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Inter-seasonal and inter-variable dependencies in multi-model projections: lessons learnt from the CH2011 climate change scenarios

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The climate change scenarios "CH2011" provide a consistent assessment of how precipitation and temperature may change in Switzerland during the 21st century. Digital data were made available at different aggregation levels. Here, we revisit one product, the climate scenarios of seasonal means, with the aim to enhance its applicability for impact studies. These scenarios are based on the joint analysis of several climate models from ENSEMBLES that were run according to the A1B emission scenario. Uncertainty arising from model projections and from internal variability is expressed with three estimates based on expert judgement: a lower, medium and upper estimate.

The three uncertainty estimates are derived separately for temperature and precipitation and separately for each season without providing information on combined changes. For impact applications, though, often several climatological variables must be considered together and across all four seasons. Here, we elucidate the inter-seasonal and inter-variable dependencies by inspecting correlations in the underlying climate model data.

The analysis shows that a firm conclusion on the correlation structure is highly challenged by the limited set of independent models and by the complex climate regime Switzerland is located in. Regarding the inter-variable relationship, confidence is still too low to make firm conclusions, but in summer a tendency for a negative relation can be inferred (a model with a stronger warming tends to simulate a stronger precipitation reduction and vice versa). No recommendation can be made on how to combine the lower, medium and upper precipitation estimates from one season to the next. However, the correlation analysis yields a positive inter-seasonal dependency in case of temperature changes.

We conclude that the choice of combination ultimately depends on the envisaged application: if the sensitivity at a particular combination is high, it is necessary to carefully explore the effects under this relationship.