Welcome to the Md De DC USGS Water Science Center

John Brakebill

- USGS Activities and Responses to Coastal Flooding
  - *Jon Dillow, Ed Doheny, Michael Geissel, Mark Nardi, and many others*

- LIDAR applications
  - *Peter Claggett, Sam Lamont, Silvia Terziotti*

- Water-Quality models of Nitrogen and Phosphorus and Sediment *(Scott Ator, John Brakebill, Andrew Sekellick, Joel Blomquist)*

FLOODS OF AUGUST AND SEPTEMBER 2011
MD-DE-DC

August 14, 2011—Thunderstorms in Baltimore–DC region produced 3--3.5 inches of rain in 3 hours in some areas.

August 27-28, 2011—Hurricane Irene, 6--12 inches of rain in Southern Maryland and areas of the Eastern Shore and Delaware.

September 5-9, 2011--Tropical Storm Lee, up to 15 inches of rain in some areas, mostly west of the Bay. Some of the hardest hit areas included Montgomery, Howard, Carroll, Anne Arundel, Baltimore County, and areas of Southern Maryland.

October, 2012 Hurricane Sandy

- Spring high tide on the New Jersey coastline, delivering hurricane-force winds, storm tides exceeding 19 feet, driving rain, and plummeting temperatures.

- Hurricane Sandy resulted in 72 direct fatalities in the mid-Atlantic and northeastern United States, and widespread and substantial physical, environmental, ecological, social, and economic impacts estimated at near $50 billion.

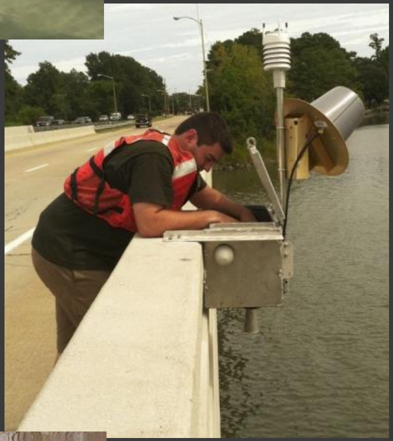
Coastal Resiliency and Response to Coastal Flooding

- USGS Strategy outlines five themes based on impact types and information needs.
  - Coastal topography and bathymetry
  - Impacts to coastal beaches and barriers
  - **Impacts of storm surge and estuarine and bay hydrology**
  - Impacts on environmental quality and persisting contaminant exposures
  - Impacts to coastal ecosystems, habitats, and fish and wildlife.
- The data, information, and tools that are produced by implementing this plan will:
  - Further characterize impacts and changes
  - Guide mitigation and restoration of impacted communities and ecosystems
  - Inform a redevelopment strategy aimed at developing resilient coastal communities and ecosystems
  - Improve preparedness and responsiveness to the next hurricane or similar coastal disaster
  - Enable improved hazard assessment, response, and recovery for future storms along the hurricane prone shoreline of the United States.

USGS Storm Tide Response
Short Term Networks

- Deploy sensors in the temporary monitoring network (designed to augment USGS permanent network)
  - Rapid Deployment Gages
  - Storm tide
  - Wave height
  - Barometric pressure
- Collect post-event high water marks
- Works for inland too!

Storm-Tide Sensor

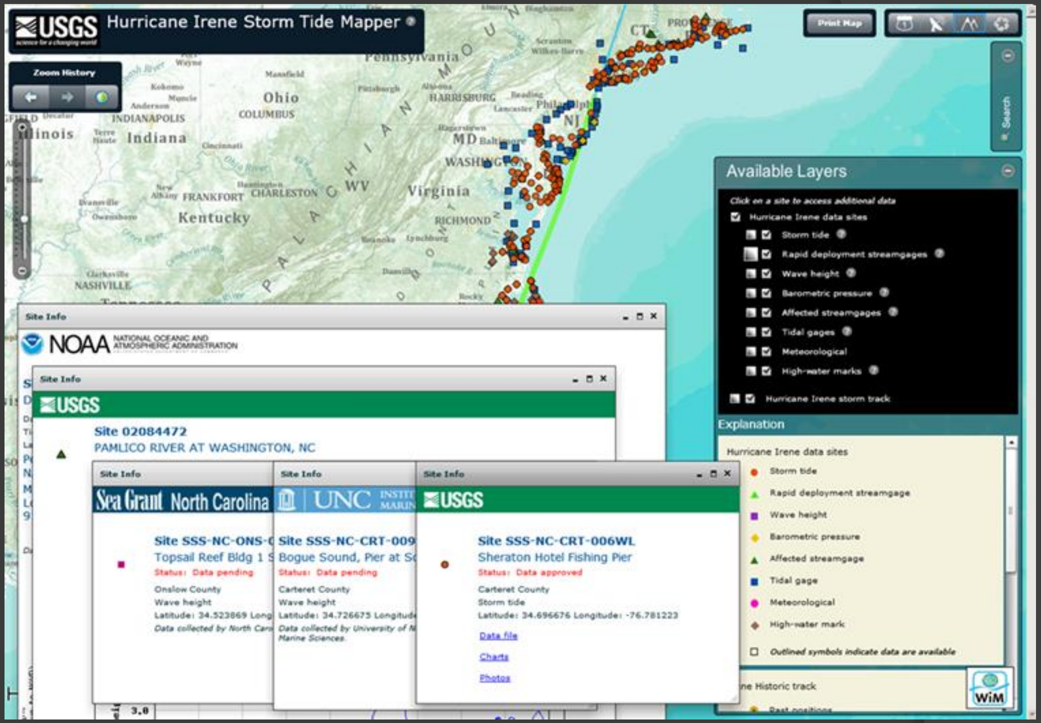


Rapid Deployment Real-Time Water Level Gage

High-Water Mark

Using a Mapper to Communicate data

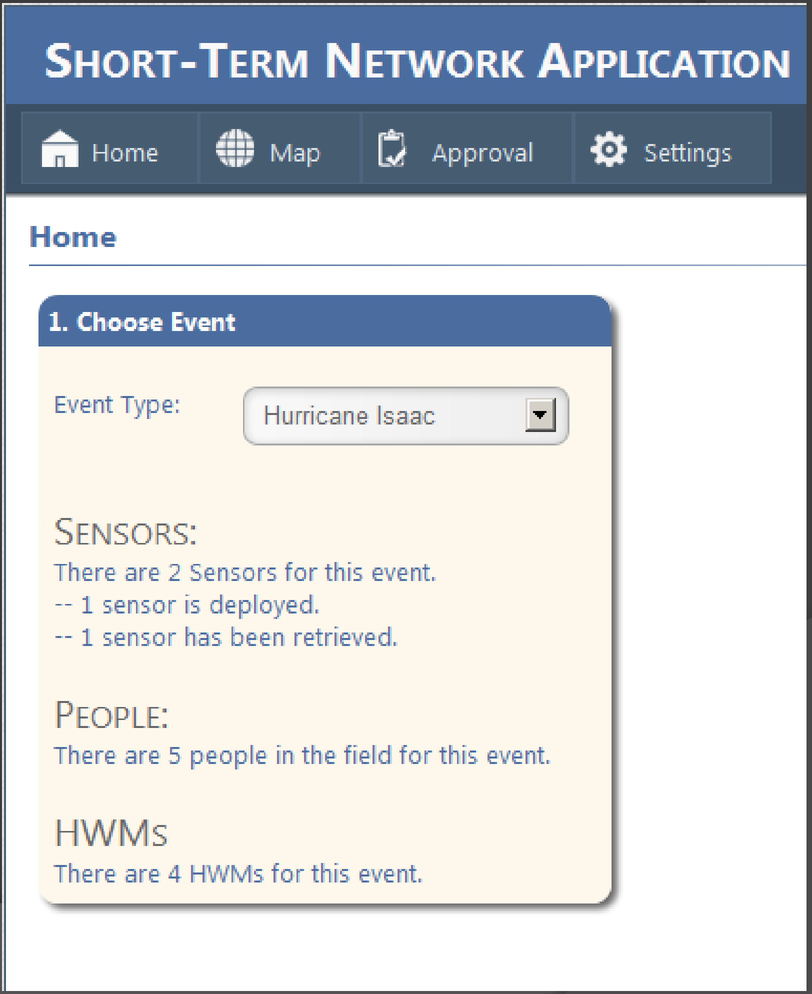
- Before storm
  - Locate sensor networks
  - Plan with cooperators
- During storm
  - Monitor real-time gaging locations
- After storm
  - Coordinate and communicate retrieval process and HWMs
  - Coordinate data processing and approval
  - Data dissemination



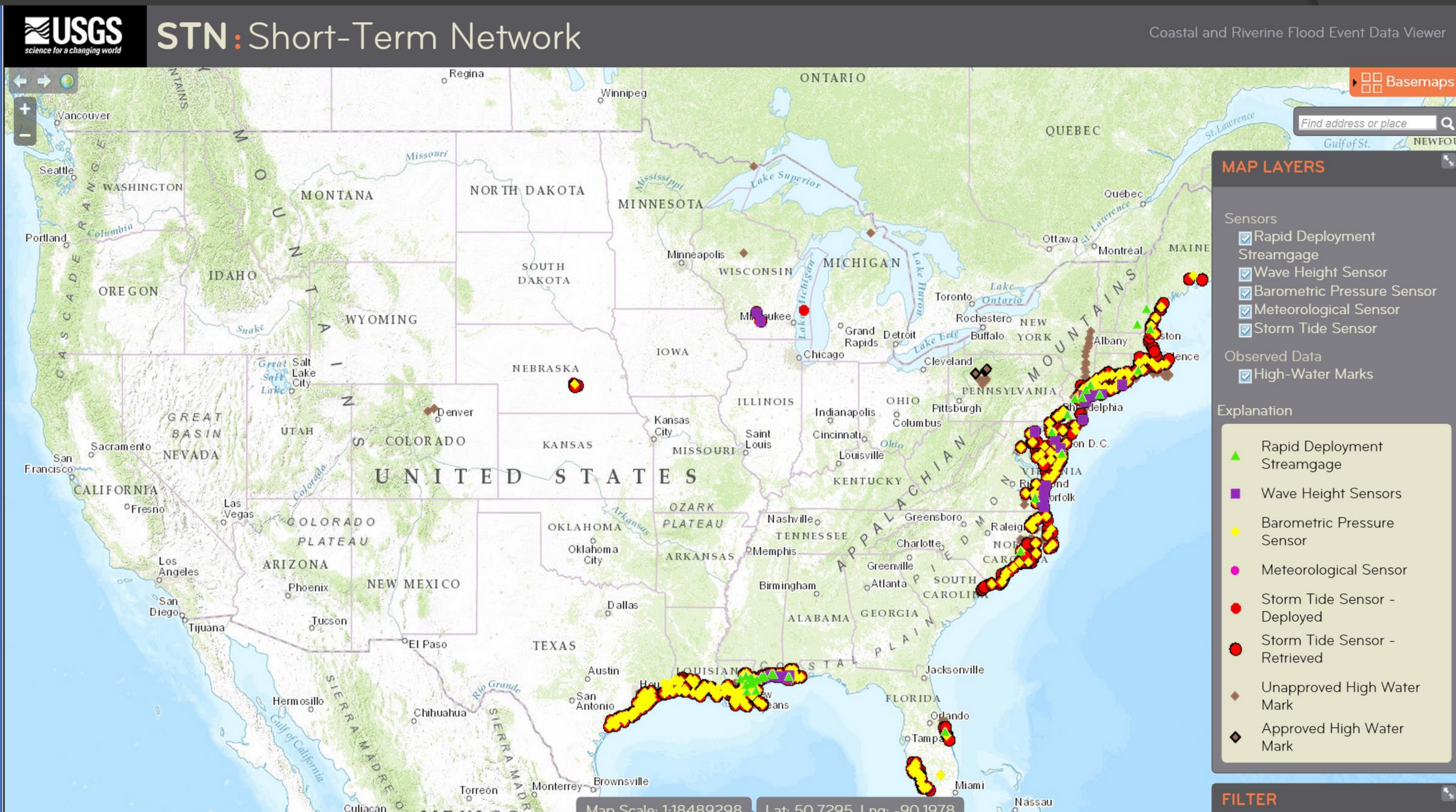
- Will include partner data
  - NOAA/NWS
  - FEMA
  - State

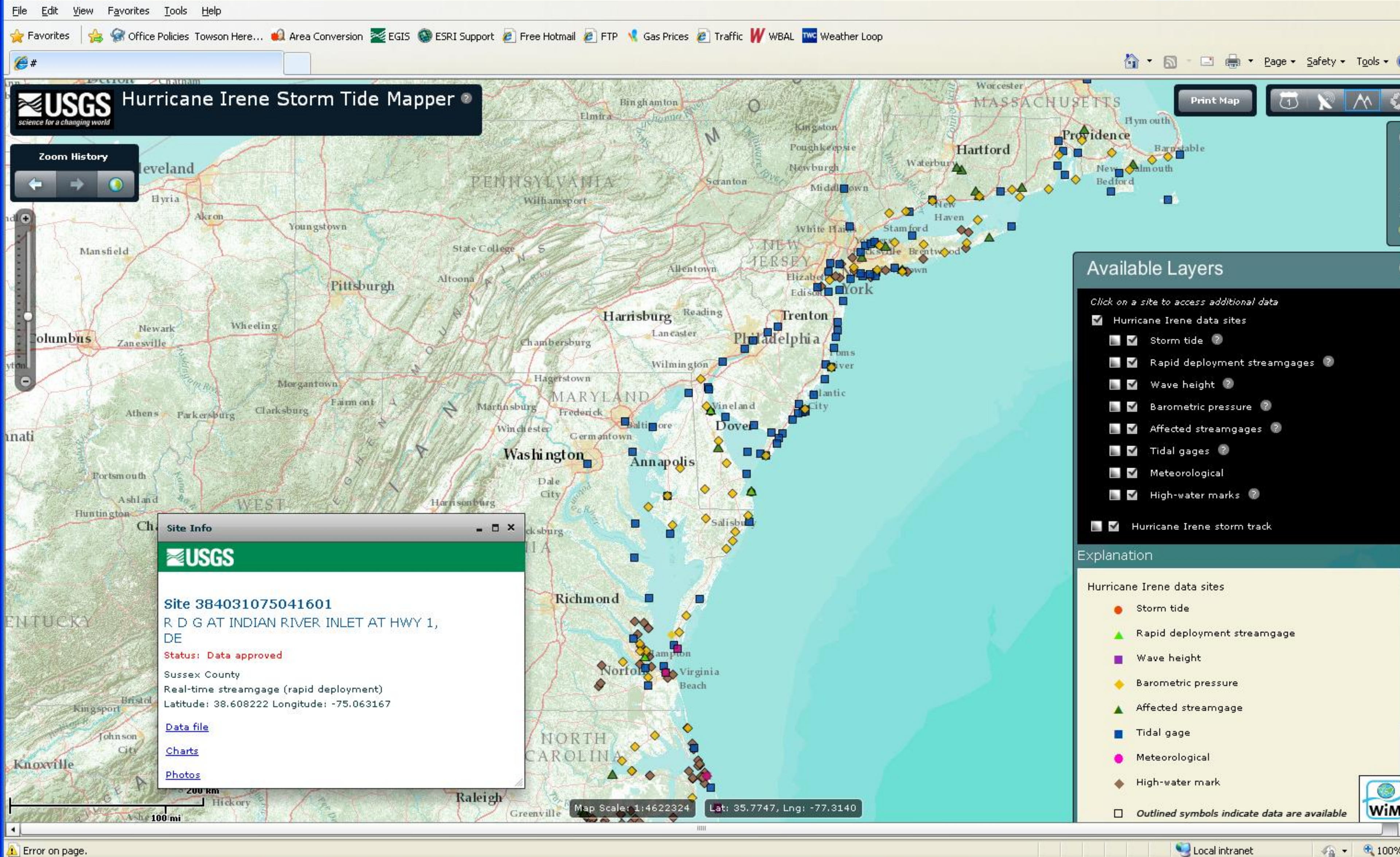
Short-Term Network Application

- Streamlines data planning, collection, approval and delivery
  - Field Tools
    - Forms
    - Mapper
    - Automatic location
    - Automatic naming
  - Manager Tools
    - Approval dashboard
    - Mapper
  - Public Mapper and web services

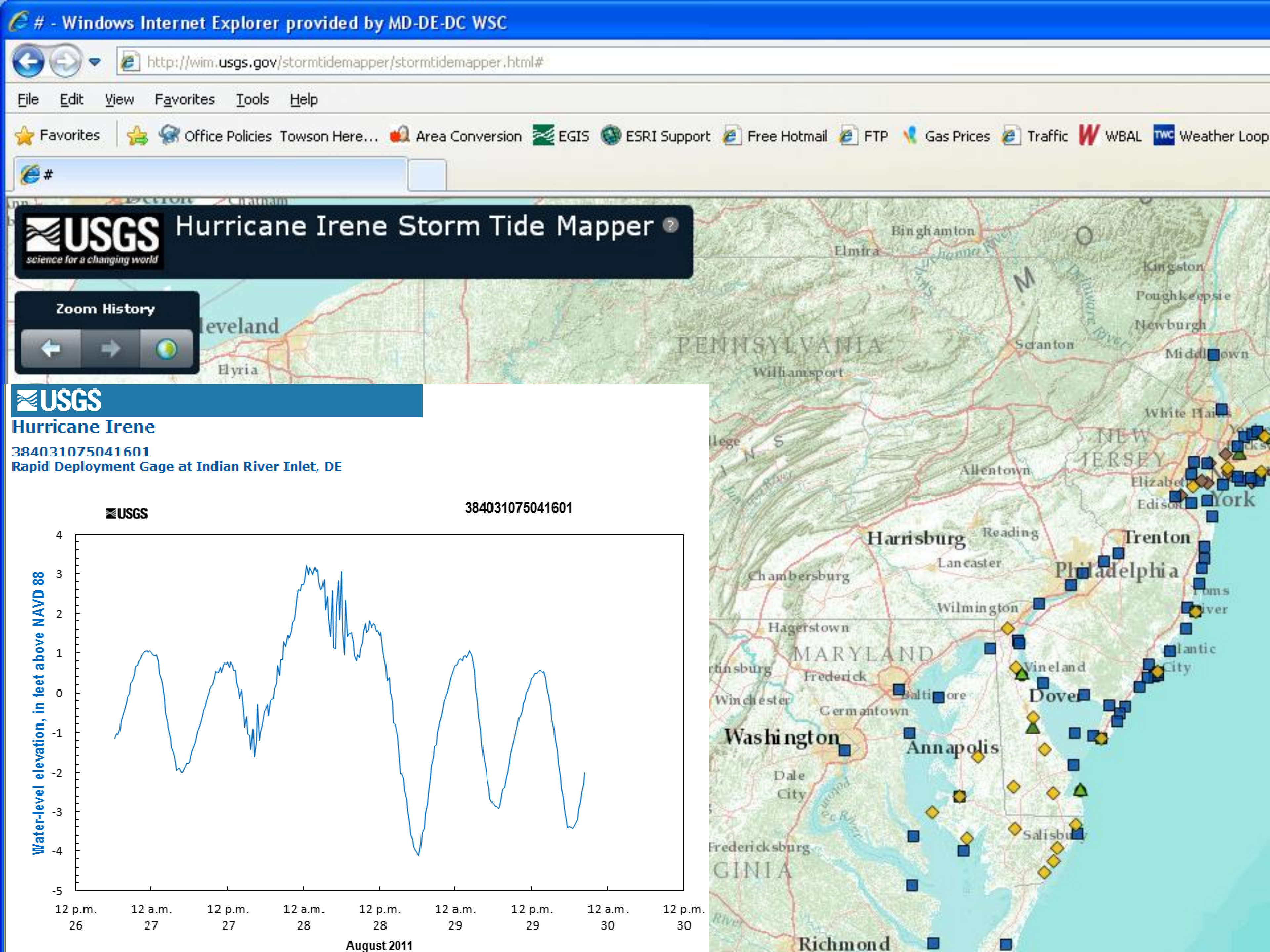


A national network collecting additional data, supplementing long-term networks. Mapping and gaining a better understanding of coastal events.





- Interactive viewer was created so users can go in and identify where data was collected throughout the event

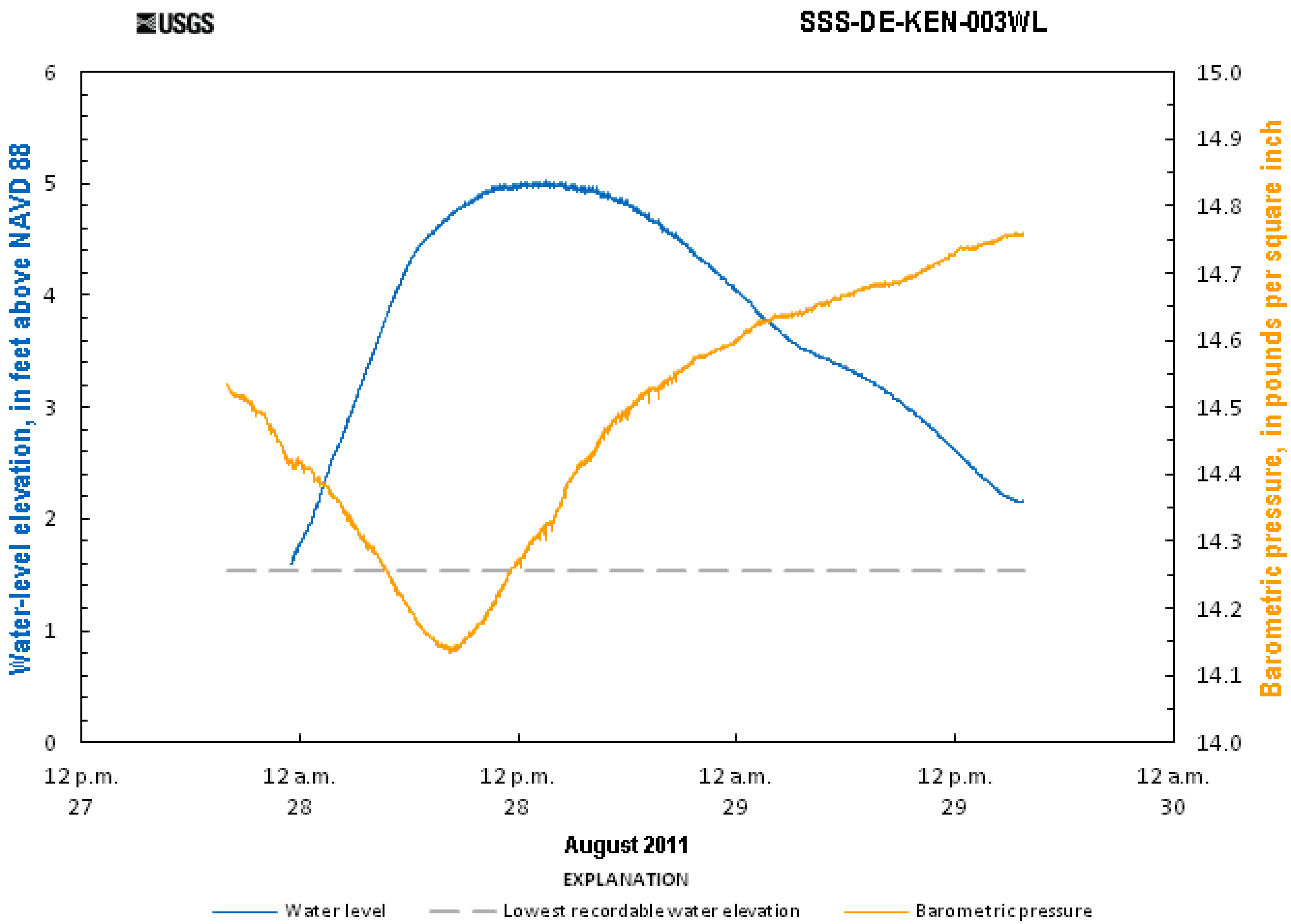


- Windows Internet Explorer provided by MD-DE-DC WSC
http://wim.usgs.gov/stormtidemapper/stormtidemapper.html#
File Edit View Favorites Tools Help
Favorites Office Policies Towson Here... Area Conversion EGIS ESRI Support Free Hotmail FTP Gas Prices Traffic WBAL Weather Loop
USGS science for a changing world
Hurricane Irene Storm Tide Mapper
Zoom History
USGS
Hurricane Irene
384031075041601
Rapid Deployment Gage at Indian River Inlet, DE
USGS
384031075041601
Water-level elevation, in feet above NAVD 88
4
3
2
1
0
-1
-2
-3
-4
-5
12 p.m. 26
12 a.m. 27
12 p.m. 27
12 a.m. 28
12 p.m. 28
12 a.m. 29
12 p.m. 29
12 a.m. 30
12 p.m. 30
August 2011
Cleveland
Elyria
PENNSYLVANIA
Williamsport
Binghamton
Elmira
Scranton
Kingston
Poughkeepsie
Newburgh
Middletown
White Plains
NEW JERSEY
Allentown
Elizabeth
Edison
York
Harrisburg
Reading
Lancaster
Trenton
Chambersburg
Philadelphia
Toms River
Wilmington
Hagerstown
MARYLAND
Frederick
Vineland
Atlantic City
Winchester
Baltimore
Germantown
Dover
Washington
Annapolis
Dale City
Salisbury
Fredericksburg
Richmond

USGS

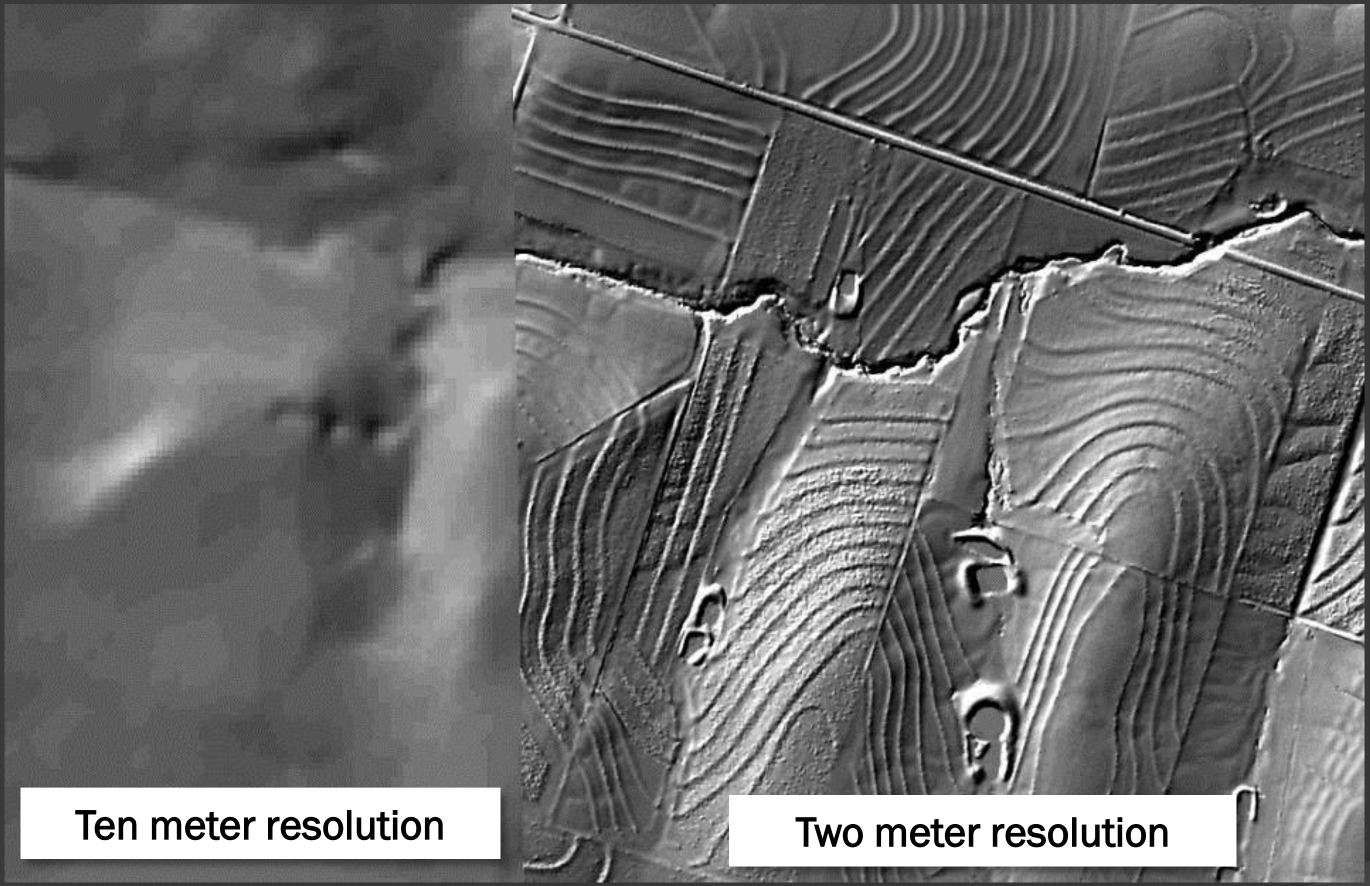
Hurricane Irene

SSS-DE-KEN-003WL
Murderkill River at Carpenter Bridge Rd



Lidar Improves Data Quality

(basic assumption)



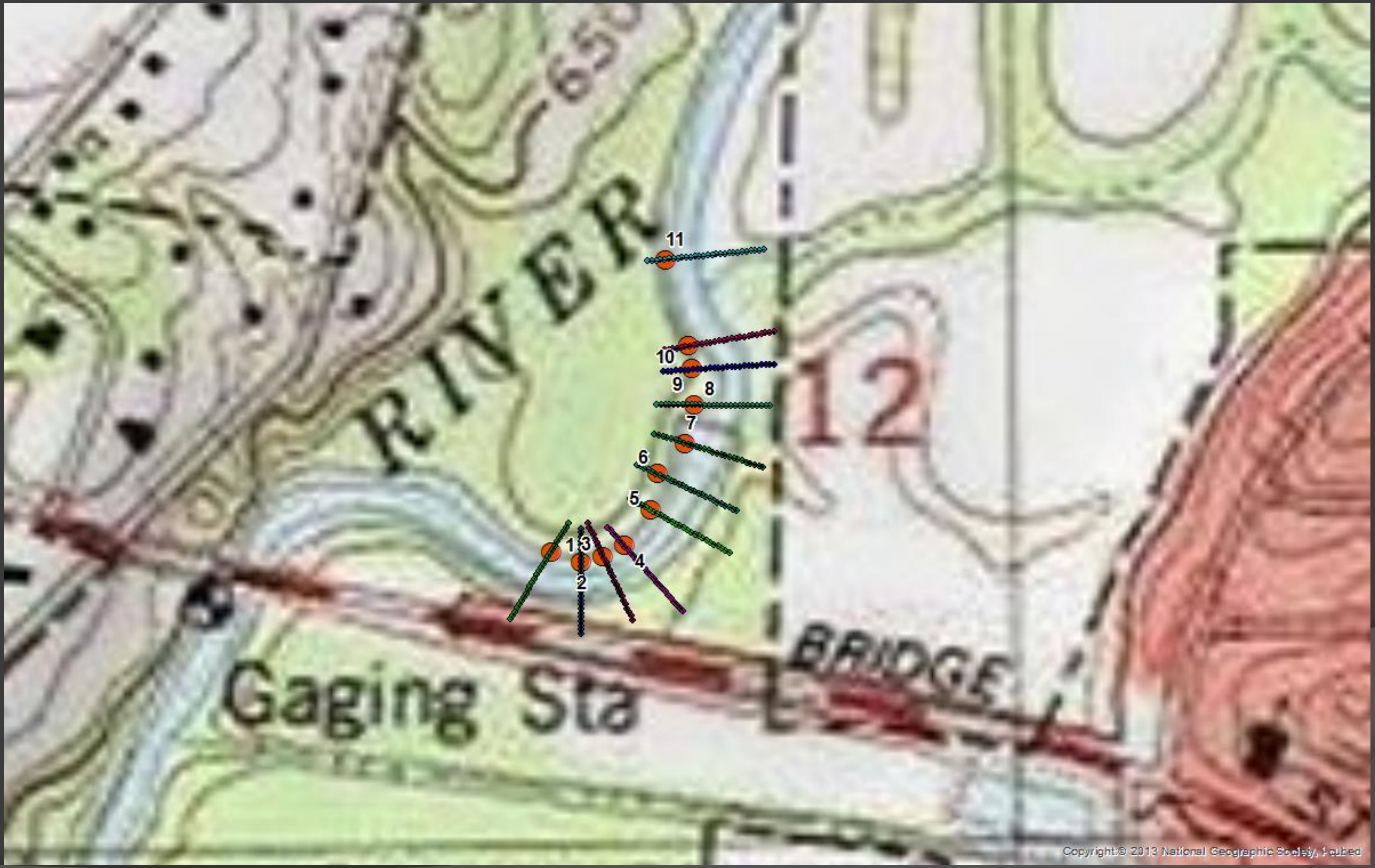
Courtesy of NRCS

10 meter elevation is available Nationwide
3 meter to sub-meter is becoming more widely available

Using lidar for geomorphic analysis

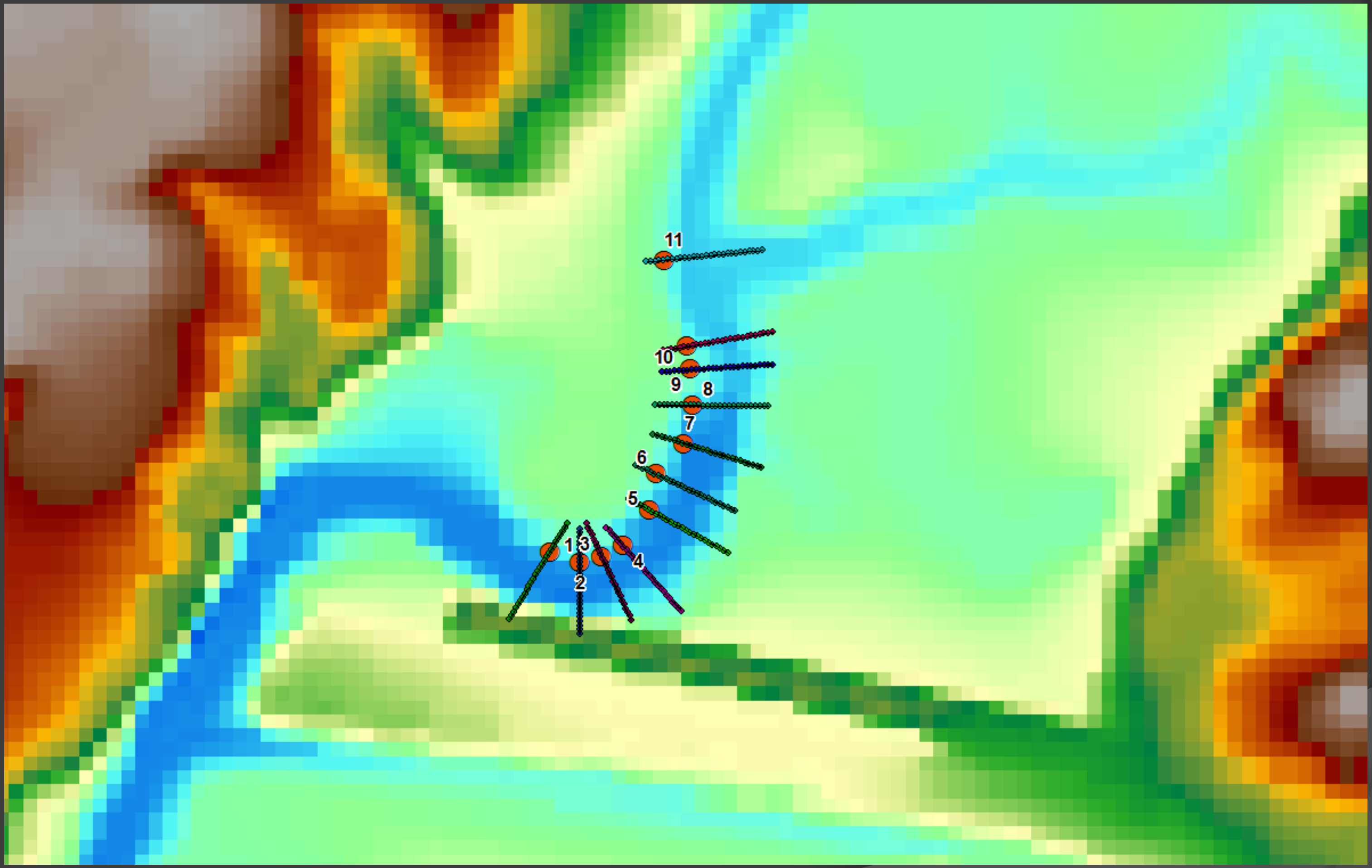
- Cross-section comparison
  - How well does lidar capture the geomorphology of a stream reach?
- Statistical differences within catchments
  - When aggregated to a catchment, do the metrics derived from 10 meter and lidar differ?
- USGS and West Virginia University work
  - Automate the generation of geomorphic characteristics from lidar
  - Bank height
  - Bank angle
  - Channel width
  - Channel profile slope
  - Floodplain width (extracted from floodplain maps)
  - Floodplain profile slope

Using LIDAR to develop geomorphic metrics at Regional Stream Assessment sites



Sangamon River at Monticello, IL – 2013 – *Silvia Terziotti and Allen Gellis*

Profiles with points every 10 feet were created

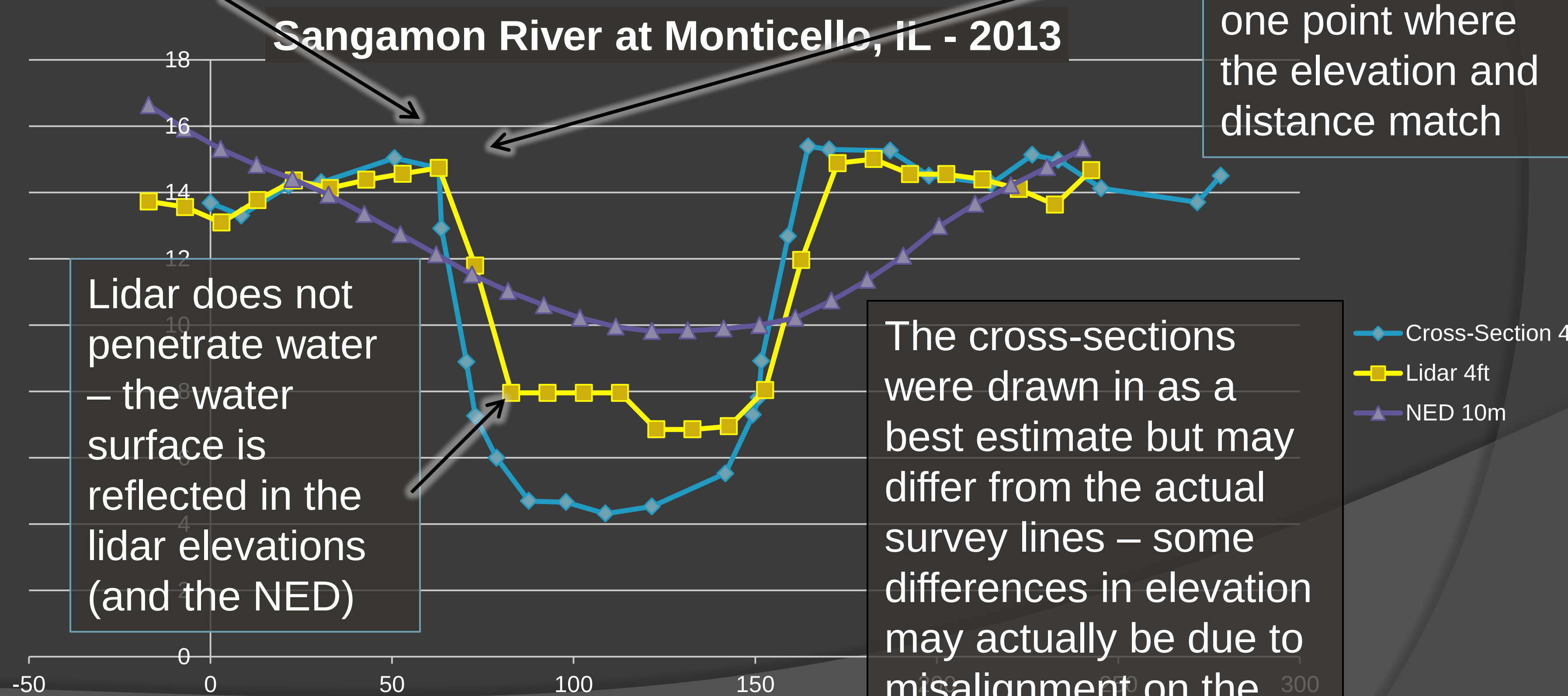


Caveats:

Distances were adjusted based on one well-defined point per cross-section – often left top of bank, right top of bank or a road feature

Cross-sections were stored in relative distance and relative elevation values so GIS-generated profiles were adjusted to match the 2013 data

Elevations were adjusted based on an anchor point so each cross-section will have at least one point where the elevation and distance match



Lidar does not penetrate water – the water surface is reflected in the lidar elevations (and the NED)

The cross-sections were drawn in as a best estimate but may differ from the actual survey lines – some differences in elevation may actually be due to misalignment on the surface

Floodplain calculation

(1) Find bank locations and elevations
   - from initial cross-section analysis

(2) Interpolate a ‘trend surface’
   - represents longitudinal trend
   - distance weighted

(3) Subtract from original DEM
   - the ‘flat’ DEM

(4) Subtract some ‘inundation’ height

(simple inundation scenario – could also be used with HEC-RAS or other model)

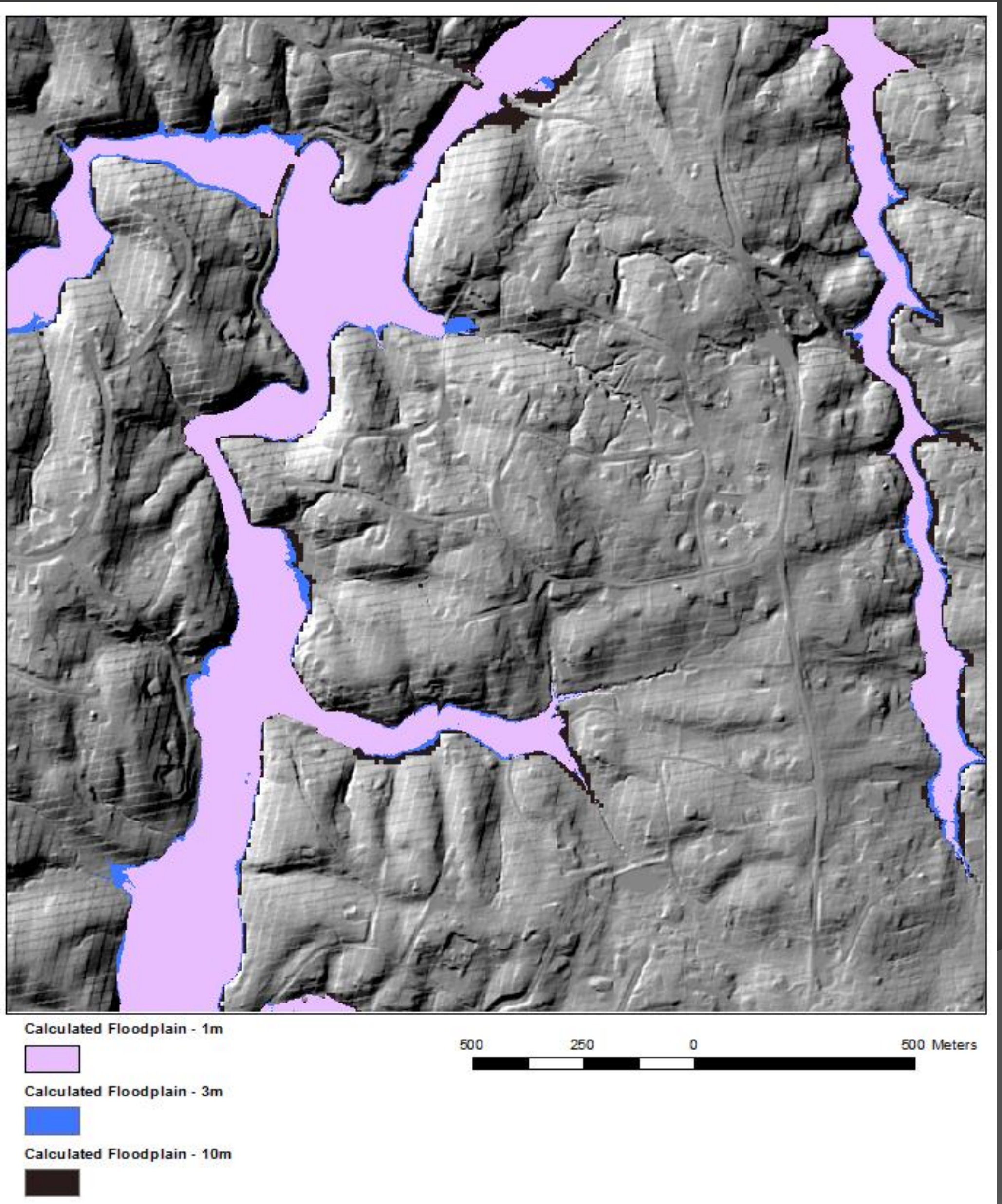
Riparian Topography Toolbox:

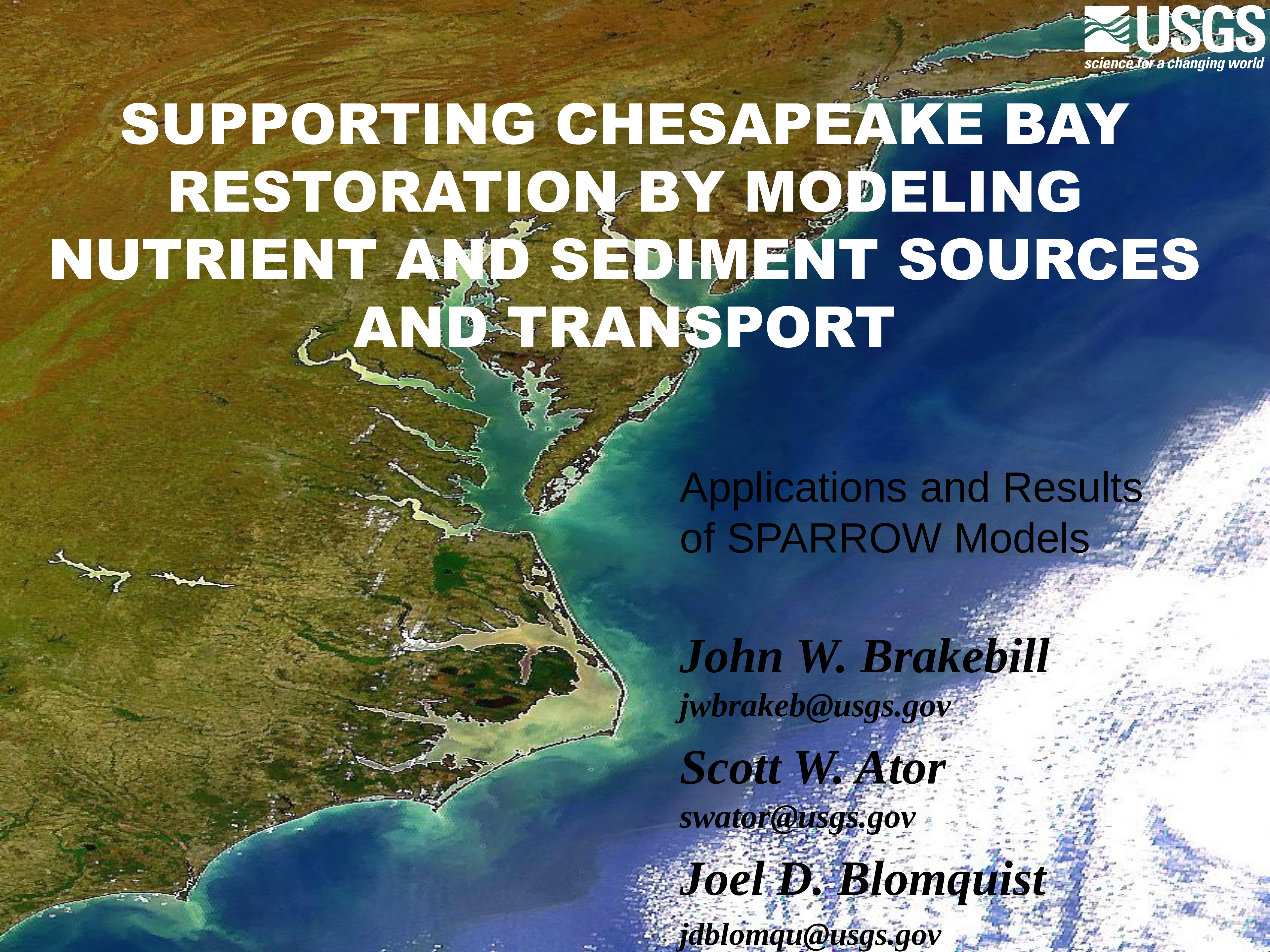
Dilts, T., and Yang, J., (2010). ArcGIS Riparian Topography Toolbox Users Manual. Great Basin Landscape Ecology Lab, Department of Natural Resource and Environmental Science, University of Nevada Reno, January 29, 2010

River Bathymetry Toolkit:

McKean, J., Nagel, D., Tonina, D., Bailey, P., Wright, C.W., Bohn, C., Nayegandhi, A., 2009. Remote sensing of channels and riparian zones with a narrow-beam aquatic-terrestrial lidar. Remote Sensing, 1, 1065-1096; doi:10.3390/rs1041065.

Floodplain calculation example





USGS
science for a changing world

SUPPORTING CHESAPEAKE BAY RESTORATION BY MODELING NUTRIENT AND SEDIMENT SOURCES AND TRANSPORT

Applications and Results of SPARROW Models

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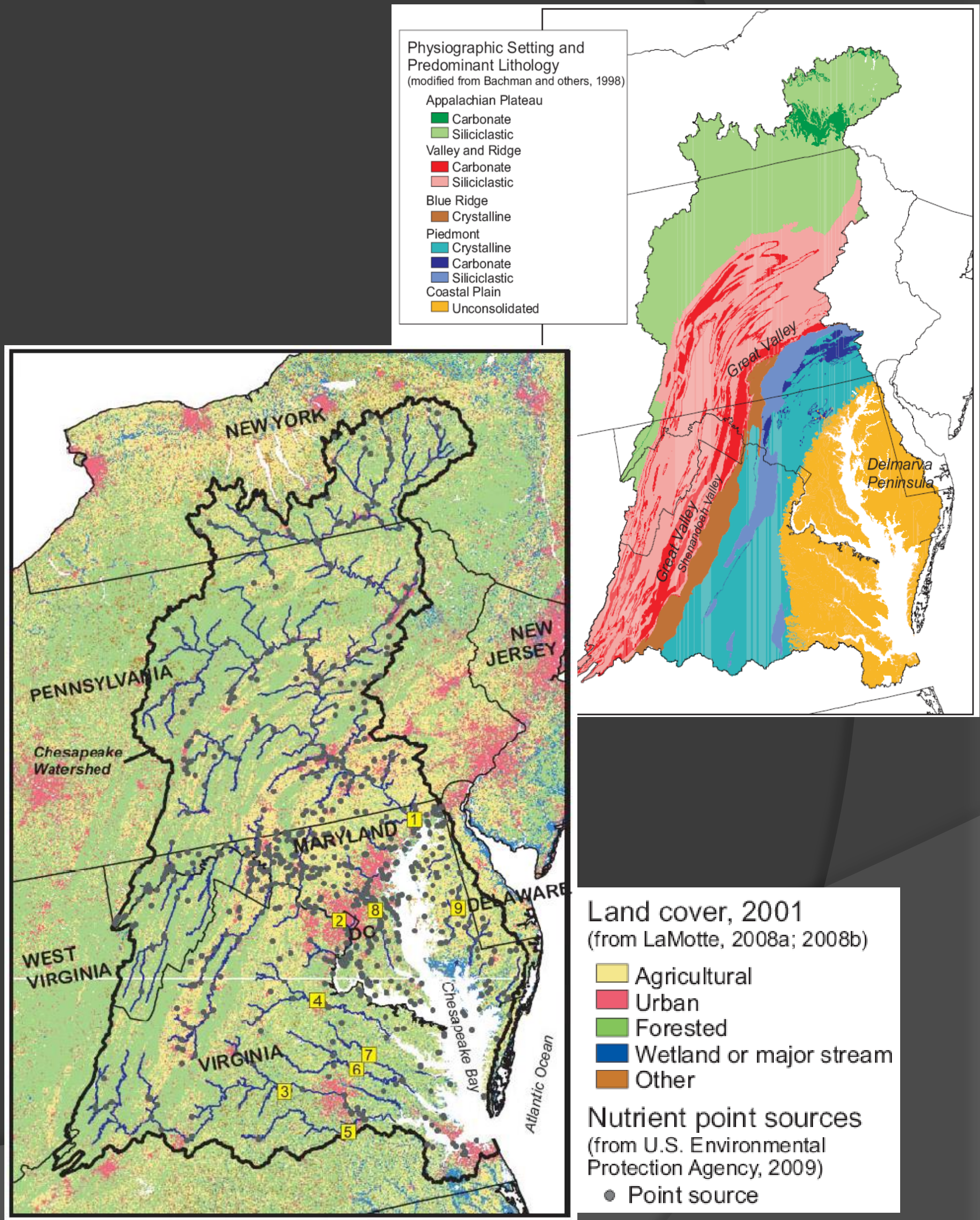
Chesapeake Bay Watershed

USGS science for a changing world

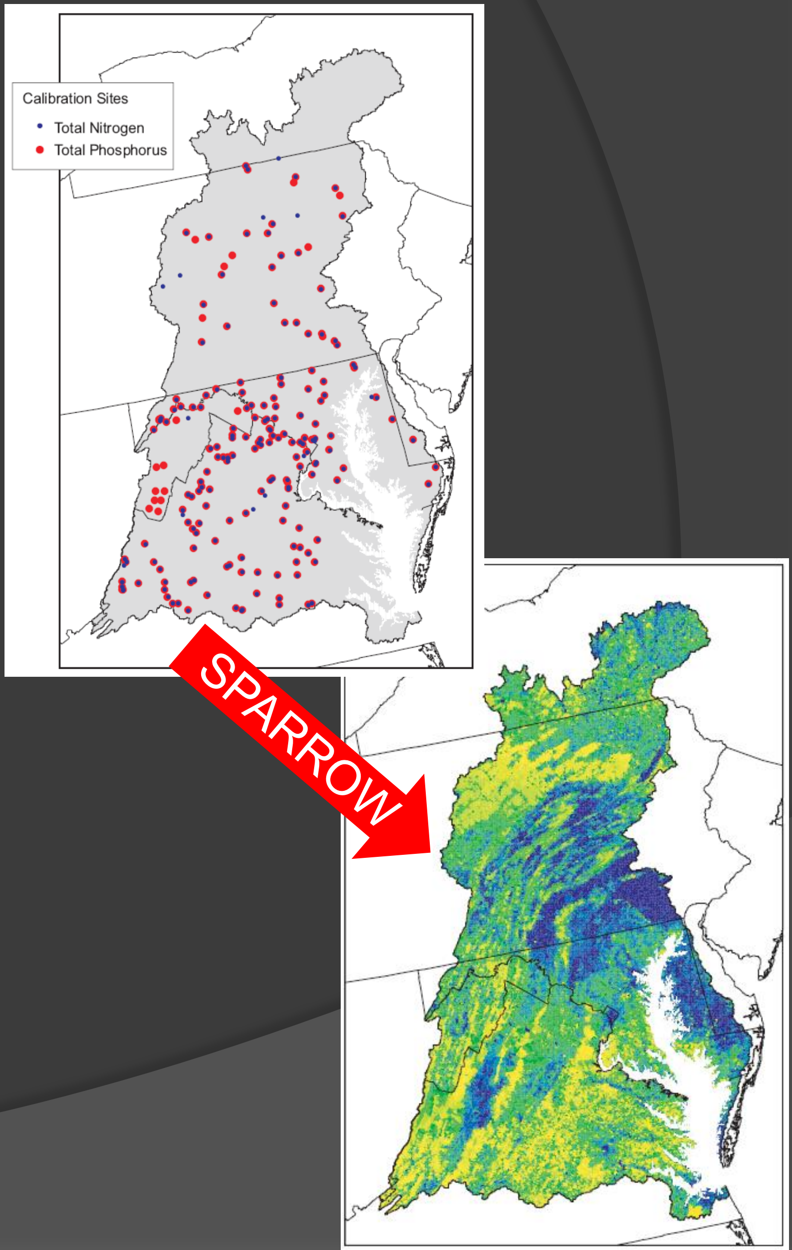
- Drains the largest estuary in North America
- Stresses led to the Bay and its tidal rivers being listed as "impaired waters" under the Clean Water Act
  - Largely because of low dissolved oxygen levels and other problems related to pollution like excessive nutrients and sediment
  - Imposed TMDL throughout watershed
- Restoration efforts have been ongoing for several decades.
- Challenges:
  - Diverse and changing land uses
  - Variety of contaminant sources
  - Diverse natural conditions relevant to contaminant fate and transport
- Restoration efforts have been designed and supported using numerical models:
  - Chesapeake Bay Program HSPF watershed model
    - TMDL's implemented and managed
  - USGS SPARROW
    - Help gain a comprehensive understanding of where nutrients and sediment originate
    - How they move throughout the watershed
    - Assist management actions



SPARROW

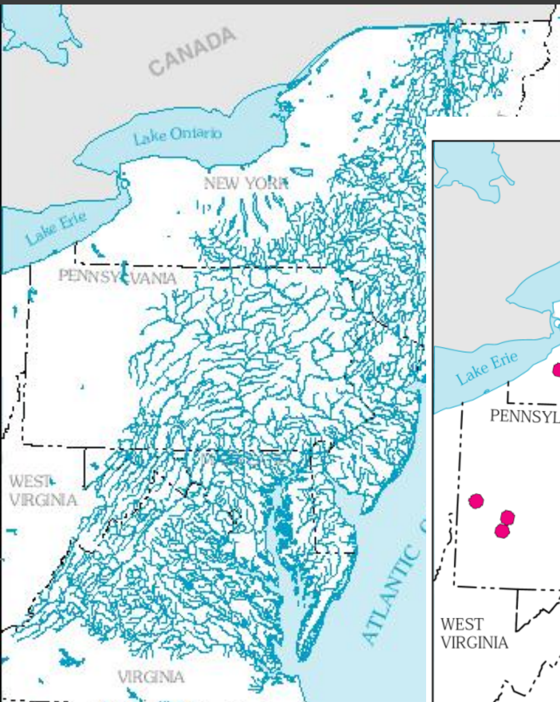
SPAtially Referenced Regressions On Watershed Attributes

- Spatial Statistical Approach that Empirically Relates Contaminant Sources and Transport Factors to Measured Stream Flux
  - Identify the spatial variability and magnitude of contaminant supply
  - Quantify the contributions at various locations
- Tool Provides Spatially Detailed Predictions:
  - Map individual contaminant sources in unmonitored locations
  - Statistical importance and quantification of contaminant sources
  - Provides measures of uncertainty
- Spatial Framework
  - Explicit for evaluating geographic distribution of sources that can be used for WIP
  - Potential Geographic Targeting

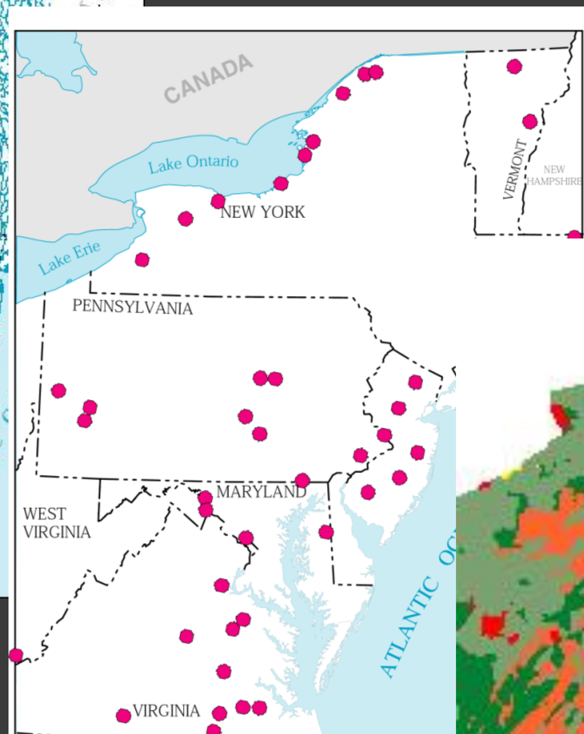


SPARROW Spatially Designed

Integrates spatial data over multiple scales to predict origin & fate of contaminants

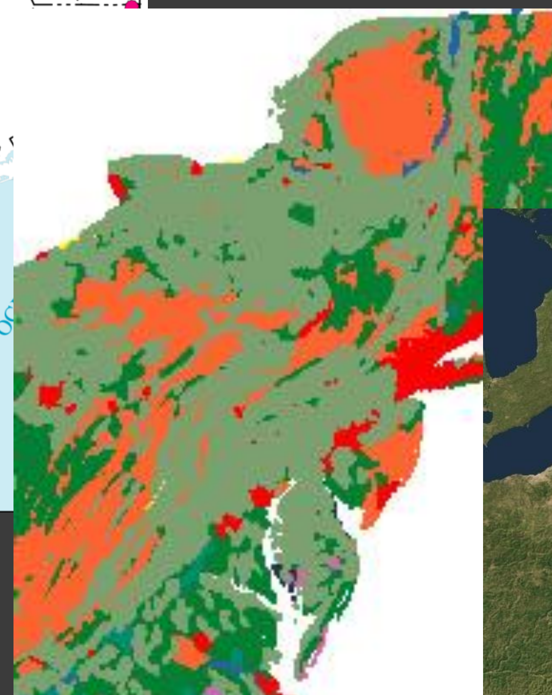


Network of connected and attributed streams and watersheds

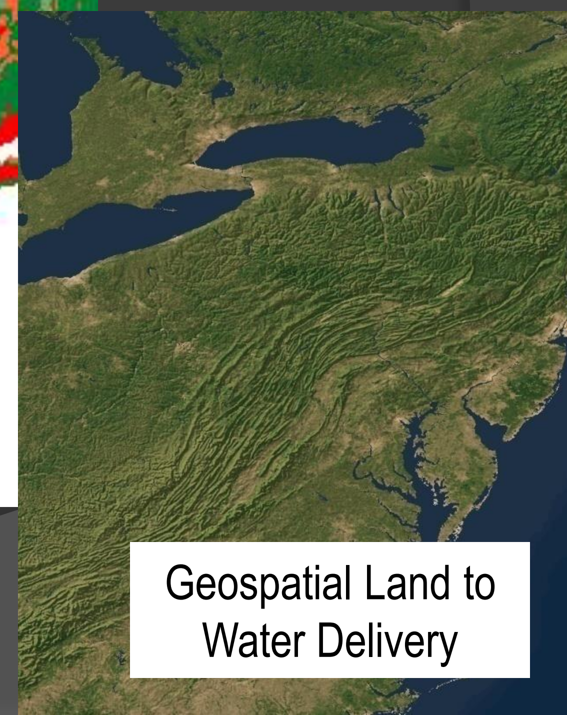


Monitoring Data (Dependent Variable)

Slope, Physiography, Soil Characteristics, Reservoir Systems



Geospatial Source data



Geospatial Land to Water Delivery

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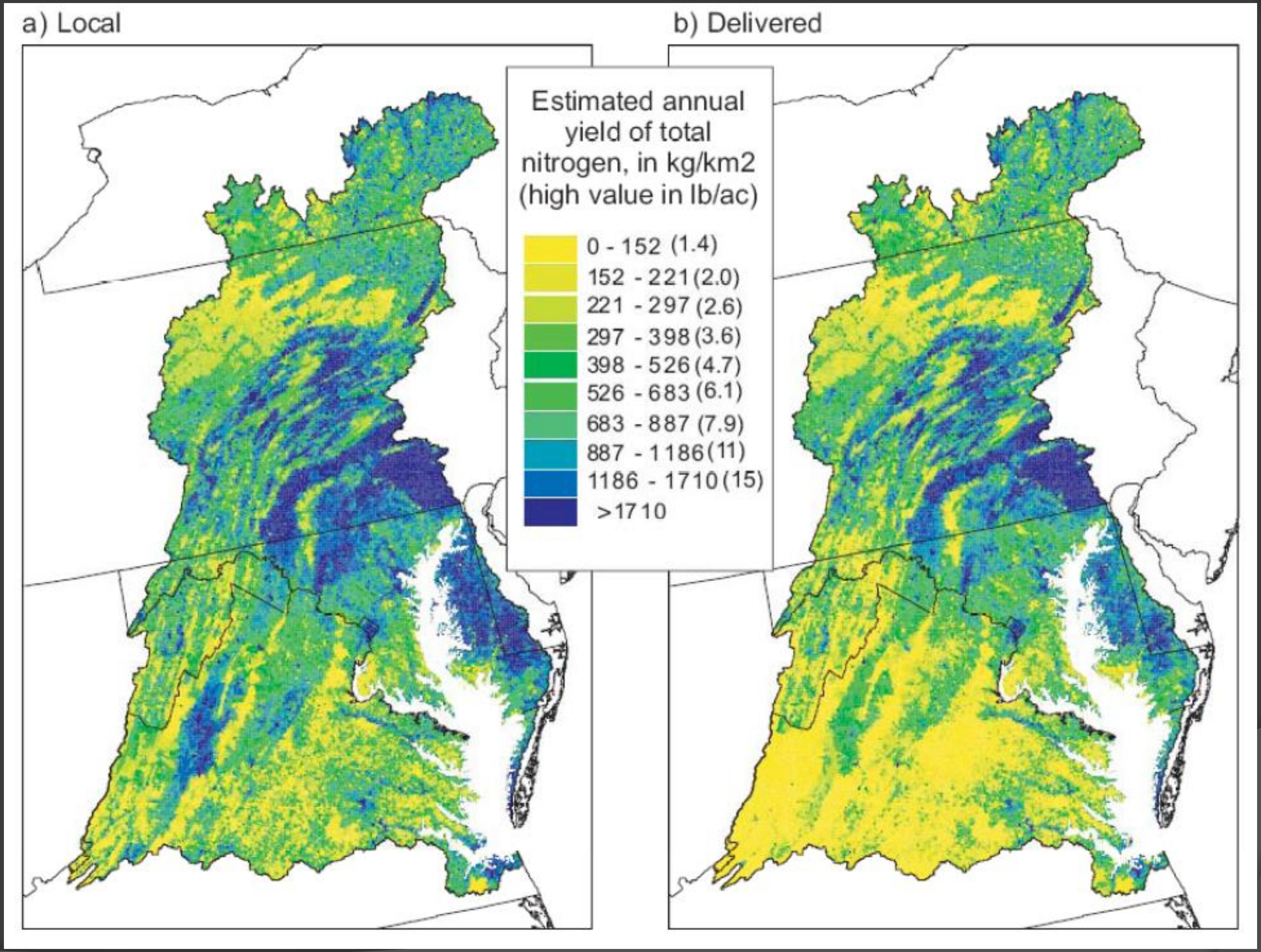
Data Access

- http://water.usgs.gov/nawqa/modeling/nhdplusattributes.html

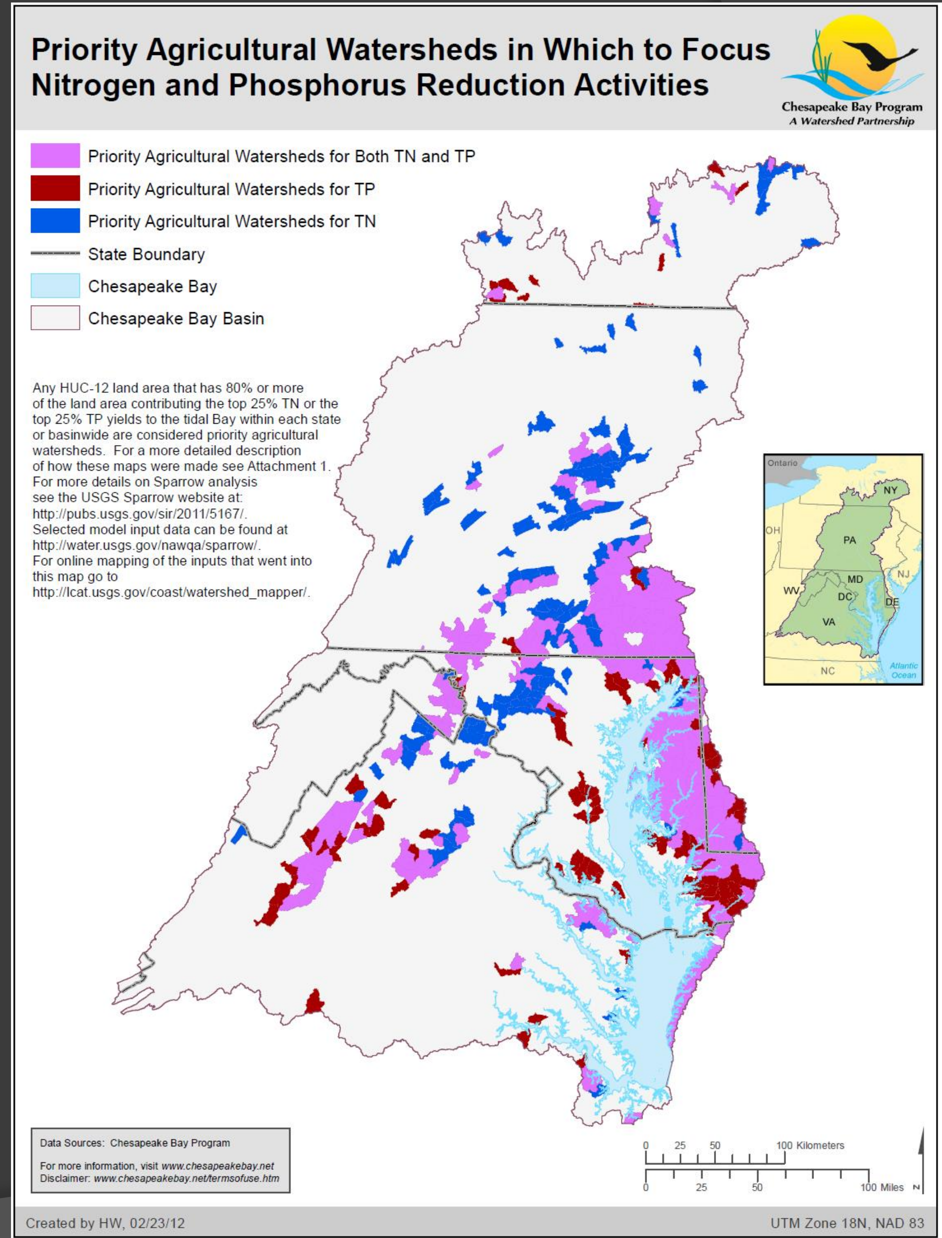
Spatial Distribution of TN



Ator and others, USGS SIR 2011-5167

Applications

- SPARROW predictions of nitrogen and phosphorus yields were used to prioritize locations for nutrient reductions through 2012 National Fish and Wildlife Federation grants.
- Similar targeting for:
  - USDA Farm Bill Programs
  - MD Bay Trust Fund
  - EPA Grants

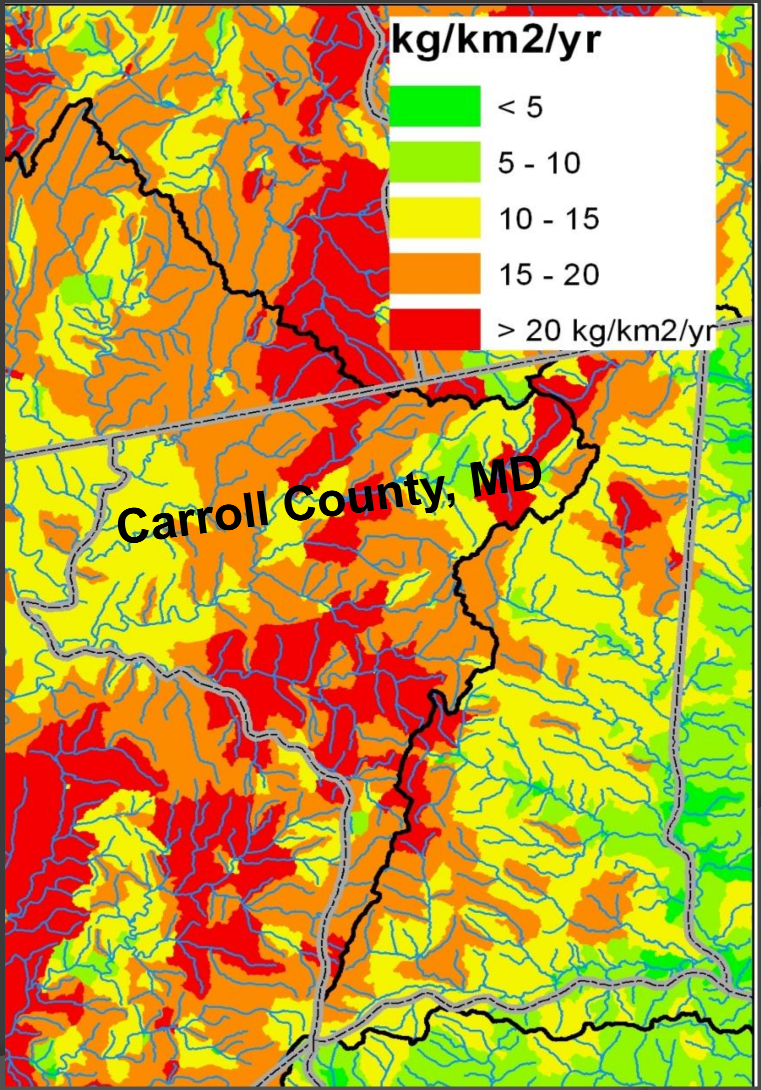


NFWF, 2012

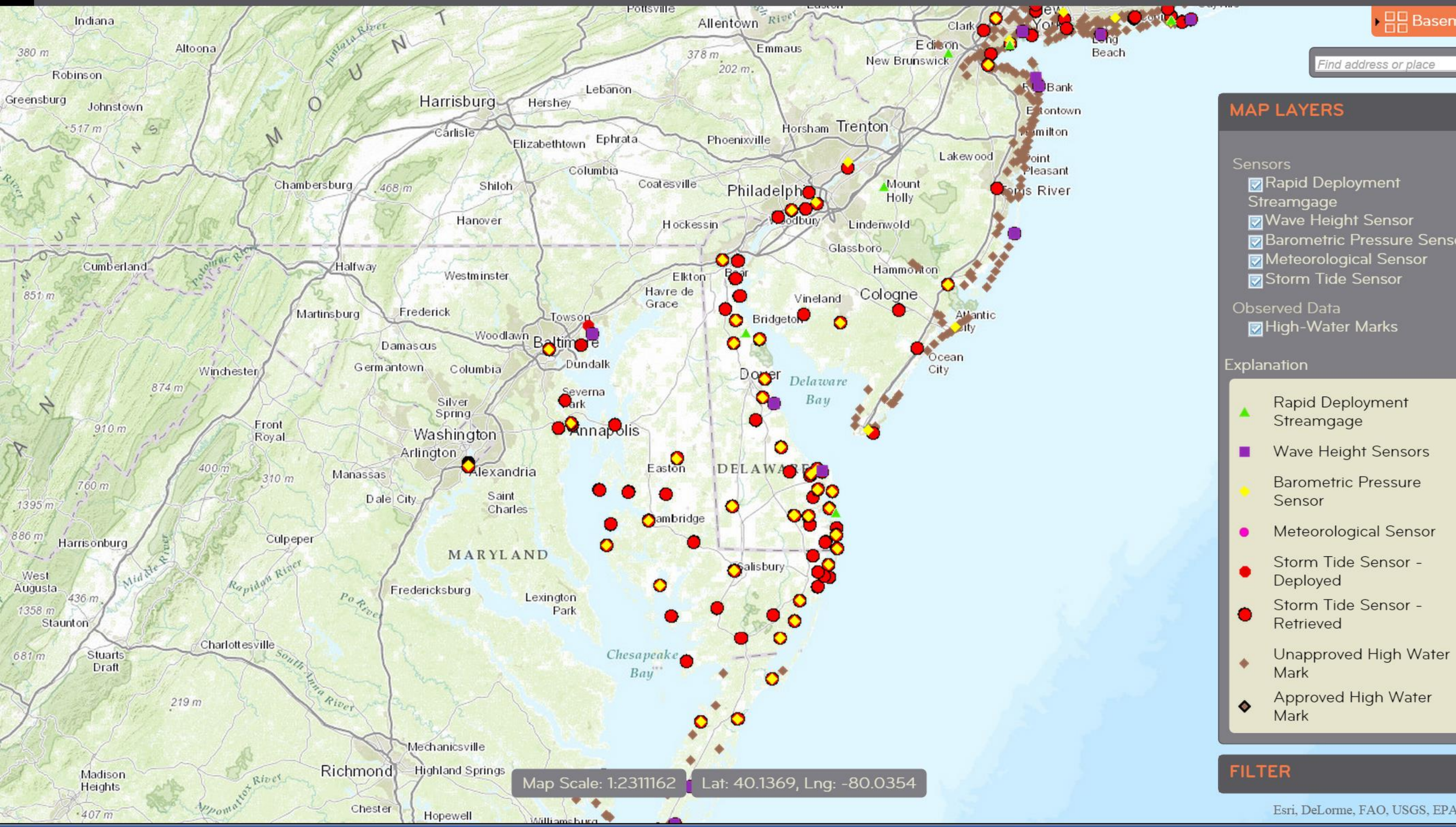
Applications

- Chesapeake TMDL mandates load reductions from specific source sectors.
- Maryland has allocated these to counties, but does not provide guidance on specific locations.
- Many local jurisdictions also manage local TMDLs.
- SPARROW can provide predictions useful for targeting at sub-county levels.

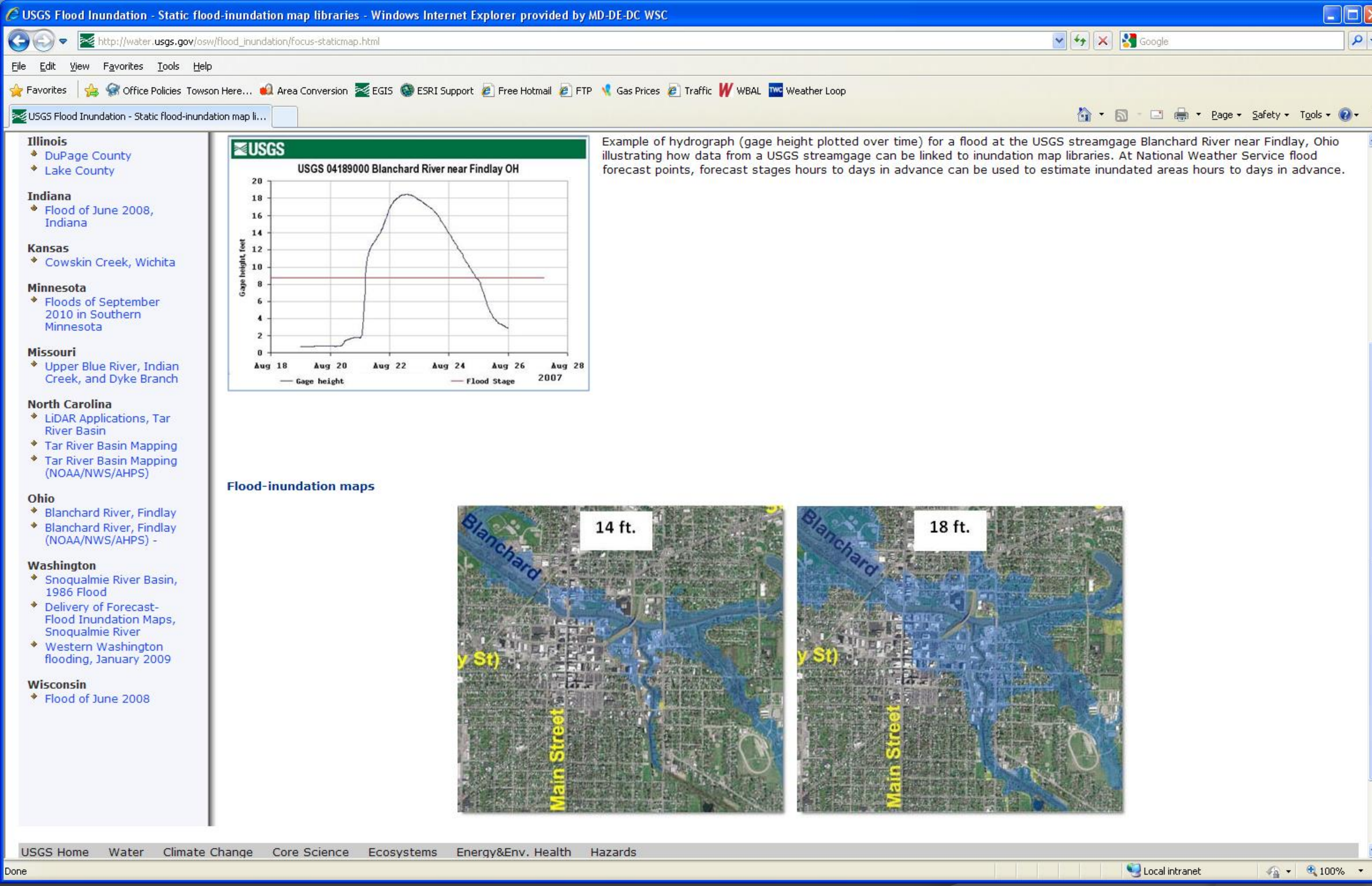
Phosphorus Yield



Thank You

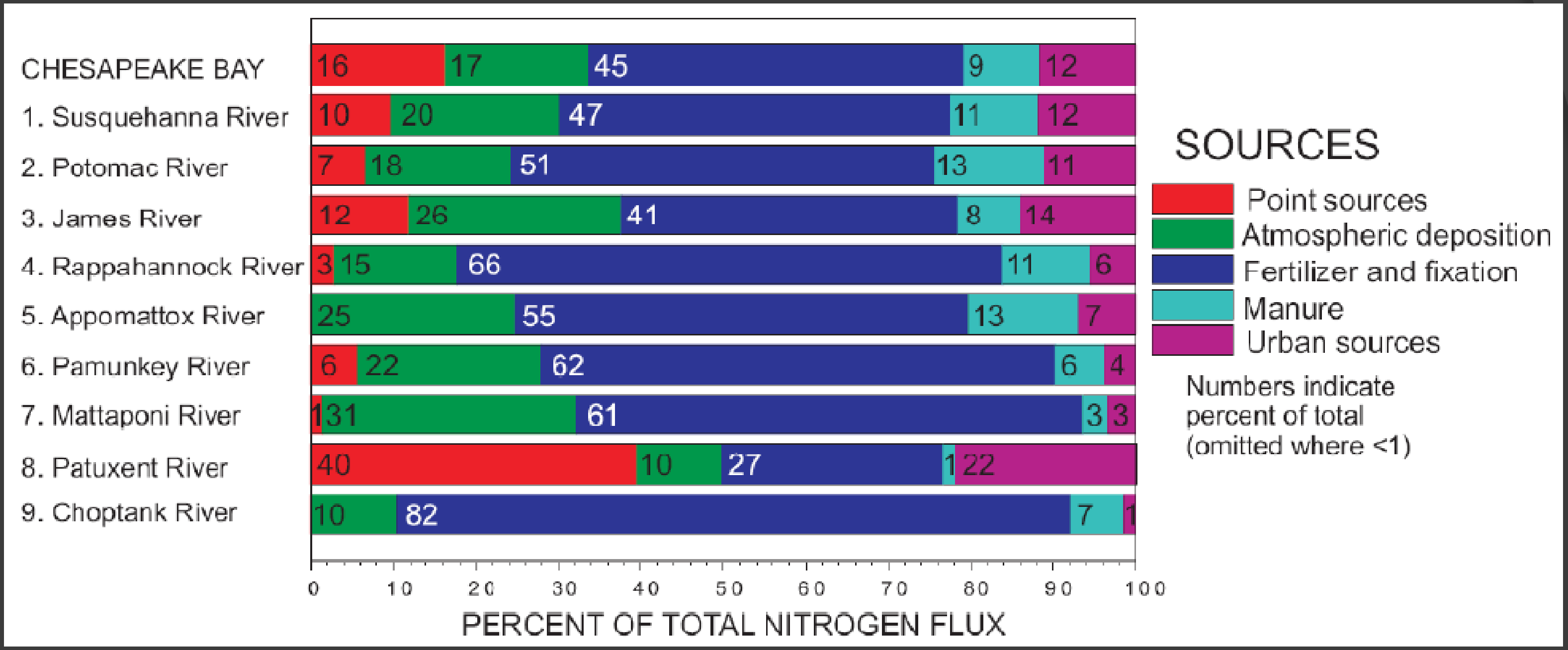


Basem
Find address or place
MAP LAYERS
Sensors
Rapid Deployment Streamgage
Wave Height Sensor
Barometric Pressure Sens
Meteorological Sensor
Storm Tide Sensor
Observed Data
High-Water Marks
Explanation
Rapid Deployment Streamgage
Wave Height Sensors
Barometric Pressure Sensor
Meteorological Sensor
Storm Tide Sensor - Deployed
Storm Tide Sensor - Retrieved
Unapproved High Water Mark
Approved High Water Mark
FILTER
Esri, DeLorme, FAO, USGS, EPA
Map Scale: 1:2311162
Lat: 40.1369, Lng: -80.0354
Harrisburg
Trenton
Philadelphia
Washington
Arlington
Alexandria
Annapolis
Baltimore
Dover
Delaware Bay
Chesapeake Bay
MARYLAND
DELAWARE
Salisbury
Cambridge
Easton
Richmond
Fredericksburg
Allentown
New Brunswick
Edison
Long Beach
Toms River
Lakewood
Atlantic City
Ocean City
Vineland
Bridgeton
Cologne
Hammonton
Glassboro
Lindenwold
Mount Holly
Elkton
Havre de Grace
Towson
Dundalk
Columbia
Frederick
Hagerstown
Martinsburg
Winchester
Front Royal
Manassas
Dale City
Culpeper
Charlottesville
Staunton
Harrisonburg
West Augusta
Stuarts Draft
Chambersburg
Hanover
Westminster
Lebanon
Hershey
Carlisle
Elizabethtown
Ephrata
Phoenixville
Coatesville
Hockessin
Altoona
Johnstown
Greensburg
Indiana
Robinson
Cumberland
Halfway
Mechanicsville
Highland Springs
Madison Heights
Chester
Hopewell
Lexington Park
Saint Charles
Silver Spring
Germantown
Damascus
Woodlawn
Severna Park
Emmaus
Horsham
Shiloh
Columbia



USGS Flood Inundation Mapping

Nitrogen Source Shares



- Agriculture is widespread, and a dominant sources of N to the Bay and most tributaries

Ator and others, USGS SIR 2011-5167.

Applications

- USDA Farm Bill allocations
- Developing EPA water-quality grant guidance
- Local Pilot
  - Carroll County Bureau of Resource Management
  - Target actions to maximize investment return and meet local TMDLs
  - Based on EPA WSM, State of MD has provided:
    - Specific required N and P load reductions
    - Sector specific: POINT, URBAN, AG
    - List of BMPs and “credits” for each
    - No guidance on what to do or where to do it