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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Understanding mercury oxidation and air-snow exchange on the East Antarctic Plateau: A modeling study" *by* Shaojie Song et al.

Anonymous Referee #1

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Over the last years exceptional measurements of mercury in air and snow have been performed in the arctic. However, current numerical models are not able to reproduce let alone explain the observed annual and diurnal variability in Hg concentrations in this region. The exact processes governing the fate of mercury in Polar Regions are currently not well understood. However, in order to understand and predict global mercury cycling it is necessary to investigate the impact of relevant chemical and physical processes. In this paper by Shaojie et al., the authors employ a box modeling approach to investigate the impact of different processes on mercury cycling in the arctic. The results of this study will benefit both the modeling and measurement community. The paper is clear and concise and overall well written. Thus, I recommend publication of

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Discussion paper

this manuscript with a few minor comments.

P2 l26-29: (quite technical, but in my opinion an important issue that should be mentioned) You should also mention physical/numerical issues of spherical global domains at the poles. To my knowledge none of the global Hg models has been run with a rotated grid to optimize transport in the area of interest. I guess this is also the reason you are using regional model data for this study. P5 l4: A uniform O3 profile for the whole year? Did you consider stratospheric O3 intrusions or O3 depletion events? P5 l20: Why didn‘t you use the inorganic bromine measurements to adjust the modelled Br/BrO concentrations fields? I think you should add this as an additional sensitivity run. (See also p12 l11-19) Please give an overview of all model sensitivity run in a separate table. I is not enough to explain that in the fig. 3 capture. Fig 1: What about dark oxidation is that included in the net. dark red rate? Later on you perform a dark oxidation experiment. Still, it would help to mention that the other scenarios do not include any dark oxidation rates. I have the opinion that you should go over your conclusions section once more. The lessons you draw from your study seem a bit too general at times: e.g. "It is also important to reduce uncertainties in existing chemical kinetic parameters of bromine oxidation mechanisms. Finally, expecting your model to be highly performant. Have you thought about a monte-carlo approach for restraining reaction and exchange rates?

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