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Calculation of Probabilistic Climate Change Scenarios for Switzerland

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Global warming and corresponding climatic changes are expected to continue well into the 21st century leaving major impacts on society and ecosystems. The assessment of different future climate pathways for a specific region or even location, however, is a highly challenging task due to the cascade of uncertainties which are still inherent to any projection of future climate, ranging from emission uncertainties over model uncertainties down to uncertainties arising from natural fluctuations. Moreover, to be of use for the development of potential adaptation measures over complex terrains such as the Alps, model projections of the future climate using regional climate models (RCMs) with a detailed topography are essential. To date, our knowledge about climatic change in the Alpine region mainly stems from the PRUDENCE RCM projections at 50 km horizontal resolution, which were run in timeslice mode from 1961-1990 and 2071-2100. Climate change information for the first half of the century was obtained using a pattern-scaling approach.

Here, we calculate climate change scenarios of temperature and precipitation over Switzerland from a new generation of RCM simulations (driven by general circulation models, GCMs) provided by the European project FP6-ENSEMBLES. The RCMs (at 25 km horizontal resolution) were run in transient mode over the period 1950 to 2050 based on the A1B emission scenario. Climate change over Switzerland is assessed for the period 2016-45 with respect to 1976-2005 in seasonal aggregation over three different regions north and south of the Alps. The scenarios are constructed in a probabilistic and Bayesian multi-model framework to reflect model uncertainties, at least to some extent. Amongst others, this Bayesian algorithm requires the specification of an informative prior for the range of possible projection errors. This prior is constructed by separately estimating the relative contributions of GCM uncertainty, RCM uncertainty and internal variability to the total projection uncertainty. It has thereby turned out that temperature changes are largely determined by the choice of GCMs whereas for precipitation RCM uncertainty and internal variability becomes relatively more important.

The probabilistic scenarios for temperature over Northern Switzerland obtained by this algorithm show a warming in all seasons with expected mean changes of around 1 °C. This is on the same order of magnitude as previous estimates based on PRUDENCE models. Yet, contrary to this previous study, the transient simulations do not show a significant signal for precipitation in any season, implying that in the first half of the century internal variability and model uncertainty dominate. It is likely that these uncertainties have been underestimated in the pattern-scaling approach applied in the previous study.