MSc thesis: Seasonal snow cover dynamics – scales and processes

Seasonal snow cover dynamics have a relevance for multiple terrestrial, hydrological and ecosystem consequences. This is comparably simple and easy to assess over flat terrain, however, in complex topography, several pre-depositional (such as preferential deposition and orographically altered precipitation) and post-depositional (such as redistribution through wind) processes occur. Most of these processes are related to wind and manifest in a complex pattern of snow height and hence water equivalent on the ground. While the general processes are well understood, the final snow cover in a catchment will depend on the local meteorological conditions, which results in a strong spatial variability on multiple scales. While general surface topography on the ridge- and slope-scale will determine the overall pattern, locally, on a smaller scale, surface roughness and the type of the underlying ground (soil, rock, vegetation,…) will play a role.

A wide range of methods exists for assessing these dynamics in the relevant scale that include field measurements, photogrammetric methods and active remote sensing. They do all have advantages and limitations and we believe that a careful combination of methods may improve the basis for quantifying the snow-related consequences: While field-based methods give a good information on the distribution within the snowpack, its application is limited to few sites due to man-power needed. This is however, a valuable validation for other methods. Snow height from UAV carries high potential due to small cell-size and its independence of an observer's field of view/shading; however, oversaturation of the imagery and high wind speeds may limit its performance to some extent. Terrestrial Laser Scanning (TLS) is known to provide very good spatial coverage within the field of view but shading may limit its application. Moreover, there is assumed to be a weather-dependence on the performance, which may impact its accuracy as a function of atmospheric conditions.

In this MSc thesis we attempt to study the seasonal snow cover dynamics over the winter 2020/2021 with multiple methods and validate them with ground-based field measurements. That way, we will learn about the advantages and limitations of the individual methods and the impact of atmospheric conditions on both measurement accuracy and snow cover variability. This outcome will help to increase our understanding of the seasonal dynamics in snow-cover as a crucial input for hydrological and ecosystem consequences. The field site will be a well-studied catchment in the Niedere Tauern where other monitoring activities take place.

We are looking for a candidate, keen on solving technical problems, skilled to work with large datasets and point clouds and interested in snow-hydrology and snow climate. Field work is a crucial part of this project and we seek independent individuals who can assess Alpine safety responsibly. The work will be conducted in tight collaboration between Graz University and the company Virtual Vehicle GmbH. We envisage joint scientific publication of the results and the use of all output for all parties involved is granted.

For more information, please send a short statement of motivation and relevant experience to jakob.abermann@uni-graz.at and Gernot.seier@uni-graz.at