

Interactive comment on “Isotopic identification of global nitrogen hotspots across natural terrestrial ecosystems” by E. Bai et al.

Anonymous Referee #2

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General comments

In this MS the authors apply the N-isotope model developed in Houlton and Bai (2009) at a global scale to estimate global NO, N₂O, and N₂ emissions from unmanaged soils (and the regional distribution of these emissions). This provides a useful comparison with other methods for estimating emissions from denitrification.

Although the paper is generally well-written, a little more care needs to be taken in the initial explanation of the model. A section giving a general overview of the model before the detailed explanations of the individual components would be helpful. Also there are several places where symbols are not explained, or where the symbols used change. Finally a table of emissions by region should be included in the main paper.

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Specific comments

* Structurally it would be nice to have an overview of how the model works at the beginning of section 2, before the detailed descriptions of each component.

* For the N isotope model it is important to emphasise that the equations represent long-term equilibrium values. For example, equation (2) does not imply that a change in the delta-N of the inputs will immediately alter the soil delta-N ratio, rather that this would be the long-term equilibrium delta-N level of the soil.

* The diagram of the model (Figure 2) does not show ammonia losses. If you are using equation 6 as the “Soil N isotope model” then it is actually splitting the N inputs into “Denitrification N losses” and “Hydrologic and ammonia volatilization N losses”. If another equation is used to discriminate between leaching and ammonia volatilization losses then this should be explained in the text and model diagram.

* In the description of the enrichment factor it is not explained what the ratio 14k/15k represents

* Section 2.6: In this section the symbol ϵ_{den} is used whereas in the previous sections it was ϵ_{G}

* It would be useful if you stated the total N input amount used in your model. Particularly given that in section 3.1 you quote the global N loss due to denitrification as a fraction of the N input.

* Supplementary Table 2 is useful for comparing your model result with previous studies, but is not so useful for summarising your findings. For example, the global total is not simply the sum of all the listed Biome types or regions. It would be nice to have tables that listed the total estimated N losses (including leaching and volatilization) by biome and geographic region (for all biomes and regions so that the sum equals the global total).

* Page 12128: For the global N₂O flux N₂O emissions from fossil fuel burning and

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industrial processes should also be considered.

* Page 12129, line 4: this should be 77% of the global natural (rather than total global) emissions?

Technical corrections

* Pg 12116, line 25: should be "partition" rather than "partitioning"

* Page 12122: The last sentence of the first paragraph needs to be clarified.

* Pg 12124, line 16: the upper end of the confidence interval should be $\mu_T + \sigma_T$ (not $\mu_T - \sigma_T$)

* Figure 2: There are two N output boxes labelled N2 and no N2O box.

* Pg 12131, line 5: the double negative "less unlikely" is confusing and should be revised.

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