



NOAA's mission to collect Emergency Response Imagery

NGS Webinar Series

July 9, 2015

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Chief, NGS Remote Sensing Division



Overview

- **Division Background**
 - Programs, Platforms, Sensors
- **Emergency Response Overview**
 - Background
 - Delivery by NOAA, USGS, & FEMA
 - Examples of Response
 - Tornadoes and Hurricanes
 - Oblique imagery
 - Coordination Discussion



Background

- U.S. Department of Commerce
 - National Oceanic Atmospheric Administration (NOAA)
 - National Ocean Service
 - National Geodetic Survey
 - Remote Sensing Division
- Primary programs
 - Coastal Mapping Program
 - Aeronautical Survey Program
 - Emergency Response





NOAA's Coastal Mapping Program

- NOAA nautical charts
- Other important applications:
 - Used in defining the United States' territorial limits
 - Coastal resource management
 - Storm surge and coastal flooding modeling
 - GIS analysis
 - Benthic habitat mapping
 - Many more...
 - <http://www.ngs.noaa.gov/NSDE/>





Platforms



NOAA King Air 350ER

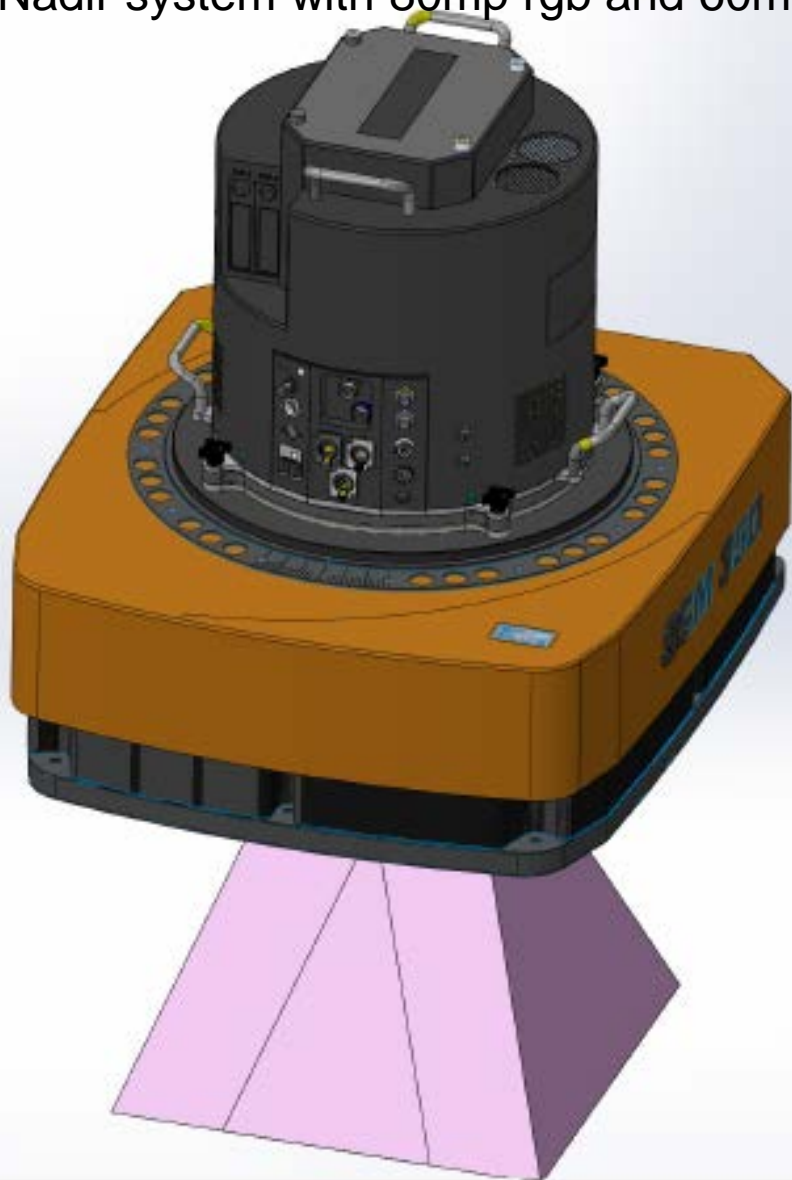
NOAA Otter DHC-6



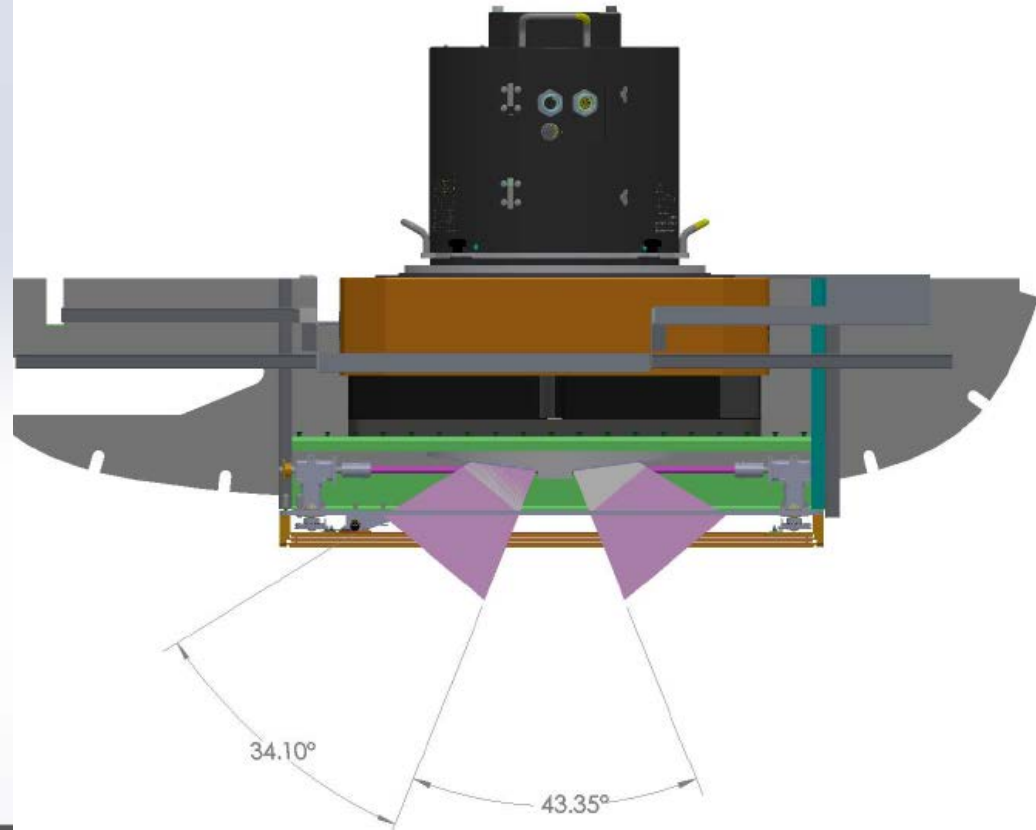


Sensors

Nadir system with 80mp rgb and 60mp nir



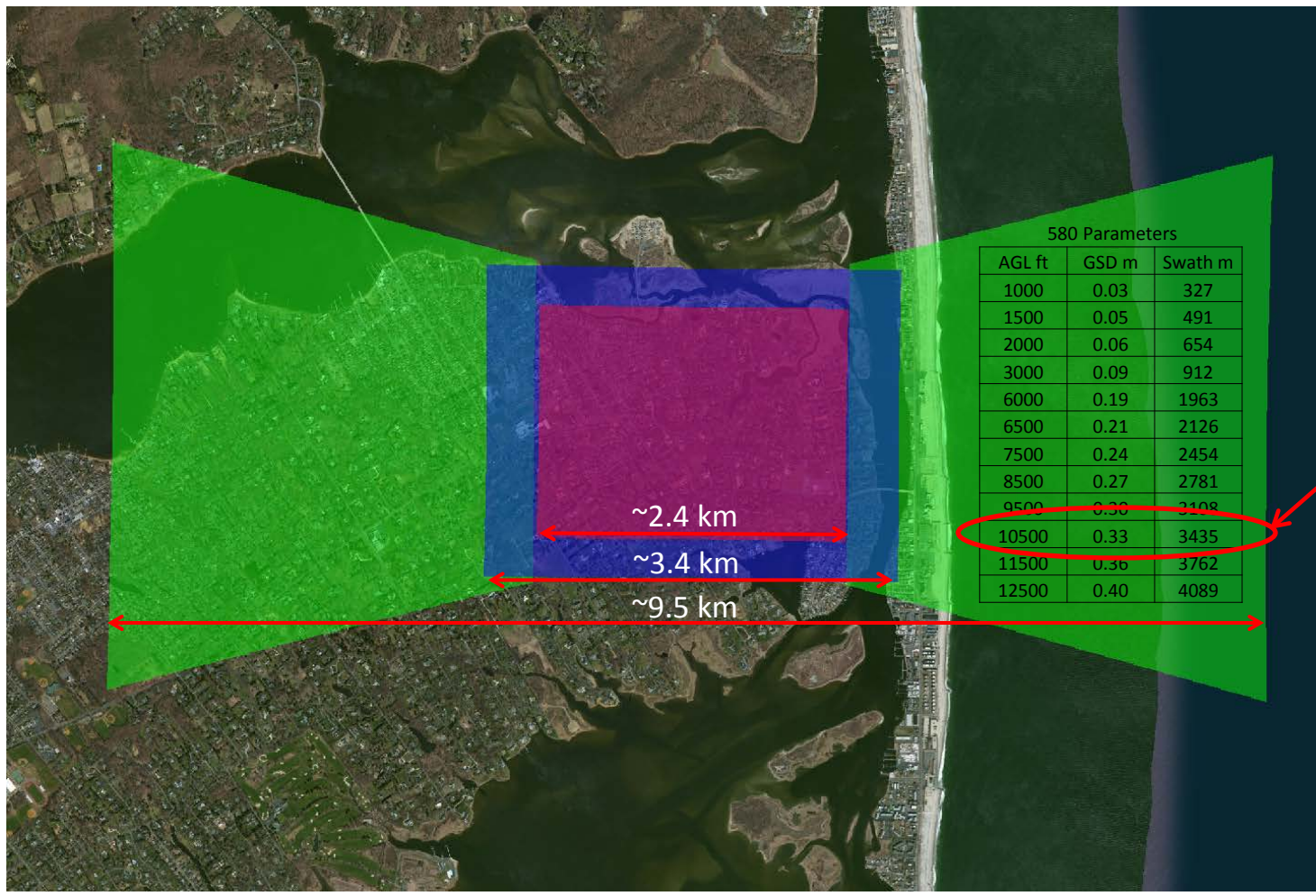
Oblique system with two 39mp rgb







Camera Resolution and GSD



King Air typical flying height



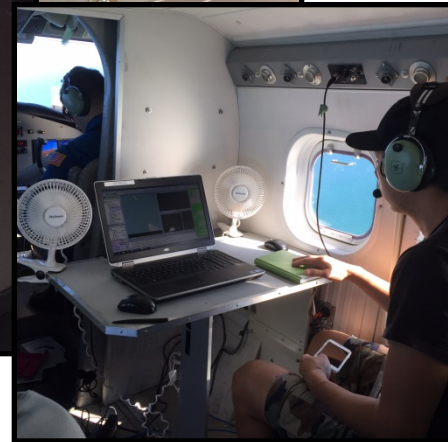
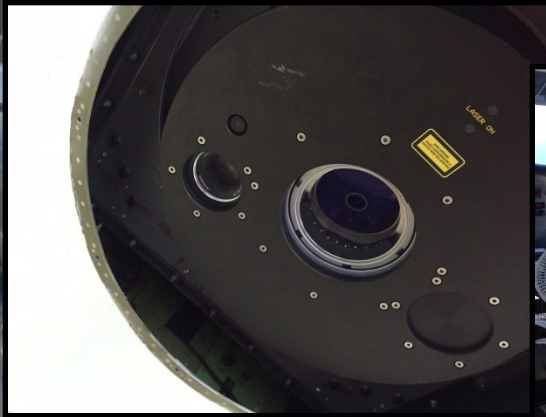
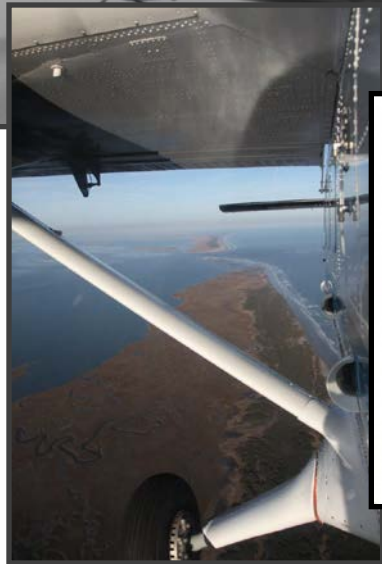
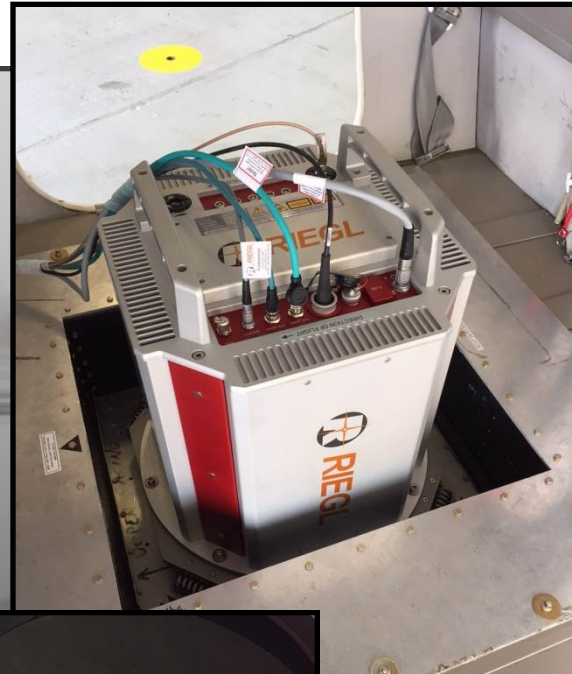
Coverage at 10,500 ft for 439 (Old System) (Red), 580 (Blue) and 539 Oblique (Green)

Example image of nadir and oblique imagery





Riegl VQ-880G Topobathy Lidar

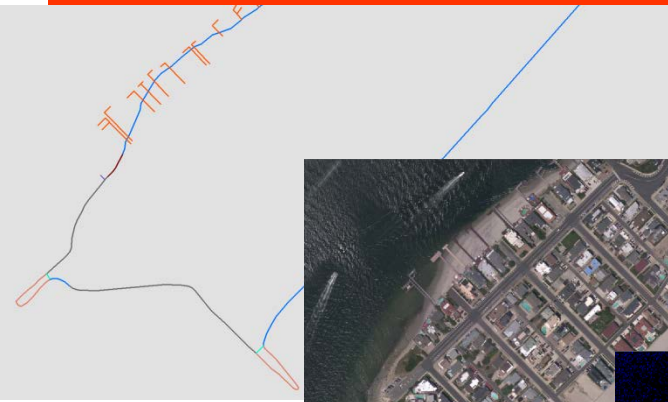




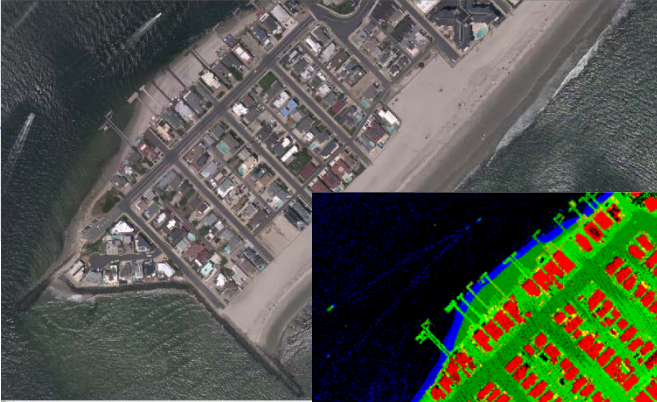
NGS IOCM Products/Deliverables from Topobathy Lidar



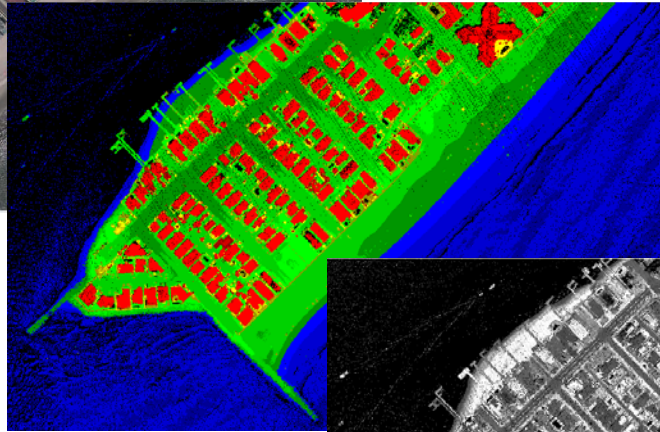
Shoreline



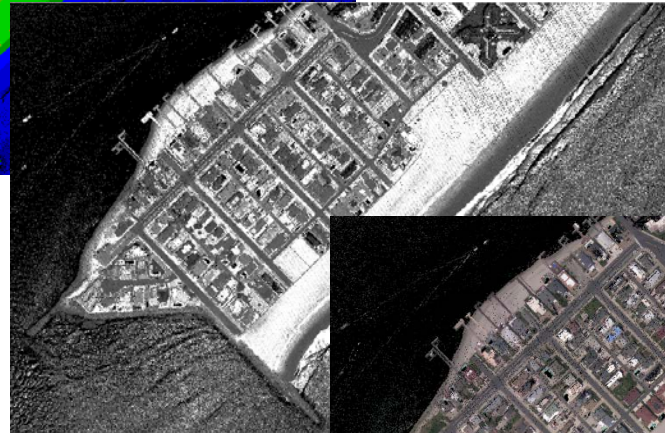
Ortho Mosaic Imagery



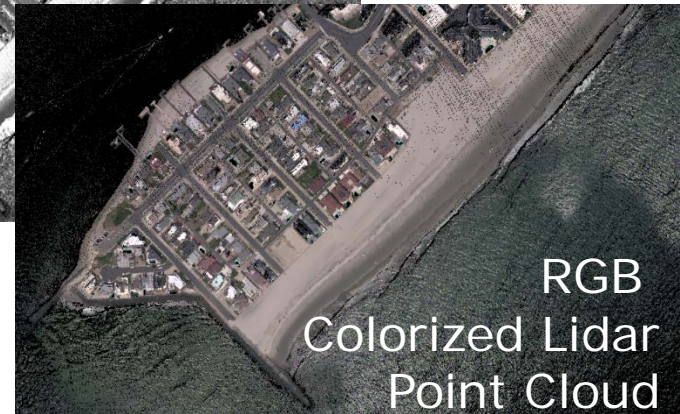
Lidar Point Cloud
(elevation)

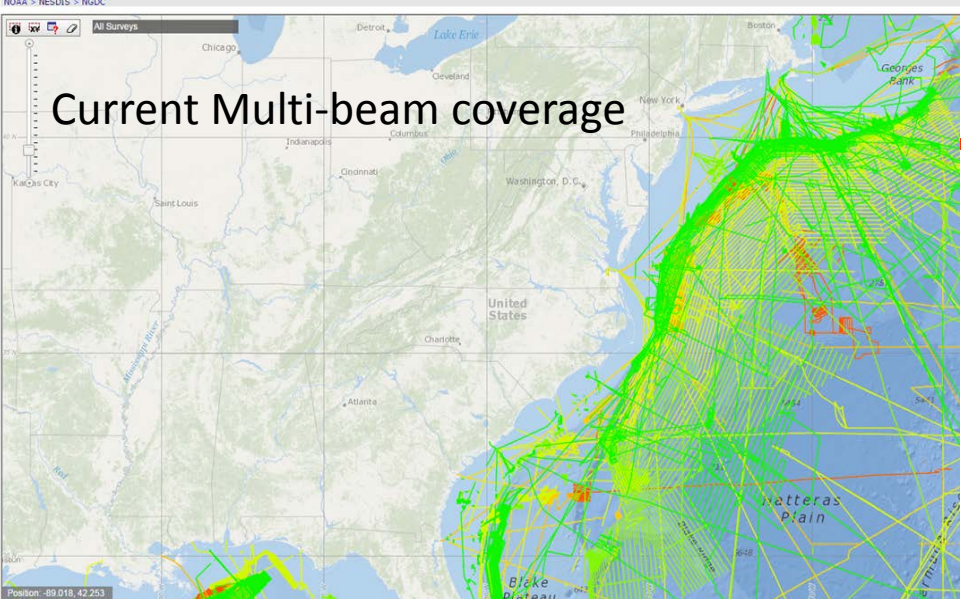


Lidar Point Cloud
(intensity)

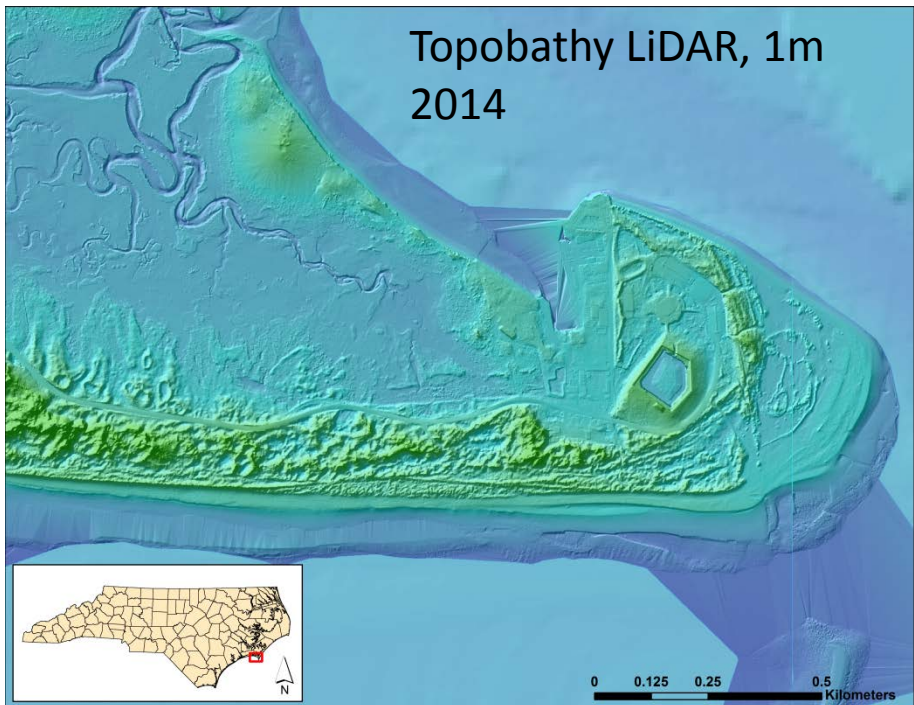
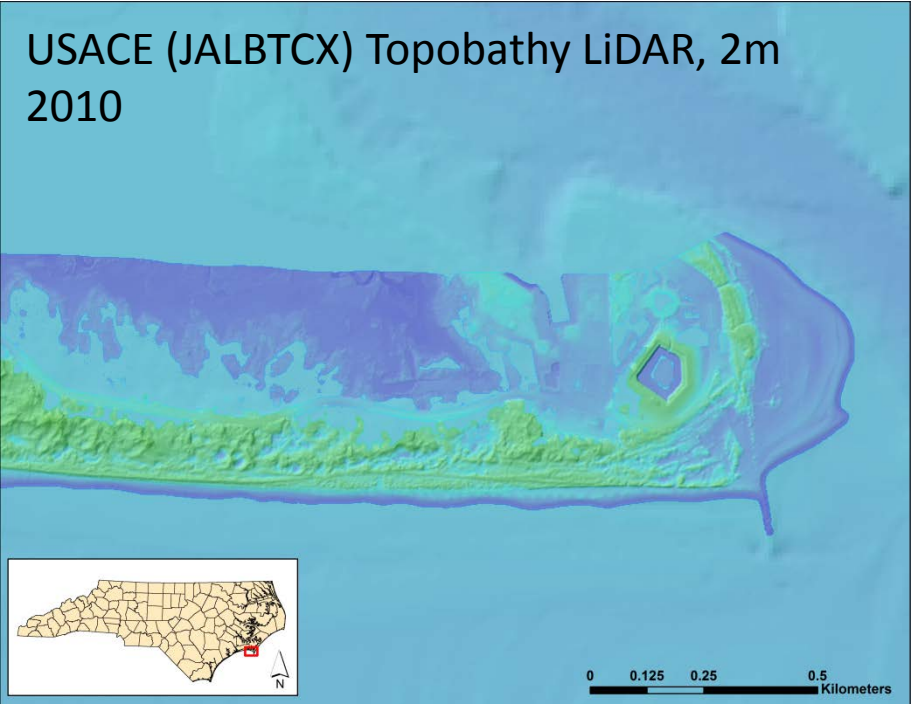
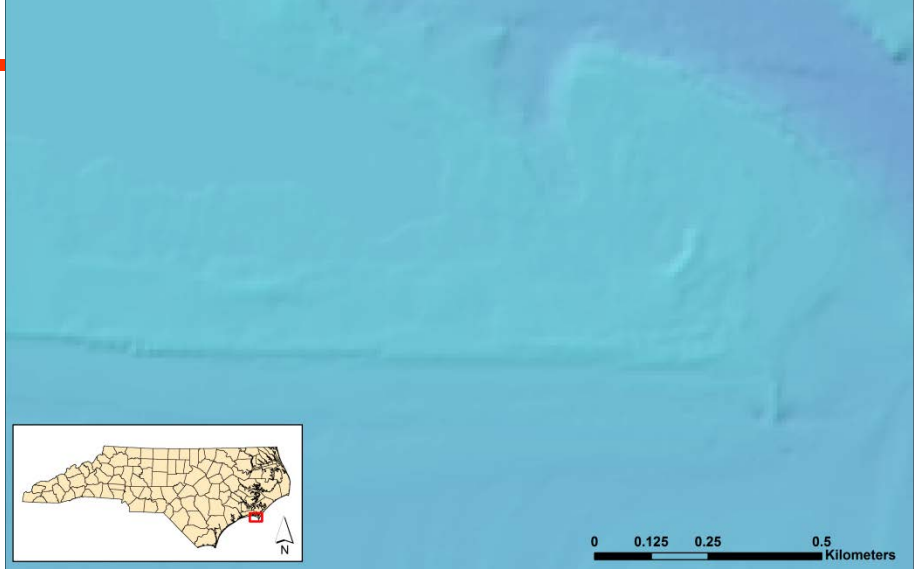


RGB
Colorized Lidar
Point Cloud





NOAA NGDC integrated dataset, 10m 1869-2010





Emergency Response Imagery

- **Remotely sensed data is acquired to support NOAA's requirements as well as other emergency response requirements (Mission Essential Activity MEA #3 under Primary Mission Essential Function DOC-2)**
- **NOAA maintains this capability to meet its own requirements as well as to provide tools, technology, and expertise we have gained to other government entities and the private sector.**
- **The remotely sensed data collected is disseminated to federal, state, and local government agencies as well as the general public to facilitate support efforts. The data is collected, processed, and disseminated in GIS ready formats by NOAA.**



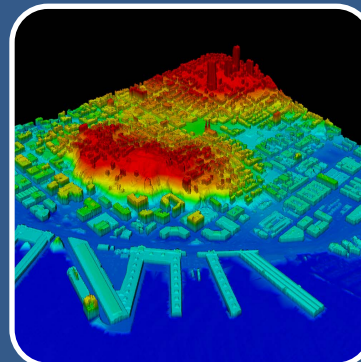
Recent Projects



9/11 Recovery Efforts



Hurricanes: Isabel (2003), Ivan, Jeanne (2004), Dennis, Katrina, Ophelia, Rita, Wilma (2005), Ernesto (2006), Humberto (2007), Gustav, Ike (2008), Earl (2009), Irene (2011), Isaac, Sandy (2012), Arthur (2014).



Lidar Acquisition to support 133 city effort.



Other response: Nor'Easter (2009), North Dakota Flooding (2011), DWH (2010,2011, 2012), Haiti Earthquake (2010), Red River Flooding (2008, 2011), AL and MO tornadoes (2011), IL tornadoes (2015)



storms.ngs.noaa.gov



Emergency Response Imagery

National Geodetic Survey

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The imagery posted on this site was acquired by the **NOAA Remote Sensing Division** to support NOAA national security and emergency response requirements. In addition, it will be used for ongoing research efforts for testing and developing standards for airborne digital imagery.

Emergency Response Imagery:

- Hurricane Arthur (2014)**
- Hurricane Sandy (2012): [Web Map Interface](#) [Mobile Web App](#)
- Hurricane Isaac (2012): [Web Map Interface](#)
- Hurricane Irene (2011): [Web Map Interface](#) [HTML Interface](#)
- Joplin, MO Tornado (2011)**
- Tuscaloosa, AL Tomado (2011)**
- North Dakota Flooding (2011)**
- Hurricane Earl (2010): [Web Map Interface](#) [HTML Interface](#)
- Nor'Easter Nov09 (2009)**
- Hurricane Ike (2008)**
- Hurricane Gustav (2008)**
- Hurricane Humberto (2007)**
- Tropical Storm Ernesto (2006)**
- Hurricane Wilma (2005)**
- Hurricane Rita (2005)**
- Hurricane Ophelia (2005)**
- Hurricane Katrina (2005)**
- Hurricane Dennis (2005)**
- Hurricane Ivan (2004)**
- Hurricane Jeanne (2004)**
- Hurricane Isabel (2003)**

Navigation
National Geodetic Survey

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Website Owner: National Geodetic Survey / Last modified by NGS Webmaster Nov 1 2012

hddsexplorer.usgs.gov

USGS science for a changing world

Hazards Data Distribution System (HDDS) Explorer

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Search Criteria Events Additional Criteria Results

1. Enter Search Criteria

To narrow your search area, type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Address/Place Feature Circle

Show Clear

Coordinates Predefined Area Shapefile KML

Degree/Minute/Second Decimal

No coordinates selected.

Use Map Add Coordinate Clear Coordinates

Date Range Result Options

Search from: mm/dd/yyyy to: mm/dd/yyyy

Search months: (all)

Events » Additional Criteria » Results »

Search Criteria Summary (Show) Clear Criteria

Google

Map data ©2015 Google, INEGI Imagery ©2015 NASA, TerraMetrics, 1000 km

The up-to-date Google map is not for purchase or for download; it is to be used as a guide for reference and search purposes only.

Accessibility FOIA Privacy Policies and Notices Google Maps API Disclaimer


NOAA data in the USGS viewer:

<http://hddsexplorer.usgs.gov/>



fema.maps.arcgis.com/home/index.html

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FEMA GeoPlatform

Providing geospatial data and analytics in support of emergency management



Hurricanes / Typhoons



Floods



Tornadoes



Winter Storms

GEOPLATFORM.gov FEMA is a partner of the FGDC's National Geospatial Platform Visit: www.geoplatform.gov

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- NOAA data in the FEMA viewer:
- <http://fema.maps.arcgis.com/>
- NOAA data as download:
- https://content.femadata.com/NationalDisasters/NOAA_Imagery/download/



Tuscaloosa/Birmingham April 2011





Tuscaloosa/Birmingham April 2011





Tuscaloosa/Birmingham April 2011



EXAMPLE 1 (Pre-event) Damage Assessment Conducted Using FEMA's 4-Level Damage Scale

FEMA Damage Classification		Observed Damages
Damage Level		Observed Damages
General Damage Classifications		
LD	Limited Damage	Generally superficial damage to solid structures (e.g., loss of tiles or roof shingles); some mobile homes and light structures are damaged or displaced.
MD	Moderate Damage	Solid structures sustain exterior damage (e.g., missing roofs or roof segments); some mobile homes and light structures are destroyed, many are damaged or displaced.
ED	Extensive Damage	Some solid structures are destroyed; most sustain exterior and interior damage (roofs missing, interior walls exposed); most mobile homes and light structures are destroyed.
CD	Catastrophic Damage	Most solid and all light or mobile home structures destroyed.



**EXAMPLE 1 (Post-event)
Damage Assessment Conducted
Using FEMA's 4-Level Damage Scale**

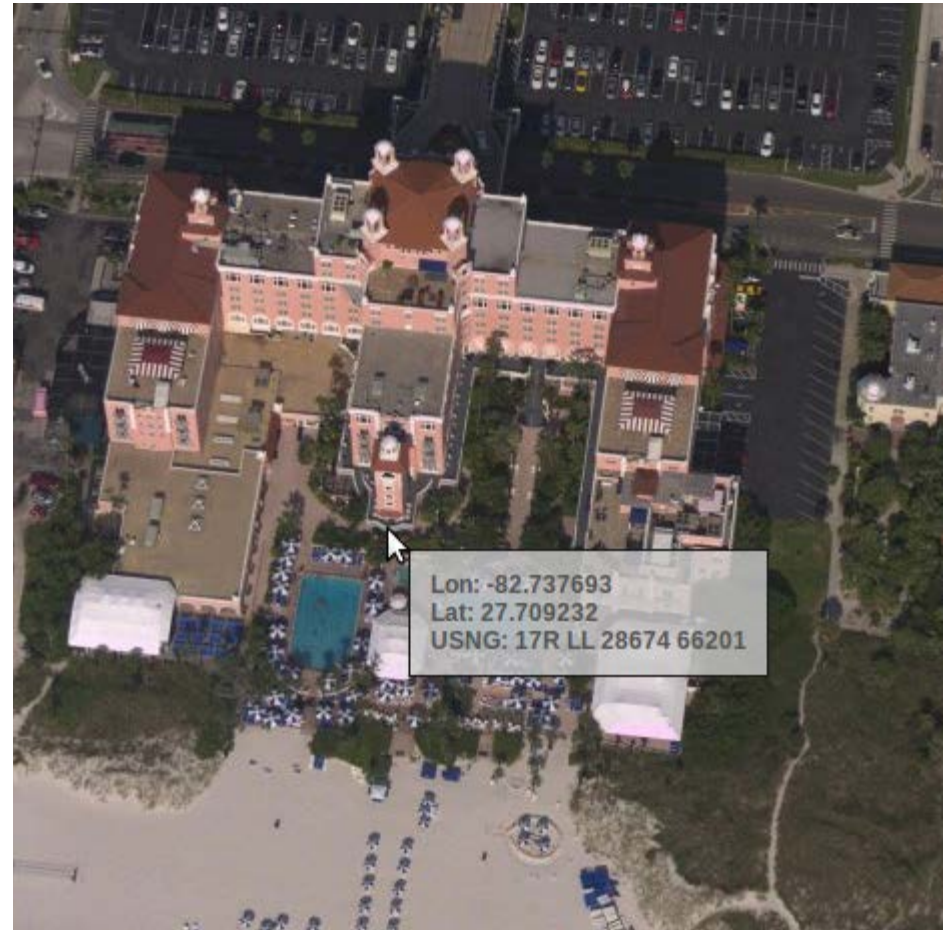
FEMA Damage Classification		
Damage Level		Observed Damages
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LD	Limited Damage	Generally superficial damage to solid structures (e.g., loss of tiles or roof shingles); some mobile homes and light structures are damaged or displaced.
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CD	Catastrophic Damage	Most solid and all light or mobile home structures destroyed.





ER Mission Profile(s) for Oblique Imagery

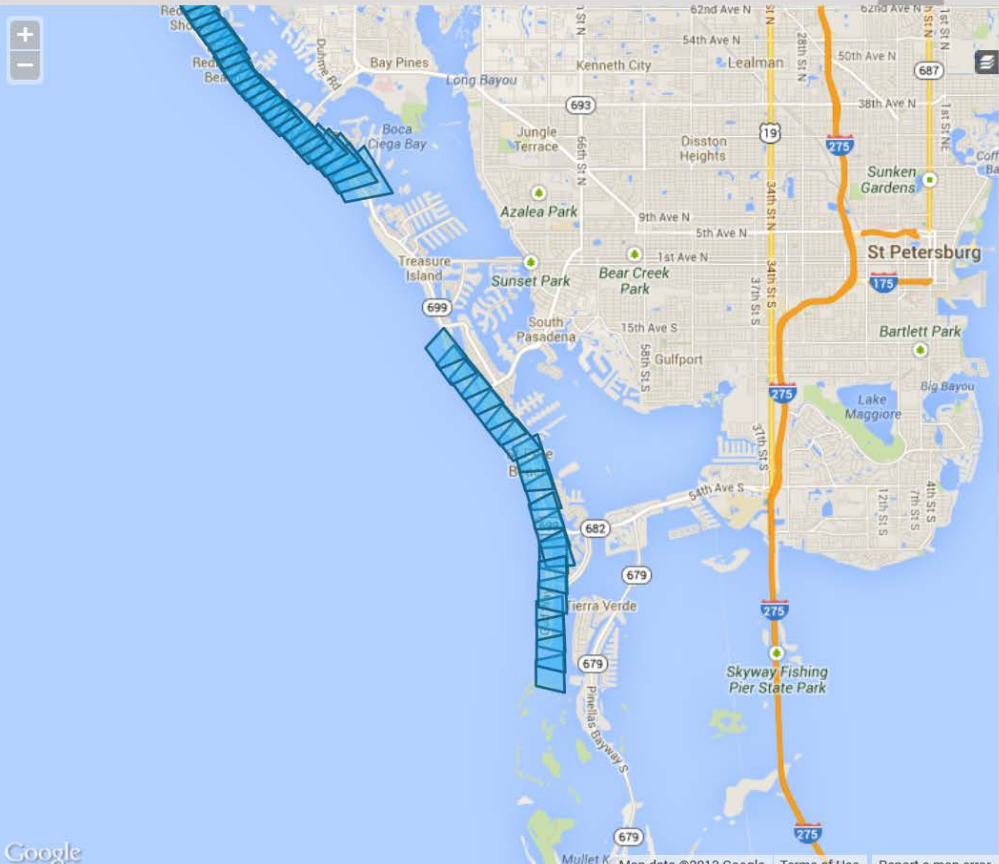
- 1500ft-3500ft (450-1067 m) AGL
- 60 mm lens
- Average GSD ~ 0.05 m - ~ 0.15 m
- Individual Images with embedded GCP's
- Small, fast *and* geo-referenced
 - JPEG compression
 - Pyramids
 - GeoTiff
- Enhanced flexibility
- Multiple perspectives
- Drag and drop in ESRI
- In browser coordinate display
 - Lat/Lon and USNG





In Browser Image Selection

St. Pete Beach Oblique Test Imagery [About](#) [Contact](#) [Download](#)



The map shows St. Petersburg, Florida, with several blue-shaded polygons indicating oblique imagery acquisition areas. The polygons are located along the coast and in the central urban area. The map includes labels for various streets, parks, and landmarks. The NOAA logo is visible in the top left corner of the map interface.

Get Started:
Search an address within the acquisition area or select a polygon in the left side map pane
Example address: 3400 Gulf Boulevard, St. Pete Beach, FL
Mouseover the image in the right side pane to display coordinates in NAD83 (2011) Geographic Latitude / Longitude and U.S. National Grid

Google Map data ©2013 Google Terms of Use Report a map error

<http://storms.ngs.noaa.gov/storms/obliquedemo/>

<http://storms.ngs.noaa.gov/storms/hxI4Test/oblique>

<http://storms.ngs.noaa.gov/storms/hxI4Test>



In Browser Image Selection

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Image ID: S24175886
Link to full resolution image.

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<http://storms.ngs.noaa.gov/storms/obliquedemo/>

<http://storms.ngs.noaa.gov/storms/hxI4Test/oblique>

<http://storms.ngs.noaa.gov/storms/hxI4Test>



ESRI ArcMap

The screenshot displays the ESRI ArcMap software interface. At the top, the title bar reads "Untitled - ArcMap". Below it is a menu bar with options: File, Edit, View, Bookmarks, Insert, Selection, Geoprocessing, Customize, Windows, and Help. A toolbar with various icons for navigation and editing is positioned below the menu bar. The main map area shows an aerial view of a coastal town with a beach and a large body of water. A semi-transparent rectangular box is overlaid on the map. On the left side, the "Table Of Contents" pane is open, showing a "Layers" list:

- S24175457.tif
 - RGB
 - Red: Band_1
 - Green: Band_2
 - Blue: Band_3
- Basemap
 - World_Imagery

On the right side, there is a "Catalog" pane and a "Search" pane. At the bottom of the map area, there is a status bar displaying the coordinates: "-82.73 27.705 Decimal Degrees".



ESRI ArcMap

The screenshot displays the ESRI ArcMap software interface. The title bar reads "Untitled - ArcMap". The menu bar includes File, Edit, View, Bookmarks, Insert, Selection, Geoprocessing, Customize, Windows, and Help. The toolbar contains various icons for navigation and editing, with a scale of 1:12,523. The Table of Contents (TOC) on the left lists several layers:

- S24175116.tif
RGB
 - Red: Band_1
 - Green: Band_2
 - Blue: Band_3
- S24175122.tif
RGB
 - Red: Band_1
 - Green: Band_2
 - Blue: Band_3
- S24176052.tif
RGB
 - Red: Band_1
 - Green: Band_2
 - Blue: Band_3
- S24176049.tif
RGB
 - Red: Band_1
 - Green: Band_2
 - Blue: Band_3
- S24176046.tif
RGB
 - Red: Band_1
 - Green: Band_2
 - Blue: Band_3
- S24175457.tif
RGB
 - Red: Band_1
 - Green: Band_2
 - Blue: Band_3
- Basemap
- World_Imagery

The main map area shows a satellite-style aerial view of a coastal region with buildings, roads, and a beach. A search bar is located on the right side of the map. The status bar at the bottom right displays the coordinates "-82.73 27.695 Decimal Degrees".



Hx Arthur Response

← → ↻ 🏠

Hurricane Arthur Imagery [? About](#) [✉ Contact](#) [⬇ Download](#)

Get Started:
Search an address within the acquisition area or zoom in and select a polygon in the left side map pane.
Example address: 2169 Ocean Pearl Rd, Corolla, NC
Mouseover the image in the right side pane to display coordinates in NAD83 (2011) Geographic Latitude / Longitude and U.S. National Grid.

GIS Users:
The image that you download (link in polygon popup) is a GeoTiff and will load as an orthorectified product in a GIS. Some users with a GDAL based viewer (QGIS) may need the associated .vrt (Virtual Raster) file. It can be downloaded from the same location by changing the .tif to .vrt. Both the tif and vrt file are included in the bulk download tar file.

© Mapbox © OpenStreetMap Improve this map

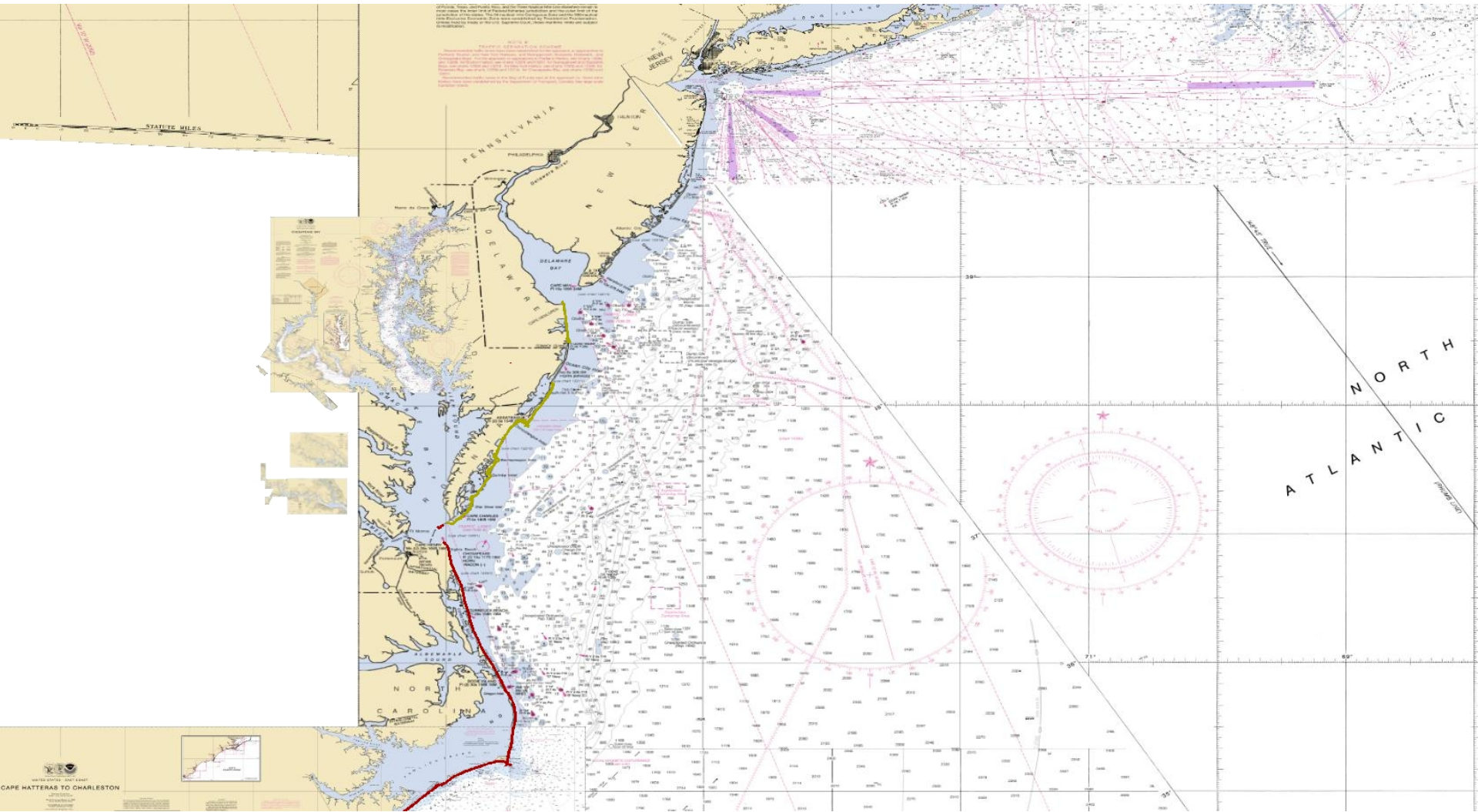
noaa.doc Elvidge_boats_2014....docx VQ-880-G_at_a_glan....pdf [Show all downloads...](#)

<http://ngs.woc.noaa.gov/storms/arthur/oblique/>

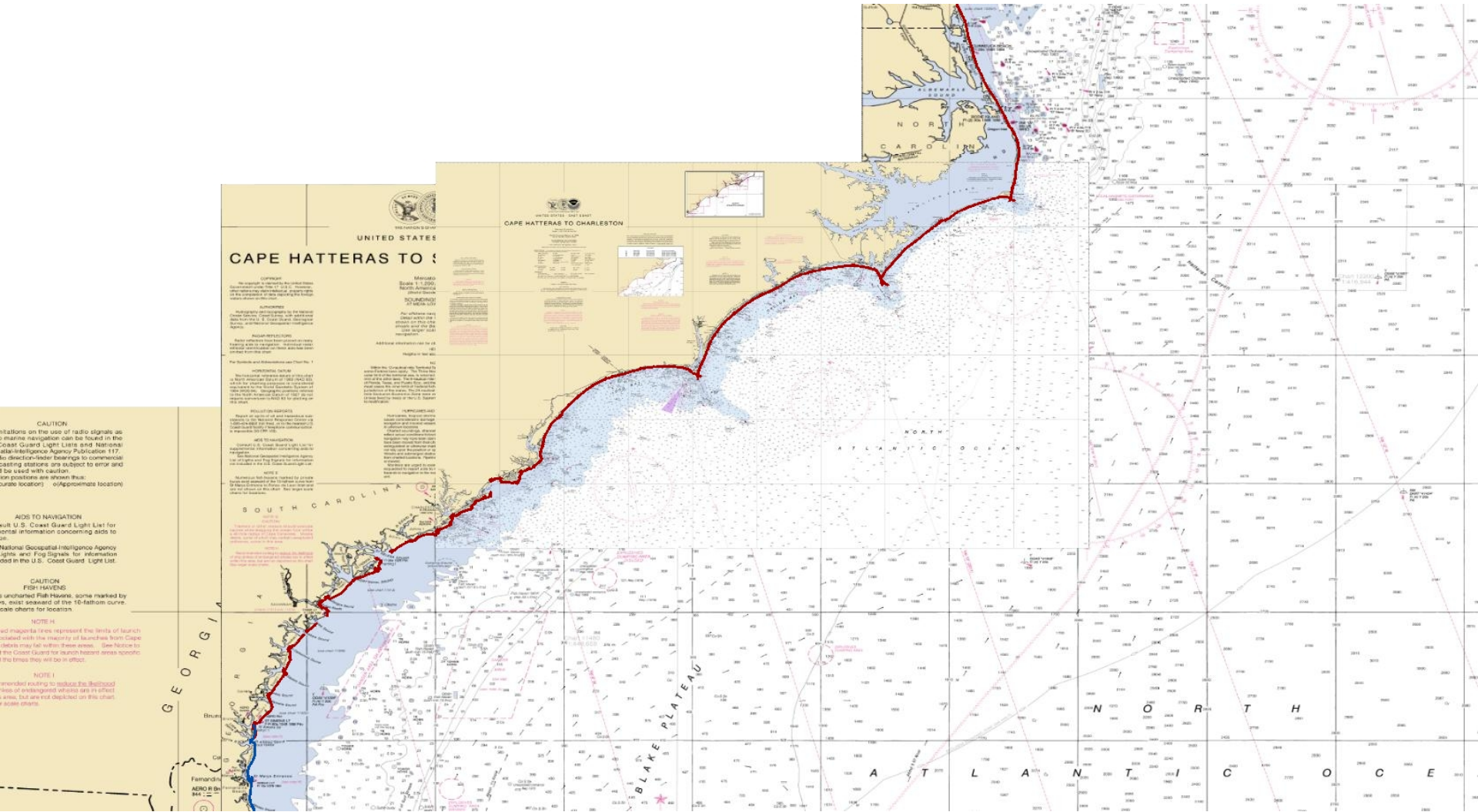




Pre-event oblique imagery

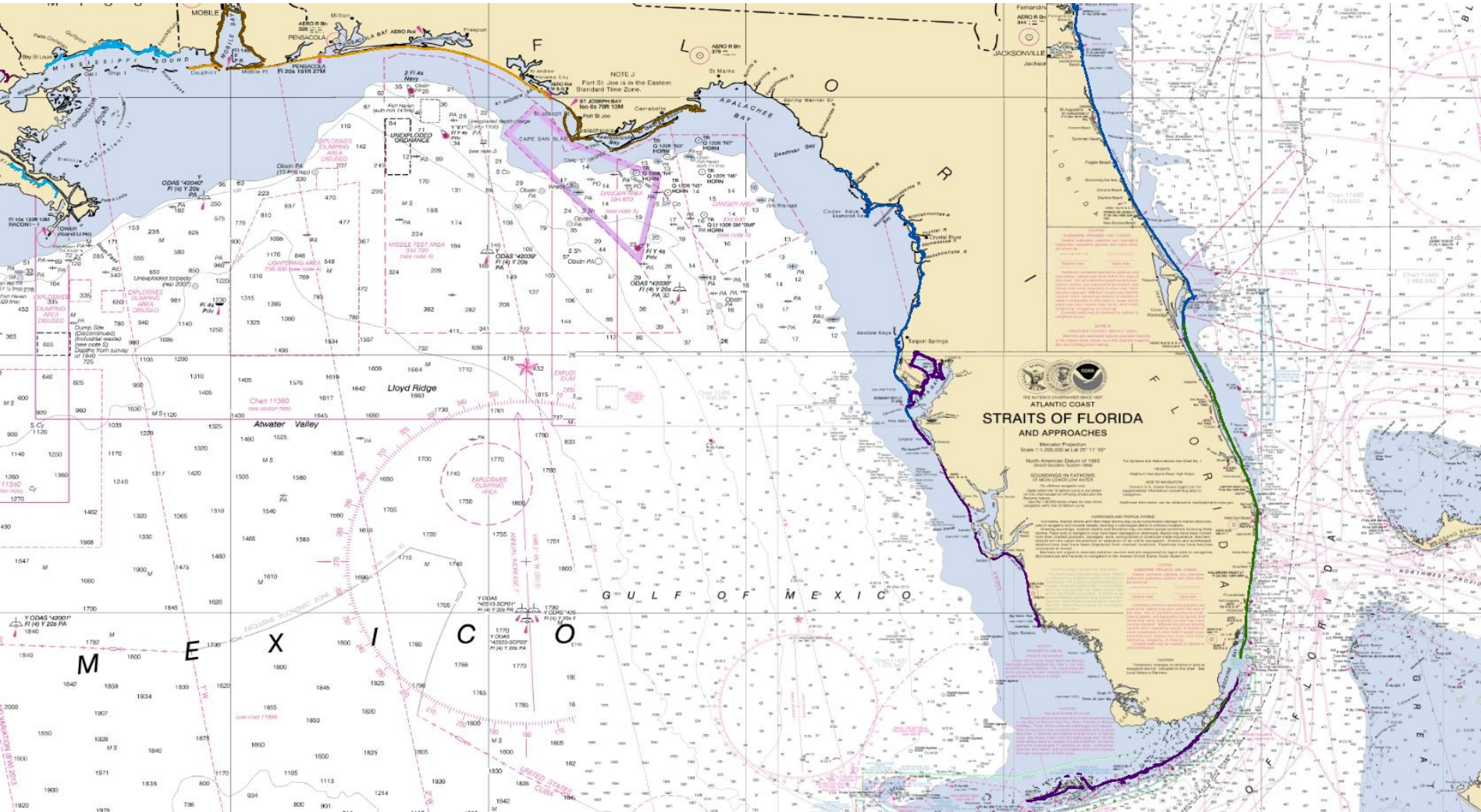


Pre-event oblique imagery





Pre-event oblique imagery





Pre-event planning/operations

Days Out

- 8/-5 Event of National Significance/Impact to NOAA Mission(s) (Charting, Weather, CZM, Facilities, Trust Resources)***
- 4 Approval by Director, NGS***
- 4/-3 Preplanned flight lines developed/updated (if a known event, Hx, or developed if not).***
- 4/-3 Disseminated to FEMA RS coordinator* and other partners (States, USGS, USACE, FEMA) for coordination/additions***
- 3/-2 Prepositioning of assets and personnel***
- 2/0 Refinement of Requirements***
- 0/+? Daily updates on collections and intentions***



NOAA HX Sandy Response Plan

Response Strategy

Preplanned flight lines for damage assessment imagery were developed and shared with interagency partners through FEMA coordination that include state and local representation as well as used modeled impacts of storm surge and damage from the FEMA Modeling Task Force (MOTF).

Requirements of Response

The flight lines cover areas of known and potential impacts to navigation, critical infrastructure including those with potential HAZMAT issues, coastal zone management concerns, and overlapping requirements of federal partners including FEMA, USCG, USACE, NGA, and USGS.

Priorities

Priorities are centered on the major ports and waterways supporting the Marine Transportation System; known or projected severe impacts to coastlines and critical infrastructure (New Jersey/New York), areas of severe flooding impacting coastal communities

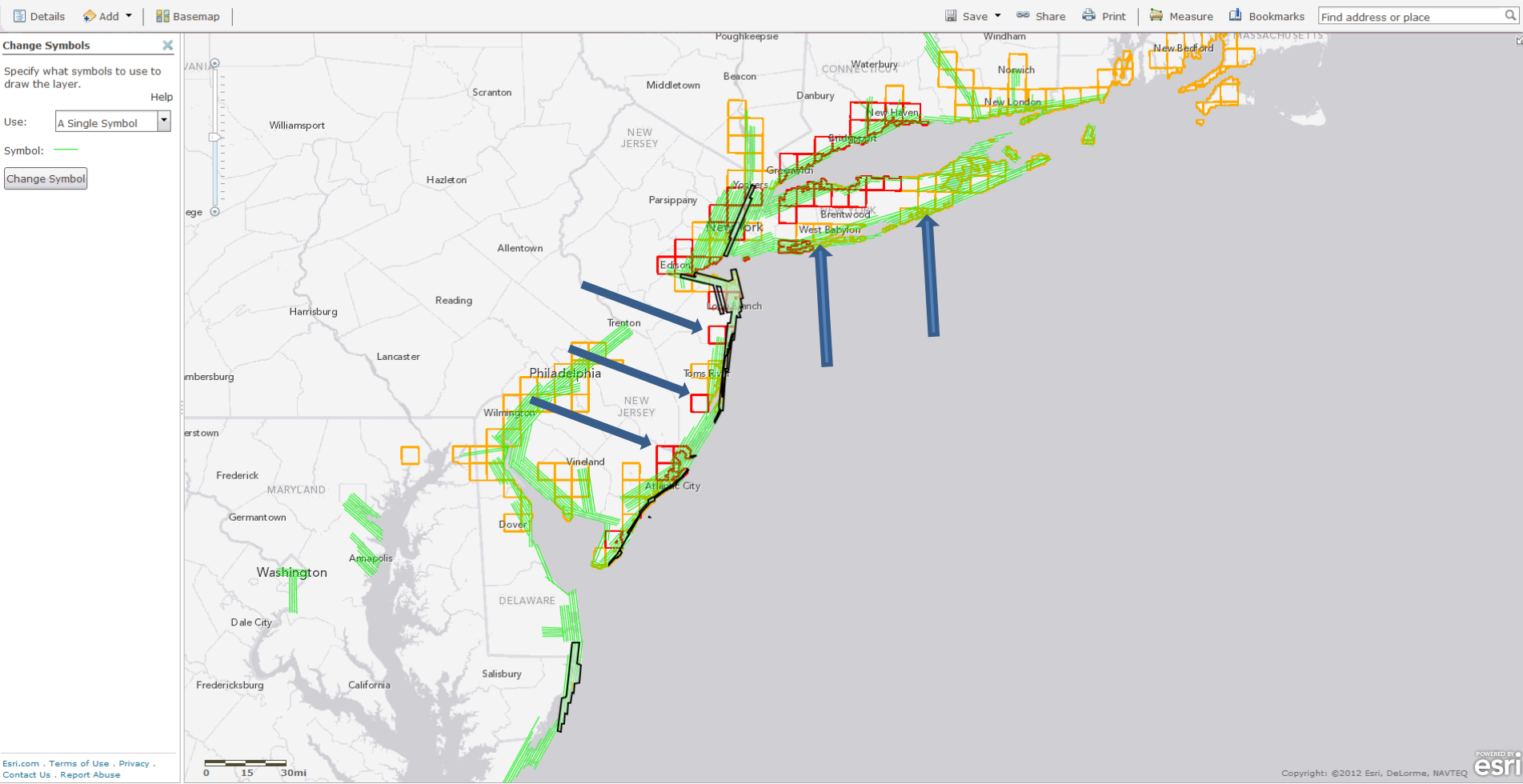


NOAA planned flight lines and collected data overlaid on MOTF Risk Matrix And Priority setting for 1-2 Nov

HOME

Hurricane Sandy-Remote Sensing Collection Planning

New Map My Content Help Sign In



Black outline = data collected Green lines = planned collection Blue Boxes = priority areas for 1-2 Nov



HOME

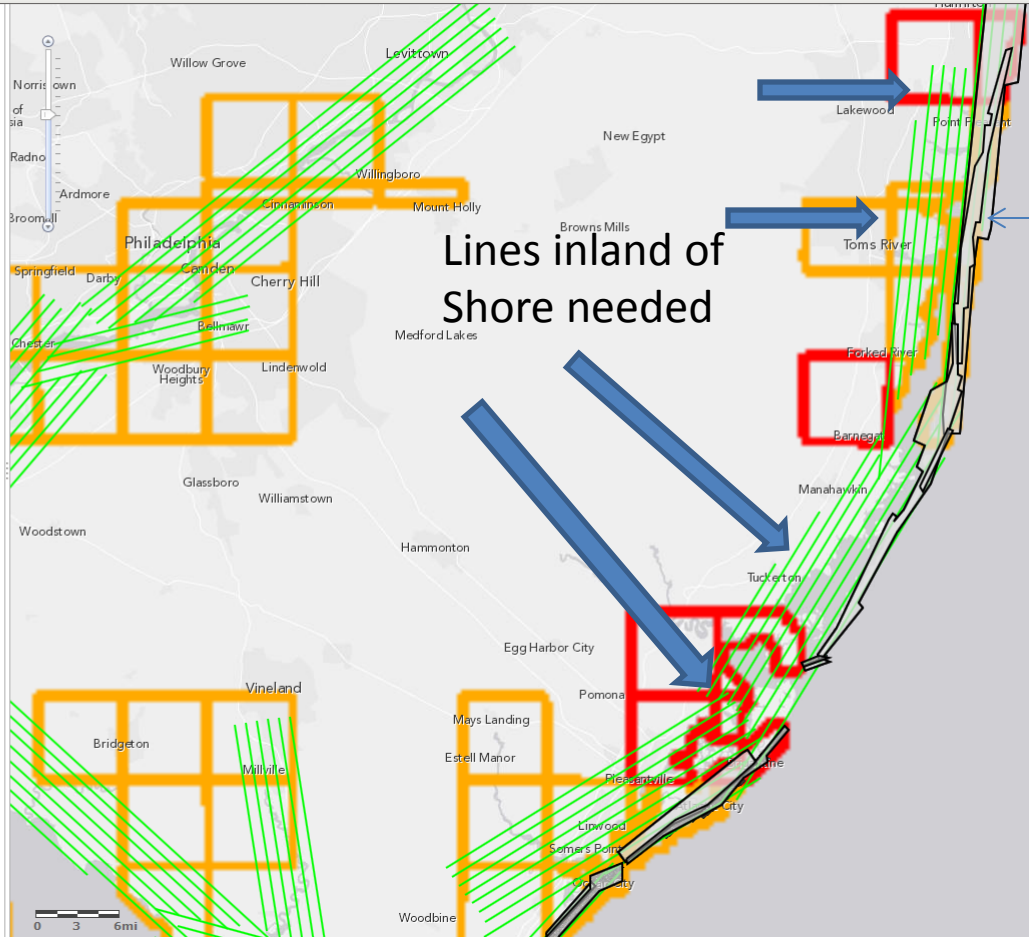
Hurricane Sandy-Remote Sensing Collection Planning

New Map My Content Help Sign In

Details Add Edit Basemap

Save Share Print Measure Bookmarks Find address or place

- Contents**
- sandy ngs rsd
 - 20121101 ngs rsd
 - 20121031 ngs rsd
 - EAARL-B post-Sandy
 - NGTOC post-Sandy lidar
 - sandy dss fit lines
 - Sandy Images
 - Collected CAP Imagery
 - CT CAP
 - Remote Sensing Plans
 - NOAA 20121031
 - Sandy Surge Extent
 - MOTF Risk Matrix
 - Light Gray Canvas

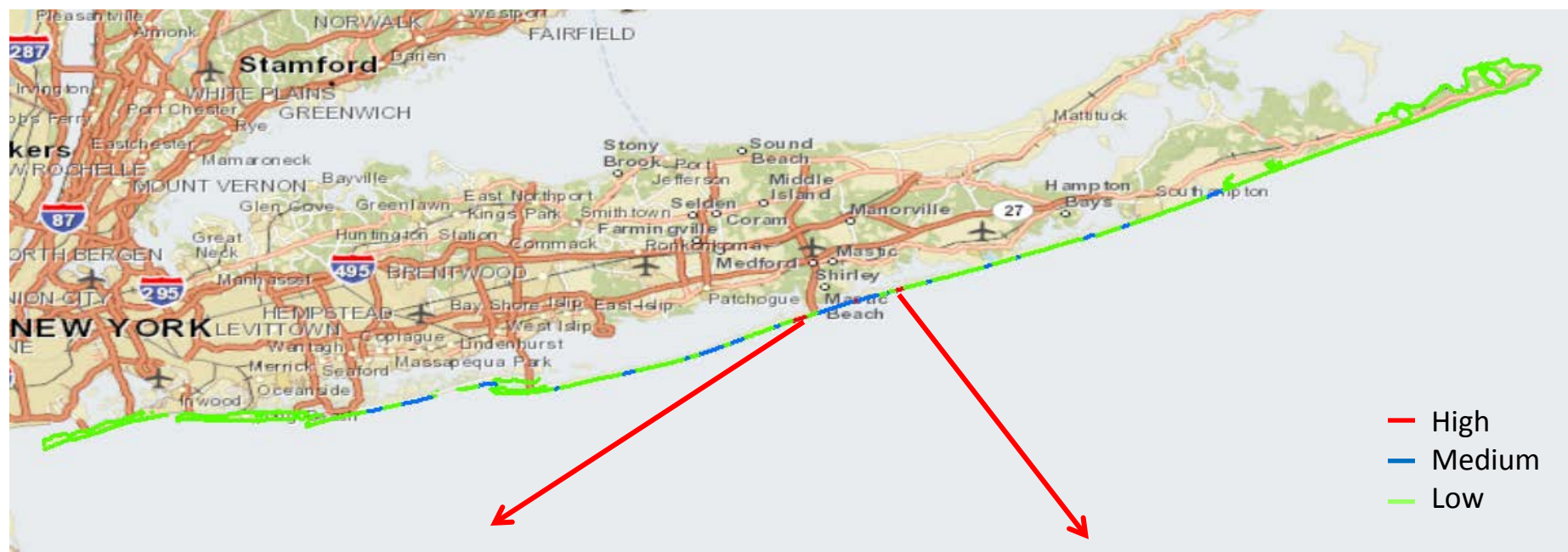


Lines inland of Shore needed

Black outline completed Lines.

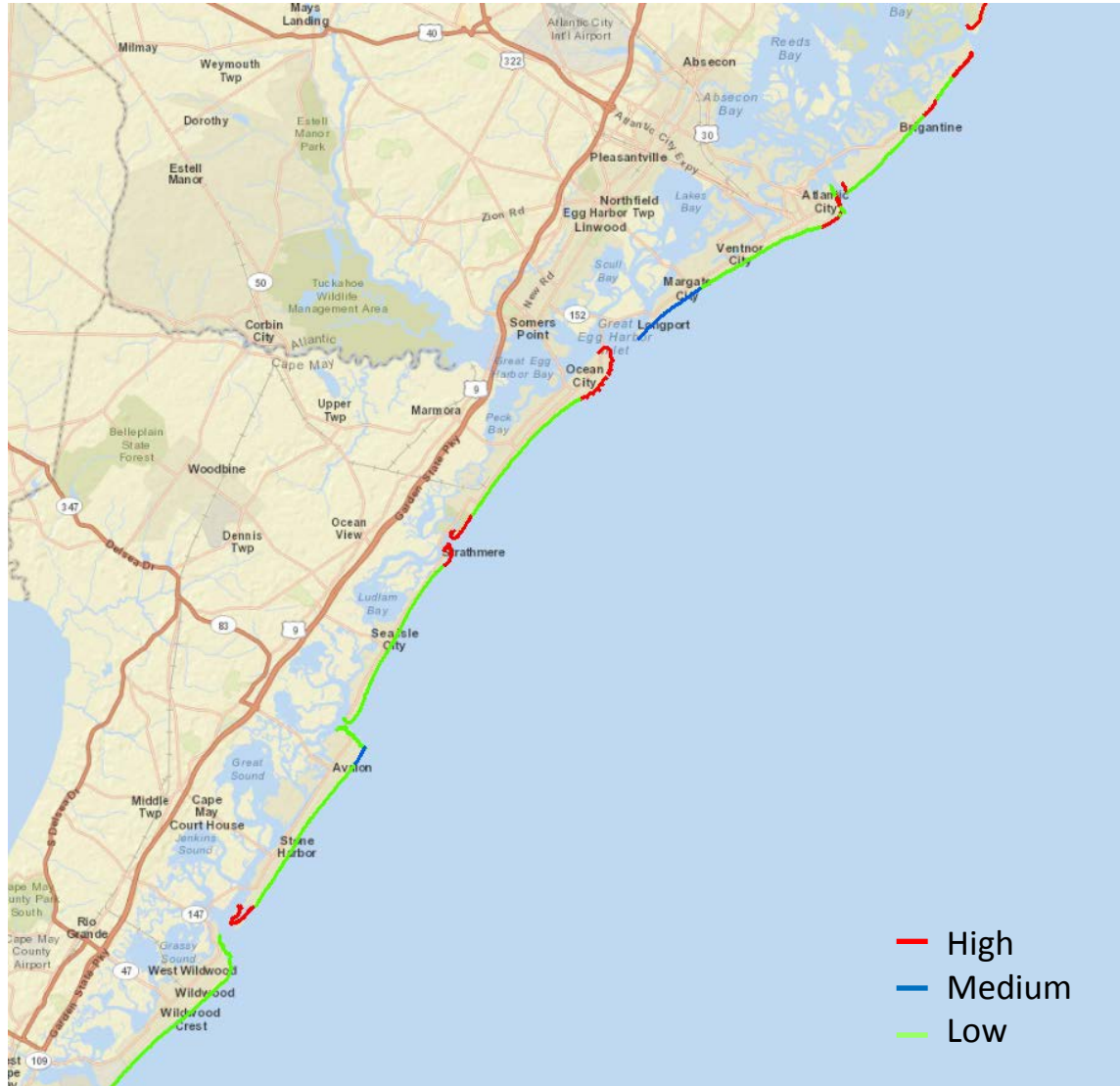


Significant Shoreline Changes (Long Island)





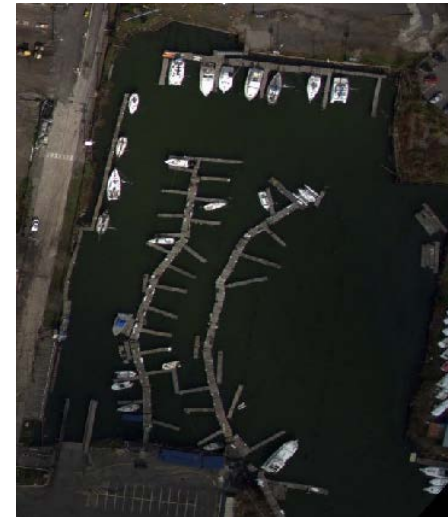
Shoreline Changes (New Jersey)



Port Infrastructure Changes

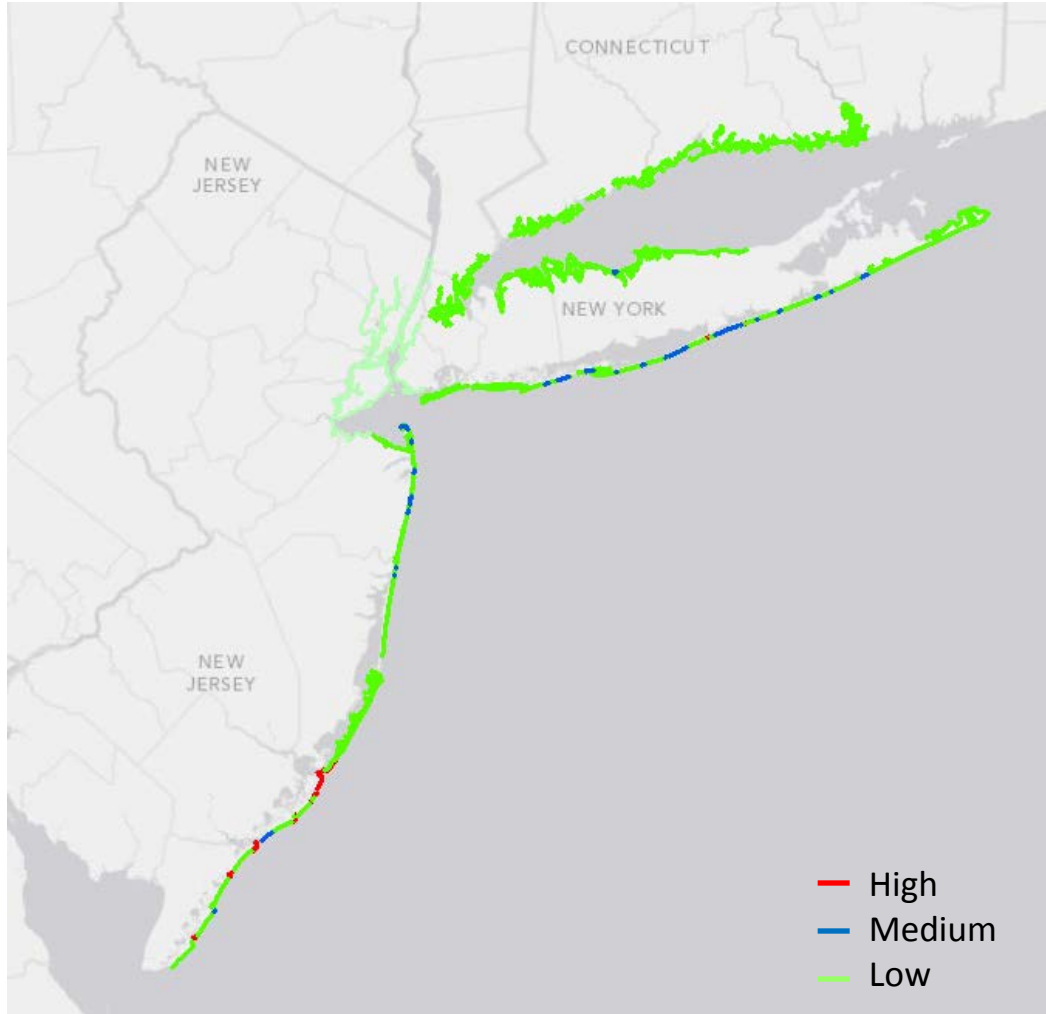


27 Destroyed Features
(Piers, Bulkheads)

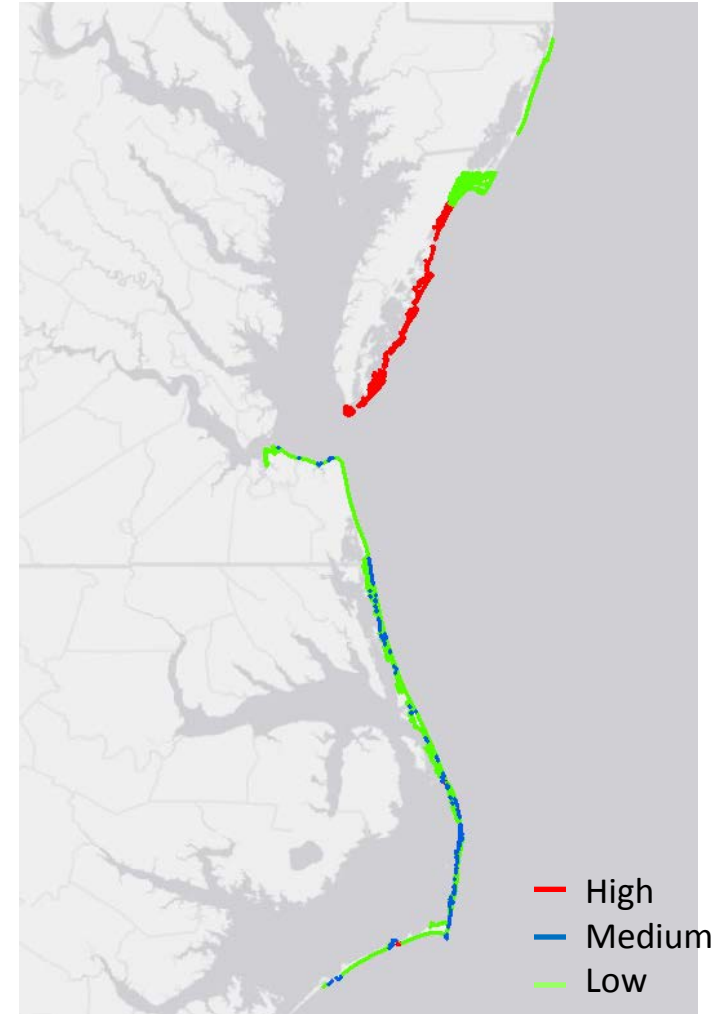




Priority Areas of Shoreline Changes



Connecticut to New Jersey



Maryland to North Carolina



FEMA use of NOAA Imagery for Damage Assessment of Individual Homes



HOME | Hurricane Sandy-Remote Sensing Collection Planning | New Map | My Content | Help | Sign In

Details | Add | Basemap | Save | Share | Print | Measure | Bookmarks | Find address or place

Contents

- ImageCat NLT
 - point_result_20121101_14
 - damage_20121101_1450P
 - Destroyed
 - Major
 - Minor
 - Affected
 - No Damage
 - Unknown
- CT CAP
- Remote Sensing Plans
- NOAA 20121031
- Sandy Surge Extent
- MOTF Risk Matrix
- Light Gray Canvas

Atlantic City, NJ

Copyright: ©2012 Esri, DeLorme, NAVTEQ | New Light Technologies / ImageCat

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Over 147,000 individual structural assessments were conducted using imagery and inundation information.



NOAA Hx Sandy response outcomes

- ***Primary users and coordination***
 - ***FEMA, NJ/NY EMA, NJ/NY DOT, USGS, USACE, DHS, USCG, NGA, Google, ESRI, Insurance industry, academia***
- ***By the numbers***
 - ***12,000 images over 3000 miles of impacted shoreline***
 - ***24 flights, 91.2 flight hours, 7 days***
 - ***Imagery delivered 4-8 hours after landing***
 - ***Supported 147,000 individual structural assessments***
 - ***Visitors 1,145,390, 856 million hits; 12.2 terabytes downloaded***
 - ***storms.ngs.noaa.gov***



Coordination recommendations

- ***NOAA activities through your NOAA CZM contacts, NOAA regional reps, directly with NGS.***
- ***Larger events including above through your State EMAs, DOTs, etc. to FEMA at the JFO.***
 - ***Requires educating now on the importance of the data***
 - ***Find out who the FEMA RS and GIS lead are for your JFO***
- ***Other federal agency contacts USGS Liaisons, USACE Districts, NSGIC, etc.***
- ***Provide feed back on plans and indicate any intentions of collecting similar data within your state.***
- ***Response efforts are from limited resources and every event is different.***