The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2019-56-AC2, 2019

Interactive comment on "Optimization of over-summer snow storage at mid-latitude and low elevation" *by* Hannah S. Weiss et al.

Hannah S. Weiss et al.

hsweiss@uvm.edu

Received and published: 9 July 2019

Interactive comment on "Optimization of over-summer snow storage at mid-latitude and low elevation" by Hannah S. Weiss et al. Nina Lintzen (Referee) nina.lintzen@ltu.se Received and published: 5 May 2019

Author responses are below referee comments.

General comments: 1) The paper presents over-summer snow storage at mid-latitude and low elevation. The tests were performed in Vermont, USA. The goals of the research (according to the statements in the introduction) was to: 1) Determine the melt rate. 2) Infer the environmental factors that most influence snow melt. 3) Suggest an optimized insulation strategy based on the data. I would have liked to see clear re-

sponses to all these questions in the conclusions section. Author Response: Thank you for this comment – we realized we've focused on 1 and 3 (though not explicitly) but did not address goal 2 in our conclusion. We will make this change in our revision. The data collected allows us to address goals 1 and 3, yet not goal 2 which we will remove from the introduction. We will then more clearly address 1 and 3 in the conclusion.

2) The climate in Europe is warmer than in North America at a similar latitude. A comparison between actual weather data from other over-summer snow storages with warm summer climate (for example in Europe, Russia and South Korea) would have been desirable. Author Response: Great suggestion – we discussed this comparison yet it did not end up in the final paper. We will incorporate this into revision.

Specific comments: 3) The results should be discussed and explained more in detail. For example, what do we see in Figure 4? Author Response: We appreciate this comment – initially, we had extensive narration and decided to simplify the section but perhaps removed too much. We will add more narration in revision.

4) How much did the temperature change between the different test methods? The scaling in the figures is not so clear so this is obvious just by looking at the figures. I think the results are very interesting but a detailed comparison of foam with and without reflective cover, how much the temperature changed in the "between- foam-spot" etc. would have given more depth to the study. Similar for figures a and b as well as e and f. How much lower was the temperature above the concrete curing blanket if you compare e and f? Author Response: Thank you for this analysis of Figure 4. Power-Density Spectrum Analysis (PDS in Figure 5) is more useful for analyzing effectiveness of different insulation test methods than temperature change alone. However, within Fig. 4 we will include ranges for the sensors at the snow-insulation interface to demonstrate temperature differences between insulation types.

Our goal in using PSD is to determine which temperature signals still displayed the diurnal oscillations – if certain insulation combinations damp the temperature signals more thoroughly than others, these insulations were more effective at preventing heat from radiating into the pile. The individual temperatures were not as important as their signals throughout the week. It's clear that we did not explain PSD in an accessible way and will revise this.

5) In figures 4 c and d, the temperature on the snow seems to be much higher than 0âŮęC in the end of the experiments. Is this due to some measurement error? Or how do you explain this temperature increase? Author Response: Thanks for this note. Due to the rigidity of the foam boards and the non-uniform melting of the pile, the foam shifted and exposed snow to direct solar radiation, as well as allowed warm air to be trapped between the snow and the foam. In panels c and d, we see this reflected in the temperature sensors at the snow interface reading significantly higher values than 0âŮęC. We will make this clearer as it could help the reader understand the ineffectiveness of the rigid foam panels.

6) The PSD and the results in Figure 8 needs to be explained more in detail. What is the PSD? How do you calculate the PSD? What do we actually see in the figures? Author Response: We thank you for identifying the lack of clarity about PSD. We realize in retrospect that we did not explain the concept in an accessible way and will in further revisions.

7) I would suggest to enlarge and develop the discussion section. Discuss the three goals with this research and compare them to other studies. Are there for example other studies where the melt rate has been studied and how do your results relate to these? Which were the environmental factors that most influenced the snow melt and how did you reach this conclusion? Author Response: This restructuring suggestion is very helpful for streamlining our discussion section. There are few studies thus far that address melt rate of snow within the context of snow storage, however none measured at the weekly time intervals at which we measured snow melt. We can infer most influential environmental factors through looking at which insulation combination was best. We'll restructure to address the three goals.

Comments from the text: 8) Page 6, # 15: How do you conclude that larger piles using an optimized insulation strategy allow for efficient over-summer snow storage from these experiments? For sure this is possible, it has been done at places with warm climate (for example in Sochi, Russia and Pyeongchang, South Korea). Author Response: Thanks for the comment. Larger piles have lower surface area/volume ratio of large piles in comparison to smaller piles. We will do a better job of incorporating the SA/V ratio into this section.

9) Page 6, # 30: The planned snow storage for the summer 2019 is interesting, but not relevant for this presented study and experiment. Author Response: Thank you for this observation – if we are short on space, we will remove it. If we do not remove it, we will be sure to more accurately label as "Future Work" to clearly identify it is not part of the current study.

10) Page 7, # 20: Conclude answers to your three research questions. Also, conclude and point out that based on your experiments and from the different experimental setups you tested, the three layer insulation was the best. Scaling up from 200 m3 to 7000 m3 will increase the remaining amount of snow, but this is not a conclusion from the performed tests in this study. Scaling up to any larger volume will render a larger remaining volume of snow, but this is not a relevant conclusion from the tests performed in this presented study. However, in the discussion section I would suggest that you mention the fact that larger volumes of snow will increase the efficiency of snow storage, as have been seen in previous studies, and as you have mentioned in #25 and 30 on page 6. Author Response: Thank you for the clarifying and structuring suggestions – you're correct that we did not test the effects of snow melt for different size piles and we will be sure to more clearly define our conclusions based on the insulation experiments alone. Great suggestion to include the larger volume, more snow scenario in the discussion section and could reference this in the conclusion while still staying true to the limitations of our experiments.

Technical comments: 11) Page 4, # 5: "man-made" snow should be changed to “machine-made snow”. Author Response: Thank you - we will change this phrase to remove the outdated gender bias.

12) Page 4, # 35: Were the sheets of plastic and wood chips removed from the whole pile or just from the 1 m2 test area? Author Response: The sheets of plastic and wood chips were removed from just the test areas – we will clarify this in the revision.

13) Page 5, # 5: It says that the humidity remained high, but how high is a high humidity? A number would have been interesting. Author Response: Agreed – we will make this comparison in the next revision.

Please also note the supplement to this comment:
https://www.the-cryosphere-discuss.net/tc-2019-56/tc-2019-56-AC2-supplement.pdf

Interactive comment on The Cryosphere Discuss., https://doi.org/10.5194/tc-2019-56, 2019.