Biscayne Bay Southeastern Everglades Ecosystem Restoration
(WQ Subteam)

DRAFT - Water Quality Evaluation - Groundwater and BBCW evaluation

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Use cursor keys for navigation, press "O" for a slide Overview

Objective

- Evaluate available groundwater total phosphorus concentrations within BBSEER project area
- Apply basic kC* model to Biscayne Bay Coastal Wetlands (L31E)

Approach

- Groundwater evaluation

  - FDEP WIN and SFWMD DBHYDRO data (Jan 2012 - Dec 2022)
  - Spatial and temporal generalized additive models
  - Model was fit using month, year and lat/long.

- Biscayne Bay Coastal Wetland kC* evaluation

  - Applied basic kC* equation to estimated FWM concentrations for wetland segment inflow to estimate potential outflow concentration
  - Focused on L31E wetlands
  - does not considered tidal effects

📄 Download Annual Loads as .csv

Groundwater Data
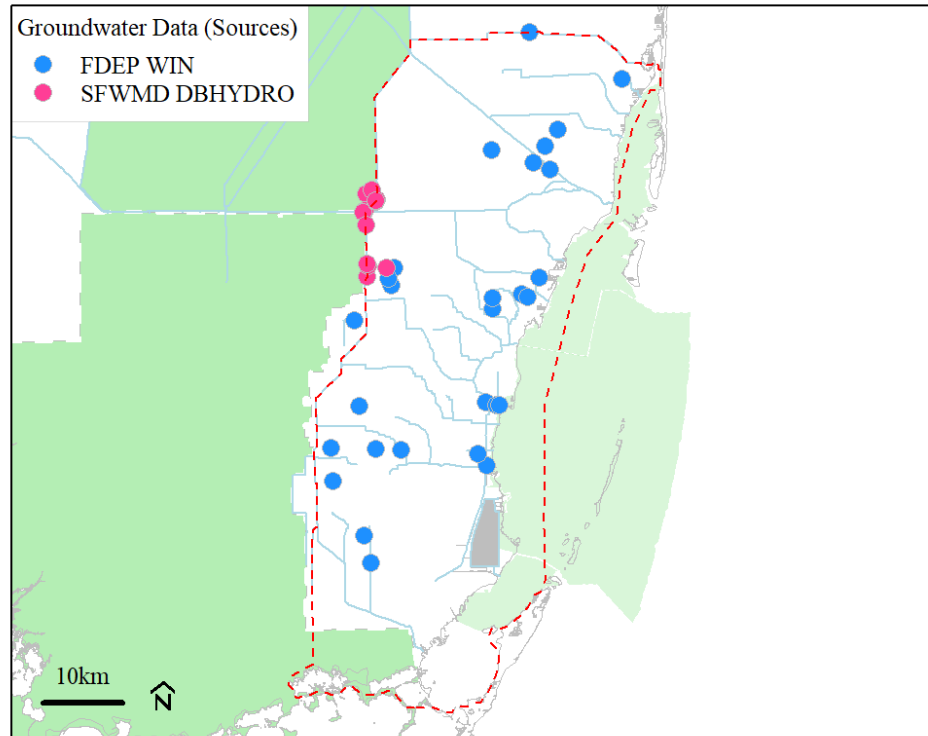
- Several sites had only one sample for the entire period of record.
  - 10 monitoring locations had more than one TP sample (limited data)
  - 283 TP samples for ~ 10 year period.
  - well/sample depth not consistently recorded.

Conceptual GAM framework

To evaluate the seasonality and/or change in groundwater TP concentrations we want to model the following features of the data:

1. any trend or long term change in the TP concentration,
2. any seasonal or within-year variation,
3. any spatial variation,
4. any variation or interaction in the trend and seasonal features, and
5. ~~any potential drivers (i.e. well/sample depth, water level, Cl/SPC)~~

The general equation would look something like this

$$y_t = \alpha + s(month) + s(Yr) + s(UTMX, UTMY)+$$
$$ti(month, Yr)+$$
$$ti(UTMX, UTMY, month)+$$
$$ti(UTMX, UTMY, Yr)$$

GW GAM effect plots
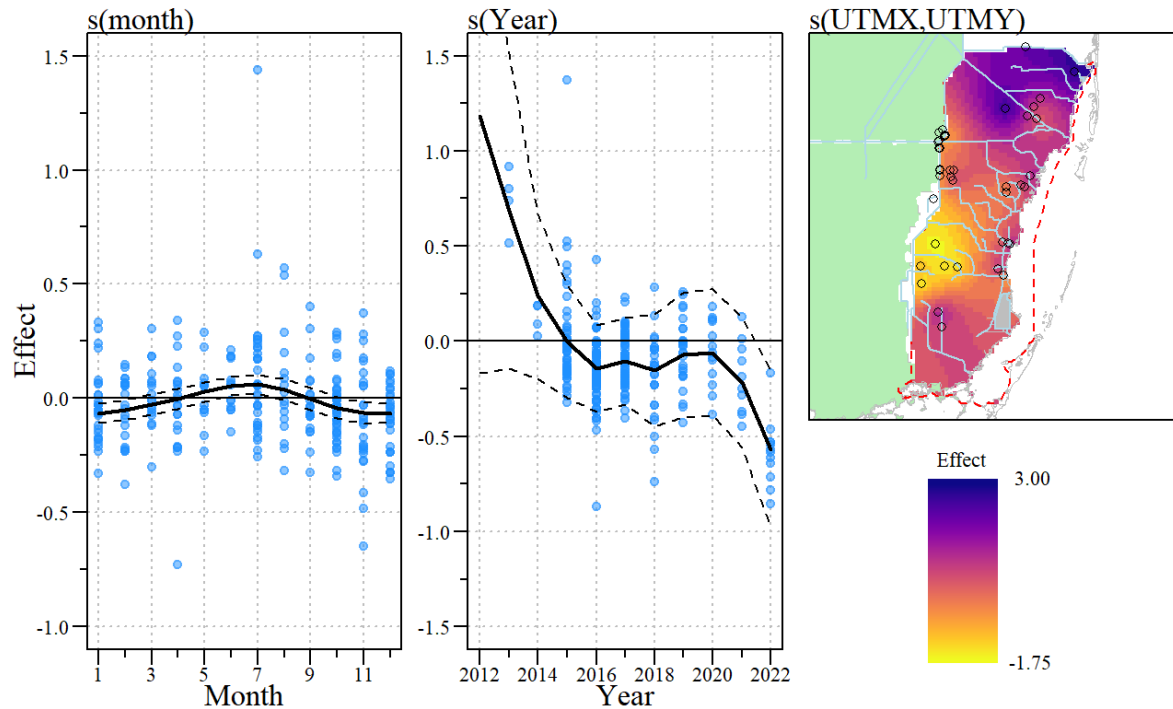
- **Does not include interaction effect plots**

Model Results

Component	Term	Estimate	Std Error	t-value	p-value
A. parametric coefficients	(Intercept)	-3.96	0.14	-27.74	<0.01

Component	Term	edf	Ref. df	F-value	p-value
B. smooth terms	s(month)	2.37	10.00	1.38	<0.01
	s(Year)	5.53	6.58	2.59	0.04
	ti(DoY,Year)	23.51	29.00	11.25	<0.01
	ti(CY,month)	0.00	61.00	0.00	0.52
	ti(month,UTMX,UTMY)	0.00	62.00	0.00	0.44
	ti(CY,UTMX,UTMY)	17.87	75.00	1.61	<0.01

Adjusted R-squared: 0.88, Deviance explained 0.90

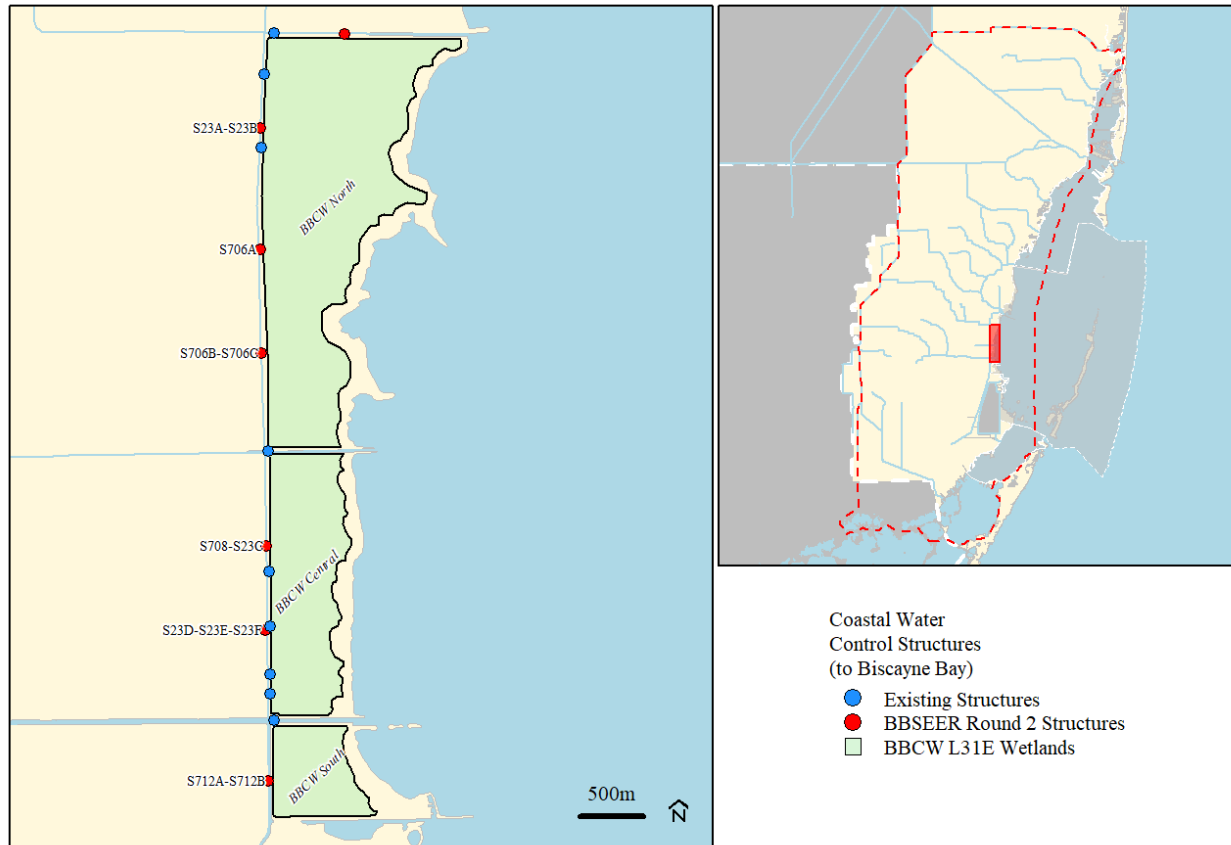fREML: 56.5, Scale est.: 0.04, N: 283
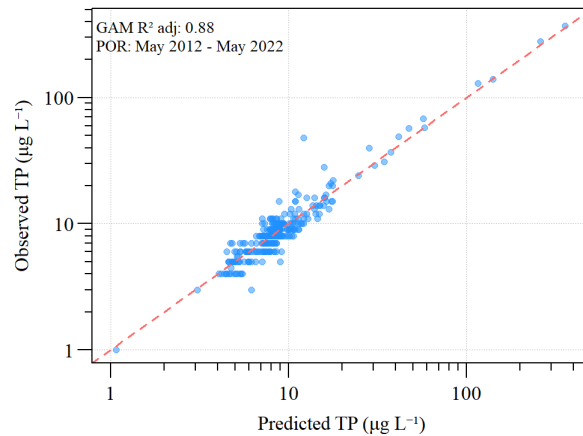
Predicted GW TP concentration
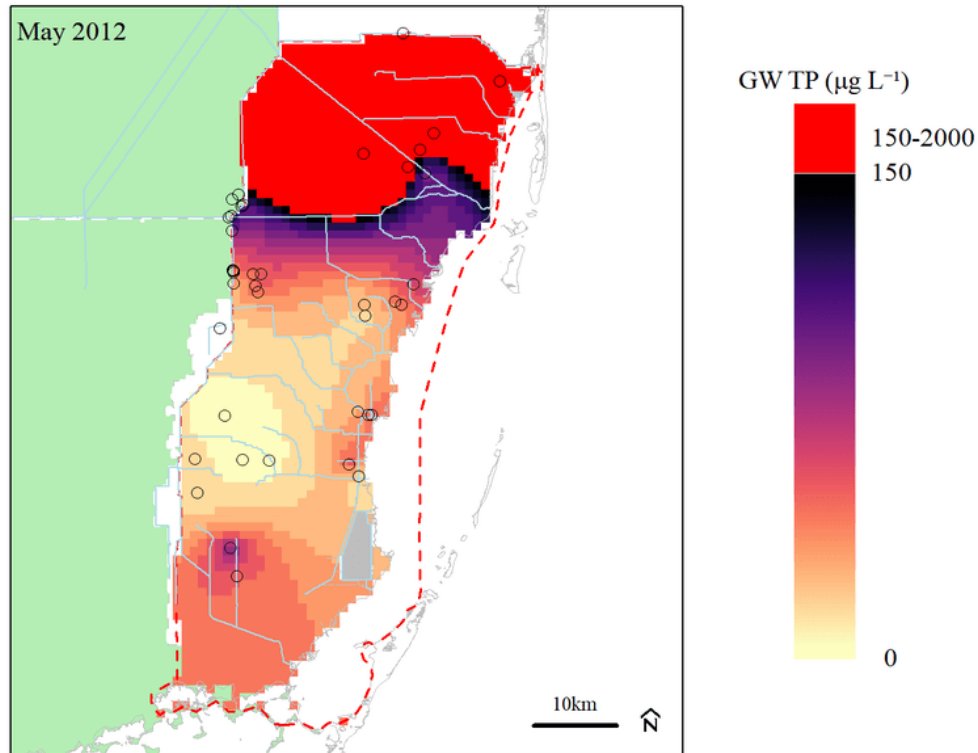
- Does not account for sample depth
- Based on relatively limited data (still search for more to add)
- Does show spatial and temporal differences over a nearly 10 year period

Biscayne Bay Coastal Wetland (L31E)

- BBCW North = S23A, S23B, S706A, S706B and S706C
- BBCW Central = S708, S23C, S23D, S23E and S23F
- BBCW South = S712A and S712B
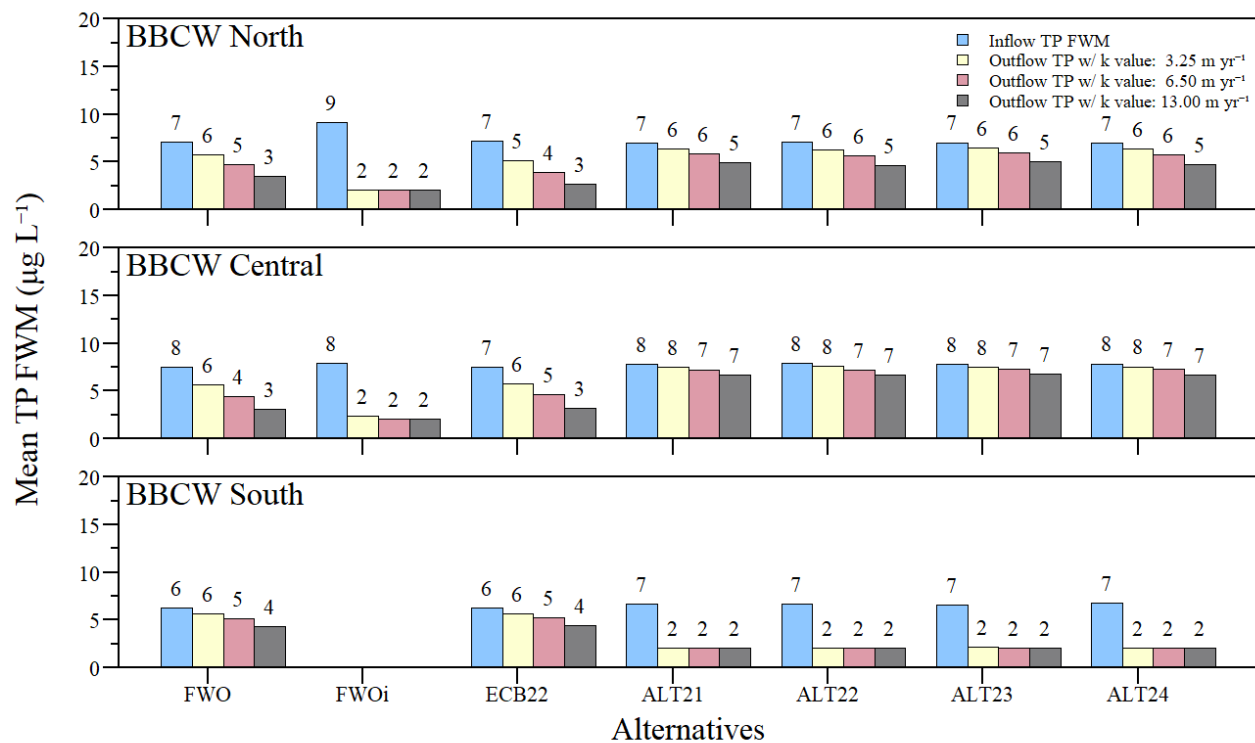
Biscayne Bay Coastal Wetland (L31E)

- Eastern boundary delineated using a combination of elevation and vegetation characteristics from aerial imagery
- Modeling does not account for tidal effects (i.e. tidal inflow, tidal pumping of groundwater to surface water, potential recirculation of seawater due to SLR, etc.)
- Model evaluated using a series of removal rate term (k) values due to uncertainty of appropriate value

$$C_o = C^* + (C_i - C^*) \times \exp - \frac{k}{Q_i \times A}$$

- Flow and load combined for each BBCW segment to estimate total TP FWM concentration (C_i)
- Background concentration (C^*) assumed to be 2 µg L^{-1}
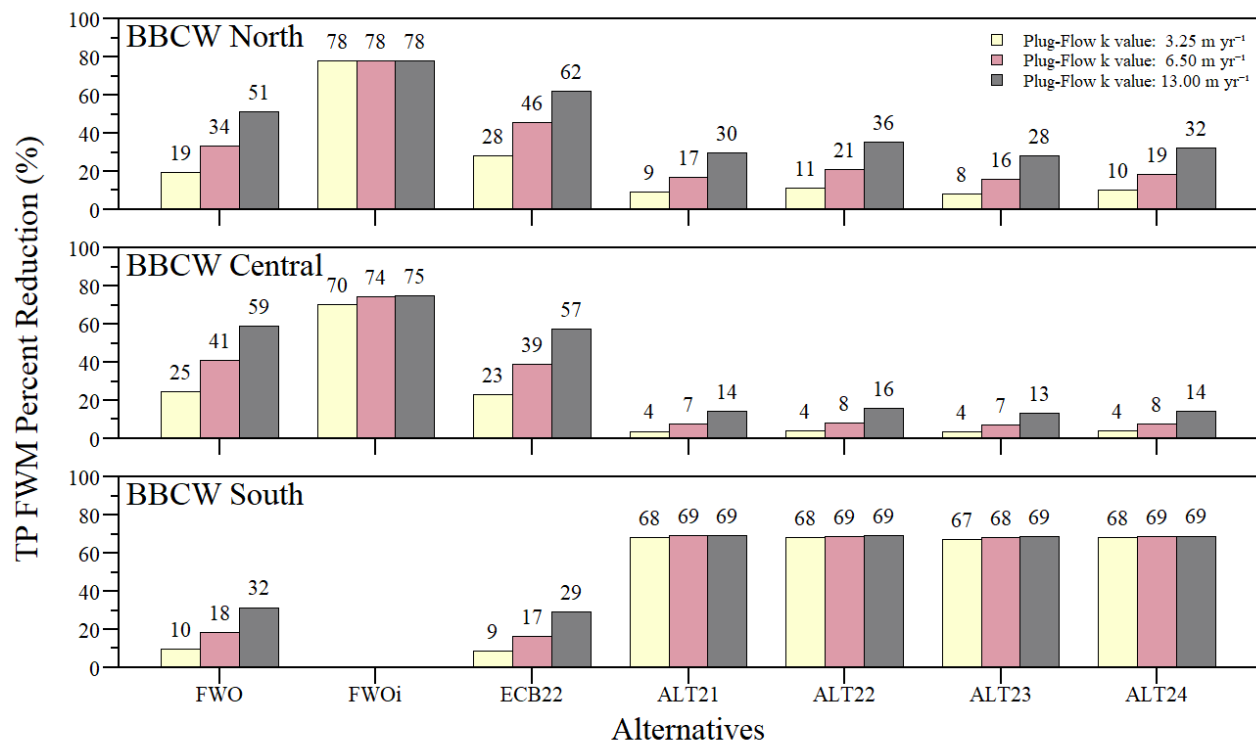- Annual total discharge was estimated for Q_i

Wetland Segment	Area (Acres)
BBCW N	689
BBCW C	278
BBCW S	112

Biscayne Bay Coastal Wetland (L31E)

Average annual flow-weighted mean concentration for each wetland segment over the period of simulation

Biscayne Bay Coastal Wetland (L31E)

Percent TP FWM reduction (inflow to outflow) for each alterantive and k-value

Acknowledgements

Data

South Florida Water Management District (DBHYDRO)

Miami-Dade Department of Environmental Resources Management via FDEP STORET/WIN

Slides

- Slide deck - HTML | PDF | © Julian (2023)
- RMarkdown Source