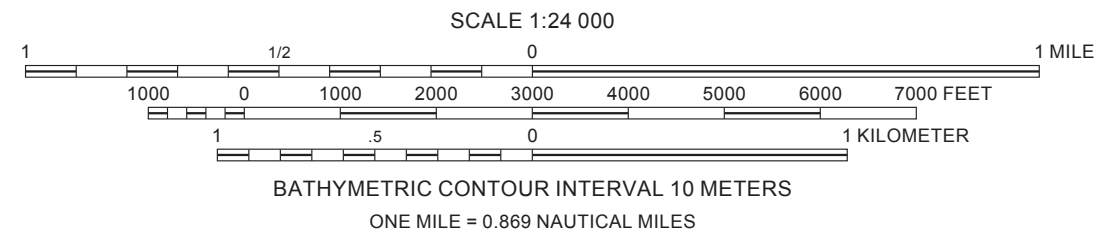
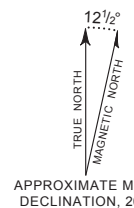


Drushere elevation data from NOAA Coastal Services Center (data collected by EarthData International in 2002-2003). California's State Waters limit from NOAA Office of Coast Survey Universal Transverse Mercator projection, Zone 11N.

NOT INTENDED FOR NAVIGATIONAL USE

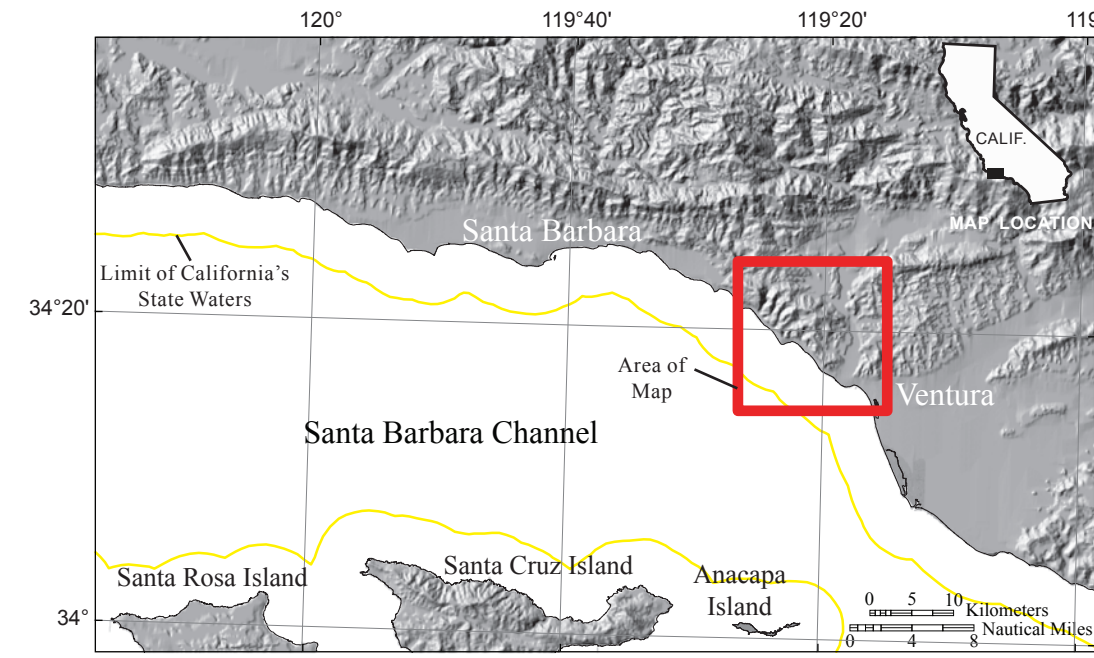


Shaded-relief bathymetry by Peter Dartnell, 2011 (data collected by U.S. Geological Survey in 2006 and 2010) and by California State University, Monterey Bay, Seafloor Mapping Lab in 2006-2007). Bathymetric contours by Nadine E. Golden and Elyne L. Phillips. GIS database and digital cartography by Nadine E. Golden and Elyne L. Phillips. Edited by Taryn A. Lindquist. Manuscript approved for publication March 11, 2013.

## Colored Shaded-Relief Bathymetry, Offshore of Ventura Map Area, California

By  
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### DISCUSSION

This colored shaded-relief bathymetry map of the Offshore of Ventura map area in southern California was generated from bathymetry data collected by California State University, Monterey Bay (CSUMB), and by the U.S. Geological Survey (USGS) (fig. 1). Most of the offshore area was mapped by CSUMB in the summers of 2006 and 2007, using a 244-kHz Reson H10 multibeam echosounder. The seafloor west of Ventura Harbor was mapped by the USGS in 2006 and 2010, using 117-kHz (2006) and 234.5-kHz (2010) SEA (AP) Ltd. SWATHplus-M phase-differencing sidescan sonars. These mapping missions combined to collect bathymetry from about the 10-m isobath to beyond the 3-nautical-mile limit of California's State Waters.

In 2009, Fugro Pelagos collected bathymetric- and topographic-lidar data along the Ventura and Santa Barbara County coastlines for the U.S. Army Corps of Engineers Joint Lidar Bathymetry Technical Center of Expertise. Although bathymetric coverage was good northwest and southeast of the map area, coverage within the Offshore of Ventura map area was very sparse; therefore, these data are not included in this map.

During the CSUMB mapping missions, an Applanix position 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 missions, differential GPS (DGPS) data (2006) and GPS with real-time kinematic corrections (2010) were combined with measurements of vessel motion (heave, pitch, and roll) 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 2006 soundings were referenced to the WGS 1984 datum to the MLLW (Mean Lower Low Water) tidal datum, but, through postprocessing using National Oceanic and Atmospheric Administration's (NOAA's) VDatum tool, the soundings were transformed to the NAVD 1988. The original 2010 soundings were referenced to the WGS 1984 datum using real-time kinematic GPS and then transformed through postprocessing to the NAVD 1988 (Dartnell and others, 2012). Finally, the soundings were converted into 2-m-resolution bathymetric-surface-model grids. Note that the northwest-southeast-trending lines offshore of Ventura Harbor are data-collection artifacts.

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 and clipped to the boundary of the map area. An illumination having an azimuth of 300° and from 45° above the horizon was then applied to the bathymetric surface to create the shaded-relief imagery. In addition, a modified "rainbow" color ramp was applied to the bathymetry data, using reds and oranges to represent shallower depths, and yellows to represent greater depths (note that the Offshore of Ventura map area requires only the shallower part of the fall-rainbow color ramp used on some of the other maps in the California State Waters Map Series; see, for example, Kvitsek and others, 2012). This colored bathymetry surface was draped over the shaded-relief imagery at 60-percent transparency to create this colored shaded-relief map. Bathymetric contours were generated from a modified 10-m-resolution bathymetric surface where a smooth arithmetic mean convolution function that assigns a weight of one-tenth to each cell in a 3-pixel by 3-pixel matrix was applied iteratively to the surface ten times.

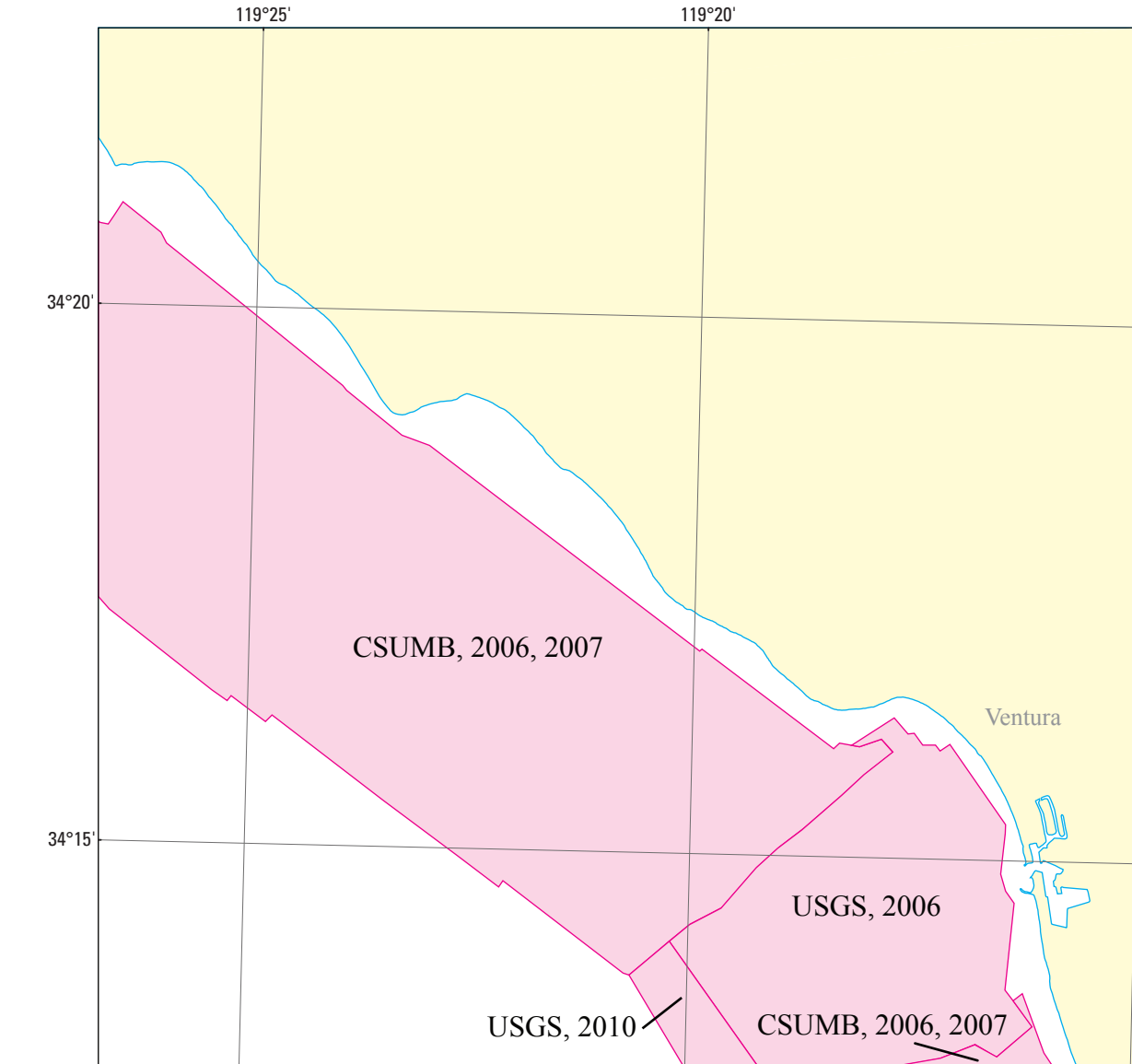
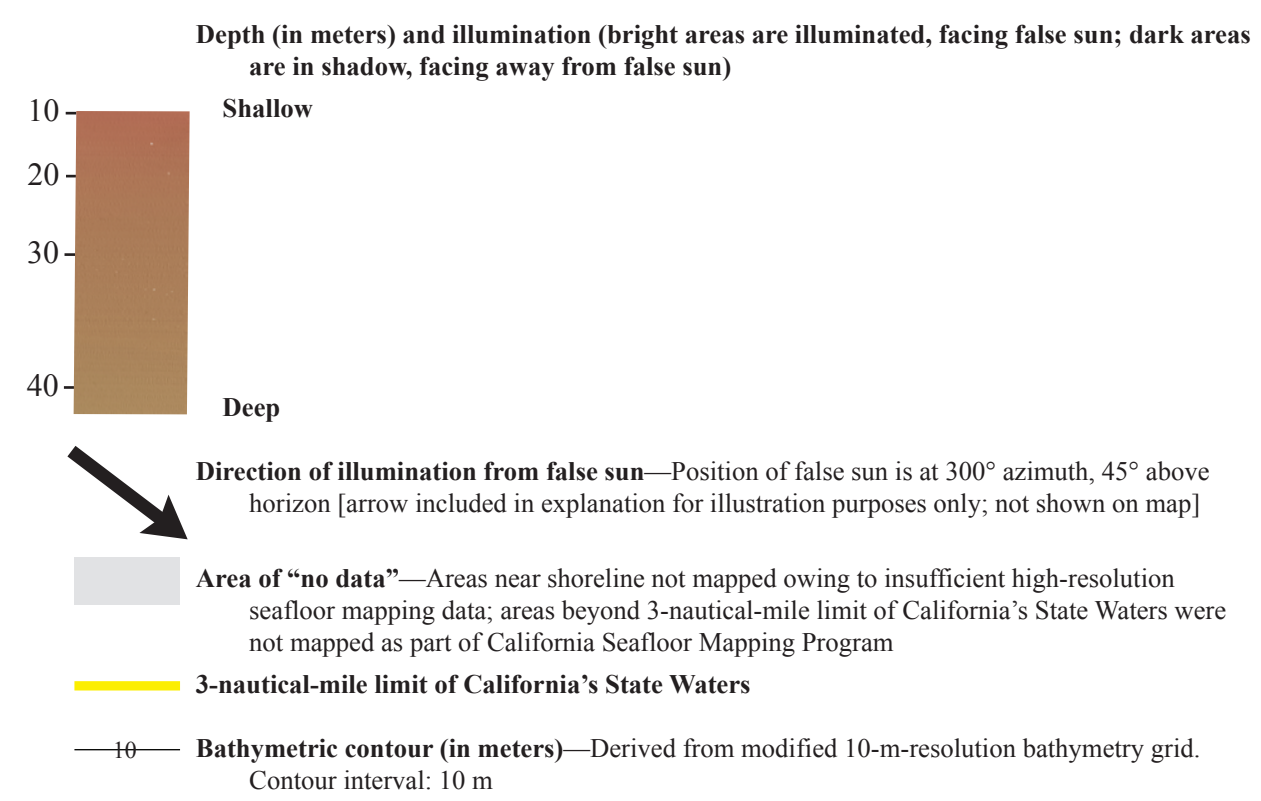
The onshore-area image was generated by applying the same illumination (azimuth of 300° and from 45° above the horizon) to publicly available, 3-m-resolution, interferometric synthetic aperture radar (ISAR) data, available from NOAA Coastal Service Center's Digital Coast, at <http://csc-s-maps-3.csc.noaa.gov/dataviewer/viewer.html> (last accessed April 5, 2011).

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### EXPLANATION



**Figure 1.** Map showing areas of multibeam-echosounder and bathymetric-sidescan surveys (pink shading) and publicly available interferometric synthetic aperture radar (ISAR) topography (yellow shading). Also shown are data-collecting agencies (CSUMB, California State University, Monterey Bay, Seafloor Mapping Lab; USGS, U.S. Geological Survey) and dates of surveys if known.



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