Illumination and turbidity effects on observing faceted bottom elements with uniform Lambertian albedos

Carder, Kendall L., Cheng-Chien Liu, Zhongping Lee, David C. English, James Patten, F. Robert Chen, James E. Ivey, Curtiss O. Davis

Limnol. Oceanogr., 48(1_part_2), 2003, 355-363 | DOI: 10.4319/lo.2003.48.1_part_2.0355

ABSTRACT: Aircraft images were collected near Lee Stocking Island (LSI), Bahamas, with wavelike features for bright sand bottoms during times when solar zenith angles were large. The image contrast between leading and trailing wave facets approached a 10-15% difference because of algae accumulations in wave troughs or topographic variations of the bottom. Reflectance contrast for blue light was greater than for red and green wavelengths when algae or detritus was present in the troughs. However, the contrast at green and red wavelengths was greater than at blue wavelengths when caused by the interplay between bottom topography and oblique illumination. A three-dimensional backwards Monte Carlo (BMC) model was developed to evaluate the effect of oblique illumination on wavelike topographic features for various values of water clarity and bottom albedo. An inverse optical modeling approach, previously developed for flat, horizontally homogeneous bottoms, was applied to the BMC results. Bathymetric estimates for bright facets tilted 10° toward the sun were slightly smaller than actual depths, whereas shaded facet depth estimates were too high by about 5%. Larger errors were associated with albedo retrievals, where shaded facets produced albedo estimates up to 15% lower than actual values. Errors increased with tilt angles up to 20° but decreased with sea and sky turbidity. Averaging sunlit and shaded pixels before running the inverse model reduced the uncertainty of bathymetric and albedo estimates to about 2 and 5%, respectively, comparable to previous field evaluations of the inversion model.

Article Links

Download Full-text PDF

Return to Table of Contents