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

### **Anonymous Referee #2**

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This paper present a comprehensive assessment of nitrogen (N) inputs and outputs at two contrasting hydrological catchments in southern Scotland and is well worth publishing. The strong aspect of the paper is the well written description how all these inputs and outputs were arrived. A weaker part is the description of results, which is sometimes confusing and repetitive. This holds specifically for various tables and figures that appear to be redundant. Furthermore, the uncertainty assessment can be written more clear. Finally, the referencing is generally fine, but lack some important articles. All aspects are detailed below

Description of results In my view the paper needs some reorganizing, in terms of order and included tables and figures. Now the results section switches from input terms (3.1 and 3.3) to output terms (3.2 and 3.4) and then suddenly to all inputs (3.5) and outputs

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(3.6), being an order inconsistent with the results in Tables and Figures. Furthermore, it sometimes refers to figures on spatial variation while it in reality discusses the total catchment numbers. This makes it all very confusing

Regarding the N budget, all the information is actually included in Table 4 and the Tables 2 and 3 and the Figure 6-8 are completely redundant and can be left out. Table 2 and 3 give the gives the mean numbers in Table 4 for each catchment but only multiplied by the catchment area of 621 ha and 895 ha, respectively. This area (mentioned in the text) can be added to Table 4 as a footnote and then each reader can make the calculation if he likes. Figure 6 and 7 simply repeats the average data in Table 4 on inputs and outputs, respectively, and Figure 8 is the balance with its uncertainties, as given in Table 4.

The logic order is in my view

- 3.1 Overall catchment N budgets are given with a discussion of uncertainty.
- 3.2 Spatially variation of the catchment N inputs and output terms

Each section could then be subdivided in e.g. (i) input terms (land surface N input, atmospheric N deposition and biological N<sub>2</sub> fixation) , (ii) output terms ( N harvest, N emissions and fluvial N export) and (iii) balances, following the same order as used in the methodological description in Section 2

Section 3.1 can then completely do with the information in Table 4 with a footnote on the area in hectare. Thus skip Table 2 and 3 and Figure 6-8.

Section 3.2, however, should be accompanied by maps on the spatial variation of all the catchment N inputs and N output terms. What misses then is land surface N input, biological N<sub>2</sub> fixation (but this may be so constant that it can be left out), and N harvest. So, here it would be relevant to ad 2 maps.

Uncertainties The uncertainty section is interesting as such, but I have 2 suggestions here as far as its quantification is concerned

- 1 The general terminology used in the paper is that a given N budget term is considered to be accurate (estimated uncertainty  $\pm 10\%$ ) or have a relatively low uncertainty (of  $\pm 20\%$ ) or higher and then estimates

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of  $\pm 30\%$  and  $\pm 50\%$  are used with one exception, ie N<sub>2</sub> emissions which go from -50 to +200%. The word “considered” already makes clear that the uncertainty is based on expert judgement and in this context, it is much better to introduce/use an explicit classification of uncertainties, as done by e.g. Kros et al. (2012) in Biogeosciences, instead of an implicit approach. These authors mention that since there is little quantitative information on the uncertainty of the model inputs, they decided to use certain levels of uncertainties depending on the model input term. That is exactly done in this study, and can best be made explicit. What I suggest is to have separate section 2.5 on uncertainties, where the classification system of 10%, 20%, 30% and 50% is introduced and allocated to the different terms with the argumentation: could come in one table. This section should then also contain Eq.2, plus a rationale for using the equation (a reference?).

**Repetition** Apart from reducing redundancy by restructuring the results section please have a close look at the paper again on unnecessary repetition in certain para's. To give one example, on p7, line 8-10, deposition estimates are said to have a relatively low uncertainty in the range of  $\pm 20\%$  and this information is repeated in different wordings on p7, line 19-23.

**References** If referring to Kros et al. (2012) for classifying uncertainties, please quote:

Kros, J., G.B.M. Heuvelink, G.J. Reinds, J.P. Lesschen, V. Ioannidi and W. de Vries, 2012. Uncertainties in model predictions of nitrogen fluxes from agro-ecosystems in Europe. *Biogeosciences Discuss.*, 9, 6051–6094.

The paper by de Vries et al.(2011) is quoted very often, but not always adequately. This paper focuses on the continental (European) scale only, but it is part of a special issue on N flux assessment going from local to continental scale and several papers in this issue would be appropriate to refer to. To give some examples: on p3, line 5-7, the authors state that N balances have recently been developed and applied at various scales, but then they should not refer to the continental scale paper, but to the

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introduction in this special issue, which is also de Vries et al (2011).

De Vries, W., P. Cellier, J. W. Erisman and M.A. Sutton, 2011. Assessment of nitrogen fluxes to air and water from site scale to continental scale: an overview. *Environmental Pollution* 159: 3143-3148.

When referring to N fluxes in European rural landscapes on p3 line 17, it would be good to refer to at least two other recent landscape papers in this special issue, i.e.:

Kros, J., K.F.A Frumeau, A. Hensen and W. de Vries, 2011. Integrated analysis of the effects of agricultural management on environmental quality at landscape scale. *Environmental Pollution* 159: 3170–3181.

Dalgaard, T., N. Hutchings, U. Dragosits, J.E. Olesen, C. Kjeldsen, J.L. Drouet and P. Cellier, 2011. Effects of farm heterogeneity and methods for upscaling on modelled nitrogen losses in agricultural landscapes. *Environmental Pollution* 159: 3182-3192.

When referring to different budget approaches on page, it is crucial to refer to Leip et al (2011) who gave the most complete review on this topic

Leip, A., W. Britz, F. Weiss and W. de Vries, 2011. Farm, Land, and Soil nitrogen budgets for Agriculture in Europe calculated with CAPRI. *Environmental Pollution* 159: 3242–3252.

Finally, at the end of the intro, the authors state that to their knowledge, “this is the first study which includes high resolution atmospheric modelling combined with a detailed spatial landscape inventory of field specific agricultural activities” to estimate N budgets at landscape scale. Well I do not think this is true. The above mentioned reference by Kros et al (2011) in *Environmental Pollution* 159: 3170–3181, does the same and should be mentioned here. A unique aspect may be the quantification of N export, but then this should be said. .

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