Geophysical Research Abstracts
Vol. 15, EGU2013-511-1, 2013
EGU General Assembly 2013

Microseismic Monitoring of Induced Slope Failures at Field Scale

Georgios Yfantis (1), Hernan Eduardo Martinez Carvajal (2), Stella Pytharouli (1), and Rebecca Lunn (1)
(1) University of Strathclyde, Civil and Environmental Engineering, United Kingdom (georgios.yfantis@strath.ac.uk), (2) Universidade de Brasília, Civil Engineering, Brazil (carvajal@unb.br)

A number of published studies use seismic sensors to identify and locate precursory landslide signals and slope failures. In this research we artificially induced failure to two, meter scaled, slopes in the field. To our knowledge there has been no previous controlled experiments that can allow calibration and validation of the interpreted seismic signals. The aim of this study was to investigate whether low-cost seismic monitoring can capture the emitted seismic waves and distinguish between different landslide failure phases (pre-, during and post-failure).

The experimental site was located in Brasilia (Brazil). Two vertical artificial faces, approximately 2m high, were excavated 3m apart in high porous tropical clay. This material is highly attenuative making the detection of weak seismic signals challenging. A hydraulic jack was used to apply an increasing vertical load through a metallic plate to the soil's surface causing failure of the slope.

Both experiments took place during night when the ambient noise was at minimum levels. The failure process of both faces was monitored using 12 short period 3D seismometers of frequency range 2-100Hz. All sensors were placed on the ground surface before the crown of the vertical faces, and one sensor at their toe. The deployment geometry created a dense microseismic network with approximately 10m spacing between the sensors and two nanoseismic arrays, with aperture sizes of 10 and 20 m, respectively.

The two faces failed in a different way despite the identical geological and loading conditions. This provided an excellent opportunity to monitor signals of different amplitude and waveform. The first face failed as two vertical slides 2m high, on each side of the metallic plate, at a vertical load of 80-90kN. Only small failures at the crown of the slope were observed for the second face. These happened at a load of 70 and 100kN.

Our analysis, based on signal processing techniques, allowed for the amplification of failure signals above noise level and therefore the identification, and location of the sources of the failure signals even in a high attenuation medium such as the tropical clay. Results were groundproofed by visual observations. Our study shows that microseismic monitoring can be used to monitor weak ground failures and provide information on the failure mechanism of slopes, a powerful tool for geotechnical engineering applications.