Title: Influence of Climate Drivers on Extreme Precipitation in Bangladesh: Spatiotemporal Patterns and Underlying Mechanisms

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Abstract: This study investigates the spatiotemporal variability of extreme precipitation indices (EPIs) and their linkages with large-scale climate drivers in Bangladesh. Daily precipitation data from 20 meteorological stations for the period 1980–2017 were analysed using the Mann–Kendall trend test and Sen's slope estimator to detect trends and abrupt change points, and complemented by Mantel tests, Geo-Detector modelling, and partial wavelet coherence (PWC) analysis to examine climatic influences. Among the eight EPIs considered, consecutive dry days (CDD), annual maximum 5-day precipitation (RX5DAY), and the frequency of heavy rainfall days (R10 and R30) exhibited increasing trends, whereas consecutive wet days (CWD), the simple daily intensity index (SDII), annual total wet-day precipitation (PRCPTOT), and maximum 1-day precipitation (RX1DAY) showed declining tendencies. Mutation analyses indicated turning points in 1997 for CDD and in 2004 for R10 and R30, marking intensified dry spells and shifts in heavy rainfall occurrence, while declines in CWD, SDII, and RX1DAY originated around 1988. Spatially, precipitation frequency and intensity are highest in the northeastern and southeastern regions, particularly along the coastal belt. Mantel and Geo-Detector results identified the Indian Ocean Dipole (IOD), El NIÑO-Southern Oscillation (ENSO), Arctic Oscillation (AO), and SUNSPOT as key climatic drivers influencing monsoon dynamics and moisture transport from the Bay of Bengal. PWC analysis further revealed positive influences of ENSO on rainfall frequency and negative associations of the AO and SUNSPOT with precipitation intensity. These findings enhance understanding of hydroclimatic extremes in Bangladesh and provide a scientific basis for adaptive water resources management and flood risk mitigation.

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