



GCM selection based on weather patterns for extreme heat: a case study over Belgium

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The process of selecting suitable time periods within the Coupled Model Intercomparison Project Phase 6 (CMIP6) for a specific region and warming level presents notable challenges, such as the incomplete representation of atmospheric dynamics and climate-change uncertainties. This study aims to develop a selection procedure for CMIP6 model periods using a methodology to address both the representation of atmospheric dynamics and the relevant changes in the climate variable of interest. In the first step, the representation of past atmospheric dynamics is evaluated to investigate the model quality. This is then used as a criterion to exclude underperforming models. The second step gives information on interesting model periods and indicates which model periods are relevant for selection.

To eliminate models that did not adequately represent historical atmospheric dynamics, the Lamb Weather Type (LWT) classification was used to assess the representation of large-scale circulation patterns across 33 CMIP6 models and compare these with ERA5. This resulted in the exclusion of three CMIP6 models for the circulation regimes over Belgium. Furthermore, in order to account for the increased occurrence of weather patterns related to extreme heat, while also reducing the number of different weather types of the existing LWT classification, the classification was adapted to incorporate a temperature-dependent classification through the optimization of the clustering of weather types and the associated maximum temperatures. Additionally, a new index, the hot weather type index, was introduced and combined with a set of heat-related metrics to illustrate the selection methodology. The final period selection was made based on the combination of the ranks of the different metrics for each global warming level considered.

The method developed in this study offers a framework for selecting periods within CMIP6 while considering both the uncertainties of the large-scale circulation patterns and changes in the climate-change signal. This framework holds potential to contribute to regional climate modelling and facilitate decisions related to the selection of model periods for dynamical downscaling of

relevant climate projections.