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Geoscientific
Model Development
Discussions

Interactive comment on "ECHMERIT V1.0 – a new global fully coupled mercury-chemistry and transport model" *by* G. Jung et al.

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Response to Reviewer #1:

Thank you very much for the in-depth review, the encouraging and valuable comments that will for sure improve the quality of the publication. In the following the specific requested revisions are addressed and commented.

To MAJOR CONCERNS:

1) We will consider also GAW stations for validation and include some ozone sounding data as well for a more profound analysis.

2) As it is really a very important mercury oxidant in the ECHMERIT model, also OH

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mixing ratios/lifetime will be included in the evaluation part of the publication. There is a discrepancy between mercury gradients from northern to southern hemisphere in the ECHMERIT simulations compared to observational evidence. (As mentioned already in the publication) this mismatch to measurements is mostly influenced by the overestimation of oceanic emissions in southern hemispheric summer. To improve the discussion of this issue, and as requested, a more quantitative consideration of this issue will be included.

3) The time step for the different modules (emissions, deposition, chemistry) is always consistent with the meteorology and transport time step of the base model ECHAM5. Just in case of running the model in a T42L19 resolution with a 30 minutes time step (or in a coarser resolution with even larger time steps), the chemistry (emission) time step was chosen to be smaller than the transport step. The photolysis time step is always the same as the chemistry time step and does not correspond with the radiation time step of ECHAM5. This will be clarified in the text.

To SECONDARY ISSUES:

1) Mixing ratios in the stratosphere of some species are set to constant values (NO=0.05 ppb, NO2=1 ppb, HNO3=3 ppb, HCl=0.6 ppb) according to McElroy & Salawitch (1989). Ozone mixing ratios in the stratosphere are as described in the publication taken from the climatology that is implemented in ECHAM5. The reference for that is: Fortuin, P and H. Kelder, 1998, Journal of Geophysical Research, 103D, 31709-31734 and will be included as well. Cross-tropopause transport is included, as transport does take part in all model levels, but considering the stratospheric ozone mixing ratios, these are always set to the standard values and are hence not influenced by transport from the troposphere. The tropospheric concentrations are instead influenced by transport from the stratosphere.

2) Thanks for mentioning the Streets et al (2009) publication, Comparison of the inventories will be added to the emissions part of the introduction.

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3) So far the model does neither include aircraft, ship, nor lightning emissions, which for sure would improve model results of ozone in the tropics. This is one of the future tasks in model development.

4) The below cloud scavenging process is described in the first part of the wet deposition description (but not in greater detail) on page 400 line 5-17 following the approach of Seinfeld and Pandis (1998) and following closely the implementation in the CAMx model. The second part of this paragraph describes only the wet deposition process of the aqueous phase mercury species. We will go into more detail in the description of the below cloud scavenging of gaseous species and try to emphasize the distinction from the wet deposition of aqueous phase species.

5) In the model simulations elemental mercury dry deposition seems negligible, as it is only 0.57 % of the total gaseous mercury dry deposition. Anyhow it cannot be excluded, that deposition velocity in the model is too low for elemental mercury (it is generally below 0.1 m/s). This will be discussed in the text as well.

6) A literature review on the issue of uncertainties and comparison between offline and online calculating models will be included.

7) The final paragraph will be rewritten to clarify about the discussion on linear response of in-domain mercury mixing ratios to boundary concentrations in regional-scale models and include some more precise discussion on the availability of measurements and recent activities.

to MINOR AND EDITORIAL ISSUES:

1) Until now no clear hint was found for this discrepancy. Probably stratospheric-tropospheric exchange is underestimated in the simulations. Anyhow this issue is subject of further investigation.

2) There was a bug in the model code that resulted in too high ozone deposition velocities over sea ice that is resolved now. New results will be included. Anyhow there

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are no large impacts of the corrected dry deposition velocities on ozone mixing ratios, hence the discussion of results does not change.

3) The world maps will be replotted without lake and country boundaries

4) Figure captions of figures 4 and 5 will be corrected

5) A non-linear scale will be chosen for additional plots where it means a further improvement.

6) Labels will be added to the y-axis of figure 16 and categories will be explained

7) The named spelling errors will be corrected

Interactive comment on Geosci. Model Dev. Discuss., 2, 385, 2009.