

Interactive comment on “Quantifying Global N₂O Emissions from Natural Ecosystem Soils Using Trait-Based Biogeochemistry Models” by Tong Yu and Qianlai Zhuang

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1. The authors modified model nitrification process. As I know, most of soil N₂O emission is from denitrification process, in which NO₃⁻ is converted to N₂, N₂O, and NO. Only a small part of N₂O is from the nitrification process. I don't think the improvement in nitrification process could substantially improve the simulated N₂O. I would suggest the authors use trait-based approach to represent denitrification as well. Response: Thank you for your suggestions. Denitrification is definitely an import process as it contributes more especially in reduced environment. In this revision, we added a paragraph about the potential effect of denitrification in Discussion section 4.3 (line 13-20,

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page 17).

2. The equations in original TEM should be described. Response: Limited by the length of the manuscript, more equations focusing on N₂O fluxes and other processes of N cycle can be referred to a Master thesis of Yu, T. (2016). Tong Yu (2016), Quantifying the global N₂O emissions from natural ecosystems using a mechanistically-based biogeochemistry model, MS thesis, <http://docs.lib.purdue.edu/dissertations/AAI10145857/>

3. The authors claim the nitrification process was improved. However, nitrification rate was not validated. Response: Because direct observational data for nitrification rate is too few to allow us conduct its validation. Instead, we validated modeled N₂O emissions by comparing with observed data.

4. For model sensitivity, authors examined model sensitivity to climate and soil C/N. It is correct that N₂O emission is sensitive to climate change (particularly temperature). However, N₂O emissions in the natural ecosystems could be very sensitive to the atmospheric N deposition. In recent years, there is a debate on how soil N₂O emissions response to CO₂ concentration. I would see some results about N₂O sensitivity to N deposition and CO₂. Response: In this revision, we conducted the sensitivity test on the effects of dry and wet N deposition on N₂O emissions, and added it to Section 2.3 and 3.2.1. The average atmospheric CO₂ was applied uniformly for each grid, so we did not do the sensitivity test on CO₂ effects. In our future work, we will obtain spatially and temporally explicit CO₂ data to drive the model to examine the CO₂ effects on N₂O emissions. This step will take a significant effort, which is beyond this study.

5. What is the date sources of atmospheric CO₂ and nitrogen deposition? Response: In this revision, we added the data sources in Section 2.2 Data.

6. Recently, a global N₂O model comparison has been initiated to run models from 1860 to 2016 (Tian et al., 2018). Ten land models were included in this project. The participating models include both natural system and cropland soils. I would suggest the authors to justify why this paper only included natural soils but ignored the more

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important N fertilizer in cropland. Response: Thank you for the reference. We have carefully read this paper and added related results to Discussion on page 14.

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