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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Quantifying global terrestrial methanol emissions using observations from the TES satellite sensor" *by* K. C. Wells et al.

Anonymous Referee #2

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Quantifying global terrestial methanol emissions using observations from the TES satellite sensor, K. C. Wells et al. 2013

This reviewer thinks it is suitable for ACP although it has a technical component.

I like the fluent writing style and it often reads as if it is part of a PhD thesis. The paper deals with top-down observed methanol emissions from space. The authors draw a couple of conclusions but most notably: 1. Even though methanol emissions in GEOS-Chem are grossly underestimated for various reasons posterior estimates are in line with previous published work, 2. flux adjustments are minor for the tropical regions but are substantial for higher latitudes. With the exception for some parts in China which are being revised downwards for the 2 years worth of data.

It should not come as a surprise that emissions not just in GEOS-Chem but probably in all the models out there either are too high or are too low. They are simply wrong. But this adjustment in itself does not necessarily warrant publication for the sake of adjusting erroneously precompiled bottom-up emissions in GEOS-Chem. However, it is remarkable that TES supports the posterior annual adjustment of about 115 Tg CH3OH yr-1 which is a value reported in the geophysical literature based on different methodologies, models and assumptions. As models are often used to interpreting observations it is more than important to get a clue about emissions in models.

Minor specific comments:

In Figure 1 coverage of the TES orbit is shown. Figure 2 shows the emissions in GEOS-Chem. I think the colour bar is a bit clunky as it seems from that plot that emissions at higher latitudes are zero or between 0 and 50 Gg yr-1. Figure 5 and Figure 6, respectively show posterior scaling factors which are more in agreement with the global coverage of TES observations presented in Figure 1. I would suggest (but only if it is easy to do so) to redo the plot with a logarithmic colour bar or to include a finer resolution, e.g. 0-25 Gg yr-1 colour code.

I think the authors need to add a sentence if a seasonal inversion for the "extra tropical regions" would give different results. I understand that TES sampling at high latitudes is the limiting factor here. But the posterior adjustments are largest for these regions and in fact contribute the most to the upward adjustment of prior emissions. This needs to be addressed. The scaling factors are often quite large due to the small magnitude of prior emissions in the extratropical regions to account for the large underestimation of prior emissions.

Pseudo observation test of the adjoint method. An OSSE (observing system simulation experiment) will always work most of the time and it will recover the truth within uncertainty. The proof lies in the application of real data. It would be interesting to know if methanol chemistry is broadly speaking linear or not in your model.

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Figure 5. I think this is once more a plotting issue. I noticed over South America most of the posterior adjustments are along the coast. But Figure 2 shows there are substantial emissions coming out from the Amazon basin region. Please check the Figure 5 again and make sure the white areas correspond indeed to 0.75–1.25 in the colour bar. Otherwise it looks as if there is a problem with the separation between land and ocean in the rather large 4x5 model grid box. As far as I understand the authors do not include the oceans in the inversion and the inversion is just being carried out over land. However, land and ocean will fall into the same 4x5 grid-box for some coastal locations.

Your comparison to aircraft profiles over the ocean. The lifetime of methanol is rather short and you applied scaling factors over land emissions. The scaling factors move the posterior profiles away from the prior but there is still a large gap between observations and model for some profiles. It would raise alarm bells if the model profiles and observations would perfectly match up though. But maybe you should add a sentence or two if the source from the oceans is important or not (although a net sink but it is a large reservoir after all).

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 21883, 2013.