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Improving the probability distribution of the change in extreme river flows due to climate change

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Probability estimates of the future change of an extreme flood event are often based on a small number of available GCM or RCM projections. This limits the possibilities to assess extreme flood risks. A relatively simple method has been developed to create a wider statistical distribution for probabilistic risk management. In the framework of the RHEINBLICK project, daily flows for the river Rhine were simulated using the HBV model. Seven RCM projections were used as input for the hydrological simulations, all forced by a small number of GCMs under the IPCC SRES A1B emission scenario. Time series resampling was applied to extend 30-year RCM time-slices to 3000-year series to be able to take floods with return periods up to 1000 year into account. To assign probabilities to these individual projections a hypothetical probability distribution is constructed that covers a broader range of uncertainty than the one based on the seven RCM projections. To achieve this, ten GCM projections, also under the IPCC SRES A1B emission scenario, are analysed for the Rhine basin. The climate responses of the GCMs are used to modify an observed (1961-1990) precipitation/temperature time series used as forcing for the HBV model. Changes in the temporal means and variability are taken into account. It is shown how far the range of extreme flows generated from the seven RCMs is affected by using a broader range of GCM projections. This method demonstrates how the estimation of the uncertainties of the change of an extreme flood event from a relatively small RCM-GCM ensemble can be improved by combining statistically the RCM-GCM ensemble with a GCM only ensemble in which a larger set of GCMs is taken into account.