

Phase 7 WSM Progress – Dynamic Watershed Model (DWSM) Hydrology and EOF Sediment Calibrations – Draft 2026 Beta

Modeling Workgroup Quarterly Meeting – July 2026

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Presentation Outline

Phase 7 Dynamic Watershed Model (DWSM)

1. Dynamic Watershed Model overview
2. Overview of prior model development progress
3. (a) Hydrology and (b) Edge of field (EOF) sediment calibration
 - Inputs and model setup
 - Calibration method
 - Results
4. Summary and next steps

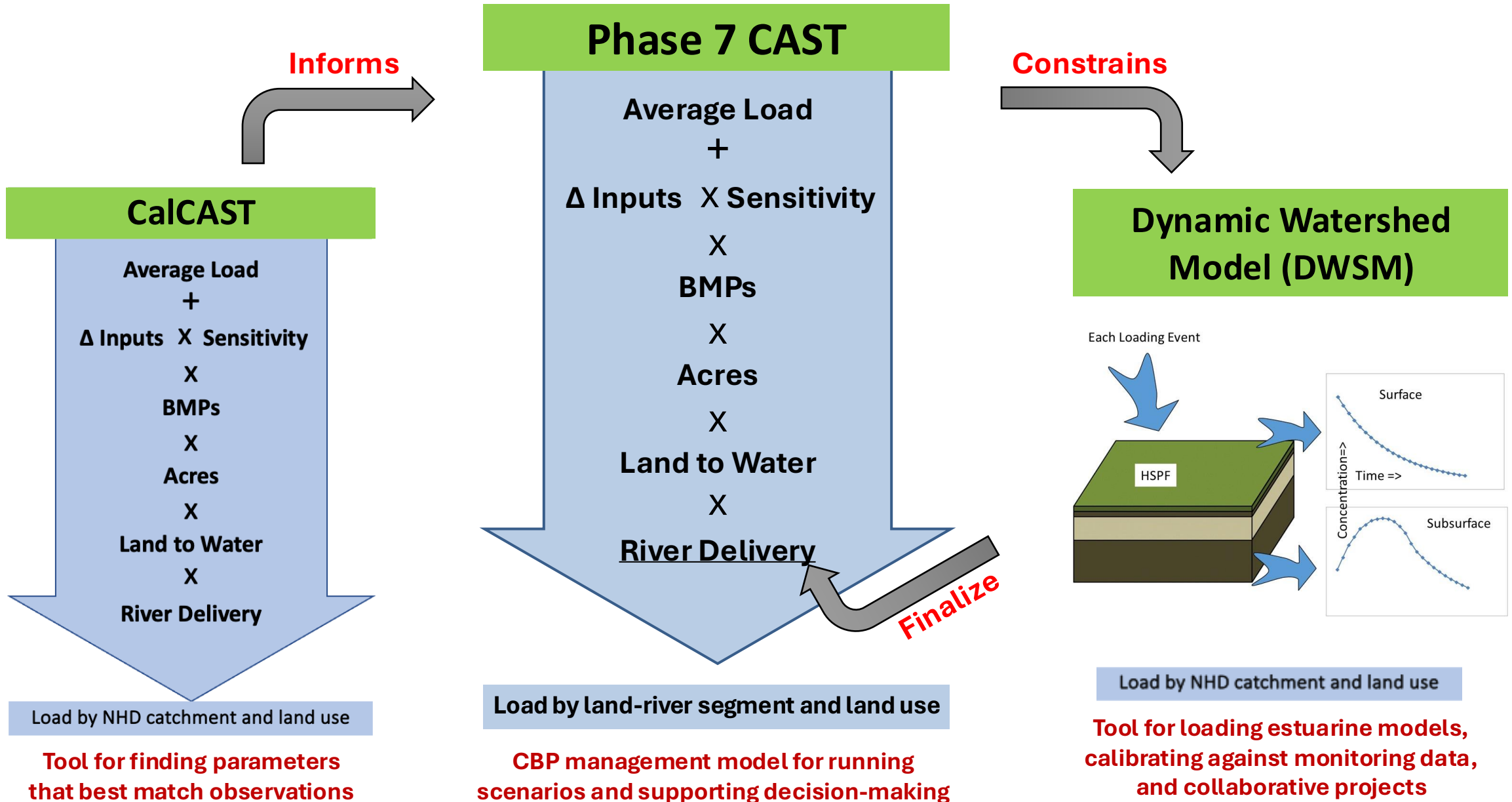
Purpose

NHD Scale Dynamic Watershed Model (DWSM)

- Inputs for the estuarine models (MBM/MTMs)
- Watershed model calibration and scenario applications
- Support research and collaboration activities

Phase 7 watershed models and structure

CAST – Chesapeake Assessment Scenario Tool



Dynamic Watershed Model (DWSM) development

- Year 2022: NHD-scale model structure and prototypes for hydrology, sediment, and nutrients.
- Year 2023: Incremental refinements of model prototypes in terms of model segmentation, CalCAST→DWSM linkage.
- Year 2024: stream water quality routing based on β parameters; refinements of small stream flow and water temperature routing modules; mechanics of riverine water quality calibrations.
- Year 2025: development and testing of DWSM and MBM linkage through beta versions; stream routing with RF model estimated β parameters, sediment routing, estimation of riverine transport parameters and further refinements of the DWSM calibration; organic scour in rivers, trend component in stream routing, BMPs, etc. Q4: P7 land use; extend simulation period to 2024; monitoring data; and GSN trends.
- **Year 2026: Q1: improved calibration of 1985-2024 hydrology and sediment using initial P7 land use and mapping CalCAST data; refined simulations of small streams and improved water quality calibration of rivers; Q2: hydrology and EOF sediment calibrations – Draft 2026 Beta;**

CY2022
[1] <https://fd18ev1ok5eia.cloudfront.net/chesapeakebay/documents/progress-in-phase-7-wsm-development-1.4.2022-gopal.bhatt.penn.state.pdf>
[2] <https://fd18ev1ok5eia.cloudfront.net/chesapeakebay/documents/progress-in-phase-7-wsm-development-4.5.2022-gopal.bhatt.penn.state.pdf>
[3] <https://fd18ev1ok5eia.cloudfront.net/chesapeakebay/documents/progress-in-phase-7-wsm-development-gopal.bhatt.penn.state.7.12.22.pdf>
[4] <https://fd18ev1ok5eia.cloudfront.net/chesapeakebay/documents/Progress-in-Phase-7-WSM-Development-Gopal-Bhatt-Penn-State-10.4.22-v2.pdf>
[5] <https://fd18ev1ok5eia.cloudfront.net/chesapeakebay/documents/Progress-in-Phase-7-WSM-Development-Gopal-Bhatt-Penn-State-10.10.2023.pdf>

CY 2023
[1] <https://fd18ev1ok5eia.cloudfront.net/chesapeakebay/documents/20230404-BHATT-Phase-7-WSM-Development-Dynamic-Model-Development-2023Q1.pdf>
[2] <https://fd18ev1ok5eia.cloudfront.net/chesapeakebay/documents/Progress-in-Phase-7-WSM-Development-Gopal-Bhatt-Penn-State-6.20.2023.pdf>
[3] <https://fd18ev1ok5eia.cloudfront.net/chesapeakebay/documents/Progress-in-Phase-7-WSM-Development-Gopal-Bhatt-Penn-State-10.17.2023.pdf>
[4] <https://fd18ev1ok5eia.cloudfront.net/chesapeakebay/documents/20240109-BHATT-Phase-7-WSM-Development-Dynamic-Model-Development-2023Q4.pdf>

CY 2024
[1] <https://fd18ev1ok5eia.cloudfront.net/chesapeakebay/documents/Progress-in-Phase-7-WSM-Development-Gopal-Bhatt-Penn-State-CBPO-4.2.2024.pdf>
[2] <https://fd18ev1ok5eia.cloudfront.net/chesapeakebay/documents/Phase-7-WSM-Development-Modeling-WQ-July-2024.pdf>
[3] https://fd18ev1ok5eia.cloudfront.net/chesapeakebay/documents/3_1000_20241008-BHATT-Phase-7-WSM-Development-Dynamic-Model-Development-2024Q3.pdf
[4] <https://www.chesapeakebay.net/files/documents/1035-20250107-BHATT-Phase-7-WSM-Development-Dynamic-Model-Development-2024Q4.pdf>

CY 2025
[1] https://www.chesapeakebay.net/files/documents/1025_20250401-BHATT-Phase-7-WSM-Development-Dynamic-Model-Development-2025Q1.pdf
[2a] https://www.chesapeakebay.net/files/documents/1010_Phase-7-Model-Review-Gopal-Bhatt.pdf
[2b] https://www.chesapeakebay.net/files/documents/1035_Phase-7-WSM-Development-Dynamic-Model-Development-Gopal-Bhatt.pdf
[3] https://www.chesapeakebay.net/files/documents/1005_Phase-7-Watershed-Model-Progress-Towards-Completion-of-the-Dynamic-Watershed-Model-Development-Gopal-Bhatt.pdf
[4] https://www.chesapeakebay.net/files/documents/1000_Phase-7-Watershed-Model-Progress-Gopal-Bhatt.pdf

CY 2026
[1] https://www.chesapeakebay.net/files/documents/1105_Phase-7-WSM-Development-DWSM-2025Q1_20260407_v2-BHATT.pdf
[2] ... this presentation ...

Aggregation of P7 CAST land uses was revised for the DWSM

1. Impervious Roads

MS4 Roads
Non-Regulated Roads

2. Impervious Non-Roads

MS4 Buildings and Other
Non-Regulated Buildings and Other

3. Tree Canopy over Impervious

MS4 Tree Canopy over Impervious
Non-Regulated Tree Canopy over Impervious

4. Turfgrass

MS4 Turf Grass
Non-Regulated Turf Grass

5. Tree Canopy Over Turfgrass

MS4 Tree Canopy over Turf Grass
Non-Regulated Tree Canopy over Turf Grass

6. Solar Infrastructure

MS4 Solar Infrastructure
Non-Regulated Solar Infrastructure

7. Solar Pervious

MS4 Solar Pervious
Non-Regulated Solar Pervious

8. Compacted Pervious

MS4 Compacted Pervious
Non-Regulated Compacted Pervious

9. Construction

10. Forest

11. Harvested Forest

12. Floodplain Wetlands

13. Other Wetlands

14. Cropland

Full Season Soybeans
Grain with Manure
Grain without Manure
Silage with Manure
Silage without Manure
Small Grains and Grains
Double Cropped Land
Specialty Crop High
Specialty Crop Low
Other Agronomic Crops

15. Pasture and Hay

Ag Open Space
Leguminous Hay
Hay Low
Pasture Low
Hay High
Pasture High

16. Water

17. Feed Space

Permitted Feeding Space
Non-Permitted Feeding Space

18. Combined Sewer System

CSS Roads
CSS Buildings and Other
CSS Tree Canopy over Impervious
CSS Turf Grass
CSS Tree Canopy over Turf Grass
CSS Solar Infrastructure
CSS Solar Pervious
CSS Compacted Pervious
CSS Construction
CSS Forest
CSS Harvested Forest

→ Combined Sewer System land use was separated.

Thanks to Jessica, Sarah, and Peter!

Framework: Statistical model (CalCAST) → Dynamic Watershed Model (DWSM)

Hydrology

CAST

- Annual land use data for 18 core land use types
- Direct loads: municipal, industrial, septic, rapid infiltration

CalCAST

- Average annual yield of flow and stormflow

→
*P7 land catchment
segment land use
scale*

Edge of field Sediment

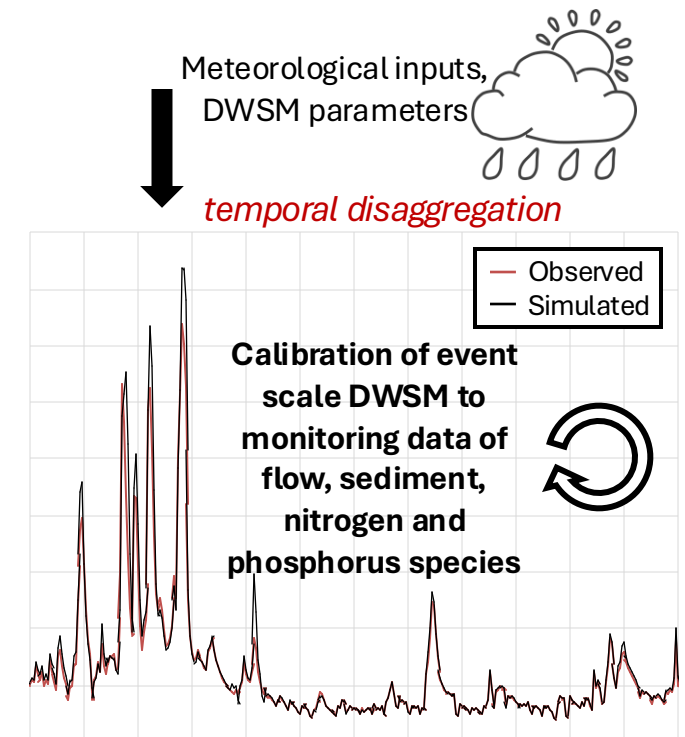
CAST

- Monthly estimates of detached sediment (land segments)
- Monthly estimates of cover fraction (land segments)

CalCAST

- Average annual yield of sediment
 - Aggregated to land segment for model calibration
 - Catchment scale data for sub-county spatial variability

DWSM process-based hourly estimates



Following updates were made to the hydrology model

- We are using 1985-2024 P7 land use data replacing previously used pre-BMP land use
- Solar infrastructure land use was converted from pervious to impervious.
- CSS land use was added. It does not yield EOS flow.
- We tested corrections for precipitation in Potomac during Nov 1-4, 1985, hurricane Juan. It improved the model performance for Potomac river near Washington DC, but the performance deteriorated at a few upstream stations, and so it was excluded.
- Previously tested refinement of Ftables of terminal HSPF river segments for better handling of extremely low flow condition was imported.
- Hydrology code base was updated for using native P7 land uses rather than using proxy of P6 land uses.
- We fixed an error related to how evaporation parameters are updated during calibration.
- Assignment of a couple of stations to river mainstems were corrected.
- Regression between flow observations at USGS 01575585 (1985-01-01 to 2021-11-15) & USGS 01575598 (2019-10-01 to 2024-12-31) was used for reconstructing flow data for model calibration.
- An adjustment factor of 0.8829 was applied to all land uses above Mattaponi RIM station for constraining currently remaining bias in estimated average annual flow.
- Improved data for CalCAST total flow yield and fraction stormflow.

Key hydrology model parameters that were calibrated

Parameter	Description	Permitted range
LAND_EVAP	PET adjustment (similar to pan evaporation coefficient)	0.01 – 2.50
INFILT	Infiltration rate	0.001 – 1.181
LZSN	Lower zone soil moisture storage index	1.0 – 20.0
AGWR	Baseflow recession coefficient	0.92 – 0.995
INTFW	Ratio of interflow to surface runoff	1.0 – 5.0
IRC	Interflow recession coefficient	0.3 – 0.85
AGWTP	Evapotranspiration from groundwater storage	0.0001 – 0.6
KVARY	Non-exponential groundwater recession	0.000001 – 2.0

Table: Relationship applied between land use parameters

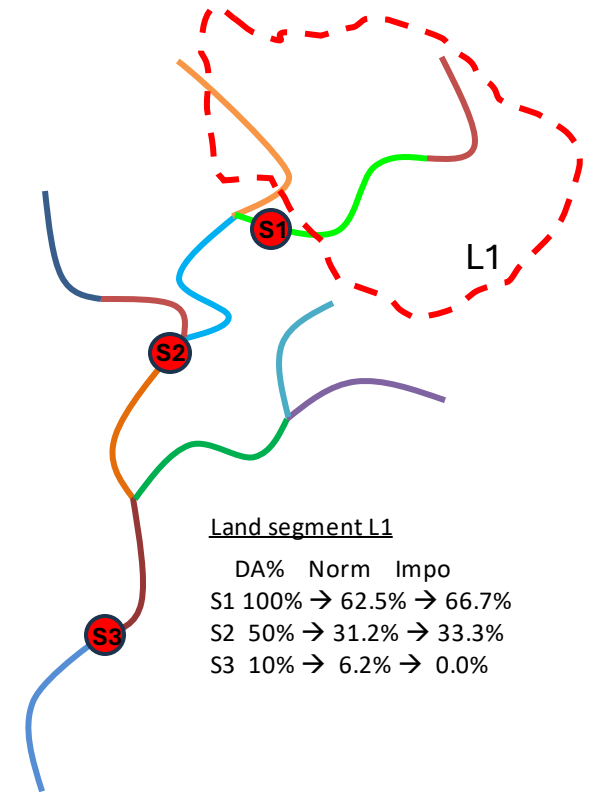
Land use	Crops	Pasture	Forest & wetlands	Harvested forest	Solar & compacted	Construction	Other developed
INFILT	1	1.5	1.6	1.3	1.5	0.4	0.8
INTFW	1	1.0	1.25	1.0	1.0	0.5	0.7
AGWETP	1	1.5	6.0	3.0	1.5	0.5	2.0
UZSN	0.14	0.10	0.12	0.10	0.10	0.07	0.08
LAND_EVAP	-	-	-	-	-	-	-

Calibration procedures have been updated ...

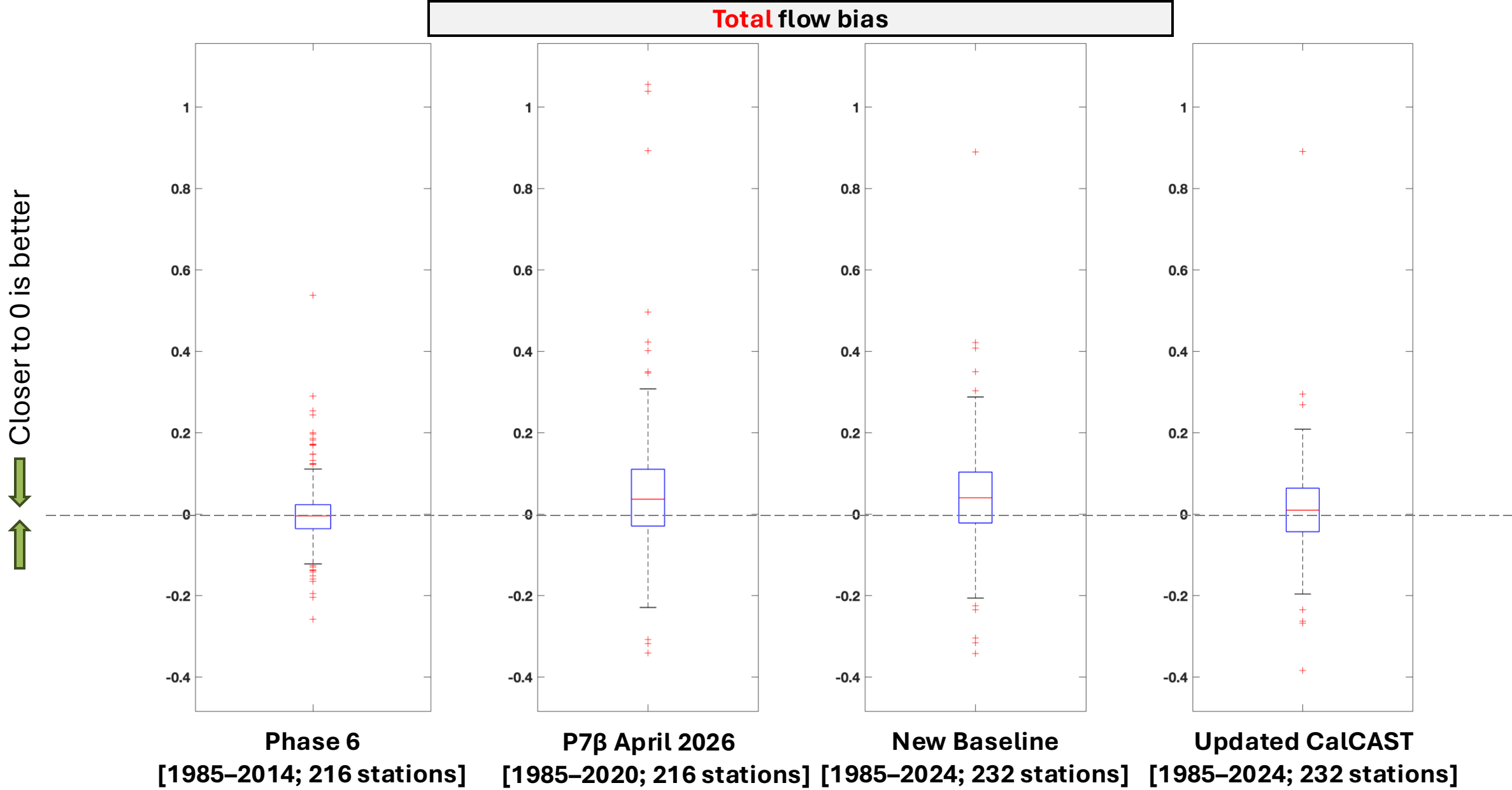
- LAND_EVAP parameters (coefficients to land use evapotranspiration) are adjusted during calibration to minimize bias (LQbias) between DWSM and CalCAST water yields.
 - $landevap = landevap * 2 / (2 - LQbias)$
- INFILT parameters are adjusted to minimize stormflow bias.
 - $INFILT = INFILT * LSstat$
 - LSstat represents stormflow bias normalized to total flow bias ($LSbias / LQbias$)

flow monitoring stations and upstream land segments

- Model performance statistics at flow monitoring stations are used for calibrating model parameters of upstream land segments.
- A land segment is related to flow monitoring stations based on **importance scores** defined as the percent of a station's drainage area covered by that land segment.
- Importance score of each land segment is scaled to 100%.
- Importance score of less than 10% is dropped, and the process is repeated.



We have a ‘as good or better’ hydrology calibration

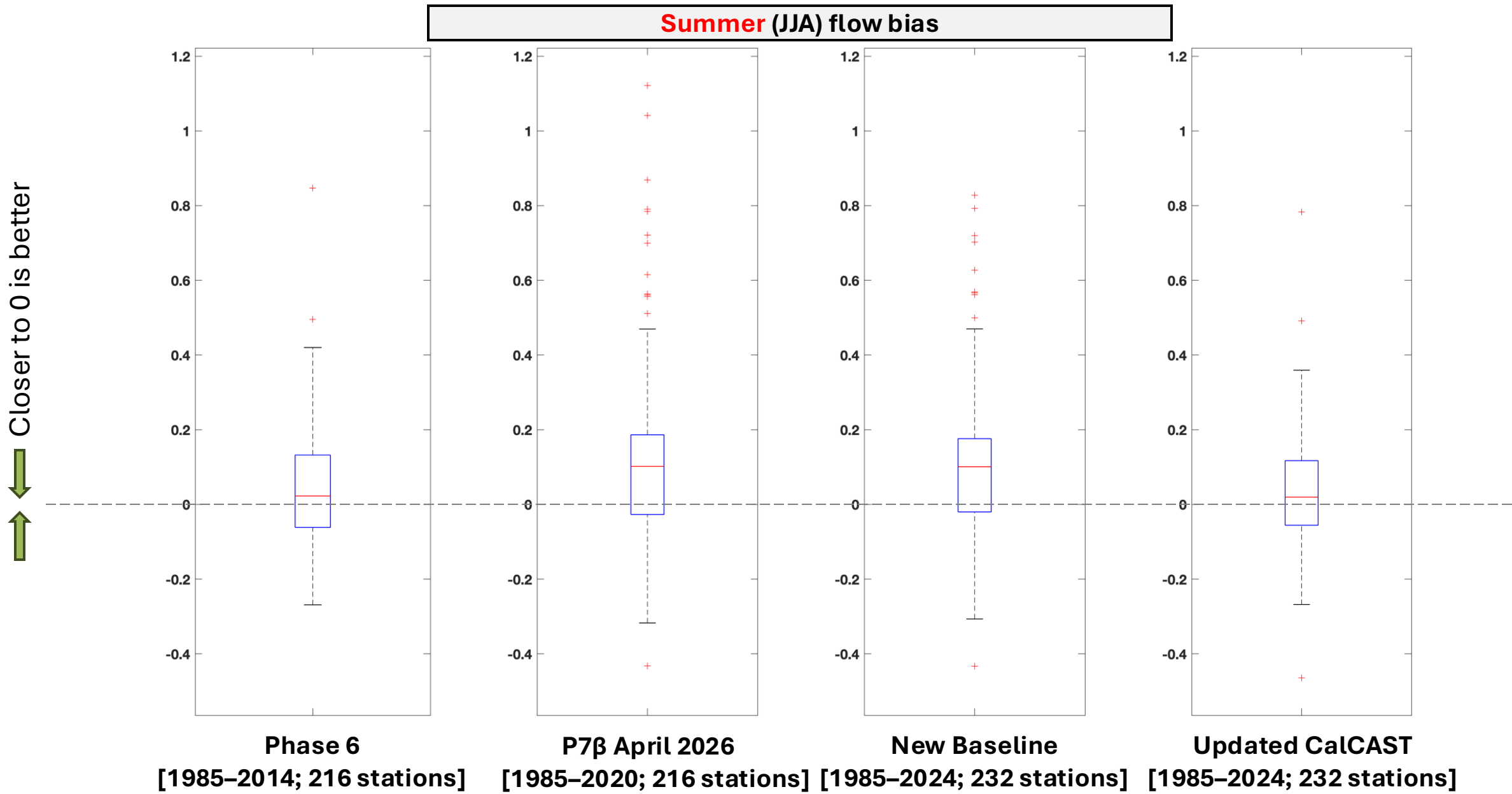


We examined the outliers ...

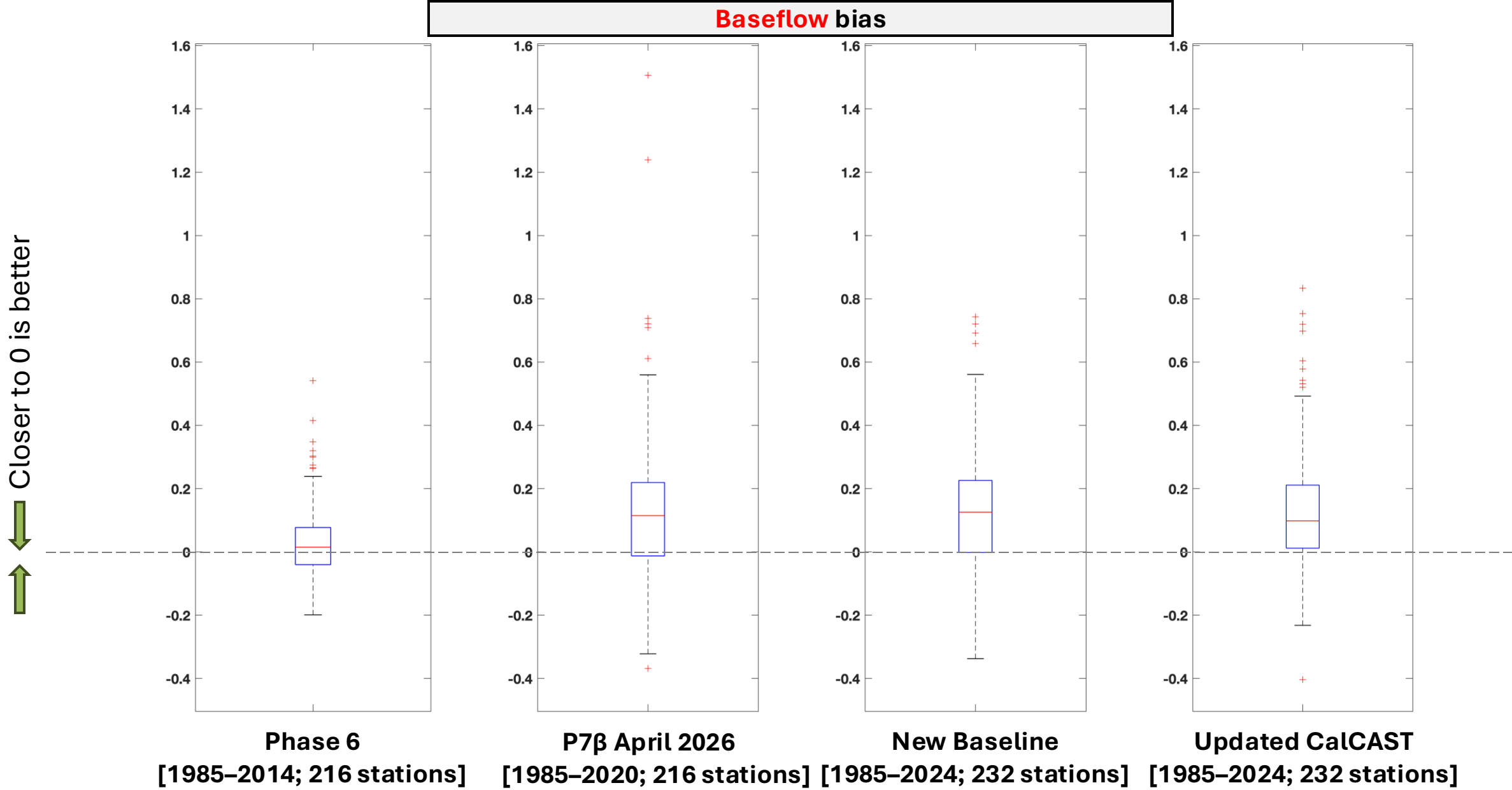
- There are a total of 5 stations with bias more than $\pm 30\%$

USGS	Station Name	Drainage area (sq. mi.)	CalCAST	DWSM
01643580	Monocacy River Near Dickerson, MD	961	not used	new in P7; has only 1.5 years of data
01617800	Marsh Run at Grimes, MD	18.9	has large bias	new in P7; 40 years
01642600	Linganore Creek at Linganore RD Near Frederick, MD	88.2	not used	new in P7; has a total of 4 months of data
01621410	Blacks Run at RT 726 at Harrisonburg, VA	10.9	not used	Nov 2000 to Sep 2002
01671025	North Anna River Above Little River NR Doswell, VA	467	not used	new in P7; 2005-2020

We have a ‘as good or better’ hydrology calibration

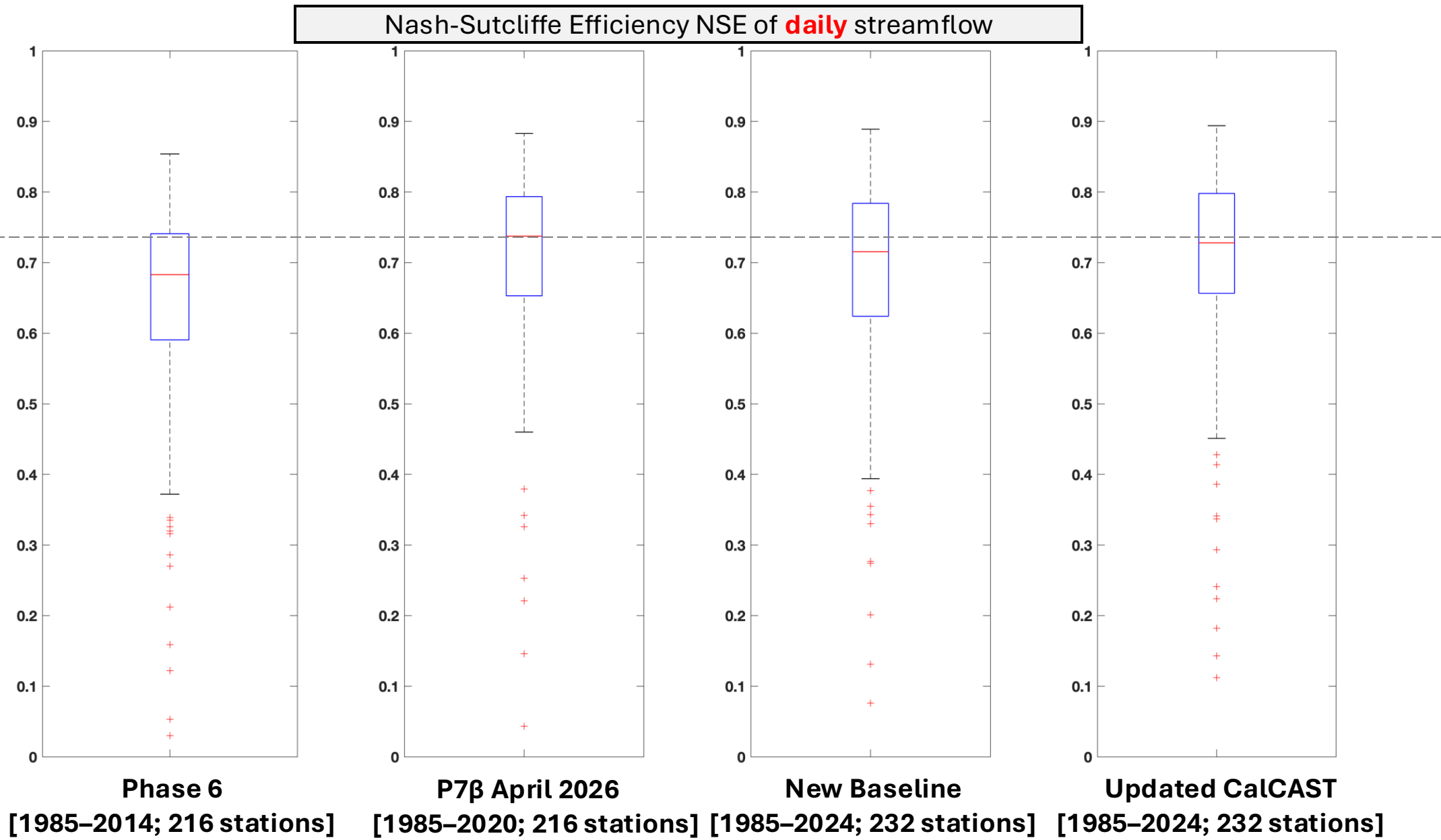


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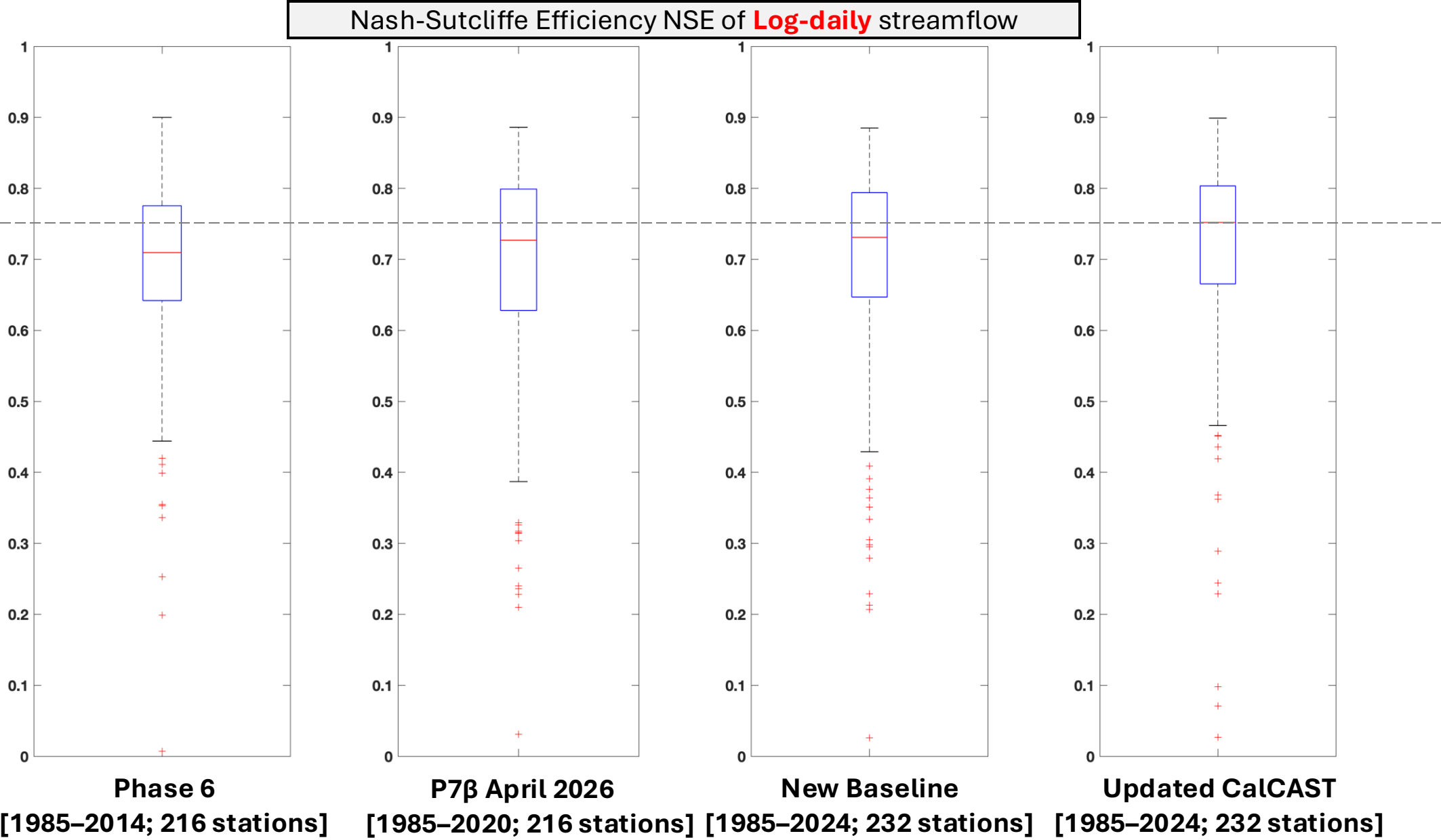
We have a 'as good or better' hydrology calibration

↑
Closer to 1 is better

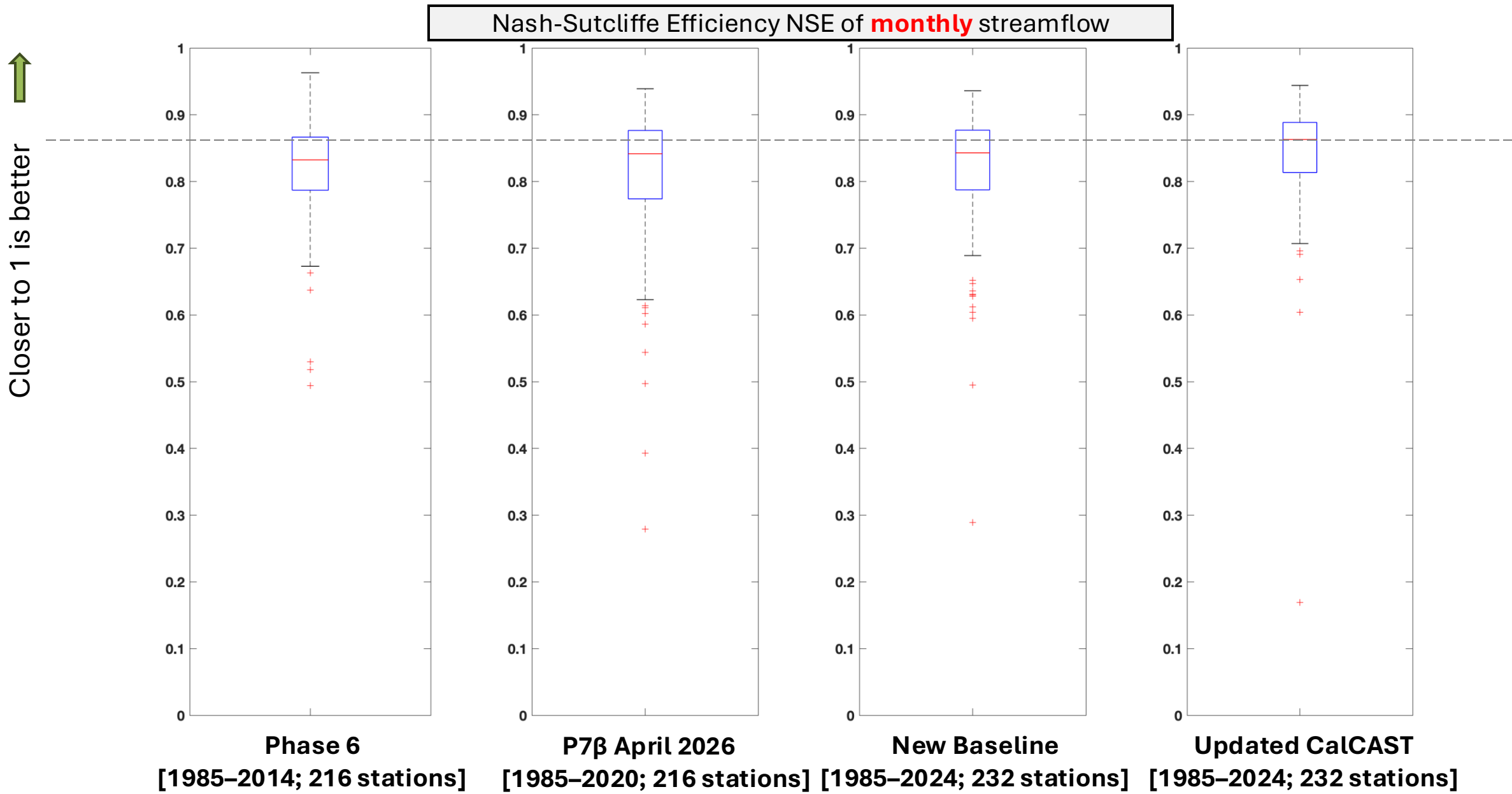


We have a 'as good or better' hydrology calibration

↑
Closer to 1 is better



We have a ‘as good or better’ hydrology calibration



RIM stations and Marietta

Bias	Phase 6	April 2026	Baseline	+ CalCAST
Conowingo	2%	2%	2%	-1%
Marietta	0%	1%	0%	-3%
Potomac	-4%	3%	4%	3%
James	1%	8%	8%	-3%
Rappahannock	1%	-2%	0%	2%
Appomattox	-4%	3%	4%	8%
Pamunkey	-3%	3%	5%	7%
Mattaponi *	-1%	10%	9%	3%
Patuxent	-1%	8%	9%	4%
Choptank	-3%	-13%	-12%	0%

* with adjusted water yield

RIM stations and Marietta

NSE daily flow	Phase 6	April 2026	Baseline	+ CalCAST
Conowingo	0.836	0.845	0.847	0.851
Marietta	0.854	0.876	0.877	0.879
Potomac	0.844	0.816	0.849	0.865
James	0.841	0.881	0.883	0.880
Rappahannock	0.786	0.861	0.859	0.863
Appomattox	0.621	0.674	0.637	0.658
Pamunkey	0.679	0.778	0.758	0.768
Mattaponi *	0.262	0.253	0.201	0.341
Patuxent	0.531	0.633	0.628	0.674
Choptank	0.504	0.704	0.674	0.693

* with adjusted water yield

RIM stations and Marietta

NSE monthly flow	Phase 6	April 2026	Baseline	+ CalCAST
Conowingo	0.879	0.906	0.906	0.914
Marietta	0.873	0.908	0.908	0.916
Potomac	0.903	0.896	0.909	0.927
James	0.919	0.927	0.924	0.941
Rappahannock	0.896	0.910	0.915	0.918
Appomattox	0.915	0.902	0.906	0.898
Pamunkey	0.894	0.892	0.897	0.900
Mattaponi *	0.846	0.810	0.813	0.855
Patuxent	0.899	0.869	0.866	0.886
Choptank	0.774	0.809	0.823	0.848

* with adjusted water yield

Rule based calibration of EOF sediment model parameters

Hydrology

CAST

- Annual land use data for 18 core land use types
- Direct loads: municipal, industrial, septic, rapid infiltration

CalCAST

- Average annual yield of flow and stormflow

Edge of field Sediment

CAST

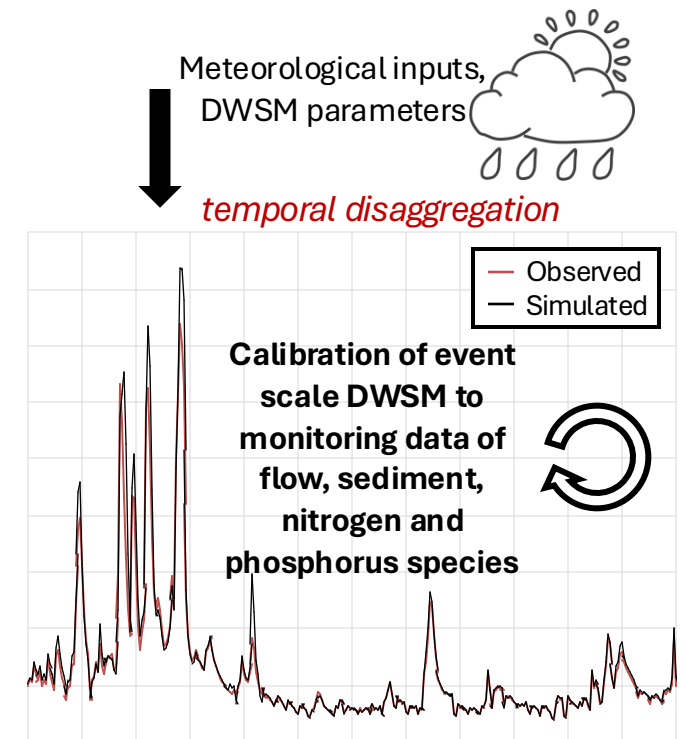
- Monthly estimates of detached sediment (land segments)
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CalCAST

- Average annual yield of sediment
 - Aggregated to land segment for model calibration
 - Catchment scale data for sub-county spatial variability

*P7 land catchment
segment land use
scale*

DWSM process-based hourly estimates

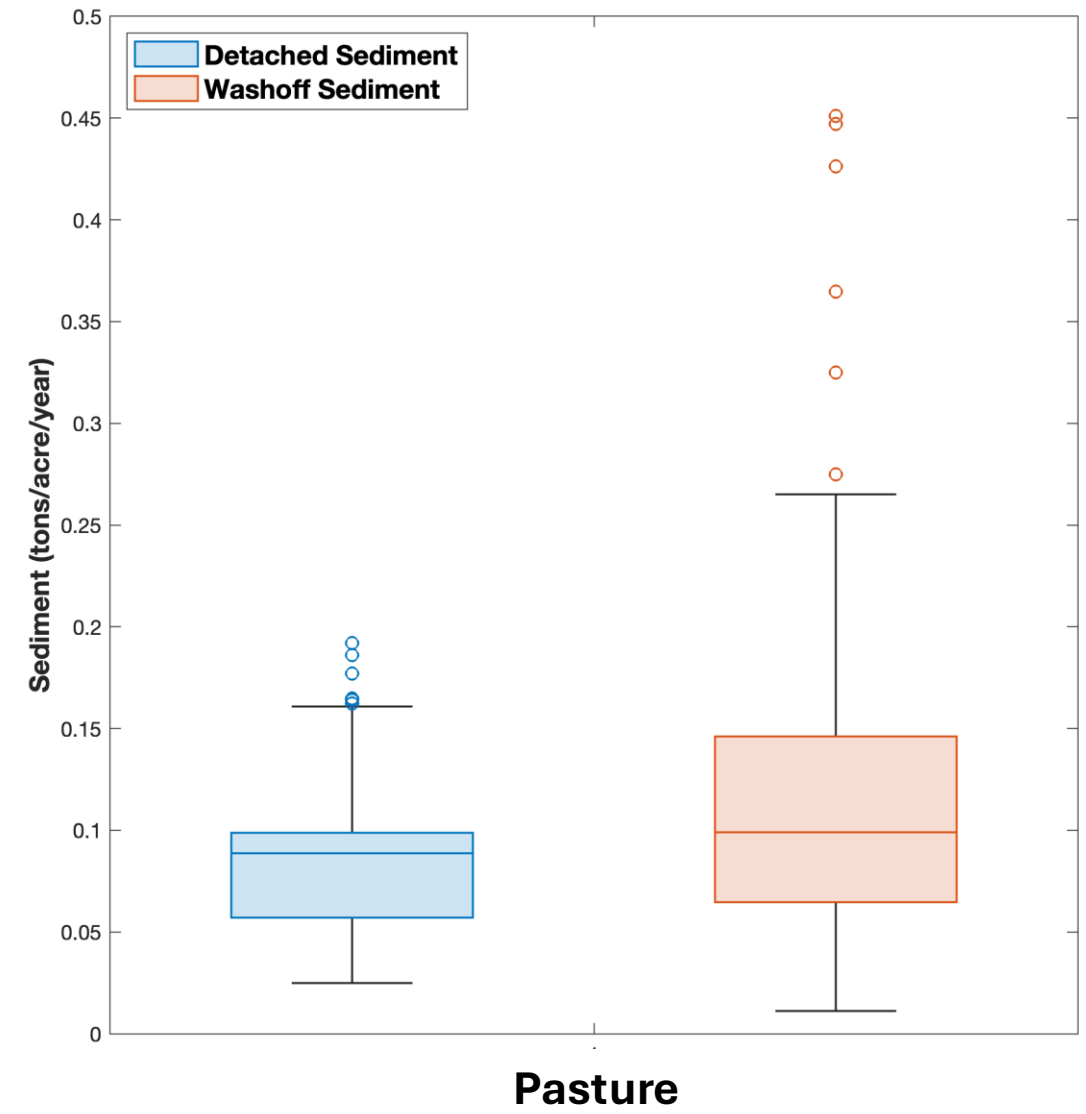
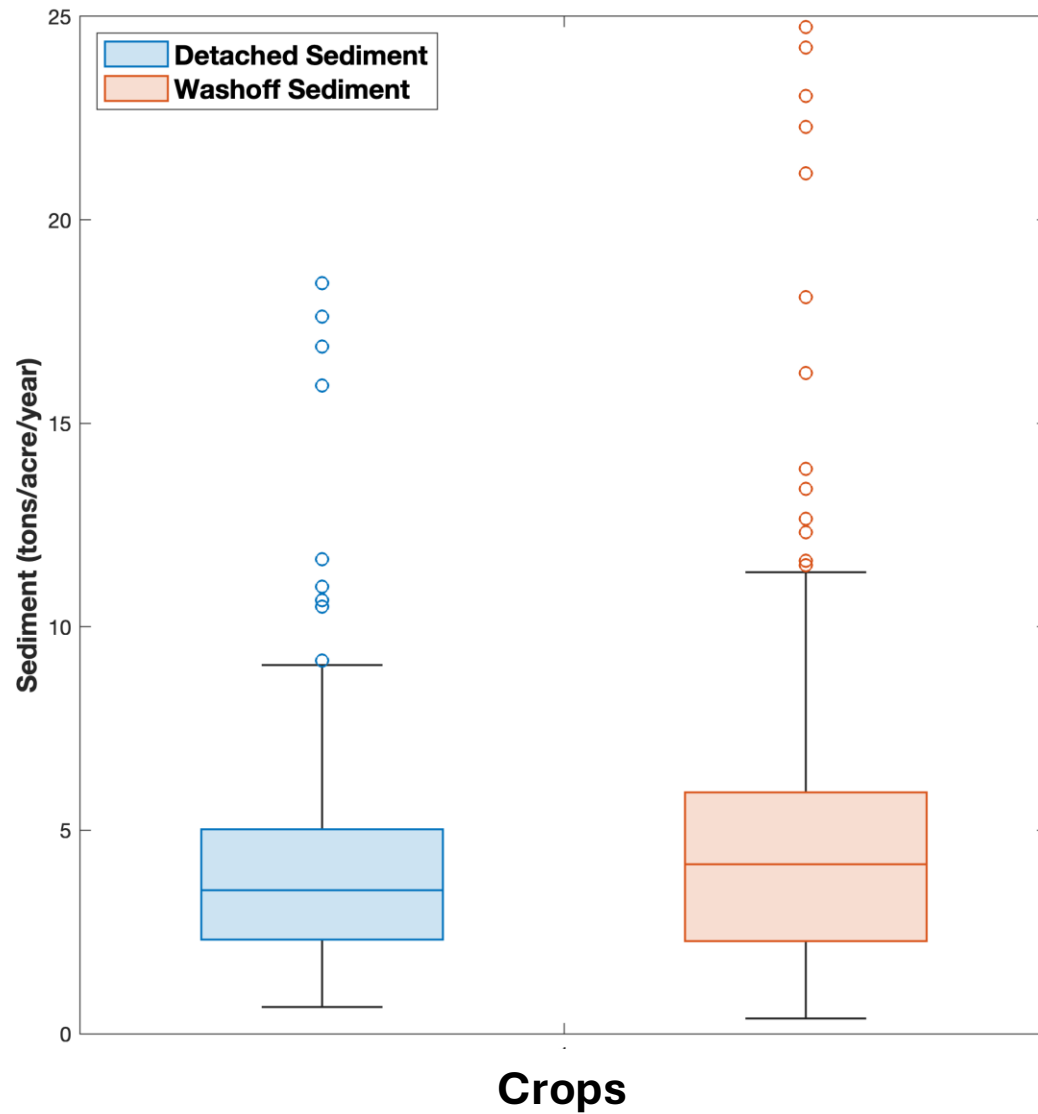


Rule based calibration of EOF sediment model parameters

Parameter	Description
KRER	Coefficient that determines how much sediment is detaches from the soil matrix as a function of rainfall.
JRER	Exponent that determines how much sediment is detaches from the soil matrix as a function of rainfall.
KSER	Coefficient that determines the sediment transport capacity as a function of surface outflow.
JSER	Exponent that determines the sediment transport capacity as a function of surface outflow.
NVSI	Rate at which sediment is added to detached soil from atmosphere; Negative values can simulate removal of sediment by wind or human activities.
COVER	Fraction of soil surface in vegetative cover and unavailable for erosion by rainfall; COVER varies monthly by land use.
AFFIX	Rate at which detached sediment is re-attached to soil matrix due to compaction.

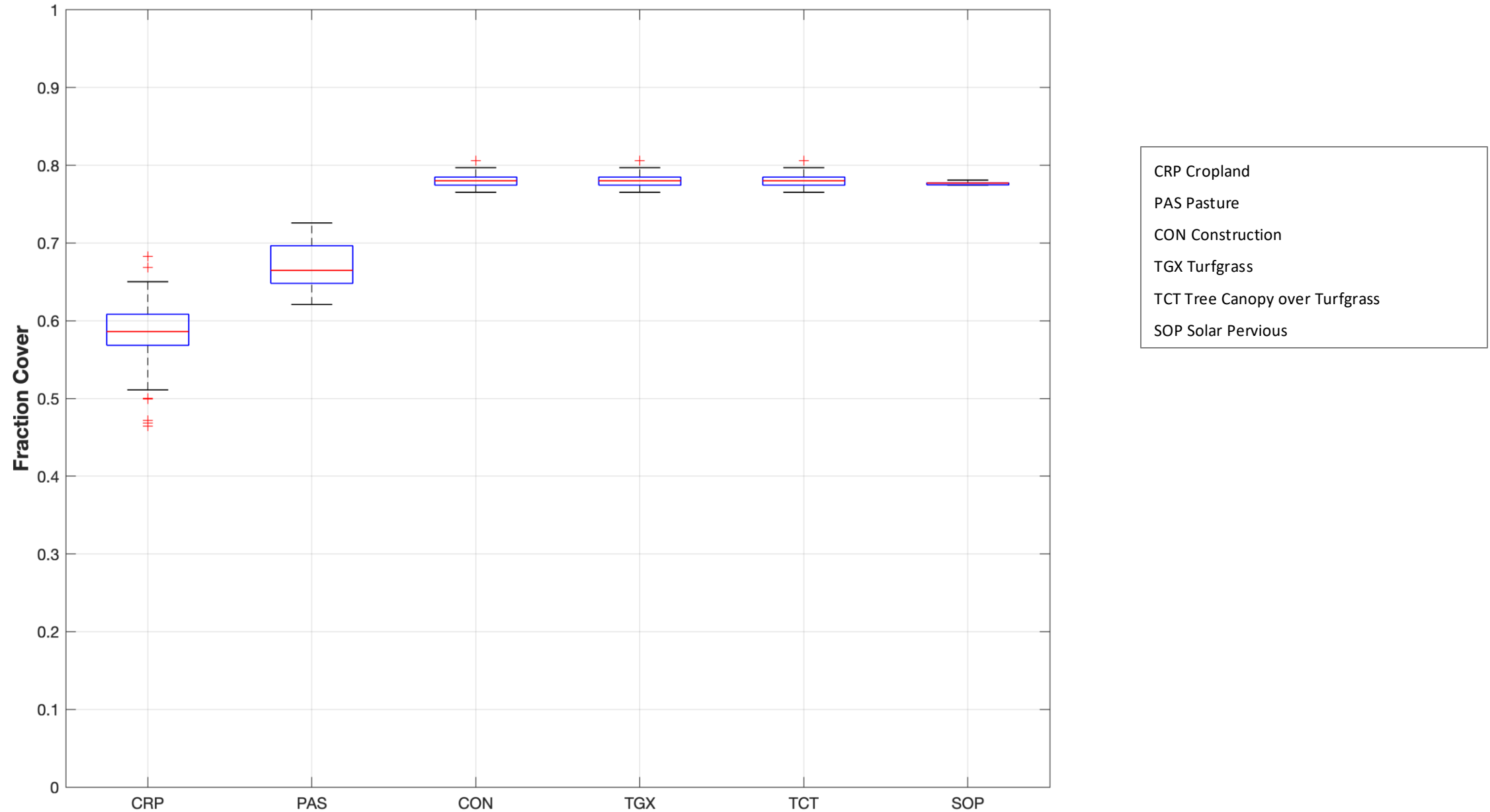
$$\begin{aligned}
 NVSI &= 1.5 \times EOF \text{ sediment yield} \\
 KRER &= 0.075 \times KSER \\
 JRER &= JSER = 6 \times \exp(-KSER^{0.25})
 \end{aligned}$$

Detached sediment and calibrated washoff



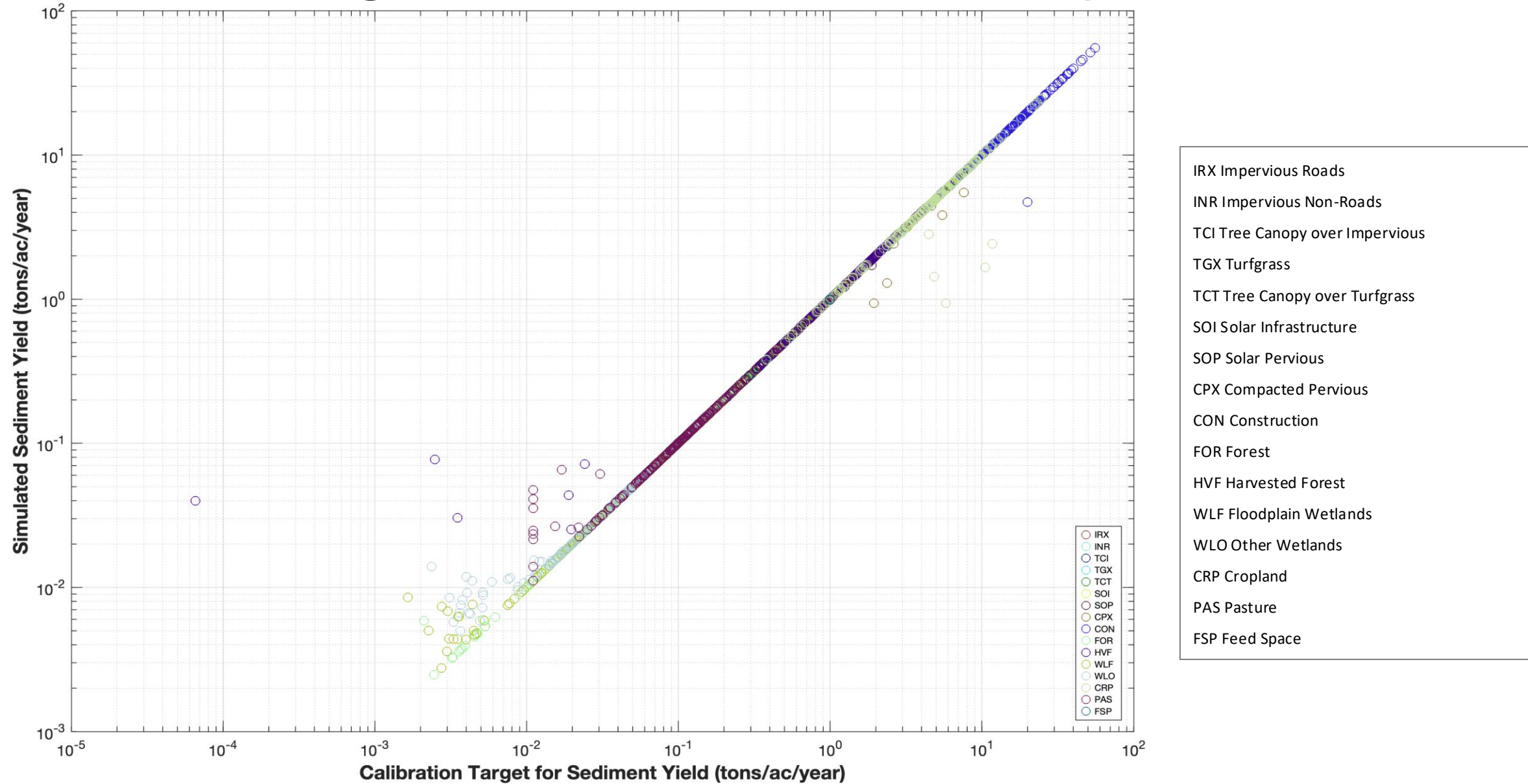
→ Left and right panels show data for crops and pasture, respectively. Boxplots show variability in data for 235 land segments.

Average annual fraction cover



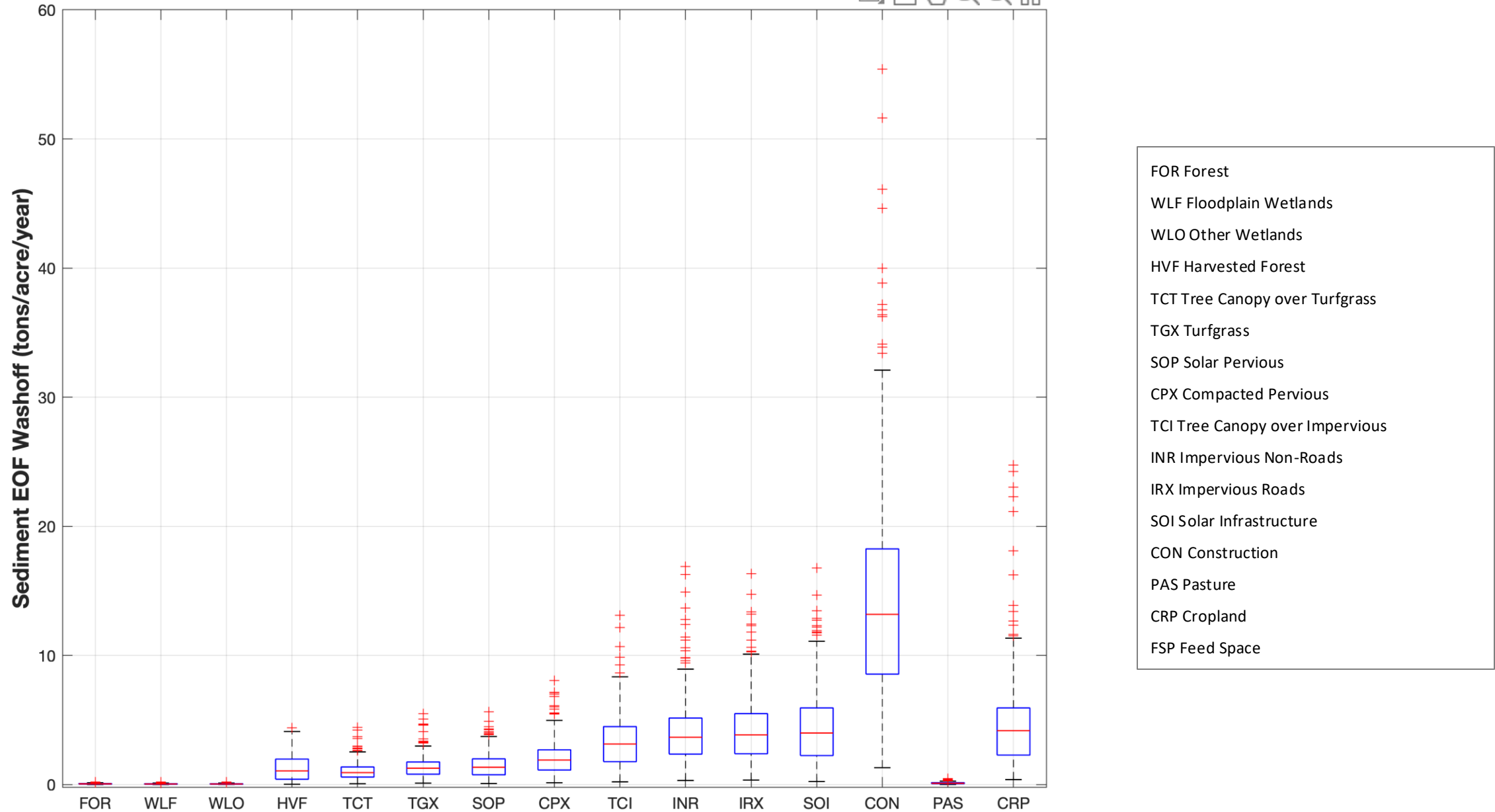
→ Each boxplot show variability in data for 235 land segments.

Calibration target vs. simulated EOF sediment yield



→ 1:1 agreement indicates calibrated parameters reproduced average annual estimates of land segment EOF sediment yields.

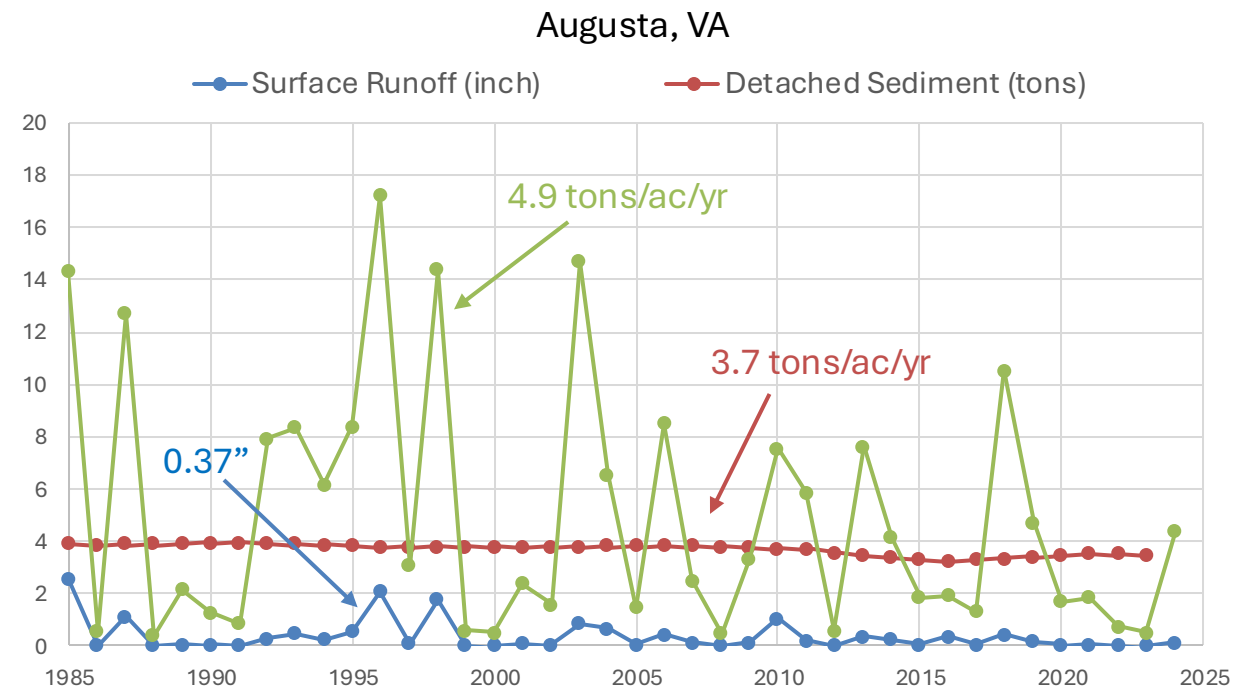
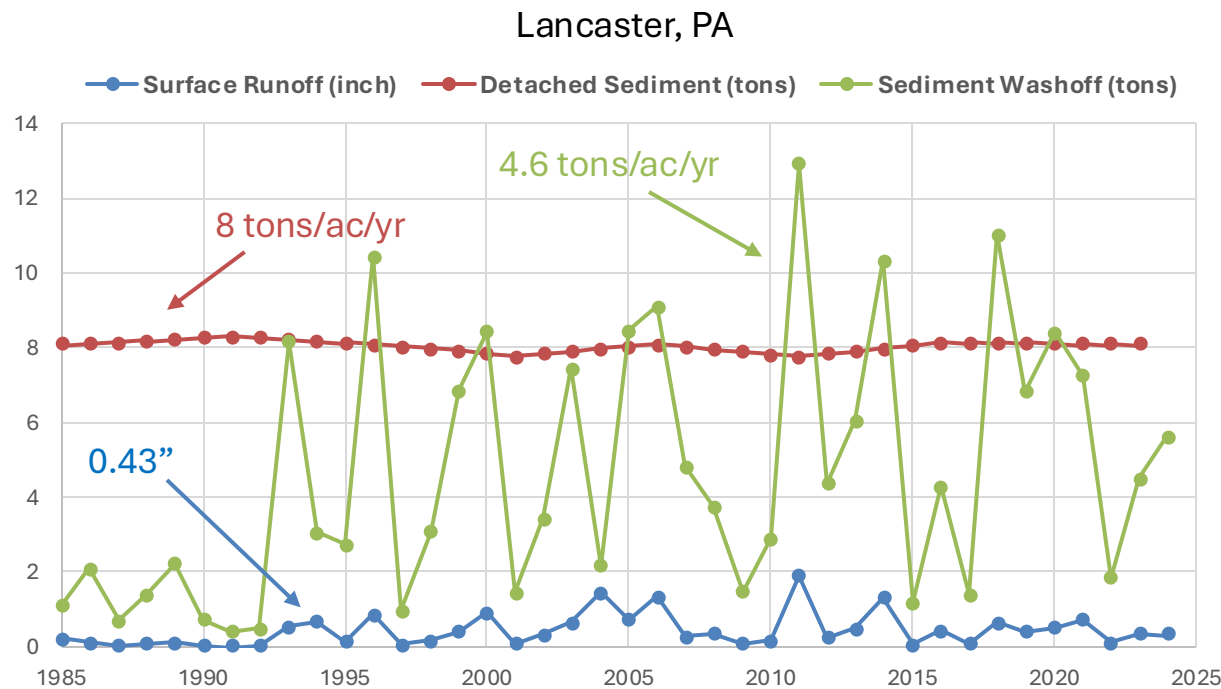
Calibrated average annual EOF sediment yield



→ Each boxplot show variability in data for 235 land segments.

Annual summary of hourly simulation

Process-based sediment model tracks storage of detached sediment (from rainfall, field operations, production/reattachment rates, etc.) and transport potential (surface flow) to estimate event scale storage and transport limiting conditions (e.g., higher concentration on the rising limb of the hydrograph than on the receding limb).



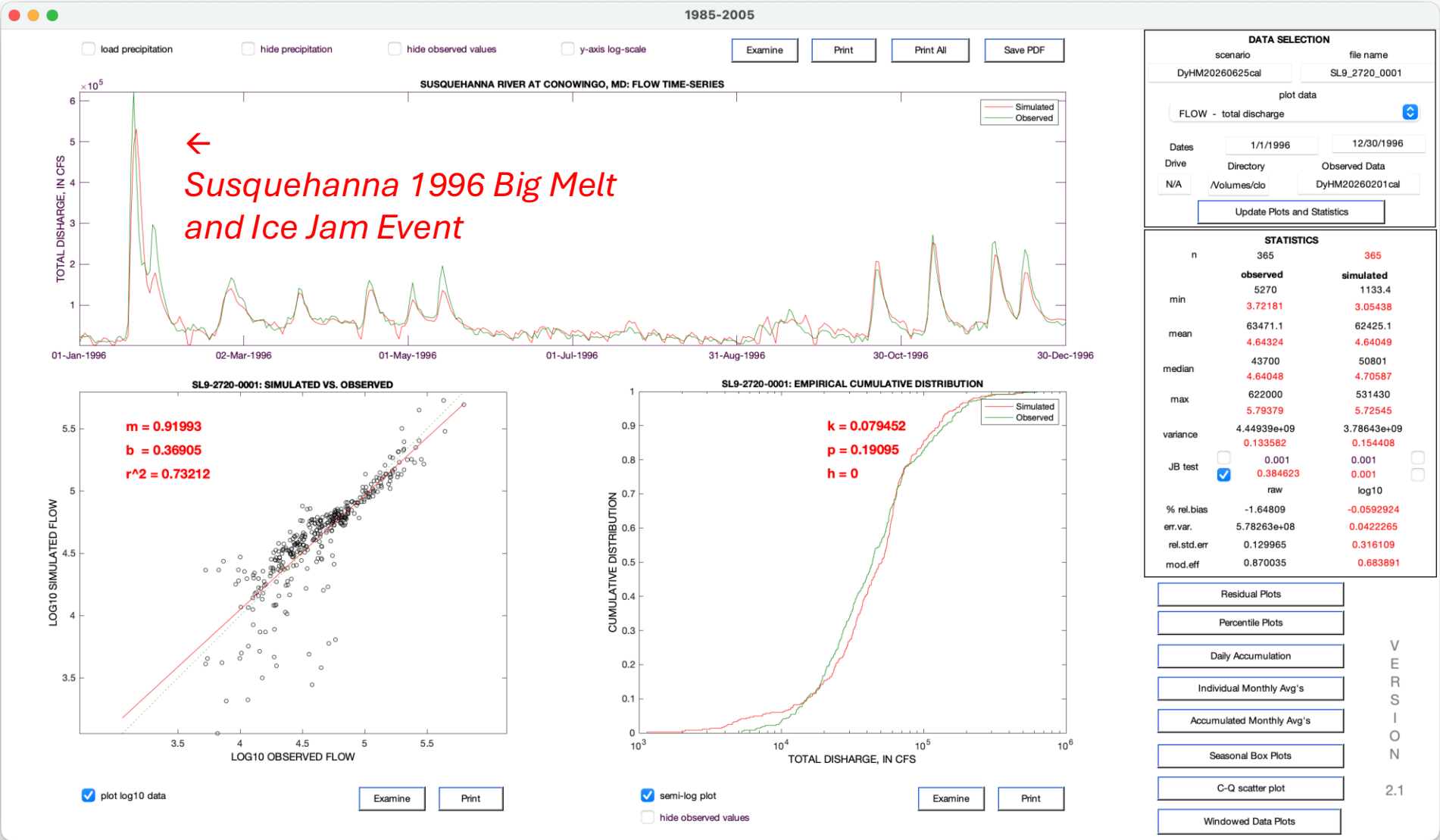
Summary and next steps

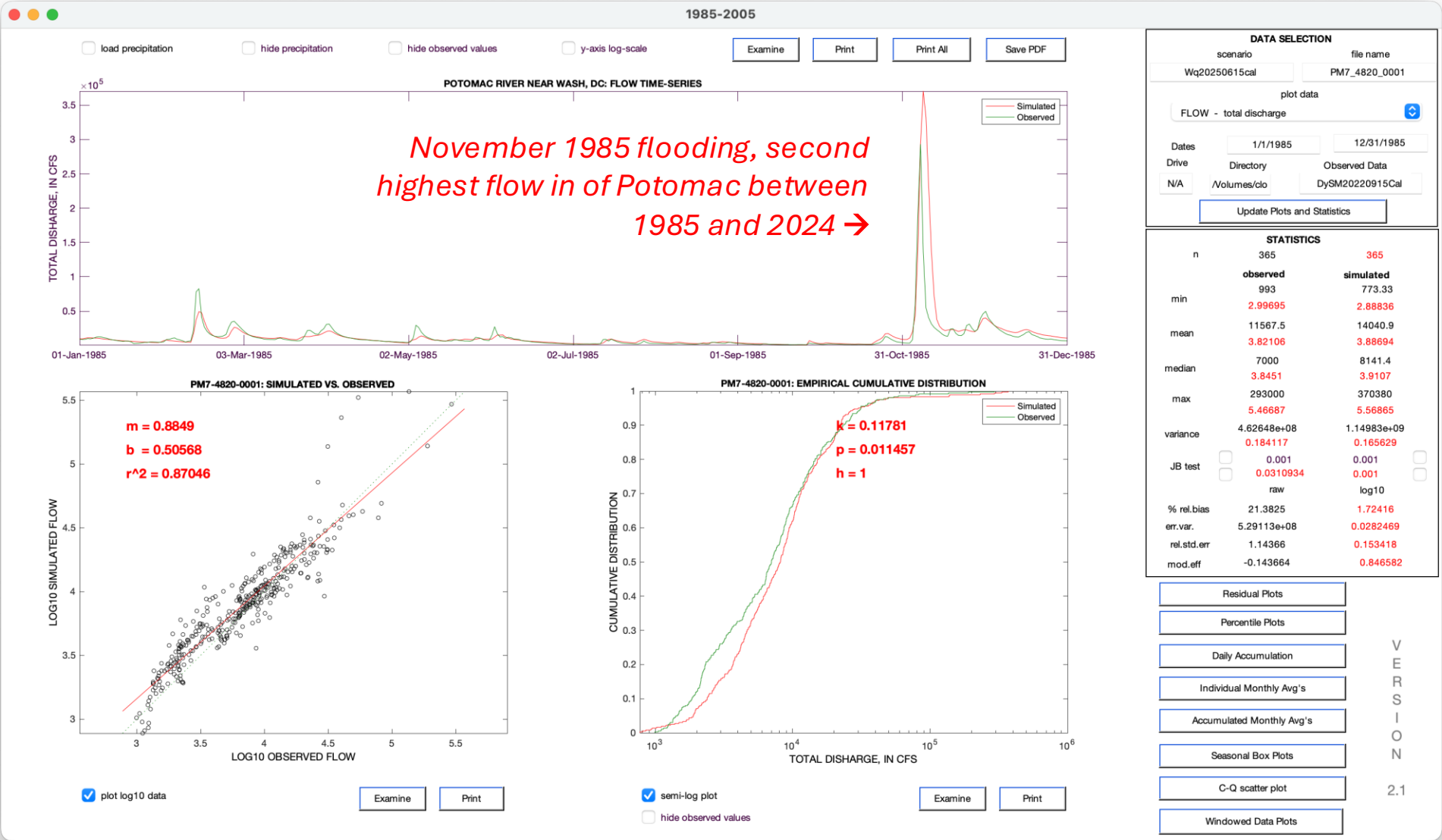
1. Draft 2026 beta calibrations of hydrology and EOF sediment models were completed. Hydrology model is performing *as good or better* to that of Phase 6 model. Model is using P7 CAST inputs for land use and sediment (detached sediment and fraction cover). It is based on the improved CalCAST 1985-2021 flow and stormflow data. The DWSM calibration uses 1985-2024 daily observations of streamflow at 232 stations.

2. Use the calibrated hydrology and EOF sediment models for developing APLE and water quality models, while integrating P7 CAST nutrient and BMP inputs.

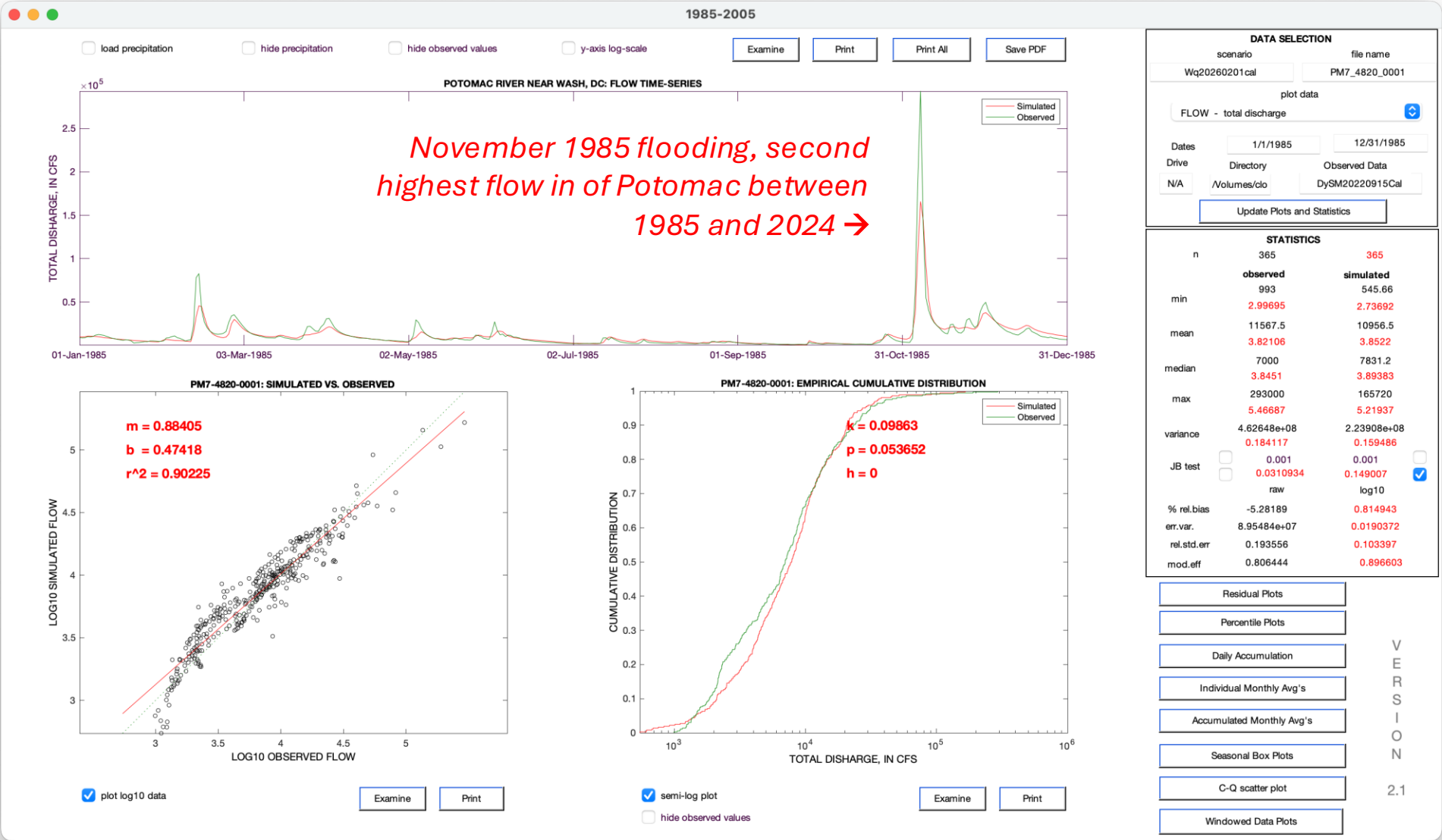
Requesting Modeling Workgroup ...

... to approve draft 2026 beta hydrology and edge of field sediment calibrations for water quality modeling.

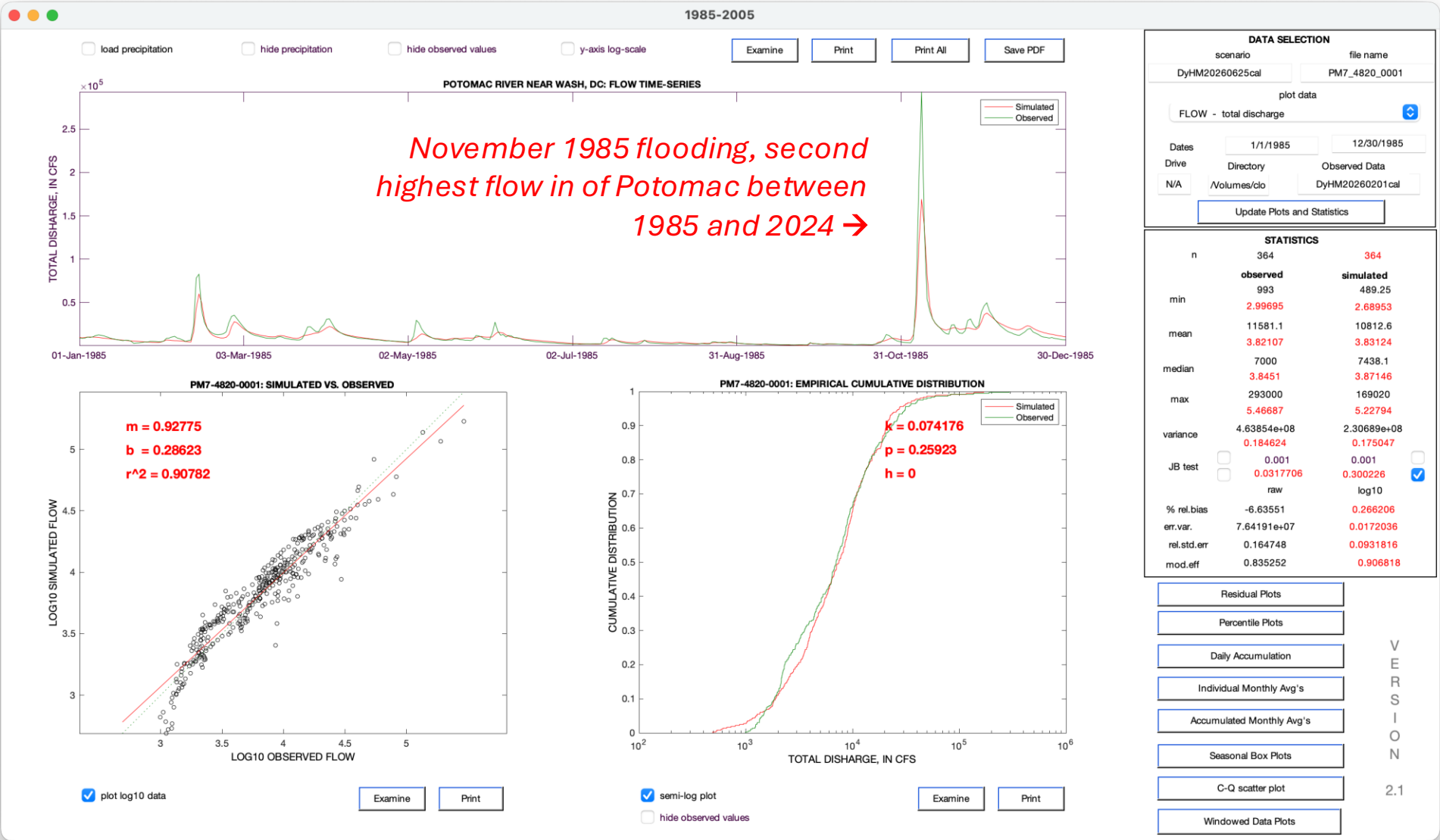




→ Observation has flow greater than 200,000 ft³/s on 1-day vs. 4-days in the April 2025 P7β hydrology calibration.



→ We are likely to end up with something like this.



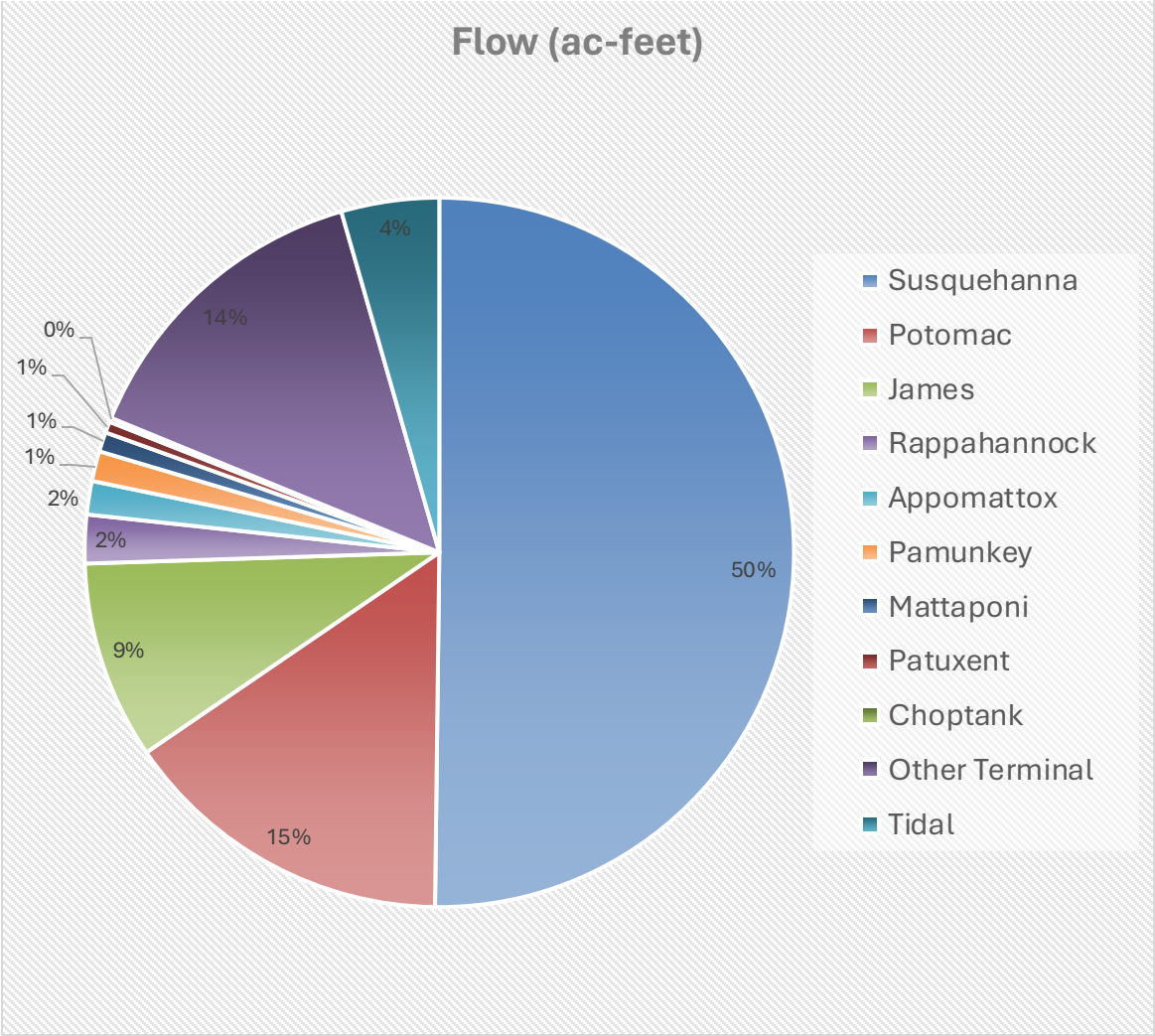
More monitoring data is being used in Phase 7

DWSM Variable	#Stations in Phase 6	#Stations in Phase 7	#Observation in Phase 6	#Observation in Phase 7	Change
Streamflow	249	266	2,749,709	3,245,529	+18%
Nitrogen	184	223	48,634	66,393	+37%
Phosphorus	211	244	55,115	66,136	+20%
Nitrate	217	245	56,514	66,045	+17%
Ammonia	212	245	54,904	66,260	+21%
Dissolve Phosphate	172	204	43,777	59,088	+35%
Suspended Sediment	164	223	57,814	68,970	+19%

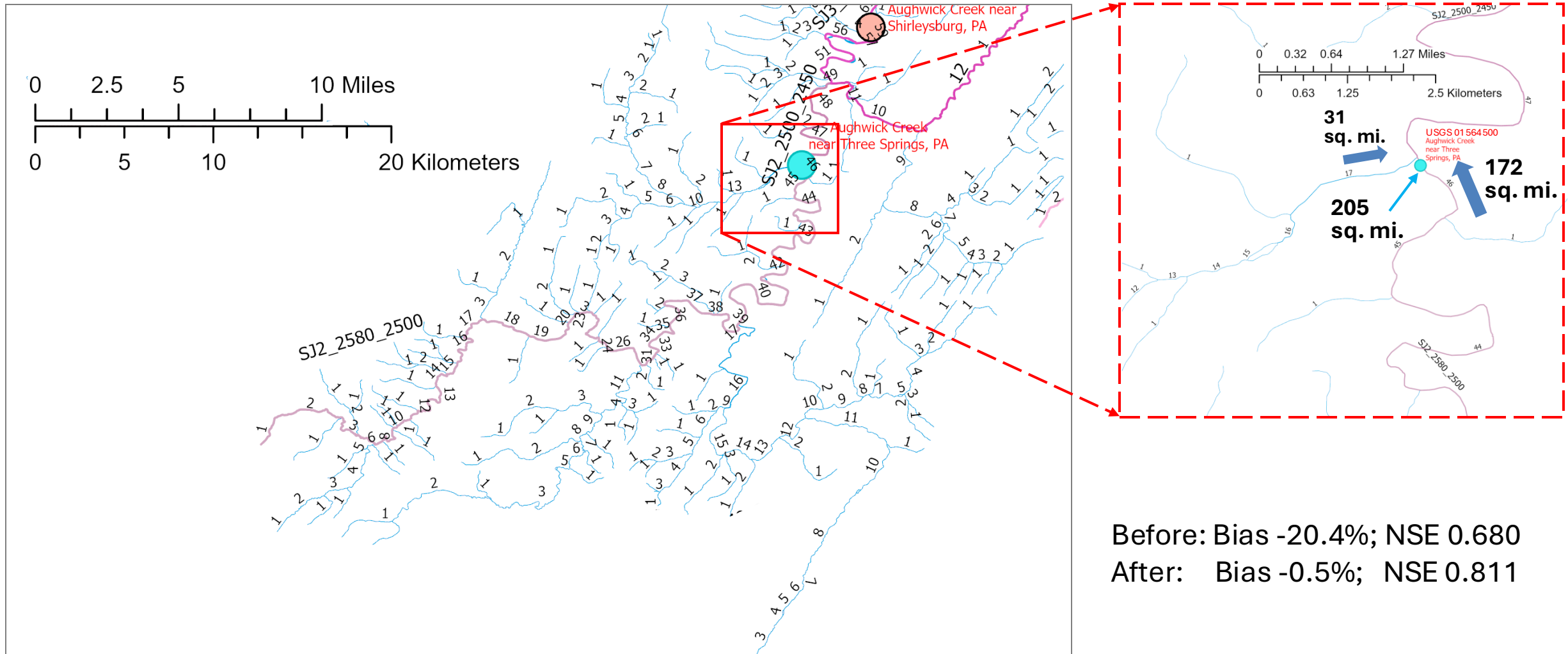
→ In Q2, we will start using concentrations data beyond 2014 for (a) riverine water quality calibration, and (b) verification in small streams.

Geography	Flow (ac-feet)	Percent
Susquehanna	29,104,202	50%
Potomac	8,854,962	15%
James	5,238,615	9%
Rappahannock	1,281,614	2%
Appomattox	883,402	2%
Pamunkey	793,500	1%
Mattaponi	517,263	1%
Patuxent	294,536	1%
Choptank	110,873	0%
Other Terminal	8,322,492	14%
Tidal	2,583,911	4%

The DWSM with CalCAST total flow and stormflow inputs

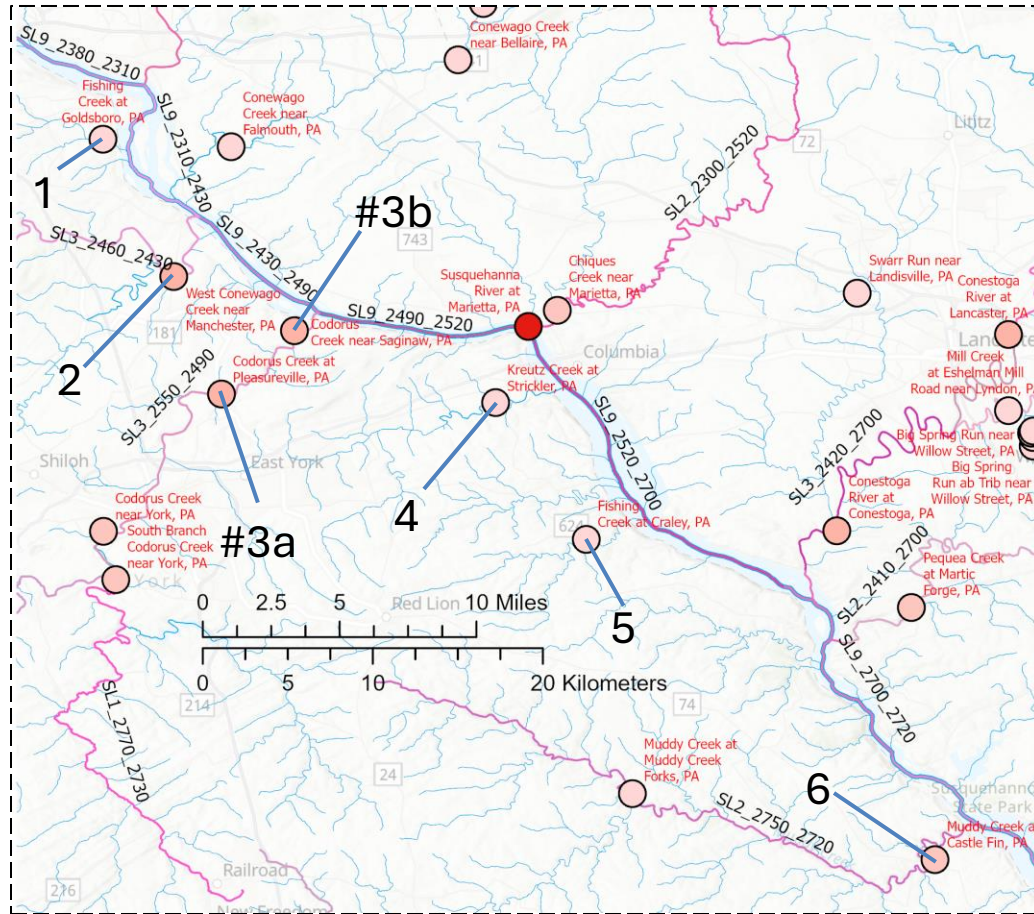


We revised mapping of monitoring stations and confluences



→ We have a total of 78 monitored mainstem confluences with as many as 6 tributaries (as compared to 31 confluences in Phase 6).

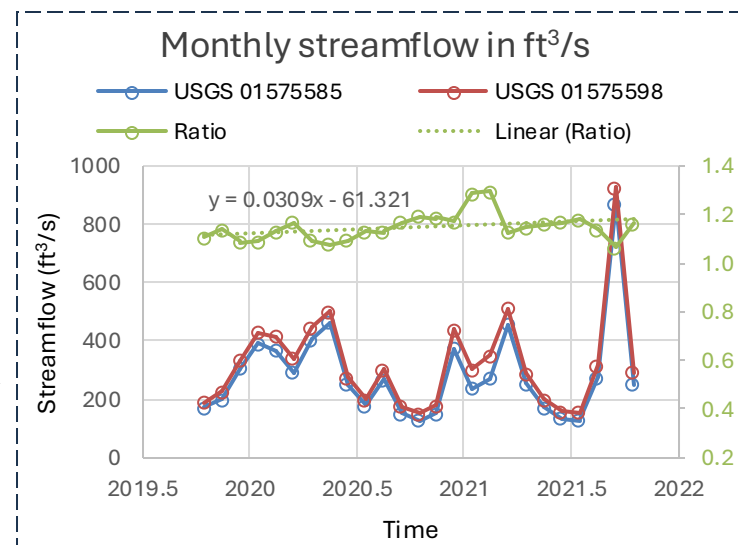
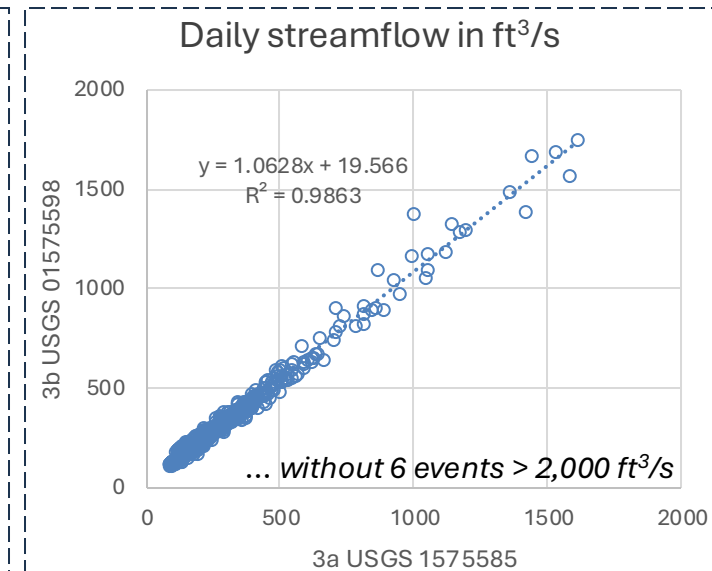
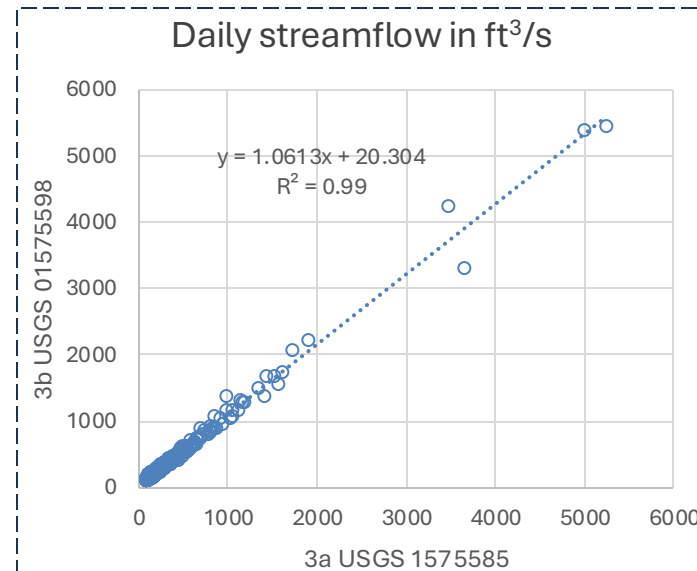
Codorus Creek in York County, PA



- **#3a USGS 01575585** Codorus Creek at Pleasureville, PA
[267 sq. mi; 1/1/1985 to **10/31/2021**]
- **#3b USGS 01575598** Codorus Creek at Saginaw, PA
[277 sq. mi; **1/1/2019** to present]

Drainage area of #3b is ~**1.04x** of #3a

Streamflow of #3b is ~**1.13x** of #3a



- At this station we have a +19.6% bias (Jan 1985 to Oct 2021) in April 2026 beta hydrology calibration.
- Q. Adjust #3a Jan 1985 to Dec 2018 streamflow data with equation in the scatter plot and append #3b from Jan 2019 onwards.

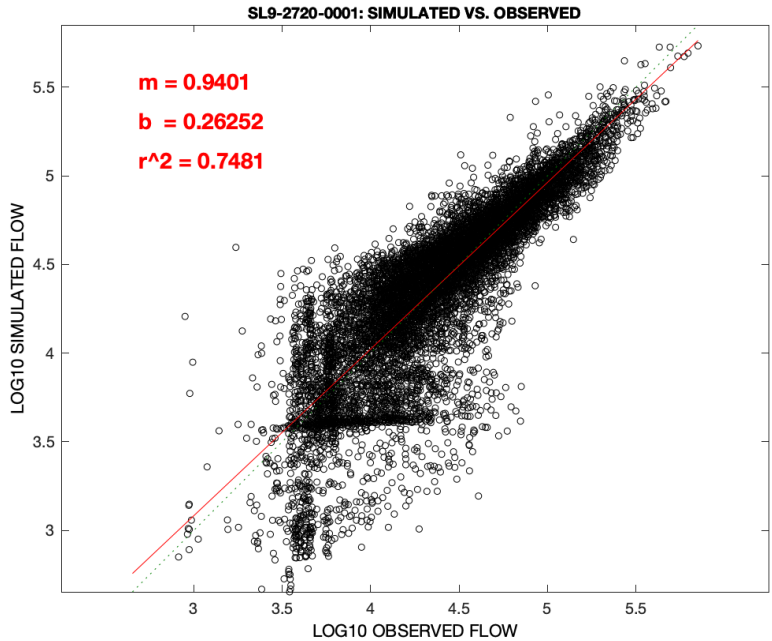
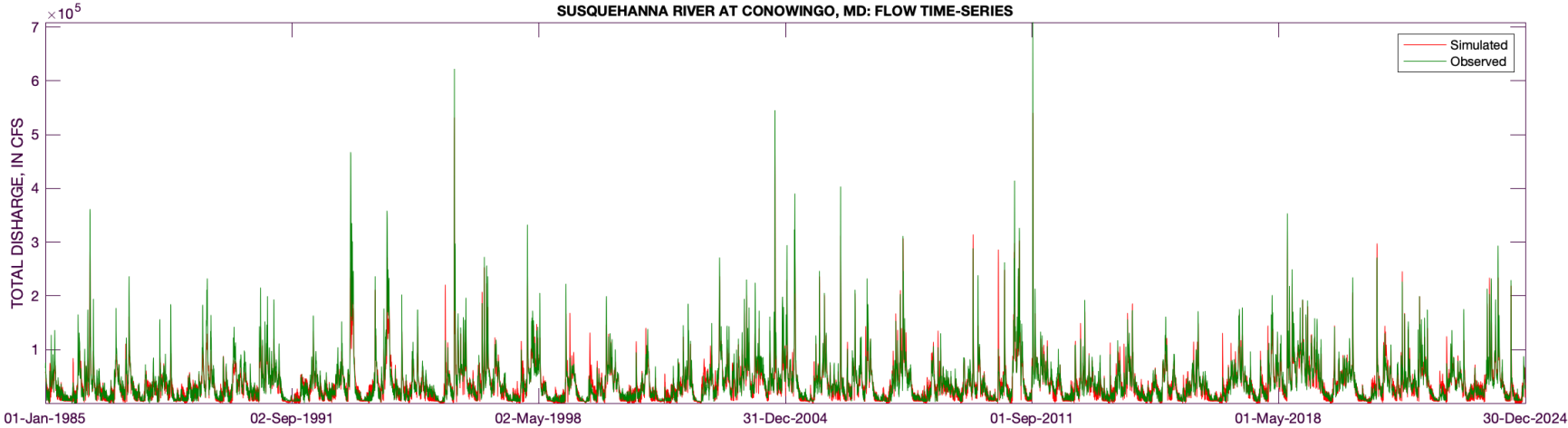
☐ load precipitation ☐ hide precipitation ☐ hide observed values ☐ y-axis log-scale

Examine

Print

Print All

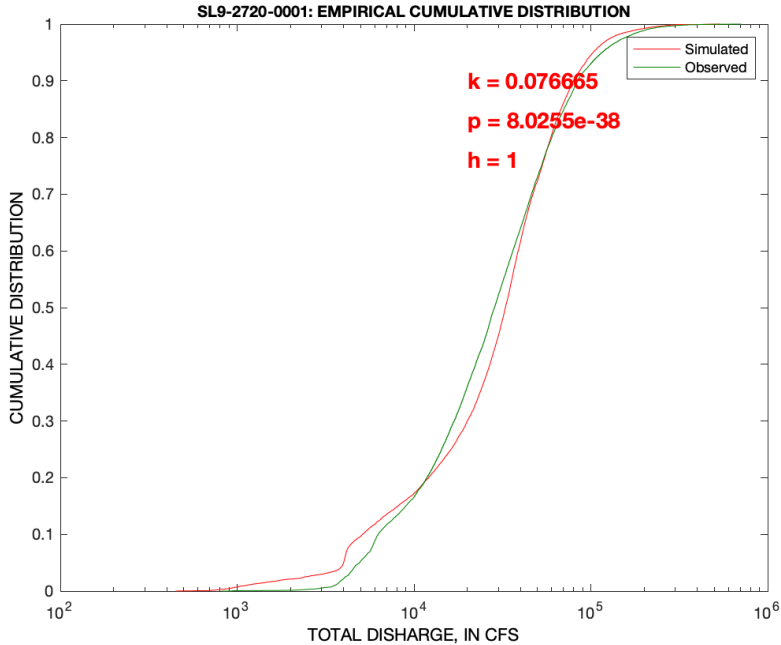
Save PDF



☒ plot log10 data

Examine

Print



☒ semi-log plot

☐ hide observed values

Examine

Print

DATA SELECTION

scenario

file name

DyHM20260625cal

SL9_2720_0001

plot data

FLOW - total discharge

Dates

1/1/1985

12/30/2024

Drive

Directory

Observed Data

N/A

/Volumes/clo

DyHM20260201cal

Update Plots and Statistics

STATISTICS

n	14609	14609
	observed	simulated
min	821	450.42
	2.91434	2.65362
mean	40604.2	40174.9
	4.42543	4.42286
median	28500	32895
	4.45484	4.51713
max	709000	540170
	5.85065	5.73253
variance	1.78517e+09	1.36079e+09
	0.171468	0.202567
JB test	☐ 0.001	0.001 ☐
	☐ 0.001	0.001 ☐
	raw	log10
% rel.bias	-1.05731	-0.057946
err.var.	2.6616e+08	0.0516481
rel.std.err	0.149095	0.301211
mod.eff	0.850905	0.698789

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

Windowed Data Plots

V
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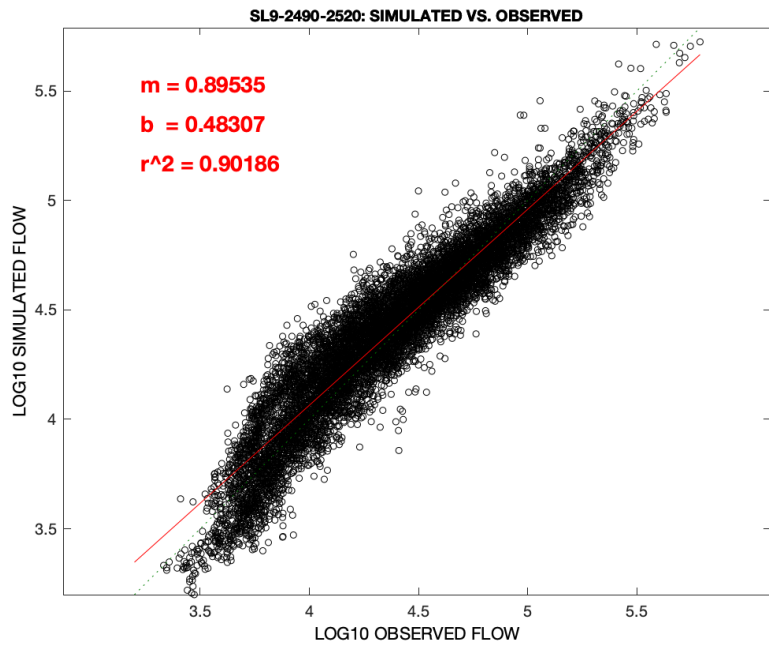
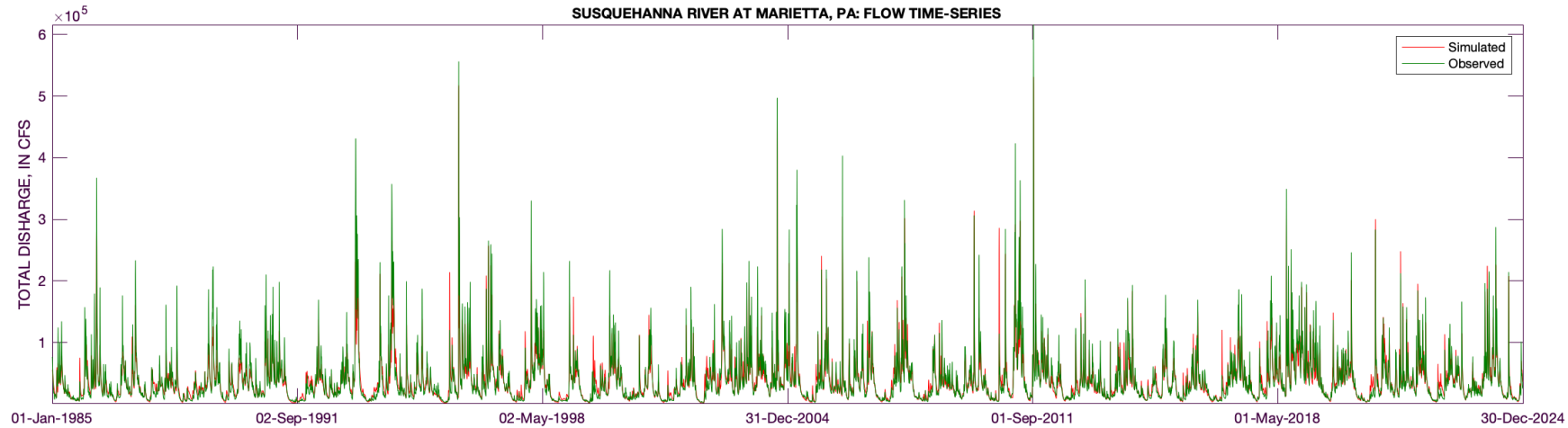
☐ load precipitation ☐ hide precipitation ☐ hide observed values ☐ y-axis log-scale

Examine

Print

Print All

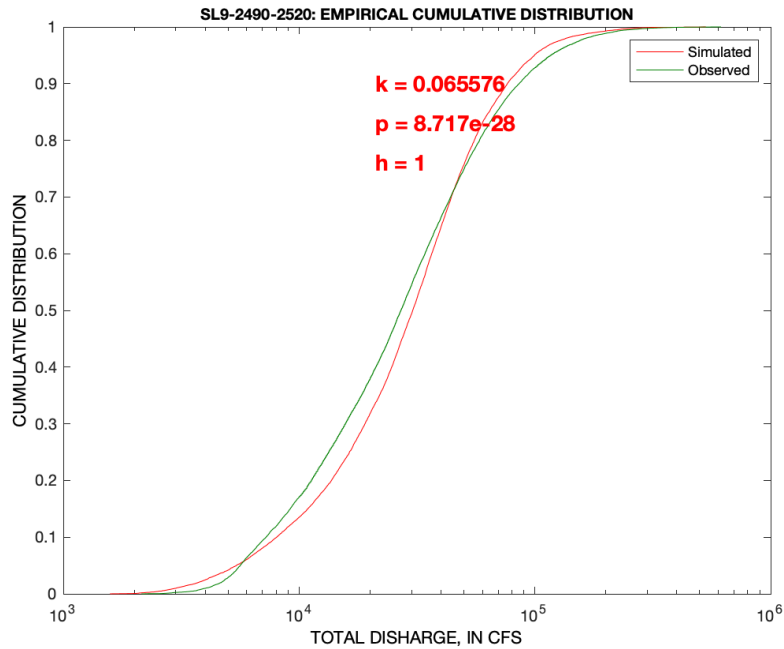
Save PDF



☒ plot log10 data

Examine

Print



☒ semi-log plot

☐ hide observed values

Examine

Print

DATA SELECTION

scenario

file name

DyHM20260625cal

SL9_2490_2520

plot data

FLOW - total discharge

Dates

1/1/1985

12/30/2024

Drive

Directory

Observed Data

N/A

/Volumes/clo

DyHM20260201cal

Update Plots and Statistics

STATISTICS

n	14609	14609
	observed	simulated
min	2150	1580.5
	3.33244	3.19879
mean	39661	38625.5
	4.41803	4.43874
median	27000	30332
	4.43136	4.4819
max	616000	530830
	5.78958	5.72496
variance	1.76158e+09	1.25013e+09
	0.159992	0.142215
JB test	☐ 0.001	0.001 ☐
	☐ 0.001	0.001 ☐
	raw	log10
% rel.bias	-2.61084	0.468888
err.var.	2.12282e+08	0.0161386
rel.std.err	0.120506	0.100871
mod.eff	0.879494	0.899129

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

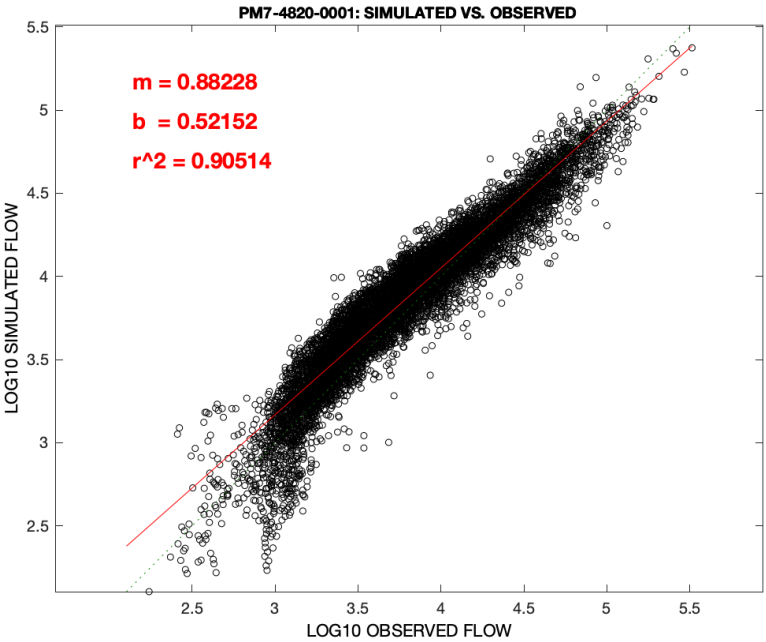
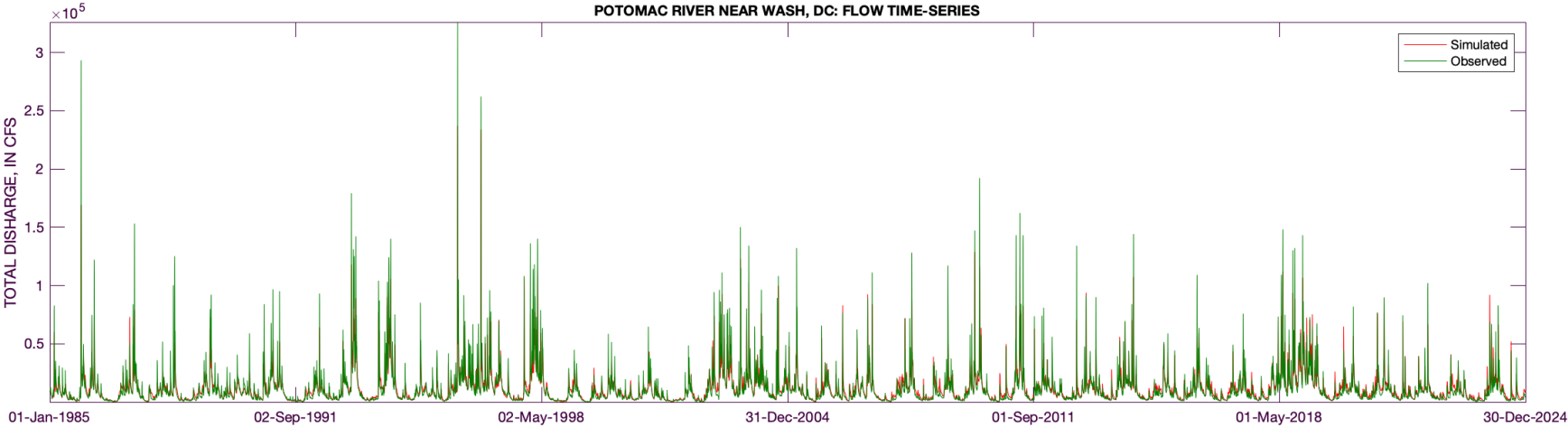
Windowed Data Plots

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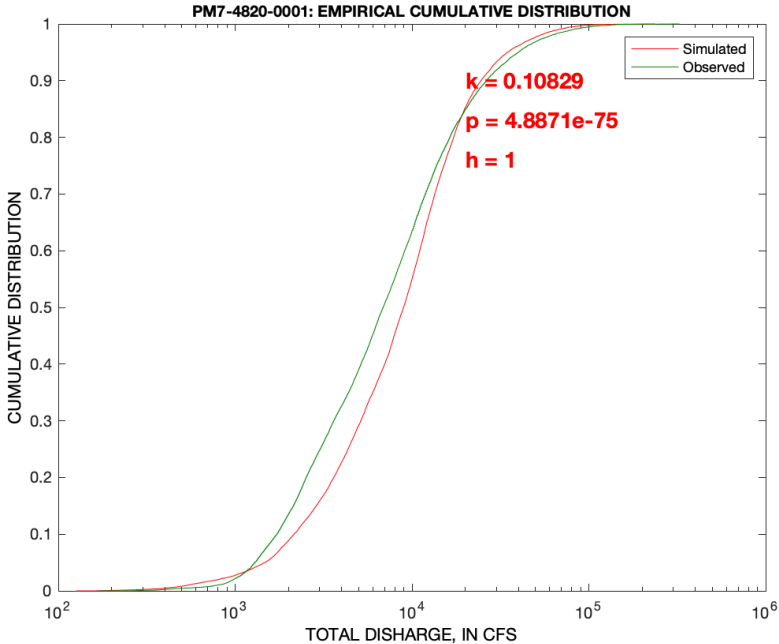
☐ load precipitation ☐ hide precipitation ☐ hide observed values ☐ y-axis log-scale

Examine Print Print All Save PDF



☒ plot log10 data

Examine Print



☒ semi-log plot

☐ hide observed values

Examine Print

DATA SELECTION

scenario file name

DyHM20260625cal PM7_4820_0001

plot data

FLOW - total discharge

Dates 1/1/1985 12/30/2024

Drive Directory Observed Data

N/A /Volumes/clo DyHM20260201cal

Update Plots and Statistics

STATISTICS

n	14609	14609
	observed	simulated
min	174	127.12
	2.24055	2.10421
mean	11857.1	12223.3
	3.83031	3.90093
median	6860	8959.5
	3.83632	3.95228
max	326000	236810
	5.51322	5.3744
variance	2.62866e+08	1.74574e+08
	0.209326	0.180021
JB test	☐ 0.001	0.001 ☐
	☐ 0.001	0.001 ☐
	raw	log10
% rel.bias	3.08904	1.84378
err.var.	3.55938e+07	0.0249653
rel.std.err	0.135407	0.119265
mod.eff	0.864593	0.880735

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

Windowed Data Plots

VERSION

2.1

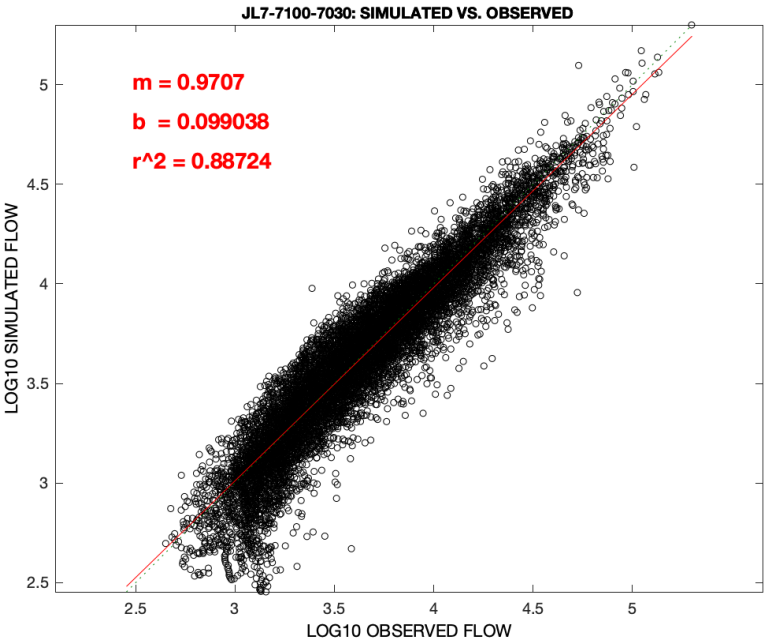
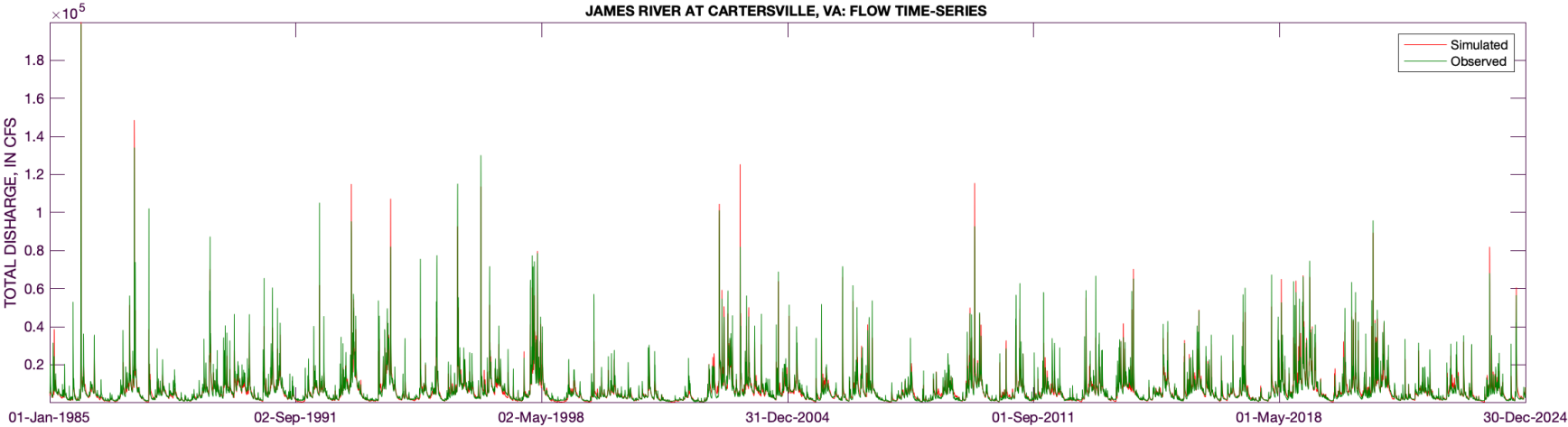
☐ load precipitation ☐ hide precipitation ☐ hide observed values ☐ y-axis log-scale

Examine

Print

Print All

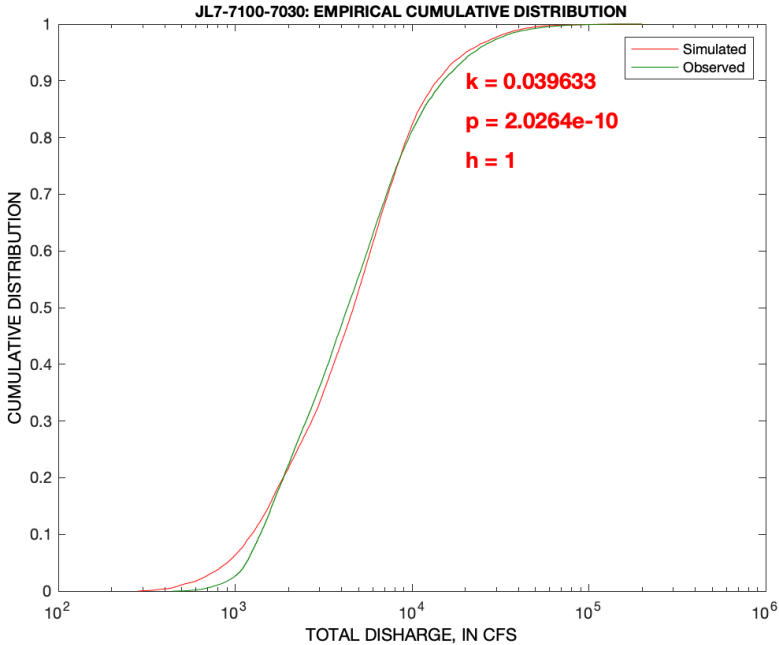
Save PDF



☒ plot log10 data

Examine

Print



☒ semi-log plot

☐ hide observed values

Examine

Print

DATA SELECTION

scenario

file name

DyHM20260625cal

JL7_7100_7030

plot data

FLOW - total discharge

Dates

1/1/1985

12/30/2024

Drive

Directory

Observed Data

N/A

/Volumes/clo

DyHM20260201cal

Update Plots and Statistics

STATISTICS

n	14609	14609
	observed	simulated
min	447	283.71
	2.65031	2.45287
mean	7048.78	6835.58
	3.64972	3.64183
median	4320	4665.5
	3.63548	3.6689
max	199000	199990
	5.29885	5.30101
variance	8.1102e+07	6.92431e+07
	0.158947	0.168803
JB test	☐ 0.001	0.001 ☐
	☐ 0.001	0.037544 ☐
	raw	log10
% rel.bias	-3.02458	-0.216174
err.var.	9.71968e+06	0.0192321
rel.std.err	0.119845	0.120997
mod.eff	0.880155	0.879003

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

Windowed Data Plots

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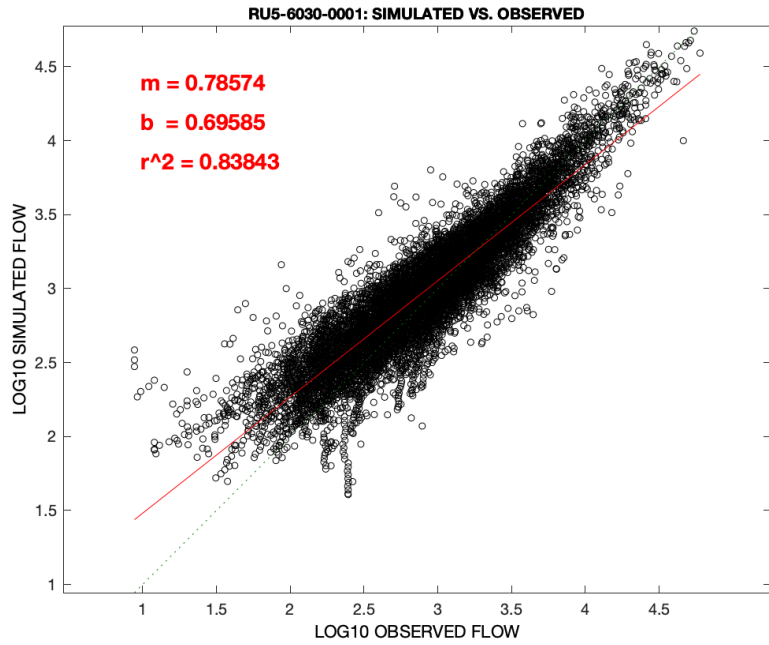
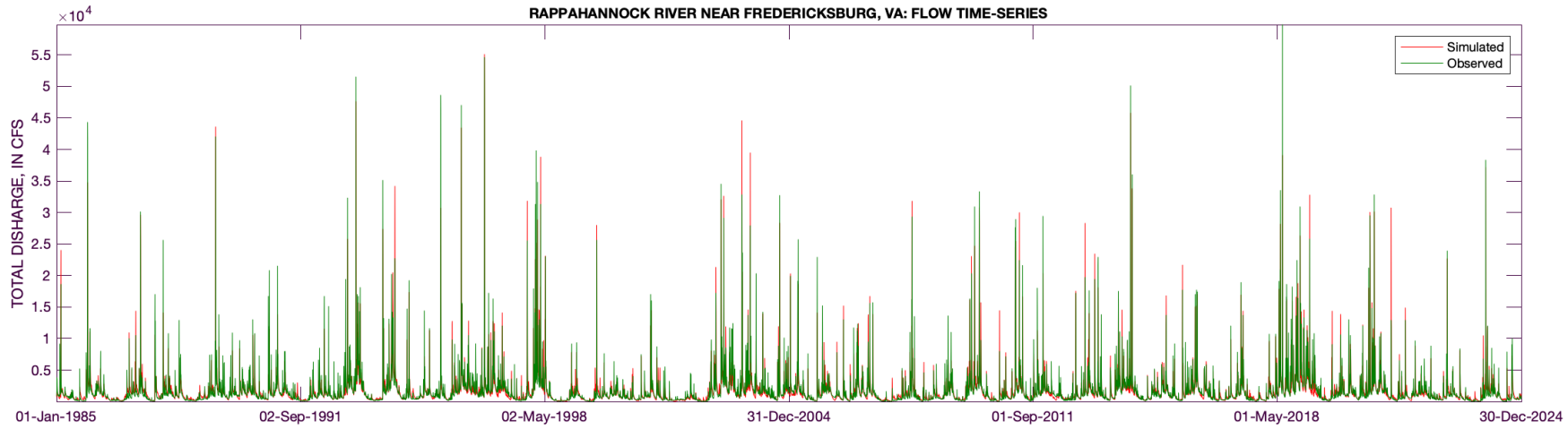
☐ load precipitation ☐ hide precipitation ☐ hide observed values ☐ y-axis log-scale

Examine

Print

Print All

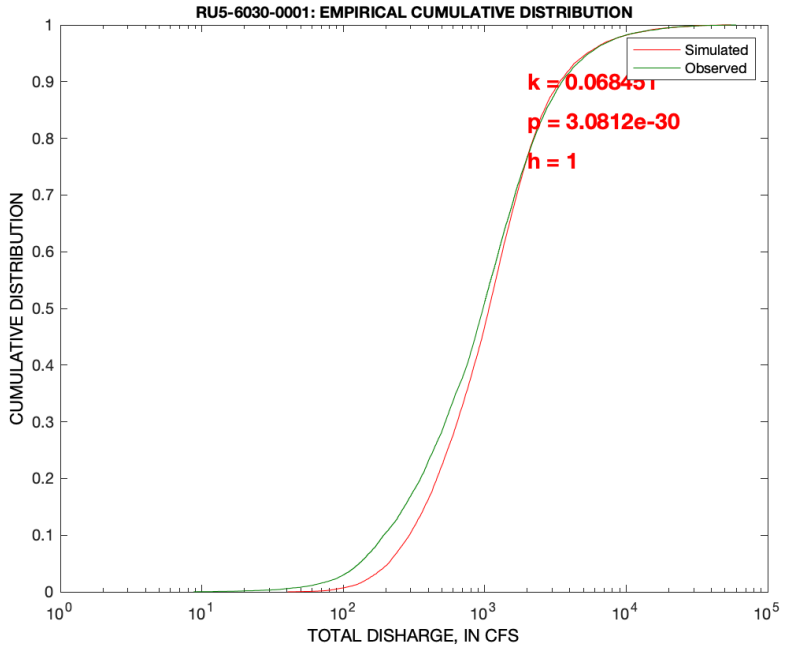
Save PDF



☒ plot log10 data

Examine

Print



☒ semi-log plot

☐ hide observed values

Examine

Print

DATA SELECTION

scenario

file name

DyHM20260625cal

RU5_6030_0001

plot data

FLOW - total discharge

Dates

1/1/1985

12/30/2024

Drive

Directory

Observed Data

N/A

/Volumes/clo

DyHM20260201cal

Update Plots and Statistics

STATISTICS

n	14609	14609
	observed	simulated
min	8.8	40.493
	0.944483	1.60738
mean	1728.6	1769.08
	2.95644	3.01884
median	973	1072.1
	2.98811	3.03024
max	59800	55080
	4.7767	4.74099
variance	8.77607e+06	8.09716e+06
	0.24709	0.181946
JB test	☐ 0.001	0.001 ☐
	☐ 0.001	0.001 ☐
	raw	log10
% rel.bias	2.34168	2.11062
err.var.	1.19895e+06	0.044634
rel.std.err	0.136615	0.180638
mod.eff	0.863385	0.819362

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

Windowed Data Plots

VERSION

2.1

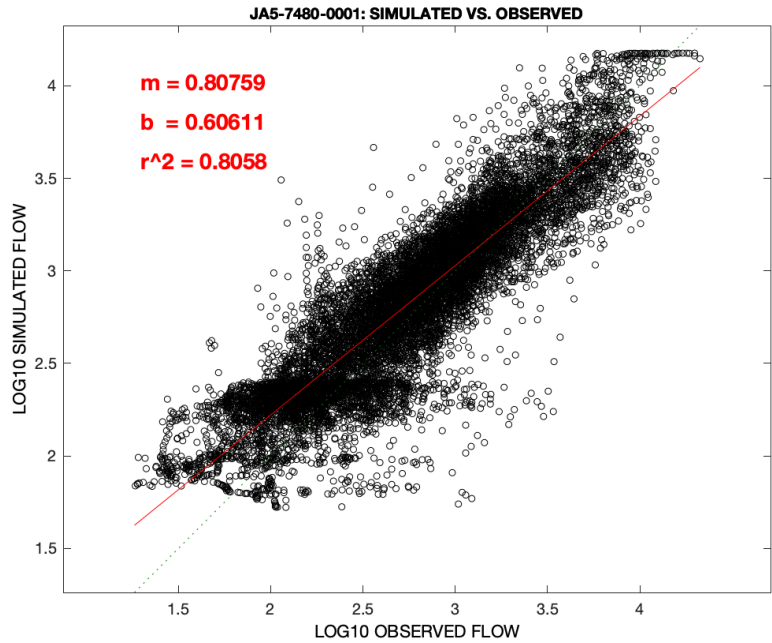
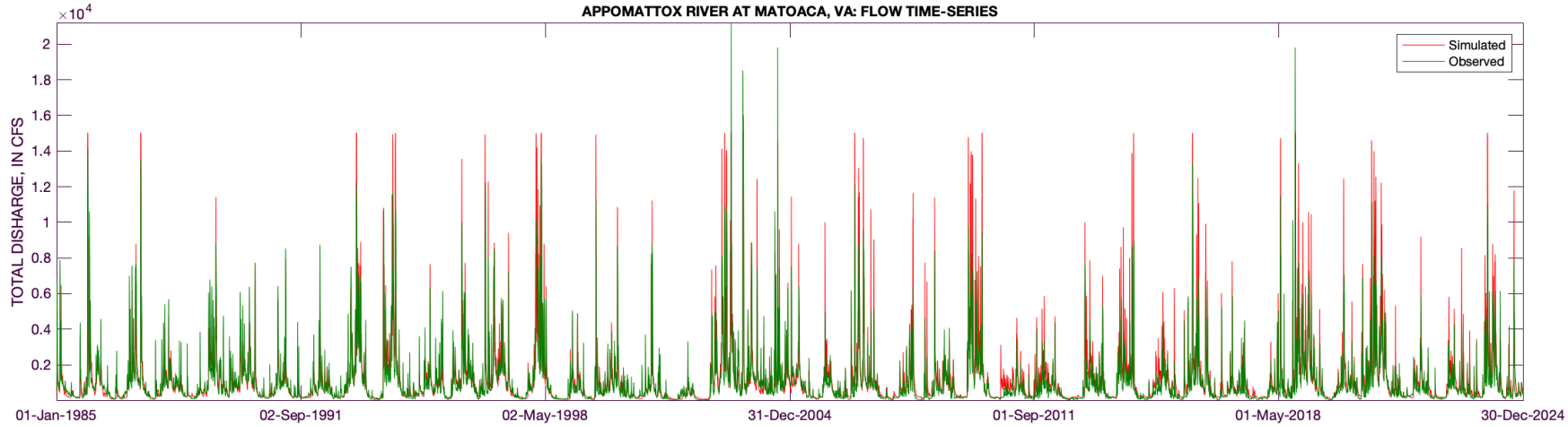
☐ load precipitation ☐ hide precipitation ☐ hide observed values ☐ y-axis log-scale

Examine

Print

Print All

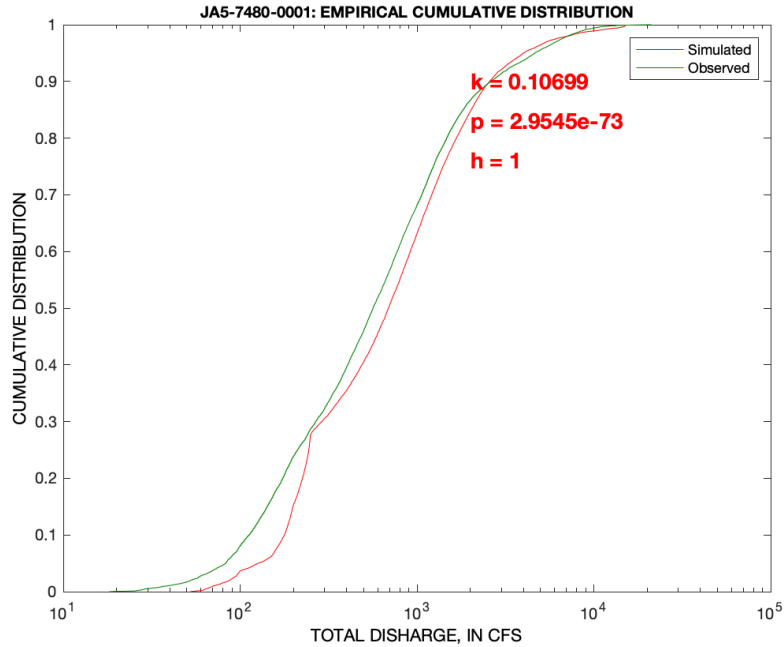
Save PDF



☒ plot log10 data

Examine

Print



☒ semi-log plot

☐ hide observed values

Examine

Print

DATA SELECTION

scenario

file name

DyHM20260625cal

JA5_7480_0001

plot data

FLOW - total discharge

Dates

1/1/1985

12/30/2024

Drive

Directory

Observed Data

N/A

/Volumes/clo

DyHM20260201cal

Update Plots and Statistics

STATISTICS

n	14609	14609
	observed	simulated
min	18.3	52.534
	1.26245	1.72044
mean	1133.85	1219.47
	2.73714	2.8166
median	564	689.27
	2.75128	2.83839
max	21200	15033
	4.32634	4.17705
variance	2.96773e+06	3.26338e+06
	0.279443	0.226177
JB test	☐ 0.001	0.001 ☐
	☐ 0.001	0.001 ☐
	raw	log10
% rel.bias	7.55139	2.90294
err.var.	1.01396e+06	0.0605829
rel.std.err	0.341662	0.216799
mod.eff	0.658338	0.783201

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

Windowed Data Plots

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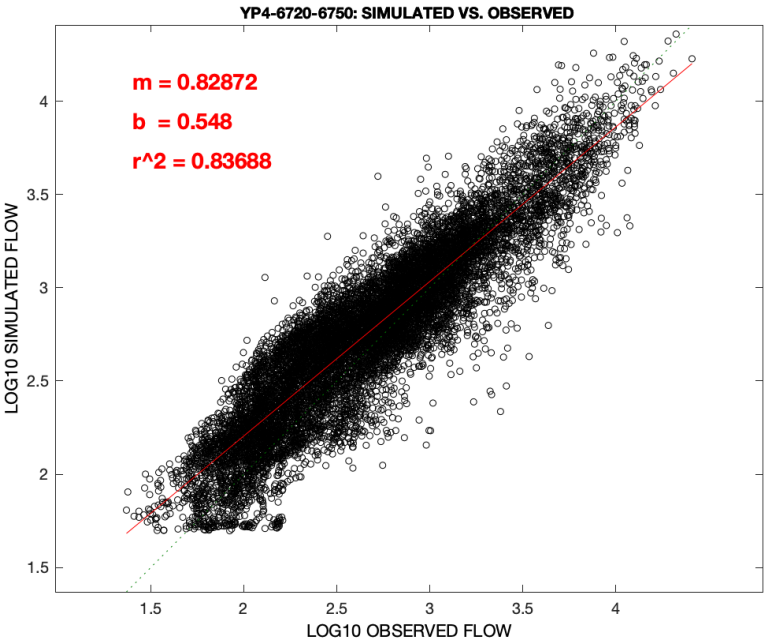
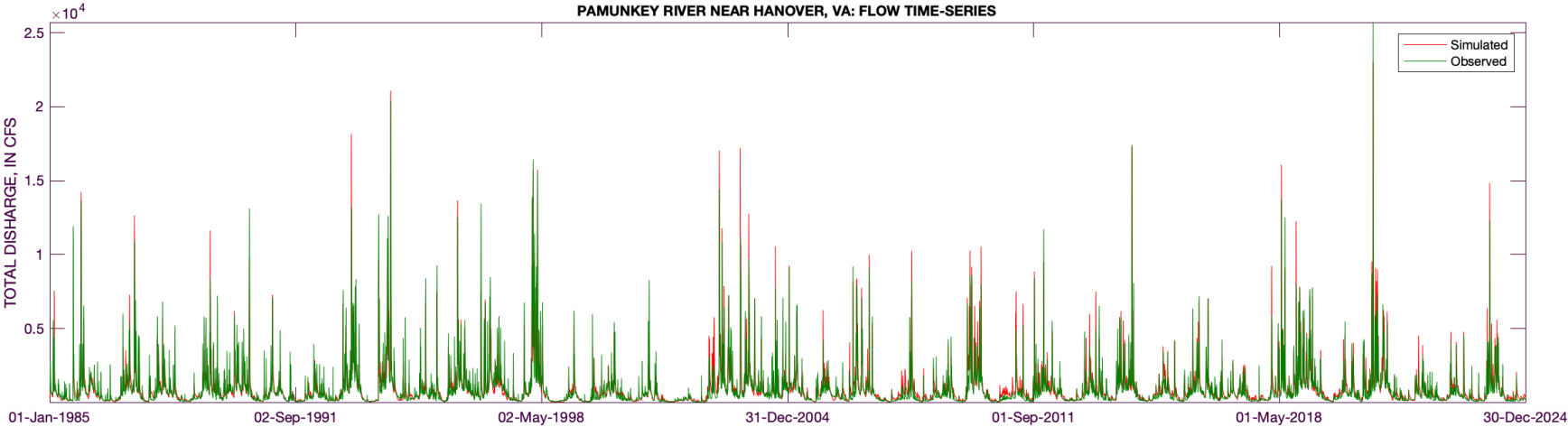
☐ load precipitation ☐ hide precipitation ☐ hide observed values ☐ y-axis log-scale

Examine

Print

Print All

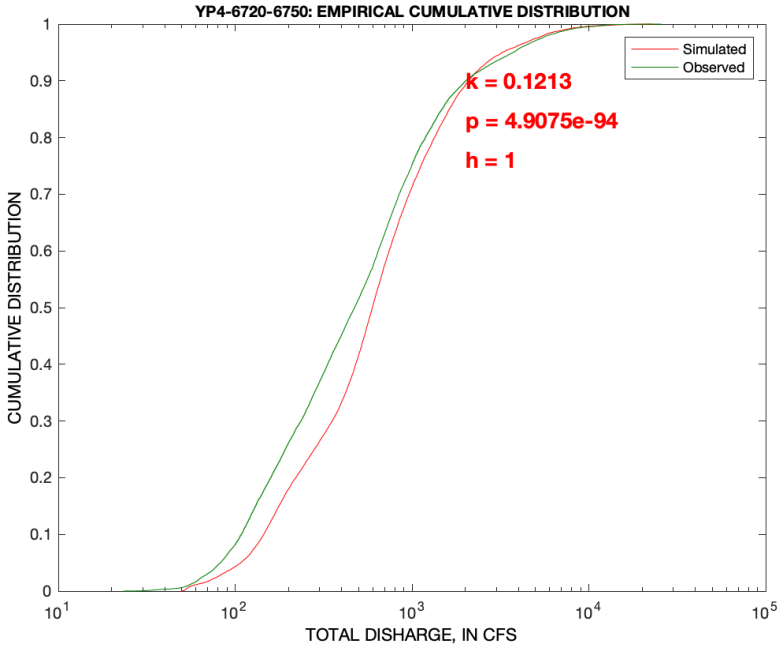
Save PDF



☒ plot log10 data

Examine

Print



☒ semi-log plot

☐ hide observed values

Examine

Print

DATA SELECTION

scenario

file name

DyHM20260625cal

YP4_6720_6750

plot data

FLOW - total discharge

Dates

1/1/1985

12/30/2024

Drive

Directory

Observed Data

N/A

/Volumes/clo

DyHM20260201cal

Update Plots and Statistics

STATISTICS

n	14609	14609
	observed	simulated
min	23.4	49.608
	1.36922	1.69555
mean	937.076	1002.68
	2.67213	2.76244
median	473	596.88
	2.67486	2.77589
max	25700	22961
	4.40993	4.36099
variance	2.25117e+06	2.02941e+06
	0.245823	0.201729
JB test	☐ 0.001	0.001 ☐
	☐ 0.001	0.001 ☐
	raw	log10
% rel.bias	7.00117	3.37942
err.var.	522828	0.0482724
rel.std.err	0.232247	0.196371
mod.eff	0.767753	0.803629

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

Windowed Data Plots

V
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1985-2005

☐ load precipitation ☐ hide precipitation ☐ hide observed values ☐ y-axis log-scale

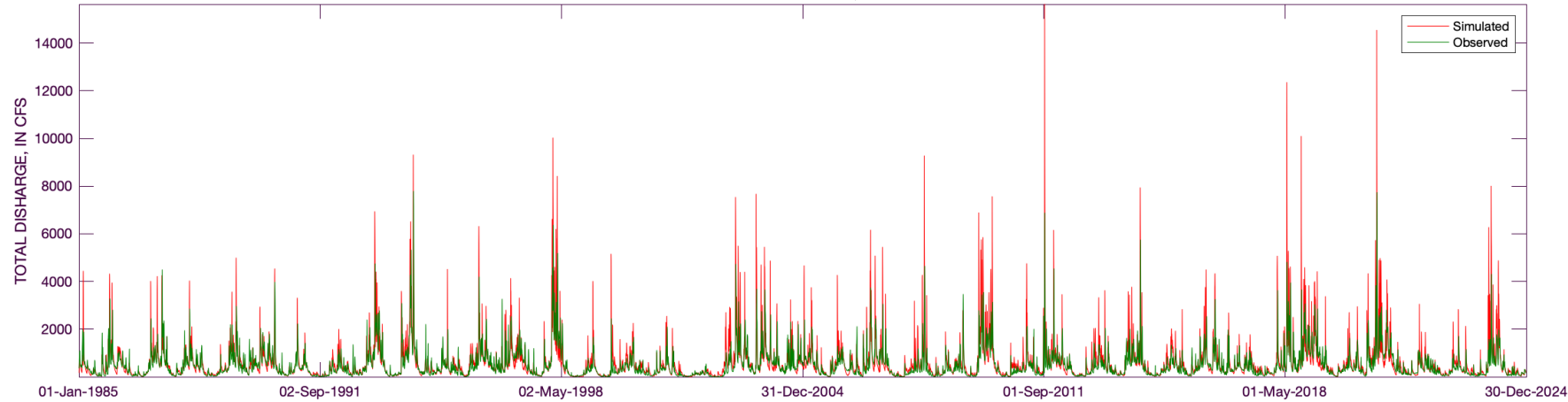
Examine

Print

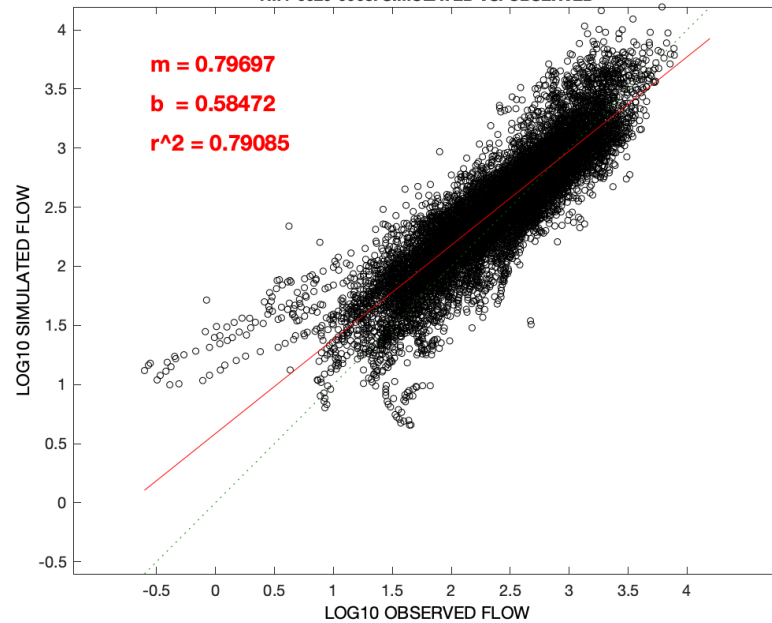
Print All

Save PDF

MATTAPONI RIVER NEAR BEULAHVILLE, VA: FLOW TIME-SERIES



YM4-6620-0003: SIMULATED VS. OBSERVED

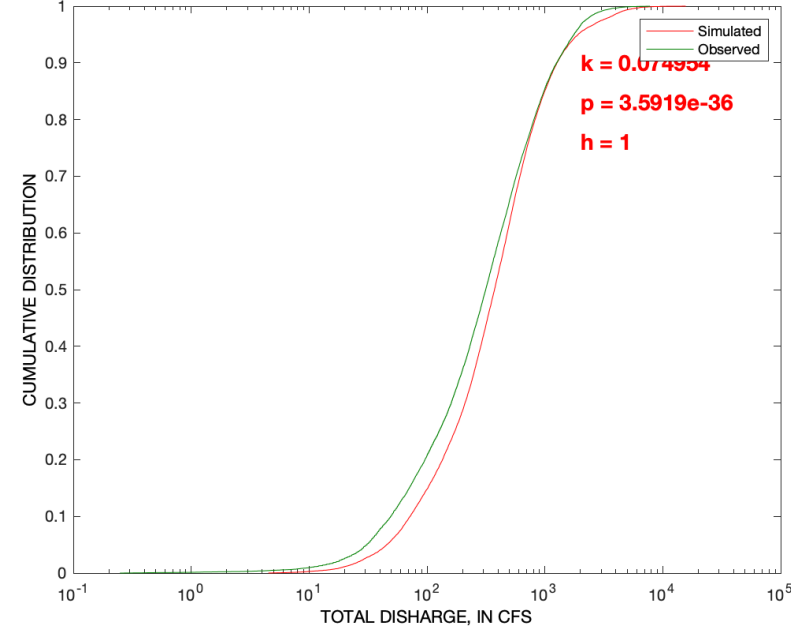


☒ plot log10 data

Examine

Print

YM4-6620-0003: EMPIRICAL CUMULATIVE DISTRIBUTION



☒ semi-log plot

☐ hide observed values

Examine

Print

DATA SELECTION

scenario

file name

DyHM20260625cal

YM4_6620_0003

plot data

FLOW - total discharge

Dates 1/1/1985 12/30/2024

Drive Directory Observed Data

N/A

/Volumes/clo

DyHM20260201cal

Update Plots and Statistics

STATISTICS

n	14609	14609
	observed	simulated
min	0.25	4.5343
	-0.60206	0.65651
mean	522.849	609.457
	2.44002	2.52934
median	315	374.14
	2.49831	2.57303
max	7780	15631
	3.89098	4.19399
variance	390168	708075
	0.300884	0.241648
JB test	☐ 0.001	0.001 ☐
	☐ 0.001	0.001 ☐
	raw	log10
% rel.bias	16.5645	3.66047
err.var.	312818	0.0709208
rel.std.err	0.801751	0.235708
mod.eff	0.198249	0.764292

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

Windowed Data Plots

V
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→ without flow adjustment



1985-2005

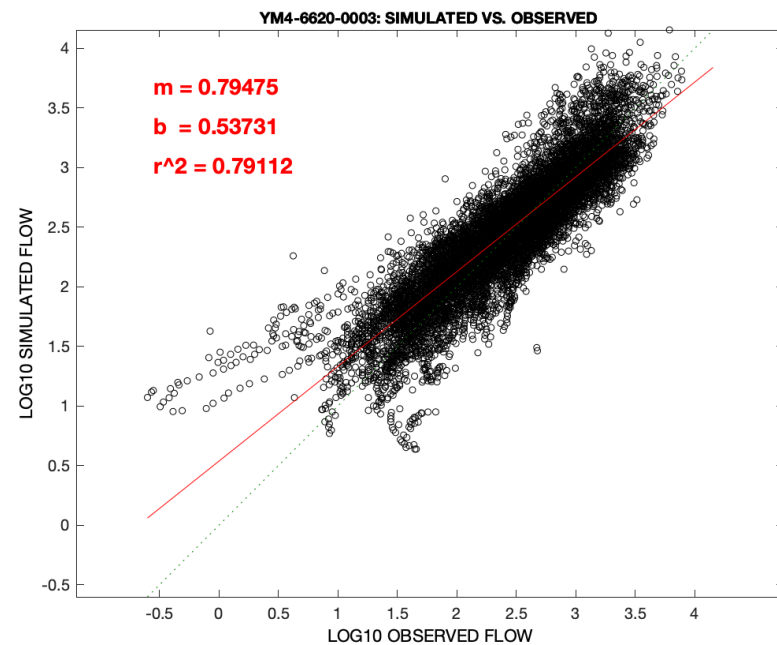
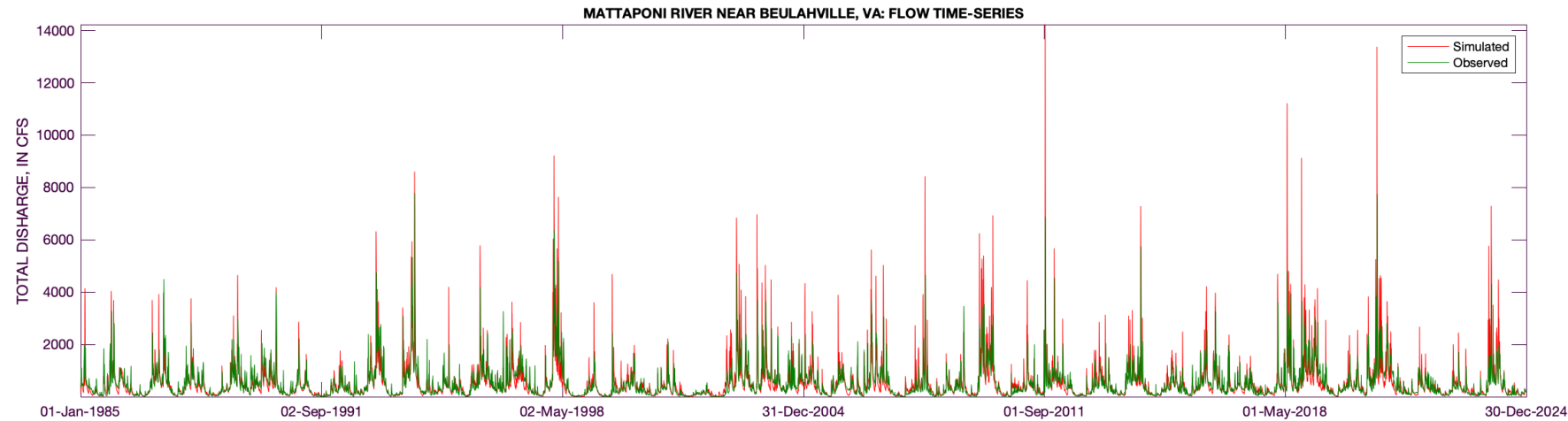
☐ load precipitation ☐ hide precipitation ☐ hide observed values ☐ y-axis log-scale

Examine

Print

Print All

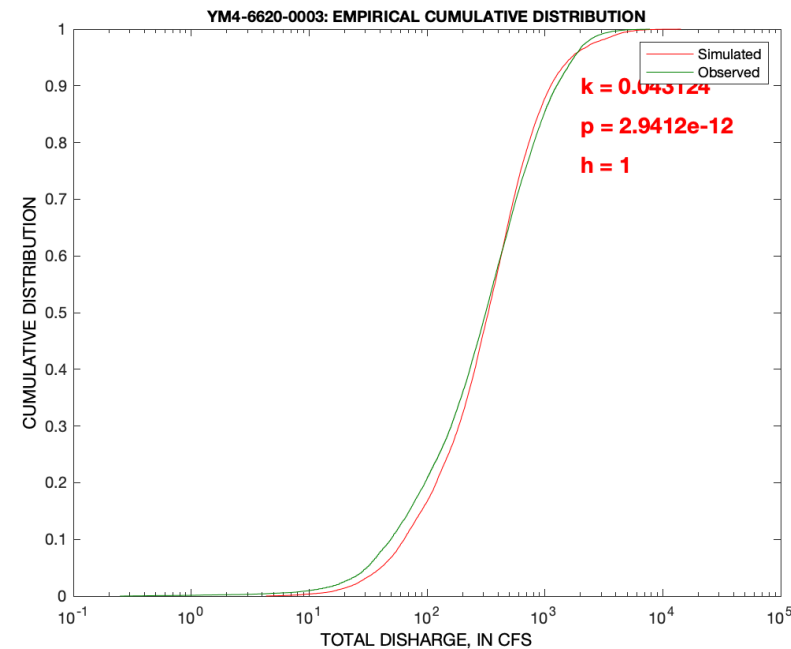
Save PDF



☒ plot log10 data

Examine

Print



☒ semi-log plot

☐ hide observed values

Examine

Print

DATA SELECTION

scenario

file name

DyHM20260630sce

YM4_6620_0003

plot data

FLOW - total discharge

Dates

1/1/1985

12/30/2024

Drive

Directory

Observed Data

N/A

/Volumes/clo

DyHM20260201cal

Update Plots and Statistics

STATISTICS

n	14609	14609
	observed	simulated
min	0.25	4.3344
	-0.60206	0.636929
mean	522.849	538.682
	2.44002	2.47651
median	315	331.02
	2.49831	2.51985
max	7780	14230
	3.89098	4.1532
variance	390168	563685
	0.300884	0.240223
JB test	☐ 0.001	0.001 ☐
	☐ 0.001	0.001 ☐
	raw	log10
% rel.bias	3.02818	1.49548
err.var.	256942	0.0641849
rel.std.err	0.658543	0.213321
mod.eff	0.341457	0.786679

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

Windowed Data Plots

V
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2.1

→ with flow adjustment

☐ load precipitation

☐ hide precipitation

☐ hide observed values

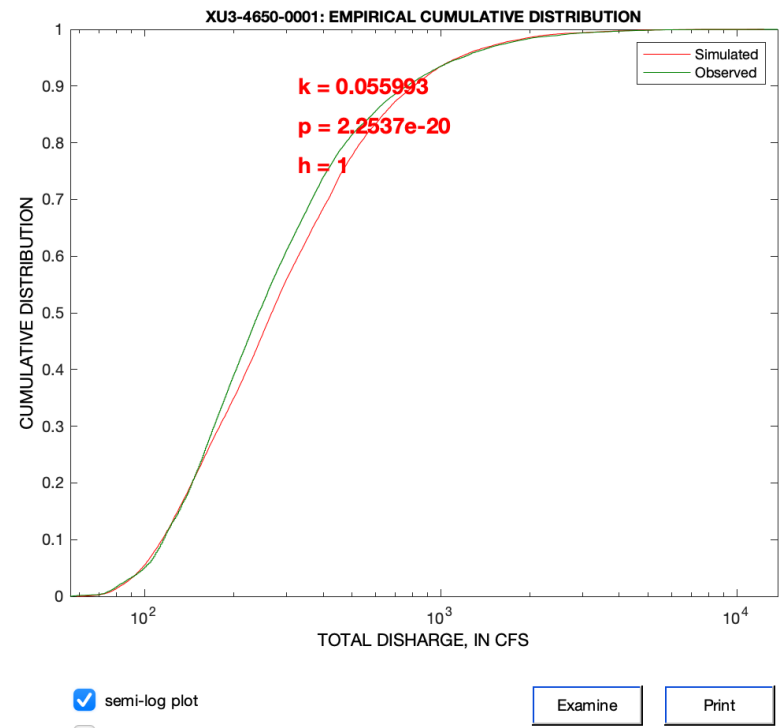
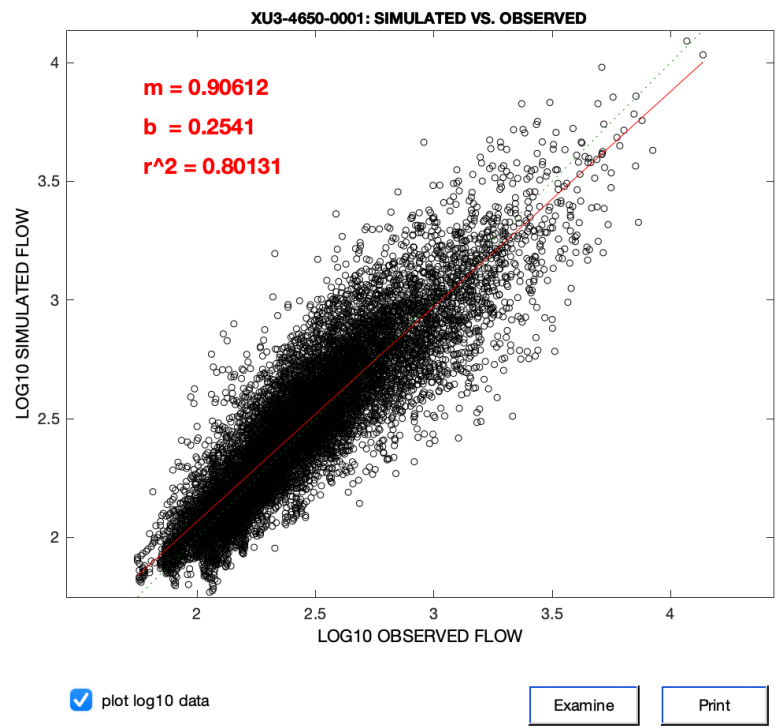
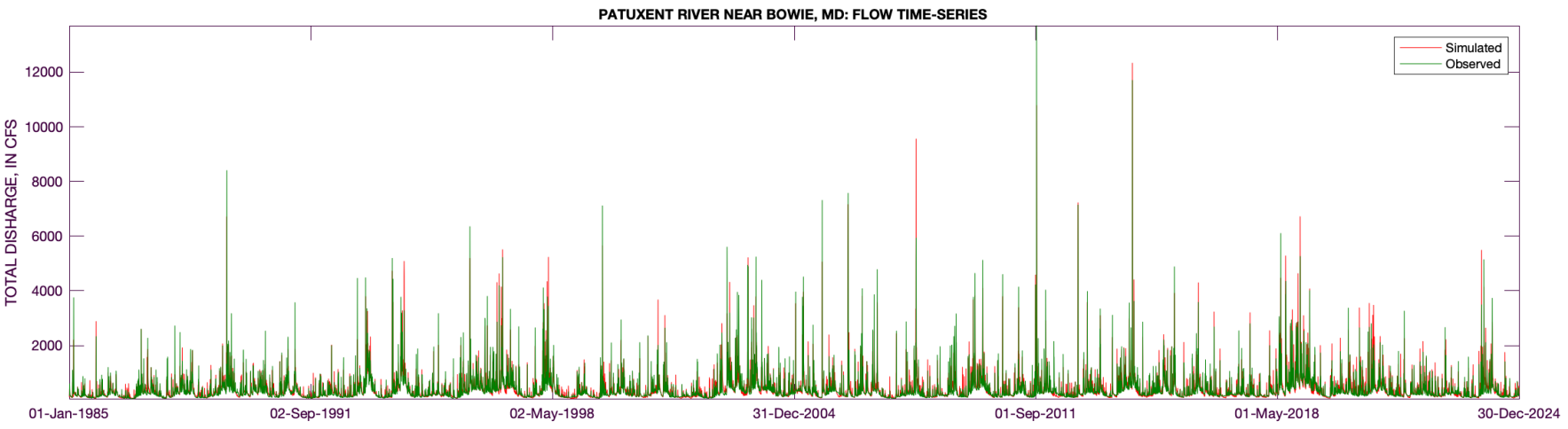
☐ y-axis log-scale

Examine

Print

Print All

Save PDF



DATA SELECTION

scenariofile name

DyHM20260625calXU3_4650_0001

plot data

FLOW - total discharge

Dates1/1/198512/30/2024

DriveDirectoryObserved Data

N/A/Volumes/cloDyHM20260201cal

Update Plots and Statistics

STATISTICS

n	14609	14609
	observed	simulated
min	56	58.743
	1.74819	1.76896
mean	389.159	406.565
	2.43564	2.46109
median	243	267.96
	2.38561	2.42807
max	13700	12329
	4.13672	4.09093
variance	257463	236074
	0.107236	0.109879
JB test	☐ 0.001	☐ 0.001
	☐ 0.001	☐ 0.001
	raw	log10
% rel.bias	4.47276	1.04487
err.var.	84031.2	0.0234245
rel.std.err	0.326382	0.218439
mod.eff	0.673618	0.781561

- Residual Plots
- Percentile Plots
- Daily Accumulation
- Individual Monthly Avg's
- Accumulated Monthly Avg's
- Seasonal Box Plots
- C-Q scatter plot
- Windowed Data Plots



1985-2005

☐ load precipitation ☐ hide precipitation ☐ hide observed values ☐ y-axis log-scale

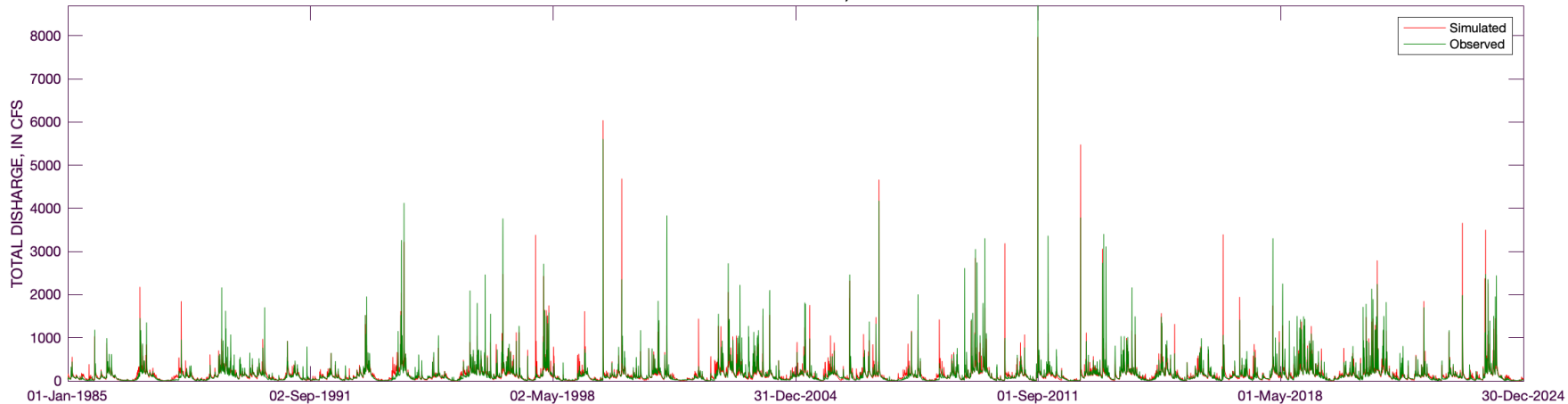
Examine

Print

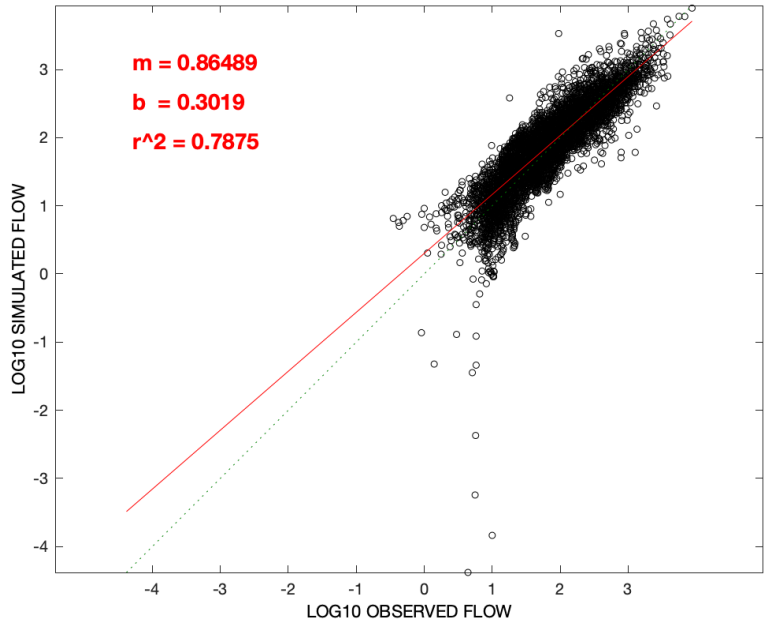
Print All

Save PDF

CHOPTANK RIVER NEAR GREENSBORO, MD: FLOW TIME-SERIES



EM2-3980-0001: SIMULATED VS. OBSERVED

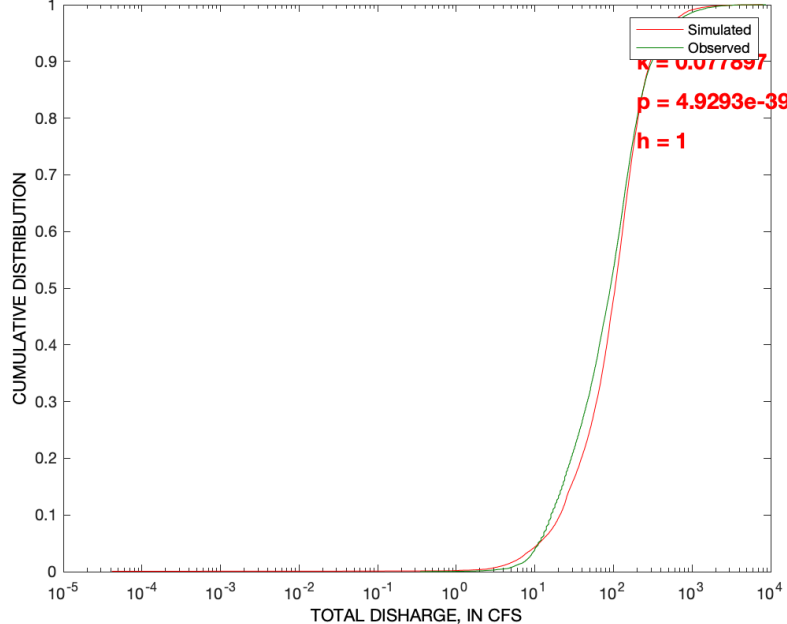


☒ plot log10 data

Examine

Print

EM2-3980-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



☒ semi-log plot

☐ hide observed values

Examine

Print

DATA SELECTION

scenario

file name

DyHM20260625cal

EM2_3980_0001

plot data

FLOW - total discharge

Dates

1/1/1985

12/30/2024

Drive

Directory

Observed Data

N/A

/Volumes/clo

DyHM20260201cal

Update Plots and Statistics

STATISTICS

n	14609	14600
	observed	simulated
min	0.35	0
	-0.455932	-4.38021
mean	153.775	153.048
	1.90745	1.95164
median	91	104.65
	1.95904	2.01991
max	8700	7966.8
	3.93952	3.90128
variance	68261.2	53875.6
	0.251074	0.238493
JB test	☐ 0.001	0.001 ☐
	☐ 0.001	0.001 ☐
	raw	log10
% rel.bias	-0.472706	2.31657
err.var.	20947.7	0.0572155
rel.std.err	0.306875	0.227883
mod.eff	0.693125	0.772117

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

Windowed Data Plots

V
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2.1