**NASA DEVELOP National Program**

****NASA Ames Research Center

**Spring 2016**

**Short Title: Caribbean Oceans**

**Subtitle:** Detection and Monitoring of *Sargassum* Utilizing NASA Earth Observations as a Response to Unprecedented Observations in the Caribbean Sea

**VPS Title:** *Sargassum* – Sea Villain or Sea Hero?

**Project Team & Partners**

**Project Team:**

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**Past or Other Contributors:**

N/A

**Partner Organizations:**

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Centro Interdisciplinario de Ciencias Marinas: Instituto Politécnico Nacional (CICIMAR-IPN) (End-

User, POC: Dr. Francisco Arreguin, Researcher, Dr. Norma Patricia Muñoz, Secretary of

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Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO) (Collaborator,

POC: Dr. Sergio Cerdeira, Marine Monitoring Coordinator)

El Colegio de la Frontera Sur (ECOSUR) (Collaborator, POC: Dr. Laura Carillo, Oceanographer)

Universidad Autónoma de Baja California (UABC) (Collaborator, POC: Dr. Eduardo Santamaria

del Angel, Professor and Researcher)

University of Puerto Rico, Department of Marine Sciences (Collaborator, POC: Dr. Roy A.

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**Project Details**

**Applied Sciences National Applications Addressed:** Oceans

**Study Area:** Caribbean Sea, Caribbean Nations, including Puerto Rico

**Study Period:** January 2002 – January 2016 (Present)

**Earth Observations & Parameters:**

Aqua, MODIS –*Sargassum* identification Surface Temperature (Day Time)

Terra, MODIS - Sea Surface Temperature (Night Time)

ISS, HICO - *Sargassum* identification,

VIIRS, Suomi NPP – *Sargassum* identification

Landsat 8, OLI –*Sargassum* identification

**Ancillary Datasets Utilized:**

* Caribbean Oceans Team - Aggregated *Sargassum* Observations
* NOAA Ocean Watch - Chromophoric Dissolved Organic Material (CDOM)
* NOAA Ocean Watch - Photosynthetically Available Radiation (PAR)
* NOAA Ocean Watch – Chlorophyll-a (CHLA)
* NOAA Ocean Watch – Primary Productivity
* NOAA Ocean Watch – Wind Stress
* NOAA Ocean Watch – Wind Diffusivity
* NOAA Ocean Watch – Sea Surface Salinity

**Models Utilized:**

* Aviso via NOAA Coast Watch – Global Ocean Currents

**Software Utilized:**

TerrSet – Time series, statistical analysis, forecasting

ENVI - ArcGIS - raster manipulation/analysis, geographic

ArcGIS - raster manipulation/analysis, geographic correlation, ground truth spatial identification

R-Studio – Statistical analysis and regression modeling

**Project Overview**

**80-100 Word Objectives Overview:**

The nations of the Caribbean were inundated by an unprecedented amount of *Sargassum,* apelagic brown seaweed, in 2015, triggering great concern across the region. Floating *Sargassum* mats serve as diverse nutrient-rich ecosystems in the open ocean. However, once they reach shore, large quantities of *Sargassum* exact an enormous toll on local economies that are dependent upon ecotourism. This project uses NASA Earth observations to detect *Sargassum* across the Caribbean Sea, model its growth, and predict its proliferation. A better understanding of these events will help these economies, and promote sustainable management practices.

**Abstract:**

In the years 2011 and 2015, the nations of the Caribbean Sea were overwhelmed by a substantial quantity of *Sargassum* that washed ashore. As part of the international response, the Caribbean Oceans project used NASA Earth observations to detect *Sargassum* across the region, model its growth, and predict its proliferation. These recent *Sargassum* events have been observed throughout the Caribbean at reportedly unprecedented levels. In the open ocean, *Sargassum* mats serve an important ecological function. Some of the ecosystem services provided by the *Sargassum* include nutrient cycling, habitat for endemic species, and fish nurseries. However, large quantities have threatened both the tourist industry, a critical part of local economies, and the near-shore ecosystems within the study region. In order to address these issues, the Caribbean Oceans project utilized the Floating Algal Index (FAI) derived from MODIS Aqua data from 1980 to 2010. This index was then modeled with various oceanic variables in order to determine the ideal pelagic environment for *Sargassum* growth. Finally, the model was used to track the spread of *Sargassum* throughout the region on a yearly basis and identify its origins. As part of the international effort to better understand the life cycle of *Sargassum* in the Caribbean, the results of this project will help local economies and promote sustainable management practices.

**Community Concerns:**

* The origins of major *Sargassum* events are unknown, which prevents a proactive solution.
* Near-shore ecosystems, especially sea turtle nesting sites, are often harmed by the large quantities of *Sargassum*. Additionally, heavy machinery that is used to clear it can be destructive to these sites.
* Communities, as well as federal and local governments across the Caribbean region, are concerned about the adverse effects on the tourist industry.

**Current Management Practices & Policies**:

Currently, tourist industries within affected coastal areas are utilizing live webcams to monitor shores for *Sargassum* occurrences. The Mexican government has released regulation standards about how to remove *Sargassum* on beaches, which usually require the use of heavy machinery. This method can kill marine species or significantly stir the sand, thereby disrupting coastal environments. Other methods include removal of *Sargassum* by hand, which is time-consuming and costly. Caribbean governments rely mostly on sightings reports from local fishermen and other coastal communities’ members, however, Earth observations have not yet been incorporated into governmental policy and practices.

**Decision Support Tools & Benefits:**

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| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Replicable and regionally-calibrated *Saragssum* Index | Aqua MODIS, VIIRS, Landsat 8 | An accurate *Sargassum* index will provide a basis for further research and a method for early warnings |
| *Sargassum* Environmental Model | Aqua Modis, VIIRS | This provides data that indicates what oceanic variables have the most significant effect on large *Sargassum* events |
| Reverse-drift Model | Aqua Modis, VIIRS | This model will help identify the origin of *Sargassum* |

**Project Imagery**

**Software Release Requirements**

Category I- Software Release action is not required.