SpringerLink

Published: 28 August 2020

Assessment of regional best-fit probability density function of annual maximum rainfall using CFSR precipitation data

Nkpa M Ogarekpe, Imokhai T Tenebe, Praisegod C Emenike, Obianuju A Udodi & Richard E Antigha

Journal of Earth System Science volume 129, Article number: 176 (2020) Cite this article

Abstract

The upper Cross River basin (UCRB) fits a true description of a data scarce watershed in respect of climatic data. This paper seeks to determine the best-fit probability density function (PDF) of annual maximum rainfall for the UCRB using the Climate Forecast System Reanalysis (CFSR) precipitation data. Also, to evaluate the performance of the Intergovernmental Panel on Climate Change (IPCC) Coupled Model Inter-comparison Project (CMIP3) Fourth Assessment Report (AR4) Global Circulation Models (GCMs) in simulating the monthly precipitation in the UCRB considering 1979–2014 data. For the determination of the best-fit PDF, the models under review included the generalized extreme value (GEV), normal, gamma, Weibull and log-normal (LN) distributions. Twenty-four weather station datasets were obtained and subjected to frequency distribution analysis on per station basis, and subsequently fitted to the respective PDFs. Also, simulated monthly precipitation data obtained from 16 AR4 GCMs, for weather station p6191, were subjected to frequency distribution analysis. The results showed the percentages of best-fit to worst-fit PDFs, considering the total number of stations, as follows: 54.17%, 45.83%, 37.50%, 45.83%, and 50%/50%. These percentages corresponded to GEV, Weibull, gamma, gamma, and LN/normal, respectively. The comparison of the predicted and observed values using the Chi-square goodness-of-fit test revealed that the GEV PDF is the best-fit model for the UCRB. The correlation coefficient values further corroborated the correctness of the test. The PDF of the observed data (weather station p6191) and the simulations of the 16 GCMs computed using monthly rainfall datasets were compared using a mean square error (MSE) dependent skill score. The result from this study suggested that the CGCM3.1 (T47) and MRI-CGCM2.3.2 provide the best representations of precipitation, considering about 36 years trend for station p6191. The results have no influence on how well the models perform in other geographical locations.

Acknowledgements

Global climate model output, from the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset (Meehl et al. 2007), were obtained from www.engr.scu.edu/~emaurer/global_data/. These data were downscaled as described by Maurer et al. (2009) using the bias-correction/spatial downscaling method (Wood et al. 2004) to a 0.5-degree grid, based on the 1950–1999 gridded observations of Adam and Lettenmaier (2003).

Author information

Affiliations

Department of Civil Engineering, Cross River University of Technology, Calabar, Nigeria

Cite this article

Ogarekpe, N.M., Tenebe, I.T., Emenike, P.C. et al. Assessment of regional best-fit probability density function of annual maximum rainfall using CFSR precipitation data. J Earth Syst Sci 129, 176 (2020). https://doi.org/10.1007/s12040-020-01434-9

DOI

https://doi.org/10.1007/s12040-020-01434-9

Keywords

Rainfall

models

fitting

probability density function

CMIP3

climate models