



EGUsphere, referee comment RC2
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Review of 'Atmospheric distribution of HCN from satellite observations and 3-D model simulations' by A. G. Bruno et al. (2022)

Anonymous Referee #2

Referee comment on "Atmospheric distribution of HCN from satellite observations and 3-D model simulations" by Antonio G. Bruno et al., EGU sphere,
<https://doi.org/10.5194/egusphere-2022-1404-RC2>, 2023

This study presents much improved understanding of the atmospheric processes that are controlling the HCN budget using the observational data sets and the global chemical transport model simulations. There are big uncertainties in the atmospheric loss processes and ocean update of HCN and this study certainly is valuable in better representation of those processes. The use of both the NDACC and the ACE-FTS satellite measurements supports the robustness of the comparison. In terms of methodology, I have little to suggest for improvements. However, I personally think that by adding a little bit more scientific background this paper will become more interesting to a broader community. Below are my comments for the authors may take into consideration.

Major Comments:

- I would like to see clearer description of what we do and do not understand about the HCN budget in introduction. All the references included in introduction seem to suggest we have good understanding about HCN in the troposphere and stratosphere and the last sentence seems to suggest otherwise. For instance, including a statement saying all the model simulations show different results would help supporting this argument.
- The motivation of this study has to be mentioned clearly. Both observational data and the model simulations are used as tools but it is not clear what the main goal of this study is.
- It is a reasonable approach to compare the model outputs to the NDACC *in-situ*

However, can we trust the ACE-FTS measurements quantitatively? Are there any *in-situ* measurements of HCN in the upper troposphere and lower stratosphere to confirm that the ACE-FTS measurements are reasonable?

Minor Comments:

- L2-22 (Abstract): I would recommend moving some of the contents explaining the background to introduction, which would make abstract a little more compact. Also put emphasis on the key findings and significance of this study. For instance, why is simulating the HCN amount using the global model correctly important?
- L2: It is mentioned that the physical and chemical processes are investigated. Are the HCN removal processes considered to be physical?
- L6-9: I would recommend combining these into one simple sentence. My recommendation for a replacement would be, 'We detected the changes in the atmospheric composition due to large wildfire events over Indonesia in 2006 and 2015 using long-term measurements from the ACE-FTS'.
- L10: 'previous lower altitude balloon comparisons' can be removed.
- L49: A citation for NDACC could be included here.
- L 67: I think this is a good place to make a statement of why a global transport model is being used to understand specific aspects of the HCN budget. Is TOMCAT model proved to be a good tool for this study?
- L70: Do Burkholder et al. (2015 & 2019) papers have the same rate coefficient for HCN oxidation?
- L83: This sentence can be augmented or replaced by a statement of the ACE-FTS sampling pattern being densely located in high latitudes.
- P4, Fig. 1: A couple of solid contours can be added to show the distributions in the stratosphere more clearly. The current color scheme makes it hard to distinguish the blue and the green area.
- L92: A reason why only 2008-2009 are used in the seasonal mean could be given here. Have there been any studies showing the HCN climatology in the past? Is ACE-FTS climatology reasonable compare to other data set quantitatively?
- P5, Fig. 2: The color scheme can be revisited to show the variability in the stratosphere clearly. Also, what is the maximum value in 2015? The color bar is saturated at 600 pptv.
- L133: What is the sampling frequency of HCN through the NDACC?
- L120: with a higher concentration -> with higher concentrations
- L134: A citation is needed for the ECMWF meteorological inputs. Also, does TOMCAT reproduce reasonable climatology of other tracers, such as carbon monoxide?
- P8, Fig. 3: The yellow lines are almost invisible on screen. A replacement color is recommended.
- P14 (Conclusion): I would recommend adding a statement what role HCN is playing in our current climate and how this study will contribute predicting future climate better related to the results presented in this work.