High-speed geoelectrical monitoring of artificial rain experiments at a slope using a large-scale rainfall simulator

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Measuring the temporal variation of water content in a slope is important for preventing slope disasters. We conducted repeated monthly geoelectrical surveys since February 2011 on one slope of an embankment in the large-scale rainfall simulator of the National Research Institute for Earth Science and Disaster Resilience (NIED). The slope from the crest to the ground is approximately 12 m in length and its angle is approximately 35 degrees. Thirty-seven electrodes are established permanently at 0.5-m intervals along the 18-m long survey line including the slope. Measurements of near-surface soil water content and temperature have been conducted every 10 minutes at five places along the slope. The embankment is usually outdoors and observations in natural weather have been performed. The results of the repeated geoelectrical surveys show that short-term changes in resistivity correspond to changes in water content caused by rainfall.

This fact suggests that a large short-term increase in water content that causes a slope disaster is detectable by a decrease in resistivity. In order to confirm this, we applied artificial rain to the embankment, controlling the total amount and intensity of rainfall using the mobile simulator. In this experiment, a high-speed resistivity profiling system which can provide 576 (24x24) data in about 10 seconds was used for the resistivity monitoring on the survey line. The resistivity measurements were carried out at intervals of 1 or 2 minutes simultaneously with the measurement of soil moisture content during the artificial rainfalls. A series of resistivity sections were analysed to each observational data. The changes of resistivity sections corresponded to rapid changes in soil moisture content. The result shows that the high-speed geoelectrical monitoring is effective for observing soil moisture changes caused by heavy rain in real time.