Would You Dare to Map Snow with a Drone?

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SUMMARY

While photogrammetry has been well investigated and documented for years, its applicability on unfavourable surfaces such as snow is still ambiguous. The spatiotemporal variability of the snowpack plays a critical role in local climate systems. Not only water management and ecology investigations, but also hazard prevention and risk evaluation generate a higher demand for information about snow surfaces. As critical areas are not accessible at certain periods, remote sensing technologies are strongly recommended. In this paper, we highlight the significance of using Unmanned Aerial Vehicles (UAVs) for high-resolution snow mapping. We also concentrate on the challenges occurring when using the principles of photogrammetry on snow-covered areas.

Snow depth and its spatial distribution are important for a wide range of applications. Their regular and accurate determination is necessary especially for detecting notable short-term changes. Over time, various practices have been developed to monitor snow depth, each one presenting a set of advantages and limitations. UAVs have become particularly useful. Their use has shown considerable advantages compared with manned aircrafts, LiDAR (Light Detection And Ranging) and manual snow surveys. By using photogrammetric techniques to process the imagery, Digital Surface Models (DSMs) of snow can be produced with one-decimetre horizontal and vertical accuracies. Nevertheless, snow constitutes a challenging surface. The accessibility of the area, the material transfer and the weather conditions constitute the first obstacles for the mapping mission. At the same time, the homogeneity of the snow surface and the extreme contrast between full-reflectance and shadow zones have an impact on the imagery.

State-of-the-art airborne photogrammetry methods boost new investigations on the snow science community. Near-InfraRed imagery (NIR) has shown some potential to identify tie points. Furthermore, different procedures have been applied to classify and to extract the snow extent. In

parallel, it is suggested to store images in raw formats in order to preserve the resolution. The proper calibration of the camera is also highly recommended. All the aforementioned challenges require the development of a specific expertise. The flight planning - including the choice of the camera - must account for the light conditions. Finally, the lack of obvious patterns in the images may call for non-default settings during the data processing.

There is a demand for flexible snow mapping operated locally at short notice, and this contribution provides an insight into what can be expected when using UAVs under these conditions.