

Utilizing NASA Earth Observations to Assess Ocean Conditions Leading to the Spread of the Nuisance Red Algae (Chondria tumulosa) in Papahānaumokuākea Marine National Monument, Hawai'i



Abstract

Chondria tumulosa, a newly discovered red alga, was observed in low abundance in 2016 but has since proliferated and is now smothering and decimating vast expanse of coral reefs in Manawai, located in Papahānaumokuākea Marine National Monument (PMNM). If the spread persists, the outbreak of this cryptogenic species could potentially cause region-wide ecosystem degradation. In coordination with the U.S. Fish and Wildlife Service, Marine National Monuments of the Pacific and the National Oceanographic and Atmospheric Administration (NOAA) Office of National Marine Sanctuaries, Hawai'i Regional Office, Papahānaumokuākea Marine National Monument, this project created a tool to analyze oceanographic conditions (sea surface temperature (SST), chlorophyll-a, water velocity, salinity, turbidity) across the Monument that could potentially be driving the algal spread. The Google Earth Engine (GEE) tool enabled the partners to visualize oceanographic conditions and gather time-series graphs utilizing Aqua and Terra Moderate Resolution Imaging Spectroradiometer (MODIS), Suomi National Polar-orbiting Partnership Visible Infrared Imaging Radiometer Suite (NPP VIIRS), Sentinel-3 Ocean and Land Colour Instrument (OLCI), Hybrid Coordinate Ocean Model (HYCOM) and NOAA's Climate Data Record (CDR) in a user-friendly interface. The team used *in situ* SST data from subsurface temperature recorders provided by the partners to validate the tool's accuracy. Preliminary statistical analysis of MODIS data found warming trends in SST in Manawai as well as increased chlorophyll-a levels during the summer months at Manawai in contrast to the control (noninfected) Lalo atoll. The tool did not aim to classify algal presence due to limited availability of higher resolution satellite imagery but instead enabled PMNM managers to monitor conditions that may be conducive to algal growth around the monument to make informed decisions and mitigation practices.

Study Area







Methodology

Data Acquisition

Objectives

- Quantify oceanographic conditions around PMNM's Manawai and other nearby atolls.
- Correlate ocean conditions (temperature, turbidity, color, tides, and wind) with algal presence.
- Create a Google Earth Engine application, Conditions Observed in Red ALgae Spread (CORALS), that will allow the partners to acquire information from NASA EOS via simple graphical user interface.

Temperature

Results



Parameters Outputs and Inputs Visualization of Chlorophyll-a ocean condition • Kd490 • Aqua/Terra variation over • Sea Surface MODIS specified time Temperature • Suomi NPP VIIRS (SST) • HYCOM Time series data and • Wind velocity • NOAA CDR graph of specified • Salinity ocean conditions

Earth Observations









Terra (MODIS)

Aqua (MODIS)

Sentinel 3 (OLCI) Suomi NPP (VIIRS)

Google Earth Engine CORALS Application



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Chlorophyll-a



Conclusions

- ▶ NASA MODIS Sea Surface Temperature (SST) was verified to be statistically similar to the field instrument data collected.
- Oceanographic conditions, specifically Chlorophyll-a and rising average SST could be important drivers for the growth of Chondria tumulosa.
- CORALS app can visualize, plot, and extract oceanographic data that could influence the growth of *C. tumulosa*.

Acknowledgements

- Juan L. Torres-Pérez, MSc, Ph.D., NASA Ames Research Center
- Kauaoa Friola, Ph.D., US Fish and Wildlife Service
- Jonathan Martinez, Ph.D., NOAA/Papahānaumokuākea Marine National Monument
- Hannah Barkley, Ph.D., NOAA/National Marine Fisheries
- Athline Clark, NOAA/Papahānaumokuākea Marine National Monument

Project Partners

- US Fish and Wildlife Service, Marine National Monuments of the Pacific.
- NOAA, Office of National Marine Sanctuaries, Hawai'i Regional Office, Papahānaumokuākea Marine National Monument.

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