Building Resilience Through Design

FORUM 8
Nov 20, 2025

Miho Mazereeuw
risk@mit.edu

MIT UrbanRISKLab


More frequent
Image source: Barry Beagan ’15 MIT


More intense
Image source: Barry Beagan ’15 MIT

And in more unexpected places

Image source: Barry Beagan '15 MIT

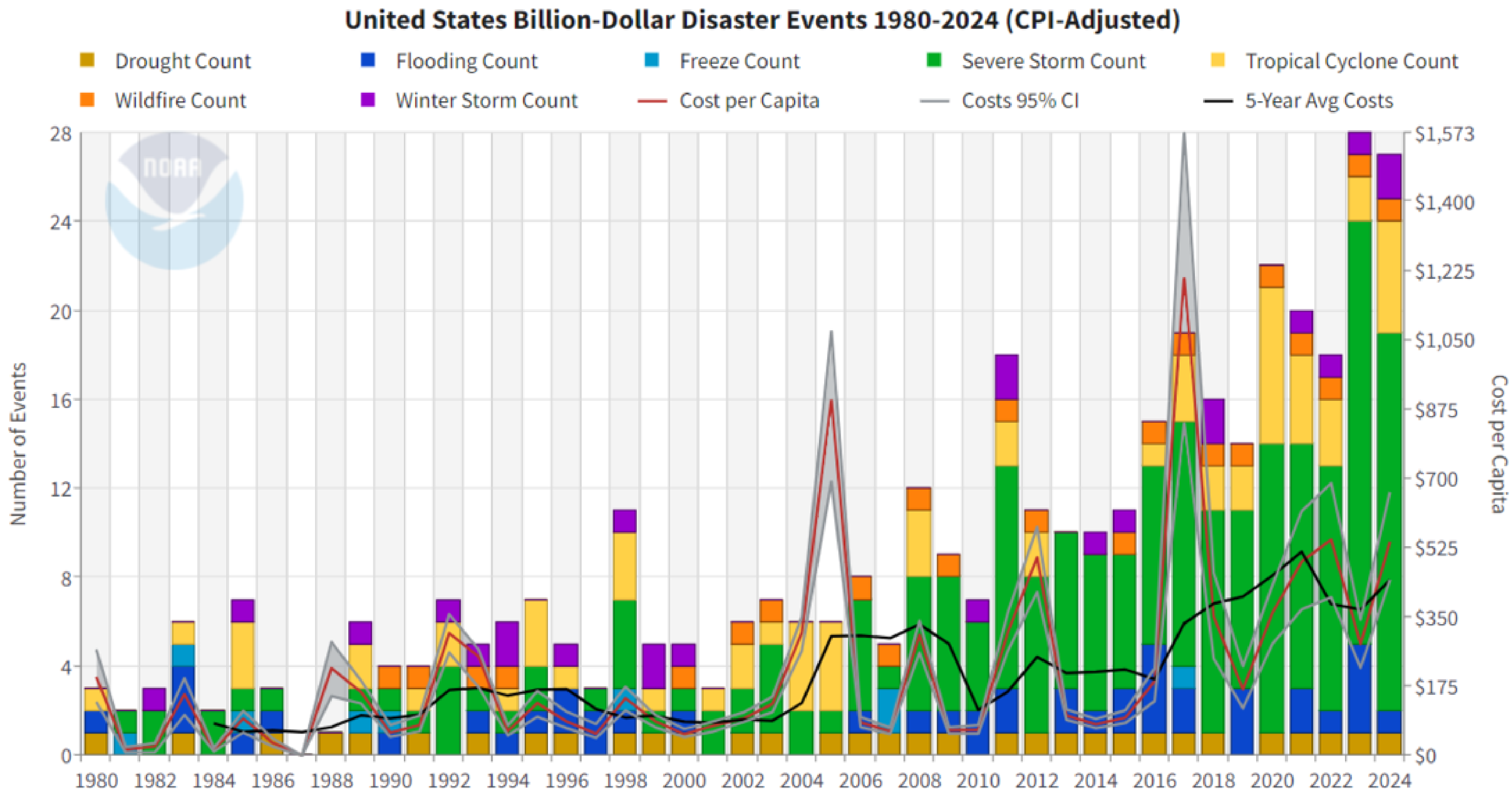


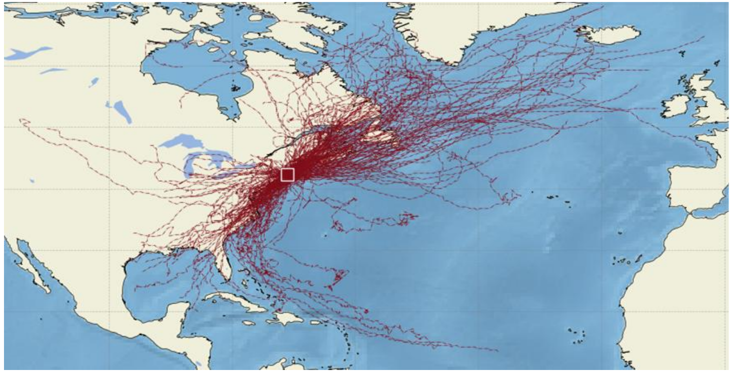
Image source: NOAA NCEI Billion-dollar Disasters

Flood mitigation simulations and increasing stewardship

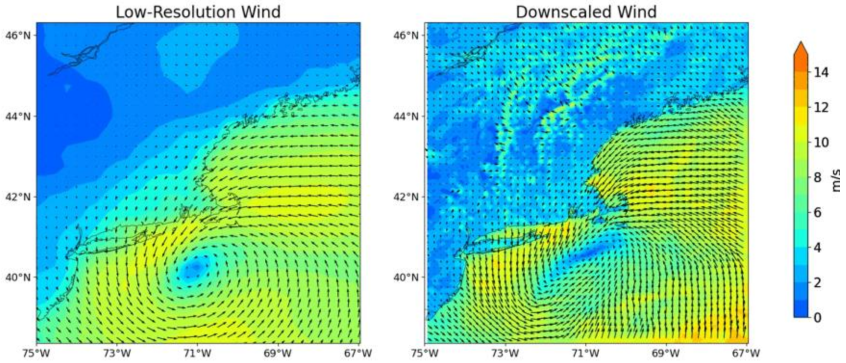
洪水軽減のシミュレーションと責務遂行能力の向上

MIT UrbanRISKLab

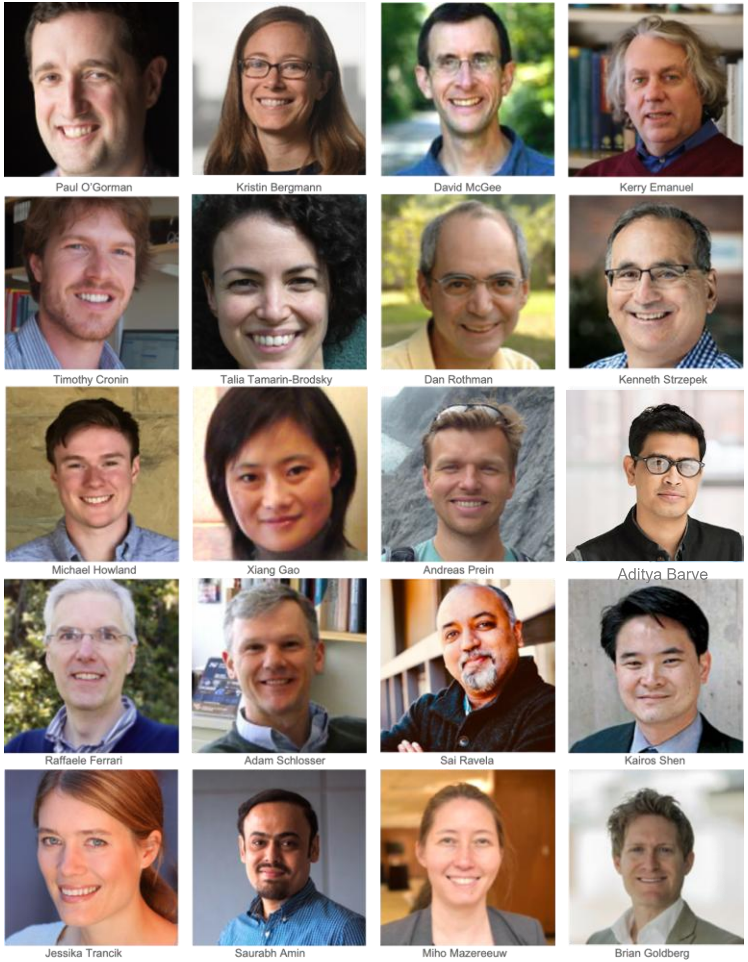
Faculty at MIT Preparing for a new world of weather extremes



Kerry Emanuel, Sai Ravela, Anamitra Saha, Jianchao Qiu

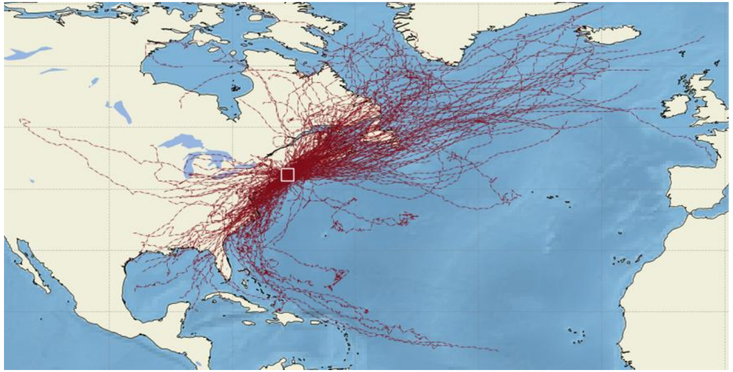


Ravela and Qiu



climate-extremes.mit.edu

Faculty at MIT Preparing for a new world of weather extremes



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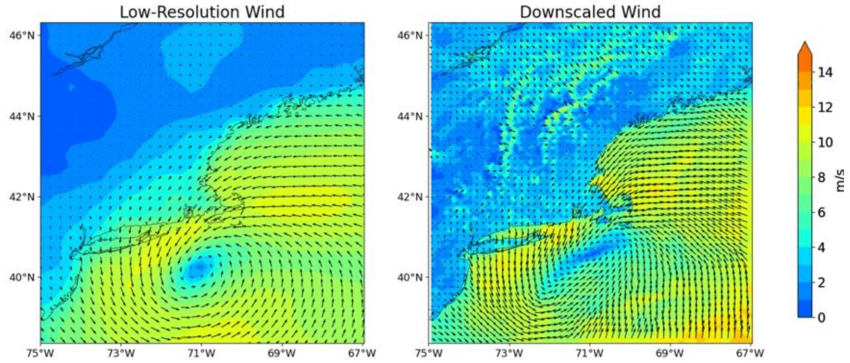
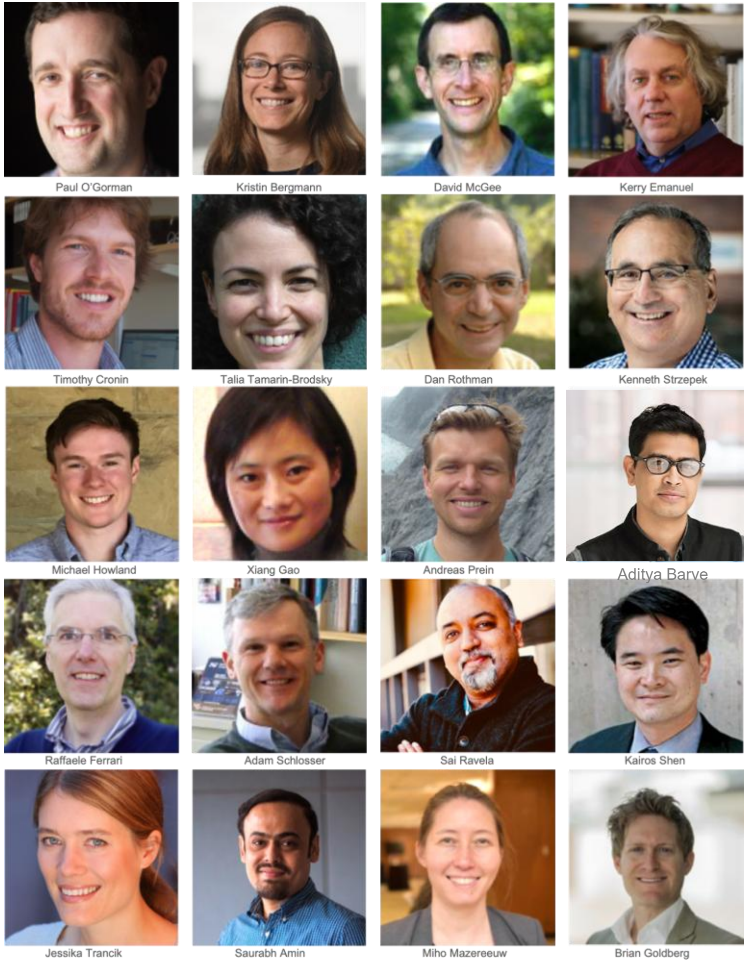


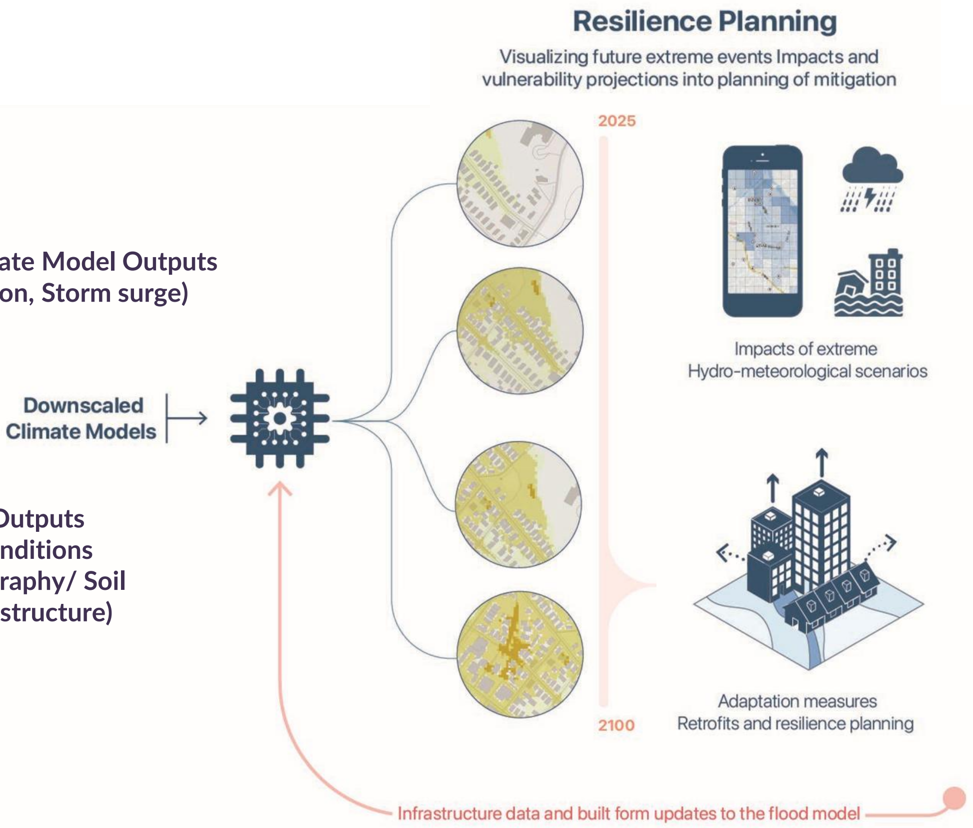
Ravela and Qiu

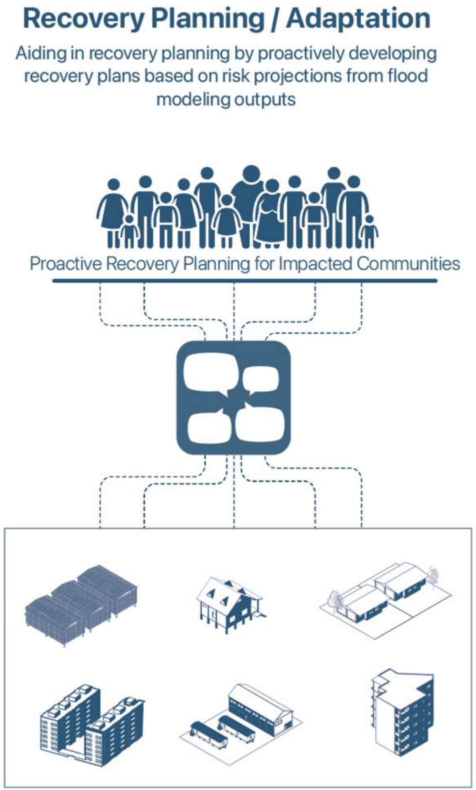


climate-extremes.mit.edu

1 Downscaled Climate Model Outputs (Wind, Precipitation, Storm surge)
PI Ravela

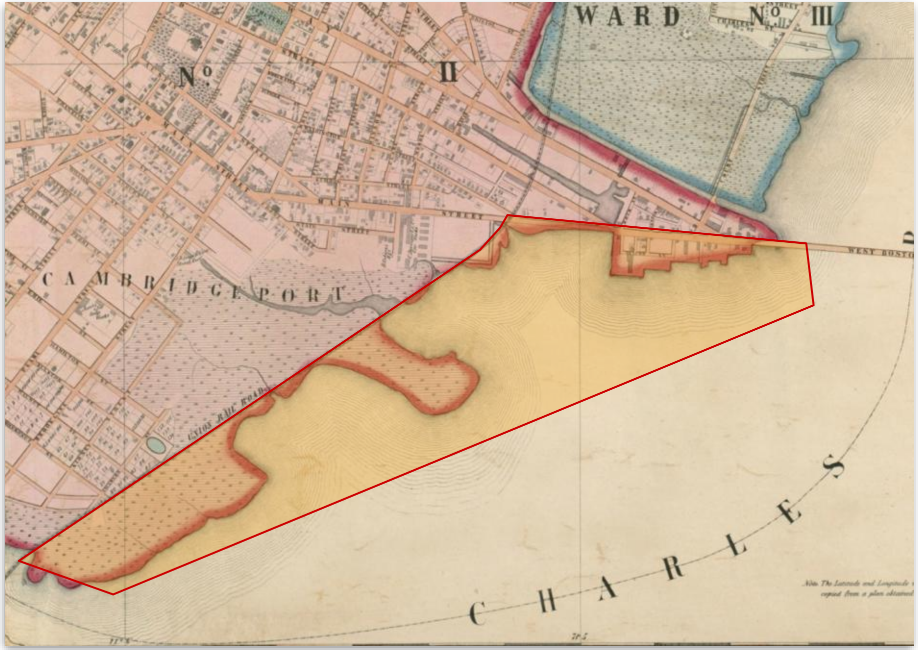
2 Flood Modeling Outputs (Geo-Physical Conditions Buildings/ Topography/ Soil Conditions/ Infrastructure)
PI Strzepek





PorosityMap

Citizen Science for Flood Modeling



Location of MIT Campus in 1854 (highlighted in red), Cambridge, MA
1854 Map of Cambridge by H.F Walling

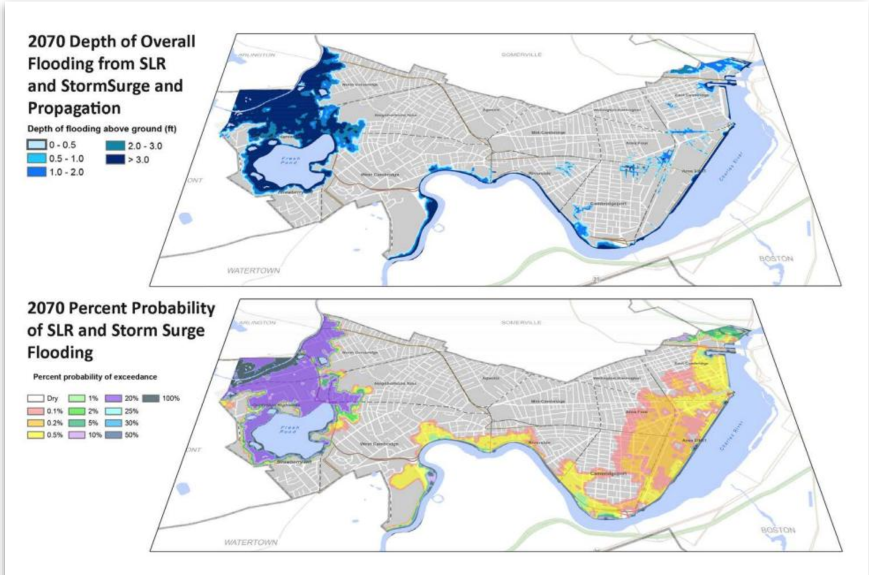
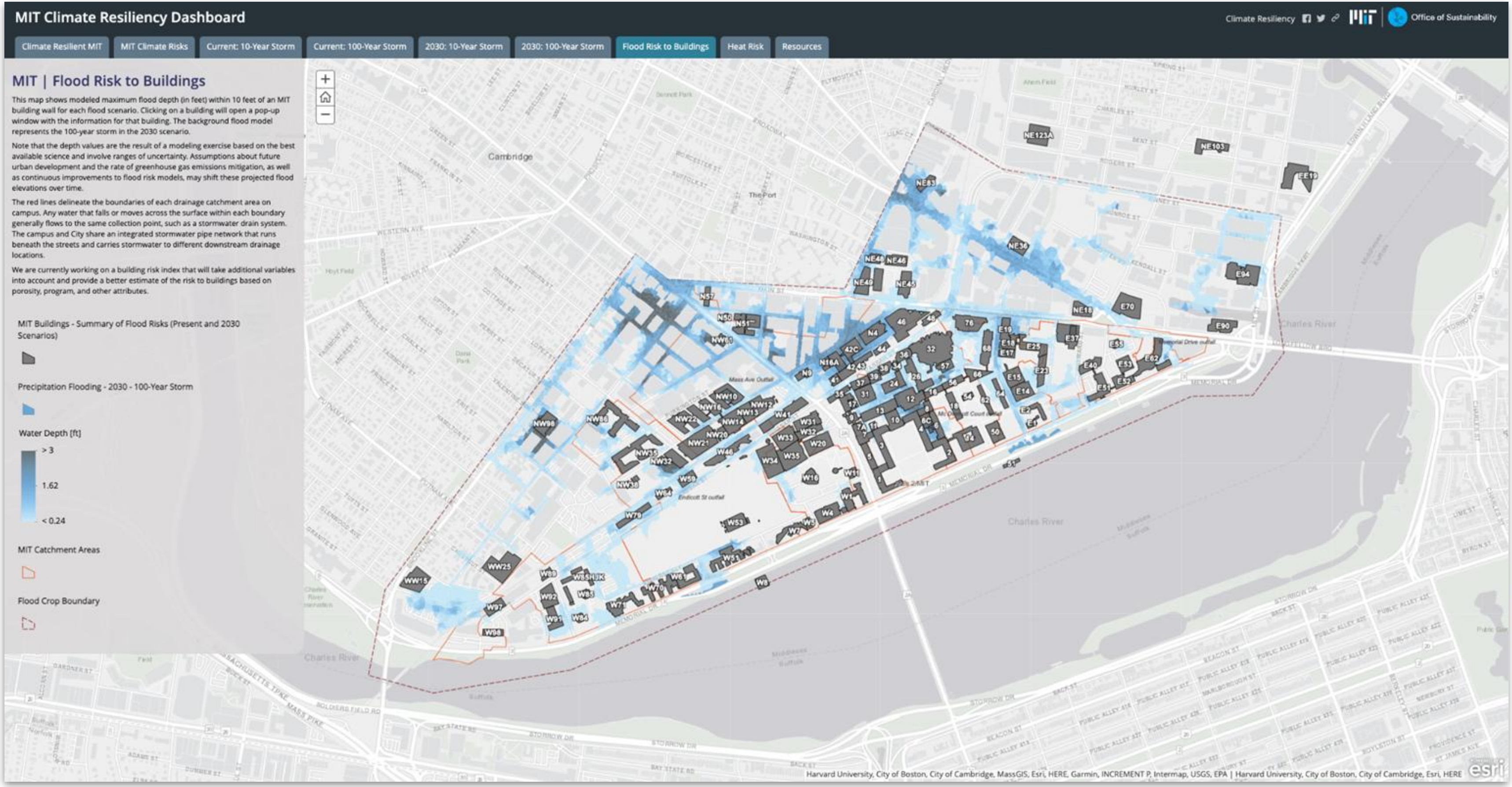
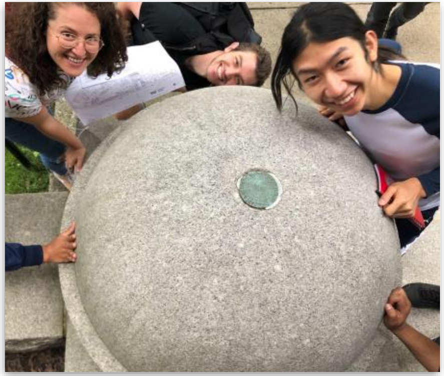


Fig. 9 Top map: **2070 Depth of Flooding from SLR and Storm Surge at 1% Probability** Bottom map: **2070 Percent Probability of Sea Level Rise and Storm Surge Flooding** (Source: Kleinfelder, February 2017, based on WHG MassDOT Boston Harbor Flood Risk Model)

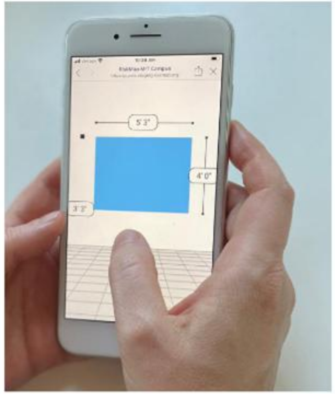
Climate Change Vulnerability Assessment, City of Cambridge, Massachusetts
February 2017


MIT Climate Resiliency Dashboard
Climate Resiliency
Office of Sustainability
Climate Resilient MIT
MIT Climate Risks
Current: 10-Year Storm
Current: 100-Year Storm
2030: 10-Year Storm
2030: 100-Year Storm
Flood Risk to Buildings
Heat Risk
Resources
MIT | Flood Risk to Buildings
This map shows modeled maximum flood depth (in feet) within 10 feet of an MIT building wall for each flood scenario. Clicking on a building will open a pop-up window with the information for that building. The background flood model represents the 100-year storm in the 2030 scenario.
Note that the depth values are the result of a modeling exercise based on the best available science and involve ranges of uncertainty. Assumptions about future urban development and the rate of greenhouse gas emissions mitigation, as well as continuous improvements to flood risk models, may shift these projected flood elevations over time.
The red lines delineate the boundaries of each drainage catchment area on campus. Any water that falls or moves across the surface within each boundary generally flows to the same collection point, such as a stormwater drain system. The campus and City share an integrated stormwater pipe network that runs beneath the streets and carries stormwater to different downstream drainage locations.
We are currently working on a building risk index that will take additional variables into account and provide a better estimate of the risk to buildings based on porosity, program, and other attributes.
MIT Buildings - Summary of Flood Risks (Present and 2030 Scenarios)
Precipitation Flooding - 2030 - 100-Year Storm
Water Depth [ft]
> 3
1.62
< 0.24
MIT Catchment Areas
Flood Crop Boundary
Cambridge
The Port
Charles River
Mass Ave Outfall
Endicott St outfall
Memorial Drive outfall
Harvard University, City of Boston, City of Cambridge, MassGIS, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, EPA | Harvard University, City of Boston, City of Cambridge, Esri, HERE
esri

MIT Porosity Hunt



MIT Porosity Hunt

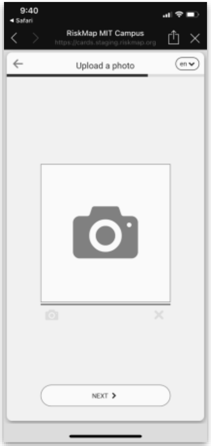


Porosity Rating (Material, opening size, condition, height from datum)

Potential Flow rate in an event of breech

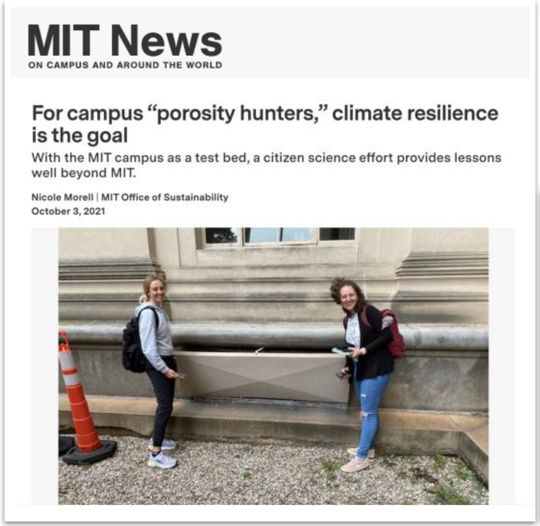
Basement Assessment (potential loss, holding capacity, connecting areas)

Provide Dimensions



Photo

Description



MIT News

ON CAMPUS AND AROUND THE WORLD

For campus "porosity hunters," climate resilience is the goal

With the MIT campus as a test bed, a citizen science effort provides lessons well beyond MIT.

Nicole Morell | MIT Office of Sustainability

October 3, 2021

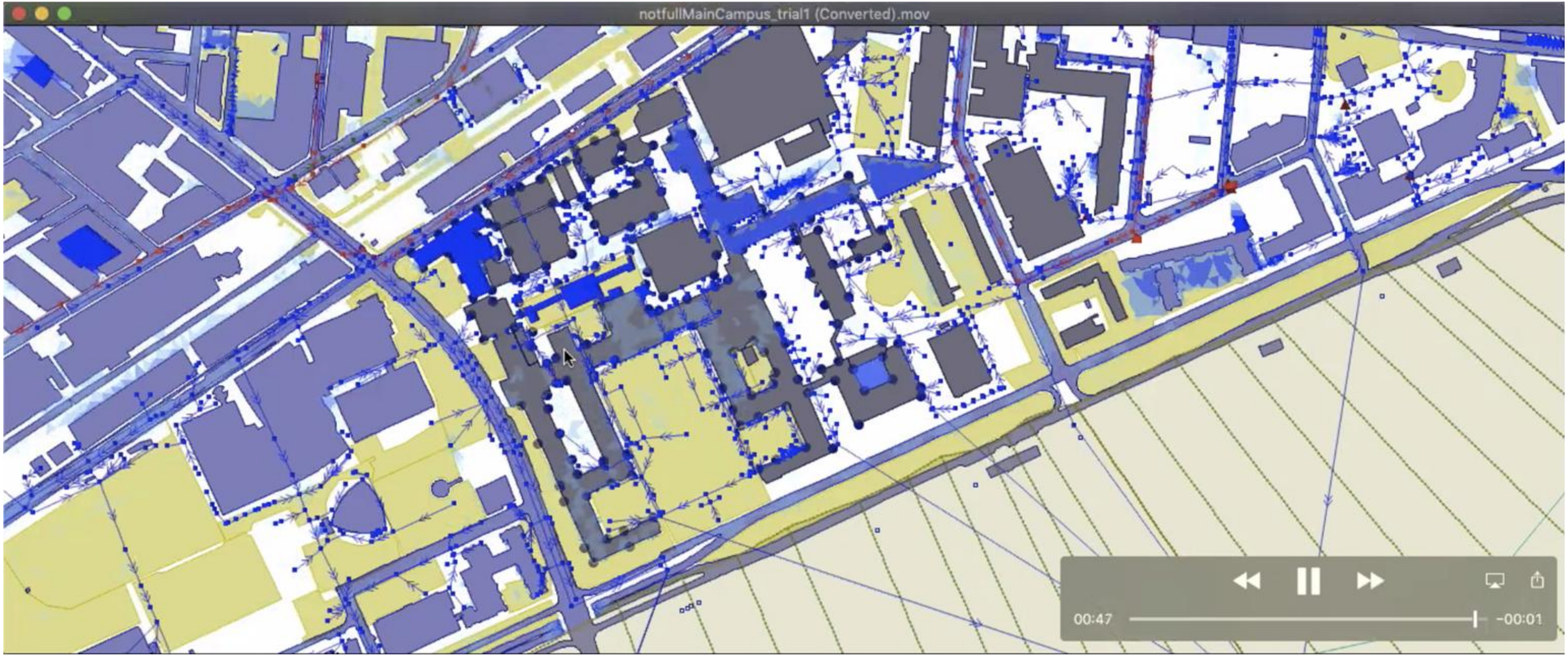
Data Collected from
42 buildings

1030 openings
714 Windows
222 Doors
89 Composite openings

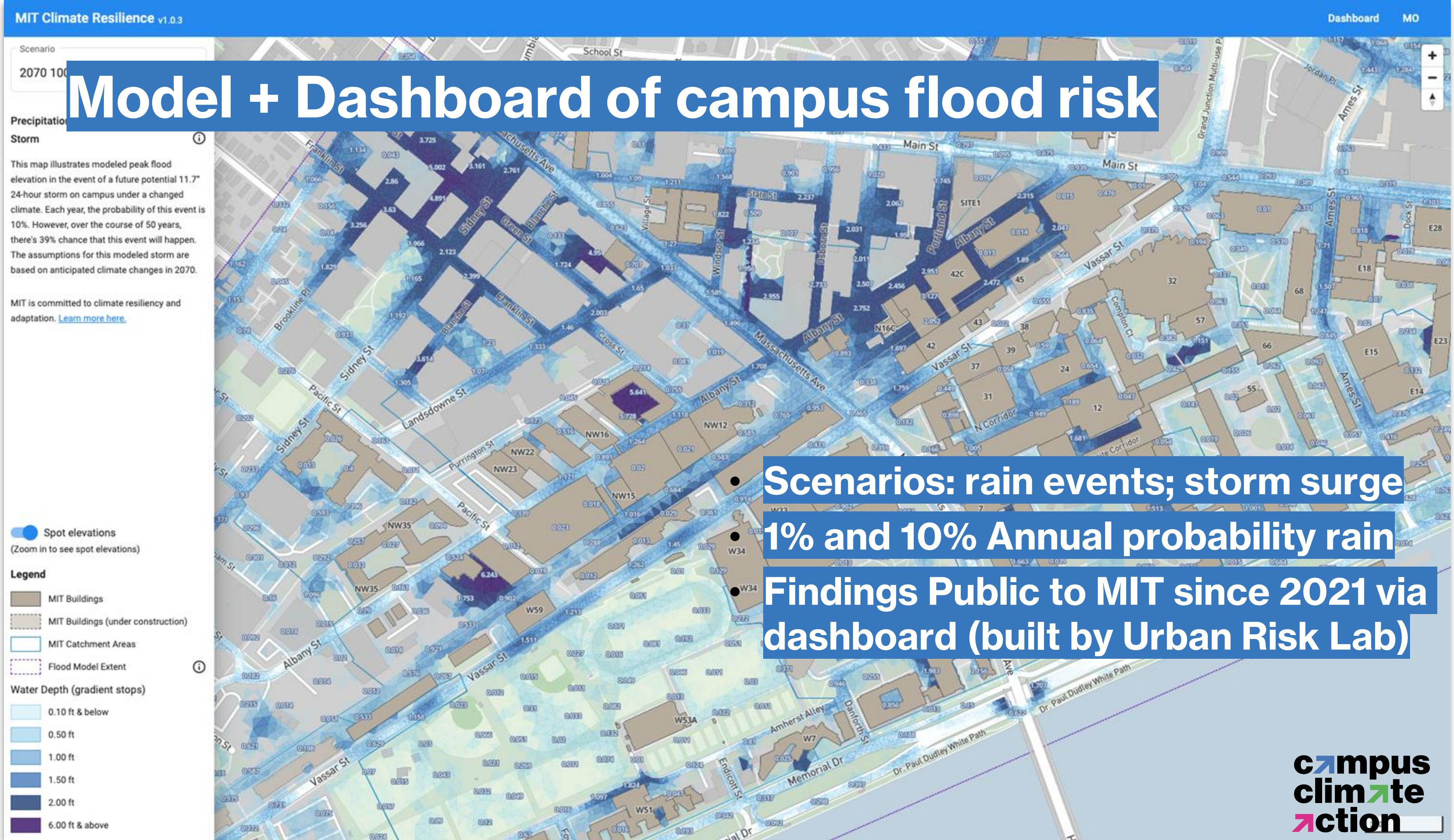
52% Openings in good condition
27% openings are in moderate condition
21% openings appear to be in the need for repairs/retrofits

MIT UrbanRISKLab

MIT Porosity Project



Model + Dashboard of campus flood risk



- Scenarios: rain events; storm surge
- 1% and 10% Annual probability rain
- Findings Public to MIT since 2021 via dashboard (built by Urban Risk Lab)

campus climate action

MIT UrbanRISKLab

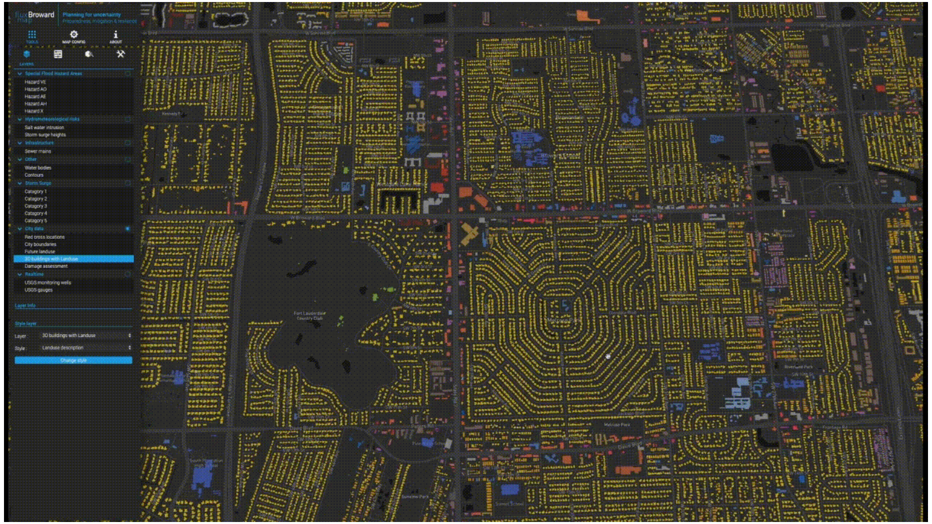
Preemptive Action through Design

Connecting Digital to Physical

デザインで先手を打つ

デジタルとフィジカルを繋ぐ

Connecting the Digital to the Physical



Flux.Land : Climate Uncertainty Planning Toolkit
With Fadi Masoud, University of Toronto

Urban Risk Lab, Massachusetts Institute of Technology

Miho Mazereeuw
Associate Professor of Architecture and Urbanism, MIT SAP
Director - Urban Risk Lab

Aditya Barve
Research Scientist, MIT Urban Risk Lab

Mayank Ojha
Research Scientist, MIT Urban Risk Lab

Abraham Quintero
Researcher Assistant, MIT Urban Risk Lab

Israel Macias
Researcher Assistant, MIT Urban Risk Lab

Chetan Krishna
Researcher Affiliate, MIT Urban Risk Lab

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Assistant Professor of Landscape Architecture and Urbanism, UoT
Director - Centre for Landscape Research

Isaac Seah
Research Assistant, UoT Daniels School of Architecture

Joshua Chua
Research Assistant, UoT Daniels School of Architecture

Fabio Dias
Postdoctoral Fellow, UoT School of Cities

Ambika Pharma
Research Assistant, UoT Daniels School of Architecture

Hillary DeWildt
Research Assistant, UoT Daniels School of Architecture

We need to visualize climate risk and vulnerability, planning policy, urban from / infrastructure, and socio-demographic data in tandem

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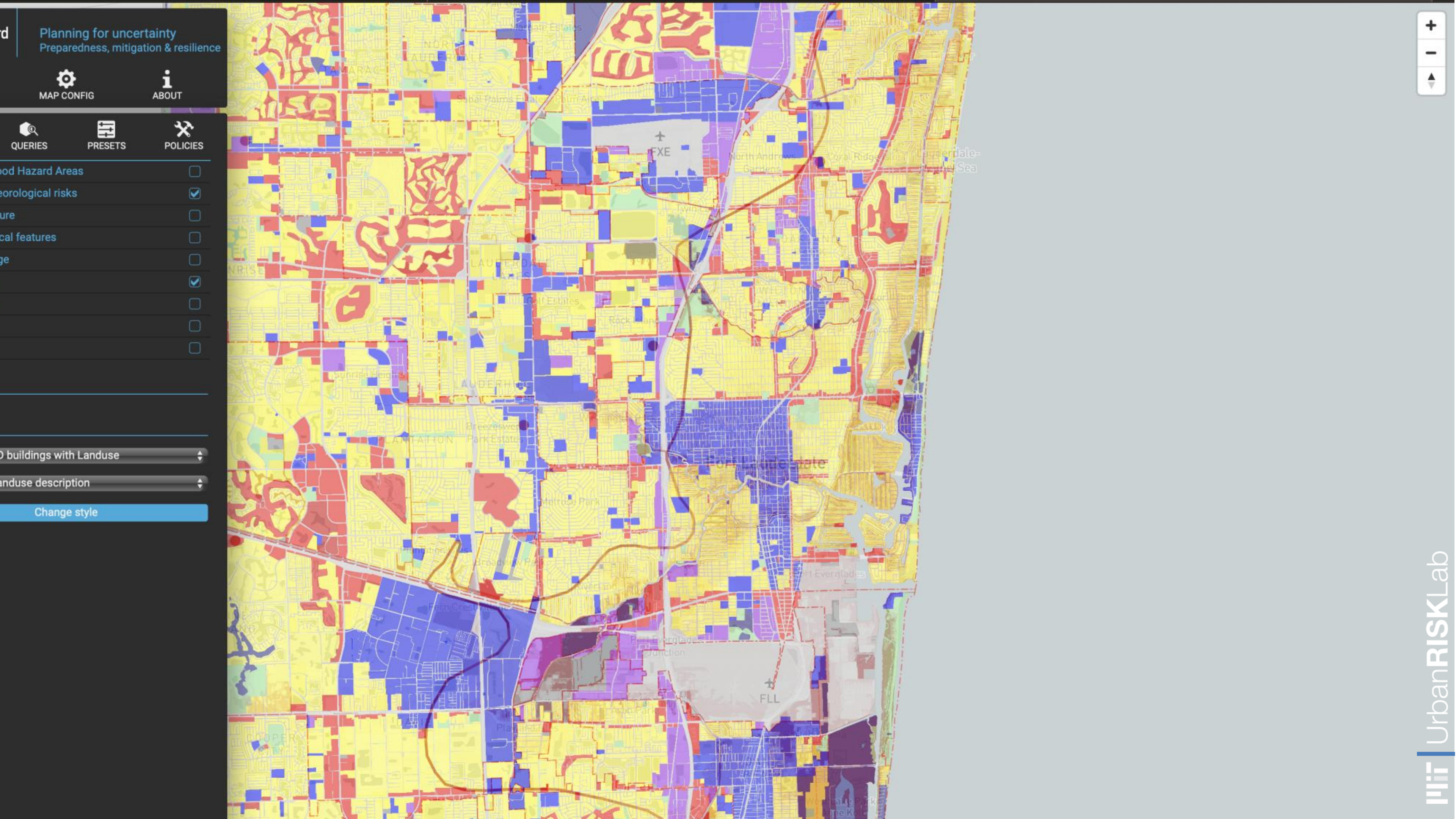
Digital and Physical

UrbanRISKLab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Planning for uncertainty
Preparedness, mitigation & resilience
MAP CONFIG
ABOUT
QUERIES
PRESETS
POLICIES
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eorological risks
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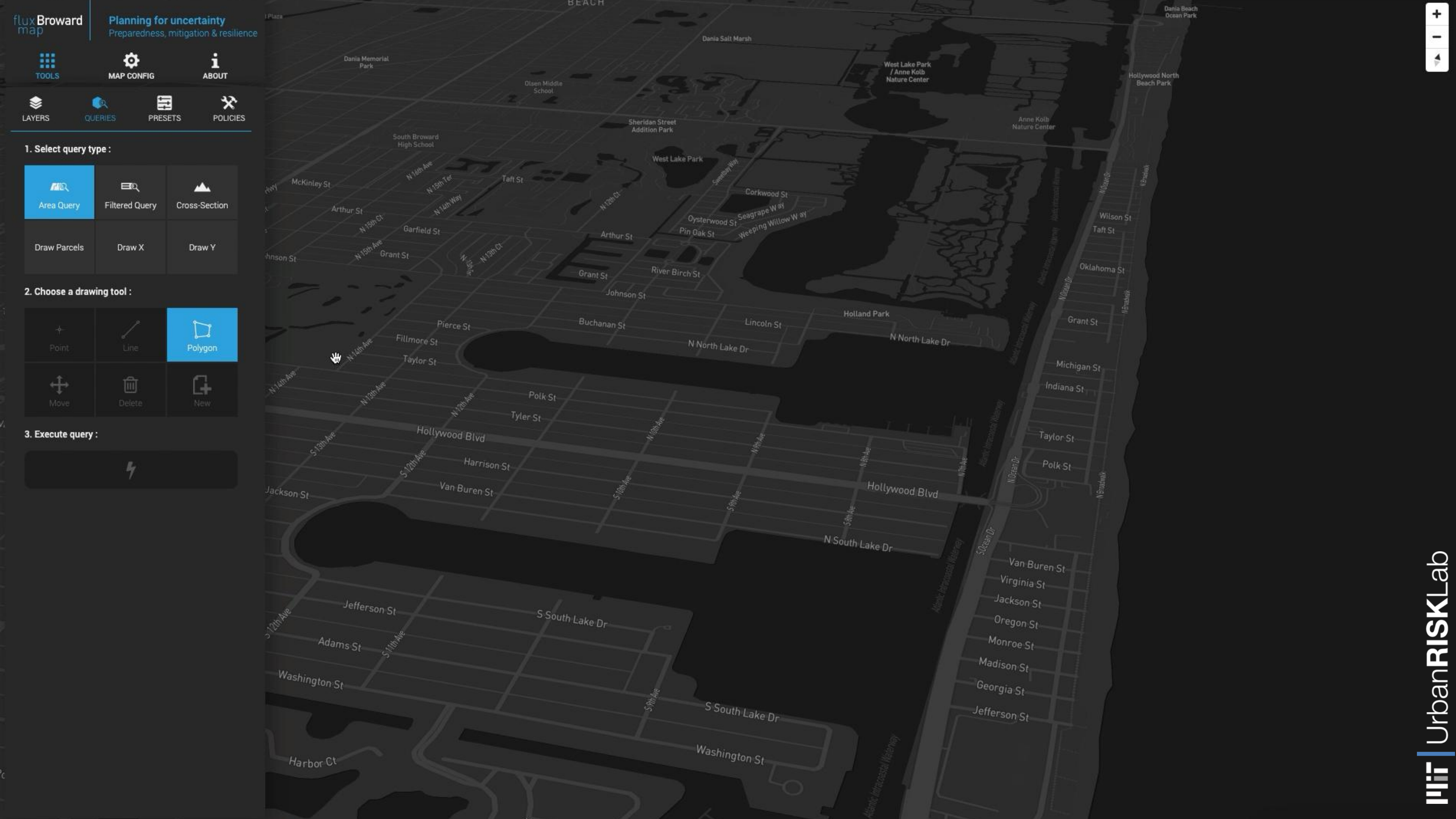
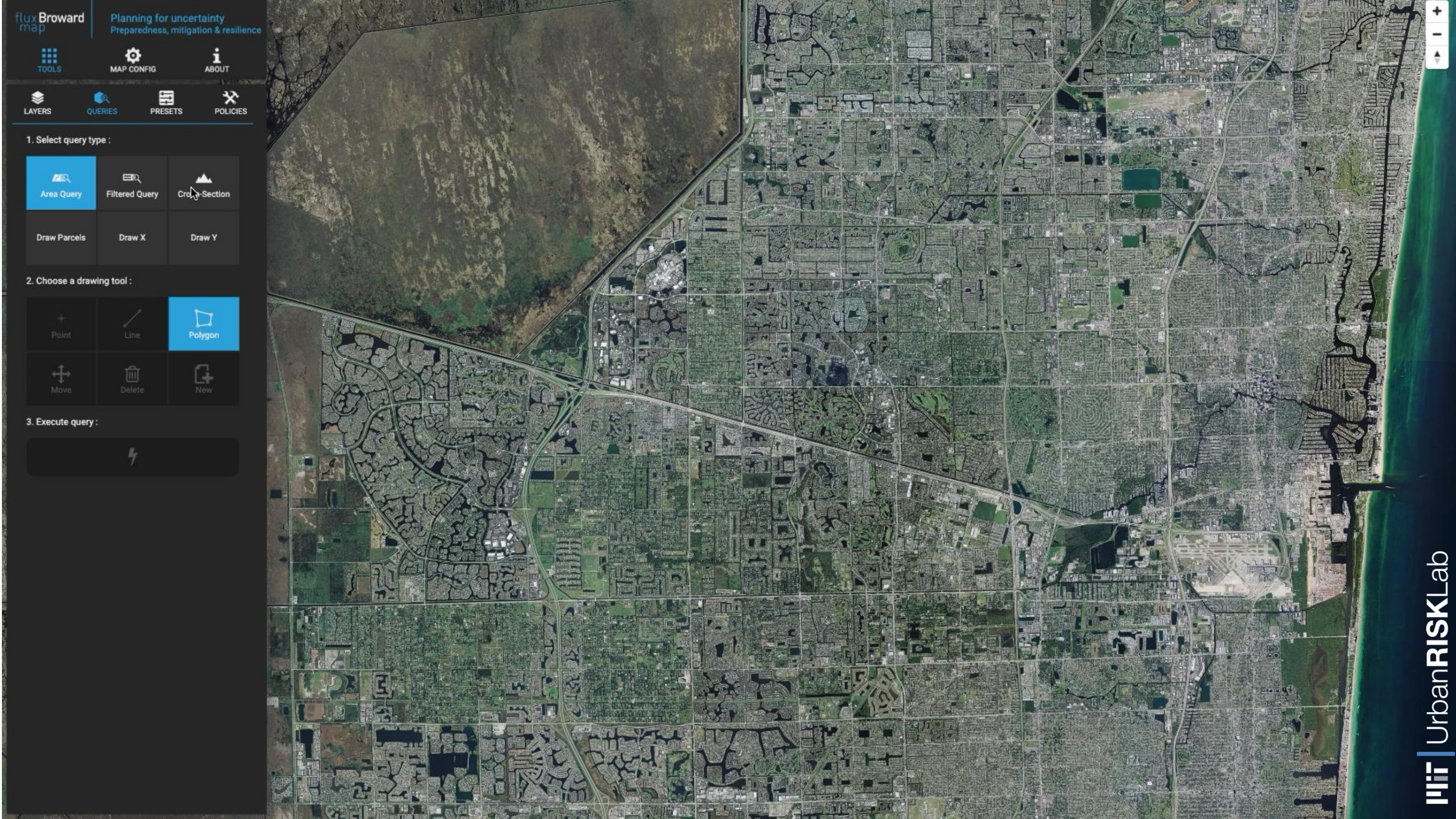
cal features
ge
D buildings with Landuse
anduse description
Change style
FXE
FLL
Fort Lauderdale
UrbanRISKLab

Map
2D
3D
Base map style:
Streets light
Layers
Flood Hazard Extents
Water Infrastructure
Water bodies
Salt water intrusion
Contours
Storm surge heights
Sewer mains
City Data
Physical Infrastructure
Realtime water monitoring
Information products
Directions
Find route to nearest shelter:
Your location
Nearest red cross shelter
Sewer gravity mains
Material: VC
Year installed: 1965
Diameter: 8 ft.
NE 54th St
NW 48th Ct
NE 45th Pl
Pompano Beach Highlands
W Sample Rd
E Sample Rd
NE 40th St
NE 33rd St
Cresthaven
Collier Manor
LIGHTHOUSE POINT
Coral Villas
Hillsboro River
UrbanRISKLab


flux Broward map
Planning for uncertainty
Preparedness, mitigation & resilience
TOOLS
MAP CONFIG
ABOUT
LAYERS
QUERIES
PRESETS
POLICIES
1. Select query type :
Area Query
Filtered Query
Cross-Section
Draw Parcels
Draw X
Draw Y
2. Choose a drawing tool :
Point
Line
Polygon
Move
Delete
New
3. Execute query :
Dania Salt Marsh
West Lake Park / Anne Kolb Nature Center
Hollywood North Beach Park
Dania Memorial Park
Olsen Middle School
Sheridan Street Addition Park
Anne Kolb Nature Center
South Broward High School
West Lake Park
McKinley St
Taft St
Arthur St
Corkwood St
Garfield St
Oysterwood St
Pin Oak St
Arthur St
Grant St
River Birch St
Grant St
Johnson St
Wilson St
Taft St
Oklahoma St
Holland Park
Pierce St
Buchanan St
Lincoln St
Fillmore St
N North Lake Dr
N North Lake Dr
Taylor St
Grant St
Michigan St
Indiana St
Polk St
Tyler St
Hollywood Blvd
Taylor St
Polk St
Harrison St
Van Buren St
Hollywood Blvd
Jackson St
N South Lake Dr
Van Buren St
Virginia St
Jackson St
Oregon St
Monroe St
Madison St
Georgia St
Jefferson St
Jefferson St
S South Lake Dr
Adams St
Washington St
S South Lake Dr
Washington St
Harbor Ct
UrbanRISKLab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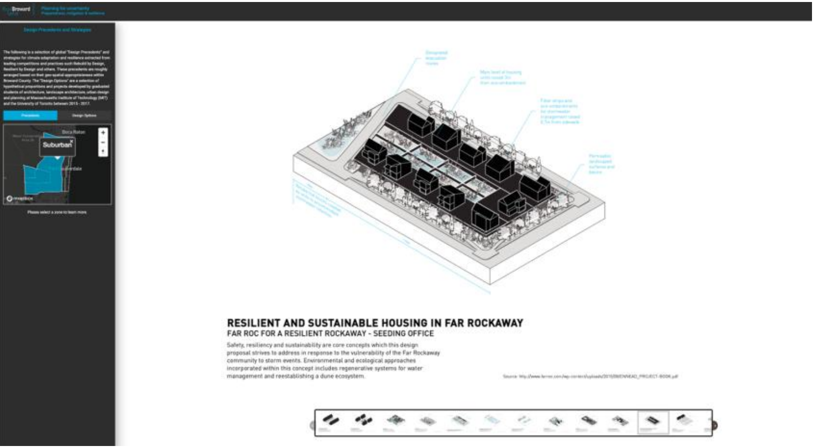
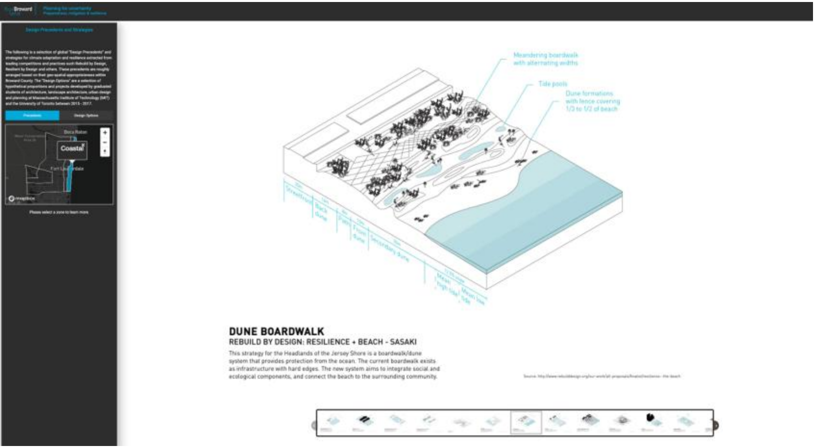
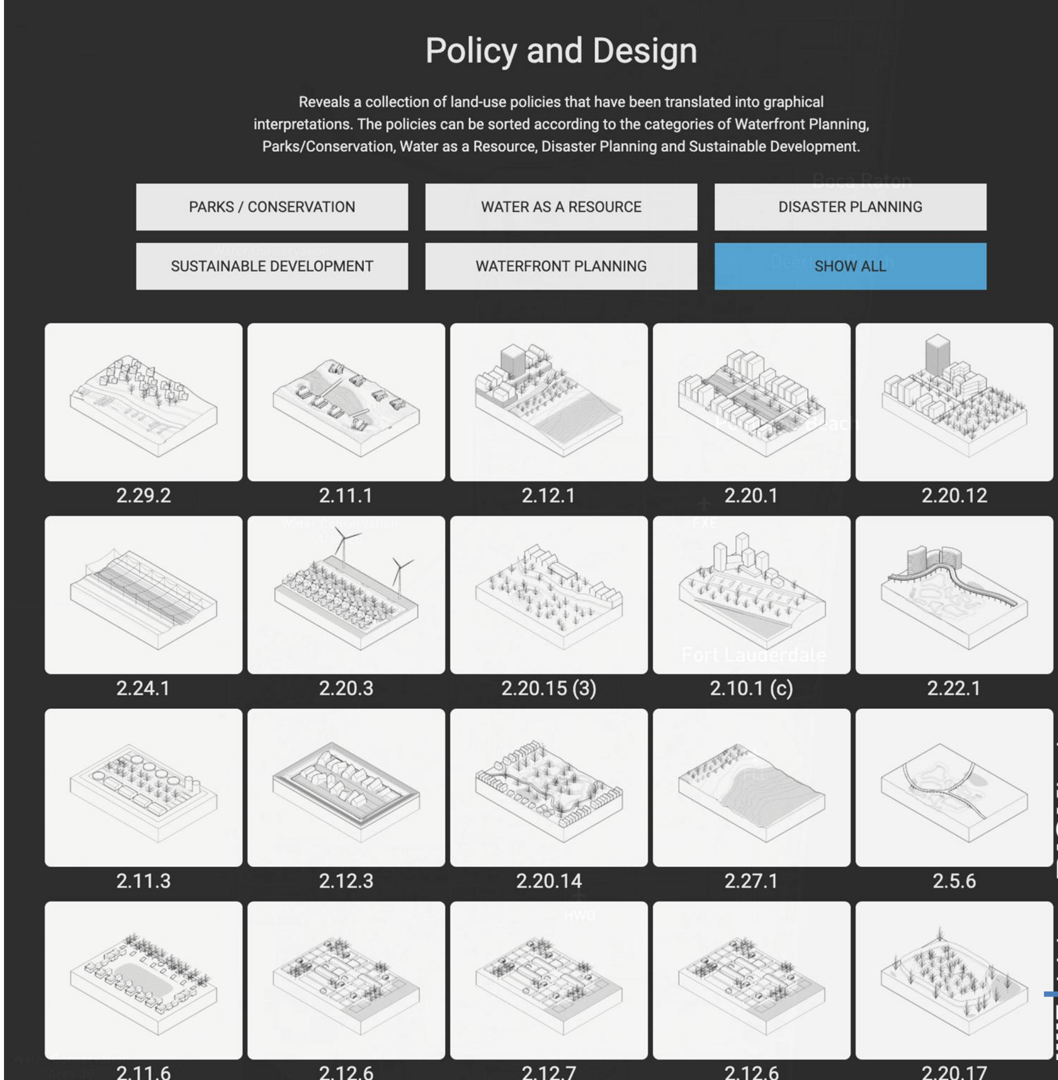
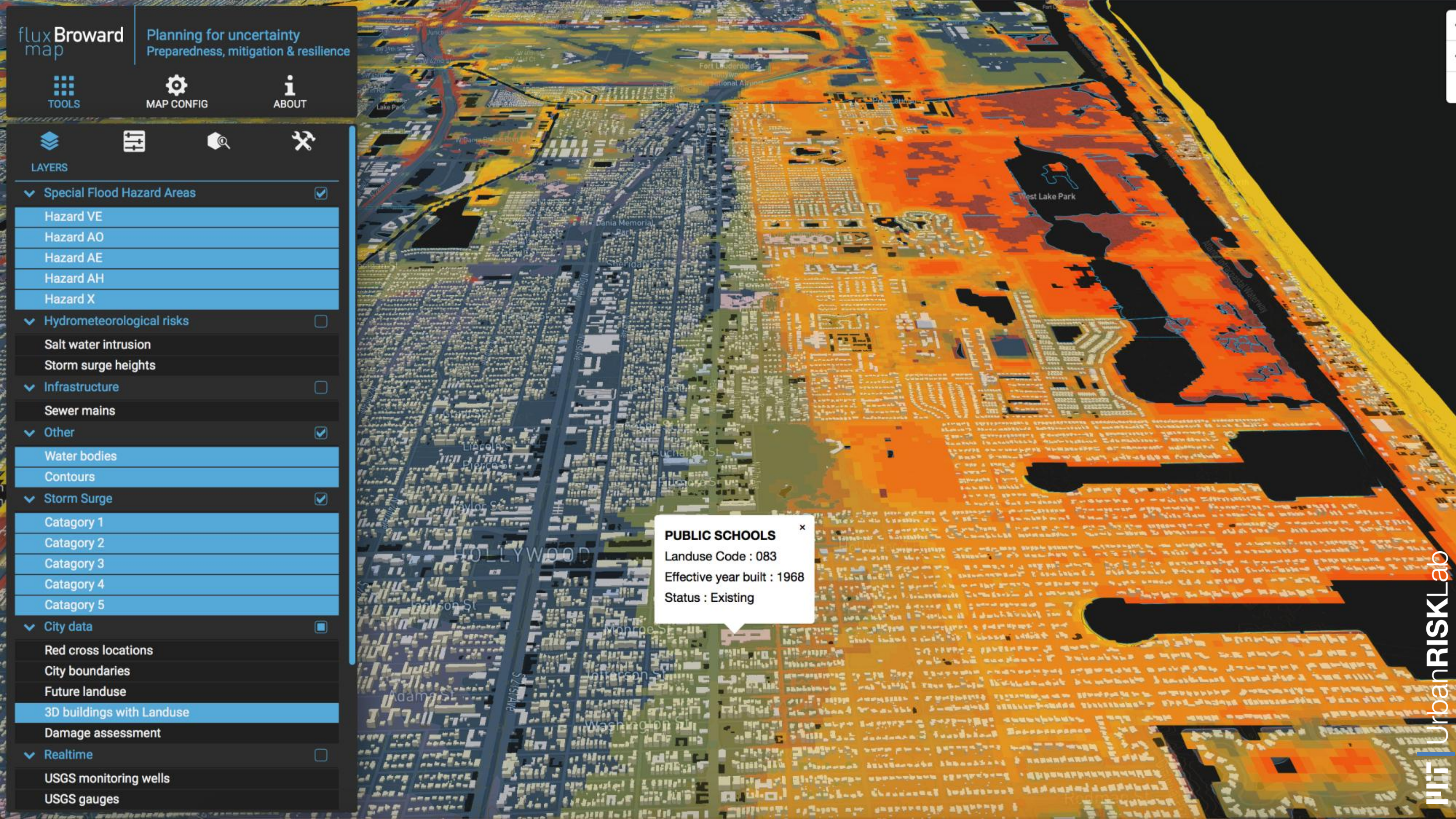
UrbanRISKLab







UrbanRISKLab


flux map Broward
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MAP CONFIG
ABOUT
LAYERS
Special Flood Hazard Areas
Hazard VE
Hazard AO
Hazard AE
Hazard AH
Hazard X
Hydrometeorological risks
Salt water intrusion
Storm surge heights
Infrastructure
Sewer mains
Other
Water bodies
Contours
Storm Surge
Catagory 1
Catagory 2
Catagory 3
Catagory 4
Catagory 5
City data
Red cross locations
City boundaries
Future landuse
3D buildings with Landuse
Damage assessment
Realtime
USGS monitoring wells
USGS gauges
PUBLIC SCHOOLS
Landuse Code : 083
Effective year built : 1968
Status : Existing
West Lake Park
HOLLYWOOD
UrbanRISKLab

FluxLand Tool, Community Design & Architecture

STUDENT ACTIVITY #4:

Using the FluxLand Tool

The FluxLand project is an interactive, web-based, geo- spatial platform designed to increase awareness and bridge the gap between different stakeholders of urban development. It offers a data-driven, collaborative, web-based toolkit for urban planning and decision making across the scales. This project is developed collaboratively by the Urban Risk Lab at MIT and the Center for Landscape Research at the University of Toronto and supported by Broward County.

The platform is designed around homeowners' concerns in the county by providing parcel-level insights that can be aggregated for neighborhood and district level planning. While FluxLand emphasizes individual agency in climate change adaptation, it simultaneously aims to drive strategic and informed decision making at the regulatory level. By visualizing the local consequences of global trends, the project aims to help planners and communities work together to build more resilient urbanization.

Student Activity #4:

Open the FluxLand Tool: https://broward.flux.land/ (Links to an external site.)and explore the different sections that compose it (left column) and answer the Guiding questions:

- **Tools** – is composed of the following options:
  - *Layers* – contains layers of information that you can see on the map.
  - *Queries* – are different ways you can get more details from the map by focusing on specific areas or changing the way you visualize them.
  - *Pre-Sets* – combine different layers to provide information from a perspective of ranges of risk or impact.
  - *Strategies* – includes the following subsections:
    - Policies: reveals a collection of Broward land-use policies that have been translated into graphical interpretations. The policies can be sorted according to themes
    - Design precedents: reveals a graphic collection of types of urban designs.
    - Section: displays a cross-section of Broward county and innovative measures that can be applied.
- **Map Configuration**: allows you to change the way you view the map.
- **About**: general information about the tool.

FluxLand Tool Guiding Questions: The FluxLand Tool has many features worth exploring that you will be able to use for future study modules. Below are a list of questions and activities that will help guide you through the Tool. Please respond to the questions below. Each section is related to a different "tool" in the FluxLand Toolbox.

Part 1: Click on the **Layers** tool [Note: Be sure to unclick the layer after you answer each question]

1. Next, click on the arrow next to "Special Flood Hazard Areas", these are the FEMA (Links to an external site.)(Federal Emergency Management Agency) flood areas.
2. Find your neighborhood by zooming into the map.
3. Find out what your flood hazard area is by clicking in the boxes to the right of each level.

Question #1: What is your flood hazard area? ______________
Go to the FEMA (Links to an external site.) website or the Broward County Flood Zone Maps (Links to an external site.)website to find out if your home needs flood insurance.

4. Storm surge is caused by seawater being pushed in by a storm and can cause inland flooding. Click on "Hydrometeorological Risks." Check the boxes below if any of the categories of storm surge listed in the table could affect your home.

CAT 1	CAT 2	CAT 3	CAT 4	CAT 5

5. Click on "City Data" down arrow, click on "3D buildings with Land use.
6. Next also click on Map Config tool and select 3D viewing. Take a look at your neighborhood.

Question #2: Are there any taller buildings nearby?_______

7. The color of the buildings is related to the type of land use. Yellow is residential and blue is for public/government buildings.

Question #3: What is red for? ______________________

Question #4: What is pink for? _____________________

[Before you move on to the next few exercises, clear the layers and use the 2D view again.]

Part 2: Click on the **Layers** tool again, however, this time you will **select two layers.**

1. **First layer:** Open the "Demographic Data" group and select the Medial Income layer.
2. Using the legend (bottom left) identify where some of the lowest median income areas are located.

Question #5: What color depicts this group? ___________________

3. **Second layer**: Open the "Hydrometeorological Risks" group and click on the CAT 2 layer.

Question #6: What happens when you see two layers at a time___________________

Question #7: Do you have more information? ___________________

Question #8: How many "very low income" polygons (red) will be affected by a CAT 2 storm surge? ____________________

4. Turn off the CAT 2 and turn on the CAT 5.

Question #9: Will more very low income polygons be affected by a CAT 5 storm surge? ________

Question #10: How many more? __________________

Question #11: How might you use or improve these data layers to identify populations vulnerable to sea level and other climate hazards? ______________________________________

Part 3: Click on the **Queries** tool

1. Click on "Cross Section".
2. Use the point tool and click on where you live or go to school.

Question #12: How does the elevation of that parcel compare to others in the cross section? ______________________________

Question #13: Estimate the height of the parcel:______________

Question #14: Is the ground water table high?_____

Question #15: How high is the highest point in your cross section? _________

Question #16: What is the lowest point in your cross section?_________

Part 4: Click on the **Presets** Tool

Make sure that all of the layers in the Layers tool are turned off before you turn on any Presets layer.

- Select the Building Age, Land Value, Base Flood Elevation cluster preset.

Question #17: Are communities impacted differently?_________

Question #18: Are low-income communities impacted differently?_________

Part 5: Click on the **Section** Tool under **Strategies**

1. Click on the numbers to explore adaptation strategies

Question #19: Select 3-5 strategies from the numbered strategies depicted and see if you can provide actual examples of how these strategies are currently being applied in South Florida. (You can use the internet to search for examples). ______________________________

Part 6: Click on the **Strategies** Tool and the "**Review Precedent Examples**" under **Design**

1. Precedents. These examples were developed by college students. Using the map, select 3 examples, one each from the Suburban Area, Ridge, and Coastal (use the Zoom tool to assist the selection).

Question #20: List each example you selected below and provide a short description:

- Suburban example: ______________________________
- Ridge example: ______________________________
- Coastal example: ______________________________

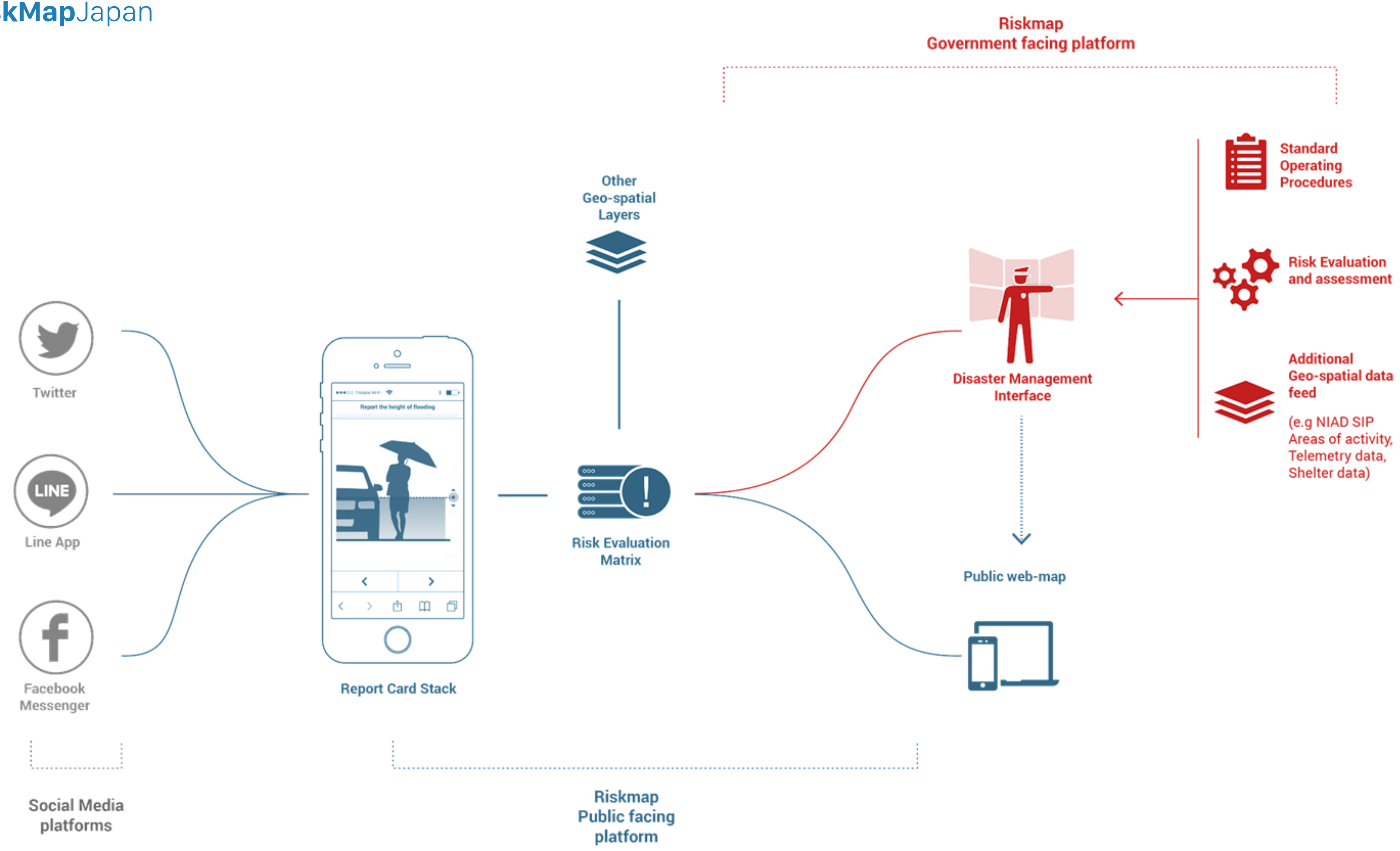
RISKMap AI

AI supported
Real-time Reporting

UrbanRISKLab

REAL-TIME RISKMAP AI

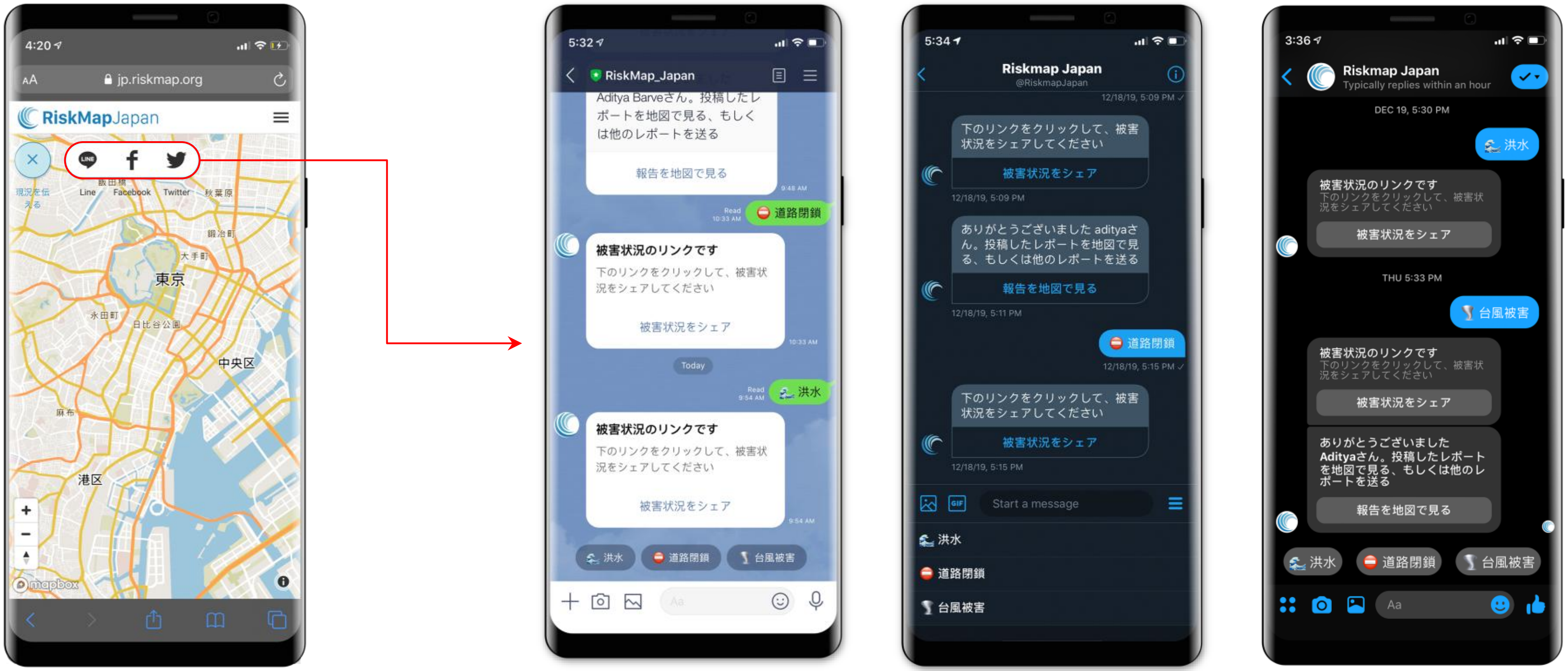
RiskMapJapan



REAL-TIME RISKMAP AI

UrbanRISKLab

RiskMap: Leveraging participatory civic sensing for disasters



Public map

Line

Twitter

Facebook

LINE Mapbox

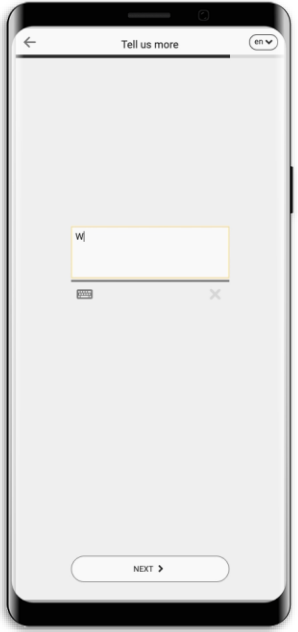
In partnership with Murakami Lab at University of Tsukuba and Mapbox (2018-present)
With support from LINE (2018-2020) and Kumamoto City, 2019

RiskMap: Leveraging participatory civic sensing for disasters

Location

Flood Depth

Photo



Description

Submit

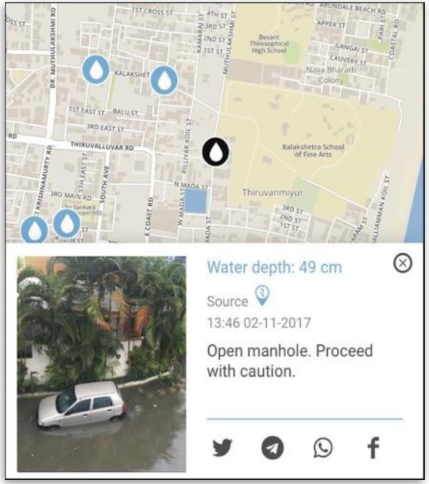
Cards - Flood

Submitting a report takes an average of 30 seconds. Reports appear on the map instantaneously.

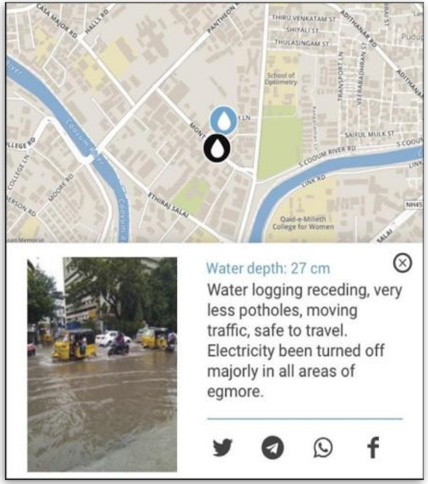
INFRASTRUCTURE ISSUES

TIMEBOUND UPDATES

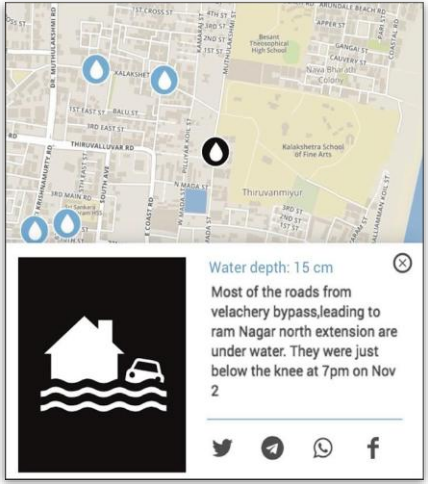
TRAFFIC SAFETY STATUS



Hyperlocal Information

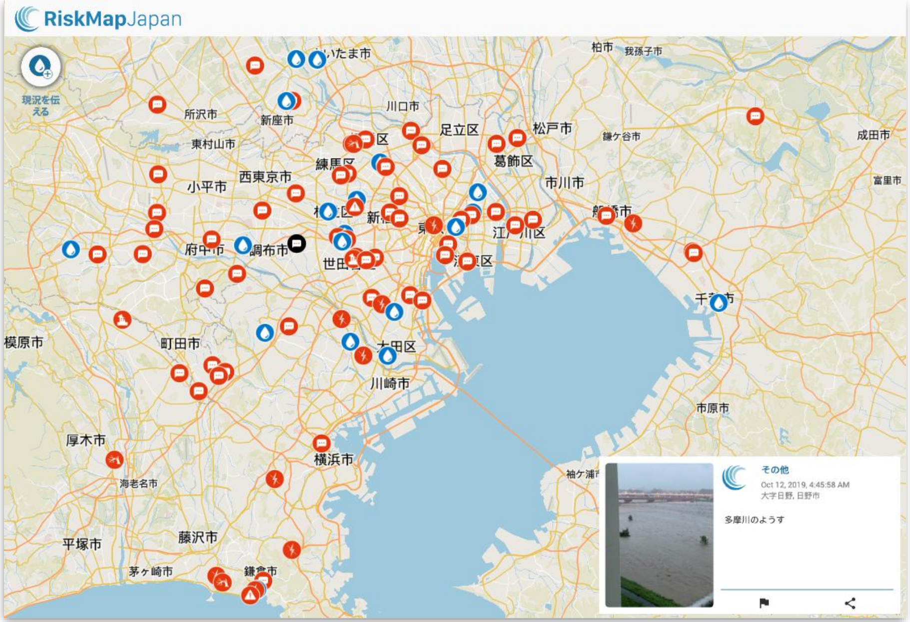


Receding water levels



Navigational Guidance

From Data to Actionable Information



Typhoon Hagibis
October 12, 2019 – October 21, 2019

Kumamoto EOC, Japan
April 2019

Flood | Landslide | Infrastructure Damage | Debris | Power Outage | Other | Fallen Trees | Road Closure

MIT | UrbanRISKLab
筑波大学 University of Tsukuba

REAL-TIME RISKMAP AI
UrbanRISKLab

ShelterMap：Shelter Management Map & Dashboard　避難所運営マップ＆ダッシュボード

パスワード認証によりアクセスできる危機管理室専用マップ

コントロールパネル

REAL-TIME RISKMAP AI

UrbanRISKLab

MIT UrbanRISKLab　筑波大学 University of Tsukuba

全避難所に関するログデータ

No.	避難所名	地区	出発 (時刻)	避難所到着(時刻)	避難所問題あり(時刻)	避難所は安全と確認(時	避難所開設(時刻)	最新避難者数
61	瓦林小学校	瓦木地区	9:16 AM	9:21 AM		9:26 AM	10:00 AM	200
62	瓦木小学校	瓦木地区	9:13 AM	10:02 AM		10:02 AM	10:02 AM	3
63	深津小学校	瓦木地区	9:20 AM	9:33 AM		9:33 AM	10:18 AM	3
64	深津中学校	瓦木地区	9:24 AM	9:29 AM		9:36 AM	9:37 AM	100
65	北甲子園口市民館	瓦木地区	9:20 AM	10:09 AM		10:25 AM	10:30 AM	1
66	瓦木公民館	瓦木地区	9:08 AM	9:16 AM		9:16 AM	10:23 AM	100
132	市民交流センター	瓦木地区	9:10 AM	9:15 AM		9:15 AM	9:29 AM	100
67	高木小学校	北口地区	9:09 AM	9:11 AM		9:12 AM	9:15 AM	250
68	樋ノ口小学校	北口地区	9:09 AM	9:37 AM		9:37 AM	10:25 AM	102
69	甲武中学校	北口地区	9:10 AM	9:19 AM		9:19 AM	9:30 AM	100
70	瓦木中学校	北口地区	9:13 AM	9:30 AM		9:31 AM	10:16 AM	20
71	高木公民館	北口地区	9:10 AM	9:10 AM		9:10 AM	10:11 AM	89
72	高木センター	北口地区	9:42 AM	9:42 AM		9:42 AM	9:46 AM	30
73	北瓦木センター	北口地区	9:19 AM	9:22 AM		9:22 AM	9:23 AM	10
139	香櫨園市民センター	北口地区	9:15 AM	9:38 AM	10:05 AM			
140	高木市民館	北口地区	9:12 AM	9:43 AM		9:43 AM	10:43 AM	500
74	平木小学校	芦原平木地区	9:21 AM	9:21 AM		9:22 AM	10:04 AM	30
75	平木中学校	芦原平木地区	9:24 AM	9:42 AM		9:42 AM	9:44 AM	100
76	中央公民館	芦原平木地区	9:14 AM	9:17 AM		9:18 AM	10:17 AM	150
77	若竹公民館	芦原平木地区	9:29 AM	9:29 AM		9:29 AM	9:51 AM	4
78	平木市民館	芦原平木地区	9:15 AM	9:19 AM		9:23 AM	9:28 AM	20
79	中市民館	芦原平木地区	9:04 AM	9:37 AM		9:37 AM	9:54 AM	3000
80	中央体育館分館	芦原平木地区	9:16 AM	9:24 AM		9:24 AM	9:25 AM	100

WebApp that provides
portability and scalability to EOC operations,

EOC shelter management dashboard runs within the browser,
without the need for expensive computational equipment,
allowing unfettered flexibility in decision making

緊急対策室の操作に
ポータビリティとスケーラビリティを提供するWebApp

RiskMap避難所運営ダッシュボードは
ブラウザー内で実行されるため
動作環境もPCに固定されず
意思決定の際の柔軟性が高い

Mayor of Kumamoto broadcasting a message to all shelters using his iPad
iPadで全避難所にメッセージを配信する熊本市市長

Google AI for Social Good Collective Intelligence for Safe Communities

Combining Human and Machine Intelligence for Disaster Preparedness and Response

MERCY CORPS

MIT UrbanRISKLab

筑波大学 University of Tsukuba

with

Fukuchiyama City, Kyoto Prefecture

REAL-TIME RISKMAP AI

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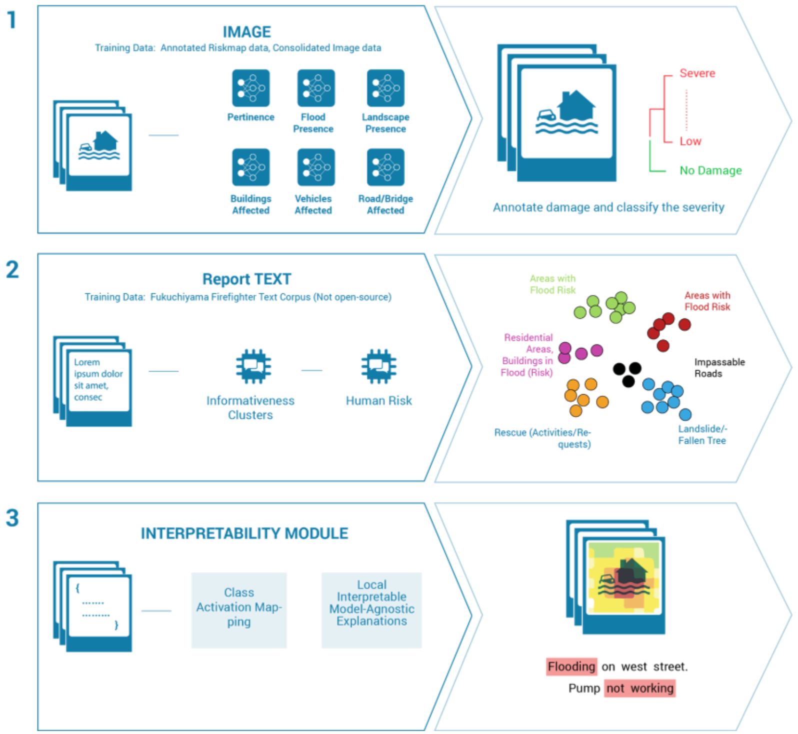
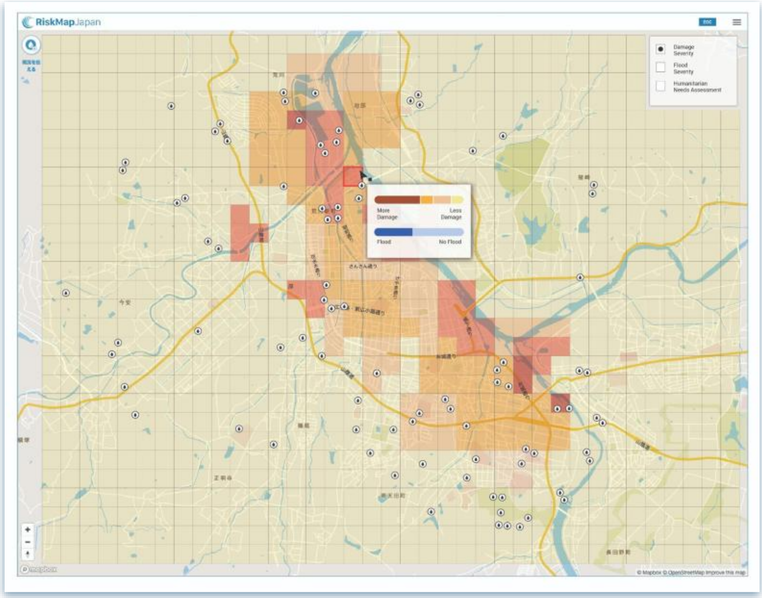
Combining Human and Machine Intelligence





In partnership with University of Tsukuba, Fukuchiyama City, Mercy Corp, and Una-May O'Reilly MIT CSAIL

With support from Google (2020-2022) and Mapbox

REAL-TIME RISKMAP AI

UrbanRISKLab

BREAK the BLACK BOX - Detailed labeling guides based on Emergency Operation Center workshops

REACT v0.3.1 (stage) Manage Analyze Label AB

Flood Severity

What is the severity of flooding shown in the image?

FYI: Look for flood height markers such as buildings, people, road signs, vehicles etc. Refer to the label descriptions to estimate severity. For aerial images, if height cannot be estimated, mark 'Not Sure / Can't say'.

Labels:

Low Severity

Image shows flood waters below knee height / upto 50cm above ground floor level.

Moderate Severity

Image shows flood waters above knee height & below chest height / 50cm to 1m above ground floor level.

REAL-TIME RISKMAP AI

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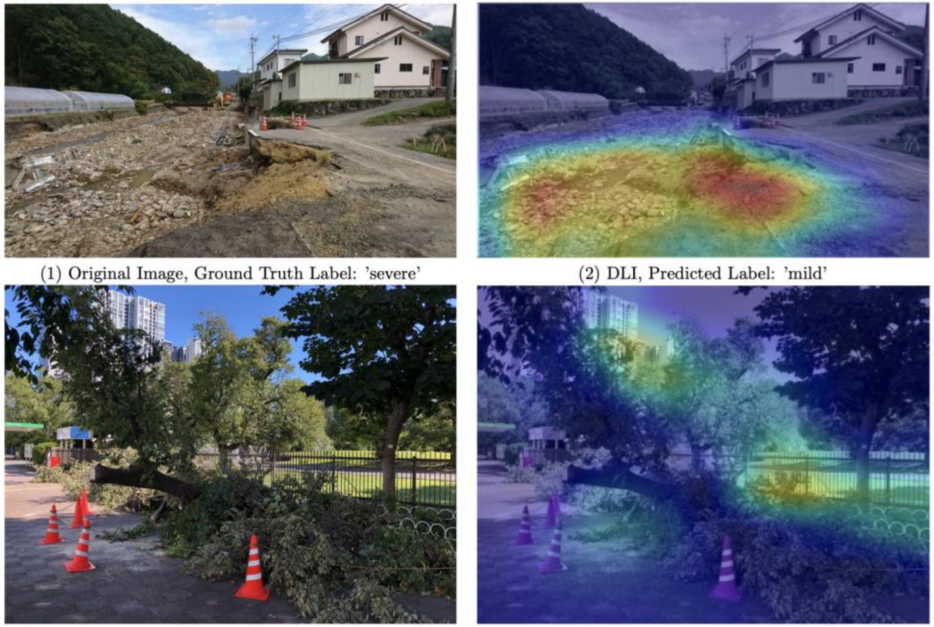
BREAK the BLACK BOX - Interpretability for Image and Text Classifica

Interpretability: Damage Localization



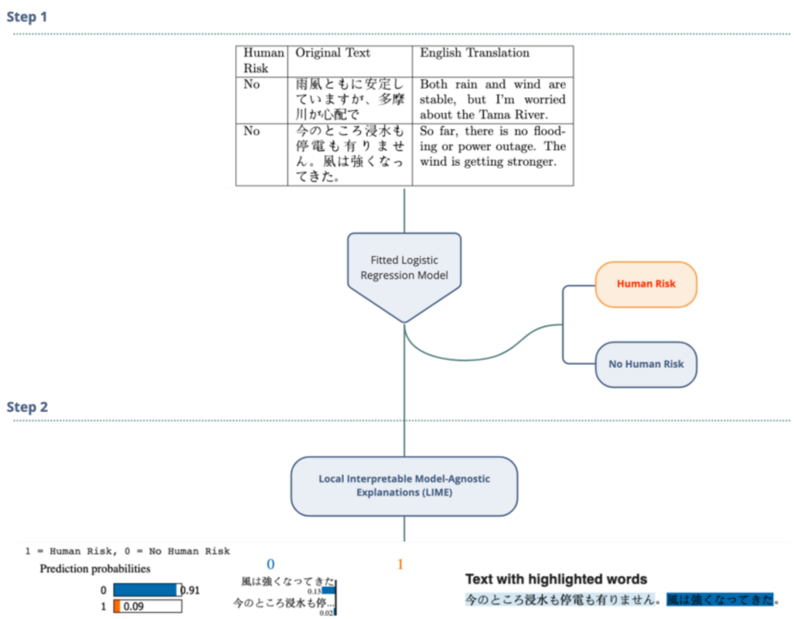
(1) Original Image, Ground Truth Label: 'severe'

(2) DLI, Predicted Label: 'mild'

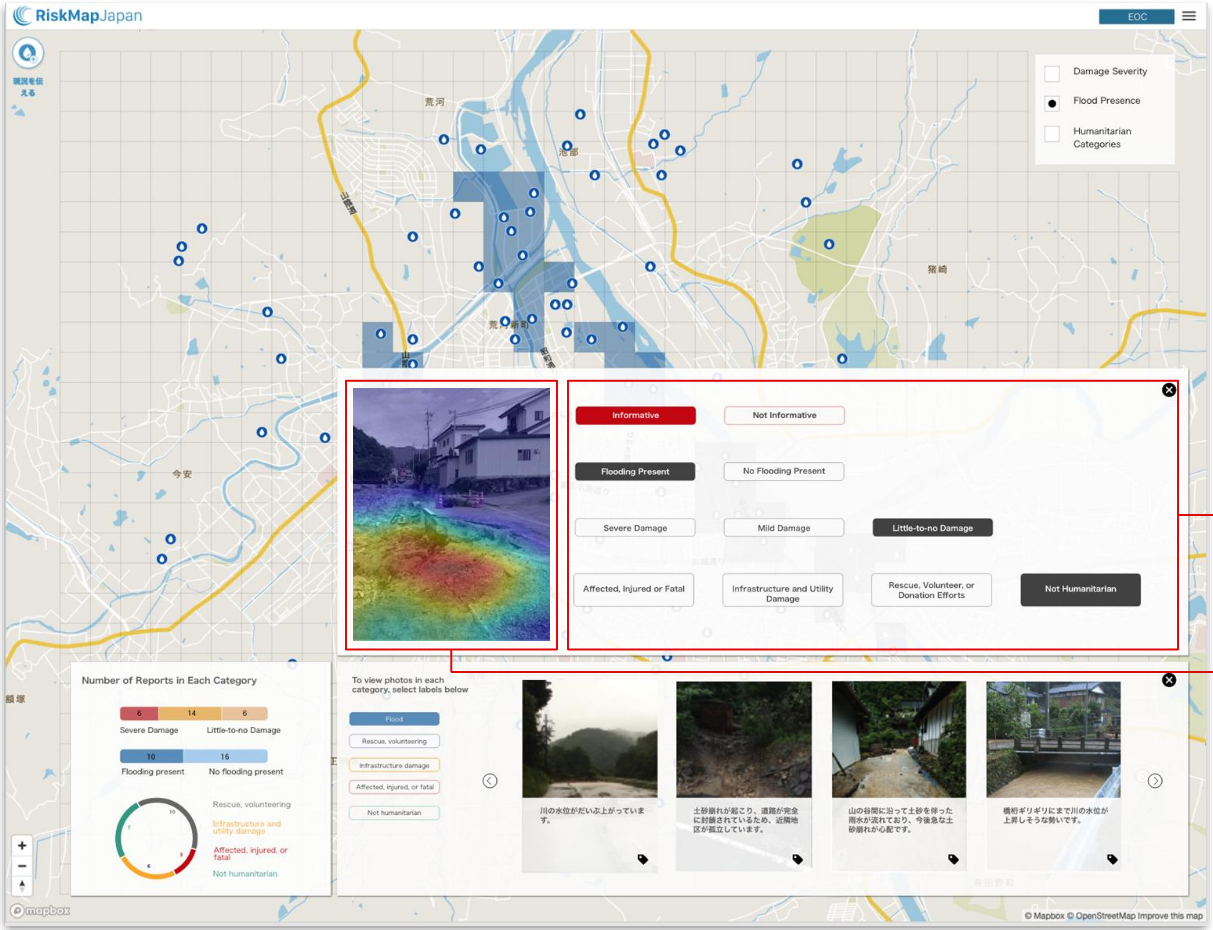
(3) Original Image, Ground Truth Label: 'mild'

(4) DLI, Prediced Label: 'little_or_none'

Interpretability: Human Risk Classification in Text



UX Research for REACT Dashboard



Retraining / relabelling options

Class Activation Map Overlay (shows which part of the image was significant for the prediction)

Interpretability + Retraining

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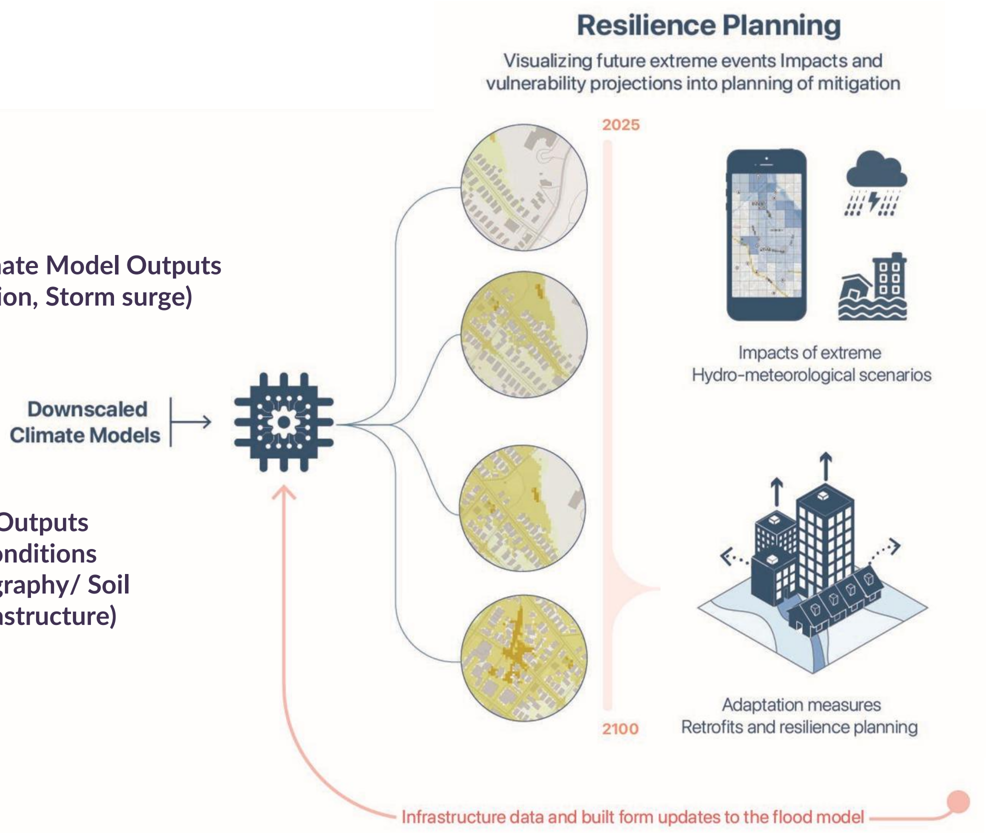
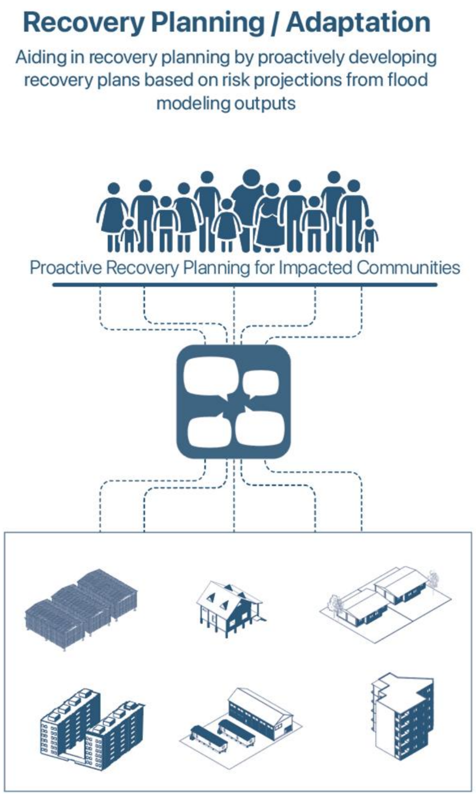
Increasing Awareness Everyday
日常的に意識を高める

1 **Downscaled Climate Model Outputs (Wind, Precipitation, Storm surge) PI Ravela**

2 **Flood Modeling Outputs (Geo-Physical Conditions Buildings/ Topography/ Soil Conditions/ Infrastructure) PI Strzepek**





Every dollar invested in disaster resilience today could save communities up to $33 in lost future economic activity.

Beyond the Payoff: How Investments in Resilience and Disaster Preparedness Protect. Communities Resilience Report 2025

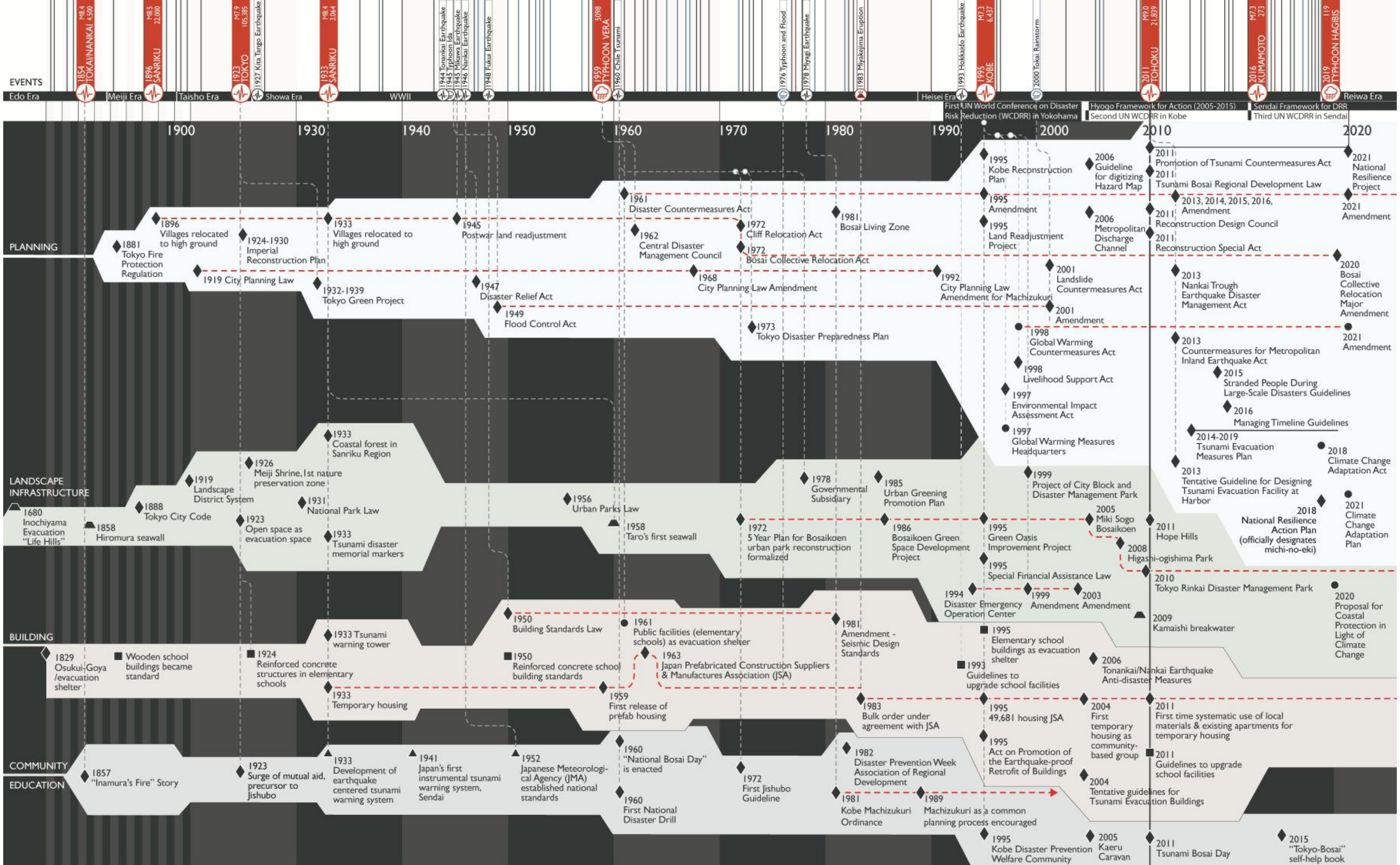
Design Before Disaster

Japan’s Culture of Preparedness

University of Virginia Press 2025

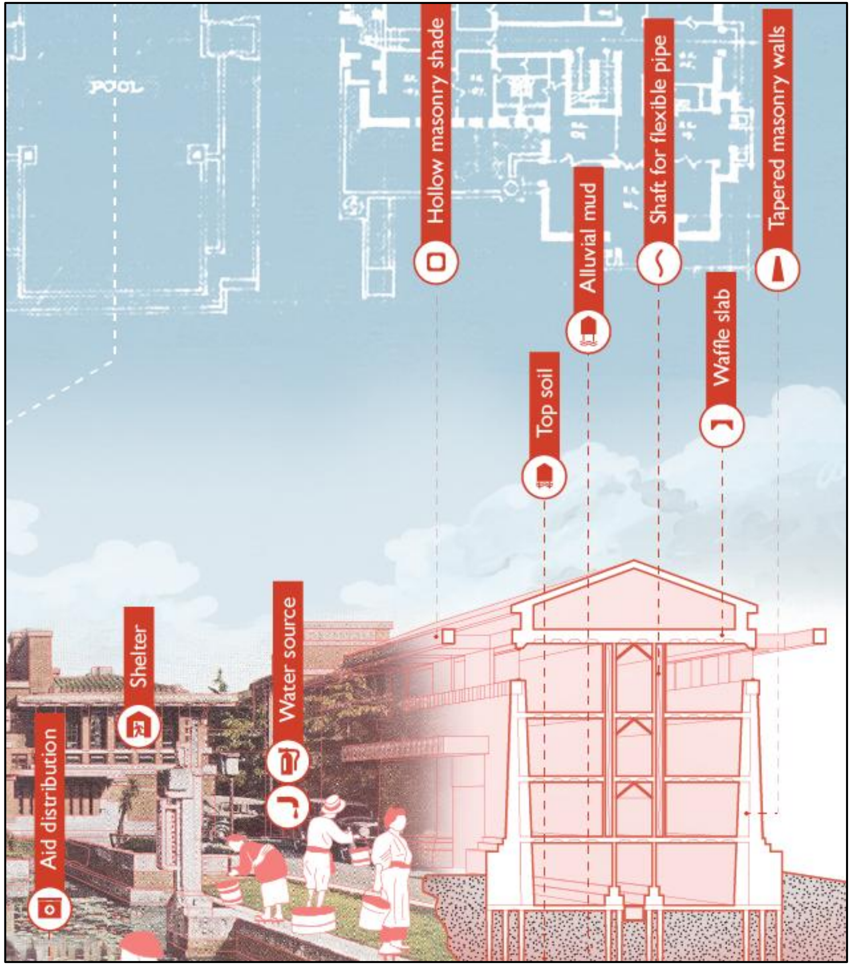
Design Before Disaster.org

IWATE	**Kamaishi**	Senjuin Temple • Kamaishi Tsunami Evacuation Network • Zenyuseki Project • Greenbelt Evacuation Path • Horaikan Hotel Kizuna no michi • Kamaishi Breakwater • Jorakuji Temple and Unosumai Shrine • Unosumai Elementary School and Kamaishi Higashi Middle School • Community-Care temporary housing • Unosumai Bosai Center	**Rikuzen-takata**	Rikuzentakata Reconstruction • NPO Riku Cafe • Honmaru Park • Shotokuji Temple • Tapic 45 and Takata Matsubara Museum/Park
			Miyako	Taro Seawall and Urban Planning • Aneyoshi Tablet
			Ofunato	Ibasho House • Okirai Elementary School
			Otsuchi	Collabo-School
MIYAGI	**Ishinomaki**	Okawa Elementary School • Ogatsu School Michi-no-eki Jobon-no-Sato • Ogatsu Reconstruction	**Sendai Iwanuma**	Kaigan Koen Boken Hiroba • Morino Project Millennium Hope Hills • Tamaura-nishi Housing
	Kesennuma	Inawashiro Hospital • Hotel Boyo • Naiwan Mukaeru Seawall • Moune Dai-ni Relocation • Minamimachi Murasaki Market • Shishiori School	**Shichiga-hama Onagawa**	Shichigahama Reconstruction • Shobutahama Public Housing Onagawa Reconstruction
	Minami-sanriku	Kaminoyama Hachimangu Shrine • Hotel Kanyo • Nagashizuso Ryokan • Shizugawa Evacuation Network • Isuzu Shrine • Mishima Shrine • Yoriki Relocation • Utatsu Middle School	**Watari Yamamoto**	Watari Green Belt • Arahama Middle School Yamashita Middle School • Yamashita Dai-ni Elementary School • Yamamoto Reconstruction • Fumonji Temple
FUKUSHIMA	**Aizu-Waka matsu**	Miharumachi Wooden Recovery Housing • Aizu-Matsunaga Danchi • Itakura Wooden Panel System		
	Iwaki	AEON Mall Iwaki Onahama		
SAITAMA	**Kasukabe**	The Metropolitan Discharge Channel		
TOKYO	**Bunkyo Chiyoda Chuo**	Tokyo Dome City Mitsubishi Estate and Daimaruyu • The Imperial Hotel • Dojunkai	**Minato Nakano Ota Setagaya Shibuya Shinagawa Suginami Sumida**	Toranomon Hills Complex Nakano-Shiki-no-Mori Park Haneda Airport Futakotamagawa Park Yoyogi Park Shinagawa Pocket Park Network Suginami Dai-ju Elementary School Narihira Rain Water Tank, Rojison • Sumo Arena • Tokyo Skytree • Shirahige Higashi Apartment • Fujinoki-san-chi
	Edogawa	Super Levee • Tokyo Rinkai Park • Matsue Elementry School		
	Itabashi Koto	Itabashi Evacuation Path • Kiyosumi Garden • Motomachi Park		
KANAGAWA	**Kawasaki Kamakura**	Higashi-ogishima Park Kamakura Central Park	**Takatsu**	Ecological Learning at the 16 Elementary Schools in Takatsu
SHIZUOKA	**Fukuroi**	Inochi Yama	**Yoshida**	Pedestrian Bridge Tsunami Platform
AICHI	**Nagoya**	Shikemichi Road and Dozou Zukuri		
GIFU	**Ono**	Palette Pier Ono	**Takasu Shirakawa**	Waju Shirakawa-go
MIE	**Taiki Minamiise**	Nishiki Towers Fire Station and Museum Minamiise Preemptive Public Facility Relocation		
KYOTO	**Kyoto**	Higashiyama Fire Fighting Project • Horikawa River • Kyoto Imperial Palace		
OSAKA	**Sakai Toyonaka**	Sakai Senboku National Logistics • Hattori Ryokuchi Park	**Daito**	Fukakita Ryokuchi Park
WAKAYAMA	**Kushimoto**	Kushimoto Preemptive Public Relocation • Wakayama East Fishermen's Association • Floating tsunami shelters		
HYOGO	**Chuo**	Rokkomichi North & South Park • Matsumoto Stream • Oji Zoo and Park • Minatogawa Park • Kamisawa Pocket Parks • Kaze-no-sato Park • HAT Kobe Fureai Public Housing	**Mano Nada Nagata Miki**	Mano Machizukuri Kinmokusei Street Joint Housing Project Mikura 5 Housing Miki Sogo Bosaikoen
KOCHI	**Suzaki Kochi**	Suzaki City Hall Tsunami Evacuation Stairs Kokatsu Project	**Kuroshio**	Saga District TET • Okata Akatsuki-Kan • Tosa Seinan Park Observation Deck • We Can Project
SHIMANE	**Misato**	Misato Preemptive Group Relocation Planning		
FUKUOKA	**Fukutsu**	Kamisaigo River Flood Management		
KUMAMOTO	**Kumamoto**	Parks in Kumamoto		
MIYAZAKI	**Hyuga**	Hyuga Tsunami Evacuation Stairs		
NATIONAL		Tsunami-hi • O-Jizo-san • Stramps• Bosai Living Zones • Mokumitsu Districts • NIGECHIZU • Cliff Relocation Project • Bosai Collective Relocation Project • Compact City Projects • Iza! Kaeru Caravan! • JPA • Minashikasetsu		


EVENTS
1854 TOKAI/NANKAI M8.4 4,500
1896 SANRIKU M8.5 22,000
1923 TOKYO M7.9 105,385
1927 Kita Tango Earthquake
1933 SANRIKU M8.4 3,064
1944 Tonankai Earthquake
1945 Typhoon Ida
1945 Mikawa Earthquake
1946 Nankai Earthquake
1948 Fukui Earthquake
1959 TYPHOON VERA 5098
1960 Chile Tsunami
1976 Typhoon and Flood
1978 Miyagi Earthquake
1983 Miyakejima Eruption
1993 Hokkaido Earthquake
1995 KOBE M7.3 6,437
2000 Tokai Rainstorm
2011 TOHOKU M9.0 21,839
2016 KUMAMOTO M7.3 273
2019 TYPHOON HAGIBIS 119
Edo Era
Meiji Era
Taisho Era
Showa Era
WWII
Heisei Era
Reiwa Era
First UN World Conference on Disaster Risk Reduction (WCDRR) in Yokohama
Hyogo Framework for Action (2005-2015)
Second UN WCDRR in Kobe
Sendai Framework for DRR
Third UN WCDRR in Sendai
1900
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
PLANNING
1881 Tokyo Fire Protection Regulation
1896 Villages relocated to high ground
1919 City Planning Law
1924-1930 Imperial Reconstruction Plan
1932-1939 Tokyo Green Project
1933 Villages relocated to high ground
1945 Postwar land readjustment
1947 Disaster Relief Act
1949 Flood Control Act
1961 Disaster Countermeasures Act
1962 Central Disaster Management Council
1968 City Planning Law Amendment
1972 Cliff Relocation Act
1972 Bosai Collective Relocation Act
1973 Tokyo Disaster Preparedness Plan
1981 Bosai Living Zone
1992 City Planning Law Amendment for Machizukuri
1995 Kobe Reconstruction Plan
1995 Amendment
1995 Land Readjustment Project
1997 Environmental Impact Assessment Act
1997 Global Warming Measures Headquarters
1998 Global Warming Countermeasures Act
1998 Livelihood Support Act
2001 Landslide Countermeasures Act
2001 Amendment
2006 Guideline for digitizing Hazard Map
2006 Metropolitan Discharge Channel
2011 Promotion of Tsunami Countermeasures Act
2011 Tsunami Bosai Regional Development Law
2013, 2014, 2015, 2016, Amendment
2011 Reconstruction Design Council
2011 Reconstruction Special Act
2013 Nankai Trough Earthquake Disaster Management Act
2013 Countermeasures for Metropolitan Inland Earthquake Act
2015 Stranded People During Large-Scale Disasters Guidelines
2016 Managing Timeline Guidelines
2014-2019 Tsunami Evacuation Measures Plan
2013 Tentative Guideline for Designing Tsunami Evacuation Facility at Harbor
2018 Climate Change Adaptation Act
2018 National Resilience Action Plan (officially designates michi-no-eki)
2021 National Resilience Project
2021 Amendment
2020 Bosai Collective Relocation Major Amendment
2021 Amendment
2021 Climate Change Adaptation Plan
LANDSCAPE INFRASTRUCTURE
1680 Inochiyama Evacuation "Life Hills"
1858 Hiromura seawall
1888 Tokyo City Code
1919 Landscape District System
1923 Open space as evacuation space
1926 Meiji Shrine, 1st nature preservation zone
1931 National Park Law
1933 Coastal forest in Sanriku Region
1933 Tsunami disaster memorial markers
1956 Urban Parks Law
1958 Taro's first seawall
1972 5 Year Plan for Bosaikoen urban park reconstruction formalized
1978 Governmental Subsidiary
1985 Urban Greening Promotion Plan
1986 Bosaikoen Green Space Development Project
1995 Green Oasis Improvement Project
1995 Special Financial Assistance Law
1999 Project of City Block and Disaster Management Park
1994 Disaster Emergency Operation Center
1999 Amendment
2003 Amendment
2005 Miki Sogo Bosaikoen
2008 Higashi-ogishima Park
2011 Hope Hills
2010 Tokyo Rinkai Disaster Management Park
2009 Kamaishi breakwater
2020 Proposal for Coastal Protection in Light of Climate Change
BUILDING
1829 Osukui-Goya /evacuation shelter
Wooden school buildings became standard
1924 Reinforced concrete structures in elementary schools
1933 Tsunami warning tower
1933 Temporary housing
1950 Building Standards Law
1950 Reinforced concrete school building standards
1959 First release of prefab housing
1961 Public facilities (elementary schools) as evacuation shelter
1963 Japan Prefabricated Construction Suppliers & Manufactures Association (JSA)
1981 Amendment - Seismic Design Standards
1983 Bulk order under agreement with JSA
1993 Guidelines to upgrade school facilities
1995 Elementary school buildings as evacuation shelter
1995 49,681 housing JSA
2004 First temporary housing as community-based group
2006 Tonankai/Nankai Earthquake Anti-disaster Measures
2011 First time systematic use of local materials & existing apartments for temporary housing
COMMUNITY EDUCATION
1857 "Inamura's Fire" Story
1923 Surge of mutual aid, precursor to Jishubo
1933 Development of earthquake centered tsunami warning system
1941 Japan's first instrumental tsunami warning system, Sendai
1952 Japanese Meteorological Agency (JMA) established national standards
1960 "National Bosai Day" is enacted
1960 First National Disaster Drill
1972 First Jishubo Guideline
1982 Disaster Prevention Week Association of Regional Development
1981 Kobe Machizukuri Ordinance
1989 Machizukuri as a common planning process encouraged
1995 Act on Promotion of the Earthquake-proof Retrofit of Buildings
1995 Kobe Disaster Prevention Welfare Community
2004 Tentative guidelines for Tsunami Evacuation Buildings
2005 Kaeru Caravan
2011 Guidelines to upgrade school facilities
2011 Tsunami Bosai Day
2015 "Tokyo-Bosai" self-help book

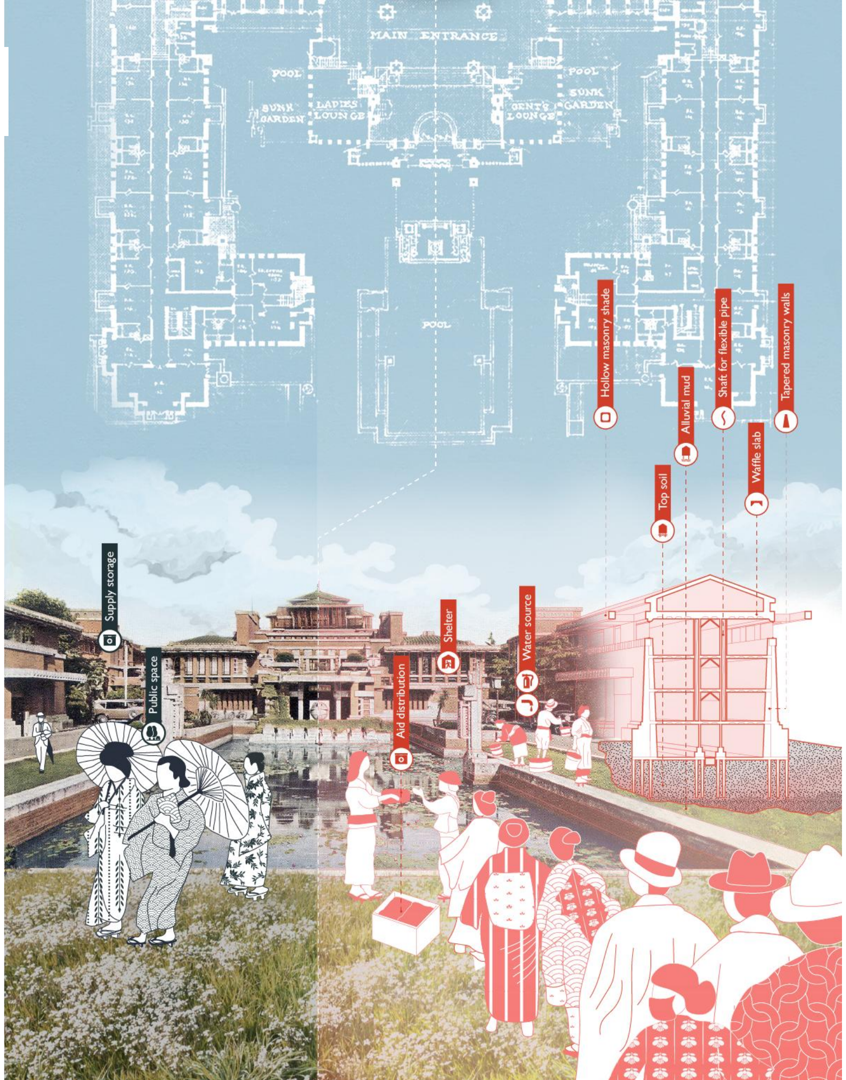
Lithograph: 880-02 Tokyo
Taishō 12 [1923] The whirlwind of fire attacked Yoshiwara street.
Library of Congress Prints and Photographs Division Washington

Imperial Hotel, Tokyo
Frank Lloyd Wright
Mayan Revival Style

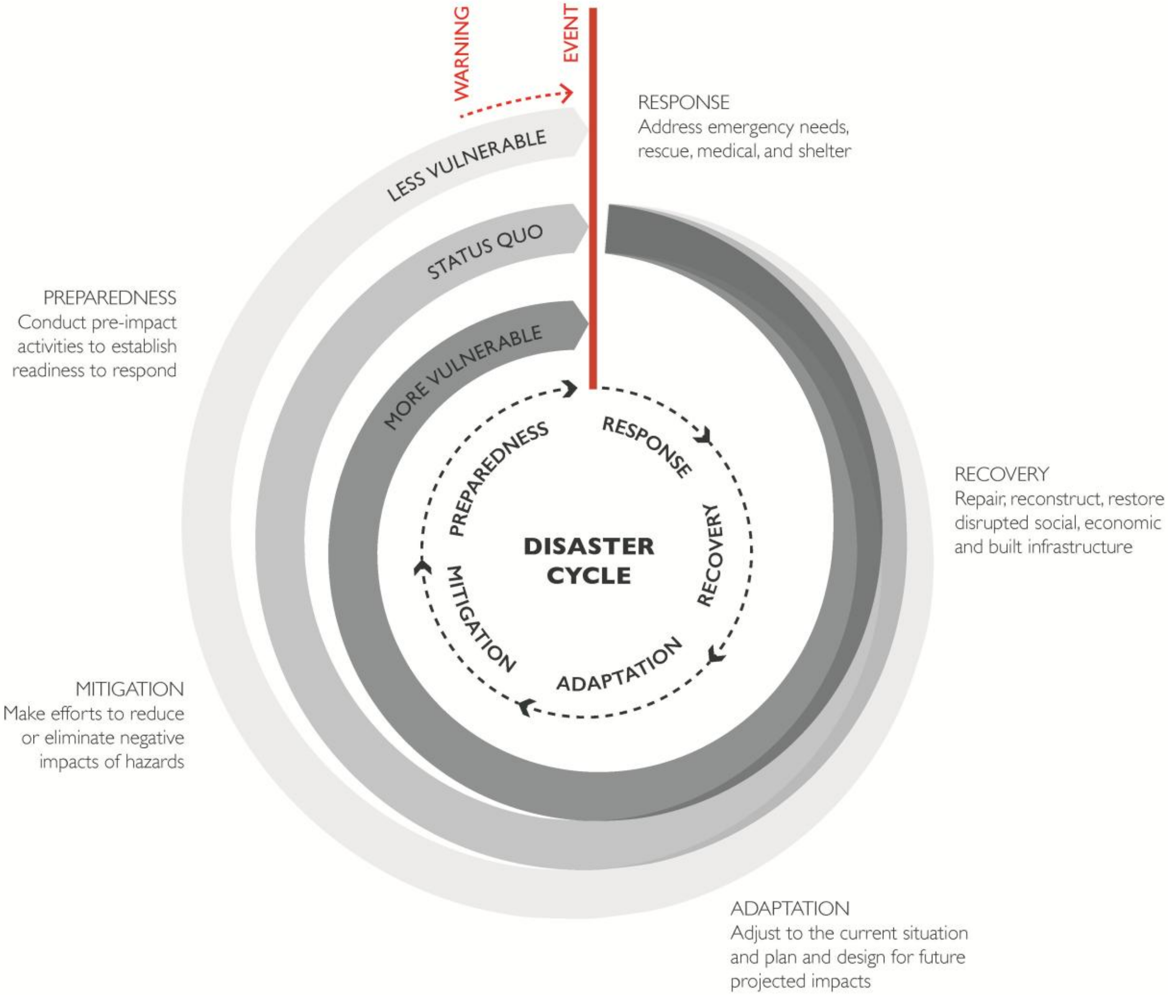


Imperial Hotel, Tokyo
Innovative Seismic Strategies

HOTEL + *bosai hub*

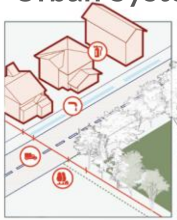


Imperial Hotel, Tokyo
Innovative Seismic Strategies

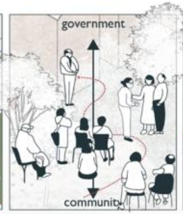


WARNING
EVENT
RESPONSE
Address emergency needs,
rescue, medical, and shelter
LESS VULNERABLE
STATUS QUO
MORE VULNERABLE
PREPAREDNESS
Conduct pre-impact
activities to establish
readiness to respond
PREPAREDNESS
RESPONSE
RECOVERY
ADAPTATION
MITIGATION
DISASTER
CYCLE
RECOVERY
Repair, reconstruct, restore
disrupted social, economic
and built infrastructure
MITIGATION
Make efforts to reduce
or eliminate negative
impacts of hazards
ADAPTATION
Adjust to the current situation
and plan and design for future
projected impacts

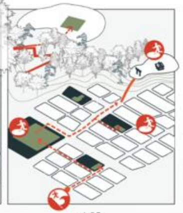
Urban Systems



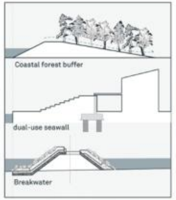
4.01
Fire Reduction
Systems



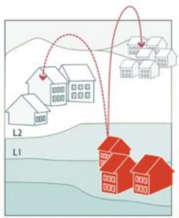
4.02
Machizukuri
(Community Planning)



4.03
Evacuation Routes

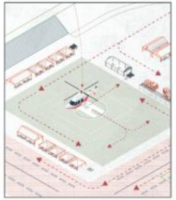


4.04
Coastal Strategies

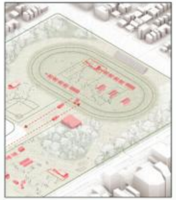


4.05
Resettlement

Park Networks



5.01
Logistics Hubs



5.02
Mixed Bōsai Hubs

5.03
Primary Evacuation Spaces

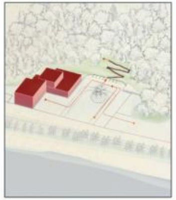
5.04
Initial Evacuation Parks

5.05
Education in Parks

Buildings

6.01
Housing - Temporary
to Permanent

6.02
Shrines and Temples



6.03
Hotels

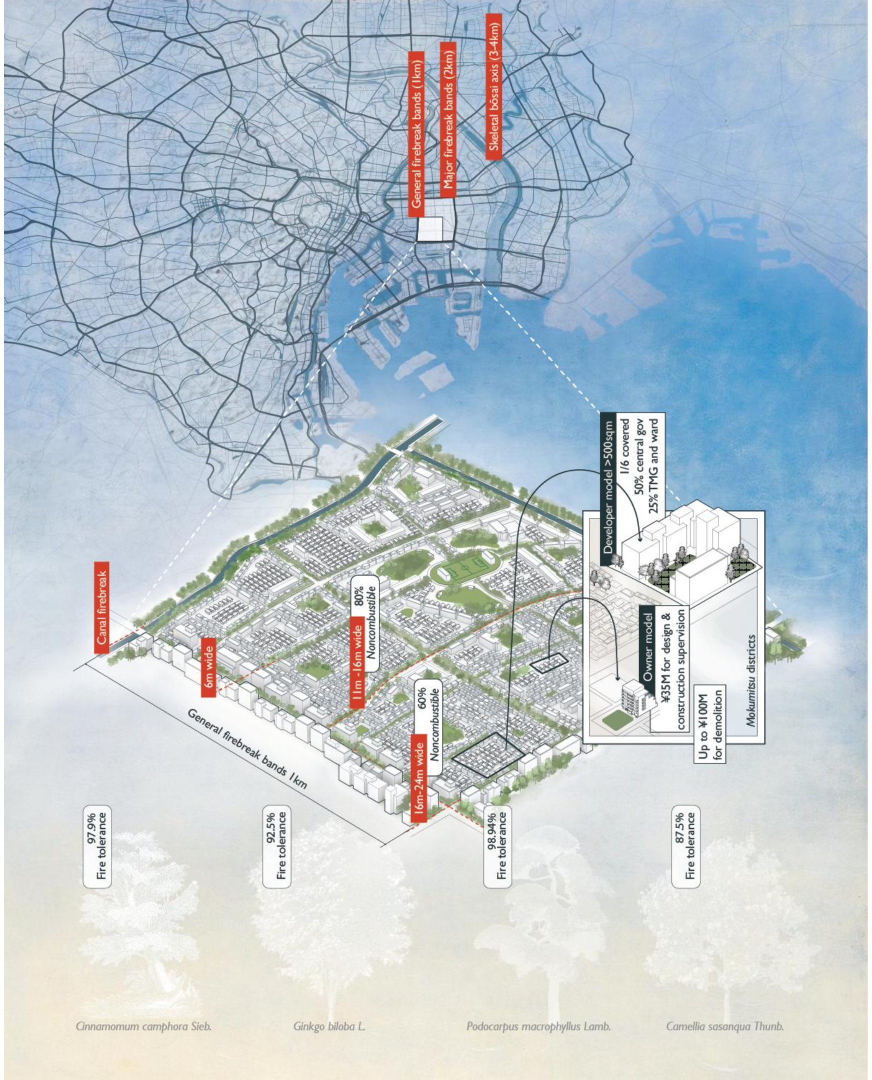
6.04
Schools

6.05
Tsunami Evacuation
Structures

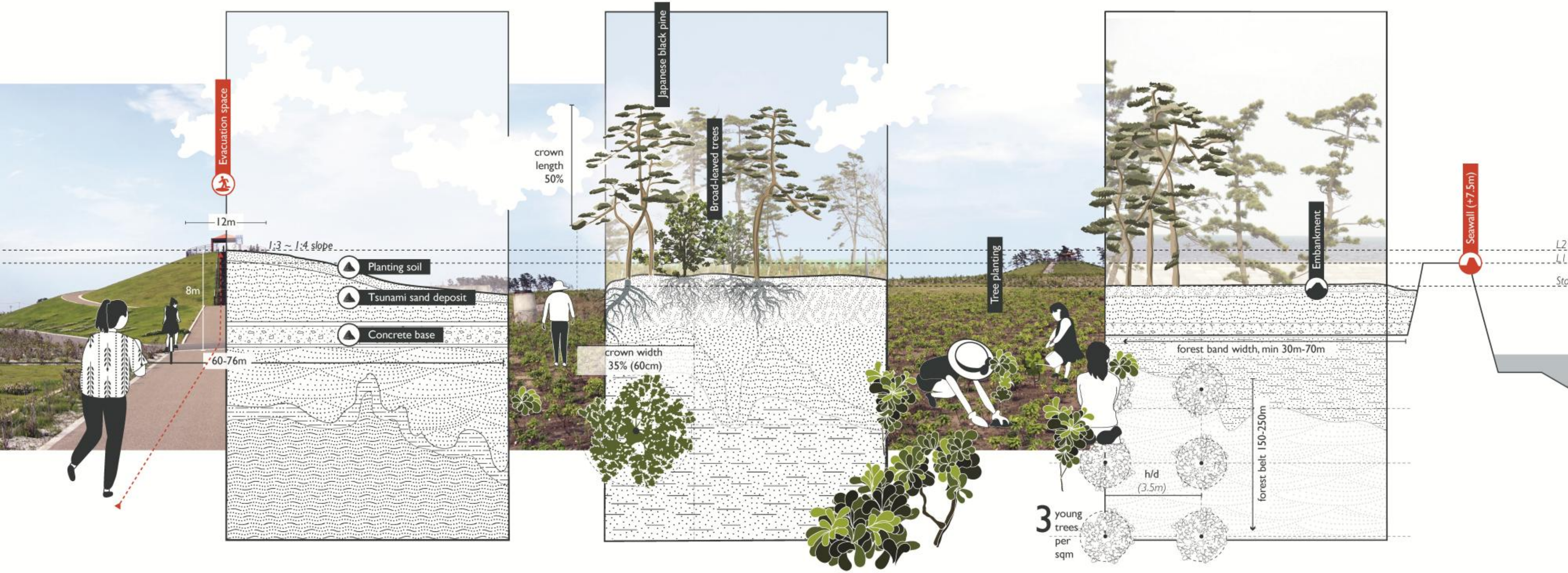
Design Before Disaster.org


General firebreak bands (1km)
Major firebreak bands (2km)
Skeletal bōsai axis (3-4km)

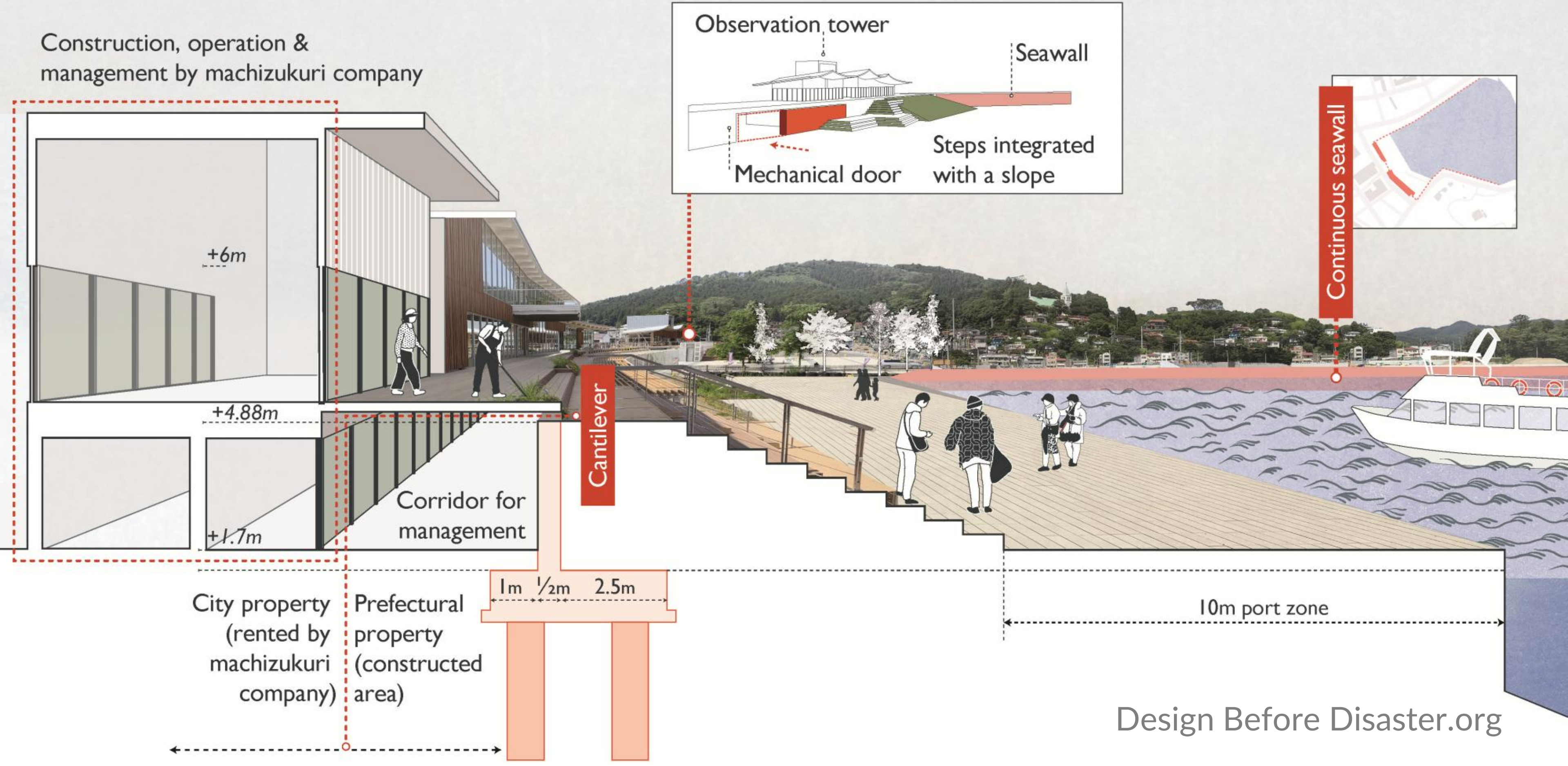
Bōsai Living Zones



COASTAL PROTECTION + *educational community forest*



COASTAL PROTECTION + ***community owned restaurants***

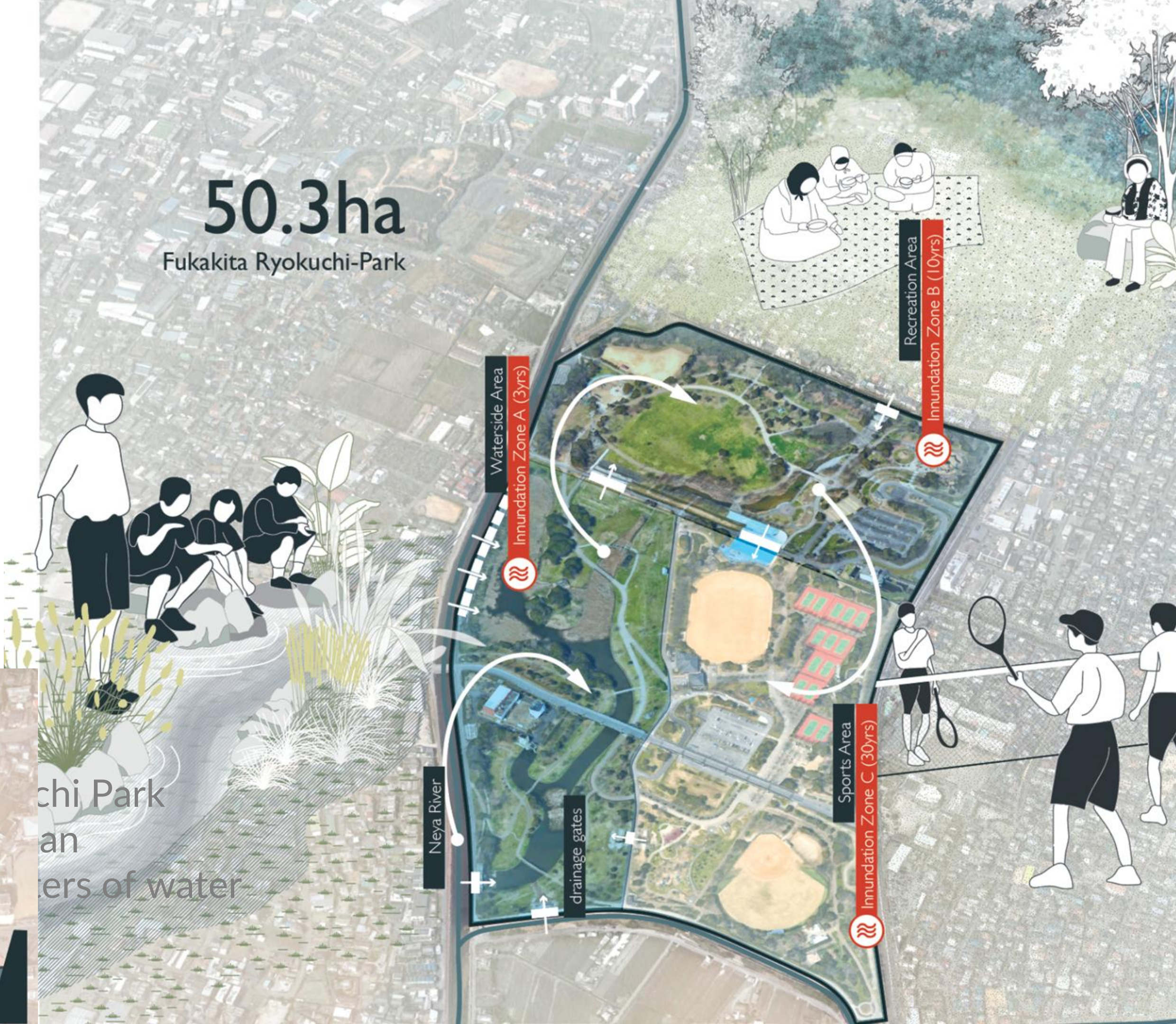


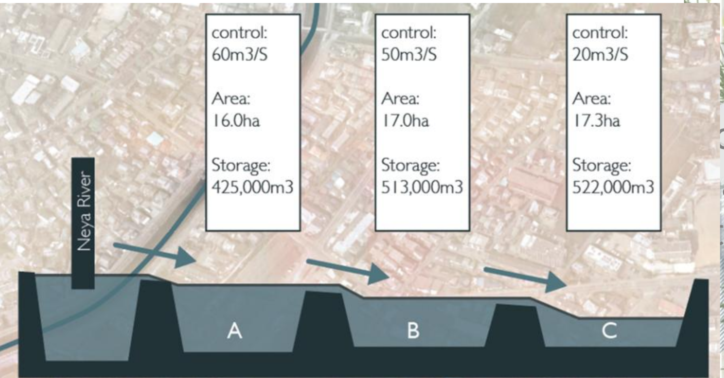
PARK + ***water retention***

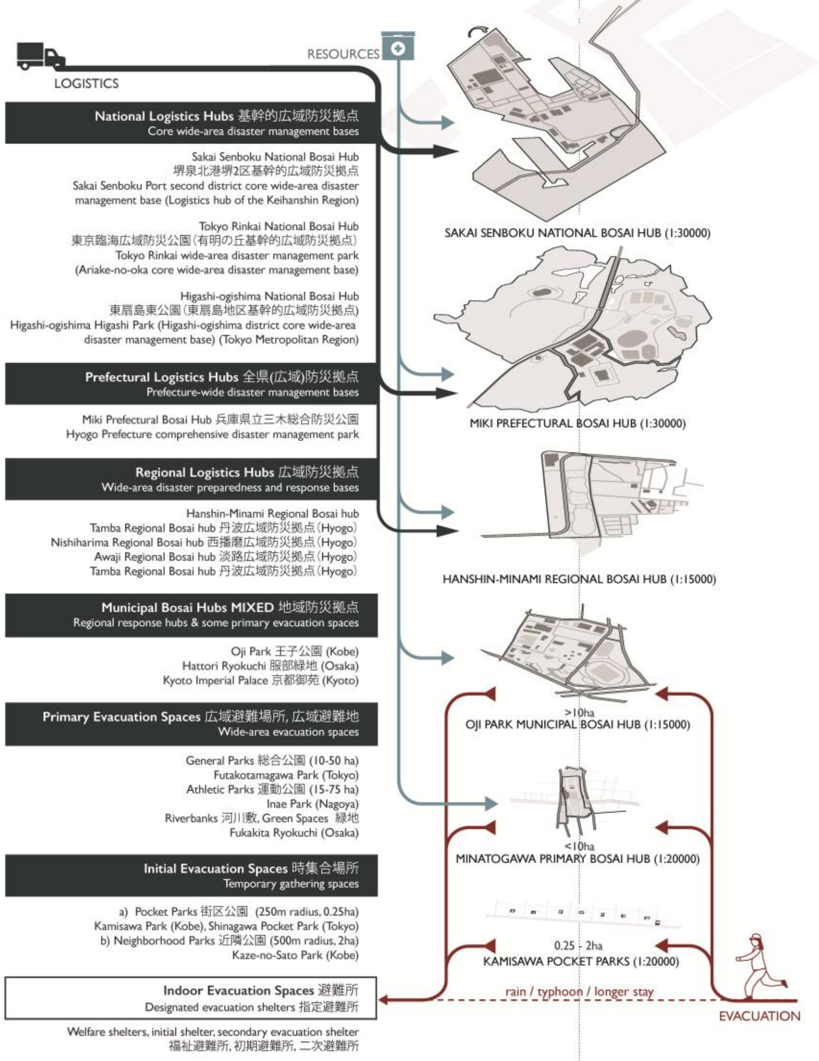
Fukakita Ryokuchi Park
Osaka, Japan
1,460,000 cubic meters of water

Design Before Disaster.org

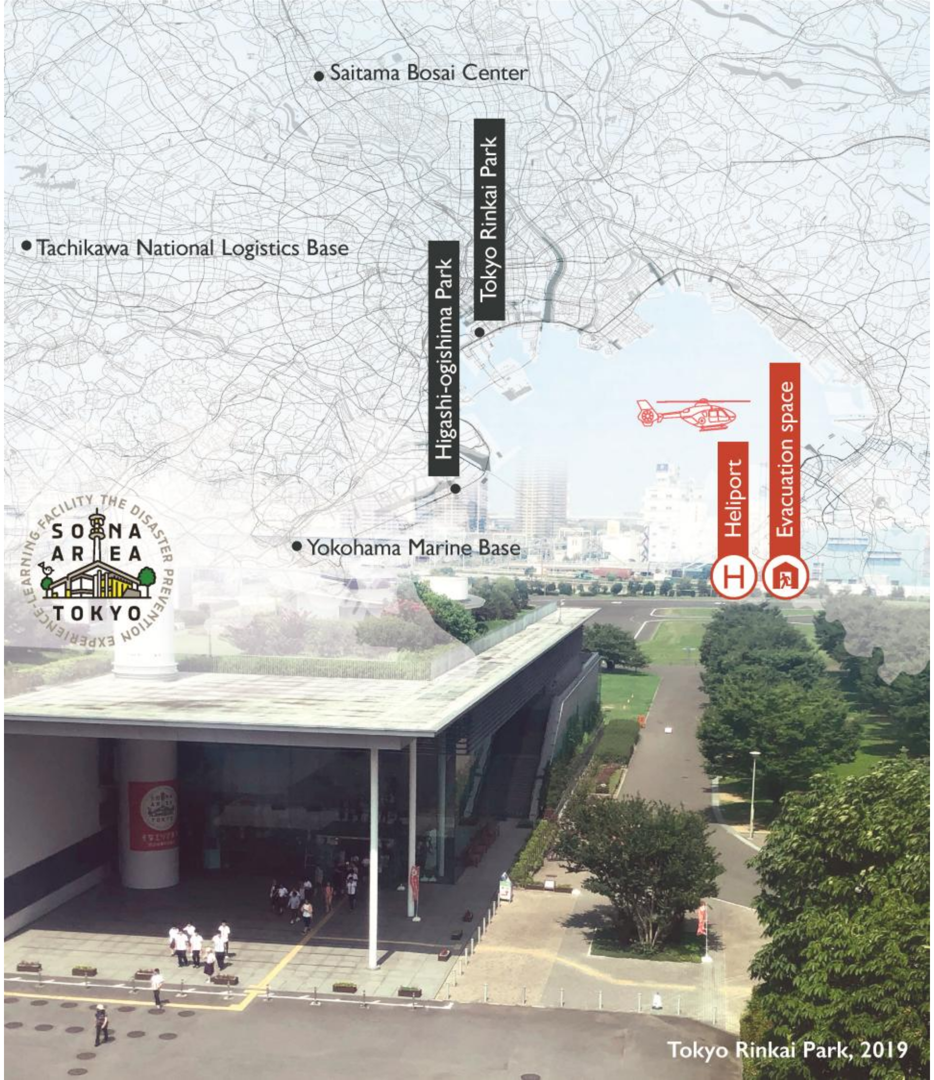
PARK + ***water retention***







Bōsaikōen Network from national scale to local parks with designated roles for logistics and evacuation.



National Logistics Hubs
Higashi-ōgishima Park and
Tokyo Rinkai Park

PARK + ***water retention + emergency training + BBQ***

PARK INFRASTRUCTURE + *preparedness*

Kamesan Pocket Park
Tokyo, Japan

Design Before Disaster.org

BENCH + ***emergency hub***

Prephub.org

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BENCH + *emergency hub*

Prephub.org

MIT | UrbanRISKLab

BENCH + *emergency hub*

Prephub.org

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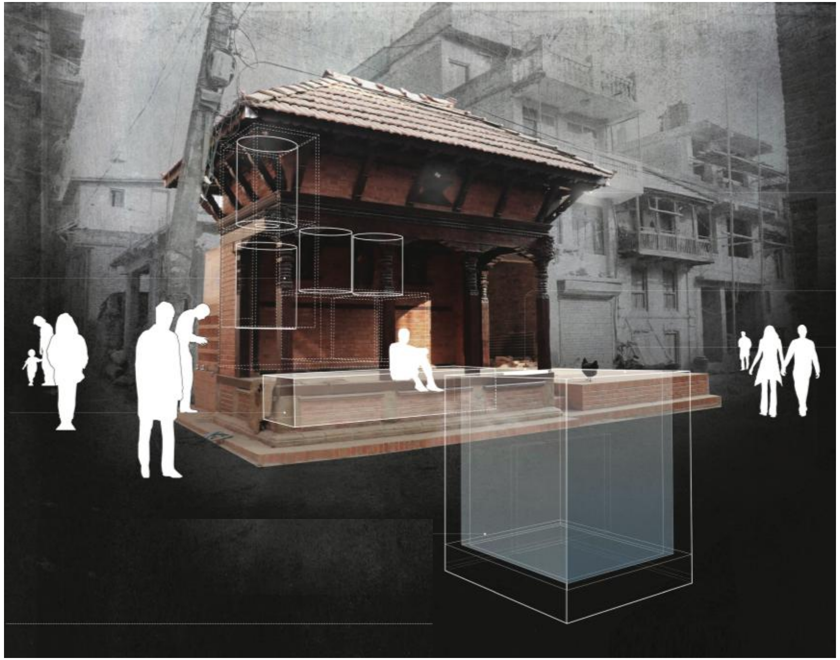
PAVILLION + *emergency hub + water purification*



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ENPHO, Techo Women's Trust, and Lumanti Support Group for Shelter
supported by the TATA Center at MIT


पिउने पानी

BUILT ENVIRONMENT + *disaster preparedness*

PARK + *water retention*

PARK + *water retention + emergency training + BBQ*

COASTAL PROTECTION + *educational community forest*

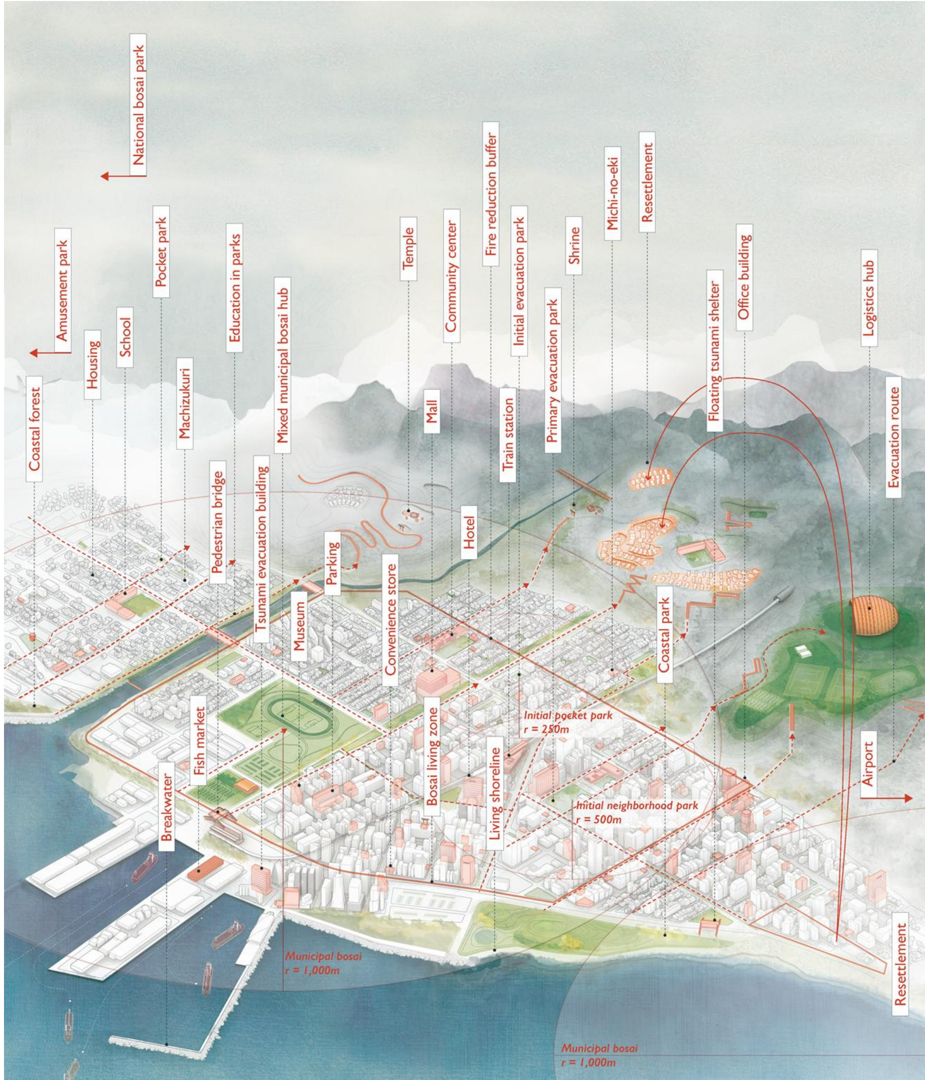
COASTAL PROTECTION + *community owned restaurants*

RIVER + *water reservoir*

PARK INFRASTRUCTURE + *preparedness*

BENCH + *emergency hub*

Risk.mit.edu
DesignBeforeDisaster.org



Design Before Disaster

Japan's Culture of Preparedness

University of Virginia Press 2025

Building Resilience Through Design

FORUM 8
Nov 20, 2025

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