

# Lake Okeechobee System Operating Manual (WQ Subteam)

DRAFT - Estuary Nutrient Loading Model

Addendum to 2020-09-18 presentation, response to comments

FDEP - Office of Water Policy and Ecosystem Restoration

November 10, 2020

## General Comments

Link to [2020-09-18 presentation](#).

Comments on FDEP presentation dated 9/18/2020 recieved from Gary Goforth

The use of water quality models for LOSOM evaluations:

1. Is unnecessary since historical data exist and can be applied to the flow values that will be simulated during the LOSOM evaluations.
2. Is inaccurate and tends to estimate values closer to averages than to extremes - which occur in real life - and have a significant effect on water quality.
3. Leads to a waste of time as people argue over the models; particularly a model from FDEP - the people who mislead the public annually using their erroneous BMAP models and claiming that water quality is significantly better than it really is (compared to measured data).

## Inclusion vs Exclusion of Hurricane Years

$$TPLoad_{S79} = Q_{C43Basin} + Q_{S77} + MeanLakeStage$$

- Data error in initially presented model
- No data transformations needed, and fit the assumptions of the statistical test
- Model Fit Summary:

Model <sup>a</sup>	R <sup>2</sup>	Adj R <sup>2</sup>	$\sigma^b$	F-Statistic	p-value	DOF (Model, Residuals)	Observations
All Data	0.80	0.78	49112	29.84	<0.01	3, 22	26
Hurricane Years Excluded	0.74	0.69	74805	14.90	<0.01	3, 16	20

<sup>a</sup> Total Phosphorus Load Model

<sup>b</sup>  $\sigma$  = Residual Standard Error

- Usually models are selected based on AIC, AICc or BIC values but due to inconsistent degrees of freedom this is not possible.
  - But we can select models based on relative ( $R^2$ ) and absolute ( $\sigma$ ) model fit.

## Inclusion vs Exclusion of Hurricane Years

$$TPLoad_{S79} = Q_{C43Basin} + Q_{S77} + MeanLakeStage$$

- Final Model

	Estimate	Standard Error	t-value	p-value	
(Intercept)	127,156.07	103,885.73	1.22	0.23	
$Q_{C43}$	0.20	0.05	3.72	0.00	**
$Q_{S77}$	0.08	0.02	3.70	0.00	**
Mean Lake Stage	-7,689.38	9,172.09	-0.84	0.41	

Signif. codes: 0 '<= \*\*\*\*' < 0.001 < '\*\*\*' < 0.01 < '\*\*' < 0.05 < '.' < 0.1 < ' ' < 1

Residual standard error: 49112 on 22 degrees of freedom

Multiple R-squared: 0.80, Adjusted R-squared: 0.78

F-statistic: 29.84 on 22 and 3 DF, p-value: 0.0000

$$TPLoad_{S79} = 127156 + 0.20Q_{C43Basin} + 0.08Q_{S77} - 7689MeanLakeStage$$

## Inclusion vs Exclusion of Hurricane Years

$$TNLoad_{S79} = Q_{C43Basin} + Q_{S77} + MeanLakeStage$$

- No data transformations needed, and fit the assumptions of the statistical test
- Model Fit Summary:

Model <sup>a</sup>	R <sup>2</sup>	Adj R <sup>2</sup>	σ <sup>b</sup>	F-Statistic	p-value	DOF (Model, Residuals)	Observations
All Data	0.95	0.94	326435	140.19	<0.01	3, 22	26
Hurricane Years Excluded	0.94	0.93	410391	81.56	<0.01	3, 16	20

<sup>a</sup> Total Nitrogen Load Model

<sup>b</sup> σ = Residual Standard Error

## Inclusion vs Exclusion of Hurricane Years

$$TNLoad_{S79} = Q_{C43Basin} + Q_{S77} + MeanLakeStage$$

- Final Model

	<i>Estimate</i>	<i>Standard Error</i>	<i>t-value</i>	<i>p-value</i>	
<i>(Intercept)</i>	27,560.89	690,496.68	0.04	0.97	
$Q_{C43}$	1.53	0.35	4.38	0.00	***
$Q_{S77}$	1.58	0.15	10.48	0.00	***
<i>Mean Lake Stage</i>	20,812.63	60,964.10	0.34	0.74	

Signif. codes: 0 <= '\*\*\*' < 0.001 < '\*\*' < 0.01 < '\*' < 0.05 < '.' < 0.1 < ' ' < 1

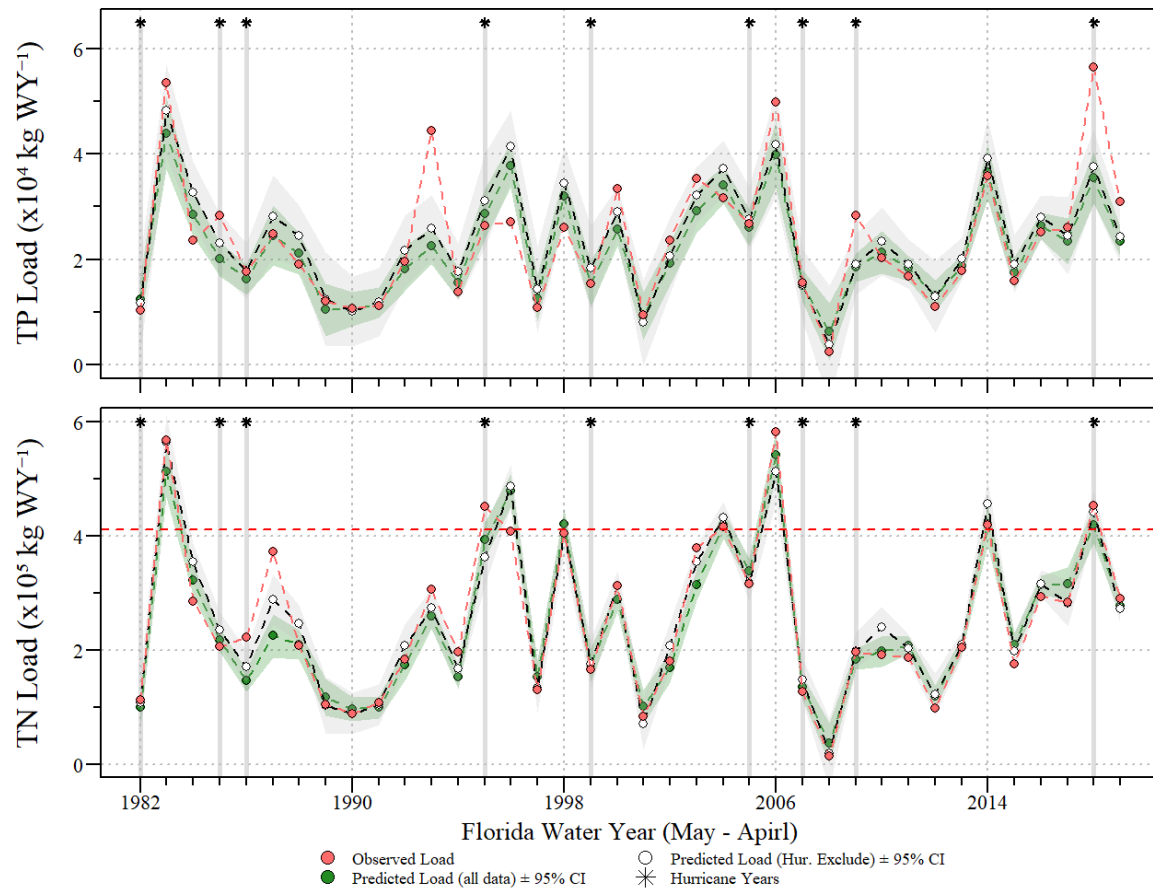
Residual standard error: 326435 on 22 degrees of freedom

Multiple R-squared: 0.95, Adjusted R-squared: 0.94

F-statistic: 140.2 on 22 and 3 DF, p-value: 0.0000

$$TNLoad_{S79} = 27561 + 1.53Q_{C43Basin} + 1.58Q_{S77} + 20813MeanLakeStage$$

## Modeled Loads



## Using monthly WQ data

### Paraphrased

*water quality models ... unnecessary  
since historical data exist ...*

*...models are inaccurate and estimates  
average values...*

See [Slide #2](#) for specific  
questions/comments.

Month	Total Phosphorus ( $\mu\text{g L}^{-1}$ ) <sup>a</sup>	Total Nitrogen ( $\text{mg L}^{-1}$ ) <sup>a</sup>
Jan	97 ± 28 (58)	1.40 ± 0.36 (56)
Feb	89 ± 21 (49)	1.71 ± 2.54 (49)
Mar	93 ± 25 (54)	1.28 ± 0.32 (55)
Apr	102 ± 26 (51)	1.25 ± 0.62 (50)
May	129 ± 37 (55)	1.34 ± 0.26 (55)
Jun	179 ± 67 (49)	1.57 ± 0.57 (49)
Jul	179 ± 66 (56)	1.47 ± 0.28 (56)
Aug	166 ± 41 (55)	1.43 ± 0.18 (54)
Sep	161 ± 49 (53)	1.47 ± 0.24 (51)
Oct	128 ± 33 (50)	1.43 ± 0.19 (50)
Nov	109 ± 26 (56)	1.43 ± 0.27 (55)
Dec	97 ± 35 (46)	1.37 ± 0.22 (46)

<sup>a</sup> Mean ± Std Dev (N)

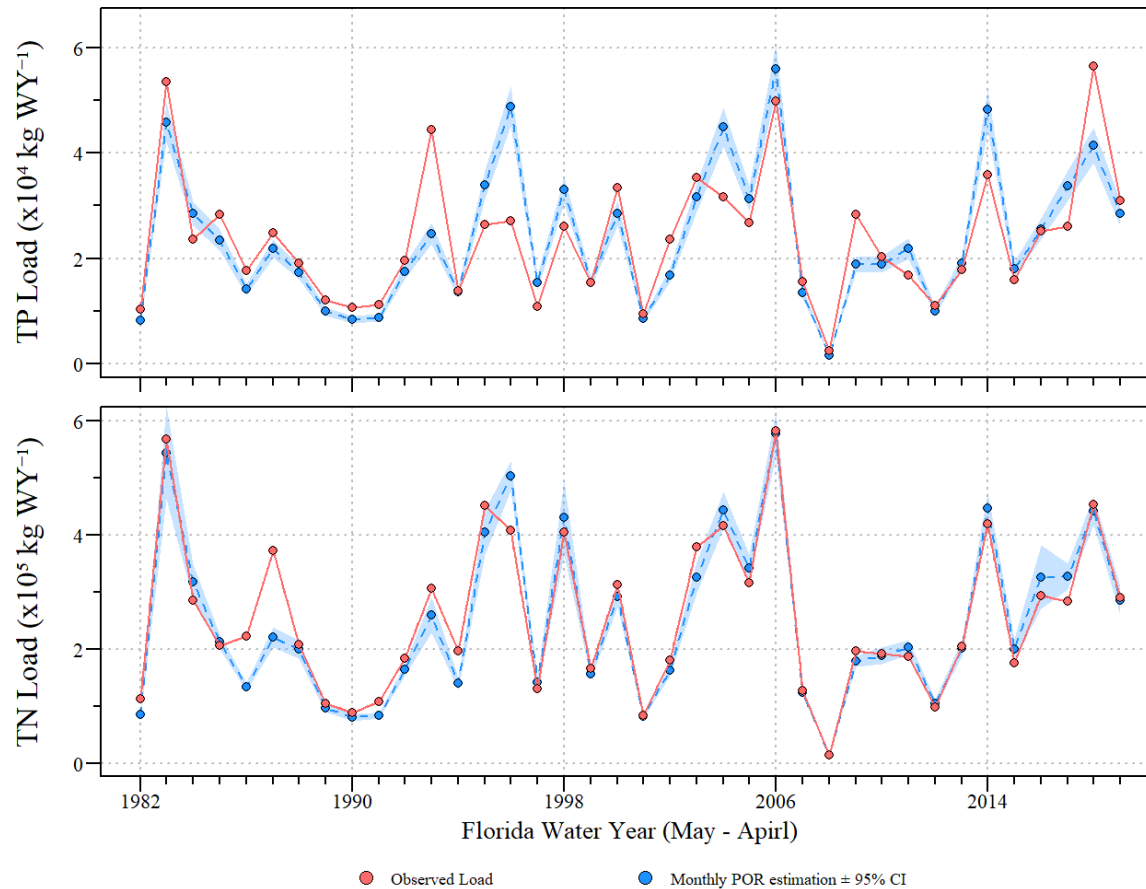
POR: Jan 1981 - April 2019

Data Source: SFWMD DBHydro



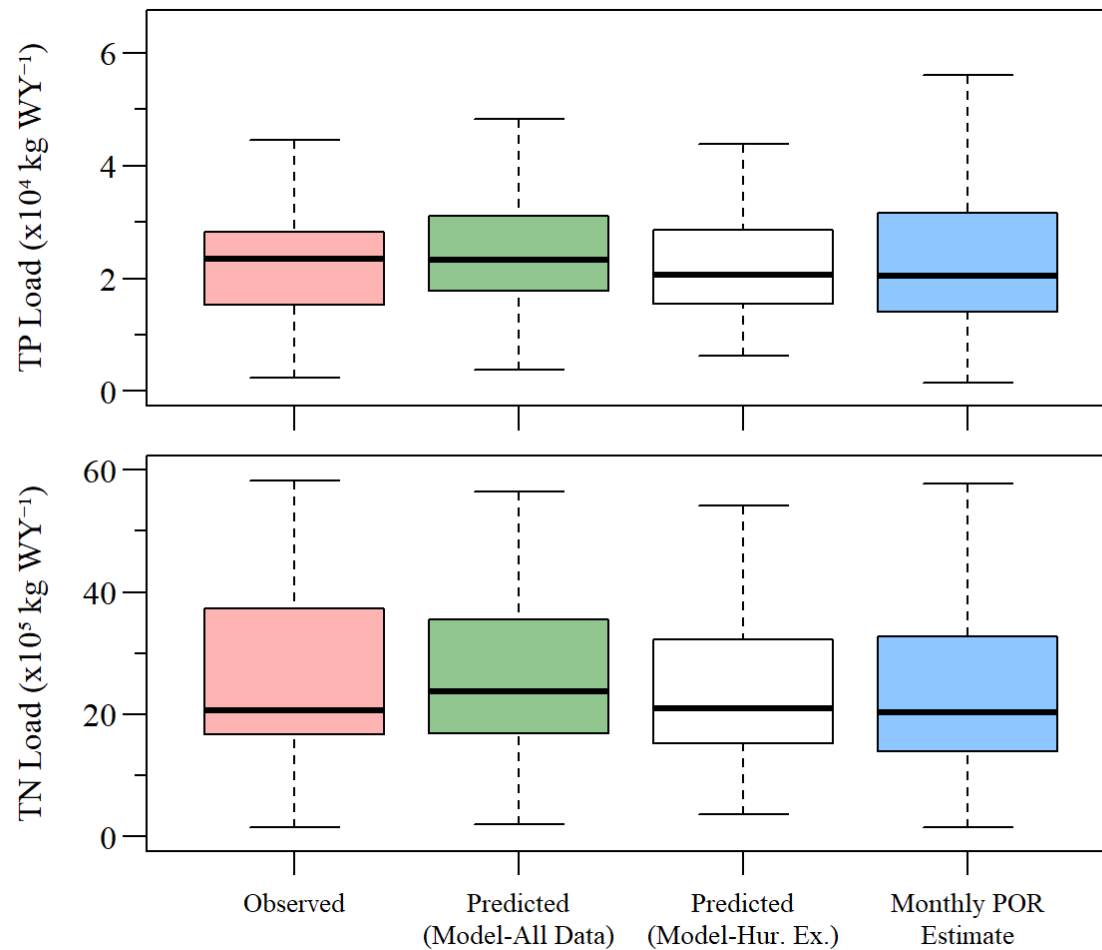
## Monthly POR Estimates

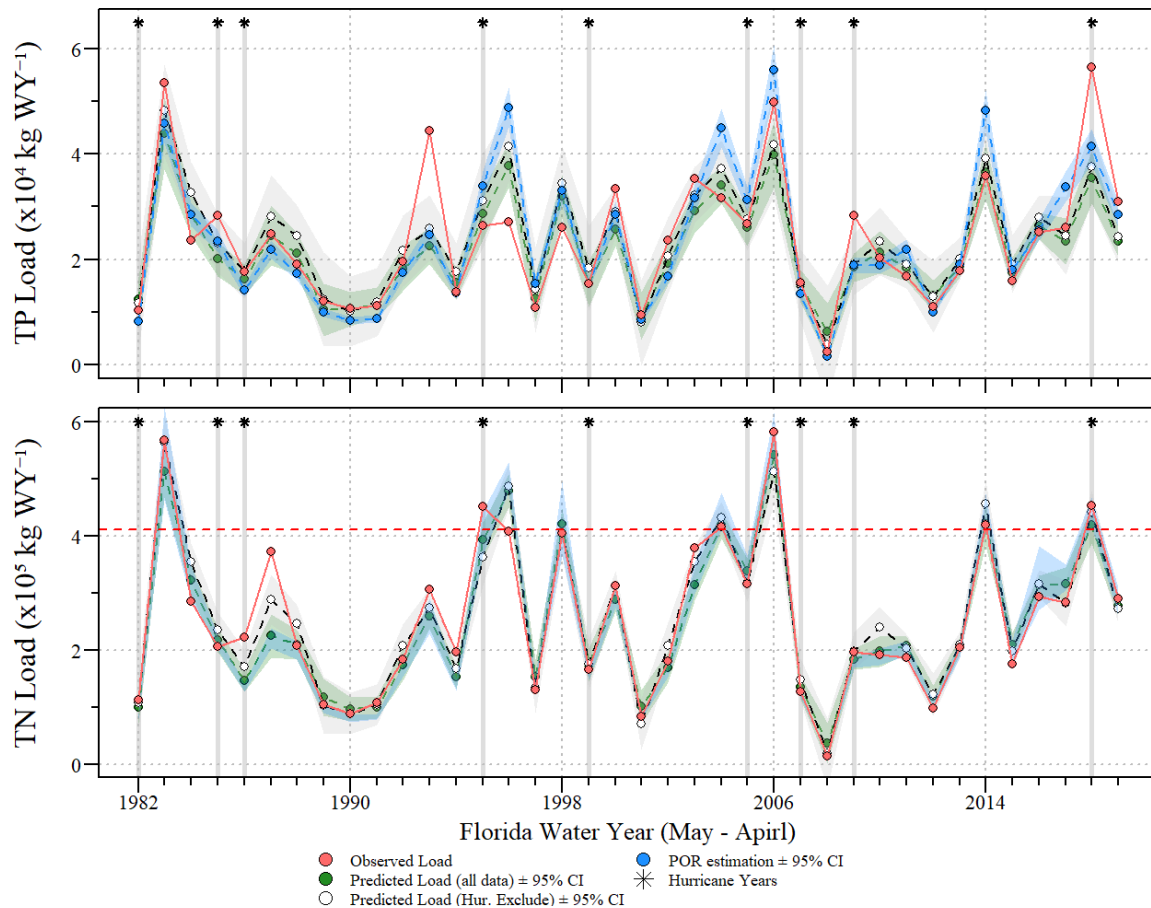
- Pair monthly mean TP and TN concentrations with discharge volumes to estimate load (See [prior slide](#)).



## Monthly POR Estimates

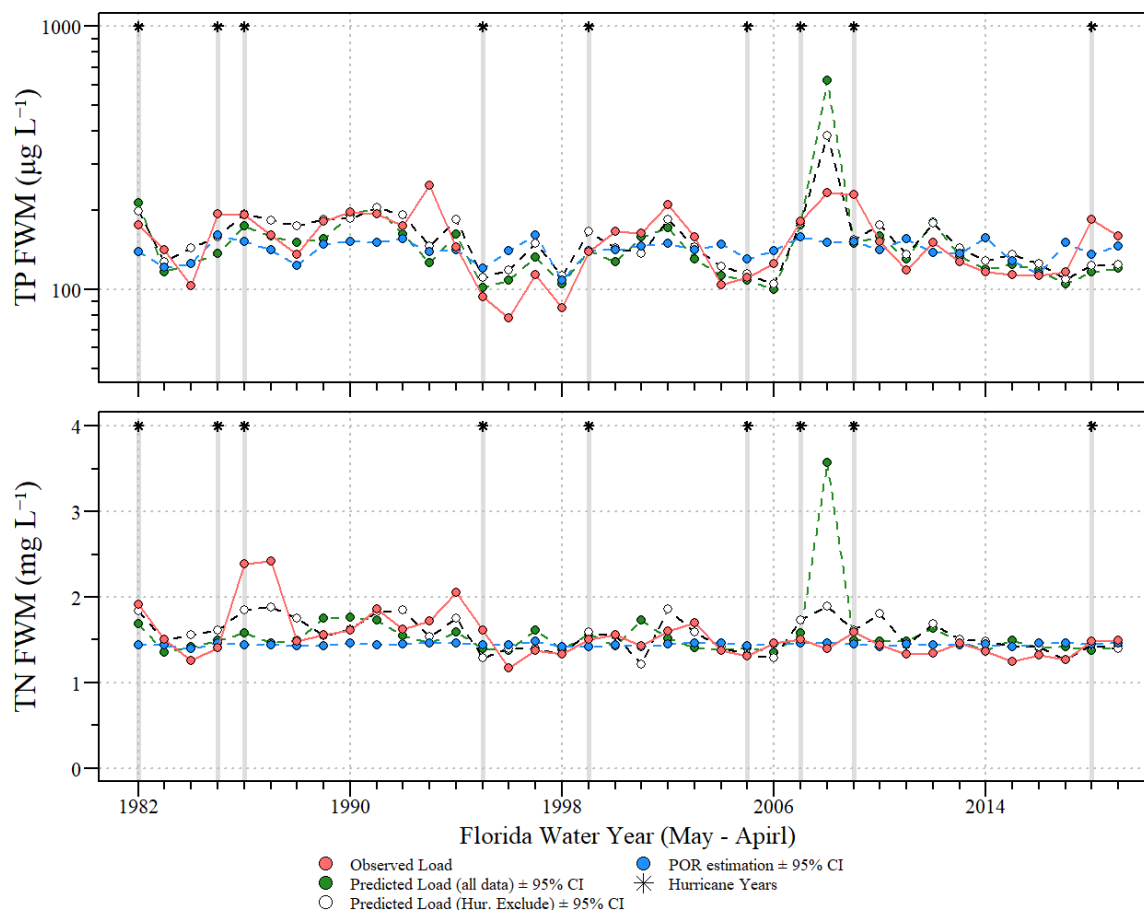
- How does POR estimates match up with the other approaches?





- Monthly POR estimate inject much more variability than modeled values (all data or hurricanes excluded) for estimating TP and TN loads.

# Flow-Weighted Mean Concentrations



## Future Work

- Continue to refine models.
- Develop St Lucie Estuary (S-80) Models.
- Apply models to RSM-BN to evaluate changes in nutrient loads relative to baseline conditions.