

VDatum

Vertical Datum Transformation Tool

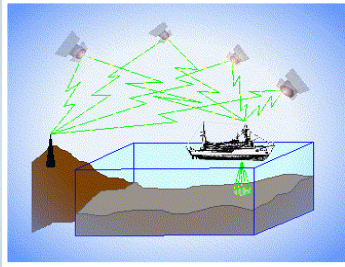


National Oceanic and Atmospheric Administration

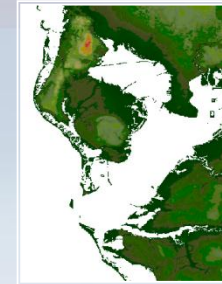
What Vertical Datum is My Data in?

Ellipsoidal Datums

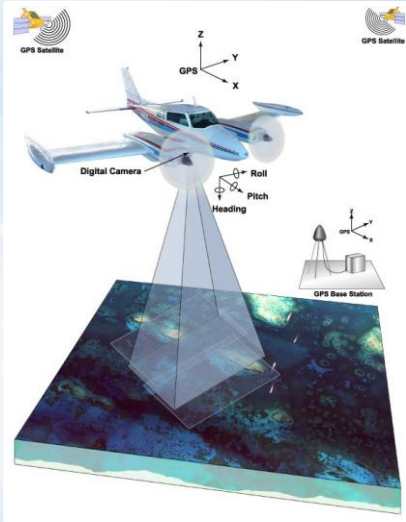
Orthometric Datums



RTK-GPS vertical
referencing
Hydrographic Surveys



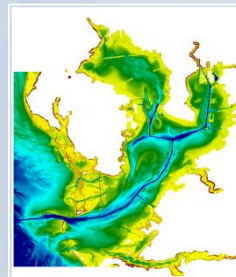
USGS
Topography



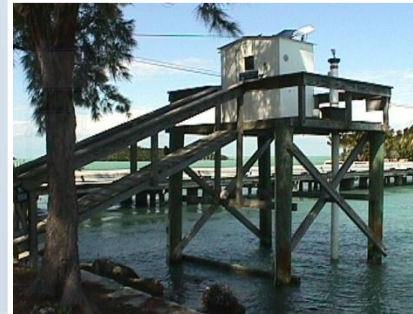
Lidar



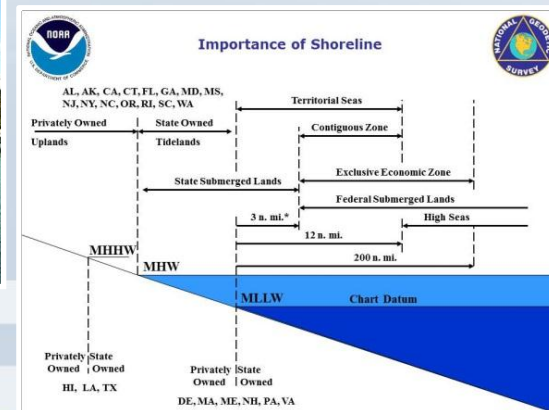
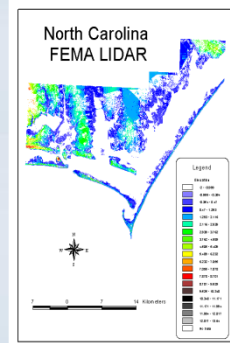
GPS



NOAA Bathymetry
(MLLW)



Tidal Datums

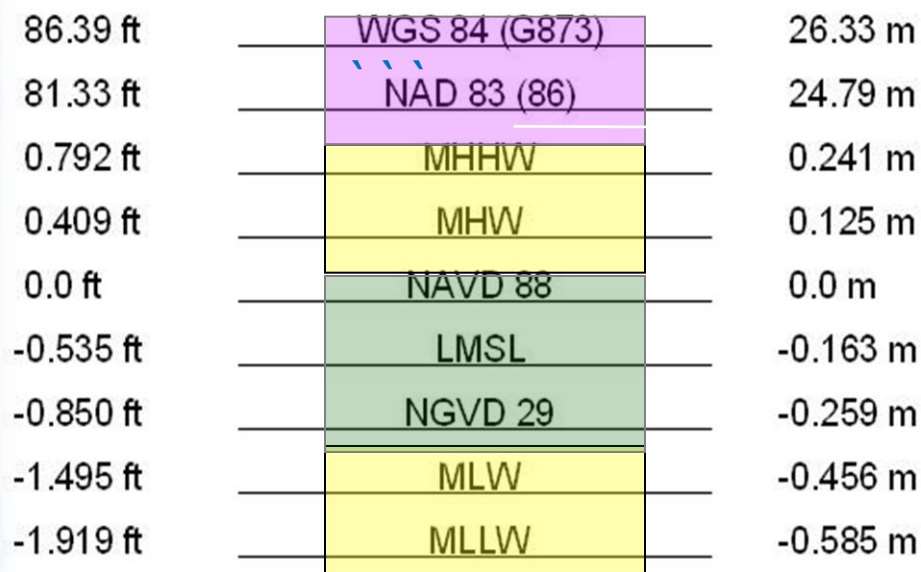


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All elevation data is referenced to a vertical datum.

BUT there are a many different vertical datums in use around the nation

Relationship of vertical datums for Tampa Bay:



ITRF,
WGS 84,
NAD 83 (NSRS)



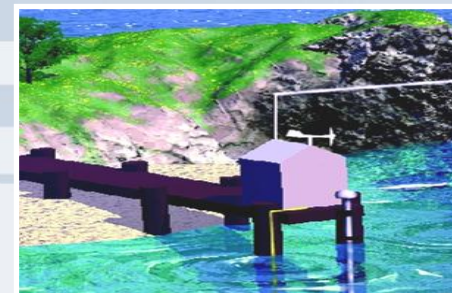
Orthometric Datums

NAVD 88,
NGVD 29



MHHW, MHW,
MTL, DTL,
LMSL,
MLW, MLLW

Tidal Datums



For elevation data sets to be blended together they must be referenced to same vertical datum.



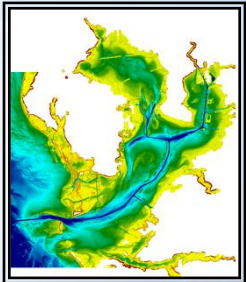
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Development and Use of VDatum

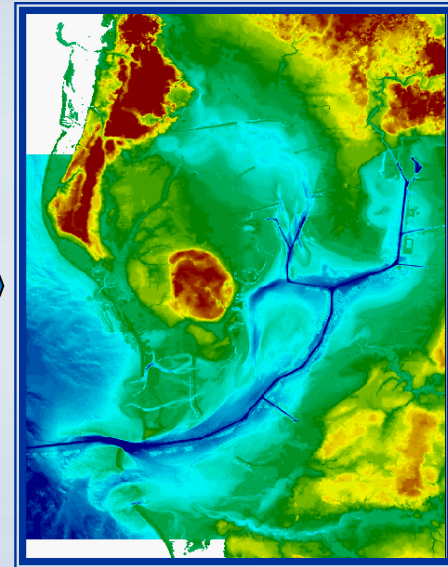
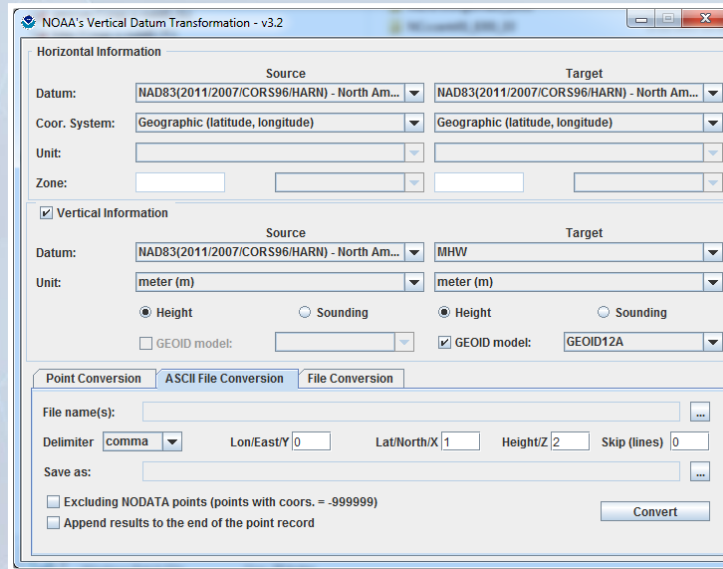
Mapping the Land-Sea Interface:
VDatum converts elevation data (heights and soundings) among different vertical datums



USGS Topography



NOAA Bathymetry



VDatum is a Java application developed jointly by :

- National Geodetic Survey (NGS)
- Office of Coast Survey (OCS)
- Center for Operational Oceanographic Products & Services (CO-OPS)



National Oceanic and Atmospheric Administration

3 Categories of Vertical Datums:

- **3D/Ellipsoidal Datums:**
 - Realized through space-based systems, such as GPS
- **Orthometric Datums:**
 - Based on a form of mean sea level
- **Tidal Datums:**
 - Based on tidally-derived surfaces such as high or low water



Vertical Datum Transformation "Roadmap"

3D Datums

Orthometric Datums

Tidal Datums

WGS 84 (G1150)

WGS 84 (G873)

WGS 84 (G730)

WGS 84 (orig.)

ITRF2000

ITRF97

ITRF96

ITRF94

ITRF93

ITRF92

ITRF91

ITRF90

ITRF89

ITRF88

SIO/MIT 92

NEOS 90

PNEOS 90

Calibrated Helmert Transformations

VERTCON

NAD83 (NSRS)

GEOID99,
GEOID03,
GEOID09

NGVD 29

NAVD 88

TSS
(Topography of
the Sea
Surface)

Tide Models

LMSL

MHHW

MHW

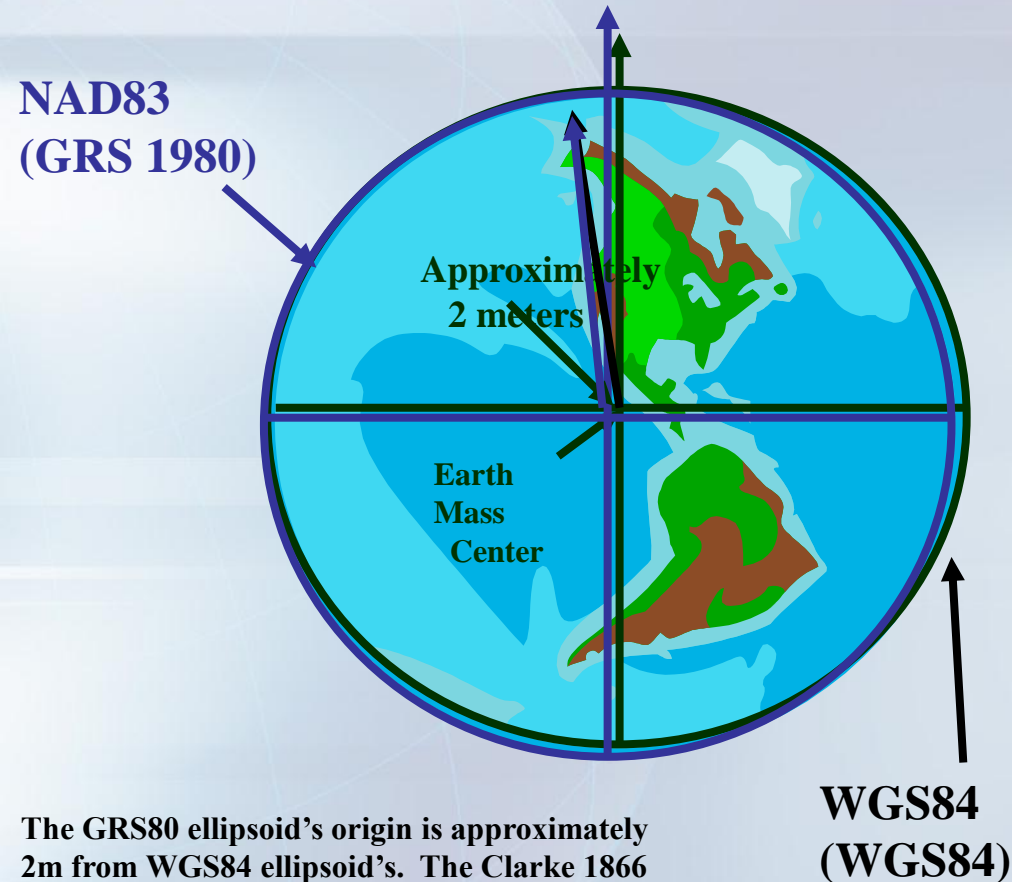
MTL

DTL

MLW

MLLW

3D/Ellipsoid Datums



- Calculation of geographic position on this irregular surface is very complex. A simpler model is needed.
- This simplified mathematical surface is the *ellipsoid*.
- An ellipsoid approximates the shape of the earth, a datum defines the position of the ellipsoid relative to the center of the earth. A datum provides a frame of reference for measuring locations on the surface of the earth.

The GRS80 ellipsoid's origin is approximately 2m from WGS84 ellipsoid's. The Clarke 1866 ellipsoid's origin is approximately 236 m from WGS84 ellipsoid's



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14-parameter transformation

Orthometric Datums and the GEOID

Ellipsoid to Orthometric

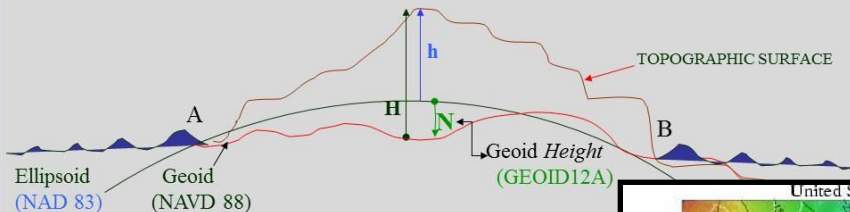
+ Ellipsoid, Geoid, and Orthometric Heights

H = Orthometric Height (NAVD 88)

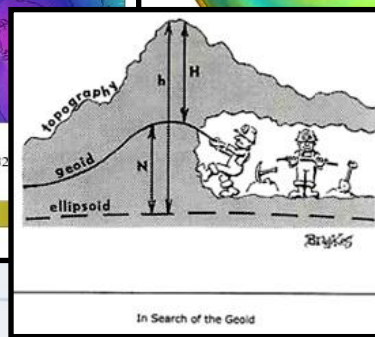
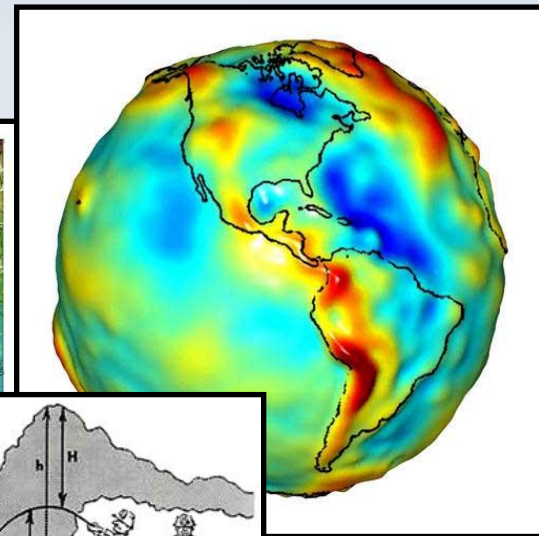
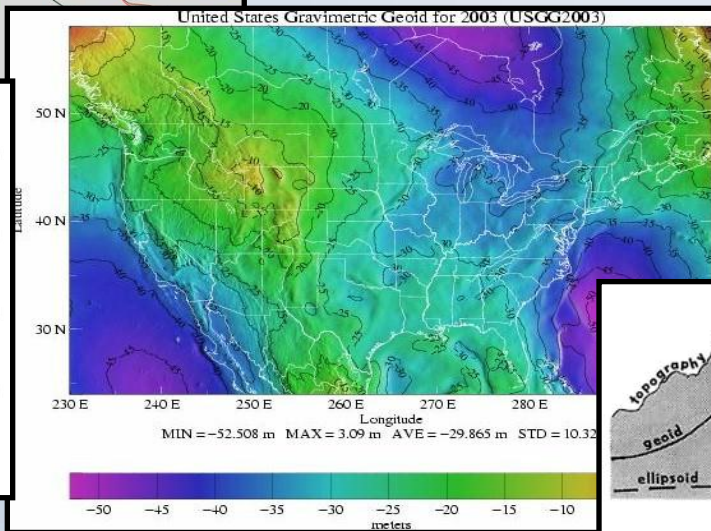
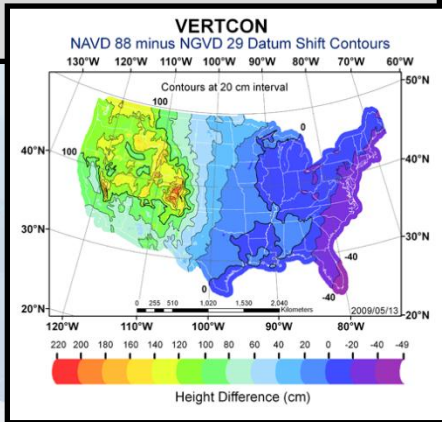
h = Ellipsoidal Height (NAD 83)

N = Geoid Height (GEOID 12A)

$$H = h - N$$



- NAVD88 is based on an adopted elevation at Point Rimouski (Father's Point). It uses Helmert orthometric heights as an approximation to true orthometric heights.
- GEOID: "The *equipotential surface* of the Earth's gravity field which best fits, in the least squares sense, (global) mean sea level."
- Can't see the surface or measure it directly.
- Can be modeled from gravity data as they are mathematically related.

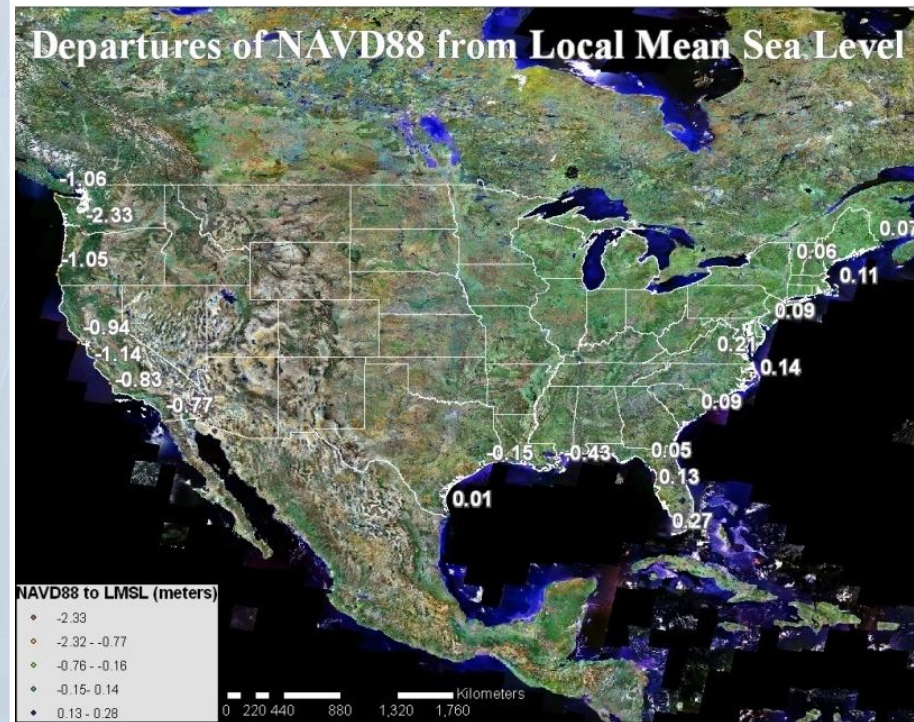


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biquadratic interpolation

Topography of the Sea Surface

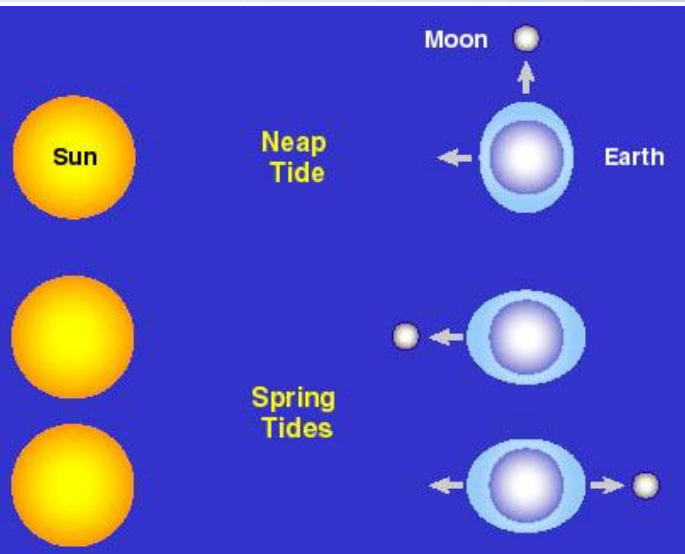
The **Topography of the Sea Surface (TSS)** is defined as the elevation of the North American Vertical Datum of 1988 (NAVD88) relative to local mean sea level (LMSL).



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bilinear interpolation

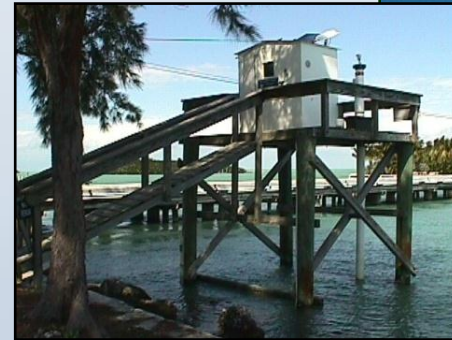
Tidal Datums



- A vertical datum is called a tidal datum when it is defined by a certain phase of the tide.
- National Tidal Datum Epoch (NTDE): is a specific 19-year period that spans the longest periodic tidal variations resulting from astronomical tide-producing forces.
- The fundamental base from which most coastal and marine boundaries are determined.
- Also important for referencing soundings and depicting shorelines on nautical charts.



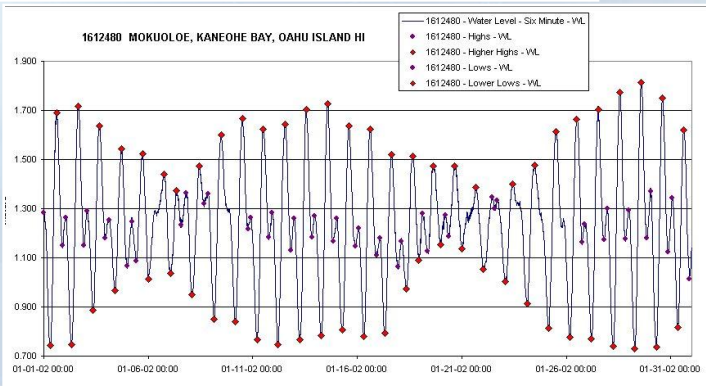
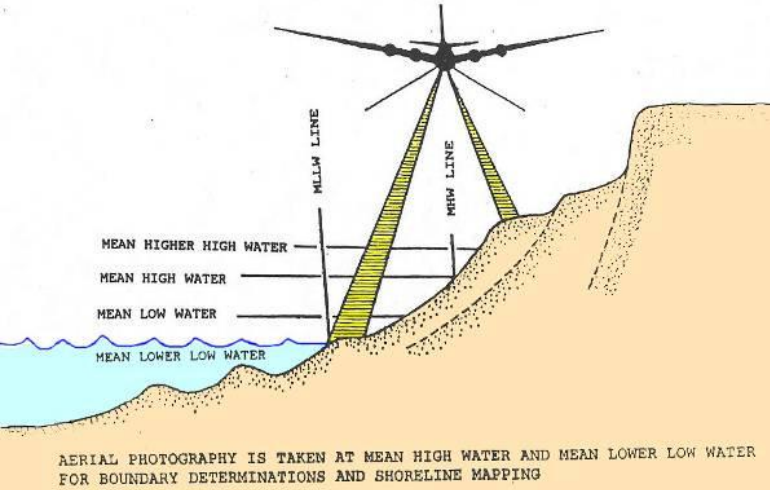
National Water Level Observation Network (NWLON)



National Oceanic and Atmospheric Administration

Tidal Datums

TIDES - SUPPORT TO NAUTICAL CHARTING PHOTOGRAMMETRY APPLICATIONS

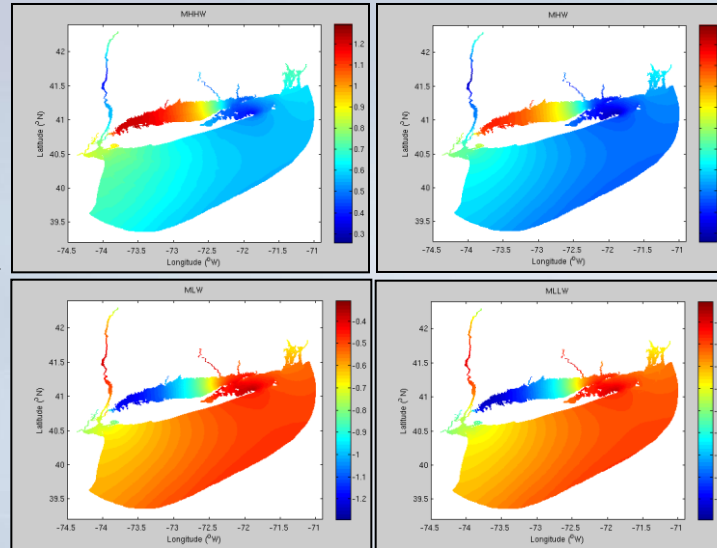
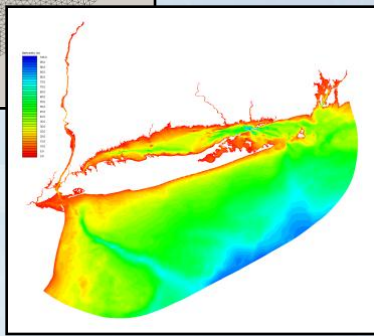


- Mean Higher High Water (MHHW): defined as the arithmetic mean of the higher high water heights of the tide over a specific 19-year Metonic cycle denoted as the NTDE.
- **Mean High Water (MHW)**: defined as the arithmetic mean of the high water heights observed over a specific 19 year cycle.
- Mean Sea Level (MSL): defined as the arithmetic mean of hourly heights observed over a specific 19 year cycle.
- Mean Low Water (MLW): defined as the arithmetic mean of the low water heights observed over a specific 19 year cycle.
- **Mean Lower Low Water (MLLW)**: defined as the arithmetic mean of the lower low water heights of the tide observed over a specific 19 year cycle.
- Mean Tide Level (MTL): a tidal datum which is the average of Mean High Water and Mean Low Water.
- Diurnal Tide Level (DTL): a tidal datum which is the average of Mean Higher High Water and Mean Lower Low Water.

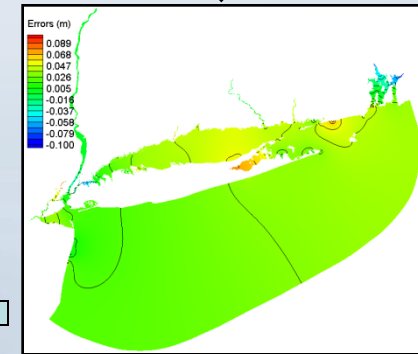


Tidal Datums and Hydrodynamic Modeling

Finite Element grid is created and populated with bathymetry

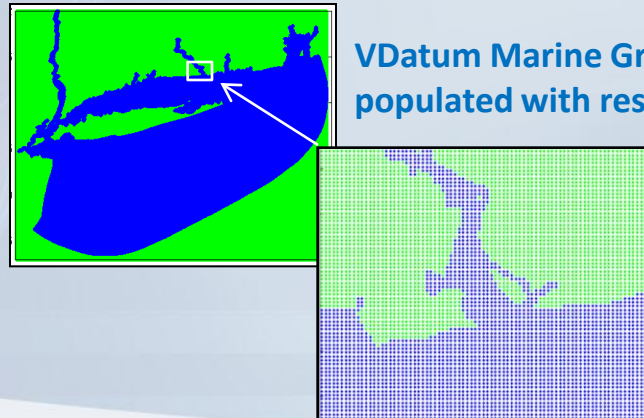


Tidal Datum fields are derived from ADCIRC (Advanced Circulation) Model, simulations are made on cluster computers at NOAA's Earth System Research Laboratory



Correct results by spatially interpolating errors with TCARI (Tidal Constituent and Residual Interpolation)

VDatum Marine Grid is populated with results

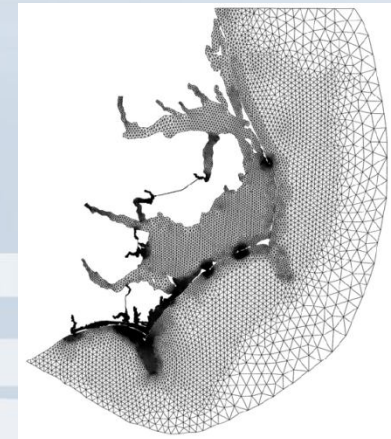
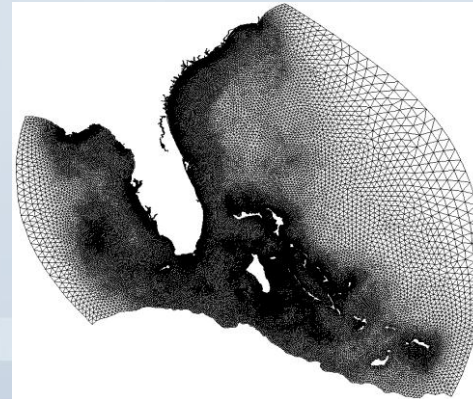
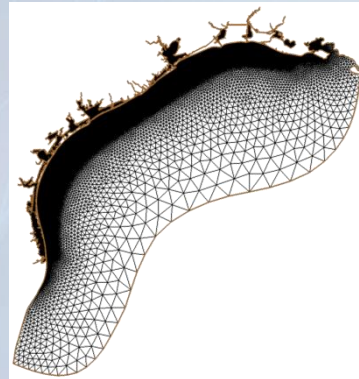
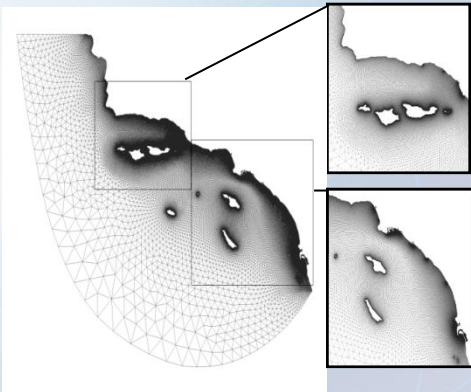
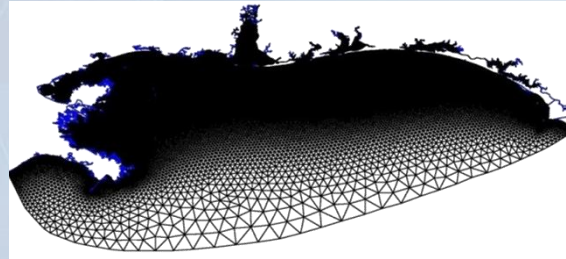
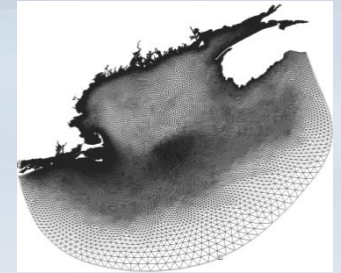
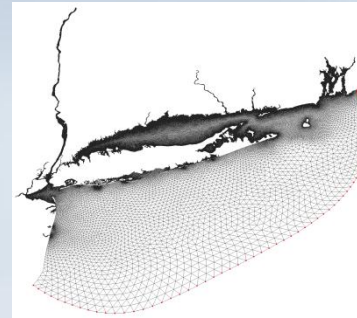
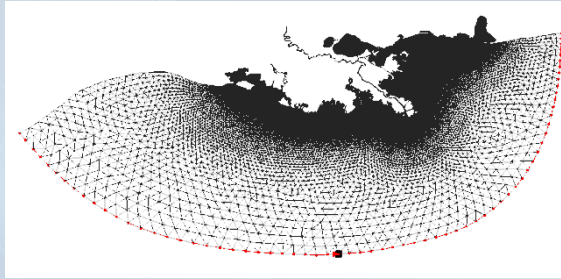
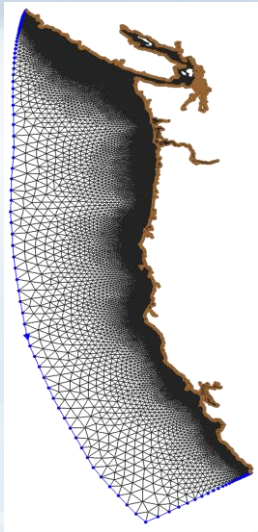


bilinear interpolation



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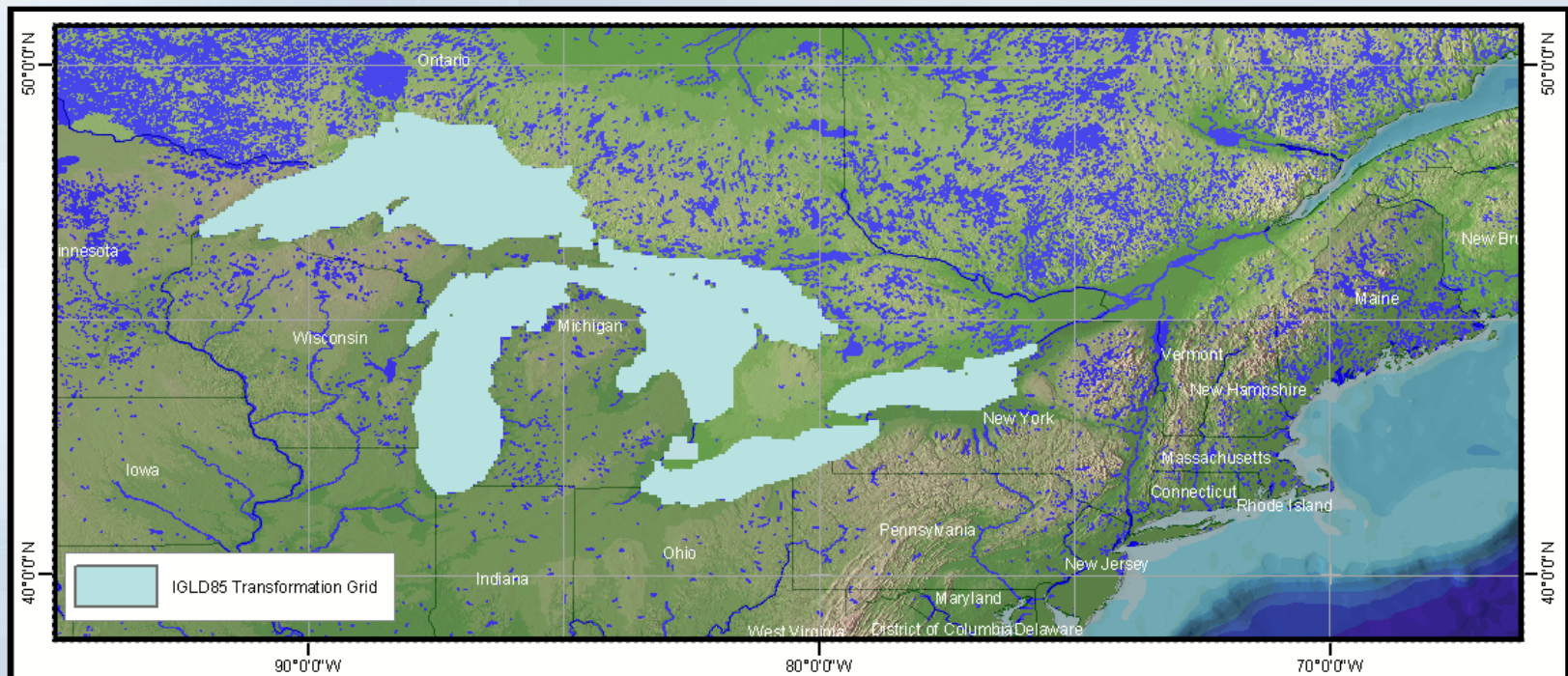
ADCIRC Modeling in Support of VDatum



National Oceanic and Atmospheric Administration

VDatum: IGLD85

- Conversions between IGLD 85 and NAVD 88 are provided based on the NAVD 88 gravity model (<http://www.ngs.noaa.gov/TOOLS/Navdgrav/navdgrav.html>) and the hydraulic corrector model.



VDatum Website: vdatum.noaa.gov

(Version 3.2 Released March 21, 2013)

NOAA's Vertical Datum Transformation - v3.2

Horizontal Information

Source Target

Datum: NAD83(2011/2007/CORS96/HARN) - North Am... NAD83(2011/2007/CORS96/HARN) - North Am...

Coord. System: Geographic (latitude, longitude) Geographic (latitude, longitude)

Unit: [] []

Zone: [] []

Vertical Information

Source Target

Datum: NAD83(2011/2007/CORS96/HARN) - North Am... MHW

Unit: meter (m) meter (m)

Height Sounding Height Sounding

GEOID model: [] GEOID model: GEOID12A

Point Conversion ASCII File Conversion File Conversion

File name(s): []

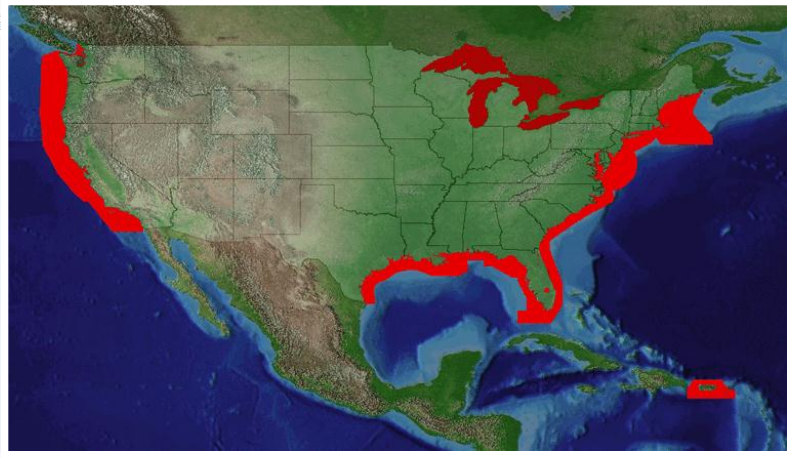
Delimiter: comma Lon/East/Y: 0 Lat/North/X: 1 Height/Z: 2 Skip (lines): 0

Save as: []

Excluding NODATA points (points with coords. = -999999)

Append results to the end of the point record

Convert



NOAA

Vertical Datum Transformation

Integrating America's Elevation Data

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Welcome to VDatum!

- ▶ [What's New?](#)
- ▶ [VDatum Features](#)
- ▶ [Est. of Vertical Uncertainties](#)
- ▶ [Download VDatum now](#)
- ▶ [Online User Guide](#)
- ▶ [Troubleshooting / FAQs](#)

VDatum 3.2 released [March 21, 2013] ^{New!}

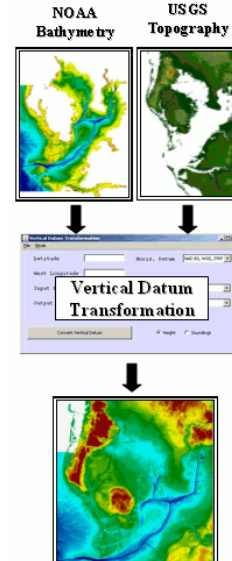
VDatum 3.2 is available, this version is a bug fix and is highly recommended to upgrade to this new version, together with its transformation grids.

VDatum is a free software tool being developed jointly by NOAA's National Geodetic Survey (NGS), Office of Coast Survey (OCS), and Center for Operational Oceanographic Products and Services (CO-OPS). VDatum is designed to vertically transform geospatial data among a variety of tidal, orthometric and ellipsoidal vertical datums - allowing users to convert their data from different horizontal/vertical references into a common system and enabling the fusion of diverse geospatial data in desired reference levels.

Where available and uncertainties are established, VDatum converts the following:

- **Horizontal datums:** from NAD 27 or NAD 83(1986) to NAD 83(HARN) and other ellipsoidal datums such as WGS 84 and ITRF
- **Vertical datums:** among three vertical groups: tidal datums, orthometric datums and ellipsoidal datums (i.e. three-dimension or 3-D datums), in which:
 - Tidal datums are available along the coastlines from Rhode Islands to Texas and from Washington to California. (Why doesn't VDatum provide tidal conversions inland?)
 - Transformations among ellipsoidal and orthometric datums are available throughout the United States;
 - Conversions between the NAD 83 ellipsoidal datum and the NAVD88 orthometric datum are calculated based on the current GEOID12A. Previous NGS's GEOID models are also supported, including GEOID96, GEOID99, GEOID03, GEOID06, GEOID09;
 - Conversions between the NGVD29 datum and the NAVD88 datum are done by the NGS's VERTCON model;
 - Conversions between IGLD85 datum and the NAVD88 datum in the Great Lakes are done by the NGS's IGLD85 model;
- **Input elevation data** in geographic (latitude, longitude), UTM (northing, easting), State Plane Coordinates, and geocentric XYZ coordinates.

The VDatum Demonstration Project in Tampa Bay, Florida



A Little History

VDatum was first introduced to support a seamless bathymetric - topographic digital elevation model (DEM) for Florida's Tampa Bay region by merging the "best available" NOAA bathymetric data and USGS topography data. The best available bathymetric data were selected from the NOAA / NOS Hydrographic Survey database. For the Tampa bay region, approximately half of the sounding data collected were referenced to a mean low water (MLW) vertical datum, and the other half to a mean lower low water (MLLW) vertical datum. The best available topographic data were selected from the USGS National Elevation Dataset (NED). The NED dataset is horizontally referenced to NAD83 and vertically referenced to NAVD88. Prior to merging, both datasets were transformed to a common reference coordinate system, both horizontally and vertically, using VDatum.



National Oceanic and Atmospheric Administration

Utilizing VDatum: Horizontal

NOAA's Vertical Datum Transformation - v3.2

Horizontal Information

Source		Target	
Datum:	NAD83(2011/2007/CORS96/HARN) - North Am...	Datum:	NAD83(2011/2007/CORS96/HARN) - North Am...
Coor. System:	UTM (northing, easting)	Coor. System:	UTM (northing, easting)
Unit:	meter (m)	Unit:	Geographic (latitude, longitude)
Zone:	18	Unit:	UTM (northing, easting)
		Unit:	State Plane Coordinate System
		Unit:	Geocentric XYZ

Vertical Information

Source		Target	
Datum:	NAD83(2011/2007/CORS96/HARN) - North Am...	Datum:	MHW
Unit:	meter (m)	Unit:	meter (m)
<input checked="" type="radio"/> Height	<input type="radio"/> Sounding	<input checked="" type="radio"/> Height	<input type="radio"/> Sounding
<input type="checkbox"/> GEOID model:		<input checked="" type="checkbox"/> GEOID model:	GEOID12A

Point Conversion | ASCII File Conversion | File Conversion

Input		Output	
Easting:	<input type="text"/>	Easting:	<input type="text"/>
Northing:	<input type="text"/>	Northing:	<input type="text"/>
Height:	<input type="text"/>	Height:	<input type="text"/>

File Report to DMS



Utilizing VDatum: Vertical

NOAA's Vertical Datum Transformation - v3.2

Horizontal Information

Source		Target	
Datum:	NAD83(2011/2007/CORS96/HARN) - North Am...	Datum:	NAD83(2011/2007/CORS96/HARN) - North Am...
Coor. System:	UTM (northing, easting)	Coor. System:	UTM (northing, easting)
Unit:	meter (m)	Unit:	meter (m)
Zone:	18	Zone:	18

Vertical Information

Source		Target	
Datum:	NAD83(2011/2007/CORS96/HARN) - North Am...	Datum:	MHW
Unit:	meter (m)	Unit:	meter (m)
<input checked="" type="radio"/> Height	<input type="radio"/> Sounding	<input checked="" type="radio"/> Height	<input type="radio"/> Sounding
<input type="checkbox"/> GEOID model:		<input checked="" type="checkbox"/> GEOID model:	GEOID12A

Point Conversion | ASCII File Conversion | File Conversion

Input		Output	
Easting:	<input type="text"/>	Easting:	<input type="text"/>
Northing:	<input type="text"/>	Northing:	<input type="text"/>
Height:	<input type="text"/>	Height:	<input type="text"/>

File Report to DMS

Vertical Datum Selection:

- GEOID12A
- GEOID09
- GEOID06
- GEOID03
- GEOID99
- GEOID96



Utilizing VDatum: Input

NOAA's Vertical Datum Transformation - v3.2

Horizontal Information

Source		Target	
Datum:	NAD83(2011/2007/CORS96/HARN) - North Am...	Datum:	NAD83(2011/2007/CORS96/HARN) - North Am...
Coord. System:	UTM (northing, easting)	Coord. System:	UTM (northing, easting)
Unit:	meter (m)	Unit:	meter (m)
Zone:	18	Zone:	18

Vertical Information

Source		Target	
Datum:	NAD83(2011/2007/CORS96/HARN) - North Am...	Datum:	MHW
Unit:	meter (m)	Unit:	meter (m)
<input checked="" type="radio"/> Height	<input type="radio"/> Sounding	<input checked="" type="radio"/> Height	<input type="radio"/> Sounding
<input type="checkbox"/> GEOID model:		<input checked="" type="checkbox"/> GEOID model:	GEOID12A

Point Conversion | ASCII File Conversion | File Conversion

Input		Output		
Easting:	<input type="text"/>	<input type="button" value="Convert"/>	Easting:	<input type="text"/>
Northing:	<input type="text"/>	<input type="button" value="Reset"/>	Northing:	<input type="text"/>
Height:	<input type="text"/>	<input type="button" value="DMS"/>	Height:	<input type="text"/>

File Report to DMS



Utilizing VDatum: Input

NOAA's Vertical Datum Transformation - v3.2

Horizontal Information

	Source	Target
Datum:	NAD83(2011/2007/CORS96/HARN) - North Am...	NAD83(2011/2007/CORS96/HARN) - North Am...
Coor. System:	UTM (northing, easting)	UTM (northing, easting)
Unit:	meter (m)	meter (m)
Zone:	18	18

Vertical Information

	Source	Target
Datum:	NAD83(2011/2007/CORS96/HARN) - North Am...	MHW
Unit:	meter (m)	meter (m)
	<input checked="" type="radio"/> Height <input type="radio"/> Sounding	<input checked="" type="radio"/> Height <input type="radio"/> Sounding
	<input type="checkbox"/> GEOID model: []	<input checked="" type="checkbox"/> GEOID model: GEOID12A

Point Conversion **ASCII File Conversion** File Conversion

File name(s): C:\temp\test.txt

Delimiter: comma Lon/East/Y: 0 Lat/North/X: 1 Height/Z: 2 Skip (lines): 0

Save as: C:\temp\result

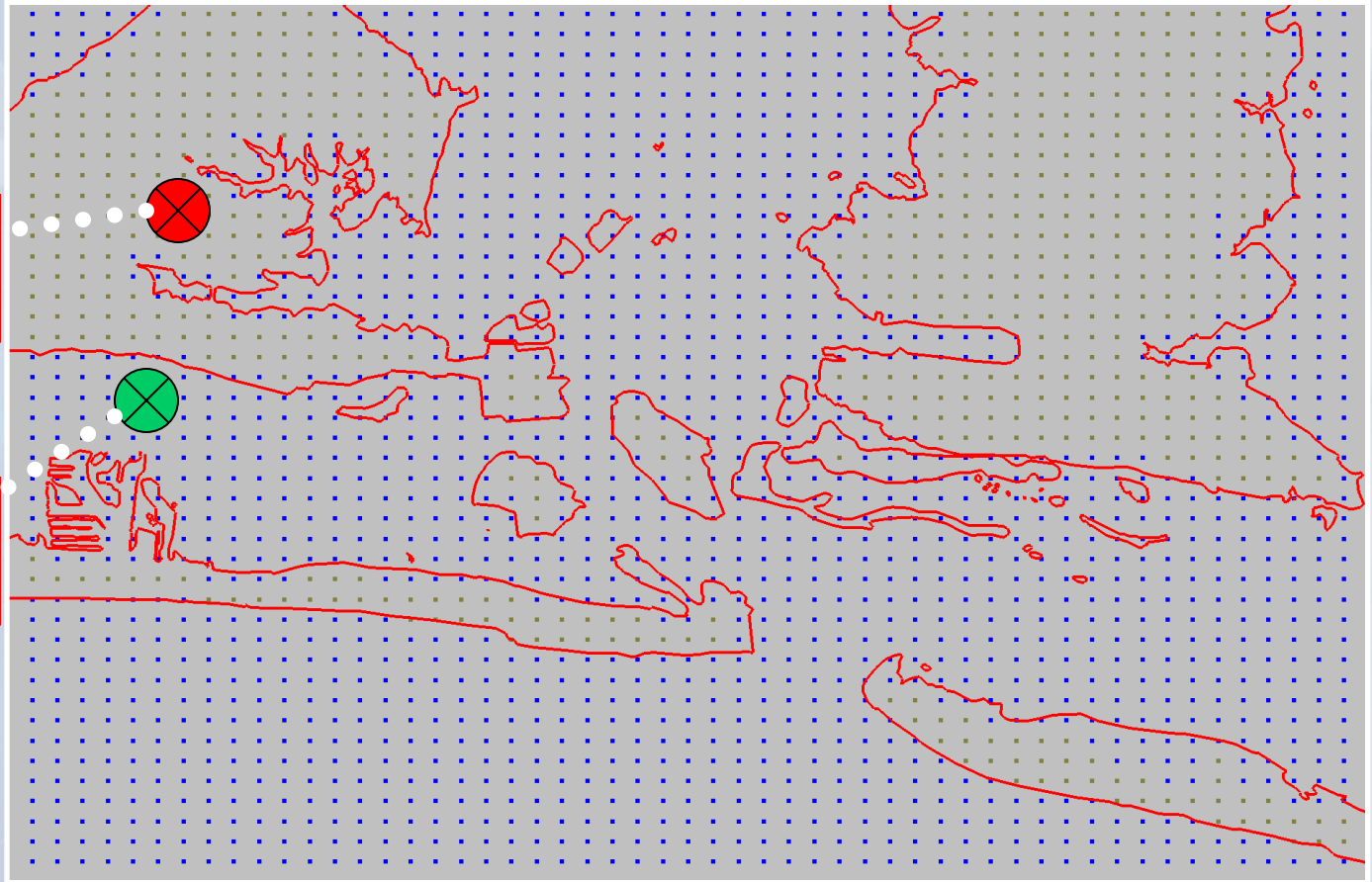
Excluding NODATA points (points with coors. = -999999)
 Append results to the end of the point record

Convert



Returned null
value = -999999.0

Returned a valid
conversion value



- With exception of small buffer region near coastline, user-input points falling on “land” side of MHW shoreline are assigned a null value.
- Orthometric and ellipsoidal conversions may still be made at land points, as only conversions involving tidal datums will be invalid inland of the buffer zone along coastline.



Utilizing VDatum: Input

NOAA's Vertical Datum Transformation - v3.2

Horizontal Information

Source	Target
Datum: NAD83(2011/2007/CORS96/HARN) - North Am...	NAD83(2011/2007/CORS96/HARN) - North Am...
Coord. System: UTM (northing, easting)	UTM (northing, easting)
Unit: meter (m)	meter (m)
Zone: 19	18

Vertical Information

Source	Target
Datum: NAVD88/GUVD04/NMVD03/ASVD02/PRVD02/V...	MHW
Unit: meter (m)	meter (m)
<input checked="" type="radio"/> Height <input type="radio"/> Sounding	<input checked="" type="radio"/> Height <input type="radio"/> Sounding
<input checked="" type="checkbox"/> GEOID model: GEOID09	<input type="checkbox"/> GEOID model:

Point Conversion | ASCII File Conversion | **File Conversion**

File type: LiDAR (.LAS)

Use VDatum's Source Georeferencing Setup (above) Use Source File(s) Built-in Georeferencing Setup

File name(s): J:\vdatum\qa_testing\las\w_georef\ARRA-LFTNE_Maine_2010_06454966 (1).las;

Save as: J:\vdatum\qa_testing\las\w_georef\result

Excluding NODATA points (points with coors. = -999999)

Convert

File Name: ARRA-LFTNE_Maine_2010_06454966_utm.las
File Size: 137,992 kb
File Date: Thu Feb 21 10:57:06 2013

File Type: LAS
File Signature: LASF
File Source ID: 0
Global Encoding: 0
LAS Version: 1.2

System Identifier: vdatum.noaa.gov
Generating Software: vdatum 3.2
File Creation Date: February 24, 2012
Per-point Time: YES
Per-point RGB: NO

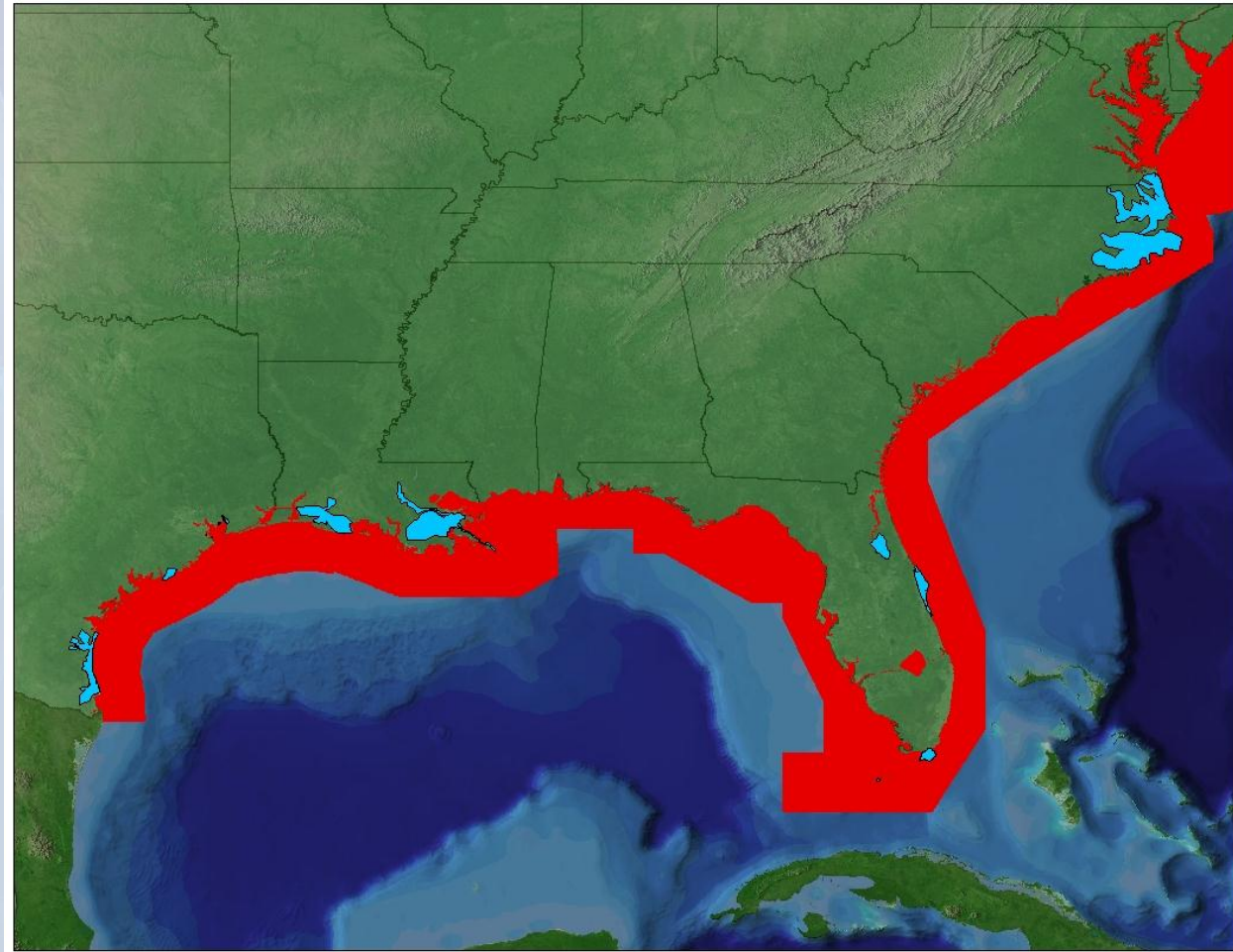
Georegistration

Coordinate System: NAD83 / UTM zone 19N
Vertical Citation: vert: MHW:m:height
Horizontal Units: Meters
Vertical Units: Meters

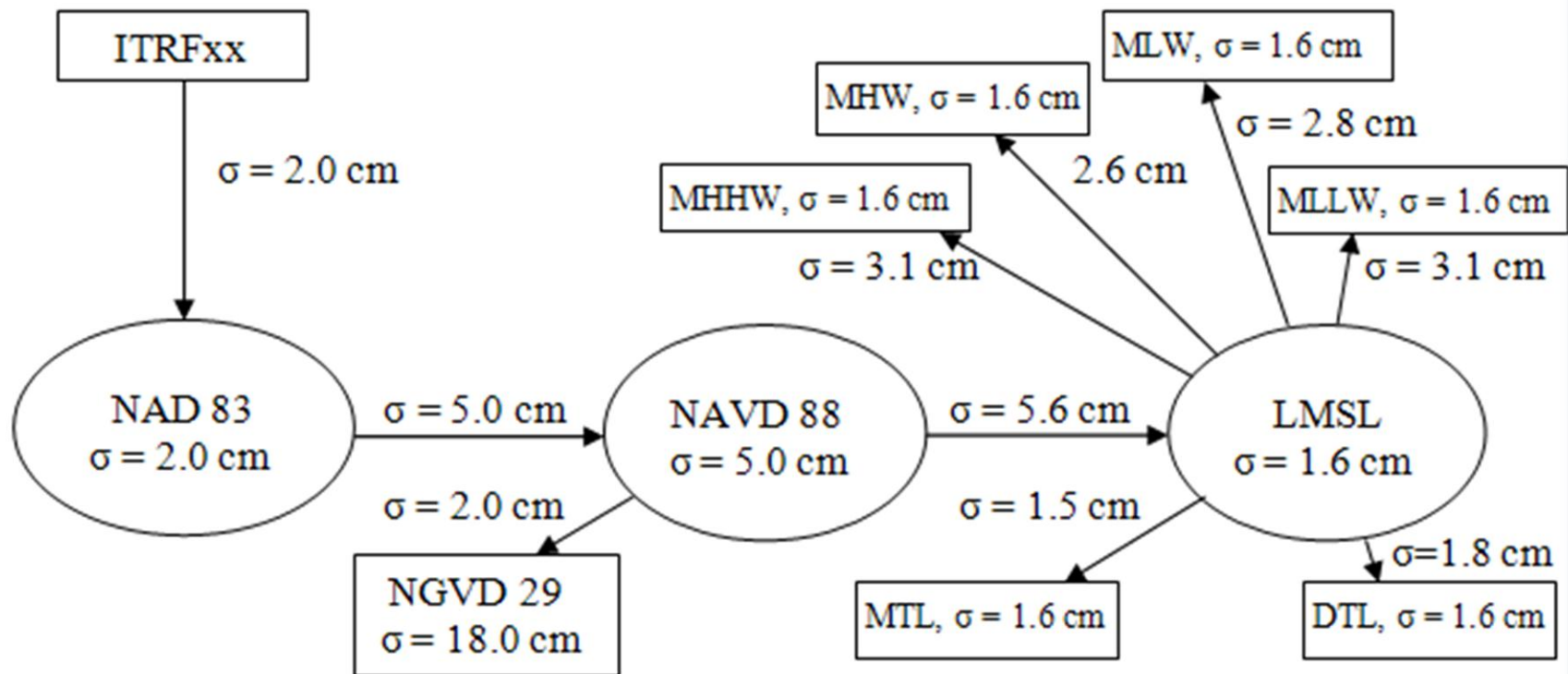


Software Updates:

- Auto detection of tidal areas
- Support for Low Water Datum (LWD) transformation in non-tidal areas
- Updated GEOID model support (96-12A)



VDatum Uncertainty Modeling



See: vdatum.noaa.gov/docs/est_uncertainties.html



VDatum Uncertainty Modeling (cm)

(ITRFxx to the tidal datum, the transformation with the greatest uncertainty)

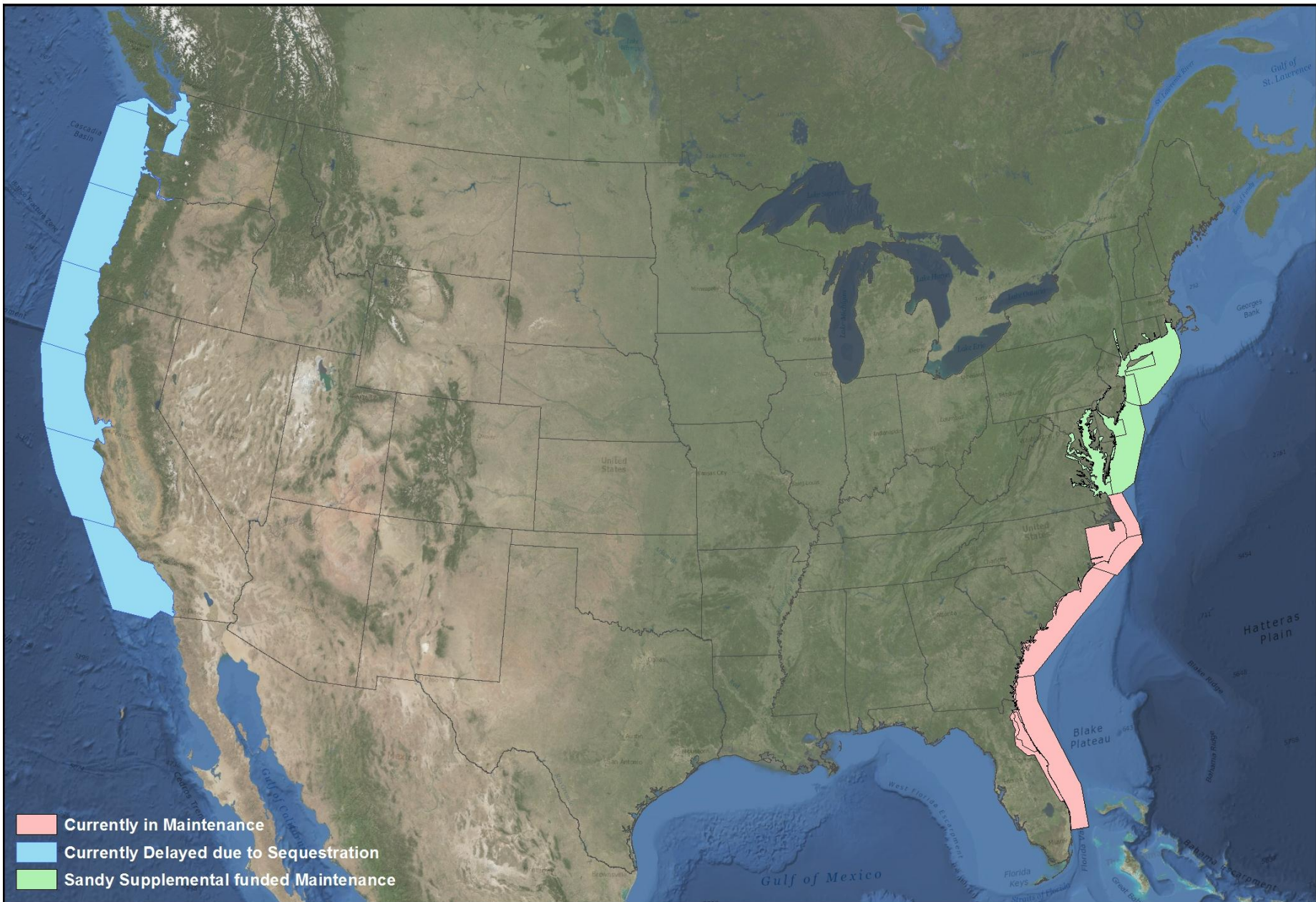
VDATUM REGION	MAXIMUM CUMULATIVE UNCERTAINTY
California - Southern California from Morro Bay south to US/Mexico border	8.1
California - Monterey Bay to Morro Bay	8.0
California - San Francisco Bay Vicinity	9.8
Oregon/ California – Punta Gorda to Cape Blanco	13.1

Uncertainties that are constant for all VDatum regions of the U.S.

TRANSFORMATION			SOURCE DATA		
ITRFx to NAD83	NAD83 to NAVD88	NAVD88 to NGVD29	NAD83	NAVD88	NGVD29
2.0	5.0	2.0	2.0	5.0	18.0

REGION	TRANSFORMATION							SOURCE DATA	MCU
	NAVD88 to MSL	MSL to MHHW	MSL to MHW	MSL to MTL	MSL to DTL	MSL to MLW	MSL to MLLW	All Tidal Datums	
California - Southern California from Morro Bay south to US/Mexico border	1.6	1.4	0.9	0.1	0.4	0.8	0.9	1.3	8.1
California - Monterey Bay to Morro Bay	1.1	0.8	1	0.7	1	0.9	1.7	1.1	8
California - San Francisco Bay Vicinity	0.1	3.7	4.5	2	2.5	4.2	5.8	1.4	9.8
Oregon/ California – Punta Gorda to Cape Blanco	4.4	2	1.6	2.5	4.4	5.7	9.5	1.2	13.1





- Currently in Maintenance
- Currently Delayed due to Sequestration
- Sandy Supplemental funded Maintenance



0 125 250 500 750 1,000
 Kilometers

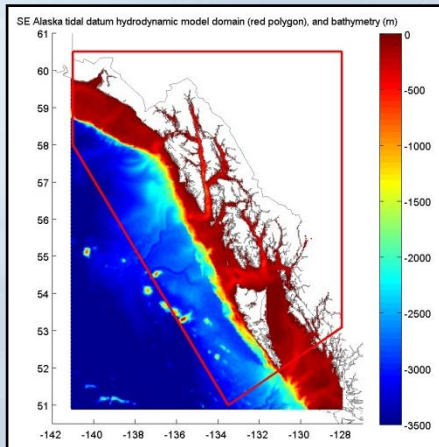
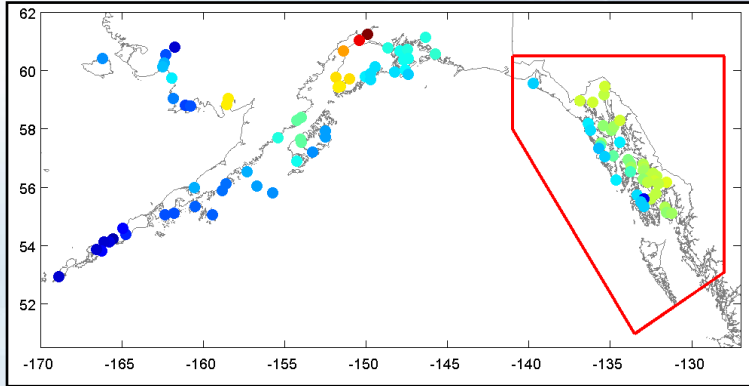
VDatum Production and Maintenance Schedule



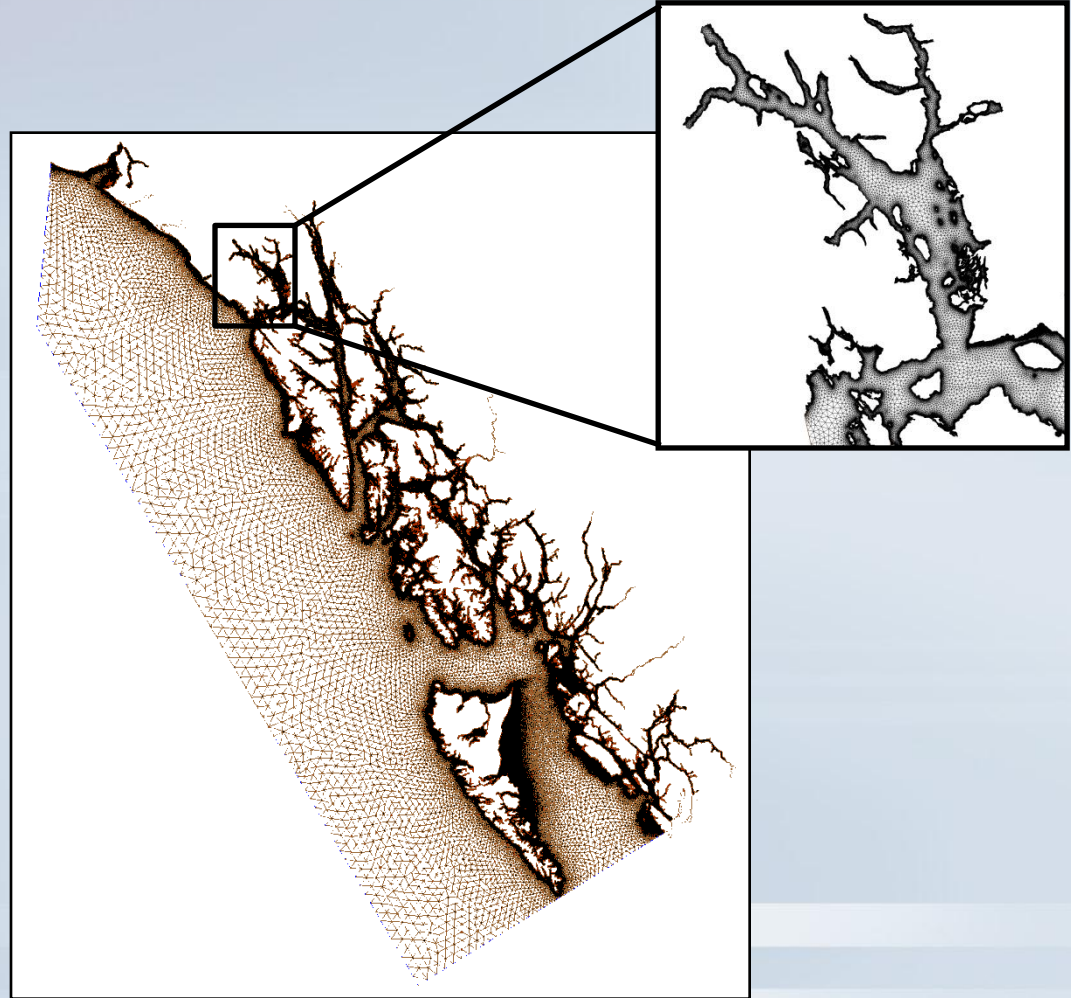
Exploratory Alaska Tidal Modeling

Southeast Alaska

Model Domain, Shoreline, and Tidal Data (M_2 amplitude shown in color)



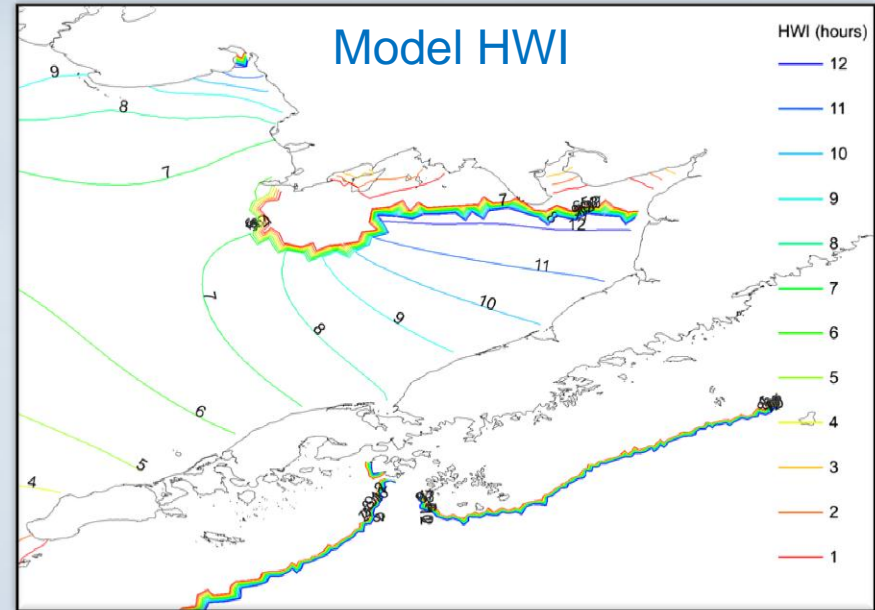
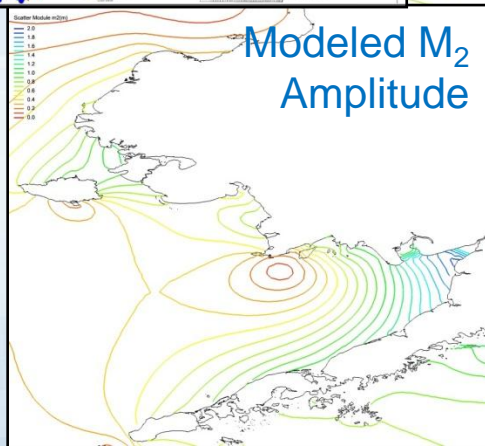
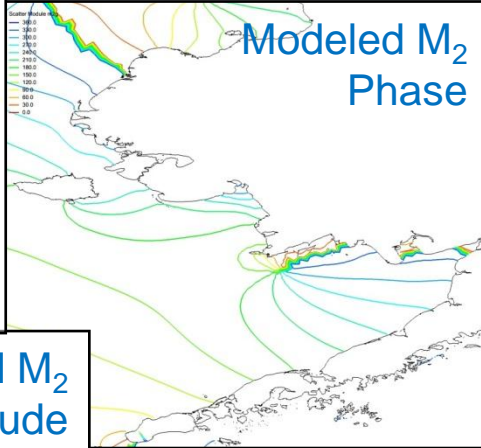
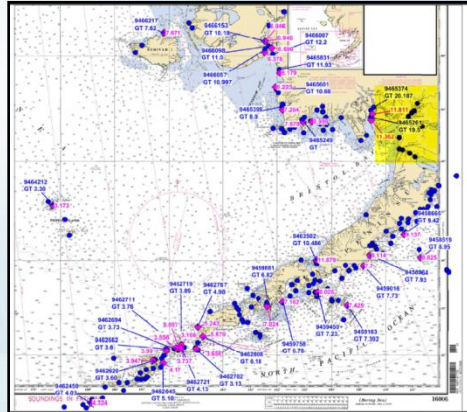
Bathymetry



National Oceanic and Atmospheric Administration

Exploratory Alaska Tidal Modeling

Western Alaska

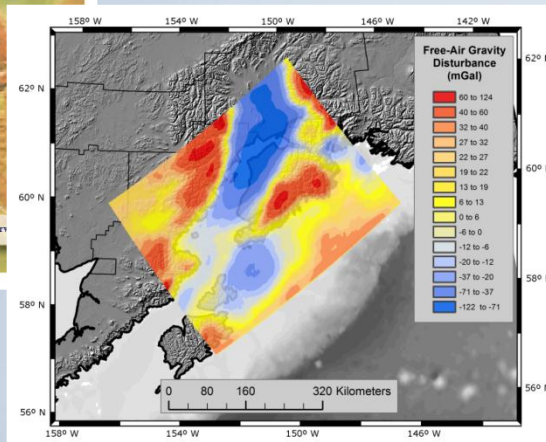
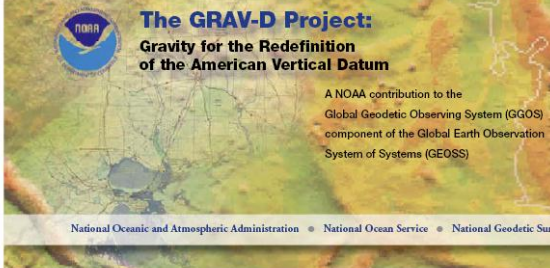


National Oceanic and Atmospheric Administration

GRAV-D: (Gravity for the Redefinition of the American* Vertical Datum)



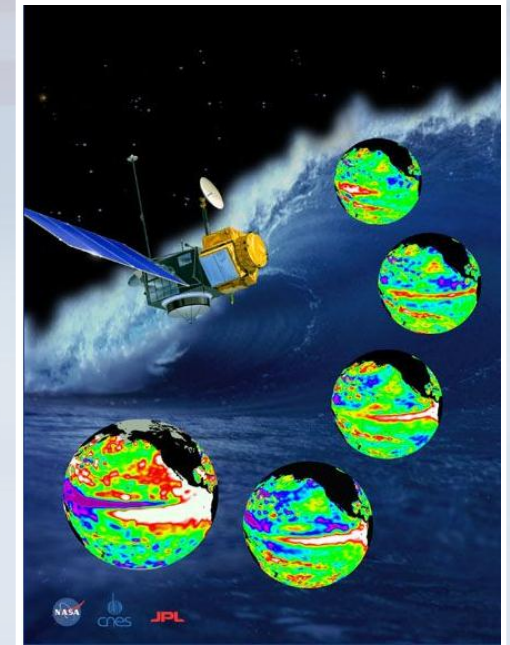
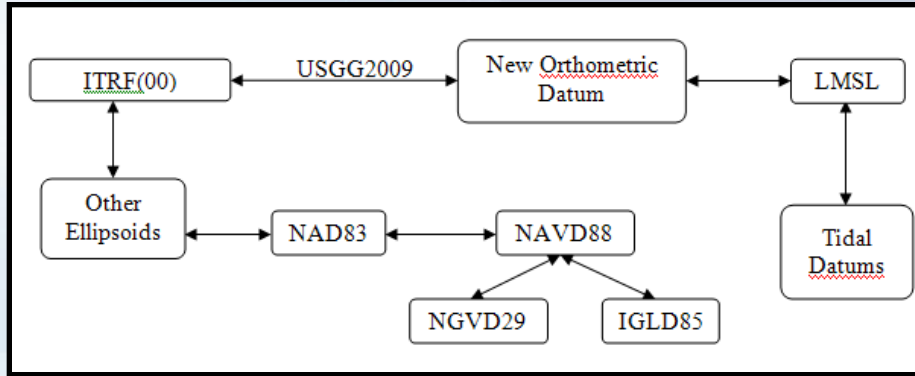
- An NGS project whose target is to redefine the official civilian vertical datum as the geoid, realized through the use of GNSS technology and a gravimetric geoid model over at least the United States and its territories
- *Official NGS policy as of Nov 14, 2007*
- *Re-define the Vertical Datum of the USA by 2022 (at current funding levels)*
- *Part of the NGS 10 year plan (2013-2023)*
- *Target: 2 cm accuracy orthometric heights from GNSS and a geoid model*



National Oceanic and Atmospheric Administration

Future Enhancements: Next Generation TSS Development

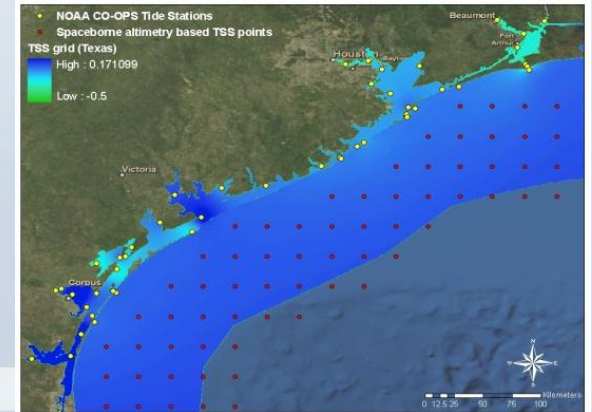
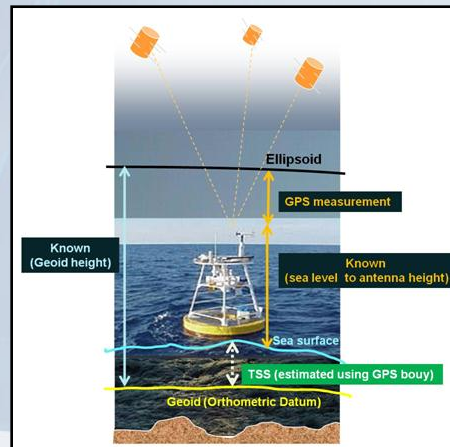
New Proposed Transformation Roadmap based on a purely Gravimetric GEOID



A Must: GPS Campaign on benchmarks to determine new relationships



Wish List: GPS tide buoys to be utilized for data input, validation, and calibration inshore and offshore

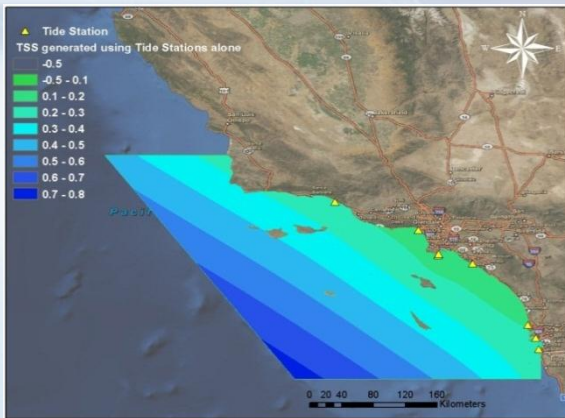


Utilization of Satellite Altimetry/Derived Products to better understand offshore Sea Surface Topography



National Oceanic and Atmospheric Administration

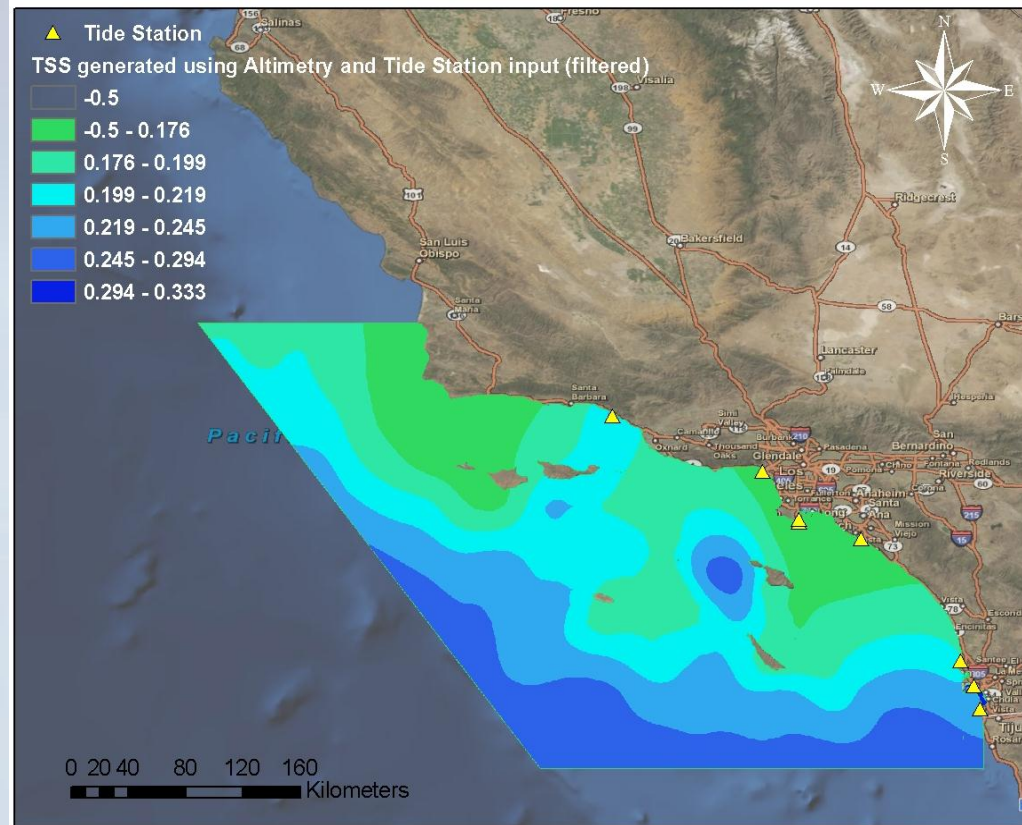
Future Enhancements: Next Generation TSS Development



TSS generated with only the 8 tide stations



TSS points derived at the location of tide stations (yellow triangle) and CNES MSS points (red dots). These TSS points are the input for TSS grid (0.001 degree spacing) creation.

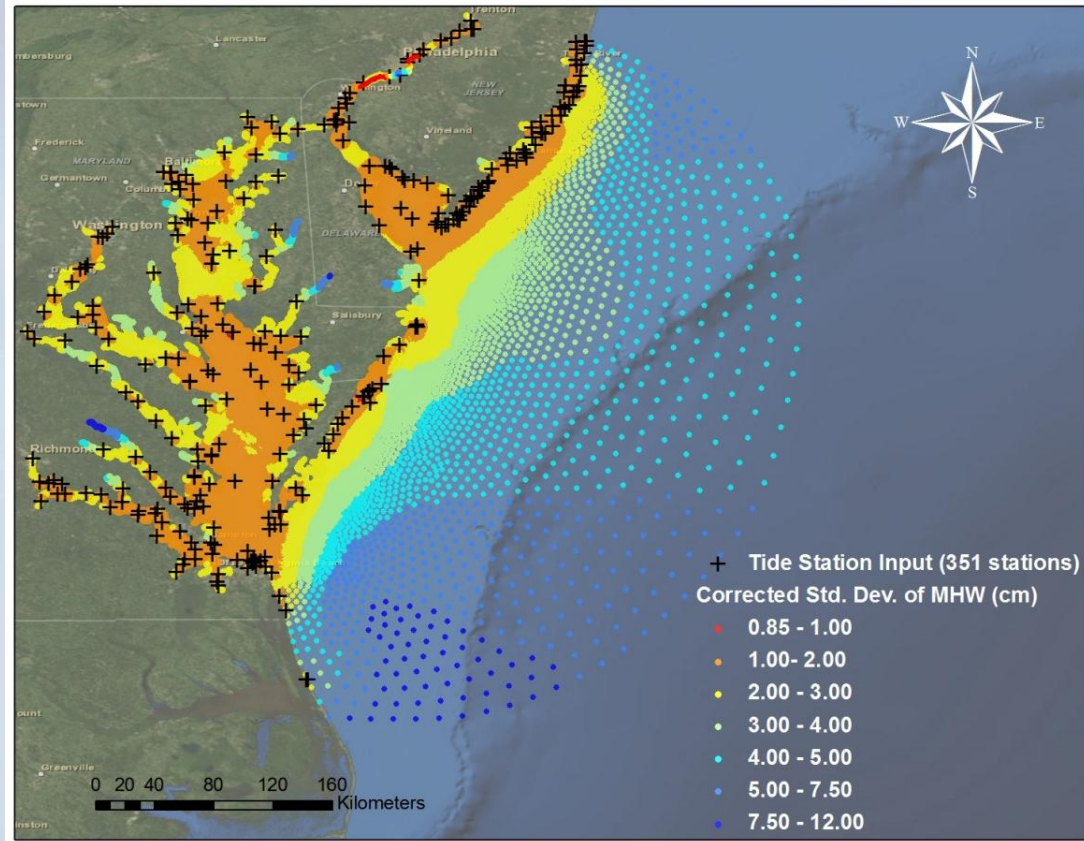
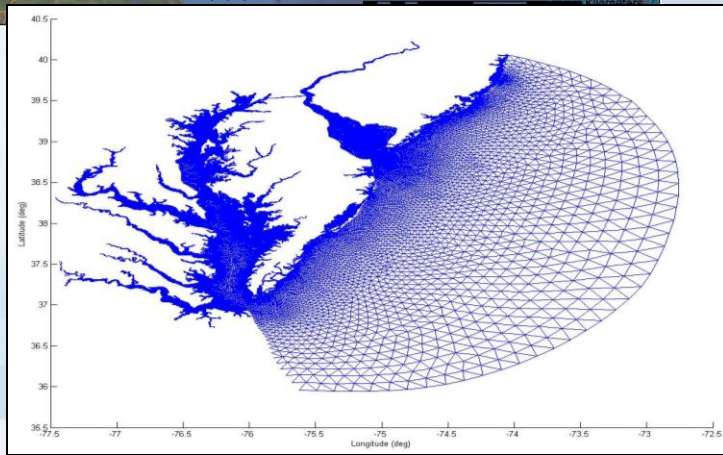
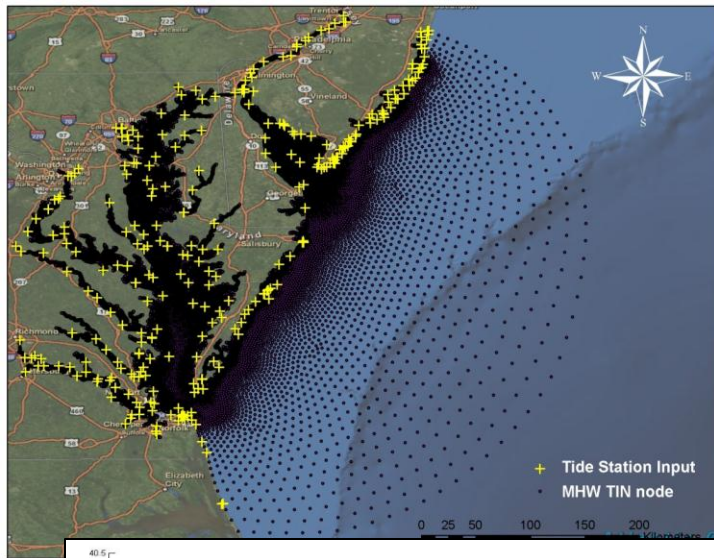


Refined TSS grid created using the derived TSS points at CNES MSS points (Gaussian filtered), and newly determined geodetic relationships at tide stations



Future Enhancements: Spatially Variable Uncertainty Estimation

- **Test Area:** Chesapeake Bay area and Delaware Bay area. 351 tide stations in this region

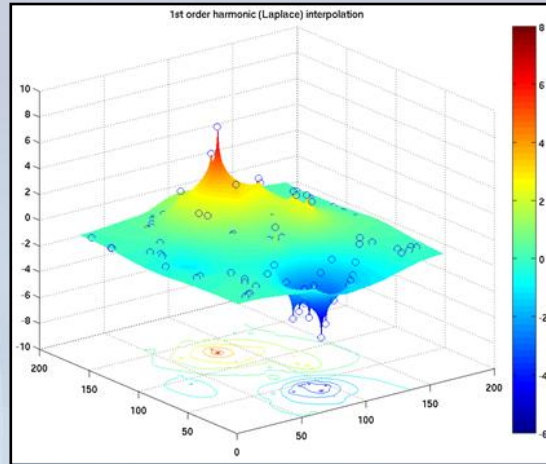


Future Enhancements: Multiple-Order Harmonic Equation

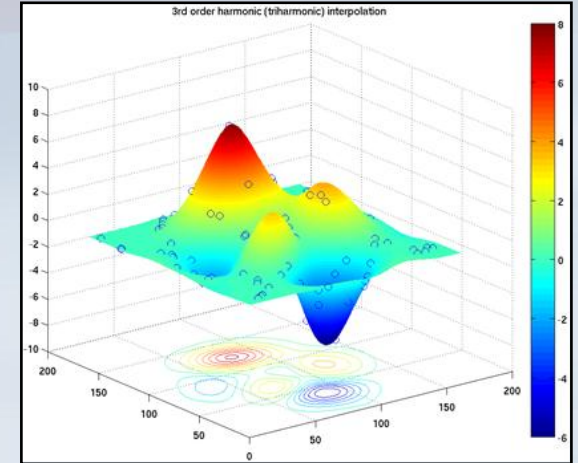
$$\sum_{k=1}^K \beta_k \Delta^k f = \sum_i F_i \delta(x - x_i, y - y_i)$$

$$\frac{\partial f}{\partial n} = \alpha(x, y) \overline{\frac{\partial f}{\partial n}}$$

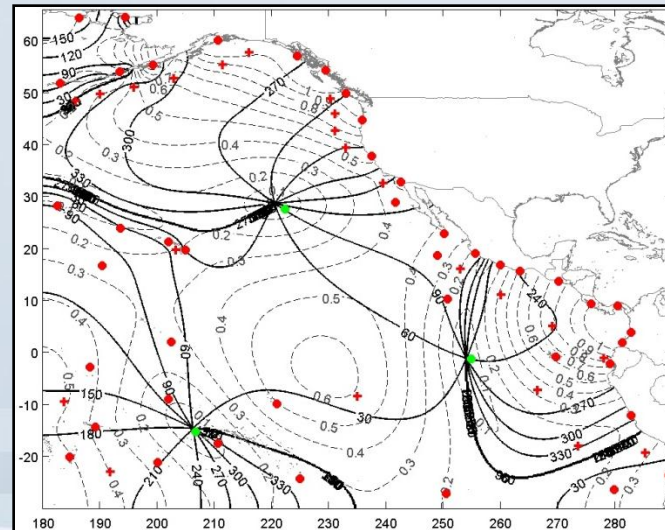
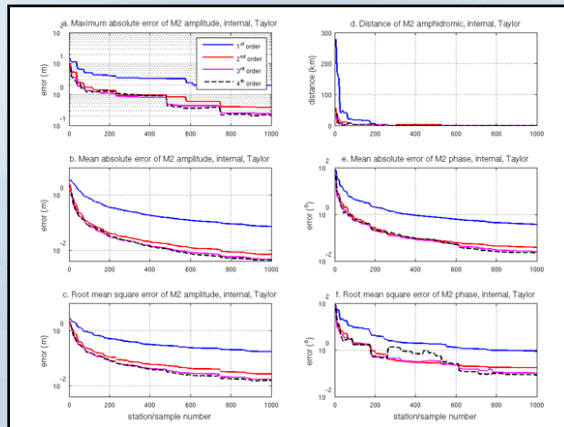
$$\frac{\partial \Delta^k f}{\partial n} = 0, (k=1, 2, 3, \dots, K-1)$$



Laplace's interpolation



Triharmonic interpolation



Future Enhancements: VDatum GIS Format Support

- **Feasibility Report:** Identify potential GIS data formats that VDatum could support.
- **Current Formats:** single point, ASCII input file, and LAS files.
- **Proposed Formats and Tools:**

Format	Data Model	Tool	Source
Shapefile	Vector	Reader and Writer	In-house
ESRI ASCII Grid	Raster	Reader and Writer	Explore Third-party tools
KML	Vector	Reader and Writer	In-house
TIFF	Raster	Reader and Writer	Explore Third-party tools

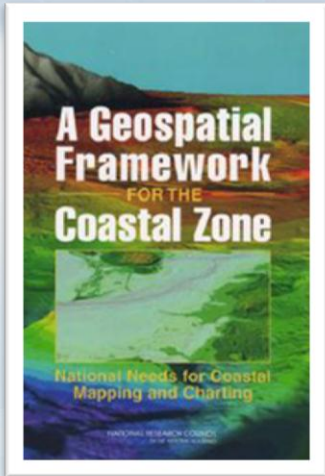


VDatum Applications



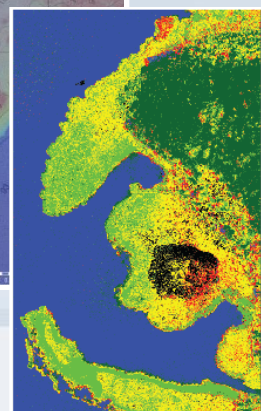
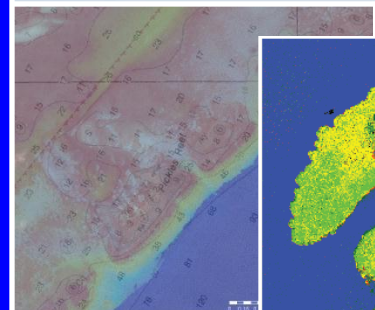
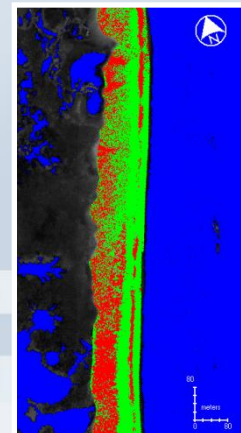
National Oceanic and Atmospheric Administration

Integrated Ocean and Coastal Mapping (IOCM)



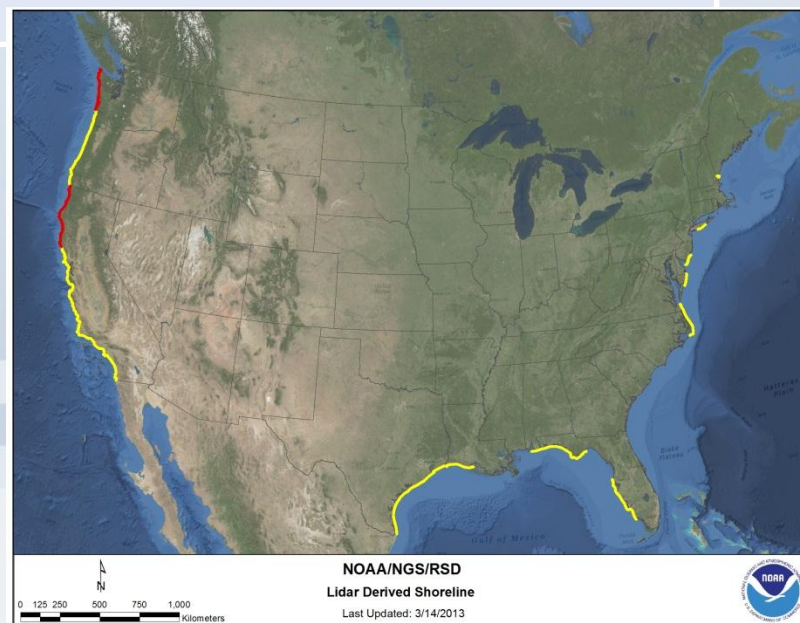
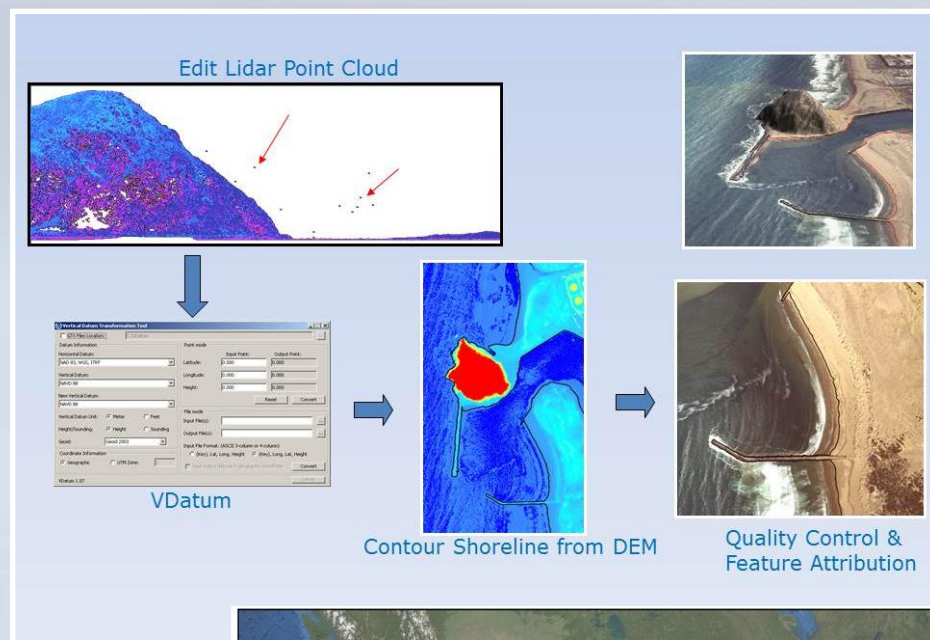
The practice of acquiring, managing, integrating and disseminating ocean and coastal geospatial mapping data in such a manner that permits these data and their derivative products to be easily accessed and used by and for the greatest range of users and purposes.

IOCM requires intra- and inter-agency coordination with a focus on streamlining operations, reducing redundancies, improving efficiencies, developing common standards, and stimulating innovation and technological development.



Shoreline Extraction: A VDatum Charting Application

- Supports delineating the National Shoreline.
- Assist in Providing the Nation With Accurate, Consistent, Up-to-Date Shoreline.
- Is utilized in defining the United States' territorial limits.
- Important applications:
 - NOAA nautical charting
 - Coastal resource management
 - Storm surge and coastal flooding modeling
 - GIS analysis
 - Coastal geomorphology studies
 - Many more...



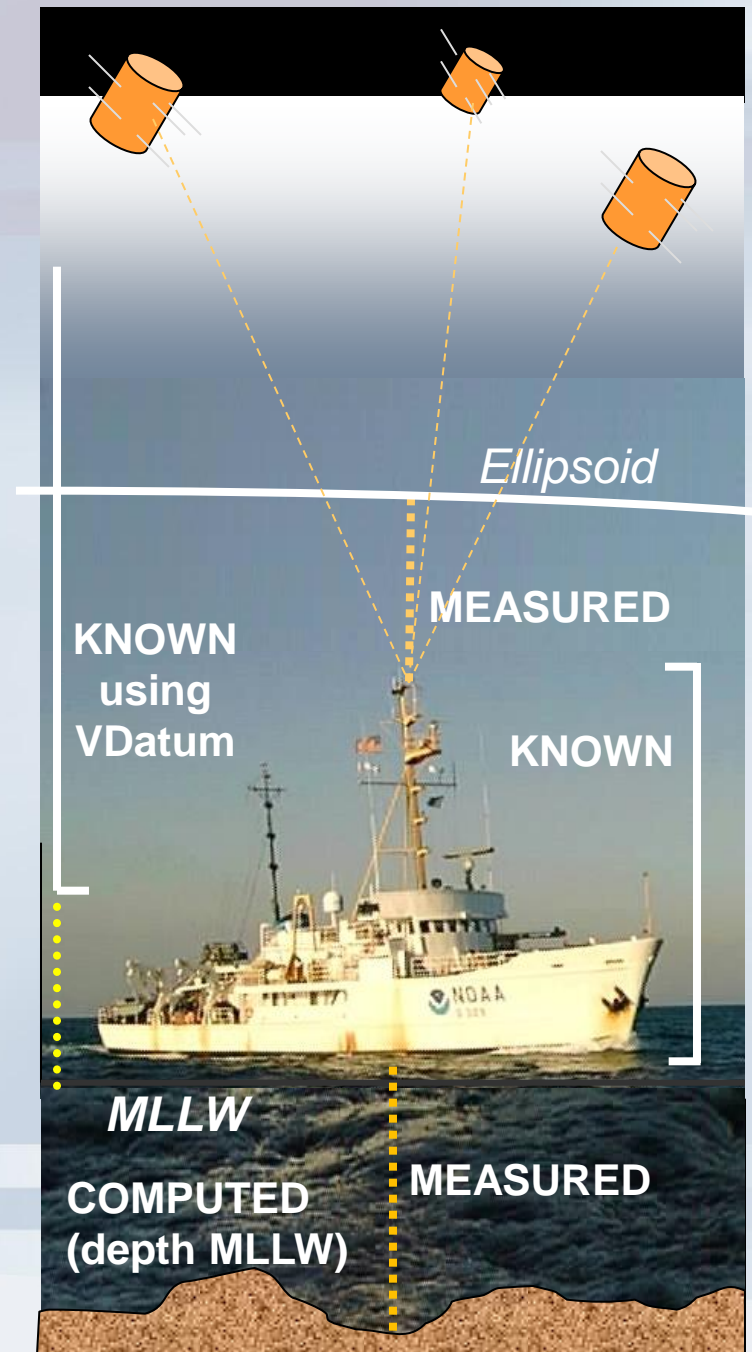
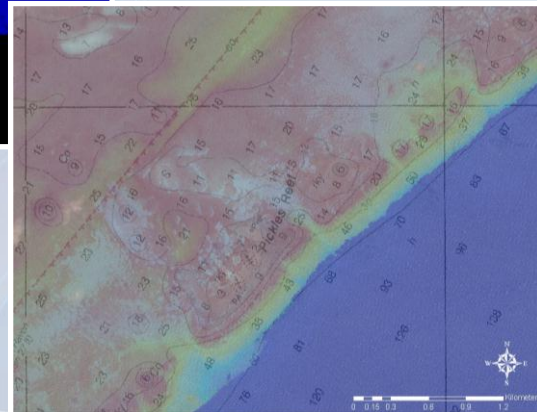
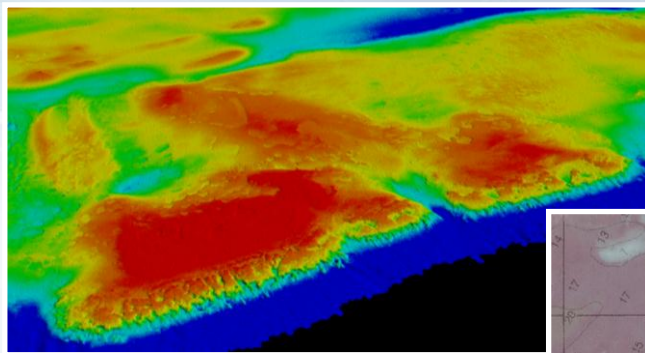
National Oceanic and Atmospheric Administration

Surveying on the Ellipsoid:

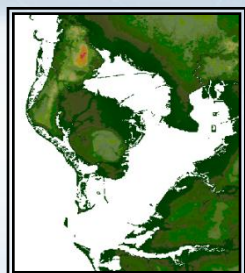
A VDatum Charting Application

Advantages:

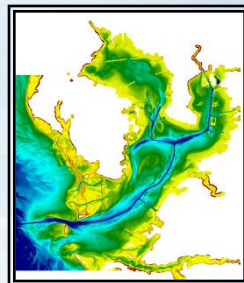
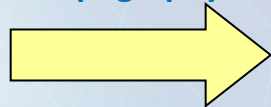
- Decouple tide measurement from survey
- Reduce vertical uncertainty from heave, dynamic draft



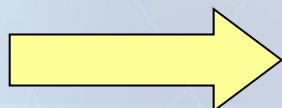
VDatum: Used to Create Digital Elevation Models



Topography



Bathymetry



VDatum

NOAA's Vertical Datum Transformation - v3.2

Horizontal Information

Source	Target
Datum: NAD83(2011/2007/CORS96/HARN) - North Am...	NAD83(2011/2007/CORS96/HARN) - North Am...
Coor. System: Geographic (latitude, longitude)	Geographic (latitude, longitude)
Unit: meter (m)	meter (m)

Vertical Information

Source	Target
Datum: NAD83(2011/2007/CORS96/HARN) - North Am...	MHW
Unit: meter (m)	meter (m)

Height Sounding Height Sounding

GEOID model: GEOID model: GEOID12A

Point Conversion | ASCII File Conversion | File Conversion

File name(s):

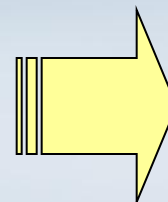
Delimiter: comma | Lon/East/Y: 0 | Lat/North/X: 1 | Height/Z: 2 | Skip (lines): 0

Save as:

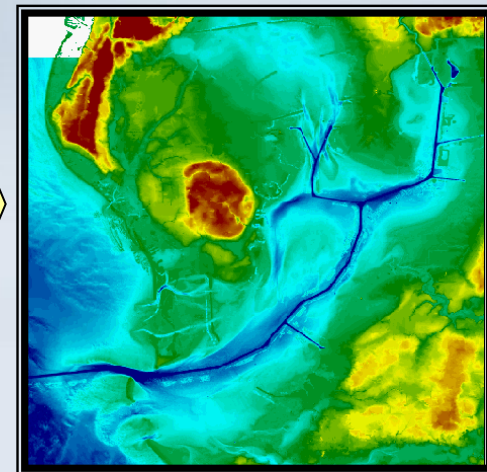
Excluding NODATA points (points with coords. = -999999)

Append results to the end of the point record

Convert



Topo/ Bathy
Digital Elevation Model



Applications for Seamless Bathy/Topo Datasets:

- Inundation modeling from storm surge, tsunamis, and sea level rise.
- Erosion, accretion, renourishment
- Analyzing storm impacts
- Determining setback lines
- Determining local, state, and national boundaries
- Navigation products and services
- Habitat restoration
- Shoreline Change Analysis
- Analyzing environmental and natural resources
- Permitting



National Oceanic and Atmospheric Administration

Utilizing VDatum for Digital Elevation Model Creation: Tsunami Inundation

NOAA Tsunami Inundation Digital Elevation Models (DEMs)

click area on map above to view the DEM regions

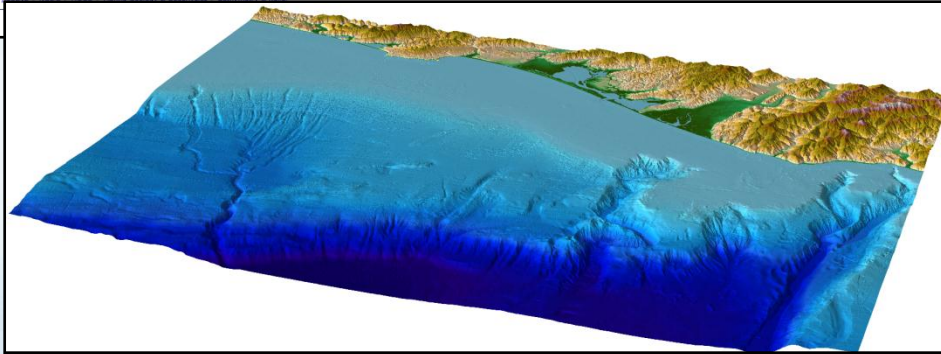
Legend:

- Arena Cove DEM Boundary
- Coastline
- CSC lidar
- USGS lidar
- NED DEM
- CSUMB multibeam
- ENC extracted points
- 2007 NOS survey
- NGDC multibeam
- Pre-1990 NOS surveys

Project contact:
 Lisa A. Taylor@noaa.gov
 phone: 303-497-6767

Technical contact:
 Barry Eshing@noaa.gov
 phone: 303-497-6505

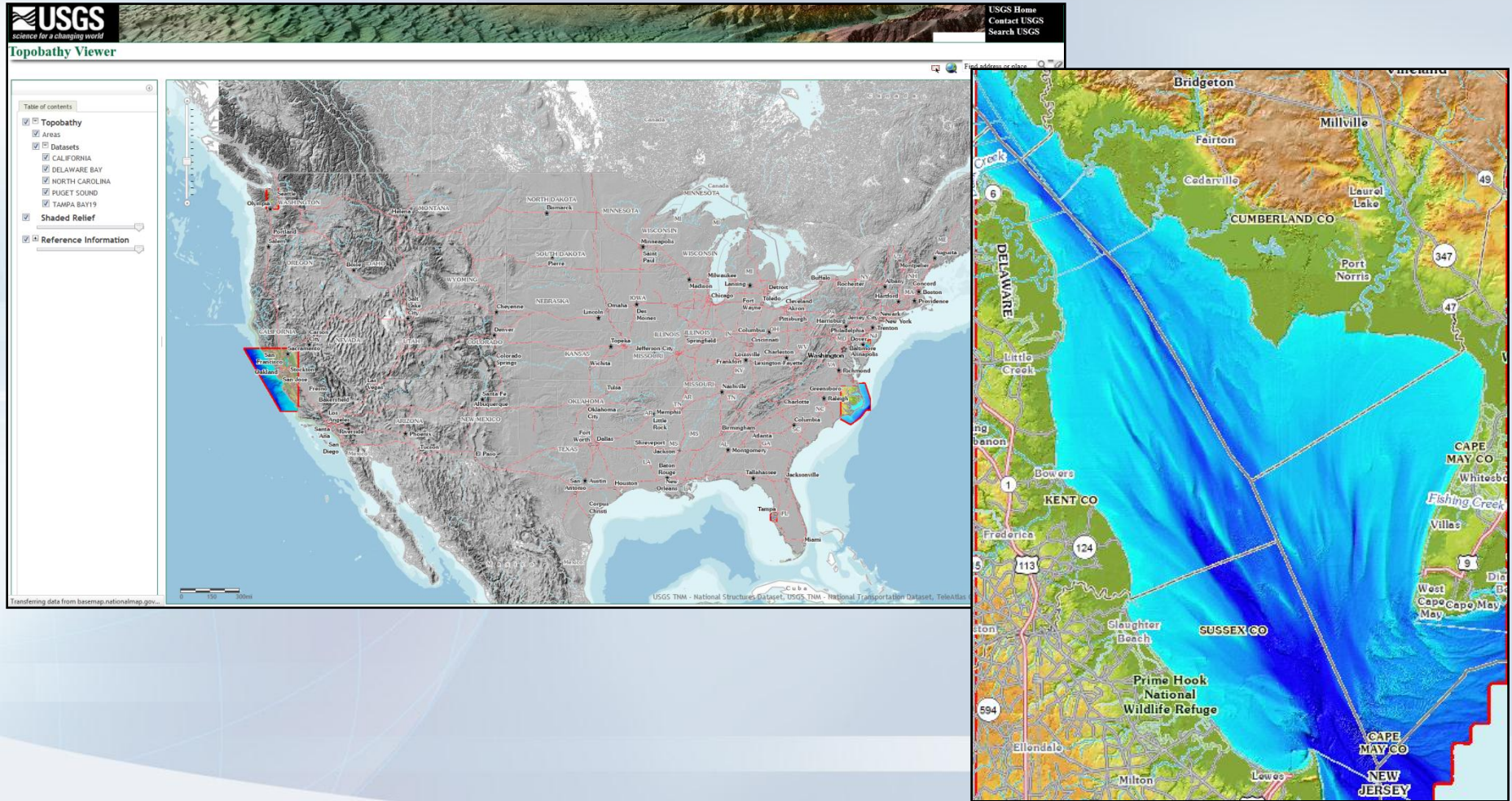
How to Cite DEMs:
 For each DEM, cite the accompanying DEM Development Report.



Source	Year	Data Type	Spatial Resolution	Original Horizontal Datum/Coordinate System	Original Vertical Datum
NGDC	1921 to 2008	NOS hydrographic survey soundings	Ranges from less than 10 m to 600 m (varies with scale of survey, depth, traffic, and probability of obstructions)	NAD 83 geographic	MLLW
NGDC	1984 to 2006	Multibeam swath sonar	gridded to 1 arc-second	WGS 84 geographic	Assumed Mean Sea Level
University of New Hampshire, Center for Coastal and Ocean Mapping, Joint Hydrographic Center	2009	Multibeam swath sonar	40 meter grid	WGS 84 geographic	Inferred Mean Sea Level
U.S. Army Corps of Engineers	2009	Hydrographic survey	Not Available	NAD 83 California State Plane I (feet)	MLLW
California State University Seafloor Mapping Laboratory	2005	Multibeam swath sonar	1 meter grid	WGS 84 UTM 10 North	NAVD 88
NOAA Office of Coast Survey	1992 to 2008	ENC extracted soundings	Not Available	WGS 84 geographic	MLLW



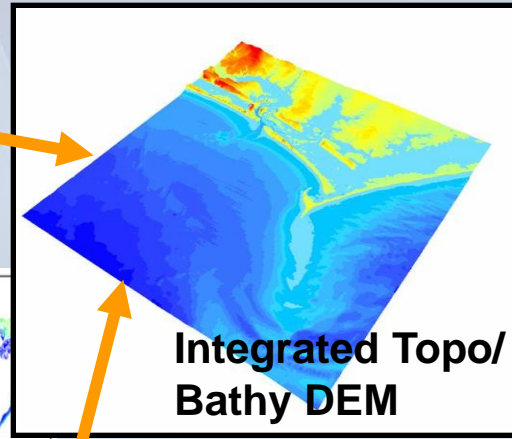
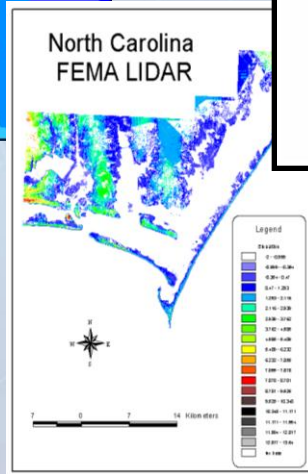
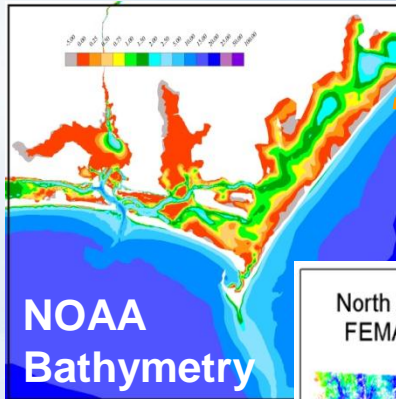
Utilizing VDatum for Digital Elevation Model Creation



National Oceanic and Atmospheric Administration

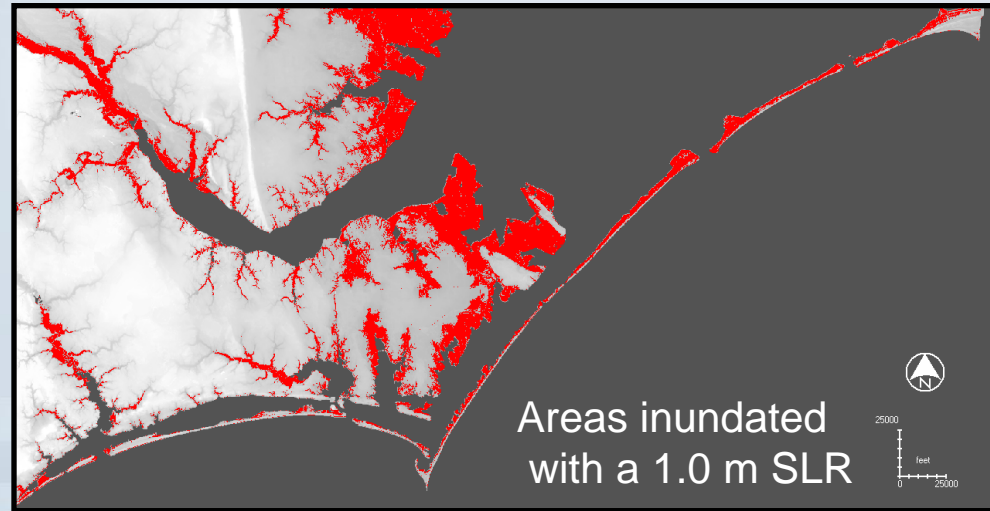
North Carolina Sea Level Rise Project

A VDatum application

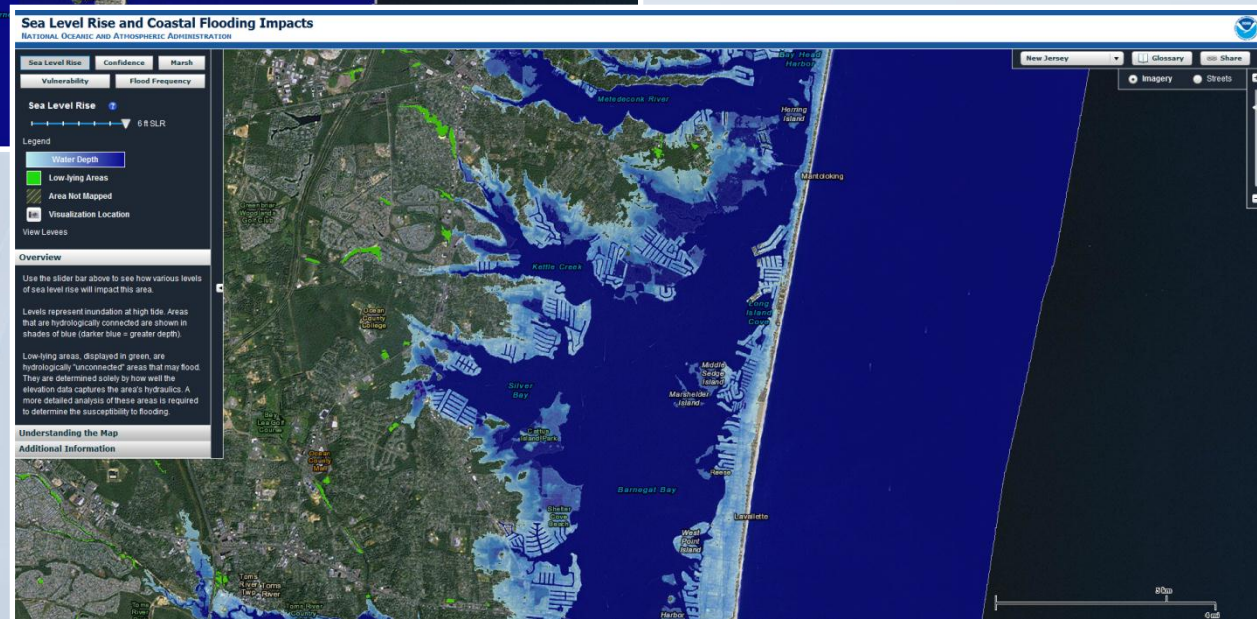
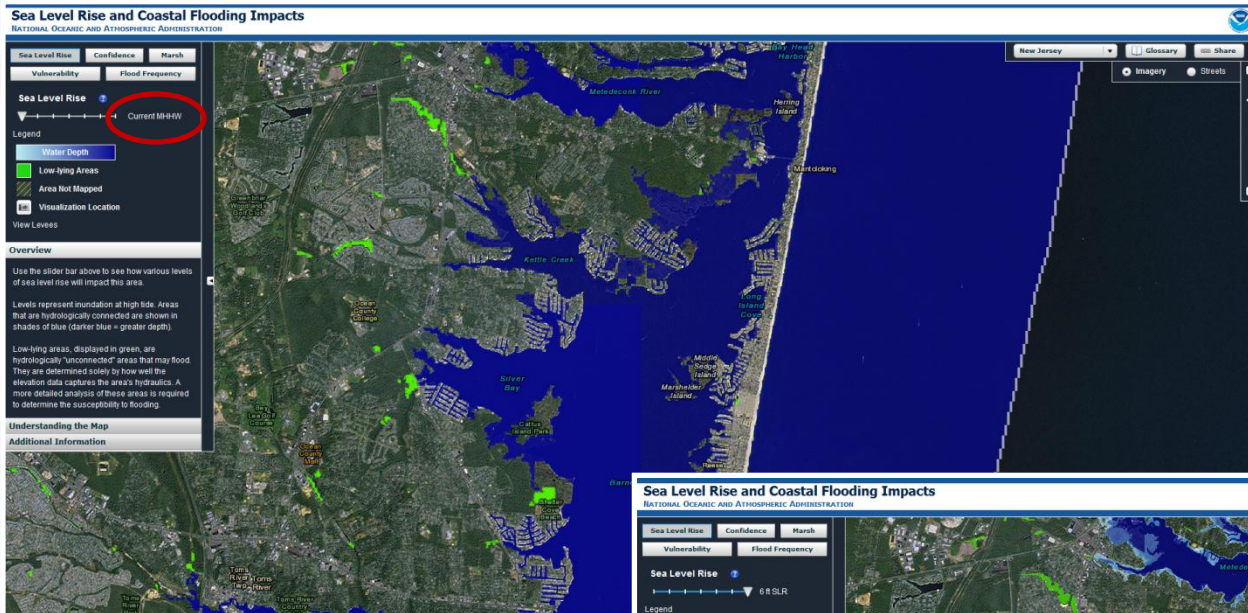


← Create a DEM
To assess
Sea Level Rise

Land
Elevations

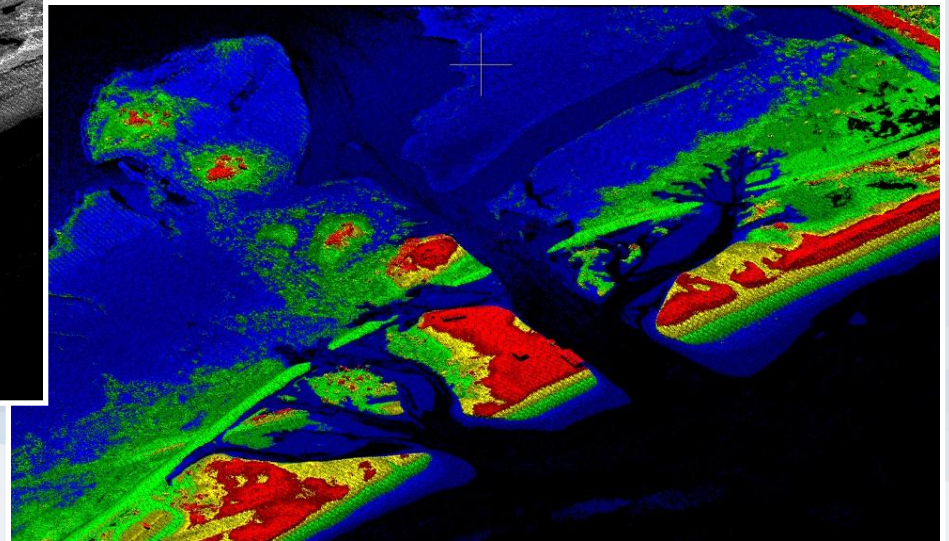
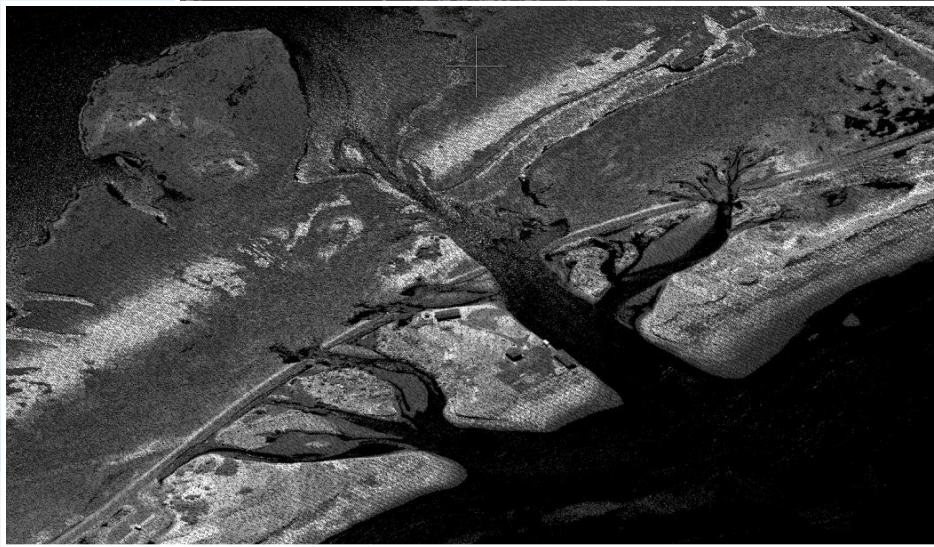
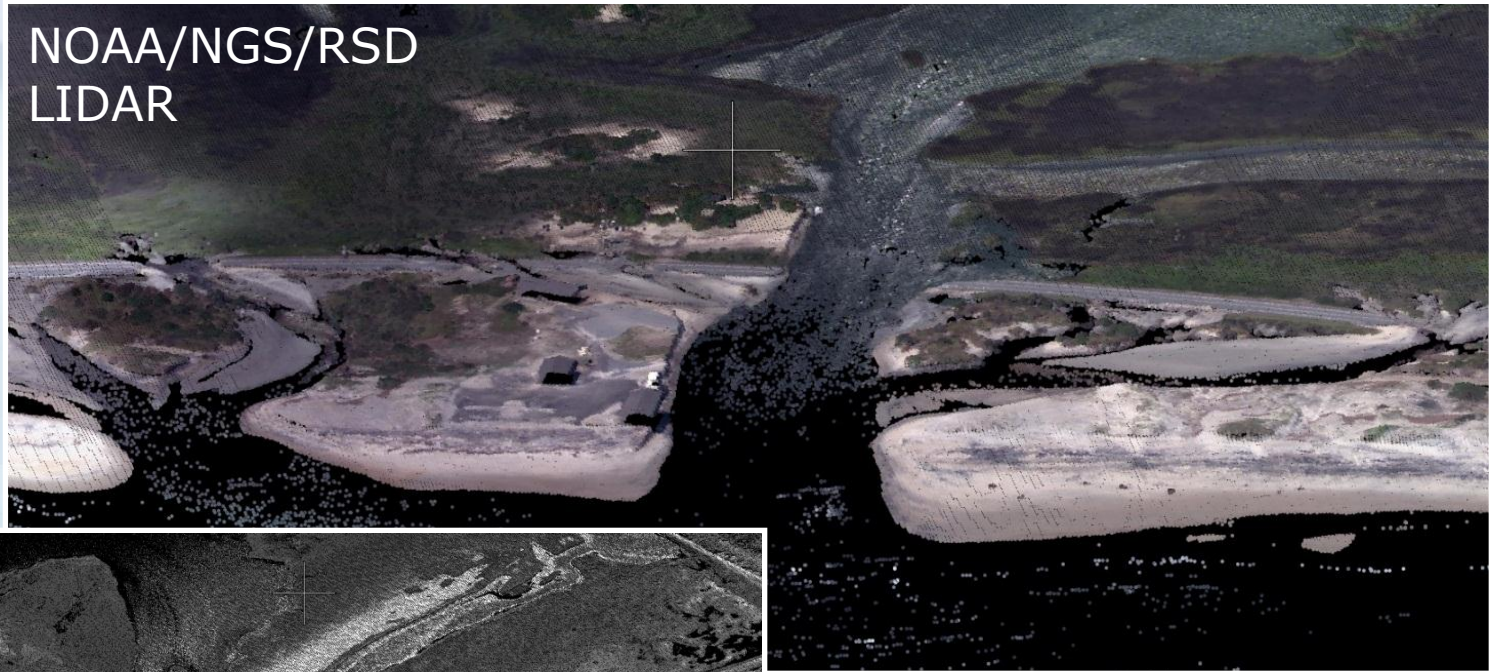


Sea Level Rise/Coastal Flooding



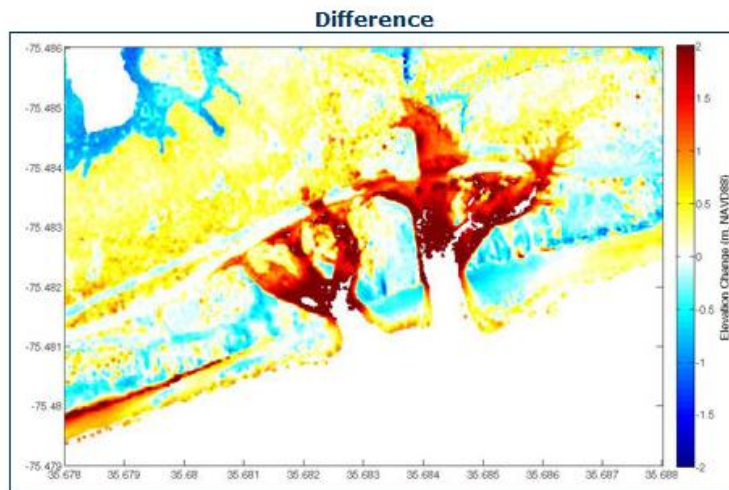
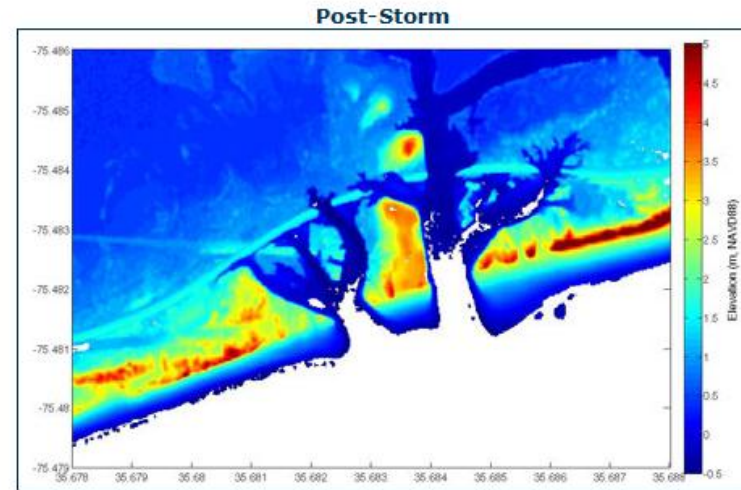
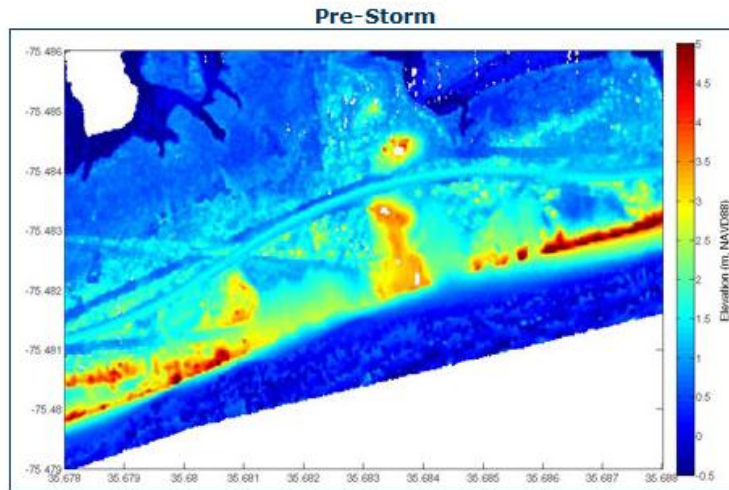
Emergency Response

NOAA/NGS/RSD
LIDAR



National Oceanic and Atmospheric Administration

Emergency Response



Location 5: Lidar topography from November 27-December 1, 2009 (Pre-Storm) and August 28-29, 2011 (Post-Storm) and topographic change (Difference) for a portion of the Outer Banks in the Pea Island National Wildlife Refuge, NC. In the pre-storm image, note the two particularly low elevation areas between a relative high. During the storm, surge and waves were funneled through the lower areas, carving two breaches (post-storm image). The difference image shows the intricate pattern of erosion associated with the formation of the breaches. See [pre- and post-storm photo comparisons](#) for additional discussion.

Courtesy of USGS



National Oceanic and Atmospheric Administration

Thank You!

Contact Information:

Email: *vdatum.info@noaa.gov*

Website: *<http://vdatum.noaa.gov>*



National Oceanic and Atmospheric Administration