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Modelling of transient river – aquifer exchange using pressure head and heat measurements: the hyporheic zone's dimension

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Water exchange processes in the floodplain of a lowland groundwater-surface water system are studied on the basis of a study site near Freienbrink, NE Germany. The surface water boundaries of this site are formed by an oxbow and the current bed of the river Spree, section Müggelspree. Surface and ground water levels and water temperatures were collected in 12 piezometers and 2 recording stage gauges of a 300 m long transect throughout a one-year-period. Due to water level fluctuations alternation of infiltration and exfiltration occurred. However, most of the time groundwater flux is directed into the river Spree and, river water infiltration events into the aquifer are usually short and of minor importance. Due to clogging of the oxbow bed with a mud layer of different thickness the hydraulic contact between the oxbow and the adjacent aquifer is heterogeneously distributed and partially marginal. These features are modelled quantitatively using SUTRA in order to simulate coupled ground water flow and heat transport. A two-dimensional vertical modelling approach along the piezometer transect is developed to study exchange processes close to the surface water bodies more in detail in order to quantify the hyporheic fluxes of both river sections and to identify the directions and quantities of mass and heat fluxes. With the results the following questions will be answered: (1) It is possible to identify and to quantify the hydraulic processes (in- and exfiltration) between both river sections and the aquifer? (2) How fast does the exchange between the surface water and the aquifer occur? (3) Is there a hyporheic zone between the river sections and the aquifer, where groundwater and surface water are mixed, and how much water and heat will be transferred through this zones?