



1st Tides and Water Levels Working Group Meeting

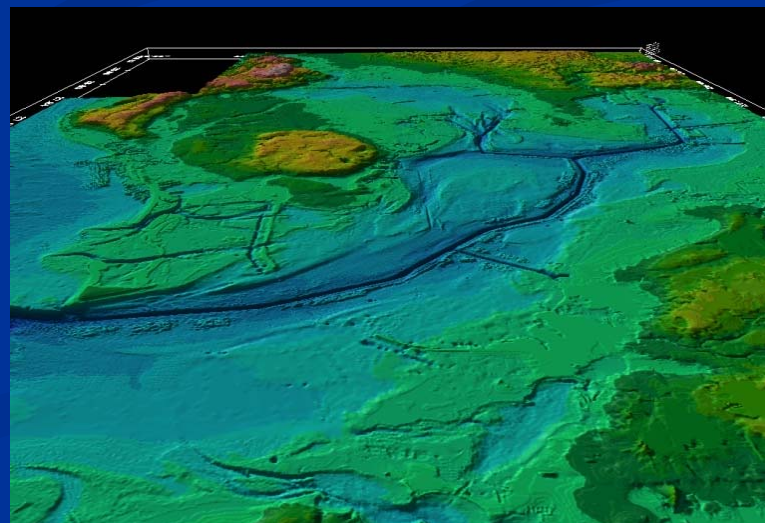
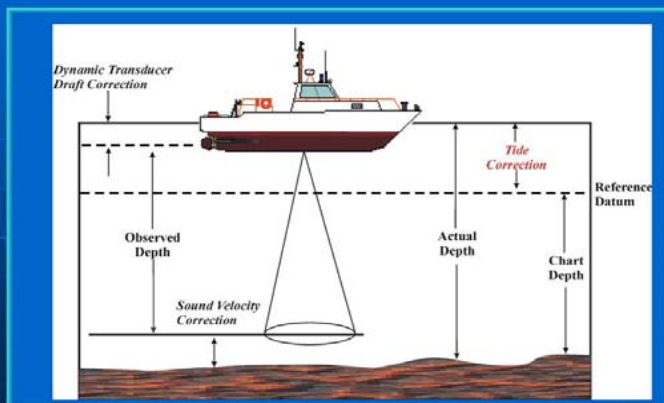


Overview of Recent Tidal Projects in the United States

Stephen Gill

National Oceanic and Atmospheric Administration, National Ocean Service
Center for Operational Oceanographic Products and Services

SUPPORT FOR HYDROGRAPHIC SURVEYS



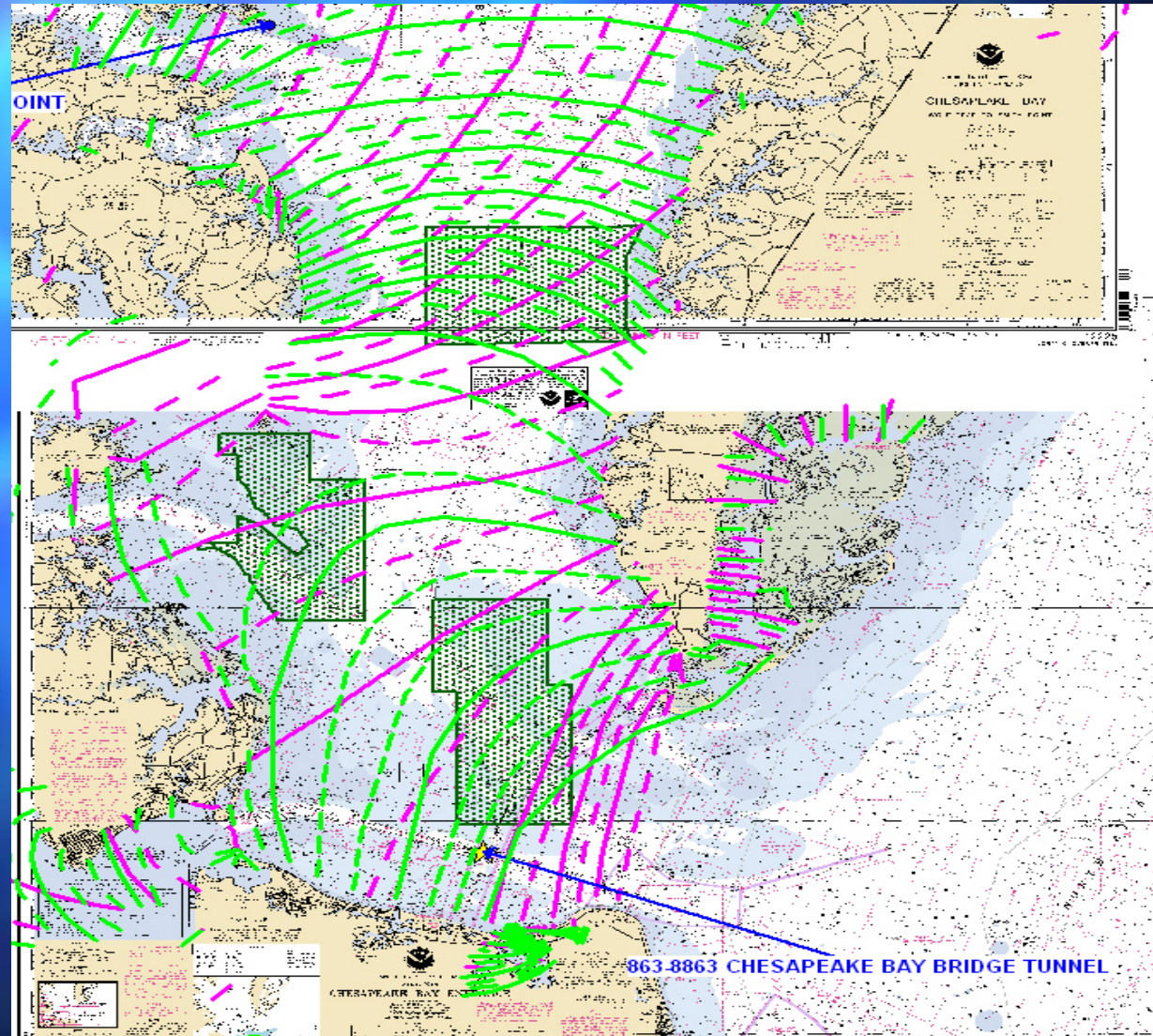


1st TWLWG Meeting



- **Tidal Constituent and Residual Interpolation Tool – TCARI**
- **NOAA’s Vertical Datum Transformation Tool - VDatum**
- **Harmonic Analysis Procedures**
- **Electronic Tide Predictions**

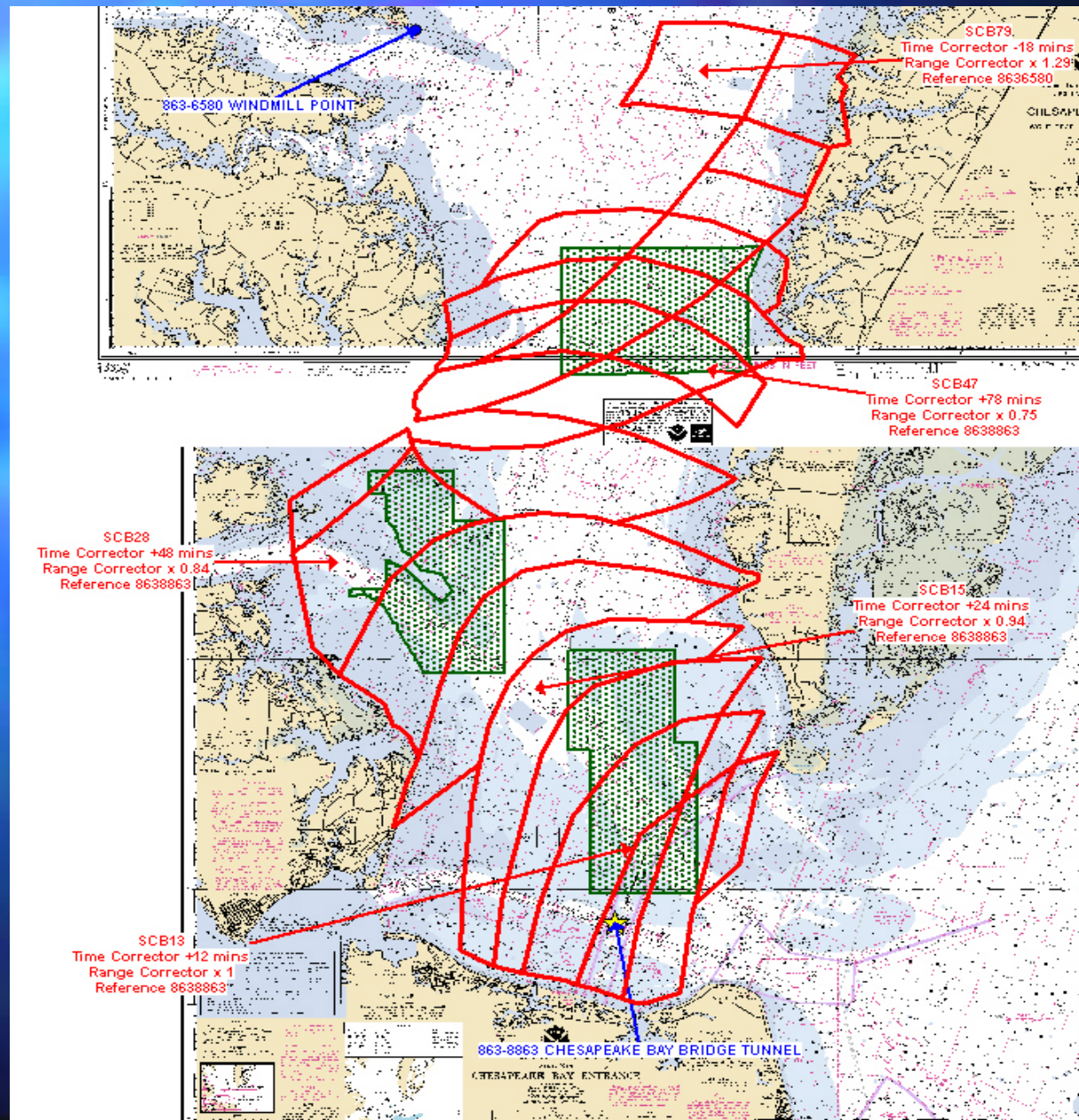
Overlay of Co-Tidal and Co-Range Maps for Tidal Zoning



Co-Range – purple: Co-Tidal - Green

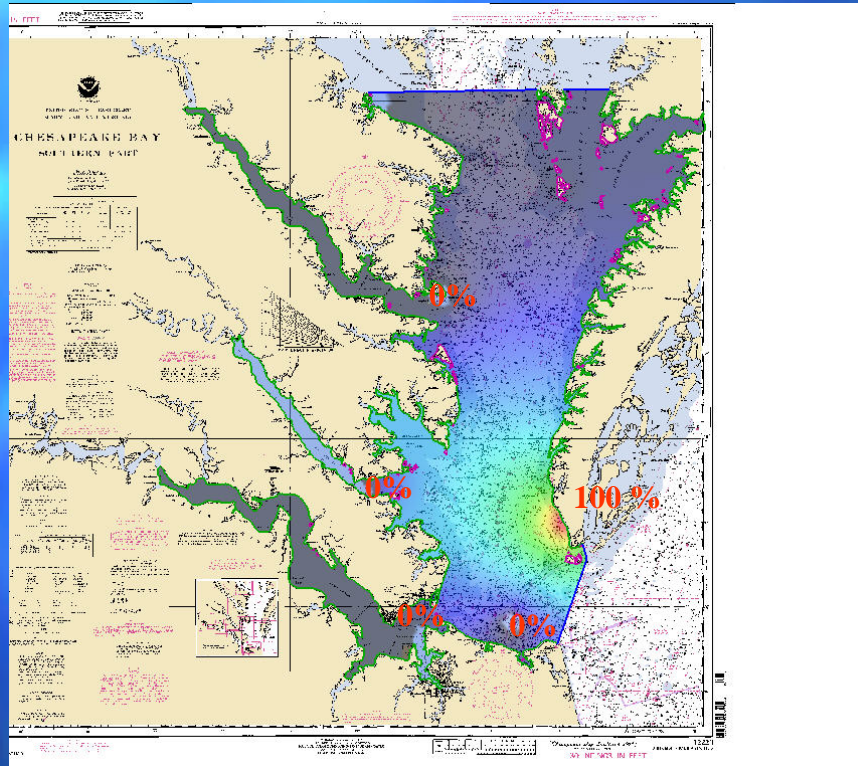


Discrete Tidal Zoning



How TCARI Interpolates

Spatial Interpolation Using Weighting Functions

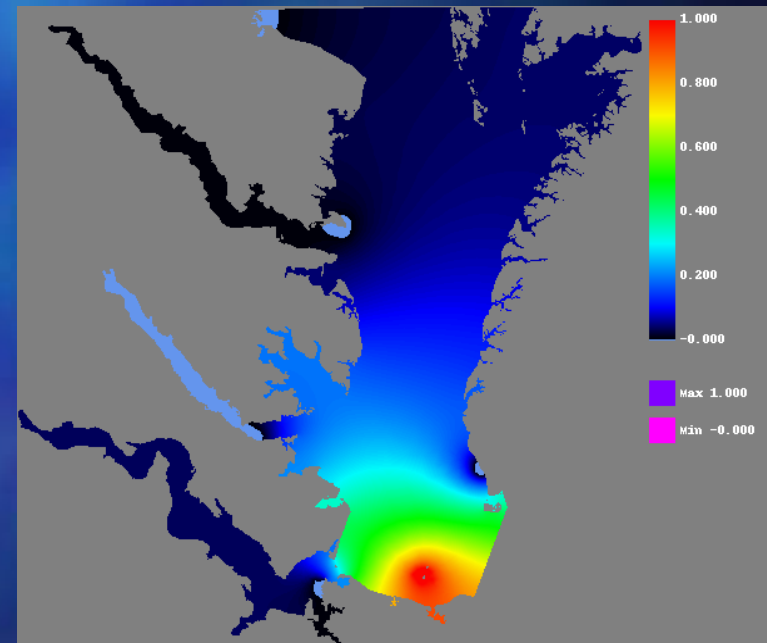
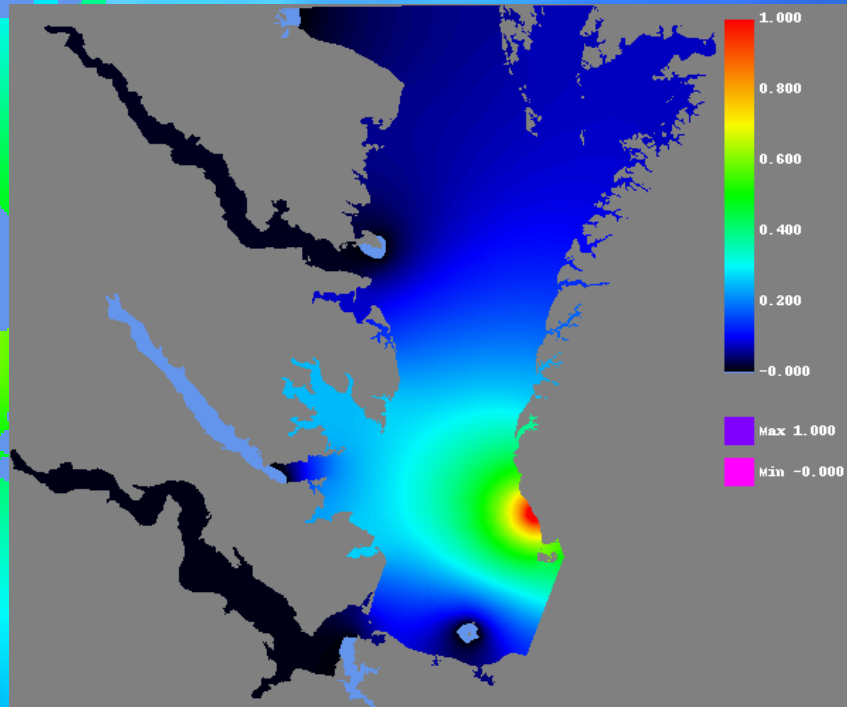


- Each grid point has a set of weighting values associated with it.
- Once these values are computed, they do not change, unless a new water level gauge is added, or if datums/HA are updated.
- The same grid can be used for multiple projects.

3 Sets of Weighting Values = 1) astronomical tide
Are Computed 2) residuals
(Since each piece is 3) datum offsets
interpolated separately)

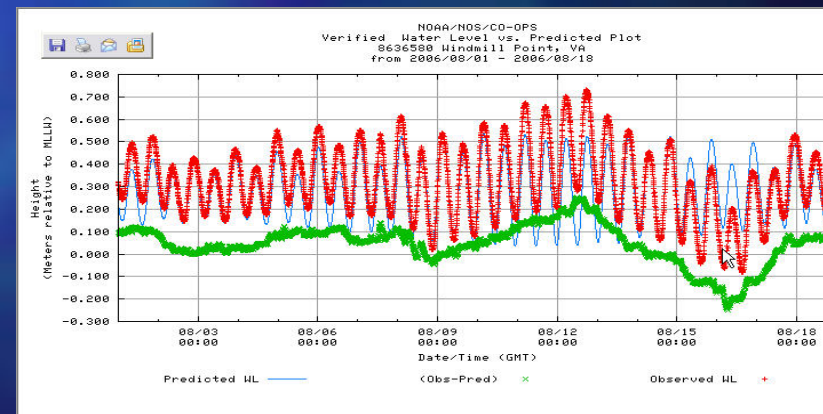
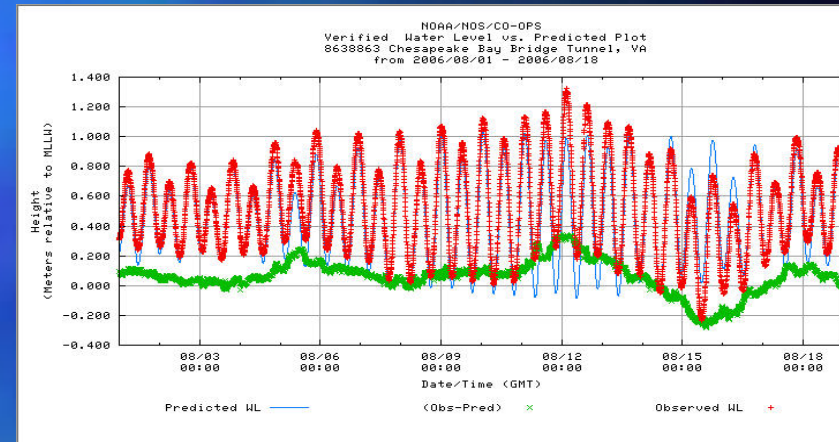


Load data and run TCARI interpolation

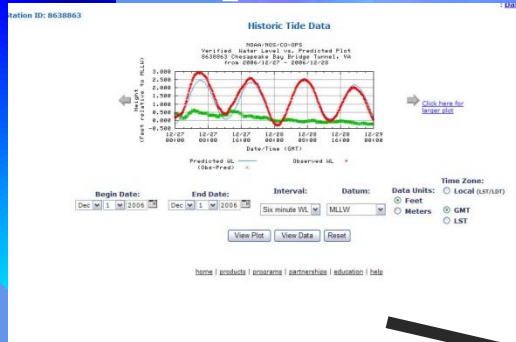


TCARI

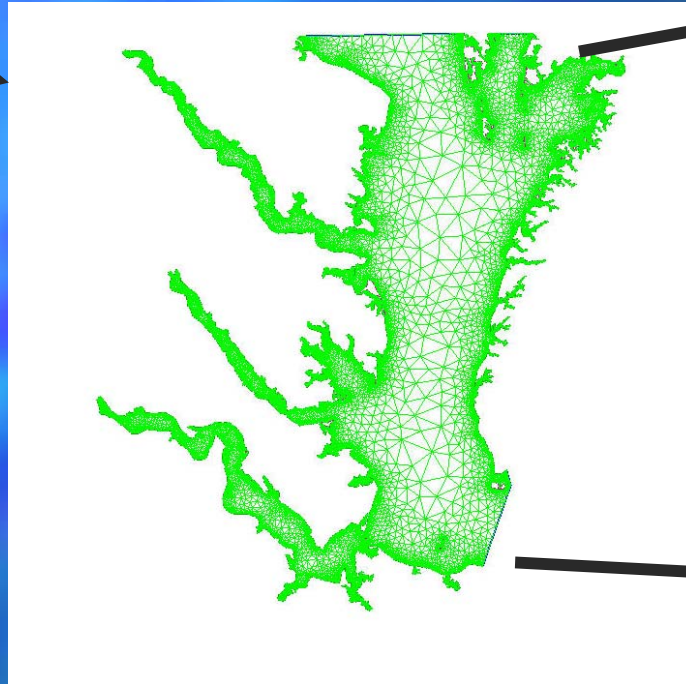
- Tidal portion induced by the interaction between the earth, sun, and moon.
- Non-tidal is induced by weather and riverine discharge.



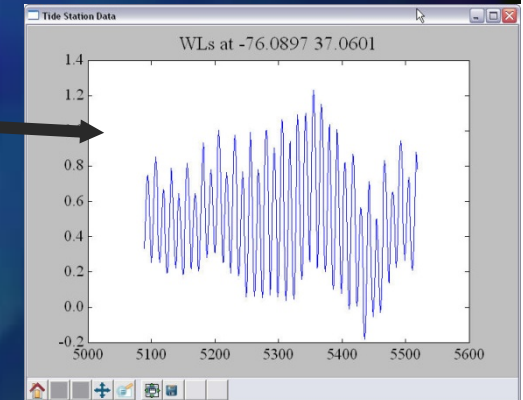
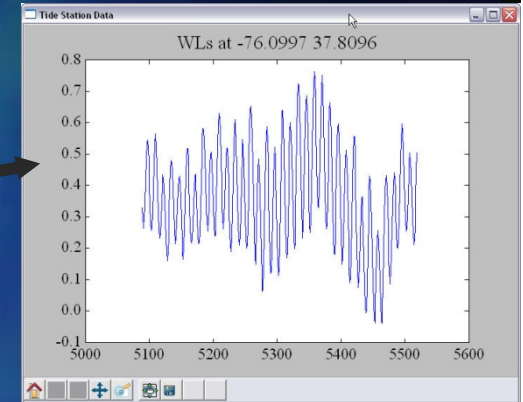
Input



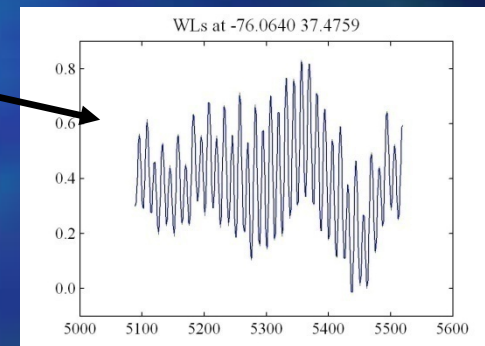
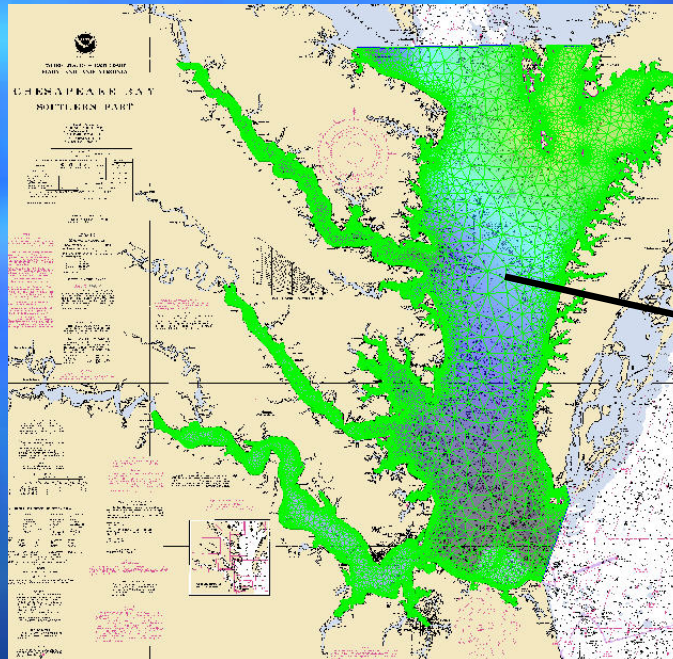
6 - Minute Water Level
Data from CO-OPS webpage



Output



TCARI spatially interpolates the tidal and non-tidal (residual) components of the water level signal, generating a tide corrector at a specific location.



Benefits

- Increased water level correction resolution.
- This method produces more realistic water level uncertainties which, in most cases, will be less than present water level uncertainties... reducing Total Propagated Error (TPE) of survey depths.
- Quantitative, automated method to account for spatial variability of water level corrections in hydrography.
- Eliminates time spent hand drawing co-tidal lines and polygons in MapInfo.
- Useful for other applications such as Restoration Projects and Photogrammetry.



All elevation data should be referenced to common vertical datums

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

Relationship of vertical datums for Tampa Bay:

86.39 ft	<u>WGS 84 (G873)</u>	26.33 m
81.33 ft	<u>NAD 83</u>	24.79 m
0.792 ft	<u>MHHW</u>	0.241 m
0.409 ft	<u>MHW</u>	0.125 m
0.0 ft	<u>NAVD 88</u>	0.0 m
-0.535 ft	<u>LMSL</u>	-0.163 m
-0.850 ft	<u>NGVD 29</u>	-0.259 m
-1.495 ft	<u>MLW</u>	-0.456 m
-1.919 ft	<u>MLLW</u>	-0.585 m

Ellipsoid Datums



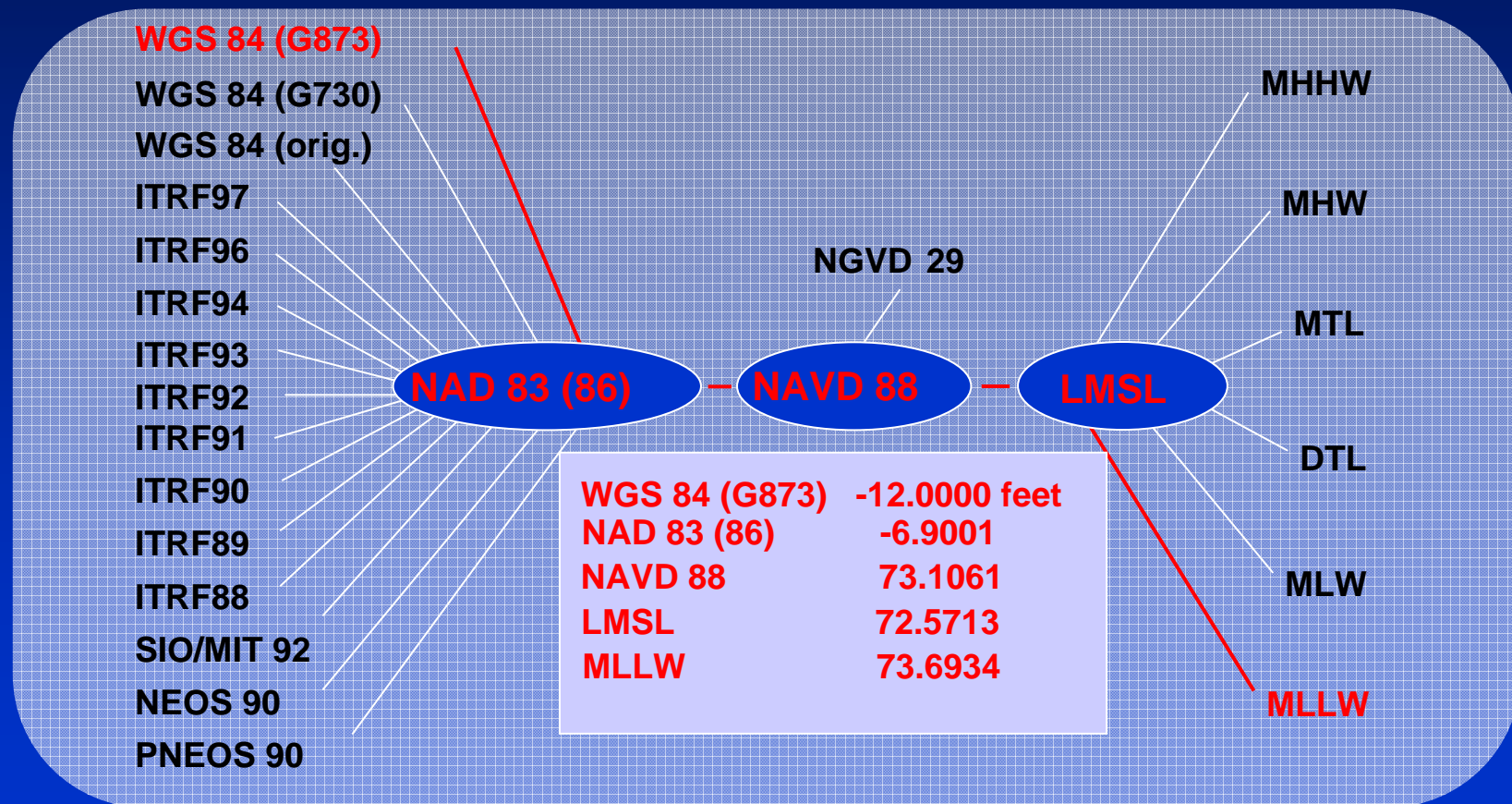
Orthometric Datums



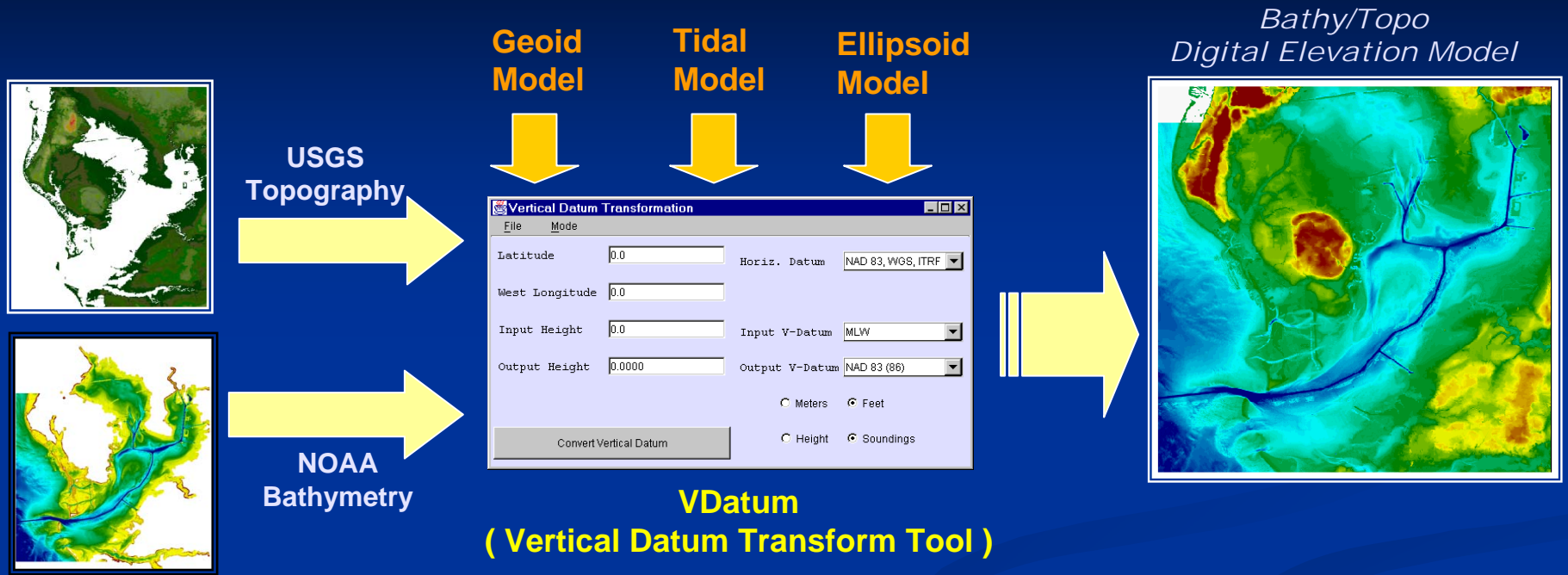
Tidal Datums



The Datum Transformation Roadmap

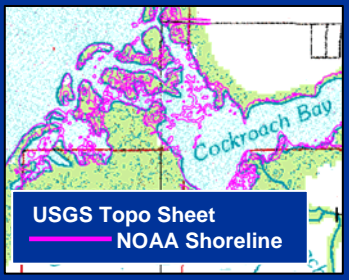


VDatum Supports Many Other Efforts

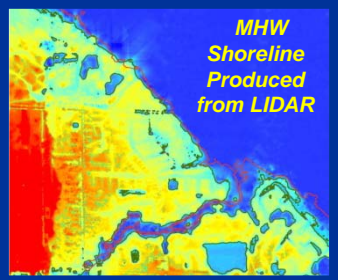


**VDatum
(Vertical Datum Transform Tool)**

Resolve NOAA-USGS shoreline inconsistencies



Consistently defined Shoreline from LIDAR data



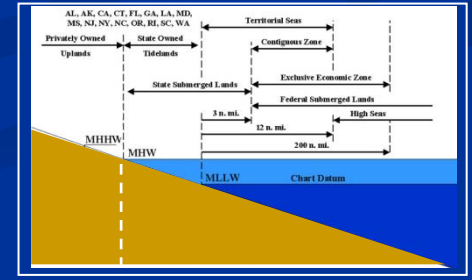
GIS users in the Coastal Community



Charting and Other Applications



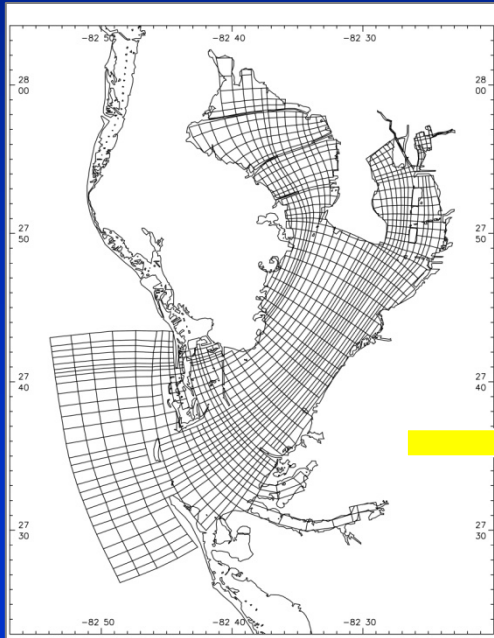
Marine Boundaries and Legal Issues



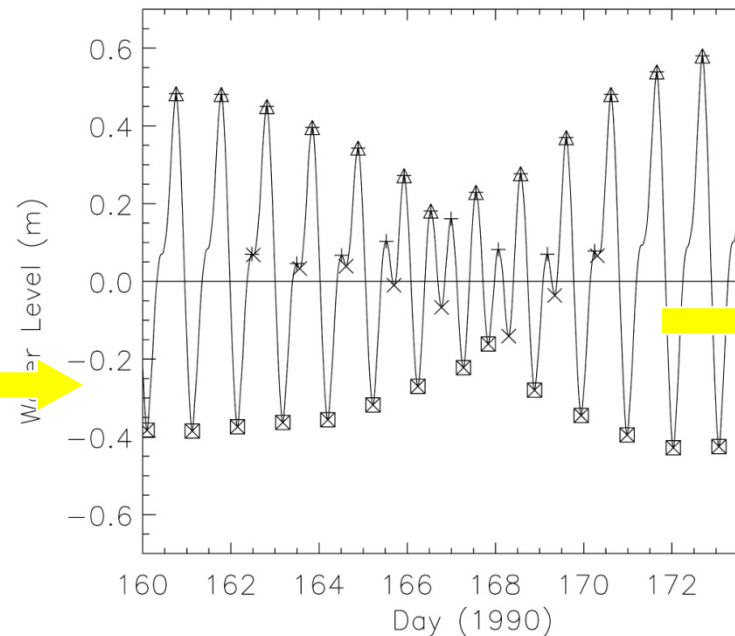
Tidal Datums from Hydrodynamic Models

- Drive model with astronomical tides
- Save water levels at each grid cell each 6 minutes (for 1 year)
- Analyze for higher high, high, low, and lower low waters
- Model's RMS error in water level is 4 cm

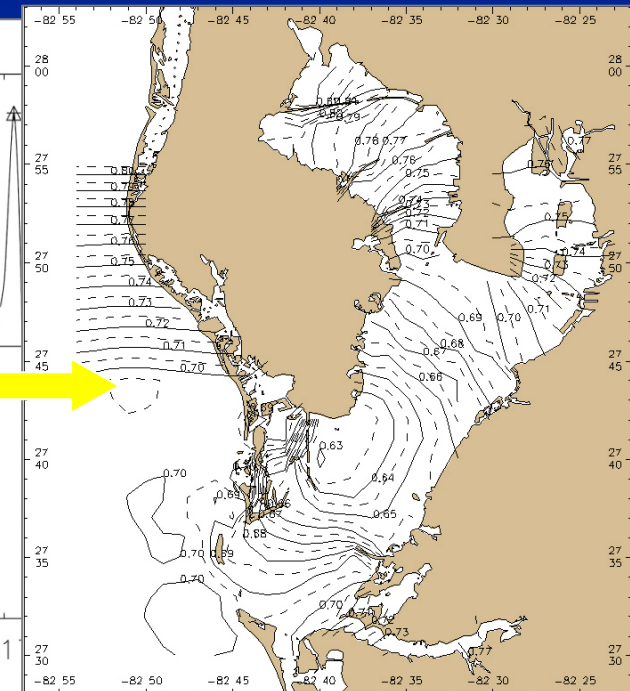
Model



Saved Time Series

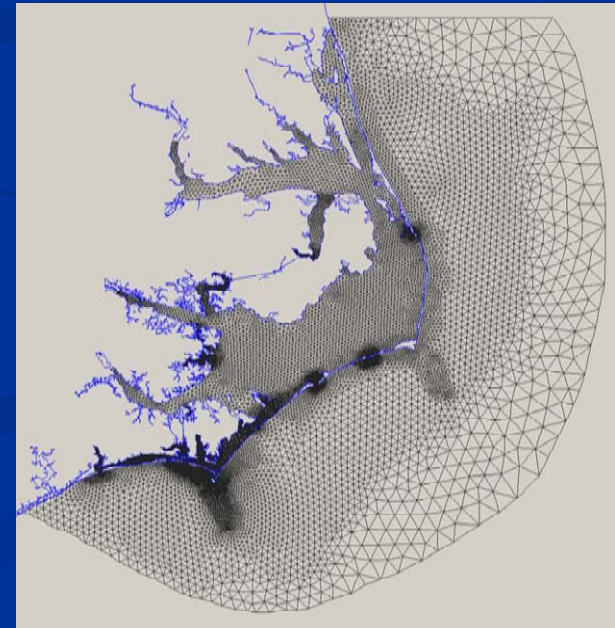
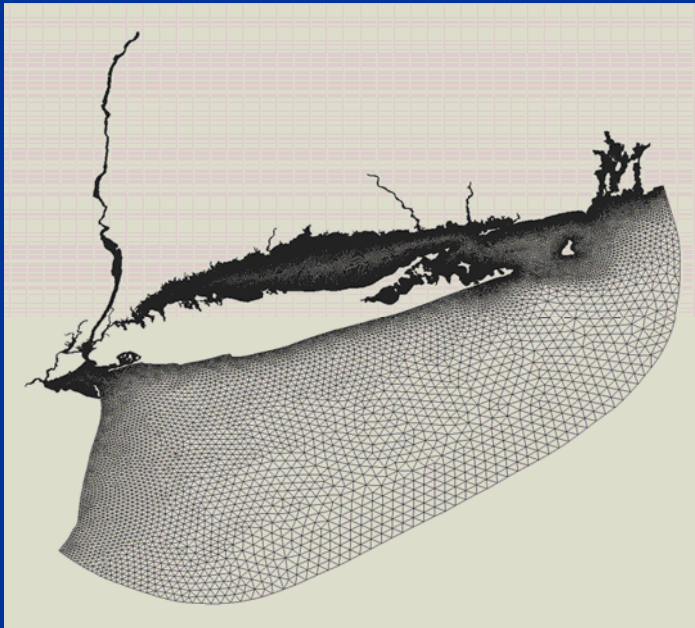


Tidal Datum Fields



Hydrodynamic Modeling to Simulate the Tides

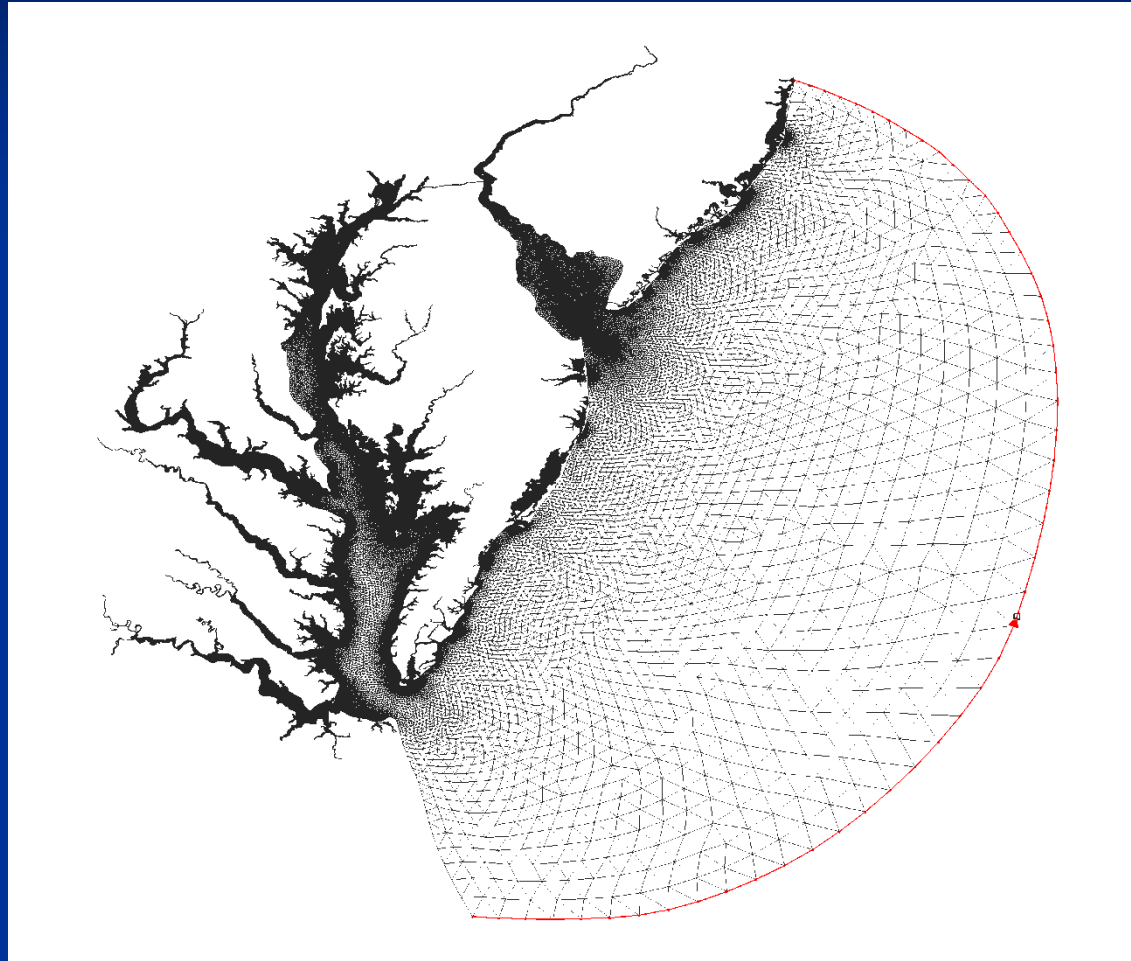
- NOAA/CSDL normally uses the ADCIRC (Advanced Circulation) Model
- *2-D depth-integrated shallow water equations*
- *Finite element solution on triangular grids*
- *Handles inundation*
- *Parallelized code (MPI), simulations are made on cluster computers.*



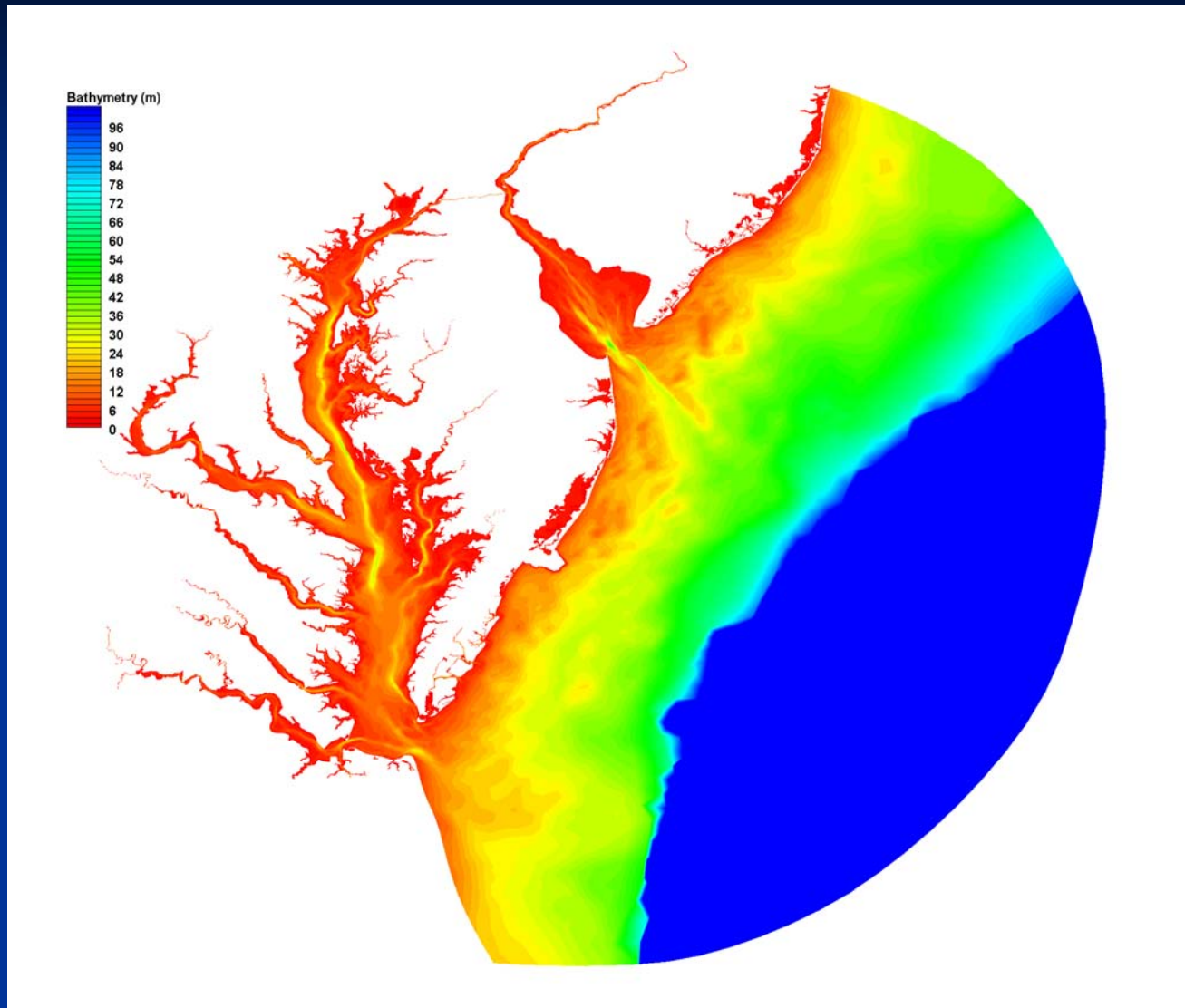
V DATUM FOR CHESAPEAKE BAY, DELAWARE BAY, AND ADJACENT COASTAL WATER AREAS: TIDAL DATUMS AND SEA SURFACE TOPOGRAPHY

Zhizhang Yang, Edward P. Myers, Adeline M. Wong, and Stephen A. White

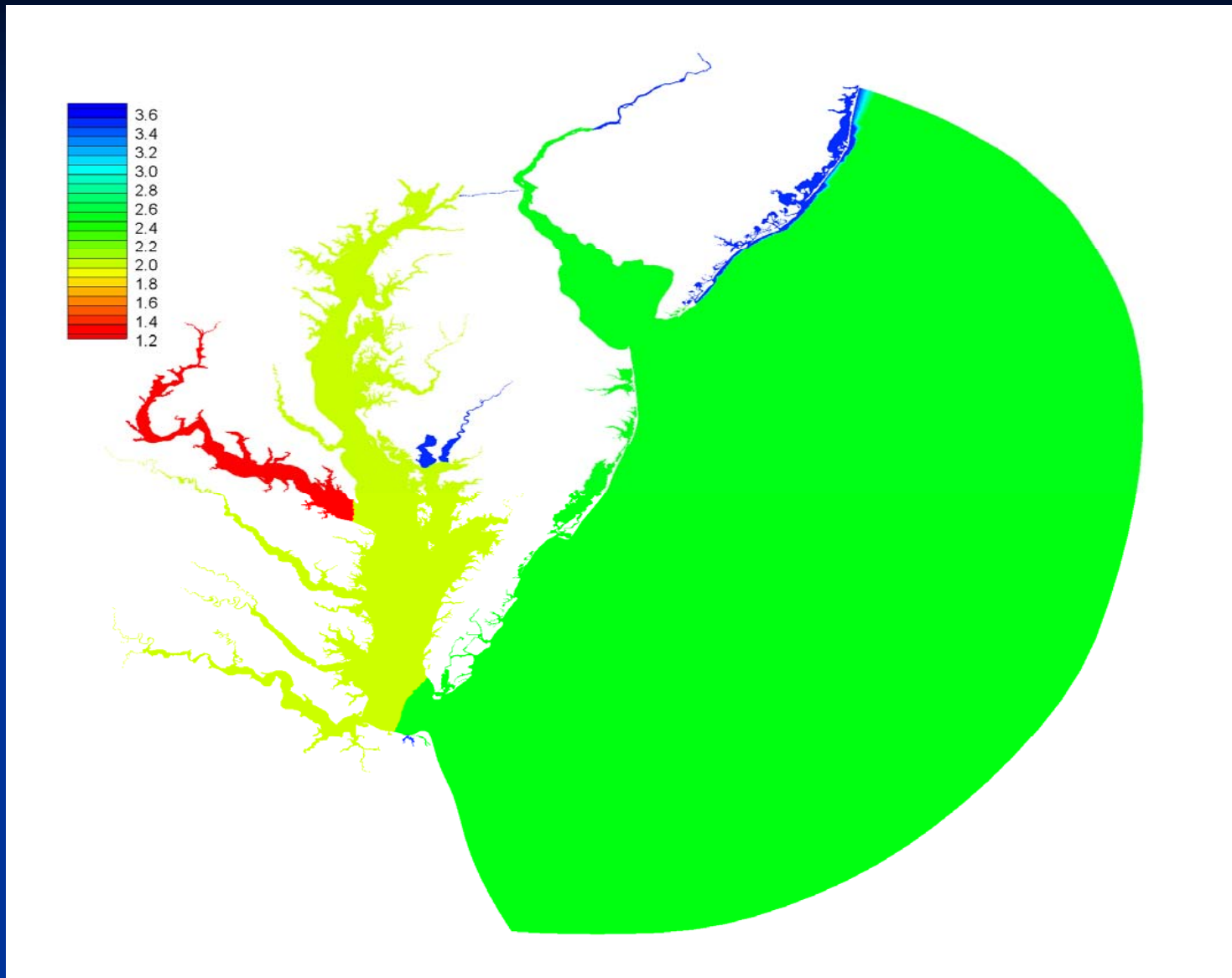
Coast Survey Development Laboratory
NOAA/NOS/OCS



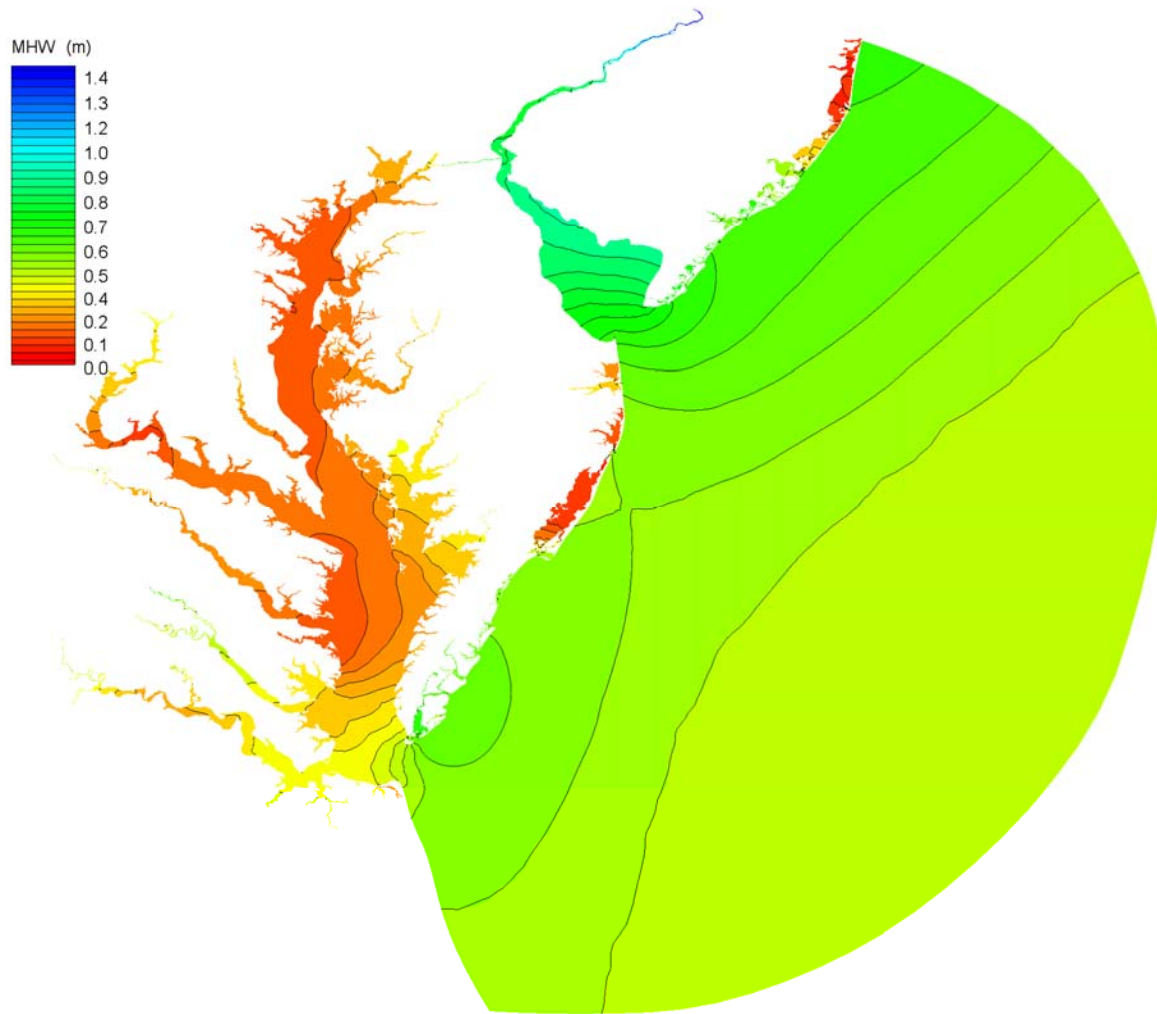
Finite element grid for the entire model domain.
Red line denotes the model open ocean boundary.



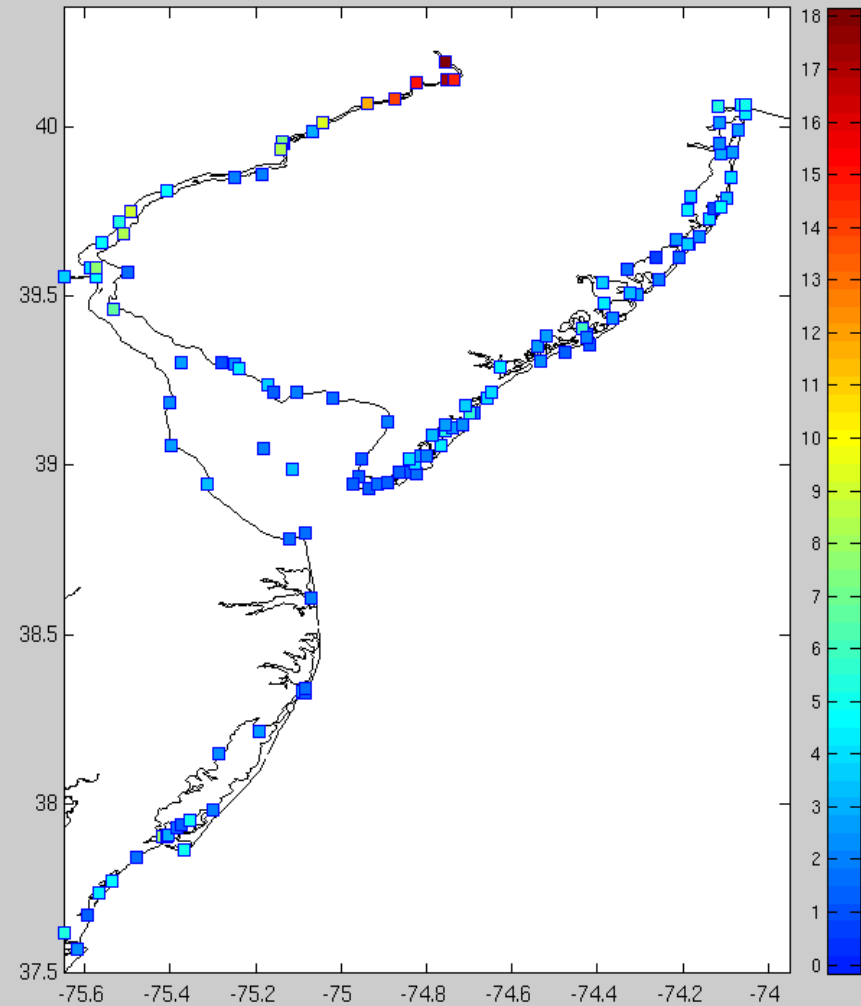
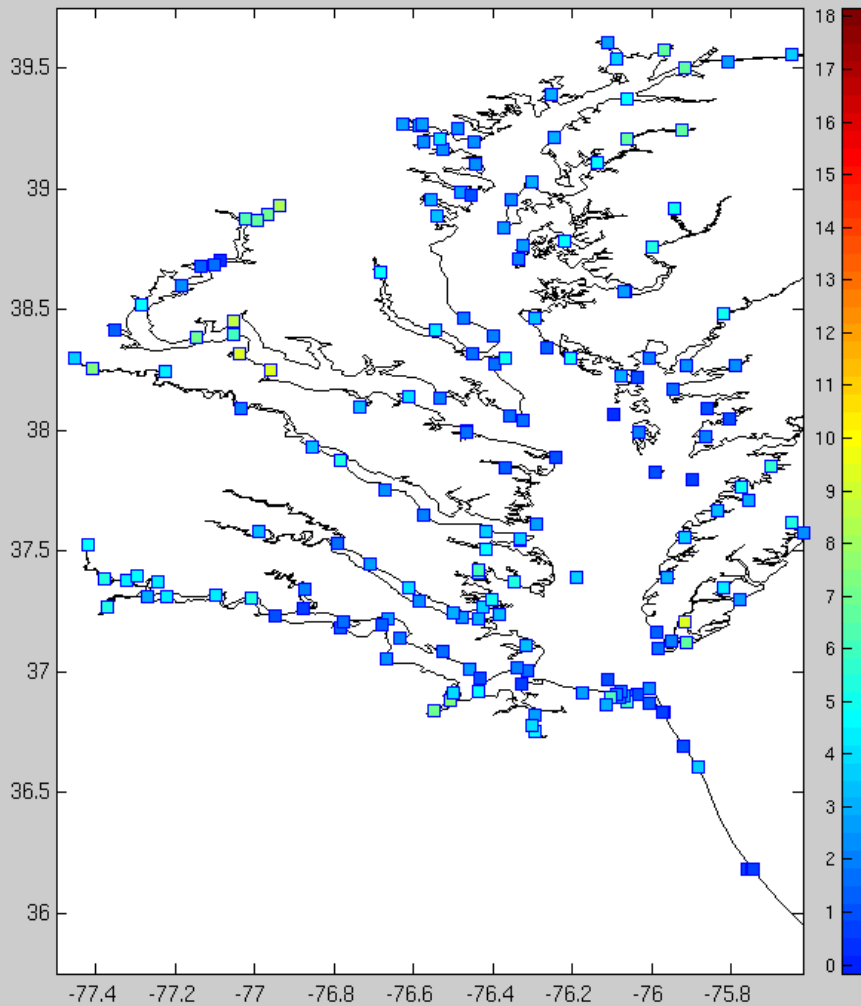
Bathymetry used in the final model run.



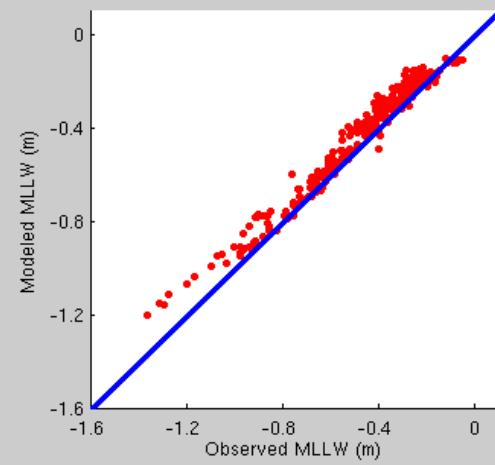
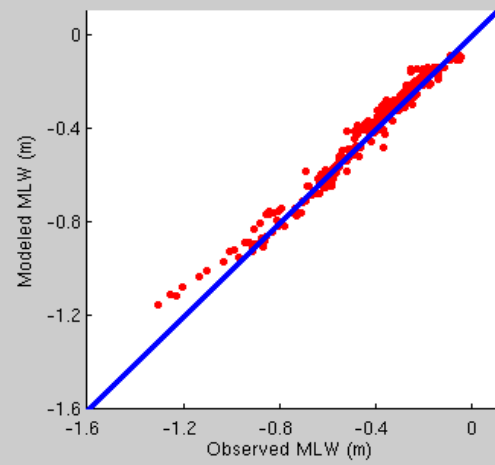
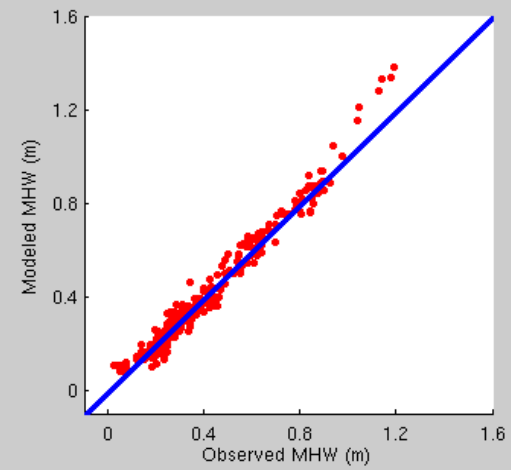
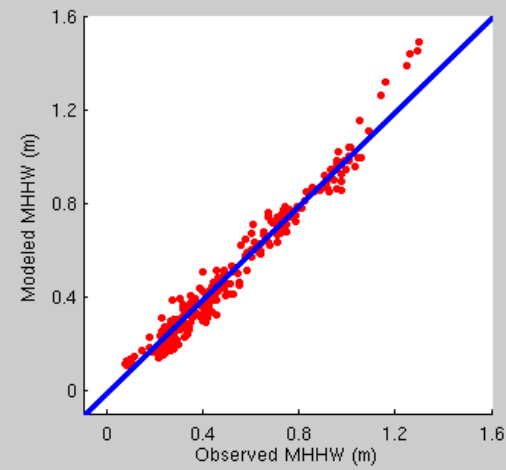
Spatially variable bottom friction coefficients used for the model simulations.



Model derived tidal datum field for MLLW

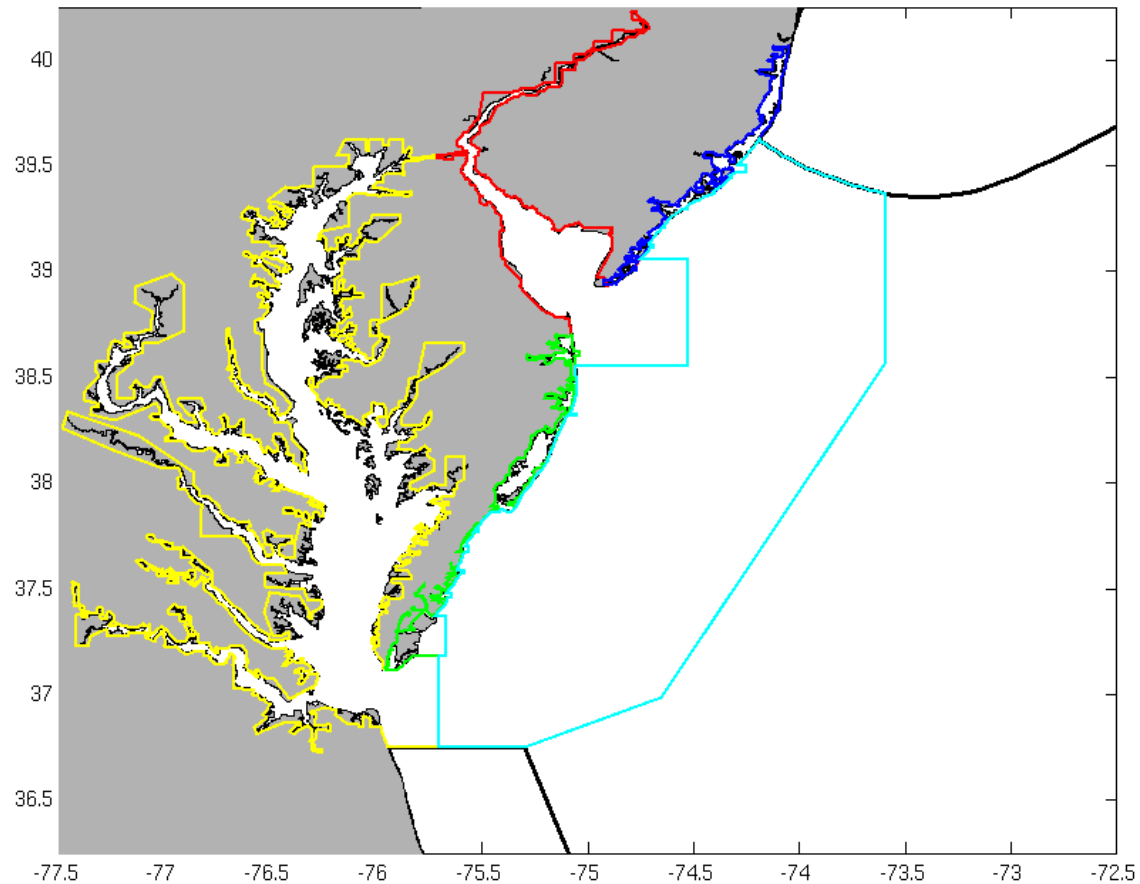


Color-coded model-data differences at each observational station, (a) Chesapeake Bay and (b) Delaware Bay. Units are meters.



Comparisons of the modeled (a) MHHW, (b) MHW, (c) MLW, and (d) MLLW datums against observations.

The Marine Grids



Bounding polygons of the five VDatum regions:

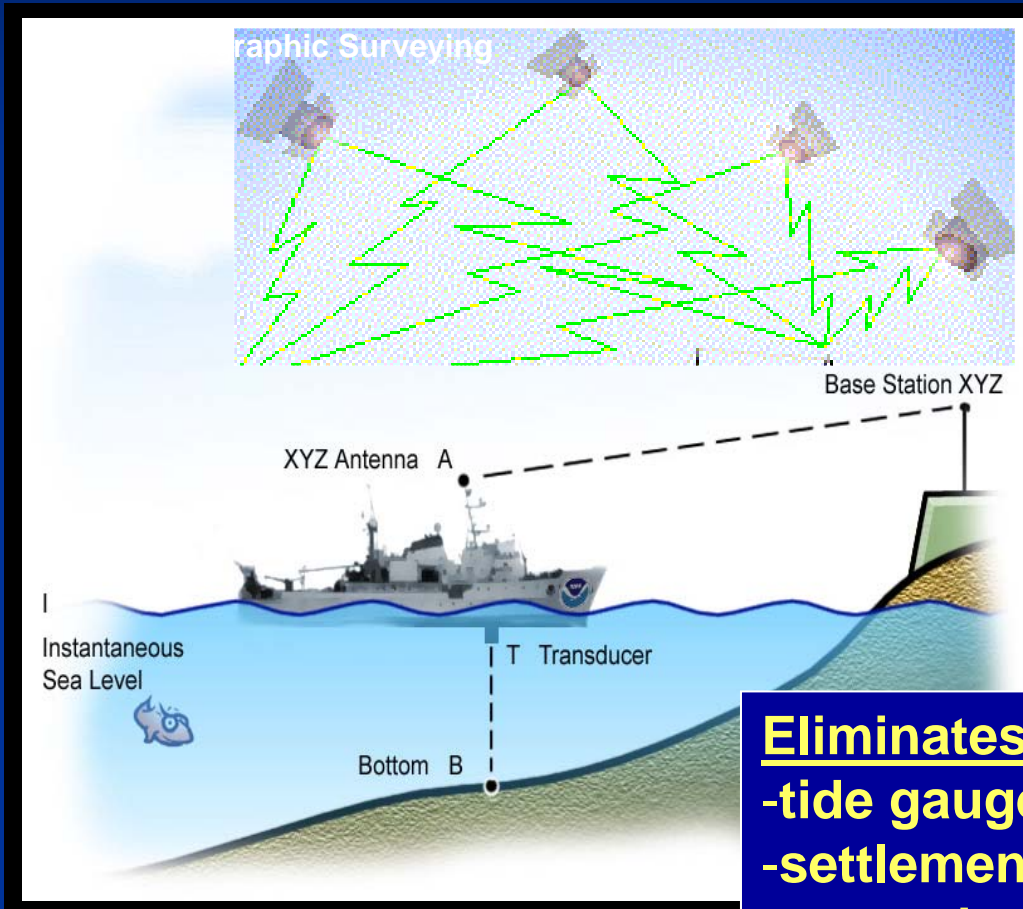
(1) Chesapeake Bay (yellow),

(2) DE-MD-VA embayments (green), (3) Delaware Bay (red),

(4) New Jersey embayments (blue), and the Mid-Atlantic Bight shelf (cyan).

VDatum Complements Innovative Technologies

Depths are measured “on the fly” or near real time relative to chart datum (MLLW) using VDatum



RTK-GPS Vertically-Referenced Hydrographic Surveys:
Hydrographic data is transformed from ellipsoid datum to MLLW datum

Eliminates need for:

- tide gauges during survey
- settlement & squat corrections for survey vessel
- time-consuming post-survey processing

Vdatum Availability – March 2009

Get VDatum - Windows Internet Explorer

http://vdatum.noaa.gov/download.html

File Edit View Favorites Tools Help

NOAA Tides and Currents - H... Get VDatum

contains information about available VDatum project areas and should be placed in the VDatum folder.

Click on the red areas on the map or the links below to go to individual VDatum areas.

- [East Coast Dataset](#)
- [Gulf Coast Dataset](#)
- [West Coast Dataset](#)
- [Great Lakes Dataset](#)

Legend:

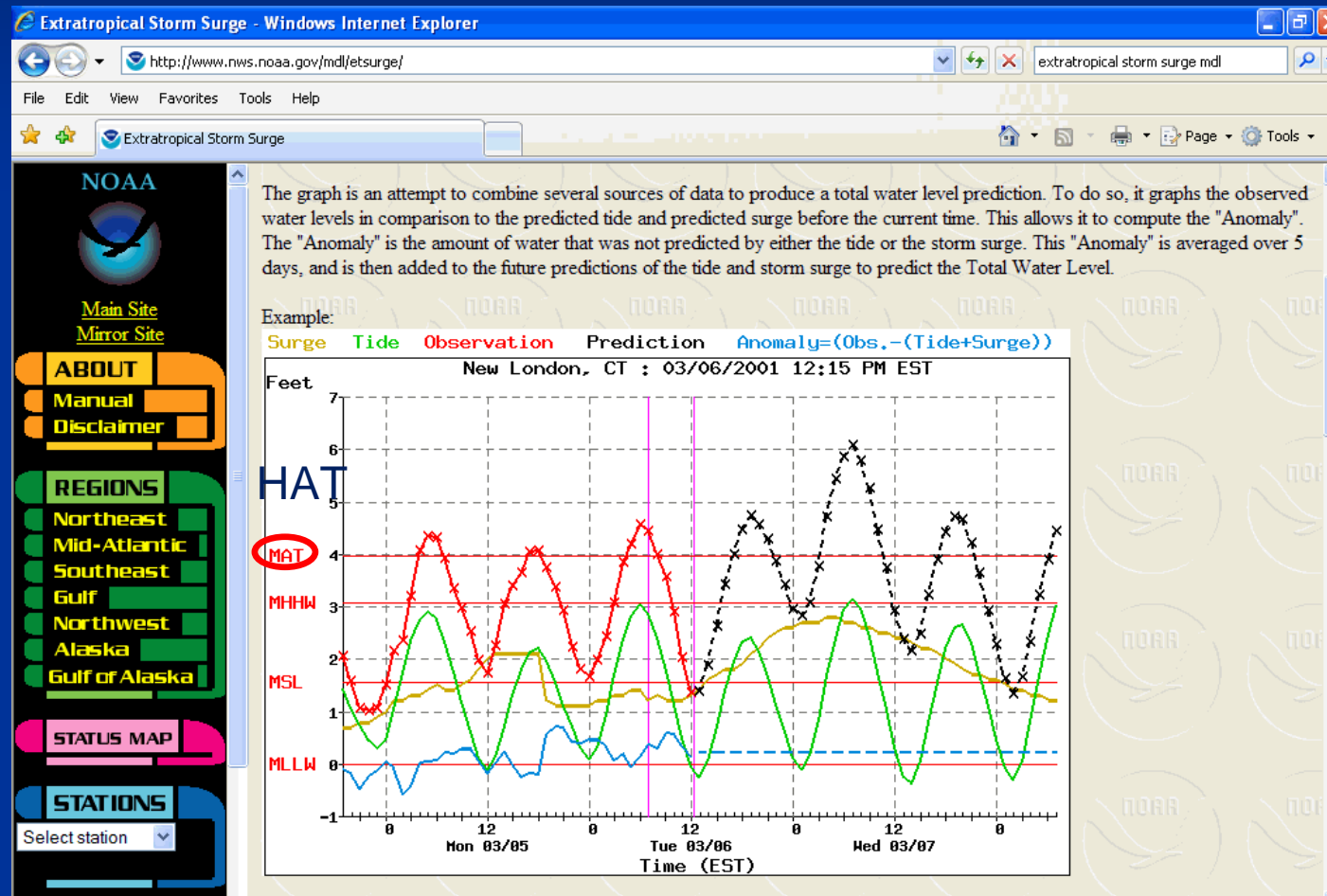
- Red: Tidal transformation grid
- Dark Red: IGLD85 Transformation Grid

Currently available VDatum's project areas

LAT/HAT Update in USA

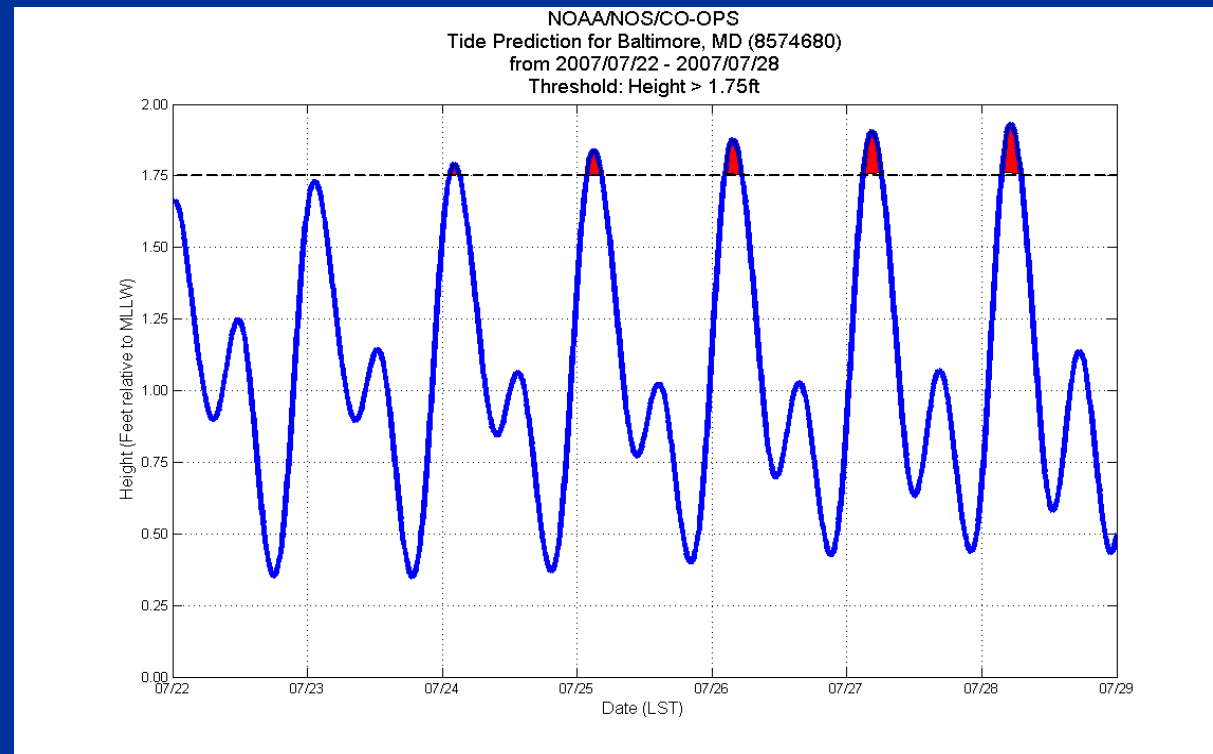
- LAT/HAT previously computed for tide table reference stations in USA
- LAT/HAT datums now computed for over 300 operating and historical tide stations
- New applications will include HAT depiction on NOAA storm surge forecast products
- Implementing new version of least-squares harmonic analysis program than can use up to 125 constituents (previously limited to 37)

Application of HAT to storm surge displays



Electronic Tides Displays

Under Final Development for release on Web in 2009
Graphical depiction for Reference and Secondary stations in Tide Tables



<http://tidesandcurrents.noaa.gov>