**The Cryosphere
Discussions**

Interactive comment on "Variability of snow depth at the plot scale: implications for mean depth estimation and sampling strategies" by J. I. López-Moreno et al.

Anonymous Referee #1

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General Comments

The authors present a study on the variability of snow depth at the meter scale and elaborate on sampling strategies for the mean snow depth and associated errors. The study is based on gridded measurements at 1 m resolution from 10 x 10m plots. The effect of sample size and sampling strategy was assessed by analyzing the error of mean snow depth estimates based on data subsets. The study results in suggestions how to sample snow depths efficiently while keeping the error of the sample mean small.

In general, the topic of the paper is interesting and the conclusions may be useful

in order to design a snow sampling strategy elsewhere. However it is based on a relatively limited range of data: 1 year, 1 research basin, a narrow elevation range, scales covering 1 order of magnitude only (1-10m). Likewise the effect of different terrain surface characteristics is not touched, i.e. flat, scree, dwarf shrubs, boulders, surrounding topography influencing wind redistribution, etc. It is thus questionable whether the results are transferable / can be generalized. The study would certainly benefit if additional data could be incorporated.

Overall, the paper is set-up thoroughly, however the methodology section lacks some specificity why it is partly difficult to follow what exactly has been done. Moreover the manuscript could also be better organized. E.g. the description of the field sampling should be moved from the introduction to the paragraph describing the data sets, and the so called "recursive random extraction" procedure should preferably be described in only one place. See specific comments for more details.

Specific Comments

Page 1629, Line 1 and onwards. I could not find many articles addressing the specific topic dealt with in this study. However, the authors should probably spend some more effort into reviewing earlier work on the topic addressed in their study. They should also better define the knowledge gap they are trying to fill. Perhaps the authors should reference some of the following articles where snow depth/snow water equivalent variability at the plot scale at least has been addressed: Rovansek et al. 1993. Improving Estimates of Snowpack Water Equivalent Using Double Sampling. Proceedings of the sixty-first annual western snow conference. Sturm et al. 2003. The snow cover on lakes of the Arctic Coastal Plain of Alaska, USA. Journal of Glaciology.

Page 1630, Line 9. I do not think that it is completely correct to say that wind influences the snowpack thickness randomly.

Page 1630, Line 20. It would probably be good to point out that the equation only is valid provided that the samples are independent.

Page 1630, Line 27. I thought that a spatial autocorrelation between individual samples might influence (1) the calculated sample mean in any direction, in either an overestimation or underestimation of the true mean, but (2) always in a too low estimated standard error of the sample mean. I might be wrong, in that case please correct me.

Page 1631, Lines 8-25. Please state the aim of the study in more detail, like objectives or research questions, and move the summary of the study presented in this paragraph to appropriate places in the manuscript (for example the section describing the data sets).

Page 1632, Line 2. Should there not be a figure showing the study site? Figure 1 displays something different.

Page 1632, Lines 12-14. The sentence sounds awkward to me, as if plots with irregular snow surfaces would have a known variability.

Page 1633, Lines 20-25. I do not understand why the method based on the random subsets would give a robust estimation of the standard error of the sample mean. Is not this estimate also influenced by the spatial autocorrelation? Please clarify.

Page 1635, Line 19. It is not perfectly clear to me what "recursive random extraction" means. Please clarify or better avoid the term completely.

Page 1636, Lines 3 - 4. The sentence referencing to Figure 3 is difficult to understand.

Page 1636, Line 4 - 6. I think it might be better to say: "Figure 4(A) shows the average error as a function of both the sample size and the CV. Figure 4(B) displays the average error as a function of the sample size and the spatial autocorrelation (the range of the correlation length)."

Page 1638, Lines 2 - 18. This part is very interesting, and should perhaps be more emphasized throughout the study.

Page 1638, Line 19 - Page 1641, Line 11. The discussion does mainly not focus on

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the topic of the paper: how snow depth variability at the plot scale may influence mean snow depth estimates and what consequences different snow sampling strategies has on the errors associated with the mean estimates. The first half of the discussion deals mostly with the factors giving rise to variations in snow depth (which already have been frequently studied), and should be shortened. I would recommend that the second half, which deals with the actual scope of the study, should be extended. I would also consider giving more advices on how to design a sampling strategy for different field sites.

Page 1640, Line 28 - Page 1641, Line 1. Please reformulate the sentence. It sounds a bit awkward to me.

Table 1. What coordinate systems was used? What different terrain surface characteristics do the sites represent (except whether they are inside or outside forest openings)?

Figure 1. What unit was used on the horizontal axis?

Technical Comments

Page 1635, Line 12. A full stop is missing.

Page 1636, Line 22. A full stop is missing.

Page 1641, Line 1. A full stop is missing.