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Studies on infiltration processes in a soil column with a single macropore

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Rapid infiltration processes were observed at an hill slope located in the proximity of the town of Ebnit, Vorarlberg, Austria. The rapid infiltration at upper slope positions generates a fast increase of soil water saturation in sections of the subsurface several hundred meters down gradient. It is postulated that the seeping soil water leads to a rapid increase in head and hence 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 systematically investigate and quantify the fast infiltration processes a laboratory experiment was designed and built at the Research Facility for Subsurface Remediation (VEGAS) at the Universität Stuttgart. The experiment 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 its center-line. The macropore has a diameter of 1 cm. In order to study the flux through the macropore as well as the exchange processes between macropore and surrounding matrix piezometric heads can be monitored with 30 soil water tensiometers placed around the artificial macropore.

For the first set of experiments homogeneous fine sand was used. Water was infiltrated into the macropore only (and not onto the matrix surface). During the experiments, the water inflow into the macropore was controlled via either constant head or constant flux boundary conditions.

In order to investigate the macropore flow and the exchange between the macropore

and the soil- matrix, the experimental data are used to validate numerical macropore-matrix models. In a first approach we coupled MUFTE-UG (soil matrix) with a cascade model (macropore) written in Python. The aim of this study was to evaluate parameters determined based on the experimental data for the exchange formulation between soil and macropore.

In the presentation, the spatial propagation of wetting fronts in two dimensions as visually observed at the glass pane side and the tensiometers, respectively, will be presented. The experiments showed a very complex infiltration process. In addition, results of the cascade model applied as a first step for simulation will be presented and the quality of the numerical representation of the experimental data will be discussed.