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Biogeosciences Discussions

Interactive comment on "Influence of short-term transfers on nitrogen fluxes, budgets and indirect N_2O emissions in rural landscapes" *by* S. Duretz et al.

Anonymous Referee #1

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This paper addresses important issues related to the influence of spatial interaction on nitrogen fluxes and a model based method to derive the emission fractions for indirect N2O emissions. Especially, I liked the procedure on deriving the indirect N2O emissions. This is certainly a novelty. The title reflects more or less the contents of the paper, but I have difficulties with the use of "short-term transfer". As I understand it clear, the paper is more dealing with spatial interaction within a landscape without addressing the temporal dimension, rather than short-term transfer. This paper certainly contains worthwhile information for being published. However, I have some doubts which I believe need to be addressed. Below I addressed a few major concerns as well as some specific comments.

Major comments

1. The title promised the role of short-term effect, but what this exactly is, is not made clear. Furthermore, this paper is more focussing on N fluxes in a landscape rather than the indirect N2O emissions as promised in the introduction. This type of landscape analyses is not new, but the effect of short-term interaction is. However, the authors does not make clear what they meant by this and what the short-term effect really is.

2. In general the description on material and method is not very concise. The model description is rather generic and copy/paste from a previous article (Duretz et al., 2011). Furthermore, crucial information on relevant process such as how N2O production/emission is calculated are not given. From a footnote of Table 1 (in the Results section) the reader is informed that the IPCC method was used for N2O farm emissions. This aspect should be clearly addressed in the Materials and Methods section. I suggest to briefly summarize the part of the model description taken from Duretz et al., (2011) and to extend the Materials and Methods section with the relevant N2O emission processes included in the used models and approaches.

3. The methodology to estimate indirect emissions is now fully focussing on N2O, whereas the results including also indirect NH3 emissions. How the indirect NH3 emissions were calculated and the meaning/relevance of these type of emissions is not included in this section. Furthermore, the used procedure to identify the indirect N2O emission by "N2Otot,all - N2Otot, not", implies that the authors assume that there is no interaction between the Nr-input and the other N processes within the model. I am not fully sure, but I presume that a model run without (dry) NH3 deposition input yields different results for e.g. N plant uptake, N (im)mobilisation, (de)nitrification and by that changes in N2O emission that are not solely caused by the cut off of (dry) NH3 deposition input. I believe that it is relevant that authors address the 'problem' of interaction both in case they are occurring or not.

4. It is a pity that this research is based on a hypothetical landscape, which limits the

relevance of this study. This e.g. limits the validation possibilities. The geographical layer seems more or less realistic and is explained, but the used management information e.g. on the amount of manure and fertilizer etc. is not addressed. I believe that this is relevant information to understand the results. From Table 1 it appears that the average Nr losses are larger than 100 kg N ha-1 yr-1, this makes the reader very curious about the amount N input (animal manure and fertilizer) that is used or calculated by the model. I strongly advocate to make this more transparent and spend some discussion on the consequences of the use of hypothetical landscape rather than an existing one.

5. In the Discussion a real discussion is missing. It comprises to much repetition of that was presented in the Results section, whereas relevant aspects such as (i) what are the consequence of using a test land scape rather than a 'real' and (ii) a more thoroughly discussion on the derive indirect N2O EF and a comparison the most recent IPCC guidelines (ie. 2006), which is even lower than previous value (0.75% compared to 2.5%).

6. The paper needs some careful editing, see specific comments

Specific comments

- P7594 l5: clarify "additional" in this context or skip it.

- P7594 l3: "recapture", be consistent in spelling us either "re-capture" or "recapture" throughout the paper.

- P7595 l8-9: Why "re-deposition"? I should say "deposition"

- P7595 l11: ". . .up the slope in the groundwater." → "..up the slope."?

- P7596 l20: Why is grassland not included?

- P7597 l12: "deposition of Nr pollutants". Within NitroScape this is limited to NH3?

- P7599 l13 and l19: not clear what "short-term transfers" means in this context. I

presume that long-term transfers are also included.

- P7599 l20: Explain why wet deposition is blocked for the atm? Does this include both NH3 and NOx? To me it seems not logical that deposition is partly include the effect of hydro, whereas the total emissions of NH3 and NOx are blocked.

- P7601 l3: Explicitly mention which atmospheric deposition is included in "captNH3", i.e. NH3 and NOx due to emission from the landscape.

- P7601 l17: What about the assumed drainage condition and organic matter content of the uniform distributed silty loamy soil? Please provide some details on this, since these factors are very relevant for the (de)nitrification process and by that for the N2O and NOx emissions. Furthermore, the assumption of one uniform soil type is also an important aspect to address in the Discussion.

- P7602 l9: "bottom" → "edge"

- P7602 l11: "on" → "to"

- P7602 l15: I presume that this is not the total deposition but the average. I suggest: "The average NH3 dry deposition within the landscape was around 9 kg NH3-N ha-1 yr-1 for the all land atm configurations (Table 1)."

- P7602 l16-l19: This sentences belongs to Ch. 2. Clarify "groundwater uprising when the water table rose in soil and brought water and NO3 to the soil surface", e.g. "water table rise bringing groundwater and dissolved NO3 into the unsaturated zone"

- P7602 l19-l21: This needs an explanation. To my imagination input of NO3 by groundwater always implies an input of NO3 which is $\geq$ 0, i.e. the NO3 concentration $\times$ waterflux.

- P7602 l25: I do not understand this (see also above). Do you me be mean that the soil profile is flushed laterally? If yes, I suggest to talk about leaching for vertical losses/transport and runoff for lateral losses/transport.

- P7603 l2-l3: Support the reader to reader to trace the mentioned figures in the text. This means “16” → “17” and “20” → “21”. Check this also for other figures in the paper.

- P7603 l5-l8: This clearly illustrates interaction, see major comments: 0.7 (from atm) + 0 (from hyd) < 0.5 (from all). Elaborate on this in the discussion.

- P7603 l9:l11: Explain how it is possible there are no NOx emissions due to atm and hyd? I should say that these emissions are related to more or less the same processes as N2O emission.

- P7605 l18-l22: Extend this seriously, since this comprises one of the major results of this research. Provide, e.g. all emissions factors you are using in the discussion.

- P7606 l2-l3: ECETOC (1994) is a rather outdated reference to compare the calculated NH3 emissions. A quick analyses of the results in ENA Chapter 16 (Leip et al., 2011) yields a soil emission factor for NH3 for the EU27 of about 9% (when taking Min. fert. and Manure into account). Please, use a more recent reference and be explicit what is compared.

- P7606 l16: The derived average direct N2O emission factors are not mentioned. Please provide these, preferably in the Results section.

- P7607 l15-l19: Why are you focusing on the absolute maximum losses. It is better to focus first on the average fluxes and secondly on the large range with (extremely!) high maximums.

- P7608 l19-l24: Explain why EF4 for unmanaged soils is much lower than EF5g for unmanaged soils.

- P7609 l2-l3: I do not understand that NH3 needs to be nitrified before it can be taken up. Most plants have a preference for ammonium uptake compared to nitrate. Furthermore, ammonia can also be taken up by the canopy. Please elaborate on this.

- P7609 l15: Not clear what is meant by short-term and long-term processes (see also

Major comments). Please, clarify this in the paper.

- P7614 Table 1: (i) Indicate that these are average fluxes. (ii) Explain the meaning of the footnote in Ch. 2. (iii) Explain how it is possible that average N losses are extremely high (NH3 + NO3 leaching > 100 kg N ha-1 yr-1, see major comments). In addition, it would be beneficial to include the inputs by chemical fertilizer and animal manure in the table. This is also relevant for the derivation of the emission fractions.

- P7615 Fig 1: NOx deposition is missing.

- P7619 Fig 5: “uptake” → “input”?

Interactive comment on Biogeosciences Discuss., 8, 7593, 2011.