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Interactive comment on "Impact of 40 years poplar cultivation on soil carbon stocks and greenhouse gas fluxes" *by* C. Ferré et al.

Anonymous Referee #3

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General comments

The study investigates how the soil-atmosphere exchange of greenhouse gases (GHG) in a natural forest and a poplar plantation vary in space and time and relates these variations to site properties and land use. The study presents interesting GHG flux data in conjunction with detailed physical and chemical soil profile data.

Spatial variability: The authors mention the importance of pedogenetic spatial heterogeneity in the order of tens of meters. However, the study lacks quantitative information e.g. by a detailed soil survey, of the spatial relevance of flooding, differences in elevation, and major soil properties. Without this, the importance of the "outlier" plot #10 and of differences in texture in the soil profiles and C contents cannot be adequately judged. Obviously, soil respiration was measured at more points than the ones presented. It would be useful to show that the subset chosen for this study really captures

the site-scale variability of conditions, at least for CO2.

Four replicates per land use type appear too low, given the high degree of spatial variability of the sites, to allow statistically sound conclusions from the observed differences in GHG fluxes. The authors further relate the N2O and CH4 fluxes and probably also CO2 fluxes of single chambers to the properties of the respective soil profiles. The high small-scale variability of GHG fluxes documented in the literature infers a high risk that the GHG fluxes measured in a chamber of 10 or 40 cm diameter are not representative for the respective soil situation. The design of the study is inadequate for the purpose of studying spatial variability.

Land use effects: The effect of occasional plowing down to 40-50 cm of the poplar site is nicely documented in Table 1. Consequently, carbon has been redistributed into deeper soil horizons and topsoil concentrations have been depleted by the mixing. Therefore, it is no surprise that the natural forest soil contains higher C stocks in the topsoil. However, the picture changes if the C stocks in the entire profile are considered. I took the data given in Table 1 to calculate the average total soil C stocks for the two sites. The results show no significant differences (as also indicated in Fig. 6) between the sites and even identical C stocks if the "outlier" plot #10 is discarded. I disagree with the conclusion that the poplar plantation has depleted the soil carbon pool.

It is interesting to note that there are no significant differences in the annual GHG budget of the soil under natural forest and poplar plantation, only of CH4 consumption, which is irrelevant. This is not evident from the conclusions of the study.

Specific comments

1. As the manuscript presents soil-related data in forest/plantation only the introduction should maintain this focus and better lead to the story of the paper. At present, the references quoted often refer to the ecosystem carbon balance rather than to soil aspects and too much to agricultural systems.

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2. Material and methods: How often were N2O and CH4 measurements performed?

3. Results: why did the authors chose to present monthly mean fluxes rather than the fluxes obtained at the measurement dates? As the flux rates are skewed taking the mean flux may overestimate the actual flux on the site, taking the median may be more appropriate.

4. The individual sections could be better balanced in the degree of detail in which CO2, CH4 and N2O are addressed.

5. Section headings and section texts do not always match.

6. The text could be structured in a clearer way, e.g. by a clearer separation of the individual gases, and, in particular, results and discussion should be separated.

7. The last paragraph of the conclusions referring to the "slow-in, fast-out" paradigm is not supported by the data, which mainly show a redistribution of C in the soil profile.

8. The English sometimes needs improvement.

Interactive comment on Biogeosciences Discussions, 2, 897, 2005.