A Geospatial Approach to Quantifying Stranded *Sargassum* Seaweed Using Drones

Un Enfoque Geoespacial para Cuantificar las Algas *Sargassum* Varadas Utilizando Drones

Une Approche Géospatiale pour Quantifier les Algues de *Sargassum* Échouées à l'Aide de Drones

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EXTENDED ABSTRACT

Mass *strandings* of pelagic *Sargasssum* on beaches across the Caribbean have become the 'new normal' and efforts to manage the negative environmental, social and economic impacts now rank among the priority issues to be solved across the region. To better understand the ecological impacts, develop appropriate strategies to respond to inundations, and assess the viability of entrepreneurial businesses using Sargasssum, requires quantitative information on the location and amount of *Sargasssum* strandings across the region. To date there are no standard monitoring protocols in place for quantifying the volume of stranded *Sargassum*, and limited resources available for sustaining time-consuming, conventional quantification methods using transects and quadrats on multiple beaches.

In this study we test and compare the use of 'off-the-shelf' recreational drones (*i.e.* equipped with a RGB camera payload), together with drone flight planning mobile application and cloud-based photogrammetry mapping software, to easily obtain and process high resolution aerial imagery (Figure 1). Remote sensing and standard geospatial techniques are then leveraged to map, classify and quantify the volume of stranded *Sargassum*. Conventional transect and quadrat surveys were simultaneously conducted to validate results of the drone mapping methodology and geospatial analyses. This research was conducted in Barbados from June to September in 2018 - 2019, at various beach morphologies, using different drones,

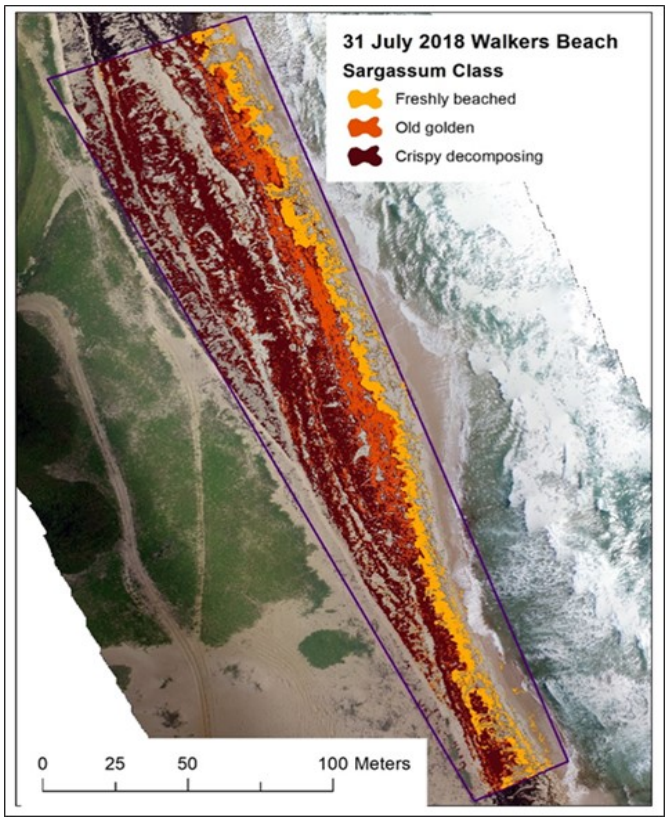

Figure 1. Results of the aerial image classification by *Sargassum* class.

flight parameters and mapping software applications to determine the most suitable methods for the Caribbean context (*i.e.* technological, human and financial resources). Here, we analyze the results of one day of survey data collected at Walkers beach to share our preliminary results and lessons learned. We examine the data from the drone survey, aerial mapping products (*i.e.* 2D orthomosaic and 3D elevation data) and geospatial analyses workflow. We also use the conventional transect and quadrat survey to quantify the cover and volume of *Sargassum* strandings to both ground-truth and validate our drone results.

We have found recreational 'off the shelf' DJI drones equipped with the standard high-definition camera payload to be easy to fly, relatively inexpensive and an excellent tool for rapidly monitoring and detecting *Sargassum* remotely. DroneDeploy flight planning and mapping software provides a non-technical, cloud-based processing, and requires only basic hardware and technological skills. Moreover drone surveys can be conducted offline and mapping products created in 'real-time' so that ground-truthing attributes can be collected simultaneously and easily, to add value to aerial data. Standard ArcGIS image classification tools allow for the accurate classification of *Sargassum* from the produced orthomosaic image and elevation data. However, quantifying the volume of *Sargassum* requires more advanced geospatial skills and the appropriate geospatial analyses tools are yet to be determined. Preliminary findings indicate that the accuracy of recreational drones' GPS and pixel resolution of the camera payload may be limiting factors. We continue to analyze collected data and are developing a geospatial framework to create a standard drone monitoring protocol and leverage the use of online collaboration tools and a web-based platform that can be easily applied across the Caribbean. This should enable regional collaboration to obtain and process *Sargassum* stranding data using a standardized methodology, and to share *Sargassum* information in near real-time with minimal financial resources and training.

KEYWORDS: *Sargassum* monitoring, standardized protocol, drone, geospatial, data sharing