SFWMD's Water and Climate Resilience Metrics: A Status Update

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9th Biennial UF Water Institute Symposium
February 21, 2024

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Summary

- SFWMD has established an initial set of metrics to aid climate-informed decision-making and resilience planning.
- SFWMD has documented emerging trends in water and climate metrics monitored by SFWMD to inform and support its mission activities.
- SFWMD is effectively monitoring evolving climate conditions and system responses.
- SFWMD is actively collaborating with local and regional institutions to both develop approaches for determining future scenario projections and create the projections.

Introduction

June 3, 2020 – Water and Climate Resilience Metrics Phase I

PROJECT TEAM

Akintunde Owosina	Hydrology and Hydraulics
Alan Buzard	Hydro Data Management
Amanda Kahn	Applied Science – Coastal Ecosystems
Brian Turcotte	Applied Science – Data Management
Carol Ballard	Hydrology and Hydraulics Modeling
Cassondra Armstrong	Applied Science – Water Quality Treatment
Christian Avila	Water Quality - Compliance Assessment & Reporting
Christopher Madden	Applied Science – Everglades Systems
Fred Sklar	Applied Science – Everglades Systems
Heather Kostura	Geospatial Services
Hongying Zhao	Hydrology and Hydraulics Modeling
Jeffrey Iudicello	Hydrology and Hydraulics Modeling
Jenifer Barnes	Hydrology and Hydraulics Modeling
Jenni Hiscock	District Resiliency
Jennifer Reynolds	Ecosystem Restoration and Capital Projects
Jesse Markle	Environmental Resources and Regulation Support
Jessica Frost	Applied Science – Coastal Ecosystems
Jill Margolius	Communication and Public Affairs
John Raymond	Hydro Data Management
Juli LaRock	Water Quality - Compliance Assessment & Reporting
Kris Esterson	Water Supply Planning
Lawrence Glenn	Water Resources
Mandy McDonald	Applied Science – Everglades Systems
Mark Elsner	Water Supply
Matthew Morrison	Ecosystem Restoration
Michael Brown	Hydrology and Hydraulics Modeling
Patricia Burke	Water Quality Monitoring
Ronda Albert	IT Applications
Sarah Noorjahan	Hydro Data Management
Sean Sculley	Applied Science - Lake and River Ecosystems
Sean Williams	Hydro Data Management
Seyed Hajimirzaie	Hydrology and Hydraulics Applied Hydrology
Shimelis Setegn	Applied Science – Coastal Ecosystems
Stuart Van Horn	Water Quality
Suelynn Kirkland	Operations
Toni Edwards	Applied Science – Coastal Ecosystems
Walter Wilcox	Hydrology and Hydraulics Modeling

Technical Leads

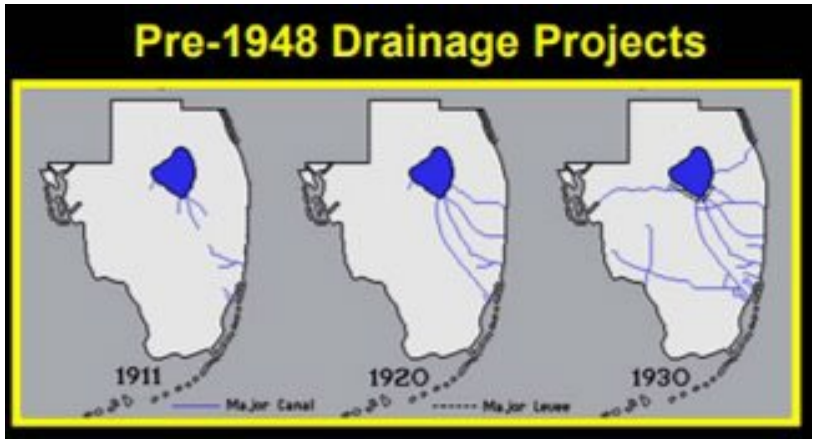
Alaa Ali	Hydrology and Hydraulics Modeling
Carlos Coronado	Applied Science – Everglades Systems
Christine Carlson	Geospatial Services
Karin Smith	Water Supply Planning
Nenad Iricanin	Water Quality - Compliance Assessment & Reporting
Tibebe Dessalegne	Hydrology and Hydraulics Applied Hydrology
Yibing Kevin Zhu	Hydro Data Management

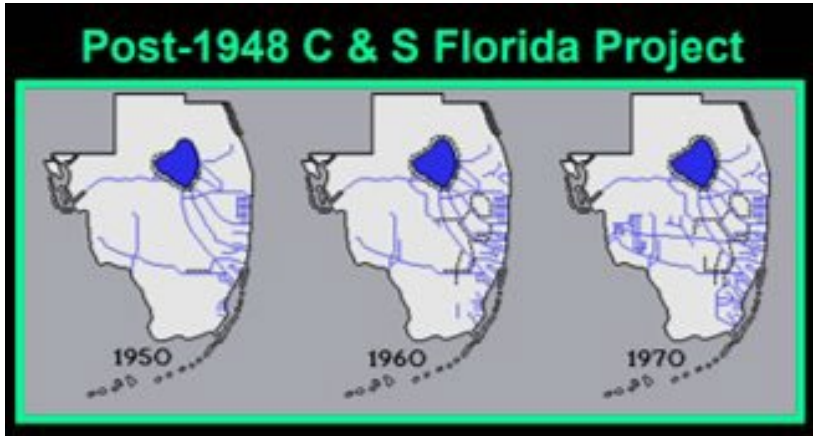
Overall Coordination

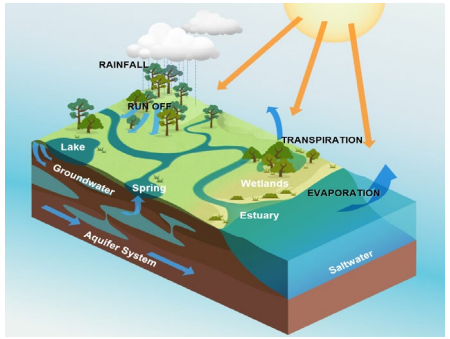
Carolina Maran	District Resiliency
Nicole Cortez	District Resiliency

Background – SFWMD

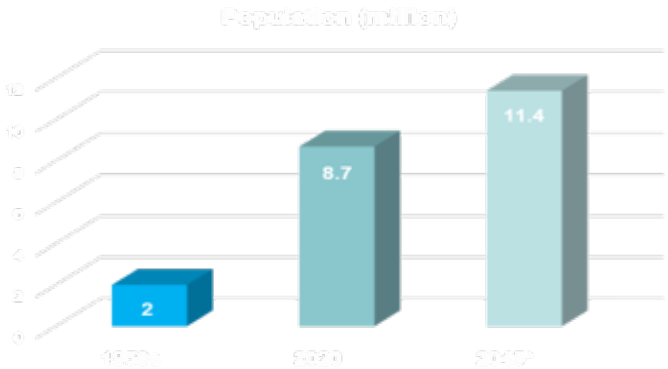
Recognizing changing conditions in a non-stationary climate

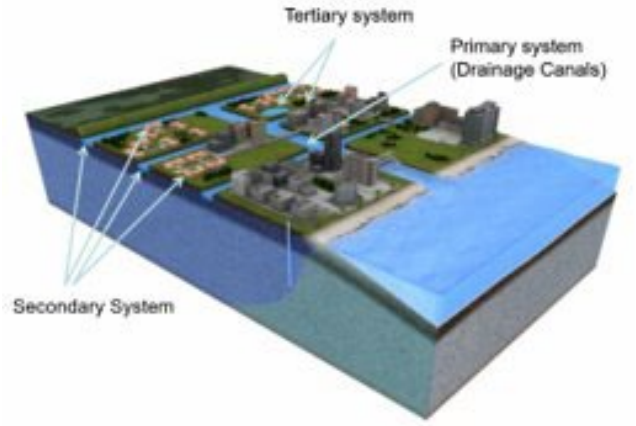






Source: Florida Center for Instructional Technology – University of South Florida





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Background – Resiliency Program

Program Highlights

Water and Climate Resilience Metrics

Advancing relevant data and science on observed changing conditions and future projections to support resiliency planning strategies and making it available to the public and partner agencies.

Regional Consistency in Assessing Vulnerability and Adaptation Planning

Advancing tools, techniques, and models to support local and regional vulnerability assessments and adaptation planning, through continuous implementation of the Flood Protection Level of Service (FPLOS) Program, Water Supply Plans, and Ecosystem Restoration efforts.

Sea Level Rise and Flood Resiliency Plan

Characterizing a comprehensive list of priority resiliency projects with the goal of reducing the risks of flooding, sea level rise, and other climate impacts on water resources and increasing community and ecosystem resiliency in Central and Southern Florida.

Resiliency Projects Implementation

Implementing relevant, funded projects to enhance infrastructure to current and future conditions, improve storage and conveyance capacity, increase operational flexibility, maximize the integration of nature-based solutions, enhance coastal wetlands and other ecosystem services, along with piloting innovative technologies that aid in protecting water systems in Central and Southern Florida.

Resiliency Coordination Forum

Promoting regional coordination and partnership opportunities by holding proactive discussions, leveraging technical knowledge and exchanging information, and fostering a constructive environment to discuss tangible asset-level solutions and support decision making on water resource management.

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Introduction

15 Priority Metrics Identified

- Climate metrics, which are the primary drivers of observed changes in climate conditions that impact the hydrological cycle.
- Resilience metrics, which represent observed consequences of changing climate conditions and can be managed or mitigated through operation of the water management system or implementation of adaptation strategies.

Hydrology

1. Rainfall
2. Evapotranspiration
3. Groundwater Levels
4. Minimum Flows and Water Levels (MFLs) –Exceedances/Violations
5. Flooding Events

Water Quality

9. Water Temperature
10. Dissolved Oxygen
11. pH
12. Specific Conductance

Sea Level

6. Tidal Elevations at Coastal Structures
7. High Tide Events
8. Saltwater Intrusion – Chloride Levels

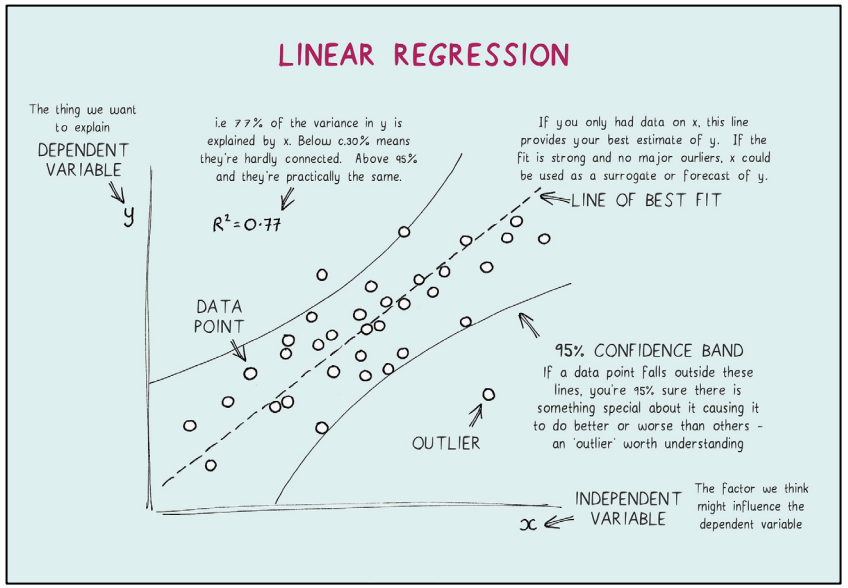
Ecosystem

13. Salinity in the Everglades and Biscayne Bay
14. Soil Subsidence/Accretion
15. Estuarine Inland Migration

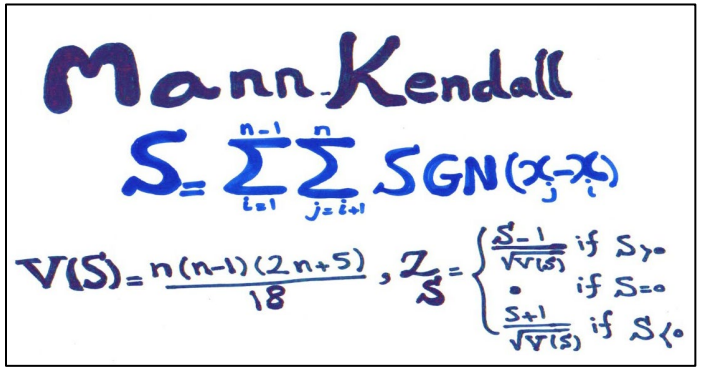
Introduction

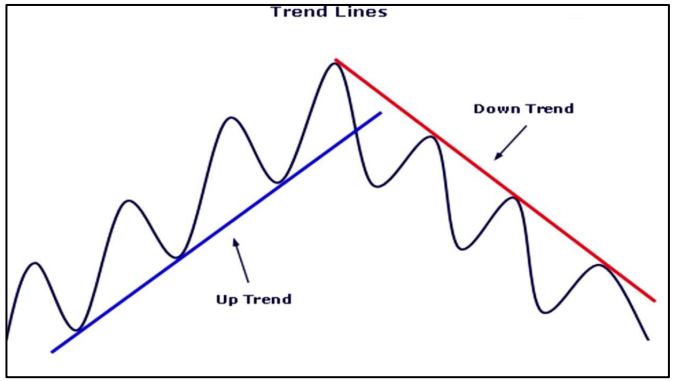
Consistent Analytical Approach Selected

- Linear Regression (correlation, not prediction) – To define relationships between variables.



- Mann Kendall (Non-seasonal and seasonal) – To identify trends over time.





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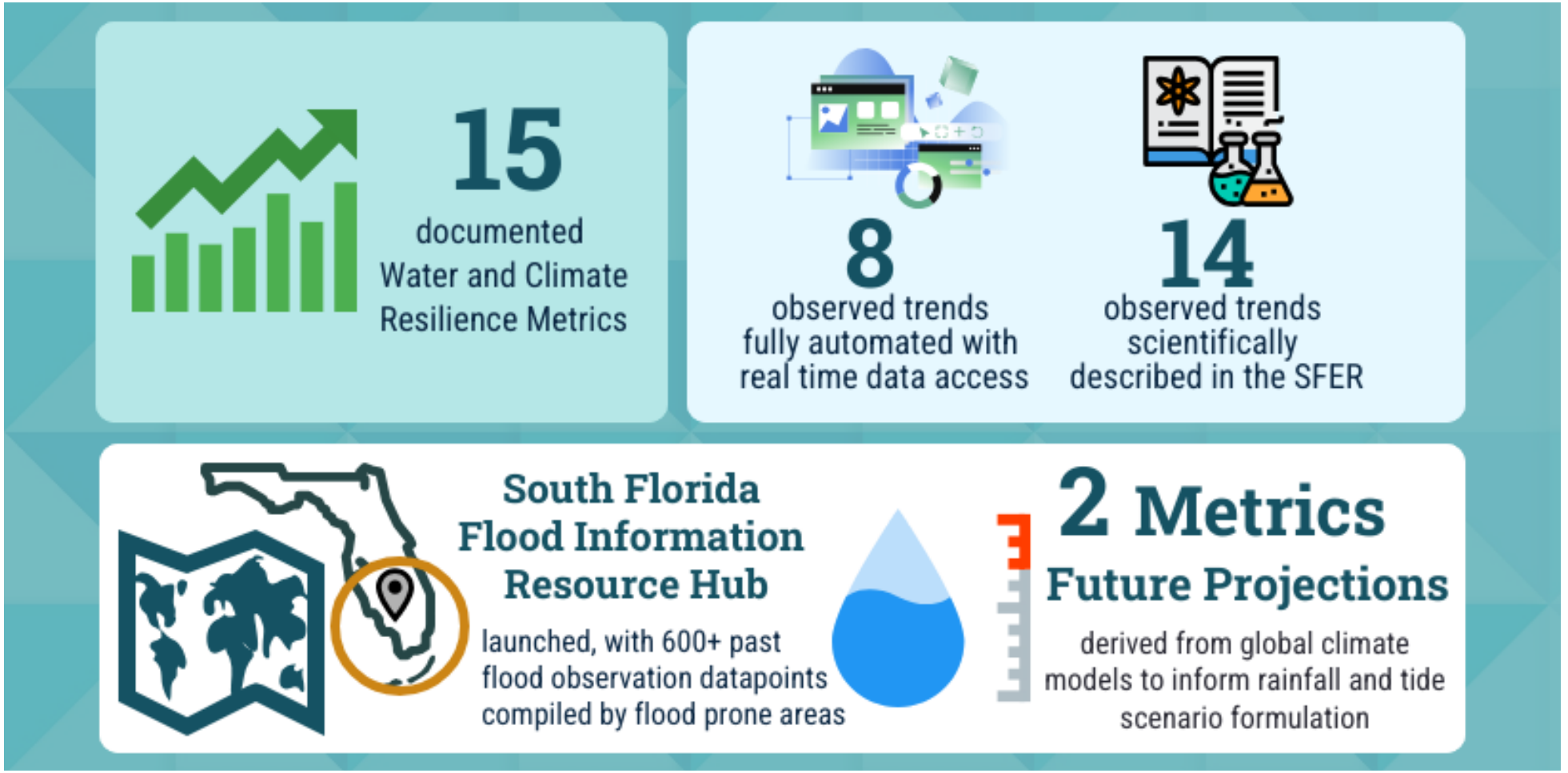
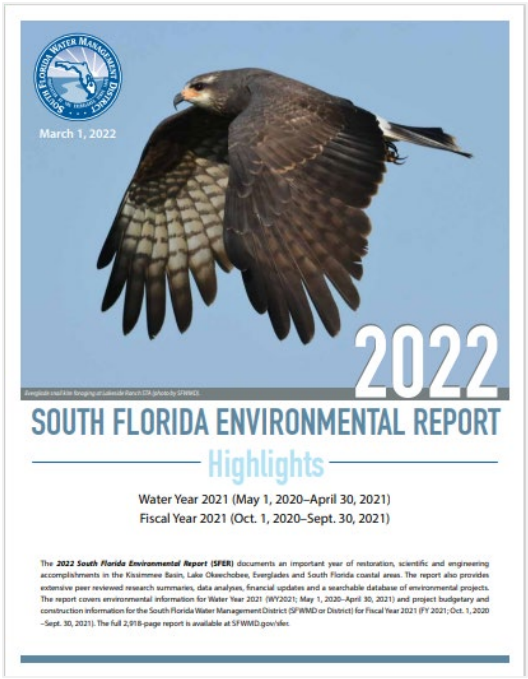
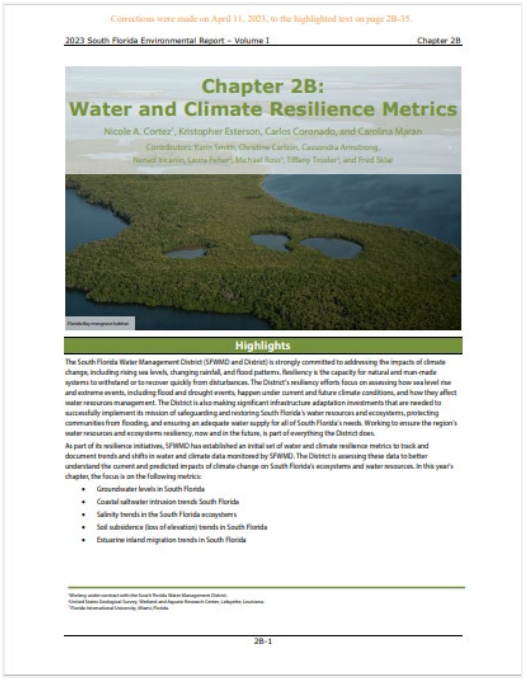
Accomplishments

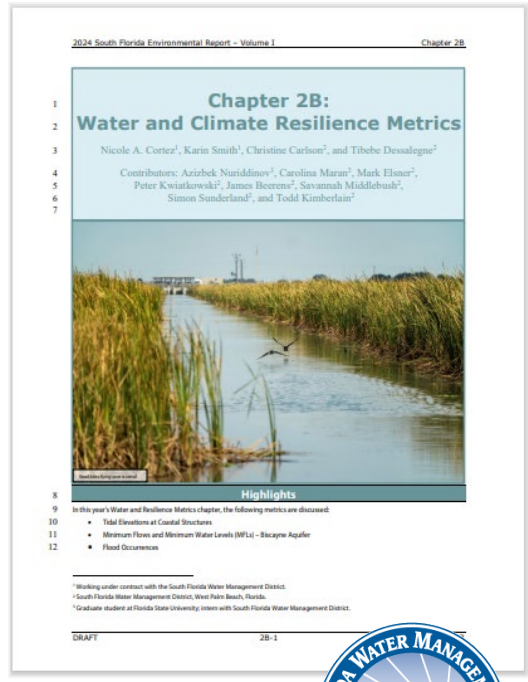


Key Publications

Technical Reports – Standalone and South Florida Environmental Report (CHapter2B)







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Key Publications

Online Resources – Resilience Metris Hub

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.

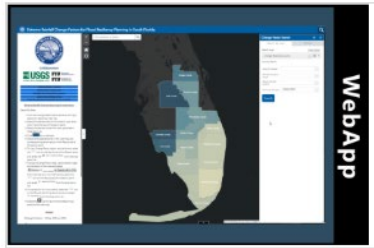
Estuarine and Mangrove Inland Migration

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.

Future Outlook in Regional Resiliency



Future Extreme Rainfall Change Factors for Flood Resiliency Planning in South Florida Web Application

This tool provides access to future extreme rainfall change factors for resiliency planning for the 16 counties and 14 rainfall areas within SFWMD boundaries, as well as the…

SFWMD Data and Support

DBHydro Insights

DBHydro Insights

DBHYDRO is the South Florida Water Management District's corporate environmental database that stores hydrologic, meteorologic, hydrogeologic and water quality data.

Details | View

SFWMD GIS Open Data Hub

SFWMD GIS Hub

Our Open Data site is where our publicly available spatial datasets can be viewed and downloaded. Additional Web Apps and Story Maps are featured to explore and learn more about the data.

Details | View

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Key Publications

Online Resources – Resilience Metris Hub (continued)

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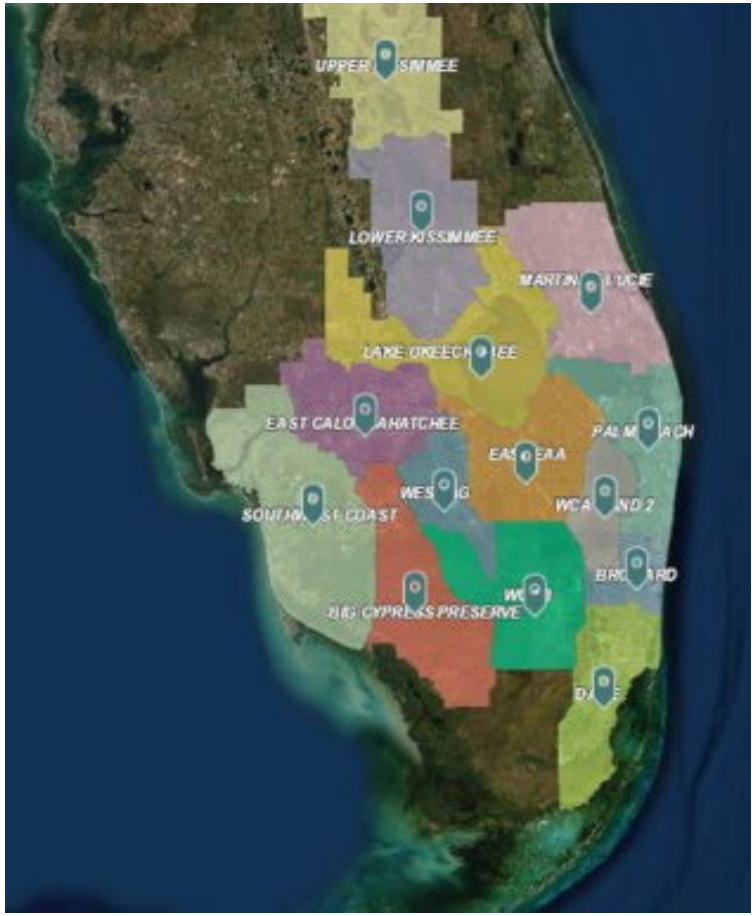
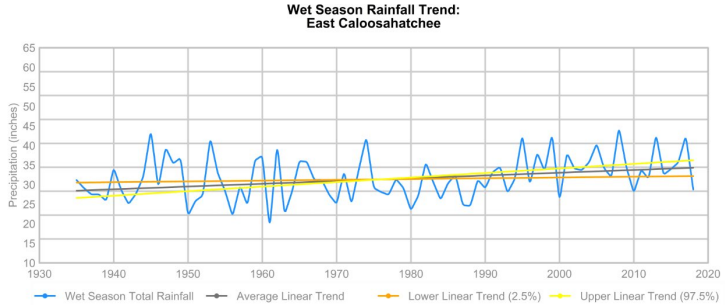
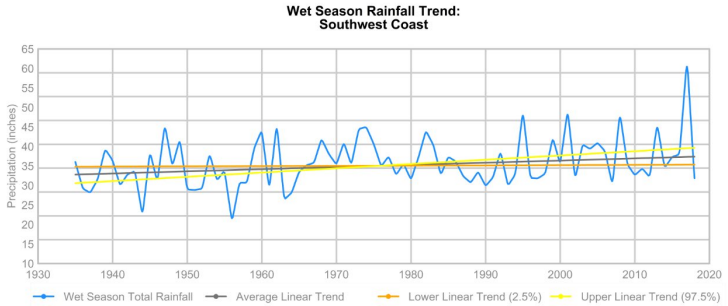
Emerging Trends – At the 2024 WI Symposium

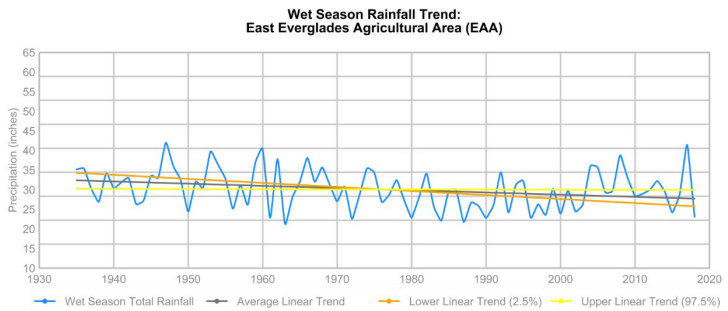
- Rainfall (Sub-Daily)
  - Session 8 – Tuesday, February 20, 1:30 PM, Room 2335
- Flood Events/Occurrence
  - Session 22 – Wednesday, February 21, 10:30 AM, Room 2335
- Evapotranspiration (this session)
  - Session 24 – Wednesday, February 21, 10:30 AM, Room 2335
- MFLS
  - Session 29 – Wednesday, February 21, 1:00 PM, Room 2335
- Tidal Elevations at Coastal Structures
  - Session 29 – Wednesday, February 21, 1:00 PM, Room 2335

Emerging Trends - Rainfall









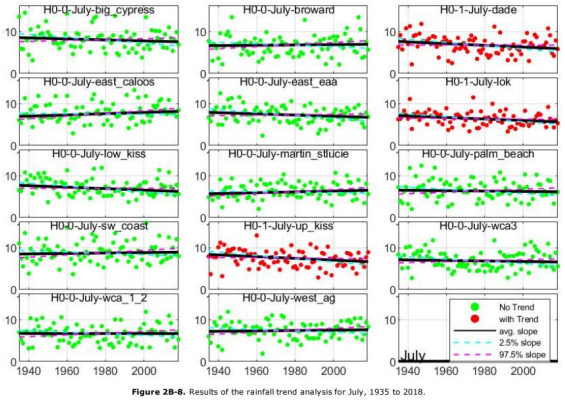


Figure 2B-8. Results of the rainfall trend analysis for July, 1935 to 2018.

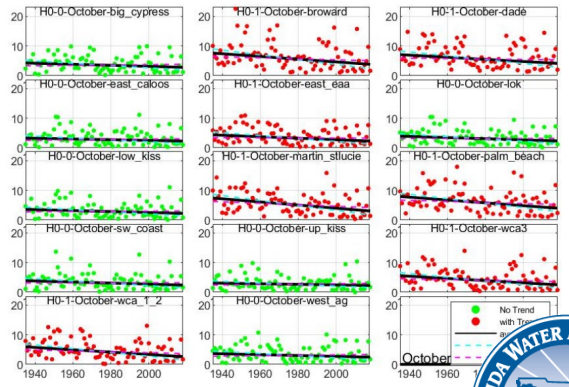


Figure 2B-11. Results of the rainfall trend analysis for October, 1935 to 2018.

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Emerging Trends – Salinity

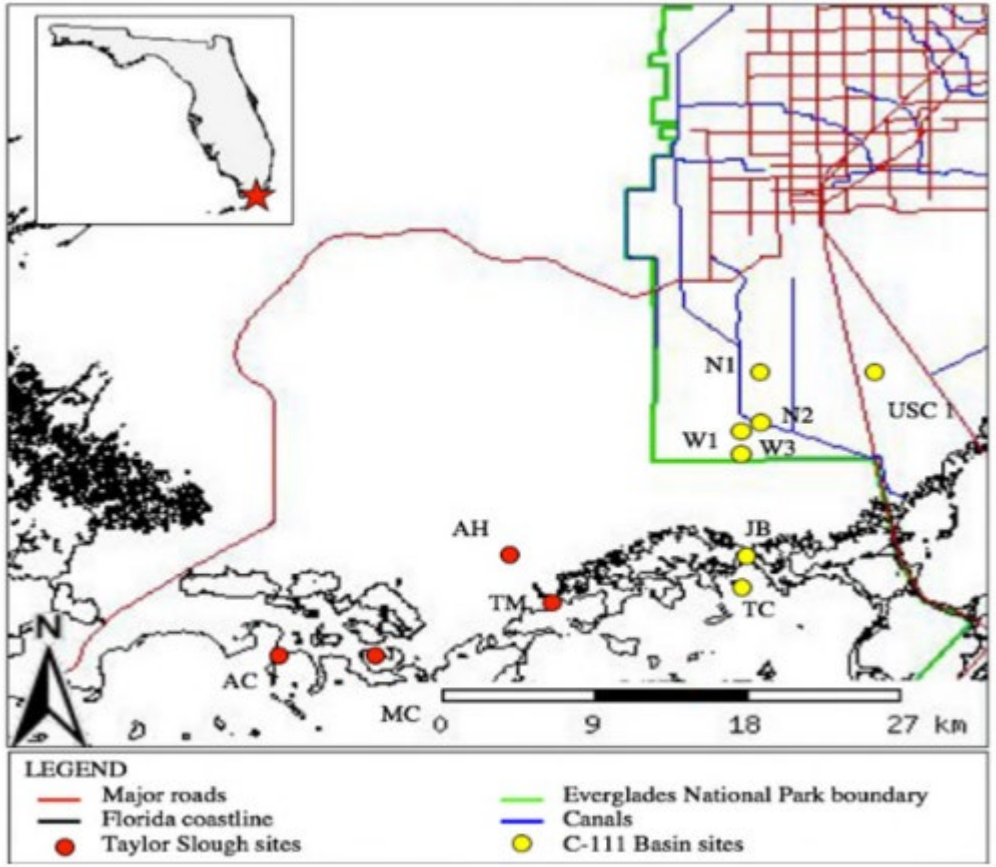


Figure 2B-6. Locations of salinity monitoring sites in Florida Bay (left) and Biscayne B

Table 2B-2. Summary of statistics and trend analyses results in Florida Bay.

	AC	MC	AH	TM	JB	TC
Period of Record	2009–2022	2008–2022	2008–2022	2008–2022	2008–2022	2008–2022
Minimum Value	5.60	4.00	0.00	0.40	0.20	0.40
Median Value	35.20	27.30	2.20	17.15	11.00	23.05
Maximum Value	82.00	63.40	47.90	49.70	55.70	56.30
Average	76.40	59.40	47.90	49.30	55.50	55.90
Magnitude	35.42	35.42	8.87	17.62	14.93	23.12
Probability value	0.74	0.55	0.87	0.55	0.30	0.70
Sen's Slope	0.14	0.35	0.05	0.32	0.70	0.29
Observed trend	No trend	No trend	No trend	No trend	No trend	No trend

Emerging Trends – Accretion/Soil Subsidence

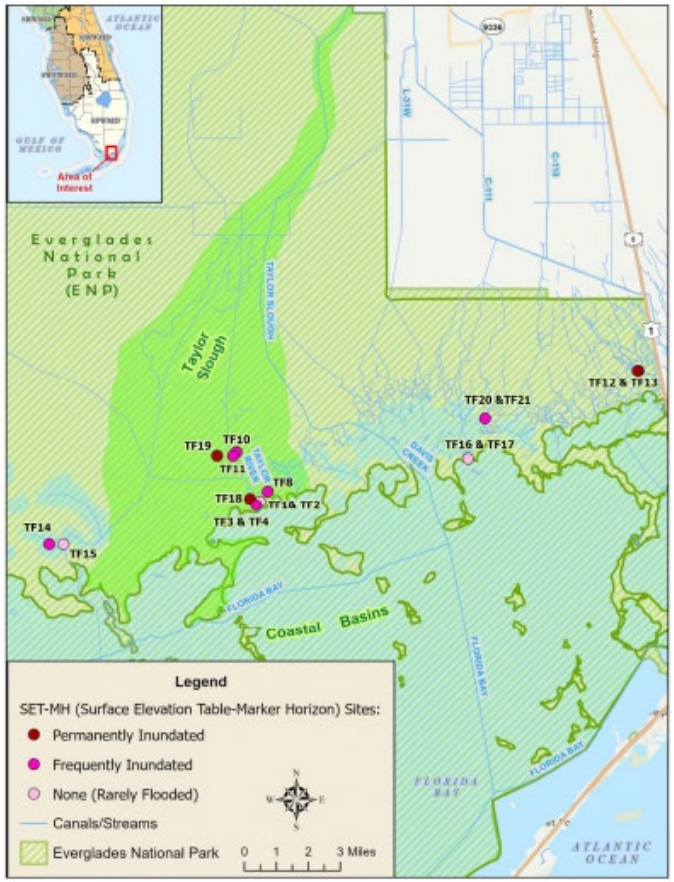


Figure 2B-14. Locations of non-flooded, frequently flooded, and permanently flooded soil monitoring sites in Florida Bay.

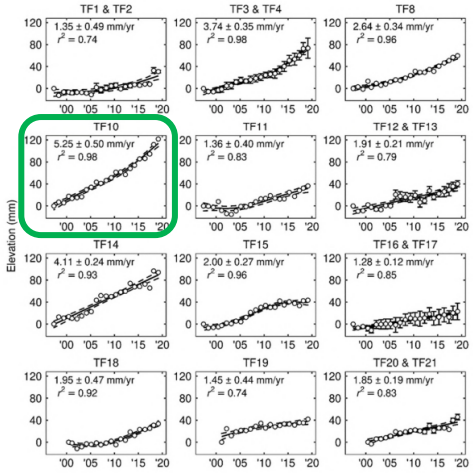


Figure 2B-15. Elevation change rates in millimeters per year (mm/yr).

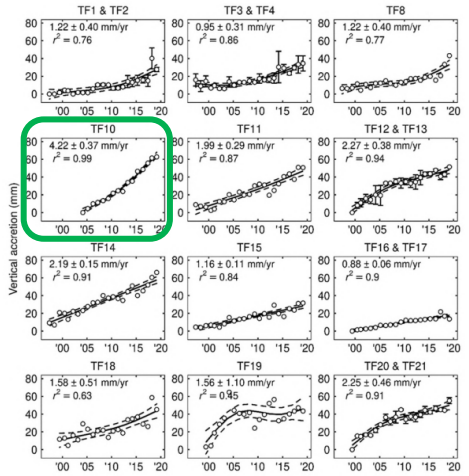
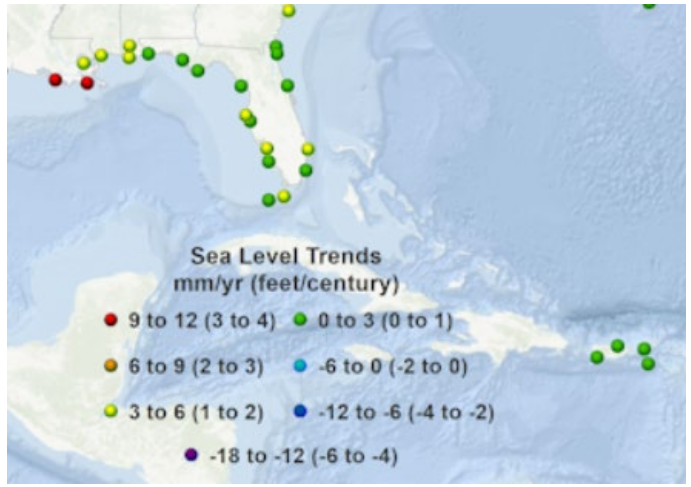
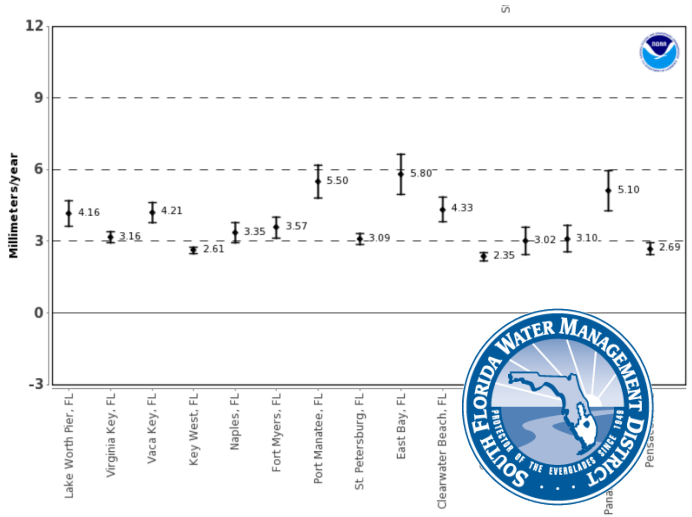


Figure 2B-16. Vertical accretion rates in mm/yr.





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Emerging Trends – Estuarine Migration

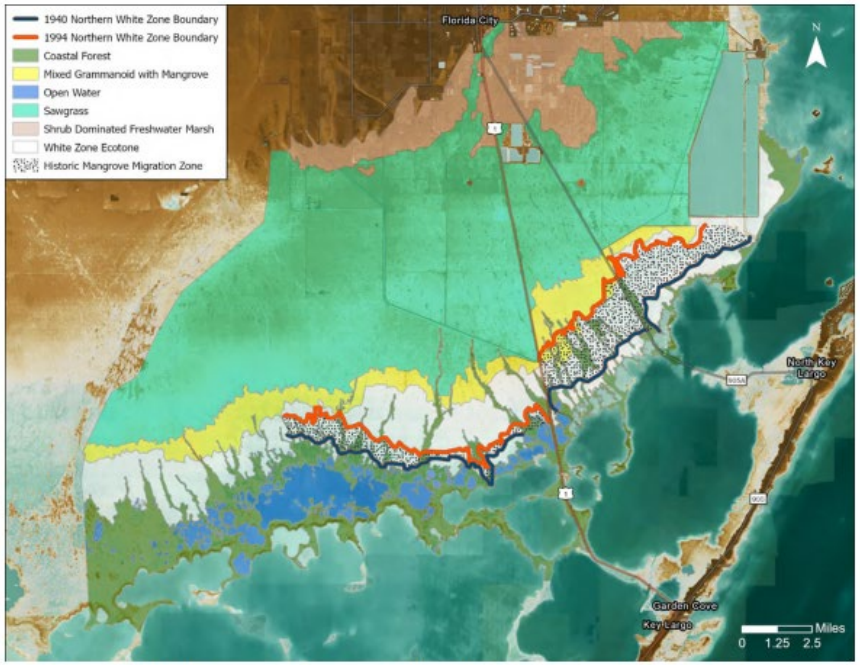
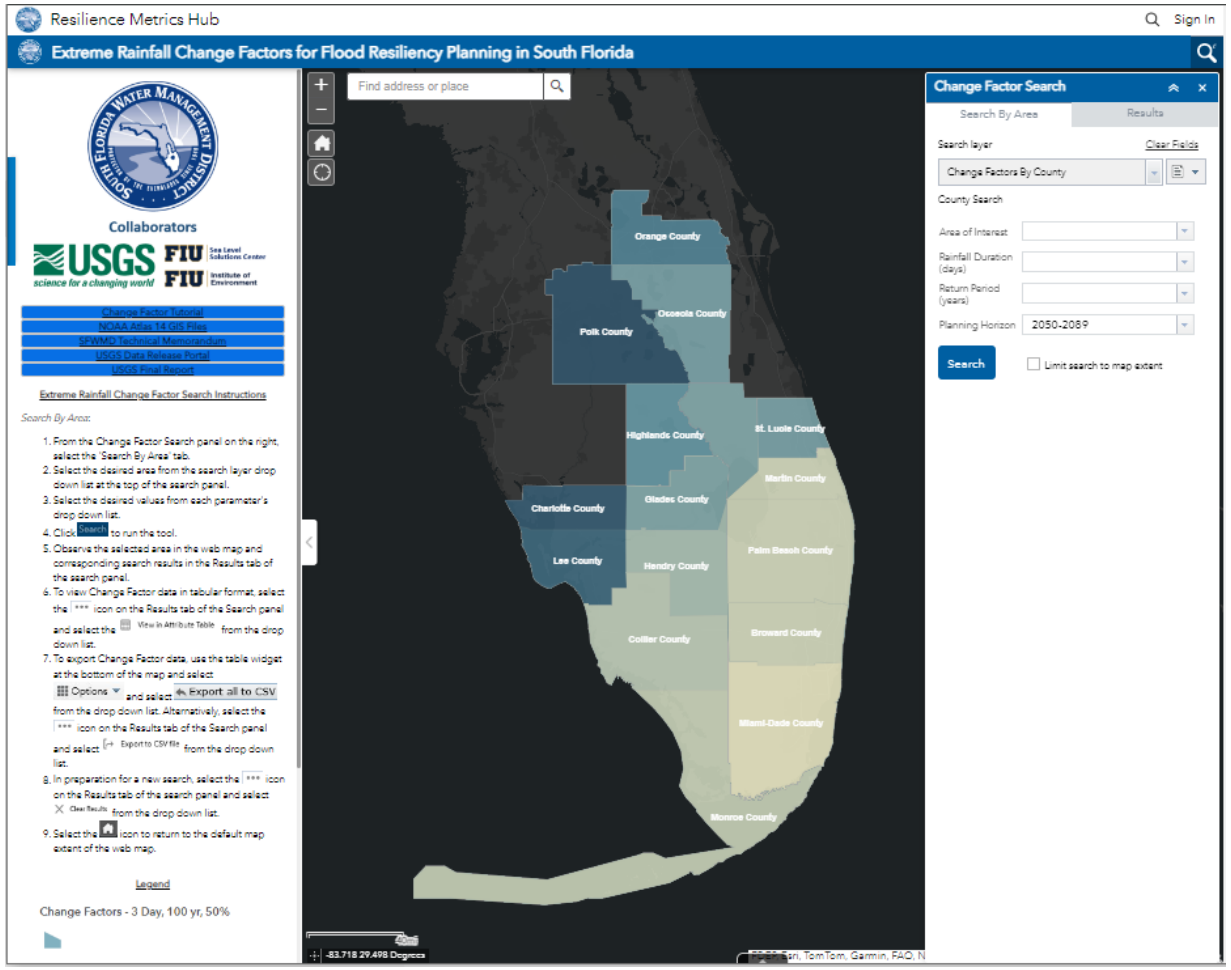


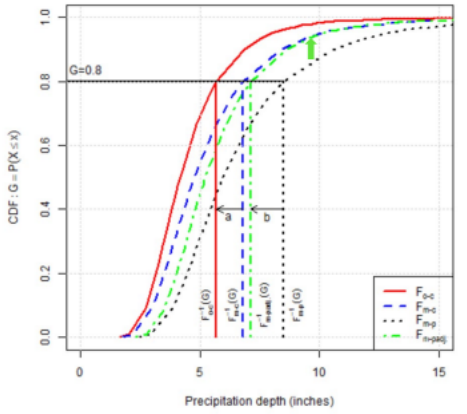
Figure 2B-18. Map of vegetation type in the southeastern glades showing the white zone, 1994 and 1940 northern white zone boundary, and historic mangrove migration zone.

Table 2B-4. Historic mangrove migration zone transect length statistics.

Location	Frequency (number of transects)	Minimum Transect Length (feet)	Mean Transect Length (feet)	Maximum Transect Length (feet)
East of US 1	19	2,613.89	6,807.65	10,279.76
West of US 1	26	799.76	2,726.61	7,196.07

Future Outlook – Extreme Rainfall Change Factors (long-term)





Change Factor Definition from the Multiplicative Quantile Delta Method

$$\hat{x}_{m\text{-}padj.} = F^{-1}_{o\text{-}c}(G) * \{F^{-1}_{m\text{-}p}(G)/F^{-1}_{m\text{-}c}(G)\}$$

CF

$F^{-1}_{o\text{-}c}(G)$ = Historic Observed Rainfall Term

$F^{-1}_{m\text{-}c}(G)$ = Modeled Historic Rainfall Term

$F^{-1}_{m\text{-}p}(G)$ = Modeled Projected Rainfall Term

Change Factor (CF) = $F^{-1}_{m\text{-}p}(G)/F^{-1}_{m\text{-}c}(G)$

Change Factor = Modeled Projected Rainfall / Modeled Historic Rainfall

Future Rainfall = Observed Rainfall * CF

Figure 1. Change factor definition from the multiplicative quantile delta method (Adapted from Irizarry et al. 2016, and as established by Yin et al. 2019).

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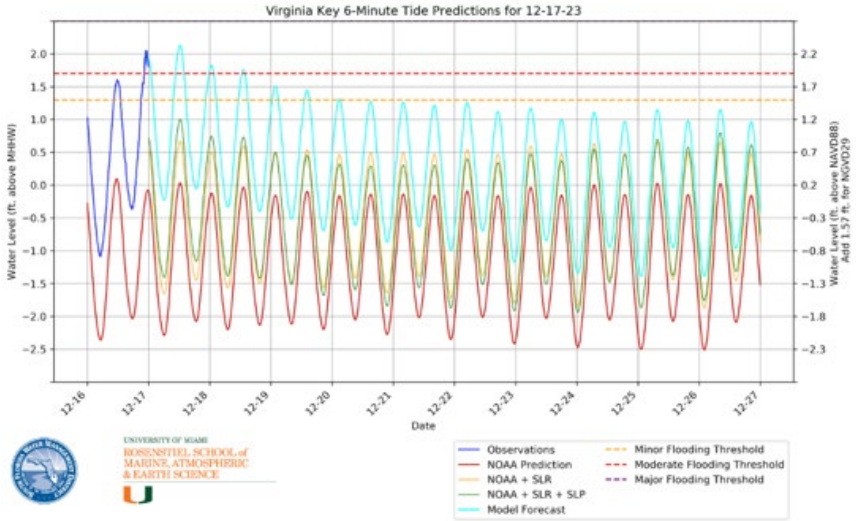
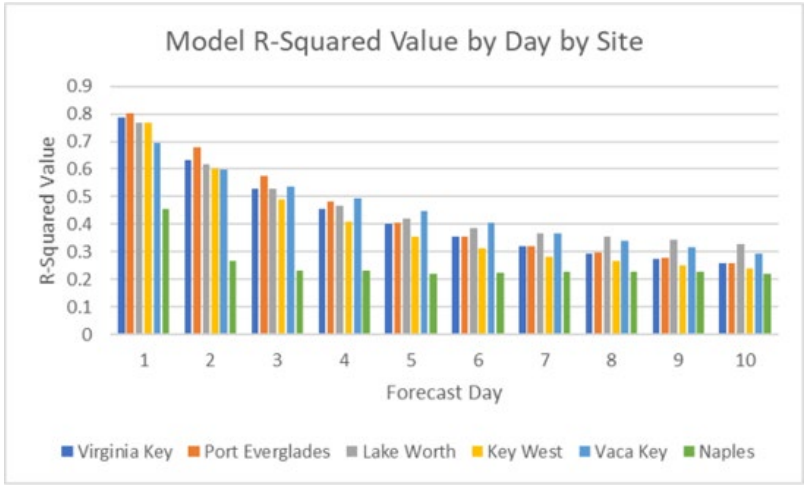
Future Outlook – Enhanced Tide Predictions (short-term)





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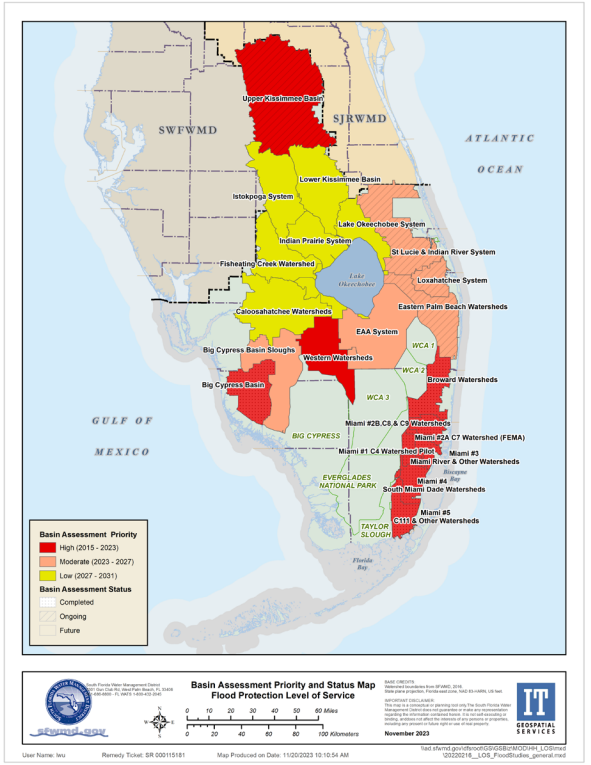
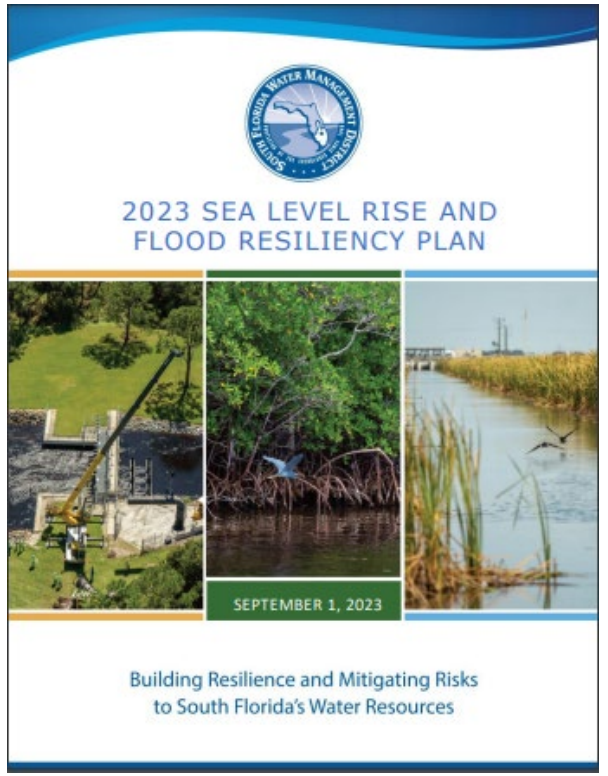
Next Steps

- Continuous monitoring and reporting (SFER 2A and 2B)
  - Data refinements
  - Advanced data correlation analyses
  - More regional comparisons
- Regular updates to Resilience Metrics Hub
  - New in 2024: Rainfall Sub-daily, Flood Observations Repository, Drought, Tide Forecast
- Public engagement
- Inter-agency and academic partnerships

Informing Resiliency Planning

- Stronger SFWMD planning capacity by documenting and publishing observed trends districtwide, based on best available data analysis and science-based approaches
- Better substantiated modeling assumptions and risk informed operational decisions
- Smarter infrastructure investment decisions, supported by robust assessment of current and anticipated future climate conditions
- More educated and engaged stakeholders and partner agencies in water resilience aspects
- Enhanced resilience of District's projects, regarding observed or expected changes in climate





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Q&A – Thank you!

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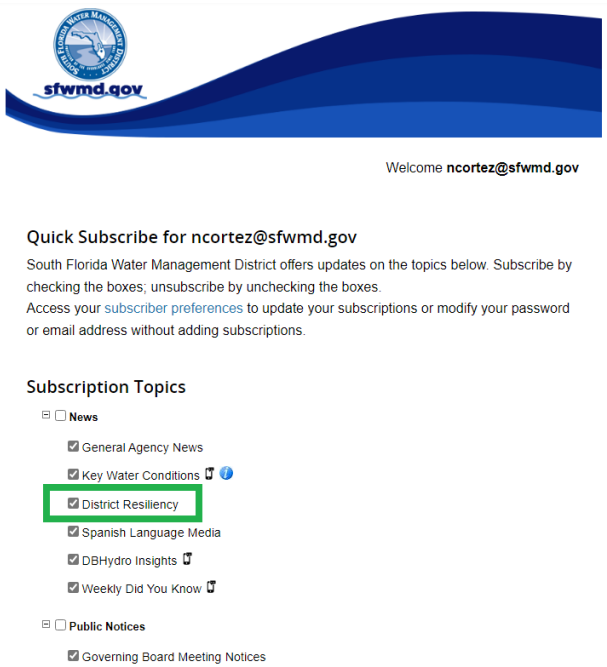
1 - Click on the “Subscribe for Email” icon

2 - Enter your email address

3 - Select “District Resiliency” under Subscription Topics



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