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Discussions

Interactive comment on "Increased nitrogen enrichment and shifted patterns in the world's grassland: 1860–2014" *by* Rongting Xu et al.

Anonymous Referee #1

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General comments:

The authors synthesized land-use and fertilizer-use datasets and produced spatially explicit maps of nitrogen (N) application across global grasslands. The study fills in the critical gap in global ecosystem and biogeochemical models to investigate N enrichment on grasslands. The analysis is well conducted, and the manuscript is well written.

I have two comments that may worth further exploring.

First, accounting for both the uncertainty and bias of the produced maps. Uncertainty refers to the confidence intervals around the point estimates. Note that none of this study's numbers come with uncertainty estimates. Uncertainty could come from the

source data, for example, fertilizer use in the early days (1860) is presumably less precise than the one in the recent days (2014). Uncertainty could also come from the process (see the next comment). In addition, bias refers to over- or under-estimate, for example, L404-405 mentions lack of human-induced sources N input will underestimate N input.

Second, the "spatialization" needs to consider the modifiable areal unit problem (MAUP) and spatial correlation. MAUP is a well-known issue in geography and spatial statistics, referring to the fact that when areal/point-based measures of spatial phenomena are aggregated into other units, they are influenced by both the shape and scale of the aggregation. It appears that the study simply takes the face values to fall into different spatial units without considering possible uncertainty and bias that are propagated through this process (coupled with the first comment). Also, note that the map estimates should somewhat consider spatial correlation. Spatial points are not independent: locations closer together will be more correlated than locations further apart.

Regardless of these improvements to be made, this study is an essential step in providing the global data and enhancing our understanding of the N issue.

Specific comments:

L155: the total number of countries is 202?

L578, Fig 4: Where are the boundaries of grasslands? The 3rd row appears to suggest grasslands cover the entire global landmass.