Bio-Optical Properties during AISA Overflight
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In order to improve the remote sensing techniques for estimation of water quality parameters and benthic habitats mapping in coral reef systems we started a new effort in October 2007 toward evaluates the water bio-optical variability in La Parguera coral reef system. This has become a monthly sampling of six permanent stations located in Media Luna, Laurel, Mario, and Enrique reefs. During December 6 of 2007, which coincided with an AISA flight over La Parguera, we also sampled these and several other stations. Figure 1 shows the sampled stations that covered diverse bio-optical conditions and habitats affected by different oceanographic processes, depth, bottom type, and distance from the coast.

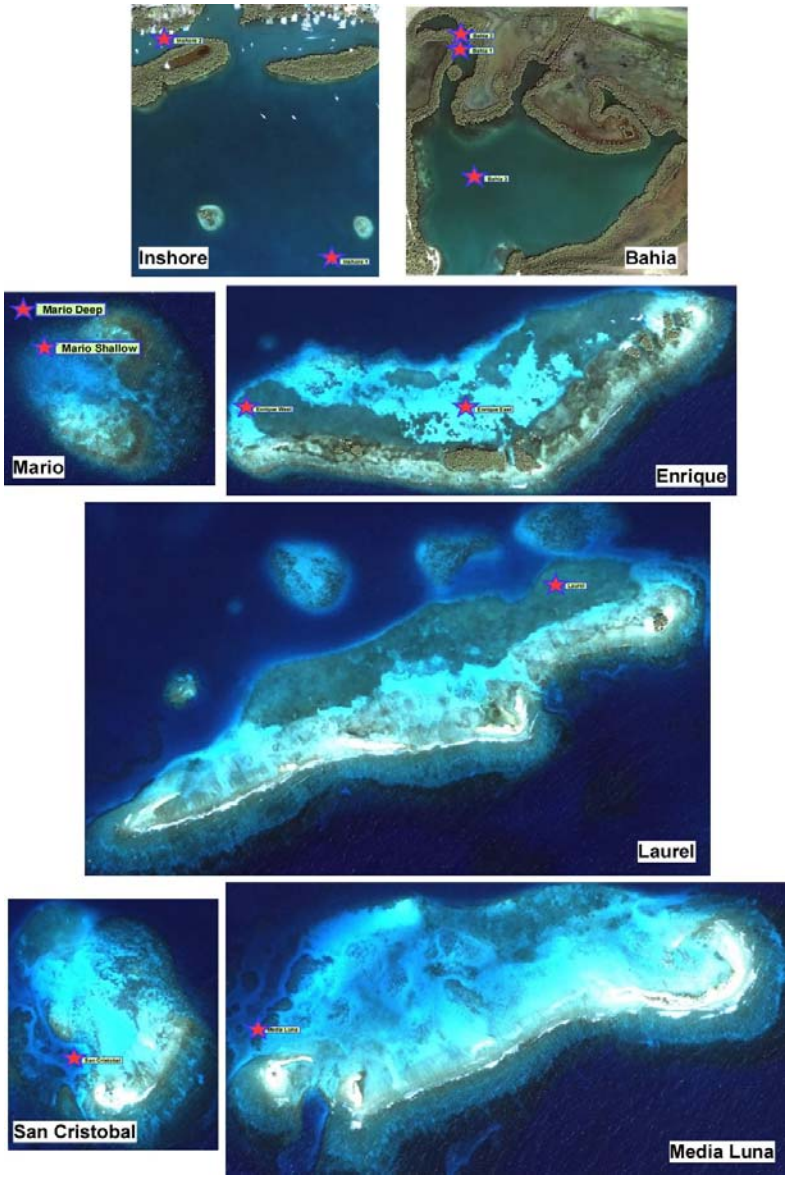

Figure 1: Sampling stations in La Parguera during AISA overflight.
The stars indicate the actual position of each station.

Twelve (12) stations were sampled with the bio-optical rosette and the GER-1500 spectroradiometer. The sampled sites provided different bio-optical conditions in the water column and different benthic communities. Table 1 shows specific information of the selected stations. Several stations were also sampled with the Satlantic hyperspectral radiometer (see Roy Armstrong's section). Figure 2 shows some pictures of the bio-optical sampling activities.

Table 1: Information of sampling stations in La Parguera during AISA overflight.

Station Name	Time	Latitude (N)	Longitude (W)	Depth
Bahia 1	9:30 AM	17 58.509	67 00.929	1.6
Bahia 2	9:53 AM	17 58.530	67 00.922	1.6
Bahia 3	10:10 AM	17 58.333	67 00.901	4.1
Laurel	10:44 AM	17 56.649	67 03.505	2.0
Media Luna	11:24 AM	17 56.325	67 03.080	2.8
Mario Shallow	11:46 AM	17 57.170	67 03.389	4.3
Mario Deep	12:03 PM	17 57.200	67 03.406	17.1
Enrique West	12:52 PM	17 57.319	67 03.152	1.7
Enrique East	1:12 PM	17 57.315	67 02.836	1.3
Inshore 1	1:32 PM	17 58.080	67 03.083	5.7
San Cristobal	2:14 PM	17 56.556	67 04.683	4.2
Inshore 2	2:52 PM	17 58.383	67 03.317	1.6

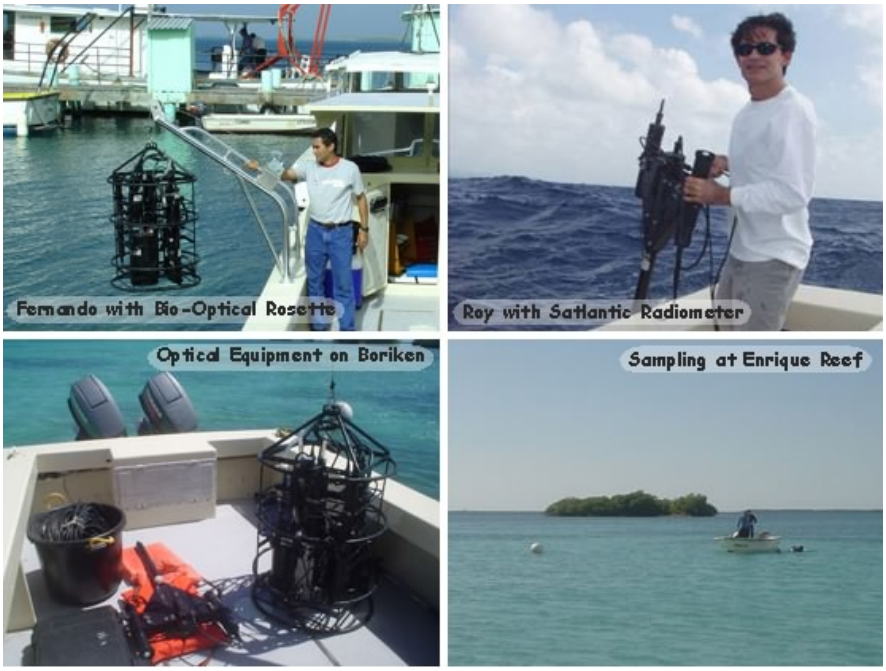

Figure 2: Bio-optical sampling activities in La Parguera.

A bio-optical rosette with several instruments was used to measure profiles of different water properties (Figure 2). A CTD (Seabird SBE-19 with pump) measured temperature and salinity. A small fluorometer (Model WetStar from Wet Labs) measured chlorophyll fluorescence. The spectral transmittance and spectral adsorption were measured over nine wavelengths with the AC-9 meter (from Wet Labs). The backscattering coefficient at six wavelengths was measured with the HydroScat-6 (from Hobi Labs). Water-leaving radiance and the above-surface downwelling irradiance were measured using the GER 1500 spectroradiometer and remote sensing reflectance will be calculated.

After data were collected several processing steps were performed to assure its quality. The data measured during the warming-up and the upcast phases were eliminated from the dataset. Only data collected during the ~5 minutes steady state phase were considered for further analyses. Also some stations had a profile of data, like Mario Deep, and that was also included. A median was computed using the ~5 minutes data from each station in order to compare them and prepare graphs. Examples of the collected data, like absorption, attenuation, backscattering, and remote sensing reflectance, are presented in Figures 3 to 6. As expected, the sampled stations showed different optical conditions; where the Bahia and Inshore stations showed the highest inherent optical properties. Media Luna and San Cristobal, which are the farthest reefs from the coast, showed the lowest values in these parameters and Enrique reef, which is the closest to the coast, showed the highest values among reefs. In general, the remote sensing reflectance (Rrs) also responded to these trends; although the spectral responses are more complicated to interpret. Laurel reef showed the highest Rrs and Bahia stations the lowest Rrs. All stations showed low Rrs in blue wavelengths (Figure 6), indicating high absorption and attenuation (Figure 3 and 4). The maximum Rrs was measured in the green region of the spectrum, although the highest Rrs peak moves at different wavelengths. Further analyses are underway to better understand the dynamics of these bio-optical properties in this complex reef system. That will allow also to better interpret the AISA images and algorithms development.

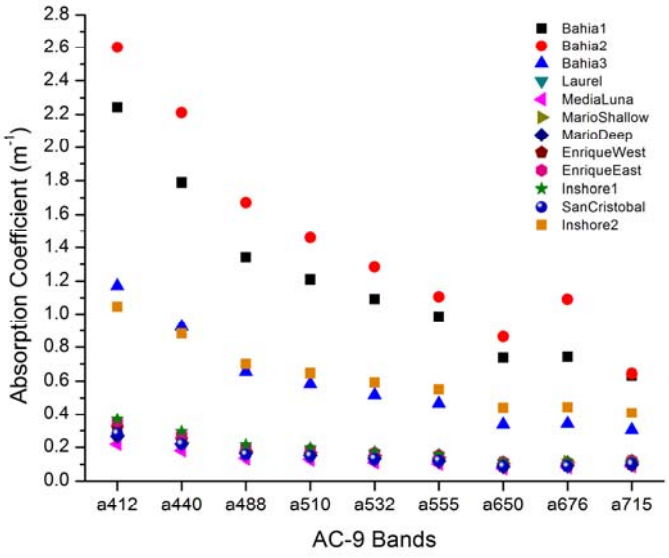

Figure 3: Absorption coefficient as measured with the AC-9 in La Parguera.

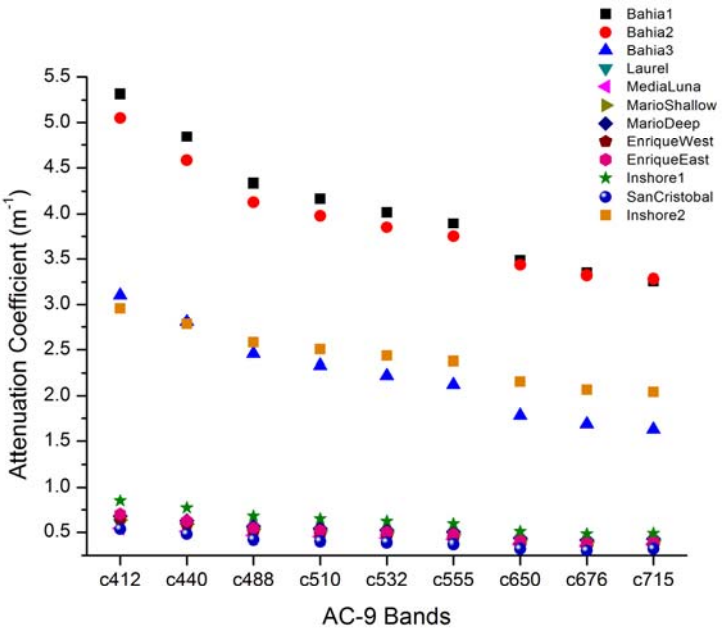

Figure 4: Attenuation coefficient as measured with the AC-9 in La Parguera.

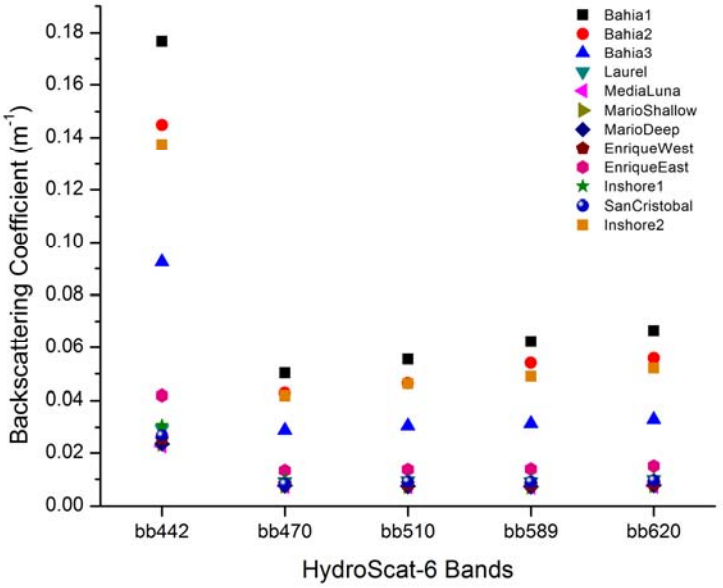

Figure 5: Backscattering coefficient as measured with the Hydroscat-6 in La Parguera.

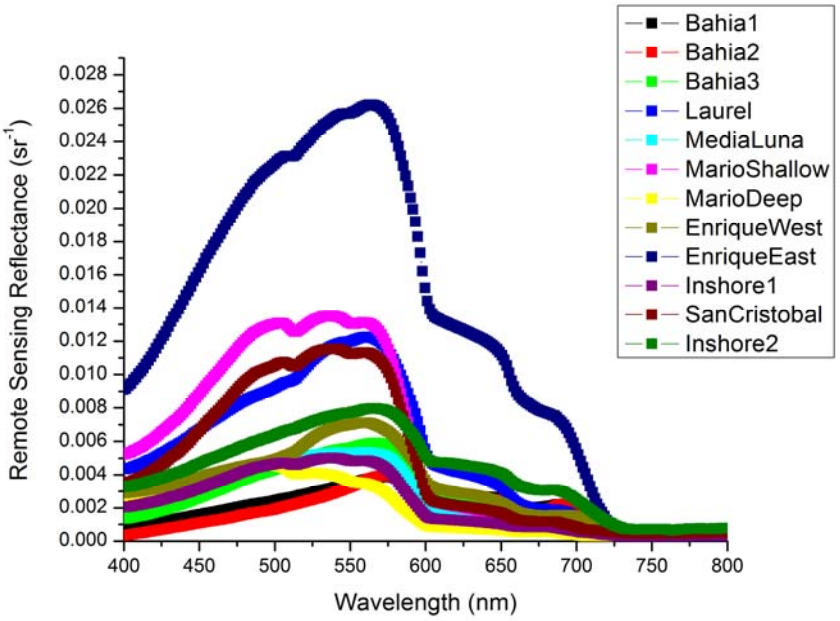

Figure 6: Remote sensing reflectance as measured with the GER-1500 in La Parguera.

This first-time comprehensive study of the bio-optical properties of La Parguera Reef System will establish the basics for further improvement of the remote sensing techniques for monitoring of benthic habitats. All data collected during the AISA mission and other monthly samplings will be incorporated into a Geographic Information System (GIS) using ArcGIS. These layers of information will be published in the internet using the recently created database system called GERSVIEW. Examples of other databases already on-line can be found at: http://gersview.uprm.edu.