

## Storage capacity and long-term water balance of the Volta Basin, West Africa

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**Abstract** Rainfall in West Africa is often typified as being subject to large inter-annual variability. For the Volta Basin, this variability is actually not very large. The coefficient of variation for rainfall is only 0.08 (1931–1995) with an average of 400 km<sup>3</sup> year<sup>-1</sup>. Yet, a much higher coefficient of variation of 0.38 (1931–1995) is found for runoff with an average of 43 km<sup>3</sup> year<sup>-1</sup>. The basin shows a nonlinear response that amplifies small changes in rainfall into large changes in runoff. A simple runoff model for the Volta Basin was formulated with a Nash-Sutcliffe efficiency of 72%. This model implies that once rainfall exceeds a threshold of 342 km<sup>3</sup> year<sup>-1</sup>, more than 50% of the exceedence runs off. This threshold behaviour makes the water resources of the Volta Basin highly sensitive to both climatic variability and anthropogenic impacts. First, the impact of climate variability is quantified. Subsequently, development of the storage capacity of the Basin is evaluated on the basis of the water balance over the period 1966–1995 with an adapted Thornthwaite-Mather model. Results show that there is no change in hydrological behaviour of the basin that could be attributed to human impact. This lack of a clear anthropogenic signal can partially be explained by two contrary developments, increase in surface water storage in reservoirs and decrease in soil moisture storage due to soil and vegetation decline.

**Key words** anthropogenic impact; basin-wide storage capacity; climate impact; Volta; water balance; West Africa