Simulated NASA Satellite Data Products for the NOAA Integrated Coral Reef Observation Network/Coral Reef Early Warning System

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Introduction and Overview This RPC (Rapid Prototyping Capability) experiment will demonstrate the use of VIIRS (Visible/Infrared Imager/Radiometer Suite) and LDCM (Landsat Data Continuity Mission) sensor data as significant input to the NOAA (National Oceanic and Atmospheric Administration) ICON/CREWS (Integrated Coral Reef Observation System/Coral Reef Early Warning System). The project affects the Coastal Management Program Element of the Applied Sciences Program.

The NOAA Office of Oceanic and Atmospheric Research operates ICON/CREWS as part of its Coral Reef Watch program, which was created in response to the increasing decline of coral reefs and related benthic ecosystems worldwide. NOAA and NASA support the U.S. Coral Reef Task Force created by Executive Order P.L. 13089 that requires the conservation and protection of the Nation's coral reefs.

Coral reefs are some of the most biologically rich and economically important ecosystems on Earth. Coral reefs are Earth's largest biological structures and have taken thousands of years to form. Coral reefs not only provide important habitat for many marine animals and plants, but they also provide people with food, jobs, chemicals, protection against storms, and life-saving pharmaceuticals. For instance, anti-cancer drugs and painkillers have been developed from coral reef products. In developing countries, such as the Philippines and the Dominican Republic, people often depend heavily on reefs for marine resources.

Severe bleaching events have dramatic long-term ecological impacts, including loss of reef-building corals, changes in benthic habitat, and, in some cases, changes in larval fish populations. Even under favorable conditions, severely bleached reefs can take many years to recover. Some experts suggest that 10 percent of Earth's coral reefs have already been destroyed and that another 60 percent are in danger. Scientists have proposed that as much as 95 percent of Jamaica's reefs are dying or dead.

In other ways, coral reefs are a valuable resource for various communities. Reefs foster tourism to different locales around the world. This form of tourism bolsters the economies of many countries. Further, coral reefs protect shores from storms and from the associated impact of waves.

ICON/CREWS DST The ICON/CREWS DST (decision support tool) uses field measurements of SST (sea surface temperature) and supplementary water data collected at coral reef stations to produce World Wide Web alerts when conditions are conducive to or predictive of coral bleaching. During the 1997-1998 El Niño events, CREWS successfully forecast a bleaching event on Sombrero Reef in the Florida Keys.

Two ICON/CREWS stations are in operation: one in the Bahamas and one in the U.S. Virgin Islands. NOAA plans to set up at least two field stations every year that could total 18 to 20 coral reef stations (e.g., 2 in American Samoa, 6 in Hawaii, 2 in Puerto Rico, and 2 in the Virgin Islands) within the next few years.

These measurement datasets are also used to provide validation of SST products for coral bleaching predictions. The monitoring of water quality issues associated with

phytoplankton biomass, changing salinity, and elevated sediments provides an alert for local officials to start efforts to reduce point-source pollution that can cause increased water turbidity.

The basic set of oceanographic measurements for a CREWS station is 1) sea temperature, 2) salinity, 3) PAR (photosynthetically active radiation), and 4) ultraviolet radiation at 1-meter nominal depth. Data from CREWS are archived in a large database specific to NOAA Coral Reef programs, known as the Coral Reef Ecosystem Integrated Observing System.

NASA Input The RPC experiment is assessing the degree to which VIIRS and LDCM simulated sensor data are capable of supplying needed inputs for use as data layers to the ICON/CREWS DST. The scope of the experiment includes detection, monitoring, and mapping of environmental factors that affect coral reef health at CREWS sites. Specifically, SST and water-quality parameters will be analyzed using VIIRS and LDCM data. The LDCM imagery will also be used to aid in benthic mapping.
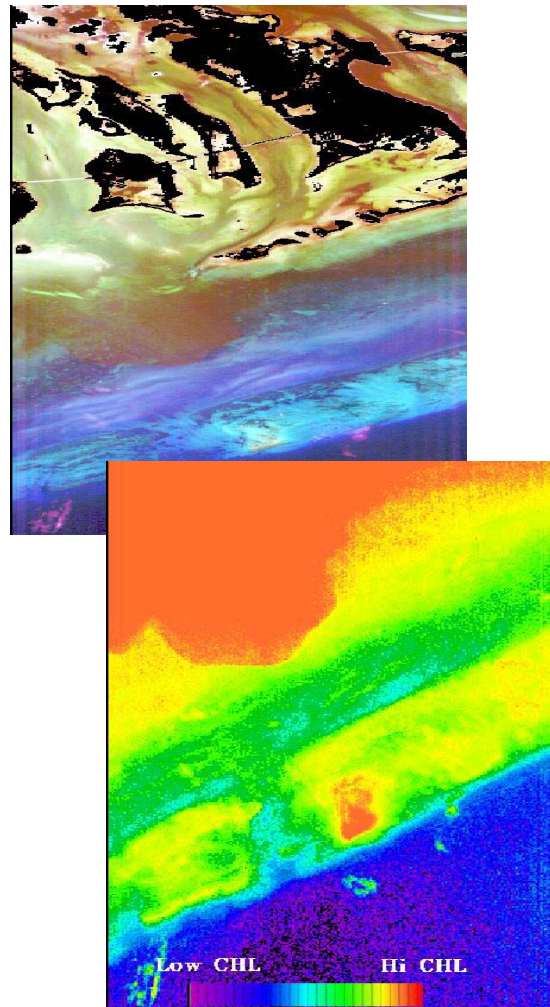
ICON/CREWS RPC Experiment Sources of hyperspectral imagery are used in conjunction with the RPC tools to simulate VIIRS and LDCM imagery. These sensor simulations have been validated through comparisons with Landsat, Hyperion, the Advance Land Imager, and high-spatial-resolution airborne imaging systems.

Hyperspectral imagery of the two coral reef sites – Looe Key, FL, and Kaneohe Bay, HI – has been archived. The Looe Key EO-1 (Hyperion) imagery has been atmospherically corrected and has been used to produce an early version of RPC simulated VIIRS spectral channel imagery.

A preliminary map of chlorophyll concentrations has been produced from this simulated data. Further, a first-cut benthic

map of the Looe Key coral area has been created.

The Kaneohe Bay, HI, imagery is over a well-studied coral reef system. The imagery will be used to produce similar water quality and benthic mapping products as that of Looe Key, FL. In both instances, these image-generated products will be validated by field-collected datasets to provide value.

Looe Key, FL, Coral Area