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Radiometric calibration of airborne laser scanning data: case study rockglaciers

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In the last years airborne laser scanning (ALS) has become a state-of-the-art technology for topographic data acquisition. Classification of the 3D point cloud into different categories (e.g. ground, vegetation, and buildings) is one of the main challenges of ALS research in order to use the point cloud for further applications. So far, most classification techniques consider just the local geometry of the 3D point cloud or parameters which can be derived by analyzing the neighborhood relationship of the point cloud or the number of echoes per emitted laser shot.

Discrete echo systems directly deliver the amplitude (often referred to as intensity) of the received signal in addition to the 3D position of the echo. In contrast to these systems full-waveform laser scanners provide after Gaussian decomposition next to the amplitude also the width of each echo. These physical observables describe the return power of the target and can thus give information about the target without any analysis of the geometry of the 3D point cloud. However, these observables are influenced by many different factors (e.g. range, angle of incidence, surface characteristics, atmosphere, etc.). Therefore, the comparability of these attributes between different sensors, different flight missions or even different flight strips within one flight campaign is poor. The usability of ALS amplitude data for landcover classification could already be shown, whereas the full potential of the radiometric observables is yet not completely explored due to the difficulty of calibrating them into physical units. By using reflectance values of natural surfaces within the area of interest, e.g. determined with a RIEGL reflectometer and Spectralon® targets, radiometric calibration enables to convert the amplitude and echo width into absolute radiometric values which describe the characteristics of the observed surface. With this procedure, classification becomes independent of sensor and mission parameters.

Within this contribution the practical benefit of radiometric calibration will be presented based on ALS data acquired in September 2009 with the Optech ALTM 3100 system of the active rockglacier Hochebenkar, which is about 4.3 km south of Obergurgl (Ötztal Alps, Tyrol, Austria). The monitoring of glaciers and permafrost (in particular rockglaciers) supply important information on climate change impacts on the cryosphere. The results of the remote monitoring of rockglaciers and permafrost are relevant for scientist (e.g. climate change impact research, natural hazard research) and in case of permafrost related hazards for stakeholders and public authorities too. In mountainous areas it can especially be shown that the effect of different ranges due to the topography of the observed area effects the amplitude measurements. As already mentioned before, radiometric calibration enables to gain absolute radiometric values, which can then be used for various tasks, such as for discrimination of different surface types. Moreover they enable to document the status of the glacier over the years, in case of continuously repeated ALS campaigns as scheduled within the ACRP project C4AUSTRIA (Climate Change Consequences on the Cryosphere).