Benthic Ecology from Space

Remote Sensing of Seagrass Productivity

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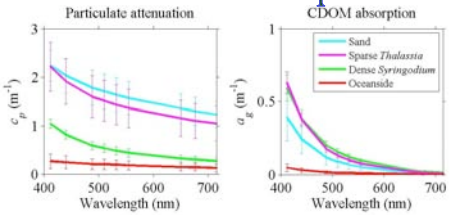
Abstract

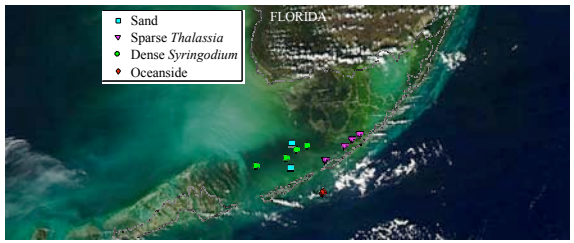
Seagrasses are prevalent in coastal waters throughout the world. The role that seagrass meadows play in global biogeochemical cycles is largely unquantified. Our objective is to develop, test, and validate new algorithms for using remotely sensed ocean color to quantify seagrass productivity. We have conducted extensive field investigations in a variety of different seagrass beds:

1. Bahamas Banks, March 2004
2. Florida Bay, June 2005, 2006
3. Port St. Joe, FL, June, October 2006
4. Monterey Bay, CA Sept. 2006

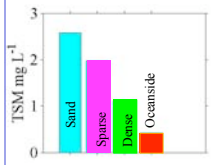
Our field efforts include quantification of seagrass biomass and productivity and coincident measurements of the optical properties of the seagrass, sediment, water column, and sea surface reflectance. We have collected an extensive spectral library of sediment and seagrass reflectance. The bottom reflectance and water column optical properties are being incorporated into algorithms for remotely quantifying seagrass biomass and productivity from remote sensing reflectance.

Water Column Optics





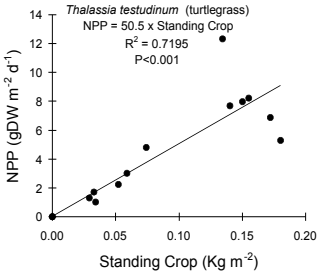
MODIS 2005327 true color image



Seagrasses are known to buffer currents and decrease water column turbidity. Our optical data show lower light attenuation due to particulates and lower Total Suspended Matter (TSM) in regions with dense seagrass compared to areas with sparse seagrass and sand bottoms. Seagrass, like terrestrial vegetation, also produce Colored Dissolved Organic Matter (CDOM), which is higher over areas with seagrass.

Quantifying Seagrass

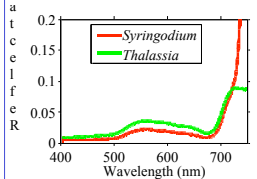
Most approaches for remote sensing of seagrasses are qualitative in nature and cannot be incorporated into global biogeochemical models. Our quantitative measurements of seagrass biomass and productivity indicate that net primary production (NPP) can be estimated from seagrass LAI or Standing crop.



Tagging plants to estimate seagrass leaf growth rates

Seagrass Reflectance

The reflectance spectra from seagrass canopies in Florida Bay show variable spectral signatures which are dependant on the mixture of seagrass species present. Differences are related to the pigments and morphology of the seagrass blades. Canopy reflectance from a dense *Syringodium* meadow is greater in the red compared to a *Thalassia* dominated area. This "red edge" may be exploited for remote sensing purposes.

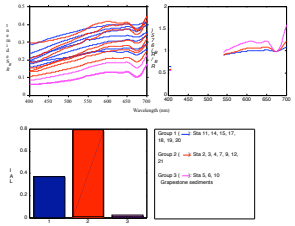


***Thalassia* dominated meadow**

Dense *Syringodium* meadow

Canopy reflectance measurements taken with the DOBBS instrument

Sediment Reflectance



We have compiled an extensive database of sediment reflectance spectra from coastal waters. Sediment reflectance (R_B) is highly variable with changing amounts of organic matter. From the Bahamas Banks, the dip in R_B at 676 nm due to pigment absorption is less pronounced in sandy regions (blue spectra) than in seagrass beds (red spectra). Grapestone sediments (magenta) have the most pigment and appear similar to a green vegetated seafloor.

Remote Sensing Reflectance

Measurements of seafloor reflectance and water column optical properties are incorporated into radiative transfer models to estimate remote sensing reflectance spectra (R_{rs}) over regions with different bathymetry and bottom types.