Hydrology Calibration

Phase 5

Calibrators

- USGS-MD
  - Jeff Raffensperger
  - Sarah Martucci
  - Joe Vrabel
  - Angelica Gutierrez
  - Gary Fisher

Calibrators

- USGS-VA
  - Doug Moyer
  - Alan Simpson
  - Jen Krstolic
- ICPRB
  - Ross Mandel
  - Julie Kiang

Calibrators

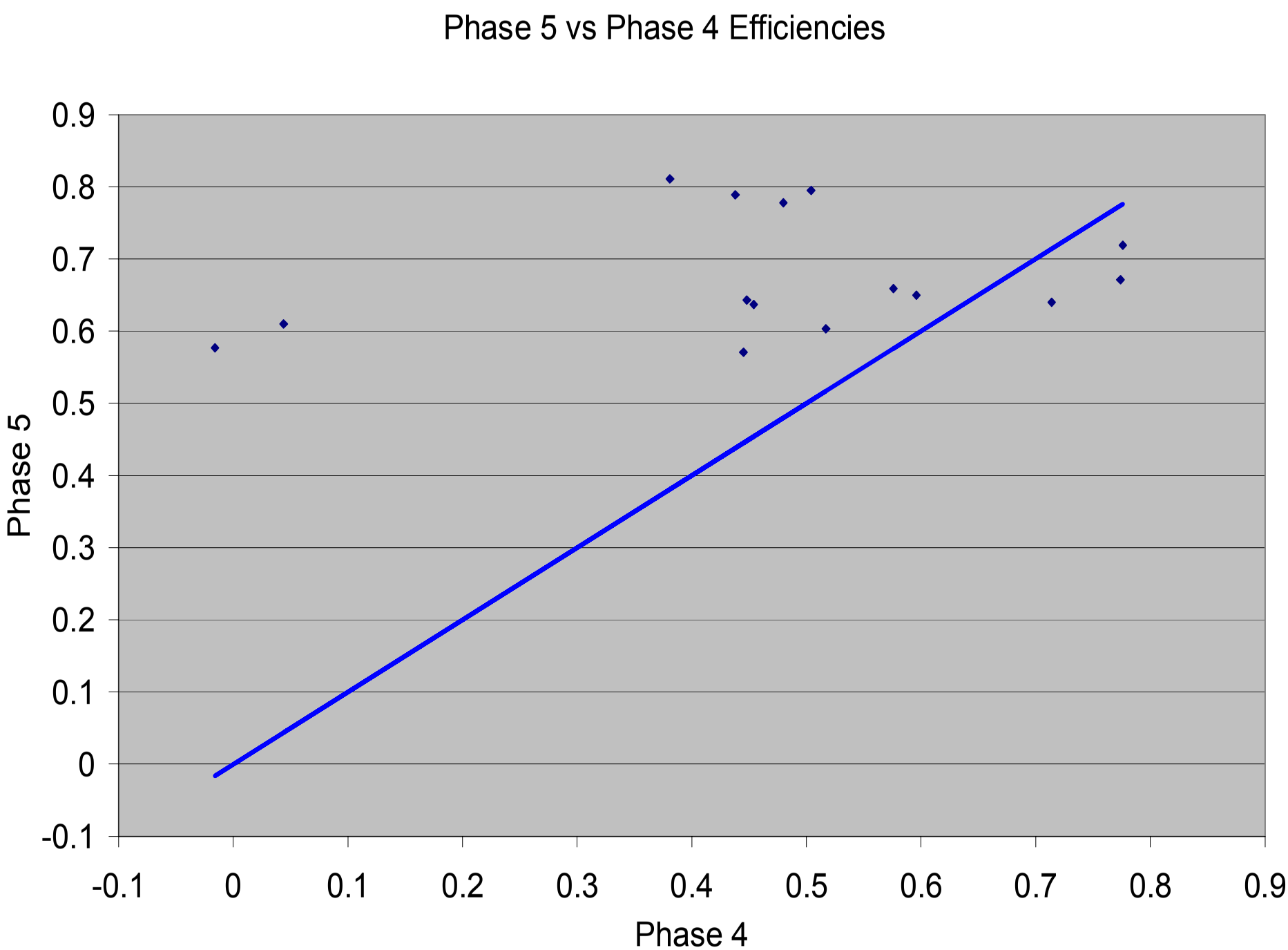
- CBP
  - Sara Brandt
  - Jing Wu
  - Kate Hopkins
  - Lewis Linker
  - Gary Shenk

Status from April

- Reaching point of diminishing returns with hand calibration
- Better and more consistent overall than phase4
- Consistent with other HSPF calibrations in the literature
- Still a few small areas and issues that need attention in hydrology

Success with Hand Calibration

- Generally better calibration than previous model
- Discovered sensitive parameters
- Discovered appropriate measures of performance


Phase 5 vs Phase 4 Efficiencies
Phase 5
Phase 4
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

But . . .

Individually Calibrated Parameters

	INFILT	AGWR	INTFW	IRC	AGWETP	UZSN	LZSN	KVARY
min	0.009	0.867	0.5	0.12	0.0000	0.25	4.0	0.0
10th	0.041	0.954	1.0	0.25	0.0000	0.50	5.0	0.0
25th	0.045	0.965	1.0	0.30	0.0070	0.50	5.0	0.0
median	0.072	0.974	1.0	0.38	0.0500	0.50	5.0	0.0
75th	0.117	0.979	2.5	0.46	0.0500	0.50	5.0	0.0
90th	0.176	0.983	3.5	0.60	0.0500	0.50	7.5	1.0
max	0.337	0.995	5.0	0.85	0.1176	1.35	13.5	3.0

ArcView GIS Version 3.1

File Edit View Theme Graphics Window Help

Scale 1:

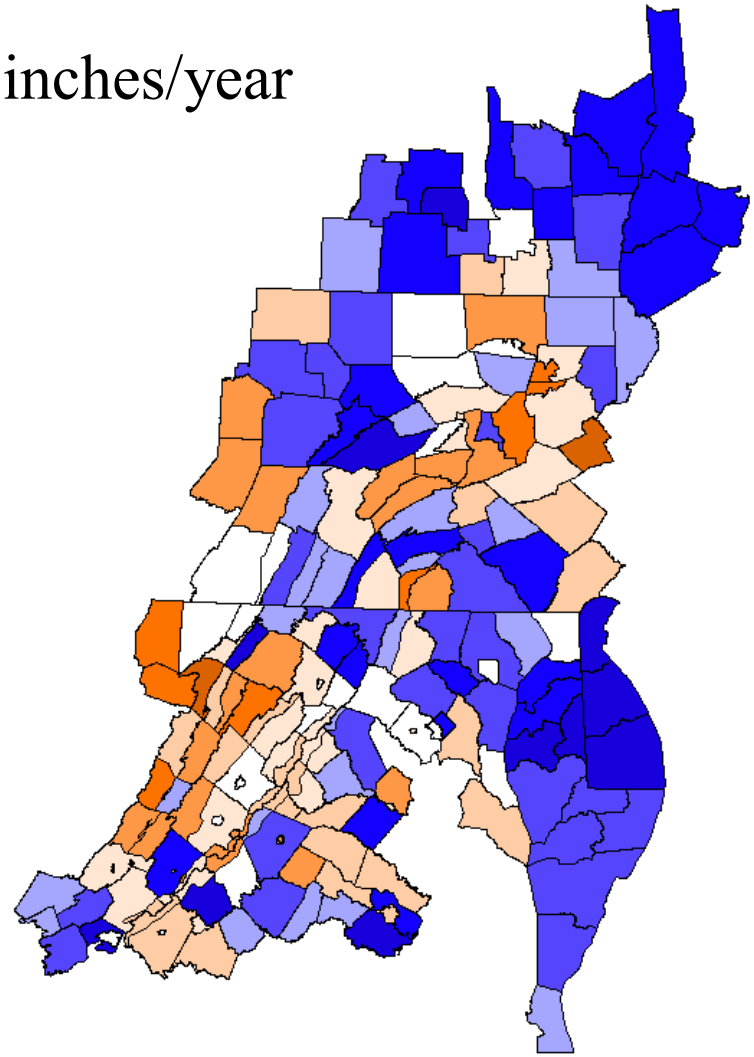
515,633.59
4,466,766.84

SURO

SURO
0.138 - 0.746
0.746 - 1.374
1.374 - 1.962
1.962 - 2.599
2.599 - 3.294
3.294 - 4.392
4.392 - 6.056
6.056 - 8.356
8.356 - 11.67
11.67 - 16.50

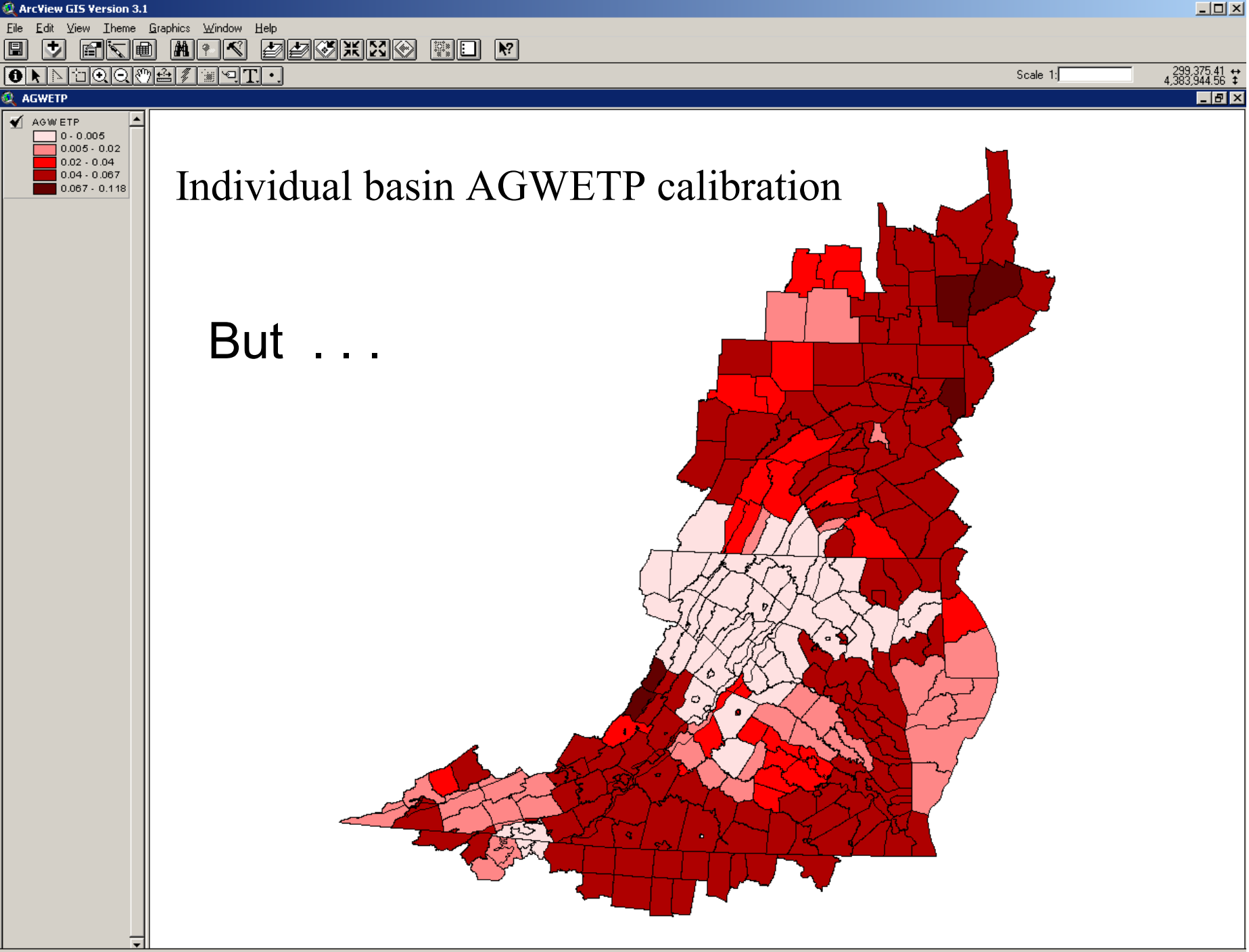
But . . .

Surface Runoff in inches/year



Individual basin AGWETP calibration

But . . .



But . . .

- Some land segments were not calibrated since they supply no monitored river
- Ratios of parameters between land uses not preserved
- Other established rules not followed

The good news:

Calibration Measure	HSPF Parameter
Overall Bias	land evap
Winter / Summer Balance	LZSN
Baseflow / Stormflow Balance	INFILT
Quickflow Recession Index	IRC
Baseflow Recession Index	AGWR
Peak Bias	INTFW

Iterative Calibration

- Started with manual calibration
  - Enforced land use ratios
  - Enforced min and max
- Used knowledge and statistics developed during the manual calibration
- Assumed sensitivities linking parameters to statistics

Sensitivities

Bias	-	land evap	-	LE = 2/(2-Bias)
Wstat/Stat	-	LZSN	-	LZSN = (3-S/W)/2
Bstat	-	INFILT	-	INFILT = 1/Bstat
QaveRI	-	IRC	-	IRC = 2/(1+QaveRI)
BaveRI	-	AGWR	-	AGWR = 2/(1+BaveRI)
Pbias/Vpbias	-	INTFW	-	INTFW = 1 + PorV/2

The Ratio Rules

	ratio to crop					
land use	infilt	intfw	lzsn	irc	agwr	agwetp
for	1.6	1.25	1	1	1	6
grs	1	1	1	1	1	2
pur	0.8	1	1	1	1	2
min	0.0125	1	12	0.35	0.92	0.0005
max	0.25	4	12	0.85	0.99	0.05

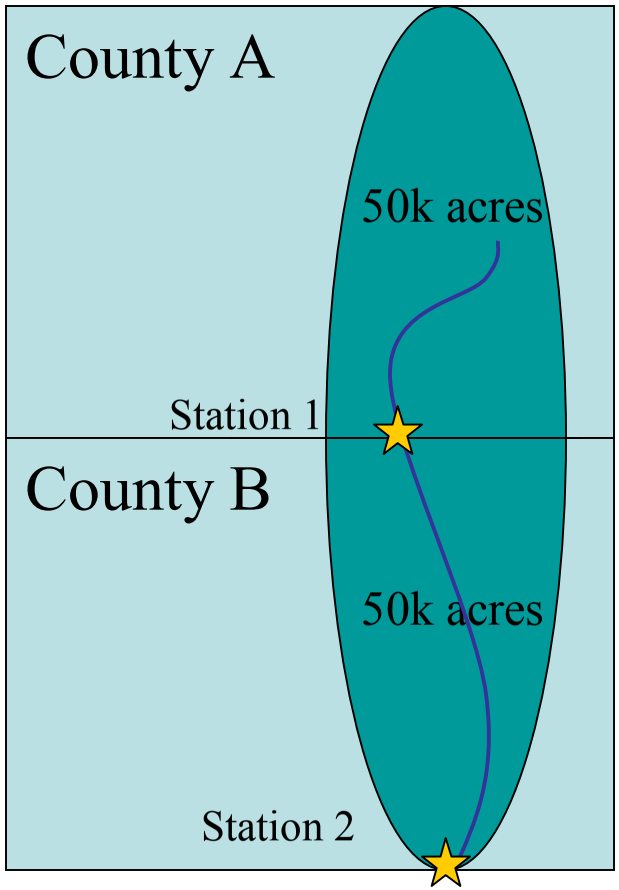
land use	uzsn factor vs lzsn
crp	0.14
for	0.12
grs	0.1
pur	0.1

crop monthly uzsn factor

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0.6	0.6	0.6	0.6	0.6	0.7	0.95	1	1	0.8	0.7	0.65

Crop SURO between 1 and 6

Link Land to River



Basis: Percent of basin made up of each county

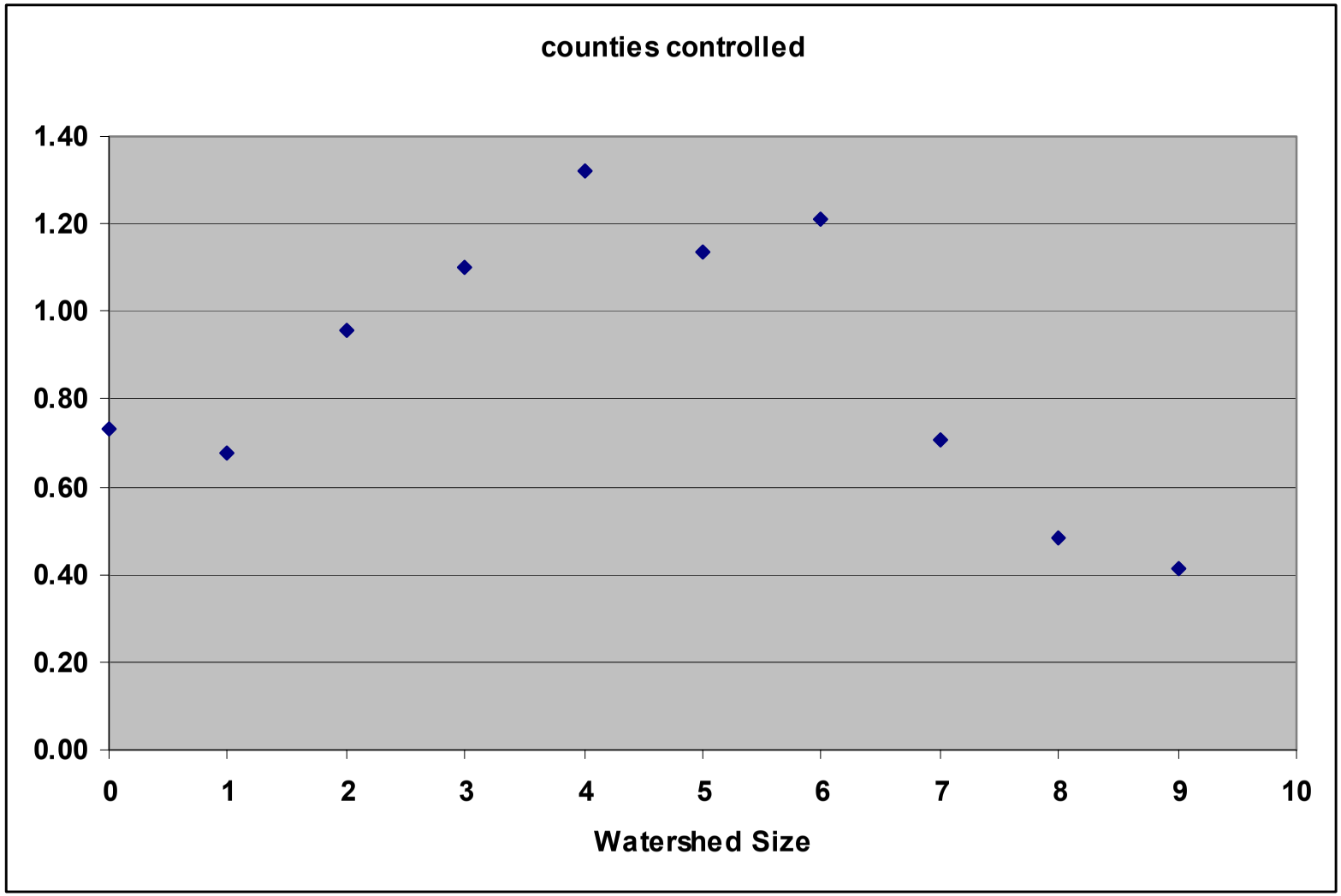
County A is:
100% of station 1
50% of station 2

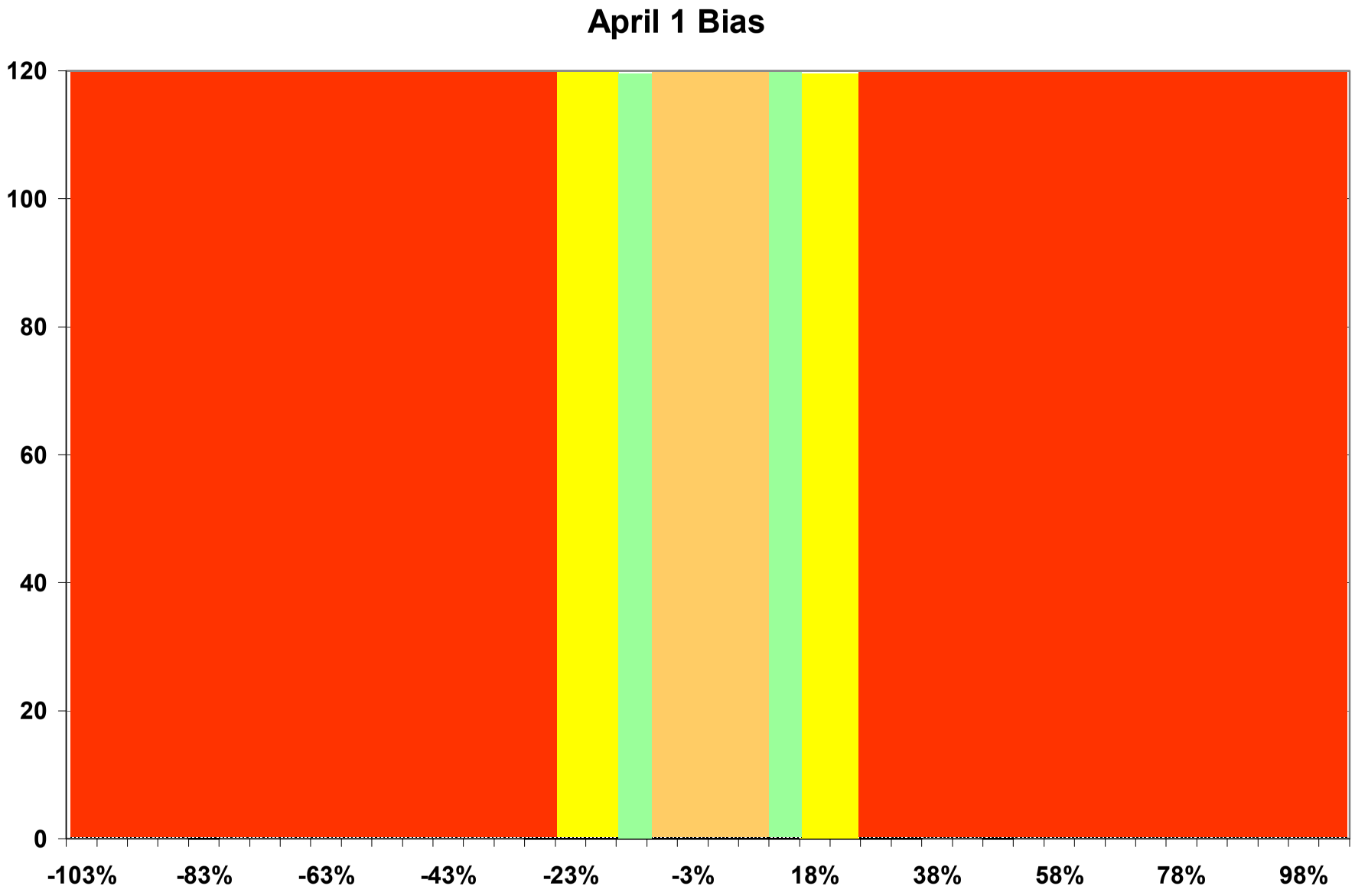
The 'importance' ratio is 2:1, so county A uses 2/3 of the station1 parameters and 1/3 station2 parameters

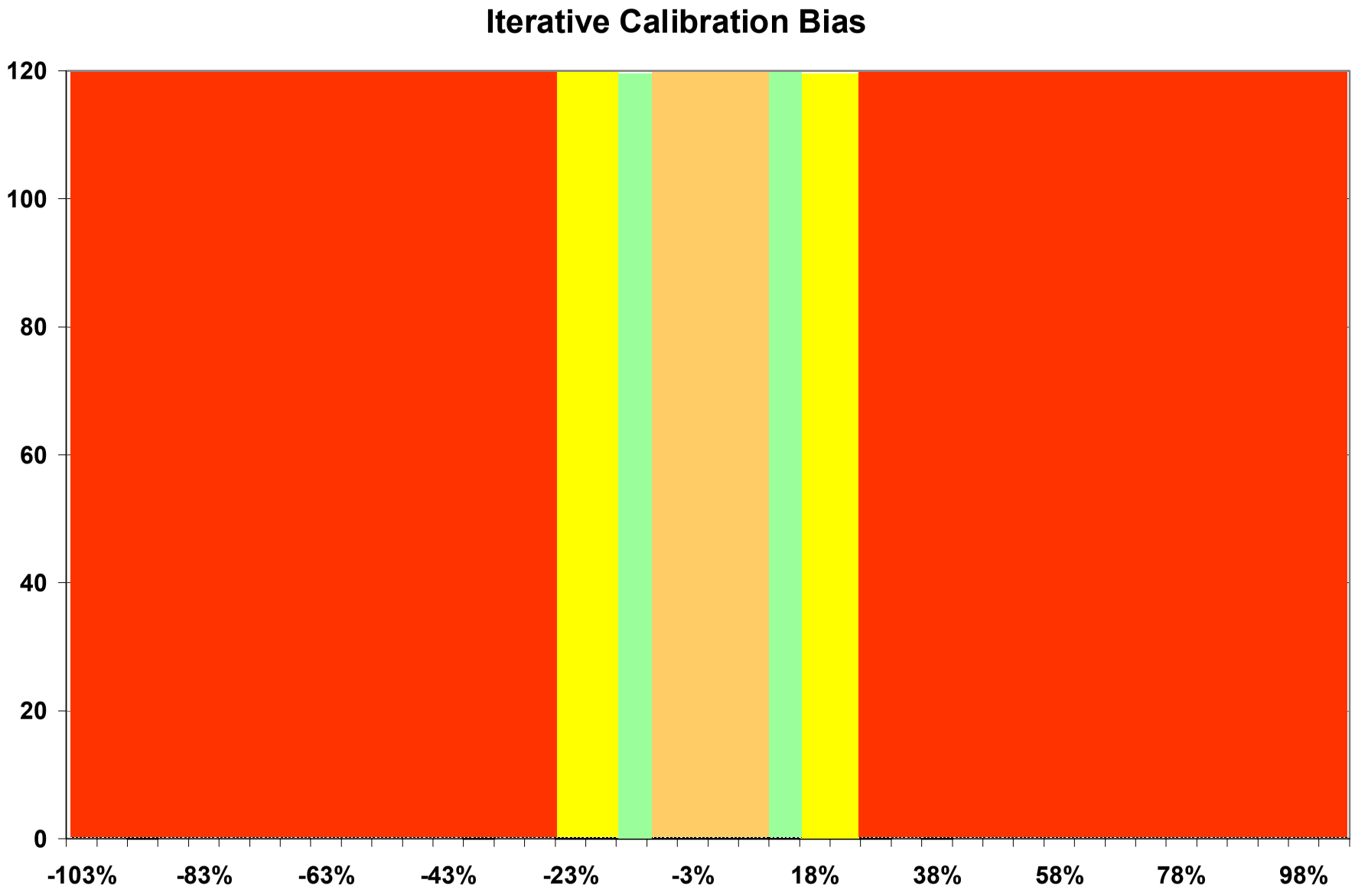
Ignored 'importances' less that 10%

Assigned 'orphan' counties to 'siblings'

10% assumption




April 1 Bias
120
100
80
60
40
20
0
-103%
-83%
-63%
-43%
-23%
-3%
18%
38%
58%
78%
98%

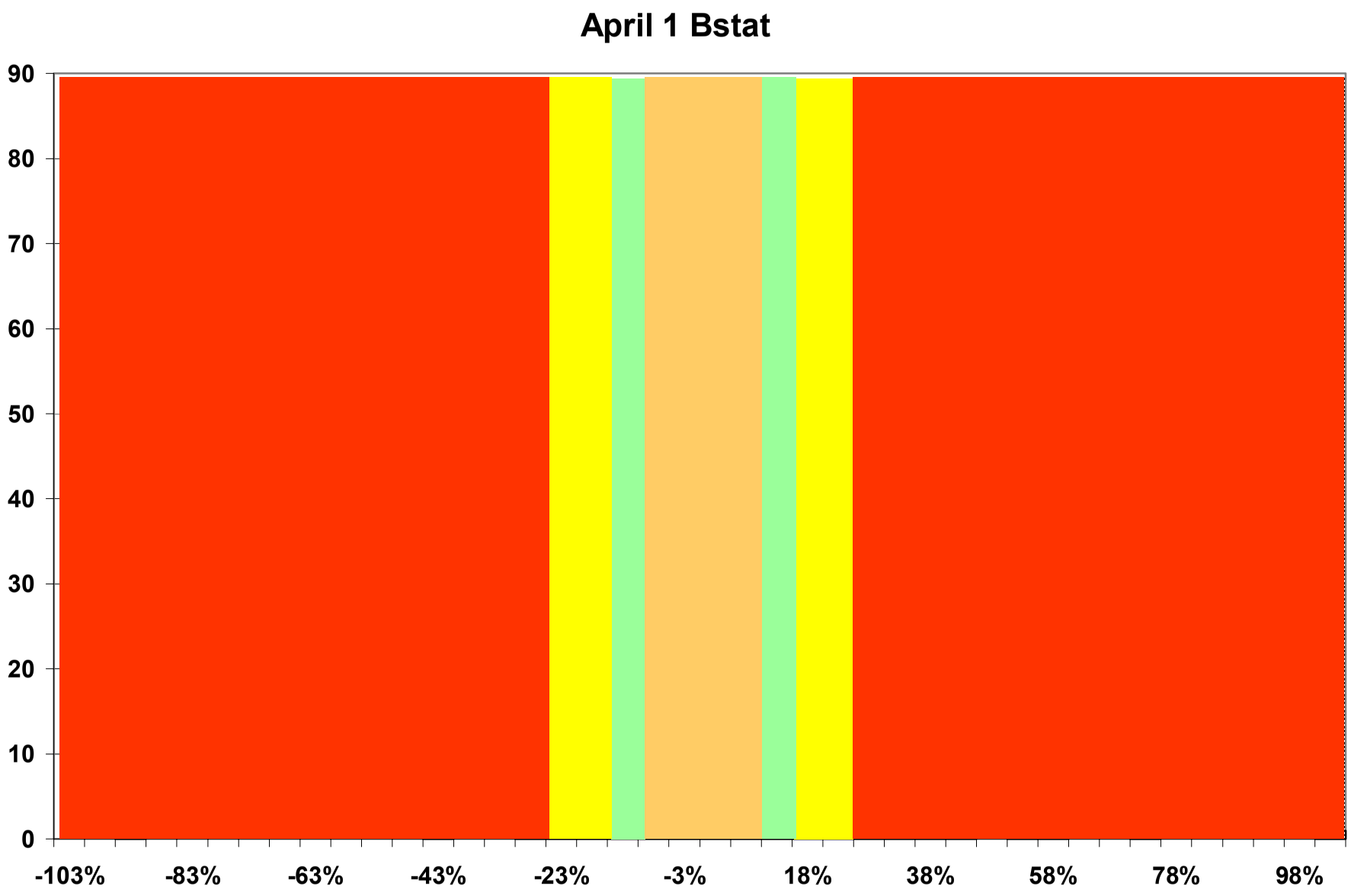

Iterative Calibration Bias
120
100
80
60
40
20
0
-103%
-83%
-63%
-43%
-23%
-3%
18%
38%
58%
78%
98%

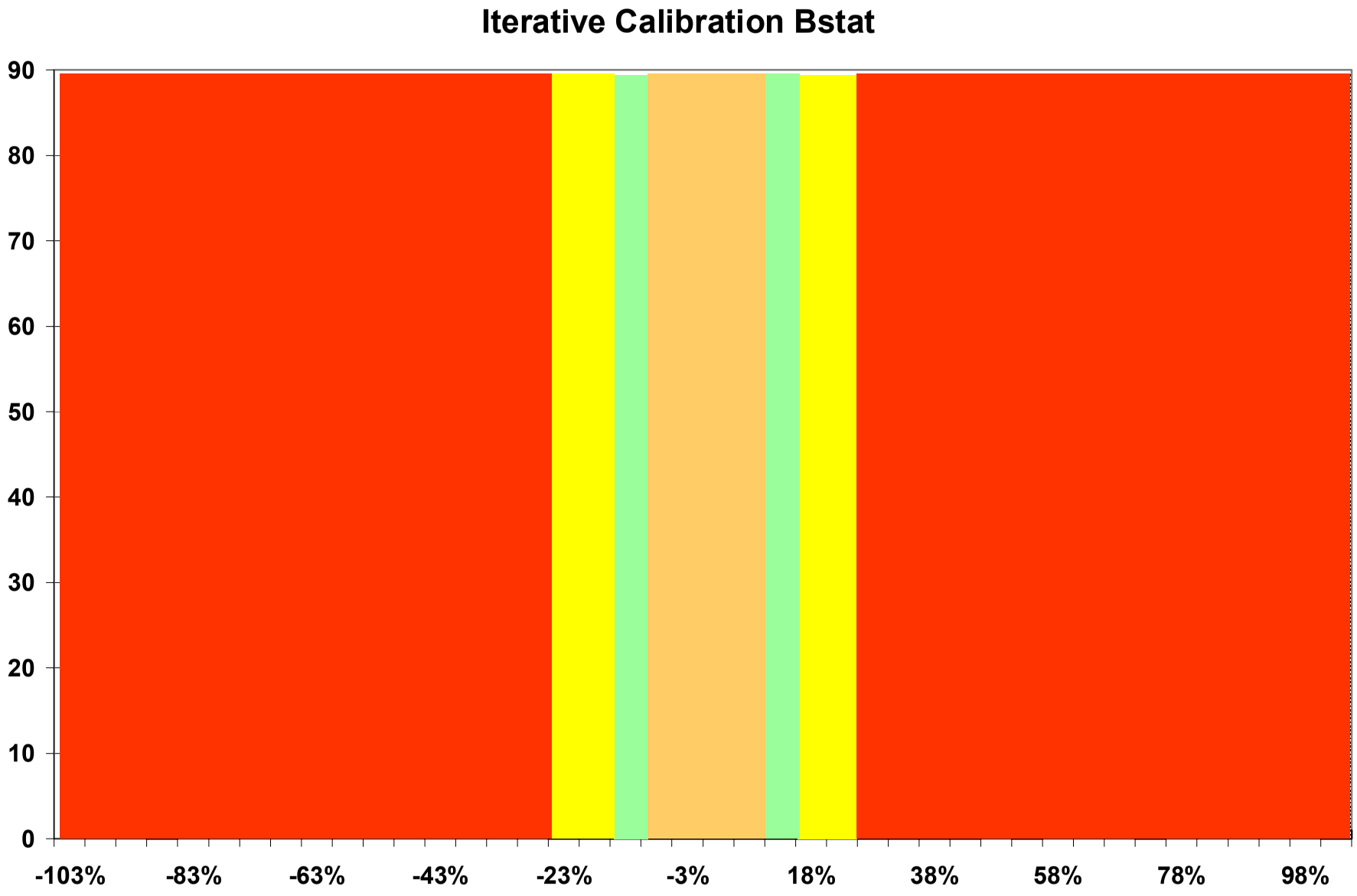
Baseflow / Stormflow Stat

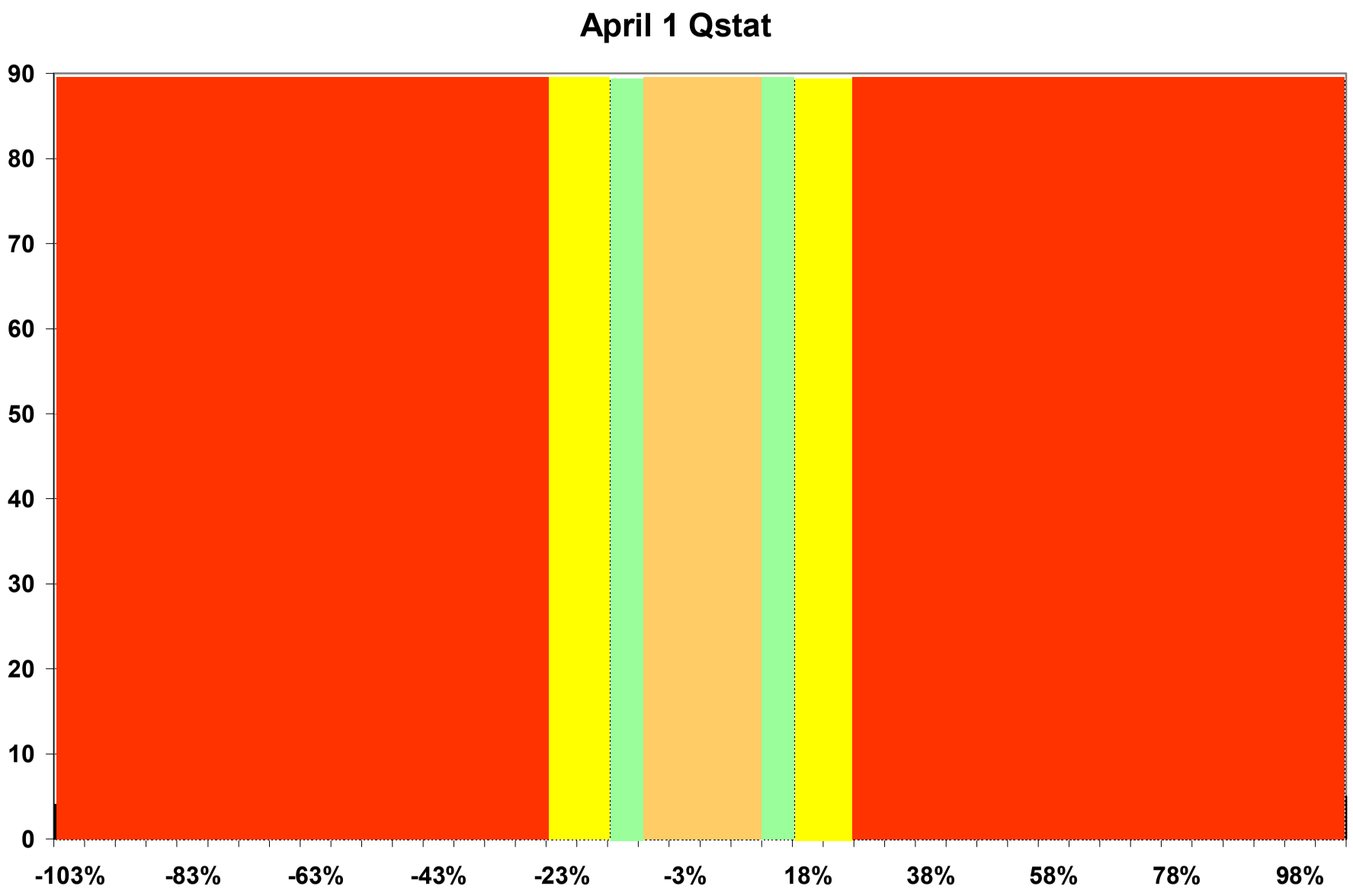
$$\text{Bstat} = 1 - \frac{\text{Fraction of flow that is baseflow (simulated)}}{\text{Fraction of flow that is baseflow (observed)}}$$

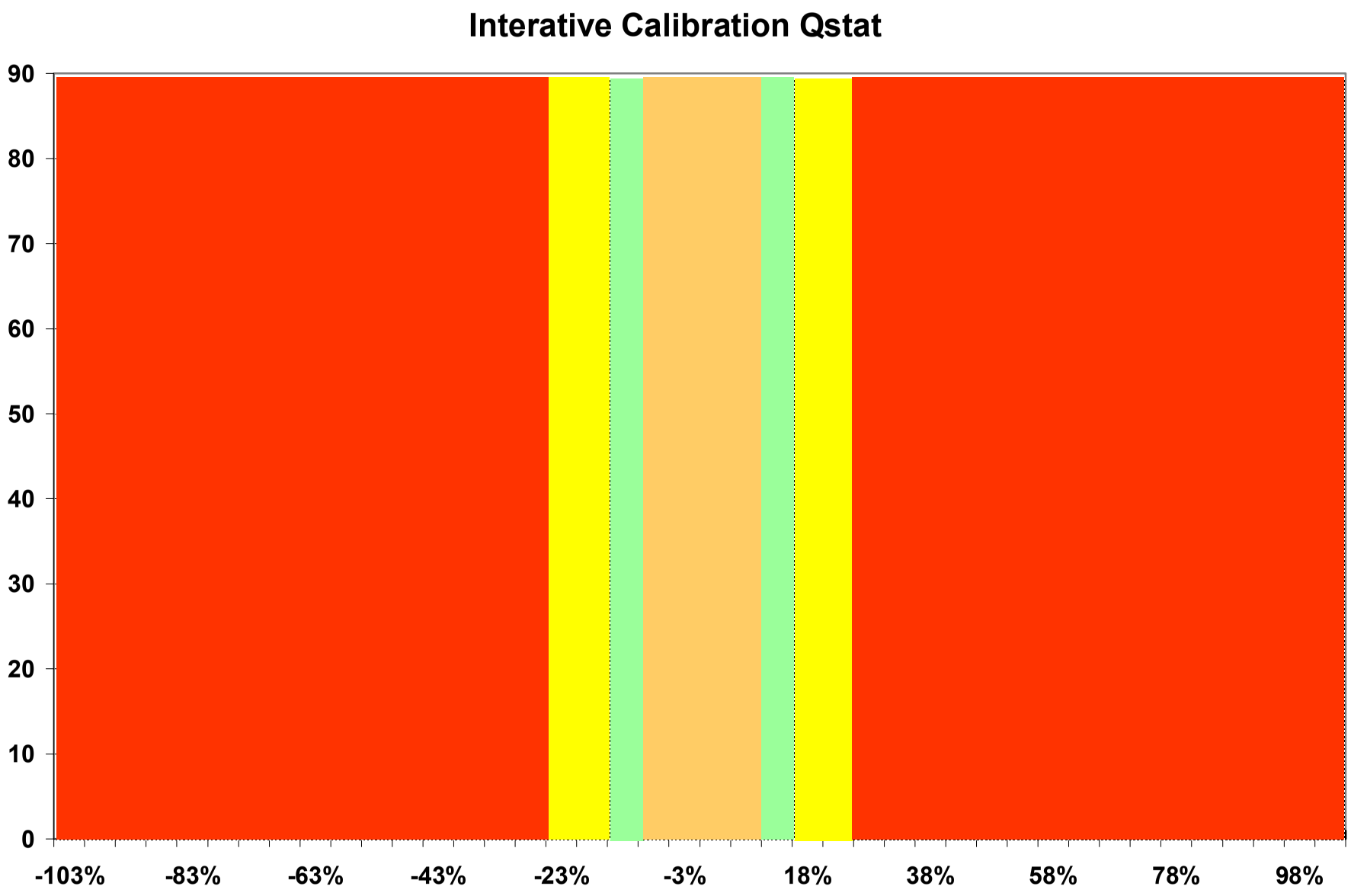
$$\text{Bstat} = 1 - \frac{\text{baseflow / total flow (simulated)}}{\text{baseflow / total flow (observed)}}$$

$$\text{Qstat} = 1 - \frac{\text{stormflow / total flow (simulated)}}{\text{stormflow / total flow (observed)}}$$


April 1 Bstat
90
80
70
60
50
40
30
20
10
0
-103%
-83%
-63%
-43%
-23%
-3%
18%
38%
58%
78%
98%


Iterative Calibration Bstat
90
80
70
60
50
40
30
20
10
0
-103%
-83%
-63%
-43%
-23%
-3%
18%
38%
58%
78%
98%

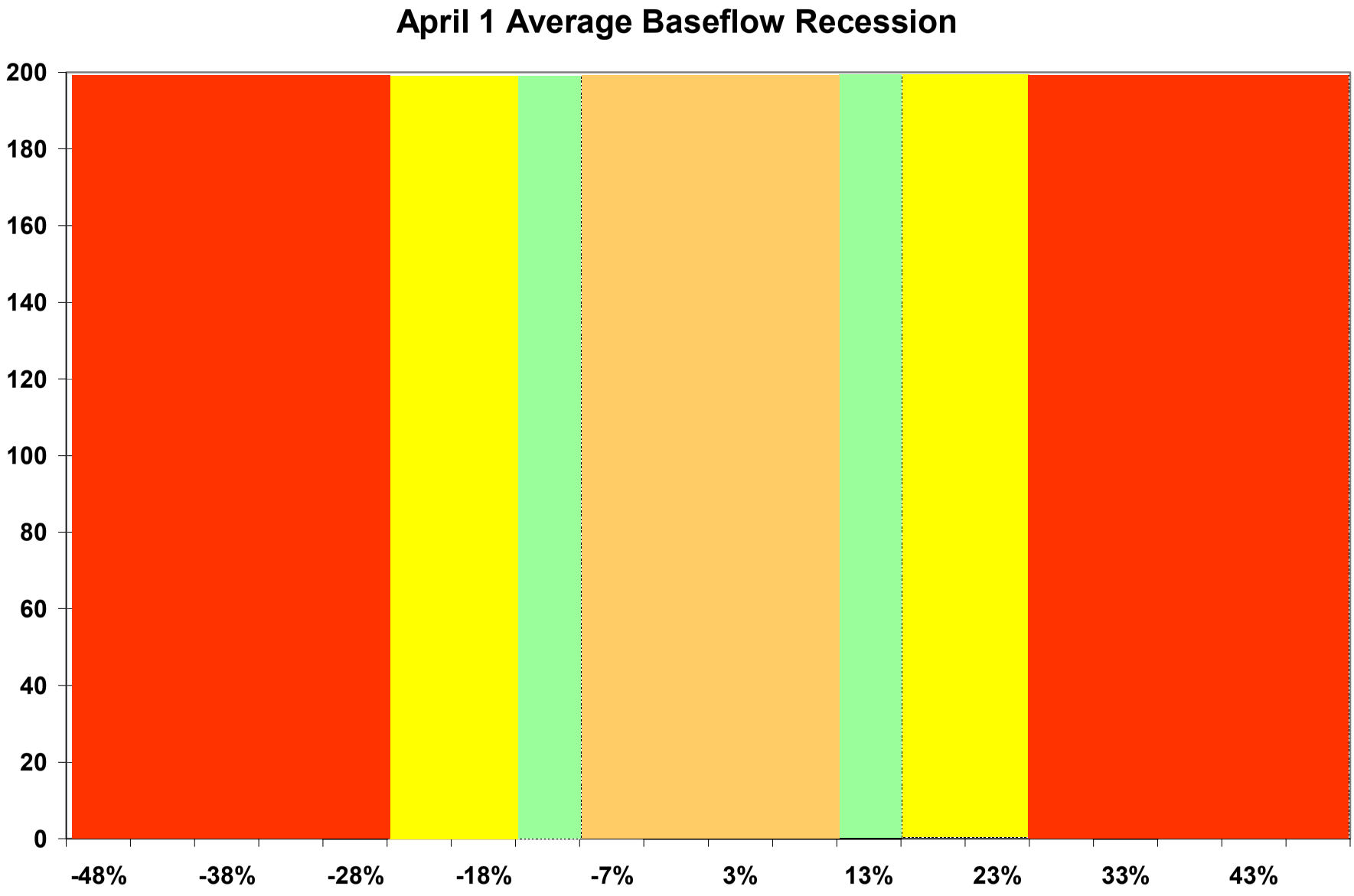

April 1 Qstat
90
80
70
60
50
40
30
20
10
0
-103%
-83%
-63%
-43%
-23%
-3%
18%
38%
58%
78%
98%


Interative Calibration Qstat
90
80
70
60
50
40
30
20
10
0
-103%
-83%
-63%
-43%
-23%
-3%
18%
38%
58%
78%
98%

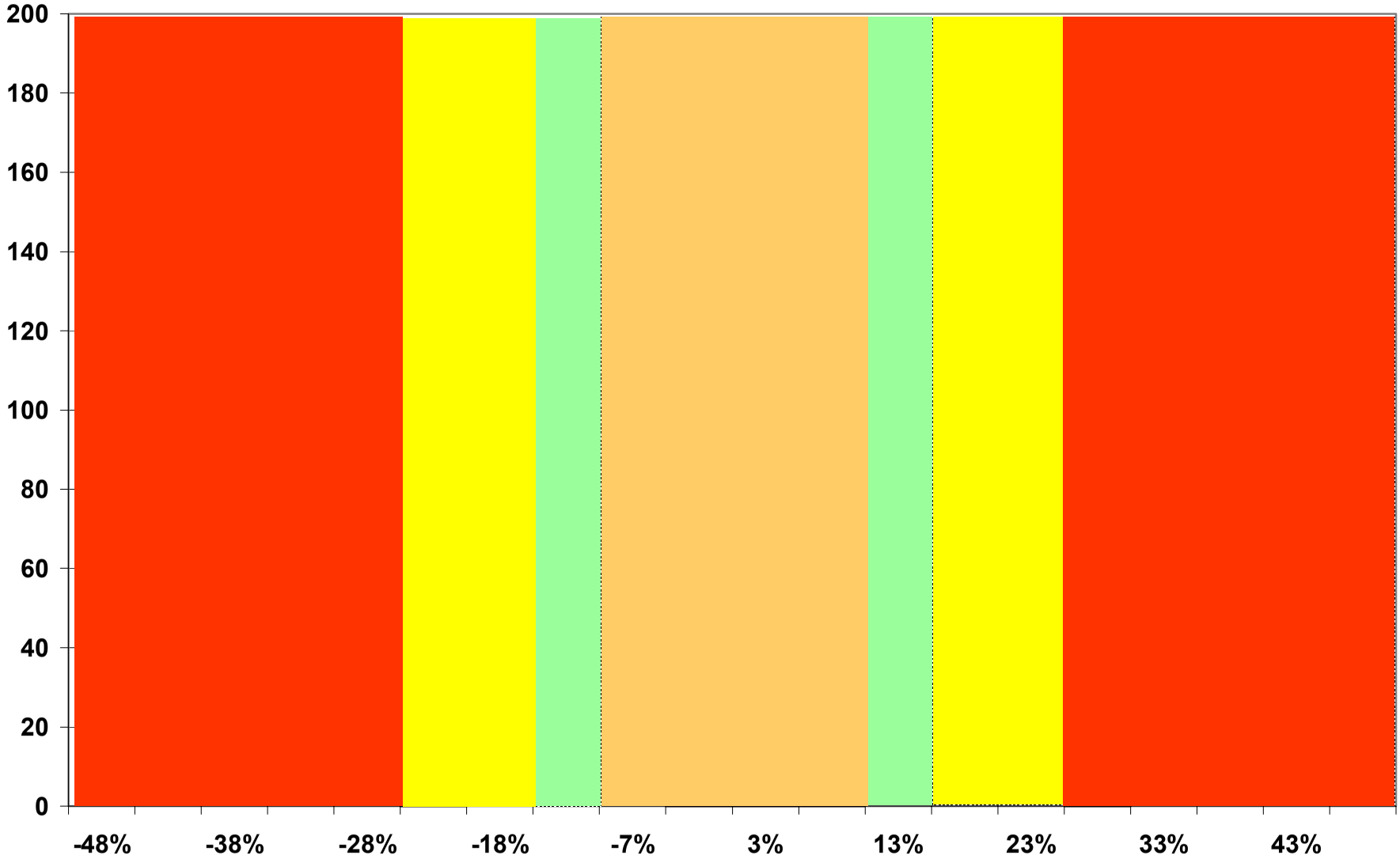
Baseflow / Stormflow Recession Statistic

$$\text{Q rec Index} = 1 - \frac{\text{average Simulated recession index}}{\text{average Observed recession index}}$$

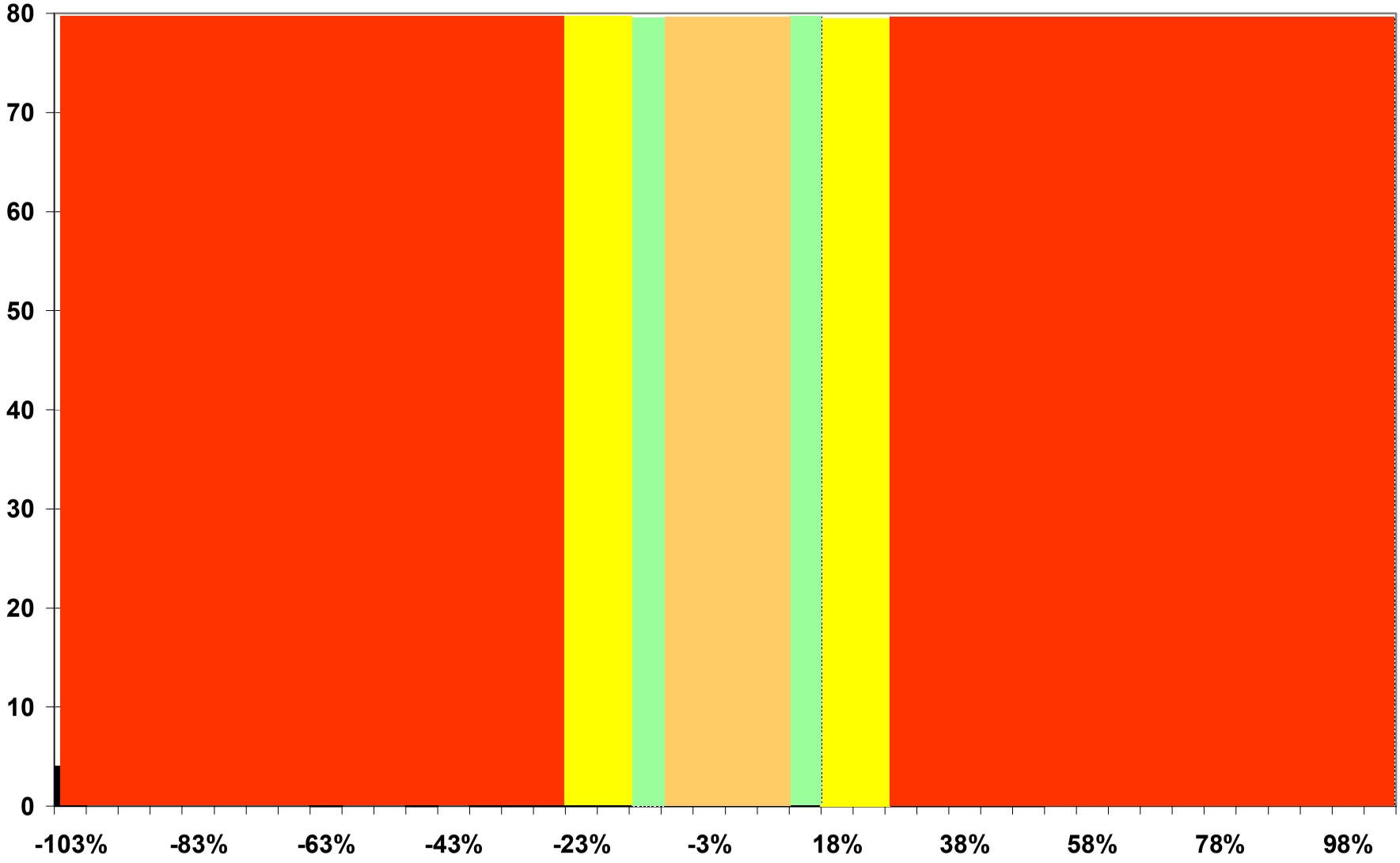
$$\text{Average Recession index} = \text{Average}\left(\frac{\text{quick flow tomorrow}}{\text{quick flow today}}\right)$$


April 1 Average Baseflow Recession
200
180
160
140
120
100
80
60
40
20
0
-48%
-38%
-28%
-18%
-7%
3%
13%
23%
33%
43%

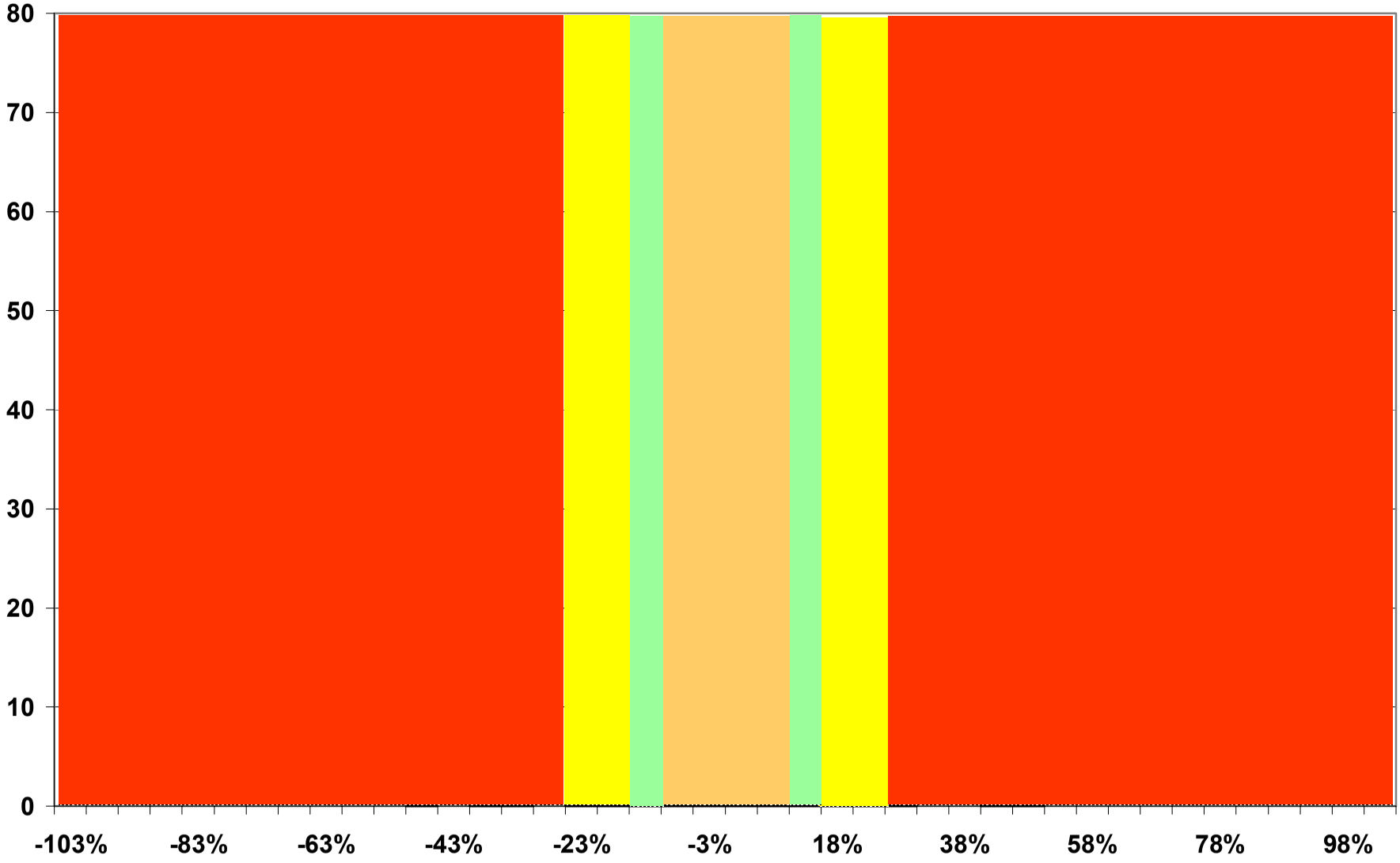
Iterative Calibration Average Baseflow Recession



April 1 Quickflow Recession Index



Iterative Calibration Quickflow Recession Index



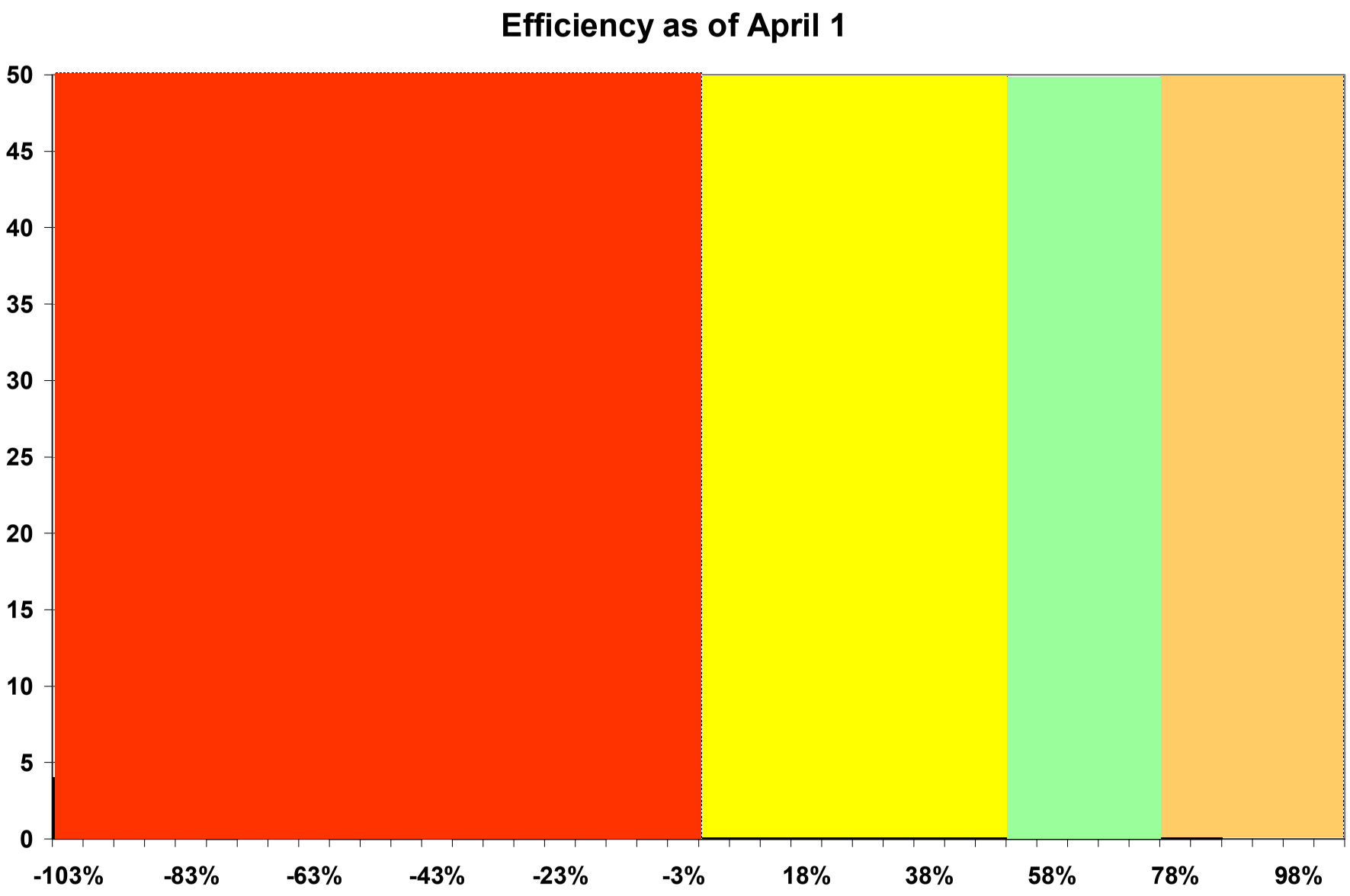
Nash – Sutcliffe Model efficiency

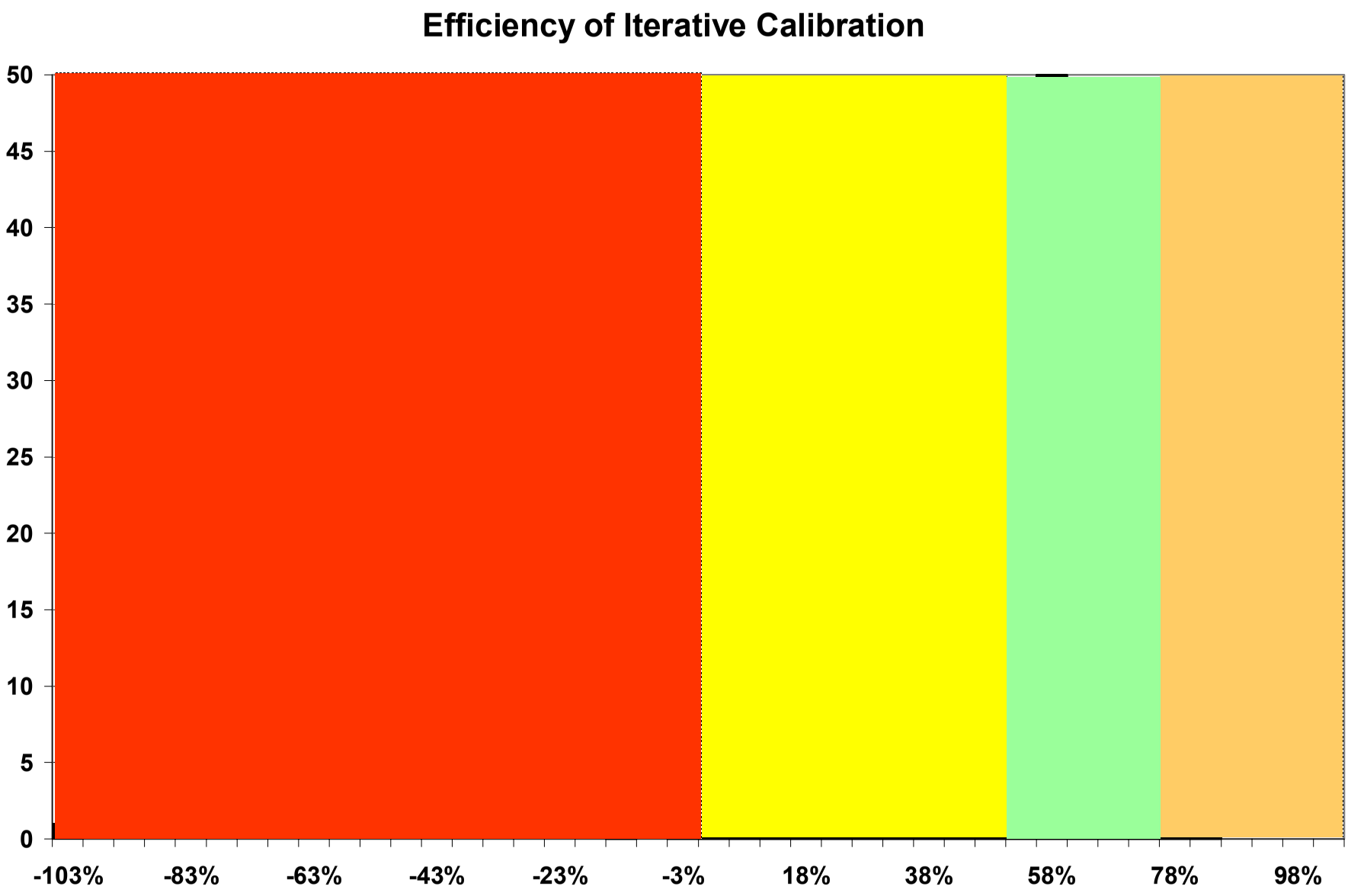
$$1 - \frac{\text{(variance of errors)}}{\text{(variance of observed)}}$$

Computed for daily, log of daily, and monthly values.

Reported values of N-S efficiency

- Often reported, but little information on ‘standards’ of efficiency
- Reported daily efficiencies ➔ 0.5 - 0.75
- Reported daily log efficiencies ➔ 0.5 - 0.75
- Reported Monthly efficiencies ➔ 0.7 – 0.8


Efficiency as of April 1
50
45
40
35
30
25
20
15
10
5
0
-103%
-83%
-63%
-43%
-23%
-3%
18%
38%
58%
78%
98%


Efficiency of Iterative Calibration
50
45
40
35
30
25
20
15
10
5
0
-103%
-83%
-63%
-43%
-23%
-3%
18%
38%
58%
78%
98%

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- Reported daily log efficiencies ➔ 0.5 - 0.75
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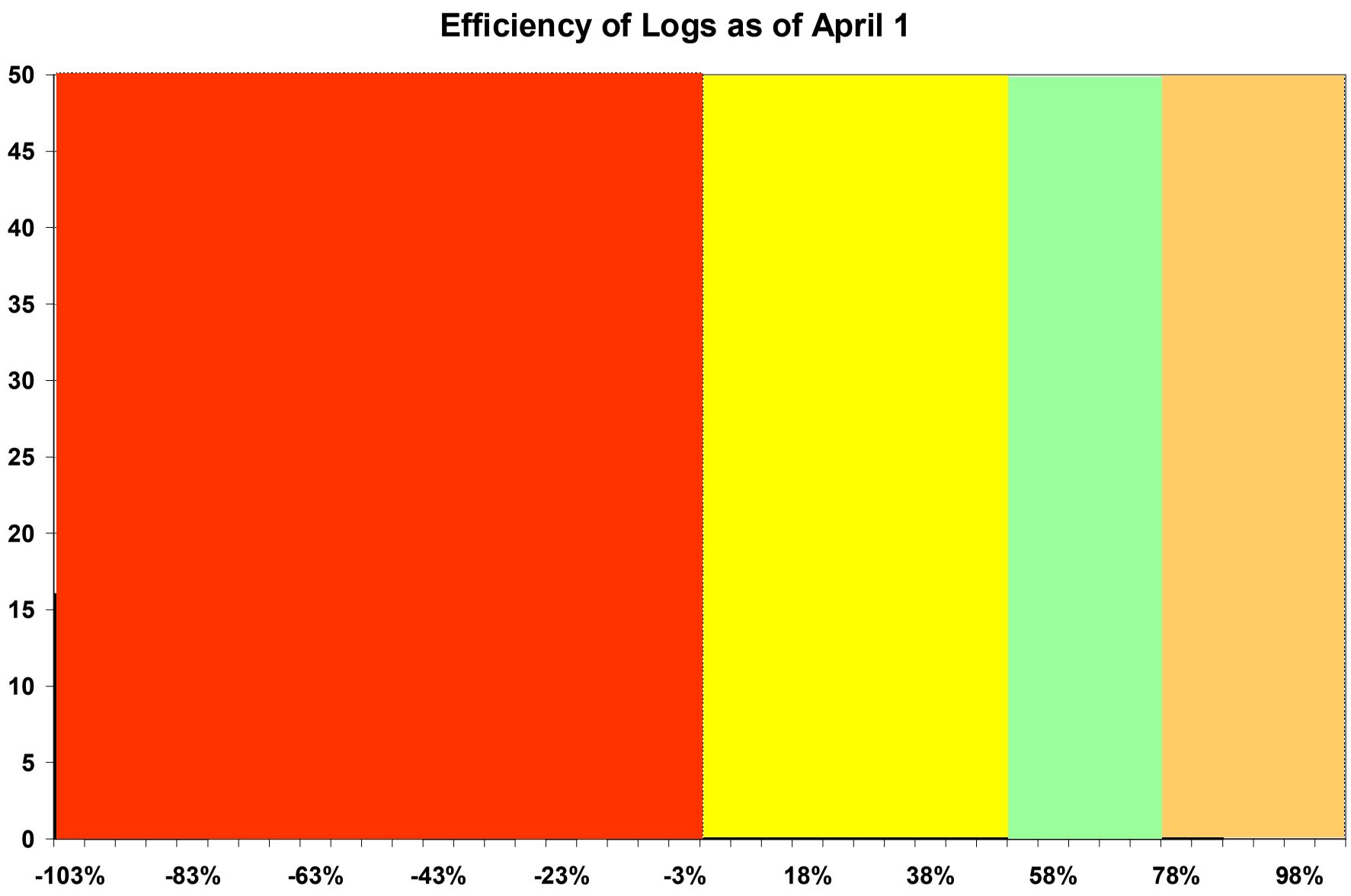
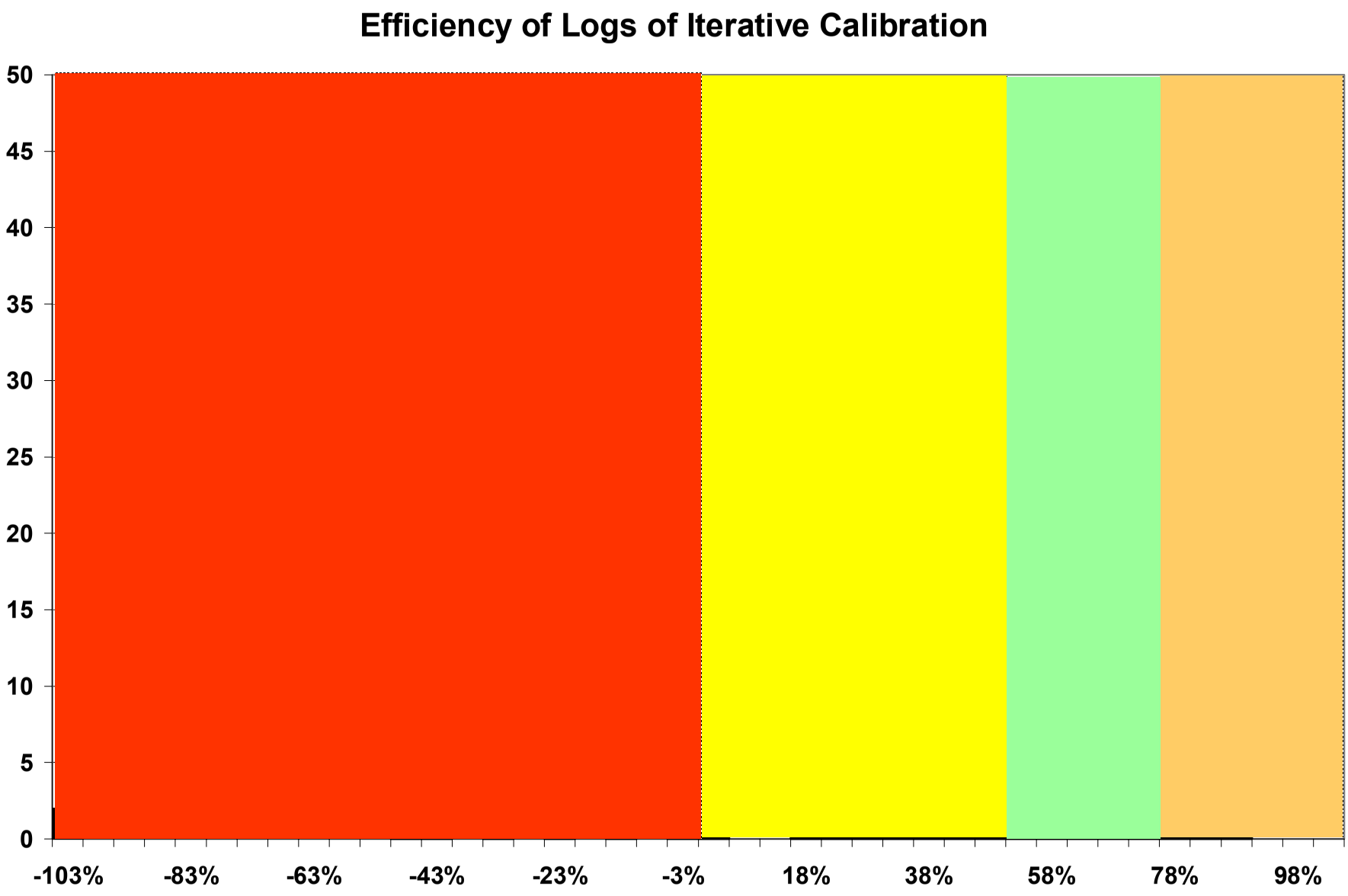

Efficiency of Logs as of April 1
50
45
40
35
30
25
20
15
10
5
0
-103%
-83%
-63%
-43%
-23%
-3%
18%
38%
58%
78%
98%


Efficiency of Logs of Iterative Calibration
50
45
40
35
30
25
20
15
10
5
0
-103%
-83%
-63%
-43%
-23%
-3%
18%
38%
58%
78%
98%

Reported values of N-S efficiency

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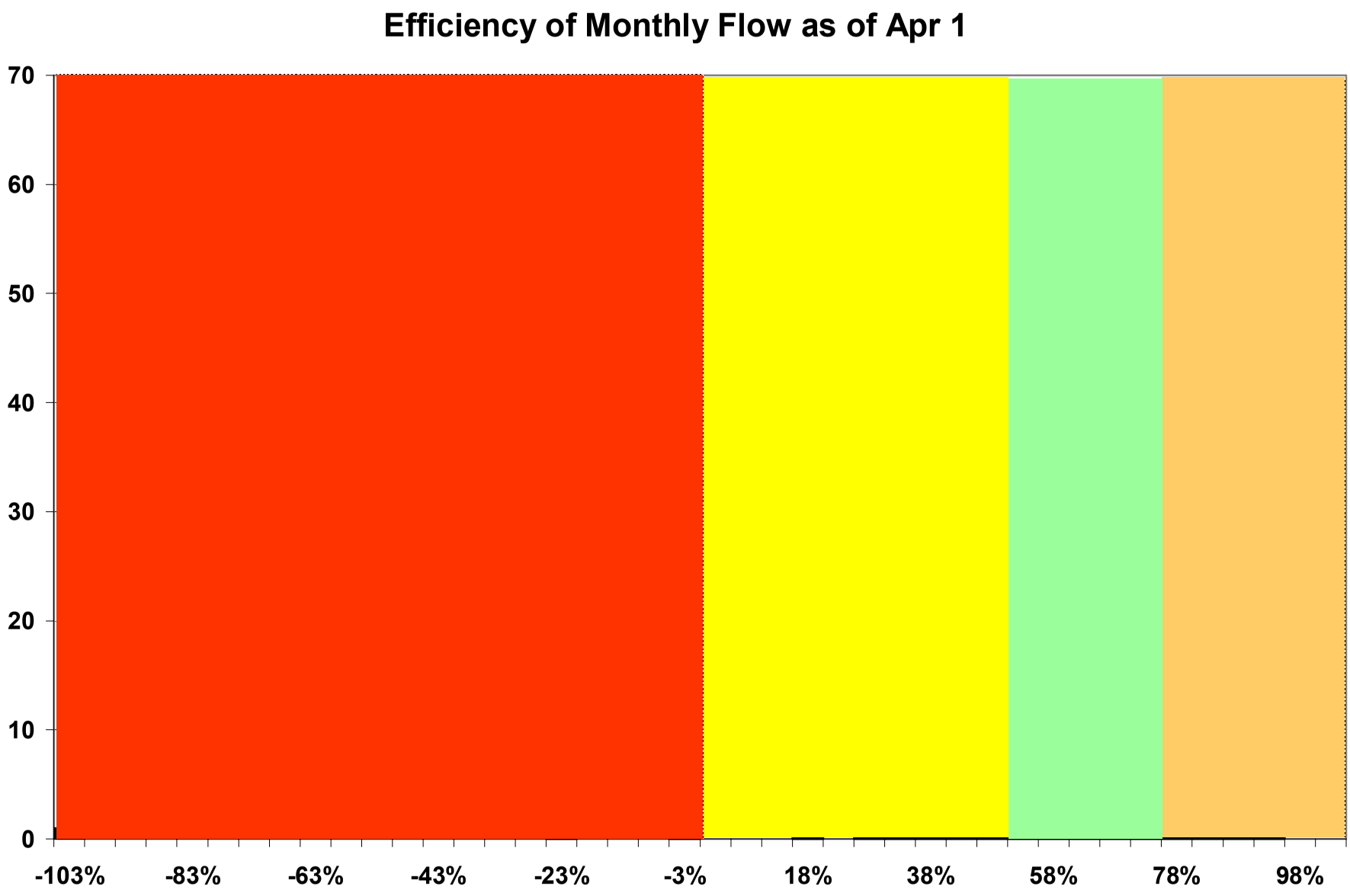
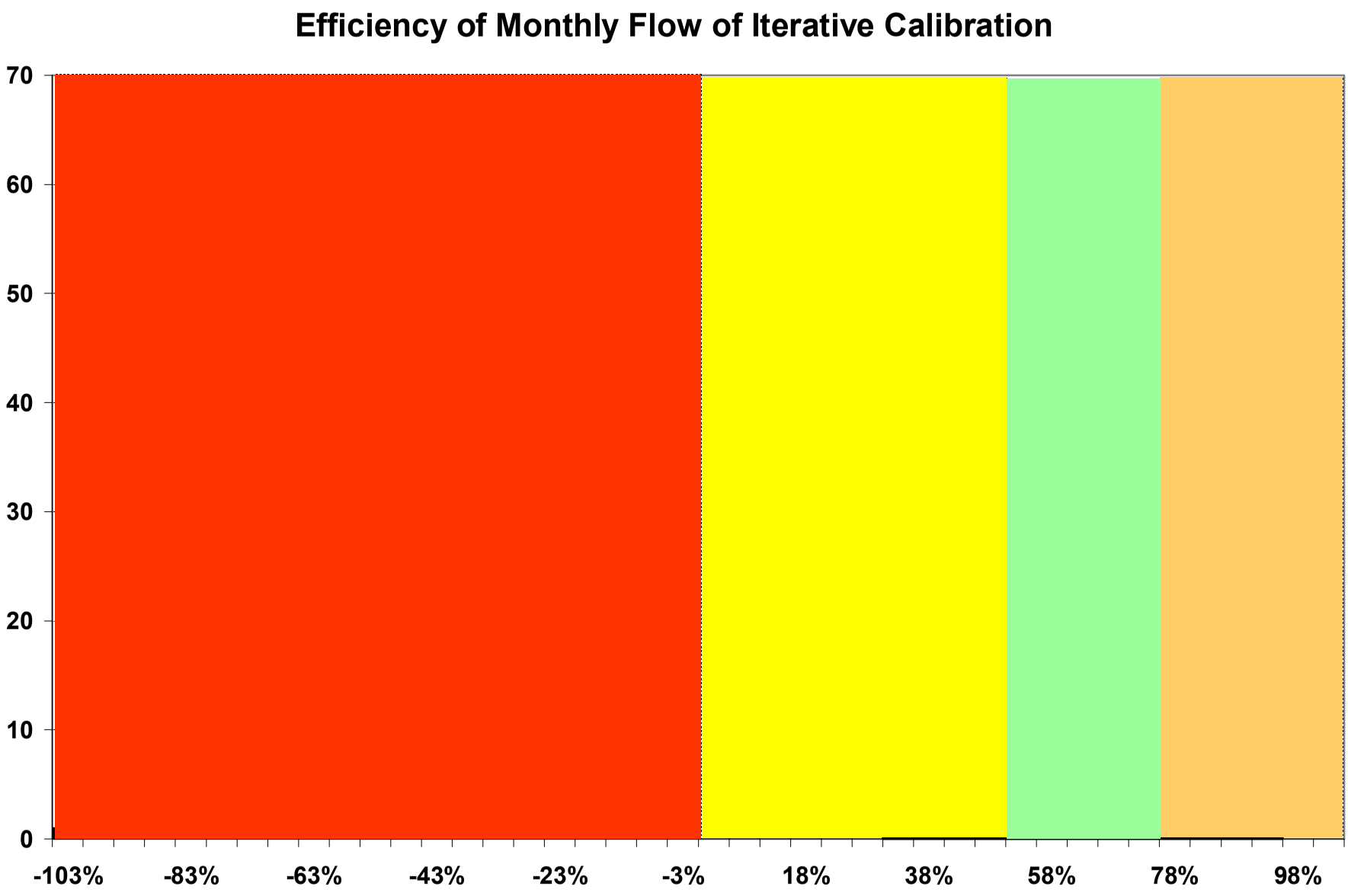
- Reported daily log efficiencies ➔ 0.5 - 0.75
- Reported Monthly efficiencies ➔ 0.7 – 0.8


Efficiency of Monthly Flow as of Apr 1
70
60
50
40
30
20
10
0
-103%
-83%
-63%
-43%
-23%
-3%
18%
38%
58%
78%
98%


Efficiency of Monthly Flow of Iterative Calibration
70
60
50
40
30
20
10
0
-103%
-83%
-63%
-43%
-23%
-3%
18%
38%
58%
78%
98%

results

Hand calib

	INFILT	AGWR	INTFW	IRC	AGWETP	UZSN	LZSN	KVARY
min	0.009	0.867	0.5	0.12	0.0000	0.25	4.0	0.0
10th	0.041	0.954	1.0	0.25	0.0000	0.50	5.0	0.0
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median	0.072	0.974	1.0	0.38	0.0500	0.50	5.0	0.0
75th	0.117	0.979	2.5	0.46	0.0500	0.50	5.0	0.0
90th	0.176	0.983	3.5	0.60	0.0500	0.50	7.5	1.0
max	0.337	0.995	5.0	0.85	0.1176	1.35	13.5	3.0

Iterative calib

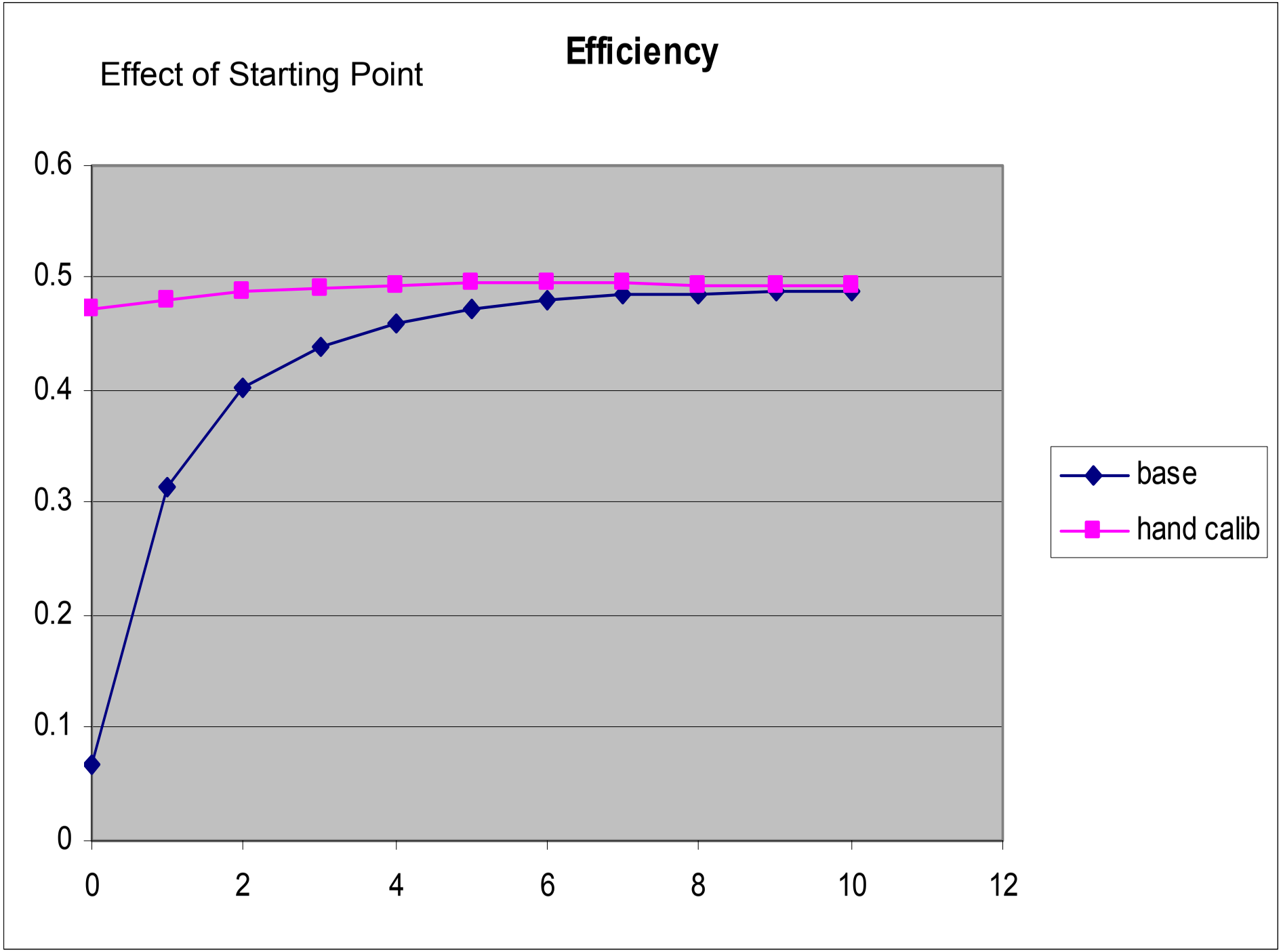
	INFILT	AGWR	INTFW	IRC	AGWETP	UZSN	LZSN	KVARY
min	0.013	0.920	1.0	0.30	0.0005	0.49	3.5	0.0
10th	0.013	0.920	1.0	0.30	0.0005	0.62	4.4	0.0
25th	0.026	0.920	1.0	0.30	0.0007	0.82	5.8	0.0
median	0.052	0.940	1.9	0.38	0.0080	1.19	8.5	0.0
75th	0.087	0.962	3.4	0.53	0.0243	1.64	11.7	0.0
90th	0.140	0.981	4.0	0.68	0.0395	1.68	12.0	0.0
max	0.250	0.990	4.0	0.85	0.0500	1.68	12.0	0.0

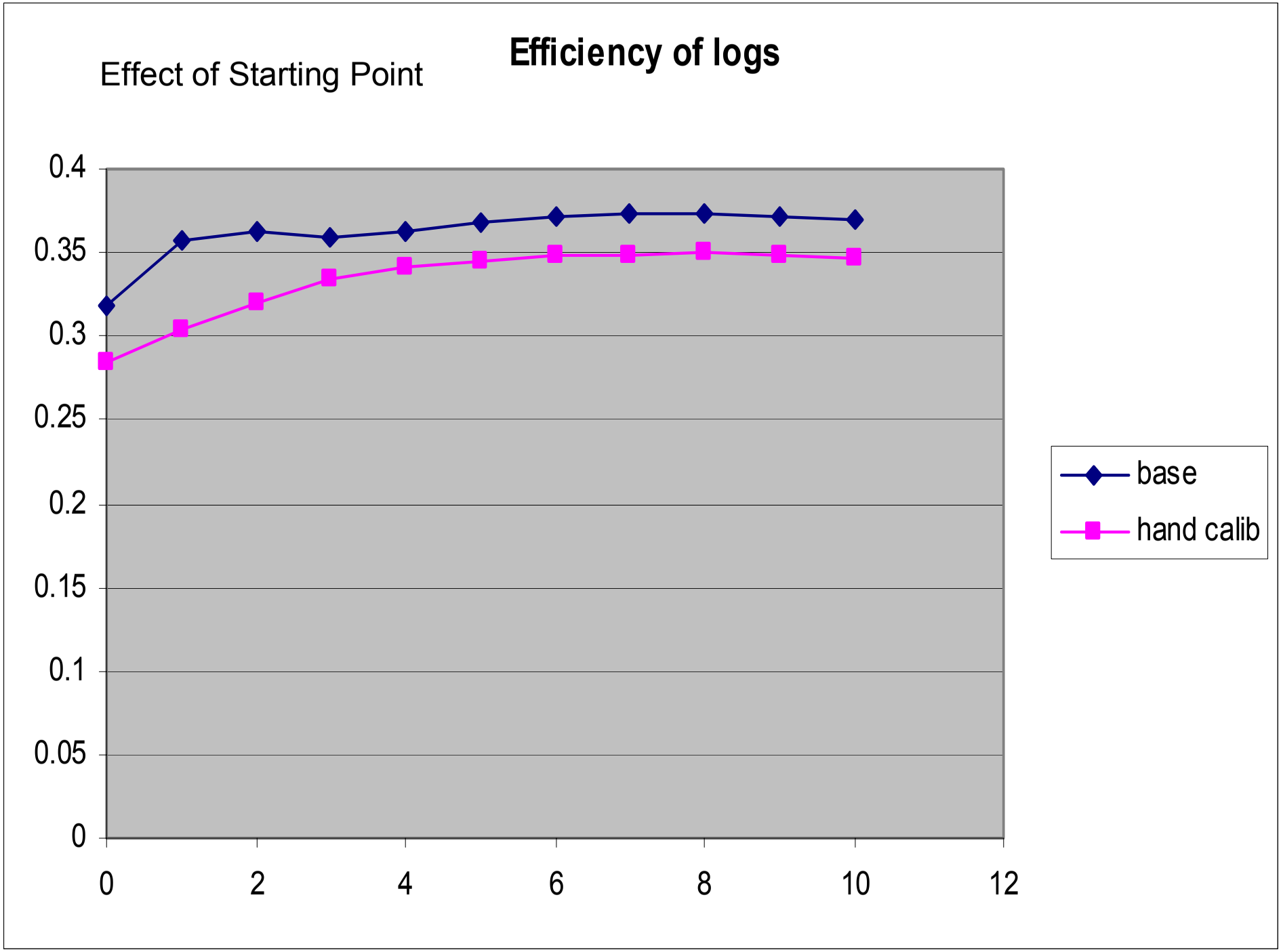
Results

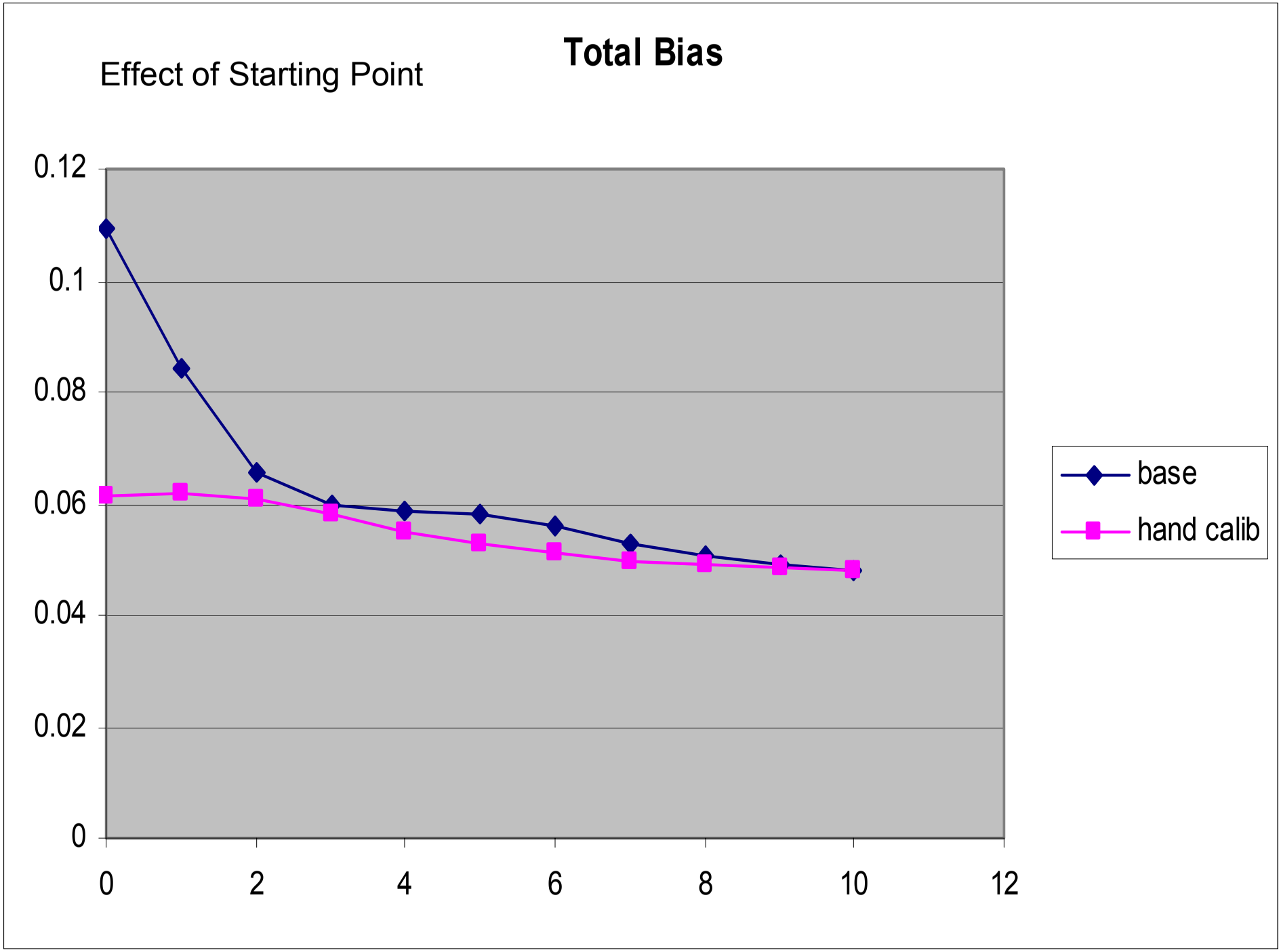
- Used the knowledge gained during the individual calibration stage
  - Sensitive parameters
  - Important statistics
- Improved the calibration by applying the knowledge in a systematic way
  - More consistent parameterization
  - Better statistical calibration

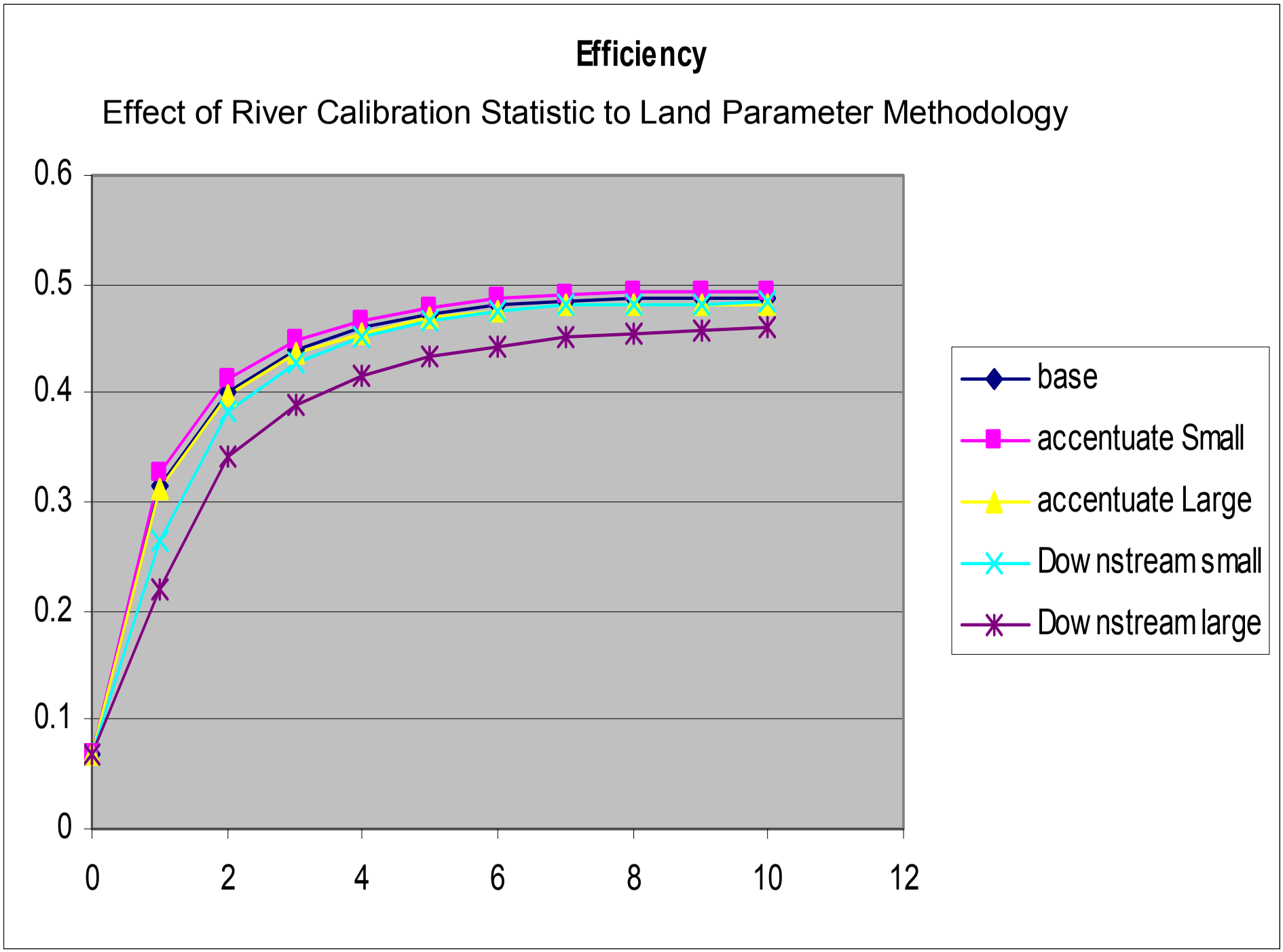
Remaining Questions

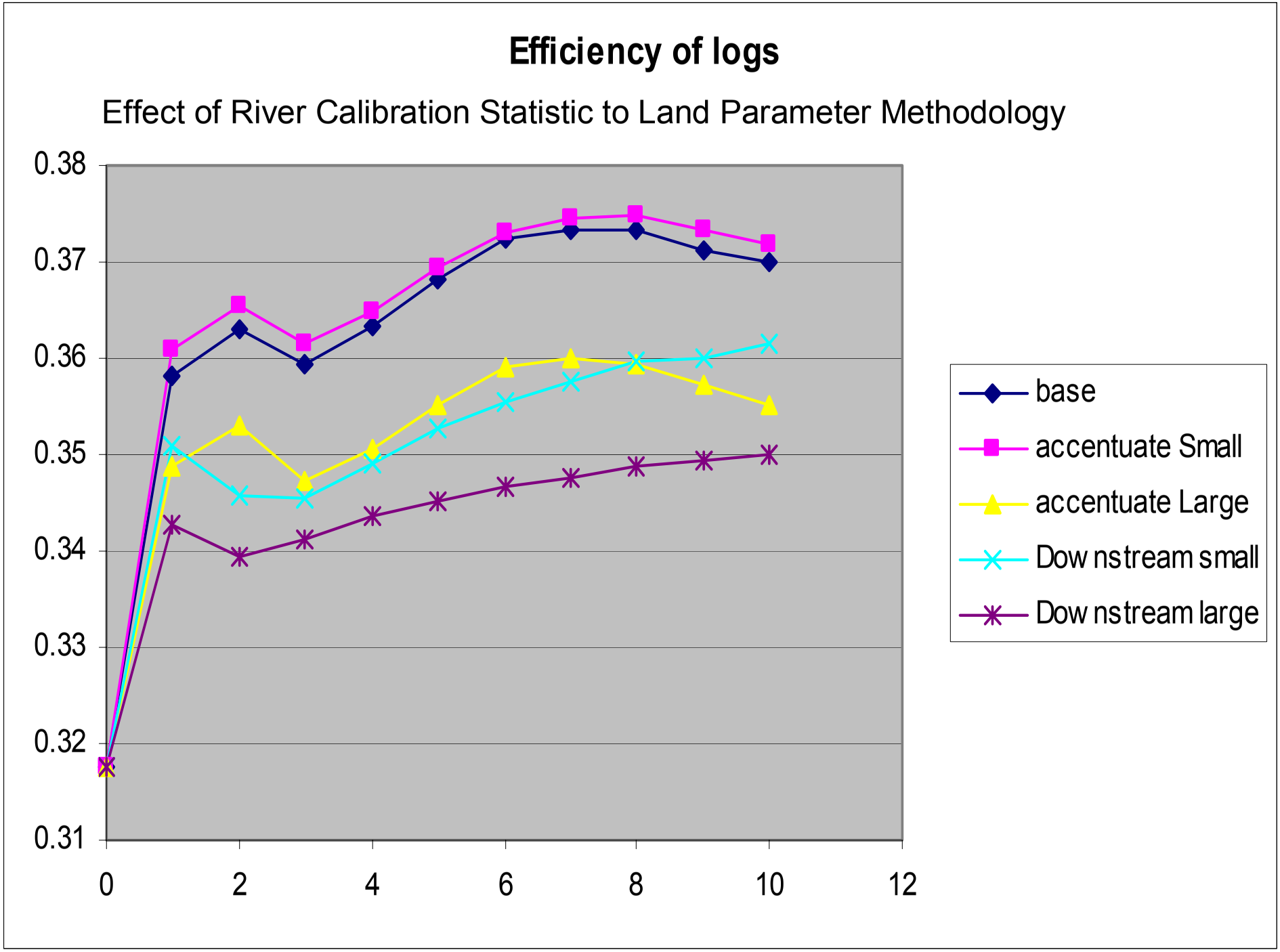
- How robust is this calibration
  - Sensitive to starting point?
  - Sensitive to rules of assigning land segments to calibration stations?
  - Sensitive to rules governing parameters to adjust?

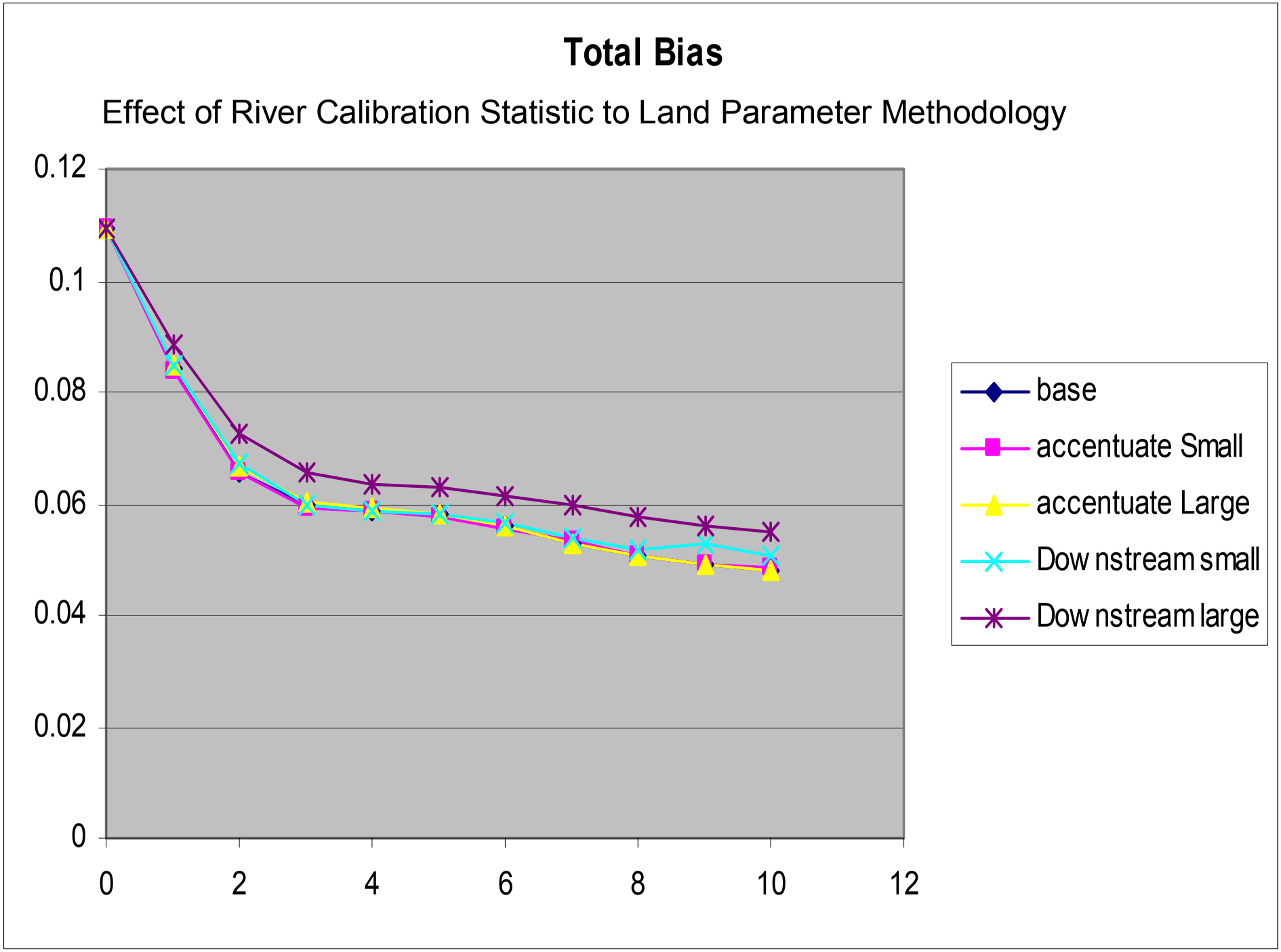

Efficiency
Effect of Starting Point
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
12
base
hand calib

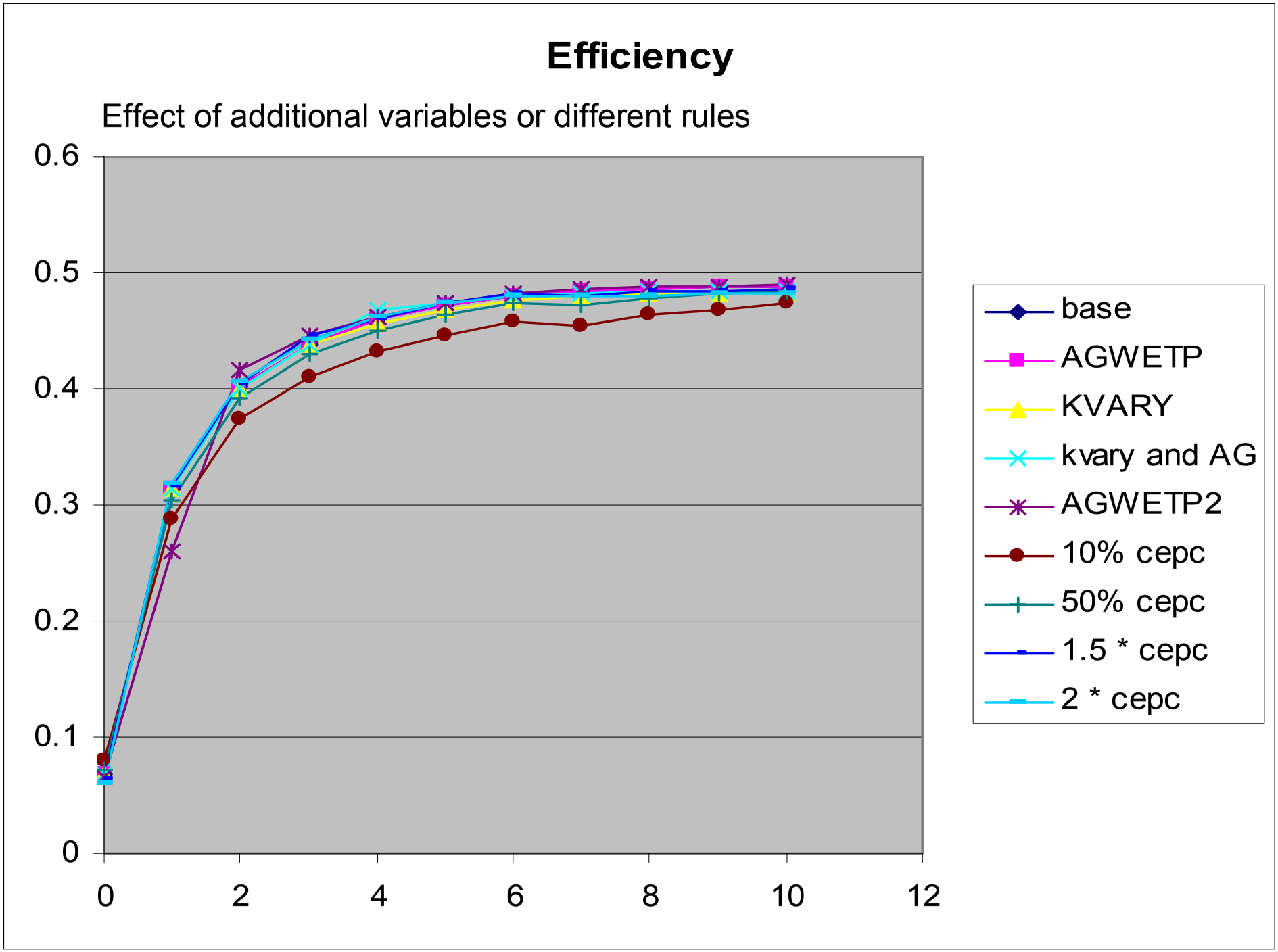

Efficiency of logs
Effect of Starting Point
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
2
4
6
8
10
12
base
hand calib

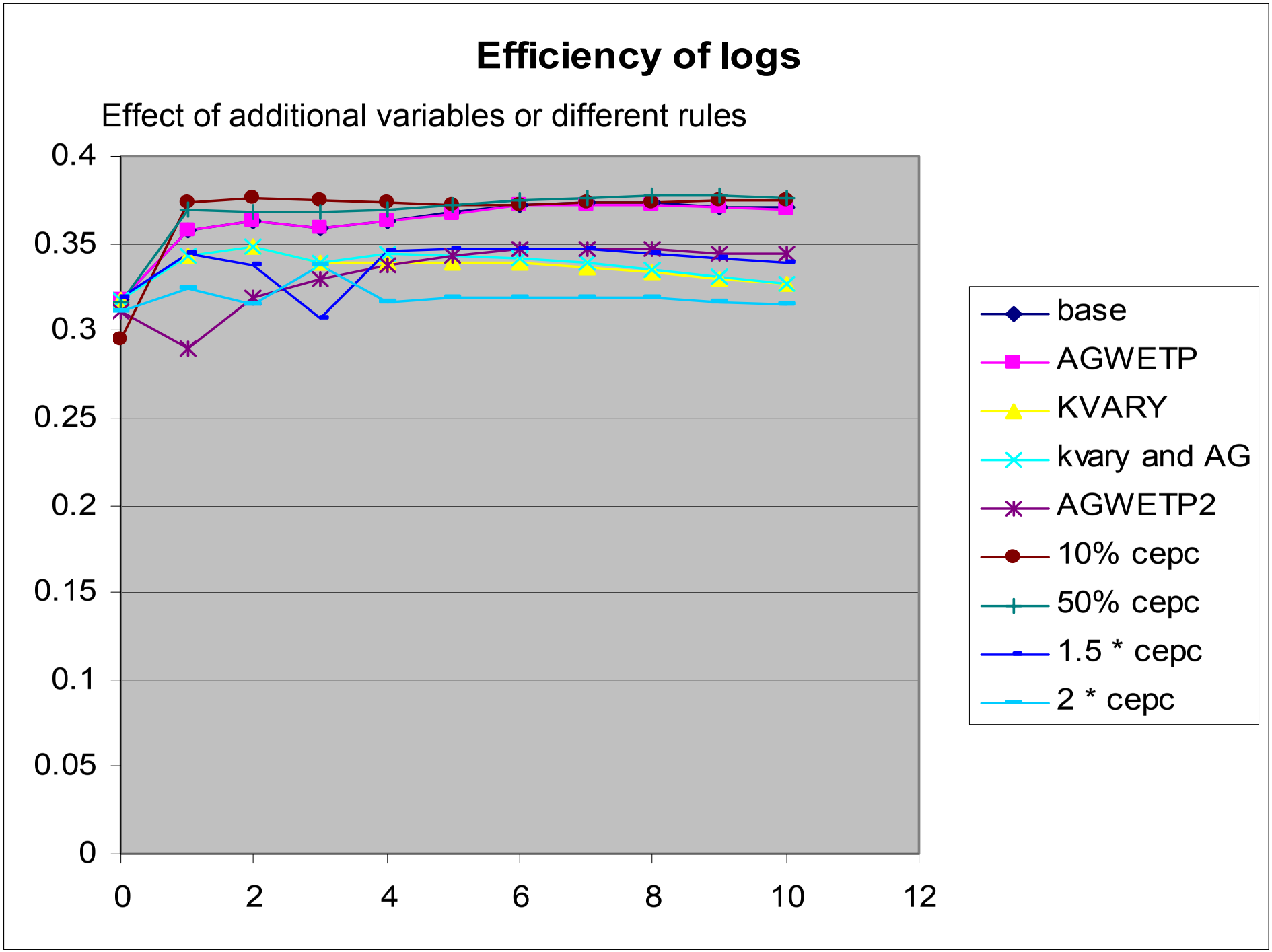

Total Bias
Effect of Starting Point
0.12
0.1
0.08
0.06
0.04
0.02
0
0
2
4
6
8
10
12
base
hand calib

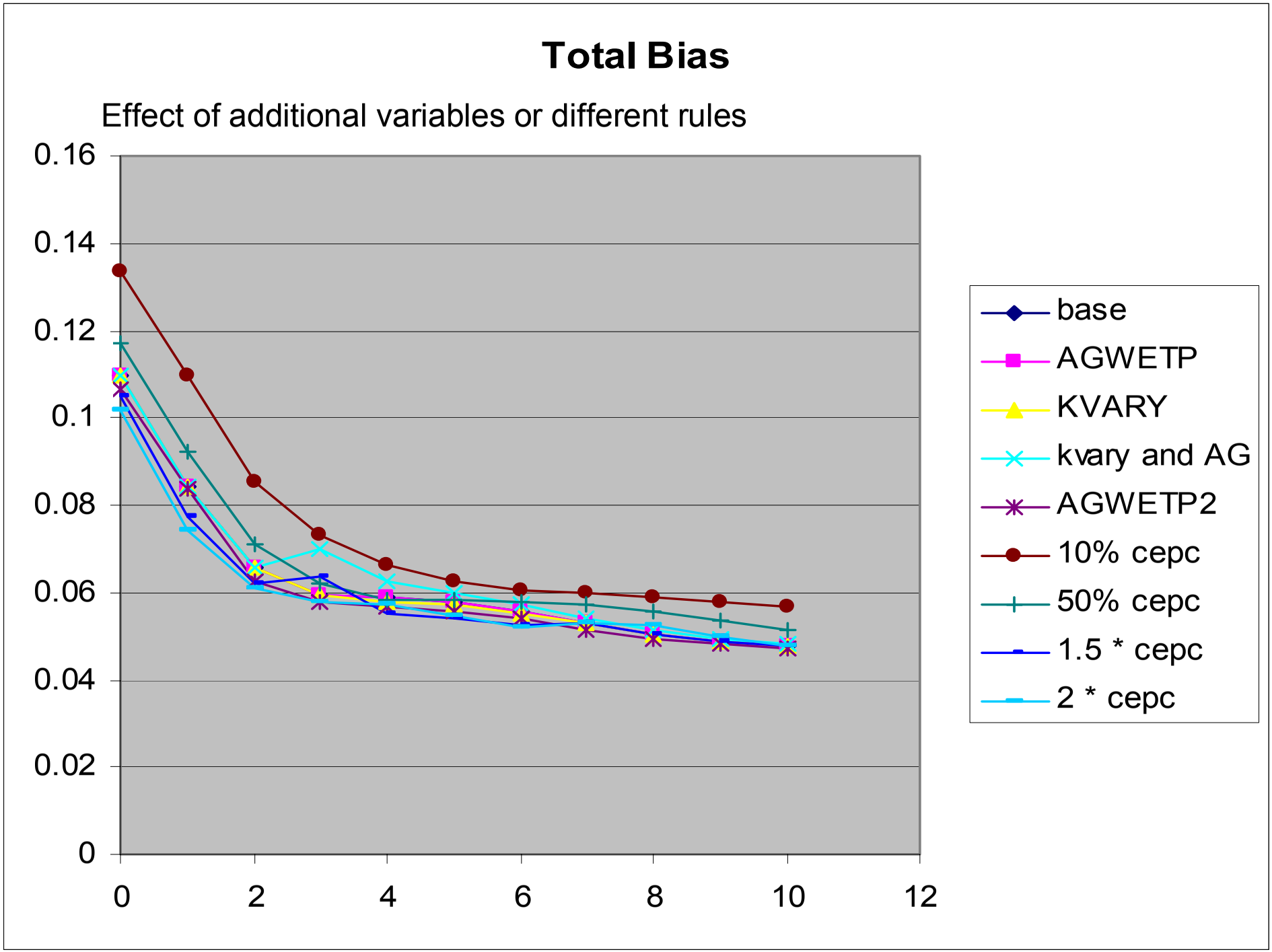

Efficiency
Effect of River Calibration Statistic to Land Parameter Methodology
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
12
base
accentuate Small
accentuate Large
Downstream small
Downstream large

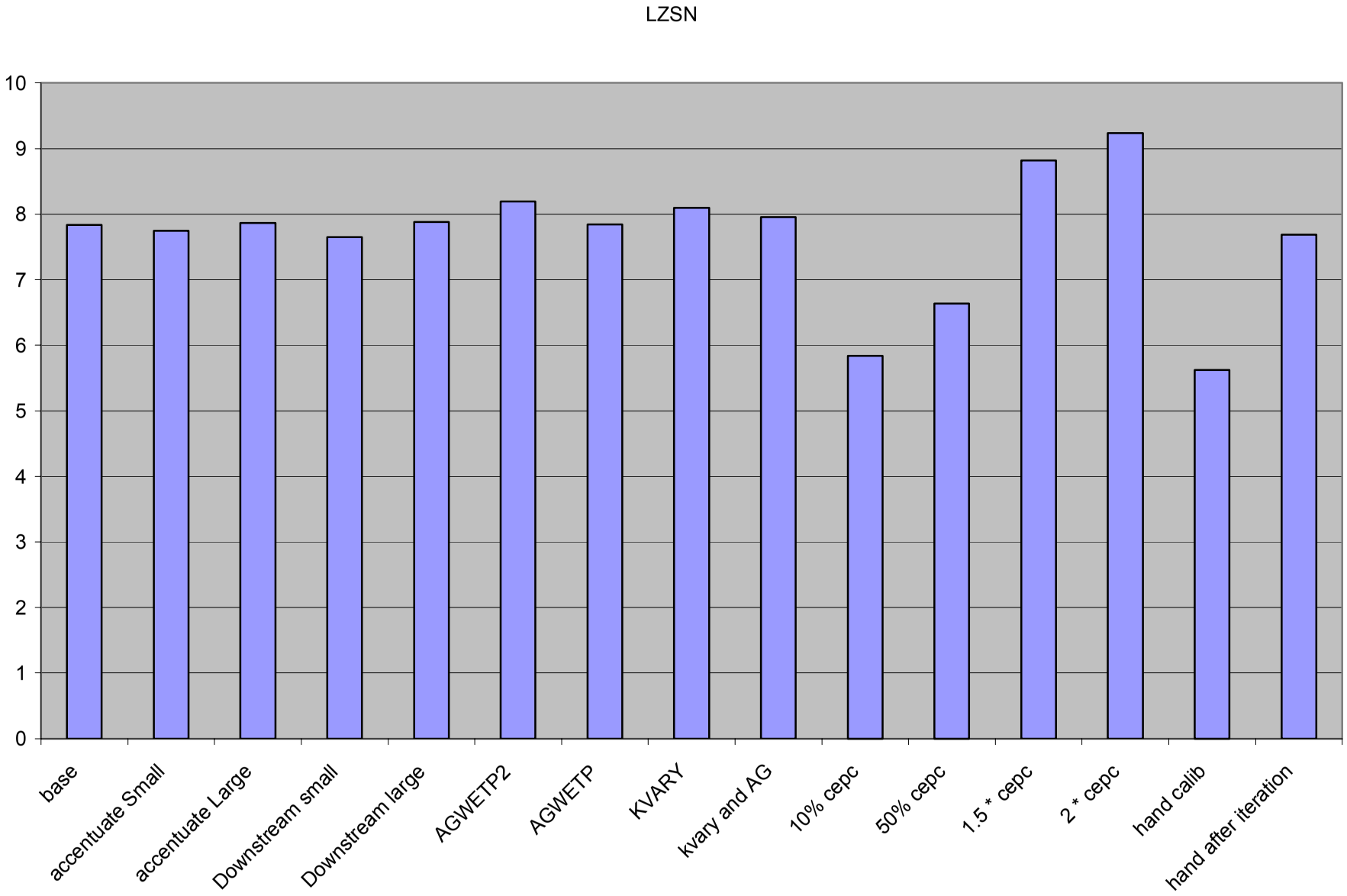

Efficiency of logs
Effect of River Calibration Statistic to Land Parameter Methodology
0.38
0.37
0.36
0.35
0.34
0.33
0.32
0.31
0
2
4
6
8
10
12
base
accentuate Small
accentuate Large
Downstream small
Downstream large

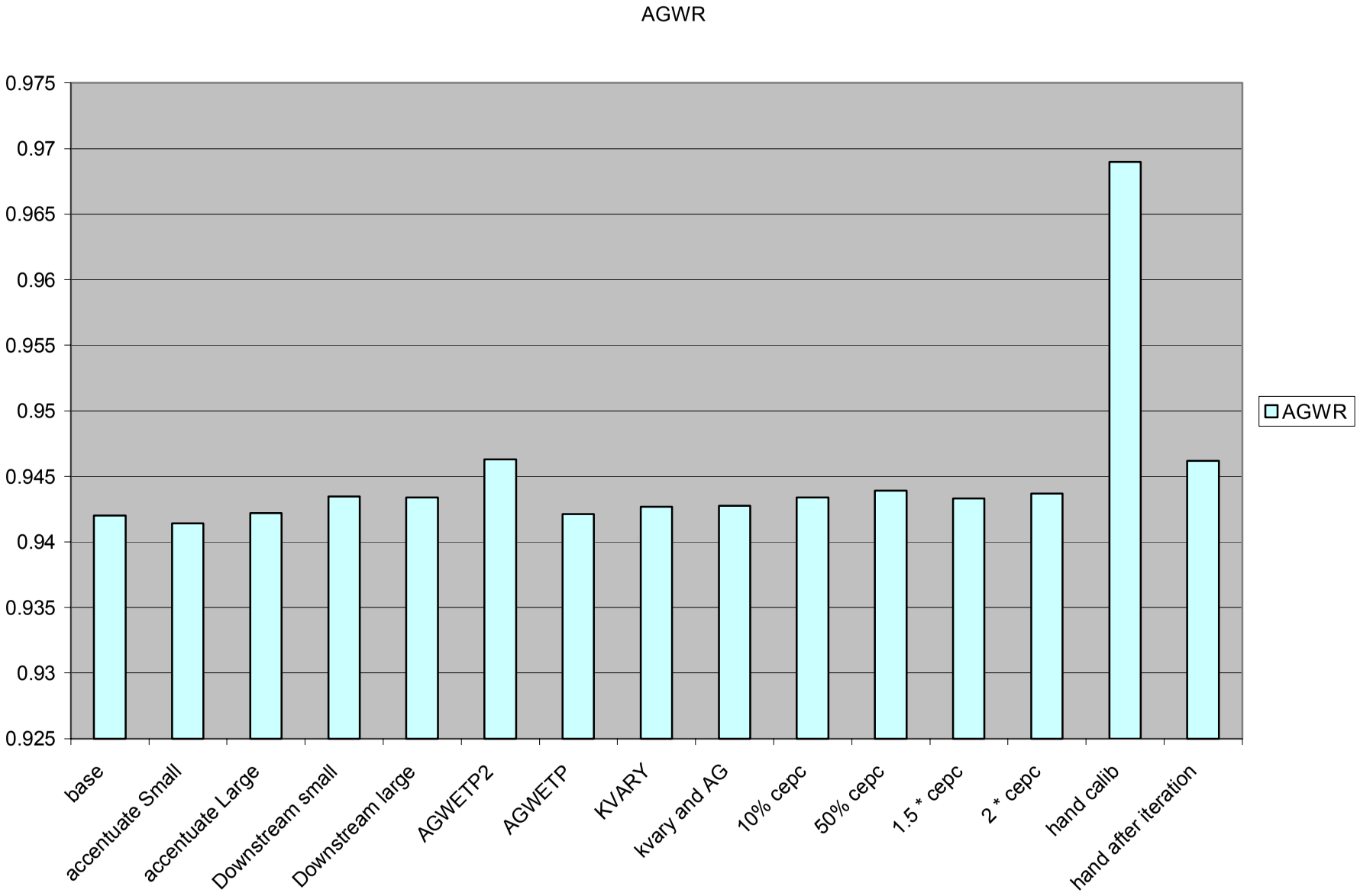

Total Bias
Effect of River Calibration Statistic to Land Parameter Methodology
0.12
0.1
0.08
0.06
0.04
0.02
0
0
2
4
6
8
10
12
base
accentuate Small
accentuate Large
Dow nstream small
Dow nstream large

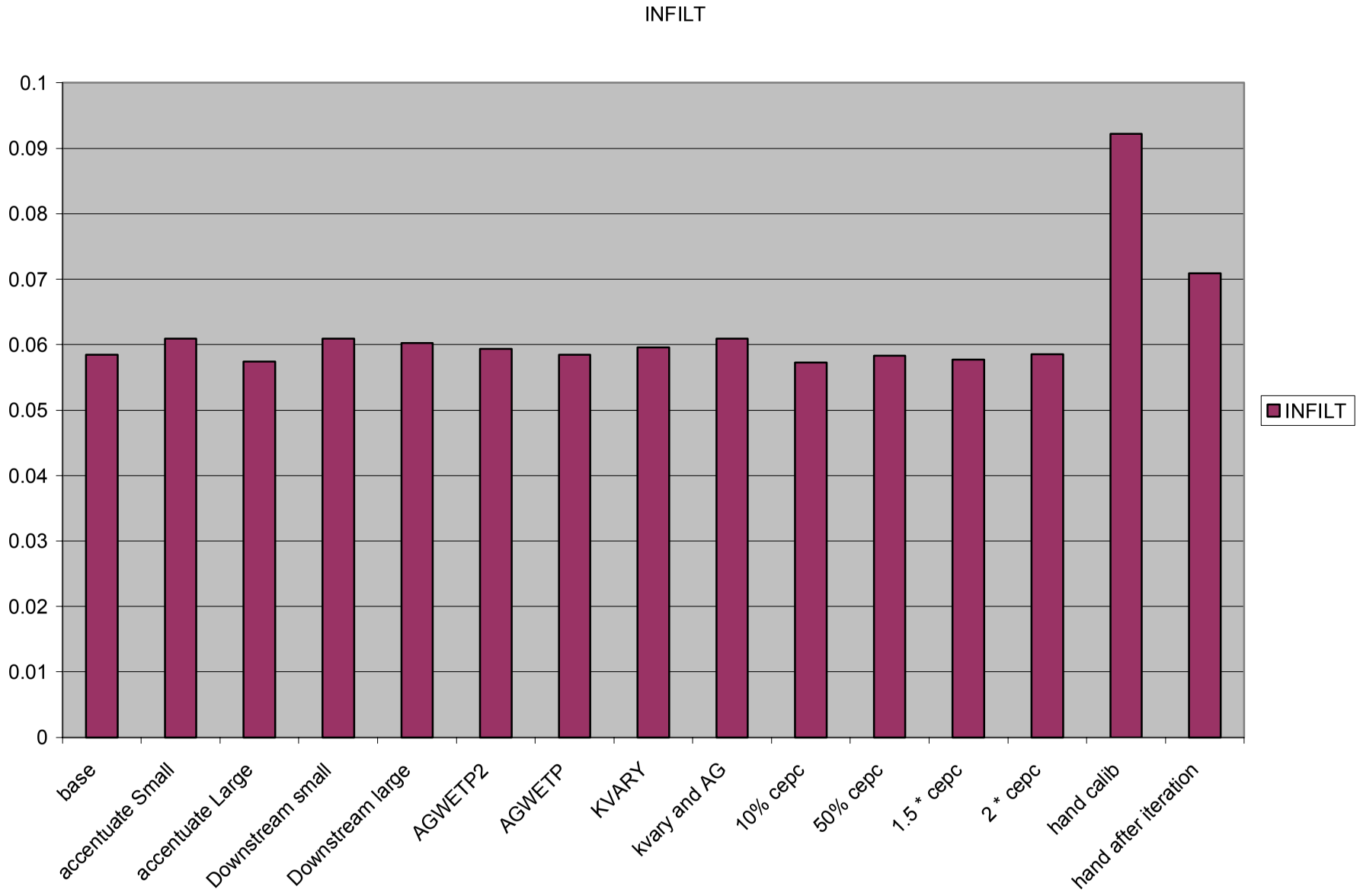

Efficiency
Effect of additional variables or different rules
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
12
base
AGWETP
KVARY
kvary and AG
AGWETP2
10% cepc
50% cepc
1.5 * cepc
2 * cepc

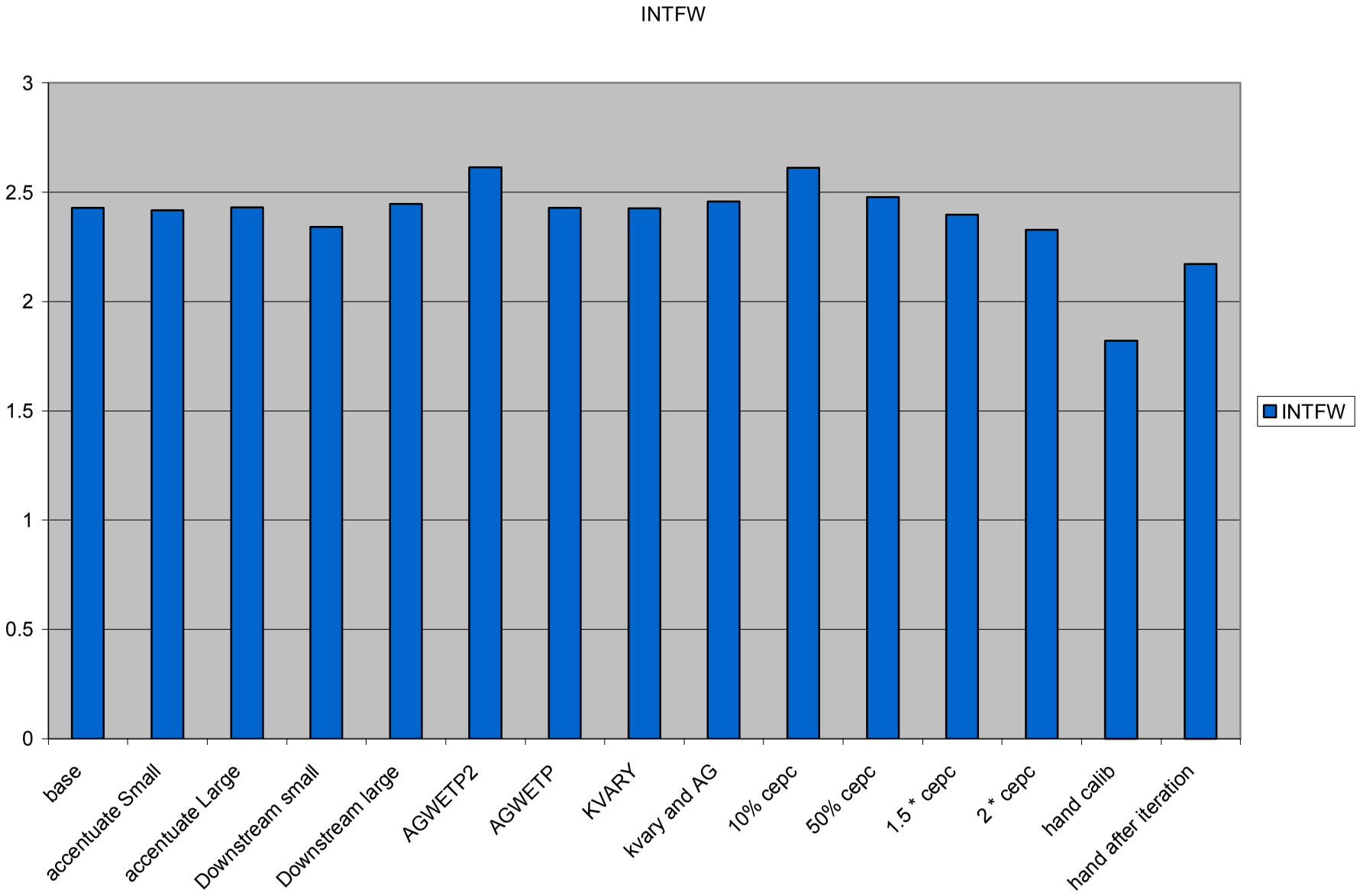

Efficiency of logs
Effect of additional variables or different rules
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
2
4
6
8
10
12
base
AGWETP
KVARY
kvary and AG
AGWETP2
10% cepc
50% cepc
1.5 * cepc
2 * cepc

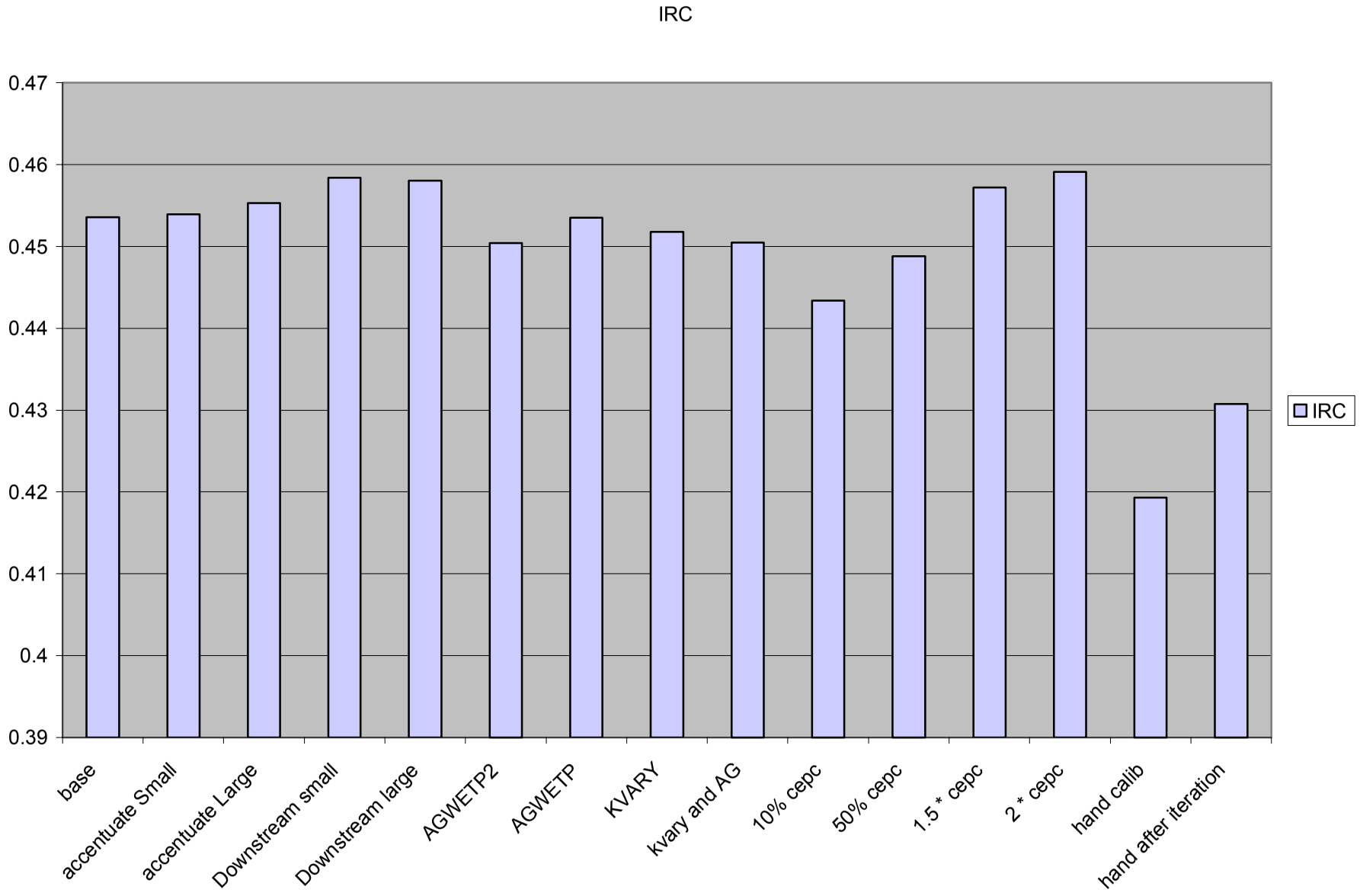

Total Bias
Effect of additional variables or different rules
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
2
4
6
8
10
12
base
AGWETP
KVARY
kvary and AG
AGWETP2
10% cepc
50% cepc
1.5 * cepc
2 * cepc

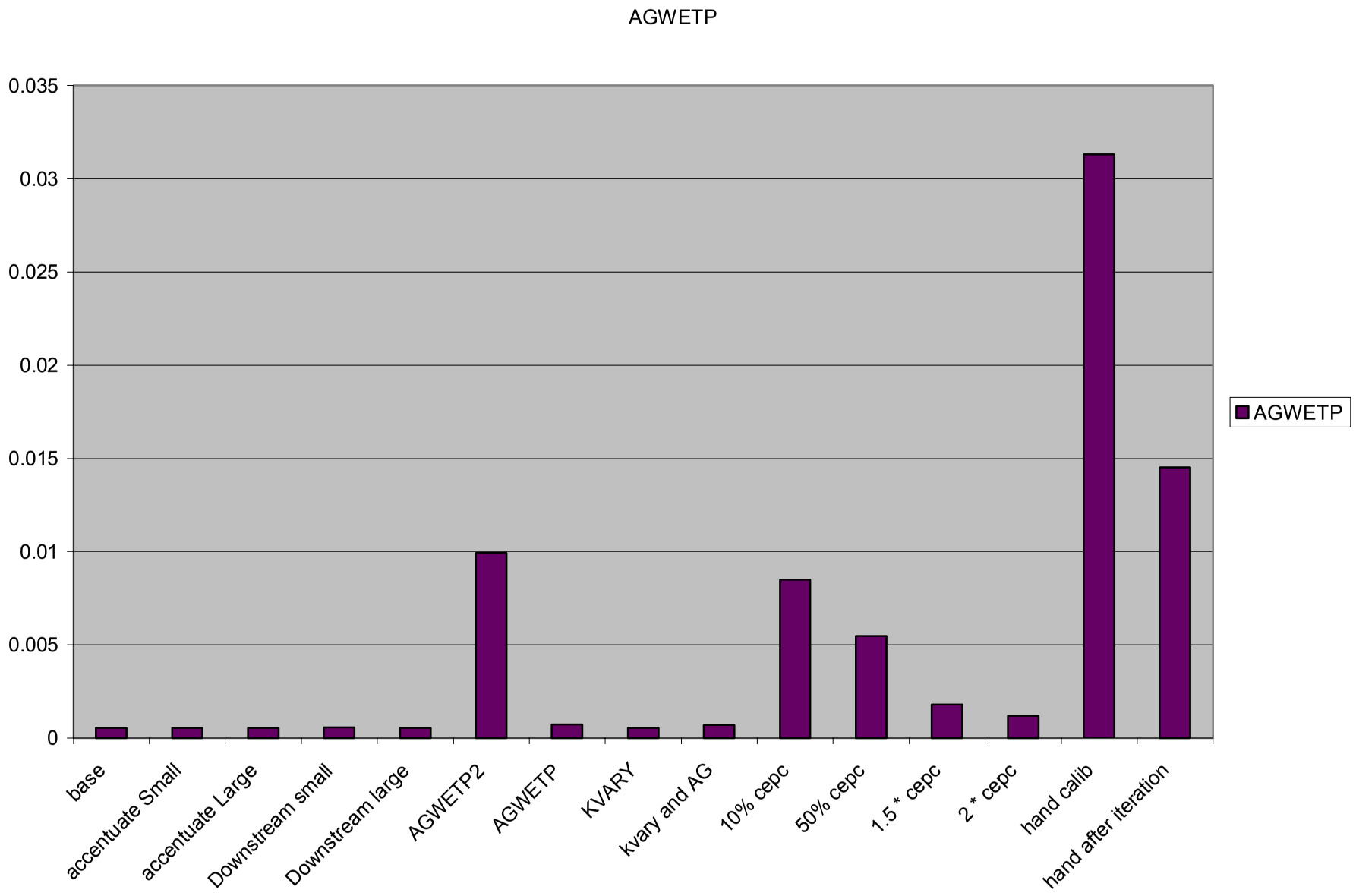

LZSN
10
9
8
7
6
5
4
3
2
1
0
base
accentuate Small
accentuate Large
Downstream small
Downstream large
AGWETP2
AGWETP
KVARY
kvary and AG
10% cepc
50% cepc
1.5 * cepc
2 * cepc
hand calib
hand after iteration

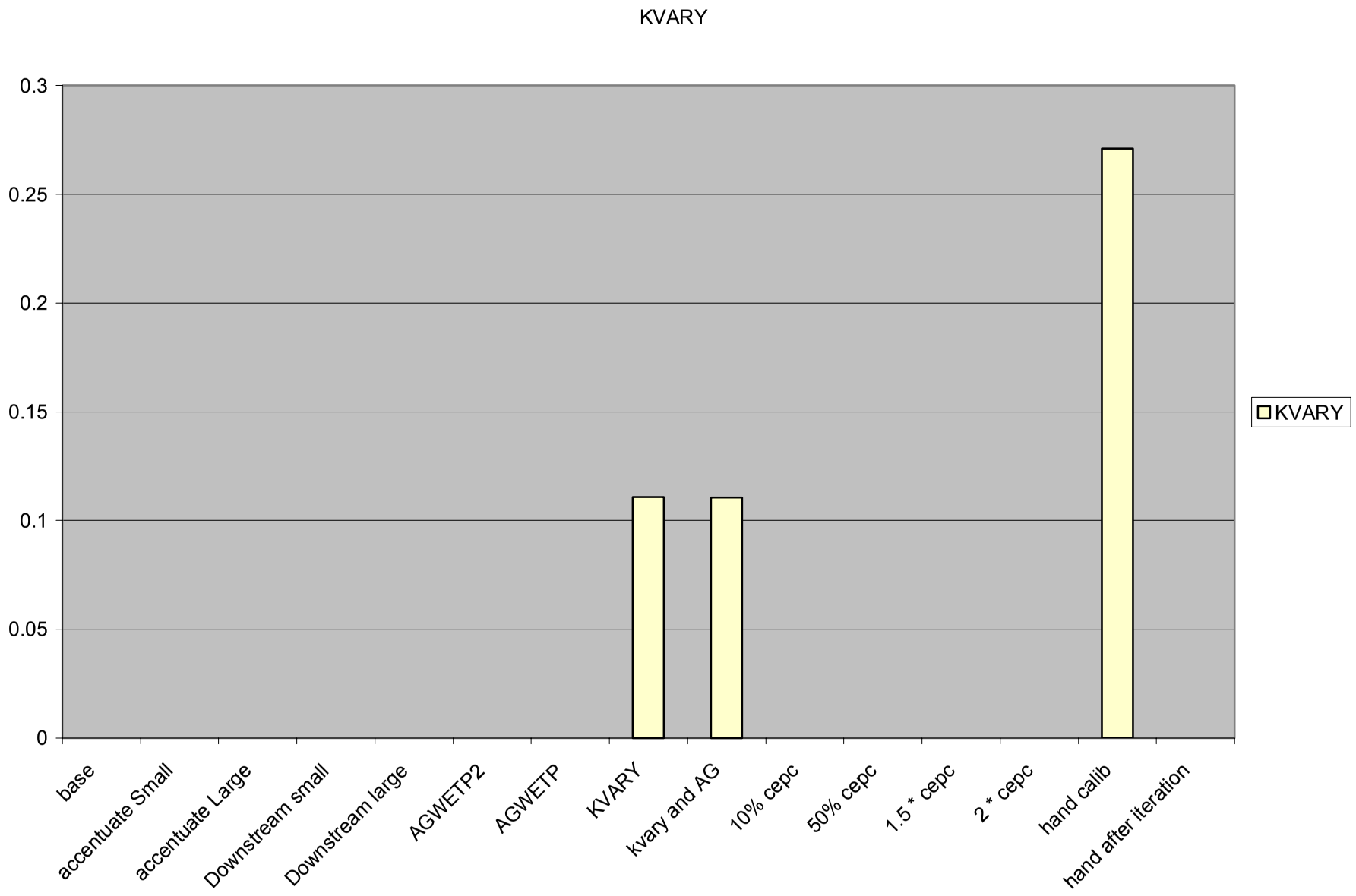

AGWR
0.975
0.97
0.965
0.96
0.955
0.95
0.945
0.94
0.935
0.93
0.925
base
accentuate Small
accentuate Large
Downstream small
Downstream large
AGWETP2
AGWETP
KVARY
kvary and AG
10% cepc
50% cepc
1.5 * cepc
2 * cepc
hand calib
hand after iteration
AGWR


INFILT
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
base
accentuate Small
accentuate Large
Downstream small
Downstream large
AGWETP2
AGWETP
KVARY
kvary and AG
10% cepc
50% cepc
1.5 * cepc
2 * cepc
hand calib
hand after iteration
INFILT


INTFW
3
2.5
2
1.5
1
0.5
0
base
accentuate Small
accentuate Large
Downstream small
Downstream large
AGWETP2
AGWETP
KVARY
kvary and AG
10% cepc
50% cepc
1.5 * cepc
2 * cepc
hand calib
hand after iteration
INTFW


IRC
0.47
0.46
0.45
0.44
0.43
0.42
0.41
0.4
0.39
IRC
base
accentuate Small
accentuate Large
Downstream small
Downstream large
AGWETP2
AGWETP
KVARY
kvary and AG
10% cepc
50% cepc
1.5 * cepc
2 * cepc
hand calib
hand after iteration


AGWETP
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
base
accentuate Small
accentuate Large
Downstream small
Downstream large
AGWETP2
AGWETP
KVARY
kvary and AG
10% cepc
50% cepc
1.5 * cepc
2 * cepc
hand calib
hand after iteration
AGWETP


KVARY
0.3
0.25
0.2
0.15
0.1
0.05
0
base
accentuate Small
accentuate Large
Downstream small
Downstream large
AGWETP2
AGWETP
KVARY
kvary and AG
10% cepc
50% cepc
1.5 * cepc
2 * cepc
hand calib
hand after iteration
KVARY

Results of Sensitivity Tests

- Very stable and robust calibration
- Stable for parameters as well as results

Today's Product

- Near final version of hydrology, still need:
  - Land use
  - Small hydrologic fixes for reservoirs, other problem areas

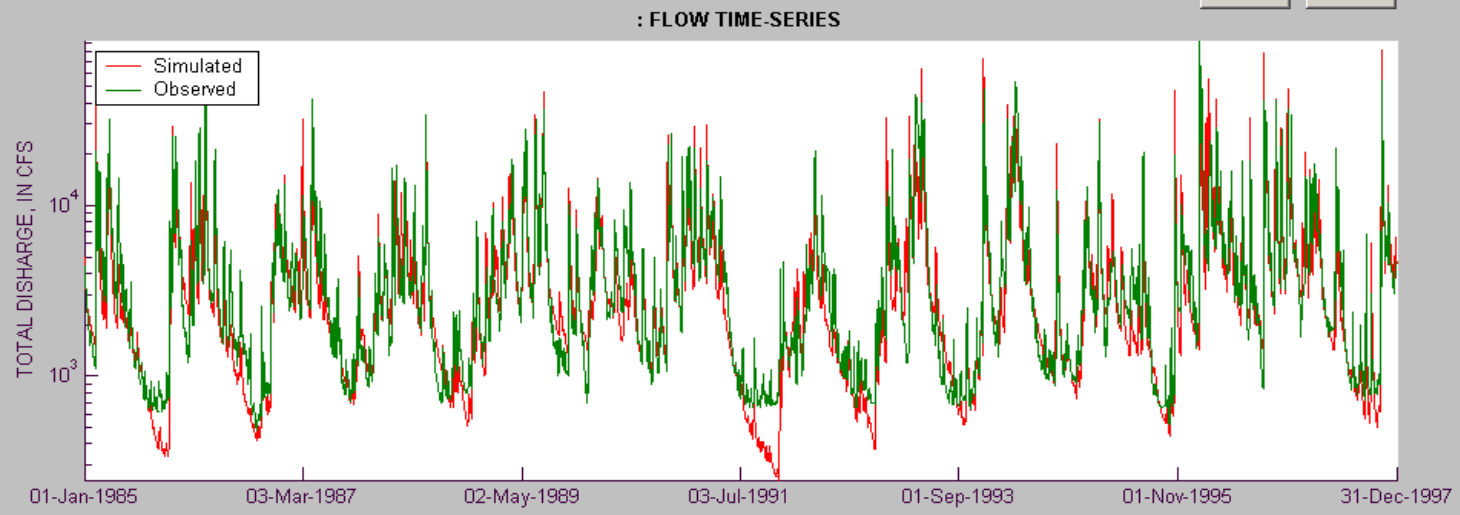
Comparison with phase 4

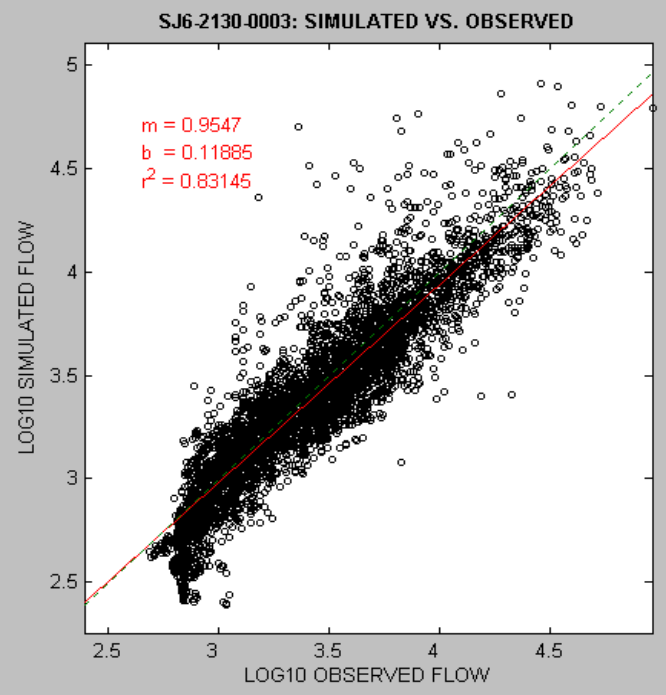
- Generally better than phase 4 from efficiency standpoint
- Phase 4 calibrated to match CFD and time series at these stations
- Phase 5 calibrated to match statistics other than efficiency
- Phase 5 mostly calibrated to smaller stations.

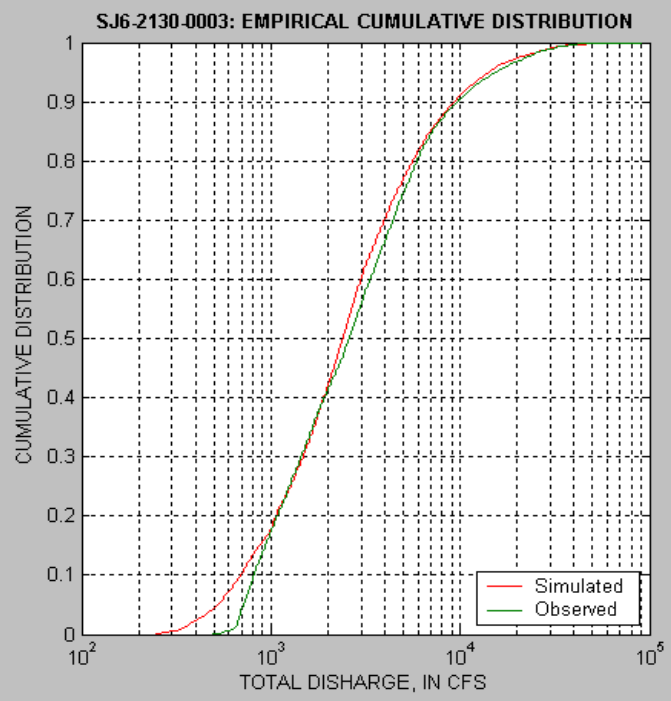
cal5

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

Examine | Print







☑ plot log10 data Print

☑ semi-log plot Print

☐ hide observed values

DATA SELECTION

scenario	file name
phase4	SJ6_2130_0003

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	484 2.68485	246 2.39094
mean	4466.54 3.43393	4229.51 3.39723
median	2600 3.41497	2400 3.38021
max	92300 4.9652	81500 4.91116
variance	3.4883e+007 0.167794	3.50628e+007 0.183941
JB test	0 0	0 1.55431e-015
	raw	log10
% rel.bias	-5.30685	-1.06881
err.var.	1.47791e+007	0.0326954
rel.std.err	0.423677	0.194854
mod.eff	0.576323	0.805146

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

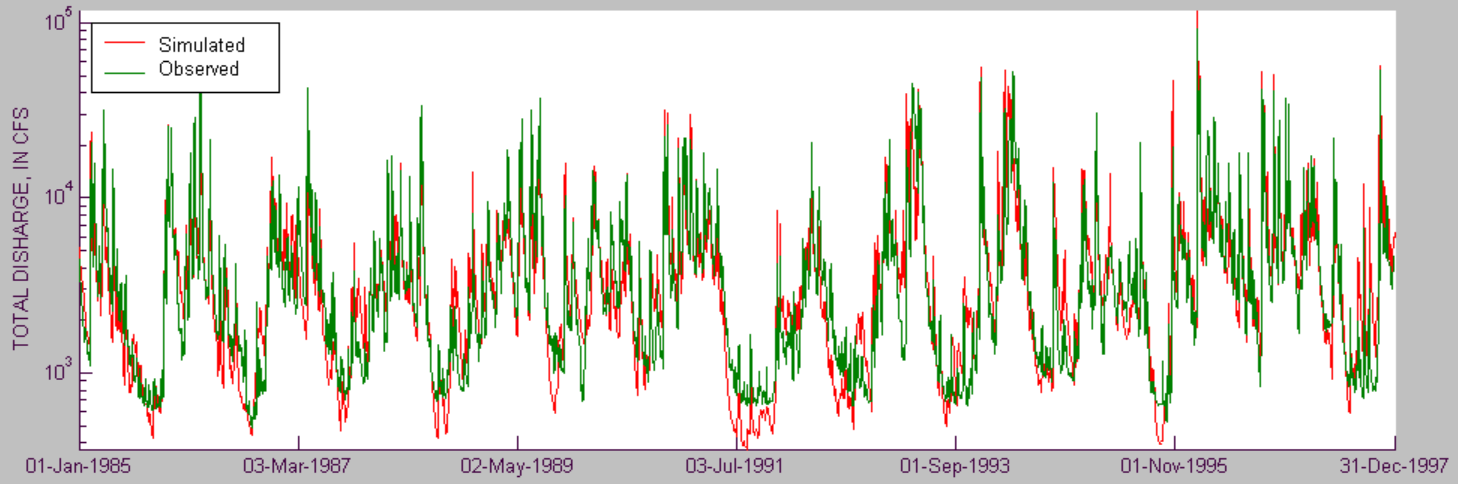
Save as PDF file

CAL5 Version 1.2

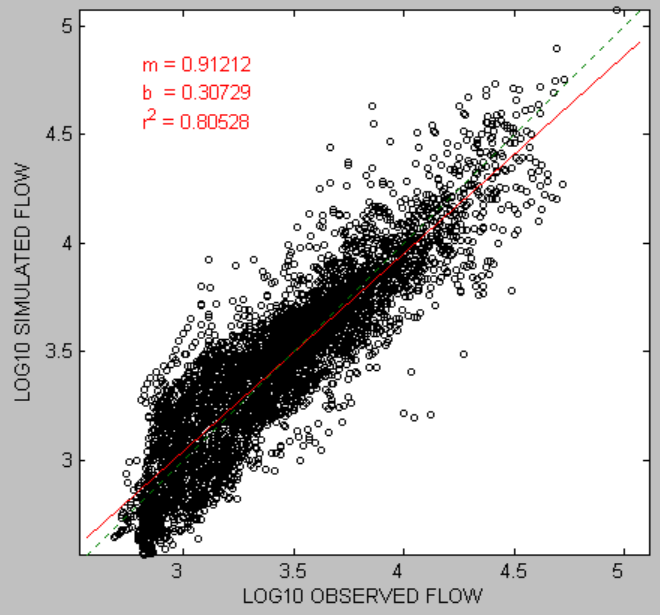
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print

: FLOW TIME-SERIES

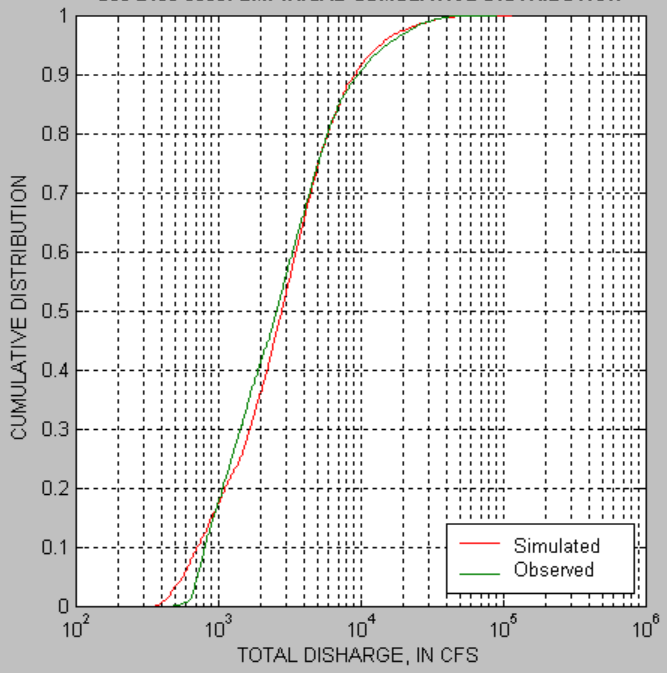


SJ6-2130-0003: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

SJ6-2130-0003: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values | Examine | Print

DATA SELECTION

scenario	file name
apr04	SJ6_2130_0003

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	484 2.68485	368.18 2.56606
mean	4466.54 3.43393	4456.88 3.43945
median	2600 3.41497	2820.35 3.4503
max	92300 4.9652	117590 5.07037
variance	3.4883e+007 0.167794	3.48519e+007 0.173354
JB test	0 0	0 1.0981e-007
	raw	log10
% rel.bias	-0.216129	0.160817
err.var.	1.09165e+007	0.0350809
rel.std.err	0.312947	0.209071
mod.eff	0.687053	0.790929

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

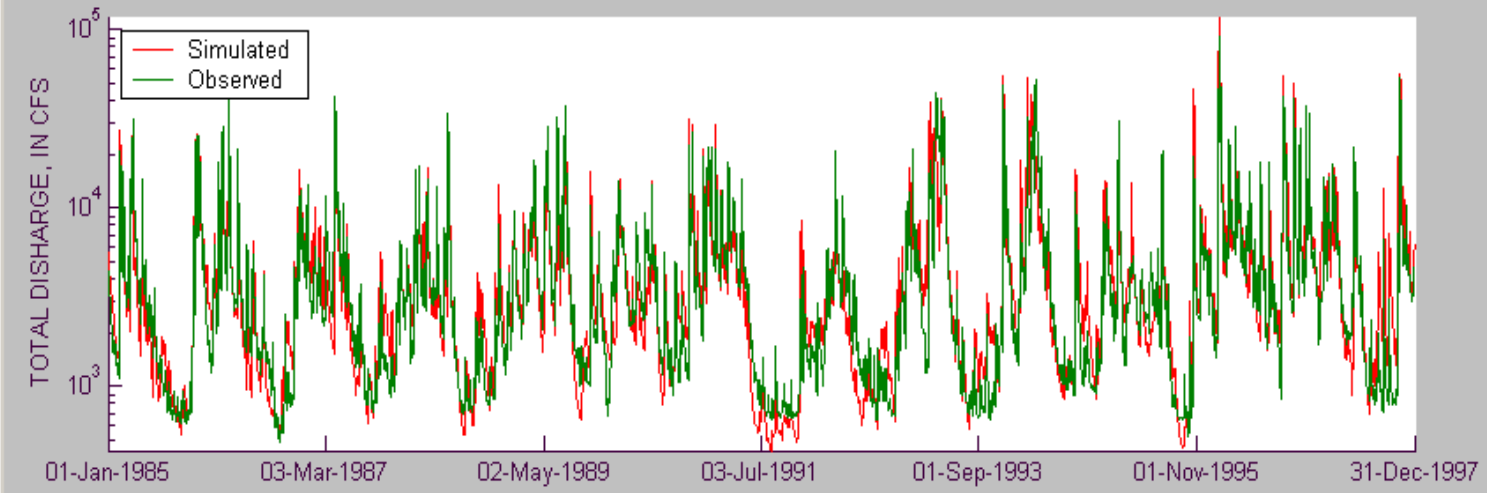
Save as PDF file

CAL5 Version 1.3

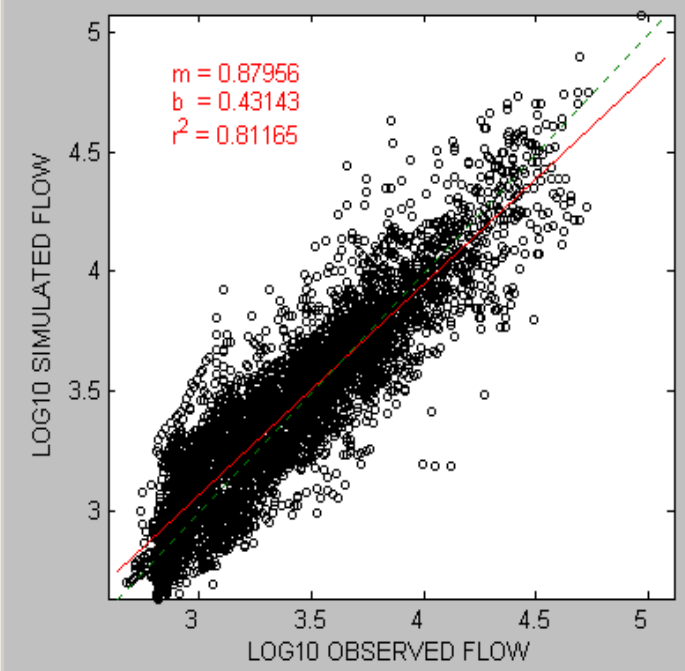
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

: FLOW TIME-SERIES

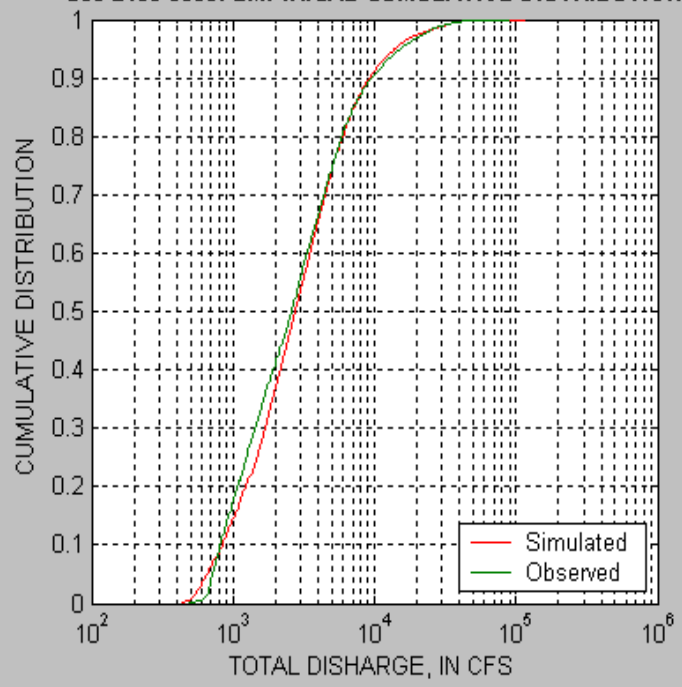


SJ6-2130-0003: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

SJ6-2130-0003: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values | Examine | Print

DATA SELECTION

scenario	file name
cut2	SJ6_2130_0003

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	484 2.68485	435.33 2.63882
mean	4466.54 3.43393	4498.26 3.45178
median	2600 3.41497	2747.65 3.43896
max	92300 4.9652	117870 5.0714
variance	3.4883e+007 0.167794	3.52202e+007 0.159933
JB test	0 0	0 0
	raw	log10
% rel.bias	0.710156	0.519781
err.var.	1.07764e+007	0.0328755
rel.std.err	0.308931	0.195928
mod.eff	0.691069	0.804072

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

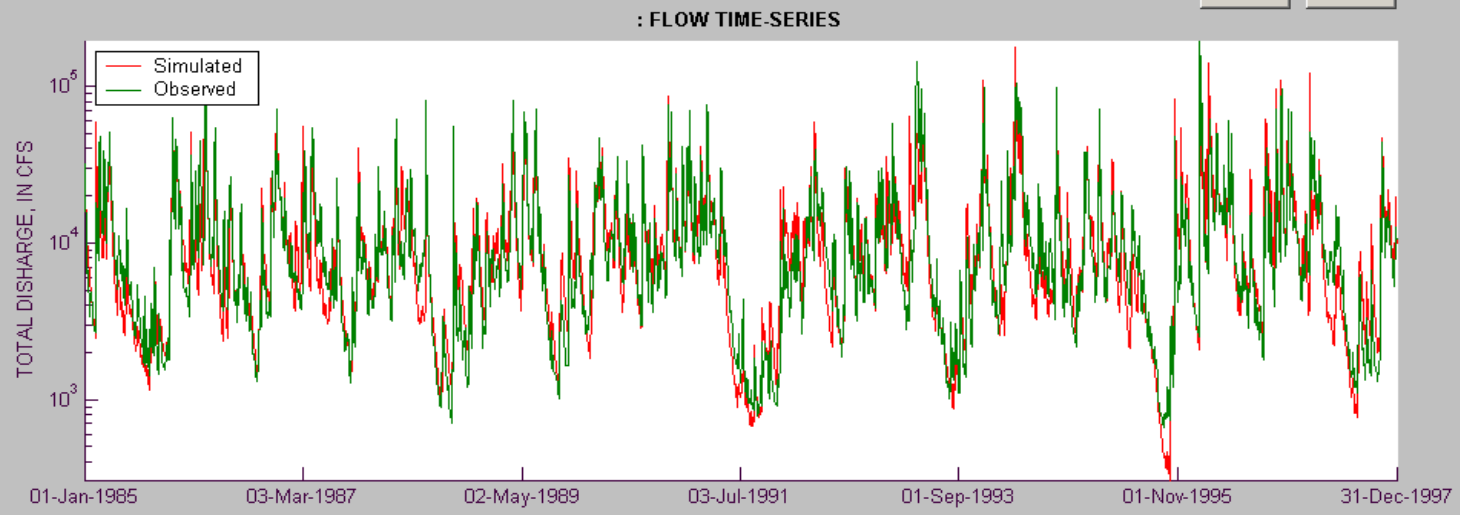
C-Q scatter plot

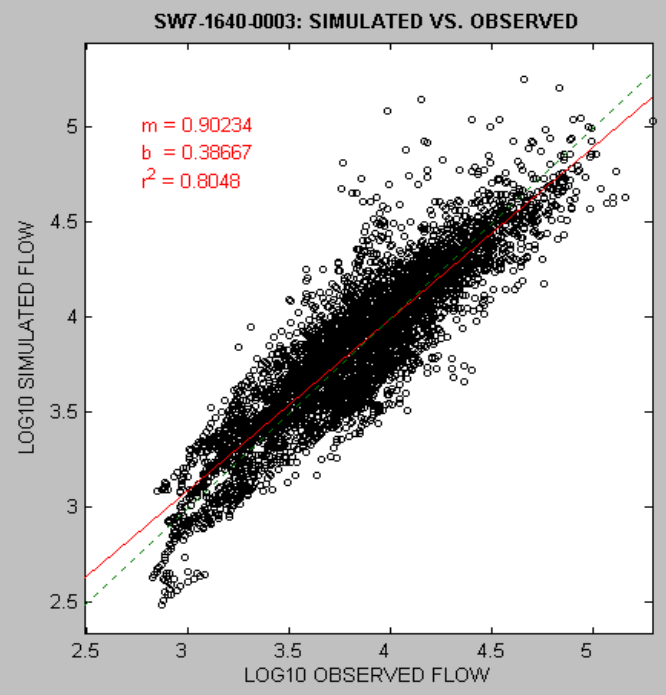
CAL5 Version 1.6

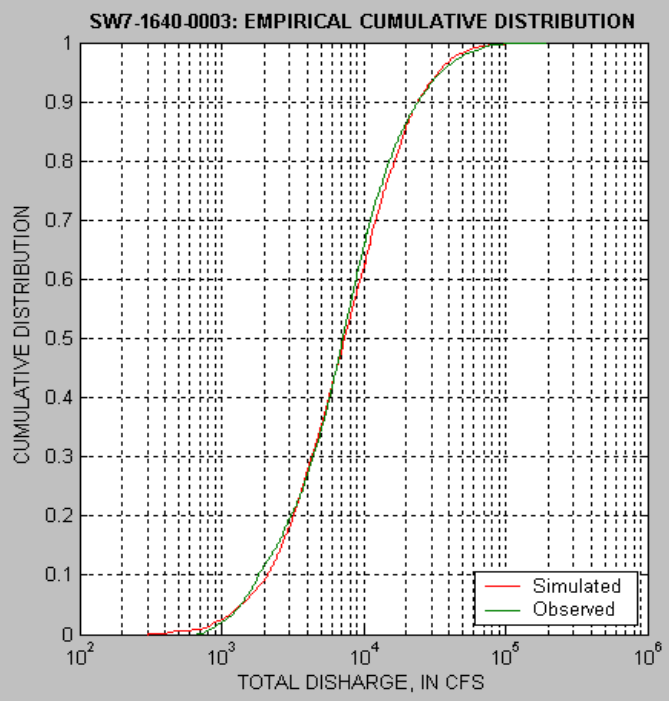
cal5

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

Examine Print







☑ plot log10 data Print

☑ semi-log plot ☐ hide observed values Print

DATA SELECTION

scenario: phase4

file name: SW7_1640_0003

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	668 2.82478	306 2.48572
mean	11113.2 3.84553	11216.8 3.85667
median	7120 3.85248	7330 3.8651
max	195000 5.29003	179000 5.25285
variance	1.73247e+008 0.17387	1.55929e+008 0.175907
JB test	0 0.0145997	0 0.000493457
	raw	log10
% rel.bias	0.932439	0.289595
err.var.	7.00119e+007	0.0361193
rel.std.err	0.404116	0.207738
mod.eff	0.595884	0.792262

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

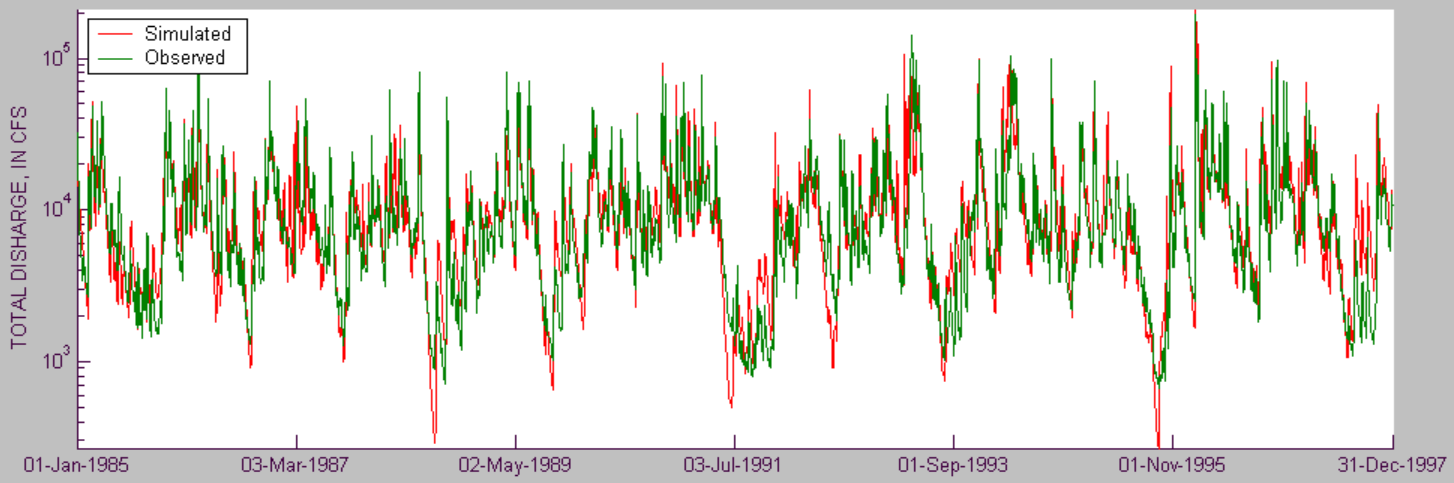
Save as PDF file

CAL5 Version 1.2

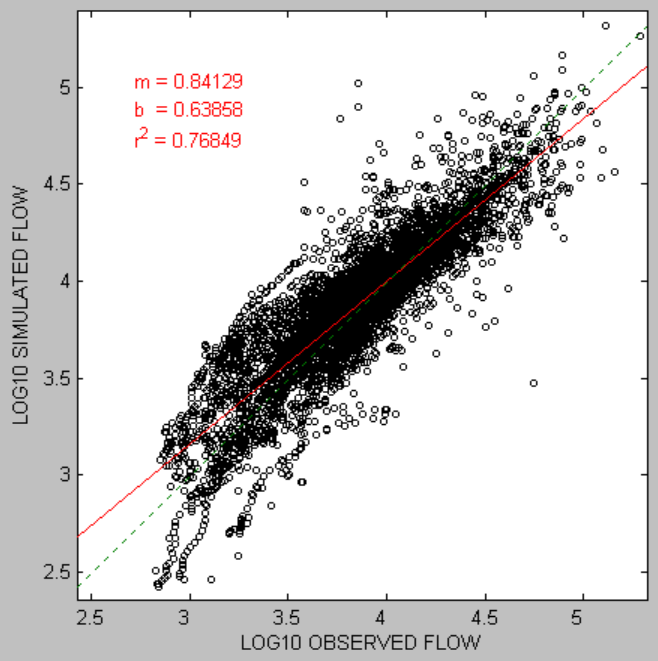
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print

: FLOW TIME-SERIES

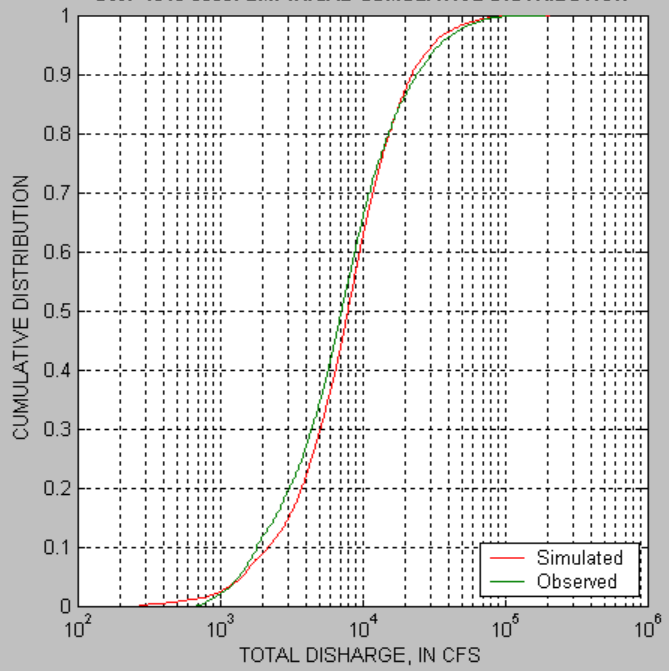


SW7-1640-0003: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

SW7-1640-0003: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values | Examine | Print

DATA SELECTION

scenario	file name
apr04	SW7_1640_0003

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	668 2.82478	267.79 2.42779
mean	11113.2 3.84553	11123.9 3.87379
median	7120 3.85248	7920.95 3.89878
max	195000 5.29003	209950 5.32212
variance	1.73247e+008 0.17387	1.45502e+008 0.160133
JB test	0 0.0145997	0 0
	raw	log10
% rel.bias	0.0964162	0.734787
err.var.	6.09589e+007	0.0422509
rel.std.err	0.351861	0.243003
mod.eff	0.648139	0.756997

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

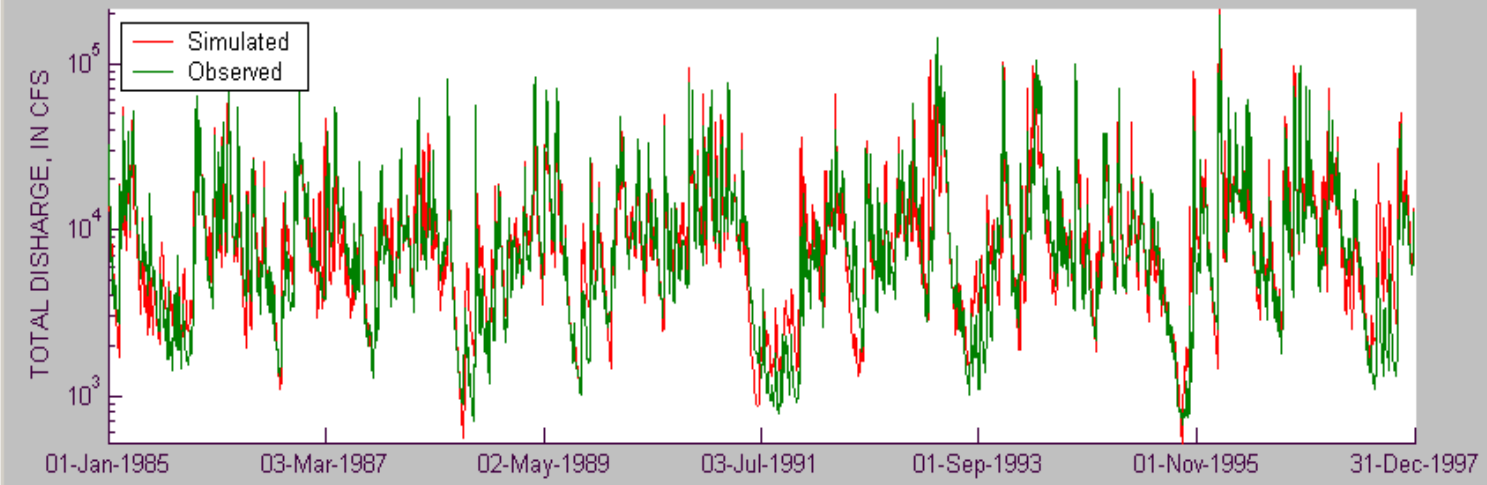
Save as PDF file

CAL5 Version 1.3

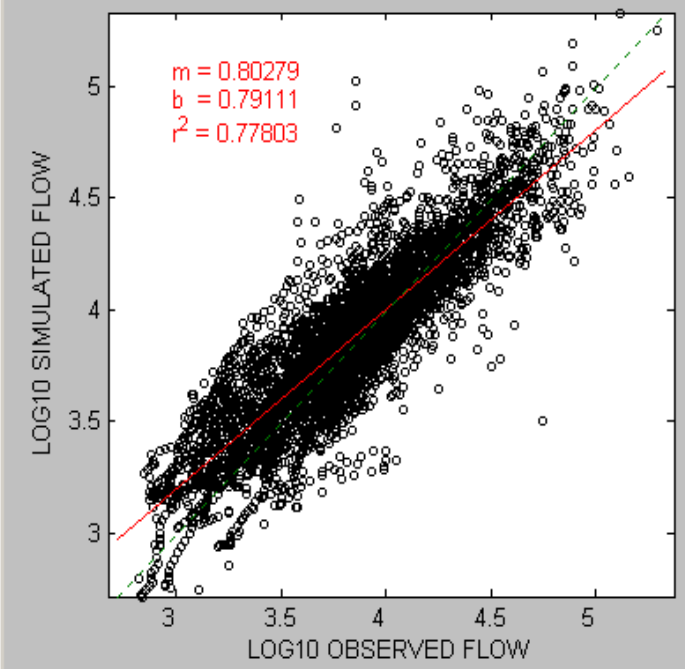
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

: FLOW TIME-SERIES

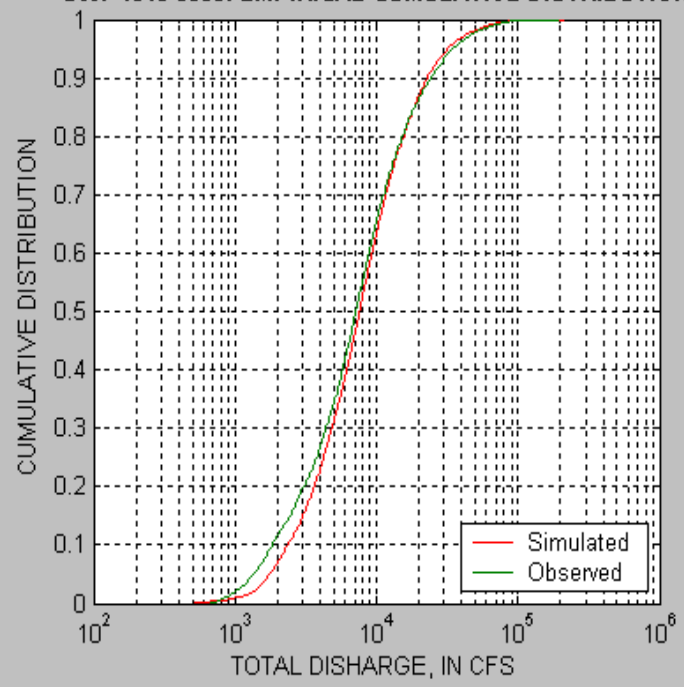


SW7-1640-0003: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

SW7-1640-0003: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario	file name
cut2	SW7_1640_0003

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	668 2.82478	522.63 2.71819
mean	11113.2 3.84553	11142 3.87826
median	7120 3.85248	7604.4 3.88106
max	195000 5.29003	213160 5.32871
variance	1.73247e+008 0.17387	1.53004e+008 0.144023
JB test	0 0.0145997	0 0.335896
	raw	log10
% rel.bias	0.259544	0.850907
err.var.	6.15572e+007	0.0398025
rel.std.err	0.355314	0.228921
mod.eff	0.644686	0.771079

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

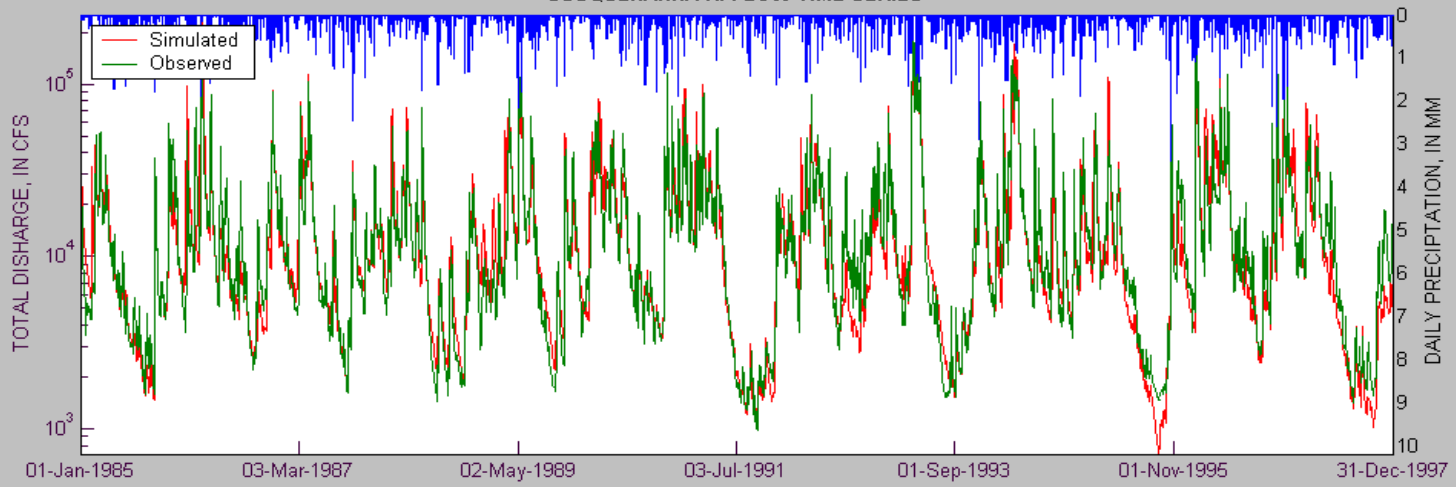
CAL5 Version 1.6

cal5

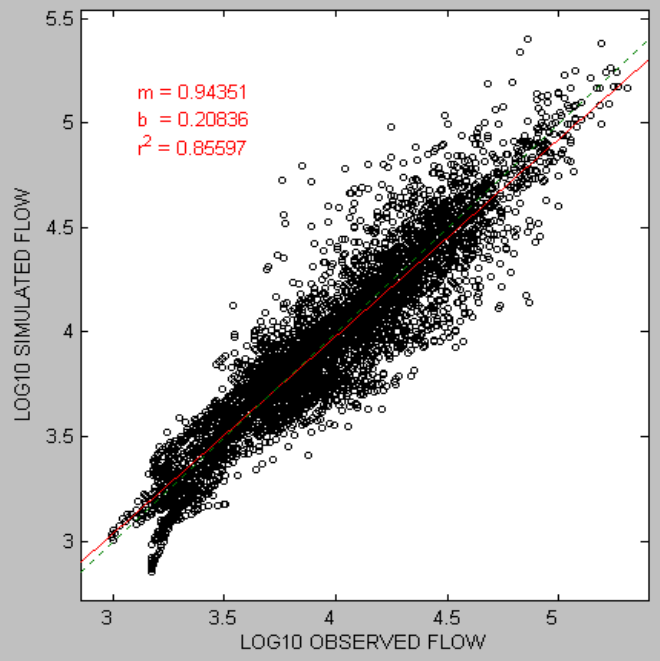
☐ hide precipitation ☐ hide observed values ☑ y-axis log-scale

Examine | Print

SUSQUEHANNA R: FLOW TIME-SERIES



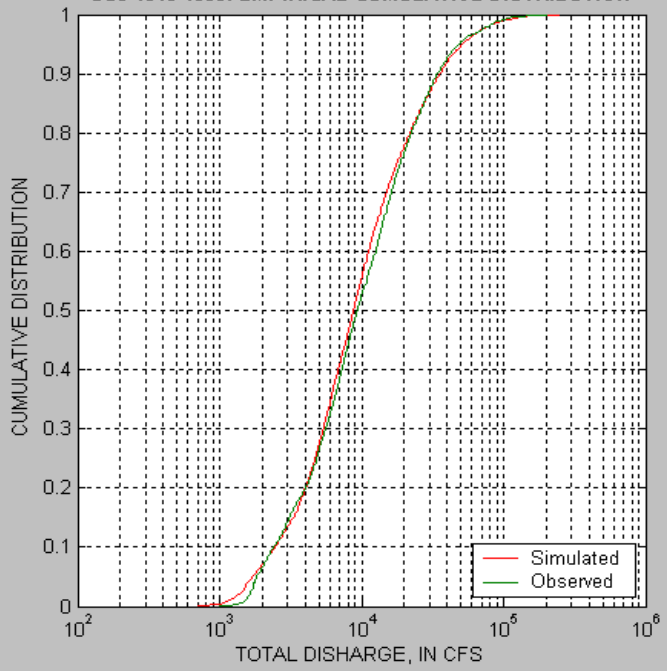
SU8-1610-1530: SIMULATED VS. OBSERVED



☑ plot log10 data

Print

SU8-1610-1530: EMPIRICAL CUMULATIVE DISTRIBUTION



☑ semi-log plot

☐ hide observed values

Print

DATA SELECTION

scenario: phase4

file name: SU8_1610_1530

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	982 2.99211	713 2.85309
mean	15593.3 3.98046	15501.7 3.96395
median	9325 3.96965	8750 3.94201
max	205000 5.31175	252000 5.4014
variance	3.5306e+008 0.182798	4.02964e+008 0.190109
JB test	0 4.40847e-012	0 1.06935e-008
	raw	log10
% rel.bias	-0.587694	-0.41469
err.var.	1.00911e+008	0.0282371
rel.std.err	0.28582	0.154471
mod.eff	0.71418	0.845529

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

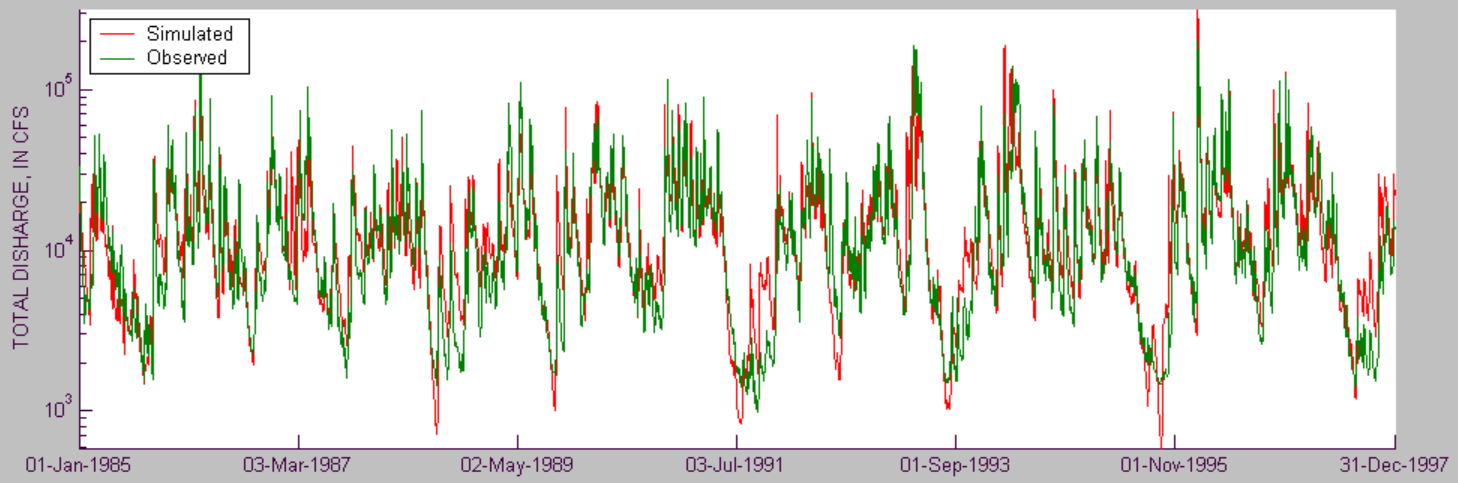
Save as PDF file

CAL5 Version 1.2

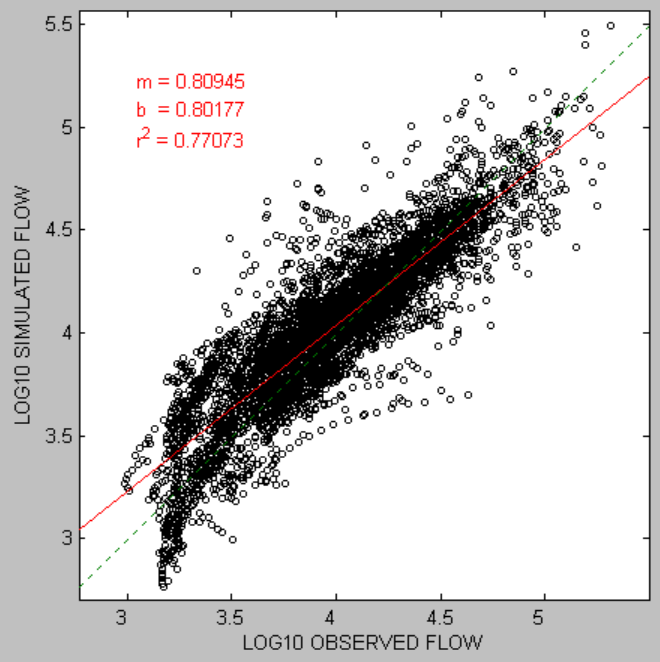
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print

SUSQUEHANNA R: FLOW TIME-SERIES

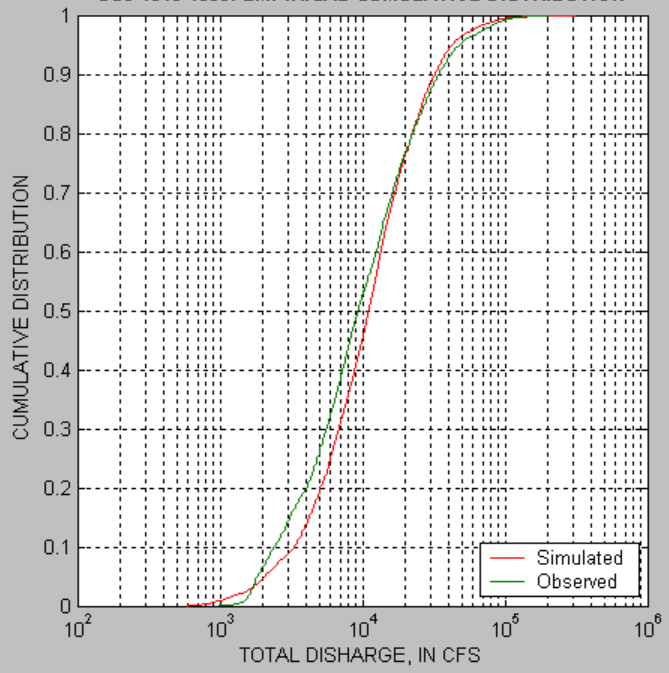


SU8-1610-1530: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

SU8-1610-1530: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario	file name
apr04	SU8_1610_1530

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	982 2.99211	588.95 2.77008
mean	15593.3 3.98046	15701.8 4.02375
median	9325 3.96965	11069 4.04411
max	205000 5.31175	313520 5.49627
variance	3.5306e+008 0.182798	3.00236e+008 0.1554
JB test	0 4.40847e-012	0 2.61119e-008
	raw	log10
% rel.bias	0.695728	1.08768
err.var.	1.27651e+008	0.0441403
rel.std.err	0.361556	0.24147
mod.eff	0.638444	0.75853

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

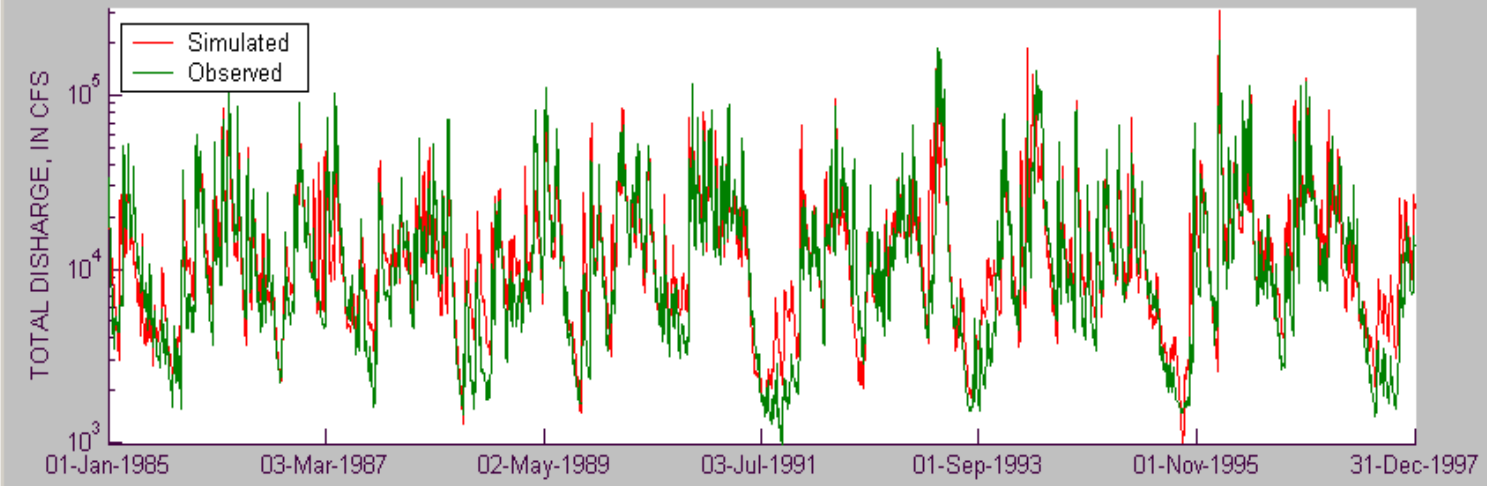
Save as PDF file

CAL5 Version 1.3

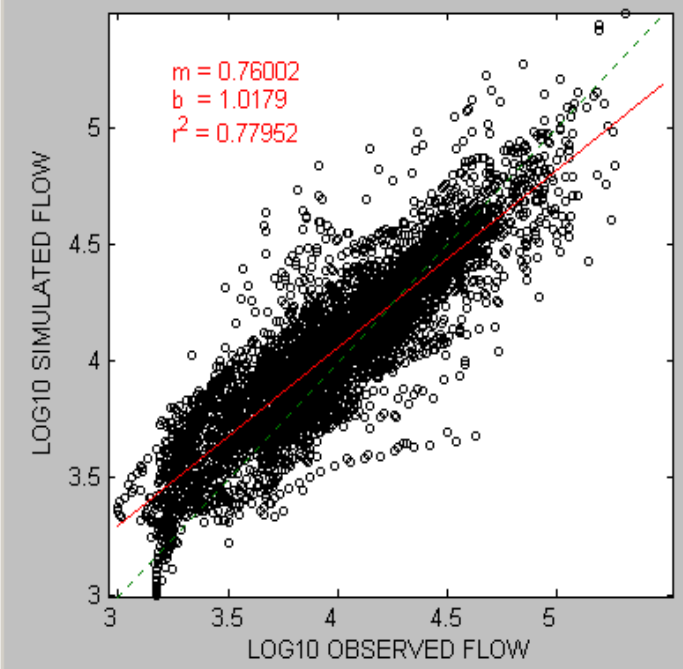
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

SUSQUEHANNA R: FLOW TIME-SERIES

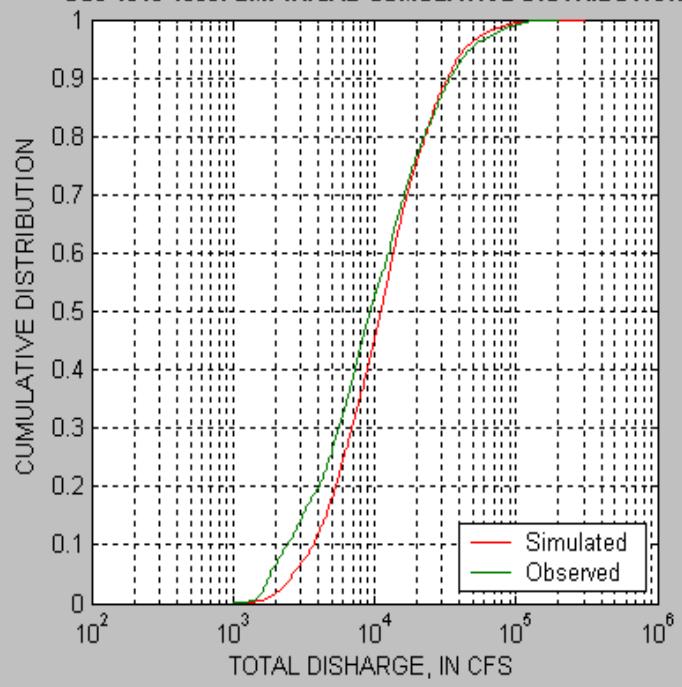


SU8-1610-1530: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

SU8-1610-1530: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario	file name
cut2	Su8_1610_1530

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	982 2.99211	995.49 2.99804
mean	15593.3 3.98046	15981.5 4.04313
median	9325 3.96965	11092.5 4.04503
max	205000 5.31175	313110 5.4957
variance	3.5306e+008 0.182798	3.05275e+008 0.135454
JB test	0 4.40847e-012	0 0.00159307
	raw	log10
% rel.bias	2.48955	1.57441
err. var.	1.26993e+008	0.0443204
rel.std.err	0.359694	0.242455
mod.eff	0.640306	0.757545

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

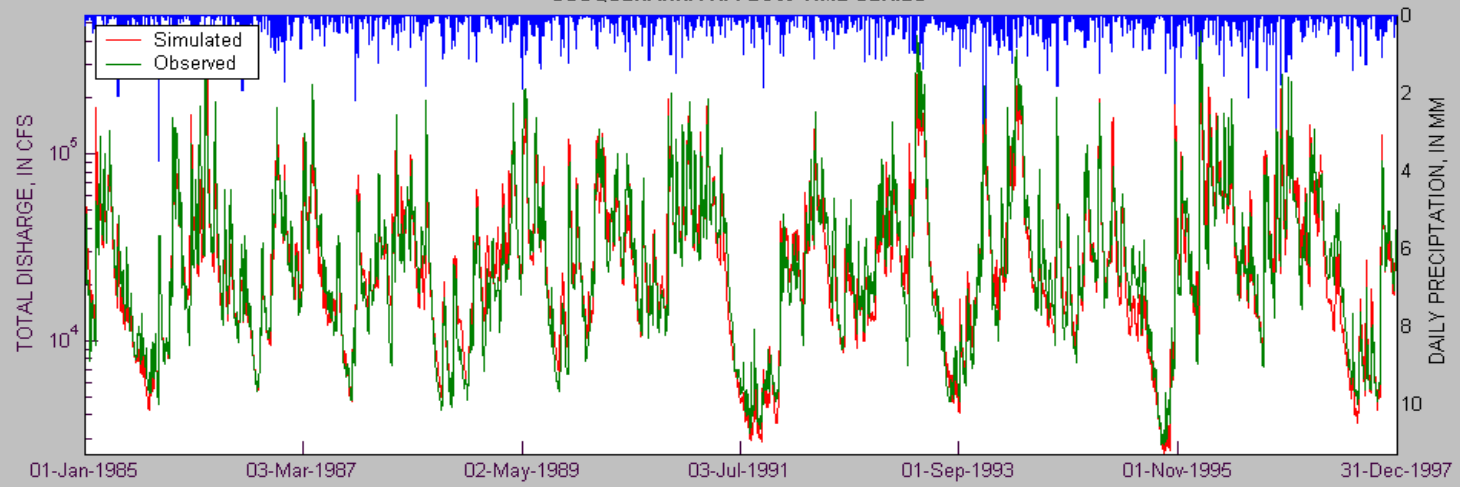
CAL5 Version 1.6

cal5

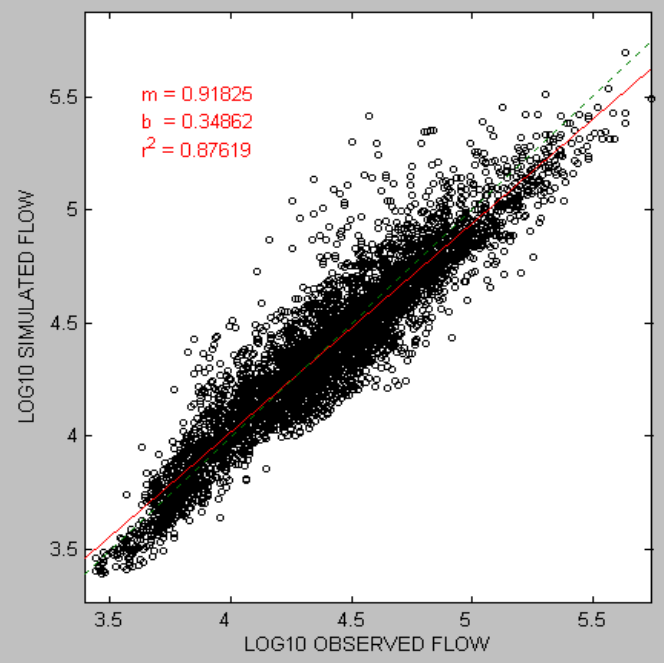
☐ hide precipitation ☐ hide observed values ☑ y-axis log-scale

Examine | Print

SUSQUEHANNA R: FLOW TIME-SERIES



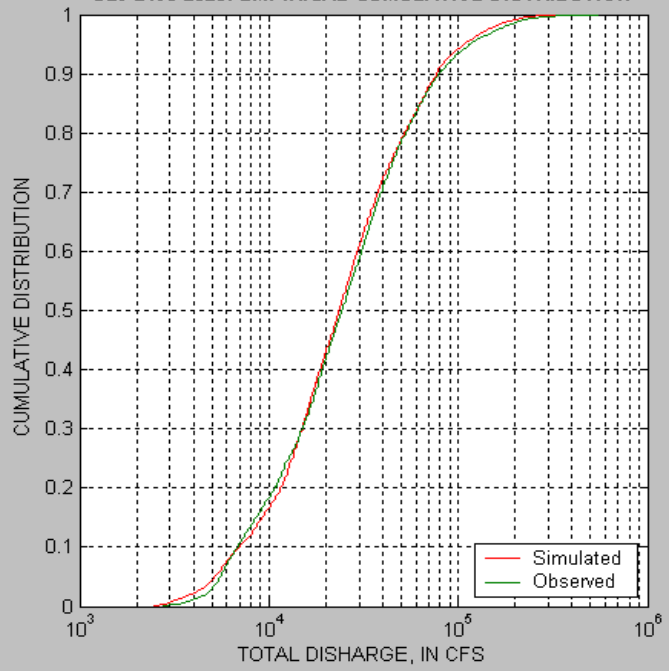
SL9-2490-2520: SIMULATED VS. OBSERVED



☑ plot log10 data

Print

SL9-2490-2520: EMPIRICAL CUMULATIVE DISTRIBUTION



☑ semi-log plot

☐ hide observed values

Print

DATA SELECTION

scenario	file name
phase4	SL9_2490_2520

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	2760 3.44091	2470 3.3927
mean	37625.1 4.3869	35726 4.37687
median	24300 4.38561	23400 4.36922
max	556000 5.74507	496000 5.69548
variance	1.87121e+009 0.159493	1.42203e+009 0.153482
JB test	☐ 0 ☐ 2.84098e-009	0 0.000467165 ☐
	raw	log10
% rel.bias	-5.04751	-0.228698
err.var.	4.19856e+008	0.0201688
rel.std.err	0.224377	0.126455
mod.eff	0.775623	0.873545

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

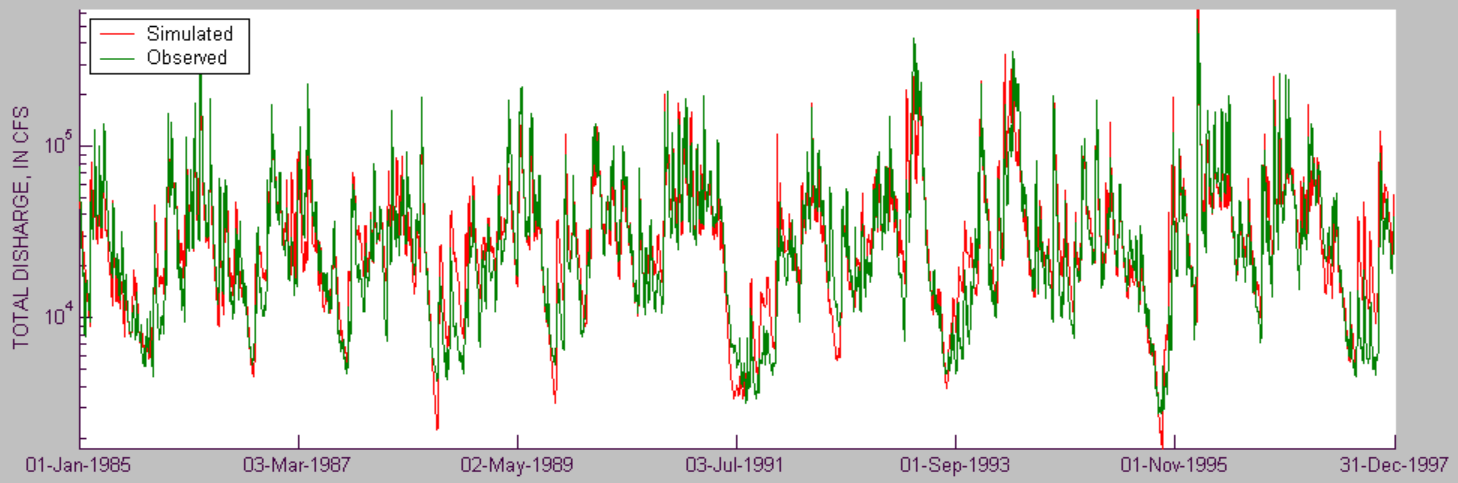
Save as PDF file

CAL5 Version 1.2

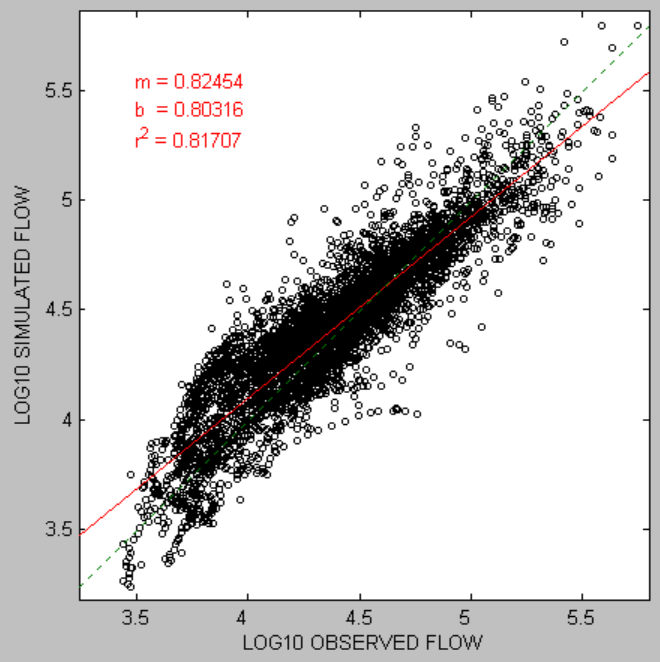
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print

SUSQUEHANNA R: FLOW TIME-SERIES

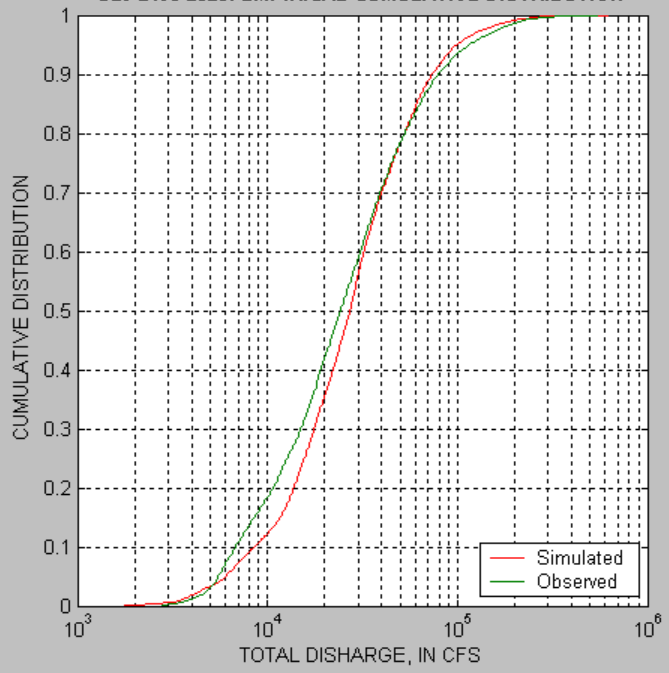


SL9-2490-2520: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

SL9-2490-2520: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values | Examine | Print

DATA SELECTION

scenario: apr04

file name: SL9_2490_2520

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	2760 3.44091	1742.5 3.24117
mean	37625.1 4.3869	37241.8 4.42032
median	24300 4.38561	27315 4.4364
max	556000 5.74507	629050 5.79869
variance	1.87121e+009 0.159493	1.46052e+009 0.132708
JB test	0 2.84098e-009	0 0.000115902
	raw	log10
% rel.bias	-1.01882	0.761676
err.var.	5.18885e+008	0.030303
rel.std.err	0.277299	0.189996
mod.eff	0.722701	0.810004

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

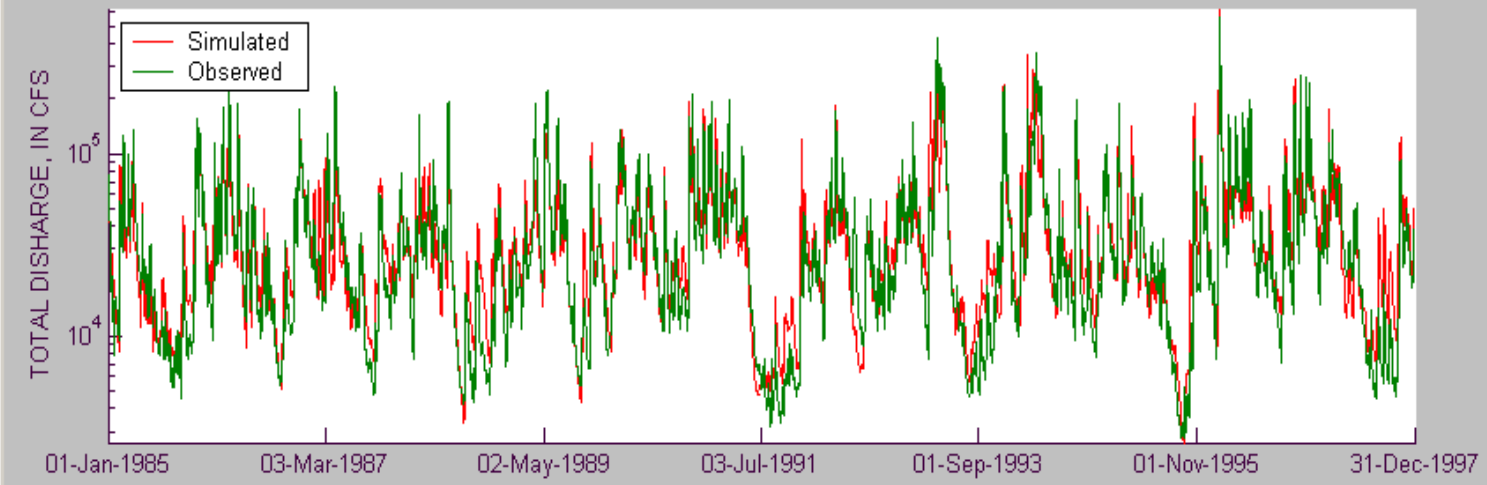
Save as PDF file

CAL5 Version 1.3

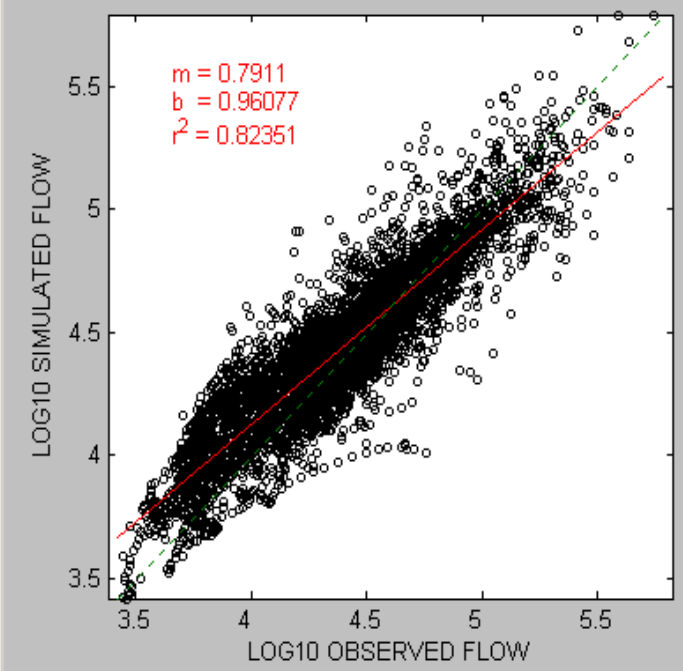
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

SUSQUEHANNA R: FLOW TIME-SERIES

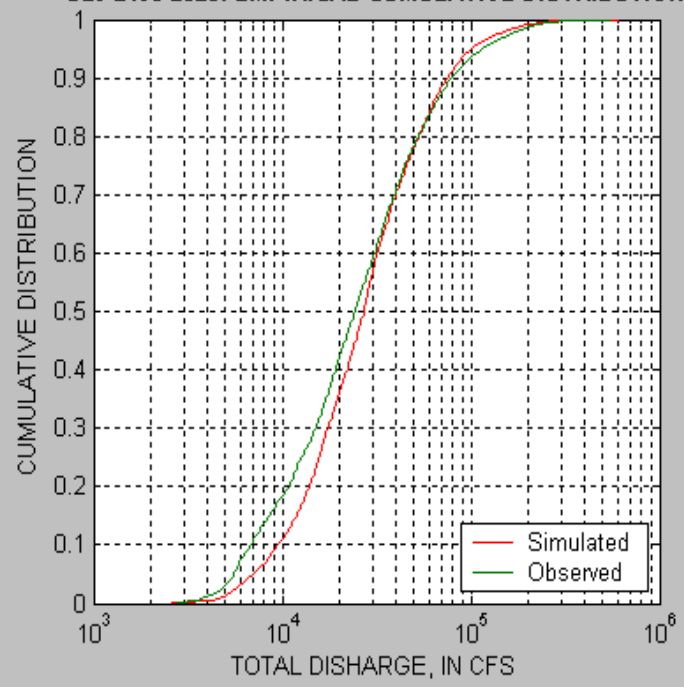


SL9-2490-2520: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

SL9-2490-2520: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario	file name
cut2	SL9_2490_2520

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

	observed	simulated
n	4748	4748
min	2760 3.44091	2607.2 3.41617
mean	37625.1 4.3869	37663.9 4.43123
median	24300 4.38561	27143 4.43366
max	556000 5.74507	620780 5.79294
variance	1.87121e+009 0.159493	1.49608e+009 0.121208
JB test	0 2.84098e-009	0 0.00130367

	raw	log10
% rel.bias	0.103092	1.01046
err.var.	5.18121e+008	0.0303181
rel.std.err	0.276891	0.190091
mod.eff	0.723109	0.809909

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

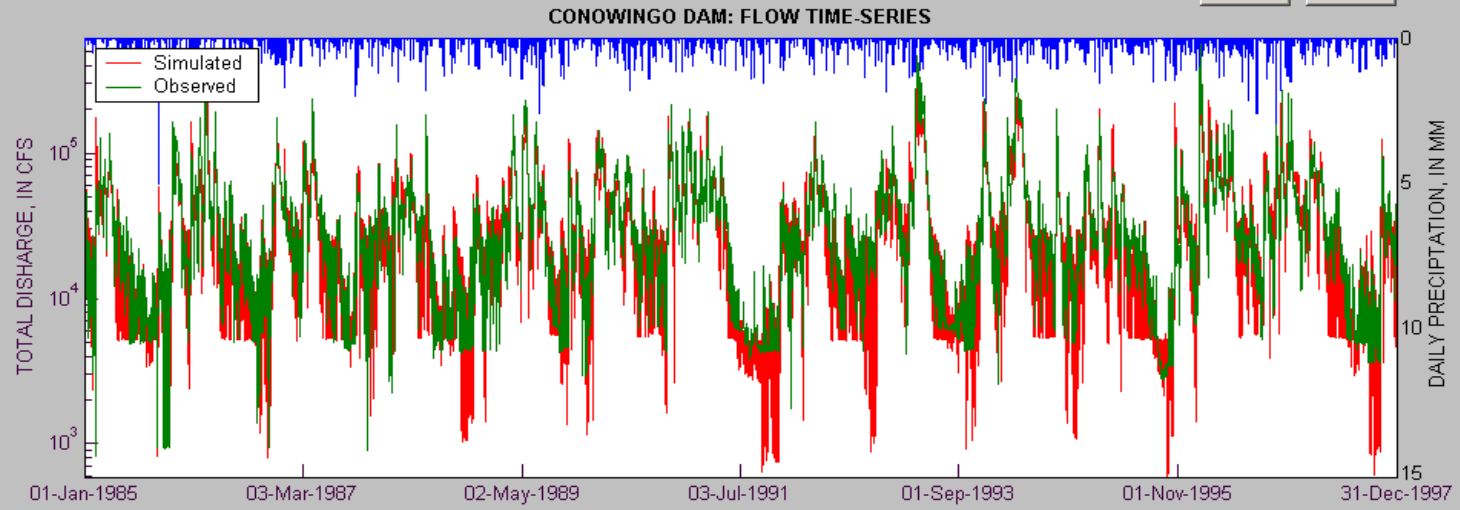
C-Q scatter plot

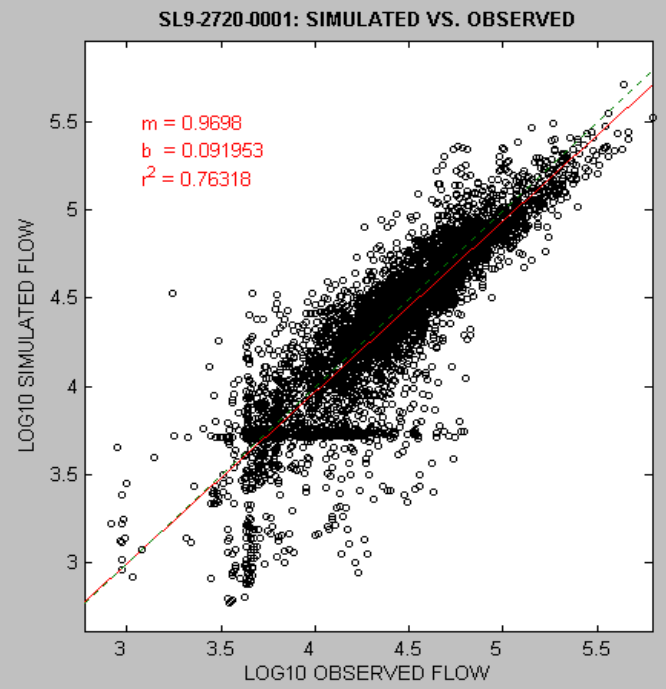
CAL5 Version 1.6

cal5

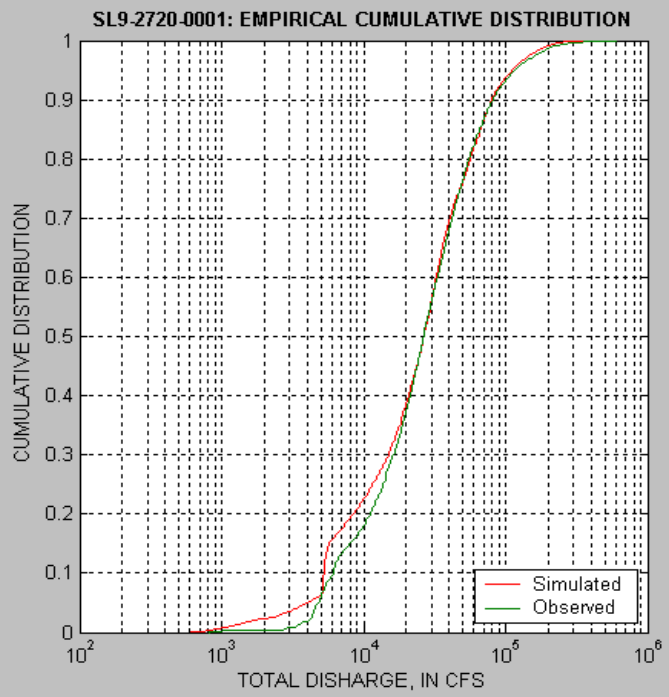
☐ hide precipitation ☐ hide observed values ☑ y-axis log-scale

Examine Print





☑ plot log10 data Print



☑ semi-log plot Print

☐ hide observed values

DATA SELECTION

scenario: phase4

file name: SL9_2720_0001

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	821 2.91434	591 2.77159
mean	39216 4.39966	37244.8 4.35874
median	26500 4.42325	26550 4.42406
max	622000 5.79379	511000 5.70842
variance	1.96184e+009 0.176168	1.52879e+009 0.217103
JB test	0 0.000259281	0 0
	raw	log10
% rel.bias	-5.02663	-0.929905
err.var.	4.42946e+008	0.0532491
rel.std.err	0.225781	0.302264
mod.eff	0.774219	0.697736

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

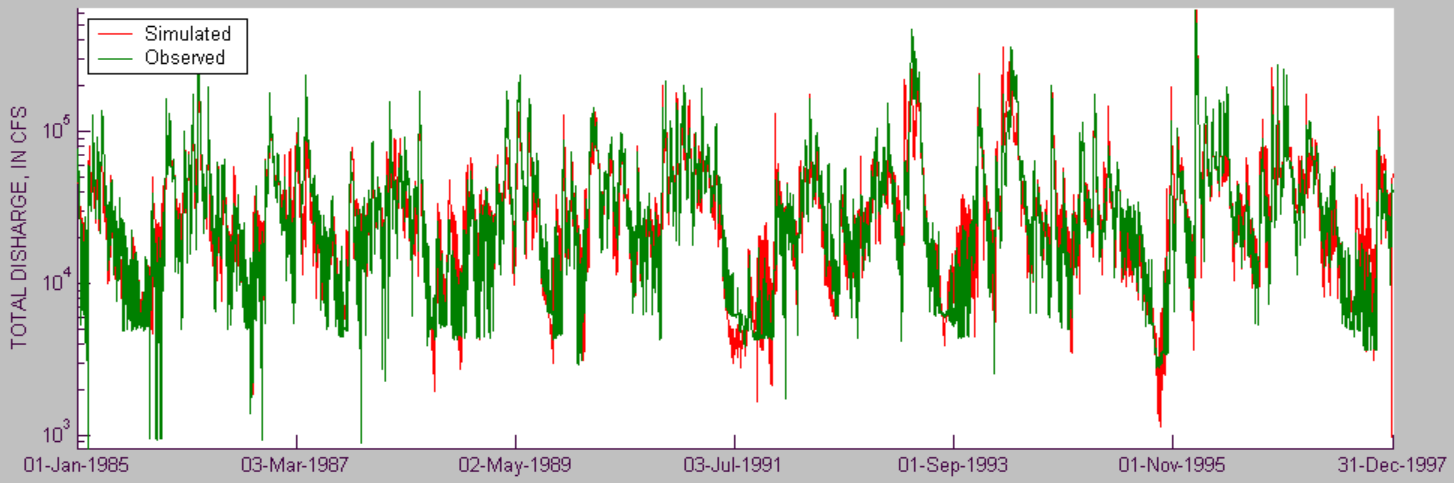
Save as PDF file

CAL5 Version 1.2

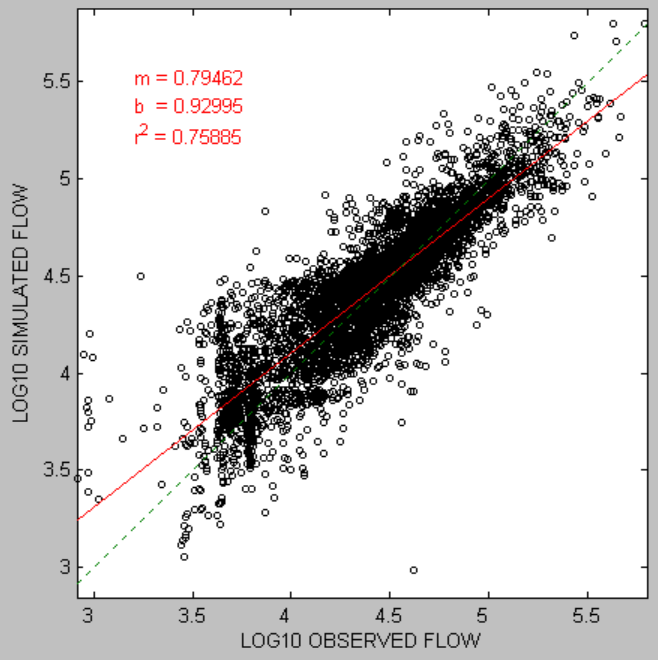
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print

CONOWINGO DAM: FLOW TIME-SERIES

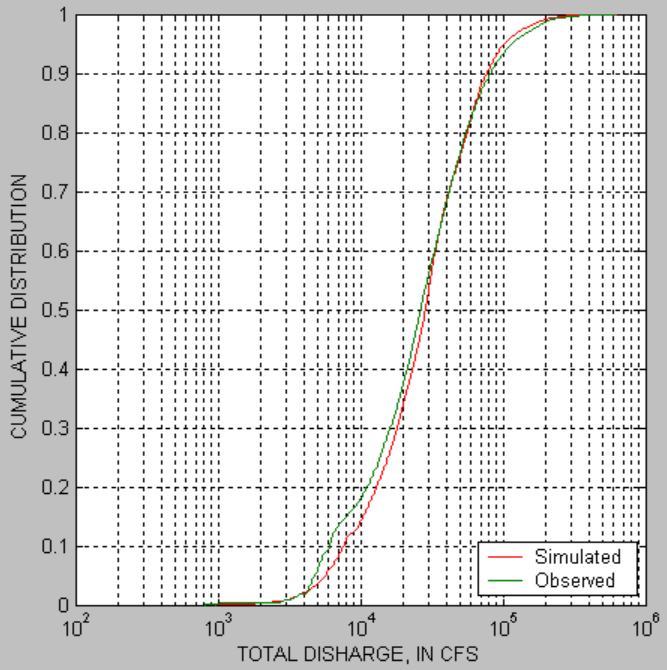


SL9-2720-0001: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

SL9-2720-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values | Examine | Print

DATA SELECTION

scenario	file name
apr04	SL9_2720_0001

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	821 2.91434	974.18 2.98864
mean	39216 4.39966	38562.9 4.426
median	26500 4.42325	28488.5 4.45467
max	622000 5.79379	633040 5.80143
variance	1.96184e+009 0.176168	1.56048e+009 0.146585
JB test	0 0.000259281	0 2.95074e-010
	raw	log10
% rel.bias	-1.66538	0.598827
err.var.	5.57743e+008	0.0434739
rel.std.err	0.284296	0.246776
mod.eff	0.715704	0.753224

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

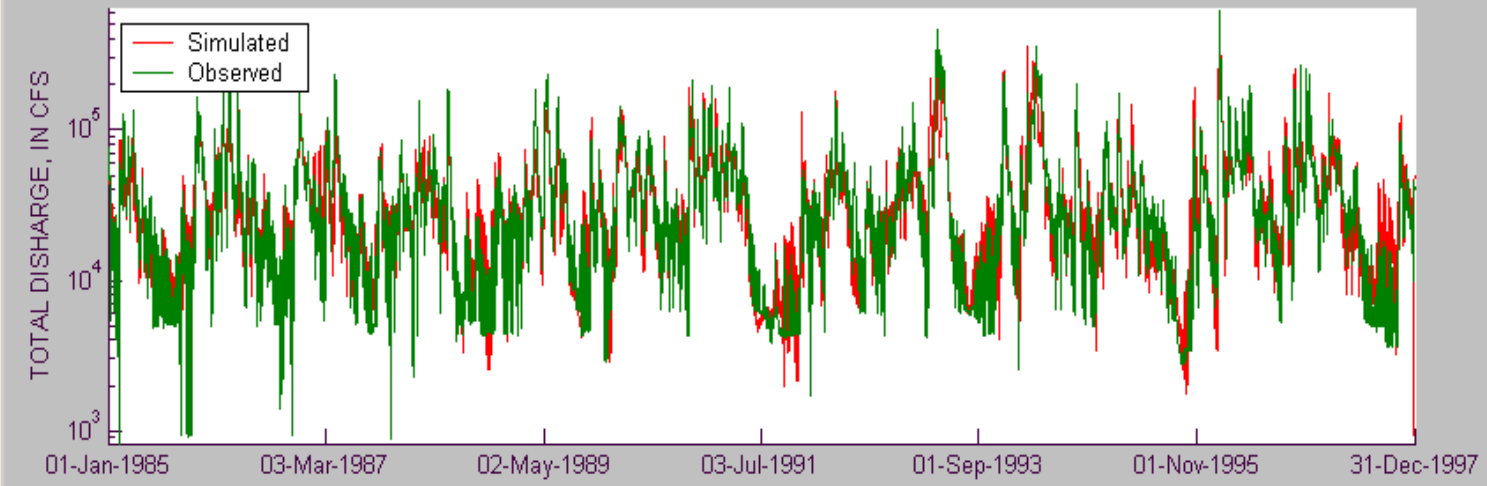
Save as PDF file

CAL5 Version 1.3

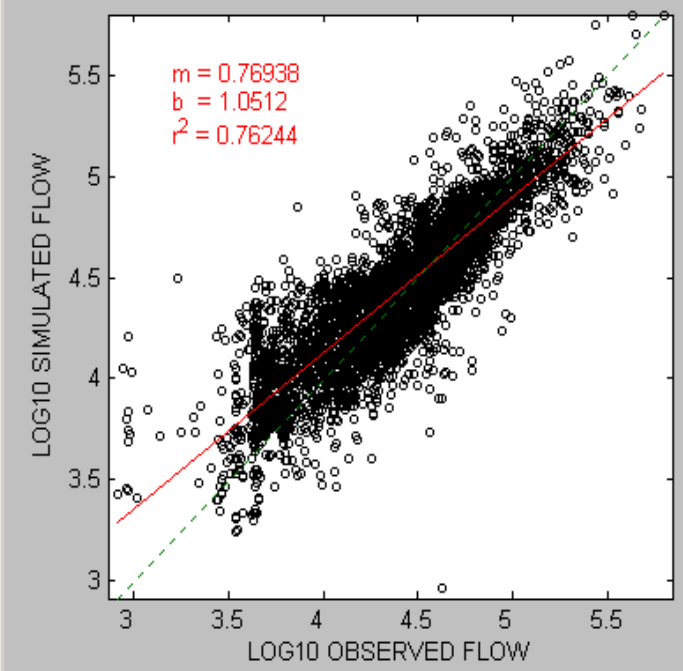
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

CONOWINGO DAM: FLOW TIME-SERIES

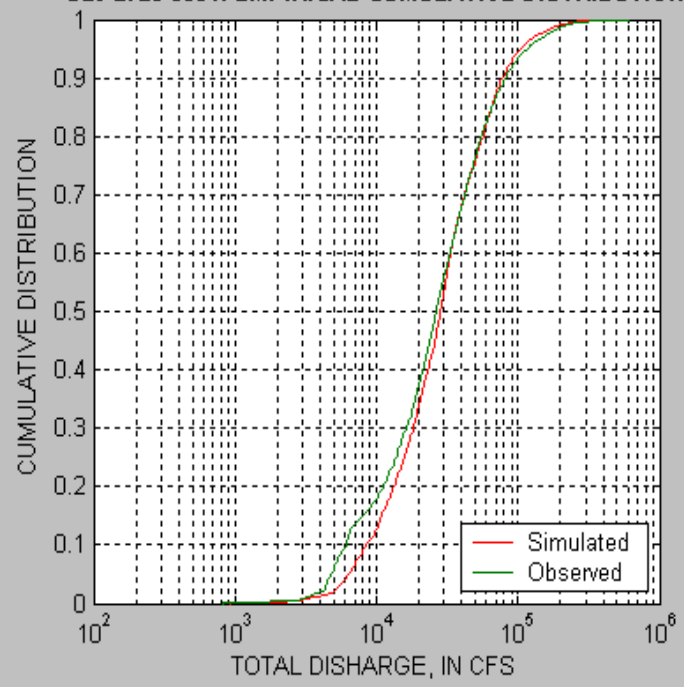


SL9-2720-0001: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

SL9-2720-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario	file name
cut2	SL9_2720_0001

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	821 2.91434	930.87 2.96889
mean	39216 4.39966	39001.5 4.43619
median	26500 4.42325	28342 4.45243
max	622000 5.79379	629110 5.79873
variance	1.96184e+009 0.176168	1.59906e+009 0.136772
JB test	☐ 0 ☐ 0.000259281	0 ☐ 0.0571517 ☑
	raw	log10
% rel.bias	-0.547014	0.830257
err. var.	5.58495e+008	0.043196
rel.std.err	0.284679	0.245198
mod.eff	0.715321	0.754802

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

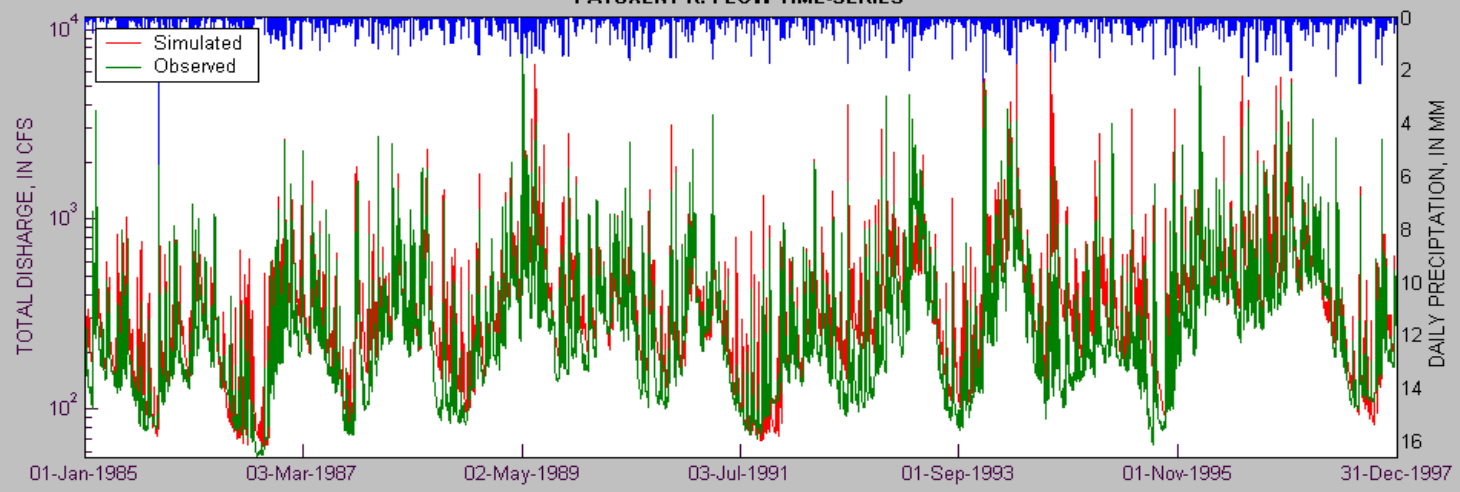
CAL5 Version 1.6

cal5

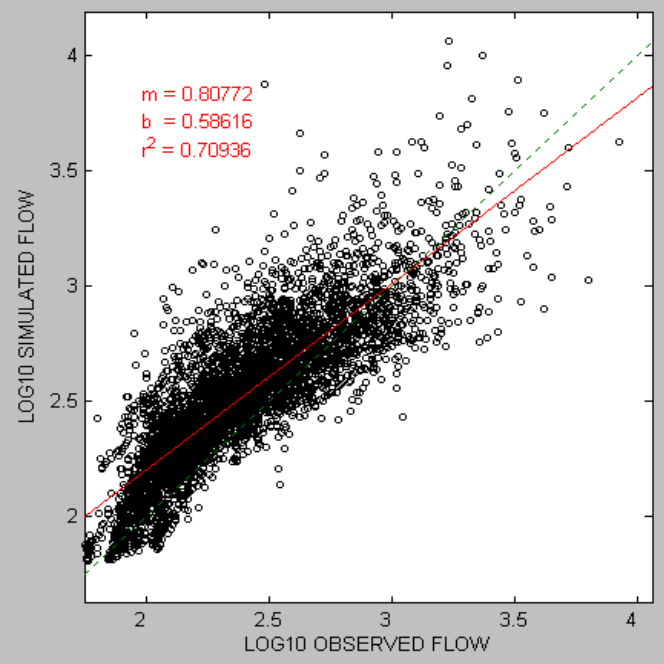
☐ hide precipitation ☐ hide observed values ☑ y-axis log-scale

Examine Print

PATUXENT R: FLOW TIME-SERIES



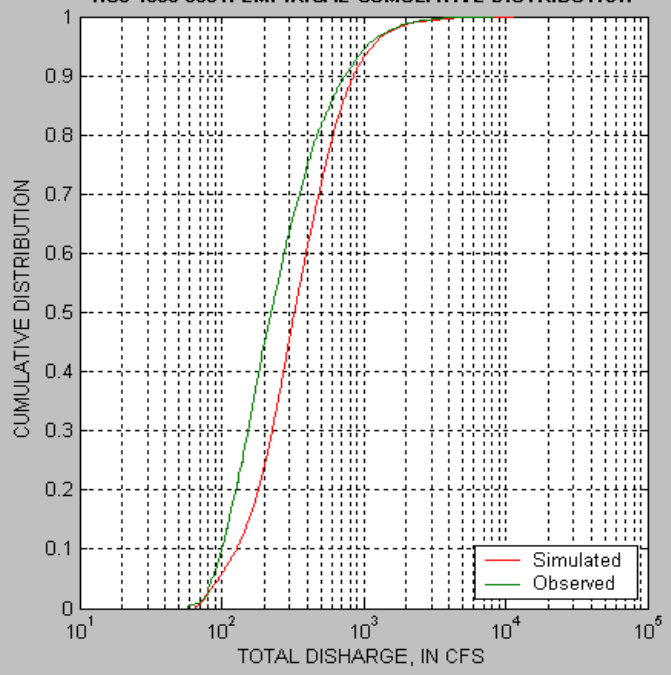
XU3-4650-0001: SIMULATED VS. OBSERVED



☑ plot log10 data

Print

XU3-4650-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



☑ semi-log plot

☐ hide observed values

Print

DATA SELECTION

scenario: phase4

file name: XU3_4650_0001

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	56 1.74819	64.2 1.80754
mean	361.457 2.39991	456.912 2.52461
median	224 2.35025	327 2.51455
max	8400 3.92428	11500 4.0607
variance	197610 0.114797	283690 0.10558
JB test	☐ 0 ☐ 0	0 ☐ 0 ☐
	raw	log10
% rel.bias	26.4083	5.19599
err.var.	188827	0.0504829
rel.std.err	0.955557	0.439759
mod.eff	0.0444434	0.560241

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

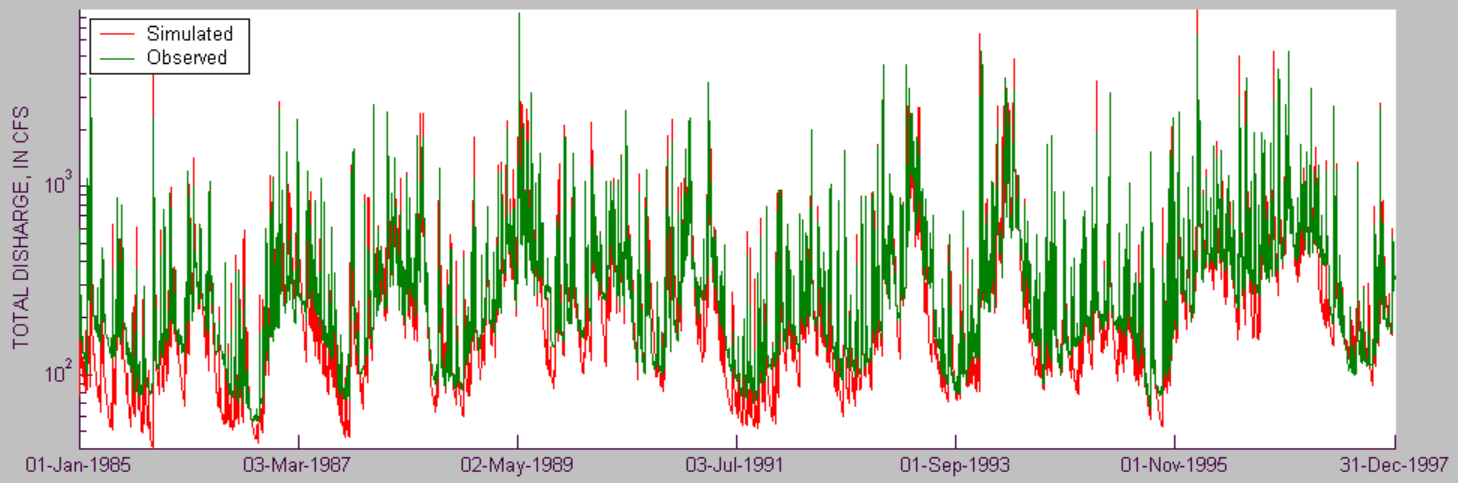
Save as PDF file

CAL5 Version 1.2

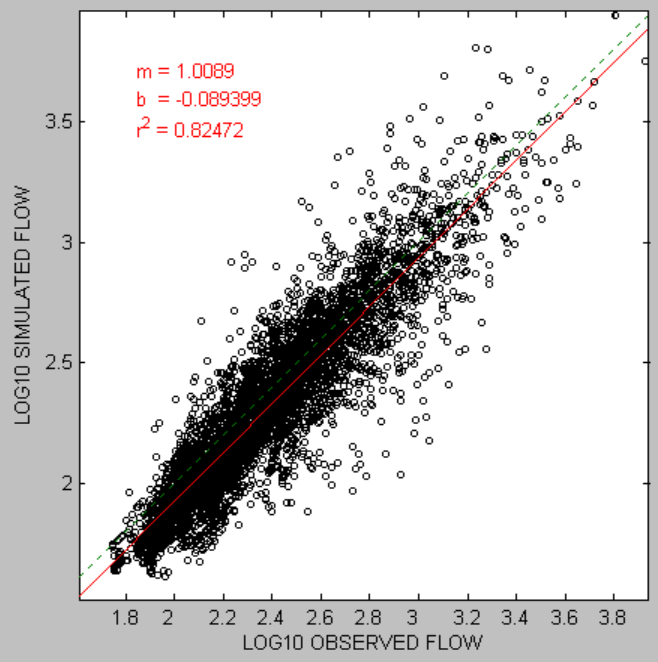
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print

PATUXENT R: FLOW TIME-SERIES

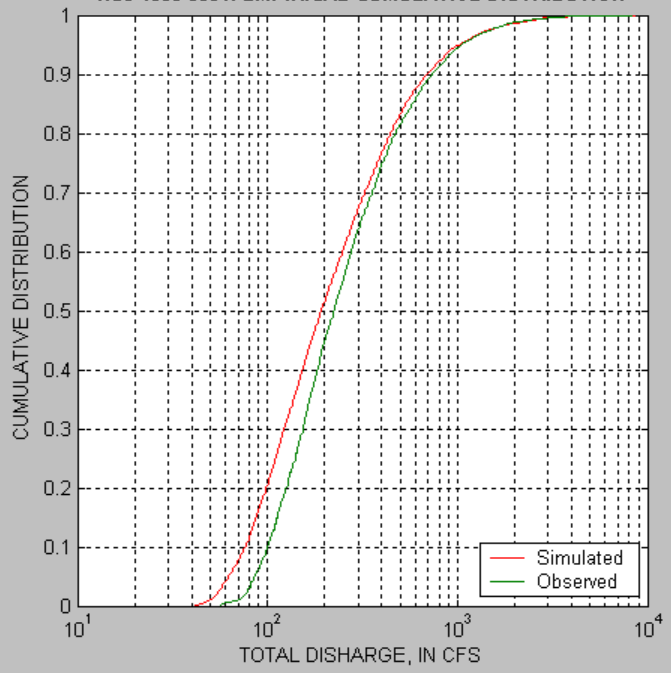


XU3-4650-0001: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

XU3-4650-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values | Examine | Print

DATA SELECTION

scenario	file name
apr04	XU3_4650_0001

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	56 1.74819	40.593 1.60845
mean	361.457 2.39991	334.255 2.33189
median	224 2.35025	192.745 2.28498
max	8400 3.92428	8763.2 3.94266
variance	197610 0.114797	214990 0.141685
JB test	0 0	0 0
	raw	log10
% rel.bias	-7.5258	-2.83433
err.var.	72621.8	0.029471
rel.std.err	0.367501	0.256724
mod.eff	0.632499	0.743276

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

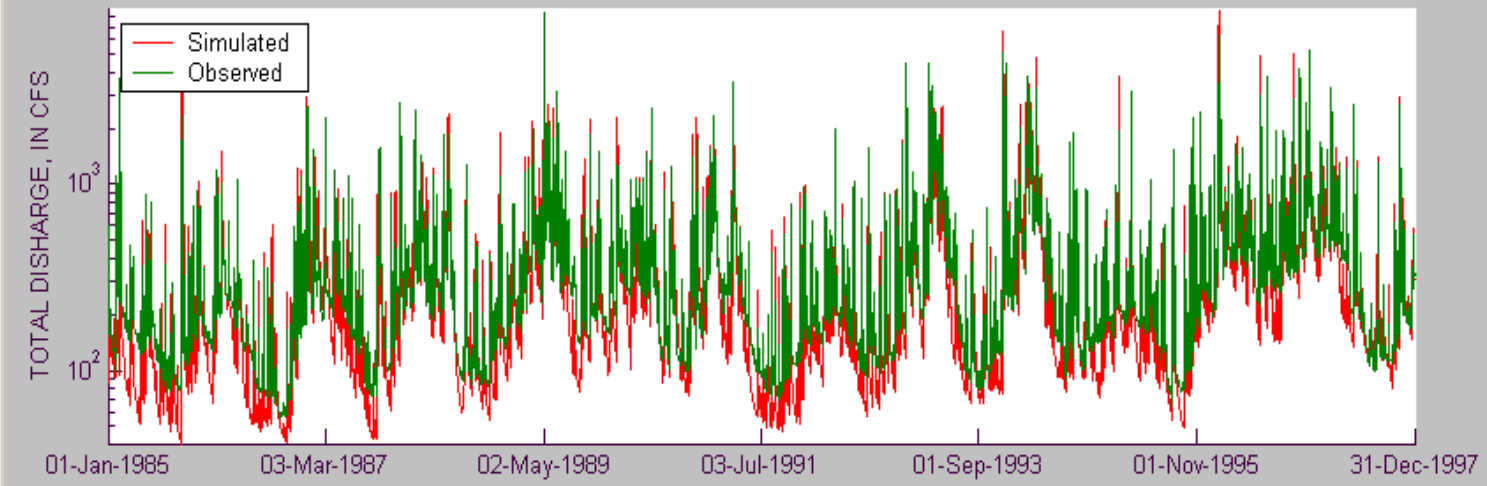
Save as PDF file

CAL5 Version 1.3

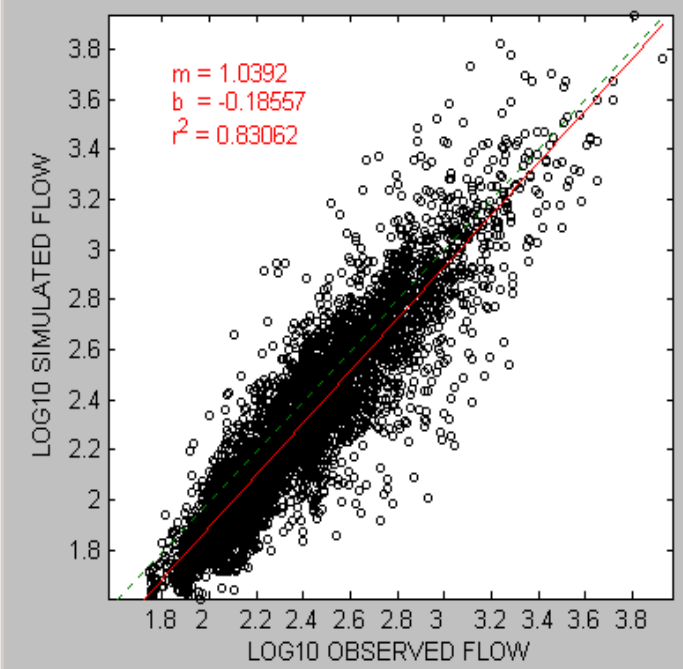
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

PATUXENT R: FLOW TIME-SERIES

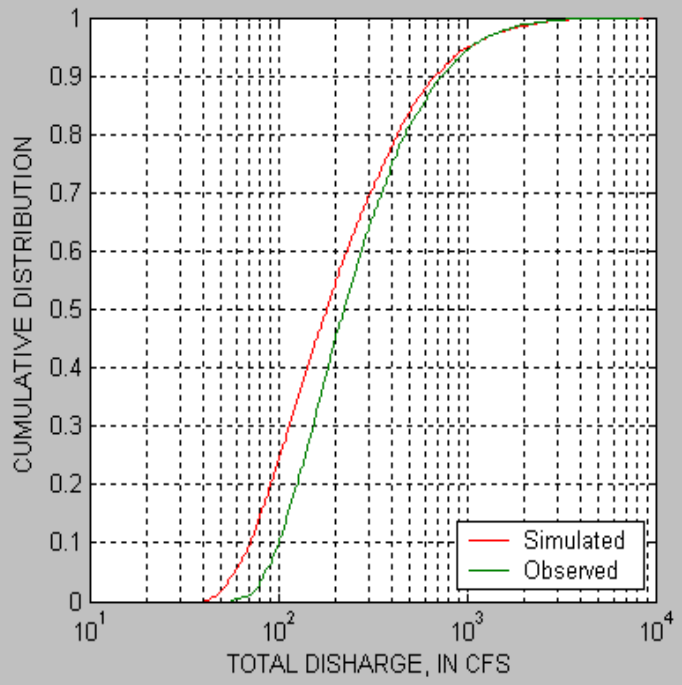


XU3-4650-0001: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

XU3-4650-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario: cut2

file name: XU3_4650_0001

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

	observed	simulated
n	4748	4748
min	56 1.74819	40.486 1.6073
mean	361.457 2.39991	326.018 2.30843
median	224 2.35025	181.51 2.2589
max	8400 3.92428	8660.8 3.93756
variance	197610 0.114797	222366 0.149256
JB test	0 0	0 0

	raw	log10
% rel.bias	-9.80453	-3.81167
err.var.	72656.9	0.0338272
rel.std.err	0.367679	0.29467
mod.eff	0.632321	0.70533

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

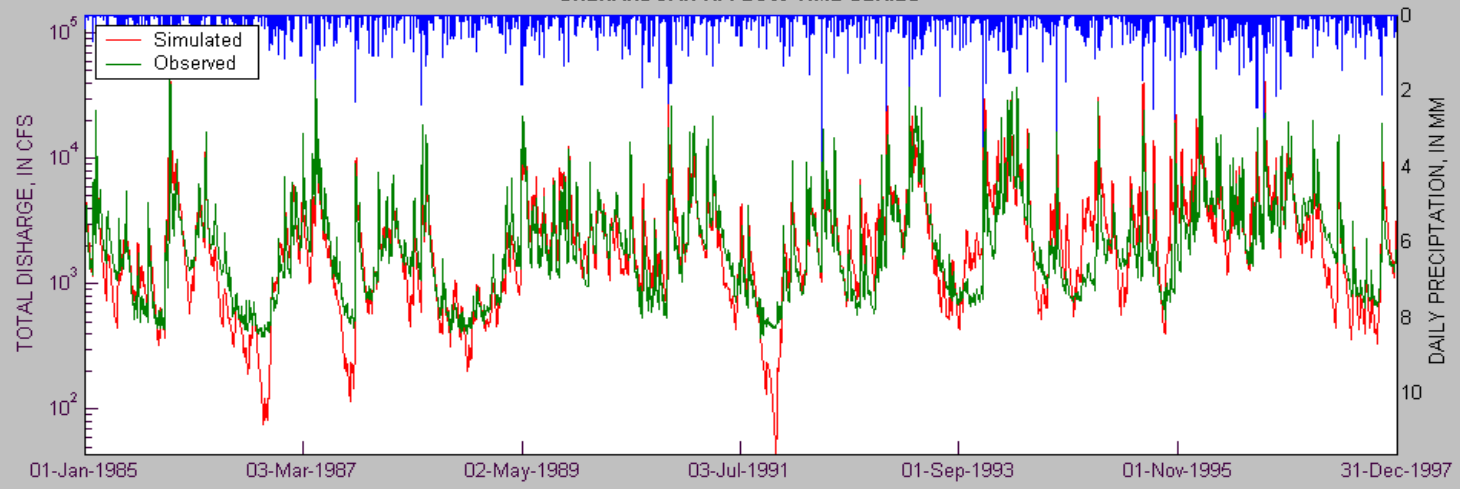
CAL5 Version 1.6

cal5

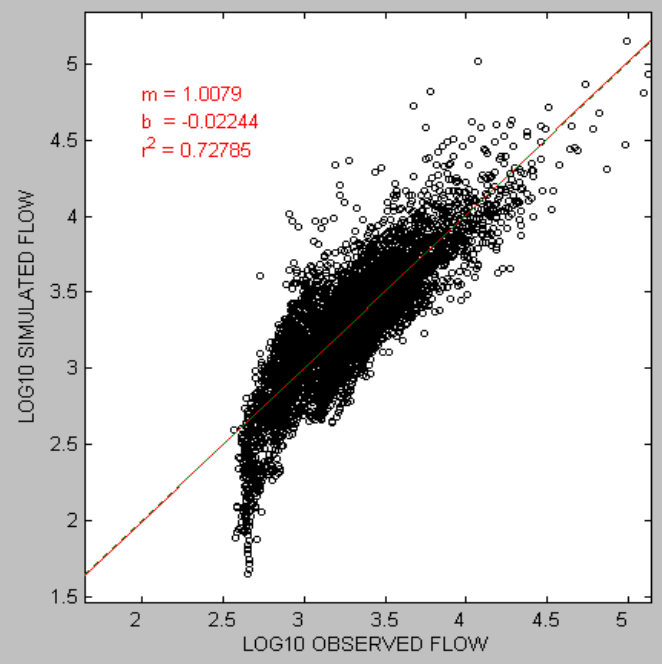
☐ hide precipitation ☐ hide observed values ☑ y-axis log-scale

Examine Print

SHENANDOAH R: FLOW TIME-SERIES



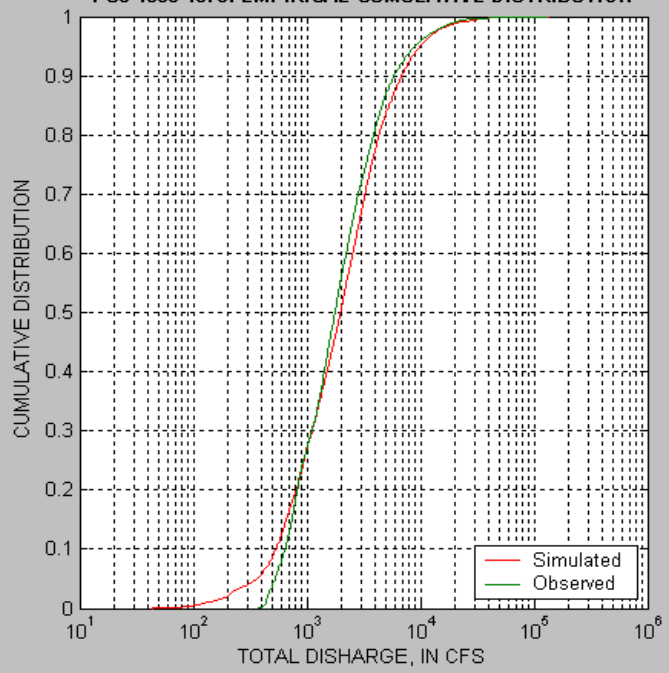
PS5-4380-4370: SIMULATED VS. OBSERVED



☑ plot log10 data

Print

PS5-4380-4370: EMPIRICAL CUMULATIVE DISTRIBUTION



☑ semi-log plot

☐ hide observed values

Print

DATA SELECTION

scenario	file name
phase4	PS5_4380_4370

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	367 2.56467	43.9 1.64246
mean	3009.1 3.27664	3281.43 3.28013
median	1770 3.24797	1980 3.29667
max	133000 5.12385	140000 5.14613
variance	2.65865e+007 0.144823	2.75119e+007 0.202137
JB test	0 0	0 1.87914e-008
	raw	log10
% rel.bias	9.05016	0.106775
err.var.	1.31807e+007	0.0550334
rel.std.err	0.495767	0.380005
mod.eff	0.504233	0.619995

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

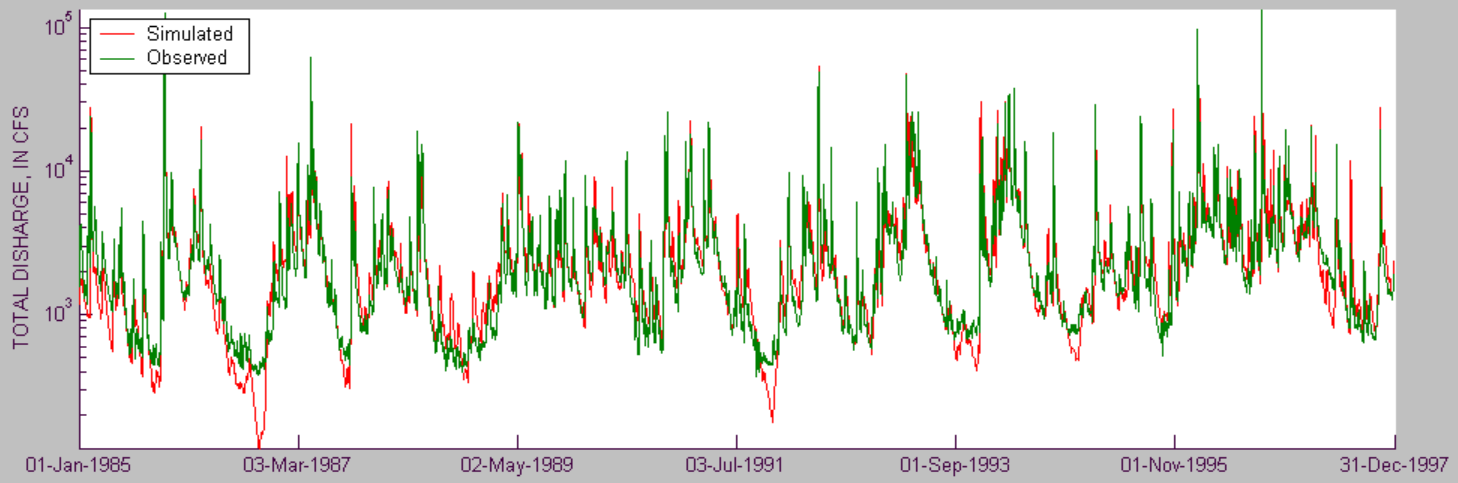
Save as PDF file

CAL5 Version 1.2

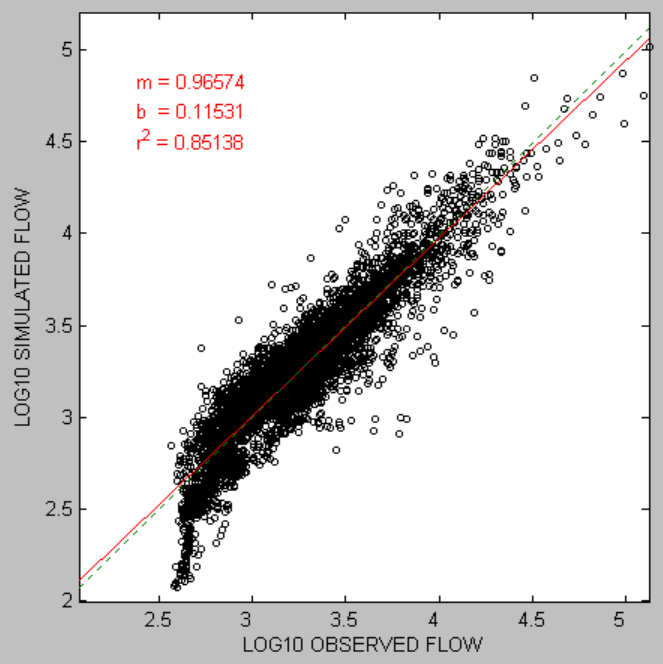
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print

SHENANDOAH R: FLOW TIME-SERIES

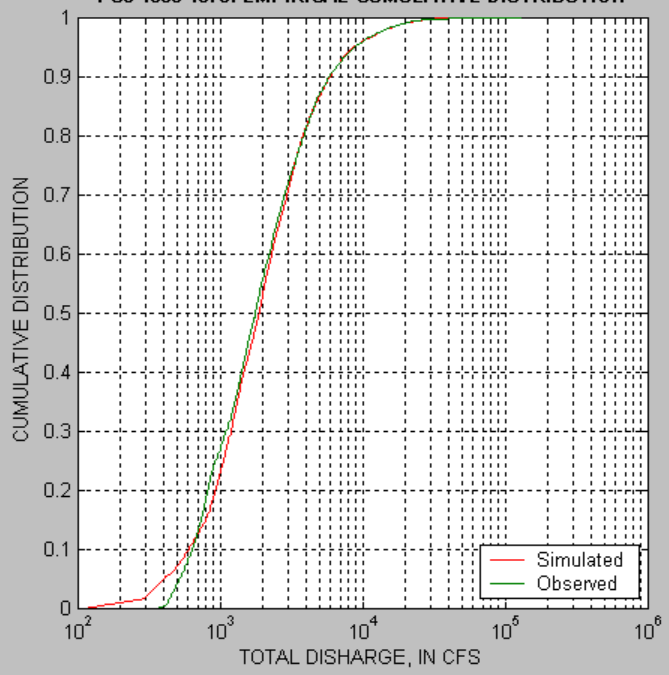


PS5-4380-4370: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

PS5-4380-4370: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values | Examine | Print

DATA SELECTION

scenario: apr04

file name: PS5_4380_4370

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	367 2.56467	117.3 2.0693
mean	3009.1 3.27664	3015.61 3.27968
median	1770 3.24797	1889.5 3.27635
max	133000 5.12385	104230 5.01799
variance	2.65865e+007 0.144823	1.94683e+007 0.158647
JB test	0 0	0 0
	raw	log10
% rel.bias	0.216235	0.0929862
err.var.	5.38616e+006	0.0237575
rel.std.err	0.20259	0.164045
mod.eff	0.79741	0.835955

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

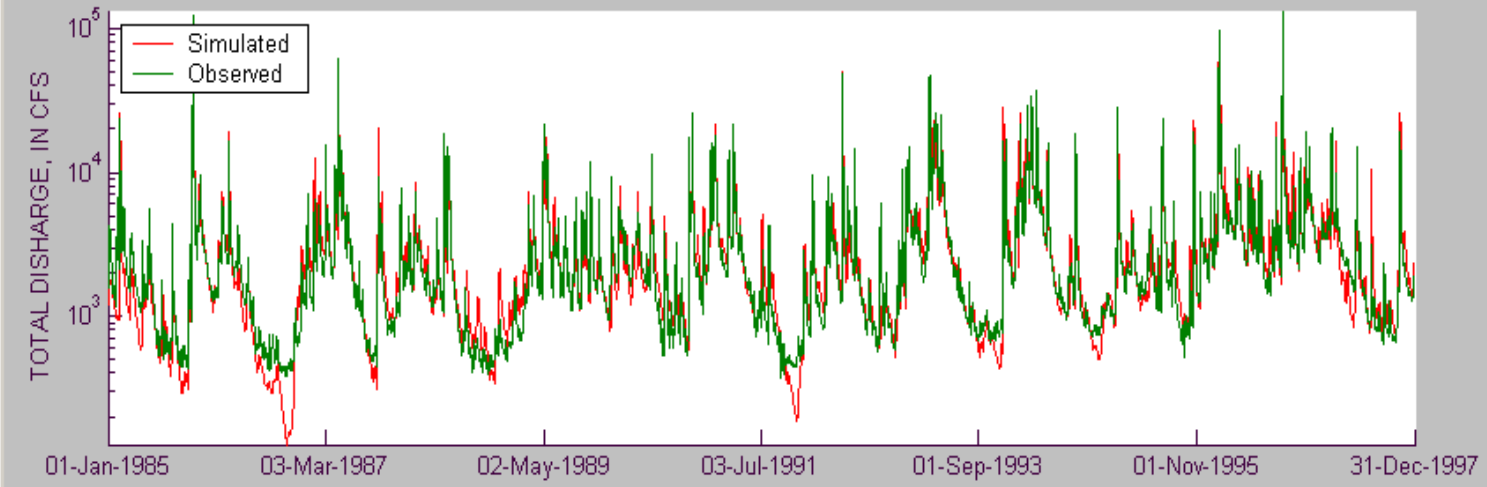
Save as PDF file

CAL5 Version 1.3

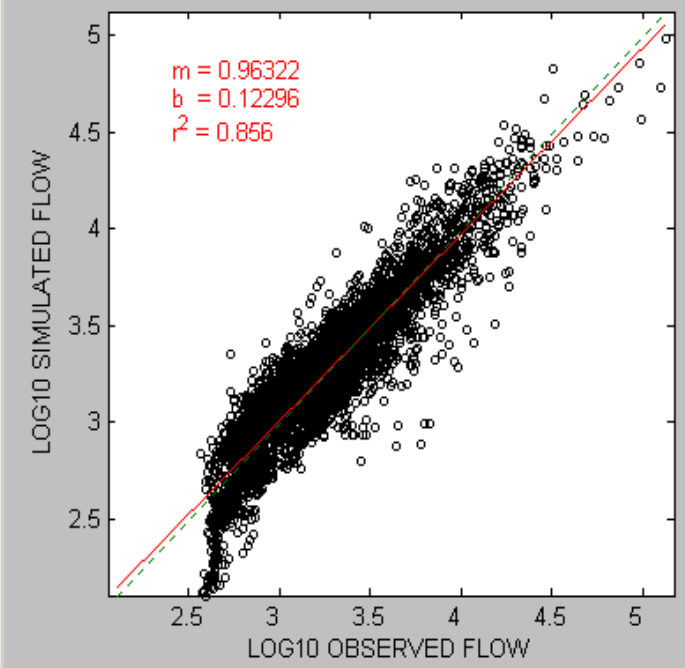
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

SHENANDOAH R: FLOW TIME-SERIES

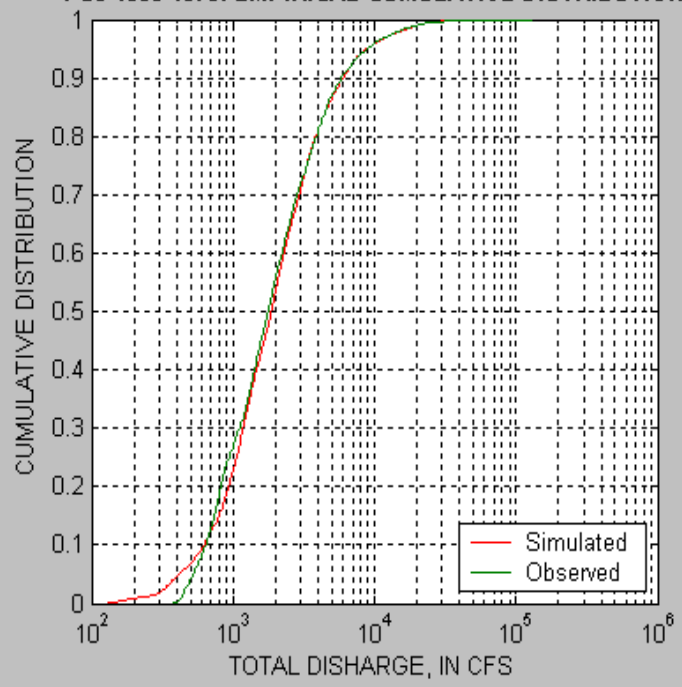


PS5-4380-4370: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

PS5-4380-4370: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario	file name
cut2	PS5_4380_4370

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	367 2.56467	127.48 2.10544
mean	3009.1 3.27664	2998.69 3.27908
median	1770 3.24797	1867.95 3.27137
max	133000 5.12385	96534 4.98468
variance	2.65865e+007 0.144823	1.84174e+007 0.156968
JB test	0 0	0 0
	raw	log10
% rel.bias	-0.346037	0.0744682
err. var.	5.67588e+006	0.0228052
rel.std.err	0.213487	0.15747
mod.eff	0.786513	0.84253

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

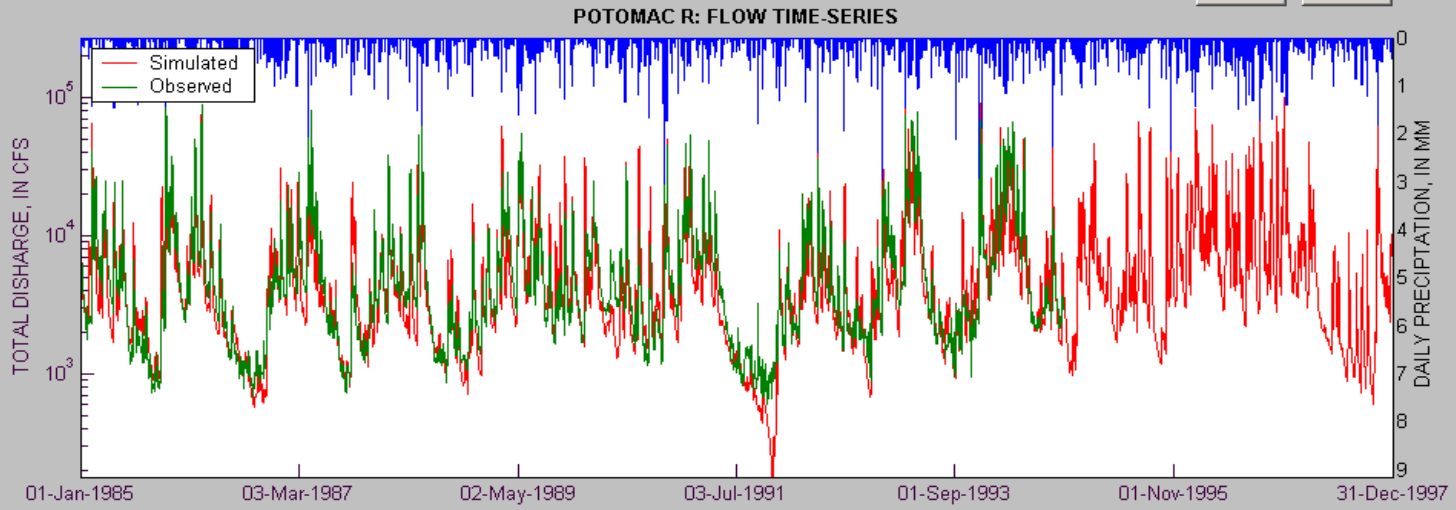
Seasonal Box Plots

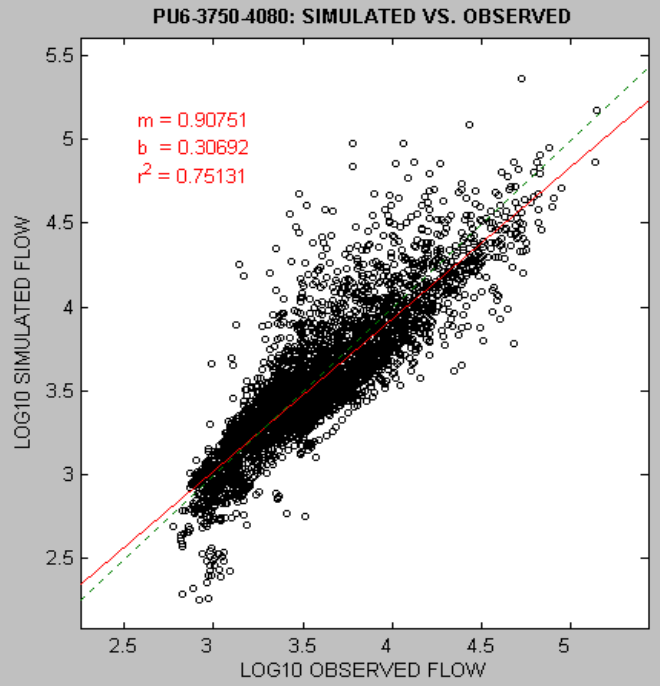
C-Q scatter plot

CAL5 Version 1.6

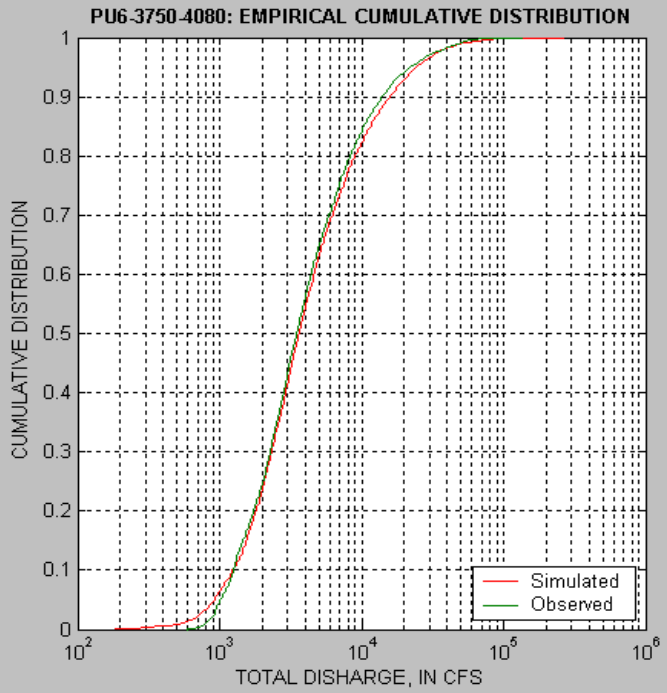
cal5

hide precipitation | hide observed values | y-axis log-scale | Examine | Print





plot log10 data | Print



semi-log plot | hide observed values | Print

DATA SELECTION

scenario: phase4

file name: PU6_3750_4080

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

n	3560	3560
	observed	simulated
min	596 2.77525	179 2.25285
mean	6479.73 3.59314	6339.67 3.56773
median	3500 3.54407	3280 3.51587
max	138000 5.13988	232000 5.36549
variance	8.5256e+007 0.162055	9.94228e+007 0.177643
JB test	0 0	0 0
	raw	log10
% rel.bias	-2.16154	-0.707035
err.var.	5.28131e+007	0.0462107
rel.std.err	0.619465	0.285155
mod.eff	0.380535	0.714845

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

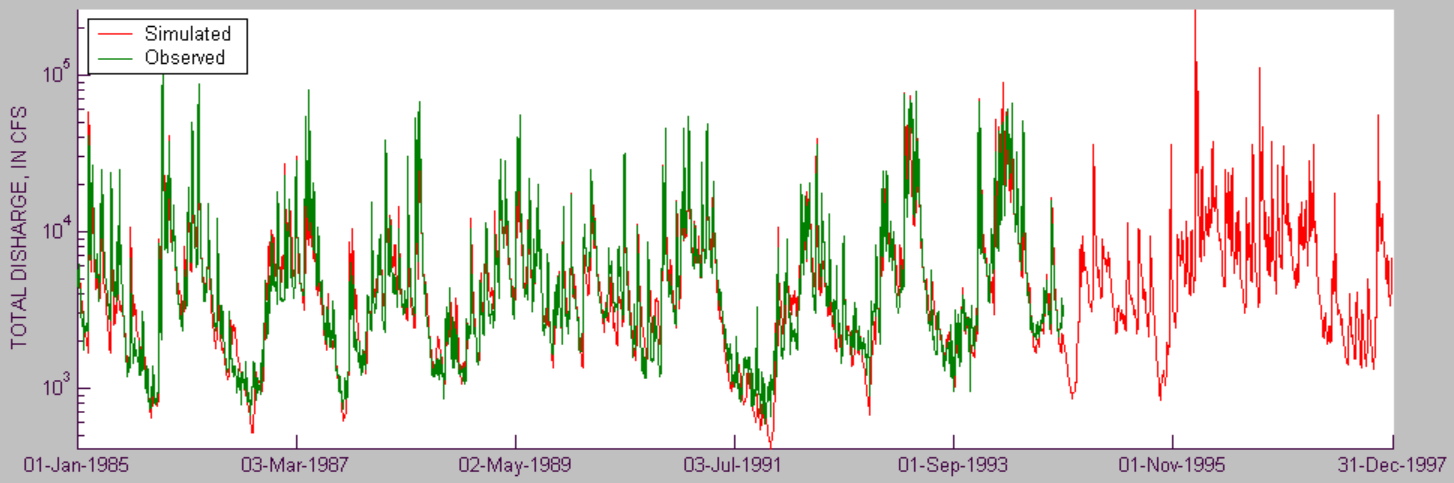
Save as PDF file

CAL5 Version 1.2

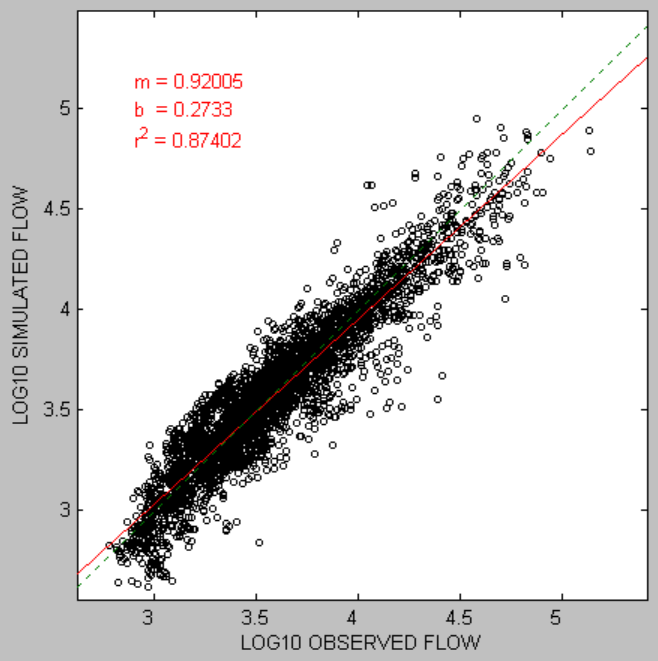
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print

POTOMAC R: FLOW TIME-SERIES

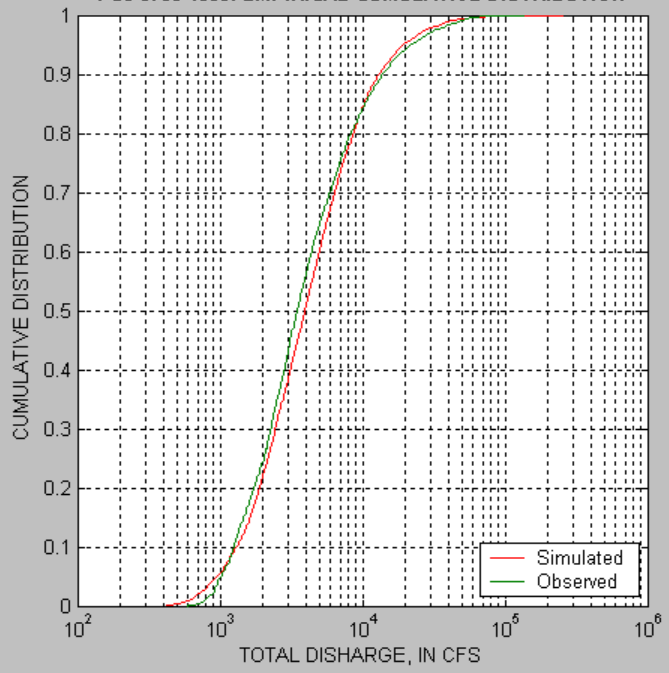


PU6-3750-4080: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

PU6-3750-4080: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario	file name
apr04	PU6_3750_4080

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	3560	3560
	observed	simulated
min	596 2.77525	414.4 2.61742
mean	6479.73 3.59314	5995.88 3.57915
median	3500 3.54407	3660.6 3.56355
max	138000 5.13988	89585 4.95224
variance	8.5256e+007 0.162055	6.06729e+007 0.156949
JB test	0 0	0 3.44169e-015
	raw	log10
% rel.bias	-7.46712	-0.389277
err.var.	1.98232e+007	0.0210039
rel.std.err	0.232514	0.12961
mod.eff	0.767486	0.87039

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

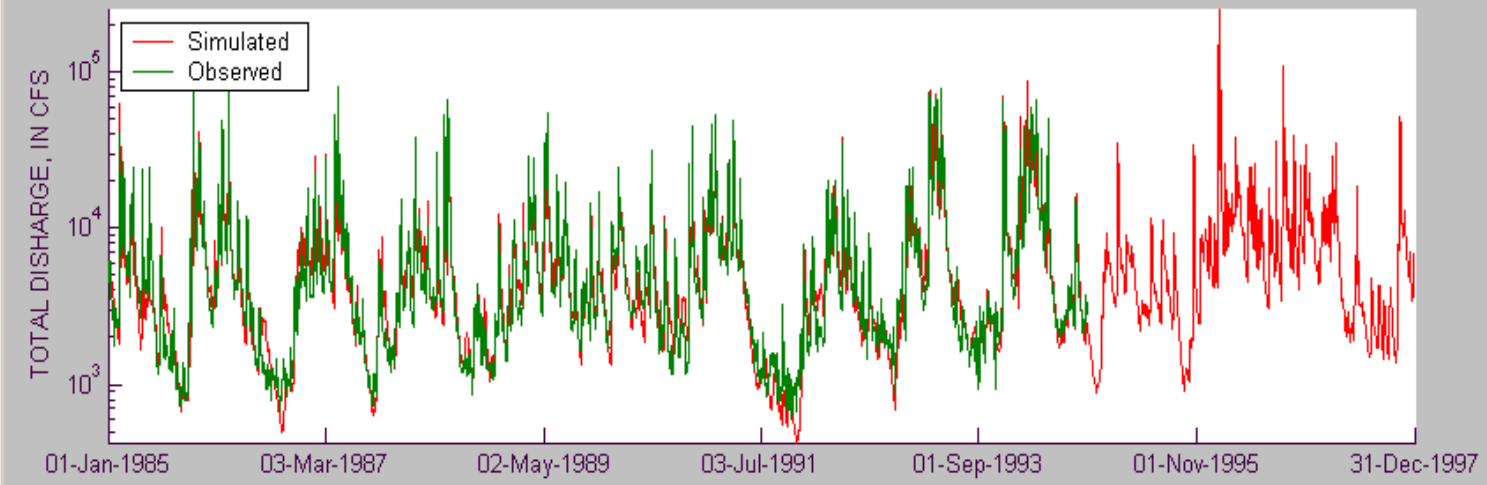
Save as PDF file

CAL5 Version 1.3

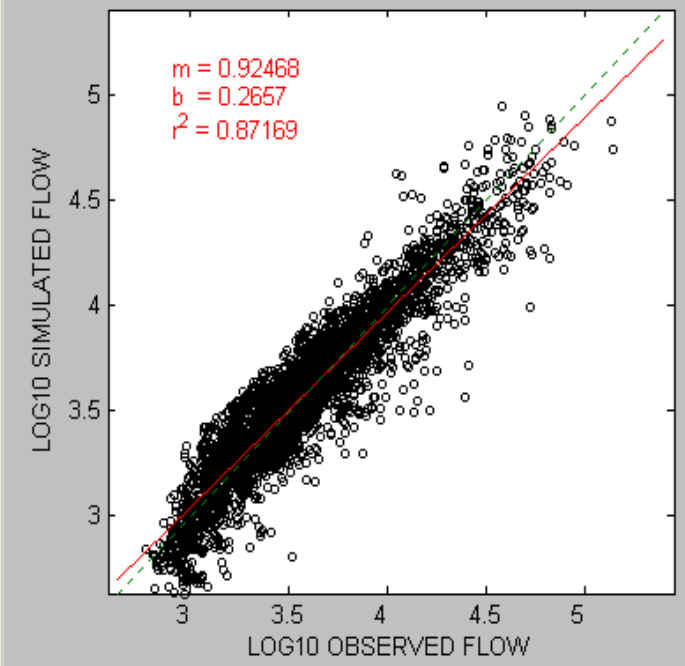
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

POTOMAC R: FLOW TIME-SERIES

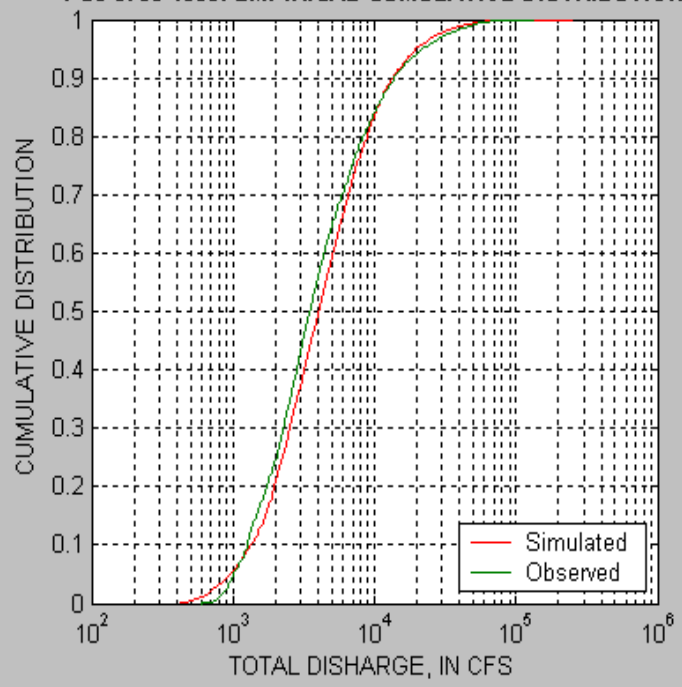


PU6-3750-4080: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

PU6-3750-4080: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario	file name
cut2	PU6_3750_4080

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	3560	3560
	observed	simulated
min	596 2.77525	423.67 2.62703
mean	6479.73 3.59314	6125.51 3.5882
median	3500 3.54407	3697.05 3.56786
max	138000 5.13988	88167 4.94531
variance	8.5256e+007 0.162055	6.16517e+007 0.158957
JB test	0 0	0 5.39055e-012
	raw	log10
% rel.bias	-5.46672	-0.137602
err.var.	1.98089e+007	0.021339
rel.std.err	0.232346	0.131678
mod.eff	0.767654	0.868322

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

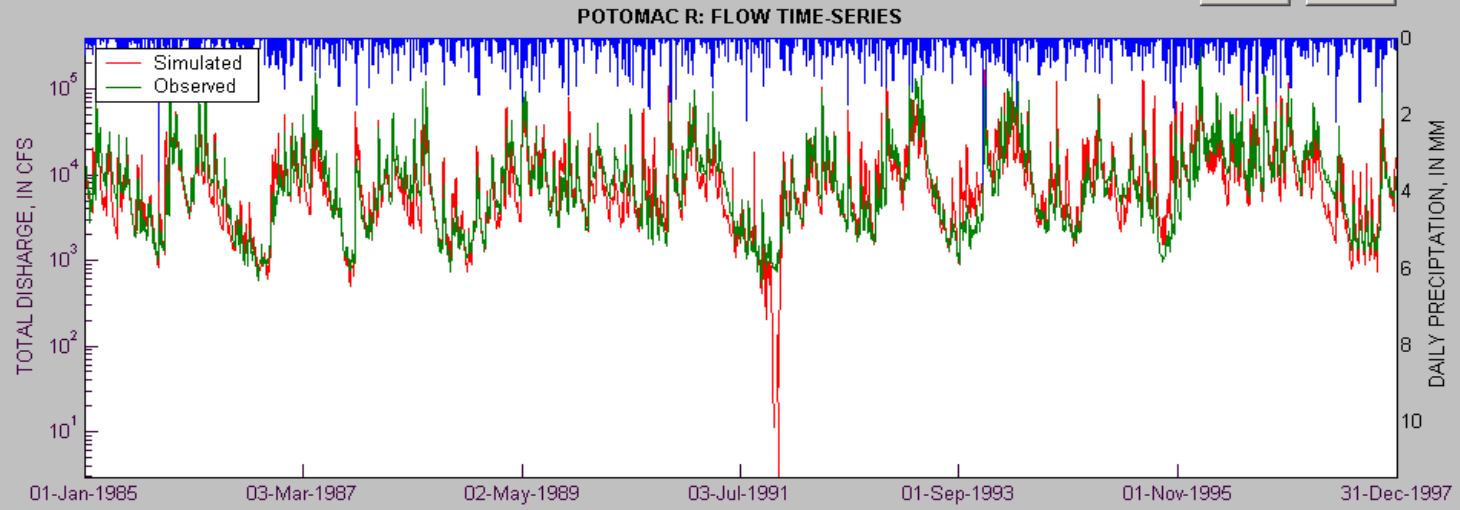
C-Q scatter plot

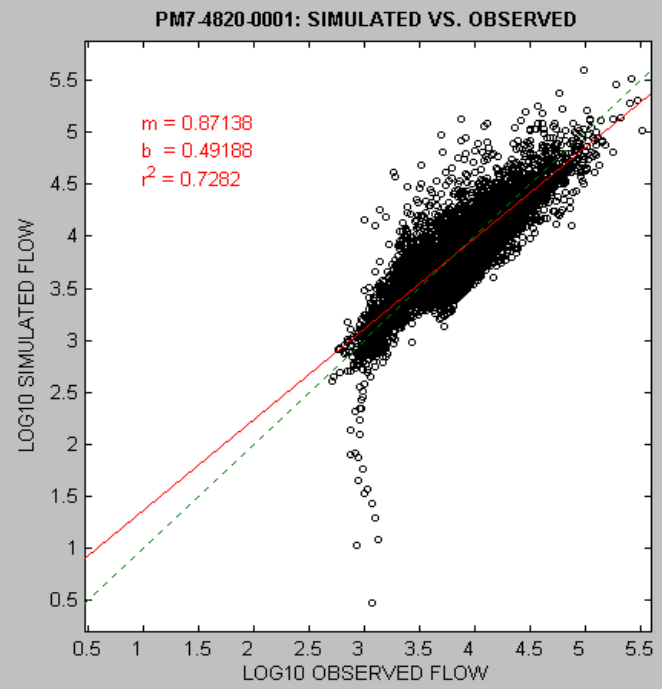
CAL5 Version 1.6

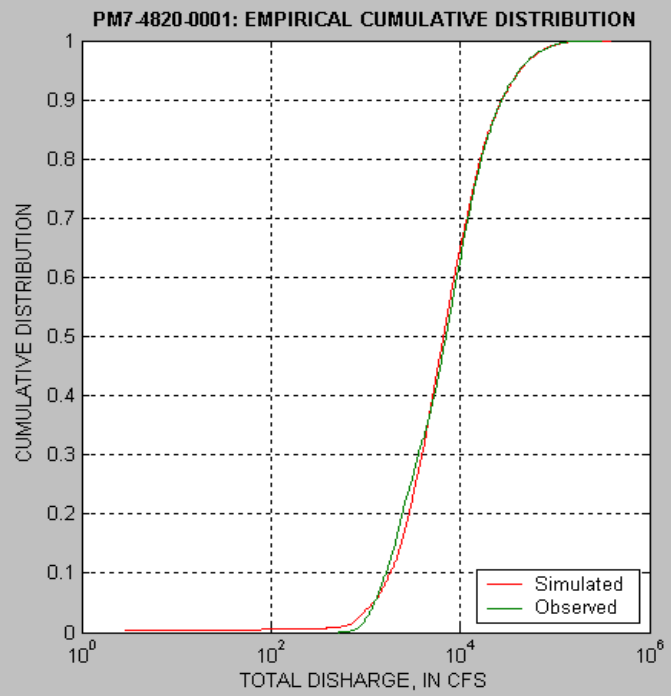
cal5

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

Examine | Print







☑ plot log10 data Print

☑ semi-log plot ☐ hide observed values Print

DATA SELECTION

scenario	file name
phase4	PM7_4820_0001

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4736
	observed	simulated
min	514 2.71096	0 0.469822
mean	12482.4 3.84034	12505.1 3.83828
median	7100 3.85309	6670 3.82478
max	326000 5.51322	400000 5.60206
variance	3.42229e+008 0.215564	3.72553e+008 0.224773
JB test	0 2.57105e-012	0 0
	raw	log10
% rel.bias	0.182083	-0.0536814
err.var.	1.78007e+008	0.0646639
rel.std.err	0.520138	0.299975
mod.eff	0.479862	0.700025

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

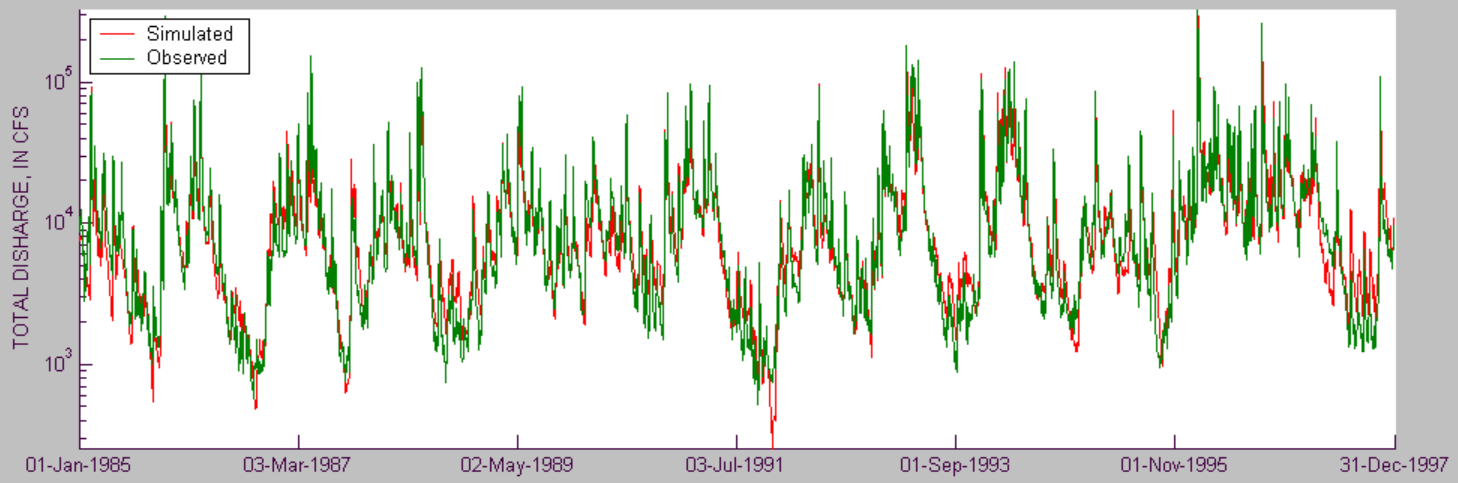
Save as PDF file

CAL5 Version 1.2

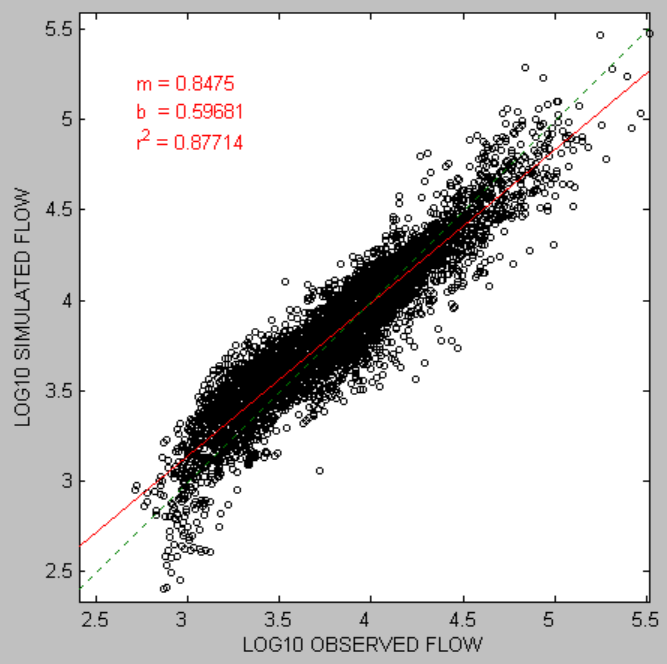
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print

POTOMAC R: FLOW TIME-SERIES

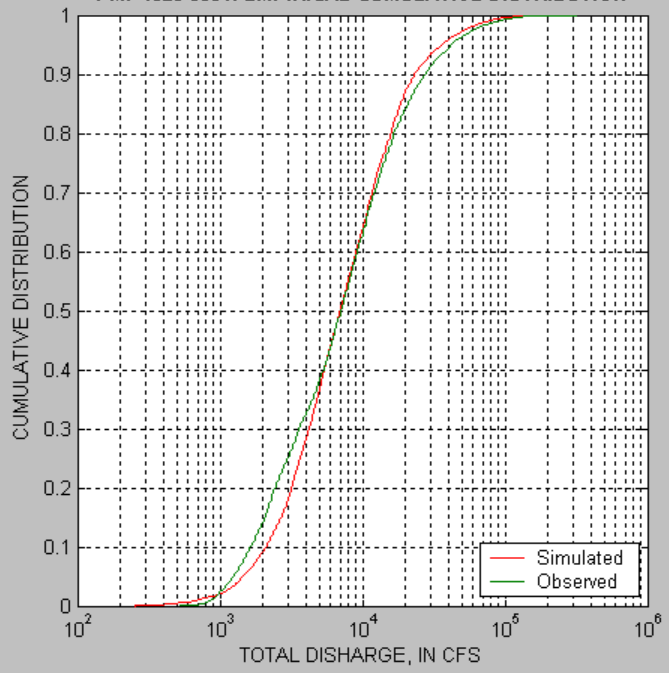


PM7-4820-0001: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

PM7-4820-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values | Examine | Print

DATA SELECTION

scenario: apr04

file name: PM7_4820_0001

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	514 2.71096	254.56 2.40579
mean	12482.4 3.83802	11499.8 3.84954
median	7100 3.85126	6973.8 3.84347
max	326000 5.51322	298160 5.47445
variance	3.42229e+008 0.217144	2.40466e+008 0.177812
JB test	0 5.22882e-012	0 0.00810395
	raw	log10
% rel.bias	-7.87202	0.300076
err.var.	8.42798e+007	0.0270288
rel.std.err	0.246267	0.124475
mod.eff	0.753733	0.875525

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

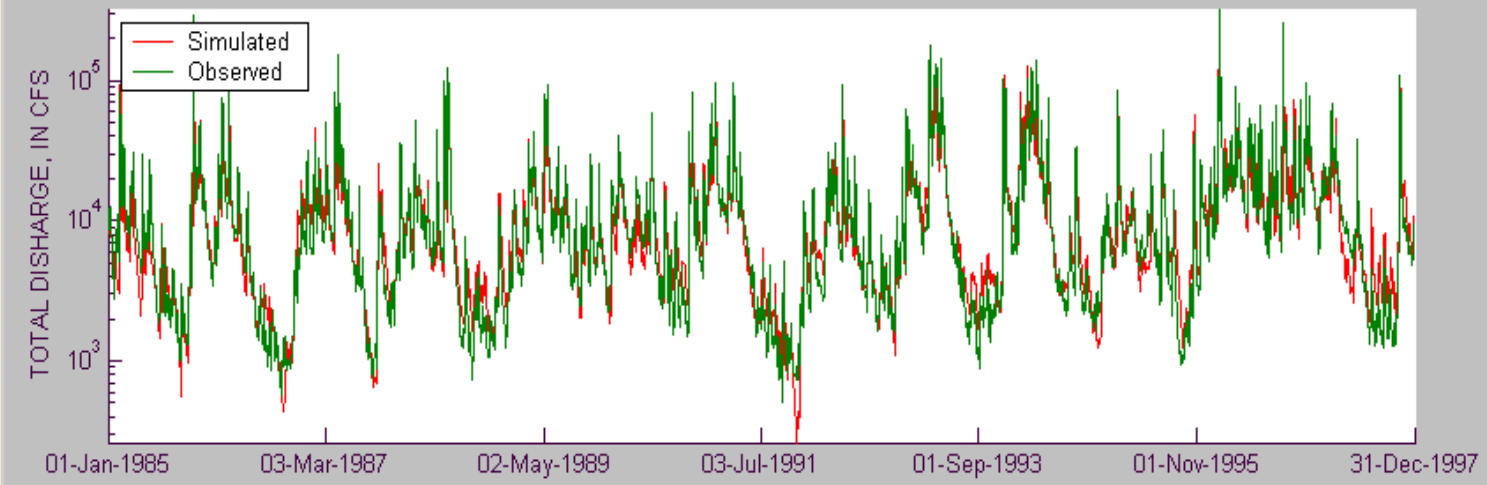
Save as PDF file

CAL5 Version 1.3

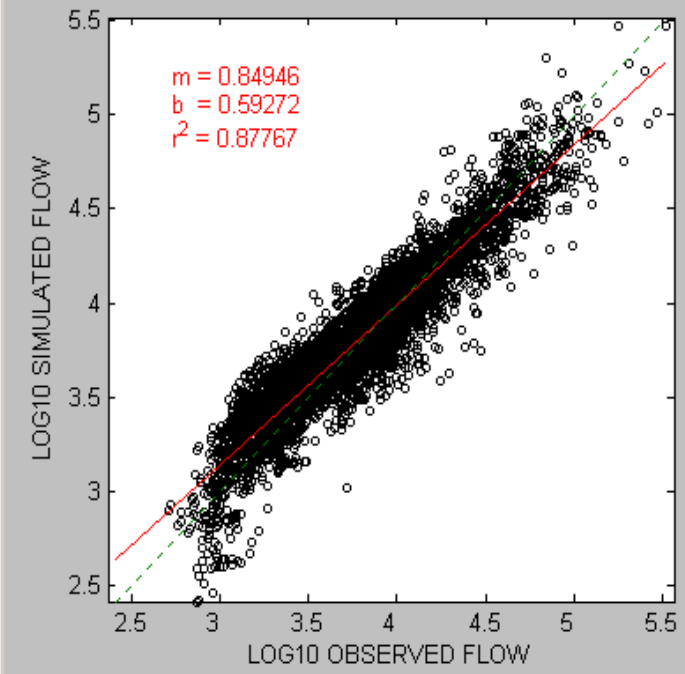
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

POTOMAC R: FLOW TIME-SERIES

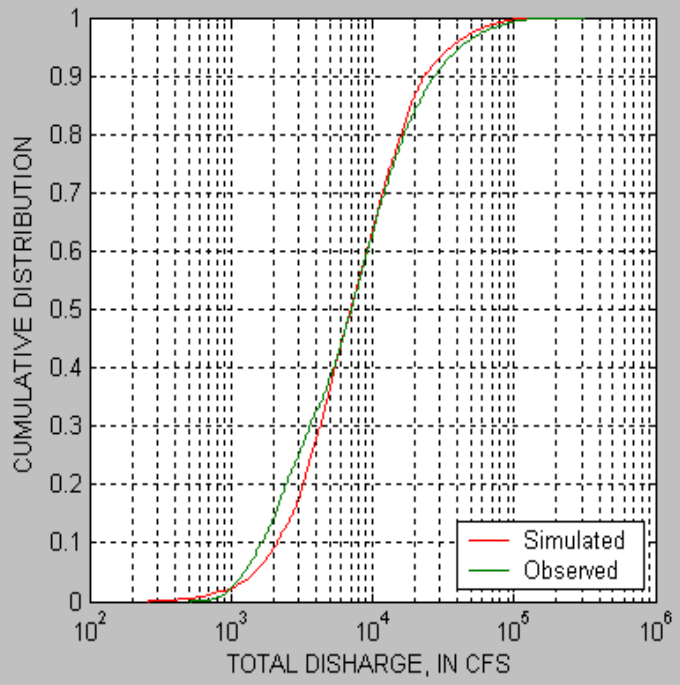


PM7-4820-0001: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

PM7-4820-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario: cut2

file name: PM7_4820_0001

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

	observed	simulated
n	4748	4748
min	514 2.71096	261.46 2.41741
mean	12482.4 3.83802	11570.8 3.85298
median	7100 3.85126	7026.25 3.84672
max	326000 5.51322	290960 5.46383
variance	3.42229e+008 0.217144	2.37305e+008 0.178528
JB test	0 5.22882e-012	0 0.0182701

	raw	log10
% rel.bias	-7.30313	0.389788
err.var.	8.49394e+007	0.0269841
rel.std.err	0.248194	0.124268
mod.eff	0.751806	0.875732

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

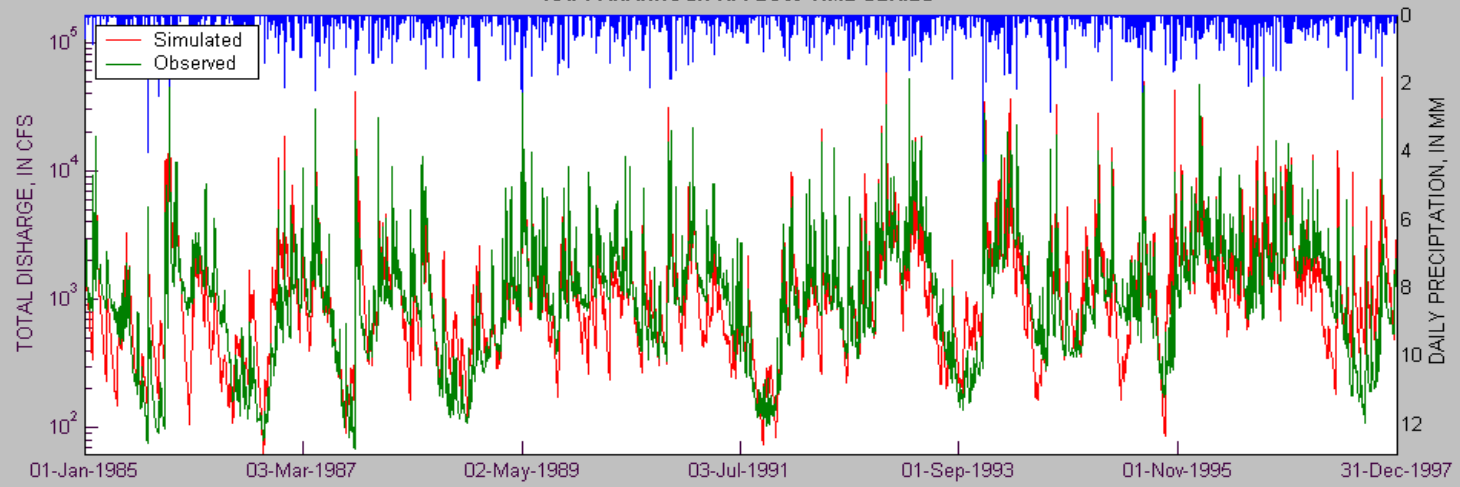
CAL5 Version 1.6

cal5

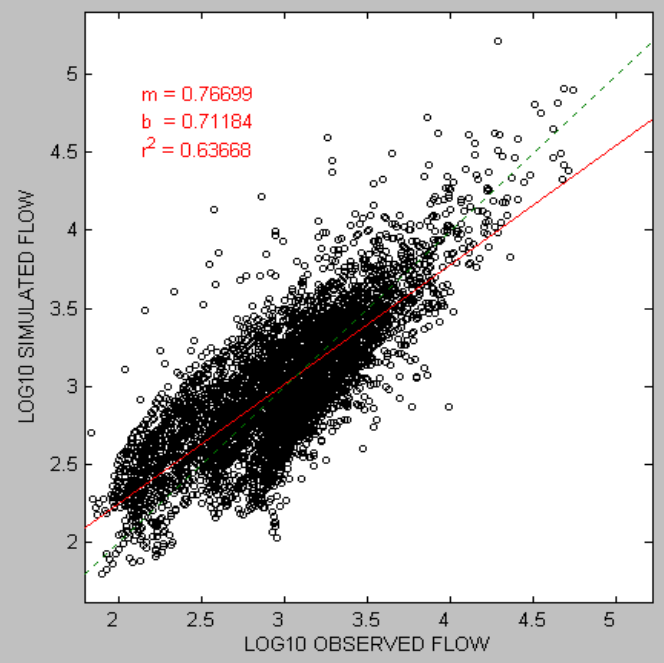
☐ hide precipitation ☐ hide observed values ☑ y-axis log-scale

Examine Print

RAPPAHANNOCK R: FLOW TIME-SERIES



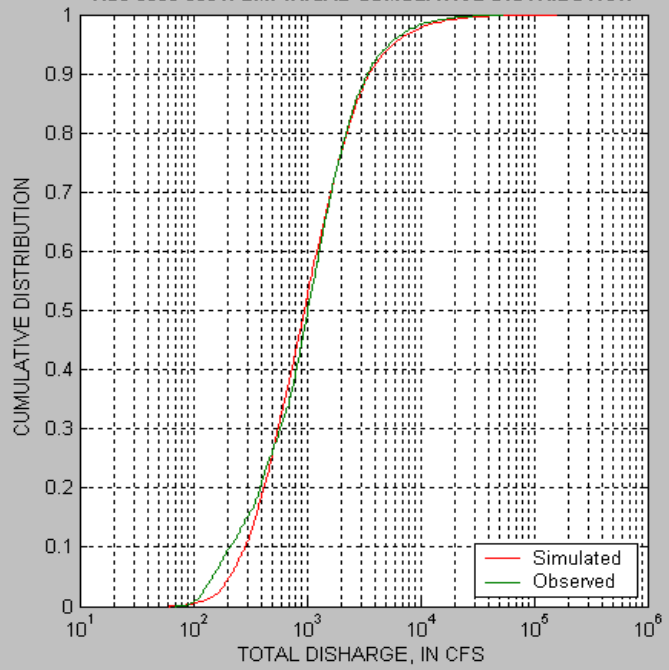
RU5-6030-0001: SIMULATED VS. OBSERVED



☑ plot log10 data

Print

RU5-6030-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



☑ semi-log plot

☐ hide observed values

Print

DATA SELECTION

scenario	file name
phase4	RU5_6030_0001

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	69 1.83885	62.6 1.79657
mean	1761.91 2.98514	1914.73 3.00141
median	1020 3.0086	959.5 2.98204
max	54600 4.73719	164000 5.21484
variance	9.87845e+006 0.213988	2.08517e+007 0.197719
JB test	0 0.034249	0 0
	raw	log10
% rel.bias	8.67347	0.5453
err.var.	1.00361e+007	0.0837186
rel.std.err	1.01596	0.391231
mod.eff	-0.015959	0.608769

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

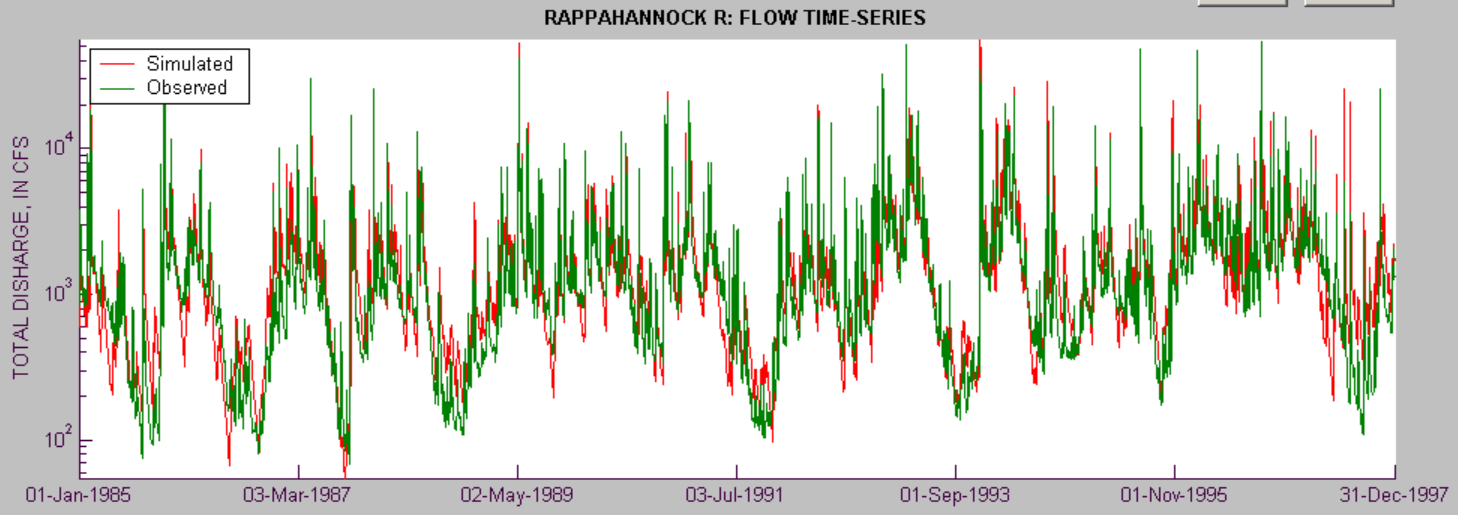
Print All

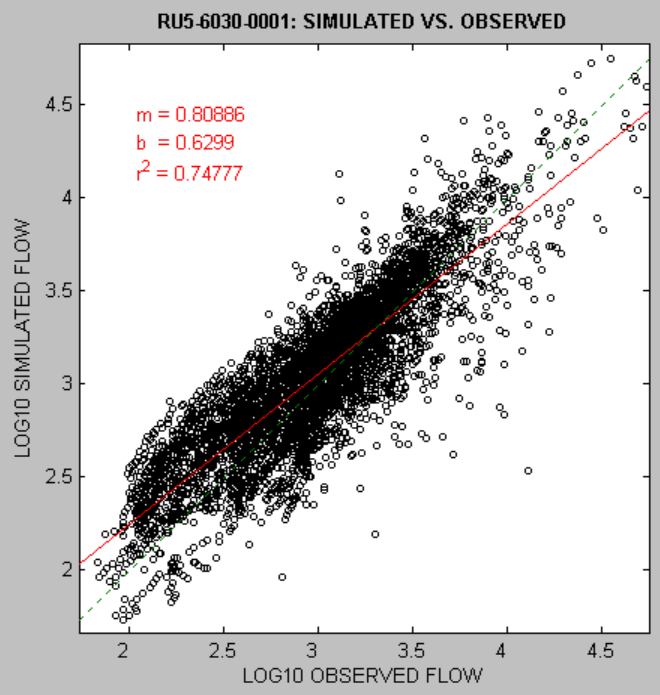
Save as PDF file

CAL5 Version 1.2

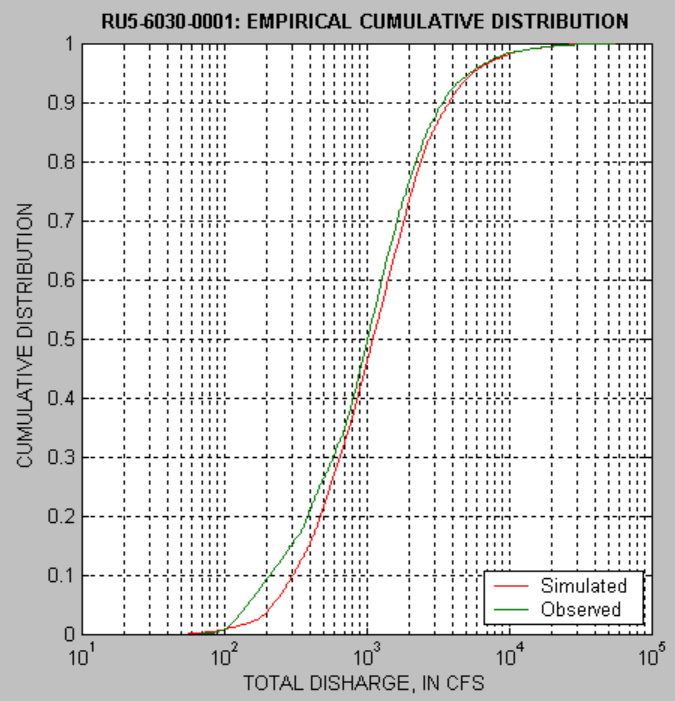
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print





plot log10 data | Examine | Print



semi-log plot | hide observed values | Examine | Print

DATA SELECTION

scenario: apr04

file name: RU5_6030_0001

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	69 1.83885	54.689 1.7379
mean	1761.91 2.98514	1896.8 3.04446
median	1020 3.0086	1112.25 3.0462
max	54600 4.73719	56028 4.74841
variance	9.87845e+006 0.213988	9.35238e+006 0.187227
JB test	0 0.034249	0 1.20214e-008
	raw	log10
% rel.bias	7.65559	1.98749
err.var.	3.98704e+006	0.0585619
rel.std.err	0.40361	0.273669
mod.eff	0.59639	0.726331

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

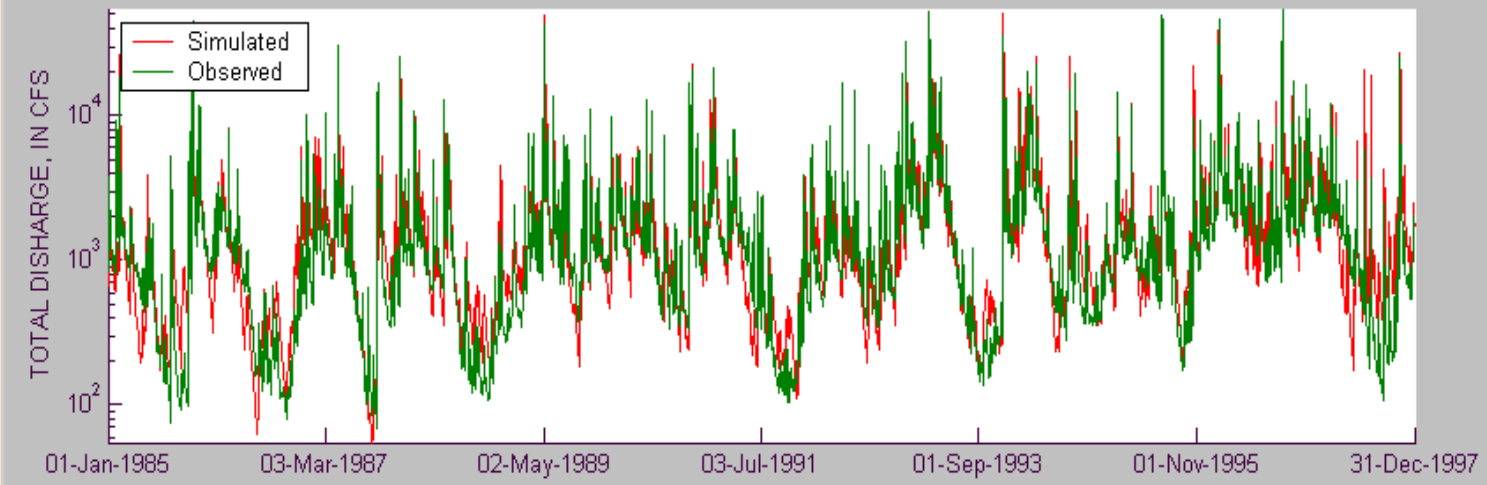
Save as PDF file

CAL5 Version 1.3

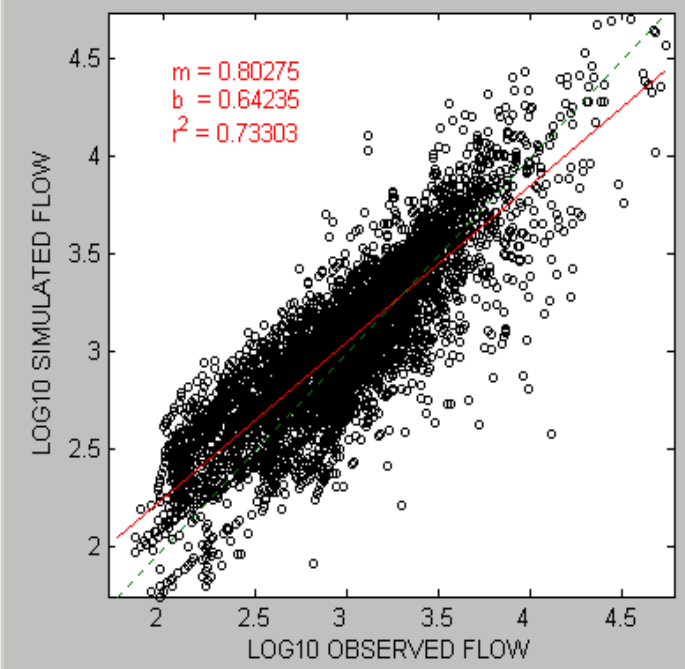
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

RAPPAHANNOCK R: FLOW TIME-SERIES

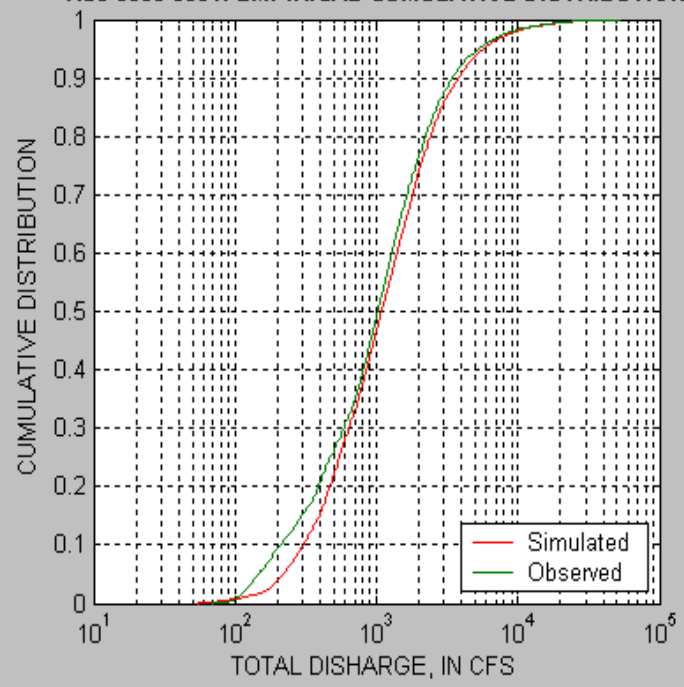


RU5-6030-0001: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

RU5-6030-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values | Examine | Print

DATA SELECTION

scenario	file name
cut2	RU5_6030_0001

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	69 1.83885	55.023 1.74054
mean	1761.91 2.98514	1881.63 3.03868
median	1020 3.0086	1089.45 3.03721
max	54600 4.73719	50386 4.70231
variance	9.87845e+006 0.213988	9.12497e+006 0.18812
JB test	0 0.034249	0 5.54452e-010
	raw	log10
% rel.bias	6.79434	1.79372
err.var.	4.07834e+006	0.0614163
rel.std.err	0.412852	0.287008
mod.eff	0.587148	0.712992

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

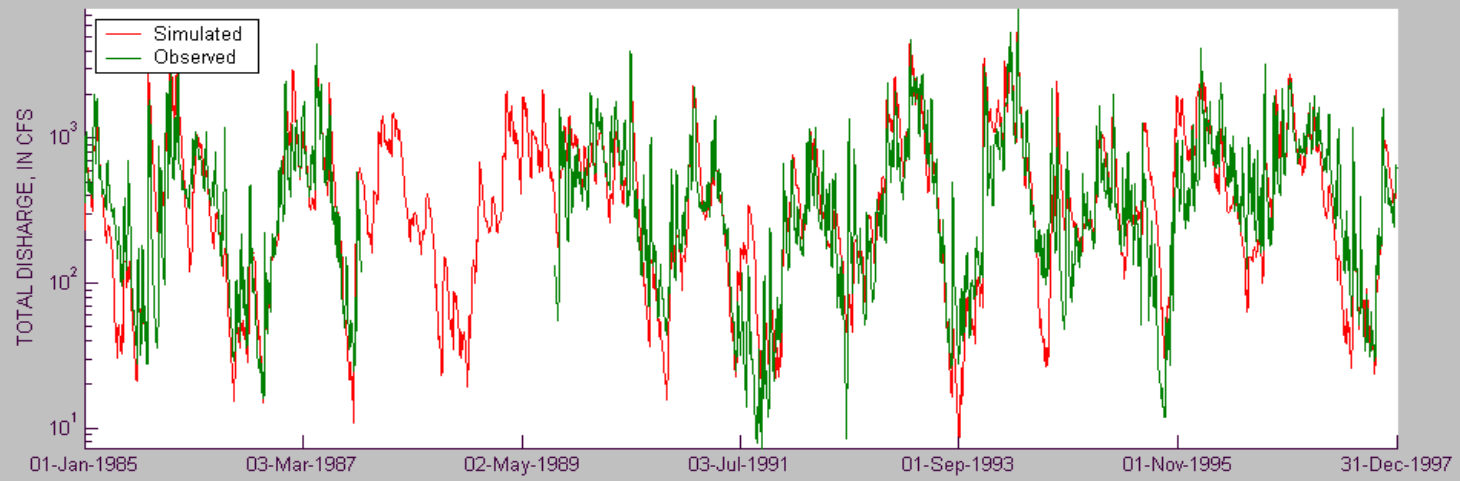
CAL5 Version 1.6

cal5

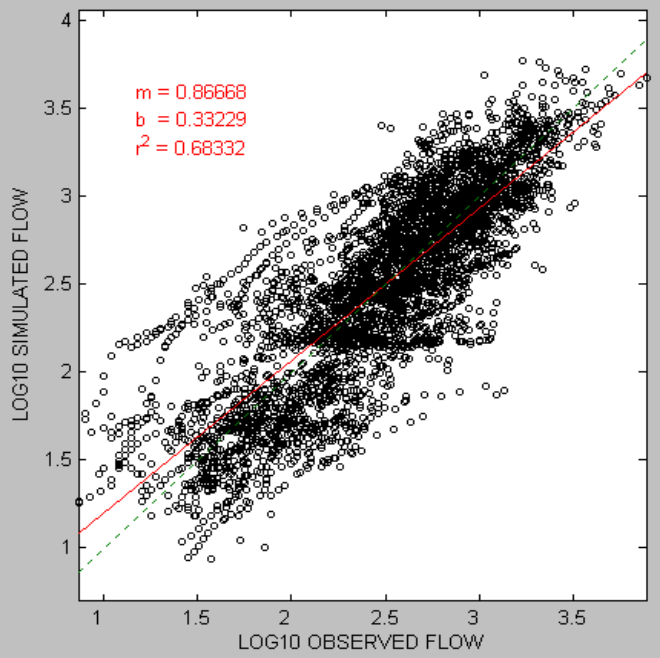
☐ hide precipitation ☐ hide observed values ☑ y-axis log-scale

Examine Print

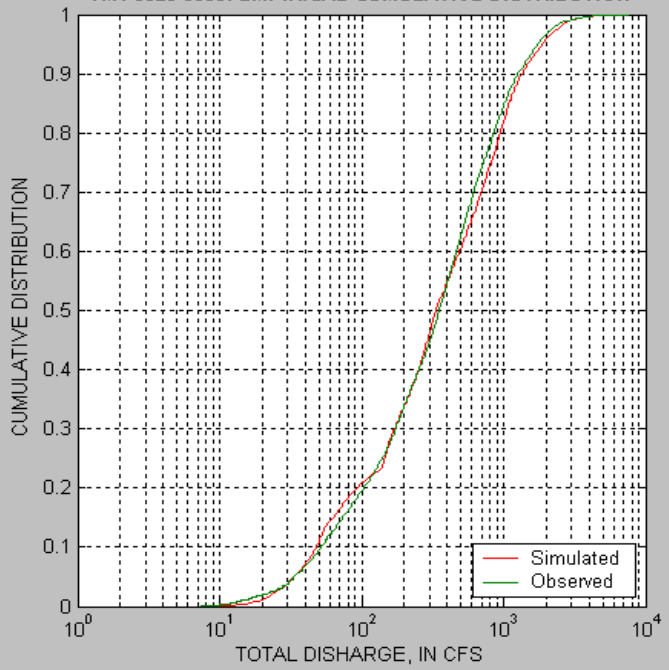
: FLOW TIME-SERIES



YM4-6620-0003: SIMULATED VS. OBSERVED



YM4-6620-0003: EMPIRICAL CUMULATIVE DISTRIBUTION



☑ plot log10 data Print

☑ semi-log plot Print

☐ hide observed values

DATA SELECTION

scenario: phase4

file name: YM4_6620_0003

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

	observed	simulated
n	4048	4048
min	7.3 0.863323	8.59 0.933993
mean	545.653 2.47674	583.611 2.47883
median	352 2.54654	331 2.51983
max	7780 3.89098	5820 3.76492
variance	389109 0.273734	464305 0.300902
JB test	0 0	0 0

	raw	log10
% rel.bias	6.95644	0.0843482
err.var.	187942	0.100161
rel.std.err	0.483007	0.365906
mod.eff	0.516993	0.634094

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

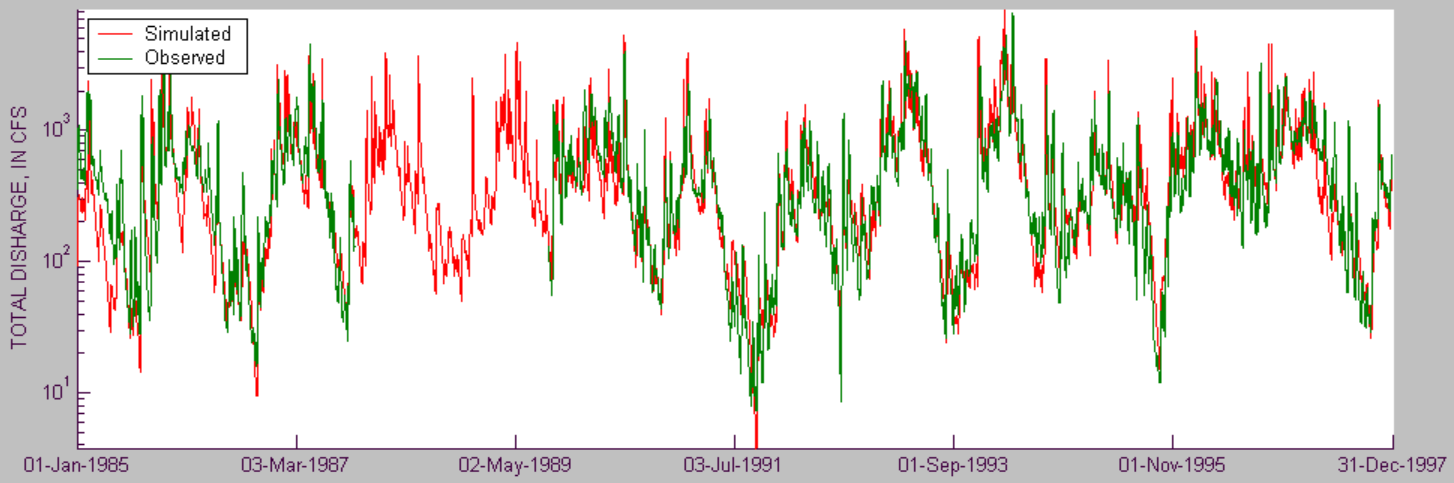
Save as PDF file

CAL5 Version 1.2

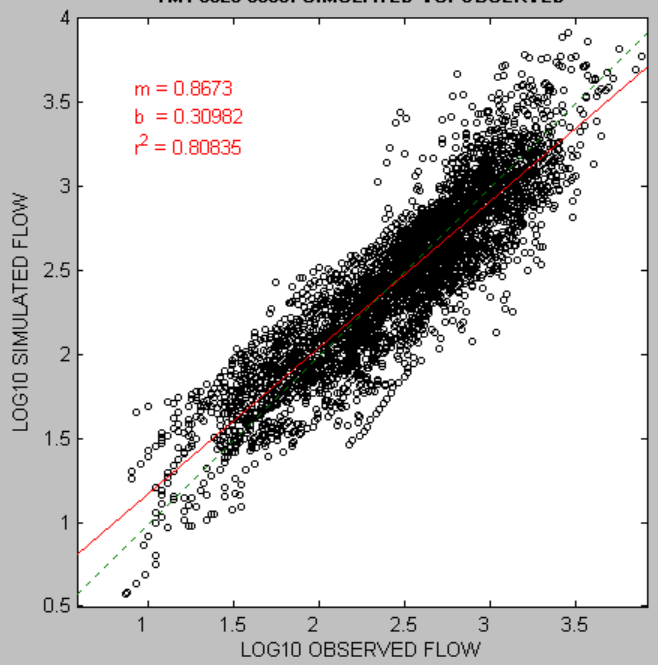
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print

: FLOW TIME-SERIES

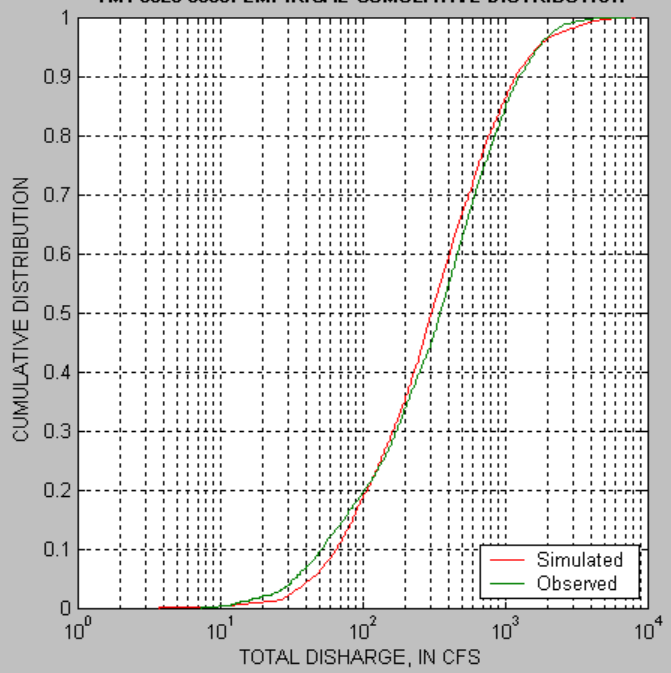


YM4-6620-0003: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

YM4-6620-0003: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario	file name
apr04	YM4_6620_0003

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

	observed	simulated
n	4048	4048
min	7.3 0.863323	3.7856 0.578135
mean	545.653 2.47674	536.038 2.45789
median	352 2.54654	307.41 2.48772
max	7780 3.89098	8320.4 3.92014
variance	389109 0.273734	532687 0.254721
JB test	0 0	0 6.93704e-006

	raw	log10
% rel.bias	-1.76214	-0.76139
err.var.	228023	0.0539938
rel.std.err	0.586014	0.197249
mod.eff	0.413986	0.802751

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

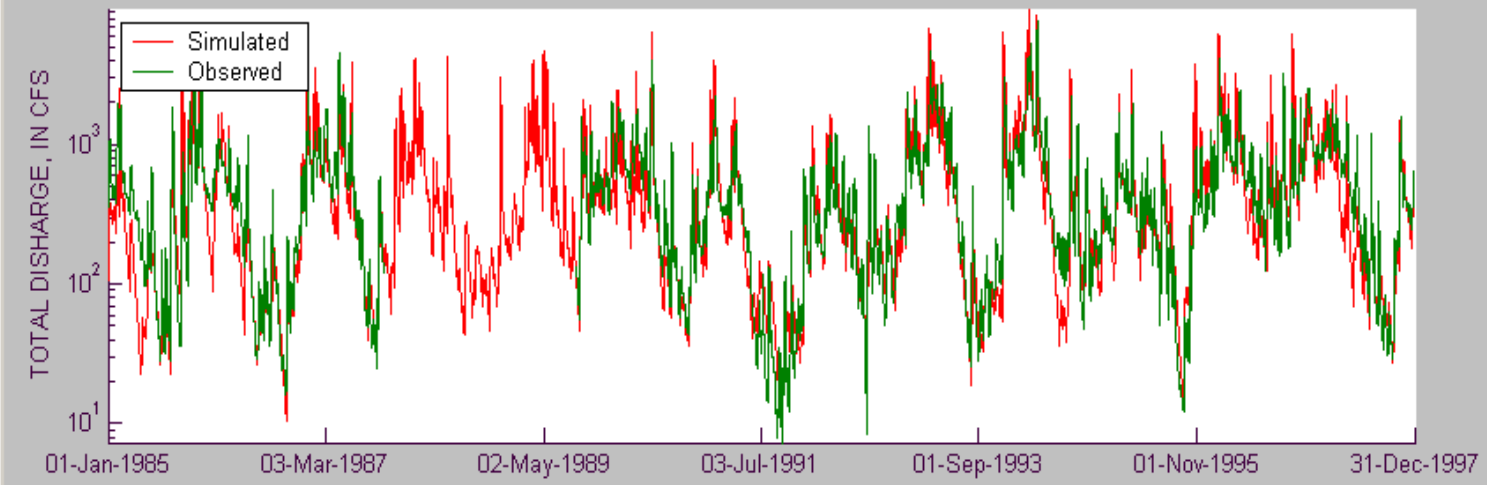
Save as PDF file

CAL5 Version 1.3

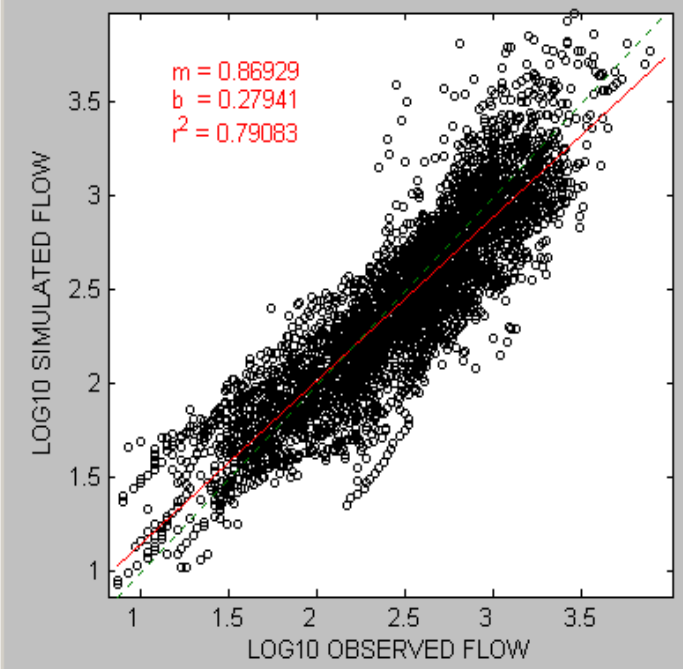
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

: FLOW TIME-SERIES

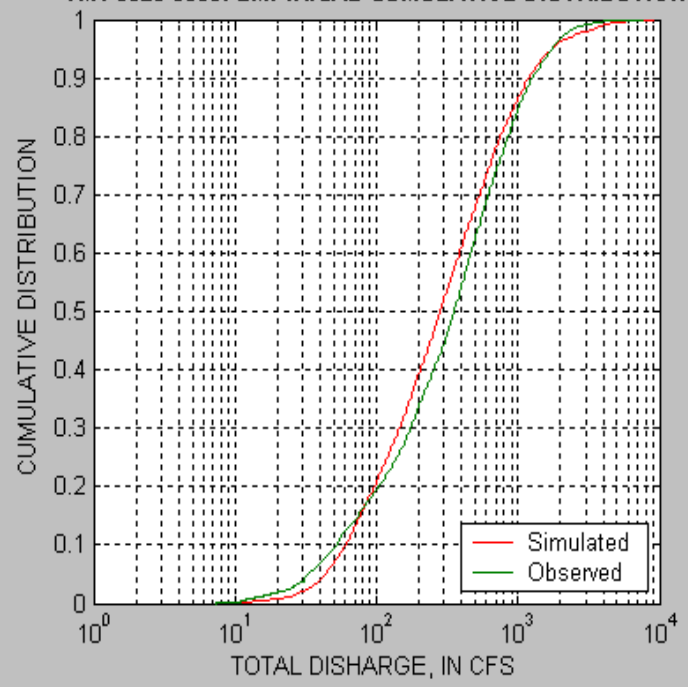


YM4-6620-0003: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

YM4-6620-0003: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario	file name
cut2	YM4_6620_0003

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4048	4048
	observed	simulated
min	7.3 0.863323	8.519 0.930389
mean	545.653 2.47674	528.067 2.43243
median	352 2.54654	281.025 2.44874
max	7780 3.89098	9407.1 3.97346
variance	389109 0.273734	593989 0.261564
JB test	0 0	0 3.73767e-006
	raw	log10
% rel.bias	-3.22292	-1.78933
err.var.	278428	0.0613526
rel.std.err	0.715552	0.224132
mod.eff	0.284448	0.775868

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

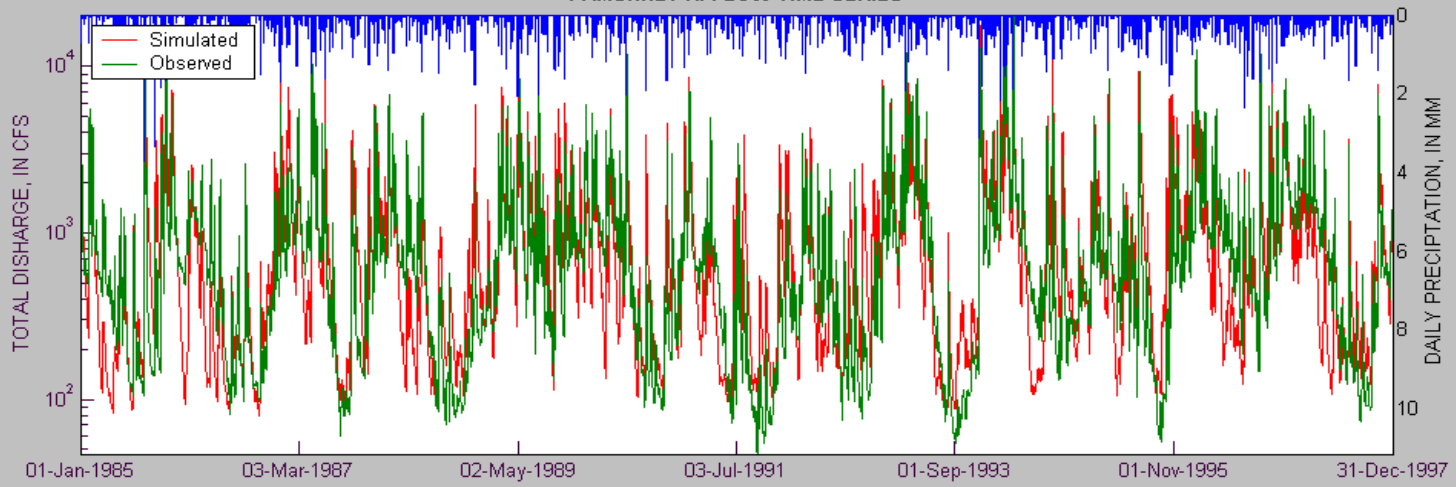
CAL5 Version 1.6

cal5

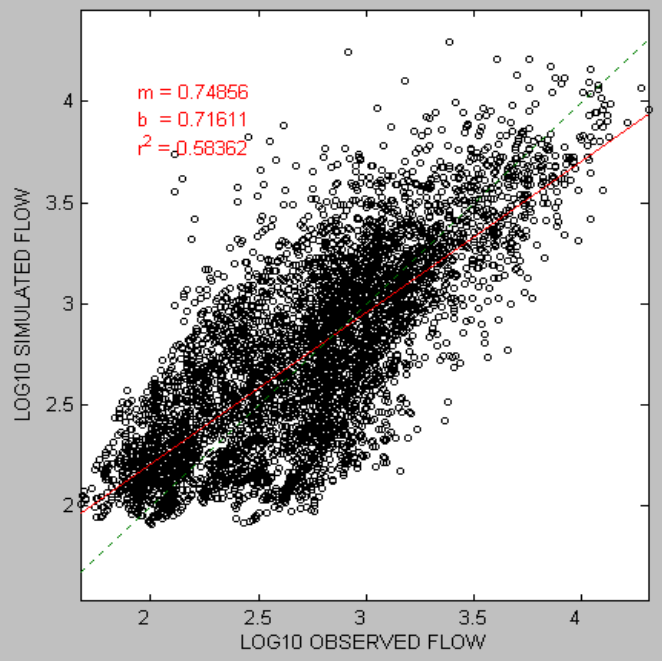
☐ hide precipitation ☐ hide observed values ☑ y-axis log-scale

Examine Print

PAMUNKEY R: FLOW TIME-SERIES



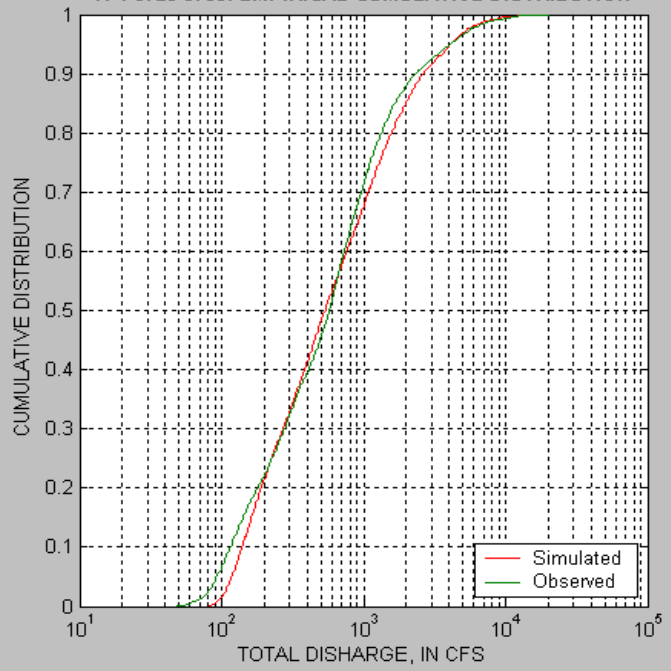
YP4-6720-6750: SIMULATED VS. OBSERVED



☑ plot log10 data

Print

YP4-6720-6750: EMPIRICAL CUMULATIVE DISTRIBUTION



☑ semi-log plot

☐ hide observed values

Print

DATA SELECTION

scenario	file name
phase4	YP4_6720_6750

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	47 1.6721	80.3 1.90472
mean	1053.69 2.73288	1102.17 2.76184
median	575 2.75967	535.5 2.72876
max	20400 4.30963	19800 4.29667
variance	2.59806e+006 0.241866	2.49068e+006 0.232219
JB test	0 2.22045e-016	0 0
	raw	log10
% rel.bias	4.60121	1.05974
err.var.	1.43407e+006	0.112821
rel.std.err	0.551977	0.466459
mod.eff	0.448023	0.533541

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

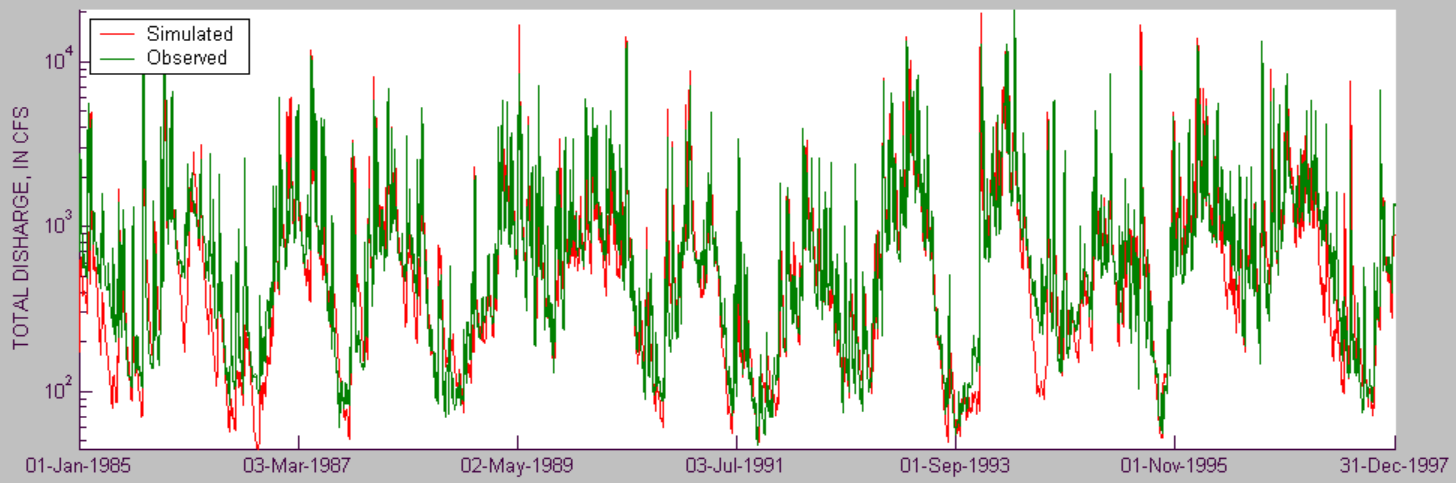
Save as PDF file

CAL5 Version 1.2

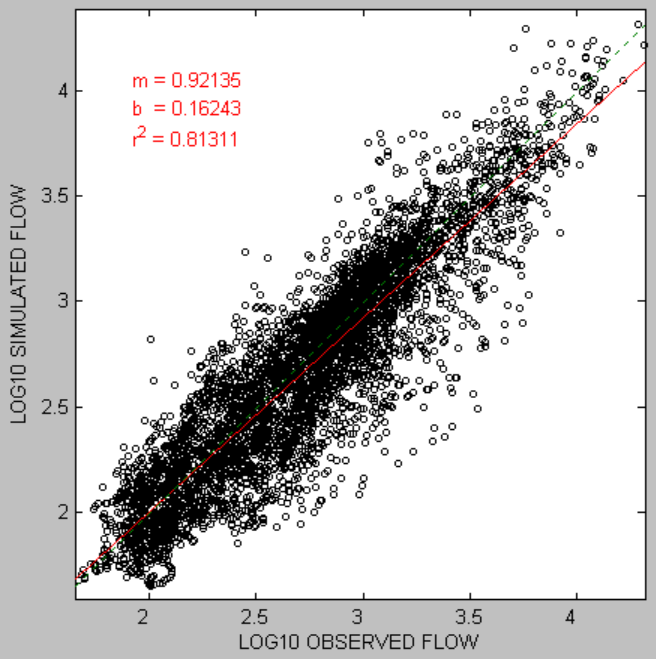
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print

PAMUNKEY R: FLOW TIME-SERIES

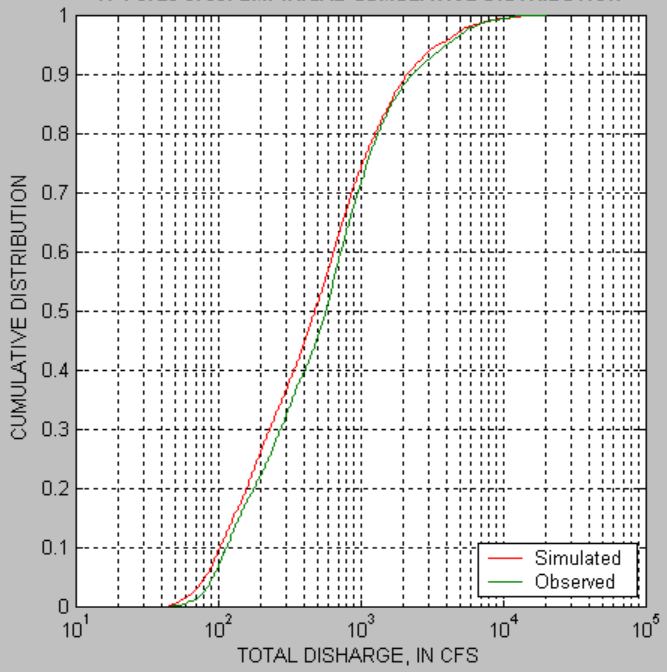


YP4-6720-6750: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

YP4-6720-6750: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario: apr04

file name: YP4_6720_6750

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	47 1.6721	44.872 1.65198
mean	1053.69 2.73288	972.556 2.68035
median	575 2.75967	479.775 2.68104
max	20400 4.30963	20680 4.31555
variance	2.59806e+006 0.241866	2.58517e+006 0.252506
JB	0	0

variance of current observed data set (log10)

	raw	log10
% rel.bias	-7.7	-1.92189
err.var.	684137	0.0514463
rel.std.err	0.263326	0.212706
mod.eff	0.736674	0.787294

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

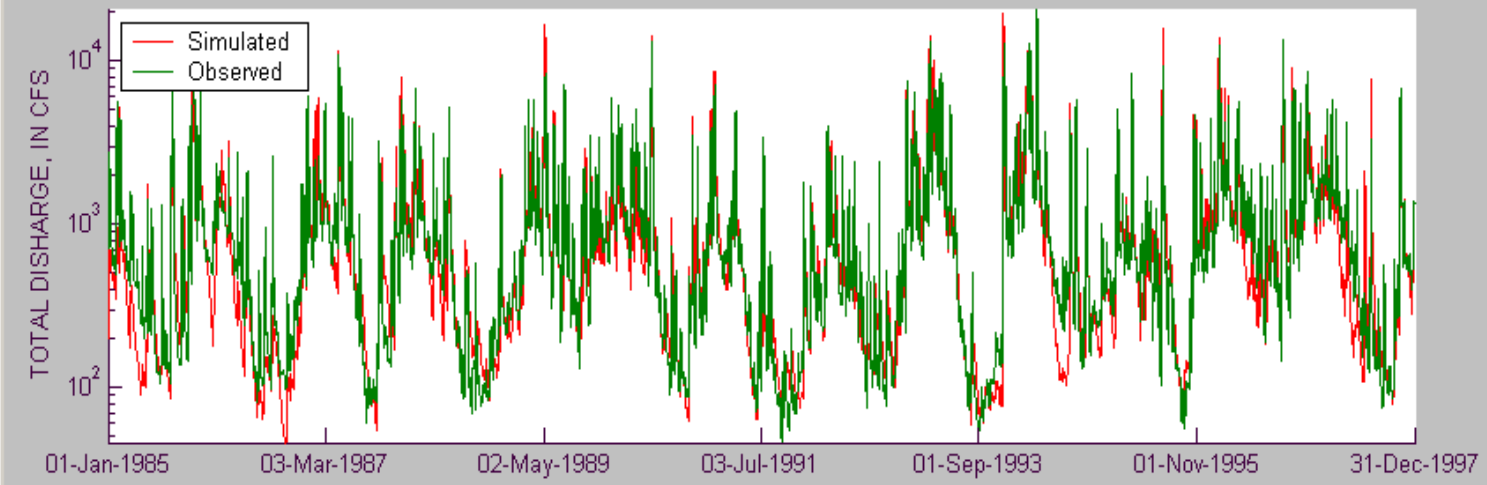
Save as PDF file

CAL5 Version 1.3

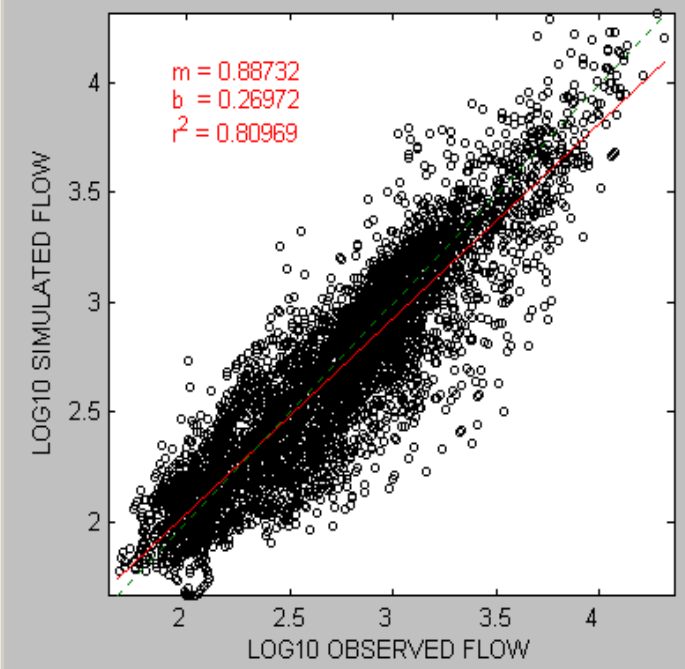
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

PAMUNKEY R: FLOW TIME-SERIES

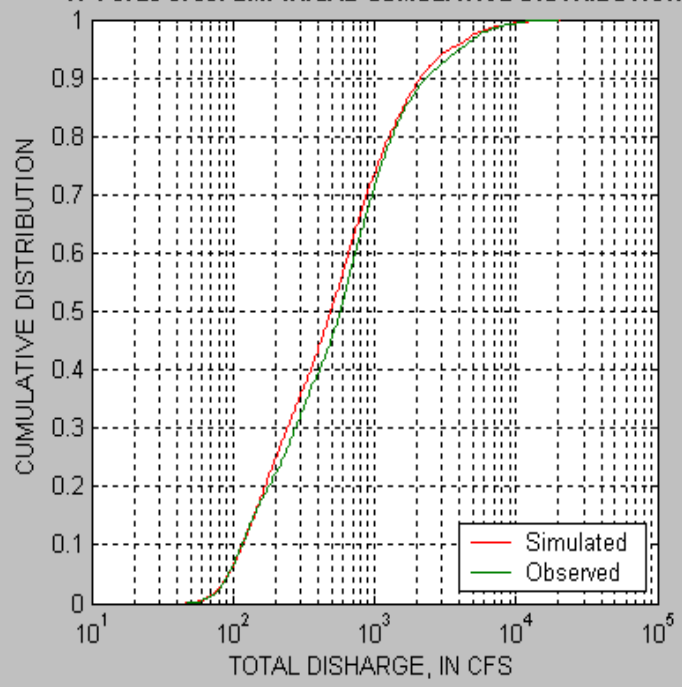


YP4-6720-6750: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

YP4-6720-6750: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario	file name
cut2	YP4_6720_6750

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	47 1.6721	45.945 1.66224
mean	1053.69 2.73288	969.081 2.69467
median	575 2.75967	488.705 2.68905
max	20400 4.30963	20784 4.31773
variance	2.59806e+006 0.241866	2.48188e+006 0.23519
JB test	0 2.22045e-016	0 0
	raw	log10
% rel.bias	-8.0298	-1.39817
err.var.	715157	0.0492895
rel.std.err	0.275265	0.203788
mod.eff	0.724735	0.796212

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

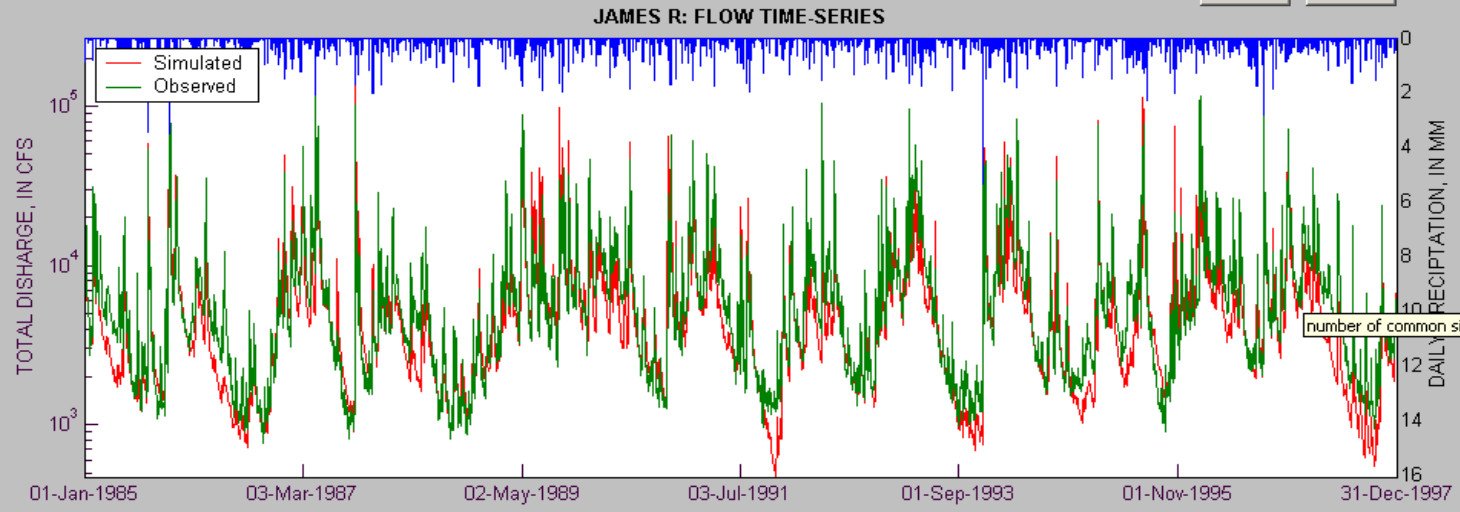
Seasonal Box Plots

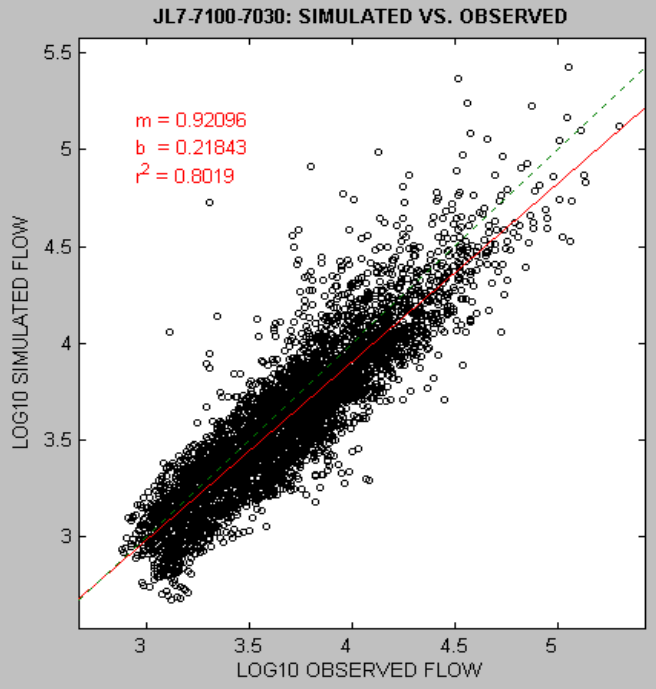
C-Q scatter plot

CAL5 Version 1.6

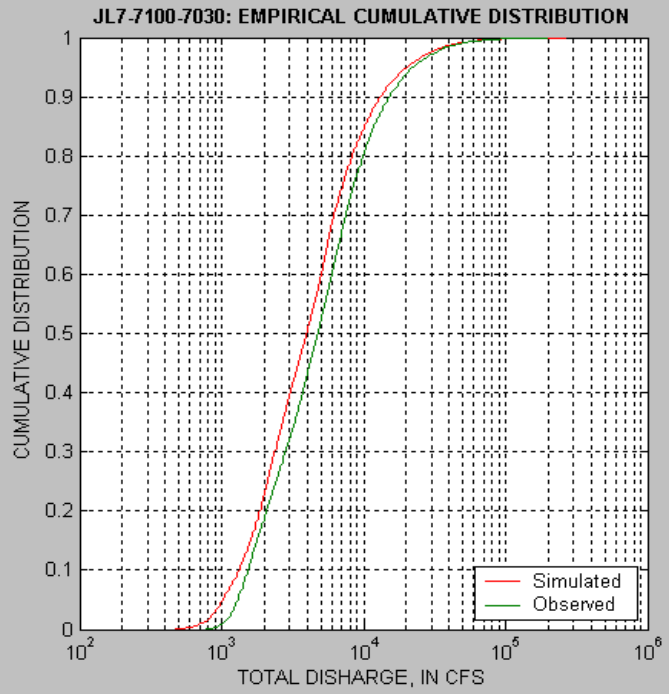
cal5

hide precipitation | hide observed values | y-axis log-scale | Examine | Print





plot log10 data | Print



semi-log plot | hide observed values | Print

DATA SELECTION

scenario: phase4

file name: JL7_7100_7030

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

	raw	log10
n	4748	4748
min	2.88252	2.6721
mean	7508.1 3.68464	6649.67 3.61182
median	4760 3.67761	3980 3.59988
max	199000 5.29885	268000 5.42813
variance	1.04506e+008 0.147315	1.209e+008 0.155813
JB test	0 0	0 0
% rel.bias	-11.4334	-1.97628
err.var.	5.86972e+007	0.0370899
rel.std.err	0.561666	0.251773
mod.eff	0.438334	0.748227

number of common simulated and observed raw data points in current data set

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

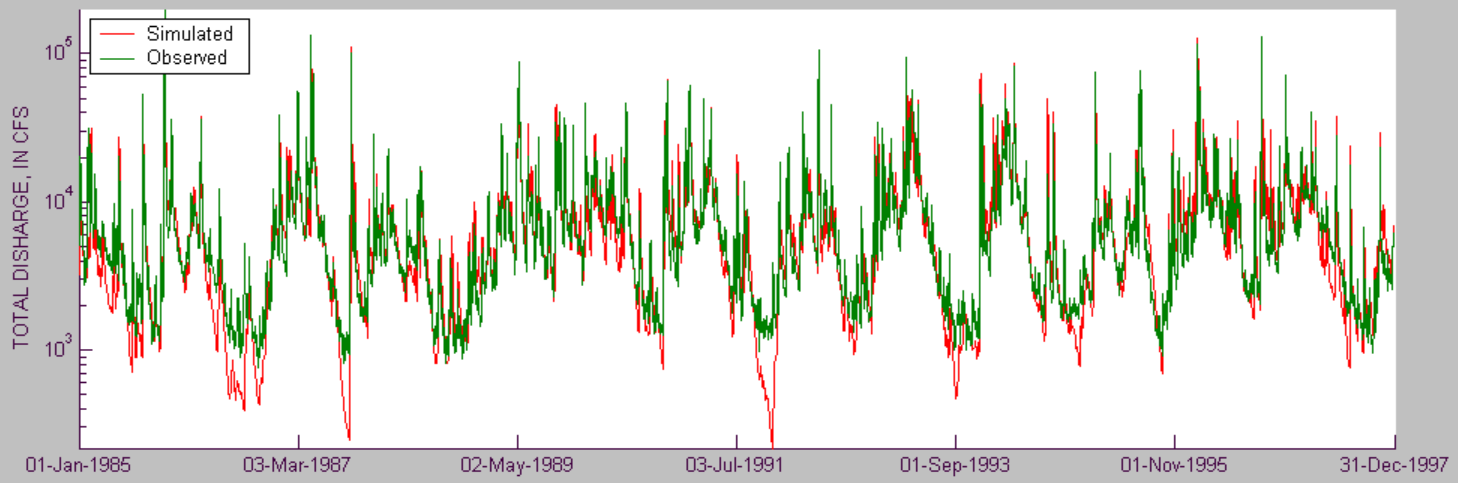
Save as PDF file

CAL5 Version 1.2

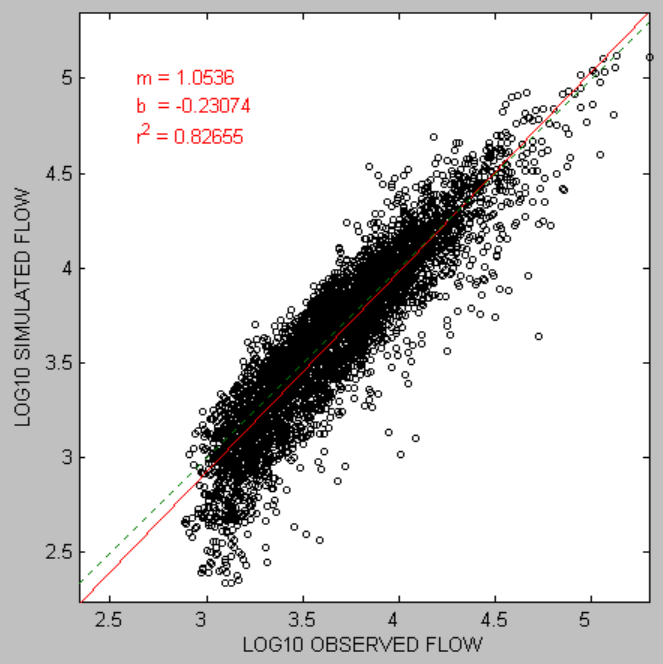
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print

JAMES R: FLOW TIME-SERIES

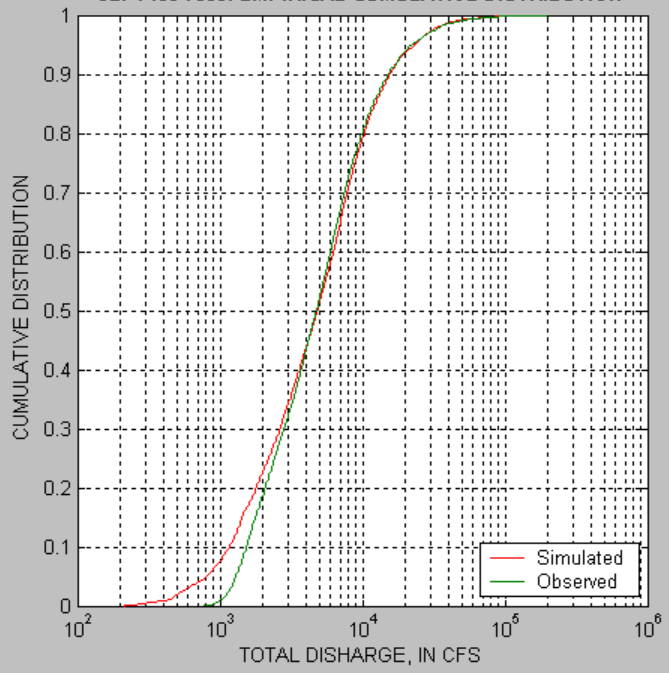


JL7-7100-7030: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

JL7-7100-7030: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values | Examine | Print

DATA SELECTION

scenario	file name
apr04	JL7_7100_7030

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	763 2.88252	216.97 2.3364
mean	7508.1 3.68464	7455.37 3.65125
median	4760 3.67761	4839 3.68476
max	199000 5.29885	131710 5.11962
variance	1.04506e+008 0.147315	9.42459e+007 0.197832
JB test	0 0	0 0.0153013
	raw	log10
% rel.bias	-0.702321	-0.906296
err.var.	2.32283e+007	0.0358517
rel.std.err	0.222269	0.243368
mod.eff	0.777731	0.756632

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

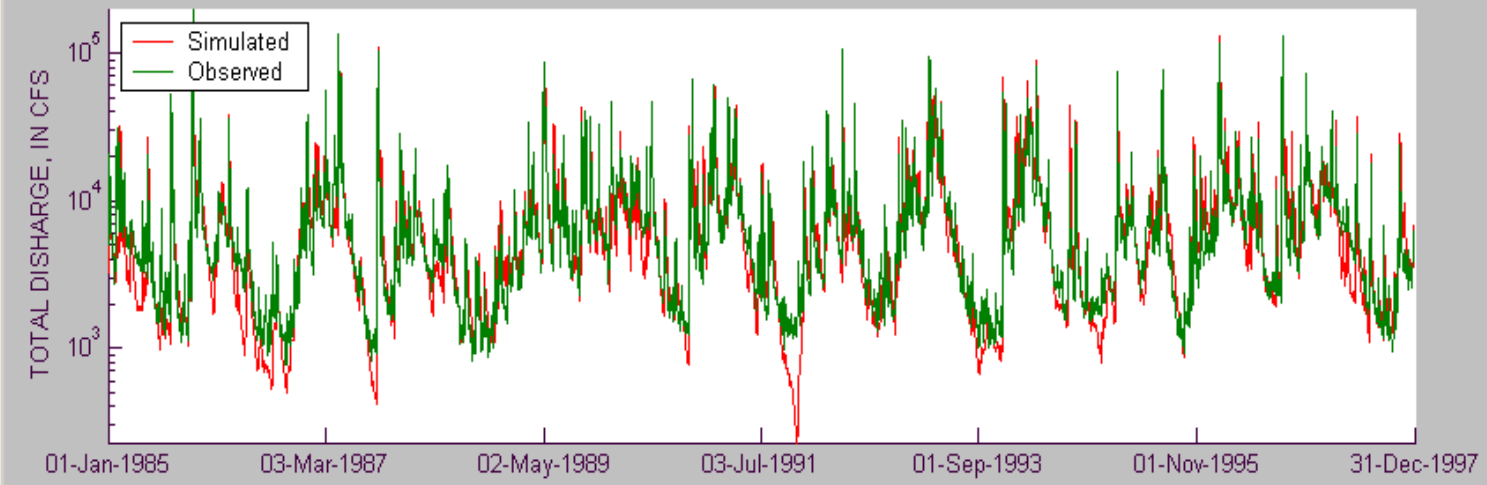
Save as PDF file

CAL5 Version 1.3

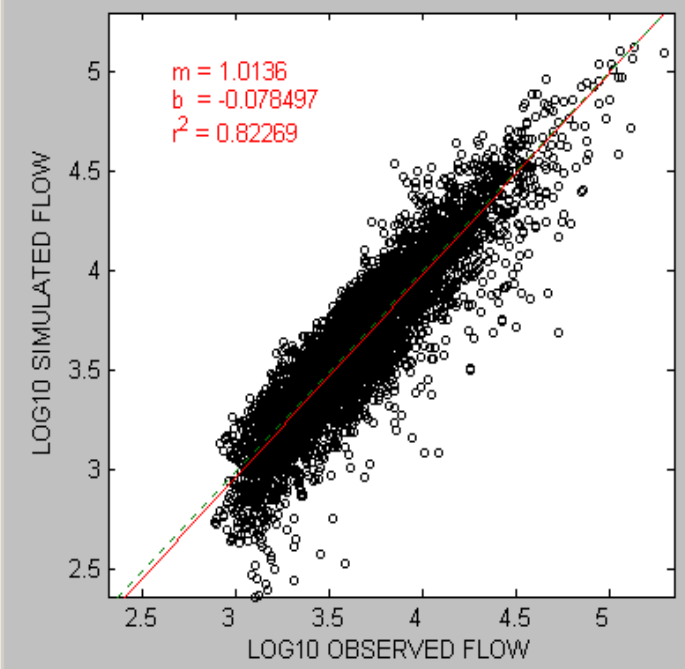
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

JAMES R: FLOW TIME-SERIES

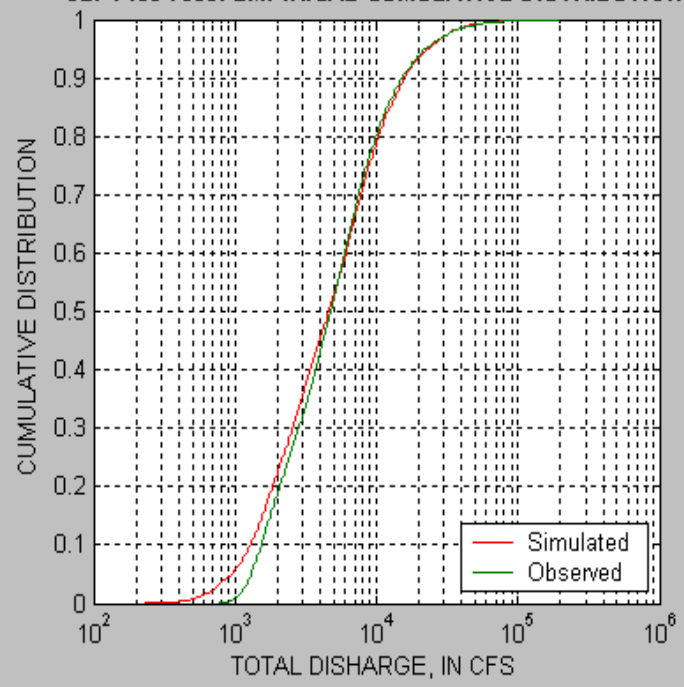


JL7-7100-7030: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

JL7-7100-7030: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario	file name
cut2	JL7_7100_7030

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	763 2.88252	228.85 2.35955
mean	7508.1 3.68464	7462.52 3.65627
median	4760 3.67761	4584.85 3.66133
max	199000 5.29885	132540 5.12235
variance	1.04506e+008 0.147315	9.57901e+007 0.18397
JB test	0 0	0 0.000130455
	raw	log10
% rel.bias	-0.607101	-0.769922
err.var.	2.52586e+007	0.0334522
rel.std.err	0.241696	0.22708
mod.eff	0.758304	0.77292

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

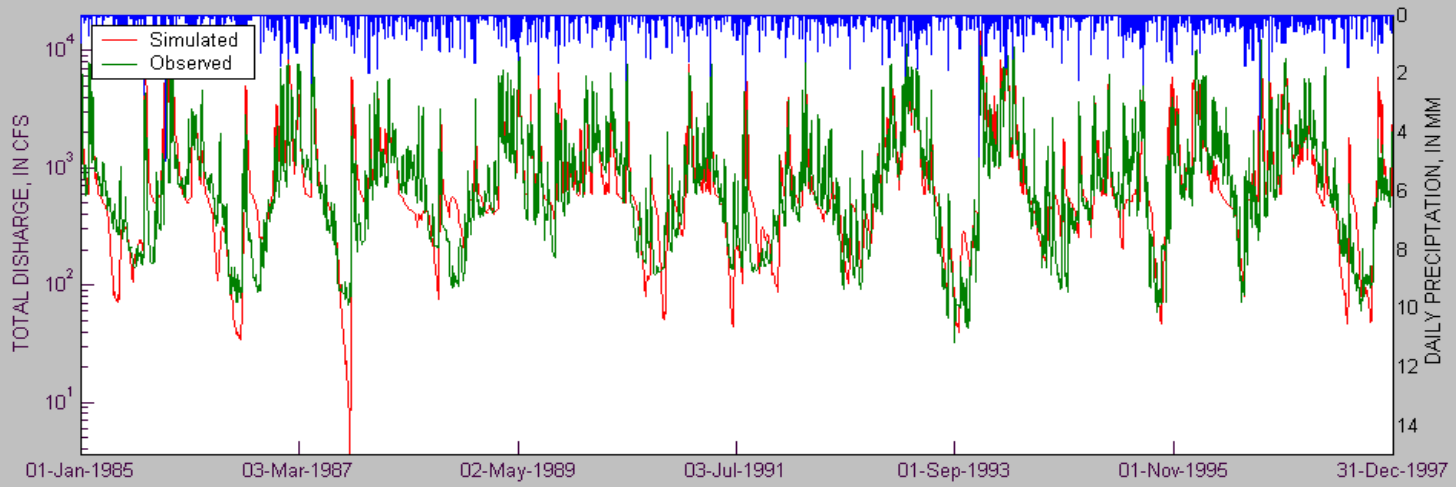
CAL5 Version 1.6

cal5

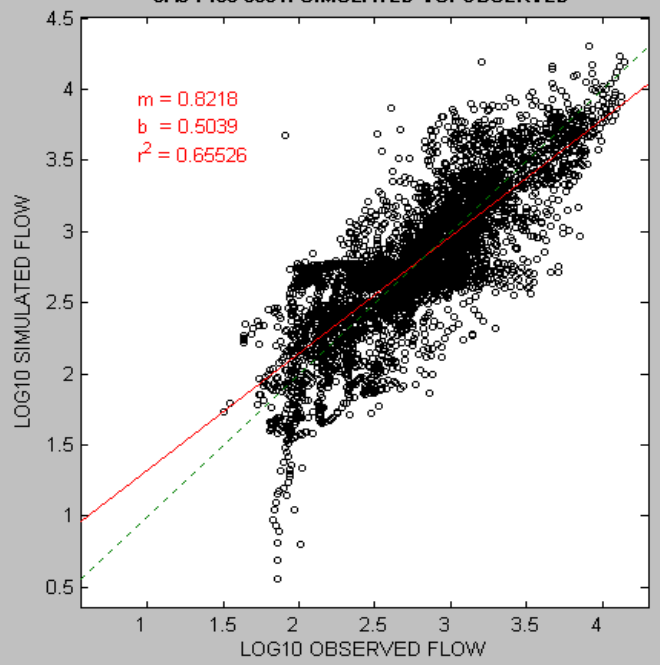
☐ hide precipitation ☐ hide observed values ☑ y-axis log-scale

Examine Print

GEORGE F. BRASFIELD DAM: FLOW TIME-SERIES



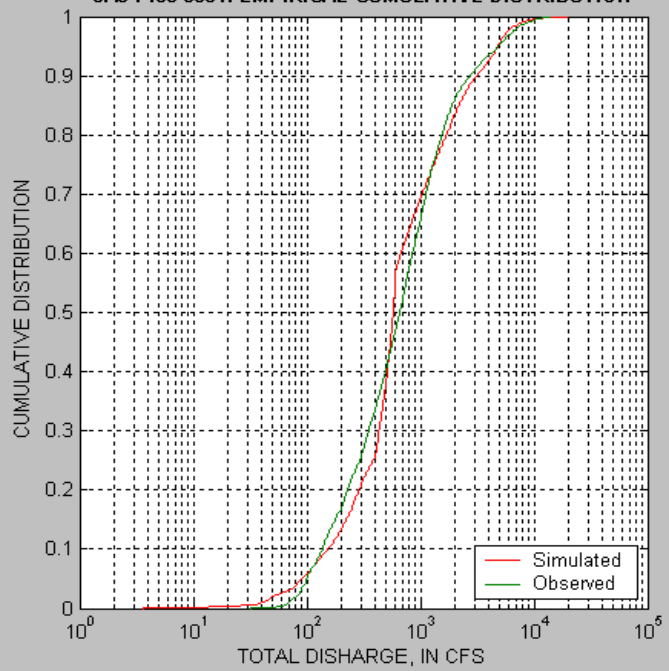
JA5-7480-0001: SIMULATED VS. OBSERVED



☑ plot log10 data

Print

JA5-7480-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



☑ semi-log plot

☐ hide observed values

Print

DATA SELECTION

scenario: phase4

file name: JA5_7480_0001

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	32 1.50515	3.62 0.558709
mean	1203.08 2.80466	1211.3 2.80877
median	661.5 2.82053	577 2.76118
max	14100 4.14922	20100 4.3032
variance	2.86727e+006 0.236802	2.81198e+006 0.244066
JB test	0 6.14947e-009	0 2.89668e-012
	raw	log10
% rel.bias	0.683713	0.146642
err.var.	1.25022e+006	0.0916765
rel.std.err	0.436031	0.387144
mod.eff	0.563969	0.612856

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

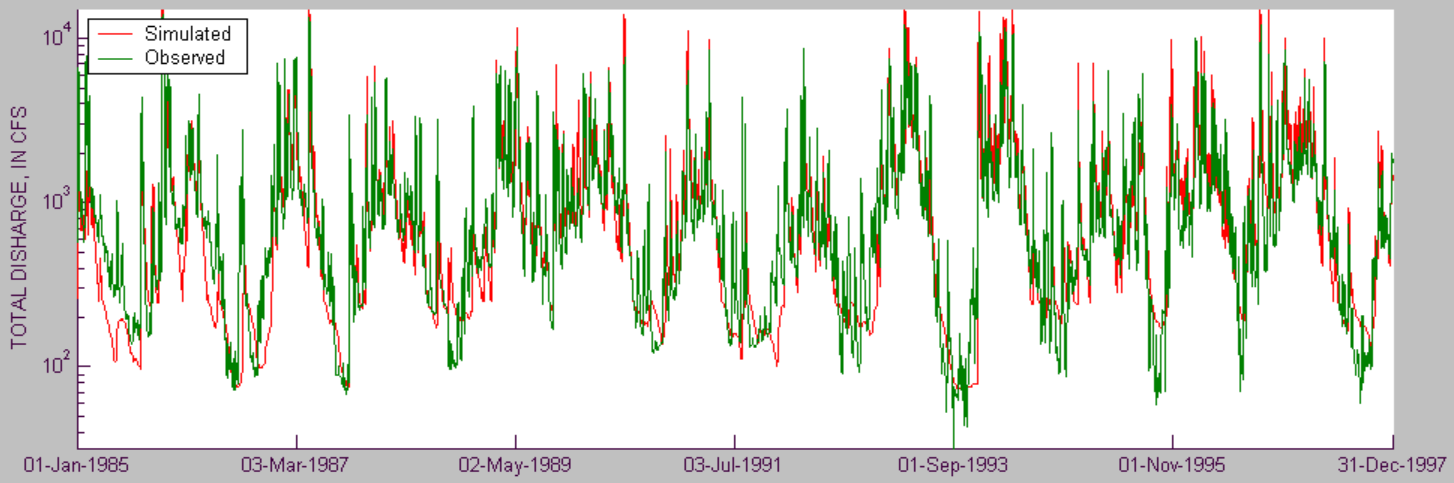
Save as PDF file

CAL5 Version 1.2

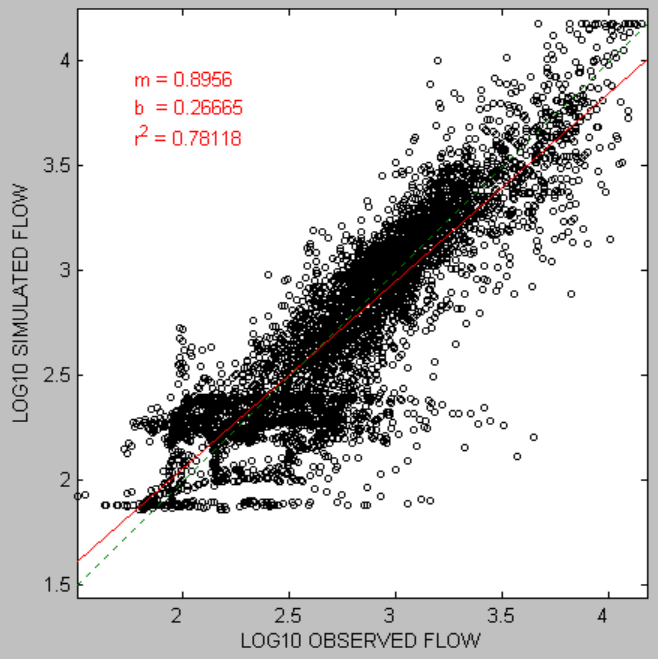
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print

GEORGE F. BRASFIELD DAM: FLOW TIME-SERIES

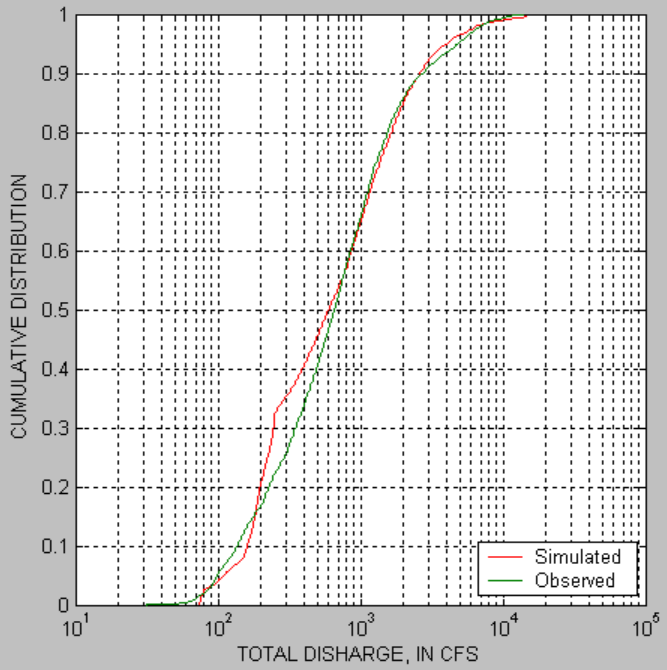


JA5-7480-0001: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

JA5-7480-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values | Examine | Print

DATA SELECTION

scenario	file name
apr04	JA5_7480_0001

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	32 1.50515	72.879 1.8626
mean	1203.08 2.80466	1177.06 2.77849
median	661.5 2.82053	597.92 2.77664
max	14100 4.14922	15028 4.1769
variance	2.86727e+006 0.236802	3.26183e+006 0.243141
JB test	0 6.14947e-009	0 0
	raw	log10
% rel.bias	-2.16288	-0.932794
err.var.	947802	0.0564689
rel.std.err	0.330559	0.238465
mod.eff	0.669441	0.761535

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

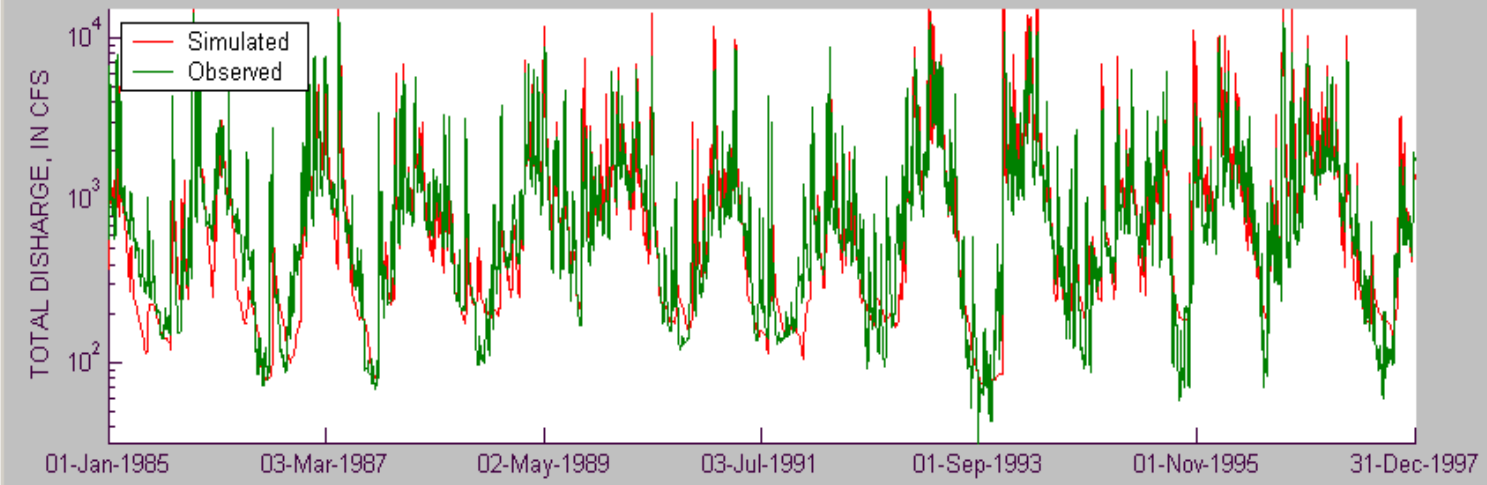
Save as PDF file

CAL5 Version 1.3

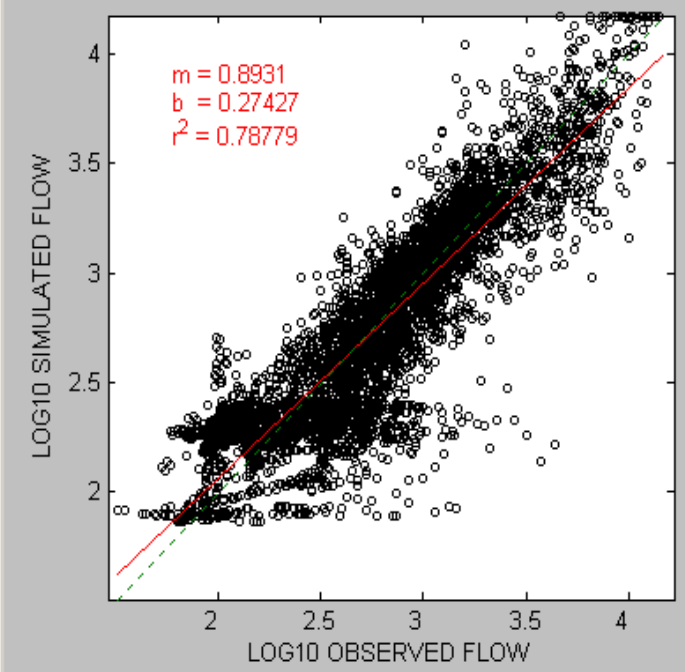
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

GEORGE F. BRASFIELD DAM: FLOW TIME-SERIES

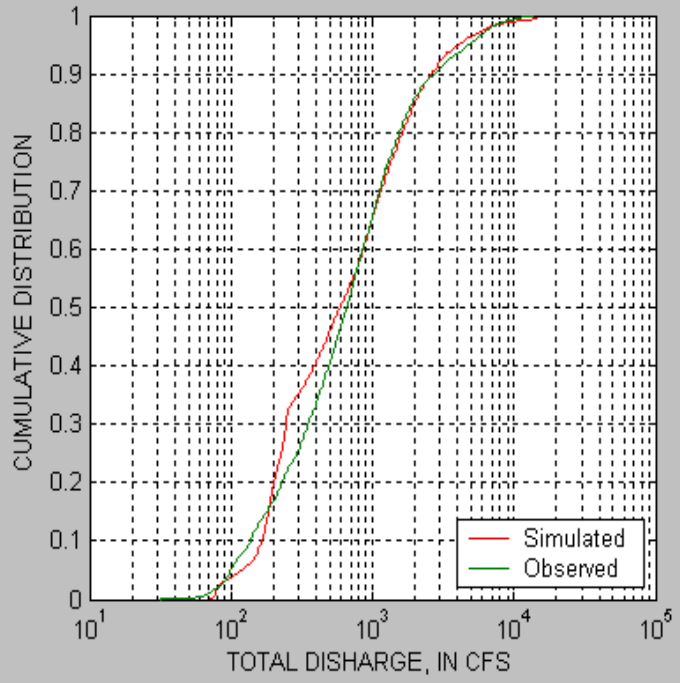


JA5-7480-0001: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

JA5-7480-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario	file name
cut2	JA5_7480_0001

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	32 1.50515	72.218 1.85865
mean	1203.08 2.80466	1178.83 2.77912
median	661.5 2.82053	589.275 2.77032
max	14100 4.14922	15033 4.17705
variance	2.86727e+006 0.236802	3.34056e+006 0.239763
JB test	0 5.14947e-00	0 0
	raw	log10
% rel.bias	-2.01525	-0.910349
err.var.	948853	0.0542389
rel.std.err	0.330926	0.229048
mod.eff	0.669074	0.770952

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

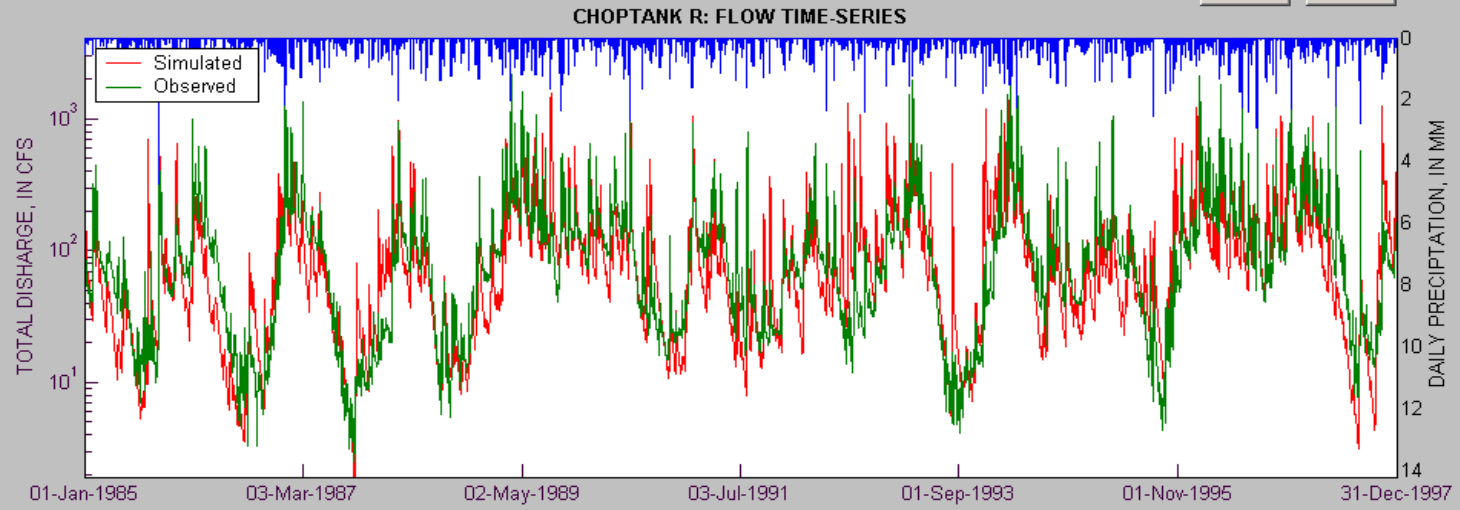
C-Q scatter plot

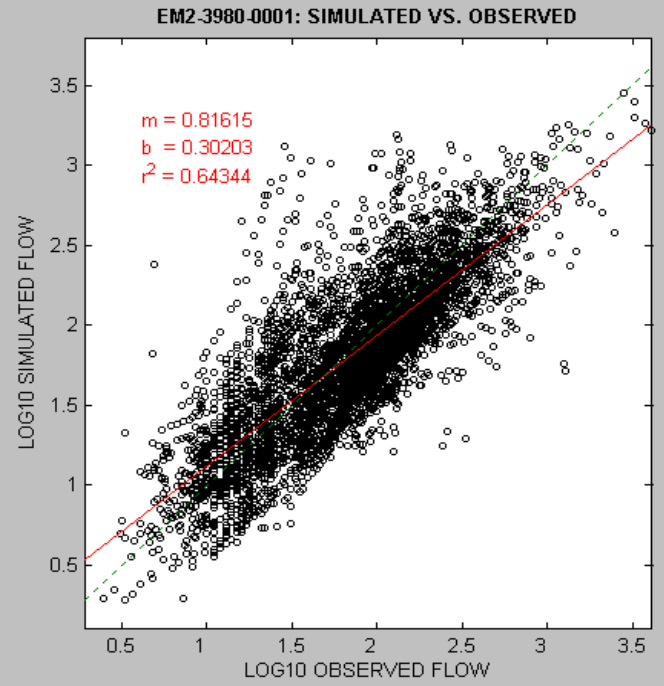
CAL5 Version 1.6

cal5

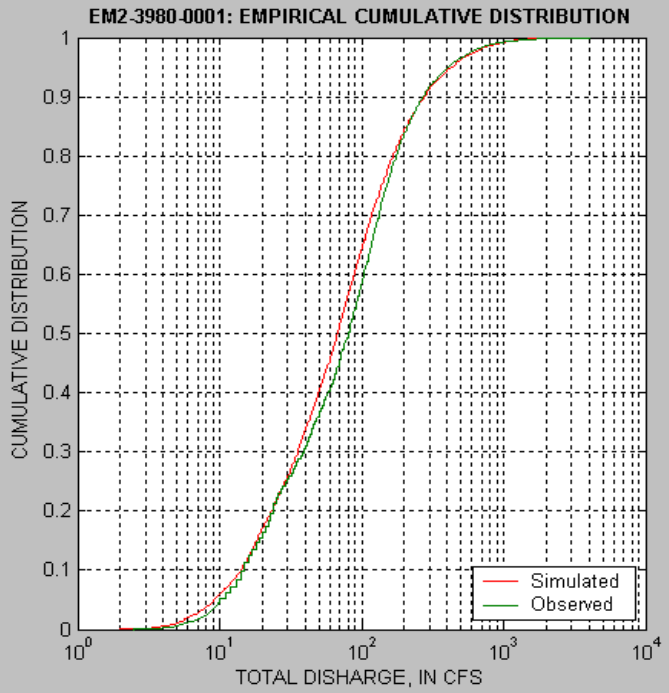
☐ hide precipitation ☐ hide observed values ☑ y-axis log-scale

Examine Print





☑ plot log10 data Print



☑ semi-log plot Print

☐ hide observed values

DATA SELECTION

scenario: phase4

file name: EM2_3980_0001

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4748
	observed	simulated
min	2.5 0.39794	1.92 0.283301
mean	130.233 1.84653	123.208 1.80908
median	81 1.90849	67.75 1.83091
max	4120 3.6149	2830 3.45179
variance	42286 0.241602	33510.8 0.250112
JB test	0 2.68177e-005	0 0.0197764
	raw	log10
% rel.bias	-5.39369	-2.02821
err.var.	23479.9	0.0987499
rel.std.err	0.555264	0.40873
mod.eff	0.444736	0.59127

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

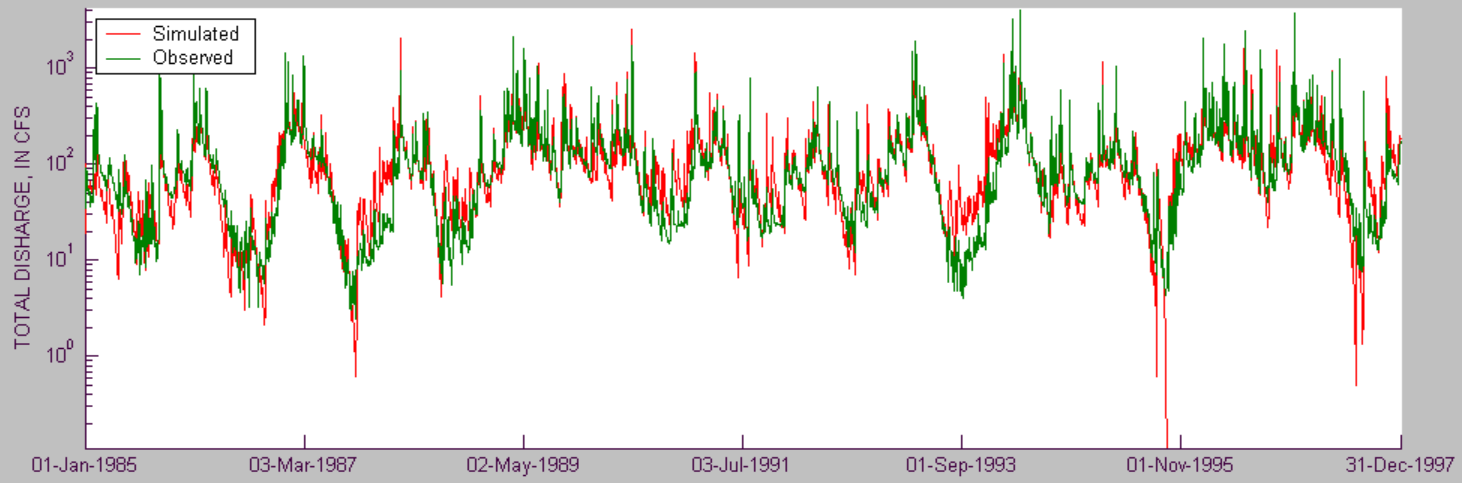
Save as PDF file

CAL5 Version 1.2

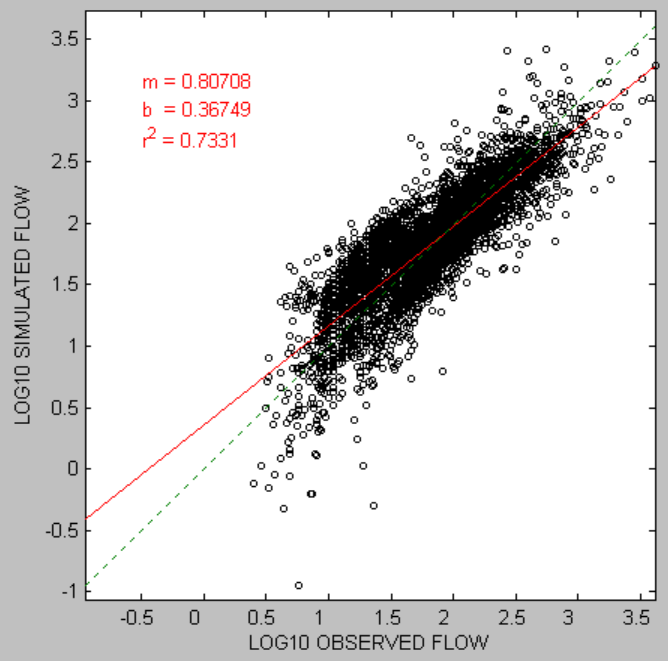
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print

CHOPTANK R: FLOW TIME-SERIES

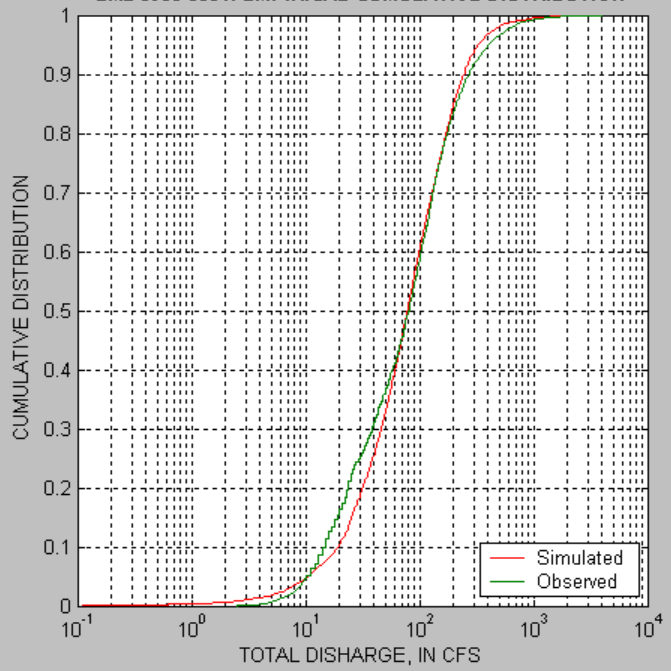


EM2-3980-0001: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

EM2-3980-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario: apr04

file name: EM2_3980_0001

plot data: FLOW - total discharge

min date: 1/1/1985

max date: 12/31/1997

Update Plots and Statistics

STATISTICS

n	4748	4741
	observed	simulated
min	2.5 0.39794	0 -0.95413
mean	130.233 1.84788	119.011 1.85887
median	81 1.90849	78.452 1.8965
max	4120 3.6149	2593.7 3.41392
variance	42286 0.240695	24077.4 0.213865
JB test	0 3.86932e-005	0 0
	raw	log10
% rel.bias	-8.61701	0.595099
err.var.	19815.9	0.0661596
rel.std.err	0.468616	0.274869
mod.eff	0.531384	0.725131

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Print All

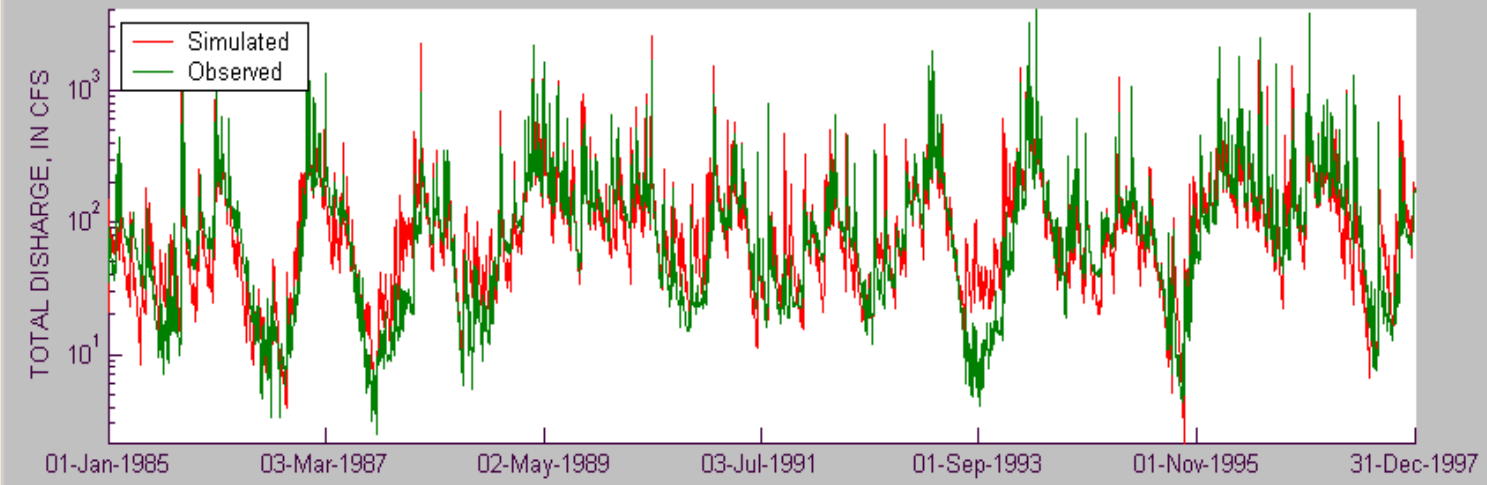
Save as PDF file

CAL5 Version 1.3

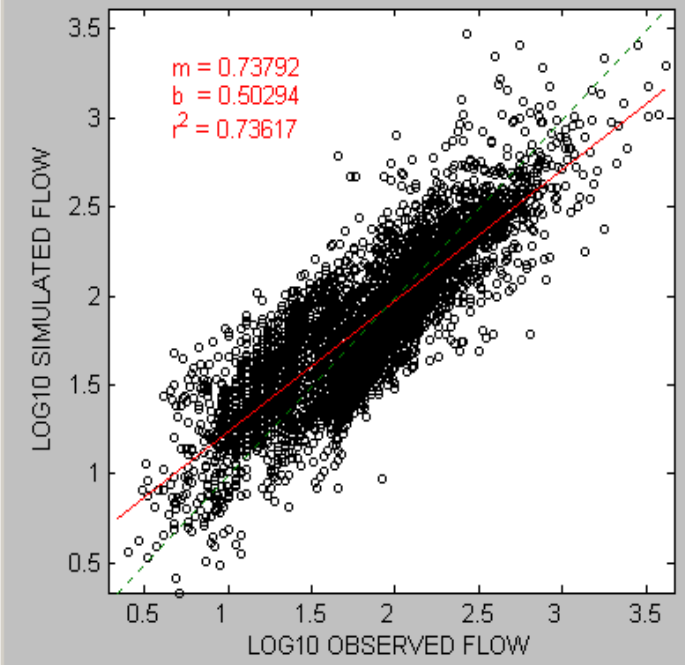
cal5

load precipitation | hide precipitation | hide observed values | y-axis log-scale | Examine | Print | Print All | Save PDF

CHOPTANK R: FLOW TIME-SERIES

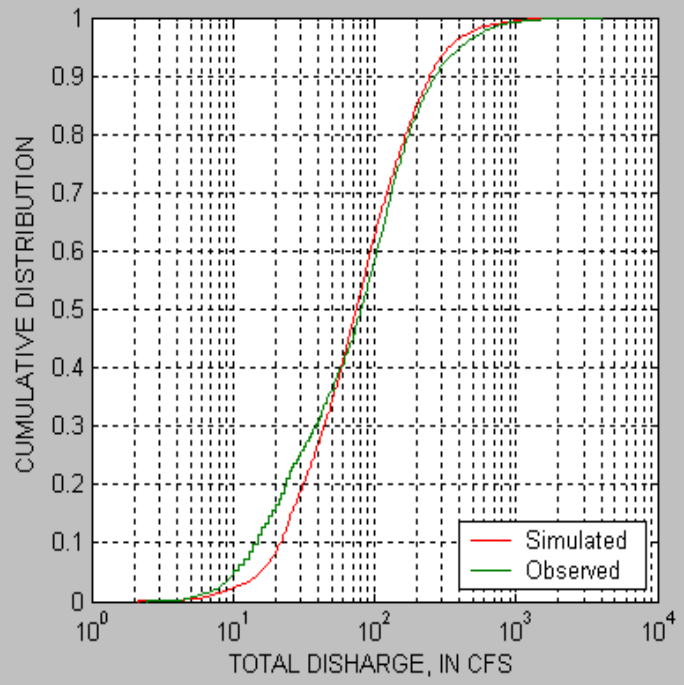


EM2-3980-0001: SIMULATED VS. OBSERVED



plot log10 data | Examine | Print

EM2-3980-0001: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | Examine | Print

hide observed values

DATA SELECTION

scenario	file name
cut2	EM2_3980_0001

plot data: FLOW - total discharge

min date	max date
1/1/1985	12/31/1997

Update Plots and Statistics

STATISTICS

	observed	simulated
n	4748	4748
min	2.5 0.39794	2.1548 0.333407
mean	130.233 1.84653	118.848 1.86554
median	81 1.90849	74.3415 1.87123
max	4120 3.6149	2942.1 3.46866
variance	42286 0.241602	26570.8 0.178708
JB test	0 2.68177e-005	0 0.0745459

	raw	log10
% rel.bias	-8.74153	1.02949
err.var.	20733.4	0.0641039
rel.std.err	0.490313	0.265329
mod.eff	0.509687	0.734671

Residual Plots

Percentile Plots

Daily Accumulation

Individual Monthly Avg's

Accumulated Monthly Avg's

Seasonal Box Plots

C-Q scatter plot

CAL5 Version 1.6