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A framework for identifying tailored subsets of climate projections for impact and adaptation studies

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In order to better understand the uncertainties in the climate of the next decades, an increasingly large number of increasingly diverse climate projections is being produced by the climate research community through coordinated initiatives (e.g., CMIP5, CORDEX), but also through more specific experiments at both the global scale (perturbed parameter ensembles) and the regional-to-local scale (empirical statistical downscaling ensembles). When significant efforts are put into making such projections available online, very few works focus on how to make such an enormous amount of information actually usable by the impact and adaptation community. Climate services should therefore include guidelines and recommendations for identifying subsets of climate projections that would have (1) a size manageable by downstream modelling approaches and (2) the relevant properties for informing adaptation strategies.

This works proposes a generic framework for identifying tailored subsets of climate projections that would meet both the objectives and the constraints of a specific impact / adaptation study in a typical top-down approach. This decision framework builds on two main preliminary tasks that lead to critical choices in the selection strategy: (1) understanding the requirements of the specific impact / adaptation study, and (2) characterizing the (downscaled) climate projections dataset available.

An impact / adaptation study has two types of requirements. First, the study may aim at various outcomes for a given climate-related feature: the best estimate of the future, the range of possible futures, a set of representative futures, or a statistically interpretable ensemble of futures. Second, impact models may come with specific constraints on climate input variables, like spatio-temporal and between-variables coherence. Additionally, when concurrent impact models are used, the most restrictive constraints have to be considered in order to be able to assess the uncertainty associated from this modelling step.

Besides, the climate projection dataset available for a given study has several characteristics that will heavily condition the type of conclusions that can be reached. Indeed, the dataset at hand may or not sample different types of uncertainty (socio-economic, structural, parametric, along with internal variability). Moreover, these types are present at different steps in the well-known cascade of uncertainty, from the emission / concentration scenarios and the global climate to the regional-to-local climate.

Critical choices for the selection are therefore conditioned on all features above. The type of selection (picking out, culling, or statistical sampling) is closely related to the study objectives and the uncertainty types present in the dataset. Moreover, grounds for picking out or culling projections may stem from global, regional or feature-specific present-day performance, representativeness, or covered range.

An example use of this framework is a hierarchical selection for 3 classes of impact models among 3000 transient climate projections from different runs of 4 GCMs, statistically downscaled by 3 probabilistic methods, and made available for an integrated water resource adaptation study in the Durance catchment (southern French Alps). This work is part of the GICC R2D2-2050[1] project (Risk, water Resources and sustainable Development of the Durance catchment in 2050) and the EU FP7 COMPLEX[2] project (Knowledge Based Climate Mitigation Systems for a Low Carbon Economy).

[1] r2d2-2050.cemagref.fr
[2] www.complex.ac.uk