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Multi-scalar association between large-scale climatic pattern and droughts in India

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Extreme meteorological events, such as droughts, are strongly influenced by large-scale climatic oscillations. Since India is one of the most drought-prone countries, comprehensive knowledge of the teleconnection of the climatic oscillations is very helpful towards developing precise drought prediction models. For evaluating the association between climatic indices and drought indices, the interdependency among the climatic oscillation time series has not been addressed well in previous studies. Hence in this study, an elaborate analysis is done in a time-frequency space using the variants of wavelet analysis such as Wavelet Coherence Analysis (WCA), Multiple Wavelet Coherence Analysis (MWCA), and wavelet reconstruction method. The study has used Five major climatic oscillations namely El Niño Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), Atlantic Multidecadal Oscillation (AMO), Indian Ocean Dipole (IOD), and Equatorial Indian Ocean Oscillation (EQUINOO), and a PET-based drought index, called Standardized Precipitation Evapotranspiration Index (SPEI) at four time-scales. The results from the analysis show that the interannual variability (2-4 years) of Indian droughts are primarily influenced by ENSO while the drought variability at 4-8-year time scale is influenced by the combined effect of PDO and EQUINOO. Similarly, the interdecadal variability (16-32 years) of Indian drought is dominantly influenced by PDO and IOD. AMO has not shown any significant association at any scale. Moreover, the droughts in Northwest and North Central India are strongly influenced by climatic oscillations. Further, the teleconnection pattern doesn't significantly vary with the different timescale of drought. The study will help the hydrologists to enhance the understanding of the connection between climatic oscillations and Indian droughts and thereby better prepare for the impending droughts.