Modeling spectral discrimination of Great Barrier Reef benthic communities by remote sensing instruments

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ABSTRACT: Remote sensing can monitor coral reef health, provided the benthic substrates are spectrally resolvable through the water column and surface. We studied the separability of eight substrate types (live coral, dead coral, soft coral, sand, brown algae, green algae, red algae, cyanobacteria) and the influence of the overlying water. A spectral library of coral reef benthic communities was collected from the Great Barrier Reef. Hydrolight 4.1 was used to simulate remote sensing reflectances. One multispectral and two hyperspectral sensors were simulated: the Advanced Land Imager (ALI, space borne), Hyperion (space borne), and HyMap (airborne, at 1.5 km altitude). Spectral radiance differences above different substrates were calculated to estimate what substrates can be separated and to what depth of waters this can be done. The dominant features in reflectance spectra of coral reef substrates are in the wavelength range 550-700 nm. Distinguishing various substrates in this part of the spectrum is limited to water depths of 5-6 m due to attenuation of the water. Below 550 nm some substrates have spectral features that are detectable by hyperspectral instruments even in deeper waters. Broader band instruments (e.g., ALI, Landsat) can provide some information about the substrate type. Sensors with a broad bandwidth provide fewer possibilities for developing analytical remote sensing algorithms for resolving significant numbers of substrate types in waters with variable depth. Hyperspectral sensors increase our capability to detect narrow spectral features that can be used for resolving various benthic communities.