



Hydroclimatology of the Volta River Basin in West Africa: trends and variability from 1901-2002

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Understanding trends and variations of current and historical hydroclimatic variables is pertinent to the future development and sustainable management of water resource of a given region. In this study, long-term historical record of rainfall, runoff and other climatic factors were used to investigate hydrological variability in the Volta River Basin over the period 1901-2002. Potential (PE) and actual evaporation (AE), rainfall variability index (RI), Budyko's aridity index (AI), evaporation ratio (ER) and runoff ratio (RR) were estimated from the available hydroclimatological records. Mann-Kendall trend analysis and non-parametric Sen's slope estimates were performed on the respective time-series variables to detect monotonic trend direction and magnitude of change over time. An increase of 0.30 mm/yr^2 ($p < 0.001$), for a total 102-year increase of 31 mm/yr , was observed in PE, whereas a decrease in rainfall of 1.38 mm/yr^2 or 13.2% of the mean was estimated over the same period. Similarly, runoff and actual evaporation decreased at the rate of 0.20 mm/yr^2 and 1.78 mm/yr^2 , for the period between 1936 and 1998, respectively. Runoff showed the highest variability with coefficient of variation (CV) of 38% whereas the lowest CV of 1.5% was estimated for PE. Rainfall variability index showed that 1968 was the wettest year ($\text{RI} = +1.75$) while 1983 was the driest ($\text{RI} = -3.03$), with the last three decades being drier than any other comparable period in the hydrological history of the Volta. Over the 20th century, this basin has been experiencing a gradual increase in dryness as revealed by an increase of $0.002/\text{yr}$ (15 % of mean) in aridity index. Possible causes, such as climate change and land cover change, on the detected changes in hydroclimatology are briefly discussed.