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Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #1

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This manuscript describes an improved retrieval of methanol profiles from TES observations. The profiles are converted to a Representative Volume Mixing Ratio (RVMR) and compared with GEOS-Chem model simulations. This is novel research and a relevant topic for Atmospheric Chemistry and Physics.

The authors acknowledge the difficulty in retrieving a minor trace gas such as methanol, which has a weak signal relative to ozone, water vapour etc. and do a good job of optimizing the retrieval to deal with the weak signal. The retrieval approach is sound and well-described. I have some issues with the justification of RVMR and its application in model comparisons; however, since the RVMR concept was already presented in an

earlier peer-reviewed paper, it is just the use and interpretation here that I comment on. Overall, the science in the paper is sound and most of the changes I recommend relate to the presentation of the results. If these changes were implemented, the paper would be acceptable for publication.

Main Comment

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.

Additional Comments

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Interactive Comment

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

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?

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

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.

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.

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

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.

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

Table 1. "V" in V_1 and V_2 should be replaced by the Greek lowercase letter ν 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 cm^{-1} need to be stated.

Figure 1. Only the CH_3OH line should have symbols in the figure legend, not the

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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.

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.

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.

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.

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