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Assessing the impacts of climate change on future water resources: a methodological approach based on equiratio CDF-matching and vine copula

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In this study, the impacts of climate change on future river discharge are evaluated using equiratio CDF-matching and a stochastic copula-based evapotranspiration generator. In recent years, much effort has been dedicated to improve the performances of RCMs outputs, i.e. the downscaled precipitation and temperature, to use in regional studies. However, these outputs usually suffer from bias due to the fact that many important small-scale processes, e.g. the representations of clouds and convection, are not represented explicitly within the models. To solve this problem, several bias correction techniques are developed. In this study, an advanced quantile bias approach called equiratio cumulative distribution function matching (EQCDF) is applied for the outputs from three RCMs for central Belgium, i.e. daily precipitation, temperature and evapotranspiration, for the current (1961-1990) and future climate (2071-2100). The rescaled precipitation and temperature are then used to simulate evapotranspiration via a stochastic copula-based model in which the statistical dependence between evapotranspiration, temperature and precipitation is described by a three-dimensional vine copula. The simulated precipitation and stochastic evapotranspiration are then used to model discharge under present and future climate. To validate, the observations of daily precipitation, temperature and evapotranspiration during 1961 – 1990 in Uccle, Belgium are used. It is found that under current climate, the basic properties of discharge, e.g. mean and frequency distribution, are well modelled; however there is an overestimation of the extreme discharges with return periods higher than 10 years. For the future climate change, compared with historical events, a considerable increase of the discharge magnitude and the number of extreme events is estimated for the studied area in the time period of 2071–2100.