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Drought variability and projections over India under high emission scenario with uncertainty assessment

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Hydrological extremes have increased in recent decades and are expected to escalate in the future. This led to global and regional water stress and drought hazards. Further down in the chain it impacts on farming, pollution, ecosystem, and socio-economic conditions. A better understanding of both quantitative and qualitative assessment of drought under changing climate is very crucial for sustainable water security and management. In the present study, over different homogeneous regions of India, using 19 Global Climate Models (GCMs) and Regional Climate Models (RCMs) 21 simulations datasets, drought climatology is prepared. The changes in drought distribution and characteristics analyzed using density functions and its probability of occurrence associated with return period derived from Standardized Precipitation Index (SPI) and Standardized Potential Evapotranspiration Index (SPEI). Each model is evaluated for biases against Multi-Model Ensembles (MME) and observational datasets for the reference period 1976-2005. Uncertainties from various sources associated with intermodal variability, including drought type and threshold, were evaluated. Under high emission (RCP8.5) scenario, both the ensembles (GCM and RCM) are showing the consistent spatiotemporal variability of precipitation and potential evapotranspiration with noticeable differences in magnitude. Biases are reduced in RCM over GCM (ensemble) with respect to observations. Modeled SPI is showing enhanced wetness derived from increased precipitation, while SPEI is exhibiting the drying trend largely associated with enhanced potential evapotranspiration under warming climate. There is an increase in the drought severity and intensity with the same return period in the future epoch. The overall analysis suggests the water scarcity and enhanced drought risks over India under unrestricted anthropogenic warming scenario.