October 17-19, 2017
Lake Placid, NY

Preparing for Future Climate: The Hudson River Flood Impacts Decision Support System

NYSERDA Program Opportunity Notice (PON) 2260, Coastal Zones, Category A Environmental Monitoring, Evaluation, and Protection (EMEP) Program: Climate Change Adaptation Research

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Energy. Innovation. Solutions.

Bio: Kytt MacManus

Adjunct Professor of International and Public Affairs at SIPA since 2010. Adjunct Professor of Ecology, Evolution, and Environmental Biology (E3B) at Columbia College since 2014. Geographic Information System (GIS) Programmer at the Earth Institute's Center for International Earth Science Information Network (CIESIN) since 2007.

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Kytt has extensive experience with global dataset and web application development for the NASA Socio-economic Data and Applications Center (SEDAC), a data center in NASA's Earth Observing System Data and Information System (EOSDIS) hosted by CIESIN. His research interests include the development of data driven web applications for decision support; the use integration of global population and housing census to support policy; and the use of Python for Scientific Computing. Most recently he has contributed to local research and development of GIS based interactive online decision-support systems for flood adaptation and mitigation in the Hudson River Valley, and in Jamaica Bay, New York. Globally, he has lead the effort by SEDAC to produce Gridded Population of the World Version 4 (GPW4), a data collection which includes demographic information which will be key for monitoring of progress toward the Sustainable Development Goals (SDGS).

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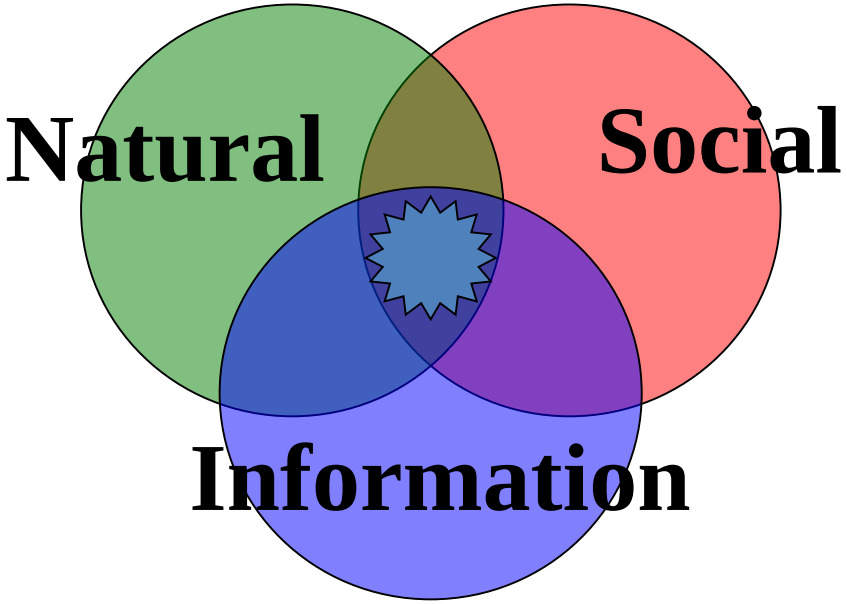
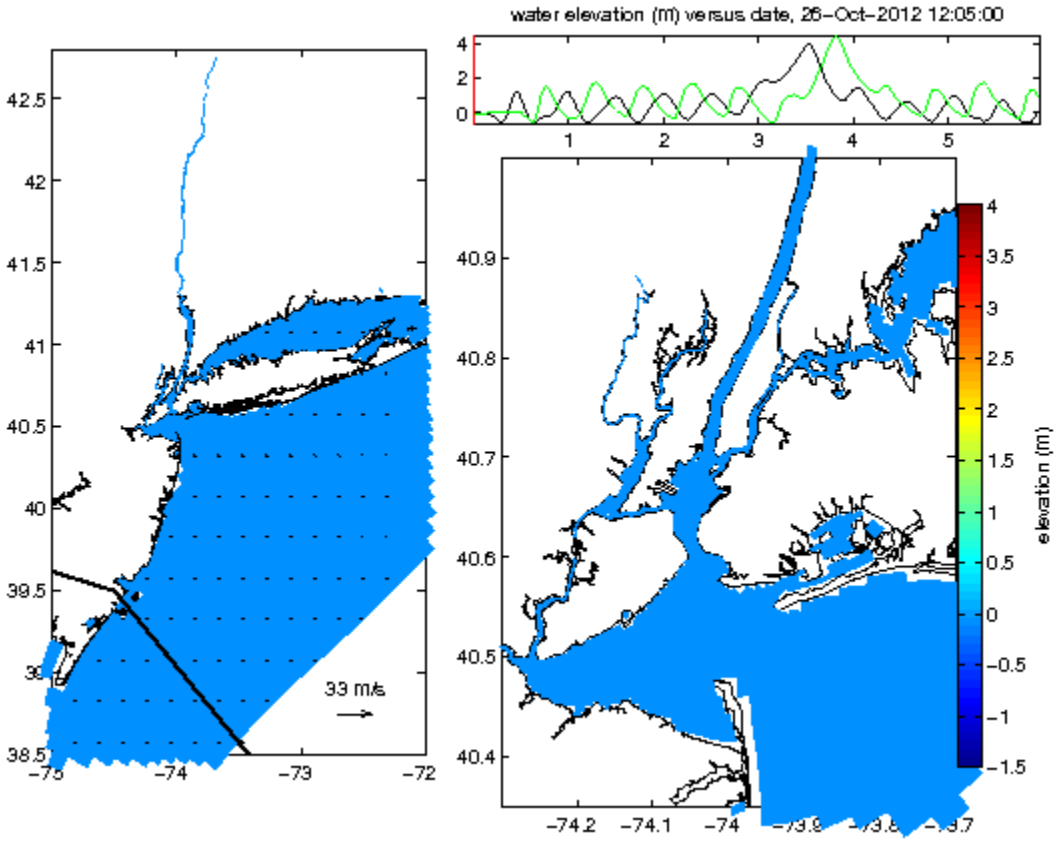


- Working at the Intersection of the natural, social and information sciences.

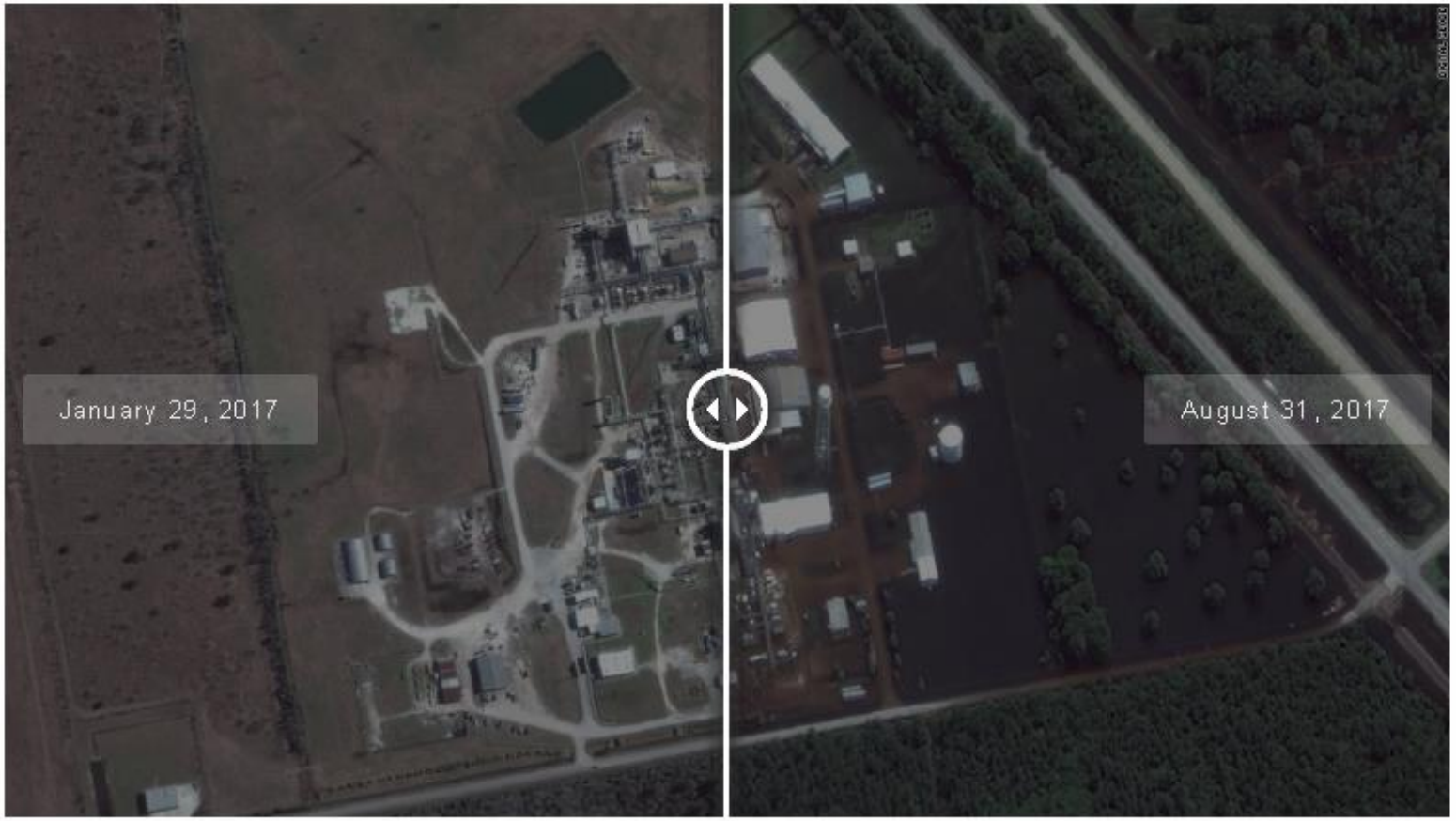
CIESIN
Columbia University

Key West Florida: September 17, 2017

Model of Hurricane Sandy



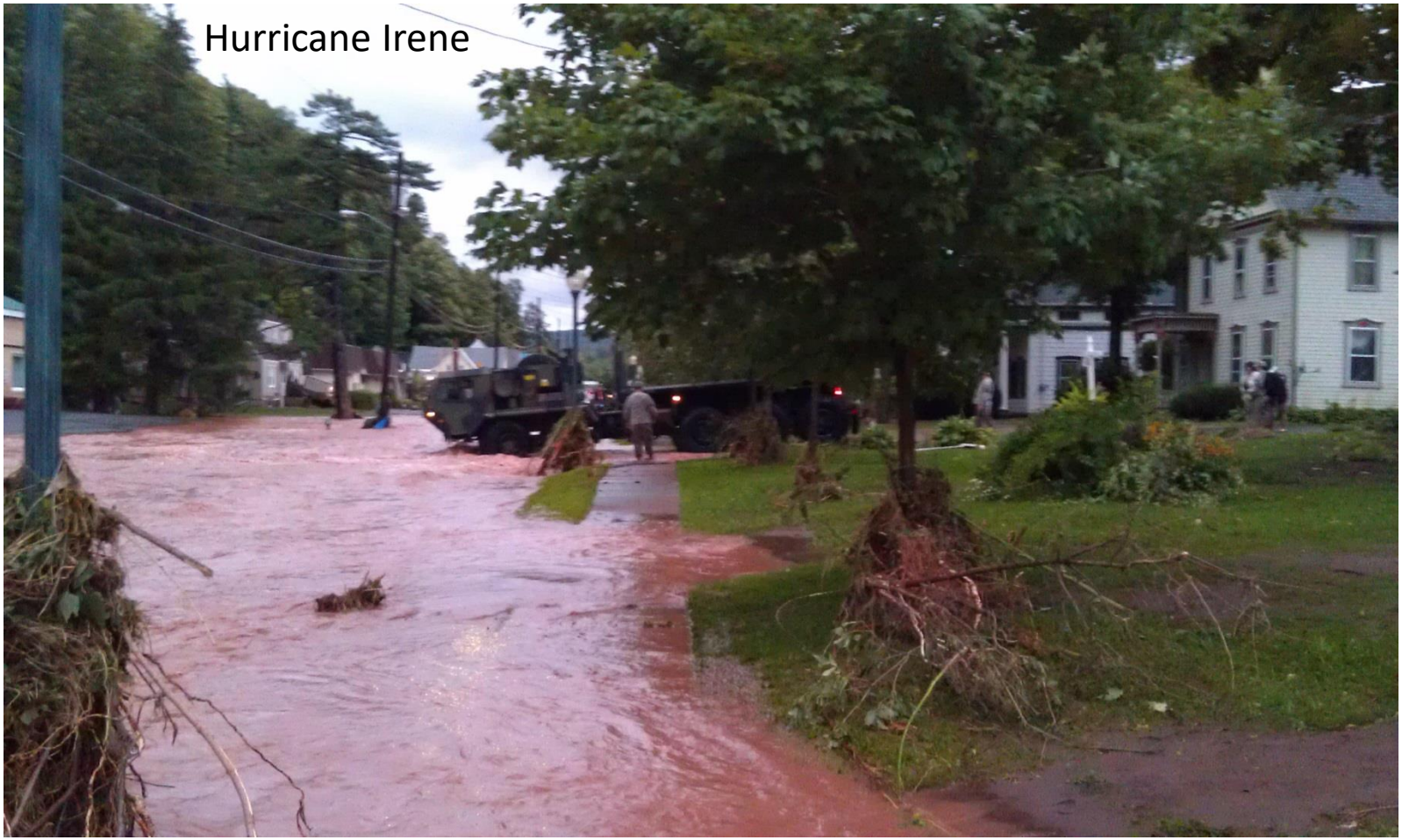
The aftermath of Hurricane Harvey



Arkema chemical plant in Crosby, Texas

DIGITAL GLOBE

Impacts in our area: Windham NY

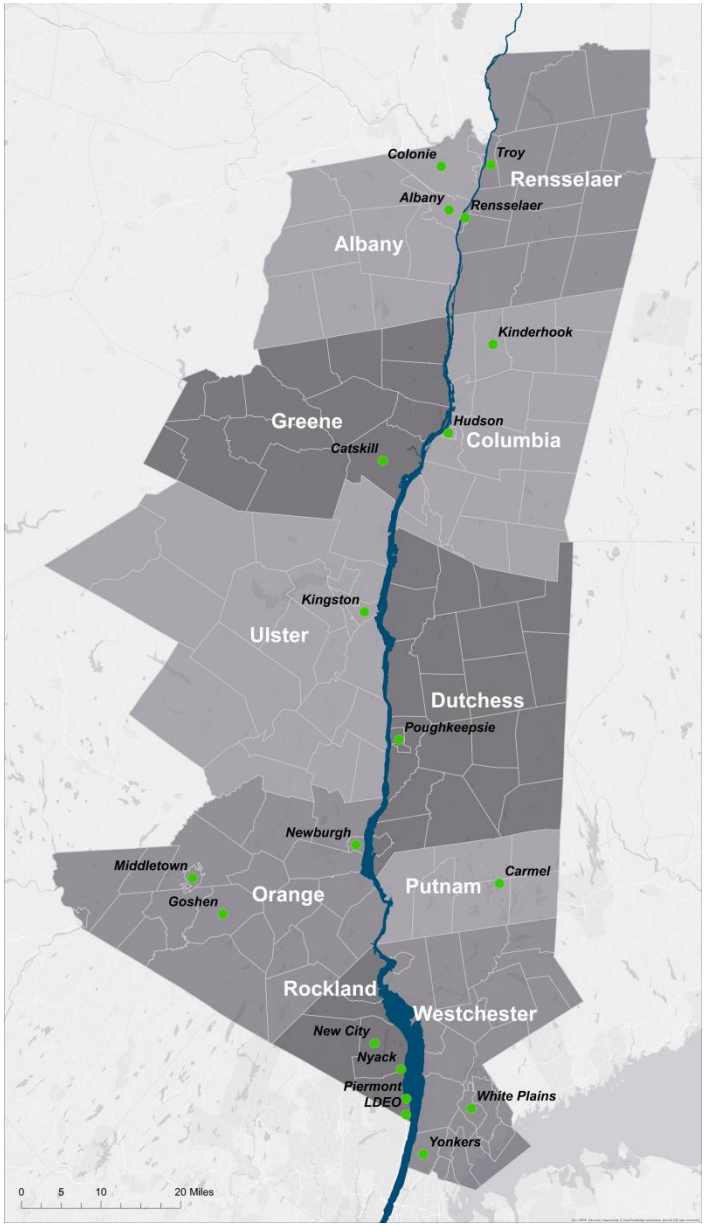


New York State
Community Risk and Resiliency Act

Primary Project Objectives

- Utilize state-of-the-art flood models and adhere to or improve upon the latest FEMA coastal flood mapping techniques.

- Create an easy to use, free, online mapping tool that lets users assess the impacts of flood inundation posed by sea level rise, storm surge, and rain events on communities bordering the Hudson River.



The Study Area

Focuses on municipal areas adjacent to the Hudson River Shoreline in 10 counties bordering the River:

Albany, Columbia, Dutchess, Greene, Orange, Putnam, Rensselaer, Rockland, Ulster, and Westchester

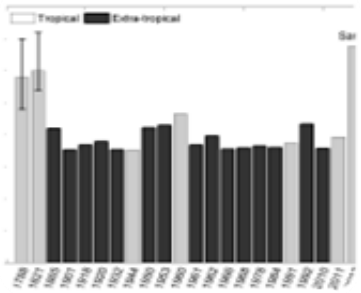
Methods: Flood Hazard Assessment

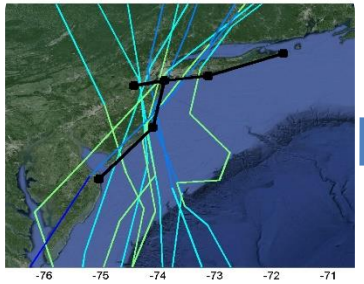
Flood modeling and mapping with Surge + Rainfall + Sea Level Rise
5-year through 1000-year flood zones
Sea level rise scenarios: 0”, 6”, 12”, 18”, 24”, 30”, 36”, 48”, 60”, 72”

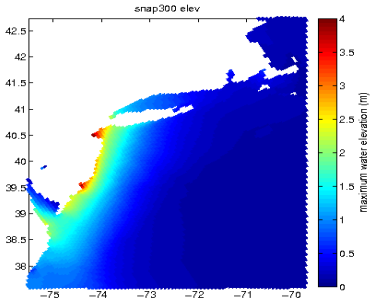
validation

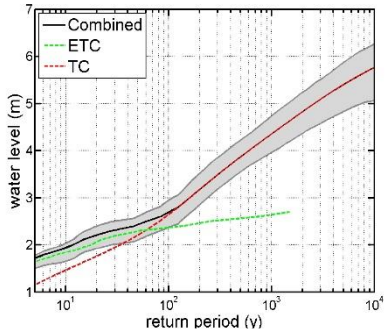
validation

validation









Historical analysis
- Flood events
- Flood probability

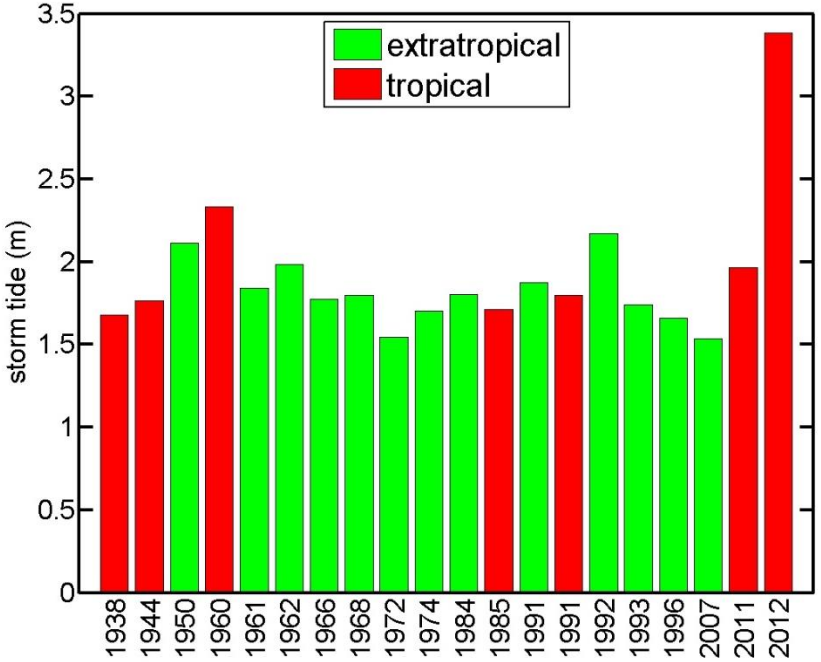
Storm climatology
- Tropical
- Extratropical

Flood modeling
- Meteorology
- Ocean (river)

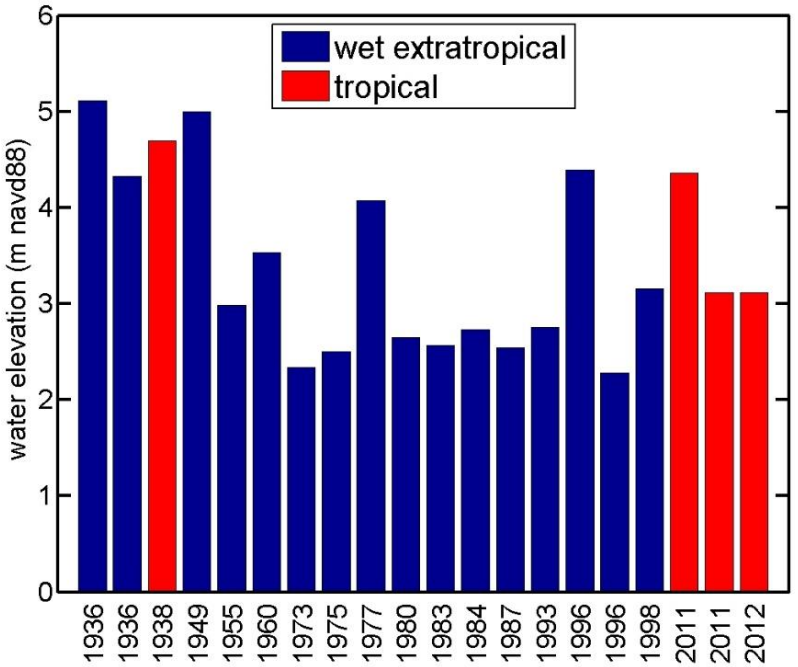
Statistical analysis
- Probability
- Uncertainty

Storm Categories: Historical Floods

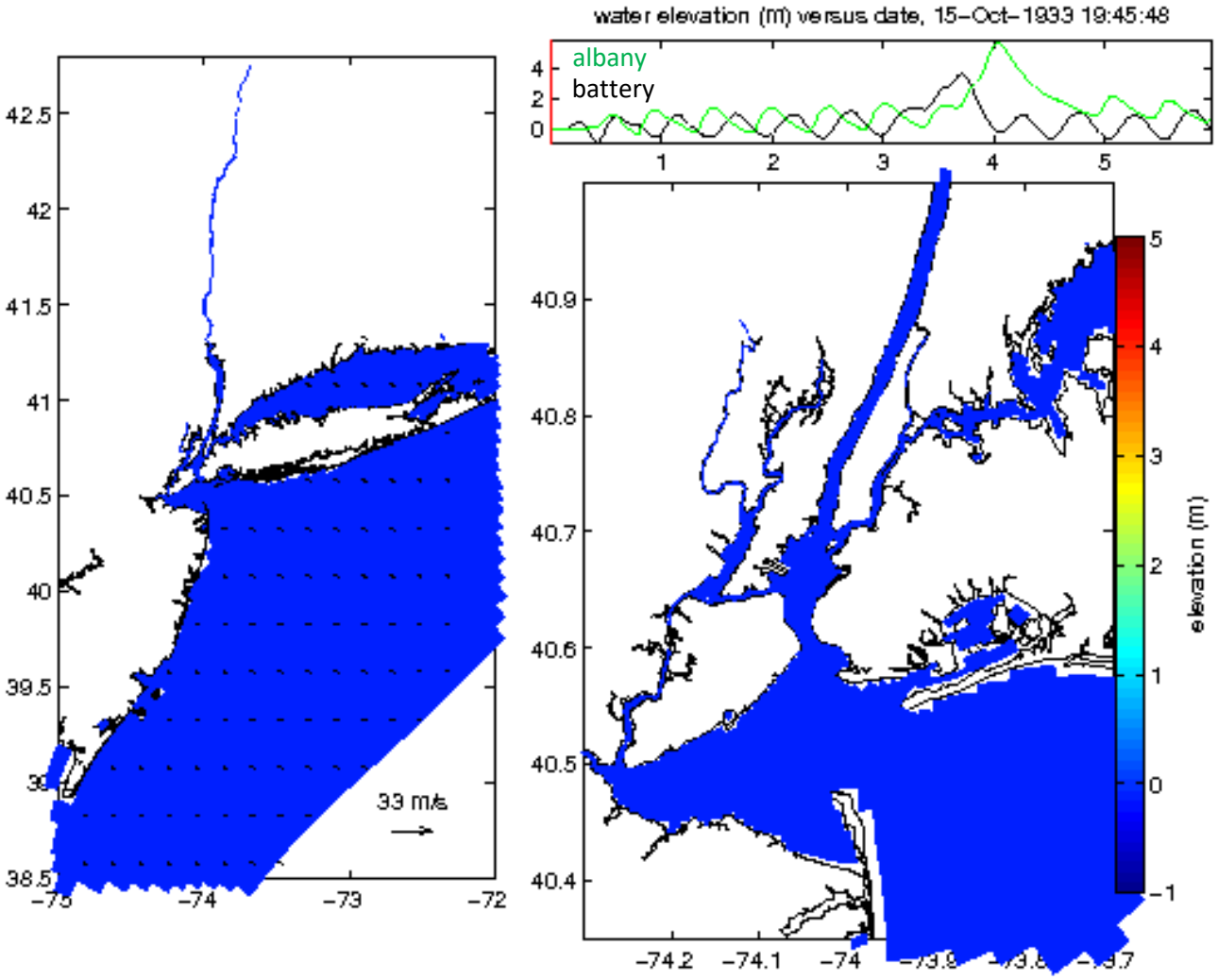
Battery Historical
Top-20 (1931-2012)



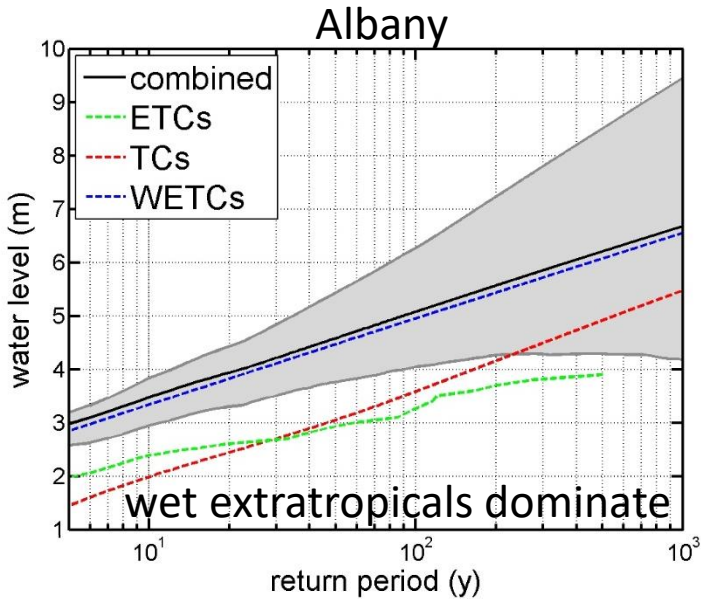
Albany Historical
Top-20 (1931-2012)

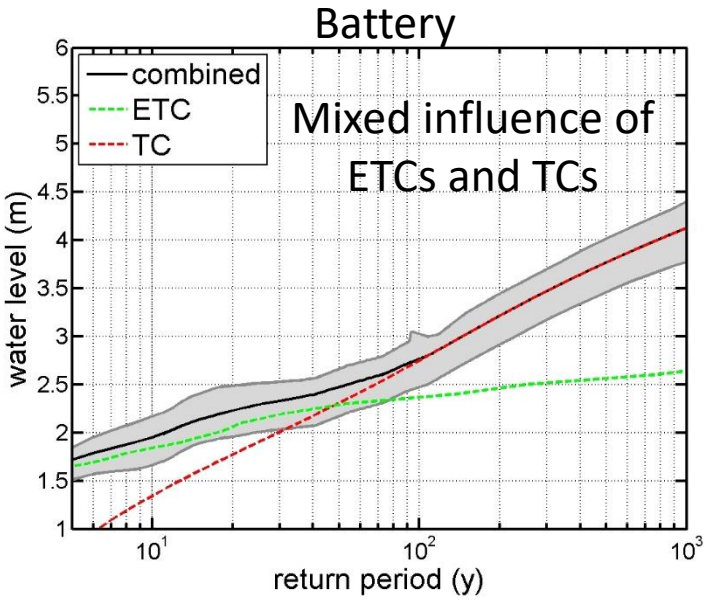


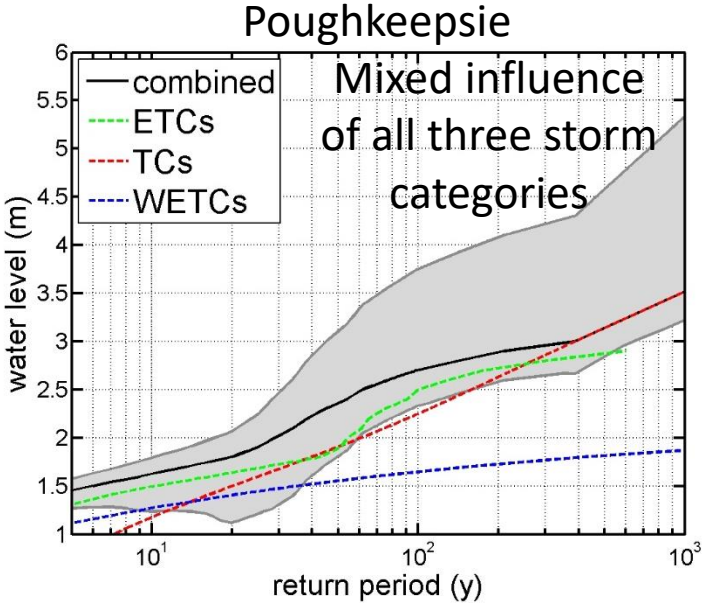
Sample Animation of Flood Event: A (Synthetic) Rainy Tropical Cyclone



Results
Flood Exceedance Curves for Hudson and its Floodplain



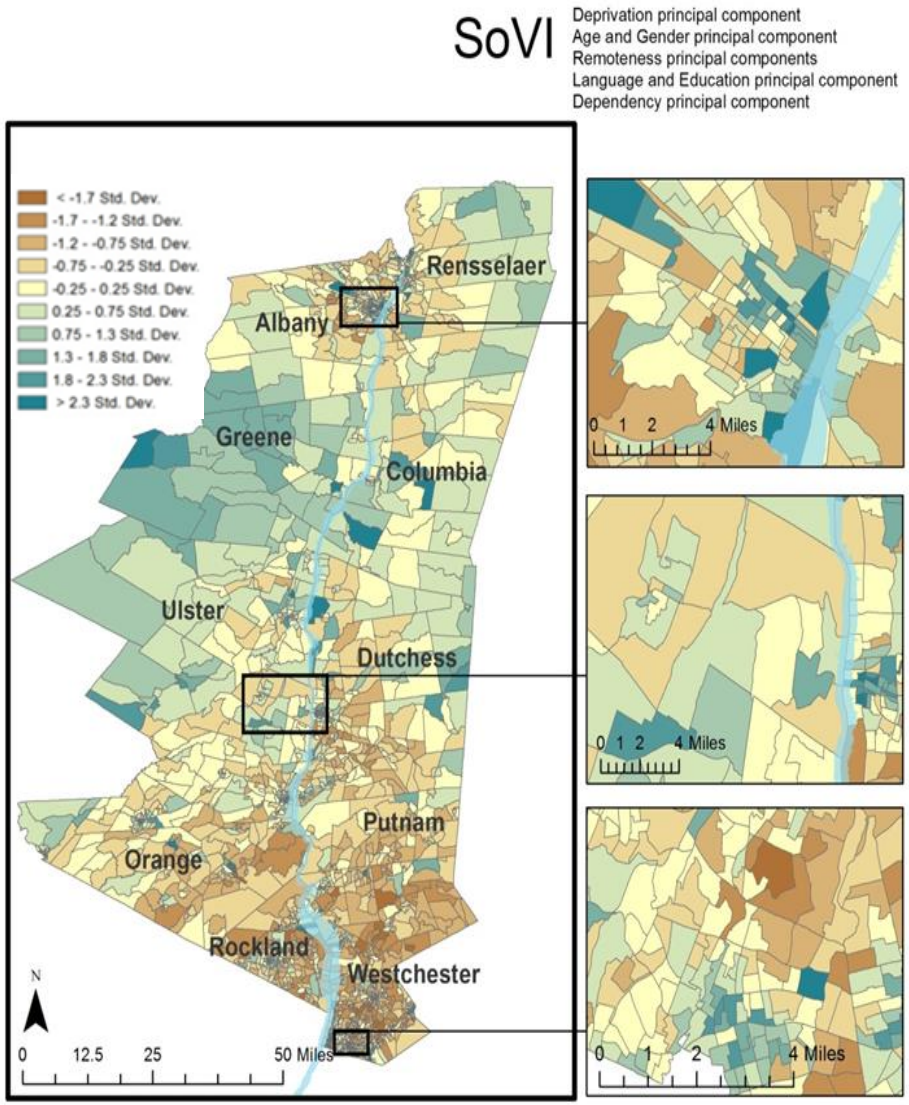




Social Vulnerability Index Component

- The Social Vulnerability Index identifies at-risk populations of U.S. census block groups as relates to environmental hazards.

- The theoretical framework of our index includes dimensions of vulnerability that are most commonly found in the literature: social and economic status, health, education and housing .

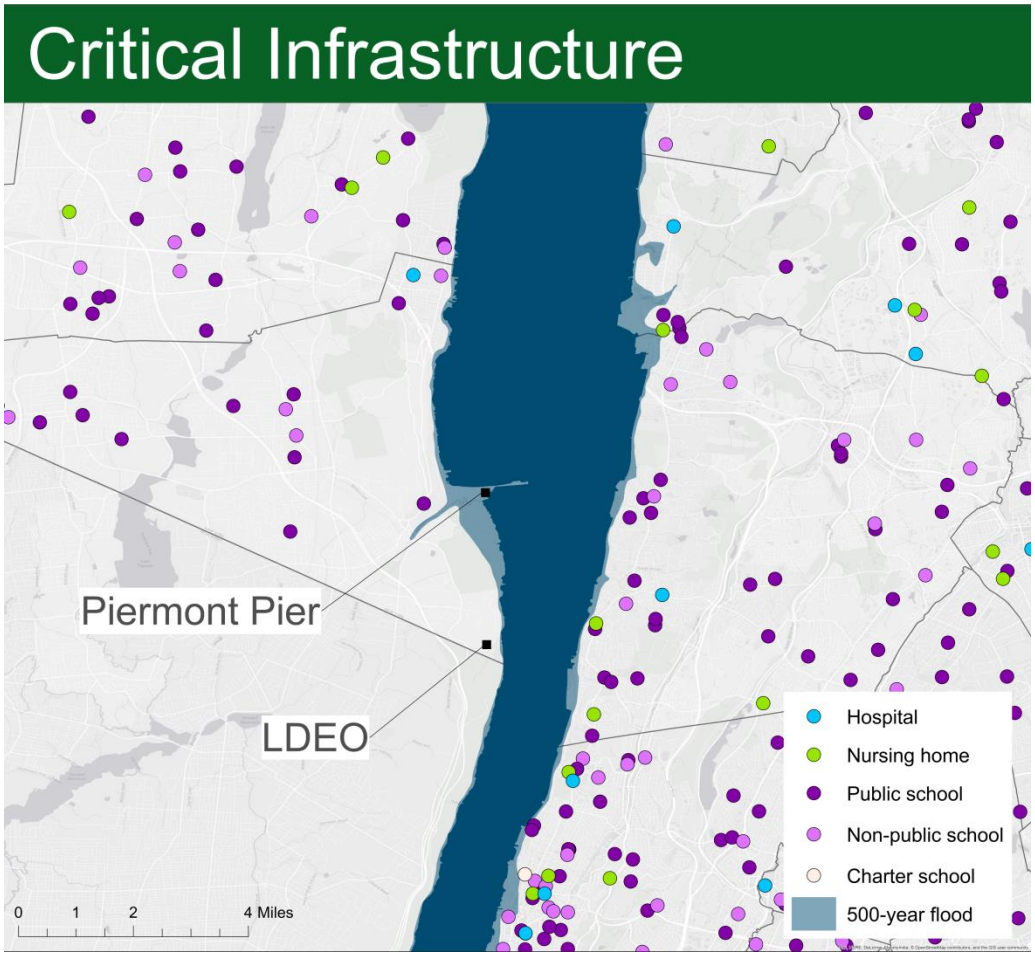


Social Vulnerability Index Principal Components and Demographic Variables Used

***variables sourced from Census 2010 and American Community Survey**

	PC1	PC2	PC3	PC4	PC5
Variables	Renting	Over 75 years old	Distance to hospitals	English as second language	Female
	No vehicle	Female headed households	Mobile homes	Less than high school education	Less than 5 years old
	Poverty	Social Security benefits	Income over 100,000(inverse)	Children in married couple families	Population in nursing homes
	Per capita income(inverse)	Median age	Asian	Hispanic	Population per housing unit
	Population density				
	Employment in services				
	Black				
	Urban				

Critical Infrastructure Component

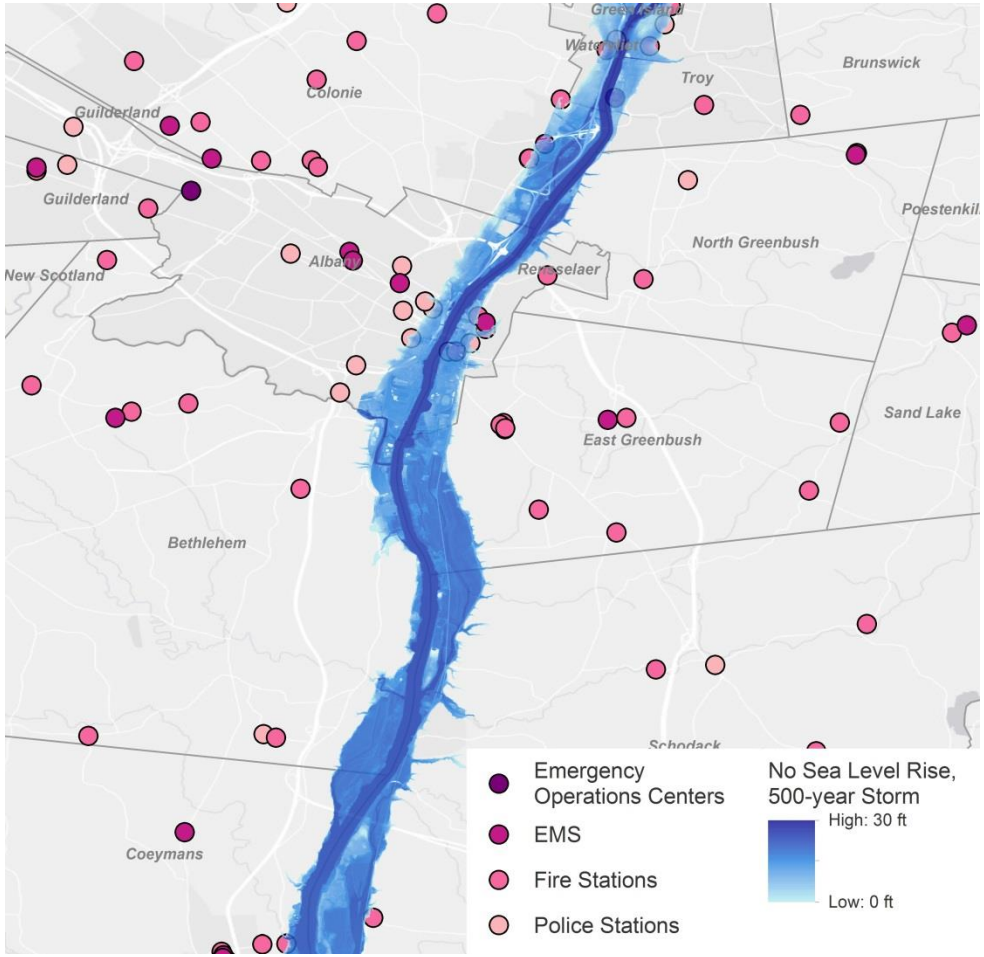


This map shows the locations of critical infrastructure for the area around Piermont Pier and Lamont-Doherty Earth Observatory - Columbia University (LDEO).

The geographic database of critical infrastructure (CI) in our study area includes information on

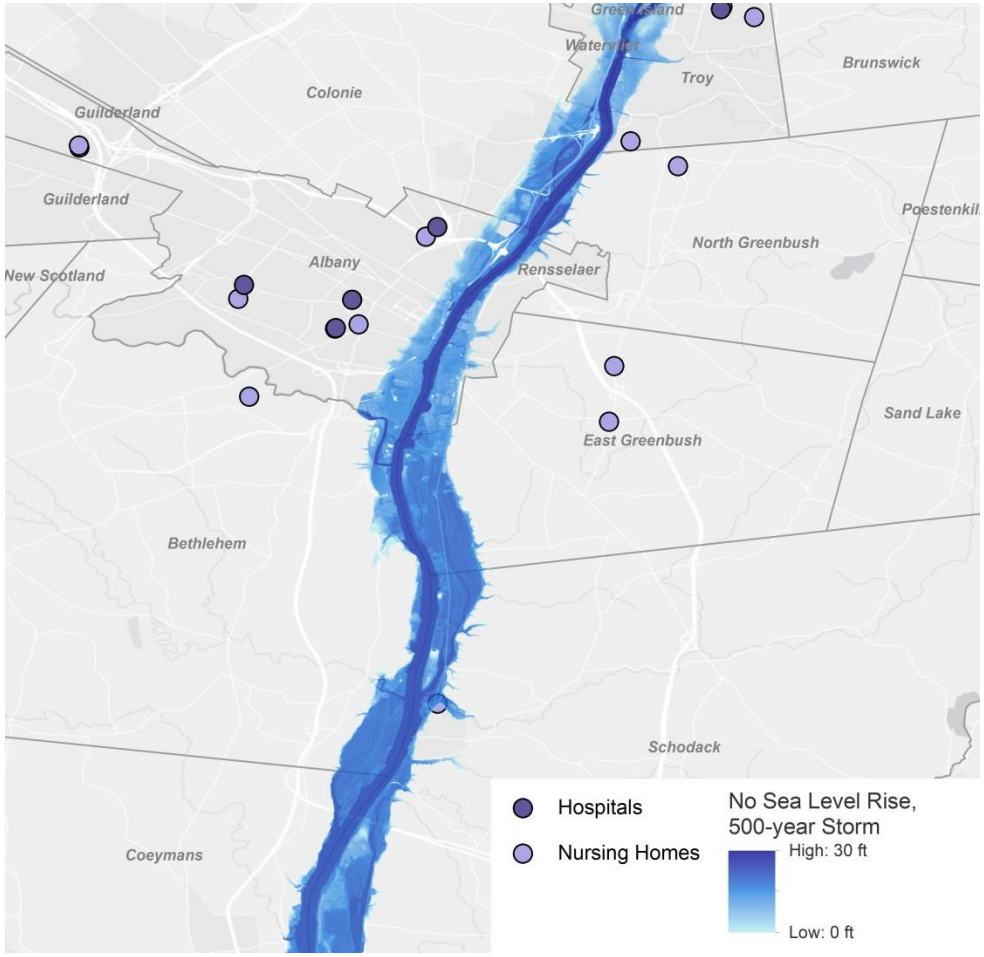
1. **Transportation**
2. **Health facilities**
3. **Schools**
4. **Energy infrastructure**
5. **Water treatment plants**
6. **Emergency operation centers**
7. **Other critical assets**

Critical Infrastructure Component:
Emergency Services



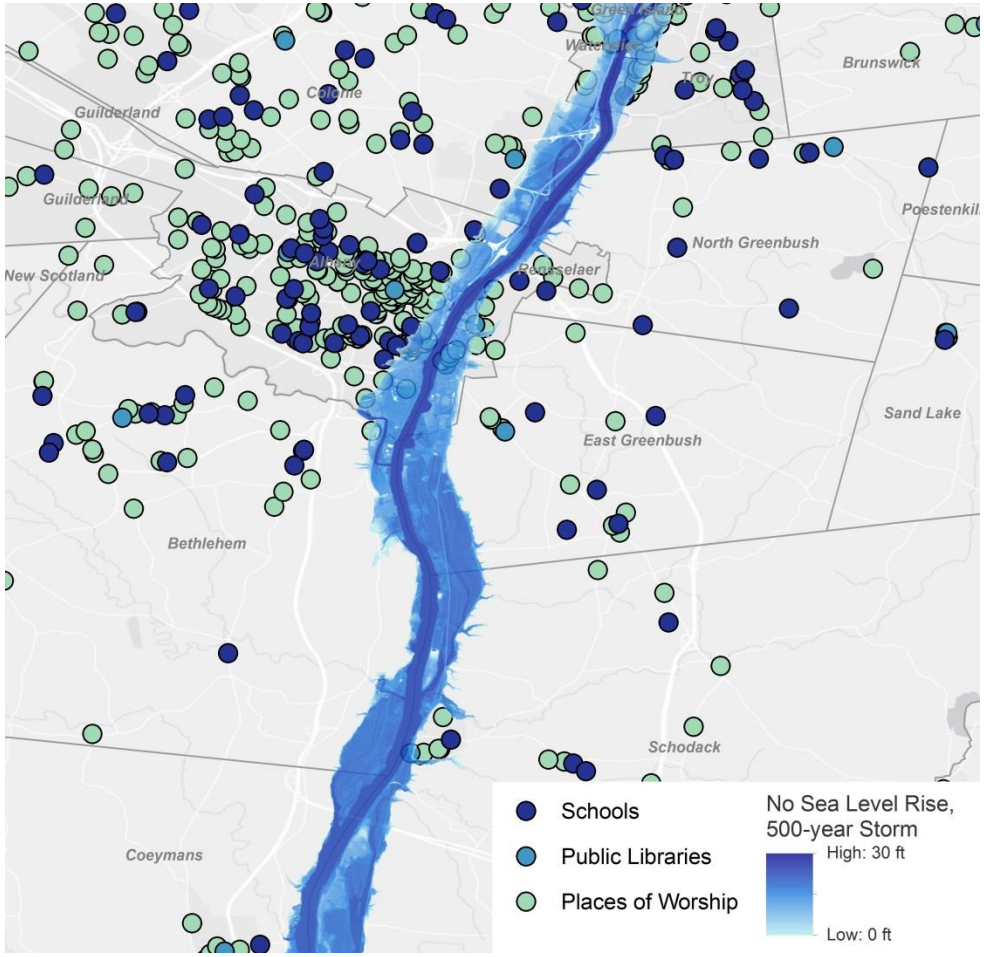
This map shows a 500-year flood and the locations of emergency services (Emergency Operations Centers, EMS, Fire Stations, and Police Stations) for the area around Albany.

Critical Infrastructure Component:
Health Services



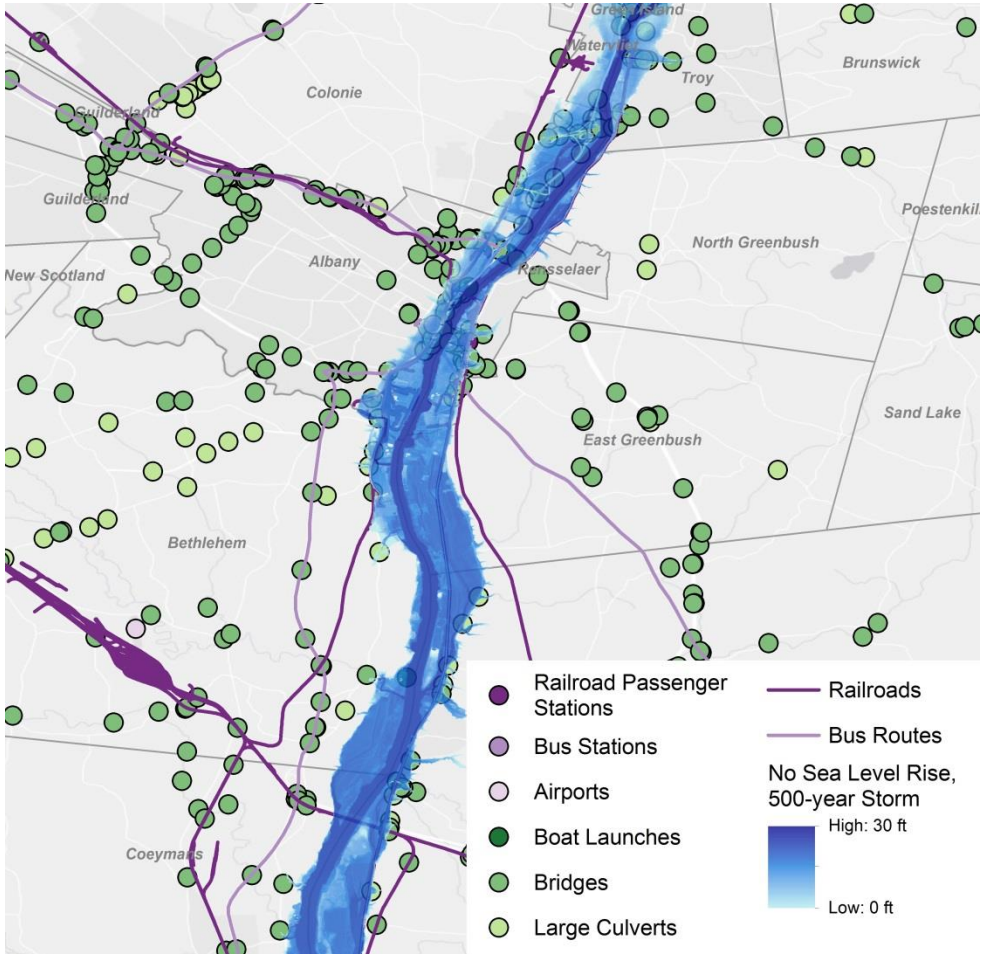
This map shows a 500-year flood and the locations of health services (hospitals and nursing homes) for the area around Albany.

Critical Infrastructure Component:
Institutions



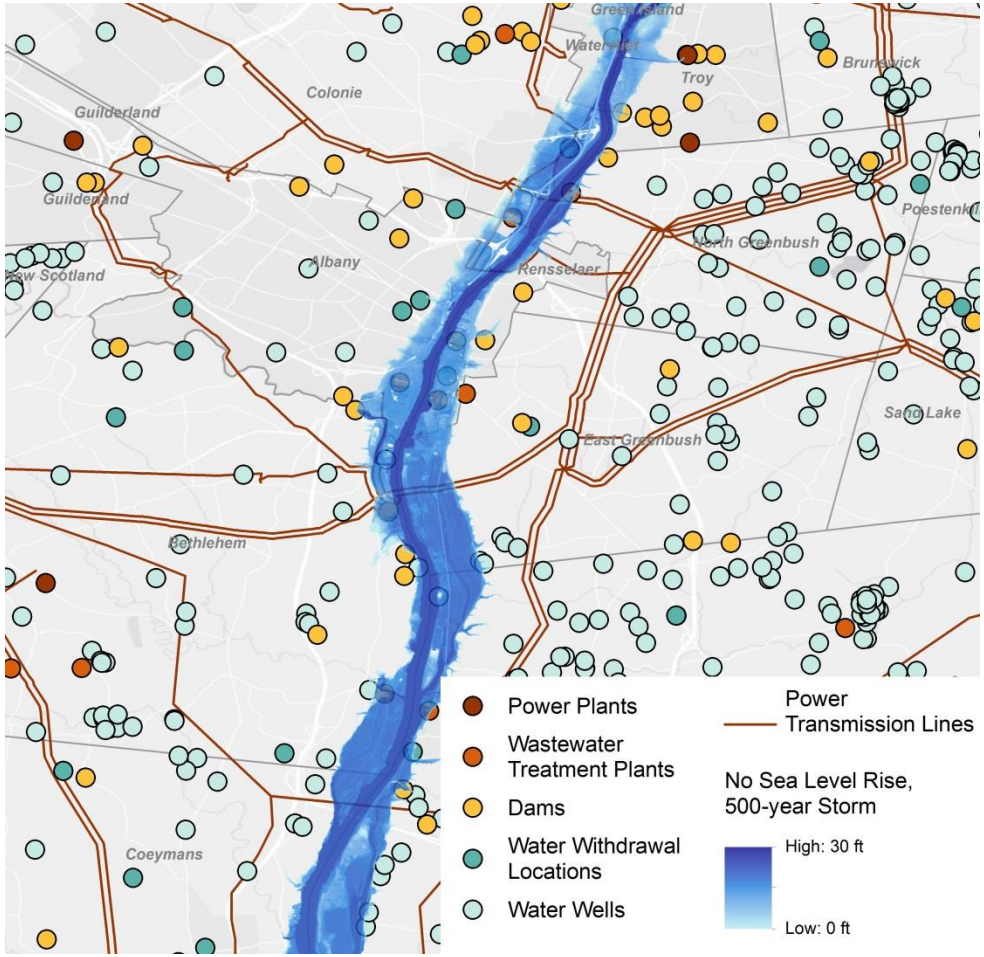
This map shows a 500-year flood and the locations of institutions (schools, public libraries, and places of worship) for the area around Albany.

Critical Infrastructure Component:
Transportation



This map shows a 500-year flood and the locations of transportation services (railroads, busses, airports, boat launches, bridges, and culverts) for the area around Albany.

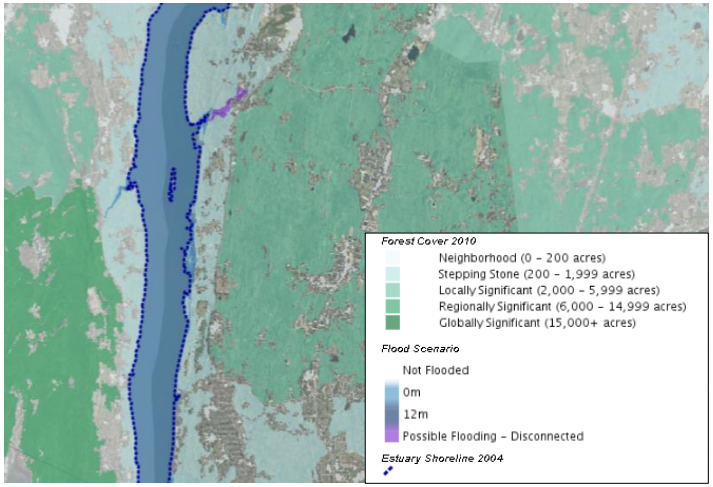
Critical Infrastructure Component:
Utilities



This map shows a 500-year flood and the locations of utilities (power plants, power transmission lines, wastewater treatment plants, dams, water withdrawal, and water wells) for the area around Albany.

Natural Resilience Features Component

- Natural areas like forests, wetlands, and floodplains are vital assets to consider in assessing vulnerability and planning for resilience. In contrast to impervious developed areas, these natural features retain, slow, filter, and infiltrate water to the soil, reducing erosion and flood impacts.

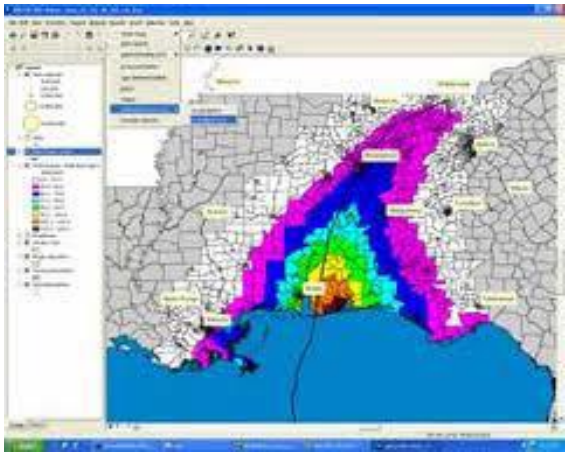


- Variables include Wetlands, Forests, Floodplain, and impervious surfaces in acres or as percentages of total municipal land area.

- Used together with the ecology and infrastructure layers, these results allow you to analyze spatial patterns and to locate areas of particular vulnerability as well as natural areas of greatest importance to slow and store water during a flood.

Impact Assessments Component

- Estimate damage to buildings and their contents
- Estimate number of building affected
- Estimate the number of critical infrastructure facilities affected



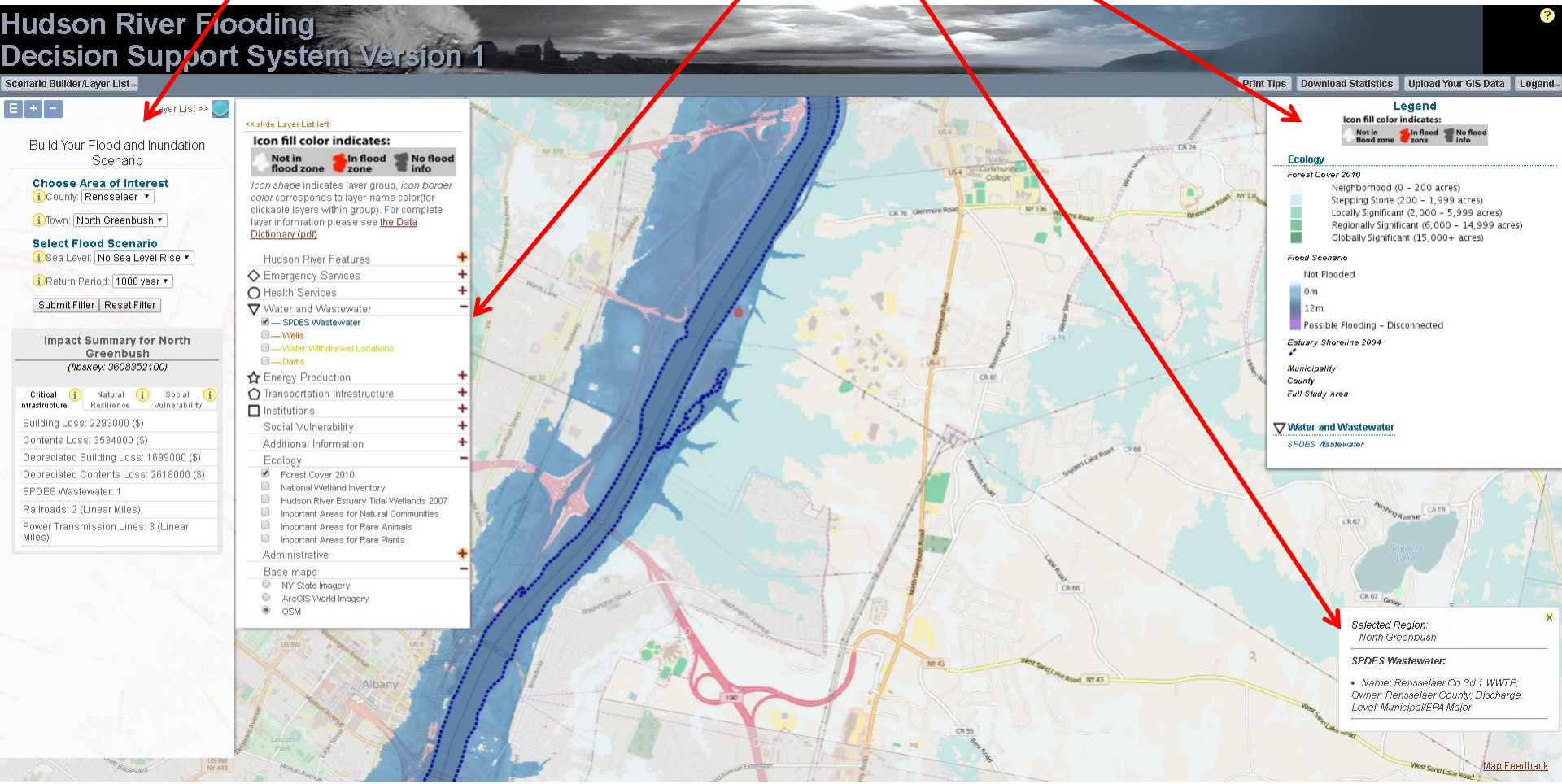
Interactive mapping application

- Key functionalities
  - **Visualize flood scenarios** for an array of SLR and Storm Return Period Options
  - **Display and make available for download impact assessment estimates by municipality and flood scenario** based on HAZUS and summaries of Social Vulnerability and Natural Resilience metrics
  - Enable users to print their scenario map
  - **Enable users to upload and visualize their own shapefiles**
  - Provide OGC Interoperable Web Services

Interactive Mapping Application

Choose from Among 80 Sea Level & Storm Return Scenarios

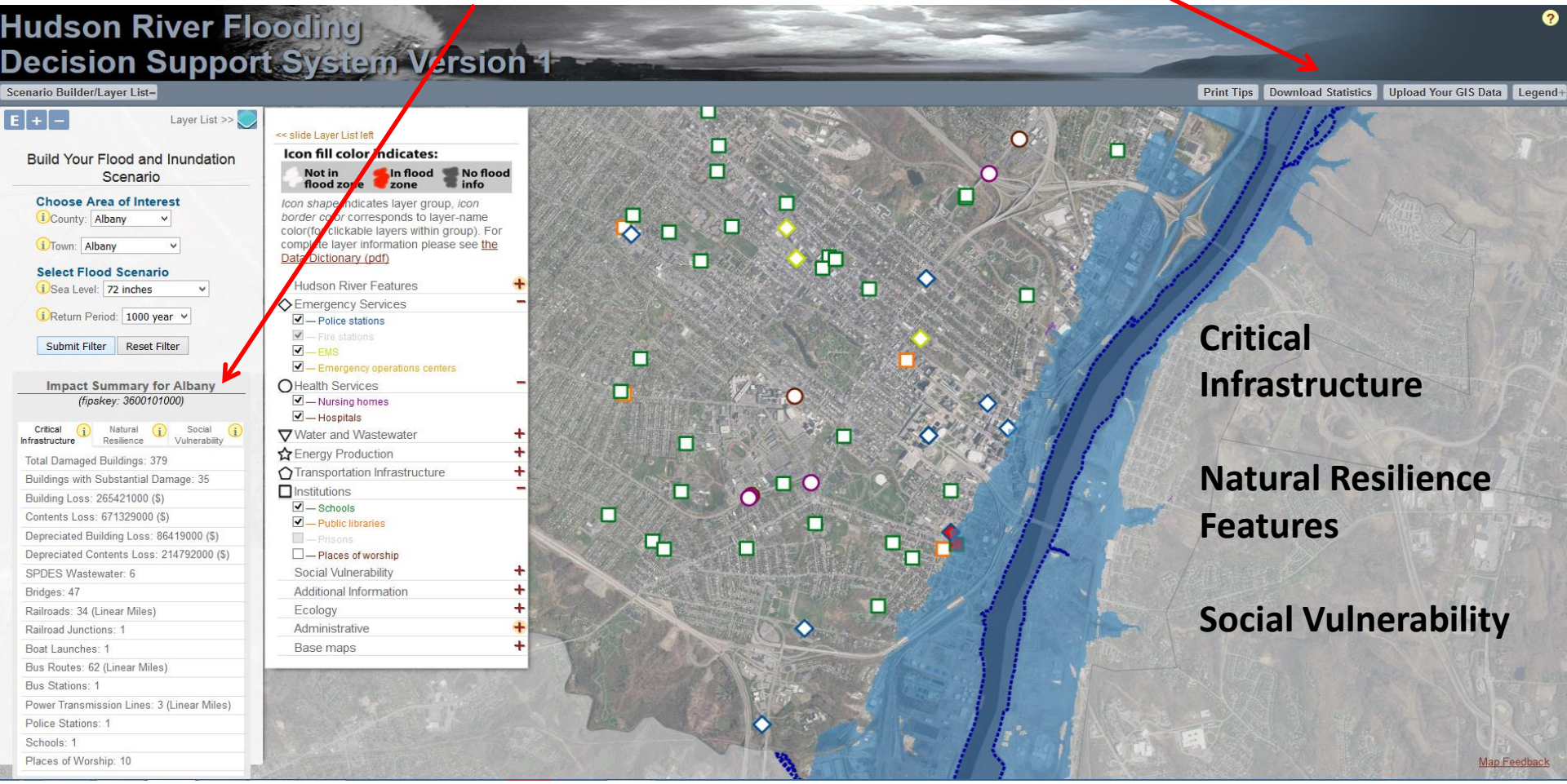
More than 30 operational layers



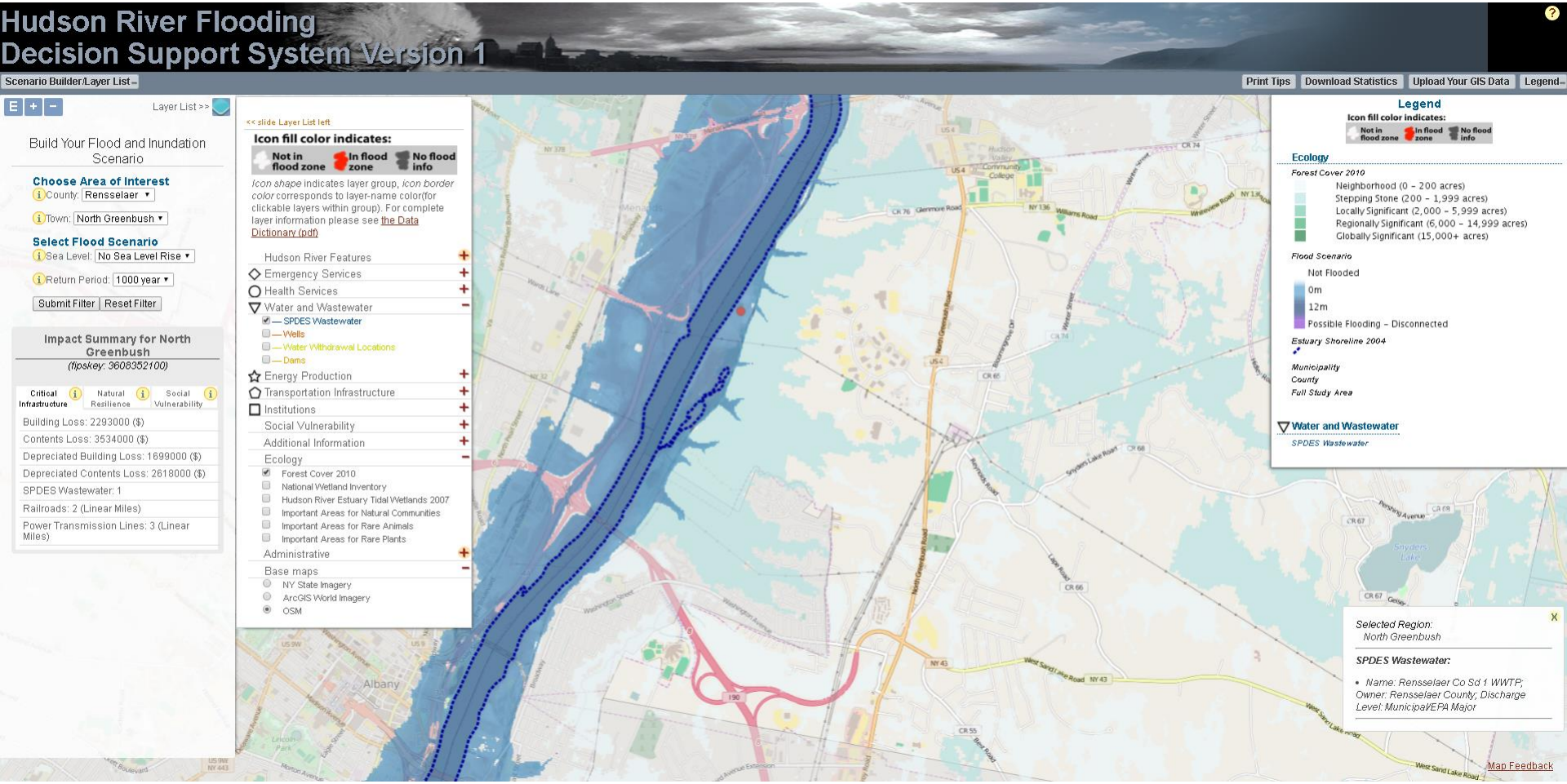
Interactive Mapping Application

Descriptive Statistics of Potential Impacts with each scenario

Available for download in Excel format



Interactive Mapping Application



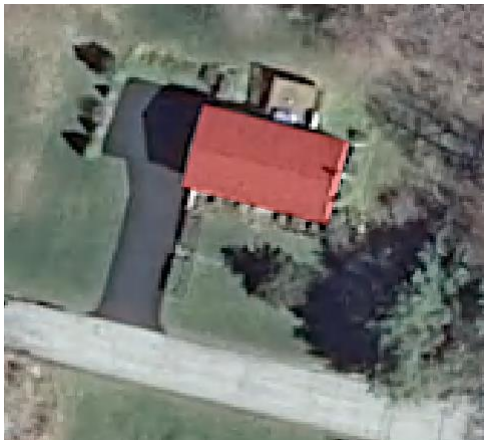
http://www.ciesin.columbia.edu/hudson-river-flood-map/

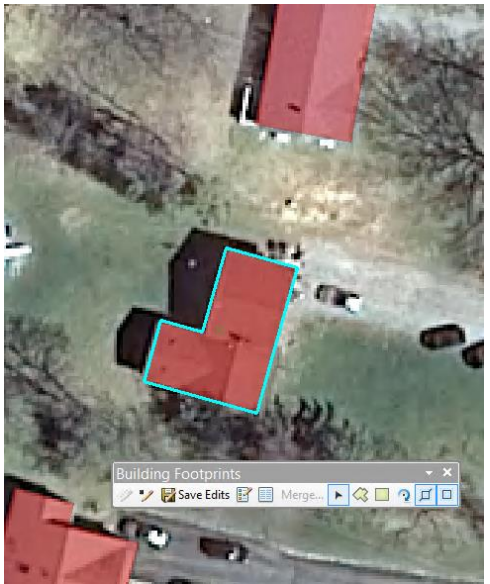
http://fidss.ciesin.columbia.edu

Continuing to Improve

Building data for climate change adaptation: filling data gaps and characterizing storm surge impacts in the Hudson River Valley and Long Island

- NYSERDA PON 2941: Climate Change Adaptation Research and Strategies
- 2 year project





Open and Accessible Building Footprints

- All counties adjacent to the Hudson River from the southern border of Westchester County to the Federal Dam at Troy, as well as counties outside NYC adjacent to Long Island Sound.

- Will be assigned attributes from New York State Office of Real Property Services

- Site-specific adaptation options will also be developed and assigned as building-footprint attributes