

**CSCAP:**  
**Coast and Shoreline Change Analysis Program**

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**Remote Sensing Division**



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# Background

- NOAA's National Geodetic Survey is responsible for mapping approximately 95,000 miles of coastline including 48 major port cities
- This shoreline is supplied to NOAA's nautical charts
- Limited resources
- Time constraints
- Emphasis on maritime commerce



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Question:

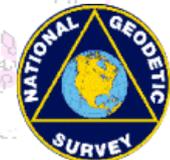
How can we prioritize mapping efforts in port cities?

Answer:

The **C**oast and **S**horeline **C**hange  
**A**nalysis **P**rogram



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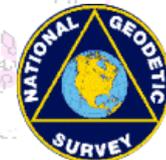
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# Processing Steps

- Georeference Imagery
- Accuracy Assessment
- Change Analysis
  - NOAA Raster Nautical Chart or NOAA Electronic Navigational Chart compared with High Resolution Satellite Imagery.



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# The Benefits:

- More frequent revisit time to port cities
- Can supply “approximate” interim shoreline in areas that have significantly changed
- Can maintain more up-to-date shoreline



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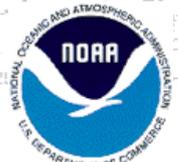
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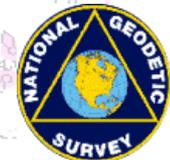
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# Evaluated Imagery

- SPOT
- IRS
- SPIN2
- IKONOS



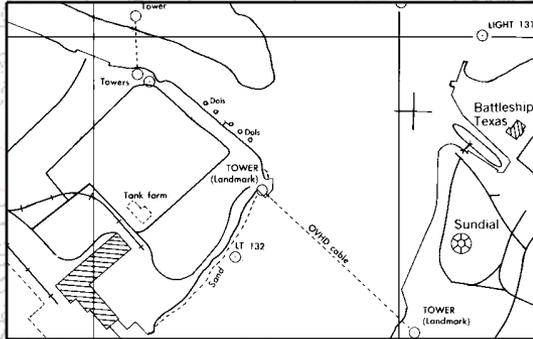
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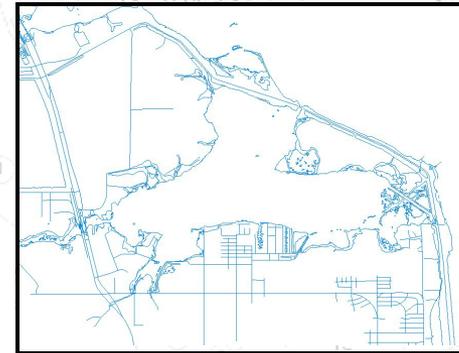
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# Georeferencing Control Sources

## Raster Shoreline T- Series Maps



## Vector Shoreline Manuscripts



## GPS Survey Points

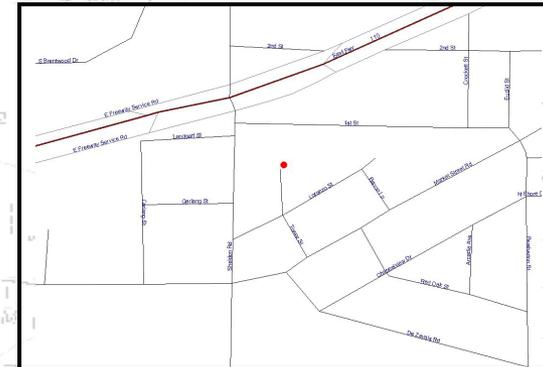


Image Source: Space Imaging

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# Image Georeferencing Accuracy

Location	Image georeferencing source	RMSx	RMSy	RMSr	CE at 95% confidence level
Houston	T-series Maps	3.18 m	2.14 m	4.20 m	6.84 m
Houston	Vector Shoreline	0.82 m	2.93 m	3.06 m	4.59 m
Houston	GPS Data Points	1.69 m	1.86 m	2.51 m	4.34 m



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# IKONOS Imagery Change Analysis (Cleveland, OH)

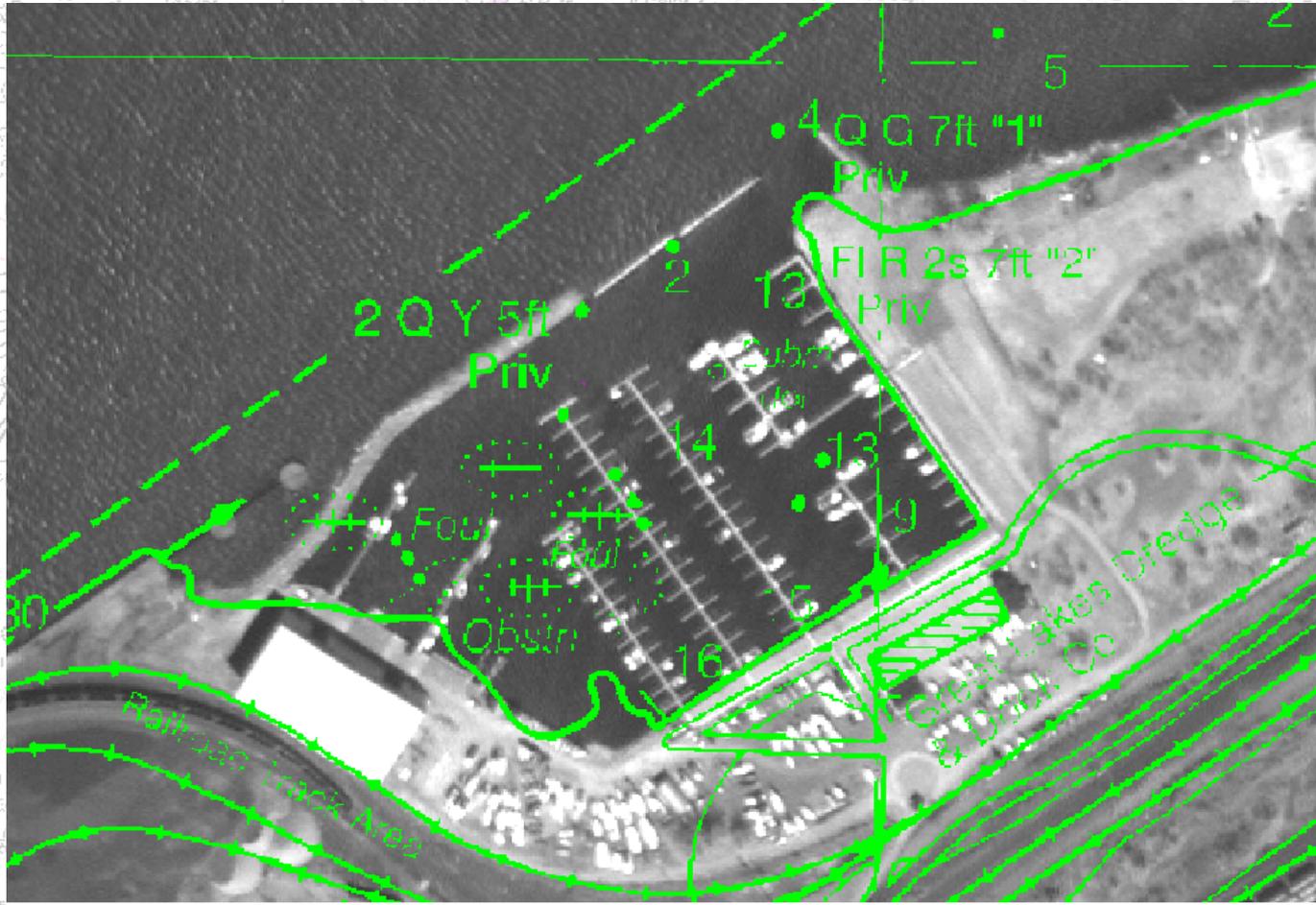


Image Source: Space Imaging



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# IKONOS Imagery Change Analysis (Galveston, TX)

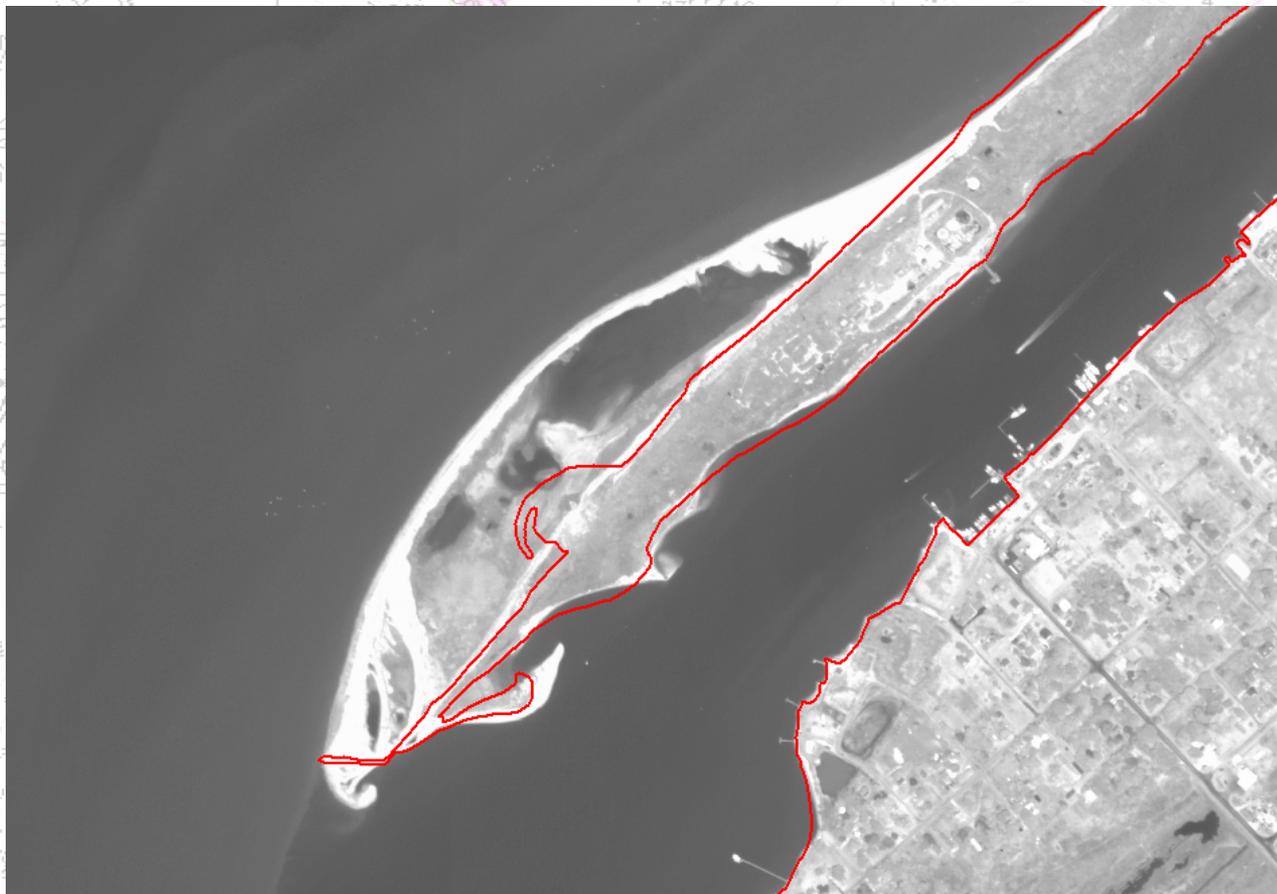


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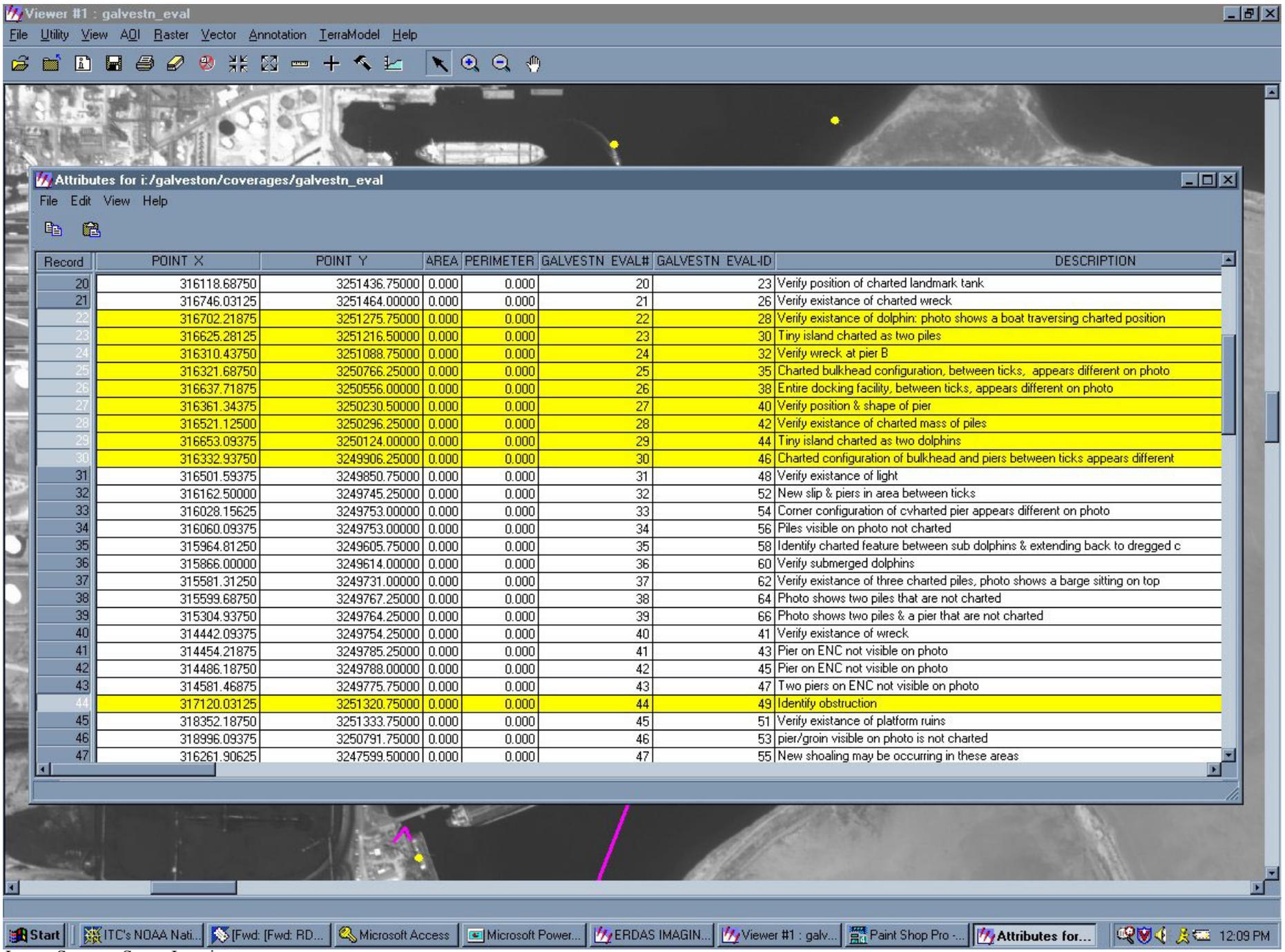
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# Cleveland, Ohio Updated Shoreline

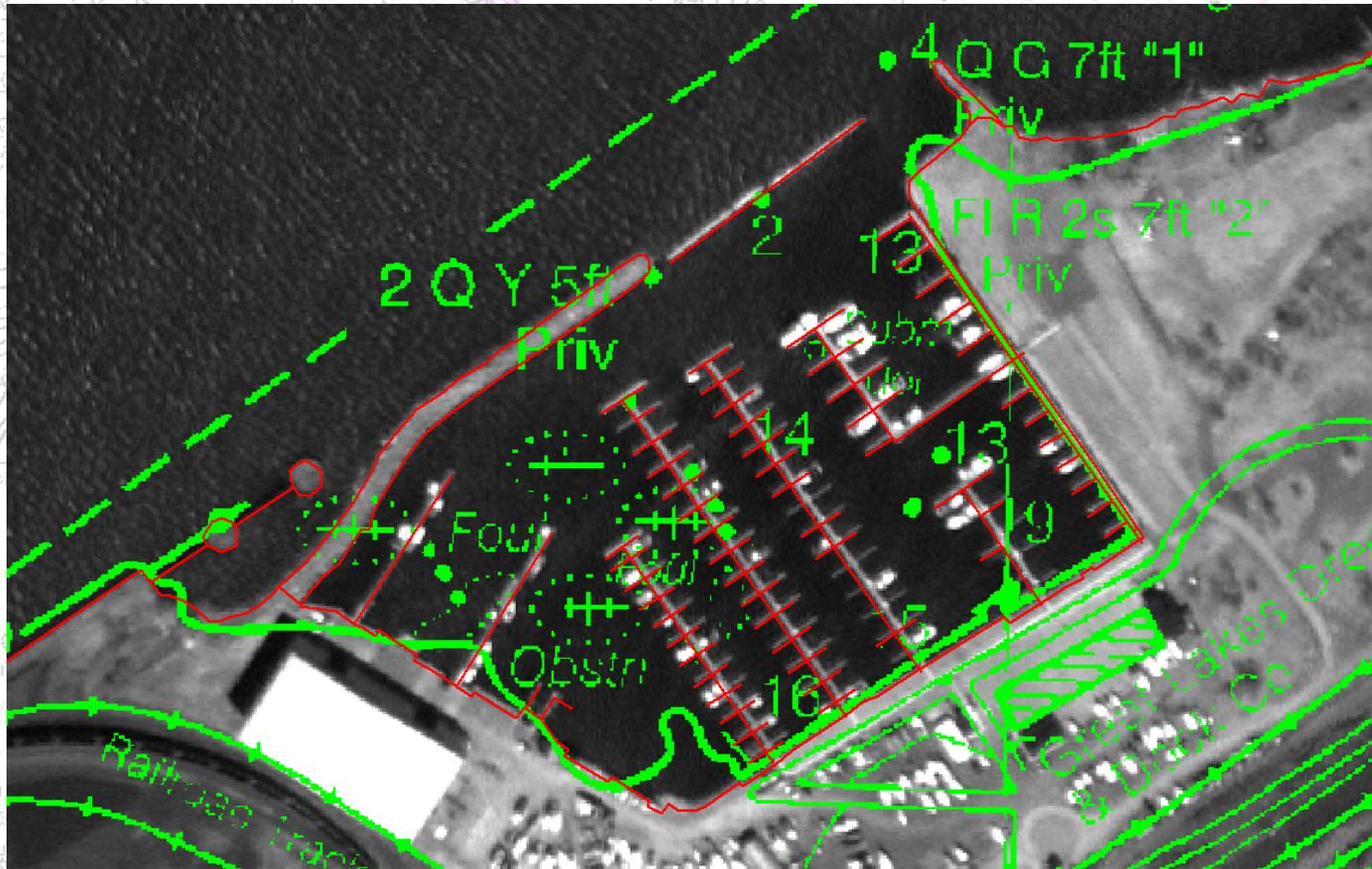


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# Additional Studies

The following additional studies are “works-in-progress”.

The results are **preliminary** and apply only to the stated geographic area.

Studies are currently underway in additional geographic locations.



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# Additional Studies

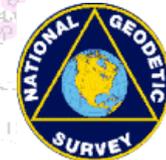
## • Shoreline Compilation

- Shoreline was compiled and feature attributed
- Well-defined points from IKONOS-derived shoreline were compared to either GPS points or photogrammetric shoreline



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# Galveston, TX: Compiled shoreline

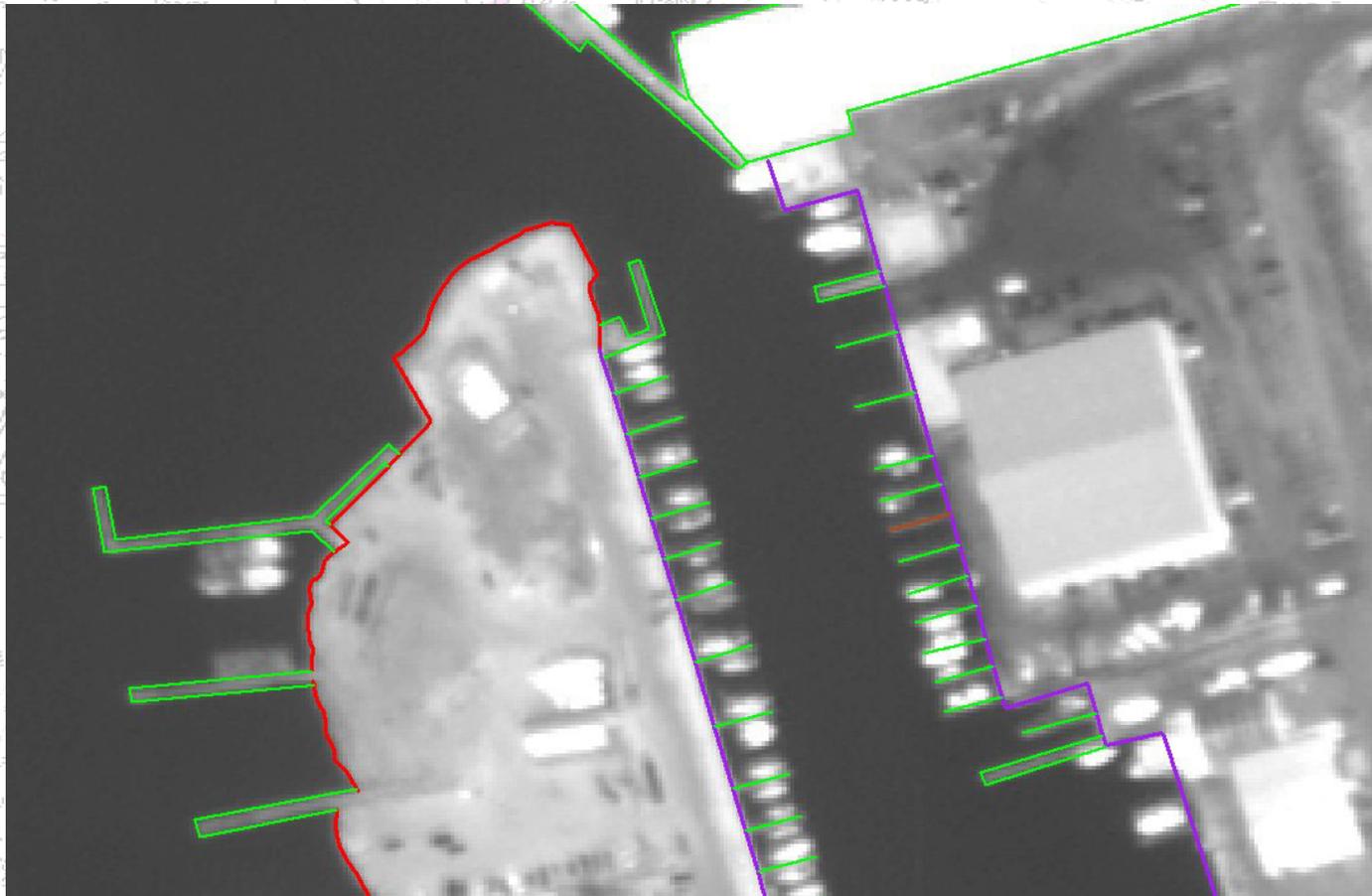
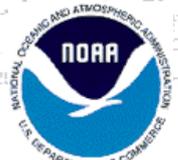


Image Source: Space Imaging



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# Compiled Shoreline Positional Accuracy

Compiled shoreline compared with GPS check points

Location	Image georeferencing source	RMSx	RMSy	RMSr	CE at 95% confidence level
Tacoma (average of 3 compilers)	t-sheets	2.26 m	1.32 m	2.62 m	4.53 m
Galveston (average of 3 compilers)	GPS data points	1.38 m	1.08 m	1.76 m	3.06 m



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# Shoreline Compilation Comparison

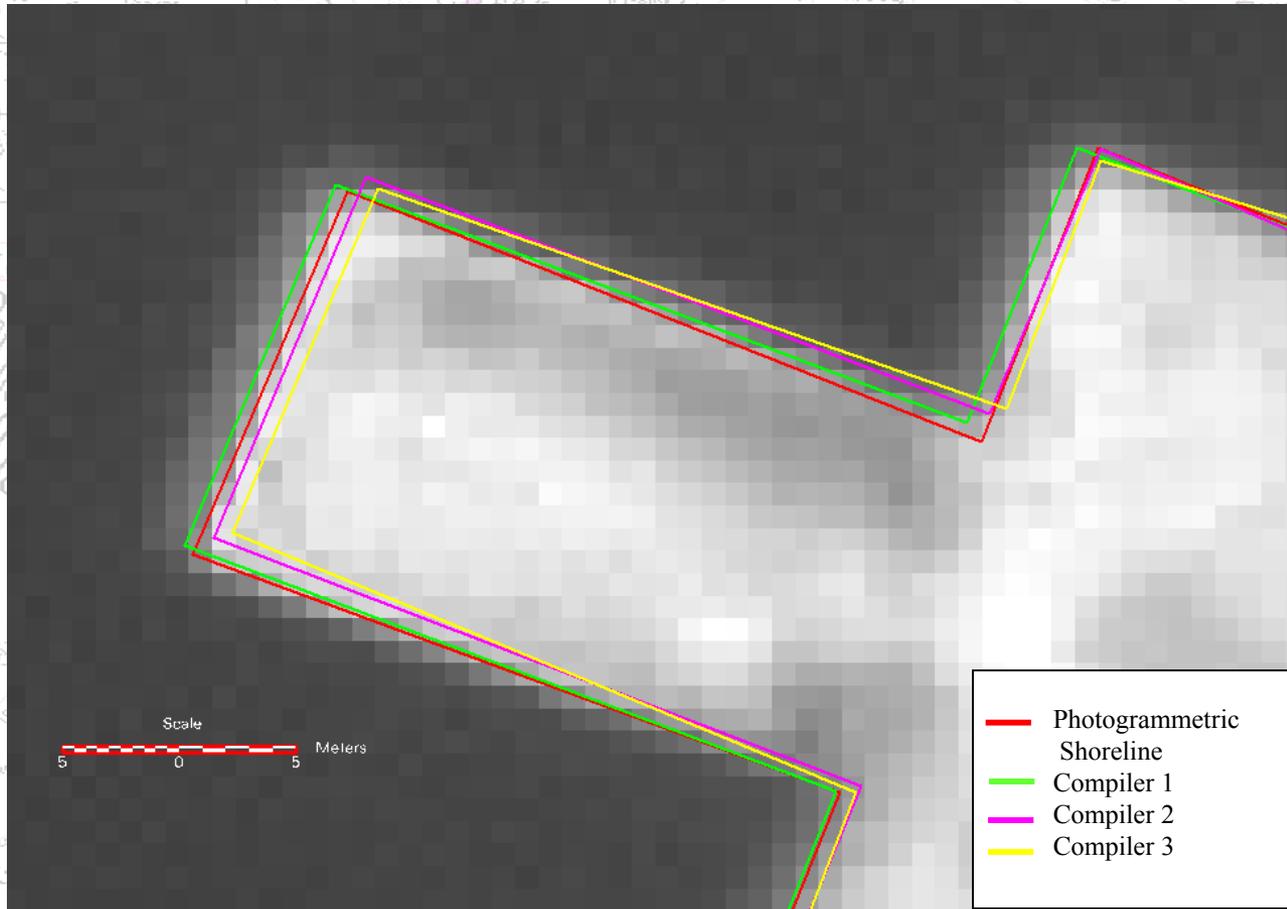
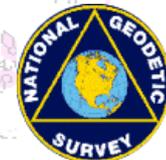


Image Source: Space Imaging



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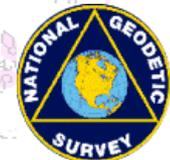
# Compiled Shoreline Positional Accuracy (Galveston, Texas)

Compiled shoreline compared with points derived from photogrammetric shoreline  
(Average of three compilers for each area)

Area	Image georeferencing source	RMSx	RMSy	RMSr	CE at 95% confidence level
<b>AOI #1</b>	GPS data points	1.52 m	1.31 m	2.01 m	3.46 m
<b>AOI #2</b>	GPS data points	1.53 m	1.26 m	1.99 m	3.42 m
<b>AOI #3</b>	GPS data points	2.11 m	1.55 m	2.62 m	4.47 m
<b>AOI #4</b>	GPS data points	1.84 m	2.22 m	2.90 m	4.98 m



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# Accuracy of Galveston, TX Shoreline Compilation

Horizontal accuracy at the 95% confidence level for compiled shorelines:

- **GPS** as ground truth:
  - 4.00 meters (t-sheet control)
  - 3.06 meters (GPS control)
- **photogrammetric shoreline** as ground truth:
  - range of 3.4-5.1 meters for study areas
  - average of 4.28 meters



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# Additional Studies

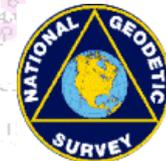
- **Feature Attribution**

- Compared IKONOS-derived feature attributed shoreline from senior compiler with photogrammetric feature attributed shoreline



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# Compiled Shoreline Attribute Accuracy

(IKONOS-derived feature attributes compared with photogrammetric-derived feature attributes)

Feature Type	Shoreline	Alongshore Feature	Cultural Feature
Correctly Identified	80.9%	88.9%	100%
Incorrectly Identified	19.1%	11.1%	0%



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# Additional Studies

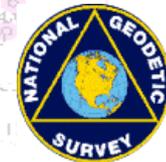
## •Stereo IKONOS Evaluation

- Evaluated the re-georeferencing accuracy of Stereo IKONOS imagery using 1 ground control point.



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# Accuracy Assessment of Richmond, CA Stereo IKONOS

Stereo pair 1

<b>Num of Check GCP's</b>	<b>Georeferencing GCP</b>	<b>RMS X</b>	<b>RMS Y</b>	<b>RMS R</b>	<b>CE at 95% confidence level</b>
<b>7</b>	<b>Original Stereo Image</b>	<b>7.95 m</b>	<b>9.50 m</b>	<b>12.39 m</b>	<b>21.36 m</b>
<b>5</b>	<b>GCP 2_6</b>	<b>2.21 m</b>	<b>1.0 m</b>	<b>2.42 m</b>	<b>3.92 m</b>

Stereo pair 2

<b>5</b>	<b>Original Stereo Image</b>	<b>5.60 m</b>	<b>6.72 m</b>	<b>8.80 m</b>	<b>15.10 m</b>
<b>4</b>	<b>GCP 1_5</b>	<b>1.51 m</b>	<b>1.03</b>	<b>1.83 m</b>	<b>3.11 m</b>



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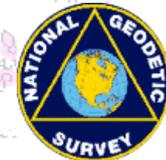
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# Shoreline Change Conclusions

- High resolution satellite imagery can be a useful tool for shoreline feature change analysis in ports.
- Accurate georeferencing is crucial.
- Georeferencing accuracy:
  - 1.5 to 2.5 m (RMSr) or
  - 3 to 4.5 m CE (95%)



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# Shoreline Compilation Conclusions

- Shoreline can be compiled from high resolution satellite imagery in port areas.
- Positional accuracy:
  - 1.5 to 3 m (RMSr) or
  - 3 to 5 m CE (95%)
- Generalized shoreline attributes can be determined from high-resolution satellite imagery



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