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Interactive comment on “Decadal variability of soil CO₂ NO, N₂O, and CH₄ fluxes at the Höglwald Forest, Germany” by G. J. Luo et al.

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1 General Comments

The manuscript reports on an impressive multi-year series of trace gas flux measurements between the soil and the atmosphere in a spruce forest in Southern Germany. The manuscript aims at revealing relationships between environmental factors and soil trace gas fluxes and to identify the most important parameters, thereby explaining interannual variation.

In general, I find that the manuscript documents an impressive achievement with a kind of World-record in the longevity of continuous soil trace gas flux measurements. The

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multi-year data-set shows clearly the importance of long-term measurements, e.g. in the finding that freeze-thaw pulses of N₂O only occurred in 5 out of 15 years.

The overall findings of the parameters controlling the trace gases are very interesting, for NO and CO₂ especially the rather low dependency on soil moisture and for N₂O and CH₄ the lack of simple parameterization.

I certainly find that this manuscript should be accepted for publication. I have, however, some major/minor points that I would like to see clarified before final publication.

2 Specific comments

p. 12203, l. 12: What kind of non-linear curve was fitted?

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-gapfilled data are used in the identification of relationships.

p. 12205, l. 20: Were gap-filled data used for this exercise?

p. 12205, l. 21: How were the data split into the two sub-sets?

p. 12206, l. 2: Did the logarithmic transformation result in normality?

p. 12206, l. 21: Why and how was a harmonization of soil moisture measurements done?

p. 12208, l. 17: Why a quadratic fit? It looks from Fig. 4 that a linear fit would be (almost) as good.

p. 12208, l. 22: It could be added here, that 1997 was a year with low precipitation and

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2002 a year with high precipitation.

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

p. 12212, l. 5: How can 2003-2005 become a 4-year period?

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.

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).

p. 12215, l. 6: Please clarify what is meant with the phrase: “a narrowing of needle C:N ratios”.

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 the physico/chemical parameters governing the flux and may have a different timing of maxima and minima.

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

p. 12220, l. 3: How would the aggregation affect the findings for the other trace gases?

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3 Technical corrections

p. 12199, l. 24: Suggest "and" in stead of "or".

p. 12205, l. 12: Replace "explained" with "explain".

p. 12207, l. 14: The sentence starting with "The annual mean ..." is redundant and can be deleted.

p. 12212, l. 5: I suppose it should be "mid-aged" rather than "middle-aged" un less it refers to the historic period "Middle Age".

p. 12220, l. 25 "reduce" rather than "reduces".

Fig. 3: Because of the common scale, it is very difficult to see the seasonal variability of N_2O and CH_4 fluxes. Consider to add a new panel for these.

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