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Interactive comment on "N_2O, NO and CH_4 exchange, and microbial N turnover over a Mediterranean pine forest soil" *by* P. Rosenkranz et al.

Anonymous Referee #2

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In the manuscript the authors report on two intensive measurement campaigns of trace gas exchange in a Mediterranean pine forest soil. Furthermore they have measured indicators of N cycling which they use to explain the observed trends in trace gas exchange. Measurements of trace gas exchange in Mediterranean climate are rare and as such this is a new contribution using an automated system that the group has already used under multiple climatic conditions. The study is well performed and should be published after my concerns have been addressed.

The most important finding of this study is that during the two campaigns net N2O uptake takes place, which makes this ecosystem one of the rare examples of a net N2O sink. These measurements were supported by sub-atmospheric N2O (and CH4) concentrations in the soil profile which confirms that the soil acts as a N2O (and CH4)

sink. This is especially surprising giving the dry and well drained conditions of the soil whereas the only known process that may lead to N2O uptake is denitrification (a normally anaerobic process). To explain these apparent contradictory results, the authors speculate that the process responsible for N2O uptake is aerobic denitrification by heterotrophic nitrifiers, which is apparently supported by high soil O2 concentrations, low soil N and high soil C contents. It becomes apparent in the discussion that soil water content plays a critical role in the trace gas exchange. In the discussion the authors could have made a stronger case for aerobic denitrification if their field measurements had not only been supported by lab measurements of N cycling but also with manipulative lab experiments on the influence of soil water content on trace gas exchange in this specific ecosystem. Especially the lacking response of N2O uptake after the simulated rainfall left me with questions how well aerobic denitrification explains the observed N2O uptake?

For me it was not clear how the 15N pool dilution was performed. Was a time-0 extraction performed to determine rapid (abiotic) reactions on injected NH4 and NO3? I think this is critical to correctly interpret 15N pool dilution data. It has been shown in other studies that abiotic reactions may be very important and should be accounted for to correctly calculate gross mineralization and gross nitrification rates (e.g. Berntson and Aber, 2000). Also, if the time-0 extraction was performed, how high was the recovery of the injected 15N? I expect that the 15N recovery will be very low in such an N limited system. I was surprised to see that the authors used a 6% 15N enrichment in the pool dilution. Normally a higher 15N enrichment and low NH4 or NO3 concentration is used. How much NH4 and NO3 was added to the soil sample in comparison to the natural amounts of available NH4 and NO3 in the samples? With the relatively low 15N enrichment and the low natural NH4 and NO3 concentrations in the soil/litter you may have run the risk that the amount of N added to the system is high compared to the natural mineral N pool which may have affected your results. Also how much water was added to the soil samples in comparison to the soil water content? Is it possible that the added water caused a peak in the microbial activity?

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Interactive Comment

Reference:

Berntson, G.M. and Aber, J.D., 2000. Fast nitrate immobilization in N saturated temperate forest soils. Soil Biology & Biochemistry, 32: 151-156.

Interactive comment on Biogeosciences Discussions, 2, 673, 2005.