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

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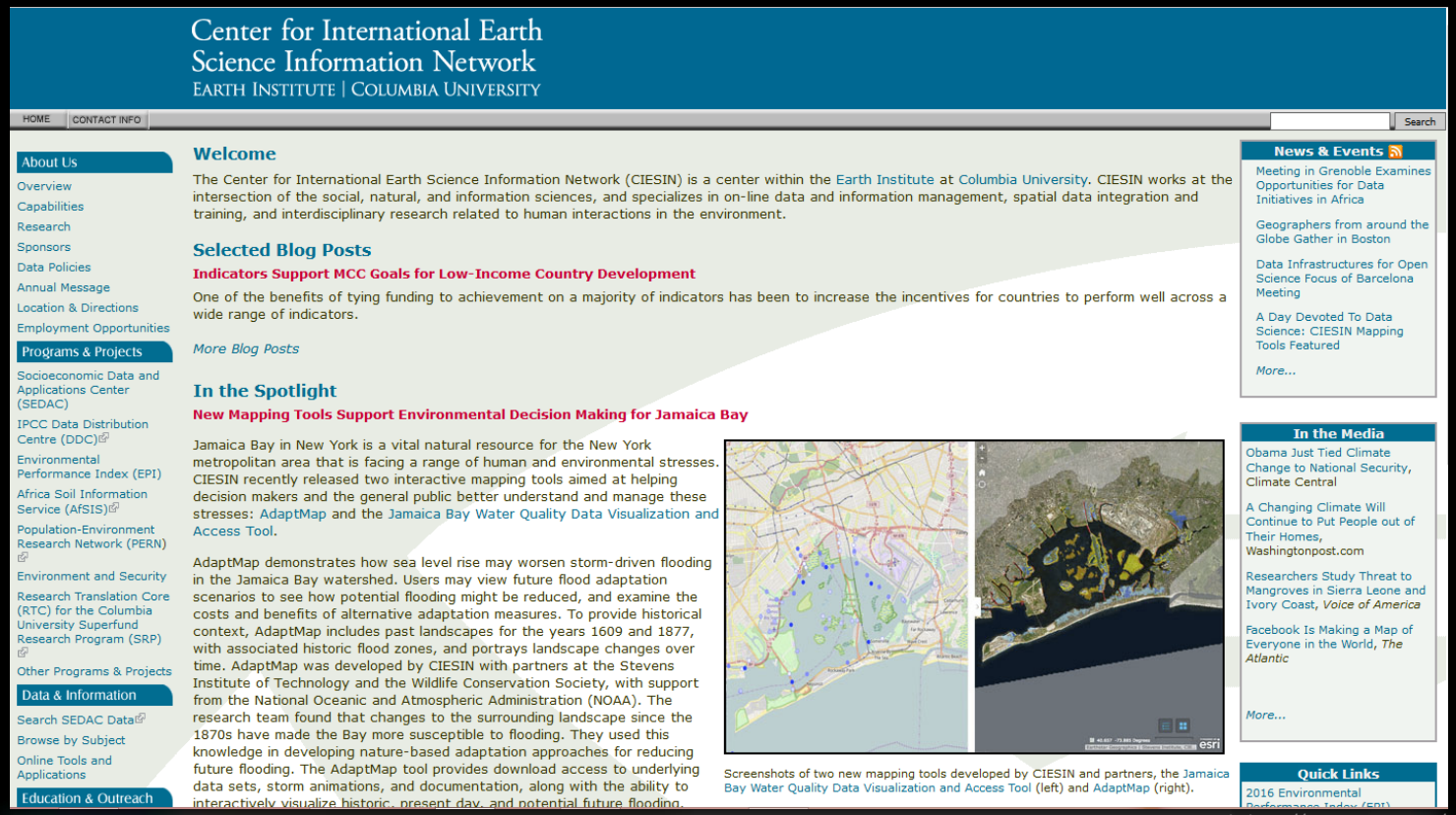
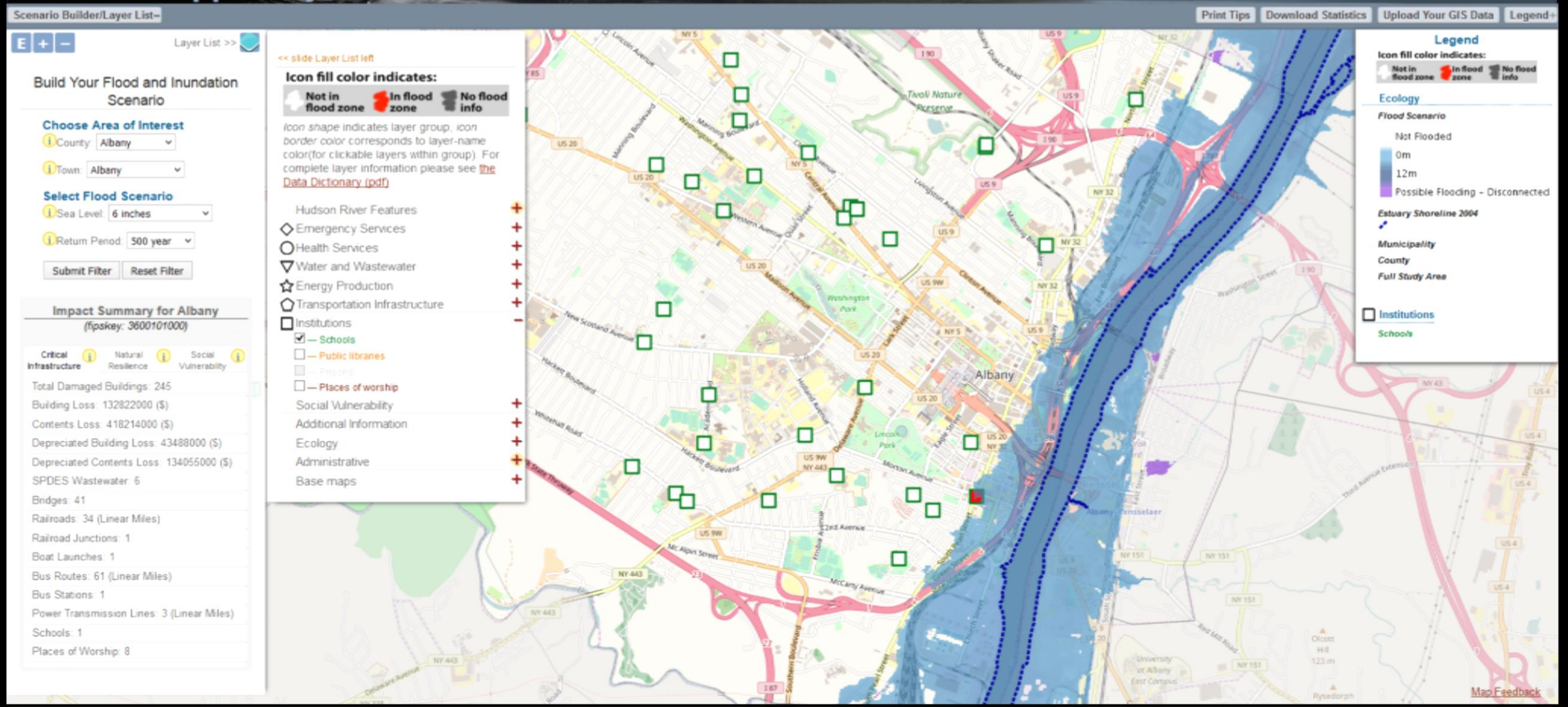


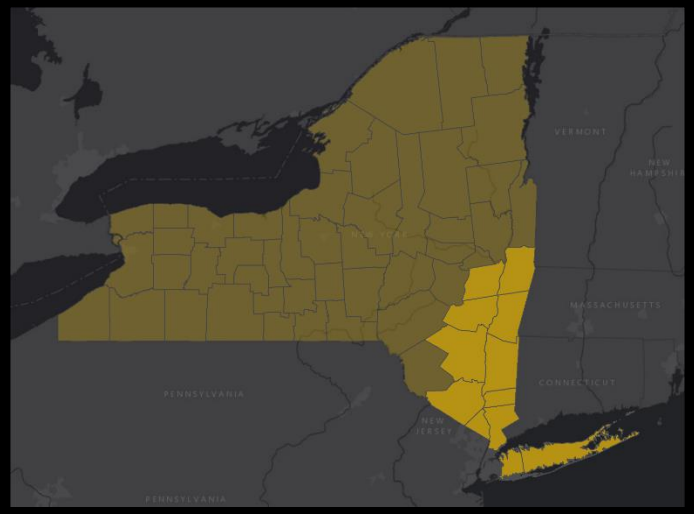
CIESIN Url: http://www.ciesin.org/

Hudson River Flooding Decision Support System Version 1

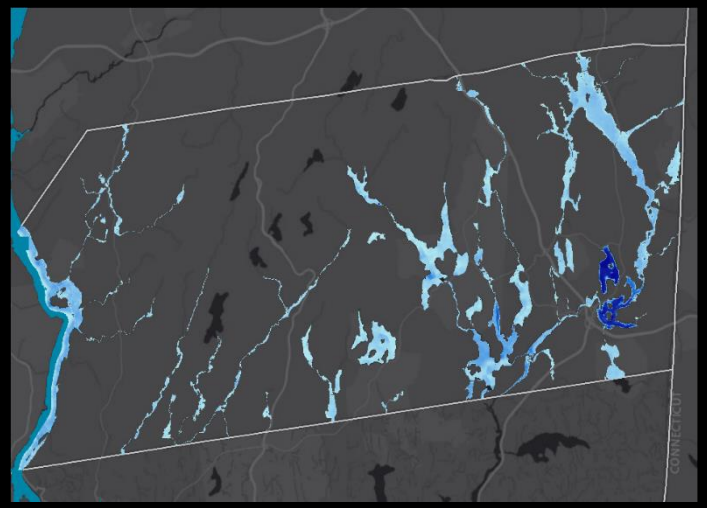


Web Map Url: http://www.ciesin.columbia.edu/hudson-river-flood-map/

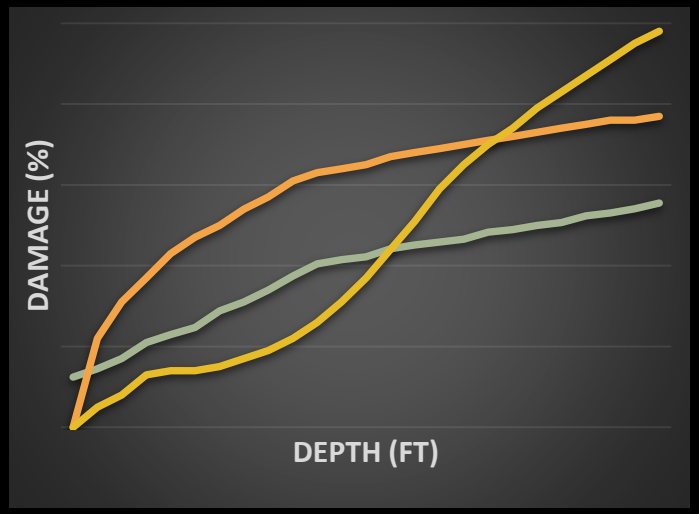
Primary Project Objectives



1. Expand the study area



2. Add Inland floods and building footprints



3. Perform detailed hazard assessment

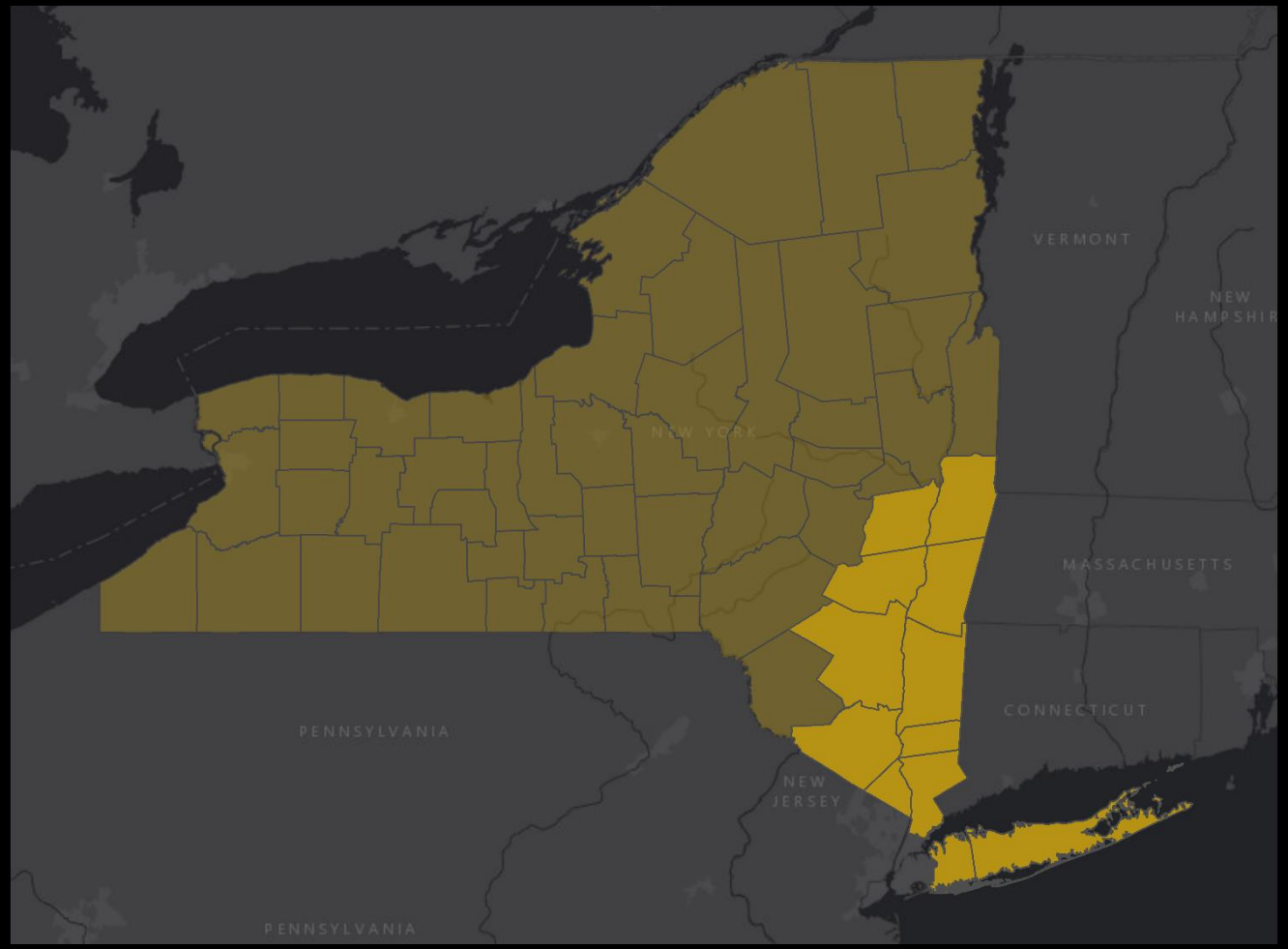
4. Enable data downloading

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



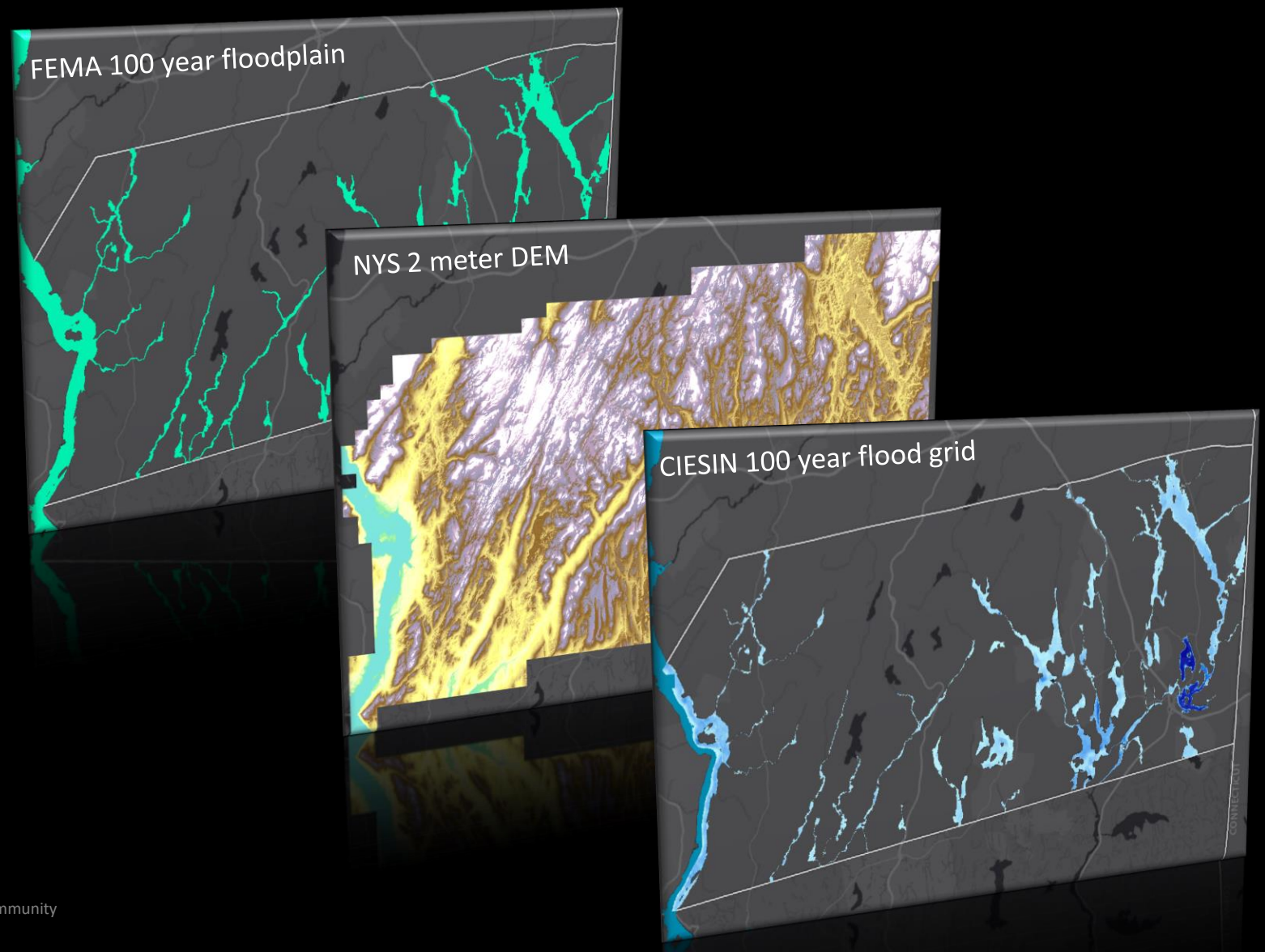
Basemap Source: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community
Data Source: NYS Civil Boundaries 2017 http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=927

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



Basemap Source: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community
Data Sources: FEMA Flood Map Service Center, New York State High Resolution 2 Meter DEM

Incorporate Building Footprints

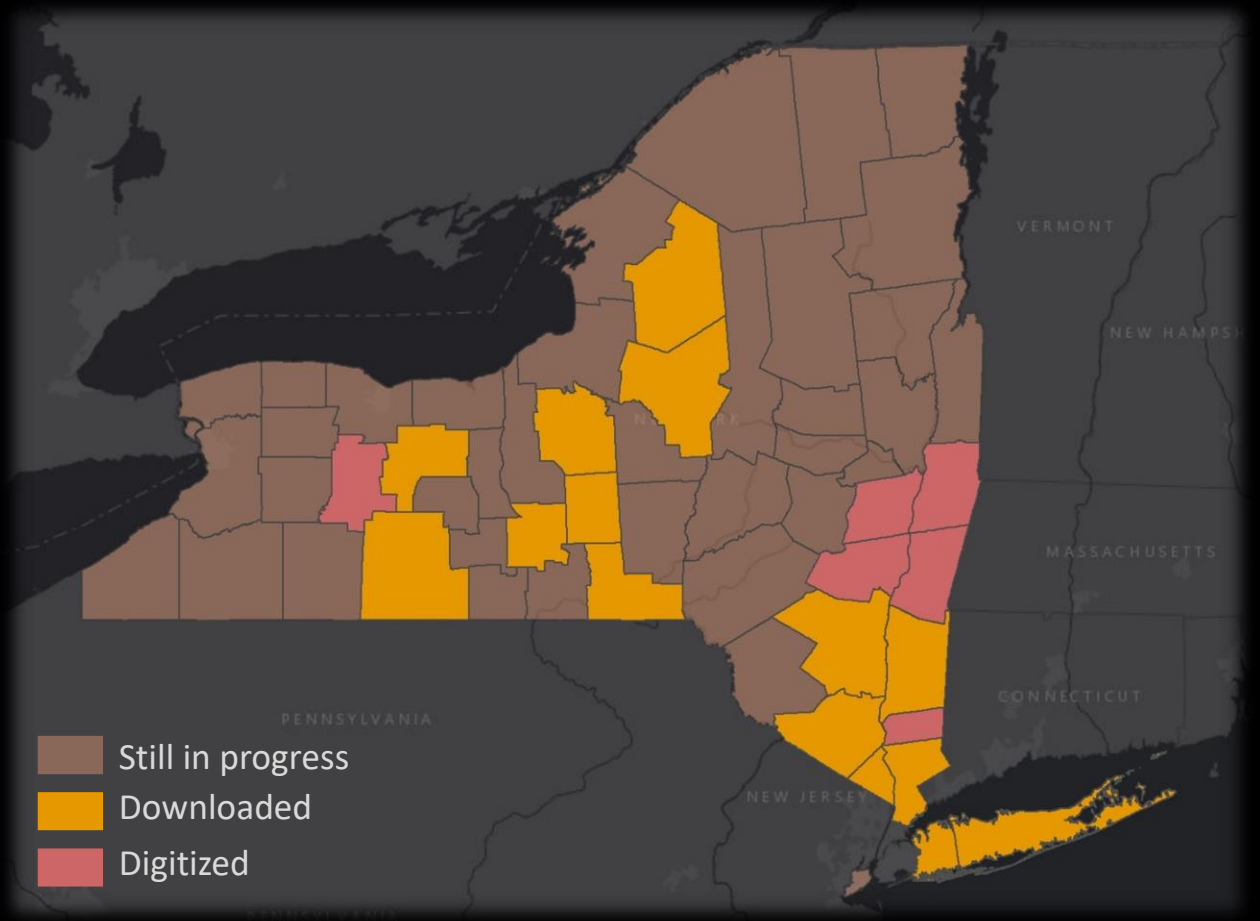
Heads up digitizing, automated extraction, and downloading from counties

- 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



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Incorporate Building Footprints

Heads up digitizing, automated extraction, and downloading from counties

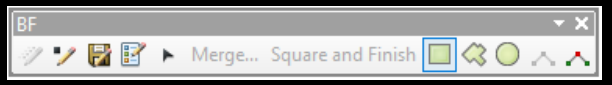
Comparison of two digitizing methods

Method 1

Heads Up Digitizing

1. Connect to NYS ortho web service

2. Digitize buildings while recording roof type (200 – 400 bph)



Chemung County 2014 Orthoimagery
Source: https://gis.ny.gov/gateway/mg/

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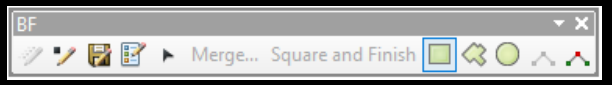

Chemung County 2014 Orthoimagery
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Method 2

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)

Columbia County 2014 Orthoimagery
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Incorporate Building Footprints

Quality Assurance/Quality Check

Category

Validation Method

Downloaded [Low Quality]

Automatic Extraction

Digitized

Downloaded [High Quality]

Pre-validation

Manually check individual buildings:

Delete low quality building footprints and features that don't correspond to a building

OR

Digitize omitted building

Validation

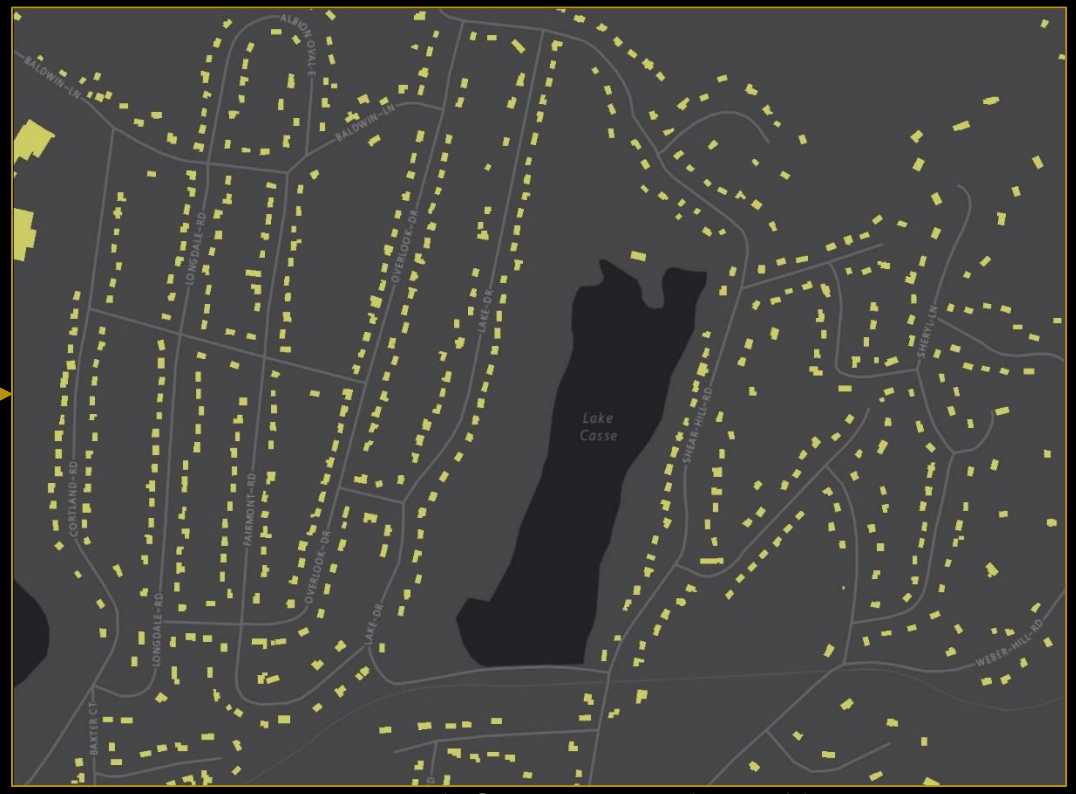
1. Check and correct topology
2. Flag possible omissions or commissions using the housing unit count in the census blocks from U.S. Census Bureau
3. Check all buildings with areas < 100 ft^2

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



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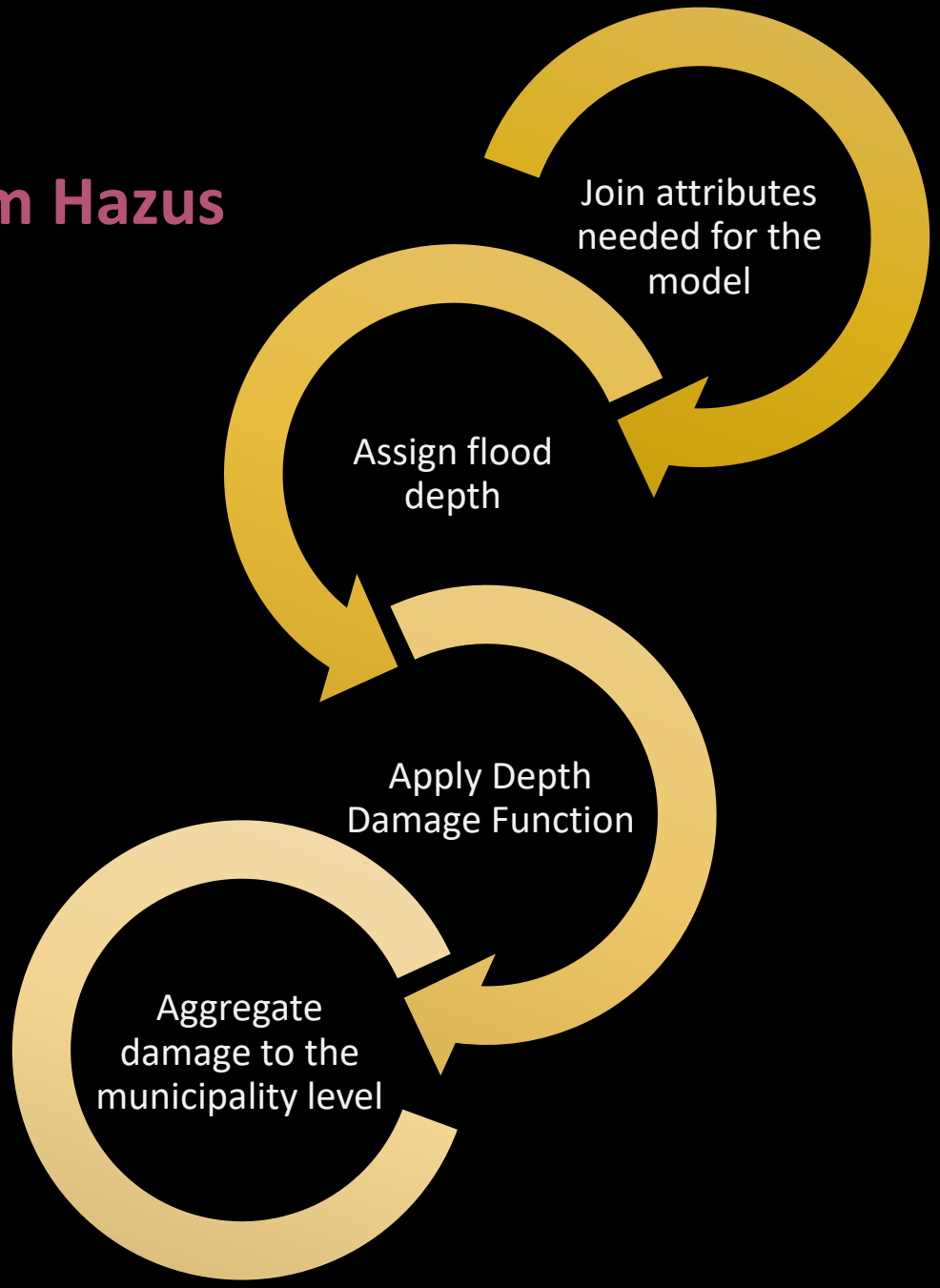
Hazard Assessment

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

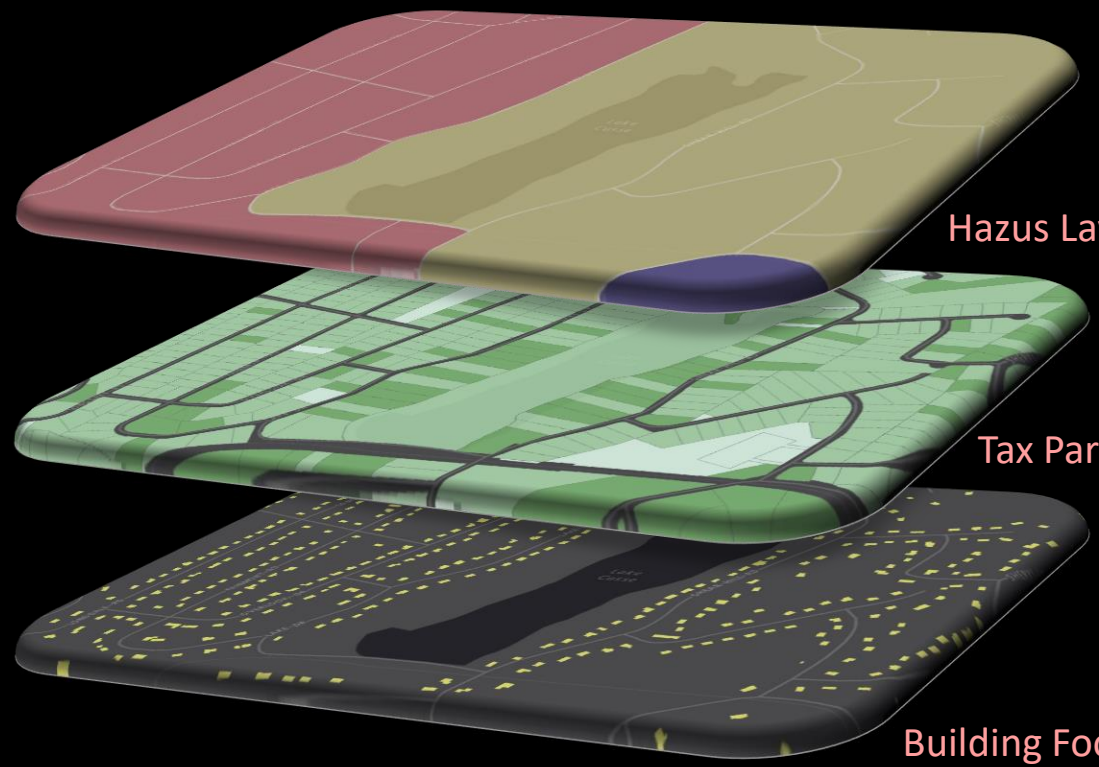
Join attributes needed for the model

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

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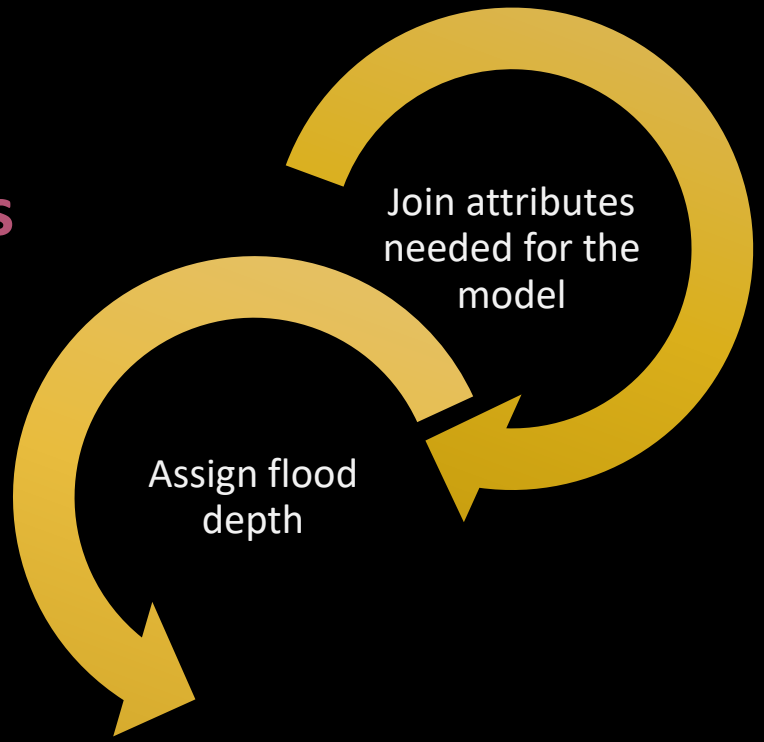


Flood depth is assigned to buildings in the flood zone

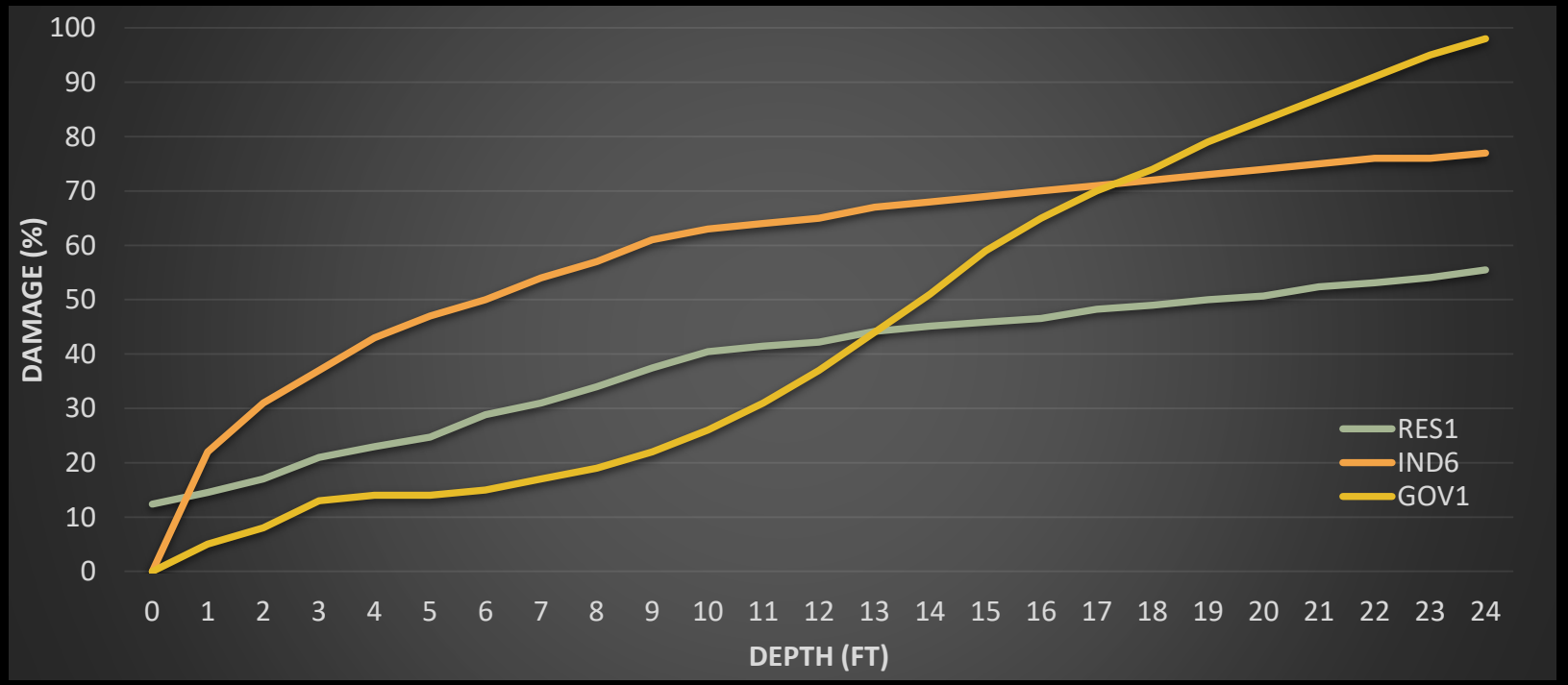
Hazard Assessment

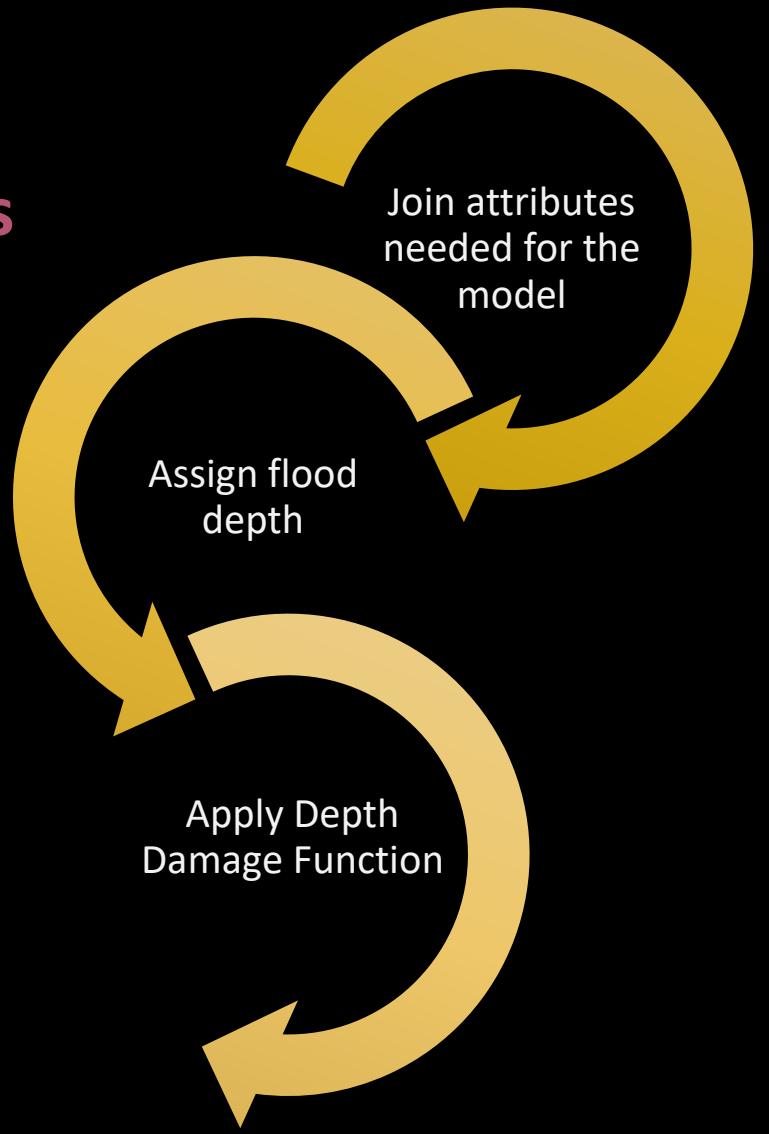
Flood impact damage assessment derived from Hazus

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

% Damage = f(flood depth, occupancy class)

Damage = % Damage x Value





Hazard Assessment

Flood impact damage assessment derived from Hazus

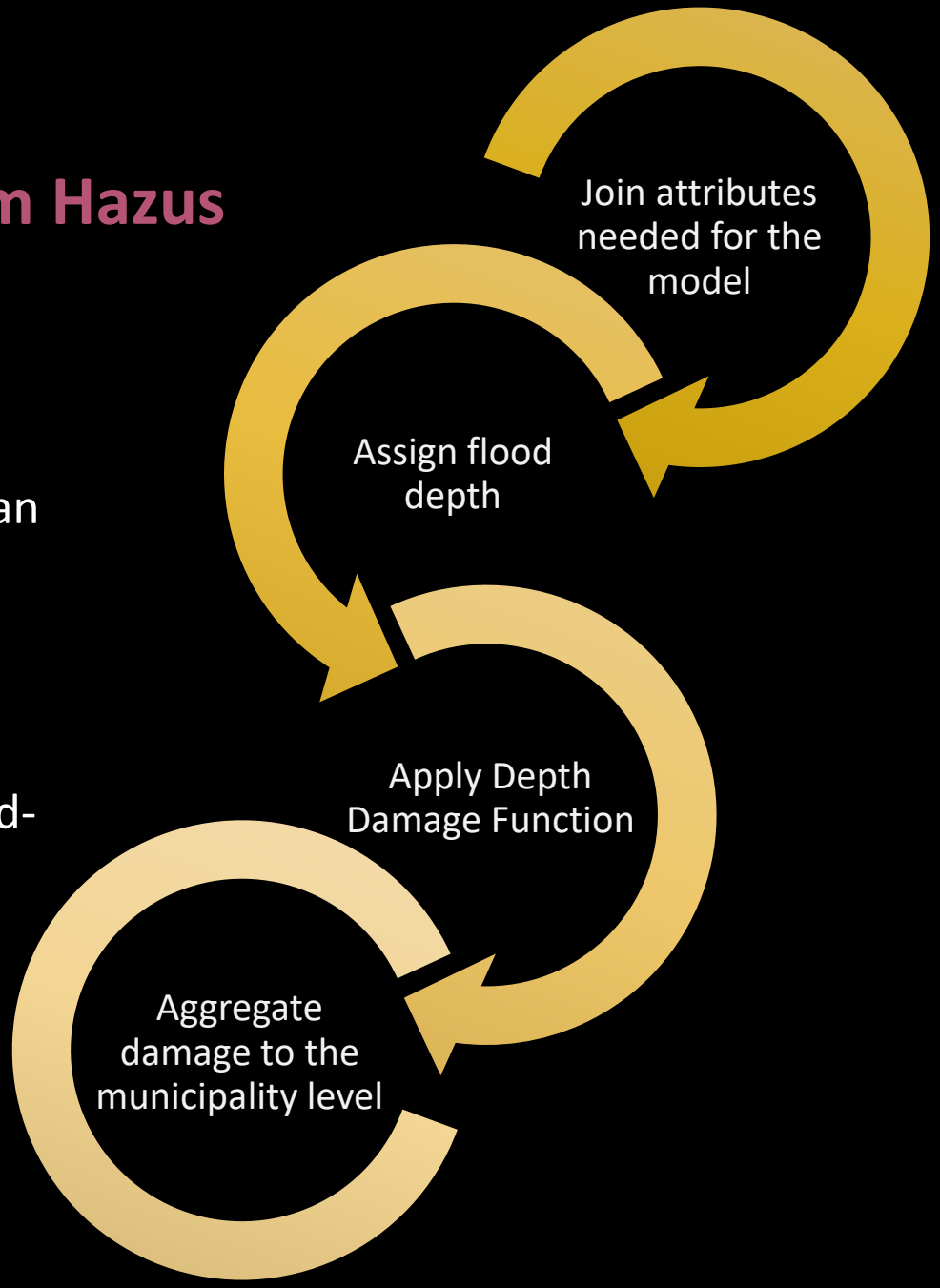
County and Municipality level:

- 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



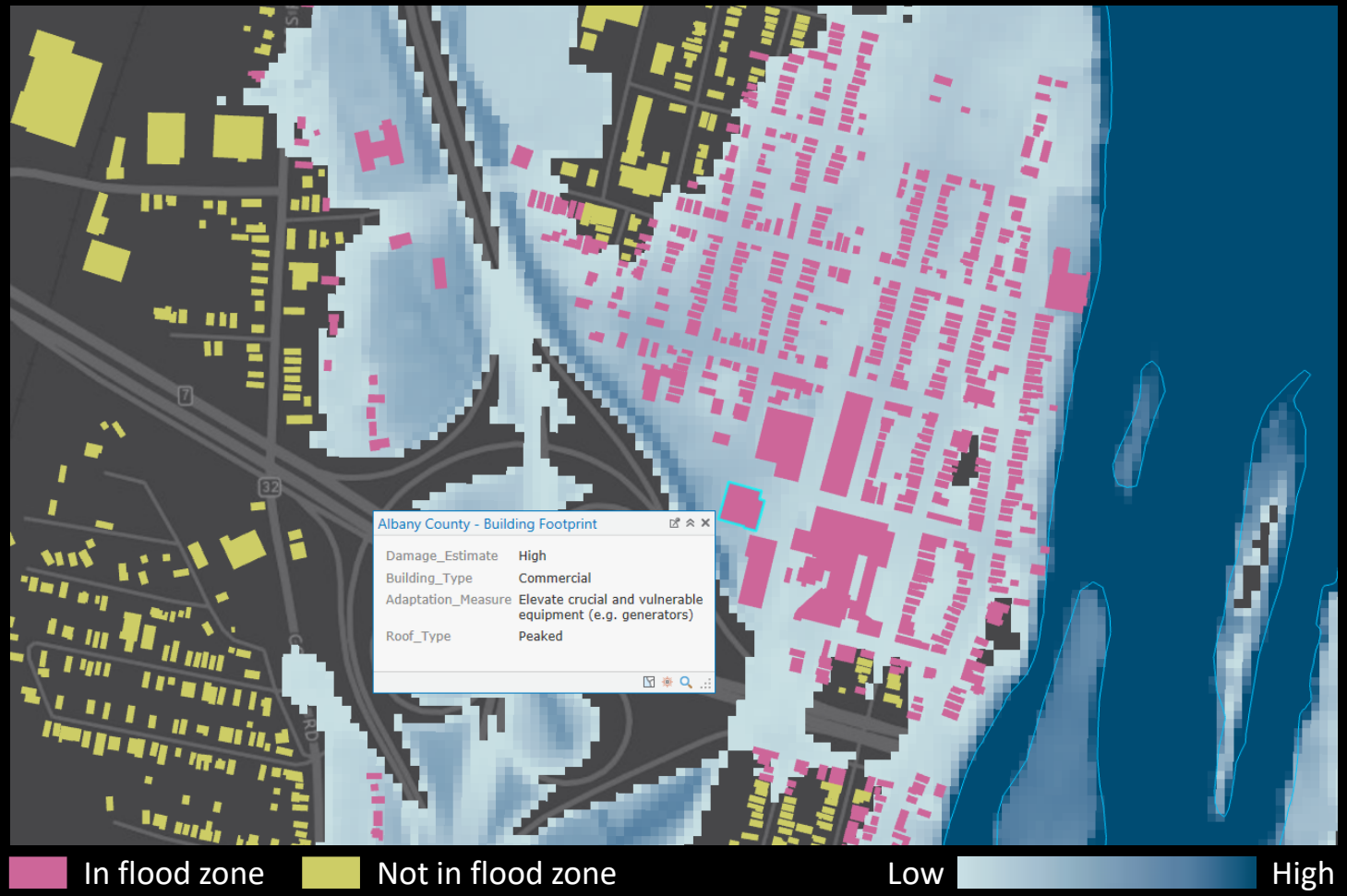
Interactive Web Mapping Application

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



Basemap Source: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community
Flood Data Source: Orton, P., MacManus, K., F. Conticello, F. Cioffi, T. Hall, N. Georgas, J. Mills, U. Lall, A. Blumberg. 2015. Hudson River Flood Elevations from Storm Tides and Rainfall. New York.

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