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The Cryosphere Discussions

Interactive comment on "Spatial and temporal variability of snow depth and SWE in a small mountain catchment" *by* T. Grünewald et al.

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The manuscript presents the application of TLC for snow depth and SWE estimation and mapping on a little Swiss watershed. It is a novel and relevant scientific theme with important practical applications for seasonal snow cover variability and water availability estimation. It is worth to be published and strongly within the scope of the journal. The proposed method seems to be applicable to many different basins, but restricted to small ones because of the properties of the instruments. It is very useful for local analysis. It's a very good work, novel and useful as a basis for further developments and comparisons with other methods.

General comments:

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Interactive Discussion

Discussion Paper

1)TLC measures the snow depth by difference with the no-snow conditions. For this reason it should be better to clarify what is measured and monitored (snow depth) and what is afterward computed by correlation (SWE). Sometimes the terminology could appear misleading (e.g. P2, line 6 “monitored”). It is worth to provide the analysis maps of space/time variability primarily for snow depth, as it has been done for the SWE. I would suggest giving more importance to snow depth analysis also in the conclusions.

2)The description of the snow density estimation should be more detailed both in terms of measurements (number, location, etc.) and analysis of data (relationship between snow depth and SWE, included parameters, assumptions, etc.). Moreover could be also included the snowpack density variability during the melting season.

3)The reliability of the snow depth measurements is compared with other indirect measures (ALS, Tachymeter). It could be interesting to include a comparison with a fieldwork using snow stake to measure the snow depth.

4)I would use a different expression for “melt” and “melt rate” (e.g. P2, line 12; P16, line 6). They are including, in this manuscript, also other processes (sublimation, new fresh snow, etc.) as already stated by the Authors. I suggest using something similar to “snow mass variation” or “SWE variation”. Then also snowdrift phenomena and avalanches could determine space/time variability of the local snow depth within the basin.

5)Please include more details on the experimental setting and instruments, experiences, suggestions

6)It is worth to test on more basins, in future works, to give more robust conclusion

Specific comments:

P2, line 2: I would use hazard instead of danger

P5, line 12: How the ending date of the accumulation season has been estimated?

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P6: the removal of the melting out cells could be misleading. Regarding the SWE I think that it would be more relevant, for practical application, the total amount of SWE on the basin than its mean value on the snow covered area (the same comment for P11).

P7, line 12 and 22: units of snow depth (HS) should be always the same in the manuscript (m or cm?).In any case I suggest to use the same units for snow depth and SWE (mm)

P8, line 25: remove the full stop between “variable” and “was”

P14, line 22: statistical

Fig. 1, 2, 3 & 6: There are already the coordinates but also a scale bar would be useful

Fig. 6: Please arrange differently the figure in order to increase its dimension and legibility

Fig. 7: Legend is missing

Fig. 9: Comment: it seems that for low slopes it is unlikely to have high “melt rate”. This could be related to local avalanches which transfer snow mass form slopes (giving high “melt rate”) to flat area and also to a greater accumulation of snow in flat area. Snow mass movements could be included in the discussion.

References: I suggest including in the reference list three more papers, considering their relevance for the topic of this paper:

Skaugen T., 2007. The spatial variability of snow water equivalent, Hydrol. Earth Syst. Sci. Discuss., 4, 1465–1489

Mizukami N, Perica S. 2008. Spatiotemporal characteristics of snowpack density in the mountainous regions of the western United States. Journal of Hydrometeorology 9(6): 1416–1426

Bavera D. & De Michele C. (2009). Snow water equivalent estimation in the Mallero basin using snow gauge data and MODIS images and fieldwork validation. Hydrological Processes, 23, 1961−1972. doi:10.1002/hyp. 7328

The first is mainly related to an analytical description of statistical spatial variability modeling of SWE, the second is interesting because of the detailed analysis on snow density space/time variability and the third present a model for SWE estimation on a basin using ground and remote sensing data validated with a fieldwork measurement dataset

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Interactive comment on The Cryosphere Discuss., 4, 1, 2010.