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Title: Climate Variability-Induced Rainfall Trends in the Baitarani River Basin, India: A Spatio-Temporal and GIS-Based Assessment

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Abstract: Understanding spatio-temporal rainfall variability is critical for water resource management, especially for climate-sensitive river basins. This study examines rainfall trends and variability in the Baitarani River Basin (eastern India) using high-resolution gridded data for 1979–2020. Rainfall trends were investigated using non-parametric Mann–Kendall test (MK test) and Sen’s slope estimator (SSE). The shift point was detected using multiple homogeneity tests [Pettitt test, Standard Normal Homogeneity Test (SNHT), and Buishand test], while rainfall variability was quantified using an entropy-based Marginal Disorder Index (MDI). The analyses were performed at annual and seasonal scales. MK Z-statistic indicates the increasing or decreasing nature of a series, whereas Sen’s β slope provides the rate of change in that particular series. The MK test and SSE were applied again to examine trends before and after the identified change point. Finally, maps illustrating spatial trends and percentage changes were produced using ArcGIS 10.6. Over the 42-year period, the MK test revealed significant increasing annual trends in both districts, Keonjhar ($Z = +2.4$, $\beta = 0.7$ mm/year), with a percentage change of around +21.8%, and Mayurbhunj ($Z = +2.4$, $\beta = 0.7$ mm/year), with a percentage change of around +19.2%. During 1979–2020 post-monsoon rainfall showed the highest increase (62–70%) while, post 2001, monsoon rainfall declined substantially (1.7–3.3 mm/year) across all districts, with Balasore showing the largest decrease (–3.3 mm/year). The earlier period (1979–2001) had stable monsoon rainfall but greater variability in retreating monsoon, especially in northern regions. Entropy-based variability analysis indicated the Bhadrak and Balasore districts as having maximum variability with an MDI value of 1.44 and 1.35, respectively, for monsoon and annual rainfall series. These findings underscore the importance of incorporating changing seasonal dynamics into water-resource planning and flood-risk management for the Baitarani River Basin in the context of climate change.



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