

Review of “Atmospheric Distribution of HCN from Satellite Observations and 3-D Model Simulations” by Bruno et al.”

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December 19, 2022

General remarks

This paper compares some new model simulations of HCN in the atmosphere to the solar occultation data from the ACE-FTS instrument. It is good to see some modelling done on this species because there remain a number of significant uncertainties in its sources and sinks. As the authors make clear, these include the rate constant for an important reaction and, more seriously, the rate at which HCN is lost from the atmosphere to the oceans.

The paper is well-written and easy to read; I have few corrections to make to the text. The figures are generally well designed and clear, except for the use of the much-derided “jet” colour scale. See <https://doi.org/10.1038/s41467-020-19160-7> for a recent discussion of colour scales, including details on why “jet” should be avoided, and a better colour scale called “batlow”. If the authors would like a scale with similar colours to jet they might try Google’s “turbo” scale: see <https://ai.googleblog.com/2019/08/turbo-improved-rainbow-colormap-for.html>.

The text labels on the figures often appears a bit small. It is difficult to judge this from the preprint; the authors should ensure that in the final version the text on figures is no smaller than the text in the caption.

My recommendation is that the paper should be accepted with minor revisions. My main non-cosmetic concern is whether the DJF panel of Figure 1 is correct.

Specific corrections

- Page 4, Figure 1: The DJF panel looks very different from the other three seasons, through the entire stratosphere. Is this real? Is it an artefact of the ACE-FTS sampling pattern? The difference appears to be such that, at 30 km, there is about 200 pptv for most of the year, but 280 pptv in DJF. Is the same pattern observed in other years? I note that the time series in Figure 2 does not make it seem that DJF differs from the other seasons. The six modelled tracers shown in Figure 6 all have a DJF season which is generally similar to the other seasons. For interest I show the equivalent plots for the MLS data in Figure 1; the DJF season does not appear clearly different from the other seasons in the way that it does in the reviewed paper.

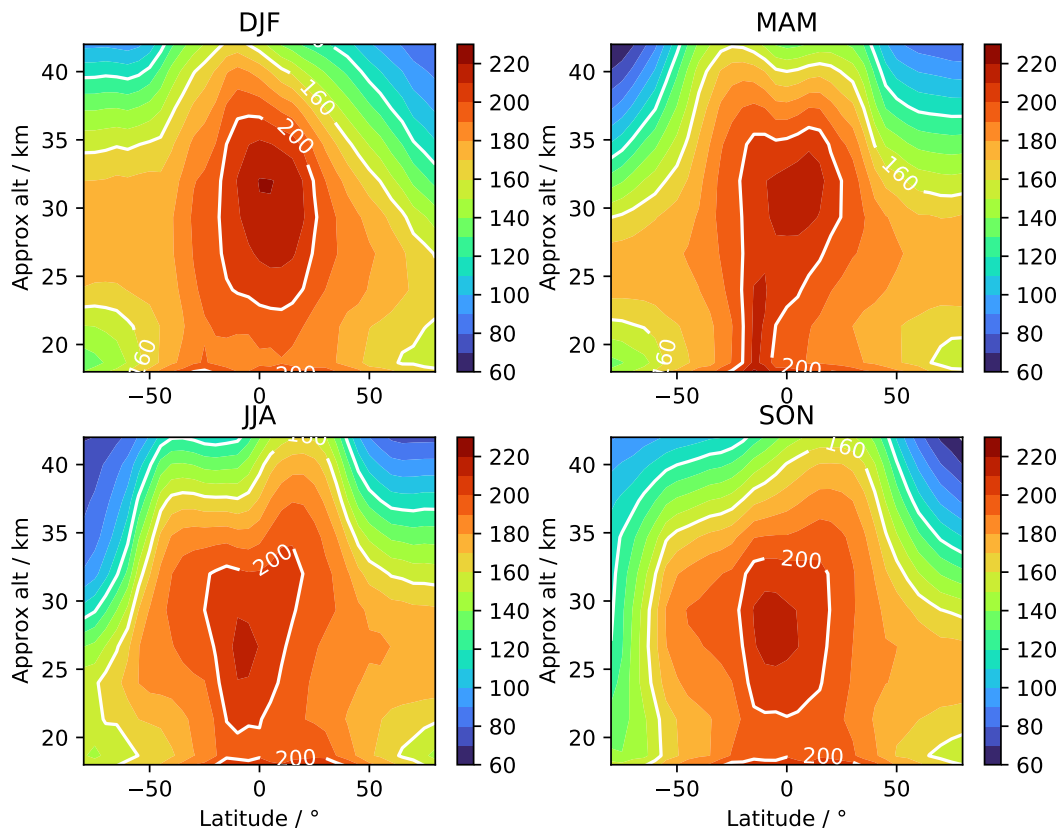


Figure 1: MLS V5 seasonal means of HCN volume mixing ratio (in pptv) for the four seasons of the 2008-9 year, as per Figure 1 of the paper reviewed. Note that the DJF season does appear to have slightly higher mixing ratios in the 30–40 km altitude range, but nowhere near to the extent suggested by Figure 1 of the reviewed paper. The systematic errors below 24 km which were the reason for the reviewed paper not using the MLS data are clear, especially at high latitudes. The colour map used is Google’s “turbo”.

- Page 4, Figure 1, Page 13, Figure 6 and any other filled contour plots: The colour bar should have bands of colour which match exactly with the colours used in the contour plots. It should not have a continuous graduation of colour from one end to the other.
- Page 5, Figure 2. On this figure, some of the text appears too large. I would also suggest that the entire figure is made taller, so that the altitude scale is less compressed. (As this figure is not a contour plot, but is an image with large pixels, a continuous colour bar is appropriate.)
- Page 6, lines 136–139: At this point there should be reference callouts to the three sources of emissions data. Datasets should be referenced in the same way as articles, and should also be mentioned in the “Code and data availability” section. Where a dataset has a DOI, it should be used. For example, the DOI for GFED4 is [10.3334/ORNLDAAAC/1293](https://doi.org/10.3334/ORNLDAAAC/1293)
- Page 8, Figure 3: The axis labels on this figure are VERY small. The authors should consider the choice of colours for the five lines. Most seriously, pure

yellow should never be used for lines on plots as it is almost invisible on a white background. Less seriously, to my eyes the red (HCN1) and magenta (HCN4) lines are not easy to distinguish.

- Page 13, Figure 6: it might be worth adding an extra column to this figure to show the ACE-FTS data from Figure 1, for easier comparison. If this is done it would probably be necessary to eliminate one of the TOMCAT tracers to ensure that the individual plots were a reasonable size. One could have the season increase horizontally and the tracer name change vertically; this would allow the individual plots to be a bit larger. The colour bar should be divided into bands which match the contour levels used in the plots, as I said for Figure 1.

Technical corrections

- Page 9, Lines 175–177: Units should not be in italics. Also, it is preferable to use negative powers in units rather than the / symbol. For example, write m s^{-1} rather than m/s.
- Page 11 Figure 4: Horizontal axis labels should probably specify that time is in years (CE). The values in the range 2000 to 2016 make it unlikely that the labels could mean anything else, but one should not leave room for doubt. The authors might like to consider the choice of colours: on my screen it is quite hard for the eye to separate the black and blue dots.