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Application of regional climate data as input for hydrological modelling

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The goal of this study was to check the suitability of application of regional climate model (RCM) forcing data for hydrological modelling.

The spatially distributed finite volume based hydrological model was set-up for the pilot basin in central Latvia (river Aiviekste, catchment area 9300 sq.km). The primary forcing input for the model consists of the time-series of temperature and precipitation. We considered set of 21 RCM model output data from the PRUDENCE project. They were statisically tested against temperature and precipitation observations for the reference period (1961-1990). The best performing RCM was selected according to penalty function constructed based on monthly average temperature, precipitation and montly standard deviation of temperature and precipitation.

The calibrated hydrological model was employed for the run-off calculations of climatic reference period (1961-1990). The first step of the study was to statistically compare (1) observed discharge, (2) modelled discharge using observed temperature and precipitation as the forcing, (3) modelled discharge using the temperature and precipitation time series from the best RCM as the forcing. The monthly average observed discharge agrees well with the modelled discharge in case of usage of the observed forcing. The agreement of observed discharge with modelled discharge using RCM data is rather disappointing, especially during winter and spring snow melt flood periods. Usage of the meteorological forcing from the RCM's reference period overestimates yearly average discharge by approximately 70%.

The second step of our study was to modify and use the modified RCM data as an input for hydrological modelling. The modification method relies on equalizing of temperature and precipitation histograms between observed and RCM data for each day of the year and each observation location. We show that monthly average discharges agree quite well with observed in the case of use of modified RCM data as a forcing.

In the third step we applied RCM modification method to the climatic scenarious A2 and B2 modeled by selected regional climate model and calculated corresponding hydrological scenarious. The main features of the expected future hydrological regime for our region were revealed, namely, (1) yearly average run-off slightly decreases, (2) winter run-off significant increases, (3) value of the peak discharge during spring snow-melt is significantly smaller, (4) spring peak shifts towards winter.