Evaluation of Commercial High-Resolution Satellite Imagery for Coral Reef Study

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Purpose: Monitoring of oceans

Study Objective: Assess the capability of commercial imagery to spectrally discriminate between coral, algae, and near-surface seafloor. Compare environmental noise equivalent spectra of each sensor; retrievals of water depth, and benthic cover

Imagery: PlanetScope, WorldView-2, WorldView-3, and PRISM airborne hyperspectral imager

Findings: Imagery from WorldView-2 and WorldView-3 showed great promise for mapping of coral reef ecology and provided 90-94% of the accuracy of the PRISM data at a finer spatial resolution at a lower cost. However, more research is required for the development of an approach that can leverage the information contained in the high-resolution multispectral data without significant human intervention. Unlike WorldView-2 and WorldView-3 imagery, PlanetScope imagery was not well suited for the understanding of reef ecology.

Sensor	# Bands[1]	Overall Accuracy[2]	Coral Accuracy[2]	ROC Coral AUC	Classifier
PRISM	106	99.7%	99.5%	1.00	Quadratic SVM
WV02	5	94.1%	91.3%	0.98	Fine Gaussian SVM[3]
WV03	5	93.3%	89.7%	0.97	Fine Gaussian SVM[3]
PS 0c-0d	3	80.7%	71.1%	0.88	Weighted KNN[4]
PS 0e	3	80.1%	70.3%	0.88	Weighted KNN[4]
PS 0f	3	81.6%	69.7%	0.89	Cubic KNN[5]

[1]Only visible bands
[2]Accuracy estimated via stratified random 5-fold cross-validation
[3]Kernel scale 0.43
[4]Euclidean distance metric, squared inverse distance weight, 10 neighbors
[5]Minkowski (cubic) distance metric, equal distance weight, 10 neighbors

List of sensors, their abilities to distinguish coral from other reef benthic types, and the classification model employed. PRISM = Portable Remote Imaging Spectrometer (airborne hyperspectral imager); WV02 = WorldView-2; WV03 = WorldView-3; PS = Planet Scope. SVM = support vector machine; KNN = k-nearest neighbor.

The relative spectral response of each sensor was applied to an existing library of coral reef reflectance spectra. With the resulting multispectral data, classification analyses quantified the sensors' abilities to spectrally distinguish coral, algae, and sand under ideal conditions (no effects of sensor noise, digitization, atmosphere, or water column). Multiple classification models were tested; the best-performing models and their performances are reported in the table above.