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A nested observation and model approach to non linear groundwater surface water interactions.

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Surface water quality measurements in The Netherlands are scattered in time and space. Therefore, water quality status and its variations and trends are difficult to determine. In order to reach the water quality goals according to the European Water Framework Directive, we need to improve our understanding of the dynamics of surface water quality and the processes that affect it.

In heavily drained lowland catchment groundwater influences the discharge towards the surface water network in many complex ways. Especially a strong seasonal contracting and expanding system of discharging ditches and streams affects discharge and solute transport. At a tube drained field site the tube drain flux and the combined flux of all other flow routes toward a stretch of 45 m of surface water have been measured for a year. Also the groundwater levels at various locations in the field and the discharge at two nested catchment scales have been monitored. The unique reaction of individual flow routes on rainfall events at the field site allowed us to separate the discharge at a 4 ha catchment and at a 6 km2 into flow route contributions.

The results of this nested experimental setup combined with the results of a distributed hydrological model has lead to the formulation of a process model approach that focuses on the spatial variability of discharge generation driven by temporal and spatial variations in groundwater levels. The main idea of this approach is that discharge is not generated by catchment average storages or groundwater heads, but is mainly generated by points scale extremes i.e. extreme low permeability, extreme high groundwater heads or extreme low surface elevations, all leading to catchment discharge. We focused on describing the spatial extremes in point scale storages and this led to a simple and measurable expression that governs the non-linear groundwater surface water interaction.

We will present the analysis of the field site data to demonstrate the potential of nested-scale, high frequency observations. The distributed hydrological model results will be used to show transient catchment scale relations between groundwater levels and discharges. These analyses lead to a simple expression that can describe catchment scale groundwater surface water interactions.