Towards the Development of a Sub-regional *Sargassum* Outlook Bulletin for the Caribbean

Hacia el Desarrollo de un Boletín Subregional de Perspectivas de *Sargassum* para el Caribe

Vers l'Elaboration d'un Bulletin Sous-régional sur les Perspectives du *Sargassum* dans les Caraïbes

SHELLY-ANN COX[1]*, HAZEL A. OXENFORD[1], PATRICK MCCONNEY[1], DONALD R. JOHNSON[2], and JAMES S. FRANKS[2]
[1]*Centre for Resource Management and Environmental Studies (CERMES), Faculty of Science and Technology, University of the West Indies, Cave Hill, Barbados*
[2]*Center for Fisheries Research and Development, Gulf Coast Research Laboratory, School of Ocean Science and Engineering, The University of Southern Mississippi, Ocean Springs, Mississippi, 39564 USA.*
**shellsalc@gmail.com*

EXTENDED ABSTRACT

Since 2011, thousands of tons of pelagic *Sargassum* seaweed have piled up on beaches and in nearshore waters of many countries across the Caribbean region (Franks et al. 2016). These periodic influx events, now considered to represent a 'new normal' in this region (Maréchal et al. 2017), have significant negative implications across multiple sectors including fisheries, tourism, health and environment (Oxenford et al. 2017). They also present new potential opportunities for development of industry using *Sargassum* as a raw material (Hinds et al. 2016, Louime et al. 2017). Adapting to this new normal by learning to cope with, and even profit from, these influx events is a critical next step for the region, and would benefit greatly from the development and communication of reliable long and medium-term forecasts of *Sargassum* arrivals. A recently launched monthly *Sargassum* outlook bulletin for the Wider Caribbean by USF/NASA is providing timely updates on *Sargassum* presence in the entire region relative to previous years and comments on future bloom probability for the next three months (Wang and Hu 2017, https://optics.marine.usf.edu/projects/saws.html). This provides an excellent opportunity to develop a complimentary Outlook Bulletin at a finer sub-regional scale that would better serve the interests of individual countries. Here we present a zero-draft of a quarterly *Sargassum* Outlook Bulletin tailored for the Eastern Caribbean sub-region.

The Outlook Bulletin is intended to serve two of the most heavily impacted sectors of the Eastern Caribbean, i.e. fisheries and tourism, with the target audiences being tourism businesses and policy makers, fisheries managers and fisherfolk. Our design criteria included the following essential elements: short and attractive publication for print or electronic delivery; simplified scientific jargon to translate the latest science into easy-to-understand language; provision of best available information on the current *Sargassum* intensity-level and a 3-month outlook of likely *Sargassum* abundance; summary of possible implications customized for each of the two sectors; and provision of links to useful resources.

Information on the current *Sargassum* intensity-level is displayed on the front cover of the bulletin. For this zero-draft we used a current AFAI (alternative floating algae index) 7-day composite satellite image of the Central Atlantic from the University of South Florida (USF) Optical Oceanography Laboratory (https://optics.marine.usf.edu/cgi-bin/optics_data?roi=C_ATLANTIC&current=1), covering the period 7-14 October 2018 for a visual reference, together with a current intensity-level gauge to help 'translate' the current satellite image into something that the audience can relate to (Figure 1 *top left*).

The intensity-level gauge was developed using a one degree square just to the east of Barbados (59.5 - 58.5° W, 12.5 - 13.5 ° N; Figure 1 *top right*) in which to quantify *Sargassum* intensity from monthly composite AFAI satellite images going back to 2010 (provided by C. Hu and M. Wang, USF Optical Oceanography Lab). Intensity was calculated each month (using the monthly composite image) as the total % cover of the one-degree square by the coloured pixels representing *Sargassum* presence, and plotted as a time series (Figure 1 *bottom panel*). The time series plot was then used to devise a simple, but somewhat arbitrary, 4-level gauge (clear, mild, moderate, severe) based on our collective experience and anecdotal reports (see Ramologan et al. 2017) of the impacts of *Sargassum* suffered in Eastern Caribbean islands (especially Barbados) over the same 8-year period.

The 3-month outlook, shown on the second page of the bulletin, is based on the best-fit model developed so far, of predicted *Sargassum* transport to this sub-region. The details of this model are given in this volume (see Johnson et al. 2019). In brief, we used the mean current field of three archived data sets, namely: satellite tracked mixed-layer drifters; and two climatological hydrographic models, HYCOM (HYbrid COordinate Model) and OSCAR (Ocean Surface Current Analysis Real-time). Starting points for the model were derived from areas of high concentration of *Sargassum* detected in the processed AFAI satellite images from the USF Optical Oceanography Laboratory (Figure 2 *top panel*). We then used a simple forward tracking algorithm with our mean current field to track the transport of *Sargassum* and predict its arrival at the 60° W meridian fronting the Eastern Caribbean island chain. The number of tracking points crossing the 60° W meridian

serves as a simple *Sargassum* prediction index. To provide better resolution of predictions, we also separated the island chain into northern and southern islands using 15.4° N as the dividing line on the meridian (Figure 2).

Summary information on likely implications for fisheries and for tourism over the next 3-months was developed with key stakeholders in an effort to add sector-specific value to the bulletin in a form that allows for development of appropriate responses. Links to media articles and other useful information were also embedded in the pdf document.

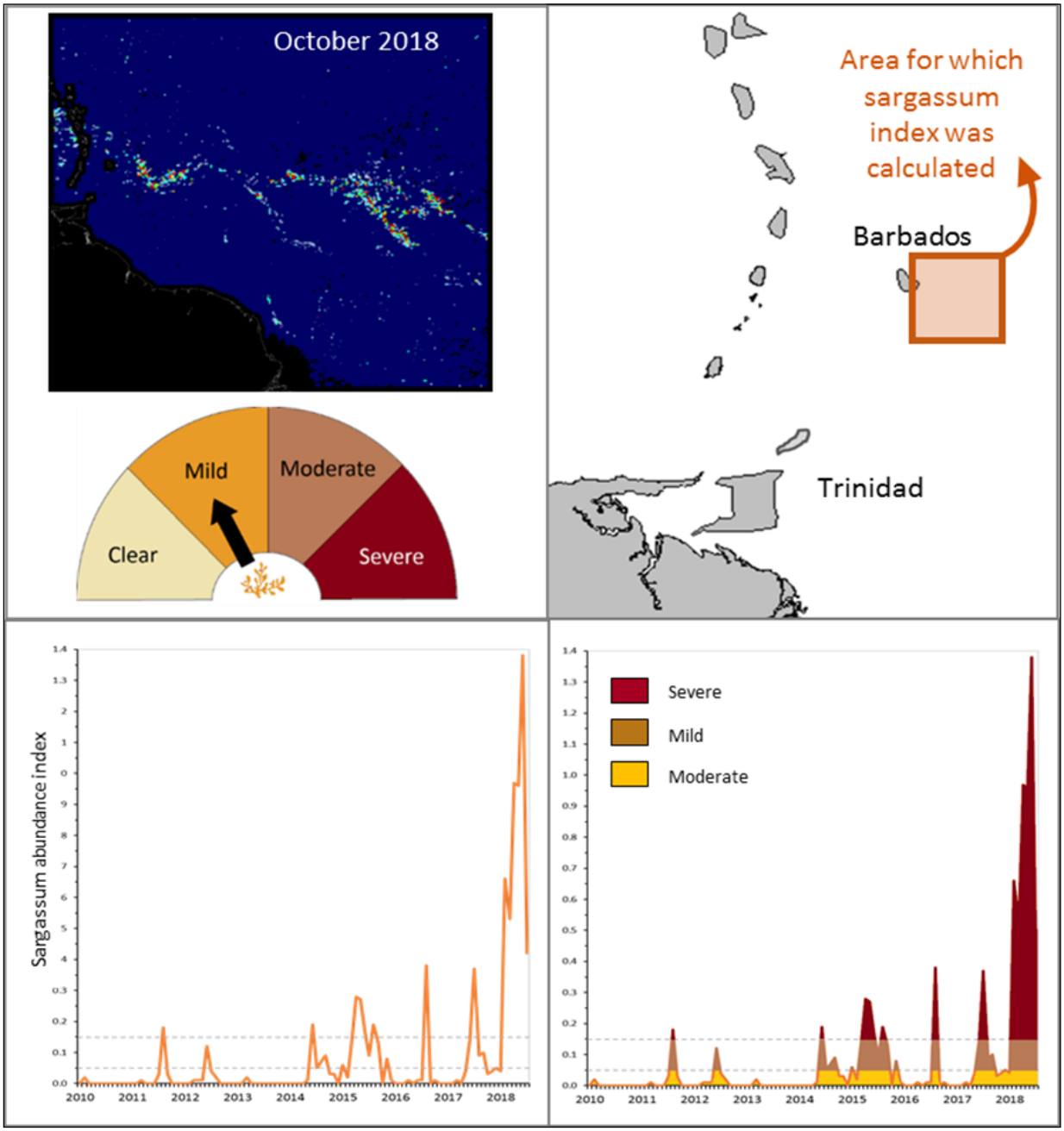

Figure 1. Interpretation of current abundance of sargassum. *Top left:* shows the satellite image and sargassum intensity-level gauge displayed on the front cover of the zero-draft *Sargassum* Outlook Bulletin. The image is an AFAI processed 7-day (07/10/2018-14/10/2018) composite satellite image showing *Sargassum* presence (as white through red pixels) in the Central Atlantic in early October (source: USF Optical Oceanography Laboratory, Hu and Wang 2017). *Top right:* shows the one-degree square to the east of Barbados in which a time-series of *Sargassum* abundance was calculated. *Bottom panels* show the time-series plot of *Sargassum* abundance (as monthly % cover of the square) up to July 2018, and the assignment of intensity-level based on the abundance index and the impacts experienced (clear = 0, mild = 0.01-0.05, moderate = 0.06-0.15, intense > 0.15).

The resulting 2-sided, zero-draft Outlook Bulletin document provides a much needed, easy to understand and fresh approach to assisting stakeholders in key sectors within the Eastern Caribbean to prepare for expected *Sargassum* influxes over the coming months. It was well received at its first release during the 71st Gulf and Caribbean Fisheries Institute and will be further tested at the up-coming FAO-UWI 2nd *Sargassum* Symposium in late November 2018. Next steps will include efforts: to continue working on improving the prediction model for this area; to use feed-back from the GCFI and FAO-UWI meetings to improve elements of the design of the bulletin; and to seek a viable method to sustain production. This will include forming partnerships with processed satellite image providers, seeking long-term funding, and automating the model for forward-tracking predictions.

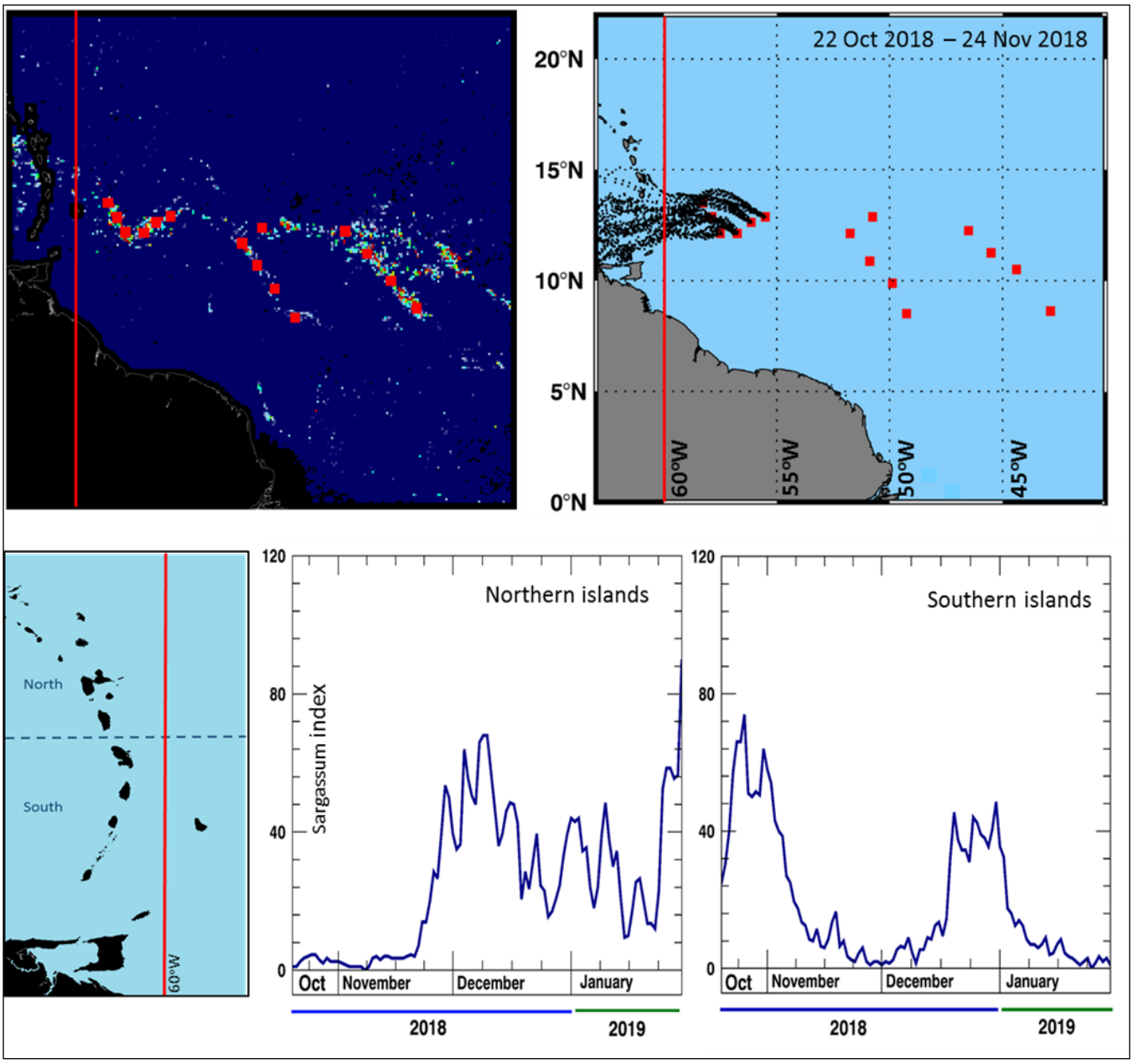

Figure 2. Development of 3-month *Sargassum* abundance outlook. Red lines mark the 60°W meridian used to measure an index of *Sargassum* arriving in the Eastern Caribbean. *Top left:* shows selection of starting points (as red squares) for *Sargassum* transport predictions superimposed on AFAI satellite image (from USF Optical Oceanography Laboratory, Hu and Wang 2017). *Top right:* shows model run for one month on nearest starting points. *Bottom left:* shows higher resolution map of division used between northern and southern eastern Caribbean islands. *Bottom middle:* shows expected *Sargassum* abundance levels arriving in the northern Eastern Caribbean islands, and *Bottom right*: shows expected levels for the southern islands, based on model runs of the starting points shown in top panel.

We anticipate that this bulletin will facilitate wider access to specifically tailored early warning information about *Sargassum* influxes in the Eastern Caribbean, allowing better decision-making processes by key socio-economic sectors in the region. It could also serve as a model for development of similar sub-regional bulletins across the entire Caribbean.

KEYWORDS: *Sargassum*, forecasting, communication, climate change adaptation

LITERATURE CITED

Franks, J.S., D.R. Johnson and D.S. Ko. 2016. Pelagic *Sargassum* in the tropical North Atlantic. *Gulf and Caribbean Research* **27**:SC6 - SC11.

Hinds, C., H. Oxenford, F. Fardin, E. Doyle, J. Cumberbatch, and A. Cashman. 2016. Sargassum *Management Brief. Golden Tides: Management Best Practices for Influxes of* Sargassum *in the Caribbean with a Focus on Clean-up*. Centre for Resource Management and Environmental Studies (CERMES), University of the West Indies, Cave Hill Campus, Barbados, 17 pp.

Johnson, D.R., H.A. Oxenford, S-A. Cox, and J.S. Franks. [2019]. Holopelagic *Sargassum* and the complexities of predicting influxes and impacts on pelagic fisheries of the Lesser Antilles. *Proceedings of the Gulf and Caribbean Fisheries Institute* **71**: In press.

Louime, C., J. Fortune, and G. Gervais. 2017. *Sargassum*m invasion of coastal environments: a growing concern. *American Journal of Environmental Sciences* **13**:58 - 64.

Maréchal, J-P., C. Hellio, and C. Hu. 2017. A simple, fast, and reliable method to predict *Sargassum* washing ashore in the Lesser Antilles. *Remote Sensing Applications: Society and Environment* **5**:54 - 63.

Oxenford, H.A., F. Fardin, E. Doyle, and J. Cumberbatch. 2017. Management recommendations to cope with *Sargassum* landings in the Caribbean. Extended Abstract, *Proceedings of the Gulf and Caribbean Fisheries Institute* **69**:215 - 216

Ramlogan, N.R., P. McConney, and H.A. Oxenford. 2017. *Socio-economic Impacts of* Sargassum *Influx Events on the Fishery Sector of Barbados*. Centre for Research Management and Environmental Studies (CERMES) Technical Report No. 81. 86 pp.

Wang, M. and C. Hu. 2017. Predicting *Sargassum* blooms in the Caribbean Sea from MODIS observations. *Geophysical Research Letters* **44**:3265 - 3273.