

Response to Reviewer Comments (Reviewer #2)

We sincerely thank the Editor and the Reviewers for their careful evaluation of our manuscript and for the constructive and insightful comments. We have revised the manuscript accordingly.

Comment: This paper analyzes snow depth and sea ice thickness relationships from in situ observations obtained during MOSAiC, the Lincoln Sea, N-ICE2015, Resolute Bay, and the Weddell Sea field campaigns. This collection of analyses span various ice types, conditions, and seasons. Snow depth distributions are fit to Normal, Log-Normal, Gamma, and Skew distributions and compared accordingly across ice thickness bins. Lastly, the authors examine snow depth correlation lengths against sea ice thickness to test these relationships at various distances. Key findings show snow depth varies considerably across ice types/thicknesses. The Log-Normal distribution tends to perform best for snow atop thinner ice conditions (newly formed ice, first-year ice and thinner multi-year ice) and under thicker ice conditions (>1.5 m), the Skew distribution is optimal. They also note that thicker ice is associated with longer correlation lengths (between depth and thickness) as a result of the common presence surface features such as hummocks and ridges.

The paper is very detailed, well-written, and illustrated. The authors' concluding remarks calling for SIT-dependent model parameterizations is supported by their findings. Just a couple of minor comments are offered below by line number of the submitted manuscript.

Response: [We thank the review for reading the manuscript and offering comments.](#)

Comment: Line (L) 6-7: Leave this definition of the coefficient of variation (CV) for the methods section, though I think it is fine to report the CV as needed here in the context of key findings.

Response: [Corrected.](#)

Comment: L85-90: Magnaprobe accuracy could be noted somewhere in this section.

Response: [We have added clarification in Section 2.2 \(Instruments\) that the Magnaprobe has a maximum measurement depth of 1.2 m, with an estimated accuracy of 3 mm \(Sturm et al., 2006\). We have also specified the performance characteristics of the EM/GEM system. The precision of the EM measurements is approximately 0.1 m for level ice up to 4 m thickness. However, the accuracy decreases over rough and deformed ice, where ridge thickness can be underestimated by up to 50% \(Haas et al., 2009\). Furthermore, we have added a new discussion \(Section 5.4 Limitations\) addressing how instrument uncertainties may influence the SND distributions.](#)

Comment: L112: Since “drifting” mentioned earlier in the sentence, “drifting with the ice” can be omitted here.

Response: [We removed the "drifting platform".](#)

Comment: Figure 9: Some brief description of each of the meteorological “events” could be offered in the methods or folded into results. It is unclear, for example, what how “storm” is characterized.

Response:

We have added a description of the meteorological events by summarising the information reported in Wagner et al. (2022). Storms were closely linked to ice deformation events during the study period. The first major change in ice conditions occurred around 16 November 2019, when a storm triggered strong ice deformation near the observation site. Another significant ice deformation event occurred around 11–12 March 2020 and periodically until 7 May 2020. Drifting snow events were identified by calculating horizontal mass flux from snow particle counter (SPC) measurements. During periods of instrument downtime, a critical friction velocity threshold was applied to infer potential snow transport. The most significant drifting snow event of the study period occurred on 24–25 February 2020, during which the lower SPC recorded a cumulative mass flux of $1.014 \times 10^6 \text{ kg m}^{-2}$. During this event, 1-hour averaged wind speeds measured at 2 m above the ice reached approximately 11 m s^{-1} , with instantaneous wind speeds at shorter temporal scales likely exceeding this value.

Comments:

Figure 17: Blue bars in panels a) and b) indicating storm presence appear to have different coloring.

L467: Change to “Future work should involve...”

Response: Corrected.

We again thank the reviewer for the constructive comments, which have greatly improved the manuscript.

References

- Haas, C., Lobach, J., Hendricks, S., Rabenstein, L., and Pfaffing, A.: Helicopter-borne measurements of sea ice thickness, using a small and lightweight, digital EM system, *Journal of Applied Geophysics*, 67, 234–241, <https://doi.org/10.1016/j.jappgeo.2008.05.005>, 2009.
- Sturm, M., Maslanik, J. A., Perovich, D., Stroeve, J. C., Richter-Menge, J., Markus, T., Holmgren, J., Heinrichs, J. F., and Tape, K.: Snow depth and ice thickness measurements from the Beaufort and Chukchi Seas collected during the AMSR-Ice03 campaign, *IEEE transactions on Geoscience and Remote Sensing*, 44, 3009–3020, <https://doi.org/10.1109/TGRS.2006.878236>, 2006.
- Wagner, D. N., Shupe, M. D., Cox, C., Persson, O. G., Uttal, T., Frey, M. M., Kirchgaessner, A., Schneebeli, M., Jaggi, M., Macfarlane, A. R., et al.: Snowfall and snow accumulation during the MOSAiC winter and spring seasons, *The Cryosphere*, 16, 2373–2402, <https://doi.org/10.5194/tc-16-2373-2022>, 2022.