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Effects of optically shallow bottoms on upwelling radiances: Inhomogeneous and sloping bottoms

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ABSTRACT: If the benthic boundary in optically shallow waters is spatially inhomogeneous or sloping, the underwater light field is inherently three-dimensional (3D). Numerical simulations of 3D underwater radiances were made for environmental conditions observed in shallow Bahamian waters. The simulations show that if the pattern of bottom reflectance for an inhomogeneous but level bottom has a spatial scale much smaller than the bottom area seen by a radiometer, the inhomogeneous bottom can be replaced by a homogeneous bottom whose reflectance is the areaweighted average of the actual bottom reflectances. For large-scale patterns of bottom reflectance, the 3D light fields near the edges of bottom patches of different reflectances can be predicted from analytical models incorporating the sensor geometry and one-dimensional (1D) light fields computed for homogeneous bottoms, with errors of order 10% when compared to the exact 3D solutions. The same holds true for uniformly sloping bottoms, whose 3D light fields can be modeled in terms of the 1D light fields computed for level bottoms, with errors of less than 10% for bottom slopes of 20° or less.

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