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Biogeosciences Discussions



# *Interactive comment on* "Decadal variability of soil $CO_2$ NO, $N_2O$, and $CH_4$ fluxes at the Höglwald Forest, Germany" *by* G. J. Luo et al.

**G. J. Luo et al.**

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Dear Kim, thanks for your valuable comments. In the following our replies to your comments:

p. 12203, l. 12: What kind of non-linear curve was fitted? At the time we started measurements we relied on the work of Hutchinson and Mosier (1981). This is now mentioned in the manuscript

p. 12204, l. 16: The gap-filling procedure seems rather crude. It might work for short gaps (hours), but what if larger gaps (days) occur? Imagine linear interpolation of day(s) following a freeze-thaw event. It seems to me that the relationships to environmental factors revealed by the study could have been used for gap-filling, provided of

course that only non-gap filled data are used in the identification of relationships.

The manuscript was not thought to explore gap filling strategies for NO and N2O, but we picked up your idea (and also of Chris Flechard and reviewer #1). We therefore changed our strategy. We now use daily mean values (we stick with daily measurements since subdaily flux measurements are not as robust due to failures of single chamber measurements) for the development of empirical models (linear and non-linear approaches). Nevertheless, the idea behind the development of empirical approaches is not to gap-fill but to explore if easy to measure parameters can be used to simulate fluxes at different time scales

p. 12205, l. 20: Were gap-filled data used for this exercise? We now provide both, analysis and with and without gap-filled data. See Table 5-6

p. 12205, l. 21: How were the data split into the two sub-sets? We randomly selected 50% of the data. We updated the manuscript.

p. 12206, l. 2: Did the logarithmic transformation result in normality? Yes, information is added now.

p. 12206, l. 21: Why and how was a harmonization of soil moisture measurements done? To harmonize soil moisture measurements by different sensors we analyzed periods during which soils were water saturated (i.e. spring period) and corrected for the off-set between the sensors.

p. 12208, l. 17: Why a quadratic fit? It looks from Fig. 4 that a linear fit would be (almost) as good If one uses a linear regression one will get a negative off-set. Furthermore, r2 values are higher for a quadratic curve-fit as compared to linear curve fit. . p. 12208, l. 22: It could be added here, that 1997 was a year with low precipitation and 2002 a year with high precipitation

done

p. 12211, l. 8: Where are the “last two columns”? I do not find them in Table 3.



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Table was revised and corrected (text was changed to lines since we mixed lines and columns)

p. 12212, l. 5: How can 2003-2005 become a 4-year period? It is our poor mathematical background

p. 12212, l. 23: Did the authors consider a carry-over effect from one year to the next? E.g. following a cold autumn with lower turnover of (new) organic material, the organic pool available in the spring might be higher and thus result in a higher respiration. Such carry-over effect are often demonstrated in tree-ring analyses We changed this section of the discussion and now also discuss carry over effects of previous litter production on soil CO2 emissions. Nevertheless, due to missing data we can not fully assess if such carry-over were possibly driving elevated soil CO2 emissions in the colder years.

p. 12213, l. 13: Here the actual boundaries of a "year" might come into play. The authors could consider whether a "production year" rather than a calendar year would be better to explain the findings. A production year could be defined as ranging from the start of growing season in one year to the corresponding time in the next (e.g. Start of April year 1 to end of March year 2 for a spruce forest).

See previous comment. We extended the discussion to reflect that also GPP may affect soil respiration.

p. 12215, l. 6: Please clarify what is meant with the phrase: "a narrowing of needle C:N ratios". Instead of narrowing we now use "decrease"

p. 12215, l. 21: The dieback of soil microorganisms can release nutrients, but I suppose nutrients would be fixed later with a new increase in the biomass of soil microorganisms thus leading to reduced substrate availability. Thus the dynamics of nutrients fixed by soil microorganisms are overlying th physico/chemical parameters governing the flux and may have a different timing of maxima and minima.

We did not change text here, since the mechanisms of pulse N2O emissions in



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freezing-thawing periods is further discussed a few lines below. There is little doubt that dieback of microbial biomass during freeze-thaw period is one of the major mechanism to supply substrate to the surviving microbial population.

p. 12216, l. 15: Why would increased substrate availability not benefit nitrification?

In these periods nitrification seems to be closely coupled to denitrification, as was already pointed out by Papen and Butterbach-Bahl (1999), and NO produced by nitrification did not escape to the atmosphere but got further reduced by denitrification to N2O (and possibly N2) in the water-saturated top soil. We added this information to the manuscript.

p. 12220, l. 3: How would the aggregation affect the findings for the other trace gases? Please note, that we now also present data analysis using daily mean values.For N2O, NO and CO2 we were able to demonstrate significant relationships (see Table 4-6).

Technical corrections:

All technical corrections have been implemented.

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Interactive comment on Biogeosciences Discuss., 8, 12197, 2011.