WHITINGS PROJECT PART 1: MACHINE LEARNING AND THE LONG-TERM WHITINGS RECORD

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PROJECT OBJECTIVES

- Deploy a neural network to identify whitings in daily MODIS ocean-color imagery over timescales of decades.
- Examine the whiting record for seasonal and multi-year trends and explore their controls.
- Develop an understanding of the variability of non-skeletal mud production through time and its influence on platform-top sedimentology.

PROJECT RATIONALE

The term "whiting" has been used to describe occurrences of lime mud precipitated directly from both marine and fresh waters. As a result of the potential of whitings to contribute to the Bahamas sedimentary record (e.g. Turpin et al., 2011; Purkis et al., 2017), considerable effort has been applied to understand the triggers and mechanisms of precipitation in this locality – a debate that has continued for more than eighty years.

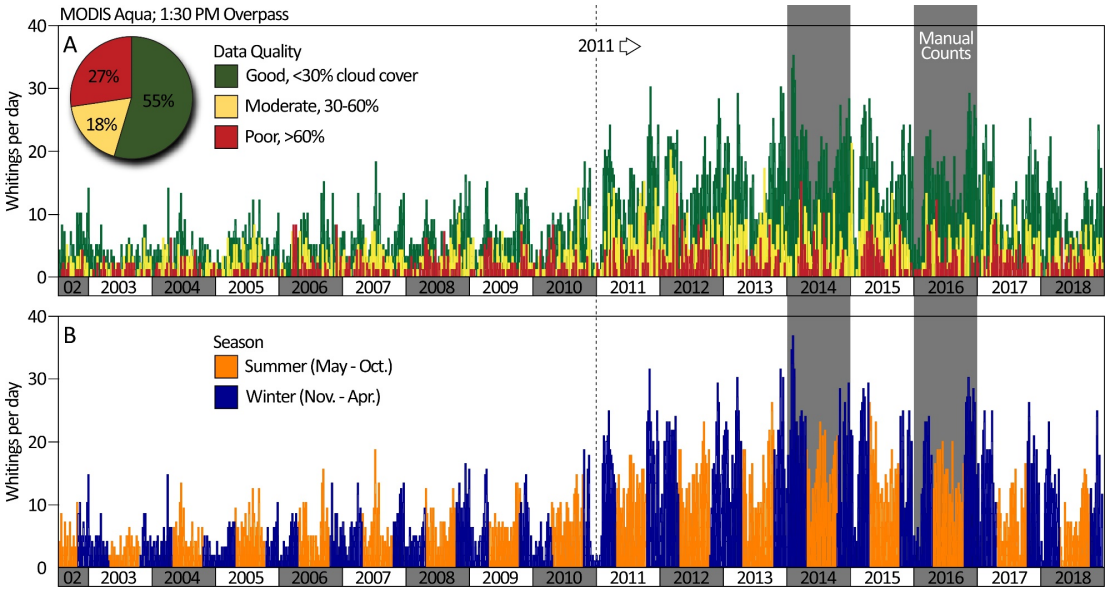

Figure 1: Whitings atop GBB tallied via a convolutional neural network from 2003 through 2018. (A) Data quality partitioned by cloud contamination and (B) summer-winter trends across the data series.

Recent work by the group has yielded a machine-learning algorithm capable of automating the identification of whitings from satellite imagery. Preliminary tests with this algorithm have allowed whitings to be mapped from the twice-daily MODIS overpasses from 2003 through 2008, a record of nearly 55,000 precipitation events (Fig. 1). These new data have the ability to greatly refine the understanding of the spatial and temporal distribution of whitings across Great Bahama Bank and beyond.

APPROACH

This study will call upon a newly developed Convolutional Neural Network (CNN), which is a class of deep neural networks, most commonly applied to analyzing visual imagery. The algorithm has been tested on MODIS imagery for Great Bahama Bank (GBB) and preliminary results suggest it to be capable of resolving whitings down to 250 sq. m with an accuracy exceeding 85%. The CNN has been trained on manual digitizations of whitings conducted for daily imagery acquired in 2014 and 2016, a training set of 15,000 events. The algorithm has now been used to map an additional 50,000 whitings and will shortly be updated to audit their shape and area, as well as their location.

SIGNIFICANCE

Preliminary results suggest that the summer-winter cycle in the abundance of whitings reported by Purkis et al. (2017) generally persists throughout the 2003 through 2018 record, but is augmented by a longer-term oscillation in frequency which can be observed in the near doubling of average annual GBB whitings after 2011 (Fig. 1). Possible controls on the decadal cycling of Bahamas lime mud production will be assessed and the geological implications for platform-top facies heterogeneity will be explored.

REFERENCES

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