Universität Rostock Traditio et Innovatio

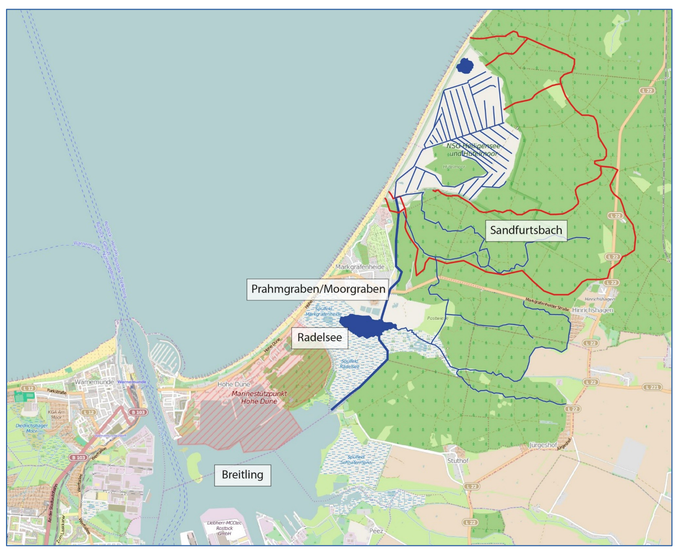
Groundsill Moorgraben

Hütelmoor und Heiligensee, Germany

Basin characteristics

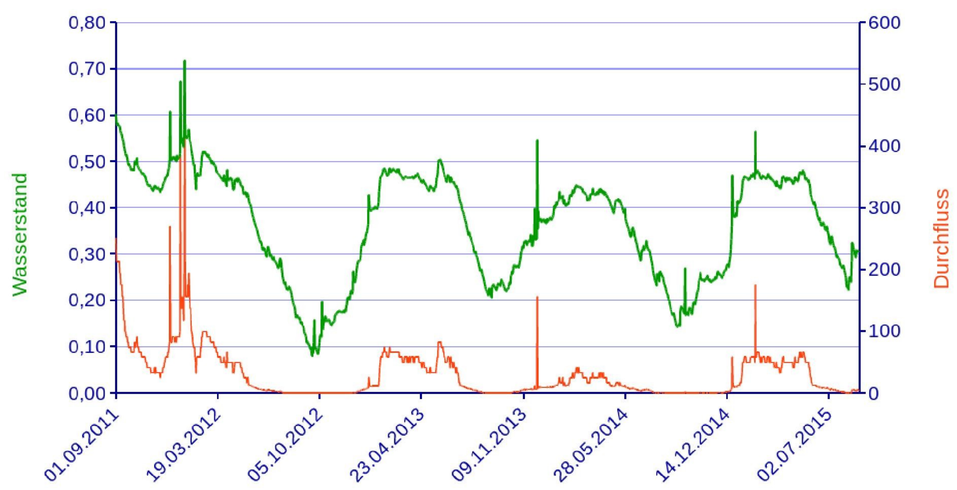
River Basin / River Basin (according EU-WFD)	Moorgraben
Operating (from… to…)	since 1987 (extended in 2009)
Gauge coordinates / Gauge datum:	N 54.20278°, E 012.15782° / 2009
Catchment area:	7,54 km²
Elevation range:	low moor: - 0,3 m – 0,7 m, forest area: predominantly 2 m
Basin type: (alpine, mountainous, lowland)	lowland
Climatic parameters: (mean precipitation, temperature and others)	precipitation: 693 mm (corrected), temperature 9,2 °C
Land use:	Forest, reed and grasland
Soils:	moor clay (fen) and iron-humus podsol (forest area)
Geology:	low moor over a sand aquifer and boulder clay
Hydrogeology: (Type of aquifers, hydraulic conductivity)	Fine sand, hydraulic conductivity (0,3 m d^{-1} - 4,3 m d^{-1})
Characteristic water discharges: (Q_{min}, Q_{max}, Q_{mean})	Q_{min} = 0 L/s, Q_{max} = 428 L/s, Q_{mean} = 24 L/s

Map of the research basin



Location of the investigation area (white area at the top right) along the Baltic Sea coast north-eastern of Rostock with the lowland fen, its sub-basins (red lines), its drainage system and its connection with the Breitling via Moorgraben and Radelsee (blue lines) (Miegel et al 2016)

Hydrograph / Pardé flow regime



Hydrographs of water level (green line) and discharge (red line) above the groundsill without correction of peaks, caused by backlog events (period September 2011 to August 2015) (Miegel et al. 2016)

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

The lowland “Hütelmoor und Heiligensee” with an area of 3,5 km² is a semi-circle low moor. The sea side (see map) is confined by a dune from the Baltic Sea. The eastern catchment area is surrounded by the nature reserve “Rostocker Heide”. Three brooks originating from the “Rostocker Heide” drain into the moor. The low moor is furthermore fed by groundwater of a regional sand aquifer. Under natural conditions, the conservation area drained directly into the Baltic Sea. After construction of a protection dune, the artificial ditch Moorgraben serves as rearward flow path between the conservation area and the Breitling, the estuary of the river Warnow.

At the beginning of the 16th Century, in the low moor as well as in the forest area, a trench system was constructed to drain and cultivate this area. The need for drainage shows that the hydrological regime is dominated by surface water and relatively dynamic processes, especially in the winter months. Since 2009, the lowland has been re-wetted by a groundsill, which is located at the above mentioned artificial outlet of the basin. Due to the groundsill, the water table of the lowland increased to an average of 40 cm above sea level.

Instrumentation and data

Measured hydrological parameters	Measuring period	Temporal resolution	Number of stations
water level	since 2009	15 min	9
electric conductivity	since 2009	15 min	5
meteorological parameters	since 2009	15 min	1
discharge	2011 – 2012	23 measurements	1
discharge (calculated by a water table – discharge relationship)	since 2011	15 min	1

Applied models

So far, the running investigations have focused on the analysis and understanding of hydrological processes. The recent modelling attempts using the models FEFLOW and OpenGeoSys address the description of the flow processes in the lowland. The mean water balance was estimated by less complex methods.

Main scientific results

The data basis consist of continuous measurements of meteorological parameters, surface water-level, groundwater table, electric conductivity (since 1987 and extended in 2009) and runoff as well as hydraulic parameters of the peat layer and sandaquifer. The measurements are sufficient to identify all relevant hydrological processes in the investigation area.

As a consequence of the storm flood in 1995, the lowland was flooded and the peat layer was salinized, setting up a natural tracer experiment. The evolution and spatial distribution of the salt concentrations after 1995 permit a deeper insight in the particular hydrological behaviour of the investigation area. Since 1995, a spatially different rehabilitation has been observed, associated with seasonal fluctuations of electric conductivity (higher concentrations in summer months and lower concentrations in winter months).

Based on measured water tables and hydraulic parameters, the groundwater flow direction and groundwater stream can be estimated. Due to low hydraulic gradients and low hydraulic conductivity of the peat layer as well as of the sandaquifer, the groundwater flow into the lowland is small compared to the surface inflow of the brooks. The subsurface flow between lowland and Baltic Sea is hydrologically insignificant and thus, nearly negligible. The results of the groundwater modelling, considering the interface between fresh and salt water, confirm these results in principle. However, they are very sensitive to the hydraulic parameters and the plane geometry of the layers.

The yearly mean runoff balanced for the investigation area amounts to 101 mm, which corresponds to 24,4 L/s. The yearly mean discharge measured at the groundsill (period September 2011 to August 2015), whose mean rainfall amount is nearly equal to the long-term average, is 27,7 L/s and coincides relatively well with the balanced runoff. This result supports the hypothesis that the subsurface stream from the lowland to the Baltic Sea is small. An uncommon feature, compared to typical runoff fluctuations of rivers in Central Europe, is the strong saisonality of discharge with maximum in late winter and minimum in late summer (see figure), following the climatic water balance. The reason is the high storage capacity of the lowland, increased by impoundage in winter months due to the groundsill.

Key references for the basin

1. Miegel, K.; Graeff, Th.; Selle, B.; Salzmann, Th.; Franck, Chr. & A. Bronstert (2016): Untersuchung eines renaturierten Niedermoors an der mecklenburgi-schen Ostseeküste – Teil 1: Systembeschreibung und hydrologische Grundcha-rakterisierung. In: Hydrologie und Wasserbewirtschaftung HW 60. 2016, H.4, S. 242 – 258.
2. Selle, B.; Graeff, Th.; Salzmann, Th.; Oswald, S.E.; Walther, M. & K. Miegel (2016): Untersuchung eines renaturierten Niedermoors an der mecklenburgi-schen Ostseeküste – Teil 2: Salzdynamik und Wasserhaushalt. In: Hydrologie und Wasserbewirtschaftung HW 60. 2016, H.4, S. 259 – 268.

Contact

Konrad Miegel
Universität Rostock
Agrar- und Umweltwissenschaftliche Fakultät
Universitätsplatz 1
Germany, 18051 Rostock
konrad.miegel@uni-rostock.de

ihp·hwrp germany