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Study on hydrological processes controlling the functioning of riparian wetland patches in central Germany

H. Müller Schmied, J. Helmschrot, and W.-A. Flügel

Friedrich Schiller University of Jena, Department of Geoinformatics, Hydrology and Modelling, Jena, Germany (hannes.mueller.schmied@uni-jena.de, 0049 3641 948852)

It is common knowledge that wetlands, especially in headwater regions, play a significant role in the hydrological cycle e.g. in terms of baseflow enhancement and flood mitigation. In addition, these often complex systems are considered as valuable habitats for endangered flora and fauna. Within the mountainous regions of the Thuringian Forest, central Germany, a variety of wetland types were formed from different natural and anthropogenic dynamics. Although the hydrology is primarily considered as the driving force for the development of hydric soils, wetland vegetation and therewith habitats, only little is known about the hydrological functioning of headwater wetland systems in this region which are often small in size. Therefore a study was initiated to identify and assess hydrological processes controlling the functioning of wetlands. Aiming to develop a regional understanding of the role of such small wetlands within the headwater of the "Wipfra" river in central Thuringia, a representative wetland patch, namely "Unter dem Teufelsteiche" (2 ha) was intensively investigated combining field observations, data analysis and model approaches. An ensemble of continuous hydro-meteorological data consisting of runoff, precipitation, temperature, wind speed and radiation for a period of 13 months (10/2006 – 10/2007) as well as water quality parameters, measured during a field campaign in 2007, was used for this study.

Three methods were chosen to characterize the wetland site in order to understand i) the wetlands water sources using the water budget approach, ii) the retention function using flow duration curves and iii) the flow systems combining flow duration curves and water quality interpretation within the wetland. Using a simple water budget calculation, it was shown, that the wetland is mainly driven by inflowing surface and subsurface water rather than direct precipitation as well as direct evapotranspiration. From this effort, the wetland was characterised as a groundwater discharge wetland. The flow duration curve analysis indicates a strong retention function of the whole wetland but has also shown significant differences between the individual runoff stations. The data, however, indicate the strongest retention function below an inflow of 3 l/s. It was also demonstrated that the base flow is enhanced and the high flows are reduced. Combining flow duration curves and water quality analyses it was possible to verify the assumption that groundwater is discharging into the wetland system. Furthermore, two different flow systems were identified showing a different behaviour depending on the flow conditions. During low flow conditions runoff is mainly generated by inflow from groundwater and a spring, while surface water input to the wetland is the main runoff component during high flow conditions.

Whereas at high flow conditions the major surface water input leaves through the main outlet, this outlet is feed only from groundwater and a spring during low flows.

The presentation will introduce and discuss methodological approaches and main findings of the study and will contribute to a better understanding of the importance of such small riparian wetland sites for regional hydrological modelling.