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Modeling urban flood risk territories for Riga city

A. Piliksere, J. Seņņikovs, J. Virbulis, U. Bethers, P. Bethers, and A. Valainis
University of Latvia, Latvia (anita.piliksere@gmail.com)

Riga, the capital of Latvia, is located on River Daugava at the Gulf of Riga. The main flooding risks of Riga city are: (1) storm caused water setup in South part of Gulf of Riga (storm event), (2) water level increase caused by Daugava River discharge maximums (spring snow melting event) and (3) strong rainfall or rapid snow melting in densely populated urban areas. The first two flooding factors were discussed previously (Piliksere et al, 2011).

The aims of the study were (1) the identification of the flood risk situations in densely populated areas, (2) the quantification of the flooding scenarios caused by rain and snow melting events of different return periods nowadays, in the near future (2021-2050), far future (2071-2100) taking into account the projections of climate change, (3) estimation of groundwater level for Riga city, (4) the building and calibration of the hydrological mathematical model based on SWMM (EPA, 2004) for the domain potentially vulnerable for rain and snow melt flooding events, (5) the calculation of rain and snow melting flood events with different return periods, (6) mapping the potentially flooded areas on a fine grid.

The time series of short term precipitation events during warm time period of year (id est. rain events) were analyzed for 35 year long time period. Annual maxima of precipitation intensity for events with different duration (5 min; 15 min; 1h; 3h; 6h; 12h; 1 day; 2 days; 4 days; 10 days) were calculated.

The time series of long term simultaneous precipitation data and observations of the reduction of thickness of snow cover were analyzed for 27 year long time period. Snow thawing periods were detected and maximum of snow melting intensity for events with different intensity (1day; 2 days; 4 days; 7 days; 10 days) were calculated.
According to the occurrence probability six scenarios for each event for nowadays, near and far future with return period once in 5, 10, 20, 50, 100 and 200 years were constructed based on the Gumbell extreme value analysis.

The hydrological modelling driven by the temperature and precipitation data series from regional climate models were used for evaluation of rain event maximums in the future periods. The usage of the climate model data in hydrological models causes systematic errors; therefore the bias correction method (Sennikovs, Bethers, 2009) was applied for determination of the future rainfall intensities.

SWMM model was built for the urban area. Objects of hydraulic importance (manifold, penstock, ditch, pumping station, weir, well, catchment sub-basin etc.) were included in the model. There exist pure rain sewage system and mixed rain-water/household sewage system in Riga. Sewage system with wastewater load proportional to population density was taken account and calibrated. Model system was calibrated for a real rain event against the water flux time series into sewage treatment plant of Riga.

High resolution ($\sim$1.5 points per square meter) digital terrain map was used as the base for finite element mesh for the geospatial mapping of results of hydraulic calculations.
Main results of study are (1) detection of the hot spots of densely populated urban areas; (2) identification of the weak chains of the melioration and sewage systems; (3) mapping the elevation of ground water mainly caused by snow melting.

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