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# *Interactive comment on* "Spatially continuous mapping of snow depth in high alpine catchments using digital photogrammetry" *by* Y. Bühler et al.

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Dear Referee

Thank you for your extensive and valuable review of our paper.

We will make the answers for your questions 1 and 2 better visible in the revised manuscript. Furthermore we will add costs for data acquisition and processing from three independent data providers (see answer to referee 1) and discuss the effort necessary for fieldwork.

As you suggest, we will rewrite the introduction including a discussion of previous work. The papers you mention are a big help for us, thank you. However, our literature search tools did not find all of them in our extensive literature review. We will also include the



key points you mention (saturation, point matching software) into the rewritten introduction. We will skip the statement "photogrammetry is not thought to work on snow" as we do not really find evidence in the literature. But this is still a prejudice I often hear and I was taught at university.

We do not think that we can take one reference data set as "the truth", as you suggest. As you say, all have their inherent problems and errors and even though they lay close together at the Wannengrat test site, there is only very few overlap. I even tend to say there is no "true snow depth" because it is very much scale dependent and varies a lot within short distances in high alpine terrain (up to 1.6m within 10 m horizontal distance as shown in Tab. 3 with the probe measurements). It is also our suggestion that terrestrial LiDAR works best; it is the dataset where we have by far most measurement points to compare to the photogrammetric snow depth maps. Therefore we will extend the discussion of Fig. 9. To give an overview on all comparisons we have Table 4. In the conclusions summarizing the comparison measures for all reference datasets.

As this paper should be helpful for both, remote sensing experts and snow researchers/practitioners we think it is important to mention the caveats especially because they are crucial to understand the snow depth maps in Fig. 7 and 8. We will try to reduce them but plan not to take them off completely.

We will provide all technical data of the performed data acquisition such as flight time and prices. As Leica was donating the data, we requested quotations from three independent data providers, which offer both, LiDAR and photogrammetry. We will publish an overview on the received quotations in the revised manuscript (see our answer to referee 1).

We will, as you suggest, overwork the figures and combine Fig. 3,4 and 5. We will also provide probability distribution function for the LiDAR and the photogrammetric data and profile lines of snow depth from GPR, thank you for this meaningful suggestion. We will also try to reduce the acronyms.

We will discuss the resolution issue in more detail. The input imagery used for point matching has a resolution of 0.25 m. From the points generated out of this imagery we extract a raster of 2 x 2 m. We smooth the imagery using a mean 3 x 3 pixel mean filter but we do not change the resolution there, it stays 2 x 2 m as we apply filtering and not resampling. We could go down to 1 m spatial resolution of the final product (max. 4 times the input GSD = 1 m (Zhang and Miller, 1997)) The Reason why we do so is that we intend to generate a final product for other users of snow depth maps and compare this final product to the reference data. There are different pre-products (point clouds etc.) we could compare to the reference data but our intention is to use the final, easy to handle product (2 x 2 m snow depth map). In our opinion this is the product most readers are interested in and describing and comparing more pre-products would be of low interest for most readers.

We will adapt the abstract and the conclusions to better bring out the key messages of the paper, as you suggest, and we will overwork the paper concerning the English.

Reference

Zhang, B. and Miller, S., 1997. Adaptive automatic terrain extraction, Proceedings of SPIE - The International Society for Optical Engineering, pp. 27-36.

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Interactive comment on The Cryosphere Discuss., 8, 3297, 2014.