at the centre' to 'in the centre' Page 6120 line 22: give company for the SPSS program. Page 6122 line: 7: Suggest removal of sentence between brackets: (automatic chambers and sub-canopy eddy covariance) Page 6127 line 3: suggest removing 'many'

Figure 2a: it is difficult to see the difference between soil and air temperature. Please use lines that are also clear in black and white.

Missing in references but given in the text: -Dutaur and Verchat 2007 -Wagner-Riddle et al 1997 -Scanlon and Kiely 2003

Page 6136: Move up Mäkiranta et al 2007 in correct alphabetic order: in english ä is considered as a.

Interactive comment on Biogeosciences Discuss., 6, 6111, 2009.

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