SEDIMENT TRANSPORT ON THE GREAT BAHAMA BANK - INSIGHTS FROM FAIR- & STORM-WEATHER CONDITIONS

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PROJECT OBJECTIVES

- To assess the sediment budget of Great Bahama Bank (GBB) via quantification of sediment production, transport, and on- and off-platform accumulation.
- To evaluate the balance between fair and storm-weather conditions on sediment transport.
- To quantify volumetric sediment loss from the platform top via analysis of off-margin geophysical data.

PROJECT RATIONALE

Recent GBB studies have primarily focused on either platform sediment production, mapping of on- and off-platform sediment distributions, or analyzing the variable filling of accommodation space. The platform's sediment budget has received little attention, which is the motivation for this project. SLIM hydrodynamic modelling (developed at UCL, Belgium) indicates that fair-weather conditions do not deliver sufficiently vigorous current velocities to resuspend meaningful volumes of sediment. By contrast, storm conditions do. Analysis of satellite-derived turbidity data suggest a seasonal cycle to sediment lofting, upon which storms overprint (Fig. 1).

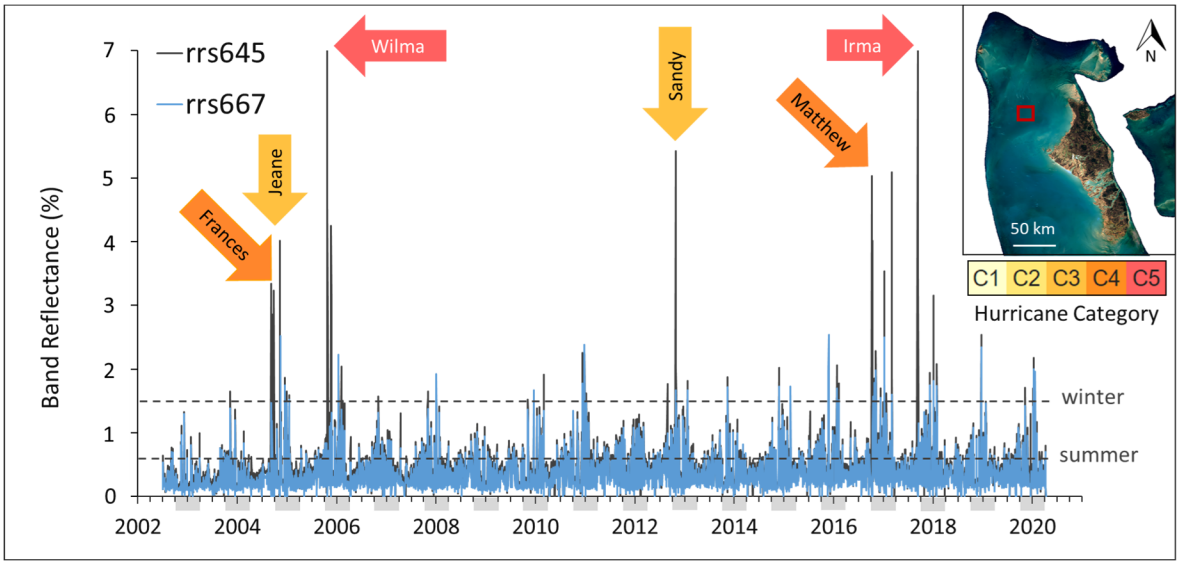

Figure 1. Timeseries of 645 and 667 nm MODIS reflectance on a portion of GBB (location map, top right). Elevated 667 nm reflectance (blue line) suggest seasonal variability in suspended sediment attributed to the passage of winter cold fronts (winter = gray bars beneath x-axis). Elevated 645 nm reflectance values (black line) capture storm-induced lofting of seabed sediment. Major hurricanes and respective categories labeled with colored arrows. Data courtesy of Brian Barnes (USF).

The question remains, however, as to how much of the GBB sediment budget is resuspended and redeposited in proximal (on-platform) locations, versus distal locations, over the platform margin in deep water. Thick accumulations of sediment sourced from the platform top have been recognized on the western flanks of GBB, and these deposits show substantial along-strike variability in their thickness and sedimentary facies (Anselmetti et al., 2000; Mulder et al., 2012). Deciphering the relative contributions of fair- versus storm-weather processes to the overall sediment budget is an important step in understanding the drivers of facies heterogeneity on this platform and its ancient analogs. Building forward from the substantial research conducted by our CSL collaborators past and present, we aim to quantify the relationship between prevailing hydrodynamics and sediment production, transport, and accumulation.

APPROACH

Satellite-derived turbidity products will be compared to model simulations capturing fair- and storm-weather conditions in order to estimate suspended sediment volumes. Off-platform suspended sediment volumes will then be compared to CHIRP sub-bottom lines acquired off the western GBB margin. This analysis will inform on the volume of sediment which has been lost from the platform top and accumulated on its margins, or else has been completely lost from the system.

SIGNIFICANCE

Intimate knowledge of sediment production and water movement atop the GBB is paramount to understanding the volumetric significance of sediment dispersal. Both processes impose physical limits on platform development. Overall, the investigation of sediment production, transport, and accumulation in a hydrodynamic context allows for a novel carbonate source-to-sink analysis.

REFERENCES

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