

Analysis and causes of non-stationary teleconnections impacting on West African Monsoon rainfall

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West Africa rainfall is influenced by several teleconnections and physical mechanisms. Known teleconnections are linked to the El Niño-Southern Oscillation (ENSO), the sea surface temperatures (SSTs) of major ocean basins, the Atlantic Meridional Mode (AMM) and/or the Atlantic Multidecadal Oscillation (AMO), and the Indian Monsoon. By using a large and high quality West African rainfall dataset, covering the period 1921-2009 for three homogenous regions; we have revisited teleconnections (e.g. ENSO, SST, AMM-AMO, Indian Monsoon) with a focus on the non-stationarity, on the percent variance explained using linear and multiple linear regression, and on potential physical mechanisms that may explain the non-stationarities. Several ENSO and precipitation indices from West Africa (5-20°N; 17°W-25°E), divided into West Sahel (WS), Central Sahel (CS), and Guinea Coast (GC), are first used in a linear correlation analysis to investigate the long-term, multi-decadal, and seasonal evolutions of their ENSO-rainfall relationship. Secondly, we have investigated the evolution of the relationship between the AMM, the AMO and the above-mentioned precipitation indices. The evolution of the coefficient correlations between monthly SST of three oceans basins (Indian ocean, the eastern Mediterranean Sea, Atlantic 3 region (ATL3), and the Gulf of Guinea) and the precipitation indices in West Africa are also evaluated. The teleconnections have a strong impact on West African Monsoon (WAM) variability, however the influences fluctuate on different time scale. Long time series give more insight on the stability of the relationship between WAM and teleconnections. However, in some cases, recent years show large and significant correlation. The SST influence on Sahel rainfall from the Atlantic and the Pacific reversed in recent years suggesting changes on the atmospheric circulation. The second rainy season (SO) in GC is strongly affected by teleconnections. ATL3 and GG seem to be the best predictors for the little dry and the second rainy season.