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A flood risk assessment and mapping for Riga city

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Riga (population ca. 800,000) is the capital of Latvia. The city is located at the southern coast of Gulf of Riga along the lower stretch of the River Daugava. The water bodies adjacent or within the territory of the city are the River Daugava itself, its connection (Bullupe) to another major river – Lielupe, several minor tributaries of the River Daugava, as well as an interconnected lake system of estuarine origin. The flow in the lower stretch of the River Daugava is regulated by Riga hydropower plant which is situated approx. 25 kilometers upstream the river mouth. The lowest 12 kilometers of the river channel is dredged to ensure the operation of the Riga Freeport.
The aims of the study were (1) the identification of the flood risk situations, (2) the quantification of the flooding scenarious of different return periods, (3) the building and calibration of the hydrodynamical mathematical model for the domain potentially vulnerable for flooding, (4) the calculation of flood events with different return period, and (5) the detailed (horizontal accuracy around 10 m) of the potentially flooded areas.
The combination of storm surges in the southern part of Gulf of Riga with unfavorable regime of hydropower plant operation was found as the most dangerous flooding situation. The time series of water level at the mouth of the River Daugava was analysed for more than 130 year long time period. The significant trend was found in the annual peak water level. Five significant storm events were found in time period 2001-2007 which roughly correspond to storm surges with return period once in 5, 10, 20, 50 and 100 years. The model storm events were created by scaling waterlevel and meteorological conditions during these selected events, and superposing them with hydropowerplant operation regime.
The finite-element based shallow water model was built for the area, potentially vulnerable for flooding. Heterogeneous depth/terrain information from various sources was integrated in the model. The linear objects (watercourses, dams, etc.) of hydraulic importance were included in the model. The typical spatial resolution of approx. 50-100 m was reached with total number of finite elements around 250,000.
The hydrodynamical model was calibrated on the basis of water level observations in 5 different locations during 5 selected real storm events. The hydrodynamics of the flood scenarious were calculated for the model storm situations. The importance of the dynamical modeling of flooded areas was shown for the domain with a complex channel system and typical length of storm event below 18 hours.
The method for the mapping of the results of hydrodynamical calculations on the digital terrain map of much higher (10 m) spatial resolution was proposed and applied.