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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Potential sources and processes affecting speciated atmospheric mercury at Kejimkujik National Park, Canada" *by* Xiaohong Xu et al.

Anonymous Referee #3

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The receptor models for source apportionment of atmospheric mercury are of great importance. This study applied PMF and PCA on the data of speciated mercury and other tracers from a coastal observation site. Different methods of data processing were conducted for comparison. The comparison between PMF and PCA as well as between the two monitoring years was also performed. Advantages and disadvantages of the two receptor models were discussed. Overall, it is an important exploration of receptor models applying to atmospheric mercury studies. Elaborations on some key points are still needed. Therefore, I suggest the manuscript be accepted for the publication on Atmospheric Chemistry and Physics after major revision. Here are some specific comments: 1. Lines 46–64: This paragraph could use more literatures. Al-

though the authors have reviewed the receptor model studies on atmospheric mercury in their previous paper (Cheng et al., 2015), examples on the applications of PMF and PCA are still needed in the introduction of this paper, not limited to atmospheric mercury. For example, Gibson et al. (2015) compared the four receptor models for PM2.5 source apportionment in Halifax. Some models could be more suitable for PM2.5 than for mercury. The authors could provide more proof on the merits and drawbacks of PMF and PCA when applied to atmospheric mercury. 2. Line 56: How do the authors define "qualitative" here? Aren't the loadings of the PCA method quantitative? To my understanding, PMF describes the contributions of one parameter in different factors, while PCA describes the contributions of different parameters in one PC. The quantitative contribution of each PC to the receptor can be reflected by the "variance explained" (in Table 7 and 8). 3. Section 2.1: A map of the observation site with locations of the emission sources listed in Table S1 and a brief description of the meteorological conditions would be useful. This information could be referred to in the discussion part to verify the results from the receptor models. 4. Lines 113–114: Is there any specific reason why the authors averaged the original data to daily values? If the original data is hourly or 3-hr, it should be possible to obtain 3-hr, 6-hr or 12-hr averages, which could result in a larger database for PMF and PCA. Isn't it better? 5. Line 145: The expression "resultant PMF result" seems repetitive. 6. Lines 192–193: Since the PCA analysis has already been conducted in Cheng et al. (2013), I think the current title of the manuscript is inappropriate. It could give the readers misimpression that this is partially repeated from the previous study. To my understanding, the methodology of this study is the novelty of this paper. Therefore, it is better to embody the methodology in the title. 7. Line 203: Have the authors checked the inter-correlations between any two of the major PCs? Varimax is an orthogonal rotation method, which requires the PCs to be independent on each other. This validation process for the applicability of the Varimax rotation could be mentioned here. 8. Table 5 and Figure 1-2: NO3 in Table 5 should be NO3-. All the "+" and "-" signs cannot be omitted in Figure 1-2. NO3 and NO3- stand for different compounds. 9. Line 212: From the context (Lines

267–268), Combustion Emission include both coal combustion and biomass burning? It is better to mention it here. Does open biomass burning or wildfires included in F1? 10. Line 232: Can the authors specify what types of sources could be Industrial Sulfur? Non-ferrous metal melting? What could be the possible Industrial Sulfur sources in this region? 11. Line 238: The authors mentioned biomass combustion in this part while the name of Factor 3 is Photochemical Process and Re-emission of Hg. Why is it necessary for the biomass combustion to be related to Re-emission? Is it possible that F1 is composed of coal combustion and controlled biomass combustion which are usually mixed from regional sources while F3 is composed of mineral dust and open biomass burning/wildfires which are usually mixed in long-range transport? 12. Table 6: The performance of 2009 GOM and 2010 PBM is poor to me. I don't think the previous discussion linked to these two parts can be validated. Is it possible to improve the model performance by using the 3-hr or 6-hr averages instead of daily averages to increase the size of the database?

Reference: Gibson, M. D., Haelssig, J., Pierce, J. R., Parrington, M., Franklin, J. E., Hopper, J. T., Li, Z., and Ward, T. J.: A comparison of four receptor models used to quantify the boreal wildfire smoke contribution to surface PM2.5 in Halifax, Nova Scotia during the BORTAS-B experiment, Atmos. Chem. Phys., 15(2), 815–827, 2015.

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