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Interactive comment on "The fate of ^{15}N-nitrate in mesocosms from five European peatlands differing in long-term nitrogen deposition rate" *by* K. Zając and C. Blodau

Anonymous Referee #2

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I like the idea of the paper, which investigates responses of various N retention pools in peatland ecosystems to different atmospheric N deposition regimes. Also the part of the study relating different N pool sizes to the N deposition regime is valid. The approach taken with the 15N tracer is however problematic and has to be interpreted with care, because the applied methods can not distinguish between 15N assimilation and 15N stuck to the surface of the tissues. Further, with the applied methods and reported results I don't see the main aims of the study (listed as followed) met.

1. transformation pathways of N within the peat soil, e.g. from inorganic N to organic N and from nitrate to ammonium,

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2. differences in N transformation in relation to the legacy of atmospheric N deposition, and

3.whether mosses from “clean” sites would be able to assimilate N more efficiently than mosses from “polluted” sites

add. aim 1: Figure 7 and 8 show excess 15N NH4 in pore water. Since NH415NO3 was used as a label any recovered 15N NH4 indicates transformation. However, the results do not show any 15N recovered as organic N, which the authors also acknowledge in the discussion.

add. aim 2: to answer whether there are responses to the legacy of atmospheric N deposition a different statistical approach needs to be taken. When evaluating a response to a N deposition gradient regression analyses need to be employed. In case of Figure 3 it would be an ANCOVA with N as continuous predictor and dry/wet as categorical. It is certainly not suitable to use t-tests together with an ANOVA. For the regression the 3 cores per site need to be averaged prior to statistical analyses to avoid pseudoreplication. The gradient approach would be in line with how the study is presented in the introduction, the discussion and for most of the description of the results. Hence, either the scope of the paper or the stats need to be adapted.

add. aim 3: to address assimilation of the applied 15N different methods incorporating a removal step of superficial 15N (that has clearly not been assimilated) need to be used.

Please make clear throughout the result section where results from the experiment are reported versus pre- treatment results from the gradient.

add chemical analyses: please mention on which material those analyses were conducted

add nitrogen uptake by plants: it is not surprising that highest retention of 15N was found in Sphagnum species during the dry period. Sphagnum has the highest surface

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to mass ratio of all investigated plants in the study. When dessicated Sphagnum shows little to no assimilating activity and the applied tracer remains sitting on the surface. Under wet conditions some of the tracer gets diluted. The applied method does not allow to draw conclusions about 15N assimilation by any of the investigated plants because an unknown proportion of the applied tracer will remain on the surface of any leaf. "The shrubs in cores from Frölichshaier Sattelmoor were particularly efficient in retaining the tracer and accounted for 91 % of the retention in vascular plants (Table 2)." Table 2 shows nicely that the 15N retention is strongly connected to the leaf surface area. Despite the fact that Graminoids show the highest total N content (Figure 1) their 15N retention is compared to the other "pools" minimal. Therefore, vegetation cover estimates need to be reported in the study and ideally the surface area of the respective "pools" should be taken into account.

add. Figure 1: what is the unit mg/g what? dry mass? N content from before or after the incubation?

add. Figure 2: what is the unit? Why square meter? How does that work particularly for the shrubs and Graminoids? I would assume the pools have a volume?

add. Figure 4: "mass" Wet or dry? And, retention pools averaged over wet and dry?

add. Table 2: NH4 and NO3 are measured from pore water?

16918/10-20 please use the same units for both the N concentrations in the fertilization slurry during the acclimation period and the 15N concentrations during the treatment period.

16925/26 "Dissolved organic N" (DON) - add abbreviation to all (PN,..) when first introduced in the paragraph

16927/22-23 "transfer of 15N into DON were, for instance, not investigated" – in that case omit it from the aims in the introduction

16927/25 "While the basic pattern of N distribution appeared to stay intact, ..." - what

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does that mean?

16929/21 “most likely by the ongoing formation of new biomass”, where is the growth data? I only see it mentioned in the abstract and the methods.

16931/15 “Shrubs and some Graminoids can experience problems when faced with continuously high water levels since they lack aerenchyma” - what problems? Also the Graminoids (Eriophorum sp.) in this study do posses aerenchyma.

16931/24 “The fact that the 15N tracer penetrated deeper into the peat and more 15 N recovered” - change to more 15 N was recovered

16933/3-8 “at the sites with low N inputs (DS), nitrate was first assimilated by the plant layer and later apparently partly released as ammonium from the vascular plant roots” - where can this time lag be seen in the results?

16933/14-15 “From our findings and earlier studies one may infer that N concentration is more important than N deposition rate for the moss filter function and the fate of N.” - how can this be disentangled with the data from this study when high N tissue concentrations result from high N background N deposition?

This whole last paragraph is not quite clear to me. First Pearce and Van der Wal (2008) found that the concentration is more important than the dose. Then Pitcairn and others (2006) concluded that wet deposition is more important than total N deposition, which is slightly different. And then I get lost: “Wu and Blodau (2015) examined if low but frequent doses of N deposition differed in their impact on the distribution of shrubs, peat mosses, and grasses in a model simulation of the long-term N fertilization experiment at the Mer Bleue peatland (Ontario, Canada).” - differed from what? compared to fewer high concentrations? Also model results always depend on the parameters fed into the model.

Interactive comment on Biogeosciences Discuss., 12, 16913, 2015.