EMS Annual Meeting Abstracts
Vol. 11, EMS2014-571-1, 2014
14th EMS / 10th ECAC

Stochastic weather generator M&Rfi: it works not only with the daily step and normally distributed variables

Martin Dubrovsky (1,3) and Miroslav Trnka (2,3)

(1) Institute of Atmospheric Physics, Praha, Czech Republic (dub@ufa.cas.cz), (3) CzechGlobe - Center for Global Climate Change Impacts Studies, Brno, Czech Republic, (2) Institute for Agrosystems and Bioclimatology, Mendel University, Brno, Czech Republic

The stochastic weather generators (WGs) are a favourite tool for creating realistic meteorological inputs (representing the present and/or future climates) for the agrometeorological modelling. M&Rfi is a single site WG, which is based mostly on parametric modelling approaches. When running with the daily step, it uses Markov chain to model precipitation occurrence, Gamma distribution for precipitation amount and the 1st order multi-variate autoregressive model to model the precipitation-dependent variables (especially temperature and solar radiation). Since 1995, when the development of Met&Roll generator (predecessor of M&Rfi) was started, many improvements have been added to the generator. This presentation focuses on two features, which expand the M&Rfi's applicability in agrometeorological applications.

The first feature is the optional time step. M&Rfi is commonly run with the daily step, which is the temporal step most frequently used in agrometeorological applications (e.g. in crop growth modelling). However, the generator may be also run with longer time steps to produce, e.g., weekly or monthly series. Not only that the weather series with a longer time steps are required in some applications, but the monthly weather generator (mWG) may be effectively used to force the daily series produced by the classical daily WG (dWG). This two step procedure improves the low-frequency variability (Dubrovsky et al, 2004, Clim Change) in daily series. In addition to the longer temporal steps, M&Rfi may also produce hourly weather series. In this case, the daily weather series produced with M&Rfi's parametric model are disaggregated into hourly values using a non-parametric re-sampling procedure (Hirschi et al, 2012, Earth Syst Dynam).

The second feature discussed here will be the treatment of the non-normally distributed variables. As the autoregressive model generally produces normally distributed variables, a special attention is given to weather characteristics, whose probabilistic distribution is far from normal (e.g. wind speed and humidity). Apart from a possibility to generate such weather variables using a separate resampling-based procedure, two options are implemented in M&Rfi: the non-normally distributed variables are optionally generated using the built-in parametric or non-parametric (quantile mapping) transformations; the parametric transformation is now used to "normalize" precipitation and solar radiation in mWG, the quantile-mapping is used for humidity and wind speed in dWG.

The utility of the above features will be demonstrated by the climate change impact experiment, in which the effect of employing mWG to force dWG will be examined. Firstly, the synthetic daily weather series (generated conditionally vs. non-conditionally on mWG) will be validated in terms of low-frequency variability, temperature and precipitation extreme indices (including the characteristics of hot/cold/dry/wet spells) and selected agroclimatic indices. Secondly, the WG will be linked with the GCM-based climate change scenarios, and the future changes in the climatic and agroclimatic indices will be assessed. In discussing the climate change impacts, a special attention will be paid to effects of (a) employing mWG and (b) accounting for the future changes in low-frequency (intermonthly) variability (used to modify mWG parameters).

Acknowledgements: The study is made within the frame of projects WG4VALUE (project LD12029 is supported by Ministry of Education, Youth and Sports and linked to the COST action ES1102 (VALUE)) and InterDrought (project OP VK CZ.1.07/2.3.00/20.0248).