Comment on tc-2021-126
Anonymous Referee #2

Referee comment on "Snowfall and snow accumulation during the MOSAiC winter and spring seasons" by David N. Wagner et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-126-RC2, 2021

Wagner et. al., tc-2021-126 Snowfall and snow accumulation processes during the MOSAiC winter and spring season

The authors present a comprehensive snowfall and snow thickness dataset collected during Legs 1-3 of MOSAiC where they investigate snowfall measuring devices and snow accumulation processes including blowing/drifting snow and snow erosional processes as a function of variable wind speed, storms/depositional events and sea ice ridges acting to capture snow and potential leads serving to trap/remove snow. The paper is well written and cites the literature extensively. Overall, this paper makes a significant contribution to the discipline of snow accumulation and erosional processes on sea ice and the authors should be congratulated for putting together such a comprehensive dataset in a very coordinated fashion. The paper also makes a significant contribution towards evaluating snowfall measurements devices.

I have the following questions/comments/concerns which should be addressed.

Length – This manuscript is made exceptionally long through the inclusion of the snowfall measurement device assessment. I completely understand why the authors felt the need to combine the two datasets (snow thickness transects and snowfall sensor assessment) but it makes the manuscript challenging to follow and keep track of all the different sensors and approaches. A quick random sample of 20 TC papers online makes this one the longest. I would suggest that the snowfall sensor assessment effort could be its own Brief Communication and use it to feed the snow transect SWE work as a separate full paper to TCD. That is a decision for the Associate Editor and the authors.

Brine/salt as a term in snow mass balance equation (Eq 2) – It is well known that
snow on first-year sea ice types entrains expelled liquid brine from the near-surface sea ice volume into its cover during the fall and winter seasons through vapour pressure gradients via capillary and wicking action. Some of this salt can also be entrained from frost flowers once they erode after formation. This well-known brine volume in the basal layer of the snow cover has significant implications for heat transfer between the sea ice and atmosphere and thermal conductivity of the snow, including microwave remote sensing and satellite estimates of the snow and sea ice thickness via altimetry. So, shouldn't brine in the snow on first-year sea ice be a mass balance input (term) in the equation (even though this study investigates mainly investigates SYI). I need to understand its magnitude relative to say sublimation or evaporation or diamond dust, which are mentioned throughout. I good starting point for assessing the magnitude of this quantity are the following four papers 10.1016/j.coldregions.2009.03.009 doi.org/10.1016/0165-232X(84)90034-X doi.org/10.1080/01431169208904280 10.1029/96JC03208 The latter paper by Nghiem et al., 1997 report 2-4 mm of discontinuous brine slush on the ice surface. If this is all wicked up, it may be a relatively significant input, especially if the snow is thin.

**Minor editorial comments**

Introduction – I'm quite surprised the work of S. Savelyev et al., 2006 is not reviewed, especially since it deals with blowing/drifting snow on sea ice. doi.org/10.1002/hyp.6118

L193 – add an ‘s’ to transect

L217-19 – Why not just say standard deviation instead of saying z-score? It's a clunky statistical term that some may not be familiar with.

Figure 3 caption – a bit odd to start your caption with ‘All used’. Why not just start with ‘Magnaprobe …’? Also, near the bottom of the caption, change ‘origin’ to ‘originate’.

L233-34 – ‘Furthermore, as we made for each snowpit ….’ Reads awkward. Consider revising to ‘Furthermore, for each snowpit we made at least …’.

L352 – I would argue that snowfall is *estimated* as opposed to *retrieved*.

L361 – ‘off’ should be ‘of’
L368 – ‘As we found for 280 m the highest snowfall rates …’ is awkward. Please revise.

L385 – I don’t think 90°C is correct ... 90°?

L416 – remove ‘take’ .. or add ‘into’

L451 – rounded rounded

L463-464 – Not so sure you should mention ‘saturation’ here. Why not just save to introduce in the Discussion. If you do so, take L459-63 with you.

L475 – confusions ... I’d make singular

L508 – add ‘one’ before another

L516 – Starting this sentence with ‘Especially’ is awkward, Just start with ‘The’

Fig 11 caption – areas ... isn’t there just a single green shaded area?

L549 – ‘than’ ... not ‘that’

L551 – only one ‘a’

L558 – Not sure this is a sentence

Fig 12 caption – ‘and’ before ‘KAZR’

L560-61 – this sentence is identical with L595-6
L599 – decreased \(d\) ... remove the ‘d’

L600 – ‘From 20 February 2020, also the standard deviation stabilized’ ... is an awkward sentence, please revise.

L613 – ‘strengths’ is spelled incorrectly

L618-19 – Please revise ... reads awkwardly

L628-20 - Furthermore, the used bond strength parameter of \(A = 0.18\) that we used in the computation was found by (Clifton et al., 2006) in a wind tunnel, with a temperature range of \(-16 \text{ to } 0 \degree \text{C}\) which was undershot 620 most of the time during our investigation period of MOSAiC (Fig. 12c). Not sure why this isn’t in Section 2.22 or 2.3.

L635 – ‘where values found of 30% less ... ’ is awkward, please reword

L636 – replace ‘as’ with ‘at’ ... the end of MOSAiC ...

L743 – spelling ‘buoys’

L751 – spelling ‘reason’

L795 – They

L796 – ‘... first validation of the ERAS’ is a bit of bold statement (I would say Wong et al., 2019 and Graham et al., 2019 evaluated it with buoy data or other validation data among others)