

Publishing Data Products for  
the California Seafloor  
Mapping Program:  
Development of a "Clip and  
Ship" Image Service using  
ArcGIS for Server

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# Topics

- Current SFML Data Product Distribution
- Limitations and disadvantages of current distribution model
- New “Clip & Ship” distribution conceptual model
- Development and implementation of “Clip & Ship” model
- Further development of server-side geoprocessing services and potential impact on production and distribution of derived raster products

# California Seafloor Mapping Project

## A Collaborative Effort

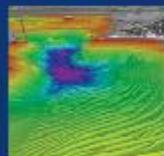
The California Seafloor Mapping Project (CSMP) is a collaborative, multi-institutional campaign creating the first comprehensive, high-resolution basemap of California's state waters (shoreline out to 3 nautical miles). Sponsored by the California Ocean Protection Council, State Coastal Conservancy, Department of Fish and Game, and several branches of the National Ocean and Atmospheric Administration (NOAA), this statewide project is being conducted as a public/private partnership involving industry, resource management agencies and academia. The tiered mapping campaign involves the use of state-of-the-art sonar, LIDAR (Light Detection and Ranging) and video mapping technologies; computer aided classification and visualization; expert geologic and habitat interpretations; and the creation of an online, publicly accessible data repository for the dissemination of CSMP products. Final products will include a folio series of multi-layer strip maps spanning California's land/sea margin showing the seafloor and coastal geology rendered in unprecedented detail.

### Technology



Acquisition of mapping data is being carried out with multibeam, sidescan and sub-bottom sonar, video tow sleds, and LiDAR to create highly detailed surface models and imagery of California's seafloor landscapes. [More...](#)

### Survey Data



The raw data are being analyzed and interpreted to create substrate and habitat maps which are then ground-truthed with video imagery for habitat verification. [More...](#)

### Map Products



Folio map sheets based on the geomorphic imagery & interpretive products at 1:24,000 scale, as well as a complete set of GIS-ready digital products, are being created from CSMP data for the entire coast of California. [More..](#)

# Current SFML Data Product Distribution

- Majority of GIS data products are raster format
- Bathymetric Digital Elevation Model (DEM) is the primary product
- Secondary products derived from DEM:
  - Slope
  - Hillshade
  - Rugosity
  - Substrate/Habitat
  - Topographic Position Index (TPI)

# Current SFML Data Product Distribution

- Raw data are originally collected in  $\sim 10$  km x 6 km survey blocks or “tiles”
  - Oceanographic variability, survey efficiency, data management considerations are primary drivers
- Survey block units persist through processing and product creation
- Final raster products are published on a block basis
  - File size is main limiting factor; high resolution of data precludes generating DEMs and derived products over large geographic areas
  - CSMP tiered depth-dependent resolution schema (2m, 5m, 10m) results in 3 DEMs/block

# Seafloor/Habitat Data Access Catalog

High resolution multibeam bathymetry data collected and processed by the Seafloor Mapping Lab is distributed to partners and the wider research community for use in ecological modeling, coastal conservation, baseline habitat maps, etc. The group is developing an online portal via Google Earth interface in addition to its existing direct data download capabilities.

**DATA LIBRARY**  
CENTRAL CALIFORNIA DATA (PART II)  
CENTRAL CALIFORNIA DATA (PART I)

Data presented here include a series of remotely sensed images (multibeam, side scan sonar), derived data (bathymetric contours, and analysis, etc.), habitat analysis, associated data sets (survey footprints, coastline), and FGDC metadata, grouped by survey location. To download zipped data files from the tables, click on the Data Type name under the desired survey location. Data are presented in ESRI ArcGIS format (shapefiles, grids). Multibeam and sidescan images are Geotiffs. These data are NOT to be used for navigational purposes.

For general data searches, use the [SURVEY LOCATION LIST](#) or [MAP LOCATOR](#)

Please review our [Data Use Policy](#)

Data Type	Data Format	File Size (M)	Data Footprint Preview
<b>South Central Coast Blocks 01-14, Blocks 15-20</b>			
<b>SCC Block 15</b>			
Shaded Relief (image, grayscale & color)	GeoTiff	2	
Shaded Relief (image, grayscale & color)	GeoTiff	3	
Bathymetry, Habitat, Slope, DEM (Geo)	GRID	2	
Bathymetry, Habitat, Slope, DEM (Geo)	GRID	<1	
Substrate, Habitat Analysis	GRID	3	
Taxonomic Pattern Analysis (TPA) & Slope Profiles (Based on TPA)	GRID	<1	
CCV Soundings	TEXT	2	
Fluorescence (image, bathymetry)	4K, IslandID, ximage	3	
Tracklines	Shapefile/lines	6	
<b>SCC Block 16</b>			
Shaded Relief (image, grayscale & color)	GeoTiff	20	
Shaded Relief (image, grayscale & color)	GeoTiff	20	
Bathymetry, Habitat, Slope, DEM (Geo)	GRID	30	
Bathymetry, Habitat, Slope, DEM (Geo)	GRID	<1	
Substrate, Habitat Analysis	GRID	14	
Taxonomic Pattern Analysis (TPA) & Slope Profiles (Based on TPA)	GRID	1	
CCV Soundings	TEXT	34	
Fluorescence (image, bathymetry)	4K, IslandID, ximage	33	
Tracklines	Shapefile/lines	9	

catalog, please be aware that we have converted terrain (although both were image to image, occurred during conversion). There are a minute amount of files will remain available for download. Please email [metz@csumb.edu](mailto:metz@csumb.edu)

use the [survey placemark balloons](#). If this [SFML Map Locator](#) to access data. Additionally, the data maps/TOC catalog in larger map" and scroll to

to View or Download Data

1 of 2 nearby results Next >

- SCC Block 19
  - Grayscale shaded-relief Geotiff - View KMZ
  - Color shaded-relief Geotiff - View KMZ
- SCC Block 20
  - Grayscale shaded-relief Geotiff - View KMZ
  - Color shaded-relief Geotiff - View KMZ

For additional data, visit:  
[http://seafloor.csumb.edu/SFMLwebDATA\\_c3.htm](http://seafloor.csumb.edu/SFMLwebDATA_c3.htm)

AOI Contains Multiple Survey Data Blocks

## CSMP Partners

- California Ocean Protection Council
- California Coastal Conservancy
- NOAA National Marine Sanctuaries
- NOAA Office of Coast Survey
- Seafloor Mapping Lab
- Fugro Pelagos, Inc
- US Geological Survey
- Moss Landing Marine Laboratories

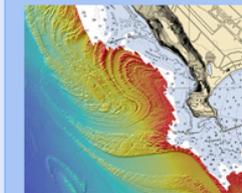
## CSMP Mission

The creation of a high-resolution 1:24,000 scale geologic and habitat base map series covering all of California's 14,500 km<sup>2</sup> state waters out to the 3 mile limit, and support of the state's Marine Life Protection Act Initiative (MLPA) goal to create a statewide network of Marine Protected Areas (MPAs).

Map generation products follow a 3-tiered approach-- from basic survey data to highly detailed habitat classification.

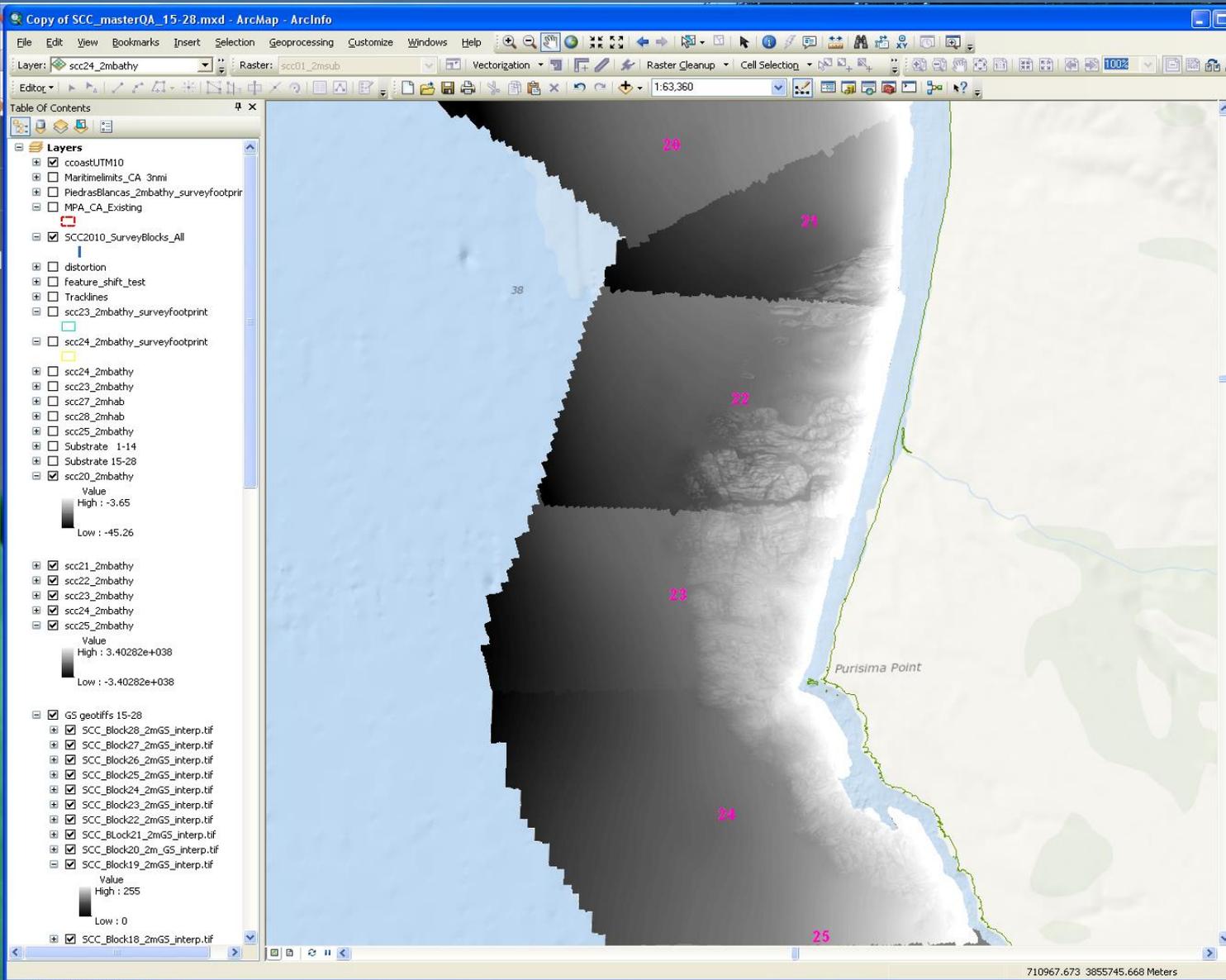
The need for baseline maps for monitoring & assessment was the most common requirement expressed among a very diverse list of mapping user needs.

- Statewide Marine Mapping Planning Workshop, 2005



SFML Data Catalog allows easy online access to zipped data files

Multiple survey blocks provide coverage for each survey region (Area of Interest)



South Central Coast

Bathymetric coverage showing individual survey Blocks

# Limitations and Disadvantages of Current Distribution Model: Server-Side

- Survey block products are pre-defined
- Large number of blocks required to cover regional or state-wide geographic area
- User interface to allow download access to potentially hundreds of blocks is unwieldy and scales poorly
- Expansions, updates, and corrections of data products are costly

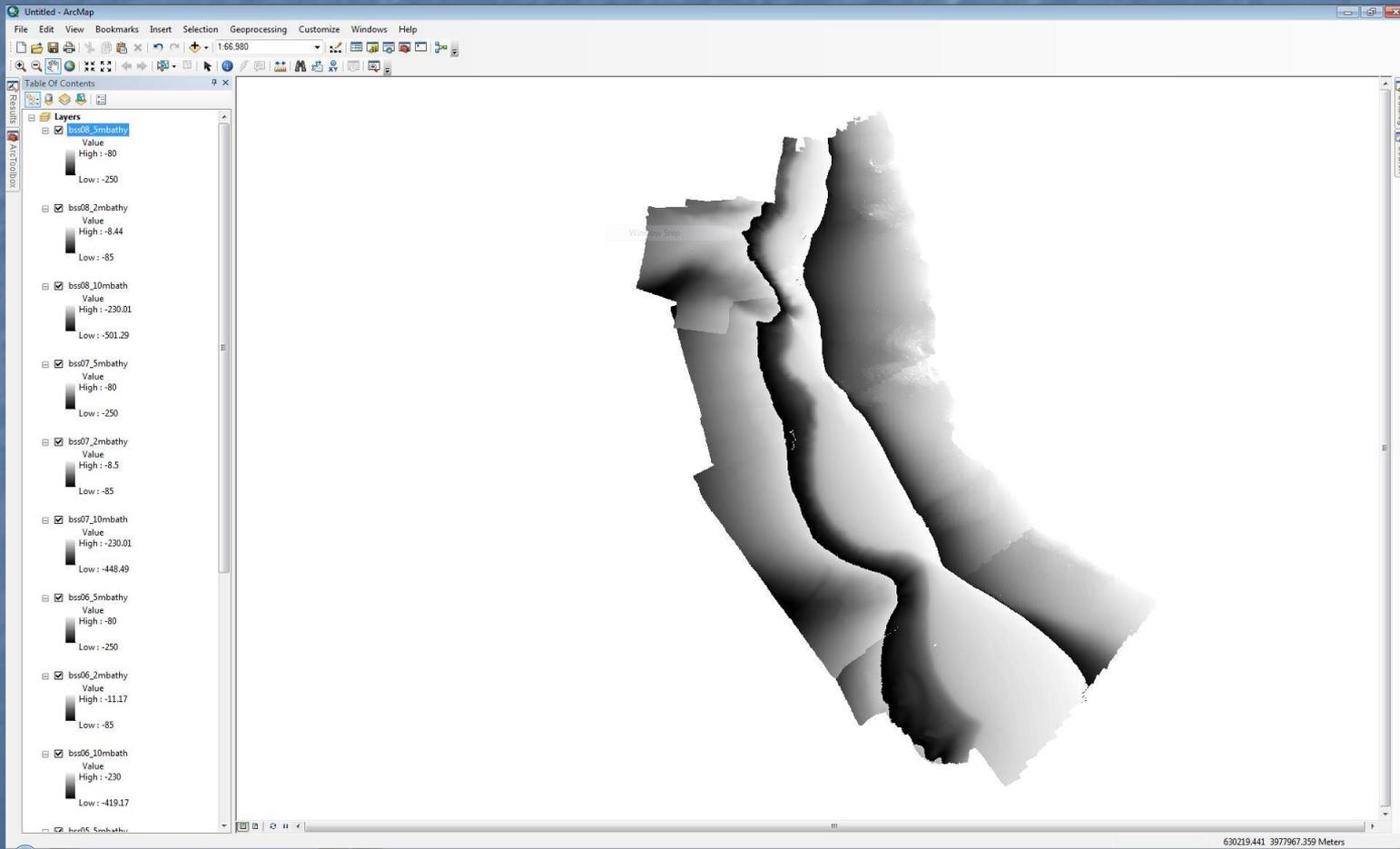
# Limitations and Disadvantages of Current Distribution Model: Client-Side

- Survey block products are pre-defined
- User must determine which block(s) are needed to cover their Area of Interest (AOI)
- AOI may be significantly *smaller* than one survey block, forcing user to download more data than they need, or
- AOI may include *multiple* blocks which must be downloaded separately
- Block products overlap slightly, so user may need to mosaic multiple block products together after downloading or otherwise deal with overlap
- Especially inefficient if AOI is small but extends across block boundary "seam"

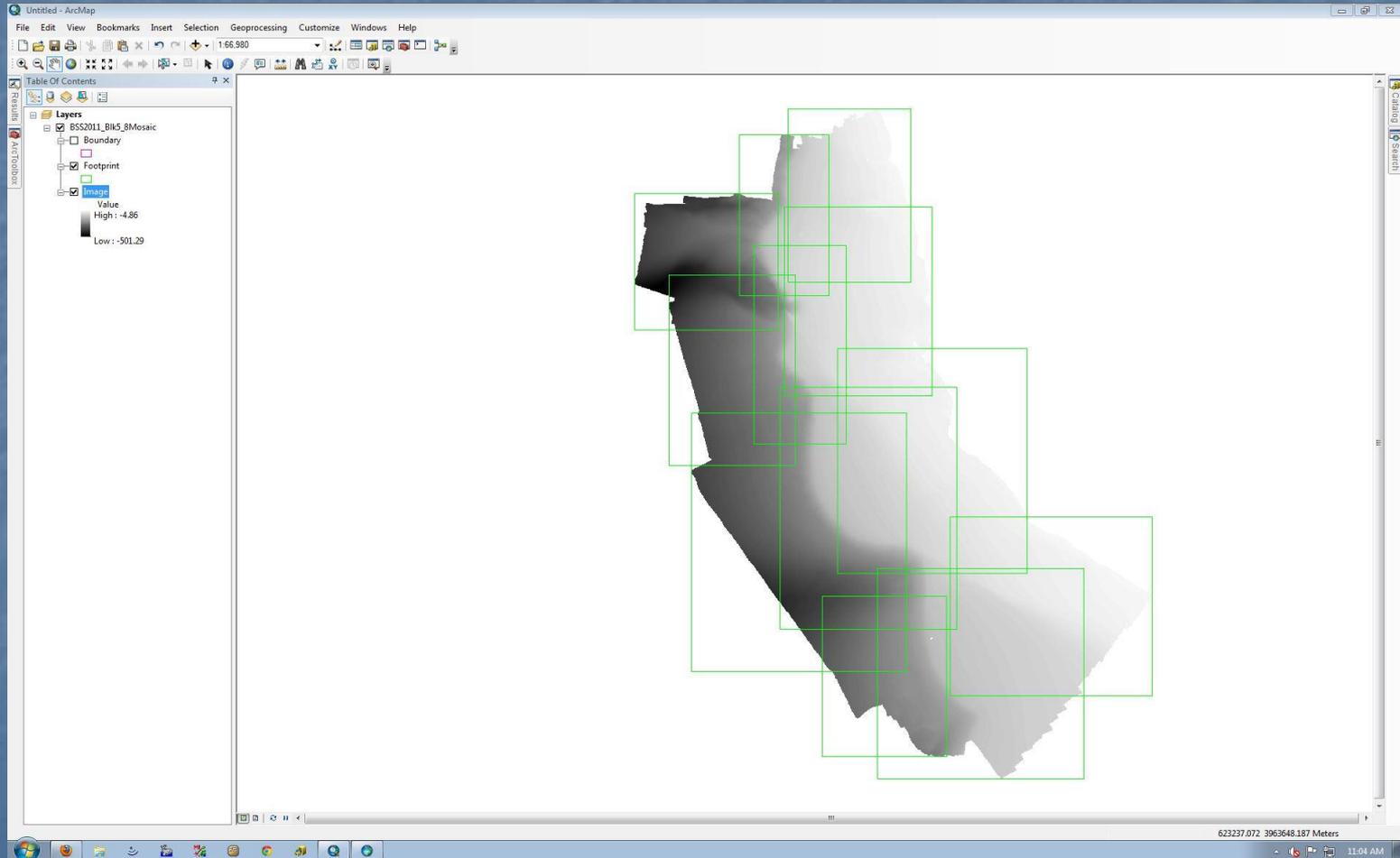
# "Clip & Ship" Model Concept

- Via a graphical map interface, user defines AOI and extracts desired raster products for just their desired footprint
- Data reside on server as a "virtual" Mosaic Dataset
  - Can still physically exist as individual survey block tiles
  - No real physical mosaic of tiles exists; just a list of all the tiles and instructions for how they should be mosaicked together when needed
  - No redundancy of data and no giant mosaic file size limitations
- Virtual mosaic = "cookie dough", AOI = "cookie cutter"

# Individual Block Bathymetry DEMs



# Mosaic Dataset of Bathymetric DEMs



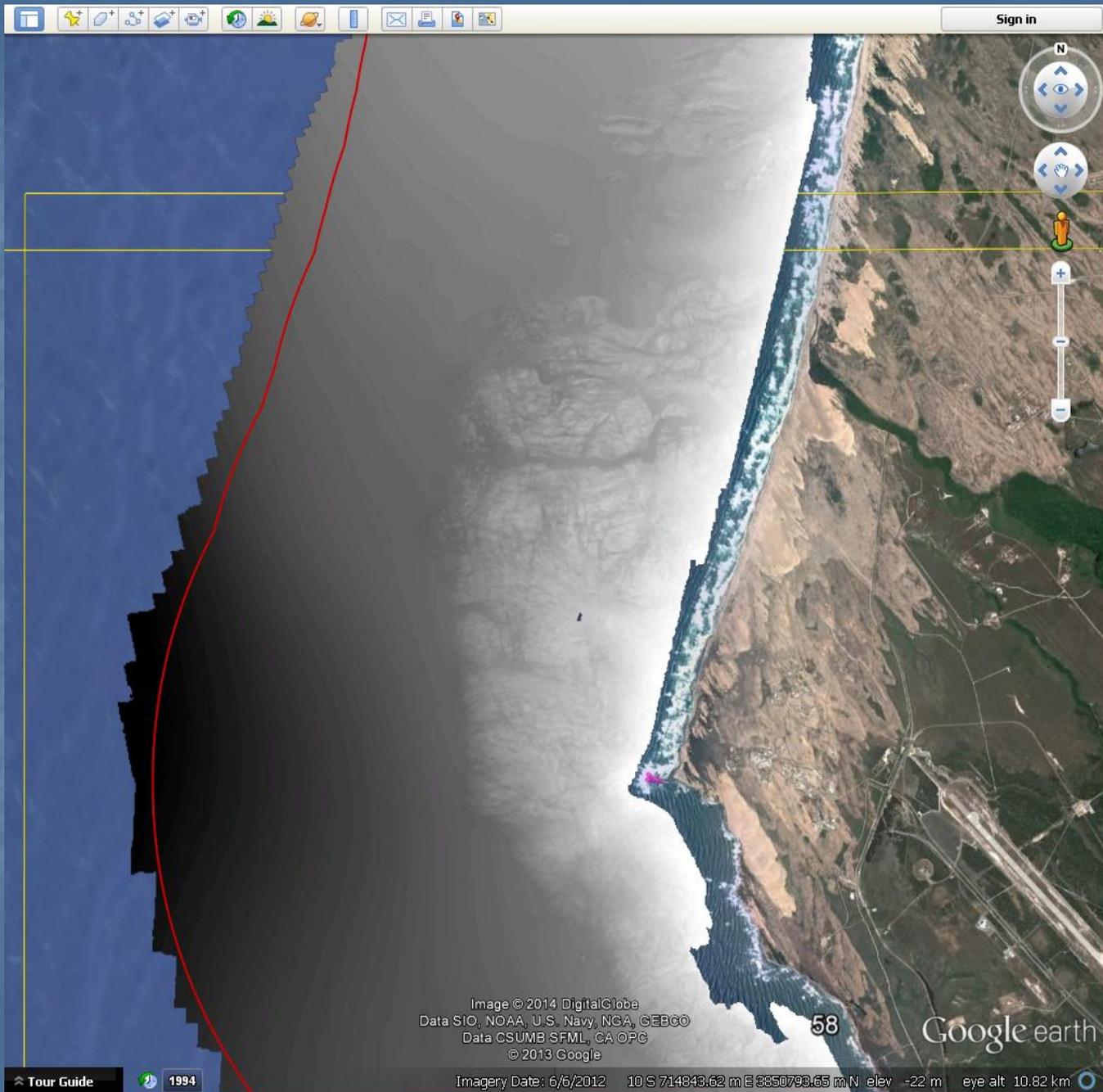


Image service  
(of mosaicked  
datasets)  
viewed in  
Google Earth  
(however, you  
cannot extract  
an AOI from  
Google Earth kmz)

# Clip & Ship Implementation

- Requires ArcGIS Server 10.1 w/ ArcGIS Image Extension for Server
- Running on HP DL360P server
- Data on server reside in an ArcGIS Geodatabase
- Mosaic Dataset(s) in Geodatabase are the virtual mosaic “cookie dough”
- Image Services expose mosaic datasets to ArcGIS Desktop and web browser clients
- Python script based on Extract-by-Mask tool provides the “cutter” functionality
- Script tool is published as a Geoprocessing Service on the server
- Flex or Silverlight viewer allows web clients to connect, view, and extract data in a web browser
- In web viewers, Data Extract “widget” calls geoprocessing service to perform extraction
- Extracted raster data are zipped and saved in specified location (client’s hard drive, FTP site, etc.)

# Data Extract Portal User Interface

(Viewer for Flex tool)

The screenshot displays the 'Bathymetry Data Viewer' web application. The interface includes a header with the CeNCOOS logo and a search bar. The main area shows a map of a coastal region with a dark grey bathymetry overlay. A 'Layer List' panel on the left shows three layers: 'BIG Sur South 1-4', 'Big Sur South 5-8', and 'South Central Coast 21-24', with the last one checked. A 'Data Extract' widget on the right is titled 'Custom Data Extract Tool ("widget")' and contains the following steps:

1. Select area (with icons for rectangle, circle, polygon, and lasso)
2. Select layers to extract
  - BSS2011BlkSubMosaic
  - SCC2010Blks21\_24
  - BSS2011\_Blks\_8Mosaic
3. Select file format (set to 'File Geodatabase (.gdb)')
4. Select raster format

A red callout box with the text 'Extract data from selected Image service layers' has two red arrows pointing to the 'South Central Coast 21-24' layer in the Layer List and the 'SCC2010Blks21\_24' checkbox in the Data Extract widget. A blue arrow points from the 'Custom Data Extract Tool ("widget")' label to the Data Extract widget icon. The map includes a scale bar (3 km / 2 mi) and a source attribution at the bottom: 'Sources: Esri, GEBCO, NOAA, National Geographi'. An inset map in the bottom right shows the location of the main map area on the California coast.

# Data Extract Portal User Interface

(Viewer for Flex tool)

**Bathymetry Data Viewer**

Enter address [About](#)

More... Basemap

**Layer List**

Layer Visibility

- BIG Sur South 1-4
- Big Sur South 5-8
- South Central Coast 21-24

Zoom to  
Transparency  
Move up  
Move down  
Description

**Data Extract**

Extract data and download zip file

1. Select area

Clear

2. Select layers to extract

- BSS2011BlkSubMosaic
- SCC2010Blks21\_24
- BSS2011\_Blks\_8Mosaic

3. Select file format

File Geodatabase (.gdb)

4. Select raster format

Draw Polygon

Purisima Point

3 km  
2 mi

Sources: Esri, GEBCO, NOAA, National Geographic

# Data Extract Portal User Interface

(Viewer for Flex tool)

The screenshot displays the 'Bathymetry Data Viewer' web application. The interface includes a header with the CeNCOOS logo, a search bar with the text 'Enter address', and an 'About' link. The main map area shows a bathymetric view of a coastline with a blue-shaded region. A 'Layer List' panel on the left shows three layers: 'BIG Sur South 1-4', 'Big Sur South 5-8', and 'South Central Coast 21-24', all of which are checked. A 'Data Extract' dialog box is open on the right, with a red circle highlighting the 'Select raster format' section. This section lists several file formats, with 'Tagged Image File Format (.tif)' selected. A red callout box with the text 'Select Export Data Format' points to this selection. The dialog also shows '2. Select layers to extract' with 'SCC2010Blks21\_24' checked, and '3. Select file format' set to 'File Geodatabase (.gdb)'. A scale bar at the bottom left indicates 3 km and 2 mi. The bottom of the map area contains the text 'Sources: Esri, GEBCO, NOAA, National Geographi'.

**Select Export Data Format**

Layer List

- Layer Visibility
- BIG Sur South 1-4
- Big Sur South 5-8
- South Central Coast 21-24
- Zoom to
- Transparency
- Move up
- Move down
- Description

Data Extract

2. Select layers to extract
  - BSS2011BlkSubMosaic
  - SCC2010Blks21\_24
  - BSS2011\_Blks\_8Mosaic
3. Select file format
  - File Geodatabase (.gdb)
4. Select raster format
  - Tagged Image File Format (.tif)**
  - ESRI GRID (ESRI GRID - GRID)
  - File Geodatabase (.gdb)
  - ERDAS IMAGINE (.img)
  - Tagged Image File Format (.tif)
  - Graphic Interchange Format (.gif)
  - Joint Photographics Experts Group (.j)

Purisima Point

3 km  
2 mi

Sources: Esri, GEBCO, NOAA, National Geographi

# Data Extract Portal User Interface

(Viewer for Flex tool)

The screenshot displays the 'Bathymetry Data Viewer' application. The main map shows a coastal area with a blue-shaded region. A 'Data Extract' dialog box is open on the right, with the 'Extract' button highlighted by a red rectangle. The dialog box contains the following steps:

- 2. Select layers to extract
  - BSS2011BlkSubMosaic
  - SCC2010Blks21\_24
  - BSS2011\_Blks\_8Mosaic
- 3. Select file format
  - File Geodatabase (.gdb)
- 4. Select raster format
  - Tagged Image File Format (.tif)

The 'Extract' button is highlighted with a red rectangle.

Other UI elements include a 'Layer List' on the left with 'South Central Coast 21-24' selected, a scale bar at the bottom left (3 km / 2 mi), and a search bar at the top right with the text 'Enter address'.

Sources: Esri, GEBCO, NOAA, National Geographic

# Data Extract Portal User Interface

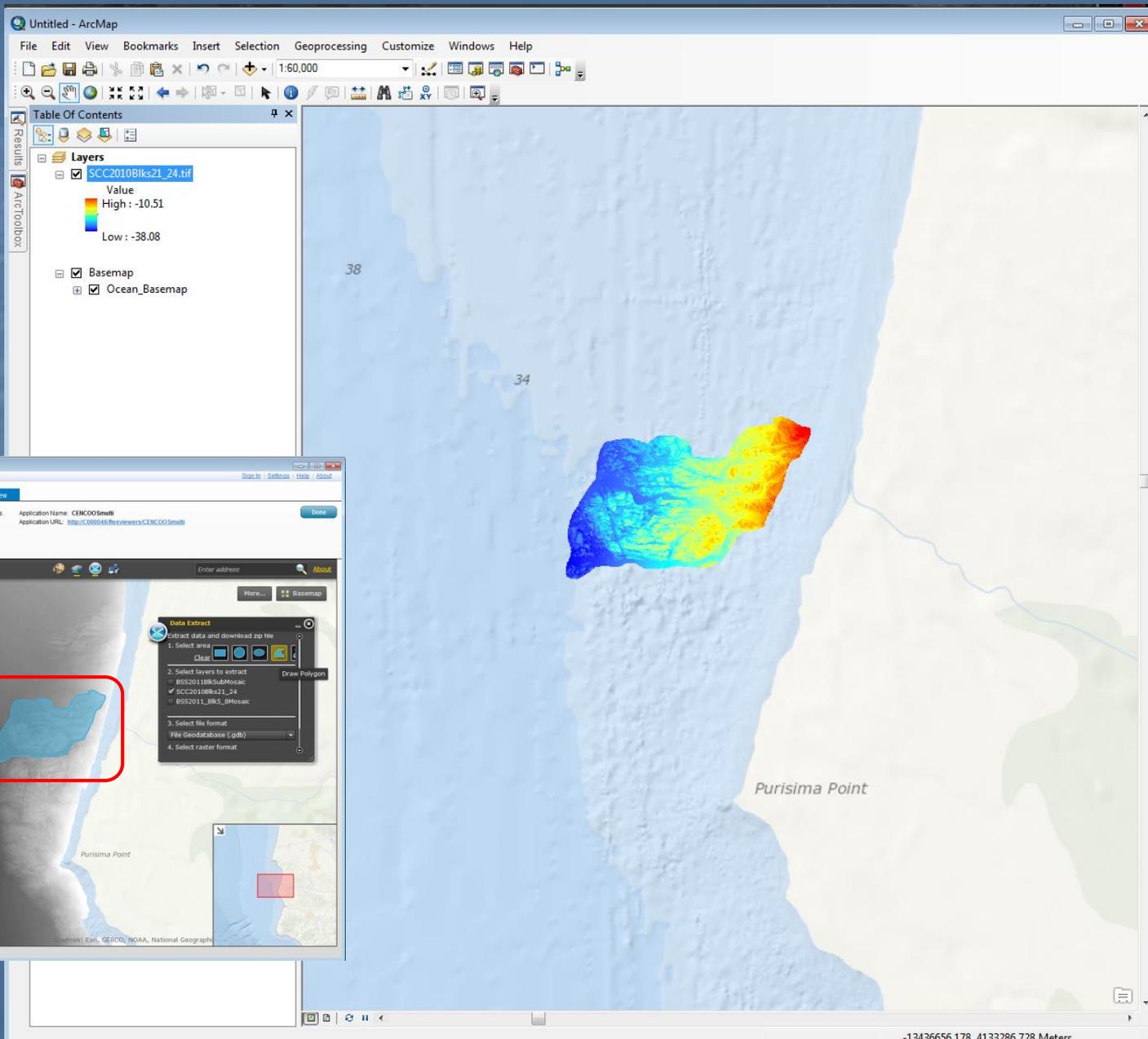
(Viewer for Flex tool)

The screenshot displays the 'Bathymetry Data Viewer' web application. The interface includes a top navigation bar with the CeNCOOS logo, a search bar with the placeholder 'Enter address', and an 'About' link. The main map area shows a bathymetric view of a coastal region with a red rectangle indicating the extraction area. A 'Layer List' panel on the left shows three layers: 'BIG Sur South 1-4', 'Big Sur South 5-8', and 'South Central Coast 21-24', with the last one checked. A 'Data Extract' dialog box is open on the right, showing the following steps:

1. Select area to extract (indicated by a red rectangle on the map)
2. Select layers to extract
  - BSS2011BlkSubMosaic
  - SCC2010Blks21\_24
  - BSS2011\_Blks\_8Mosaic
3. Select file format
  - File Geodatabase (.gdb)
4. Select raster format
  - Tagged Image File Format (.tif)

An 'Extract' button is visible at the bottom of the dialog. A central confirmation dialog box asks: 'Data file created. Would you like to save it?' with 'Yes' and 'No' buttons. A red text box at the bottom right states: 'Zip file is exported for direct download, or email with link'. A scale bar at the bottom left shows 3 km and 2 mi. The map includes a scale bar and a scale of 38. Sources at the bottom are listed as Esri, GEBCO, NOAA, and National Geographic. The map also shows 'Purísima Point' and a 'Basemap' button.

# Extracted Data from defined AOI viewed in ArcMap



# Potential Uses for other Server-side Geoprocessing Services

- Geoprocessing services can be created and published to perform most tasks server-side
- This can include deriving new products from existing inputs
- For example, a service to derive & deliver a slope raster from the extracted DEM could be added, eliminating the need to create a comprehensive mosaic dataset for slope (essentially all DEM-derived products could be handled this way)

# Summary

- Advantages of “Clip & Ship”
- Client-side:
  - Easier data discovery
  - Custom tailored dataset
  - Improved user experience
- Server-side:
  - Reduced data redundancy
  - Improved scalability
  - Potential for streamlining workflow and reducing processing and storage overhead via on-the-fly product derivation

# Acknowledgements

- Funding for the CSMP “Clip & Ship” server development was provided by The Central and Northern California Ocean Observing System (CeNCOOS)



