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Linking probabilistic climate scenarios with downscaling methods for impact studies

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This paper develops a method for linking probabilistic climate scenarios with downscaling methods for hydrological impact studies, using Bayesian statistics to weight climate model outputs based on bias and convergence criteria.

The method uses a weather generator model recently developed for the Environment Agency in the UK. Six Regional Climate Models from the PRUDENCE project, driven by boundary conditions from two different GCMs, are used to produce pdfs of change in temperature and precipitation for regions in the north-west and south-east of the UK. A weather generator approach is then used to downscale these change pdfs to the catchment scale using change factors (CFs; the difference between the future and control simulations). These CFs (Rainfall: mean, proportion dry days, variance, skewness, Lag 1 autocorrelation; Temperature: mean, standard deviation) are applied to the weather generator, which incorporates a stochastic rainfall model based on the Neyman Scott Rectangular Pulses model, and a regression-based temperature and PET generator. Time series of precipitation and temperature/PET are then used as input to a calibrated rainfall-runoff model of the river Eden catchment in northwest England. The different RCMs are weighted by using multiple simulations, based on the weighting derived for the regional change pdfs; providing pdfs of change in various flow statistics. This method allows the uncertainty in the forecasts of different RCMs to be assessed, providing a probabilistic estimate of future climate change impacts. The sensitivity of the weighting procedure is also tested.