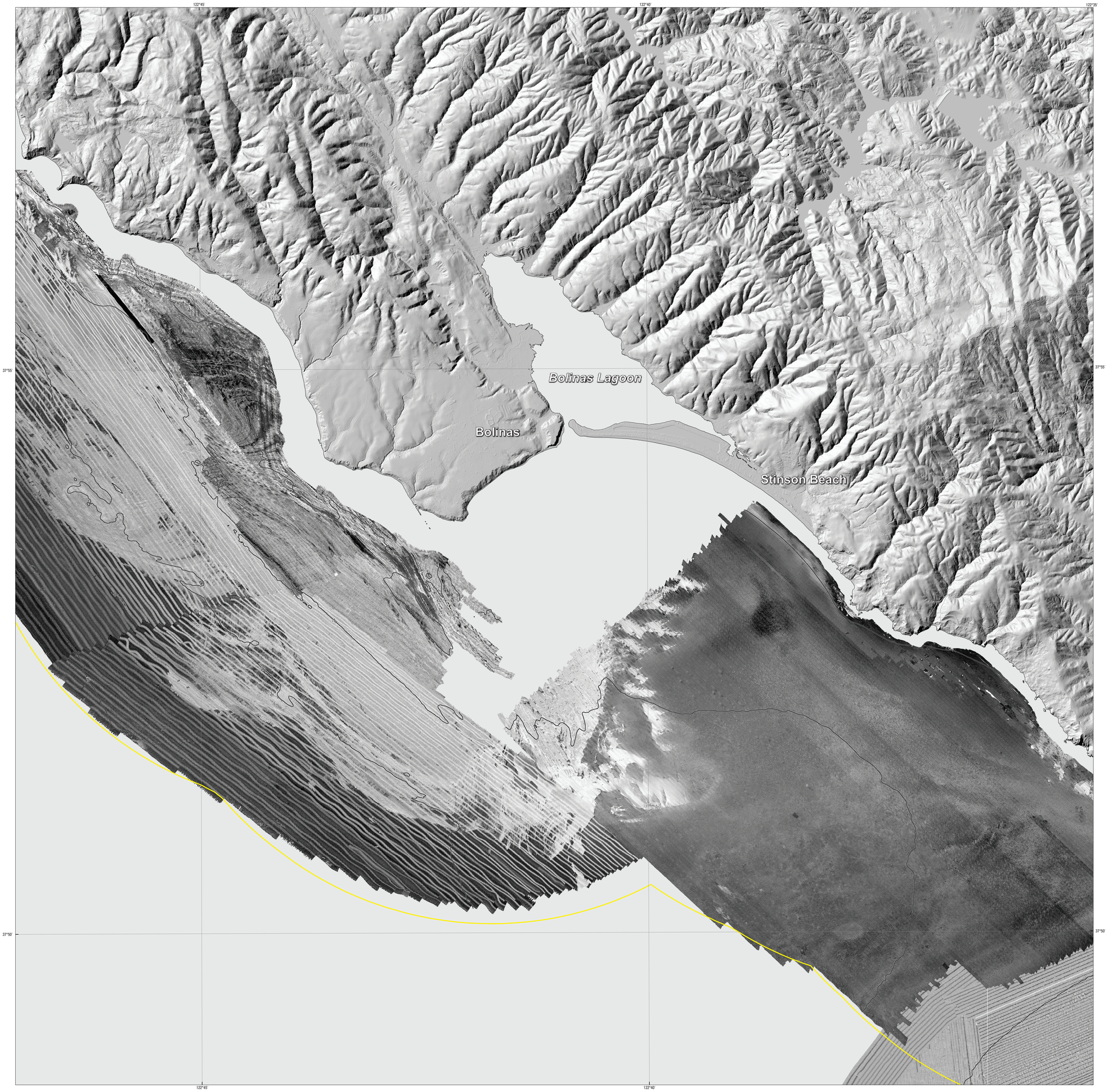
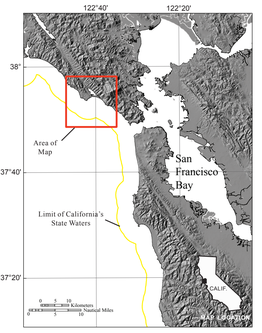
U.S. Department of the Interior
U.S. Geological Survey

Open-File Report 2015–1135
Sheet 3 of 10
Pamphlet accompanies map





DISCUSSION

This acoustic-backscatter map of the Offshore of Bolinas map area in northern California was generated from bathymetry data collected by Fugro Pelagos, by California State University, Monterey Bay (CSUMB), and by Moss Landing Marine Laboratories (fig. 1). Mapping was completed between 2004 and 2010, using a combination of 200-kHz and 400-kHz Reson 7125, and 244-kHz Reson 8101 multibeam echosounders, as well as 468-kHz SEA SWATHplus and 250-kHz GeoSwath interferometric systems. These mapping missions combined to collect bathymetry data from about the 10-m isobath to beyond the 3-nautical-mile limit of California's State Waters.

During the mapping missions, an Applanix POS MV (Position and Orientation System for Marine Vessels) was used to accurately position the vessels during data collection, and it also accounted for vessel motion such as heave, pitch, and roll (position accuracy, ±2 m; pitch, roll, and heading accuracy, ±0.02°; heave accuracy, ±5%, or 5 cm); in addition, sound-velocity profiles were collected with an Applied Microsystems (AM) SVPlus sound velocimeter. To account for tidal-cycle fluctuations, CSUMB used NavCom 2050 GPS receiver (CNAV) data, and Fugro Pelagos used KGPS data (GPS data with real-time kinematic corrections). Soundings were corrected for vessel motion using the Applanix POS MV data, for variations in water-column sound velocity using the AM SVPlus data, and for variations in water height (tides) using vertical-position data from the KGPS receivers.

The multibeam-echosounder backscatter data were postprocessed using the CARIS 7.0 integration of Geocoder software. Within Geocoder, the backscatter intensities were radiometrically corrected (including despeckling and angle-varying gain adjustments), and the position of each acoustic sample was geometrically corrected for slant range on a line-by-line basis. After the lines were corrected, they were mosaicked into a 1-m-resolution image. Overlap between parallel lines was resolved using a priority table whose values were based on the distance of each sample from the ship track, with the samples that were closest to and furthest from the ship track being given the lowest priority. An anti-aliasing algorithm was also applied. The mosaics were then exported as georeferenced TIFF images, imported into a geographic information system (GIS), and converted to GRIDs at 2-m resolution. The interferometric backscatter data were postprocessed using U.S. Geological Survey software (D.P. Finlayson, written commun., 2011) that normalizes for time-varying signal loss and beam-directivity differences. Thus, the raw 16-bit backscatter data were gain-normalized to enhance the backscatter of the SWATHplus system. The resulting normalized-amplitude values were rescaled to 16-bit and gridded into GeoJPEGs using GRID Processor Software, then imported into a GIS and converted to GRIDs.

The acoustic-backscatter imagery from each different mapping system and processing method were merged into their own individual grids. These individual grids, which cover different areas, were combined in a GIS to create this map, on which brighter tones indicate higher backscatter intensity, and darker tones indicate lower backscatter intensity. The intensity represents a complex interaction between the acoustic pulse and the seafloor, as well as characteristics within the shallow subsurface, providing an indication of seafloor texture and sediment type. Backscatter intensity depends on the acoustic source level; the frequency used to image the seafloor; the grazing angle; the composition and character of the seafloor, including grain size, water content, bulk density, and seafloor roughness; and some biological cover. Harder and rougher bottom types such as rocky outcrops or coarse sediment typically return stronger intensities (high backscatter, lighter tones), whereas softer bottom types such as fine sediment return weaker intensities (low backscatter, darker tones). Note that the parallel lines of higher backscatter intensity throughout the map area are data-collection artifacts.

Bathymetric contours were generated at 10-m intervals from a merged 2-m-resolution bathymetric surface. The merged surface was smoothed using the Focal Mean tool in ArcGIS and a circular neighborhood that has a radius of between 20 and 30 m (depending on the location). The contours were generated from this smoothed surface using the Spatial Analyst Contour tool in ArcGIS. The most continuous contour segments were preserved; smaller segments and isolated island polygons were excluded from the final output. The contours were then clipped to the boundary of the map area.

The onshore-area image was generated by applying an illumination having an azimuth of 300° and from 45° above the horizon to 1-m-resolution topographic-lidar data collected by Earth Eye in 2010 for San Francisco State University and the U.S. Geological Survey (available at http://ned.usgs.gov/).

EXPLANATION

Backscatter intensity

High

Low

Area of "no data"—Areas near shoreline not mapped owing to insufficient high-resolution seafloor mapping data; areas beyond 3-nautical-mile limit of California's State Waters were not mapped as part of California Seafloor Mapping Program

3-nautical-mile limit of California's State Waters

Bathymetric contour (in meters)—Derived from modified 2-m-resolution bathymetry grid. Contour interval: 10 m

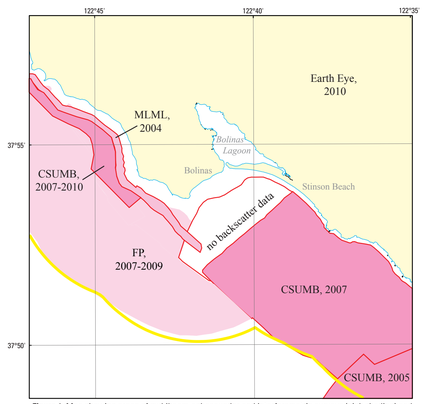


Figure 1. Map showing areas of multibeam-echosounder and interferometric surveys (pink shading) and onshore topographic lidar surveys (yellow shading). Also shown are data-collecting agencies (CSUMB, California State University, Monterey Bay, Seafloor Mapping Lab; FP, Fugro Pelagos; MLML, Moss Landing Marine Laboratories) and year of surveys if known. Yellow line shows limit of California's State Waters.

Onshore elevation data collected by Earth Eye in 2010 for San Francisco State University and U.S. Geological Survey (available at http://ned.usgs.gov/), California's State Waters limit from NOAA Office of Coast Survey

Universal Transverse Mercator projection, Zone 10N

NOT INTENDED FOR NAVIGATIONAL USE

14°
TRUE NORTH
GRID NORTH
APPROXIMATE MEAN DECLINATION, 2015

SCALE 1:24 000

1 1/2 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

BATHYMETRIC CONTOUR INTERVAL 10 METERS
ONE MILE = 0.869 NAUTICAL MILES

CALIF.
MAP LOCATION

Acoustic-backscatter imagery by Peter Dartnell, 2012 (data collected by Moss Landing Marine Laboratories, 2004; by California State University, Monterey Bay, Seafloor Mapping Lab, 2004–2010; and by Fugro Pelagos, 2007–2009). Bathymetric contours by Mercedes D. Erdey, 2012

GIS database and digital cartography by Nadine E. Golden

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Acoustic Backscatter, Offshore of Bolinas Map Area, California

By

Peter Dartnell,[1] Rikk G. Kvitek,[2] Mercedes D. Erdey,[1] and Carrie K. Bretz[2]

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[1]U.S. Geological Survey;
[2]California State University, Monterey Bay, Seafloor Mapping Lab

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