



# US Federal Emergency Management Agency (FEMA)

National Flood Insurance Program and Hazus Loss Estimation

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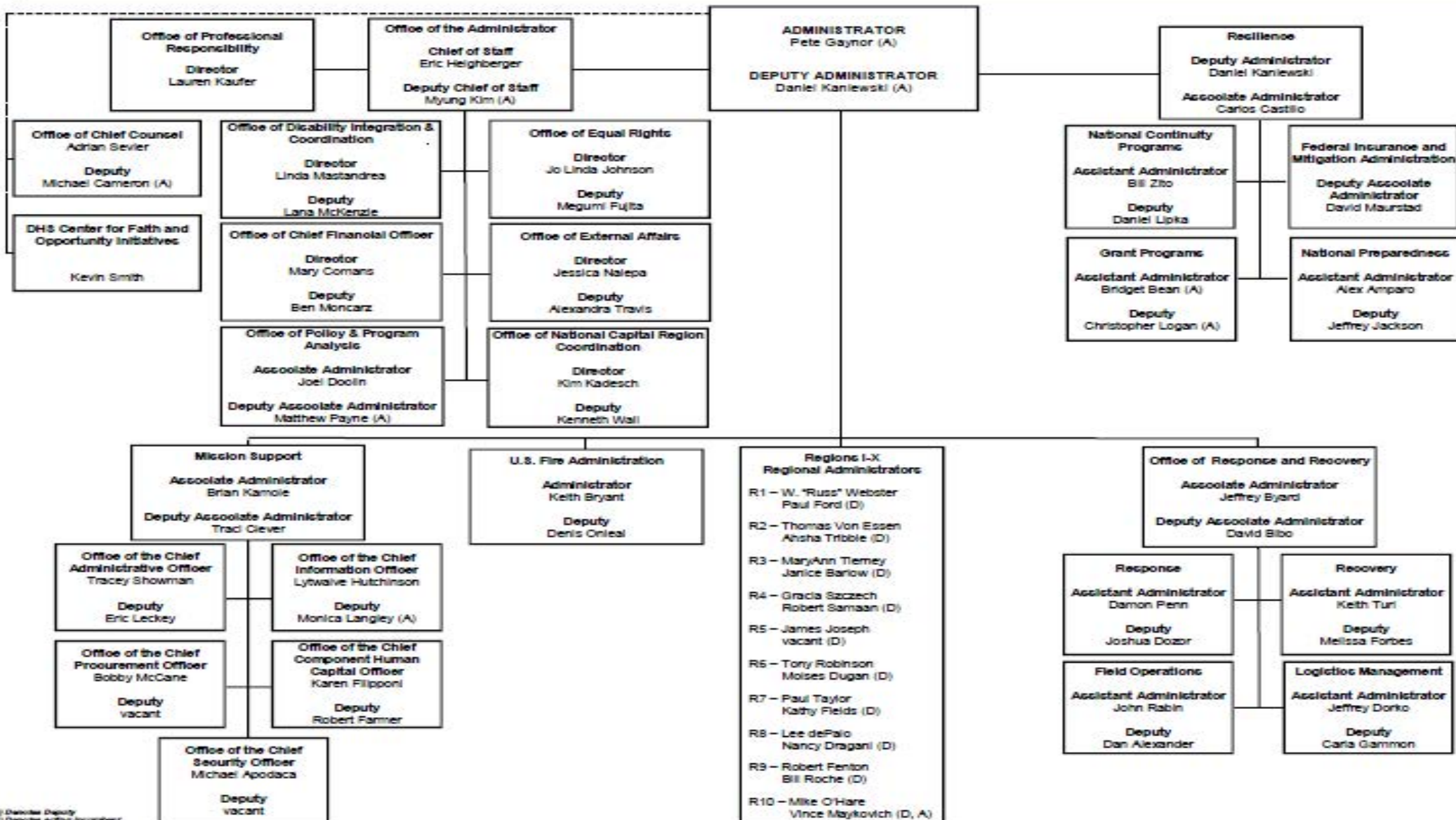
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**HAZUS**  
EARTHQUAKE • WIND • FLOOD • TSUNAMI









# FEMA National Flood Insurance Program

## - Insurance



- Founded by the National Flood Insurance Act of 1968 after Hurricane Betsy
- NFIP policies available in 22,000 communities across the US
- The NFIP assists and regulates local governments lowering the built environment's exposure to flood, which saves the Nation more than \$1.6 billion/year in avoided flood losses.
- The NFIP paid over \$64 billion in claims during the last 50 years, averaging \$1.28 billion per year.



# FEMA National Flood Insurance Program

## - Mitigation

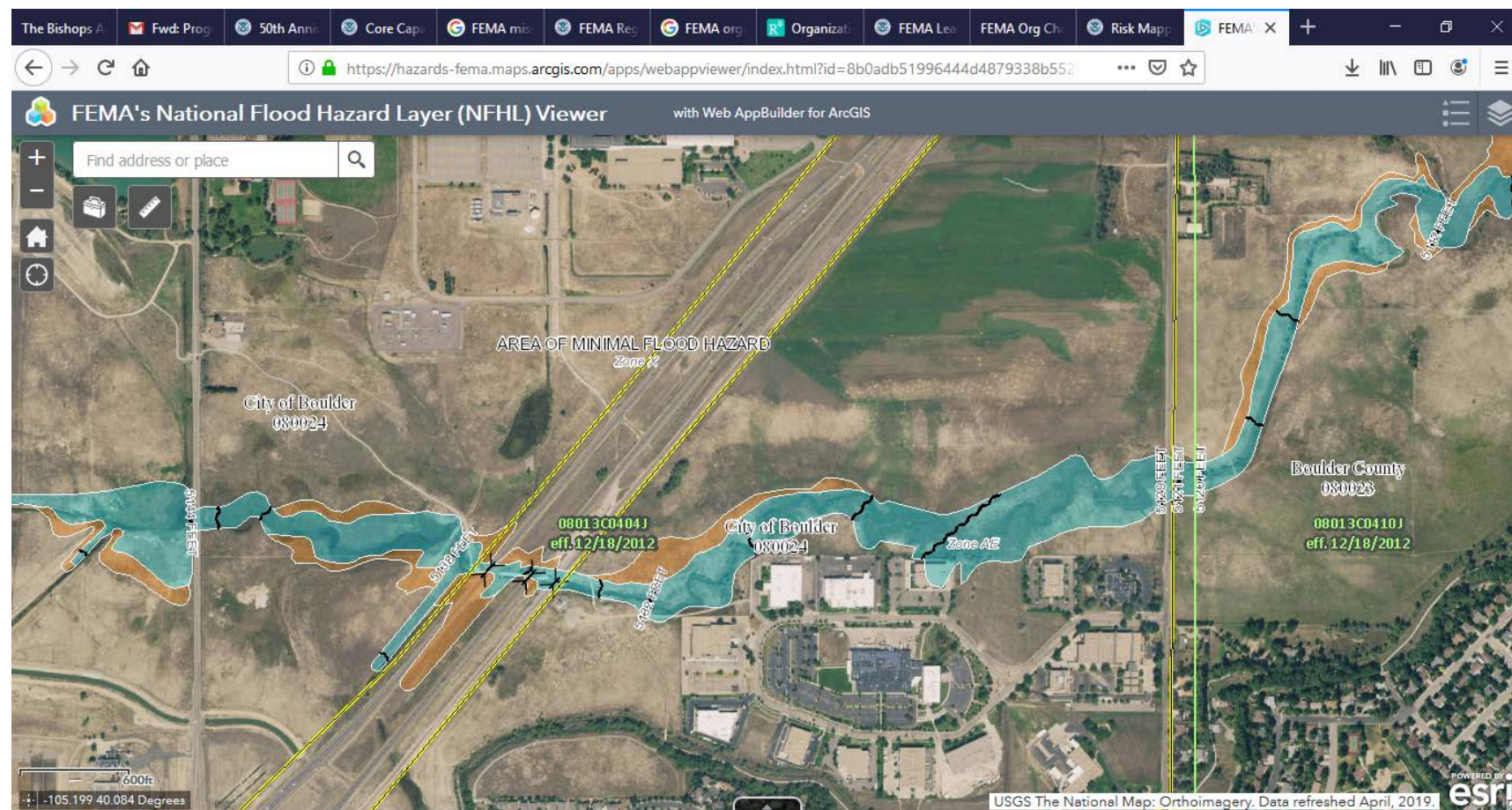


- More than 1,485 communities have taken a more assertive approach to keep their residents safe by joining the NFIP's Community Rating System, which provides discounts for some flood insurance policies. NFIP policies available in 22,000 communities across the US
- FEMA has dedicated nearly \$4 billion in flood grants--buying out or elevating nearly 53,000 properties.
- Since NFIP Flood Mitigation Grants were first provided, in 1996, the NFIP has helped mitigate more than 6,300 flood prone properties, investing \$1.1 billion. For every one dollar invested in disaster mitigation today, six dollars can be saved.

# FEMA National Flood Insurance Program - Risk Management



- Since 1970, over 1.1 million riverine and coastal miles have been mapped to identify flood hazards, assess flood risks, and provide accurate flood hazard data, which has created more safe and resilient communities.







# What is Hazus?





# What is Hazus?

- Software tools and support system designed by FEMA for the purpose of providing communities with the means to identify and reduce risk from natural hazards
- Nationally applicable standardized methodology
- Estimates physical, economic, and social impacts at the state, county, census tract, census block level, or site-specific level
- Used by a variety of communities and organizations
- Available from FEMA free of charge (requires ArcGIS license)



# Supported Hazards



Hurricane Wind (can be combined with Storm Surge/Coastal)



Flooding (both Riverine and Coastal)

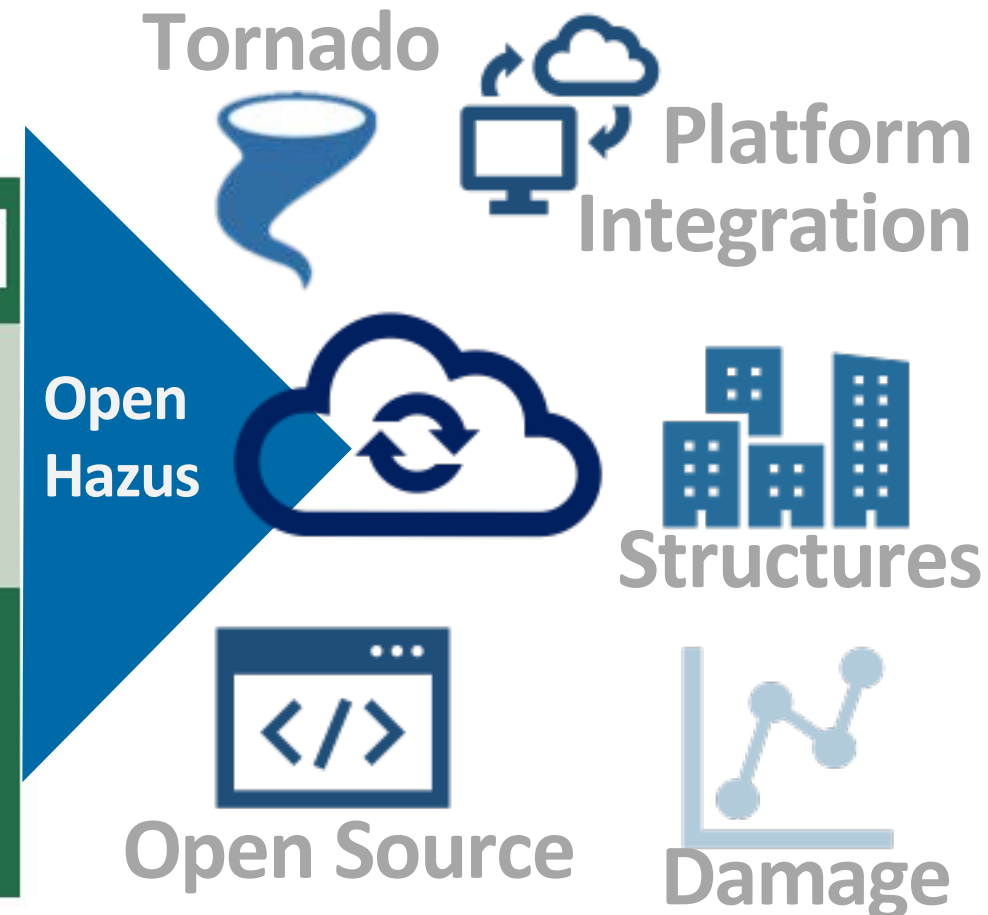
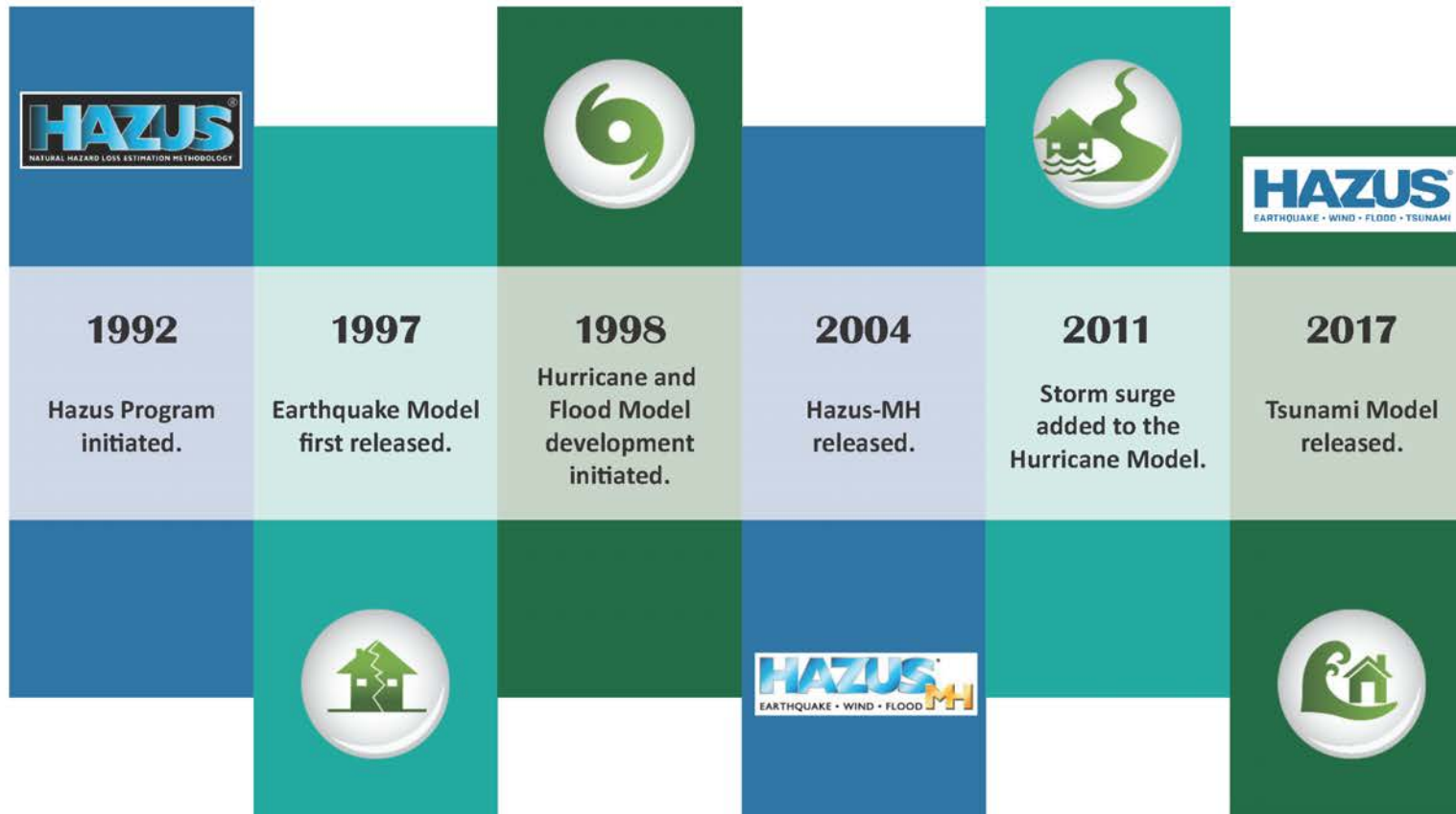


Earthquake



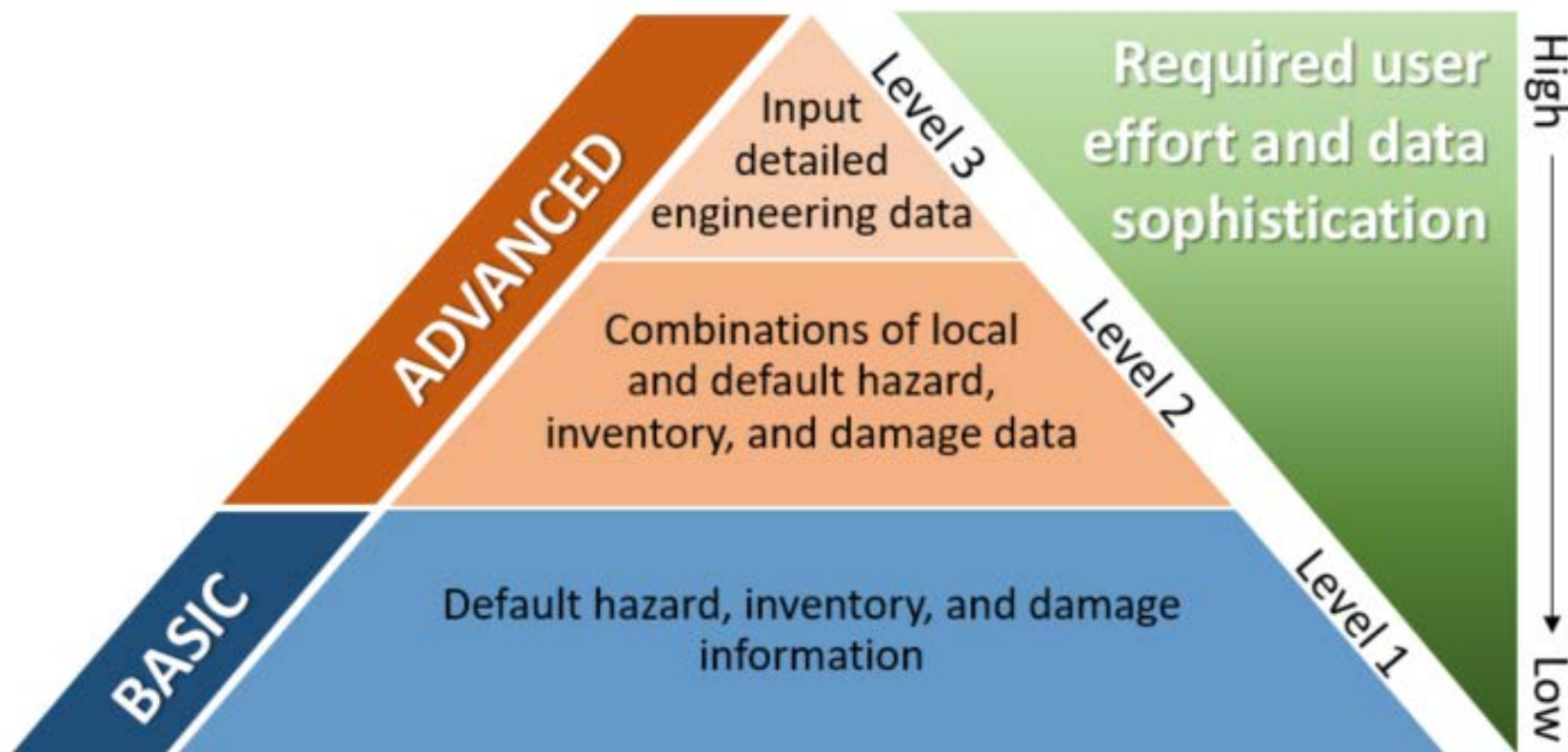
Near and Distant Source Tsunami (can be combined with Earthquake)

# Hazus History





# Use Levels



# Hazus Risk Assessment Process



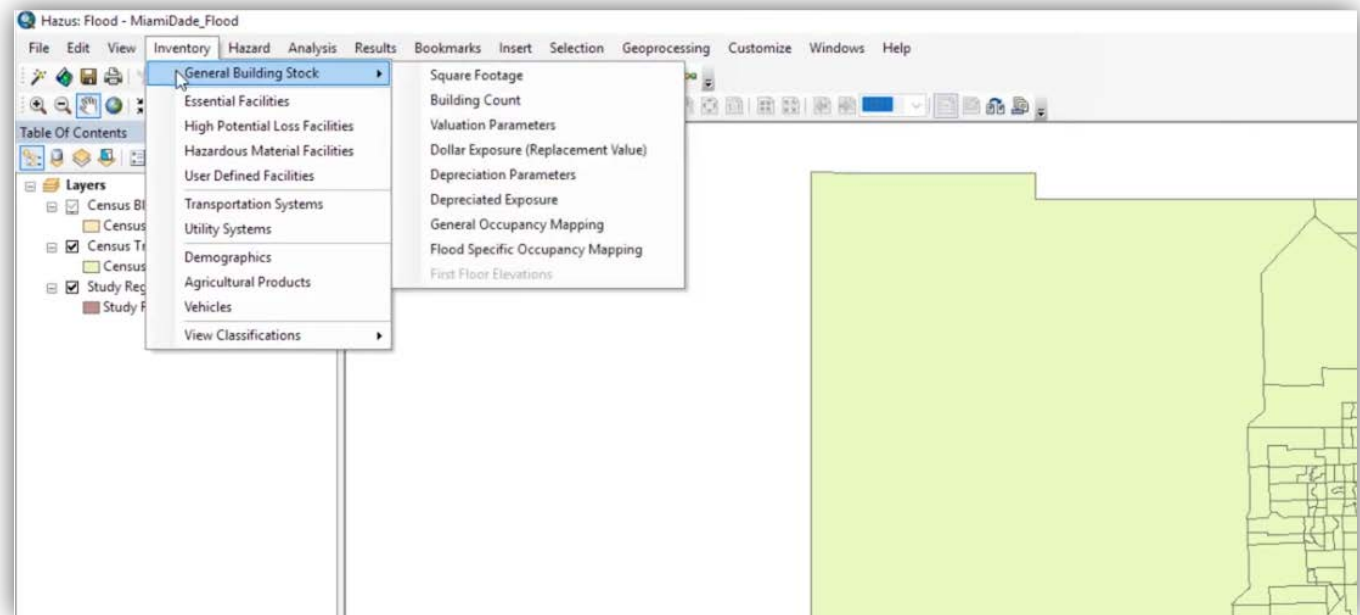
- Hazus allows users to follow a simplified process to create a local risk assessment





# Inventory/Exposure Data

- General building types and occupancies
  - Lifelines
  - Replacement costs
  - Demographics
- Hazard-specific
  - Specific building types
  - Elevation
  - Building configurations



# Integrating User-Provided Data



- Non-Hazard Data Integration Tools
  - Comprehensive Data Management System (CDMS) enables integration of locally developed non-hazard data
  - CDMS validates that user data are compliant with Hazus requirements
- Hazard Data Integration
  - ShakeMap and Hurrevac hazard data integration
  - Each model includes tools for integrating user-provided hazard data
- Techniques for integrating user-provided data are covered in other courses.

# Analysis and Output



Hazus Capabilities	Earthquake Ground Shaking Ground Failure	Flood Frequency   Depth Riverline   Coastal Surge	Hurricane Wind   Surge	Tsunami Depth   Momentum Flux   Runup   Velocity
<b>Inputs</b>				
Historic	✓		✓	
Deterministic	✓	✓	✓	✓
Probabilistic	✓	✓	✓	
User-supplied	✓	✓	✓	✓
Other supported inputs	Real-time & scenario USGS ShakeMaps	Risk MAP, User-supplied depth grids (ArcGRID, GeoTIFF, IMAGINE), HEC-RAS (.FLT)	Hurrevac, User-supplied wind files (.dat)	NOAA PMEL SIFT, State models
<b>Direct Damage</b>				
General Building Stock	✓	✓	✓	✓
Essential Facilities	✓	✓	✓	
Transportation Systems	✓	✓		
Utility Systems	✓	✓		
User-Defined Facilities	✓	✓	✓	✓
<b>Induced Damage</b>				
Fire Following	✓			
Debris Generation	✓	✓	✓	
<b>Direct Losses</b>				
Cost of Repair	✓	✓	✓	✓
Income Loss	✓	✓	✓	✓
Agricultural		✓		
Casualties	✓			✓
Shelter and/or Evacuation Needs	✓	✓	✓	✓
Average Annualized Loss (AAL)	✓	✓	✓	



# Hazus Capabilities

- Produce maps, tables, and reports
- Analyze social and economic impacts
- Consider what is at risk
- Identify hazard
- Identify physical landscape

## Social Impacts



## Direct Damages



# How Hazus Can Be Used

- Identify vulnerable areas
- Estimate potential impacts of hazards
- Assess level of readiness and preparedness
- Inform resource allocation
- Prioritize mitigation measures
- Inform response and post-disaster recovery efforts





# Why Choose Hazus?

- Hazus can help build stronger and safer communities by providing communities with the ability to
  - Identify their areas at risk
  - Assess vulnerabilities
  - Help support their planning and mitigation options



# Hardware and Software Requirements



- Computer Speed: 2.2 GHz dual core or higher
- Memory: 2 GB or higher
- Disk space: 10GB for one multi-hazard large urban study region, plus inventory data size (varies by state), or 70 GB to store entire U.S. inventory data
- Graphics Adaptor: 24-bit capable video card with at least 128 MB of video memory, resolution of 1078 x 768 or higher
- Operating System: Windows 7 Professional 64-bit, Windows 8.1 Professional 64-bit, Windows 10 Professional
- Supporting Software: Appropriate version of Esri ArcGIS and Spatial Analyst extension for flood model

# FEMA Hazus Website



<https://www.fema.gov/hazus>

A screenshot of the FEMA Hazus website. The page has a blue header with the FEMA logo and navigation links. The main content area is white and contains the following sections: 

- Hazus**: A paragraph explaining the program and its purpose, followed by a "Download Hazus Today" section with a link to the FEMA Flood Map Service Center (MSC).
- Hazus News**: A section titled "Hazus 4.2 Now Available" with a list of key highlights, including compatibility with ArcGIS 10.5.1, processing time reductions, and support for various data formats.
- NOTE**: A warning that users must uninstall existing versions of Hazus and Microsoft SQL components before downloading the new version.

## Other Useful Links

- GITHUB
  - <https://github.com/NHRAP-Hazus>
- Training Videos
  - <http://bit.ly/HAZUS>
- Disaster Information and Training Material
  - <https://disasters.geoplatform.gov/publicdata/NHRAP/Training/>



# New in Hazus 4.2 Service Pack 3







# New To Hazus in 2019-2020

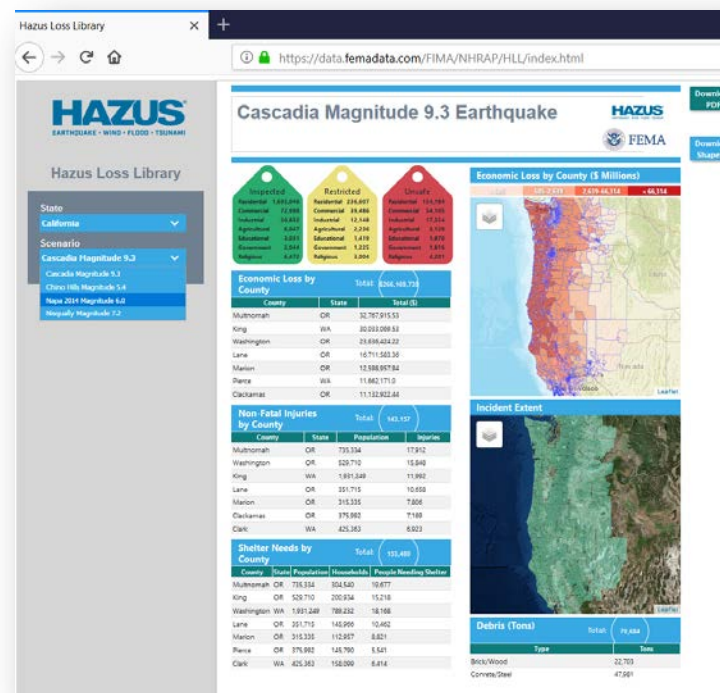


## Automated data updates

- Hospitals
- Schools
- Police Stations
- Fire Stations
- EOCs
- Other HIFLD Data Coming Nov 2019

## Hazus Loss Library

- Scenario Library With Results
- Reports and Data Download
- All Hazus Hazards Supported



```

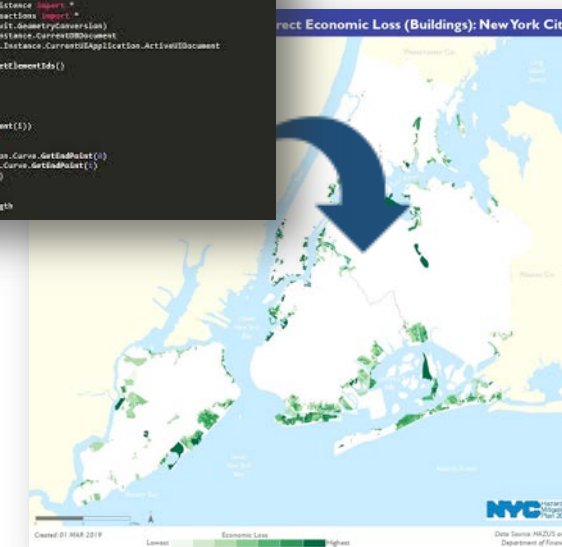
var clr =
clr.AddReference("ProtoGeometry")
var Autodesk.DesignScript.Geometry import =
clr.AddReference("RevitAPI")
var Autodesk.Revit.DB import =
clr.AddReference("RevitServices")
var RevitServices import =
clr.AddReference("RevitServices")
var RevitServices.Transactions import =
clr.ImportReferences(Autodesk.Revit.GeometryConversion)
var doc = DocumentManager.Instance.CurrentDocument
var uidoc = DocumentManager.Instance.ActiveDocument

var sel = uidoc.Selection.GetElementIds()

var list = []
var endList = []
var length = []

for each (id in sel)
{
var item = doc.GetElement(id)
var loc = item.Location
var len = item.Length
var start = item.Location.Curve.GetEndPoint(0)
var end = item.Location.Curve.GetEndPoint(1)
var list.append(start)
var endList.append(end)
var length.append(len)
}

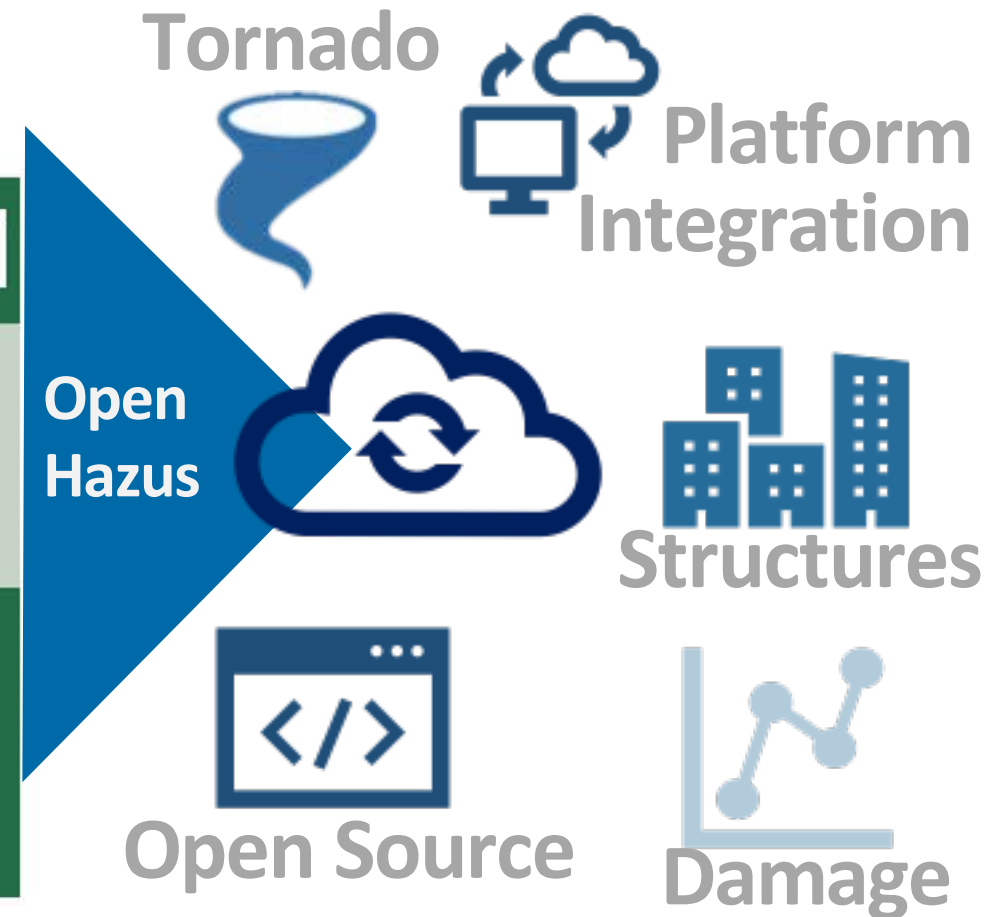
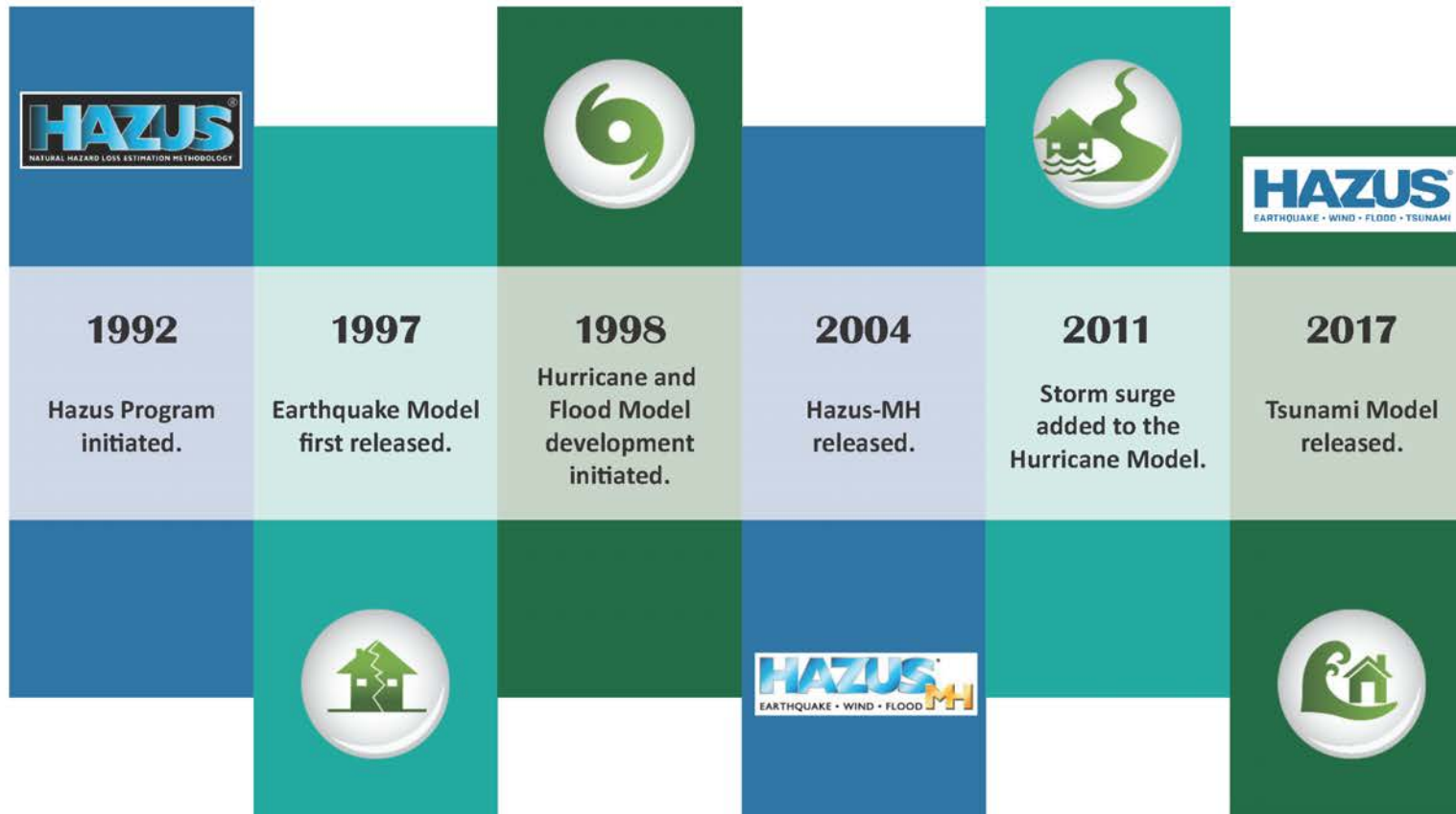
var list = list, endList = endList, length = length
    
```



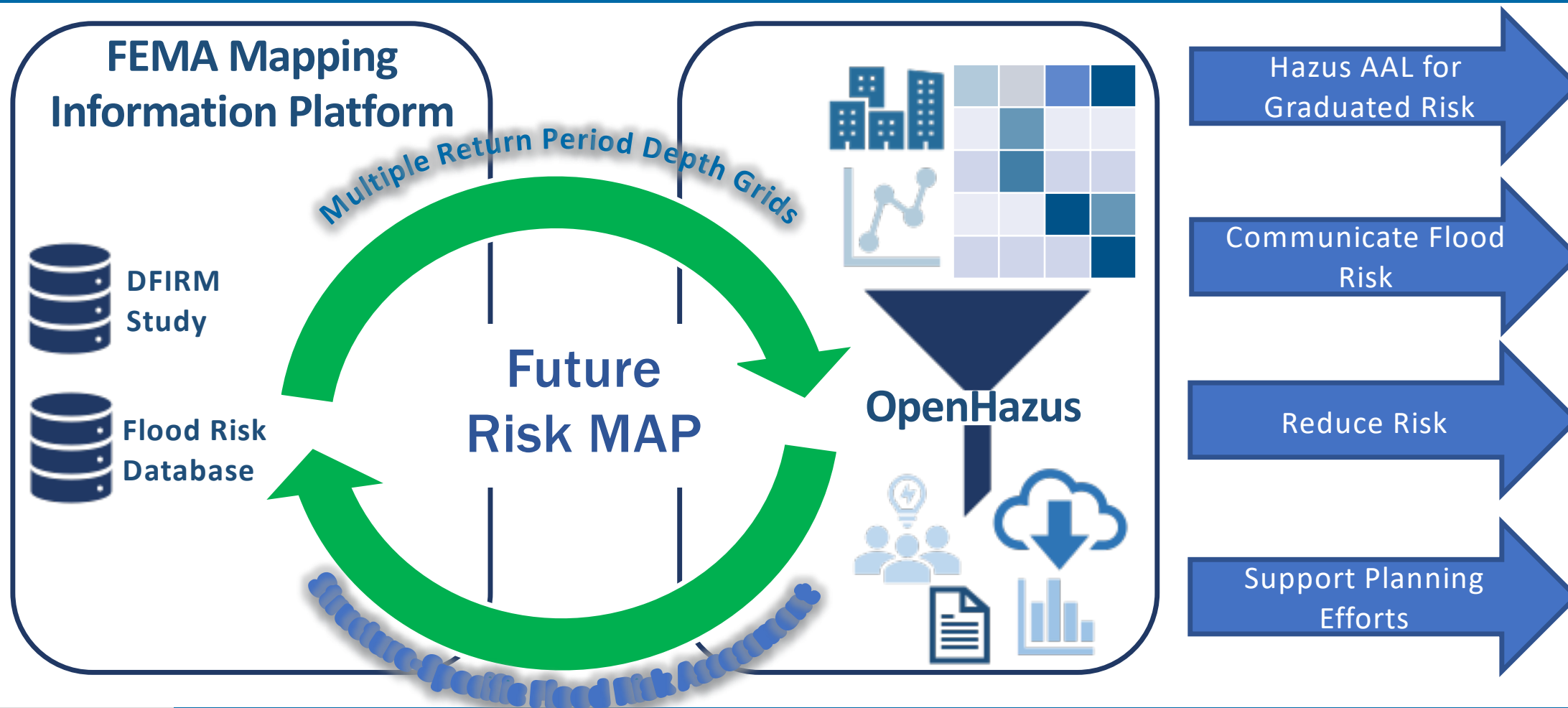
## Site-Specific Utilities

- FAST – Flood Assessment Structure Tool
- Building Specific Results in Seconds
- Additional Utilities Forthcoming

# OpenHazus



# Connecting Hazus to FEMA Programs





# Hazus 4.2 Service Pack 3 Updates



- FEMA IA Damage Categories
- Updated Essential Facilities
- Combined Wind and Surge Losses with Custom Flood Hazard Data
- Better USGS ShakeMap Scenario Library Integration
- Hurricane Seasons 2017/2018 Data



Release Notes: <https://www.fema.gov/media-library/assets/documents/105743>

# HIFLD Data Integration



- Hazus 4.2 Service Pack 3

- Hospitals
- Schools
- Police stations
- Fire stations
- EOCs



- 11/29/2019 Release

- Infrastructure
- Transportation
- Communication

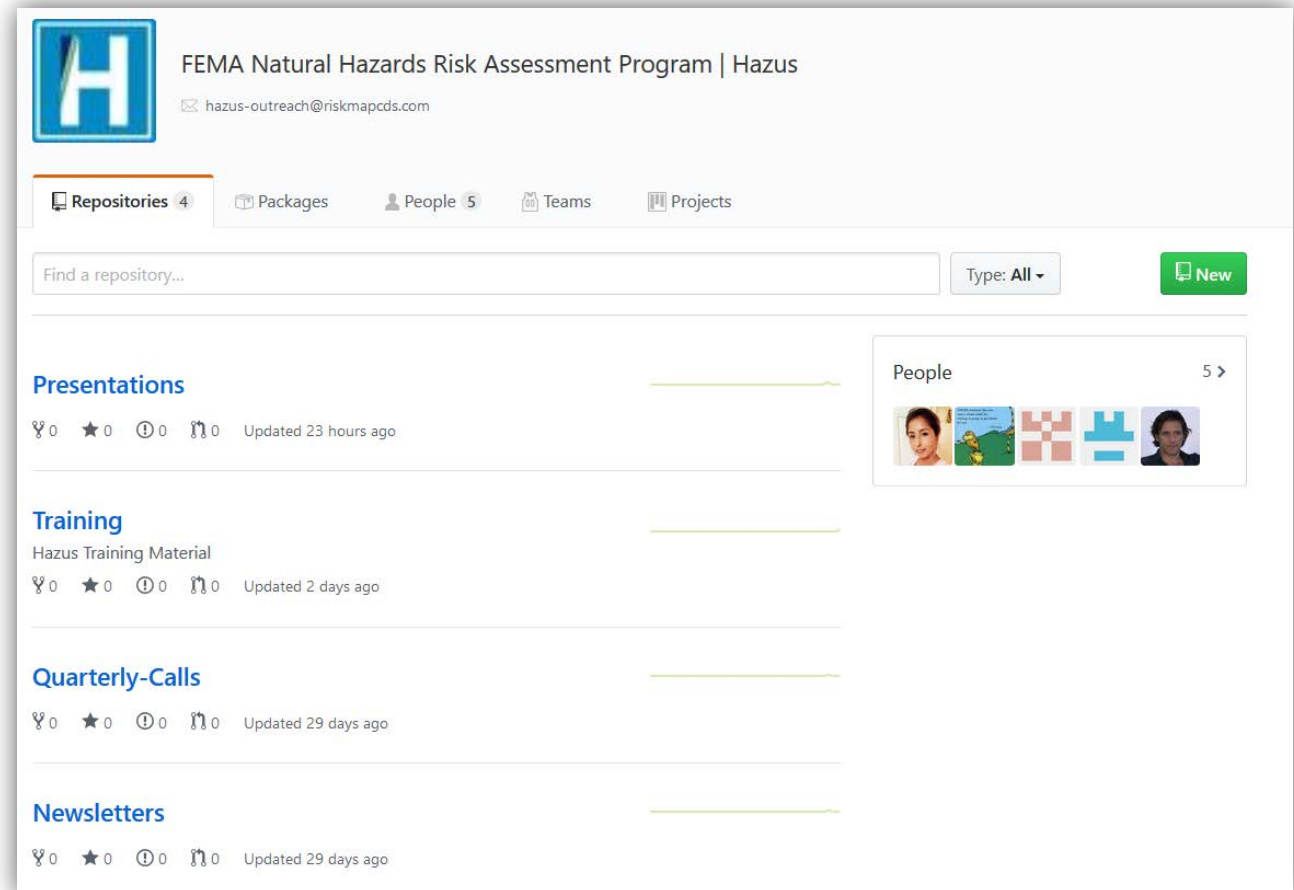


# Now Available Hazus Github

<https://github.com/nhrap-hazus>



- FAST (Flood Assessment Structure Tool) and Export and Report tool available 11/29/2019
- Hazus Quarterly call presentations and newsletters
- Hazus Program conference presentations
- Training Material



# Hazus Help Using Twitter

## @HazusProgram | #Hazus #HazusHelp



**#hazushelp**

Top Latest People Photos Videos News Broadcasts

Search filters · Show

**Who to follow** · Refresh · View all

- SoFi** @SoFi · Follow · Promoted
- Followed by David H and others  
**Esri Startup Program** @Es... · Follow
- NOAA's Ocean Service** · Follow

Find people you know

**Hazus Program** @HazusProgram · May 2  
Troubleshooting the "Class Not Registered" error? Check out our quick fix below.  
[#hazushelp](#) [#hazusclassnotregistered](#)

The Class Not Registered error message will appear when Hazus starts up, notifying the user that there has been an incomplete install. Please follow the steps below to re-install Hazus.

**Remove SQL Server**

- 1) Navigate to Add or Remove Programs
- 2) Right click Microsoft SQL Server 2014 (64 Bit)
- 3) Choose Remove
- 4) In the "Instance to remove features from" Select: HAZUSPLUSDRVR
- 5) Check the Box for "Database Engine Services" and "SQL Client Connectivity SDK" to remove those features
- 6) Click Next and Remove

**Remove Hazus application**

- 1) Navigate to Add or Remove Programs
- 2) Right click Hazus M4 -> Uninstall
- 3) Select Remove

**Restart the Machine**

- 1) After machine is restarted, run the "InstallHazus.exe" -> Run As Administrator ->
- 2) Please run the SP1 patch after Hazus 4.2 has been installed.  
[https://hazus-support.emac.fema.gov/patches/13-2-6/FATC-Hazus\\_4.2\\_SP1.msp](https://hazus-support.emac.fema.gov/patches/13-2-6/FATC-Hazus_4.2_SP1.msp)

**Hazus Program** @HazusProgram · Aug 21  
Learn #Hazus for risk assessment on YouTube with our introductory training videos! Videos cover Hazus basics like data management and analytical steps for earthquake, hurricane, flood and tsunami risk assessment. [bit.ly/HAZUS](https://bit.ly/HAZUS)

**Getting Started Install Hazus**

FEMA FEMA Flood Map Service Center Hazus

**HAZUS**

**lazu: Getting Started**

EMA

**IEW FULL PLAYLIST**

2 4

Working with Hazard Data  
Import a Shemap for an Earthquake Scenario  
6  
HAZUS: Working with Hazard Data  
EMA  
IEW FULL PLAYLIST  
Managing Inventory Data  
Import User Defined Facilities (UDF)  
6  
HAZUS: Managing Inventory Data  
EMA  
IEW FULL PLAYLIST  
Analysis and Sharing  
Run Your Analysis  
5  
HAZUS: Analysis and Sharing  
EMA  
IEW FULL PLAYLIST

#HazusHelp



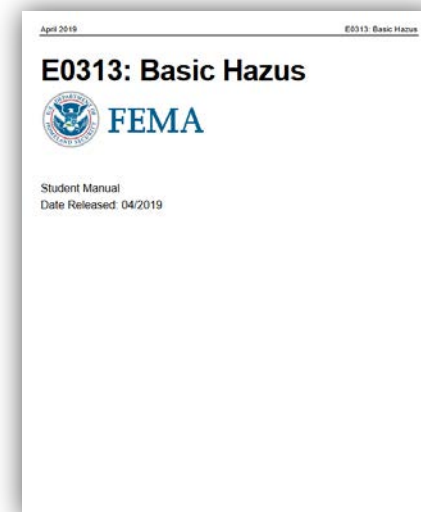
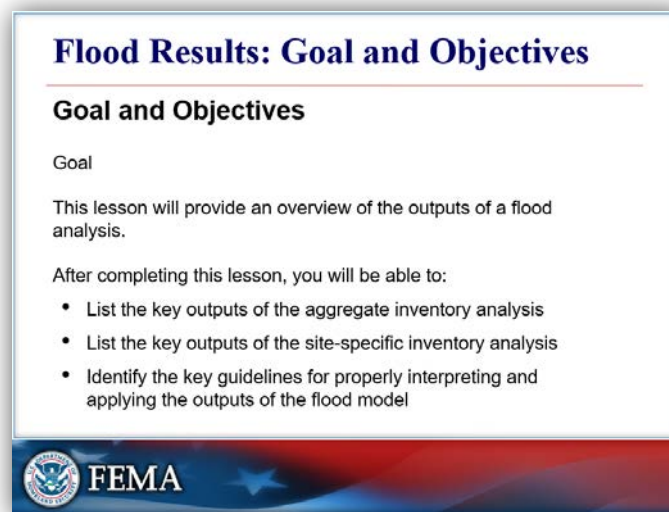


# Hazus Training Platform

<https://disasters.geoplatform.gov/publicdata/NHRAP/Training/>



- Full Hazus training course curriculum now publicly available
- Includes student guides, slide presentations, exercises, and exercise data

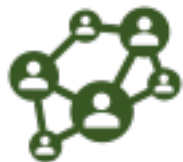


# Hazus Training Videos

<http://bit.ly/HAZUS>



- Learn or Refresh Hazus on YouTube!
- Hazus Training Video Series
  1. Getting Started: Download and Install
  2. Managing Inventory Data
  3. Working with Hazard Data
  4. Analysis and Sharing



# FAST – Flood Assessment Structure Tool



- Inputs: flood depth grid, structures
- Outputs: economic loss
- Python, runs independent from Hazus
- FAST – not flash!

tk

User Defined Flty Id\*:

Occupancy Class\*:

Building Cost\*:

Building Area\*:

Number of Stories\*:

Foundation Type\*:

First Floor Height\*:

Content Cost:

Building DDF:

Content DDF:

Inventory DDF:

Inventory Cost:

Specific Occupancy ID:

Latitude\*:

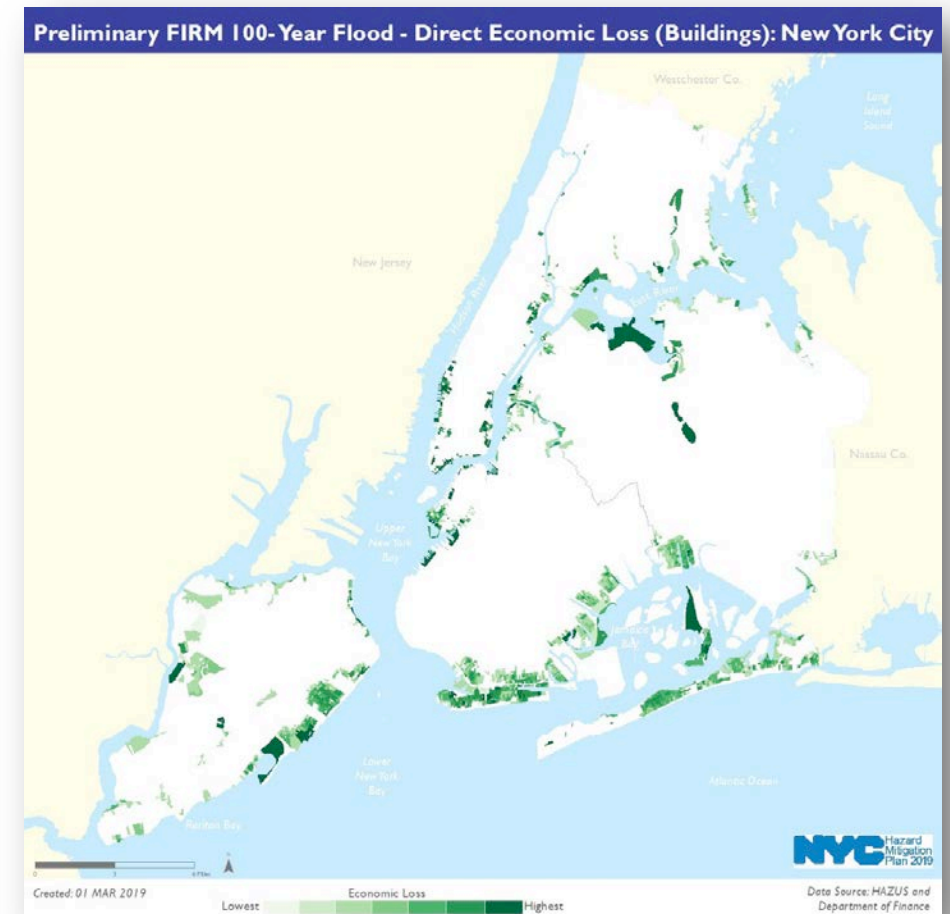
Longitude\*:

Coastal Flooding attribute (fIC)\*:

Depth Grid (ft)\*:

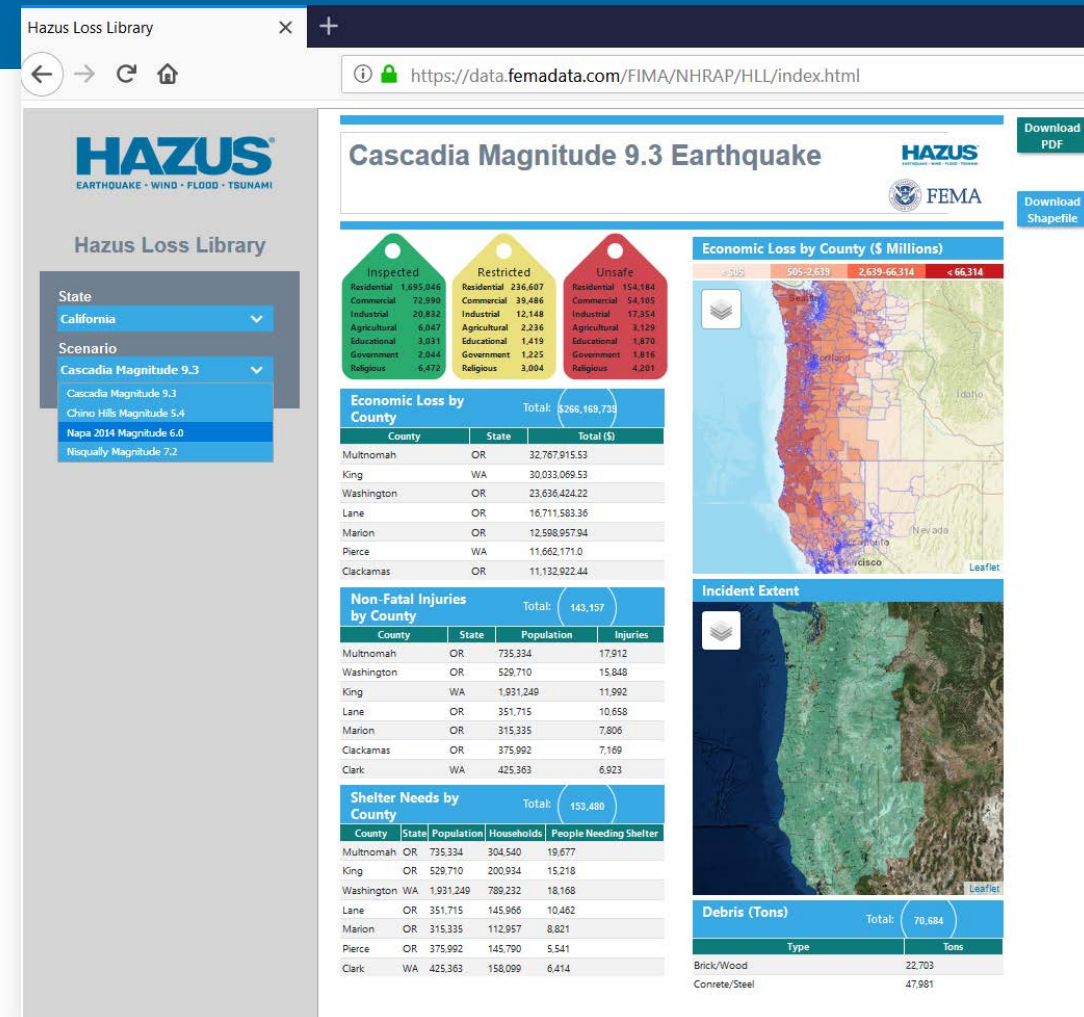
Fields named similar to defaults are searched for.  
\* indicates required field.  
Red fields are required and must be mapped.  
Yellow fields have not been mapped, but are not required.  
Green fields have been mapped successfully.

Execute Browse to Inventory Input (.csv) Quit



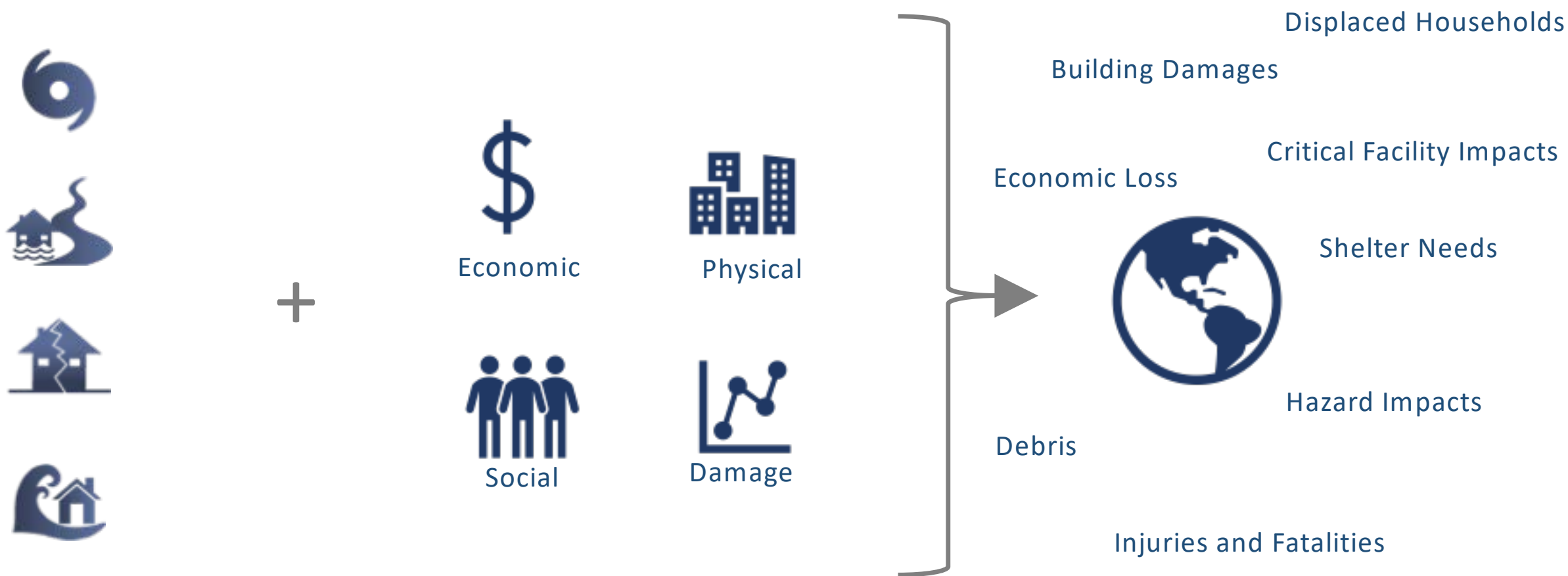
# Hazus Loss Library (in dev)

- Library of Authoritative Hazus Analysis to Support non-technical Hazus Users
- Simple Interface
- All Hazards and Data Available
- Results Distribution Platform
- Public Release: May 2020

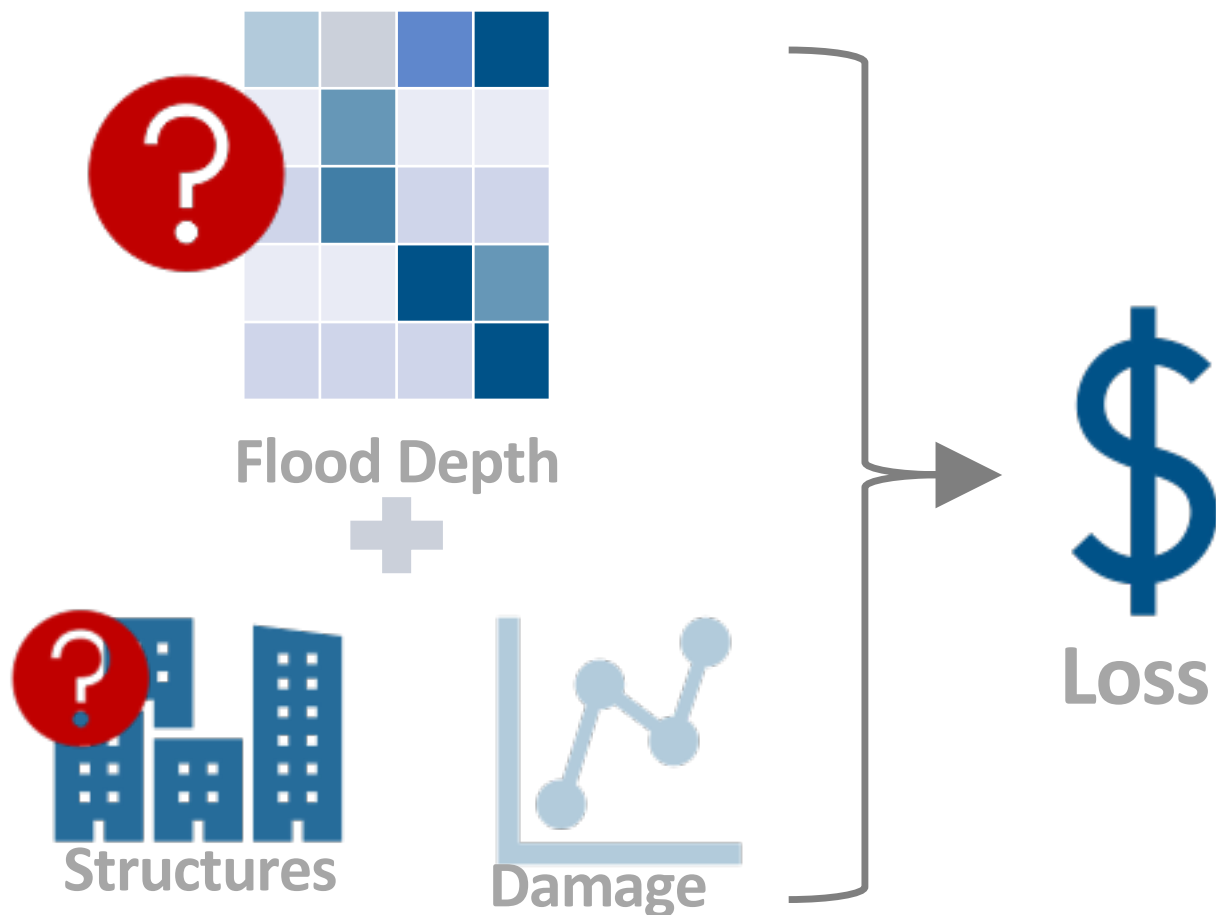




# How Does Hazus Work



# Flood Hazard Challenges



- Flood hazard data not available continuously across the country
- Flood hazard data provided as lines (BFE) or areas (A zone) – NOT DEPTHS
- Structure data generalized to the census block
- Structure data collected and analyzed for local studies in an EXPENSIVE process

# FEMA Flood Strategy is Changing



- RiskMAP is acknowledging the need for non-regulatory flood data to help communicate risk more effectively
- RR 2.0 is transitioning to graduated risk measurement
- FEMA wants to communicate risk to individual property owners



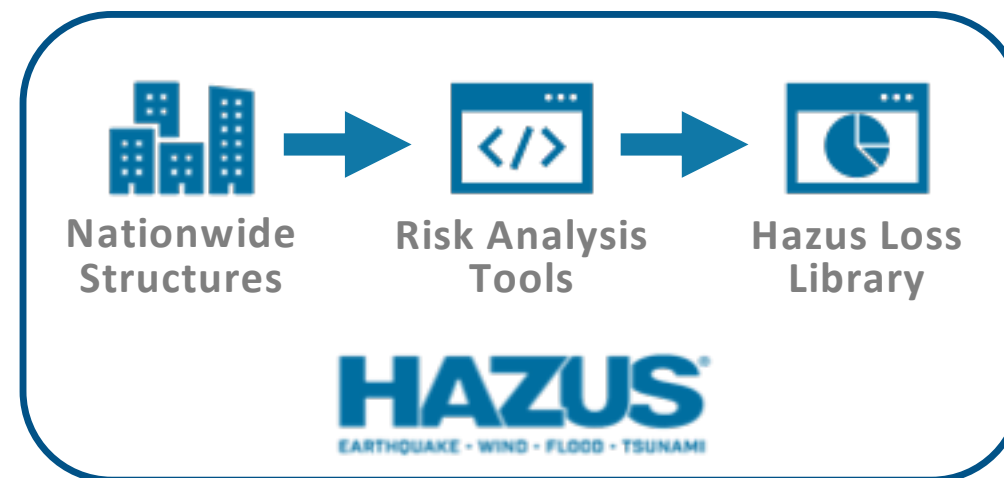
# Risk MAP Flood Risk Assessments in OpenHazus



Flood Data



OpenHazus

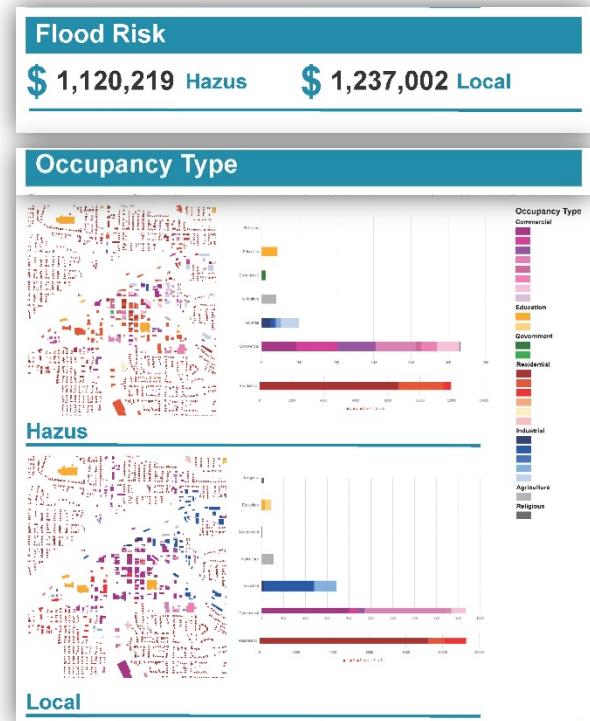
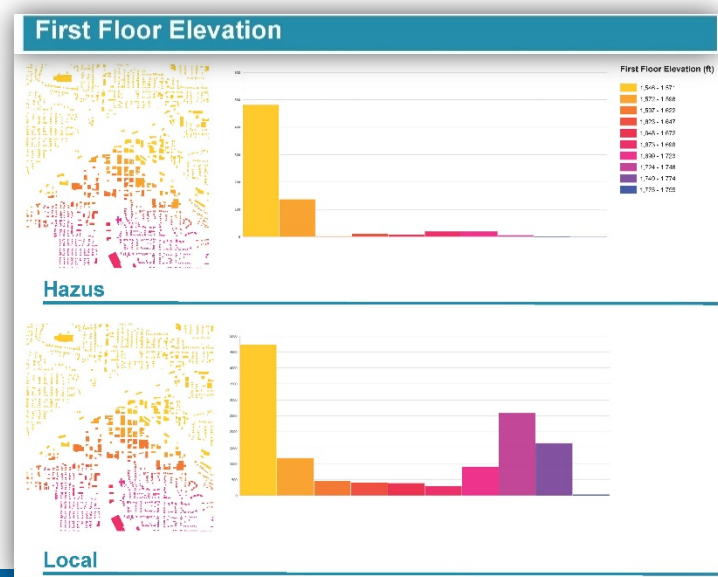
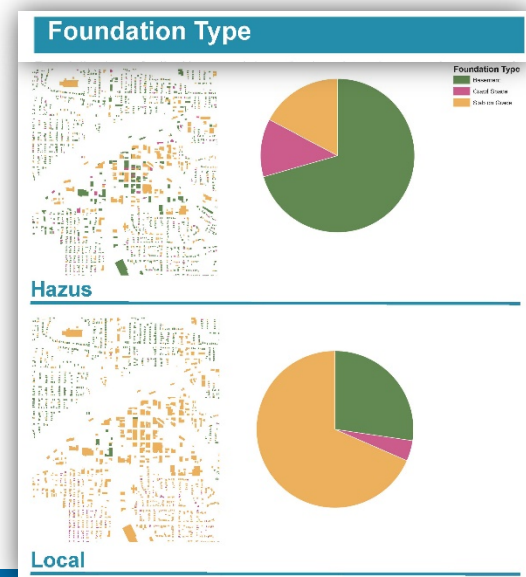




# Nationwide Structures

## Local Attributes vs Statistical Assumptions

- Microsoft/Oak Ridge nationwide building footprints offer an exciting opportunity for structure-level risk assessment nationwide, but footprints are missing attribute information crucial for risk analysis.



In Minot, ND, we got within 89% of general occupancy type, 64% of specific occupancy type, and 91% of averaged annualized flood losses

# NHRAP Partnerships



**Natural Hazards Risk  
Assessment Program**

- NHRAP has fostered strong and cooperative relationships with numerous federal agencies, scientific communities, and academia
- Allows NHRAP to provide dynamic data linkages to authoritative hazard risk data sets and validate scientific methodologies
- Impact
  - Increased credibility of hazard risk data
  - More focused program investment in accurate loss estimation methodology and effective delivery of model results
  - Translate hazard data into actionable risk information



National Water Center  
National Hurricane  
Center



# Hazus Support for Hurricanes

- NHRAP serving as Hazus wind modeling SME to support Hurricane Dorian response
  - Improves confidence by conducting QA/QC of model results
  - Ensures HQ and Regions are using the same planning factors
- Model results provide readily-available and credible data
  - Provides common operating picture for senior leadership
  - Compares building damages to PDA classes to support States' declaration requests
  - Allows state and local emergency management to target life safety concerns
  - Supports resource planning to prioritize high impact areas





# Questions?

FEMA's Hazus Program is now managed by the Natural Hazards Risk Assessment Program under FIMA's Risk Management Directorate.

For any questions or comments regarding OpenHazus please feel free to contact [FEMA-NHRAP@fema.dhs.gov](mailto:FEMA-NHRAP@fema.dhs.gov).

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