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Biogeosciences Discussions

Interactive comment on "Soil-atmosphere exchange of nitrous oxide, methane and carbon dioxide in a gradient of elevation in the coastal Brazilian Atlantic forest" *by* E. Sousa Neto et al.

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1. The effect of increasing temperature on CO2, CH4 and N2O ïňĆuxes The authors suggest that increasing temperatures will result in a consequent increase in soil CO2 and N2O ïňĆuxes and CH4 consumption. Considering the limitations of their observed data (i.e. once a month frequency and missing data) and provided statistical results (i.e. no clear correlation between soil temperature with N2O and CH4 ïňĆuxes through the gradient of elevation), the suggestion may not be robustly supported by the results of this study.

Author's comment: We accept the reviewer's comment. Temperature increase alone

may be insufficient to cause increases in N2O and CO2 emissions and in CH4 uptake rates. The variation of soil gas emissions with altitude responds to combinations of factors including climatic conditions, species composition and structure, nutrient supply and soil physical and chemical properties. We reformulated the abstract and the conclusions to reflect greater caution. See lines 35-38 and lines 352-364 in the manuscript.

2. Estimate cumulative annual CO2, CH4 and N2O ïňĆuxes for different altitudes The authors provide annual mean ïňĆux of N2O and CH4 for different altitudes and statistical signiïňĄcance in the difference of ïňĆuxes by altitudes. The cumulative annual ïňĆux of N2O and CH4 could also be calculated by linear interpolation and numerical integration of observed ïňĆuxes between sampling times (i.e. area under the ïňĆux curves) and the authors can test the signiïňĄcance in differences of cumulative annual ïňĆux by altitudes. Additional efforts will provide clearer information. In the case of CO2 ïňĆux, the Q10 model (relationship between soil temperature and CO2 ïňĆux) can be developed with currently available soil temperature and CO2 ïňĆux data and the authors can then estimate the missing CO2 ïňĆux (Oct. 2006 to Dec. 2006) using the Q10 model with observed soil temperature (Oct. 2006 to Dec. 2006). After ïňĄlling the gap of CO2 ïňĆux, the authors can estimate cumulative annual CO2 ïňĆux.

Author's comment: We accept the reviewer's comment. We calculated the cumulative annual ïňĆux of N2O and CH4 and tested the differences of cumulative annual ïňĆux by altitudes. This calculation approach is now described in the methods and results sections (See lines 175-177, 220-224) and is summarized for N2O and CH4 in Table 5. The statistical outcome does not change for N2O. For CH4, the cumulative results show no significant difference among altitudes. This is because the test has fewer degrees of freedom. We do not believe that the cumulative results for N2O or CH4 change any of our conclusions. They may be useful to compare our sites to other sites. (See lines 175-177, 220-224 and Table 5). For CO2, we estimated the missing CO2 values by using the exponential model and estimated the cumulative annual CO2 fluxes as suggested. See lines 177-180, 225-236.

3. Add a rainfall ïňĄgure and check possibility of peak N2O emission caused by rewetting of dry soil Beyond the signiïňĄcantly higher annual mean ïňĆux of N2O at 100 m, two very high N2O peak emissions occurred in Dec. 2006 and Jun. 2007 in 100 m. Since the soil temperatures of both months were not particularly high (Fig. 1), the peak emissions may not be caused by high soil microbial activity inïňĆuenced by soil temperature. Looking at the WFPS ïňĄgure (Fig. 2), there is an interesting common point: WFPS abruptly increased in both months. Considering the well-matched timing of N2O peak emissions and WFPS changes, it is possible the peak emissions may be caused by rewetting events (rewetting of dry soils). Studies have reported increased soil N2O emission following the wetting of dry soil in various ecosystems, including forest (e.g., Groffman Tiedje, 1988; Vitousek et al., 1989; Garcia-Mendez et al., 1991; Davidson et al., 1993; Nobre et al., 2001). If there are available rainfall data for the sites (i.e. from the nearest weather station) plot them with WFPS and check whether the changes of WFPS were associated with rainfall events. If they are well matched, further discussion related to N2O peak emissions and rewetting events will contribute to our understanding of N2O ïňĆuxes. It would be very interesting if the authors could discuss why high N2O peak emissions occurred only in the 100-m site.

Author's comment: We followed the referee's interesting suggestion but we found no evidence for a rewetting event as the cause of the increased N2O fluxes. In our text (lines 298-306) we discuss the coincidence of three factors that promote N2O production, soil moisture, soil temperature and organic matter decomposition at the beginning of the Austral summer. This explanation may explain the December peak in N2O emissions but does not explain the June peak.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/7/C4797/2011/bgd-7-C4797-2011-supplement.pdf

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