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Flow through and around an artificial macropore: experimental investigations in a specific laboratory soil column

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In January 2006 the interdisciplinary research project "Coupled Modelling of Flow and Deformation Processes at Creeping Hillslopes", funded by the DFG (German Research Foundation), was established. Rapid infiltration processes were observed at an investigated slope in the proximity of the town of Ebnit, Vorarlberg, Austria. The rapid infiltration at upper slope positions generates a fast rise of soil water saturation in sections of the subsurface of the several hundred meters long slope. It is assumed that the seeping soil water leads to buoyancy forces in the lower regions of the slope resulting in slope deformations, observable in the form of slow slope creeping.

In order to be able to systematically investigate and quantify the fast infiltration processes a laboratory experiment was designed and built. It consists of a 120 cm high stainless steel half cylinder with a diameter of 100 cm. The section plane of the half cylinder is constructed by a glass pane with an artificial macro-pore emplaced vertically along it's center-line. For experimental alternatives the penetrating depth of the macropore into the soil matrix can be varied. In order to study the flux through the macropore as well as the exchange processes between macropore and surrounding matrix pressure head conditions can be monitored with up to 30 soil water tensiometers placed around the artificial macropore. Furthermore, long suction cups (suction tubes) are installed horizontally just above the bottom plate inside the soil material.

Initial and boundary conditions will be changed systematically in the experiments. During the initial runs, water is only infiltrated into the macropore and not into the matrix. Using the tensiometers the soil water tension in the surrounding soil matrix will be measured in up to six depth levels and up to five distances to the macropore in

order to quantify the flow processes during the infiltration. The spatial propagation of wetting fronts in two dimensions can be visualized by the addition of colour tracers at the glass pane side. With the suction cups it is possible to install a constant head boundary at the lower end of the column and to sample leachate water.

For the initial experiments homogeneous fine sand was used. After the first infiltrations specific lateral and vertical flows nearby the macropore are observed. The distribution of these flow components will be presented. In further steps, the infiltration rate into the matrix and/or the macropore respectively will be varied. Hence a systematic observation of flow behaviour under soil moisture conditions ranging from dry to wet will be possible.