

## ***Interactive comment on “Natural and anthropogenic atmospheric mercury in the European Arctic: a speciation study” by A. O. Steen et al.***

**Anonymous Referee #2**

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This paper presents a long term data set of air Hg speciation from a European Arctic site. I found that despite having an interesting data set the paper does not present a sufficient detailed data assessment and because of this has many statements that are conjecture and not supported by the data or data analyses presented. The paper is also hard to read. The authors should separate the results and data analyses and then provide discussion and interpretation. The authors need to go back and do a more detailed assessment of their observations as well as a more complete statistical analyses and then place their work within the context of others work and data collected. The paper should be checked for significant figures, there should only be one decimal place for GEM and none for RGM and PHg (i.e. Table 1). In the abstract they state their data

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shows an undiscovered seasonal trend. However this trend is not clear from the data presented or as discussed. Also some graphical presentation is needed to show how RGM trends correlate with sunrise. It would be good to show some plot that shows this and how this differs from data collected at other sites. Also in the abstract they state that high PM constituted 75% of the reactive Hg. I am not sure they know this. They show in fairly poor graphs that there is elevated RGM that is anticorrelated with GEM however the trends are hard to see and the details not clear. It might be best for the authors to develop a graph that shows the daily mean or median GOM and GEM rather than the hourly data. Statistical analyses should be done using daily mean data and then also hourly data for each month. This might better show trends. A table with correlation coefficients may be more useful than as show in figure 6 that is fairly busy and a bit hard to understand. Also what are the correlations between GEM and GOM are they well anticorrelated on a daily and hourly time step? It is really hard to see this as they have presented the data. Also what about ozone and GEM and GOM correlations on a daily time step and hourly? In the abstract they suggest that reactions with ozone are responsible and in the next sentence they suggest reactions with BrO are responsible. What exactly does their data suggest based on clearly shown relationships. So they think that the AMDE were occurring outside of the area and then RGM being advected in? It is not clear how they came to this conclusion. In the introduction –line 30 how does the relative distribution indicate the age of a parcel? Are the GRAHM results published? Some discussion of the emission sources in pristine areas needs to be discussed. Is this due to evasion from snow? Could down slope and upslope air movement off the mountains and then land – oceans air movement influence the data as shown? Methods- They describe the site as having two Tekran systems operating one to measure GOM/ GEM/PHg and one to measure TGM. Is there anything to be better understood from the data with both systems? This is not really discussed in the paper. Results and discussion First paragraph- they do not know that the larger standard deviation reflects faster reactivity and lower atmospheric residence time. Second paragraph they discuss a GEM spring emission increase from snow. They should

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quantify this. Could the emission expected account for the increase in air concentration? They say this needs to be investigated. So what do they have that supports this? Based on their data analyses they cannot really state that efflux from water and arrival of air parcels explains the fluctuating GEM. There are no really detailed data analyses that have been done to support what they are saying. Some time series showing polar night versus then average daily light would be useful here. The best way to deal with this rambling paper is to clearly present the data and the correlation analyses and then discuss the implications. More detailed statistical analyses are needed. Does RGM correlate with wind speed and direction if so how? How could low PHg be attributed to short lived RGM species? They describe March through April as having the highest BrO vertical densities. Was this measured for the year of the study? And where is the data? In section 3.2 a more detailed investigation of their data may provide more robust statement for the RGM being advected. They only now have a speculative discussion rather than quantitative support. Then in 3.3 they describe it as forming locally? What do does the meteorological and air chemistry show to support this? Figures 1 B is not very useful Figure 2. What are the units on the x axis? It would be useful to have a time series of light and perhaps other parameters. Mean daily value might be more useful than hourly average Figure 3 is not very useful nor is figure 4 Figure 5 has this data been published elsewhere? How good is this GEM emission estimate over North Pole? Figure 6. A correlation analyses table may be more useful here. Figure 7. The back trajectory data is small and hard to see.

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