

Precipitation Trend Analysis over National Capital Territory, India from 1975 to 2024: An SDG-Aligned Urban Climate Assessment

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Abstract:

Urban challenges are becoming increasingly severe in the most populous metropolitan region of Delhi in India, due to rapid urbanization, increasing pollution and changing urban land uses, which all severely affect urban water security. The solutions to these challenges are essential for SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action). To investigate the precipitation changes over the last five decades (1975–2024) in the National Capital Territory of Delhi (NCTD), high-resolution ($0.25^\circ \times 0.25^\circ$) gridded daily precipitation dataset from India Meteorological Department (IMD) was analysed in this study. The spatial clipping technique using shapefiles was adopted to isolate representative rainfall data, and then the data was aggregated using area weighted averaging to generate the monthly, seasonal and annual time series. Several advanced non-parametric statistical tools such as homogeneity testing, autocorrelation function (ACF) analysis, Mann-Kendall (MK) test, autocorrelation-corrected Modified Mann-Kendall (MMK) test and Precipitation Concentration Index (PCI) were used to describe temporal variability and identify significant trends. The results show that there is a significant change point around the middle of the 1990s indicating a significant change in the precipitation regime of Delhi. This change is primarily affected by the trends in the monsoon season, with relatively smaller changes during pre- and post-monsoon periods. Progressive increase in PCI toward abnormal concentrations was observed suggesting increasing intra-annual variability. The results provide crucial insights into urban drainage infrastructure design, groundwater recharge potential and water security and provide evidence-based recommendations for SDG aligned, climate resilient urban planning in rapidly urbanising areas.

Keywords:

Precipitation, mann-kendall test, precipitation concentration index, IMD gridded data, delhi, sustainable development goals.