Coral Reef Early Warning System (CREWS) RPC Experiment

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CREWS/ICON Talk Overview

- Background
- Objectives
- Methodology and Discussion
- Validation
- Present Status

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Background

- Coral reefs are some of the most biologically rich and economically important ecosystems on Earth.
- Coral reefs worldwide have declined seriously primarily due to bleaching events.
- “Bleaching” is the loss of symbiotic algae living with the coral host, upon whom the corals depend for survival.
- Increasingly warmer waters are suggested as the primary cause of coral reef decline, although there are other causes for coral reef loss – for instance, disease (e.g., black-, red-, white-band disease), natural events (e.g., earthquakes), and anthropogenic causes (e.g., polluted runoff).
- Summer of 2005 saw exaggerated levels of coral bleaching in the GOM (Gulf of Mexico) and Caribbean.
- Some experts have suggested that 10% of all coral reefs have died and another 60% are at risk.

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Background Cont'd

- NOAA has been tasked by Executive Order P.L. 13089 to provide a strong supporting role in the U.S. Coral Reef Task Force.
- NOAA instituted the CRW (Coral Reef Watch) program that instrumented various sites at key coral reef areas to collect long-term datasets.
- RPC CREWS (now subsumed under ICON) links to NOAA's DST that uses CRW and other data plus custom software to generate coral bleaching forecasts.
- Input layers to the CREWS DST include sea temperature, salinity, PAR, UVR, and, at some stations, meteorological parameters.
- Potential NASA contribution to CREWS DST centers on remotely sensed imagery products.
- Contact made with J. Hendee as NOAA POC.

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Objectives

- Objectives – CREWS/ICON RPC experiment
  - Identify potential next-generation sensor data applicable to CREWS DST-- VIIRS and LDCM targeted.
  - Demonstrate that RPC simulated VIIRS and LDCM would be useful to the NOAA CREWS DST.
  - Simulated imagery used to produce water clarity parameters – e.g., chl-a, absorption
  - Additionally, the RPC imagery would be used to produce a map of the benthos (i.e., bottom habitat types).
  - Perform validation of the simulated CREWS GIS data layers to show viability of the NASA next-generation sensor data.
  - Provide partner agency with results of the experiment.

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Basic Methodology

- Acquire hyperspectral datasets over target area(s).
- Preprocess the acquired datasets.
- Submit to RPC for simulation of VIIRS and LDCM imagery.
- Process the RPC provided imagery to produce salient CREWS/ICON DST data input layers.
- Perform validation of the RPC image derived data layers by comparing to field data.
- Analyze the value of the simulated datasets in CREWS/ICON GIS DST.
- Write and submit End-of-RPC-experiment report.
- Provide results to NOAA through its POC.

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Discussion

- Selected areas for CREWS/ICON RPC Experiment are Looe Key, FL, and Kaneohe Bay, HI.
- EO-1 Hyperion data downloaded for Looe Key.
- Key field data provided by NRL Stennis for Looe Key.
- Recently, AVIRIS 3-m data procured from JPL for Kaneohe Bay.
- Field data hunt is still ongoing for the AVIRIS data.
- RPC simulated VIIRS (spectral only to this point) performed on EO-1 imagery.
- RPC simulated LDCM on Hyperion data is still in progress.
- AVIRIS data will begin RPC processing shortly.
- MODIS SST data has been downloaded and will be used to simulate VIIRS SST imagery.

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Results to Date

- Atmospheric correction performed on EO-1 data.
- Imagery de-glinted.
- Vertical striping in image – left as is.
- Bad lines in imagery corrected.
- VIIRS simulated imagery used to produce preliminary Chl-a map (Cannizzaro and Carder, 2006) over Looe Key.
- VIIRS simulated imagery used to produce preliminary benthos mapping.
- Atmospheric correction performed on AVIRIS imagery.

Hyperion True Color Image – Looe Key

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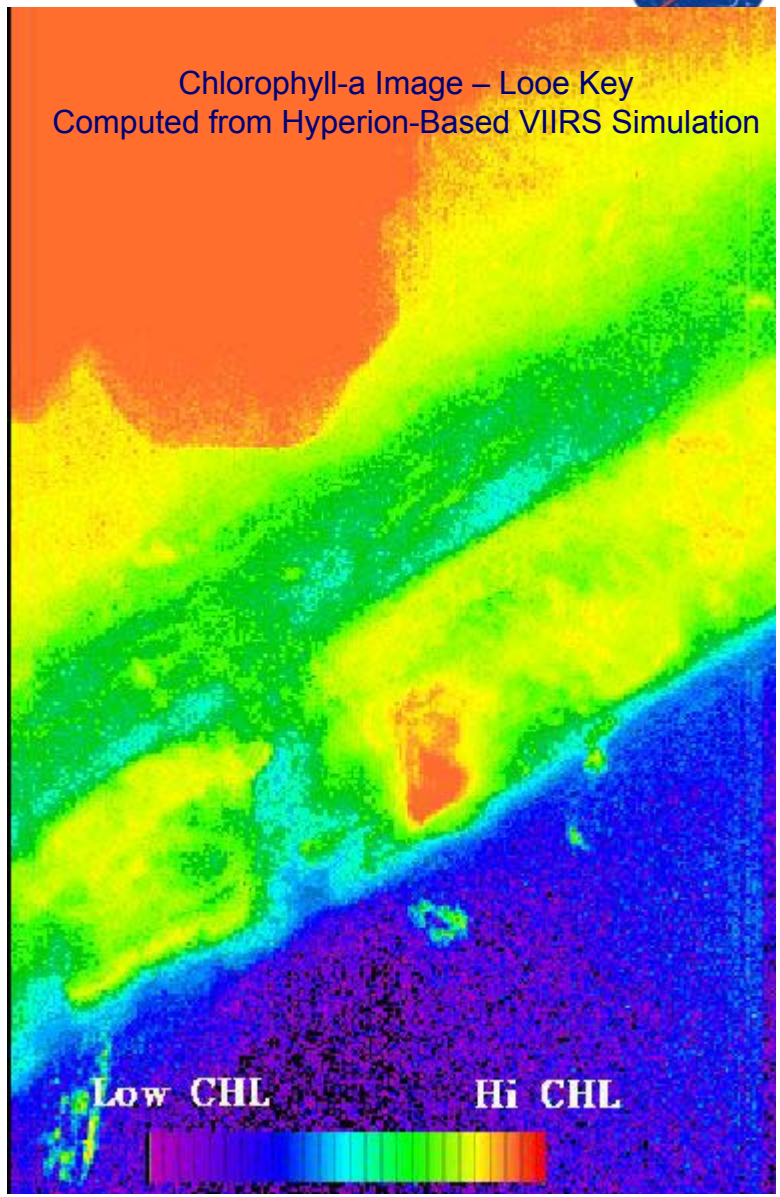
Results II

- Chl-a image of Looe Key, FL, derived from the simulated VIIRS multispectral image.
- Image is of offshore water area only.
- Have not processed image yet to quantitative Chl-a values.
- Red pixels are proximate to urban area of Big Pine Key. The deep blue pixel area is indicative of deeper offshore water.
- Intermediate colors - the coral reef area that runs like a ridge across the scene



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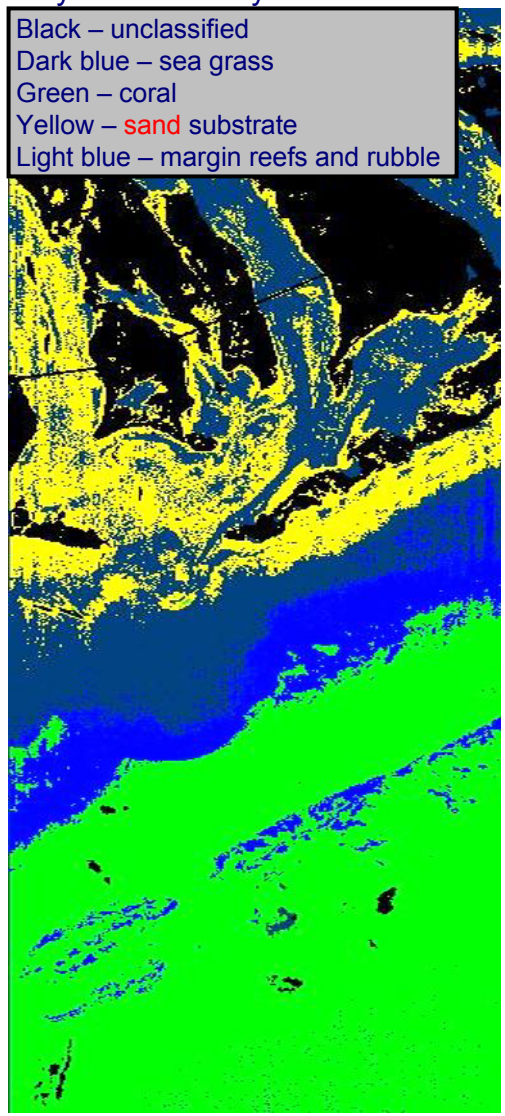
Results III

- Preliminary benthos map produced
  - Four classes parsed out of VIIRS simulated image – map will undergo refinement – will employ LDCM simulated data when available to aid in producing the benthic map

Looe Key – Preliminary Benthic Habitat Map



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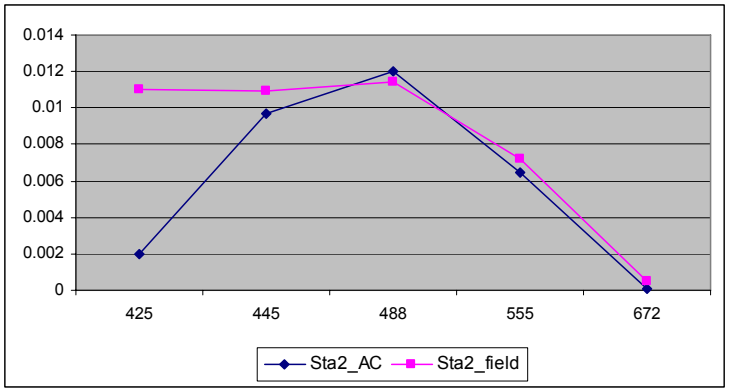
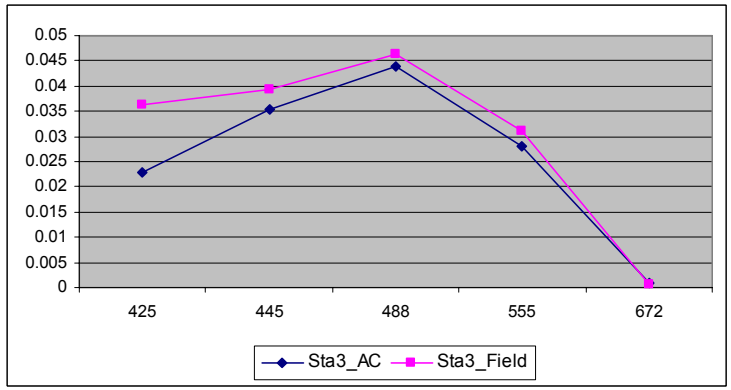
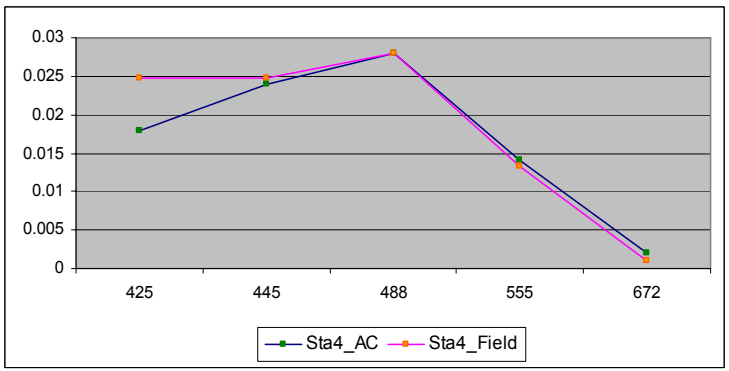
Validation

Early validation efforts have compared the Rrs values from field data collect to that of the atmospheric correction performed on the EO-1 data and how that carries through to the VIIRS imagery.







Ordinate axis: Rrs Abscissa axis: Lambda
Due to the simulation of VIIRS band M1 – the blue end of the spectrum is impacted
Mean bias error ~ 30%

Field Data – Colored Symbols

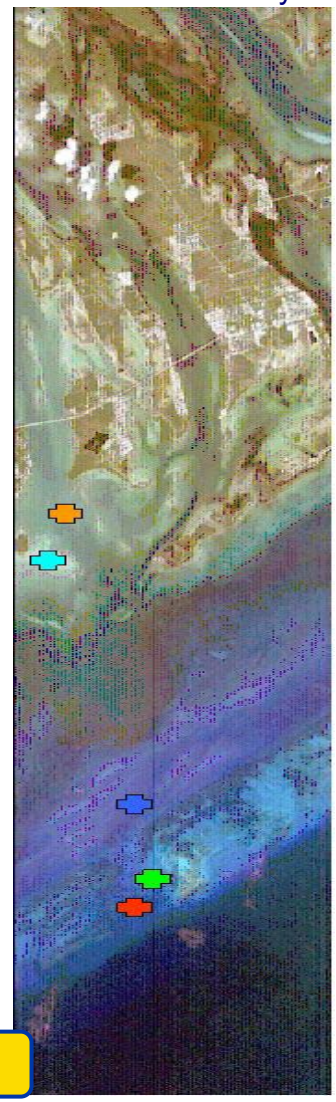


Image provided by NRL

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CREWS/ICON Status

- The near-term focus will be on getting Looe Key, FL, simulated image data products complete and delivered to the RPC CREWS/ICON team.
- The corresponding related CREWS/ICON data layer products – i.e., SST imagery, Chl-a, absorption, and benthic mapping – will be then be weeks away from completion.
- AVIRIS imagery will be worked in parallel – however, 70% of the effort will go into early completion of the Looe Key site.
- Continuing effort will be expended to find appropriate field reference data to support analysis of the AVIRIS-based VIIRS/LCDM simulation products.

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