Derived Bathymetry of Nearshore Benthic Habitats Overivew

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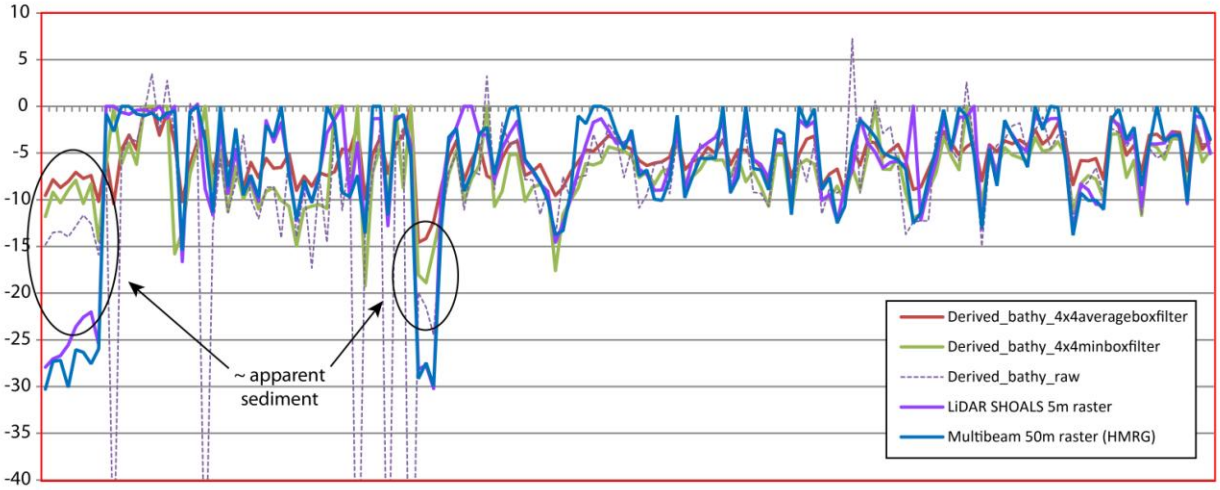
Methods

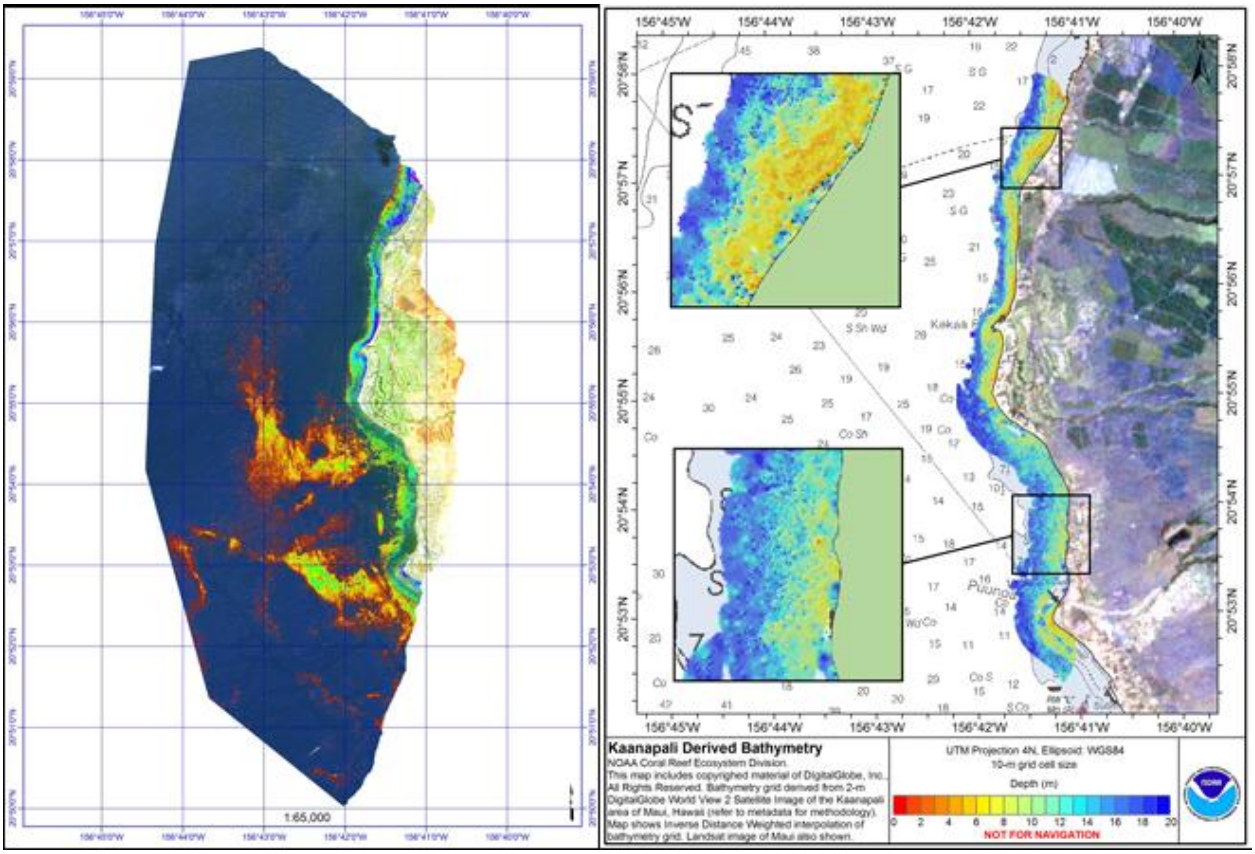
Methods used were adapted from a "cookbook" of instructions developed by Kyle Hogref for using IKONOS imagery data to derive seafloor elevations in optically clear water. This dataset was derived from high-resolution (2 m) imagery from DigitalGlobe's WorldView-2 sensor of the Kaanapali area of Maui, Hawaii. Sensor bands 1,2 and 5 (coastal, blue and near IR respectively) were used to derive depth information. The method assumes unifrom water clarity but deviations from that condition made extraction difficult in water greater than 30 m depth in the Kaanapali scene used. Results show that biotic material or sediment in the water column skewed results shallower if the material has a high albedo and deeper if the material has a low albedo. Nearshore areas were signifcantly less impacted in the Kaanapali area, due to the geomorphology of the area and the hi resolution and quality of the imagery, allowing visual descrimination of apparent sediment in the water column. For presentation purposes the map product shows an Inverse Distance Weighted interpolated bathymetry surface, restricted to data within 600 m of the shoreline.



DigitalGlobe's(DG) WorldView-2 data are used as the base imagery to derived pseudobathymetry of the Kaanapali area of Maui. This area has both SHOALS and multi-beam acoustic derived bathymetry coverage and will provide an example case of the strengths and weaknesses of pseudobathymetry extraction from high resolution satellite imagery methods. LiDAR bathymetry of Kaanapali, Maui from Scanning Hydrographic Airborne Operational LiDAR data from the United States Army Corps of Engineers Joint Airborne LiDAR Bathymertry Technical Center for Expertise. Multibeam sonar data from the Main Hawaiian Islands Multibeam Bathymetry Synthesis (http://www.soest.hawaii.edu/HMRG/Multibeam/explorer.php#Google) maintained by the Hawaii Mapping Research Group at the University of Hawaii, School of Ocean and Earth Science and Technology.

Process Description

Multiple tools in ENVI 4.8 were used to complete the following processing steps: Data conversion from digital number to radiance, correction for atmosphere and water surface reflection, linearization of spectral decay as function of depth, masking of non-applicable values, and bathymetric derivation using variables from multiple linear regression analysis. Multiple tools in ArcGIS 10.0 were used for dataset integration and to extract values for the multiple linear regression analysis and subsequent error analyses. The statisitcs program Matlab was used for the multiple linear regression analysis to provide original variables for depth derivation. The multivariate slope intercept formula used to derive depth was D = a + (bi)(xi) + (bj)(xj) Where: D = depth a = intercept b = slope x = the linearized spectral value resulted in 7.8491 - 2.8696(b1) + 7.9593(b2) b1 is the output masked linearized pictral value of each pixel of Coastal band b2 is the output masked linearized pictral value of each pixel of Blue band More information on this



integration process is provided in the product error analysis, availble from PIBHMC upon request. This mosaiced derived bathymetry product (JohDBall3) was then integrated with the multibeam sonar data, with sonar data prioritized over derived data, to create the final product (JohDB3MB). A detailed description of all processing steps is available at:
ftp.soest.hawaii.edu/pibhmc/website/webdocs/documentation/Cookbook_042108.pdf

An error analysis of each derived bathymetry grid used is available from PIBHMC upon request. To produce the interpolated surface shown in the map, the floating point grid was converted to a point shapefile in Arc GIS 9.3 using the 'float to raster' and 'raster to point' tools in

the Arc Toolbox. A buffer of 600m from the shoreline was created and the derived bathymetry points were clipped to exclude data outside this buffer. This distance was chosen to exclude areas of deeper water that were erroneously returning shallow depth values, due to characteristics of the water column. An Inverse Distance Weighted interpolation was run using 3D Analyst, to produce an interpolated surface, with a grid cell size of 10 m, a variable search radius with a maximum distance of 60 m, and using the coastline as a barrier. All other settings used were default. The interpolated surface was clipped using the coastline and a small number of isolated cells were manually deleted.