

Zoning coincidence of flood wave peaks

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Knowledge of high water and determination of threatened area is extremely important for flood protection. Flood formation mainly depends on atmospheric conditions, i.e. precipitation duration, intensity and spatial extend as well as on a river basin characteristics and its hydrological conditions. Large-scale weather systems generating prolonged rainfall over wide areas may cause flooding in main rivers and in smaller basins that drain into the major river system.

The research presents a method to assess the interactions between two main Polish rivers: Odra and Vistula and their tributaries during the episodes of high water levels over large areas in order to designate zones of flood wave peak coincidence for building regional and catastrophic floods scenarios.

Assessment the interaction between flood wave peaks was done based on daily hydrological data collected within the period of 1975-2010 by 330 gauging stations. The term "coincidence" was used as the simultaneous occurrence of flood wave peak on two or more rivers. The assessment method was based on the application of signal processing techniques in order to investigate similarity of time series of daily hydrographs for each pair of water gauging stations in the analyzed system of rivers. Dynamical Time Wrapping (DTW) method allows finding the smallest distance between two time series when allowing time transformation for both series. The biggest advantage of this method is its ability to recognize corresponding flood events as well as their wave peak values. Based on the results obtained, water gauges were grouped into flood wave peak zones using taxonomy methods. The target characteristic of the developed zones was a high similarity of flood hazard within a zone expressed in terms of peak flow occurrence in relation to climatological, hydrological and topographical conditions. Spatial distributions of the latter conditions were used to supervise the process of grouping DTW results into clusters. Clusters delineation was an interactive and iterative step-by-step process to find an optimal range of each zone. Optimal was defined as spatially consistent, hydrographically and climatically coherent. The applied methodology yielded to determination of 35 zones covering most of the territory of Poland that represents areas of risk of simultaneous riverine flooding during the episodes of large scale floods.

The obtained zoning of flood wave peak coincidence can be applied to optimize the flood protection system management, insurance as well as flood forecasting and warning.