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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Diurnal cycle of iodine and mercury concentrations in Svalbard surface snow" *by* Andrea Spolaor et al.

Andrea Spolaor et al.

andrea.spolaor@unive.it

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Reply to Anonymous Referee #1

Diurnal cycle of iodine and mercury concentrations in Svalbard surface snow, by Spolaor et al. conducted 3 high temporal resolution field campaigns between 2015 and 2017 at Ny-Alesund (Svalbard). Although previous studies show bidirectional exchange and indicate post-depositional processing of Hg, I, Na, and Br, little is known about the diurnal behavior of these species (especially iodine and mercury) and their interaction in surface snow. These experiments investigated the diurnal behavior of iodine, mercury, sodium, and bromine in the surface snowpack during varying polar seasons: 1) In 2017 during the polar night; 2) In 2016 during the spring when the night and day cycle

are present; and 3) In 2015 during late spring with 24 hour sunlight. Governed mainly by sunlight and deposition, these elements have distinctly different behaviors in surface snow. These experiments show for the first time the varying behaviors of I, Hg, Br, and Na in polar surface snow, thus reinforcing the fact that the polar snowpack is an active substrate for photochemical activity. They found that the highest iodine and mercury concentrations in surface snow occurred during the winter polar night while the lowest concentrations of iodine and mercury in surface snow occurred during the day/sunlight periods. The authors quantify that up to 70% of iodine present in snow can be released into the overlying atmosphere via photo-induced reactions, which has implications for polar boundary layer chemistry, climate, and particle formation. Bromine (and its enrichment factors) did not exhibit a diurnal cycle. All instruments made measurements of Hg, I, Br, and Na with RSD values < 5%. This study provides novel results in regard to the diurnal variability of Hg, I, Br, and Na in the polar snowpack surface as a function of select polar seasons. My only recommendation is that the authors consider providing more in-depth and specific content pertaining to the practical implications of their study (e.g., from the perspective of modeling, field studies, air and water quality, climate, etc). It is an excellent manuscript, and I recommend it for publication.

Reply: We thank the referee for their positive evaluation. As suggested, we added to the end of the conclusions section possible practical implication for this study. The text have been improved at line 556-561

Text: We hope that these results contribute to the efforts in understanding the role of the snow pack in the Arctic mercury and iodine cycles and bromine behaviour in surface snow. Understanding the behaviour of these elements in the surface snowpack may shed light on the role and the contribution of snow emissions, primarily to the marine boundary layer. For example, species such as iodine, are directly active in the formation of cloud condensation nuclei that could have a direct effect on polar climate.

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