

Title: Modulation of coupling climatic extremes and their climate signals in a subtropical monsoon country

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Abstract: The interaction between extreme precipitation and temperature events has significant implications for society, the economy, and the ecosystem. While numerous studies have explored changes in precipitation and temperature extremes in subtropical monsoon country, there is a dearth of knowledge regarding the coupling of these extremes, particularly the simultaneous occurrence of extreme events. To bridge this research gap, our study aims to investigate the modulation of coupling climatic extremes, their climate signals in subtropical monsoon country, and the underlying causes of changes. To accomplish this, we utilized monthly precipitation and temperature datasets from 20 sites across Bangladesh, along with two climate signal indices, covering the period from 1980 to 2017. We employed four indices, namely consecutive dry days (CDD), consecutive wet days (CWD), minimum daily temperature (TNn), and maximum daily temperature (TXx), to assess temperature and precipitation modulation patterns. Our findings indicate a positive trend in temperature indices, with warm days and nights exhibiting a more rapid increase compared to cool days and nights in Bangladesh. Analysis of precipitation indices reveals a mixed pattern of changes, with an increase in CWD and a decrease in CDD. However, when examining specific regions, we observe an increasing trend in monsoon CDD in the northwest and coastal districts, suggesting a shift towards drier conditions. Conversely, a declining trend in winter CDD in the southeast and northwest indicates a shift towards wetter conditions. Comparing coupled precipitation and temperature extremes between 1999 and 2017 and 1980–1998 reveals a broader impact of these extremes in recent decades. Detrended fluctuation analysis further suggests that the current trend in extremes is likely to persist in the future. Our study also establishes a relationship between the El Niño-Southern Oscillation (ENSO) and climate extremes in Bangladesh, albeit with modulations in cycles. Overall, a combination of elevated summer geopotential height, the absence of a visible anticyclonic center, reduced high cloud cover, and enhanced low cloud covers collectively contribute to increased frequency and intensity of warm extremes in subtropical country.

Keywords: Climate Sciences, Climate Change, Drought, Flooding, Meteorology, Climate and Earth System Modelling

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