Response to reviewer 1

NISHINA et al.

January 12, 2017

Dear anonymous reviewer 1

Thank you for sharing your time to review our manusctipt. We'd like to respond the individual comment one by one as follow;

> 1. The authors used a crop calendar map for the seasonal distribution of fertilizer in a grid, which is good. However, even within a grid, the calendar of the major crop may vary and the fertilizer input vary accordingly. Therefore I suggest author allow crop calendar to vary, for example, a period of 10-15 days. This can be done with a normal distribution, not in a uniform distribution.

We agreed the schedule is better to be fluctuated in some extent. So, we made the new dataset for the fertilizer input date map, which has normal distribution error (as σ = 2) to the original date.

> 2. In the results section, there needs some description on the seasonality of fertilizer input, say, give results of some sample regions. Otherwise it does not match the methodology section.

Thank you for your suggestion. According to your and reviewer 2's comments, We added the discussion about seasonal changes in N fertilizer input in our dataset.

However, we added latitudinal seasonal N fertilizer input (for both NH_4^+ and NO_3^-) instead of examples for time-series of regional fertilizer input. This is because the figure for regional time-series inputs in our dataset could just show the spikes (2 or 4 (for double cropping) per year) in each region and this is not so impressive. So, we added the latitudinal time-series data according to the way of display for global time-series data in atmospheric chemistry studies as follow.

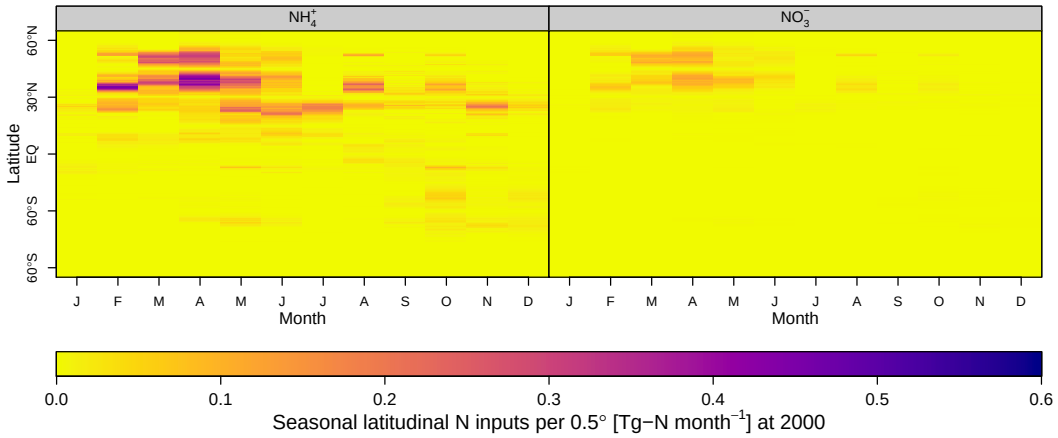

Figure 1: Fraction of NH_4^+ in N fertilizer input map during 1961–2010

3. For the second dose of fertilizer, it was not consistent in the text. Somewhere says 45 days after the first, somewhere says 30 days after the first.

Thank you for your comments. This is typo. "45 days" is correct. I'd like to revise it in the revision.

4. Section 3.4 seems not meaningful and thus not necessary.

We partially agreed with your suggestion and meaning to the comparison of N fertilizer with N deposition. There are some spatial and temporal inconsistency between them (e.g., fertilizer input only in crop land area).

On the other hand, to date, there are no quantitative comparative reference for NH_4^+ and NO_3^- input, respectively. In the view to global N cycling, our comparison could be good start point to recognize how each N input matters in terrestrial ecosystem. In addition, reviewer 2 valued this comparison in the comment. So, we remained this figure in the revised manuscript.

5. For large countries like US, China and India, fertilizer rate for the same crop may have large regional difference. If possible, for these three large and major nitrogen consumption countries, it is better to obtain N consumption data at subnational level.

We fully agreed on your suggestion. We should harmonize more detail information from various regional studies into our N fertilizer map to improve our N fertilizer map.

For example, for US, more spatially detailed N fertilizer map is available in USGS (Gronberg & Spahr, 2012). And, some regional studies in China and Europe —even though they are snapshot for time-series— can be available as more fine spatial resolution of N fertilizer input. However, it is not easy to harmonize these dataset due to the different time- (e.g., just one year) and spatial-scales (e.g., different boundaries) in their map. So, in this time, we acknowledged this insufficiency in the discussion in revised manuscript.

Reference

Gronberg, J.M., and Spahr, N.E., 2012, County-level estimates of nitrogen and phosphorus from commercial fertilizer for the Conterminous United States, 1987–2006: U.S. Geological Survey Scientific Investigations Report 2012-5207, 20 p.