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# Joint analysis of the Super-Sauze (French Alps) mudslide by Nanoseismic Monitoring and UAV-based remote sensing

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We describe the joint analysis of the fast moving mudslide in Super-Sauze, southern French Alps, by Nanoseismic Monitoring and UAV-based (Unmanned Aerial Vehicle) remote sensing approaches. The joint observation of subsurface fracture processes during the movement of the slope and the mapping of deformations at the surface allows a common interpretation of complex slope dynamics.
During a 10 day field campaign in July 2008, we were able to detect and locate different signals caused by the movement of the mudslide by applying Nanoseismic Monitoring. While some events are caused by rockfalls in the source area of the slope, we were able to identify different types of signals, which have been obviously generated by material failure within the unstable part of the mudslide. Signal analyses (e.g. frequency content, signal duration, attenuation effects, amplitude analysis) as well as in-situ field experiments have been applied in order to characterize the varying slope dynamics. We identified two different deformation processes: fracture processes within the slope material and superficial fissure development. The spatial distribution of the fracture processes, respectively the estimated source area of fissure development, correlates well with parts of the slope which show higher velocities at the surface.
Beside the seismic observation, a series of UAV-borne photographs of the Super-Sauze mudslide has been acquired during the field campaign. The covered area was in the range of 850 m x 250 m. The photographs have been combined to an ortho-mosaic. The achievable ground cell resolution was in the range of 3 cm to 8 cm. A comparison between the achieved ortho-mosaic and an airborne ortho-mosaic from May 2007 has been carried out. In this period, displacements varying from 2.7 m to 55.4 m as well as different structures, indicating variable deformation and sedimentation processes at the surface of the slope, have been detected and identified.
The comparison of the results achieved by the seismic monitoring of slope dynamics with observations based on UAV-based remote sensing approaches assists the estimation of source areas and possible source mechanisms and vice versa. The analysis and the data-fusion of the seismically detected signals and the observed dynamic processes by the UAV-based remote sensing methods lead us to the interpretation, that most of the dynamic processes take place close to the in-situ crests, mostly covered by the mudslide today. These hidden crests ‘canalize’ the slope material and lead to varying slope dynamics and movement velocities respectively.