

Interactive comment on “Description and evaluation of the Model for Ozone and Related chemical Tracers, version 4 (MOZART-4)” by L. K. Emmons et al.

Anonymous Referee #3

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General Remarks:

The manuscript presents a description of the global chemistry-transport model MOZART in its version 4. It discusses the improvements that have been carried out over the last tropospheric version MOZART-2. These improvements are numerous and in cases substantial. Especially the chemical mechanism has seen substantial enhancements. All the updates to the model are discussed clearly and in detail. The text is well structured and the changes are documented with sufficient detail and references. The length of the text is adequate to the purpose. Model evaluation is treated with care, either by providing external references to studies with MOZART-4 that have

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been conducted prior to the publication of this manuscript or by including them directly in the model evaluation section. The model evaluation documented here covers some very important model quantities such as OH or lightning NO and is sufficiently detailed. An extended section of the manuscript has been dedicated to the implementation of the interactive BVOC emission model in MOZART-4. Overall, the document is well balanced in terms of detail and information presented. Also, this document is well within the scope of GDM. I therefore recommend the publication of the manuscript after the minor revisions outlined below have been carried out.

Specific Remarks:

On page 1162 at lines 15 to 20 you describe how black and organic aerosols are treated in the model. Specifically it says that "Black carbon and organic carbon aerosols are emitted in a combination of hydrophobic and hydrophilic forms (80% and 50% hydrophobic, respectively), and are converted from hydrophobic to hydrophilic with a time constant of 1.6 days". Could you add references or some explanation to substantiate these specific choices.

On page 1165 lines 20 to 25 you make the statement that "It is straight-forward to use other vegetation maps, such as for future climate scenarios, if desired". In that case the base emission factor distributions in MEGAN have to be replaced by some other data, though, because they exist only for the present-day (yet). Could you please discuss this fact in one or two sentences (generally, in the future case the geographic distributions for the present are replaced by a single base emission factor per PFT for the entire globe).

The section "2.7.1 General formulation" (of BVOC emission model) on pages 1166 to 1168 could be improved. I suggest to consolidate the use of equation number in these paragraphs by (1) Using a consistent numbering for the equations presented in this section (starting from one and ascending from there on) and (2) adding the reference of the paper to the equation number in case you make reference to an external

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equation. In the latter case, lines 10 to 15 on page 1167 would read, e.g., as "The temperature dependences of Eq. (18) **n Guenther et al., 2006,** are based on the average temperature...".

More specifically, on page 1166 at line 20 you state that "... and dependence on soil moisture is ignored ($\gamma_{SM}=1$)". But no explanation is given as to why the soil moisture is ignored, even though it is argued in the same paragraph that including soil moisture would change the global isoprene emission magnitude by "only 7%". Could you add one or two sentences discussing your choices in more detail.

On page 1176 at line 25 you say that "... MOZART-4 has skill at reproducing tropospheric ...". Please rephrase this very vague expression. I would prefer something like "the model reproduces well..." or similarly.

Technical Remarks:

I have checked that all citations in the text appear in the reference section but not the other way round. There might be orphaned references in this list. Worthwhile giving it a quick check. Also, on page 1170 reference is made to "Tang et al., 2008" but in the references this seems to appear as "Tang et al., 2007". Furthermore, on page 1162 and in the references referenc is made to "Lamarque et al., 2005**b**" but there is only one reference for this author. Please update.

On page 1172 at line 5 please add references for the EDGAR-FT2000 and EDGAR-2 emission databases.

On page 1174 at line 13 please correct typo. It should read: "and the middle panel shows the MOPITT column retrieval, **expressed* as average mixing ratio."

On page 1175 lines 22 to 24 I suggest that you add the title of the individual you of Figure 8 you are making reference to. The text would then read, e.g., "... whereas it is slightly high in the Northern Tropics (Eq-30N, 650hPa).", similarly in other cases. This would make it easier to identify the plots in Figure 8.

On page 1205 in Figure 1 could you agree to changing the units from "kg/m²/s" to "mg/m²/day". These units are also frequently used in BVOC emission modeling and read more easy. "mg/m²/day" generally range from roughly 01 to 200 which for me is easier to grasp than 1.0E-13 kg/m²/s. But this is just a mere suggestion.

On page 1206 in Figure 2 I believe the units are Mg-N/gridbox/yr in case of the total column lightning-NO emission plot. Please change the units to XXXg-N/m²/yr or at least add the fact that they are computed per gridbox to the units.

On page 1207 in Figure 3 it would be nice if you could add an ozonesonde profile for the appropriate location to the plot. This would put the model quantities in some perspective to observations.

Finally, a general remark on the figure captions in the figures presented. The font size used for the individual figure captions vary vastly in size. I understand that might have been due to the fact that they amount of text varies substantially between the captions. I would prefer to have the same font size for all the captions, though, since this gives a much more consistent impression.

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