Objectives and Research Questions

- Detailed understanding of groundwater – river water exchange dynamics at the meander to reach scale
- Quantifying water and solute fluxes across this interface
- Delineating controls of turnover of redox-sensitive compounds (carbon, oxygen, nitrate) by aerobic and anaerobic reactions
- Spatial extent and temporal dynamics of water exchange, solute transport and reactive zones

The Selke field site, Central Germany
Nico Trauth, Andreas Musolff, Christian Schmidt, Michael Vieweg, Toralf Keller, Ulrike Werban, Kay Knöller, Erik Nixdorf, Jan H. Fleckenstein

Area: 456 km²
Length: 66.7 km
Mean Q: 1.5 m³/s

Aquifer characterization

- Sediment cores | EC-logs | Inj.-logs | ERT cross-sections
- Groundwater levels
- Natural gradient salt tracer tests

Travel times | Aerobic respiration

Time series analysis of electrical conductivity and dissolved oxygen

- Windowed cross correlation of EC signal (after Vieweg et al. 2016, JGR-B)
- Average travel time of 2.3 days to well Fx1 over 10 m distance (Fig. d) → 4.3 m/d GW-flow velocity
- Travel time slightly increases with river discharge
- Mean oxygen consumption: 5 mg/L/d (Fig. e)
- Highest oxygen consumption during summer season

Denitrification

Identification of denitrification by 15N & 18O isotopes

- Typical enrichment of 15N and 18O isotopes during denitrification
  - Favorable conditions:
    - Warm season
    - Close to the river (<25m) distance
    - Low oxygen concentration

Synthesis and Outlook

Main findings
- Highly conductive riparian aquifer built up of fluvial sediments (K=3·10⁻³ m/s)
- Highest permeability in the upper 1-2 m
- Groundwater flow velocities of up to 10 m/d
- Alternating losing and gaining sections along the river reach, depending on river discharge and channel morphology
- Strong seasonal effects on aerobic and anaerobic reactions
- Highest reactivity of the riparian zone in the vicinity of the river, presumably by bioavailable carbon and heat supply of infiltrating river water

Future research
- Linking aquifer heterogeneity, (preferential flow paths), solute transport and reaction (mixing vs. reaction)
- Evaluating sensitivity of discharge events on reaction by e.g. solute mobilization of bioavailable carbon
- Effect of variation of solute concentration over depth
- Reactive transport model of the reach, implementing aquifer texture derived from geophysics
- Effect of riparian vegetation on preferential flow paths and nitrogen transformation

References