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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 #2**

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The manuscript "Understanding mercury oxidation and air-snow exchange on the East Antarctic Plateau: A modelling study" by Song et al. deal with box model calculations with the aim to reproduce the diurnal variation of mercury in the atmosphere surrounding the snow pack and in connection with changes in surface snow concentration. The role of the polar area is particularly important for global mercury cycle and, the process occurring in these remote regions, are attracting more attention. The poles have been suggested to be a sink (during winter) and source of mercury during summer. The rapid atmospheric chemical reaction that mercury could undergoes, make this elements particularly difficult to study, and full understand its biogeochemical cycle is not always an easy task. In addition mercury is not stable after deposition in surface snow ad can un-



dergoes to rapid re-emission from snow surface impacting the polar atmosphere. The study presented by Song and co-author is the first attempt to reproduce the diurnal variation of mercury in connection with snow. Thought there are assumptions adopted in the box model calculation the authors success to reproduce the average monthly and diurnal observations at Dome C, for winter time some bias have been suggest might due to the dark mercury reaction. Thus, I recommend publication of this manuscript with few minor comments.

Considering the lack of data for specific atmospheric species, important for the box model calculation (such as BrO), together with the statements made by the authors (for example do not consider the wet depositions), I recommend to include a table with all the assumption made to give a clear view and the limit to a possible reader. In addition this table might be useful for promote additional field measurements helpful for better constrain the model simulation.

Specific comments:

Page 3, line 15. The authors claim that they do not consider the wet deposition in Dome C. I am agree with them since the wet deposition are rare and more often during wintertime. However I would like to ask if the authors have considered the diamond dust deposition. This phenomenon seems quite efficient in removing Hg from the atmosphere and can occur pretty often during summer time.

Page 5, line 13. Why didn't you use the inorganic bromine measurements to adjust the modelled Br/BrO concentrations fields (agree with the anonymous referee #1)

Page 6, line 14. The wind and the snow proprieties are not included in the study but they should play a non-negligible role in the mercury re-emission from the snow pack. For example the thickness of the surface wind packed snow layer could have an impact in gas release as well the wind strength could have a different pumping effect. Data on physical snow proprieties in Dome C exist and should be consider for future mercury model exercise.

Page 9, line 1. Field experiments suggest that the mercury lifetime in surface snow (2-3 cm) might be much less than 16 days.

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