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Atmospheric Measurement Techniques Discussions

Interactive comment on "Validation analysis of deriving acetonitrile (CH_3CN) profiles by observations of SMILES from the International Space Station, in the stratosphere and lower mesosphere" *by* T. Fujinawa et al.

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1 General Comments

This paper introduces a new measurement of CH_3CN and assesses its quality. The paper is generally well written and produced; it should be published subject to minor corrections. The standard of written English is generally good and it is nearly always clear what the authors mean. I identify a few exceptions below.

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Discussion paper

2 Specific comments

- Page 2 line 25: “Acetonitrile [. . .] is one of the dominant gases emitted during wildfire events (90%-95%)”. This statement is either wrong or confusing as wildfires emit far more CO and CO_2 than they do CH_3CN. What I suspect that the authors mean is that 90%-95% of CH_3CN comes from wildfires. If that is what the authors mean, they should say so explicitly.

- Page 2 line 27:“. . . ocean uptake and the reaction with hydroxyl radicals (OH)([. . . refs . . .]).” This sentence appears to be missing some words at the end. Maybe it should read “. . . ocean uptake and the reaction with hydroxyl radicals (OH)([. . . refs . . .]) being the main loss mechanisms.”

- Page 5 line 58 “maximum a posteriori solution” should be “maximum a posteriori probability solution”. When mentioning the MAP solution it is surely obligatory to cite Rodgers (2000).

- Page 16, Figure 10. I struggle to interpret this figure. This is partly because the individual panels are rather small; I do not know what might be done about this as the arrangement of the figure is useful.

  The MLS data appear to have a lot of gaps in; the number of gaps increases with altitude. Now, it is clear that some of the gaps are there because the authors have chosen to show MLS data only for times when there is also SMILES data available. I would suggest that for the middle column of data they might want to show MLS data for all days, so that the eye can more easily pick out the patterns in the data.

  The actual MLS data do not become more sparse with altitude as the figure suggests: I just plotted them up to check. However, they **do** become negative on average, as can be seen in Figure 9 (left). I would suggest that the authors use a colour scale which spans the range of both the MLS and SMILES data. Clearly,

the MLS data are wrong in the sense that the atmosphere can not contain less than none of a constituent. But the time-latitude dependence of the MLS data is actually rather similar to that of the SMILES data — it would be nice if the plot could bring that out.

I am pleased to see a sequential colour scale used for the actual quantities and a diverging one for the SMILES-MLS differences. Less satisfactory is the choice of sequential colour scale; the authors have used the notorious "jet" scale, or something very like it. (See https://hughpumphrey.wordpress.com/2017/06/29/colours-for-contours/ for some thoughts and some useful links.) They might want to consider whether a scale other than "jet" might be appropriate in this figure.

- Page 16 Lines 194-196: The time-latitude dependence of the MLS data is actually quite clear and easy to see as long as you plot the data up with a colour scale that goes into the negative. Clearly, the MLS data have a negative bias of over 100% in the upper stratosphere, but this does not, of itself, prevent the seasonal behaviour being observed.

- Page 16 Lines 198-199 and page 17 lines 210-211: It is not at all clear to me why there should be a connection between the maximum observed at 1 hPa – 5 hPa in February and the timing of the biomass-burning season. Tropospheric source gases such as CH_3CN enter the stratosphere via the tropical tropopause and take over a year to ascend from 100 hPa (16 km) to 10 hPa (32 km). This "tape recorder" effect was first observed in water vapour (Mote et al., 1996) and subseqently in HCN (Pumphrey et al., 2008, 2018) among other species. Figure 1 shows that CH_3CN is similar to HCN, although the tape recorder signal is only clear in the 2016-18 period. There was a large influx of both HCN and CH_3CN at that time due to a very strong El Niño event.

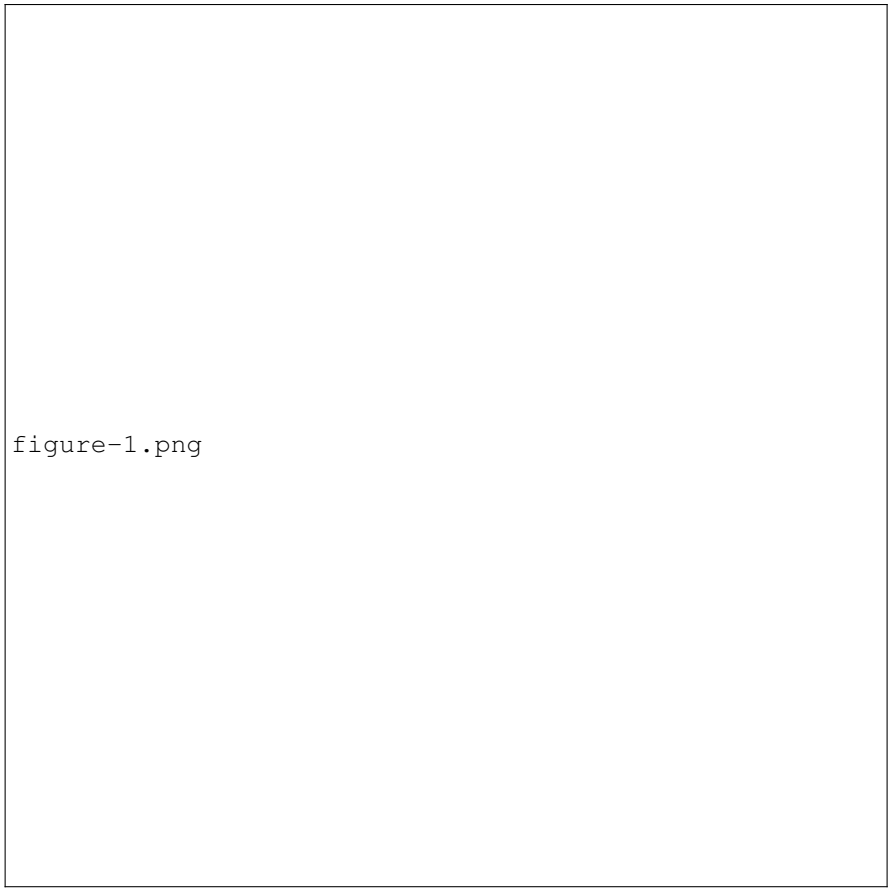

Fig. 1. Time series of MLS CH_3CN anomaly. The data are zonal means covering the latitude range 15°S to 15°N; the time mean of those zonal means has been subtracted.

3 Technical corrections

- Page 1 Line 1: Maybe replace “one of the volatile organic compounds” with “a volatile organic compound”.
- Page 1 line 7: Maybe replace “a pressure broadening” with “pressure broadening” or “the pressure broadening coefficient”.
- Page 2 line 33: “lower stratosphere Kopp and Arnold et al. (1978); Schneider et al. (1997).” should be “lower stratosphere (Kopp and Arnold et al., 1978; Schneider et al.,1997)” (In LaTeX this would be a `\citep`, not a `\citet`.)
- Page 2 Lines 51-53: Figures should be called out in numerical order. Here, Figure 2 is mentioned in the running text before Figure 1.
- Page 17 line 216: AMT prefers datasets to be referenced in the same way as papers, with the DOI included. The full reference for the MLS CH_3CN data is Santee and Read (2015).

References

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