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# Field Study of Groundwater - Surface Water Interactions at the Lowland River Spree (Germany)

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Hyporheic zones are ecotones where groundwater and surface water mix. The hydrology of the exchange processes as well as biogeochemical turnover processes affect the quality of both water bodies: surface water is influencing groundwater and vice versa. Therefore, understanding of local flow and mass transport mechanisms is important for water management. To find out more about the involved processes we conduct investigations at a study site surrounded by the current river bed and an old branch of the lowland River Spree, a 6th order river, near Freienbrink, north-eastern Germany. Water levels and temperature in the River Spree, in its old branch and in 12 groundwater wells of a 300 m long transect are collected automatically with data loggers in order to model groundwater recharge and water exchange between surface water and groundwater. Normally, a hydraulic gradient in the aquifer causes groundwater flow into the stream. However, water level fluctuations of the stream spread out surprisingly quickly in the near-surface aquifer of the floodplain. As a result, an inverse hydraulic gradient and infiltration of surface water into the aquifer and temporary bank storage take place. We investigate how deep into the aquifer surface water infiltrates, how fast this infiltration takes place and whether there are stable mixing zones in the aquifer.

Additionally, bi-weekly measurements of chemical compounds (pH, conductivity, redox potential, oxygen, phosphate, nitrate, ammonium, sulphate, dissolved iron and chloride) are conducted to investigate nutrient exchange and the buffer zone function of the flood plain. High water levels in the flood plain support denitrification resulting in a complete elimination of nitrate. We observed high spatial variabilities of the concentrations of all ions. Exchange pattern between surface water and groundwater is

much more complex than previously thought. High spatial heterogeneities complicate data interpretation and general conclusions whereas temporal variability is surprisingly low at most locations. High chloride concentrations in some wells are caused by mineral feeding stuff fed to cattle raised on the study site. While the riparian zone can be regarded as perfect buffer zone for nitrate there is an adverse effect of high water levels on phosphate mobilization due to anaerobic conditions in the near-surface aquifer. Surprisingly high phosphate concentrations in the groundwater (more than 1000 $\mu$g PO4-P/L) are probably due to peat mineralization of relictant layers in the soil or cattle breeding on the study site. Long-term data also indicate that phosphorus concentrations of the River Spree increase in this section of the river. We assume that this is caused by infiltration of phosphorus rich groundwater.