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The Åknes rockslide: Characteristics of subsurface deformation

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The Åknes rockslide represents a possible collapse of 20-55 million cubic metres, moving with a velocity of up to 10 cm/year. The risk is associated with the generation of catastrophic tsunamis, having run-up potential of up to 80 m in nearby villages. The surface monitoring systems is today based on extensometers/crackmeters, tiltmeters, single lasers, GPS, total station and a microseismic network, in addition to a climate station.
Large efforts have been paid to the establishment of subsurface investigations and monitoring systems in deep boreholes. Tree boreholes have been instrumented with 50 to 120 m long active multiparametric in place columns (DMS system: Differential Monitoring of Stability). The system consists of 1 m long modules connected by special flexible junctions being free to move. Each module contains of a biaxial inclinometric sensor, a temperature sensor, and selected modules have a piezometric sensor. Also digital compass is emplaced in specific modules for controlling the direction of column. Measurements are continuous and are automatically downloaded.
The DMS data has documented a well-defined upper sliding zone in two boreholes at depth of 35 and 50 m depth. This is above the water-level measured in open standpipes. The video inspection before instrumentation and the core data shows distinct fracture zones in this upper part, in addition to water inflow at some parts. The continuous temperature data from the DMS columns can also be used to measure the inflow of water through time, by the fact that the flow of water influences the temperatures. The deformation data also show that there are creeping movements in lower part, down to below 120 m depth.
The mode of deformation is varying from continuous displacements through time to suddenly and abrupt steps in movement rates. Also, it is possible to detect a series of different displacements rates during small time windows. For examples, in the upper borehole, the movement velocity at 49-51 m depth beginning from November 2009 to middle of January 2010 depicts 3 velocity trends. This range from 0,1 mm/day the first month, decreasing to 0,05 mm/day the next month, and finally reducing to 0,02 mm/day the last half month. This velocity change seems to correlate broadly with the decreasing water level during the transition from relative wet autumn to colder winter conditions.