Rainfall-runoff modelling of extreme events coupled to statistically downscaled precipitation from GCM scenario runs for two Swedish catchments

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Precipitation is assumed to change in both timing and amount in a changed climate. Obviously this will together with a changed temperature influence catchment runoff, and rainfall-runoff models have been used to estimate these potential changes. However, predictions from global climate models can not be used directly. In the past, in many studies simply the average change (e.g., +10%) from the global climate model was used, but this neglects any changes in the temporal patterns. Downscaling methods are required for a more realistic assessment of the effect of precipitation changes on catchment runoff. In this study, simulations from two global climate models, the HadAM3P and the ECHAM4 model, for the IPCC A2 and B2 scenarios were used to downscale daily precipitation in two small catchments in central Sweden. For the downscaling, an objective weather-classification was developed for Sweden (SWP) by applying a multi-objective fuzzy-rule-based classification method (MOFRBC) to large-scale-circulation predictors in the context of statistical downscaling for local precipitation. The predictor data was MSLP and geopotential heights at 850 and 700 hPa from the NCEP/NCAR reanalysis project. The precipitation series were generated with a stochastical model conditioned on SWP and a locally optimised classification. The downscaling was optimised to capture extreme events, such as prolonged dry periods and maximum 5-day precipitation. The precipitation time series were used as input to a conceptual rainfall-runoff model, the HBV model. A Monte-Carlo approach was used for calibration of the HBV model. We randomly generated 5 million parameter sets and evaluated these parameter sets using observed climate and runoff records. The parameter sets providing the 100 best fits between observed and simulated runoff were kept for the further analysis. The HBV model simulation using the downscaled climate data allowed us then to evaluate effects of a potential climate change on extreme situations in the hydrologic regime, such as probabilities of floods and prolonged dry-spells. The preliminary results for the runoff modelling indicated that maximum flows would decrease despite the increase in precipitation. Also, the minimum flow over a 15-day period increased in the scenario runs.