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Stochastic modelling of future daily weather consistent with RCM projections and the space-time covariance of present-day observations

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Given the expected changes in the climate system over the 21st century, the need for reliable 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. 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 space-time covariance of observations.

Here, we present first 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 1961-2011 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. Even though the expected changes in the climatological mean are within the range of present day interannual variability, the changes in future climatology are significant. Summers with extremely dry conditions today like the one in 2003 resemble normal summers at the end of the 21st century.