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Biogeosciences
Discussions

Interactive comment on "Effects of soil temperature and moisture on methane uptakes and nitrous oxide emissions across three different ecosystem types" *by* G. J. Luo et al.

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Reviewer's comment: Comparing soil nitrous oxide and methane fluxes from three very contrasting ecosystems is a nice idea; and as the authors suggested may help with the development of environmental response models. However, the data included in this comparison are: (i) data from their well studied Höglwald site, for which they have _ 10 years of flux data. For this paper's comparison they picked 1995 and 1997, as these years are 'typical with regard to flux magnitudes, seasonal flux patterns and environmental conditions'. For cross – site analysis they use the data for both years. However for some specific data analysis, the authors randomly select data from 1995

and 1997. (ii) a tropical forest in Australia, data for Nov 2001 – Oct 2002, (iii) a steppe in Mongolia, data for mid August 2007 to mid August 2008. I assume the authors don't have more than one year's worse of good quality data from the tropical forest and the steppe. I don't, however, understand why they did not make use of the _10 year record of nitrous oxide and methane flux measurements at Höglwald, and use the average/median of all years? Neither do I follow why 2 representative years for Höglwald were included, surely with all the generalisation done in this paper, one year would do?

Answer: Obviously we failed to explain in the Material and Method section how and why data were chosen in such a way for our Höglwald site. The reviewer is right that we have a continuous dataset of soil greenhouse gas fluxes from end of 1993 onwards until 2010. For the both other sites, i.e.the steppe site and the tropical forest site, we only have one year of continuous measurements of soil CO2/CH4/N2O fluxes. Our aim was to compare soil fluxes across sites. To avoid overrepresentation of the Höglwald site in the overall dataset we needed to pick a "typical" year. However, there is no typicial year, since approx. 1/3 of all observation years show significant N2O pulses due to spring-thaw, whereas all the other years do not show this feature (Luo et al., 2012). The years 1995 and 1997 we finally selected are typical for the two types of seasonal variations we observe for soil N2O fluxes (but also for CH4 and CO2, with regard to magnitude and seasonality): In 1995 we did not observe a spring-thaw N2O pulse emission event. Emissions were rather low, but typical with regard to years with no spring-thaw events with regard to seasonality and magnitude. 1997 was a year with a significant spring-thaw N2O emission pulse, though the pulse was not as important as compared e.g. to the year 1996. In both years, N2O annual emission were approx. 0.7-0.8 kg N2O-N ha-1 yr-1, which is the long-term average emission from the Höglwald site (Table 3, Luo et al., 2012).While 1995 tended to be somewhat wetter and colder than in average, the year 1997 was somewhat dryer, but warmer. Therefore, the both years we finally picked are rather representative for the Höglwald site. However, we still would have two years and not one as for the other sites. To overcome this problem

we randomly selected data from both sites (50% from each year) to compose a virtual year which may represent conditions at the Höglwald site best. This virtual year was used for comparison across sites.

It now reads (Page 4, line 32 following): In order to consider such irregular events in our cross-site data analysis, we randomly chose 365 observation days from the years 1995 and 1997 to form a new, more representative dataset for this site. For the specific site analysis (e.g. Table 2), all data obtained in both years were considered, whereas for cross site comparison a synthetic dataset was derived by randomly selecting 50% of data for the year 1995 and 50% of data from the year 1997.

We did not use the average of +10 observational years since this would have involved another step of calculating average fluxes. By this one would dampen direct responses of microbial processes involved in N2O/CH4/CO2 exchange to changes in temperature and moisture.

Also this is now mentioned (Page 4, line 28 following): We did not use average values across all observations years, since averaging would have dampened the observed response of microbial processes involved in soil-atmosphere CH4 and N2O exchange to changes in soil temperature and moisture.

Luo GJ, Brüggemann N, Wolf B, Gasche R, Grote R, Butterbach-Bahl K, 2012, Decadal variability of soil CO2, NO, N2O, and CH4 fluxes at the Höglwald Forest, Germany. Biogeosciences, 9, 1741–1763, doi:10.5194/bg-9-1741-2012

Reviewers comment: Table 1: Why do you use 2004-2010 rainfall and temperature for the temperate forest, 1982 -2007 data for the steppe and data set of unknown (?) length for the tropical forest? A more consistent approach in deriving the temperature and rainfall data for your study would be more credible. Answer: Valid comment. We now give meteorological data explicitly for the observation period.

Reviewers comment: The comparison would be much stronger if you would have used

same length data.

Answer: We did use for each site one year of data. Sorry, for the confusion we caused due to the approach we used for the Höglwald data set. But that should be clarified yet.

Reviewers comment: Below are some additional comments: Section 3.1, p935 line 17 – 23 and Table 2: are the differences between sites significant?

Yes, this is now indicated in the text as well as for the table Section 3.1. p935, last paragraph, line 22: replace ‘emission’ with ‘flux’ in: ‘ done A comparison of soil nitrous oxide and methane emission...’ Section 3.1. p935, last paragraph, line 2 delete ‘sites’ in ‘temperate forest sites ecosystems’ done

Section 4.1 p937 first paragraph: Nitrous oxide is a ‘product’, and not a ‘byproduct’ of denitrification. And ‘nitrification is the oxidation of ammonium to nitrite and nitrate’. Please make these changes.

done

Section 4.1 p937 line 3: delete ‘approximately’ and change to (0.22 kg ...), Section 4.1 p937 line 20: change to (r20.33)

done

Section 4.2 p 941 line 19: change to: equals 44% and 43%, respectively.

done

Section 4.2 p 941 line 20-25: The comparison of Sitaula’s presumably in vivo measurements of CH4 uptake rates in a pine forest at relatively low WFPS with an agricultural soil (in vitro) study, where maximum CH4 uptake rates were observed at 50-70% WFPS is a little odd. The word ‘SIMILAR’ in line 23 is certainly not correct. I am sure you can find a more suitable in vivo study for this comparison?

We skipped the comparison with the Nesbit and Breitenbeck study and now cite studies by Dobbie and Smith and Smith et al how report on the moisture dependency of soil CH4 uptake in Scottisch woodland soils: However, for Scottish woodland soils (Dobbie and Smith, 1996; Smith et al., 2000) with a sandy texture and a high porosity, oxidation rates were still high even at 80% WFPS, indicating that site specific soil properties and here soil gas diffusion potentials control soil moisture thresholds for optimal CH4 uptake.

Table 1: what is Dfb, Af, DwB?

These are abbreviations which are used for the Köppen-Geiger climate characterization. In the Table footnotes we now provide the details.

Table 1: Should you not change 'Mean annual precipitation' to 'Cumulative annual precipitation'?.

We changed that to annual precipitation and changed numbers to reflect the specific observation dates.

Table 1: Can you synchronise the display of pH (3.4 -4, 4.1 0.03), and the other chemical, physical properties across the three sites.

Done. However, this is somehow critical, since at the Höglwald a thick organic layer sits on top of the mineral soil. To avoid misunderstanding we provide data for the topmost mineral soil.

Fig 1-3: It is difficult to distinghuish between the 4 flux lines, when viewing in black and white.

Line styles have been changed to increase bw readability

Fig 4: is the box plot of daily AVERAGE soil volumetric water content?

Yes, these are daily average values. The word average was added.

Fig 6 ,7,8: delete Höglwald in legend

Done

Fig 9,10,11: it is difficult to distinguish the black, grey and white dots. Perhaps increase the graph size.

Done âĂČ

Interactive comment on Biogeosciences Discuss., 10, 927, 2013.