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# A flood risk assessment for Riga city taking account climate changes

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Riga, the capital of Latvia, is located on river Daugava. Several lakes with remarkable basin comparable to city size are also located in Riga. Storm surges in the winter and snow and ice melting during spring time are considered as the most dangerous flooding situations for the city. In this study we assume that winter storm and spring flooding events can not occur simultaneously therefore both cases are studied separately.
The aims of the study were (1) the identification of the flood risk situations, (2) the quantification of the flooding scenarios caused by spring snow-melt flood of different return periods, (3) the building and calibration of the hydrodynamical mathematical model for the domain potentially vulnerable for flooding nowadays, in the near future (2021-2050) and far future (2071-2100) taking into account projections of near and far future climate changes, (4) the calculation of flood events with different return periods, (5) mapping the potentially flooded areas on a fine grid and also taking into account future city development plans and potential changes of topography and (6) joining results obtained for storm surges and snow and ice melting events of the same return period.
The time series of water level in river Daugava and entrances of lakes were analyzed for more than 130 year long time period. Maximal water level occurrence probability was calculated. According to occurrence probability six scenarios for nowadays, near and far future with return period once in 5, 10, 20, 50, 100 and 200 years were constructed.
The hydrological modelling driven by the temperature and precipitation data series from regional climate models were used for evaluation of snow-melt flood maximums in future reference periods. The usage of the climate model data in hydrological models causes systematic errors, therefore the delta change method is applied for determination of the future level maximums during the snow and ice melting floods. Small growth of the snow melting event maximum in the nearest future and small reduction of the snow melting event maximum in the far future comparing to nowadays is expected.
The finite-element based shallow water model was built for the area, potentially vulnerable for flooding. High resolution (approx. 1.5 points per square meter) digital terrain map (DTM) was used as the base for finite element mesh. Additionally, linear objects (watercourses, dams, etc.) of hydraulic importance were included in the model. The typical spatial resolution of approx. 20-100 m was used with total number of finite elements around 250 000.
The method for the mapping of the results of hydrodynamical calculations on the DTM of very high spatial resolution was proposed and applied.