The Cryosphere Discuss., 4, C1396–C1399, 2010
www.the-cryosphere-discuss.net/4/C1396/2010/

The Cryosphere Discussions

Interactive comment on "Point observations of liquid water content in natural snow – investigating methodical, spatial and temporal aspects" *by* F. Techel and C. Pielmeier

F. Techel and C. Pielmeier

techel@slf.ch

Received and published: 22 December 2010

Reviewers comments are in italics, response in normal font.

1970: 18 the sentence "Wet snow metamorphism is faster when the water content is higher" may be a bit too general if you include a completely water saturated snowpack, i.e slush.

This section now reads: "Wet snow metamorphism commences as soon as liquid water is present. The introduction of liquid water into snow leads to changes in grain shape (Brun, 1989; Colʹeou and Lesaffre, 1998), grain coarsening (Raymond and Tusima, 1979; Brun, 1989; Marsh, 1987) and an increase in bulk density (Marshall et al., 1999;

Jordan et al., 2008). Grain coarsening, for instance, occurs much faster in snow with very high liquid water content than in snow with low wetness content. Important feedback mechanisms exist between snow metamorphism, hydraulic conductivity and water flow (Jordan et al., 2008)."

1972: The Sommer instrument could have been mentioned here (Sommer Mess-Systemtechnik. 2010. Snow Pack Analyser (SPA) zur Bestimmung des Schneewasseräquivalents und des Flüssigwasseranteils)

We have included the reference to the Snow Pack Analyser into the section 1973: 9-13 (Discussion paper). "More recently, non-destructive measurement methods like the Snow Pack Analyser (Sommer Mess-Systemtechnik, 2010) and ground-penetrating radar installed upward-looking at the snow-ground interface have been applied to measure snow wetness in a snowpack (Heilig et al., 2009). Satellite remote sensing is a suitable method to distinguish between areas of a dry and a wet snow surface (e.g. Gupta et al., 2005)

1987:11 "a basic classification can facilitate the description of the snowpack wetness, in particular for practical purposes." Here it could be specified more which practical purposes the authors have in mind.

We have now included a more detailed explanation. The section now reads: "We propose this very simplified classification and are aware that more variations will exist. However, such a basic classification can facilitate the description of the snowpack wetness, in particular for hydrological and avalanche forecasting purposes. One advantage of such a classification is that the distinction between dry and not dry snow will likely be more accurate than the estimated wetness classes. Additionally, it describes the spatial wetness distribution which currently is not included in a snow profile observation. The spatial wetness distribution may be observed when excavating a snow pit for avalanche forecasting or snow hydrological purposes."

1980:2 "The wetness in layers consisting of coarse melt-freeze particles (MF, snow

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

class MF, Fierz et al., 2009) is more frequently falsely estimated (33% of cases) than in layers consisting of fine precipitation particles and snow which has undergone low temperature gradient metamorphism (LTG, snow classes PP,DF,RG, 13%) or coarse medium to high temperature gradient metamorphosed grains(TG,snow classes FC, DH, 13%). Neither hardness nor grain size seem to influence the correct estimation of the water content." -The last sentence here ("..nor grain size..") seems to contradict some of what is stated in the previous sentence about layers of "coarse melt-freeze particles" being more frequently falsely estimated than "fine precipitation particles".

This is correct. The final sentence now reads: “No significant correlation was observed between snow hardness and the correct estimation of the water content.”

1980:21 "The results indicate that in particular grain shape (and size) and layer hardness may unconscientiously influence even experienced observers when estimating the liquid water content." -"unconscientiously" should probably be changed to "unconsciously".

Changed to: "The results indicate that in particular grain shape (and size) and, to a lesser extent, also layer hardness may unconsciously influence even experienced observers when estimating the liquid water content."

1987:5 "With continued water infiltration the snowpack will be fully wet and homogenize." -"homogenize" should probably be changed to "homogenous".

Changed to: "With prolonged water infiltration the snowpack will become fully wet and homogeneous."

1981:17 "These measurements show that there is considerable uncertainty due to spatially heterogeneous water distribution in the initial part of the melt-phase. Even if we are considering just the six observations, where overall snowpack wetness decreased during the day, this represents almost 20% of the measurements." -here it seems that a clarification could be made regarding to what the uncertainty refers to (distribution?)

TCD
4, C1396–C1399, 2010

We have clarified this aspect. This section now reads: "The measurements show that there is considerable measurement uncertainty when measuring snow wetness at point locations. The reason for this is the spatially and temporally highly variable water infiltration pattern in the beginning of the melt-phase. Considering just the six observations, where overall snowpack wetness decreased during the day, almost 20% of the measurements gave a unrepresentative picture of snowpack wetness."

Interactive comment on The Cryosphere Discuss., 4, 1967, 2010.