***Reviewer #2:***

***The manuscript attempts to investigate spatial-temporal variations of atmospheric $NH_3$ concentration and its dry deposition across China in 2013-20123 by combining satellite-based, ground-level observational data in publica domain and 3-D modeling results. The analysis sounds scientific, but it needs a substantial revision on potential uncertainty and modeling accuracy. The major comments are listed as below:***

Thanks so much for these detailed suggestions. All points have been addressed below (review query in black; author response in blue). Changes to the text in the manuscript have been marked in blue.

***1) Key scientific questions are too general to be valuable by considering the uncertainties associated and previous studies published in the literature. The authors are encouraged to deeply think the issues.***

Thanks so much and done as suggested. To address the importance of science question regarding quantify one decade's spatial-temporal patterns of $NH_3$ concentration, dry deposition and driving factors, we have considerably added and revised the introduction section, which highlights recent knowledge gap in China shoes the importance of addressing above science questions. Please see changes from line 75 to 196.

***2) Figure 4, the size of data is too small by considering one decade observations, what happens?***

Thank you for your question. Figures 4a and 4b present the results of the correlation analysis between satellite-based and ground-based $NH_3$ concentrations at monthly averages, each scatter plot represents averages of all available observations for either urban or rural site, and some sites only have 1-2 years with the same overlap period of satellite. Figure 4c further compares the calibrated satellite $NH_3$ concentrations with the corresponding site-based monitoring concentration. Due to discrepancy in the observation institutions and monitoring periods across stations, with some stations providing valid data for only a single year, we adopted a monthly-scale analysis approach to ensure an adequate sample size given the limited data. This method involves extracting monthly average values from ground-based observations and corresponding satellite concentration, thereby decreasing the number of data points to 12 per year and significantly enhancing data reliability of the analysis.

We have revised caption of Figure 4 as: "Figure 4. (a) Comparison between CrIS satellite-based column average (from ground to ~1 km) $NH_3$ concentration and ground site based (~1.5 m) $NH_3$ observations before calibration; (b) comparison between CrIS satellite-based column average $NH_3$ concentration and ground site based $NH_3$ observations after calibration to ground level ; (c) Spatial distribution of calibrated satellite at with ground site based $NH_3$ concentrations in 2015 (Unit: ppb), note the calibration from CrIS satellite-based column average (ground to ~1 km) to ground level (~1.5 m) is by using the linear regression equation derived from panel a, each scatter plot represents monthly averages of all available observations for either urban or rural site."

***Modeling results always suffer from the errors. However, most of air quality modeling results in China well reproduce PM2.5 in approximately 1/3 days in each year. However, it is not case in other times because of the poor prediction of one or several meteorological conditions. The authors should select the 1/3 days with good prediction performance for machine learning.***

We agree that Modeling results always suffer from the errors and it's better to choose days with good prediction. Here the $NH_3$ observation were measured by passive sampling representing averages of one week. And to avoid the random errors from observations and simulations, monthly average was conducted for $NH_3$ concentration for machine learning. To make clarification, we have added more description as "Note previous modeling results (i.e. $PM_{2.5}$) always suffers from bias in 1/3 of modeling days and it's better to choose days with good predictions. And in this study for $NH_3$ observations, they were measured by passive sampler, representing averages of one week instead of hourly or daily scales. Therefore, to avoid the random errors from observations and simulations, monthly average was conducted for $NH_3$ concentration for machine learning." on lines 390-394.

***4) Line 399-400, "Elevated temperatures further enhance volatilization from manure and urban waste, intensifying atmospheric $NH_3$ levels.". The reviewer has much concern on the statement, i.e., the authors might not know what exactly happen for agriculture emissions of $NH_3$ in China? With a large population moving from the country land to the city in the last decade, the sources are negligible.***

Done as suggested, we have added more clarification in this part as "Elevated temperatures further enhance volatilization from manure of agricultural area and urban waste in cities, intensifying atmospheric $NH_3$ concentration. Although urbanization has increased over the past decade, many system-scale farms continue to be used for agricultural production." on lines 487-490.

***Minor comments:***

***1)The effective number through the manuscript are total off and needs to be corrected. Principally, it should be consistent with the analytic error, i.e., 5-10% analytic errors correspond two effective numbers.***

Don as recommended, we have revised with the two effective numbers regarding errors throughout this MS.

***2)Abstract, lines 37, "our results", what does it means? Modeling results? Observations from CrIS, AMoN-China or NNDMN?***

Here "Our results" in line 37 means observation from CrIS, we have revised it as "The CrIS observations results show that column-averaged (averages from ground to ~1 km) $NH_3$ concentrations were the highest in the North China Plain (>10 ppb), with notable annual and seasonal increasing trends"

***3)Abstract, line 40-42, "Dry deposition fluxes exhibited a clear east-west gradient, with maxima in the North China Plain and Sichuan Basin. " The sentence is problematic. Sichuan Basin should be located in southwestern China, correct?***

Done as suggested, we have revised this sentence as "The $NH_3$ dry deposition fluxes exhibited a clear east-west gradient, with maxima in the North China Plain, and another hotpot region is also observed in the Sichuan Basin, southwestern China."