

Interactive comment on “Sensitivity analysis of an updated bidirectional air-surface exchange model for mercury vapor” by X. Wang et al.

Anonymous Referee #3

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The authors developed a detailed air-surface exchange model for mercury vapor over North America and used this model to test the sensitivity of mercury exchange flux to physical and environmental factors. However, there are several critical shortcomings for this paper against its publication in this journal:

1) This paper may have been lack of a proper motivation for their study. The authors developed a very detailed model and run this model for hundreds of times to answer a very trivial question. The authors may need a better review of the previous observations and model efforts for air-surface exchange of mercury vapor in the introduction. I'm not convinced that we really need this study. Do the observations support your model assumptions, especially for such a detailed and complex one? Did previous model studies fail to capture some important features in the observations? It will easily

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bore your reader if without a proper motivation for your study. 2) The authors may need to connect their model results more with empirical evidence. My feeling of reading this paper is that the authors develop a model and run sensitivity runs, but rarely interpret their model results in a broader picture of mercury biogeochemical cycle. The lack of evaluation of the accuracy of the model against observations is another issue. 3) The authors probably need to compare their results with those predicted by previous models, too, especially they declare they are presenting an UPDATED air-surface exchange model. They need to convince the readers that their model is somehow better than previous ones. To my knowledge, there is nothing new for the air-water exchange of mercury in this study. The authors use an old scheme to calculate the piston velocity and assume uniformly DGM concentrations in the surface ocean. This is even worse than the state of the art air-sea exchange model for mercury which considers the spatial distribution and chemical reactions of mercury in the surface ocean (e.g. Strode et al., 2007; Soerensen et al. 2010). The discussion of the influencing factors for air-sea exchange flux is also very superficial, and can be directly deduced from equation (1). I suggest the authors focus on air-land exchange only.

Reference Strode, S., L. Jaegle, N. Selin, D. Jacob, R. Park, R. Yantosca, R. Mason, and F. Slemr (2007), Air-sea exchange in the global mercury cycle, *Glob. Biogeochem. Cycl.*, 21(1), doi:10.1029/2006GB002766. Soerensen, A. L., Sunderland, E. M., Holmes, C. D., Jacob, D. J., Yantosca, R. M., Skov, H., Christensen, J. H., Strode, S. A., and Mason, R. P. (2010), An Improved Global Model for Air-Sea Exchange of Mercury: High Concentrations over the North Atlantic, *Environmental science & technology*, 44, 8574-8580, 10.1021/es102032g.

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