Responses to the reviews for the manuscript titled, “Ammonia measurements from space with the Cross-track Infrared Sounder (CrIS): characteristics and applications”.

We would first like to thank the Reviewers for taking the time to review the manuscript as their comments and edits strengthened the paper. Below you will find responses to each of their comments.

Reviewer #3:

The manuscript entitled “Ammonia measurements from space with the Cross-track Infrared Sounder (CrIS): characteristics and applications” describes the strategy of ammonia retrieval from CrIS on Suomi-NPP and availabilities of the product. This paper investigates the capabilities of the product for monitoring, model evaluation, dry deposition, and emission estimates. This work is quite important and largely contributes to the atmospheric chemistry community. I recommend publishing the paper after addressing several questions and comments.

Major comments:

1) Cloud filtering is mentioned in section 3.1.1. Why didn’t you use the VIIRS data in the current system? In Fig.2, several scans over clouds are not eliminated. The cloud filtering described in the paper seems not so accurate and likely occur some bias to ammonia concentrations. The author should add some evaluations of cloud filtering. In addition, I would suggest that the description of the cloud filtering strategy is moved to section 2.

The reviewer brings up a very important point in using VIIRS for cloud filtering. In terms of using VIIRS in the operational CrIS NH3 retrieval, we know of one prototype VIIRS product that is mapping the VIIRS footprints onto the CrIS footprint. However, presently there is just a few days available for this prototype product. Once this mapping product is available globally covering the CrIS timeframe we will use the VIIRS to identify cloudy CrIS pixels. This is noted in the text, “Algorithm refinements such as directly incorporating a newly developed coincident VIIRS cloud products mapped onto the CrIS footprints to distinguish the pixels with no ammonia signal due to cloud from those that have concentrations levels below the detection limits are presently being tested.” Essentially, using VIIRS to identify if the pixel in cloudy, and the reason why there is no NH3 spectral signature.

The cloud filtering does perform well, especially for clouds with cloud optical depths > 1.0, which will make the underlying ammonia spectral signature opaque and filtered out. This is shown in Figure 2 and Figure 6 by comparing the cloud and CrIS ammonia maps. The conditions that can have some impact are the very optically thin clouds that are warmer near the surface. However, looking closely at edges of clouds, etc., this does not have much of an overall impact. This is stated in the text, “Note that thin clouds (cloud optical depth < 1.0) that are near the surface with cloud-top temperatures close to the surface temperature still impacts the current ammonia retrievals, but in general has a non-significant impact on the overall results as seen in the examples in Figure6”. A more quantitative evaluation of the cloud filtering will done in the future at the same time as when the mapped VIIRS cloud product on the CrIS footprint is available. Essentially, comparing the current v1.5 with the future version that has the VIIRS cloud mask incorporated.

The cloud discussion section was moved into Section 2 as suggested.

2) Page 18, line 2: Why did you select that two months, July and August? How is the consistency in the other seasons that there are no obvious wildfires? The figure for the difference between Fig. 11a and 11b is also helpful.

One of the important sources of NH3 emissions is agricultural activities. We are conducting a research project to evaluate agricultural NH3 emissions during warm season using CrIS observed NH3. These two months were selected just as an example showing an application for such model evaluation. Similar consistency for comparisons among emissions, model predictions, and CrIS observations were seen for other months, however, we are still in the process of performing a detailed quantitative analysis. We did add a little more discussion to this section (see in the response to Review #1 "P17-18, Figure 11:" question).

Minor comments:

1) Figure 1: The account for the circle and bar plots in the right figure should be added in the caption.

Good catch. Added the line in the caption: "The box-and-whiskers showing the statistics (e.g. median, percentiles, and outliers (circles)) of the rows of the averaging kernel values at each retrieval level are also provided on the averaging kernel plot."

2) Page 4, line 22: "elevationsin" should be "elevations in".

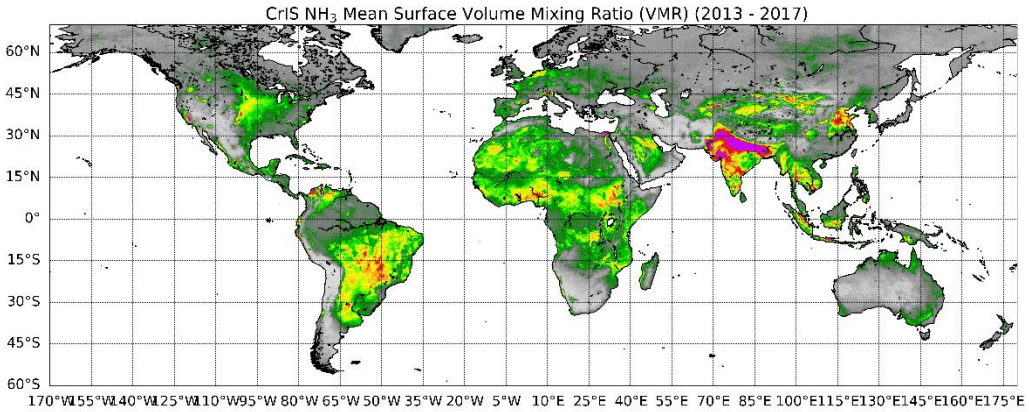
Fixed as suggested.

3) Page 5, line 15: ")" corresponding to "(includes: : :" is missing (after "(or smoothing) error"?).

Fixed, added a ")" after error.

4) Figure 5: Some other papers (e.g. Van Damme et al., 2014) and Warner et al. (2016)) reported the high concentration in Siberia and Alaska. I would recommend expanding the latitudinal area to around 70N. If there aren't significant high values, it is also valuable information.

The global plots were expanded to 70N. The higher concentrations in Siberia and Alaska are likely due to large episodic forest fires that still impact a multi-year average. CrIS having more sensitivity than AIRS or IASI has the potential to contain lower retrieved values in these regions contributing to the multi-year mean over this region.



5) Figure 5: Are the plots only over land? If so, it should be added to the body text or caption.

Added to caption as suggested.

6) Page 9, line 30: “SCCP” should be “ISCCP”.

Fixed as suggested.

7) Page 12, line 7: “norther” should be “northern”. 8) Page 17, line

Fixed as suggested.

8: “Gong et al., 015” should be “Gong et al., 2015”. 9) Page 17, line 26: “aggrees” should be “agrees”.

Fixed as suggested.