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Application of the Newtonian nudging data assimilation method for the Biebrza River flow model

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Data assimilation provides a tool for integrating observations of spatially distributed environmental variables with model predictions. In this paper a simple data assimilation technique, the Newtonian nudging to individual observations method, has been implemented in the 1D St. Venant equations. The method involves adding a term to the prognostic equation. This term is proportional to the difference between the value calculated in the model at a given point in time and space and the one resulted from observations. Improving the model with available measurement observations is accomplished by adequate weighting functions, that can incorporate prior knowledge about the spatial and temporal variability of the state variables being assimilated. The article contains a description of the numerical model, which employs the finite element method (FEM) to solve the 1D St. Venant equations modified by the 'nudging' method. The developed model was applied to the Biebrza River, situated in the north-eastern part of Poland, flowing through the last extensive, fairly undisturbed river-marginal peatland in Europe. A 41 km long reach of the Lower Biebrza River described by 68 cross-sections was selected for the study. The observed water stage collected by automatic sensors was the subject of the data assimilation in the Newtonian nudging to individual observations method. The water level observation data were collected in four observation points along a river with time interval 6 hours for one year. The obtained results show a prediction with no nudging and influence of the nudging term on water stages forecast. The developed model enables integrating water stage observation with an unsteady river flow model for improved water level prediction.