Integrating Deep Learning and Coastal Vulnerability Index for Analyzing Shoreline Evolution in the Niger Delta Region

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Key words: Shoreline; Coast Sat Toolkit; Erosion; Accretion

SUMMARY

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ABSTRACT

Coastal erosion and vulnerability have become pressing issues in many parts of the world, including the Niger Delta region of Nigeria, where rapid shoreline changes threaten communities and ecosystems. This study aimed to assess shoreline dynamics and coastal vulnerability by integrating remote sensing, deep learning, and statistical analysis. Using Landsat data, the Coast-Sat toolkit, and Modified Normalized Difference Water Index (MNDWI), shoreline positions for 2002, 2015, and 2023 were derived. Statistical analysis with Digital Shoreline Analysis System (DSAS) revealed a high rate of shoreline erosion, with 75.3% of transects showing erosional trends. To further understand the drivers of vulnerability, a Coastal Vulnerability Index (CVI) was developed by combining elevation (DEM), slope, and distance to shoreline, tidal range, and tidal height. Regression analysis indicated that slope and distance to shorelines were the most significant factors influencing coastal vulnerability, while tidal range had lesser impact. The study's findings emphasize the need for proactive coastal management strategies in the Niger Delta, including monitoring high-risk areas and implementing protective measures. This research demonstrates the effectiveness of integrating deep learning with geospatial tools to quantify and analyze coastal vulnerability, providing essential insights for future studies and coastal management

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efforts.

Keywords: Shoreline; DSAS; Coast Sat Toolkit; Statistical Analysis; Erosion; Accretion; CVI