FUTURE TIME SERIES: TIMES SERIES TRANSFORMATION VS MODEL DATA

2010

Bakker, A.M.R., 2010. Future time series: time series transformation vs. model data. Conference Deltas in times of climate change, 29/9/2010-1/10/2010, Rotterdam, (int.).

Abstract

Climate scenarios are necessary to study impacts of climate change. These climate scenarios are usually generated with the use of a set of climate models and statistical downscaling. Yet, due to biases in climate models, the direct output of these models can usually not be used directly for impact modelling. A climate model is said to be biased when the statistical characteristics significantly differ from the observed climate. In general, even key-parameters, such as mean precipitation, are heavily biased.

Nevertheless impact modellers need future time series. There are roughly three common methods to generate plausible time series for the future:
- The first method applies corrections to the biased climate model output.
- The second method transforms observed climate data according to a climate change scenario.
- The third method develops a stochastic weather generator for the current climate and adapts it according to the climate change scenario.

The bias correction is thought to be superior with respect to spatial consistency and consistency between different climate variables. Indeed, even implicit changes in relations are automatically taken into account. Accordingly, hidden biases within these interrelations will remain in the corrected output. In practice, all statistical properties, like the mean, the standard deviation and higher quantiles of a certain climate variable can be biased. Since all these variables and their characteristics are mutually dependent, corrections of one bias will by definition change other characteristics and relations with other variables. Some other biases will be (partly) solved, but new biases and artefacts will be introduced.

Transformation of observed time series is often referred to as the delta-change method or perturbation method. Precipitation is typically multiplied by a certain factor whereas a specific offset is added to variables as temperature. Of course it is possible to control variability characteristics separately, if more sophisticated transformations are used. The transformation method will not include all important changes. Besides, every transformation may introduce new biases and artefacts. But time series generated by transformation will generally contain fewer biases than bias corrected climate model output.

Stochastic weather generators time series are randomly formed on the basis of a set of statistical moments, temporal dependency etc. Often the generation of precipitation series serves as a conditional basis for the other variables. More complex relations and characteristics are very hard to include in the weather generator. Especially, spatial dependency remains very difficult till date. On the other hand, weather generators are relatively easy and flexible to adapt for future climate. Since only the statistical characteristics and relations have to be altered, no new artefacts will be introduced.

The use of different methods of generating future climate time series may result in different conclusions in the impact studies. Nonetheless, most studies only pay very limited attention to this crucial step. This study compares the influence of the method and the choices within each method on assessed impact. The comparison is both theoretically and by means of hydrological examples.