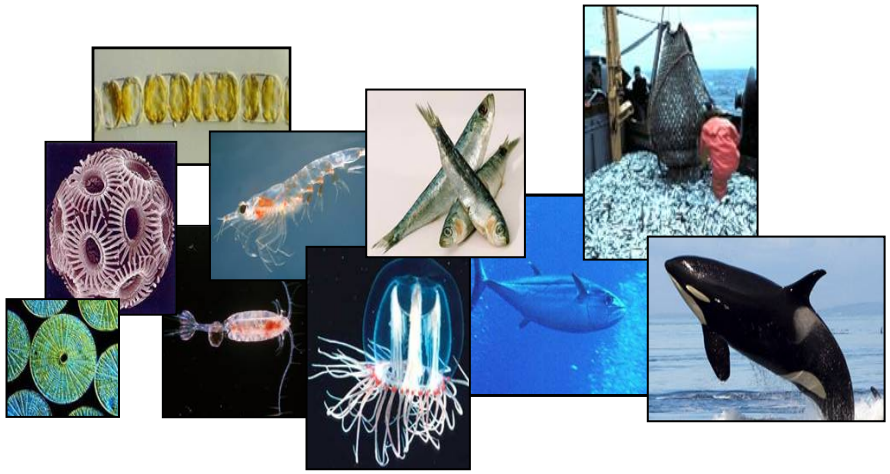
HyspIRI Combined (CQ) VSSWIR and TIR Science Questions

Http://HyspIRI.jpl.nasa.gov

CQ1: Coastal, ocean, and inland aquatic environments

Frank Muller-Karger, Kevin Turpie, David Siegel

and many others



Overarching Question (CQ1)

- How are local & landscape-scale changes in inland, coastal, and open ocean aquatic ecosystems related to changes in local, regional and global climate?

Subquestions (CQ1)

- What are the feedbacks between a warming climate and changes and disturbance in habitat structure, biogeochemical cycling, biodiversity, and ecosystem productivity of landscape-scale aquatic habitats, including ice-covered habitats? [DS 201/Table 7.1, DS 208; GEO 2007; USCOP 2004]
- How are small-scale processes in water column, shallow benthic, and ice-covered habitats related to changes in functional community types (including harmful algal blooms and vector-borne diseases), productivity, and biogeochemical cycling including material fluxes and water quality, at local scales? [DS 200]
- What is the ecological role of landscape-scale ocean-atmosphere interactions including the hydrologic cycle, aerosol production and transport, and cloud radiative forcing? [DS 338, DS 276, DS 313]
- How can these observations be used to guide the wise management of living marine and other aquatic resources? [DS 179-185; USCOP 2004]

Rationale (CQ1)

Geographic scope:

- Aquatic environments: Inland, coastal, and ocean waters, including ice-covered environments
- The oceans cover over 70% of the Earth's surface and about half of the globe's primary productivity occurs within them.
- Coastal zones (inland and marine) include:
  - coastal watersheds, dunes and wooded coastal areas, beaches and cliffs, wetlands, estuaries, barrier islands, and shallow submerged lands like seagrass beds, kelp beds, coral reefs, and ice cover

Rationale (CQ1)

Aquatic environments:

- Play a critical role in Earth's climate, the hydrological cycle, and biogeochemical cycles
- Are part of ecosystems that span the land, and are affected by changes on land and the atmosphere
- Contain habitats that are defined by the interaction between small physical processes and large-scale processes
- Provide important ecosystem services, exceeding $1 trillion in a narrow strip along the coastal zone (land and water)

Rationale (CQ1)

Ecosystem Services Provided by Aquatic environments:

- Purification of water through nutrient recycling,
- Sediment storage,
- Shoreline protection,
- Habitat and food for migratory and resident animals, humans
- Industrial resources: pharmaceutical, oil, gas, sand and gravel, fisheries, maritime operations including ports.
- Recreation
- Cultural values

Issues:

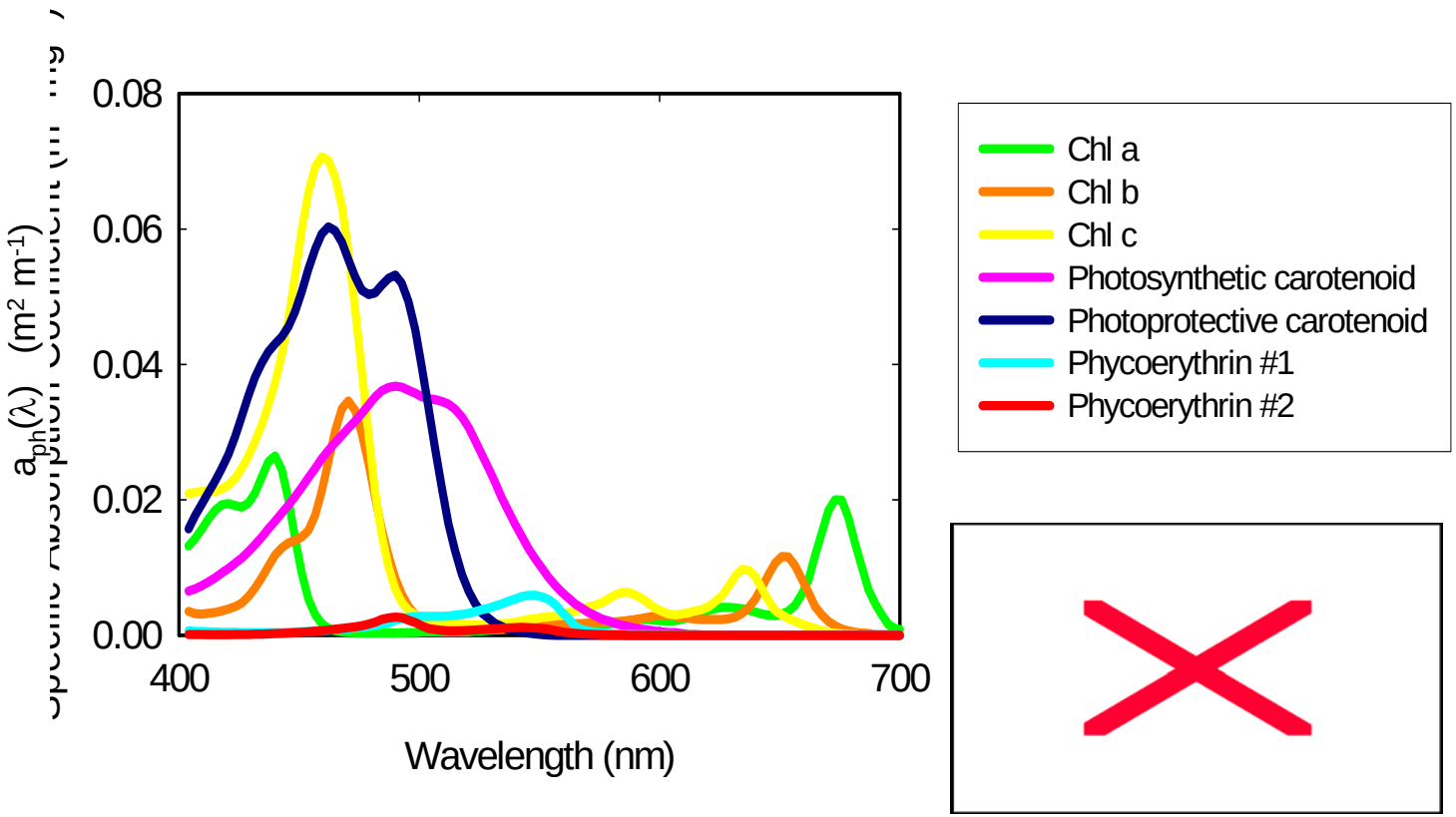
Climate change, land subsidence, aerosol production, and sea level rise complicate our understanding of the processes of pollution, development, and structures that alter sediment flow.

Science (CQ1)

HyspIRI hyperspectral and thermal infrared imaging at high spatial resolution will allow:

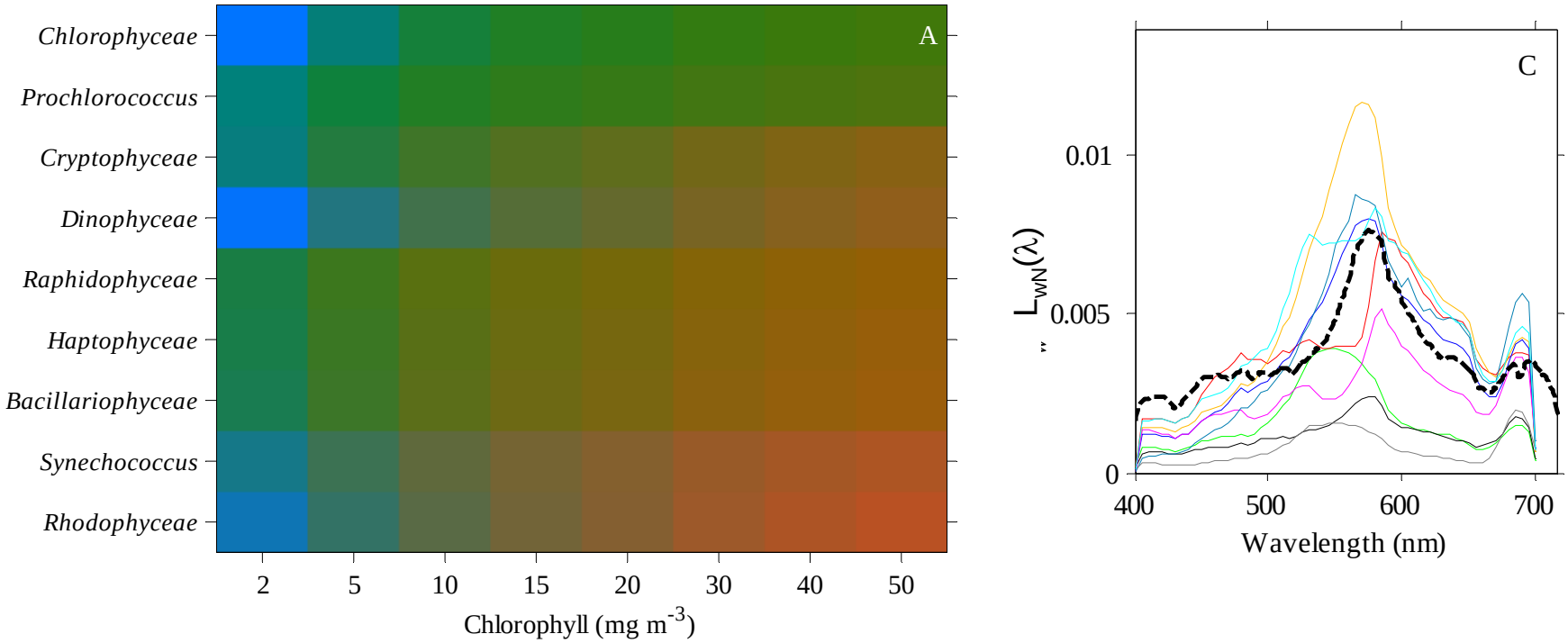
- The study of the interaction between small-scale physical variability and biological / biogeochemical variability
- Separation of phytoplankton pigments and phytoplankton functional groups simultaneously with the physical environment leading to their blooms
- Improve the accuracy and diversity in retrievals of absorption and backscattering coefficients and of other environmental properties:
  - colored dissolved organic matter, phytoplankton concentration and composition, suspended sediments, bottom type, physical properties (e.g., temperature, bathymetry, light attenuation; GEO 2007).

Phytoplankton Pigments & Functional Groups



Weight-specific absorption coefficients (m^2 mg^{-1}) derived for the major pigment types found in marine phytoplankton (from Bidigare et al. 1989).

Phytoplankton Spectroscopy and Functional Groups



(A) Color of the sea surface as a function of surface biomass concentration (Chl *a* used as a proxy) for different phytoplankton taxa. Color was modeled from water-leaving radiance using the CIE color matching functions and mean absorption and backscattering properties for each taxa. (B) Water-leaving radiance, *Lw*, modeled for dense phytoplankton bloom conditions (30 mg Chl *a* m^{-3}) from a variety of phytoplankton taxa. (Dierssen et al. 2006)

Dierssen et al., 2006

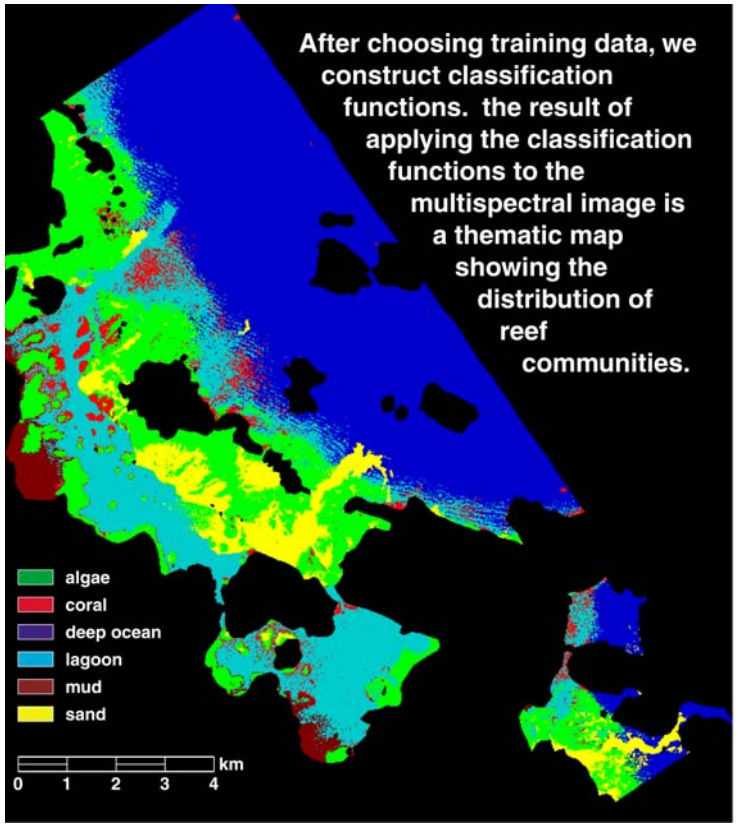
Dinoflagellate Blooms in Monterey Bay

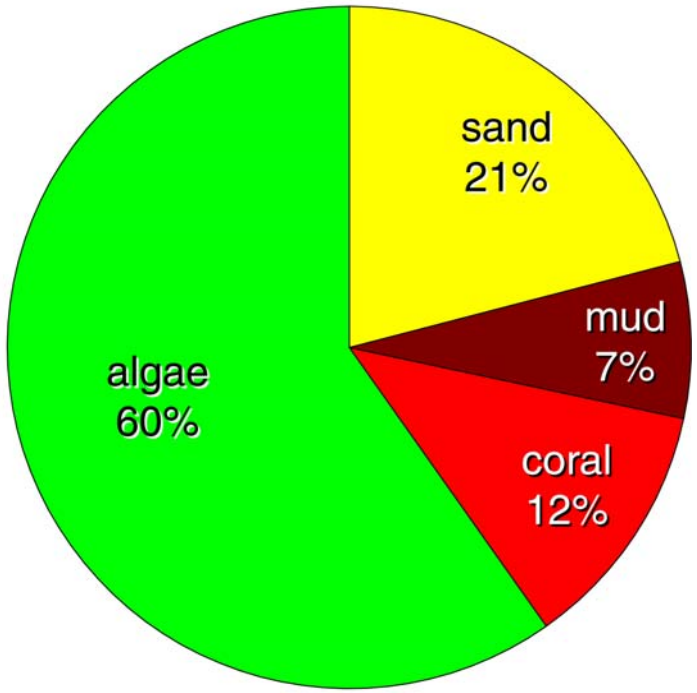
QuickTime™ and a
decompressor
are needed to see this picture.

QuickTime™ and a
decompressor
are needed to see this picture.

Ryan et al. 2005

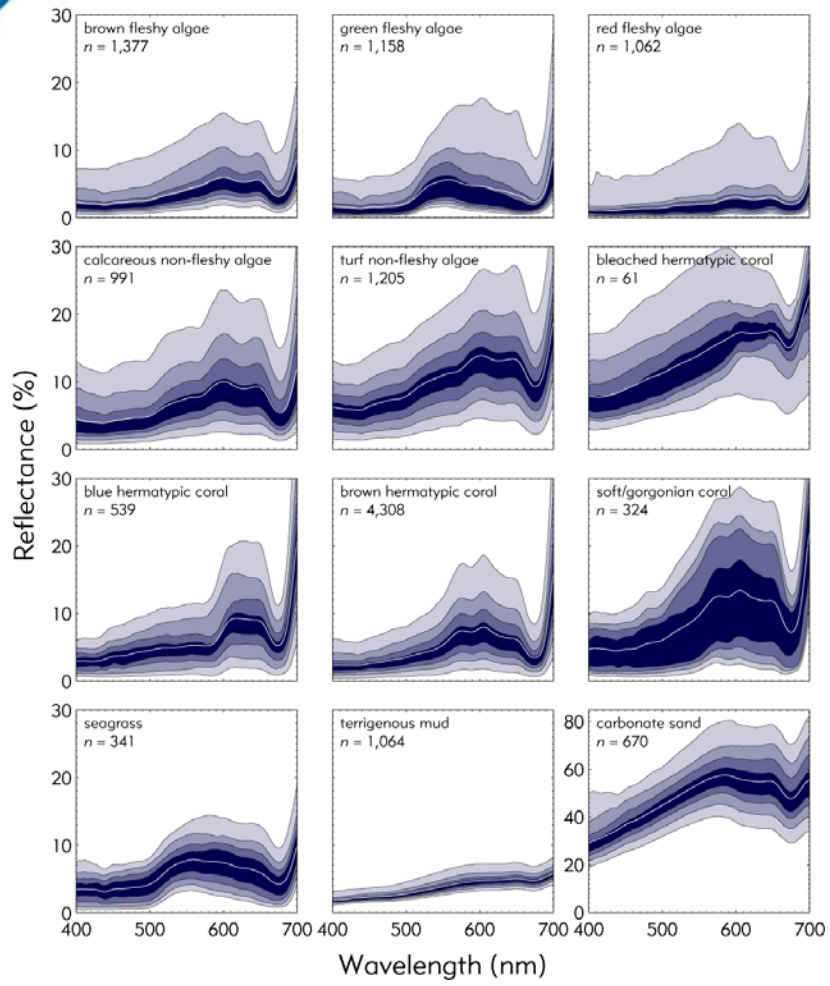
Coral Reefs





Fractional cover of bottom types derived from AVIRIS imagery of Kaneohe bay, Hawaii. (Courtesy: Eric Hochberg)

Spectroscopy of corals and algae

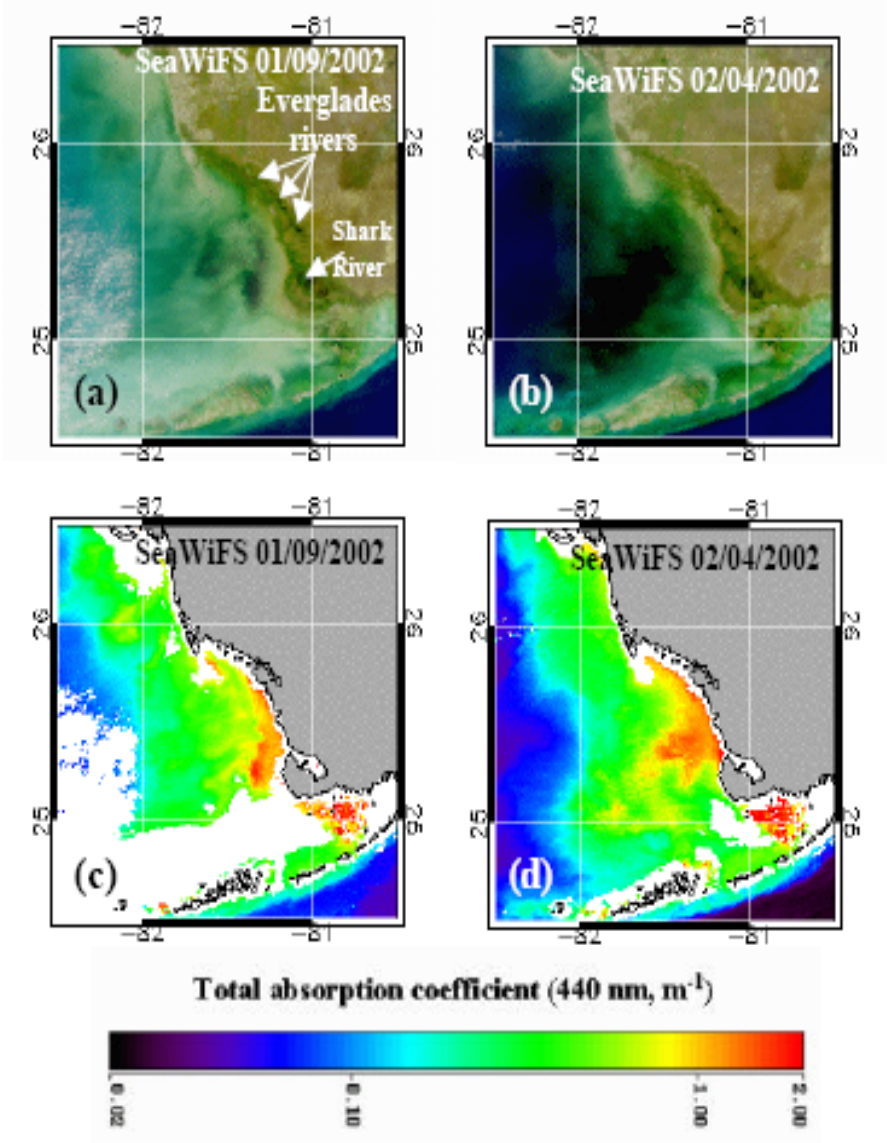


- Rough
- High productivity/calcification
- "Healthy"

- Smooth
- Low productivity/calcification
- Not "healthy"

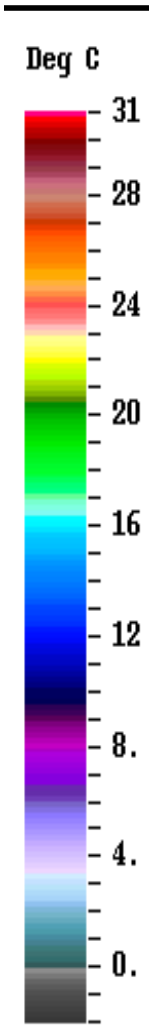
Pigments and "architecture" discriminate types of algae and coral and provides a measure of coral health

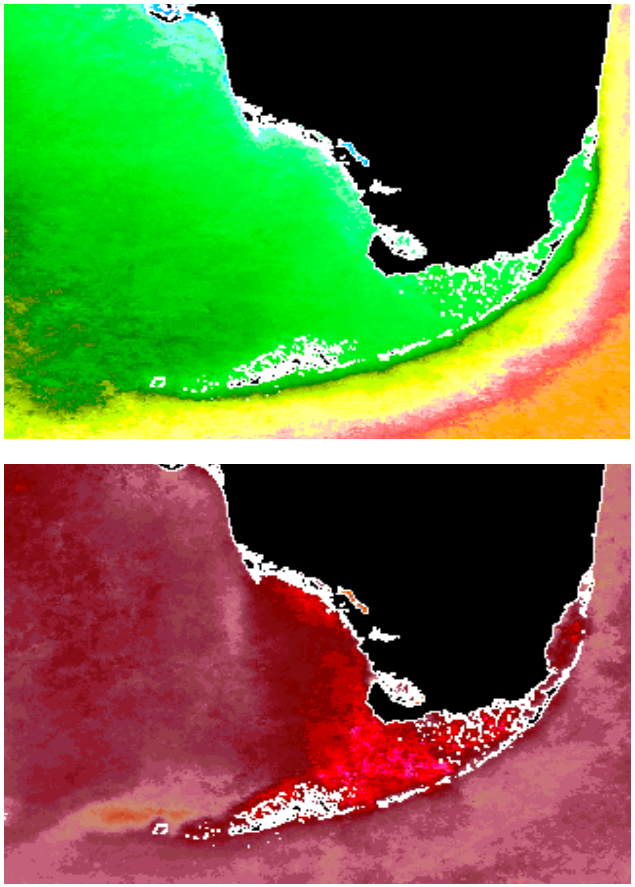
Hochberg et al. 2003



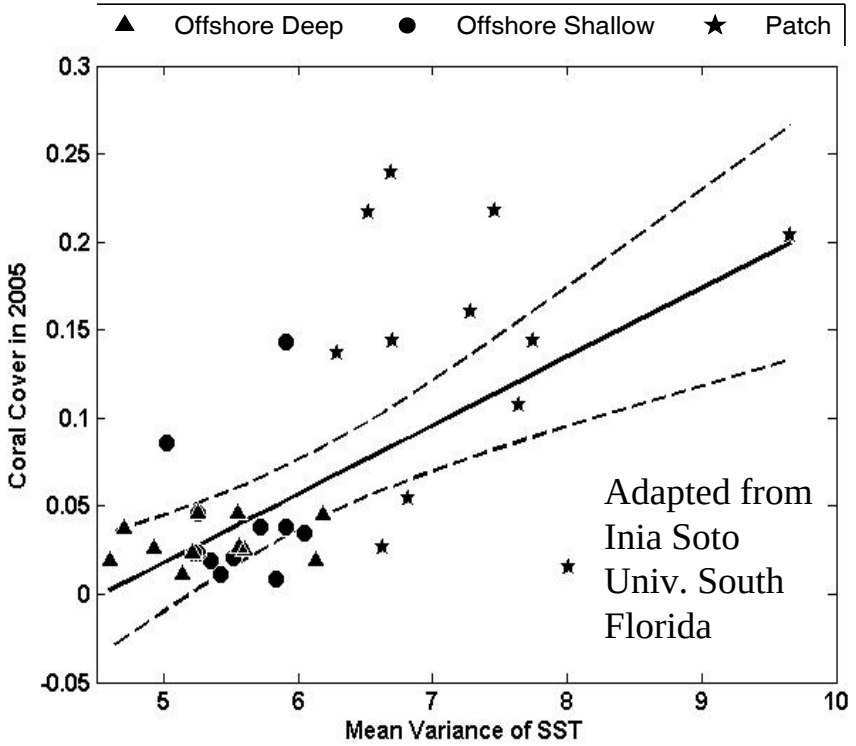
SeaWiFS images (a&b): true color image composites showing location of dark water; taken on 9 Jan and 4 Feb 2002. The dark water patches in Florida Bight have been reported as "black water"; (c&d): total absorption coefficient. The white color represents algorithm failure caused by extreme turbidity or clouds.

Temperature Variability & Coral Reef Cover in the Florida Keys National Marine Sanctuary



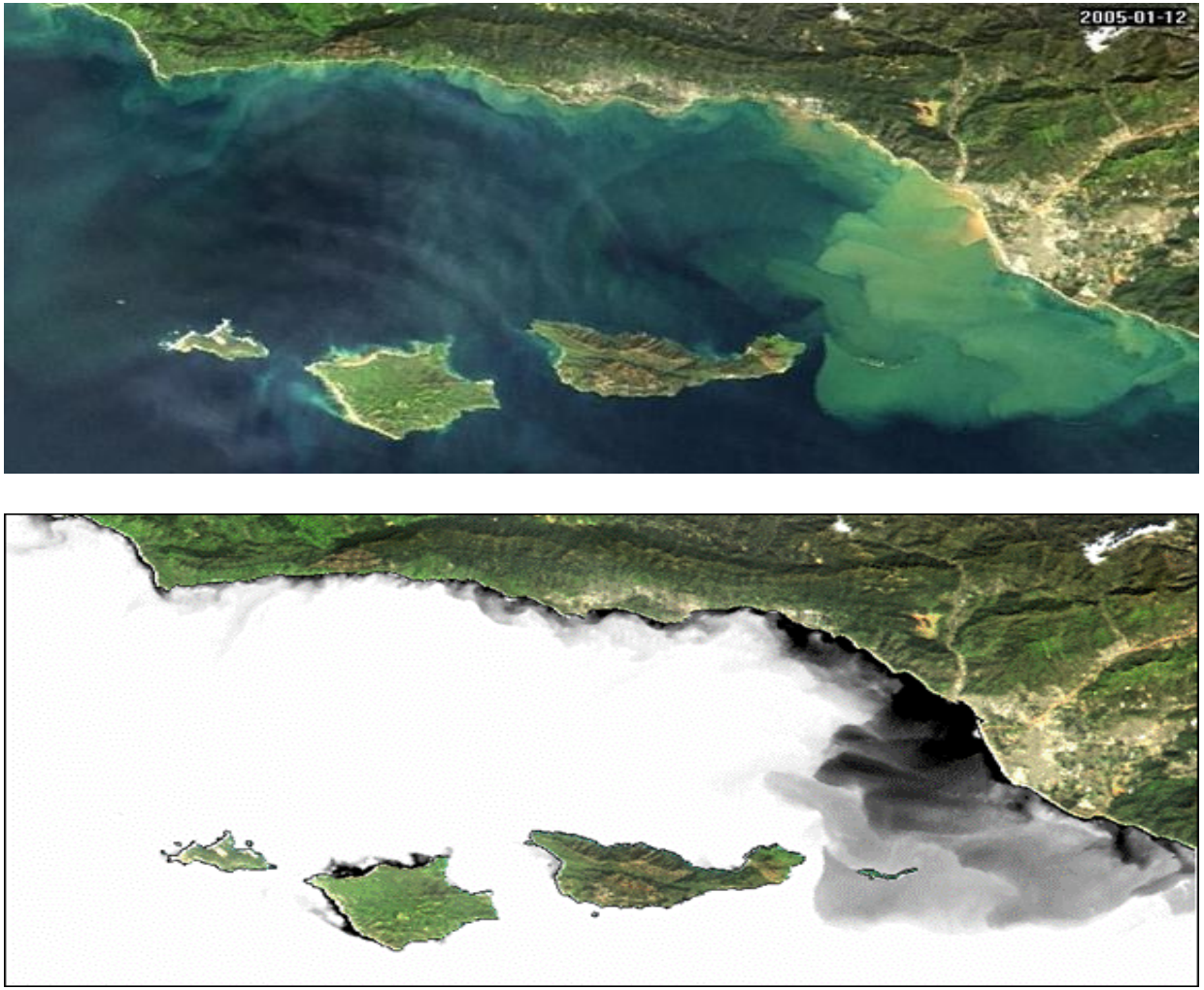


AVHRR weekly mean sea surface temperature composites. TOP) February 5, 1998 to February 11, 1998. BOTTOM) June 4, 1998 to June 10, 1998.



Comparison between coral cover in 2005 and variability of SST from 1994 to 2005. The dotted lines represent the 95% confidence intervals

Land-Ocean Interactions



Sediment plumes occurring off of the coast of California during exceptional rainfall of 2005 from MODIS imagery A) "true-color; B) turbidity

Primary Science Justification

The combined use of HyspIRI TIR and VSSWIR will provide significant insight on biological and biogeochemical controls by small-scale physical processes, and how these translate into small-scale ecosystem changes, globally