

# **Preliminary report on the model predicting pelagic sargassum seaweed growth, abundance and mass transport within the North Equatorial Recirculation Region (NERR) and the Eastern Caribbean**

J.S. Franks and D.J. Johnson

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Center for Fisheries Research and Development (CFRD)  
The University of Southern Mississippi  
School of Ocean Science and Engineering  
Gulf Coast Research Laboratory (GCRL)  
Ocean Springs, Mississippi, USA

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## Abstract

Trial projections ('trial runs') were conducted in order to test the steps needed to develop a long-range pelagic sargassum movement prediction scheme/methodology. Processed satellite images of pelagic sargassum available from the University of South Florida (USF) Optical Oceanography Laboratory were used in the modeling process. These images were used to select starting points and times (date of image) for forward tracking using the climatology of HYCOM ocean current data (years 2006-2016). These projections appear promising and could be compared with actual observations. Not only pelagic sargassum growth but mortality is of major importance for prediction of the intensity of sargassum inundation events; these unknowns require investigation. At present, we are relying on satellite imagery and conjecture. Trials are on-going, including attempts to composite starting locations over multiple images on 3-5 day schedules.

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## Introduction

Predicting pelagic sargassum seaweed growth, abundance and mass transport within the North Equatorial Recirculation Region (NERR) and the Eastern Caribbean requires a fundamental understanding of recent blooms and incursions, including continued identification of variables and knowledge gaps critical to studies of the events and to building prediction capacity. We continue to identify data gaps and initiate 'trial projections' as contributions toward prediction.

## Progress to date

We have made a number of trial projections ('trial runs') on the methodological steps needed to develop a long-range (> 1 month) pelagic sargassum movement prediction scheme. Processed optical spectral satellite images of pelagic sargassum from the University of South Florida (USF) Optical Oceanography Laboratory website (C. Hu and M. Wang; [http://optics.marine.usf.edu/cgi-bin/optics\\_data?roi=C\\_ATLANTIC&current=1](http://optics.marine.usf.edu/cgi-bin/optics_data?roi=C_ATLANTIC&current=1))

were used to select starting points and times (date of image), and to forward track sargassum movement using modeled ocean currents.

**Initial trials:** Since the HYCOM model does not forecast beyond 5 days, we used archived HYCOM data from several different years separately to trace currents forwards from the same image starting month and day, but different model years. The results were not satisfactory due to the wide variation in the predicted outcomes between different years, due to the high inter-annual variation in surface currents in this region.

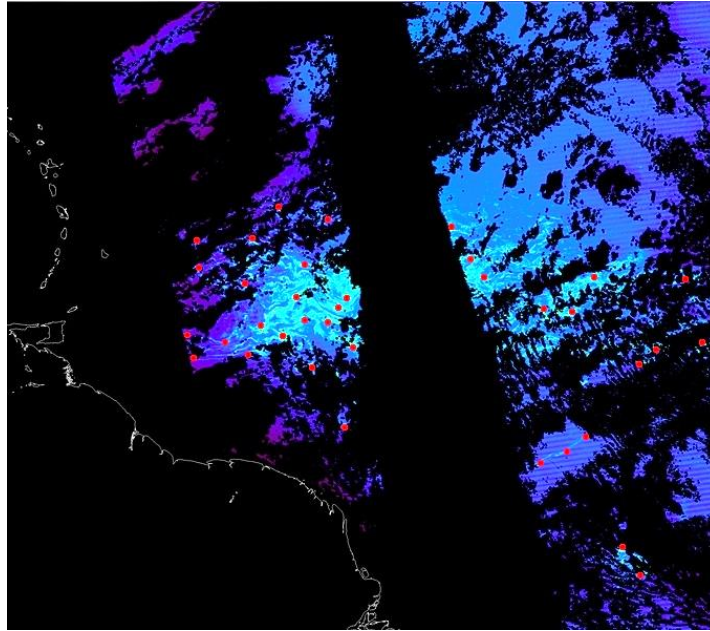
**On-going trials:** Our most recent effort uses a climatology of HYCOM data (years 2006-2016). Climatology here refers to mean year days (value for same day in each year averaged across years) for archived data. Trials (tests) are on-going. Present tests involve selecting starting locations where possible from the satellite imagery. Since cloud cover frequently masks identification of pelagic sargassum on many of the daily images, we are attempting to use 7-day composites of images, recognizing that these composites will 'smear' the sargassum locations as it moves over the 7-day period, potentially making mats appear larger and more extensive than in reality. As such we are currently attempting to composite starting locations over multiple images on 3-5 day schedules.

**Future challenges:** Pelagic sargassum growth and mortality remain large unknown factors for developing prediction models, particularly long-range models, which will require significant *in-situ* measurement capability. Growth and mortality of pelagic sargassum from satellite imagery is presently ambiguous. Furthermore, pertinent input (quantitative data) from West Africa on recent pelagic sargassum inundation events stretching from Dakar to Nigeria are lacking. We believe such data are key to a greater understanding of the overall bloom and transport process in the North Equatorial Recirculation Region (NERR), with connection to the Eastern Caribbean.

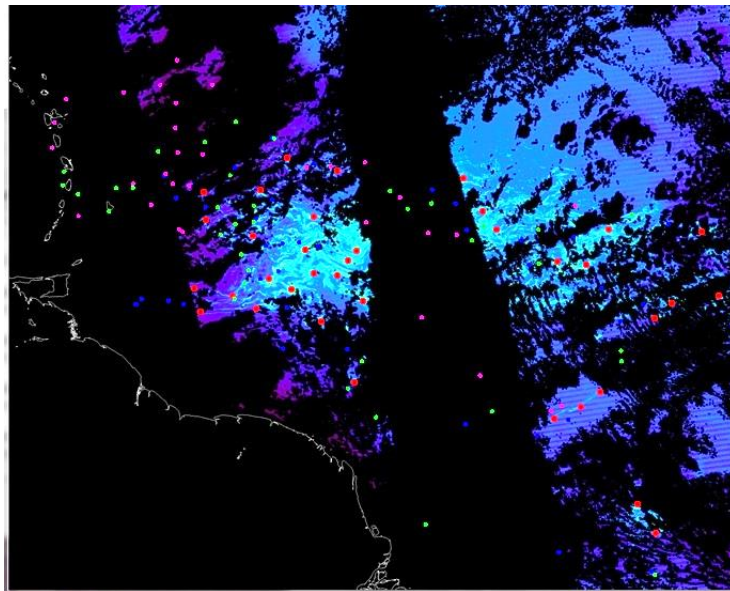
## Recent projections (demonstration)

A satellite image (23 March 2018) downloaded from USF Central Atlantic website was used to develop short-term projections of pelagic sargassum transport in the Eastern Caribbean region. Points at sargassum locations on the image were selected to start running the forward tracks using an algorithm developed by Dr. Don Johnson (this project) in concert with archived HYCOM ([www.hycom.org](http://www.hycom.org)) model

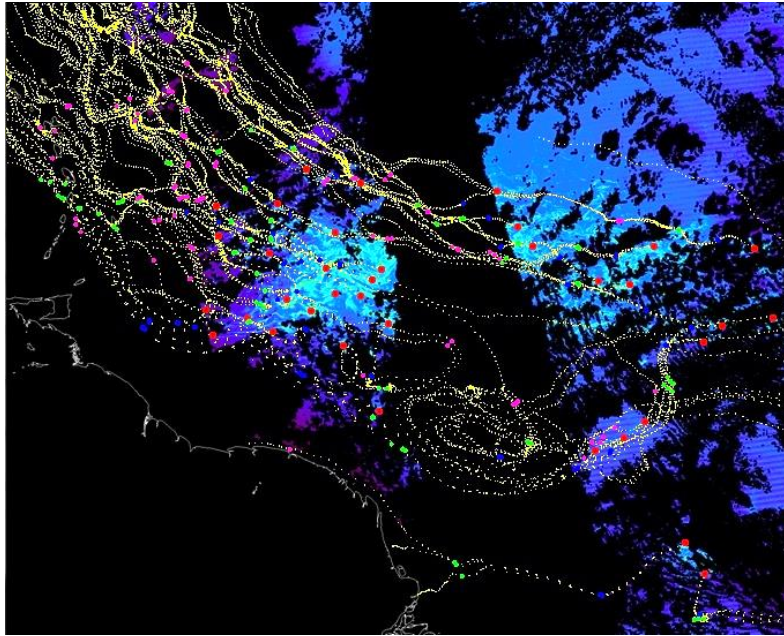
data (surface current climatology for the years 2009-2016). For better clarity the results are separated into three images provided below.



**Image 1. Shows the NASA Aqua Modis image from March 3, 2018. Red points are selected starting points for the forward predictions.**



**Image 2. Shows selected starting points (red dots) and predicted locations at select future dates: 15 March 2018 (blue dots), 31 March 2018 (green dots) and 30 April 2018 (purple dots).**



**Image 3. Shows predicted daily tracks (yellow dots) taken by sargassum from each selected starting location (red dots), superimposed on predicted positions on 15 March 2018 (blue dots), 31 March 2018 (green dots) and 30 April 2018 (purple dots). Three points are projected from each starting location with a random current (turbulence) addition to help illustrate the possible spreading of a line of sargassum as it moves.**

There are extensive regions outside and within the satellite swaths that are covered in clouds (black out) and may contain hidden sargassum. HYCOM model currents are climatology (only forecasts for 5 days), so currents are ‘average.’ Sargassum also appears at low latitudes in the images. Based on our observations that March is early for sargassum to be arriving off Brazil from the Gulf of Guinea, we hope this is sargassum being recycled in the general area of the North Brazil Current Retroflexion ([http://oceancurrents.rsmas.miami.edu/atlantic/north-brazil\\_2.html](http://oceancurrents.rsmas.miami.edu/atlantic/north-brazil_2.html)) and not an advance on a spring deluge of sargassum along the coast of NE Brazil.

These projections appear promising and could be compared with actual observations (i.e., ‘ground truthed’). Not only pelagic sargassum growth but mortality is of major importance for prediction of the intensity of inundation events. Use of pelagic sargassum growth rates reported in previous studies in our transport models have shown little relationship to reality. Dedicated studies on sargassum mortality are urgently needed as well. At present, we are relying on satellite imagery and conjecture. Franks et al. (2015) suggest that stronger than normal currents and higher sea surface temperatures can be expected as the earth warms, enhancing retention of pelagic sargassum in the NERR and producing growth for subsequent blooms.

## Next steps

We will work to advance our fundamental understanding of recent blooms and incursions, including continued identification of factors critical to understanding bloom events, including an examination of temporal change over time in the sargassum consolidation regions of the NERR as related to mass accumulations of sargassum and dynamics of the original bloom. Information on sargassum growth, mortality and genetics is also critical for improving the prediction model. We intend to ground- truth trial predictions using stranding reports, on- ground monitoring, and quantification of sargassum in

satellite images. Through our ongoing work, we are testing components of a methodology (system) that can be applied to routine prediction.

## References

**Franks, J.S., D. R. Johnson and D. S. Ko.** 2015. Retention and growth of pelagic Sargassum in the North Equatorial Convergence Region of the Atlantic Ocean: a hypothesis for examining recent mass strandings of pelagic Sargassum along Caribbean and West Africa shorelines. *Proceedings of the Gulf and Caribbean Fisheries Institute* 67: 36.