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Biogeosciences Discussions

Interactive comment on "Stand age and tree species affect N_2O and CH_4 exchange from afforested soils" *by* J. R. Christiansen and P. Gundersen

Anonymous Referee #2

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General comments

This paper by Christiansen & Gundersen reports data from two years of monthly N2O and CH4 flux measurements with chambers in pedunculate oak and Norway spruce stands of two different age classes (approx. 13-17 and 40 yrs) in Denmark. The trace gas measurements were amended by soil temperature and soil moisture measurements at the same time with chamber measurements. Furthermore, soil samples were taken at the end of the two-year measurement period and analyzed for their ammonium and nitrate content. The data were tested for significant effects of tree species and stand age on N2O and CH4 fluxes as well as on soil mineral N and bulk density,

and for relationships between N2O/CH4 fluxes and pH, bulk density, mineral N and SOC content, and C/N ratio. The authors found a significant effect of stand age on trace gas fluxes, with higher N2O fluxes in the older stands of both spruce and oak, and with higher CH4 uptake in the older oak stands and lower CH4 uptake in the older spruce stand. However, they did not observe a significant species effect alone.

The study seems in principle to be well conducted and is in the scope of Biogeosciences. It is well written, and the data are presented in an adequate way. Although the authors state themselves that they have not included "true" replicates in their study, the design of the study with three different plots per stand, with minimum distances between single plots of 35-120 m, with three chambers for each plot seems to be appropriate, also given the fact that a range of data from previous studies at this site, especially on soil characteristics, is available. However, I agree with Reviewer 1 that there are two weaknesses in the study that require modification of the manuscript, i.e. (i) the fact that soil mineral N content was determined only once at the end of the study, whereas soil N2O and CH4 fluxes of the whole observation period were related to it, and (ii) the relation of N2O fluxes of the observation period 2008-2010 with nitrate leaching data from 2000-2002, although determined for the same site. I am afraid to have to say that this is like comparing apples with pears, given the relatively young age of the stands with their high developmental changes within the eight years between the two observation periods, and also potential differences in climatic conditions might completely hamper a scientifically sound interpretation. Thus, all parts relating to this comparison including Fig. 5 should be removed from the results part of the paper, albeit they should be included in the discussion section. All interpretations based on the relationship between mineral N content and N2O fluxes should be treated with care.

Specific comments

p. 5735, l. 15f.: For your trace gas analysis, you removed 4 times 60 ml from each chamber, i.e. 3-5% of the chamber volume, leading to a pressure drop of 3-5%. Please interpret your data against the background of the effect of pressure changes on trace

gas flux measurements with chambers, which can be huge.

p. 5737, l. 2-6: I don't understand the extraction procedure. What is the difference between "soil samples for 0-5 and 5-15 cm" and "depth segments". Were the soil samples divided in half? Please clarify.

p. 5737, l. 8-9: Why were the soil extracts kept in the freezer until analysis? Was assured that there was no significant concentration change during the storage time in the refrigerator?

p. 5737, l. 18: Why were log-natural transformed flux data used for statistical analysis? Have you also tried the original data? If so, what do the differences between "original" and log-transformed data tell us?

p. 5738, l. 16-20: As mentioned already in the general comments, this comparison is scientifically not sound and should be removed from the paper.

p. 5742, l. 19-20: This would mean that CH4 uptake increases with increasing bulk density. At least for oak definitely the opposite is true according to your data.

p. 5744, l. 16-18: One explanation could also be that with higher bulk density the oxygen availability decreases and more N2O is reduced to N2 during denitrification.

p. 5748, l. 22-23: On the basis of your data you cannot write "in the first period (up to 17 yr) after planting", as you have not measured during the whole 17 years, but only the last two years. The same applies to l. 25f.

p. 5748, l. 26-27: "the differences. . .were not evident": this reads as if certain differences should have appeared, but did not. This is anticipation is not justified.

p. 5749, l. 3-5: Where is the justification for this suggestion? Do you data support this assumption? Or is it pure speculation? Please clarify.

p. 5749, l. 6f: The last two sentences are pure speculation and should be removed from the conclusions.

Table 2: The meaning of the numbers for "Intercept", "Bulk density" and "%NO3" are not clear to me.

Figure 5: As said above, Fig. 5 should be removed from the paper.

Technical corrections

p. 5730, l. 20: Replace "on a long term scale" with "in the long term"

p. 5730, l. 21: Replace "gasses" with "gases"

p. 5733, l. 19-20: Be consistent: write either "Norway Spruce" and "Pedunculate Oak", or "Norway spruce" and "pedunculate oak" throughout the paper; give also the scientific names here.

p. 5739, l. 9: Replace "consistent" with "consistently"

p. 5740, l. 23: Delete "in" after "than"

p. 5741, l. 2: Delete "and" after "significantly"

p. 5743, l. 26: Replace "it" with "is"

p. 5745, l. 2: Replace "adhere" with "derive"

p. 5745, l. 6: Add "that" after "shown"

p. 5745, l. 8: Rewrite: "Low soil C/N ratios facilitate. . ."

p. 5748, l. 6: Start a new sentence after "(Borken et al., 2003)".

p. 5749, l. 1-3: Rephrase this sentence.

Interactive comment on Biogeosciences Discuss., 8, 5729, 2011.