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

Anonymous Referee #1

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The authors investigate the distribution and magnitude of the sum of terrestrial methanol emissions inferred from a seasonal inversion in the Tropics and an annual inversion in the extratropics, both driven by TES methanol columns retrieved in 2008-2009. The inversion suggests increased a posteriori fluxes by 56% globally, and leads to an improved CH3OH simulation. The global results are found to be consistent with previous estimates based on IASI methanol columns. The conclusions seem to be supported by the analysis. This study is well fitted to the scope of the journal, and its publication is recommended provided that the following concerns are adequately addressed in a revised version.

General comments

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- The MEGANv2.1 biogenic CH3OH flux used in this study is found to be by 35% lower than the MEGANv2.1 inventory by Stavrakou et al. (2011), and by Guenther et al. (2012) (105 Tg/yr and 100 Tg/yr, respectively). The authors propose that the differences are due to different LAI and meteorology, however, Stavrakou et al. and this study use the same LAI database. Does this mean that the differences between the two estimates are due to meteorology? To clarify this, a global map of the MEGANv2.1 source is needed here to allow comparisons with published work. This is also necessary in order to facilitate comparison of the top-down results iwth those of Stavrakou et al.

- A different inversion approach is used for tropical and extratropical regions. In the first case a seasonal inversion is performed, whereas in the latter, the seasonality is obtained from an earlier publication (Wells et al. 2012), so an annual inversion is conducted. The authors should clarify the reasons for this choice, especially since the seasonality in Wells et al.(2012) was derived from IASI measurements. It would be interesting to know if TES measurements would lead to a similar seasonality as in Wells et al. Please consider providing results using a uniform treatment for tropical and extratropical regions.

- In the pseudo-observation test, it would be insightful to add noise to the pseudo-observations in order to account for the observational error.

- An objective criterion should be used to test the convergence of the iterations. Please provide the final value of the gradient of the cost function. 26 iterations might be enough in the standard case ($\gamma = 0.5$), but I suspect that many more iterations are needed when γ is decreased to low values.

- Figure 7 indicates that the emission updates in tropical regions, except Southeast Asia, are extremely small, in spite of persistent underestimations. An annual inversion would have possibly done a better job in reducing this bias. The fact that the regional emissions in tropical areas show very little changes in the γ

tests is very puzzling. The case $\gamma = 0$ would have been expected to eliminate those biases. This might be related to the previous comment on the number of iterations.

- Is the AltOH test supposed to represent the true model uncertainty on OH? Its usefulness is clearly limited. But additional tests that could be interesting are the use of a lower deposition velocity, or reduced ocean source/sink of methanol.

- p.21901, l.20-23 : FTIR measurements at Kitt Peak are available and could possibly confirm the need for larger emissions over the Western US in the summer.

- p.21902, l.10 : It should be made more clear that the biogenic methanol emission underestimation refers to the specific inventory used in this study (which differs from previous implementations of MEGANv2.1, cf. point 1).

- In Fig.6, note that the regions with the lowest a posteriori errors are biomass burning hot spots in GFED3 database.

Specific comments

- p. 21892, l.13 : The scale factors are defined relative to what? Clarify also Figs. S1, S2 captions.

- The color code of Figs. S1, S2, and 5 is inappropriate. Please add more intervals between 0.25 and 2.

- Bousserez et al. paper : please provide the names of all authors

- The discussion of the results could be more quantitative (Section 6).

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

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