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Unveiling the Subjectivity in Ranking of NEX-GDDP-CMIP6 Climate Models Over Munneru River Basin, India

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Regional climate modelling has evolved significantly, offering versatile applications across various scales and resolutions. This study aims to provide a comprehensive framework for selecting top five Climate Models at each grid for climate variables in the Munneru River Basin, comes under Lower Krishna River Basin, India. Employing the NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP) datasets, which are derived from General Circulation Model (GCM) runs under the Coupled Model Intercomparison Project Phase 6 (CMIP6), is compared with the observed precipitation, maximum, and minimum temperature datasets obtained from the Indian Meteorological Department (IMD). These datasets have a spatial resolution of (0.25° × 0.25°) and available from 1970 to 2014. The methodology adopted in this study uses advanced statistical techniques to evaluate the performance of the CMIP6 models. The study incorporates Multicriterion Decision-Making Techniques (MCDM) and Group Decision-Making (GDM) methodologies within the Reliable-Ensemble Averaging (REA) framework. MIROC-ES2L, GISS-E2-1-G and TaiESM1 are the top ranked models for precipitation data. Whereas, BCC-CSM2-MR, ACCESS-ESM1-5 and GFDL-CM4_gr2 obtained as most suitable RCMs for maximum temperature data. For minimum temperature data, MIROC-ES2L, KIOST-ESM and MIROC6 obtained as top ranked CMIP6 models. The projected climate variables, including precipitation, maximum temperature and minimum temperatures, under three distinct Shared Socioeconomic Pathways (SSP) scenarios: SSP 245, SSP 370 and SSP 585 extending up to the year 2100. The spatio-temporal analysis encompasses key climate parameters, identifying trends, variations, and potential anomalies in the Munneru River Basin. This study contributes to the broader context of regional climate modelling research and enhances our understanding of the Munneru River Basin's climate dynamics. The research findings presented in this study aim to understand the methodological advancements in regional climate modelling, performance assessments of CMIP6 models and the application of CMIP6 models in regional process studies.