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The Hupsel Brook Catchment: Nested scale observations to quantify catchment-scale Rainfall-Runoff behavior from field-scale flux measurements.

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The Hupsel Brook Catchment in The Netherlands (6.6 km2) has been an experimental catchment for hydrological studies since 1960. Traditionally, research focused on describing the Rainfall-Runoff process of this catchment. Especially during the last decade, water quality issues led to a shift in interest from purely describing the Rainfall-runoff behavior at catchment-scale to quantifying the contribution of field-scale flow routes to the catchment-scale discharge. In densely drained lowland catchments, such as the Hupsel brook catchment, surface water discharge is fed by groundwater flow toward streams and ditches, tile drain flow, and overland flow.
However, at catchment-scale it is not possible to measure the contribution of tile drain flow or overland flow to discharge directly. At field-scale this is possible, but to translate findings at field-scale to catchment-scale requires an up-scaling approach. We continuously measured at the field-scale (0.9 ha), tile-drain flow, overland flow and groundwater flow for a period 1.5 years. Groundwater storage during the same period was estimated from 31 groundwater wells within the field measured with a 5 minute interval. This data allowed us to derive simple storage-discharge relationships for each of the flow routes at the field-scale. Inspired by these relations, we formulated a spatial averaging approach that integrates the fluxes of each flow route over the spatial distribution in groundwater depths. Extrapolating the field site results using this averaging approach to sub-catchment (0.4 km2) and catchment-scale (6.6 km2), where we continuously measured the discharge and nitrate concentrations, allowed us to confidently upscale the contribution of individual flow routes at field-scale to contribution of these flow routes at catchments-scale.
We will present the results of the innovative field-scale measurement setup and demonstrate the potential of nested-scale observations by showing how a measurement-based upscaling approach can be used to translate field-scale findings to the catchment scale.