Optical remote sensing of benthic habitats and bathymetry in coastal environments at Lee Stocking Island, Bahamas: A comparative spectral classification approach

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ABSTRACT: Remote sensing is a valuable tool for rapid identification of benthic features in coastal environments. Past applications have been limited, however, by multispectral models that are typically difficult to apply when bottom types are heterogeneous and complex. We attempt to overcome these limitations by using a spectral library of remote sensing reflectance (R_{rs}), generated through radiative transfer computations, to classify image pixels according to bottom type and water depth. R_{rs} spectra were calculated for water depths ranging from 0.5 to 20 m at 0.5- to 1.0-m depth intervals using measured reflectance spectra from sediment, seagrass, and pavement bottom types and inherent optical properties of the water. To verify the library, computed upwelling radiance and downwelling irradiance spectra were compared to field measurements obtained with a hyperspectral tethered spectral radiometer buoy (TSRB). Comparisons between simulated spectra and TSRB data showed close matches in signal shape and magnitude. The library classification method was tested on hyperspectral data collected using a portable hyperspectral imager for low light spectroscopy (PHILLS) airborne sensor near Lee Stocking Island, Bahamas. Two hyperspectral images were classified using a minimum-distance method. Comparisons with ground truth data indicate that library classification can be successful at identifying bottom type and water depth information from hyperspectral imagery. With the addition of diverse sediments types and different species of corals, seagrass, and algae, spectral libraries will have the potential to serve as valuable tools for identifying characteristic wavelengths that can be incorporated into bottom classification and bathymetry algorithms.