HYDRODYNAMIC MODEL FOR ISOLATED CARBONATE PLATFORMS

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PROJECT OBJECTIVES

- Combine the MIKE hydrodynamic model with facies maps for the Cay Sal Bank (CSB) and Great Bahama Bank (GBB) to examine the development of hiatal surfaces.
- Derive accurate bathymetry for Little Bahama Bank (LBB) so that it may be included in the model domain.
- Expand the analysis of MODIS imagery to audit whitings on the CSB and LBB to explore synchronicity with events on the GBB.
- Run the MIKE model for the Pleistocene S. Florida shelf to explore hydrodynamic control on the Miami oolite.

PROJECT RATIONALE

Purkis et al. (2016) initiated a two-year project utilizing MIKE 3, a hydrodynamic model, to simulate flow across the GBB and CSB (Fig. 1). The motivation was threefold. First, to examine the degree to which off-platform ocean climate influences platform-top hydrodynamics. The model suggested that the Florida Current (FC) makes episodic but meaningful excursions atop both the CSB and GBB. Second, to investigate the ability of the model to predict the accumulation of oolitic sand complexes along the margin of the GBB, with the outcome that the areal extent of sand bodies is well differentiated by the MIKE current velocities. Third, the ability of the MIKE model was trialed to forecast the initiation/suppression of whitings events atop the GBB (drifting patches of lime mud). This question is pertinent considering that the trigger for whiting events remains controversial, but they are calculated to have immense significance for the production and accumulation of muds on the Bahamas banks. By analogy, whitings were likely significant for the lime mud budget of ancient platforms also. Comparative analysis using the MIKE model and whitings tallied from MODIS satellite imagery suggest that strong incursions of the FC atop the GBB serves to suppress the formation of whitings, but that areas lacking any influence from that current (such as the precinct of the GBB in the lee of CSB) are not conducive to whitings events. These results suggest a complex dependency on whitings formation and renewal of platform-top waters by surrounding ocean circulation.

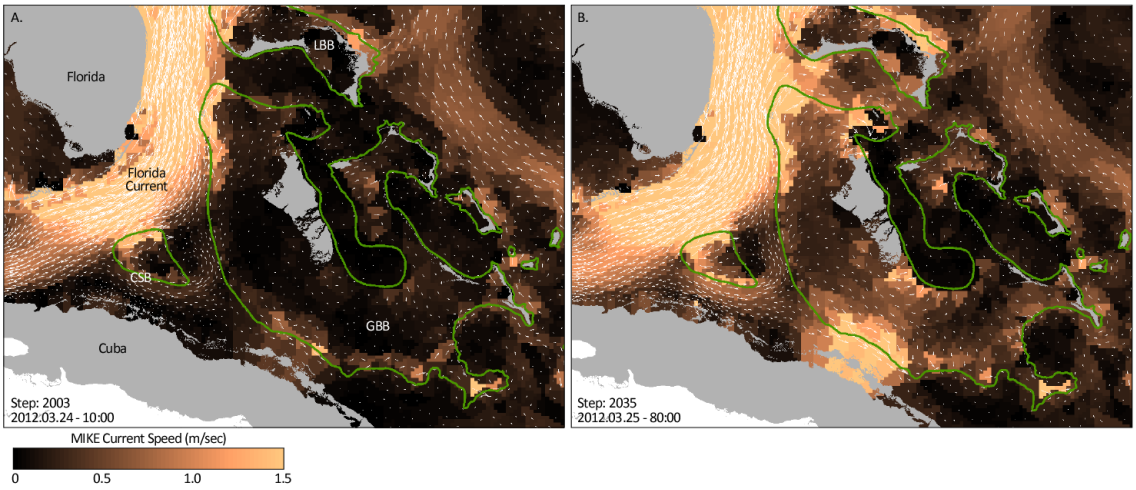

Figure 1. Temporal variation in the influence of the FC atop the CSB and GBB during March, 2012. (A) Shows limited incursion, whereas (B) reports meaningful connection between off-platform circulation and platform-top hydrodynamics.

SCOPE OF WORK

Hydrodynamic Model and Remote Sensing - The domain of the MIKE 3 model will be developed to incorporate the LBB and the examination of whitings from MODIS will be expanded to cover the LBB and CSB. Particular attention will be paid to synchronicity in the seasonal variation of whitings between the GBB, LBB and CSB and possible control by variations in intensity of the FC. The MIKE model will also be trialed atop the MIS 5e Florida Shelf with reference to established sea-level curves in order to examine hydrodynamic control of the deposition of the Miami oolite.

Sediment Transport Model - In order to evaluate sediment movement, the MIKE hydrodynamic model will be merged with depositional facies maps (Harris et al., 2015). The sediment transport model will be used to compare and contrast flow simulations with patterns of sediment fill of accommodation space across the platform tops of the GBB and CSB.

SIGNIFICANCE

An improved understanding of hydrodynamic control over platform-top sedimentation can only refine our general depositional models for platform carbonates, and lead to an enhanced use of these analogs in subsurface characterization and modeling.

REFERENCES

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