SATELLITE-BASED NEARSHORE SANDBAR DETECTION WITH IMPLICATIONS FOR BEACH CLASSIFICATION

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INTEREST

Nearshore morphology, including sandbars, has a strong influence on coastal development. Despite their importance, these morphological features are well documented only at a few, but growing, hotspot beaches, despite their presence along important stretches of sandy coasts worldwide. Located in the surf zone, sandbars play a fundamental role in coastal dynamics by reducing the energy of incoming waves by acting as a temporary sediment reservoir and a mobile, flexible obstacle to waves and currents.

Wright and Short (1984) established an initial coastal classification by defining a beach as reflective, dissipative, or intermediate based on observations of a large panel of single sandbar, microtidal coastal areas. Masselink and Hughes (2003) reclassified different types of beaches based on the amplitude of the tidal range. These morphologies are generally considered to be in equilibrium with tidal and wave forcing. However, the morphological response of the sandbar is generally longer than the time scales associated with changes in the wave regime. This reshaping is the main source of bathymetric profile variability on short intra-seasonal scale, mid-seasonal scale and long term inter-annual scale.

METHOD

While the detection of fine-scale near-shore features has historically been beyond the reach of Earth observation satellite methods at large scales, current missions such as regularly revisiting satellite optical imagery now provide such detailed level data on a regular (5-10 days) and global basis at increasing resolutions.Compared to traditional methods, satellite capacity offers a nice alternative way to monitor these submarine features on large temporal scales for regional areas, thus allowing the detection of these sandbars to understand local morphodynamics by understanding regional processes even over entire undocumented continents such as Africa (Almar et al., 2023).

Lippmann and Holman (1989) deduced that the location of natural sandbars can be inferred remotely from the dissipation of wind waves and swell over the bar crest. Like video monitoring, remote sensing detects areas with strong spatial variations in color intensity, and thus identifies the breaking zones on the nearshore sandbars and shoreline by analyzing the cross-shore locations of maximum pixel intensity within the bright areas of the images (e.g., wave foam, see Figure 1).But unlike video monitoring, where the position of the nearshore sandbar is determined by the time-exposure intensity averaged images, satellites provide only a single instant of wave breaking, which can introduce uncertainties.

FOCUS

Using a combination of satellite Earth observation and high performance computing, our work is an initiative to systematically estimate the evolution of beach conditions. Special emphasis will be given to well-documented sites, but also to application sites with limited in-situ observations.

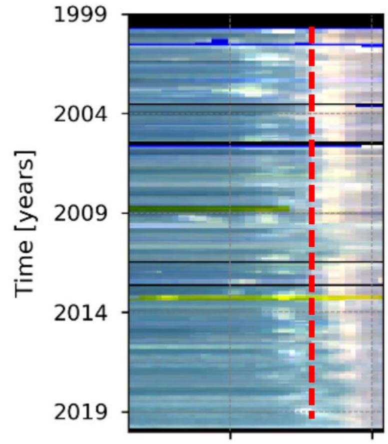

Figure 1: True color (red, green, blue) imaging from Landsat and Sentinel missions monthly aggregates and stacked along a cross-shore section at Saint Louis, Senegal (from Bergsma et al., 2020).Red dashed line shows the 1999 shoreline location given as reference.

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