Responses to comments of Reviewer 2

We wish to express our great appreciation to Reviewer 2 for the very careful review, instructive comments, and recognition of the value of our work. We have revised the manuscript following these comments. Your comments and suggestions significantly improve the quality of this manuscript. In the response below, we address each of these comments. The Reviewer's comments are italicized and our responses immediately follow.

Overall I think that this is a good paper, well thought out, well written and merits publication with minor revisions. This type of research is important for the analysis of impacts of both changes in anthropogenic activities and potential climate changes.
Thanks for your supportive word and helpful comments to improve our manuscript.

Scientific comments:
1. Page 3 line 54 – have the HTAP and UNEP reports not touched on this topic we well?
Revised: They discussed this topic. Sentence revised to be more objective.
2. Page 4 line 81 – was this not also addressed in the AMAP Hg assessment? If so, add that to the references
Revised: Added AMAP report.
3. *Page 6 line 124 – why is bromine not included as an oxidant of Hg? Is this not in the model? If not, please state why.*
Revised: Full chemical and physical mechanism of bromine is not included in the CAM-Chem model. Therefore, future projection of bromine is not available. Although we tested the bromine mechanism in the model development paper based on other's bromine field, we only used the ozone-OH mechanism in this projection study. In addition, the debate on both mechanisms continues, further evidence may be needed. The previous sensitivity study incorporate both mechanisms show too much oxidation and then deposition.

4. *Page 6 line 133 – please describe the various IPCC scenarios. Many readers do not know the details of each scenario. Either in the text or in a table.*
Revised: We added the descriptions of IPCC scenarios in the text.

5. *Page 7 line 153 – This section is entitled "Anthropogenic Emissions" but you are mostly discussing coal burning and not other inputs or regulation so I suggest that you change the title to more accurately reflect the discussion*
Revised: changed anthropogenic emissions to industrial emissions.

6. *Figure 1 – is the projection of Hg(II) really so high in comparison to Hg(0)? The concentrations are so much smaller for Hg(II) in the atmosphere that I can't see how, in North America, these number are possible. Maybe a statement about that is required.*
Revised: It is the emission from industrial sources. If counting the emissions from other sources together, the ratio fo Hg(II) will be much lower. Mercury emissions from other sources are all Hg(0), and the emission strength is comparable to industrial emissions.

7. Page 8 line 182 – please reference the relative percents of different species emitted
Revised: The relative percent of species are followed.

8. Page 9 line 212 – In regards to no future changes considered as a result of volcanoes, there may not be any primary changes from historical background but what about secondary effects such as changes in transport patterns? Also, is this number from Hg(0) emissions of PHg?
Revised: The transport patterns are considered in the modeling process when meteorology is used to calculate the dispersion. Due to the high temperature of magma and low decomposition temperature of Hg compounds, the emissions from volcanoes are assumed to Hg(0).

9. Page 10 line 227 for what region is this land mercury storage mass, please specify?
Revised: The mercury is stored in the soil over the global surface. The distribution and emission region follows the present pattern in the dynamic emission scheme.

10. Section 3.3 So what are the results? This section only discusses how it was done but not the results of the analysis. What are the projections for land and soil emissions?
Revised: The soil and land emissions are calculated based on a dynamic scheme, which responds to the instant meteorology and radiation conditions. We only project the total budget, then the scheme will automatically calculate the instant emissions based on future meteorology.

11. Page12 line 272 – you introduce TGM here but do not say what it is, please define using the terms you have been using within the text.
Revised: We modify the TGM definition.

12. Page 13 line 285 – have you looked at the 1995-2000 emissions, run the model and compared with actual measurements? There are many sources of this kind of data available especially for GEM/TGM.
Revised: We tested the model in the model development paper. The base (2000) anthropogenic emissions used in from [Pacyna et al, 2006] was evaluated. The major biases are reported in south Africa. To keep consistence, we did not modify the base emission data.

13. Page 13 line 293 – 4.7 is a very high increase for TGM/GEM and considering levels are decreasing in the Northern hemisphere. Do you want to comment on how realistic this is?
Revised: The increase is up to 2.4. 4.7 is the peak concentration. If examining the anthropogenic emission change from 1995 to 2000, you will notice that the concentration double is totally possible. Under the A1FI scenario, the fossil fuel energy is not controlled. 50 years just like the extension of industrial revolutionary. Glacial evidence shows that present Hg concentration in air is more than 10 times of that in preindustrial age.

14. Figure 5 – hard to read the numbers on the plots
Revised: the quality is improved.

15. Figure 6 – I would like to see the data presented as % change rather than concentration because its hard for the reader to tell the impact of the concentration changes.
Revised: The ratios are mentioned in the text when discussing each scenario.

16. Page 16 line 351– please reference the acceleration of Hg(0) oxidation from temperature
Revised: reference added.

17. Page 17 lines 384-386 – do you have any estimate of uncertainty? You have 2 decimal places for GEM and 1 for the others, can you please discuss this briefly.
Revised: We added the discussion on the uncertainty based on previous model bias.

18. Page 18 line 411 define high latitudes
Revised: We defined the latitude as above 60° latitude.

19. Page 18 likes 411-419 – you use the word relatively but that is not scientific, please use other words or use numbers to be less vague and more precise
Revised: get words revised.

20. Page 19 line 421 – and what about PHg?
Revised: The summary on PHg change is added.

21. Table 2 – are the deltaHg numbers statistically significant? Please add in some discussion about that.
Revised: we revised the text to clearly express. The changes are calculated based on averages of US surface Hg concentrations.

22. Table 2 - Its very odd to me that PHg would decrease in increasing anthropogenic – climate scenarios.
Revised: PHg concentrations only slightly decrease under the B1 scenario, when considering the emission change alone. It is noted that Hg emissions decreased under B1 and the ratio of PHg in emissions did not increase Considering a unchanged climate, the concentration decrease is reasonable.

Maybe a few sentences about that is warranted in the discussion Editorial comments: 1. Page 2 line 49 – maybe update the UNEP report with the currently available 2013 report. 2. Page 6 line 140 – do you mean archived or achieved? 3. Page 10 line 226 – net accumulation not net accumulations 4. Page 17 lines 378-379 I don't understand this sentence, please rephrase 5. Page 18 line 399 – deposition not depositions 6. Page 18 line 401 – findings not finding
Revised: All revised.