

Center for International Earth
Science Information Network
EARTH INSTITUTE | COLUMBIA UNIVERSITY

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Building Data for Climate Change Adaptation

Filling data gaps and characterizing storm surge impacts in the
Hudson River Valley and Long Island

Center for International Earth Science Information Network

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The screenshot shows the CIESIN website homepage. At the top, the header reads "Center for International Earth Science Information Network" and "EARTH INSTITUTE | COLUMBIA UNIVERSITY". Below the header is a navigation bar with "HOME" and "CONTACT INFO" links, and a search box. The main content area is divided into several sections: "About Us" (Overview, Capabilities, Research, Sponsors, Data Policies, Annual Message, Location & Directions, Employment Opportunities), "Programs & Projects" (Socioeconomic Data and Applications Center (SEDAC), IPCC Data Distribution Centre (DDC), Environmental Performance Index (EPI), Africa Soil Information Service (AFSIS), Population-Environment Research Network (PERN), Environment and Security Research Translation Core (RTC), Columbia University Superfund Research Program (SRP)), "Data & Information" (Search SEDAC Data, Browse by Subject, Online Tools and Applications), and "Education & Outreach". The "Welcome" section introduces CIESIN as a center within the Earth Institute at Columbia University, focusing on the intersection of social, natural, and information sciences. It highlights "Selected Blog Posts" such as "Indicators Support MCC Goals for Low-Income Country Development" and "New Mapping Tools Support Environmental Decision Making for Jamaica Bay". The "In the Spotlight" section features two screenshots of mapping tools: the Jamaica Bay Water Quality Data Visualization and Access Tool (left) and the AdaptMap tool (right). The "News & Events" section lists recent activities like a meeting in Grenoble and a day devoted to data science. The "In the Media" section mentions Obama's climate change stance and research on mangroves. A "Quick Links" section at the bottom provides access to the 2016 Environmental Performance Index (EPI).



Hudson River Flooding Decision Support System Version 1



Scenario Builder/Layer List

Print Tips Download Statistics Upload Your GIS Data Legend

E + - Layer List >>

Build Your Flood and Inundation Scenario

Choose Area of Interest

County: Albany

Town: Albany

Select Flood Scenario

Sea Level: 6 inches

Return Period: 500 year

Submit Filter Reset Filter

Impact Summary for Albany (fipskey: 3600101000)

| Critical Infrastructure | Natural Resilience | Social Vulnerability |
|--|--------------------|----------------------|
| Total Damaged Buildings: 245 | | |
| Building Loss: 132822000 (\$) | | |
| Contents Loss: 418214000 (\$) | | |
| Depreciated Building Loss: 43488000 (\$) | | |
| Depreciated Contents Loss: 134055000 (\$) | | |
| SPDES Wastewater: 6 | | |
| Bridges: 41 | | |
| Railroads: 34 (Linear Miles) | | |
| Railroad Junctions: 1 | | |
| Boat Launches: 1 | | |
| Bus Routes: 61 (Linear Miles) | | |
| Bus Stations: 1 | | |
| Power Transmission Lines: 3 (Linear Miles) | | |
| Schools: 1 | | |
| Places of Worship: 8 | | |

<< slide Layer List left

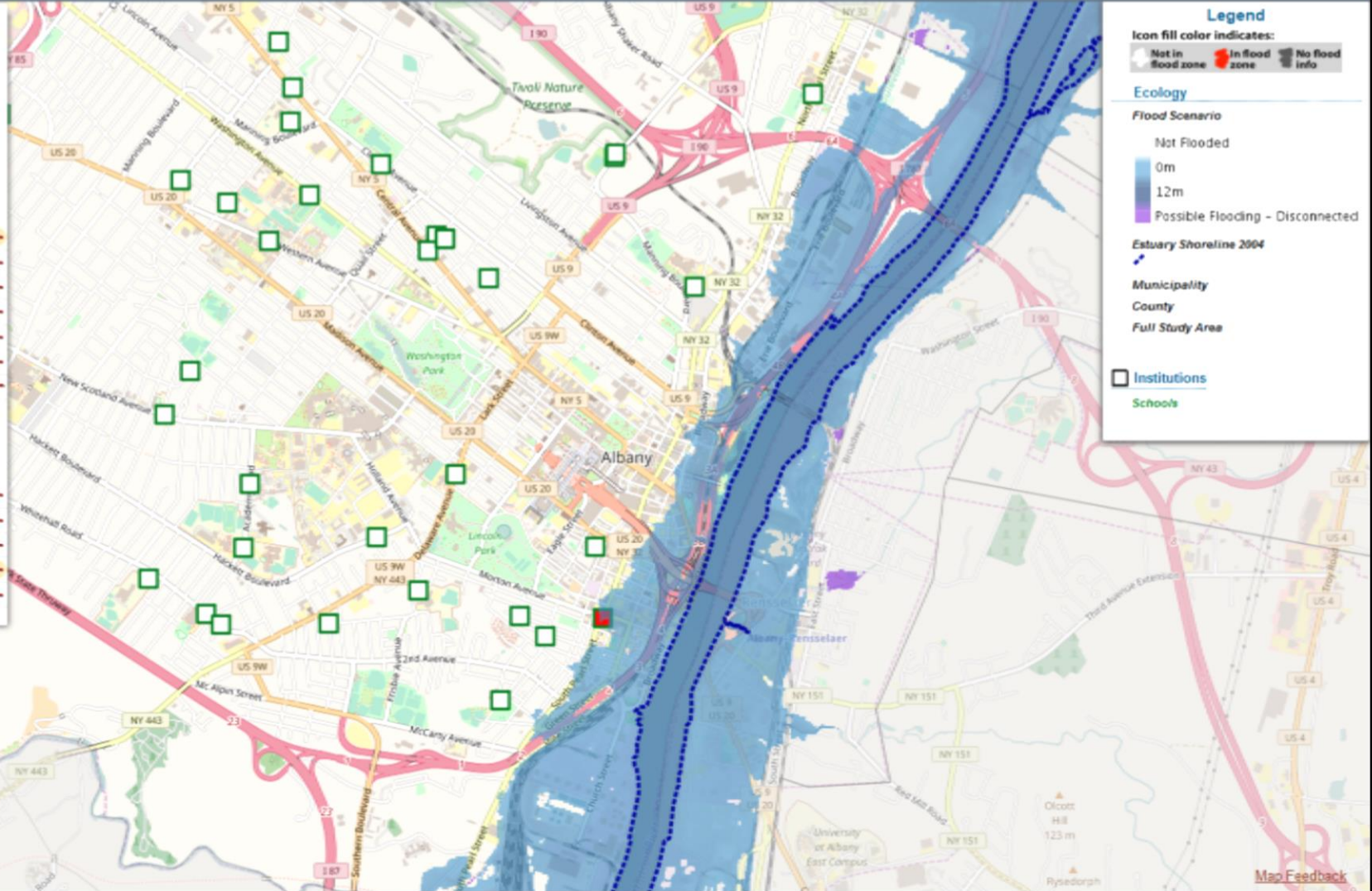
Icon fill color indicates:

- Not in flood zone
- In flood zone
- No flood info

Icon shape indicates layer group, icon border color corresponds to layer-name color (for clickable layers within group). For complete layer information please see [the Data Dictionary \(pdf\)](#)

Hudson River Features

- Emergency Services
- Health Services
- Water and Wastewater
- Energy Production
- Transportation Infrastructure
- Institutions
 - Schools
 - Public libraries
 - Prisons
 - Places of worship
- Social Vulnerability
- Additional Information
- Ecology
- Administrative
- Base maps



Legend

Icon fill color indicates:

- Not in flood zone
- In flood zone
- No flood info

Ecology

Flood Scenario

- Not Flooded
- 0m
- 12m
- Possible Flooding - Disconnected

Estuary Shoreline 2004

Municipality

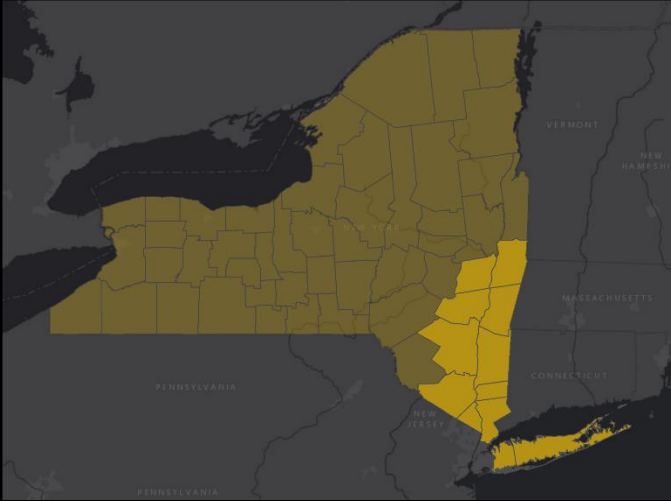
County

Full Study Area

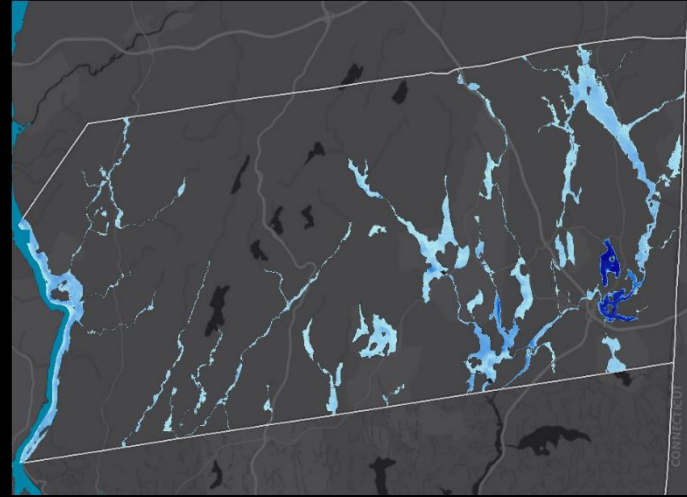
Institutions

Schools

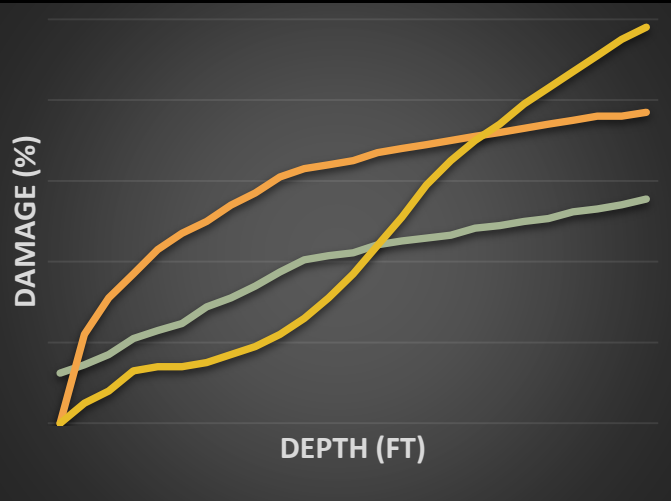
Primary Project Objectives



1. Expand the study area



2. Add Inland floods and building footprints



3. Perform detailed hazard assessment



4. Enable data downloading

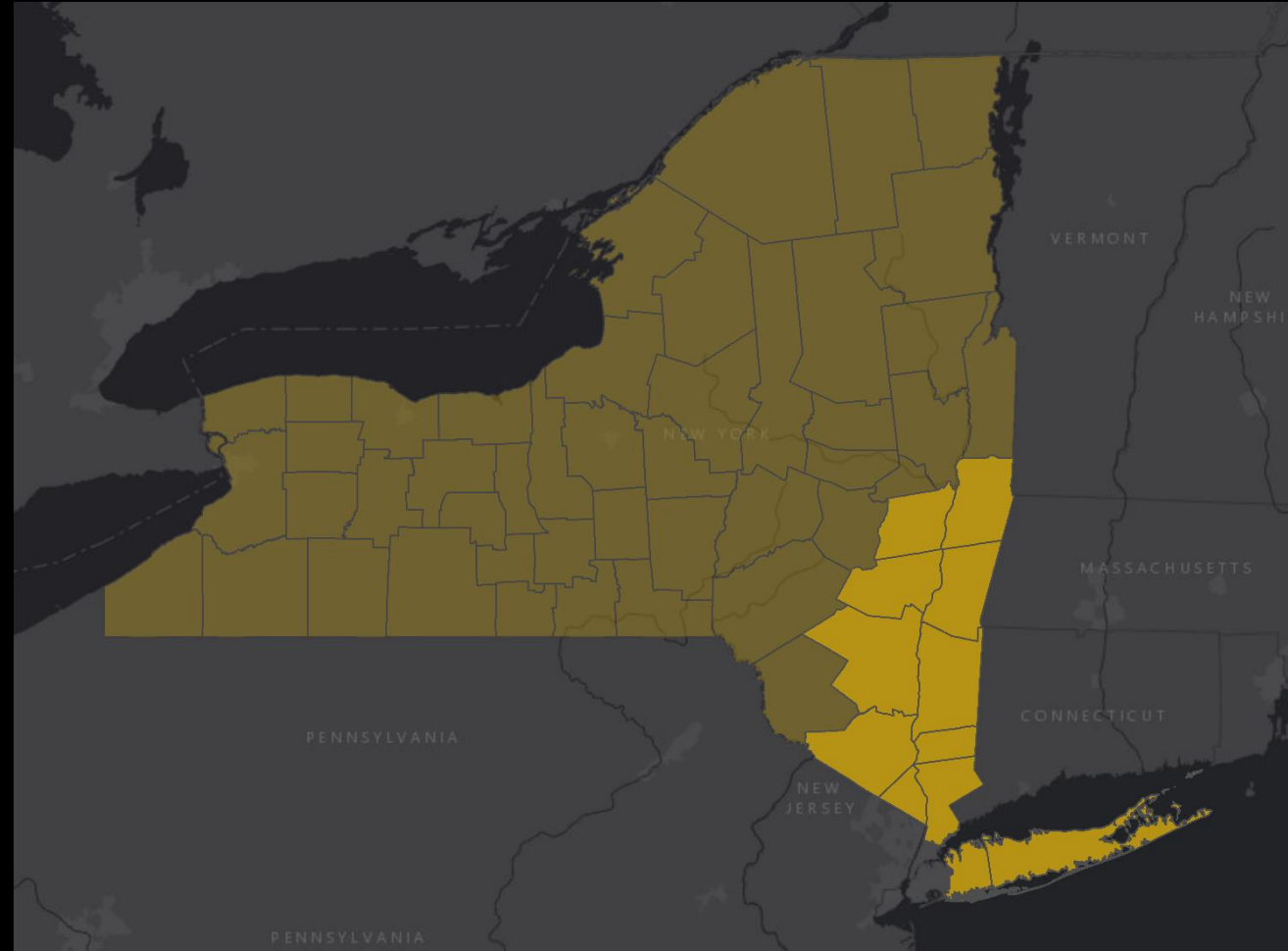
1. Update the current web mapping application to encompass NYS.
2. Incorporate inland flood scenarios and building footprints
3. Perform detailed hazard assessment
4. Allow users to download data sets used within the mapper

Hudson River Flood Impact Decision Support System

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

Update Mapper Extent

- The current mapping extent consists of the 10 counties along the Hudson River
- Data collection and processing is currently underway for the rest of NYS
- Includes the expansion of other data sets currently within the mapper:
 - Critical Infrastructure geodatabase
 - Flood Scenarios

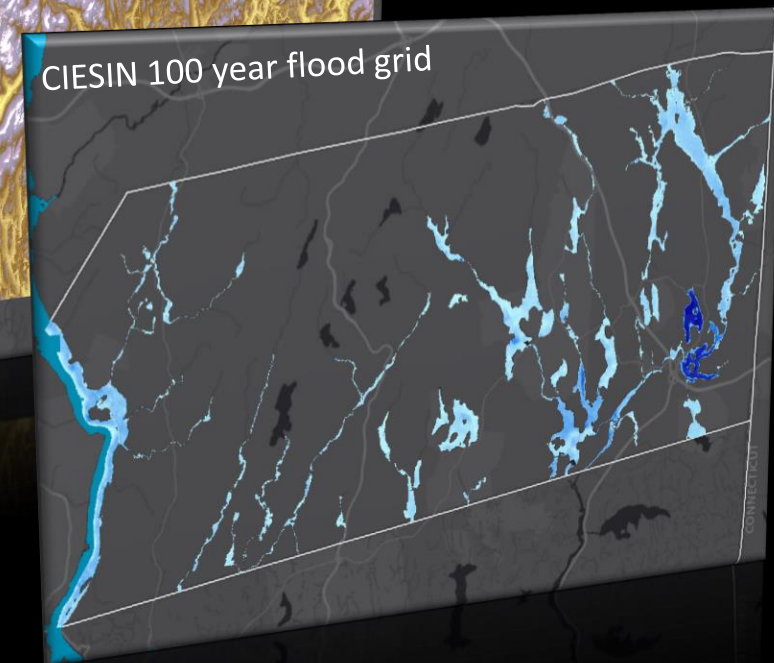
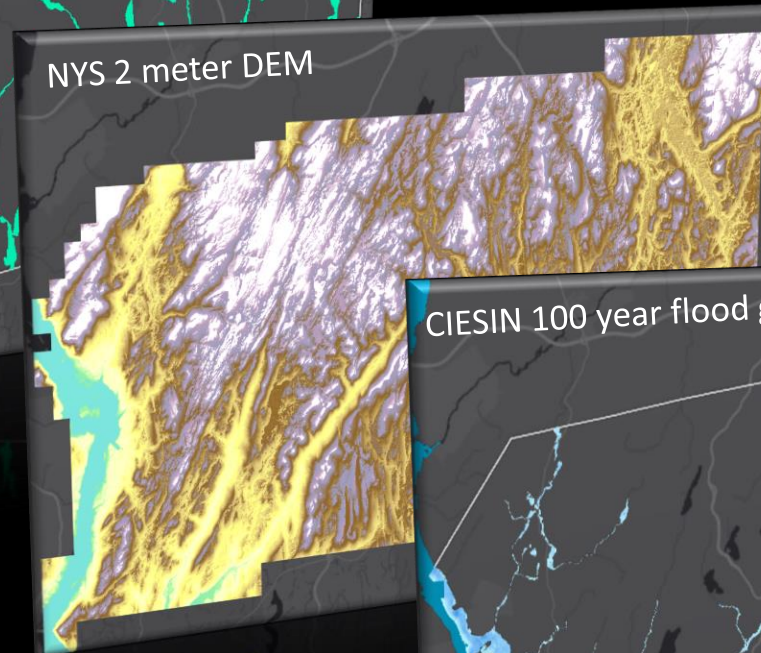
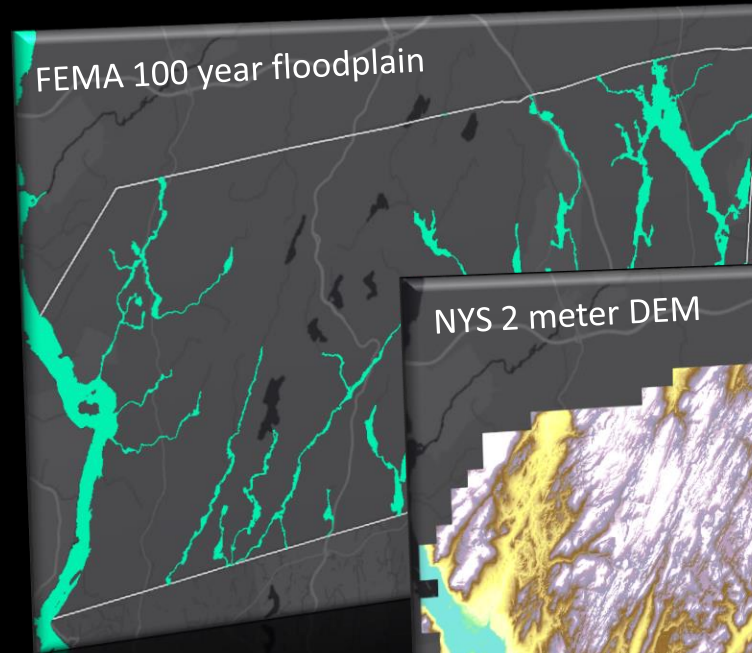


Basemap Source: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community
Data Source: NYS Civil Boundaries 2017 <http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=927>

Incorporate Inland Flood Scenarios

Derived from FEMA Floodplains

- Extracted floodplain extents for 100 year and 500 year storm return periods from FEMA's National Flood Hazard Layer where available and Q3 flood data
- Created flood grids based on bathtub modeling and floodplain polygon extent



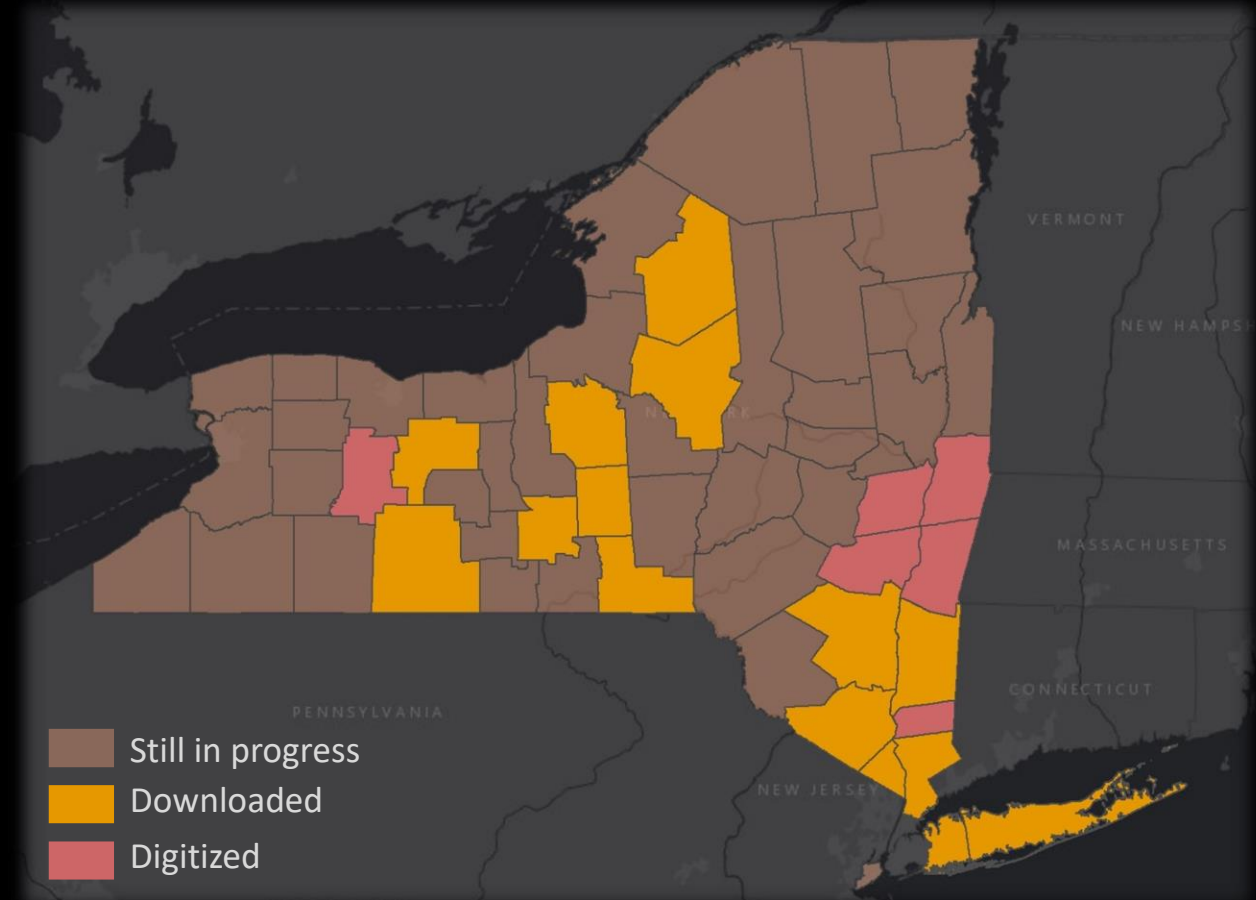
Incorporate Building Footprints

Heads up digitizing, automated extraction, and downloading from counties

- Download available building footprints
- Digitize buildings if unavailable or permissions restrict redistribution

Digitizing Methods:

- Manually digitize with automatic building extraction as a supplement
- Use NYS Orthoimagery Web Service and ESRI Basemap Imagery
- Use ArcMap and ArcGIS Pro
- Roughly 336,000 buildings to digitize



Basemap Source: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community
Data Source: NYS Civil Boundaries 2017 <http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=927>

Incorporate Building Footprints

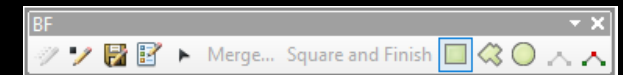
Heads up digitizing, automated extraction, and downloading from counties

Comparison of two digitizing methods

Method 1

Heads Up Digitizing

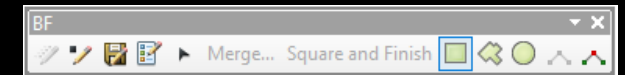
1. Connect to NYS ortho web service
2. Digitize buildings while recording roof type (200 – 400 bph)



Method 1

Heads Up Digitizing

1. Connect to NYS ortho web service
2. Digitize buildings while recording roof type (200 – 400 bph)





Method 2

Automated Extraction

1. Download Lidar data
2. Run automated extraction process
3. Delete low quality buildings or features that are not buildings and digitize omitted buildings (200 – 350 bph)



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Automated Extraction

1. Download Lidar data
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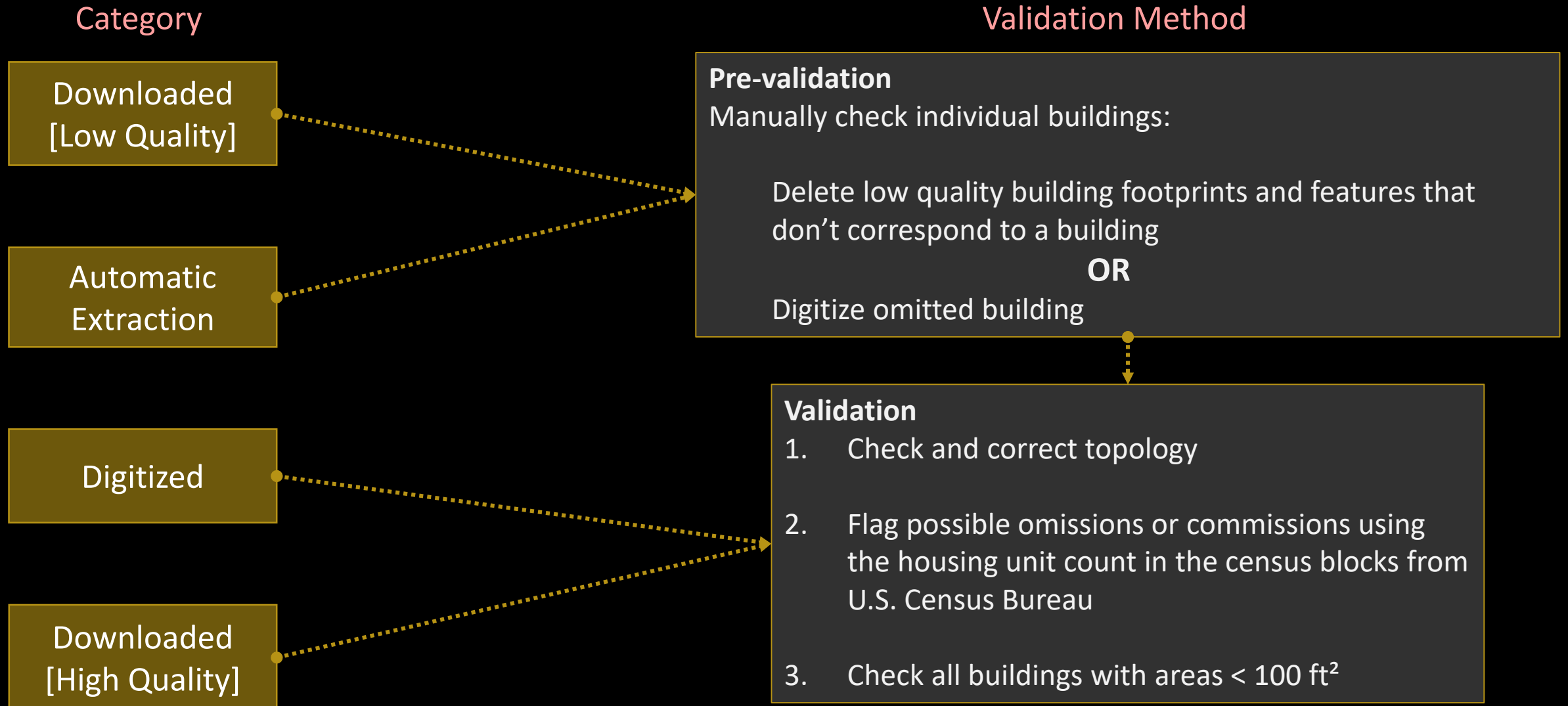
Method 2

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Incorporate Building Footprints

Quality Assurance/Quality Check



Incorporate Building Footprints

Attaching attributes

A key component of the building footprints data set will be the attributes compiled within them and their availability to the public.

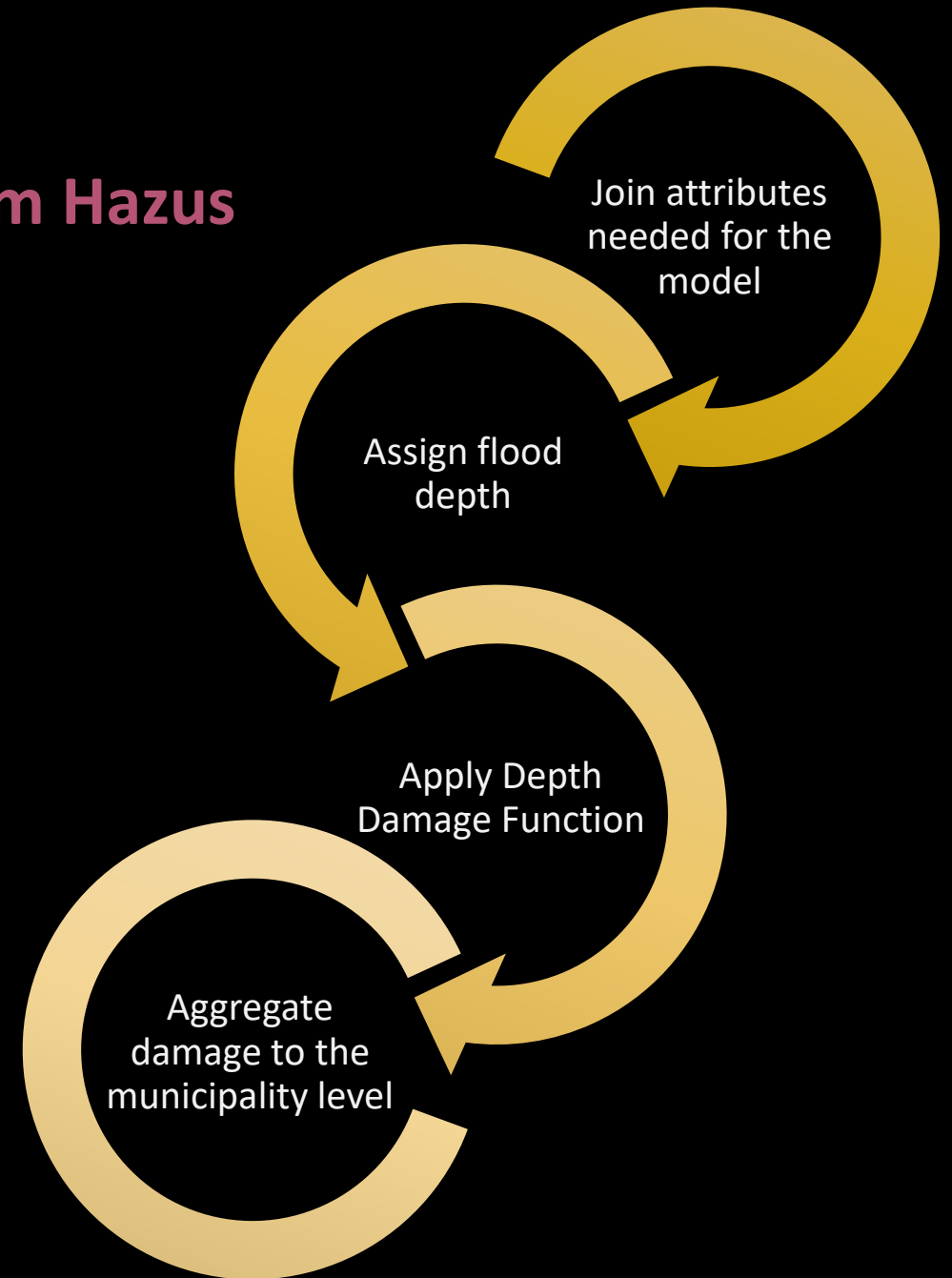
| Source | Attributes | Description |
|-------------------|----------------|--|
| Index or metadata | Source | Imagery source or download source |
| | Source Date | Date of imagery used to create the buildings |
| | Roof Type | Applicable for digitizing buildings only (peaked, flat, or unknown) |
| County | Raw Attributes | Information already included with building footprints downloaded from a county |



Hazard Assessment

Flood impact damage assessment derived from Hazus

- A comprehensive financial impact assessment will be produced for all flood scenarios
- The damage estimation model uses similar methods from FEMA's Hazus MH flood model coupled with detailed data obtained from Hazus, the tax parcels, and the building footprints



Hazard Assessment

Flood impact damage assessment derived from Hazus

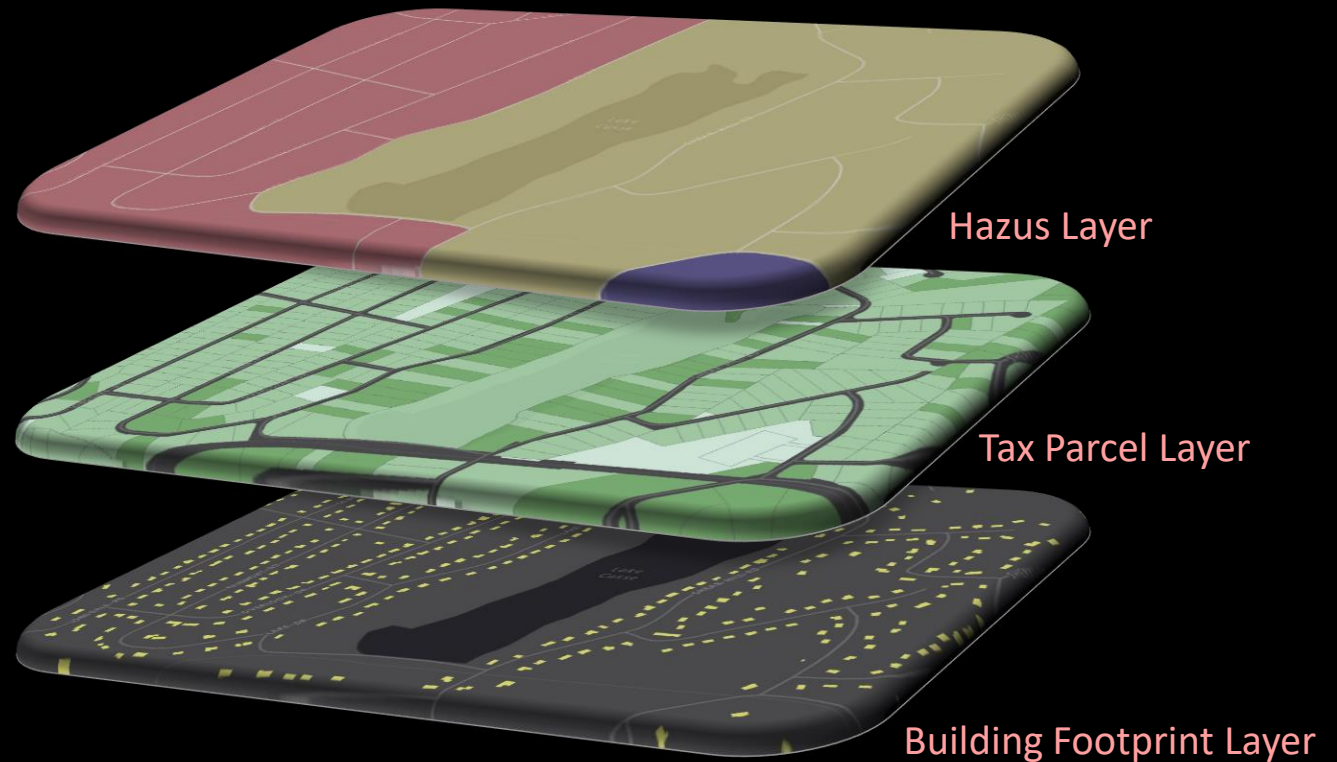


From NYS Tax Parcels:

1. Property Class
2. Year Built
3. Building Value

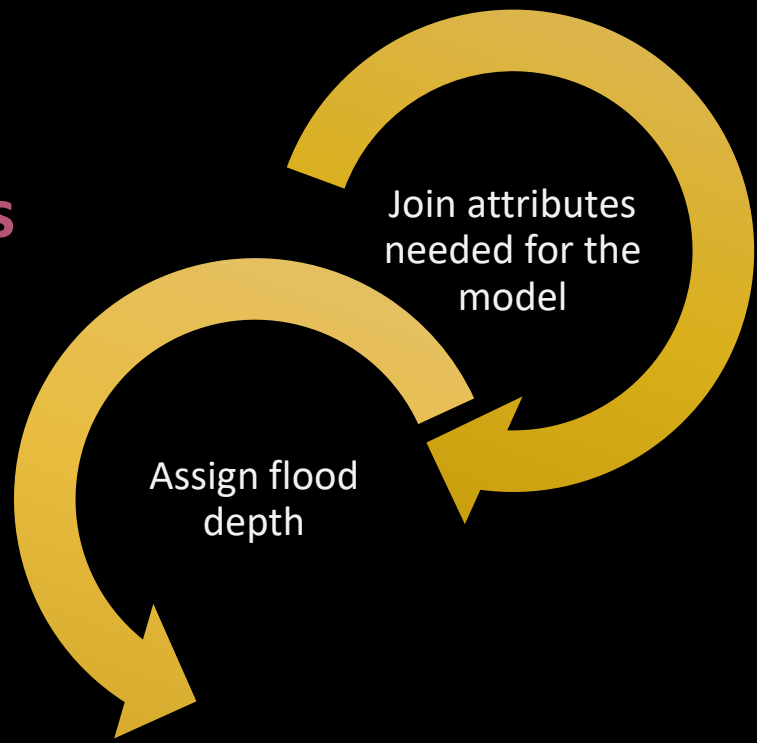
From Hazus Database:

1. Building Content Values
2. Flood Insurance Rate Map status
3. First Floor Elevation



Hazard Assessment

Flood impact damage assessment derived from Hazus



Flood depth is assigned to buildings in the flood zone

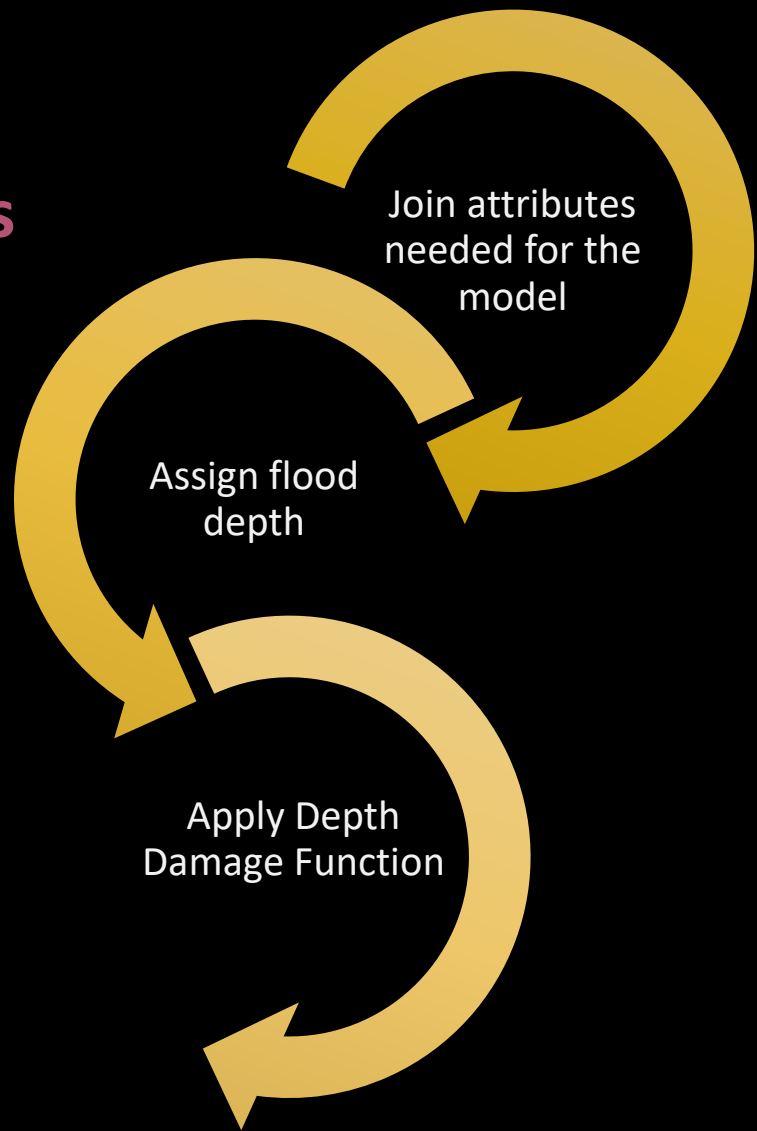
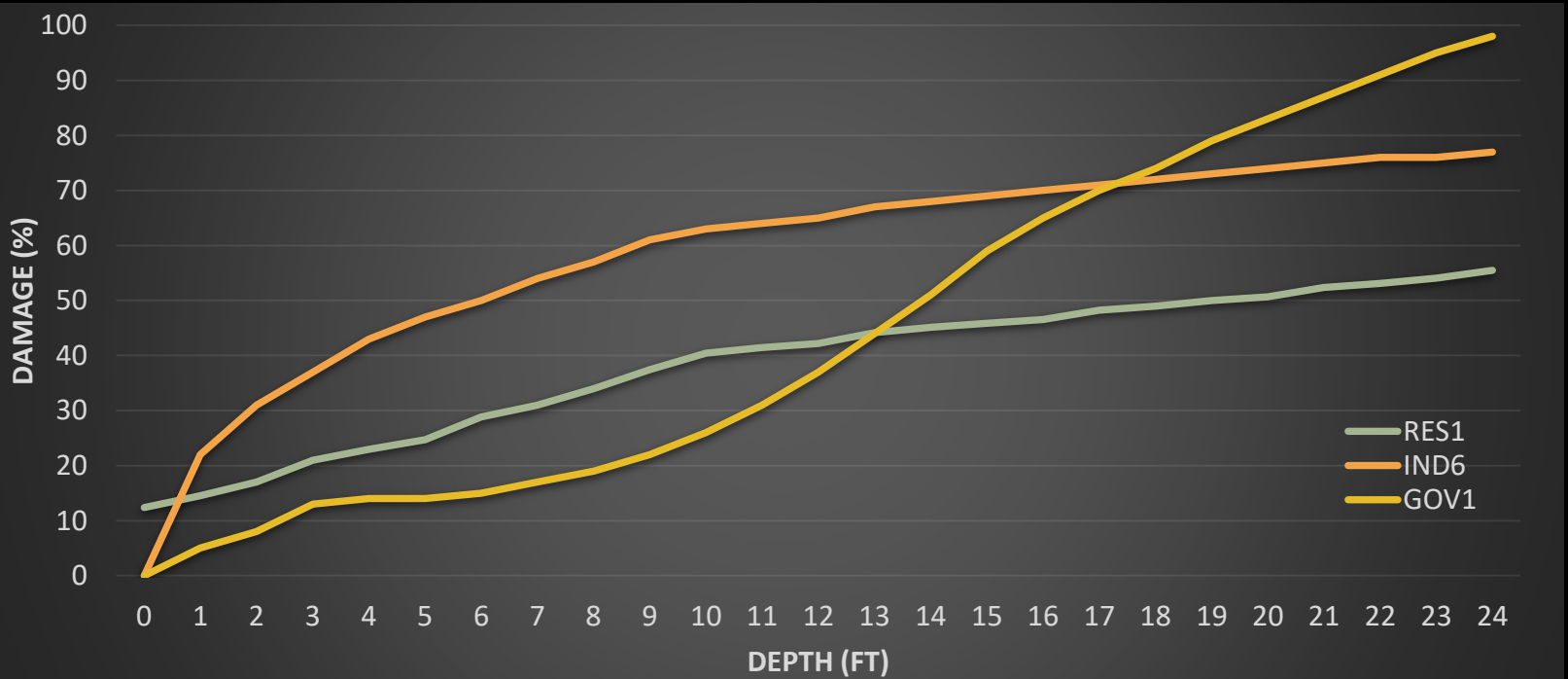
Basemap Source: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Hazard Assessment

Flood impact damage assessment derived from Hazus

- The Depth Damage Function relates flood depth to building and contents damage. Hazus has over 700 different DDF

$\% \text{ Damage} = f(\text{flood depth, occupancy class})$
 $\text{Damage} = \% \text{ Damage} \times \text{Value}$



Hazard Assessment

Flood impact damage assessment derived from Hazus

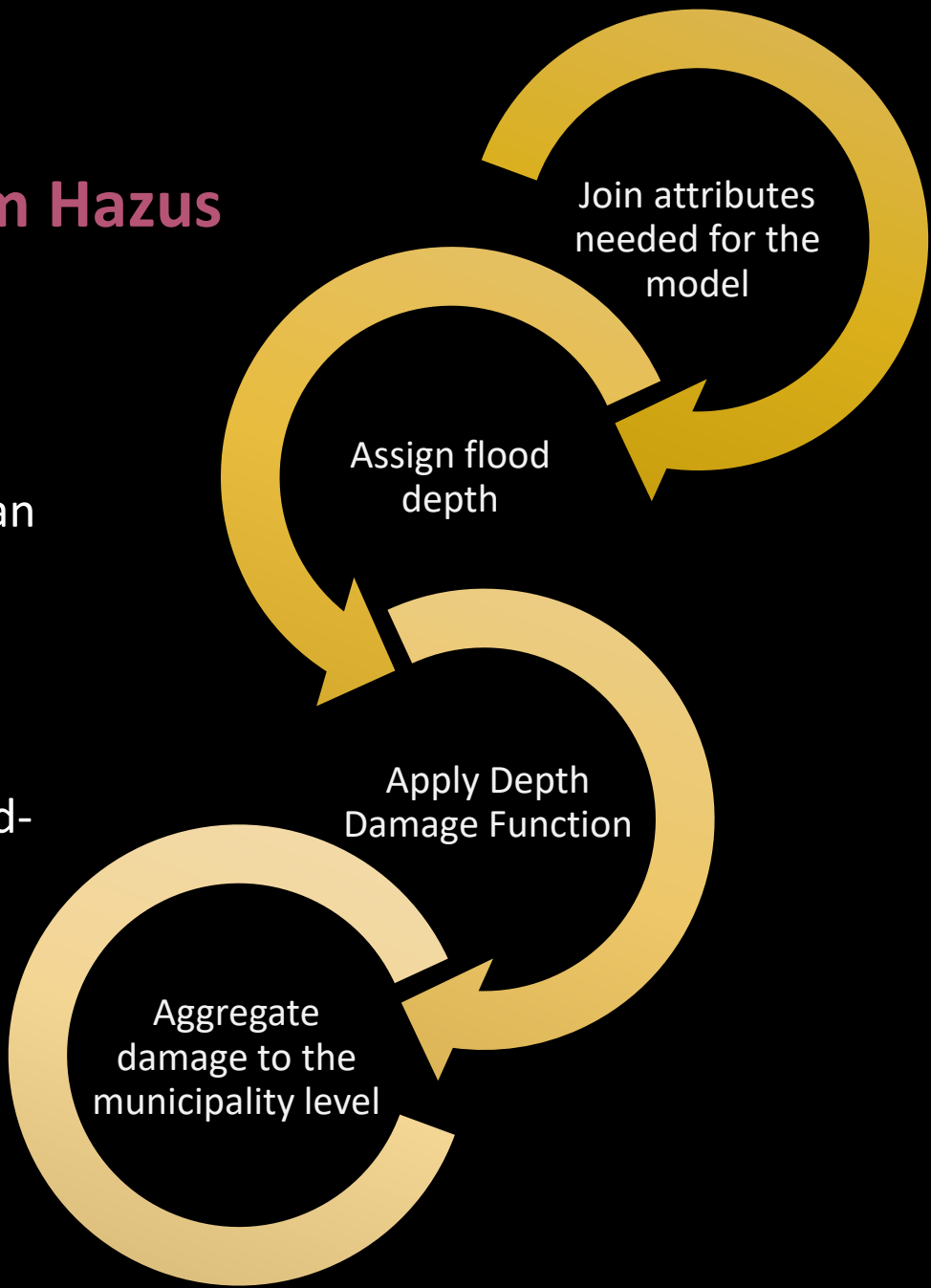
County and Municipality level:

- Building level damages will be summed to the municipal and county level
- The impact assessment will be available for download as an .xlsx and will provide a financial estimate of potential damages caused by each flood scenario

Building level:

- Building level damages will be transformed into a low-med-high range and will be available to view in the mapper

| County | Municipality | Return Period (years) | Building and Contents loss (\$) | Number of buildings damaged |
|----------|--------------|-----------------------|---------------------------------|-----------------------------|
| Dutchess | Beacon | 100 | 544,803 | 17,235 |
| Dutchess | Beacon | 500 | 1,114,386 | 29,169 |
| Dutchess | Fishkill | 100 | 127,938 | 5,217 |
| Dutchess | Fishkill | 500 | 272,665 | 12,494 |

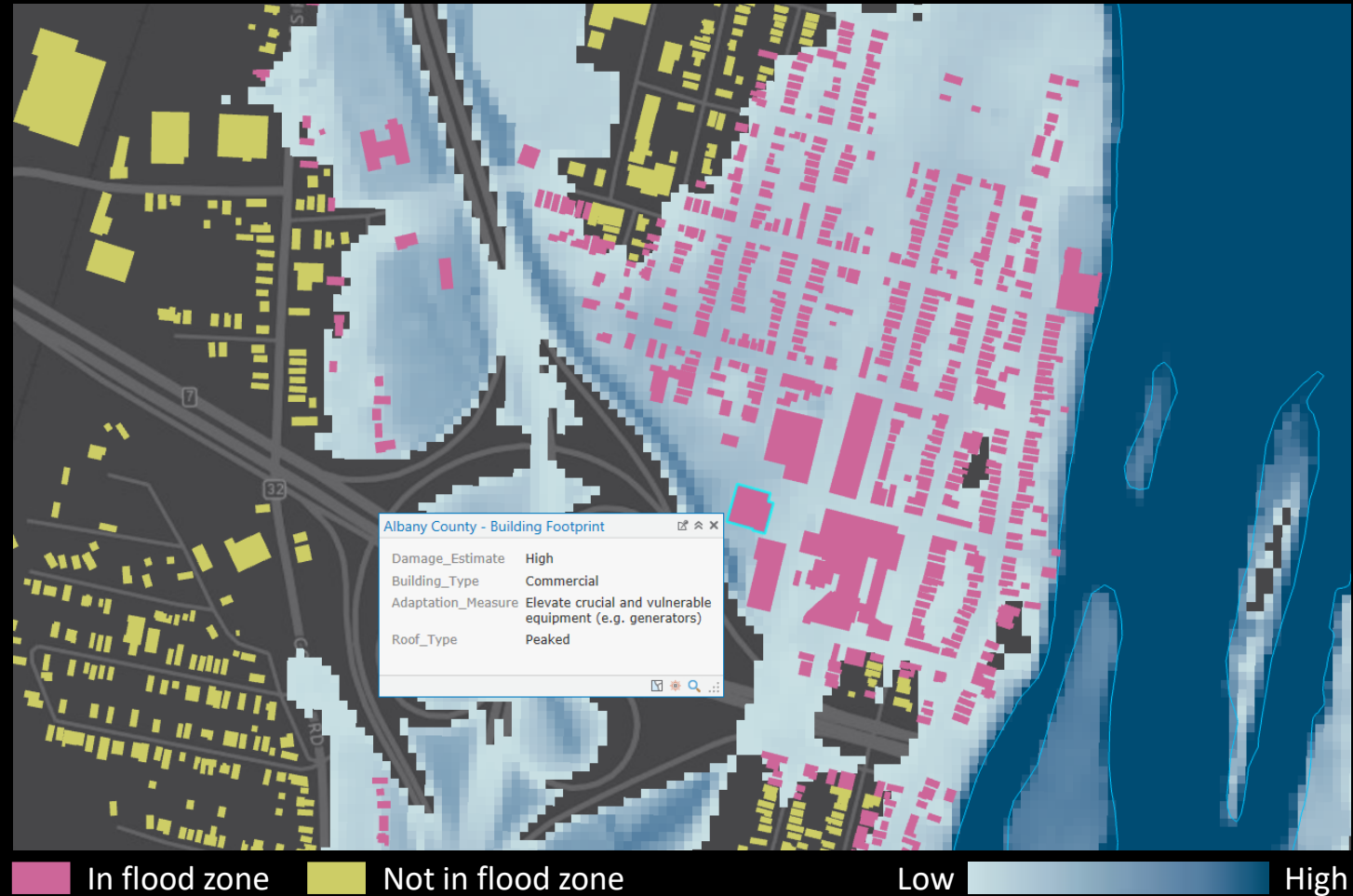


Interactive Web Mapping Application

Putting it all together..

Version 2, mock up:

1. Click or zoom to an address and see the building type, damage estimate, and adaptation measure associated with that building
2. Download building footprints and flood depth grids to conduct their own analysis



Challenges

Obstacles we overcame and some that persist

1. Obtaining data
2. Digitizing
3. Automatic building extraction
4. Financial impact assessment
 - Varying spatial accuracy
 - Hazus as a black box
5. Providing data access to the public
6. How to communicate what makes our mapper unique

Thank you

Questions, comments, feedback?

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Inland Flood Modeling

