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Atmospheric
Chemistry
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Discussions

Interactive comment on "Methanol from TES global observations: retrieval algorithm and seasonal and spatial variability" *by* K. E. Cady-Pereira et al.

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It would be helpful if the current manuscript provided more information on calculating RVMR (perhaps equations), rather than just referring to Shepherd et al. (2011), since the concept is quite novel. On page 11831, line 25, I disagree with the statements that it is useful to collapse a profile to an RVMR for comparing with in situ observations or a model, or Page 11832, line 10-11, that RVMR makes comparisons with in situ data simpler. Figure 6 shows that at 800 hPa, the RVMR is 8 ppb while the retrieved value is 23 ppb and the prior 4 ppb at this level (assuming an enhanced continental value as in Figure 4). Figure 8 in Shepherd et al. (2011) demonstrates the consistency of RVMR when there is large uncertainty in the shape of the true profile, but it is still not clear to me how well the RVMR would agree with the true profile, which would determine if a direct comparison of the RVMR with an in situ measurement would be reasonable. In fact, according to page 11836 line 23 of the manuscript, the TES operator (averaging kernel and prior) is applied along with the RVMR weighting function in the model comparisons, so this does not make a comparison (with models or in situ data) simpler at all, but adds another step and makes the comparison more opaque than the standard approach where only the a priori and averaging kernel are used. Since the 825.4 and 749.4 hPa levels in Figure 6 have the largest values and the averaging kernel indicates the most sensitivity to these levels, a more useful quantity than RVMR (in my opinion) would be one that was somehow more heavily weighted to these levels rather than the upper/lower altitudes, which I interpret as the reason for the RVMR being lower.

The reviewer had questions about the RVMR and the appropriateness of using it for comparisons with model output and in situ measurements. We have added an equation and some text in section 3.1, and a supplement that discusses and illustrates the use of the RVMR in model/satellite comparisons, and shows that when modeled and measured profiles agree, so do the RVMR values. We hope these additions will provide sufficient detail for the reader to gain a clearer understanding of the RVMR concept without going to the original papers. Two further points need to be addressed. First, since the retrieval is done in log space, the RVMR is also applied in log space, i.e, the mapping is applied to the log of the mixing ratio, then the result is converted to mixing ratio. Thus the final RVMR value is driven by a mapping in log space. In order to make this clearer we have redrawn the profile plot in Figure 6 with a log x-axis. In model/satellite comparisons since both profiles have the same mapping applied, the comparisons are not very sensitive to the fine details of the mapping. Comparisons with in situ measurements, especially surface measurements, are more difficult. For trace species with low DOFS, the goal is to find what additional information the satellite observations provide, and the collapsing of the information to an RVMR has proven to be very useful for comparisons with point source measurements and generating maps where the influence of the a priori has been reduced. The RVMR values from the different mappings we have tested have proven to be very highly correlated, and have been very useful when generating maps and comparing against in situ measurements for correlations (e.g. Pinder et al., 2011). Finally, when the CH3OH retrieval algorithm becomes operational in 2013 at JPL the TES product will include retrieved profiles, averaging kernels and various mapping arrays, which will allow users to develop their own products as they best see fit.

Pinder R.W., J.T. Walker, J.O. Bash, K.E. Cady-Pereira, D.K. Henze, M. Luo, M.W. Shephard, Quantifying spatial and temporal variability in atmospheric ammonia with in situ and space-based observations, Geophysical Res. Letters, Vol. 38, L04802, doi:10.1029/2010GL046146, 2011.

Page 11824, line 17: “simulated”, “modeled” or “the model” would be better than “predicted”.

Done.

Page 11825, line 24-25: I am not sure what is meant by “typical scanning infrared satellite sensors”. By scanning do they mean wavelength scanning as in dispersive/grating instruments (because FTSs scan to give an optical path difference) or do they mean cross-track scanning for horizontal coverage?

Scanning was removed from the text, as it was not correct.

Page 11826, line 1-2: Providing the resolution of IASI and overpass time would be helpful for the justification of the advantages of TES.

Done.

Page 11830, line 6: It should be clarified whether GEOS-4 or GEOS-5 is used, as well as the number of vertical levels in the simulation, since both will impact the comparisons with the retrieved methanol.

Done.

Page 11833, line 6-15: For biases, it would be good to state the sign of the bias (+/-) or present it as a high or low bias.

Done.

Page 11835, equation 4: E is not defined in the text.

E is now defined.

Page 11836, line 7: The leading superscript 32 is not the correct way to describe a molecule with a molar mass of 32 units. The notation is used for isotope atomic masses but should not be used for an isotopologue mass. The molecular mass can just be given in the sentence or the atomic masses of each isotope in the molecule can be given.

Notation has been corrected.

Page 11838, line 17: “emission models” is poor wording. “model simulations” would be better since both transport and emissions affect the comparison with observations.

Wording has been changed.

Table 1. "V" in V1 and V2 should be replaced by the Greek lowercase letter _ to comply with the correct spectroscopic notation and it should be specified that they represent the start and end boundaries of the microwindow. Also, units of cmôĂĂĂ1 need to be stated. Figure 1. Only the CH3OH line should have symbols in the figure legend, not the others since the other symbols are not used in the figure. Either in the caption, a table or the text, the background and enhanced values should be provided for the reader to understand the relative sensitivity of each species.

Note that Table 1 has become Table 2. Notation has been changed and units have been added. All symbols except those for CH3OH have been removed from Figure 1 and the background and enhanced values are presented in Table 1.

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Figure 5 caption. “from the second phase of the NASA ARCTAS campaign” makes it sound like TES was part of the aircraft campaign, which was obviously not the case. Simply replacing this with the latitude, longitude and date-time would be best.

Done.

Figure 11. I assume the numbers on the colorbars were not intentionally omitted, but without them, the figure is not much use. The caption should also state that the TES operator (averaging kernel and prior) were applied to the model.

Colorbars now have numbers and the caption has been changed.

Figure 13 and 14. In my opinion, the clearest way to present this information would be in a single figure with two colors so that the smaller differences between TES and GEOS-Chem could be assessed more easily, but this is just a suggestion.

We agree that the display is not ideal. We had considered this when writing the paper, but could not reconcile the size of the figure with the amount of information we wanted to show.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/12/C5684/2012/acpd-12-C5684-2012-supplement.pdf

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 11823, 2012.