

Analysis of Hydroclimatic Extremes over Narmada Basin under Climate Change

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A robust characterization and risk assessment of hydroclimatic extremes is essential considering their pervasiveness and consequences; however, their precise physical quantification is a difficult geophysical endeavor. This is becoming a serious issue for India, having 18% of the world's population and 4% of global freshwater, out of which 83% is used in agriculture. In this study, a detailed spatiotemporal assessment of the meteorological droughts (using Standardized Precipitation Index) and extreme rainfall events is carried out over the Narmada Basin for 1951- 2016, using the high-resolution ($0.25^\circ \times 0.25^\circ$, daily) gridded rainfall data. The non-parametric Mann-Kendall (MK) test is applied to investigate the trend of droughts and the 1-day maximum rainfall series. The entire duration is divided into two epochs i.e. 1951-1981 and 1982-2012, for a comparative assessment of hydrological extreme characteristics. Further, the frequency of these extremes are determined for 2020-2050 under RCP 4.5 and RCP 8.5 scenarios to assess the impacts of climate change. The results reveal that the Narmada basin is prone to droughts with a frequency of once in 3 to 6 years. The frequency and severity of droughts have significantly increased in 1982-2012 as compared to 1951-1981. The MK test results indicate a significant increase in the trend of droughts and 1-day maximum rainfall over most parts of the basin. The frequency, severity, persistence and areal extent of droughts are found to be increasing for both the RCP scenarios. The heavy rainfall events are also showing widespread prominence over the basin with a remarkable increase in frequency and intensity. This study suggests that appropriate measures must be taken for better management of the water resources in the basin, and also for mitigation of floods and droughts, considering the increased risk of the high-intensity storms as well as the severe drought occurrences under climate change.

Keywords: Narmada Basin, Droughts, Heavy rainfall events, Mann-Kendall test, Climate change