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Interactive comment on “Sources and seasonality of atmospheric methanol based on tall tower measurements in the US Upper Midwest” by L. Hu et al.

L. Hu et al.

huxxx249@umn.edu

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We thank referee # 2 for their comments and for their recommendation for publication. Responses to specific comments are below.

Comment 1: In this study, the model is found to significantly underestimate the methanol measurements. However, from two previous modelling studies we get a different message. In fact, when using GEOS-Chem model and a NPP-based parameterization for methanol plant emissions, Millet et al. (2008) concluded that a significant decrease of biogenic methanol emissions over the US is required in order to match boundary layer methanol concentrations from in situ and aircraft observations.

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Furthermore, the use of the latest version of MEGAN (MEGANv2.1, Stavrakou et al., 2011) in the IMAGES global model resulted in important overestimations of aircraft, in situ and satellite observations in the US. This point merits to be addressed in the revised version.

Response:

Thank you for the comment. We agree that this point needed to be clarified in the manuscript. As the reviewer points out, the Millet et al. (2008) paper used an entirely different algorithm for estimating emissions, so the simulations are not precisely comparable with this paper. In fact the MEGAN approach used here results in a global emission from terrestrial vegetation of 95 Tg/y, which is similar to the optimized estimates from Millet et al. (2008) using a reduced biogenic source (72-89 Tg/y), and quite a bit lower than the base-case from that study (145 Tg/y). However, the 2008 paper found that the model overestimate was mainly over the eastern part of the country, with an underestimate over the west (their Fig. 7). There was too little data over the Upper Midwest to say conclusively one way or the other for that region, although the model was too low over a ground station in Michigan (UMBS site, their Fig. 9), similar to our present findings for Minnesota. The modeling study of Stavrakou et al. (2011) did use MEGAN (with a different canopy representation), and they also found a model overestimate in the eastern US and underestimate in the west (their Fig. 4). In the revised manuscript we have added a paragraph to better discuss this previous work and context for the present study (sections 2.4 and 3.1).

Comment 2: The authors should drive the model with other available inventories for biogenic methanol emissions. How does the MEGANv2.0 used in this paper compare with the NPP-based inventory used in Millet et al. (2008), and with the MEGANv2.1 inventory (<http://accent.aero.jussieu.fr>)?

Response:

Thank you for the suggestion. As discussed in the comment above, we have now

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added a more detailed discussion of the context of this work in relation to that of Millet et al. (2008) and Stayrakou et al. (2011), which use those other inventories. However, we feel implementing an entirely separate emission inventory into the model is beyond the scope of this manuscript, which is to test basic understanding of methanol sources and their seasonal changes.

Minor comments:

1. p. 17474 : The measurement period must be mentioned in the abstract and the introduction section.

Done.

2. p. 17481 : The GFEDv2 biomass burning inventory is, to my knowledge, not available after 2008. Are the simulations performed for the measurement period?

Response: Thank you for catching this. Yes, the simulations are performed for the measurement period, but GFED2 is not available beyond 2008. The simulations therefore use climatological biomass burning emissions, and we have clarified this point in the paper.

3. p. 17500 : Please plot also the simulated annual cycles for CO, benzene and toluene in Fig.3.

Response: The model simulation for methanol is an offline simulation and does not include benzene or toluene.

4. p.17483, l.27: "but make up" : replace by "and make up"

Done.

5. p.17487 : Section 3.4 does not bring new insight in the interpretation of the measurements and could be either omitted or shortened.

Response: We disagree and feel that this section provides useful information on

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methanol's seasonal impact on atmospheric chemistry. The seasonal importance of methanol as a source of formaldehyde and carbon monoxide is highest in spring through early summer, when biogenic methanol emissions are high but isoprene emissions are still relatively low, demonstrating that the importance of methanol versus isoprene oxidation varies substantially during the course of the growing season.

6. p.17488: l.15: replace "over 1 year" by "over one year"

Done.

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