Elevation – An Important Starting Point

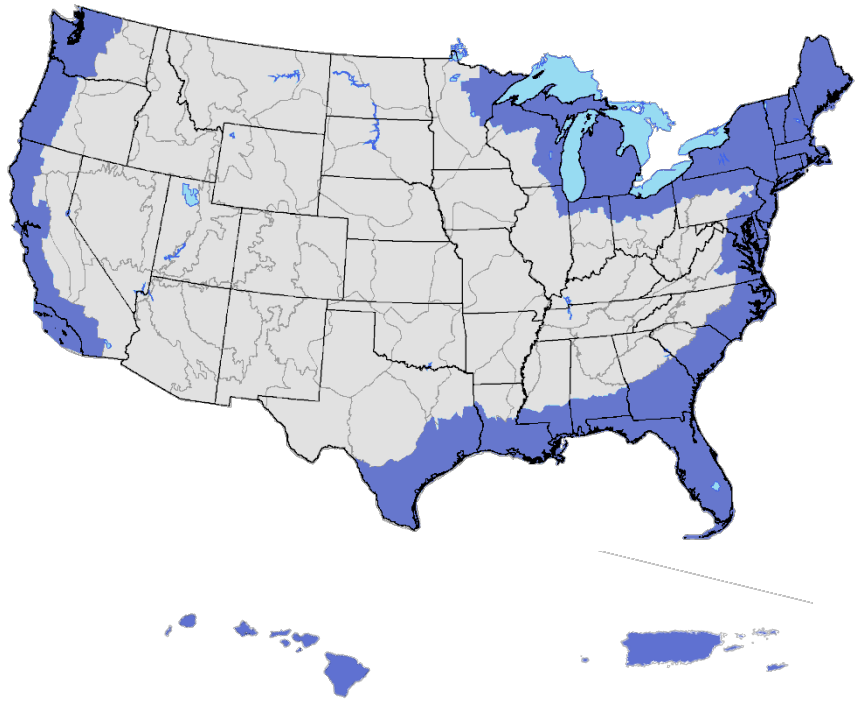
- Error
  - RMSE
  - Bias
  - Date (season)
- Resolution
  - Post spacing
  - Noisy vs smooth
- Tidal
  - Collection
  - Datum
    - VDatum

Elevation – A Model That Can Be Improved

- Post-processing
  - Hydro “correction”
    - Hydro-flattening – making water bodies “water”
    - Hydro-enforcement – making water bodies flow downhill
    - Hydro-conditioning – making surface water flow downhill
  - Marsh “correction”
    - By vegetation – adjusting elevation by plant type
    - By surveys – adjusting elevation by location
    - By re-sampling – assuming most lidar pts hit vegetation
  - Slopes – to remove noise or not?

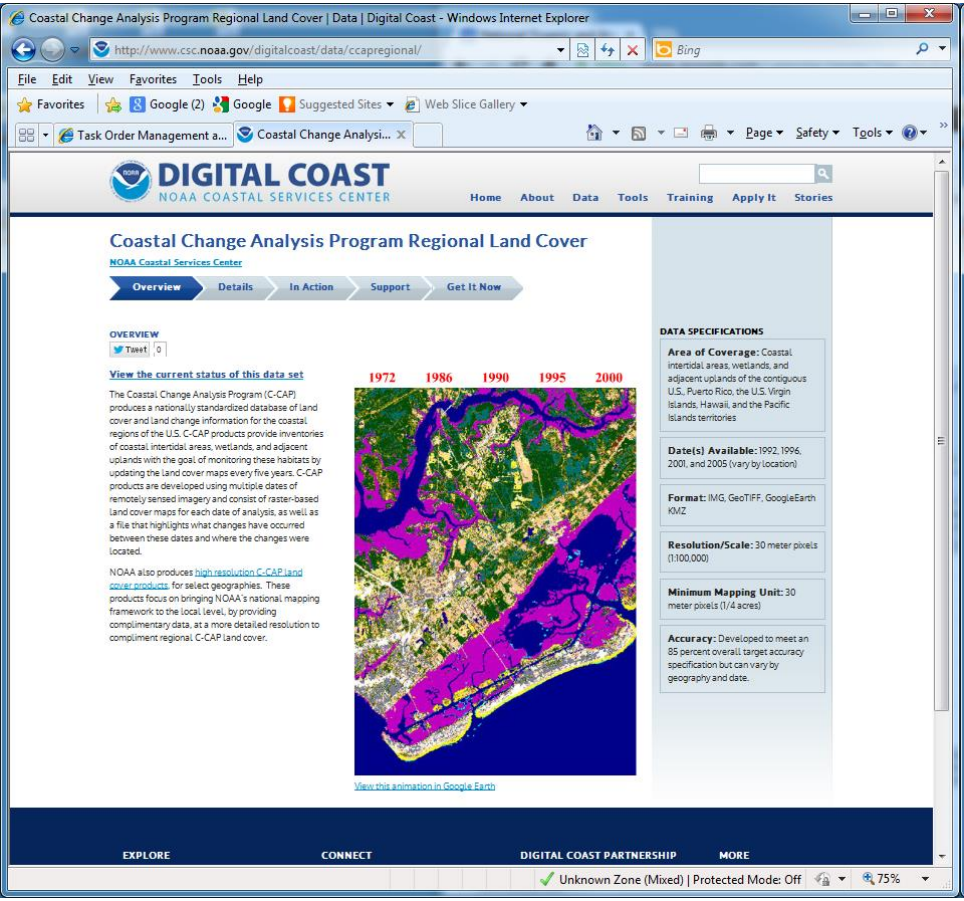
The Coastal Change Analysis Program (C-CAP)

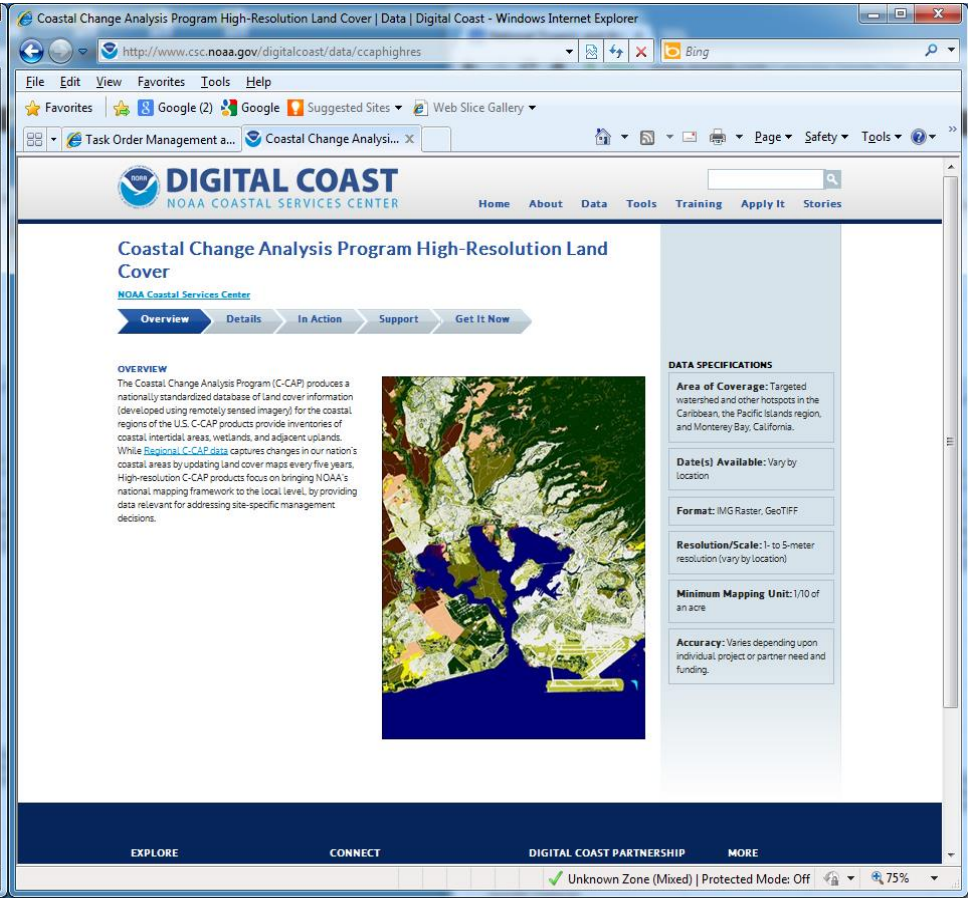
- National coastal land cover and change mapping program
- Inventory of intertidal areas, wetlands, and adjacent uplands
- Updated every five years
- Consistent, accurate products via standard data and methods
- Coastal expression of the National Land Cover Database (NLCD)



Designed to help improve understanding of linkages between land change and the environment

C-CAP Product Lines





- Nationally available
- Updated every five years
- Screening level for site-specific decisions

- Developed in “hotspots”
- Updated as needed
- More applicable to address more site-specific issues

Moderate Resolution C-CAP Class Scheme

Developed
- Developed, High Intensity
- Developed, Medium Intensity
- Developed, Low Intensity
- Developed, Open Space

Agricultural
- Cultivated Crops
- Pasture/Hay

Rangeland
- Grassland and Herbaceous
- Scrub / Shrub

Forest Land
- Deciduous Forest
- Evergreen Forest
- Mixed Forest

Barren Land
- Barren Land
- Unconsolidated Shore

Water
- Open Water
- Palustrine Aquatic Bed
- Estuarine Aquatic Bed

Wetlands
- **Woody Wetlands**
  - Palustrine Forested Wetland
  - Palustrine Scrub/Shrub Wetland
  - Estuarine Forested Wetland
  - Estuarine Scrub/Shrub Wetland
- **Herbaceous Wetlands**
  - Palustrine Emergent Wetland
  - Estuarine Emergent Wetland

Perennial Ice/Snow

High Resolution C-CAP Class Scheme

Developed
- Impervious
- Developed, Open Space

Agricultural
- Cultivated Crops
- Pasture/Hay

Rangeland
- Grassland and Herbaceous
- Scrub / Shrub

Forest Land
- Deciduous Forest
- Evergreen Forest

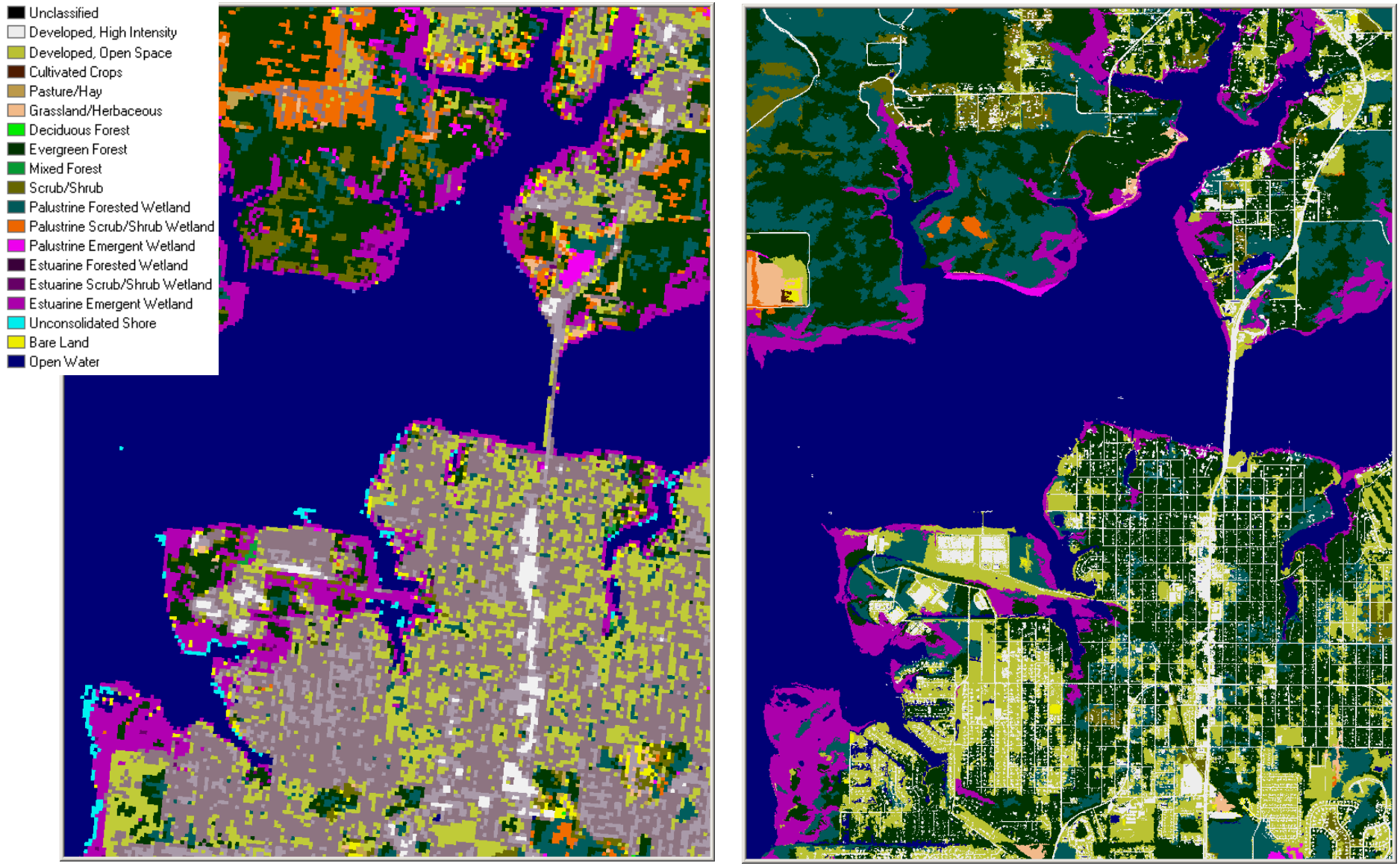
Barren Land
- Barren Land
- Unconsolidated Shore

Water
- Open Water
- Palustrine Aquatic Bed
- Estuarine Aquatic Bed

Wetlands
- **Woody Wetlands**
  - Palustrine Forested Wetland
  - Palustrine Scrub/Shrub Wetland
  - Estuarine Forested Wetland
  - Estuarine Scrub/Shrub Wetland
- **Herbaceous Wetlands**
  - Palustrine Emergent Wetland
  - Estuarine Emergent Wetland

Perennial Ice/Snow

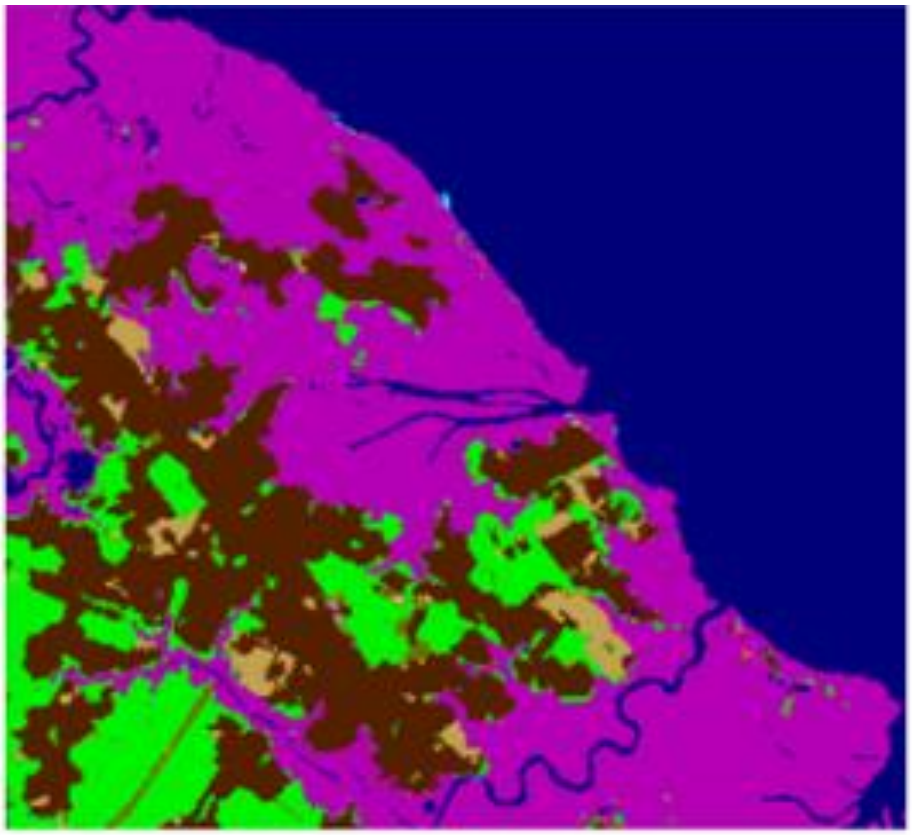
Comparison of C-CAP Products



Moderate Resolution (30m) C-CAP

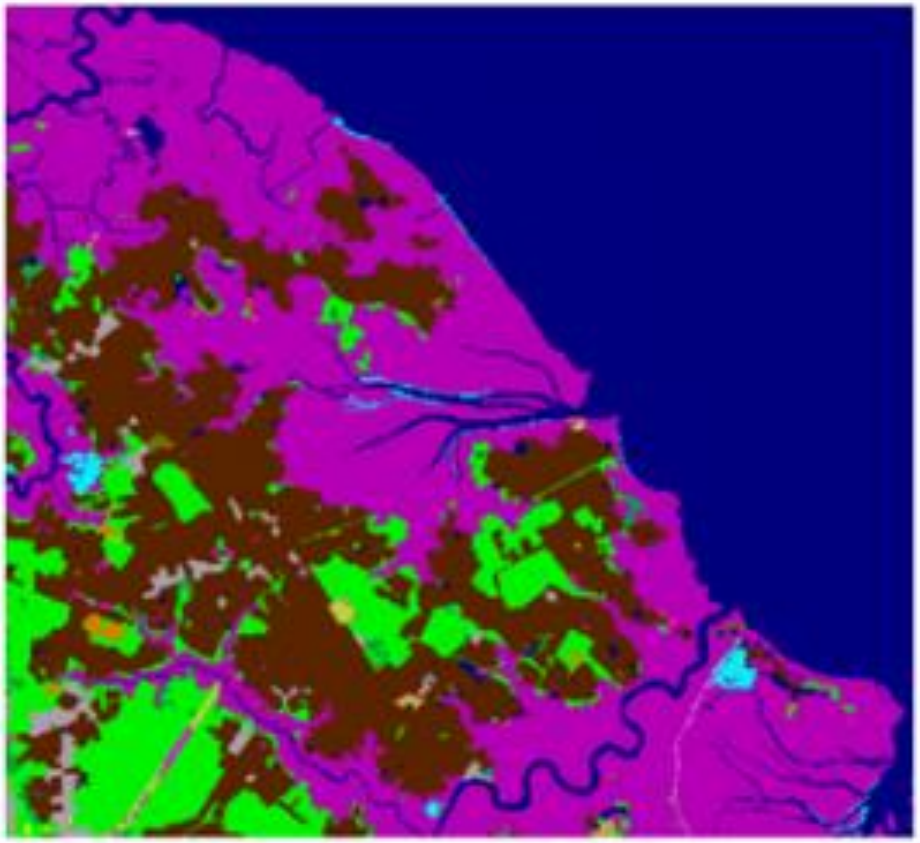
High Resolution (1-5m) C-CAP

C-CAP Minimum Mapping Unit



30 meter Land Cover
0.25 to 1 acre MMU

Resolution ≠ Accuracy

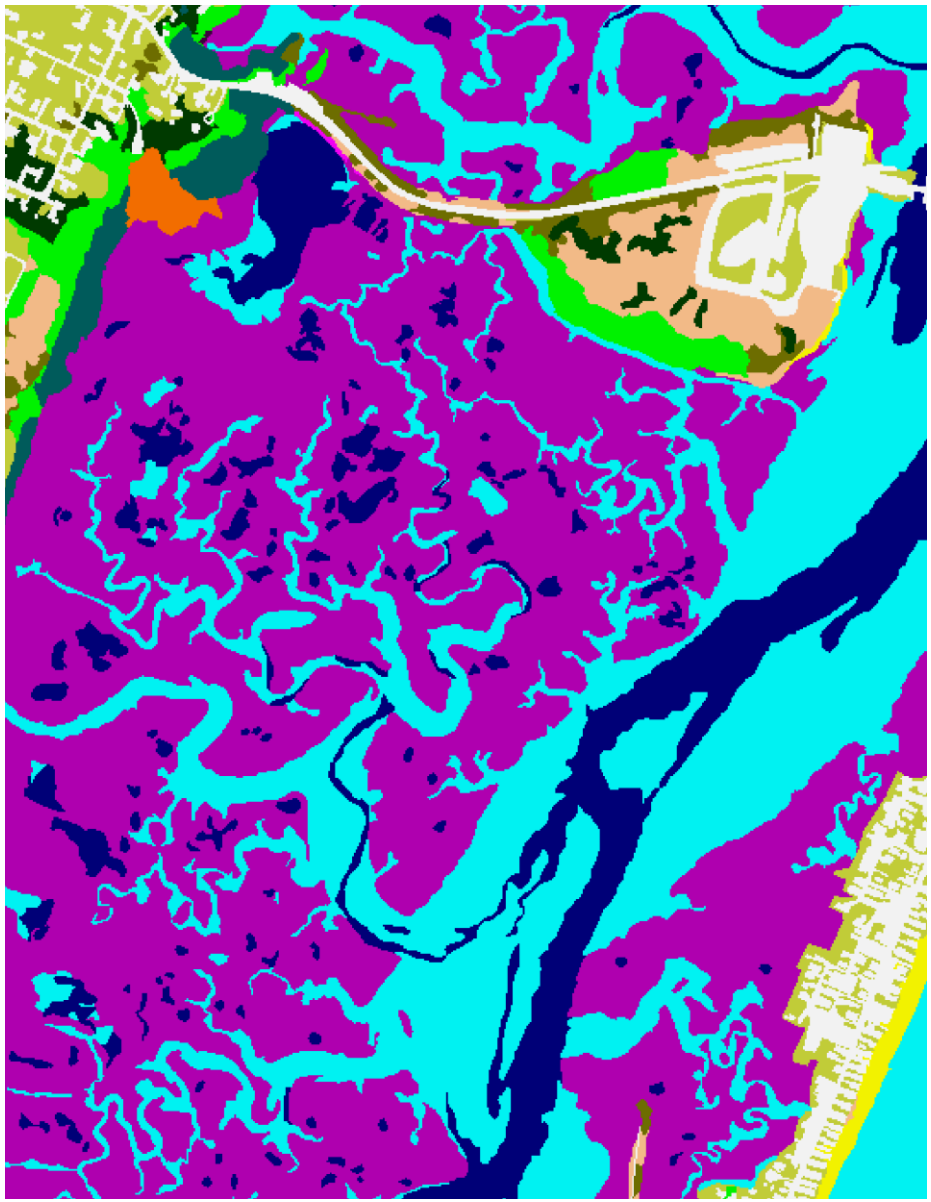


0.25 meter Land Cover
0.25 acre MMU

Resolution = Spatial Detail

High Resolution C-CAP

2012 Ortho Imagery



Land Cover based on Segments

Resolution ≠ Accuracy

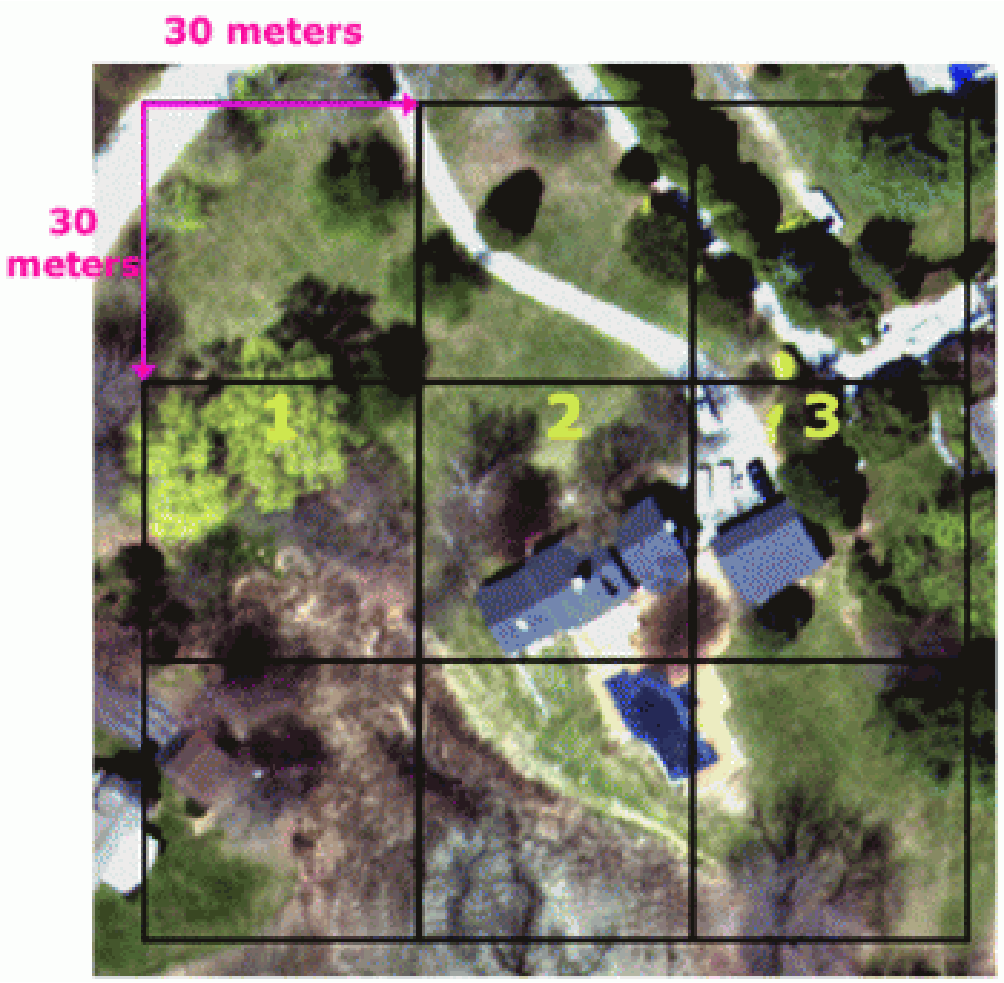


Image source: University of Connecticut Center for Land Use Education and Research, n.d. Web. July 12, 2011

- 30 meter pixels can be a mix of land covers
- A single land cover cannot capture all details of these "mixed pixels"
- The 30-meter classification captures the majority (or best class based on rules)
- Not necessarily wrong
- But maybe not detailed enough for your needs

Classification Scheme Examples

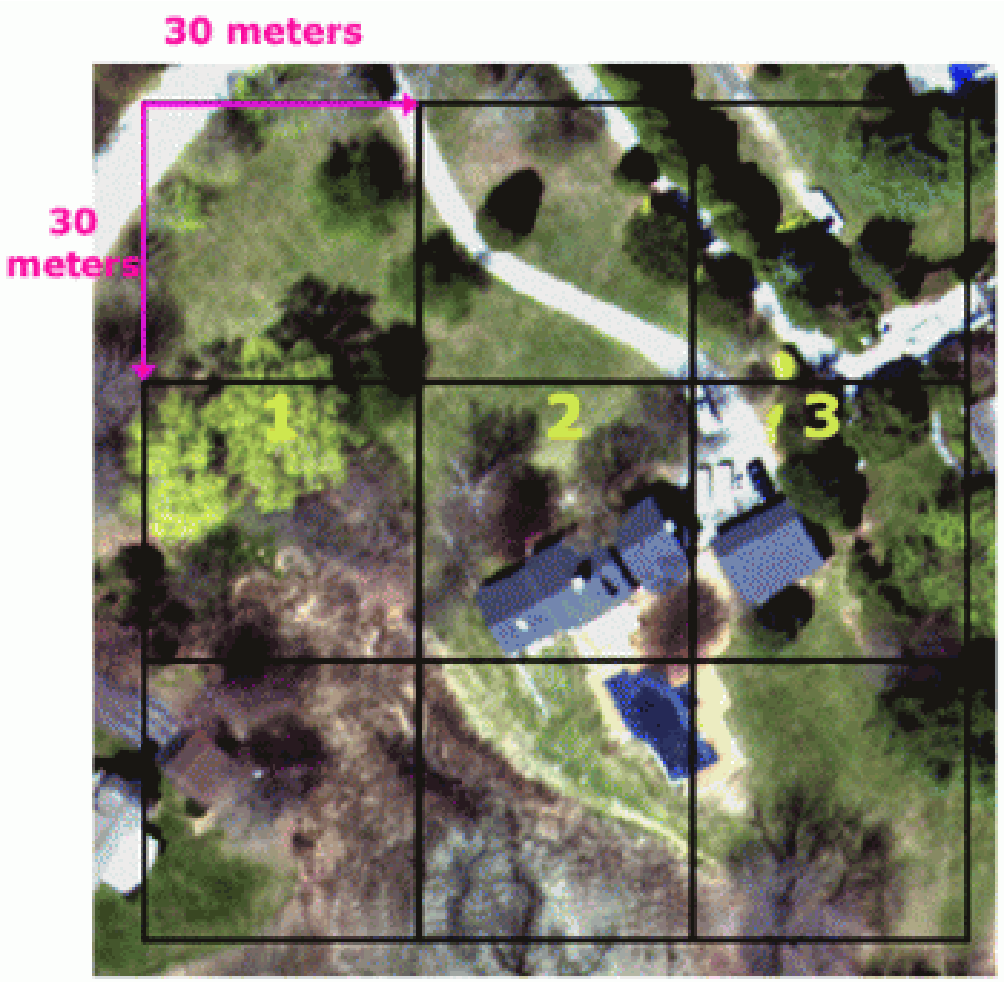


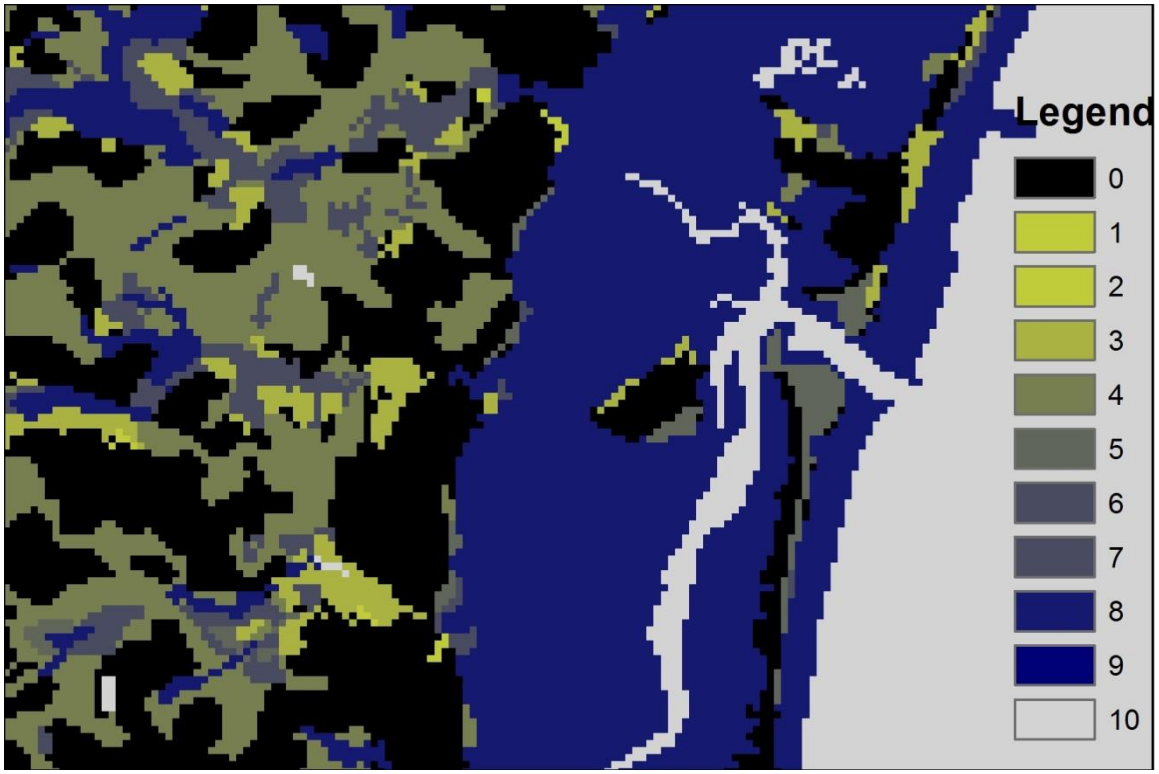
Image source: University of Connecticut Center for Land Use Education and Research, n.d. Web. 12 Jul 2011.

- Forest versus forest types
- Deciduous versus evergreen
- Forest species

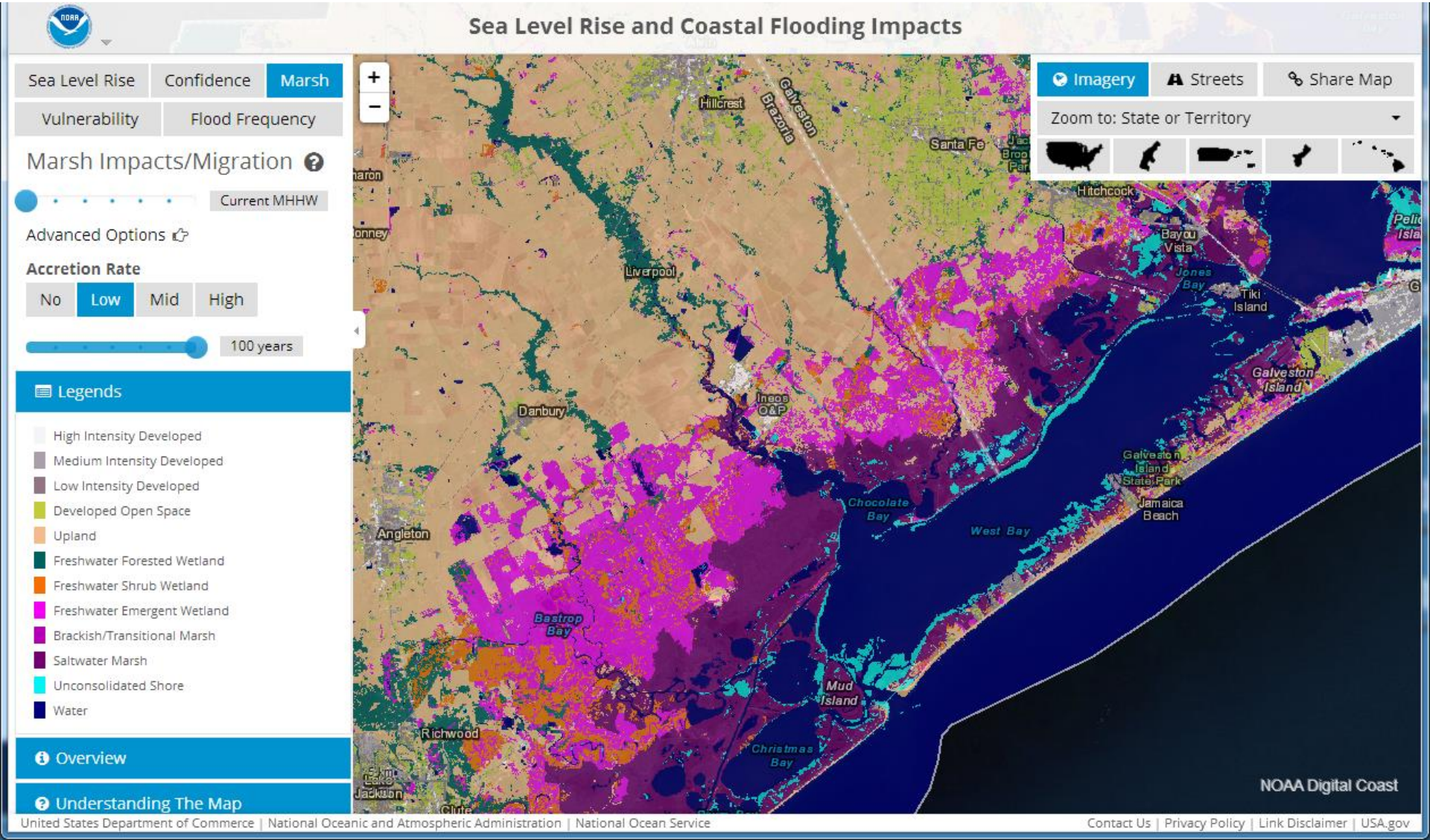
- Developed areas versus developed features

- Wetlands versus uplands
- Wetland types

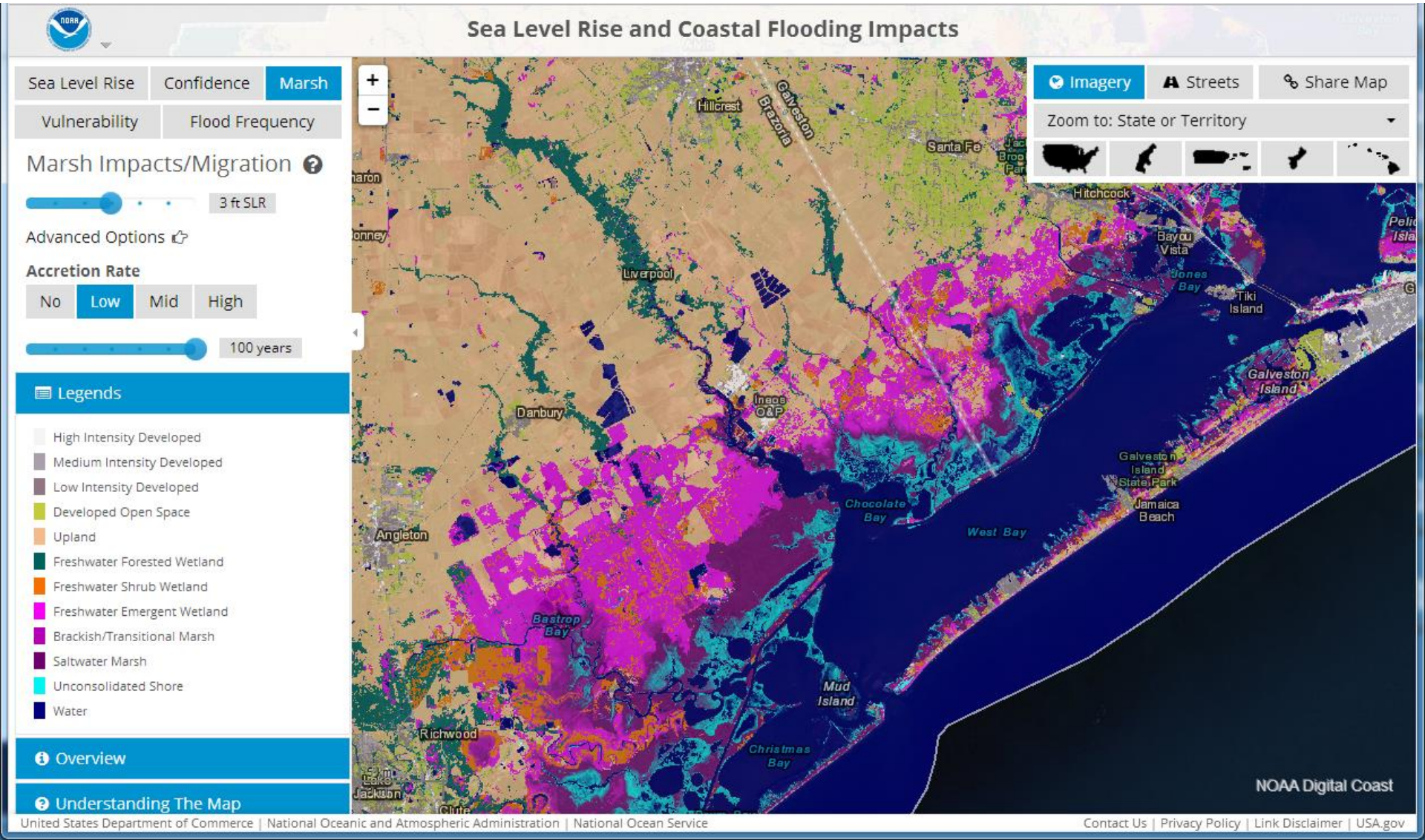
Wetland Potential



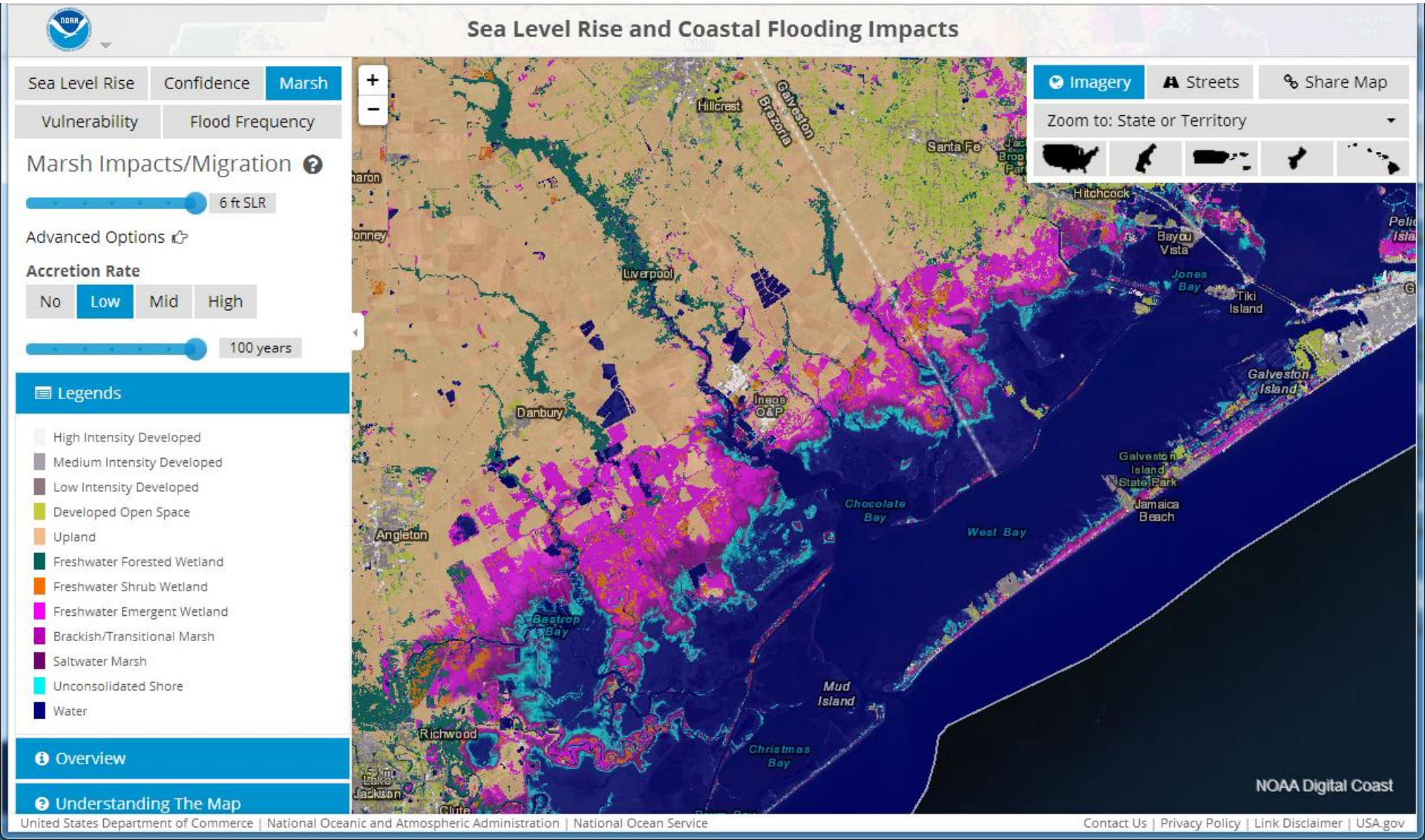
Sea Level Rise and Coastal Flooding Impacts Viewer



Sea Level Rise and Coastal Flooding Impacts Viewer

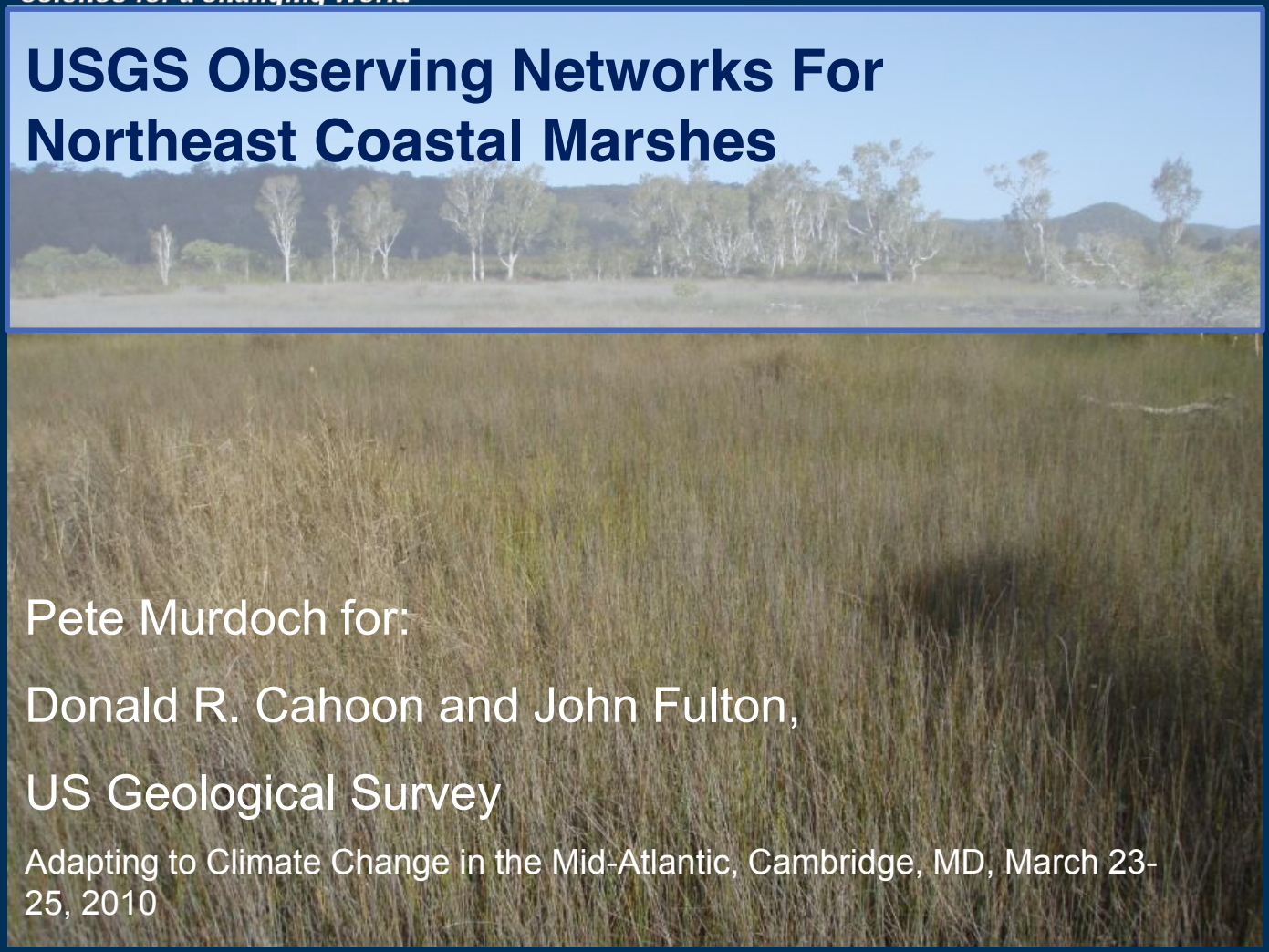


Sea Level Rise and Coastal Flooding Impacts Viewer



USGS
science for a changing world

USGS Observing Networks For Northeast Coastal Marshes



Pete Murdoch for:

Donald R. Cahoon and John Fulton,

US Geological Survey

Adapting to Climate Change in the Mid-Atlantic, Cambridge, MD, March 23-25, 2010

Coastal Wetlands & Sea-Level Rise

Tidal marsh survival depends on a balance between the forces leading to their creation (mineral and organic sediment accumulation) and the forces leading to their deterioration (sea-level rise, subsidence and wave erosion).

The critical factor controlling wetland sustainability is the rate of vertical development compared to the local relative sea-level rise rate.

Relative sea-level rise is the combination of the change in sea level and the change in land level.

USGS

Wetland Vertical Development

Surface Elevation Table (SET) network

Plant matter accumulation in the soil
[< 10 % to > 90 %]
(root production:decomposition)

Coastal Vulnerability and Wetlands Impact Assessment: Climate Change Forecasting and Coastal Planning

PWRC: Don Cahoon (with Grace, Guntenspergen, Stagg)

- Analysis and integration of Surface Elevation Table (SET) network data
- Fine-scale sediment changes that may impact wetland vegetation stability

USGS

Coastal Vulnerability and Wetlands Impact Assessment: Climate Change Forecasting and Coastal Planning

NWRC: Jim Grace and Camille Stagg (with Cahoon, Guntenspergen)

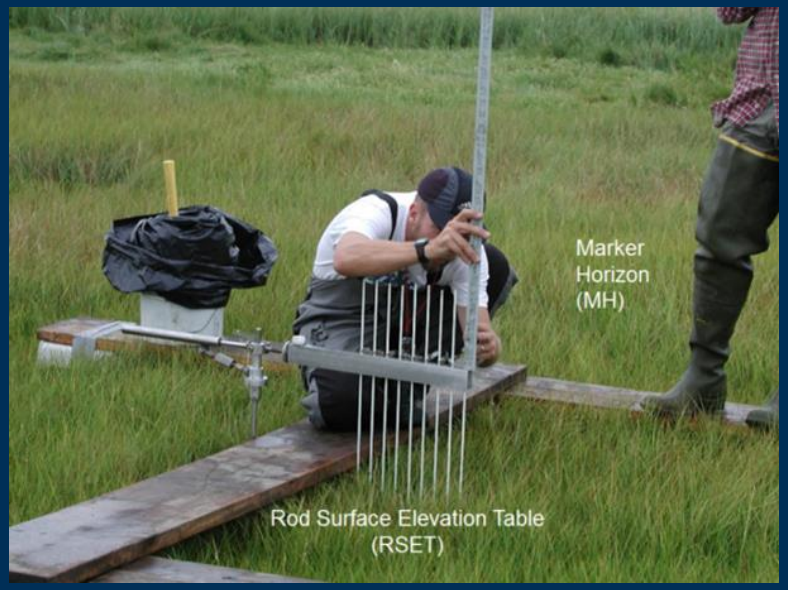
- Process small-scale sediment core collection in association with SET network
- Provide interpretation and analyses of storm sediment deposits
- Apply Submergence Vulnerability Index (SVI)

USGS

Coastal Vulnerability and Wetlands Impact Assessment: Climate Change Forecasting and Coastal Planning

PWRC: Don Cahoon (with Grace, Guntenspergen, Stagg)

- Expand SET network with more monitoring stations to assess long-term vulnerability and develop strategies to increase resilience of coastal wetlands

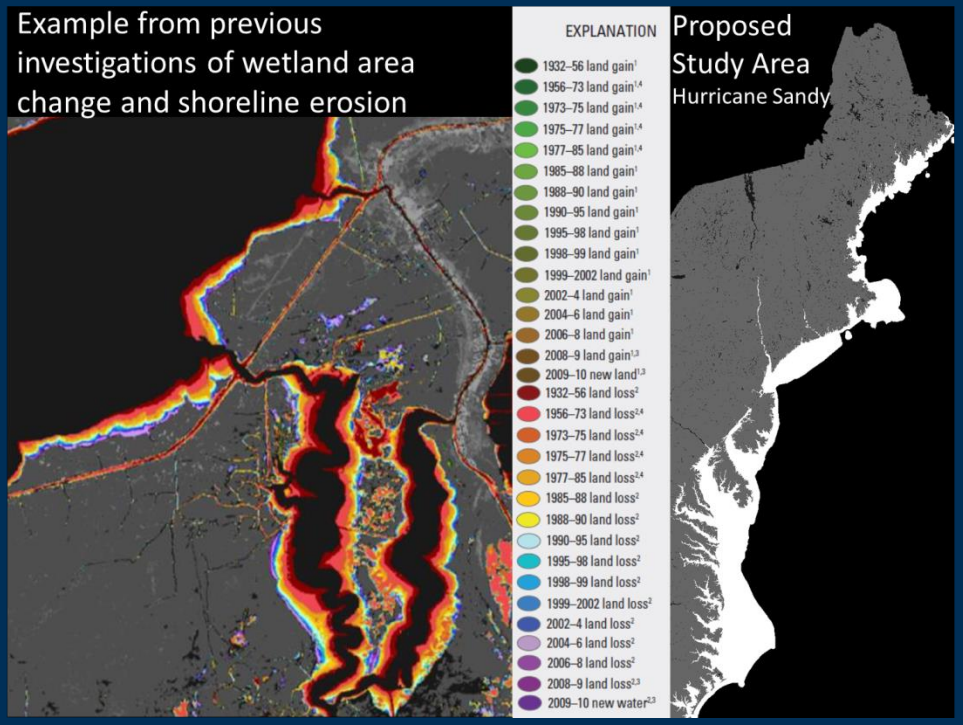


USGS

Assessment of Wetland Area Change and Shoreline Erosion

NWRC: Brady Couvillion

- Use multiple dates of satellite data to track landscape changes
- Build coastal habitat change maps to focus conservation efforts



USGS

Predicting the Long-term Impact of Hurricane Sandy on Spatial Patterns of Wetland Morphology in Salt Marshes of Jamaica Bay, New York

NWRC: Hongqing Wang (with Cahoon, Snedden, Couvillion, Steyer)

- Develop a high spatial resolution, process-driven hurricane-wetland numerical modeling system (Delft3D model)
- Assess short-term sedimentation and erosion; predict long-term morphologic impact

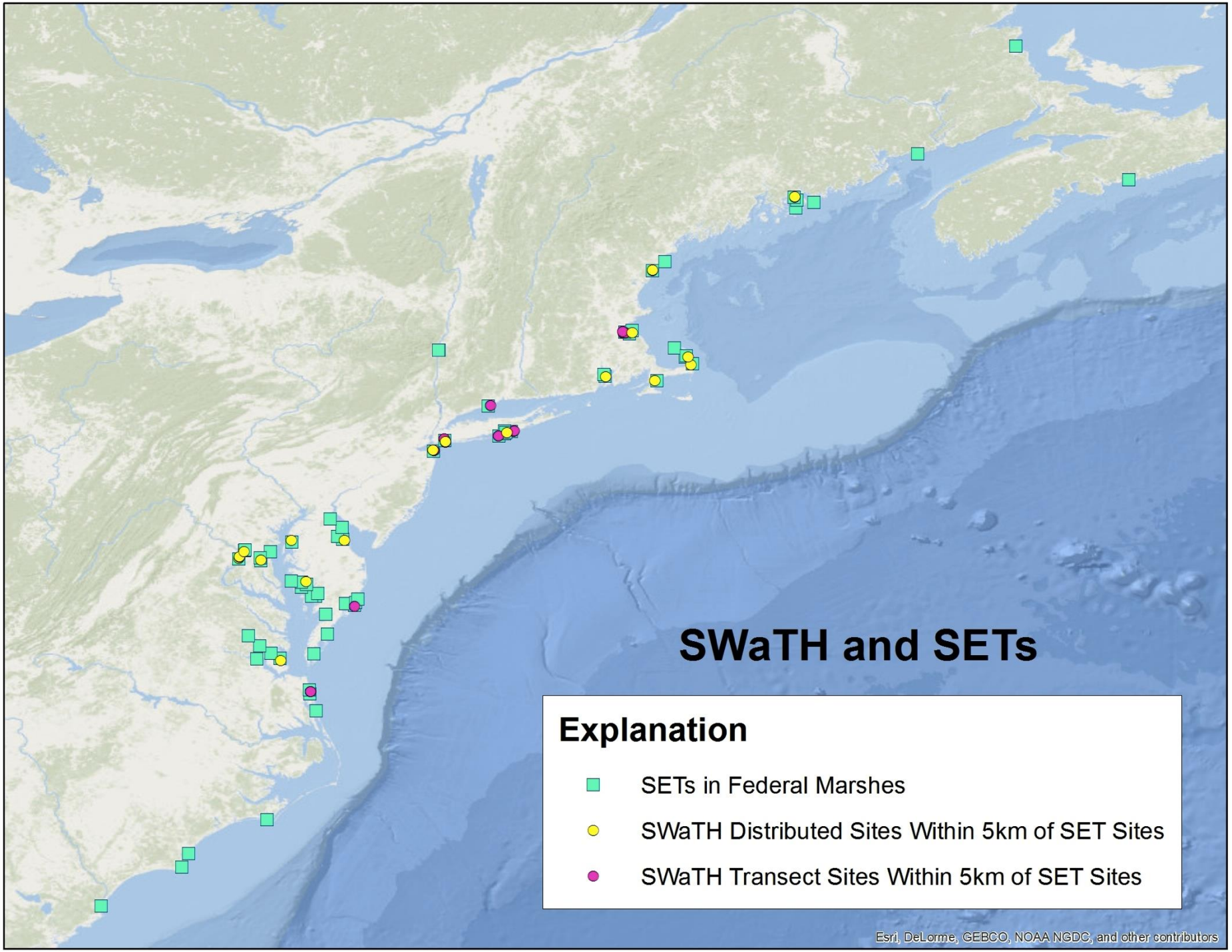
USGS

Modeling Hurricane Sandy Impacts and Storm Surge Protection of Coastal Forest Resources

NWRC: Thomas Doyle

- Assess storm impacts to 30+ Atlantic coast DOI Parks and Refuges from Florida to Maine
- Assist short-term salvage and remediation decisions
- Aid long-term restoration prioritization and ecosystem modeling applications
- Determine resilience and recovery potential of coastal forests

USGS


SWaTH and SETs
Explanation
SETs in Federal Marshes
SWaTH Distributed Sites Within 5km of SET Sites
SWaTH Transect Sites Within 5km of SET Sites
Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors

Issues

- Proximity to tide gages
- More SET stations needed along transects
- More linkages to other measurements (cores, grass mapping, erosion studies, water quality)
- Need better understanding of energy dissipation across marshes for building resilience to future storms.
- Future measurements– who will fund?

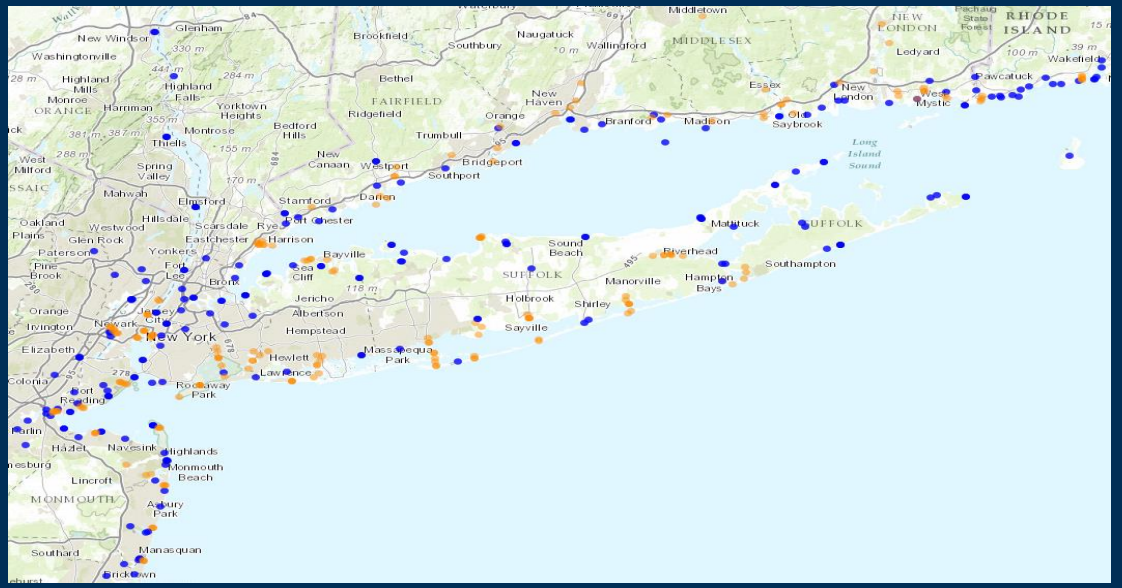
USGS

SWaTH Network

USGS science for a changing world

What is being added?

- Linked data from distributed sensor network and transects of multiple sensors across key landscape features
- Added barometric and weather data to support modeling
- Integrating River discharge, Water quality, and contaminant measurements to detect pollution dispersal and salt-fresh interface
- Provides real-time access to data on a web server

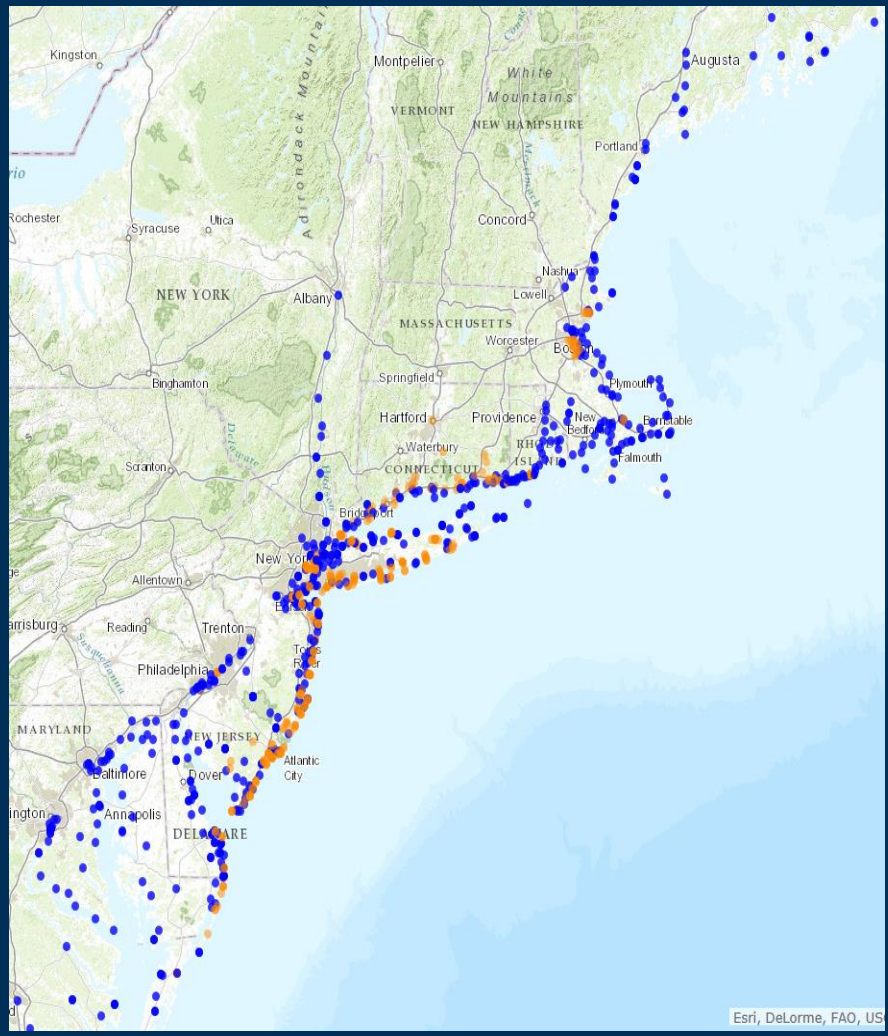


- Distributed (blue points): stations spaced geographically to facilitate monitoring on a regional scale or for high-priority sites.
- Transect (orange points): stations included as part of a wetlands or urban transect (e.g. from open coast to back bays to inland).

Surge, Wave, and Tide Hydrodynamics (SWaTH) Network

USGS science for a changing world

- Entire proposed network will consist of approximately 1,050 sites:
  - 76 non-USGS stations
  - 530 temporary storm-tide sensors
  - 117 coastal stations/tidal streams
  - 85 rapid-deployment gages
  - 32 tide crest stage gages
  - 45 tide gages
  - 112 surveyed reference points
  - 63 temporary barometric-pressure sensors
- Pre-emptive network- brackets pre-installed
- Northeast Coast from North Carolina to Maine
- Nor'easters and tropical storms of varying magnitude
- Data distributed through an online mapper termed the "Short-term Network"

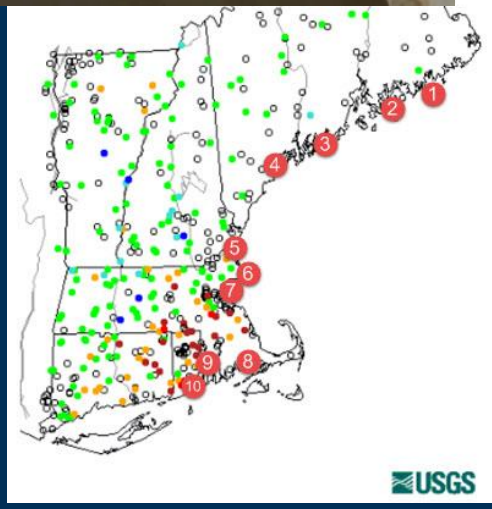


Bracket Designs

- Sites are pre-determined and pre-surveyed, many with installed fixed-place brackets for easy storm deployment
- Data collected at 6-min. averages at coastal stations and RDGs; transmitted by GOES satellite every 15-min or more frequently as needed
- Temporary tide-sensor data collected at 1-Hz intervals (once per second) or greater, and wave sensors at 4-Hz intervals (4 times per second) and downloaded and processed

Rapid Deployment Gage

- RDGs secured to bridges or structures
- Welded aluminum box provides quick and secure deployment of real-time tide stage and meteorological data-collection
- Measures and delivers real-time:
  - Stage
  - Surface-water velocity
  - Discharge
  - Meteorological parameters



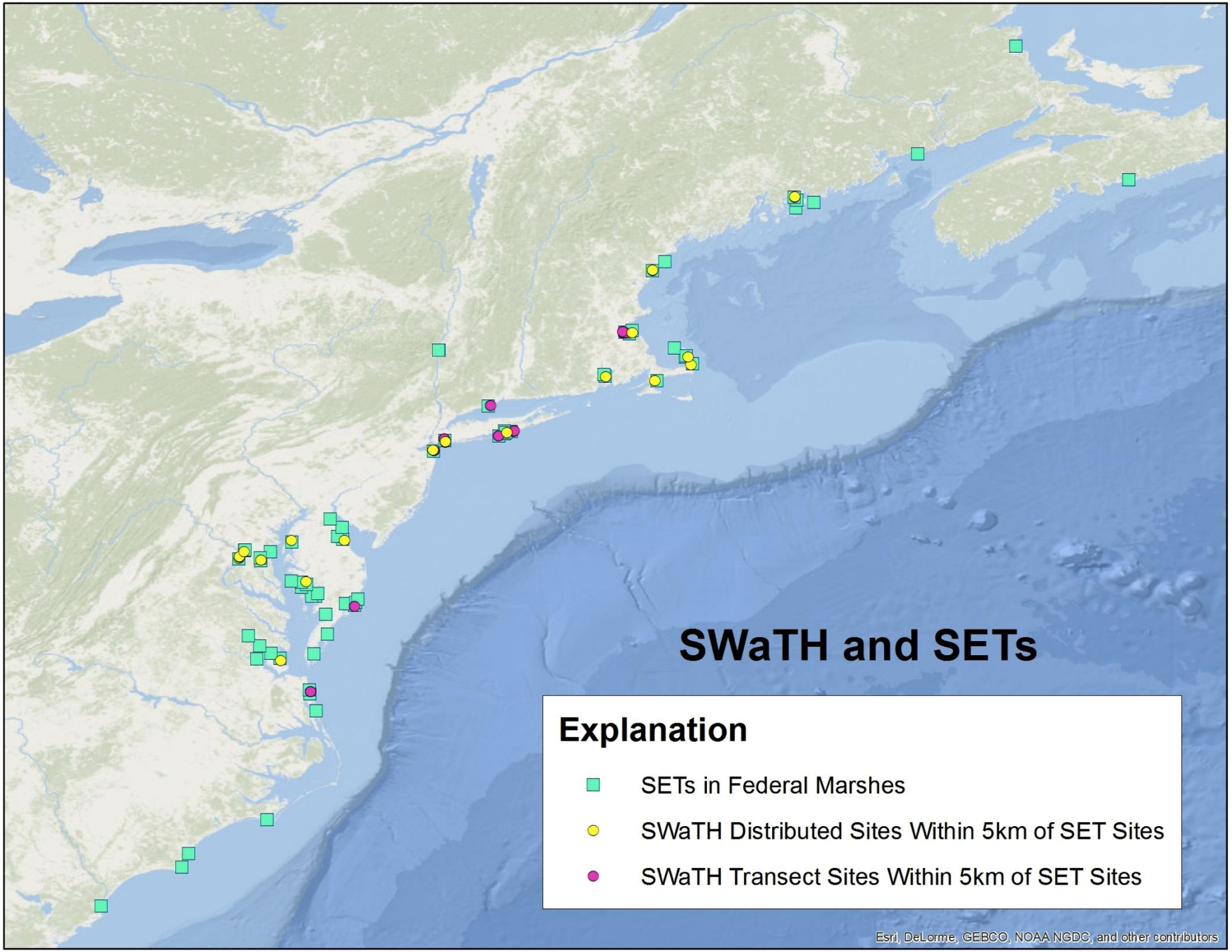
U.S. Department of the Interior
U.S. Geological Survey

Surge Flooding Extent and Persistence and Marsh Dieback within the New Jersey Coastal Zone

NWRC: Amina Rangoonwala (with Enwright, Hartley, Ramsey)

- Construct a series of surge extents from satellite radar images
- Direct spatial association between elevated salinity persistence and marsh dieback
- Identify hotspots of critically damaged marsh

USGS


SWaTH and SETs
Explanation
SETs in Federal Marshes
SWaTH Distributed Sites Within 5km of SET Sites
SWaTH Transect Sites Within 5km of SET Sites
Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors

Issues

- Needs a big storm or two to test the system
- Needs linked water quality measurements
- Adding North Carolina this winter- SE coast not funded
- Future measurements– who will fund beyond 2015?
- Results from Federal Sandy projects need integration, synthesis, and seamless data shared openly

USGS


USGS

1. How do you interpret the data to inform models and planning – calibration/ verification or pre/post.

A: Link accurate tide gage, SET, SWaTH, flow data. Refine models with surge and wave dissipation information across different coastal features

2. How does this type of data play into the uncertainty analysis of models?

A: Goal is to decrease uncertainty of predictive models

3. Is there a type of data you find most critical to accurate model outputs? A: Surge and wave data linked to SET

4. How do you see sea level rise and accretion affecting your data?

A: Surge and wave will rise with the sea levels

USGS

5. If you had a modest set of funds for data collection, how would you spend it?
A: fund monitoring beyond 2015.

6. Where does biological data come into play?
A: Wildlife decline from hydrologic system disturbance; marsh vegetation health related to water quality, quantity, and timing

7. In your opinion, what is the biggest data/parameter interaction that affects models the most?
A: Uncertain

USGS

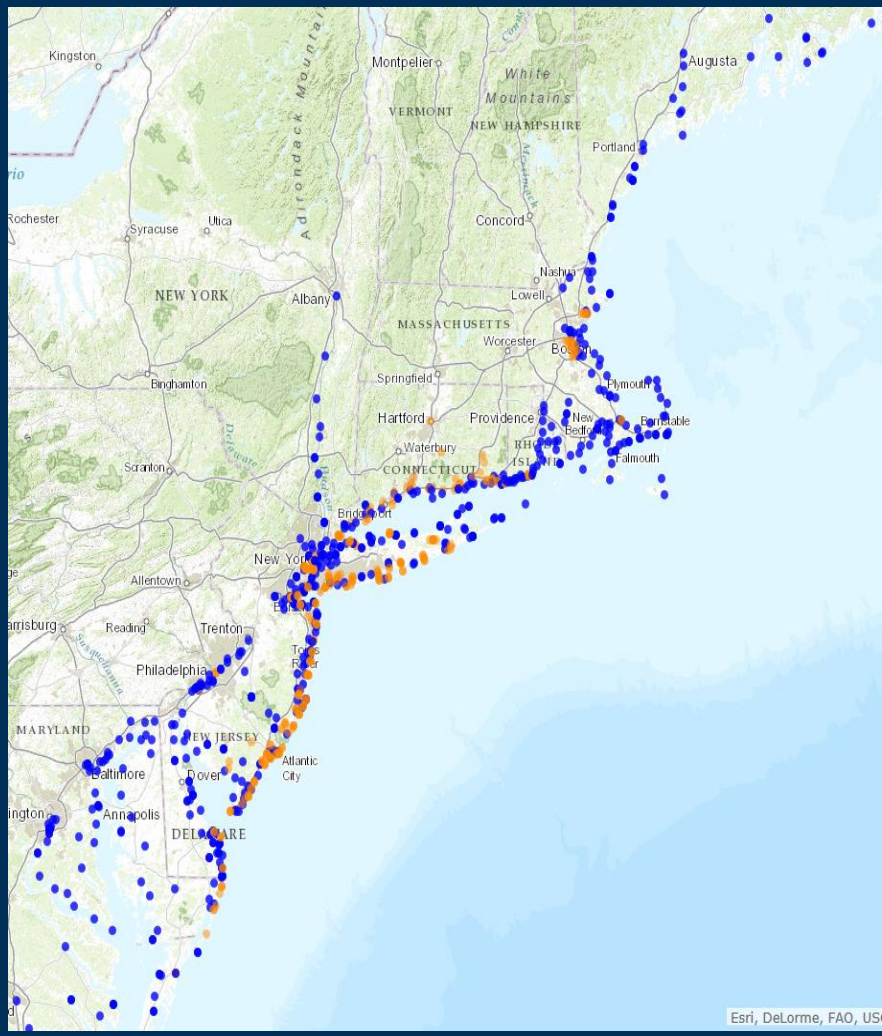
Surge, Wave, and Tide Hydrodynamics (SWaTH) Network

USGS science for a changing world

Why a surge, wave, and tide network?

- Surge and wave dissipation across different landscape features is poorly understood
- Waves are a significant source of damage from erosion or battering of infrastructure
- Current forecasting tools have simplified surge and wave modeling components
- Emergency response and early warning would benefit significantly from more, strategically-placed real-time data

*Rapid deployment is a cost-effective way to fill these information gaps



U.S. Department of the Interior
U.S. Geological Survey

Defining Long-term Consequences and Management Responses to Coastal Wetlands and Lagoons

NWRC: Elijah Ramsey III and Beth Middleton

- Apply fused ground-based and optical and radar remote sensing methods to identify and track coastal forest, marsh, and lagoon response to storm impacts
- New Jersey coastal marshes; southern Delmarva

Canopy photos of tree damage
Cat Island NWR – No Hurricane

Jean Lafitte NP – Hurricane Impacted

USGS

USGS
science for a changing world

Hurricane Sandy Theme 5 Ecosystems Projects

Matthew E. Andersen

June 18, 2013

U.S. Department of the Interior
U.S. Geological Survey

Analysis of Marine and Estuarine Wetlands, Deep-water Habitats, and Buffer Zones for the New Jersey Shore and Raritan Bay

NWRC: Bill Jones and Irene Huber

- Build maps of wetland vegetation species changes along Atlantic coastline
- National Wetlands Inventory classification standard
- USGS Anderson Land Use/Land Cover system
- Includes Cape May, Brigantine, and Forsythe National Wildlife Refuges

USGS

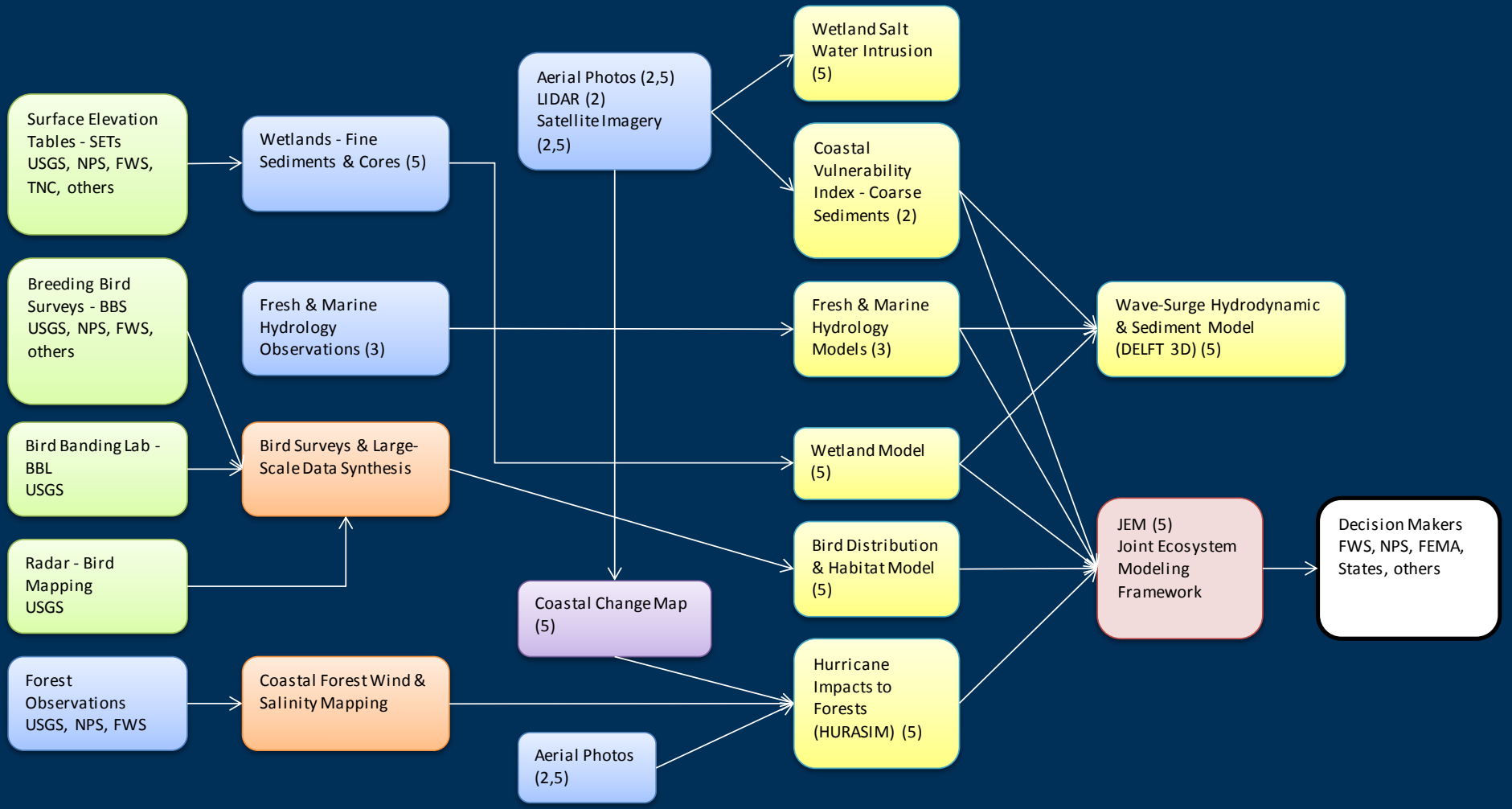
Joint Ecosystem Modeling (JEM): Decision Support for Ecological Recovery and Resilience

NWRC: Craig Conzelmann (with SBSC, PWRC)

- Support decision-making for a sustainable ecosystem
- Cultivate network of regional science partners
- Assess needs; identify and gather relevant ecological data
- Compile inventory of existing ecological models, data standards, visualization and analysis tools, and decision support tools
- Refine existing models and tools; develop new ones

USGS

Integrated Science in Response to Sandy



USGS

KEY: DATA | OBSERVATION | SURVEY | MAP | MODEL | DECISION SUPPORT

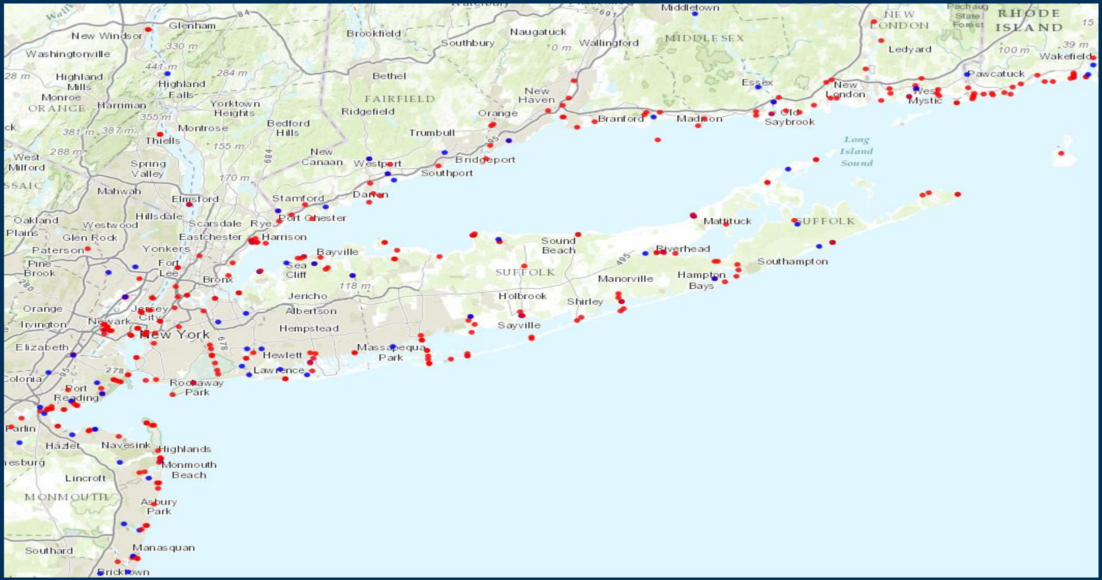
(#) USGS Science Themes

science for a changing world

SWaTH Network

What is being added?

- Linkage of long-term and rapid deployment sensors for tide and surge
- Added real-time sensors for early-warning
- Sensors measuring 4X per second to detect wave forces



- Long Term (blue points): station such as a continuous-record coastal-monitoring station or tidal streamgage.
- Temporary (red points): storm-deployed gage such as an RDG, or storm-tide, wave-height, or barometric-pressure sensor.