Synthesizing the effects of soil dryout, vegetation disturbance, and other perturbations on treatment performance across the Everglades STAs

Mike Jerauld, **Luke Evans**, Jessica Vaccare

DB Environmental Inc.

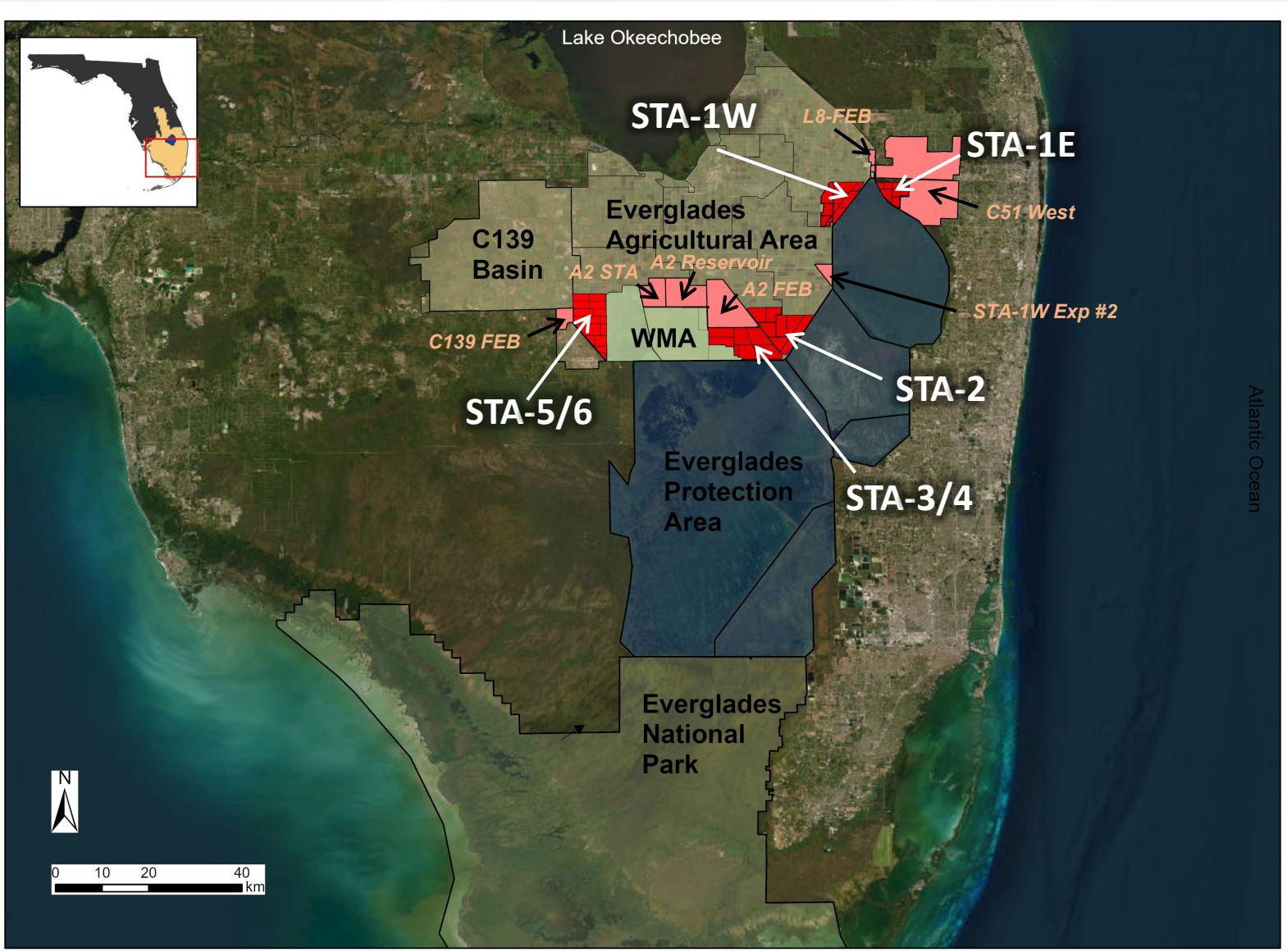
R. Thomas James, Jill King

South Florida Water Management District

GEER 2025

Stormwater Treatment Areas (STAs)

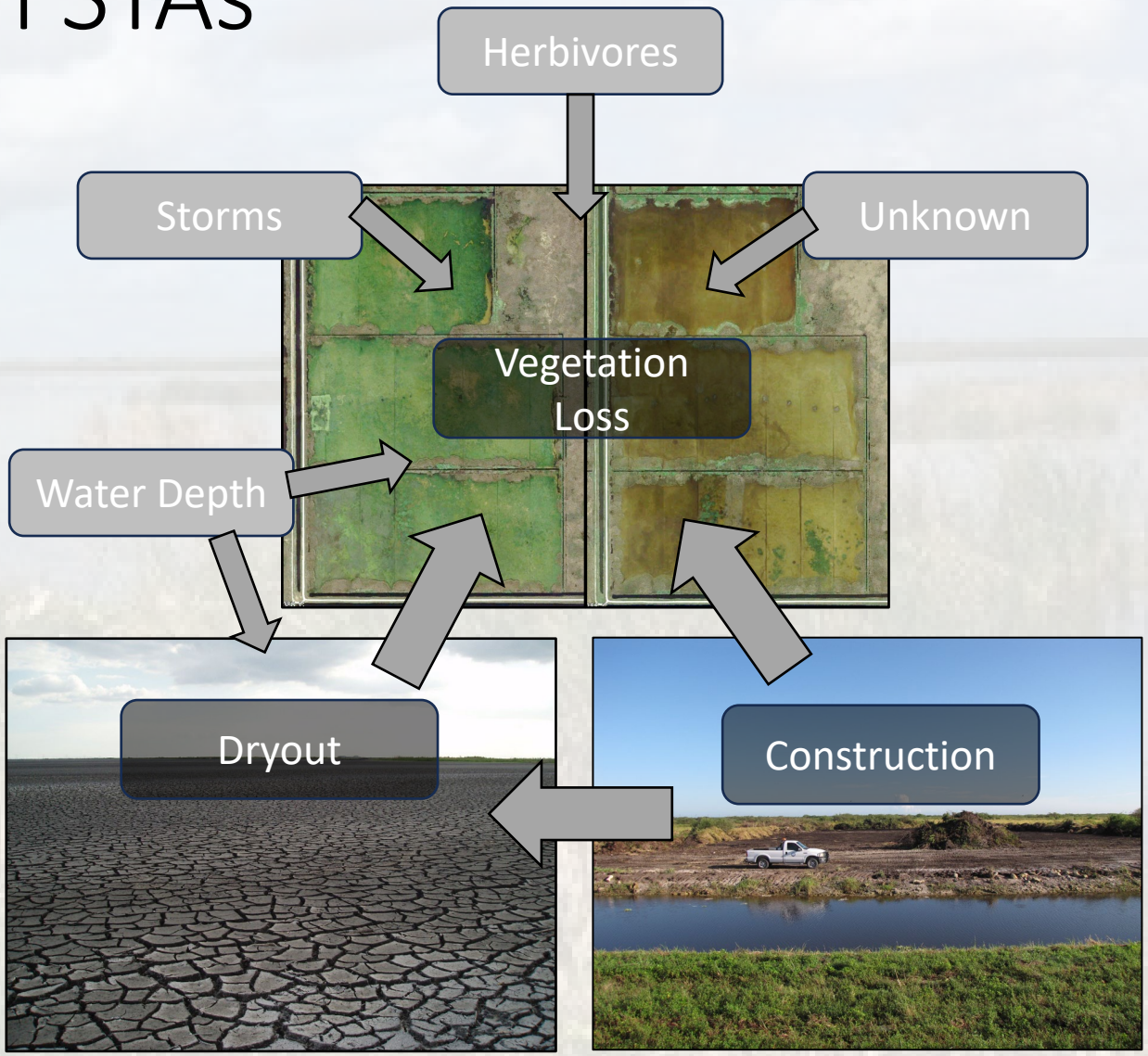
- STAs are a ~250 km² network of constructed wetlands
- This study quantified disturbance in individual STA flow-ways (n=22) and STAs as a whole (n=5)
- Disturbances disrupt the effectiveness of STA nutrient removal



Types of Disturbance in STAs

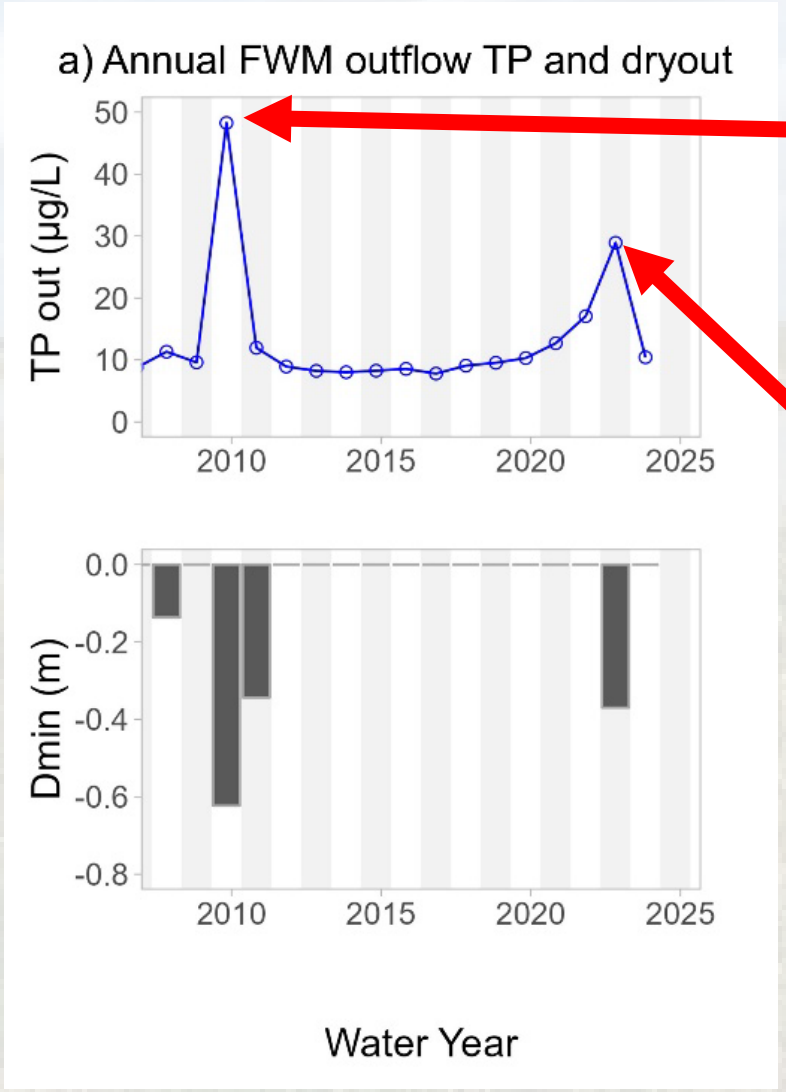
- Dryout/reflood
- Vegetation loss
  - Storm induced, herbivory, unknown
- Construction activities

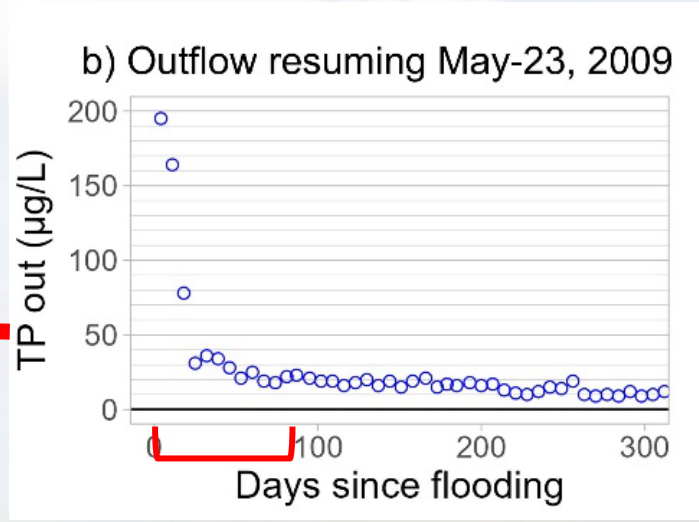
- Disturbances identified from:
  - SFWMD annual reporting
  - Vegetation coverage data
  - Historical satellite imagery
  - Hydrologic data

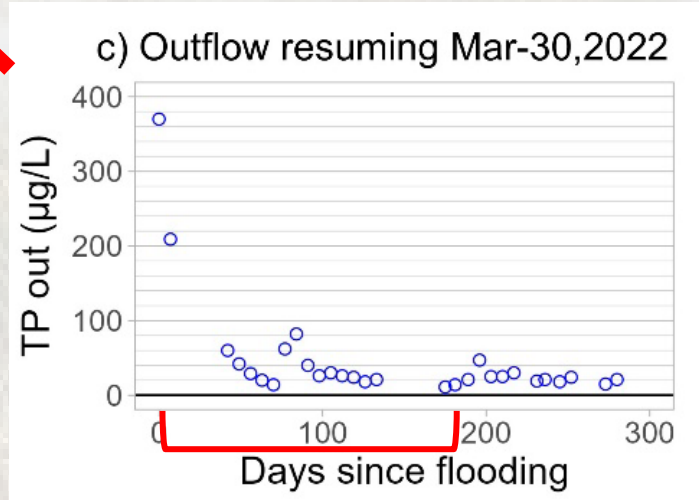


Dryout – STA-2 FW1 Case Study

- Annual FWM outflow TP peaks during WYs when water levels receded below ground surface
- Dryout in 2009 for 123 days, reflooded in May 2009 (WY2010)
- Another dryout in early 2022 for 83 days, reflooded in March 2022
- Post reflood recovery ~100-200 days
- Disturbance biased annual FWM performance for affected WYs
  - Effect on TP was exacerbated when water discharged immediately after reflood



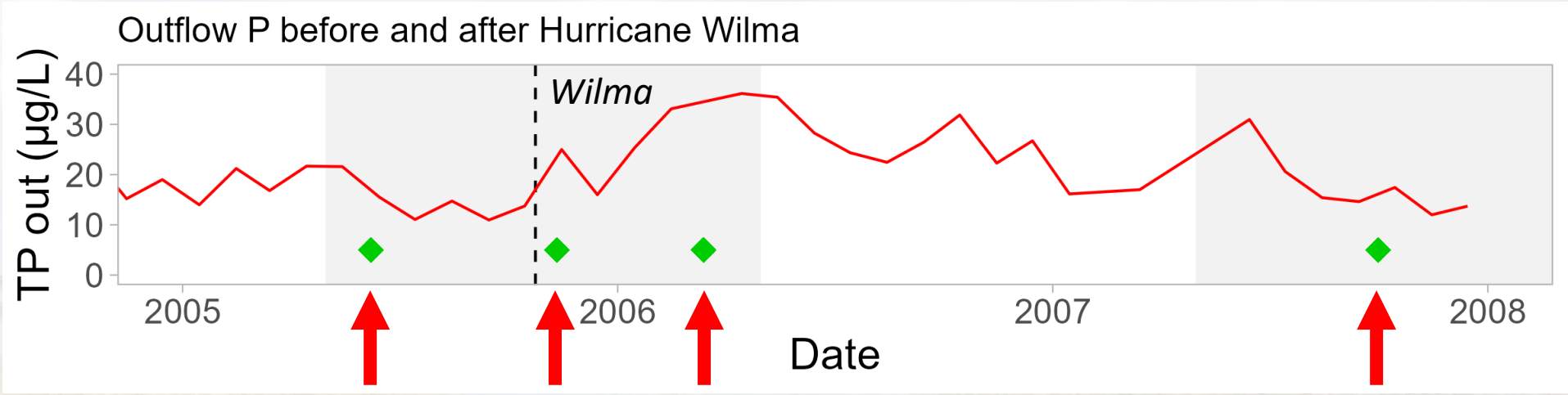


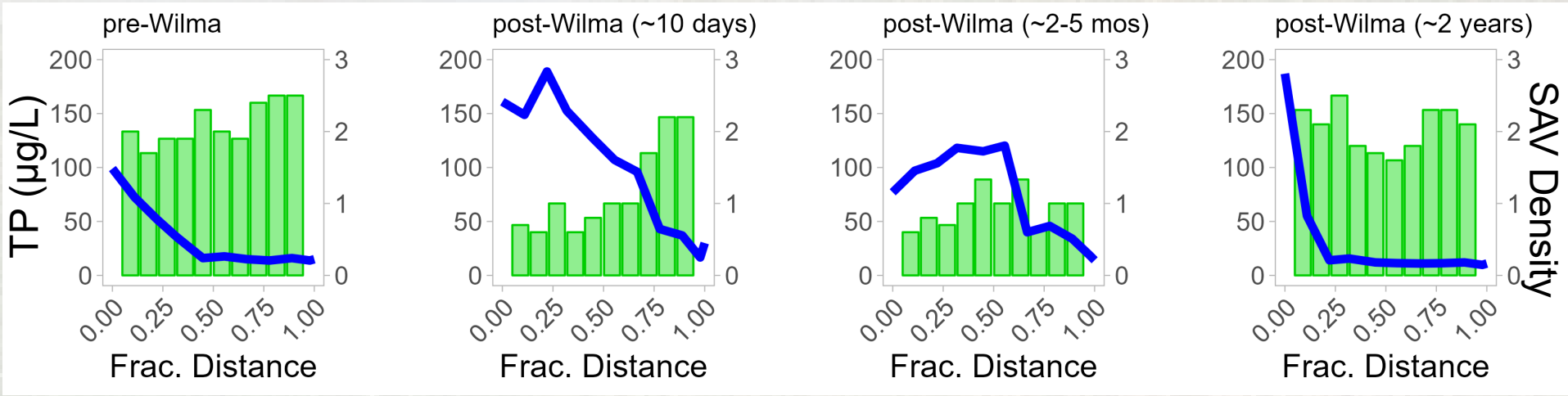


(D_{min} represents the maximum water depth below ground surface during a WY)

Vegetation Loss – STA-2 FW3 Case Study

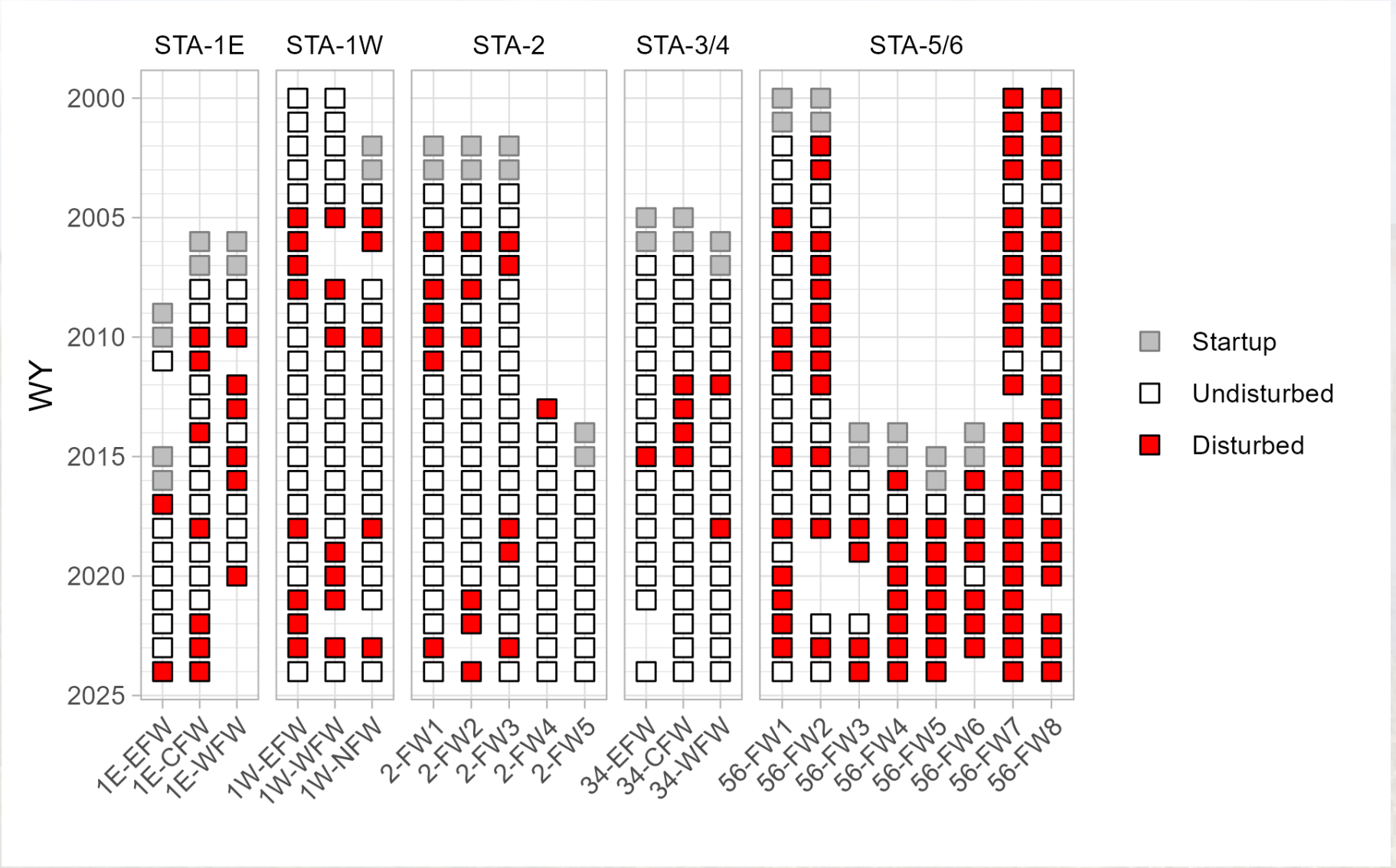
- TP removal effective pre-Wilma, dense SAV
- TP spike and loss of veg post Wilma
- Months of performance and SAV recovery
- Recovered FW performance once SAV reestablished nearly 2 years later





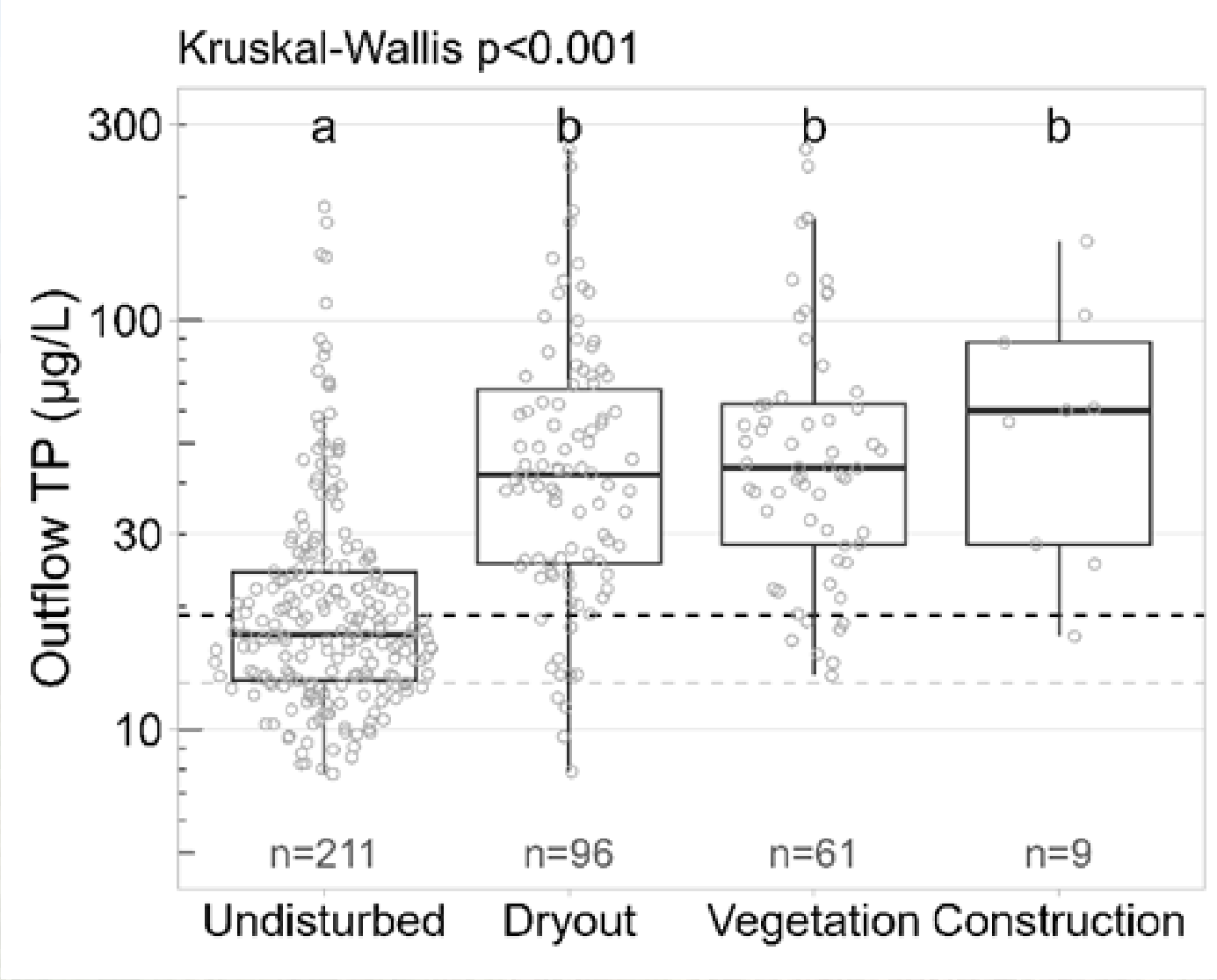
Disturbed vs non-Disturbed STA Performance

- STA and flow-ways during online WYs
- Some STAs have experienced more disturbance than others
- Unique mix of disturbance types



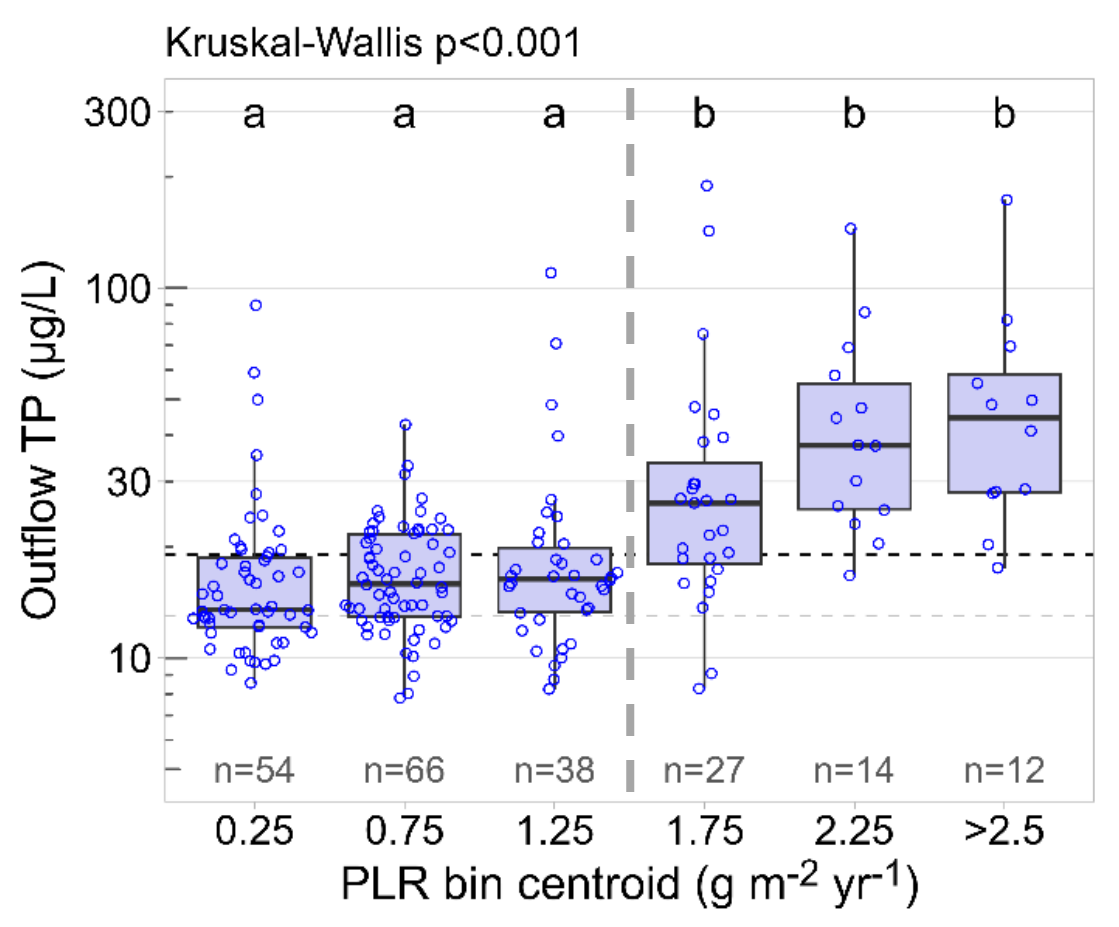
Outflow TP and Disturbance Type

- Data points represent annual outflow TP from each flow-way
- Outflow TP significantly increased during WYs with disturbance when compared to WYs without disturbance
- Dryout most common disturbance type



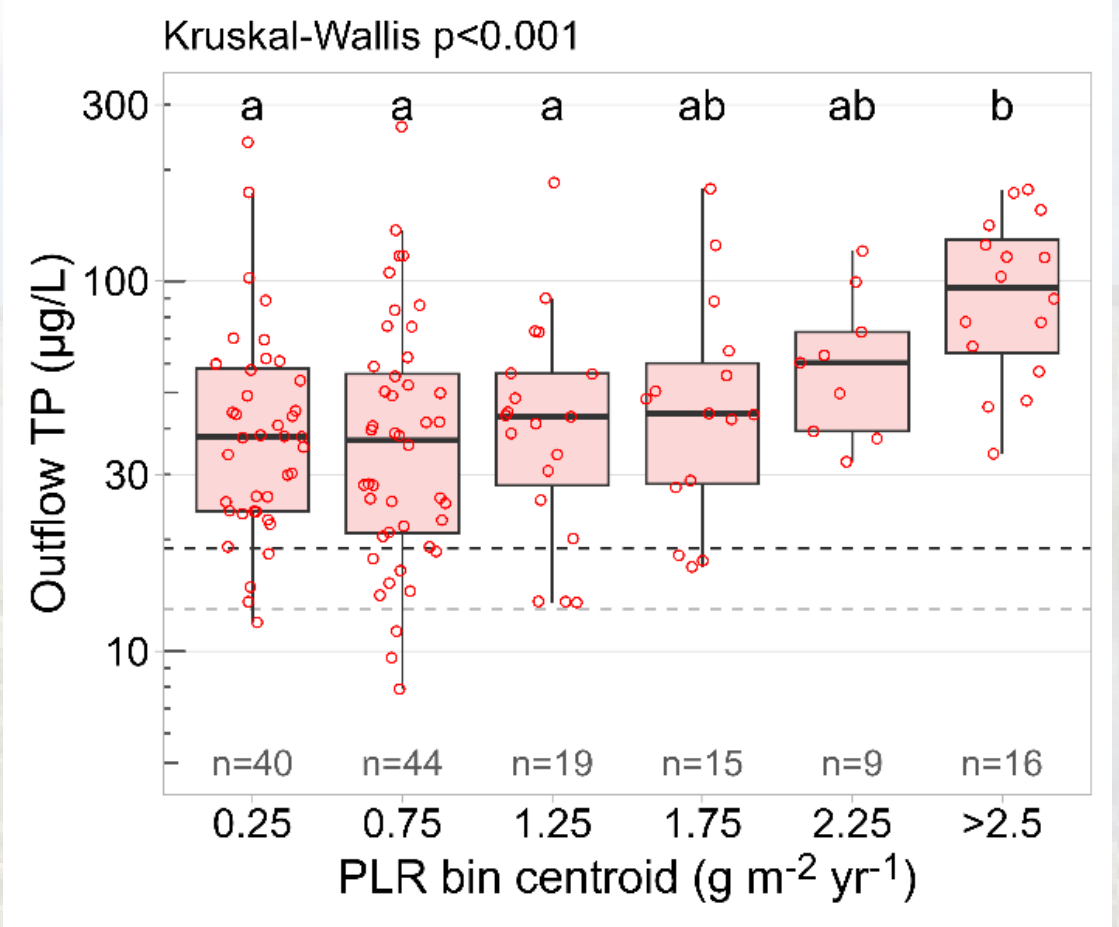
Outflow TP, PLR, and Disturbance

Undisturbed



- Observed relationship highly consistent with theoretical PLR breakpoint of 1.5 g m^{-2} yr^{-1}

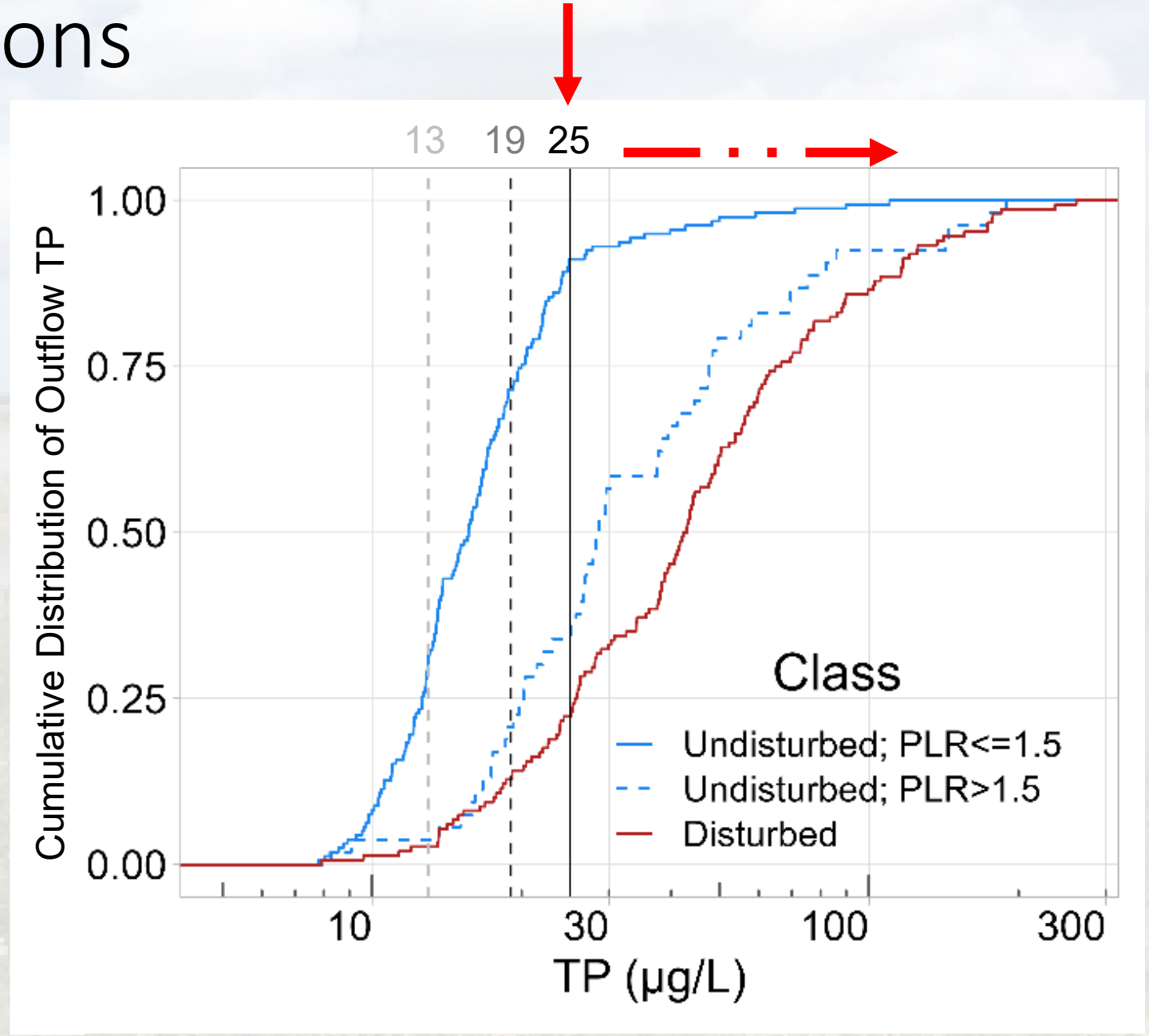
Disturbed



- Under disturbance, PLR breakpoint deteriorates, loss of outflow TP-PLR relationship, reduced retention of P (72-85% retention of P entering)

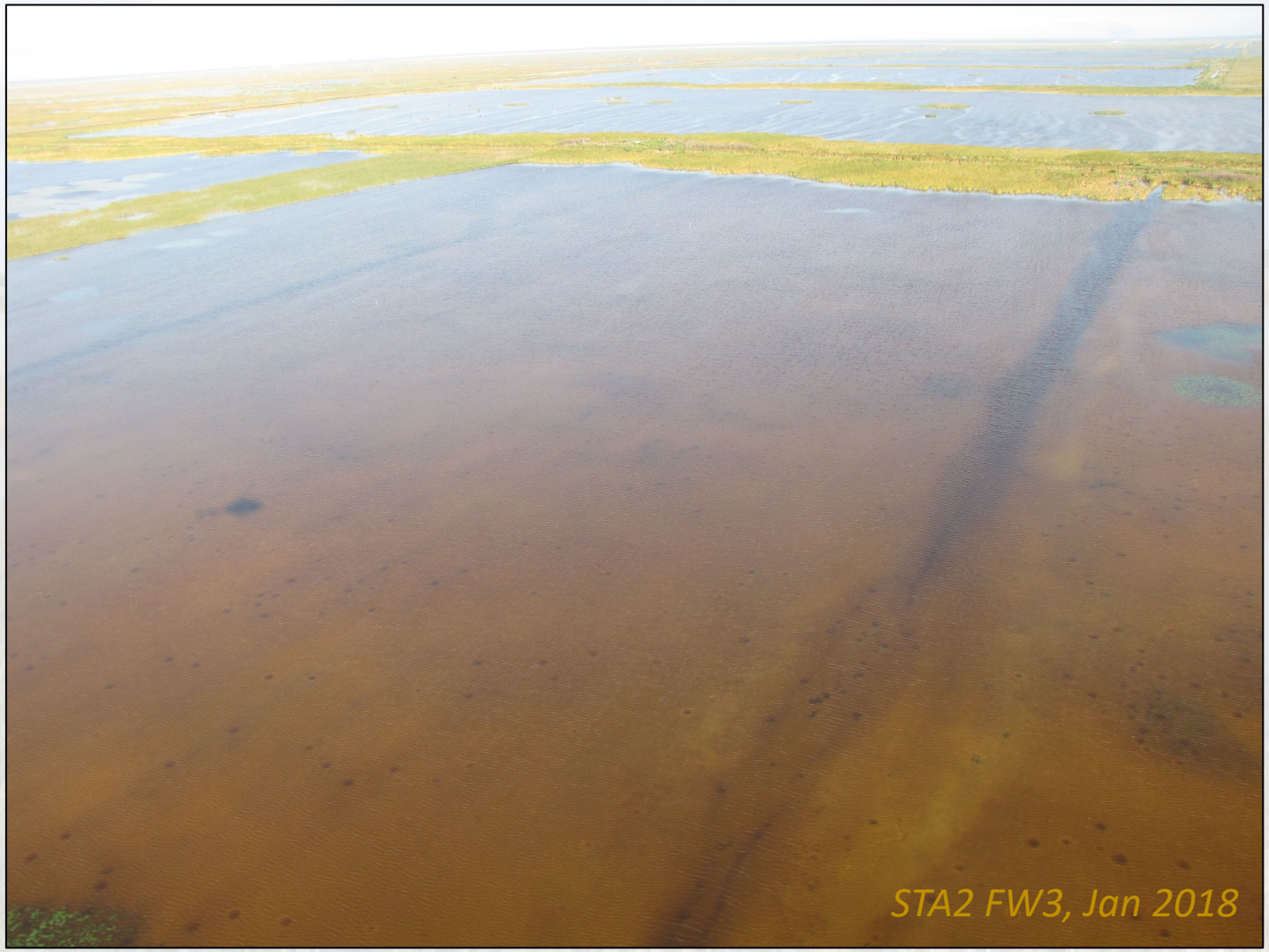
Cumulative Distributions

- Under undisturbed conditions with PLR ≤ 1.5, natural inflection point emerges where most outflow TP < 25 µg/L
- Disturbance takes inflection point far away from WQBEL target 19 µg/L
- Disturbance must be considered when assessing outflow TP performance



STA Performance Assessments Should…

1. Consider causes of disturbance
2. Screen data to identify trends within the “undisturbed” dataset
3. Identify options to mitigate disturbances, drawing from previous observations and successful mitigation



DB Environmental

QUESTIONS?

Contact Information

Luke Evans

Email: l.evans@dbenv.com

References

- Jerauld, M., L. Evans, J. Vaccare, R.T. James, J. King, 2025. Effect of disturbance on outflow phosphorus concentrations in the Everglades Stormwater Treatment Areas. [Manuscript submitted for publication]