

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2021-404

Anonymous Referee #1

Referee comment on "Modeling the high-mercury wet deposition in the southeastern US with WRF-GC-Hg v1.0" by Xiaotian Xu et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-404-RC1>, 2022

General Comments

The manuscript describes the development of WRF-GC-Hg model, based on the already developed WRF-GC model and also shows a case study of the application of WRF-GC-Hg model in understanding the high Hg wet deposition in Southeast US. I do have several major comments:

- Does the paper focus on the study of the high Hg wet deposition in Southeast US only or also the development of the WRF-GC-Hg model? I would suggest including the development of the WRF-GC-Hg model as an important component of the paper. If so, the title should be revised as something: Development of WRF-GC-Hg v1.0 and its application in studying Hg wet deposition in Southeast US. This will make the paper stronger and more applicable. With that, the paper will need to be reorganized to include one part to focus on the new development and its evaluation and another part to focus on the study of the high Hg wet deposition in Southeast US. It will be also nice to extend the domain to the whole continental US for the WRF-GC-Hg evaluation part.
- The paper conducts two WRF-GC-Hg sensitivity simulations with a horizontal resolution of 50 km and 25 km respectively and compare the results to the GEOS-Chem simulation with a spatial resolution of $4^{\circ} \times 5^{\circ}$. As expected, the WRF-GC-Hg simulations with a finer spatial resolution will resolve more spatial signals. The comparison will be more meaningful to include the GEOS-Chem nested Hg simulation results, which are comparable to WRF-GC-Hg simulations.
- Some of the sentences are confusing. I would suggest improving the English language throughout the manuscript.

Specific comments:

- Line 23-26, can you be more explicit here about the heights, different types of precipitation etc.?
- Line 28: It is atmospheric Hg that can undergo long-range transport, it is not accurate to say that Hg goes through long-range transport here.
- Line 46-48: I am not sure what it means here. What is the 80% of rainfall?
- Line 108: The model is run as one domain with 50 km and 25 km, right? "The model horizontal resolution is set as ranged from 50 km to 25 km, with 50 vertical layers." It sounds like the model is run as a nested domain. Please clarify here.
- Line 120: what are the CMAP data? Are they merging observation and model data? Please provide more information here.
- Line 131-132: I do not quite understand the sentence here.
- In Table 1, please spell out the lw and sw.
- Line 140: the average total precipitation increases to 4.63 mm/day and 4.33 mm/day, so is it 4.63 or 4.33?
- Line 152: Are the eight AMNet sites shown in Figure 1? If so, can you use different symbols to differentiate them from the MDN sites?
- Line 205: However, we find that this increase of resolution is finite. What do you mean here?
- Line 254: whilst?
- Line 156-158, 273-275: WRF-GC-Hg simulated Hg⁰ concentration is 1.61±0.20 ng m⁻³, which does not quite agree with the GEOS-Chem and observation concentration. Do you know why WRF-GC-Hg simulated higher Hg⁰ concentration than both GEOS-Chem and the ground observation, even though WRF-GC-Hg simulated better Hg wet deposition? It is due to the atmospheric redox chemistry or something else?
- Line 279: in this area, which area do you mean here?
- Line 450-454: (Zhang et al., 2016a) and (Zhang et al., 2016b) are the same.
- Figure 7, 9, 10 are hard to read.
- In section 3.2-3.3: did you compare the model simulated precipitation vs precipitation measured at MDN sites?
- This work only focuses on only one year (2013) study, what do you think of the interannual variability of the precipitation and Hg wet deposition?