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Analysis of high resolution temperature observation for spatial and temporal soil moisture variation in an unstable slope

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Hydrological processes control the behaviour of many unstable slopes hence their importance for landslide hazard is generally accepted. The unsaturated zone buffers precipitation and moisture conditions of this zone affect distribution, intensity and time delay of ground water recharges. Therefore, high resolution monitoring of hydrological features of the near surface soil layer is necessary, especially when studying rainfall triggered landslides.

The aim of our research is to test the use of temperature as a tracer for soil moisture distribution. Recently, much research attention has been given to the temperature measurements as surveying technique in the hydrological studies. We applied so-called distributed temperature sensing (DTS) fibre optic cable to obtain high resolution soil temperature observation. Two cables were installed in the soil (approximately at 25 cm depth) at different location within the landslide to measure the near surface soil temperature with 2 m spatial resolution and 3 minutes time step.

We will present the result obtained during the field campaigns that took place at Super-Sauze landslide, French Alps. Phase and amplitude shifts of temperature signal will be analyzed and related to the soil moisture dynamics. Moreover, the temperature signals will be confronted with the coupled soil heat flux and soil moisture flux model. Furthermore, the temperature data set will be used to evaluate the time variation of the soil moisture content and position of ground water level based on the determination of the soil thermal parameters fluctuation.

Our work will discuss the applicability of distributed temperature sensing for hydrological studies, especially to monitor soil moisture distribution and development of preferential flow paths in a landslide area.