Anonymous Referee #1
Received and published: 29 December 2018
Review of Pearson et al.
This manuscript provides a detailed analysis of long term atmospheric chemical measurements at sites in Alaska. The authors provide a wealth of statistical and back trajectory analyses and the wealth of information is well presented. This manuscript will be of interest to a variety of readers and is well suited for ACPD. There are a lot of small grammatical and typographical errors and it is frustrating to see this and have to address it all. In the future I recommend all authors read and edit and fix these issues as I do not feel it is a Reviewer's job to fix grammar and punctuation. That said I recommend minor editing and a few suggestions but overall I strongly recommend this for publication.

General comments keyed to the text:
12: no comma after Service
Removed comma.

13: after "years." I recommend a sentence identifying the locations of the stations. I also recommend mentioning here that there are data from a variety of other metals otherwise at line 31 we see mention of the other metals.
We believe we already appropriately give the location of the five stations in the abstract, and highlight in line 14 that additional metals (Cr, Ni, As, and Pb) were analysed.

16: were statistically significantly?
Modified wording to "statistically higher"

30: here and elsewhere (line 38) it is "in between" with no hyphen
Edited to consistently use "in-between" throughout paper.

66: to Alaska
Corrected.

76: study of
Corrected.

78: Perhaps a sentence here providing context for Hg deposition attribution from other locations? Perhaps the Lower 48 since that is brought in later for the other metals. Is 57% high, low, or likely about average for global sources and deposition?
Added citation for context:
This estimate may be high given that globally, anthropogenic Hg emissions are estimated to account for approximately 30% of total atmospheric sources (i.e., total anthropogenic and natural emissions plus re-emission) (UNEP 2013).

86: Program's
Corrected.

98-101: I like that a little description of the terrain and vegetation is given for the Gates of the Arctic site but what about the others? Add some more info please. Maybe a sentence for each site?
Added additional vegetation and landcover descriptions for each site.

128-9: “due to the low sample volume collected for each deposition sample”?
Edited to “due to low sample volumes collected during sampling”

220: The highest
Corrected.

231: also occur
Corrected.

232: and decrease
Corrected.

249: Gates
Corrected.

259-264: what about the typical and long term different fractions of wet and dry precipitation at each site? Is this changing over time? How were snow samples collected? And is there any sense that the dry precipitation is shifting towards wet? Particularly at the more northern sites? This could feed into some comments I have later about the future deposition. Were there any major storm events that stood out in the analysis? I realize long precip event samples were broken up but can they be pieced back together to identify how/where large precip events may affect the overall yearly deposition at a site? I realize this may be a giant analysis that I do not want to send the authors out on but I am curious. This is sort of addressed in the next few lines.

*We clarify that all samples were collected using the standard NADP wet deposition sampling protocols which do not analyze individual storms based on 2-week sampling periods in the NADP program. However, we already discuss the close relationships between deposition concentrations/amounts and precipitation size in detail in section 3.1. (*We determined that the major reason for higher Hg concentrations at northern sites was a lower dilution (or “wash-out” effect) of Hg concentrations by smaller storm sizes (**Figure 1** and discussion below)….and following paragraph.)

The reviewer is correct about the importance of dry deposition. We added a short section in paragraph 3.2.1. about the importance of dry deposition that is based on recent studies in the Arctic tundra.

280: the MDN
Corrected.

328-9: This is an extremely important finding. Figure 4a: why do Gates of the Arctic and Nome have seemingly anomalously higher values (ie the small circles of higher color keyed values) only where the stations are located? I assume some sort of kriging of data analysis artefact?
The “hotspots” of seemingly higher values at Gates of the Arctic and Nome are due to limitations with IDW interpolation and a small number of sites. We applied IDW to follow standard methods developed by NADP utilized for CONUS deposition mapping. In general, the concentration map agrees with the precipitation map and shows higher concentration in the dryer northern portions of AK and lower concentrations at the wetter southern and coastal sites. We caution readers about the limitations of applying spatial interpolation with such a limited number of sites, but felt that the overall figure demonstrates the spatial patterns found between these five sites.

394: Since Denali National Park is mentioned. Isn't there some data or results from Denali? Again I do not want the authors to spend a lot of time on this but I wonder if there are similar results or analyses from any other locations. Or other studies with similar approach applied to Alaska that could be referenced? What about the long term DOE air monitoring sites- do they measure metals or Hg?
To our knowledge, there are no published wet deposition studies of Hg in Alaska, with the exception of the study by Jaeglé we cite in the manuscript.

395: amounts
Corrected.

401: maps of estimated
Corrected.

418: remove "deposition" after "lowest"
Corrected.

419-420: "individual used twice. Can this be cleaned up to one mention of "individual"?
Corrected.

435-445: This is an interesting result of the study.

523: elements
Corrected.

525: suggests. Here and elsewhere I recommend active and not passive tense.
Corrected here and throughout.

526: the results also support the possibility
Corrected.

530: crustal sources while (no comma)
Corrected.

533: in between and thereby do not indicate (if you agree to shift to active tense)
Corrected.

General comment: There are an increasing number of studies showing that the Arctic is getting wetter, particularly that the winter is shortening and the snow to rain fraction is decreasing. Could the authors break their data into snow versus rain as the seasonal sources and then use potential projections to address who/where a wetter Arctic may affect deposition? At the least there should be some mention of how a warmer future Arctic and its' changing precipitation dynamic may affect loadings.
We added a few sentences in the summary section discussing impatct of global warming and arctic amplification on Hg deposition and other relevant ecosystem processes. While we cannot discuss specific responses on Hg deposition, we highlight global warming will result in complex, yet poorly understood, consequences of climate change on Arctic Hg exposure.

Figure 2: how were the different season parsed? And were snow versus rain events separated? I realize the coastal sites may see lots of winter rain but I am curious again at the snow versus rain breakdowns.
We added season definitions to Figure text for clarity.

Figure 5: The areas projected by the true color images (ie the map area) are slightly different. I recommend providing one consistent background and maps at the same scale to show the different source regions and distances of back trajectories.

Figure was regenerated to use same spatial extent for all plots.