Geophysical Research Abstracts
Vol. 12, EGU2010-12997, 2010
EGU General Assembly 2010

Combined application of airborne and terrestrial laserscanning for quantifying sediment relocation by a large debris flow event

Magnus Bremer (1), Oliver Sass (1,2), Michael Vetter (3), and Martin Geilhausen (4)

(1) Institute of Geography, Innsbruck, Austria, (2) Geography and Regional Science, Graz, Austria (oliver.sass@uni-graz.at), (3) Institute of Photogrammetry and Remote Sensing, Vienna University of Technology, Austria, (4) Department of Geography and Geology, Salzburg, Austria

Country-wide ALS datasets of high resolution become more and more available and can provide a solid basis for geomorphological research. On the other hand, terrain changes after geomorphological extreme events can be quickly and flexibly documented by TLS and be compared to the pre-existing ALS datasets. For quantifying net-erosion, net-sedimentation and transport rates of events like rock falls, landslides and debris flows, comparing TLS surveys after the event to ALS data before the event is likely to become a widespread and powerful tool. However, the accuracy and possible errors of fitting ALS and TLS data have to be carefully assessed.

We tried to quantify sediment movement and terrain changes caused by a major debris-flow-event in the Halltal in the Karwendel Mountains (Tyrol, Austria). Wide areas of limestone debris were dissected and relocated in the course of an exceptional rainstorm event on 29th June 2008. The event occurred 64 years after wildfire-driven deforestation. In the area, dense dwarf pine (pinus mugo) shrub cover is widespread, causing specific problems in generating terrain models. We compared a pre-event ALS-dataset, provided by the federal-state of Tyrol, and a post-event TLS survey. The two scanner systems have differing system characteristics (scan angles, resolutions, application of dGPS, etc.), causing different systematic and random errors. Combining TLS and ALS point data was achieved using an algorithm of the RISCAN_PRO software (Multi Station Adjustment), enabling a least square fitting between the two surfaces.

Adjustment and registration accuracies as well as the quality of applied vegetation filters, mainly eliminating non-groundpoints from the raw data, are crucial for the generation of high-quality terrain models and a reliable comparison of the two data sets. Readily available filter algorithms provide good performance for gently sloped terrain and high forest vegetation. However, the low krummholz vegetation on steep terrain proved difficult to be filtered. This is due to a small height difference between terrain and canopy, a very strong height variation of the terrain points compared to the height variation of the canopy points and a very high density of the vegetation. The letter leads to very low percentages of groundpoints (1 – 5%). A combined filtering approach using a surface-based filter and a morphological filter, adapted to the characteristics of the krummholz vegetation were applied to overcome these problems. In the next step, the datasets were compared, erosion- and sedimentation areas were detected and quantified (cut-and-fill) in view of the accuracy achieved. The position of the relocated surface areas were compared to the morphological structures of the initial surface (inclination, curvature, flowpaths, hydrological catchments).

Considerable deviations between the datasets were caused, besides the geomorphic terrain changes, by systematic and random errors. Due to the scanner perspective, parts of the steep slopes are depicted inaccurately by ALS. Rugged terrain surfaces cause random errors of ALS/TLS adjustment when the ratio of point density to surface variability is low. Due to multiple returns and alteration of pulse shape, terrain altitude is frequently overestimated when dense shrub cover is present. This effect becomes stronger with larger footprints. Despite these problems, erosional and depositional areas of debris flows could be clearly identified and match the results of field surveys. Strongest erosion occurred along the flowpaths with the greatest runoff concentration, mainly at the bedrock-debris interface.