



The U.S. Geological Survey's Sediment-bound Contaminant Resiliency and Response Strategy: A tiered multi-metric approach to environmental health and hazards in the Northeastern USA

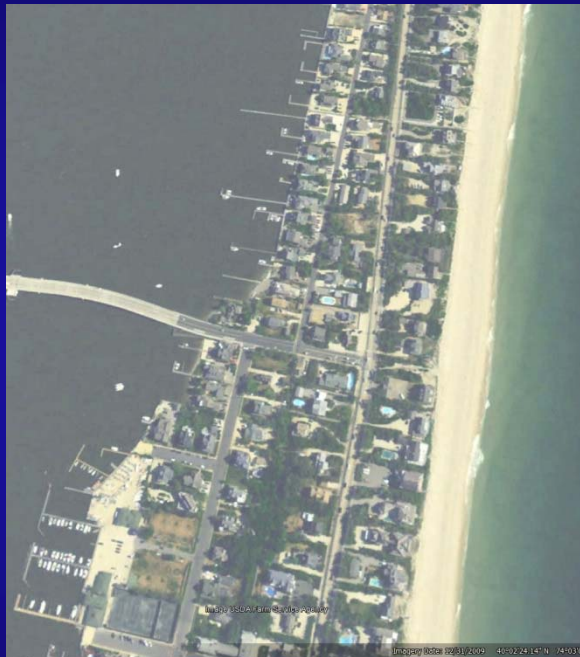
Presented by Kim Aquino

2016 TRI National Training Conference, Washington DC

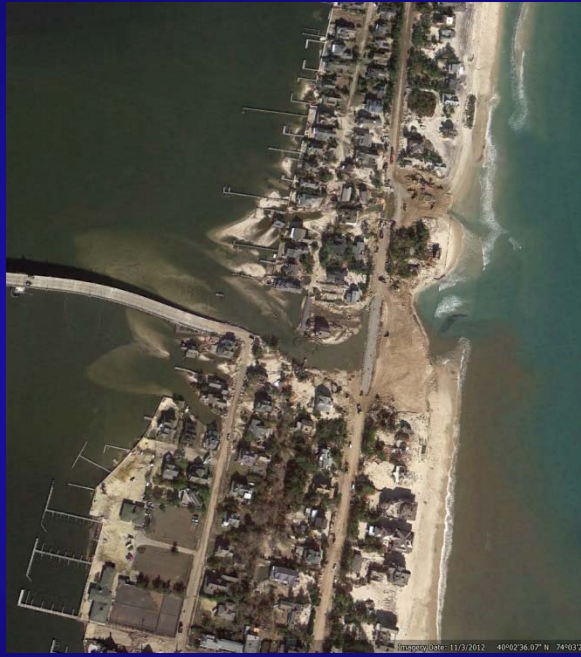
October 19, 2016

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Mantoloking, NJ: Before and after Hurricane Sandy



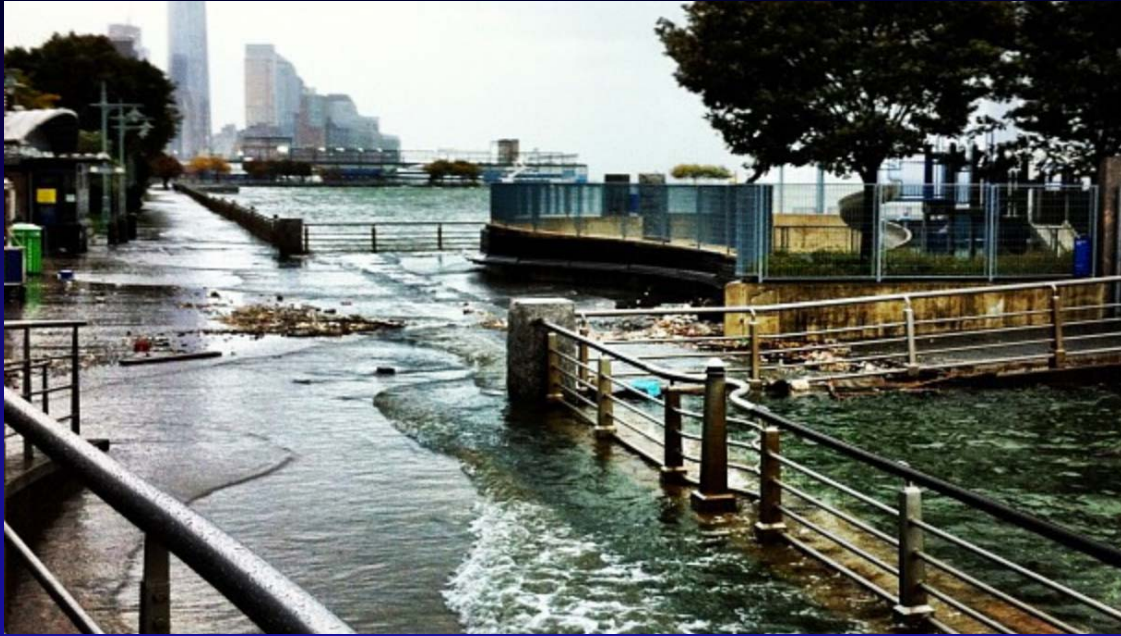
2009



2012



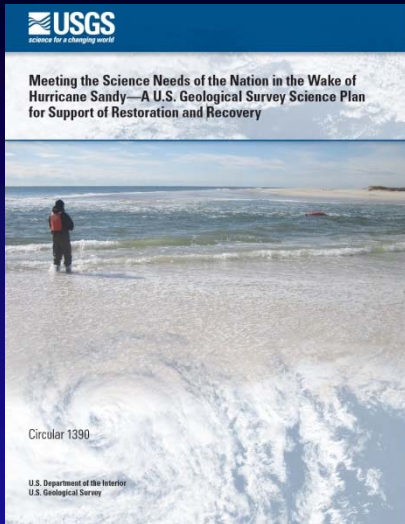
2013



“The Hudson River has breached it’s banks 8.53 am” (sic) - @NigelBarker

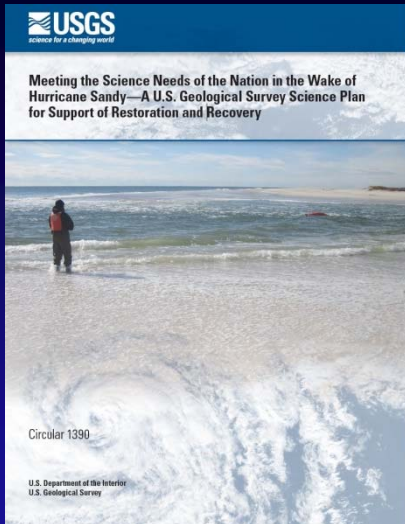
*110 homes “burned to the ground” in Breezy Point, Queens
- FDNY*





2012 Hurricane Sandy Science Plan

- **Five Themes based on impact types and information needs:**
 - 1. Coastal topography and bathymetry**
 - 2. Impacts to coastal beaches and barriers**
 - 3. Impacts of storm surge and estuarine and bay hydrology**
 - 4. Impacts on environmental quality and persisting contaminant exposures**
 - 5. Impacts to coastal ecosystems, habitats, and fish and wildlife**



2012 Hurricane Sandy Science Plan

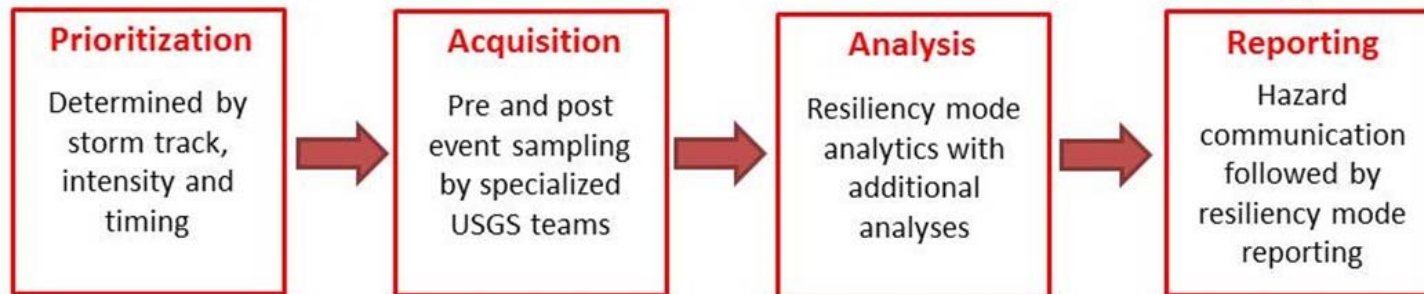
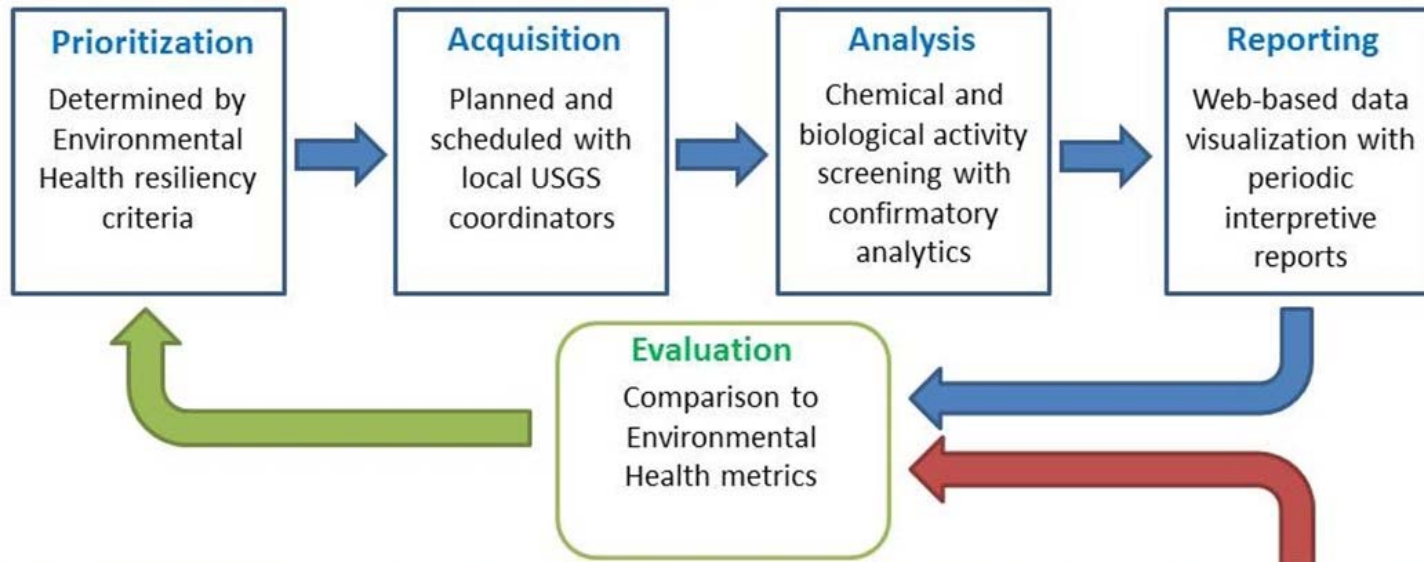
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Additional goals:

- **Guide restoration of affected ecosystems and communities**
- **Inform strategies to develop resilient coastal communities and ecosystems**
- **Enable improved hazard assessment, response, and recovery for future storms**

SCoRR Resiliency and Response Mode

Resiliency Mode: Definition of Baseline



Response Mode: Determine Post-Event Changes

SCoRR: Sediment-bound Contaminant Resiliency and Response

- **Map and identify contaminant sources and potential exposure pathways to humans and ecosystems**
- **Define baseline (resiliency) and post-event (response) sediment bound environmental health stressors**
- **Establish and apply metrics to quantify changes in coastal resilience**

SCoRR: Sediment-bound Contaminant Resiliency and Response

SCoRR Decision Support Tool

- **Publicly available data (EPA TRI and FRS, NWS, FEMA, etc.)**
- **Rank TRI and FRS facilities based on perceived contaminant hazard (1-4)**
- **Identify existing monitoring stations which are vulnerable to contaminants that may be mobilized by coastal storms**
- **Prioritize stations for sampling under resiliency or response mode activities**

SCoRR Decision Support Tool: How it was developed

SCoRR Rankings Explained:

1 – Little to no hazard risk to human/aquatic life

2 – Mild effects on human/aquatic life

3 – Slightly hazardous effects on human/aquatic life

4 – Hazardous effects on human/aquatic life

SCoRR Decision Support Tool: How it was developed

- For TRI ranks, CAS (chemical identification) numbers matched to 2,541 constituents prioritized in Olsen et al (2013)

Olsen tier Water	Olsen tier Sediment
1	1
1	2
2	1
1	3
3	1
1	N/A
N/A	1
2	2
3	2
2	3
2	N/A
N/A	2
3	3
3	N/A
N/A	3



Olsen et al., 2013, Prioritization of constituents for national- and regional-scale ambient monitoring of water and sediment in the United States: U.S. Geological Survey Scientific Investigations Report 2012-5218, <http://pubs.usgs.gov/sir/2012/5218/>.

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2	N/A
N/A	2
3	3
3	N/A
N/A	3

Tier 1: highest likelihood to naturally occur in the environment, or likelihood of effects on human health or aquatic life

Tier 2: lower likelihood to naturally occur in the environment, or lower likelihood of effects on human health or aquatic life

Tier 3: low or no priority for monitoring due to unlikelihood they would occur naturally in the environment or lack of effect on human health or aquatic life, or insufficient evidence of occurrence or effects

SCoRR Decision Support Tool: How it was developed

- Olsen et al (2013) prioritization scheme modified for SCoRR

Olsen tier Water	Olsen tier Sediment	SCoRR Rank
1	1	4
1	2	4
2	1	4
1	3	4
3	1	4
1	N/A	4
N/A	1	4
2	2	3
3	2	3
2	3	3
2	N/A	3
N/A	2	3
3	3	2
3	N/A	1
N/A	3	1

- SCoRR ranks are 1-4 (4 is highest priority)

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N/A	1	4
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3	2	3
2	3	3
2	N/A	3
N/A	2	3
3	3	2
3	N/A	1
N/A	3	1

- SCoRR ranks are 1-4 (4 is highest priority)
- Chemicals not found in Olsen were ranked using material safety data sheets on the Toxnet Hazard Substances Data Bank
- Solubility, mobility, toxicity, bioaccumulation/absorption, and decomposition characteristics considered in establishing SCoRR ranks

SCoRR Decision Support Tool: How it was developed

- FRS SCoRR ranks assigned based on “perceived contaminant hazard” using three attributes:
 1. Environmental Programs – state and federal level information management systems that monitor each facility (e.g. ACRES, BRAC, NPDES, TSCA, etc.)
 2. Environmental Interest Type – represents the federal environmental permit or regulatory program that applies to each facility (e.g. Brownfields, Gasoline and Diesel Producers, Superfunds, TRI reporters, etc.)
 3. Site Type – Facility, Stationary, Monitoring Station, Potentially Contaminated Site, Brownfield, or Water System
- To minimize bias, a panel of five experts (4 internal to SCoRR and 1 external) were consulted for individual assessments and generated a consensus rank value per attribute

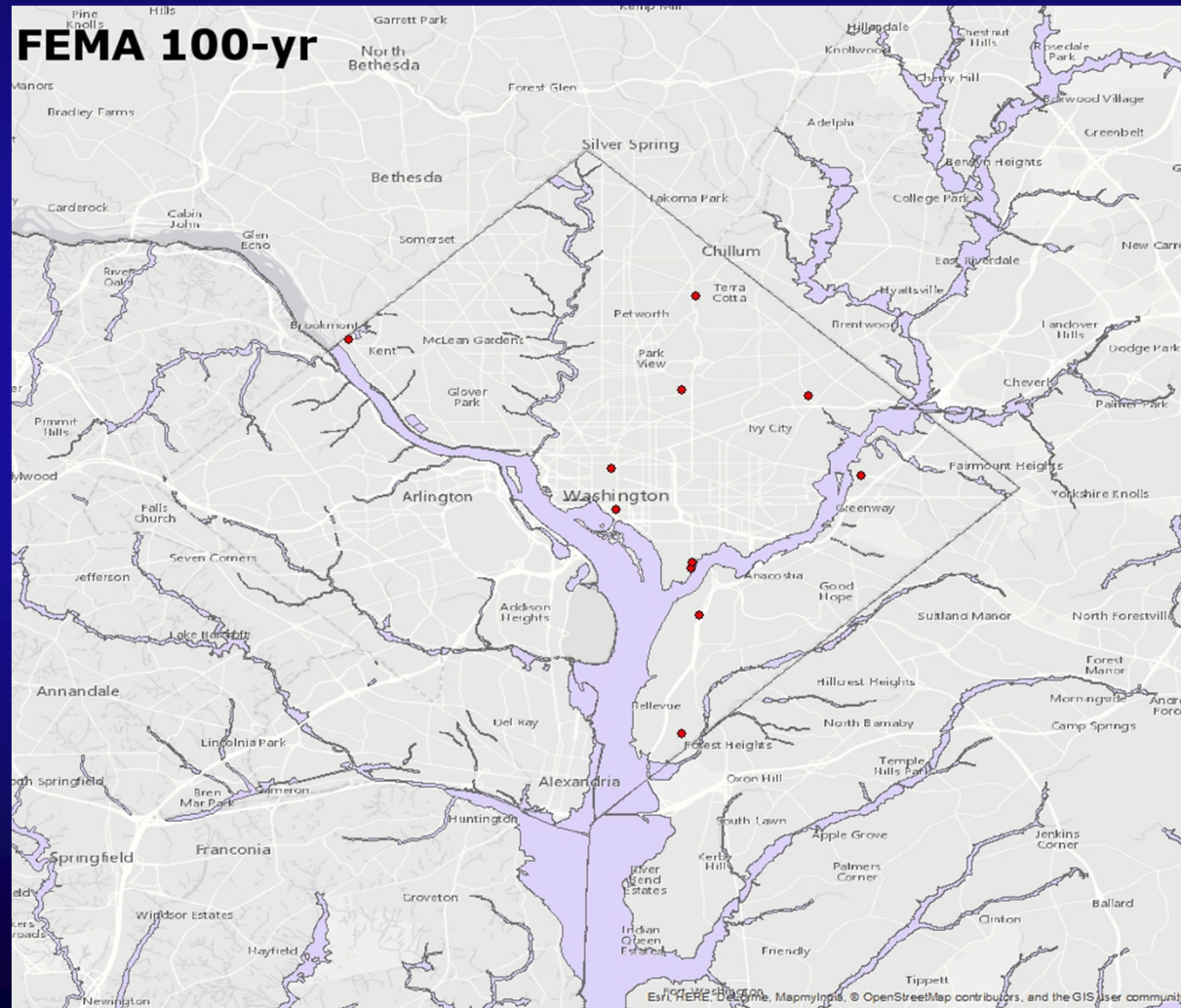
SCoRR Decision Support Tool: How it was developed

Overlay Analysis

- 1. Shapefiles made from QC'd and ranked TRI and FRS data**
- 2. Storm vulnerability layers:**
 - a) FEMA 100-year flood zones derived from the Special Flood Hazard Area (SFHA), representing areas with a 1% chance of being inundated during a flood event**
 - b) Historical storm track data from the Extended International Best Track Archive for Climate Stewardship (IBTrACS)**
 - c) Modeled Sea, Lake, and Overland Surges from Hurricanes (SLOSH) CAT 1-5 inundation zones**
- 3. Facility ranks weighted by storm vulnerability using overlay analyses**
- 4. Inverse distance weighting used to apply weighted ranks to over 5000 sampling stations provided by federal and local stakeholders and prioritized; 250 sampled**

SCoRR Decision Support Tool: How it was developed

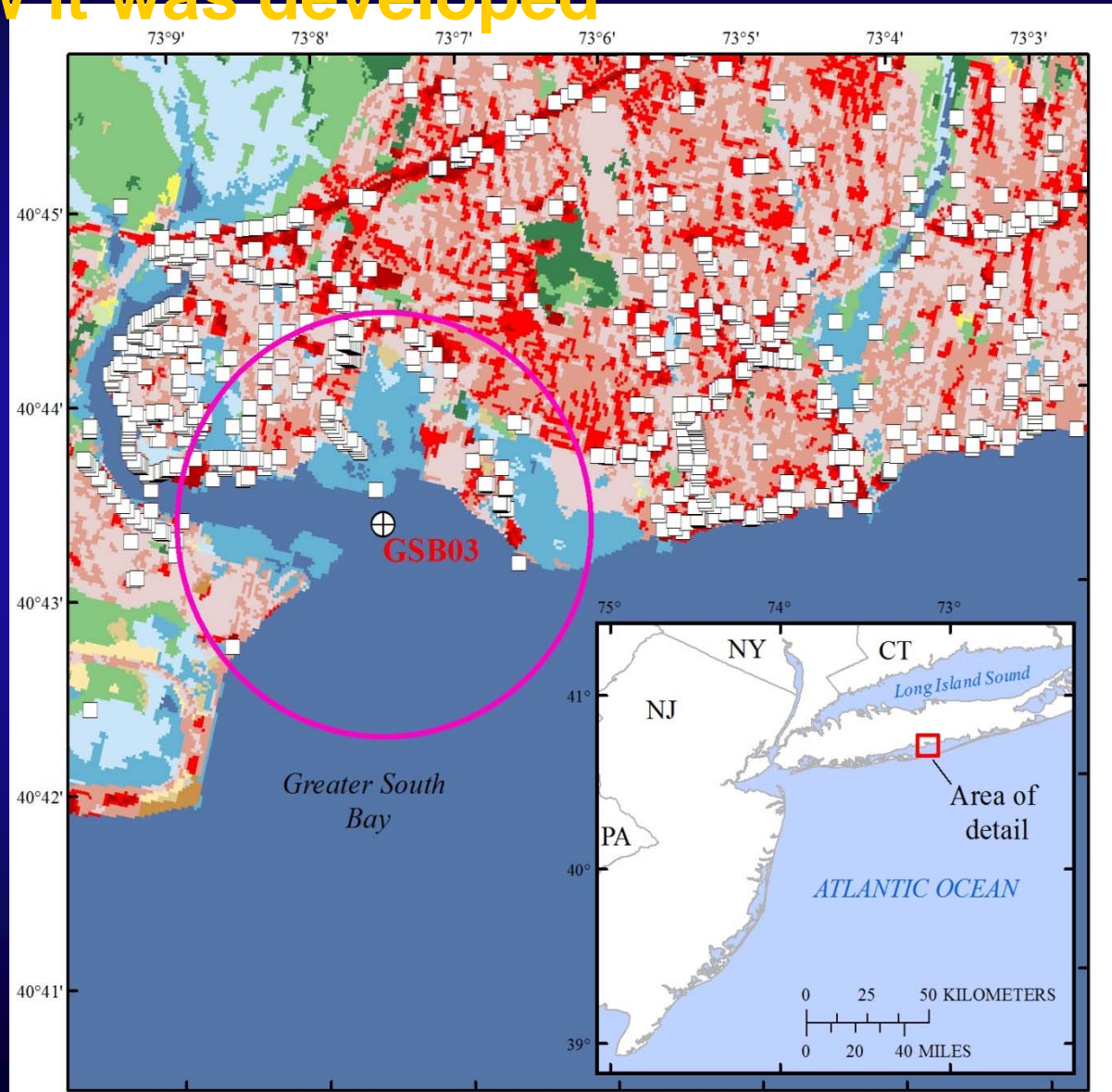
Overlay Analysis



SCoRR Decision Support Tool: How it was developed

- U.S. States
- ⊕ Sampling Location
- Facility with Potential Contaminant Hazard Rank
- Extent of 2-kilometer search radius

Reilly et al., 2015, Strategy to evaluate persistent contaminant hazards resulting from sea-level rise and storm-derived disturbances— Study design and methodology for station prioritization: U.S. Geological Survey Open-File Report 2015–1188A, <http://dx.doi.org/10.3133/ofr20151188A>.



SCoRR Decision Support Tool: How it was developed

Sampling_Site_Name	TRI_FACILITY_NAME	Adj_Rank	Adj_Rank_2	Dist_wt_Adj2
Anacostia Main Pump Pier	VIRGINIA CONCRETE - SOUTHWEST DC PLANT	32	4	5.343825324
Station WASD2 - 8594900 - Washington, DC	VIRGINIA CONCRETE - SOUTHWEST DC PLANT	32	4	3.312121632
Anacostia Main Pump Pier	SUPERIOR CONCRETE MATERIALS INC	8	2	3.335645912
Station WASD2 - 8594900 - Washington, DC	SUPERIOR CONCRETE MATERIALS INC	8	2	1.736283969
Blue Plains Pier	DC VILLAGE PLANT	4	4	2.882511305
Blue Plains Pier	DC VILLAGE PLANT	4	4	2.882511305
Station WASD2 - 8594900 - Washington, DC	US DEPARTMENT OF THE TREASURY-BUREAU OF ENGRAVING & PRINTING	4	4	2.404555657

Sampling Site ID	Average of Distance Weighted Adjusted Rank 2
87	2.882511305
88	2.882511305
91	4.339735618
92	2.484320419



Reilly et al., 2015, Strategy to evaluate persistent contaminant hazards resulting from sea-level rise and storm-derived disturbances—Study design and methodology for station prioritization: U.S. Geological Survey Open-File Report 2015–1188A, <http://dx.doi.org/10.3133/ofr20151188A>.

SCoRR Resiliency and Response Mode

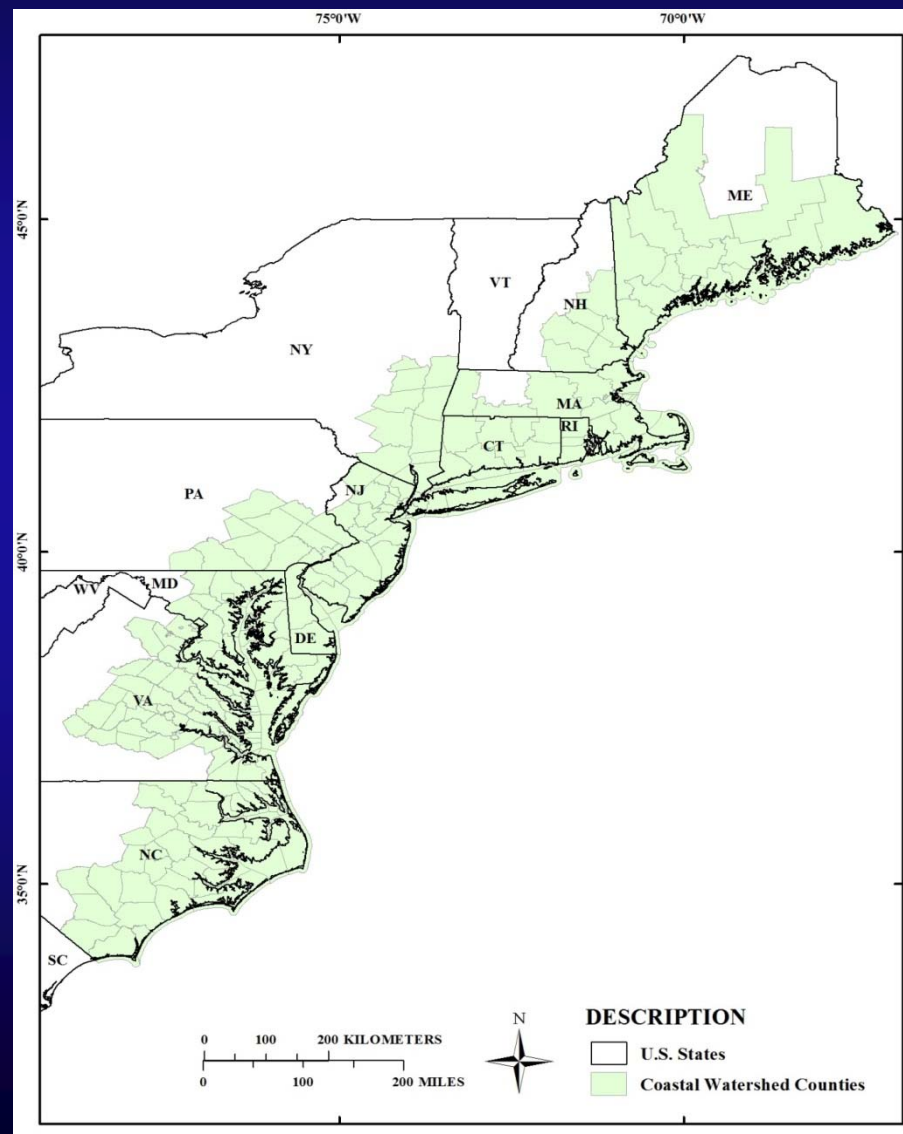
Hurricane Joaquin
October 2015



*Response Mode sediment-quality
sampling. Above: Virginia Beach, VA
Right: Georgetown, DC*

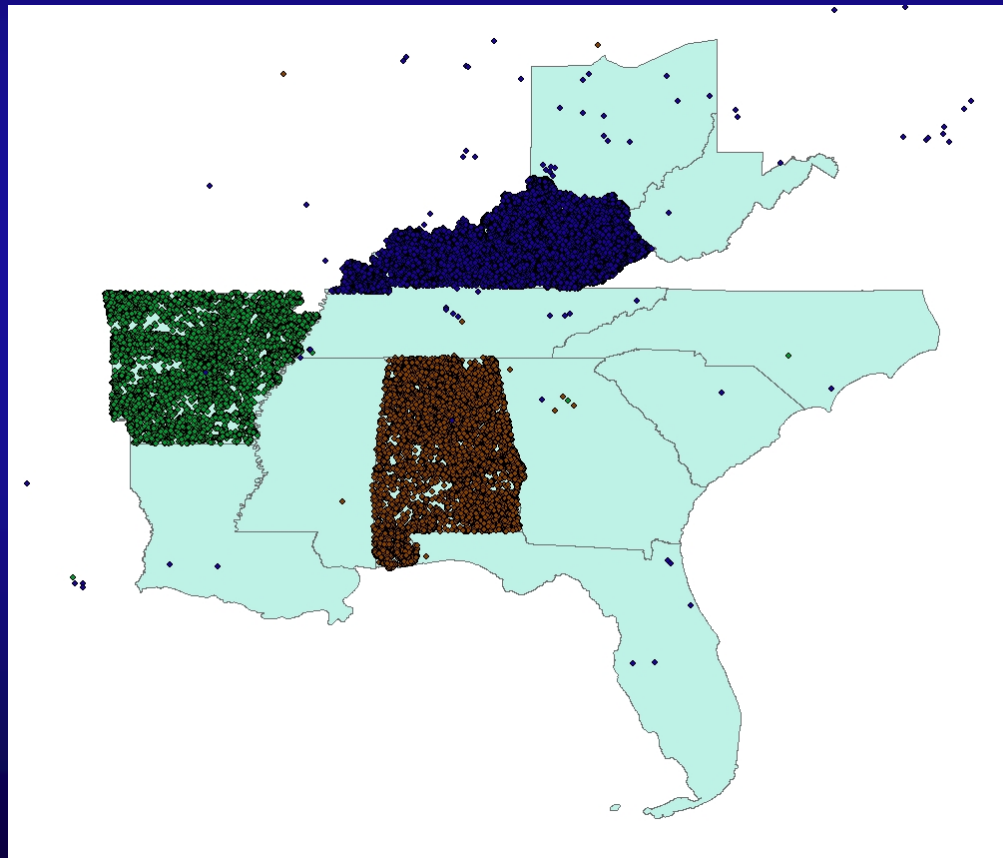
Issues found during Decision Tool development

- Massive amounts of data



Issues found during Decision Tool development

- Massive amounts of data
- Inaccurate GPS coordinates



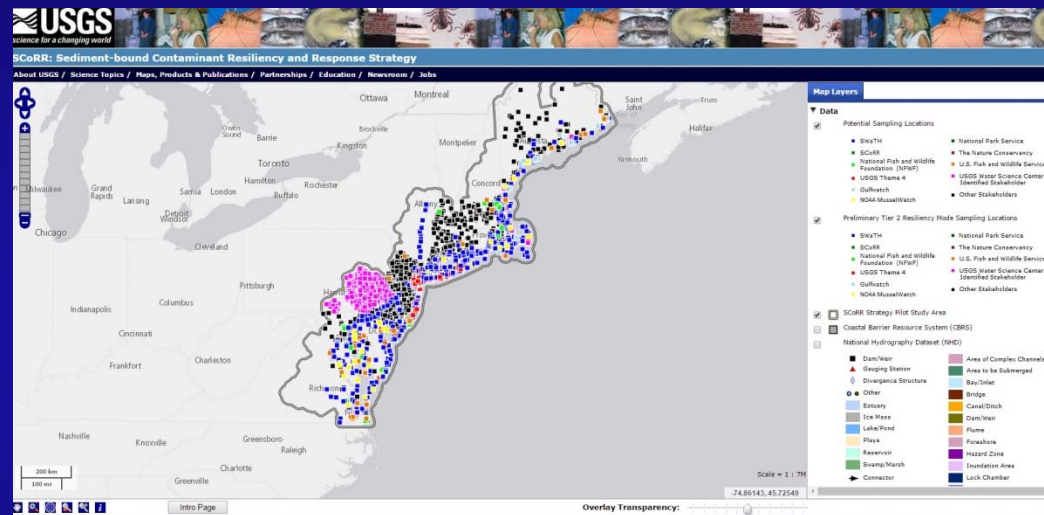
Other applications for the Decision Support Tool

- Barnegat Bay, NJ
- Incorporating other layers (e.g. Congressional district, Federal Lands, Endangered Species, etc.)
 - Identifying vulnerable communities
 - Sample gap analysis
 - Targeting mitigation activities
 - Resiliency efforts
- Source-sink linkages: connecting measurements back to the landscape

For more information

■ USGS Toxic Substances Hydrology Program

<http://toxics.usgs.gov/scorr>



<http://toxics.usgs.gov/scorr/map/index.html>

For more information:

<https://pubs.er.usgs.gov/publication/ofr20151188A>

<https://pubs.er.usgs.gov/publication/ofr20151188B>

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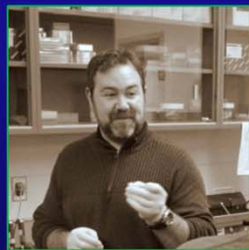
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