The application of terrestrial laser scanning for snow depth observation

A. Prokop

Institute of Mountain Risk Engineering, Department of Civil Engineering and Natural Hazards
BOKU - University, Vienna, Austria (alexander.prokop@boku.ac.at / Fax: +43 1 47654 4390 /
Phone: +43 1 47654 4357)

Snow depth observation in potentially dangerous avalanche-starting zones is vitally important, both in terms of avalanche-prediction and dimensioning of permanent protection measures. Unfortunately, inaccessibility of the alpine terrain, as well as the acute danger of avalanches complicates snow depth measurements, for example when probes are used. Therefore, the possibilities of measuring the snow pack using terrestrial laser scanners were analysed.

For a comparison three different devices were used: The long-range laser profile measuring system Riegl LPM-i800HA, the Riegl LPM-2K and the terrestrial laser measuring system Riegl LMS-Z420i. Without the use of a retroreflector, these scanners calculate the distance to the surface in question, based upon the time-of-flight measurement of a short laser pulse. Combinations with calibrated and oriented high resolution digital cameras hybrid sensor systems were created. The measuring ranges of the devices are in between 800 m and 2500 m, depending also upon the weather-situation and the reflective condition of the snow pack. The wavelength lies in between 0.9 μm and 1.5 μm (near infrared); the accuracy is within 10 mm and 100 mm.

The objectives of the study are to prove under which meteorological conditions, state of the snow pack and technical circumstances the measurements with the different devices have to take place to show accurate results. Additionally, the results were analysed to show possible limitations and properties of every single device.

The results of the measurements taken at test sites in the Austrian Alps are presented and the relevance of the gained data for analysing the changes in snow depth and snow mass caused by snow drift or melting is discussed.