

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
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Comment on hess-2021-281

Anonymous Referee #1

Referee comment on "Mapping snow depth and volume at the alpine watershed scale from aerial imagery using Structure from Motion" by Joachim Meyer et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-281-RC1>, 2021

Meyer et al. present an assessment of Structure from Motion (SfM) to map snow depth at basin scale. They do so by presenting two flights, where photogrammetric images were captured in the context of the Airborne Snow Observaotry (ASO) lidar scans. This allowed authors to compare SfM to lidar scan. Results show that where snow was mapped by both ASO and SfM, the depths compared well, with a mean difference between -0.02 m and 0.03 m, NMAD of 0.22 m, and close snow volume agreement (+/- 5%). Limitations were found in vegetated areas, locations with shallow snow, and steep terrains. Overall, ASO mapped a larger snow area relative to SfM, with SfM missing ~14% of total snow volume as a result.

I enjoyed reading this manuscript, which focuses on an important topic: measuring high-resolution snapshots of snow depth at watershed scale using remote sensing. Comparatively new techniques have emerged over the course of the most recent decades, including lidar, drones, and in fact photogrammetric flights. From this standpoint, the topic covered by this ms is certainly relevant and in line with the scope of HESS. At the same time, the comparatively large body of literature on these techniques (which the authors present in their ms) means that the novelty provided by this specific study is quite unclear. Some novelty points are highlighted at lines 55ff page 3, but they appear incremental to me. Also, the conclusion that SfM may be biased in areas with vegetation or shallow snow is not new. A more effective case should be made to justify publication.

Secondly, results by these surveys look a little unconvincing with regard to SfM applicability, to the extent that the main conclusion of this manuscript (capturing large scale snow depth and volume with airborne images and photogrammetry could be an additional viable resource for understanding and monitoring snow water resources in certain environments) may be not supported by results. SfM missed about 14% of total snow, while snow volume was 86% of ASO volume. Fig 5 also shows clear biases in case of shallow snow cover, which overall leads to SfM underestimating snow depth (line 199).

From a presentation standpoint, the ms reads a little like a technical report. According to their aims and scope, "HESS encourages and supports fundamental and applied research that advances the understanding of hydrological systems, their role in providing water for ecosystems and society, and the role of the water cycle in the functioning of the Earth system." What are the specific research questions of the study that could justify publication in an international, broad journal? In other words, how could this survey be used to advance understanding of hydrological systems?

I encourage authors to work on the above points, since obtaining snapshots of snow depth at basin scale is indeed a clear and important open issue in snow hydrology. I am looking forward to reading a revised version.

SPECIFIC COMMENTS

- Line 47: various regulations exist at national and international level, which may limit the use of RPAS (e.g., over populated areas). This fact may be worth mentioning here.

- Line 134: why was the 1 m raster downsampled from the 3 m one, instead of being directly derived from the point cloud? What is the associated uncertainty?

- Line 196: 3770 m is unclear to me. Do you mean 3770m^3 (likely too small for watershed SWE) or 3770 mm on average?

Line 285: despite being supported by some references, this threshold on 25 m for hydrologic models looks a little arbitrary. Hyper-resolution models are on the rise, also supported by satellite products that now exceed that threshold (e.g., Sentinel-2 images at 20 m).