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James town shoreline variability relative to high frequency forcing signals: Pressure, wind and tide

Donatus Bapentire Angnuureng (1) and Rafael Almar ()
(1) DFAS, University of Cape Coast, Cape Coast, Ghana, (2) LEGOS/IRD, Toulouse, France

Global climate change in response to buildup of human-induced greenhouse gases in the atmosphere has already resulted in several visible consequences such as increase of ocean heat content and melting of glaciers. This paper evaluates the relative effect of high frequency forcing such as tides and sea level variability on shoreline changes at the James Town, Ghana (Gulf of Guinea) exposed to medium energetic waves (max. 3m).

The novelty in coupling of archival data with remotely sensed data in data starved locations, to obtain reliable information for developing shoreline management strategies has shown progress. Using novel hydro-morphodynamic data gathered over an 8-month period (2013-2014) from nearshore video installation and Era-Interim hindcast and satellite altimetry (sea level anomaly), the evolution of the beach was then evaluated. Although the use of video systems has emerged as an alternative to measure hydrodynamic and morphodynamic parameters, the practice is not common in West Africa where lack of resources has affected consistent data collection. The application of this remote sensing technique is relatively cheaper and safer than deploying in-situ instruments. To address this shortfall, a network of video stations along the coastline of West Africa is being developed which could provide important data at these sites.

Data shows that though beach changes are not directly driven by sea level variability, its action is key in modulating waves influence especially at narrow and shallow continental shelves, within the Gulf of Guinea. Our results show that video derived shoreline responds in decreasing order to sea level variations (86%), waves (9%) and tidal cycles (5%) on daily bases. While wind-induced setup has limited effect on the shoreline, seasonality of waves plays an important role with predominating wave induced setup. The observed most important component of sea level anomaly at this tropical “storm free” coast is the influence from inverse barometer. Shoreline recession occurred under large inverse barometer, but, in general, the overall beach change was remarkably stable. Decadal observations from satellite shows that sea level anomaly is continuously rising in the Gulf of Guinea subregion with expected strong consequence for this urbanized low lying sandy coast.