Geophysical Research Abstracts
Vol. 15, EGU2013-5382, 2013
EGU General Assembly 2013

Early Warning at the Gradenbach Mass Movement

Werner Lienhart (1), Erich Lang (2), Stefan Mertl (3), Ulrike Stary (2), and Ewald Brückl (3)

(1) Institute of Engineering Geodesy and Measurement Systems, Graz University of Technology, Graz, Austria (werner.lienhart@tugraz.at), (2) Department of Natural Hazards and Alpine Timberline, Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW), Vienna, Austria, (3) Research Group Geophysics, Department of Geodesy and Geoinformation, Vienna University of Technology, Vienna, Austria

The Gradenbach mass movement (GMM) is an example of a deep seated gravitational slope deformation in the crystalline rocks of the Eastern Alps (12.85˚E, 47.00˚N). The main body of the GMM covers an area of 1.7km^2 and comprises a volume of 0.12km^3. The main scarp is located below the mountain crest at an elevation of 2235m. The toe is at 1200m elevation in the Gradenbach valley. The GMM became active during the second half of the 19th century according to historic documents. Quantitative data about the movement are available since 1962. Quasi-stationary phases of creep or slow sliding were interrupted by accelerations in 1965-1966, 1975, 2001, and 2009 yielding a total displacement of about 20m. The cumulative displacement during the high velocity phases was about 8m in 1965/66 and about 1m in 2001 and 2009. A transition to rapid and catastrophic sliding cannot be excluded during the acceleration phases in the future.

The early warning system of the Gradenbach Observatory at the GMM consists of a geodetic, a hydro-meteorological, and a seismological component. The geodetic component comprises a GPS network with stations distributed over the whole GMM and two wire-extensometers recording the displacement at the toe of the landslide relative to the opposite slope. The GPS data are available in real time. The extensometer data are currently transmitted in weekly intervals. The hydro-meteorological component comprises the real time registration and data transmission of precipitation and temperature at one station on the GMM. The water equivalent of the snow cover is weekly determined at 15 profiles. Snow melt and infiltration into the GMM are estimated from this data. The hydrostatic water level is measured at two borehole gauges. A proxy of the hydrostatic water level at the surface of rupture is derived from the hydro-meteorological data and related to the velocity of the GMM by a power law. Investigations show that a variation of the hydrostatic water level at the surface of rupture is delayed to the actual input of precipitation and snow melt. The velocity of the GMM can therefore be predicted more than one month in advance. The seismological component at the GMM is based on measurements of the seismic activity with a local seismic monitoring network with near real time data transmission. The acceleration phase in 2009 was preceded by an increase of the ambient noise and the occurrence of micro-earthquakes which also continued during the acceleration phase. The noise analysis can be supplied in near real time.

The backbone of the early warning system at GMM is the geodetic component. However, the hydro-meteorological prediction and the seismic precursors enhance the preparedness and allow for a better judgement of an incipient acceleration. So far the early warning system is based only on the experiences from a relatively short monitoring period. Continued monitoring will further improve its performance and reliability in the future.