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A Comparison of stochastic and hybrid based weather generators

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Climate change modeling is obviously one of the fundamental basis for further environmental studies such as hydrological modeling, flood forecasting, watershed planning, etc. However, Global Circulation Models (GCMs) provide possible climate change scenarios, nevertheless even if they are run at a high resolution, which they are not, it is still necessary to downscale their results before employing them for local impact studies. Downscaling approaches are typically categorized mainly into four types; dynamical, weather typing, stochastic weather generators and transfer function-based approaches. The accuracy of two types of weather generators is evaluated in this study, Long Ashton Research Station-Weather Generator (LARS-WG) and Statistical Down Scaling Model (SDSM), stochastic and hybrid of the transfer function and stochastic-based weather generators, respectively. Therefore, these weather generators have been employed to simulate three daily climate parameters, including; precipitation, minimum and maximum temperature data between 1990 to 2010 in Guilan province of Iran. Subsequently, modeling performances have been evaluated, applying Akaike information criterion (AIC) and Bayesian information criterion (BIC). According to the calculated AIC and BIC values, LARS-WG has performed slightly more reliable in simulating the daily precipitation data and significantly better in simulating the minimum and maximum daily temperatures. Despite these results, is it adequate for a conclusion to prefer stochastic-based weather generators rather than the other? Indeed, more considerations are required to investigate the preferable downscaling approach. Hence, some statistical coefficients, i.e. coefficient of determination (R-squared) and correlation coefficient have also been employed to evaluate the simulation performances in more detail by investigating the correlation between individual daily simulated data, variances and daily maximas and minimas in comparison to the actual recorded data. According to results, simulated precipitation values by the stochastic-based approach (LARS-WG) are more reliable based on all evaluation criteria. Though, hybrid-based simulated values for minimum and maximum temperature have more correlated variances to the observed time series. Apart from these, there is an undeniable and meaningful fact in the results, which is a huge correlation between daily simulated values, maxima, and minima of both the simulation approaches and the actual time series, which can be possibly misdirecting. Are these amounts of correlations representing a perfect reliability for these downscaling approaches or is it an absurd consequence due to overfitting related to the construction of these kind of models? The answer is discussed in this contribution via a detailed investigation on the structure of these models.