Fachabteilung Hydrologie und Wasserwirtschaft

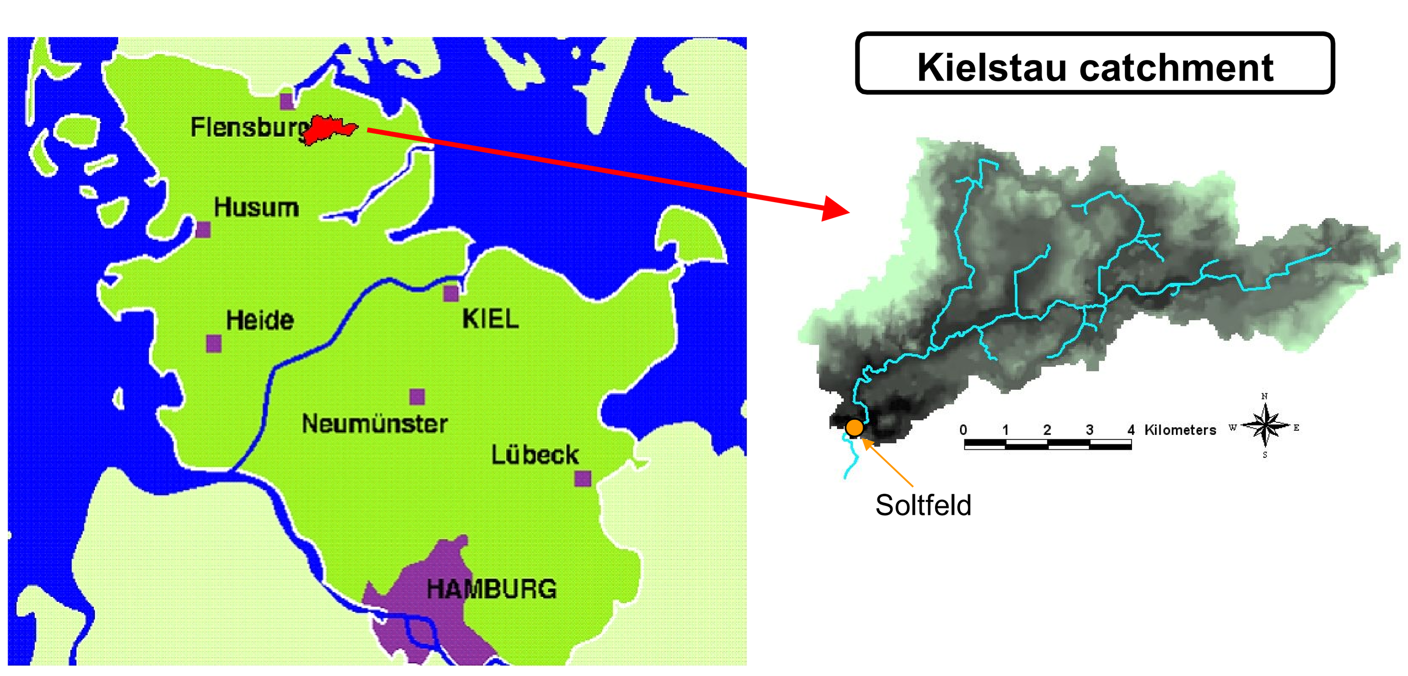
Soltfeld

Kielstau basin, Germany

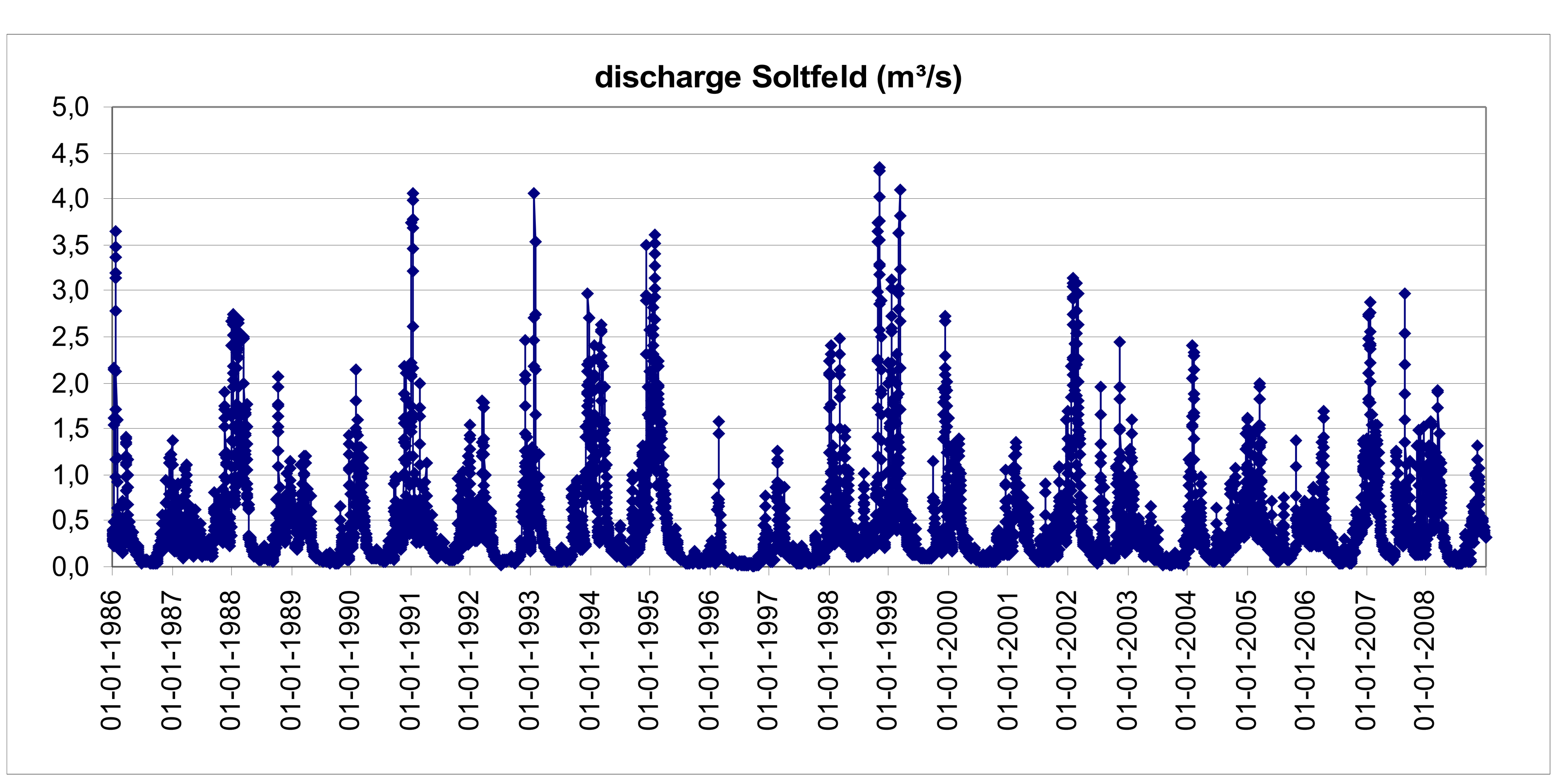
Basin characteristics

River Basin / River Basin (according EU-WFD)	Kielstau river basin / Treene basin / Eider basin
Operation (from... to...)	Since 1985, still in operation
Gauge coordinates / Gauge datum:	GK: 3532037/6064565, 26.569 m.a.s.l.
Catchment area:	49.3 km² up to Gauge Soltfeld
Elevation range:	78 m to 27 m a.m.s.l.
Basin type: (alpine, mountainous, lowland)	lowland
Climatic parameters: (mean precipitation, temperature and others)	mean annual precipitation and temperature: 893 mm and 8.3°C, respectively (DWD, 2007)
Land use:	56% arable land, 33% grassland+fallow (DLR 1995)
Soils:	Stagnic and Haplic Luvisols, Stagnic Gleysols, Sapric Histosols
Geology:	Pleistocene-Holocene, formed by ice-ages
Hydrogeology: (Type of aquifers, hydraulic conductivity)	3 porous aquifers: I and II sands Pleistocene, III lignite sands Tertiary; separated by clay-silt layers
Characteristic water discharges: (Q_{min}, Q_{max}, Q_{mean})	QNN 0.009, QMN 0.048, QM 0.424, QMH 2.747, QHH 4.522 [m³/s] (1987-2005)

Map of the research basin



Mean hydrograph / Pardé flow regime



Special basin characteristics (hydrogeology, lakes, reservoirs etc.)

1. flat area but relatively uneven with rolling hills and numerous depressions
2. hydrology characterised by shallow groundwater, low hydraulic gradients and high interaction between groundwater and surface water
3. Kielstau flows through Lake Winderatt (surface area of 0.24 km², mean depth of 1.2 m)
4. two large tributaries: Moorau and Hennebach
5. rural catchment: only few small villages and detached farms
6. fraction of drained agricultural area in the catchment is estimated to be 38% (Fohrer et al., 2007)
7. six municipal wastewater treatment plants (in total: 6378 population equivalents)
8. many parts of the Kielstau markedly changed from its natural course: river straightened, incised and thus disconnected from its floodplains; relative low hydromorphological variety and value, some near-natural river sections still exist, overall morphological state of the stream is poor - moderate
9. Kielstau is part of the flora fauna habitat protection area (FFH-directive; EC, 1992)
10. 175 ha of land along the river and around Lake Winderatt are owned by nature conservation foundations

Instrumentation and data

Measured hydrological parameters	Station, Measuring period	Temporal resolution	Operator
Water level & discharge	Soltfeld, 1985-cont.	hourly	LLUR
Water level	Soltfeld,		Ecology Centre
NO3, NH4, NtotPO4, Ptot, Cl, SO4	Soltfeld, 2006-cont.	daily	Ecology Centre
Temp, O2, pH, EC	Soltfeld, 2005-cont.	weekly	Ecology Centre
Water quality along longitudinal sections, precipitation, interaction groundwater-surfacewater, lake water quality, macrozoobenthos	different locations in basin, starting 2005	diverse	Ecology Centre

Applied models

SWAT (Soil and Water Assessment Tool, Arnold et al. 1998)

- water balance, N balance, sediment transport

Main scientific results

1. The measured and modelled discharges at the catchment outlet show a good agreement for the SWAT model set-up of the study area. The model performance (calibration) shows a Nash-Sutcliffe index between 0.80 (calibration period 2002-2007; Kiesel et al. 2008) and 0.77 (calibration period 1998-2004; Lam et al. 2008, 2009).
2. The results of sensitivity analyses show that groundwater and soil parameters were found to be most sensitive in the studied lowland catchment and they turned out to be the most influential factors on simulated water discharge (Schmalz & Fohrer 2009). The model efficiency for daily nitrate loads is 0.64 for the calibration period (June 2005 to May 2007) at gauge Soltfeld (Lam 2009).
3. A high seasonal variability in water levels and flow dynamics in the shallow groundwater as well as in the drainage ditches and the river was observed. Far from the river, at the ditch origins, the interactions in the riparian wetland are characterised by continuous effluent conditions which originate from positive differences in groundwater heads. Close to the river, at the mouth of the ditches, lower differences in groundwater heads are observed. They are partially negative, or change between positive and negative differences and result in a change between influent and effluent conditions (Schmalz et al. 2008b).
4. The measurement results showed that the in-stream water quality was influenced both from diffuse and point sources. Using a German classification system (LAWA, 1998), the NO_3-N results can mostly be assigned to water quality class III (heavily contaminated) and NH_4-N to class II (moderately polluted). Tributaries with waste water treatment plants show higher NH_4-N concentrations. High NO_3-N-values from diffuse entries were observed in most inflows, but some tributaries increased the main stream NO_3-N concentrations especially in autumn (Schmalz et al. 2008a).
5. The water quality in the drainage ditches showed a variability dependent on their hydrological integration. At the far-from-river end, groundwater and ditch water quality were in most parameters much more alike than at the close-to-river end. The composition of ditch water at the close-to-river end of the ditch was determined by transformation processes and dilution which took place along the ditch much more than exfiltration processes like those that were dominant at the far-from-river end (Schmalz et al. 2009, submitted).

Key references for the basin

1. Schmalz, B., Bieger, K. & Fohrer, N. (2008a) A method to assess instream water quality – the role of nitrogen entries in a North German rural lowland catchment. Adv. Geosci. 18: 37-41.
2. Schmalz, B., Springer, P. & Fohrer, N. (2008b) Interactions between near-surface groundwater and surface water in a drained riparian wetland. Groundwater–Surface Water Interaction: Process Understanding, Conceptualization and Modelling. IAHS Publ. 321, 21-29.
3. Schmalz, B., Tavares, F. & Fohrer, N. (2008c) Modelling hydrological lowland processes in mesoscale river basins with SWAT - Capabilities and challenges. Hydrological Sciences Journal, 53(5), 989-1000.

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