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## ***Interactive comment on “Understanding atmospheric mercury speciation and mercury in snow over time at Alert, Canada” by A. Steffen et al.***

### **Anonymous Referee #1**

Received and published: 21 August 2013

Review of Steffen et al. “Understanding atmospheric mercury speciation and mercury in snow over time at Alert, Canada.”

This is a well written, informative, and innovative study that makes use of the detailed data set from Alert to investigate the timing and sources of atmospheric mercury that is deposited to the area. This study will be of interest to atmospheric chemists, climatologists, and Polar and cryospheric scientists. I suggest publishing this paper with minimal changes. Some comments and suggests to this end are presented below.

Abstract Line 8: “concentration” Line 14: “decreases” instead of “drops down”

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Page 17024 Line 24: “period and were”

Page 17025 Lines 3-5: elaborate a bit more by stating the measurements done and the statistical analyses done. Maybe one more sentence in total?

Line 17: “using a Tekran”

Page 17026 Line 3: I am not sure what it means to “break all PHg to GEM.” Is this slang or perhaps a term that is not commonly used?

Page 17027 Line 9: “, the particle at” appears awkward as written

Page 17028 Line 2: Here it is present tense and elsewhere past tense. I recommend going through the manuscript and making past tense any measurements done for this specific study and present tense for the types of ongoing measurements at Alert that the study utilizes. Or at least making sure all the tenses are the same and make sense.

The snow sampling in general: Were specific storms targeted? It is hard to tell why or when a given snow sample was collected. Was there any correlation between the amount of snow deposited in a storm versus the Hg concentration? Was there any relationship between the timing of the snow fall and the Hg concentrations and/or the snow storm amount? I realize these questions are a bit off the main intended aspects of the paper but the authors may have data to present in this regard that could strengthen the applicability of the paper. With climate warming some areas may receive more or less snow and this relationship to the Hg cycle warrants a further look.

Page 17029 Lines 19-22: The words “run” and “running” are used three times to represent “measured” or “analyzed” or “quantified.” I recommend against using the word “run” for any of these instances anywhere. It is slang.

Page 17035 Line 2: “onto snow and ice” Line: 9: I thought GEM was not deposited to snow but had to be converted to RGM first. This may have been explained earlier but please clarify. I also thought the RGM could be photochemically reduced to GEM and re-emitted so again this is confusing for me.

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Any idea as to the back trajectories of the snow storms in terms of where they came from and their Hg concentrations? I do not expect this paper to address this but am curious.

Page 17036 and the Conclusions page 17038: The results of this study suggest that the Hg in snow is predominantly present as RGM and that particles or pHg are not a major factor or component in the snow Hg cycle. This is an important result that should be stressed with greater emphasis. It supports findings of AMDE chemistry and elevated Hg in Antarctic snow where the elevated aerosol component from Arctic haze is not present. It also suggests that cleaning up aerosol emissions will not reduce Arctic Hg deposition?

The total Hg is sensitive to the presence of RGM whereby the instance the pHg increases the RGM does and as soon as pHg decreases the Hg in snow decreases. This is an intriguing dataset. It is worth adding a few more references that have similar data or research questions but not the large sample dataset available here.

Figure 4: Present the datapoints in the legend in chronological order with 2011 last.

Figure 5: another random question/comment: are there any trends in the monthly backscattering values over time? IE has the Arctic haze aerosol amount changed at all over the past decade? Also I am curious that January has as much backscatter as March and April when I thought the Arctic haze aerosols were at their maximum concentration.

Figure 8: “The atmospheric data have been”

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Interactive comment on Atmos. Chem. Phys. Discuss., 13, 17021, 2013.

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