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title: **Groundwater modelling and wetland flow system analysis of Czerwone Bagno, Biebrza Valley, Poland**

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Groundwater modelling is a widely used tool for identification of flow paths in wetlands, where the soil, vegetation and groundwater flow processes are strongly connected (Wassen, 1990). Spatial distribution of seepage and dynamics of the phreatic groundwater table are the most important parameters that influence main function of those ecosystems (Van Loon et al., 2009). However, the detailed spatial variation of phreatic organogenic aquifer is often neglected in wetland groundwater modelling due to lack of data and complexity of the soil profile. Comprehensive wetland groundwater models should therefore consider spatially distributed physical complexity of surficial layers. Validation of such models should involve dynamic criterions such as inundation time and seasonal variability of unsaturated zone thickness (Chormanski et al., 2009).

Main goal of this study was to examine spatial distribution of groundwater discharge within the Middle Biebrza Basin. Biebrza Valley (Poland) becomes one of the largest coherent wetlands on European Lowlands. To analyze groundwater flow pathways that determine ecohydrological continuum of wetlands, a regional steady-state groundwater flow model based on the MODFLOW code (McDonald, Harbaugh, 1988) was setup. Developed model covers the area of 182,5 km^2 and consists of four layers, which include fluvio-glacial sands as a main regional aquifer and Holocene sediments (peat, moorsh and gyttia) (Falkowski, Złotoszewska-Niedziałek, 2008; Pajnowska, 1996). Physical parameters of organic soils as well as its spatial distribution was based on field research. To quantify groundwater discharge patterns the DRAIN PACKAGE was applied to the whole model domain (Batelaan, De Smedt, 2004). Calibration of presented model included data of groundwater level measured in 33 shallow piezometers located in various wetland habitats. In result of trial-and-error calibration as well as the PEST inverse modelling calibration (Doherty, 1994), root mean squared error of presented model was reduced to 0,3 m. EC and pH measurements were taken into account in the groundwater discharge conditions examination. Spatial analysis of groundwater seepage was compared to actual wetland habitat distribution within the Middle Biebrza Basin. Groundwater catchment mapping indicated areas of rivers and canal's draining impact, which can cause wetlands degradation in future.

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REFERENCES

Batelaan O., De Smedt F., 2004: *Seepage, a new Modflow Drain Package*. Ground Water 42 (4): pp. 576–588.

Chormański J., Kardel I., Świątek D., Grygoruk M., Okruszko T., 2009: *Management Support System for wetlands protection; Red Bog and Lower Biebrza Valley case study*. Hydroinformatics in Hydrology, Hydrogeology and Water Resources, Proc. of Symp. JS.4, Joint IAHS & IAH Convention, Hyderabad, IAHS Publ. 331: pp. 423–431.

Doherty J., 1994: *PEST; Model–independent parameter estimation, User Manual, 5th ed*. Watermark Numerical Computing.

Falkowski T., Złotoszewska-Niedziałek H., 2008: *„Czerwone Bagno" Geological research for hydrogeological model of water feeding of peatlands of "Red Bog" Reserve [in Polish]*. Biuletyn PIG 431.

McDonald M.G, Harbaugh A.W., 1988: *A modular three-dimensional finite-difference groundwater flow model*. U.S. Geological Survey Techniques of Water-Resources Investigations, book 6.

Pajnowska H., 1996: *Hydrogeology and the groundwater inflow of the Middle Biebrza Basin [in Polish]*. Zeszyty Problemowe Postępów Nauk Rolniczych 432.

Van Loon A.H., Schot P.P., Griffionen J., Bierkens M.F.P., Batelaan O., Wassen M.J., 2009: *Throughflow as a determining factor for habitat contiguity in a near-natural fen*. Journal of Hydrology 379: pp. 30–40.

Wassen M.J., 1990: *Water flow as a major landscape ecological factor in fen development*. PhD Thesis, University of Utrecht: 200p.

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