

Investigating Benthic Habitats in the Florida Reef Tract with Lidar

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The topographic variability of reef substrates and the composite three-dimensional thicket structure of their variable benthic communities are morphologic components of habitat complexity. The NASA Experimental Advanced Airborne Research Lidar (EAARL) is designed to survey these components of habitat complexity simultaneously at high horizontal (< 1 m) and vertical spatial resolution (< 0.2 m). In early August 2002, an intensive USGS - NASA EAARL survey was conducted over a broad swath of the northern Florida reef tract, extending from north of Triumph Reef to south of Carysfort Reef. Algorithms were developed to analyze the one-nanosecond temporal-resolution laser reflections that are provided at rates up to 5000 Hz by the NASA EAARL. Two highly complementary types of information on benthic morphologic complexity were extracted from the EAARL active optical soundings acquired over the northern Florida reef tract: 1) substrate optical rugosity, and 2) the range-amplitude characteristics of the laser bottom reflections. These two measurements are used to quantify the instantaneous vertical thicket structure of the benthic community. Optical rugosity was determined by converting each across-track lidar raster scan into a submarine topographic transect, followed by computing the ratio of surface contour length to direct geometric length along each transect. The time-amplitude reflection history of each laser-pulse bottom reflection was converted to a range-backscatter record and normalized for attenuation using water-column thickness derived from the full laser reflection. Bottom-reflection metrics, including total reflection length, integrated backscatter, and weighted-mean backscatter, were calculated for each optical sounding. The validity of these bottom-reflection metrics as proxies for the thicket density and height of branching or leafy organisms is being evaluated through the detailed *in-situ* measurement of patch-reef communities surveyed by the EAARL.