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Synthetic future daily weather time-series over Switzerland in consistency with RCM projections

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Given the expected changes in the climate system over the 21st century, the need for future climate data with high resolution in space and time is continuously growing. This is especially true for impact modelers that require daily input data of several variables. Regional climate models (RCMs) typically provide information on possible future climatic changes at a spatial resolution of 10-50 km, which is often too coarse for direct use in climate impact models requiring realistic spatio-temporal structures. Hence, further statistical downscaling is necessary. In this regard, stochastic multi-site weather generators (WGs) are an appealing technique that allow the simulation of synthetic weather series consistent with the locally observed weather statistics across several stations and its future changes.

Here, we present results of stochastically simulated future daily weather time-series (precipitation, minimum and maximum temperature) with a spatio-temporal correlation structure similar to present-day in-situ observations. For this purpose, a multi-site WG recently developed by the authors has been perturbed with WG parameter changes from RCM projections of the ENSEMBLES project. The multi-site WG is calibrated over a network of Swiss measurement stations from MeteoSwiss over the time-period 1980-2009 and run under future climate conditions for the time-period 2070-2099.

The RCM analysis reveals that largest deviations from present-day precipitation time-series are expected in summer, consistent with the seasonal mean results from the Swiss climate scenario initiative CH2011. Both the number of wet days and the chances of two consecutive wet days is reduced in a future climate, while the likelihood to remain in a dry state given a preceding dry day increases. Concerning temperature, the temporal analysis of daily maximum temperature reveals, that future summers are characterized by more frequent and more persistent warm spells at the end of the 21st century. The time-span in which summer days are expected to occur in the future will increase by 1-3 months. These changes are not uniform across Switzerland and exhibit a pronounced altitude-dependence. Even though the expected future temperature increase will result in a general decrease of snow days, it is still likely that some future winters fall within the range of present-day interannual variability.