

The water budget of a coastal low-lying wetland area at the German Baltic Coast

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Coastal wetlands along the German Baltic Sea coastline and the Bodden waters are characteristic elements of the landscape of this region. Their hydrological dynamic is characterized by a significant groundwater flow from the hinterland towards the landscapes areas close to the coast, a direct hydrological intertwining of groundwater and surface waters (creeks, ponds, lakes and fens) in those near-coast areas and a potential for exchange between the fens and the Baltic Sea. Due to human interventions, e.g. the construction of dunes and dykes, drainage systems and lately also renaturation measures, their hydrological regime has undergone several transitions during the last centuries.

We present the results of studies at a catchment “Hütelmoor und Heiligensee” close to the city of Rostock, aimed at understanding and quantification the relevant hydrological process dynamics of such catchments. This area has formerly been used for pasture and has recently been restored as a nature reserve, which allows the investigation of past changes and the evaluation of possible and future developments. The investigations are based on a monitoring network measuring groundwater levels and electric conductivity within the fen since 2009, as well as on measurements of the flow and of meteorological variables. We have conducted a general water budgeting, i.e. the balancing of the different water flows across the system’s borders, such as precipitation, evapotranspiration, inflows from the neighboring parts of the catchment area, subterranean exchange processes with the Baltic Sea and the area’s surface discharge.

The analysis of the general hydrological characterization showed that the internal processes of those fens can only be understood if the groundwater flow from the hinterland is taken into consideration. The surface discharge out of the area is mainly generated within the catchment, whereby this area is also a transfer zone with considerable retention effects. It is surprising that despite low slope, sandy soils and forest vegetation, the catchment’s hydrology is dominated by quick discharge components, for which the near-surface groundwater and the reaction for open water surfaces are the main cause.

The seasonality of the area’s discharge is characterized by the formation of quick discharge components mainly during the winter half-year, and by the retention effect of the lowland/fen. This retention is especially high in summer, when the surface and ground water levels have decreased due to high evaporation rates and the discharge out of the area may cease. The magnitude of the area’s outflow thus generally depends on the catchment’s water level. Due to the possible backlog of surface water caused by high water levels of the Baltic Sea, the direction of flow may reverse episodically. In the subareas between the trenches of the lowland, vertical exchange processes from precipitation and evaporation dominate. The lateral sub-surface interaction from/to the Baltic Sea is rather small due to the particular low local subsurface hydraulic conductivity and the very small hydraulic gradient.

In summary, it can be said that this coastal low-lying wetland in the restoration phase shows rather heterogeneous hydrological processes and water balance. Characteristic are the high relevance of the subsurface processes and a strong seasonal variation, i.e. very low discharge rates in summer (except for summer convective rain storms) and considerable discharge rates in winter. The anthropogenic interventions in those coastal areas during the last two centuries have changed their water balance exceedingly. The interaction with the Baltic Sea via groundwater exchange under the dunes is very small.