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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Measurement-based modeling of bromine-induced oxidation of mercury above the Dead Sea" *by* E. Tas et al.

Anonymous Referee #1

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Review for "Measurement-based modeling of reactive bromine species over the Dead Sea: 2. Atmospheric Mercury Depletion " by Tas et. al. [ACPD (11), 24467-24502]

The manuscript presents the results of chemical modeling of oxidative mercury depletion observed in the Dead Sea using the MECCA box model as the driver generating mercury oxidants. This is an interesting modeling study attempting to better understand the chemical mechanisms responsible for the observed mercury depletion outside of the Polar Regions. The manuscript is generally well written with a number of us useful sensitivity simulations representing different kinetic scenarios. On the other hand, there are a few areas that should be made more explicit to substantiate the very strong conclusions made in the study (BrO being the most predominant oxidant). Overall, I recommend the manuscript be accepted for publication in ACP after the authors ad-

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dress the following points.

1. Some discussion regarding how mercury chemistry was implemented in the MECCA simulation will be useful. Was the oxidant generation simulated on-line or off-line? This could make a significant difference of the model results because the resulted oxidant concentrations would be different. Also, the generation of reactive halogen species is highly dependent on the aerosol generation scheme and associated meteorology (i.e., wind and sunlight), and should be made clear. Finally, a table summarizing the initial conditions and the atmospheric environment for the chemical modeling will be extremely helpful, as it would significantly affect the model results. 2. The entire simulation has a strong emphasis on bromine species (Section 3.1). Although the authors stated that other reactive halogen species were also included in the modeling, it is not clear to what extend this was done. MECCA is capable of calculating a wide range of odd oxygen and reactive halogen species, and therefore it is possible to compute the relative importance of various oxidants. Depending on the atmospheric conditions, the role of reactive chlorine and iodine species could be important. There is a need for the author to make a stronger case that the contribution of the reactions involving other oxidants can be ruled out. 3. Was there any measurement performed for Br to suggest that the simulated concentration is representative? What was the cause for the sudden peak for the BrO/Br ratio? 4. From Figures 1-9, the authors only showed the concentration changes or depletion rate of gaseous elemental mercury (GEM). Since reactive gaseous mercury (RGM) was also measured during the campaign, would it be possible to show the corresponding RGM production from the measurement and model simulation to better illustrate the fate of mercury during the depletion events?

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