Climate Information Distillation

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Research field "Physical climate science: extreme events in a warming climate, underlying processes, modelling and uncertainties"
Research question 2 | Cluster 2
Links to showcases Kirchengast 1, Steiner 1, Birk 2, Bednar-Friedl 1, Sass 1+2

Background: For adapting to climate change, credible and defensible information about future climate is required (Hewitson et al., 2014). Yet climate projections are—and will be in the foreseeable future—affected by substantial uncertainties, in particular at the regional scale. Without observations of the future, reliability of projections cannot strictly be established. The representation of many phenomena suffers from similar biases across different models; the simulated model spread thus does likely not span the full uncertainty range. Conversely, for some phenomena, projections of different models, model generations or modeling approaches sometimes provide contradicting results. For instance, whereas the regional climate models (RCMs) from the ensembles project indicate no trends in Austrian autumn precipitation (Maraun, 2013), the RCMs from the CORDEX initiative indicate an overall wetting (Jacob et al., 2014). Similarly, model results are often inconsistent with observations: observed winter precipitation has decreased in Austria between 1950 and 2000 (Hydrol. Service Austria), but all RCMs project a substantial wetting. The causes of these contradictions—e.g., large-scale circulation errors or simply internal variability—are in general not known. Finally, some phenomena, in particular extreme events, may not be credibly simulated at all. In brief, the information content of regional climate projections is largely unknown.

Goal: In response, the research field of climate information distillation is emerging. It spans a wide range of topics from understanding GCM and RCM errors, the uncertainties and artefacts of statistical post-processing, down to communicating with users. As the field is in its infancy, there are not yet agreed and established procedures.

Here we will pursue two goals: first, develop and test concepts for climate information distillation; and second, apply these concepts to a user relevant showcase example in Austria. The focus will be on the hydrological cycle including extreme precipitation events. The specific research questions will be: what are the main large-scale drivers of variability and trends? How are these represented in climate models? Can differences between models and with observations be attributed to model errors and/or internal variability? What is, finally, the overall robust information in the available data? More generally, we aim to develop a precise understanding of the role of different sources of uncertainty in different user contexts, and develop appropriate communication strategies.

Methods and disciplinary background: The study will be based mostly on observational data (e.g., E-OBS, Hadley Centre, Climatic Research Unit, ERA-Interim reanalysis), existing climate model simulations, namely the global models from the Coupled Model Intercomparison Project Phase 3 and 5 (CMIP3 and CMIP5), as well as RCMs from the ENSEMBLES project and the CORDEX initiative (based on CMIP3 and CMIP5 respectively). Based on ensemble regression and ANOVA type approaches, the model spread will be analyzed: differences in model projections will be attributed to the representation of relevant physical processes (e.g., storm track position and shifts, cyclogenesis over the Mediterranean, regional circulation phenomena) or the major modes of internal climate variability (e.g., NAO, AMO). The results will be compared with the upcoming ensemble from of convection permitting simulations of the CORDEX Flagship Pilot Study on Convection. These simulations are expected to improve the representation of localized extreme precipitation events.

References:

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