Ocean color remote sensing of seagrass and bathymetry in the Bahamas Banks by high resolution airborne imagery

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ABSTRACT: New coastal ocean remote sensing techniques permit benthic habitats to be explored with higher resolution than ever before. A mechanistic radiative transfer approach is developed that first removes the distorting influence of the water column on the remotely sensed signal to retrieve an estimate of the reflectance at the seafloor. The retrieved bottom reflectance is then used to classify the benthos. This spectrally based approach is advantageous because model components are separate and can be evaluated and modified individually for different environments. Here, we applied our approach to quantitatively estimate shallow-water bathymetry and leaf area index (LAI) of the seagrass Thalassia testudinum for a study site near Lee Stocking Island, Bahamas. Two high-resolution images were obtained from the ocean portable hyperspectral imager for low-light spectroscopy (Ocean PHILLS) over the study site in May 1999 and 2000. A combination of in situ observations of seafloor reflectance and radiative transfer modeling was used to develop and test our algorithm. Bathymetry was mapped to meter-scale resolution using a site-specific relationship (r^2 = 0.97) derived from spectral ratios of remote sensing reflectance at 555 and 670 nm. Depth-independent bottom reflectance was retrieved from remote sensing reflectance using bathymetry and tables of modeled water column attenuation coefficients. The magnitude of retrieved bottom reflectance was highly correlated to seagrass LAI measured from diver surveys at seven stations within the image (r^2 = 0.88-0.98). Mapped turtlegrass LAI was remarkably stable over a 2-yr period at our study site, even though Hurricane Floyd swept over the study site in September 1999.