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Climate of the Past Discussions

Interactive comment on "Estimation of pre-industrial nitrous oxide emissions from the land biosphere" *by* Rongting Xu et al.

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Dear reviewer #2,

Many thanks for your highly valuable comments! All your questions have been answered as follows:

1. The country-level analysis does not make much sense as a large amount of countries had different boundaries compared to present. In line 396, those country-level emissions might need to be removed.

Response: Yes, the current country boundaries are different from that in the preindustrial era. Here we just want to look at the regional differences in N2O emission for current country-level from geographical perspective. The region division based on

country scale could be more interesting, so we still hope to keep this country-level analysis here.

2. I am little curious to see the small uncertainties in continent-level N2O show in Figure 5 as the LHS was used and the large uncertainties were shown in below panel in Figure 5.

Response: The small uncertainty range shown in the upper panel of Fig. 5 was the 95% confidence interval of the mean estimate, as explained in the manuscript. The uncertainty range of pre-industrial N2O emissions was present using the minimum and maximum estimate (4.76-8.13 Tg N yr-1) in this study, which was consistent with other studies, such as the reported estimates in the IPCC AR5. Here, the Bootstrap resampling method was used to define the uncertainty bounds of global mean N2O emission (6.20 Tg N yr-1) (shown in line 216-219 of previous manuscript). It was used to verify the stability of the LHS approach. The 95% confidence intervals (6.03-6.36 Tg N yr-1) of the mean did not represent the uncertainty range for pre-industrial N2O emission in this study. In order to avoid the confusion, we will not report this narrow range in the revised manuscript.

Meanwhile, the first reviewer also suggested to remove it because the upper and below panel deliver the same information. Instead, we replaced the Fig. 5(a) with a panel of N2O emission rates per unit area (g N m-2 yr-1) with uncertainties.

3. The model implementation is not clear. I assume this study is based on a steady state or semi-steady state simulation. The equilibrium run was for 1860, followed by a spinup. The transient run was driven with climate data in 1860 (line 153). What is the data source? If the equilibrium run was based on 1860 data (most). Then, there are small discrepancies among spinup and transient runs. A comparison between equilibrium and transient run might be needed. If there are no big differences, using equilibrium run might be more convincing, as most driving forces were 1860 except climate data of 1901-1930. If the authors really want to have a transient run, the

model simulations should start even further to capture the legacy impacts of natural and anthropogenic impacts, particularly the land use change.

Response: Yes, this study was based on steady state simulation. The data sources for equilibrium run were all based on the data in 1860. Our transient run for 1860 was actually an extension of the equilibrium run. We don't have transient data before 1860 to realistically include the legacy effects from land use change, climate, etc. before 1860. The reason we ran this transient run was to avoid the abnormal fluctuations after equilibrium run, rather than capturing the legacy impacts. Fig. 4 in the manuscript is the result from equilibrium run. We made a comparison between the equilibrium and transient results for 1860 (Fig. S3). Although there were small differences for some grid cells between the two simulation results, the simulation results for the equilibrium run were similar to the transient run as a whole.

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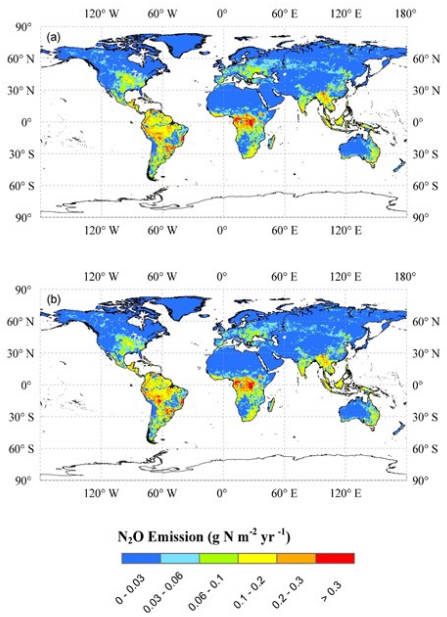

Fig. S3 (a) The spatial distribution of global N_2O emission from the equilibrium run; (b) The spatial pattern distribution of global N_2O emission from the transient run.

Fig. 1.