

## ***Interactive comment on “Insights from mercury stable isotopes on terrestrial – atmosphere exchange of Hg(0) in the Arctic tundra” by Martin Jiskra et al.***

### **Anonymous Referee #2**

Received and published: 16 July 2019

Review of Jiskra et al.

This manuscript is well written and represents the work of a strong field and laboratory team focused on mercury deposition to the Arctic. The study is well conceived and presented. It will be of interest to a variety of leadership, particularly because there is an increasing interest in understanding the source and ultimate fate of Hg in permafrost soils. I have some small to moderate comments/recommendations:

Title: “Insights” is not a strong word for this study. I recommend a far better title. “Mercury stable isotopes reveal XYZ on the terrestrial-atmosphere exchange of Hg(0) in arctic tundra”

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This brings me to a question about the conclusions (more later): what does this study say about the seasonal net in versus out of Hg with respect to the snow pack, inferring snow melt, and summer soils? I kept hoping they would provide a seasonal diagram with the Hg % deposited, % re-emitted, and overall fluxes for their site.

Page 1: 12: in arctic mercury Make sure “Arctic” versus “arctic” are correct You could say “the Arctic mercury cycle” 17-18 net emission fluxes based on the AMDEs or over the entire spring there was an overall net loss? 32: Hg emission 33: such as the Arctic, through 36: (AMDEs), leads

Page 2: 32: Toolik Lake is on the Arctic Coastal Plain of Alaska. Not the Interior.

Page 3: 15: an assembly with two 47mm diameter single stage filters (?) membrane 16: apart 18: Since the site visits were every 6-8 weeks: did the filter void spaces fill up? 20: The 5.7 to 17.7 m3. Is this for the long term or short term deployments? 22: no comma after 22:00 24: what is “sufficient Hg for analysis”? 26: the soil pore 29: no comma after IAC trap 30: no comma after oven system

Page 4: 11: were determined 31: Here Teflon has the registered trademark but not earlier when “Teflon” is written (page 3, line 15)

Page 5: 5: do you mean sonic sounder? There is little information on the meteorological measurement instrumentation except perhaps here?

Was wind direction measured and analyzed? Any association between MDEs and prior wind from the coast? Any association at all with wind direction and the Hg values measured?

Results and Discussion Were there any measurements during snow melt? How/why were the different time intervals selected? They seem arbitrary. Perhaps non-AMDE winter and AMDE conditions instead of winter and spring? The “spring” is actually colder than “winter.”

Where are the data from 5 April to 3 May?

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Was snow melt part of the 3 May to 9 Sep timeframe? Or an inundated tundra surface following melt?

Any relationships between summer seasonal thaw and Hg?

30: under the snowpack

38: coastal snowpacks

Page 6: 4: remove “also” as “possibly” is already in there 8 (Figure 3): How were AMDEs defined?

The main text Figure order is 1, 2, 8, 3, 6, 4, 5, 7 Please reorder in numerical order

16: similar AMDE events

8-20: Was there any analysis of the wind back trajectories or the Barrow (now Utqiagĭġvik) based GMD ozone to identify whether the AMDEs were regional to the coast?

Page 7: 8-9: each night, and the strongest

24-28: Here and elsewhere where these types of data are presented. Are the different pools statistically significantly different? Providing the analytical errors is helpful but a statistical analysis of these data is in order. From a visual perspective the standard deviations likely cross over and there is no significant difference.

Page 8 24: data in Figure 7. Same comment as above about statistical analyses

39: strongly affect

Conclusions: I really like the information in this manuscript and how it is presented. There is a lot of work here.

However, the conclusions read like a summary of the results. This study could go far in identifying the seasonal aspects of Hg deposition and re-emission but the authors mostly just summarize. All the way back to the title word “insights” I recommend they go farther.

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What can they say about the Hg seasonality of deposition in the Arctic?

In the introduction the authors start with Hg being a pollutant and then introduce AMDEs and talk about snowpack re-emission. A large question there is- what fraction of snowpack Hg makes it into runoff and of that how much ends up stored in soils?

They then mention tundra soils can draw down summertime Hg(0). So can they say at all what the overall fluxes are from the soils and vegetation exchange with the atmosphere?

From the abstract: in winter. . . . Small overall Hg(0) deposition. Is this a net over the winter? i.e. the snowpack at the end of winter has more Hg than earlier in winter? What does this say about snow melt which this study seems to ignore? Are there measurements from the snow melt period? If so, they should be incorporated here so that a total "year round" net Hg deposition can be calculated.

And in spring there were AMDEs and post-AMDE re-emission. But the total net for spring was an overall loss of H(0) from the snowpack? Where did this added snowpack Hg(0) come from to be lost?

Finally, in summer, what was the overall net increase/deposition? And taken in total what were the yearly net fluxes? I feel this set of questions are important because of the still uncertain seasonal loss versus loading calculations folks have been trying to make. This study may have the most up to date information to address this need. They cite the Douglas et al., (2012) review for some mention of this (page 1, 37-38) but that paper provides a wide range of re-emission values.

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