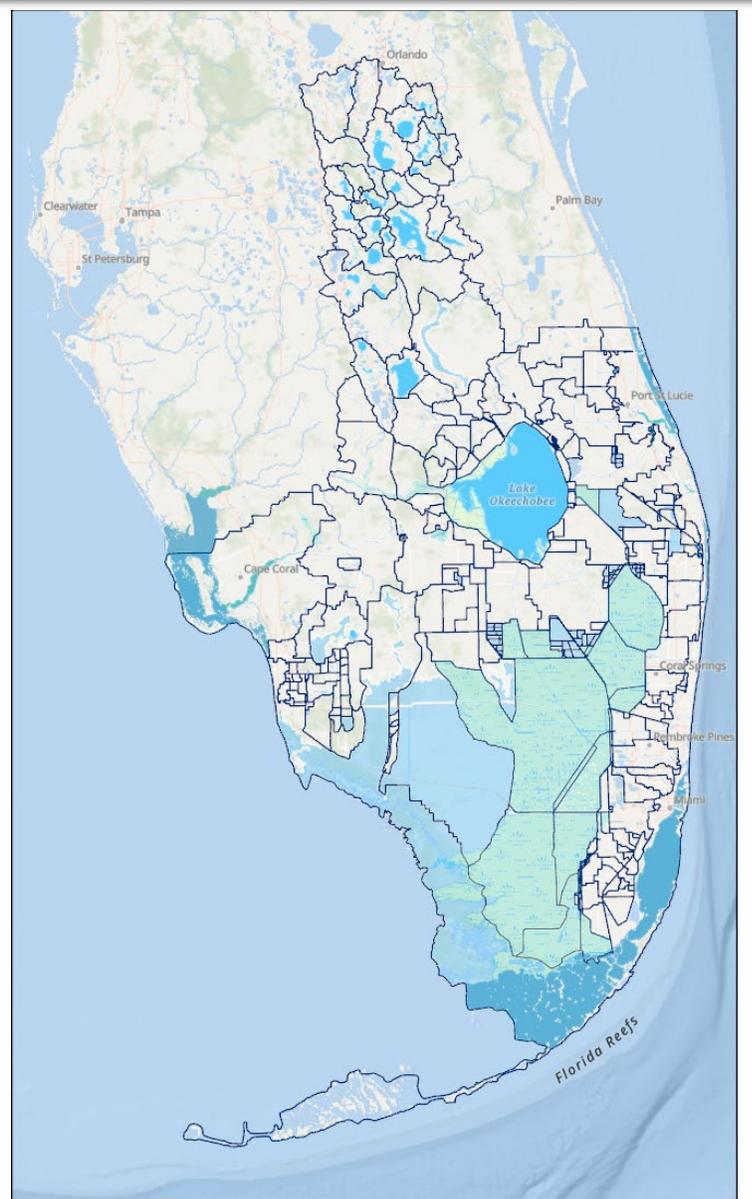
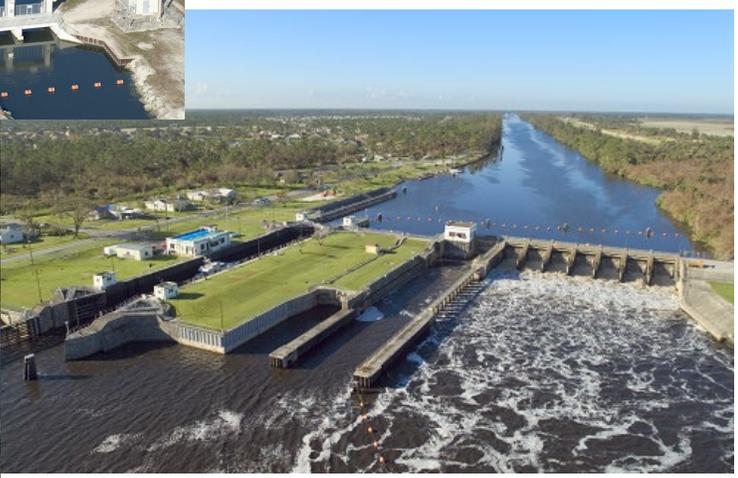


Documenting Flood Occurrence, Estimating Exposure, and Evaluating Sea Level Rise

**Christine Carlson, Lead Geospatial Scientist, IT Geospatial Services,
South Florida Water Management District**

Who Is the SFWMD and What We Do

- Mission:
 - Safeguard and restore South Florida's water resources and ecosystems;
 - Protect communities from flooding; and
 - Meet the region's water supply needs
- Serve:
 - 16 Counties from Orlando to Key West
 - ~ 18,000 square miles
 - ~ 9 million residents



Resiliency at SFWMD

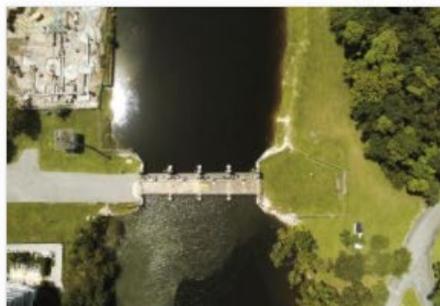
(<https://sfwmd-district-resiliency-sfwmd.hub.arcgis.com/>)

Emerging Trends in Regional Resiliency



Regional Rainfall

Changes in rainfall patterns will impact people and ecosystems by altering the amount of water in our region throughout t...



Elevations at Coastal Structures and Sea Level Rise

Tailwater and headwater elevations at coastal structures represent how sea level rise affects stormwater discharge capacity in South...



Saltwater Intrusion in Coastal Aquifers

The inland migration of saltwater poses a threat to water supply and critical freshwater habitats.



Salinity in the Everglades

The salinization of previously freshwater systems poses threats to several factors.



Estuarine and Mangrove Inland Migration

Trends in Estuarine Inland Migration provide insights to the impacts of sea level rise in coastal areas and the Everglades.



Soil Subsidence in South Florida

Maintaining soil elevations within coastal and intertidal habitats, as sea level changes, is an indicator of long-term stability of coastal.



ArcGIS Hub

Today's Presentation

- Documenting Flood Occurrence
- Estimating Exposure
- Evaluating Sea Level Rise effects on Coastal Systems
- Geospatial Tools and Technologies

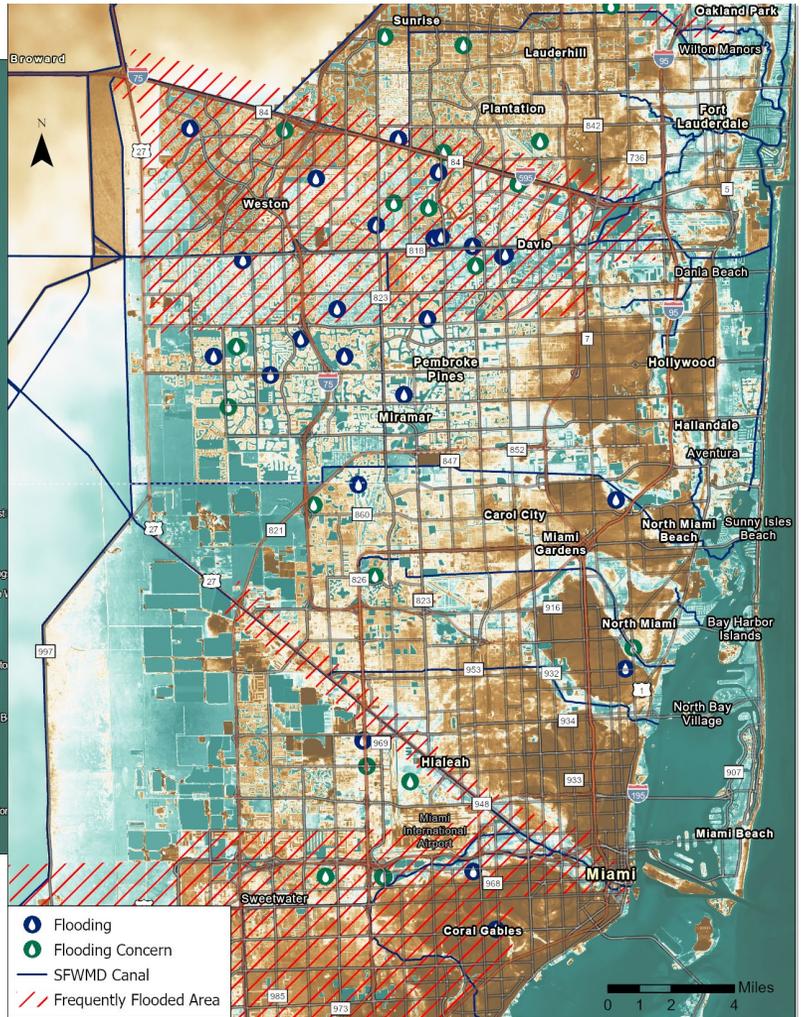
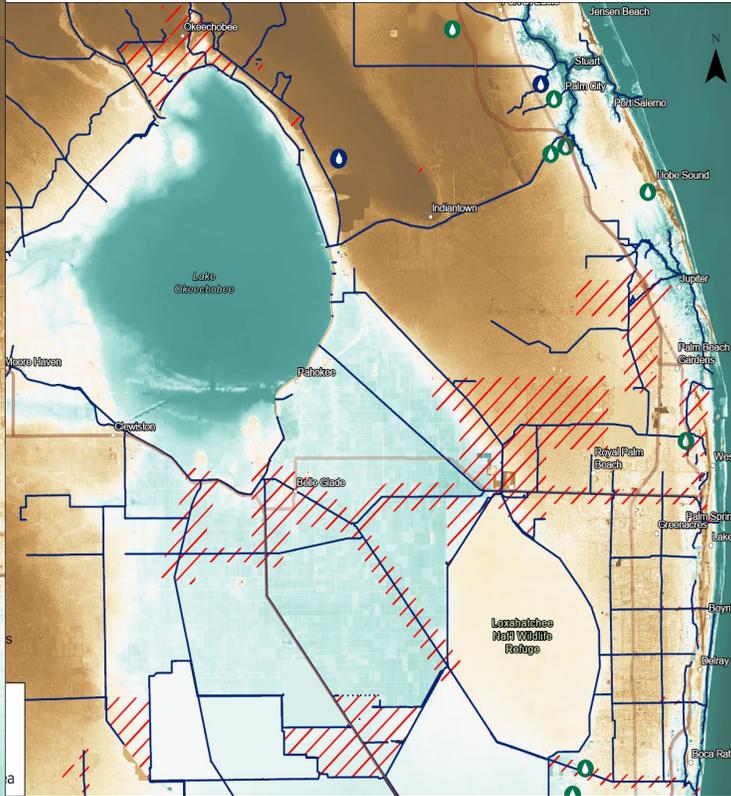
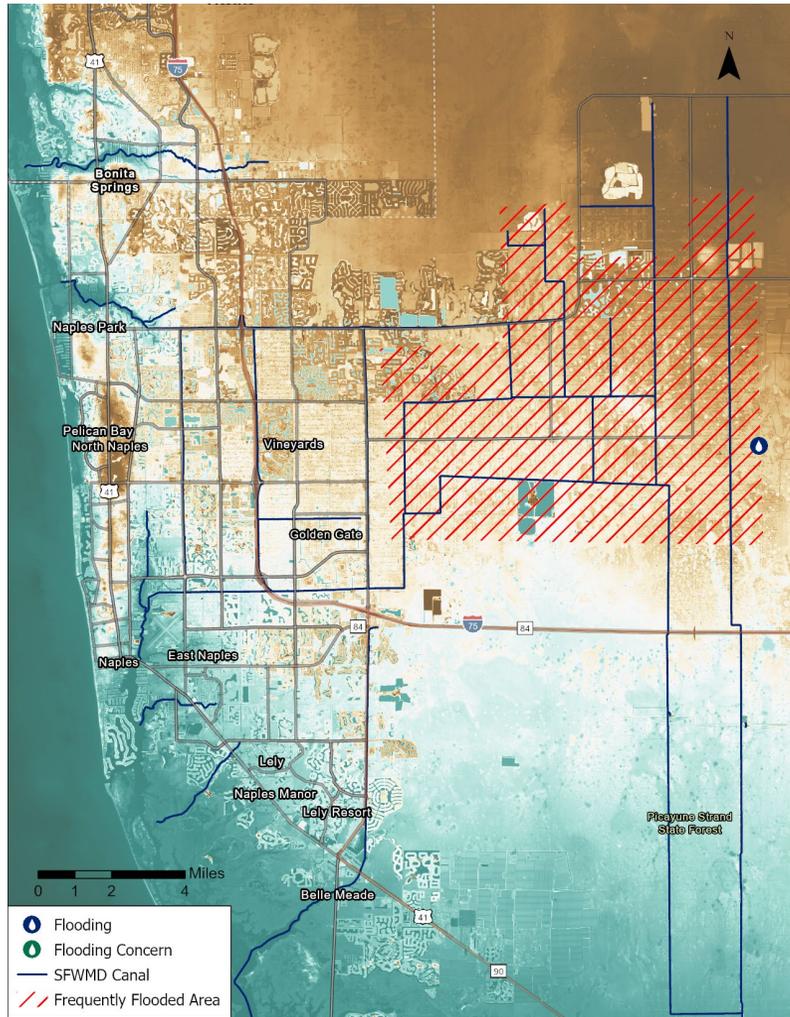


Flood Occurrence

- Standing water in areas that are generally dry



Flood Reporting Tool



FDEM Silver Jacket High Water Mark Survey

High Water Marks Survey



Collection Date:*

10/19/2021

Event Type:*

Please select one

Hurricane

Flooding

Tidal

Other

Event Name:*

Name of Hurricane or Flooding event, i.e. Michael or 2019 Spring Flooding

County:*

Select County from dropdown

-Please Select-

Recorder Name:*

Provide your Name

Recorder Email:*

Provide your Email

Location Description:*

Provide exact address or general location of high water mark, i.e. right-of-way of State Road 60

High Water Mark Description:*

Provide description of High Water Mark, i.e. water line identified on exterior of structure on garage door

Elevation (ft):*

Provide High Water Mark elevation in feet

Elevation Comments:

Provide comment on elevation, i.e. elevation provided is above ground or above datum (NAVD29 or NAVD88)

Additional Notes:

Provide any additional notes about High Water Mark

Location*

Provide location of High Water Mark

Esri, USGS | FDEP, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA
Powered by Esri

Lat: Lon:

Attachment (Required)*

Select image file

Attachment (Optional)

Select image file

Submit



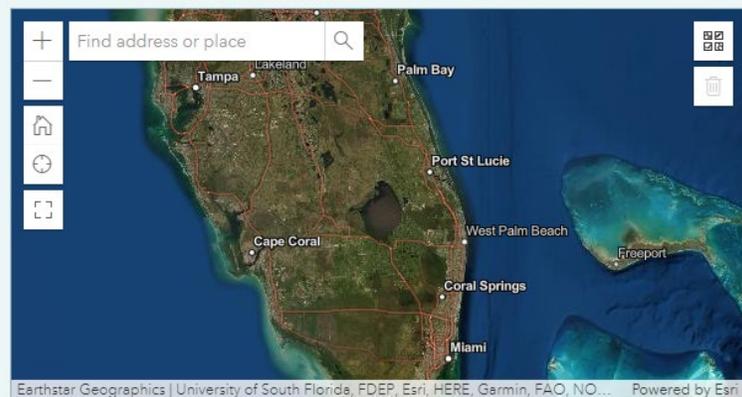
Regional Flood Observation Survey

Report Flooding Date

Please select the date that flooding occurred.

Report Flooding Location

If you are on a mobile device, please use the location icon on the left side of the map to identify your location. If on a computer, enter your address or navigate to your location using the map.



Submit Photos

We would like to see pictures of this flooding. Use your computer/mobile device to upload up to 3 photos or take a picture using the camera icon seen in this section of the survey.

1

Provide More Information About This Flooding

What type of flooding?

Standing Water

Street Flooding

Structure Flooding

Agricultural Flooding

What type of structure?

Residential

Commercial

Industrial

Other

How deep is flooding?

-Please Select-

Ankle deep

Knee deep

Greater than knee deep

Other

Does this area flood frequently?

Yes

No

How frequently?

Only during hurricanes and tropical storms

Only during heavy rain events

During King Tides

Every time it rains

Other

Please enter other information about this flooding you would like to report



ArcGIS Survey123

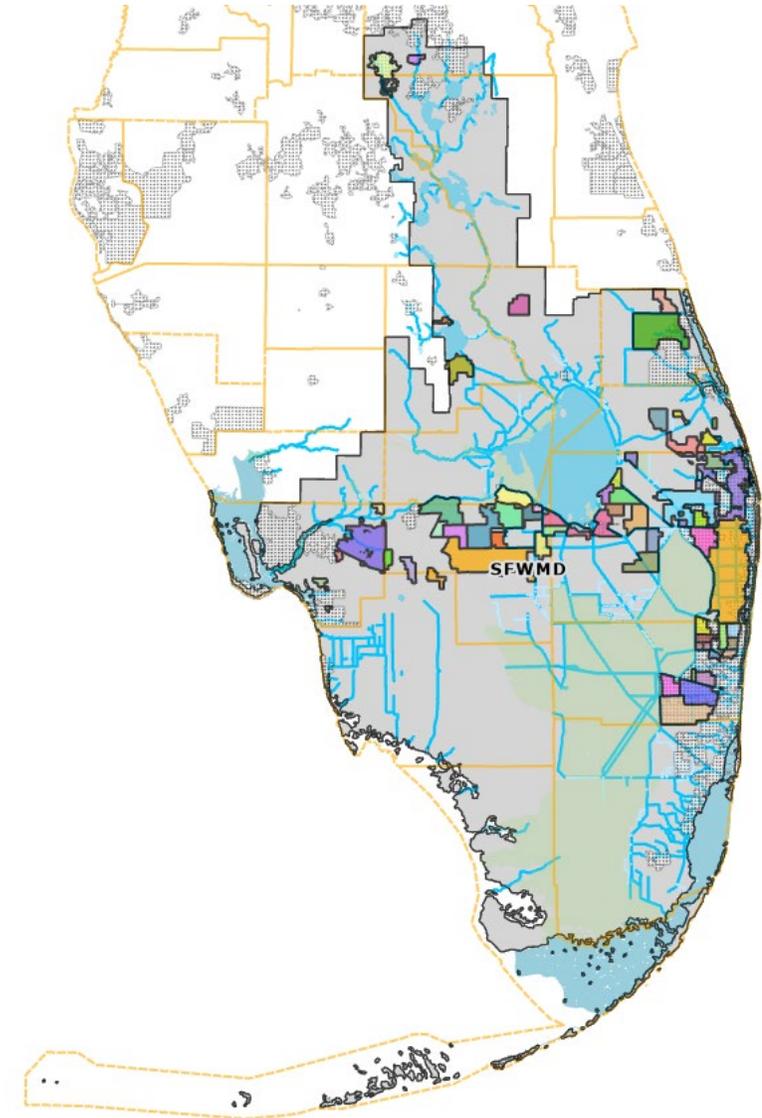
Uses for these data

- Validate / Ground Truth modeling results
- Increase our understanding of frequently flooded areas
- Estimate inundation depths and extents associated with measured high water marks



Challenges to Regional Reporting and Analysis

- Regionally consistent information
 - Different entities collect different information in different ways for different purposes
- Translation ambiguities
 - Does my good mean the same as your good?



Flood Occurrence – In Summary

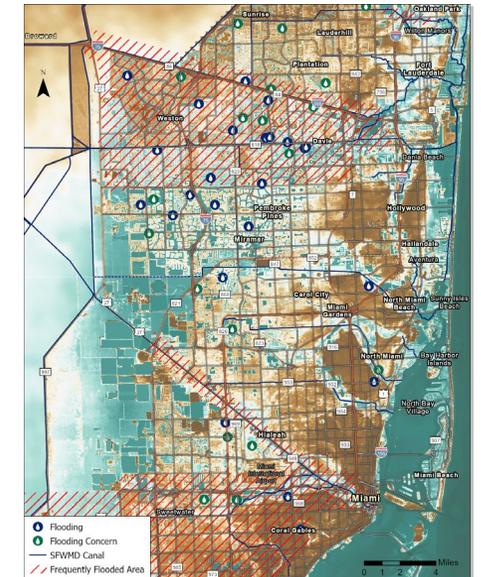
- Flood Occurrence is standing water in areas that are generally dry. Documenting flood occurrence at a regional scale will help us to better understand the scope and frequency of flooding and allow us to track this occurrence over time.



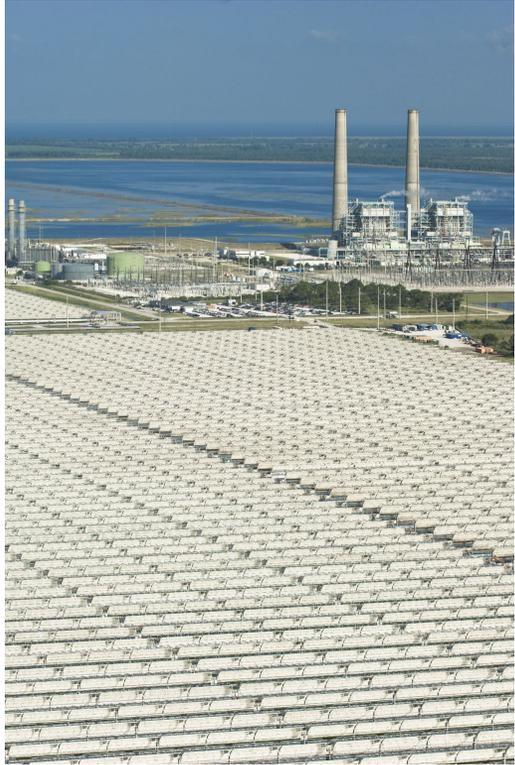
- Timely reporting of emerging flood conditions will support deployments of resources to collect additional information



- Widely accepted and used regional tools will bring equity in reporting capabilities across the region and provide increased situational awareness not previously available to water managers



Quantifying Susceptibility to Loss, a.k.a. Exposure



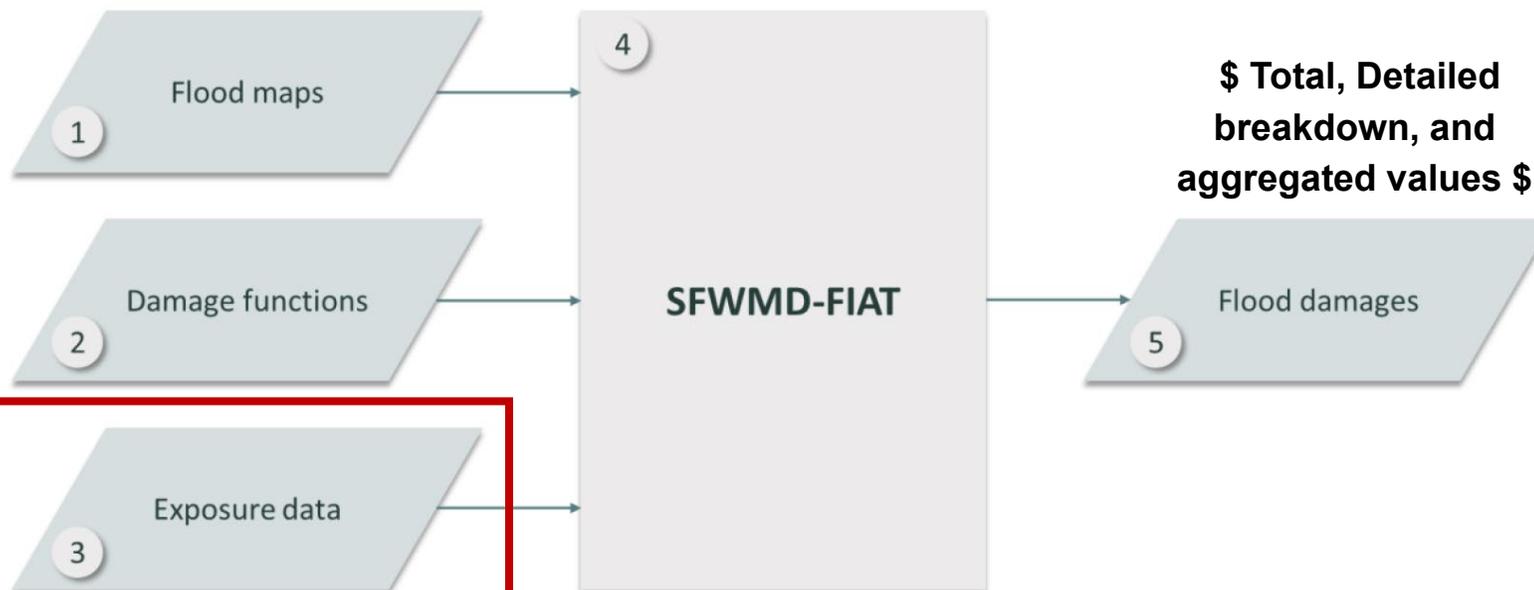
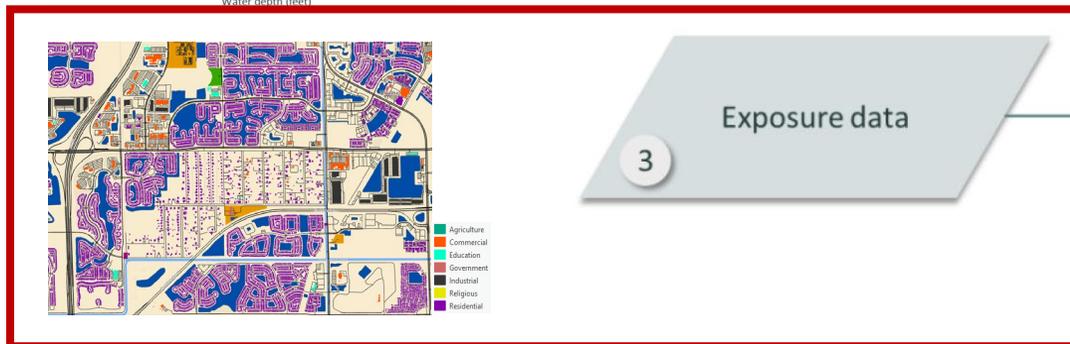
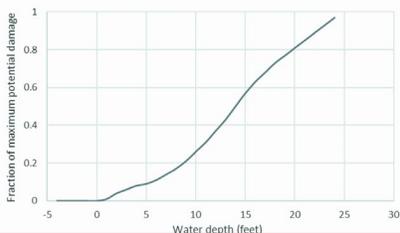
- Determine susceptibility of Infrastructure to flooding
 - Buildings, Utilities (water treatment, electrical substations, water management structures), and roads
- Assign replacement values



SFWMD-FIAT Desktop Damage Calculator

- Collaboration between SFWMD and Deltares USA
- FIAT – Fast Inundation Assessment Tool

- Inundation Depth
- Water Surface elevation

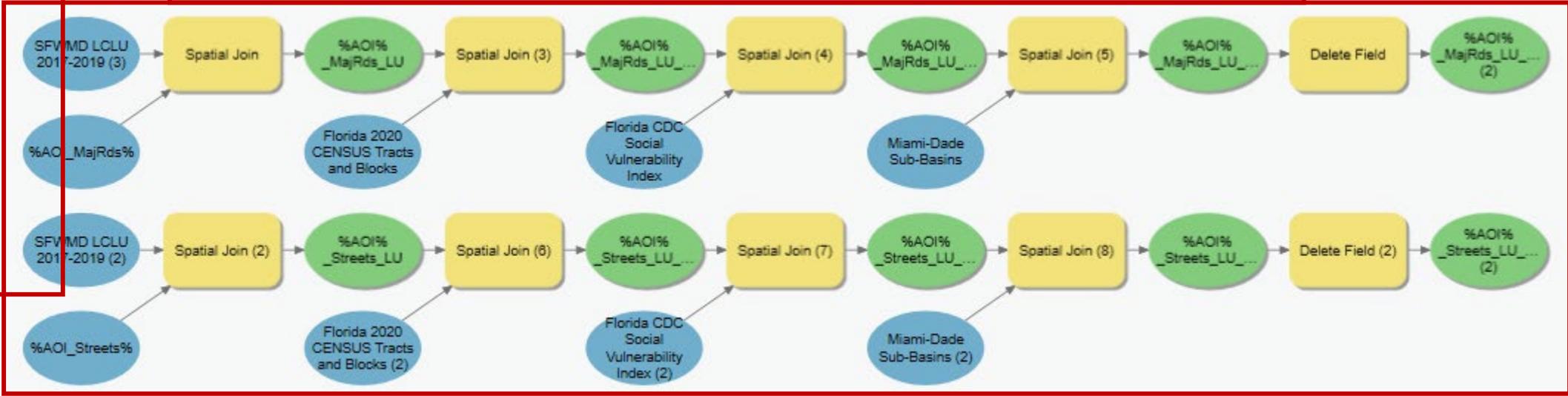
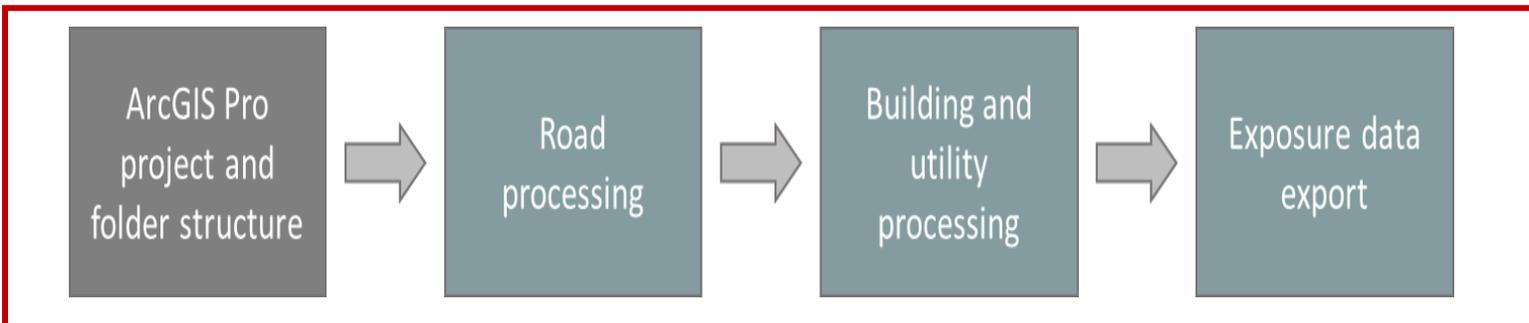


Deltares USA

Leveraging Model Builder to Compile FIAT Exposure Data Inputs

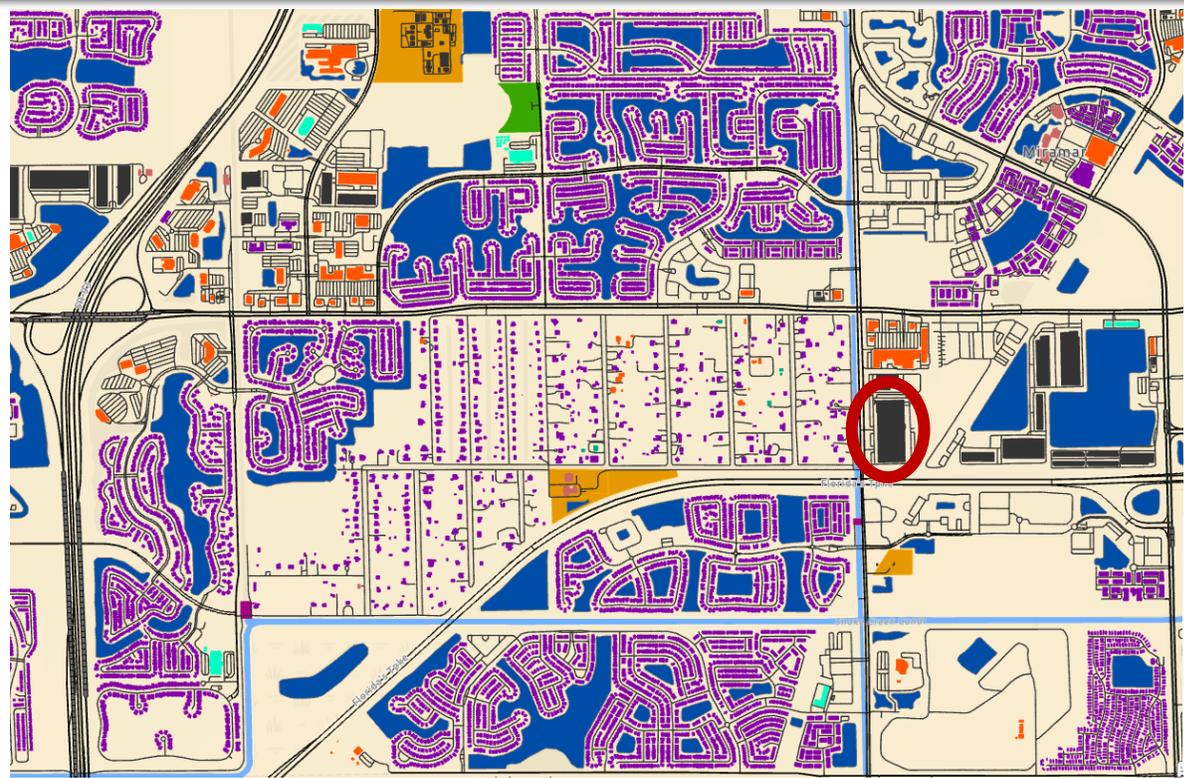


- ExposureDataProcessing.tbx
 - CombineExposureAndOutput
 - ExposureFix
 - FpAOI
 - FpAOIDmgFuncValues
 - FpAOILU
 - FpAOITaxUse
 - FpAOIUtilities
 - FpAOIZonalStats
 - FPprocessing
 - RdAOI
 - RdAOIZonalStats
 - RdExposure
 - RdGenerateSegments
 - RdSpatialJoins



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

SFWMD-FIAT Exposure Data

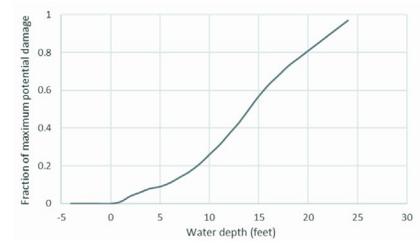


Exposure Data Sources:

- County Supplied Building Footprints
- SFWMD Normalized Parcel and Land Use
- High Resolution Topo-Bathymetric Data
- Navteq / HERE Roads
- HAZUS Occupancy Types and Depreciated Replacement Values

Primary Object Type	Secondary Object Type	Damage Function: Structure	Structure Replacement 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
EDU2	Average college/university	h_struct_652	184.68

Object Name	Primary Object Type	Secondary Object Type	Ground Elevation	Max Potential Damage: Structure	Shape_Area
fp_14	RES3E	Condominium, living area on multiple floors	5.775975	1065164	4900.234817
fp_15	COM4	Average Prof/Tech Services	4.319839	2145821	11274.214758
fp_16	RES3C	Condominium, living area on multiple floors	10.29773	947148.1	4357.308334
fp_17	IND3	Average Food/Drug/Chem	7.725961	353595.4	1814.705511
fp_18	RES3E	Condominium, living area on multiple floors	5.953907	1091480	5021.298025
fp_19	RES3E	Condominium, living area on multiple floors	6.359	1039605	4782.653075
fp_20	RES1-2SNB	Res 1, 2 Story no Basement	6.383797	872329.1	6582.125531



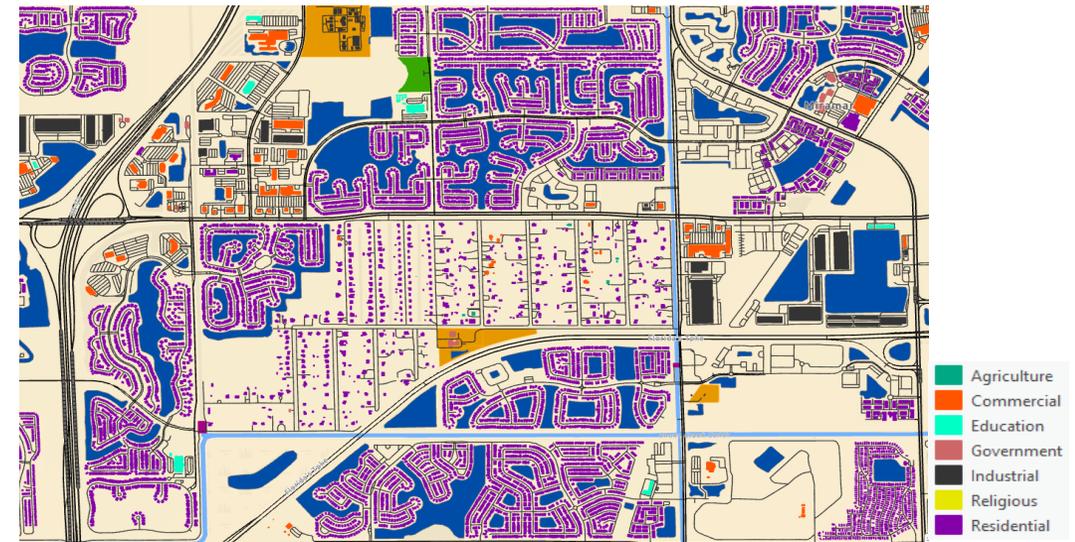
Deltares USA

Exposure Data – In 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.



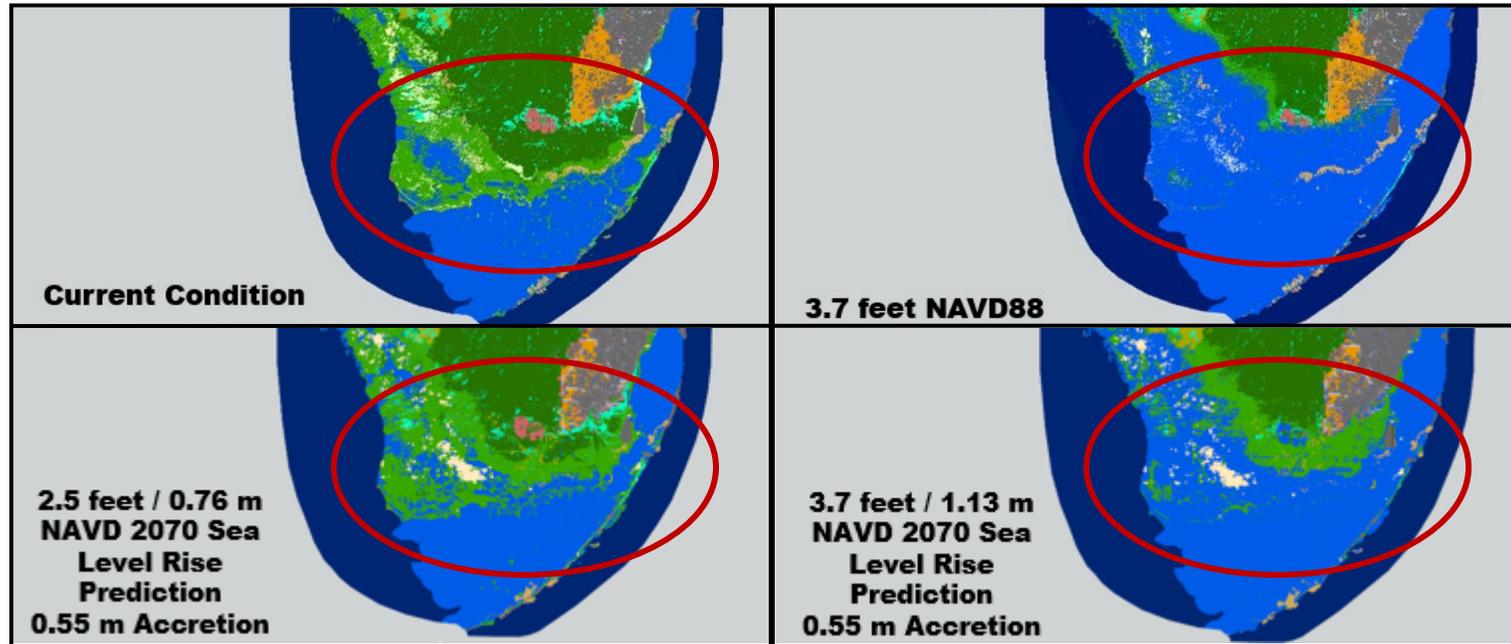
- These data provide a means for us to quantify the cost of flooding within the built environment and put a financial value on a flood mitigation strategy



- Quality of the damage estimation is dependent on the combination of all the data inputs

Evaluating Sea Level Rise effects on Coastal Systems

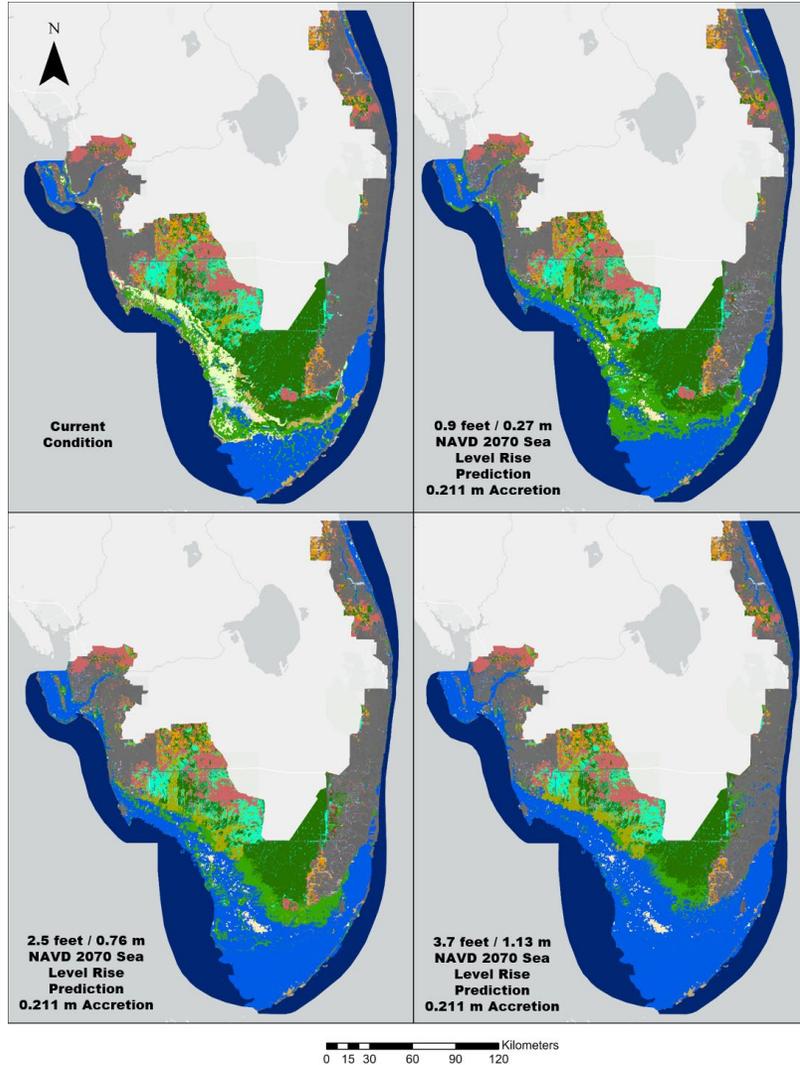
- Study evaluated how coastal wetlands will likely respond to increased water levels associated with projected sea level rise and the potential for natural soil accumulation to mitigate these water level impacts
- Study found natural processes may be able to mitigate lower sea level rise projections but under higher sea level projections, these wetlands would convert to open water and the coast would lose the protective services these wetlands provide
- Study outcome is a project to explore the potential use of dredged material from federal channels for a nature-based mitigation method called thin-layer placement (TLP)



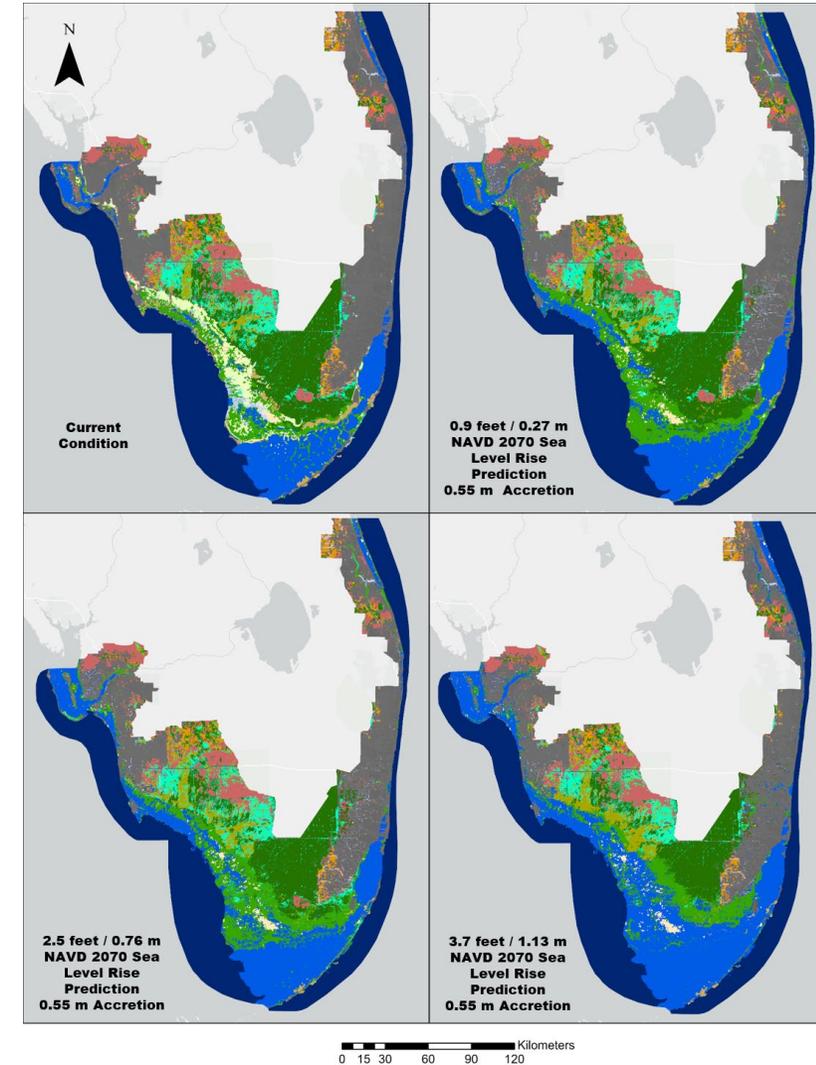
- Viability of TLP to maintain the ecosystem functions of mangrove wetlands
- Improve understanding of TLP applications in mangrove wetlands
- Evaluate methods/logistics involved with TLP and options for beneficial use of dredged material and other sediment sources in mangrove wetlands



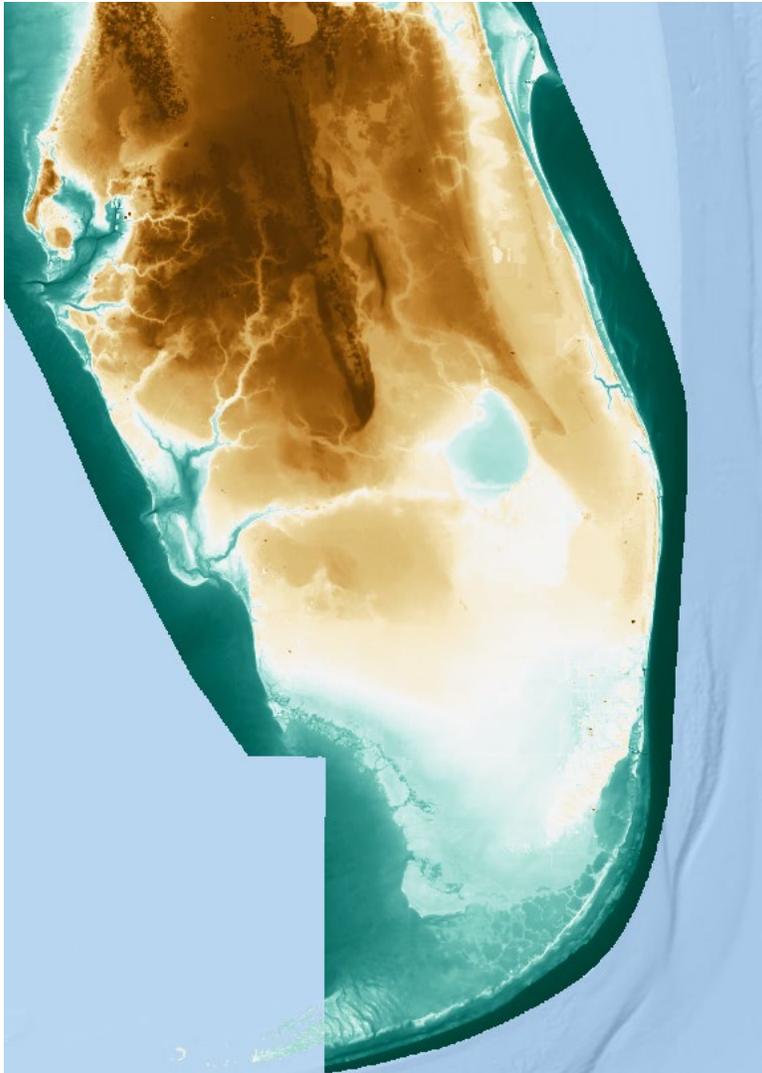
Coastal Ecosystem Vulnerability and Sea level Rise in South Florida: A Mangrove Transition Projection



- A topobathymetric elevation mosaic was created and resampled to produce the study and accretion DEMs
- Sea level rise (SLR) masks were generated using raster calculator conditional statements
- Land cover data were reclassified to study land cover classes
- Masks were used to calculate water depths within study cover classes
- A land cover transition model was applied to predict cover class change with and without accretion



SFWMD Districtwide Elevation Mosaic



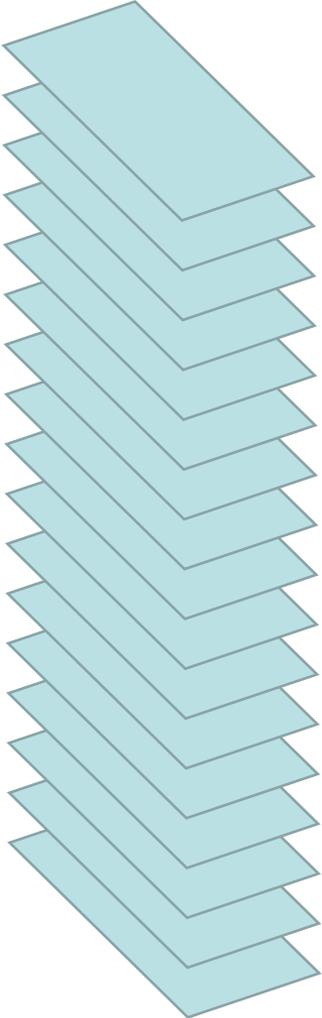
- Developed using Esri's Image Management Workflows
- Incorporates best available USGS 3D Elevation Program terrestrial and NOAA topobathymetric digital elevation models (DEMs)



Overview

Image Server provides a distributed computing and storage system to power analytics and serve large collections of imagery, elevation data, rasters, and other remotely sensed data.

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, sea levels, etc.

- Flood Reports
- Highwater Marks
- 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/>



ArcGIS Living Atlas of the World

ArcGIS Open Data



Utopia



biography.com

**A world governed by
reason and people who
share a common culture
and way of life**

Sir Thomas More (1477-1535)

Data Utopia

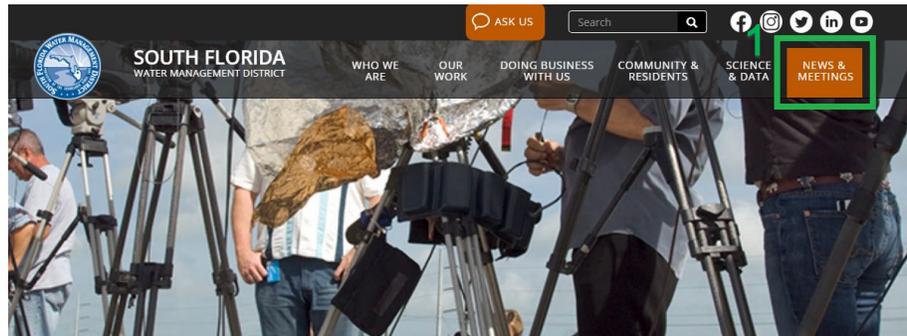


Istockphoto.com

**A world with high quality
readily accessible data that
can be applied to large- and
small-scale local and global
challenges**

Subscribe for District Resiliency Updates

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

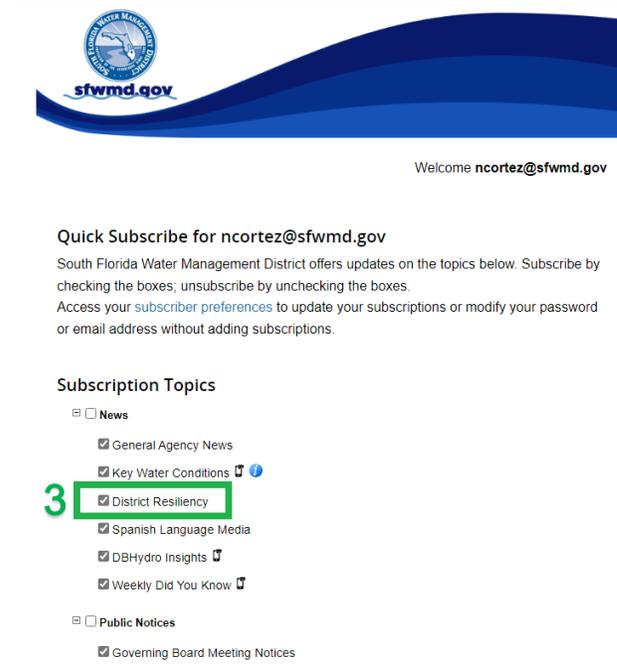


Home >> News Events

News Releases
News Archive (Oct. 2009 - July 2020)
Fact Sheets
Calendar
Photo and Video Resources
Public Meetings and Forums

News and Meetings

Our large network of communication channels allows you to interact with the District, share opinions, participate in public meetings and engage with us in real-time. You can also use these channels to read statements and news releases, find information during an emergency, or learn about our mission and the work we do. The following is a directory of all of the District's communication channels.



- You may sign-in to update your current preferences if you're already signed-up.

Thank You!