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Biogeosciences Discussions

Interactive comment on "Estimation of nitrogen budgets for contrasting catchments at the landscape scale" *by* E. Vogt et al.

E. Vogt et al.

chri2@ceh.ac.uk

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The authors thank the Anonymous Reviewer for their comments. We have responded to the specific comments below.

(Note: "Author's reply:..." inserted after the original text from the Review ("Referee #1:...")

Referee #1: I do not feel comfortable with the concept "landscape NANI" proposed by the authors in this paper. The strength of the NANI approach (recently overviewed by Swaney et al. 2012) lies in the fact that only "new nitrogen" is accounted. With this approach all double counting related to N recirculation is avoided. On the other hand NANI approach has not the power of resolution achieved by authors in this work.

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Interactive Discussion

Discussion Paper

The budget presented in the paper (Section 3.9) is practically the same as a regular soil balance approach on agricultural soils but including the estimation of deposition in the entire catchment surface. The result of the subtraction is the agricultural surplus + deposition in non-agricultural areas. In a relative equilibrated catchment NANI and agricultural surpluses should be quite comparable because NANI (new N) will replace that N that is being lost or not used. If the catchment is populated (not the case) we should also add point sources. As conclusion: I would clearly avoid the use of the term "landscape NANI" because highly differs from the original and will generate misunderstandings. The "catchment retention" estimated by authors can be therefore perfectly compared with the estimations carried out by Billen et al. (2011) for large catchments, indeed there are two papers in this special issue performing similar comparisons (Bartoli et al. and Lassaletta et al.).

Authors' reply: The reviewer makes a good case for changing the terminology used in Section 3.9. The calculation of "landscape NANI" will be left out of the paper. Instead the "agricultural surplus" (i.e. all N inputs (including deposition and biological N fixation) minus N outputs via grazed grass and harvested products) will be calculated and compared to the NANI of European regional catchments. The relative difference of the agricultural surplus to the stream export gives the proportion of N retained within the catchments. The thus calculated catchment retentions will then be compared to regional estimations by Billen et al. (2011).

Referee #1: Finally, N fixation in managed grasslands needs to be included as anthropogenic input.

Authors' reply: See response below.

Referee #1: P8990 L9 In croplands and managed grasslands N-fixation must be also considered as an agricultural input.

Authors' reply: The estimation of N fixation of the grassland catchment was revised (see response to comment on P8996) and thus this form of agricultural N input will be

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mentioned in the abstract.

Referee #1: P8991 L5. Despite being similar, N budget and N balance are not exactly the same. Budgets provide a full record and account of all N flows as is generally done in the cited literature. Please substitute balances by budgets.Authors' reply: This will be changed as it also brings it in line with terminology used later in this paragraph.

Referee #1: P8992 L2-5 Expressed like this, objectives look like conclusions of the study.

Authors' reply: This sentence has been rewritten as follows: "The study aims to assess how landscape N budget analysis can provide insights into the main N flux terms, key uncertainties associated with these terms and the overall implications for the environmental status of the landscape."

Referee #1: Section 2.1 Please provide information on PP and temperature on the studied area.

Authors' reply: This will be added to Section 2.1: "As part of the NitroEurope Integrated Project (Sutton et al., 2007), a landscape study area of 6 km x 6 km was established in southeast Scotland for detailed inventory of agricultural activities, Nr concentration and flux measurements. The area has a temperate oceanic climate with an annual mean temperature of $\sim$8°C and a typical rainfall of $\sim$1000 mm."

Referee #1: Fig 1. It could be obvious, but a label indicating each catchment name (Grassland – moorland) in this first figure would be the useful to facilitate the reading.

Authors' reply: OK, labels will be put into Figure 1.

Referee #1: P8994 L6 Do you mean section 3.8?

Authors' reply: The budget table with all the error terms given (Table 4) is included in Section 3.7, so this will be changed to "Section 3.7 and 3.8".

Referee #1: P8996 Herridge et al 2008 have estimated 150 kgN/ha for clover grass-

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lands and 50 kgN/ha for legume-grass pastures. Despite there is no much clover in this pastures, 1kgN/ha it could be a too low value for any grassland.

Authors' reply: The fixation rate of the grassland catchment has been revised and the text will be changed accordingly: "[...] The catchment N input through biological N2 fixation (Nbio fix) was thus estimated to be 1 kg N ha-1 yr-1 for the moorland catchment. As there was little or no clover in most of the grassland, Nbio fix for the grassland catchment was estimated to be 5 kg N ha-1 yr-1. This is in agreement with grassland fixation rates used by various N budget models compared by de Vries et al. (2011)."

Referee #1: P9000 L15 No NH3 emissions for animal excreta?

Authors' reply: 4-5% of the N contained in excreta from grazing animals are emitted as NH3, hence 95% of the N in grazing excreta enter the soil (as the text says in lines 13-15).

Referee #1: P9004 L2 "originated from direct agricultural land inputs" because a proportion of the atmospheric deposition comes from volatilized and redeposited N.

Authors' reply: Ok, "direct" will be added (and so it will be in the abstract).

Referee #1: P9005 L17-19. In my opinion, this sentence is unnecessary.

Authors' reply: This sentence will be removed.

Referee #1: P9006 L15 Do you mean section 3.9?

Authors' reply: Yes, this will be corrected.

Referee #1: Fig 6 and 7. Please put y-axis in the same scale.

Authors' reply: OK, this will be changed.

Referee #1: P9009 L13 For my part, the accuracy of stream fluxes estimation performed in this study is pretty good. I agree with authors and levels of PON are probably

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very low when compared with DIN and DON. I would not be so critical with stream fluxes estimation in the conclusions.

Authors' reply: The reviewer has picked up an ambiguity in the wording of the conclusions. We agree that the stream fluxes, as measured in this study, are of good quality. However, they still introduce a key uncertainty to our budget calculation because they represent large budget terms. This emphasises how large the uncertainty of stream fluxes are in other studies where DON has not been measured or measurements have been less frequent or over a shorter period of time. Therefore we are recommending that this term is in the future measured as accurately as possible. We have rephrased the paragraph as follows: "The key uncertainties of our N budget approach were N2 emissions and stream N export. This emphasises, firstly the need for more studies addressing the quantification of N2 emissions and, secondly the importance of estimating downstream fluxes accurately when compiling N budgets. Even the well-established downstream fluxes of this study (including DON) introduce a key uncertainty to the budget calculations as the stream exports represent large budget terms."

Interactive comment on Biogeosciences Discuss., 9, 8989, 2012.