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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observational constraints on the global atmospheric budget of ethanol" *by* V. Naik et al.

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We thank the reviewer for reviewing our manuscript and providing us constructive comments. Their comments with our responses are given below.

Response to Anonymous Referee #1

This manuscript describes the development of a model budget of global atmospheric ethanol and subsequent comparison of the model simulation with observations. The authors apply the most recent updates to source and sink estimates and yet still find a significant underestimate of free tropospheric ethanol that cannot be reconciled with an oxidation source from known VOCs. The paper is concisely written and motivates further investigation of the sources of ethanol. I have only minor suggestions to improve

the clarity of the text.

1. Page 930, line 3: Why are the biogenic emissions calculated offline? What kind of daily variability in emissions would be expected and how might not accounting for this impact comparisons with field observations?

The parameterization and emission factor maps for biogenic ethanol emissions are extremely preliminary. Since these were meant to provide a first-guess of biogenic ethanol emissions, they were not implemented interactively in MOZART-4. We calculate emissions at an hourly time step and average them for each month to create monthly emissions. We expect the daily variability of ethanol emissions to be similar to that for monoterpenes i.e., increase (decrease) with warmer (cooler) temperature. By not accounting for the daily variability, we are most likely overestimating the emissions on cool days and underestimating them on warm days.

2. Page 930, line 4: What LAI product was used for these calculations?

We note in the paper that Leaf Area Index has been derived from MODIS satellite measurements for 2003.

3. Page 930, line 13: Is there significant uncertainty in the biomass burning emission factors for ethanol used here? Perhaps a sentence on how extensively measured these EFs are for different ecosystems?

Thank you for pointing this out. Yes, there is significant uncertainty in the biomass burning ethanol emissions factors we have used to estimate biomass burning emissions. We note in the manuscript that ethanol emission factors are not measured directly, rather, they have been extrapolated from those of carbon monoxide (Andreae and Merlet, 2001).

4. Page 931, line 25: A global annual mean BL concentration of ethanol is not particularly useful given its short lifetime and strong gradients – perhaps the authors could separate into continental and oceanic BL?

Thank you for the suggestion. We now report that the annual mean boundary layer (0-2 km) concentration of ethanol in the model over continents is 71 pptv while that over oceans is 11 pptv.

5. Page 932: when first introducing the field observations, please list the campaigns/sites in the text.

We have now added a table that provides details of the field observations.

6. Figure 3: Having performed tagged simulations, perhaps the authors could shade the BASE bars by tagged source to illustrate the role of different sources in different regions as discussed in the text.

Since we show the comparison of model simulated ethanol concentrations with observations as percent model bias in Fig 3 (now Fig. 4), we cannot shade the BASE bars by the amount of ethanol contributed by each tagged source. We have, therefore, added another figure (Fig. 5) showing the percent contribution of each of the four (industrial, biofuel, biogenic and biomass burning) sources to ethanol concentrations for the BASE simulation.

7. Figures 3 &4: The colours between these figures should be coordinated (i.e. BASE blue in both plots).

We have updated Fig 3 (now Fig. 4) to be colour coordinated with Fig. 4 (now Fig. 6).

8. Page 936, line 1: Please elaborate a bit on what aqueous-phase chemistry might be important for ethanol.

For lack of evidence in the scientific literature on the impact of aqueous-phase chemistry on atmospheric abundance of ethanol, we have removed this sentence from the manuscript.

9. Given that both the supplementary information and the main article are fairly short and that the information given in the supplement is of general interest for the construc-

tion of the ethanol budget, I would recommend that the authors integrate the text.

Done.

References:

Andreae, M., and Merlet, P.: Emissions of trace gases and aerosols from biomass burning, Global Biogeochem. Cycl., 15, 955-966, 2001.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 925, 2010.