

The perirheic zone in Biebrza wetlands: its dynamics and interrelations with ecology and climate

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The perirheic zone, i.e. mixing zone between river and floodplain waters, is present during floods it natural wetlands. Many studies show that the different properties of floodplain water, river water and the resulting perirheic water constitute environmental gradients and thresholds which affects biogeochemistry and ecology. Therefore, understanding the spatiotemporal dynamics of the perirheic zone is critical to floodplain management. One of the perirheic zone sites is the Biebrza River catchment (north-east Poland), which we use in this study to apply the Hydraulic Mixing-Cell (HMC) method in a fully integrated surface-subsurface hydrological model (HydroGeo-Sphere). The model is run for a 1 year period and the catchment area is 7000 km² with 220 km² wetland floodplain that we especially focus on. The HMC method allows calculation of the composition of water sources in each computational node of the model. The water sources have to be pre-defined and differentiated by area (e.g. subcatchments, landscape forms) and boundary conditions (e.g. rain, snowmelt). HMC calculation depends only on computed nodal water fluxes and does not require any extra parameters.

As compared to field sampling and hydrochemical analysis, the HMC results accurately reproduced the temporal and spatial patterns of distinct water signatures from river, precipitation (snowmelt and rain) and groundwater, while simultaneously providing an interpretation into the development, persistence and recession of the river, floodplain and perirheic zones. Simulation results show that within the inundation area the river water zone comprises only area adjacent to the river, in a few kilometers buffer, whereas the remaining part is covered by water from rainfall, snowmelt and groundwater. The temporal and spatial variability of these zones affects such processes as denitrification, sedimentation and biomass removal. We analyses the zonation using the vegetation pattern in the floodplain. And look at the implications of climate change (e.g. increase of rainfall or decrease of snowfall) on the river, floodplain and perirheic zones dynamics.