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Evaluation of Downscaled Daily Precipitation for Field Scale Hydrologic Applications

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Rationale: Recent dissemination of statistically downscaled Global Circulation Model climate projections are commonly used to investigate climate change impacts. Landscape and environmental features affected by anticipated climate change include air quality, flood control, water quantity, water quality, agricultural crop production, soil erosion, adaptive planning, and ecosystem management.

Simulation of hydrologic, agronomic, and conservation activities require reliable representation of precipitation characteristics, in particular wet-day/dry-day sequences, as well as physically meaningful and realistic precipitation distributions. Monthly precipitation projections representing various climate change scenarios have been available for over a decade. More recently, Bias Corrected Constructed Analogue (BCCA) daily precipitation projections have been developed.

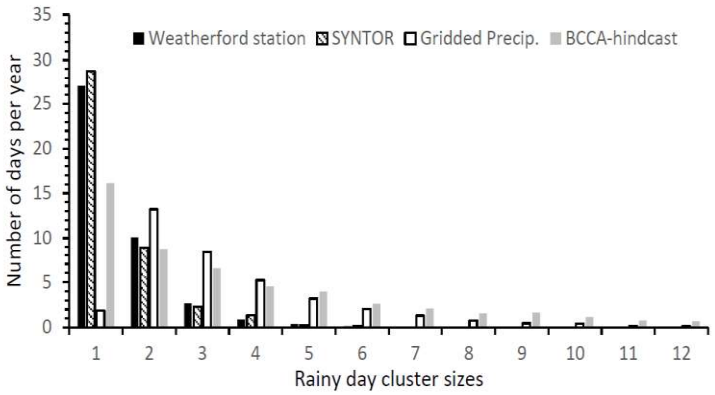
In this study, the accuracy and appropriateness of BCCA precipitation projections for field-scale hydrologic applications was examined for central Oklahoma climatic conditions.

Objectives: (1) to review the ability of BCCA daily precipitation hind-casts to replicate wet-day and dry-day sequences of locally observed daily precipitation; and (2) to demonstrate that statistical downscaling based on a synthetic weather generator can replicate number of rainy days, amount of rain on a rainy day, rainy-day cluster distribution, and wet-dry/dry-wet day sequences of observed daily precipitation.

What we did: We evaluated the BCCA daily precipitation hind-cast time-series to determine their suitability to study daily soil moisture dynamics at the field-scale for central Oklahoma climatic conditions.

Three daily precipitation data sets were considered in this evaluation: (i) the 1961-1999 BCCA precipitation projections for a 12 km grid in central Oklahoma; (ii) the 1961-1999 spatially interpolated daily precipitation data used in the BCCA downscaling procedure; (iii) the 1961-1999 observed daily precipitation observations at the Weatherford COOP weather station located within the 12 km grid of the BCCA projections.

Results: Results showed that BCCA daily precipitation hind-casts compared to observations display (i) a large number of rainfall days; (ii) a smaller rainfall amount on rainy days; (iii) a high clustering of consecutive rainy days; and (iv) a high probability of a wet day following a wet or dry day.



These shortcomings may impact field-scale hydrologic investigations by leading to higher infiltration amounts and lower surface runoff volumes.

Given the aforementioned shortcomings, caution is advised to end-users to use BCCA daily precipitation products judiciously- particularly for field-scale hydrologic applications that require reproducing sequential rainfall patterns. Statistical downscaling based on stochastically generated weather reproduced daily observed daily precipitation patterns.

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