SFWMD-FIAT Workshop

May 31, 2022

sfwmd.gov

Welcome

Moderator: Nicole Cortez

Housekeeping

Q&A Session

If you're participating in person – please fill out Section 5 at the Technical Question / Public Comment Card and give to a meeting attendant

If you're participating via Zoom – use the Q&A function to submit a written question or use the Raise Hand feature

If you're participating via Phone:
*9 Raises Hand
*6 Mutes/Unmutes

Housekeeping

Public Comments

If you're participating in person – please fill out Section 6 at the Technical Question / Public Comment Card and give to a meeting attendant

If you're participating via Zoom – use the Raise Hand feature

If you're participating via Phone:
*9 Raises Hand
*6 Mutes/Unmutes

1. Welcome and Opening Remarks

John P. Mitnik, P.E.
Assistant Executive Director and Chief Engineer
South Florida Water Management District

2. WORKSHOP GOALS AND FLOOD RESILIENCY PLANNING INTRODUCTION

Carolina Maran, Ph.D., P.E.
District Resiliency Officer
South Florida Water Management District

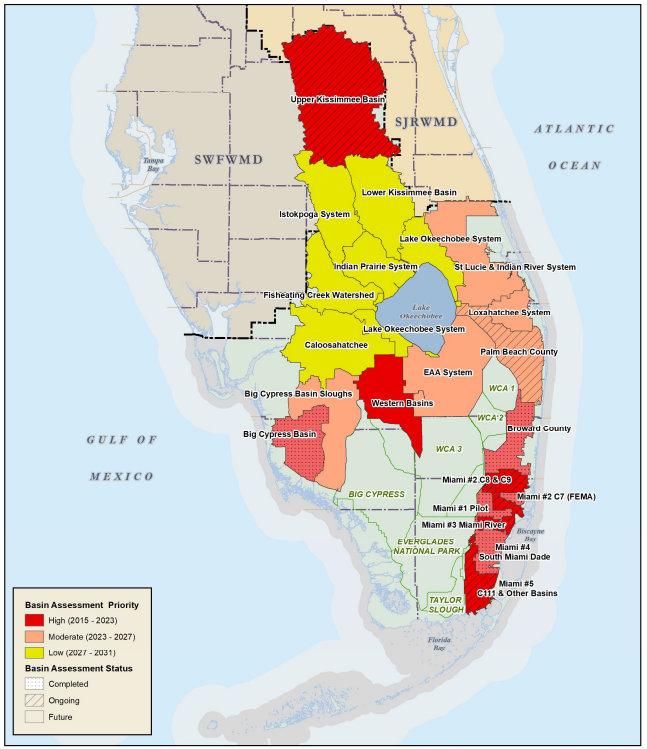
3. FLOOD PROTECTION LEVEL OF SERVICE (FPLOS) ADAPTATION PLANNING AND FLOOD DAMAGE COST ESTIMATES

Hongying Zhao, Ph.D., P.E.
Hydrology and Hydraulics Bureau
South Florida Water Management District

Flood Protection Level of Service Program

How we ensure that our flood control assets are up to the task considering development, land use change, SLR and climate change

- Assess level of flood protection throughout the 16-counties of the SFWMD – relative to design
- Identify at-risk structures and needed improvements to operations, canal conveyance or structures
- Provide a **formal process** to initiate retrofit and adaptation efforts for future infrastructure improvements and/or modification of regulatory criteria
- Incorporate **resilient** design standards and constructions
- Coordinated with SFWMD Operations, local government entities, drainage districts and other agencies with flood control or related responsibility



Three Phases of the FPLOS Program

Phase 1
Assessment

- Focus on Flood Control Assets in Primary system
- Identify flood vulnerable assets and regions

Phase 2
Mitigation and Adaptation Planning

- Focus on Primary, Secondary and Tertiary systems
- Collaboratively identify projects, operations or regulations to meet flood control needs

Phase 3
Implementation

- Design, permit and build identified projects to achieve resilient flood protection goals, integrated into the Sea Level and Flood Resiliency Plan

Current Status of FPOLS Program

Completed FPLOS studies

- BCB FPLOS Phase I
- C4 FPLOS Phase I
- C7 FPLOS Phase I
- Low-Lying Tidal Structure Assessment
- C8/C9 FPLOS Phase I
- South Miami-Dade
- Broward County
- Atlas Update

Ongoing FPLOS studies

FPLOS Phase I

- C111-Model Land-L31NS
- C2-C3W-C5-C6
- Upper Kissimmee Basin
- Palm Beach County

C8/C9 Phase II

Atlas Update

FY2023 Planned FPLOS studies

FY2023 Planned study

- Two Phase I projects
- C7 Phase II
- Atlas Update

C8/C9 FPLOS Adaptation and Mitigation Study

1. Stakeholders/partners engagement
2. H&H assessment
3. Economic assessment
   - Flood damage reduction estimate
   - Mitigation strategy cost estimate
   - Cost/Benefit estimate
4. Adaptation planning
5. Workshop to present the results

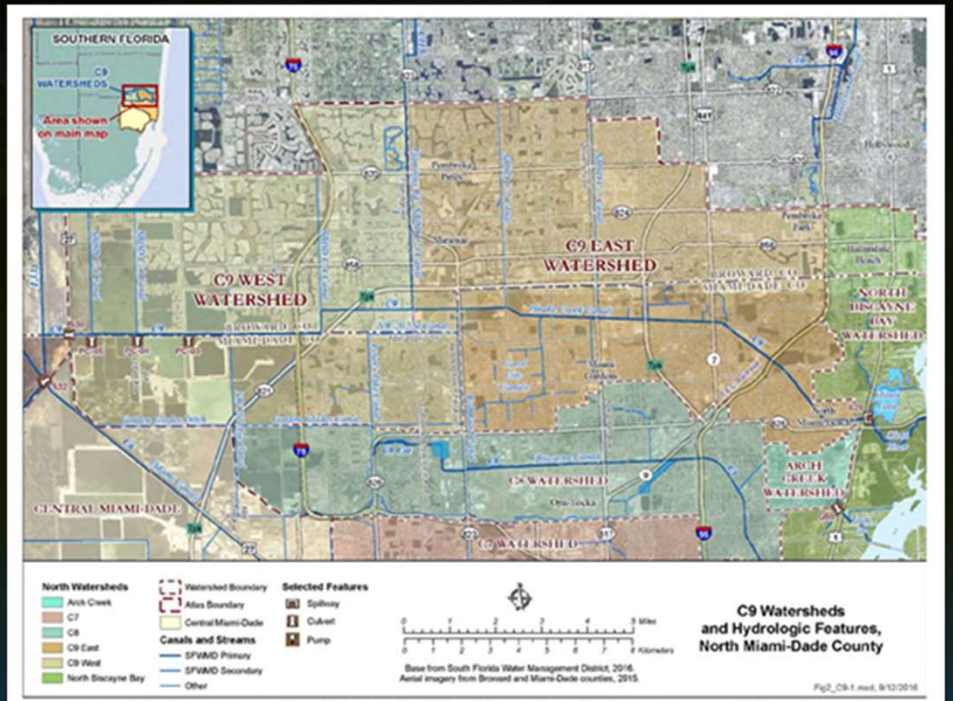
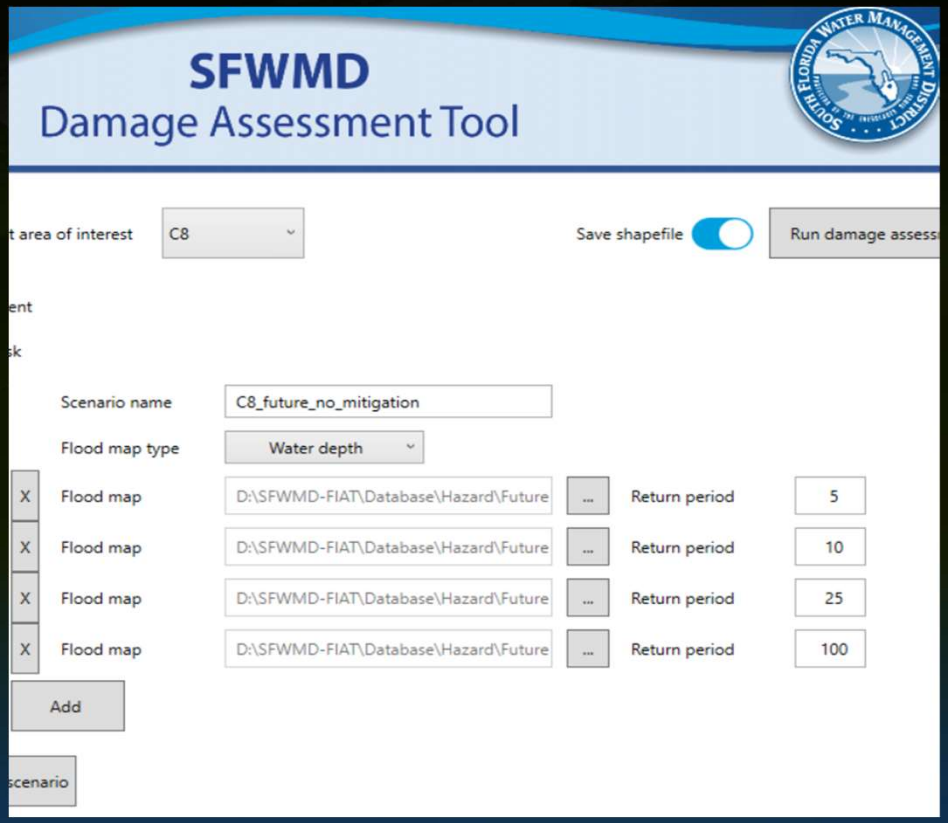


Figure 2. Major features of the C9 East and C9 West Watersheds in Miami-Dade and Broward counties.

work in progress, subject to change

SFWMD-FIAT Application in C8/C9 FPLOS Adaptation and Mitigation Study

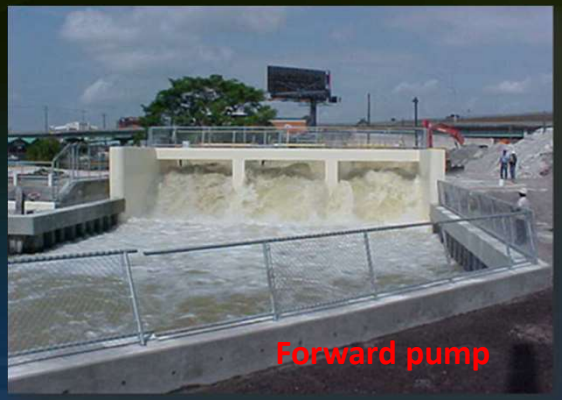
- Estimate the expected annual damage
- What liability or risk is the system exposed to – due to action or inaction?
- What is the cost/benefit ratio for different mitigation strategies
- Provide strong support in selecting the best cause of action



SFWMD-FIAT Application in C8/C9 FPLOS Adaptation and Mitigation Study

Preliminary M2A (regional level strategy)

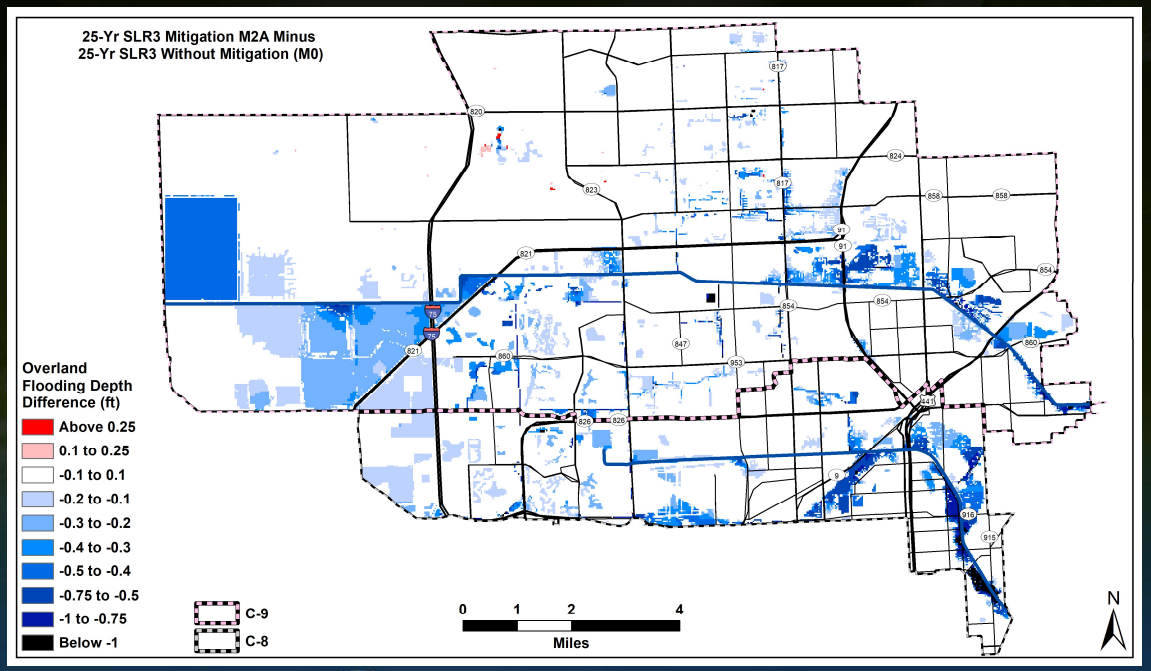
- S28 and S29 forward pumps
- Gate improvement
- Tieback levees
- 500 ac-ft distributed storage
- Canal improvement



work in progress, subject to change

SFWMD-FIAT Application in C8/C9 FPLOS Adaptation and Mitigation Study

Flood Depth Reduction Map



Flood Risk/Damage Reduction Comparison

Flood Risk and Damage Reduction Comparison		
Basin	**Scenario**	**WSEL**
C8	SLR3 no mitigation	$ 13,163,070
	SLR3 with M2A mitigation	$ 4,878,539
	Flood damage reduction $	$ 8,284,531
	Flood damage reduction %	63%
C9	SLR3 no mitigation	$ 10,956,530
	SLR3 with M2A mitigation	$ 9,105,004
	Flood damage reduction $	*$ 1,851,526*
	Flood damage reduction %	*17%*

work in progress, subject to change

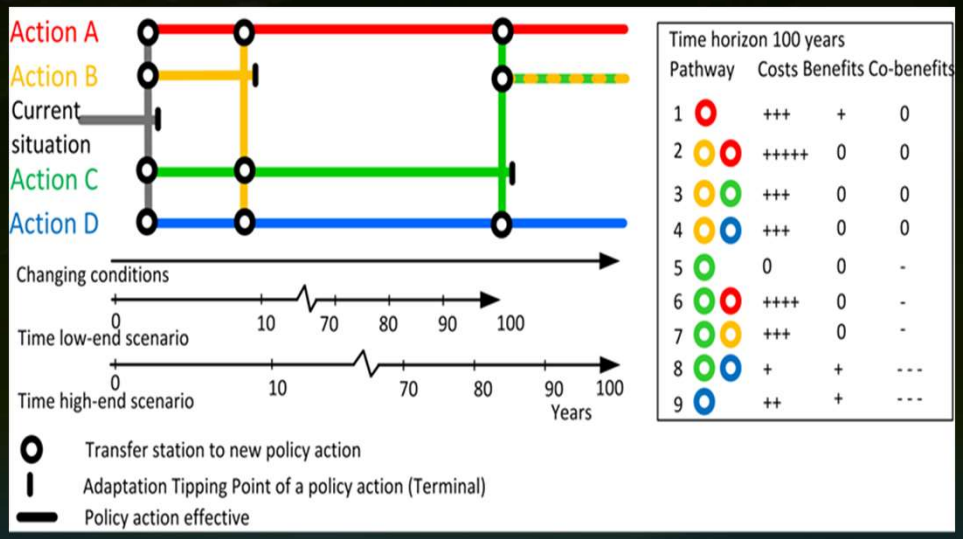
FIAT-SFWMD Application in C8/C9 FPLOS Adaptation and Mitigation Study

EAD assessment for different mitigation strategies using **SFWMD-FIAT Tool**

Cost estimate

Cost/benefit analysis

- Adaptation planning
- Final comprehensive plan

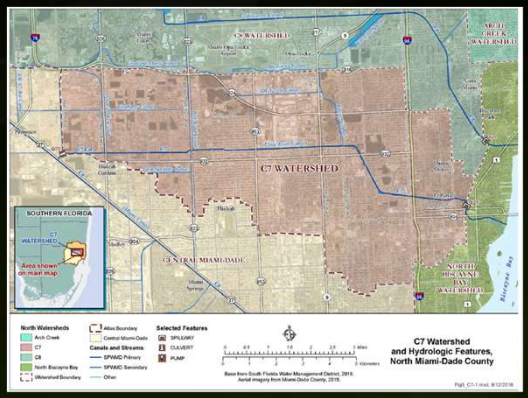


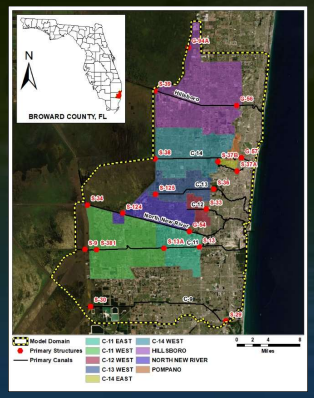
Example of an adaptation pathway map (Deltares)

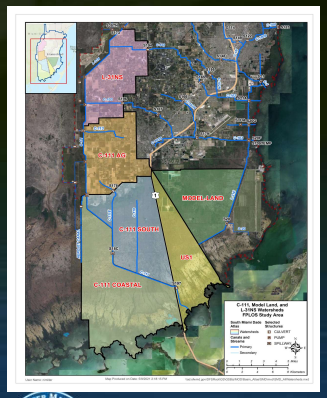
work in progress, subject to change

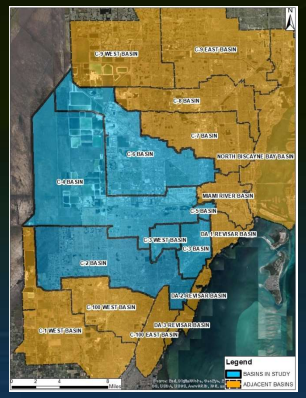
Other Applications

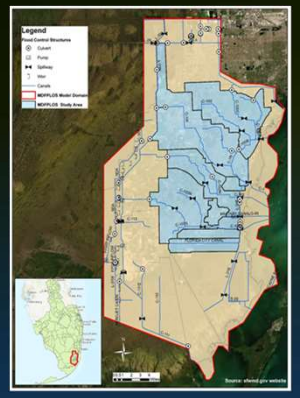
- C-7 basin
- Future FPLOS adaptation planning and mitigation study in other regions

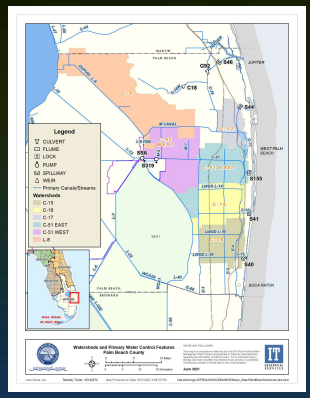


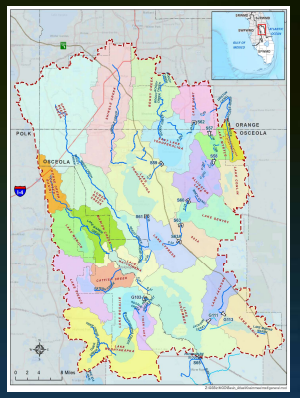










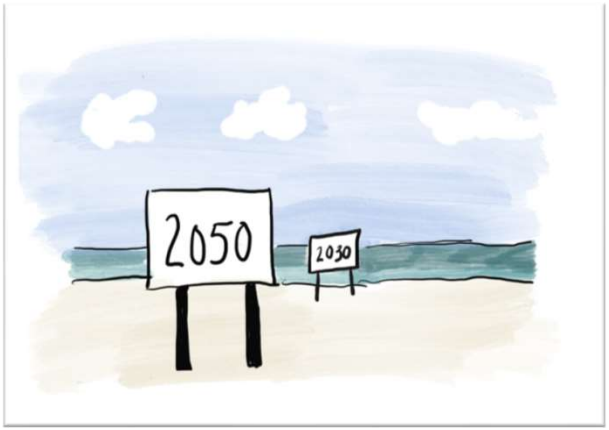


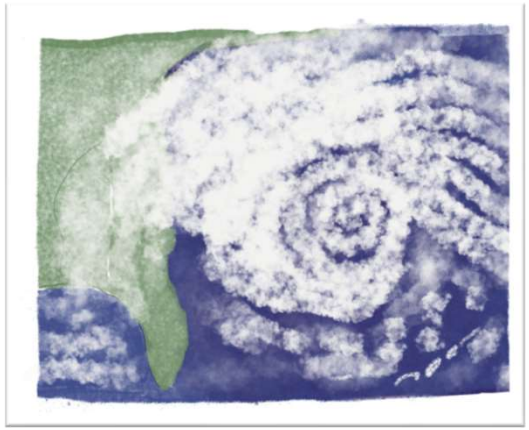
4. Collaborations, Partnerships and Engagement

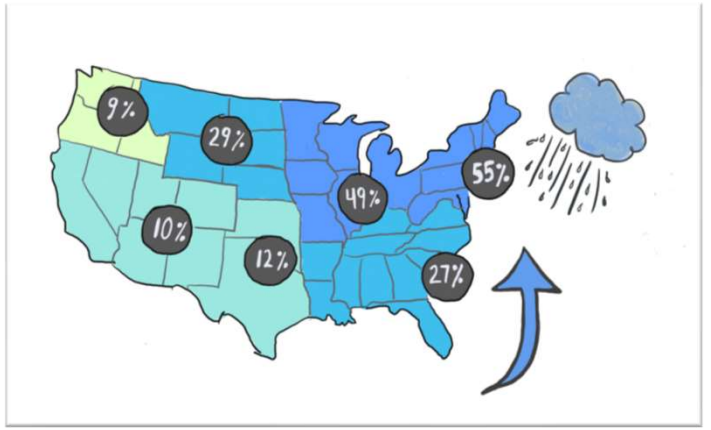
Claire Jeuken, Ph.D.
Senior Consultant and Researcher Nature-Based Solutions
Deltares USA

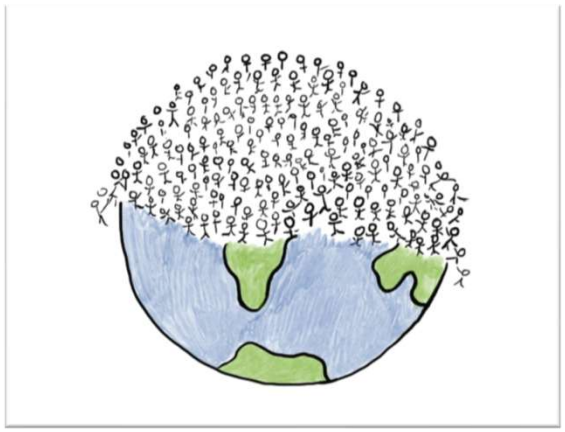
Preparing for the future

Drivers of flood risk





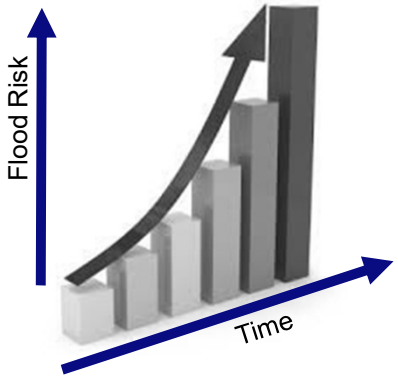




Deltares

Presenter: Claire Jeuken

What is the system response?



Deltares

Presenter: Claire Jeuken

Modeling needs to be better, easier and faster

Deltares

Presenter: Claire Jeuken

Deltares and U.S. Agencies on Coasts and Flood Risk

U.S. Geological Survey

Understanding coastal hazards and processes using models and data

Office of Naval Research

Model capability to enable naval operations in the coastal zone

The Department of Homeland Security

Collaborate on the development of a community flood resilience support system (CFRSS)

NOAA-NWS

Development of the CHPS, operational forecasting system USA, at all 13 river Forecast Centers

U.S. Corps of Engineers

Development of XBeach & prediction of hurricane hazards for the Mississippi, NNBF guideline

SFWMD, Broward and Miami Dade County Alameda Flood Control District, San Francisco Estuary Institute (SFEI)

Development and application of tools and adaptation strategies

Massachusetts Water Resources Authority

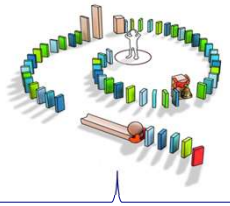
Hydrodynamics and water quality modeling Massachusetts Bay

Deltares

Presenter: Claire Jeuken

Presenter: Claire Jeuken

SFL Government and Deltares: 2015 -present



2014 MOA SFWMD-RWS

2015-2016 NOAA grant 1

2015 Delft3D @SFWMD

2016-2017 FEMA grant 1

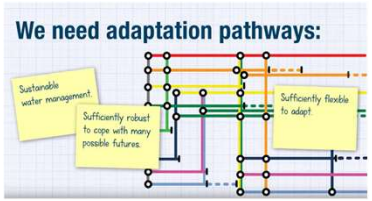
2016-2017 NOAA grant 2

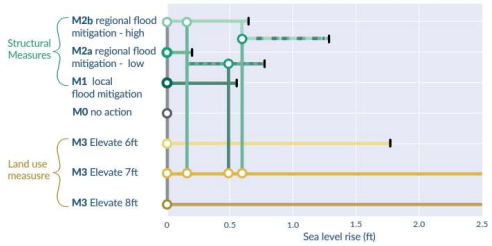
2018-2019 FEMA grant 2

2019-2021 NOAA grant 3

2020-2021 BRIC support

2021-2022 FIAT desktop





Deltares

MIAMI-DADE COUNTY

NOAA

BROWARD COUNTY FLORIDA

FEMA

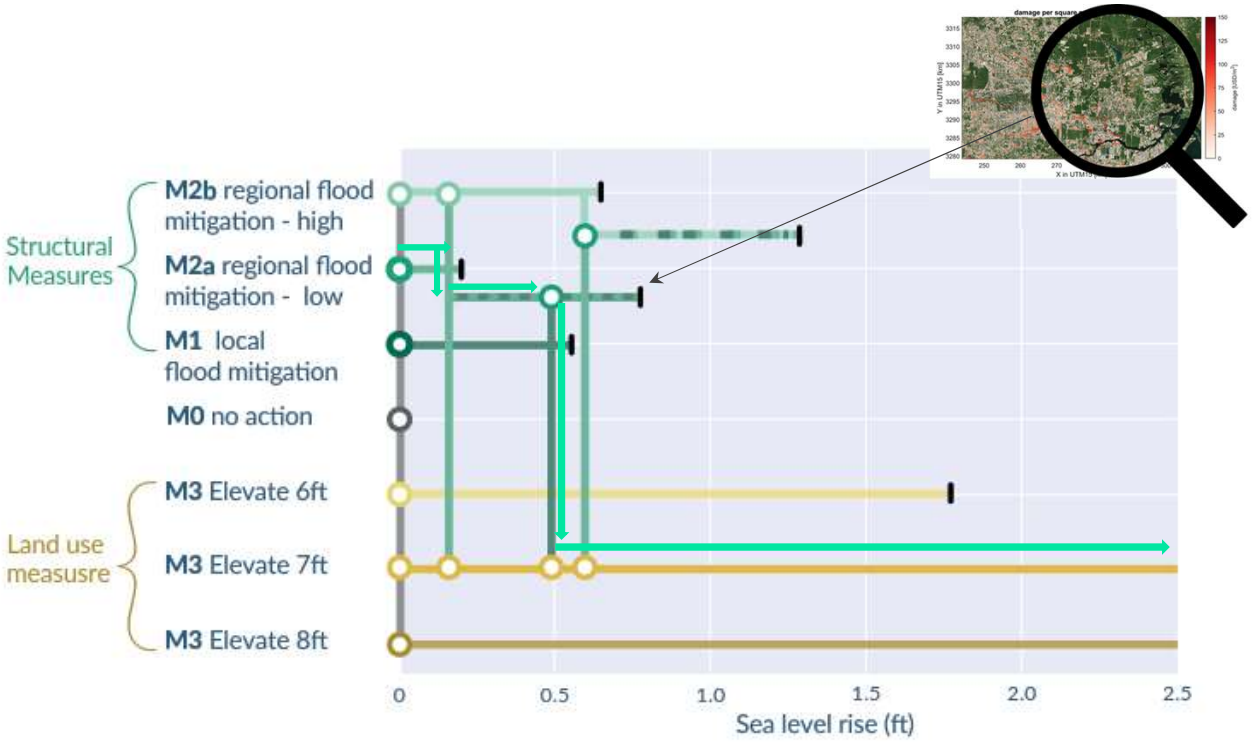
FIU Sea Level Solutions Center

FDEM

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Presenter: Claire Jeuken

Adaptation pathways for C7-basin – 2016-2017



http://dx.doi.org/10.5065/fp9y-ae42

Deltares

MIAMI-DADE COUNTY

FEMA

FDEM

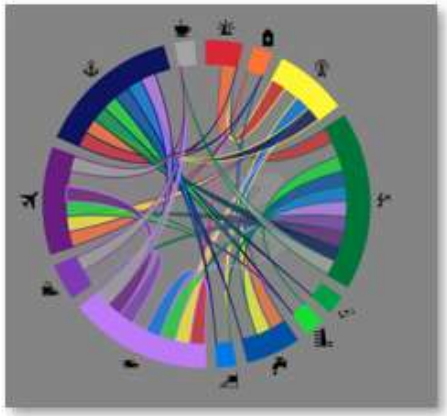
Critical infrastructure vulnerability and dependencies

OpenStreetMap
- Hospitals
- Power
- Roads
- Telecommunication
- ...

Stakeholders

Flood Simulation (USGS)
- Intense rainfall 22”
- Increased sea water level (2060)

Workshop 1: Inventory of dependencies with CIrcle



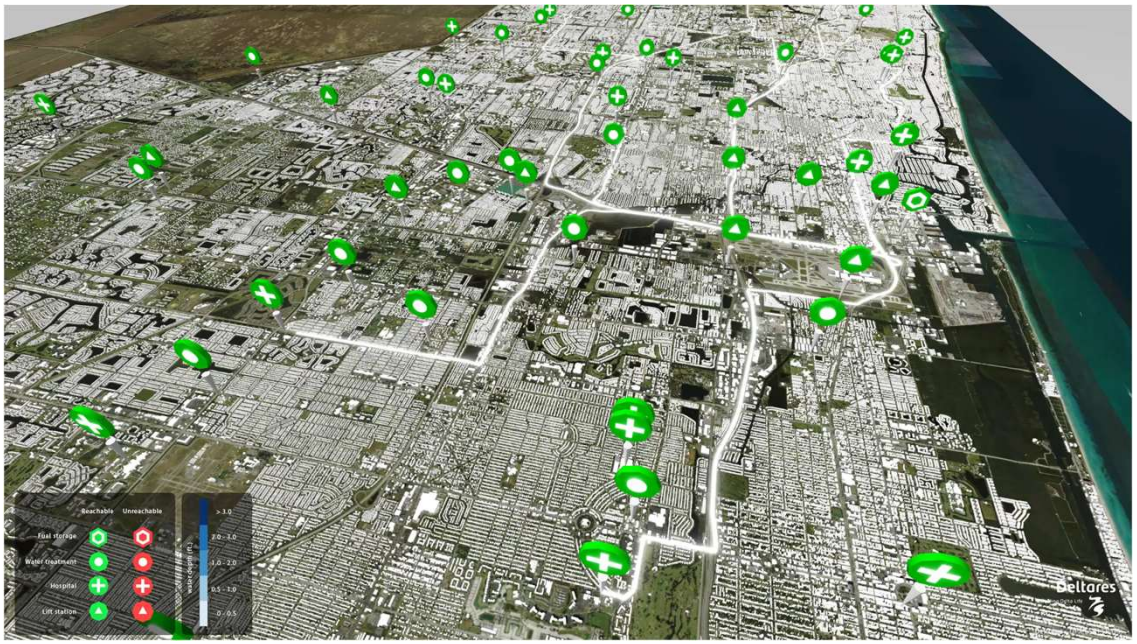
Workshop 2: Review of Cascading Effects

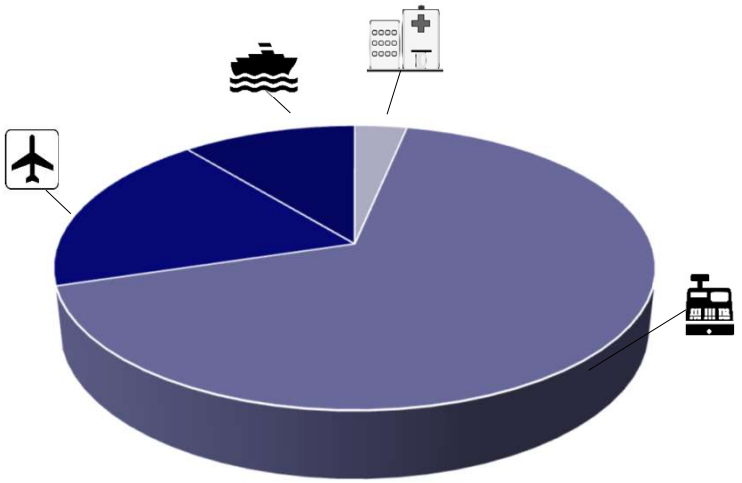
Workshop 2: Identification of measures to increase resilience

Deltares

Presenter: Claire Jeuken

Cascading Impact of Critical infrastructure disruptions



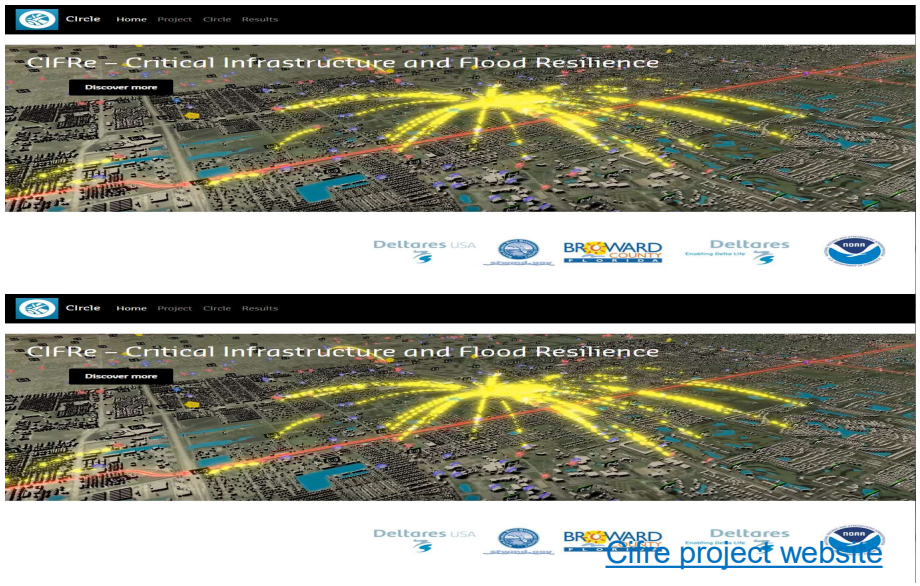


Identify, quantify and communicate cascading impacts to other critical infrastructures and the community.

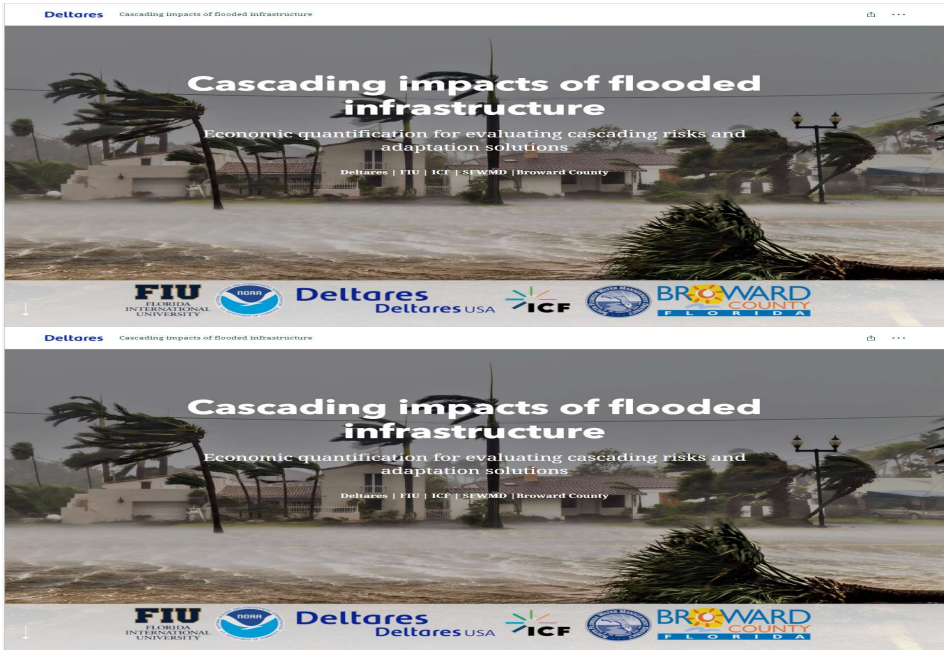
Deltares

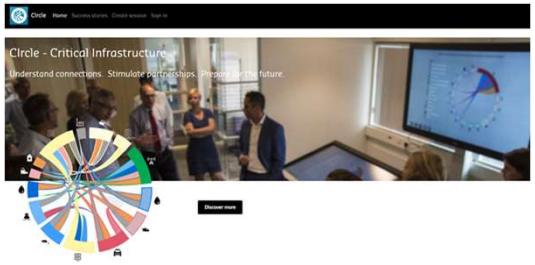
Presenter: Claire Jeuken

Cascading Impacts of flooded Critical Infrastructure 2016-2021



Cifre project website





project storymap

water

MDPI

Article

Flood Resilience of Critical Infrastructure: Approach and Method Applied to Fort Lauderdale, Florida

Karin M. de Bruijn [1,*], Carolina Maran [2], Mike Zygnerski [2], Jennifer Jurado [2], Andreas Burzel [1], Claire Jeuken [3] and Jayantha Obeysekera [4,*]

Deltares

Presenter: Claire Jeuken

Thank you for your attention

www.deltares-usa.us ☎ 240-338-6526

Claire.Jeuken@deltares-usa.us per September 1, 2022 Claire.Jeuken@deltares.nl

Deltares

5. Q&A Session 1

If you're participating in person – please fill out Section 5 at the Technical Question Card and give to a meeting attendant

If you're participating via Zoom – use the Q&A function to submit a written question or use the Raise Hand feature

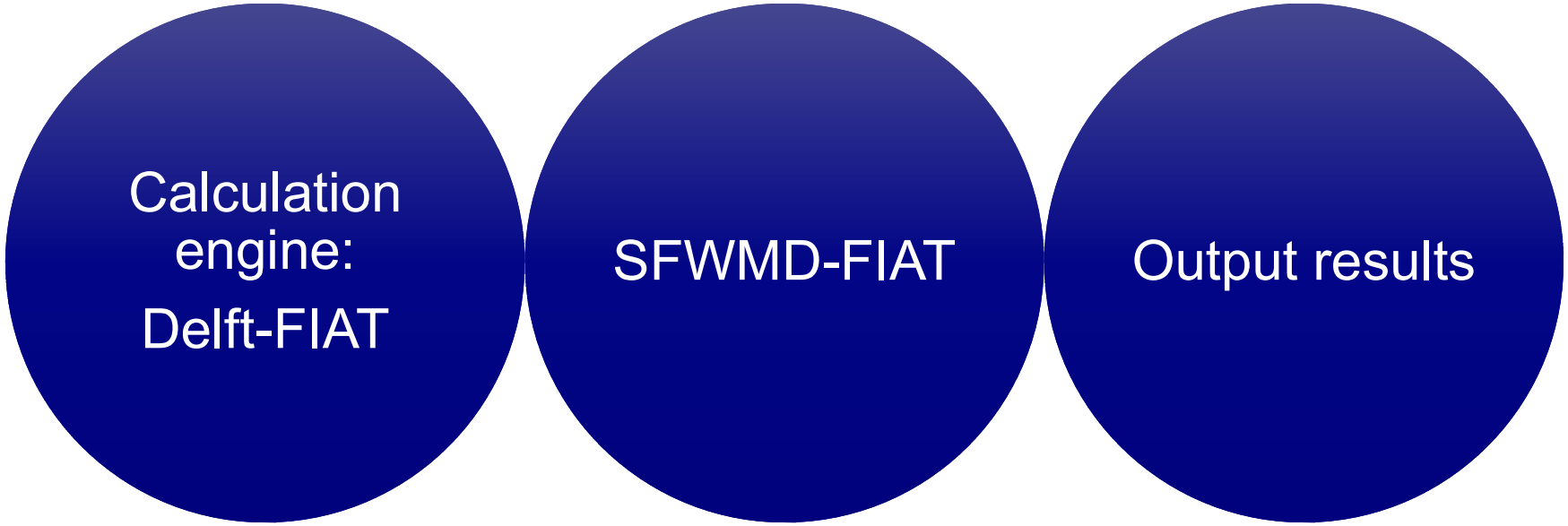
If you're participating via Phone:
*9 Raises Hand
*6 Mutes/Unmutes

Moderator: Nicole Cortez

6. Flood Impact Assessment Tool and Functions Overview

Frederique de Groen, M.S.
Junior Advisor/Researcher
Deltares

Contents



FIAT – Flood Impact Assessment Tool

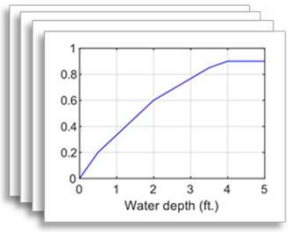
RISK / DAMAGE = HAZARD × EXPOSURE × VULNERABILITY

Damage/risk maps

Flood hazard maps

Exposure maps

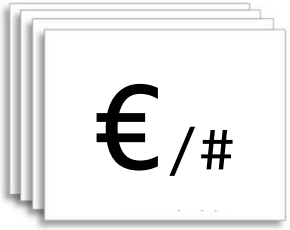
Damage functions



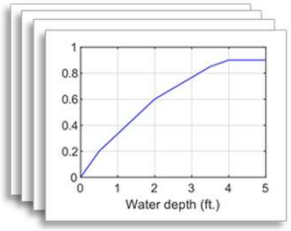
Deltares

Presenter: Frederique de Groen

Maximum damages

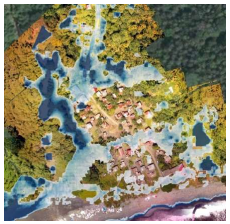


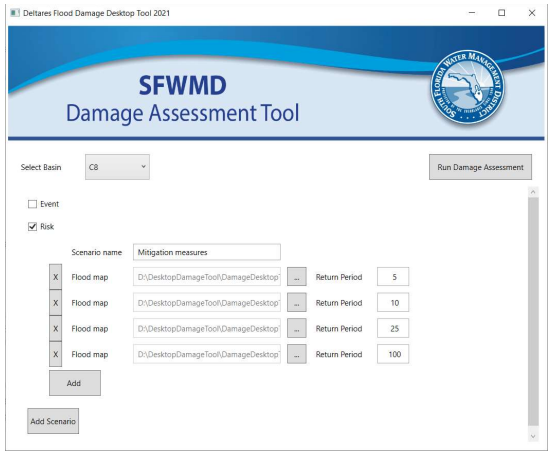
Damage functions



Exposure maps

Flood hazard maps





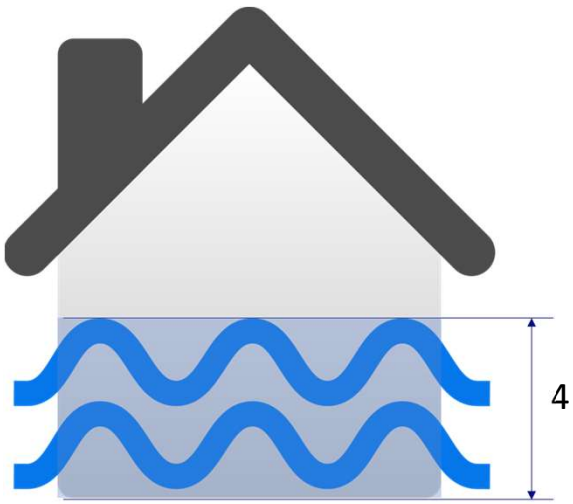
Damage/risk maps

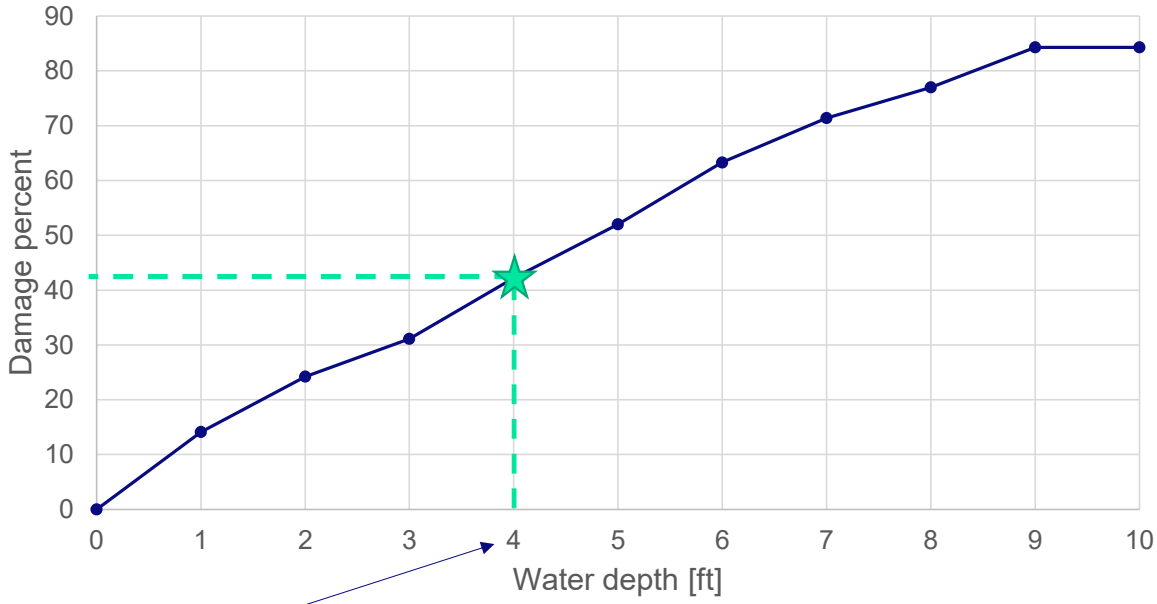
Deltares

Presenter: Frederique de Groen

Depth-damage curve

Maximum potential damage:
$100k





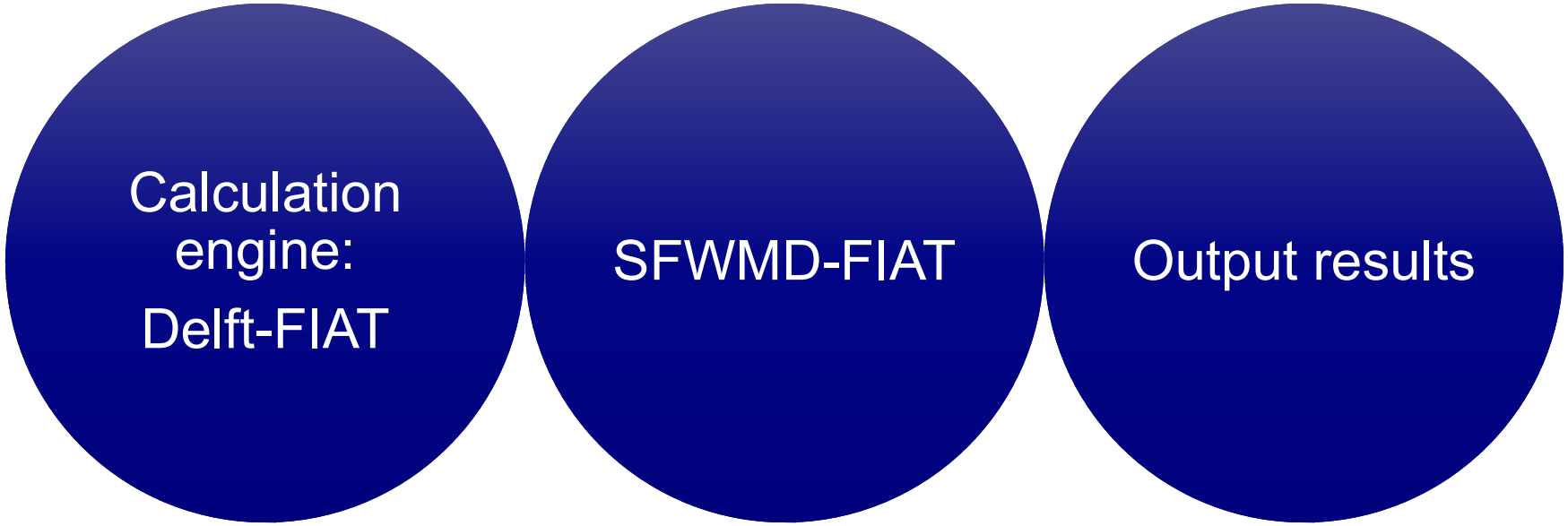
Damage = max potential damage * damage percent

42k = 100k * 42%

Deltares

Presenter: Frederique de Groen

Contents



Desktop Damage Tool for SFWMD

Set up a streamlined system

- Easy to use
- Standardized

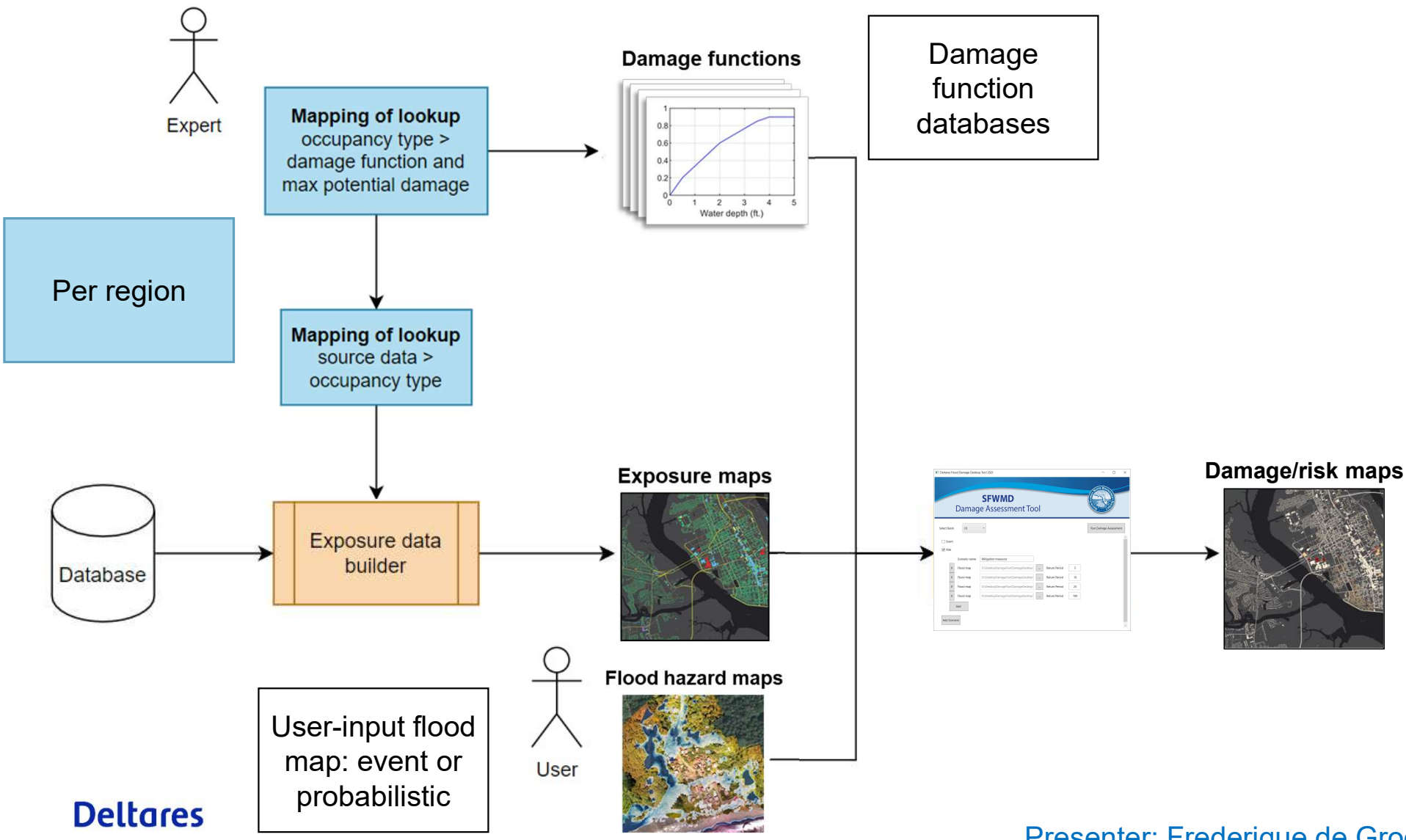
Exposure data builder

Flood Desktop Damage Tool

All data set up for C-8 and C-9

Deltares

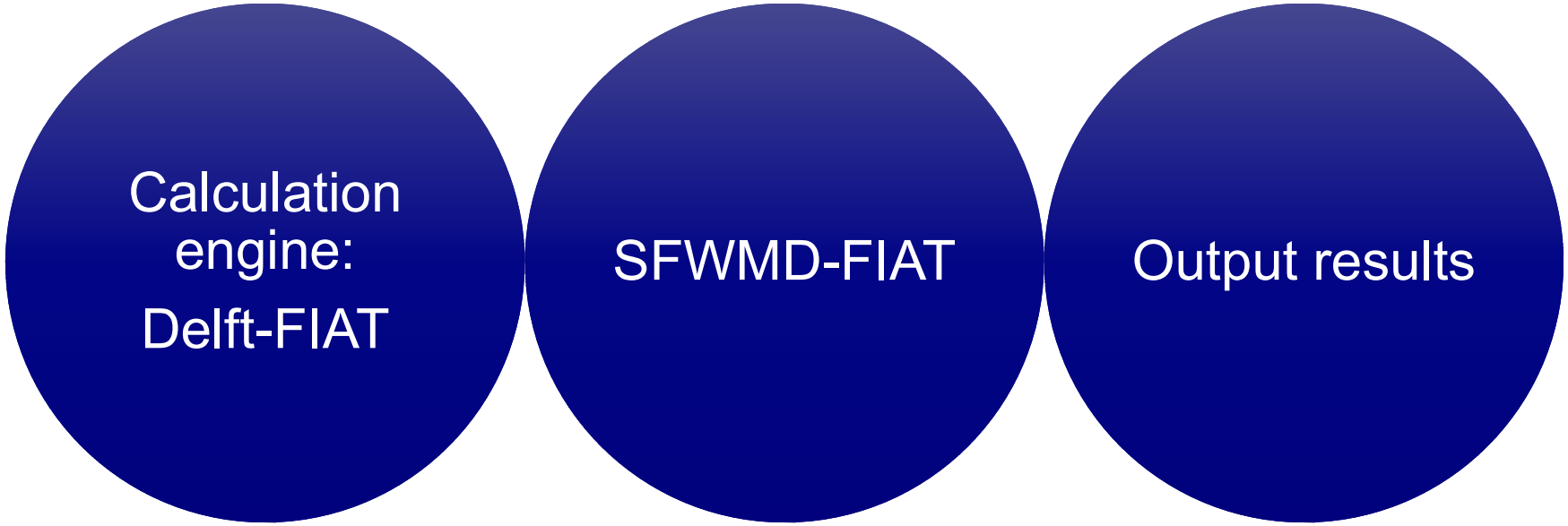
Presenter: Frederique de Groen



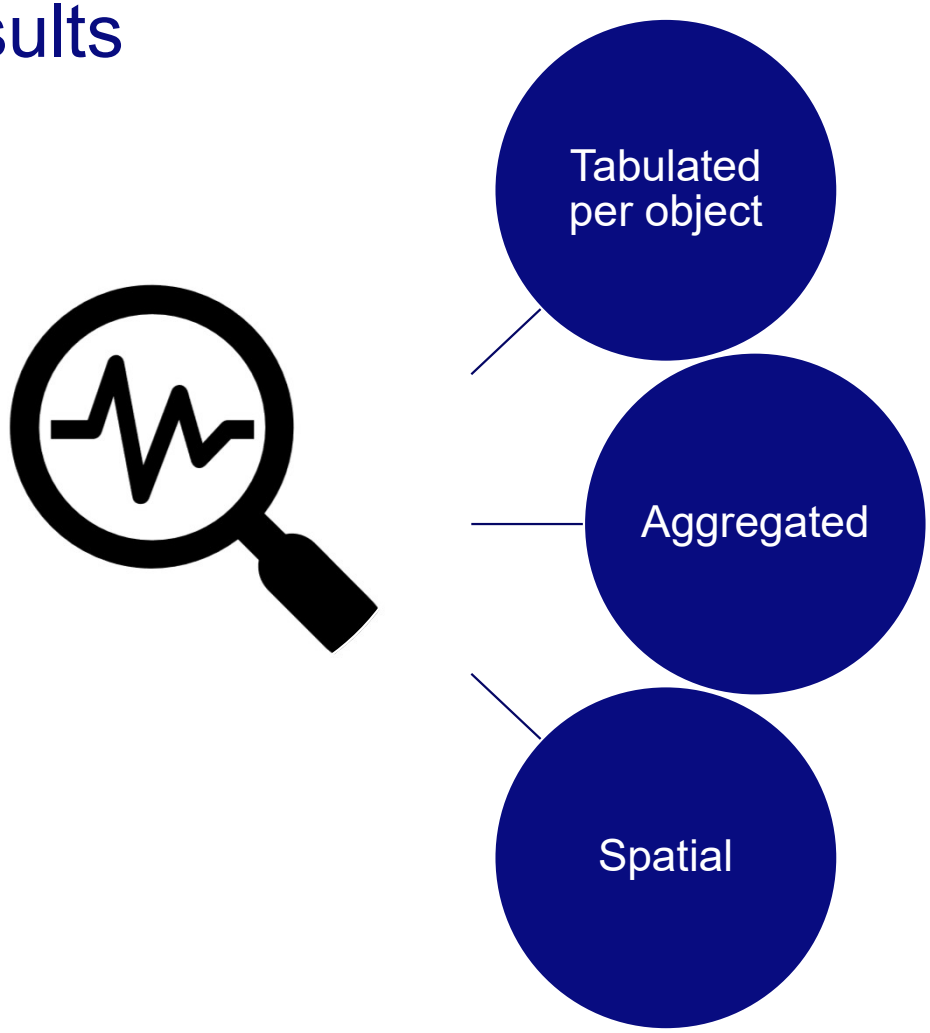
Deltares

Presenter: Frederique de Groen

Contents



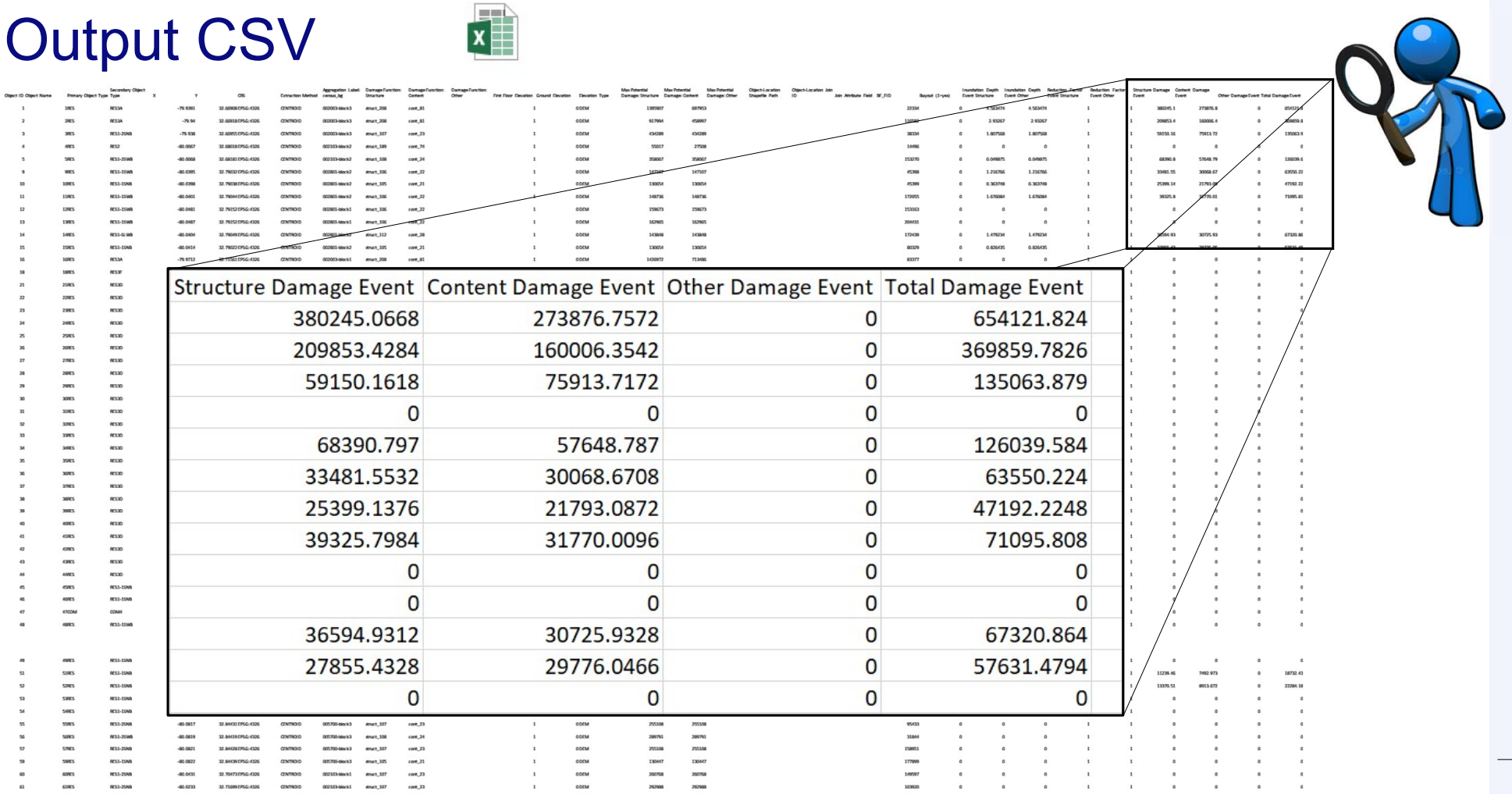
Output results



Deltares

Presenter: Frederique de Groen

Output CSV



Structure Damage Event	Content Damage Event	Other Damage Event	Total Damage Event
380245.0668	273876.7572	0	654121.824
209853.4284	160006.3542	0	369859.7826
59150.1618	75913.7172	0	135063.879
0	0	0	0
68390.797	57648.787	0	126039.584
33481.5532	30068.6708	0	63550.224
25399.1376	21793.0872	0	47192.2248
39325.7984	31770.0096	0	71095.808
0	0	0	0
0	0	0	0
36594.9312	30725.9328	0	67320.864
27855.4328	29776.0466	0	57631.4794
0	0	0	0

Global overview

Global overview ($)

Total damages								
RP = 1 year	RP=2 year	RP = 5 year	RP = 10 year	RP = 25 year	RP = 50 year	RP = 100 year	RP = 500 year	EAD

Damaged roads

Road damages				
RP = 1 year	RP=2 year	RP = 5 year	…	EAD

Deltares

Presenter: Frederique de Groen

Aggregated information

Aggregated:
Sub basin

Zip code	Damages				
	RP = 1 year	RP=2 year	RP = 5 year	…	EAD
135ST-2					
135ST-3					
135ST-4					
135ST-5					
135ST-6					
135ST-7					

Aggregated:
Tax use

Aggregated:
Census Tract

Aggregated:
Census Block

Aggregated:
Poverty

Aggregated:
Land use

Land use	Damages				
	RP = 1 year	RP=2 year	RP = 5 year	…	EAD
Airports					
Cemeteries					
Commercial and Services					
Educational Facilities					
Golf Course					

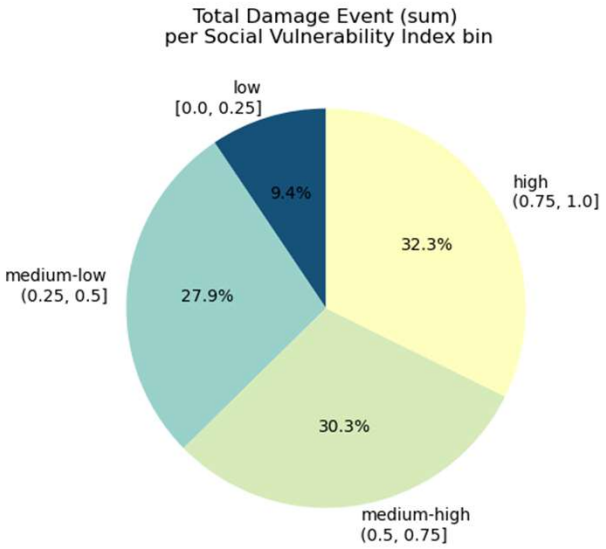
Deltares

Presenter: Frederique de Groen

Grouped information

Grouped: SVI

Social Vulnerability Index	Damages				
	RP = 1 year	RP=2 year	RP = 5 year	…	Risk (EAD)
0.00 - 0.25					
0.25 - 0.50					
0.50 - 0.75					
0.75 - 1.00					



Deltares

Presenter: Frederique de Groen

Spatial results

Deltares

Presenter: Frederique de Groen

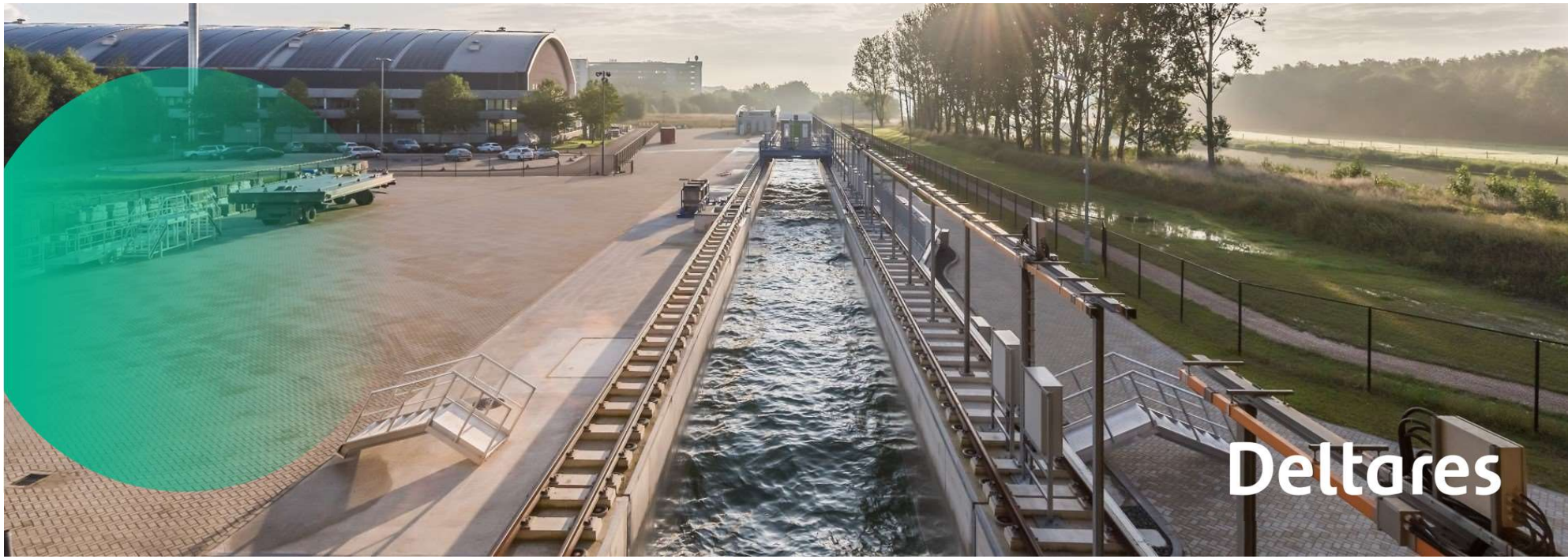
Thanks for your attention

www.deltares.nl

linkedin.com/company/deltares

Frederique.deGroen@deltares.nl

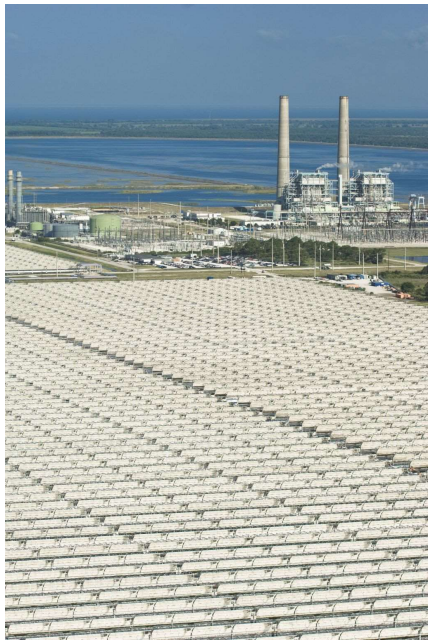
facebook.com/deltaresNL



7. Building Exposure Data Sets for Damage Assessment

Chris Carlson, M.S.
Lead Geospatial Scientist, IT Geospatial Services
South Florida Water Management District

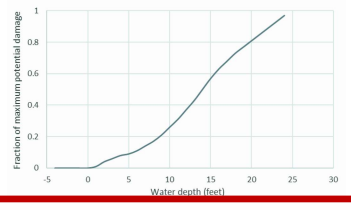
Exposure Data Sources

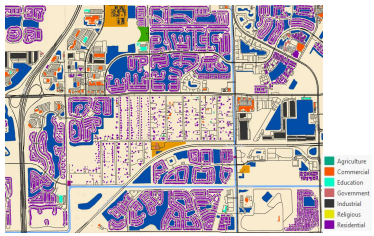


- County Supplied Building Footprints
- SFWMD Normalized Parcel and Land Use
- High Resolution Topo-Bathymetric Data
- HAZUS Occupancy Types, Damage Functions and Depreciated Replacement Values

SFWMD-FIAT Damage Calculator

- **Inundation Depth**
- **Water Surface elevation**





1 Flood maps

2 Damage functions

3 Exposure data

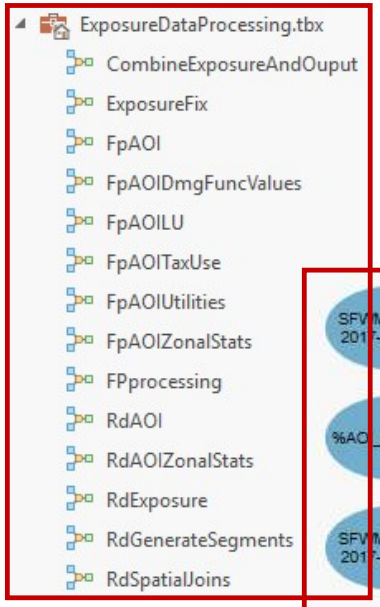
4 SFWMD-FIAT

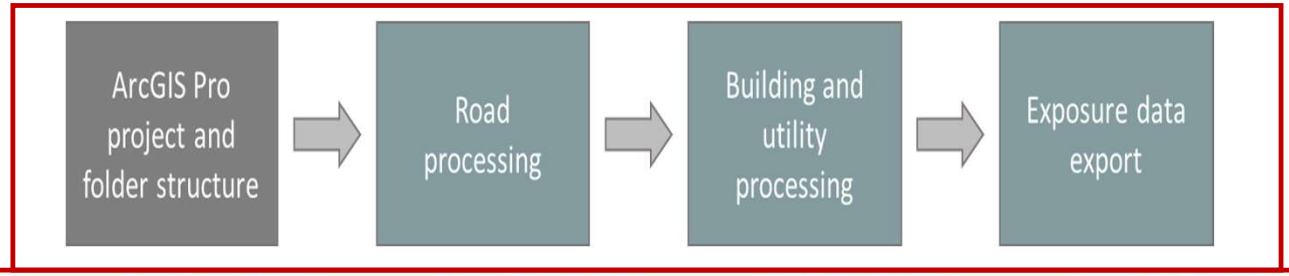
5 Flood damages

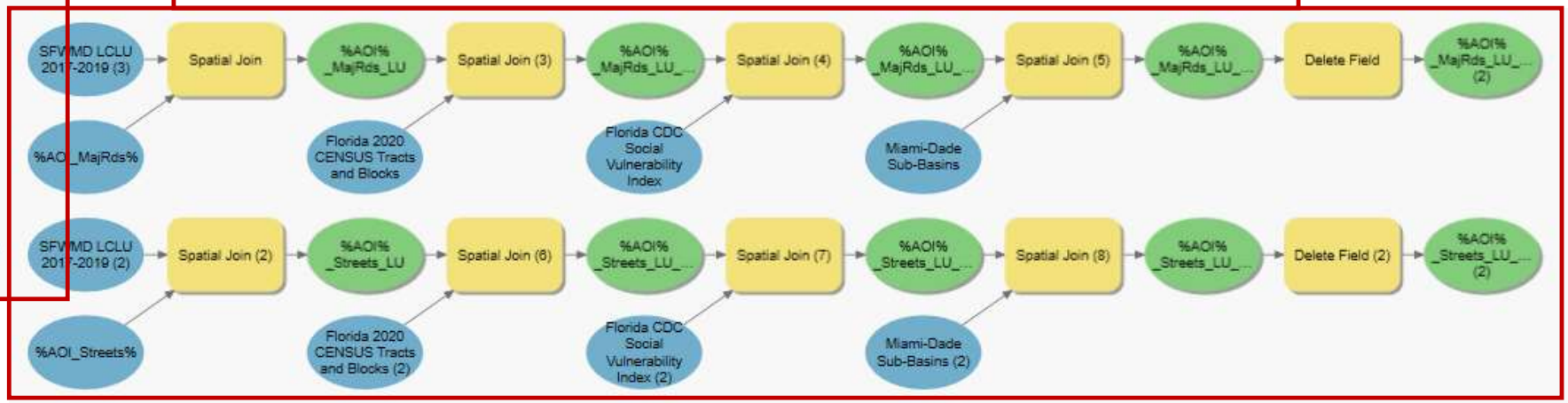
$ Total, Detailed breakdown, and aggregated values $

Exposure Data Compilation

Presenter: Chris Carlson

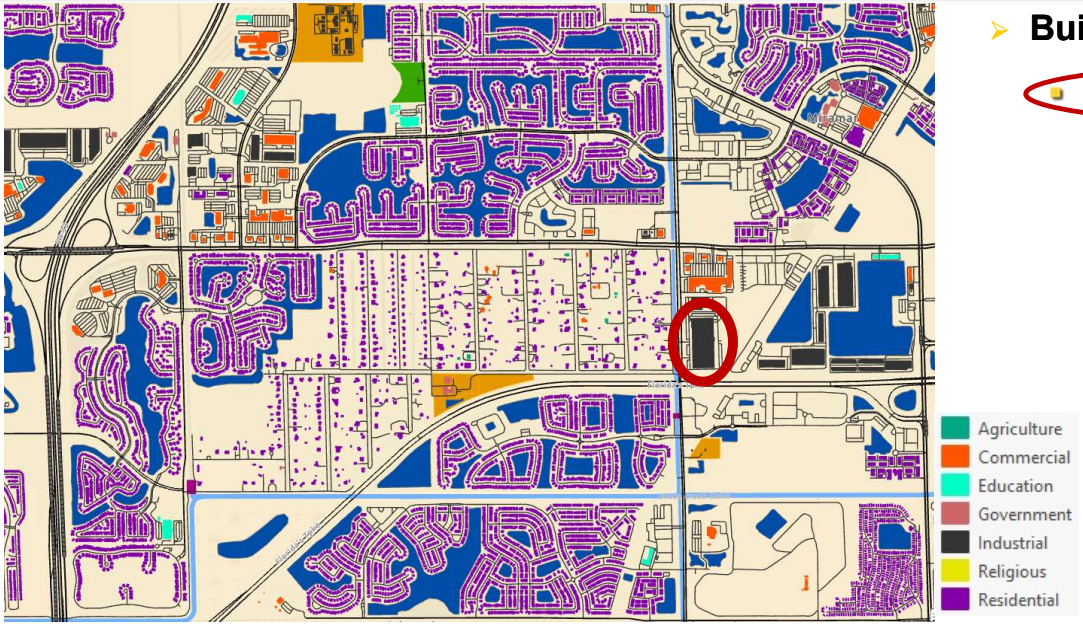






Object ID	Object Name	Primary Object Type	Secondary Object Type	Damage Function: Structure	Damage Function: Content	Ground Elevation	Max Potential Damage: Structure	Max Potential Damage: Content
1	fp_1	RES1-1SNB	Res 1, 1 Story no Basement	g_struct_2	g_cont_62	10.1086435	641415.6875	320707.8438
2	fp_2	RES1-1SNB	Res 1, 1 Story no Basement	g_struct_2	g_cont_62	8.2923002	626291.0625	313145.5313
3	fp_3	RES1-1SNB	Res 1, 1 Story no Basement	g_struct_2	g_cont_62	7.7843499	716537.3125	358268.6563
4	fp_4	RES1-1SNB	Res 1, 1 Story no Basement	g_struct_2	g_cont_62	8.4981661	640921.8125	320460.9063
5	fp_5	RES1-1SNB	Res 1, 1 Story no Basement	g_struct_2	g_cont_62	7.6534019	651511.4375	325755.7188
6	fp_6	RES1-1SNB	Res 1, 1 Story no Basement	g_struct_2	g_cont_62	7.7510338	652998.9375	326499.4688
7	fp_7	COM1	Average Retail, structure only	h_struct_217	h_cont_90	8.3033361	1158319.875	1158319.875

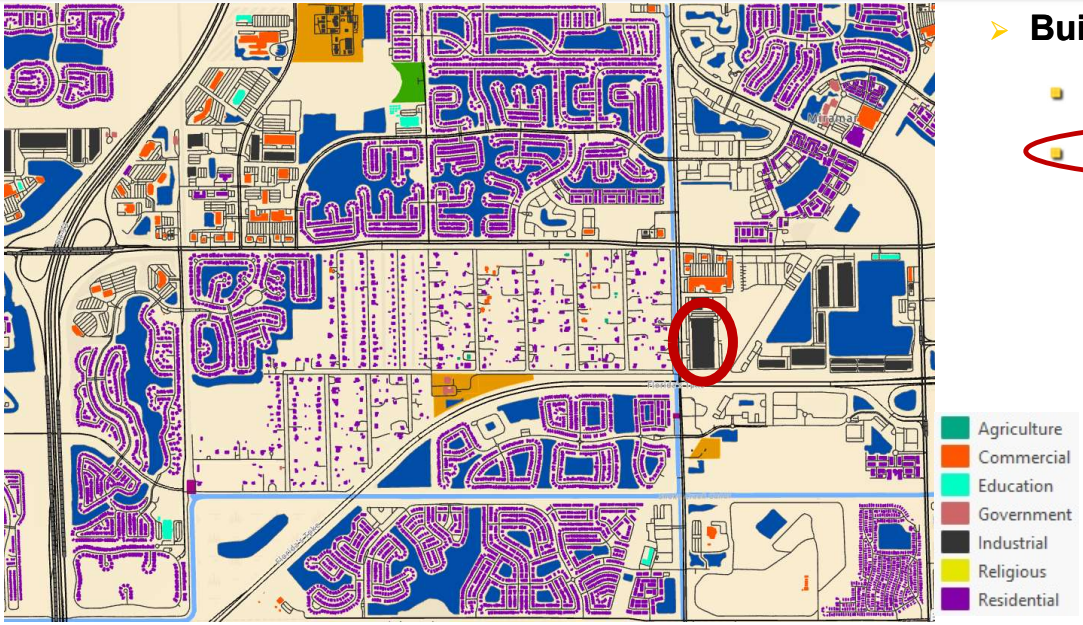
Building Data



- **Building Exposure Data Sources:**
  - County Supplied Building Footprints

Object Name	Primary Object Type	Secondary Object Type	Damage Function: Structure	Finished Floor Elevation	Ground Elevation	Max Potential Damage: Structure	Shape_Area
fp_15	COM4	Average Prof/Tech Services	g_struct_35	1	4.319839	2145821	11274.214758
fp_16	RES3C	Condominium, living area on multiple floors	g_struct_23	1	10.29773	947148.1	4357.308334
fp_17	IND3	Average Food/Drug/Chem	h_struct_575	1	7.725961	353595.4	1814.705511
fp_18	RES3E	Condominium, living area on multiple floors	g_struct_23	1	5.953907	1091480	5021.298025
fp_19	RES3E	Condominium, living area on multiple floors	g_struct_23	1	6.359	1039605	4782.653075

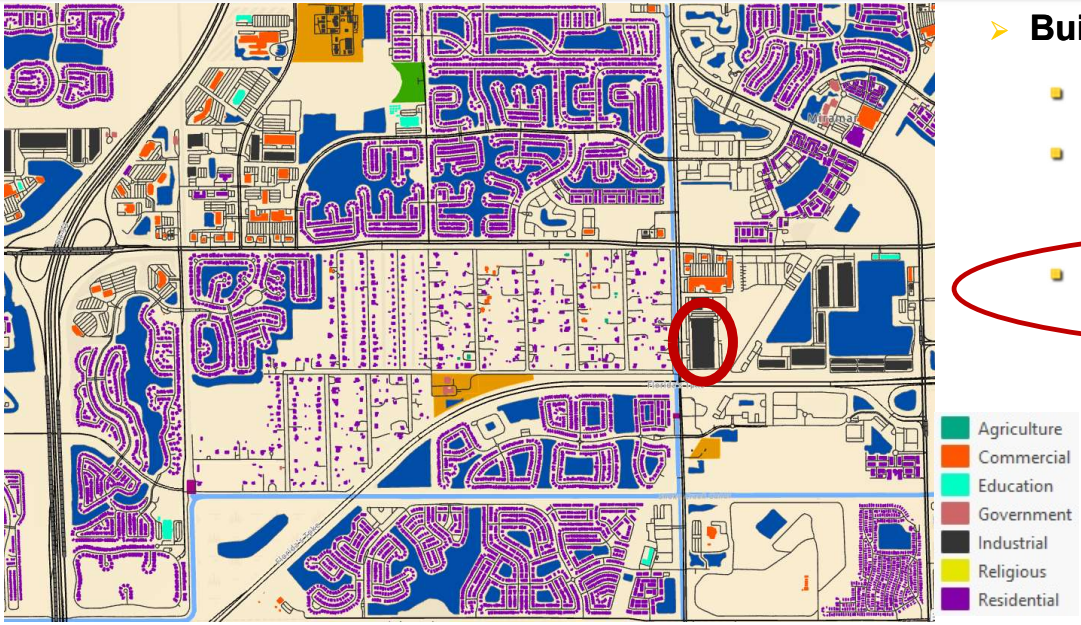
Building Data



- **Building Exposure Data Sources:**
  - County Supplied Building Footprints
  - SFWMD Normalized Parcel and Land Use

Object Name	Primary Object Type	Secondary Object Type	Damage Function: Structure	Finished Floor Elevation	Ground Elevation	Max Potential Damage: Structure	Shape_Area
fp_15	COM4	Average Prof/Tech Services	g_struct_35	1	4.319839	2145821	11274.214758
fp_16	RES3C	Condominium, living area on multiple floors	g_struct_23	1	10.29773	947148.1	4357.308334
fp_17	IND3	Average Food/Drug/Chem	h_struct_575	1	7.725961	353595.4	1814.705511
fp_18	RES3E	Condominium, living area on multiple floors	g_struct_23	1	5.953907	1091480	5021.298025
fp_19	RES3E	Condominium, living area on multiple floors	g_struct_23	1	6.359	1039605	4782.653075

Building Data

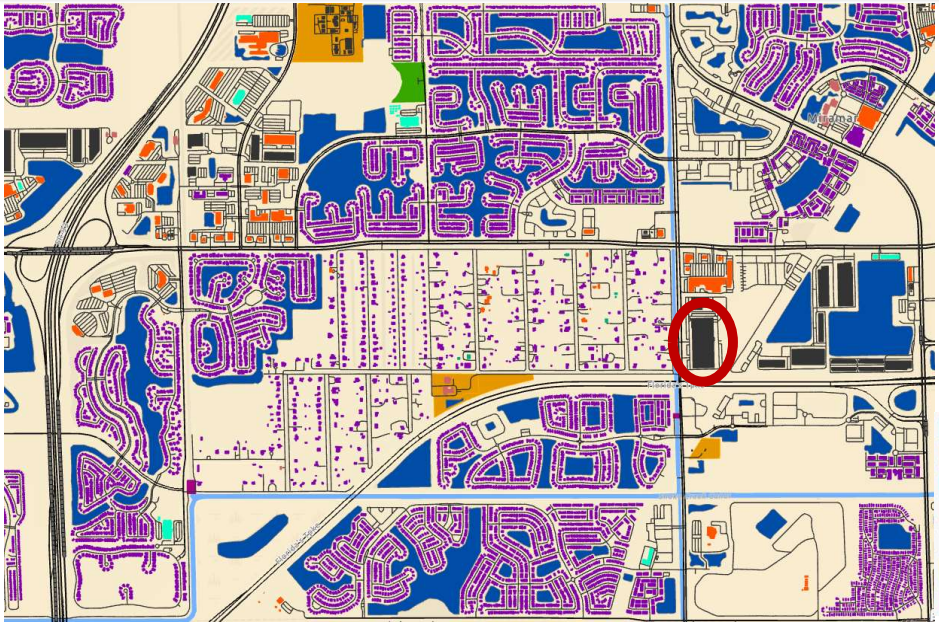


- **Building Exposure Data Sources:**
  - County Supplied Building Footprints
  - SFWMD Normalized Parcel and Land Use
  - HAZUS Occupancy Types, Damage Functions and Depreciated Replacement Values

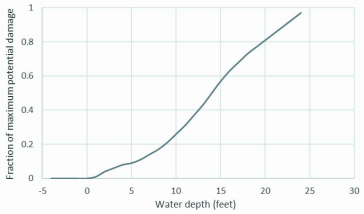
Primary Object Type	Secondary Object Type	Damage Function: Structure	Structure Replacment Value
COM6	Hospital	g_struct_38	326.44
IND3	Average Food/Drug/Chem	h_struct_575	194.85
IND3	Food Processor, structure only	h_struct_580	194.85
IND4	Average Metals/Minerals processing	h_struct_586	194.85
IND5	Average High Technology	h_struct_591	194.85
IND3	Chemical refinery	h_struct_578	194.85
IND4	Sand and gravel	h_struct_589	194.85
IND3	Port Facilities	h_struct_580	194.85
COM5	Bank	h_struct_467	282.15

Object Name	Primary Object Type	Secondary Object Type	Damage Function: Structure	Finished Floor Elevation	Ground Elevation	Max Potential Damage: Structure	Shape_Area
fp_15	COM4	Average Prof/Tech Services	g_struct_35	1	4.319839	2145821	11274.214758
fp_16	RES3C	Condominium, living area on multiple floors	g_struct_23	1	10.29773	947148.1	4357.308334
fp_17	IND3	Average Food/Drug/Chem	h_struct_575	1	7.725961	353595.4	1814.705511
fp_18	RES3E	Condominium, living area on multiple floors	g_struct_23	1	5.953907	1091480	5021.298025
fp_19	RES3E	Condominium, living area on multiple floors	g_struct_23	1	6.359	1039605	4782.653075

Building Data



- **Building Exposure Data Sources:**
  - County Supplied Building Footprints
  - SFWMD Normalized Parcel and Land Use

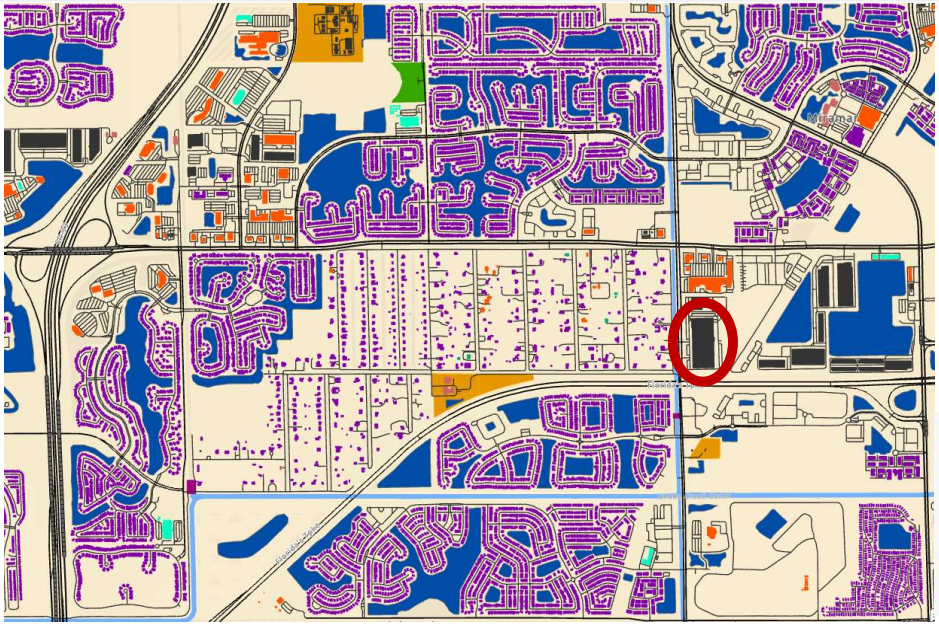


  - HAZUS Occupancy Types, Damage Functions and Depreciated Replacement Values

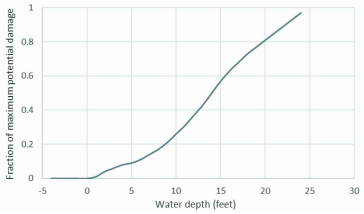
Primary Object Type	Secondary Object Type	Damage Function: Structure	Structure Replacment Value
COM6	Hospital	g_struct_38	326.44
IND3	Average Food/Drug/Chem	h_struct_575	194.85
IND3	Food Processor, structure only	h_struct_580	194.85
IND4	Average Metals/Minerals processing	h_struct_586	194.85
IND5	Average High Technology	h_struct_591	194.85
IND3	Chemical refinery	h_struct_578	194.85
IND4	Sand and gravel	h_struct_589	194.85
IND3	Port Facilities	h_struct_580	194.85
COM5	Bank	h_struct_467	282.15

Object Name	Primary Object Type	Secondary Object Type	Damage Function: Structure	Finished Floor Elevation	Ground Elevation	Max Potential Damage: Structure	Shape_Area	
fp_15	COM4	Average Prof/Tech Services	g_struct_35	1	4.319839	2145821	11274.214758	184.68
fp_16	RES3C	Condominium, living area on multiple floors	g_struct_23	1	10.29773	947148.1	4357.308334	
fp_17	IND3	Average Food/Drug/Chem	h_struct_575	1	7.725961	353595.4	1814.705511	
fp_18	RES3E	Condominium, living area on multiple floors	g_struct_23	1	5.953907	1091480	5021.298025	
fp_19	RES3E	Condominium, living area on multiple floors	g_struct_23	1	6.359	1039605	4782.653075	

Building Data



- **Building Exposure Data Sources:**
  - County Supplied Building Footprints
  - SFWMD Normalized Parcel and Land Use
  - High Resolution Topo-Bathymetric Data
  - HAZUS Occupancy Types, Damage Functions and Depreciated Replacement Values



Primary Object Type	Secondary Object Type	Damage Function: Structure	Structure Replacment Value
COM6	Hospital	g_struct_38	326.44
IND3	Average Food/Drug/Chem	h_struct_575	194.85
IND3	Food Processor, structure only	h_struct_580	194.85
IND4	Average Metals/Minerals processing	h_struct_586	194.85
IND5	Average High Technology	h_struct_591	194.85
IND3	Chemical refinery	h_struct_578	194.85
IND4	Sand and gravel	h_struct_589	194.85
IND3	Port Facilities	h_struct_580	194.85
COM5	Bank	h_struct_467	282.15

Object Name	Primary Object Type	Secondary Object Type	Damage Function: Structure	Finished Floor Elevation	Ground Elevation	Max Potential Damage: Structure	Shape_Area
fp_15	COM4	Average Prof/Tech Services	g_struct_35	1	4.319839	2145821	11274.214758
fp_16	RES3C	Condominium, living area on multiple floors	g_struct_23	1	10.29773	947148.1	4357.308334
fp_17	IND3	Average Food/Drug/Chem	h_struct_575	1	7.725961	353595.4	1814.705511
fp_18	RES3E	Condominium, living area on multiple floors	g_struct_23	1	5.953907	1091480	5021.298025
fp_19	RES3E	Condominium, living area on multiple floors	g_struct_23	1	6.359	1039605	4782.653075
						184.68	

Road Data

- **Road Exposure Data Sources:**
  - Navteq / HERE Roads
  - HAZUS Occupancy Types, Damage Functions, and Depreciated Replacement Values

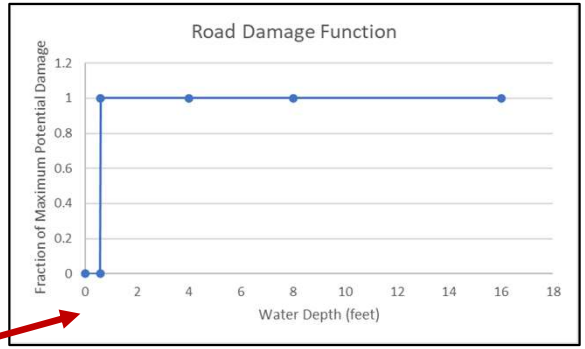
ST_NAME	FUNC_CLASS	SPEED_CAT	BRIDGE	TUNNEL	RAMP	PHYS_LANES	SEG_LENGTH	MaxPotentialDamageStructure	GroundElevation
W HALLANDALE BEACH BLVD	3	5	N	N	N	3	91.985331	36611.08	6.977387
I-95	2	2	Y	N	N	5	49.999605	33167.24	25.3995
NW 186TH ST	4	5	N	N	N	3	99.999675	39800.87	5.915051
49	3	5	N	N	Y	0	49.999865	6633.482	10.02319
2X	3	5	N	N	Y	2	50.000046	13267.01	16.37863
SW 184TH AVE	4	5	N	N	N	4	49.999927	26533.96	7.329951

Primary Object Type	Secondary Object Type	Damage Function Name	Damage Function: Structure	Structure Replacment Value	Critical Infrastructure
road	Street	road_damage_9	road_damage	1194.02	Y
road	Major Road	road_damage_9	road_damage	1107	Y
road	Street	road_damage_8	road_damage	1061.36	Y
road	Major Road	road_damage_8	road_damage	984.12	Y

Road Data

- **Road Exposure Data Sources:**
  - Navteq / HERE Roads
  - HAZUS Occupancy Types, Damage Functions, and Depreciated Replacement Values

ST_NAME	FUNC_CLASS	SPEED_CAT	BRIDGE	TUNNEL	RAMP	PHYS_LANES	SEG_LENGTH	MaxPotentialDamageStructure	GroundElevation
W HALLANDALE BEACH BLVD	3	5	N	N	N	3	91.985331	36611.08	6.977387
I-95	2	2	Y	N	N	5	49.999605	33167.24	25.3995
NW 186TH ST	4	5	N	N	N	3	99.999675	39800.87	5.915051
49	3	5	N	N	Y	0	49.999865	6633.482	10.02319
2X	3	5	N	N	Y	2	50.000046	13267.01	16.37863
SW 184TH AVE	4	5	N	N	N	4	49.999927	26533.96	7.329951

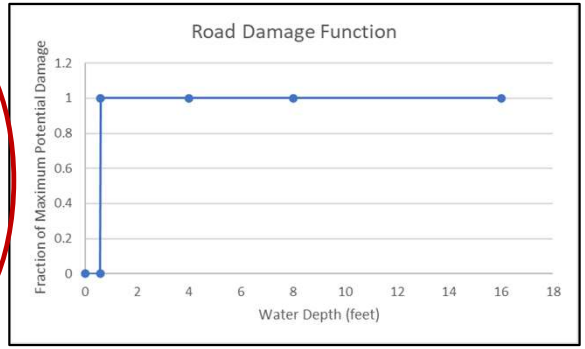


Primary Object Type	Secondary Object Type	Damage Function Name	Damage Function: Structure	Structure Replacment Value	Critical Infrastructure
road	Street	road_damage_9	road_damage	1194.02	Y
road	Major Road	road_damage_9	road_damage	1107	Y
road	Street	road_damage_8	road_damage	1061.36	Y
road	Major Road	road_damage_8	road_damage	984.12	Y

Road Data

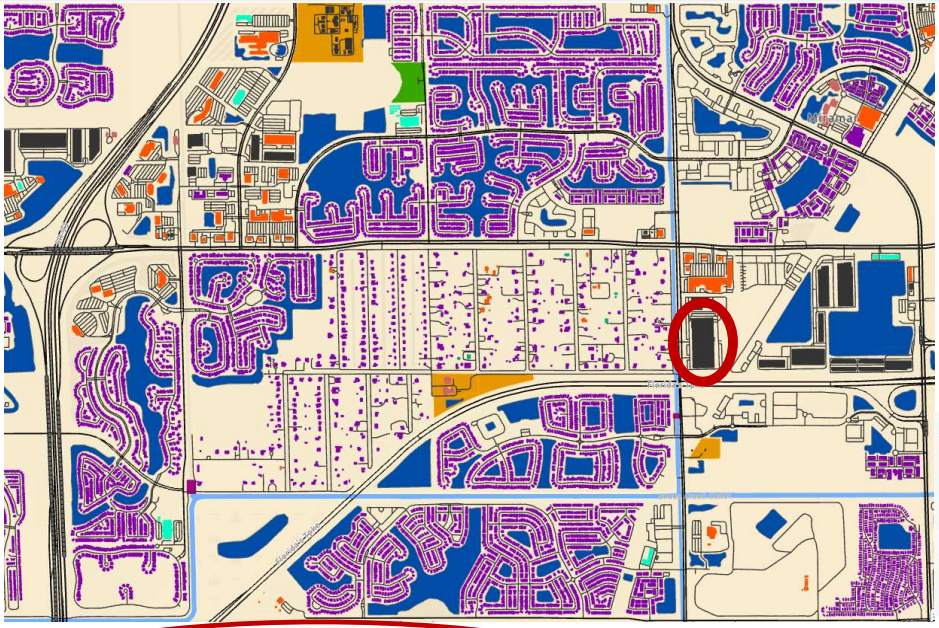
- **Road Exposure Data Sources:**
  - Navteq / HERE Roads
  - HAZUS Occupancy Types, Damage Functions, and Depreciated Replacement Values
  - High Resolution Topo-Bathymetric Data

ST_NAME	FUNC_CLASS	SPEED_CAT	BRIDGE	TUNNEL	RAMP	PHYS_LANES	SEG_LENGTH	MaxPotentialDamageStructure	GroundElevation
W HALLANDALE BEACH BLVD	3	5	N	N	N	3	91.985331	36611.08	6.977387
I-95	2	2	Y	N	N	5	49.999605	33167.24	25.3995
NW 186TH ST	4	5	N	N	N	3	99.999675	39800.87	5.915051
49	3	5	N	N	Y	0	49.999865	6633.482	10.02319
2X	3	5	N	N	Y	2	50.000046	13267.01	16.37863
SW 184TH AVE	4	5	N	N	N	4	49.999927	26533.96	7.329951

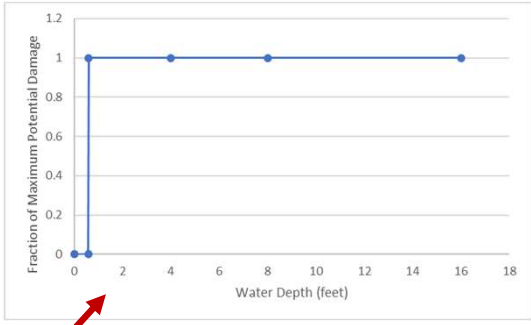


Primary Object Type	Secondary Object Type	Damage Function Name	Damage Function: Structure	Structure Replacment Value	Critical Infrastructure
road	Street	road_damage_9	road_damage	1194.02	Y
road	Major Road	road_damage_9	road_damage	1107	Y
road	Street	road_damage_8	road_damage	1061.36	Y
road	Major Road	road_damage_8	road_damage	984.12	Y

Utility Data



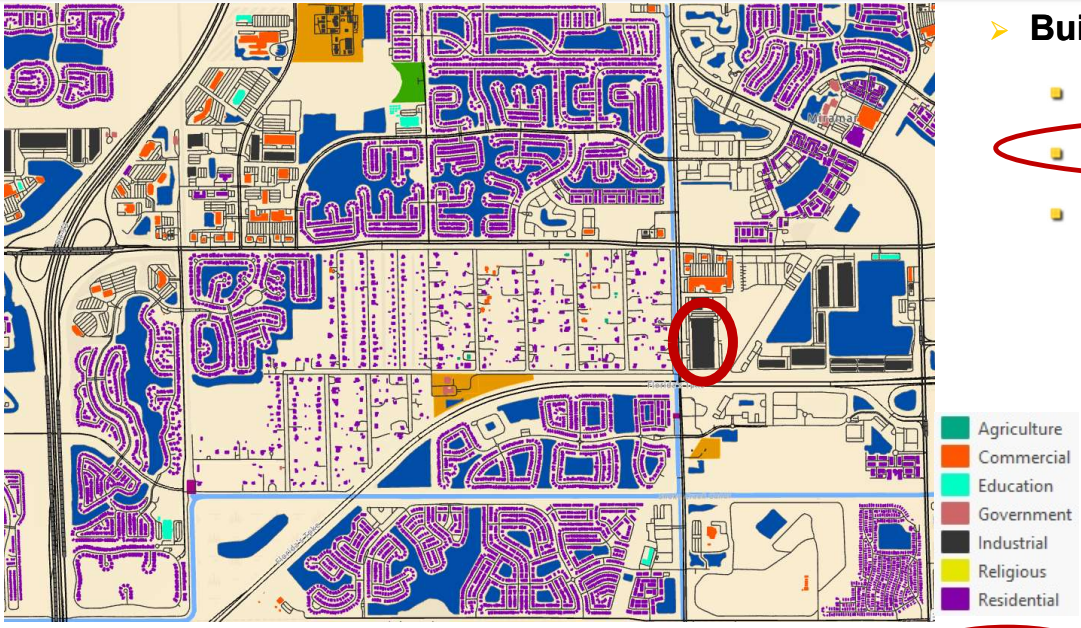
- **Utility Exposure Data Sources:**
  - SFWMD Normalized Parcel and Land Use
  - High Resolution Topo-Bathymetric Data
  - HAZUS Occupancy Types, Damage Functions, and Depreciated Replacement Values



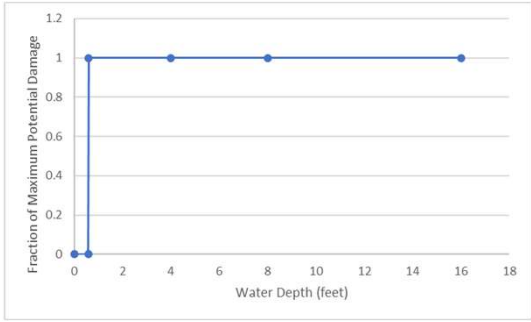
Primary Object Type	Secondary Object Type	Damage Function: Structure	Finished Floor Elevation	Ground Elevation	Max Potential Damage: Structure	Aggregation Label: Critical Infrastructure
ESSM	Medium Voltage (230 KV) Substation	h_util_4	1	3.386046	24874480	Y

Primary Object Type	Secondary Object Type	Damage Function Name	Damage Function: Structure	Structure Replacment Value	Critical Infrastructure
ESSM	Medium Voltage (230 KV) Substation	Substation, equipment height	h_util_4	24874478	Y
PWTM	Medium Water Treatment Plant (50-200 MGD)	Water Treatment Plant, equipment height	h_util_1	153119245	Y
utility	Water Control Structure	water_control_1	w_util	1949346	Y
WWTM	Medium Waste Water Treatment Plant (50-200 MGD)	Wastewater Treatment Plant, equipment height	h_util_3	117686816	Y

Utility Data



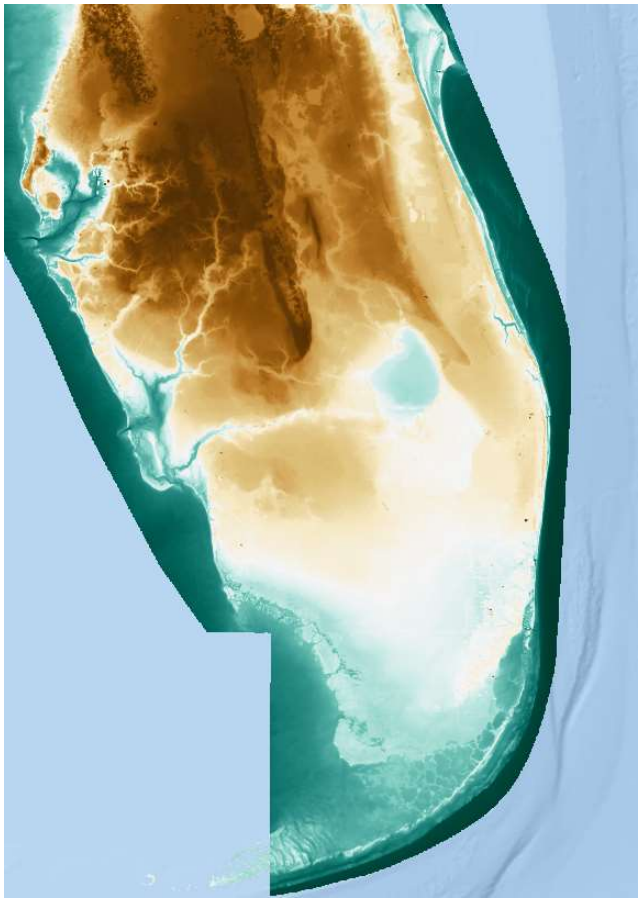
- **Building Exposure Data Sources:**
  - SFWMD Normalized Parcel and Land Use
  - High Resolution Topo-Bathymetric Data
  - HAZUS Occupancy Types, Damage Functions, and Depreciated Replacement Values



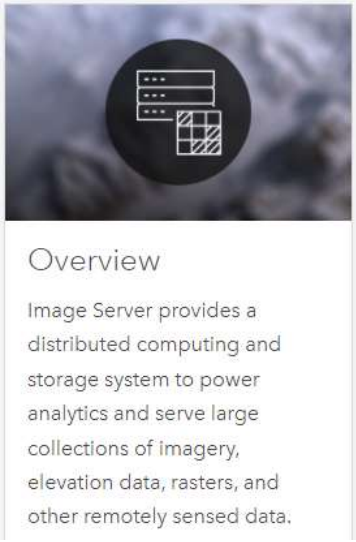
Primary Object Type	Secondary Object Type	Damage Function: Structure	Finished Floor Elevation	Ground Elevation	Max Potential Damage: Structure	Aggregation Label: Critical Infrastructure
ESSM	Medium Voltage (230 KV) Substation	h_util_4	1	3.386046	24874480	Y

Primary Object Type	Secondary Object Type	Damage Function Name	Damage Function: Structure	Structure Replacment Value	Critical Infrastructure
ESSM	Medium Voltage (230 KV) Substation	Substation, equipment height	h_util_4	24874478	Y
PWTM	Medium Water Treatment Plant (50-200 MGD)	Water Treatment Plant, equipment height	h_util_1	153119245	Y
utility	Water Control Structure	water_control_1	w_util	1949346	Y
WWTM	Medium Waste Water Treatment Plant (50-200 MGD)	Wastewater Treatment Plant, equipment height	h_util_3	117686816	Y

SFWMD Districtwide Elevation Mosaic



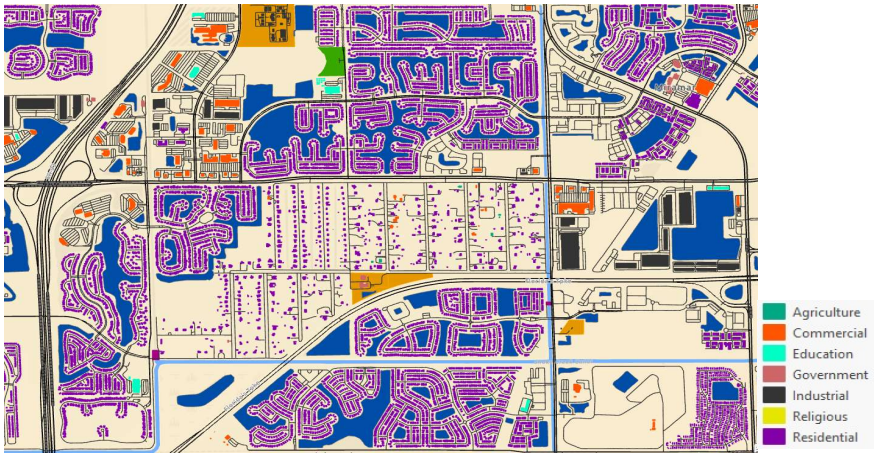
- Developed using Esri's Image Management Workflows
- Incorporates best available USGS 3D Elevation Program terrestrial and NOAA topobathymetric digital elevation models (DEMs)



Summary

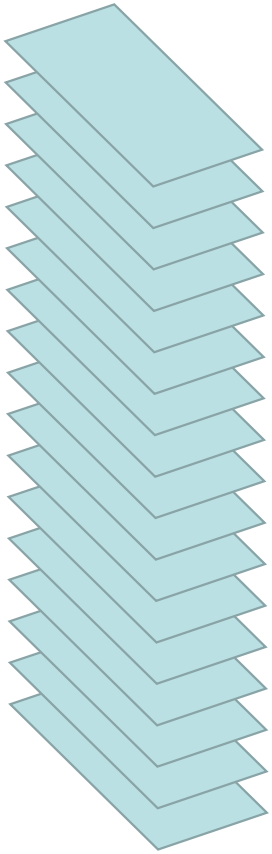
- Exposure data includes road segments, building and utility footprints, finished floor elevations, primary and secondary object types, damage functions, and maximum potential replacement costs.

- These data provide a means for us to quantify the cost of flooding within the built environment and put a financial value on a flood mitigation strategy



- Quality of the damage estimation is dependent on the combined quality of all input data sets

In Summary

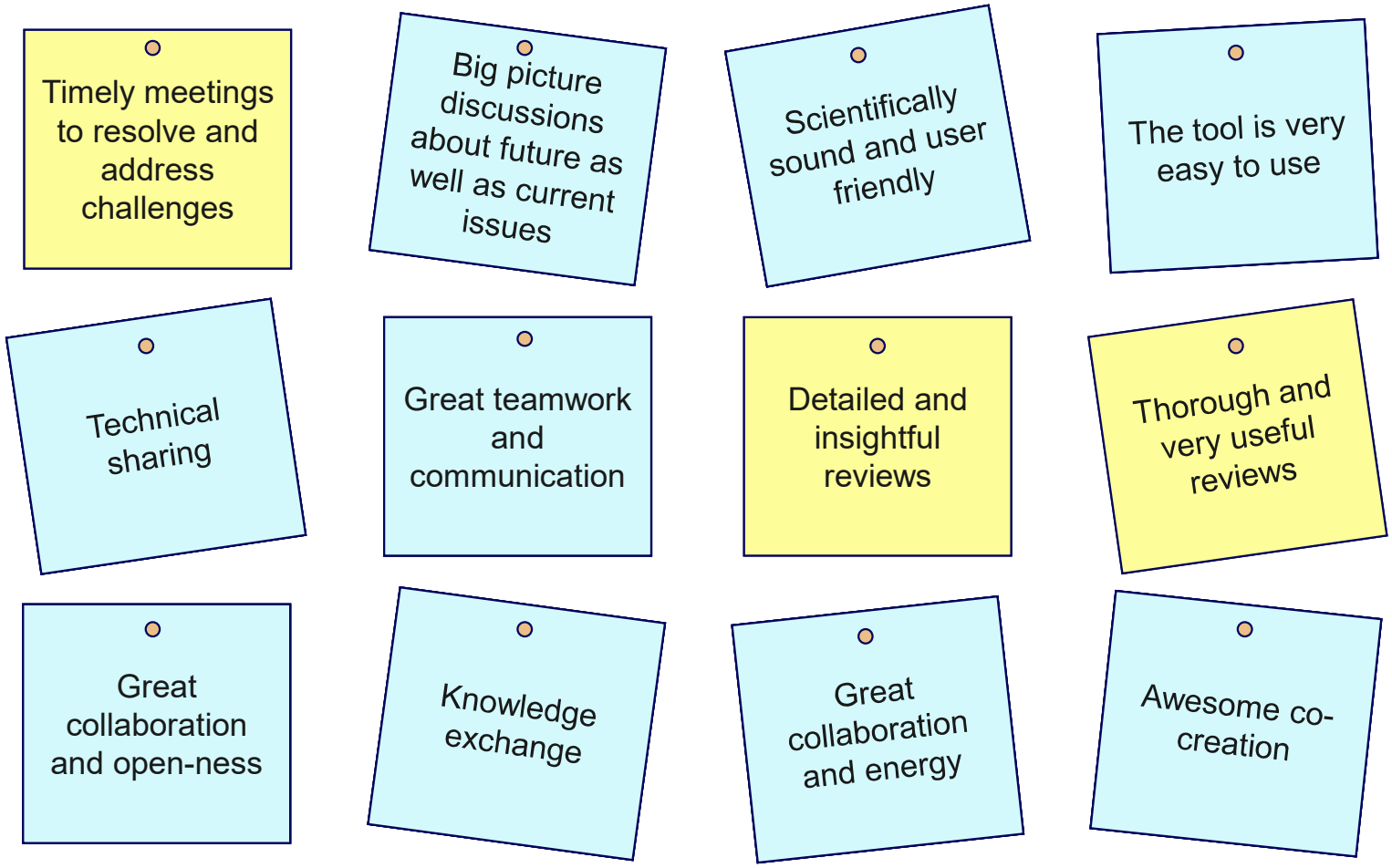


- Geospatial data are critical to our ability to evaluate and understand how to respond to and mitigate for changed conditions brought on by changes in rainfall, ET, groundwater, sea levels, etc.

  - Land Cover
  - Building Footprints
  - Normalized Parcels
  - Structures
  - Canals
  - Lakes, Impoundments, Reservoirs, Stormwater Treatment Areas (STA), Flow Equalization Basins (FEB)
  - Water Control Units
  - Water Control Systems
  - Water Control Networks
  - Land Surface Elevations
  - Predicted / modeled water surface elevations
  - Etc.
  - https://geo-sfwmd.hub.arcgis.com/

8. REFLECTIONS: Lessons Learned and Next Steps to Scale it Up

Kathryn Roscoe, Ph.D.,
Senior Researcher
Deltares USA



Deltares

Presenter: Kathryn Roscoe

NEXT STEPS…

Improve the generation and quality of input data

- Damage function validations and updates
- Develop exposure model-building tool in Python
- Develop method for first-floor home elevations

Develop new functionality

- Training

Deltares

Presenter: Kathryn Roscoe

9. Q&A Session 2

If you're participating in person – please fill out Section 5 at the Technical Question Card and give to a meeting attendant

If you're participating via Zoom – use the Q&A function to submit a written question or use the Raise Hand feature

If you're participating via Phone:
*9 Raises Hand
*6 Mutes/Unmutes

Moderator: Nicole Cortez

10. PARALLEL EFFORTS: SACS HAZUS Web Mapping Application & Measures and Cost Library Tool

Idris Dobbs, M.S.
Senior Economist
U.S. Army Corps of Engineers

South Atlantic Coastal Study (SACS)

TIER 2 ECONOMIC RISK ASSESSMENT (ERA) & THE MEASURES & COST LIBRARY (MCL)

- Idris Dobbs
- Jacksonville District, Planning Division Economics Branch
- U.S. Army Corps of Engineers

- May 31th, 2022

U.S.ARMY

US Army Corps of Engineers®

RSM RCX

SACS Tier 2 ERA & MCL BLUF

- **Framing problems, assumptions, and opportunities are crucial for CSRM plan formulation as well as using the Tier 2 ERA and the MCL**

- **SACS Tier 2 Economic Risk Assessment (ERA) - tool to help understand the spatial distribution of storm surge risk to economic development.**

- **SACS Measures & Cost Library (MCL) – tool to help users align CSRM problems and opportunities with the appropriate measures for plan formulation purposes**

Problems, Assumptions, & Opportunities

Presenter: Idris Dobbs

- **CSRM Problems -**
  - **Who/What** – Subject of concern that is susceptible to harm (subject/resource context)
  - **Where** - Location of subject that is susceptible to harm (spatial context)
  - **Why** - Coastal storm related hazard(s) that causes harm (hazard context)
  - **How** – How do we know this is a problem? What is the proof?
- **CSRM Assumptions –**
  - Exogenous factors that influence context (resource, spatial, and or hazard)
  - Leads to change over time
  - Source of uncertainty
  - State rationale for and effect of assumption
- **CSRM Opportunities -**
  - Desired future outcome for resources potentially impacted by coastal storms
  - Derived from interplay between CSRM problems and assumptions

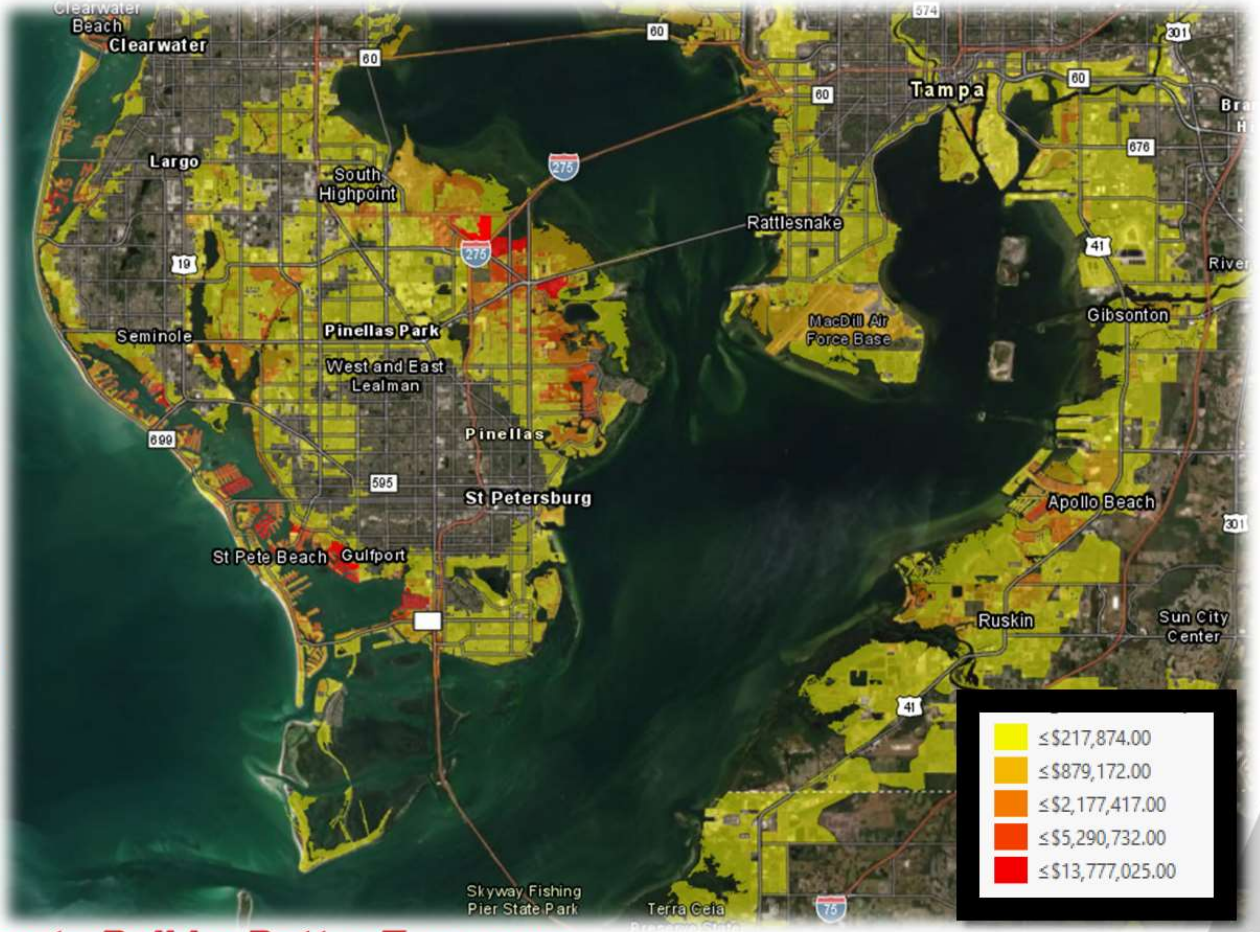
Working Today to Build a Better Tomorrow

Why does this matter?

- **Inform decisions on what all is at risk (Use of Tier 2 ERA)**
- **Inform decisions on study boundary conditions**
- **Focus your inventory and forecast of conditions**
- **Keep facts separate from future condition assumptions and uncertainties**
- **Define problems/ opportunities with enough detail to support formulation (Use of MCL)**
- **For Tier 3, provide basis for validating FWOP modeling**

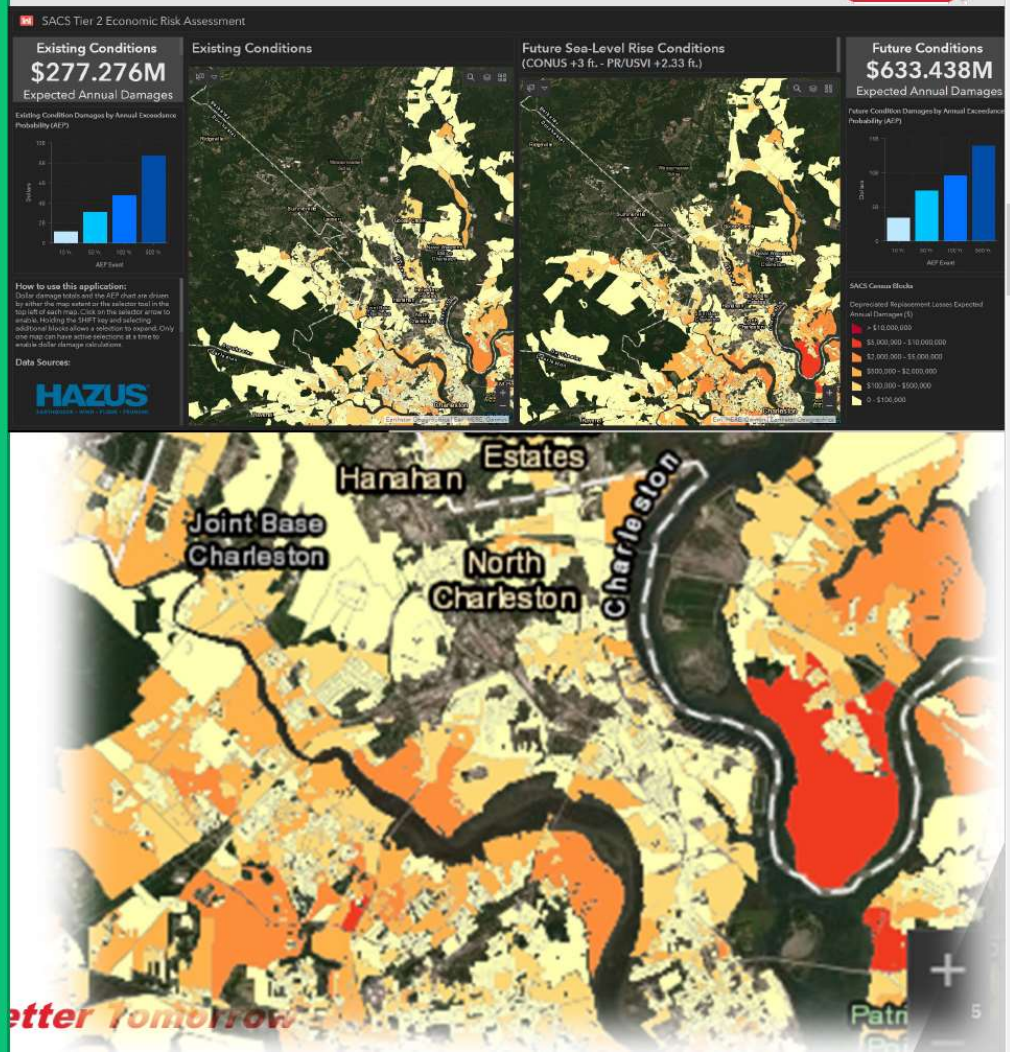
SACS – Tier 2 Economic Risk Assessment (ERA)

- Provide information to support designation of potential high-risk areas based on damage to property for the SACS.
- Provide a method for users to quickly estimate the economic risk of coastal storm surge
- Provide a method for users to scale damages from coastal storm events to cost of CSRM measures.
- Help users define boundary conditions for areas that warrant a deeper technical analysis



SACS – Tier 2 ERA

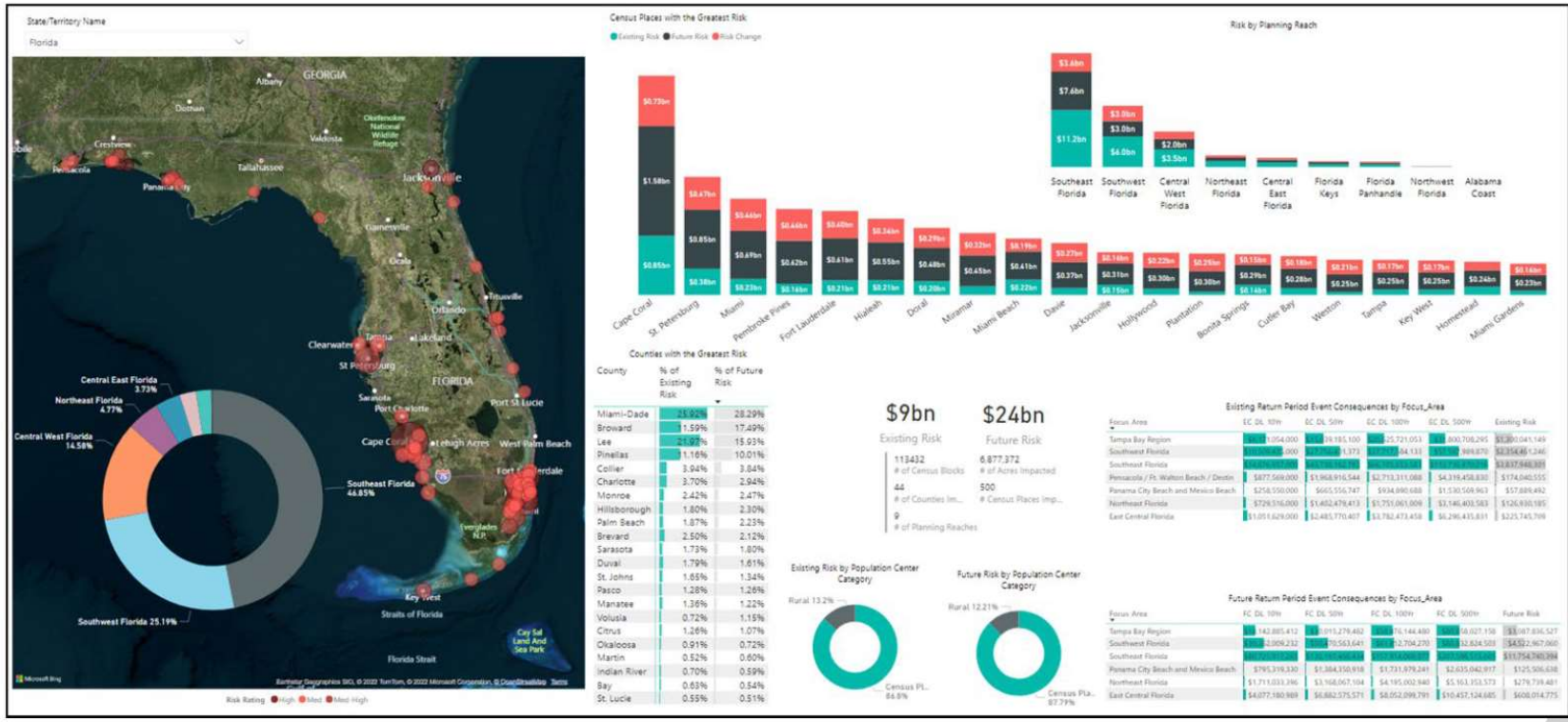
- Products - Technical Report & Web Application
- Models Used / Area Covered:
  - Hazus (Level-1) – North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi
  - FAST (Flood Assessment Structure Tool) – Puerto Rico, & US Virgin Islands
- Consequence & Risk Estimates
  - Consequences - $ damage depreciated losses from 10 yr. , 20 yr.*, 50 yr., 100 yr., & 500 yr. Return Periods
  - Risk – Expected Annual Damages (EAD) in any given year if consequence likelihoods and magnitudes are evenly distributed over time
  - Consequence & Risk estimates by census block
- Scenarios: Presented as a range between low (existing) & high (future)
  - Existing Conditions (low)– no sea level change included
  - Future Conditions – (high) sea level change included
    - CONUS: 3' of Sea Level Rise
    - OCONUS: 2.33' of Sea Level Rise



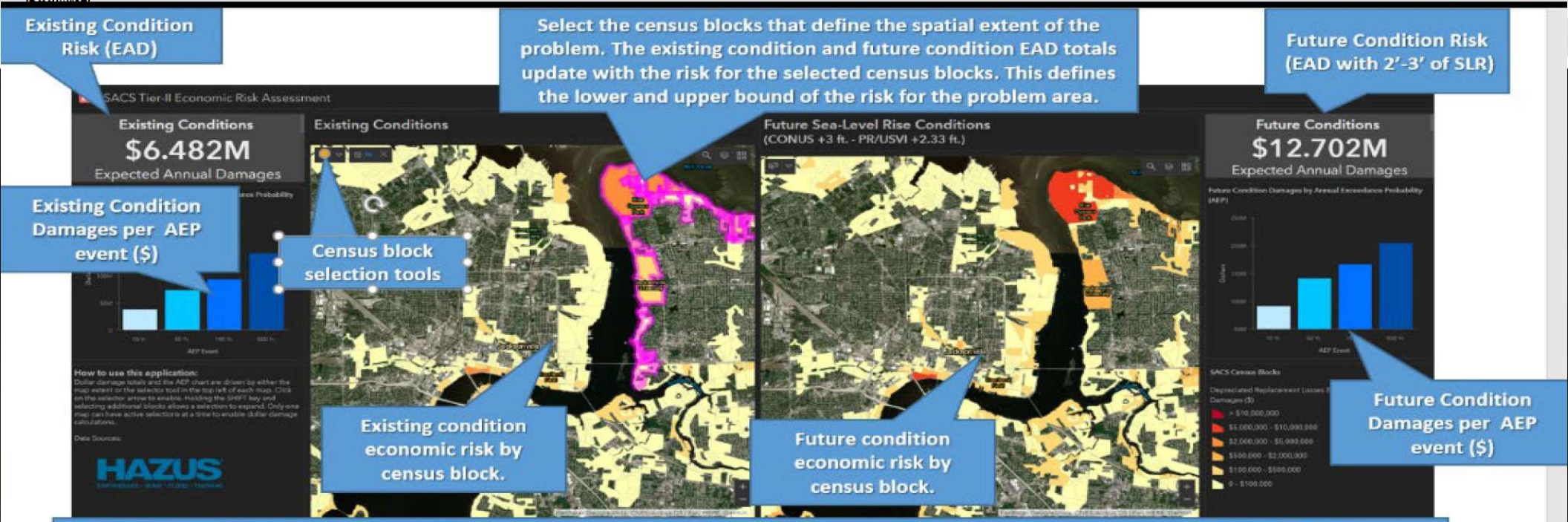
SACS Tier 2 ERA – Overview / Florida

Florida:

- **Existing Risk: $9 Billion**
- **Future Risk: $24 Billion**
- **Comparison of highest risk census places, counties, and planning reaches throughout Florida**



SACS Tier 2 ERA Dashboard Diagram....



- **Annual Exceedance Probability (AEP):** The percent chance a hazard of a certain magnitude or lesser will occur in any given year. Higher magnitude events are associated with lower AEPs.
- **Damages (Consequences):** The damages are the consequences expressed in dollars given the occurrence of an AEP event. These damages represent the cost of replacing structure and content asset losses minus the depreciation of those assets.
- **Expected Annual Damages (EAD):** The damages expressed as a monetary value that occur in any given year if all AEP event probabilities and magnitudes were spread out equally over time. expense that would occur in any given year if monetary damages from all hazard probabilities and magnitudes were spread out equally over time. This is not to imply that the same level of damages will happen every year ; some years could see large impacts, other years could receive moderate impacts, while other years could see minimal to no impacts. EAD is a reflection of economic risk and is linked to the NED (National Economic Development) account.

Presenter: Idris Dobbs

SACS - Measures & Cost Library (MCL)

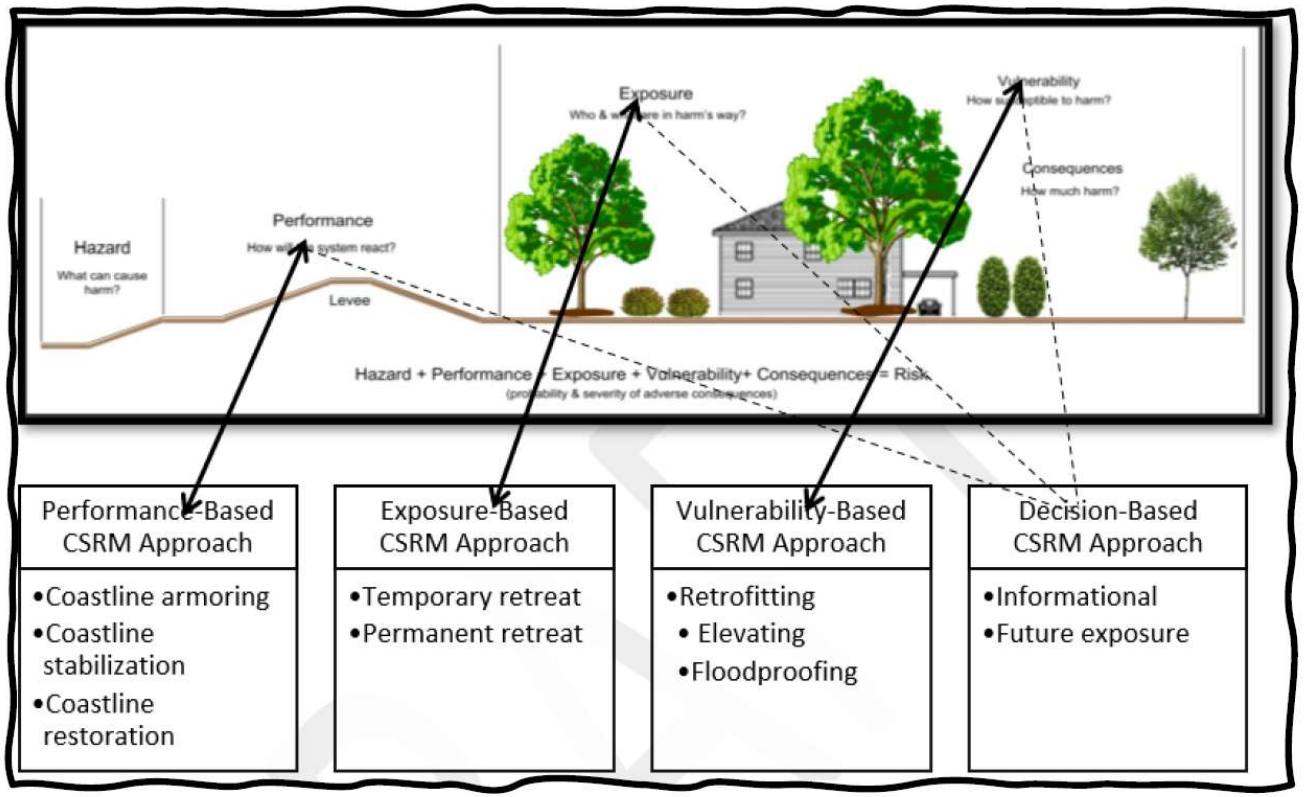
- **MCL : Library of standardized measures & costs for use in USACE PDT & stakeholder entry level CSRM planning efforts**
- **Purpose / Usage:**
  - **Link CSRM problems/CSRM opportunities to appropriate CSRM measures and cost**
  - **Develop conceptual understanding of ROM range of cost of associated with CSRM effort**
  - **Inform alternative development decisions**
  - **Use in development of FAAS for the SACS**
- **Products**
  - **(Current)Technical Report/Spreadsheet Tool**
  - **(Potential) Technical Report / Web Application**
- **Measures**
  - **13 (ea.) Structural Measures**
  - **12 (ea.) Natural & Nature Based Features**
  - **15 (ea.) Nonstructural Measures (5 costed)**
- **Costs**
  - **Constant dollar & Equivalent Annual Costs (EAC for life cycle)**
  - **Unit Costs & ROM based on user input ranges**
- **Status**
  - **SME, Focus ATR**
  - **Legal & Policy Review**

Use of the MCL

- **Specify regional location of measure within SAD (22 planning reaches)**
- **Specify unit parameters for measure(s) of interest such as:**
  - **project or shoreline length**
  - **# nourishments**
  - **# acres**
  - **# buildings to retrofit**
- **Tool computes range of costs for measures in constant dollar or annualized terms (EAC).**
  - **Return period consequences from Tier 2 ERA can be compared to constant dollar cost from MCL**
  - **EAD from Tier 2 ERA can be compared to EAC from MCL**
  - **Use with Tier 2 ERA not required…**

SACS - MCL Considerations

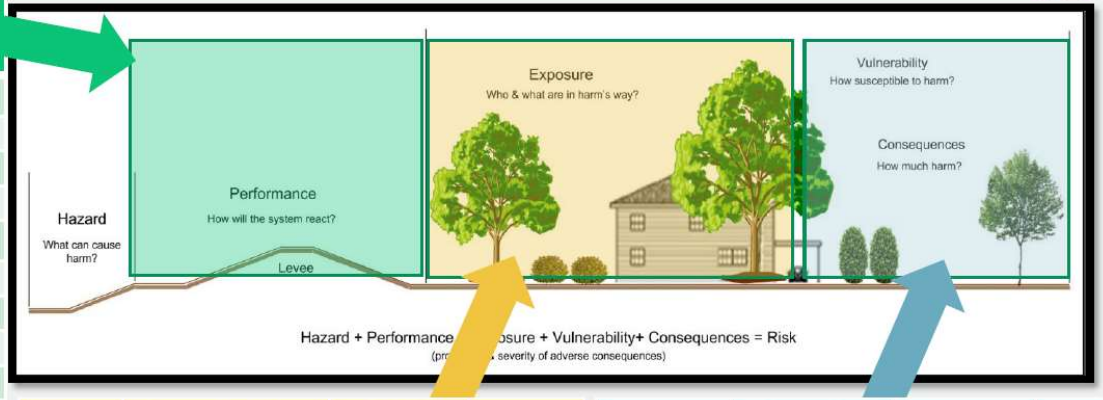
- **Non-cost Considerations**
  - CSRM Approach / Method
  - Resiliency principles (PARA)
  - CSRM function
  - Applicability
  - Physical / Temporal effect on risk
  - NED, RED,OSE, & EQ effects
  - Sea level change adaptability
- **Cost Considerations**
  - Regional location
  - Cost Features (unit price/quantity)
  - Contingency
  - S&A, E&D, M&AM
  - Uncertainty



SACS –MCL List of Measures

Presenter: Idris Dobbs

Measure Category	Measure to Address Performance	CSRM Method(s)	PARA
Structural	Groins	Coastline Stabilization	Absorb
	Seawall	Coastline Armoring	Absorb
	Revetment	Coastline Armoring	Absorb
	Bulkhead	Coastline Armoring	Absorb
	Breakwaters	Coastline Stabilization	Absorb
	Floodwalls	Coastline Armoring	Absorb
	Deployable Floodwalls	Coastline Armoring	Absorb
	Levees / Dikes	Coastline Armoring	Absorb
	Surge Barrier	Coastline Armoring	Absorb
	Beach Nourishment	Coastline Restoration	Absorb
	Nearshore Nourishment	Coastline Restoration	Absorb
	Road Elevation	Coastline Armoring / Retrofit*	Absorb
	Ringwalls	Armoring / Retrofit*	Absorb
Natural and Nature Based Features (NNBF)	Barrier Island	Coastline Restoration	Absorb
	Tidal Flats	Coastline Restoration	Absorb
	Wetland	Coastline Restoration	Absorb
	Maritime Forest	Coastline Restoration	Absorb
	Wet Pine Savannah	Coastline Restoration	Absorb
	Mangroves	Coastline Restoration	Absorb
	Living Shoreline Vegetation	Coastline Stabilization	Absorb
	SAV	Coastline Stabilization	Absorb
	Coral Reef Breakwater	Coastline Stabilization	Absorb
	Oyster Reef Breakwater	Coastline Stabilization	Absorb
	Living Shoreline Reefs	Coastline Stabilization	Absorb
	Living Shoreline Sills	Coastline Stabilization	Absorb



Measure Category	Measure to Address Exposure	CSRM Method(s)	PARA
Non-Structural	Buyout & Acquisition	Permanent Retreat	Adapt
	Relocation	Permanent Retreat	Adapt
	Flood Warning Systems	Temporary Retreat	Prepare
	Flood Emergency Preparedness Plans	Temporary Retreat	Prepare
	Evacuation Plans	Temporary Retreat	Prepare

Measure Category	Measure to Address Vulnerability	CSRM Method(s)	PARA
Non-Structural	Building Elevation	Retrofit	Absorb
	Dry Flood Proofing	Retrofit	Absorb
	Wet Flood Proofing	Retrofit	Absorb

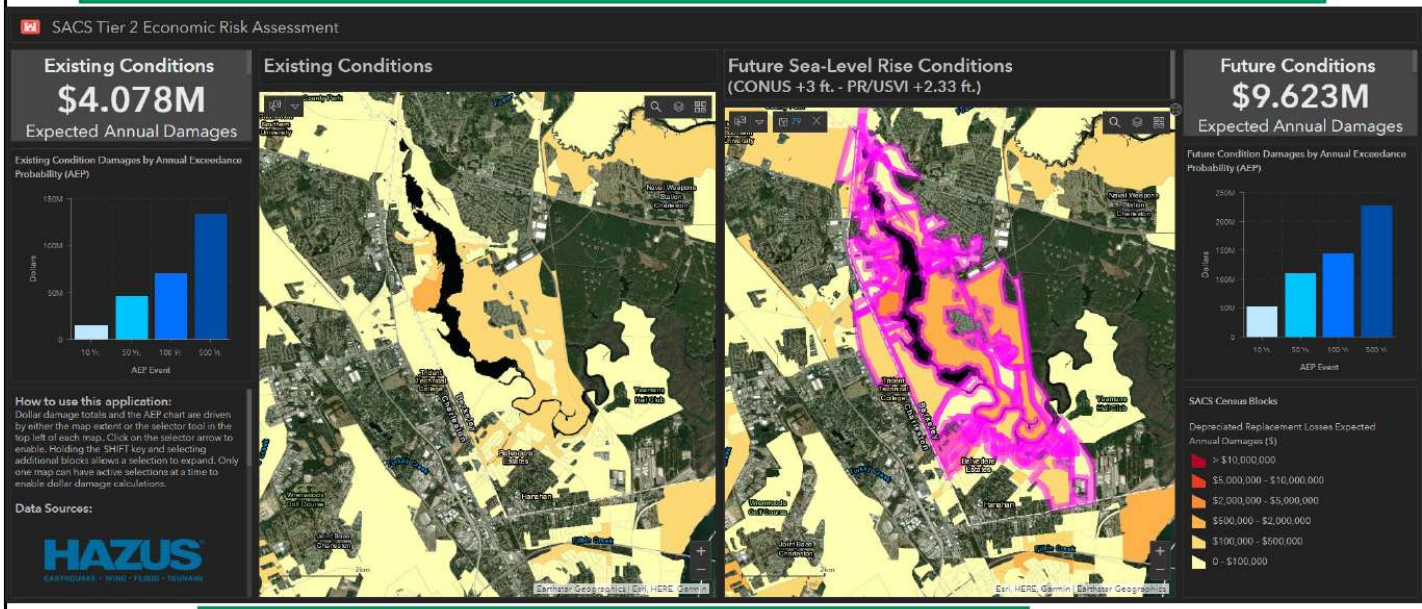
Decision Based CSRM Approaches

Measure Category	Measure Group Name	CSRM Approaches	CSRM Method(s)	PARA
Non-Structural	Flood Insurance	Decision-Based	Future Exposure	Recover
	Floodplain Mapping	Decision-Based	Informational	Adapt
	Land Use Regulations	Decision-Based	Future Exposure	Adapt
	Zoning	Decision-Based	Future Exposure	Adapt
	Risk Communication	Decision-Based	Informational	Prepare
	Risk Analysis	Decision-Based	Informational	Adapt
	Land Conservation	Decision-Based	Future Exposure	Adapt

Process for Use of Tier-II Economic Risk & MCL Tools

- **Step-1 Clearly define problem / opportunity in terms of:**
  - Who, What, Where, Why & How
- **Step-2 Using Tier 2 ERA web app tools, select census blocks that define the extent of the problem**
- **Step-3 Record range of risk**
  - Risk between $4M - $9.6M
  - Record range of consequences per return period (user discretion)

Step-1: Define the Problem
Storm surge inundation damages to the Belvedere Estates, SC area



Step-3:
- **Existing Condition EAD $4.078M (Low Range)**
- **Future Condition EAD $9.623M (High Range)**

Process for Use of Tier 2 ERA & MCL Tools

Select the Planning Reach	SC_04
Select the Type of Cost	Equivalent Annual Cost

Select planning reach & cost type

ters to Compute ROM Cost Ranges

Enter # assets to buyout:	80
Enter # assets to elevate:	20
Enter # assets to floodproof:	700
Enter groin length (LF)	
Enter measure length (LF)	25000
Enter breakwater length (LF)	
Enter deployable wall length (LF)	
Enter surge barrier length (LF)	
Enter measure area (AC)	336

Enter parameters to populate ROM cost range

Compare measure annual cost ranges with risk range ($4.078M -$9.623M)

Measure Code	Measure Group Name	Annual Cost Low	Annual Cost High
NS-1	Buyout_Acquisition	$809,558	$2,182,597
NS-2	Elevation_Bldgs	$3,675	$8,373
NS-3	Dry_Flood_Proofing	$937,772	$3,076,622
NS-4	Wet_Flood_Proofing	$310,351	$573,471
S-6	Floodwalls	$4,963,240	$7,996,600
S-8	Levees_Dikes	$3,733,591	$6,098,832
NNBF-3	Wetland	$3,044,057	$9,921,143
NNBF-4	Maritime_Forest	$20,521	$114,325
NNBF-5	Wet_Pine_Savannah	$20,521	$114,325
NNBF-6	Mangroves	$1,712,846	$3,014,131
NNBF-7	Living_Shoreline_Vegetation	$8,734	$1,369,218
NNBF-8	SAV	$2,075,274	$11,285,069
NNBF-11	Living Shoreline Reefs	$5,964,514	$19,702,991
NNBF-12	Living Shoreline Sills	$1,408,925	$13,395,811

Better To

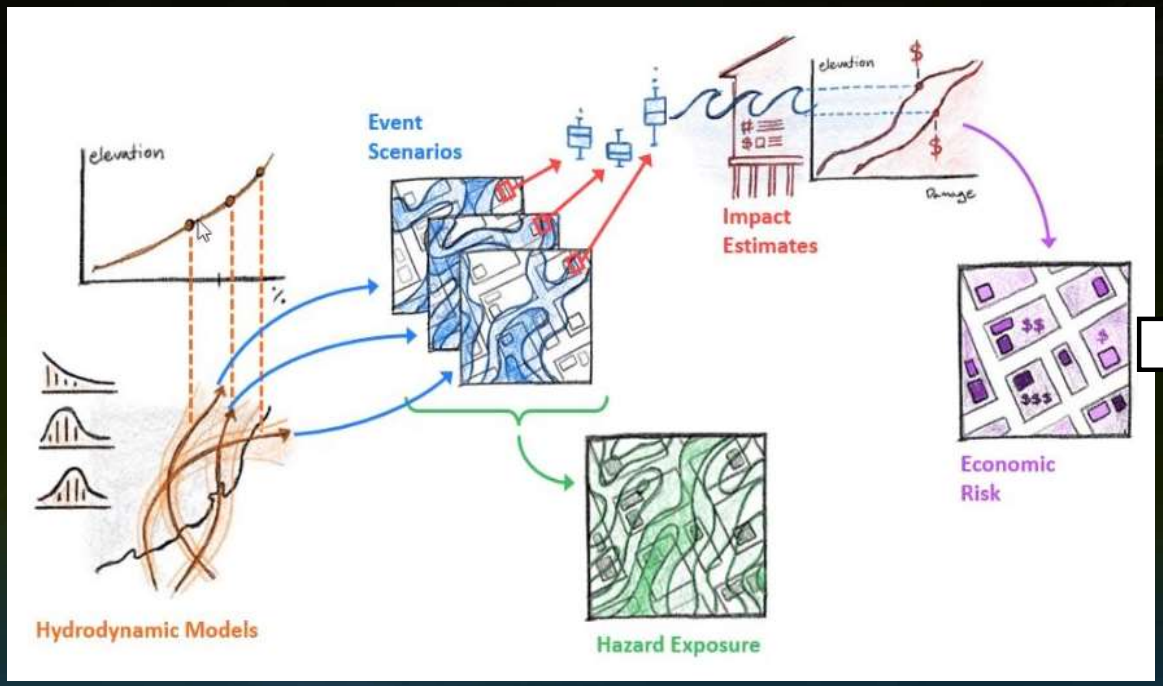
- Step-4 Use MCL to select measures that correspond with problem described in step-1
  - Select planning reach to apply regional factors
  - Select constant or annualized cost
- Step-5 Enter the estimated project length & other parameters
- Step-6 Observe the annualized range of cost and compare to range of risk
- **Decision Criteria** – If low boundary of cost exceed high boundary of damages indicates that measure that may be too costly from an economics perspective.
- Describe risks and uncertainties with making decisions without getting more specific info

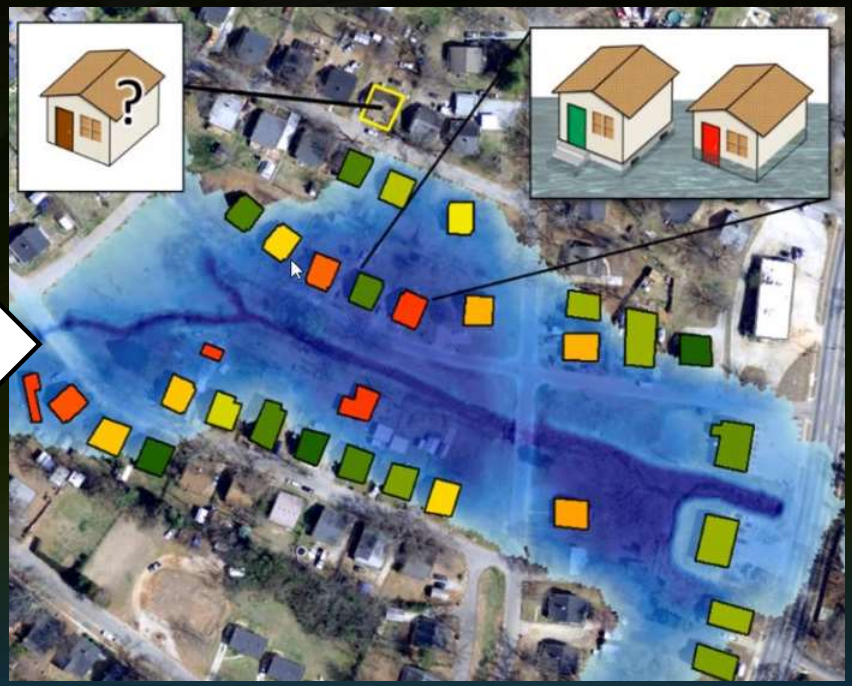
Presenter: Idris Dobbs

11. Tool Application: Vulnerability Scenarios in the Arch Creek Basin for Single and Multiple Flood Drivers

Francisco Peña, Ph.D.
Resiliency Project Manager, SFWMD
Courtesy Post-Doc, Florida International University

H&H Models to Damage Assessment

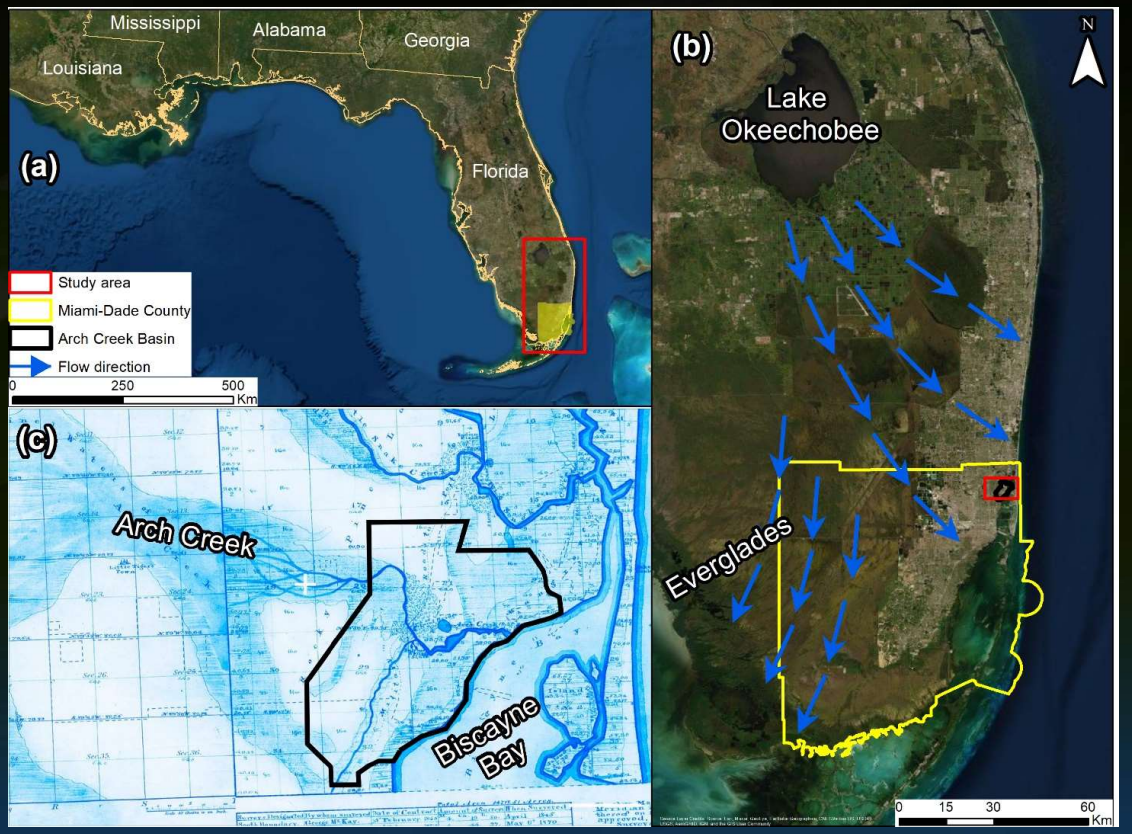




Source: Taylor Engineering

Case Study: Arch Creek Basin

Characteristics	Arch Creek Basin
Climate	Tropical monsoon
Topography	Flat
Precipitation	1570 mm/year
Pluvial	High risk
Fluvial	Medium risk
Coastal surge	High risk
Groundwater	High risk
Sea level rise	5-13 mm/year
Flood risk	Very high



Results Copulas

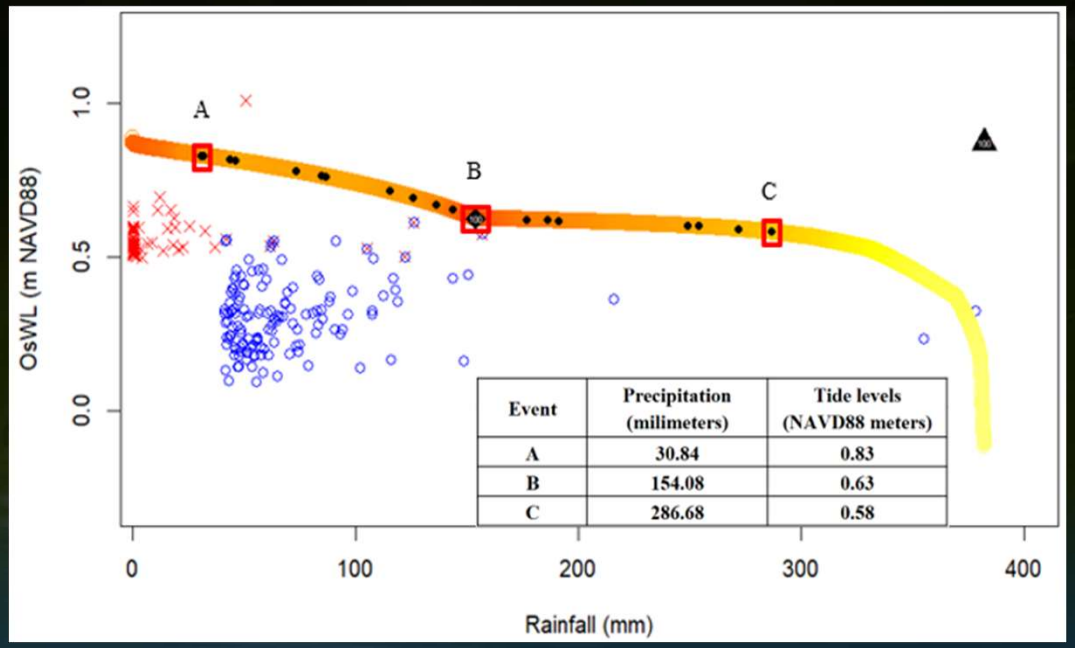
Nat. Hazards Earth Syst. Sci., 22, 1–18, 2022
https://doi.org/10.5194/nhess-22-1-2022

Natural Hazards and Earth System Sciences

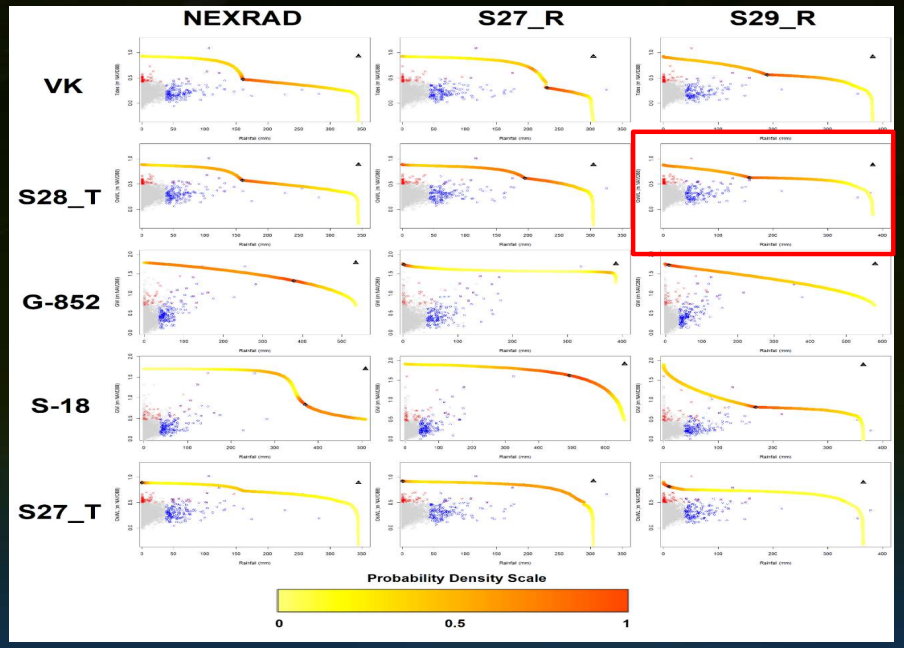
Compound flood modeling framework for surface–subsurface water interactions

Francisco Peña[1,2,3,4,5], Fernando Nardi[1,3], Assefa Melesse[3,4], Jayantha Obeysekera[3,4,5], Fabio Castelli[2], René M. Price[3,4], Todd Crowl[3], and Noemi Gonzalez-Ramirez[6]

[1]WARREDOC, University for Foreigners of Perugia, Perugia, 06123, Italy
[2]Department of Civil and Environmental Engineering (DICEA), University of Florence, Florence, 50139, Italy
[3]Institute of Environment, Florida International University, Miami, FL 33199, USA
[4]Department of Earth and Environment, Florida International University, Miami, FL 33199, USA
[5]Sea Level Solutions Center, Florida International University, Miami, FL 33181, USA
[6]Riada Engineering, Inc., P.O. Box 104, Nutrioso, AZ 85932, USA



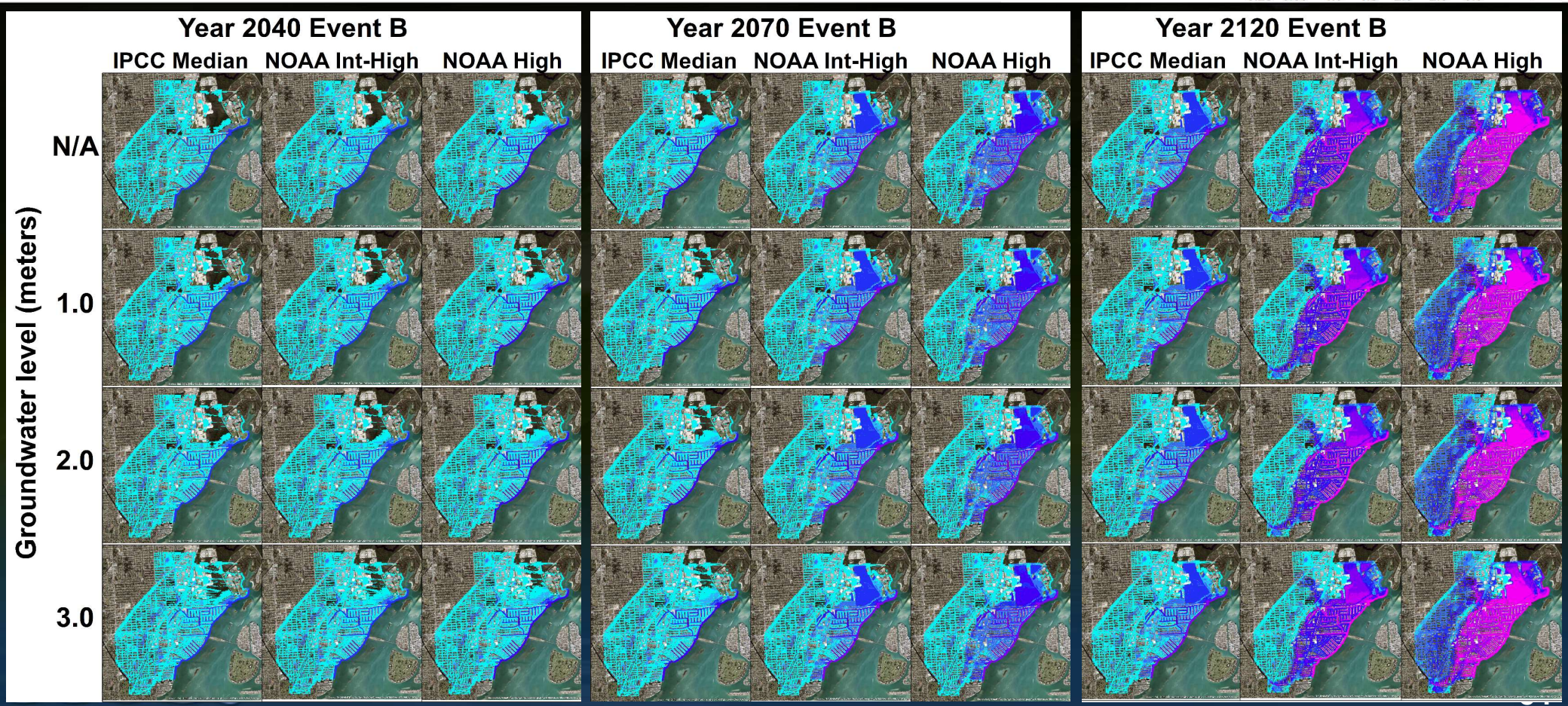
Event	Precipitation (milimeters)	Tide levels (NAVD88 meters)
A	30.84	0.83
B	154.08	0.63
C	286.68	0.58



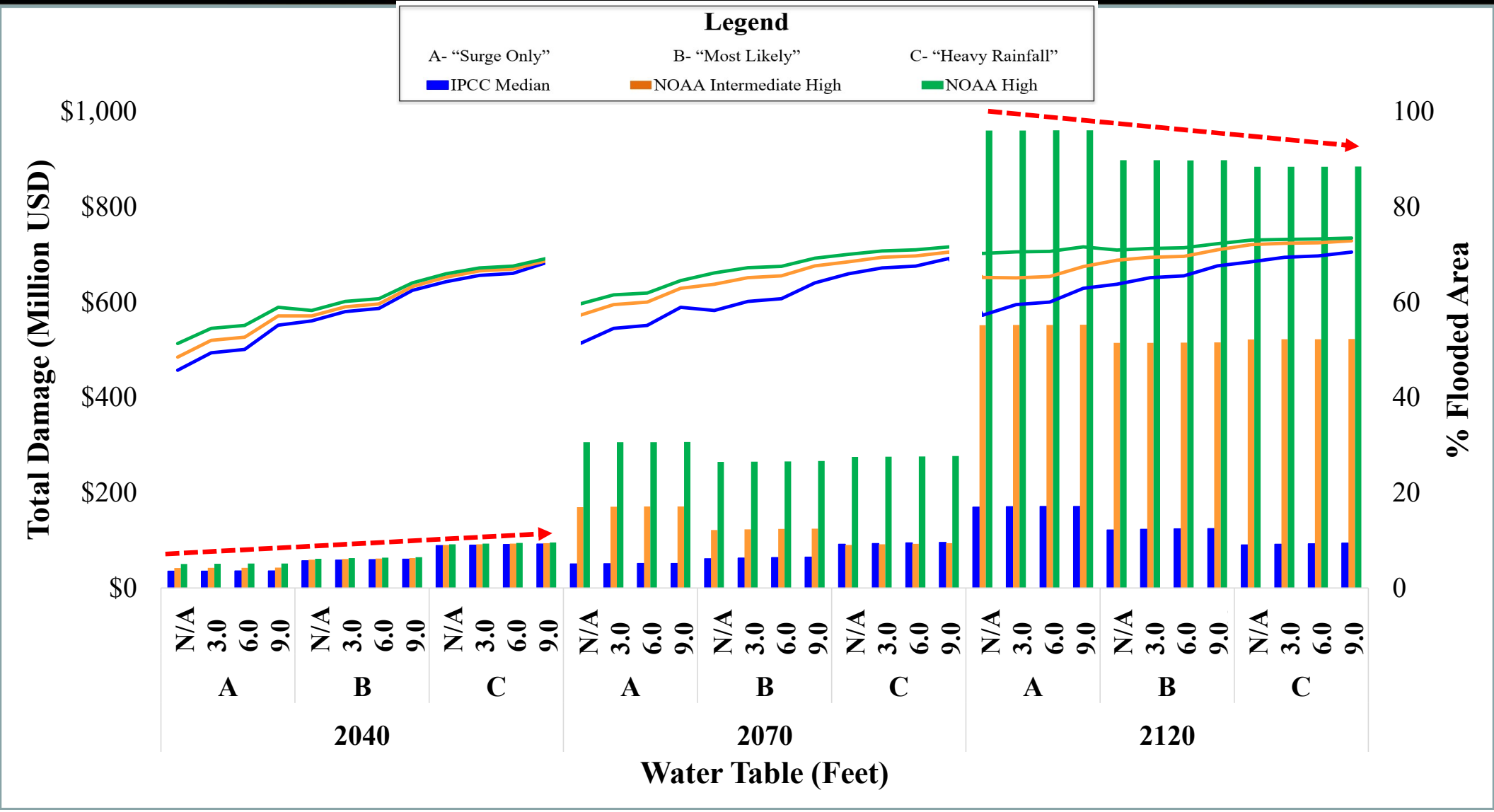
Quantile isoline for a 100-year return period between rainfall and Ocean-side Water Levels at site S29_R and S28_T

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Results



SOUTH FLORIDA WATER MANAGEMENT DISTRICT

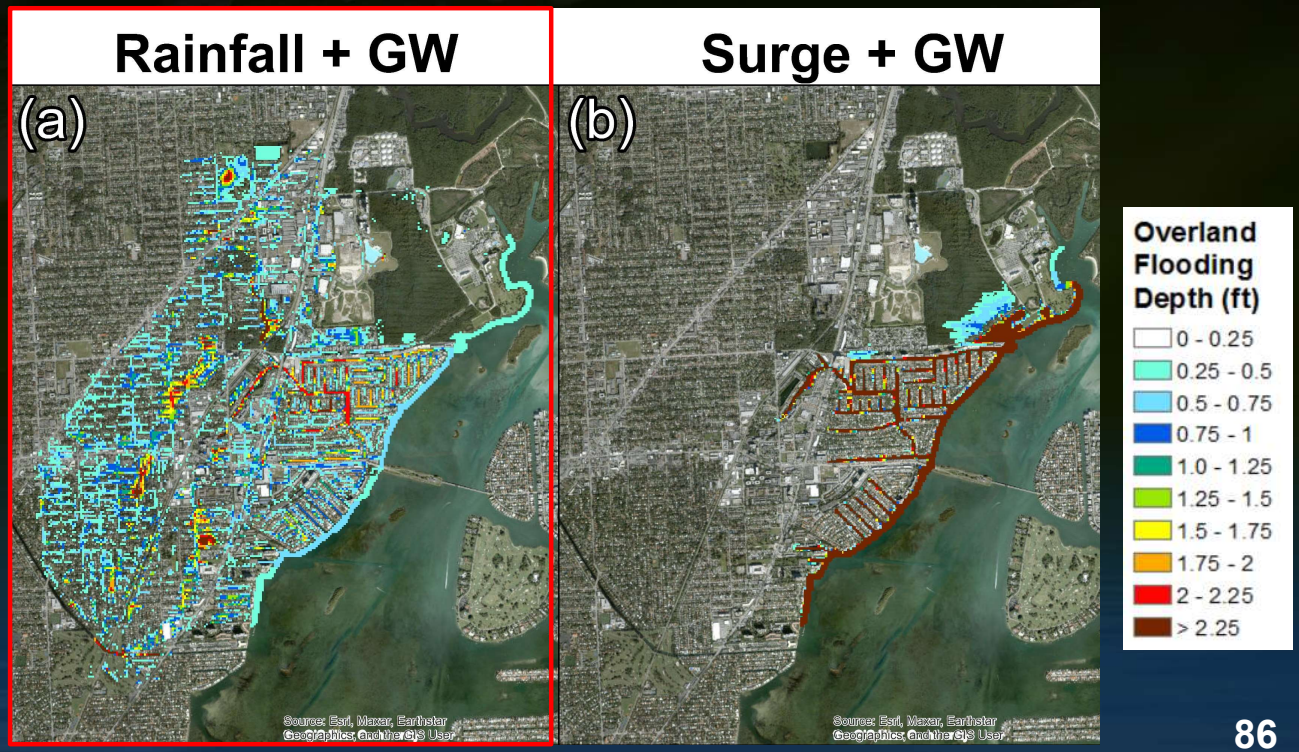


Tool Application

Inland & Coastal Flooding vs Compound Flooding

- Projection: NOAA Int High
- Event: "Most Likely"
- Year: 2070
- GW: 3 feet

ID	Driver	Total Damage (Million USD)
A	Rainfall + GW	$30,682,624

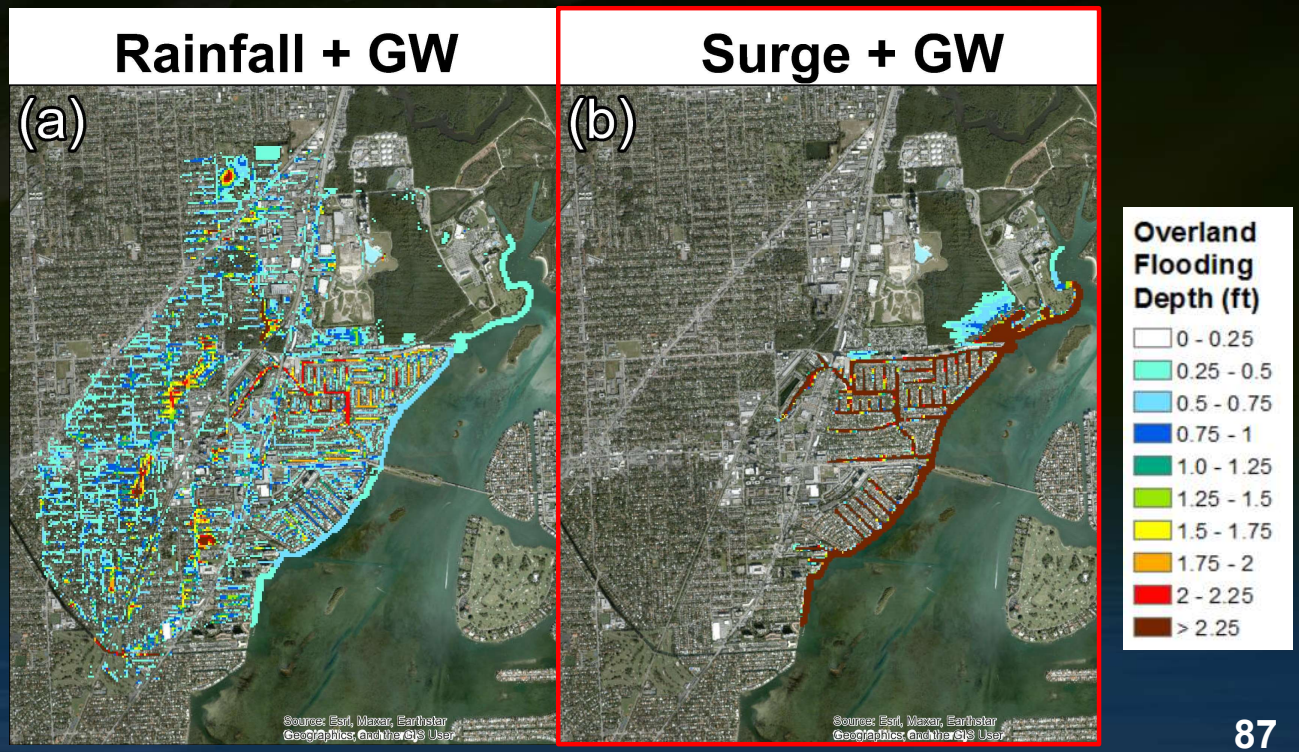


Tool Application

Inland & Coastal Flooding vs Compound Flooding

- Projection: NOAA Int High
- Event: "Most Likely"
- Year: 2070
- GW: 3 feet

ID	Driver	Total Damage (Million USD)
A	Rainfall + GW	$30,682,624
B	Surge + GW	$1,545,752

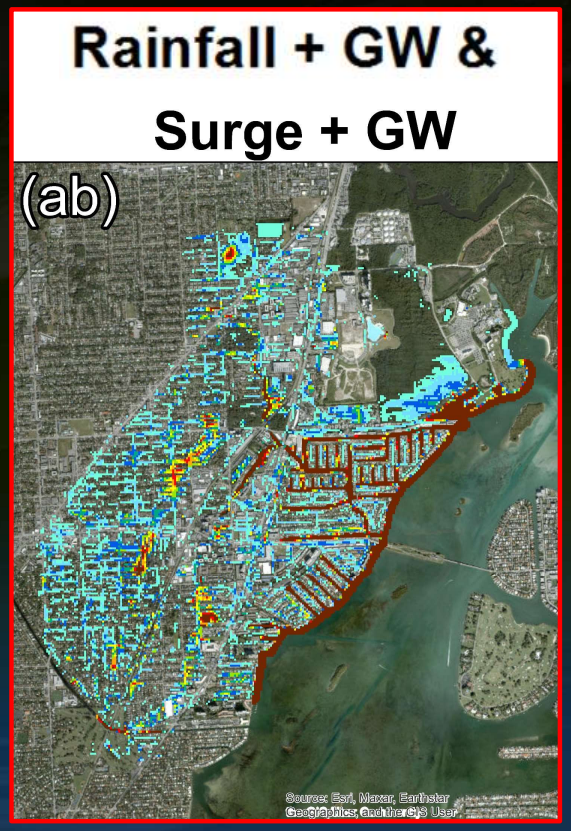


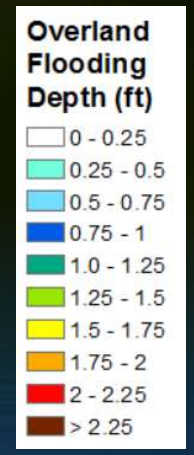
Tool Application

Inland & Coastal Flooding vs Compound Flooding

- Projection: NOAA Int High
- Event: "Most Likely"
- Year: 2070
- GW: 3 feet

ID	Driver	Total Damage (Million USD)
A	Rainfall + GW	$30,682,624
B	Surge + GW	$1,545,752
AB	A + B	$32,228,376



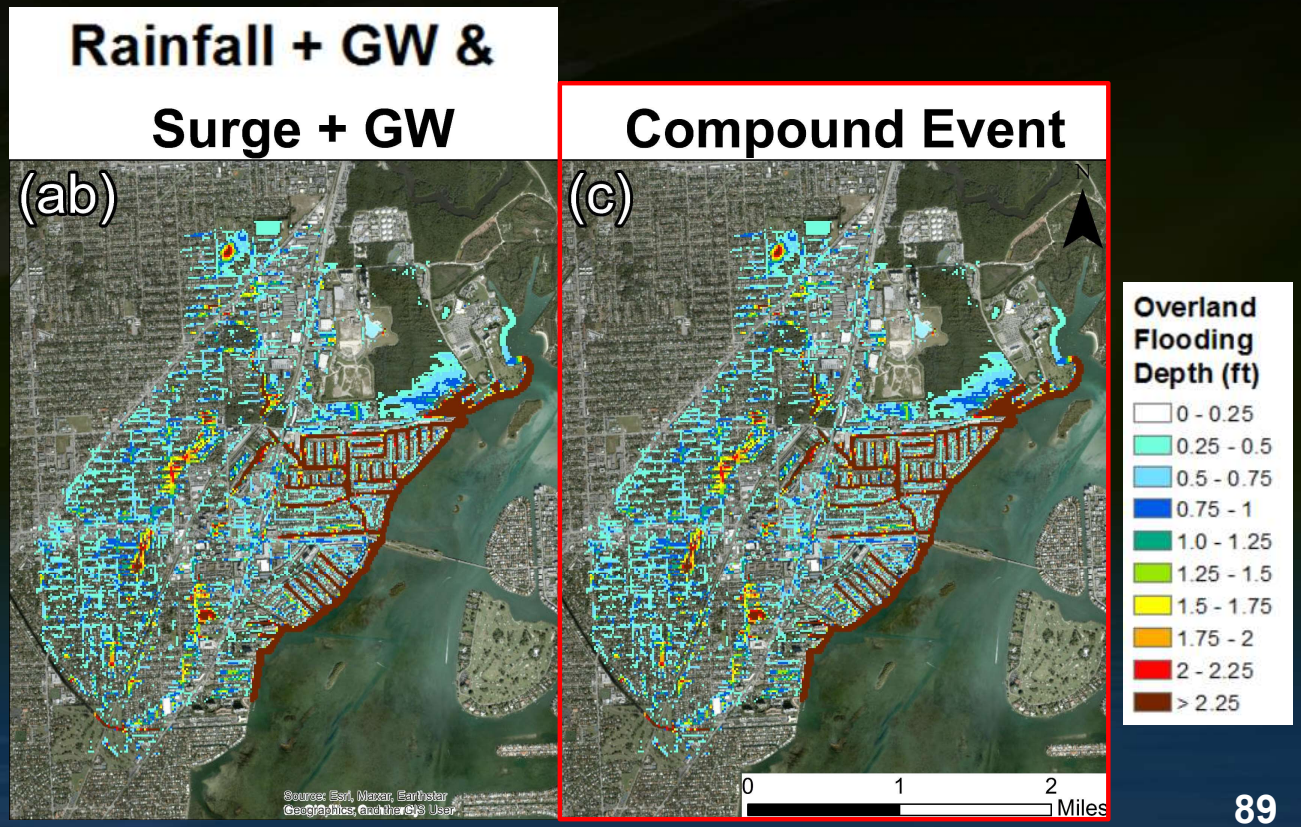


Tool Application

Inland & Coastal Flooding vs Compound Flooding

- Projection: NOAA Int High
- Event: "Most Likely"
- Year: 2070
- GW: 3 feet

ID	Driver	Total Damage (Million USD)
A	Rainfall + GW	$30,682,624
B	Surge + GW	$1,545,752
AB	A + B	$32,228,376
C	Compound Events	

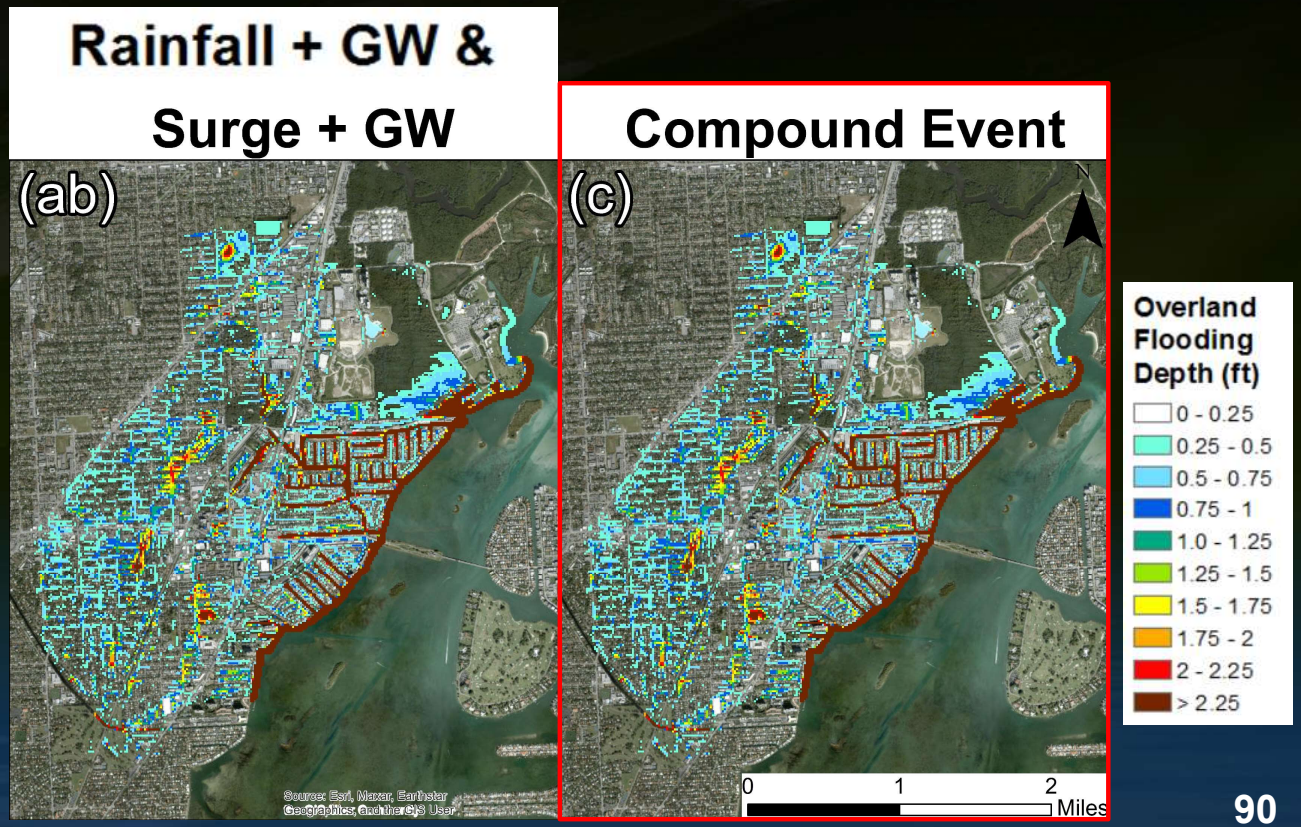


Tool Application

Inland & Coastal Flooding vs Compound Flooding

- Projection: NOAA Int High
- Event: "Most Likely"
- Year: 2070
- GW: 3 feet

ID	Driver	Total Damage (Million USD)
A	Rainfall + GW	$30,682,624
B	Surge + GW	$1,545,752
AB	A + B	$32,228,376
C	Compound Events	$35,611,731
D	Estimate Difference (%)	11.05%



Example #1

Megan

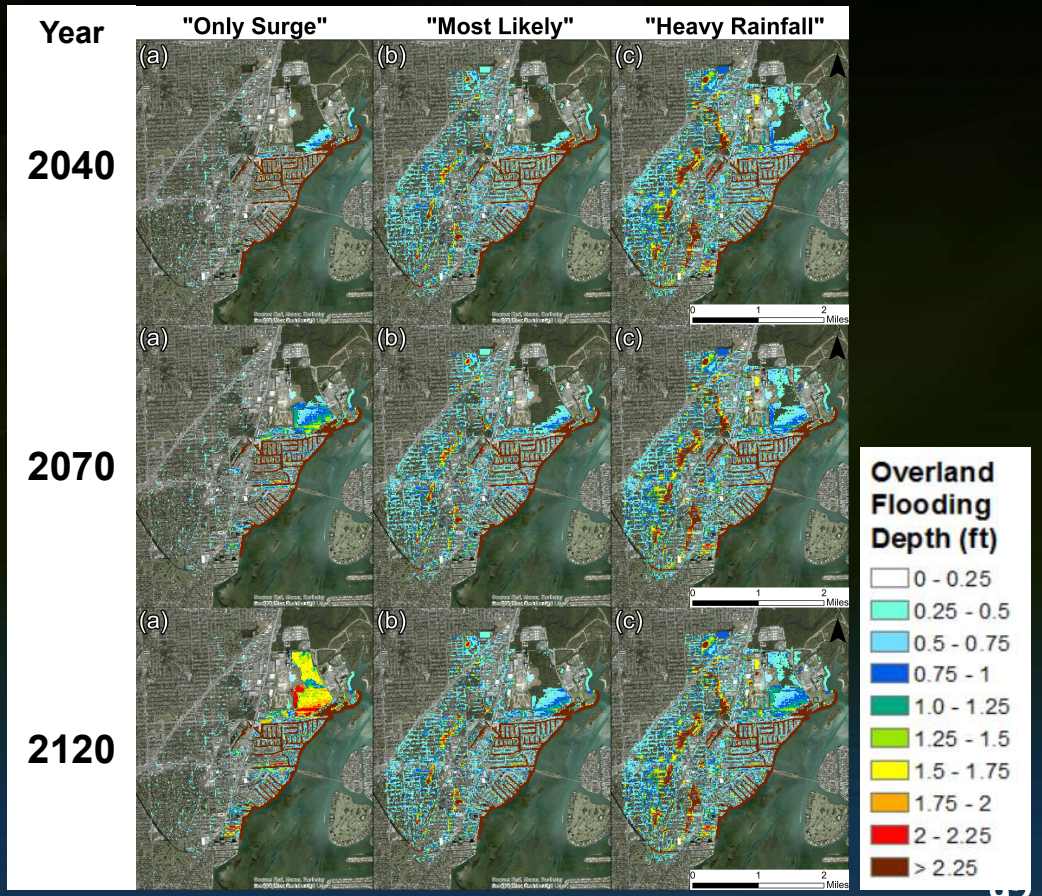
- Elected Official for a city in North Miami
- Concerned coastal property values
- Cares about her constituents
- Planning around election cycles

Example #1

Megan

- Highest tax base lives within 1 mile shoreline (Coastal centered)
- Projection: IPCC Median Curve
- Water Table: 3 feet

ID	Event	Total Damage (Million USD)		
		2040	2070	2120
A	Only Surge	$35.43	$51.03	$170.47
B	Most Likely	$58.60	$62.82	$122.96
C	Heavy Rainfall	$90.14	$90.32	$91.77

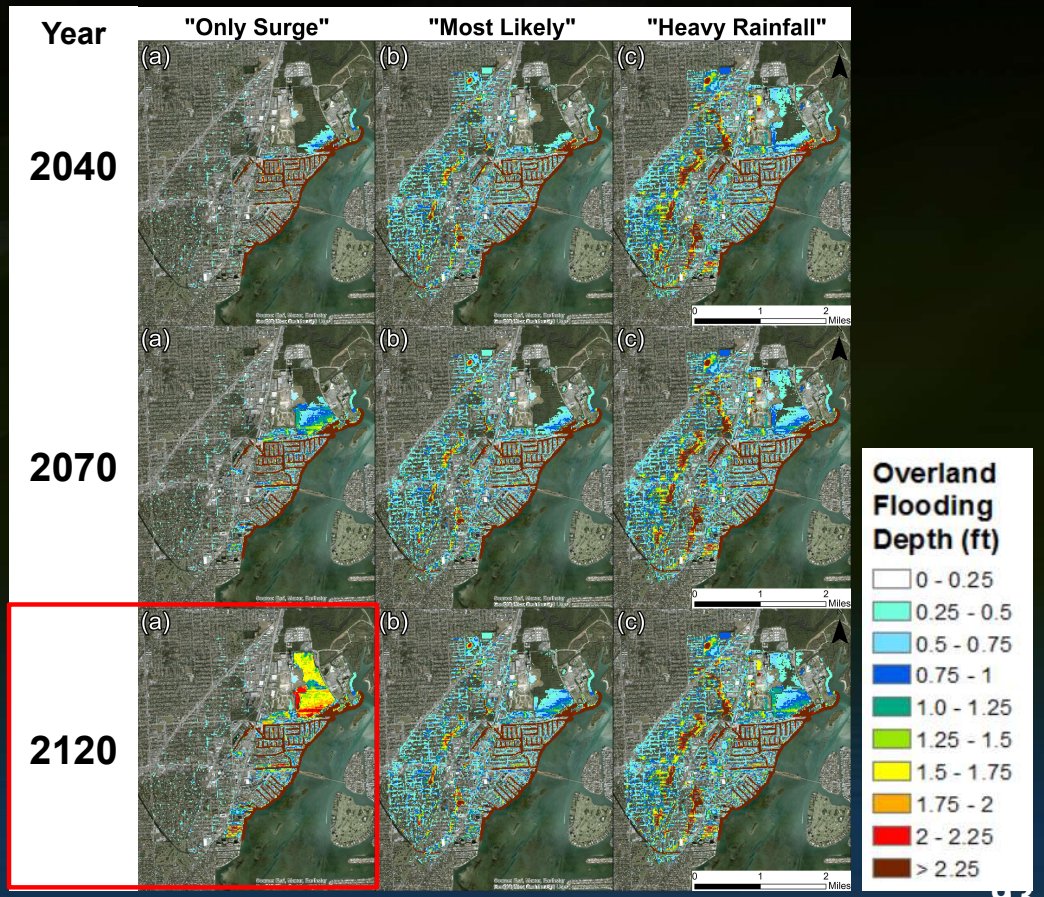


Example #1

Megan

- Highest tax base lives within 1 mile shoreline (Coastal centered)
- Projection: IPCC Median Curve
- Water Table: 3 feet

ID	Event	Total Damage (Million USD)		
		2040	2070	2120
A	Only Surge	$35.43	$51.03	$170.47
B	Most Likely	$58.60	$62.82	$122.96
C	Heavy Rainfall	$90.14	$90.32	$91.77



Example #1

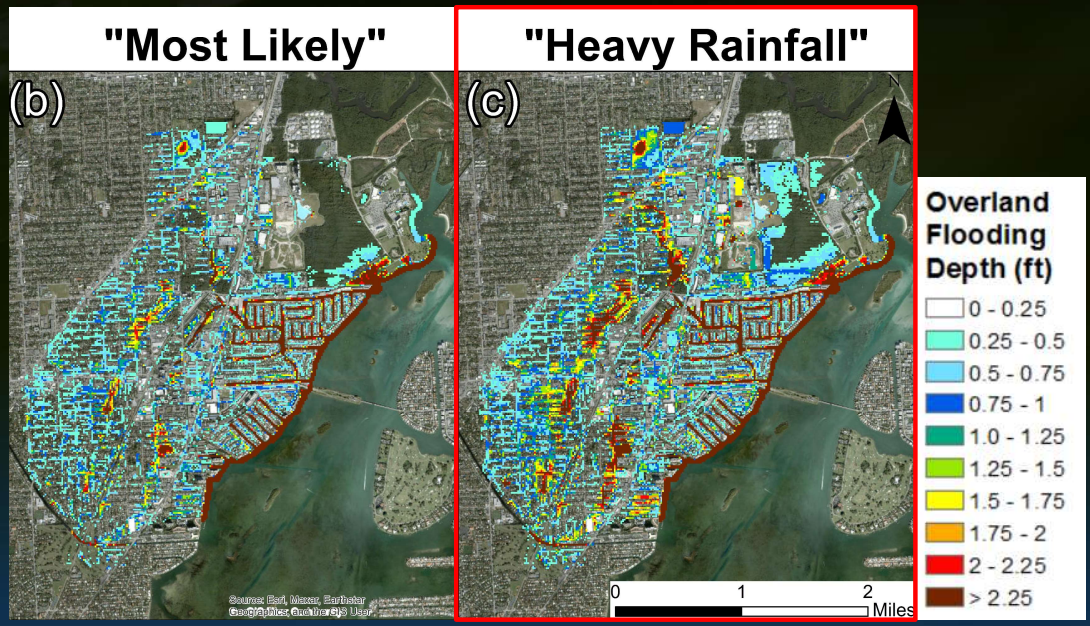
Few weeks later…

Example #1

Megan

- Projected damage to short term horizons: 2040 scenario

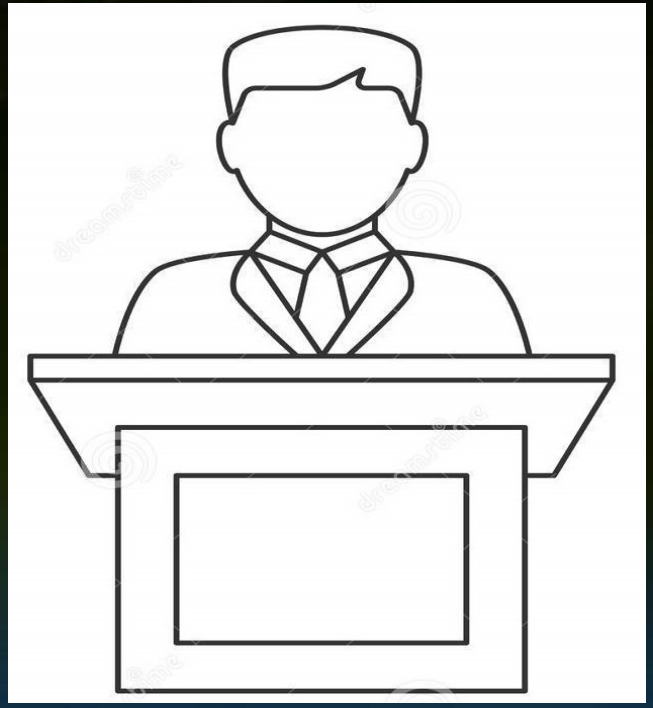
ID	Event	Total Damage (Million USD)		
		2040	2070	2120
A	Only Surge	$35.43	$51.03	$170.47
B	Most Likely	$58.60	$62.82	$122.96
C	Heavy Rainfall	$90.14	$90.32	$91.77



Example #2

Michael

- Planning Director for a city in North Miami
- Responsible to adapt buildings and roads to future flood conditions and rising sea levels
- Seeking grant funding

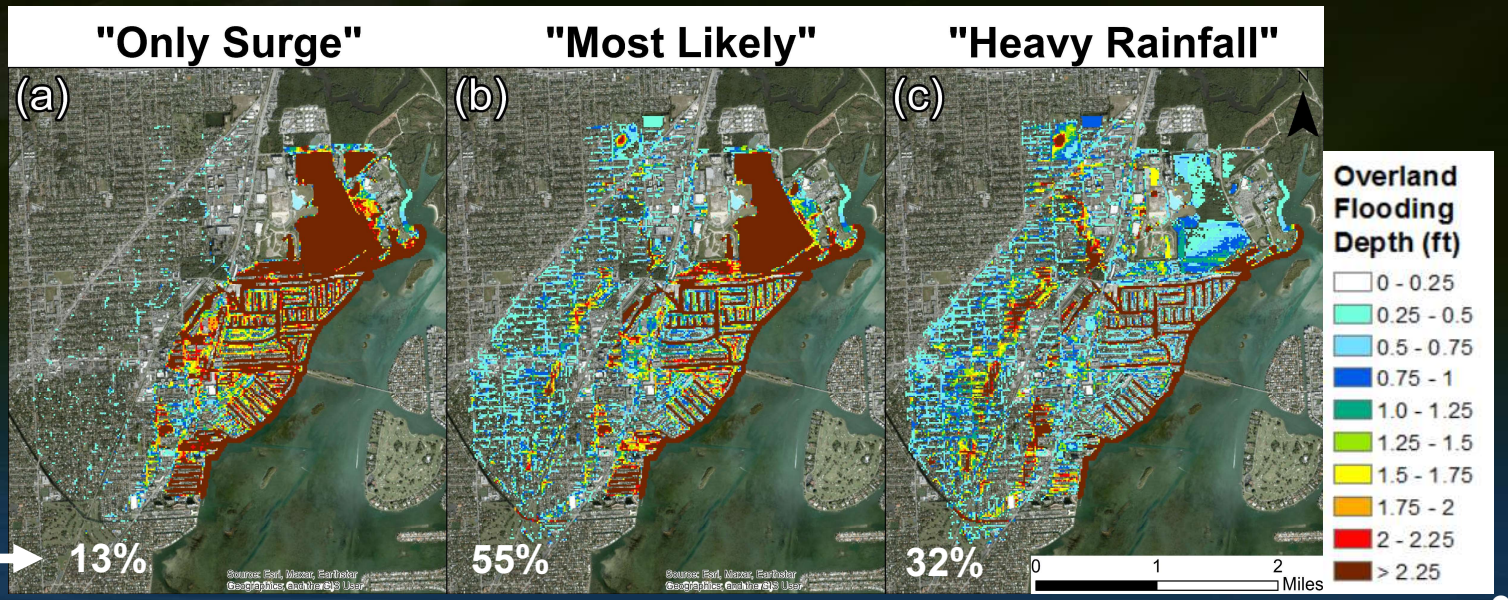


Example #2

Michael

- Ensure safe neighborhoods and access to essential services
- Risk averse mindset (NOAA Intermediate High) + long term planning: 2070

ID	Event	Total Damage (Million USD)
A	Only Surge	$171.07
B	Most Likely	$124.00
C	Heavy Rainfall	$92.94



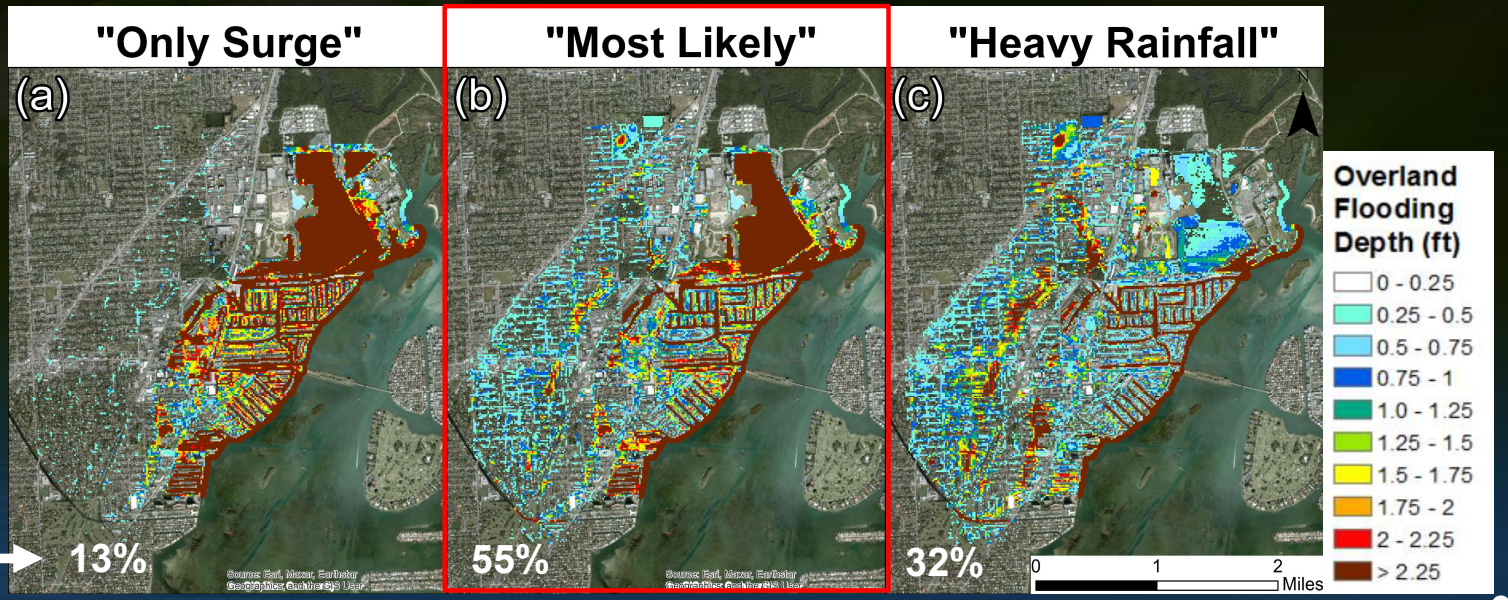
Probability of occurrence

Example #2

Michael

- Ensure safe neighborhoods and access to essential services
- Risk averse mindset (NOAA Intermediate High) + long term planning: 2070

ID	Event	Total Damage (Million USD)
A	Only Surge	$171.07
B	Most Likely	$124.00
C	Heavy Rainfall	$92.94



Probability of occurrence

Take Away Messages

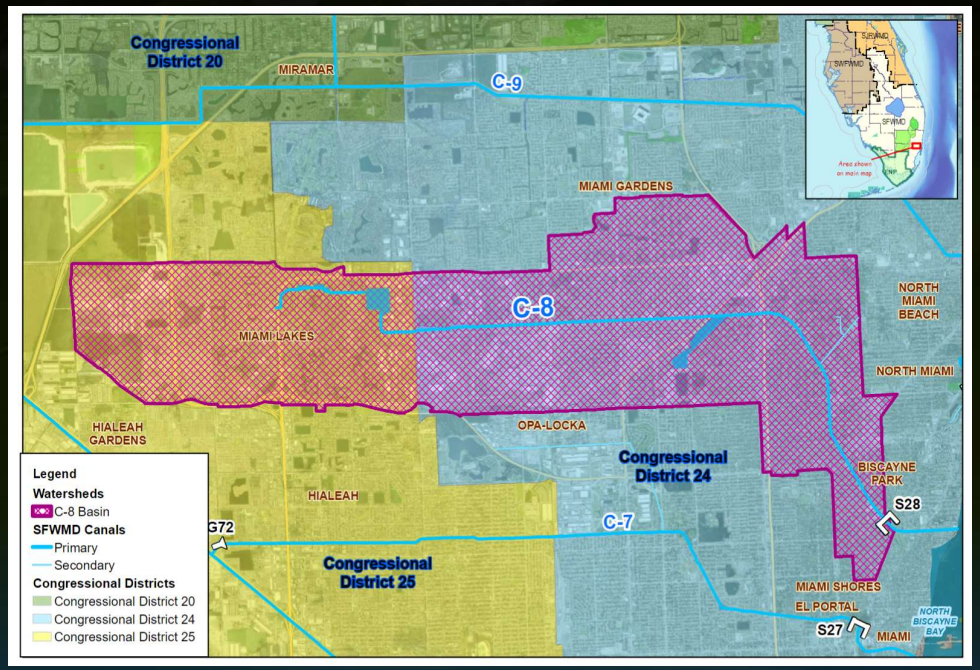
- **SFWMD-FIAT Tool:**
  - Translates hydrodynamic modeling results into economic risk assessments
  - Supports the selection of advanced H&H models that can produce more accurate flood risk estimates, while neglecting the dependence of flood drivers reduces the accuracy of estimations.
  - Performs future flood damage cost estimates using multiple flood elevation/inundation scenarios developed as part of future conditions modeling efforts
  - Helps support recommendations for flood mitigation and adaptation measures by providing a non-action cost baseline

12. Tool Application: District Resiliency Planning and Priority Projects: C-8 Basin Resiliency FEMA BRIC Application

David Colangelo
Resiliency Grant Manager
South Florida Water Management District

C-8 Basin Information

- Population of approx. 270,000
  - 19% financially disadvantaged
- 28 square miles in the northeastern portion of Miami Dade County (8 cities/towns)
- Fully developed residential/commercial
- Critical assets supporting Community Lifelines include:
  - Fire stations, other emergency operations
  - Schools and emergency shelters
  - Utilities
  - Medical facilities and others



Presenter: Dave Colangelo

S-28 Coastal Structure Information

- Main flood control features are the C-8 Canal and S-28 Coastal Structure
- S-28 conveys floodwaters by gravity to Biscayne Bay
- C-8 Canal managed by SFWMD
- Secondary canals managed by Miami-Dade County

Presenter: Dave Colangelo

Limitations in Operation

Structure Inspection Program

S28
SPILLWAY
MIAMI Field Station
South C&SF
C-8
# of Gates: 2
Lifting/Pumping Mechanism: Cable Drum, Description: Roller

Lead P.E.:
Jill Skaggs, Lead Inspector
SFWMD
Underwater P.E.:
Jeffrey O'Connor, Underwater Checklist
Underwater Engineering Services Inc.
Sep 30 2020 15:10:02

Presenter: Dave Colangelo

Flood Risks in the C-8 Basin - FPLOS PM5

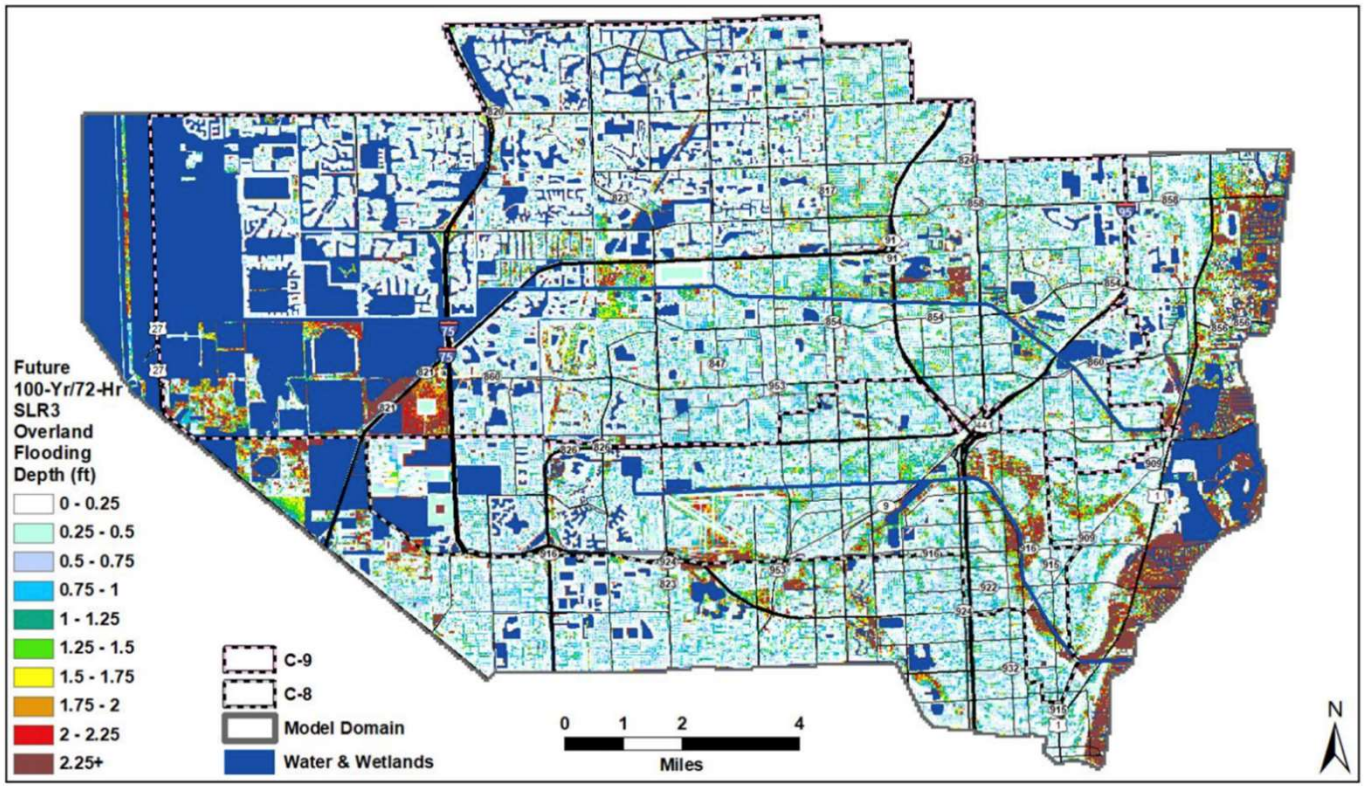


Figure 4: Flood Inundation Map for 100-Year Sea Level Rise 3 Design Storm Event

Presenter: Dave Colangelo

SFWMD FY21 FEMA BRIC Proposal @ C-8 Basin

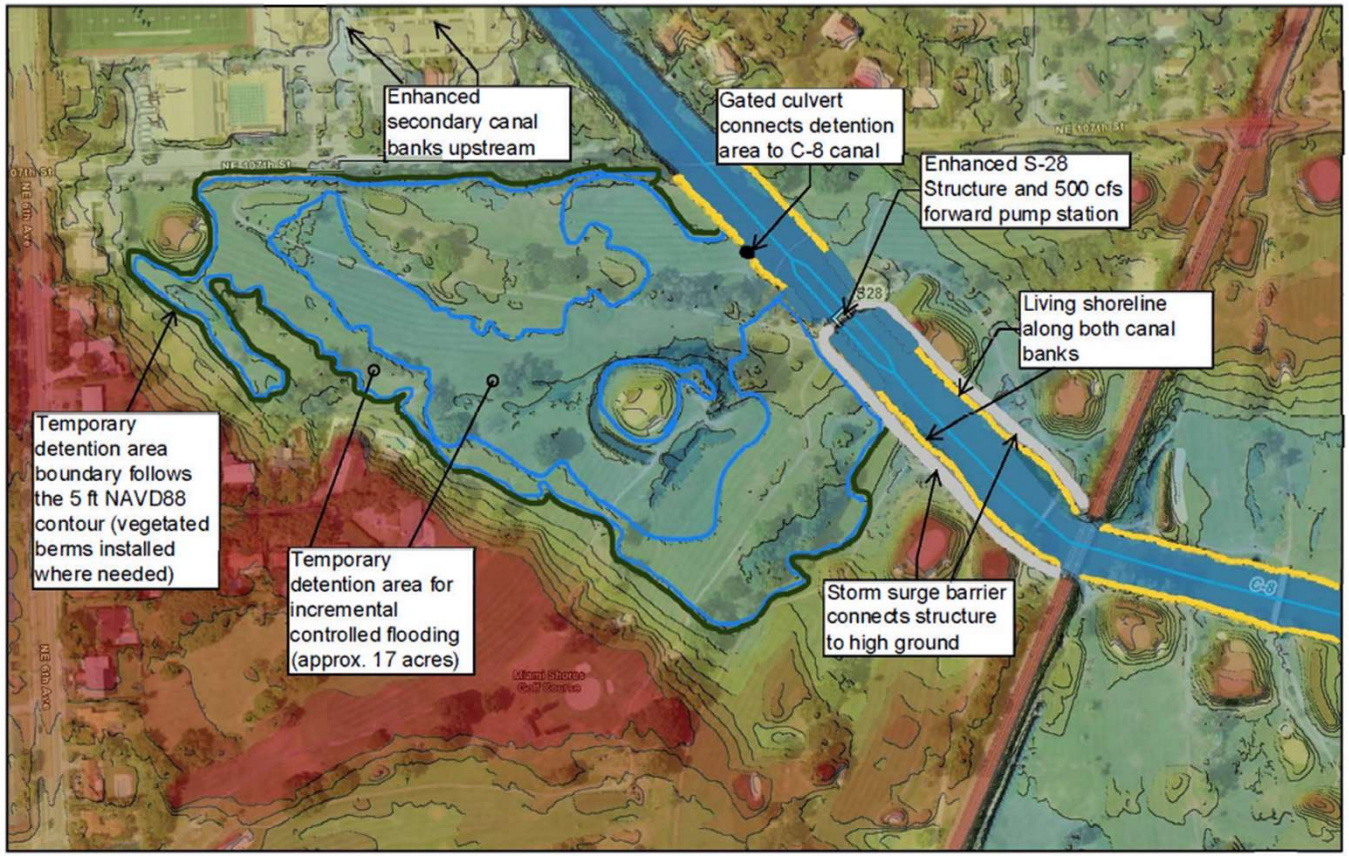
- Replacement of S-28 Structure with a more robust structure and elevated components to withstand the impacts of sea level rise and climate change
- Installation of a 500 cubic foot per second forward pump station adjacent to the S-28 structure to maintain basin discharge levels while sea levels rise.
- Construction of a flood barrier tying S-28 Structure to higher ground elevations to mitigate the impacts of sea level rise and storm surge.

GOALS: reduce flood risk under sea-level rise, by restoring the structure discharge capacity and the basin's flood level of service to enhancing quality of life in the region

SFWMD FY21 FEMA BRIC Proposal @ C-8 Basin

- Enhancement of secondary canal banks to improve flood control throughout the basin.
- Construction of a temporary floodwater detention area in a portion of the Miami Shores Golf Course near the S-28 Structure to provide temporary storage of floodwaters during extreme rainfall events.
- Installation of nature-based features such as living shoreline along the C-8 Canal and vegetated flood control berms to enhance flood protection.

GOALS: reduce flood risk under sea-level rise, by restoring the structure discharge capacity and the basin's flood level of service to enhancing quality of life in the region



C-8 Basin Conceptual Plan

South Florida Water Management District
3301 Gun Club Road, West Palm Beach, Florida 33406
561-686-8800; www.sfwmd.gov

N W E S

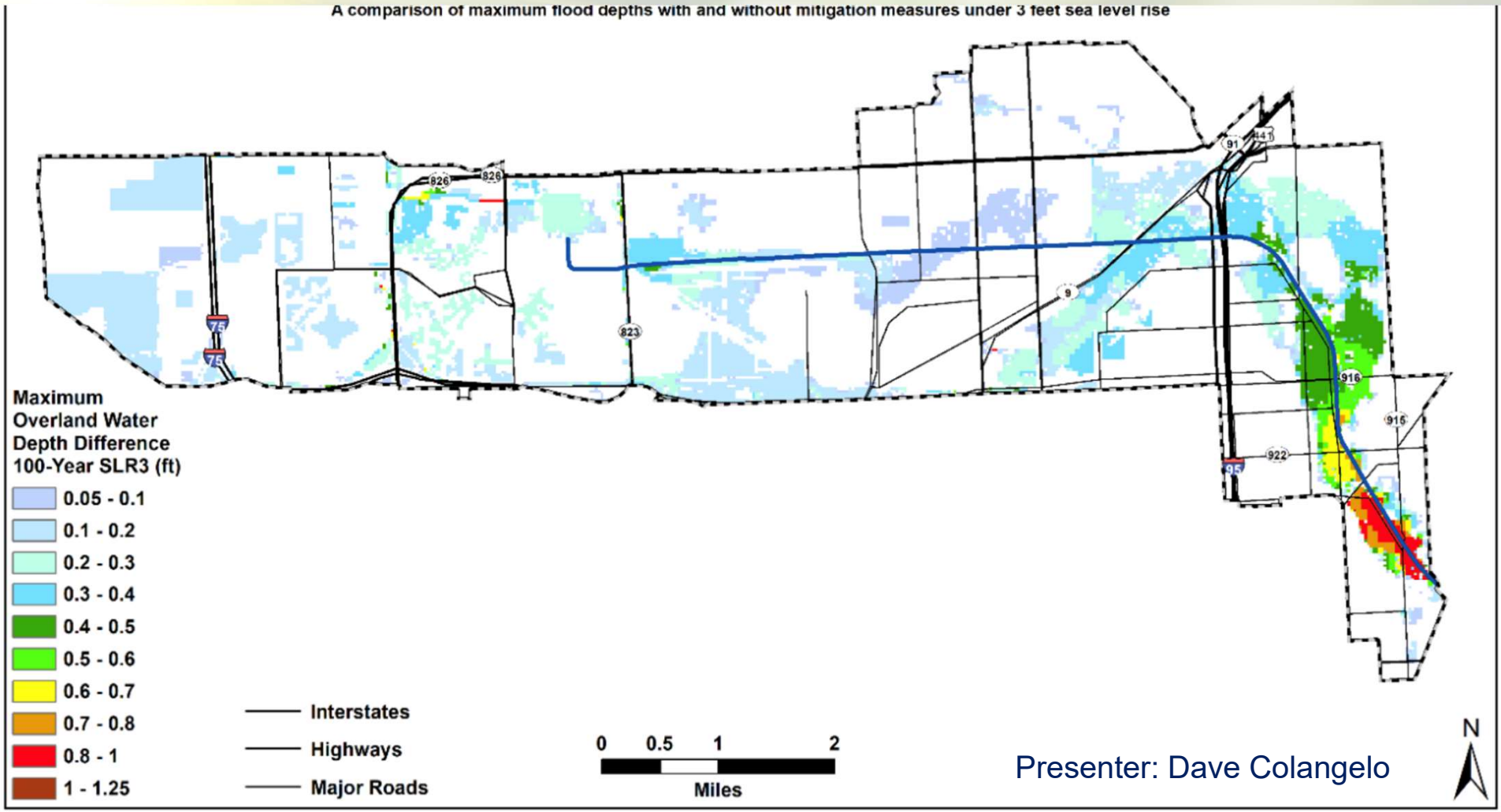
0 0.02 0.04 0.06 0.08 Miles
0 0.045 0.09 0.135 Kilometers

DISCLAIMER:
This map is a conceptual or planning tool only. The South Florida Water Management District does not guarantee or make any representation regarding the information contained herein. It is not self-executing or binding, and does not affect the interests of any persons or properties, including any present or future right or use of real property and is exempt from public records disclosure and confidential under Section 119.071(3)(e)(1), Florida Statute.

Map Produced on Date: 11/8/2021 2:54:10 PM

Geospatial Services

Presenter: Dave Colangelo



Presenter: Dave Colangelo

Figure 6: Maximum Flood Overland Depth Difference at C-8 Basin – Existing versus Mitigation Implementation

Cost Benefit Analysis:
Flood Damage Cost Estimate using SFWMD FIAT Tool

NO MITIGATION 3FT SLR

Total Damage RP5	Total Damage RP10	Total Damage RP25	Total Damage RP100	EAD
$ 1,871,247,765	$ 2,346,093,611	$ 3,202,734,771	$ 4,836,521,207	$ 534,205,224

MITIGATION 3FT SLR

Total Damage RP5	Total Damage RP10	Total Damage RP25	Total Damage RP100	EAD
$ 1,792,393,968	$ 2,278,674,886	$ 3,104,097,370	$ 4,702,260,804	$ 517,269,057

USD REDUCTION

Total Damage RP5	Total Damage RP10	Total Damage RP25	Total Damage RP100	EAD
$ 78,853,798	$ 67,418,725	$ 98,637,401	$ 134,260,404	$ 16,936,167

Total Cost including O&M = $78M

Total Benefits = $233M

Benefit Cost Ratio = 2.98

Damages calculated using SFWMD-FIAT Tool: Flood Depth Maps – FPLOS Model Simulation Results; Exposure Data – SFWMD latest spatial databases; Damage functions – USACE IWR for single family residents, other RES types, COM, EDU light industrial; FEMA Hazus 4.0 for remaining building occupancy types, roads with 100% damage at 0.6ft flood depth

13. Q&A Session 3

If you're participating in person – please fill out Section 5 at the Technical Question Card and give to a meeting attendant

If you're participating via Zoom – use the Q&A function to submit a written question or use the Raise Hand feature

If you're participating via Phone:
*9 Raises Hand
*6 Mutes/Unmutes

Moderator: Nicole Cortez

14. Public Comments

If you're participating in person – please fill out Section 6 at the Public Comment Card and give to a meeting attendant

If you're participating via Zoom – use the Raise Hand feature

If you're participating via Phone:
*9 Raises Hand
*6 Mutes/Unmutes

Moderator: Nicole Cortez

15. Closing Remarks

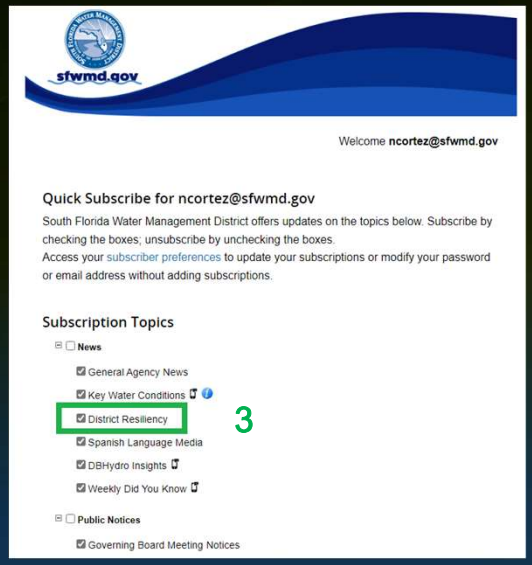
Carolina Maran, Ph.D., P.E.
District Resiliency Officer
South Florida Water Management District

Invitation for Collaboration

- SFWMD partnered with Deltares to enhance and customize the FIAT tool and facilitate its use and post-processing of results
- SFWMD leveraged Deltares expertise in building exposure datasets, identifying additional sources of data and processing workflows
- SFWMD is committed to continued enhancement of the SFWMD-FIAT to include automated exposure data compilation and processing tools
- SFWMD-FIAT tool and the associated manual are available for download (via Deltares Website) and use as is
- SFWMD will provide existing exposure datasets via e-mail request to resilience@sfwmd.gov
- SFWMD will create and provide new exposure datasets during and in preparation for FPLOS Phase II Studies
- Partnerships to further develop automation of exposure data compilation and processing tools are welcome

Subscribe for District Resiliency Updates

- Sign-up for our updates by visiting https://www.sfwmd.gov/news-events and following these steps:
  - 1 - Click on the “Subscribe for Email” icon
  - 2 - Enter your email address
  - 3 - Select “District Resiliency” under Subscription Topics



SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Thanks for participating!

Photo by Miami DDA