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Daily precipitation fields from climate change scenarios for Switzerland

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Regional climate models (RCM) are useful tools to generate physically and spatially consistent information about possible future climate change at a horizontal scale of several tens of kilometers. However, RCM data often suffer from substantial biases and in light of effective climate adaptation planning, their spatial scale is often too coarse to model the impact of climate change at the local scale. Ideally, probabilistic projections of potential future weather situations should be available locally and at least in daily resolution. Statistical downscaling approaches based on weather generators are particularly appealing to generate large ensembles of local scenarios with reduced mean biases in the control period. However, they often do not guarantee temporal and spatial coherence of the downscaled weather variables and the dependencies between them. The spatial coherence is of particular importance over climatologically heterogeneous topographies such as the Swiss Alps.

To meet some of the manifold needs of the impact community, we explore here the potential of a statistical downscaling approach for precipitation that combines a multi-site weather generator (WG) with a conditional resampling approach. This hybrid approach aims at generating future daily precipitation fields for Switzerland based on RCM simulations (from ENSEMBLES) and gridded, high-quality and high-resolution (∼2 km x 2 km) observational data from MeteoSwiss.

We present the underlying concept of this approach which is to apply the multi-site WG to aggregated regions in Switzerland in order to generate daily wet-dry patterns. The analysis of observed transition probabilities reveals a large spatial, seasonal and interannual variability. In general, the latter exceeds those of space and season, including both sampling uncertainty and changes from one year to another. There is also a clear distinction between high-elevated regions and the lowlands. RCM simulations reproduce altitude- and season-dependent transition probabilities of daily precipitation. They differ, however, largely on the geographic manifestation depending on the model's topography. On the other hand, the analysis of future changes in these WG parameters reveals remarkably homogenous changes in space and season. We use the observed transition probabilities and their changes together with the observed spatial correlation structure in order to generate spatially coherent future dry-wet fields with daily resolution. These can for instance be used for improved projections of summer droughts.