Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-749-RC2, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Agricultural ammonia emissions in China: reconciling bottom-up and top-down estimates" *by* Lin Zhang et al.

Anonymous Referee #2

Received and published: 11 October 2017

This manuscript uses both top-down and bottom-up methods to investigate the spatial and temporal variations of agricultural ammonia emissions in China. The top-down estimates of NH3 emissions, constrained by TES satellite NH3 observations and optimized by GEOS-Chem adjoint model, show a summer peak that is underestimated in current bottom-up emissions inventories. To resolve the seasonal difference, the authors construct a new bottom-up inventory that takes account of seasonal variability in fertilizer application rates and emissions factors. The improved bottom-up inventory is broadly consistent with the top-down inversion results; both are validated by surface concentrations of NH3 and wet deposition fluxes of NH4+. Overall, I think the paper reads well, provides interesting results and deserves publication. I include some minor comments and suggested revisions in the following text.

Printer-friendly version

Discussion paper

1. Inverse method. The TES satellite NH3 columns are included in the observation vector, and these measurements are the basis for deriving seasonal variations in inverted NH3 emissions. Given the essential role of observational constraints, it is necessary to discuss in detail the influence of different satellite observations on seasonal variations of inversion results. It is good to see that "observations from AIRS, IASI, and CrIS" will be included in future studies. I suggest authors, at least in current state, to compare the seasonal cycle of NH3 columns measured by all the satellite sensors and to discuss the potential influences of using different data. Besides, it is not clear what means the offline NHx simulation for the iterative adjoint inversions. Please clarify it.

2. Bottom-up method. There have been several recent studies that use bottom-up method to establish high resolution emission inventory for NH3 in China. Most of these inventories peak its emissions during summer months, as shown in the literature review part of this paper. Therefore, in my opinion, improving NH3 inventory with strong seasonal cycle is not completely novel. The paper readers may ask what are the improvements and new points of this study in terms of approaches taken with the inventory development. These concerns are suggested to be clearly clarified in the revised manuscript.

3. Results. I think the paper would be stronger if the improved emission inventory is compared in detail with previous bottom-up inventories. Table 1 presents comparison of national emission totals. Because this paper shows more concern on seasonal variations of NH3 emissions, more comparisons are needed to evaluate the new emission inventory, especially for seasonal variability.

4. Evaluation. I have significant concerns about the emission inventory evaluation with surface measurement of NHx. If I understand correctly, the GEOS-Chem model results for 2008 are directly compared against measurement data over 2008-2012 period. If this is the case, it may involve large uncertainties due to varying meteorological conditions and varying concentrations of SO2, NOx and oxidants in the atmosphere from year to year. It would be better to conduct an air quality modeling for 2008-2012.

The NH3 emission used for the 5 years of model simulations can be fixed at 2008 because of small interannual variations. Or if the authors would not like to do this time-consuming work, I suggest only the measurement data for the year of 2008 can be used for model evaluation.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2017-749, 2017.

Printer-friendly version

Discussion paper