Selecting representative climate simulations for impact studies using cluster analysis

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In climate change impact research it is crucial to carefully select the climatic input in order to realistically represent the uncertainty in climate scenarios. Usually, the selection of a few simulations as input for the impact investigation is mostly based on subjective expert judgment. However, a more sophisticated objective approach should consider the fact that these climate simulations stem from an ensemble of opportunity, which might inherit model inter-dependencies and biases. Such objective methods for sub-sampling climate simulations from a larger ensemble receive relatively small attention in scientific literature.

This study represents one possible framework to aid selecting representative climate simulations for specific climate impact studies. By doing so, model interdependence is taken into account, leading to a more reliable ensemble. Multivariate statistical methods are used to describe model dependence based on the spatial patterns of their climate change signals. Several meteorological parameters important for impact models are therefor considered simultaneously. After using dimension reduction techniques, like principal component analysis, similar behavior of climate simulations is detected using cluster analysis. From each grouping found, one representative simulation will be selected, leading to a more independent sub-sample while conserving the main climate change characteristics of the original ensemble.

This method can be applied using standard statistical software and is easily adoptable to various sets of meteorological variables and regions. We present an application of this method to select representative simulations from the ENSEMBLES regional multi-model ensemble for a variety of climate impact studies spread over the whole European continent in the EU-FP7 project IMPACT2C.