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Flow prediction using stochastic emulators of flood wave propagation process: middle Vistula case study

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Flow predictions along the river reach are required for flood protection, flood risk assessment and also for the planning of water infrastructures and water management. Due to uncertainties involved in hydro-meteorological observations and mathematical modelling, the predictions are always uncertain. Their uncertainty increases with an increase of the time horizon of the prediction – e.g. when forecasts of flow are required many days ahead. Apart from the uncertainty, also the speed of forecast acquisition might also be of concern, in particular when fast preventive actions should be taken to issue flood warning to the public, or some water management actions should be performed. In these cases, the stochastic emulators of flood wave propagation might be very useful. The emulators can be based on available data but also be built using the modelled flows along the river in the absence of the required observations.
The middle River Vistula reach stretches between Zawichost and Warsaw and is 100 km long. Two distributed flow routing models were built for the reach based on the detailed river channel and floodplain geometry data. These models are used for the temporal and spatial interpolation of the water level observations available at only 5 cross-sections and in the form of daily averages of water levels. The observations span over 50 years, but they are irregular, with long periods missing either flow or level data. The observed and modelled water level data were used to build stochastic emulators in the form of a nonlinear transformation of water levels at cross-sections along the river reach. The validation of the emulators and the comparison of their performance are done using the available observations of water levels at those cross-sections. A discussion is given on the uncertainty of predictions and the application of emulators to on-line forecasting.

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