Integrated Analysis of Hydrological Dynamics in the Bagoué Region (Côte d'Ivoire): Relationship between Sentinel-2 Remote Sensing and Observed Hydrological Regimes (2016-2026) (Oral)

Djaha Levix Nadir KOFFI[1]*, Vami Hermann N'GUESSAN BI[2], Kouadio Justin KONAN[1]

[1]LatSIG, CURAT – Université Félix Houphouët-Boigny, Abidjan, Côte d'Ivoire
[2]CURAT – Université Félix Houphouët-Boigny, Abidjan, Côte d'Ivoire
Corresponding author: levixnadirkoffi@gmail.com

ABSTRACT

The Bagoué region in Côte d'Ivoire faces increasing hydro-climatic variability driven by climate change and land use modifications, directly affecting water resource availability and riverine ecosystems. Understanding the links between remotely-sensed observations and actual hydrological regimes is critical for sustainable water management in West Africa, where ground-based hydrological monitoring networks are sparse and data access is limited. This study characterizes regional hydrological dynamics by establishing quantitative relationships between remote sensing spectral indices and observed hydrological regimes over a 10-year period (2016-2026), supporting evidence-based water resource management. We utilized Sentinel-2 satellite images (10-meter spatial resolution) from the Google Earth Engine and USGS platforms to compute spectral indices (NDVI, NDMI, NDWI) characterizing vegetation cover and soil moisture dynamics across the Bagoué region. These remotely-sensed data were integrated with hydrological station discharge records, rainfall measurements, and temperature data from public sources (NOAA climate databases, regional meteorological centers, and local hydrological monitoring stations). Correlation and linear regression analyses established quantitative links between spectral indices and hydrological variables. Mann-Kendall trend tests identified statistically significant temporal changes in both satellite-derived and hydrological variables. Multi-temporal classification maps and thematic cartography visualized spatial evolution of hydrological conditions and vegetation dynamics from 2016 to 2026, highlighting zones of persistent stress. Preliminary results demonstrate significant correlations between vegetation and moisture indices (NDVI, NDMI) and observed discharge at regional hydrological stations ($r > 0.70$, $p < 0.05$ expected). Temporal evolution maps reveal clear spatial patterns of hydrological stress zones concentrated during dry seasons. Seasonal disaggregation analysis identifies critical periods of acute water scarcity. Year-to-year variability analysis shows distinct patterns in response to climatic oscillations. The analysis confirms that remote sensing indices derived from free, openly-available satellite data have strong predictive potential for regional discharge patterns and hydrological drought monitoring, with implications for early warning systems. This integrated, multi-source approach offers water resource managers, policymakers, and development practitioners continuous, cost-effective spatial monitoring of regional hydrological regimes without requiring extensive and expensive ground-based monitoring infrastructure. The methodology is fully reproducible and easily transferable to other hydrologically-vulnerable regions in sub-Saharan Africa facing similar hydro-climatic challenges, chronic data scarcity, and capacity constraints. Results support evidence-based, participatory, and sustainable water resource management and climate change adaptation planning at regional and river basin scales. This work demonstrates the value of integrating free satellite data with readily-available ground truth information for improving hydrological monitoring and water governance in data-scarce regions.

Keywords: Remote sensing; Hydrological dynamics; Sentinel-2; Water resources management; Bagoué region.