
An Open Source Weather Generator for Downscaling Climate Model Outputs

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Abstract

We present a multi-site weather generator with a stochastic rainfall field generator at its core. The weather generator is developed with the motive to produce downscaled projections for the future by utilizing the suite of climate models from the CMIP5/6 archive. The rainfall fields are sampled from a spatio-temporal Neyman-Scott Rectangular Pulse (NSRP) process. When considering a single site, the NSRP model parameterizes storm arrivals as a poisson process and storm separation time as exponential distribution. Each storm is assigned a certain number of raincells (a poisson random number) with each raincell having a duration and intensity which are exponentially distributed. For a multi-site model, additional considerations are made which include the radius of raincell parameterised by exponential distribution and the raincell density as a uniform poisson process (which is a replacement to the raincell generation process of single site model). For the single site model capturing the mean monthly rainfall totals, daily variance, skewness, lag-1 autocorrelation, dry-day proportion and daily annual maximums are considered to be of paramount importance. Whereas for the multi-site model, its efficacy in capturing intergauge correlations is emphasized. The developed rainfall generator has shown its efficacy in capturing the statistics of the observed rainfall across point and catchment scales. Following the calibration and testing of the NSRP-based rainfall generator, the other weather variables such as temperature and wind speed are ascertained through regression relationships by considering wet and dry states. The climate model downscaling is then initiated by computing multiplicative and additive change factors for rainfall and temperature respectively. Overall, the developed weather generator can provide multiple plausible future scenarios which shall aid in climate change impact assessment and adaptation planning.

Keywords: Neyman, Scott Rectangular Pulse (NSRP), Downscaling, Change Factors

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