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A terrestrial laser scanning survey to derive snow volume and water equivalent on the slopes of Austre Lovén glacier basin (Svalbard - 79°N)

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Steep slopes represent 35% of Austre Lovén glacier basin, a small valley glacier in Svalbard (79°N). Slopes and their dynamics do have an important impact on polar glaciers. They also are of high hydrological importance in the water budget of basins. One major issue in studying slopes is the fact that they are hard to instrument and both equipment and staff have to deal with the steepness of the field and the exposure to avalanches and rock fall. In order to minimize this exposure without giving up the required spatial and temporal precision, terrestrial laser scanning (TLS) is used. A monitoring program is now starting using TLS. TLS allows for remote high quality measurements. It can be operated by small teams and scanning may be repeated as many times as needed even over short time periods. Acquired point clouds are interpolated to generate surface models. These models are used to reveal slope dynamics over short time, seasonal or interannual periods. Rock and snow movements and volumes may therefore be accounted for at a high resolution.

In order to assess the volume of snow on slopes two scanning field surveys were conducted. The first one took place in April at the yearly expected maximum snow cover. The second took place in August to record the seasonal minimum. In addition density measurements were conducted in April in the safely accessible lower parts of slopes. Some of the April scans have been repeated over an 8 days interval. The results showed the high quality of the data and clearly showed snow movements including small avalanches. Subtraction of the snow minimum surface model (August) to the snow maximum acquired in spring provided a good estimation of the global snow volume on slopes. Using density values measured in April, these volumes have then been expressed in water equivalent. In addition to these measurements laser scanning was also performed on some areas of the glacier and in the moraine.