NASA MUREP/SMD Ocean Biology and Biogeochemistry Awards (OCEAN)

Title: Remote Sensing of Sargassum Accumulation and Impacts on Tropical Marine Ecosystems: A Multi-Scale Approach

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Summary: Since 2011, there has been a sudden increase in Sargassum biomass in the tropical Atlantic and Caribbean Sea with significant accumulation in coastal areas resulting in mangrove mortality and habitat displacement of benthic ecosystems such as coral reefs and seagrass beds, as well as altered wetland biogeochemistry and release of toxic decomposition products. This has local economic and public health impacts. The change in Sargassum biomass has been linked to increased sea surface temperature (SST) from climate change. Satellite remote sensing data have been used to identify and monitor Sargassum distributions throughout the Greater Caribbean Region, but this approach has been limited by the coarse spatial resolution of existing NASA sensors (MODIS, etc.) and the spectral similarity of in-water materials.

The proposed research focuses on the impacts of Sargassum "blooms" on fringing red mangroves and benthic habitats, specifically coral reefs and seagrass beds, along Puerto Rico's coastline on seasonal (acute impacts) and multi-year (chronic impacts) timescales. Sargassum area and volume will be quantified with satellite remote sensing data at various spatial scales with moderate resolution MODIS and VIIRS, high resolution Landsat 8 OLI and Sentinel 2 MSI, and very high resolution Planet Scope and Worldview 2-3 commercial sensor data from NASA CSDAP, tapping into the NASA satellite data buy to better understand Sargassum hot spots and potential associated impacts on SW Puerto Rico mangroves, coral reefs, and seagrasses and enable better management decisions. The proposal describes validation of satellite data products from field sampling of Sargassum, water quality and optical measurements of Sargassum, water column, and benthic habitat cover. To enable utilization of extensive remote sensing data from various satellites at different spatial, spectral and temporal resolutions, novel data-fusion techniques and various machine learning image processing approaches are proposed including object-based image classification (OBIA), Deep Neural Networks (DNN), convolutional NN (CNN), and Long Short-Term Memory NN (LSTMNN). The research responds to objective 1.1 of the solicitation (Quantitative remote sensing analyses of impacts and/or vulnerability of aquatic ecosystems to climate variability and change). A thorough outreach program and a STEM educational component was presented and well supported. Two minority graduates will work on the proposed research for the duration of the project to complete master's degrees.