NOAA & HOMELAND SECURITY

detection preparedness prevention protection response recovery

NOAA's Geospatial Response Activities during the 2005 Hurricane Season

2nd Annual GIS Conference
Sponsored by
The Office of the Lieutenant Governor
St Croix, U.S.V.I.
June 22-23, 2006

Mike Aslaksen

Acting Chief, Remote Sensing Division

NOAA's National Geodetic Survey

NOAA's Geospatial role in the NRP

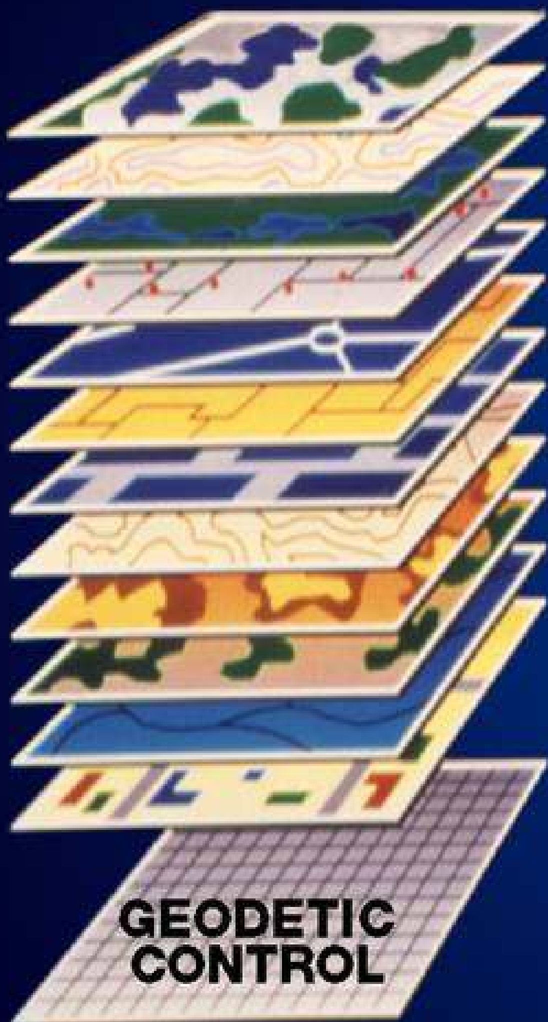
#10 - Oil and Hazardous Materials Response • Oil and hazardous materials (chemical, biological, radiological, etc.) response • Environmental safety and short- and long-term cleanup	- Provides charts and maps for coastal and territorial waters and the Great Lakes. - Conducts emergency hydrographic surveys, search and recovery, and obstruction location to assist safe vessel movement.
#11 - Agriculture and Natural Resources • Nutrition assistance • Animal and plant disease/pest response • Food safety and security • Natural and cultural resources and historic properties protection and restoration	- Conducts emergency hydrographic surveys, search and recovery, and obstruction location to assist safe vessel movement.
#13 – Public Safety and Security	- Provides law enforcement and security capabilities, nautical charting, surveys, tidal and geodetic services, and geo-referenced coastal imagery.

***Explicit roles in ESF's 1,2,4,9,10,12,13,14, and 15**

How Geospatial Technologies are currently used at NOAA to support Emergency Response

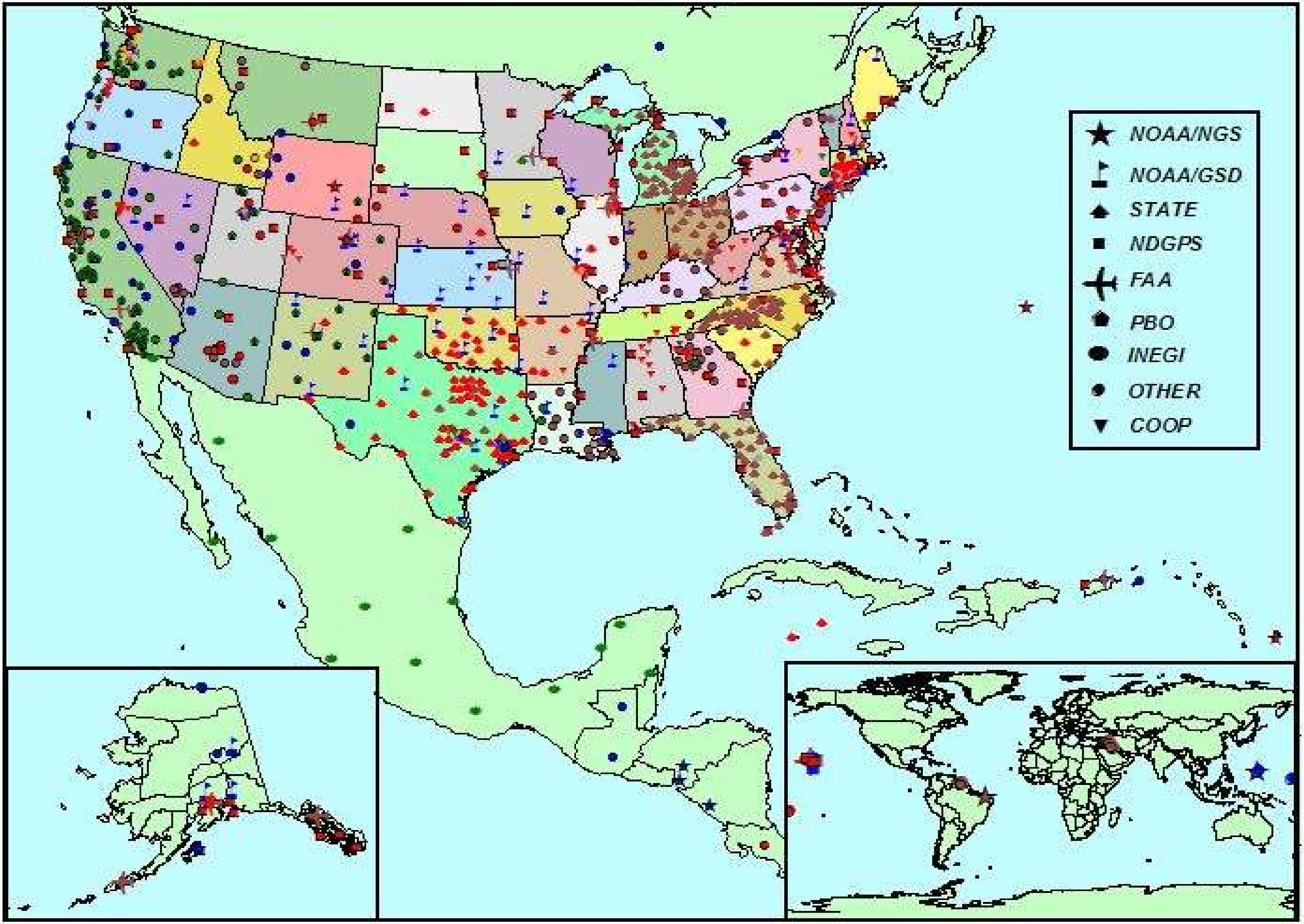
- Geodetic/Surveying – importance of accurate elevations (evacuation routes, levee heights, rebuilding), supporting remote sensing operations
- Imagery and other remotely sensed data - satellite and airborne
- Hydrographic data - clearing waterways, marine debris detection
- Modeling, Existing Data Availability, GIS Applications, HAZMAT support

Geographic Information Systems Layers



Wards and Precincts
Demographics
Structures
Water Utilities
Sewerage
Electrical Utilities
Roads
Boundaries
Land Use
Hydrology
Soils
Topography

CORS Coverage - April 2006



Symbol color denotes sampling rates: (1 sec) (5 sec) (10 sec) (15 sec) (30 sec) (Decommissioned)

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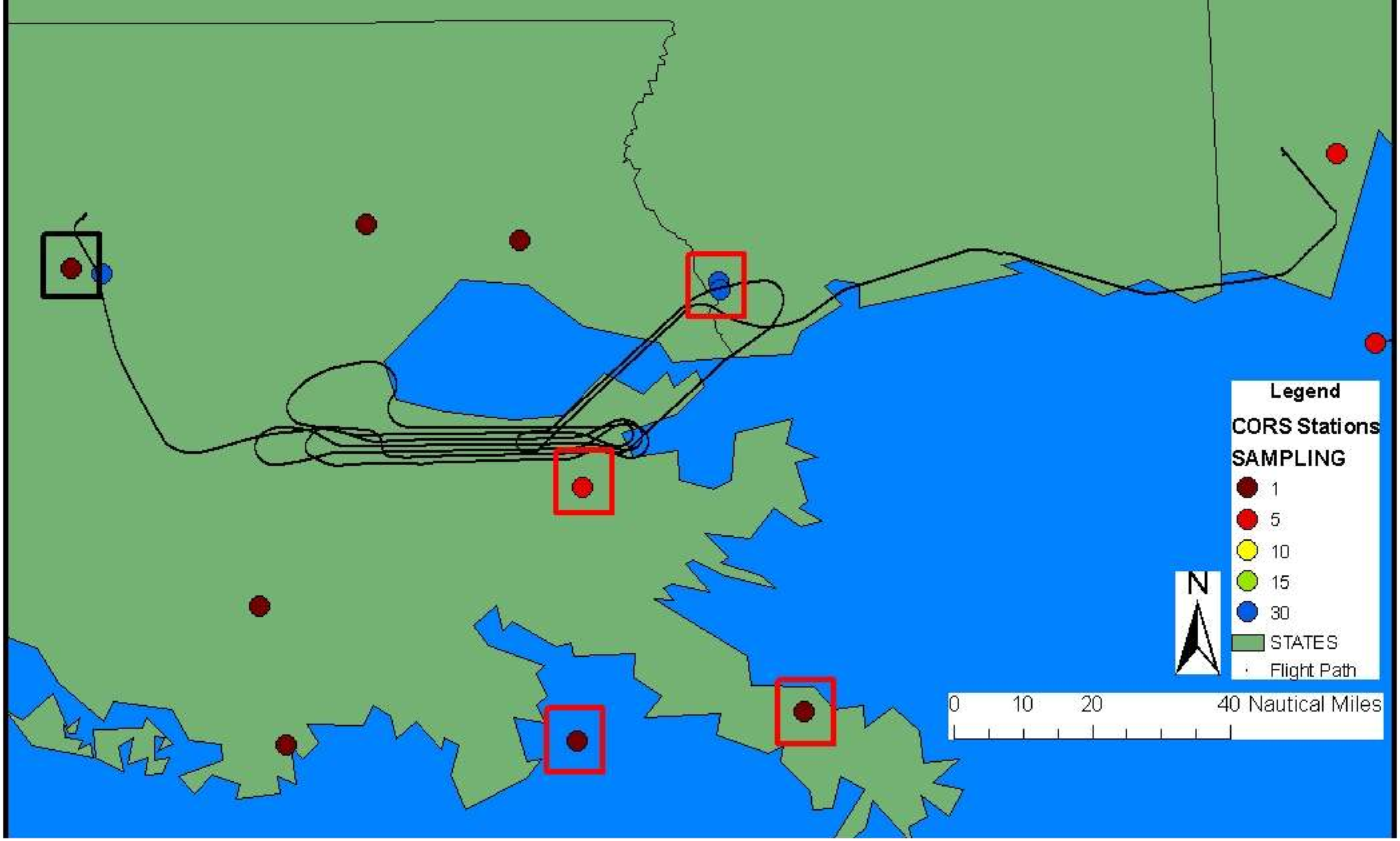
31AUG06 NOAA DSS Flight 2 and CORS Stations

Stations in red boxes were offline after the storm.
Station in black box (1LSU) was used as base station for this mission.



Geodetic/Surveying Capabilities

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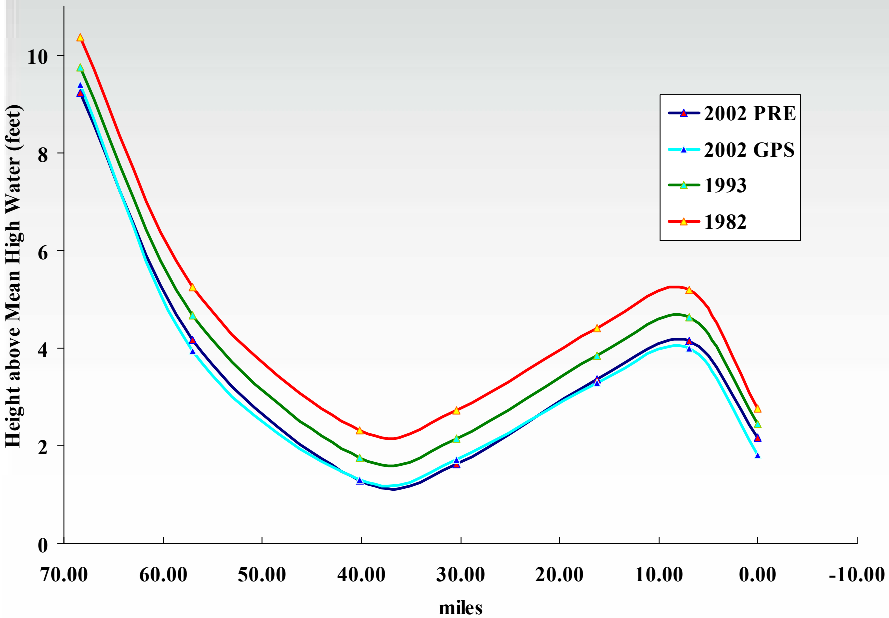
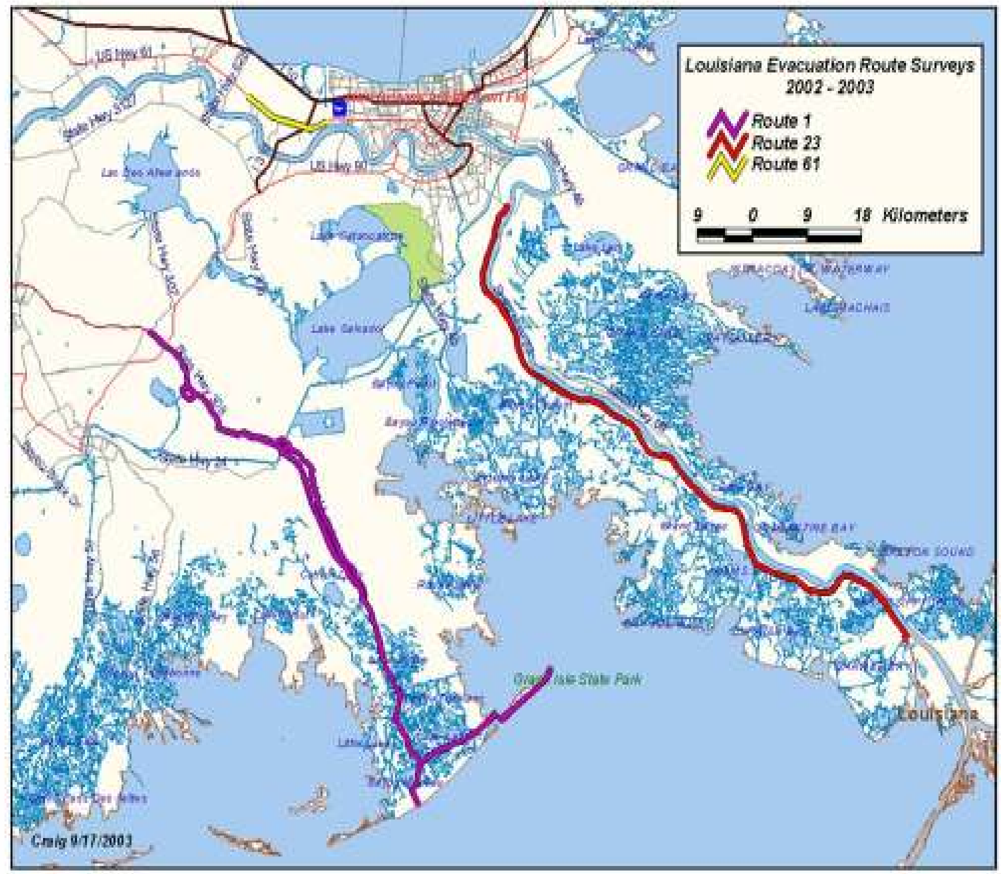
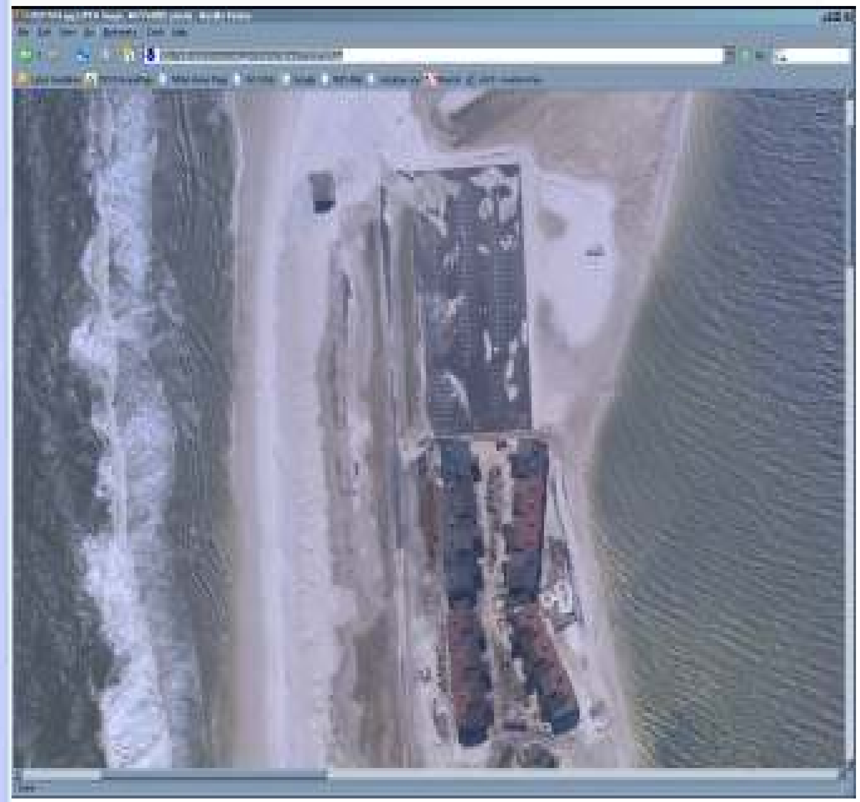
Evacuation Routes and Subsidence





Damage Assessment Imagery

JPEGs of storm impacted areas available for download



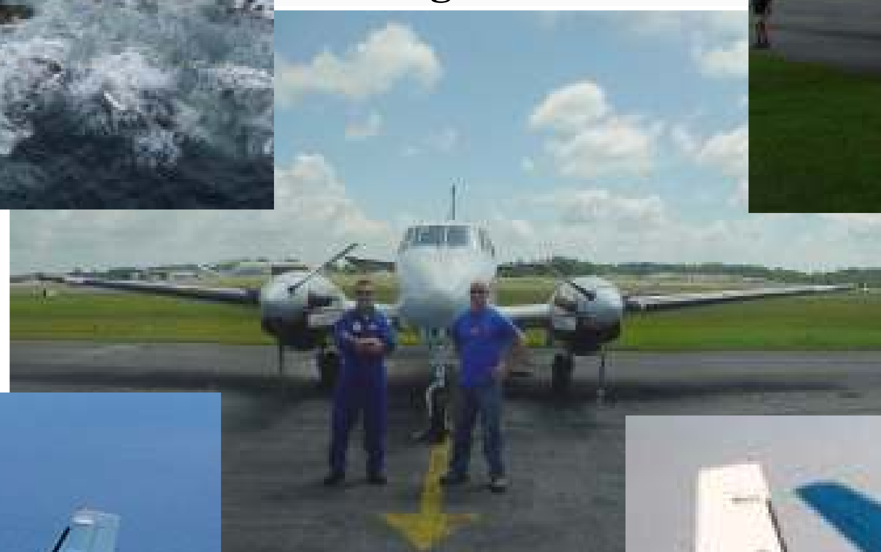
Platforms

NOAA Citation

NOAA Twin Otters

Dynamic Aviation

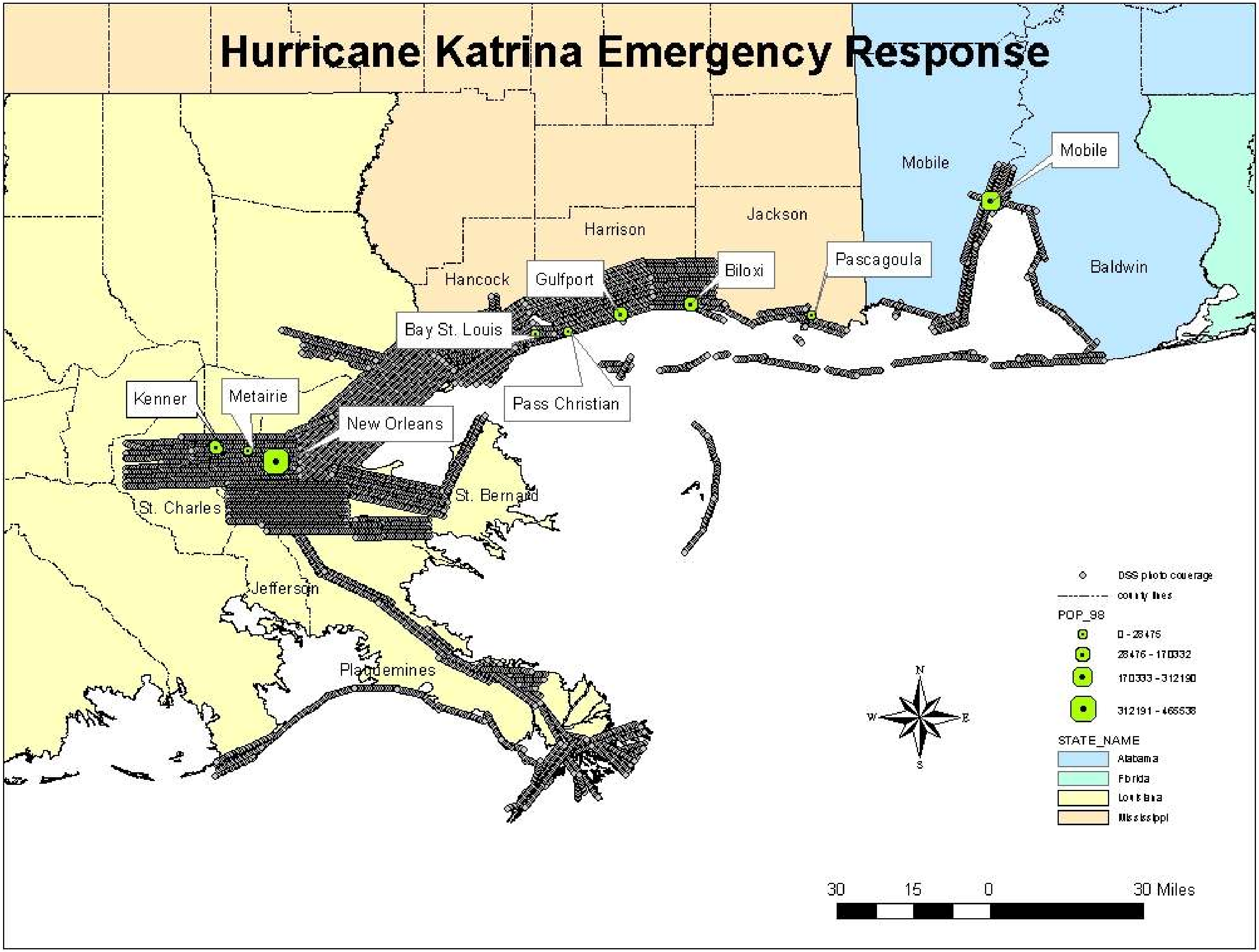
King Air 90/200



NOAA Shrikes

NOAA Turbo Commander

Sensors – DG Medium Format Digital Camera, LIDAR, HSI, Thermal Imager



9 Days

19 Flights

8327 images

48 Terabytes downloaded


Grand Isle, LA
HELP!
HELP!


Pass Christian, MS

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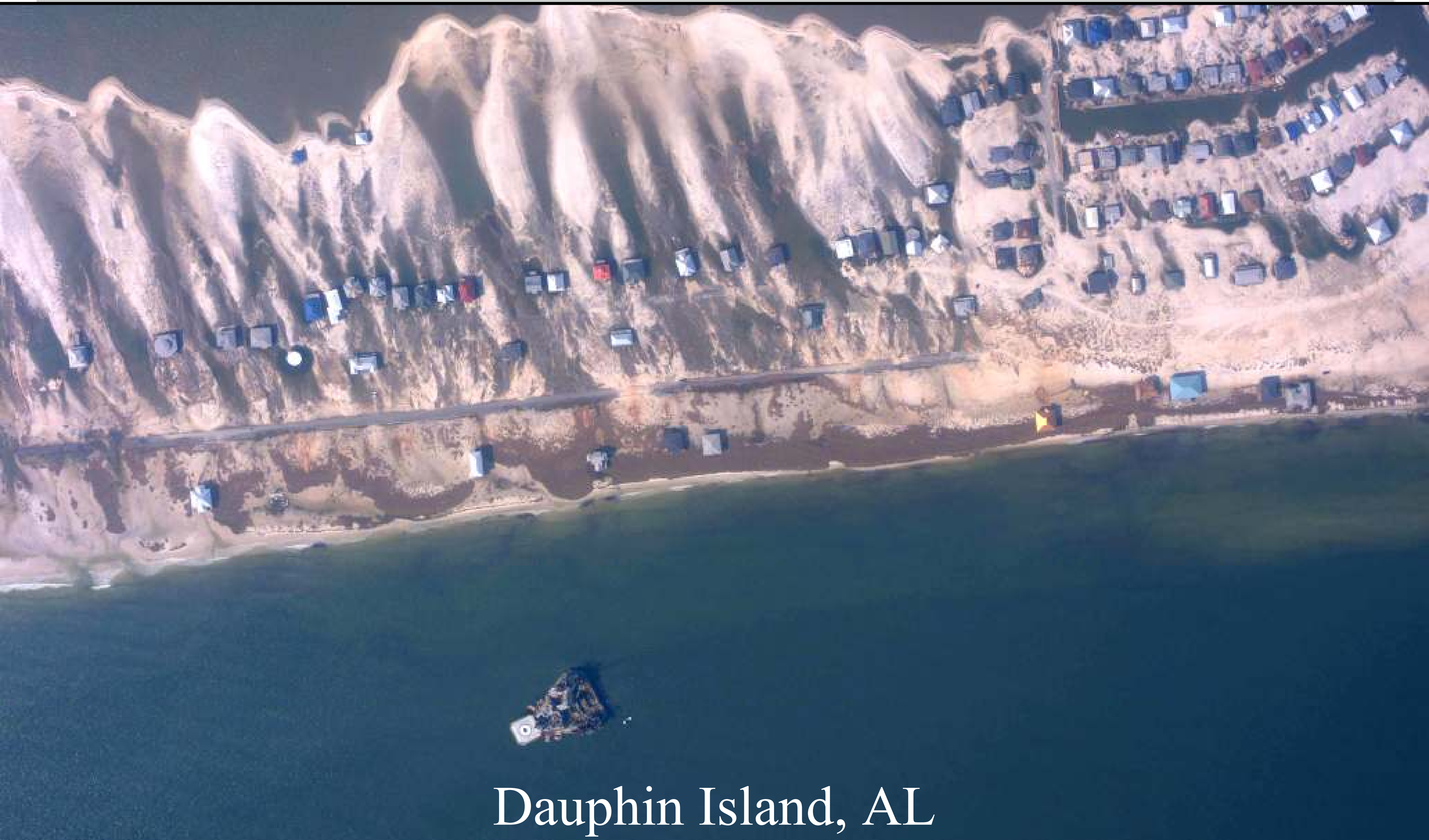
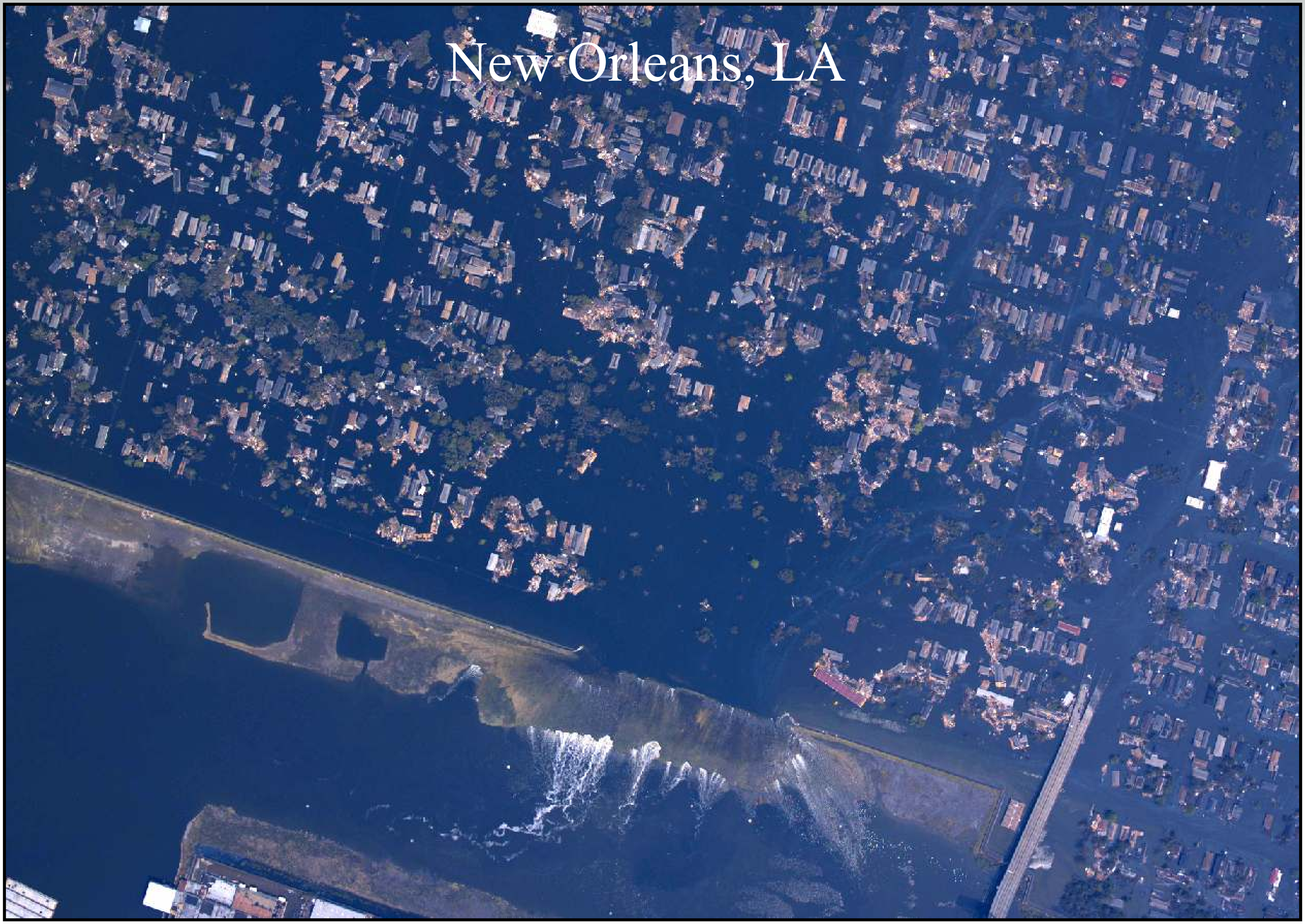
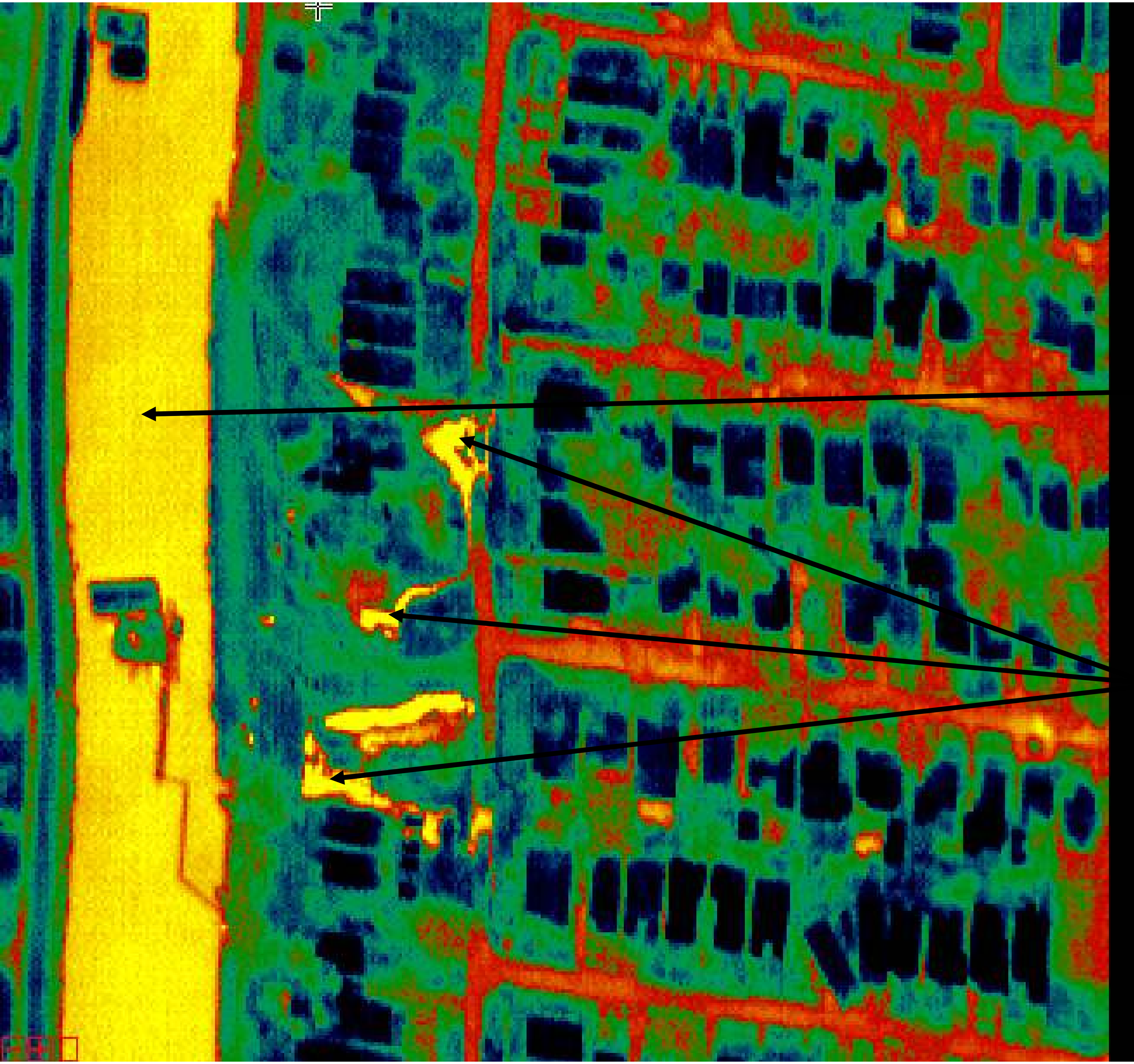
Gulfport, MS

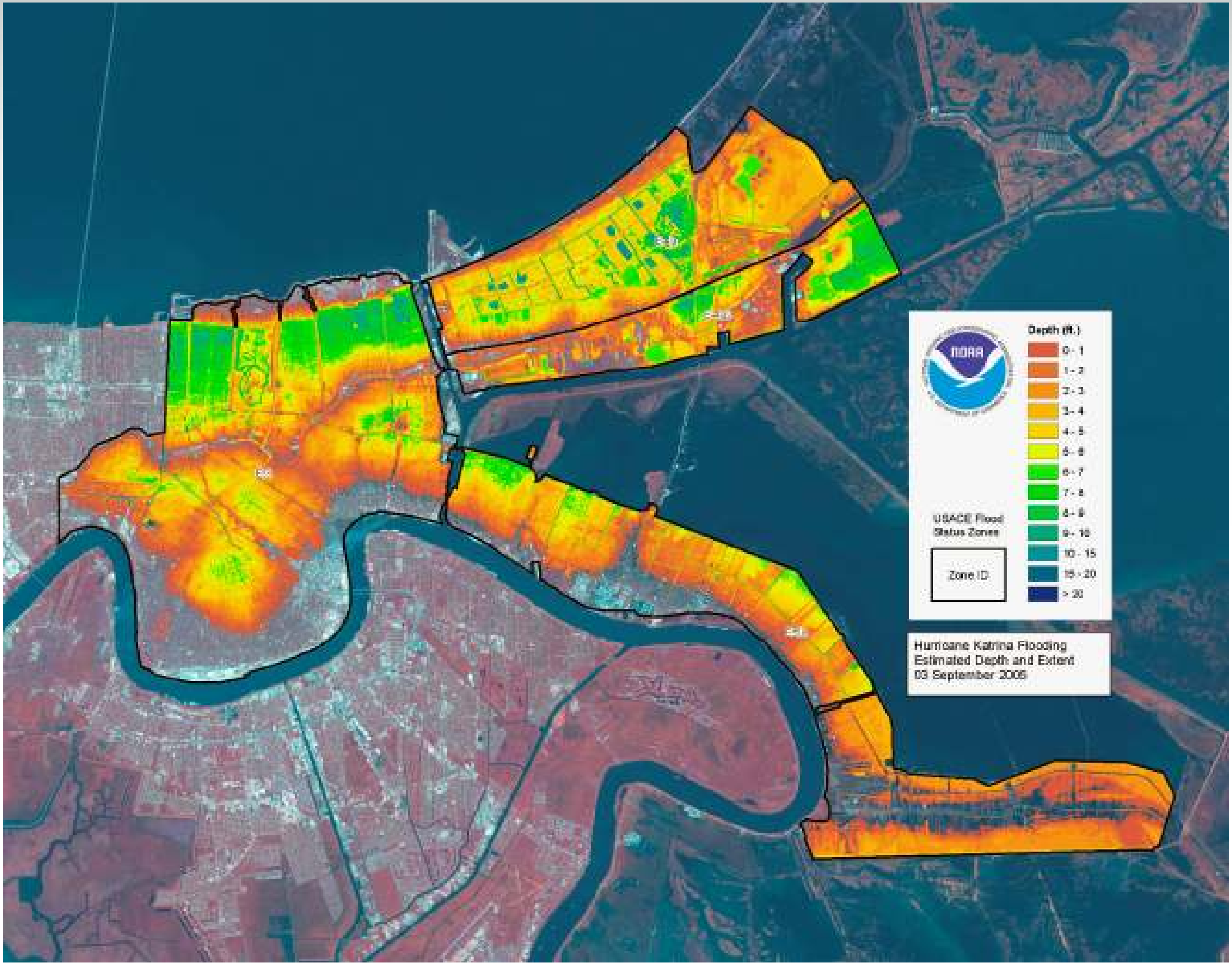


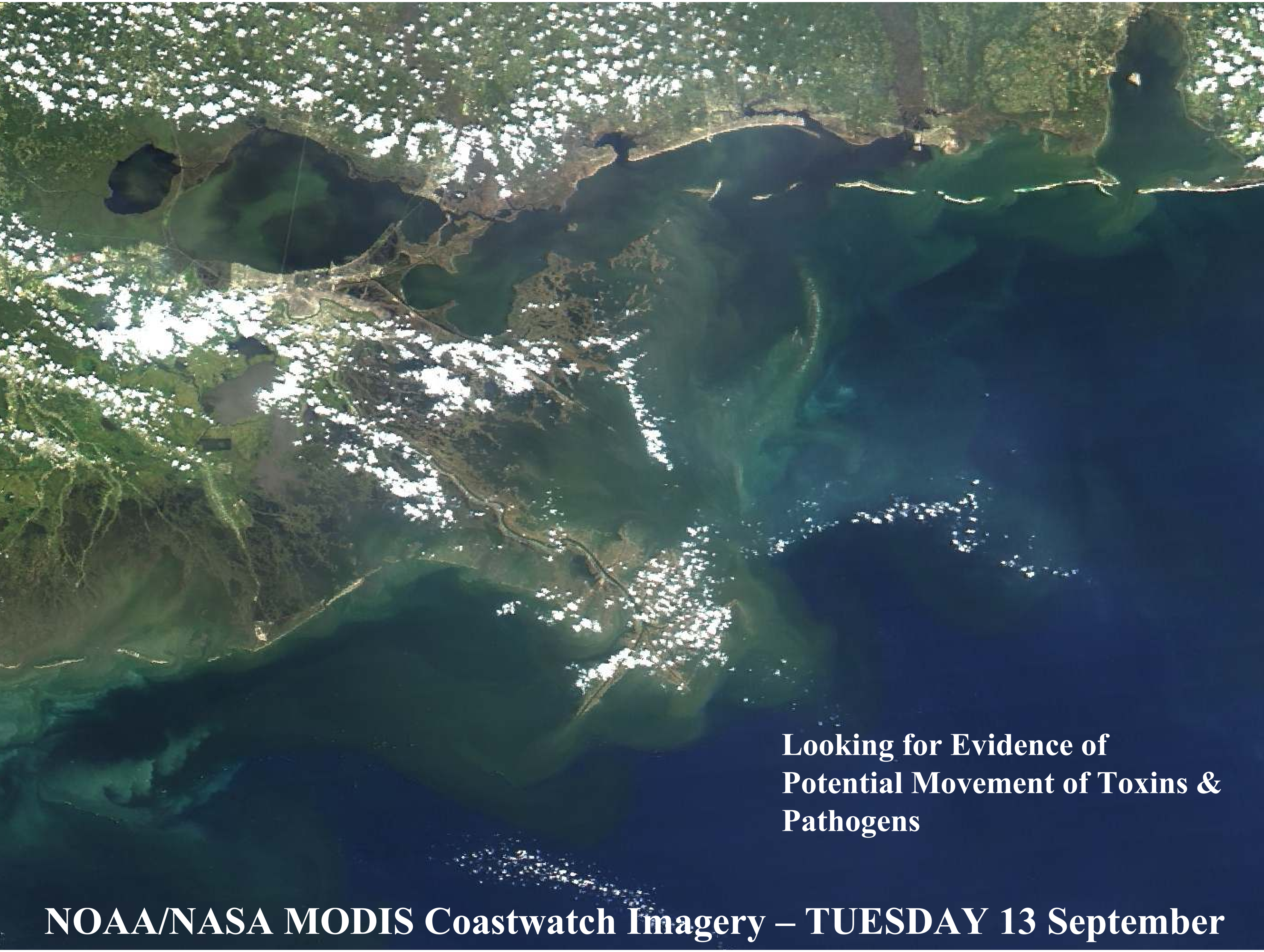
Dauphin Island, AL


New Orleans, LA

New Orleans Thermal Surveys November 2005

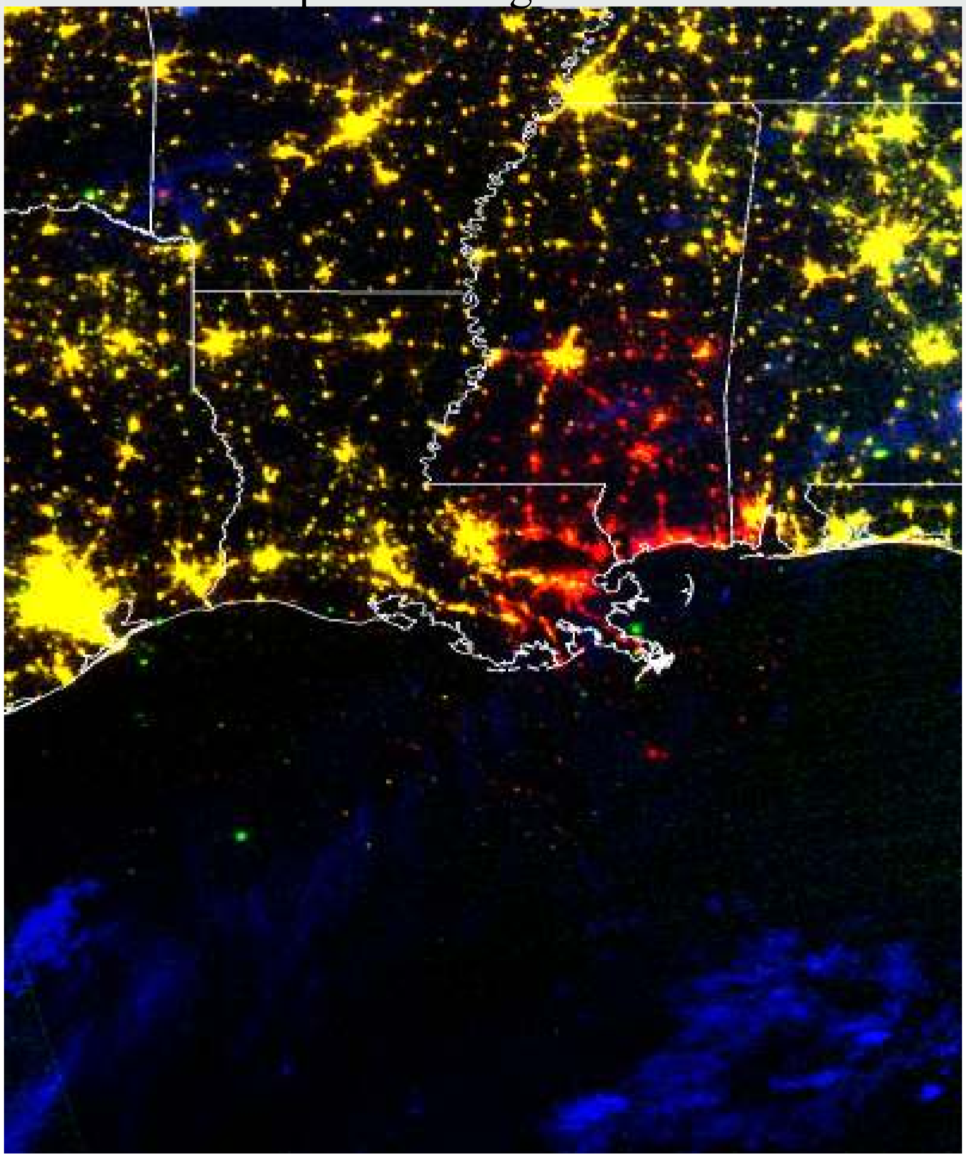



Depth (ft.)
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 15
15 - 20
> 20
USACE Flood Status Zones
Zone ID
Hurricane Katrina Flooding
Estimated Depth and Extent
03 September 2005


Looking for Evidence of
Potential Movement of Toxins &
Pathogens
NOAA/NASA MODIS Coastwatch Imagery – TUESDAY 13 September

DMSP Optical Linescan System

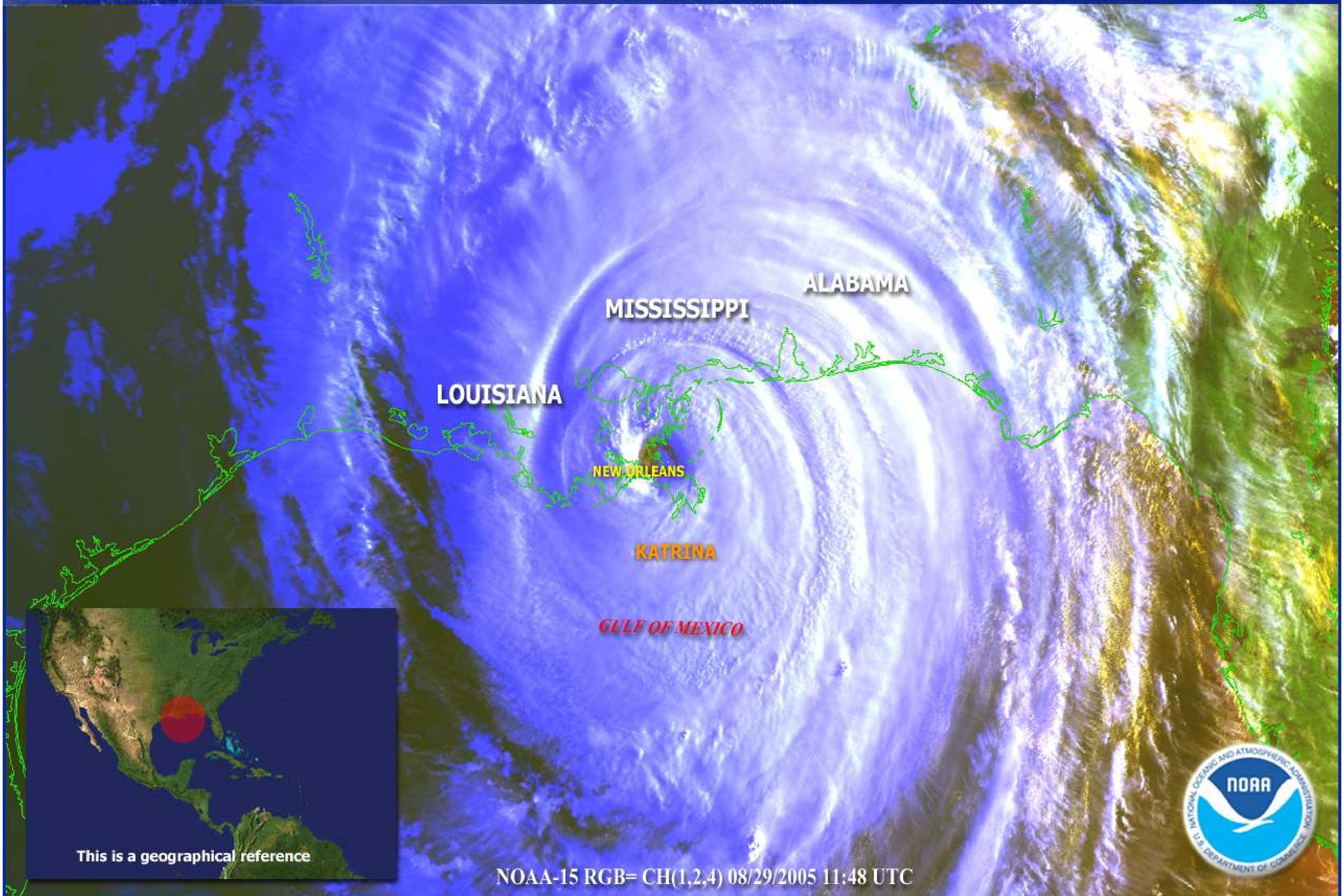
August 31, 2005 after landfall. Red shows power outage areas.



September 12, 2005 after landfall. Most power restored. Small area still Out, shown in red.

Hurricane KATRINA has hit land and is moving north at 15mph. It has max sustained winds of 150mph and gust of 184mph.

Credit: NOAA



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Hydrographic Survey Assets

Thomas Jefferson

Nancy Foster

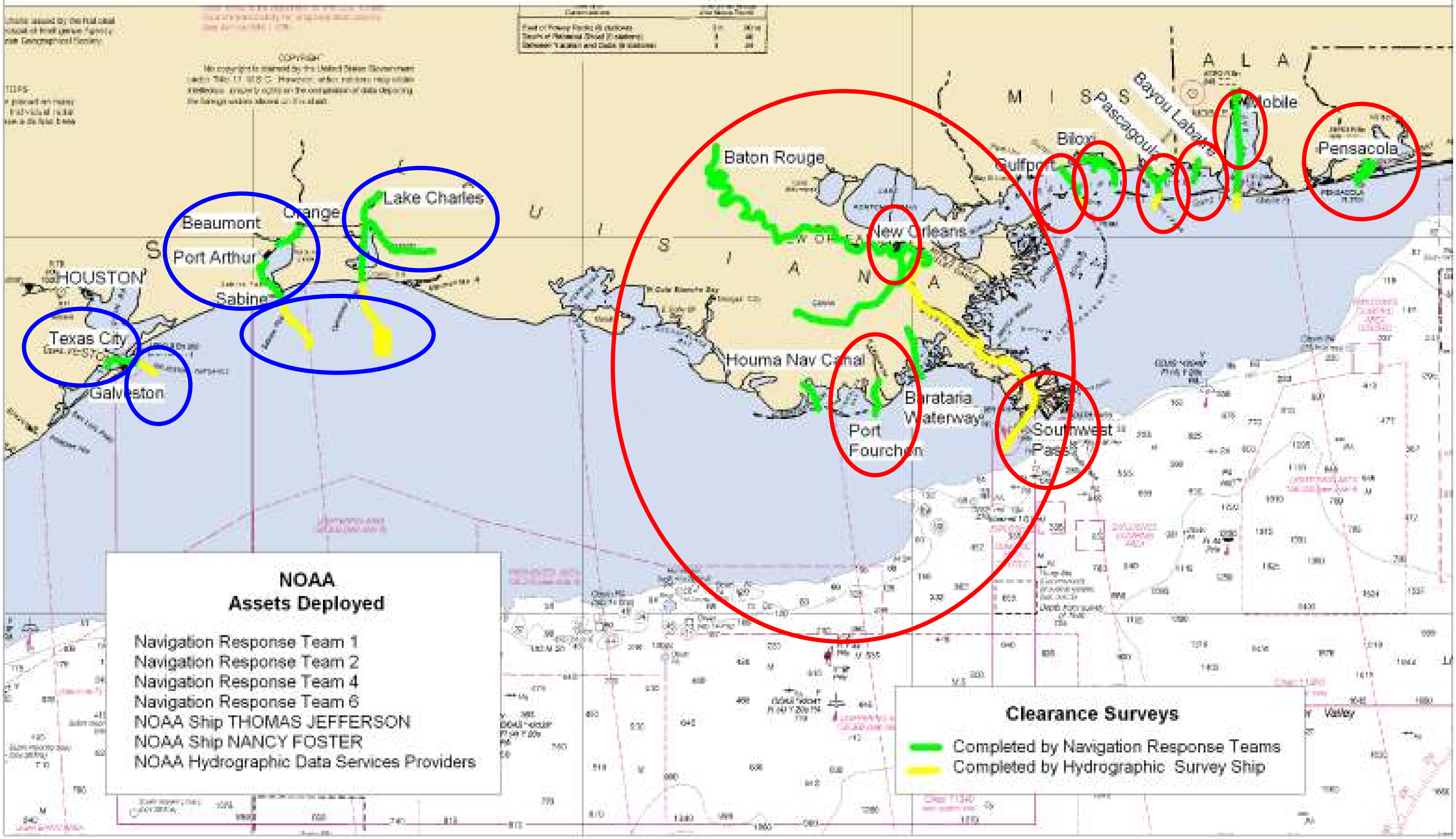
NRT1, NRT2, NRT3, NRT4, NRT 5, NRT6

Fugro

SAIC

NOAA Hurricane Katrina and Rita Response: Emergency Hydrographic Surveys In Support of Reopening Ports and Waterways

Office of Coast Survey and Office of Marine and Aviation Operations



NOAA Assets Deployed

- Navigation Response Team 1
- Navigation Response Team 2
- Navigation Response Team 4
- Navigation Response Team 6
- NOAA Ship THOMAS JEFFERSON
- NOAA Ship NANCY FOSTER
- NOAA Hydrographic Data Services Providers

Clearance Surveys

- Completed by Navigation Response Teams (green)
- Completed by Hydrographic Survey Ship (yellow)

Modeling, Existing Data Availability, GIS Applications, HAZMAT support

Vertical Datum Transformation (VDatum)

Relationship of vertical datums for Tampa Bay:

86.39 ft	WGS 84 (G873)	26.33 m
81.33 ft	NAD 83 (86)	24.79 m
0.792 ft	MHHW	0.241 m
0.409 ft	MHW	0.125 m
0.0 ft	NAVD 88	0.0 m
-0.535 ft	LMSL	-0.163 m
-0.850 ft	NGVD 29	-0.259 m
-1.495 ft	MLW	-0.456 m
-1.919 ft	MLLW	-0.585 m

WGS 84, NAD 83 (86)

3-D Datums

NAVD 88, NGVD 29

Orthometric Datums

MHHW, MHW, MTL, DTL, MLW, MLLW

Tidal Datums

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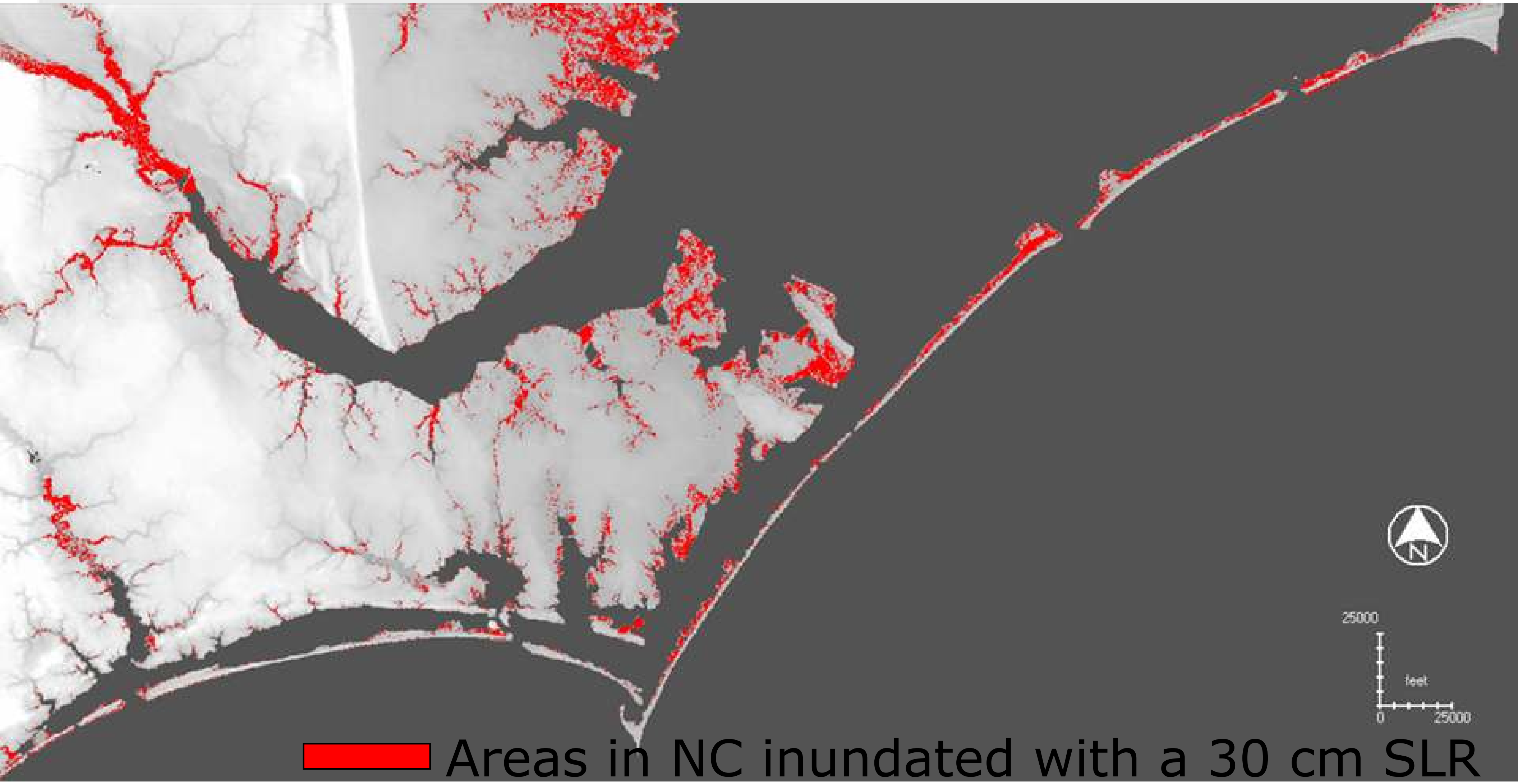
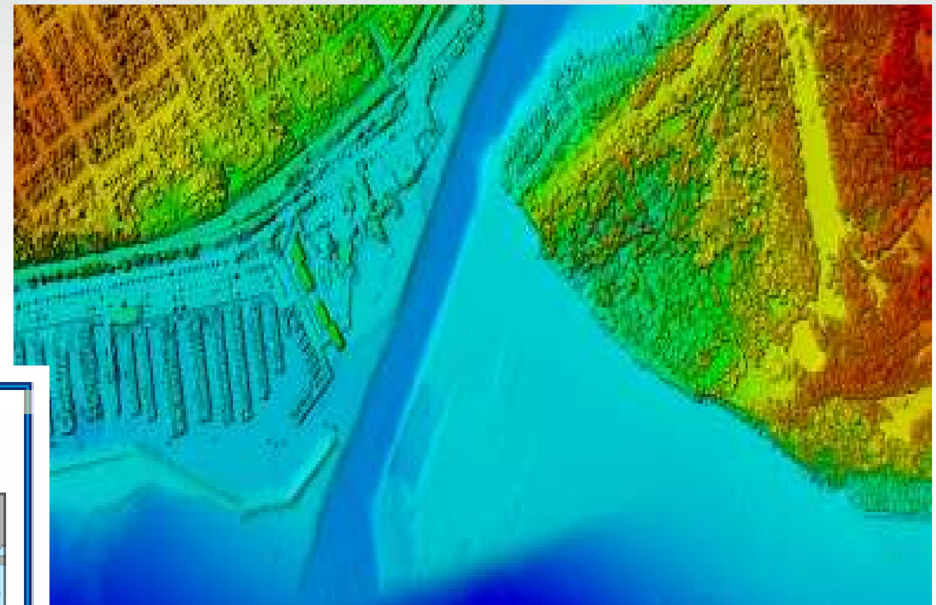
Sea Level Rise Scenarios in North Carolina using VDatum



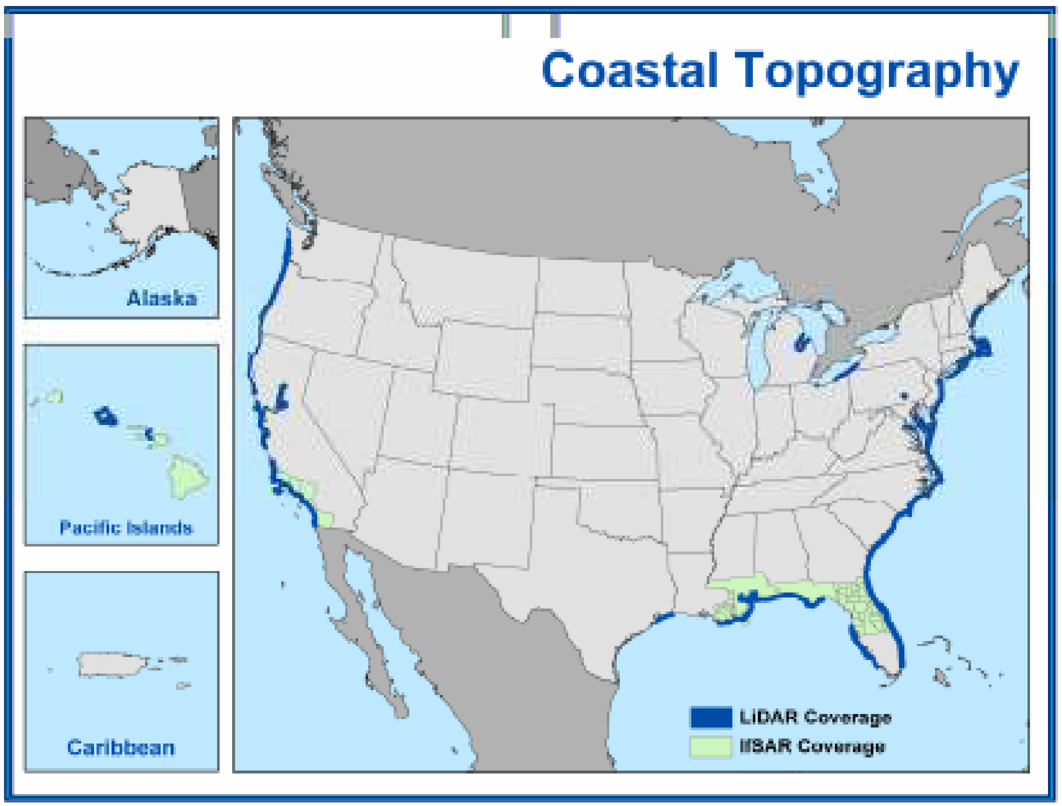
Geospatial Data Development

Topo LIDAR, Bathy LIDAR and IfSAR

Coastal hazards / flooding
Shoreline / beach change
Tsunami Inundation
Storm modeling
Coastal erosion
Visualization



Entrance to Lake Union, WA

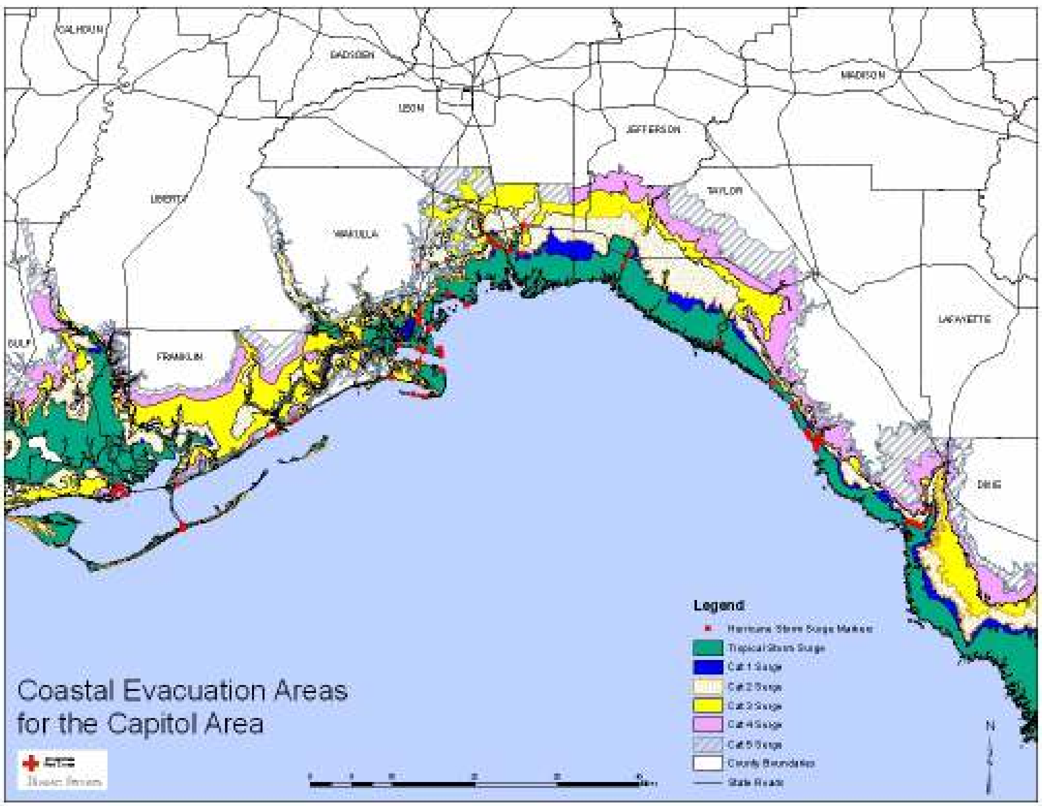


- Open access to all LIDAR
- Currently contracting LIDAR collection for coastal counties
- Coordinating data collection with federal, state and local organizations
- Data distribution through LDart www.csc.noaa.gov/crs/tcm/

Geospatial Technology Used in Enhancing Storm Surge Guidance

NOAA Storm Surge Action Plan

- Recommendations to improve storm surge information and availability
- Focused on making GIS-based tools for decision-support

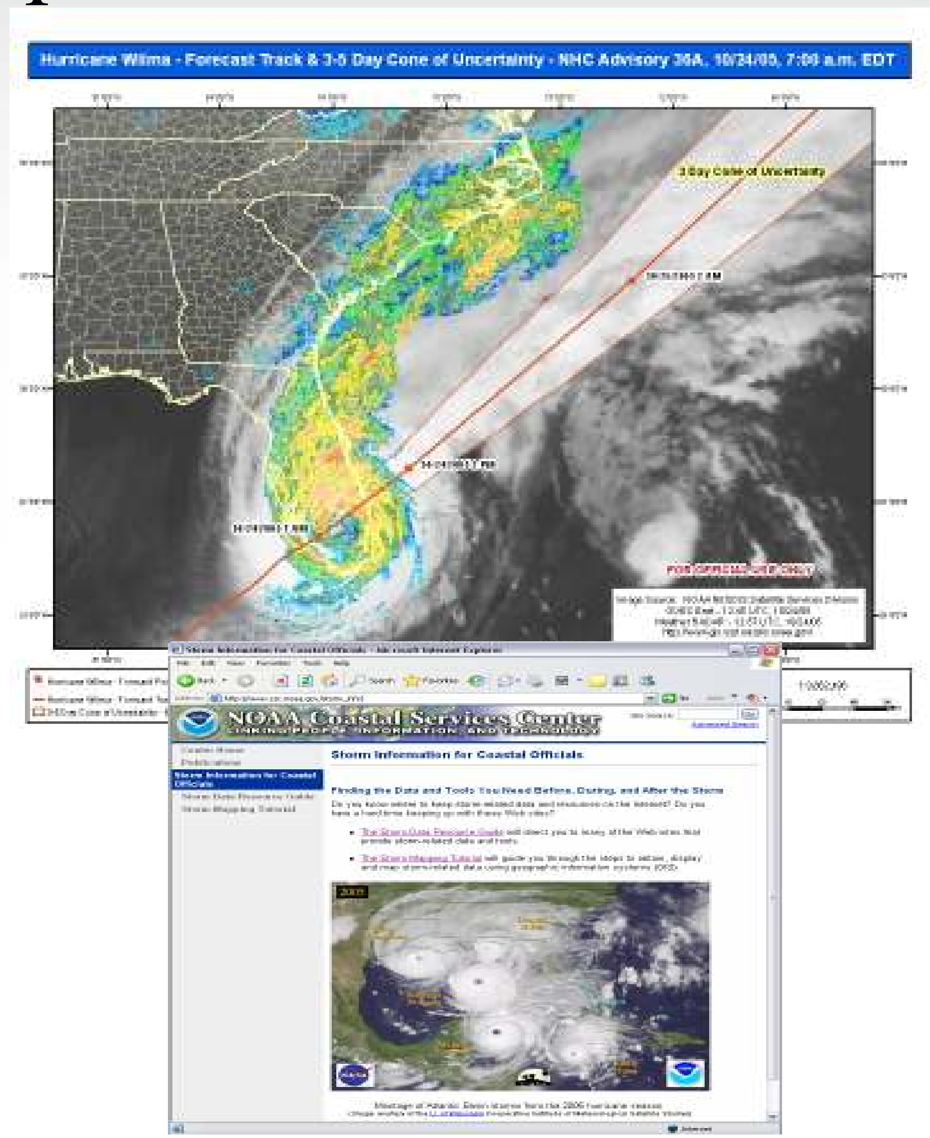


GIS Assistance and Geospatial Data Resources for Storm Response

GIS assistance to FEMA
- Forecast information and decision mapping based on NOAA forecast datasets

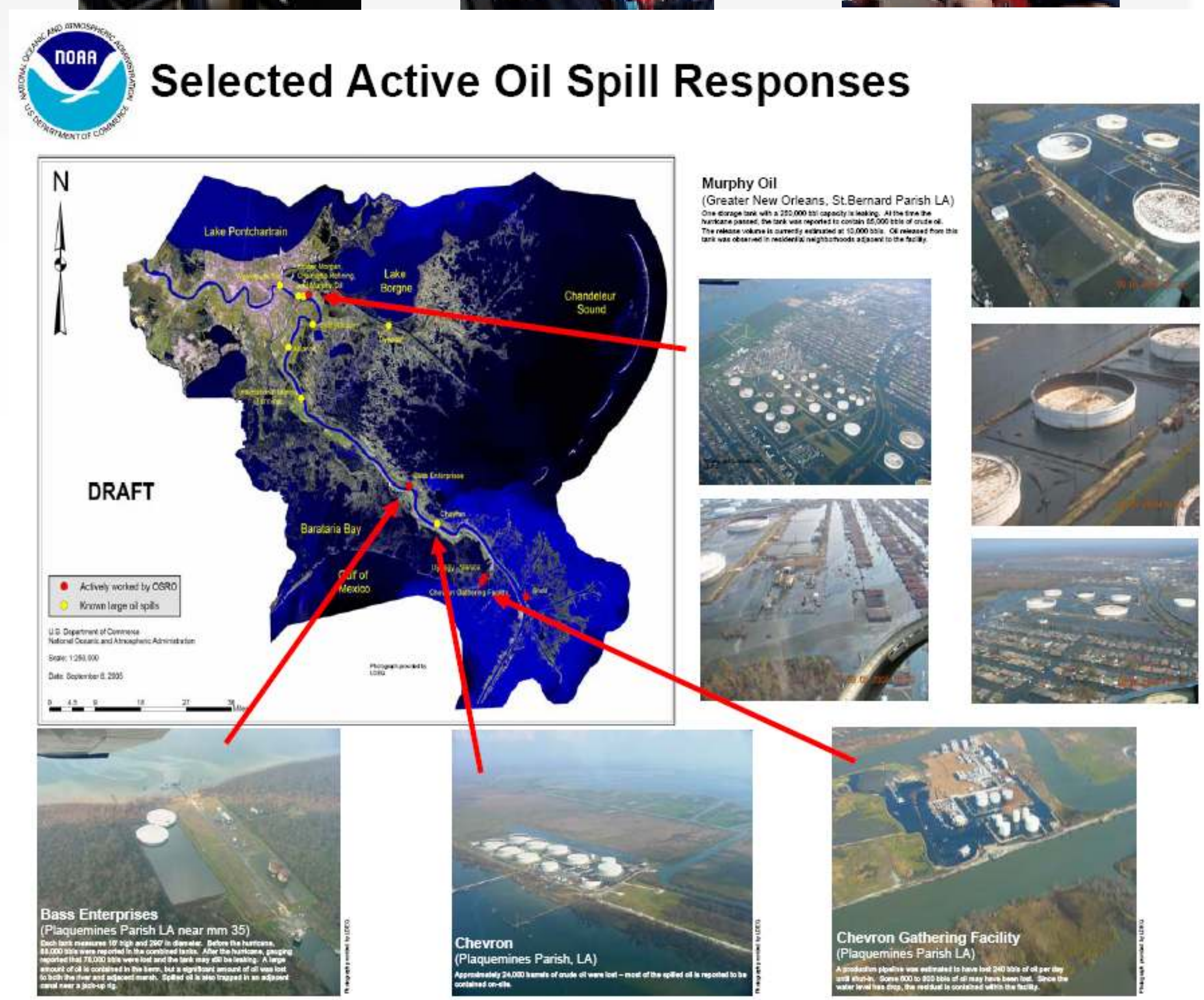
Storm data resource guide
- Links and description to storm related geospatial data
- Data sources can be used in GIS for managing storm impacts

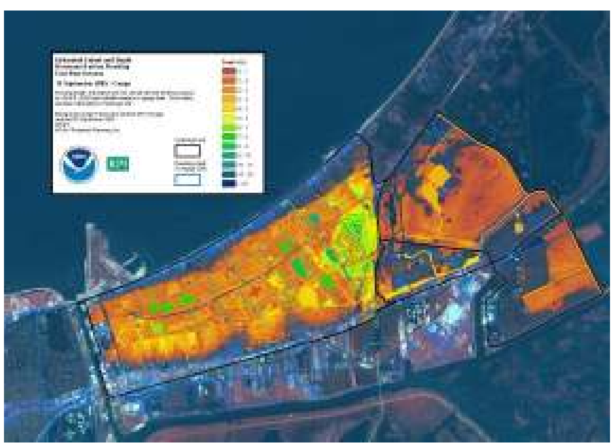
Storm Mapping Tutorial
- Assists in downloading, converting, and displaying NOAA forecast data in a GIS
- Allows users to display NOAA data with local data to visualize storm impacts on a community



Hazardous Materials

- Provided information for USCG Search and Rescue
- Working with Federal, State, and local agencies to identify, assess, prioritize, and mitigate oil and hazardous material spills
- Providing guidance on vessel salvage and shoreline cleanup assessments
- Conducting natural resource damage assessment to restore harm caused by major oil spills





Known Gaps in Geospatial Preparedness and Suggested Solutions

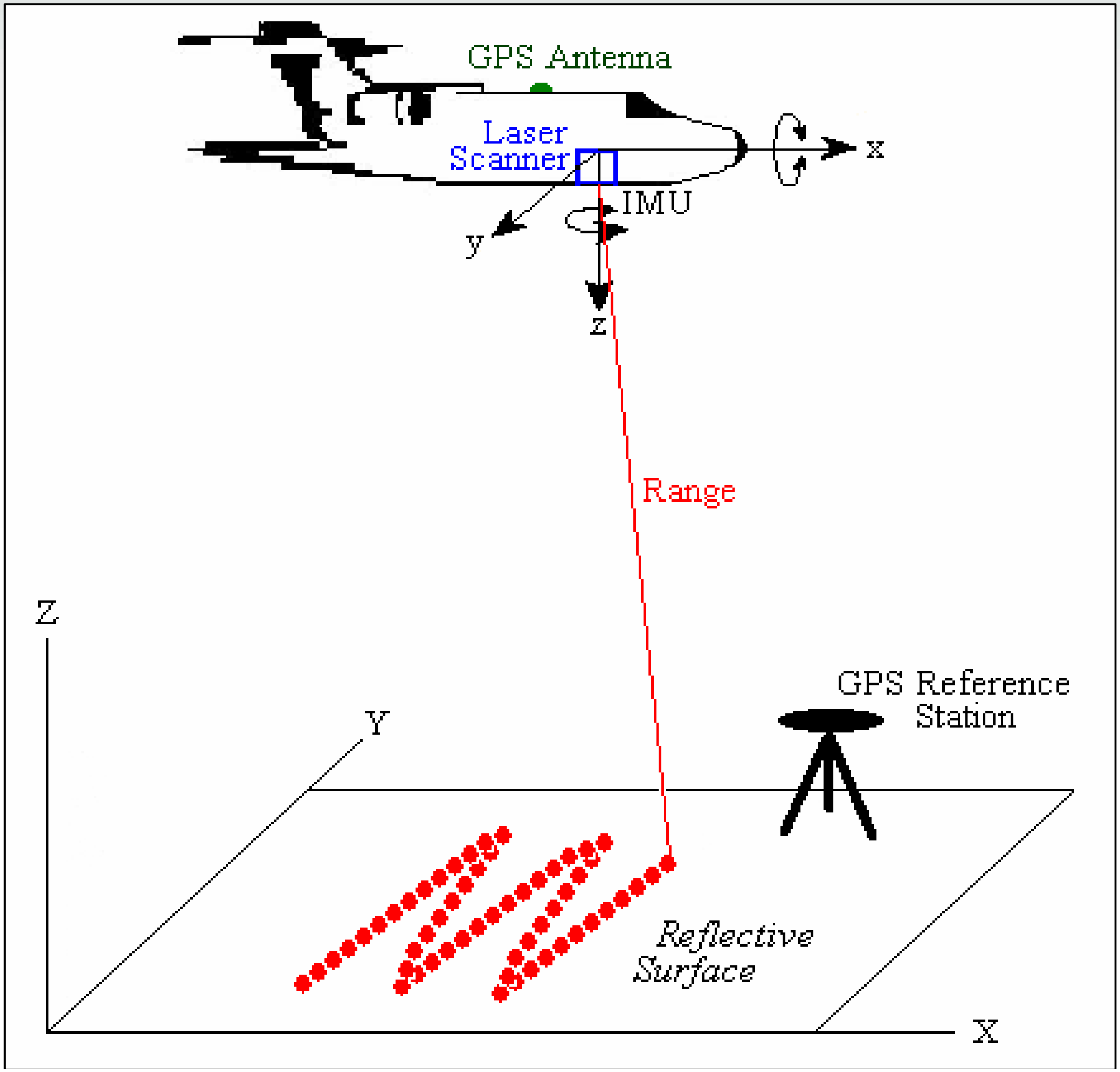
DHS Office of Intelligence and Analysis designated by SECHOME as single Coordinating authority for geospatial data collection, exploitation, and coordination in Support/response to Incidents of National Significance

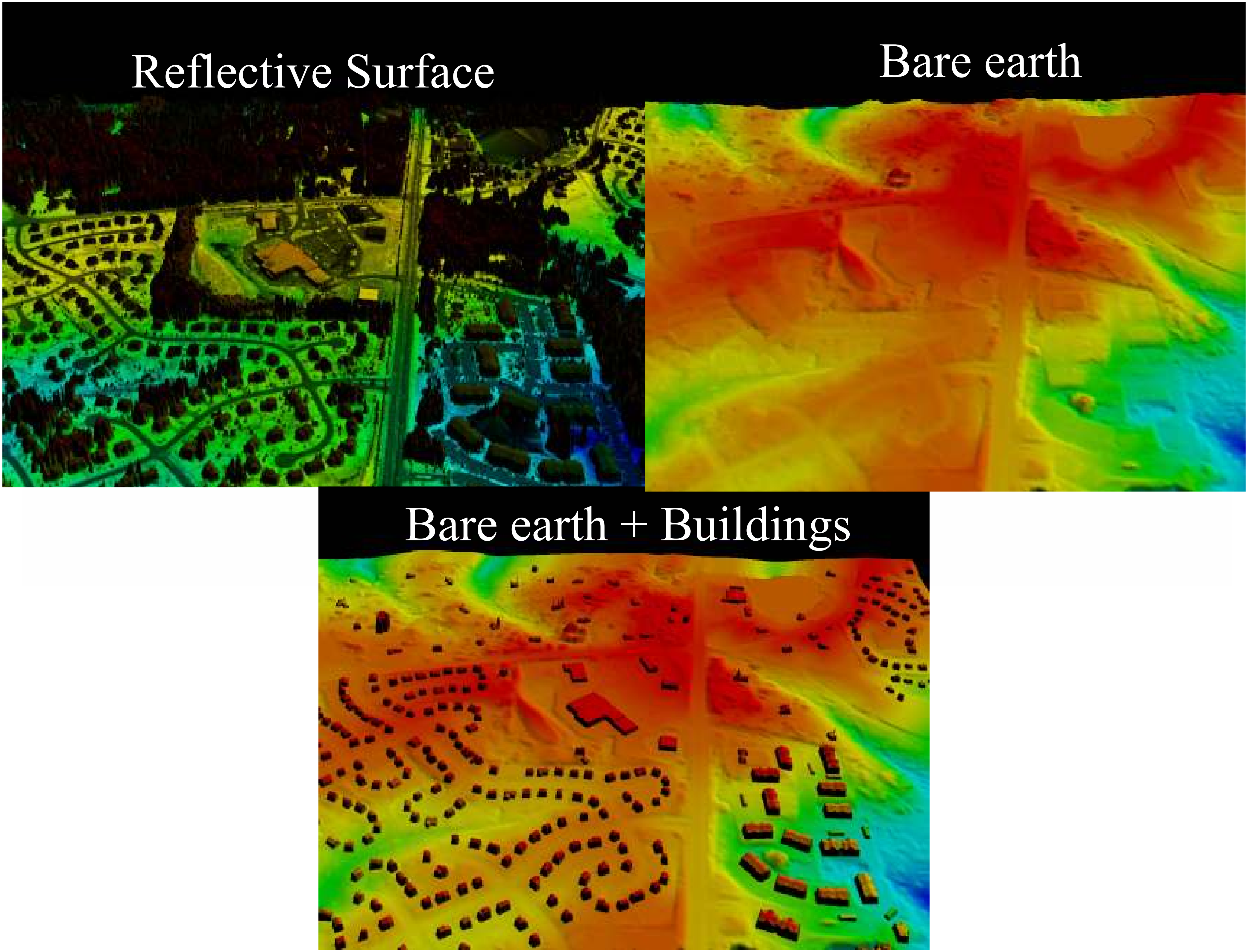
DHS/IA has created Interagency Remote Sensing Coordination Cell (IRSCC) to Address these issues.

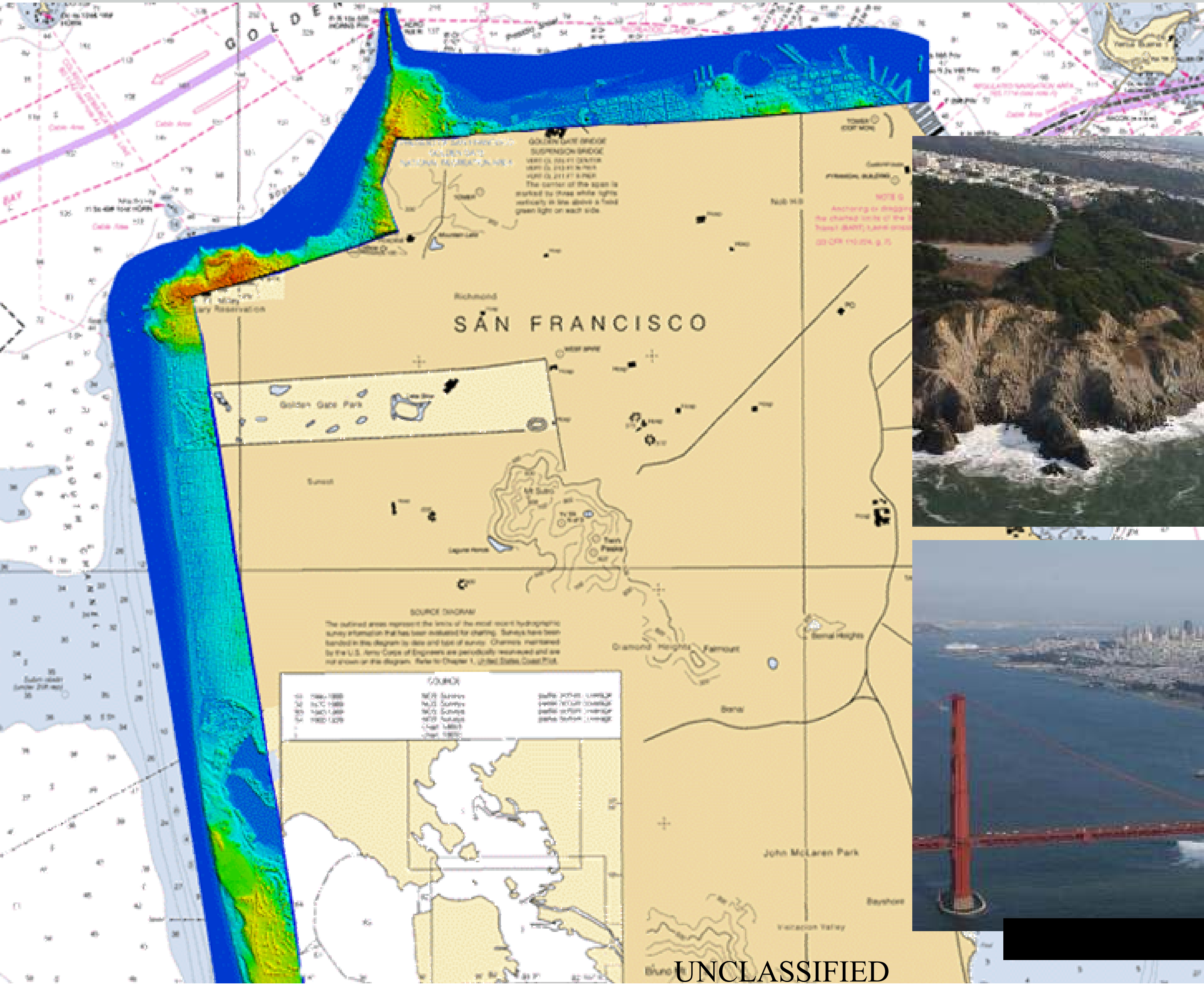
- Chaired by DHS (OA/FEMA/HSOC)
- Department of Commerce (NOAA)
- Department of Defense (NORTHCOM)
- Department of Interior (USGS)
- National Geospatial – Intelligence Agency
- U.S. Army Corps of Engineers

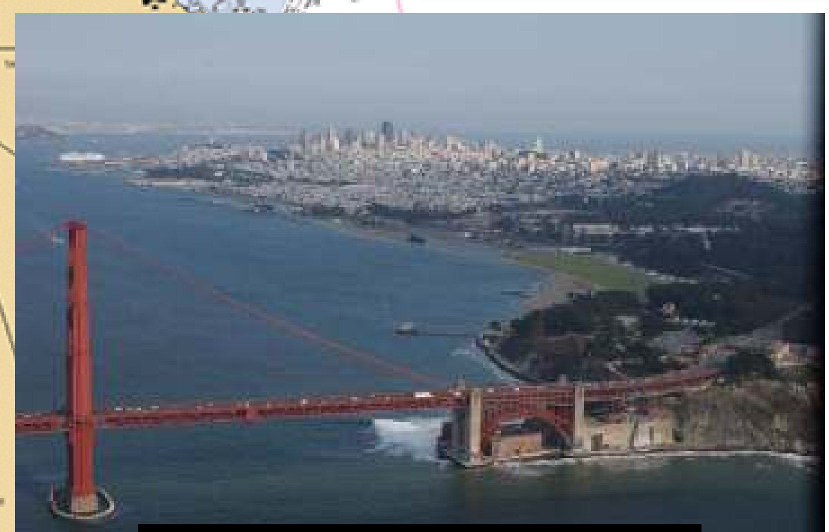
Under review

LIght Detection And Ranging




Reflective Surface
Bare earth
Bare earth + Buildings


SAN FRANCISCO
Richmond
Golden Gate Park
Sunset
Diamond Heights
Fairmount
Bernal Heights
John McLaren Park
SOURCE DIAGRAM



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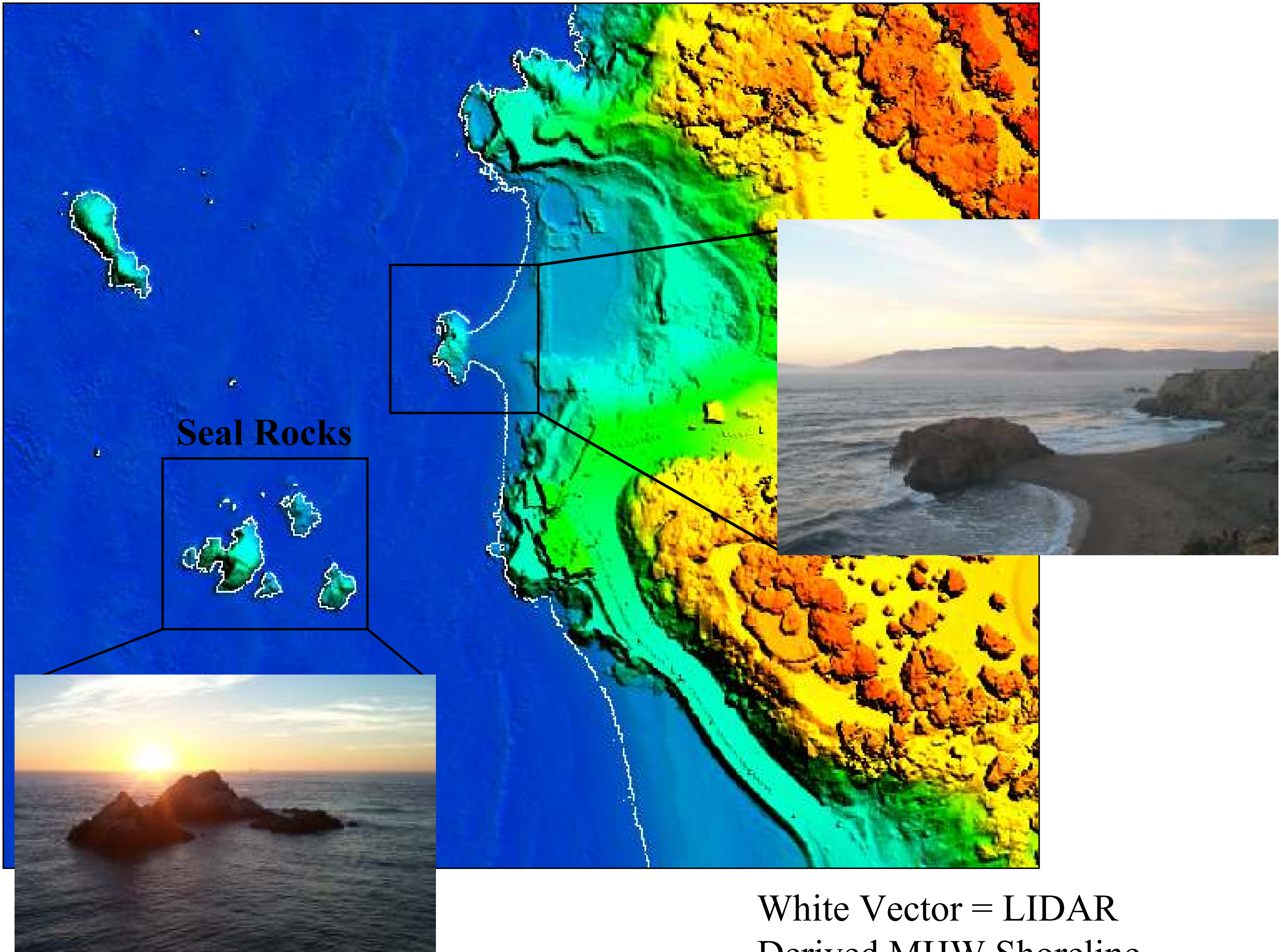

White Vector = LIDAR
Derived MHW Shoreline

Vertical Datum Transformation (VDatum)

Relationship of vertical datums for Tampa Bay:

86.39 ft	WGS 84 (G873)	26.33 m
81.33 ft	NAD 83 (86)	24.79 m
0.792 ft	MHHW	0.241 m
0.409 ft	MHW	0.125 m
0.0 ft	NAVD 88	0.0 m
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WGS 84, NAD 83 (86)

3-D Datums

NAVD 88, NGVD 29

Orthometric Datums

MHHW, MHW, MTL, DTL, MLW, MLLW

Tidal Datums

Topo/Bathy LIDAR Concept of Operations

- Collect Topographic and Bathymetric at same temporal scale
- Fly topographic LIDAR at the lowest low water for maximum shoreline/near shore rocks exposure
- Fly bathymetric LIDAR at highest high water to maximize overlap with topographic LIDAR
- Provide NOAA Hydrographic Ships with shoreline and near shore hydrographic data within days of acquisition

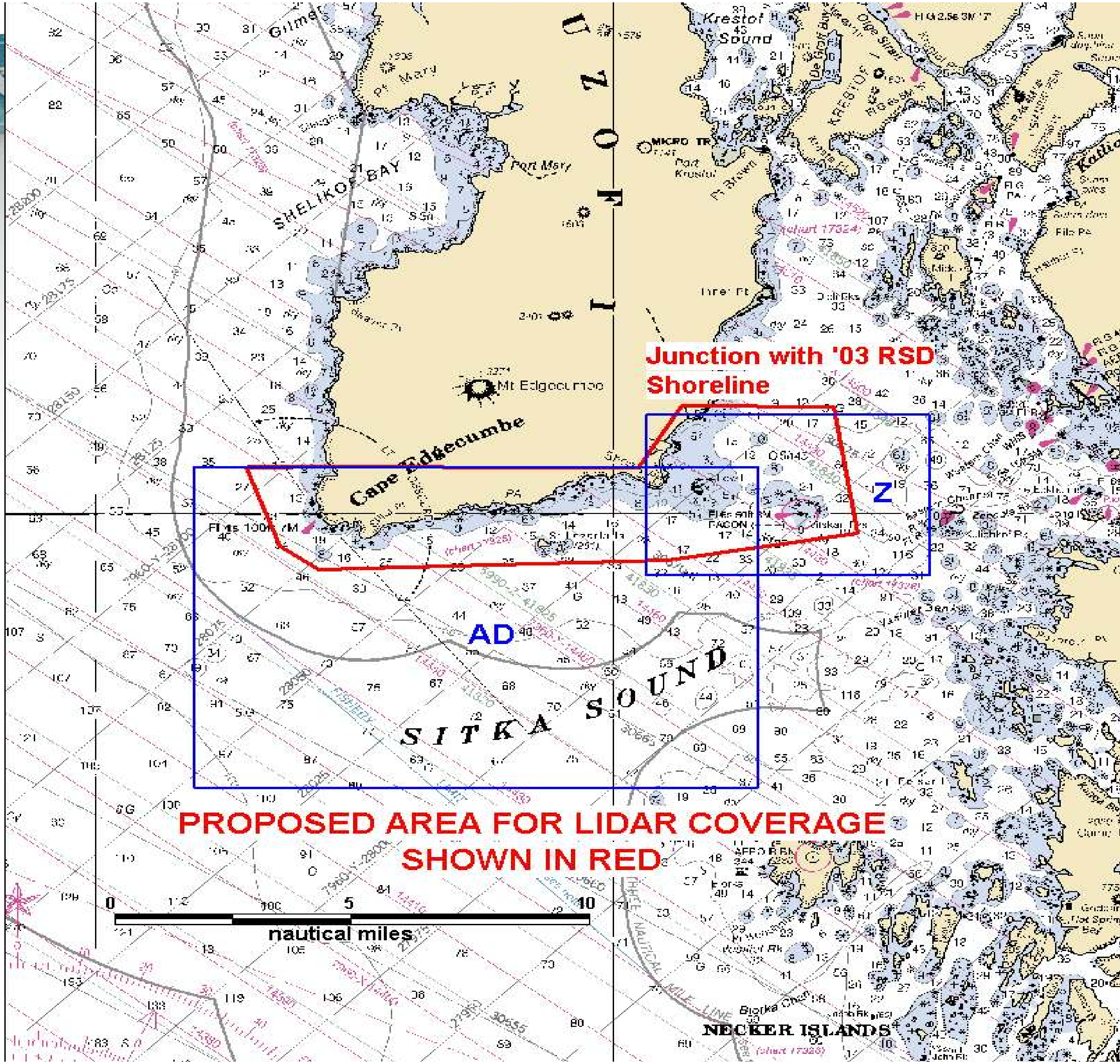
Cape Edgecumbe, AK LIDAR Demonstration

Ship and Aircraft worked together closely to provide shoreline and hydro data within days instead of months

NOAA Cessna Citation

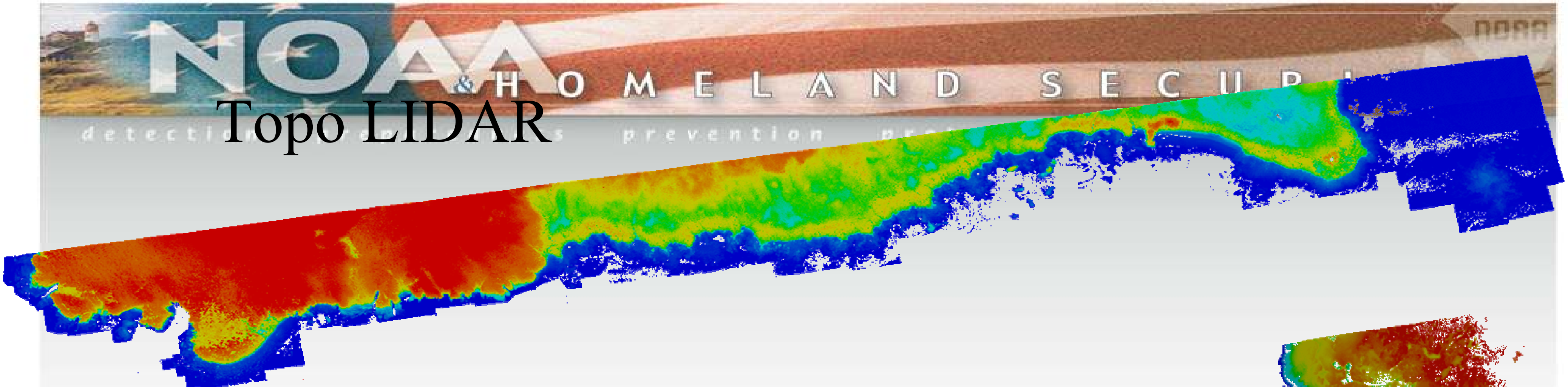
NOAA Ship Rainier

Tenix LADS Dash 8

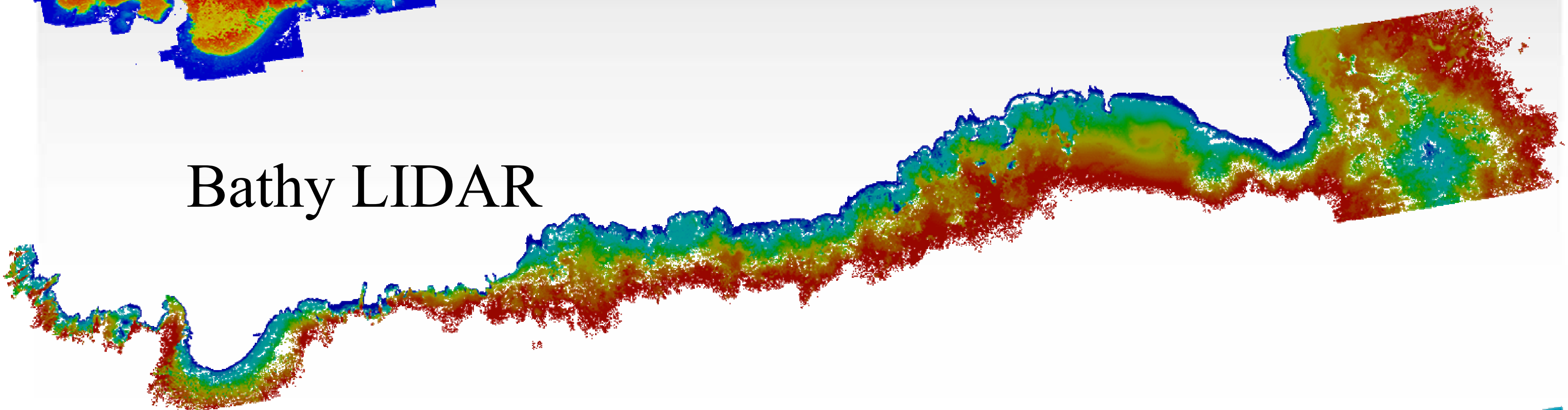


Junction with '03 RSD Shoreline
Z
AD
Cape Edgecumbe
SHELIKOF BAY
Mt Edgecumbe
Port Mary
Krestof Sound
SITKA SOUND
NECKER ISLANDS
PROPOSED AREA FOR LIDAR COVERAGE SHOWN IN RED
0
5
10
nautical miles

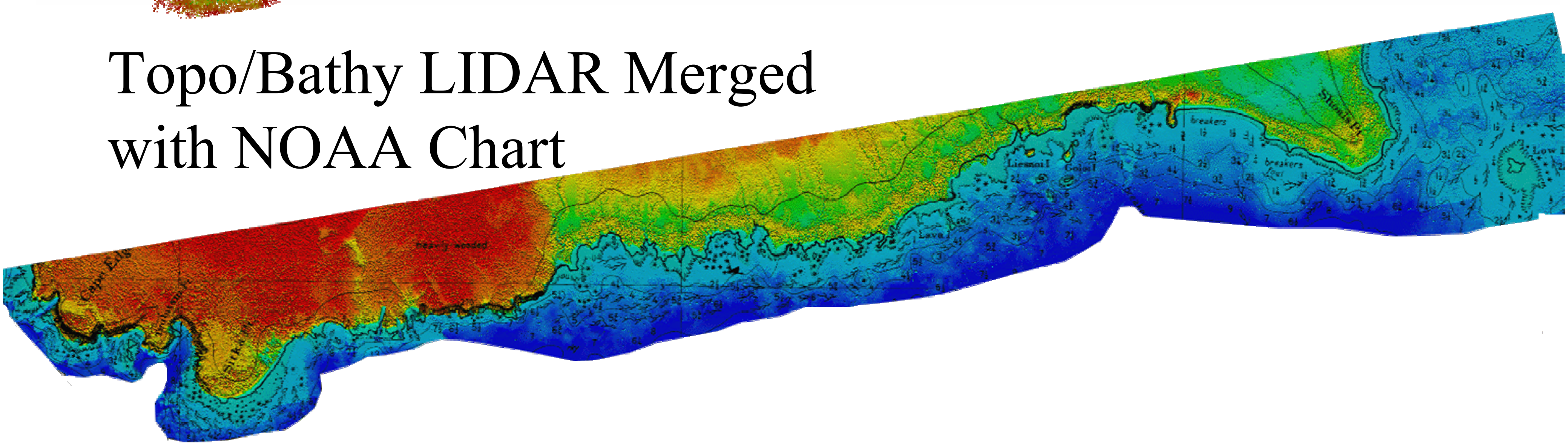
Topo LIDAR



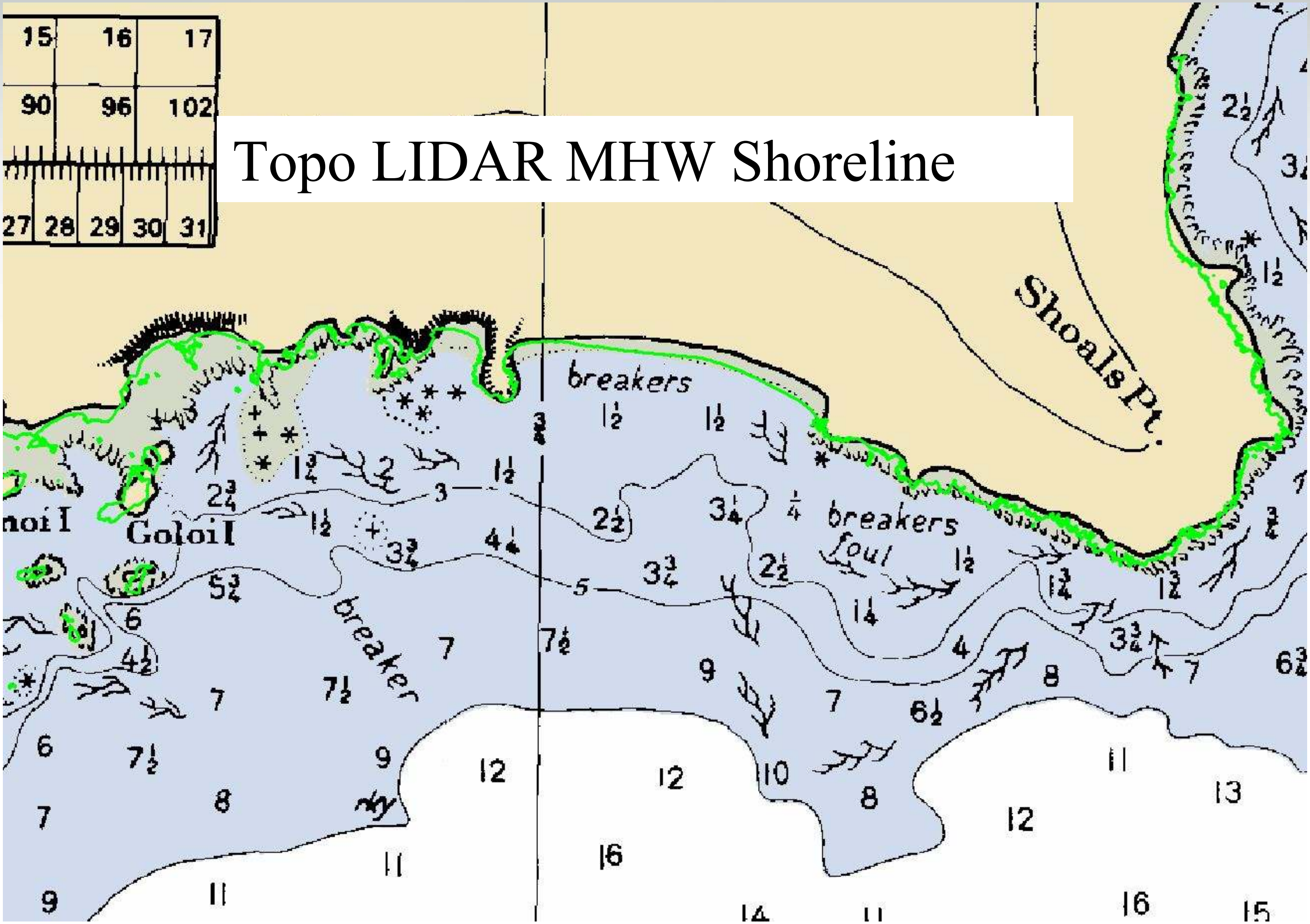
Bathy LIDAR



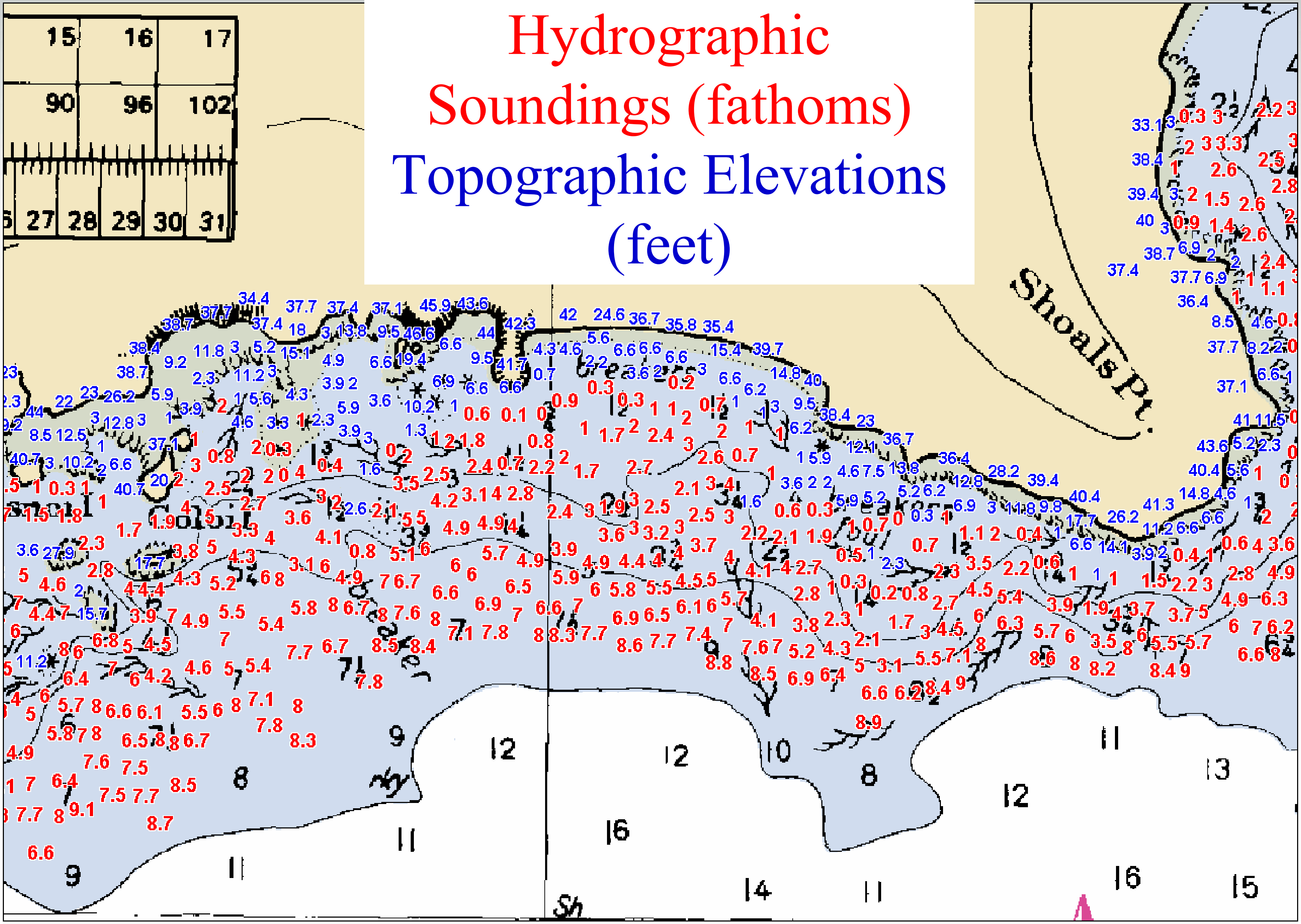
Topo/Bathy LIDAR Merged
with NOAA Chart

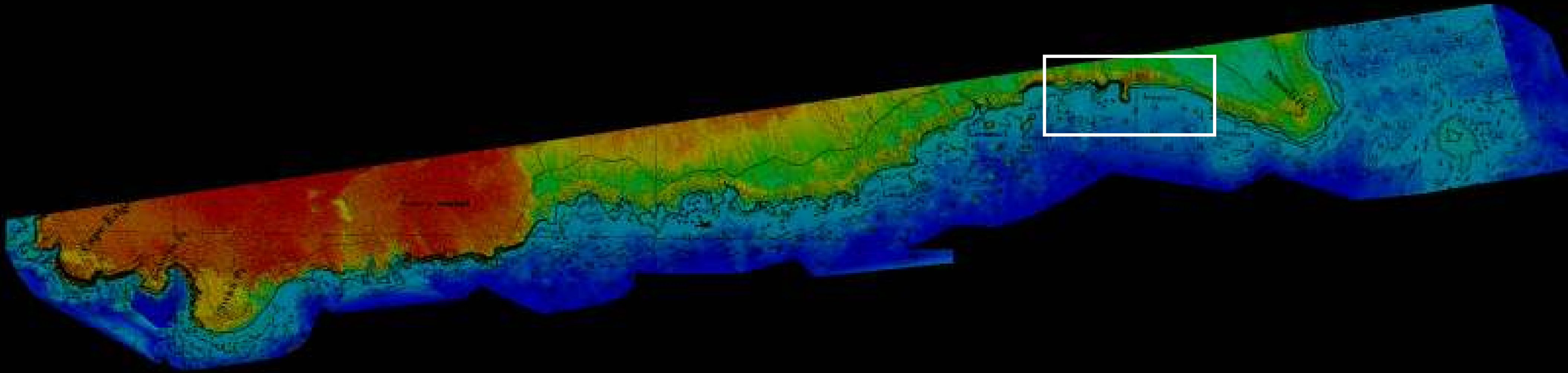


Topo LIDAR MHW Shoreline

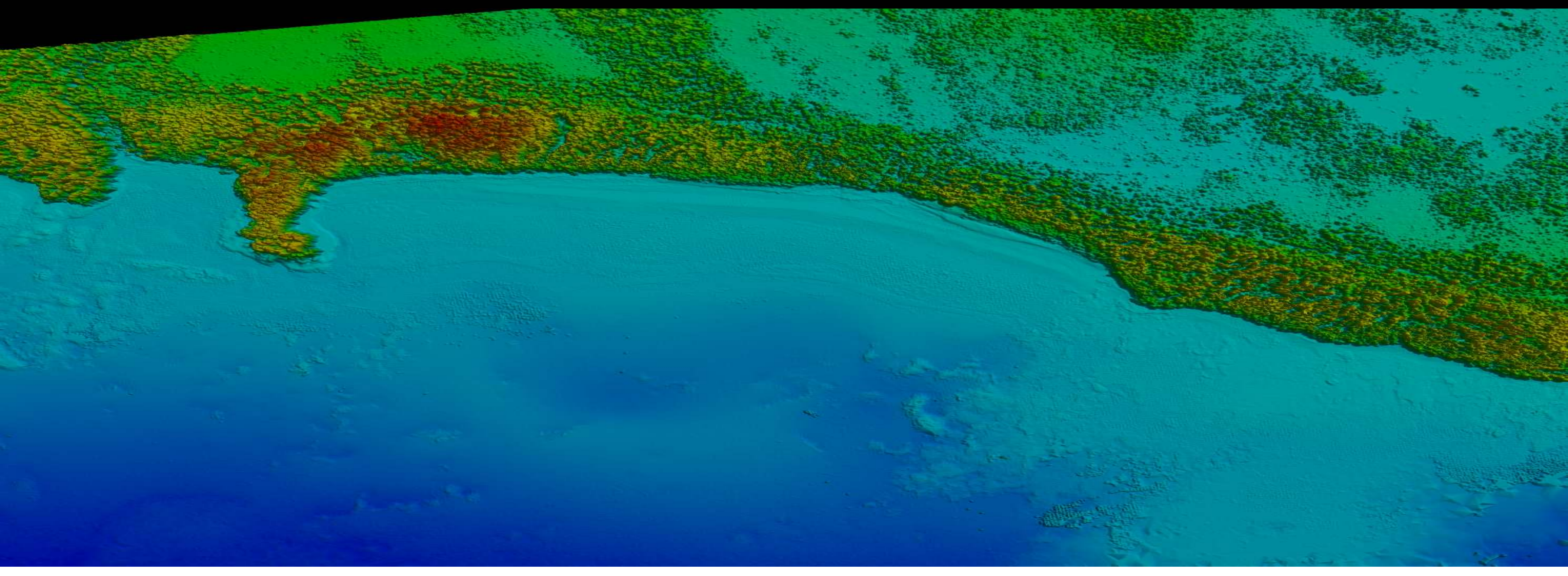


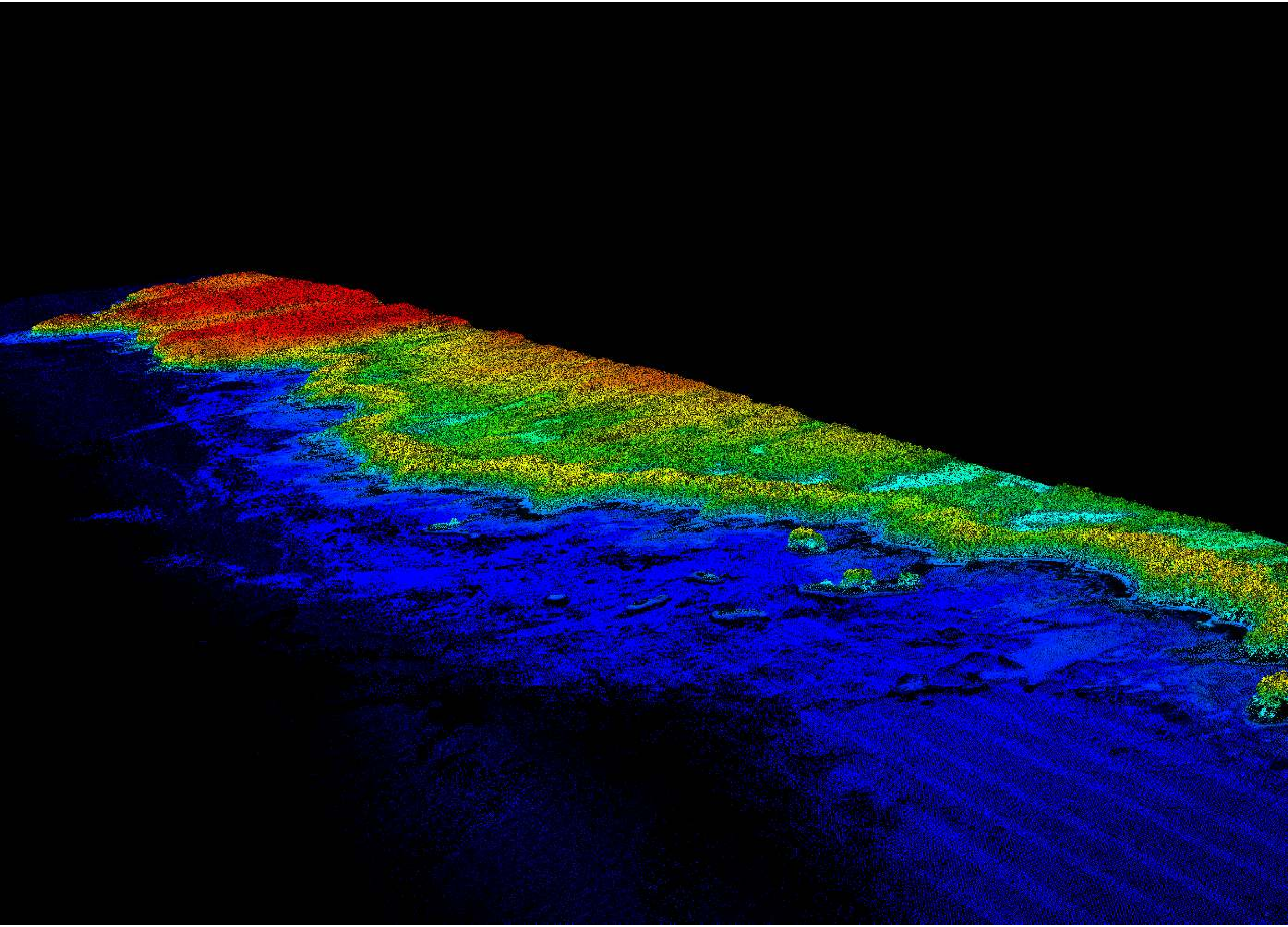
Hydrographic Soundings (fathoms)
Topographic Elevations (feet)

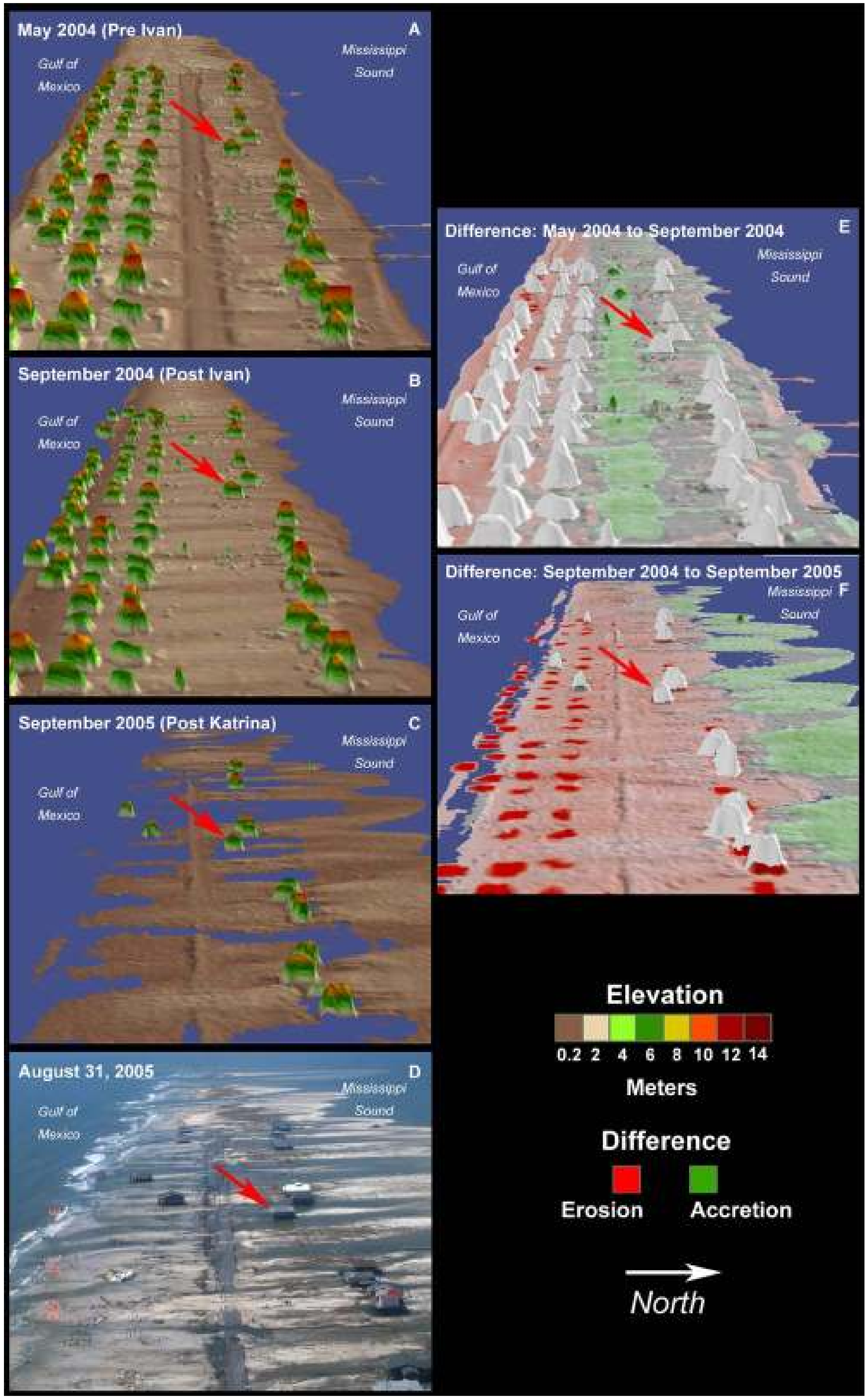


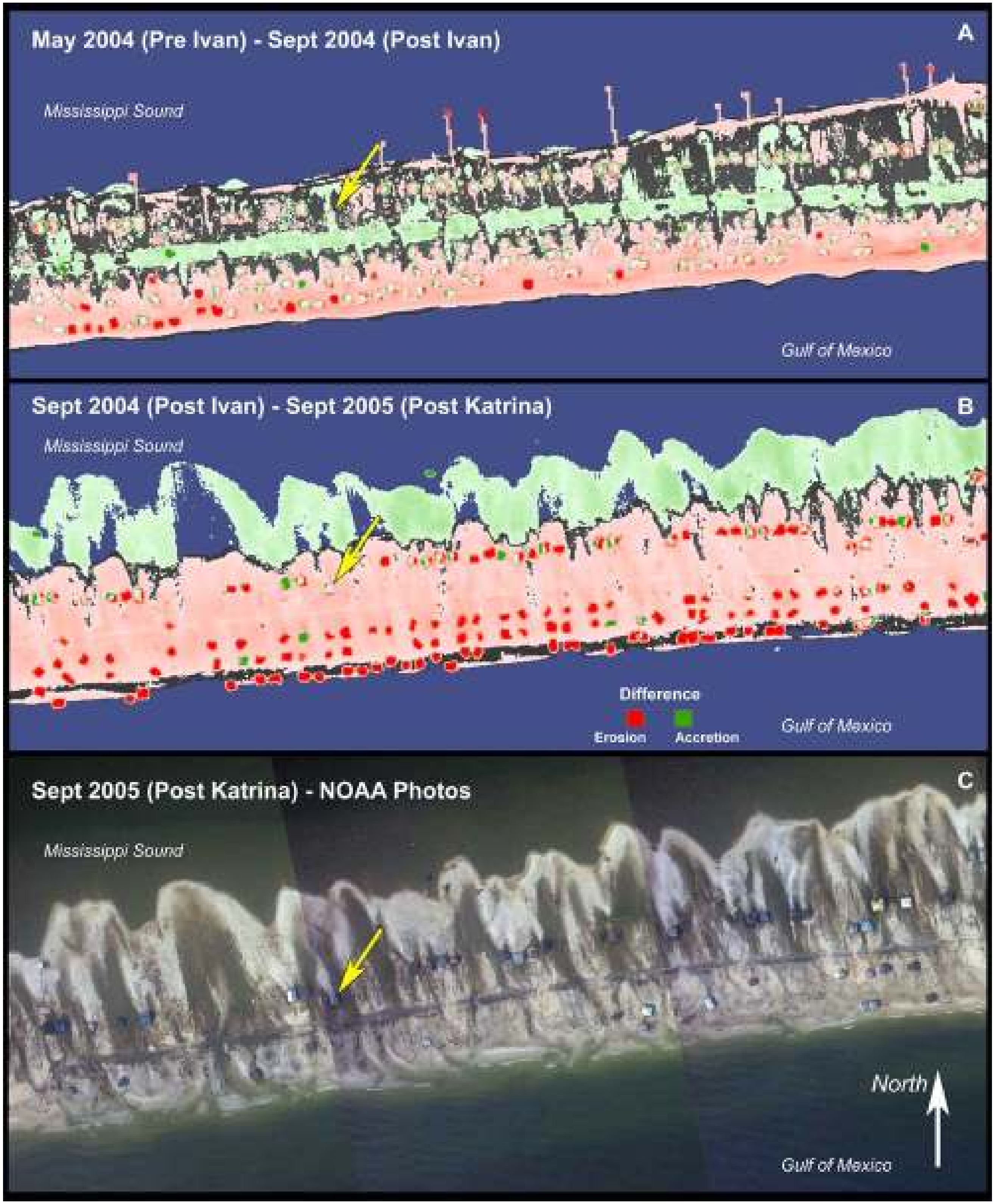


Sitka, AK Topographic and Bathymetric LIDAR





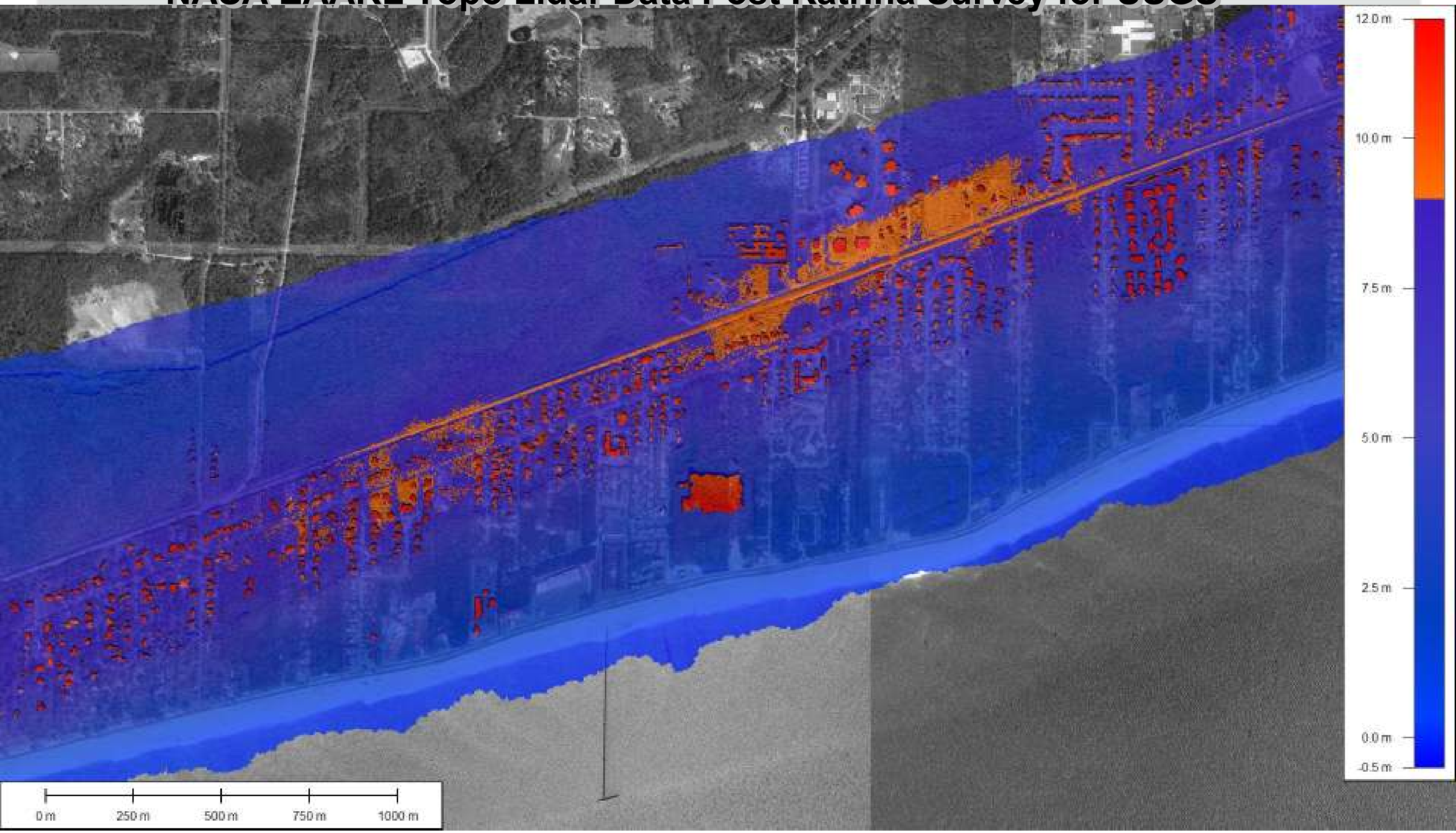

May 2004 (Pre Ivan)
A
Gulf of Mexico
Mississippi Sound
September 2004 (Post Ivan)
B
Gulf of Mexico
Mississippi Sound
September 2005 (Post Katrina)
C
Gulf of Mexico
Mississippi Sound
August 31, 2005
D
Gulf of Mexico
Mississippi Sound
Difference: May 2004 to September 2004
E
Gulf of Mexico
Mississippi Sound
Difference: September 2004 to September 2005
F
Gulf of Mexico
Mississippi Sound
Elevation
0.2 2 4 6 8 10 12 14
Meters
Difference
Erosion
Accretion
North

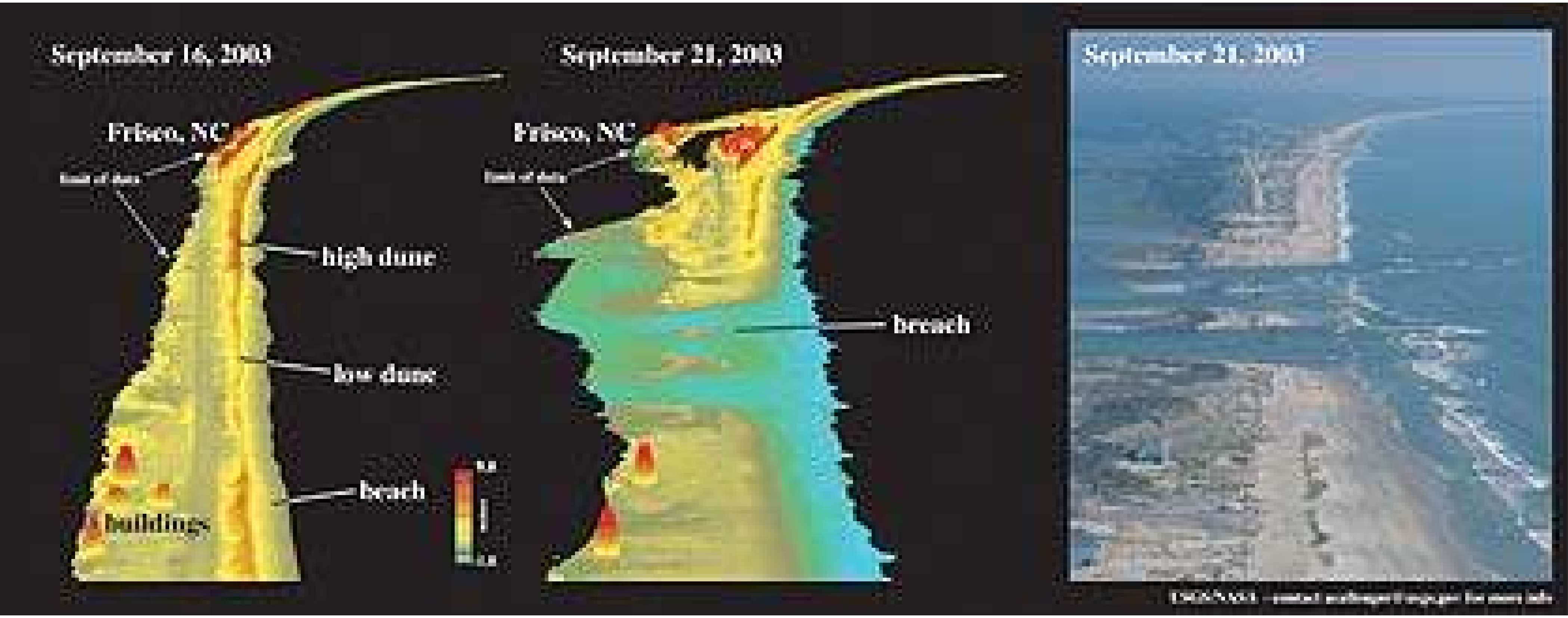


May 2004 (Pre Ivan) - Sept 2004 (Post Ivan)
A
Mississippi Sound
Gulf of Mexico
Sept 2004 (Post Ivan) - Sept 2005 (Post Katrina)
B
Mississippi Sound
Difference
Erosion
Accretion
Gulf of Mexico
Sept 2005 (Post Katrina) - NOAA Photos
C
Mississippi Sound
North
Gulf of Mexico

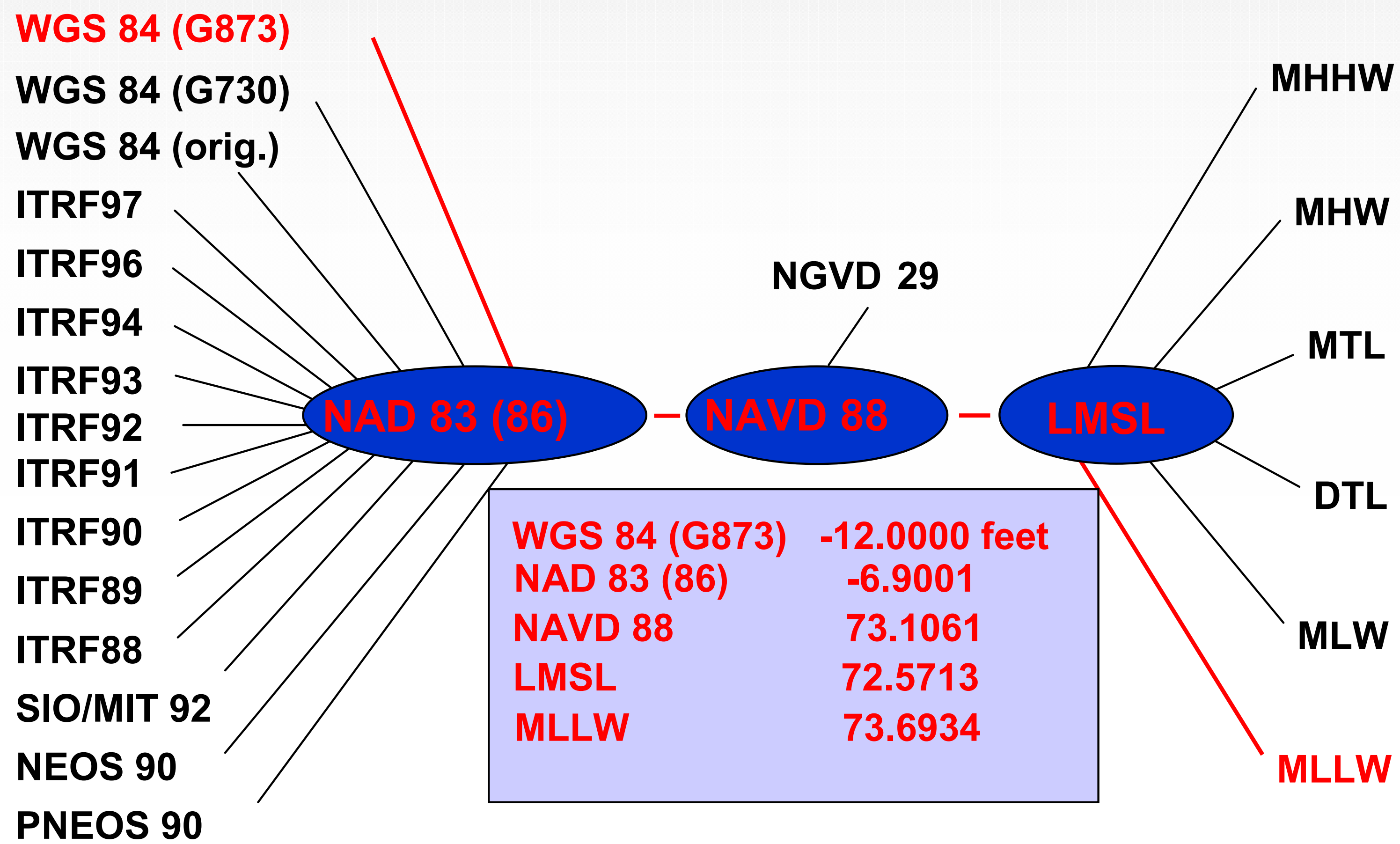
Topo & Bathy to Measure Coastal Change

NASA EAARL Topo Lidar Data Post Katrina Survey for USGS




September 16, 2003
Frisco, NC
high dune
low dune
beach
buildings
September 21, 2003
Frisco, NC
breach
September 21, 2003

The Datum Transformation Roadmap



NOAA/NGS GPS Receiver at Liberty State Park, NJ supporting the collection of airborne LIDAR and Photography over the WTC site.

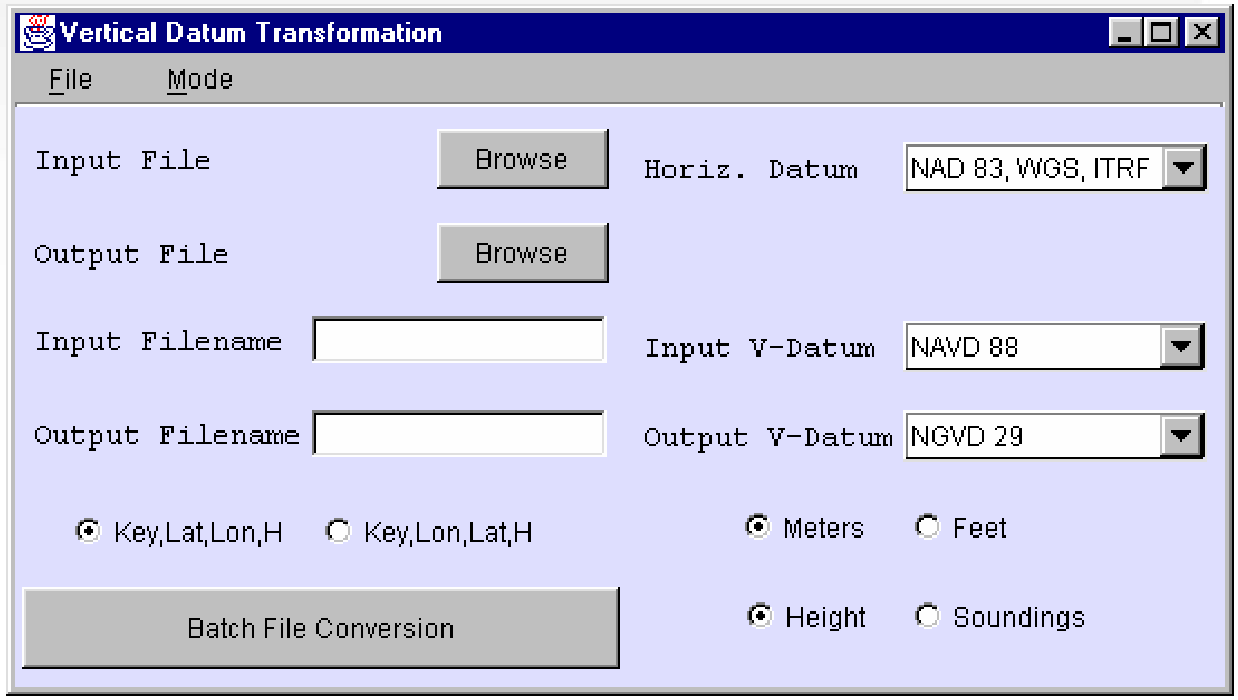
Optech employee and ground LIDAR working at WTC

NOAA Truck and equipment being set up at Pentagon

NOAA/NGS and Optech equipment set up at Pentagon

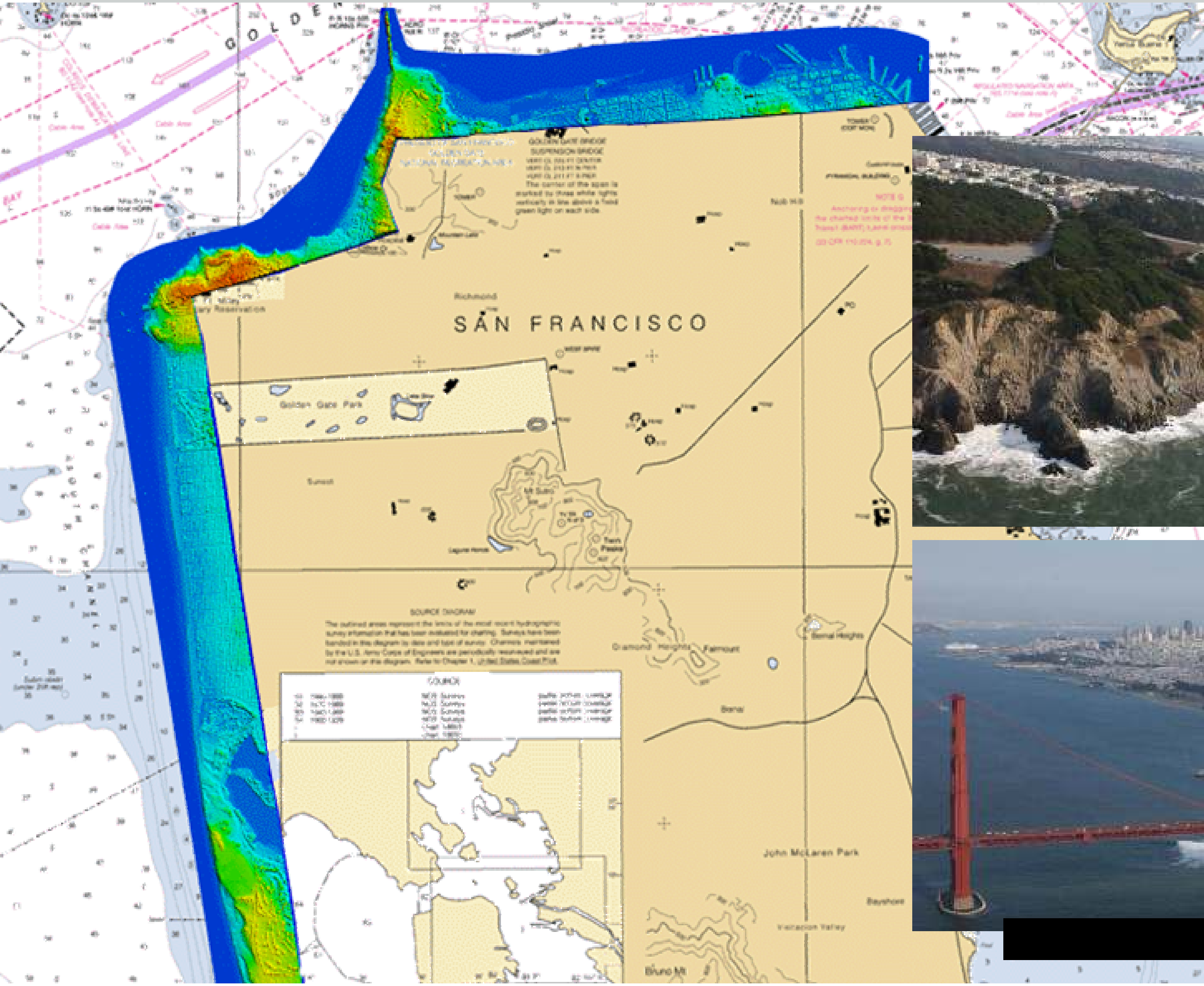
VDatum

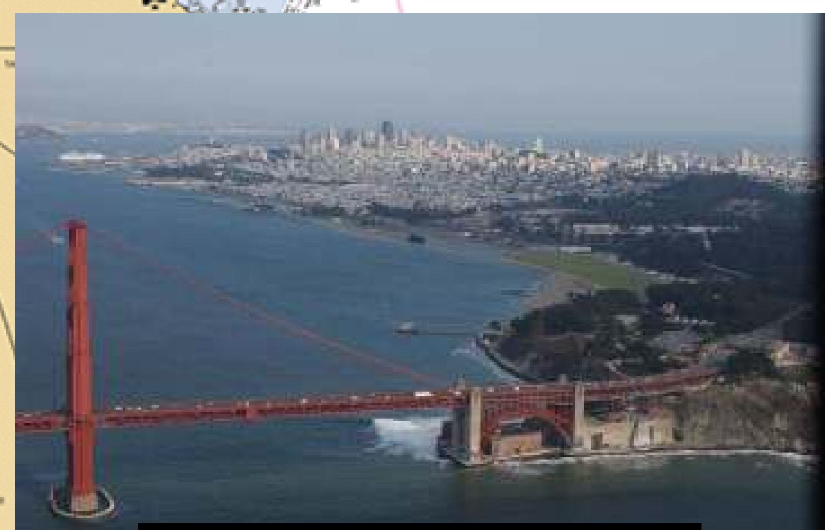
- VDatum
  - Vertical Datum Transformation Tool
  - Supports 28 Datums
- Incorporates Tidal Hydrodynamic Models
  - Translated through Local Mean Sea Level (LMSL)
  - Relations Interpolated among NAVD88 elevations on tidal benchmarks
- Allows blending of data sets with different vertical datums
  - MLLW from nautical charts
  - NAVD 88 from topographic maps



NOAA & HOMELAND SECURITY

detection preparedness prevention protection response recovery





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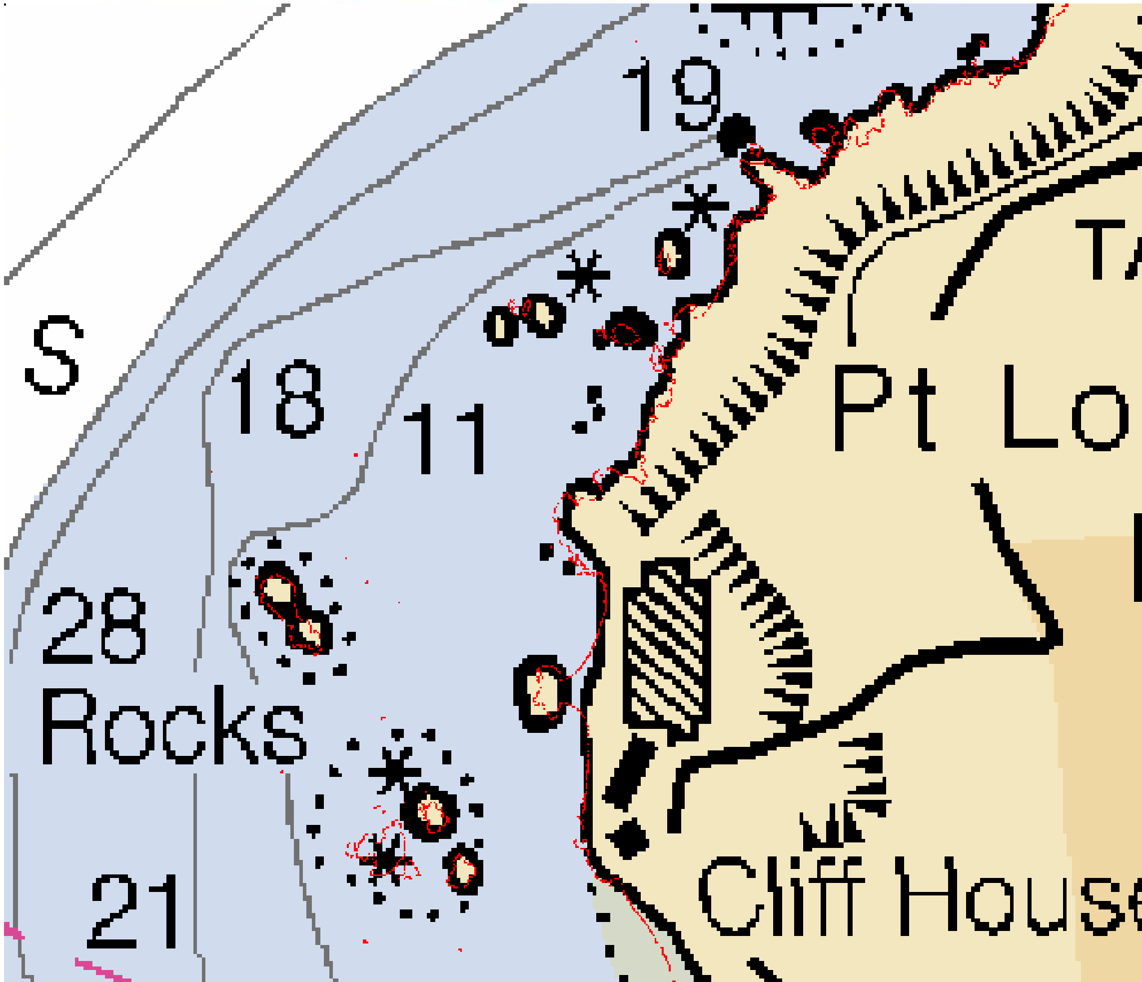
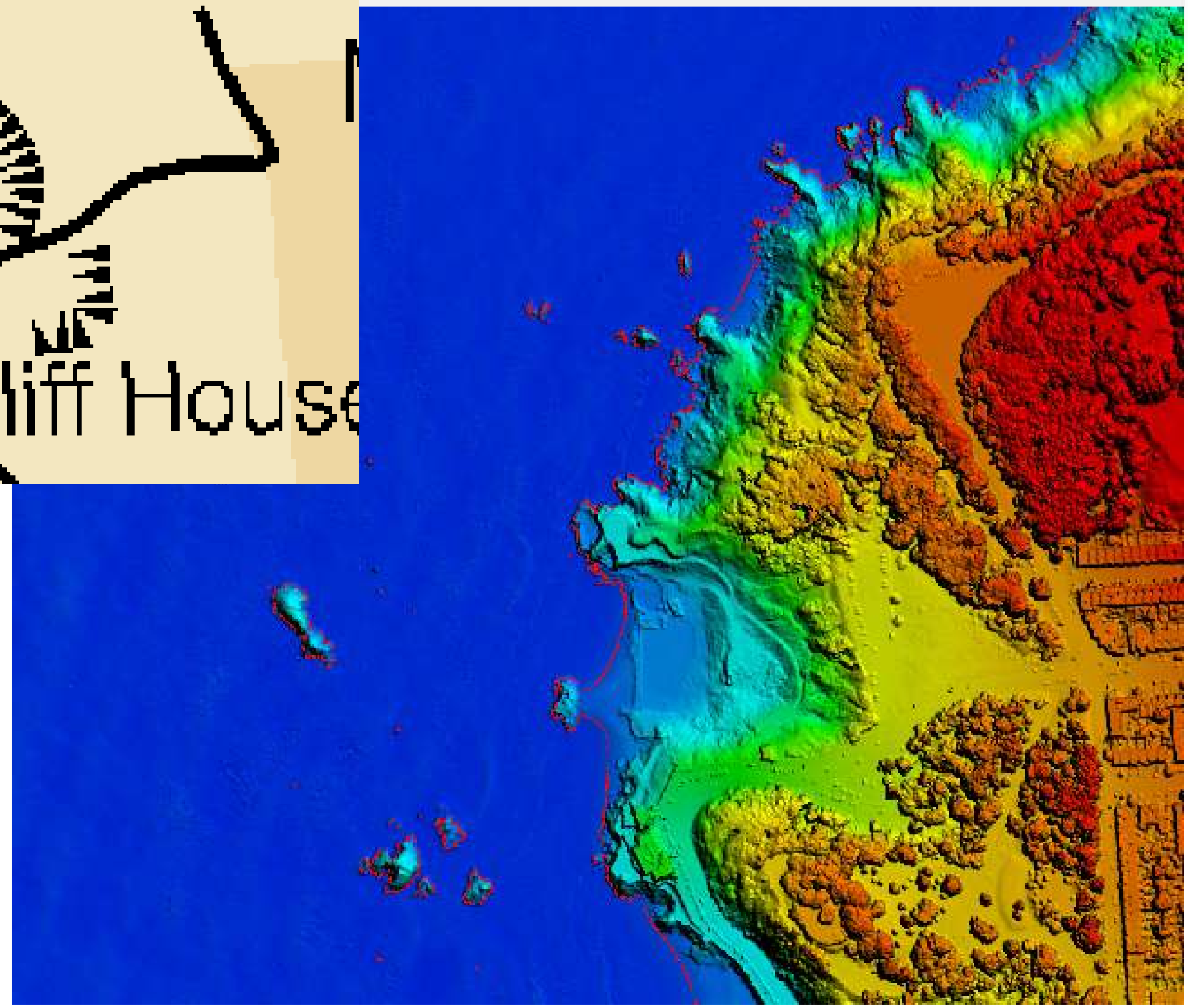
D SECURITY
rotection response recovery

Contoured shoreline from lidar





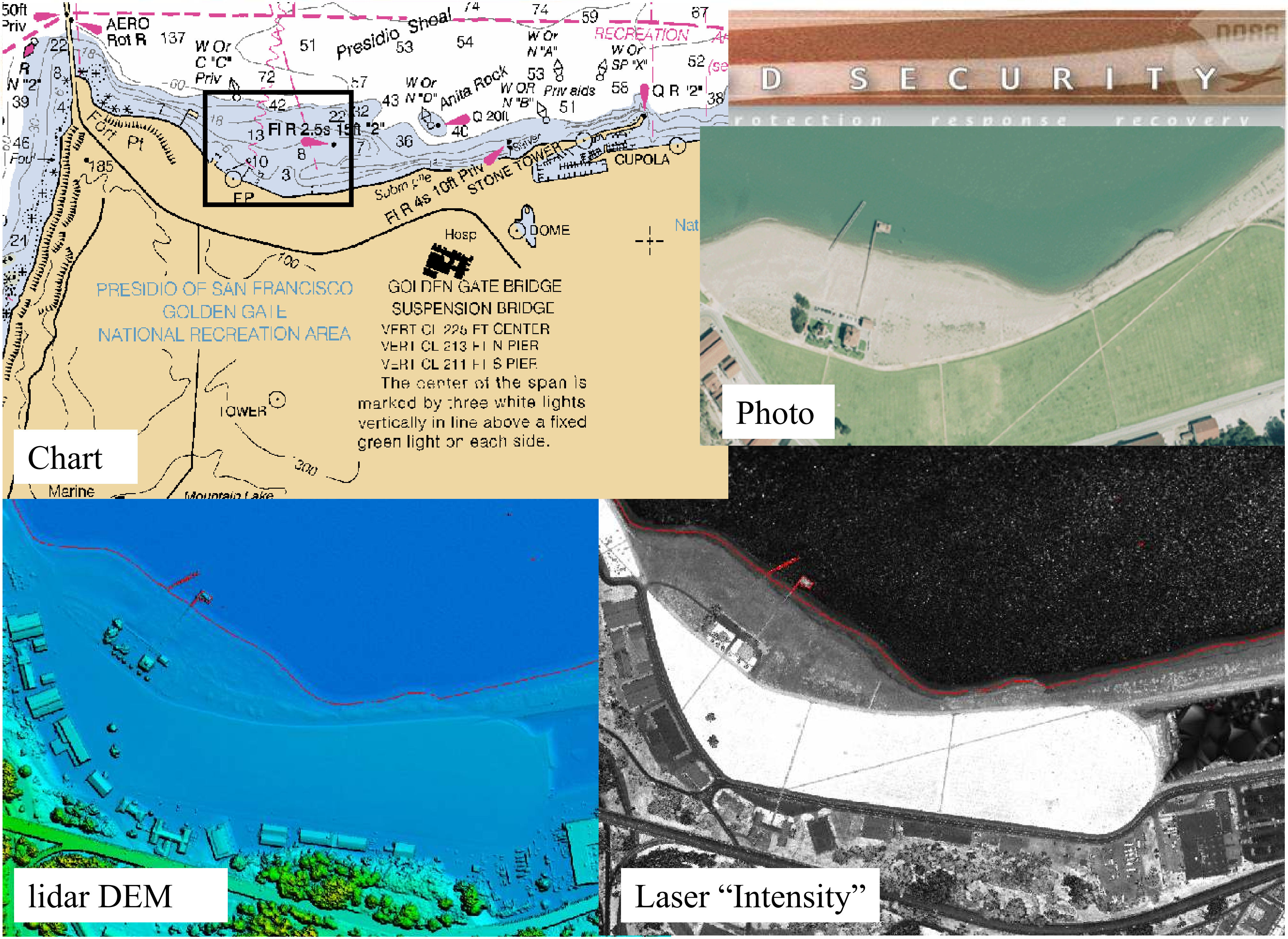
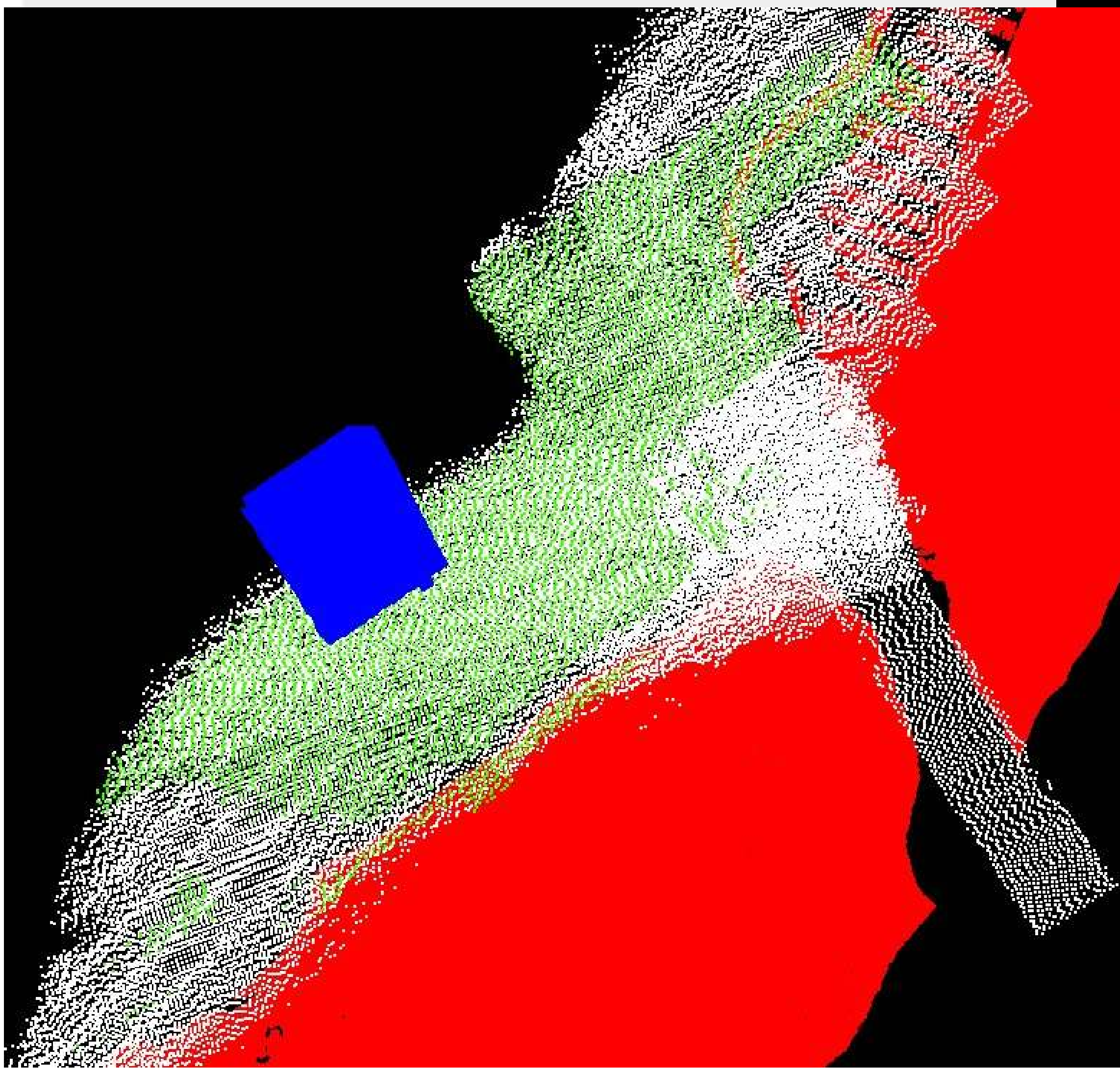
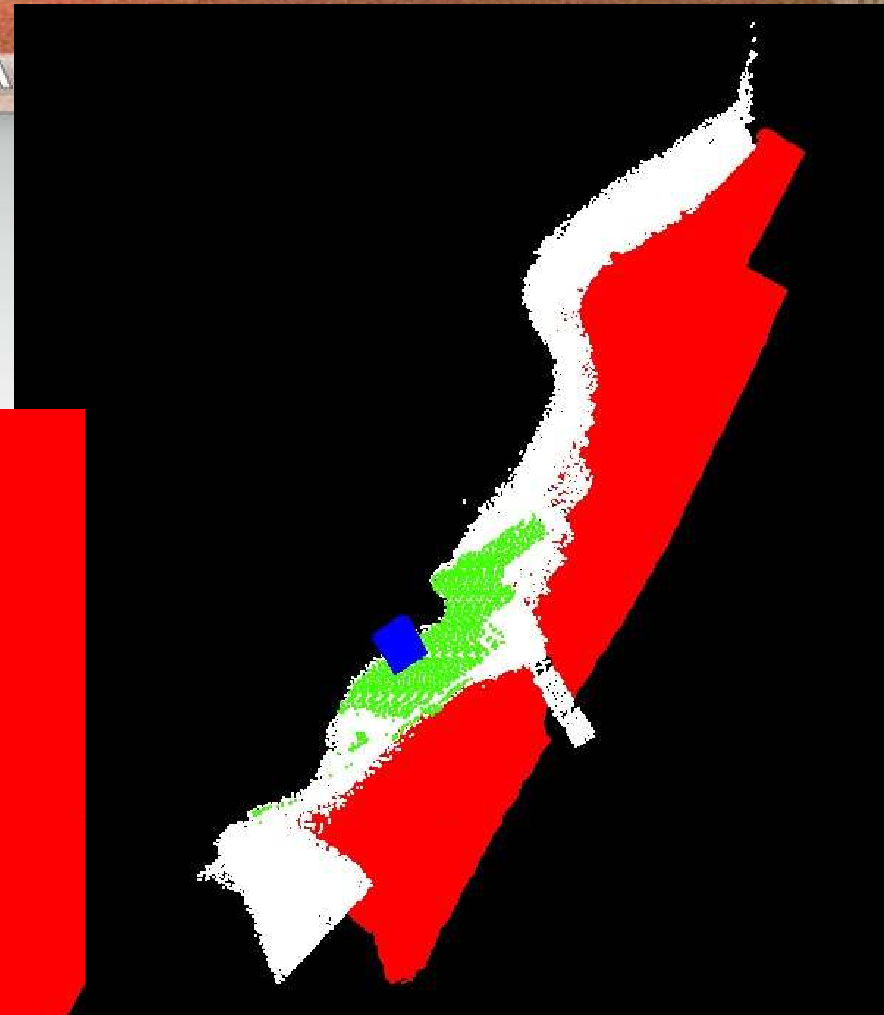


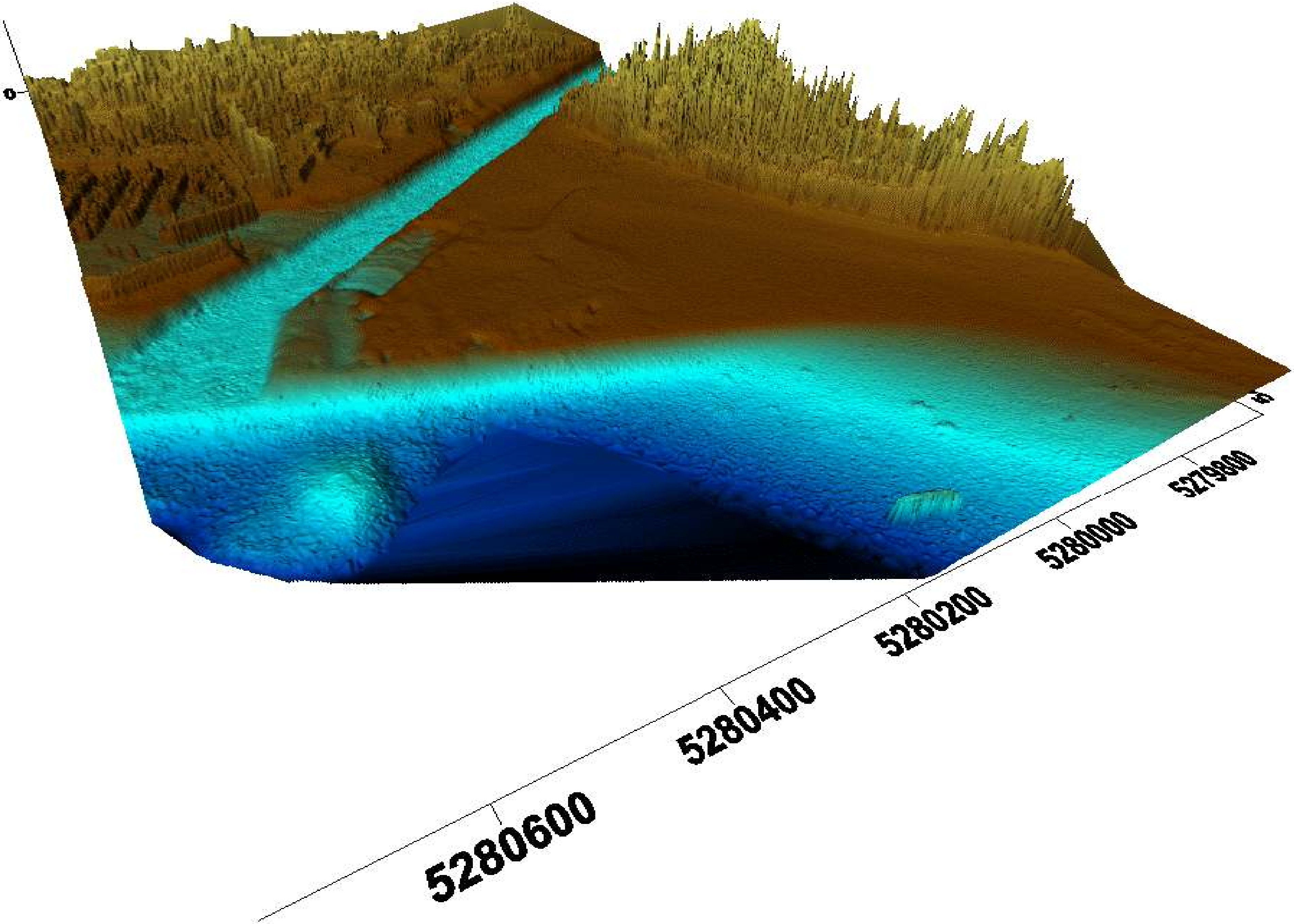
Chart
Photo
lidar DEM
Laser “Intensity”
D SECURITY
protection response recovery
PRESIDIO OF SAN FRANCISCO
GOLDEN GATE
NATIONAL RECREATION AREA
GOLDEN GATE BRIDGE
SUSPENSION BRIDGE
VERT CL 225 FT CENTER
VERT CL 213 FT N PIER
VERT CL 211 FT S PIER
The center of the span is
marked by three white lights
vertically in line above a fixed
green light on each side.
Presidio Shoal
Anita Rock
Fort Pt
STONE TOWER
CUPOLA
DOME
TOWER
Hosp
RECREATION
Marine
Mountain Lake

Shilshole Bay, WA Test Site Data shown by class





- ALTM 2050 Topo lidar
- LADS Bathy lidar
- SHOALS Bathy lidar
- NOAA Ship Multi-beam Data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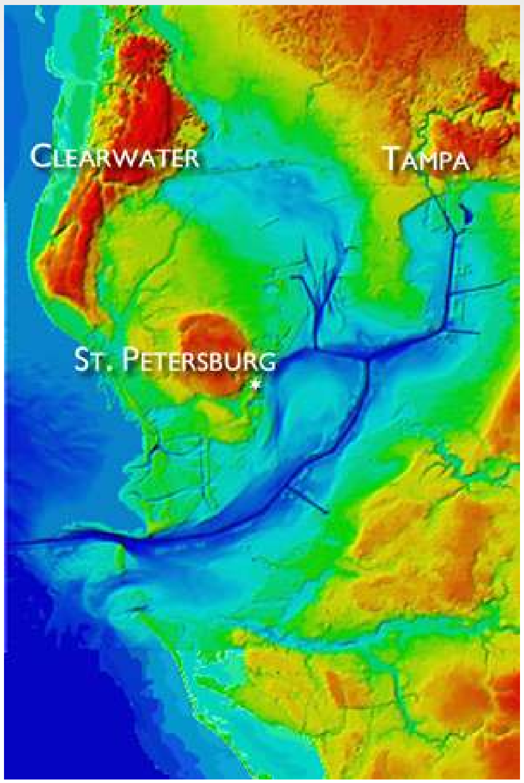
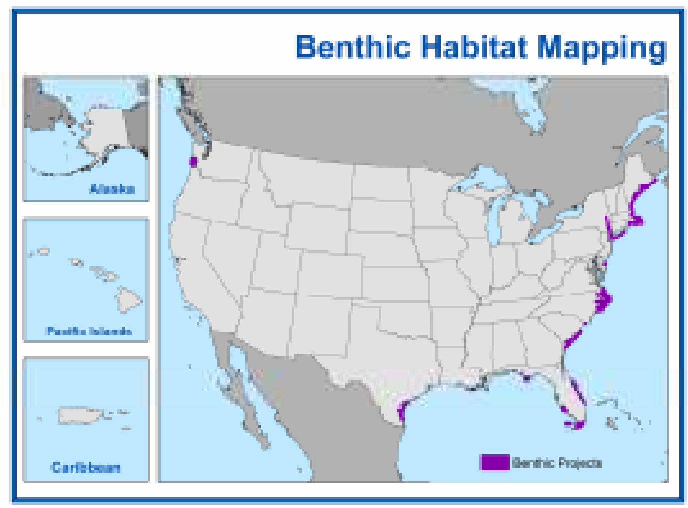
Geospatial Data Application in Storm Surge Modeling and Habitat Mapping



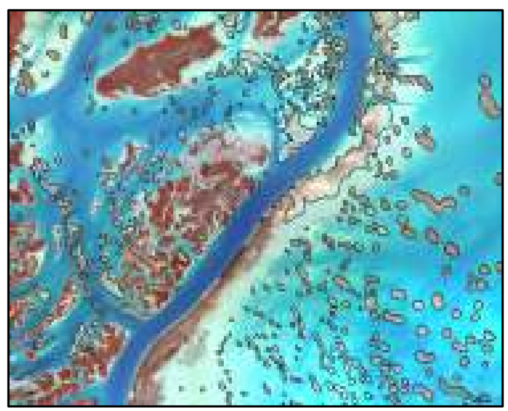
Topo/bathy integration activities (Gulf of Mexico)

- Inventory of data resources and integration approaches
- Gap analysis and investigation of data standards
- Pilot topo/bathy data integration for the Storm Surge Action Plan



Benthic Habitat Mapping

- High-resolution imagery for oyster and SAV mapping



Oyster reefs mapped at low tide

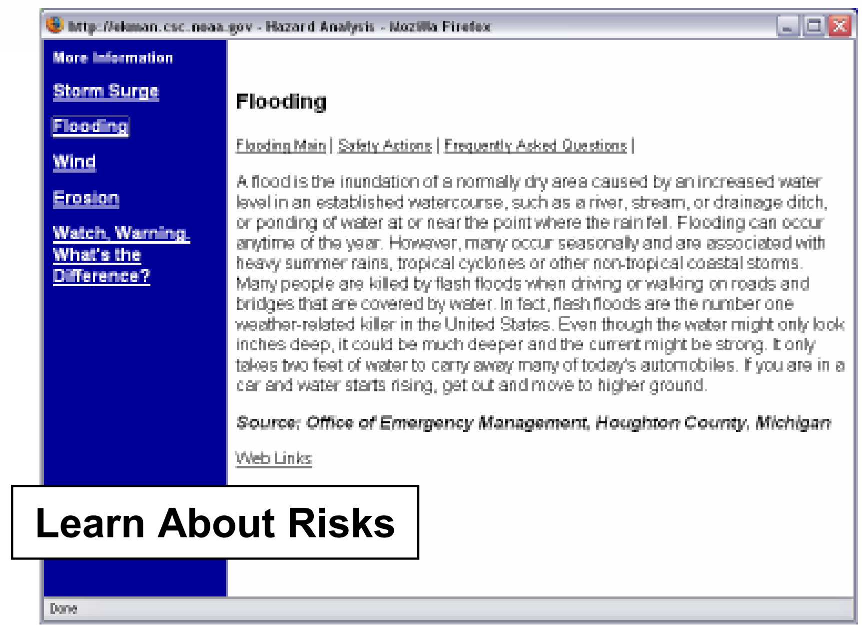
GIS Layers Key Component of Risk and Vulnerability Assessment Tools

Risk and Vulnerability Assessment Tools

- Help to identify people, property, and resources that are at risk of injury, damage, or loss from hazardous incidents or natural hazards.

Hazards Locator Tools (American Samoa, Kaua'i, O'ahu)

- Streamlined means for users to identify their local multi-hazard risk and determine hazard mitigation techniques and practices for their location.



Geospatial Technology Used to Explore Development Alternatives

- Maps of alternative scenario designs
- GIS-based 3-D views of site designs
- Measured comparisons of the potential outcomes and impacts of each alternative

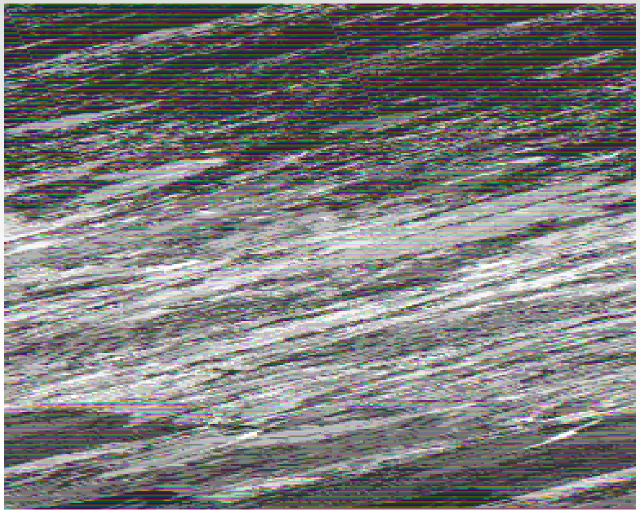
Indicator	Conventional	Conservation	New Urbanist
Docks			
• Total dock length (feet)	46,263 feet	1,013 feet	2,086 feet
• Total dock area (square feet)	277,576 ft²	6,506 ft²	12,518 ft²
Water Consumption (estimated total gallons per day)	189,096 (gal/day)	119,660 (gal/day)	156,601 (gal/day)
Impervious Surface			
• Percentage	26 %	12 %	18 %
• Total acres	169 acres	82 acres	119 acres
(percentage of total site acres)			

Laser Geolocation Equation:

$$\begin{bmatrix} X_f \\ Y_f \\ Z_f \end{bmatrix} = \begin{bmatrix} X_{GPS} \\ Y_{GPS} \\ Z_{GPS} \end{bmatrix} + \mathbf{M} \begin{bmatrix} x_l - \delta_x + R\cos s \sin t \\ y_l - \delta_y + R \sin s \\ z_l - \delta_z - R\cos s \cos t \end{bmatrix}$$

- Errors in X_{GPS}, Y_{GPS}, Z_{GPS} propagate directly to errors in the computed elevations of laser data points
- cm-level vertical accuracy in final data products can only be achieved if you have cm-level vertical accuracy in the airborne kinematic GPS

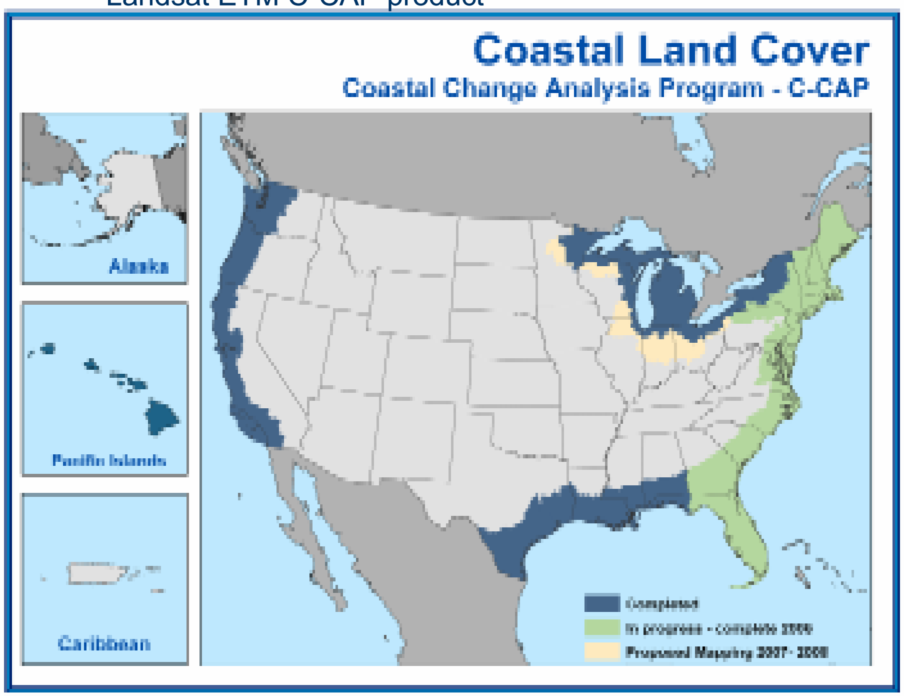
Geospatial Data Development



Landsat ETM C-CAP product

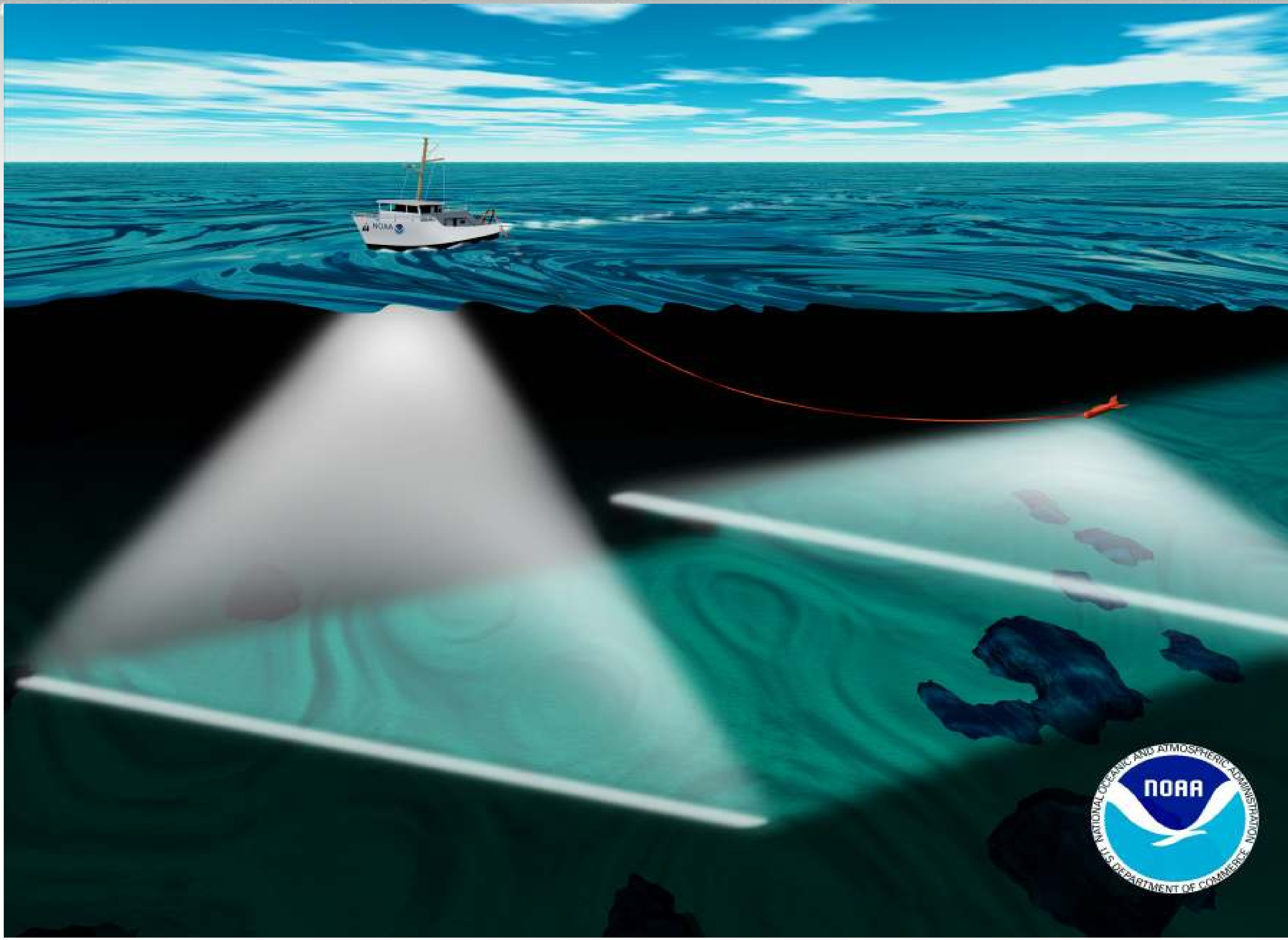
Land Cover and Imagery

- Baseline of land cover classification and 30m Landsat imagery for coastal regions (coverage area in CCAP figure)
- Enhance imagery in priority areas using high-resolution aerial and satellite imaging



Aerial Imagery- ADS40, UltraCam, DMC, GeoScanner
Satellite Imagery - Space Imaging IKONOS, DigitalGlobe Quickbird, ORBIMAGE OrbView
Current priority areas - Major US ports, New England, Hawaii, MS/LA coast, SE coast

NOS Data Explorer
www.oceanservice.noaa.gov/dataexplorer/


NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE