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In-situ self potential measurement for monitoring of landslide process

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Recently, rainfall-induced landslides occur frequently. In order to mitigate landslide disasters, understanding of the landslide process and developing of early warning is important. In this study, self-potential (SP) approach has been attempted to develop an early warning system for rainfall-induced landslides. The laboratory experiments of landslides under the controlled artificial precipitation and a sandbox have been performed. Their results show the capability to monitor the subsurface water condition using the self-potential method. However, laboratory experiments have limitations in scale and soil layers. Therefore, it is necessary to verify the obtained results by a field (in-situ) experiment and we selected landslide site in Pelabuhan Ratu, Indonesia as a field experiment site.

In August 2010, we installed 39 non-polarizing (Pb-PbCl2) electrodes at 13 points. At each point, we buried the electrodes at a depth of 1.0m, 2.5m and 4.0m. And in order to check the relationship between self potential and water or soil displacements, 25 tensiometers, two borehole to measure tilt and a rain-gauge have been installed.

From the observed data, there is linear relationship between SP and pore water pressure. And electrokinetic coupling coefficient was yielded about -2.0 mV/m using this linear relationship.

It's recognized that SP changes in association with rainfall have been recorded at the site. We consider that these changes are caused as the result of groundwater flow. In order to check the groundwater flow, we calculate the electrical potential differences between neighboring two electrodes. The groundwater flow almost vertical direction in low rainfall day. In heavy rainfall day, the lateral flow dominates in the slope profile. And we calculate the hydraulic gradient using SP data and electrokinetic coupling coefficient. The hydraulic gradient of lateral direction tends to increase associated with heavy rainfall. From the indoor landslide experiment, the groundwater flow changes from vertical direction to lateral direction 20 min before the main collapse. Therefore, it indicates that the capture lateral flow might be connected with landslide process. The details will be provided our presentation.