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Projection of extreme precipitation and temperature characteristics with use of multi-GCM climate change scenarios and daily weather generator

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Introduction: One of the possible approaches (employed also in this contribution) to downscale the low-resolution output from Global Climate Model (GCM) into spatial and temporal scales required by impact models consists in using the stochastic weather generator (WG), whose parameters are calibrated using the site-specific observed weather data and then modified according to the GCM-based climate change scenario. The popularity of this approach is based on (i) a flexibility of weather generators and (ii) an assumption that the GCMs are better in reproducing the shifts in climatic characteristics rather than in their ability to reproduce the absolute values of individual weather variables. This contribution focuses on an effect of a complexity of the scenario (the complexity is related to a number of parameters involved in a climate change scenario) on projected changes in selected extreme precipitation and temperature characteristics (lengths of hot/cold/dry/wet spells and extremes of temperature and precipitation).
Motivation: The scenario may consist of changes in various climatic characteristics derived from daily or monthly GCM output. The available monthly outputs from GCMs usually relate to longer periods than the daily outputs so that they allow to determine the scenario parameters with higher accuracy. The use of the daily GCM-simulated series is further complicated by the fact that they are not available from all GCMs involved in IPCC-AR4 database. On the other hand, changes in some climatic characteristics (e.g. probability of wet day occurrence) must be derived from the daily GCM output. In result, the following question is raised and being answered in this contribution: What is the effect of including additional characteristics derived from daily GCM outputs on a structure of the synthetic weather series produced by WG (and thereby on the climatic characteristics derived from the synthetic weather series)?
Methodology: The M&Rfi weather generator used here is based mostly on pametric models. The generator may be run at optional time step and allows to deal with an optional number of weather variables. In present experiments, it is run with a daily time step and involves three variables: [PREC, TMAX, TMIN] or [PREC, TAVG, DTR]. The climate change scenarios are determined by comparing selected WG parameters derived from the future GCM-simulated daily series (2081-2100) vs reference series (1961-1990). The “additional” parameters of climate change scenario include (a) changes in parameters which cannot be derived from the monthly GCM outputs: Pwet (probability of wet day occurrence), P01 (transitional probability of wet day following the dry day), DTR (daily temperature range), variability of daily temperature; (b) variability of monthly means. The projection of extreme climatic characteristics for climate change scenarios of given degree of complexity will be represented by probability distribution function based on several GCMs.
Input data: The present analysis of climate change impacts on the above climatic characteristics will be based on daily outputs from 8 GCMs (from IPCC AR4 database) and 10+11 weather stations in Europe+U.S.A.
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