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Impact of water management policy on flow conditions in wetland areas

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In this study we apply methodology based on Global Sensitivity Analysis (GSA) and Generalised Likelihood Uncertainty Estimation (GLUE) to the assessment of the impact of human activity in a river system. The Upper Narew Basin, NE Poland, is used as a case study. A relatively large lowland reservoir, Siemianówka, constructed at the beginning of the 1990s, is situated upstream. The studied river reach is 140 km long, with a valuable wetland ecosystem enclosed within the Narew National Park (NNP) at its downstream end. Previous management plans for the reservoir were focused on direct economic goals, such as energy production, fisheries and land irrigation. However, because of a rapid degradation of the NNP ecosystem in recent times, it was decided to include the protection of the wetland areas. After establishment of the NNP as one of the Natura 2000 regions, ecosystem protection became one of the reservoir's main goals. To achieve it, the current influence of its release policy on flow conditions has to be investigated. In addition, this investigation should be performed jointly with an analysis of other factors, such as land use changes and modification of channel geometry.

The flow in the river reach was modelled using a One-dimensional Unsteady NETwork model (UNET), developed by the Hydrologic Engineering Center (HEC). Water management activities were represented by the parameterised inferences having an impact on ecological measures, representing the water demands of the Narew National Park. Their significance was measured using a Global Sensitivity Analysis technique. This allowed each inference, in the form of sensitivity indexes, to be quantified and compared. Additionally, in the case of spatially distributed (diffuse) impacts, it was possible to estimate their significance on the hydrology and ecology of wetland area situated along the river reach. The study showed that flood peak reduction has had a major impact on the ecological systems, through a decrease of the flooded areas within the NNP. Additionally, changes in channel and floodplain geometry have had a significant local effect on water levels and the extent of related flood inundation.