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Atmospheric Chemistry and Physics Discussions

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

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We thank referee # 1 for their comments and their recommendation for publication. Responses to their specific comments are below.

Comment 1 (page 17475, line 9-12): This sentence seems to be out of place here and separates the introduction to the topic into two pieces. In my opinion it does not provide information which is not given anywhere else in the introduction and makes the introduction less structured therefore I would suggest to delete it.

Response: Thank you for the suggestion. We choose to keep this sentence. It states the goal of the paper at the end of the first paragraph in the Introduction. We feel this

aids communication, as the reader does not have to get all the way to the end of the Introduction to find out what the paper is about.

Comment 2 (page 17476, line 8-14): This information fits to the field site description but is too detailed for the introduction. Therefore I would suggest changing the sentence accordingly and moving it to the field site description.

Response: We feel this sentence provides context for the overall study and thus belongs in the introduction.

Comment 3 (page 17477, line 22): 'using a PTR-MS'

Response: Changed accordingly.

Comment 4 (page 17477, line 23): Please provide the information about the location of Ionicon '(HS-PTR-MS, Ionicon Analytik, Austria)'

Response: Changed accordingly. And we also provided the manufacture's location for other instruments mentioned in this manuscript.

Comment 5 (page 17477, line 27): Please provide information about type and manufacturer of the SEM.

Response: Changed "secondary electron multiplier" to "secondary electron multiplier (Inficon, Liechtenstein)"

Comment 6 (page 17478, line 3): Was the inlet line heated?

Response: The last $\sim$1 m of inlet line is composed of silcosteel (passivated stainless steel) and is heated to 60 °C. The rest of the inlet line (up to the inlet) is composed of PFA Teflon and kept at room or ambient temperature. We clarified this point in the manuscript.

Comment 7 (page 17478, line 5): The inner diameter of the Teflon line is the more important information: Could you please provide both outer and inner diameter? Alter-

natively you could provide outer diameter and wall thickness or only the inner diameter.

Response: Changed "1.27 cm OD" to "0.95 cm $\times$ 1.27 cm (I.D. $\times$ O.D.)"

Comment 8 (page 17478, line 23): Was the background signal stable within the 2-5 h? If not do you interpolate the background signal which is subtracted in between?

Response: Yes, within 2-5 h, the background signal is stable. However, we do interpolate the background signal between sequential readings to obtain the most accurate subtraction possible. In the revised version, we changed "Post-processing of the raw data following de Gouw et al. (2003) is employed to account for humidity effects." to "After subtracting the interpolated background signals, the raw data are post-processed following de Gouw et al. (2003) to account for humidity effects."

Comment 9 (page 17478, line 25): See comment 8.

Response: Changed "1.27 cm OD" to "0.95 cm $\times$ 1.27 cm (I.D. $\times$ O.D.)"

Comment 10 (page 17479, line 10): Could you please provide information about typical sensitivities during the calibration of methanol and possibly of benzene and toluene?

Response: We added this information in the revised version as follows:

We changed page 17479, line 10 "The detection limited for methanol, defined as 3$\times$ the precision, is $\sim$220 pptv for a 5 s dwell time" to "Detection limits, defined as 3$\times$ the precision, are $\sim$220 pptv for methanol (5 s dwell time), $\sim$18 pptv for benzene (10 s dwell time) and $\sim$30 pptv for toluene (10 s dwell time). Typical sensitivities during calibration are $\sim$10.9 ncps/ppbv for methanol, $\sim$10.2 ncps/ppbv for benzene, and $\sim$13.2 ncps/ppbv for toluene for a drift tube pressure of 2.2 mbar and drift tube voltage of 600 V"

Comment 11 (page 17480, line 16-17): Explain more detailed - why do you use exactly those four plant functional types and how do needle-leaf trees and herbaceous plants correspond to the land cover map in figure 1.

Response: Those four plant functional types reflect current implementation of the MEGANv2.0 emission model (Guenther et al., 2006). For methanol, MEGANv2.0 uses the same emission factor for all PFTs in any case. To clarify the relationship with Figure 1, we added more explanation to the text and modified the figure legend for consistency with the terminology in the text.

Comment 12 (page 17480, line 20): Explain why you use identical emission factors of 800 μg m-2 h-1? I wonder if this makes sense (the four different ecosystems in use seem to be quite different). Is there any reference? I know emission factors to be uncertain but does it make sense to use different plant functional types if the emission factors for all plant functional types are assumed to be equal?

Response: This reflects the current implementation in MEGANv2.0, which our aim here is to test with our tall tower observations. Use of the same emission factor for each PFT in the model simply reflects the state of current understanding; there is not enough known about the emissions from different PFTs to justify specifying them differently in the model. Our goal for this paper is to test and help to improve that state of understanding based on observations.

Comment 13 (page 17481, line 4): In general I would embrace some more information in section 2.4 (GEOS-Chem chemical transport model). For example: do you account (except of temperature and LAI) for other environmental conditions which differ from standard conditions (e.g. PAR) for biogenic emission modeling?

Response: Yes, the emission model accounts for the dependence of biogenic emissions on PAR, temperature, leaf area, and leaf age. In the revised manuscript, we have added some text to clarify the dependence of the activity factor γ on different environmental variables.

Comment 14 (page 17482, section 3.1): Figure 3 shows the methanol VMR simulated by GEOS-CHEM, MEGAN compared to the measurements. The model seems to underestimate the VMRs continuously but especially during summer (discussed on page

17487, paragraph 2). Wouldn't it be more straightforward to discuss it right away?

Response: We added a paragraph in section 3.1 to address this.

Comment 15 (page 17484, line 13): I think you mean 'atmospheric background concentrations' - the use of background concentration in combination with PTR-MS measurements might be misleading.

Response: We changed "background concentrations" to "atmospheric background concentrations"

Comment 16 (page 17486, section 3.3): Temperature is most probably not the only driver for biogenic methanol emissions. Did you try to identify other drivers (e.g. LAI, PAR)?

Response: It's true that temperature is not the only driver for biogenic methanol emissions. Based on this set of observations, the LAI dependence would be difficult to resolve from uncertainty in the base emission factors. The dependence on PAR in MEGAN is modeled in the same way across biogenic VOCs (except in the separation of light-dependent versus independent fluxes). The temperature dependence on the other hand is specified separately for each compound. We thus feel our dataset offers the most useful constraint on this methanol-specific parameter, and focused our analysis accordingly.

Comment 17 (page 17497, table 1): Could you provide information about the main vegetation at the different sites all along with the table? The measurement height could be an interesting fact as well.

Response: Thank you for the suggestion. We added two more columns to state the main vegetation type and measurement height at the different sites.

Technical comments:

Comment 18 (page 17479, line 9): Please change 'detection limited' to 'detection limit'.

Done.

Comment 19 (page 17499, figure 2): Please indicate the northern direction within the wind rose plots.

Done.

Comment 20 (page 17500, figure 3): The units belong to the y-axes labeling – is it possible to move them below the compound name? They are hardly readable in some panels.

Done.

Comment 21 (page 17501, figure 4) Is it possible to place the tick marks further away from the ticks for x-axis and the right y-axis?

Done.

Comment 22 (page 17504, figure 7): It is rather difficult to differ between the blue line (SOS) and the KCMP measurements (black line). Is it possible to use another color or a lighter blue? Is it possible to place the tick marks further away from the ticks for x-axis?

Done.

Comment 23 (page 17505, figure 8): The blue shaded area is quite dark therefore it is difficult to recognize the line in between. Could you use a more transparent blue? Is it possible to place the tick marks further away from the ticks for x-axis.

Done.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 17473, 2011.