

Trends in River and Floodplain Water Depths During Ascension and Recession Events on the Kissimmee River

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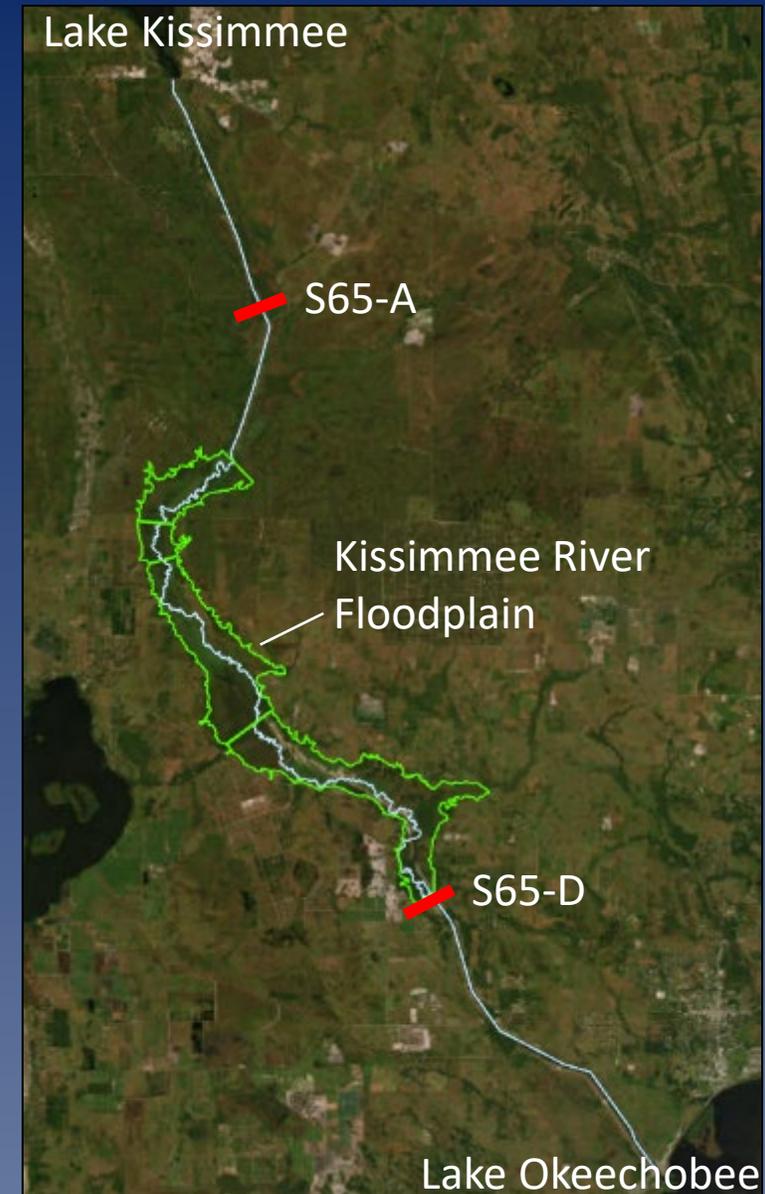
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GEER 2025 – Coral Springs, FL



Background

- Flood pulses are an essential characteristic of river ecosystems
 - Flooding delivers water, nutrients, and organic material to the floodplain
 - Essential habitat for fish and other aquatic species is established when the floodplain becomes inundated
 - The rate of floodplain drainage after a flood pulse is important for wading bird foraging
- Flow in the Kissimmee River Basin is largely controlled by the S-65A Water Control Structure



Introduction

- Since the Kissimmee River Restoration Project began, a spatially and temporally dense dataset of stage values has been collected in the Phase I and Phase II/III areas:
 - 7 stage gauges in the river channel
 - 30+ stage gauges in the floodplain
 - Collecting data at 15-minute or less intervals

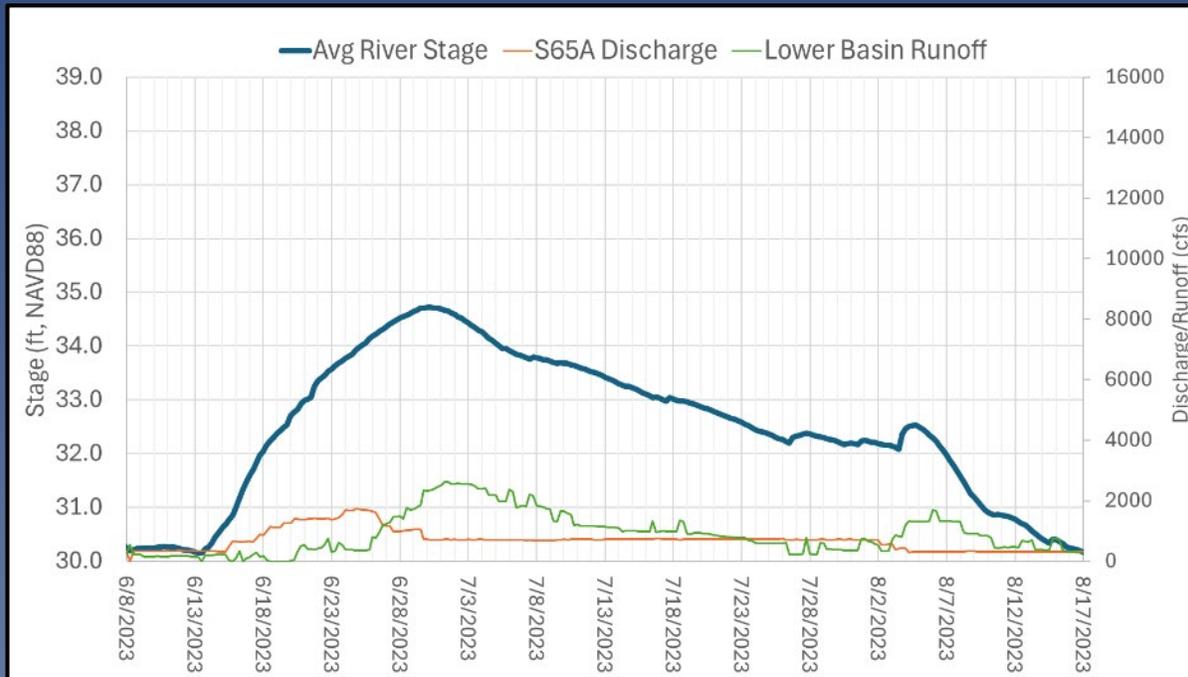
- Despite this, we still do not have a great understanding of how, where, and when water moves across the floodplain during the ascension and recession periods of a flood pulse event

- Providing a means to visualize these flood pulse events in a spatially-explicit way over small timesteps can improve our understanding of the dynamics of the system

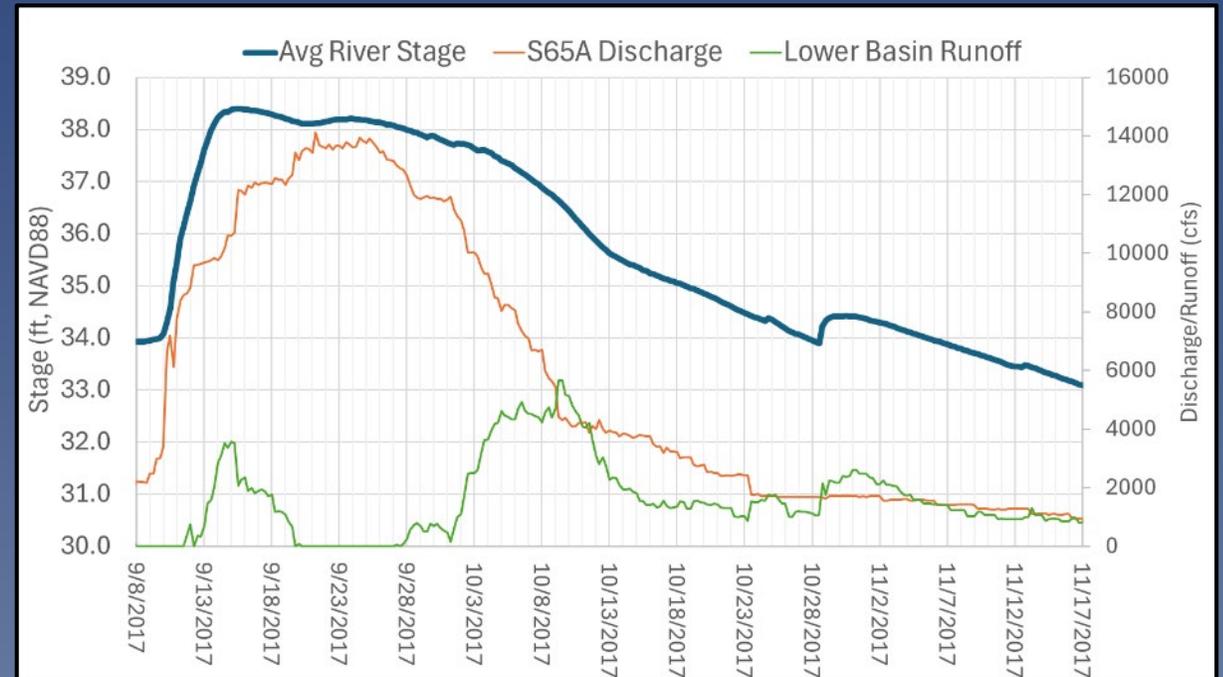
Outline

- Visualize the ascension and recession of 2 events of different magnitude and driving factors
- Compare how the Phase I and Phase II/III floodplains respond differently during ascension and recession using 6-hour data
- Analyze relative effects of S65-A Discharge, Local Runoff, and S65-D Gate Operations

2023 Wet Season - 9 inches of rain in 20 days

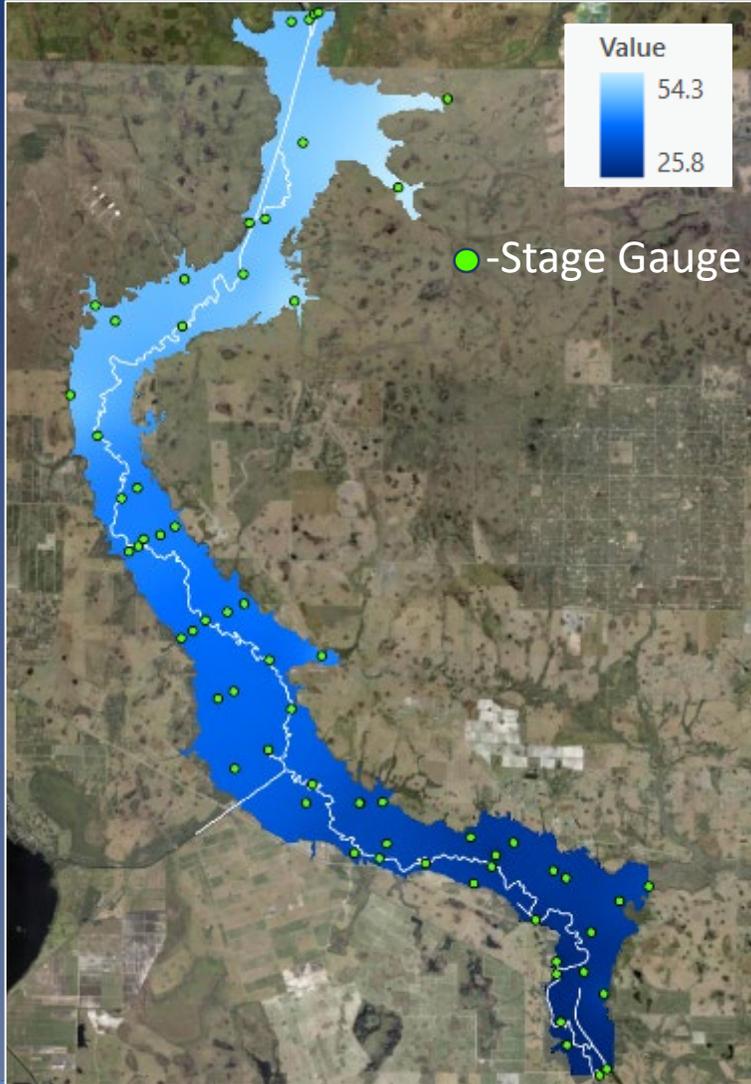


2017 Hurricane Irma – 9 inches of rain in 5 days



Water Depth Map Creation with ESRI™ Hydroperiod Tool

6-hour Interpolated Water Surface from Stage Gauge Network (Inverse-Distance Weighting)

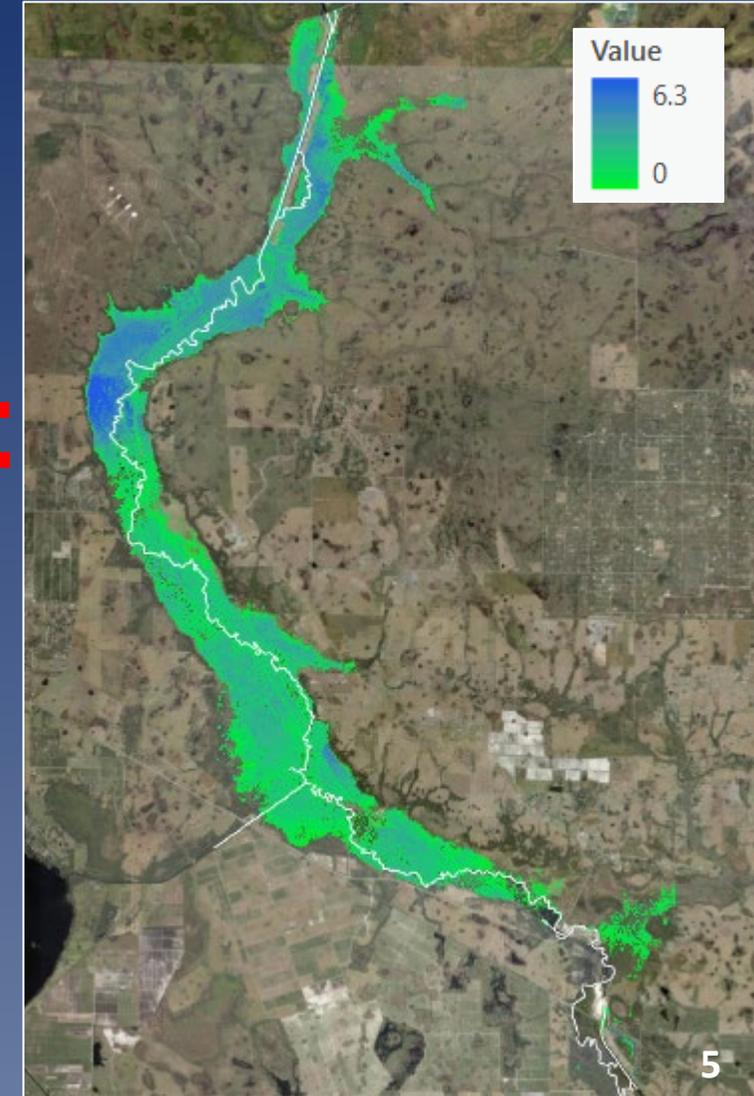


Surface Elevation DEM (2022 LIDAR)

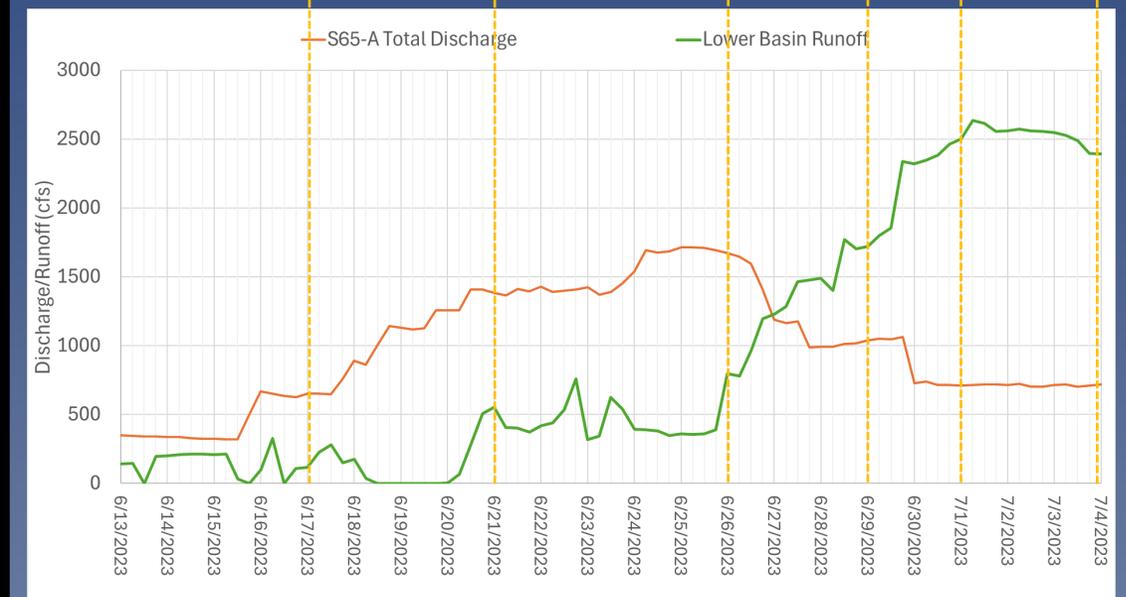
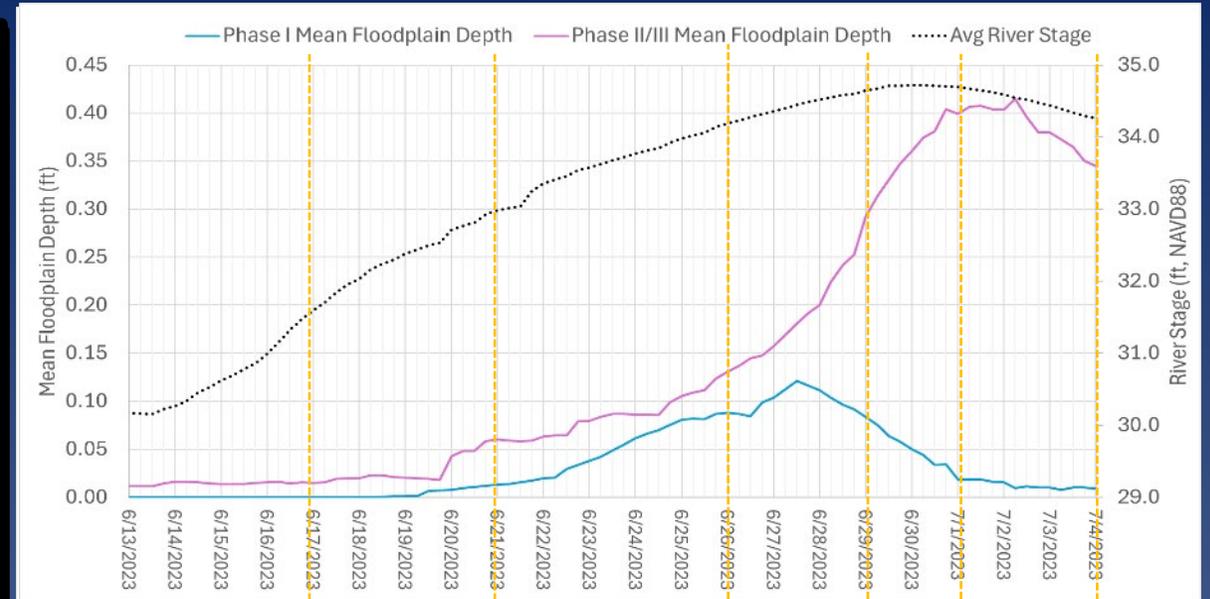
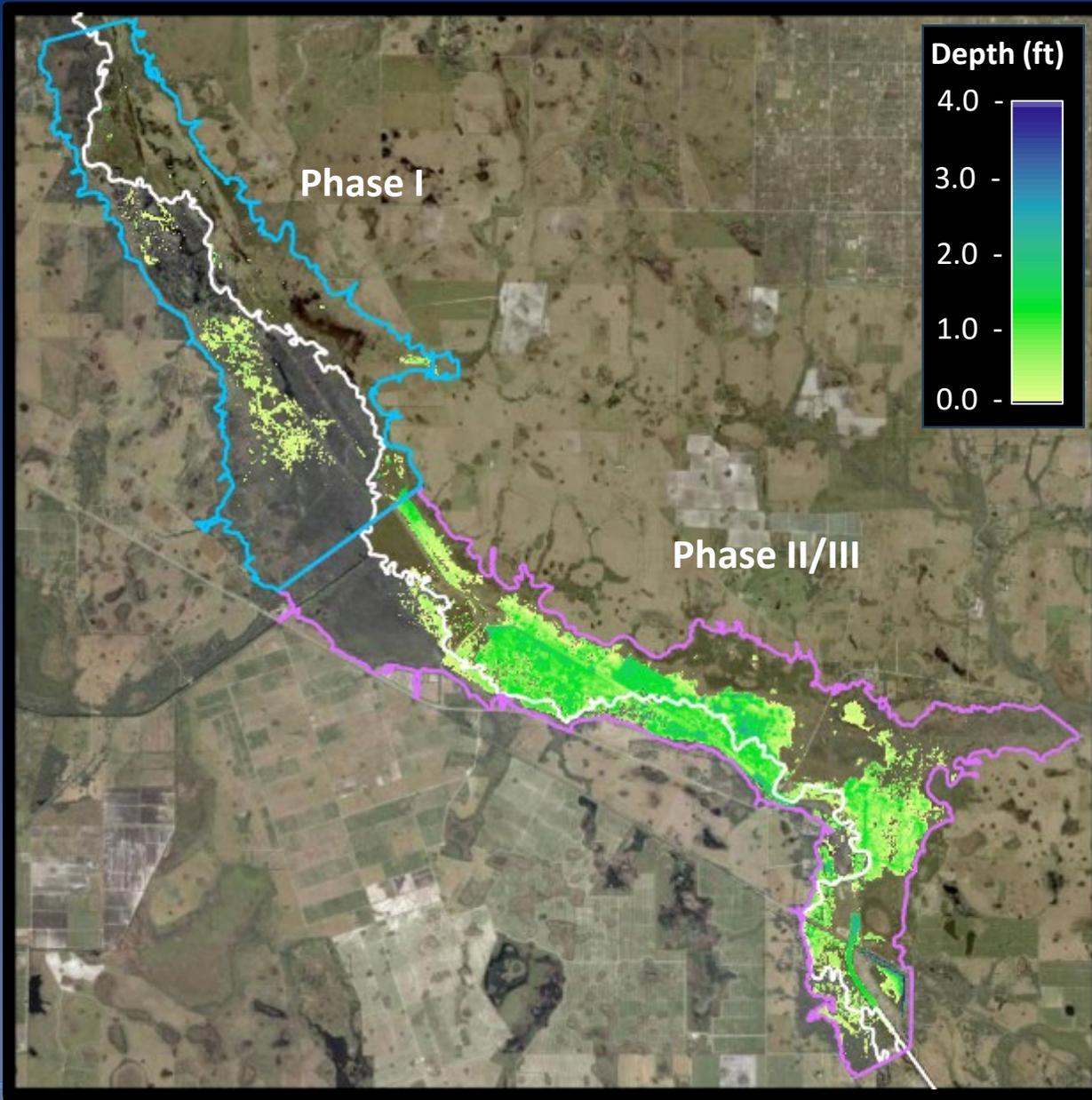


Subtract
=

Water Depth Maps at 6-hour intervals

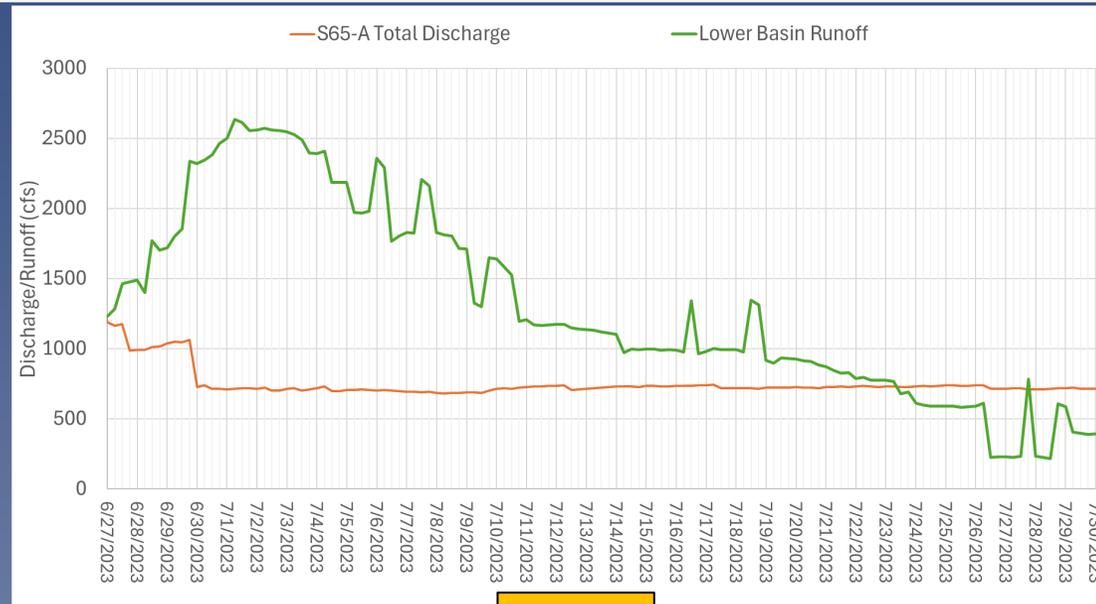
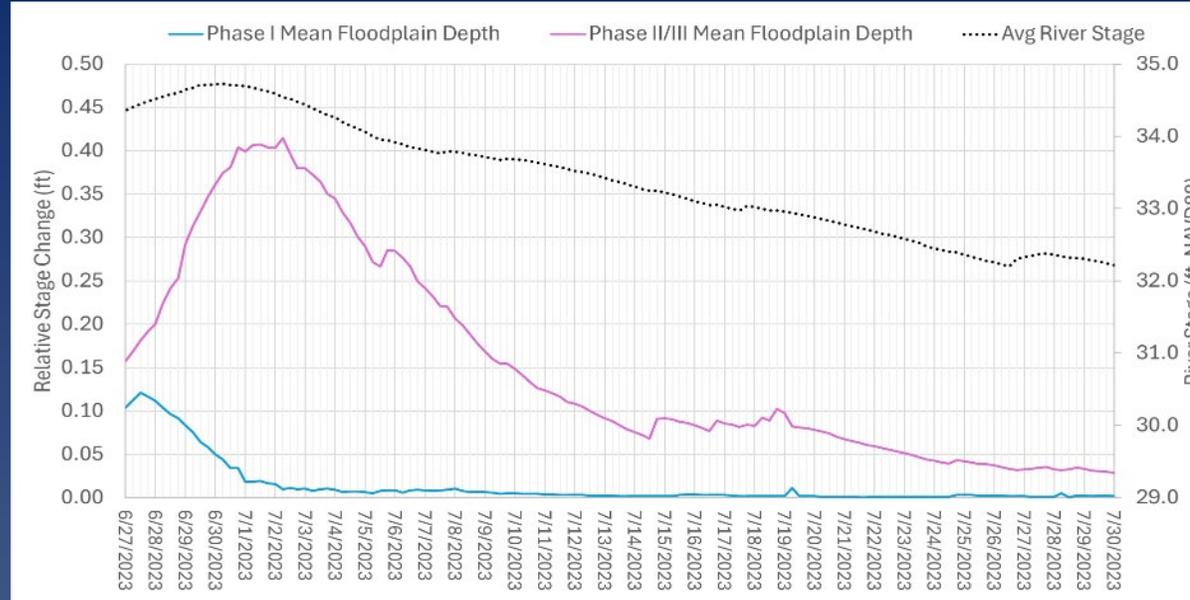


2023 Wet Season Flood Pulse (9 inches rainfall in 20 days) – Ascension



3 Weeks

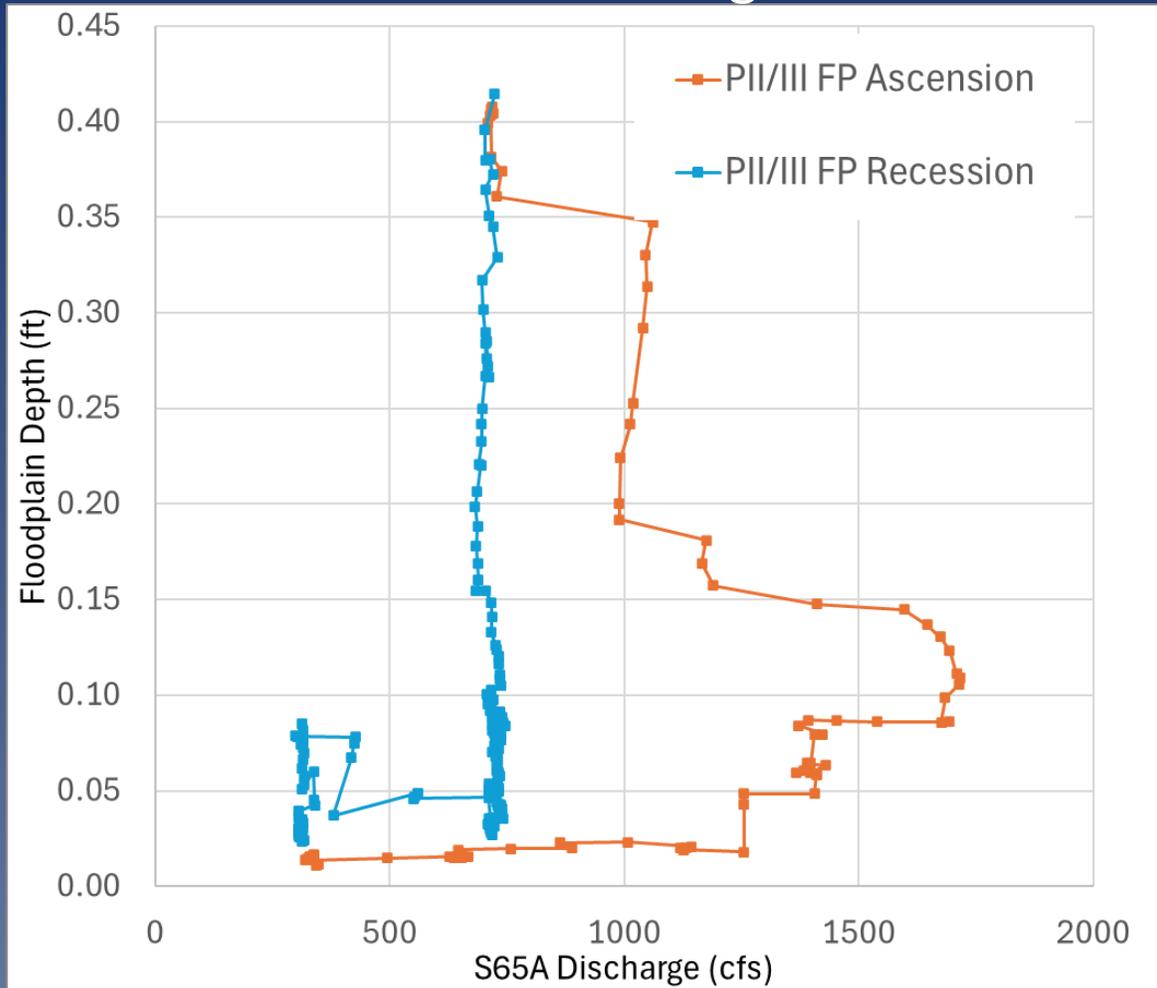
2023 Wet Season Flood Pulse (9 inches rainfall in 20 days) – Recession



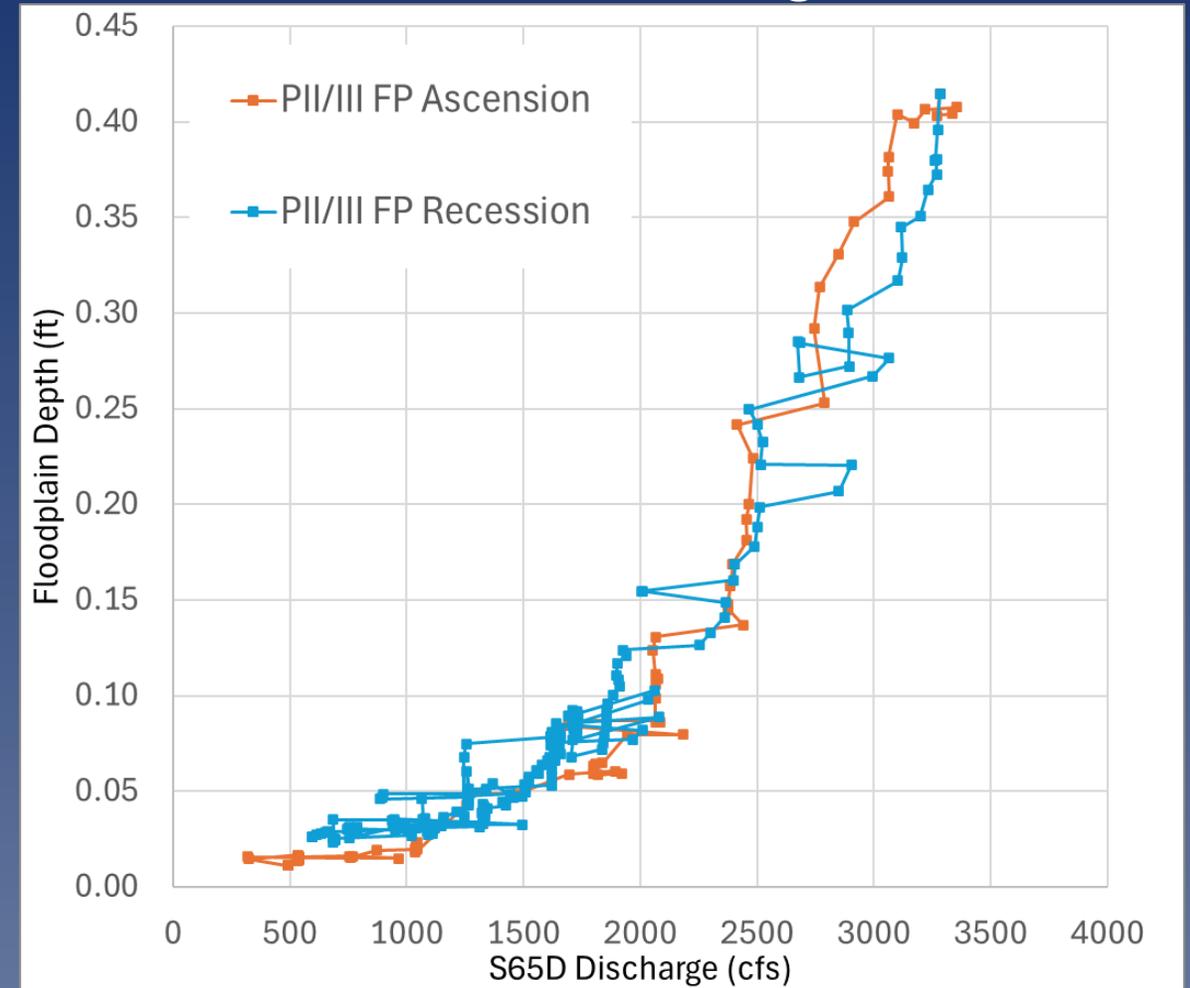
1 Month

Ascension vs Recession Phase II/III Depth-Discharge Curves 2023

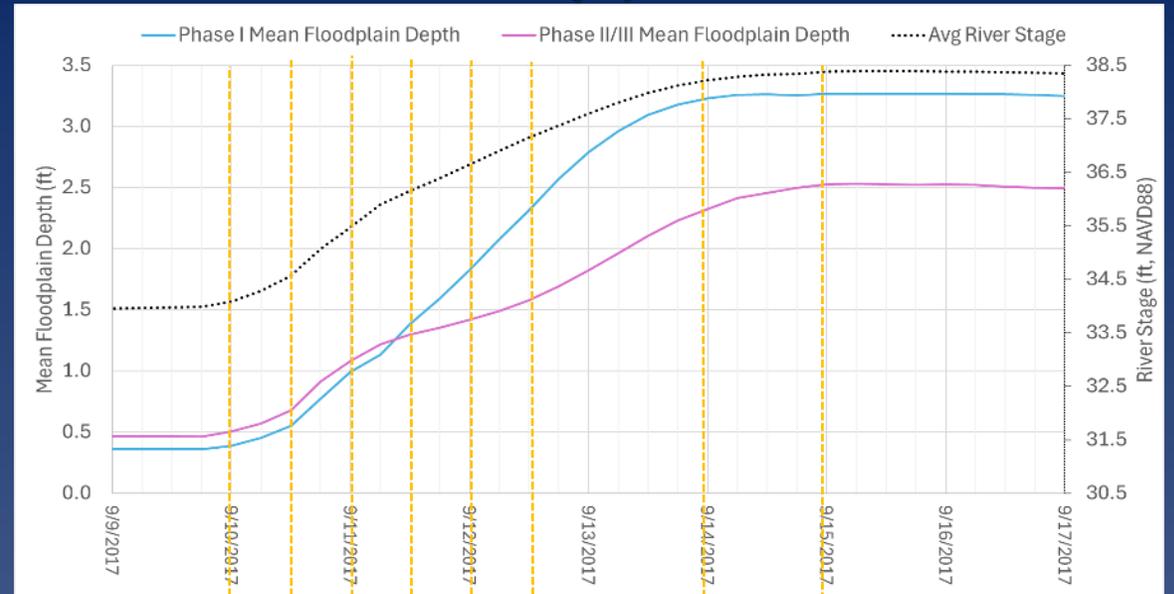
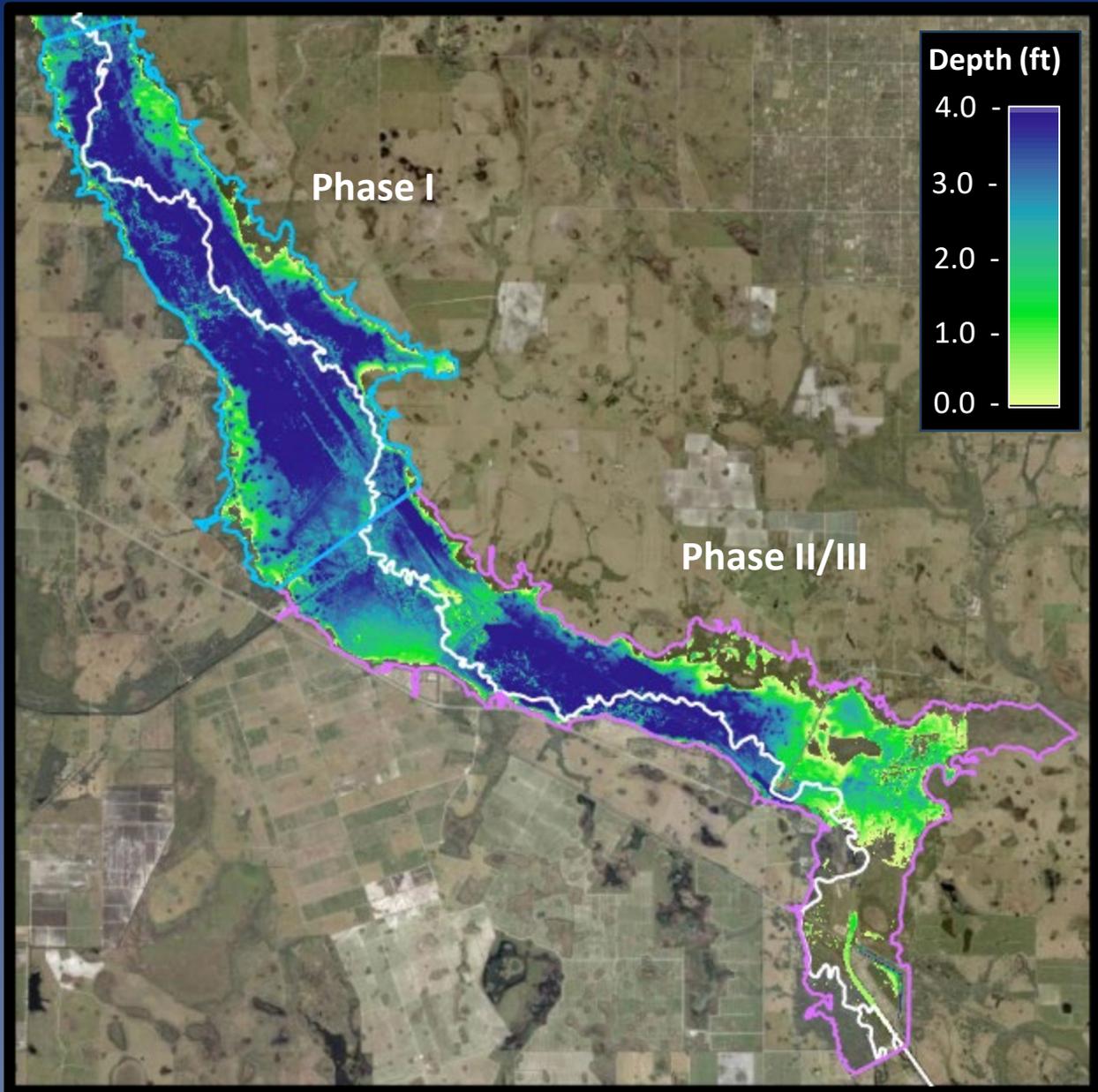
S65-A Discharge



S65-D Discharge

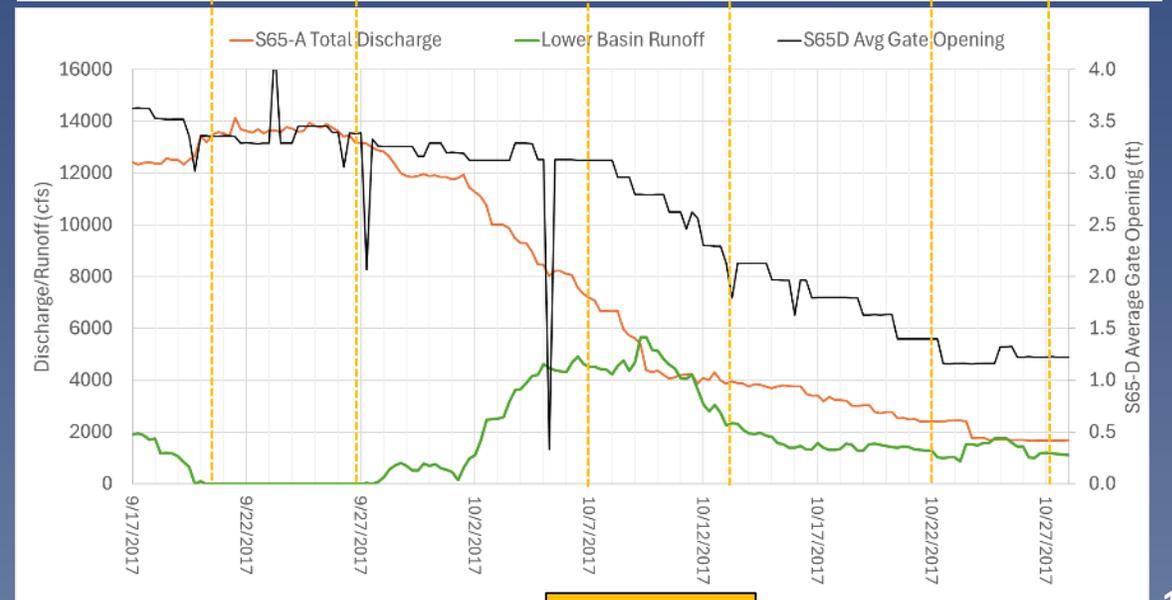
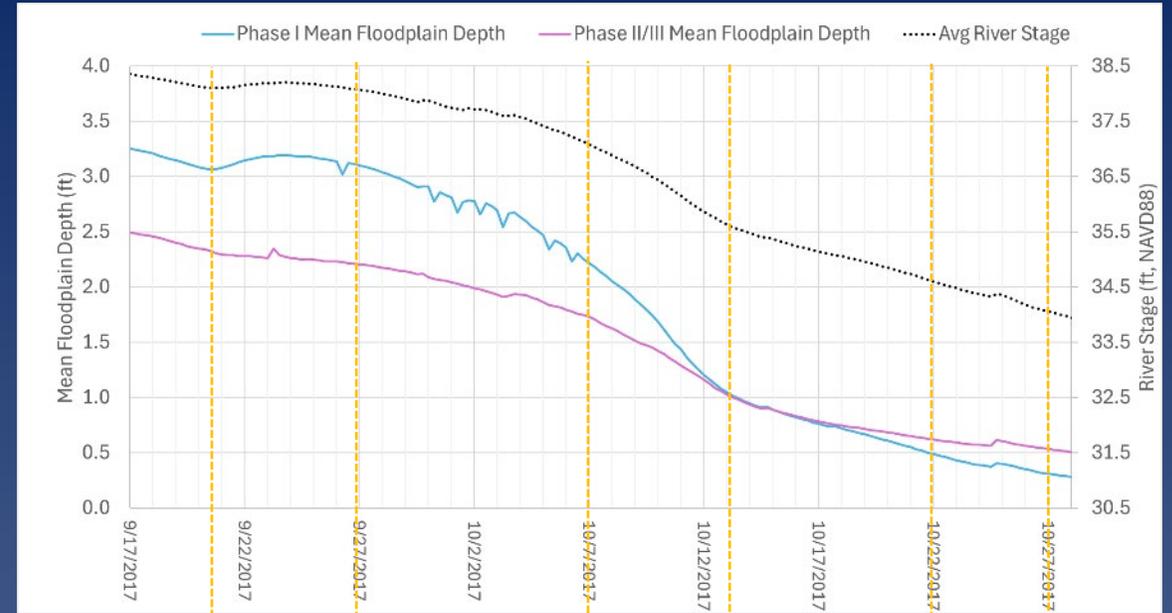
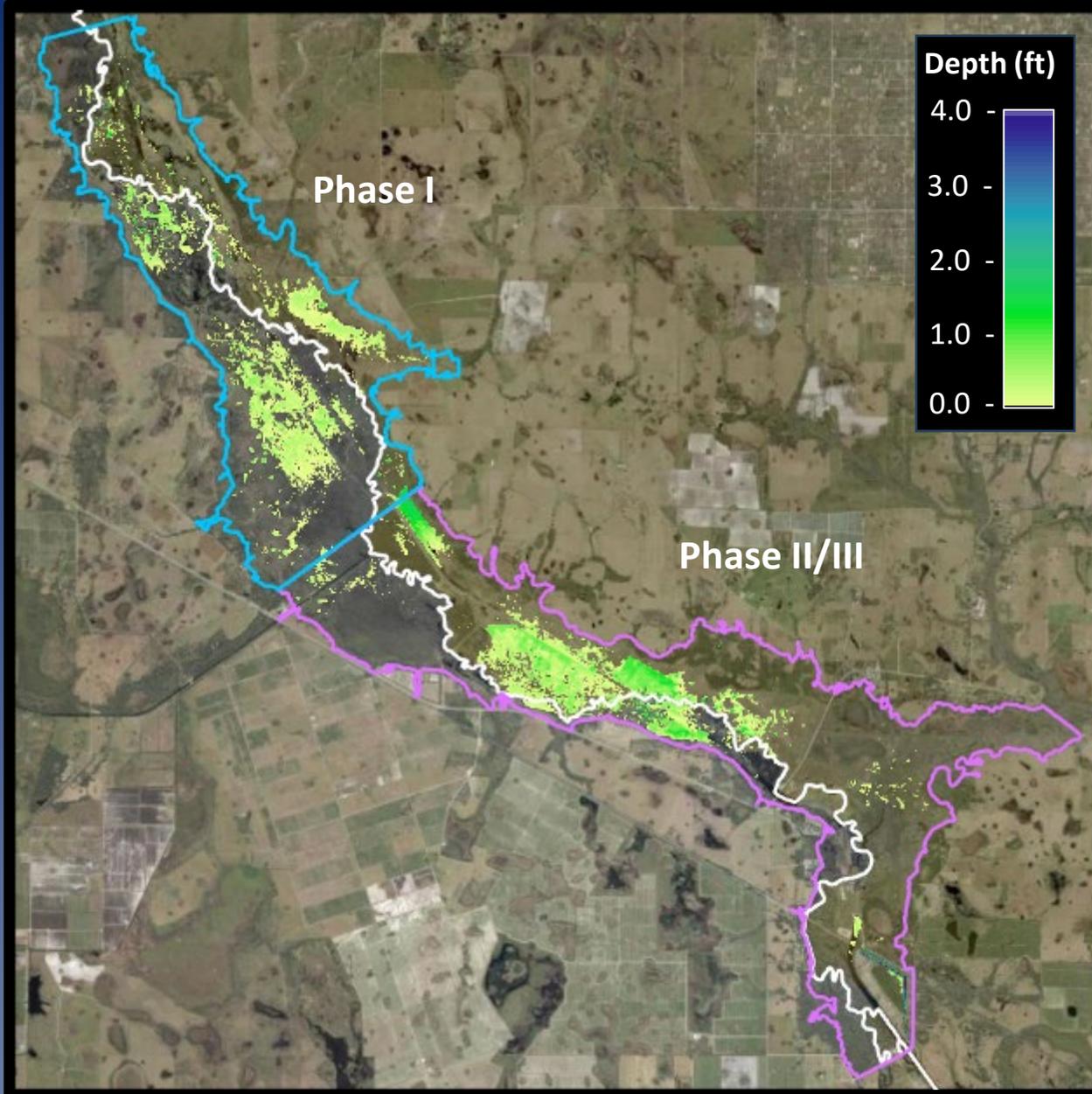


2017 Hurricane Irma Flood Pulse (9 inches of rainfall in 5 days)- Ascension



1 Week

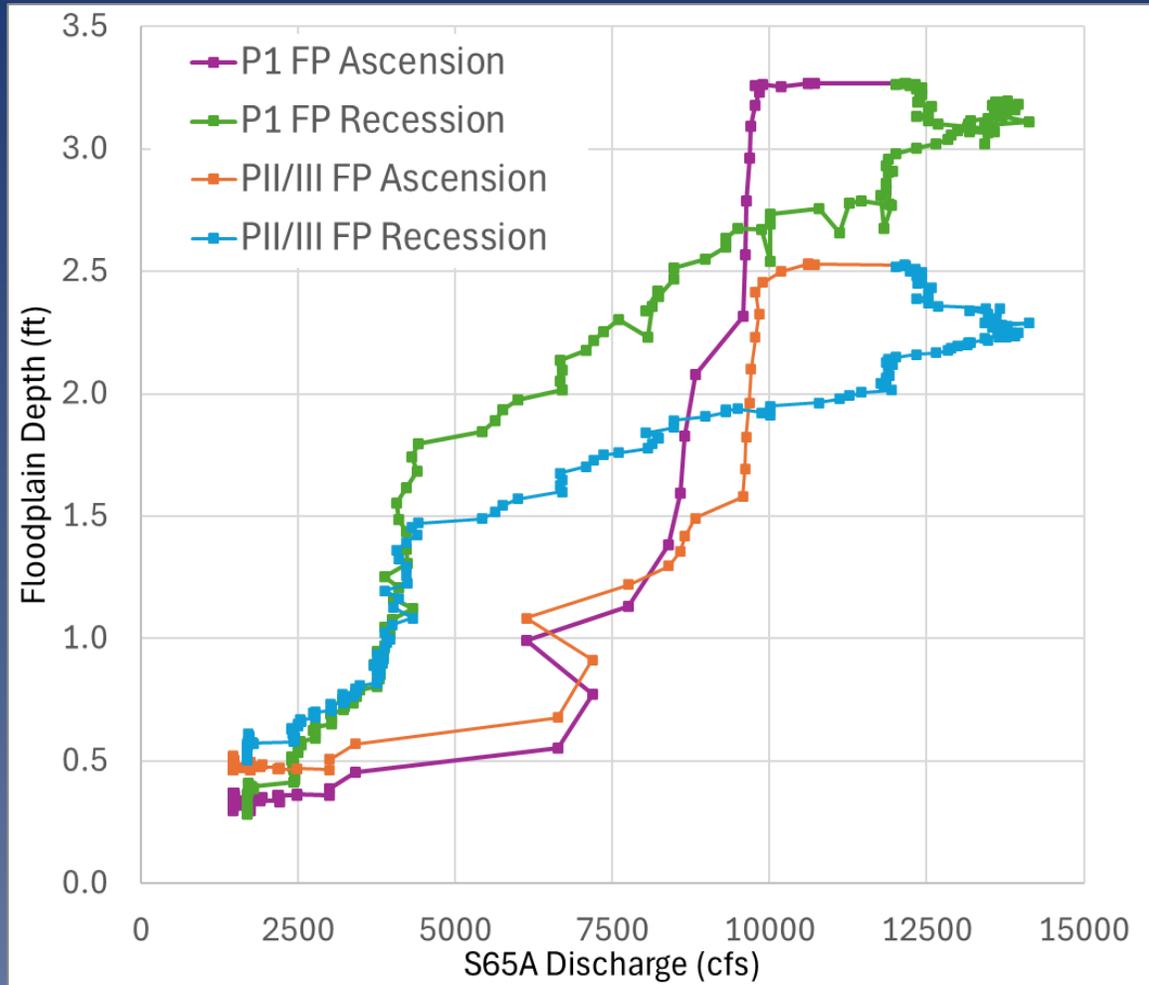
2017 Hurricane Irma Flood Pulse (9 inches of rainfall in 5 days)- Recession



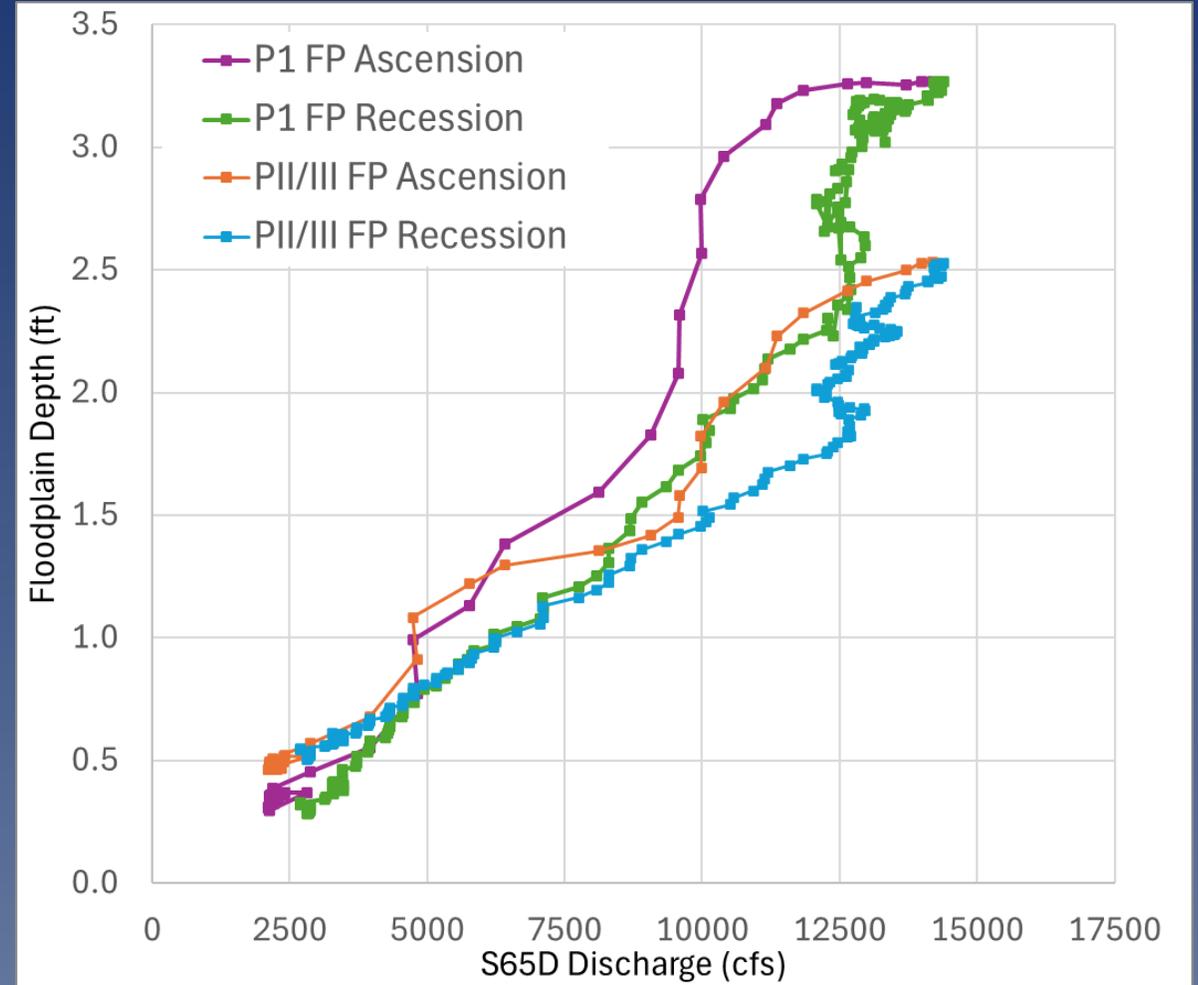
1.5 Months

Ascension vs Recession Depth-Discharge Curves

S65-A Discharge



S65-D Discharge



Ascension Events Summary Table

Event Name	Event Duration (days)	S65A Flow Change (cfs)	S65D Flow Change (cfs)	S65A Avg Rate of Change (cfs/day)	S65D Avg Rate of Change (cfs/day)	Phase I Floodplain Depth Change (ft)	Phase II/III Floodplain Depth Change (ft)	Phase I Depth Rate of Change (ft/7 days)	Phase II/III Depth Rate of Change (ft/7 days)
2023 Wet Season Ascension Event	18	1,400	2,100	79	118	0.1	0.4	0.04	0.15
2017 Hurricane Irma Ascension Event	6	10,100	12,100	1,683	2,017	2.9	2.1	3.39	2.41

Recession Events Summary Table

Event Name	Event Duration (days)	S65A Flow Change (cfs)	S65D Flow Change (cfs)	S65A Avg Rate of Change (cfs/day)	S65D Avg Rate of Change (cfs/day)	Phase I Floodplain Depth Change (ft)	Phase II/III Floodplain Depth Change (ft)	Phase I Depth Rate of Change (ft/7 days)	Phase II/III Depth Rate of Change (ft/7 days)
2023 Wet Season Recession Event	48	-700	-2,100	-15	-44	-0.1	-0.4	-0.02	-0.06
2017 Hurricane Irma Recession Event	41	-10,700	-11,400	-263	-280	-2.9	-1.6	-0.50	-0.27

Conclusions

- Water levels in different areas of the floodplain do not always behave the same during both ascension and recession periods of flood pulses and are influenced by more factors than just S65-A discharge:
 - The event driven primarily by local runoff (2023 Wet Season) saw a greater gain of depth in Phase II/III, while the event driven primarily by S-65A discharge (Irma) saw a greater gain of depth in Phase I
 - During Hurricane Irma, depth in Phase II/III increased faster than Phase I until S65-D gates were opened allowing water to move further downstream
 - After Hurricane Irma, Phase I drained faster than Phase II/III, likely due to effects of runoff and S65-D operations
- Local Runoff and S65-D operations can significantly influence river and floodplain hydrology in addition to the influence of S65-A discharge

Next Steps

- Just scratching the surface of what could be learned about floodplain hydrology with this temporally and spatially dense set of stage data
- Meta-analysis of more events
- Incorporating well data to investigate the role of groundwater
- Estimate flow directions based on relative stages over time
- Transfer knowledge gained to other gated river systems

Acknowledgements

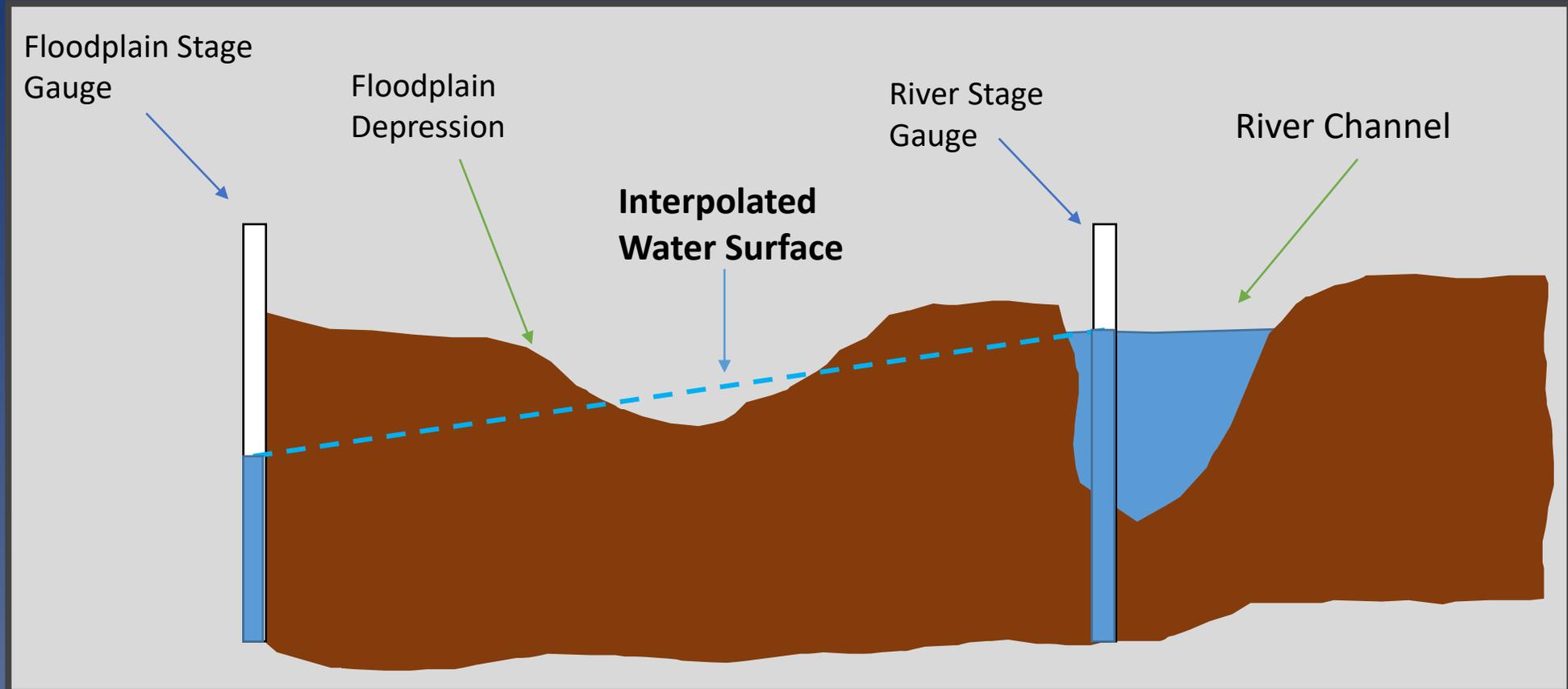
- Kissimmee River Scientists in the Field: Brent Anderson, Rich Botta, Joe Koebel, Alli Lippert, and Tyler Parr
- GIS Assistance: Lawrence Spencer
- Maintaining Stage Gauges: Applied Science Bureau Field Staff



Photo Source: Brent Anderson, Kissimmee River Floodplain

Extra Slides

Potential source of error in Floodplain Depth calculation due to water surface interpolation



Temporal Resolution of Stage Data

Many analyses have been done in 1-day time-step but this does not fully capture hydrologic dynamics and we have more frequent data available

