Creating DEMs of Coastal Areas Using Satellite Imagery

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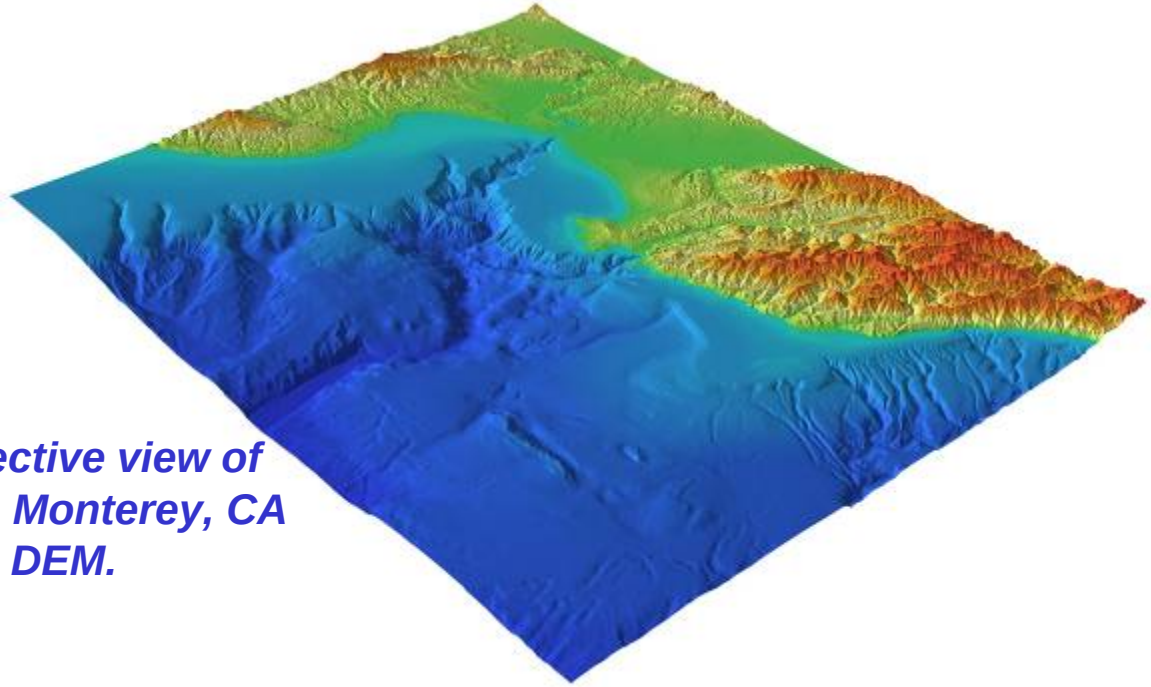
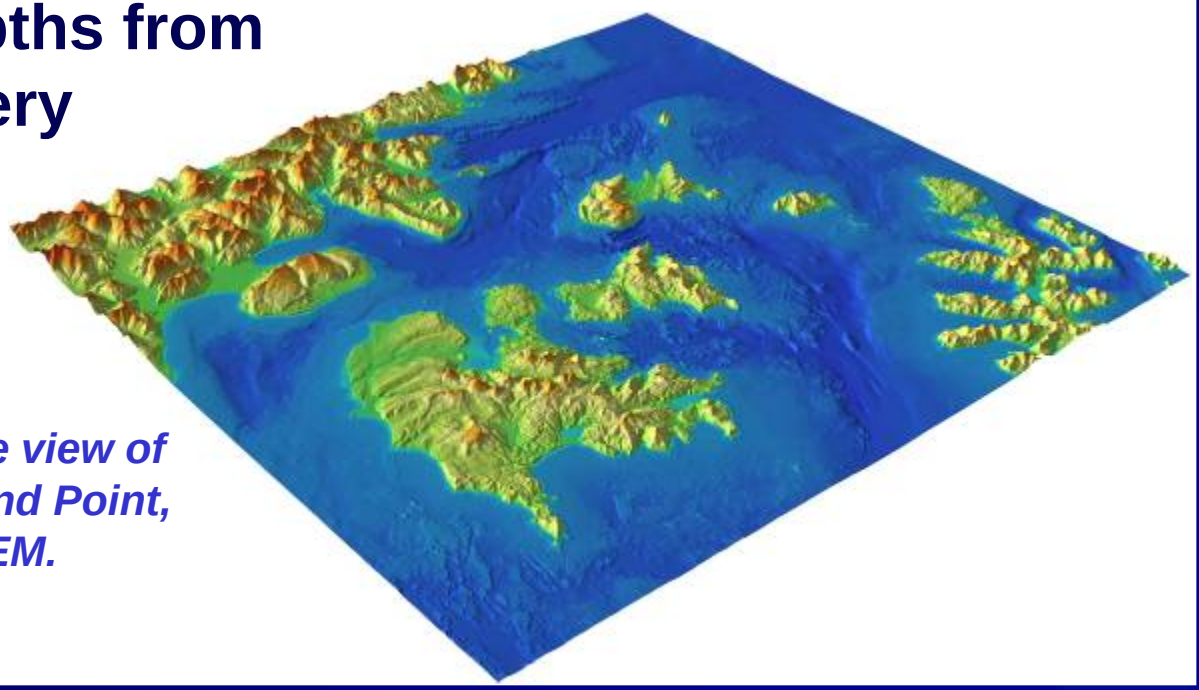


Perspective view of NGDC's Monterey, CA DEM.

Talk Outline

- DEM project background
- Typical methodology
- Recent morphologic change
- Estimated depths from satellite imagery

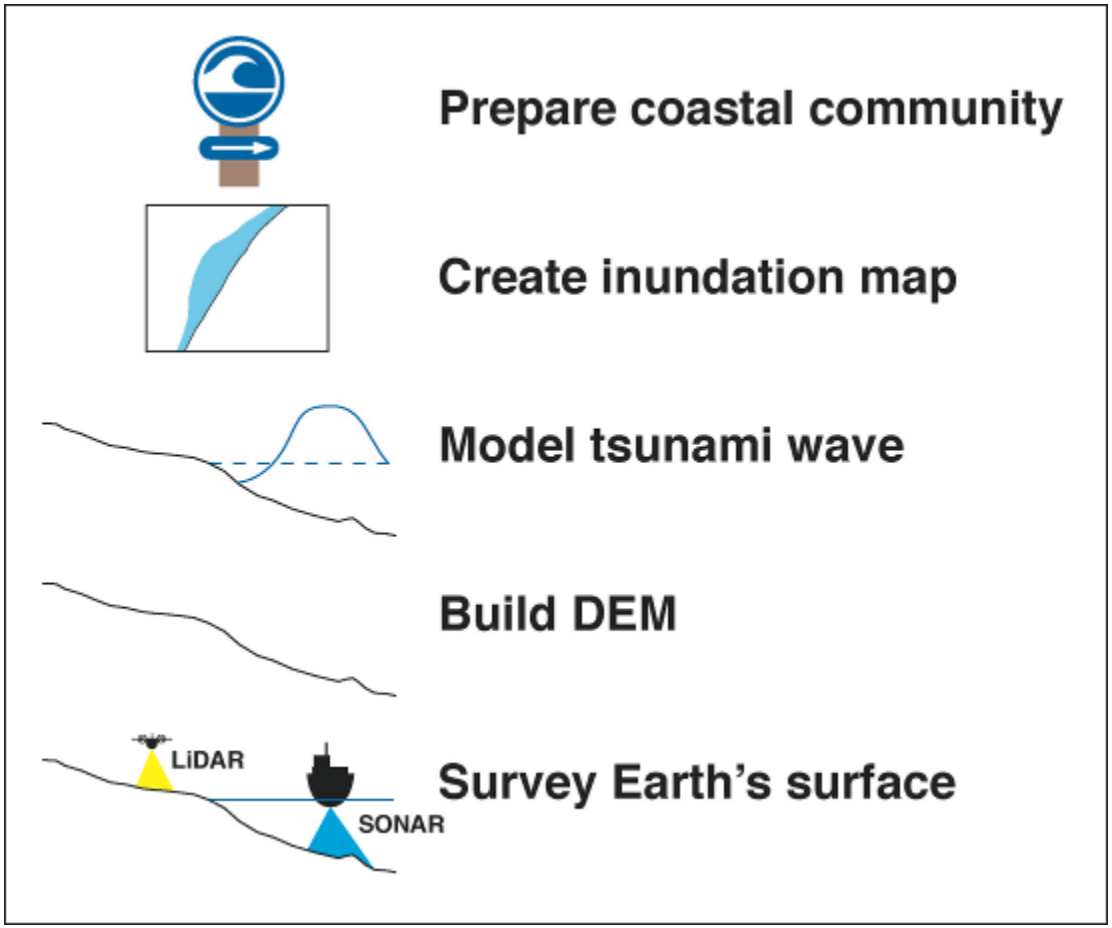


Perspective view of NGDC's Sand Point, AK DEM.

Tsunami Inundation Gridding Project

- Began in 2006
- DEMs to meet MOST (Method of Splitting Tsunami) Model requirements
- Detailed reports and metadata describing DEM creation
- Web dissemination to public: http://www.ngdc.noaa.gov/mgg/inundation/

Role of DEMs in Tsunami Preparedness



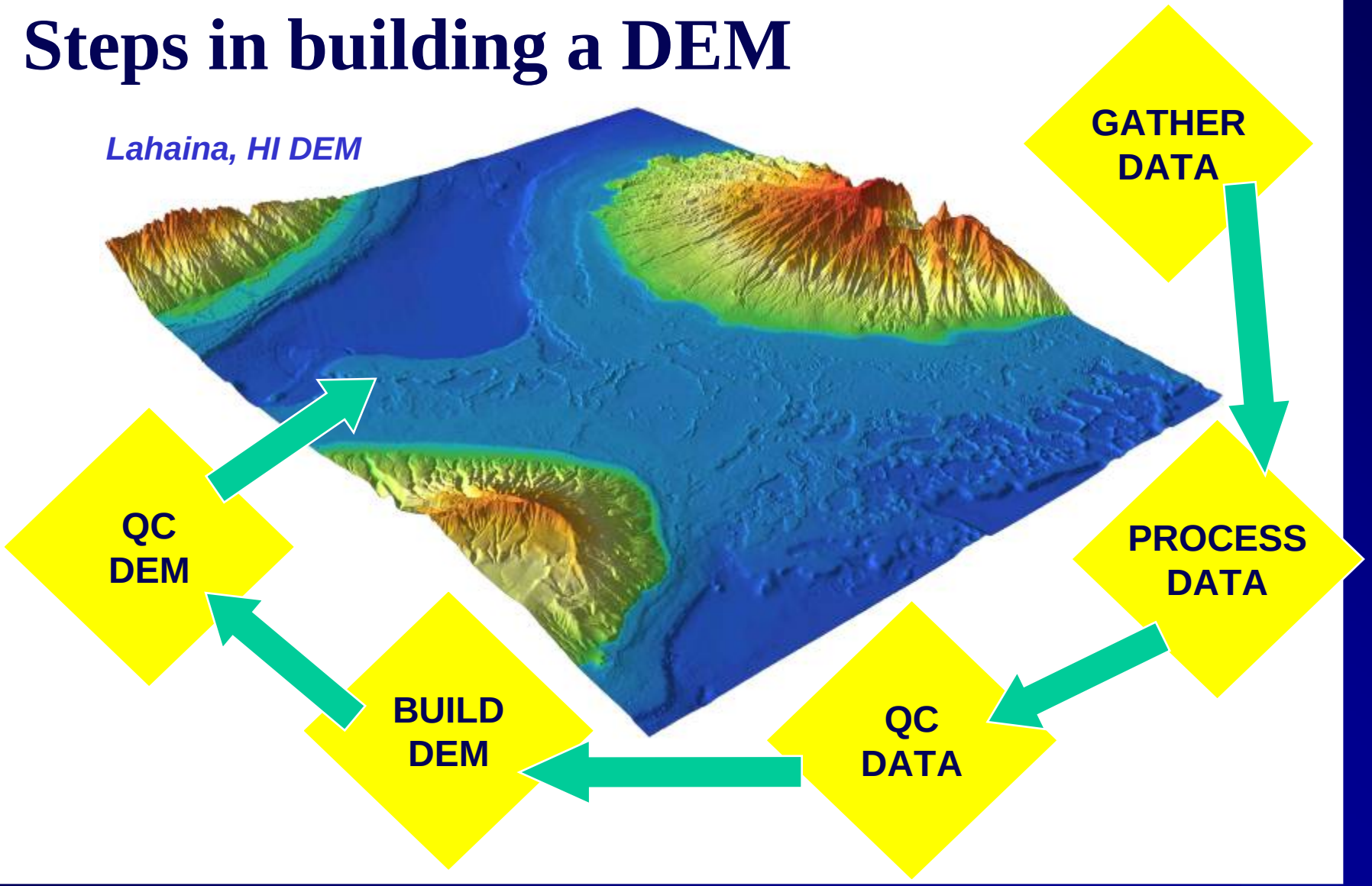
MOST Model DEM Requirements

- **Seamless at coast and with adjacent DEMs**
- **WGS84 geographic and MHW datums**
- **Each cell is square, has the same size, and has an elevation value**
- **DEM represents bare earth**
- **ESRI ASCII raster format**
- ***Represents modern morphology***

Table 1: PMEL specifications for the 1 arc-second King Cove, Alaska DEM.

Grid Area	King Cove, Alaska
Coverage Area	161.8 º to 162.8º W; 54.45º to 55.35º N
Coordinate System	Geographic decimal degrees
Horizontal Datum	World Geodetic System 1984 (WGS84)
Vertical Datum	Mean High Water (MHW)
Vertical Units	Meters
Grid Spacing	1 arc-second
Grid Format	ESRI ASCII raster grid

Steps in building a DEM



DEM Development Reports

Describe data sources, methodology, problems encountered, recommendations for improvement, etc.

NOAA Technical Memorandum NESDIS NGDC-5

DIGITAL ELEVATION MODELS OF SAND POINT, ALASKA: PROCEDURES, DATA SOURCES AND ANALYSIS

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noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / National Environmental Satellite, Data, and Information Service

http://www.ngdc.noaa.gov/mgg/inundation/

TIGP Web Site

NOAA > NESDIS > NGDC > MGGD > bathymetry & topography > tsunami inundation gridding project

National Geophysical Data Center (NGDC)
NOAA Satellite and Information Service

6 Completed and 20 Planned DEMs for

shift-click-drag a rectangle to zoom to a particular

Start a New Search

Completed DEMs

DEM name	Cell Size	State	Region	Date Completed
Monterey	1/3 arc-second	CA	West Coast	2008-01-11
Port San Luis	1/3 arc-second	CA	West Coast	2006-07-08
Astoria	1/3 arc-second	OR	West Coast	2008-05-30
Garibaldi	1/3 arc-second	OR	West Coast	2007-08-22
Port Orford	1/3 arc-second	OR	West Coast	2008-03-14
La Push	1/3 arc-second	WA	West Coast	2007-07-26

NOAA > NESDIS > NGDC > MGGD > bathymetry & topography > tsunami inundation gridding project — privacy policy

National Geophysical Data Center (NGDC)
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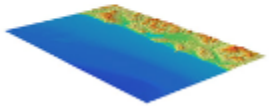
Tsunami Inundation Gridding Project

If you came from an ArcIMS map, close this window/tab to return to the map.

Garibaldi, OR 1/3 arc-second Tsunami Inundation DEM



click on image above to view a larger version

DEM not to be used for navigation.

Download DEM Development Report (.PDF)

Download 1/3 arc-second DEM, Metadata File, Projection File, & Readme File (.zip MB)

Date Completed: 2007-08-22

Format: ESRI Arc ASCII

Horizontal Datum: WGS84 geographic

Vertical Datum: Mean High Water

Vertical Units: meters

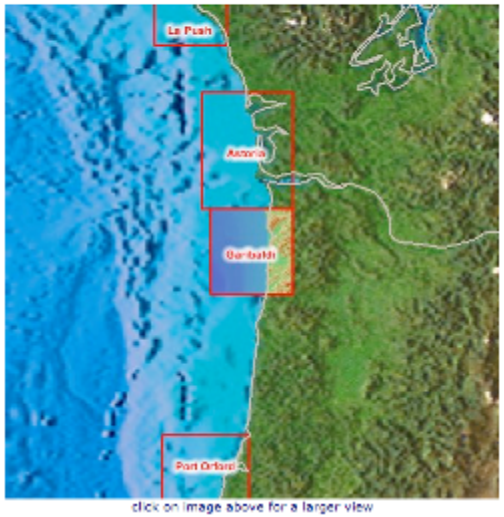
Coverage: Bathy-topo

Registration: Grid-node

Source: NOAA/NGDC/MGG

Project URL:
http://www.ngdc.noaa.gov/mgg/inundation/

Contact: Barry W. Eakins, Barry.Eakins@noaa.gov, 303-497-6505



click on image above for a larger view

The Garibaldi DEM covers the coastal region surrounding the town of Garibaldi, Oregon, located on the northern edge of Tillamook Bay. Included within the DEM boundary are the neighboring communities of Cannon Beach, Manzanita, and Rockaway Beach to the north and Oceanside, Netarts, and Pacific City to the south.

Start a New Search

NOAA > NESDIS > NGDC > MGGD > bathymetry & topography — questions: tsu.a.taylor@noaa.gov

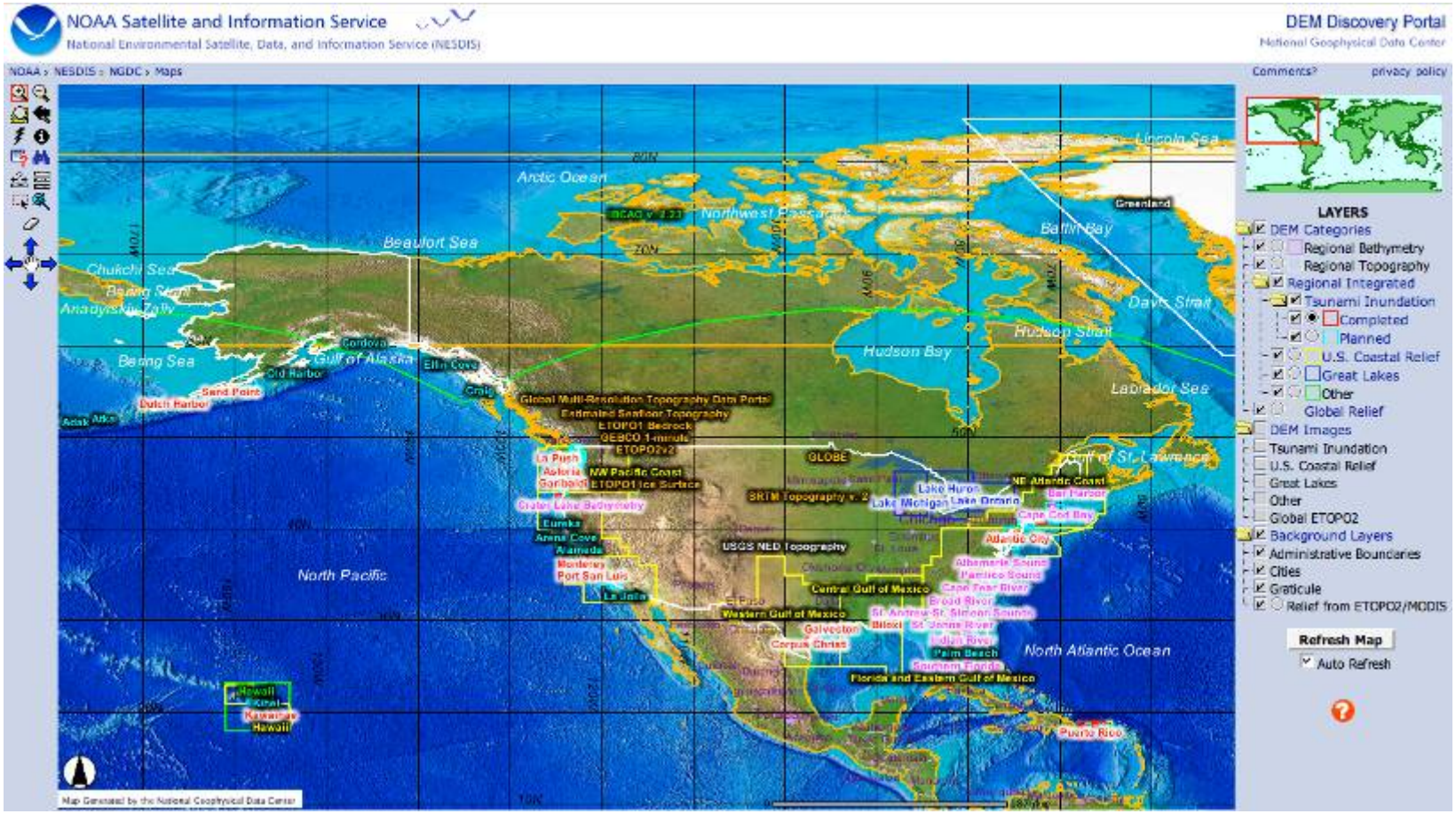
home | contacts | data | disclaimers | education | news | site map

maintained by: kelly.carignan@noaa.gov

date displayed Tue Sep 02 2008 14:08:47 GMT-0600 (MDT) W3C

http://www.ngdc.noaa.gov/mgg/inundation/

DEM Discovery Portal



http://www.ngdc.noaa.gov/mgg/dem/

http://www.ngdc.noaa.gov/mgg/inundation/

Principal Data Sources

Source	*Dataset*	*URL*
NGDC	NOS hydrographic surveys Multibeam swath sonar surveys	http://www.ngdc.noaa.gov/mgg/bathymetry/
NOAA OCS	Nautical Charts: RNCs and ENCs	http://nauticalcharts.noaa.gov/
NOAA CSC	Coastal LiDAR and IfSAR data	http://www.csc.noaa.gov/digitalcoast/data/index.html
USACE	Hydrographic harbor surveys	http://www.usace.army.mil/
USGS	NED and SRTM topography Multibeam swath sonar surveys	http://seamless.usgs.gov/
Local govt's	LiDAR surveys	

NGDC also develops a high-resolution, detailed coastline for each DEM for clipping datasets, such as NED, SRTM and LiDAR, that contain ocean-surface elevation values, and for interpolating bathymetry to the coastline. Coastlines typically contain piers, docks, etc. that must be removed. ***Datasets capture morphology at time of survey.***

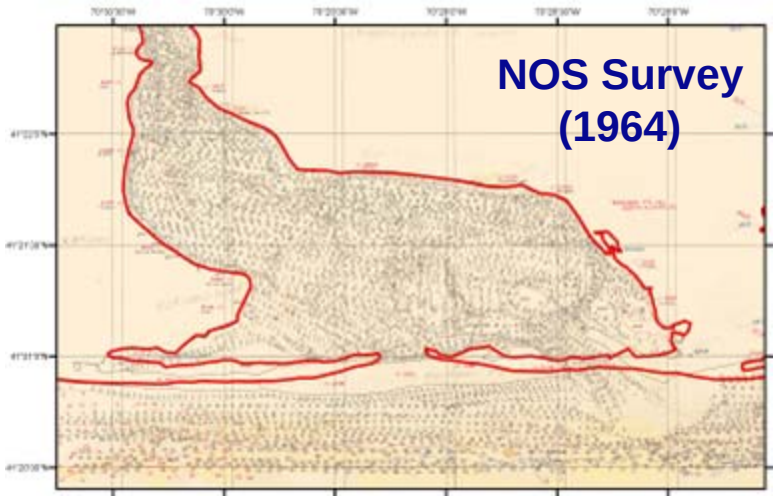
Recent Morphologic Change …

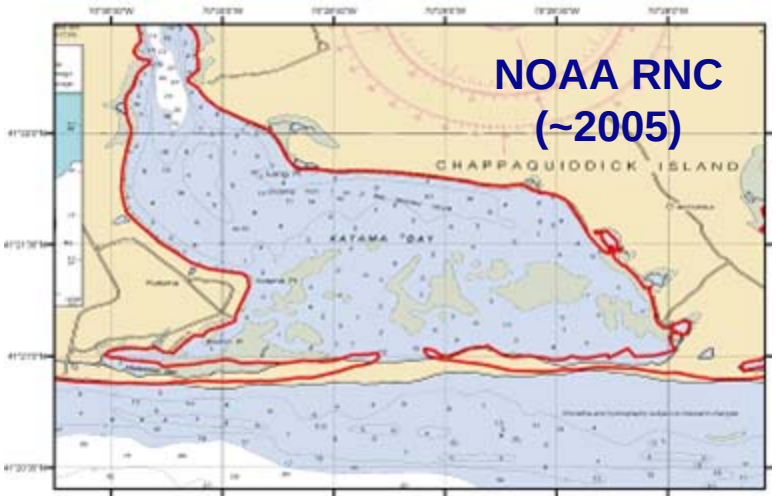
In April 2007, a storm surge breached the sand bar on the south side of Katama Bay, Martha's Vineyard, Mass.

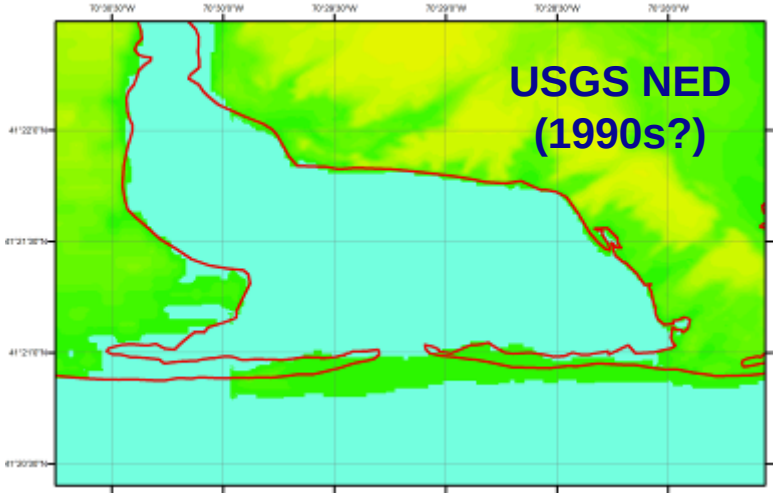
Not captured in:

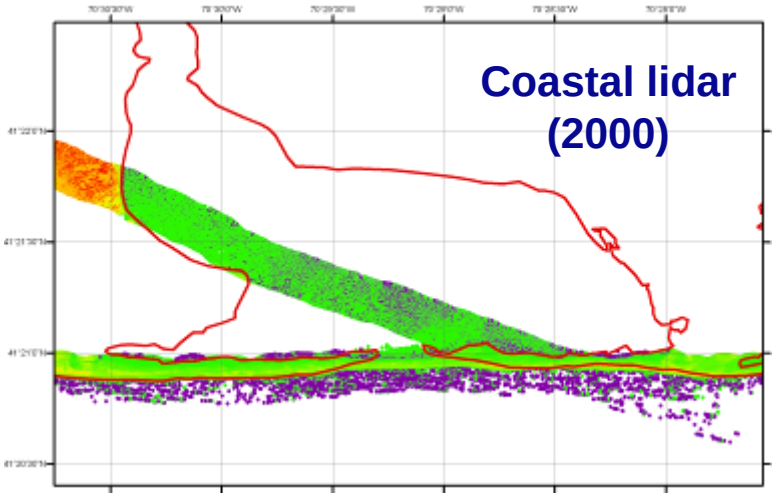
- USGS NED
- SRTM
- coastal 2000 lidar survey
- NOS survey (1964)
- NOAA nautical charts

Older Datasets



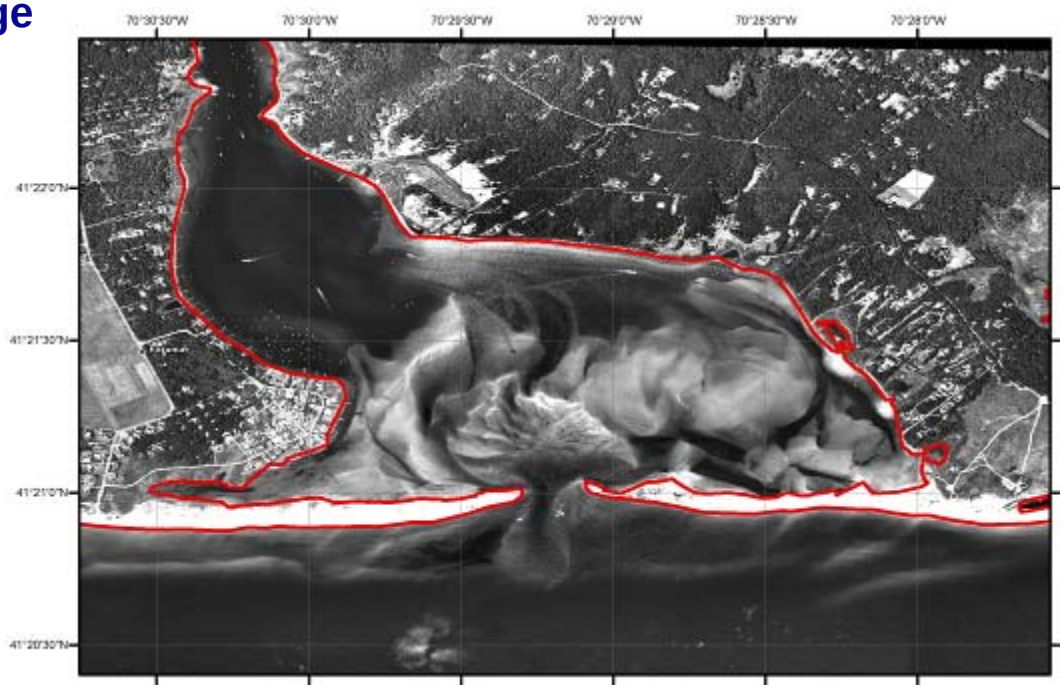






What to do?

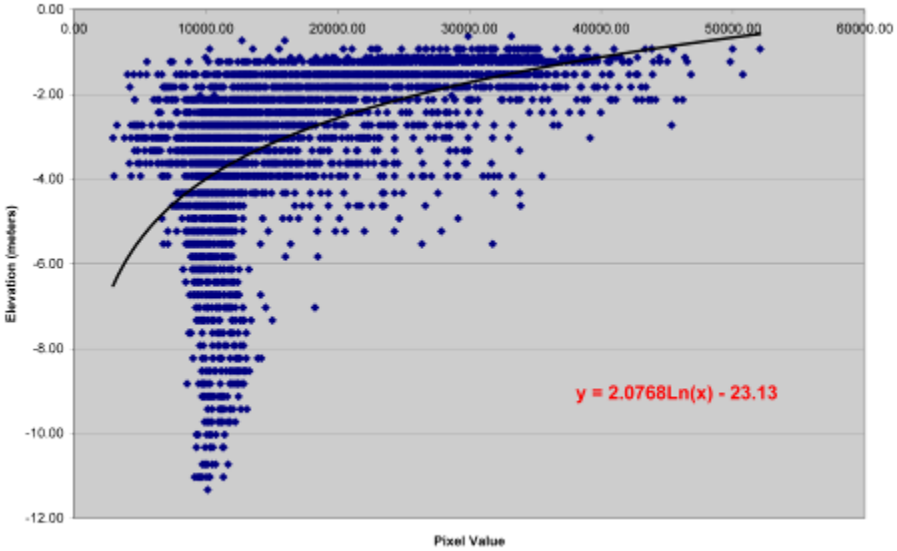
- Export jpg from Google Earth
- Convert to tif
- Georeference in ArcMap using identifiable stable features (e.g, intersections)
- Export to new tif
- Convert to 16-bit greyscale in Photoshop
- Assign georeferencing info using GDAL
- Adjust coastline to match image



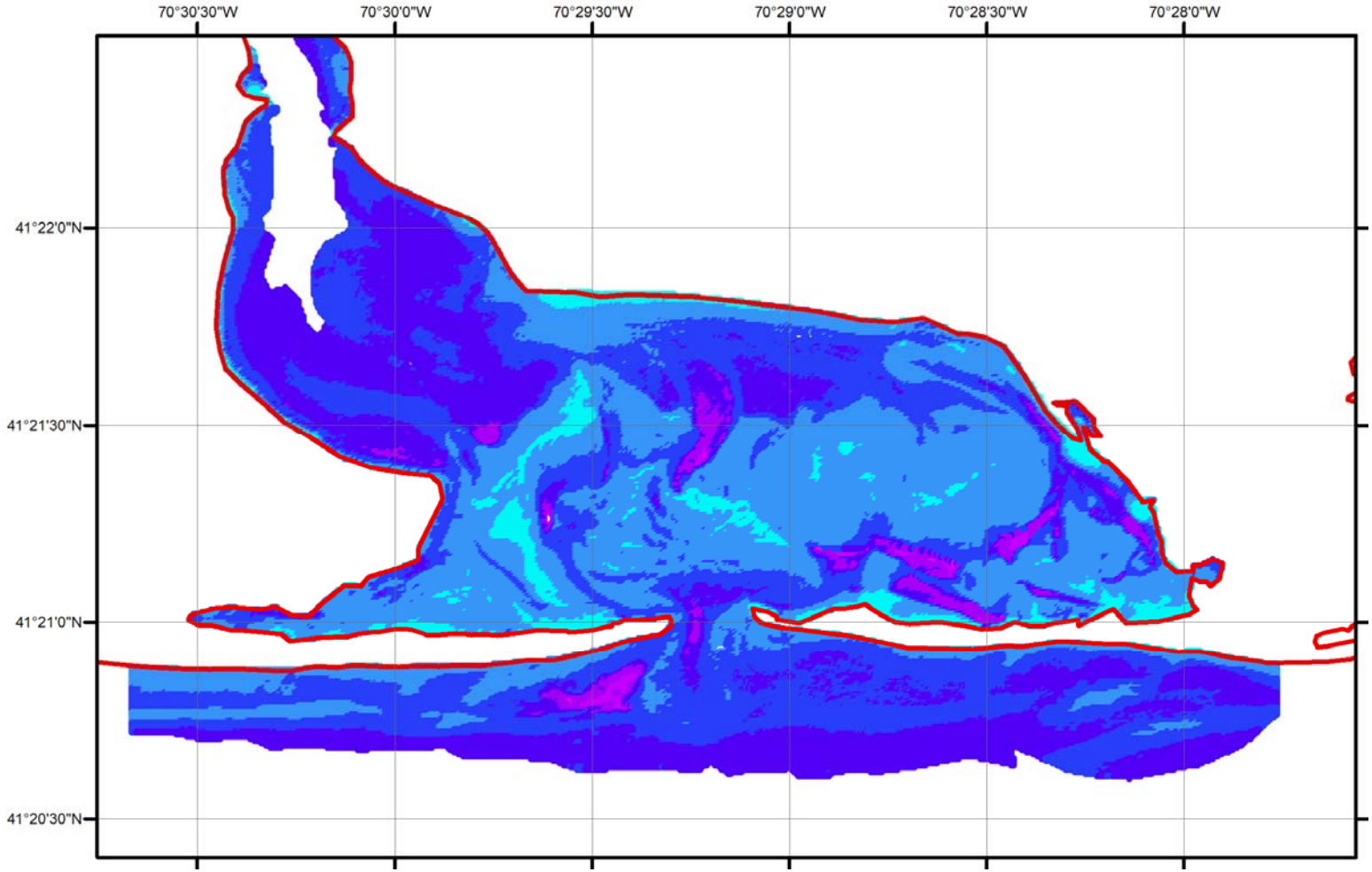
Note that boats, piers, waves, and clouds are visible in the image.

How do pixel values compare to depths?

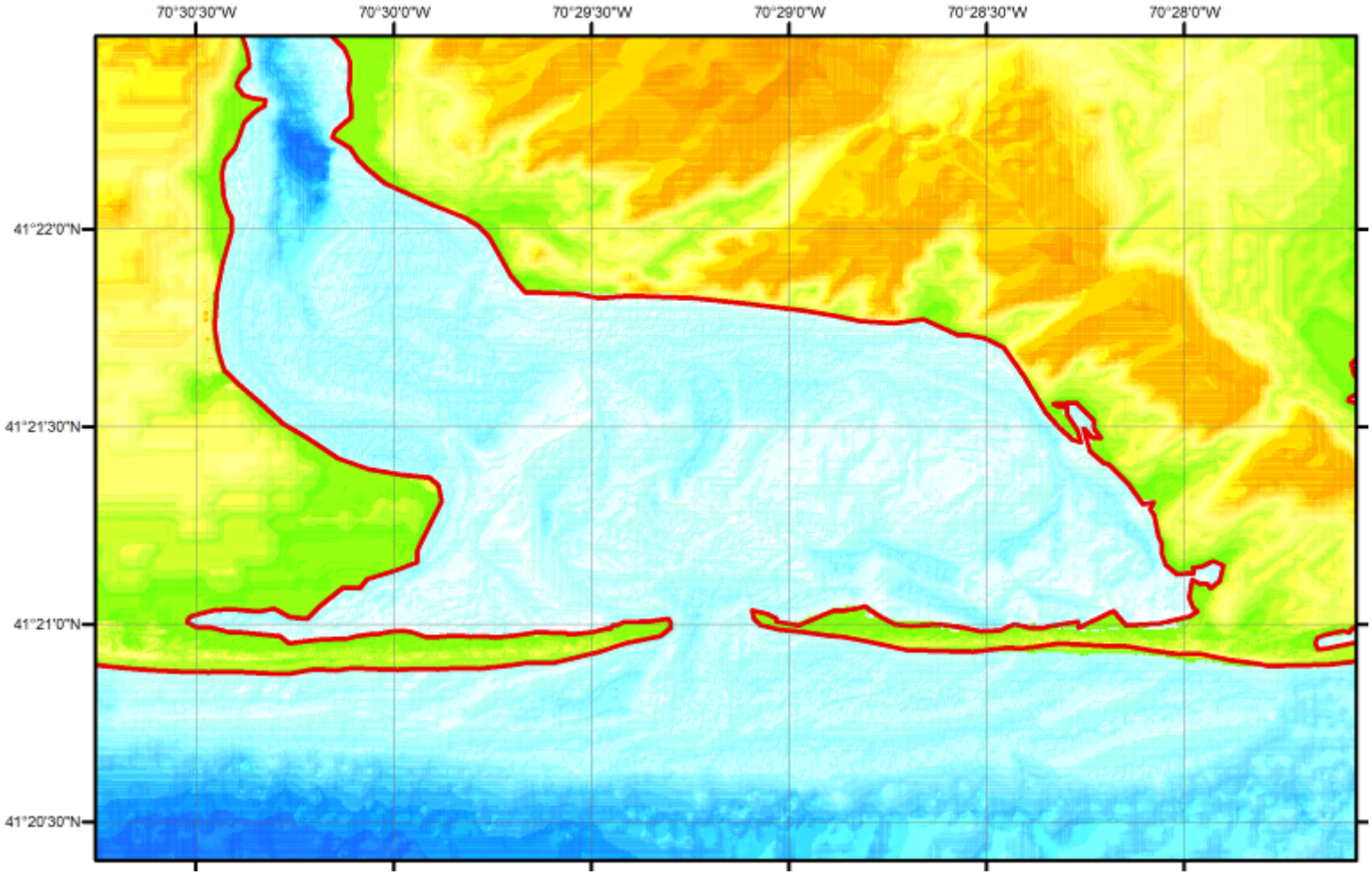
- Compare NOS survey with pixel values
- Determine logarithmic trendline
- Note where pixel values no longer correlate with depth values
- Use ArcMap 'Raster Calculator' to apply log equation [y = 1.35 Ln (x-4000) -15]
- Resample calculated image depths to 1/3 arc-second
- Clip raster to coastline
- Convert clipped raster to points
- Edit point shapefile to remove anomalous values (e.g., over ships)



Estimated Depths from Satellite Imagery

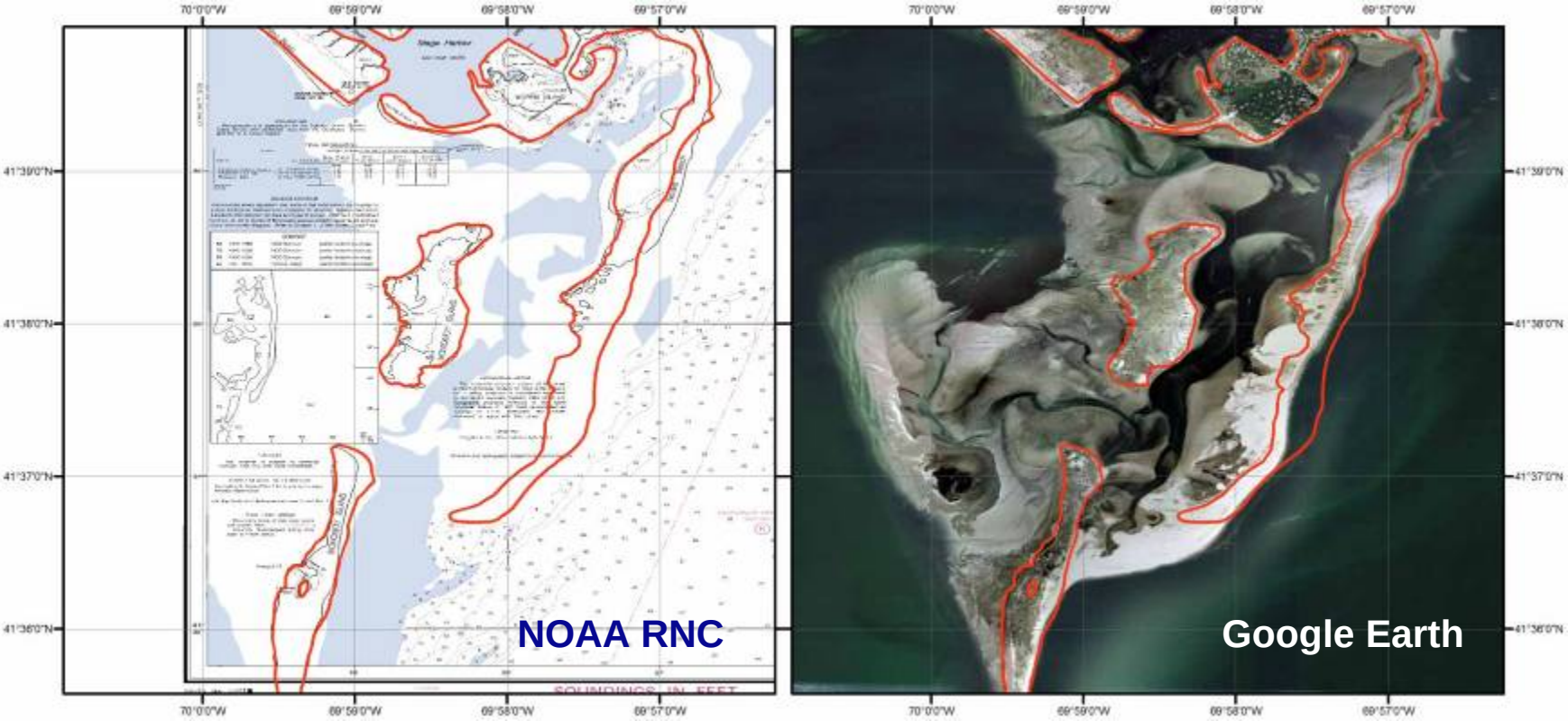


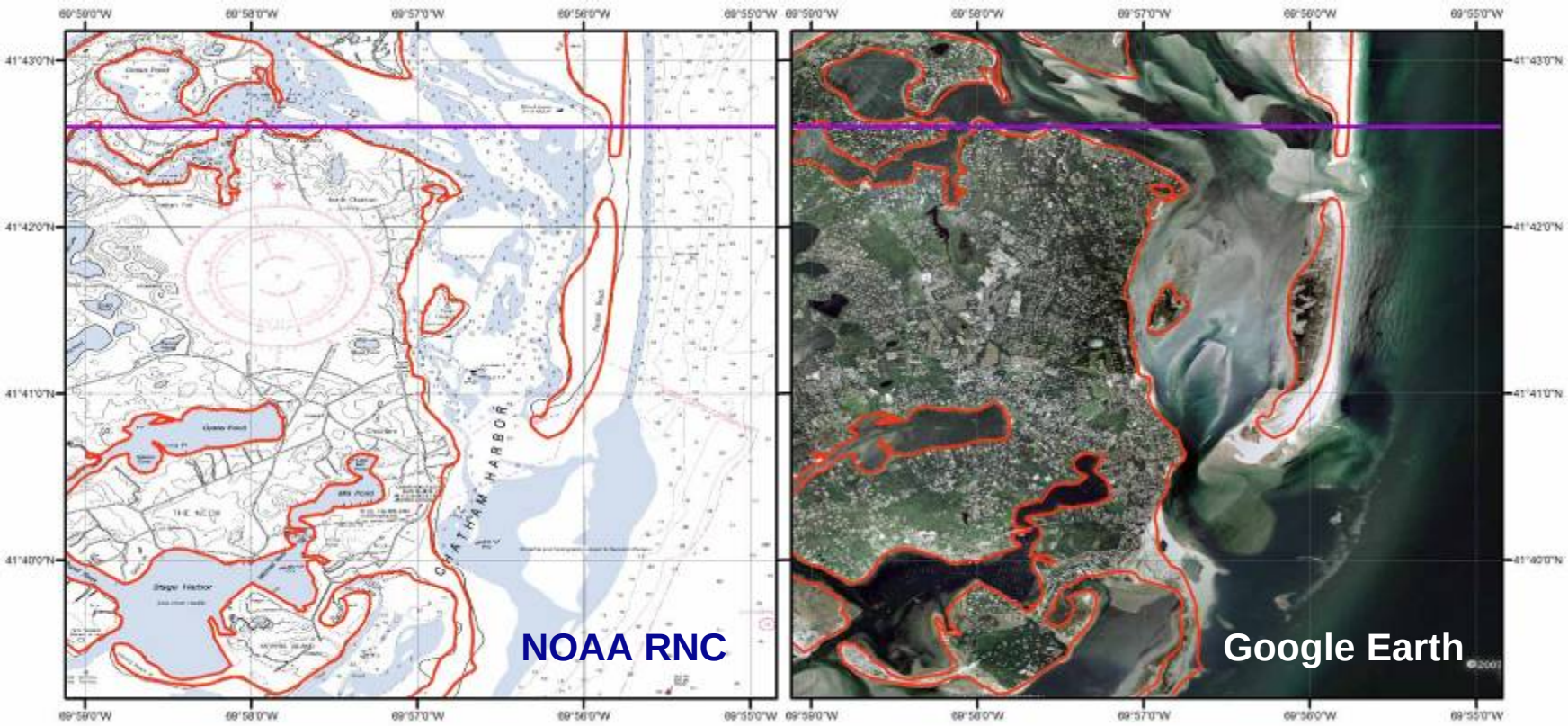
Nantucket DEM



Other Morphologic Changes …

Monomoy Island and Nauset Beach, Cape Cod.



Other Morphologic Changes …

Pleasant Bay, Cape Cod.