



Spatial heterogeneity and temporal variability in repeated hillslope tracer experiments

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Subsurface flow in small first-order catchments is dominated by both, precipitation patterns and subsurface structure. We report on a series of repeated tracer experiments under transient conditions in a small forested first-order catchment (F4, 2.3 ha) at Gårdsjön in SW Sweden. Podzols are the dominant soil types, soil thickness varies strongly (0-50 cm) and bedrock outcrops are partly visible at the surface. A small wetland is situated directly upstream of the runoff weir. A hillslope of the catchment is equipped with a sprinkler system and can be irrigated at around 38-45 m³ day⁻¹. Depending on the meteorological conditions in the respective year of the experiment, natural rainfall comes in addition.

A bromide tracer solution was injected into groundwater at a single location about 40 m upstream the weir over a period of approximately an hour, and was monitored using a set of groundwater tubes and the weir at the outlet over the following 3-4 days. Additionally, discharge and meteorological conditions were recorded. The experiments were repeated each summer from 2007 to 2019. In summer 2019, electrical resistivity tomography was done during the experiment. We measured a profile perpendicular to the flow direction covering the whole study site. This data shows how subsurface patterns could influence water flow on the soil-bedrock interface. We investigated tracer recovery rates against cumulated runoff since tracer application. Substantially different transit times and qualitatively different behaviour of the breakthrough curves were observed, even under steady state conditions. We present first results how these differences could be linked to the structure of the subsurface.