SPATIAL AND TEMPORAL VARIABILITY OF SOIL MOISTURE PATTERNS RELATED TO PREFERENTAIL FLOW MEASURED USING DISTRIBUTED TEMPERATURE SENSING

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The disastrous events over the last few years clearly show that adequate security in the mountain areas remain limited despite preventive measures (Argawal *et al.,* 2003). Thus advanced development and improvement of mountain risk issues, especially hazard analyses and risk management, is fundamental.

One of the major landslide triggers is precipitation. The temporal occurance of landslides and movement activities is controlled by rainfall patterns. To make progress in mountain hydrogeomorphological hazard analyses, it is necessary to quantify the groundwater recharge processes of preferential infiltration of rainfall and consequently the triggering of slope movements (Savage *et al.*, 2003; Coe *et al.*, 2004). The role of the preferential flow in landslide initiation and reactivation has to be considered (van Asch *et al.*, 1996; Bogaard and van Asch 2002).

A large scale infiltration experiment was carried out at black marls mudslide of Super-Sauze in the Southern Alps of France. The aim of this experiment was to study the hydrological system of a slope and the role of preferential water flows on landslide triggering. During two periods of three days continuous artificial rainfall of approximately 15 mm·h^{-1} was applied on an infiltration experiment area of about 14x7 m. Abundant

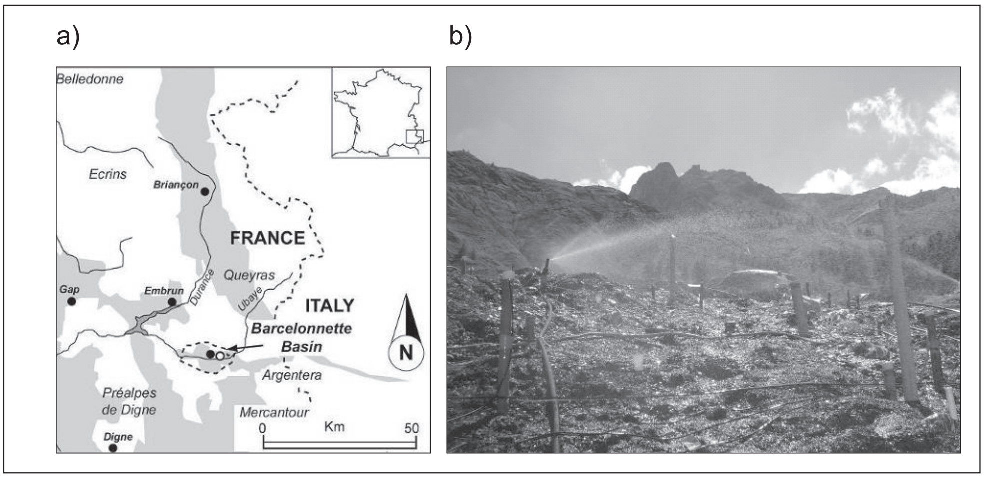

Figure 1. a) The location of the Super-Sauze mudslide, b) The large scale infiltration experiment, infiltration research area (IRA)

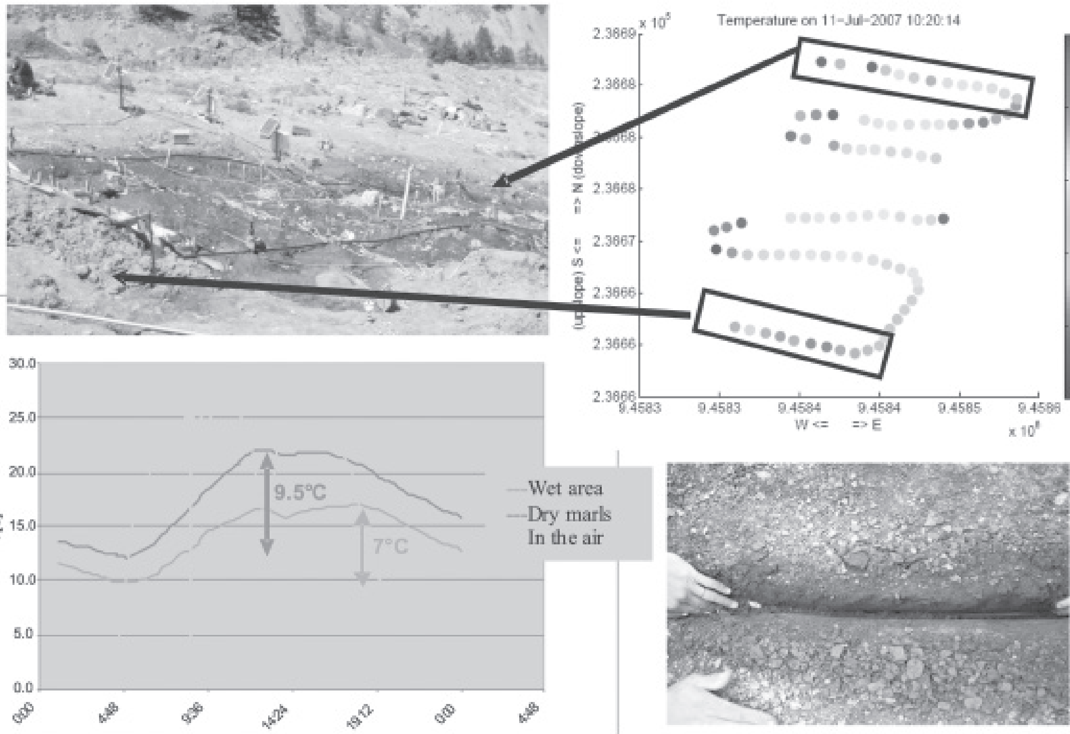

Figure 2. Example of DTS measurements analyses

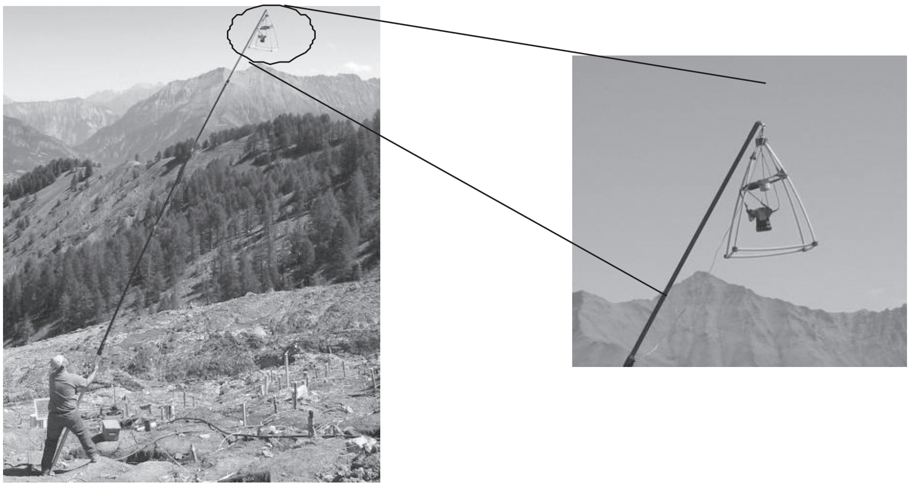

Figure 3. NESCAFE equipment

hydrologic and geophysical equipment was installed to monitor the infiltration process (37 piezometers, 9 nests of soil moisture profiles, water quality sampling for tracer detection and resistivity and seismic geophysics).

Moreover, high resolution temperature measurements were done in order to test the use of temperature as a tracer for spatial distribution of soil moisture in the experimental infiltration area. These distributed temperature sensing (DTS) measurements use fibre optic cable technology (Selker *et al*, 2006). Two cables were installed in the soil, at an average depth of 25 cm. The first cable (130 m) is installed within the infiltration research area (IRA). The second cable (300 m) is placed along the upper shelf which is the most stable part of the Super-Sauze landslide. The DTS measurements monitor the soil temperature along the cable with a spatial resolution of 1 m and temporal resolution of 1 min. Spatial and temporal trends of temperature measurements were studied and related to differences in hydrological characteristics of the area.

Furthermore, the DTS measurement results were compared with Near Sensing Camera Field Equipment (NESCAFE) and in-situ soil moisture observations. NESCAFE pictures were taken from the attitude of 8 meters using a carbon fibre fishing rod. This system gives the opportunity to take a picture of the area around 12x12m. The pictures are used for detailed terrain analyses with respect to changes in morphology.

Our work will discuss the possibilities of distributed temperature sensing and near surface photogrammetry for hydrological studies. We will present the results obtained during the large scale infiltration experiment and other field campaigns that aim to study the role of preferential flow in highly heterogeneous mudflow of Super-Sauze, France.

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