Typology of flood trends across West Africa

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ABSTRACT

West Africa is a region highly vulnerable to global change, where hydro-climatic extremes become increasingly frequent and intense. While previous floods studies have been limited to few river basins with scattered observational data, the availability of a recent regional hydrometric in-situ database offers the opportunity for studying hydrological extremes at the west African scale. This study investigates trends in hydrological extremes using annual maximum streamflow (AMAX) over 80 West African catchments from 1950 to 2018.

A rigorous flood frequency framework based on Extreme Value Theory is used for trends detection in return levels, comparing a wide variety of non stationary models. In order to synthesize the regional patterns, an objective typology of flood evolution trajectories is developed using k-means clustering.

The results reveal widespread non-stationarity in flood extremes, affecting 85% of the catchments, with contrasted trajectories of extremes. The clustering reveals 6 main types of trends in hydrological extremes. While most catchments exhibit a general decline in flood magnitude until the major droughts affecting the region (1970s-1990s), recent decades show divergent evolutions, ranging from stabilization to moderate or strong increase. At the regional scale, a north–south gradient emerges. The Sahelian catchments display trajectories ranging from persistent decreases to weak flood intensification, whereas the Sudano-Guinean basins are predominantly characterized by decreasing trends, with additional nuances related to the shape and magnitude of these declines. Overall, these results challenge the assumption of an homogeneous signal of hydrological intensification over West Africa and provide a more nuanced depiction of typical Sahelian and Sudano-Guinean flood evolution patterns. Furthermore the contrasted trends identified are only weakly explained by catchment physical or hydrological characteristics, underscoring the complexity of non-stationary hydrological dynamics in the region.

By documenting the diversity of long-term flood trajectories over 1950–2018, this study refines the regional narrative of hydrological changes in West Africa and has important implications for anticipating future hydro-climatic extremes and for supporting the strengthening of resilience of ecosystems and societies.

Keywords: Hydrology ; Extremes ; Flood ; Rivers ; Trend detection.