Phase 6 October Draft Recalibration – Status Update

Modeling Workgroup Quarterly Meeting – October 2017

Gopal Bhatt[1], Ross Mandel[2], Guido Yactayo[3], and Gary Shenk[4]

[1] Penn State, [2] ICPRB , [3] MDE, [4] USGS

Presentation outline

1. Incorporation of partnership review comments in the re-calibration
2. Removal of enhanced vegetation index (EVI) based nitrogen land to water (L2W) delivery variance factors (DVFs)
3. Flow-weighted observations
4. Stream loads based on Chesapeake floodplain network (CFN) regressions (Noe et al.)
5. Incorporation of organic scour processes
6. Brief review of state-basin loads – September Draft

SCHEDULE FOR PHASE 6 WATERSHED MODEL COMPLETION

Disclaimer: Any additional tasks or priorities may adversely impact the proposed schedule.

October Re-calibration Timeline

September 26 – all inputs are final for the October re-calibration. **DONE**

September 26-Oct 12 – four auto-calibrations & analysis [1] (4 x 3 days = 12 work days) **DONE**

October 6 - Select auto-calibration runs to go forward with and combine the four auto-calibrations as needed to make the final auto-calibration run. **DONE**

October 12 – WQGIT: report out progress and completed products at WQGIT conference call

October 13 – Auto-calibration final (1 work day) **DONE**

October 17 – Mod WG Quarterly – progress on Phase 6 calibration status including nutrient budgets by basin and State incorporating tidal shoreline and atmospheric nutrients

October 16-19 – hand calibration (3-4 work days)

October 20-27 – lower Susquehanna reservoirs + DE (5-6 work days)

October 23 – WQGIT: report out progress and completed products at WQGIT conference call

October 30-30 – below fall line (1 work day)

October 31-31 – calibration final (1 work day)

November Post Re-calibration Timeline

November 1-8 – Key scenarios [2] completed by the WSM including 2010 No Action, 1985, 1993, 2013, 2010 WIP2 LOE, 2010 E3, All-Forest, and other scenarios (6 work days - See note 2)

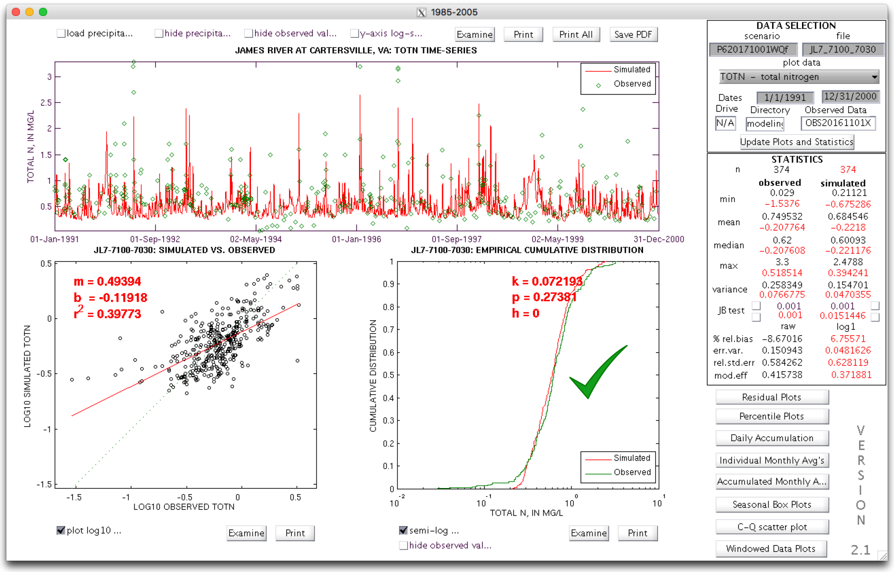
November 6-10 – CERF

November 9-13 – Generate calibration plots.

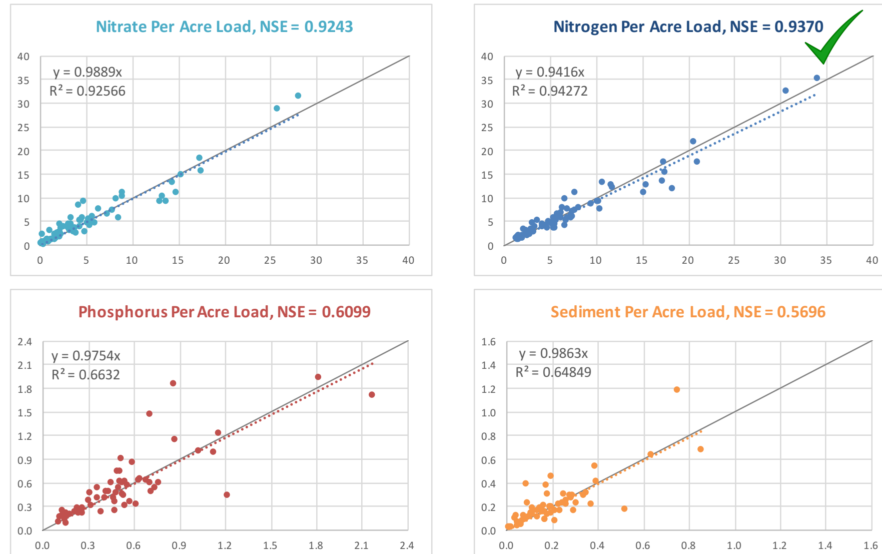
November 13 – WQGIT: report out progress and completed products at WQGIT conference call

[1] 3-4 auto calibration: (a) pending changes, (b) Without EVI, (c) Noe/Claggett Bank & Floodplain, (d) Daily weighted observations. Each requires hours to days of preparation.
[2] (a) Baseline, (b) 2010WIP2+90s, (c) *Baseline+Conowingo Infill*, (d) 2010WIP2+Conowingo INfill, (e) Baseline+CC, (f) 2010WIP2+Conowingo Infill+CC, (g) 1985 Progress, (h) 2010 No Action, (i) 2013 Progress, (j) 2010 E3

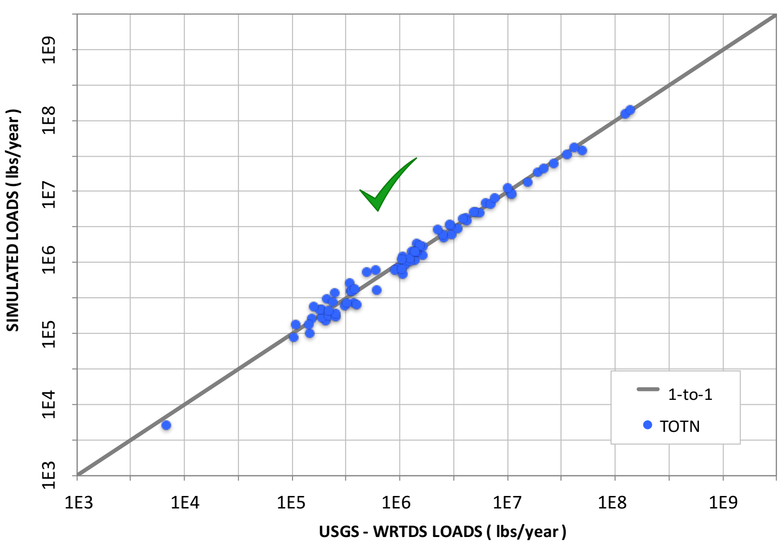
Evaluating the performance of calibration



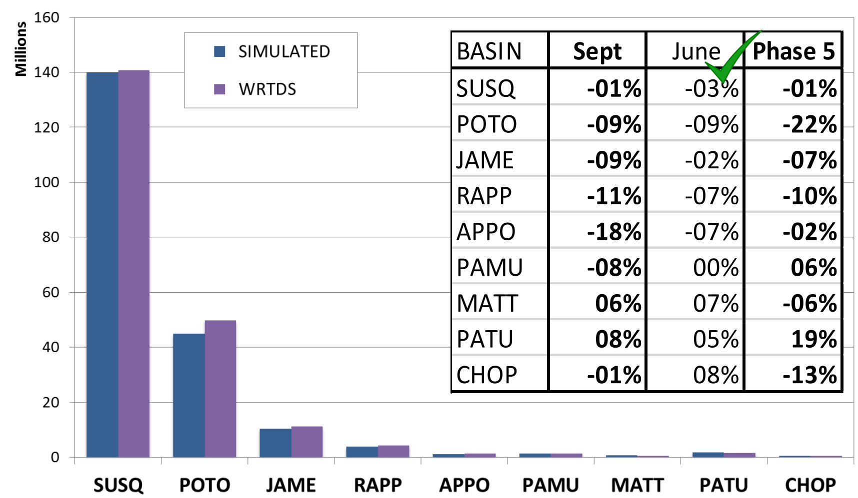
[1] Model calibration is made to improve agreement with monitoring data



[2] Simulated vs. WRTDS Per Acre Load and the Geographic Efficiencies



[3] Simulated vs. WRTDS loads



BASIN	Sept	June	Phase 5
SUSQ	**-01%**	-03%	**-01%**
POTO	**-09%**	-09%	**-22%**
JAME	**-09%**	-02%	**-07%**
RAPP	**-11%**	-07%	**-10%**
APPO	**-18%**	-07%	**-02%**
PAMU	**-08%**	00%	**06%**
MATT	**06%**	07%	**-06%**
PATU	**08%**	05%	**19%**
CHOP	**-01%**	08%	**-13%**

assuming +/- 10% uncertainty in WRTDS estimates

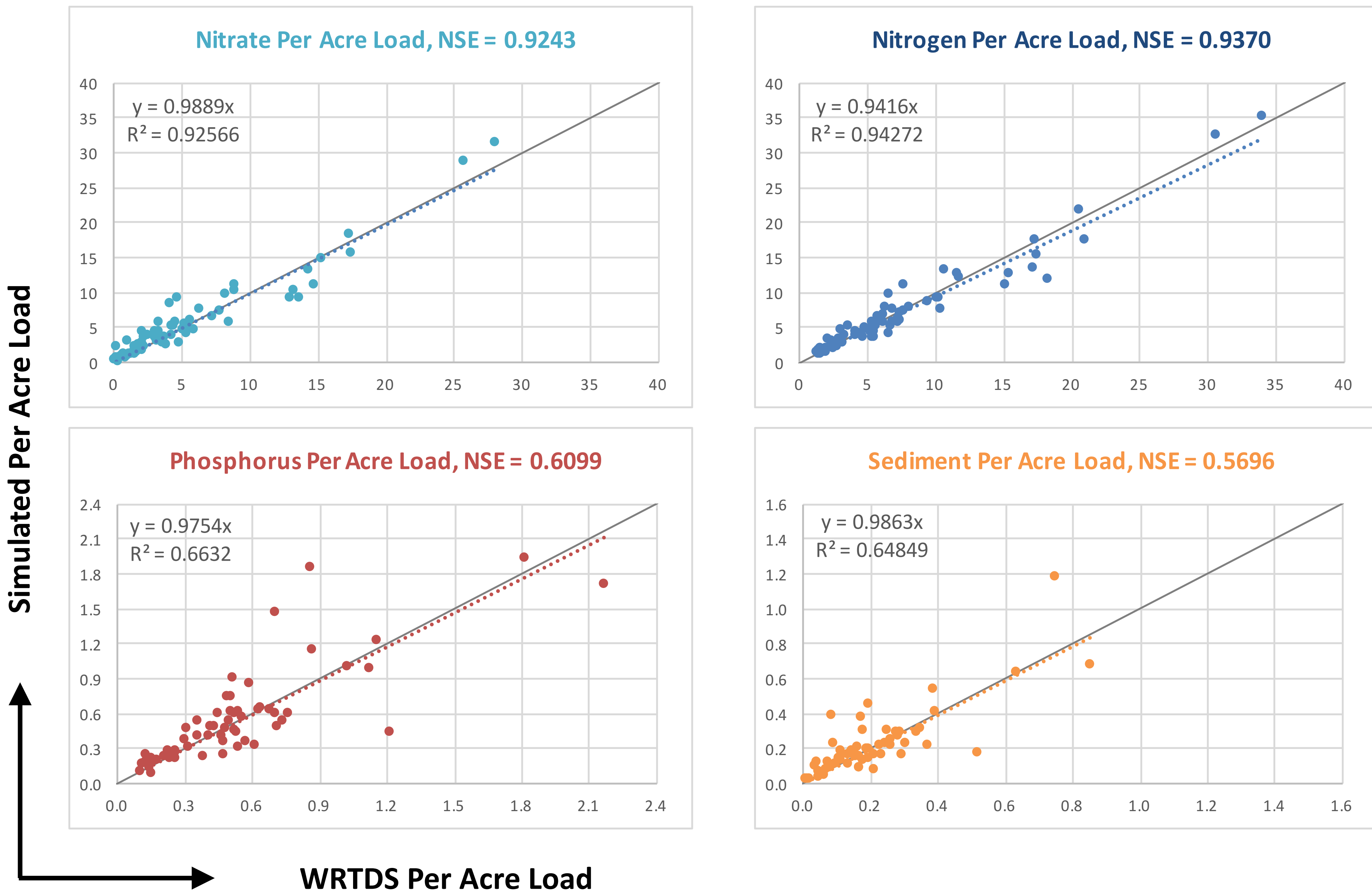
[4] Agreement between the simulated and WRTDS loads at the RIM sites

1. Incorporation of partnership review comments

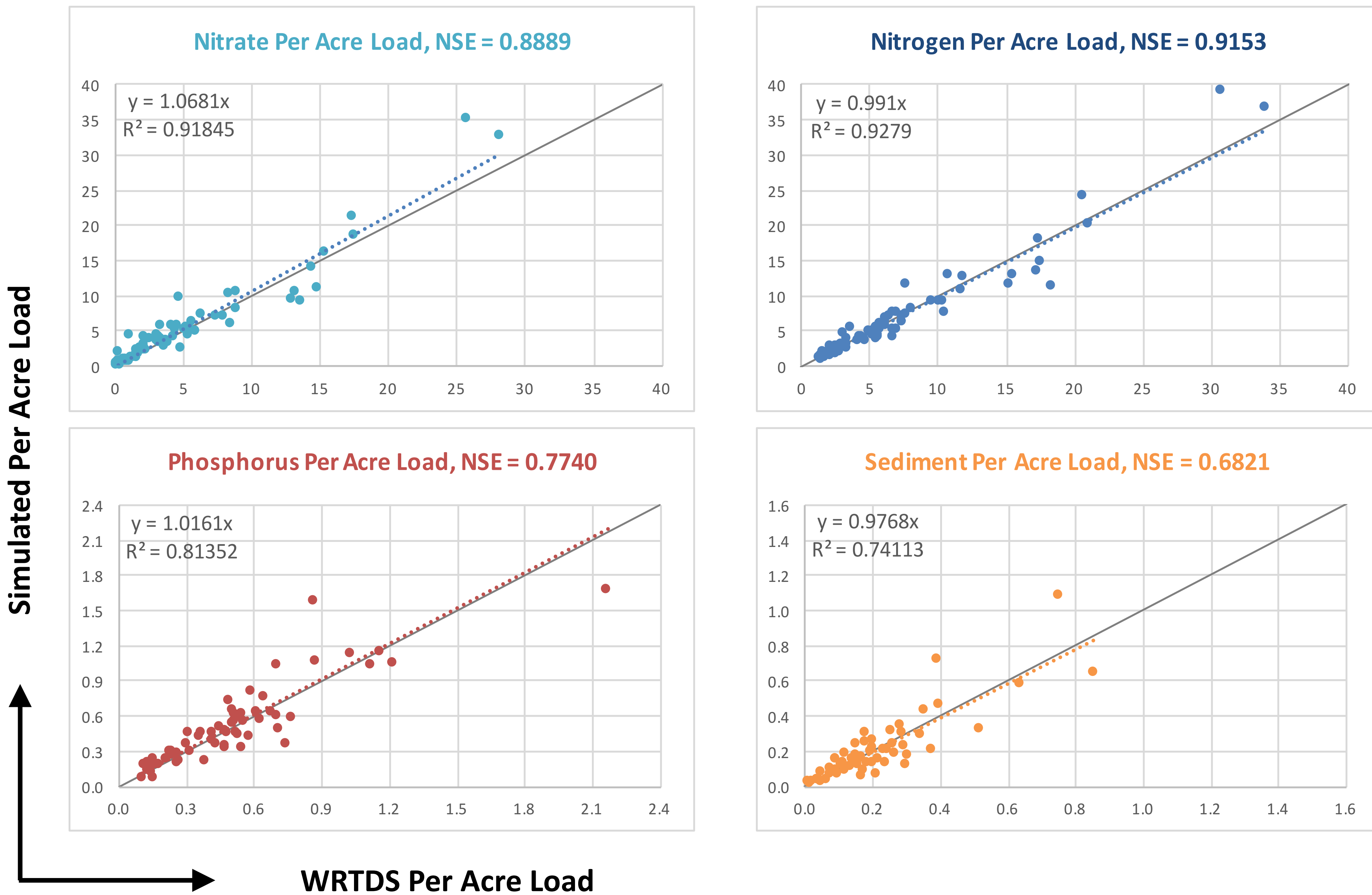
- Incorporation of fatal flaw review comments as the starting point for October re-calibration
- New starting point for other calibrations

June Auto Calibration

NSE closer to 1 the better

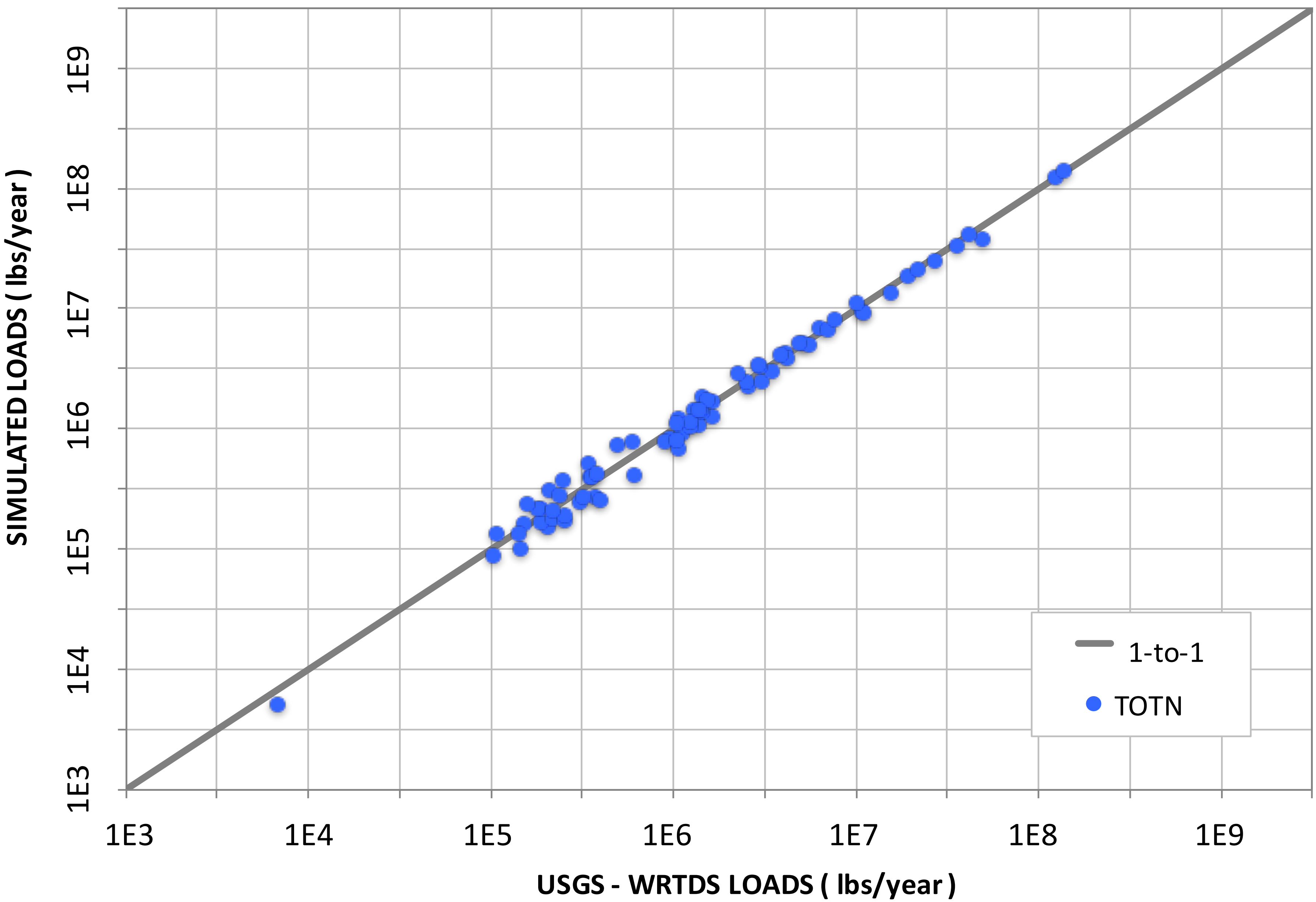


#A: CBP Review Comments



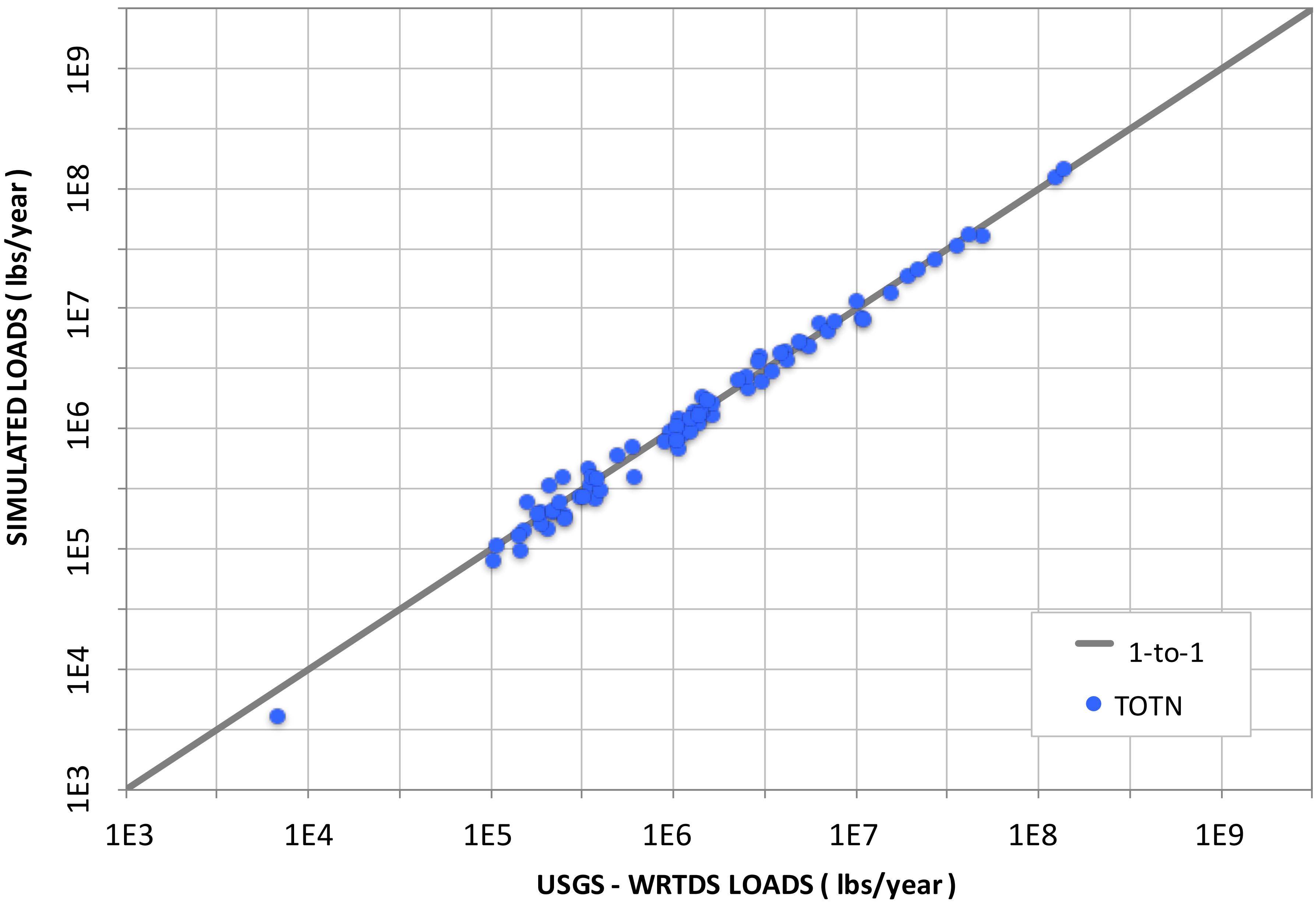
June Auto Calibration

NITROGEN



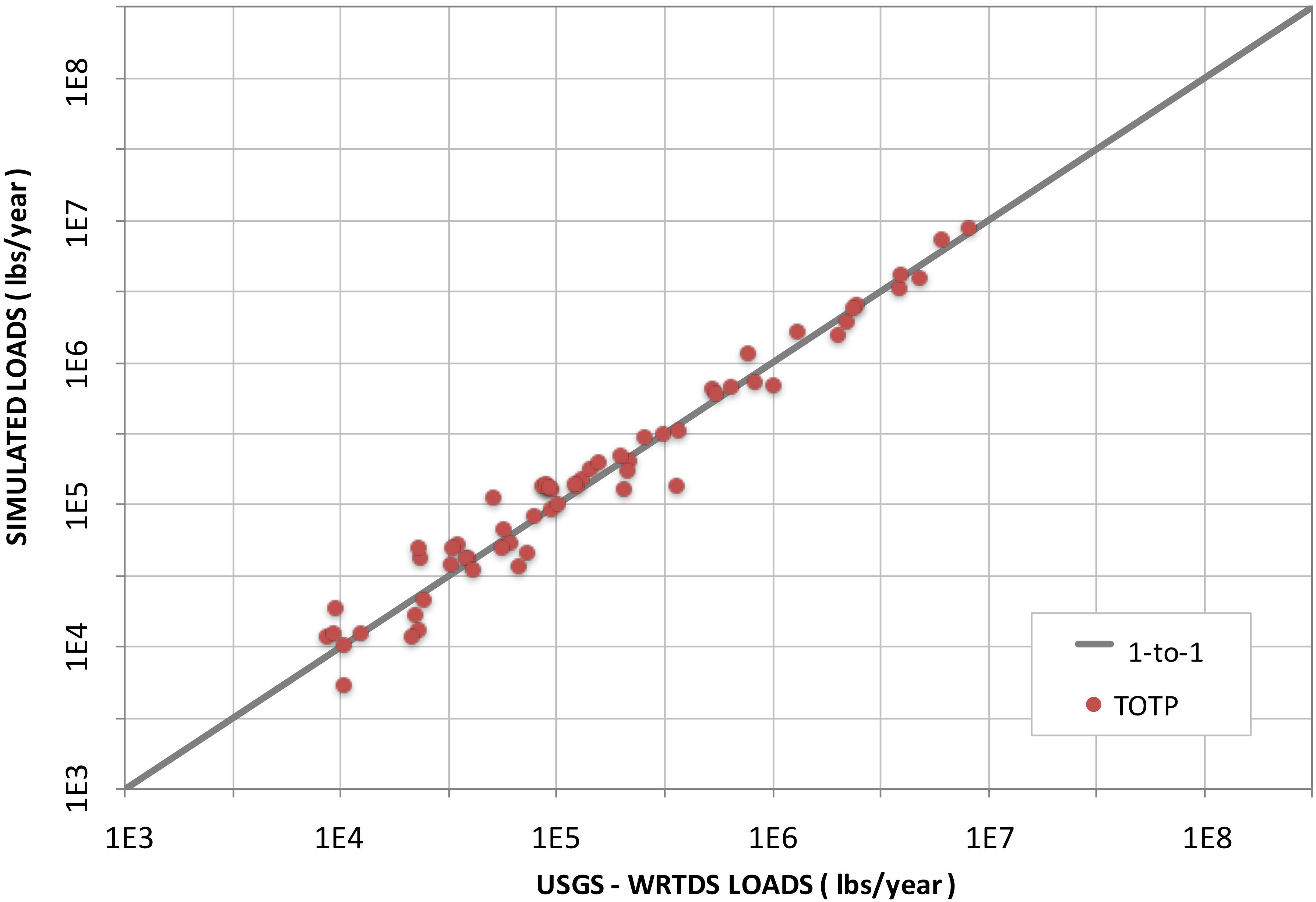
#A: CBP Review Comments

NITROGEN



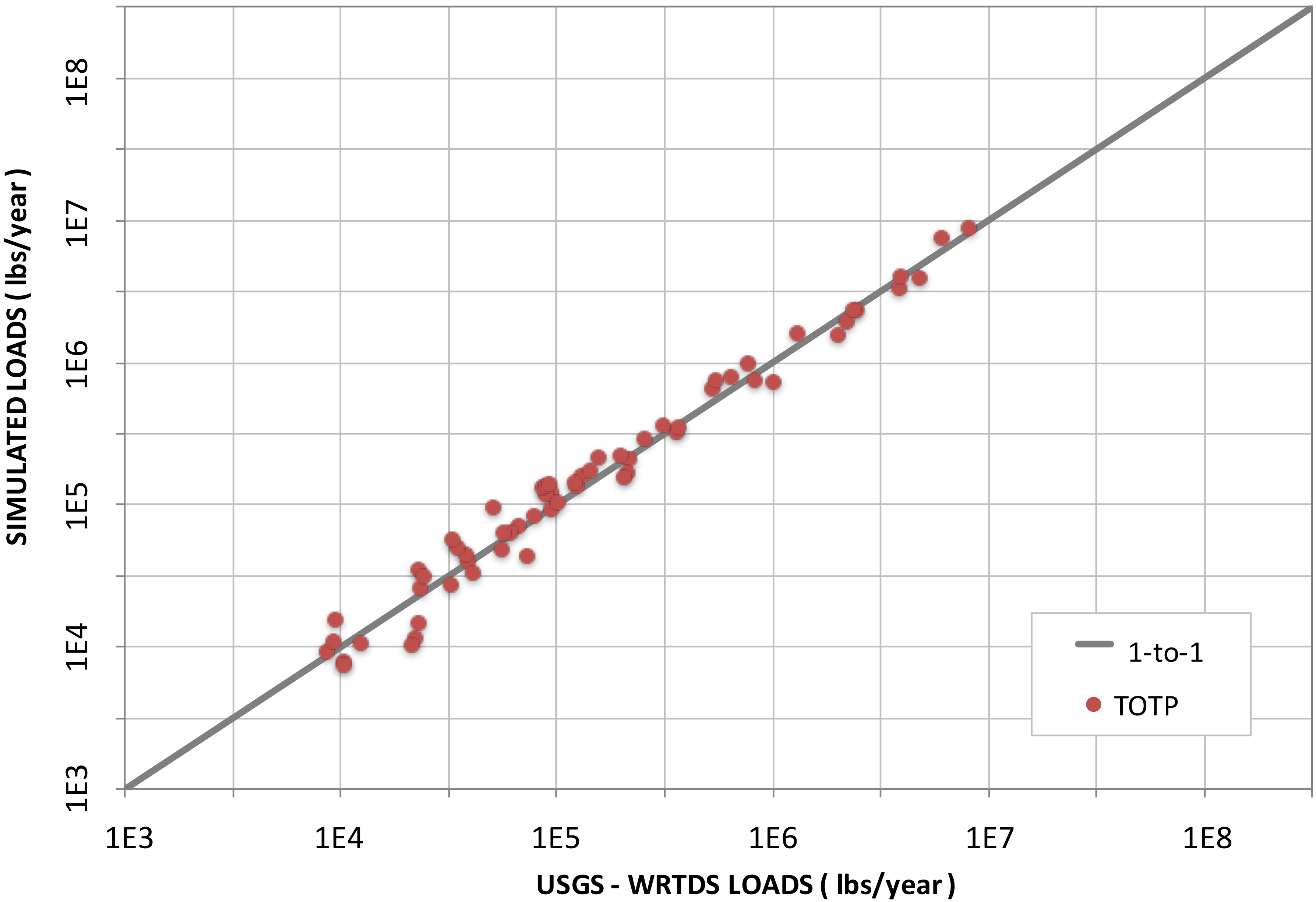
June Auto Calibration

PHOSPHORUS



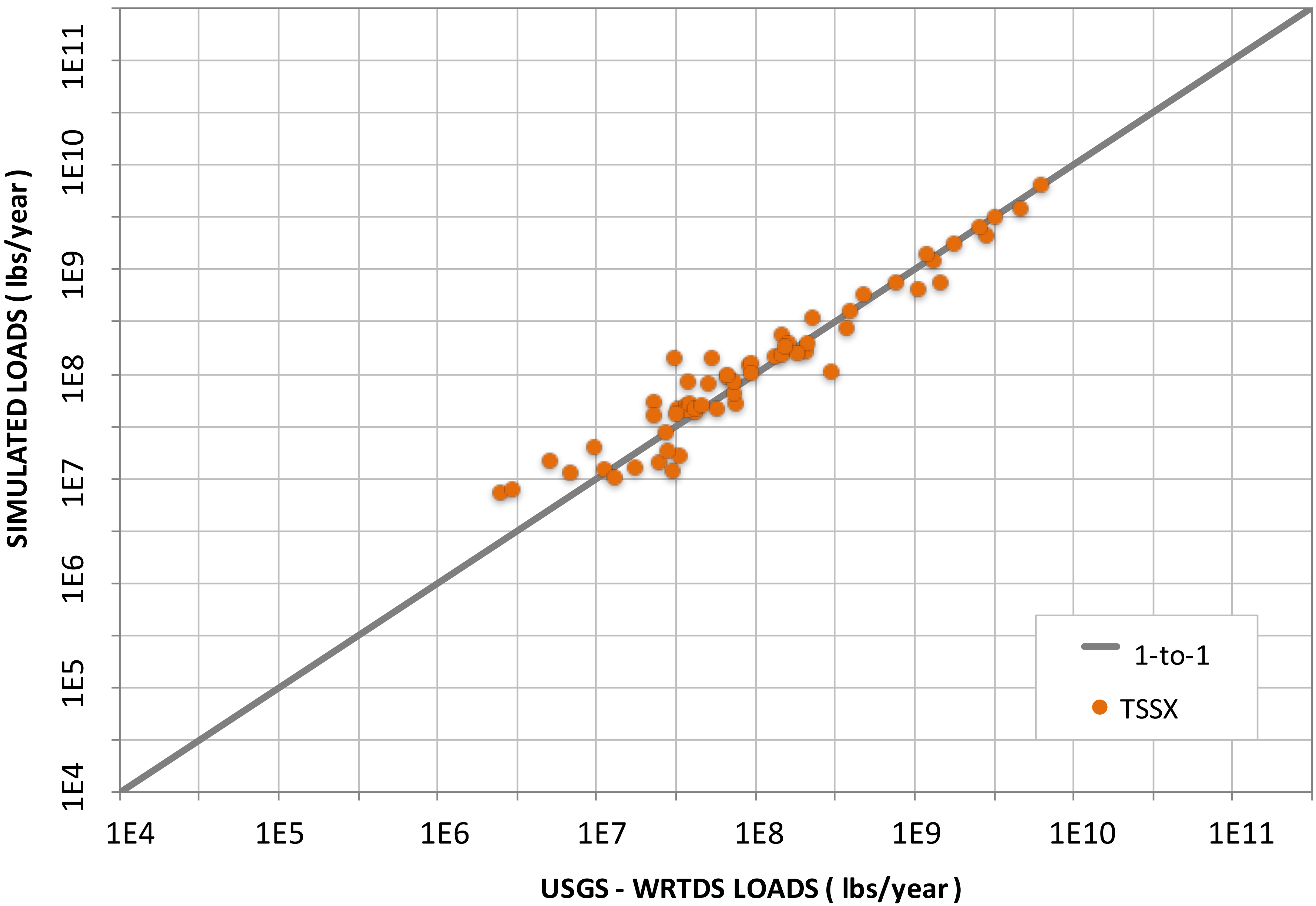
#A: CBP Review Comments

PHOSPHORUS



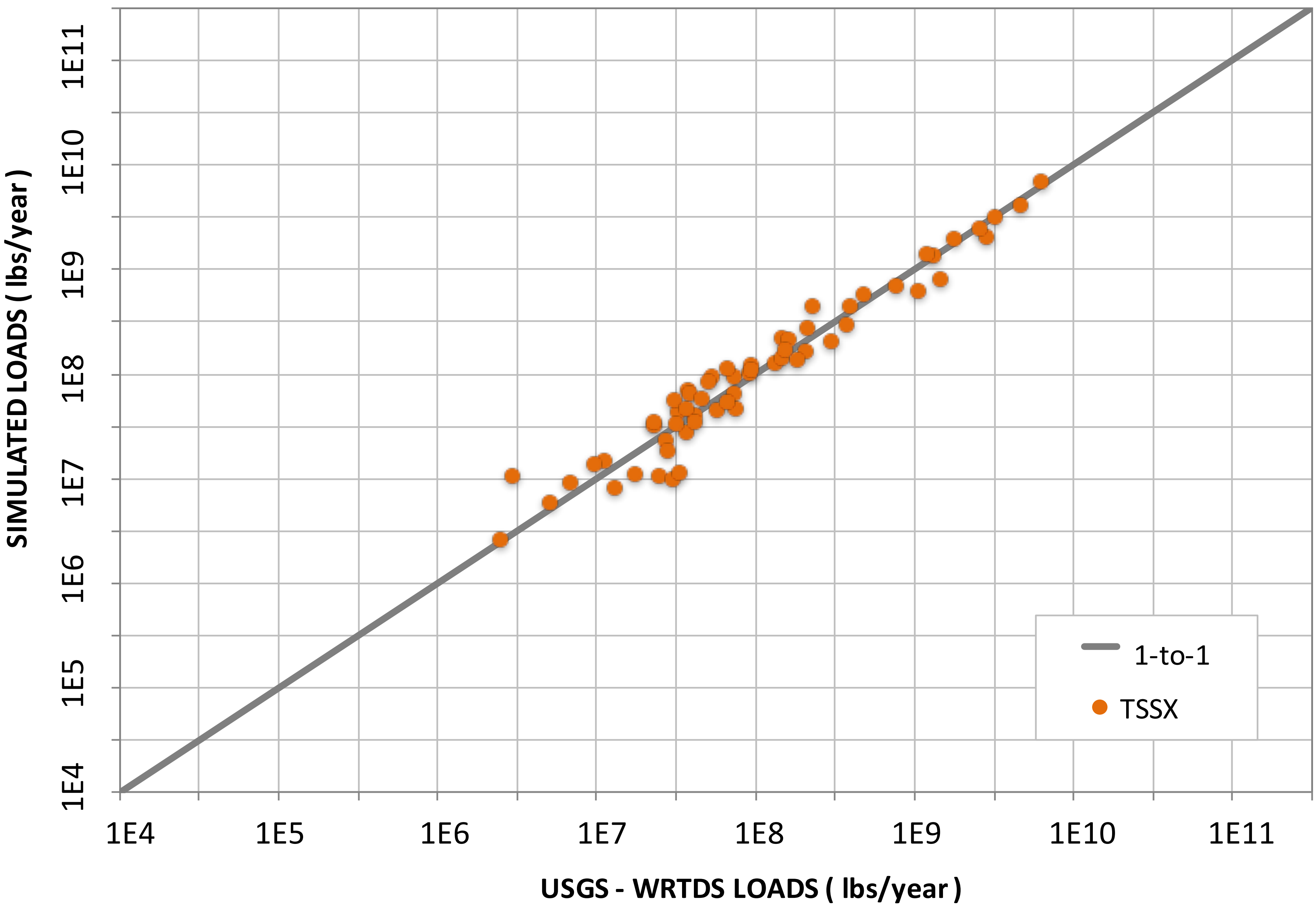
June Auto Calibration

SEDIMENT



#A: CBP Review Comments

SEDIMENT



2. Removal of enhanced vegetation index (EVI) based nitrogen land to water (L2W) delivery variance factors (DVFs)

- Calibration Run #B removes the EVI based Nitrogen L2W factor.
- Also updates with final soil phosphorus

Removing Enhanced Vegetation Index From Nitrogen Delivery Variation Factor

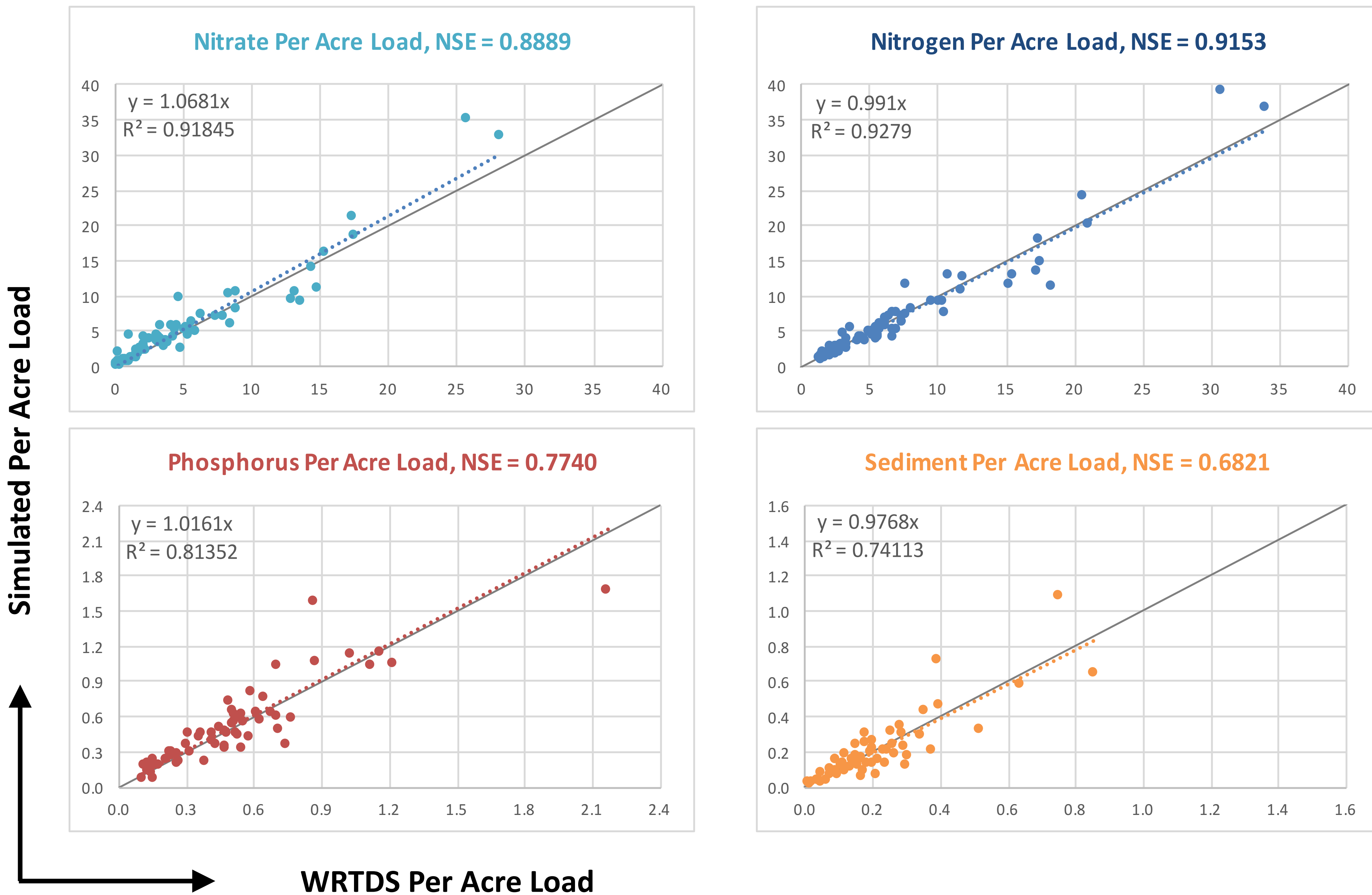
- Enhanced Vegetation Index (EVI): remote-sensing measure of vegetation density
- EVI used in SPARROW CBTN_v4 as TN land to water delivery factor—coefficient has negative sign, higher EVI means less N transported
- Problems with using EVI in P6 DVF:
  - Correlated with land use
  - Correlated with plant uptake
  - Responsible for high DVFs, particularly in Baltimore City, Alexandria, Virginia Beach, and Coastal Plain areas
  - Effects of low EVI (high DVF) downstream of SPARROW calibration points

TN DVF Range With and Without EVI

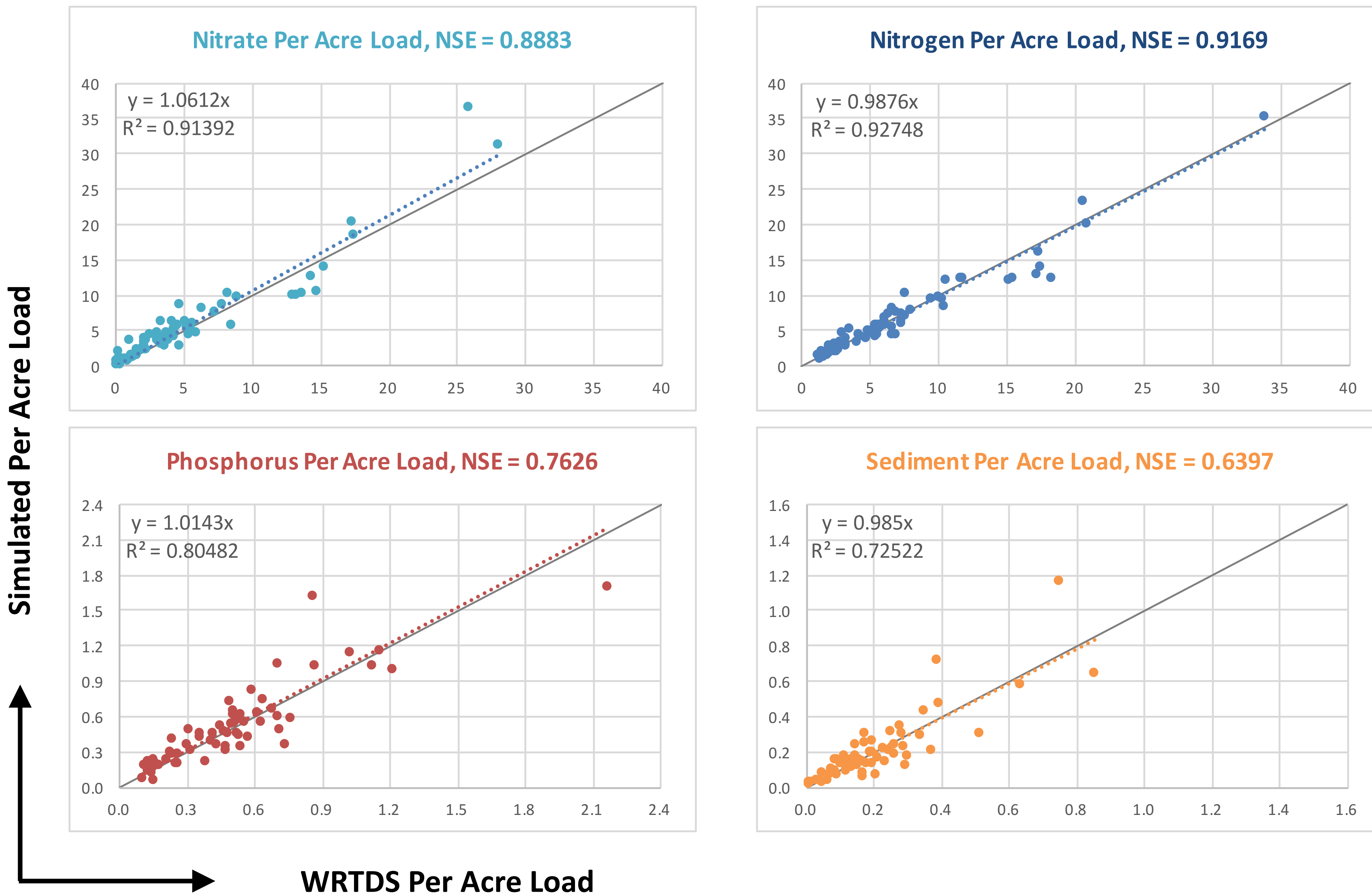
Cover Class	DVF With EVI		DVF Without EVI	
	max	min	max	min
crop	6.05	0.46	2.41	0.54
pasture/hay	4.99	0.47	2.41	0.54
developed	7.35	0.46	2.42	0.54
natural	5.08	0.47	2.42	0.54

Name	Land Segment	River Segment	Developed DVF With EVI	Developed DVF Without EVI
Virginia Beach	N51810	JB0_7662_0000	7.35	1.91
Alexandria	N51179	PL0_5495_0000	4.43	0.87
Baltimore City	N24510	WM0_3961_0000	4.10	0.85

#A: CBP Review Comments

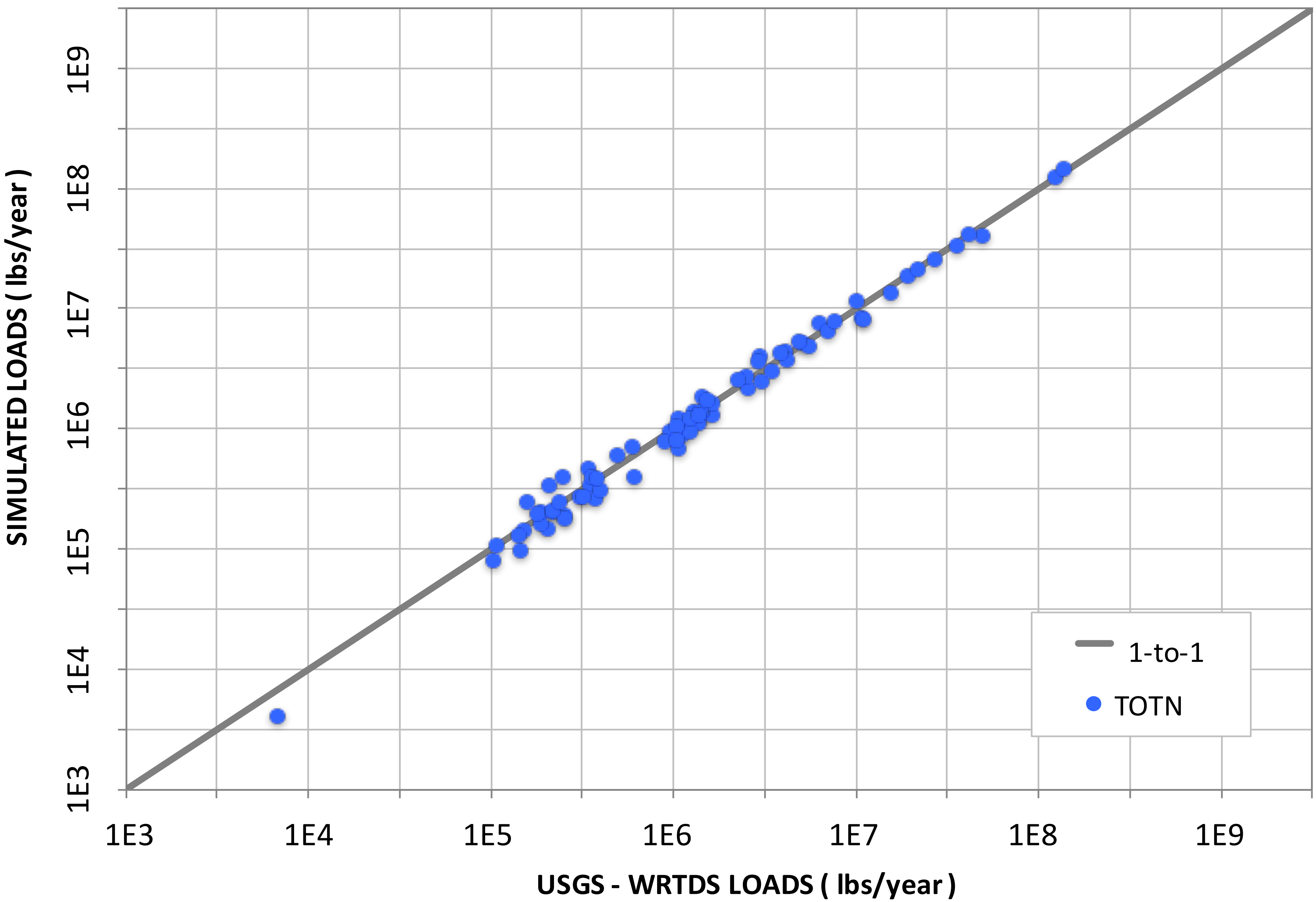


#B: +Remove EVI N-DVF



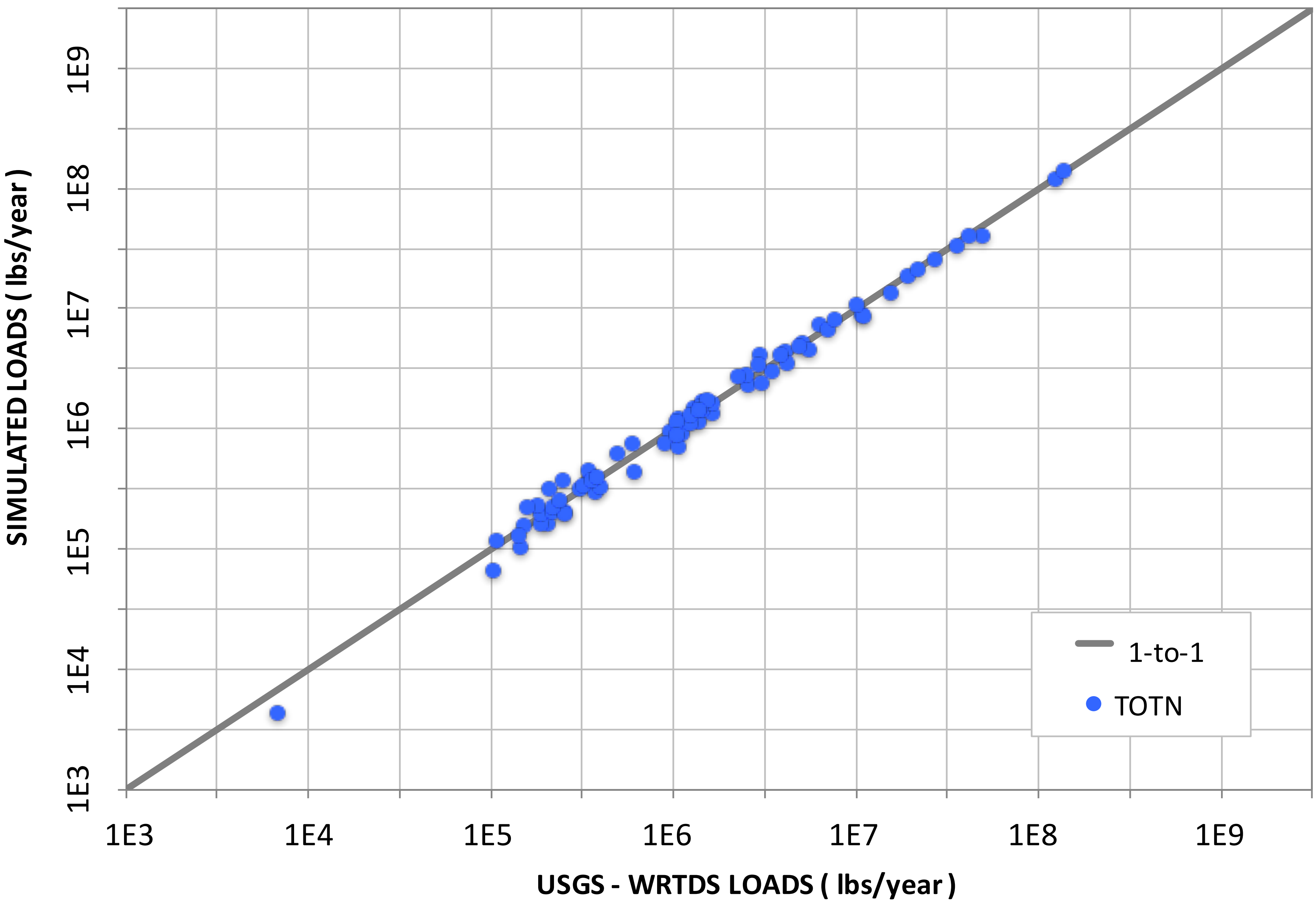
#A: CBP Review Comments

NITROGEN



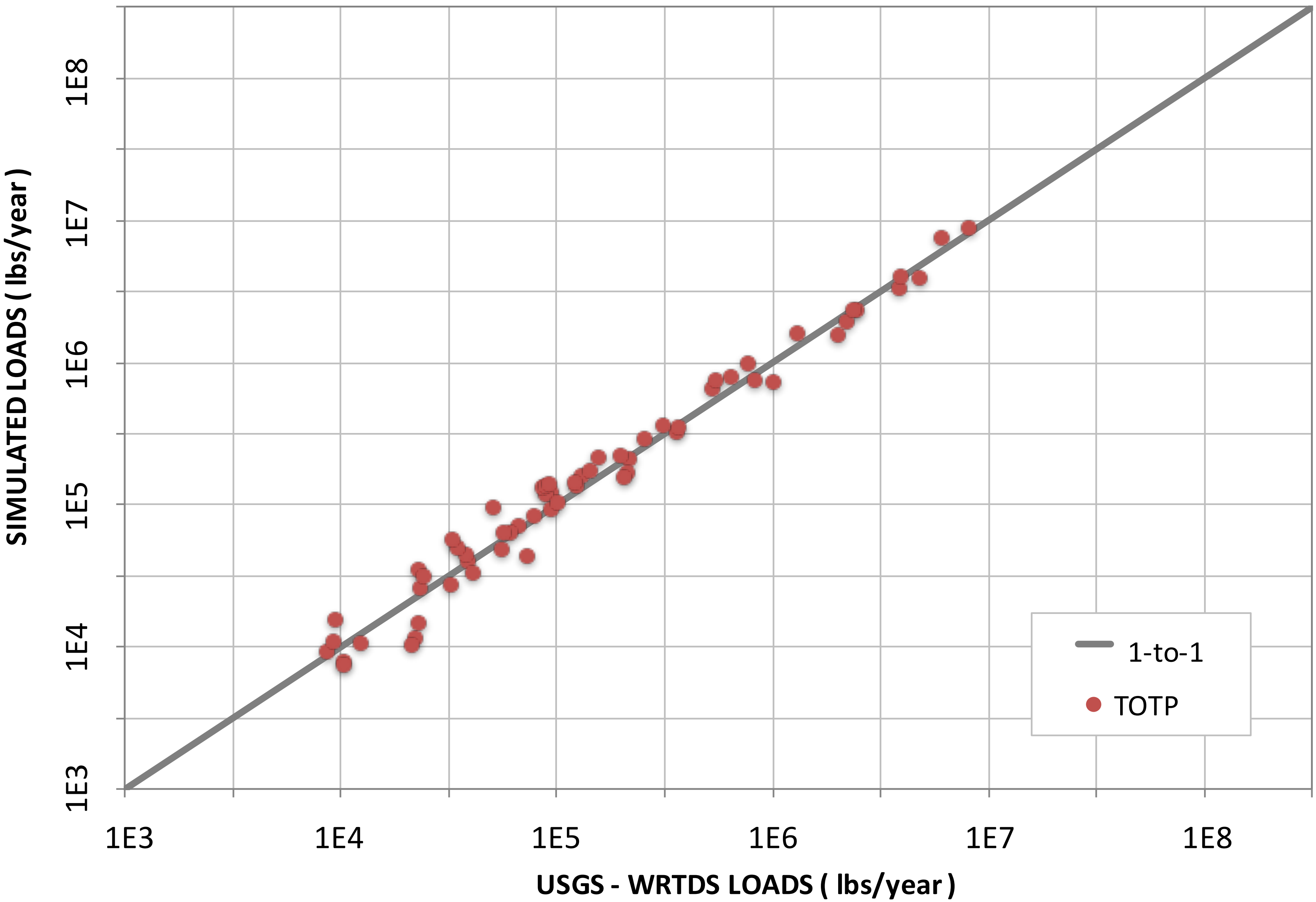
#B: +Remove EVI N-DVF

NITROGEN



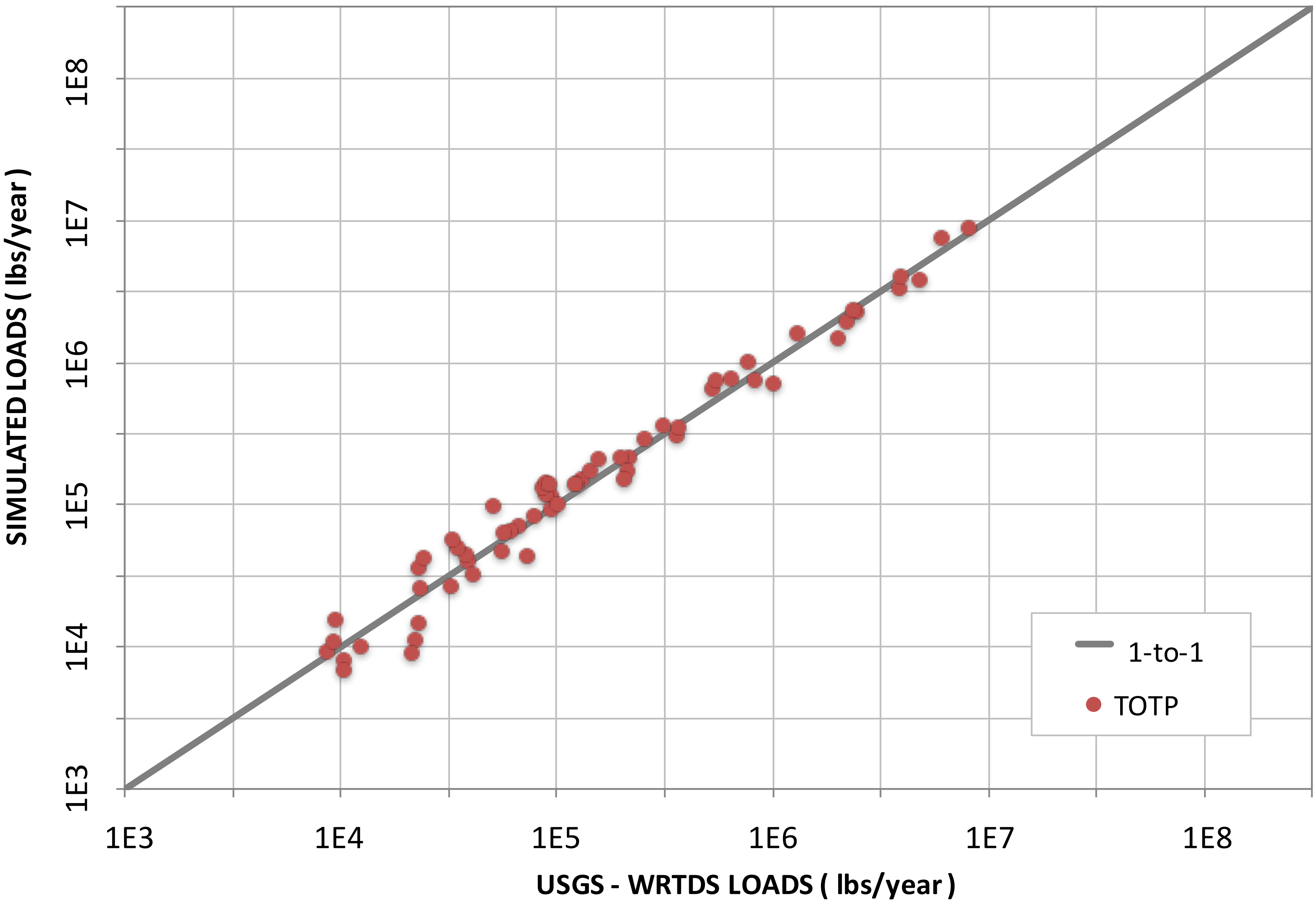
#A: CBP Review Comments

PHOSPHORUS



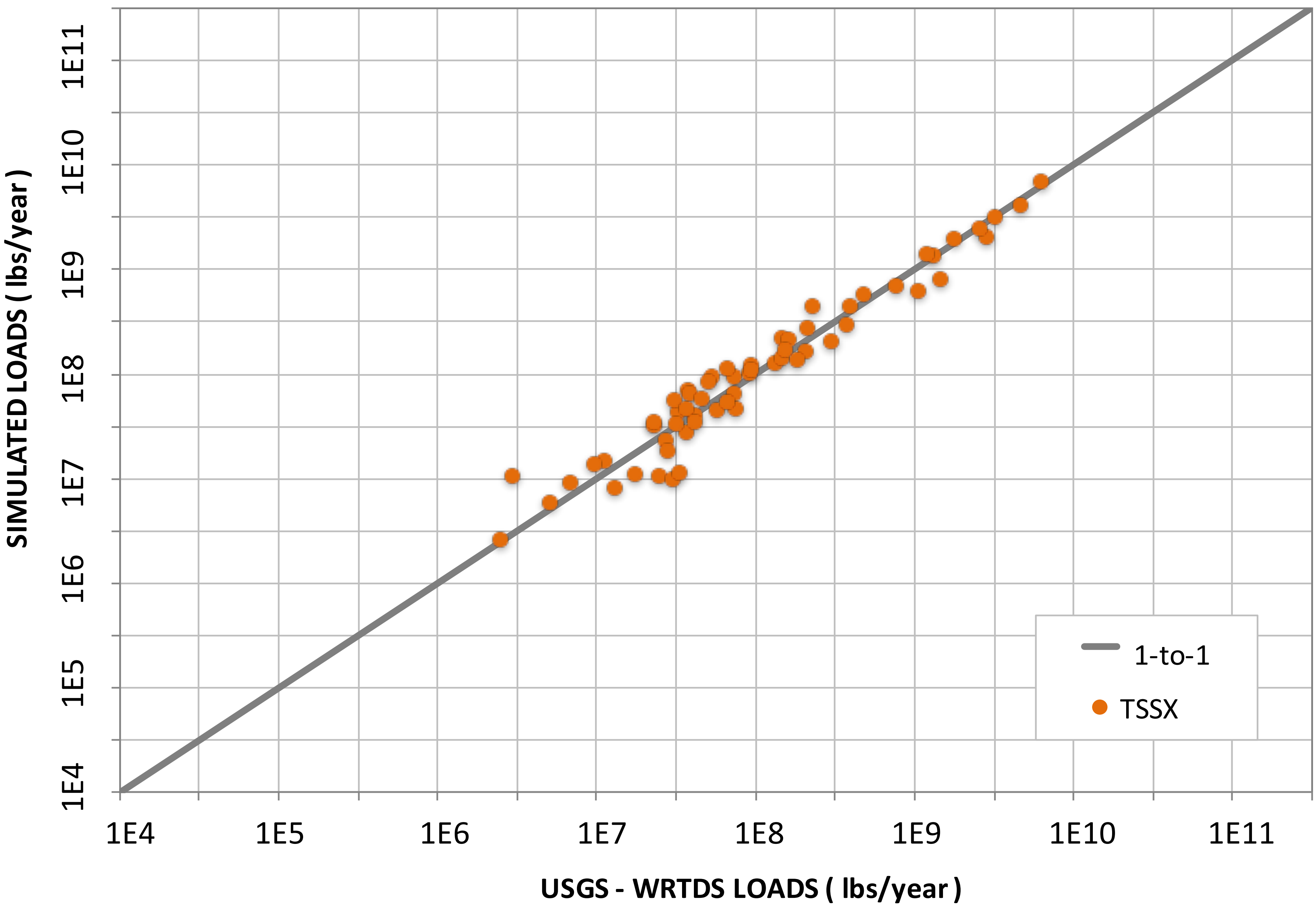
#B: +Remove EVI N-DVF

PHOSPHORUS



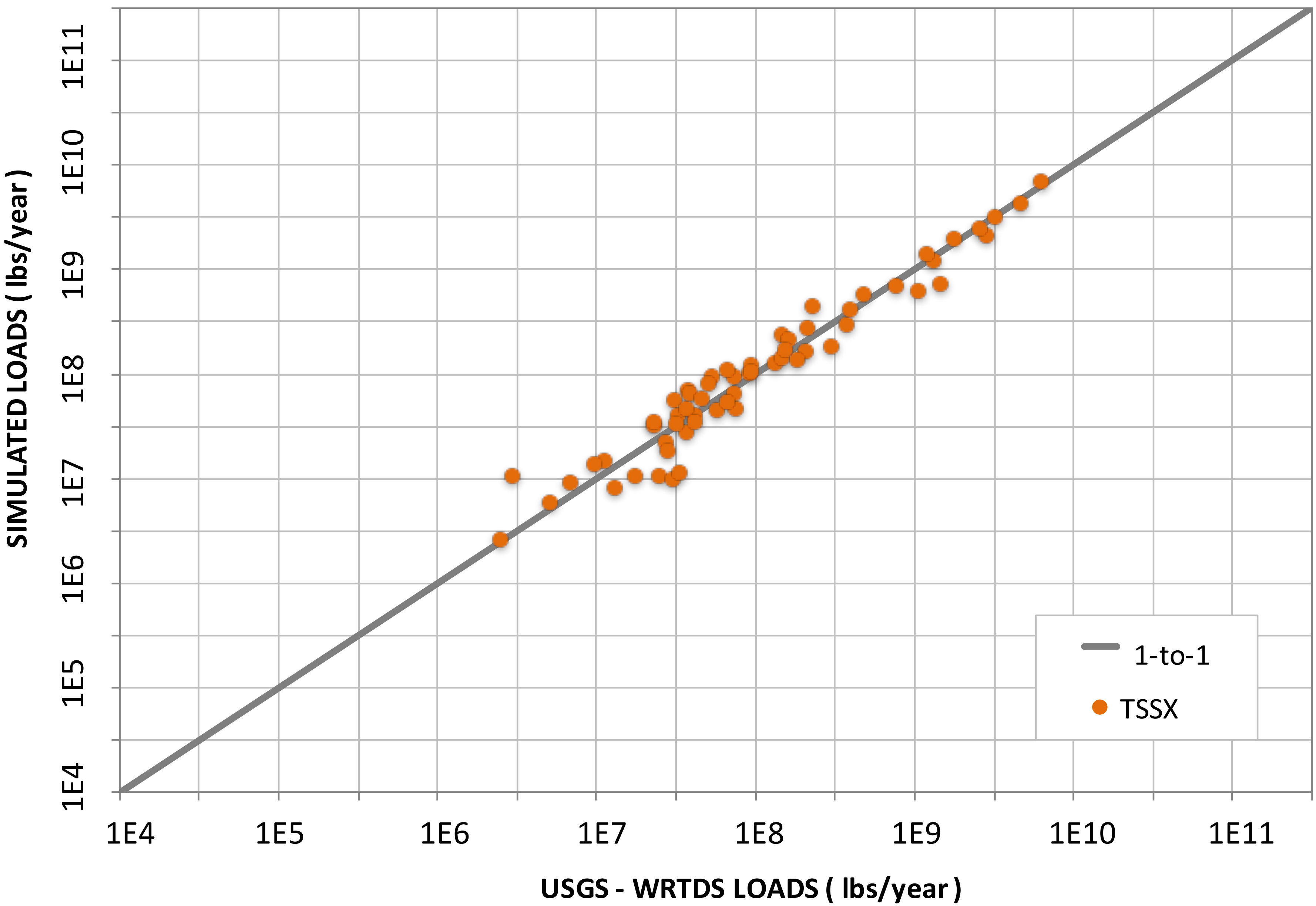
#A: CBP Review Comments

SEDIMENT



#B: +Remove EVI N-DVF

SEDIMENT



Suggested resolution

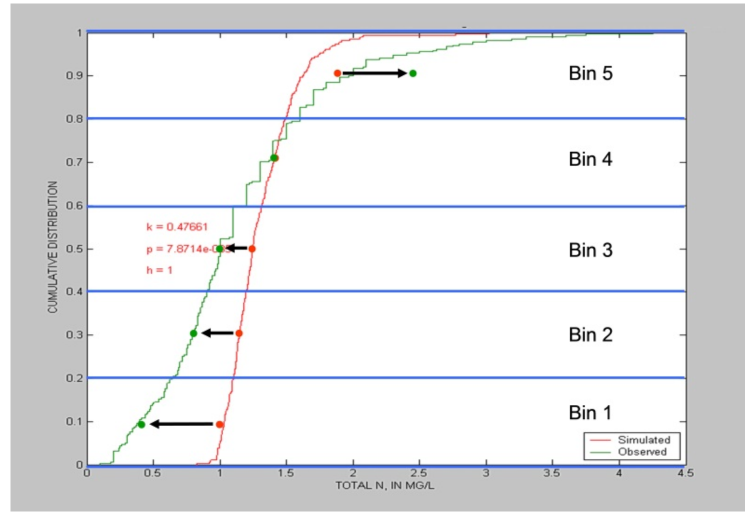
- Exclude EVI N-DVFs
  - Responds to partner request
  - EVI has no benefit to calibration
  - EVI has its highest effects in areas that are below observation stations and therefore not considered in the sparrow model that produced them
  - EVI is spatially correlated with land use which is already considered

3. Flow-weighted observations

- Modify observed data set that are used in the model calibration so that multiple observations on a single day are used as a single flow-weighted observation

Averaging Observations Taken on Same Day

- Calibration based on comparing CFDs of observed and simulated concentrations
  - Individual grab sample observations
  - Paired daily average simulated concentrations



- What happens if there are multiple observations in a single day?
  - Multiple observations on the same day in CFD, compared to
  - Multiple copies of the same average daily simulated concentrations
- Ideal solution: if there are multiple observations on the same day, use flow-weighted average of concentrations, but
  - Some WQ data not associated with USGS gage
  - Some gages do not have instantaneous/hour flow data
  - Almost all stations do not have instantaneous flow data over entire calibration period.

Example: NE Branch Anacostia TSS (top bin)

Observed					Simulated		
Date	Flow (cfs)	Flow Percentile	TSS (mg/l)	Samples Collected on Date	Date	Flow Percentile	TSS (mg/l)
4/2/2005	1,500	0.996167	1,980	1	10/8/2005	0.999382	2,418.1
5/26/2009	2,100	0.998162	1,730	4	10/8/2005	0.999382	2,418.1
8/14/2011	572	0.977513	1,730	2	10/8/2005	0.999382	2,418.1
8/14/2011	572	0.977513	1,710	2	10/8/2005	0.999382	2,418.1
1/14/2005	2,110	0.998279	1,670	4	7/8/2005	0.992935	2,417.9
8/28/2009	498	0.971568	1,600	4	7/8/2005	0.992935	2,417.9
7/8/2005	975	0.991083	1,580	5	7/8/2005	0.992935	2,417.9
8/12/2010	575	0.977786	1,430	1	7/8/2005	0.992935	2,417.9
6/3/2009	420	0.964685	1,400	2	7/8/2005	0.992935	2,417.9
9/30/2010	1,420	0.995581	1,310	4	3/23/2005	0.997704	2,242.9
1/14/2005	2,110	0.998279	1,300	4	3/23/2005	0.997704	2,242.9
8/18/2010	2,020	0.998045	1,290	3	3/23/2005	0.997704	2,242.9
8/15/2011	517	0.973837	1,230	1	3/23/2005	0.997704	2,242.9
8/28/2009	498	0.971568	1,180	4	3/23/2005	0.997704	2,242.9
5/9/2008	1620	0.996832	1170	3	3/23/2005	0.997704	2242.9
5/26/2009	2100	0.998162	1170	4	5/12/2008	0.998852	2162.3

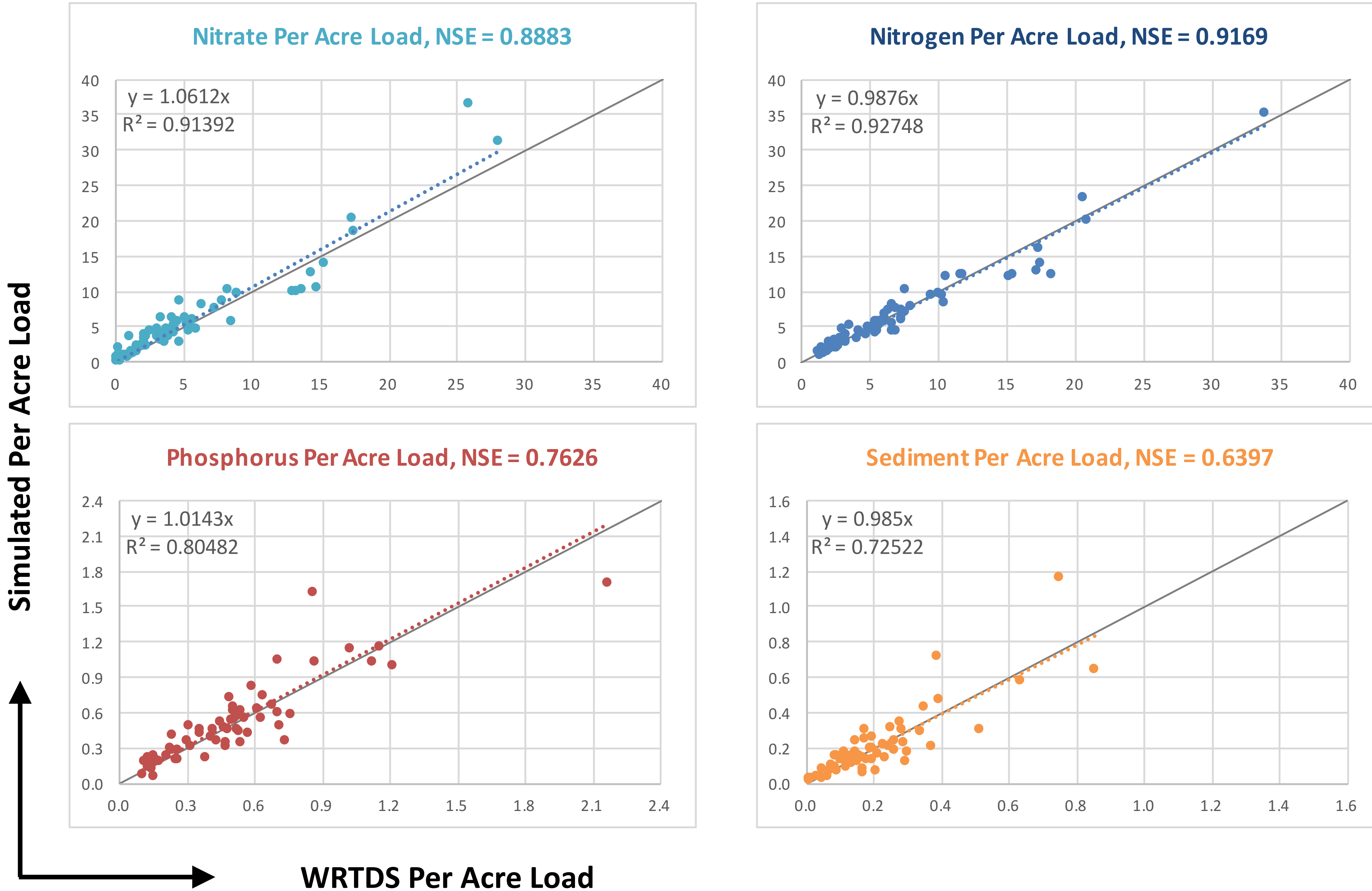
Copies of same day

Multiple samples on same date

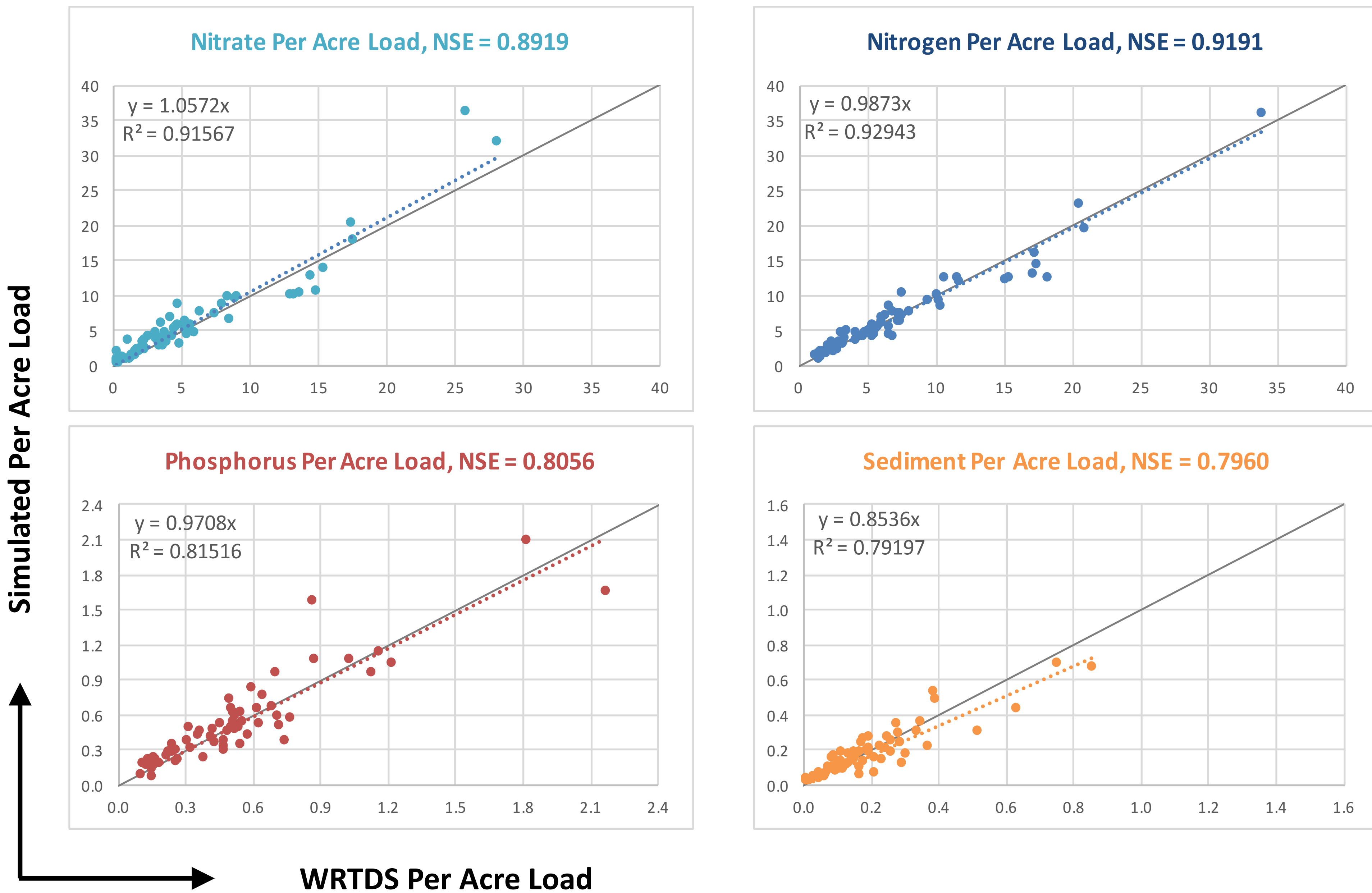
Implementation of WQ Averaging

1. Find surrogate gages for reaches without instantaneous/hourly flow data
2. Average to flows to hourly time scale
3. Averaging: if every observation in a day has associated hourly flow, take flow-weighted average; otherwise take arithmetical average
4. Qualifier: if any observation is less than reported value, the qualifier of the average concentration is given qualifier of less than reported value

#B: Remove EVI N-DVF

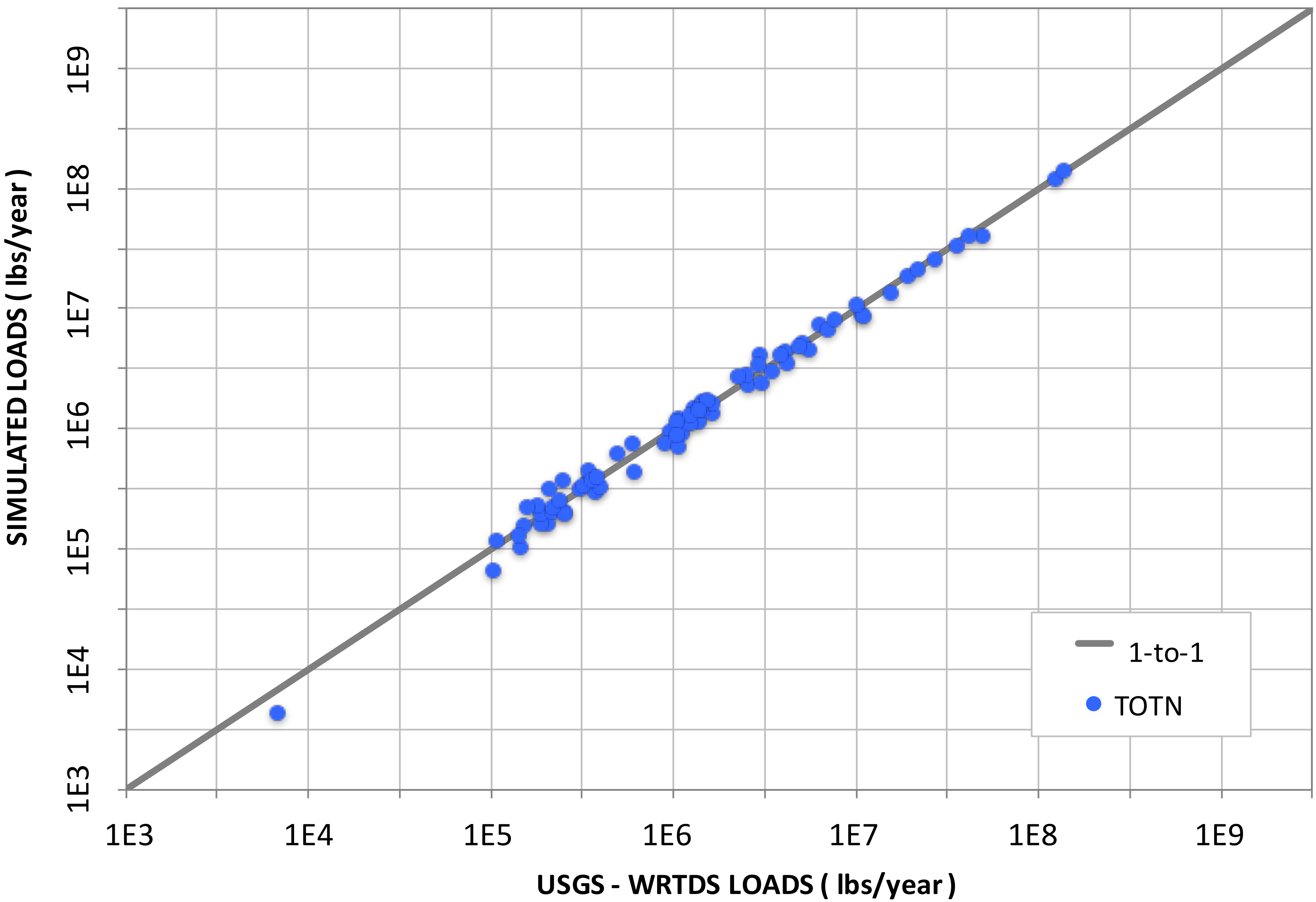


#D: +Flow-weighted Obs



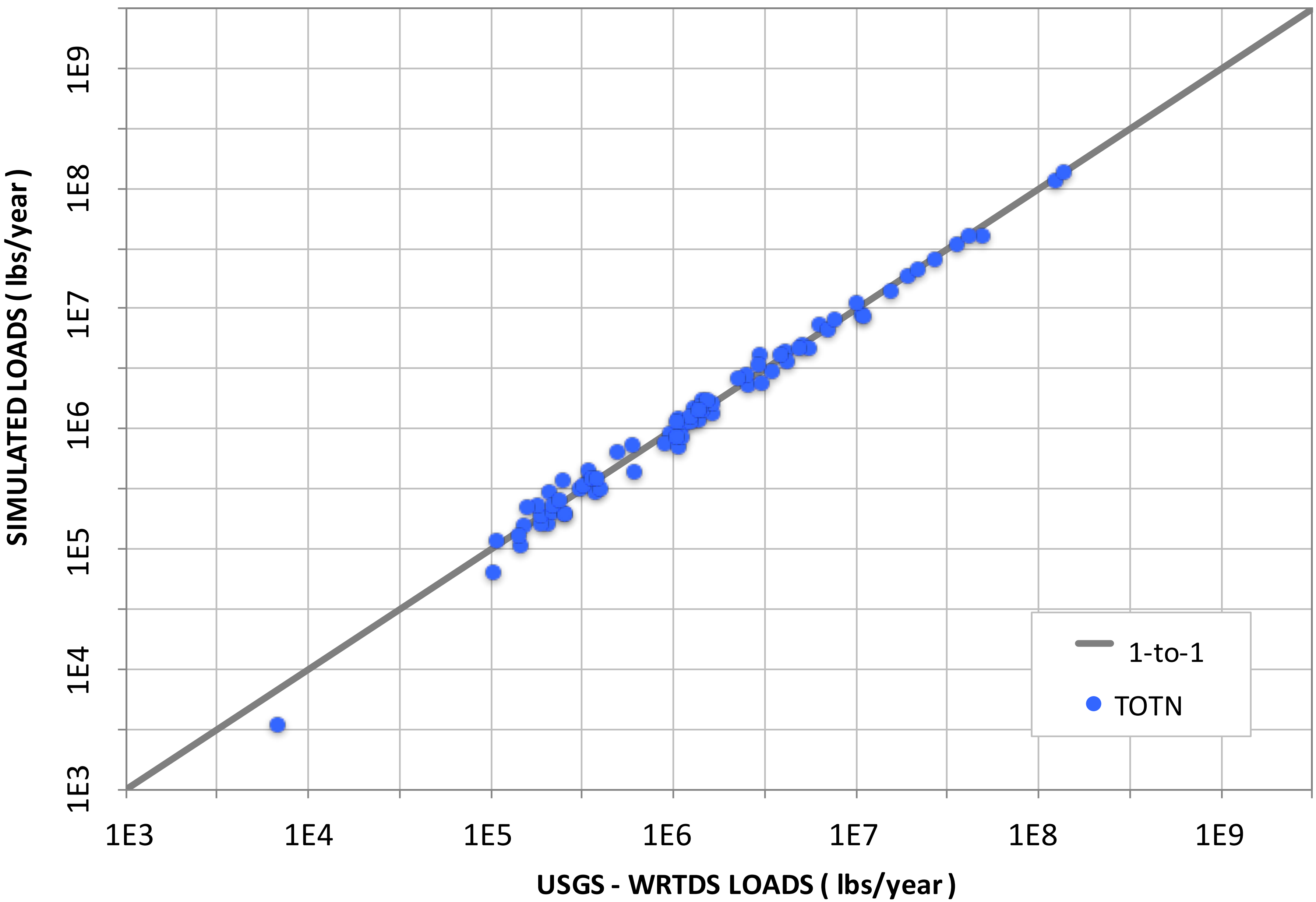
#B: Remove EVI N-DVF

NITROGEN



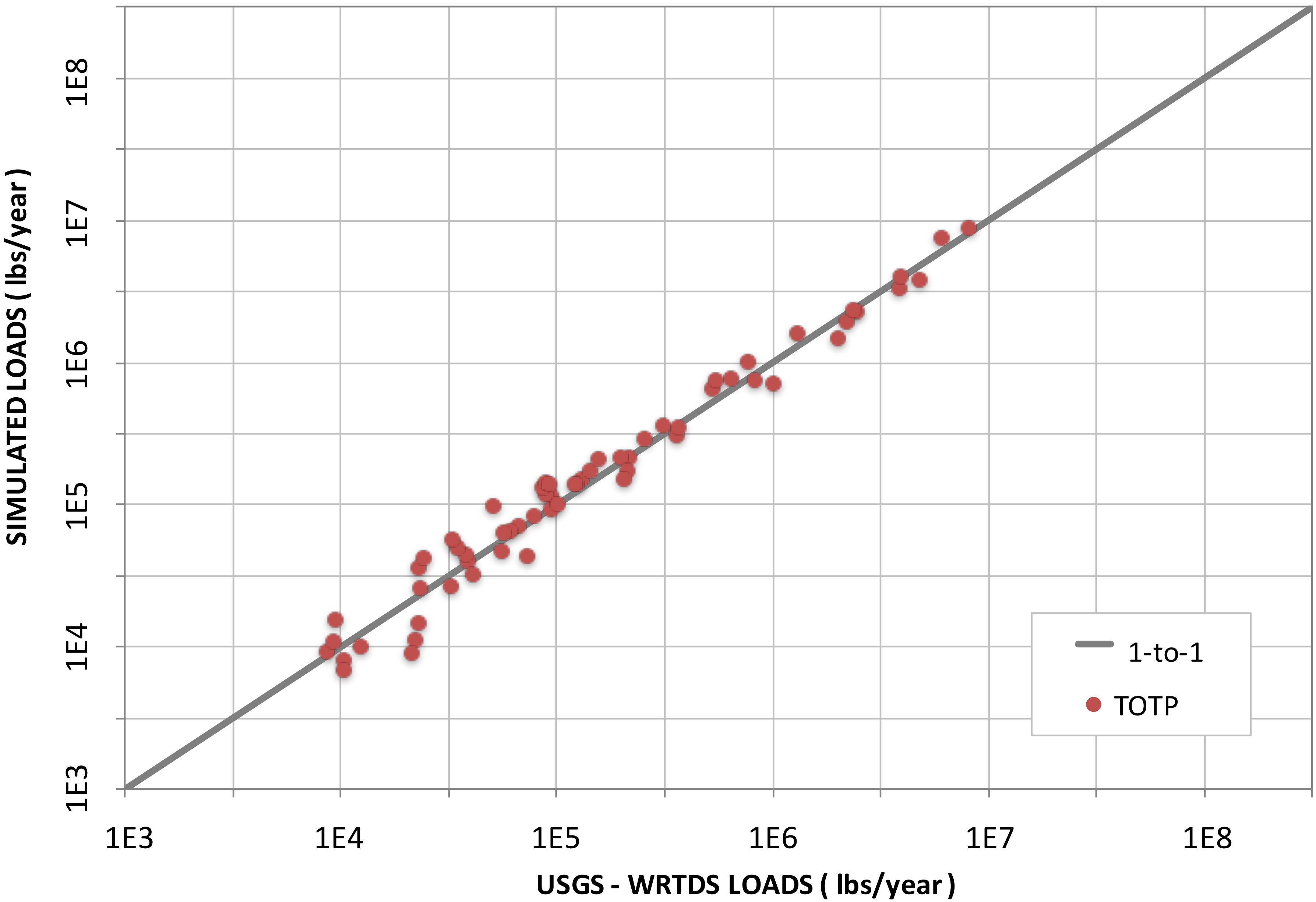
#D: +Flow-weighted Obs

NITROGEN



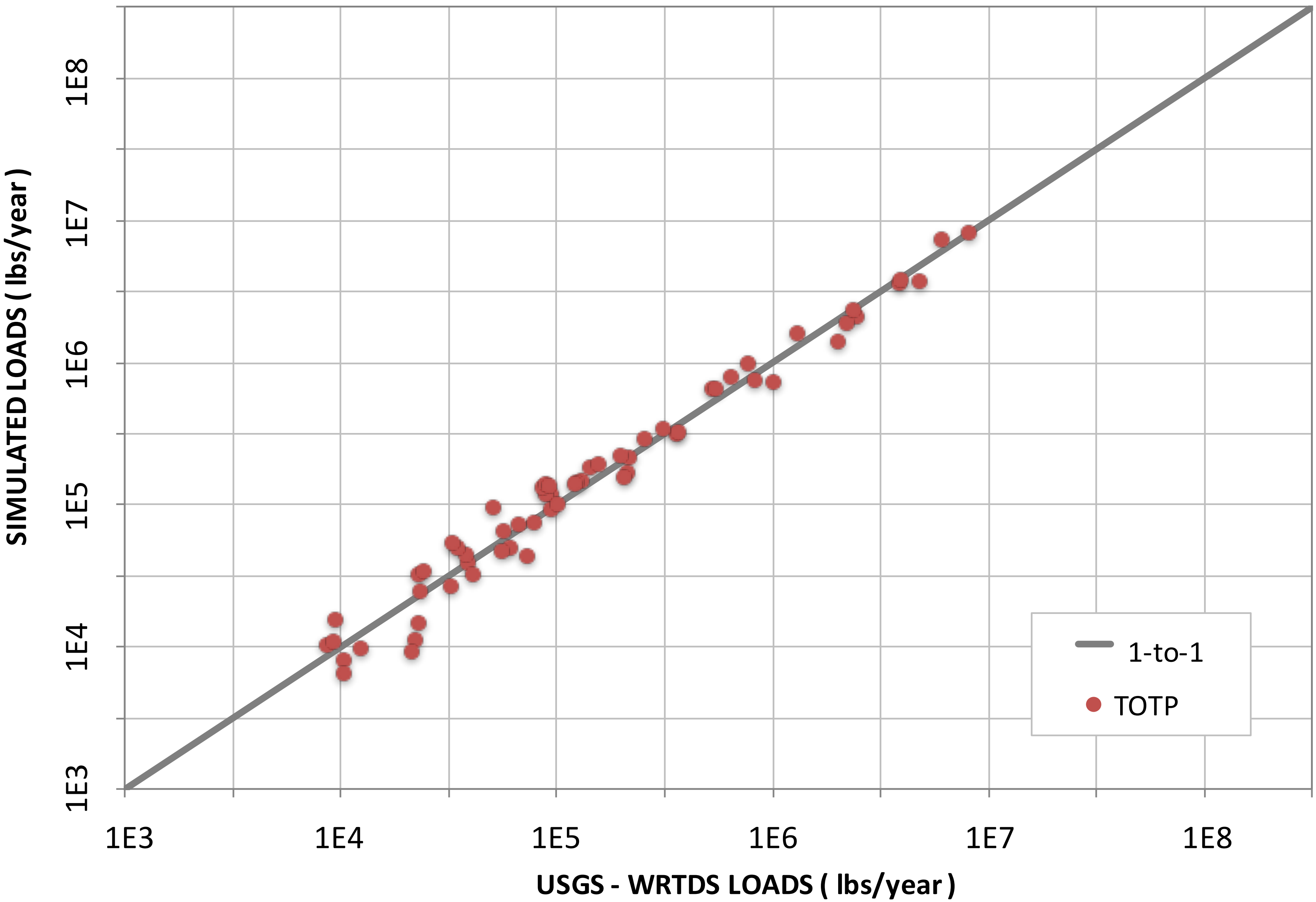
#B: Remove EVI N-DVF

PHOSPHORUS



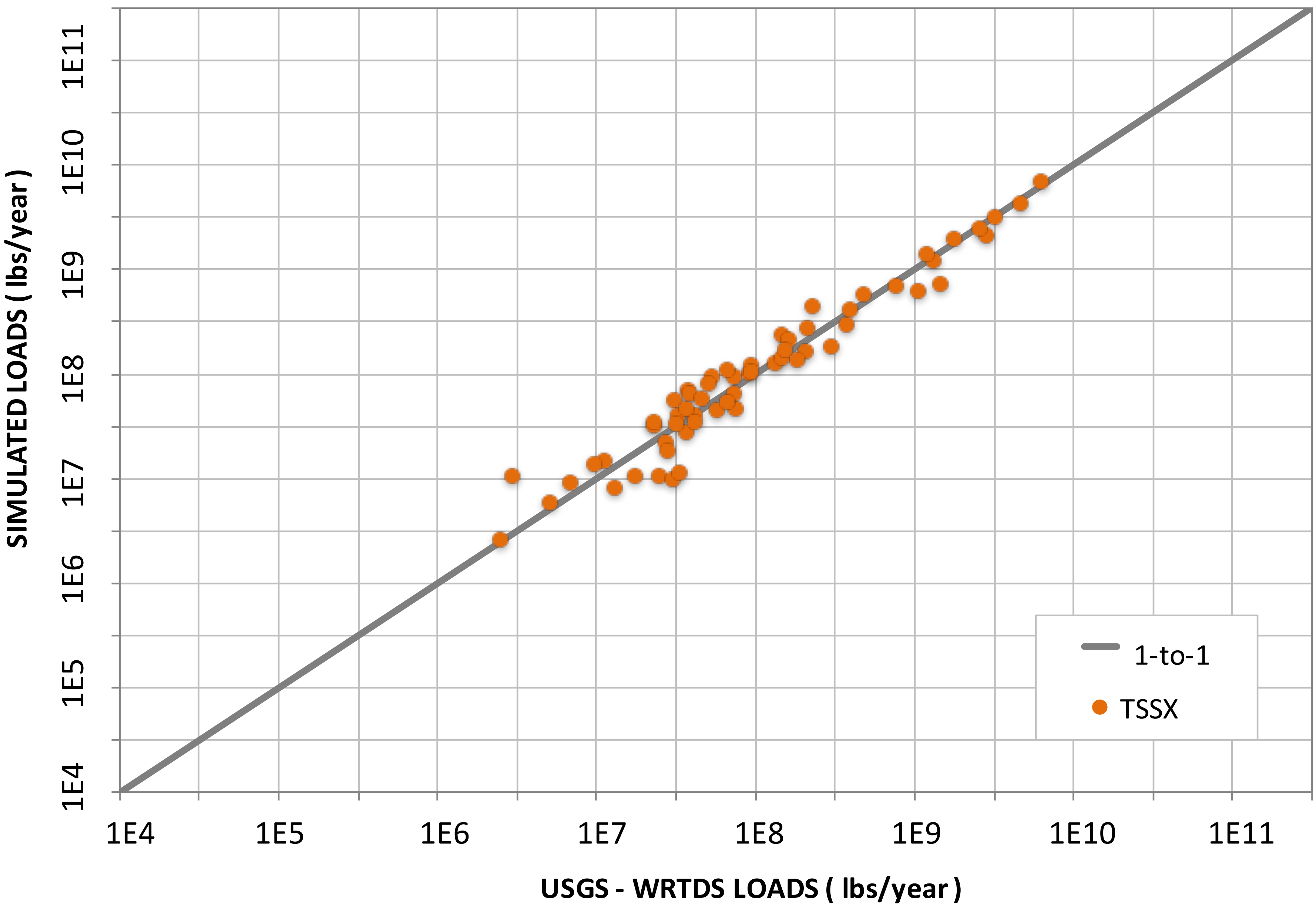
#D: +Flow-weighted Obs

PHOSPHORUS



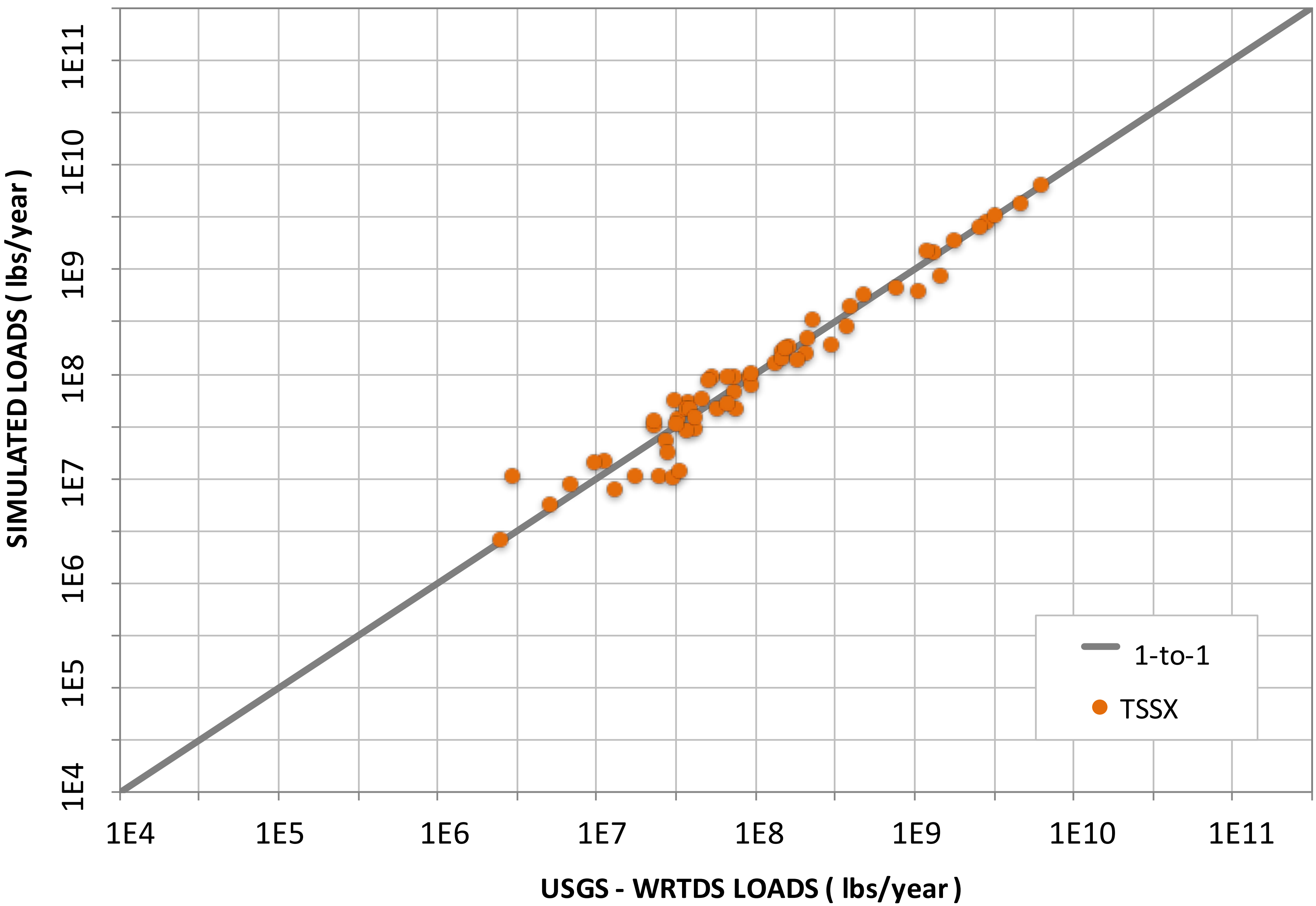
#B: Remove EVI N-DVF

SEDIMENT



#D: +Flow-weighted Obs

SEDIMENT



Suggested resolution

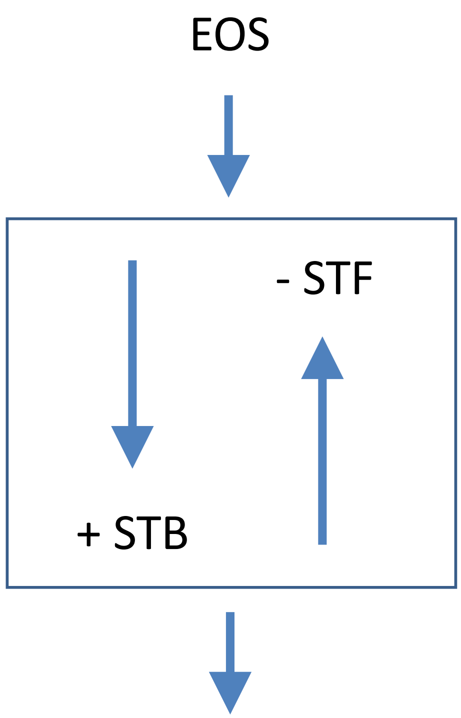
- Use flow-weighted observations
  - Responds to partner request
  - Calibration is improved

4. Stream loads based on Chesapeake floodplain network (CFN) regressions (Noe et al.)

- Current method is using Chesapeake Floodplain averages and multiplying by the length to get stream erosion and deposition.
- Stream erosion and deposition are assumed equal to each other
- The deposition is converted to a stream delivery factor
- Trial – removing length based estimates and using regression based estimates instead

June to September/October transition

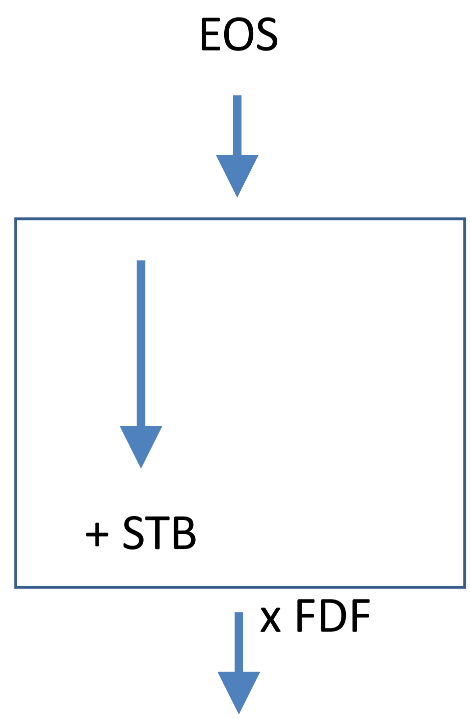
- STB estimated from CFN average and stream length, + 4/3 x Impervious SS
- STF = STB, but STF applies to all load sources
- STB changes for scenarios with changes in EOS



Output = EOS + STB – STF
Output = EOS

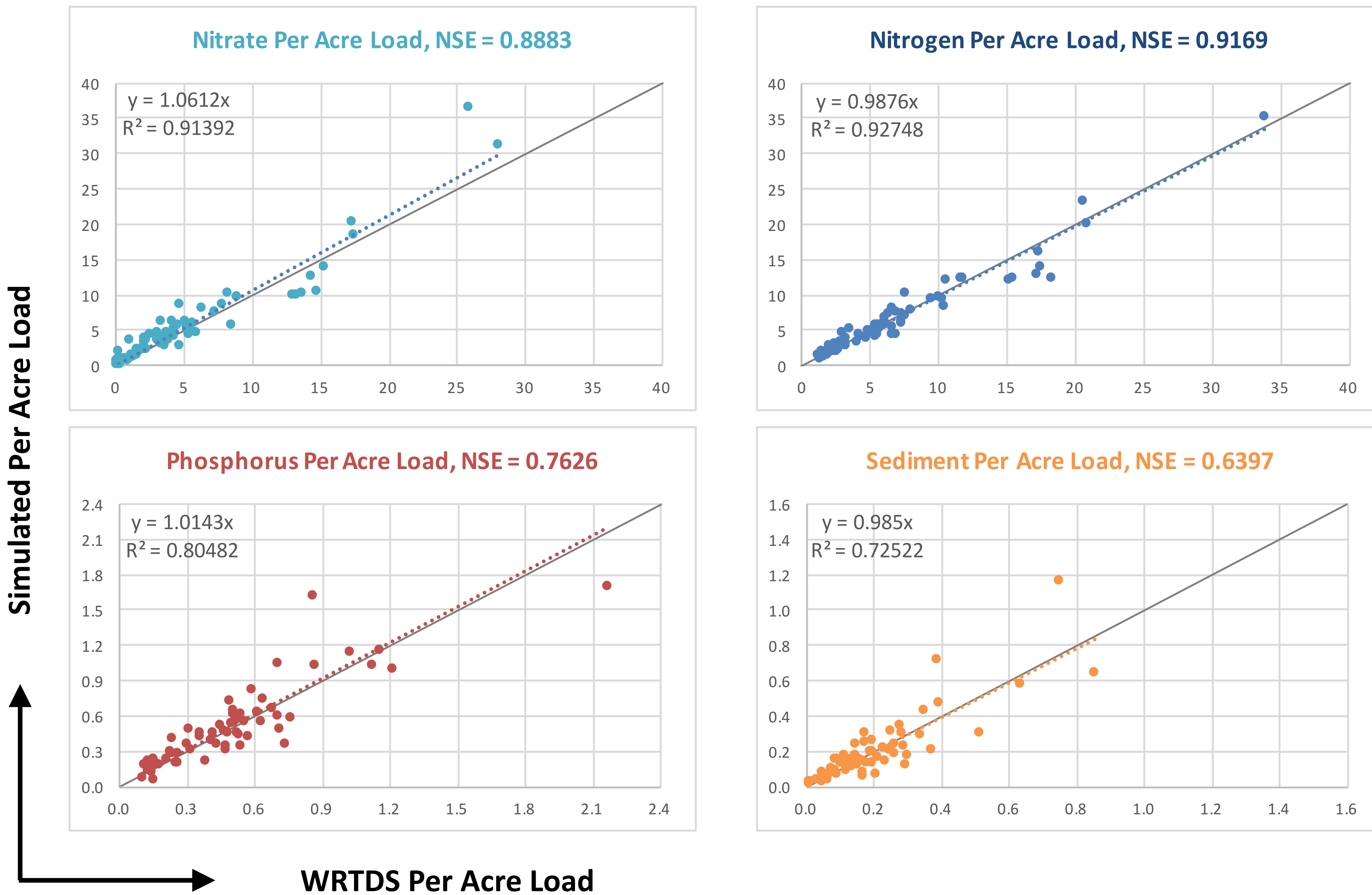
$$\text{FDF} = \frac{EOS+STB-STF}{EOS+STB}$$

$0 < \text{FDF} < 1$

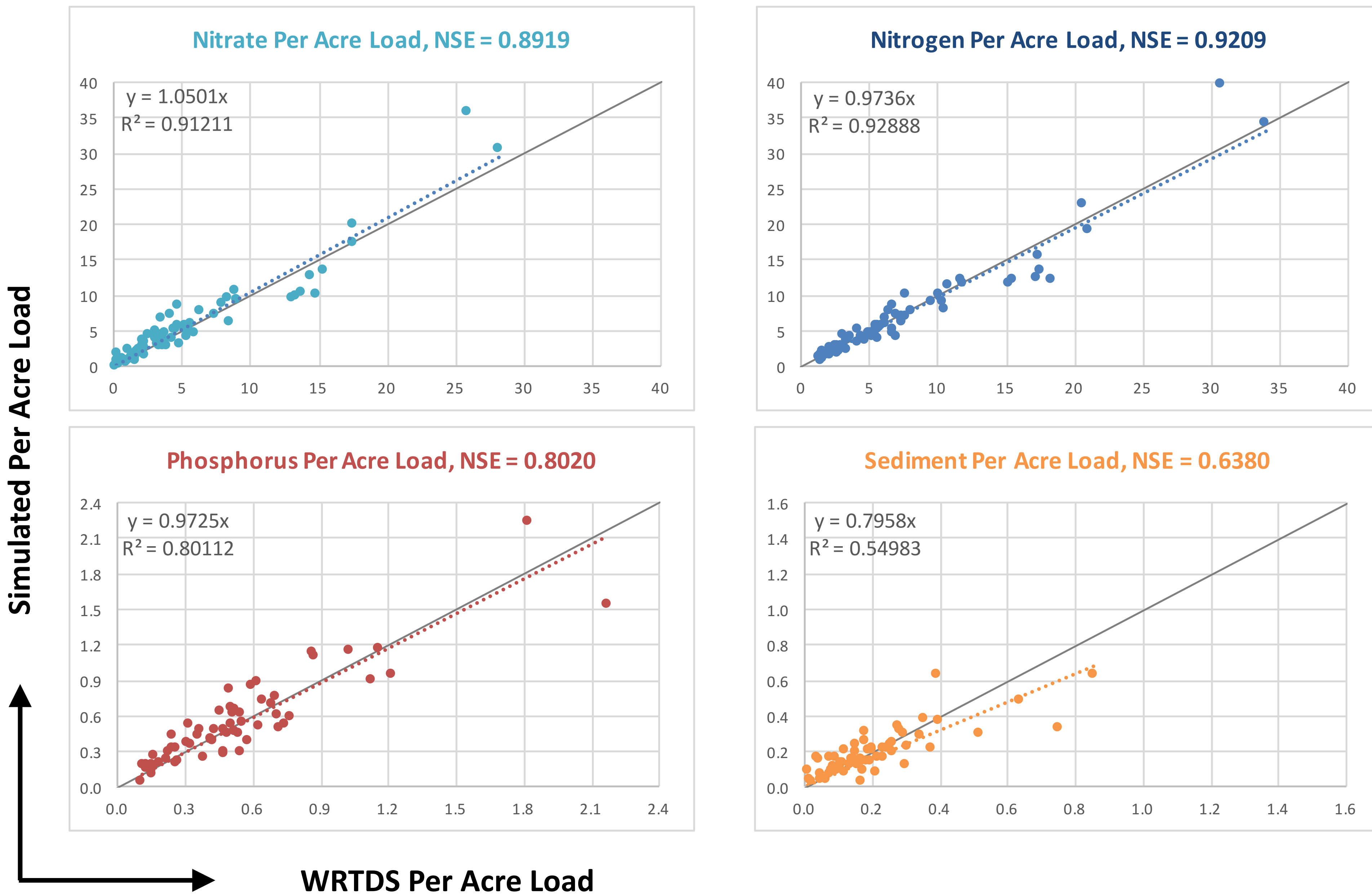


Output = {EOS x FDF} + {STB x FDF}

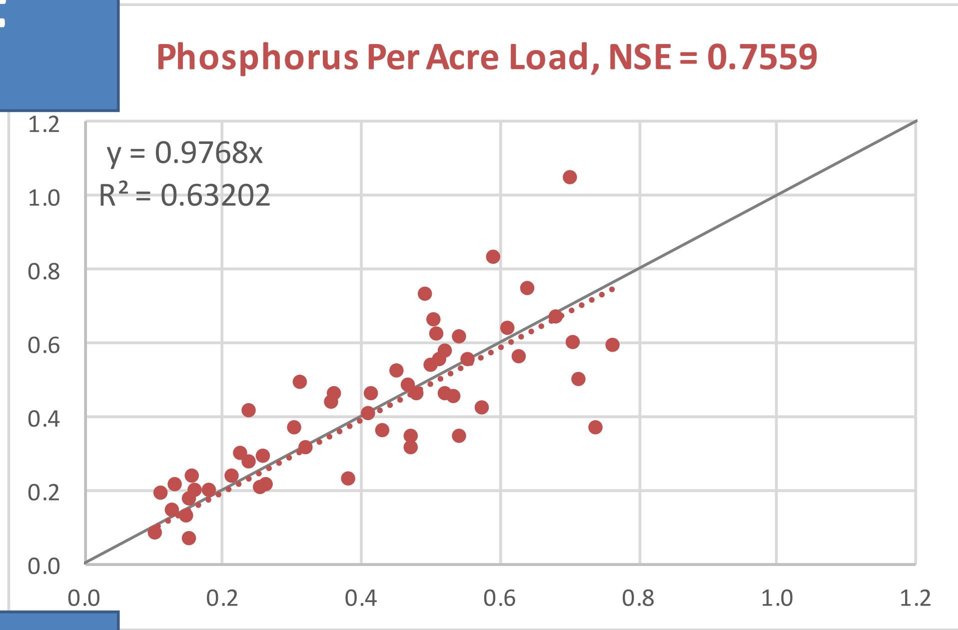
#B: Remove EVI N-DVF



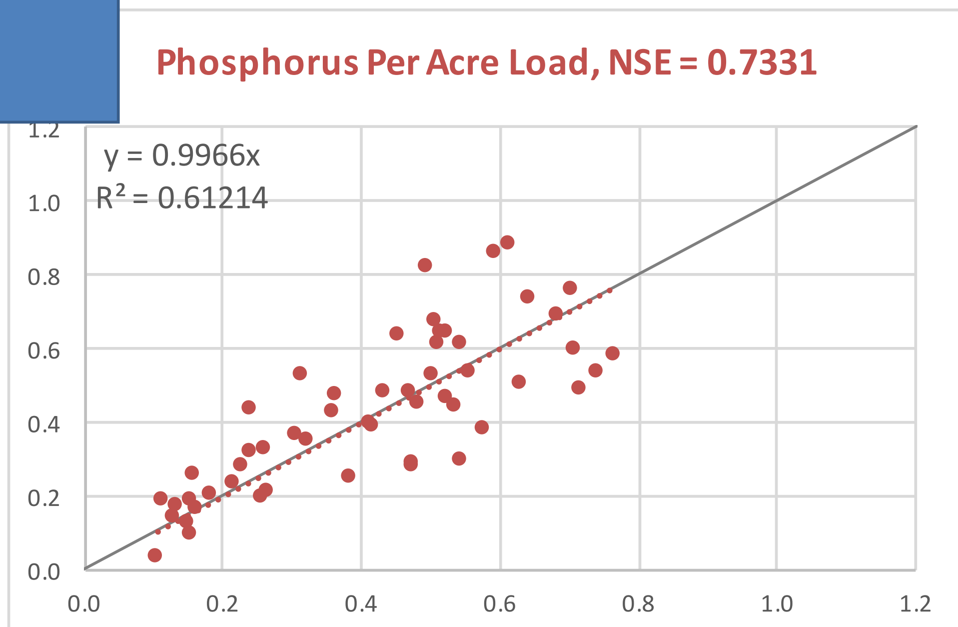
#C: +CFN Regressions



#B: Remove EVI N-DVF



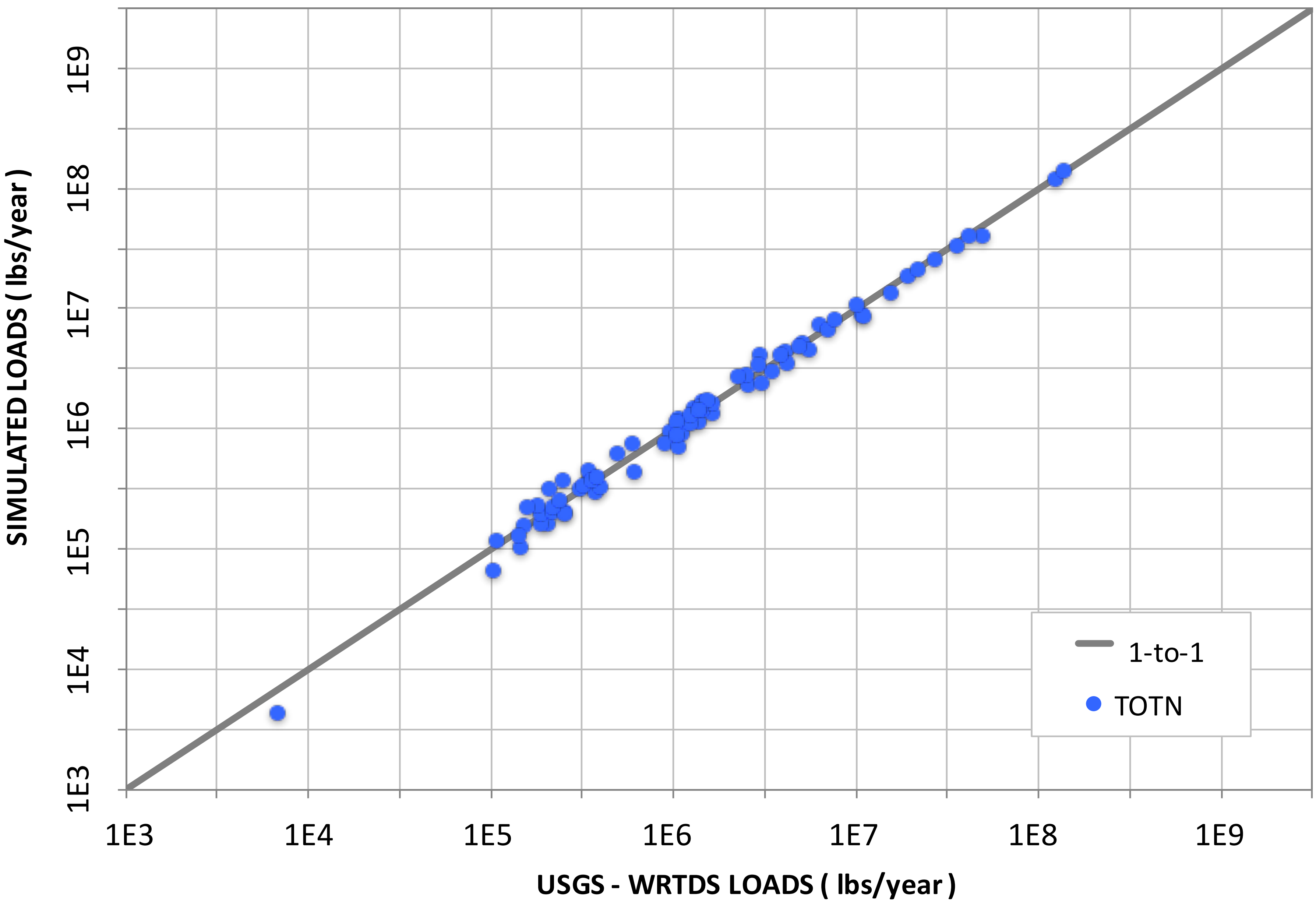
#C: +CFN Regressions



Examination of segments with < 0.85 P-lb/ac, where majority of WRTDS sites are located, shows more scatter when Noe-regression is used.

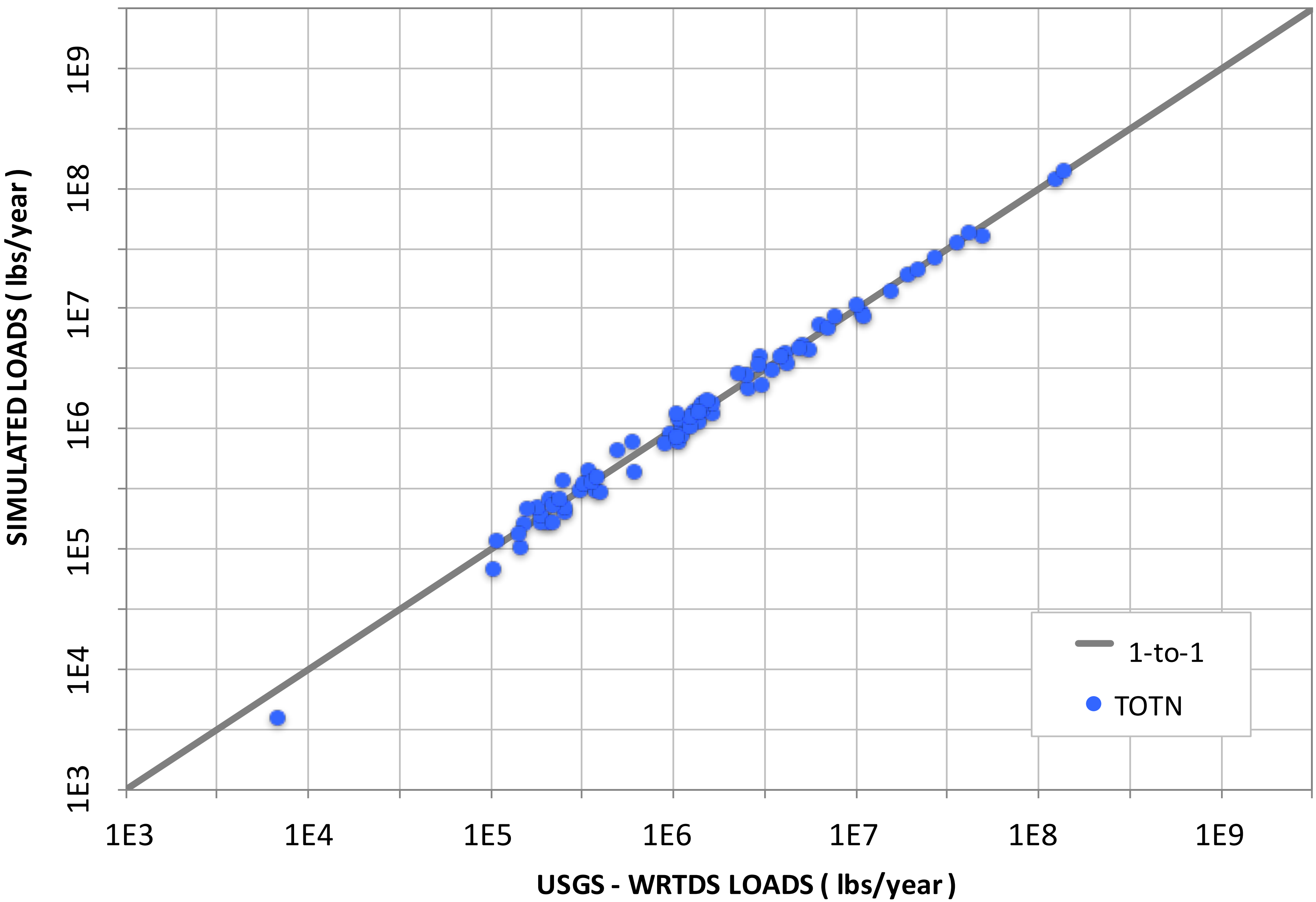
#B: Remove EVI N-DVF

NITROGEN



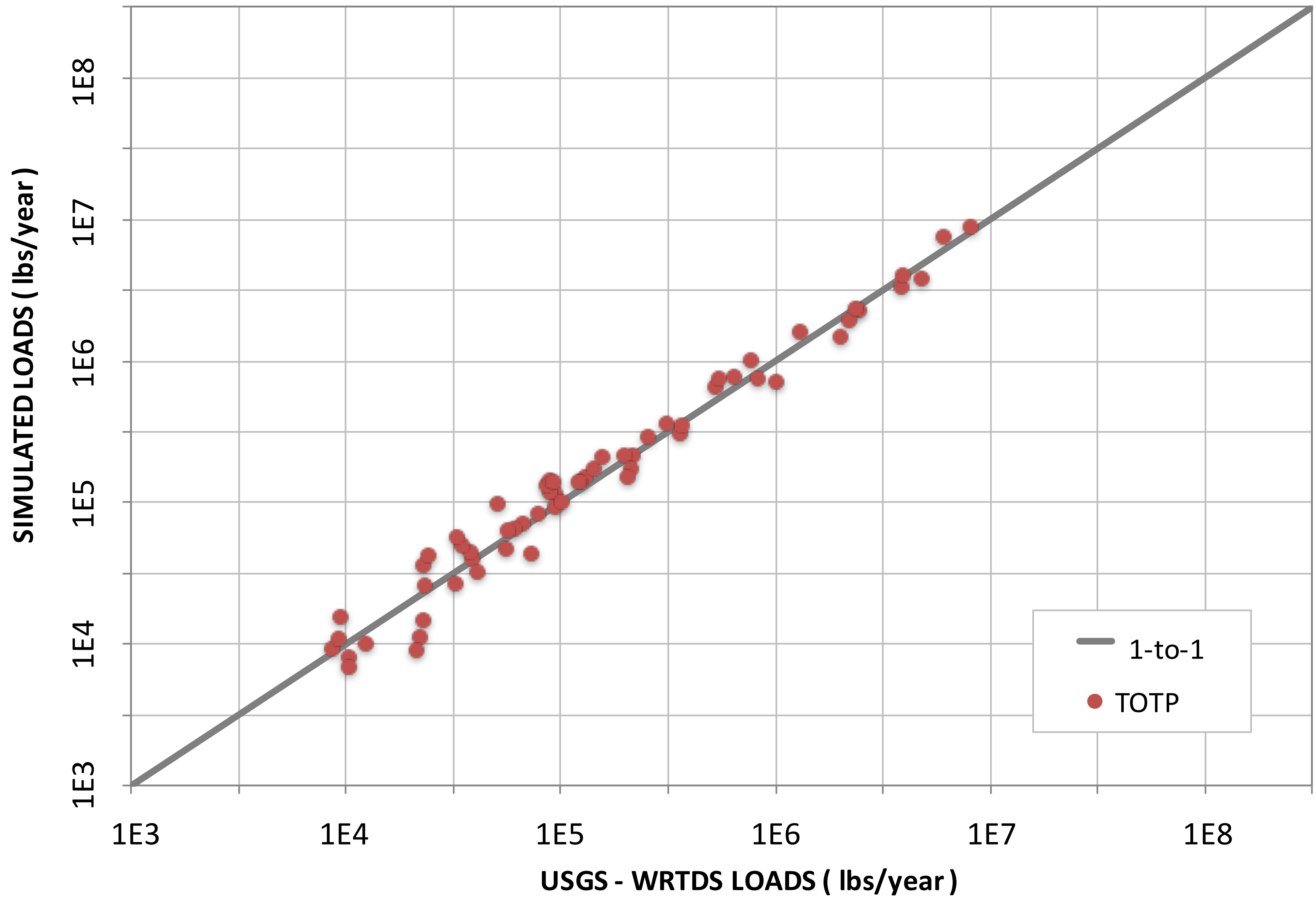
#C: +CFN Regressions

NITROGEN



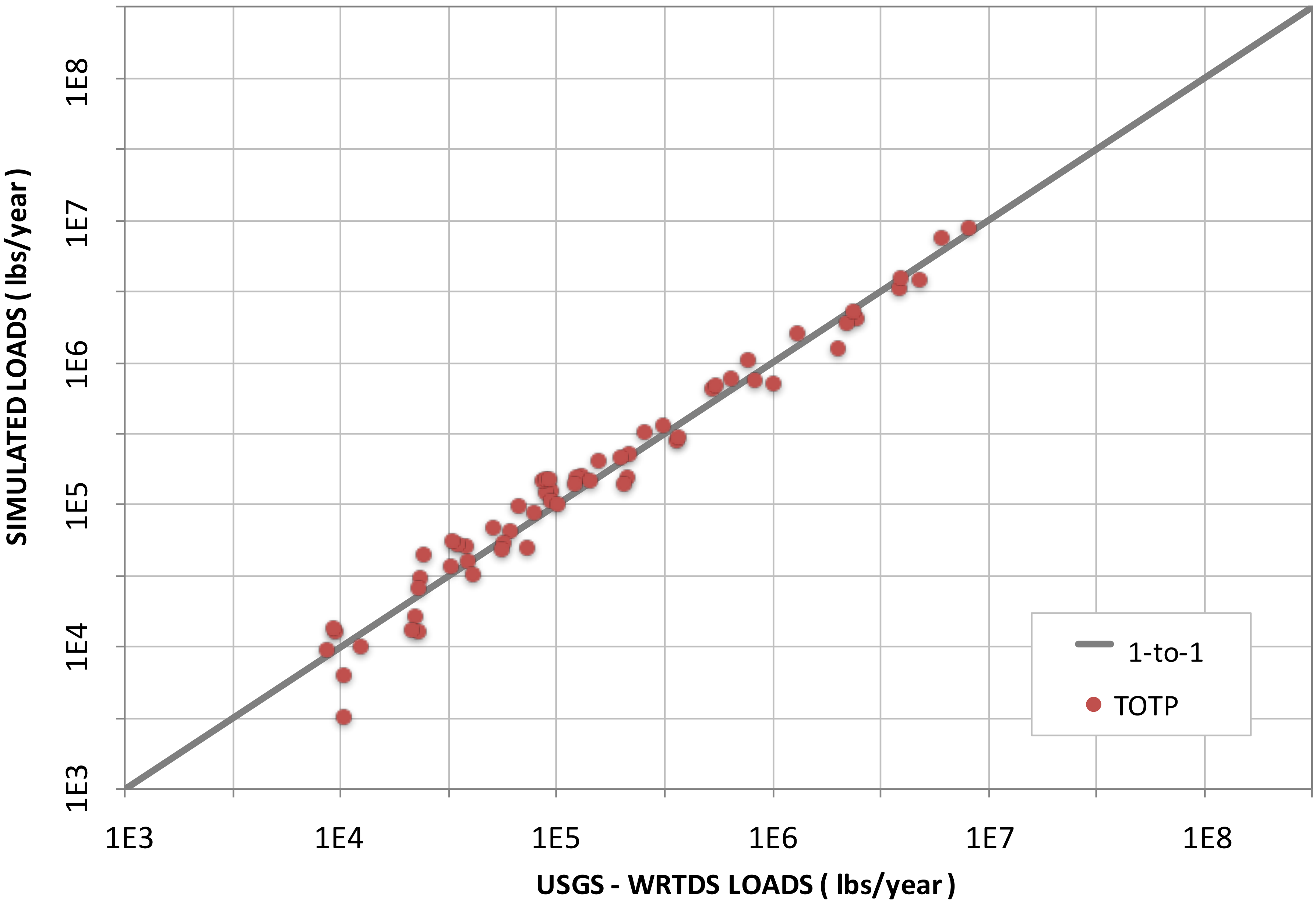
#B: Remove EVI N-DVF

PHOSPHORUS



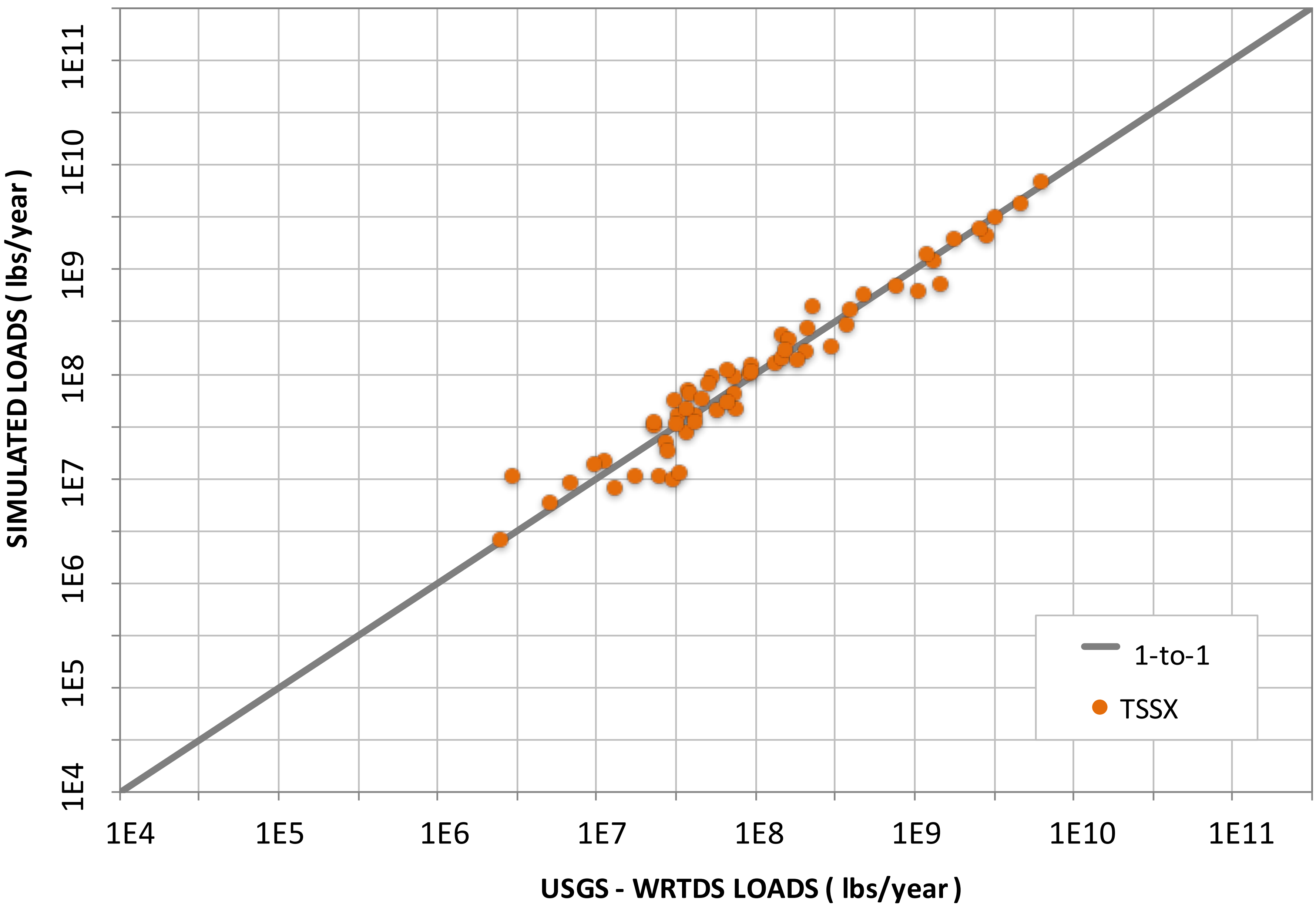
#C: +CFN Regressions

PHOSPHORUS



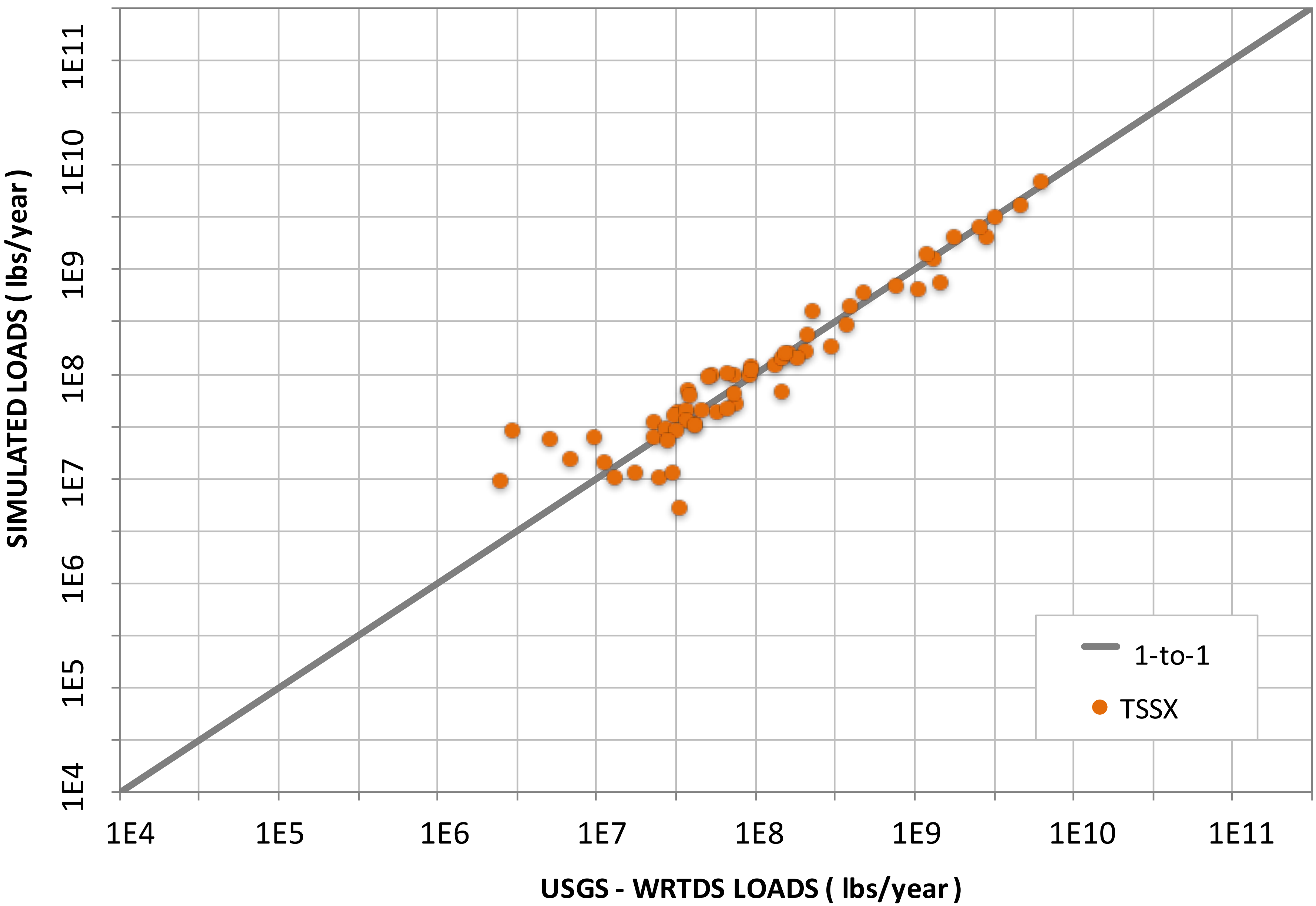
#B: Remove EVI N-DVF

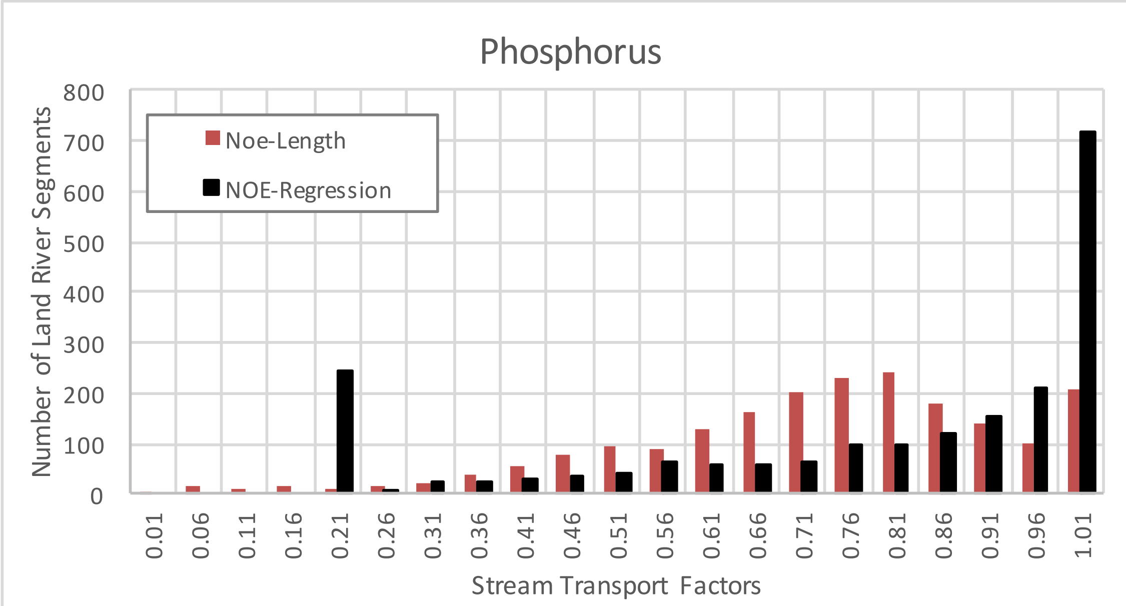
SEDIMENT

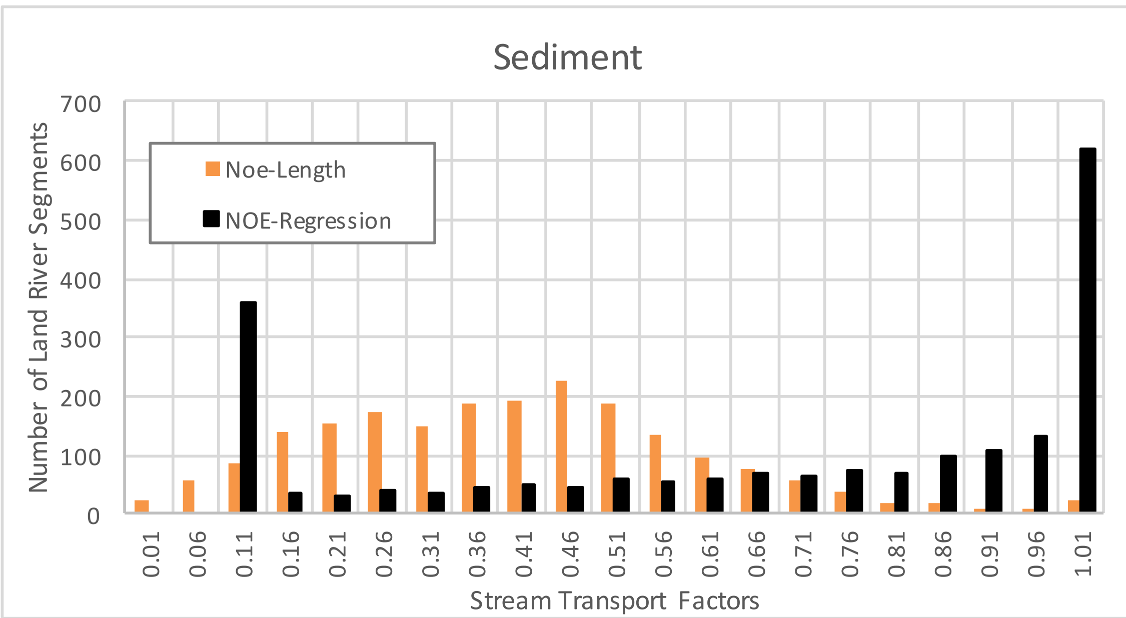


#C: +CFN Regressions

SEDIMENT







$$\text{FDF} = \frac{EOS+STB-STF}{EOS+STB}$$

$$\text{STF} = \frac{EOS+SER-SDP}{EOS+SER}$$

Noe-regression results in several LR-segments with extreme stream transport factors.

Suggested resolution

- Using CFN averages rather than regression predictions
  - Unclear change in P calibration
  - Worse sediment calibration
  - Introduced variability would not be well understood
  - Variability due to developed area handled separately

Summary tables

Geographic efficiencies

Constituents	Phase 5	June Auto	#A	#B	#C	#D ✓
			CBP Review updates	A + New Soil P + no EVI	B + CFN Regression	B + Flow Weighted Observations
Nitrate	0.8284	0.9243	0.8889	0.8883	0.8919	0.8919
Nitrogen	0.8704	0.9370	0.9153	0.9169	0.9209	0.9191
Phosphorus	0.6321	0.6099	0.7740	0.7626	0.8020	0.8056
Sediment	-0.0770	0.5696	0.6821	0.6397	0.6380	0.7960

NSE closer to 1 the better

Nitrogen at RIM

BASIN	June Auto	#A	#B	#C	#D
SUSQ	-03%	-01%	-04%	-04%	-07%
POTO	-26%	-22%	-21%	-22%	-21%
JAME	-20%	-30%	-25%	-26%	-25%
RAPP	-11%	-14%	-20%	-20%	-18%
APPO	-07%	-09%	-02%	-02%	-02%
PAMU	00%	-09%	-01%	-02%	-02%
MATT	23%	13%	19%	25%	16%
PATU	06%	07%	07%	06%	07%
CHOP	43%	14%	18%	28%	25%

Phosphorus at RIM

BASIN	June Auto	#A	#B	#C	#D
SUSQ	14%	20%	20%	17%	16%
POTO	-18%	-17%	-17%	-17%	-10%
JAME	-01%	-08%	-11%	-20%	-17%
RAPP	01%	19%	16%	14%	18%
APPO	13%	17%	11%	18%	08%
PAMU	21%	31%	28%	23%	17%
MATT	-14%	-17%	-19%	-16%	-20%
PATU	11%	14%	12%	11%	12%
CHOP	13%	-17%	-19%	10%	-20%

Phosphorus at RIM

BASIN	June Auto	#A	#B	#C	#D
MARI	05%	06%	05%	04%	-03%
POTO	-18%	-17%	-17%	-17%	-10%
JAME	-01%	-08%	-11%	-20%	-17%
RAPP	01%	19%	16%	14%	18%
APPO	13%	17%	11%	18%	08%
PAMU	21%	31%	28%	23%	17%
MATT	-14%	-17%	-19%	-16%	-20%
PATU	11%	14%	12%	11%	12%
CHOP	13%	-17%	-19%	10%	-20%

Suspended Solids at RIM

BASIN	June Auto	#A	#B	#C	#D
SUSQ	-23%	-14%	-14%	-15%	-14%
POTO	-31%	-31%	-30%	-31%	-06%
JAME	-14%	-02%	-14%	-10%	05%
RAPP	-04%	09%	01%	08%	05%
APPO	36%	26%	17%	25%	09%
PAMU	40%	65%	58%	48%	36%
MATT	91%	35%	35%	142%	41%
PATU	53%	58%	53%	77%	61%
CHOP	171%	07%	07%	352%	06%

Suspended Solids at RIM

BASIN	June Auto	#A	#B	#C	#D
MARI	-01%	-05%	-05%	-04%	-01%
POTO	-31%	-31%	-30%	-31%	-06%
JAME	-14%	-02%	-14%	-10%	05%
RAPP	-04%	09%	01%	08%	05%
APPO	36%	26%	17%	25%	09%
PAMU	40%	65%	58%	48%	36%
MATT	91%	35%	35%	142%	41%
PATU	53%	58%	53%	77%	61%
CHOP	171%	07%	07%	352%	06%

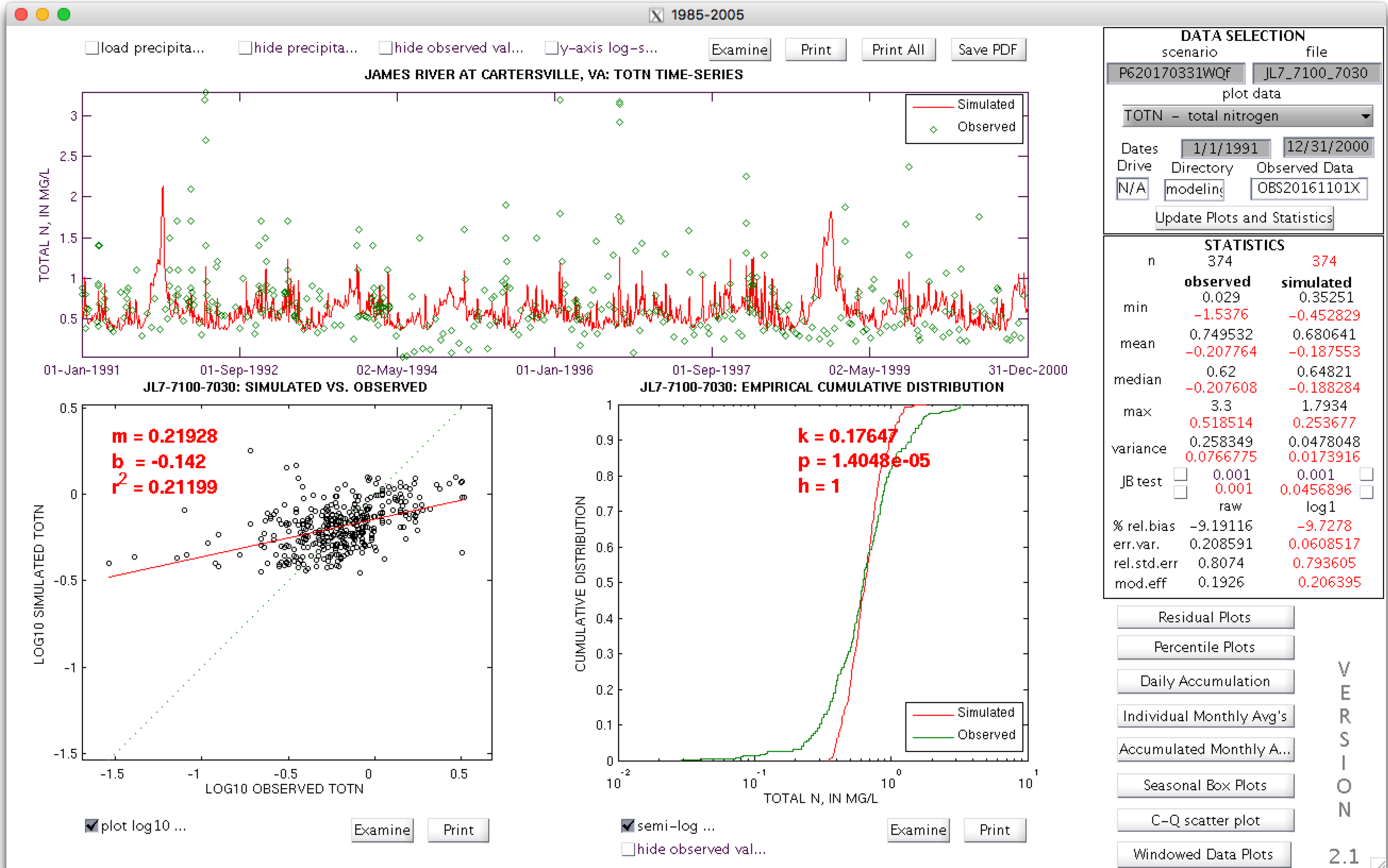
5. Incorporation of organic scour

- HSPF reach and reservoir simulation does <u>not</u> provide a mechanism for refractory organics scour.
- An examination of prior model calibrations along with the monitoring data provide a strong evidence for the presence of organic scour, particularly during large stormflow events.

June Auto

JAMES RIVER

NITROGEN

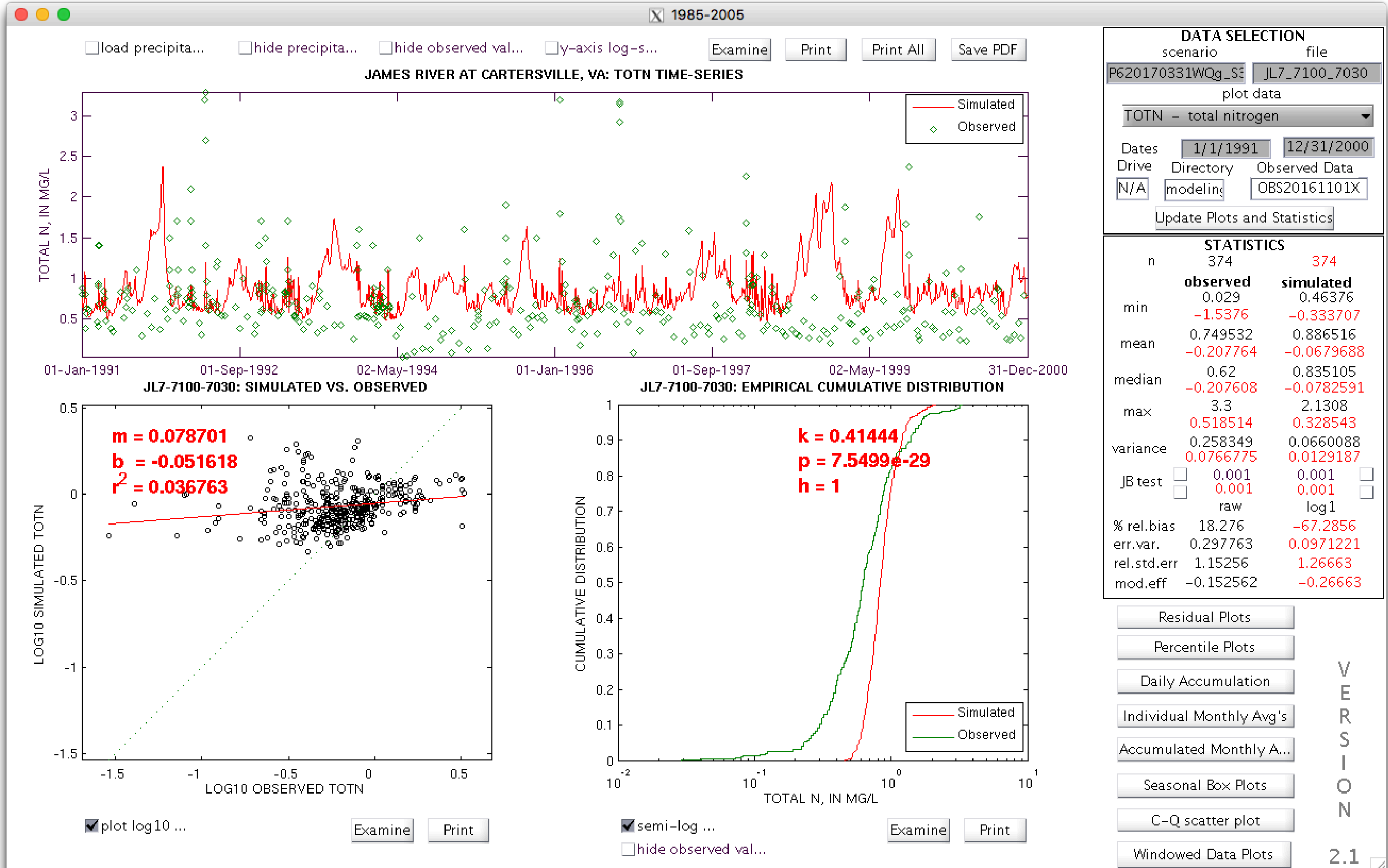


TN under simulated by 20% wrt WRTDS

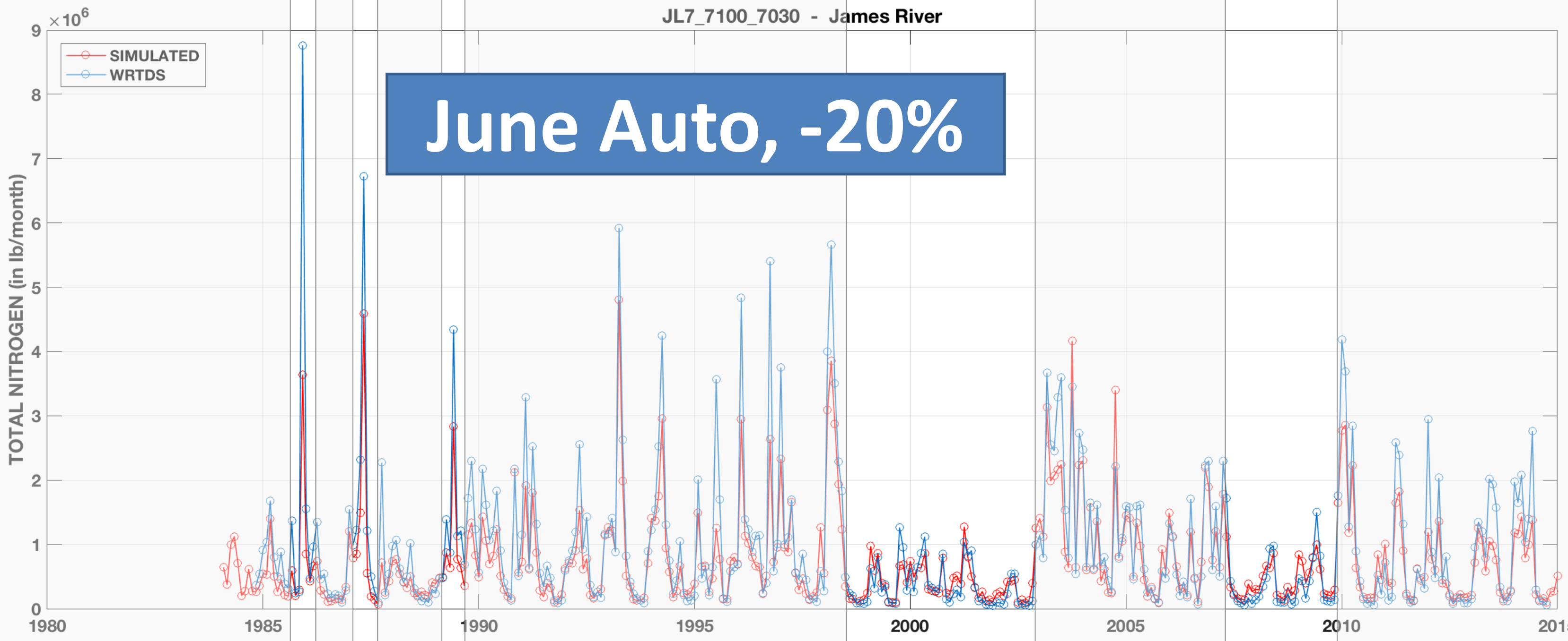
June Final

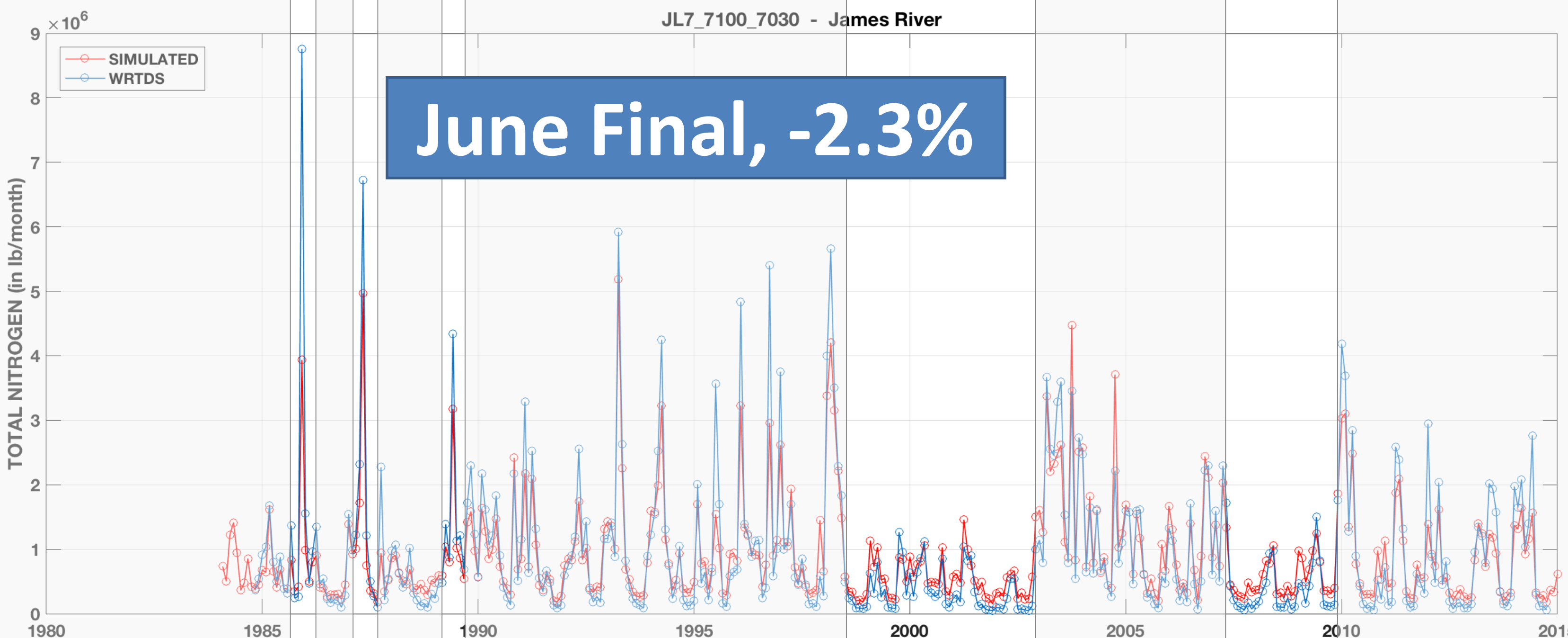
JAMES RIVER

NITROGEN



TN under simulated by 2.3% wrt WRTDS


JL7_7100_7030 - James River
June Auto, -20%
SIMULATED
WRTDS
TOTAL NITROGEN (in lb/month)
×10^6
0
1
2
3
4
5
6
7
8
9
1980
1985
1990
1995
2000
2005
2010
2015


JL7_7100_7030 - James River
June Final, -2.3%
SIMULATED
WRTDS
TOTAL NITROGEN (in lb/month)
×10^6
0
1
2
3
4
5
6
7
8
9
1980
1985
1990
1995
2000
2005
2010
2015

Incorporation of organic scour

- Processes representing the scour of organic nitrogen and organic phosphorus were added.
- The scour occurs in conjunction with the scour of sediment.
- Scoured organics is proportional to <u>net</u> sediment scour as:

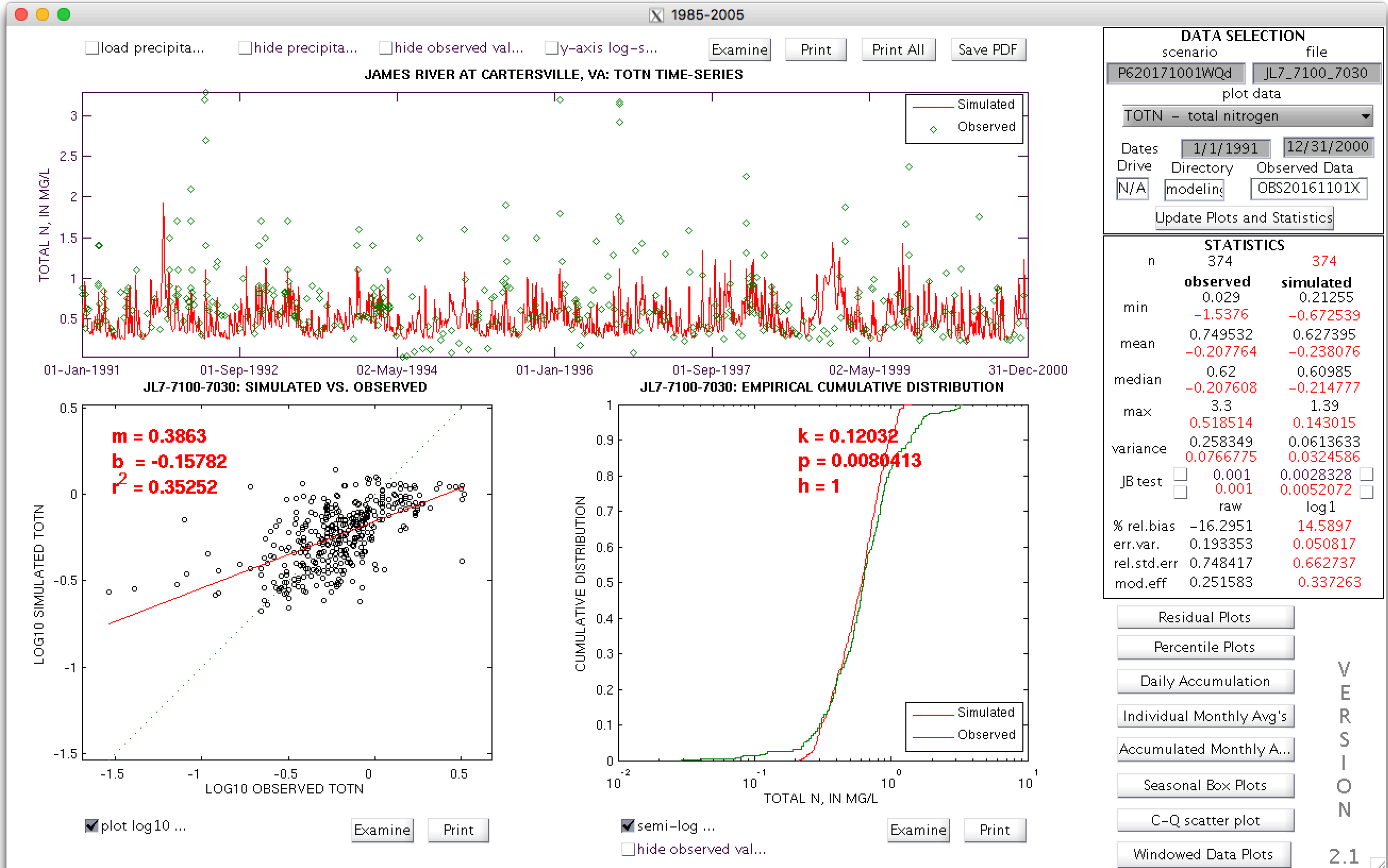
$$Organic\ scour = K \times Net\ sediment\ scour$$

$$where, K\ is\ a\ concentration\ parameter$$

#D: Flow-weighted Obs

JAMES RIVER

NITROGEN

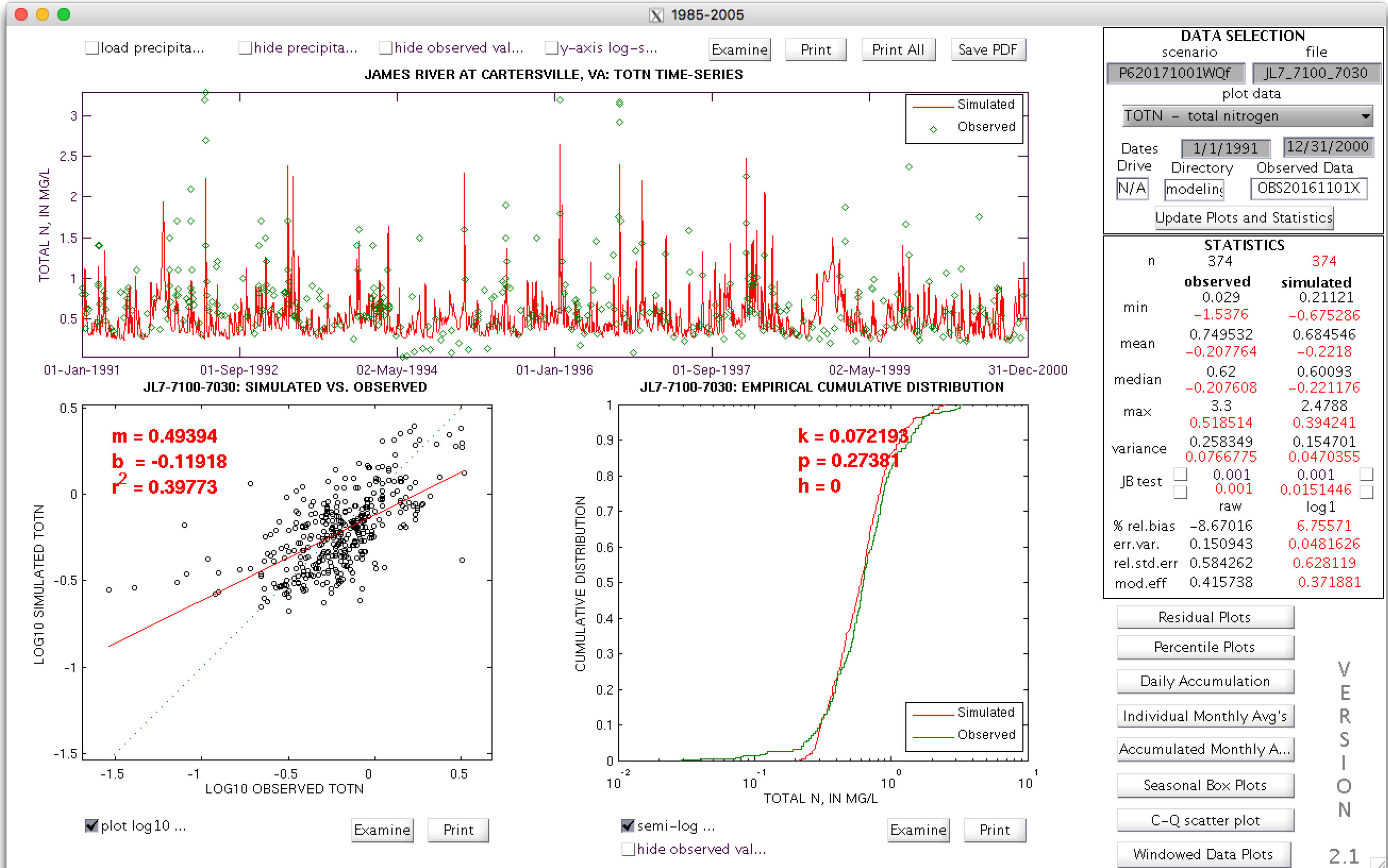


TN under simulated by 25% wrt WRTDS

#F: +Organic Scour

JAMES RIVER

NITROGEN



TN under simulated by 13% wrt WRTDS

Suggested resolution

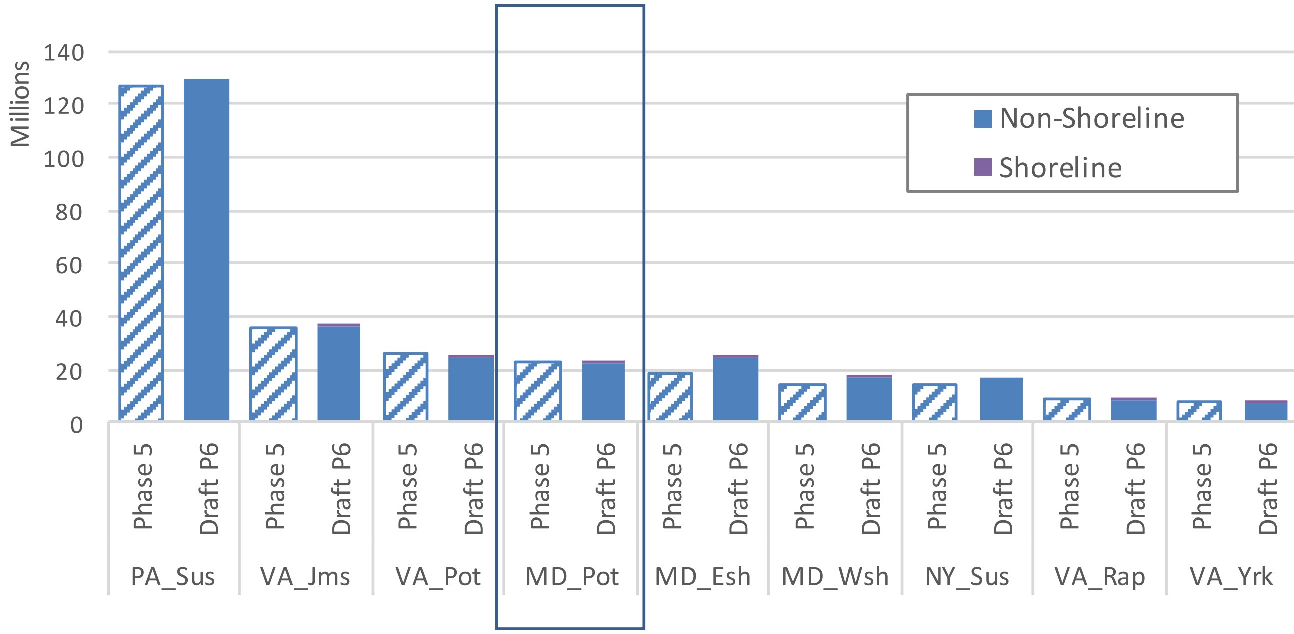
- Incorporate organic scour
  - Calibration is improved
  - It works with the auto-calibration framework
  - It can be used in the post auto-calibration phase to further improve the calibration by appropriately balancing the inorganic and organic loads

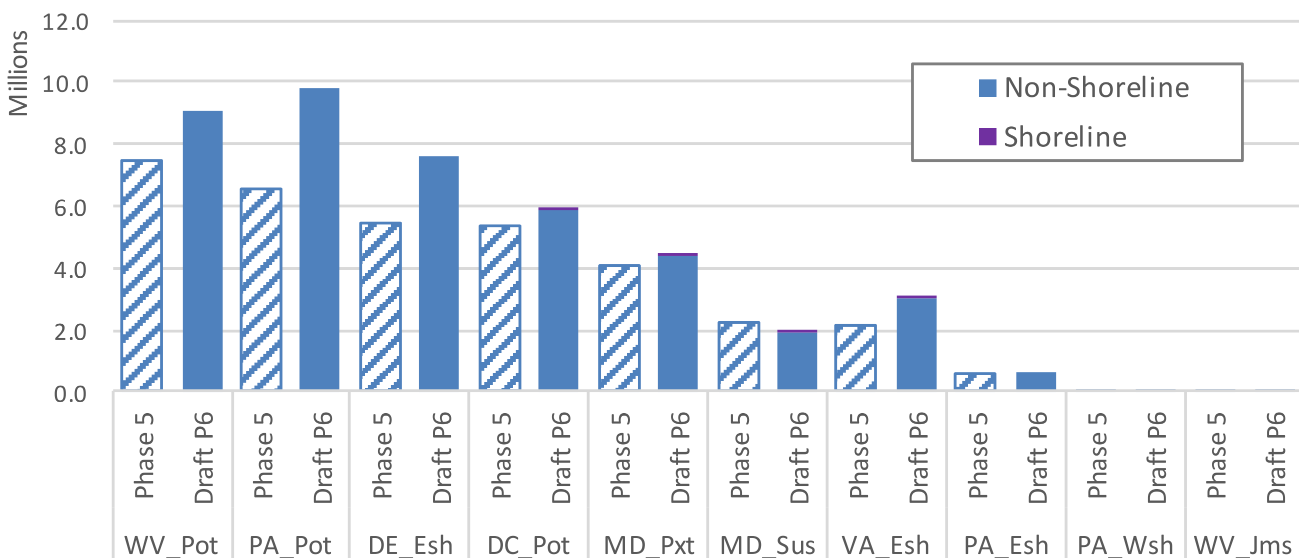
6. Brief review of state-basin loads

- An analysis was made to compare **Phase 5** and **Phase 6 Draft September Final** state-basin loads

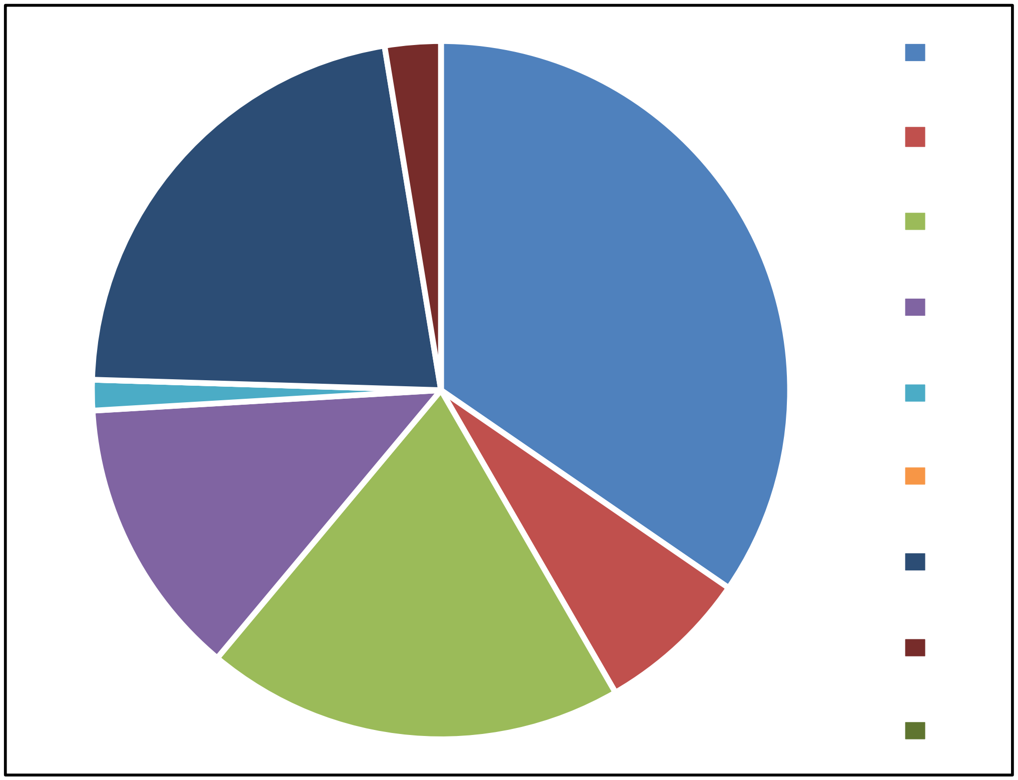
Calibration

NITROGEN



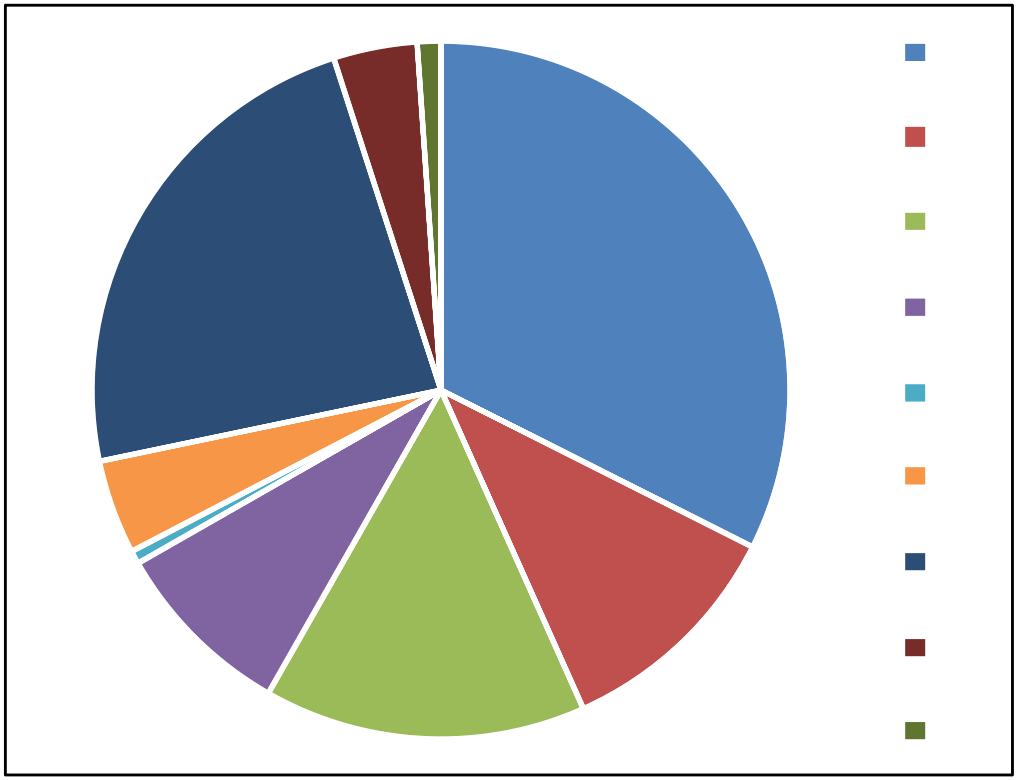


Phase 5: Nitrogen – MD Potomac



Crops	35%
Pasture & Hay	7%
Developed	19%
Natural	13%
Feeding Operations	1%
Stream Bank & Bed	0%
Wastewater	22%
Septic	3%
Shoreline	0%

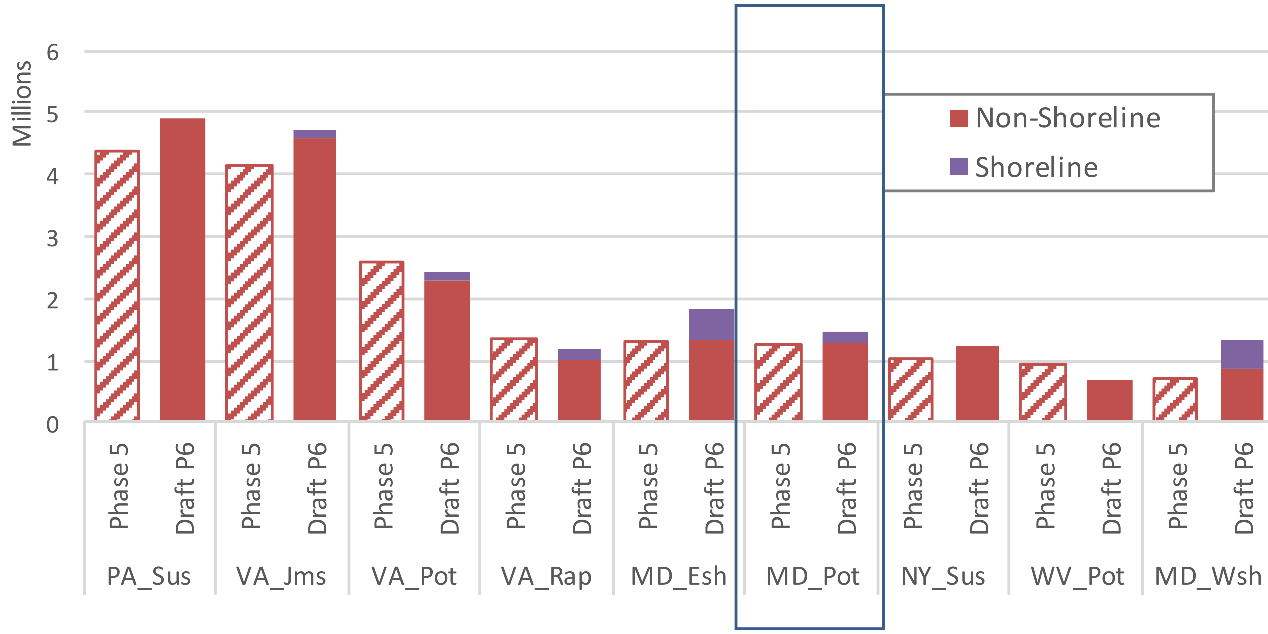
Draft P6: Nitrogen – MD Potomac

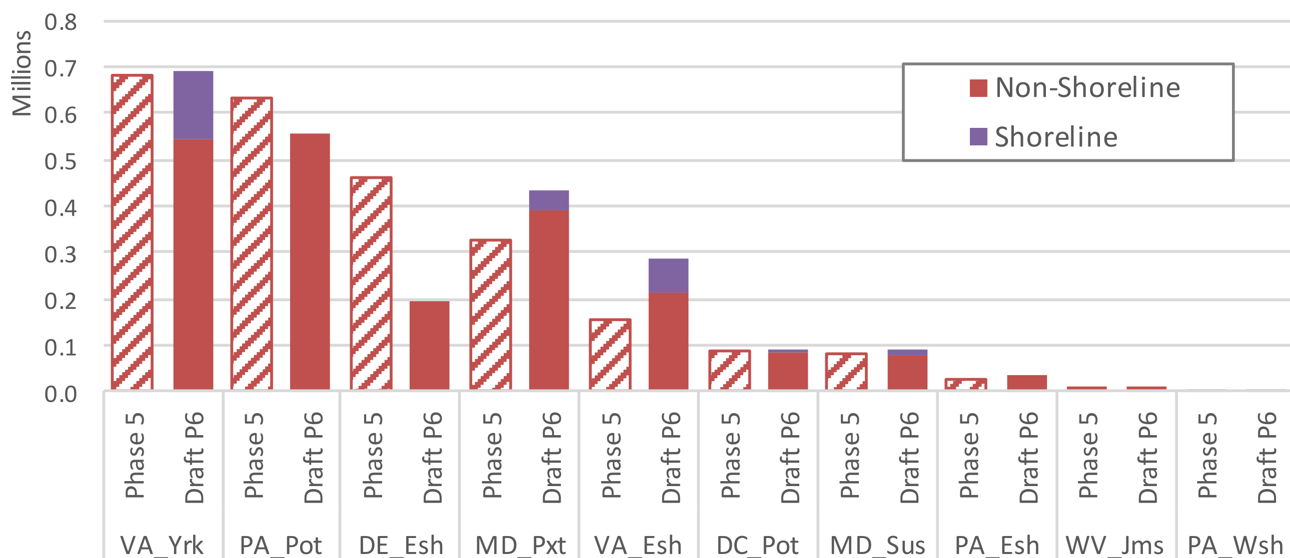


Crops	32%
Pasture & Hay	11%
Developed	15%
Natural	8%
Feeding Operations	1%
Stream Bank & Bed	4%
Wastewater	23%
Septic	4%
Shoreline	1%

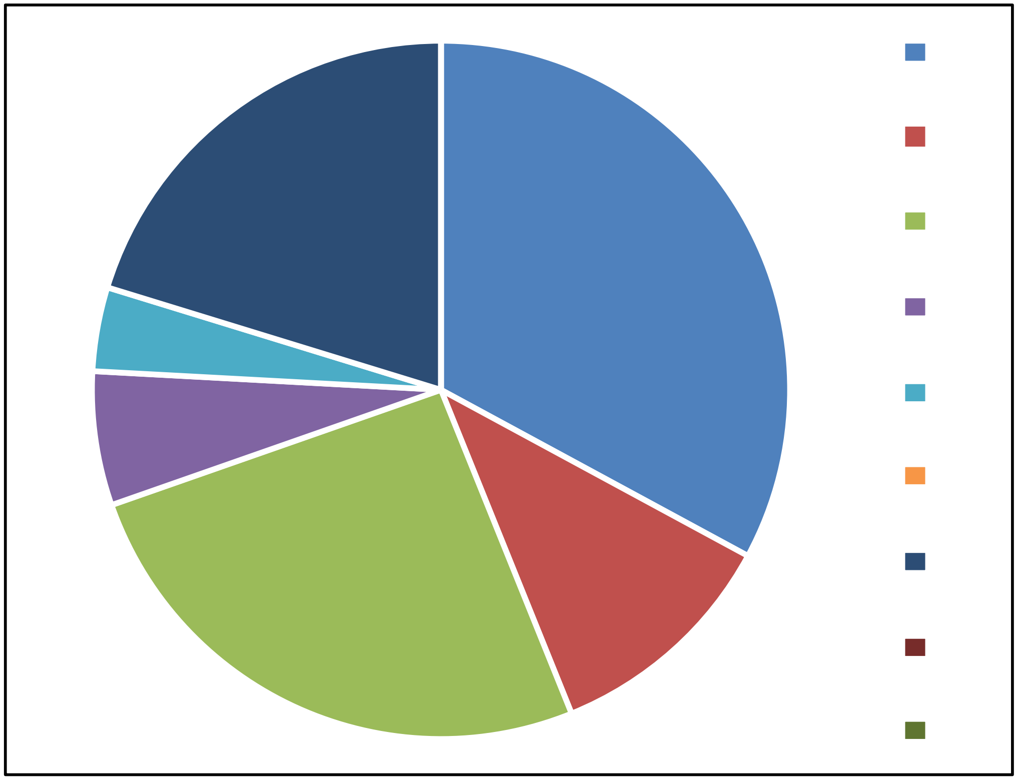
Calibration

PHOSPHORUS



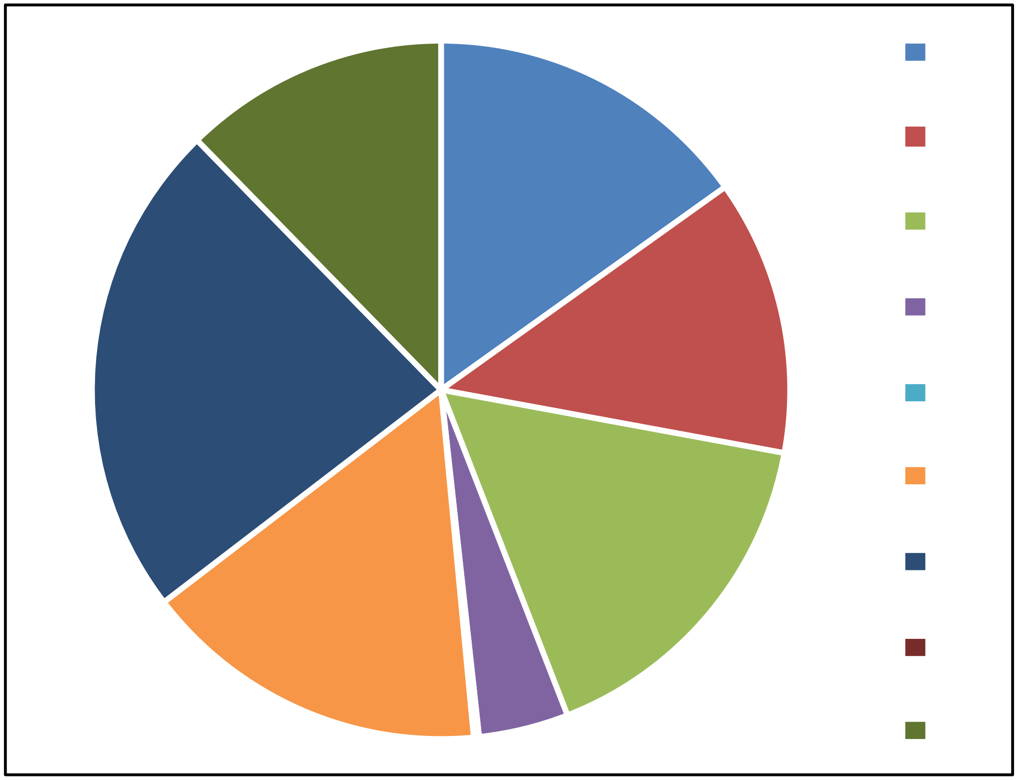


Phase 5: Phosphorus – MD Potomac



Crops	33%
Pasture & Hay	11%
Developed	26%
Natural	6%
Feeding Operations	4%
Stream Bank & Bed	0%
Wastewater	20%
Septic	0%
Shoreline	0%

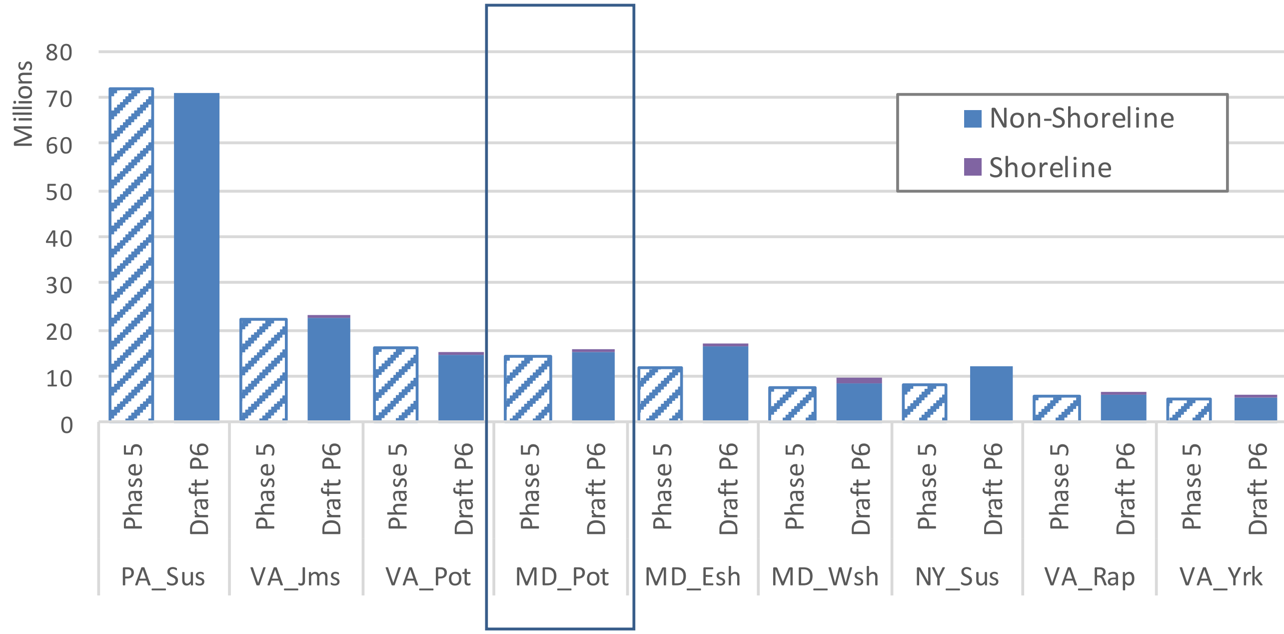
Draft P6: Phosphorus – MD Potomac

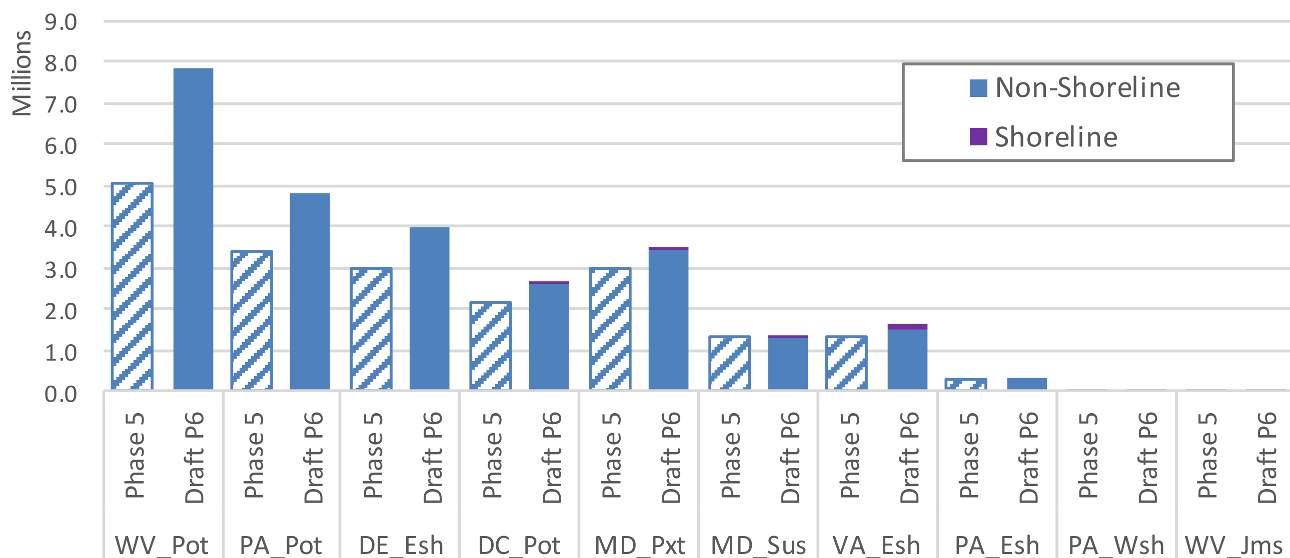


Crops	15%
Pasture & Hay	13%
Developed	16%
Natural	4%
Feeding Operations	0%
Stream Bank & Bed	16%
Wastewater	23%
Septic	0%
Shoreline	12%

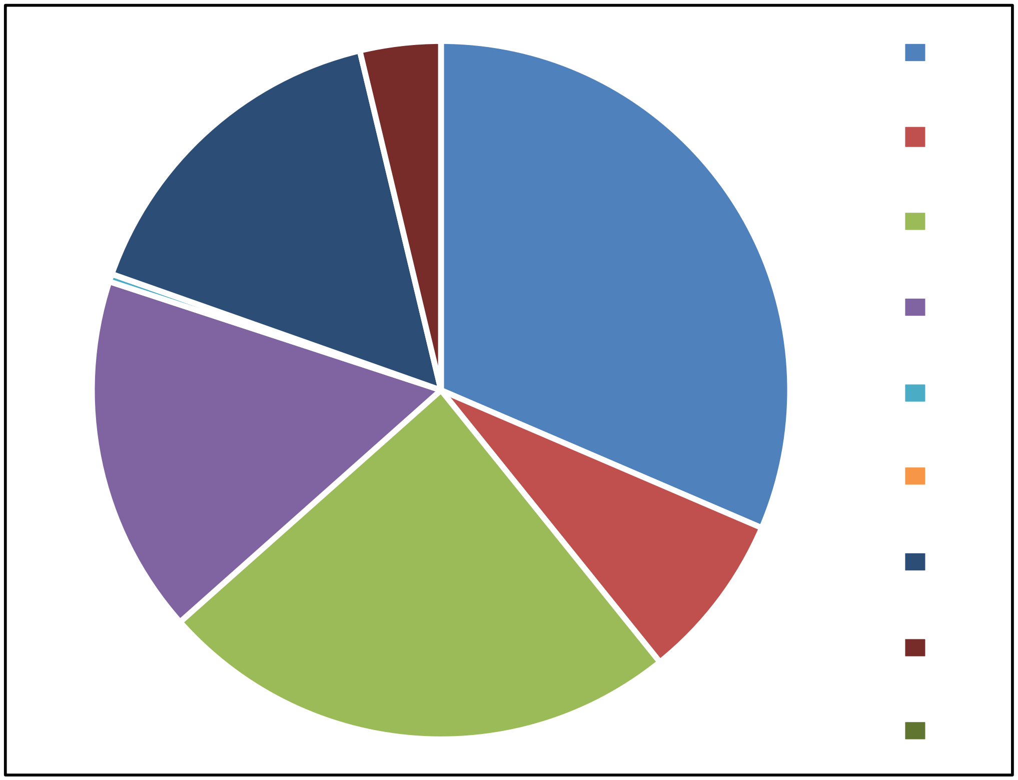
2010 WIP2

NITROGEN



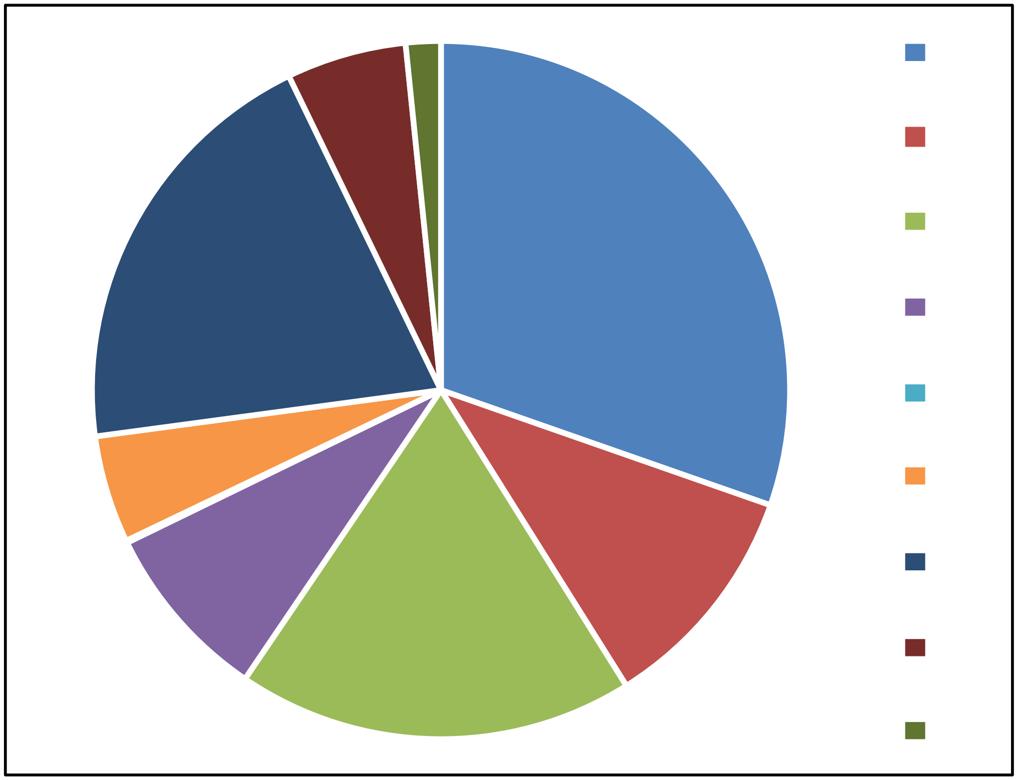


Phase 5: Nitrogen – MD Potomac



Crops	31%
Pasture & Hay	8%
Developed	24%
Natural	17%
Feeding Operations	0%
Stream Bank & Bed	0%
Wastewater	16%
Septic	4%
Shoreline	0%

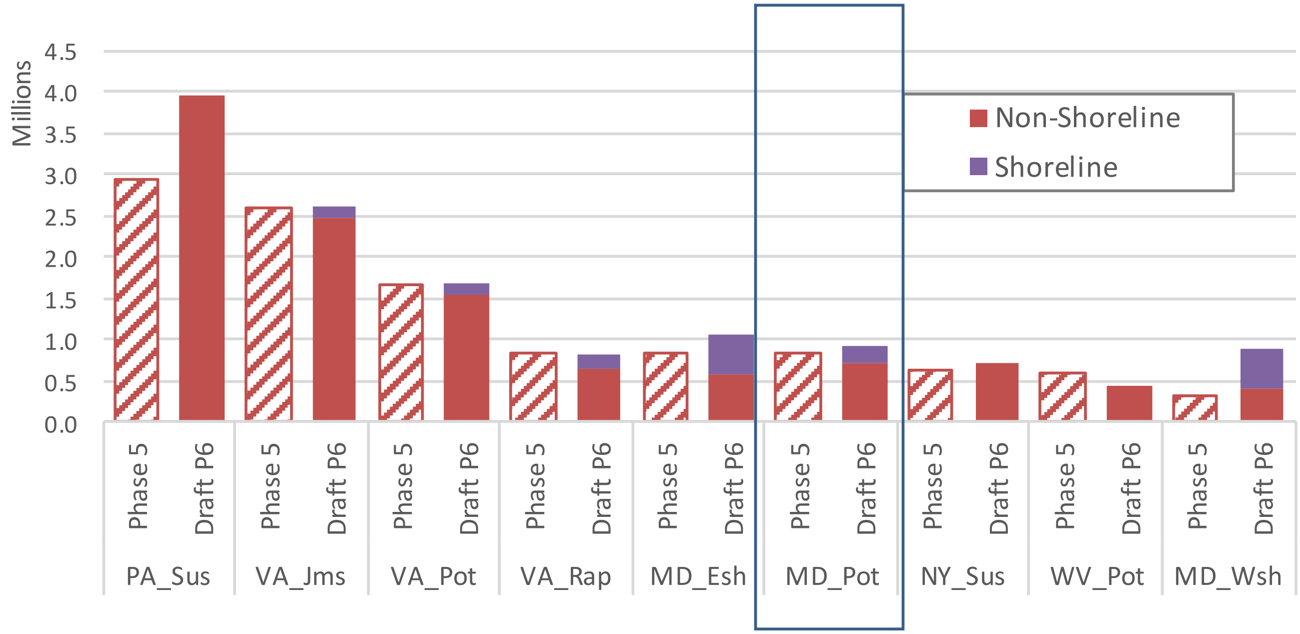
Draft P6: Nitrogen - MD Potomac

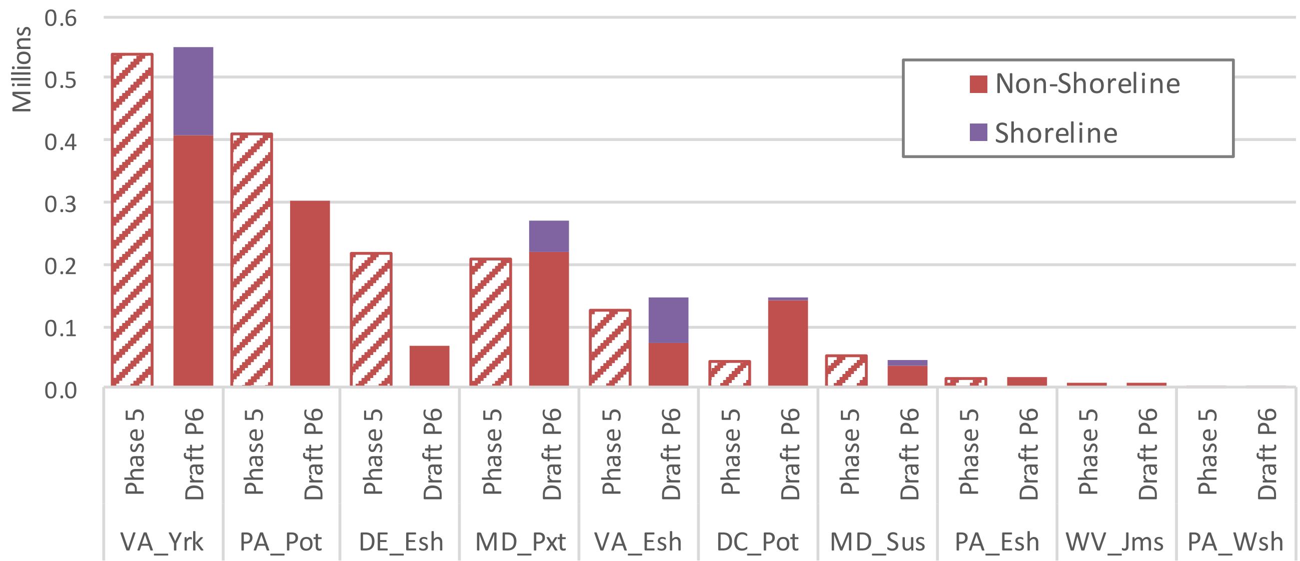


Crops	30%
Pasture & Hay	11%
Developed	18%
Natural	8%
Feeding Operations	0%
Stream Bank & Bed	5%
Wastewater	20%
Septic	6%
Shoreline	2%

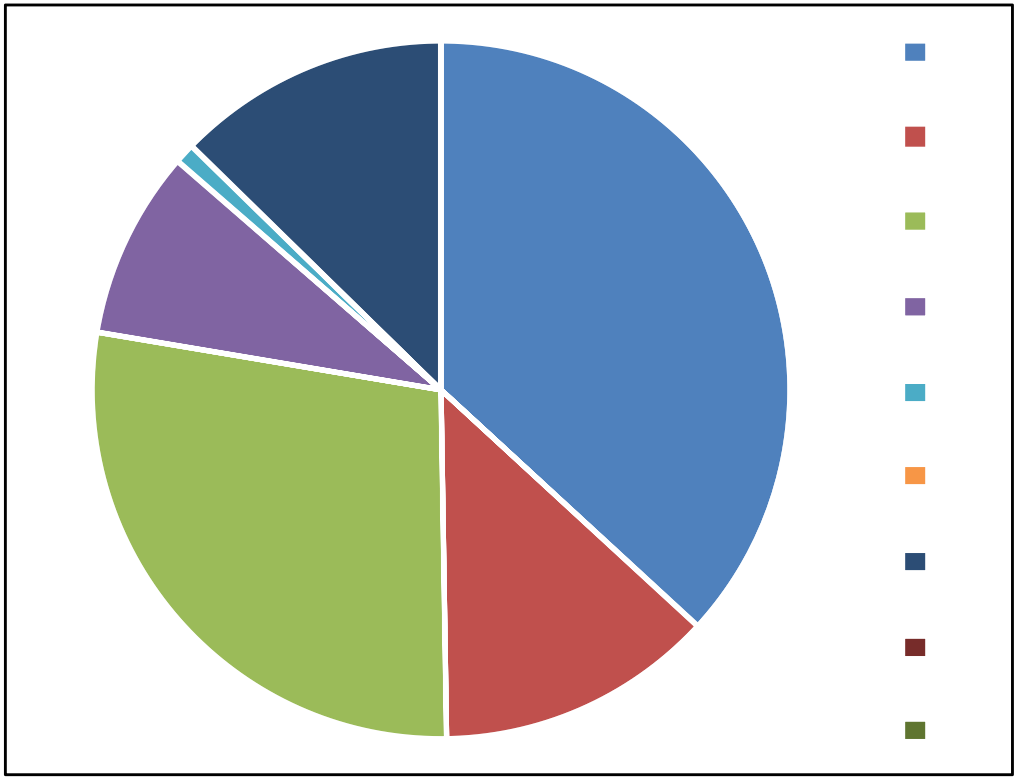
2010 WIP2

PHOSPHORUS



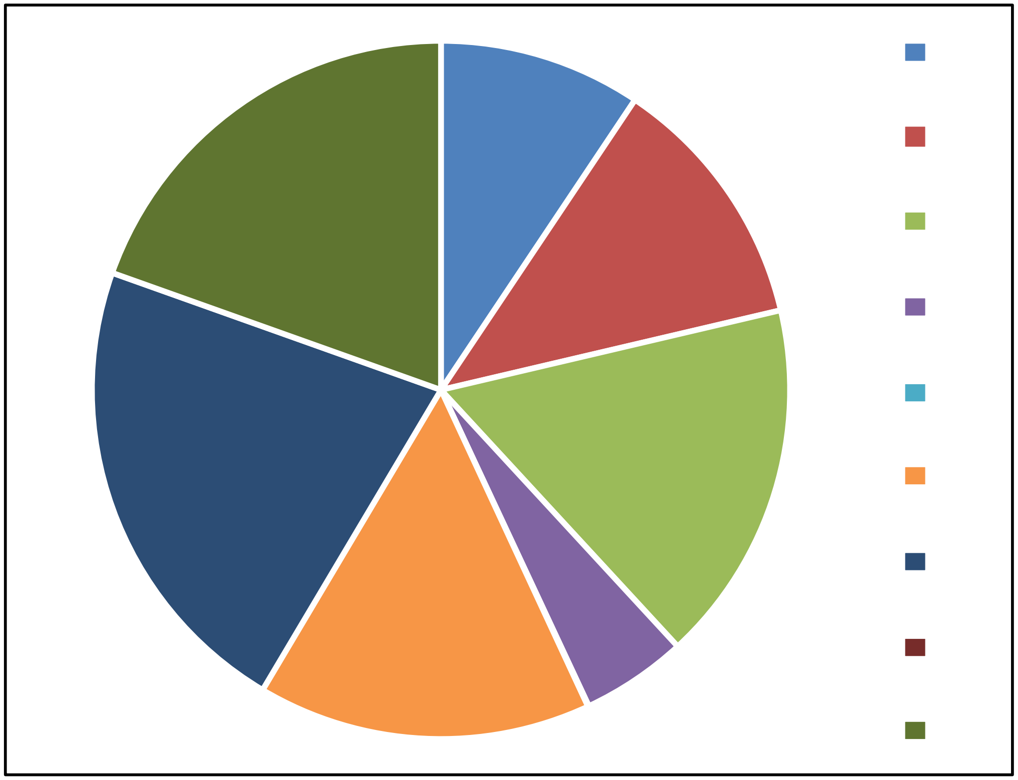


Phase 5: Phosphorus - MD Potomac



Crops	37%
Pasture & Hay	13%
Developed	28%
Natural	9%
Feeding Operations	1%
Stream Bank & Bed	0%
Wastewater	13%
Septic	0%
Shoreline	0%

Draft P6: Phosphorus - MD Potomac



Crops	9%
Pasture & Hay	12%
Developed	17%
Natural	5%
Feeding Operations	0%
Stream Bank & Bed	15%
Wastewater	22%
Septic	0%
Shoreline	20%

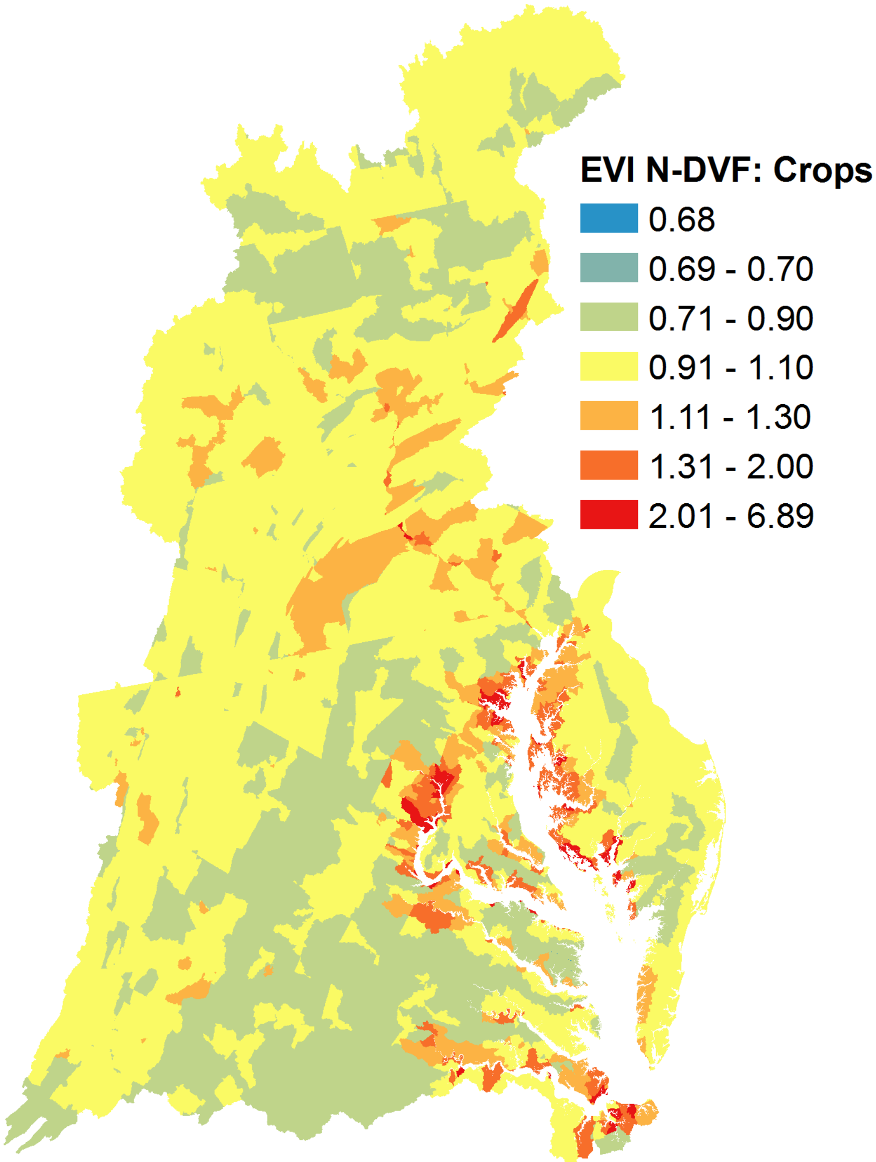
Summary and Conclusions

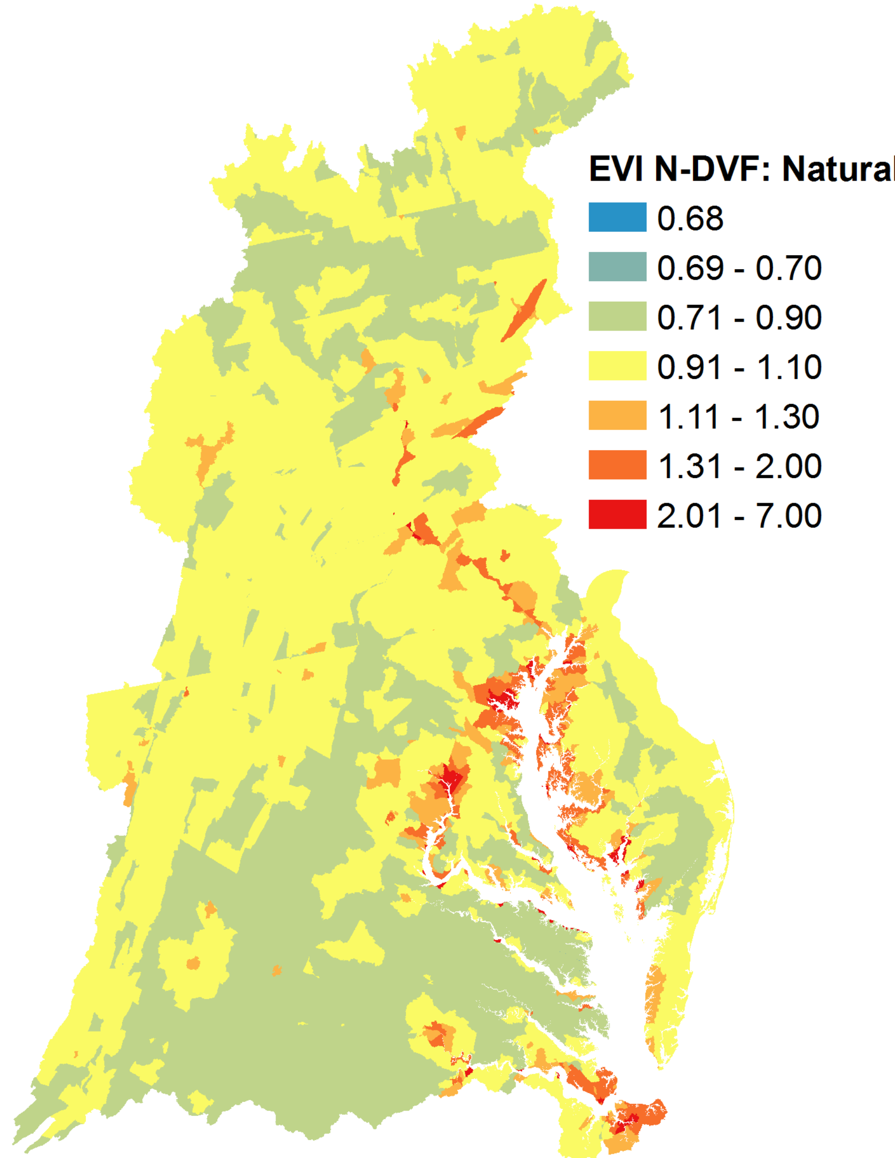
- The re-calibration is underway with an anticipated completion date of October 31^{st}.
- The Chesapeake floodplain network regression negatively impacted the model calibration.
- The calibration responded positively to – (a) the exclusion of enhanced vegetative index based nitrogen delivery variance factor, (b) flow-weighted monitoring data, and (c) scour of organic- nitrogen and phosphorus.
- After the completion of re-calibration, the Key scenarios runs will be made with an anticipated completion during the first fortnight of November.

Appendices

June Auto Calibration Final
P620170331WQf

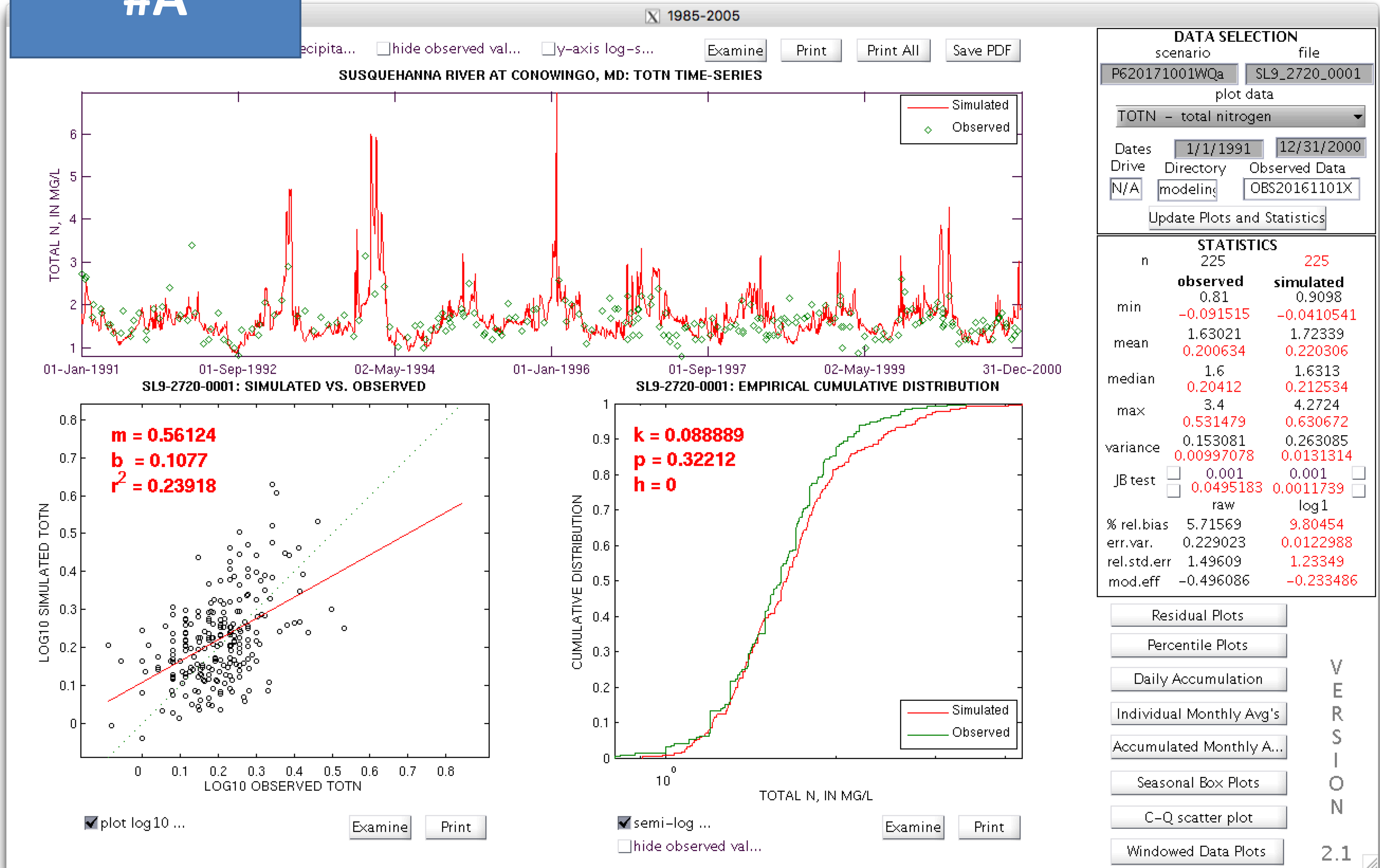
Calibration **#A** (P620171001WQa)	+ October Inputs + Calibration targets + Model updates + Stream transport factors (STF)
Calibration **#B** (P620171001WQb)	+ Calibration **#A** + APLE with final inputs, Bayesian Soil P, Calibration target + Remove EVI DFs, renormalize DVFs, update FDF, update EOR direct load inputs (ind, mun, rib, rpa, sep)
Calibration **#C** (P620171001WQc)	+ Calibration **#B** + Erosional and Depositional loads based on Noe/Claggett regressions, update calibration target, update SDR, calculate EOS, redo STB, calculate FDF, update EOR direct load inputs
Calibration **#D** (P620171001WQd)	+ Calibration **#B** + Daily flow weighted observations
Calibration **#F** (P620171001WQf)	+ Calibration **#D** + Scour of organic nitrogen and phosphorus


EVI N-DVF: Crops
0.68
0.69 - 0.70
0.71 - 0.90
0.91 - 1.10
1.11 - 1.30
1.31 - 2.00
2.01 - 6.89


EVI N-DVF: Natural
0.68
0.69 - 0.70
0.71 - 0.90
0.91 - 1.10
1.11 - 1.30
1.31 - 2.00
2.01 - 7.00

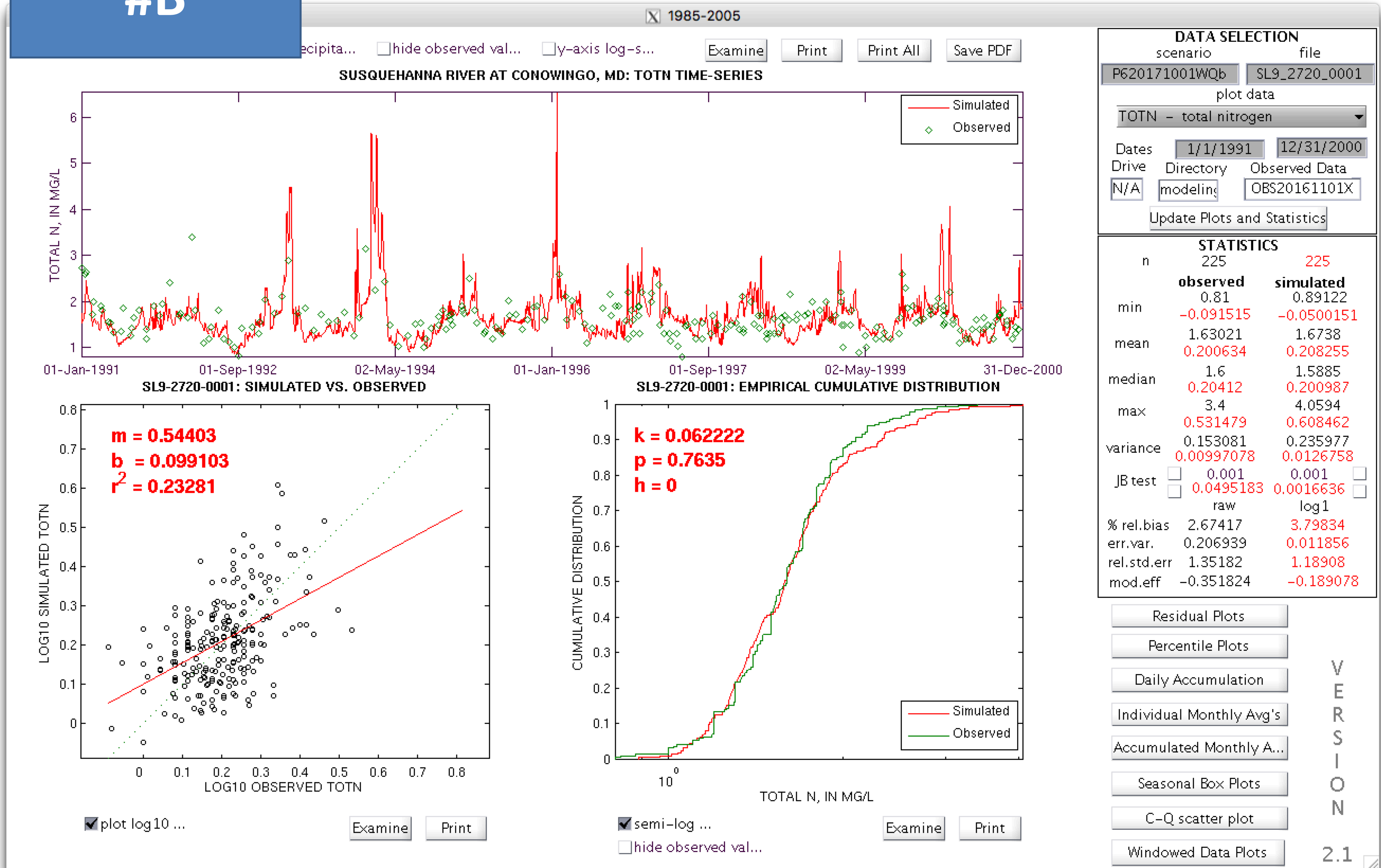
#A

Performance at large scale – <u>with</u> EVI N-DVF



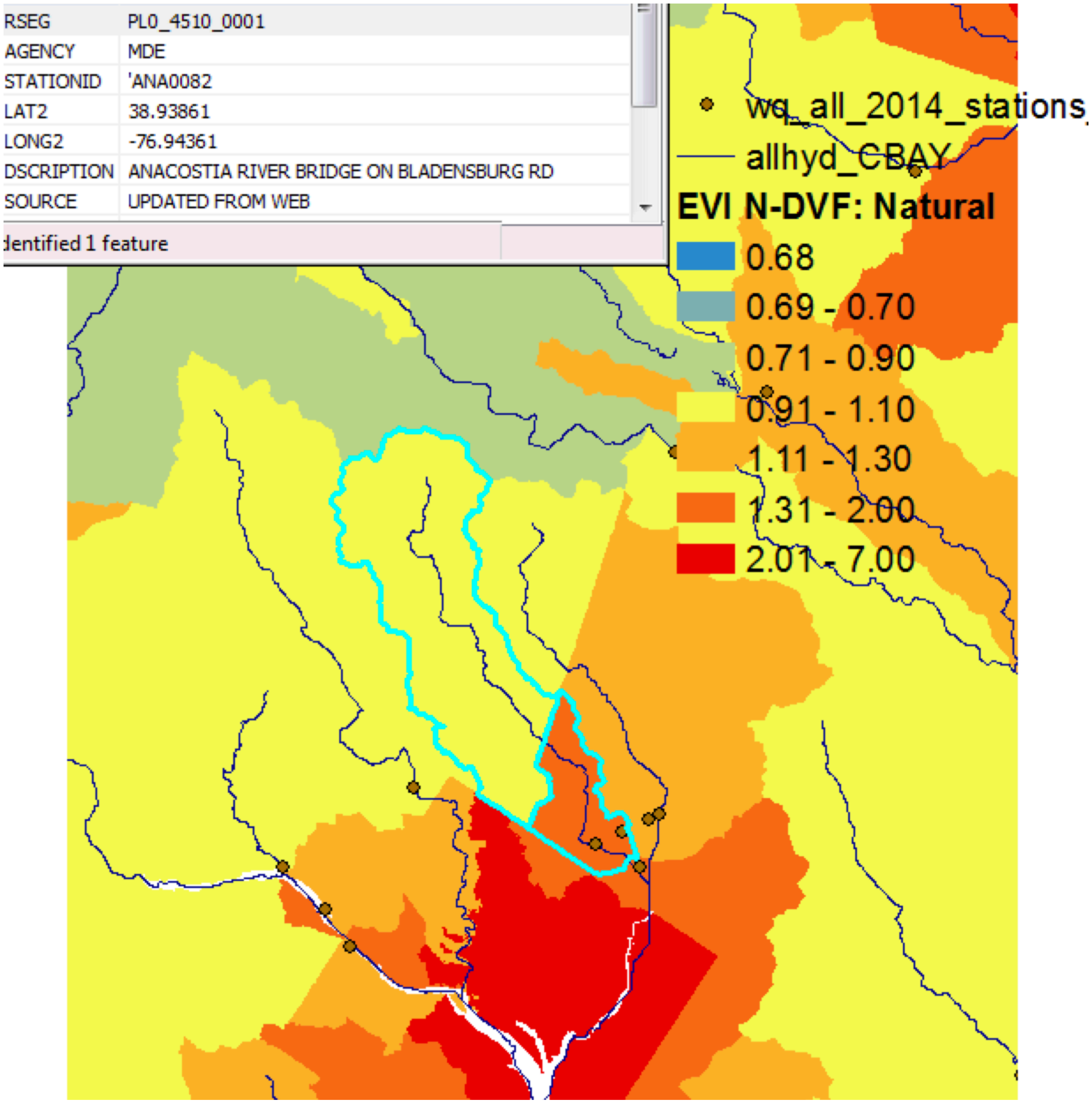
#B

Performance at large scale – without EVI N-DVF



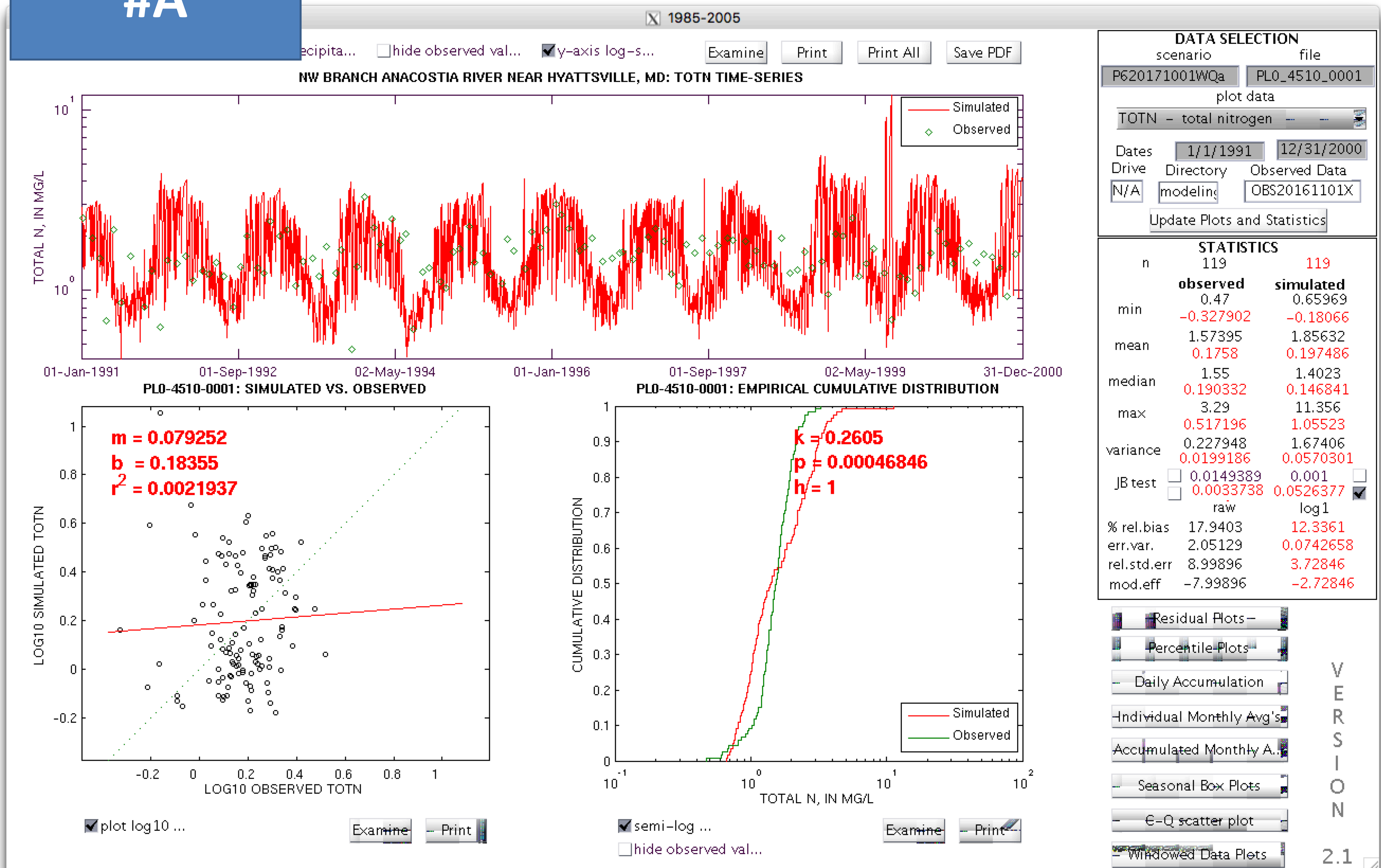
Some improvement in the agreement between the cumulative distributions

EVI N-DVF > 1



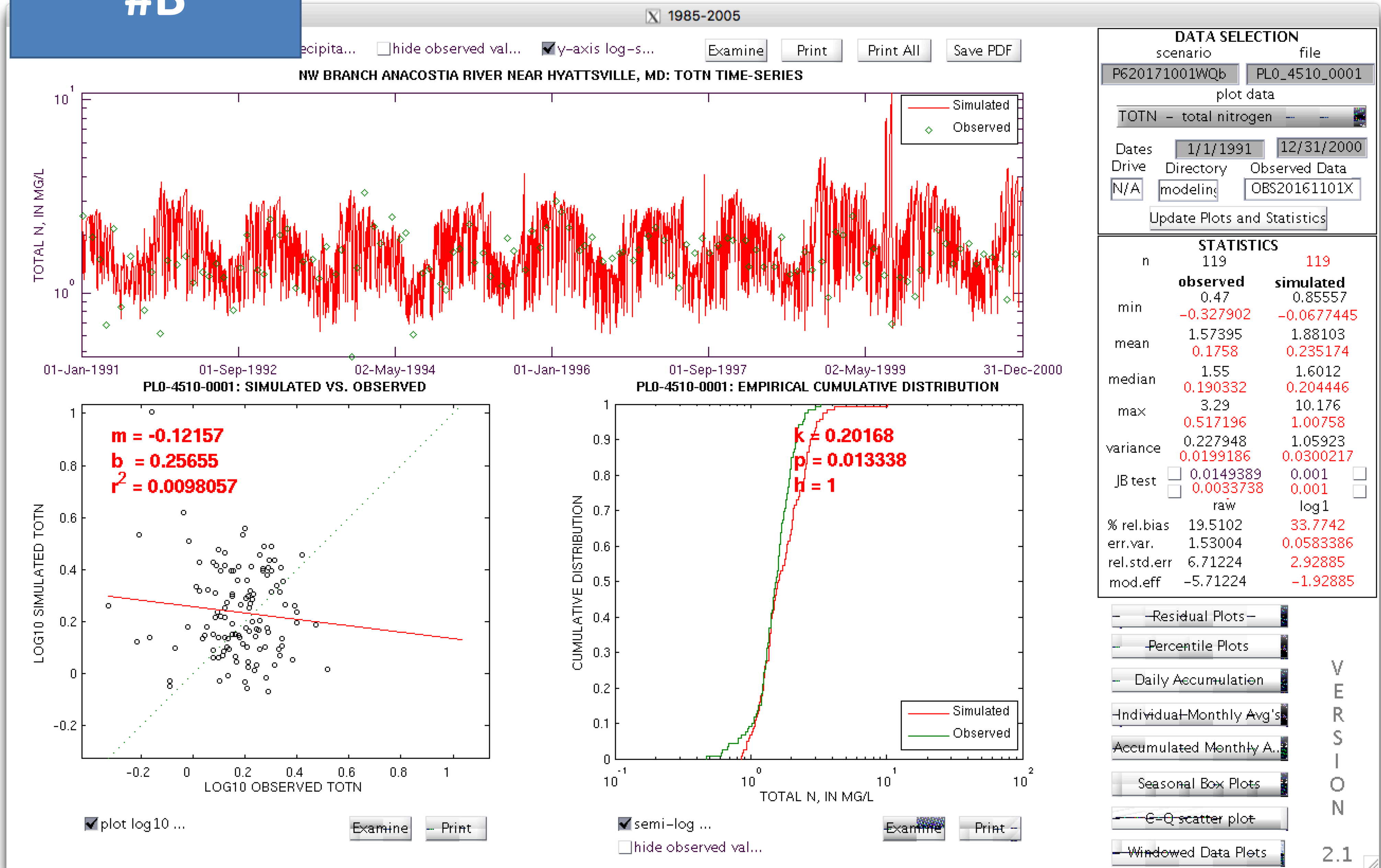
RSEG PL0_4510_0001
AGENCY MDE
STATIONID 'ANA0082
LAT2 38.93861
LONG2 -76.94361
DSCRIPTION ANACOSTIA RIVER BRIDGE ON BLADENSBURG RD
SOURCE UPDATED FROM WEB
Identified 1 feature
wq_all_2014_stations
allhyd_CBAY
EVI N-DVF: Natural
0.68
0.69 - 0.70
0.71 - 0.90
0.91 - 1.10
1.11 - 1.30
1.31 - 2.00
2.01 - 7.00

#A



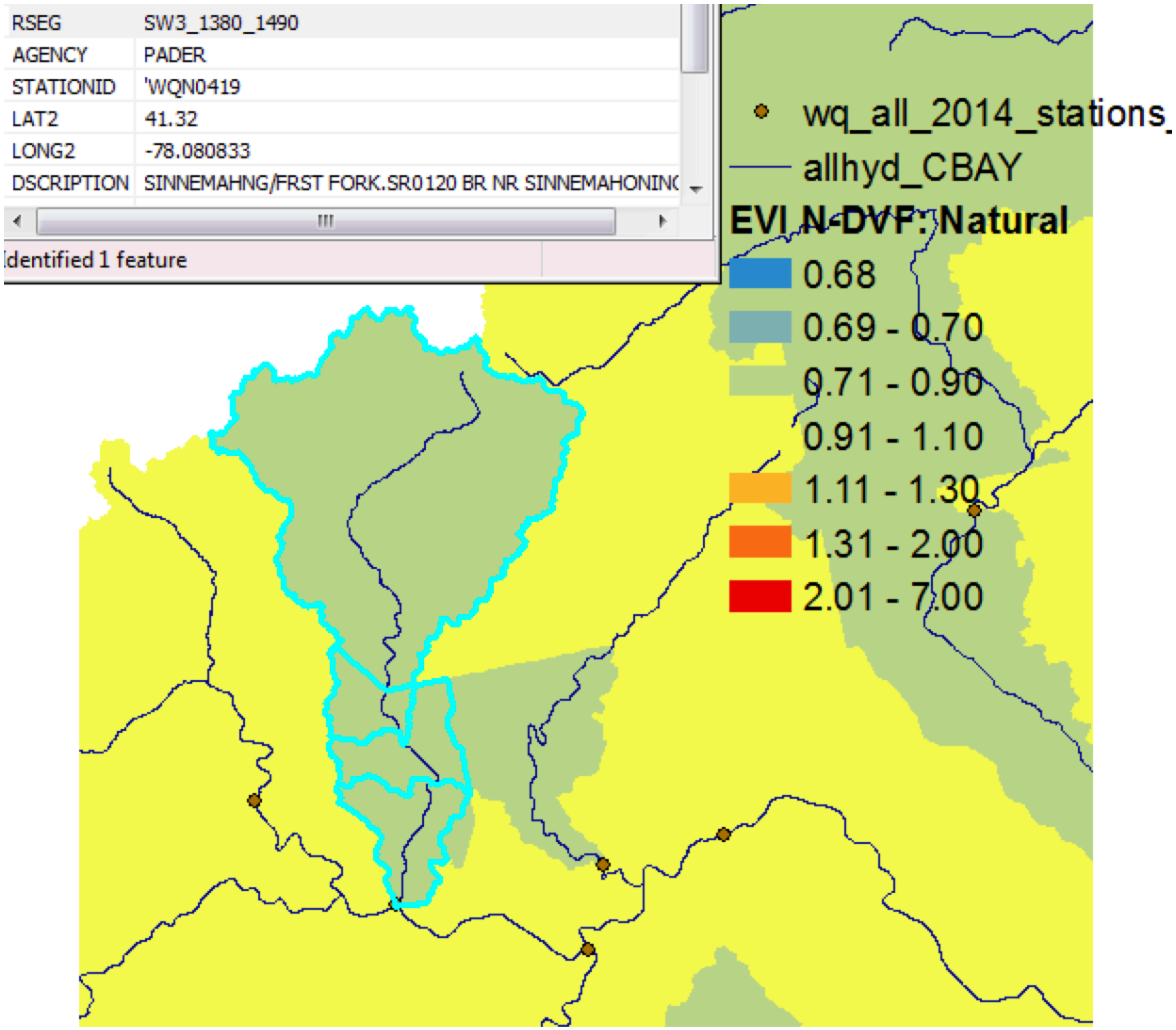
1985-2005
ecipita...
hide observed val...
y-axis log-s...
Examine
Print
Print All
Save PDF
NW BRANCH ANACOSTIA RIVER NEAR HYATTSVILLE, MD: TOTN TIME-SERIES
TOTAL N, IN MG/L
Simulated
Observed
01-Jan-1991
01-Sep-1992
02-May-1994
01-Jan-1996
01-Sep-1997
02-May-1999
31-Dec-2000
PL0-4510-0001: SIMULATED VS. OBSERVED
m = 0.079252
b = 0.18355
r2 = 0.0021937
LOG10 SIMULATED TOTN
LOG10 OBSERVED TOTN
plot log10 ...
PL0-4510-0001: EMPIRICAL CUMULATIVE DISTRIBUTION
k = 0.2605
p = 0.00046846
h = 1
CUMULATIVE DISTRIBUTION
TOTAL N, IN MG/L
semi-log ...
hide observed val...
DATA SELECTION
scenario
file
P620171001WQa
PL0_4510_0001
plot data
TOTN - total nitrogen
Dates
1/1/1991
12/31/2000
Drive
Directory
Observed Data
N/A
modeling
OBS20161101X
Update Plots and Statistics
STATISTICS
n 119 119
observed simulated
min 0.47 -0.327902 0.65969 -0.18066
mean 1.57395 0.1758 1.85632 0.197486
median 1.55 0.190332 1.4023 0.146841
max 3.29 0.517196 11.356 1.05523
variance 0.227948 0.0199186 1.67406 0.0570301
JB test 0.0149389 0.0033738 0.001 0.0526377
raw log1
% rel.bias 17.9403 12.3361
err.var. 2.05129 0.0742658
rel.std.err 8.99896 3.72846
mod.eff -7.99896 -2.72846
Residual Plots
Percentile Plots
Daily Accumulation
Individual Monthly Avg's
Accumulated Monthly A...
Seasonal Box Plots
C-Q scatter plot
Windowed Data Plots
VERSION 2.1

#B



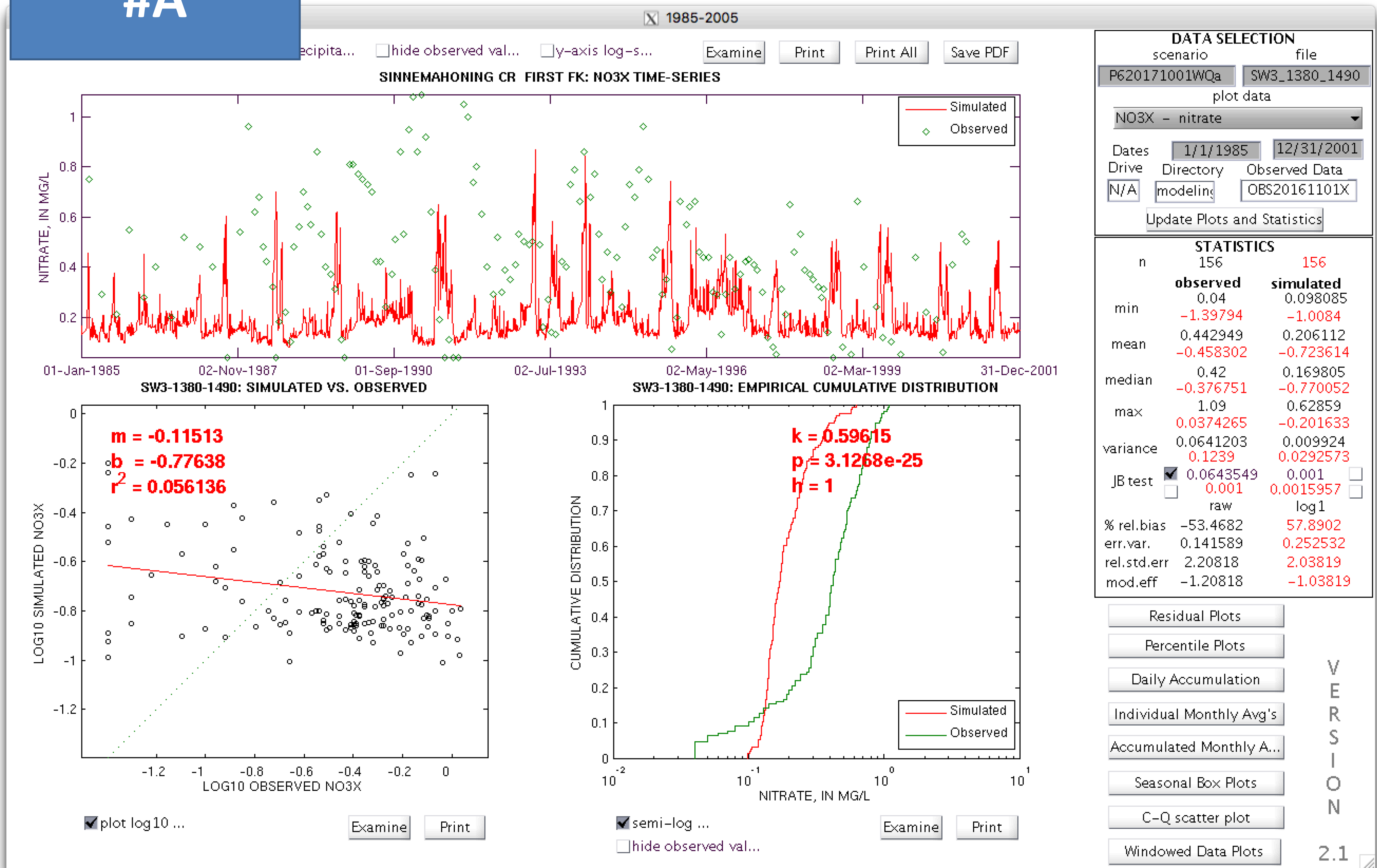
Some improvement in the agreement between the cumulative distributions

EVI N-DVF < 1



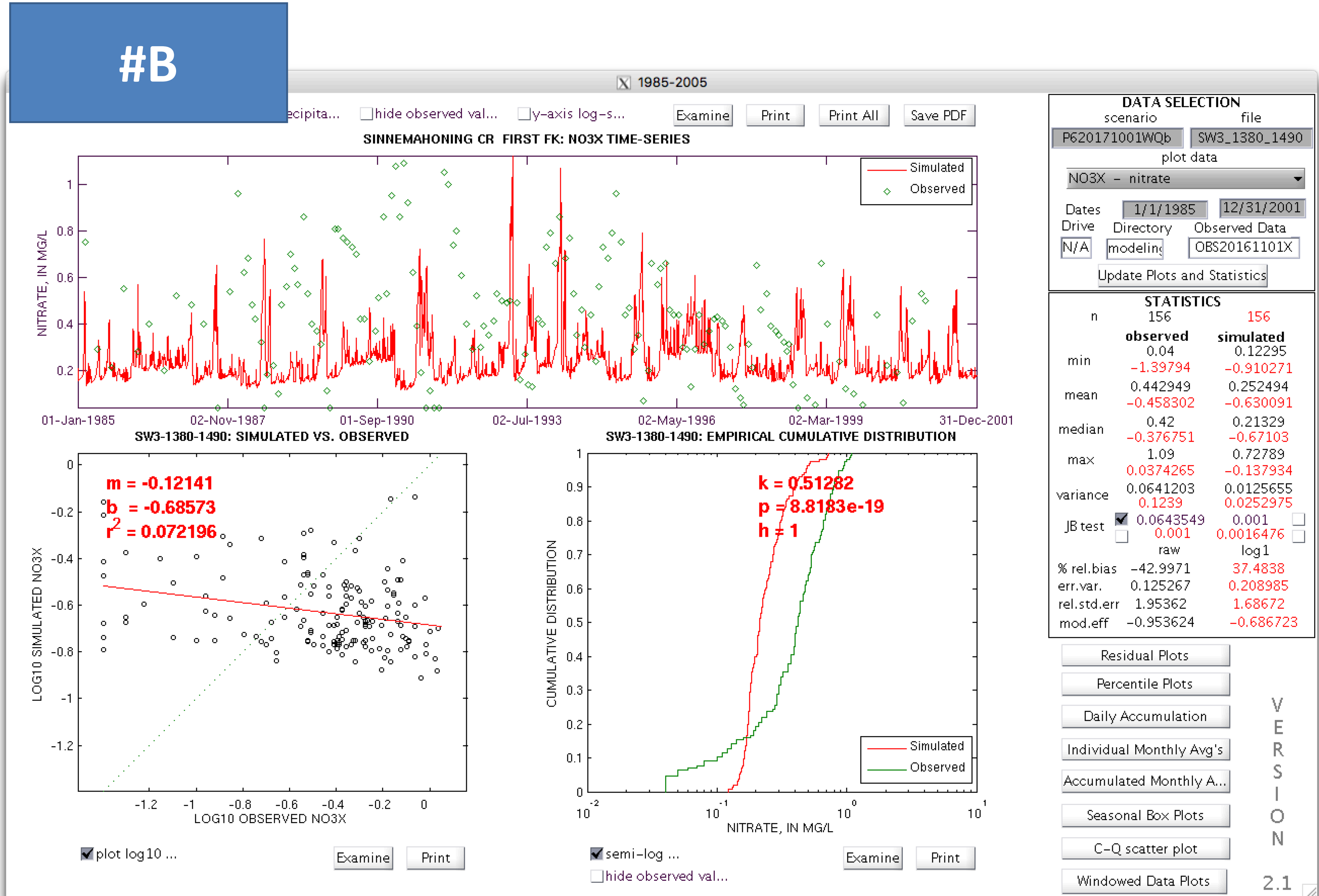
RSEG SW3_1380_1490
AGENCY PADER
STATIONID 'WQN0419
LAT2 41.32
LONG2 -78.080833
DSCRIPTION SINNEMAHNG/FRST FORK.SR0120 BR NR SINNEMAHONING
Identified 1 feature
wq_all_2014_stations_
allhyd_CBAY
EVI N-DVF: Natural
0.68
0.69 - 0.70
0.71 - 0.90
0.91 - 1.10
1.11 - 1.30
1.31 - 2.00
2.01 - 7.00

#A



1985-2005
ecipita...
hide observed val...
y-axis log-s...
Examine
Print
Print All
Save PDF
SINNEMAHONING CR FIRST FK: NO3X TIME-SERIES
NITRATE, IN MG/L
Simulated
Observed
01-Jan-1985
02-Nov-1987
01-Sep-1990
02-Jul-1993
02-May-1996
02-Mar-1999
31-Dec-2001
SW3-1380-1490: SIMULATED VS. OBSERVED
m = -0.11513
b = -0.77638
r2 = 0.056136
LOG10 SIMULATED NO3X
LOG10 OBSERVED NO3X
plot log10 ...
Examine
Print
SW3-1380-1490: EMPIRICAL CUMULATIVE DISTRIBUTION
k = 0.59615
p = 3.1268e-25
h = 1
CUMULATIVE DISTRIBUTION
NITRATE, IN MG/L
Simulated
Observed
semi-log ...
hide observed val...
Examine
Print
DATA SELECTION
scenario
file
P620171001WQa
SW3_1380_1490
plot data
NO3X - nitrate
Dates
1/1/1985
12/31/2001
Drive
Directory
Observed Data
N/A
modeling
OBS20161101X
Update Plots and Statistics
STATISTICS
n 156 156
observed simulated
min 0.04 -1.39794 0.098085 -1.0084
mean 0.442949 -0.458302 0.206112 -0.723614
median 0.42 -0.376751 0.169805 -0.770052
max 1.09 0.0374265 0.62859 -0.201633
variance 0.0641203 0.1239 0.009924 0.0292573
JB test 0.0643549 0.001 0.001 0.0015957
raw log1
% rel.bias -53.4682 57.8902
err.var. 0.141589 0.252532
rel.std.err 2.20818 2.03819
mod.eff -1.20818 -1.03819
Residual Plots
Percentile Plots
Daily Accumulation
Individual Monthly Avg's
Accumulated Monthly A...
Seasonal Box Plots
C-Q scatter plot
Windowed Data Plots
VERSION
2.1

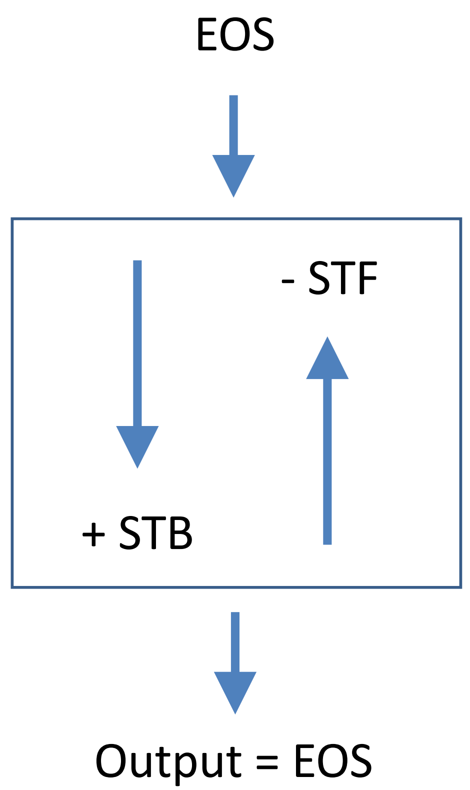
#B



Some improvement in the agreement between the cumulative distributions

June to September/October Transition

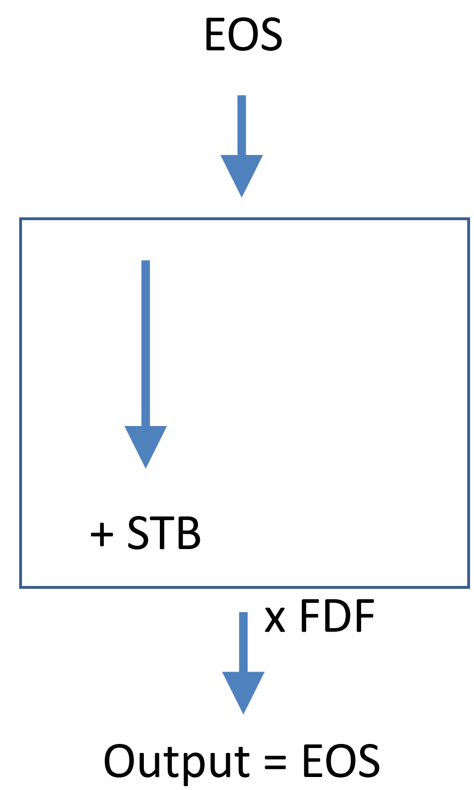
- STB estimated from obs. load/length data, and stream length, + 4/3 x Impervious SS
- STF = STB, but STF applies to all load sources
- STB changes for scenarios with changes in EOS



$$\text{FDF} = \frac{EOS+STB-STF}{EOS+STB}$$

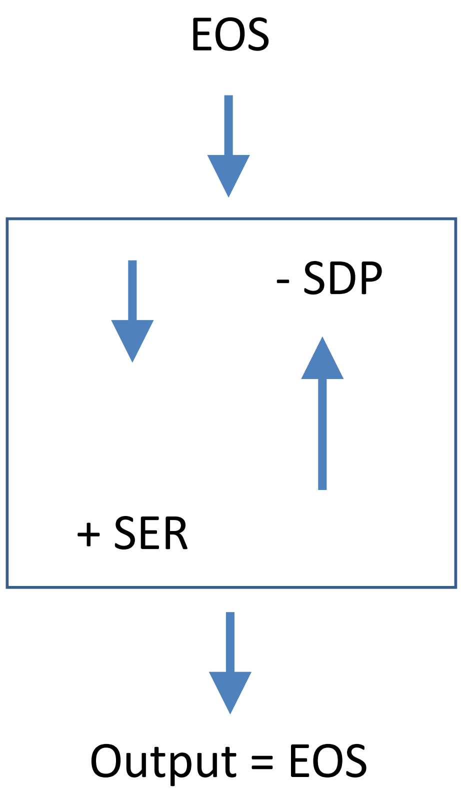
$$\text{FDF} = \frac{EOS}{EOS+STB}$$

0 < FDF < 1



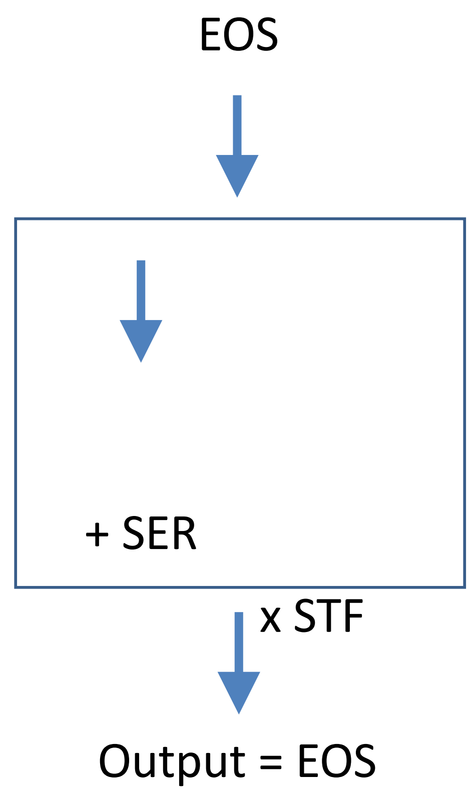
Noe/Claggett CFN in October Calibration Test

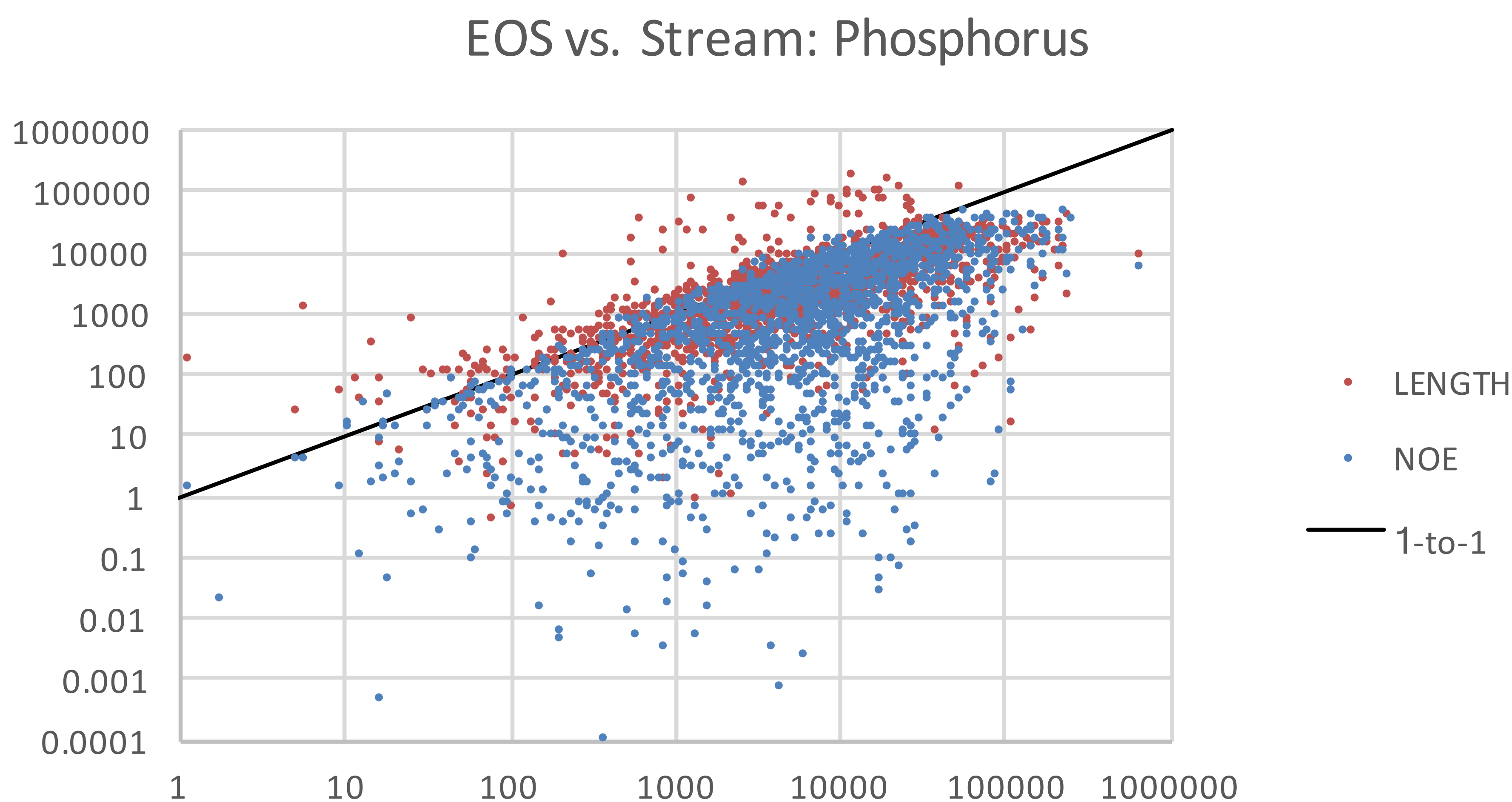
- S**ER** (ER for erosion) estimated from Noe/Claggett CFN regression
- S**DP** (DP for deposition) estimates from Noe/Claggett CFN regression
- SER changes for scenarios with changes in EOS

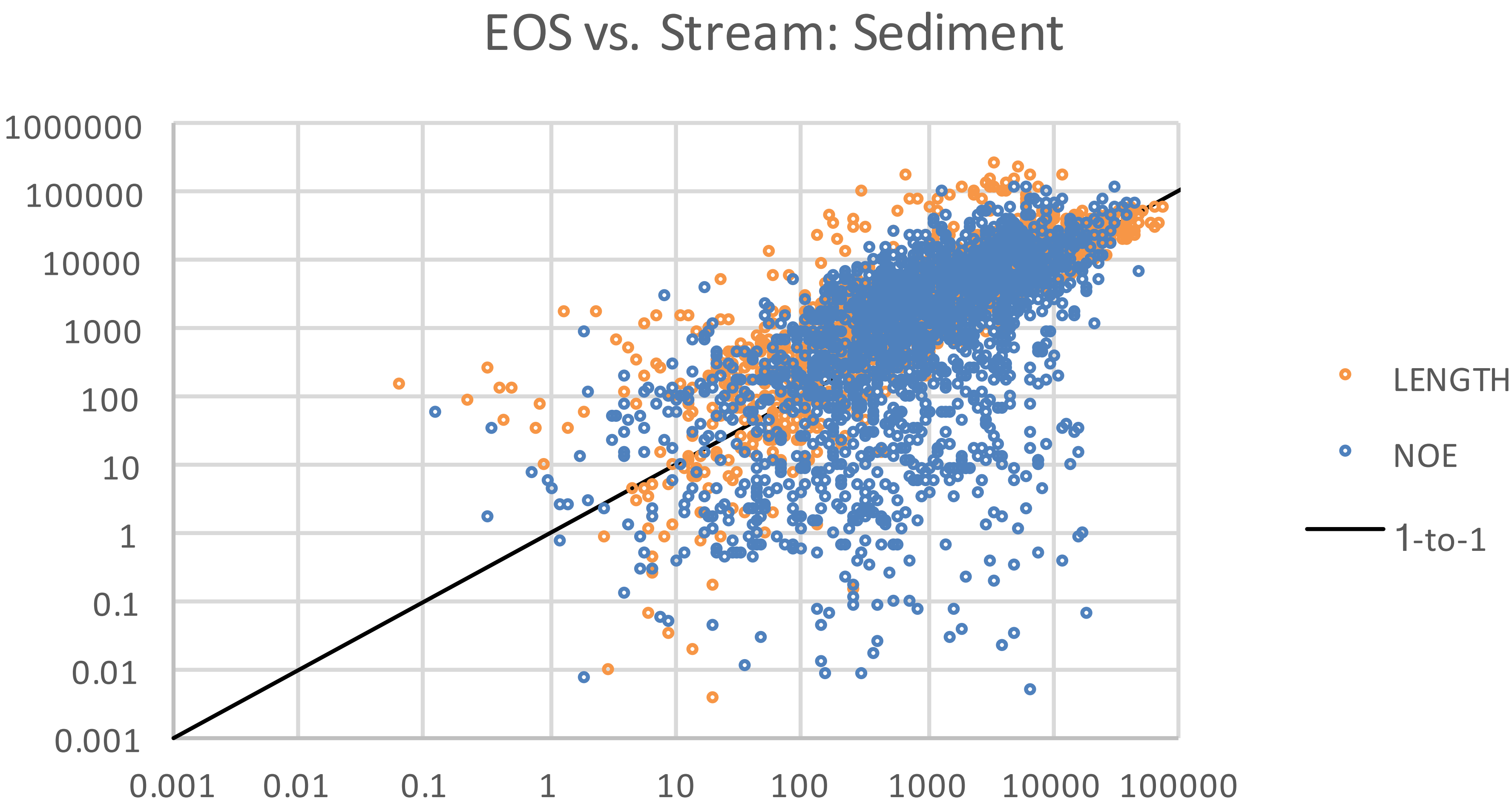


$$\text{STF} = \frac{EOS+SER-SDP}{EOS+SER}$$

$0 < \text{STF} < 1$




EOS vs. Stream: Phosphorus
1000000
100000
10000
1000
100
10
1
0.1
0.01
0.001
0.0001
1
10
100
1000
10000
100000
1000000
LENGTH
NOE
1-to-1


EOS vs. Stream: Sediment
1000000
100000
10000
1000
100
10
1
0.1
0.01
0.001
0.001
0.01
0.1
1
10
100
1000
10000
100000
LENGTH
NOE
1-to-1