Hurricane Irma Impact on South Florida Water Management System and Storm Surge

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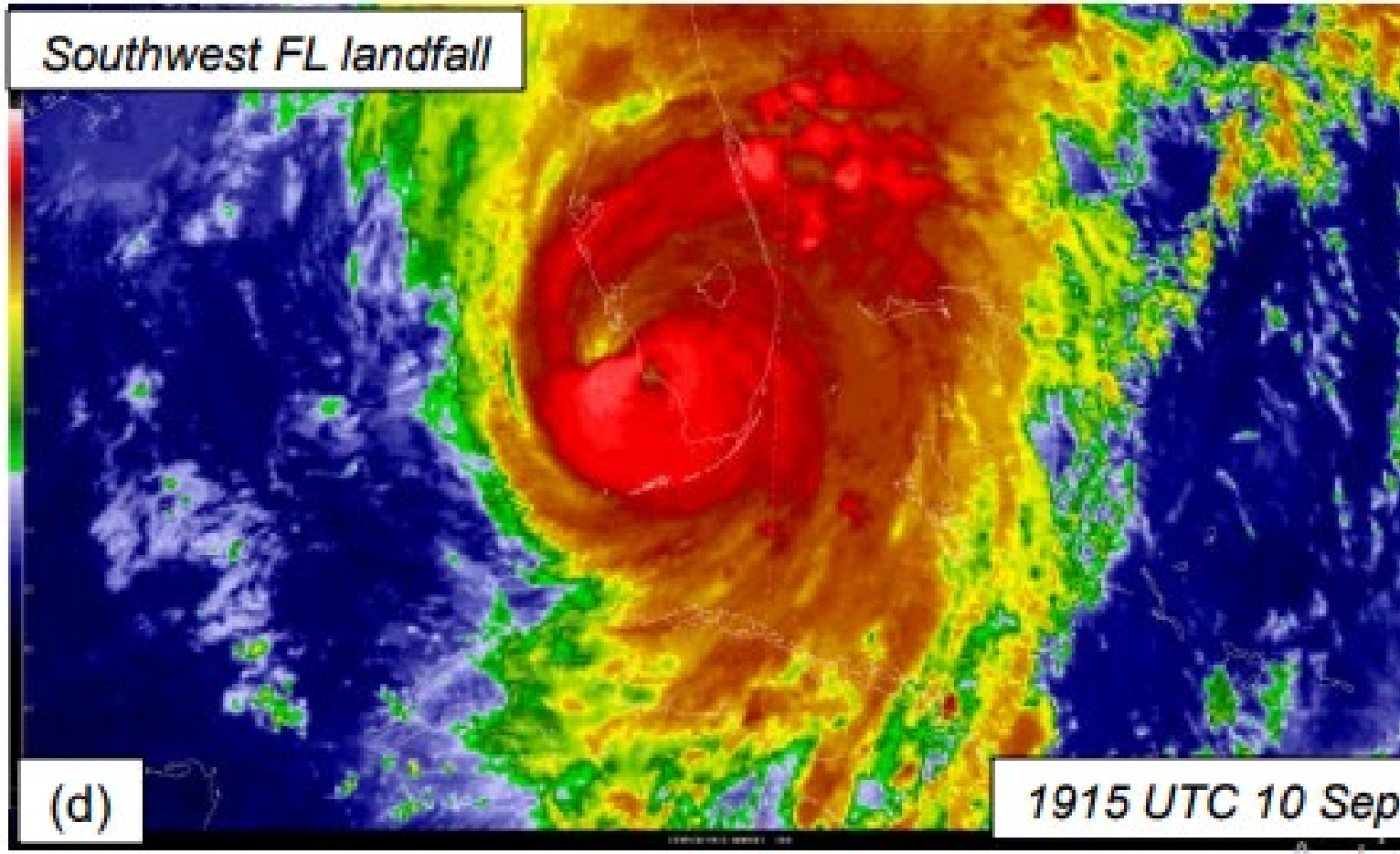
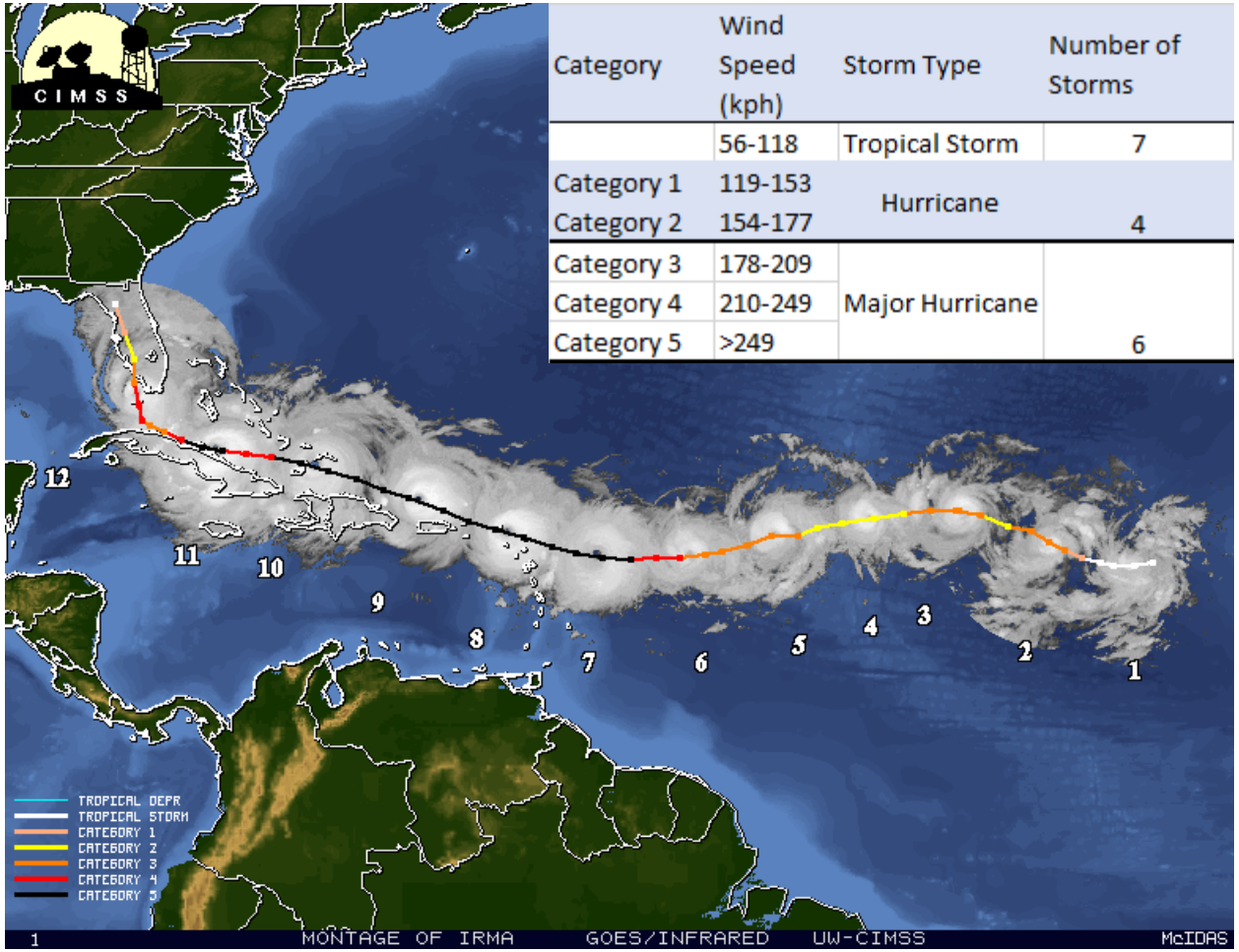
Coral Springs, FL

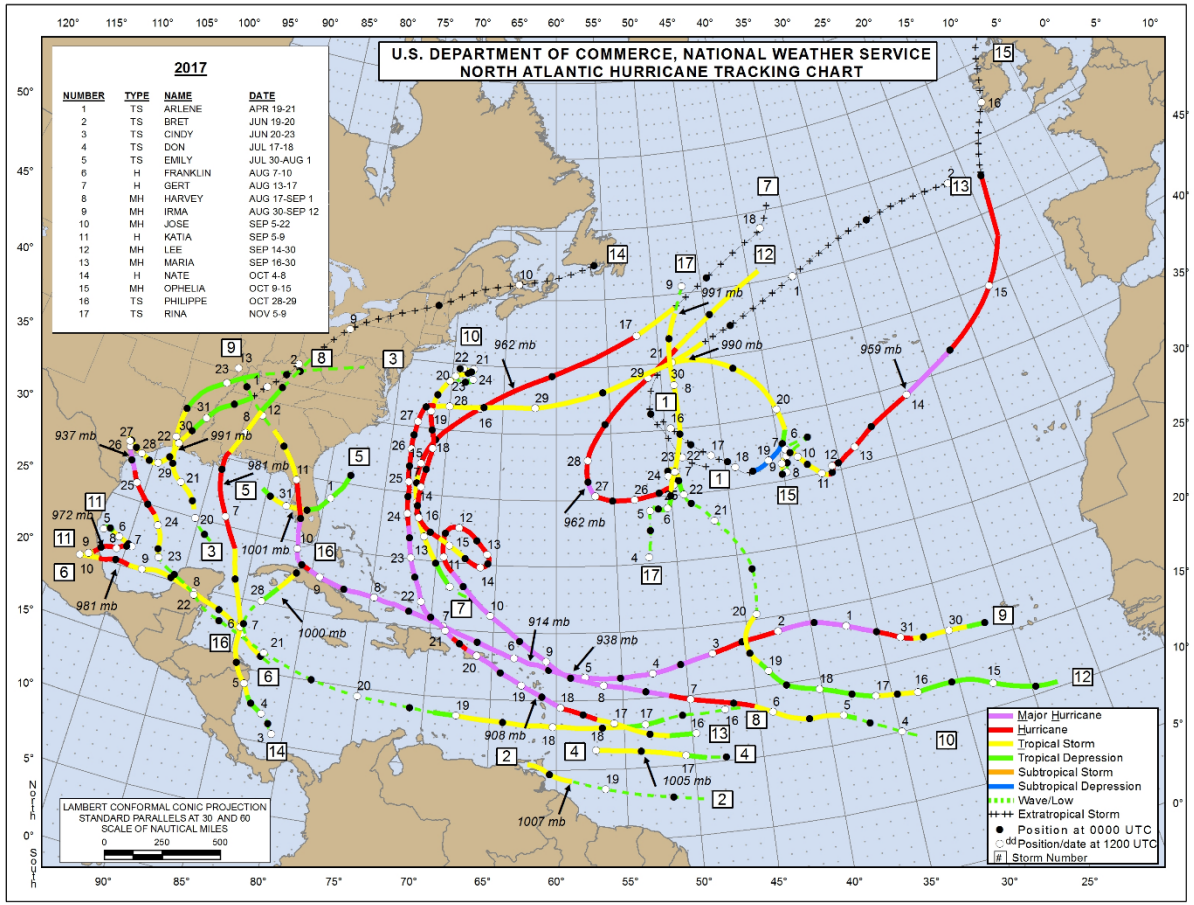


Source: Cangialosi et al. 2018. Hurricane Irma. AL112017, NHC

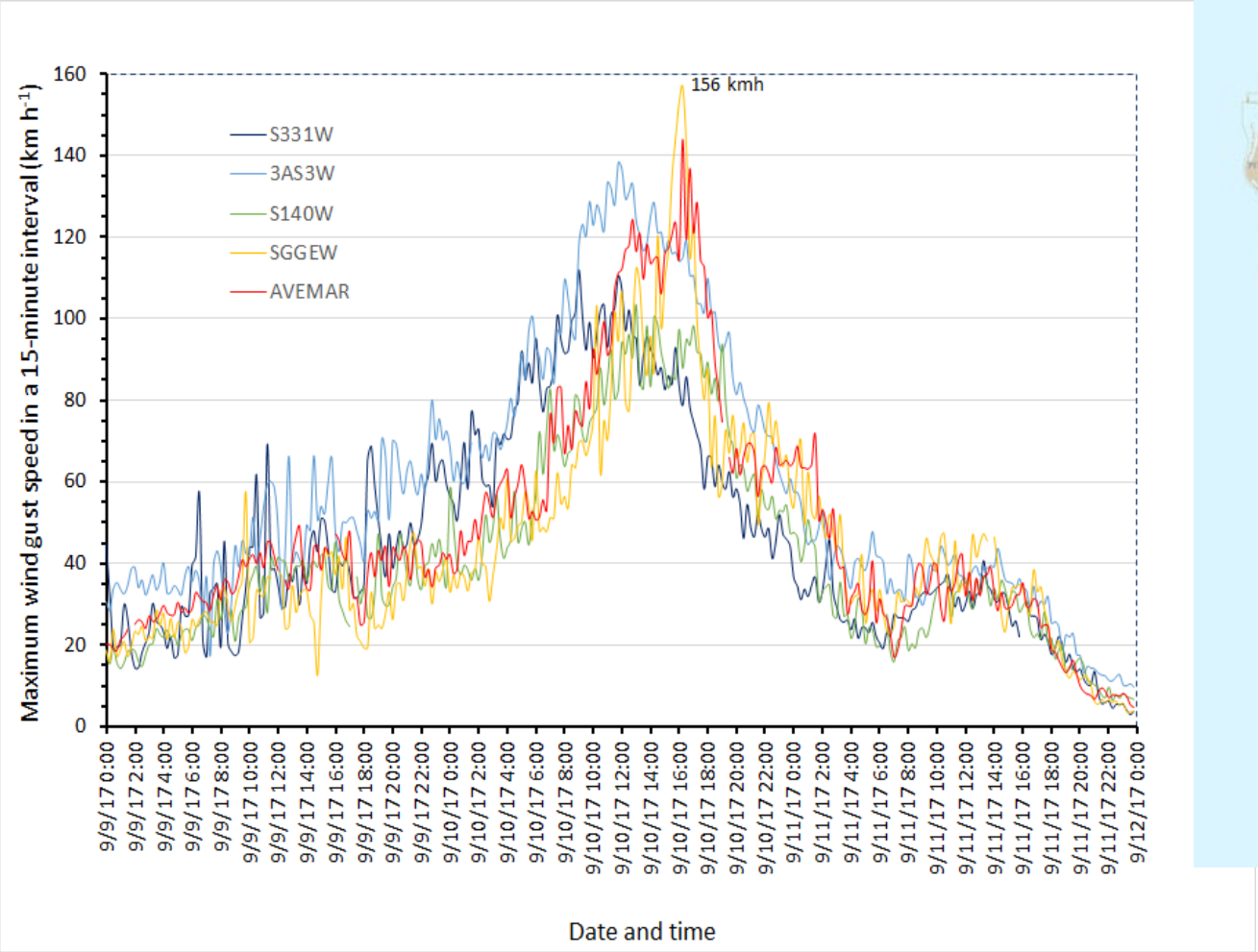
Hurricane Irma (August 30 – September 12, 2017) and the 2017 Hurricane Season

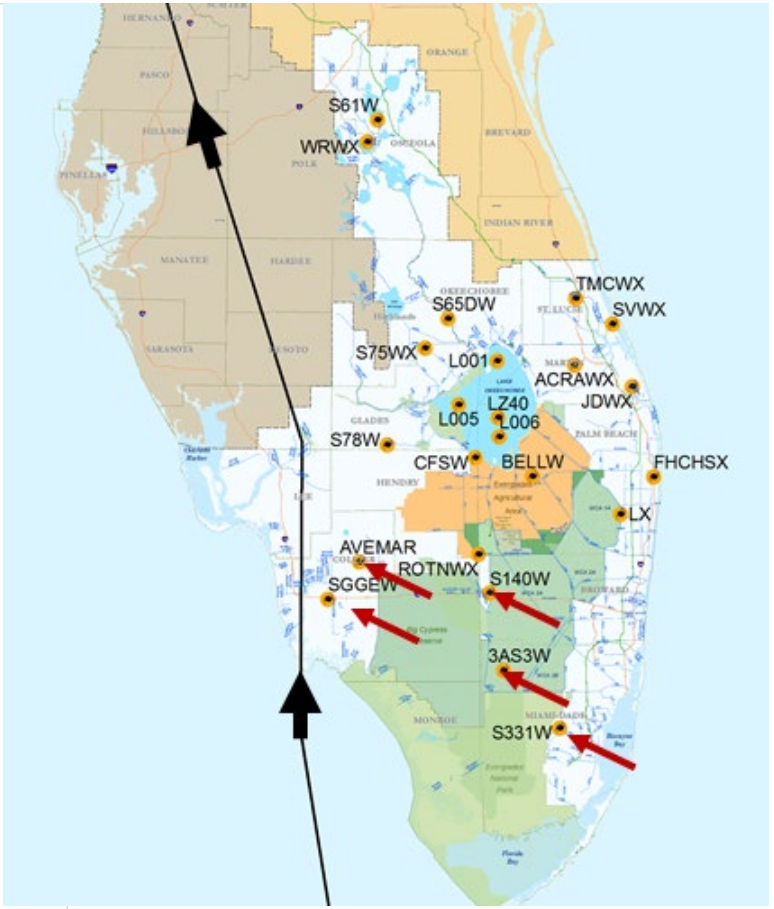


Category	Wind Speed (kph)	Storm Type	Number of Storms
	56-118	Tropical Storm	7
Category 1	119-153	Hurricane	
Category 2	154-177		4
Category 3	178-209	Major Hurricane	
Category 4	210-249		
Category 5	>249		6



Wind Gust Speed from Hurricane Irma (September 9-11, 2017)





Wind Gust Speed from Hurricane Irma (September 9-11, 2017)

source NHC AL112017 Date	Time	Site	Sustained Wind Speed (kph)	Wind gust Speed (kph)
9/10/2017	12:00 p.m.	Pembroke Pines		175
9/10/2017	3:00 p.m.	Naples Municipal Airport	88	132
9/10/2017		Miami-Opa Locka Executive Airport	101	135
9/10/2017	4:00 p.m.	Marco Island Police dept.		209
9/10/2017		Weather station in Naples	114	156
9/10/2017	6:00 p.m.	Naples Municipal Airport		228
9/10/2017	7:00 p.m.	Southwest FL Int. Airport, FM		142
9/10/2017	9:00 p.m.	unofficial observing site in Moore Haven		143
9/10/2017	10:00 p.m.	National Ocean Service Observing site, Tampa		126
9/10/2017		unofficial observing site in Clearwater		126
9/10/2017		Juno Beach Pier		134
9/11/2017	12:00 a.m.	National Ocean Service Observing site, Clearwater Beach	95	127

1) Wind sensor height, location clearance, calibration and maintenance

2) Frequency at which wind gust is measured, averaged and reported

3) Sensor malfunction

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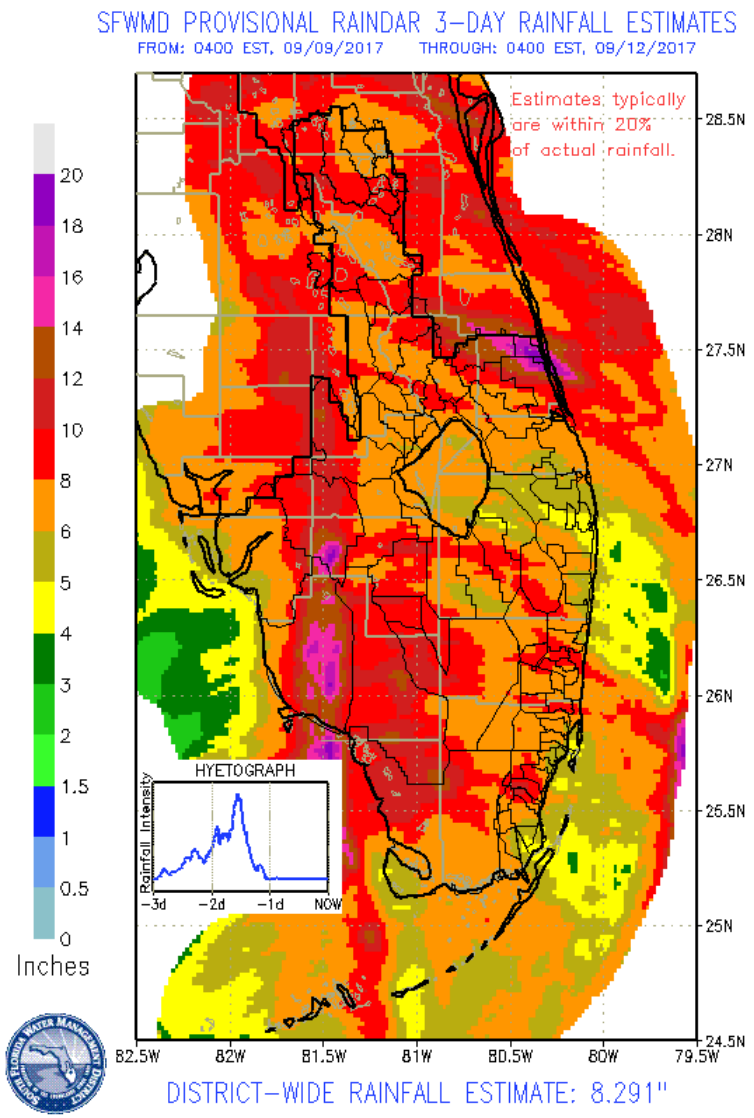
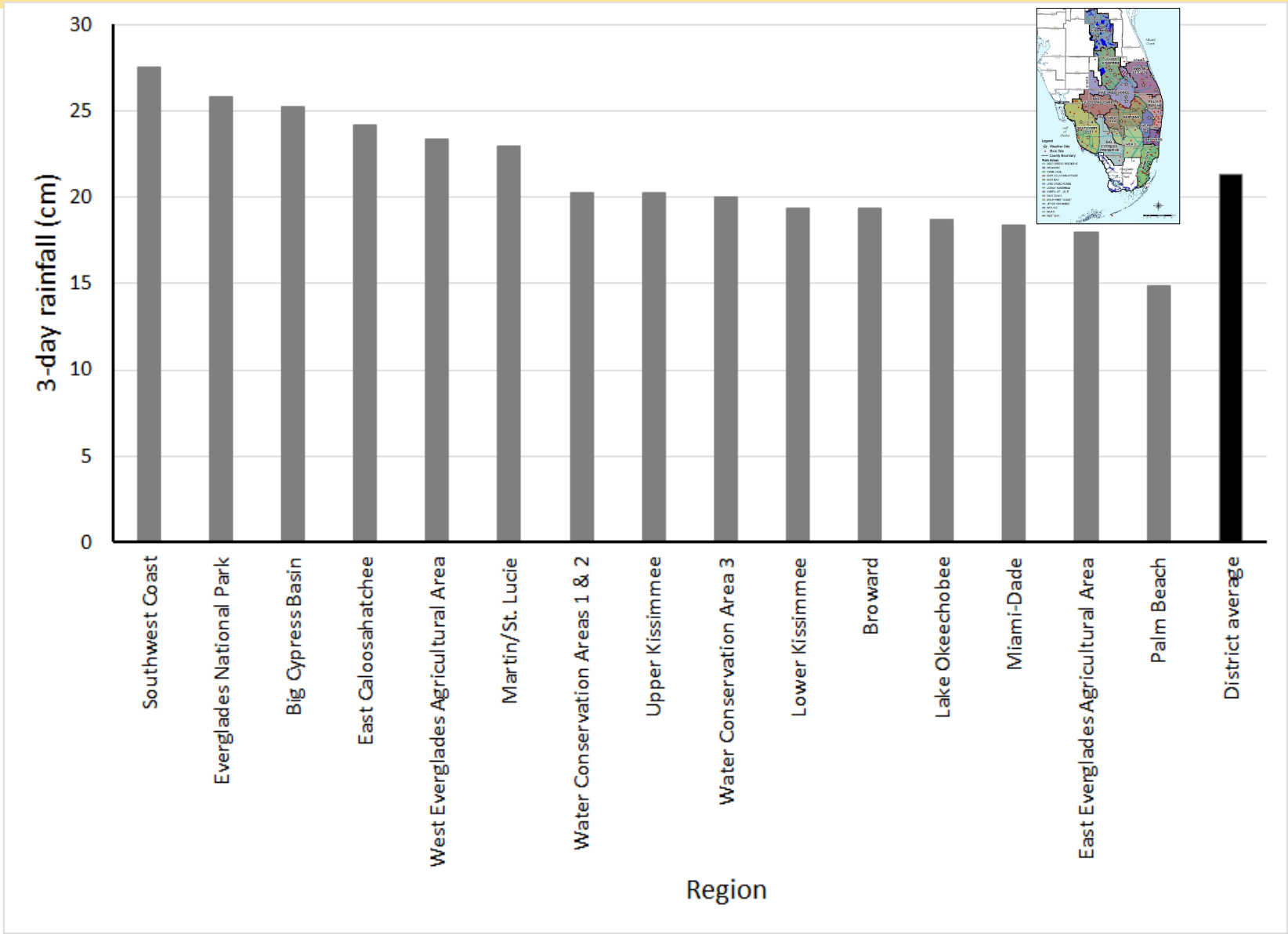
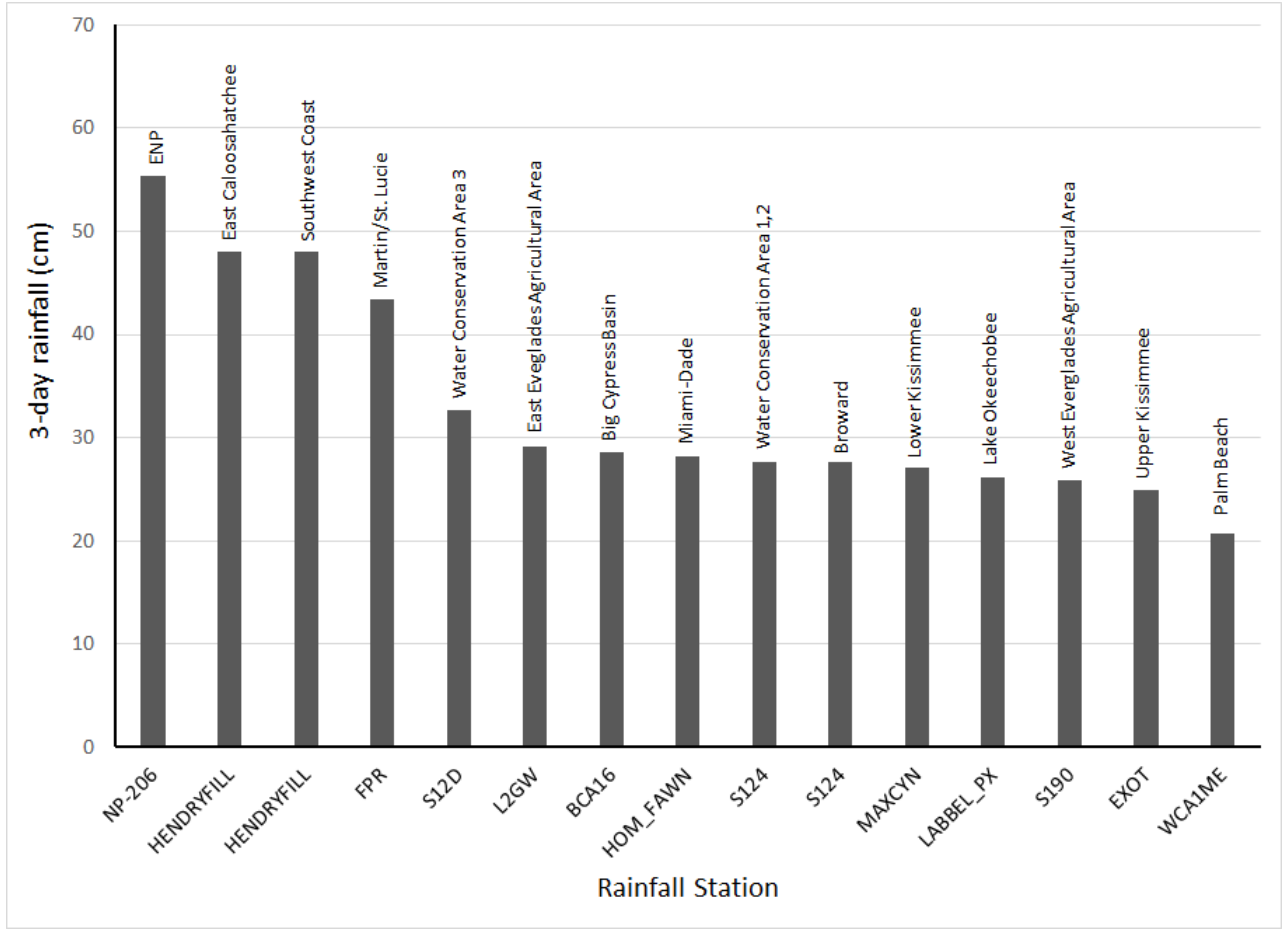
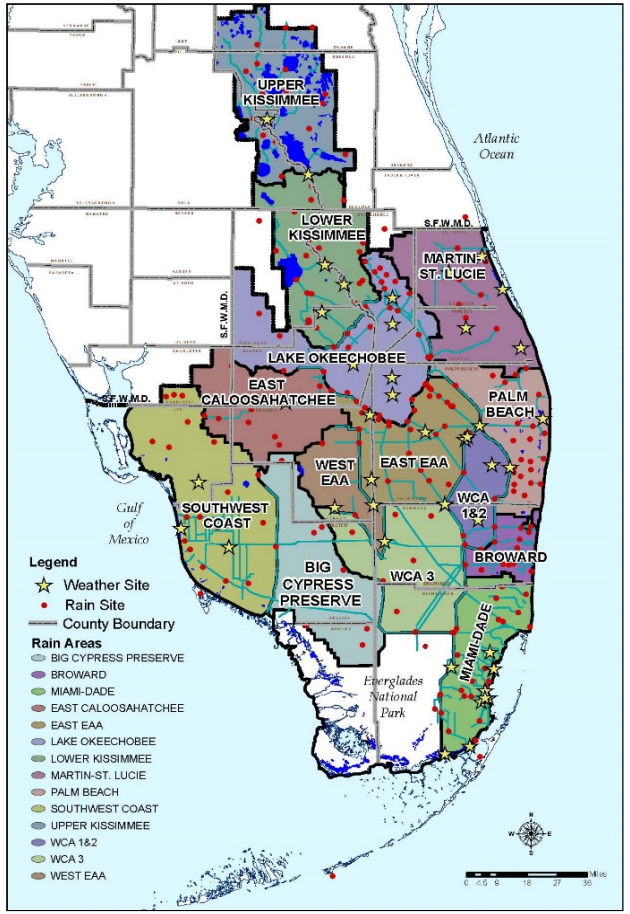
Rainfall from Hurricane Irma (September 9-12, 2017)



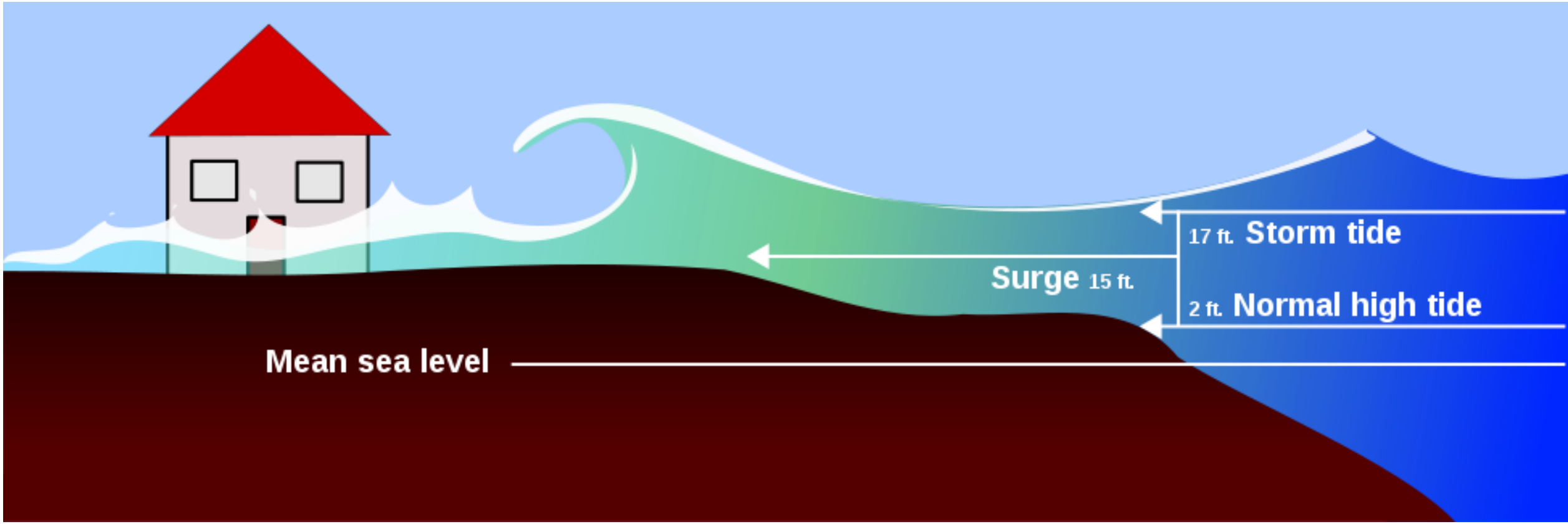


Maximum Rainfall from Hurricane Irma at a Site in a Region



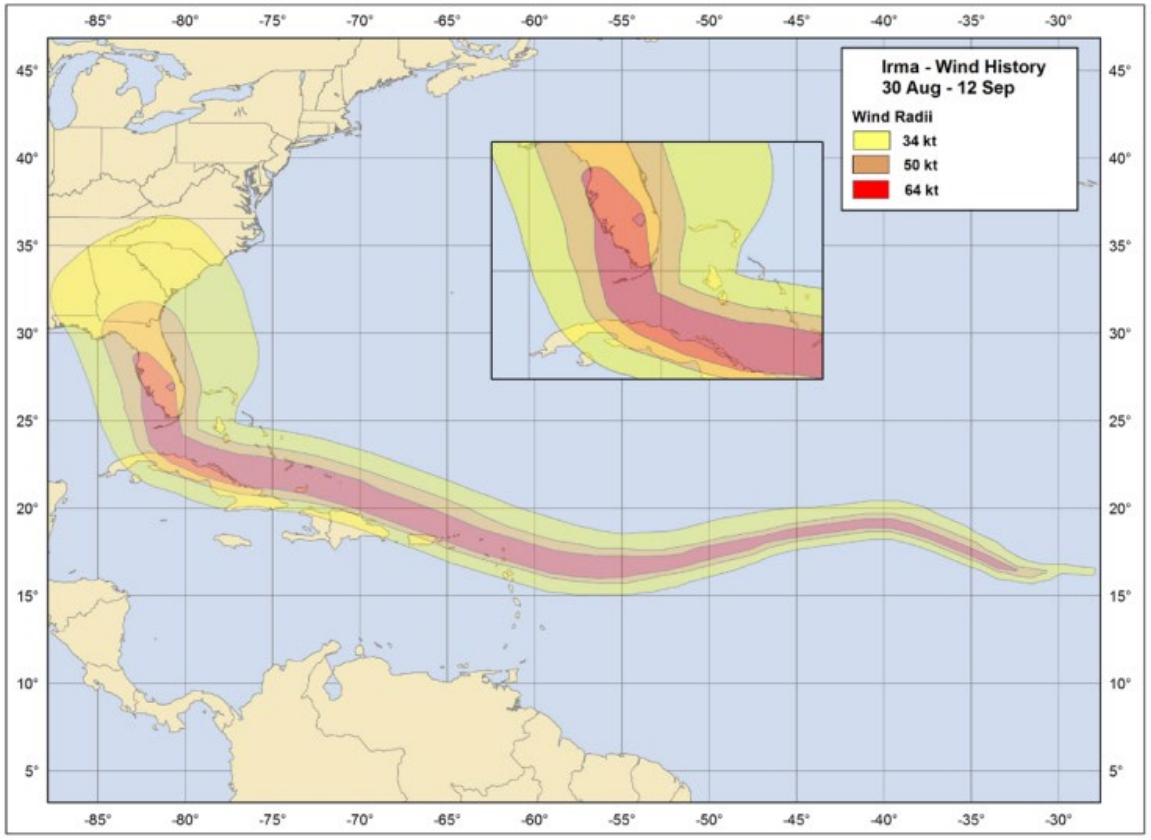


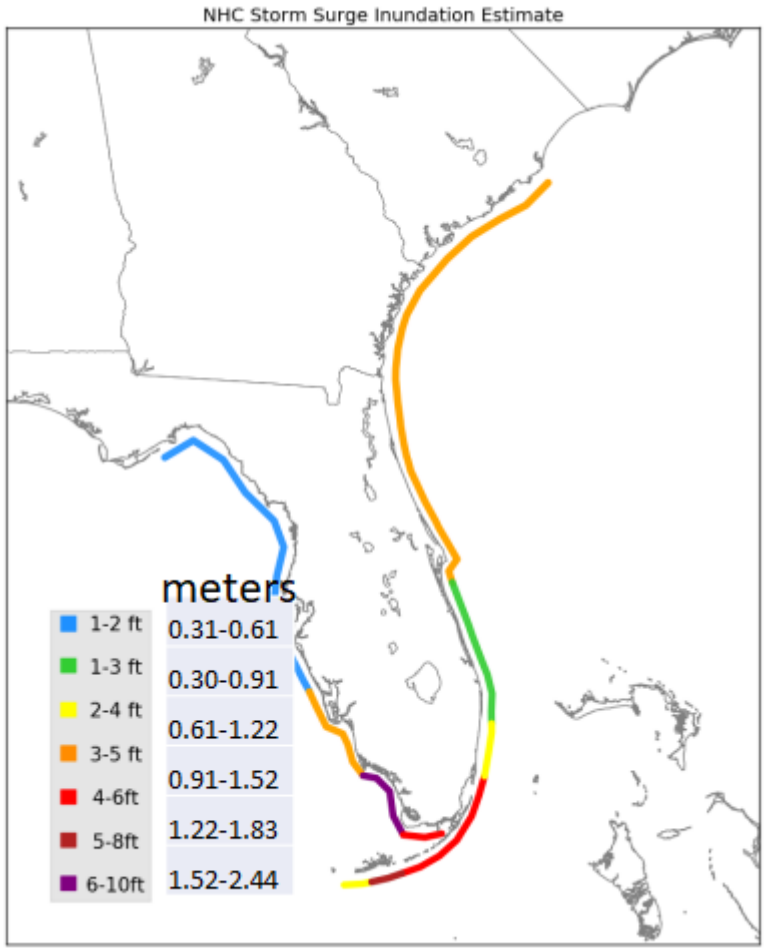
Storm Surge during Hurricane Irma and Storm Impact on ENP Marine Monitoring Stations



https://en.wikipedia.org/wiki/Storm_surge#/media/File:Surge-en.svg

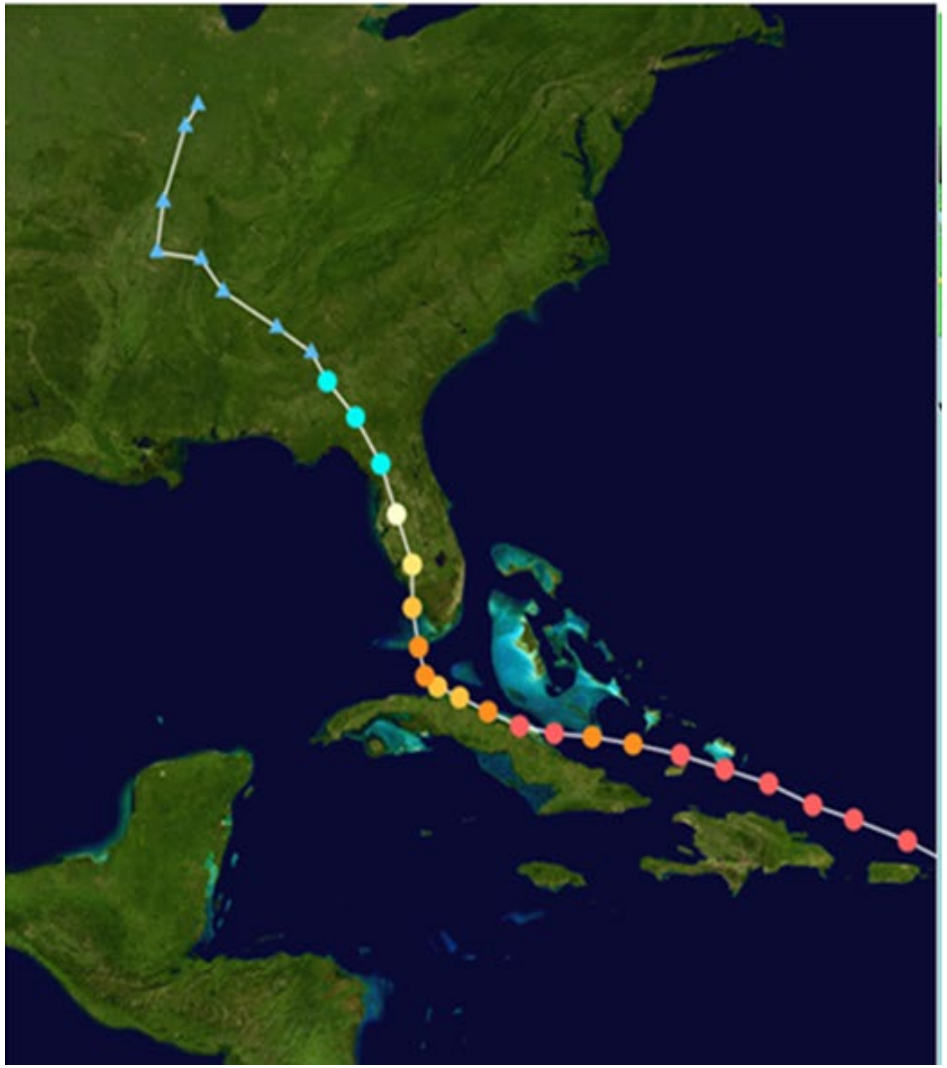
Storm Surge during Hurricane Irma (NHC Report)

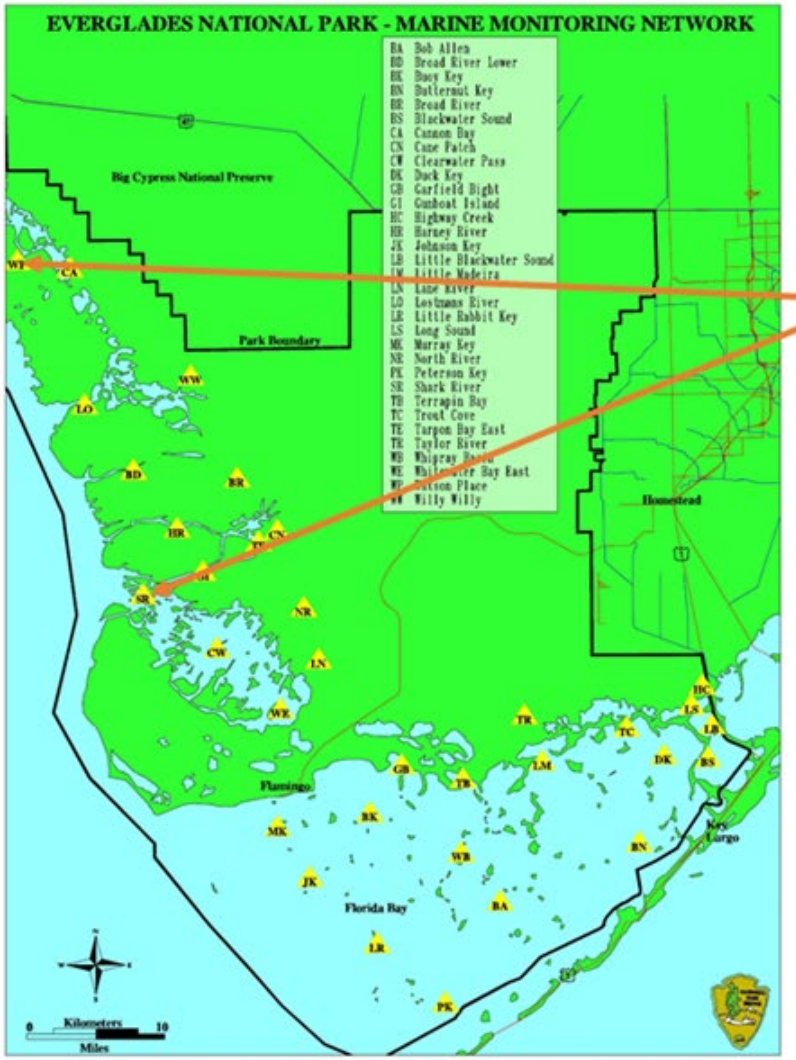




(Cangialosi et al. 2018), NHC
https://www.nhc.noaa.gov/data/tcr/AL112017_Irma.pdf

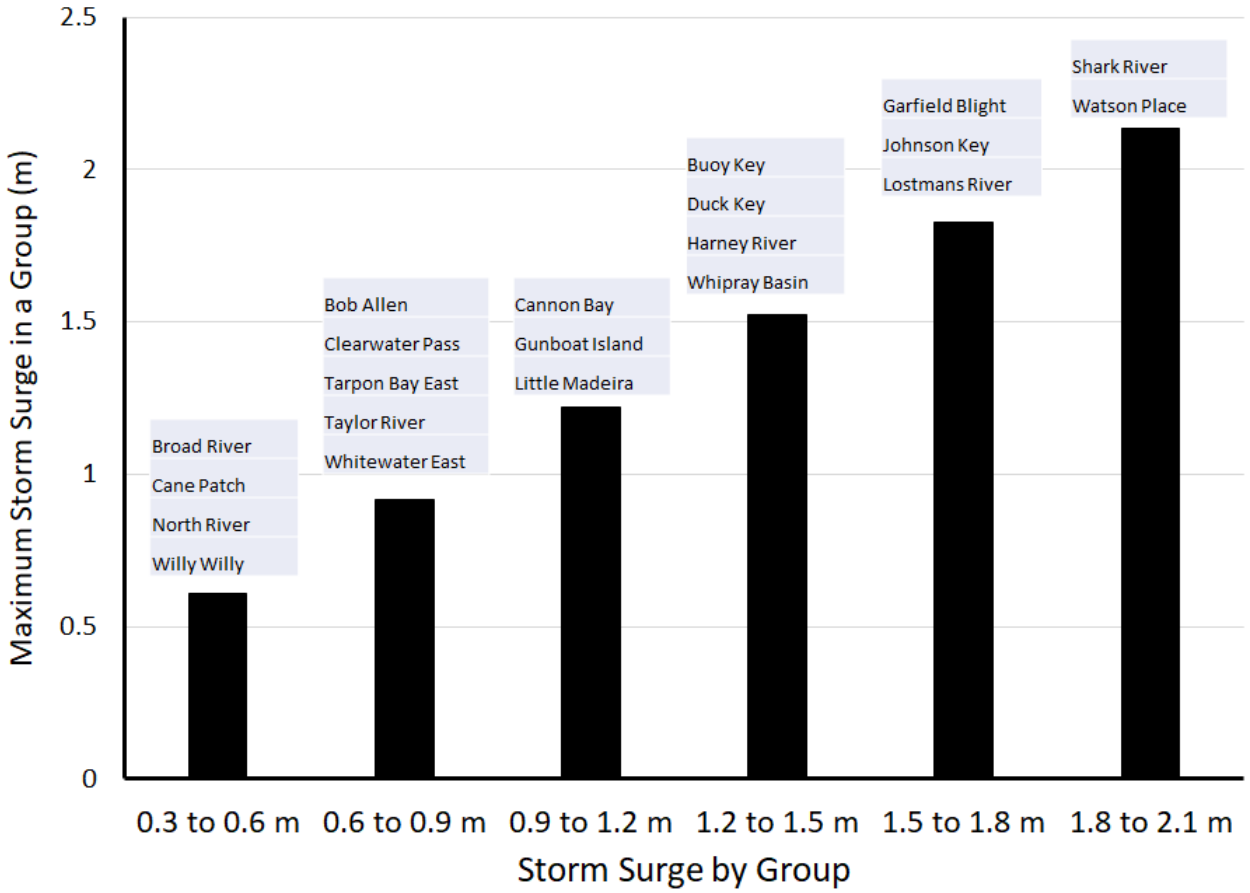
Everglades National Park Marine Monitoring Stations (33) Maximum Storm Surge (several malfunctioned)



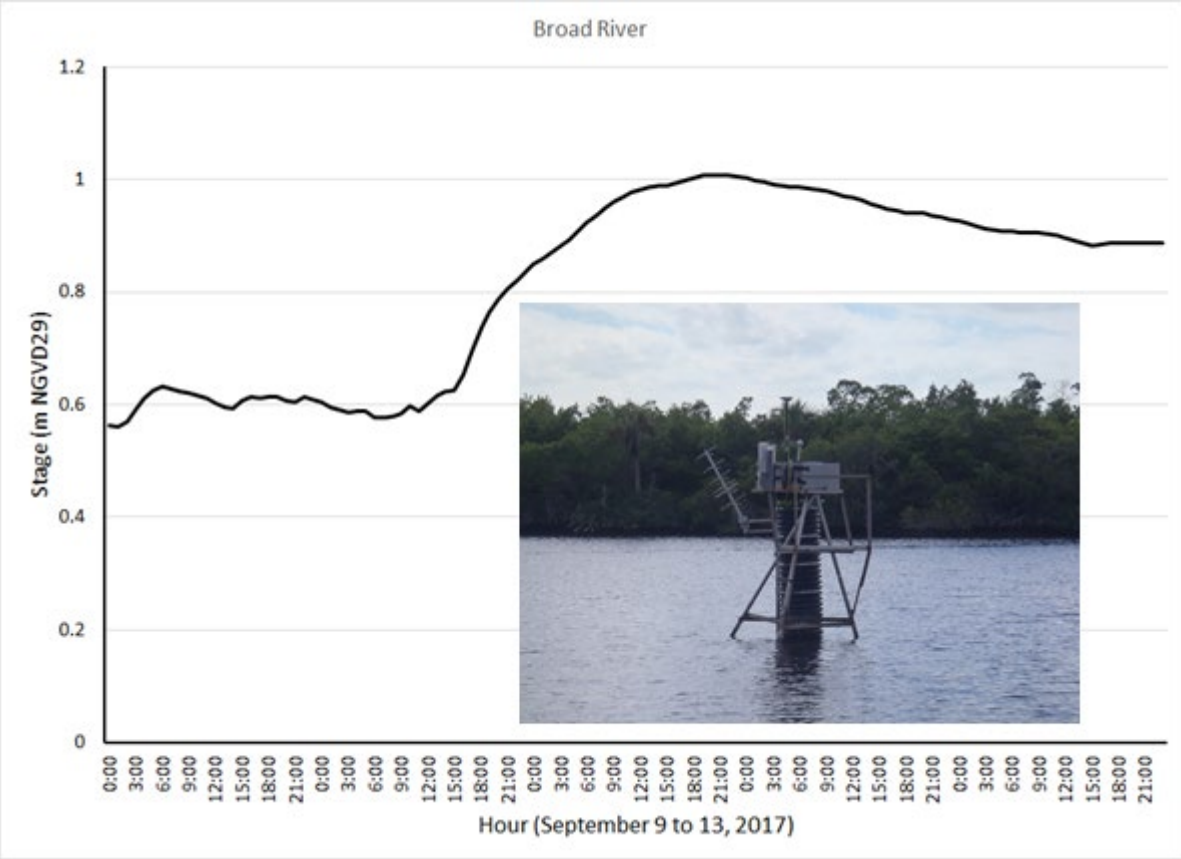


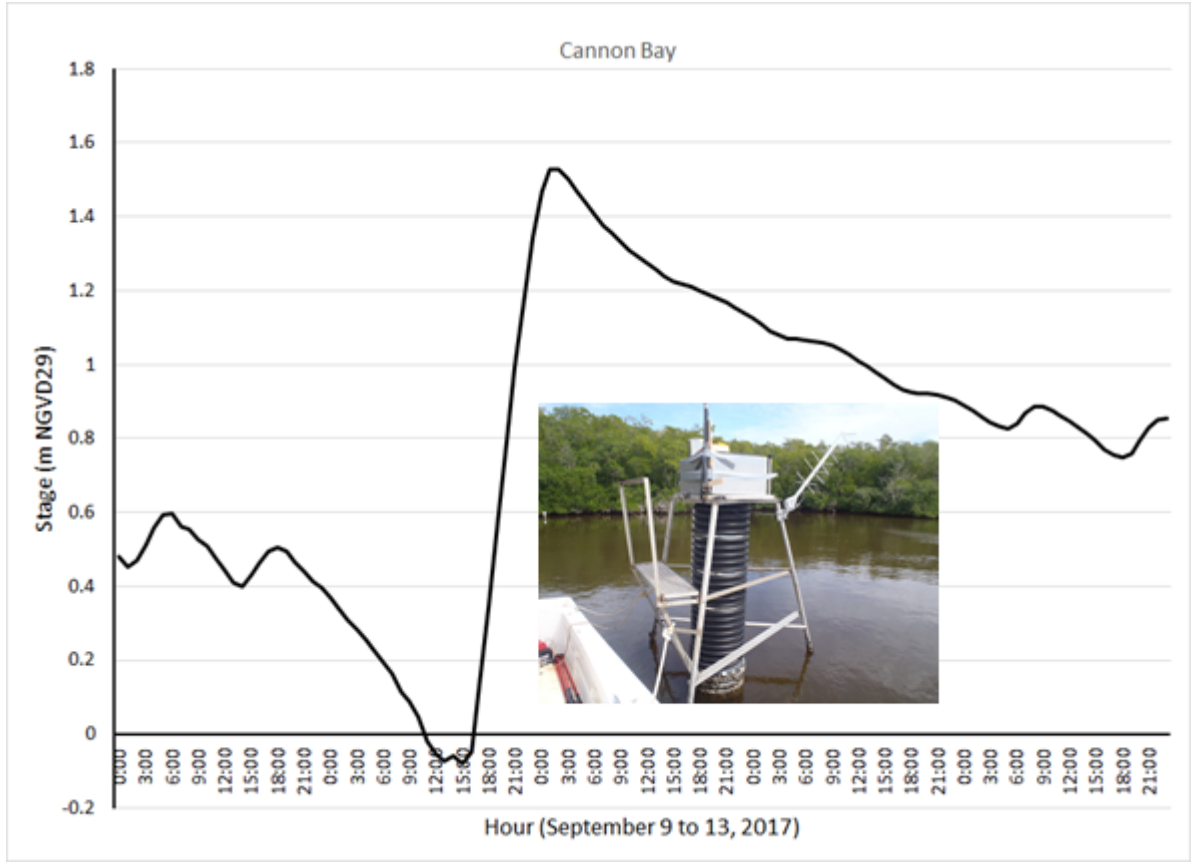
1.85 to 2.15 m Highest storm surge

Storm Surge during Hurricane Irma and Storm Impact on ENP Marine Monitoring Stations

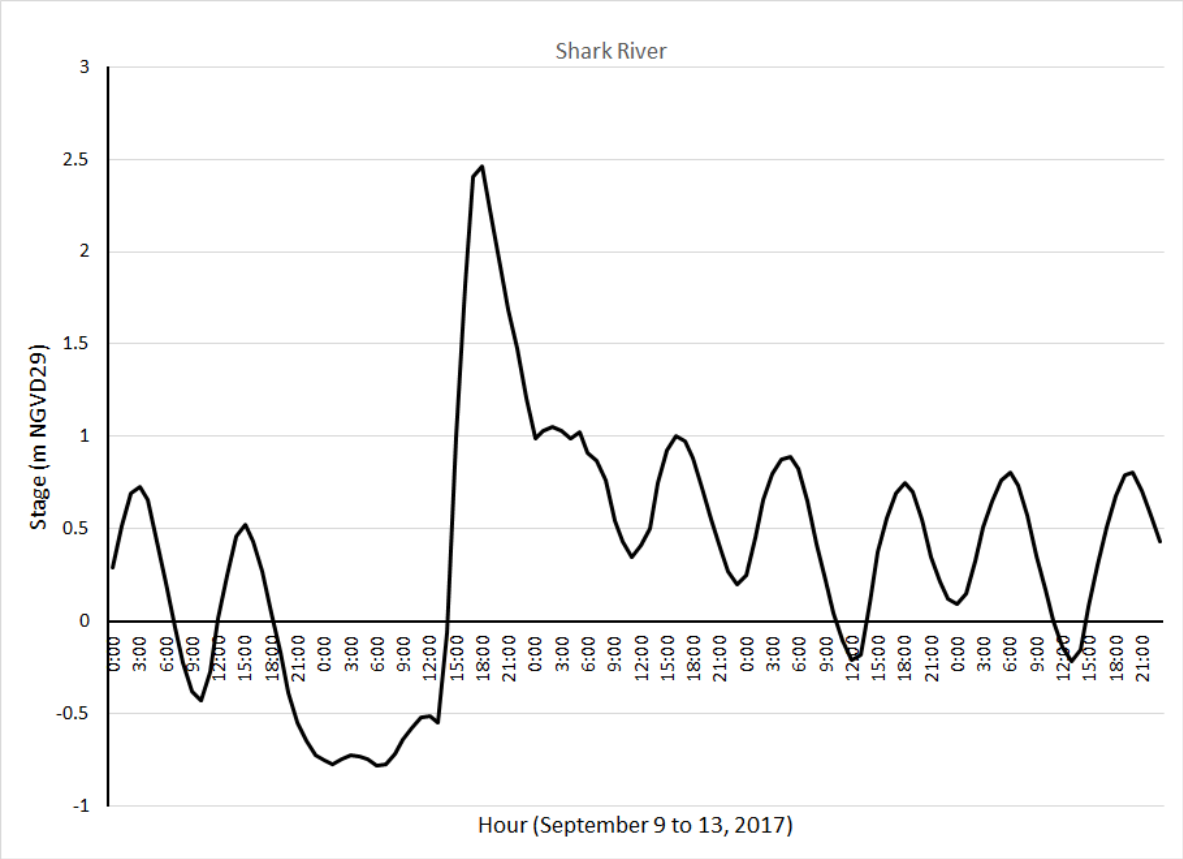


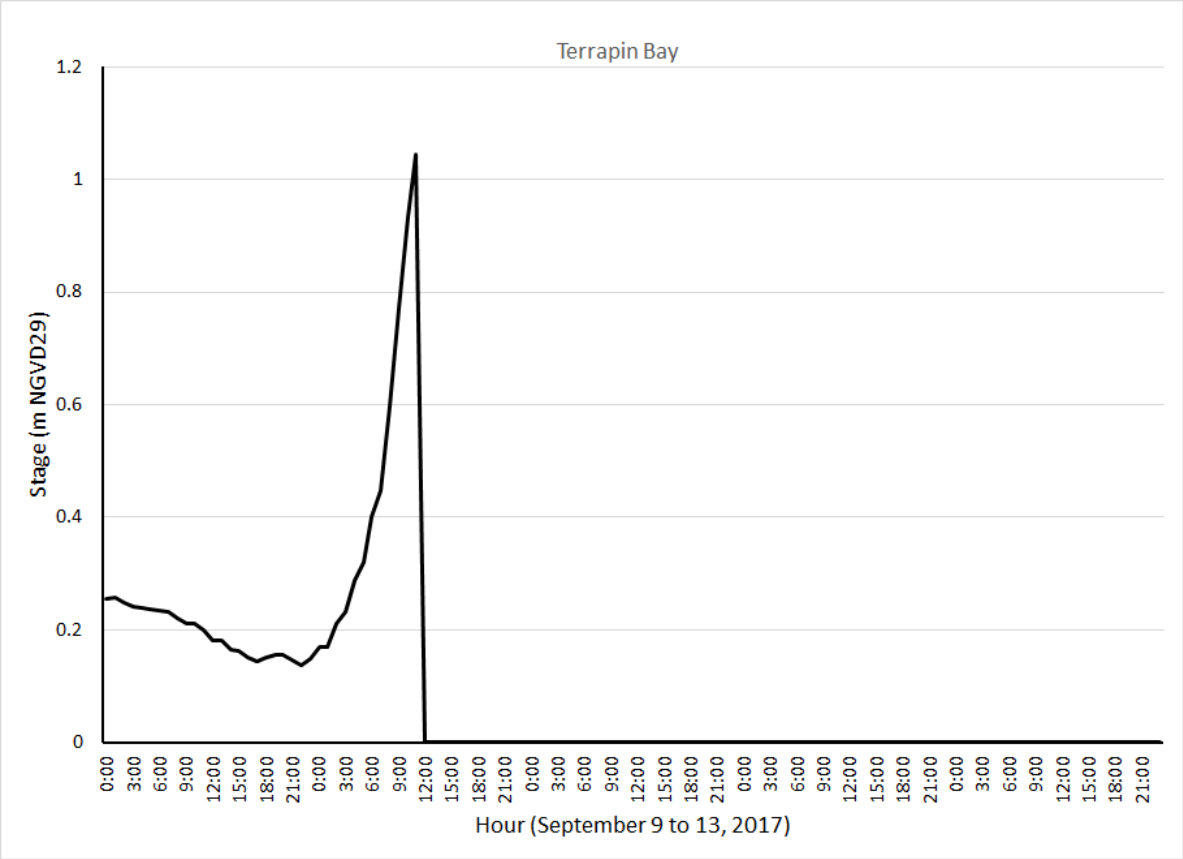
Broad River Lower and Cannon Bay



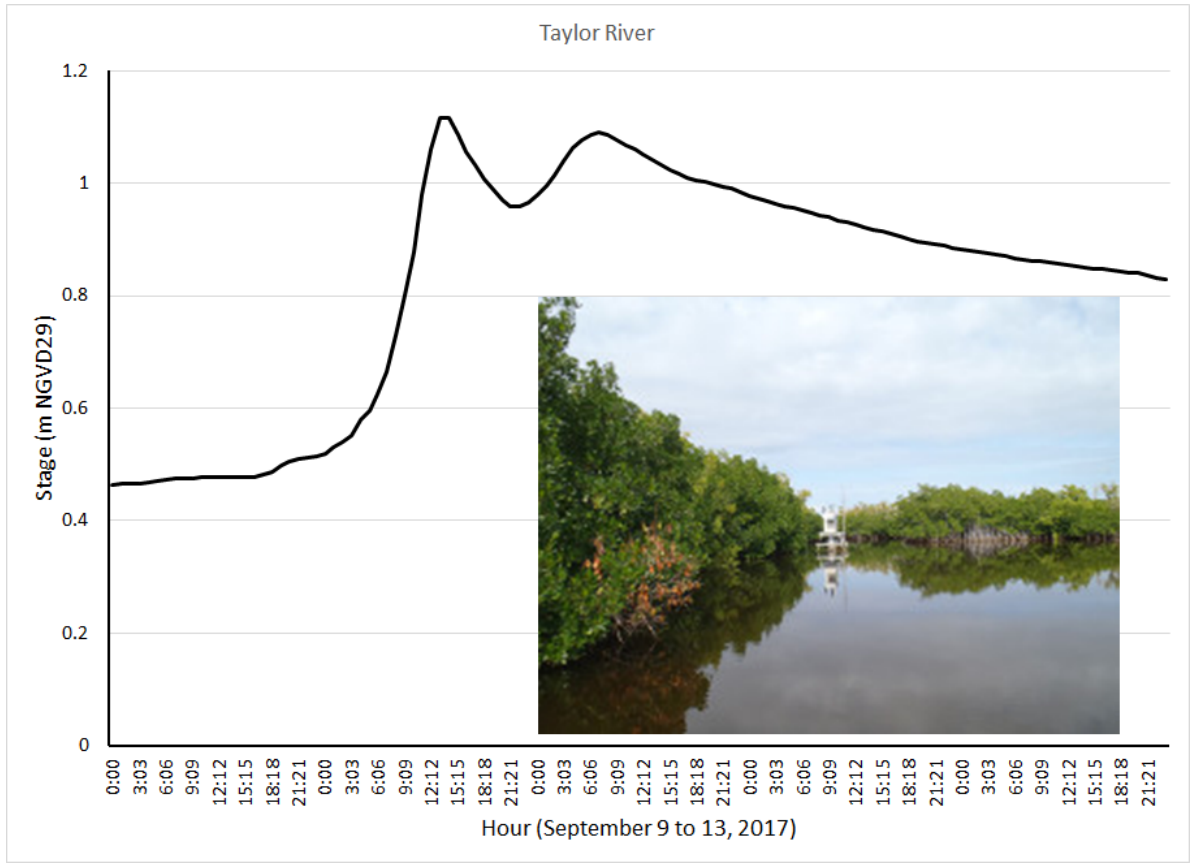


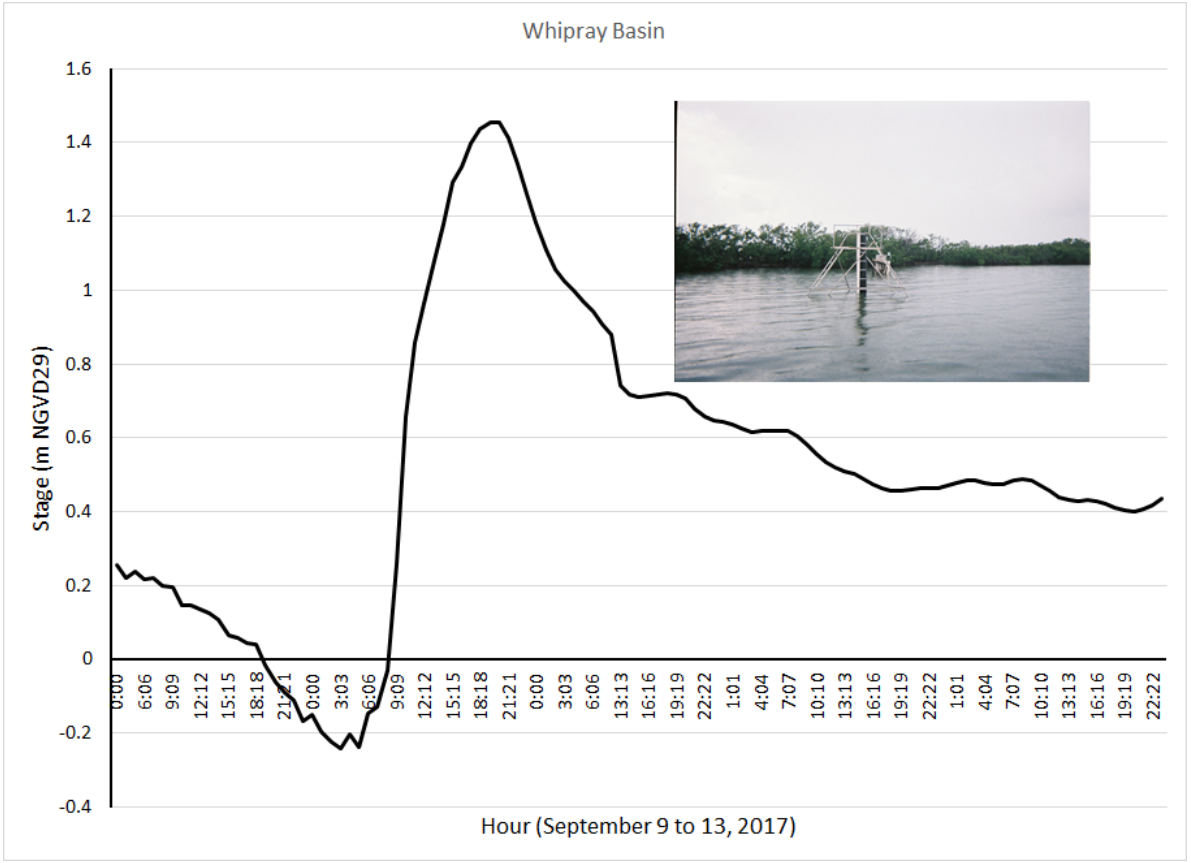
Shark River and Terrapin bay



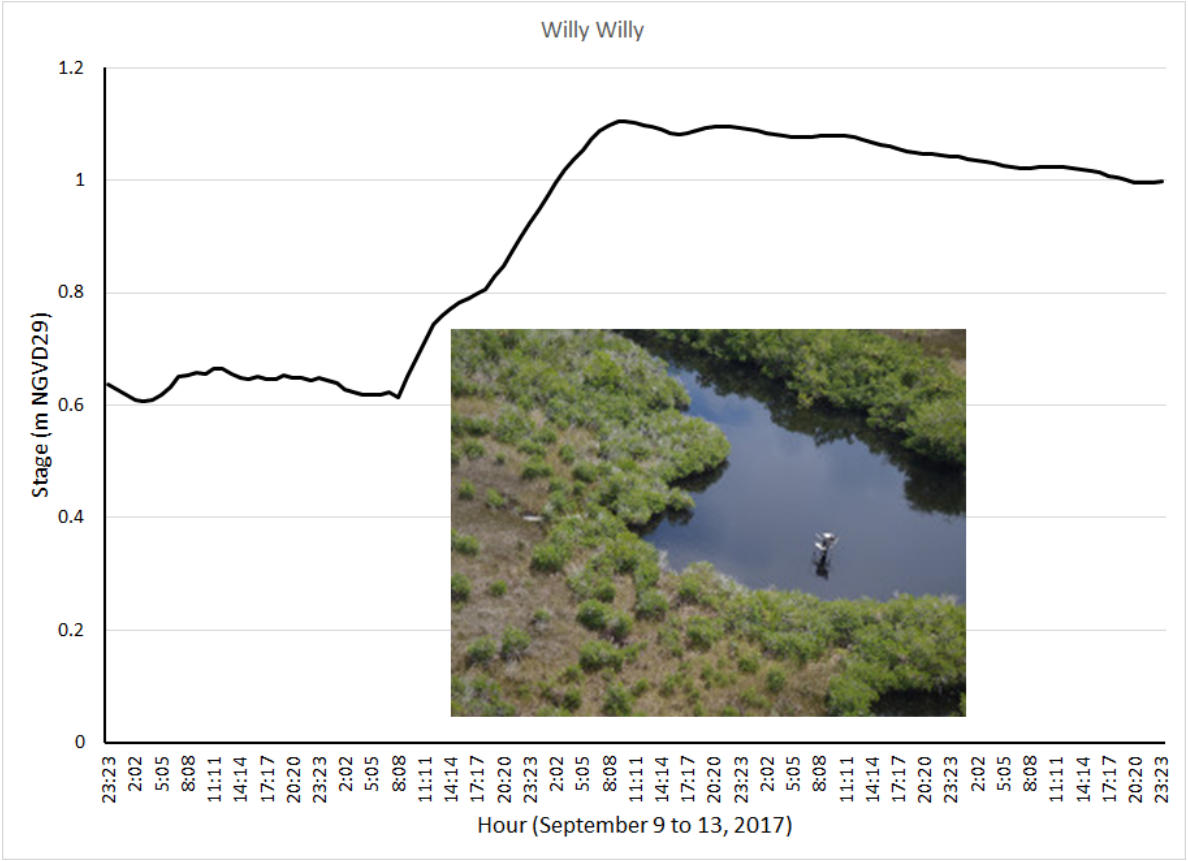


Taylor River and Whipray Basin

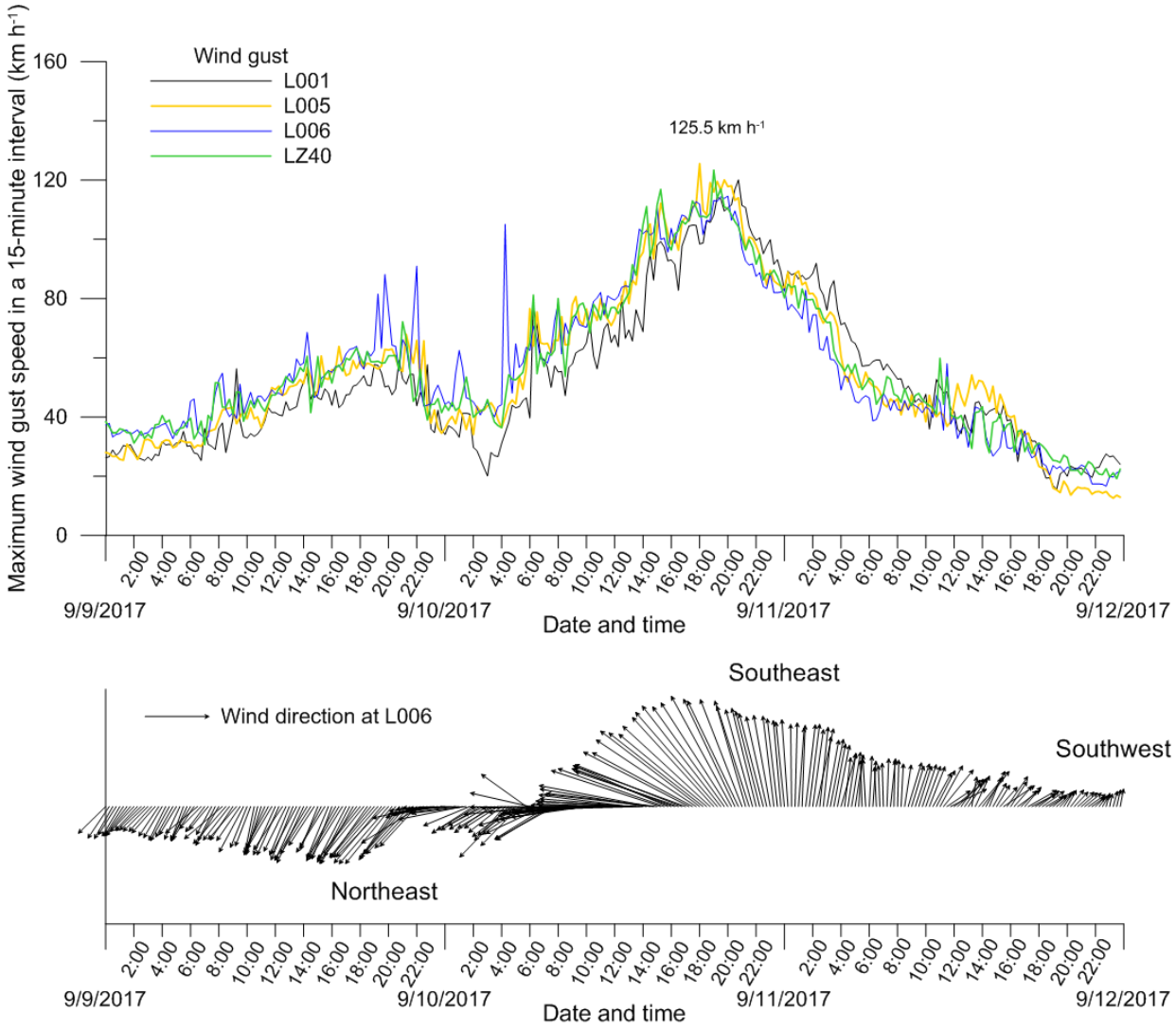


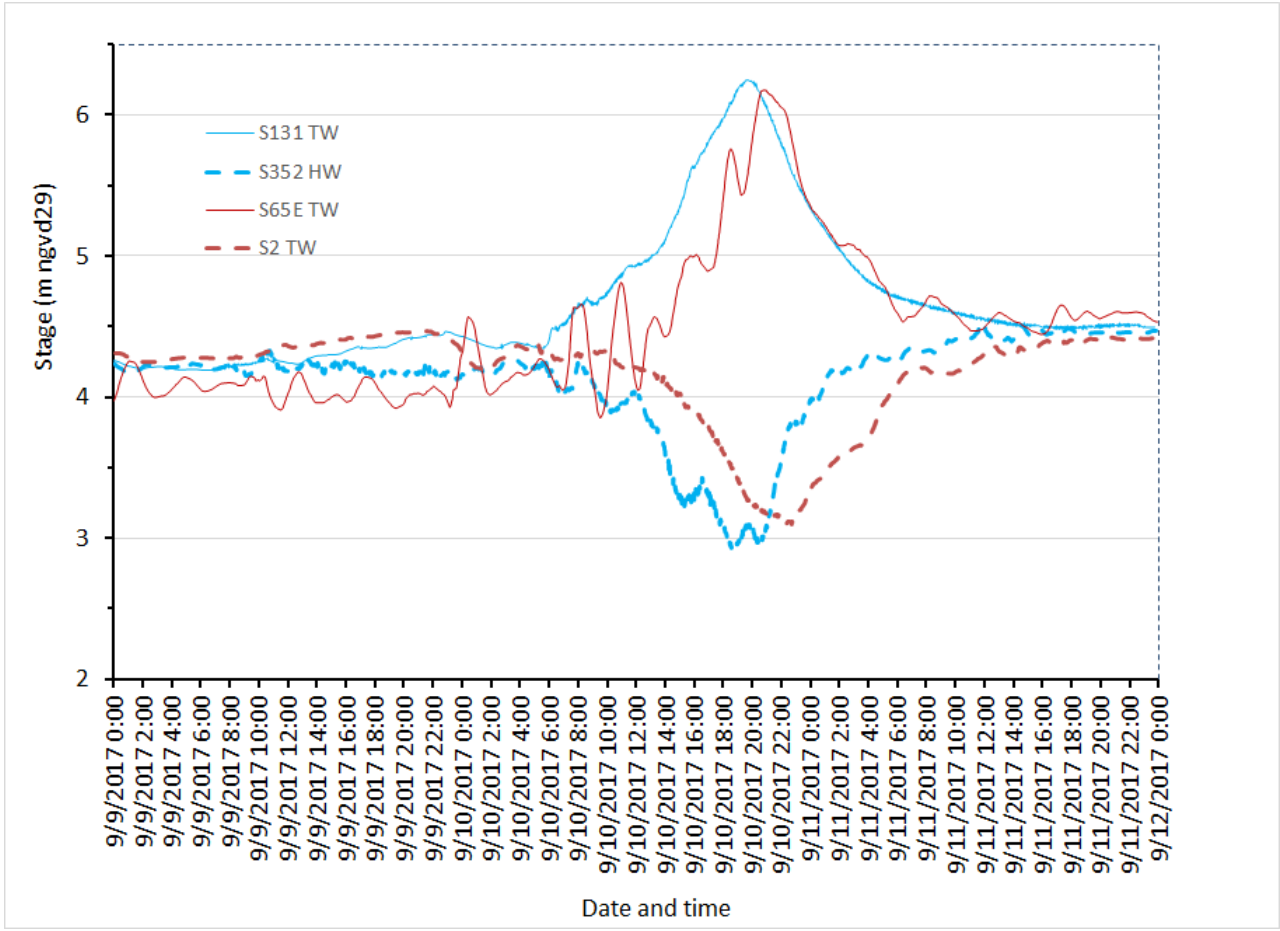


Willey Willey

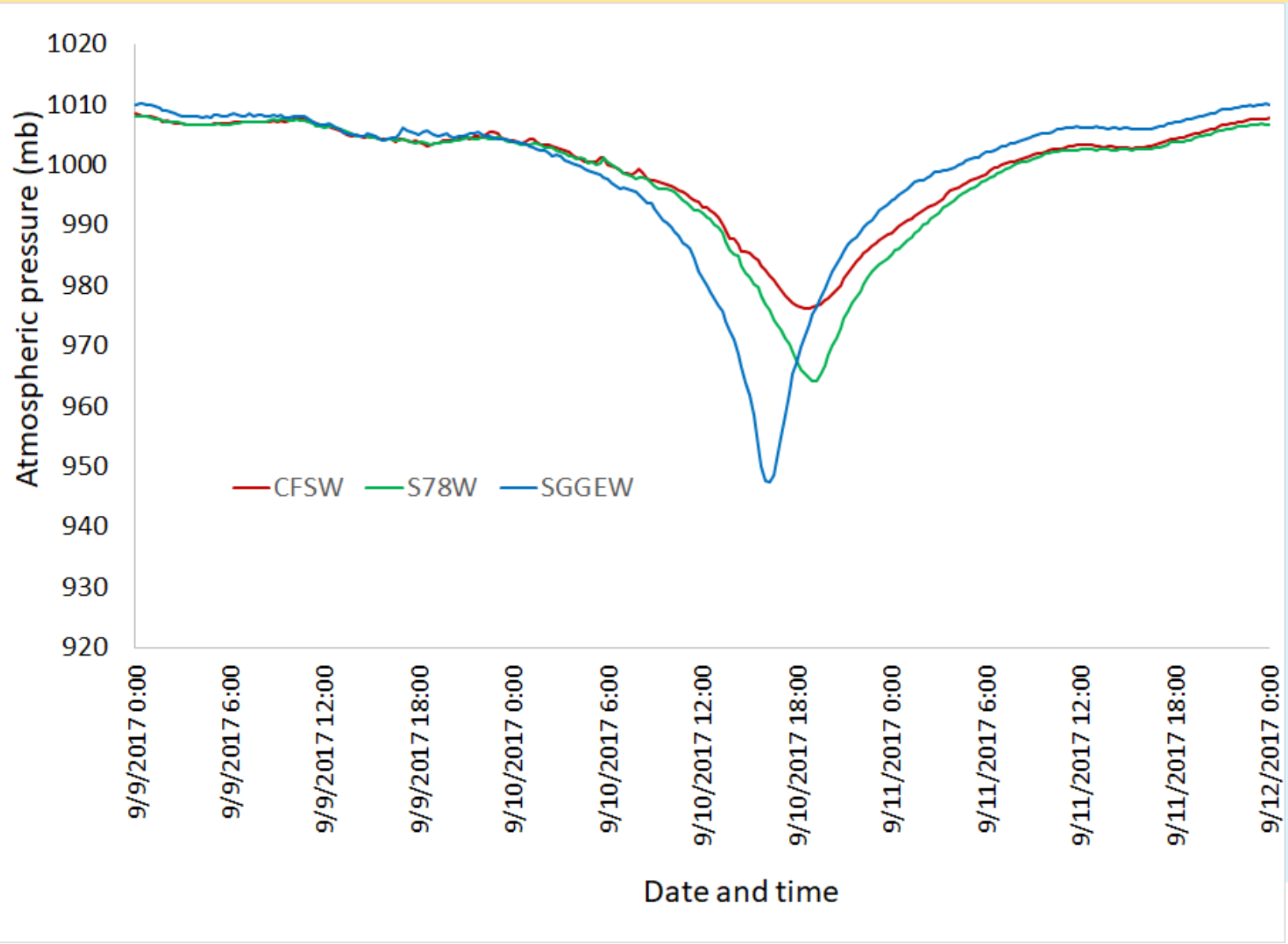


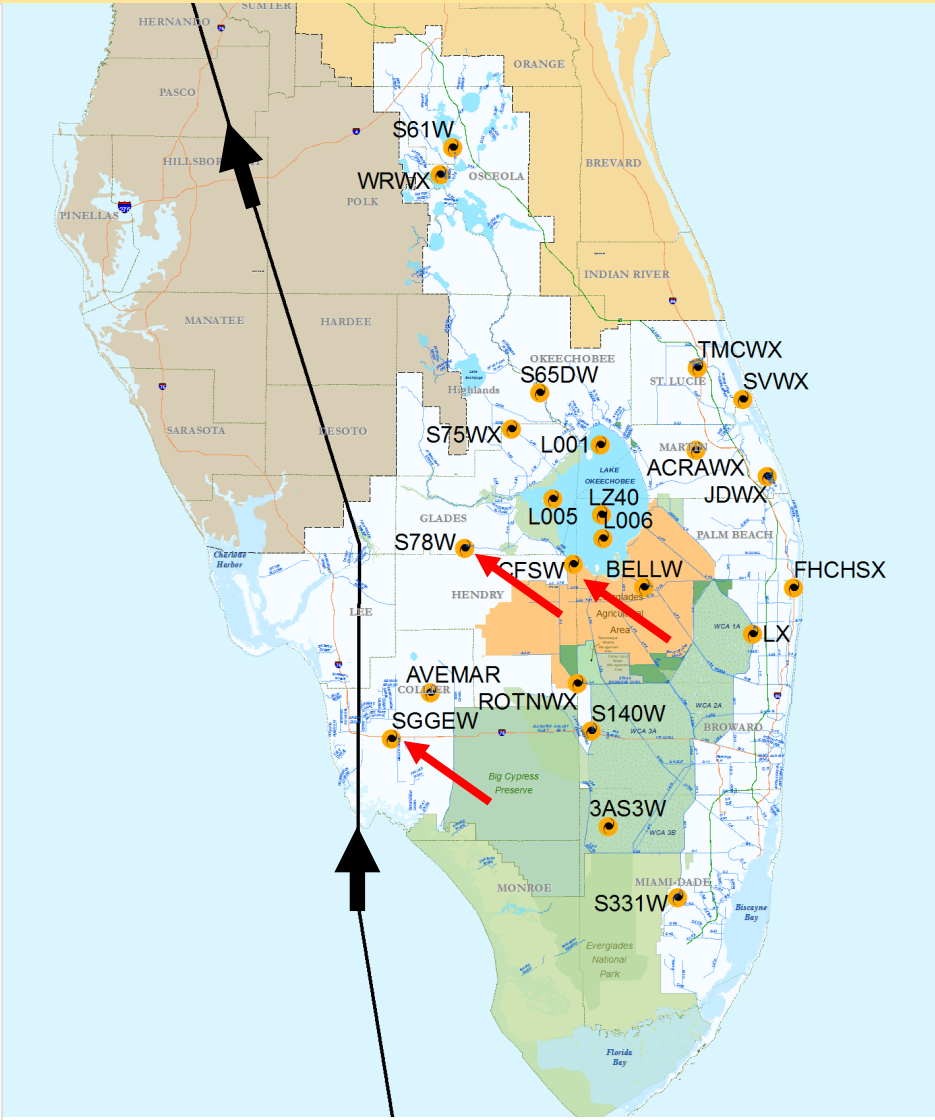
Wind speed, Direction, Water Level Change on Lake Okeechobee



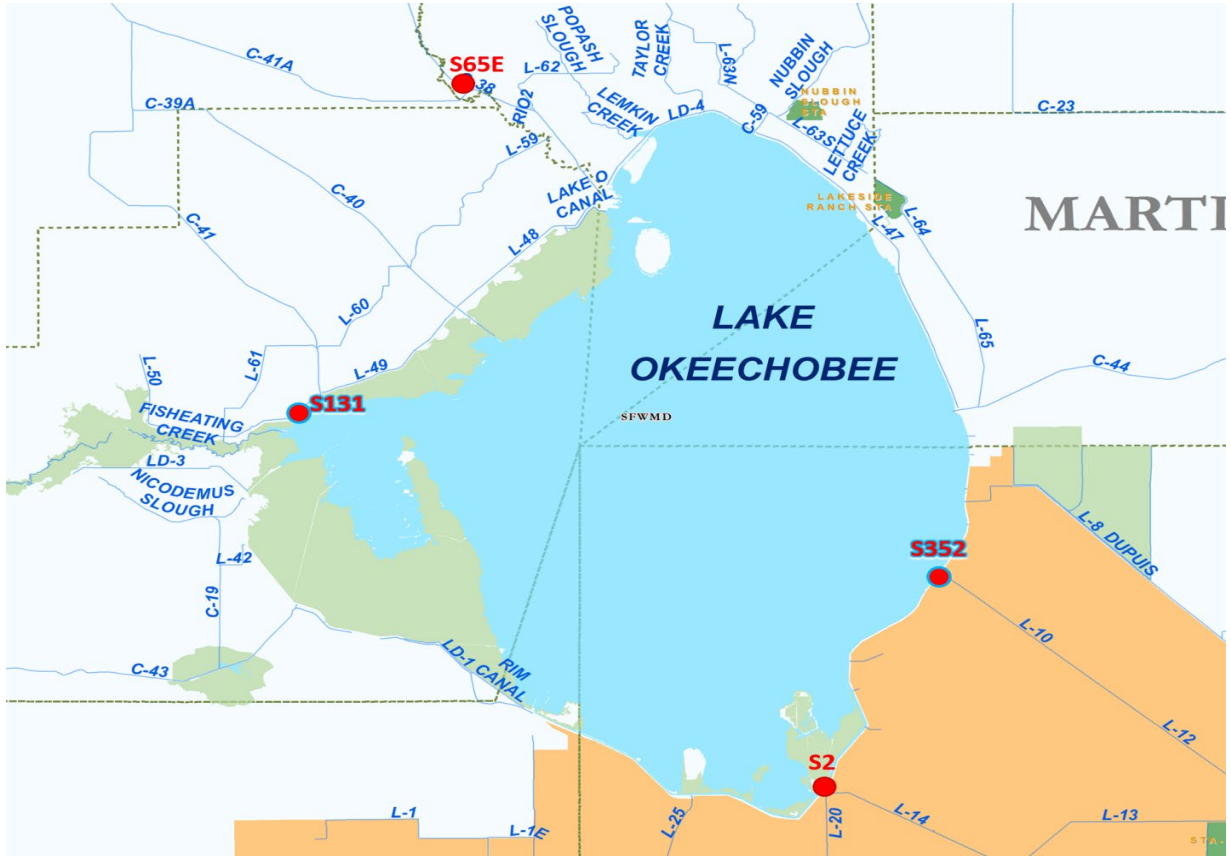


Atmospheric Pressure during Hurricane Irma

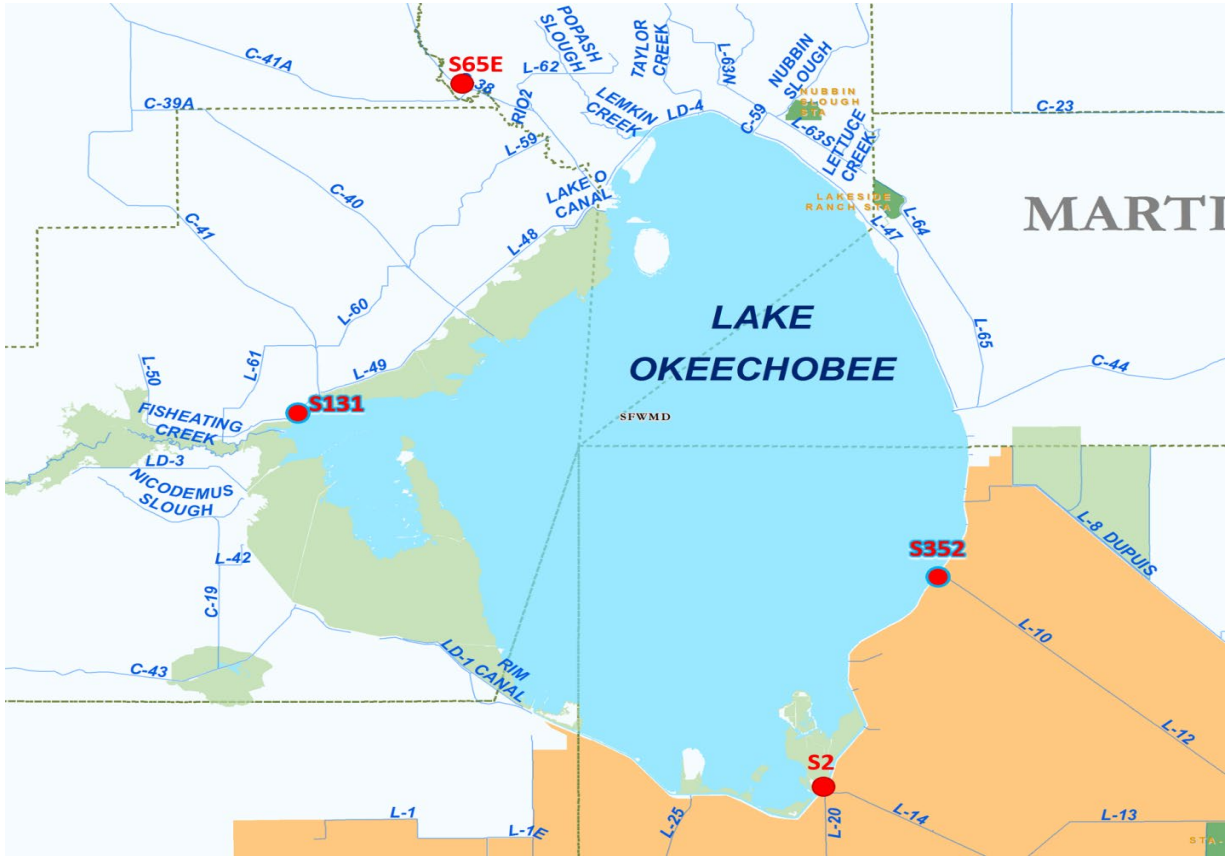




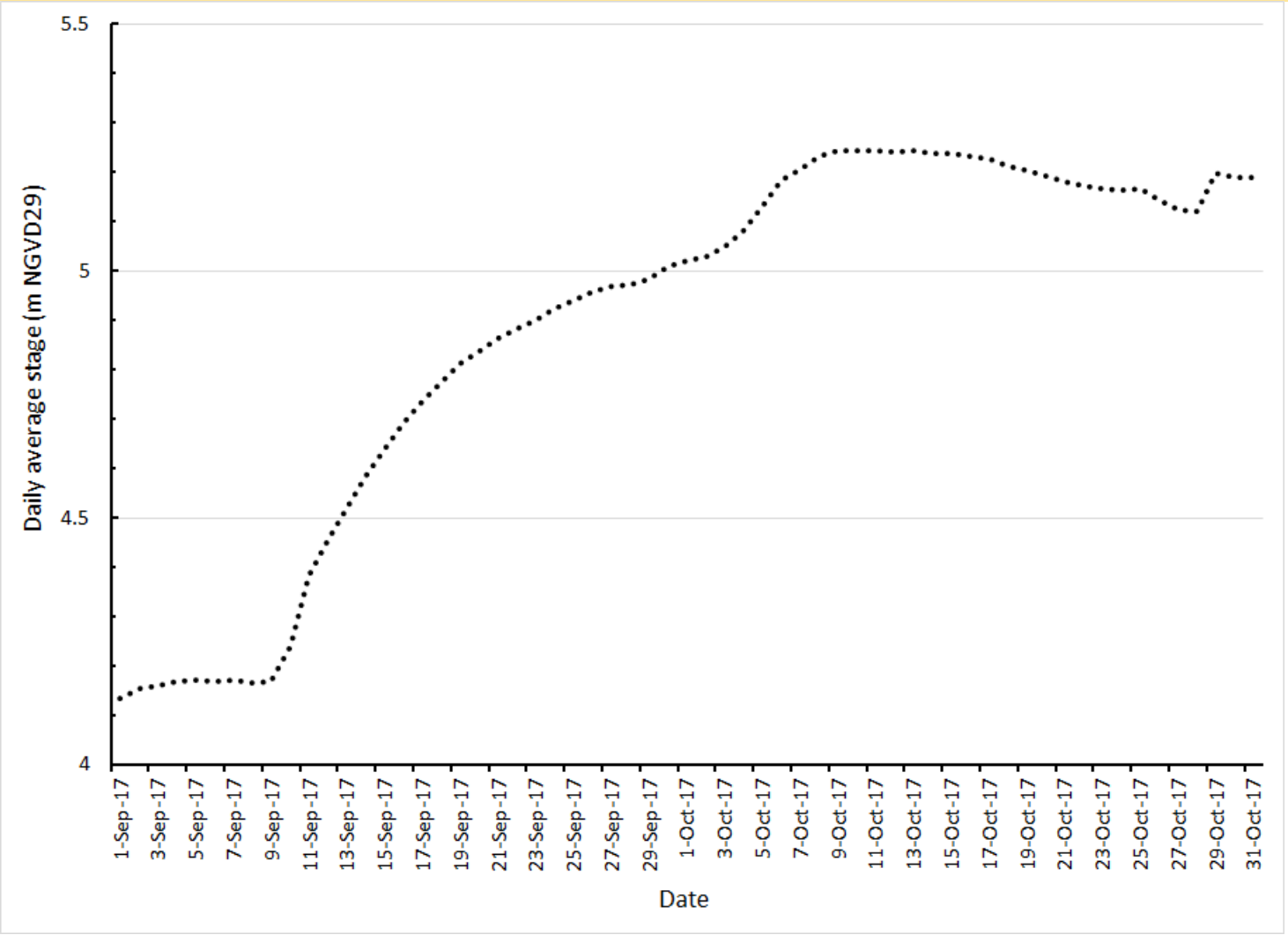
Erosion Damage from Hurricane Irma on S-65E tailwater

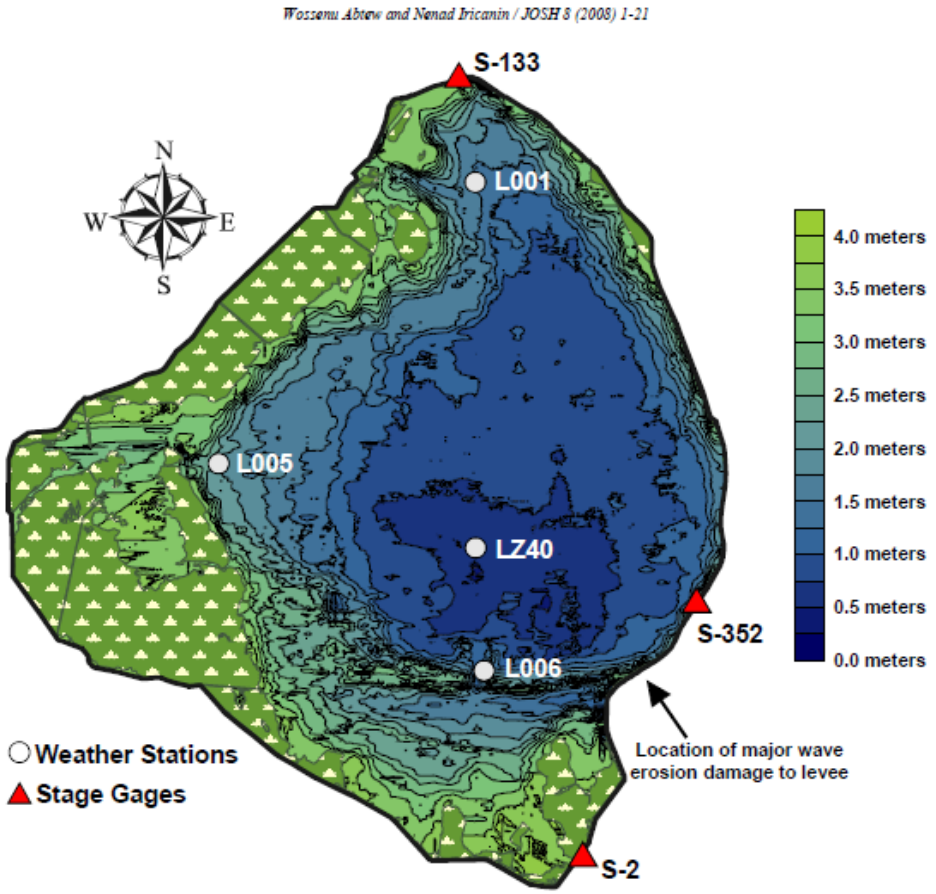


Lake Okeechobee Damage from Hurricane Wilma

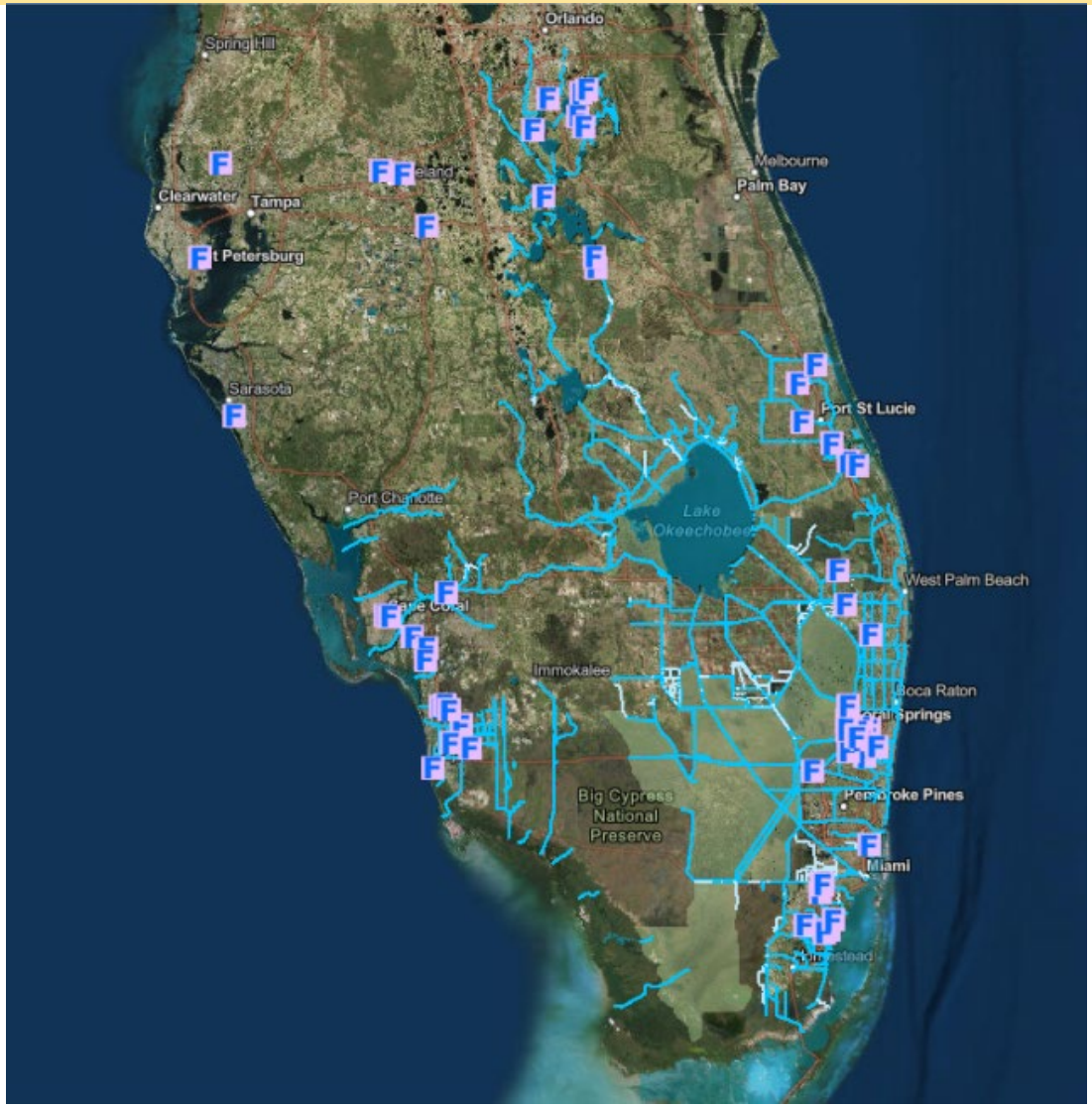


Lake Okeechobee Stage Rise from Hurricane Irma





Some of the Flooded Areas from Hurricane Irma (source: SFWMD)



Hurricane Irma Impact a) Fallen tree in C-51 Canal b) Fallen Tree in C-13 Canal c) S-72 Canal Bank Damage and d) G-310 Pump Station Roof

a

b

c

d

Hurricane Irma Impact a) S-65A Access Road Flooding and Washout b) C-25 Bank Erosion c) C-41 Bank Erosion and d) C-14 Bank Erosion

a

b

c

d

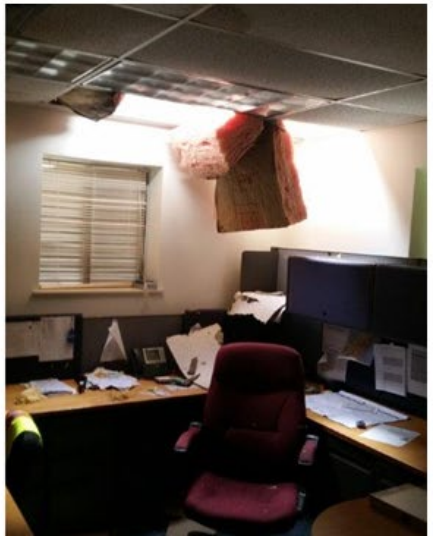
Hurricane Irma Impact a) C-23 Bank Erosion b) Faka Union Canal Bank Erosion c) Flooded Community Along Shingle Creek and d) West Palm Beach Field Station Structure Damage

a

b

c

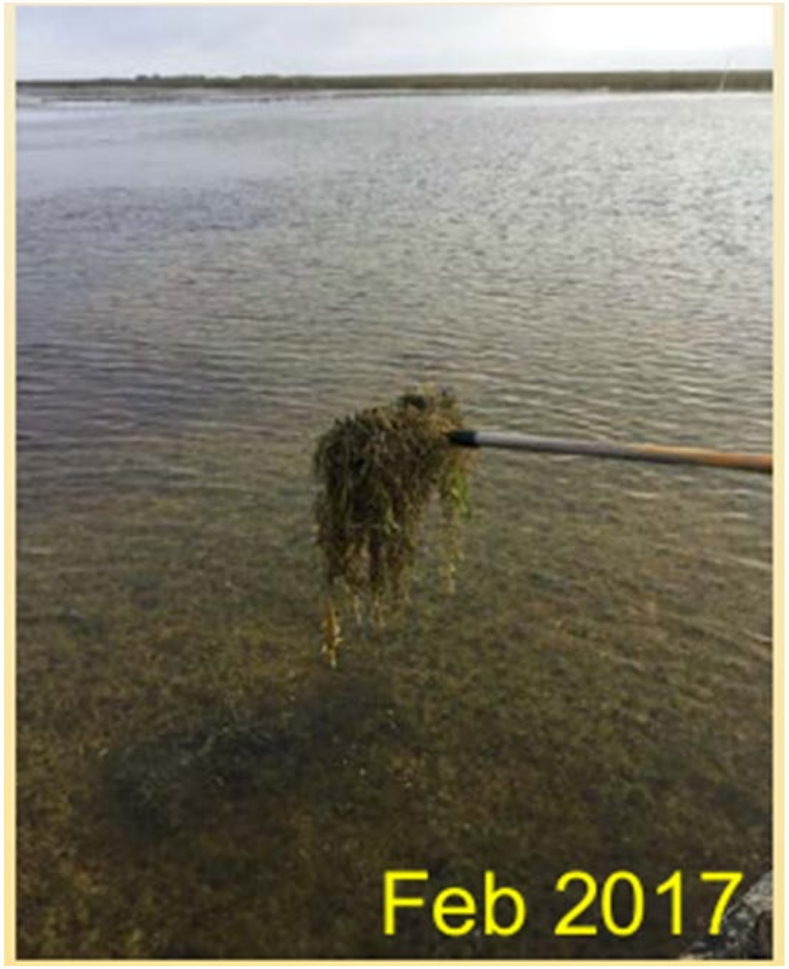
d



STA-1W Cell 4 Cattails Before and After Hurricane Irma

Hurricane Irma Impact a) STA-2 Flow-Way 3 (Mid Flow-Way) Pre-Storm SAV Density and b) Post-Storm Reduced Density. (photos by N. Ralph and W. Larson, SFWMD)

a



b

Uprooted Vegetation from Hurricane Irma Impact in STA-1E Cell 2, b) STA-1W Cell 4 (photos by N. Ralph and W. Larson)

a

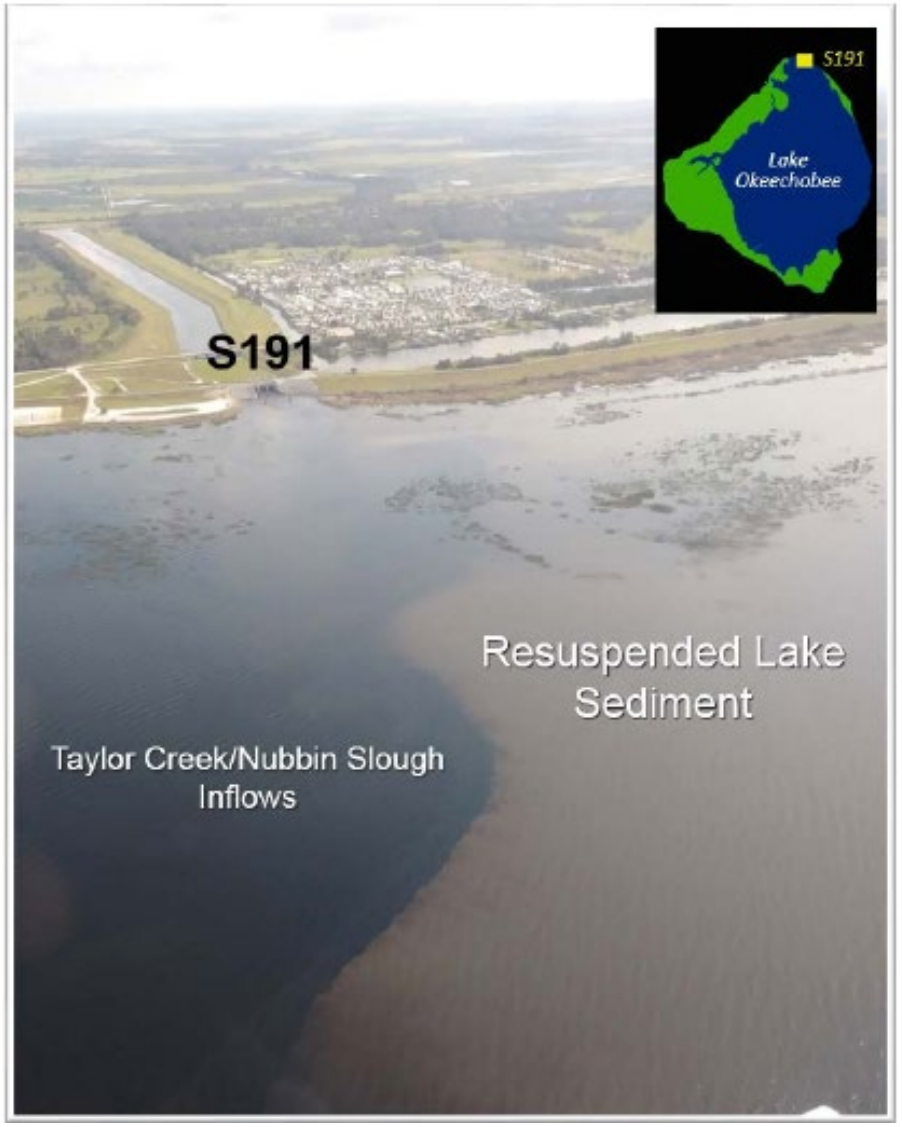
b

Sediment Resuspension from Hurricane Irma Impact in a) STA-1W Cell 5B and b) Cell 2B (photos by N. Ralph and W. Larson)

a

b

Lake Okeechobee Water Quality Impact from Hurricane Irma Impact (Ch. 8; SFER2019)



High TP load from high runoff

High TP concentration from sediment resuspension

High suspended solids and decrease in water clarity

Summary

- ENP marine monitoring network gauges need higher reading capacity at each gauge to correctly record storm surge
- Storm surge appears lower in the southeast with the highest along the path of the hurricane in the southwest
- Rainfall over the SFWMD region was 21 cm with site measurements of as high as 55 cm in ENP
- Wind gust speed of ≈ 200 km h^{-1} was observed on land at the southwest
- Damages occurred to water management facilities and constructed wetlands
- Lake Okeechobee experienced wind setup of close to 2 m