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Monitoring head scarp deformation of an alpine rockslide: seasonal and interannual variations

R. Nishii (1) and N. Matsuoka (2)

(1) University of Tsukuba, Tsukuba, Japan (ryoko911@geoenv.tsukuba.ac.jp), (2) University of Tsukuba, Tsukuba, Japan (matsuoka@geoenv.tsukuba.ac.jp)

The head area of the Aresawa rockslide, located at about 3000 m a.s.l. in the Japanese Alps, has experienced significant rock slope deformation associated with opening of a number of tension cracks that were produced by a partial collapse in May 2004. The collapsed rock mass in 2004 was 400m high, 250 m wide and 13 m in the mean depth and composed of fractured sandstone and shale. Deformation of the head area was evaluated by a geodetic survey using a total station, performed 17 times from October 2006 to November 2008. Concurrently, data loggers monitored meteorological parameters, including precipitation, snow distribution and depth, and air and ground surface temperatures. The head area moved downslope along the slip plane at an average rate of 0.6 m/year. In addition to the major movement along the slip plane, the slipping rock mass showed downward extension (toppling) resulting from opening of the tension cracks. The surface velocity indicated a significant seasonal variation associated with the snow regime. The surface movement was very slow (<1 mm/day) in the snow-covered period, during which the ground surface temperature (GST) remained below 0°C for half a year. The thick snow cover and underlying seasonally frozen ground would prevent water infiltration in the bedrock, which contributes to the rock slope stability. The surface movement accelerated to 1-10 mm/day in the snow-melting and snow-free periods, during which GST remained at 0°C or rose above 0°C. The snow-melt water and rainfalls probably infiltrate into the fractured bedrock, enhancing the rock slope instability. The observations suggest that the tension cracks produced by the 2004 collapse are in turn preparing a forthcoming collapse.