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Infiltration process monitoring with hydrogeophysics – insights, limitations and lessons learned from in-situ experiments combining time-lapse GPR and hydrological techniques

Conrad Jackisch (1) and Niklas Allroggen (2)

(1) TU Braunschweig, Geoecology, Landscape Ecology and Environmental Systems Analysis, Braunschweig, Germany (c.jackisch@tu-braunschweig.de), (2) University of Potsdam, Institute of Earth and Environmental Science, Potsdam, Germany

Measuring soil water content and its distribution in a spatio-temporally continuous manner is still a challenging target. Geophysical methods, i.e. ground penetrating radar (GPR) and electrical resistivity tomography (ERT), are promising tools providing information on the relative electrical permittivity or the electrical resistivity of the soil. Given the situation that soils are highly heterogeneous and soil water flow is commonly non-uniform, interpretation and quantification of the data can be obscured by ambiguous signal responses.

Over the last years we conducted several irrigation experiments at plot and hillslope scale combining hydrological experiments with time-lapse GPR surveying. They have shown that observation of non-uniform subsurface flow requires high data resolution in time and space. Although, we have demonstrated the use of time-lapse GPR to quantify temporal and spatial soil water dynamics, the heterogeneous infiltration patterns associated with infiltration events remain a challenge. In addition, differences between the GPR datasets can also originate from other sources (e.g., antenna coupling to the ground, positioning errors and systematic noise), which challenges current data interpretation approaches.

In the PICO, we present an overview about the experiments to share our insights about the current capabilities and limitations of using GPR for assessing soil water dynamics in reference to ERT, TDR and tracer observations and numerical simulations. Moreover, we discuss the role of changing surface conditions during irrigation and its effects on the quantification approaches.