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Interactive comment on "Characterisation of NO production and consumption: new insights by an improved laboratory dynamic chamber technique" *by* T. Behrendt et al.

T. Behrendt et al.

thomas.behrendt@mpic.de

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Indeed the MS is very long, but the authors decided to join the results for the different soils and the technical part together since the results are needed to understand why the incubation system needed to be improved (see reply to referee #1). Thank you for the recommendation to join the result and discussion section and to shorten the conclusion section. We will modify that in the final version and will reduce the total length of the MS. The authors appreciate the evaluation of referee #2 to publish the technical part.

For the part of the experimental setup as well as the results, the authors will give an explanation in more detail to the comments of referee #2:

A detailed sequence of sampling can be found in the supplement Fig. S1 (referenced in line 22 p.1206). The change of soil moisture, soil temperature, and incoming mixing ratio of NO on one sub-sample is necessary to avoid sub-sample variability. The main reason is simply that the net NO release rate (first order result) of all four experiments are needed to calculate several second order results e.g. production of NO, NO consumption rate coefficient, NO compensation point. If different sub-samples will impact the release of NO the calculation of these second order results will be erroneous. There are several publications available testing the relationship of soil mass, respectively thickness of soil (e.g. Remde et al., 1989, Laville et al., 2009), flow rate (Remde et al., 1989) and soil cores (Rudolph and Conrad 1996; Rudolph et al., 1996) to determine the effective soil layer involved in NO release to about < 5cm. We performed that experiments for some soils as well. Since our MS focuses on net NO release rate, NO production, NO consumption rate coefficient we did not include these. They are only needed to convert the net NO release rate to a net potential NO flux. The authors decided to use gravimetric soil moisture content as unit for soil moisture, since the water filled pore space – used in earlier publications – is prone to large errors caused by the variability of bulk density and particle density (c.f. Bargsten et al., 2010).

For the part of the interpretation of nutrient data and exchange of NO, the authors will give an explanation in more detail to the comments of referee #2:

(a) Within the time of our dry-out experiments in the order of 24-48h the chemical and physical soil properties are hardly changing. Therefore, the authors used the nutrient concentration prior incubation and combined them to the NO production, NO consumption rate coefficient, and NO compensation point. Referee #2 is right that our interpretation needs to be restricted to the NO release processes within our incubation measurements. We will change this in the revised version, since we did not have any plants or leaching processes in our chamber and concluded based on our data for NO production, NO consumption rate coefficient, and NO compensation point.

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Interactive Discussion

Discussion Paper

To the knowledge of the authors only in the process of denitrification NO can be consumed by NOR to N2O. However, NO can be produced in the process of nitrification and denitrification. Therefore the maximal release of NO of 1.0 ng kg-1 s-1 for the FINTHEN grassland soil under zero-air and 0.5 ng kg-1 s-1 at 131 ppb NO fumigation at 20°C suggests that denitrification might be more important within this soil. Since the ratio of NO production over NO consumption rate coefficient equals the NO compensation mixing ratio, a low NO compensation mixing ratio indicates a higher potential consumption of NO and thereby larger contribution of denitrification, respectively.

(b) The authors agree to Referee #2 that the point about the heterotrophic process might not be clear enough to understand. However, EGER spruce and EGER blueberry show the largest potential NO consumption rate coefficients and given the facts that (i) only within the process of denitrification NO can be consumed, (ii) the CO2 release rates are very high, and (iii) most denitrifiers are known to be heterotrophs we conclude that heterotrophic denitrification might be the dominant process. Autotrophic and heterotrophic processes of course occur simultaneously, however, we used the NO production, NO consumption rate coefficient, NO compensation point, chemical and physical properties of the soils to interpret the dominant process. Since in blueberry soils less organic matter was observed compared to forest soil (Hanson et al., 2002), and the amount and composition of organic matter impacts nitrification rates (Zak and Pregitzer, 1990), we hypothesize that the large differences in JNO, PNO, kNO, Q10P, Q10K might be caused by a small scale difference in heterotrophic microbes.

The authors are already working on another MS to relate transcripts of functional genes to NO release rates. However, transcripts of functional genes and be only used as proxy for microbial activity and therefore it is quite challenging to collect more indications about the dominant processes within dry-out experiments.

(c) Both samples EGER young spruce and EGER blueberry understory were sampled within a spruce forest. Thanks to referee #2 we will include a potential small scale difference in soil N mineral content and change ‘precipitation’ to ‘atmospheric N deposition'.

(d) We will change the statement (p 1234 line 29) from 'Orlando (2012) found low abundance of denitrifiers in dryland soil' to 'Orlando (2012) suggest that a very low abundance of nirS-type denitrifiers and lack of denitrification activity for a desert soil from ATACAMA desert, Chile'.

(e) We will change the sentence (p1235 line 1-2) 'Due to very low ammonium contents, limited NO production within those soils is most likely by autotrophic nitrification' to ' Due to very low ammonium and organic C contents, limited NO production within those soils is most likely by autotrophic nitrification'

(f) The authors agree that the main variables for predicting the NO flux are mineral N supply and availability, soil moisture and soil temperature. However, the NO flux results from NO production and NO consumption. As stated in Dunfield and Knowles (1998), the organic carbon content of soil and the evolution of CO2 are good predictors for NO consumption rate coefficients and thereby NO consumption.

Interactive comment on Biogeosciences Discuss., 11, 1187, 2014.