Accuracy Requirements in Coastal Applications – Sea Level Rise and Shoreline

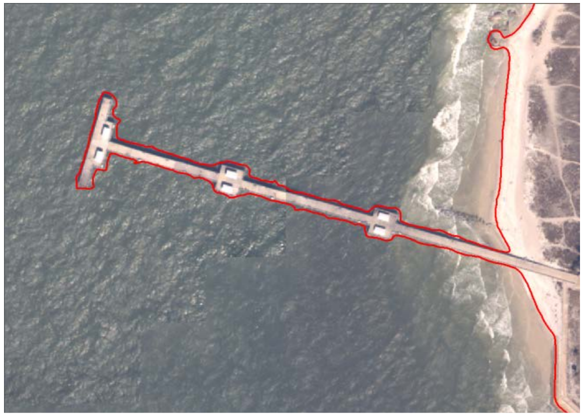
Kirk Waters

NOAA/CSC

8/18/2011

NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

Mapping Shoreline



Charting

Property Rights

Coastal Management

NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

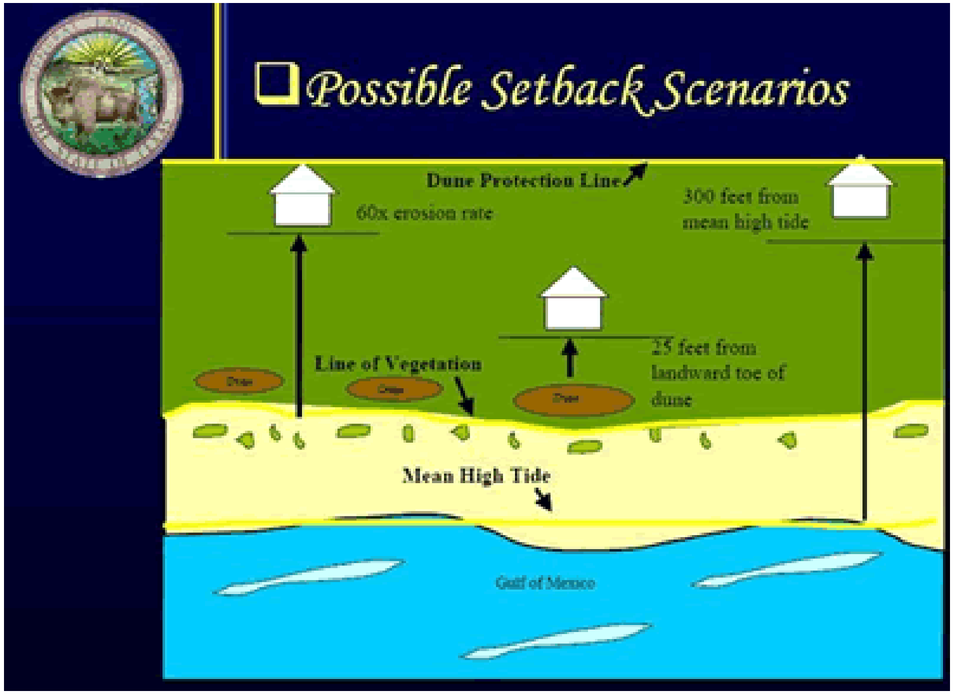
Coastal Management

Jurisdiction

Shoreline change – erosion

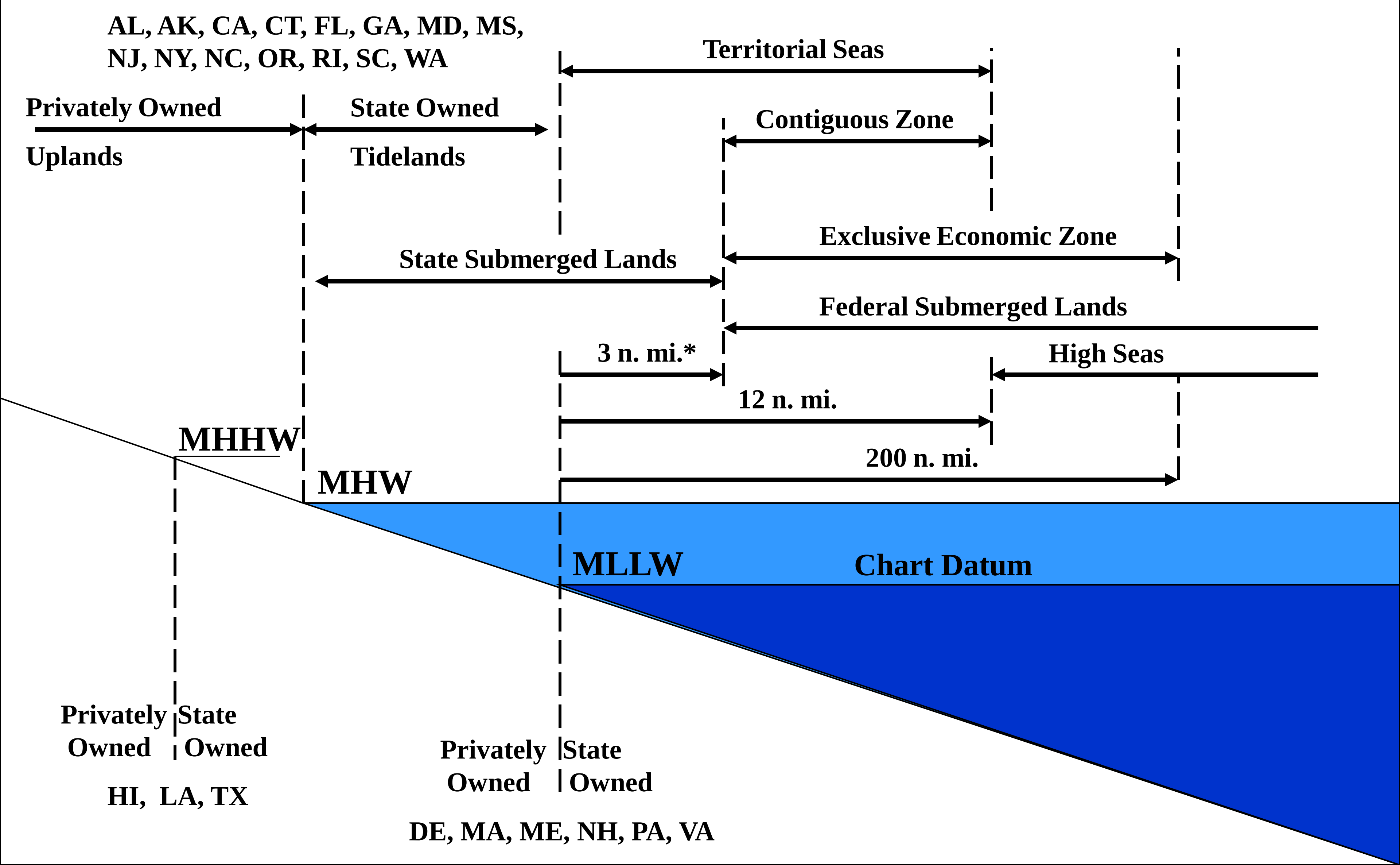
Setback lines

Habitat suitability



NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

Importance of Shoreline



Charting Accuracy - IHO

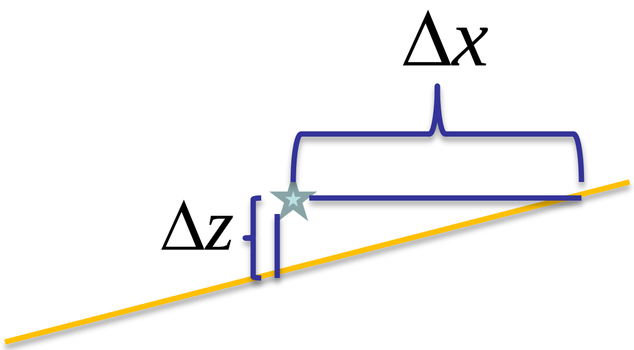
	Special Order surveys	Order 1 surveys	Order 2 and 3 surveys
Fixed aids to navigation and features significant to navigation	2 m	2 m	5 m
Natural Coastline	10 m	20 m	20 m
Mean position of floating aids to navigation	10 m	10 m	20 m
Topographical features	10 m	20 m	20 m

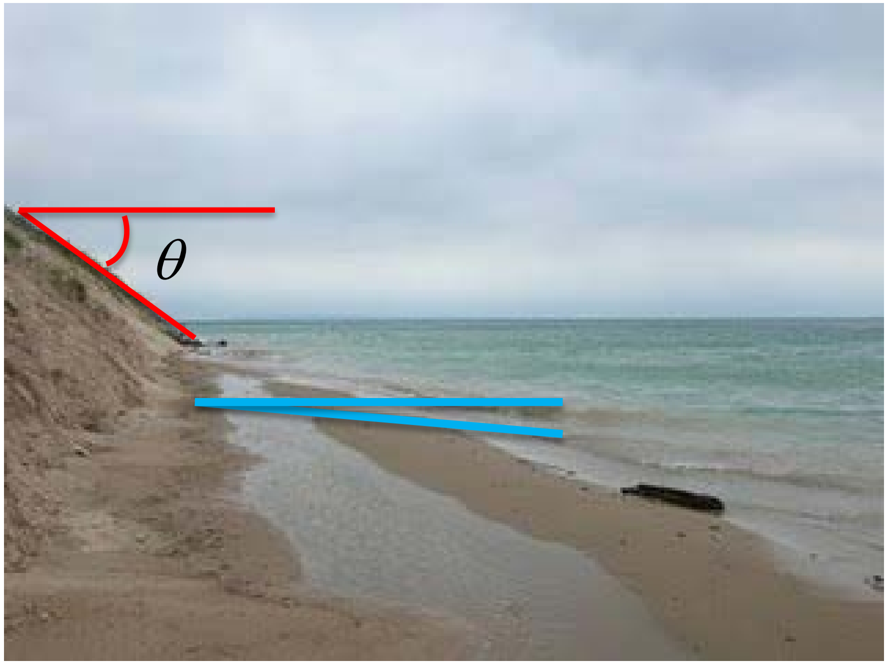
95% confidence level

NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

Vertical versus Horizontal Accuracy

$$\Delta x = \frac{1}{\tan\theta}\Delta z_{bias}$$

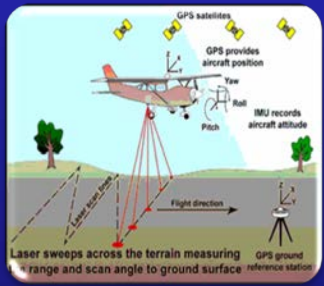




	Error [m]		
	0.10	0.20	0.30
1° slope = fine grain beach	5.73	11.46	17.19
2° slope = Frisco, NC	2.86	5.73	8.59
5° slope = Duck, NC	1.14	2.29	3.43
11° slope = granules	0.51	1.03	1.54

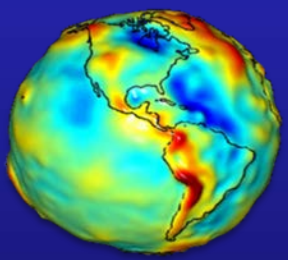
NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

Tying In to Control



Lidar collected

- GPS on ellipsoid
- Should be tied into NSRS



Transform to Orthometric NAVD88

- Geoid -> NAVD88
- Updates happen!

Transform to Tidal Datum

- VDatum where applicable
- Hydrodynamic model

Lidar and VDatum Error

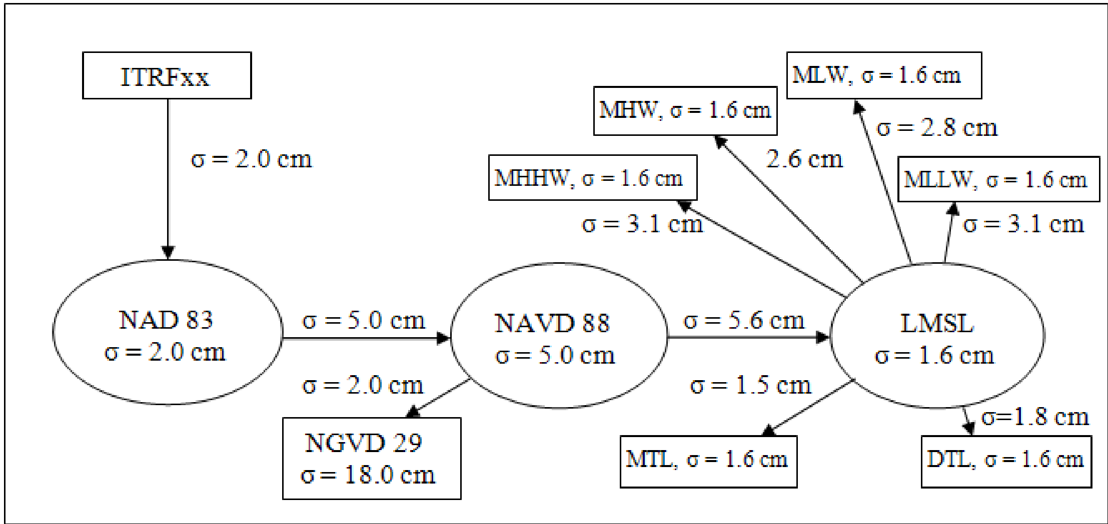
Lidar

- **Circa 2005 – 18 cm RMSE**
- **Circa 2010 – 10 cm or less RMSE**
- **Independent QA recommended**
- **Issues are often qualitative**
- **Marsh bias seen**

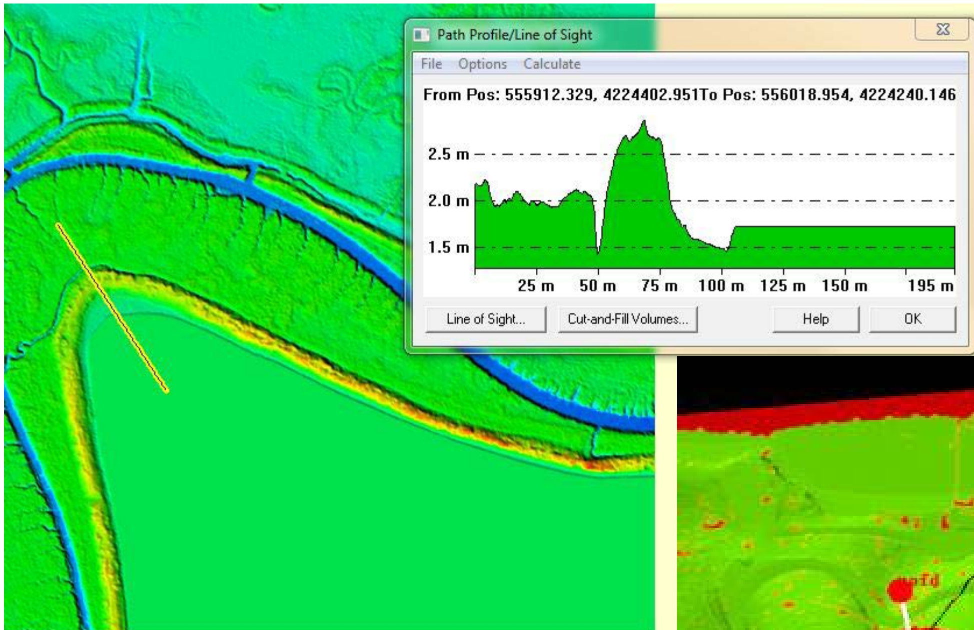
VDatum

- **Approx 11 cm std dev on average**
- **Range from 8 – 22 cm depending on area**

~30 cm combined error @95%



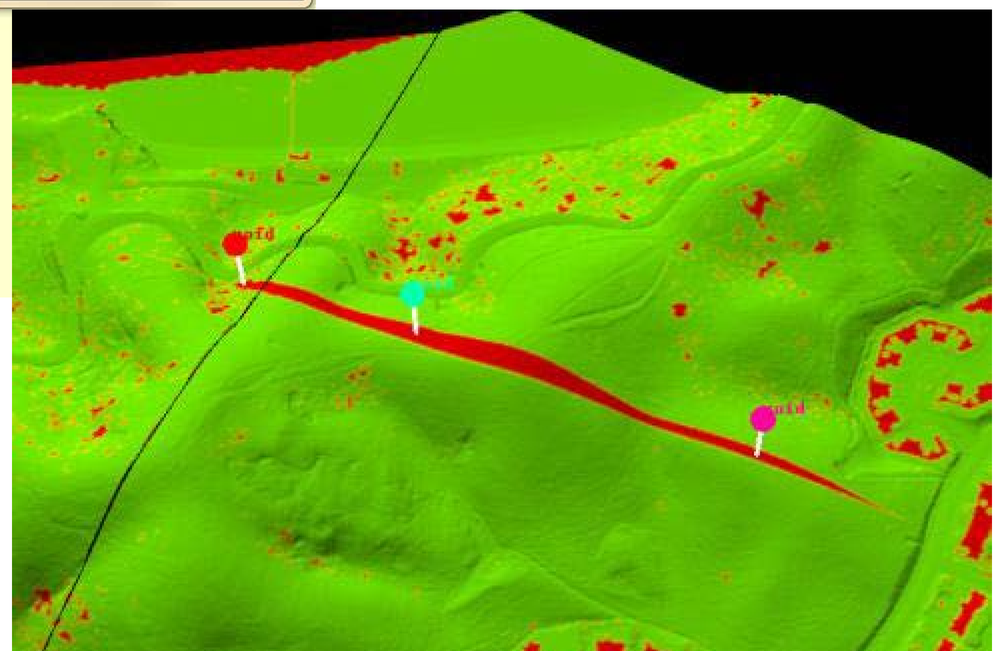
Example Qualitative Issues



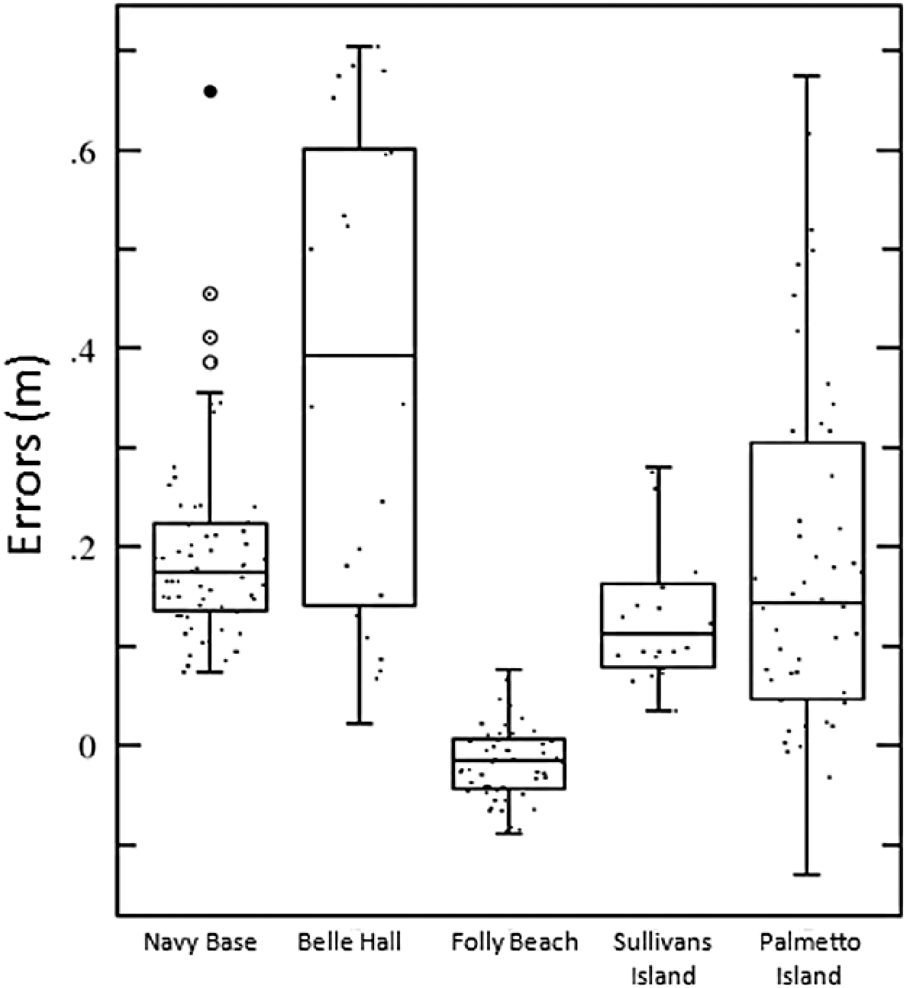
Breaklines

Data Density

Classification Error



Problems with Vegetation

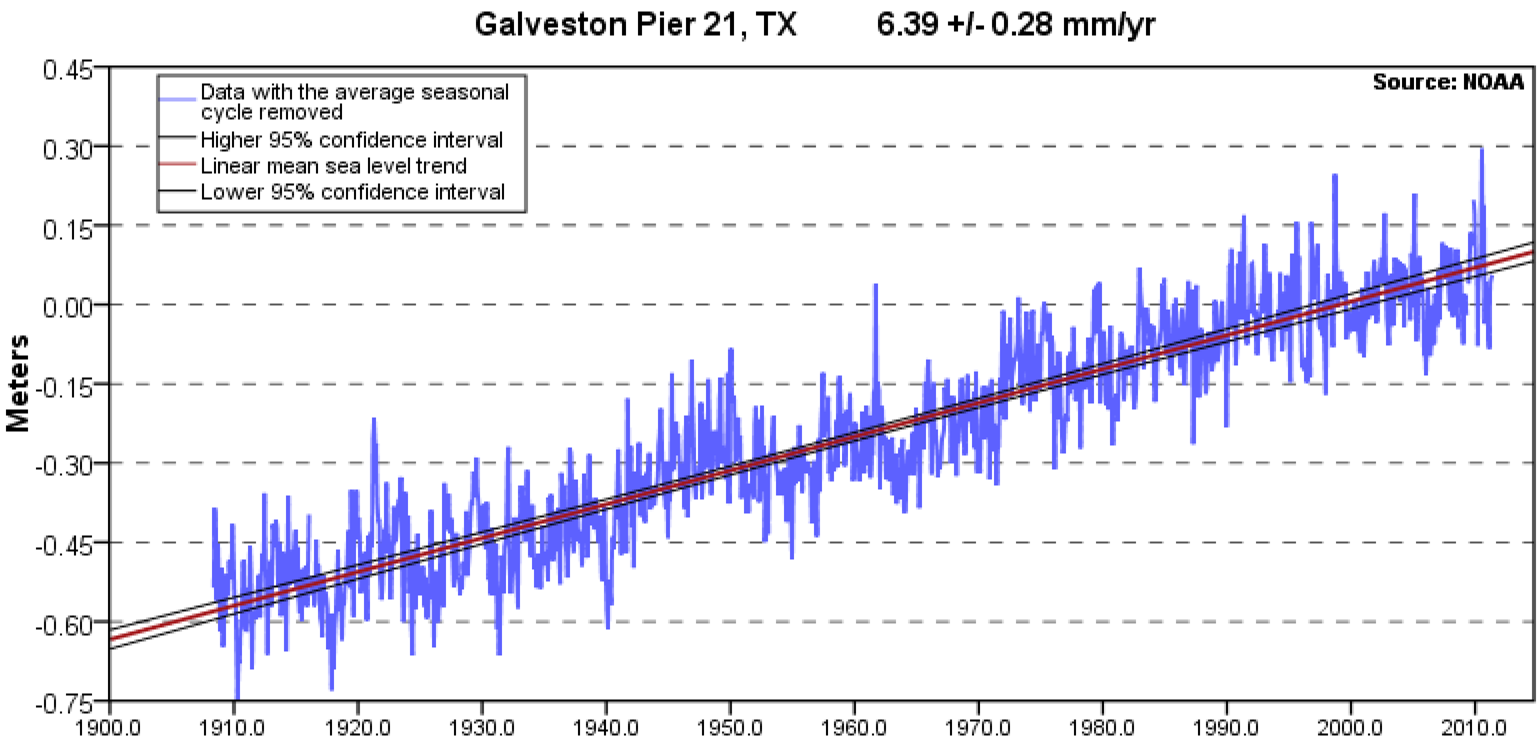


Errors in different marshes around Charleston, SC

- **Thick low vegetation is hard to classify**
- **Marshes are a particular problem**
- **Response is not uniform**
- **Could lead to significant error in shoreline.**

NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

Mapping Sea Level Rise



Historic record in Galveston shows over 2 feet rise over 100 years.
Potential for increased rate with a warming climate.

NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

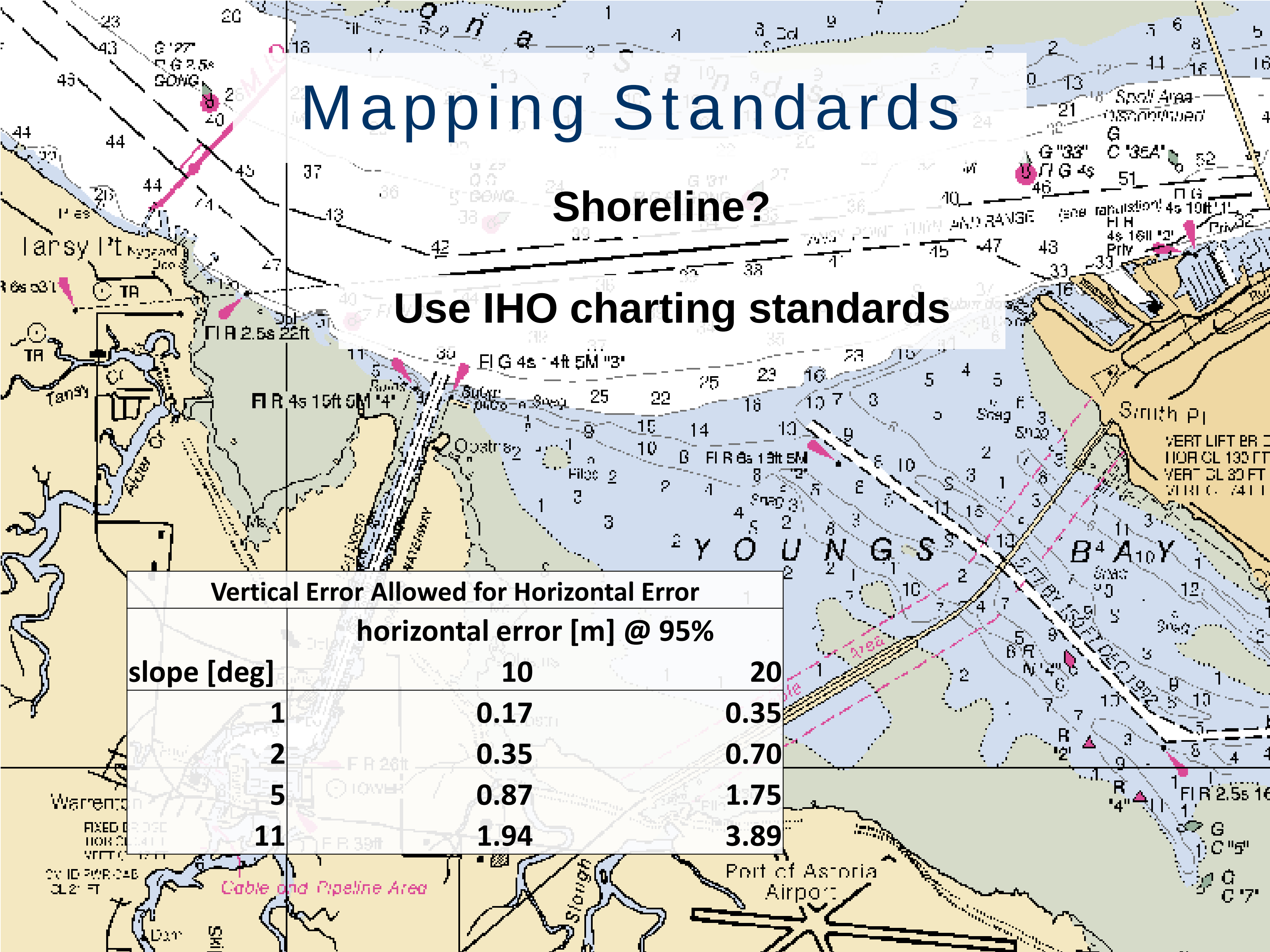
Mapping Standards

Shoreline?

Use IHO charting standards

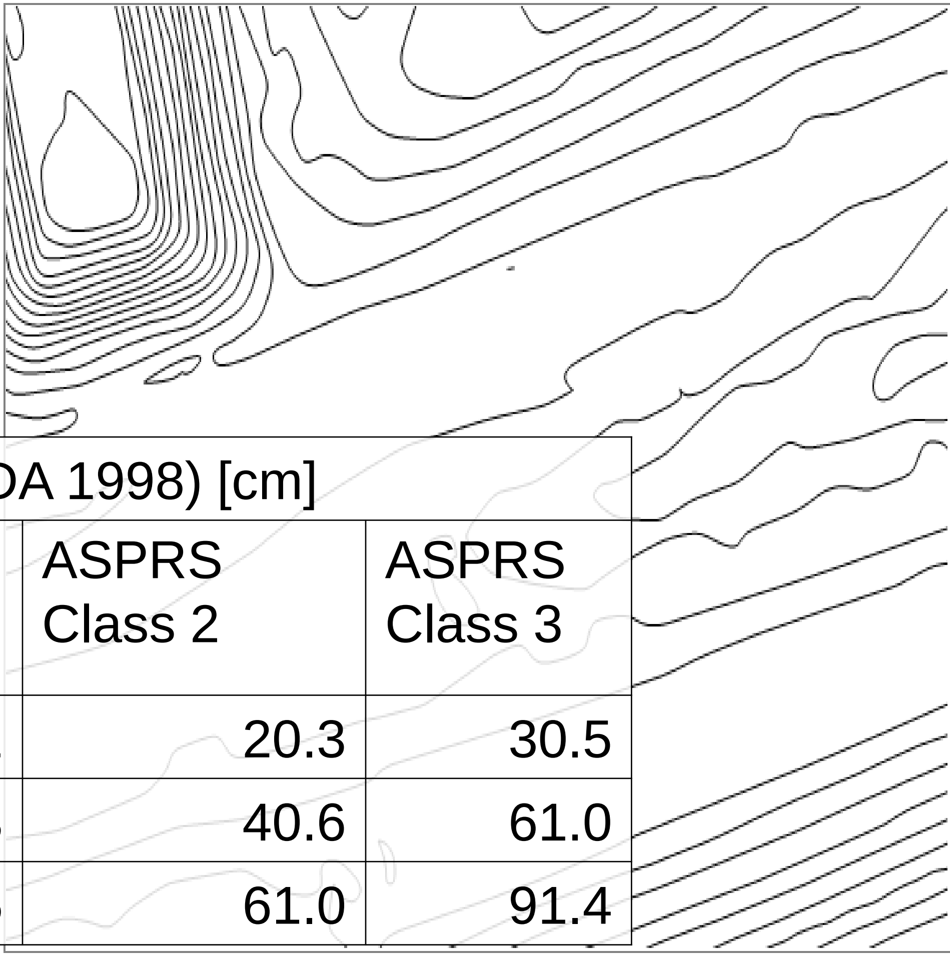
Vertical Error Allowed for Horizontal Error

slope [deg]	horizontal error [m] @ 95%: 10	horizontal error [m] @ 95%: 20
1	0.17	0.35
2	0.35	0.70
5	0.87	1.75
11	1.94	3.89



Mapping Standards

Are these contours?



Vertical accuracy sets smallest allowed interval

CI [ft]	RMSE (NSSDA 1998) [cm]			
	NMAS '47	ASPRS Class 1	ASPRS Class 2	ASPRS Class 3
1	9.3	10.2	20.3	30.5
2	18.5	20.3	40.6	61.0
3	27.8	30.5	61.0	91.4

Mapping Standards

Single line features?

- **NMAS '47**
- **Max map scale set**
- **Depends upon the slope**

30cm RMSEz @ 1° slope = 1:30K map

NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

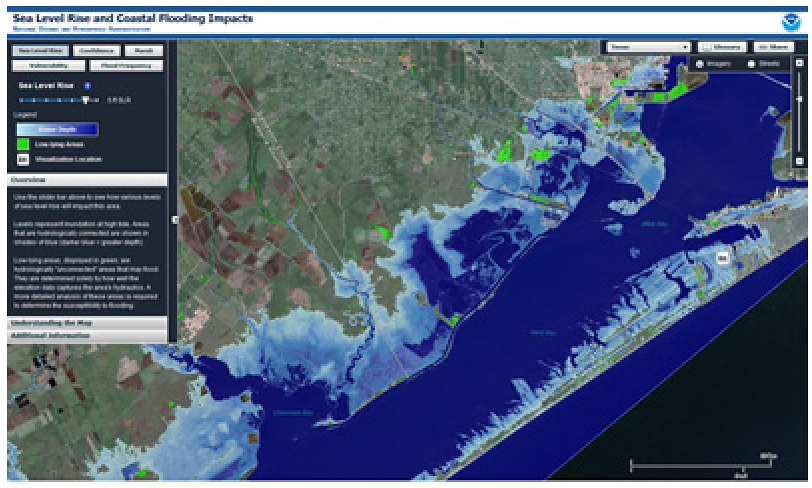
Tools

Sea Level Rise and Coastal Flooding Impacts Viewer

NOAA Coastal Services Center

Overview

Being able to visualize potential impacts from sea level rise is a powerful teaching and planning tool, and the Sea Level Rise Viewer brings this capability to coastal communities. A slider bar is used to show how various levels of sea level rise will impact coastal communities. The initial project areas include Mississippi, Alabama, and parts of Texas and Florida, with additional coastal counties to be added in the near future. Visuals and the accompanying data and information cover sea level rise inundation, uncertainty, flood frequency, marsh impacts, and socioeconomics.



Launch Now

www.csc.noaa.gov/slr

Features

Displays potential future sea levels

Provides simulations of sea level rise at local landmarks

Communicates the spatial uncertainty of mapped sea levels

Models potential marsh migration due to sea level rise

Overlays social and economic data onto potential sea level rise

Examines how tidal flooding will become more frequent with sea level rise

Acknowledgements

The NOAA Coastal Services Center would like to acknowledge those organizations that provided direct content used in this tool or feedback, ideas, and reviews over the course of the tool's development. Specifically the Center would like to acknowledge the following groups

Summary

- **Lidar can be suitable for mapping shoreline and sea level rise.**
- **Accuracy requirements for sea level rise aren't obvious.**
- **Mapping standards may not be the only way to look at uncertainty.**

NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY