

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

Anonymous Referee #2

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Yu and Zhuang improved the N₂O emission processes in one existing land ecosystem model by using trait-based biogeochemistry models. Trait-based modeling is a new direction for model development. This could potentially improve model. However, I think this paper has some deficits and drawbacks need to be addressed.

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.

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2. The equations in original TEM should be described.
3. The authors claim the nitrification process was improved. However, nitrification rate was not validated.
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.
5. what is the date sources of atmospheric CO₂ and nitrogen deposition?
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 important N fertilizer in cropland.

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