

Can Satellite Products be Used to Study Extreme Precipitation Trends across West Africa?

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Understanding changes in extreme precipitation is critical for enhancing climate resilience, particularly in regions such as West Africa, where communities are highly susceptible to hydroclimatic extremes. Trend detection in daily precipitation remains challenging due to sparse and inconsistent ground-based observations. Satellite datasets provide extensive spatial coverage and consistent temporal resolution. While Climate Data Record (CDR) datasets are designed to ensure temporal homogeneity, extreme precipitation in West Africa shows large spatial variability, making trend detection sensitive to spatial resolution. Although High-Resolution Precipitation Products (HPRR) are not specifically intended for long-term consistency, they may provide additional value in capturing localized changes in extreme precipitation characteristics.

This study evaluates the consistency of the Integrated Multi-satellitE Retrievals for GPM (IMERG V07 Final Run), as an HPRR, with the Global Precipitation Climatology Project (GPCP v3.3) daily CDR in detecting spatial and temporal trends in the frequency and intensity of extreme precipitation across West Africa from 1998 to 2024. Extreme indices from the Expert Team on Climate Change Detection and Indices (ETCCDI) were analyzed using the Theil–Sen slope estimator and the Mann–Kendall test.

Results reveal coherent patterns in both datasets, including significant weakening of extremes along eastern coastal Nigeria and increasing frequency of extremes in parts of the western Sudanian and Sahelian regions. The agreement is also strong for trends in annual totals. IMERG indicates that 6.8% and 7.7% of West Africa experience significant negative and positive trends, respectively, at the 0.05 significance level, compared to 5.2% and 9% for GPCP. Results demonstrate that IMERG reliably captures changes in extreme precipitation consistent with GPCP across West Africa, while benefiting from its higher spatial resolution.