

Interactive comment on “Stand age and tree species affect N₂O and CH₄ exchange from afforested soils” by J. R. Christiansen and P. Gundersen

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Specific comments p. 5730, l. 17: changed to: “...related to changes of bulk density and gas diffusivity in the top soil and competition of soil N with trees.” p. 5731, l. 4-6: done p. 5732, l. 1: changed to: “A pure European beech stand in southern Germany forest emitted 4 to 5 times more N₂O compared to an even-aged Norway spruce stand, although the combined NO+N₂O emissions were largest from the soil under the Norway spruce (Papen and Butterbach-Bahl, 1999).” p. 5732, l. 10-12: rephrased to “It has also been suggested that conversion of deciduous forests to Norway spruce and pine plantations would decrease CH₄ oxidation potential in the soil because of the

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higher N deposition in coniferous forests (Borken et al., 2003).” p. 5732, l. 12: done p. 5732, l. 23: done p. 5732, l. 25: replaced “forest age” with “stand development stand development on the fluxes of N₂O and CH₄ from soils”. It is not the intention to state here if N₂O either increases or decrease, as contrasting results have been reported (sentence below). p. 5736, l. 10: the phrase has been deleted p. 5736, l. 20: this has been specified in the text p. 5737, l. 18: we added a constant to each flux value for N₂O it was 18 and for CH₄ it was 80. This has been specified in the text. p. 5739, l. 5-7: this has been deleted and numbers moved to the sentence on p. 5738, l. 27 p. 5739, l. 11: corrected to ug m⁻² h⁻¹ p. 5739, l. 12: has been rephrased to eliminate the contradicting wording, so it appears that the majority of emission events occurred in winter and spring. p. 5739, l. 18: The numbers for both N₂O and CH₄ has been changed to represent the range in observed fluxes and not stand means as before. p. 5739, l. 24-25: done p. 5739, l. 26-29: done p. 5740, l. 11: agree p. 5741, l. 2: done p. 5741, l. 17: deleted p. 5741, l. 19: done p. 5743, l. 9: done p. 5744, l. 7: corrected p. 5744, l. 11: I have added following sentence to mention this aspect: “In addition the lower exchange capacity from the more compact soil in the younger stands will lead to longer retention time of N₂O in the soil increasing the likelihood of reduction of N₂O to N₂ especially if the soil water content is high. This would in turn lower the net N₂O emission.” p. 5745, l. 5: The entire paragraph has been shortened and the discussion regarding nitrification and C/N ratio has been deleted, since it did not serve to bring explain our different fluxes. p. 5745, l. 8 and l. 13: the discussion regarding nitrification and C/N ratio has been deleted p. 5745, l. 17: I agree that this is equally as important. This was partly the reason why we included the regression of N availability measure and N₂O fluxes. However, without quantative comparisons between fluxes and N availability I find it difficult to highlight it more than it is now, since we merely discuss the qualitative relationship. We have added a figure containing only the relationship with NO₃ leaching and N₂O emissions without any regression line. Furthermore, we have argued that we believe that the younger stands are still in a phase where N demand from plants result in low N leaching. We therefore would expect to see the same rel-

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ative difference in leaching between young and older stands today, meaning that the relationship would be the same with data from the same period as our N₂O fluxes. I have added a sentence here: "There was a positive relationship between past NO₃ leaching (Hansen et al. 2007) and our mean annual N₂O fluxes (Fig. 5). This relationship can only serve as qualitative indicator that the soil N status changes over time resulting in increased N availability and larger N₂O emissions. However, we believe the difference in NO₃ leaching between young and older stands is still valid today because the young stands (less than 20 years) are still expected to be in the phase of high N demand by plants, i.e. low leaching below the root zone (Hansen et al. 2007)." p. 5748, l. 18-19: done p. 5748, l. 24: done p. 5749, l. 5: We have removed this from the discussion. However, we find that including a discussion of tree species effects on N cycling in the soil will not serve to explain the insignificantly different N₂O emissions between Norway spruce and oak at both the stages of forest development we studied. This is for two reasons. One, and the most important reason for this is that our study, as you also point to, indicate that the plant demand to a higher degree drives the differences in N availability between young and old stands regardless of tree species. This was also reflected in our statistical analyses, i.e. that stand age was the only significant factor explaining the increased N₂O emissions. Two, we have not measured any gross N transformation and we believe that we might add another speculative layer to the discussion which would not be beneficial. Instead we point to that the tree species effect related to ecosystem N cycling is related to N deposition that can result in different N availability. However, this tree species effect might not be visible yet in the older stands of oak and Norway spruce.

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