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Weighting climate models for regional projections

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Estimates of impacts as well as adaptation and mitigation strategies related to anthropogenic climate change require a precise understanding of the anticipated changes as well as the uncertainties associated with it. Recent coordinated efforts, in which numerous climate models have been run for a common set of experiments, have produced large datasets of projections of future climate for various scenarios. Those multi-model ensembles sample initial condition, parameter as well as structural uncertainties in the model design, and they have prompted a variety of approaches to quantify uncertainty in future climate in a probabilistic way. However, difficulties arise in combining the information from various models and aggregating the information over space.

The “IPCC regions”, a set of about twenty rectangular land areas, have often been used as the basis for calculations of regional climate change. However, increasing resolution of models may provide information on smaller regional scales. Furthermore, these regions should be based on similar future changes, depending on the variable of interest and of the consistency of simulations across models. Regions being too small may lead to a disagreement in the signal of the models, regions being too large average different regimes together and changes will be blurred. Using clustering algorithms, we identify regions encompassing similar projections in climate change across models and grid points to find an optimal set of regions where future climate change appears to be most consistent across models.

Aggregating information from different models remains a challenge, since it requires an assumption of how models should be weighted, or which ones should be discounted. We propose to use a set of indices like the meridional temperature gradient,

land ocean warming ratio, seasonal cycle and the hemispheric asymmetry as benchmarks for the models. Uncertainties for future regional temperature changes are compared for the whole ensemble, a small subset of models, and a weighted average of the models.