Geophysical Research Abstracts
Vol. 16, EGU2014-3401, 2014
EGU General Assembly 2014

From airborne laser scanning intensity to a distributed glacier surface albedo product

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In recent years, multi-temporal topographic measurements from airborne laser scanning (ALS) have been increasingly used as an accurate information source to calculate geodetic glacier mass balances. Simultaneously to collecting topographic data, most ALS instruments record the reflected signal intensity for each laser emission and therefore provide additional information on the reflectance characteristics of the scanned surface. Along with air temperature, the surface albedo of snow and ice was identified as a major driving factor of glacier melt. Consequently, better knowledge on glacier albedo could substantially improve energy balance based glacier melt modeling.

In this study, we collected on-glacier spectro-radiometric and albedometer measurements to serve as ground reference to radiometrically calibrate high resolution ALS intensity data into a distributed albedo map. This method resulted in albedo values between 0.5 on the glacier tongue and 0.9 on fresh snow in high altitudes with 99.6% of all albedo values falling within the albedo boundary conditions, i.e. values between 0 and 1. Corrected ALS intensity data provided distributed albedo products which allow simulating albedo in glacier energy and mass balance models more realistically. Remaining challenges are the coarse intensity sampling interval of the ALS system, an insufficient correction of the snow bidirectional reflectance distribution function (BRDF) resulting in a striped pattern in the albedo map, and the physical linking of narrow to broad band albedo.