Interactive comment on "Mercury and trace metal wet deposition across five stations in Alaska: controlling factors, spatial patterns, and source regions" by Christopher Pearson et al.

Anonymous Referee #2

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Here are a few concerns this reviewer has. One problem is their analysis of "precipitation origins/sources". Precipitation formation is in large part driven by microphysics; it is not like pollutants that can be transported from upwind source regions. This sort of analysis and language is really odd. Hence quite a bit of their "intensive" trajectory analysis for "precipitation origins/sources" is not valid.

This is a good point. We removed the trajectory analyses for precipitation origins/sources, and now only present the analysis for Hg deposition. We also adjusted the text accordingly.

Section 2.2 is not necessary.

We disagree (see also comments below). While we agree that there are in fact only five stations, we strongly feel that providing these maps ideally highlights that large parts of this northern parts is expected to have very low Hg deposition loads due to low precipitation amounts. We provided sufficient caution to read these maps in the text and highlight the limitations of the maps as well.

The maps were extrapolated from 5 sites only apparently with too large uncertainties. For instance, the spatial distributions of Hg concentrations can be quite complex. Their results showed that Dutch Harbor saw a similar precipitation amount to that at Glacier but had a median Hg concentration >50% greater, and Kodiak had >30% more precipitation and >15% more Hg concentration that those at Glacier. How to reconcile these disparate spatial differences? Why would one expect simplistic linear extrapolation to capture these differences?

Our inverse-distance weighted interpolation maps follow procedures developed by the National Atmospheric Deposition Program, which creates CONUS wide maps of annual Hg deposition. Following a similar methodology allows readers to directly compare maps from this analysis to maps produced by NADP. The concentration and deposition maps highlight larger-scale spatial patterns (i.e. North/South, East/West) and will not (and are not intended to) fully capture or model smaller scale depositions trends related to geographic and point/local sourcing. Throughout this section, we clearly mention the limitations of this analysis. As our analysis shows, precipitation is the largest control on annual deposition, and hence the use of the Reanalysis Precipitation product is a valid approach to capture the overall spatial patterns of Hg deposition across this region. We strongly feel that this mapping is very useful to pinpoint the areas of particular concern for Hg deposition and further expansion and investment of monitoring networks.

Section 3.3 needs to be redone. First the authors conducted a PCA analysis. Usually one uses tracers that represent distinctly different sources, but the metals they used could not seem to do the job. It was not clear why they did a PCA of the metals to begin with. Since Al measurements were not available, the authors decided that Cr and Ni can be used as alternatives of Al, a crustal tracer. Where did they get [xucc]/[Crucc] or [xucc]/[Niucc]? At one point the authors decided that Asian pollution could influence Alaska based on As and Pb (line 489). But there are major anthropogenic sources for Cr and Ni in Asia as well. It was unclear what the authors were trying to do with Figure 6. No interpretation was given but merely description of how the first two components were positively or negatively correlated. What do those correlations really mean?

We clarified the PCA section. Specifically we identified PC1 as Precipitation with all elements showing a negative correlation due to washout effects. Hg's relationship to PC1 (precipitation) was slightly different from the other metals due to its reactive nature and susceptibility to gaseous reemission.

This manuscript can be shortened significantly, by removing tutorial material, redundancy, repetition, and passages that merely pointed out the obvious. To be specific, Section 2 can be cut down quite a bit by removing the tutorial stuff in the statistics and trajectory sections.
We significantly shortened Section 2.2; however, key elements related to the data treatment and statistical handling were left as we feel it is important to highlight data processing (such as treatment of outliers and below detection limit values). Section 2.3 was also shortened to include only key information related to the HYSPLIT model and data processing. Finally, we removed the discussion of backtrajetory analysis for precipitation as well as suggested above.

In their results and discussion sections they often stated the obvious.
We edited the manuscript and tried to remove non-critical text and "obvious" discussion related to the interpretation of our results.