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ORIGINAL PAPER

Impact of climate teleconnections on hydrological drought in the Sahel Region of Nigeria (SRN)

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Abstract
Understanding the spatial and temporal patterns of drought and their connection with major climate indices is crucial for creating early warning and drought mitigation strategies. This study analyzed hydrological drought variability and its association with global climate indices in the Sahel Region of Nigeria. Before conducting drought analysis, temperature and precipitation data were verified for consistency using three homogeneity tests. The study utilized six synoptic stations across the area to identify drought periods through the Standardized Precipitation Evapotranspiration Index (SPEI). Drought characteristics such as duration, severity, and amplitude were examined using SPEI data. Trend and variability in drought patterns were assessed with Mann–Kendall trend analysis and wavelet analysis, respectively. The relationship between large climate indices and drought was explored using Pearson correlation analysis. Trend analysis indicated an increase in drought occurrences, with significant findings in four stations. Wavelet analysis identified the 2–4 and 4–8 year bands as crucial for understanding SPEI drought patterns. Correlation analysis showed the influence of various climate trends on concurrent climate events, ranking the impact of climate indices on drought as MEI/SOI > NAO > AMO > DMI. Coherence analysis found significant correlations between ENSO and SPEI, and NAO and SPEI, in the 2–7 and > 8-year bands, respectively. Phase differences suggested that severe wet and dry periods align with La Nina and El Nino events, with strong El Nino events and AMO negative phases mainly causing severe droughts in the area.

1 Introduction

Drought, a highly challenging natural disaster to predict, is primarily caused by insufficient precipitation during a region's main wet season. Certain areas are more prone to experiencing droughts, which have significant impacts on emerging nations that rely on rain-fed crop farming, including their economies, living conditions and agriculture (Kamruzzaman et al. 2019; Qin et al. 2015; Yang et al. 2017). Globally, drought characteristics have been increasing, leading to drastic impacts on agricultural crop production (Spinoni et al. 2020; Kamruzzaman et al. 2019). The rising drought trend in West Africa has been attributed to variability in some climate parameters, such as temperature and precipitation which usually have a significant link with large-scale climate indices (Ayugi et al. 2022).

Drought can be categorized into four main types: meteorological (low rainfall), agricultural (low soil moisture), hydrological (reduced water levels in bodies of water), and socio-economic (where water demand surpasses supply). It is caused by factors such as decreased rainfall, high temperatures, water resource mismanagement and climate change, which alters weather patterns, potentially increasing drought frequency and severity. Atmospheric dynamics play a key role, where the descent of air masses, associated with high-pressure systems, reduces precipitation by causing air to warm and hold more moisture, thus preventing cloud and

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