

Characterisation of Meteorological Drought at Sub-Catchment Scale in Afghanistan Using Time-Series Climate Data

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Abstract : Droughts have severely affected Afghanistan over the last four decades, leading to critical food shortages where two-thirds of the country's population are in a food crisis. Long years of conflict have lowered the country's ability to deal with hazards such as drought, which can rapidly escalate into disasters. Understanding the spatial and temporal distribution of droughts is needed to be able to respond effectively to disasters and plan for future occurrences. This study used Standardized Precipitation Evapotranspiration Index (SPEI) at monthly, seasonal, and annual temporal scales to map the spatiotemporal change dynamics of drought characteristics (distribution, frequency, duration, and severity) in Afghanistan. SPEI indices were mapped for river basins, disaggregated into 189 sub-catchments, using monthly precipitation and potential evapotranspiration derived from temperature station observations from 1980 to 2017. The results show these multi-dimensional drought characteristics vary along different years, change among sub-catchments, and differ across temporal scales. During the 38 years, the driest decade and period are the 2000s and 1999-2022, respectively. The 2000-01 water year is the driest, with the whole country experiencing 'severe' to 'extreme' drought, more than 53% (87 sub-catchments) suffering the worst drought in history, and about 58% (94 sub-catchments) having 'very frequent' drought (7 to 8 months) or 'extremely frequent' drought (9 to 10 months). The estimated seasonal duration and severity present significant variations across the study area and throughout the study period. The nation also suffered from recurring droughts with varying length and intensity in 2004, 2006, 2008, and, most recently, 2011. There is a trend towards increasing drought with longer duration and higher severity extending all over sub-catchments from southeast to north and central regions. These datasets and maps help to fill the knowledge gap on detailed sub-catchment scale meteorological drought characteristics in Afghanistan. The study findings improve our understanding of the influences of climate change on drought dynamics and can guide catchment planning for reliable adaptation to and mitigation against future droughts.

Keywords : SPEI, precipitation, evapotranspiration, climate extremes

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