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Geomorphic characterization of the Lower Niger River using Google Earth Engine

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The Niger River, the third-largest river on the African continent with a length of about 4,200 km, is a major transboundary river that flows through 9 countries. It is a mainstay of the economy in West African countries with over 20 million people directly or indirectly depending on it for their livelihoods. Although the geomorphology of the Niger Delta is well studied, comparatively little is known about the fluvial portions of the system, despite their considerable value to local communities. Here, we focus on a ~100 km braided segment of the Lower Niger River located between Lokoja and Idah, downstream of the Niger-Benue confluence in south-central Nigeria. The hydrogeomorphology of the segment is largely controlled by the Kainji Dam (Niger tributary) and the sediment supplied from the Benue catchment (Benue tributary). Our study aims to assess changes in river planform by applying semi-automated satellite imagery analyses. We use the cloud-based computing platform Google Earth Engine (GEE) to analyse multi-temporal collections of Landsat, Sentinel and Planet satellite imagery acquired between 1987 and 2021. At decadal time intervals, we classify the active river channel (including water and exposed alluvial deposits) using a HSV colour representation of the RGB imagery, combined with conventional multispectral indices. We quantify areas of erosion and accretion to identify laterally dynamic reaches during the analysis period. We link these findings to changes in the hydrological regime using discharge estimates from nearby gauging stations. Findings are useful for predicting and building resilience to river-related hazards in dynamic landscapes and will support sustainable river management interventions in the area.