FY 2022 Research NOFO Abstracts

Title: Application of UAV and satellite based optical sensors to help preserve the coral reefs of the US Virgin Islands

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Abstract: We propose to assess uncertainties in existing data and model products and quantify relationships between in situ water quality parameters measured in coral reef environments and optical measurements of water properties obtained from high-resolution field and orbital sensors. These relationships will be tested against long-term records and targeted assessments of coral health to accurately identify potential water quality stressors on coral reef ecosystem health. This project is a continuation of the scientific partnership between the University of the Virgin Islands, College of Charleston, Kent State University, and NASA's Jet Propulsion Laboratory. Our project is aligned with NASA's Earth Science MD in areas of oceanography and Biology and is directly relevant to NASA's Strategic Goal 2 "Advance understanding of Earth and develop technologies to improve the quality of life on our home planet", and Objective 2.4 "Advance the Nation's STEM education and workforce pipeline by working collaboratively with other agencies in NASA's missions and unique assets".

The corals of the US Virgin Islands (USVI) are facing stressful levels of land-based runoff, more frequent and severe bleaching events, and unprecedented mortality due to the recent and novel stony coral tissue loss disease (SCTLD). Water quality decline from urbanization in some cases is compounding these effects and/or hindering recovery from mass bleaching events, as coral reefs have low tolerances to changes in nutrient, sediment, and phytoplankton concentrations. On the other hand, more opaque water associated with lower water quality may slow the progress of SCTLD. Current methods of water quality assessment in the USVI are based on in situ measurements. Although these measurements provide good baseline data, they are labor intensive, costly and lack the spatial and temporal coverage needed to better understand changes in such a highly dynamic environment. This makes them less useful for understanding relationships between water quality and high-resolution coral reef ecological data sets.

Remote sensing (RS) is an indispensable tool for early detection and monitoring of stressors related to temperature and water quality constituent's indicative of environmental impairments. The goal of the proposed project is to integrate the use of Unoccupied Aerial vehicles (UAVs) and satellite-based sensors to develop a practical approach to assess the physical environment of coral reefs rapidly and quantitatively by more accurately determining the RS signatures of various water quality parameters. This capability will enable early warning of detrimental ecosystem changes and provide inputs for management and mitigation decisions. We seek to establish the link between SCTLD refuges and water quality, and to establish RS techniques to track the spread of SCTLD within the USVI and greater Western Atlantic. Our team will use existing field data coupled with new data to be collected during this project. The specific data that will be used includes in situ optical data from targeted sampling and by deploying moored near-continuously recording optical sensors (radiance, irradiance, backscattering), satellite and UAV-based optical data, water quality data, and high-resolution coral reef ecological data. We believe this data volume will greatly strengthen the modeling coefficients used to describe water optics from remotely sensed data. Information on uncertainties in retrievals carry tremendous significance from an operational standpoint, especially if management decisions are to be based on RS retrievals. We anticipate that our approach will apply to the variety of aquatic environments that are characteristic of the USVI waters.