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Investigations of infiltration processes from flooded areas by column experiments

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In case of inundation of flood plains during flood events there is an increased risk of groundwater contamination due to infiltration of increasingly polluted river water. Specifically in densely populated regions, this groundwater may be used as source for drinking water supply. For the evaluation of this a detailed quantitative understanding of the infiltration processes under such conditions is required. In this context the infiltration related to a flood event can be described by three phases. The first phase is defined by the saturation of the unsaturated soils. Within the second phase infiltration takes place under almost saturated conditions determined by the hydraulic load of the flood water level. The drainage of the soils due to falling groundwater table is characterizing the third phase.

Investigations by soil columns gave a detailed insight into the infiltration processes caused by flooding. Inflow at the soil top was established by a fixed water table fed by a Mariotte bottle. Free outflow and a groundwater table were used as lower boundary condition. Inflow and outflow volume were monitored. The evolution of the matrix pressure was observed by micro-tensiometers installed at several depths within the soil column. The flow processes during phase one and two were characterized by a tracer test. Some of the experiments were repeated in order to study the influence of preliminary events.

Main results were a difference in infiltration due to the lower boundary condition with regard to inflow rate, outflow dynamics and matrix pressure evolution which is directly related to the water content evolution. Further, the influence of preliminary events was different for the different boundary conditions. A replacement of pre-event water could be observed which was confirmed by volume balances calculated for the infiltration experiments. Although these water balances were almost closed significant dynamics of the matrix pressure remained in soil column in the drainage phase. The detailed analysis of the hydraulic conditions and the flow rates provided an estimate of the unsaturated hydraulic conductivity that could be related to the degree of saturation. Numerical simulations were not able to reproduce these conditions. These results could be used to estimate time scales of flow and solute transport in soils caused by flood events.