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UAV-based landslide deformation monitoring – first results from Corvara landslide

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In recent years, unmanned aerial vehicles (UAVs) have been more frequently utilised to study geomorphological and natural hazard processes, including gravitational mass movements such as landslides. UAVs can be equipped with different sensors, e.g. photo cameras and laser scanners, and the data that can be achieved can substantially improve the monitoring and understanding of the involved natural processes. One of the main advantages of UAVs is their flexibility that allows for carrying out assessments of large areas in short periods of time and at much lower costs than other platforms, e.g. airplanes or helicopters. Thereby, UAVs represent an interesting technique to complement more traditional monitoring methods.

Here we present some first results of the EUREGIO-funded LEMONADE project that is concerned with the combination and integration of novel and traditional landslide monitoring techniques. We carried out a series of UAV flights over a particularly active part of the Corvara landslide and acquired aerial imagery for quantitative assessments of the retrogressive enlargement of the landslide over recent years. Additional field surveys including terrestrial laser scanning, and UAV-based photogrammetry and laser scanning are scheduled for summer 2016.

The Corvara landslide is a large complex earthflow in the Italian Dolomites that has been investigated by a wide range of methodologies over the past years. The landslide is characterised by movement patterns of greatly varying magnitude, ranging from annual rates of a few cm to more than 20 m. The current and past monitoring activities concentrated on GPS measurements as well as multi-temporal differential radar interferometry utilising artificial corner reflectors. Thereby, primarily punctual displacement data were achieved and spatial information on topographic and geomorphic changes were consequently sparse.

For our photogrammetry study, we utilised a SoLeon octocopter equipped with a Ricoh GR 16.2 Megapixels camera. Three photos were taken with different exposure settings every 2 seconds while the UAV followed a pre-programmed flight track in an elevation of 70 m above ground and a flight speed of 1 m/s. Ground-control points were distributed to allow for reliable merging as well as for georeferencing of the resulting imagery. Within one day, approximately 13 ha were covered with an orthophoto and point cloud of extremely high spatial resolution. The point cloud consisting of more than 200 million points was transferred to a digital surface model (DSM) with 1.5 cm resolution, and was subsequently compared to the 2006 LiDAR based DSM. The comparison of the results highlights areas of vertical topographic changes which reached up to 12 m. Moreover, the retrogressive enlargement of the landslide could be quantified and partly exceeds 30 m within the past 4 years only.