

Interactive comment on “Spatio-temporal measurements and analysis of snow depth in a rock face” by V. Wirz et al.

Anonymous Referee #1

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This paper presents important work. The measurement of snow depth on steep slopes such as rock faces is a valuable contribution, but more importantly provides insight into snow depth measurements where safety concern are paramount.

The description of the snow season is a good addition that put the measurements into context as well as the nature of the measurement season. However, it is unclear how some of this work is different from Grünewald et al. (2010) or Schirmer et al. (2011 in review).

In the measurement methods section, the specifics of the Terrestrial Laser Scanner (TLS) are outlined, but the accuracy and thus actual error estimation are not integrated, so this needs to be at least discussed if the authors do not present results.

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What about the other topographic/terrain variables that other use. These should be discussed more or included in the analysis.

specific questions:

- p 1388: why was the duration of one scan restricted to one hour?
- p1389: more information and likely references are required to explain how the DEM was created. Explain “triangulated using Delauny triangulation within ArcGIS.”
- p 1389: Are there enough points within each 1-m pixel for each scan (DEM and snow surface) to provide a good difference to estimate snow depth?
- p 1389: Using the digital photography to estimate SCA is good since it overcomes the problem with snow vs. DEM differences for shallow snow depths. However, what threshold was used to determine snow vs. bare in the RGB images? What was the colour of the underlying rock face? This could include the colour difference. See Fassnacht et al. (2009 Water Resources Research) who discussed the threshold issue.
- p 1390, line 3: Is ablation based on snow depth useful? Perhaps remove this statement.
- p 1390: what is meant by “The pathologic case is excluded in which many pixels may show a small ablation rate for a given time period between TLS measurements, caused by the fact that the pixel was already close to complete ablation at the start of the period?” The word “pathologic” is unclear.
- p 1391: The Data Quality Analysis section is very good. I am confused by the statement on line 8 that “the main differences occurred in the steep, rough parts of the rock face.” The rough part I understand, but the error should be reduced in steep sections as the horizontal angle increased and thus those areas are more perpendicular to the TLS thus giving less error. The rough sections obviously provide more problems.
- p 1392, l1-2: what is meant by exposition in the statement “it was not possible to study

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the influence of the frequently used parameters exposition and elevation on the snow distribution in the rock face?"

- p 1392: The daily measurements of snow depth at WJF should be included in Figure 2, rather than the sampling dates as those data are measured. Then the actual date of peak snow depth accumulation can be determined.
- p 1392-1393: compare the slope histograms for the two sites. Show as a plot.
- section 3.2: it would be useful to illustrate more of the snow depth distribution patterns either as images as Figure 4 is difficult to read or using spatial statistics metrics.
- section 3.3: how is roughness computed? This needs to be explained in more detail earlier - section 2.6?
- p 1395: what about the other variables typically used to correlate to the distribution of snow depth. These are mentioned earlier, but not used.
- p 1396: How is this present paper different than Schirmer et al. (2011 in review for WRR)?
- p 1397: there are other suitable references for the advection of heat from bare areas to snow covered areas. See Neumann and Marsh (1998 Hydrological Processes).
- section 4 Discussion: this is limited. What about the error of the TLS. It has been discussed in other papers, but it could be different here, as the slopes are larger. See the work by Hopkinson et al. (2004) and others for more specifics on error. It is often given as the tangent of the slope when using ALS, so it would be the tangent of (90 degrees minus slope) for TLS.
- p 1399: the authors state the limitations of the particular study. With more analysis, as listed in this review (e.g., error), the paper could have greater applicability. If not, then the focus of this paper is too narrow to be published in TC.
- Table 2: snow depth change compared to what or when?

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- Tables 2-4: How do you know you are at the same point in space to compute changes and differences in the average?
- Table 2-6: be consistent when listing the periods - either use dates or refer to Table 2.
- Figure 3: Where is Wannengrat that is stated in the legend?
- Figure 4: the underlying maps in these 4 figures make them quite busy and difficult to read. Perhaps use a hillshaded DEM.
- Figure 6: add the standard deviation of Coefficient of Variation
- Figure 8: this figure is confusing.

Interactive comment on The Cryosphere Discuss., 5, 1383, 2011.

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