The manuscript by Shephard et al. entitled “Ammonia measurements from space with the Cross-track Infrared Sounder (CrIS): characteristics and applications” presents the characteristics of the CrIS NH3 Fast Physical Retrieval (CFPR). Several examples are shown and applications are detailed (monitoring, model evaluation, dry deposition estimates and emission estimates). For several applications, the results have already been published and updated numbers are provided taking advantage of the newly available 5-year dataset.

The paper is well written and the figures provide nice illustrations of the applications. However, as the retrieval approach as already been published, as well as a substantial part of the results, I wonder if the title should not be adapted to reflect this (e.g., by adding “update of” before characteristics and applications?).

I recommend the paper to be published after the consideration of the following important points:

1. Some numbers/statistics to better characterize the CrIS dataset are missing. Firstly on the DOFS: How are they distributed? Could you provide a representative distribution? What are the proportion of the CrIS measurements characterized by a DOFS>0.5 for example?
   Secondly, the paper misses a discussion on the bias introduced by the pre- and post-filtering of the data. First of all, the fact that the entire dataset is filtered using an “estimated ammonia spectral signal” will bias high any type of average. This should be specified and commented in Section 2; I suggest you to move and expand the last paragraph of Section 3.1.1 in Section 2. As an illustration of this, it can be observed in Figure 7 that the surface concentrations are very high in terms of ppb- (5-year average >1-2 ppb in remote areas). Figure 9 also shows relatively high winter values, likely due to the data filtering (and the fact that low NH_3 values are filtered out).
   Interesting numbers to add in the study would also be (1) the proportion of CrIS observations processed and (2) the number of observation per quality flags to assess their impact on the data availability. In addition, the number of observations used to make the map of each subpanel of Figure 7 (and Figure A2) would be useful to exclude any sampling bias.

2. As stated by the authors, the DOFS are generally between 0.1 and 1 (rarely above 1 if I understood it well). Is it therefore relevant to present surface concentrations? Why don’t you present integrated columns when you show CrIS NH_3 distributions?
   The total errors shown in figures 3 and 4 also strongly encourage the use of the total columns.
   Regarding this issue, could you comment the differences that can be observed between the 5-year averaged surface concentration distribution shown in Figure 5 and the 5-year averaged total columns distribution shown in Figure 1 of Dammers et al., ACP 2019 paper (apparently made with the same dataset).
   In the model comparison, why not comparing directly the total columns instead of surface concentrations?
   I am also curious to have a look at a global distribution made only with observations characterized by a DOFS above 0.5. Would you mind providing such a figure?
   Finally, when calculating the estimated emissions based on CrIS NH3 measurements, you only keep the observations with a DOFS above 0.8. How this threshold has been defined? Why not always using this threshold? How does it affect your results?

3. I was surprised to note that the authors do not refer to relevant work made on the remote sensing of atmospheric NH_3 using the IASI satellite, such as the first global distribution provided from space measurements presented in Clarisse et al., NatGeo 2009 (doi: 10.1038/ngeo551) and the first estimation of NH_3 emissions from industrial and agricultural sources in Van Damme et al., Nature 2018 (doi: 10.1038/s41586-018-0747-1). At the very least, these two papers should be cited.

Minor comments:

- Several papers are not referenced in the bibliography:
  Divarkarla et al., 2014 ; Li et al., 2019 ; Ellis et al., 2013 ; Losdale et al., 2019
- Units are generally missing in the captions of the figure, I would add them
- Consistency in the writing of "hotspot" (currently, we have in the paper: hotspots (e.g., p1), "hotspots" (e.g., p8), hot spots (e.g., p9), hot-spot (e.g., p17) and "hot-spot" (e.g., p17))
- P2, L26: change Clarisse et al., 2010 to Clarisse et al., 2009
- P3, L15-18: What is impact of the change in Level 2? From what can be seen in Figure 9, it looks not negligible for some regions. Could you comment on this in the text?
- P3, L26-30: Have you changed the pre-filtering following that update? It should be specified in the text.
- P14, Figure 8: this figure could be moved to the supplementary materials (or at least reduced in size)
- P15-16, Figure 10: What is striking in this figure is the increase in 2017. While this is mention later in the text, the description of that figure does not mention it.
- P17-18, Figure 11: Lethbridge is highlighted as a place where the model match well the satellite data. However, if you look at the southern part of Alberta, this is not really the case. Could you comment on this? While I agree that overall, there is a good match between the model and the satellite distributions, I miss some discussion on the large regions where the model disagree with CrIS. Eastern US is an important example to discuss but also Mexico (while introduced when listing the emission inventories, it is not discussed at all in the text).
- P23, Figure 15: Having in mind the data filtering ("cloud screening", DOFS>0.8, only warm season considered) and the different adjustments applied on the calculate emissions, I found the error bars presented in the figure not really meaningful and think that it could be misleading (even if the caption lists what is included in the uncertainty estimate).

Technical corrections:

- P2, L6: $NH4^+$ -> NH_4^+
- P2, L18: add a comma after "(hours to a day)"
- P3, L16: Cross-Track -> Cross-track
- P3, L18: CPFR -> CFPR
- P3, L31: Since he -> Since the
- P4, L21: 1to -> 1 to
- P4, L22: elevationsin -> elevations in
- P5, L15: a bracket is not closed -> add ")" between "error" and "are"
- P9, L18: consider rephrasing "(do that there is bi-directional flow)"
- P12, L7: norther states -> northern states ?

- P17, L23: two month summer period -> two-month summer period
- P17, L16-17: consider rephrasing: “The GEM-MACH-ready hourly gridded NH3 emissions at 10-km resolution over a North American(NA) grid […]”
- P18, L7: “Munoz-Aluzar” does not correspond to what is in the reference list (“Munoz Alpizar”)
- P19, L6-7: Consider rephrasing “The atmospheric deposition of NH3 contributes excessive reactive nitrogen into water that contributes to eutrophication. ”
- P19, L20: “50 U.S. states are mostly located in central and western U.S. show greater […]” -> “50 U.S. states (mostly located in central and western U.S.) show greater […]”
- P22, Figure 14: the caption misses the time period (and units) of the data used
- P23, Figure 15: CrIS* -> CrIS
- P24, Figure 16: rephrase “Plot showing the monthly emissions.” E.g.: “Time-series of the monthly NH_3 emissions (kt/day) over Lethbridge (AB, Canada).”
- P37, Figure A 3: I would saturate a bit more the difference plot -> colorbar from -1 to 1 e16 for example?
- P32, L1: PM2:5 -> PM2.5
- P32, L15: retrievalfrom -> retrieval from
- P33, L4: reference “2014 NWT Fire Season Review Repot” to be revised
- P38: consider rephrasing sentence L1-3