The Cryosphere

Discussions

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# Interactive comment on "A key factor initiating surface ablation of Arctic sea ice: Earlier and increasing liquid precipitation" by Tingfeng Dou et al.

## Anonymous Referee #1

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While the topic of the manuscript falls with the preview of the Cryosphere, the ideas are not novel; however, the approach to quantifying, or alt the least qualifying, the impacts of increasing rain on snow events in the late fall and early winter seasons, as well as earlier rain on snow events in the late winter and early spring season in important. This manuscript serves as a simplified starting point for further exploration. However, there are several large gaps in that have escaped consideration, or even mention, in this work. The greatest being the presence of brine in snow over first-year sea ice. Per the extensive literature, brine is known to impact the thermodynamics of snow covers as it allows for melt and the presence of liquid water at temperatures below 0 C, and through the constant phase and volume change in brine pockets. This is not addressed or even

noted as a consideration in this manuscript, and warrants major revisions to define and discuss, at the very least, the theoretical impacts of brine (assuming it wasn't actually measured as a variable in this experiment) and brine volume throughout each step of the analysis, and any and all potential impacts to the conclusions derived from this work.

Additionally, there is no representation at all showing the composition, stratigraphy (layering, intra-pack ice layers), or distribution of either the character (density, etc), or the depth of the snow on first-year sea ice...all of which potentially impact the effect of rain on snow thermodynamics through runoff, percolation, and drainage. There is not even a representation of the character of an "average" snow pack during the case study where only photos of grains are presented. Major revisions are required to address these impacts, or at the very least, acknowledge the theoretical impacts and how they may affect the results and conclusions drawn by this work.

Minor revisions include: 1. Line 390-391: Plot/represent synoptic events in Figure 1 and 2 to better visualize with the rainfall/snow depth/air temp trends. 2. Line 399: Units for water content (ie. %) should be indicated in the text and in Table 1. 3. Line 418: Show a full temperature profile/gradient of the snowpack over time with "average" temperature of -0.7C. 4. Line 434: Show full temperature profile/gradient of the snowpack over time. 5. Introduction: "Here we investigate. . ." There should be specific quantitative questions driving this investigation. What are they? Answer these quantitative questions in the Discussion/Conclusion section of the manuscript? Asking very specific (quantitative/qualitative) questions in the introduction should lead to clearer quantitative/qualitative answers and inferences in the discussion section of this work.