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Biogeosciences Discussions

Interactive comment on "Nitrous oxide fluxes from tropical peat with different disturbance history and management" *by* J. Jauhiainen et al.

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General comments The justification for the research reported in this manuscript is the lack of data on N2O emissions from tropical peat. Measurements of N2O flux at 6 sites subjected to different disturbances (drainage, burning, agriculture) were measured over various periods from 2000 to 2007. Water table depth was also measured. The manuscript is well written for the most part, but makes only a modest contribution to our knowledge of factors influencing N2O fluxes from tropical peat. Partly this is due to a lack of supporting data to relate the N2O flux values to, as only water table depth was measured concurrent with N2O fluxes. Its main contribution is flux values for these under-studied ecosystems, which are then compared to CO2 and CH4 fluxes (measured at the same sites and reported elsewhere). The authors conclude that N2O

fluxes are very variable in time and space (a fact well-known) and that annual emissions in terms of CO2eq are relatively small when compared to CO2 and CH4. The study is inconclusive with respect to effect of disturbances and management, likely because of the experimental design (uncontrolled conditions, non-simultaneous measurements). Perhaps the flux values could be reported in a short communication article. MS TEAM REPLY: Compliments for text flow are appreciated. Total number of international peer reviewed N2O flux papers concentrating on tropical peat is 6 (excluding this MS). Considering area and volume of organic matter in tropical peat, and the speed of land use change and resulted GHG emissions in this ecosystem, six papers on the topic is very low. Even if N2O fluxes or N2O flux dynamics do not differ greatly among these studies, or in relation to fluxes at other peat based systems, there should be a clear need for confirmative studies. The study presented in this MS contains likely the largest N2O flux data base collected from tropical peat forest systems affected by drainage (DF site) and deforested, drained and burned peat (DBP site). In the revised MS, supporting ancillary data is added (new table 2), summary statistics of flux values is added (new Table 3), and information from these is applied in Results and Discussion sections. We hope that this added supporting data and major revision in text are found satisfactory improvements. In addition to studies by Inubushi et al. (2003), Hadi et al. (2005) and Furukawa et al. (2005) this study forms the fourth study comparing three major tropical peat GHGs determined from same samples. Present understanding of relatively minor importance of cumulative N2O emissions in comparison to CO2 in ombrotrophic tropical peat is largely based on the few studies referred above, and our publications on CO2 and CH4 emissions reported elsewhere. The study is inconclusive with respect to the effects of disturbances and management on N2O fluxes, which is also true for majority of other reported studies based on gas flux monitoring in situ conditions.

Specific comments P. 5424. L. 1: The opening sentence is a bit awkward; consider re-phrasing. MS TEAM REPLY: Sentence is rephrased.

P. 5424. L. 3: Is this the main knowledge gap that is being addressed with the study

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reported? (i.e. "N2O dynamics"). It would be better to more specific on the research question that authors are trying to address. MS TEAM REPLY: “Nitrous oxide emissions and dynamics in tropical peat systems is still poorly known.” is omitted from the abstract. Rephrased abstract 1st paragraph addresses; (i) importance of tropical peat as carbon store, (ii) effect of land use on green house gas emissions, and (iii) aim of the study in quantifying N2O fluxes on specified land uses on tropical peat.

P. 5424. L. 5: Objective(s) and the location of the study site (country) should be added here. Also, the period of measurement. MS TEAM REPLY: Details on the location of the study are added. Monitoring periods are defined as wet and dry season. As periods varied by length, intensity and years, further details are provided in the main manuscript text.

P. 5424. L. 14-15: Please quantify these statements (most; modest peak). MS TEAM REPLY: Percentage of efflux and influx readings, mean and SD are now provided.

P. 5424. L. 15-16: It is well known that N2O fluxes vary significantly in space and time, typically presenting log-normal or other ’skewed’ probability distributions (eg. Yates et al., 2007. SSSAJ 70(3)). The main (novel) finding of this research should be stated here. The title refers to ’disturbance history’ and ’management’ so this factor should be addressed in your summary of results: what are the conclusions related to these two factors? MS TEAM REPLY: ‘Disturbance history’ refers to land use change from undrained forest to any other conditions (drainage, clear felling, burning, use in agriculture etc.) that have taken place in the study included sites at specific periods of time before flux monitoring, while ‘management’ refers to current land uses on the sites, and thereby both descriptive words were included in the title. Land cover (not changing during flux monitoring was described), disturbance history (already taken place prior to flux monitoring is referred through peat characteristics data) and water table (changed during flux monitoring was monitored and reported) were addressed in data inspection. Gas fluxes in “settled” conditions at the 5 land uses were compared and fluxes were referred to land cover, peat characteristic and water table. The main conclusion, based

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on the data, was “Continuous labile nitrogen availability from vegetation in forest subject to enhanced drainage was concluded to result marked N2O flux activity”, while the availability of labile organic nitrogen or peat water table conditions restricted emissions at other land use types.

P. 5425. L. 8: What is the relevance of N2O exchange being ’concurrent’ with CO2 and CH4? MS TEAM REPLY: Concurrent exchange of N2O, CO2 and CH4 refers to emissions that have taken place in similar conditions i.e. samples are taken at same time and place or even from the same sample. Sentence is rewritten. “Concurrent” was considered poor phrasing and the word is omitted.

P. 5426. L. 10-13: Consider changing to ’There are a limited number of studies quantifying all three major GHG fluxes form tropical peat sites’. MS TEAM REPLY: The whole paragraph describing objectives of this study is rephrased.

P. 5426. L. 15-20: More background and justification on the research questions related to potential factors affecting N2O fluxes from peat should be given in the introduction. What led the authors to choose the study sites with the given characteristics (e.g. how are N2O fluxes affected by peat burning? drainage?)? As the authors state, most research has been conducted in boreal peatlands. What is known about N2O production in peat of cold regions? What are contrasting factors (temperature, rainfall, pH?) in tropical regions that would affect N2O fluxes? Which hypothesis did the authors formulate before their study? MS TEAM REPLY: Background information on various land uses and their potential impact on nitrogen cycle is added in form of new paragraph in the introduction. Boreal peatlands are outside the defined topic so N2O production in organic soils are referred in more general terms, recent references on summary papers on boreal peat N2O emissions at various land uses are referred. Major potential N2O flux influencing differences between peat in the tropics and at more seasonal climate areas are addressed. Major potential N2O flux influencing abiotic and biotic factors in tropical peat are presented. Hypotheses are provided in the end of discussion section.

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P. 5426. L. 19-20: This is a relatively weak objective. Can it be formulated to address a research question? MS TEAM REPLY: The whole paragraph describing objectives of this study is rephrased.

P. 5427. L. 6: More information on the peat chemical characteristics at each site needs to be given (eg. pH, N content). What type of peat was present at each site? MS TEAM REPLY: This information is now added to Table 1 and in added new table (Table 2), information dealt in the tables is quoted/referred in the text.

P. 5430. L. 6: What is the justification for selecting these arbitrary values for data filtering. Why only at these two sites? MS TEAM REPLY: As it was pointed out by the referee and also by the other 2 referees, use of arbitrary cut points are difficult to reason. Therefore, new cut points for the highly deviating emission values, based on statistical criteria, are applied. The new selection is based on 75% quartile limit i.e. the highest 25% of the emission values are included in the group. Results, graph and discussion is based on the new approach. New added table (Table 3) also includes these cut point values.

Interactive comment on Biogeosciences Discuss., 8, 5423, 2011.