Development of Mosaic Datasets and Image Services for Bathymetric Data

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NOAA Data Center Consolidation

- NOAA's Data Centers have merged into the National Centers for Environmental Information (NCEI)

- Former data centers:
  - National Geophysical Data Center – Boulder, CO
  - National Climatic Data Center – Asheville, NC
  - National Oceanographic Data Center – Silver Spring, MD
    - Includes National Coastal Data Development Center - Stennis, MS

NOS Hydrographic Surveys

- NOAA National Ocean Service performs hydrographic surveys in U.S. coastal waters
- Used by NOAA Office of Coast Survey for nautical chart production
- Since early 1800s
- Survey data is archived, stewarded, and made available to the public by NCEI, Boulder, CO
- Modern surveys since 2001 provide Bathymetric Attributed Grids (BAGs)
- ~5800 BAGs from ~1200 surveys
- Archive continually growing at 5-10 surveys per month

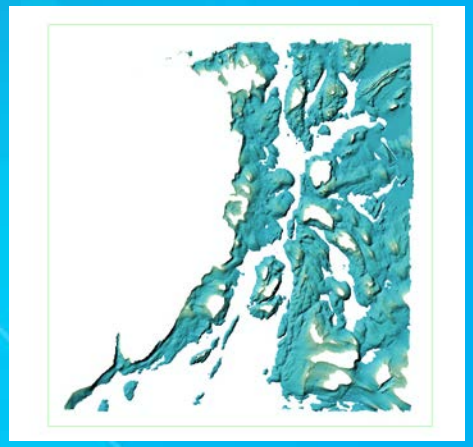
Bathymetric Attributed Grid (BAG) Characteristics

- HDF5 format
- Two 32-bit floating-point bands: elevation and uncertainty
- Datum is usually Mean Lower Low Water (MLLW)
- Projections: various local UTM zones
- Wide range of cell sizes from ~25 cm to >30 m
- Some gzipped, some are newer compressed BAGs

Spatial Layout of BAGs

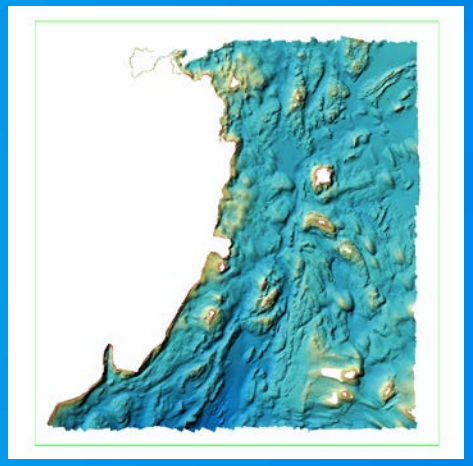
- BAGs are overlapping, lower-res in deep water, higher-res in shallow water
- Irregularly-shaped coverage
- For mosaic: higher-res on top of lower-res

4m



2m

1m



Combined Together

First Step: Stage BAGs as TIFF

- To simplify, first stage all BAGs as Web Mercator GeoTIFFs
  - Discard band 2 (uncertainty); not needed for mosaic
  - Project all source rasters to Web Mercator
    - gdalwarp –r cubic –t_srs epsg:3857
  - Build pyramids for all source rasters
    - gdaladdo –r average
    - Does a good job minimizing aliasing/moiré effects
  - LZW compression
    - gdal_translate -co "COMPRESS=LZW" -co "PREDICTOR=2" -co "TILED=YES“
- Total Size: ~165 GB

Create and Populate the Mosaic Dataset

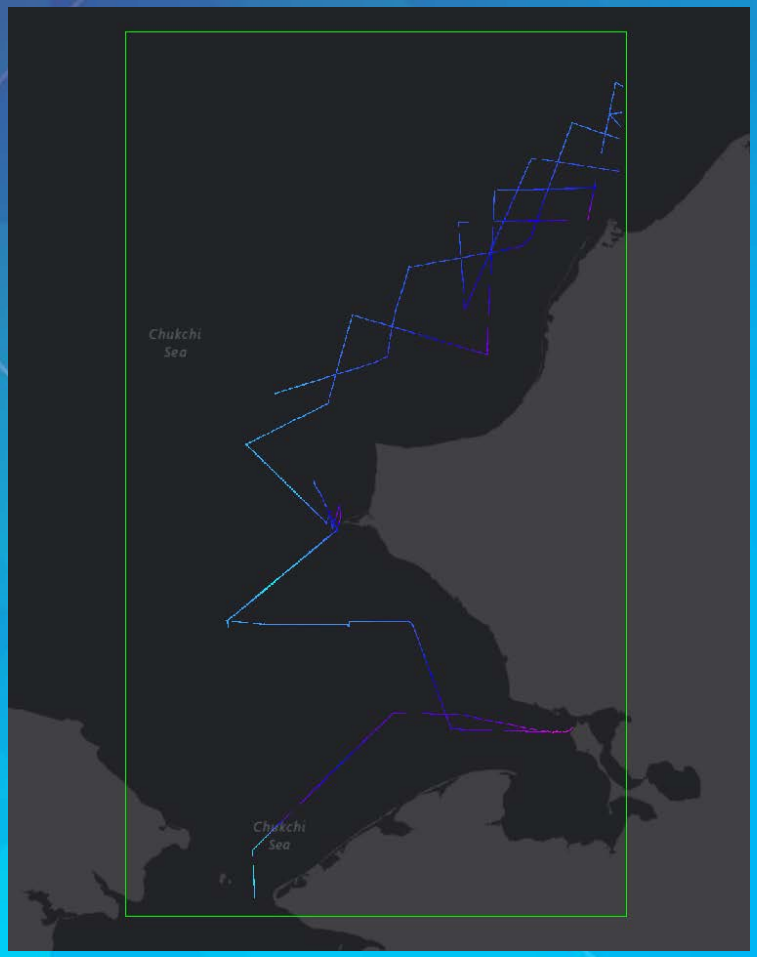
- Create new mosaic dataset ‘bag_bathymetry’
- Single-band, 32-bit float
- Add all source rasters
- Mosaic method: order by attribute (lowPS), ascending
- For all rows, set minPS=0, maxPS=99999
  - Ensures all rasters are visible at all scales, for later overview generation

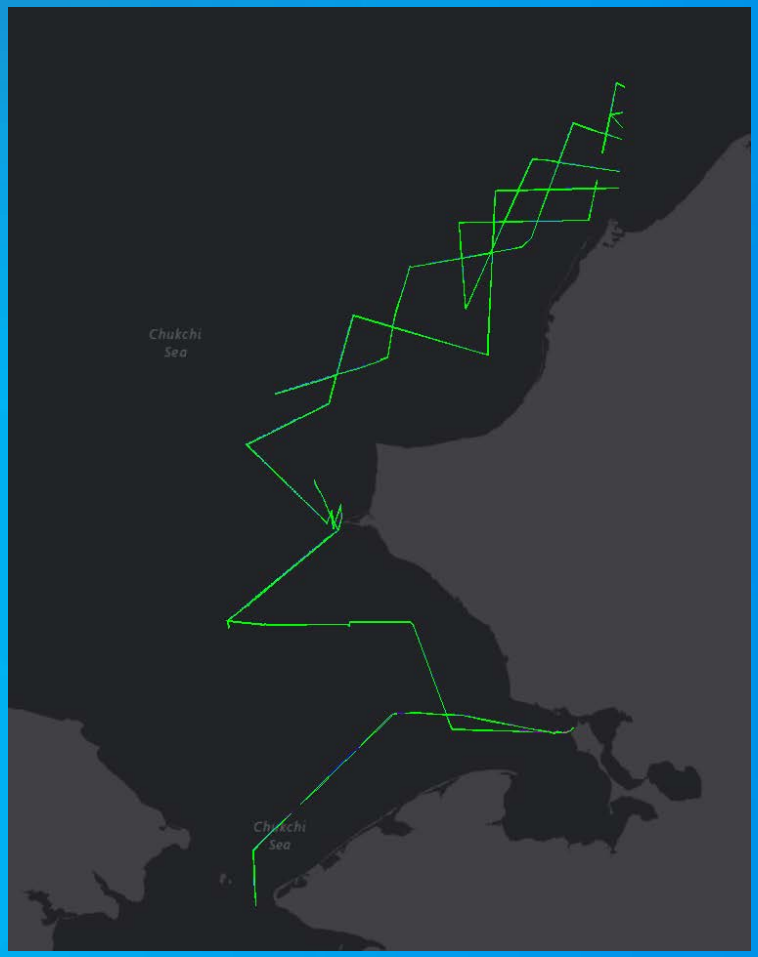
Build Footprints Only for Rasters with Very Large Geographic Extent

- A few BAGs are composed of narrow strips of data, but the rectangular footprint covers a very large area
- Build irregular footprints for these:

  Build Footprints tool (radiometry) -> Simplify -> Buffer -> re-import
- With fewer areas of NODATA, subsequent overview-generation steps are simplified
- Not feasible to build footprints for all rasters – too many vertices bogs it down

Build Footprints Only for Rasters with Very Large Geographic Extent



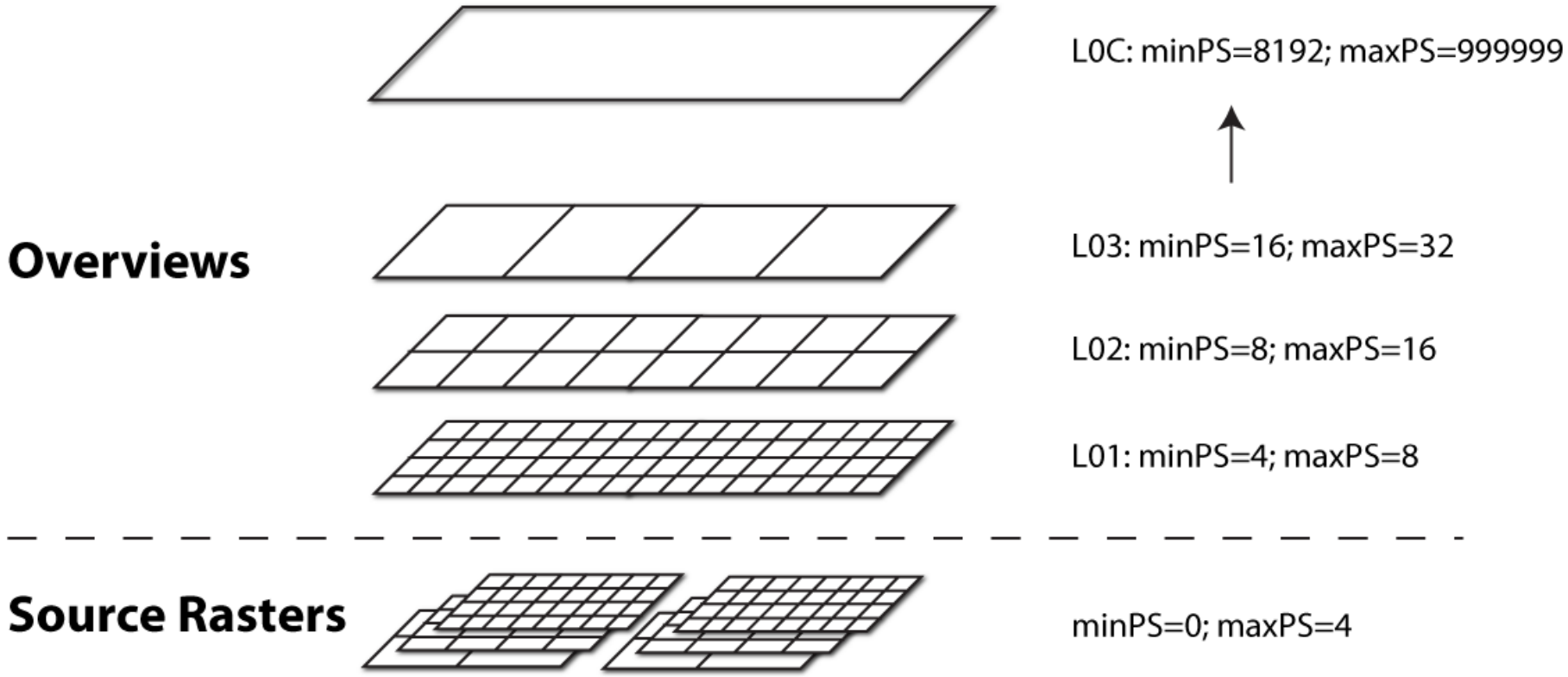


D00168_UTM03_MB_8m_MLLW_2of5, northern Alaska

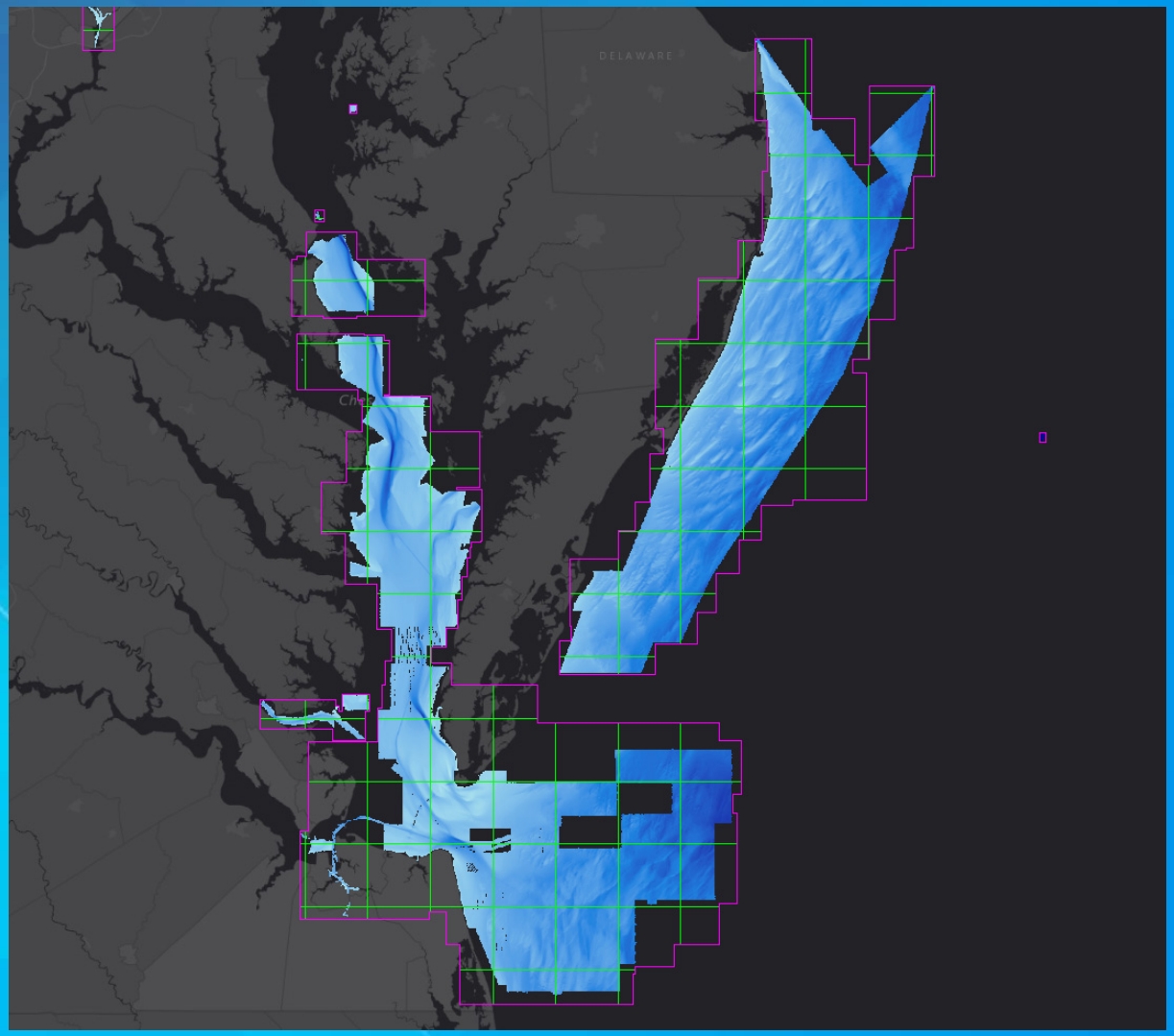
Define the Overview Schema

- Objective: to consistently control the visibility scales of overviews and source rasters
- Source rasters: visible from 0 (fully-zoomed in) to pixel size = 4m
- Overviews start at 4m threshold
  - Overview sampling factor 2 *(4m, 8m, 16m, 32m, 64m, …)*
- Overviews are defined everywhere, even if that results in up-sampling
  - Temporarily set lowPS=4 for all source rasters, then run "Define Overviews"

Mosaic Dataset Visibility Scales



Overview “Tiles” – complete coverage within boundary

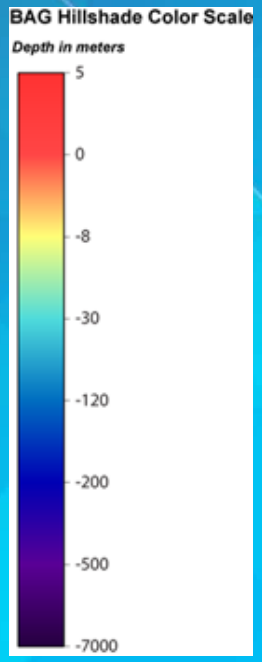


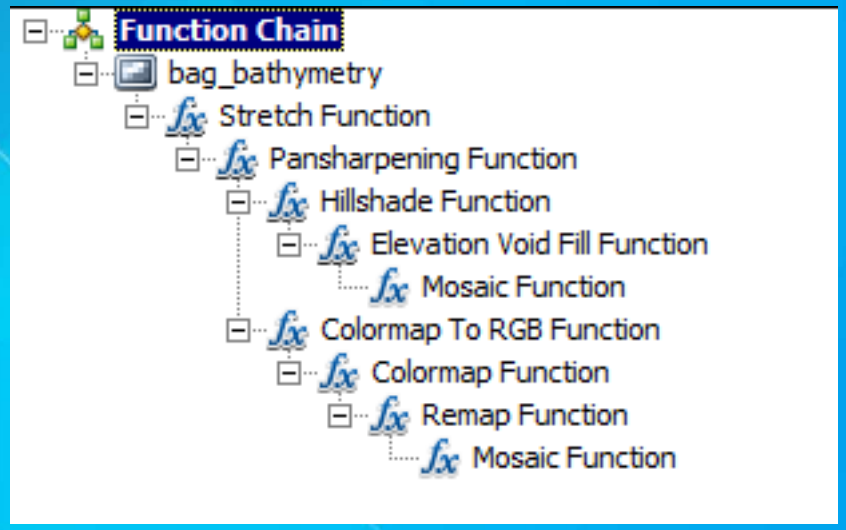
Build the Overviews

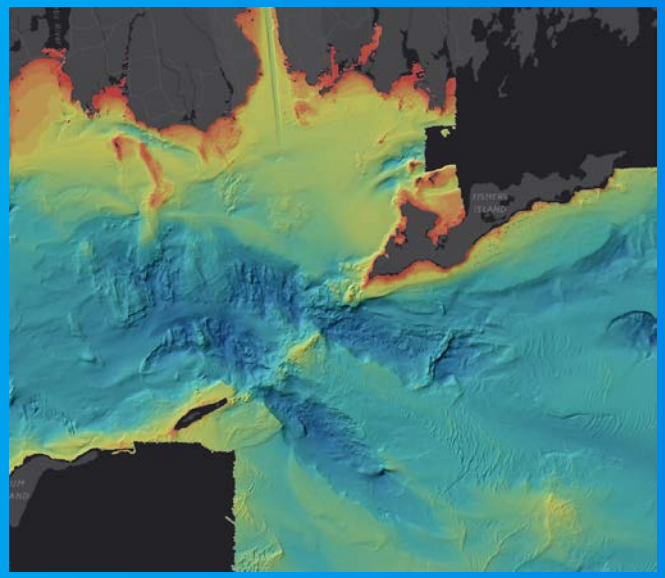
- Takes ~11 hours
- Recompress the overviews using GDAL to save space
  - gdal_translate -co “COMPRESS=LZW” -co “PREDICTOR=2” -co “TILED=YES”
  - Size reduced from ~73 GB to ~53 GB
- Total size of source rasters + overviews: ~220 GB
- Deploy imagery to server
- Repair paths in mosaic dataset
  - Replace Windows paths with Linux

Color-Hillshade Function Chain

- Combination of elevation colors and grayscale hillshade
- No Alteration of Grayscale or Intensity (NAGI) fusion method, see articles and blog posts by Rajinder Nagi (Esri)
- Elevation Void Fill function used to prevent thin lines from disappearing (Hillshade doesn't compute to edge)



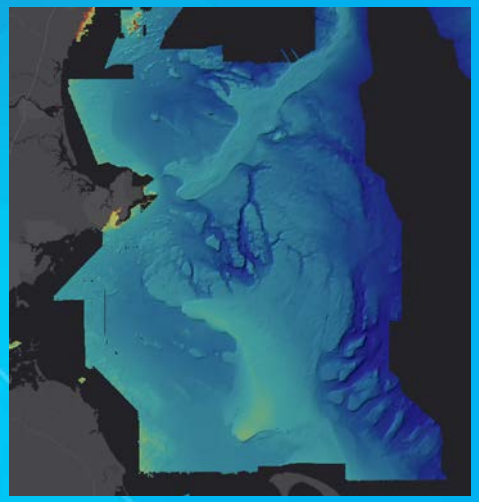




Server-Side Function Templates

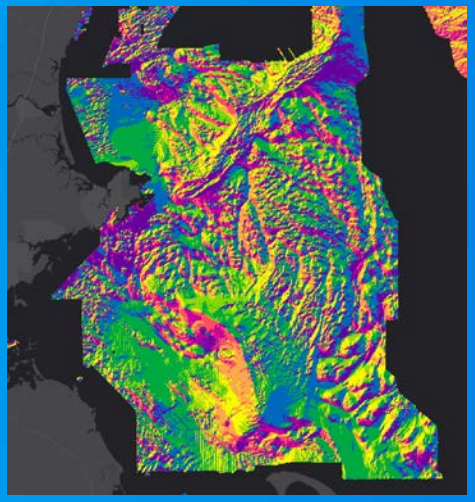
- Slope (numeric), Slope (RGB), Aspect (numeric), Aspect (RGB), Grayscale Hillshade
- Function templates borrowed from Esri's Elevation Services

Grayscale Hillshade



Color Hillshade

Slope RGB Map

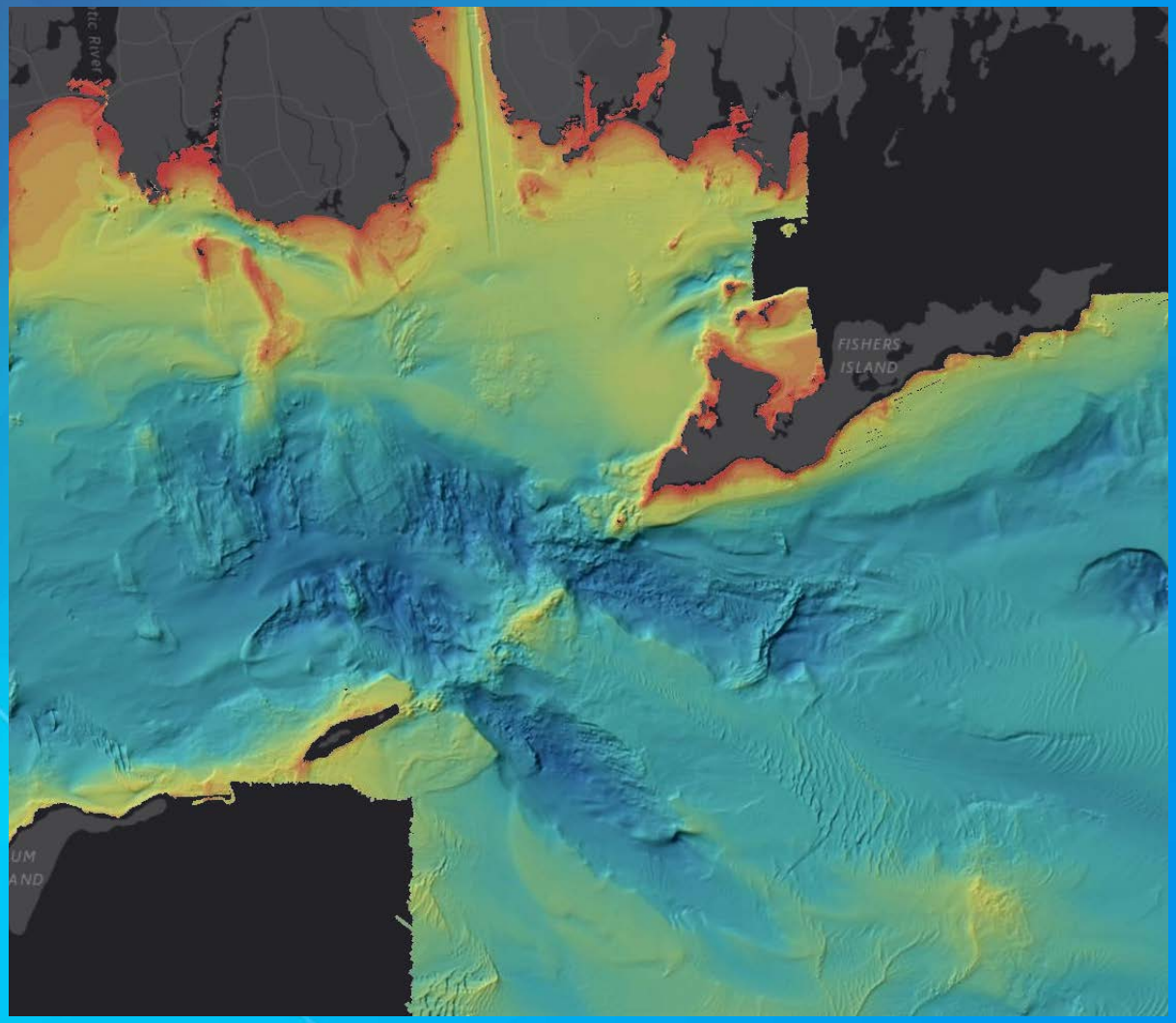


Aspect RGB Map

Deploy ArcGIS Image Services

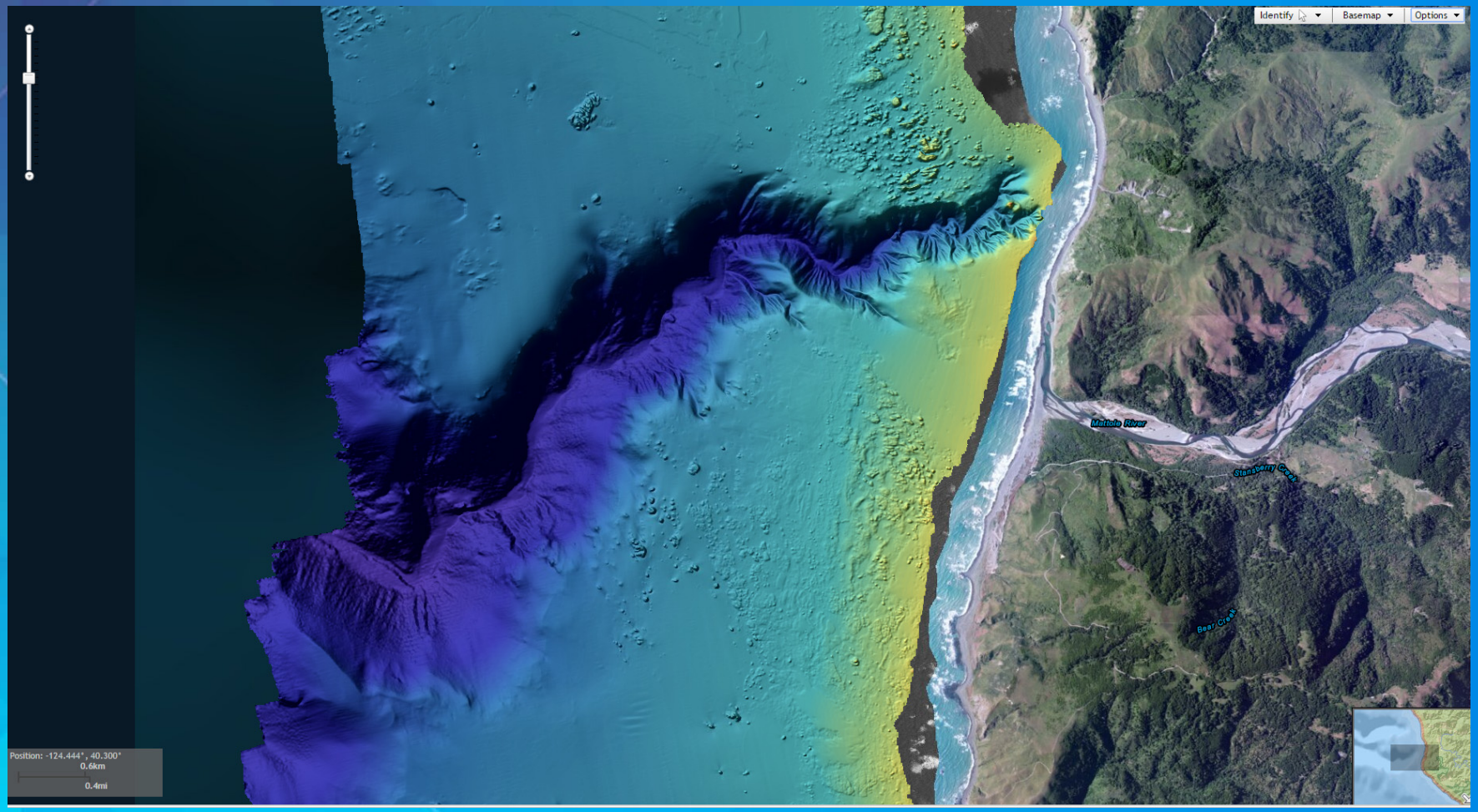
- 3 related image services:
  - bag_bathymetry
    - Provides elevation values
    - Functions: Slope, Slope RGB map, Aspect, Aspect RGB map, Grayscale Hillshade, Color Hillshade
  - bag_hillshades
    - Color-Hillshade function “baked-in”
    - Cached (tiled) image service – zoom levels 0-16, to level 17 in select areas
  - bag_hillshades_subsets
    - Color-Hillshade function “baked-in”
    - Subsets allowed using definition queries – e.g. BAGs from a single survey
    - Up to 80 source rasters only; no overviews
    - Used on NOS survey products pages “preview map”

Screenshots



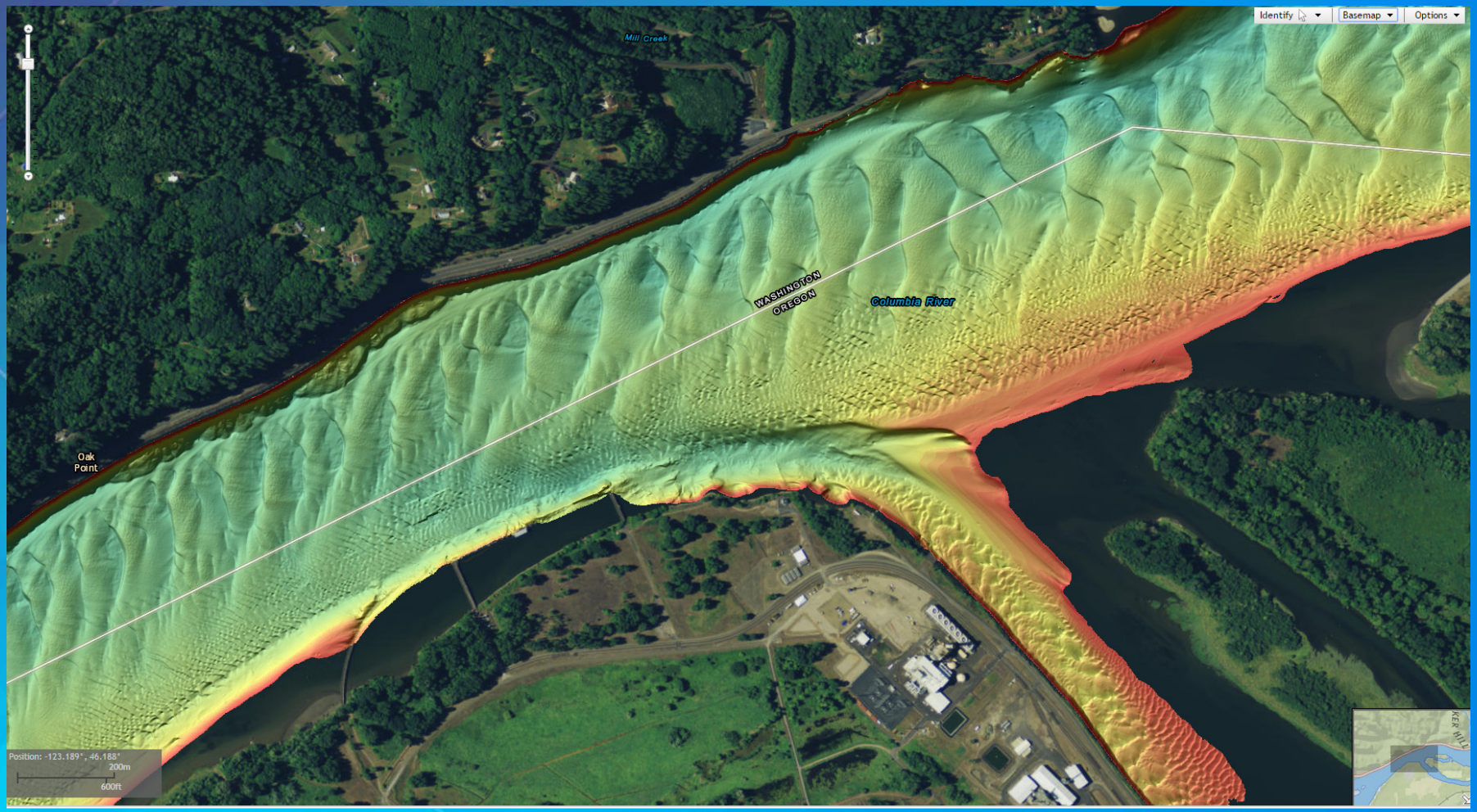
Long Island Sound

Screenshots



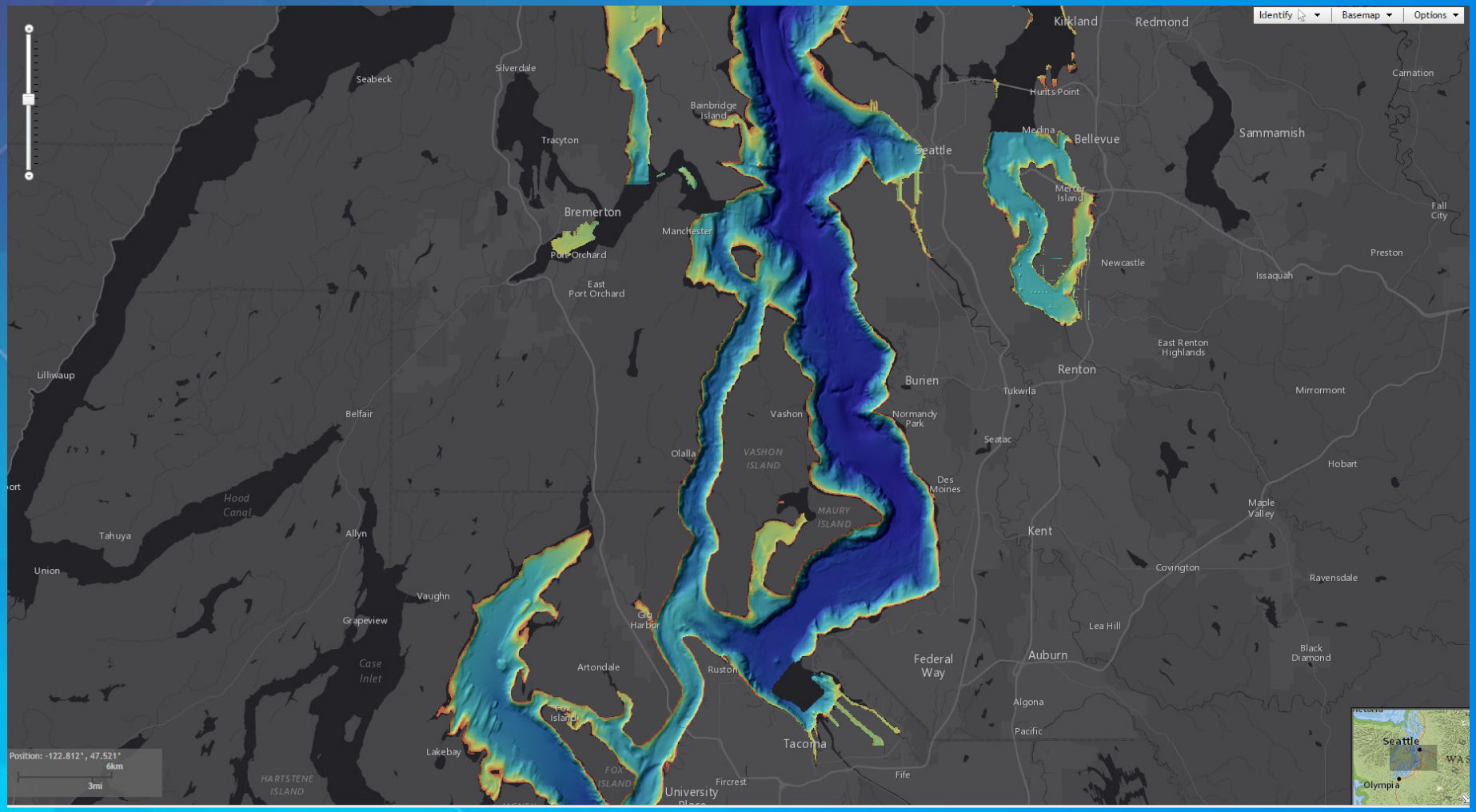
Mattole Canyon, CA

Screenshots



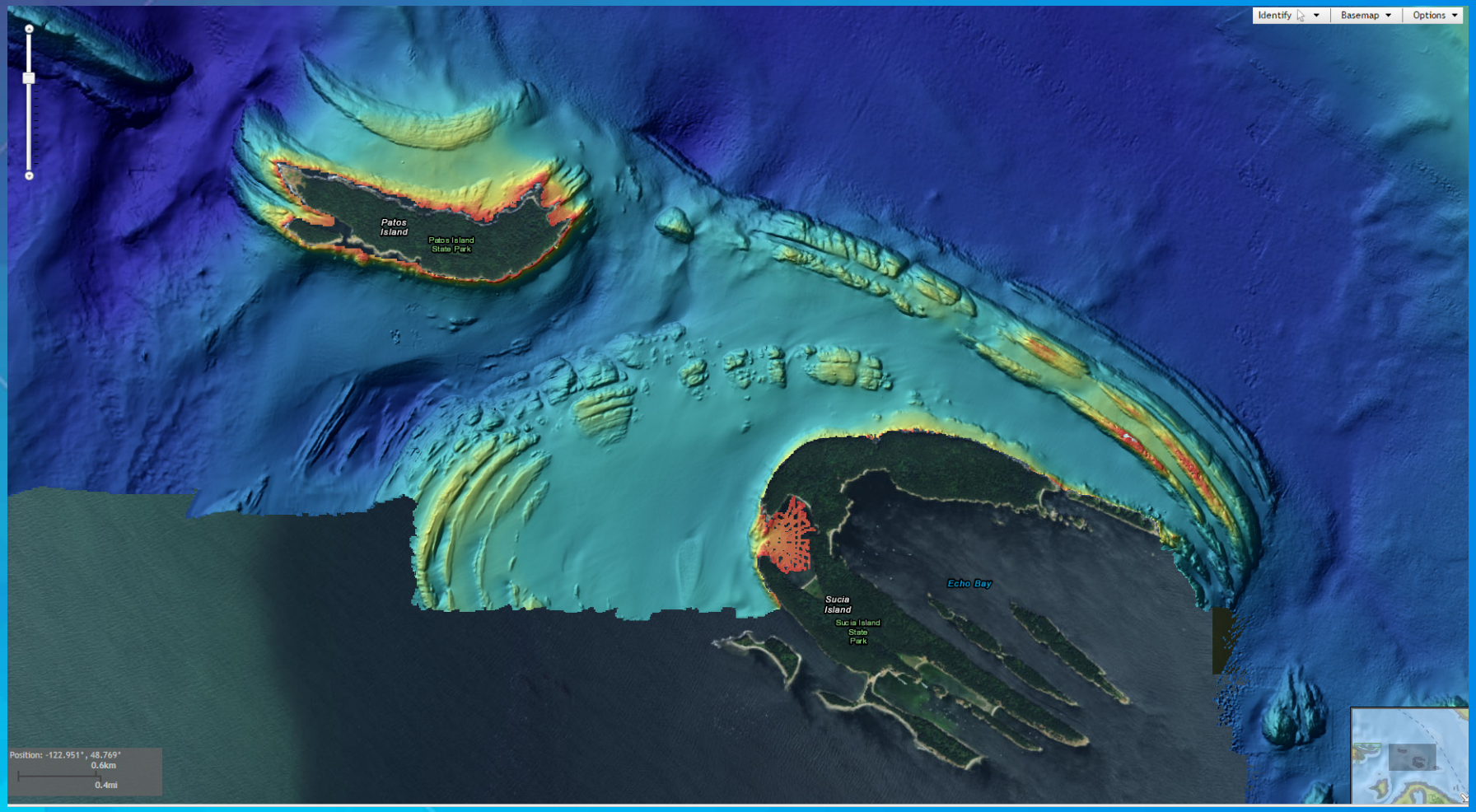
Columbia River, WA/OR

Screenshots



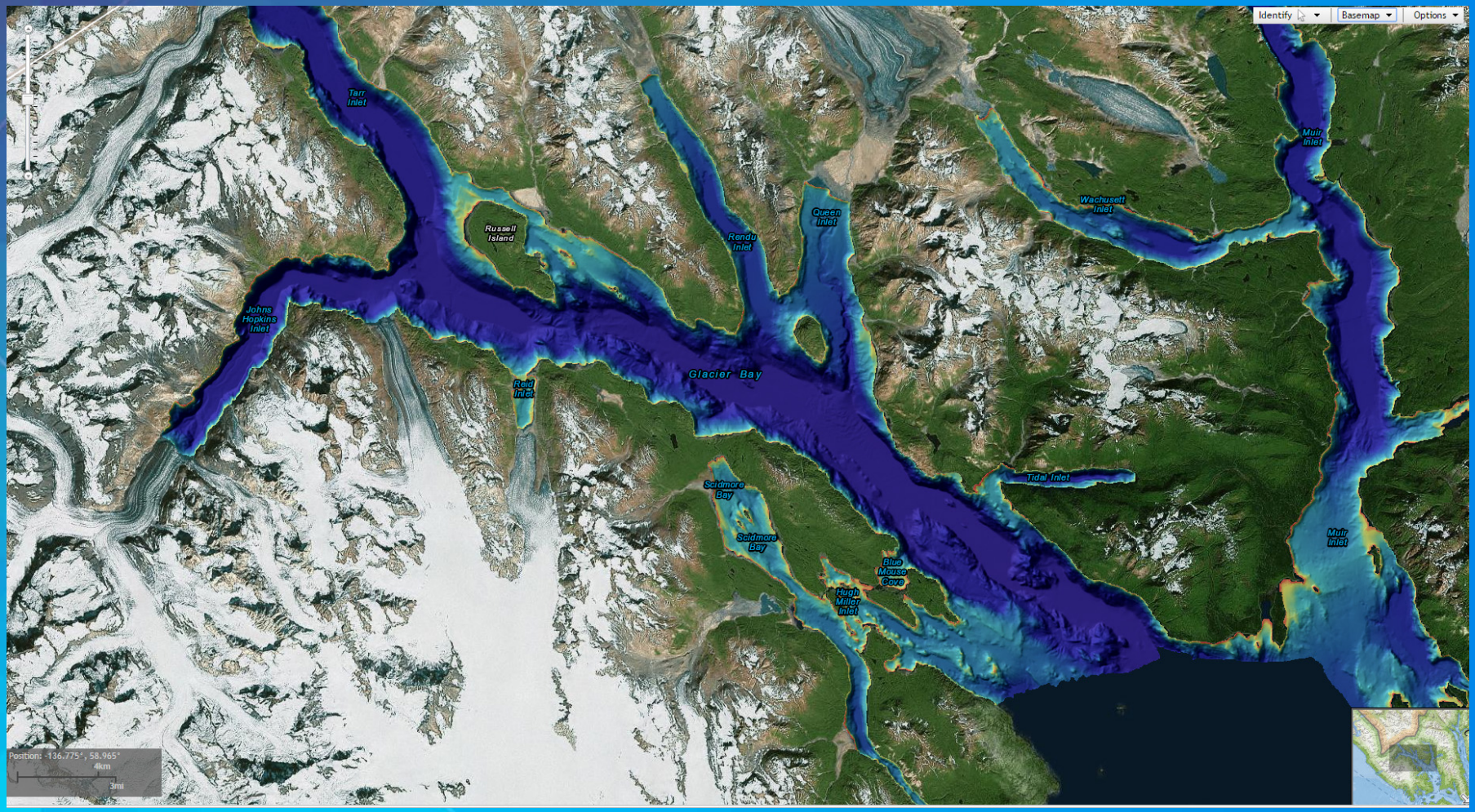
Puget Sound, WA

Screenshots



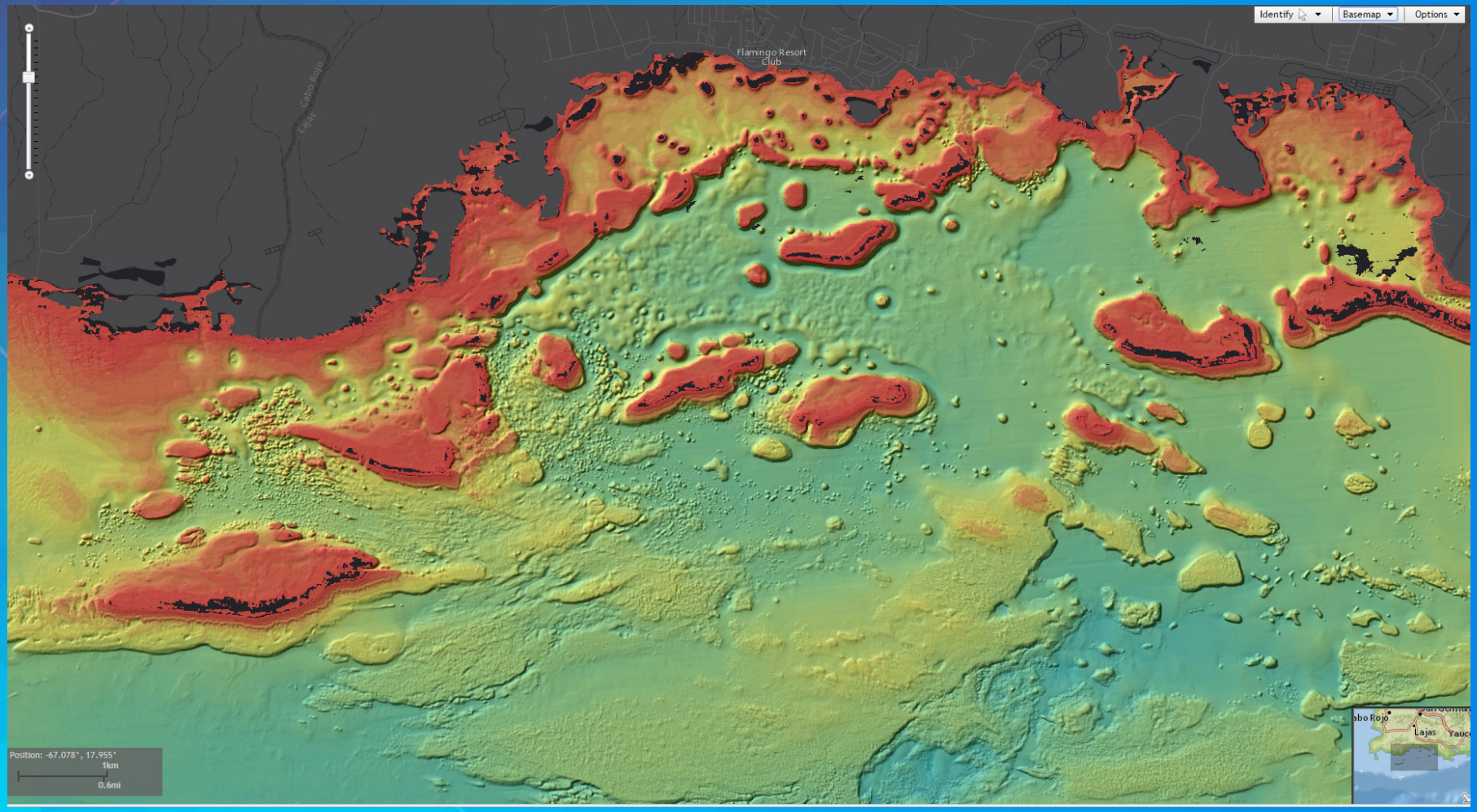
San Juan Islands, WA

Screenshots



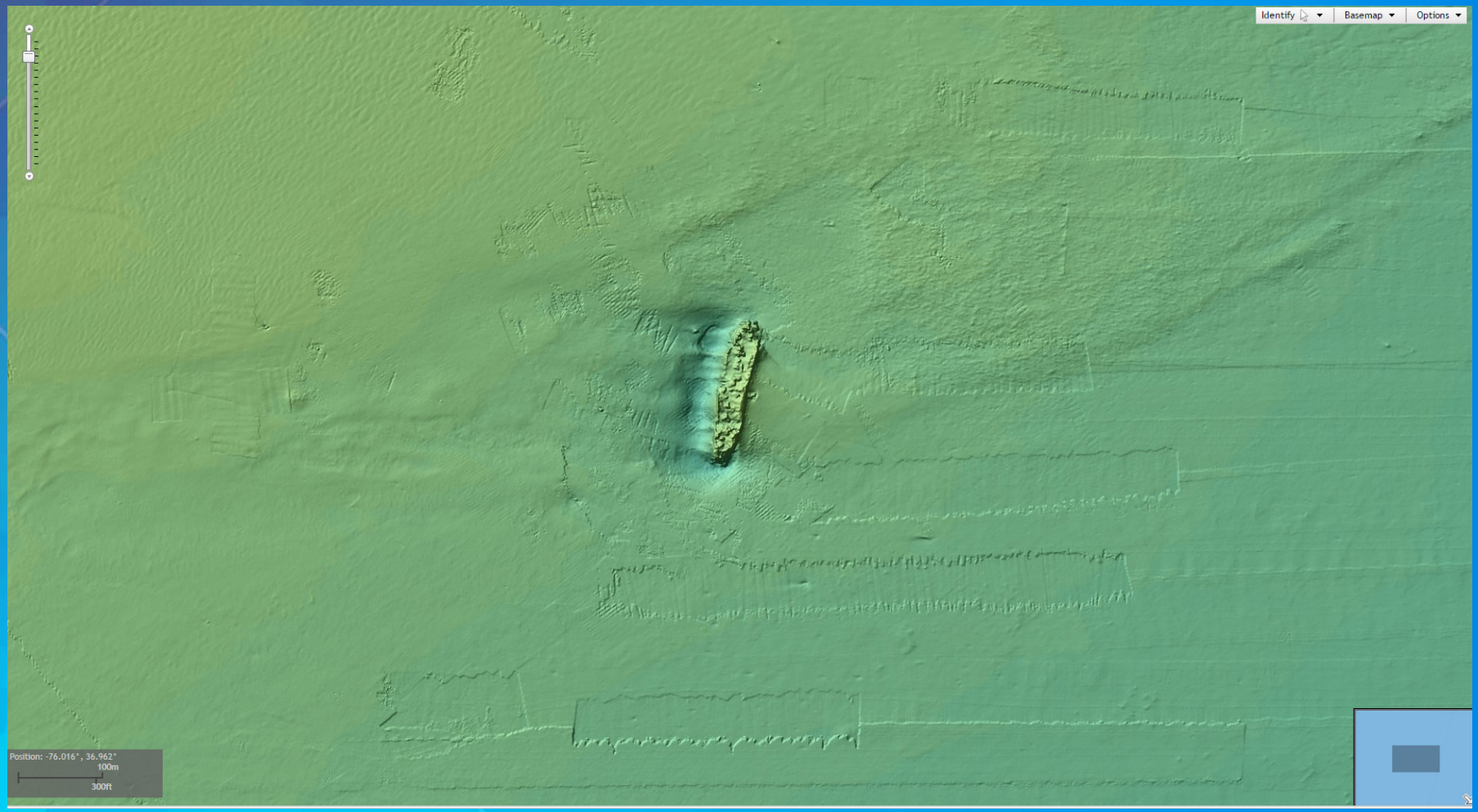
Glacier Bay, AK

Screenshots



Coral reefs, Puerto Rico

Screenshots

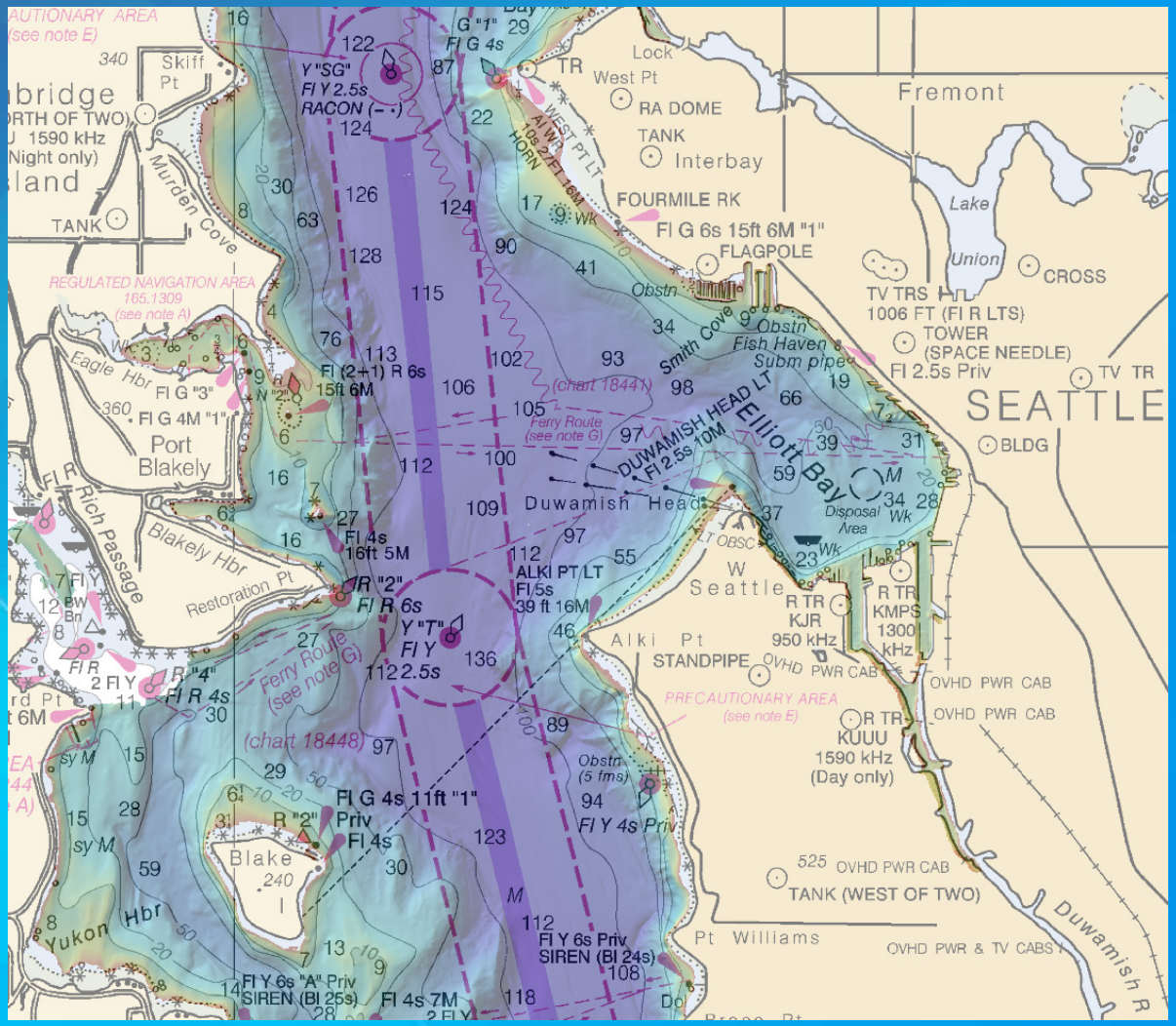


Shipwreck near mouth of Chesapeake Bay

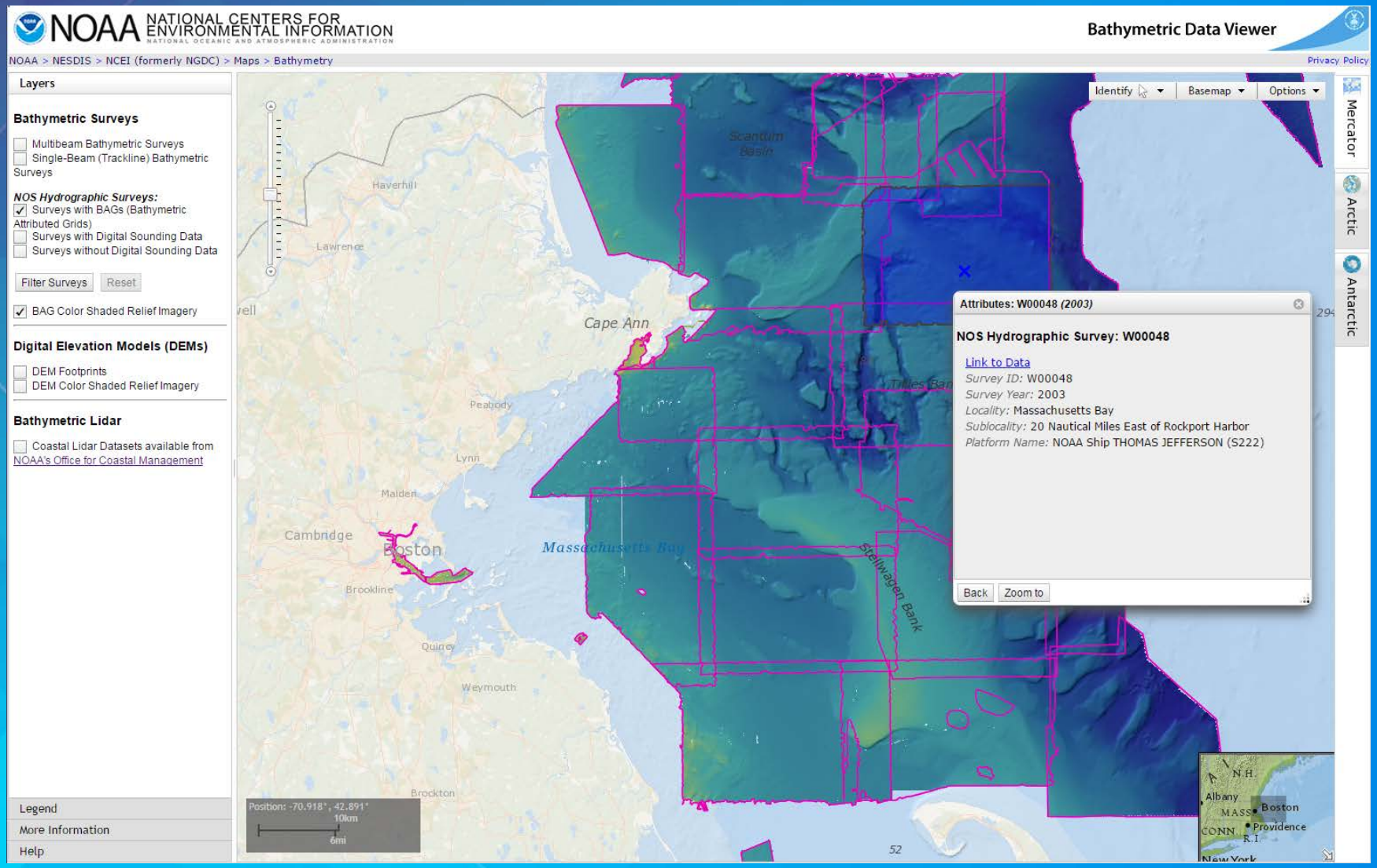
Screenshots

New York City

NOAA Seamless Raster Navigational Charts (RNC) mashup



Bathymetric Data Viewer



http://maps.ngdc.noaa.gov/viewers/bathymetry

NOS Survey Products Pages

NOAA NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Office of Coast Survey
NOAA National Ocean Service

NOAA > NESDIS > NCEI (formerly NGDC) > Marine Geology and Geophysics > Bathymetry & Relief

privacy policy

All Bathy/Relief | Coastal | DEM Portal | Fishing | Global | Lakes | Multibeam | NOS

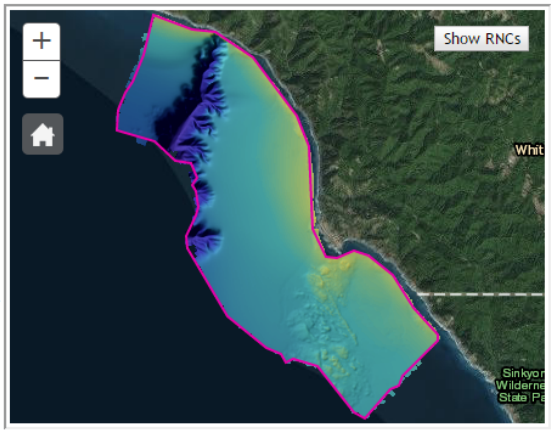
Report for H11972

Locality: Pacific Ocean - Northern California
Sublocality: Vicinity of Point Delgada
State(s) or Region(s): California

Start Date: 2008-11-29
End Date: 2009-10-18

These data are not to be used for navigation.
For navigation please refer to NOS Nautical Charts.

Downloads may take a long time, depending on file size and data transfer rates.



Visit the full NGDC Bathymetry Viewer.

Survey Products

[Expand All] | [Collapse All]

Descriptive Report and Metadata Documents

NOAA/NOS Descriptive Report

H11972.pdf	2.88Mb	The document may be read using a free Adobe Reader.

NOAA/NOS ISO metadata record

H11972 View / Download H11972.xml	Usually presented as an XML document, which captures the basic characteristics of HSMDB metadata verified from H10000 (1982) to the present as well as F00200 (1965) to the present.

NOAA/NOS Survey Rap Sheet

H11972 Rap Sheet	An HTML document with geography, platform, reference system information and links to affected products from HSMDB metadata verified from H10000(1982) to the present as well as F00200(1965) to the present.

Bathymetry

Survey products may use different units, datums or projections than the associated survey. Please consult product-specific metadata for additional details.

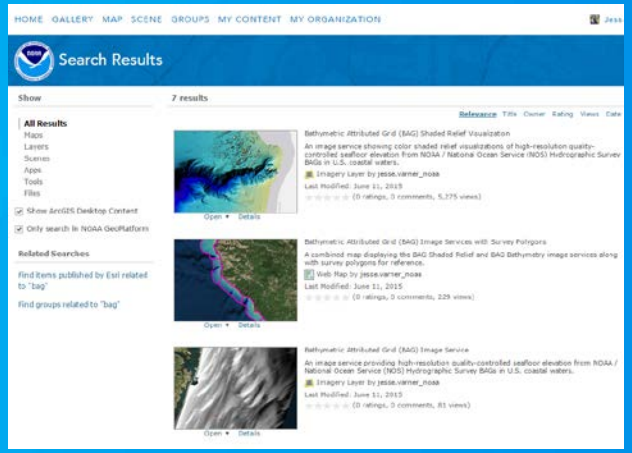
Bathymetric Attributed Grid (BAG) Data

The BAG format is a gridded, multi-dimensional bathymetric data file (see Open Navigation Surface).
Readable with various applications such as the free CARIS Easy View, ESRI ArcGIS or open source GDAL. The BAGXYZ files are ascii representations of the BAG data in XYZ format, but do not include uncertainty.

H11972_MB_5m_MLLW_5of6.bag.gz	32.65Mb
H11972_MB_4m_MLLW_4of6.bag.gz	50.43Mb
H11972_MB_2m_MLLW_3of6.bag.gz	191.49Mb
H11972_MB_1m_MLLW_1of6.bag.gz	687.13Mb
H11972_MB_150cm_MLLW_2of6.bag.gz	332.64Mb
H11972_MB_10m_MLLW_Combined.bag.gz	8.01Mb
H11972_MB_10m_MLLW_6of6.bag.gz	448.7kb

ArcGIS Online (NOAA GeoPlatform)

- **BAG Image Service:** http://noaa.maps.arcgis.com/home/item.html?id=2320b46f76c34230a72a70029a970f64
- **BAG Shaded Relief Visualization:** http://noaa.maps.arcgis.com/home/item.html?id=af0614c88e0d4cad9a72115a944b37ff
- **Combined map with survey polygons:** http://noaa.maps.arcgis.com/home/item.html?id=26ee4c6159b842219cb9729b9ef1b881



Questions?

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