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Image acquisition effects on Unmanned Air Vehicle snow depth retrievals

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Fresh water resources are mainly fed by rainfall or snowmelt runoff. Thus monitoring the snow cover and changes in the snowy areas are very important for optimum water resources management. However, the snow courses performed generally twice a month is not temporally and spatially dense enough to catch the changes in snow covered areas. Moreover, since snowfall generally occurs on high elevated regions, taking data from these areas are dangerous from security and logistics point of views. These issues arise uncertainties in estimation of the water potential within the basin.
Technical improvements enabled production of faster hardware, performance optimized softwares and reduced prices. These all enabled new opportunities in aerial photogrammetry . New opportunities provided higher spatial and temporal resolutions in snow cover monitoring with reduced costs. Using unmanned air vehicle (UAV) in snow depth estimations is one of these. Various studies indicated good results in UAV derived snow depth calculations.
In this study, an octocopter type UAV is used in snow depth retrievals over an area of172000 m2. Photos were taken by UAV on two different days, where there was snow on the ground first and it was snow free in the second. 3D stereo surface models for both days are produced using the images acquired with 80% forward and 60% side overlaps. The difference in 3D surface models gave the snow depth estimations. To perform accuracy assessment of UAV derived snow depths, manual snow depth measurements on the ground are performed concurrent with UAV flights. An addition of present study to current UAV derived snow depth literature is that, the 3D stereo surface models of the snowy day are derived from two different image acquisition modes. In the first mode, images were taken as UAV was continuously flying and in the second UAV had small stops and kept its position in air constant as the photos were taken. Root mean square error of UAV derived snow depths is calculated as 2.43 cm in continuous and 1.79 cm in fixed acquisitions. The results are in agreement with the theoretical estimation mentioned in current literature where it is mentioned that multi-rotor platforms may enable higher snow depth accuracies. It is further seen that, as snow depths increased, the errors in snow depth calculations are reduced.

Keywords: Snow depth, Unmanned Air Vehicle (UAV), image acquisition model, Hydrology, Snow hydrology