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Weather patterns as a downscaling tool – evaluating their skill in stratifying local climate variables

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The use of a weather pattern based approach for downscaling of coarse, gridded atmospheric data, as usually obtained from the output of general circulation models (GCM), allows for investigating the impact of anthropogenic greenhouse gas emissions on fluxes and state variables of the hydrological cycle such as e.g. on runoff in large river catchments. Here we aim at attributing changes in high flows in the Rhine catchment to anthropogenic climate change. Therefore we run an objective classification scheme (simulated annealing and diversified randomisation – SANDRA, available from the cost733 classification software) on ERA20C reanalyses data and apply the established classification to GCMs from the CMIP5 project. After deriving weather pattern time series from GCM runs using forcing from all greenhouse gases (All-Hist) and using natural greenhouse gas forcing only (Nat-Hist), a weather generator will be employed to obtain climate data time series for the hydrological model.
The parameters of the weather pattern classification (i.e. spatial extent, number of patterns, classification variables) need to be selected in a way that allows for good stratification of the meteorological variables that are of interest for the hydrological modelling. We evaluate the skill of the classification in stratifying meteorological data using a multi-variable approach. This allows for estimating the stratification skill for all meteorological variables together, not separately as usually done in existing similar work. The advantage of the multi-variable approach is to properly account for situations where e.g. two patterns are associated with similar mean daily temperature, but one pattern is dry while the other one is related to considerable amounts of precipitation. Thus, the separation of these two patterns would not be justified when considering temperature only, but is perfectly reasonable when accounting for precipitation as well.
Besides that, the weather patterns derived from reanalyses data should be well represented in the All-Hist GCM runs in terms of e.g. frequency, seasonality, and persistence. In this contribution we show how to select the most appropriate weather pattern classification and how the classes derived from it are reflected in the GCMs.