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Climate change signal over the Alpine region – sensitivity to GCM selection

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The use of multi-model ensembles has become a common and widely accepted practice to evaluate climate change signals and various aspects of the associated uncertainties. However, for regional analysis of climate change, it is not always feasible to use all of the available model simulations. Some models do not sufficiently represent processes that are important for a particular region, or they lack crucial topographic details to represent the corresponding climate in a realistic manner. When relying on regional climate model projections, a GCM selection is implicitly done, as not all of the available GCM simulations are being dynamically downscaled.
Specifically, within EURO-CORDEX, more than 30 RCM simulations and more than 10 GCMs are provided for the strongest emission scenario RCP8.5 from the CMIP5 ensemble. Simulations with other emission scenarios are also provided. However, many RCMs in EURO-CORDEX are driven by one of only five of the available GCMs (CNRM-CM5, MPI-ESM, HadGEM, IPSL and EC-EARTH). It was shown previously that in particular RCM temperature responses tend to cluster according to their driving GCM. Therefore, it is important to better understand the relation among the GCMs. In multi-model ensembles as large as CMIP5, in which models tend to correlate due to their similar origin, model selection or weighting becomes an important issue.
This study evaluates the distribution of climate change signals in the CMIP5 ensemble for temperature and precipitation over the Greater Alpine region and shows that different methods of model selection considerably influences the resulting temperature spread in the climate change signals at the end of the century relative to 1980-2009: excluding those GCMs with a poor representation of Alpine climate leads to a spread-difference of more than 1°C compared to a choice where all models are included and given the same weight. Furthermore, it is highlighted that the largest amount of spread can be retained with a weighting scheme based on a cluster analysis. Hence, this work may have important implications for current and future design of multi-model projects such as CORDEX.