Comments:

The study estimated the changes of hourly NH_3 concentrations, surface NH_3 concentrations and NH_3 emissions in China using the polar-orbiting satellite (IASI) and Fengyun-4 geostationary satellite. The results show NH_3 concentration in daytime was generally higher than that at night. Satellite-based NH_3 emissions ranged from 12.99-17.77 Tg N yr^{-1} during 2008-2019. The manuscript is overall well organized and written. The analyses are neatly conducted and fit the scope of ACP. Before recommending publish the study, I have the following comments that I think the authors shall address to improve the manuscript.

We thank the reviewer for your time and helpful comments. Our point-by-point response is enclosed.

General comments:

1. Throughout the paper, there are issues with the use of plural vs singular and or verb tense, especially in the use of 3rd person, plural or singular. There is also extensive mixed use of past tense and present tense instead. I strongly recommend using unified tense instead, throughout the paper.

Thanks, we have re-checked the use of plural/singular, used the present tense, and conducted a careful copyediting throughout the paper.

2. The feedback between surface NH_3 concentration and emissions was calculated by GEOS-Chem. Please describe the simulation process in detail and driven data in SI.

We thank the reviewer for the comment. The study used the global 3-D chemistry transport model GEOS-Chem v12.3.0 , developed by Harvard University, to simulate and calculate the conversion ratio of surface NH_3 concentrations and emissions, which was widely used in the field of atmospheric physical chemistry

research (Chen et al., 2009; Zhang et al., 2011). GEOS-Chem contained detailed tropospheric gas-aerosol (O_3, NO_x, NH_3, SO_4^{2-}, NO_3^- and NH_4^+, etc.) chemistry, and driven by assimilated meteorological information from the NASA Goddard Earth Observing System (GEOS-5) (https://gmao.gsfc.nasa.gov/). The source programs of GEOS-Chem were freely available from Atmospheric Chemistry Modeling Group at Harvard University (http://acmg.seas.harvard.edu/geos/geos_overview.html). The driver input files contained meteorological data and emission inventory, and the directory file contained the initial concentration file, photolysis mechanism and chemical mechanism files.

In this study, the nested regional model for Asia was driven by assimilated GEOS-5 meteorological data with a horizontal resolution of $1/2^\circ \times 2/3^\circ$. The GEOS-Chem model here did not consider land-atmosphere bi-directional NH_3 exchange, and the NH_3 flux was parameterized as uncoupled emission and dry deposition processes. Anthropogenic emissions in China are from the Regional Emission in Asia (REAS-v2) inventory. The GEOS-Chem NH_3 concentrations output includes 47 layers from the ground to the top of the atmosphere to capture the NH_3 vertical profiles. Only the inventory data overlapped with the IASI measured period were used, which was sampled and consistent with the model resolution. We have added the following figure in the supplement.

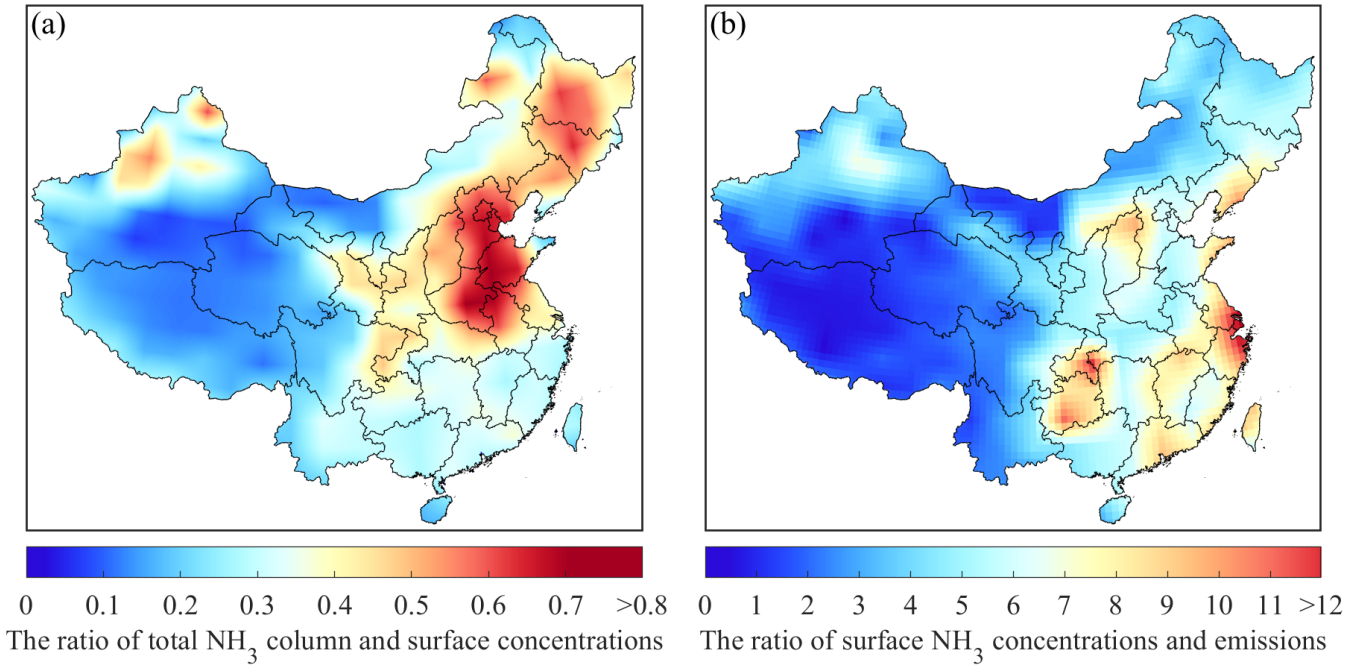

Figure S2. Conversion ratios from GEOS-Chem simulations. (a) The conversion ratio of total NH_3 concentrations and surface NH_3 concentrations. (b) The feedback ratio of surface NH_3 concentrations and NH_3 emissions.

Minor comments:

L56, please further check if the value is 40%, if so, annual farmland NH_3 emission were estimated as 2.4 Tg N yr^{-1} by the IPCC tier 1 guidelines.

We have further checked the citation and the method in the paper calculates NH_3 emissions from China's farmland to be 40% higher than the IPCC in 2008. However, we lacked clarification and the data used in the paper were for the specific year. We have made the following changes to the original text.

"Zhou et al. (2016) calculated the annual farmland NH_3 emission (3.96 ± 0.76 Tg N yr^{-1}) over China in 2008 based on the bottom-up method, which is 40% higher than the emission in the Intergovernmental Panel on Climate Change (IPCC) Tier 1 guidelines (2.89 Tg N yr^{-1})."

L29, 57, what's SO_2, NOx, NH_4^+, and IPCC, etc.

NH_3 reacts with acid pollutants (Sulfur dioxide (SO_2) and nitrogen oxides (NO_x)) to form fine particulate matters (such as PM2.5 (particles less than 2.5 micrometers in diameter)), leading to haze pollution. In addition, the deposition of NH_3 and ammonium (NH_4^+) could also cause environmental problems such as water eutrophication, biodiversity loss and soil acidification (Paerl et al., 2014).

We have added the following content to explain them. "…, which is 40% higher than the emission in the Intergovernmental Panel on Climate Change (IPCC) Tier 1 guidelines (2.89 Tg N yr^{-1})."

L113, correct word 'is' to 'are', please check similar mistake throughout the manuscript.

It is fixed now, and we have double-checked and corrected similar errors in the manuscript

L201, in Figure 1, check NH_3 concentrations (kg N ha^{-1}) or NH_3 concentrations (ppb).

We have revised the units of NH_3 concentrations in Figure 1 to 10^{15} molecules cm^{-2}.

L201, in Figure 1, the figure shows the 2019-2020 average or sum, please check similar mistake throughout the manuscript.

The time series of NH_3 columns by GIIRS was between 2019.11 and 2020.10. We showed the spatial variation of the monthly average NH_3 columns at 10 overpass times for GIIRS from 2019-2020. We have revised the similar mistake throughout the paper and made the following changes to the figure captions.

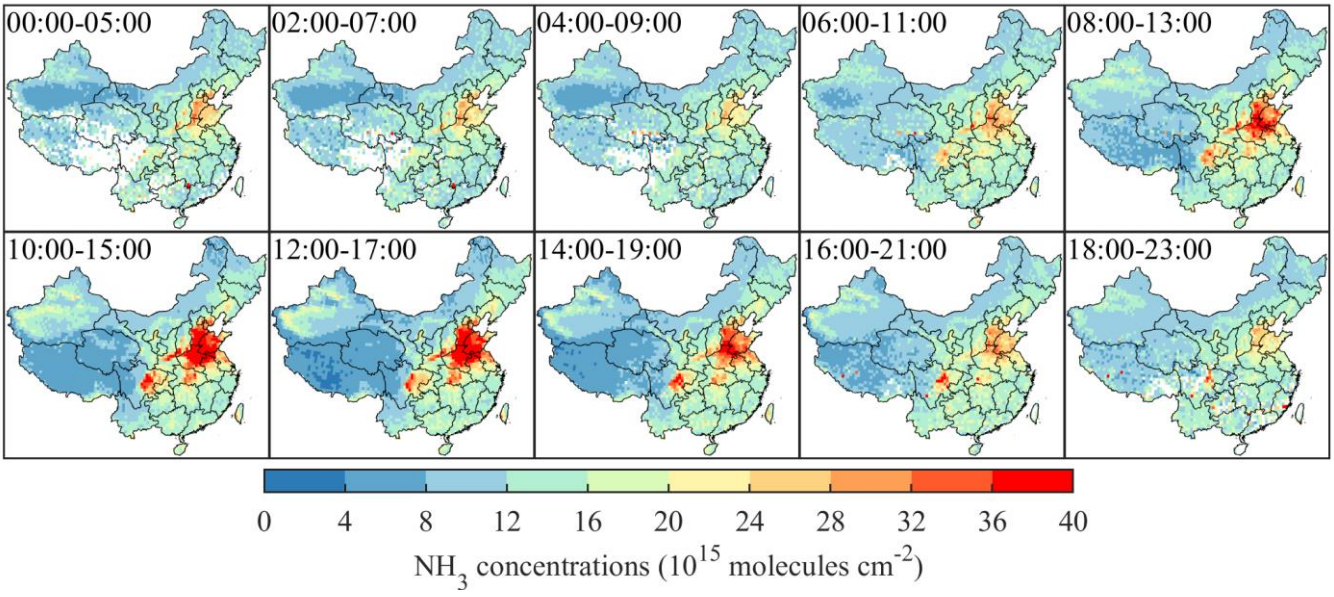

Figure 1. Monthly average NH_3 columns for each of the 10 GIIRS overpass time periods during 2019-2020.

L282-283, need the data link or reference.

We have added references as suggested.

"The North China Plain is China's granary, with developed agriculture and animal husbandry, high population densities and strong human activities (including vehicle emissions) (Zhang et al., 2006; Wang et al., 2020)."

Reference

Chen, D., Wang, Y., McElroy, M. B., He, K., Yantosca, R. M., and Le Sager, P.: Regional CO pollution and export in China simulated by the high-resolution nested-grid GEOS-Chem model, Atmos. Chem. Phys., 9, 3825-3839, https://doi.org/10.5194/acp-9-3825-2009, 2009.

Wang, Z., Zhang, X., Liu, L., Cheng, M., and Xu, J.: Spatial and seasonal patterns of atmospheric nitrogen deposition in North China, Atmospheric and Oceanic Science Letters, 13, 188-194, https://doi.org/10.1080/16742834.2019.1701385, 2020.

Zhang, L., Jacob, D. J., Downey, N. V., Wood, D. A., Blewitt, D., Carouge, C. C., van Donkelaar, A., Jones, D. B., Murray, L. T., and Wang, Y.: Improved estimate of the policy-relevant background ozone in the United States using the GEOS-Chem global model with 1/2× 2/3 horizontal resolution over North America, Atmos. Environ., 45, 6769-6776, https://doi.org/10.1016/j.atmosenv.2011.07.054, 2011.

Zhang, Y., Liu, X., Zhang, F., Ju, X., Zou, G., and Hu, K.: Spatial and temporal variation of atmospheric nitrogen deposition in the North China Plain, Acta Ecologica Sinica, 26, 1633-1638, https://doi.org/10.1016/S1872-2032(06)60026-7, 2006.

Zhou, F., Ciais, P., Hayashi, K., Galloway, J., Kim, D.-G., Yang, C., Li, S., Liu, B., Shang, Z., and Gao, S.: Re-estimating NH_3 emissions from Chinese cropland by a new nonlinear model, Environ. Sci. Technol., 50, 564-572, https://doi.org/10.1021/acs.est.5b03156, 2016.