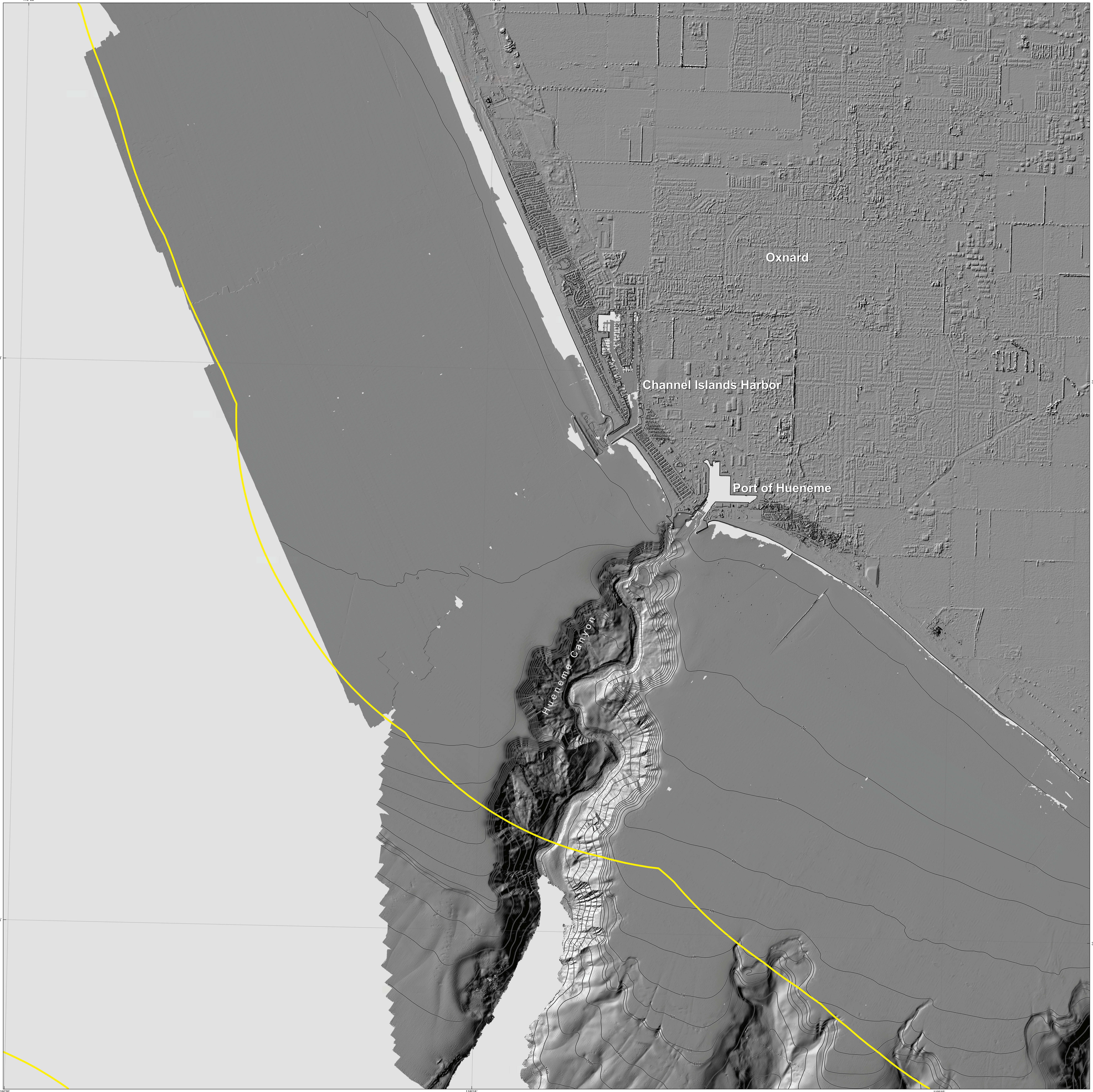
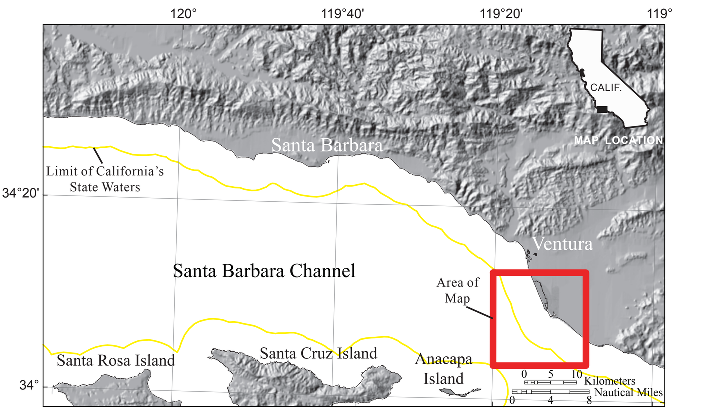
U.S. Department of the Interior
U.S. Geological Survey

Scientific Investigations Map 3225
Sheet 2 of 12
Pamphlet accompanies map





DISCUSSION

This shaded-relief bathymetry map of Hueneme Canyon and vicinity in southern California was generated from bathymetry data collected by California State University, Monterey Bay (CSUMB), by the U.S. Geological Survey (USGS), and by Fugro Pelagos for the U.S. Army Corps of Engineers (USACE) Joint Lidar Bathymetry Technical Center of Expertise (fig. 1). Most of the offshore area was mapped by CSUMB in the summers of 2006 and 2007, using a 244-kHz Reson 8101 multibeam echosounder. The far northern part of the offshore area was mapped by the USGS in 2006, using a 117-kHz SEA (AP) Ltd. SWATHplus-M phase-differencing sidescan sonar. The nearshore bathymetry and coastal topography were mapped for USACE by Fugro Pelagos in 2009, using the SHOALS-1000T bathymetric-lidar and Leica ALS60 topographic-lidar systems. All these mapping missions combined to collect bathymetry from the 0-m isobath to beyond the 3-nautical-mile limit of California's State Waters.

During the CSUMB mapping missions, an Applanix positioning and motion compensation system (POS/MV) was used to accurately position the vessel 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). NavCom 2050 GPS receiver (CNAV) data were used to account for tidal-cycle fluctuations, and sound-velocity profiles were collected with an Applied Microsystems (AM) SVPlus sound velocimeter. 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 CNAV receiver. Final XYZ soundings and bathymetric-surface models were referenced to the World Geodetic System of 1984 (WGS 1984) relative to the North American Vertical Datum of 1988 (NAVD 1988).

During the USGS mapping mission, GPS data and measurements of vessel motion (heave, pitch, and roll) were combined in a CodaOctopus F180 attitude-and-position system to produce a high-precision vessel-attitude packet. This packet was transmitted to the acquisition software in real time and combined with instantaneous sound-velocity measurements at the transducer head before each ping. The returned samples were projected to the seafloor using a ray-tracing algorithm that works with previously measured sound-velocity profiles. Statistical filters were applied to the raw samples that discriminate the seafloor returns (soundings) from unintended targets in the water column. The original soundings were referenced to the WGS 1984 relative to the MLLW (Mean Lower Low Water) tidal datum, but, through postprocessing using NOAA's VDatum tool, the soundings were transformed to NAVD 1988. Finally, the soundings were converted into 2-m-resolution bathymetric-surface-model grids.

During the Fugro Pelagos mapping mission that was completed as part of the National Coastal Mapping Program of USACE, the Leica ALS60 topographic-lidar and the SHOALS-1000T bathymetric-lidar systems were mounted on an aircraft that flew survey lines at an altitude of 300 to 400 m (bathymetry) and 300 to 1,200 m (topography), at speeds of between 135 and 185 knots. The ALS60 system collected data at a maximum pulse rate of 200 kHz, and the SHOALS system collected data at 1 kHz. Information on aircraft position, velocity, and acceleration were collected using the Novatel and POS A/V 410 systems (SHOALS) and the onboard GPS/IMU system (ALS60). Aircraft-position data were processed using POSPac software, and the results were combined with the lidar data to produce 3-D positions for each lidar shot. Various commercial and proprietary software packages were used to clean the data, to convert all valid data from ellipsoid to orthometric heights, and to export the data as a series of first-return topography and bathymetry ASCII files. Final grids were provided in geographic coordinates referenced to the NAVD 1988.

Once all the bathymetric-surface models were transformed to a common projection and datum, the files were merged into one overall 2-m-resolution bathymetric-surface model. An illumination having an azimuth of 300° and from 45° above the horizon was then applied to the surface to create this shaded-relief map. Bathymetric contours were generated from a modified 10-m-resolution bathymetric surface where a smooth arithmetic mean convolution function applying a weight of one-ninth to each cell in a 3-pixel by 3-pixel matrix was applied iteratively to the surface ten times.

The onshore-area image was generated by applying the same illumination to the topographic-lidar data, as well as to publicly available, 3-m-resolution, interferometric synthetic aperture radar (ifSAR) data, available from NOAA Coastal Service Center's Digital Coast, at http://csc-s-maps-q.csc.noaa.gov/dataviewer/viewer.html (last accessed April 5, 2011).

EXPLANATION

Amount of illumination

Illuminated (facing false sun)

In shadow (facing away from false sun)

Direction of illumination from false sun—Position of false sun is at 300° azimuth, 45° above horizon [arrow included in explanation for illustration purposes only; not shown on map]

Area of "no data"—Areas from shoreline (defined as Mean Higher High Water) out to 10-m water depth not mapped owing to lack of reliable sounding returns to airborne-lidar system caused by sea state (for example, breaking waves or turbidity); 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—Line in southwest corner of map area is limit surrounding Anacapa Island (outside of map area)

100 **Bathymetric contour (in meters)**—Derived from modified 10-m-resolution bathymetry grids. Contour intervals: 1–100 m water depth, 10 m; >100 m water depth, 50 m

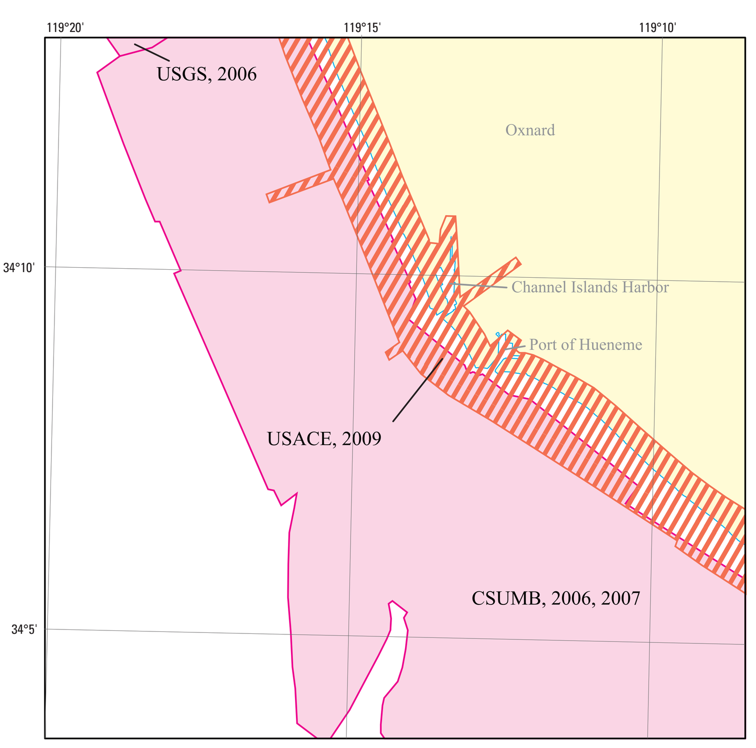


Figure 1. Map showing areas of multibeam-echosounder and bathymetric-sidescan surveys (pink shading), bathymetric- and topographic-lidar surveys (orange diagonal lines), and publically available interferometric synthetic aperture radar (ifSAR) topography (yellow shading). Also shown are data-collecting agencies (CSUMB, California State University, Monterey Bay, Seafloor Mapping Lab; USACE, U.S. Army Corps of Engineers; USGS, U.S. Geological Survey) and dates of surveys if known.

Onshore elevation data from NOAA Coastal Services Center (data collected by EarthData International in 2002-2003) and from U.S. Army Corps of Engineers (data collected by Fugro Pelagos in 2009). California's State Waters limit from NOAA Office of Coast Survey

Universal Transverse Mercator projection, Zone 11N

NOT INTENDED FOR NAVIGATIONAL USE

13°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2012

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 INTERVALS 10 METERS AND 50 METERS

ONE MILE = 0.869 NAUTICAL MILES

MAP LOCATION

Shaded-relief bathymetry by Peter Dartnell, 2011 (data collected by U.S. Geological Survey in 2006, by California State University, Monterey Bay, Seafloor Mapping Lab in 2006-2007, and by Fugro Pelagos for U.S. Army Corps of Engineers in 2009). Bathymetric contours by Andrew C. Ritchie, 2011

GIS database and digital cartography by Nadine E. Golden and Eleyne L. Phillips

Edited by Taryn A. Lindquist

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US Army Corps of Engineers

Shaded-Relief Bathymetry, Hueneme Canyon and Vicinity, California

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