Workshop
Nov 7-8, 2024
Eugene, OR

CRESCENT
CASCADIA REGION EARTHQUAKE SCIENCE CENTER

Cascadia CoPes Hub
THE CASCADIA COASTLINES AND PEOPLES HAZARDS RESEARCH HUB

Session 4

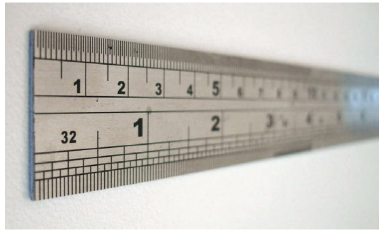
Implementation: How do our models/estimates make it into policy and industry applications

Ron Eguchi
ImageCat, Inc.

How do our models/estimates make it into policy and industry applications?

How do our models/estimates make it into policy and industry applications?

measuring stick



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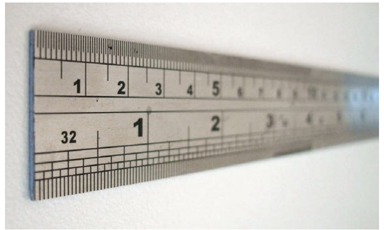
- Provide a **measuring stick** for assessing how bad and how likely a disaster could be



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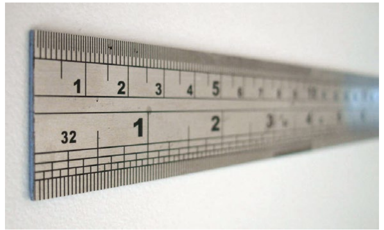

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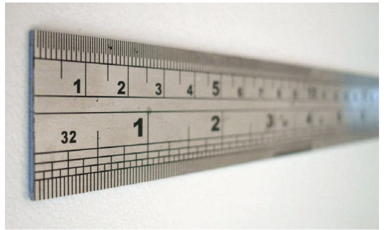

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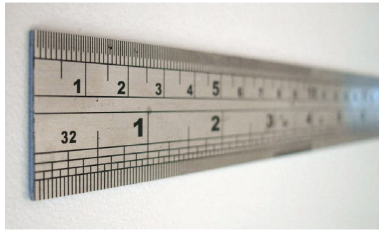
actuary



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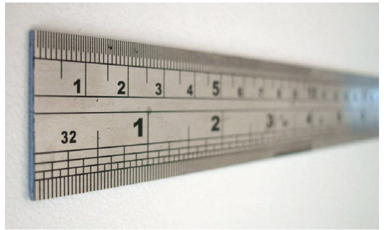

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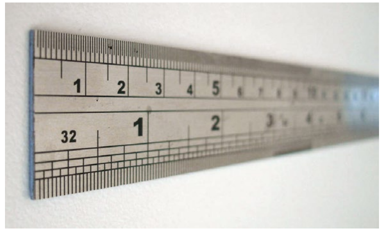
safe routes



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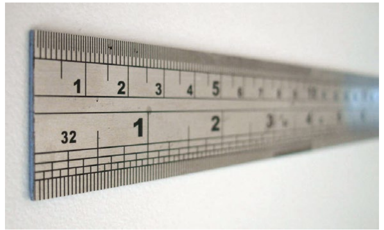

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Expedia

ChatGPT

Software

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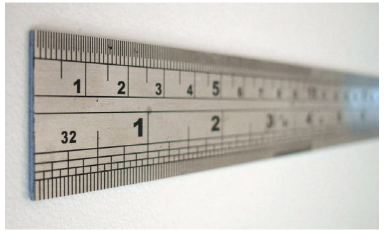
ChatGPT



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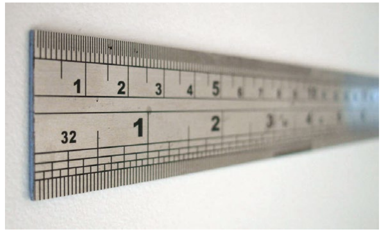
- Provide a tool for assessing **safe routes** for evacuation
- Serve as a **ChatGPT** tool for generating emergency response plans

Expedia

ChatGPT
Software



Leveraging Earth Observation Data and Products to create a Comprehensive Tsunami Loss Estimation Platform – Impacts in a Changing Climate

Diego Melgar, Ron Eguchi, Shunichi Koshimura, Brendan Crowell, Kevin Kwong, Yajie Lee, Charlie Huyck, Shubharoop Ghosh, Georgiana Esquivias, ZhengHui Hu, David Small, and Sean Santellanes

NASA

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NASA Earth Science
DISASTERS PROGRAM

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IRIDeS
International Research Institute of Disaster Science

Knowledge gaps addressed by this study

- A probabilistic framework for modeling future tsunami hazards and risks
- A comprehensive view of the financial and societal impacts of tsunamis
- How to build and update data and models for exposure and impacts of climate change analysis using remote sensing
- How to incorporate physics-based models of earthquake generation and tsunami inundation into loss estimation
- A unified methodology (using geodesy) that can inform tsunami risk assessments in real-time

Project Deliverables

- An operational model for scenario-based and probabilistic risk/loss estimates at short, decadal and long-time scales
- Pilot study results for the U.S. West Coast that demonstrate the use of the methodology.
- Case studies of how the platform is used to assess the efficacy of possible adaptations to reduce future risks to property and people

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Another priority for project --- meaningful outreach and end-user engagement

Pre-Award Demonstration Study …

Cascadia Earthquake

M 9.0 Cascadia Subduction Zone

6-hour duration

Study Area

Ocean Shores, Western Washington

Study Products:

Loss estimates ($) for residential & commercial construction

Casualty estimates using different assumptions re. community preparation & evacuation times

Intended Users

Local and Regional Govts

NOAA – rapid post-earthquake loss estimation

FEMA – flood insurance program

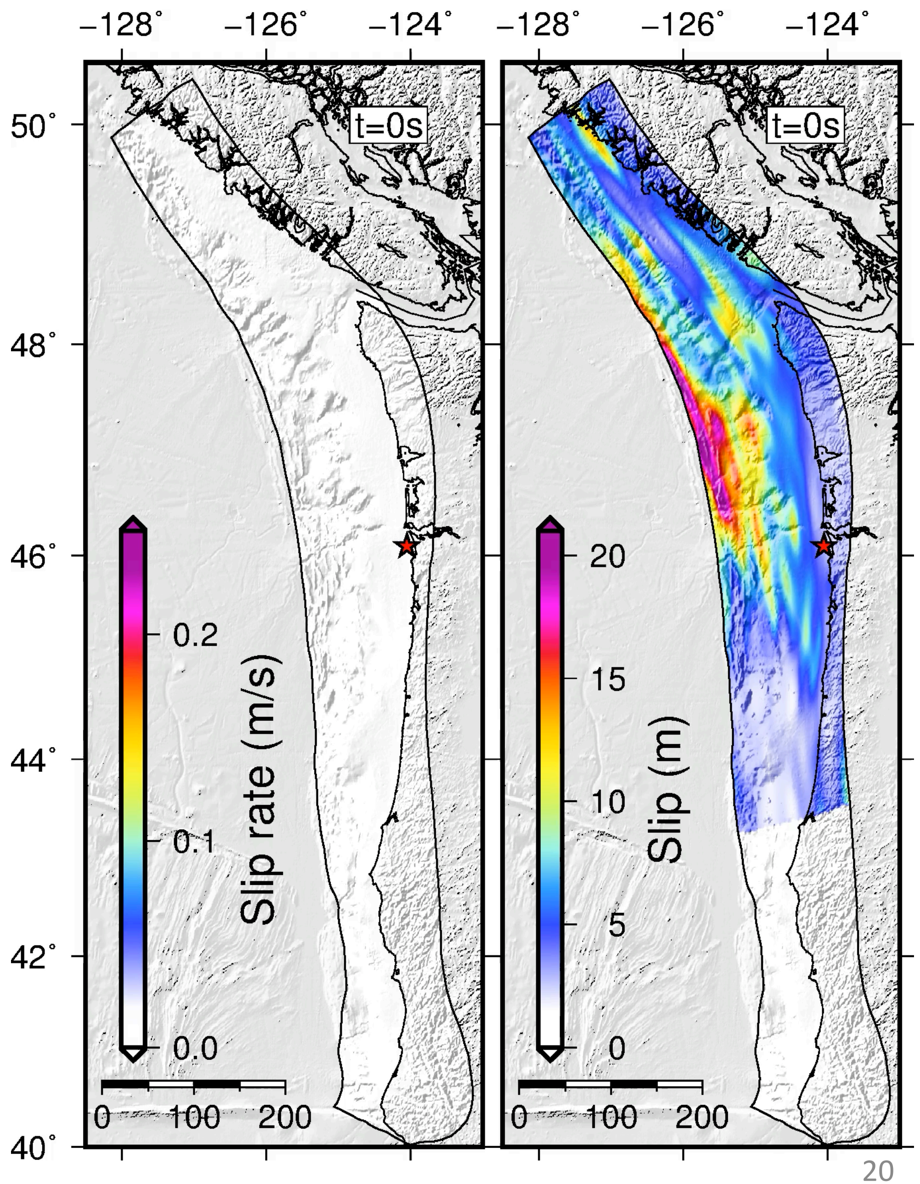
Re/Insurance companies

The Public

Study Area: Ocean Shores, Washington

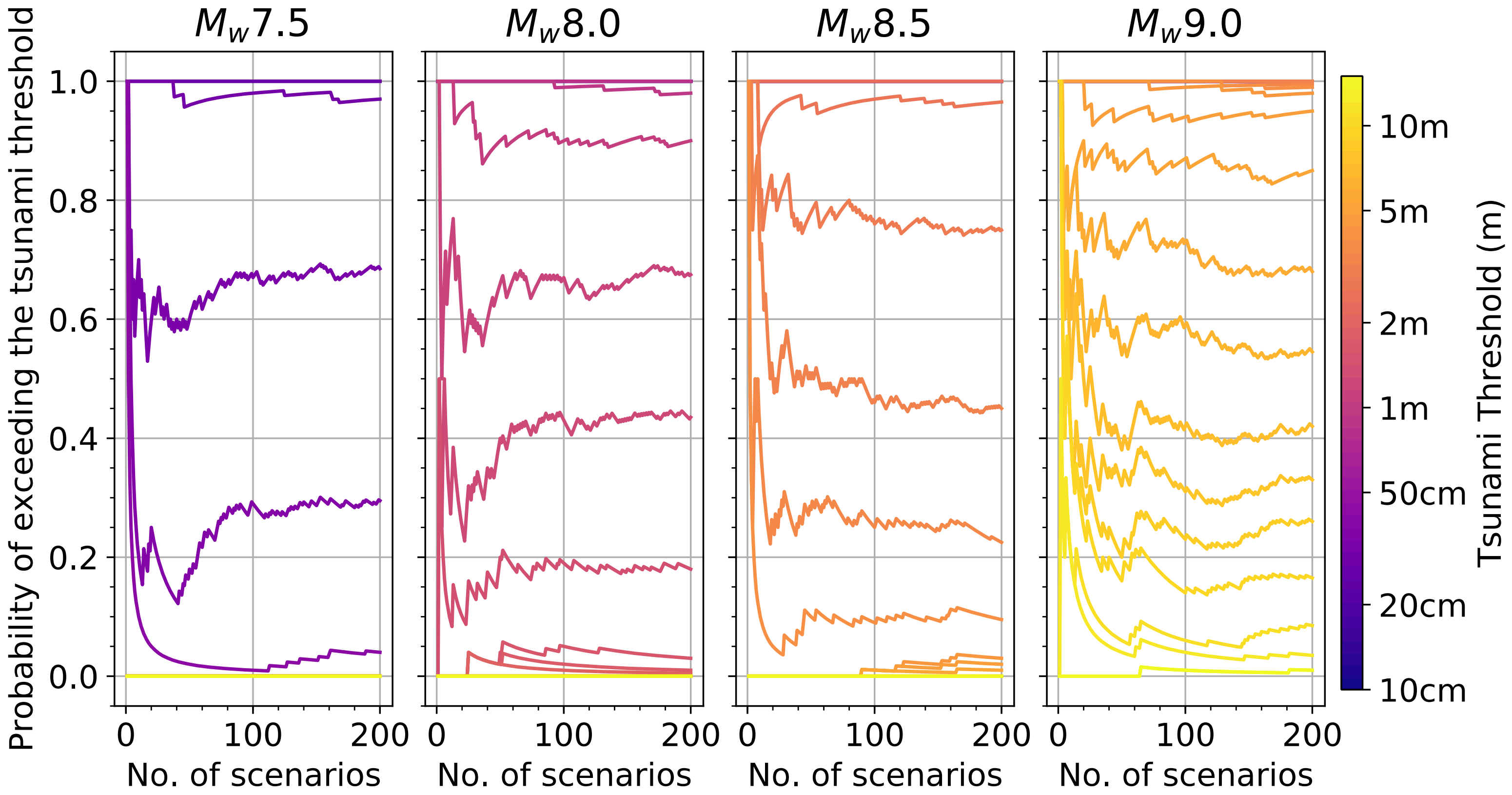
Earthquake sources

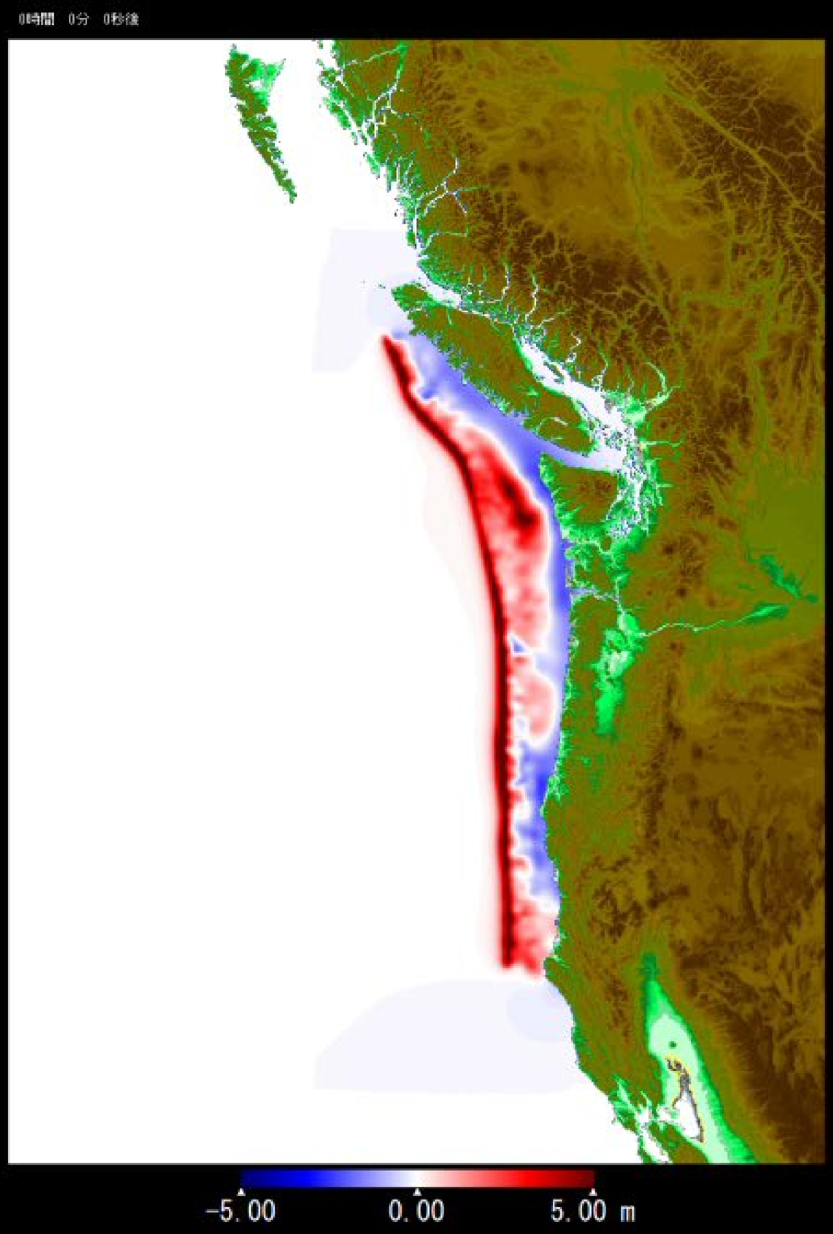
- As part of the NASA DISASTERS work, we've produced a code that can efficiently generate thousands of realistic earthquake sources on any fault and for any magnitude range
- Methodology is being applied to the US but can be extended globally
- Next step to focus on probabilistic modeling to capture comprehensive assessment of future risks



Earthquake sources

- This allows you to empirically characterize the potential distribution of near-source tsunami inundations simply by modeling the tsunamis for all these earthquakes





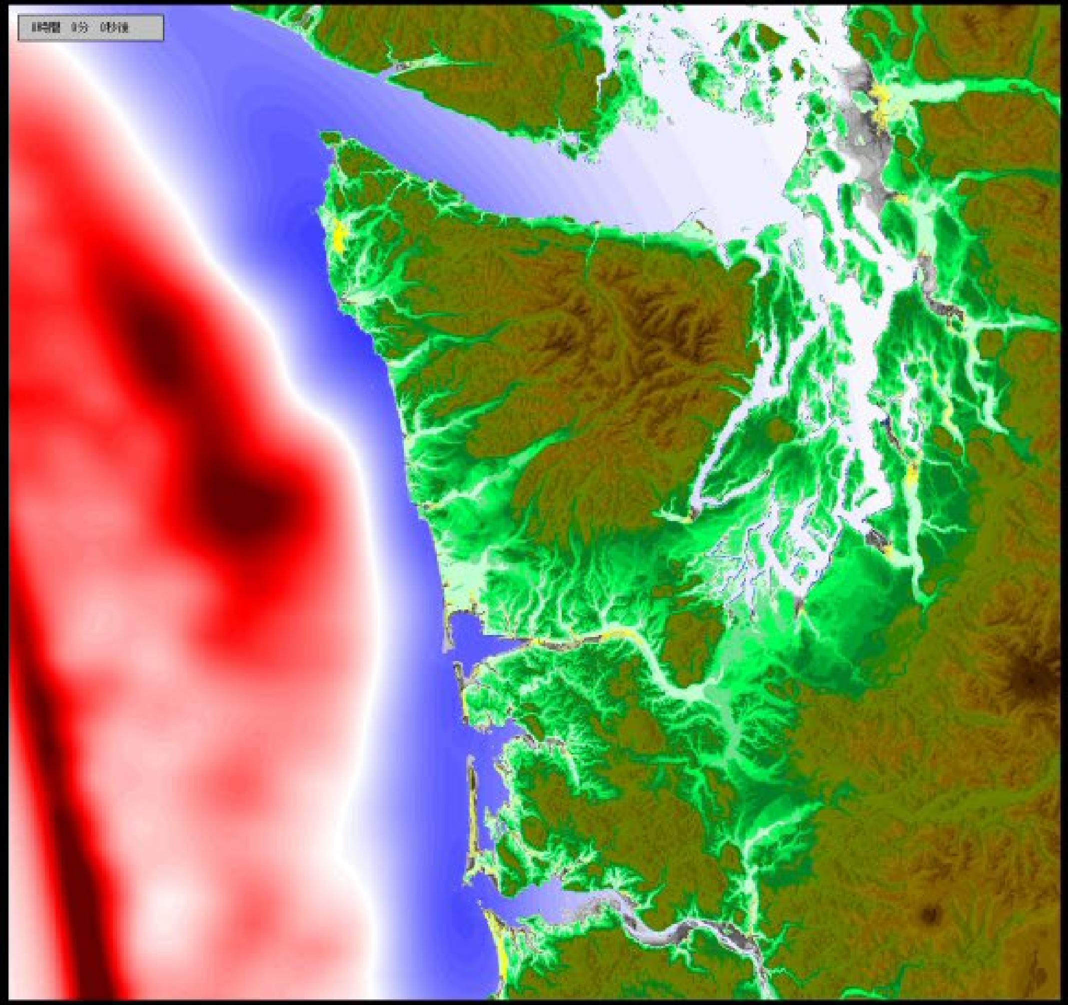
UTM10

Cascadia Mw9.0

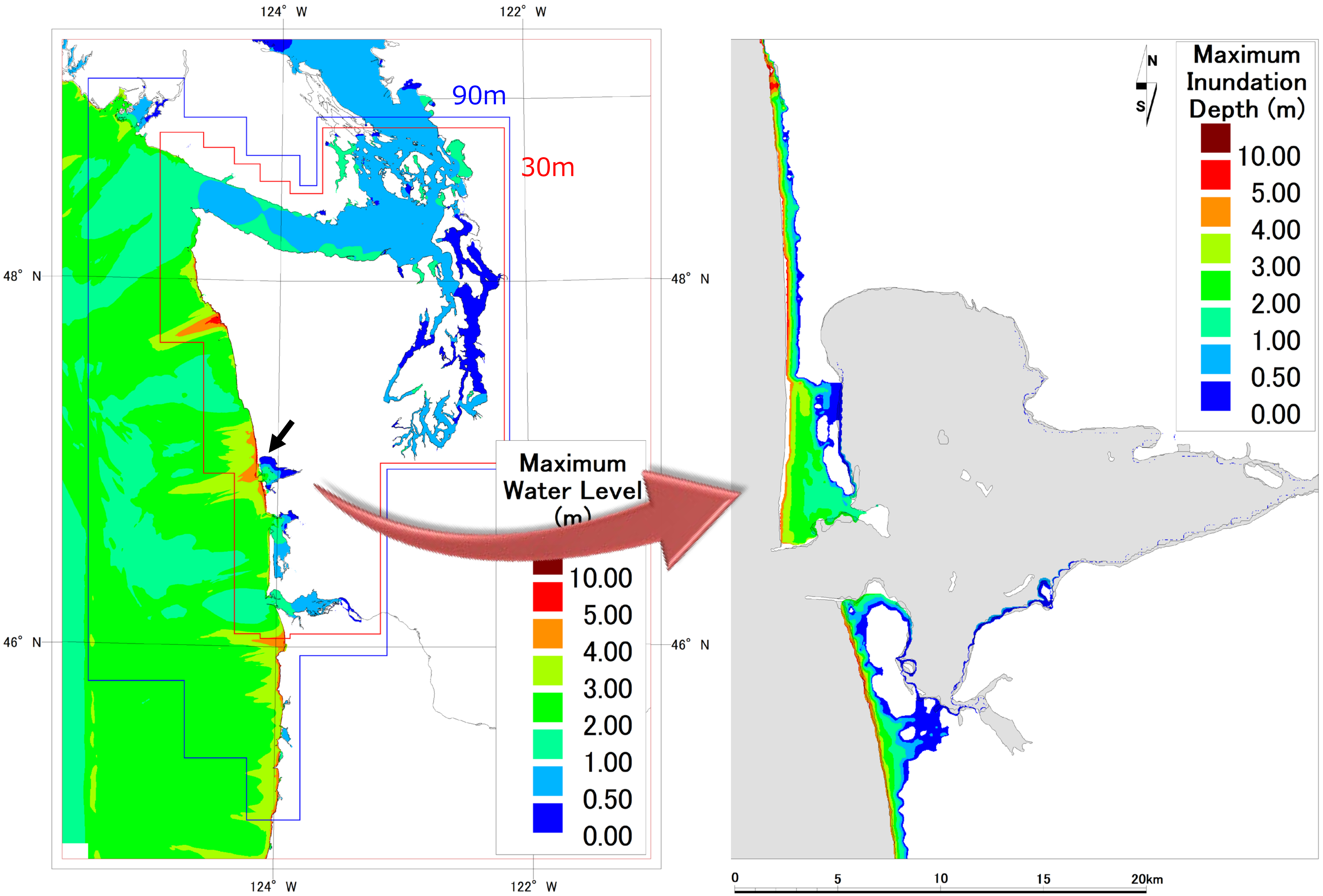
Duration: 6 Hours

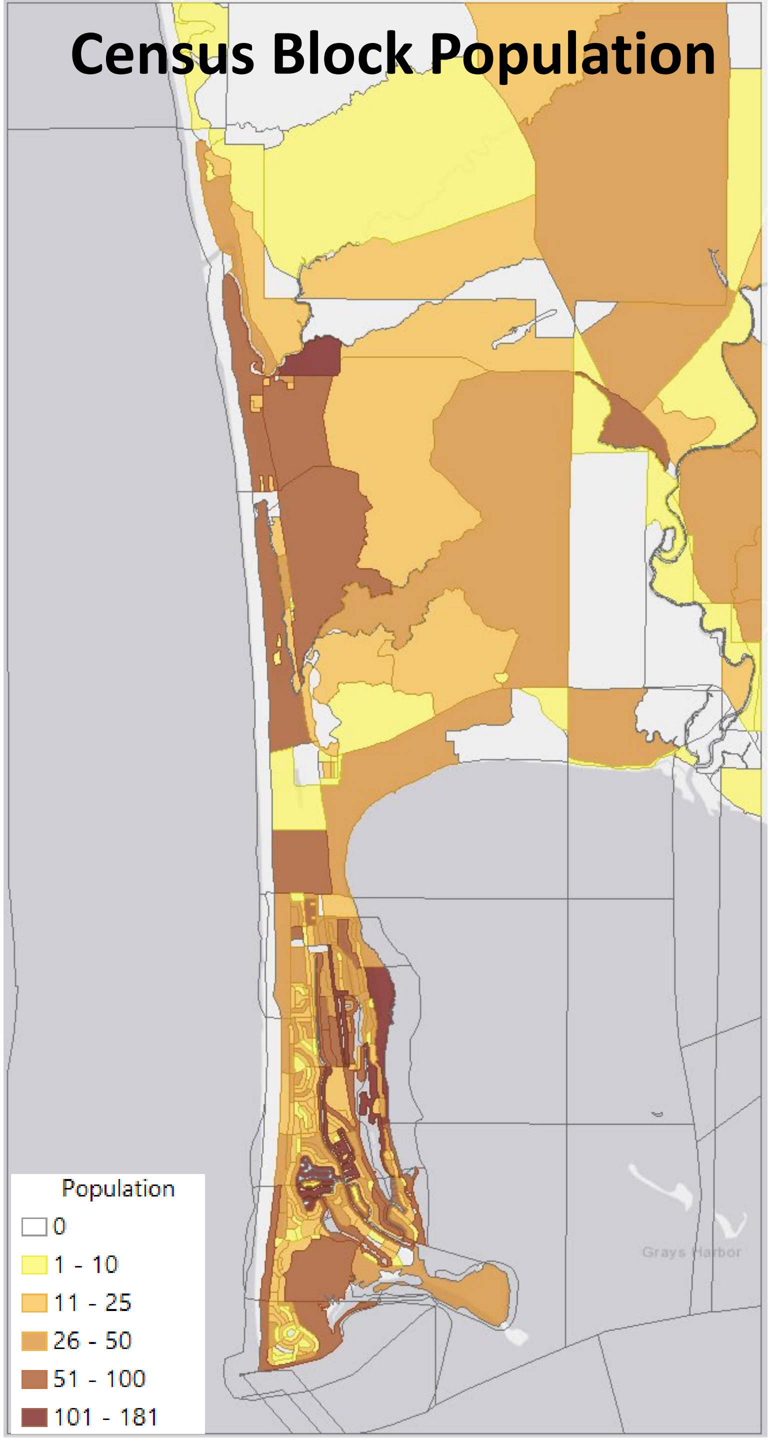
hh:mm

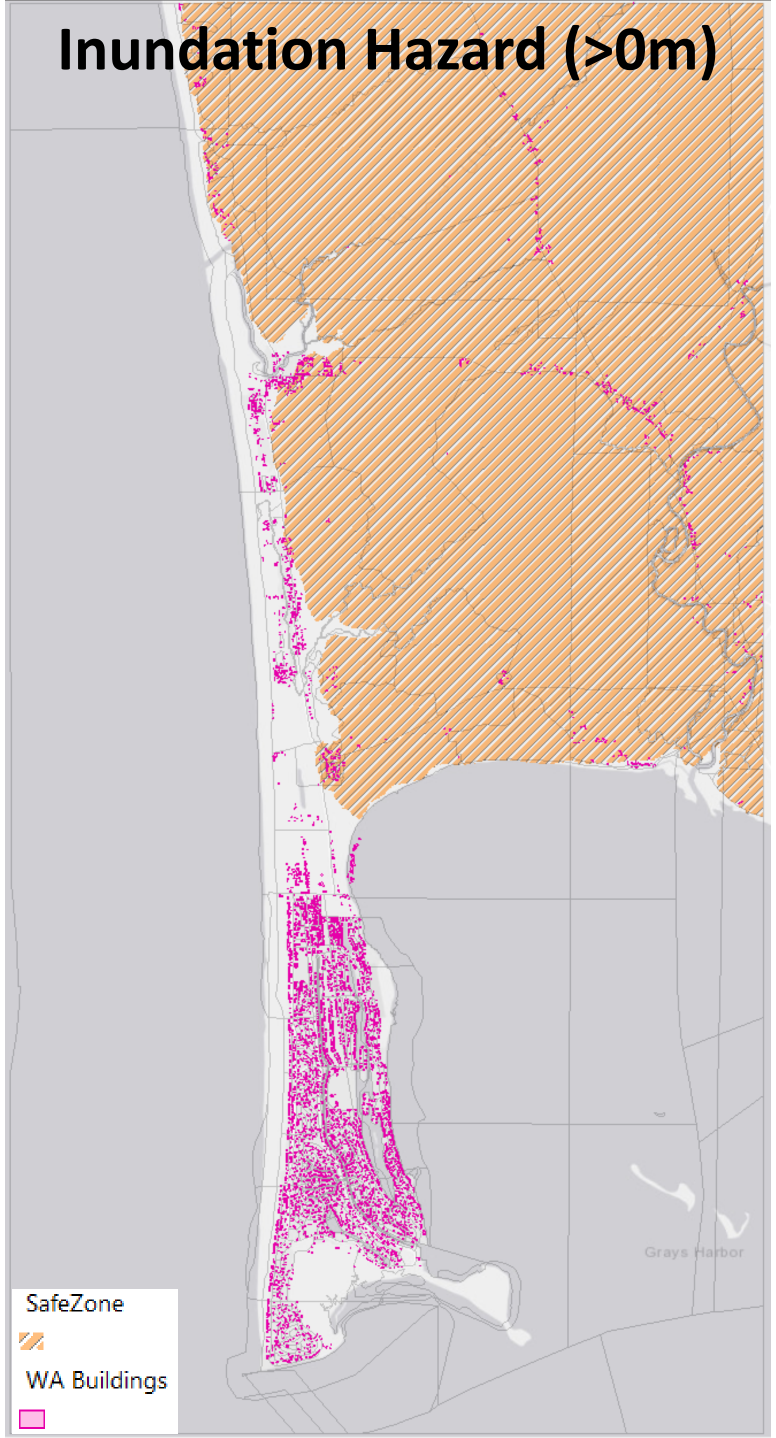
00:00

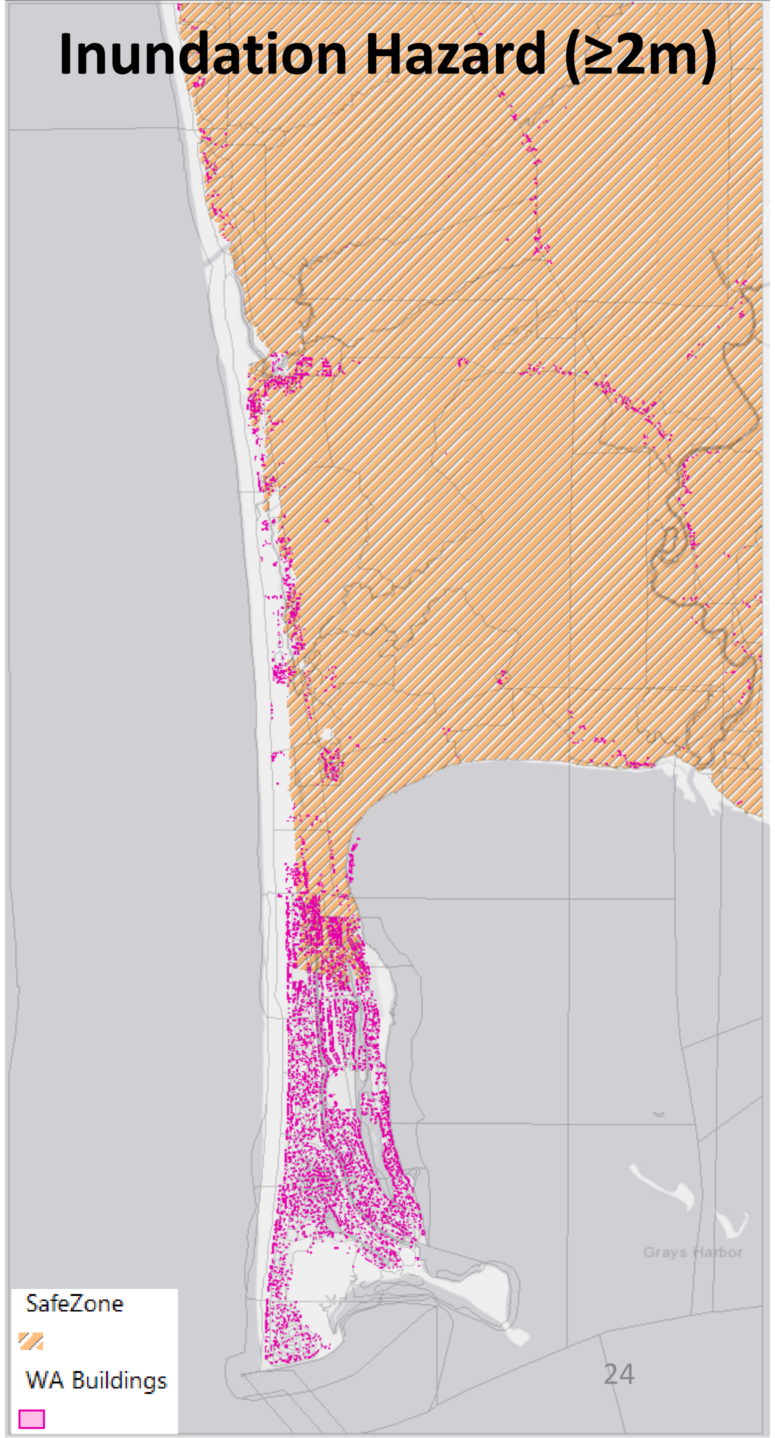


Inundation Model Example (M9)

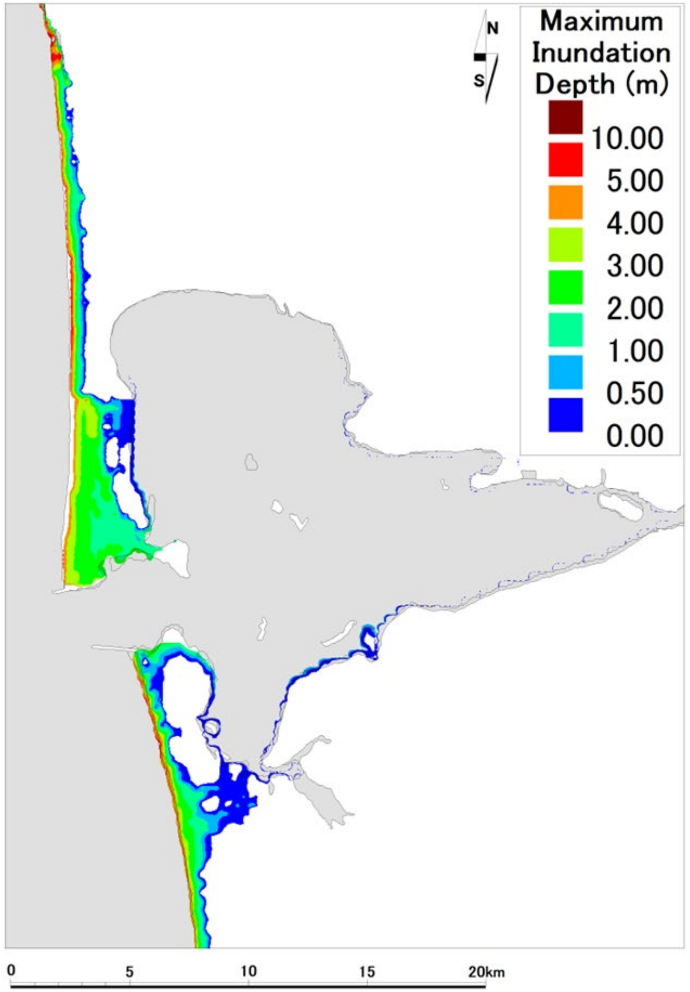



Census Block Population
Population
0
1 - 10
11 - 25
26 - 50
51 - 100
101 - 181
Grays Harbor


Inundation Hazard (>0m)
SafeZone
WA Buildings
Grays Harbor


Inundation Hazard (≥2m)
SafeZone
WA Buildings
Grays Harbor

Structural and Contents Damage by Flow Depth

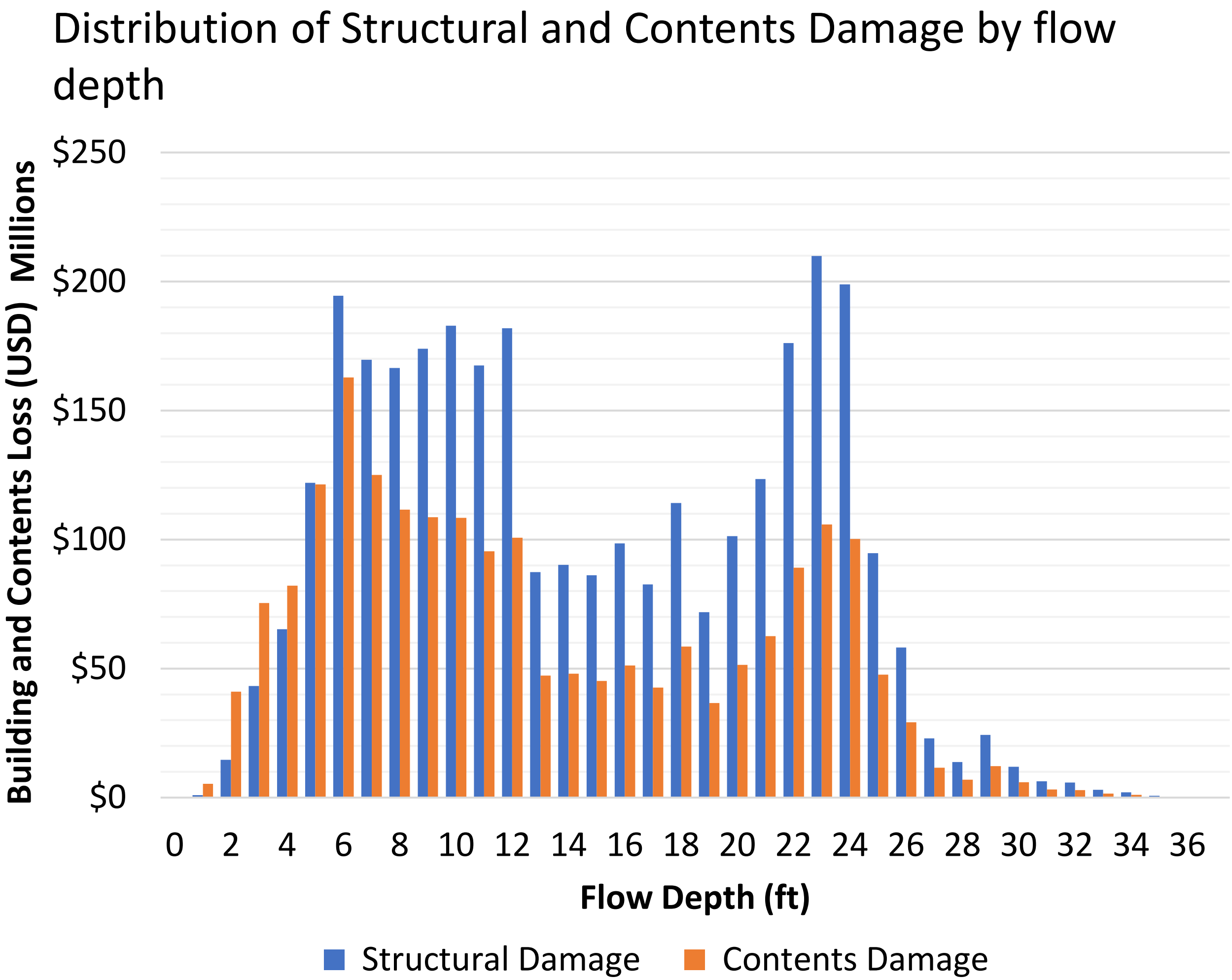


30 ft

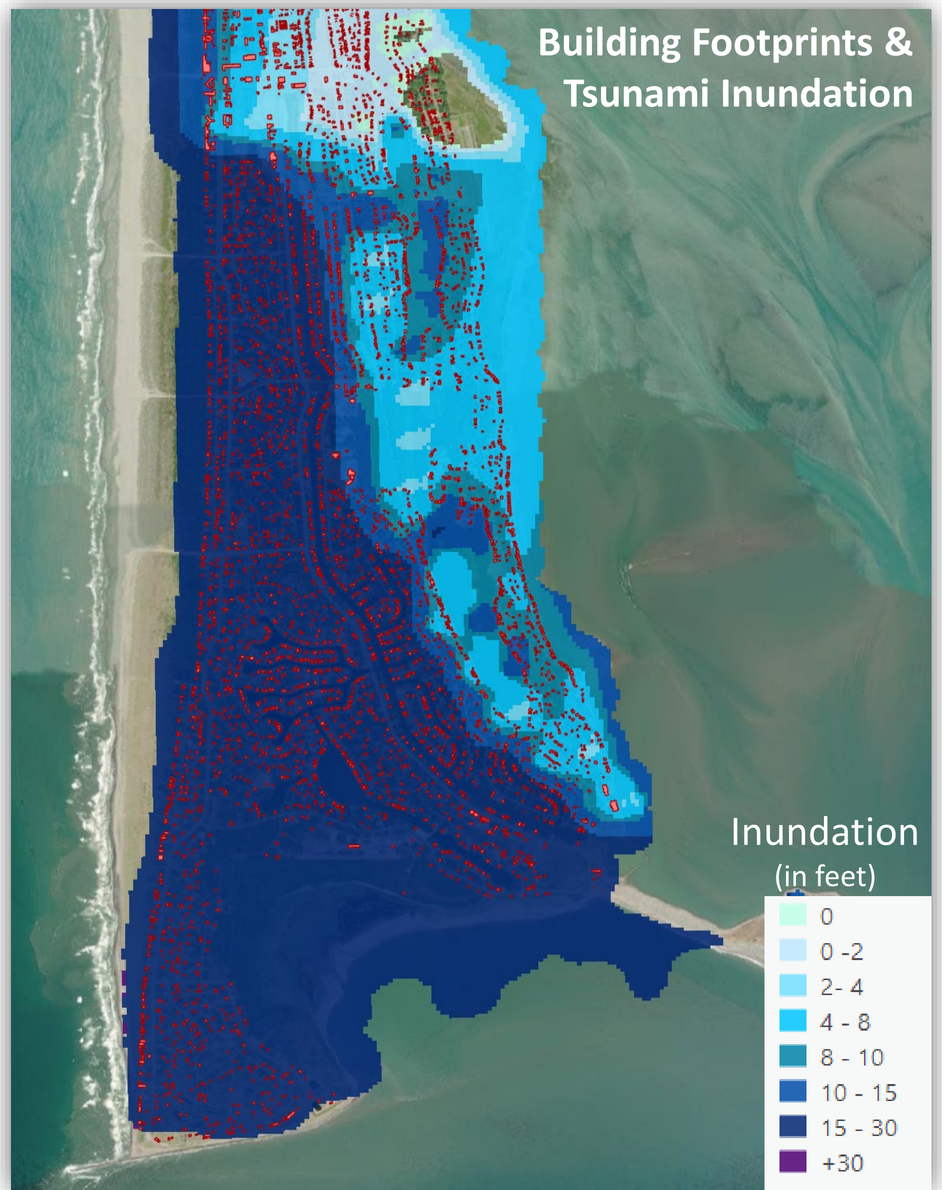
10 ft

6 ft

Cascadia Mw 9.0 Simulation



Financial Losses, including Downtime …



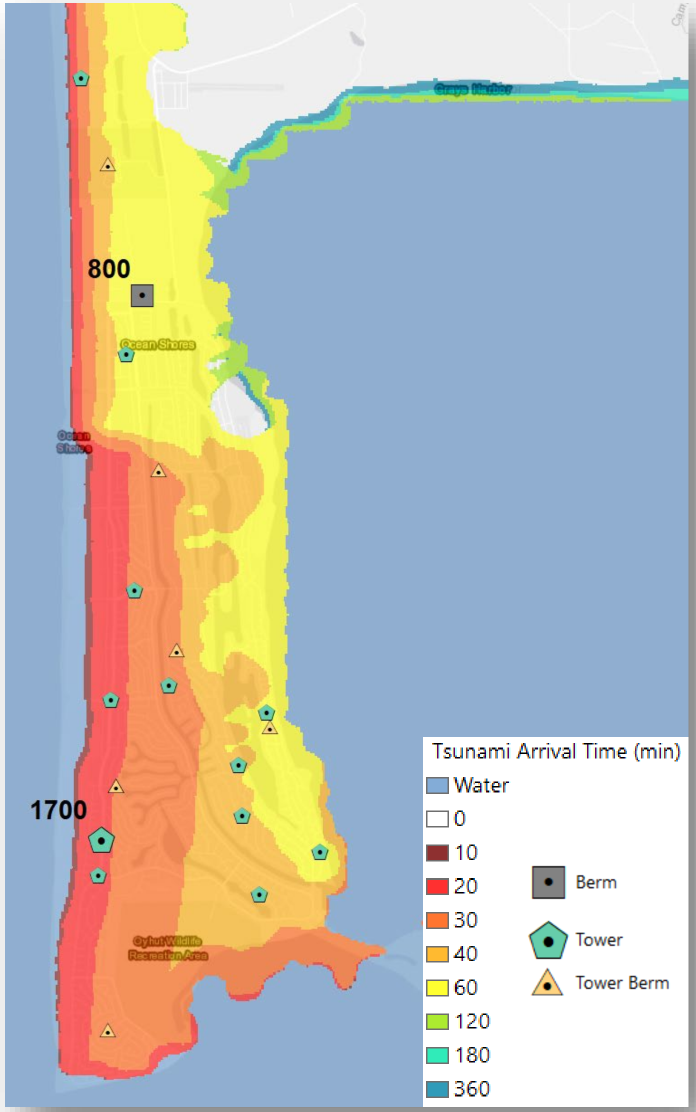
Building and Population Exposure

Time	Buildings	Population	Total Pop.	Pop.%
10	892	1,034	1,034	14%
20	1,484	1,720	2,754	38%
30	1,941	2,250	5,004	70%
40	1,358	1,574	6,578	92%
50	469	544	7,122	99%
120	30	35	7,157	100%

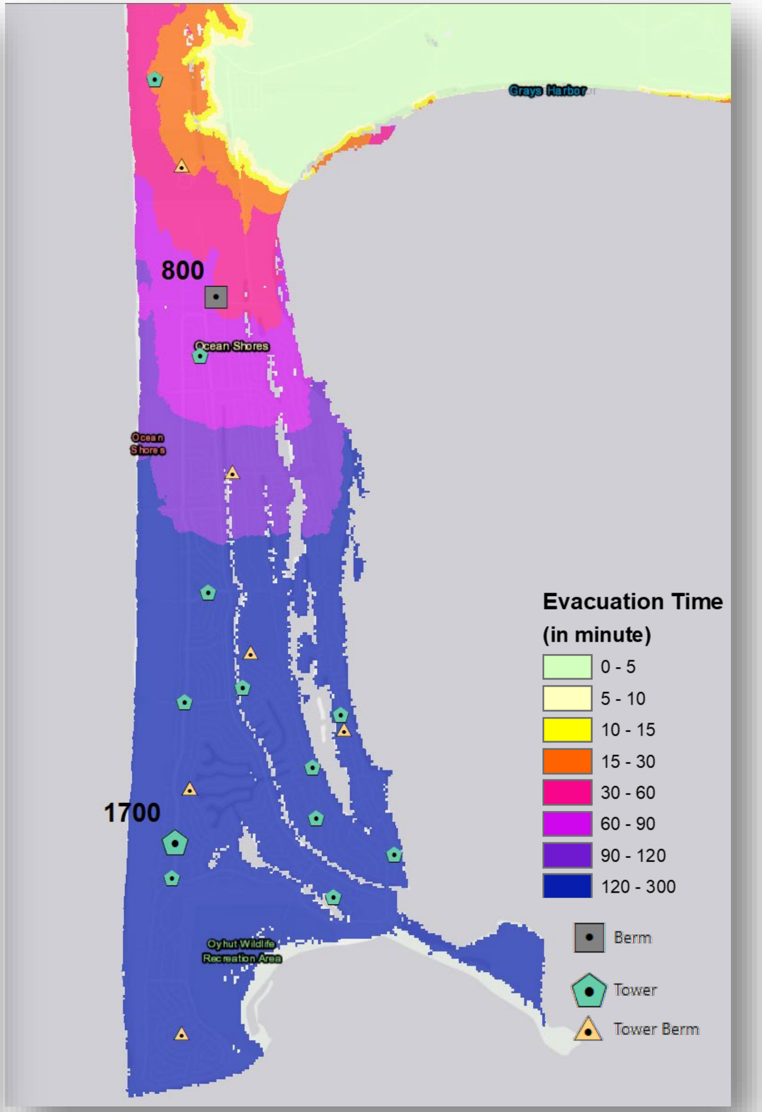
	Structural + Non-Structural	Contents	Downtime	Total
Exposure	$ 4,768,293,803	$ 2,384,146,901	-	$ 7,152,440,704
Loss per "Surge Damage Function"	$ 3,426,620,607	$ 1,644,658,161	$ 1,133,660,175	$ 6,204,938,943
Loss per HAZUS Tsunami Damage Functions	$ 3,167,237,250	$ 1,999,256,884	$ 1,056,111,316	$ 6,222,605,450

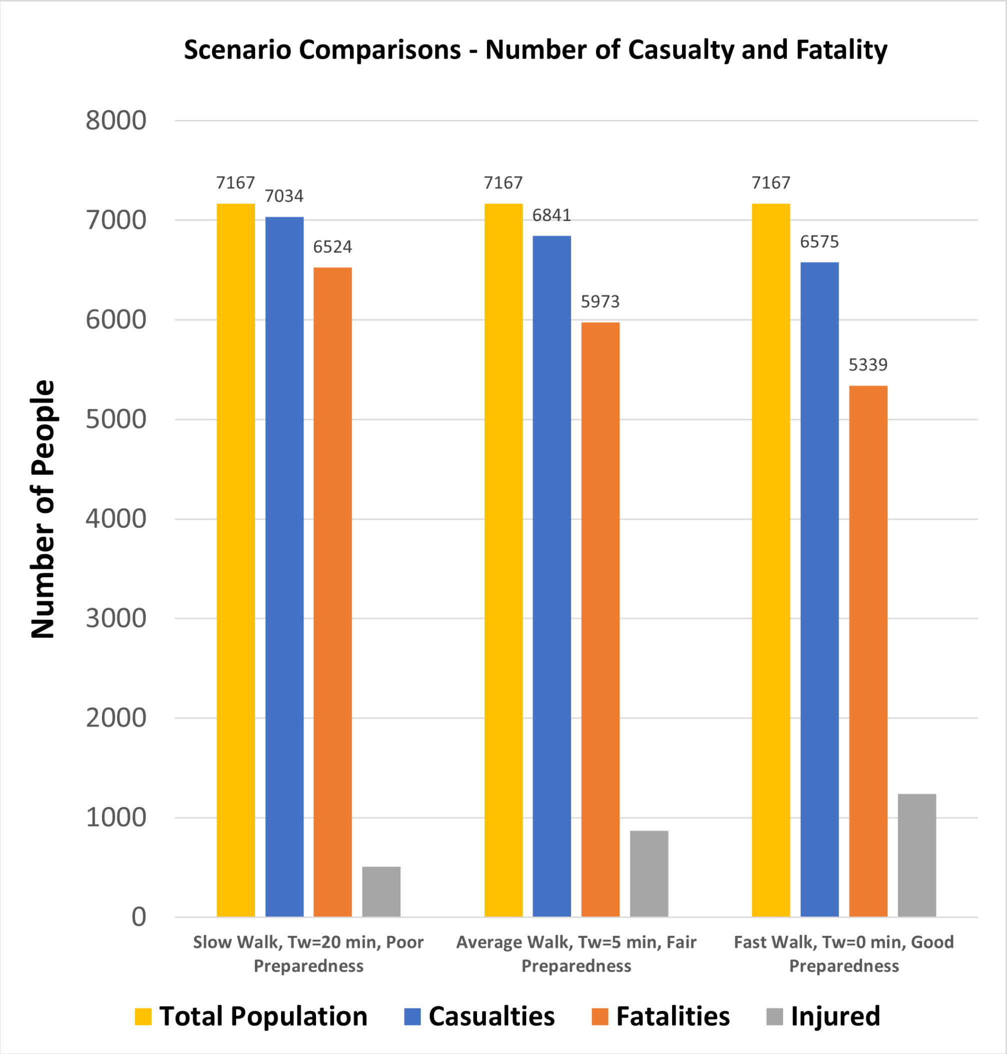
Estimation of Number of Injuries and Deaths from M9.0 Scenario

Tsunami Arrival Time Map



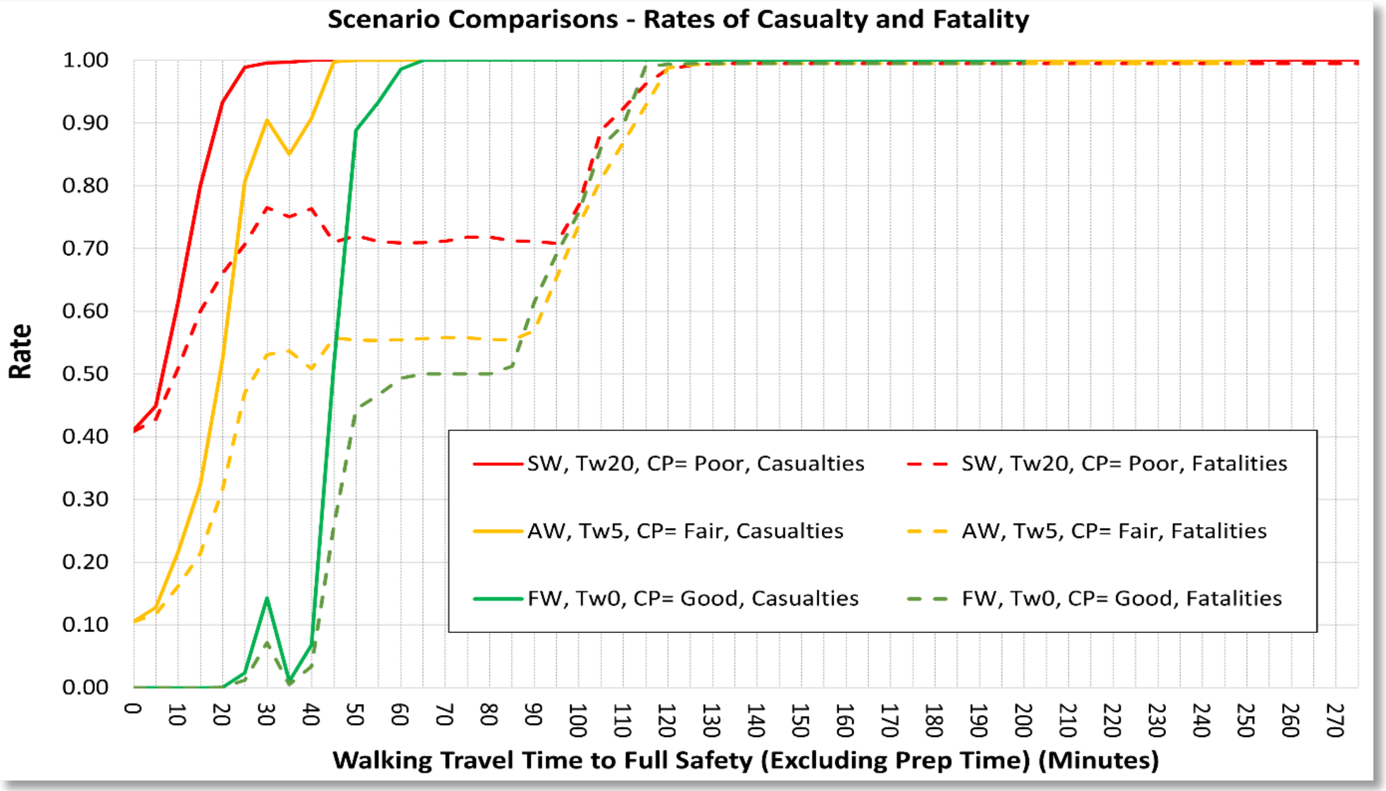
Evacuation Time Map



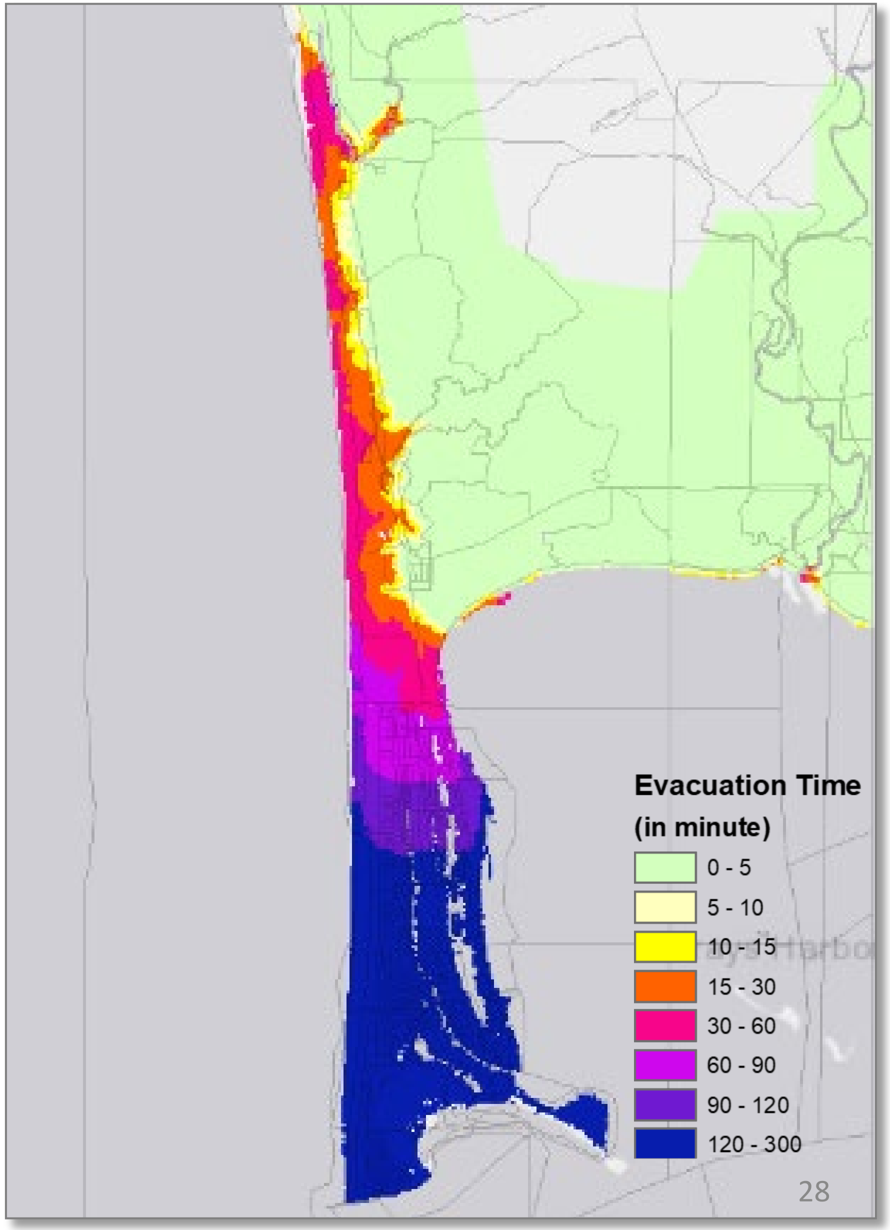


Cascadia Mw 9.0 Simulation

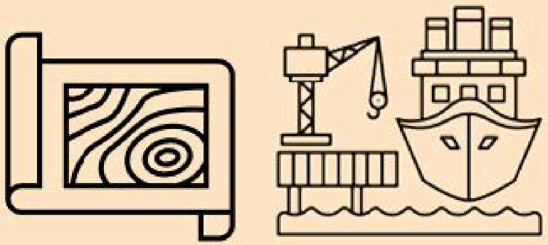
Casualty Modeling, including Evacuation Times



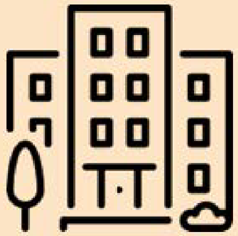
Preliminary results of pedestrian evacuation time required to reach full-safety based on a slow walk (1.1 meters/sec) scenario to fast walk (1.52 meters/sec) scenario.



Adaptation planning framework for reducing vulnerabilities and enhancing coastal resilience

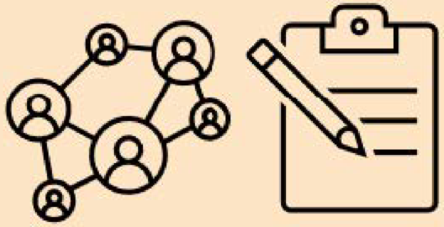


Physical Adaptation and Policy Planning



Climate-Proofing Wholesale & Retail Buildings

Financing and Financial Instruments for Adaptation

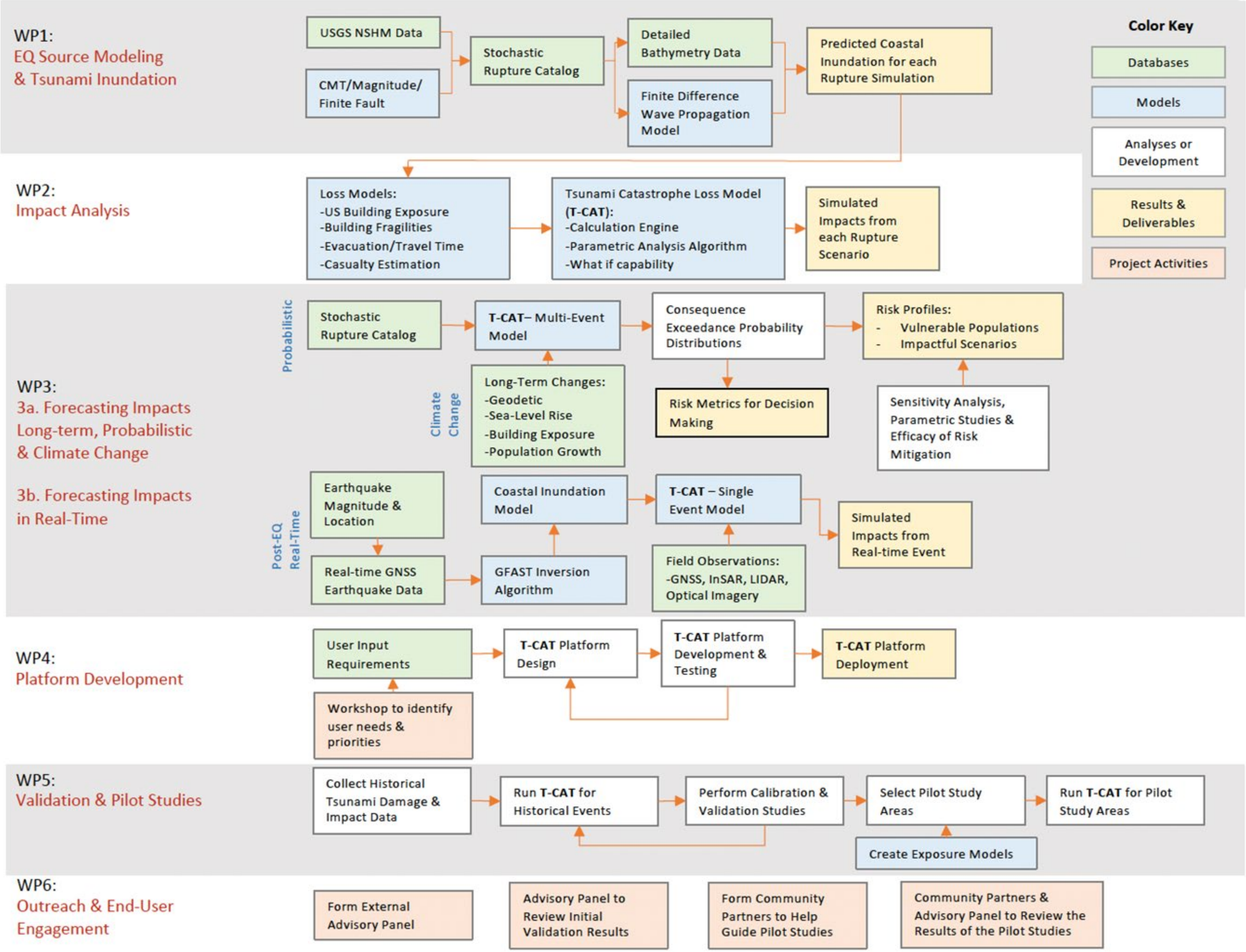


Training, Capacity Building, Knowledge Transfer for Climate Adaptation & Business Continuity Planning

Six Main Work Packages:

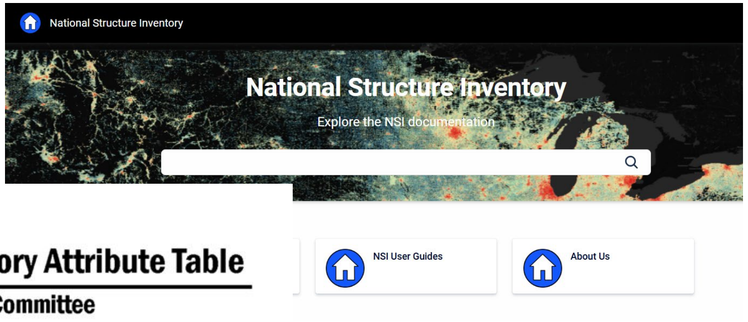
1. EQ Source Modeling & Tsunami Inundation
2. Impact Analysis
3. Forecasting Impacts:
   i. Long-Term, Probabilistic & Climate Change
   ii. Real-Time
4. Platform Development
5. Validation & Pilot Studies
6. Outreach & End-User Engagement

Workshops & Advisory Panel meetings



NSI data- building specific data set for risk assessment

- National Structure Inventory from USACE
- An amalgamation of building footprints and assessor data nationwide
- Data fusion process often leads to errors.
- Many assumptions required for use in risk modeling



US Army Corps of Engineers

Structural Inventory Attribute Table

National Nonstructural Committee

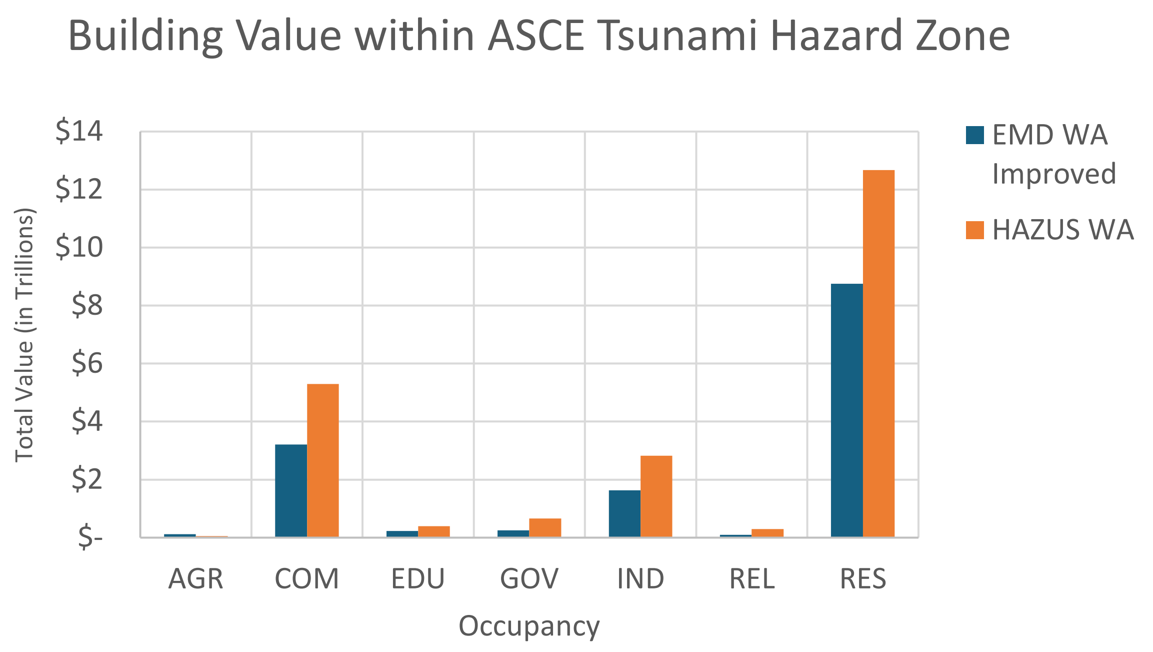
Structure Data	Data Definition
Building Identification Number	Specific to Structure (geo referenced, coordinates, etc.)
Structure Address	Specific Postal Location of Structure
Critical Facility	Yes / No
Lowest Adjacent Ground Elevation	Elevation of Lowest Ground at Structure
First Floor Elevation	Elevation of Finished First Floor
Structure Category	Residential, Commercial, Industrial, Public
Structure Use	What is the Specific Use of Structure
Total Stories	Total Number of Floors Above Grade
Structure Footprint	Total Square Foot Area of At-Grade Floor
Number of Structural Corners	Total Number of Corners in Perimeter
Structure Foundation Type	Slab, Reinforced Slab, CMU, Piers, Columns, Posts, Stone
Structure Perimeter Distance	Total Length of All Exterior Sides of Structure
Exterior Wall Construction	Wood, Masonry, Brick, Metal, Stone, Concrete, Other
Structure Visual Condition	Good / Fair / Poor
Garage	Attached, Detached, None
Doorways	Number of Pedestrian Doorways
Basement	Full Basement, Half, Crawl Space, None
Structure Photos	Photograph of Four Sides of Structure
Utilities Location	Electrical, Gas, Water, Sewer, Oil, Propane, Coal, Other
Structure Value	Assessed Value of Structure
Fireplace	Yes / No
Structure Owner	Who Owns the Structure
Year Structure Built	Year Structure was Constructed (Any Historic Significance)
Water Surface Elevation	Elevation or Depth of Water at Structure (H&H activity)
Water Velocity	Erosive Potential of Flood Waters (H&H activity)

Note: Bold/Shaded cells represent most pertinent data requirements.

For more information, please contact the NNC Chairman and committee members at: dll-cenwo-nfpc@usace.army.mil
or visit the NFPC website at http://www.usace.army.mil/Missions/CivilWorks/ProjectPlanning/nfpc.aspx

Washington EMD improvements

- Labor intensive update of the data for areas in the tsunami risk zone
- 30 to 40% less building value in the ASCE tsunami hazard zone.
- *Distribution* of exposure varies significantly.



Example: Ilwaco, Washington (South of Long Beach)

- Added exposure at the marina

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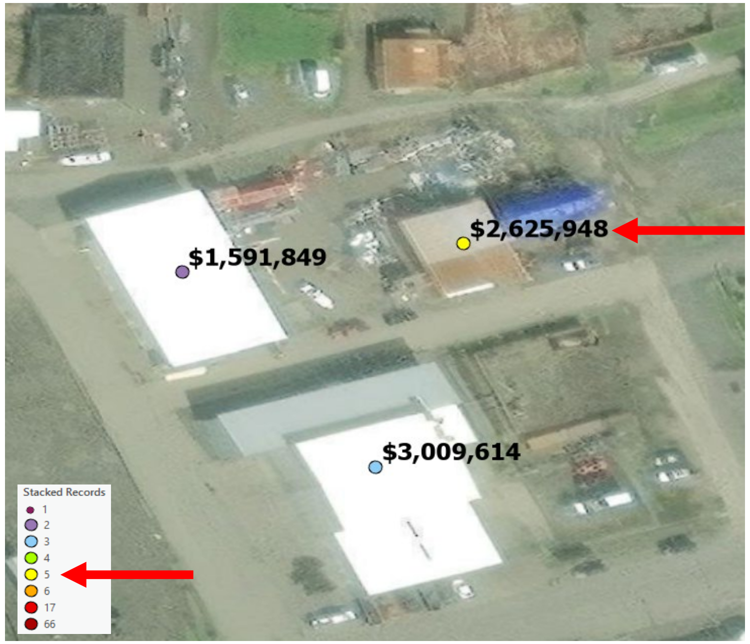
- Added exposure at the marina
- Removed exposure where fences of other factors create illusion of buildings
- Remove “Stacked” buildings from NSI

Building Value Total



WA HAZUS Default

WA EMD Improved

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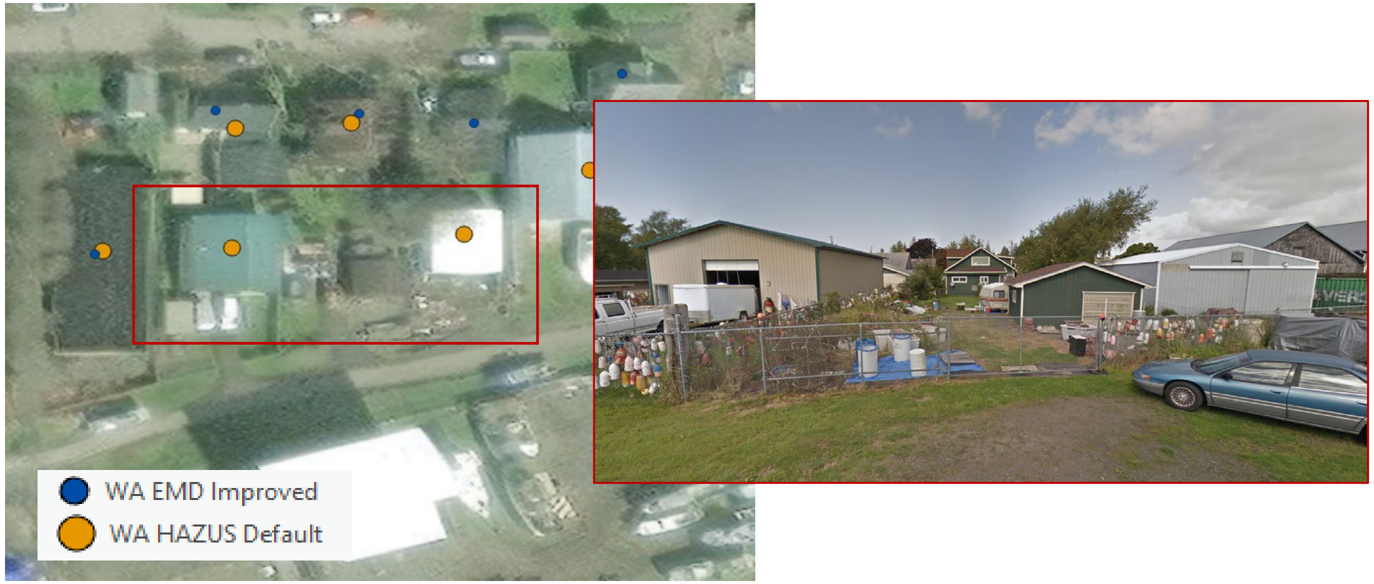
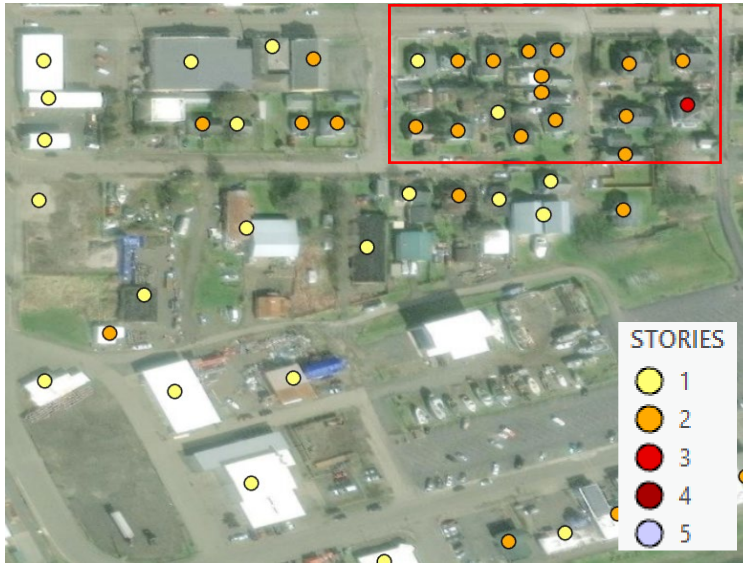


Example: Ilwaco, Washington (South of Long Beach)

- Added exposure at the marina
- Removed exposure where fences of other factors create illusion of buildings
- Remove "Stacked" buildings from NSI
- Remove out-buildings
- Adjust attributes

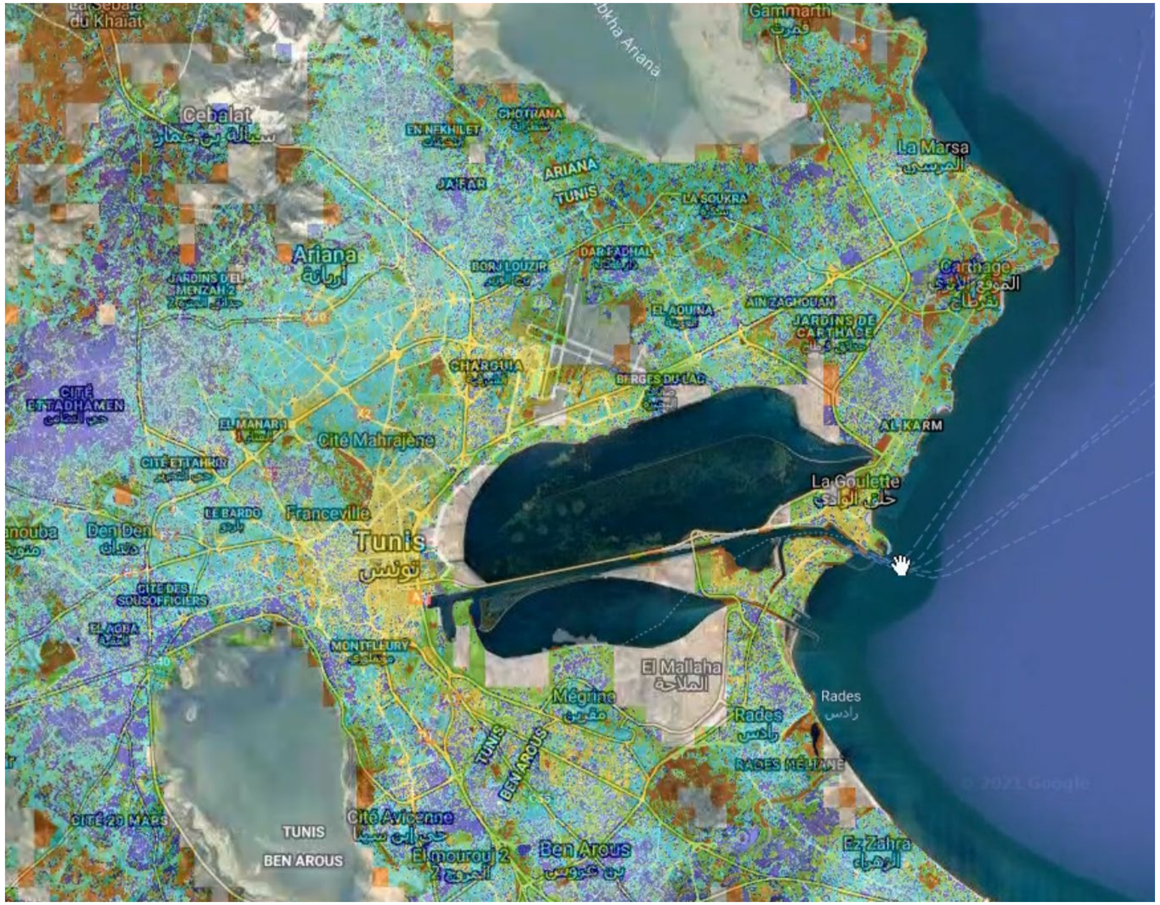
WA HAZUS Default



WA EMD Improved

Application of EO

- Estimation of regional story heights
- Checking volumetric estimates of buildings against NSI to identify "stacked" buildings of regions of under-estimation
- "Outlying building factor" for rural areas
- Addressing faulty attribute data

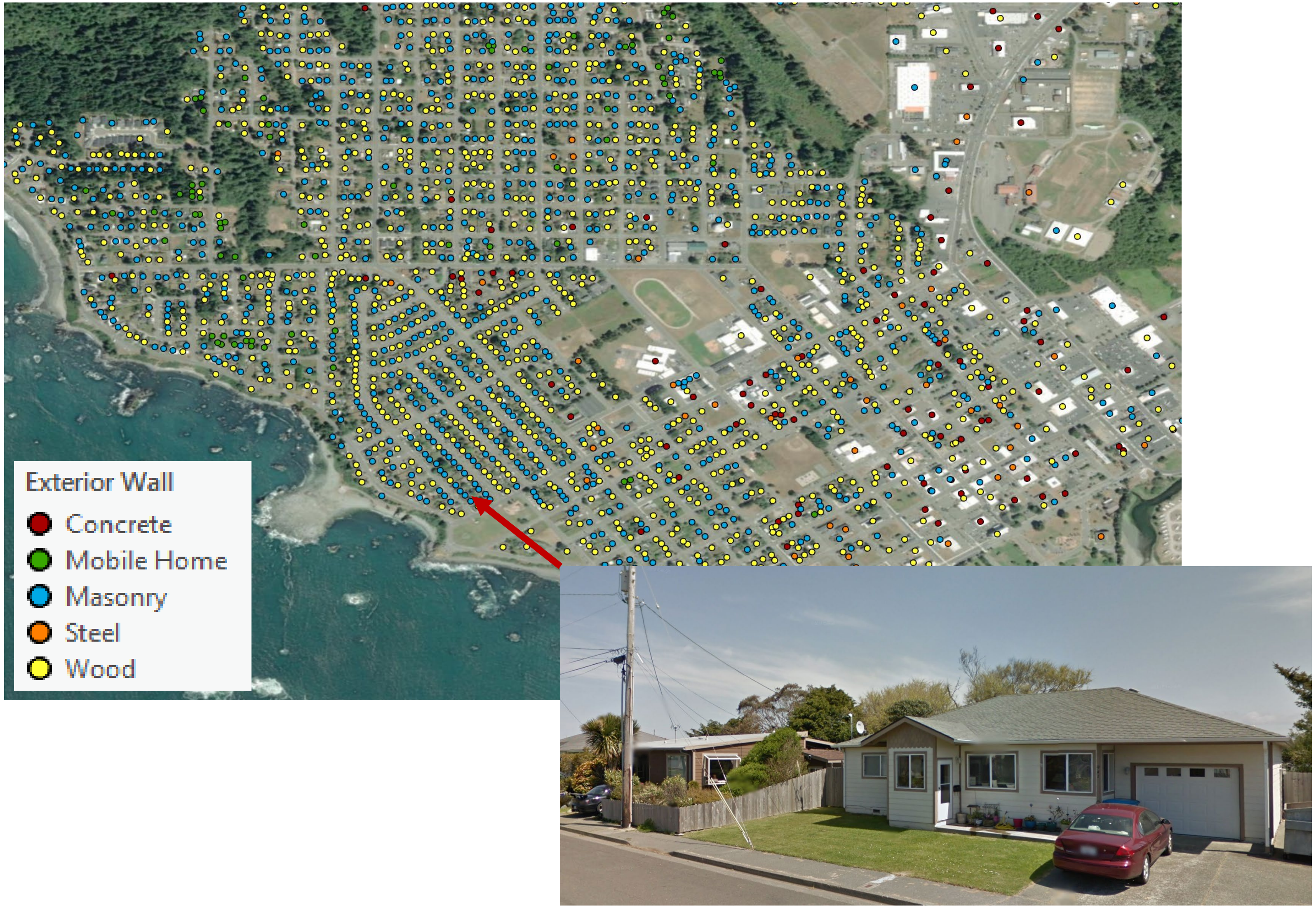


Example of urban development patterns in Tunisia, used to build exposure data

Example: Crescent City

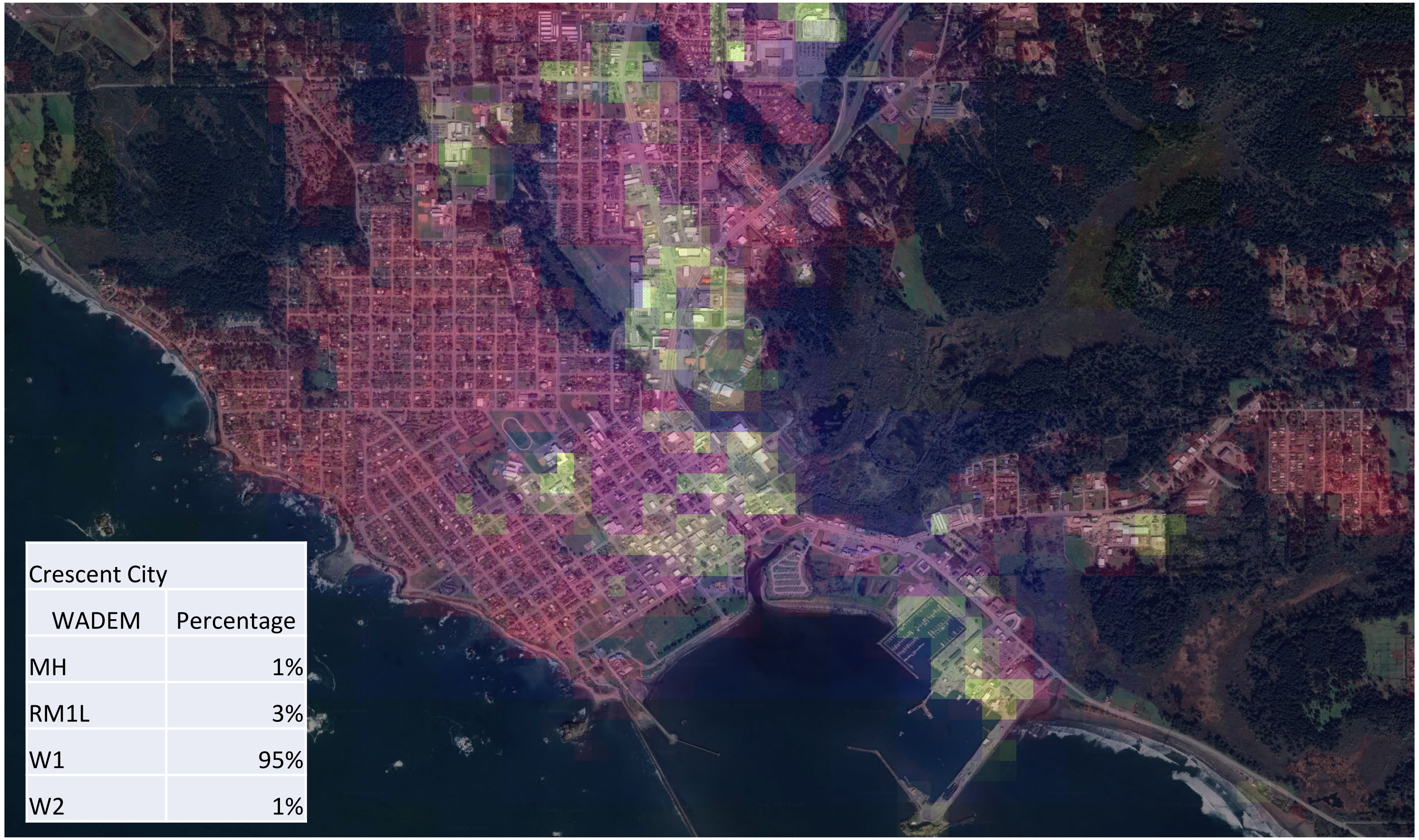
- Suspicious "Exterior Wall" identification
- Hazus uses "Exterior Wall" and occupancy to infer vulnerability by region
- Brick is much more robust than wood frame.
- Random sample of 100 buildings reveals classification of Masonry exterior is primarily stucco cladding

Determination	Count
No Streetview or visibility issues.	5
Brick or Brick Veneer	1
Stucco	78
Siding- wood or vinyl.	16



Example: Crescent City

- Moderate resolution remote sensing data and interpreted data sets used to identify “Development patterns”
- Using engineering expertise, NSI can be updated probabilistically based on these zones
- Example illustrates preliminary work extracting regions with primarily residential development, and update of structure type for HAZUS Modeling.
- Analysis captures significantly more vulnerability in Crescent City.



Crescent City	
WADEM	Percentage
MH	1%
RM1L	3%
W1	95%
W2	1%

False color image used to accentuate urban development patterns
Red: mostly light residential. Yellow: Light urban

EARTH SCIENCE
APPLIED SCIENCES

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questions

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