Hydrology Calibration

Phase 5

Phase 5 Topics

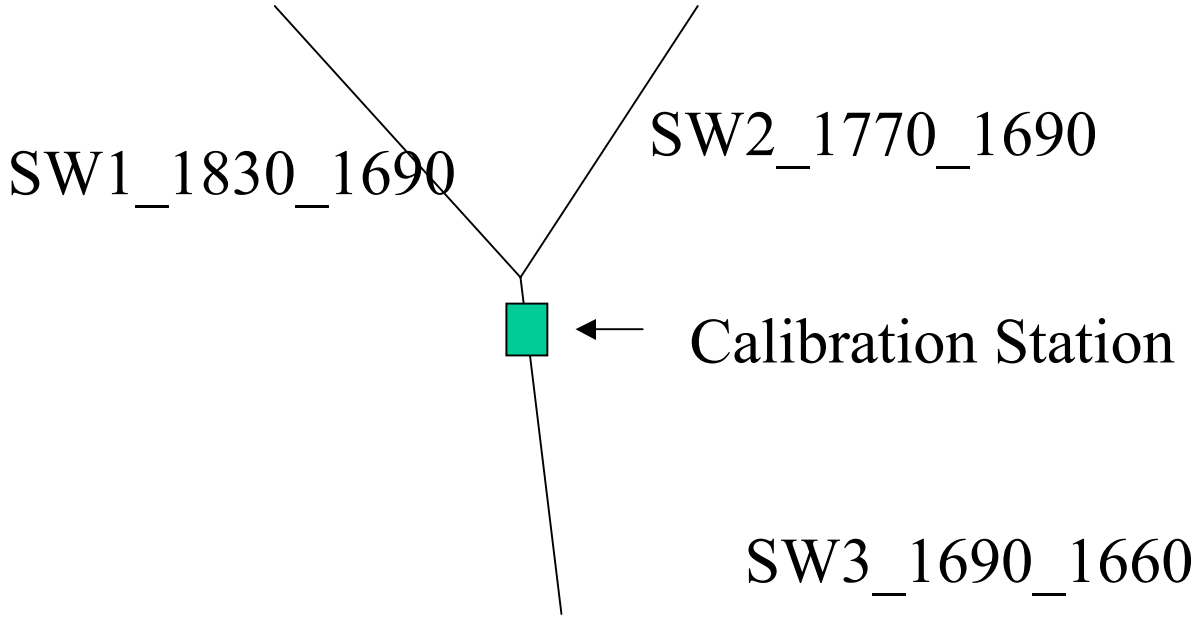
- New developments
- Tests of new data sets
- Starting Point
- Calibration Plan

Still gathering model pieces

- Hydrograph separation
- Reservoirs
- System changes to incorporate stations below a confluence
- Matlab calibration software
- Landuse
- Computer

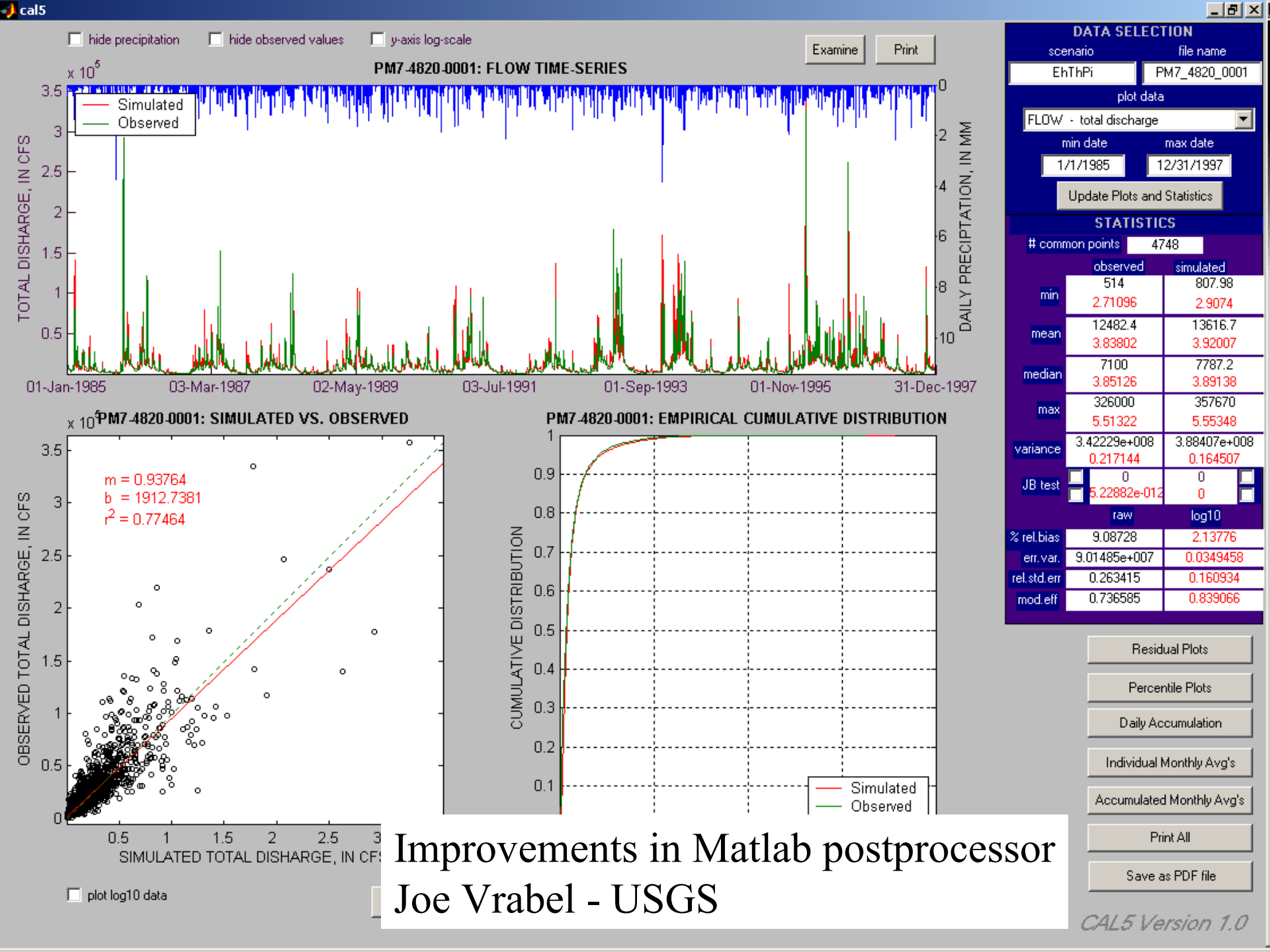
Confluence stations

Code changes in the external transfer module
Code changes in the postprocessor
Changes in the linux scripts



Increased usable Stations by 13%

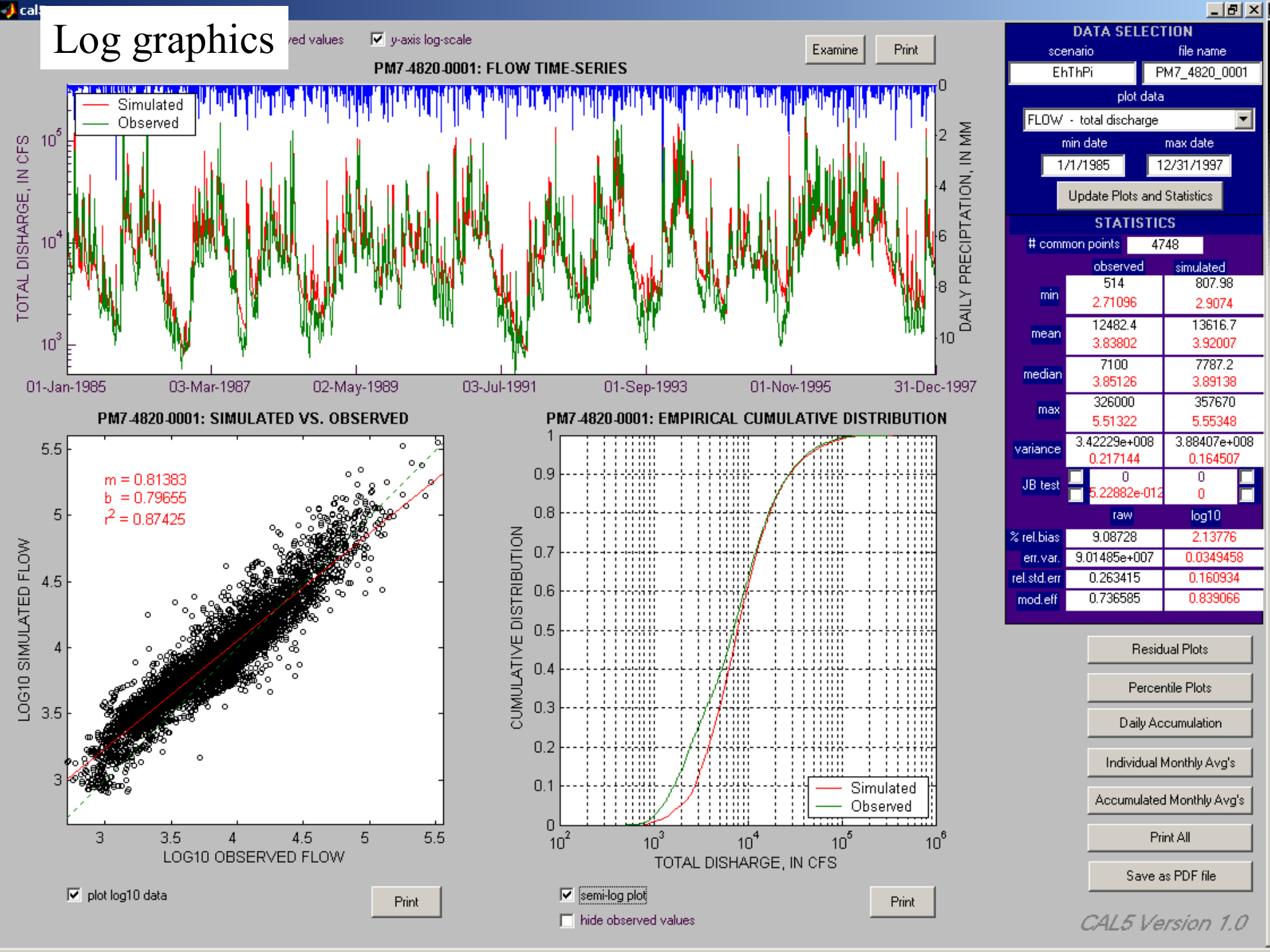
Work done by Sara Brandt



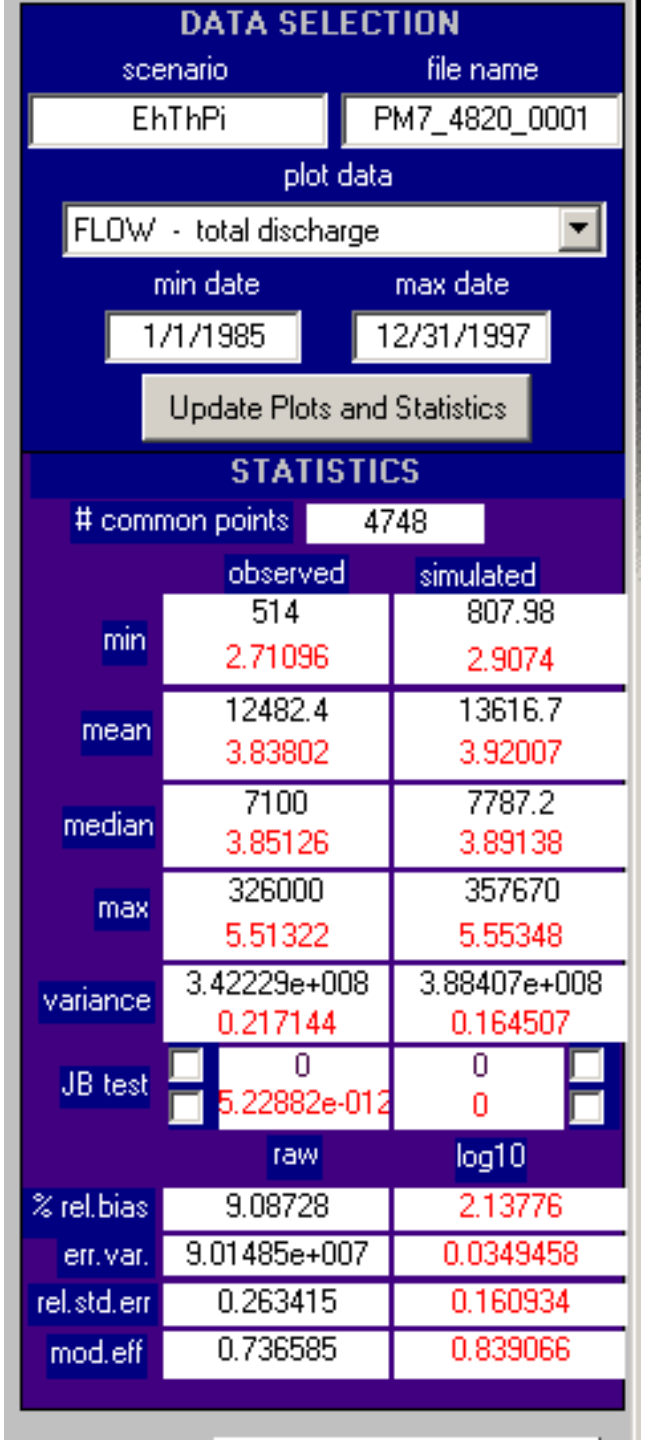
Improvements in Matlab postprocessor

Joe Vrabel - USGS

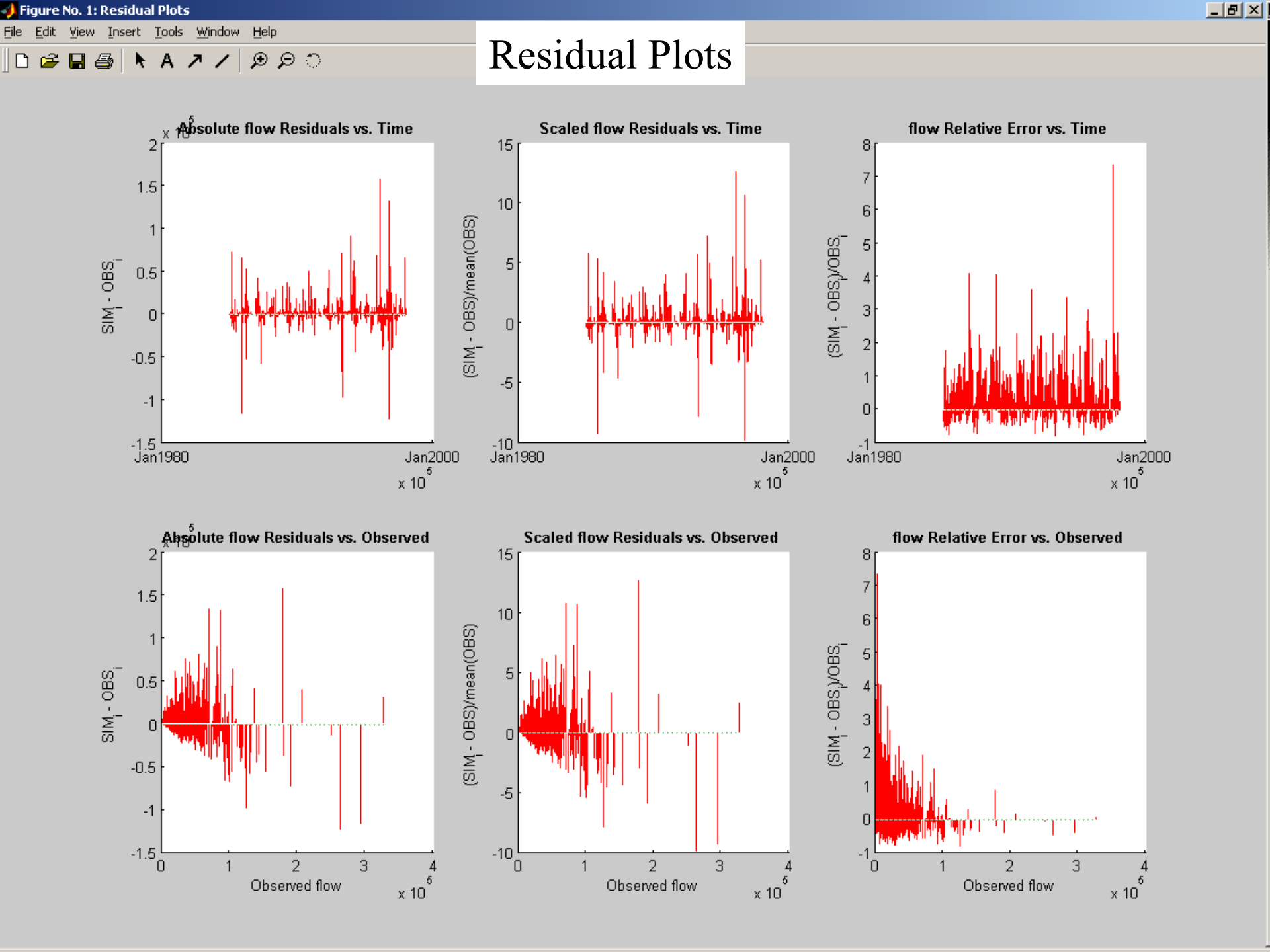
Log graphics



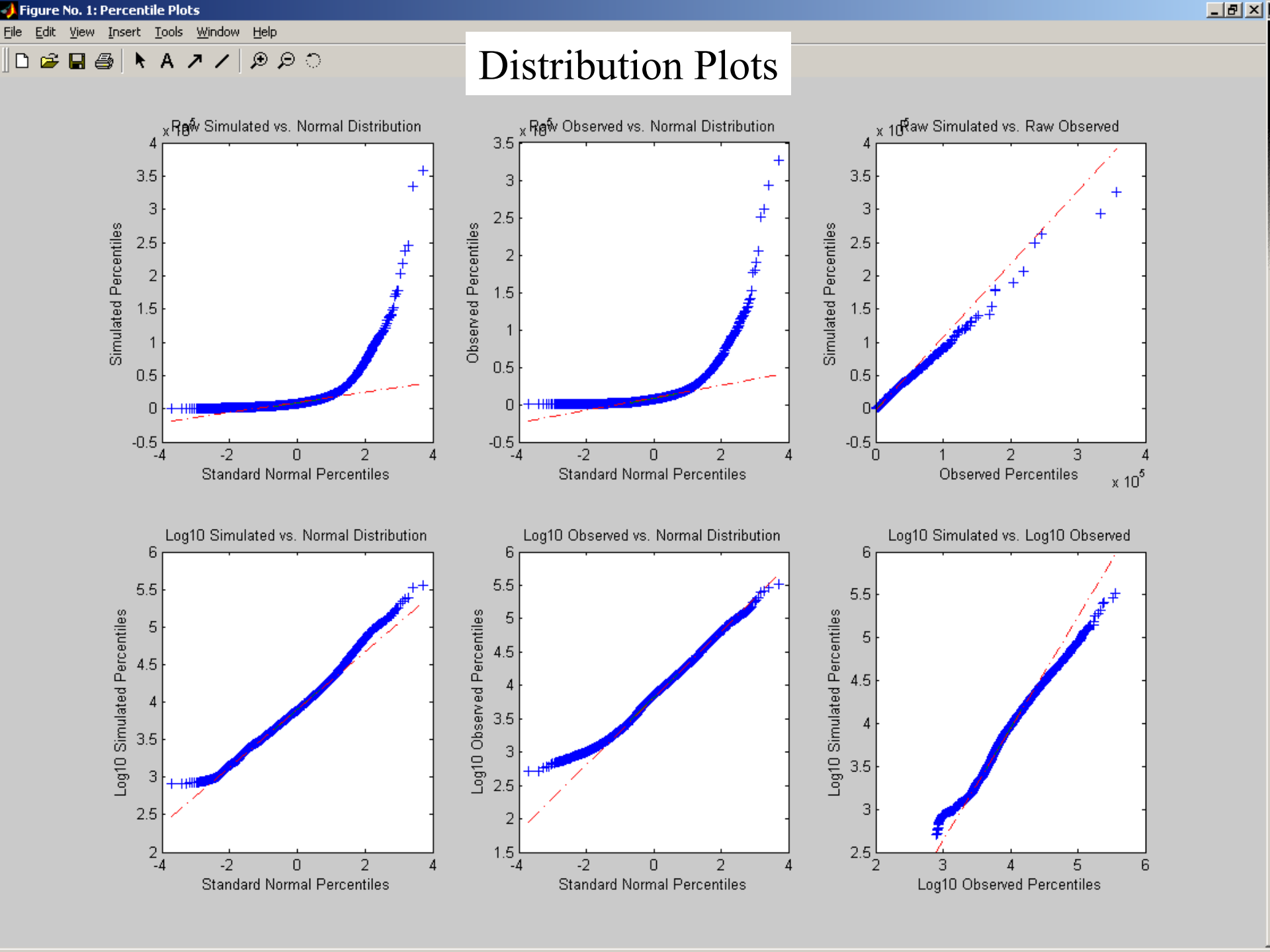
Log and linear stats



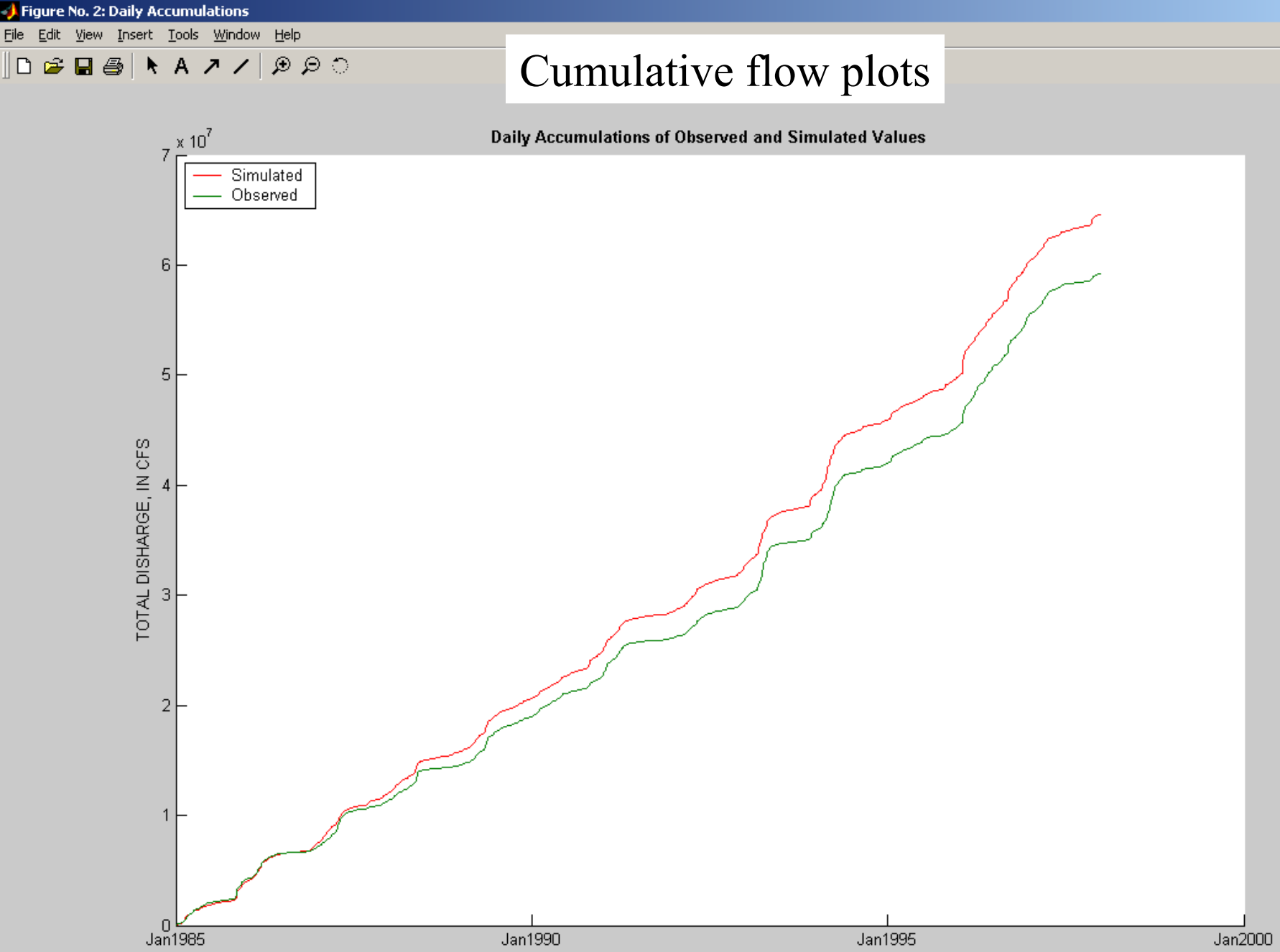
Residual Plots



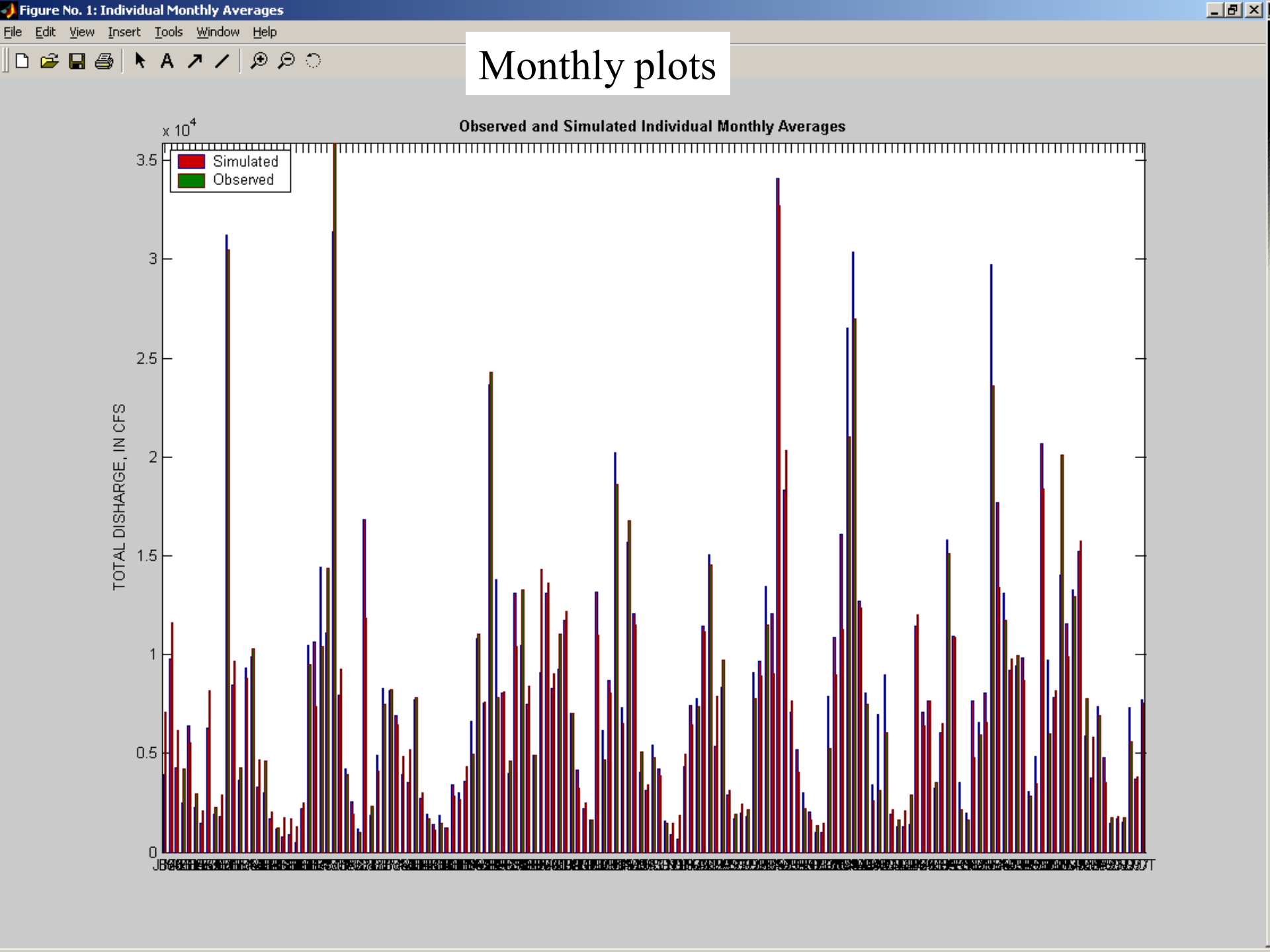
Distribution Plots



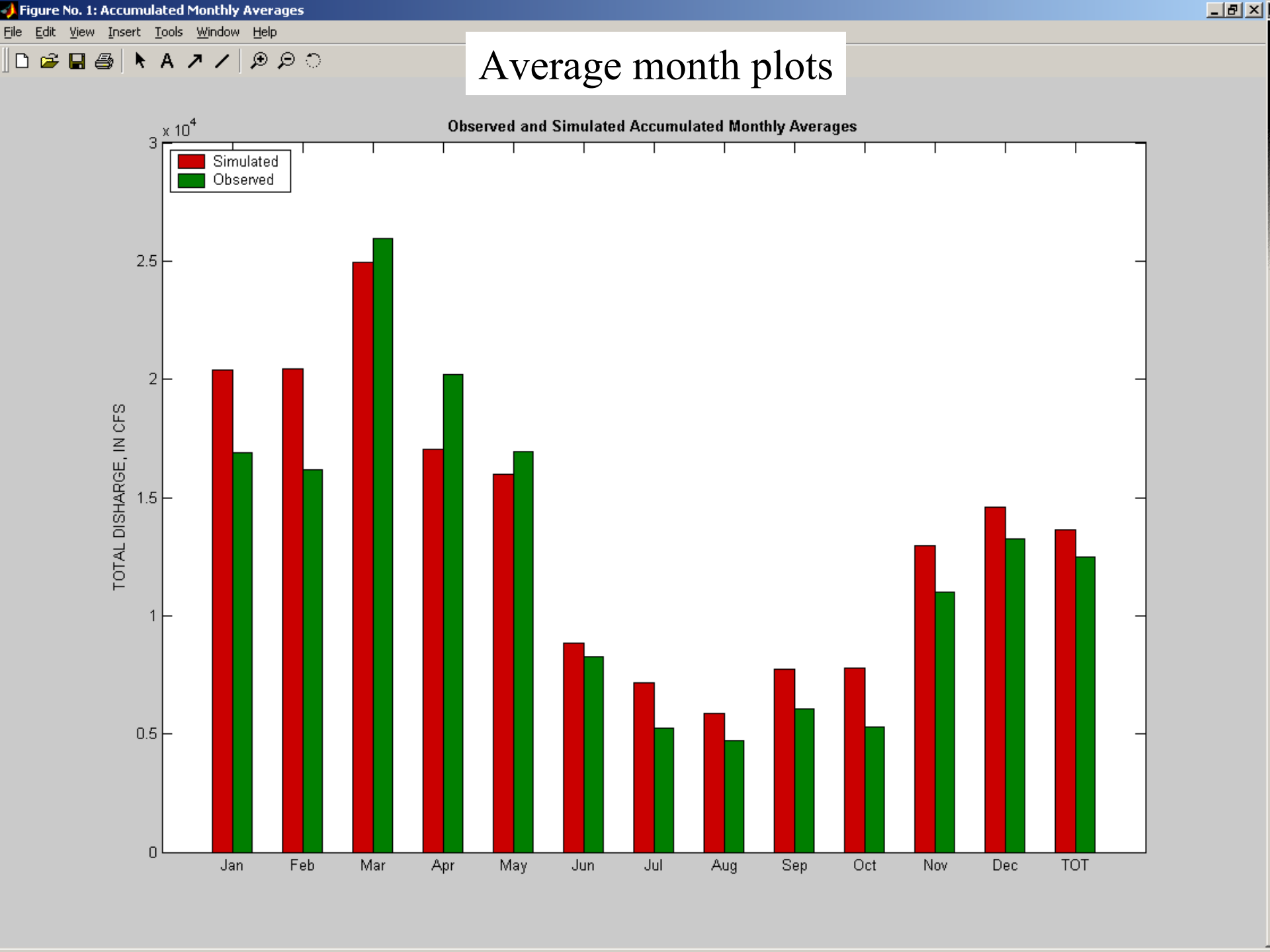
Cumulative flow plots



Monthly plots



Average month plots



Tests of new data sets

- Rain
- PET
- Temperature
- Parameters

Test Method

- Start with ‘Arbitrary’ data sets
- Run phase5 and phase4 data set for entire watershed
- Average watershed-wide statistics

Rain

Rain		Correl of Log	Correl	Efficiency of logs	Efficiency	absbias	bias
Phase5	ave	0.817	0.690	0.342	-0.323	13.4%	4.3%
Phase5	weighted	0.831	0.701	0.491	-0.124	11.6%	3.2%
p4	ave	0.810	0.650	0.336	-0.415	18.3%	8.8%
p4	weighted	0.826	0.674	0.484	-0.185	16.5%	7.9%
Winner	ave	Phase5	Phase5	Phase5	Phase5	Phase5	-4.4%
Winner	weighted	Phase5	Phase5	Phase5	Phase5	Phase5	-4.8%

PET

PET		Correl of Log	Correl	Efficiency of logs	Efficiency	absbias	bias
Phase5	ave	0.817	0.690	0.342	-0.323	13.4%	4.3%
Phase5	weighted	0.831	0.701	0.491	-0.124	11.6%	3.2%
p4	ave	0.804	0.671	-0.292	0.029	27.4%	-25.4%
p4	weighted	0.817	0.681	-0.146	0.133	28.0%	-26.3%
Winner	ave	Phase5	Phase5	Phase5	p4	Phase5	29.8%
Winner	weighted	Phase5	Phase5	Phase5	p4	Phase5	29.5%

Temperature

Temperature		Correl of Log	Correl	Efficiency of logs	Efficiency	absbias	bias
Phase5	ave	0.817	0.690	0.342	-0.323	13.4%	4.3%
Phase5	weighted	0.831	0.701	0.491	-0.124	11.6%	3.2%
p4	ave	0.811	0.667	0.339	-0.281	13.9%	2.3%
p4	weighted	0.823	0.675	0.482	-0.094	12.2%	0.7%
Winner	ave	Phase5	Phase5	Phase5	p4	Phase5	2.1%
Winner	weighted	Phase5	Phase5	Phase5	p4	Phase5	2.4%

Parameters

Parameters		Correl of Log	Correl	Efficiency of logs	Efficiency	absbias	bias
Phase5	ave	0.817	0.690	0.342	-0.323	13.4%	4.3%
Phase5	weighted	0.831	0.701	0.491	-0.124	11.6%	3.2%
p4	ave	0.820	0.720	0.371	0.012	17.8%	12.4%
p4	weighted	0.835	0.733	0.506	0.133	15.0%	10.9%
Winner	ave	p4	p4	p4	p4	Phase5	-8.1%
Winner	weighted	p4	p4	p4	p4	Phase5	-7.8%

Recommendations

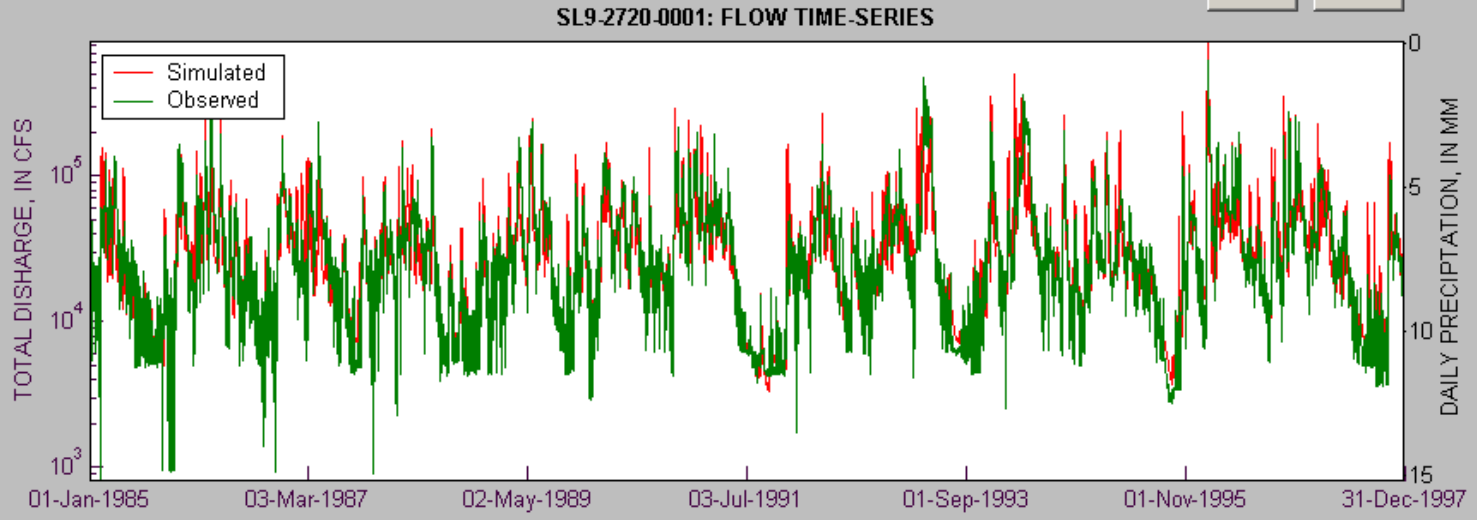
- Accept new:
  - Rainfall
  - Temperature
  - PET
- Incorporate some parts of P4 parameters

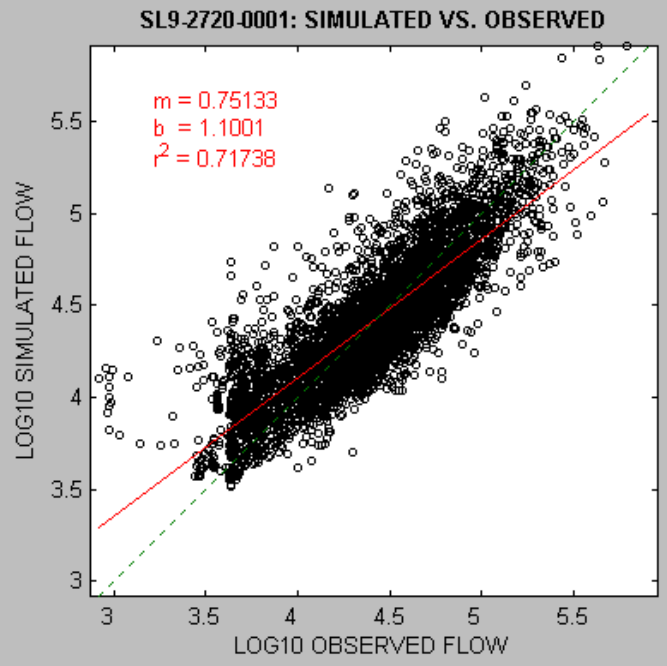
Starting Point

- Look at Phase5 vs Phase4 through cal5 software

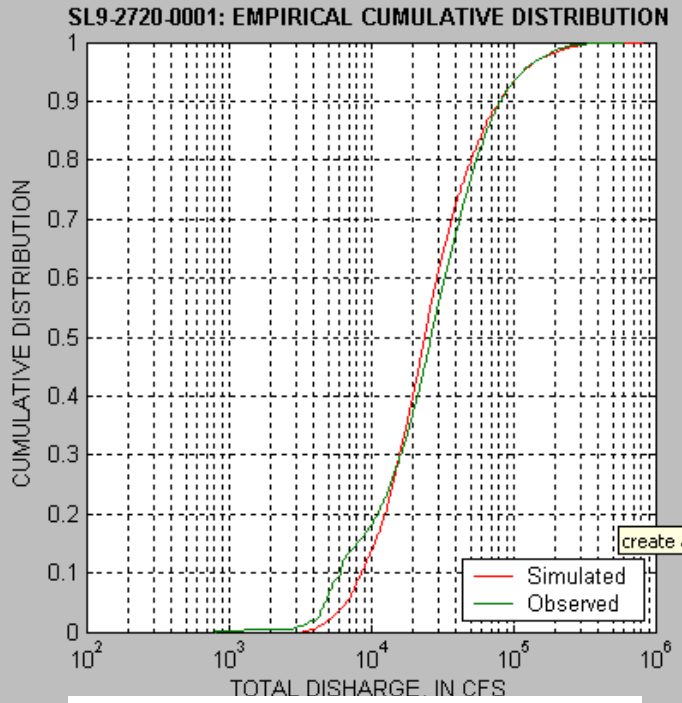
cal5

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





plot log10 data | Print



DATA SELECTION

scenario: EhThPi | 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

common points: 4748

	observed	simulated
min	821 2.91434	3282 3.51614
mean	39216 4.39966	38374.4 4.4057
median	26500 4.42325	23950.5 4.37931
max	622000 5.79379	824000 5.91593
variance	1.96184e+009 0.176168	2.33182e+009 0.138626
JB test	0 0.000259281	0 0

	raw	log10
% rel.bias	-2.14603	0.13727
err.var.	9.37441e+008	0.0501089
rel.std.err	0.477837	0.284439
mod.eff	0.522163	0.715561

Residual Plots

Percentile Plots

Daily Accumulation

create accumulative plot of daily simulated and observed values

Accumulated Monthly Avg's

Print All

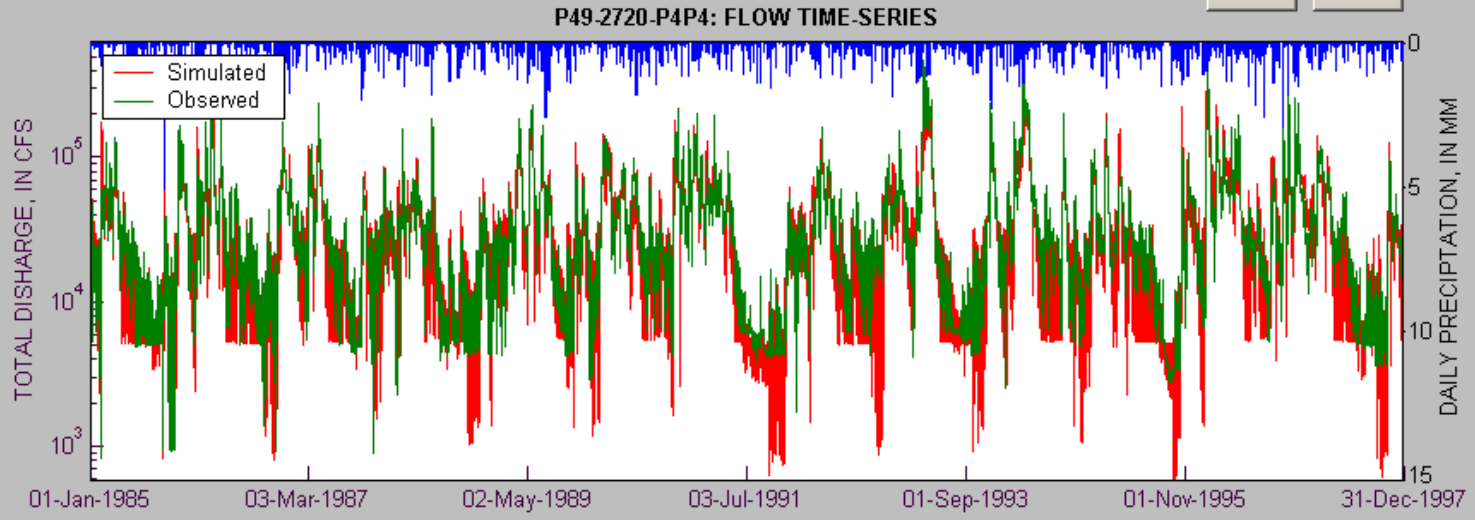
Save as PDF file

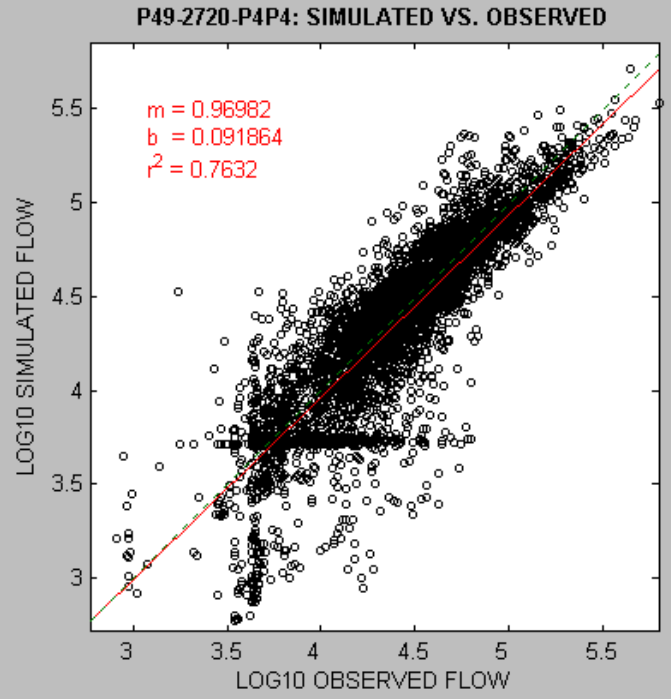
Susquehanna Phase5

CAL5 Version 1.0

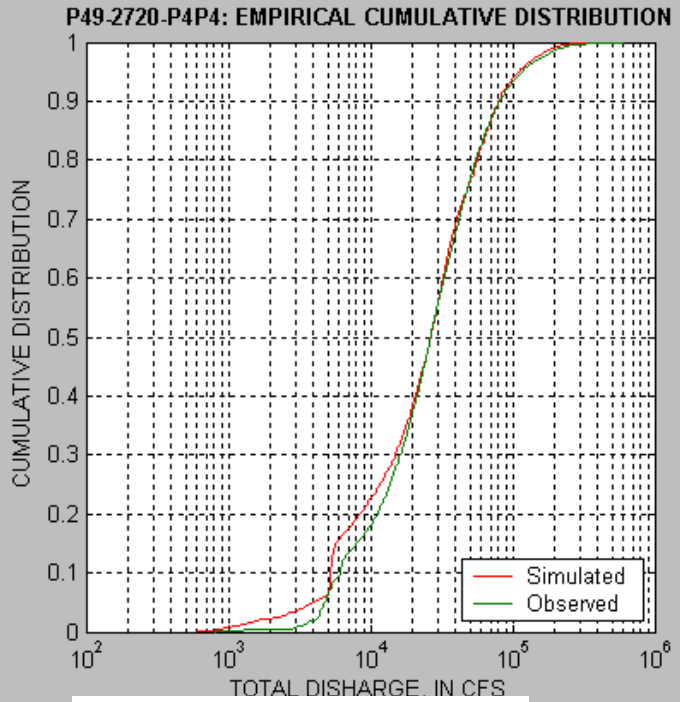
cal5

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





plot log10 data | Print



Print

DATA SELECTION

scenario	file name
EhThPi	P49_2720_p4p4

plot data: FLOW - total discharge

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

Update Plots and Statistics

STATISTICS

common points: 4748

	observed	simulated
min	821 2.91434	591.22 2.77175
mean	39216 4.39966	37244.8 4.35874
median	26500 4.42325	26555.5 4.42415
max	622000 5.79379	510810 5.70826
variance	1.96184e+009 0.176168	1.52887e+009 0.217104
JB test	0 0.000259281	0 0

	raw	log10
% rel.bias	-5.02662	-0.930096
err.var.	4.42981e+008	0.053245
rel.std.err	0.225798	0.30224
mod.eff	0.774202	0.69776

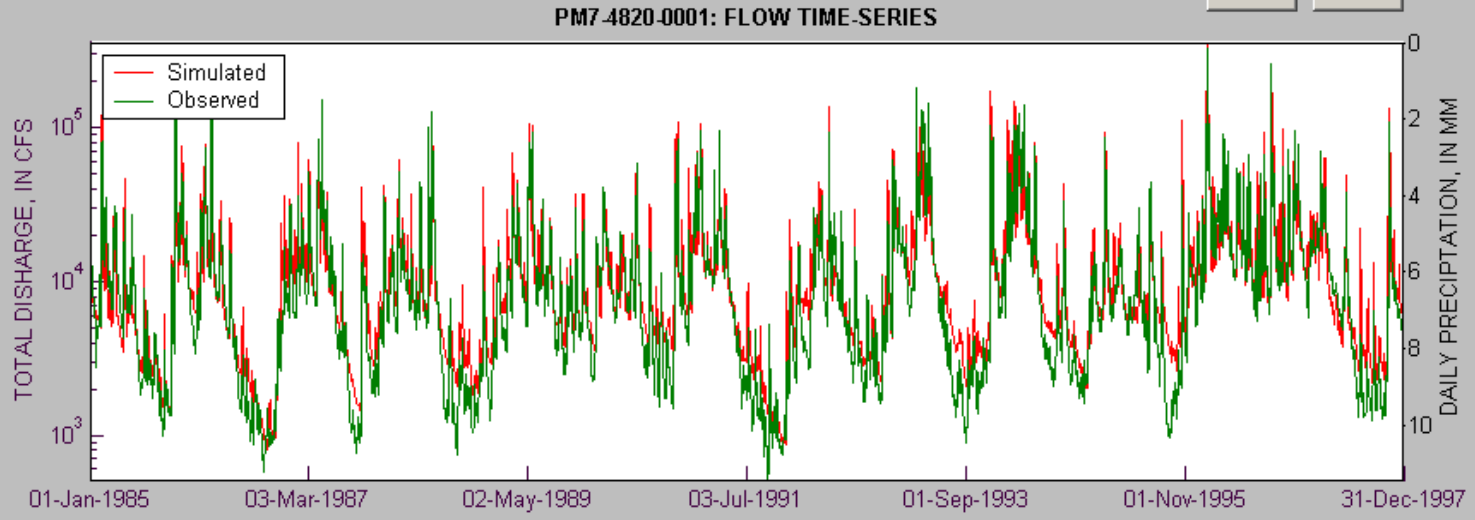
Residual Plots
Percentile Plots
Daily Accumulation
Individual Monthly Avg's
Accumulated Monthly Avg's
Print All
Save as PDF file

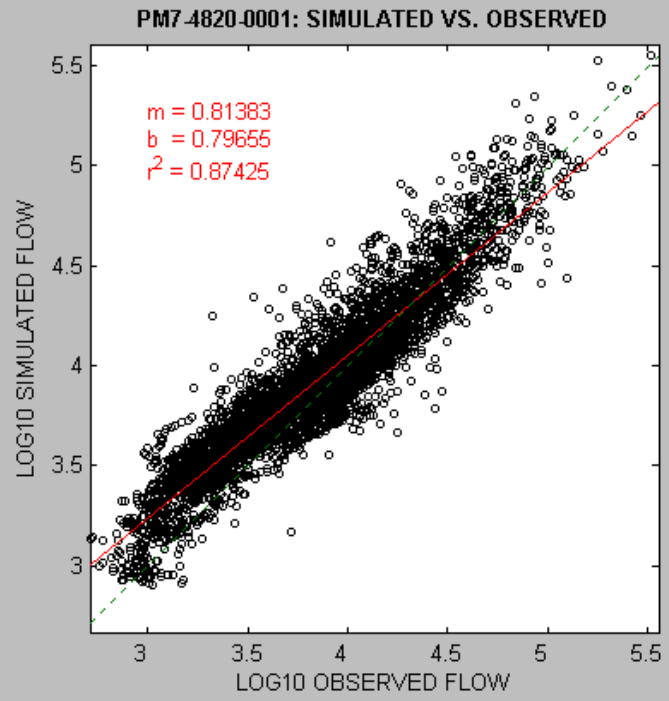
Susquehanna p4

CAL5 Version 1.0

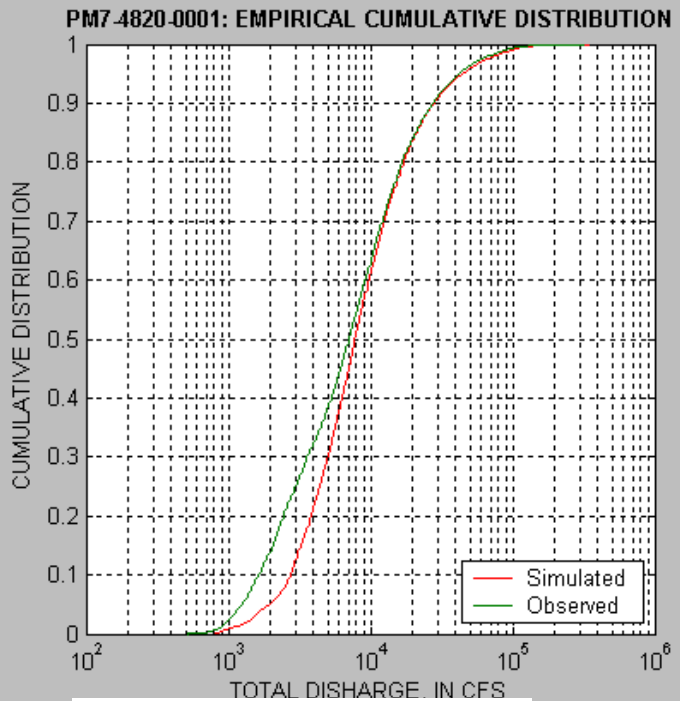
cal5

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





plot log10 data | Print



Print

Potomac Phase5

DATA SELECTION

scenario	file name
EhThPi	PM7_4820_0001

plot data: FLOW - total discharge

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

Update Plots and Statistics

STATISTICS

common points: 4748

	observed	simulated
min	514 2.71096	807.98 2.9074
mean	12482.4 3.83802	13616.7 3.92007
median	7100 3.85126	7787.2 3.89138
max	326000 5.51322	357670 5.55348
variance	3.42229e+008 0.217144	3.88407e+008 0.164507
JB test	0 5.22882e-012	0 0

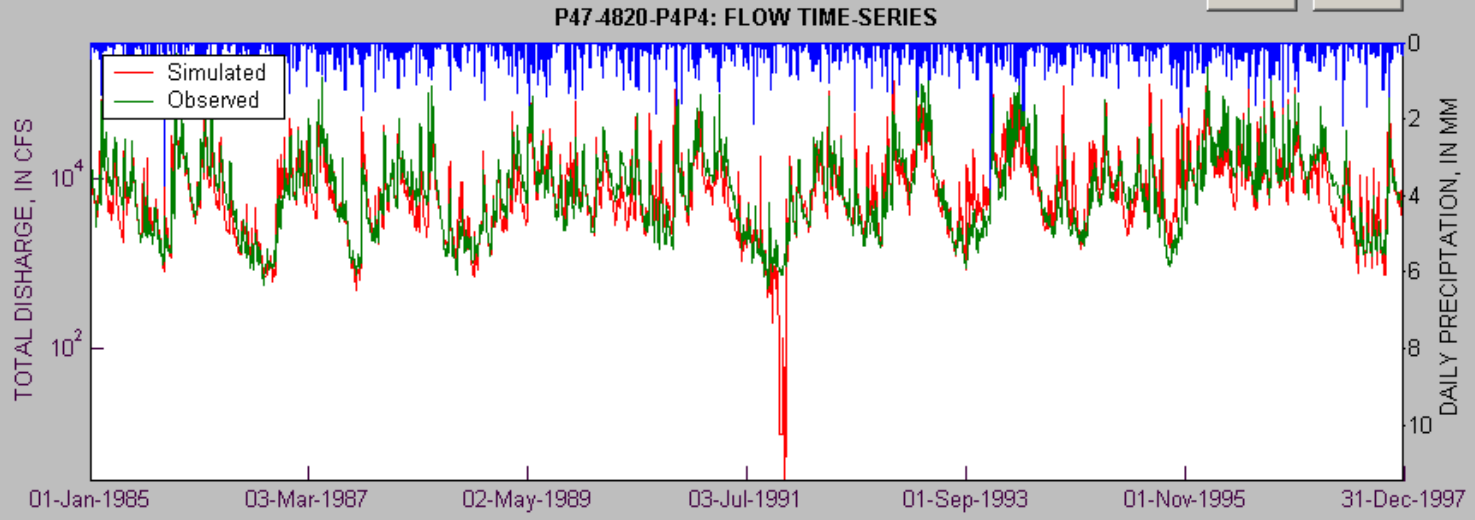
	raw	log10
% rel.bias	9.08728	2.13776
err.var.	9.01485e+007	0.0349458
rel.std.err	0.263415	0.160934
mod.eff	0.736585	0.839066

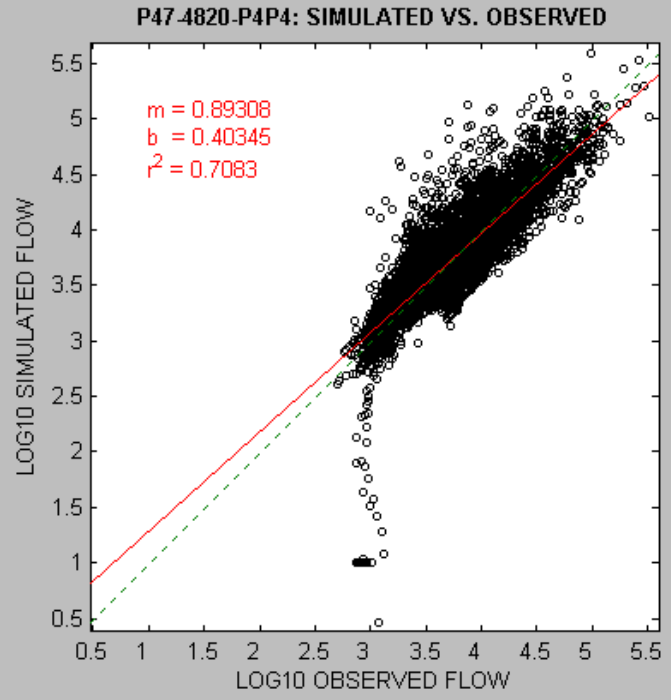
Residual Plots
Percentile Plots
Daily Accumulation
Individual Monthly Avg's
Accumulated Monthly Avg's
Print All
Save as PDF file

CAL5 Version 1.0

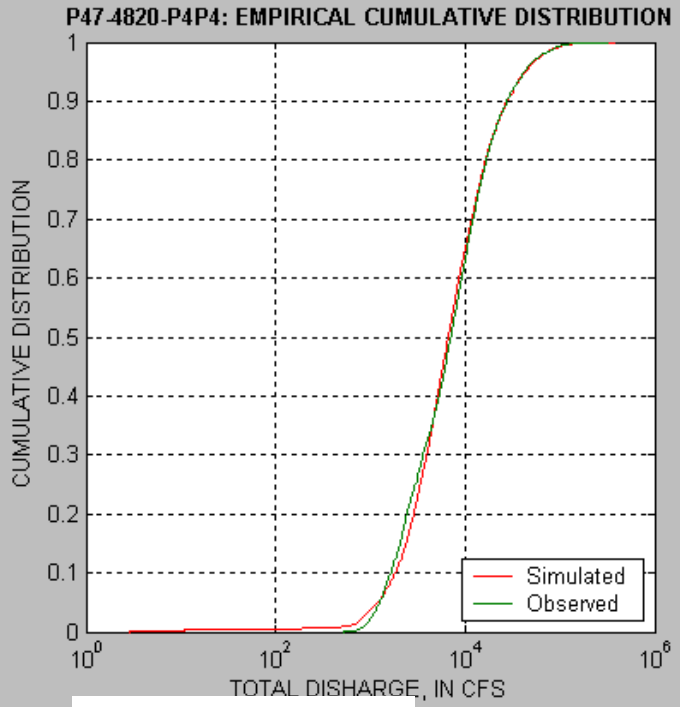
cal5

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





plot log10 data | Print



Print

Potomac p4

DATA SELECTION

scenario	file name
EhThPi	P47_4820_p4p4

plot data: FLOW - total discharge

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

Update Plots and Statistics

STATISTICS

common points: 4748

	observed	simulated
min	514 2.71096	2.9489 0.46966
mean	12482.4 3.83802	12504.8 3.8311
median	7100 3.85126	6668.45 3.82402
max	326000 5.51322	399580 5.6016
variance	3.42229e+008 0.217144	3.72482e+008 0.244514
JB test	0 5.22882e-012	0 0

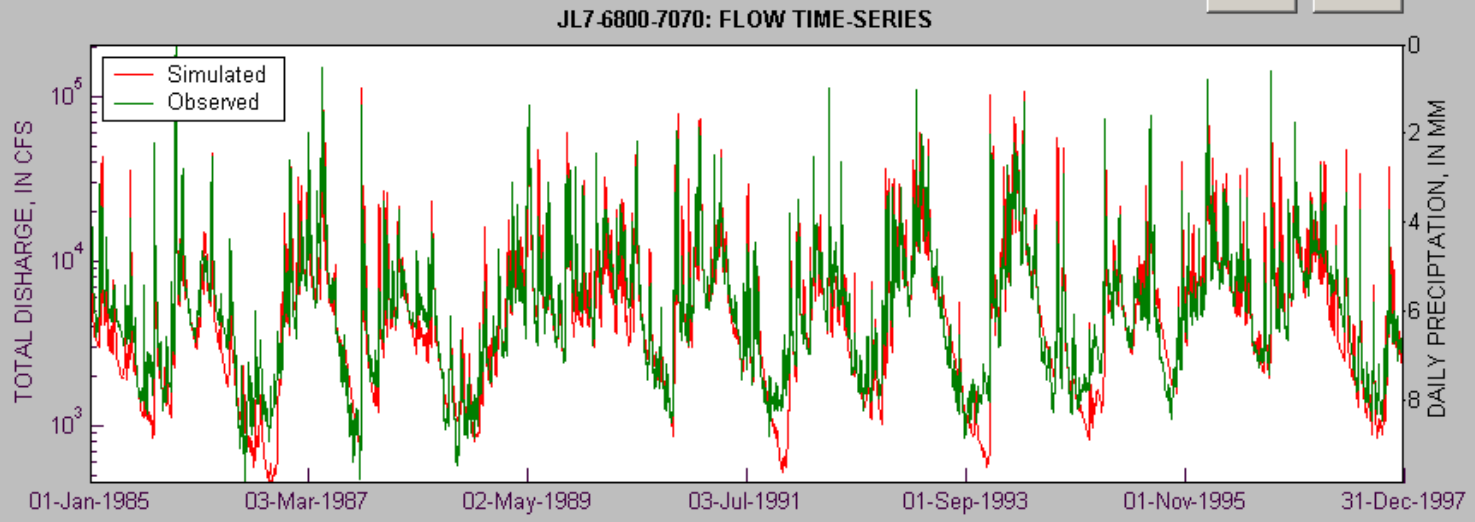
	raw	log10
% rel.bias	0.179523	-0.180481
err.var.	1.77855e+008	0.0738546
rel.std.err	0.519694	0.340119
mod.eff	0.480306	0.659881

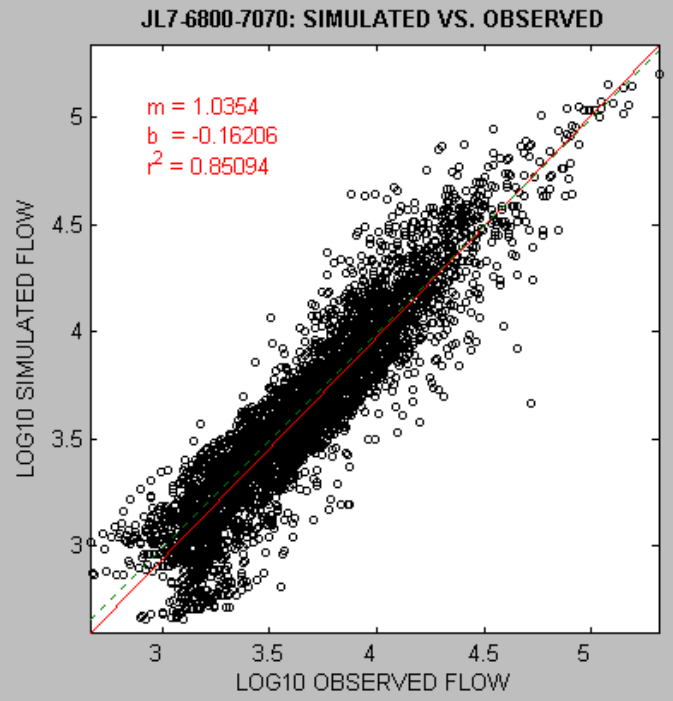
Residual Plots
Percentile Plots
Daily Accumulation
Individual Monthly Avg's
Accumulated Monthly Avg's
Print All
Save as PDF file

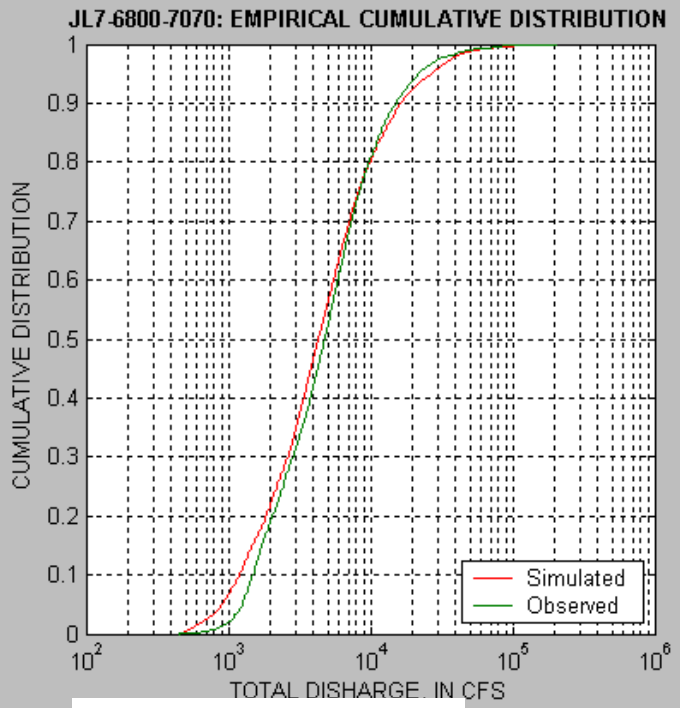
CAL5 Version 1.0

cal5

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







plot log10 data | Print | Print

James Phase5

DATA SELECTION

scenario	file name
EhThPi	JL7_6800_7070

plot data: FLOW - total discharge

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

Update Plots and Statistics

STATISTICS

common points: 4748

	observed	simulated
min	459 2.66181	458.45 2.66129
mean	7523.3 3.67978	7734.68 3.64792
median	4760 3.67761	4304 3.63387
max	206000 5.31387	157880 5.19833
variance	1.1536e+008 0.151974	1.3318e+008 0.191457
JB test	0 0	0 1.44329e-015

	raw	log10
% rel.bias	2.80967	-0.865782
err.var.	2.55067e+007	0.0297439
rel.std.err	0.221105	0.195716
mod.eff	0.778895	0.804284

Residual Plots
Percentile Plots
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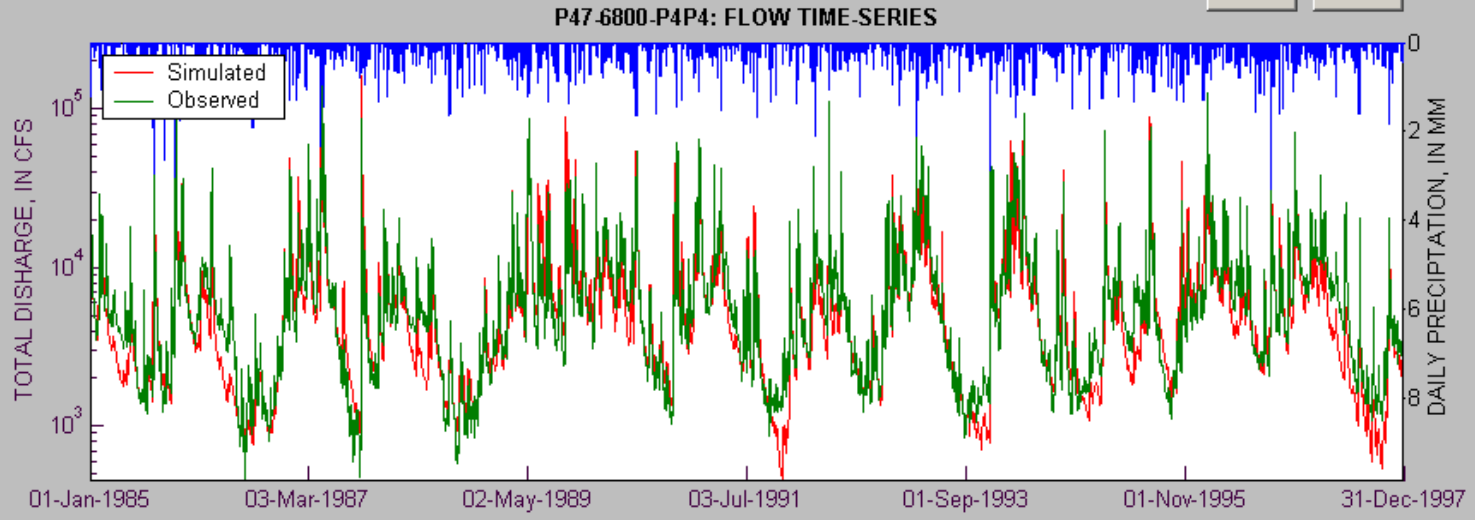
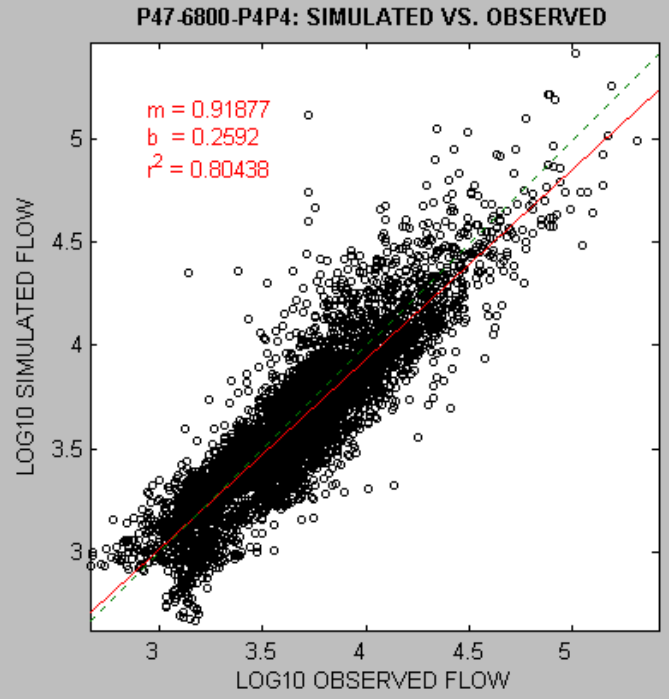
Individual Monthly Avg's
Accumulated Monthly Avg's
Print All
Save as PDF file

CAL5 Version 1.0

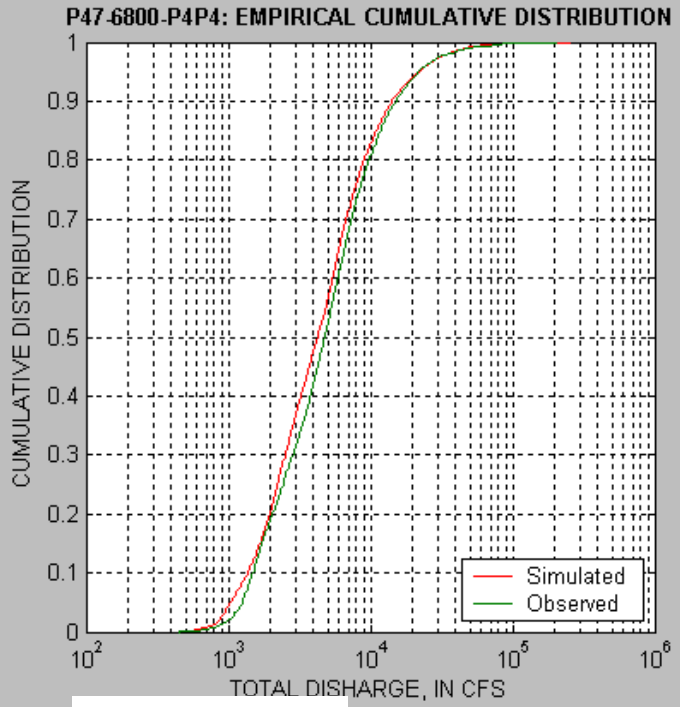
cal5

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





plot log10 data | Print



Print

James p4

DATA SELECTION

scenario	file name
EhThPi	P47_6800_p4p4

plot data: FLOW - total discharge

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

Update Plots and Statistics

STATISTICS

common points: 4748

	observed	simulated
min	459 2.66181	467.06 2.66937
mean	7523.3 3.67978	7066.28 3.64008
median	4760 3.67761	4262.4 3.62965
max	206000 5.31387	261960 5.41823
variance	1.1536e+008 0.151974	1.18521e+008 0.159486
JB test	0 0	0 0

	raw	log10
% rel.bias	-6.07475	-1.07907
err.var.	5.3397e+007	0.0337784
rel.std.err	0.462873	0.222264
mod.eff	0.537127	0.777736

Residual Plots
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CAL5 Version 1.0

Calibrated P4 vs uncalibrated P5

Susquehanna	Correl of Log	Correl	Efficiency of logs	Efficiency	bias
Phase5	0.847	0.785	0.716	0.522	2.1%
p4	0.874	0.881	0.698	0.774	5.0%
Winner	p4	p4	Phase5	p4	Phase5

Potomac	Correl of Log	Correl	Efficiency of logs	Efficiency	bias
Phase5	0.935	0.880	0.839	0.737	9.1%
p4	0.842	0.752	0.660	0.480	0.2%
Winner	Phase5	Phase5	Phase5	Phase5	p4

Potomac	Correl of Log	Correl	Efficiency of logs	Efficiency	bias
Phase5	0.922	0.900	0.804	0.779	2.8%
p4	0.897	0.773	0.778	0.537	0.2%
Winner	Phase5	Phase5	Phase5	Phase5	p4

Timeline

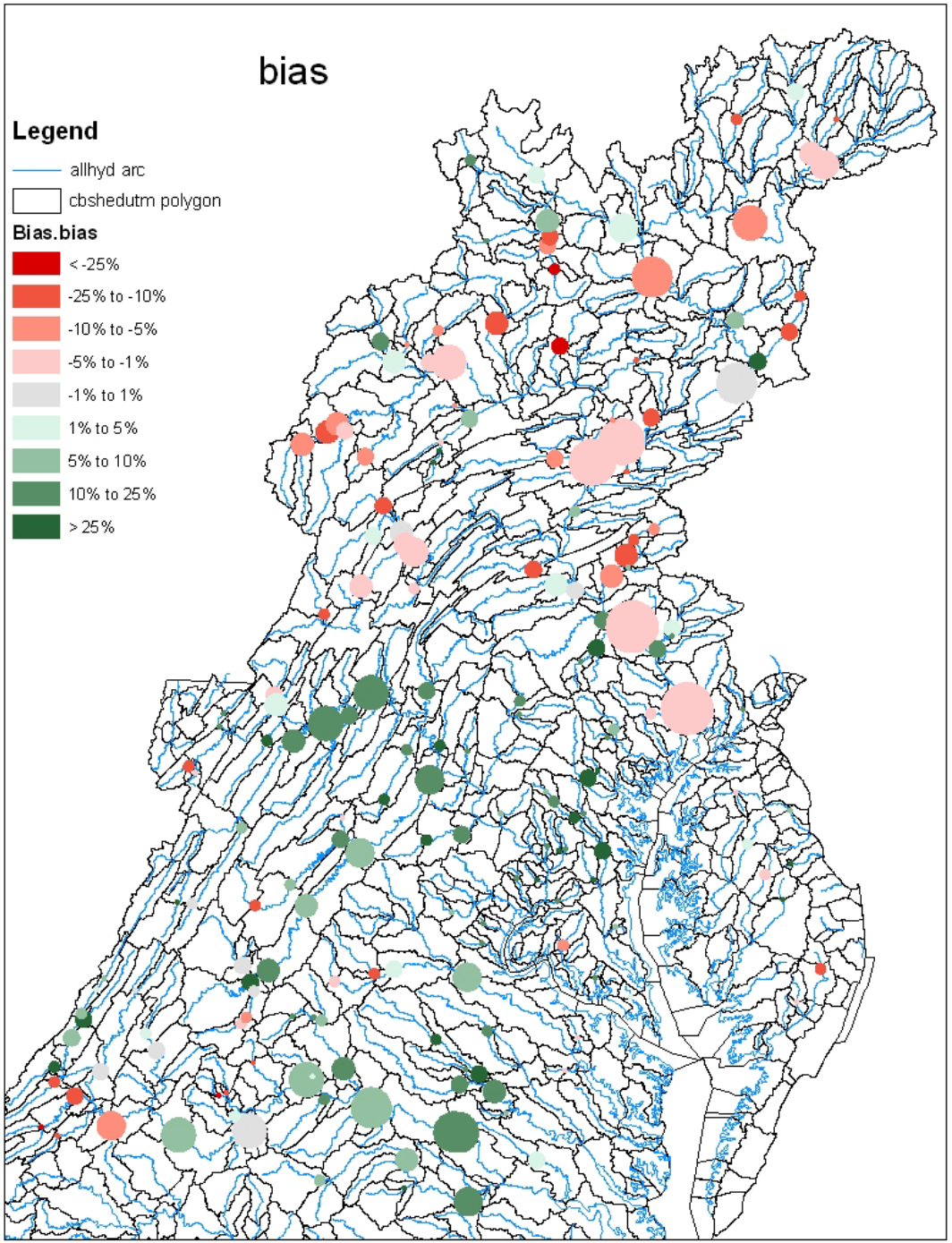
- August – Up and running (?)
- September – showed initial run of whole watershed
- October –
  - Showing final (?) data sets
  - Operational improvements

Timeline

- November –
  - Calibrated for bias
  - Separate storm and base flow
- Dec – Calibrate storm and base flow
- Jan – Show calibration.

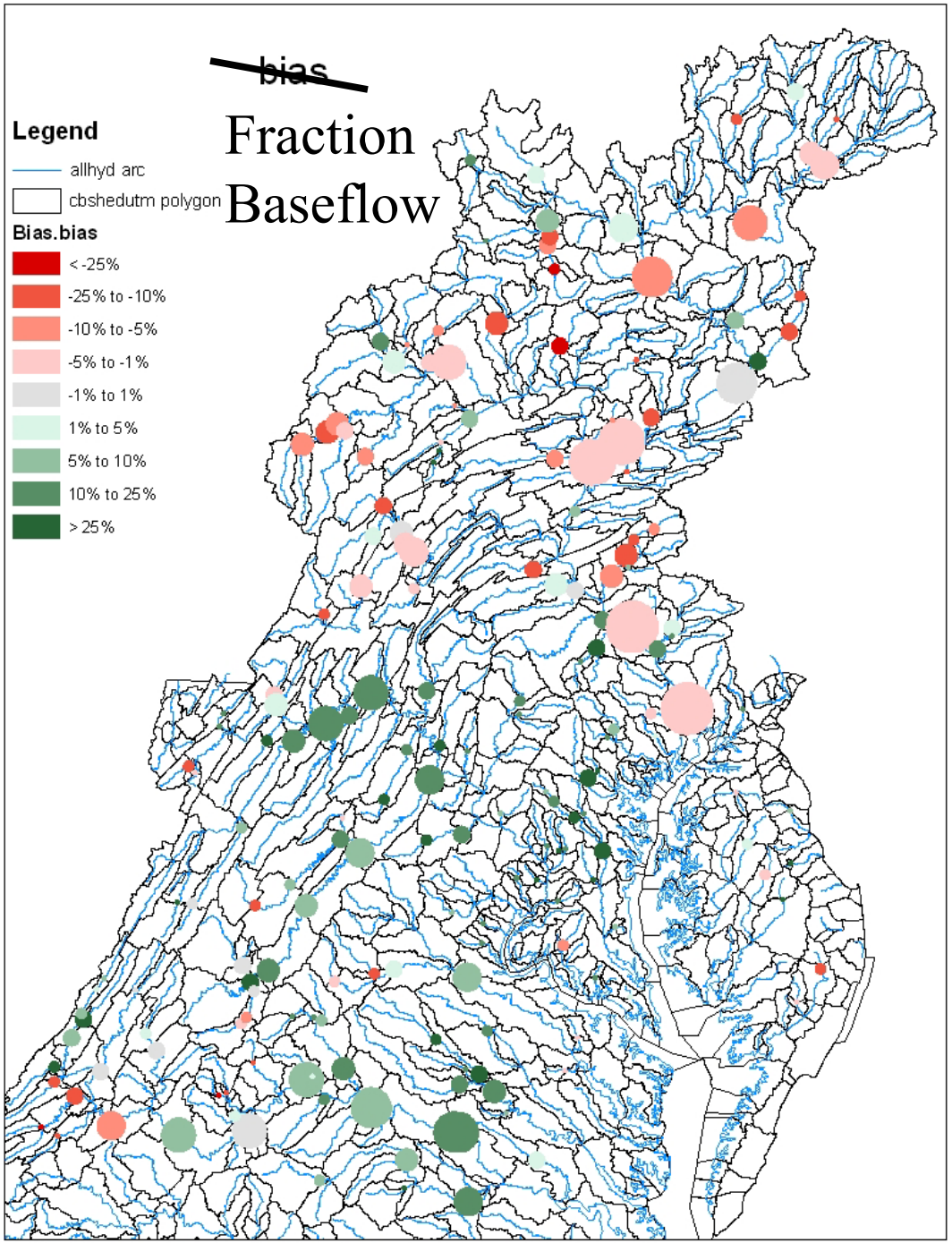
Method

- Try to calibrate bias globally
- If not possible, send out to team
- Bring back in for consitency



Method

- Try to calibrate Quick/Base flow globally
- If not possible, send out to team
- Bring back in for consitency



. . . and so on through December

- Bias
- Quick/Base separation
- Base flow recession
- Quick Flow calibration
- Seasonal adjustments

Strategy

- Water Balance
- Stormflow / Baseflow separation
- Base Flow
- Storm Flow
- Seasonal Changes

Adapted From:

Users Manual for an Expert System (HSPEXP) for Calibration of the Hydrological Simulation Program—Fortran

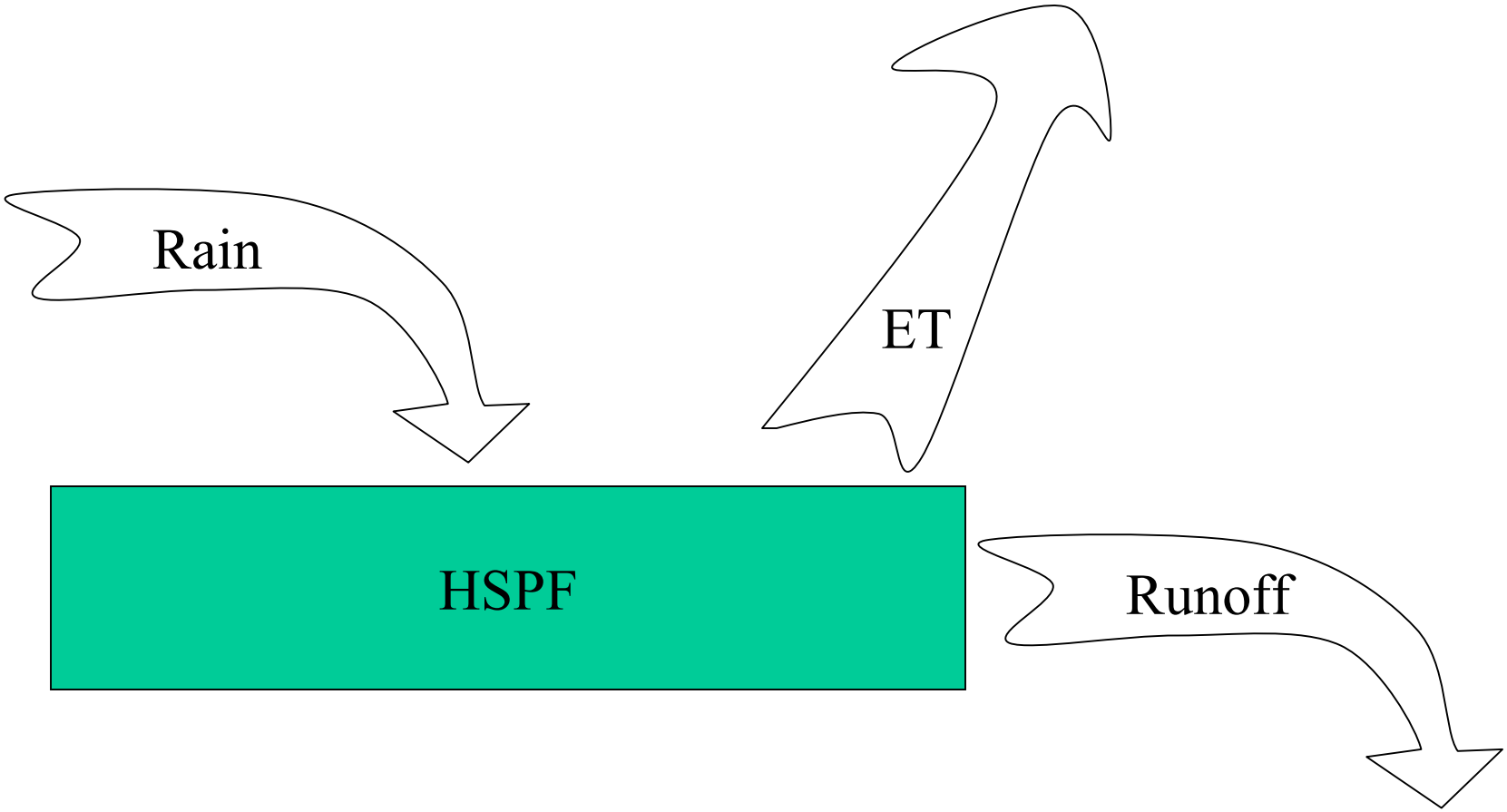
By Lumb, McCammon, and Kittle USGS-WRI Report

Principles

balance between fair and accurate calibration

- Use the same parameter everywhere (TSNOW=32)
- Use spatial data (Slope, latitude)
- Set a regional parameter (GW recession)
- Set land-use specific values (Lower Zone ET)
- Last resort (site-specific calibration)

Water Balance

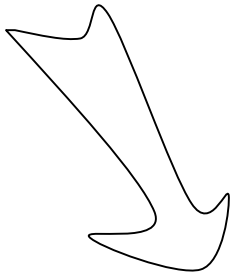


ET – Controlled by

- Potential ET – Can be calculated, but not always accurately

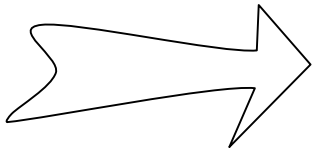
- Lower Zone ET “vigor” parameters

Storm / Base Division

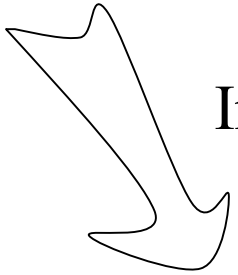


Net Water In

Upper Layer

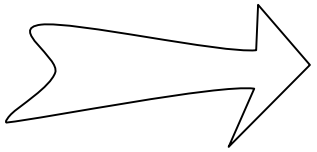


Surface



Infiltration Parameter (INFILT)

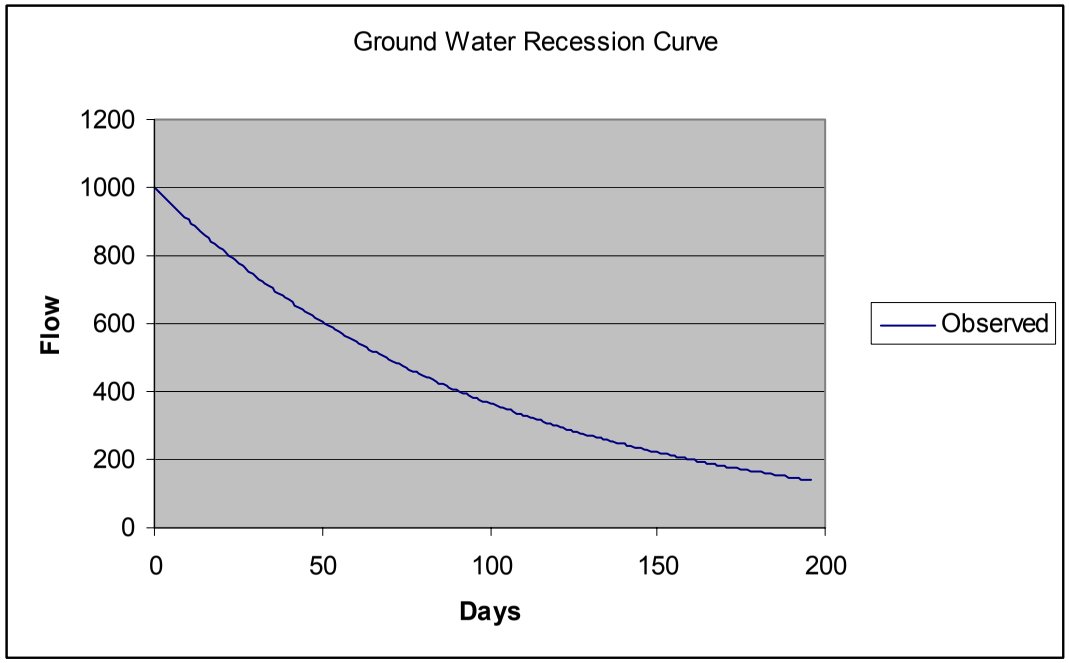
Ground Water Layer



Ground Water

Base this on Hydrograph Separation of Observed Flow

Base Flow Calibration

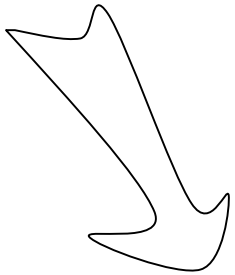


AGWR = Flow today / Flow yesterday

Ground Water Layer

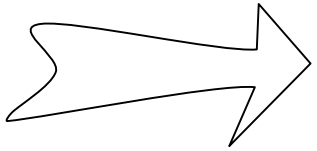
Base this on Regional Observed Recession Rates

Storm Calibration

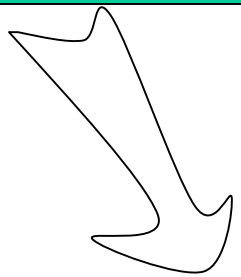


Net Water In

Surface Layer

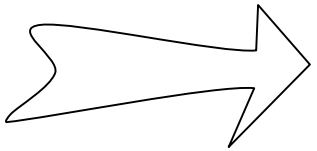


Quick Flow



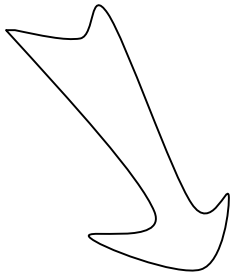
Separation Parameter (INTFW)

Interflow Layer



Not-so-quick Flow

Base this on Calibration



Water to base flow

Other Adjustments

- KVARY – “quick” base flow

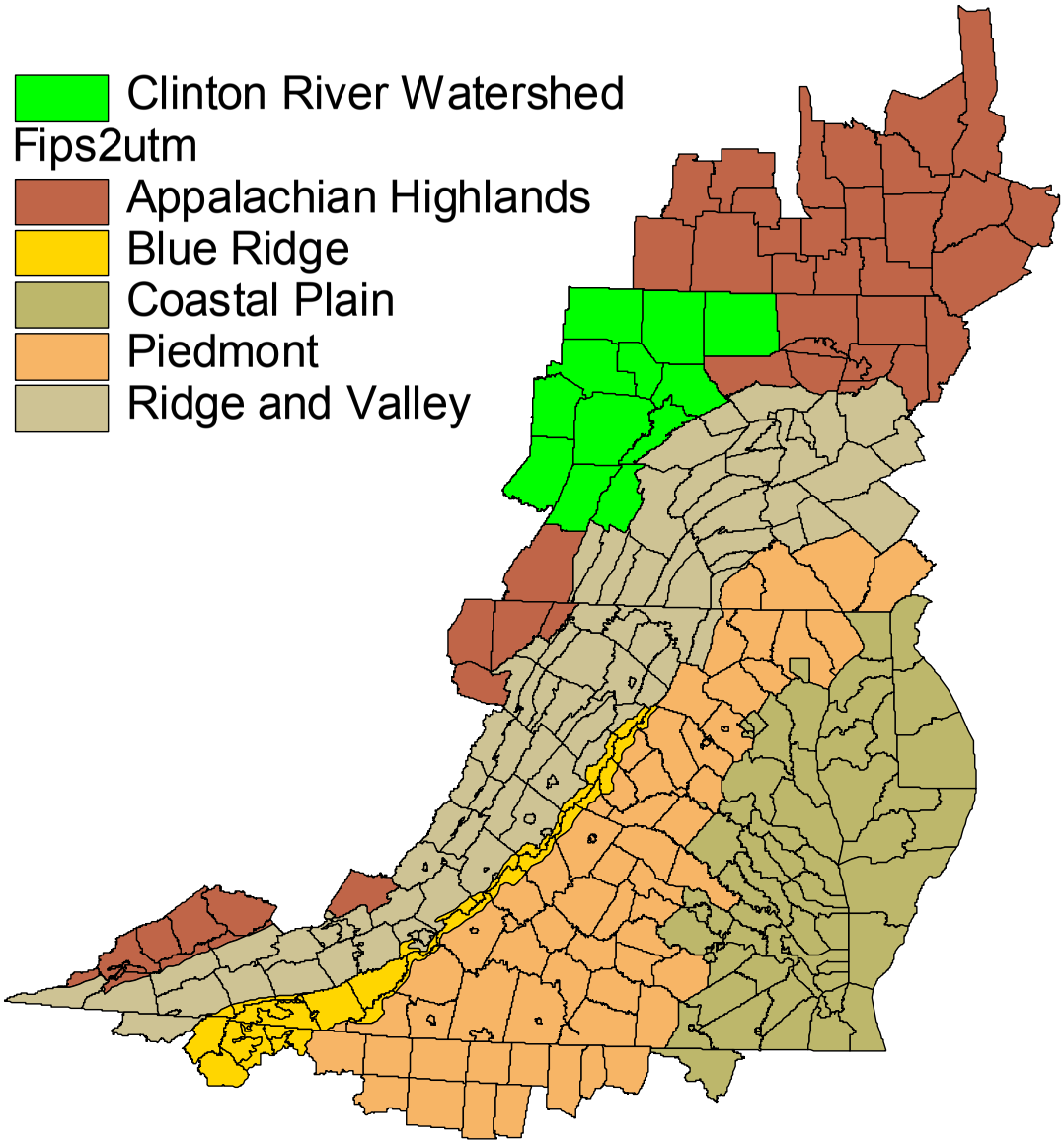
- ET from ground-water storage
- ET from base flow at the channel

- Make ET and Interception parameters monthly (correct monthly water balance)

Example

- Same ET time series everywhere
- Calibrate water balance by adjusting ET
- Look at spatial pattern in ET parameter
- Caveat – land use, met, parameters not ‘official’

Station SW6_1330_1230



plotter

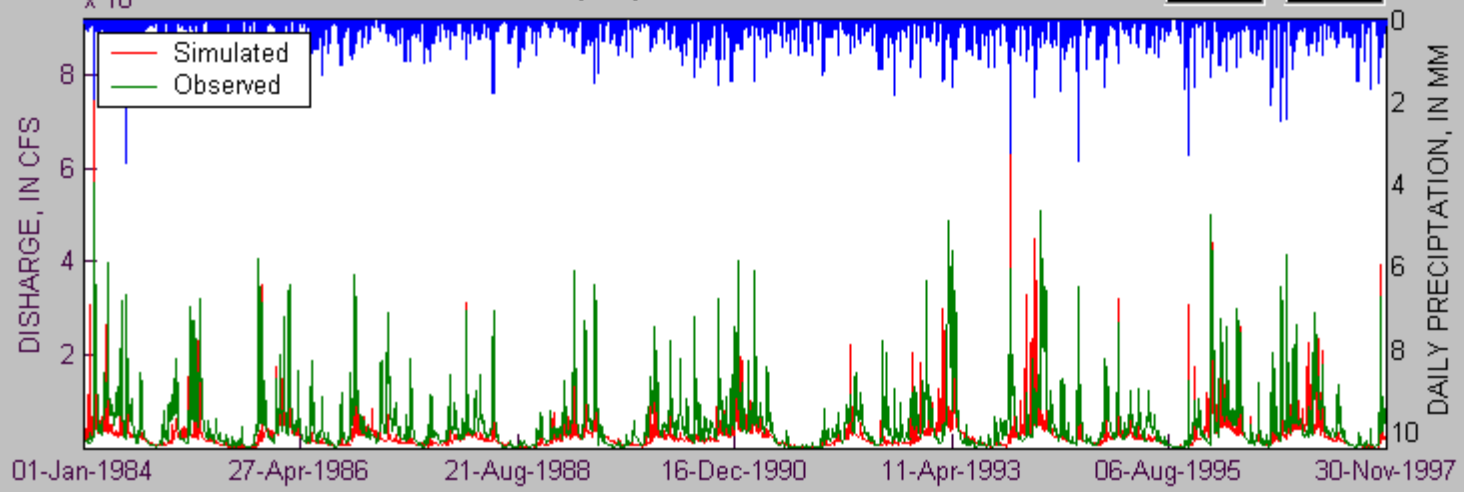
Clinton station

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

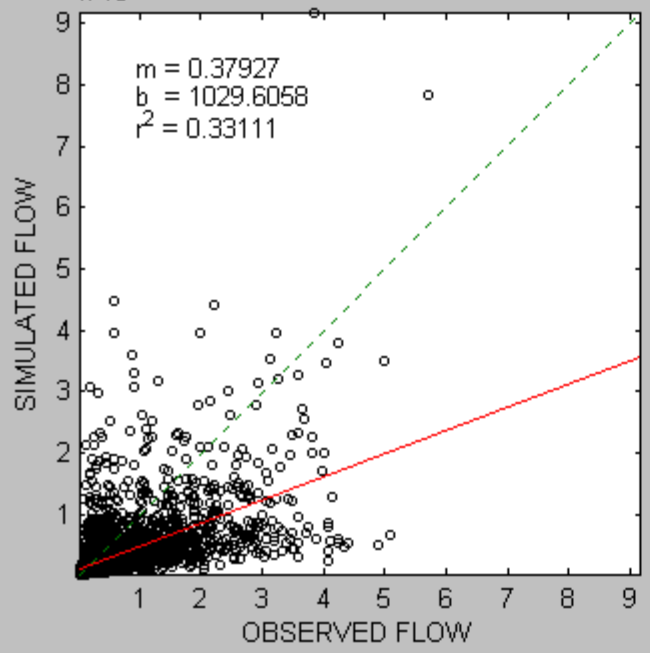
Init EP

Examine | Print

SW6_1330_1230: FLOW TIME-SERIES



SW6_1330_1230: SIMULATED VS. OBSERVED

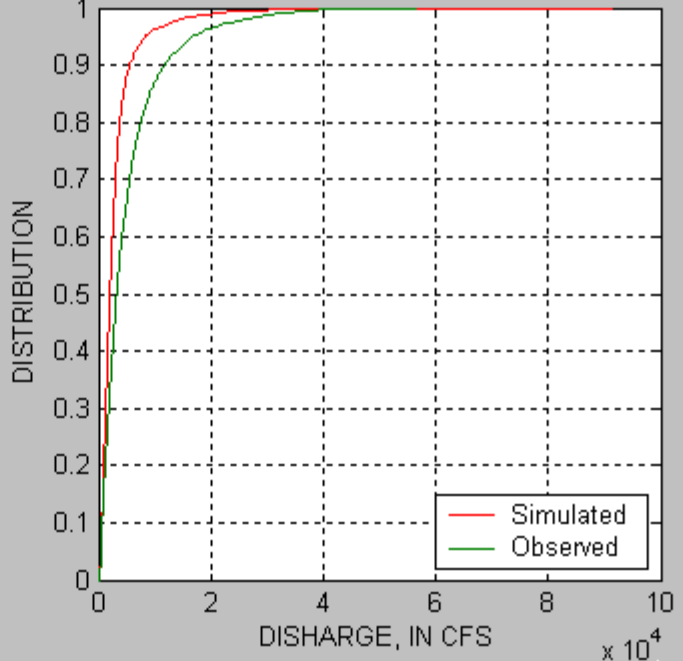


hide regression line

hide y = x line

Print

SW6_1330_1230: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot

hide observed values

Print

DATA SELECTION

file name: SW6_1330_1230

plot data: FLOW - discharge

min date	max date
1/1/1984	11/31/1997

Update Plots

STATISTICS

common points: 5083

	observed	simulated
min	248	145.88
mean	5224.17	3011
median	3270	2050.4
max	56900	91767
variance	.73047e+00	.62069e+00

error variance	.01133e+00
relative bias	-0.423641
rel. std. error	0.807226
model efficiency	0.192774

Save Statistics Report

Monthly Averages

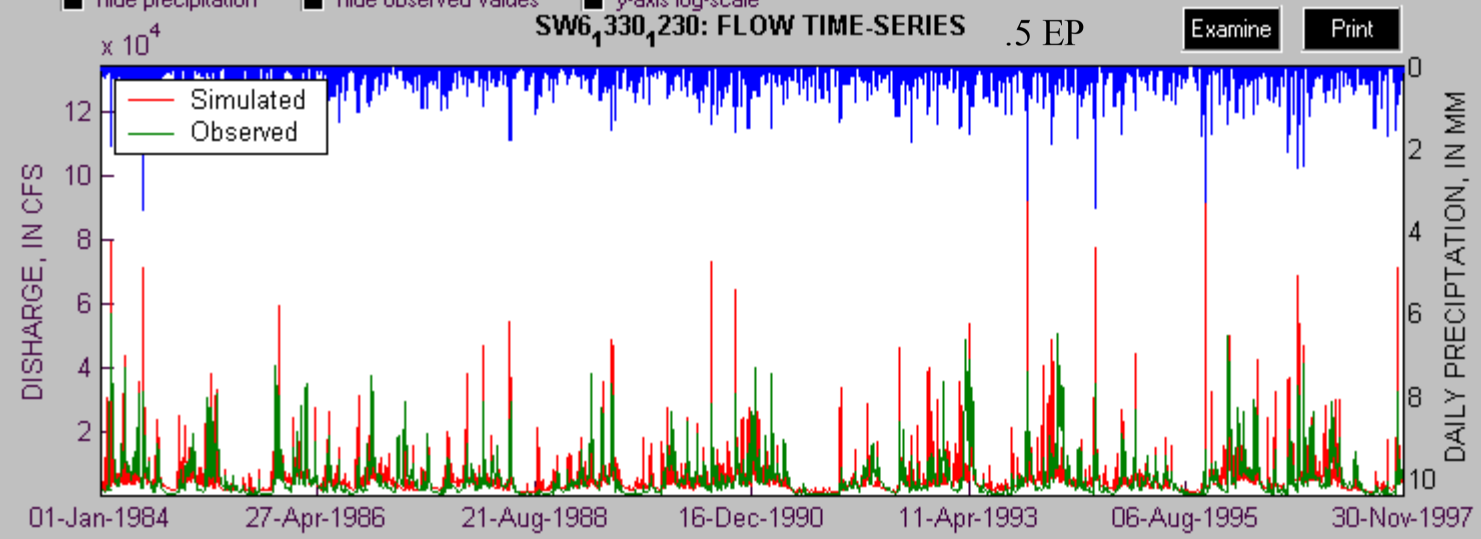
Print All Plots

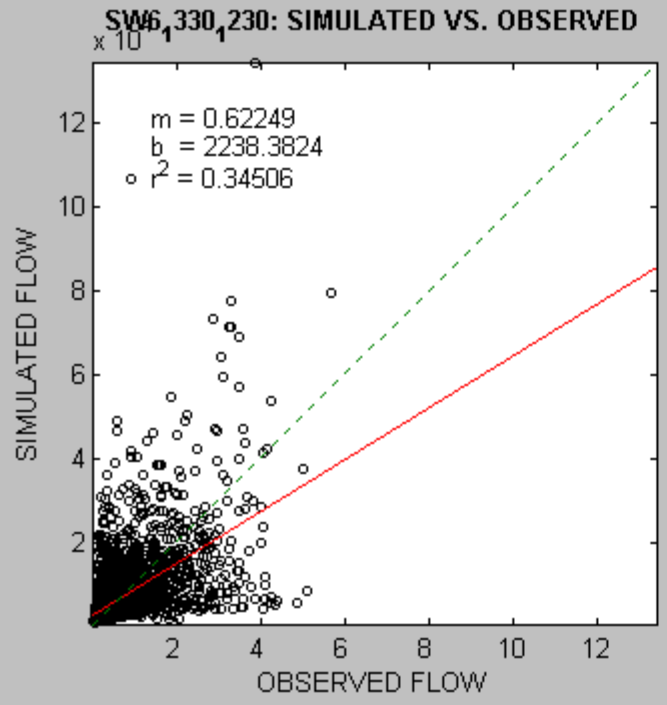
plotter

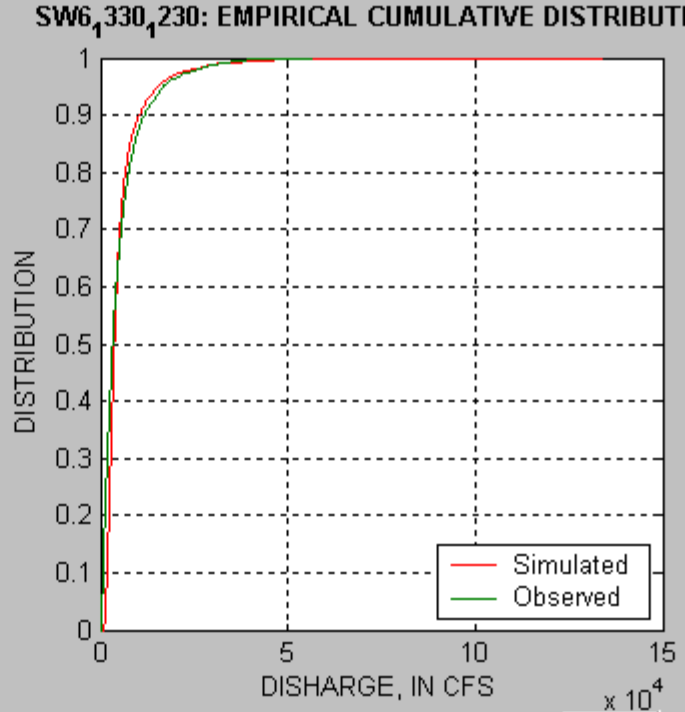
Clinton station

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

Examine | Print







hide regression line | hide y = x line | Print

semi-log plot | Print

print current simulated vs. observed plot

DATA SELECTION

file name: SW6_1330_1230

plot data: FLOW - discharge

min date	max date
1/1/1984	11/31/1997

Update Plots

STATISTICS

common points: 5083

	observed	simulated
min	248	850.37
mean	5224.17	5490.4
median	3270	3725.1
max	56900	134060
variance	.73047e+00	.18924e+00

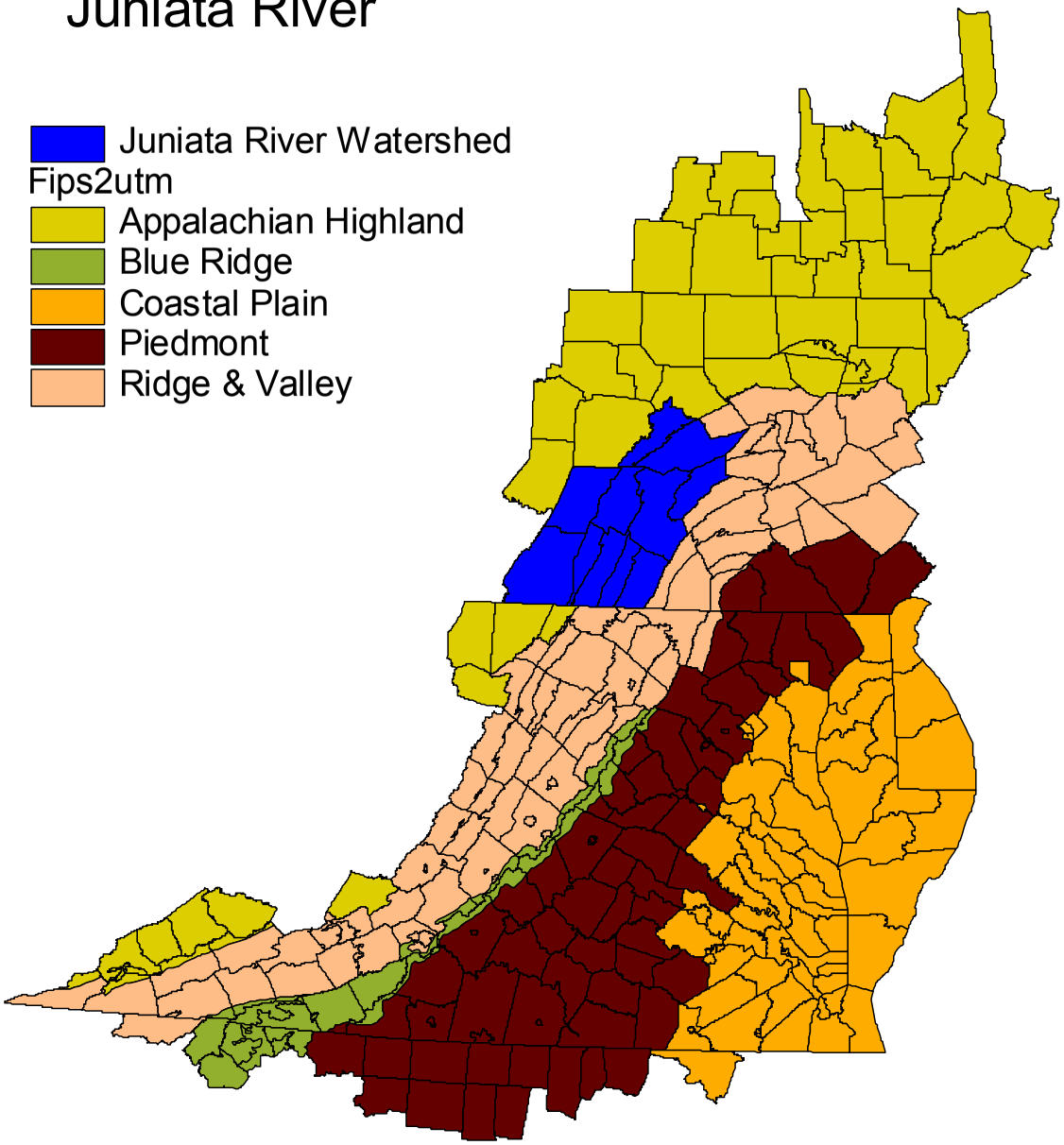
error variance	3.2824e+007
relative bias	0.0509612
rel. std. error	0.879889
model efficiency	0.120111

Save Statistics Report

Monthly Averages

Print All Plots

Station SJ5_2210_2320
Juniata River

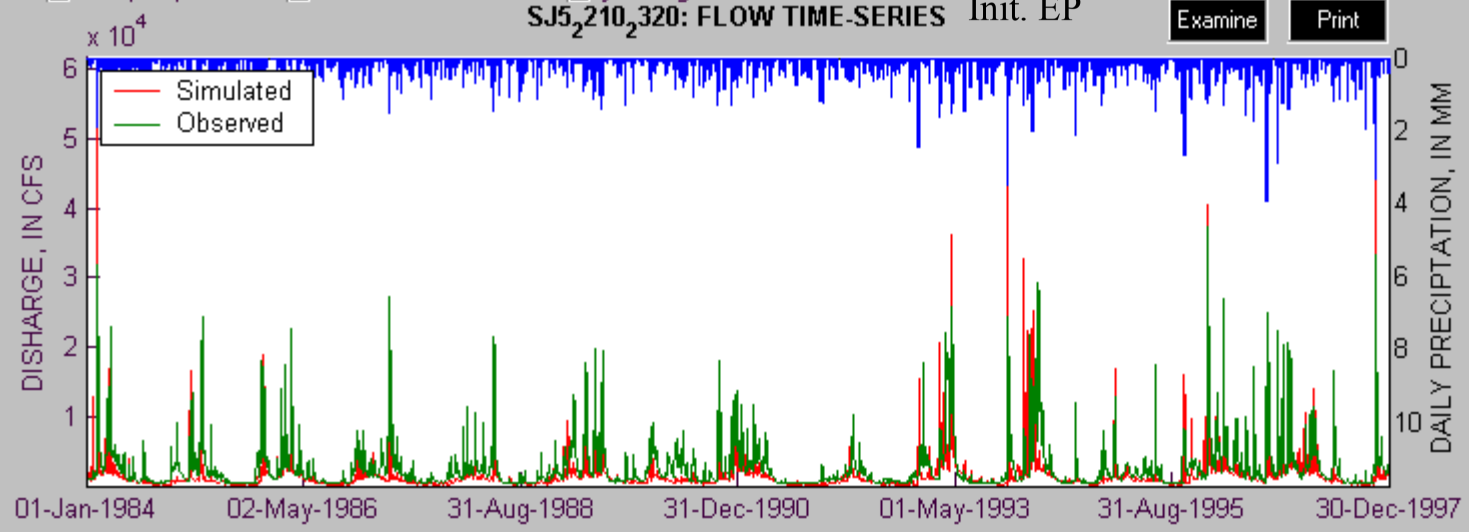


plotter Juniata

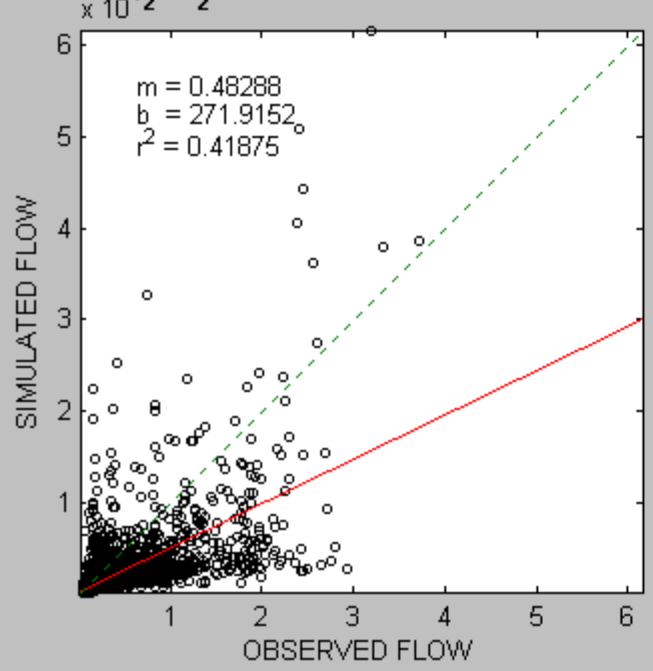
hide precipitation | hide observed values | y-axis log-scale

$SJ5_2210_2320$: FLOW TIME-SERIES Init. EP

Examine | Print

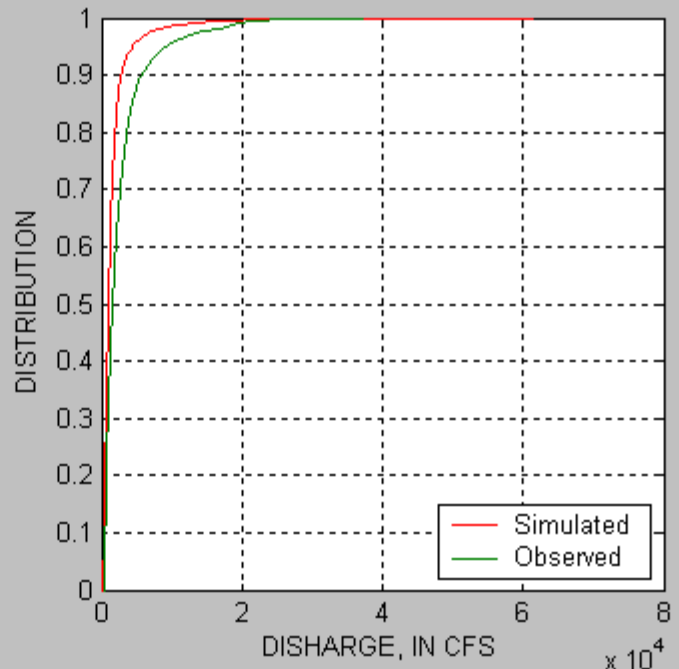


$SJ5_2210_2320$: SIMULATED VS. OBSERVED



hide regression line | hide y = x line | Print

$SJ5_2210_2320$: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values | Print

DATA SELECTION

file name: SJ5_2210_2320

plot data: FLOW - discharge

min date	max date
1/1/1984	12/31/1997

Update Plots

STATISTICS

common points: 5113

	observed	simulated
min	416	132.7
mean	2752.57	1601.07
median	1600	1010.1
max	37300	61575
variance	1.2715e+007	1.07996e+00

error variance	8.8416e+006
relative bias	-0.418337
rel. std. error	0.69537
model efficiency	0.30463

Save Statistics Report

Monthly Averages

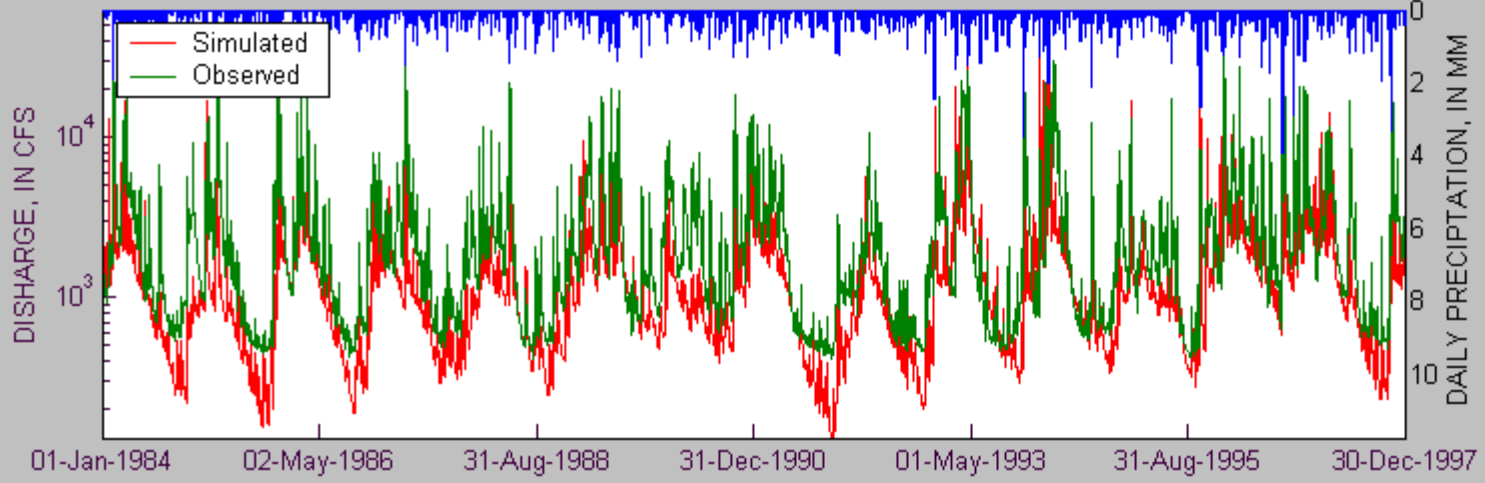
Print All Plots

plotter Juniata

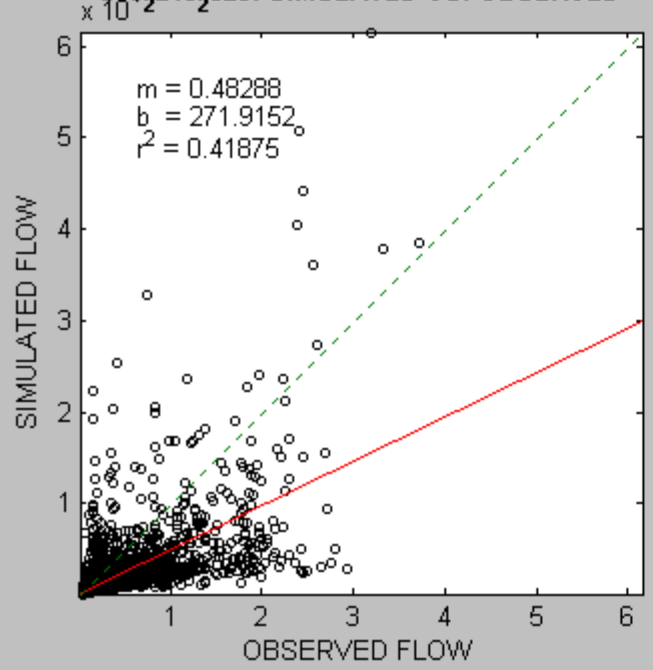
hide precipitation | hide observed values | y-axis log-scale

$SJ5_2210_2320$: FLOW TIME-SERIES

Init. EP | Examine | Print

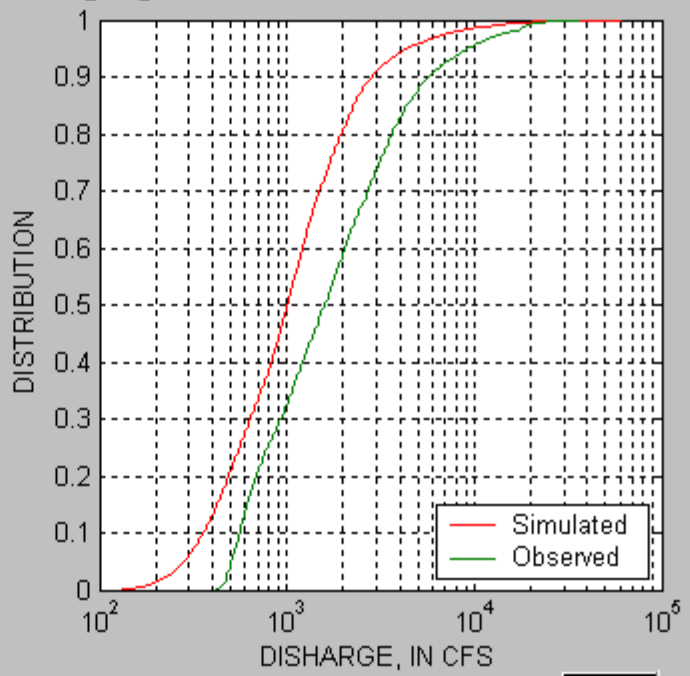


$SJ5_2210_2320$: SIMULATED VS. OBSERVED



hide regression line | hide y = x line | Print

$SJ5_2210_2320$: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values | Print

DATA SELECTION

file name: SJ5_2210_2320

plot data: FLOW - discharge

min date	max date
1/1/1984	12/31/1997

Update Plots

STATISTICS

common points: 5113

	observed	simulated
min	416	132.7
mean	2752.57	1601.07
median	1600	1010.1
max	37300	61575
variance	1.2715e+007	1.07996e+00

error variance	8.8416e+008
relative bias	-0.418337
rel. std. error	0.69537
model efficiency	0.30463

Save Statistics Report

Monthly Averages

Print All Plots

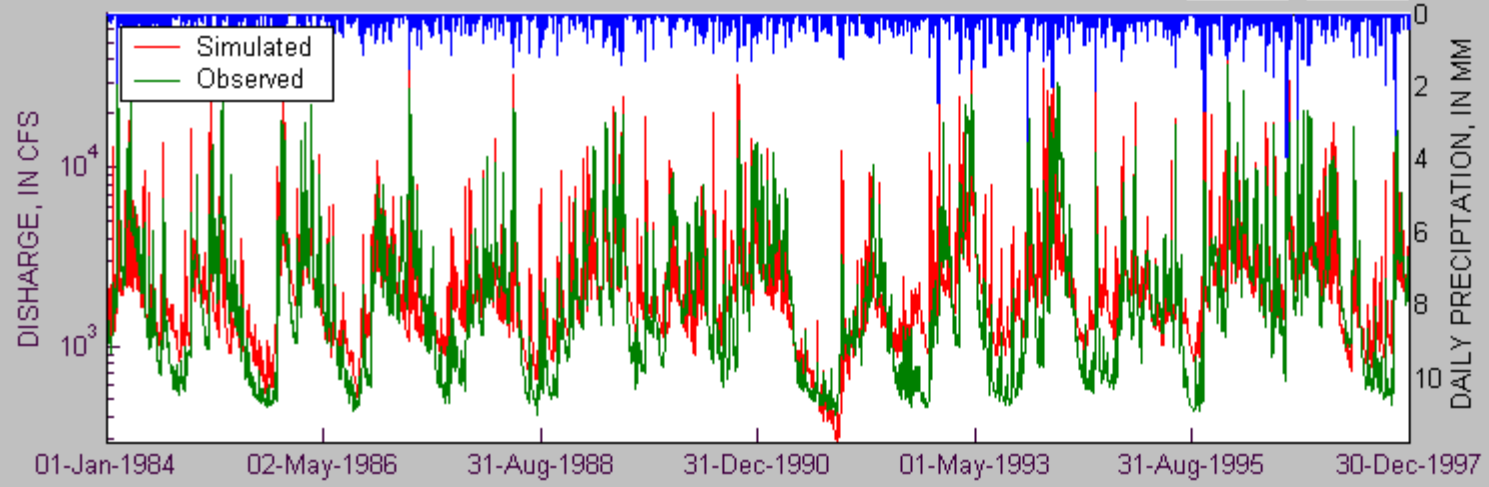
plotter Juniata

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

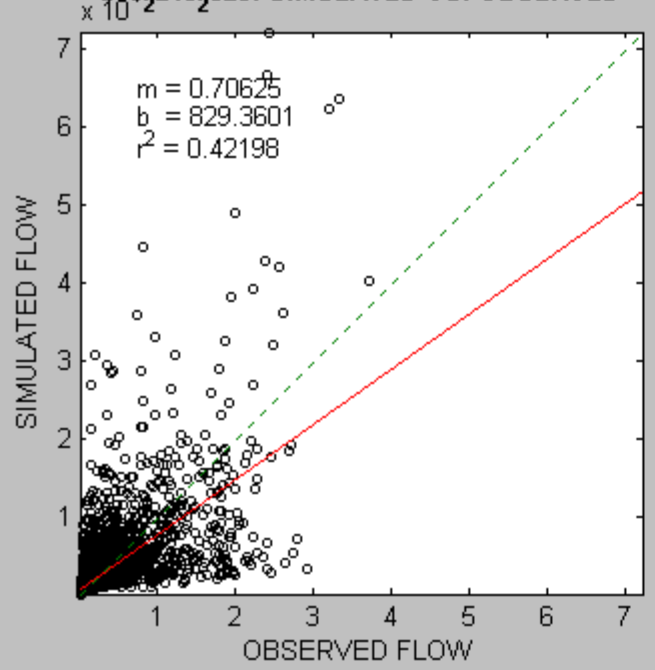
SJ5_2210_2320: FLOW TIME-SERIES

0.5 EP

Examine | Print



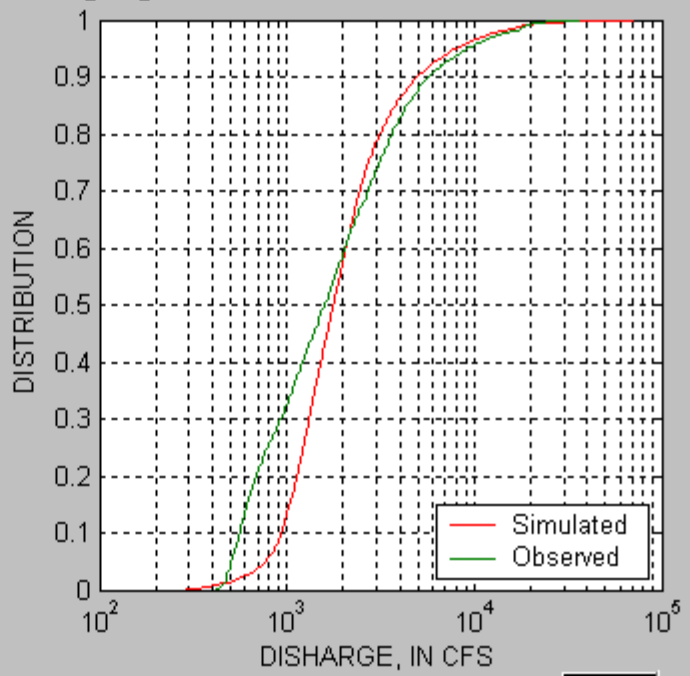
SJ5_2210_2320: SIMULATED VS. OBSERVED



hide regression line | hide y = x line

Print

SJ5_2210_2320: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values

Print

DATA SELECTION

file name: SJ5_2210_2320

plot data: FLOW - discharge

min date	max date
1/1/1984	12/31/1997

Update Plots

STATISTICS

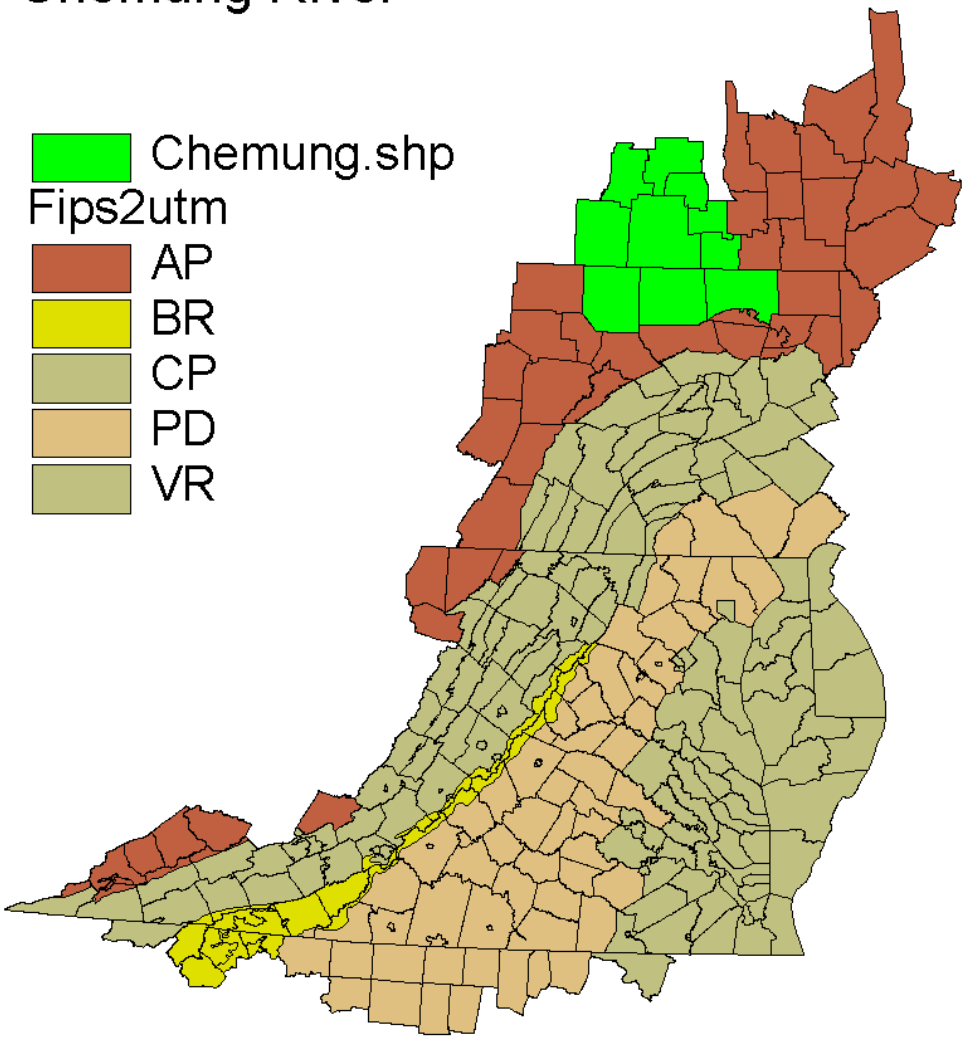
common points: 5113

	observed	simulated
min	416	290.75
mean	2752.57	2773.37
median	1600	1775.9
max	37300	72068
variance	1.2715e+007	.50294e+00
error variance		.78482e+00
relative bias		0.00755689
rel. std. error		0.769552
model efficiency		0.230448

Save Statistics Report

Monthly Averages

Print All Plots


Station SU5_0610_0600
Chemung River
Chemung.shp
Fips2utm
AP
BR
CP
PD
VR

plotter

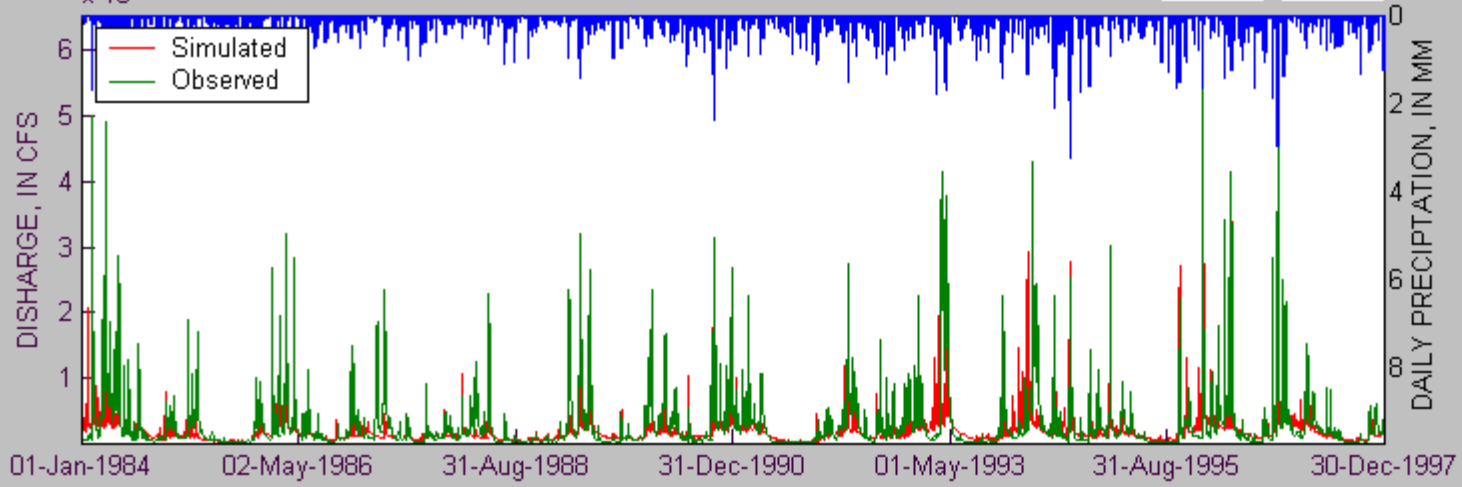
Chemung

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

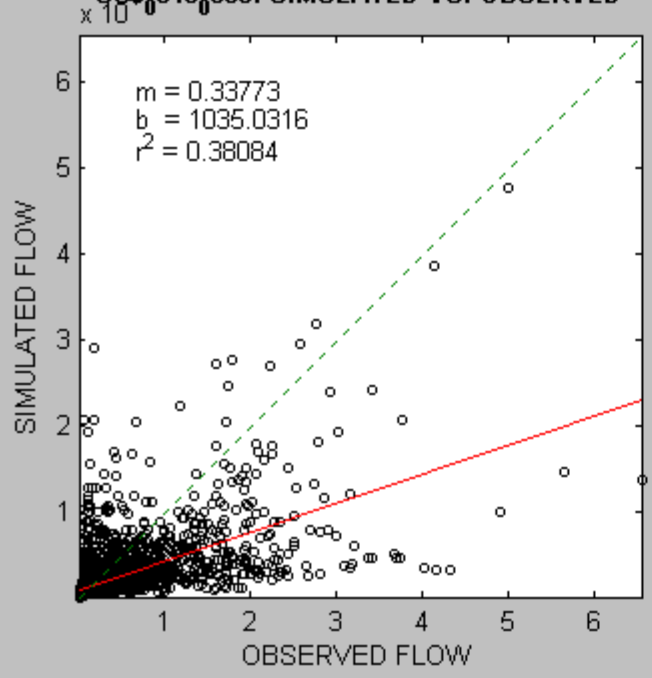
$SU5_0610_0600$: FLOW TIME-SERIES

Init EP

Examine | Print



$SU5_0610_0600$: SIMULATED VS. OBSERVED

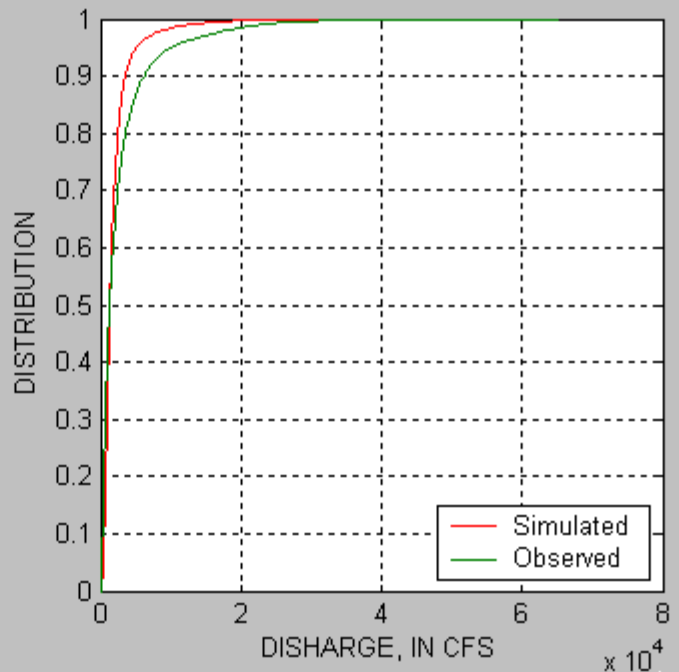


hide regression line

hide y = x line

Print

$SU5_0610_0600$: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot

hide observed values

Print

DATA SELECTION

file name: SU5_0610_0600

plot data: FLOW - discharge

min date	max date
1/1/1984	12/31/1997

Update Plots

STATISTICS

common points: 5113

	observed	simulated
min	113	161.39
mean	2758.18	1966.54
median	1300	1340.8
max	65400	47782
variance	.00255e+00	.99749e+00
error variance	.31235e+00	
relative bias	-0.287015	
rel. std. error	0.65534	
model efficiency	0.34466	

Save Statistics Report

Monthly Averages

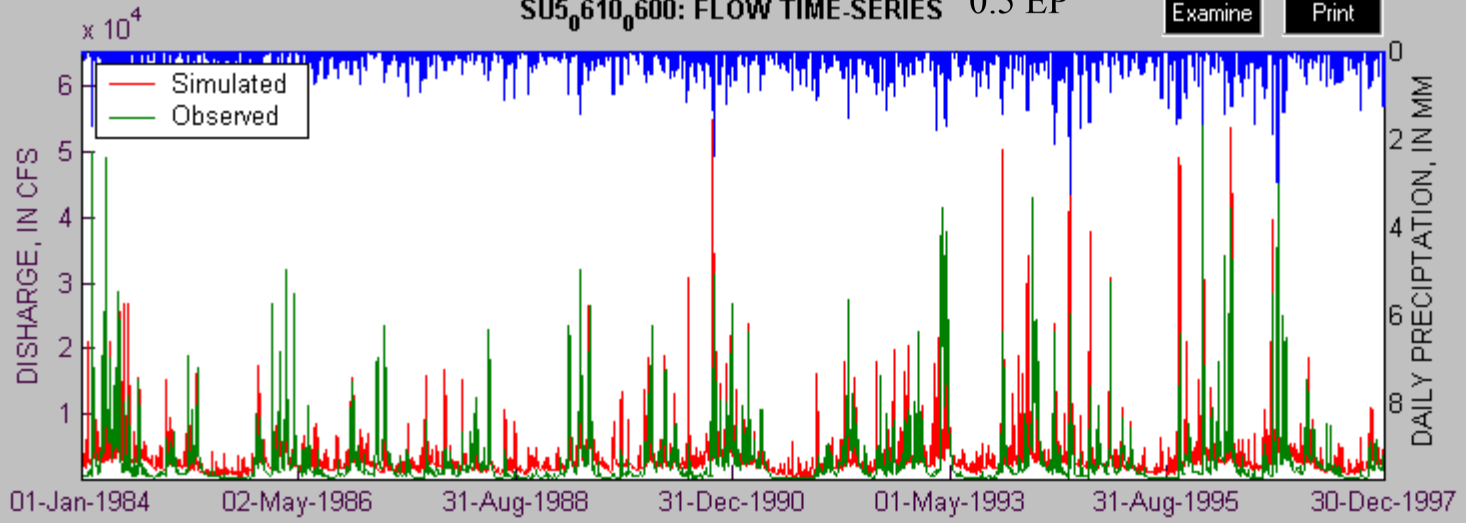
Print All Plots

plotter Chemung

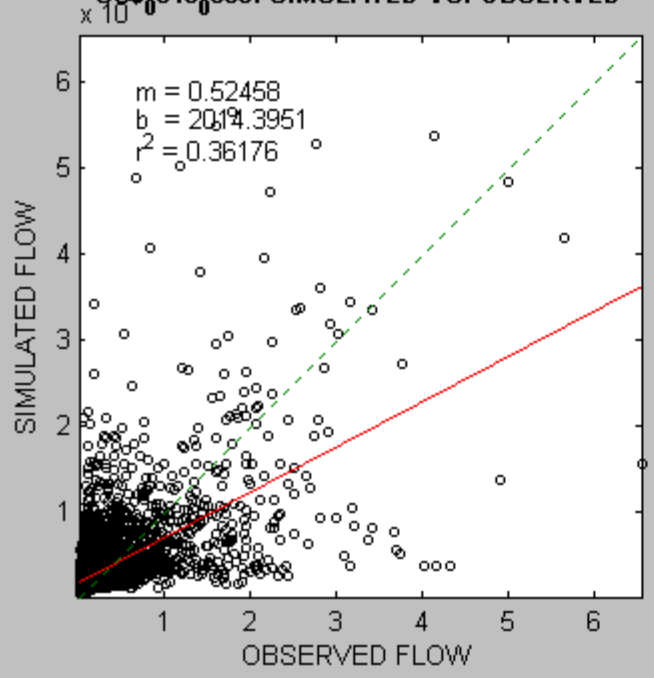
hide precipitation | hide observed values | y-axis log-scale

$SU5_0610_0600$: FLOW TIME-SERIES 0.5 EP

Examine | Print



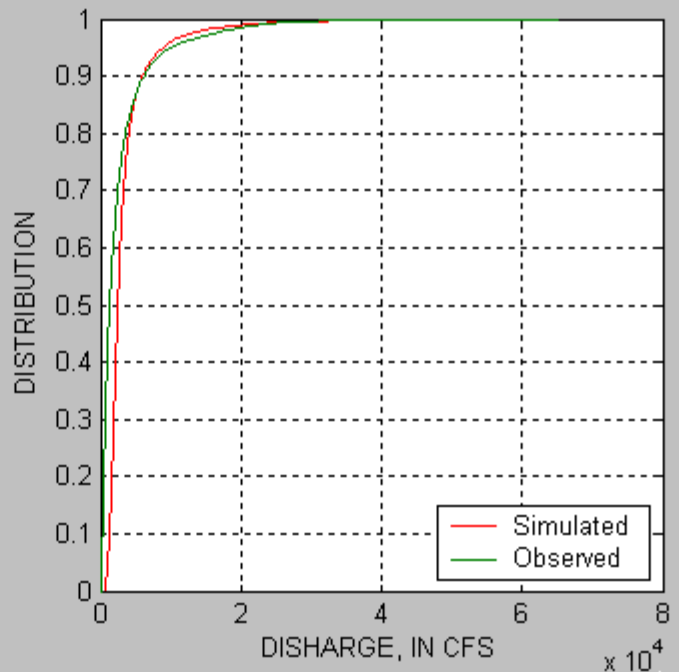
$SU5_0610_0600$: SIMULATED VS. OBSERVED



hide regression line | hide y = x line

Print

$SU5_0610_0600$: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot | hide observed values

Print

DATA SELECTION

file name: SU5_0610_0600

plot data: FLOW - discharge

min date	max date
1/1/1984	12/31/1997

Update Plots

STATISTICS

common points: 5113

	observed	simulated
min	113	501.58
mean	2758.18	3461.29
median	1300	2479.4
max	65400	56475
variance	.00255e+00	.52332e+00

error variance	.47432e+00
relative bias	0.254916
rel. std. error	0.736219
model efficiency	0.263781

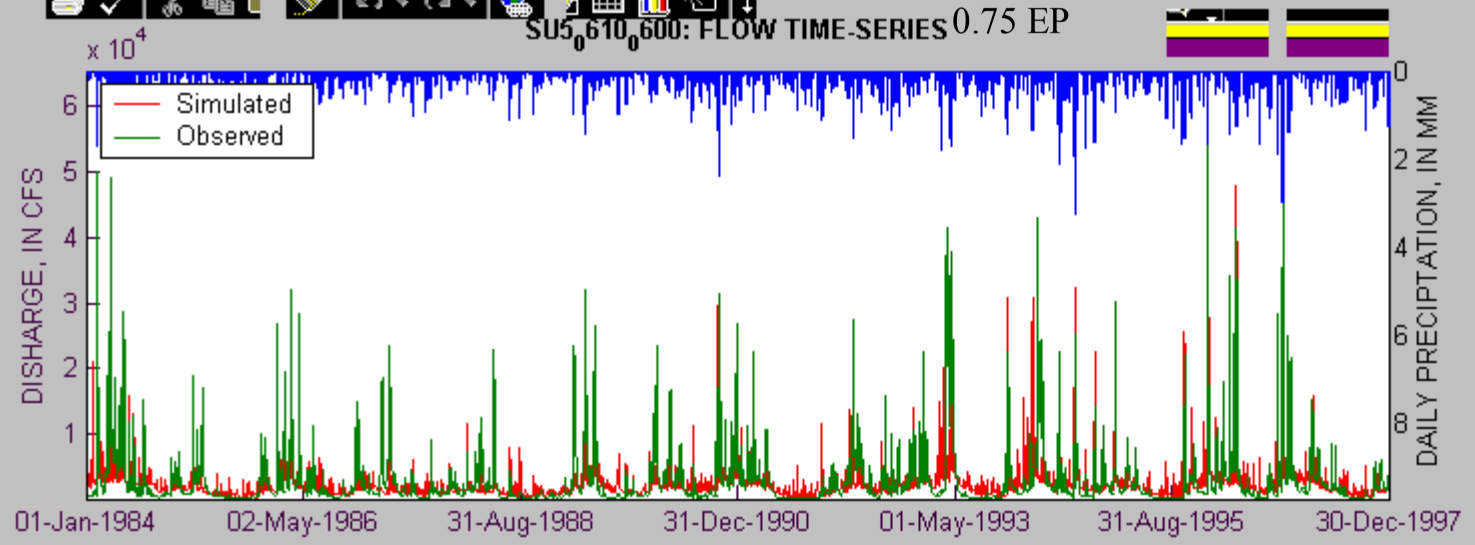
Save Statistics Report

Monthly Averages

Print All Plots

plotter

Chemung



DATA SELECTION

FLOW - discharge

SU5_0610_0600

plot data

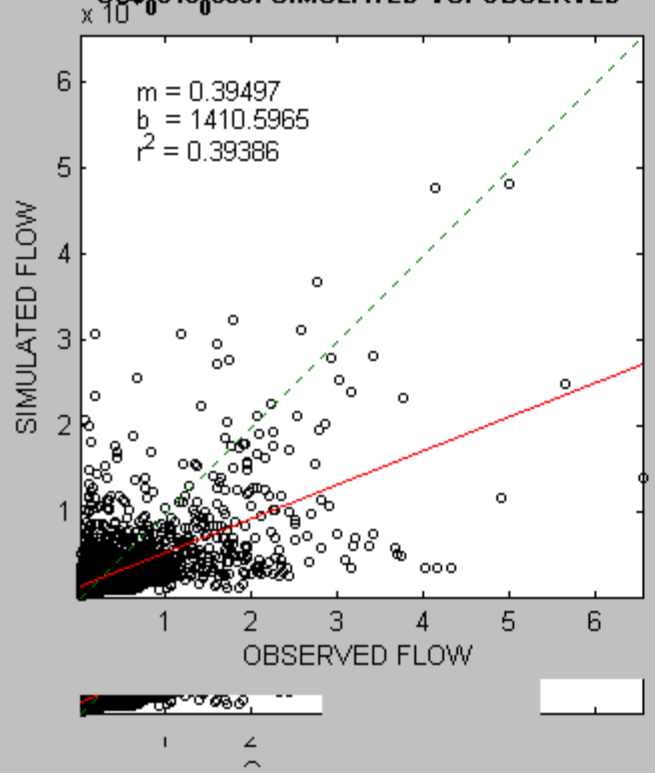
FLOW - discharge

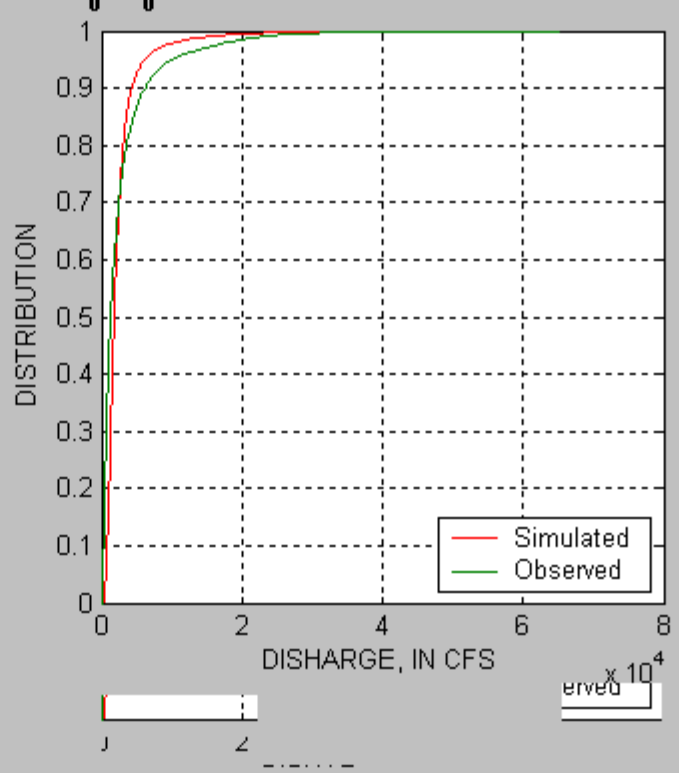
min date: 1/1/1984

max date: 12/31/1997

Update

common points: 5113





STATISTICS

min common points: 276.65

	observed	simulated
min	113	276.65
max	65400	48154
median	1300	1801.9
max	65400	48154
variance	.00255e+00	.93173e+00

error variance: .22049e+00

relative bias: -0.0936069

rel. std. error: 0.60947

model efficiency: 0.39053

Monthly Averages

Save Statistics Report

plotter

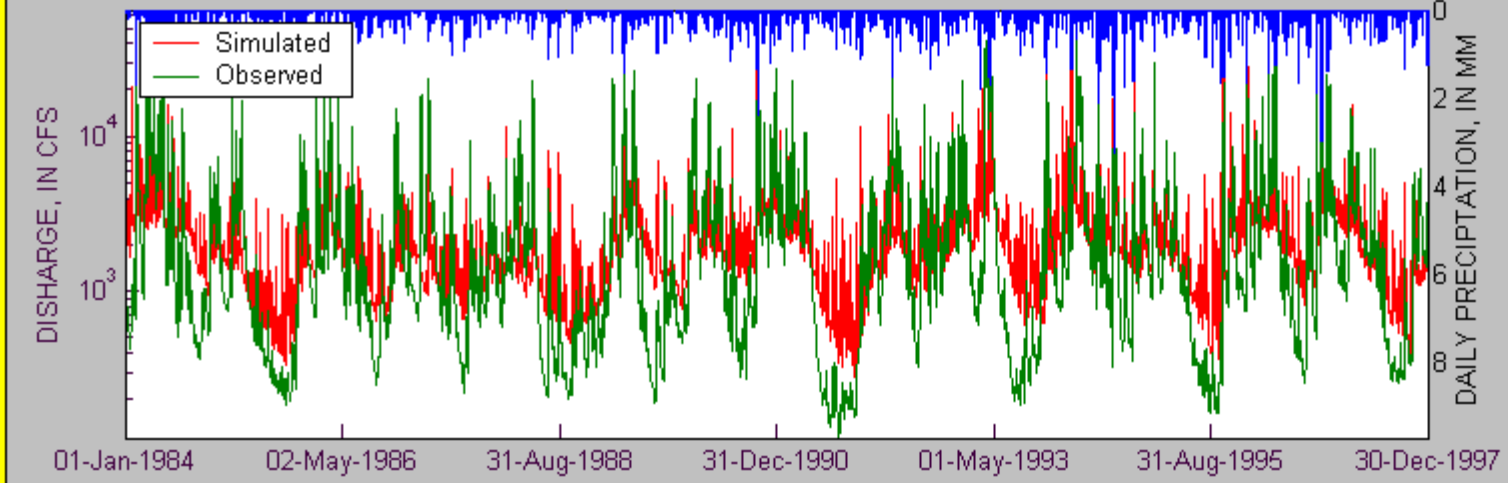
Chemung

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

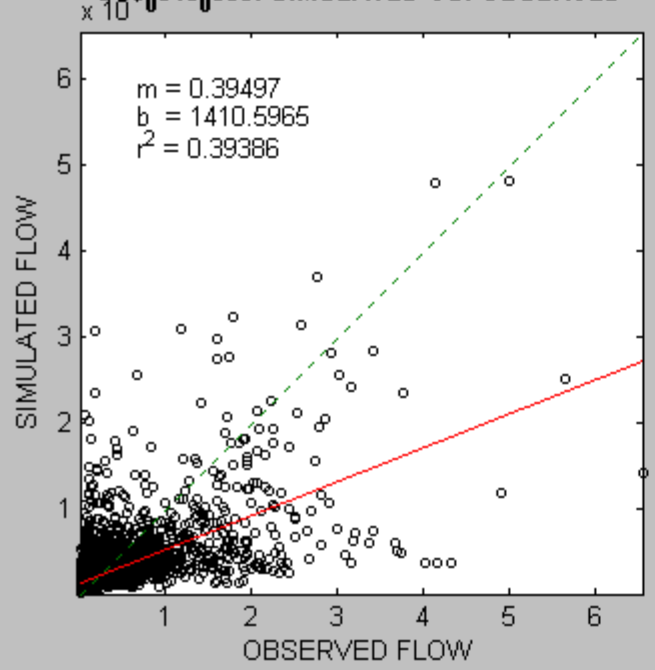
$SU5_0610_0600$: FLOW TIME-SERIES

0.75 EP

Examine | Print



$SU5_0610_0600$: SIMULATED VS. OBSERVED

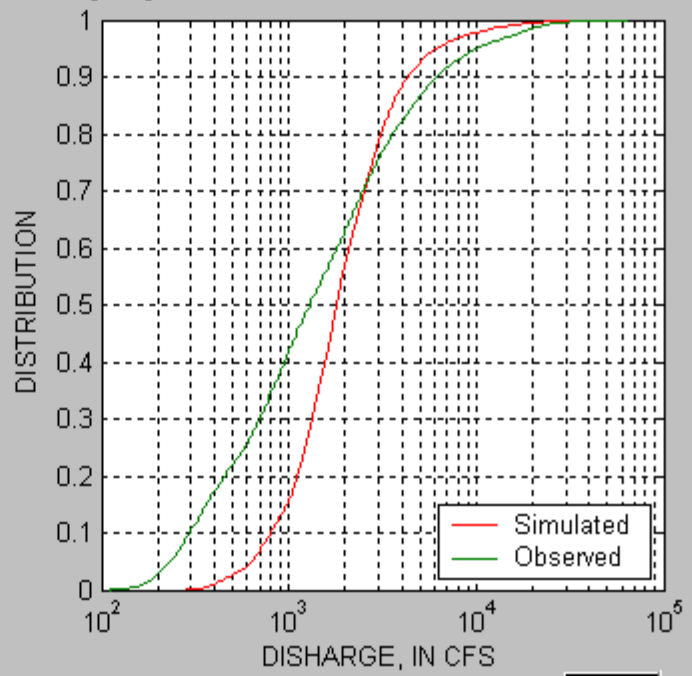


hide regression line

hide y = x line

Print

$SU5_0610_0600$: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot

hide observed values

Print

DATA SELECTION

file name: SU5_0610_0600

plot data: FLOW - discharge

min date	max date
1/1/1984	12/31/1997

Update Plots

STATISTICS

common points: 5113

	observed	simulated
min	113	276.65
mean	2758.18	2500
median	1300	1801.9
max	65400	48154
variance	.00255e+00	.93173e+00

error variance	.22049e+00
relative bias	-0.0936069
rel. std. error	0.60947
model efficiency	0.39053

Save Statistics Report

Monthly Averages

Print All Plots

Points

- First test of system
- Reasonable results
- Still need
  - Correct ET
  - Better land use
  - Better initial parameterization

Next Steps

- Test ET
  - Spatially distributed Hamon
  - 7-station polygon (phase4)
- Test parameters
  - Best guess *a priori*
  - Phase 4.3

Phase 5 Hydrology Calibration

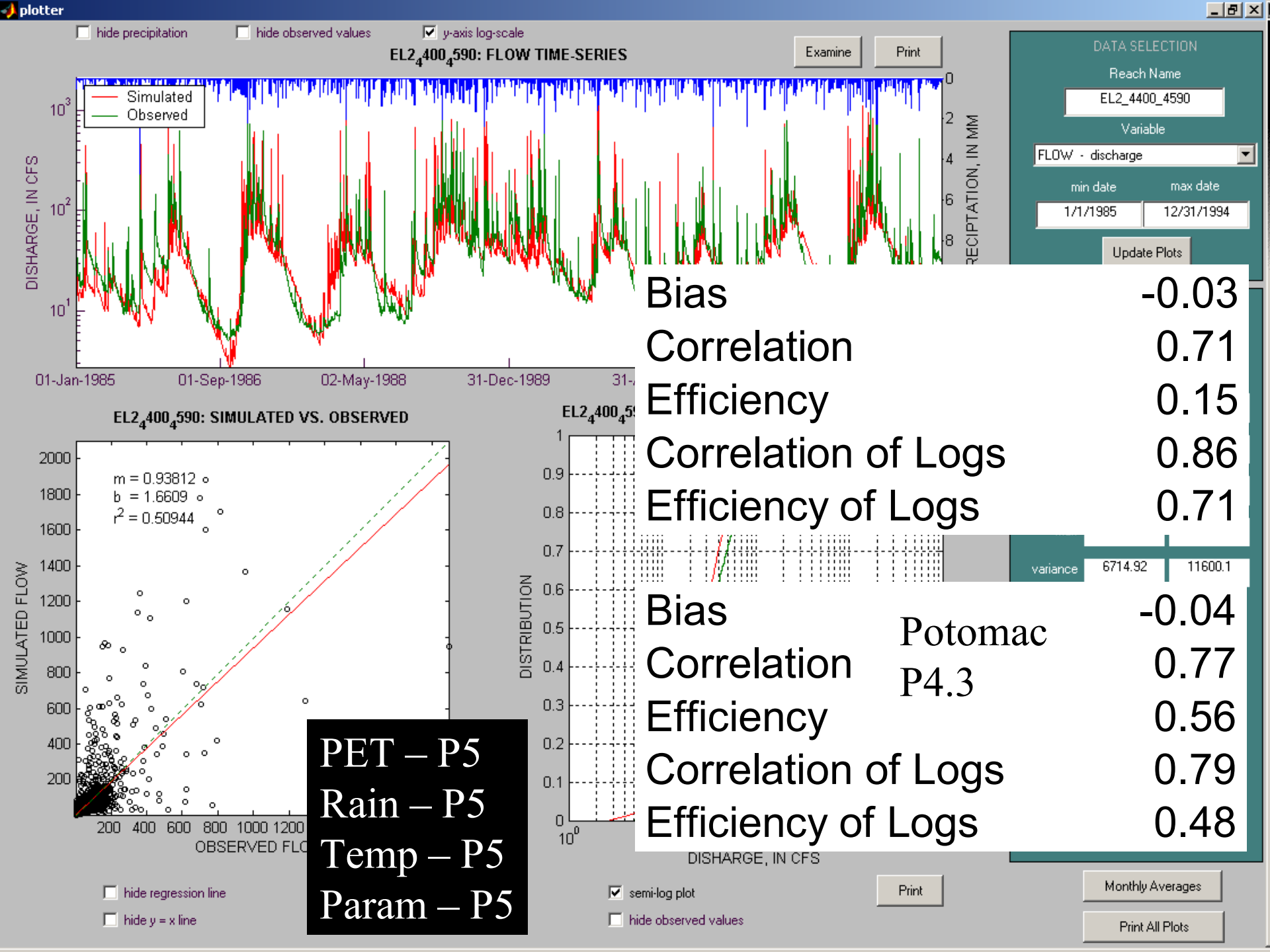
Initial steps and
strategy

P5 Hydrology Calibration Strategy

- Will be impossible to maximize calibration everywhere ~280 flow stations
- Use statistics as well as graphical inspection
- Spend time on data sets and *a priori* parameters so that initial results are optimized

Conflicting hydrologic objectives

- High flow accuracy – loads
- Low flow accuracy – in-stream TMDLs
- Minimize overall errors – best fit
- Minimize log errors – best fit (distribution)
- Match CFD – match system variability


plotter
hide precipitation
hide observed values
y-axis log-scale
EL2_4400_4590: FLOW TIME-SERIES
Examine
Print
Simulated
Observed
DISCHARGE, IN CFS
PRECIPTATION, IN MM
01-Jan-1985
01-Sep-1986
02-May-1988
31-Dec-1989
DATA SELECTION
Reach Name
EL2_4400_4590
Variable
FLOW - discharge
min date
max date
1/1/1985
12/31/1994
Update Plots
Bias -0.03
Correlation 0.71
Efficiency 0.15
Correlation of Logs 0.86
Efficiency of Logs 0.71
variance 6714.92 11600.1
EL2_4400_4590: SIMULATED VS. OBSERVED
m = 0.93812
b = 1.6609
r2 = 0.50944
SIMULATED FLOW
OBSERVED FLO
DISTRIBUTION
DISHARGE, IN CFS
Bias -0.04
Correlation 0.77
Efficiency 0.56
Correlation of Logs 0.79
Efficiency of Logs 0.48
Potomac
P4.3
PET – P5
Rain – P5
Temp – P5
Param – P5
hide regression line
hide y = x line
semi-log plot
hide observed values
Print
Monthly Averages
Print All Plots

Tests of P5 vs P4 data sets

- PET
- Rain
- Temperature
- Parameters

PET-P4

- Penman-Monteith method
  - Multi-Parameter model
- 7 areas extrapolated to groups of counties
- Over-estimates
- Daily

PET-Precipitation Model – P5

- Hamon method
- Specific to each county
- Under Estimates
- Hourly

Rainfall

- P4 - Thiessen Polygons ~ 300 stations
- P5 – regression model with ~ 500 stations adjusting for latitude, longitude, and slope

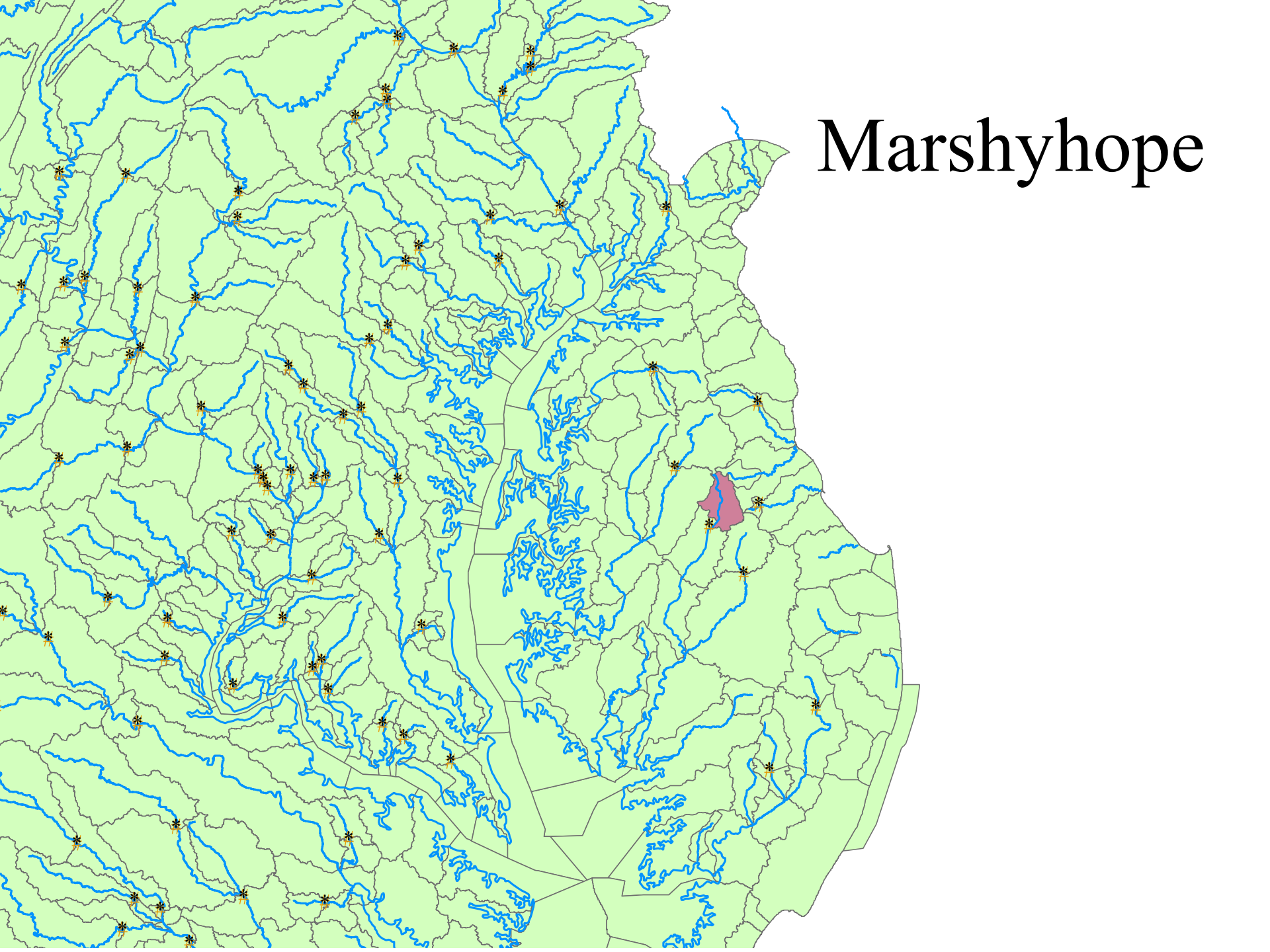
Temperature

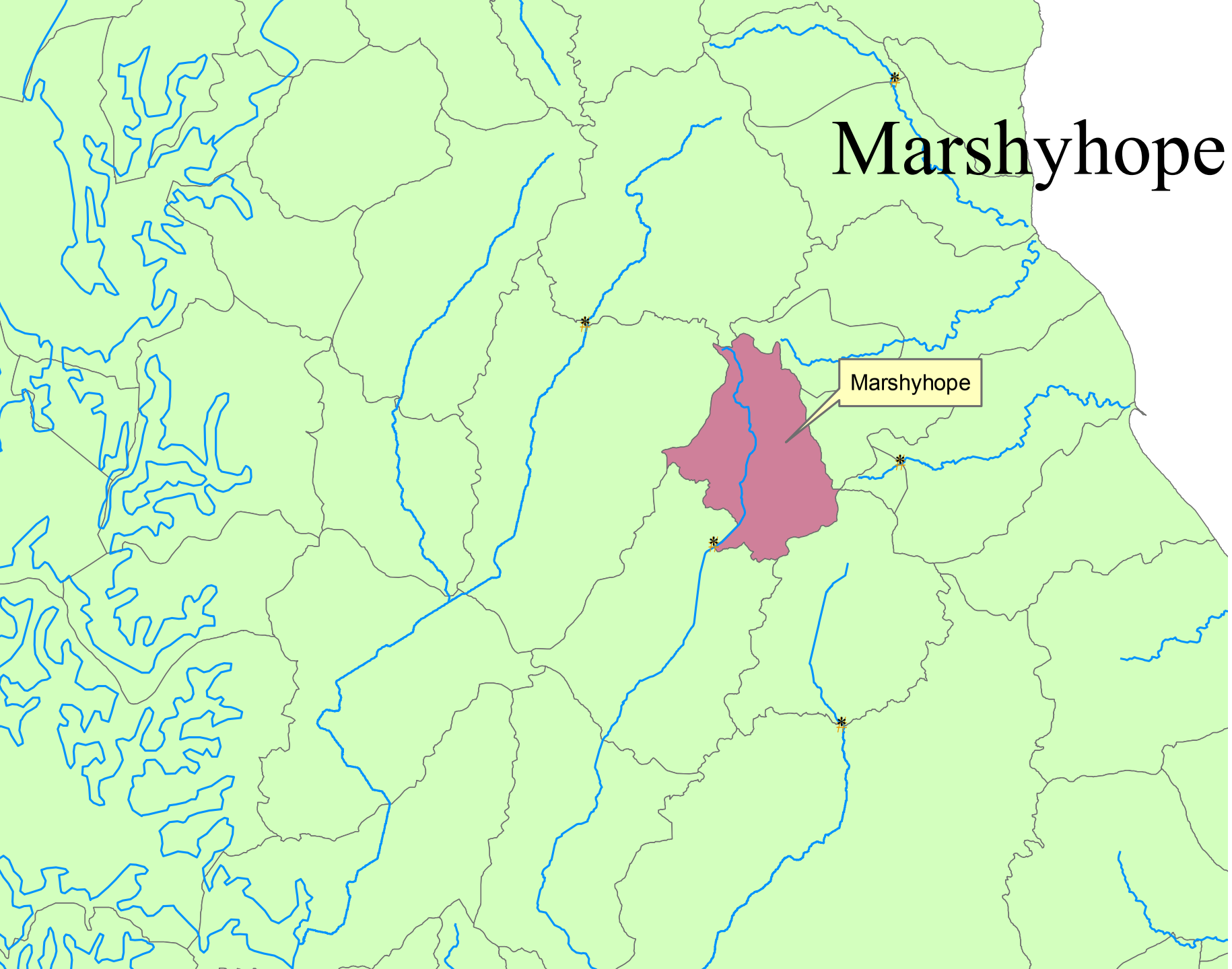
- P4 – 7 stations
- P5 – from Rainfall model – adjusts for latitude, longitude, altitude

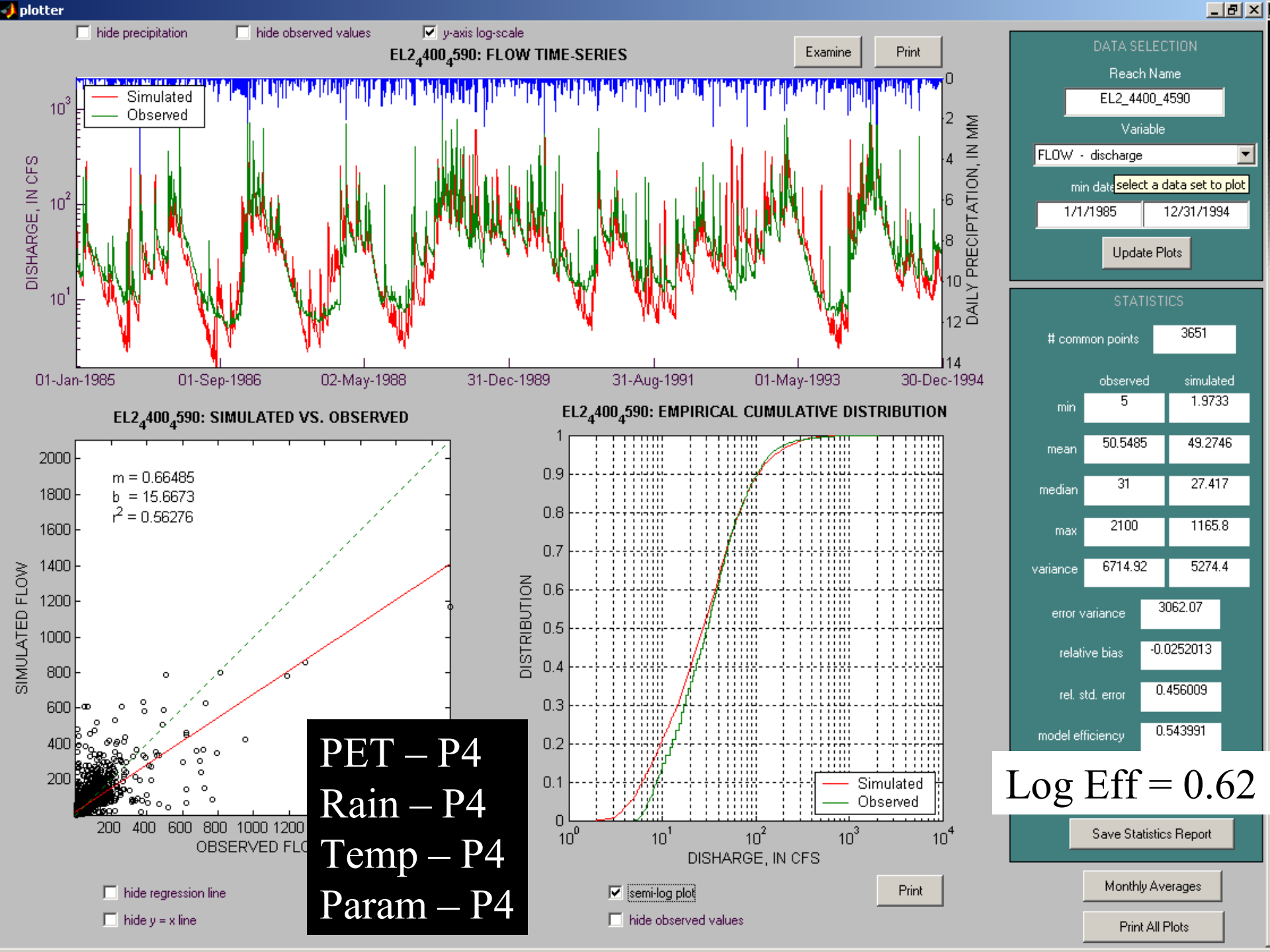
Parameters

- P4 – Used parameters from coincident segment

- P5 – Went to several resources for default values and added spatially-varied:
  - Slope
  - Coniferous percentage
  - Groundwater recession rate


Marshyhope


Marshyhope
Marshyhope

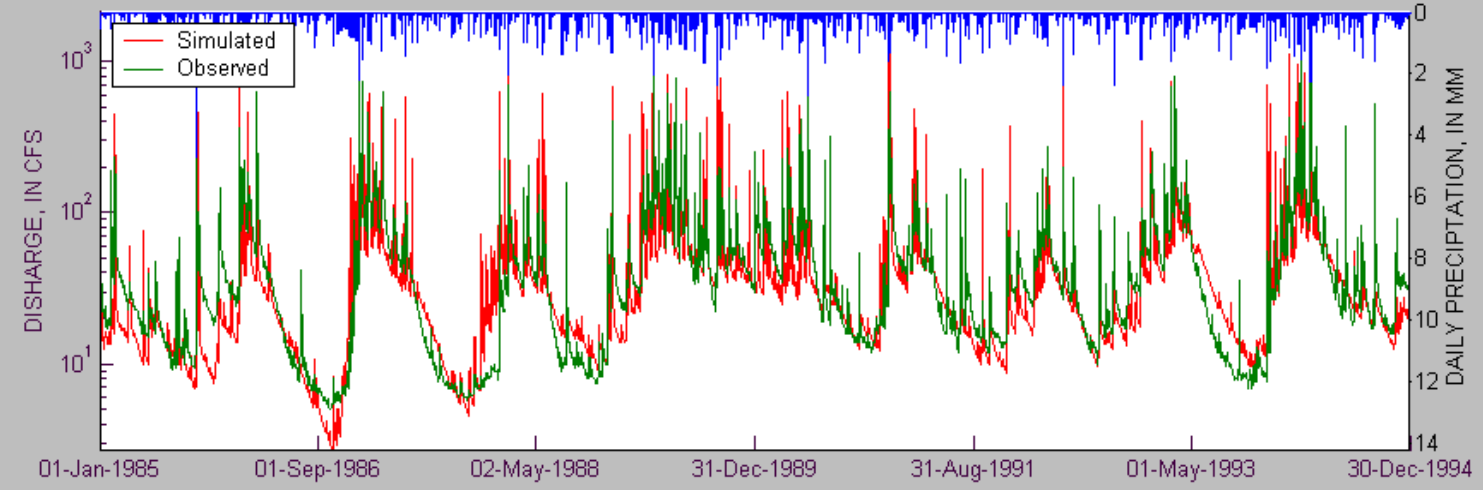

plotter
hide precipitation
hide observed values
y-axis log-scale
EL2_4400_4590: FLOW TIME-SERIES
Examine
Print
Simulated
Observed
DISHARGE, IN CFS
DAILY PRECIPTATION, IN MM
01-Jan-1985
01-Sep-1986
02-May-1988
31-Dec-1989
31-Aug-1991
01-May-1993
30-Dec-1994
DATA SELECTION
Reach Name
EL2_4400_4590
Variable
FLOW - discharge
min date
select a data set to plot
1/1/1985
12/31/1994
Update Plots
STATISTICS
common points
3651
observed
simulated
min
5
1.9733
mean
50.5485
49.2746
median
31
27.417
max
2100
1165.8
variance
6714.92
5274.4
error variance
3062.07
relative bias
-0.0252013
rel. std. error
0.456009
model efficiency
0.543991
EL2_4400_4590: SIMULATED VS. OBSERVED
m = 0.66485
b = 15.6673
r2 = 0.56276
SIMULATED FLOW
OBSERVED FLO
EL2_4400_4590: EMPIRICAL CUMULATIVE DISTRIBUTION
DISTRIBUTION
DISHARGE, IN CFS
Simulated
Observed
PET – P4
Rain – P4
Temp – P4
Param – P4
Log Eff = 0.62
hide regression line
hide y = x line
semi-log plot
hide observed values
Print
Save Statistics Report
Monthly Averages
Print All Plots

plotter

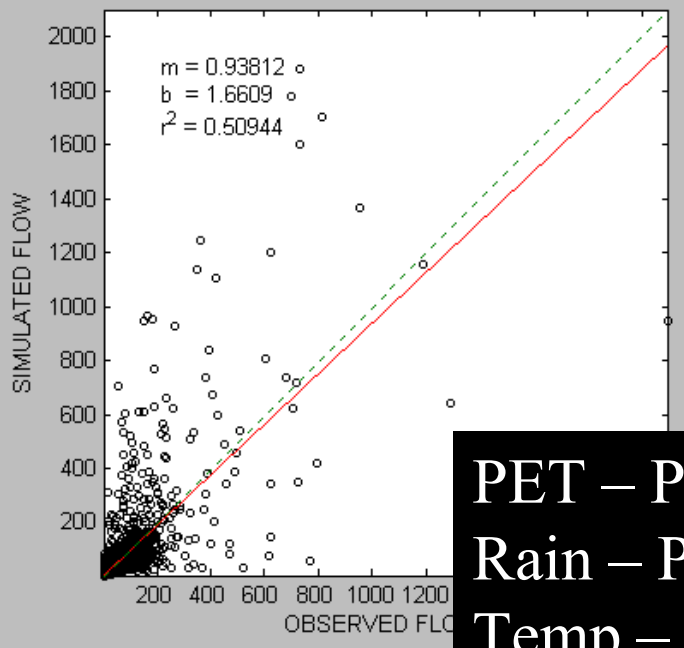
hide precipitation | hide observed values | y-axis log-scale

EL2_4400_4590: FLOW TIME-SERIES

Examine | Print



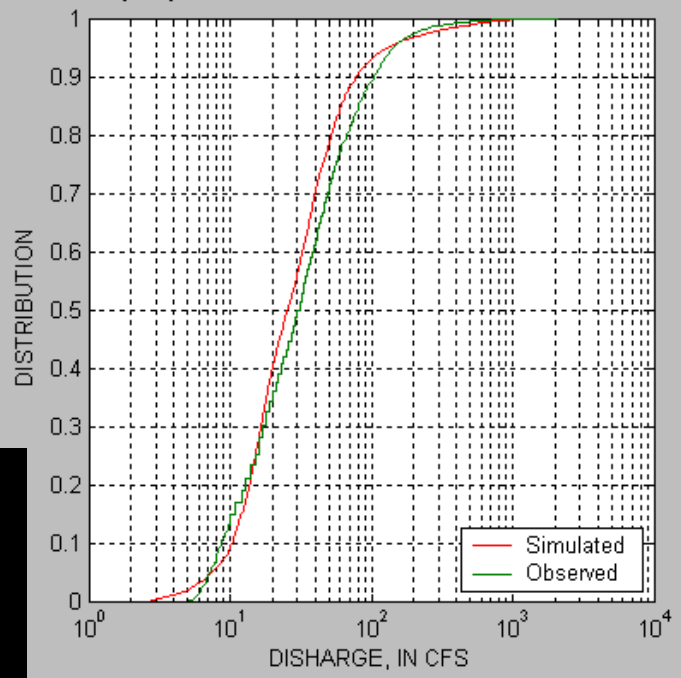
EL2_4400_4590: SIMULATED VS. OBSERVED



hide regression line

hide y = x line

EL2_4400_4590: EMPIRICAL CUMULATIVE DISTRIBUTION



semi-log plot

hide observed values

Print

PET – P5
Rain – P5
Temp – P5
Param – P5

DATA SELECTION

Reach Name: EL2_4400_4590

Variable: FLOW - discharge

min date	max date
1/1/1985	12/31/1994

Update Plots

STATISTICS

common points: 3651

	observed	simulated
min	5	2.7274
mean	50.5485	49.0813
median	31	25.604
max	2100	1878.1
variance	6714.92	11600.1

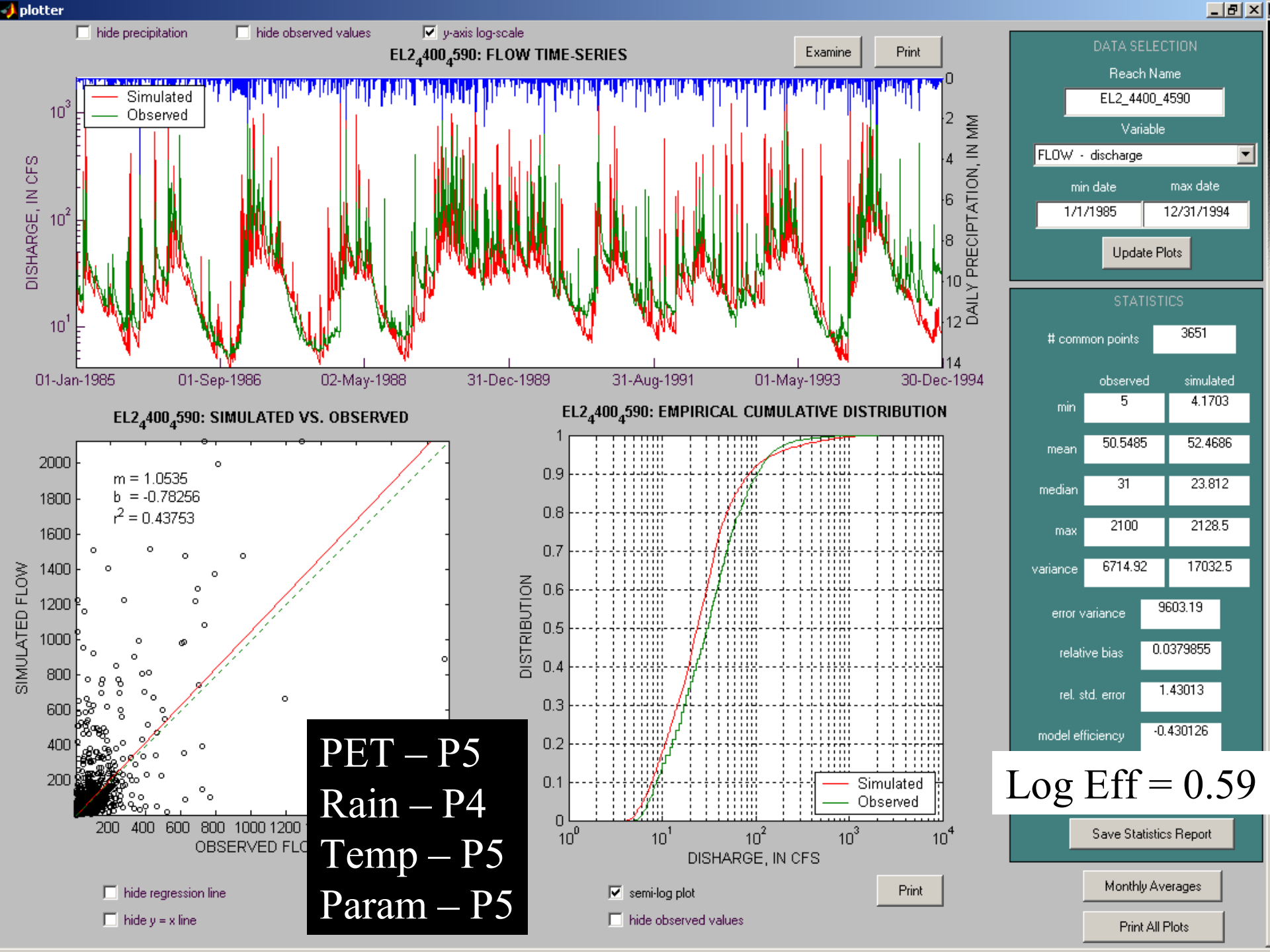
error variance	5718.43
relative bias	-0.0290262
rel. std. error	0.851601
model efficiency	0.148399

Log Eff = 0.71

Save Statistics Report

Monthly Averages

Print All Plots


plotter
hide precipitation
hide observed values
y-axis log-scale
EL2_4400_4590: FLOW TIME-SERIES
Examine
Print
Simulated
Observed
DISHARGE, IN CFS
DAILY PRECIPTATION, IN MM
01-Jan-1985
01-Sep-1986
02-May-1988
31-Dec-1989
31-Aug-1991
01-May-1993
30-Dec-1994
EL2_4400_4590: SIMULATED VS. OBSERVED
m = 1.0535
b = -0.78256
r2 = 0.43753
SIMULATED FLOW
OBSERVED FLO
hide regression line
hide y = x line
EL2_4400_4590: EMPIRICAL CUMULATIVE DISTRIBUTION
DISTRIBUTION
DISHARGE, IN CFS
Simulated
Observed
semi-log plot
hide observed values
Print
DATA SELECTION
Reach Name
EL2_4400_4590
Variable
FLOW - discharge
min date
max date
1/1/1985
12/31/1994
Update Plots
STATISTICS
common points
3651
observed
simulated
min
5
4.1703
mean
50.5485
52.4686
median
31
23.812
max
2100
2128.5
variance
6714.92
17032.5
error variance
9603.19
relative bias
0.0379855
rel. std. error
1.43013
model efficiency
-0.430126
Save Statistics Report
Monthly Averages
Print All Plots
PET – P5
Rain – P4
Temp – P5
Param – P5
Log Eff = 0.59

Overall Test on Marshyhope

RAIN	PET	TEMP	PARM	Bias	correl	Starting nse	correl log	nse log
Phase5	Phase5	Phase5	Phase5	-0.03	0.71	0.15	0.86	0.71
Phase5	Phase5	Phase5	P4	-0.02	0.73	0.54	0.88	0.76
Phase5	Phase5	P4	Phase5	0.01	0.69	0.11	0.85	0.70
Phase5	Phase5	P4	P4	0.01	0.73	0.53	0.88	0.76
Phase5	P4	Phase5	Phase5	-0.38	0.74	0.43	0.83	-0.01
Phase5	P4	Phase5	P4	-0.42	0.71	0.42	0.87	0.10
Phase5	P4	P4	Phase5	-0.32	0.72	0.38	0.83	0.16
Phase5	P4	P4	P4	-0.38	0.71	0.43	0.87	0.22
P4	Phase5	Phase5	Phase5	0.21	0.63	-0.88	0.81	0.61
P4	Phase5	Phase5	P4	0.21	0.75	0.48	0.84	0.63
P4	Phase5	P4	Phase5	0.23	0.62	-0.90	0.81	0.60
P4	Phase5	P4	P4	0.22	0.75	0.48	0.84	0.63
P4	P4	Phase5	Phase5	-0.19	0.68	-0.05	0.84	0.35
P4	P4	Phase5	P4	-0.24	0.78	0.58	0.86	0.42
P4	P4	P4	Phase5	-0.14	0.66	-0.10	0.83	0.41
P4	P4	P4	P4	-0.21	0.78	0.59	0.86	0.47

Overall Test on Marshyhope

				Ending				
				Bias	correl	nse	correl log	nse log
Phase5	Phase5	Phase5	Phase5	-0.03	0.71	0.15	0.86	0.71
Phase5	Phase5	Phase5	P4	-0.02	0.73	0.54	0.88	0.76
Phase5	Phase5	P4	Phase5	0.01	0.69	0.11	0.85	0.70
Phase5	Phase5	P4	P4	0.01	0.73	0.53	0.88	0.76
Phase5	P4	Phase5	Phase5	-0.03	0.72	0.14	0.86	0.69
Phase5	P4	Phase5	P4	0.02	0.71	0.50	0.86	0.72
Phase5	P4	P4	Phase5	-0.05	0.70	0.18	0.85	0.65
Phase5	P4	P4	P4	-0.01	0.71	0.50	0.87	0.73
P4	Phase5	Phase5	Phase5	0.04	0.66	-0.43	0.83	0.59
P4	Phase5	Phase5	P4	0.04	0.78	0.59	0.85	0.67
P4	Phase5	P4	Phase5	0.05	0.65	-0.43	0.82	0.59
P4	Phase5	P4	P4	0.04	0.78	0.60	0.85	0.68
P4	P4	Phase5	Phase5	-0.03	0.66	-0.38	0.84	0.52
P4	P4	Phase5	P4	-0.02	0.75	0.53	0.85	0.61
P4	P4	P4	Phase5	-0.03	0.65	-0.34	0.83	0.52
P4	P4	P4	P4	-0.03	0.75	0.54	0.85	0.62

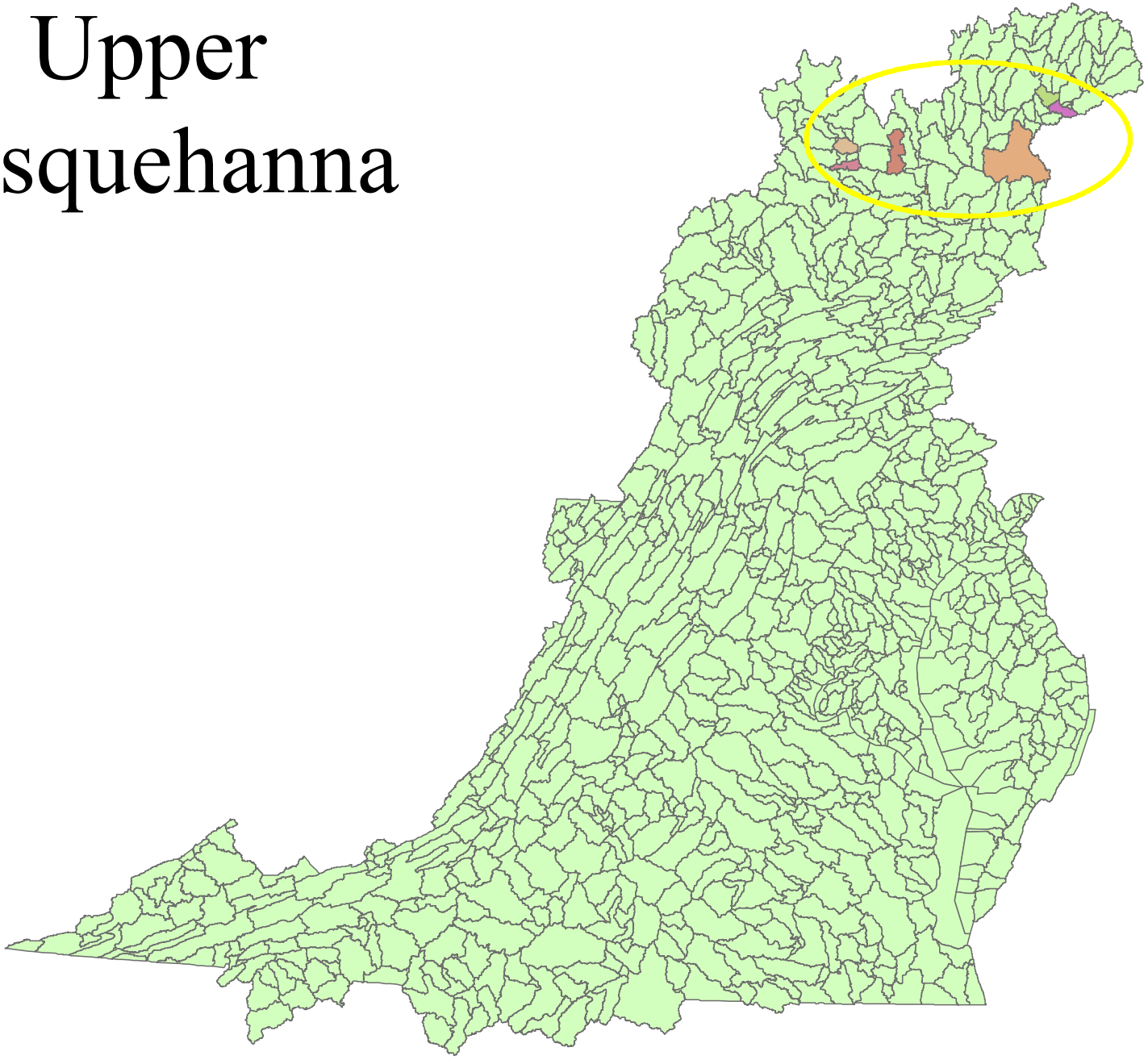
Effect on Log Efficiency

- Rain
  - P5 .114 better than P4
- PET
  - P5 .048 better than P4
- Temperature
  - P5 .001 better than P4
- Parameters
  - P4 .074 better than P5

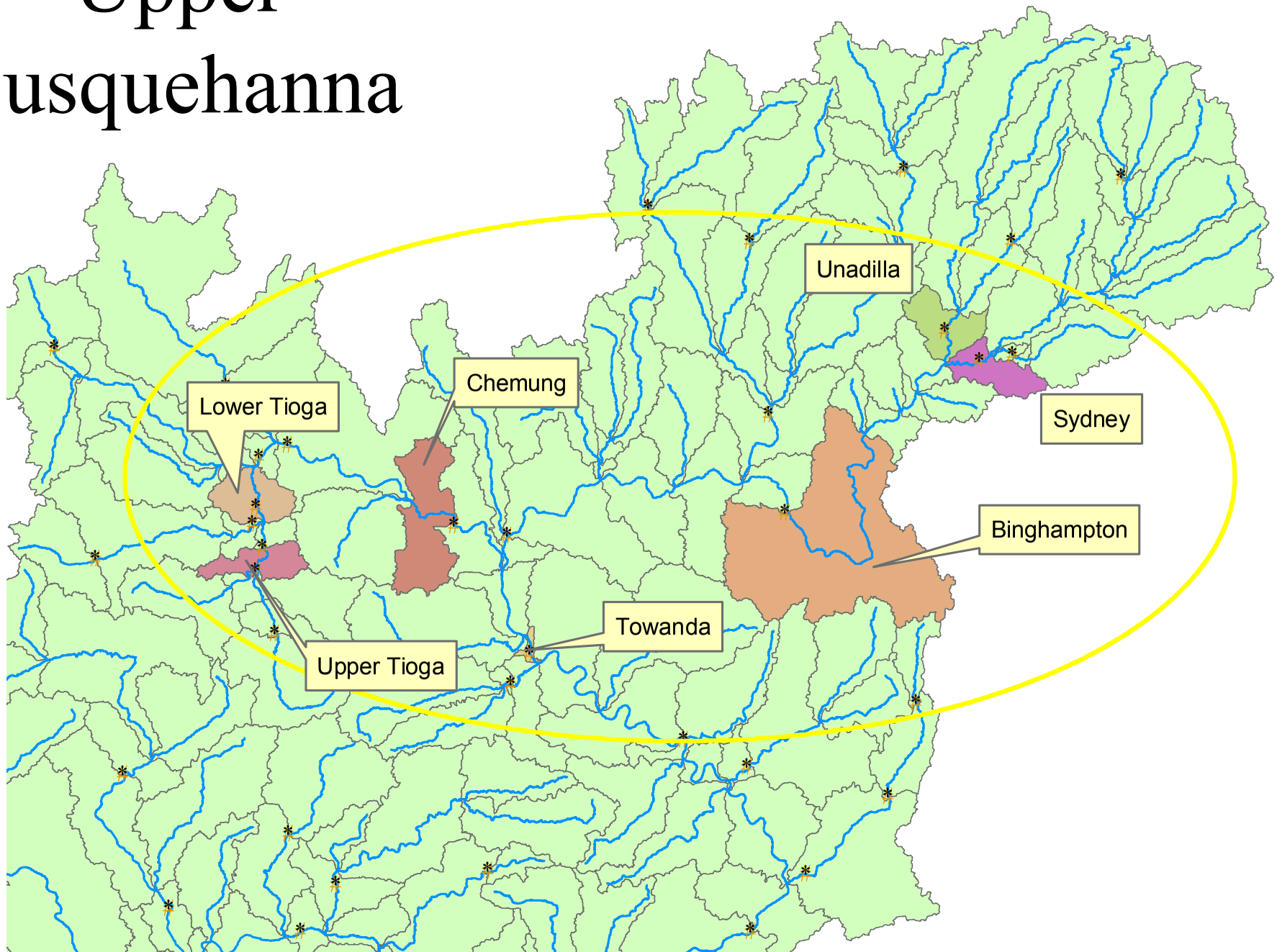
Effect on Initial Bias

- Rain
  - P5 1% better than P4
- PET
  - P5 17% better than P4
- Temperature
  - P4 2% better than P5
- Parameters
  - P5 3% better than P4

Upper Susquehanna



Upper Susquehanna



Unadilla (Sydney very similar)

Effect on Log Efficiency (biased)

- Rain
  - P4 .075 better than P5
- PET
  - P5 .243 better than P4
- Temperature
  - P5 .038 better than P4
- Parameters
  - P4 .210 better than P5

Effect on Log Efficiency (biased)

- Rain
  - P4 .094 better than P5
- PET
  - P5 .266 better than P4
- Temperature
  - P5 .034 better than P4
- Parameters
  - P4 .209 better than P5

Below Tioga Dam

Effect on Log Efficiency (biased)

- Rain
  - P5 .060 better than P4
- PET
  - P4 .180 better than P5
- Temperature
  - P5 .035 better than P4
- Parameters
  - P5 .175 better than P4

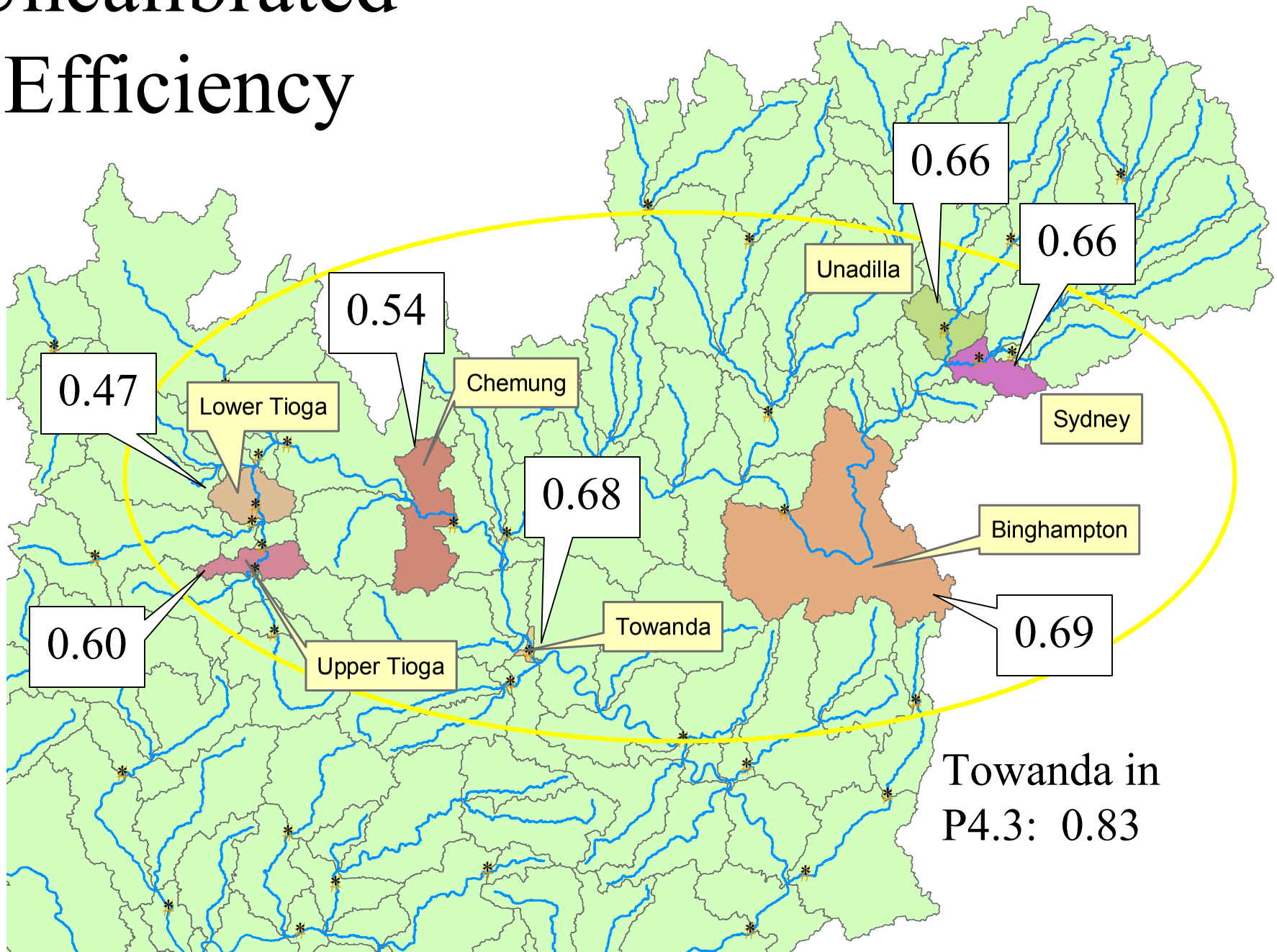
Effect on Log Efficiency (biased)

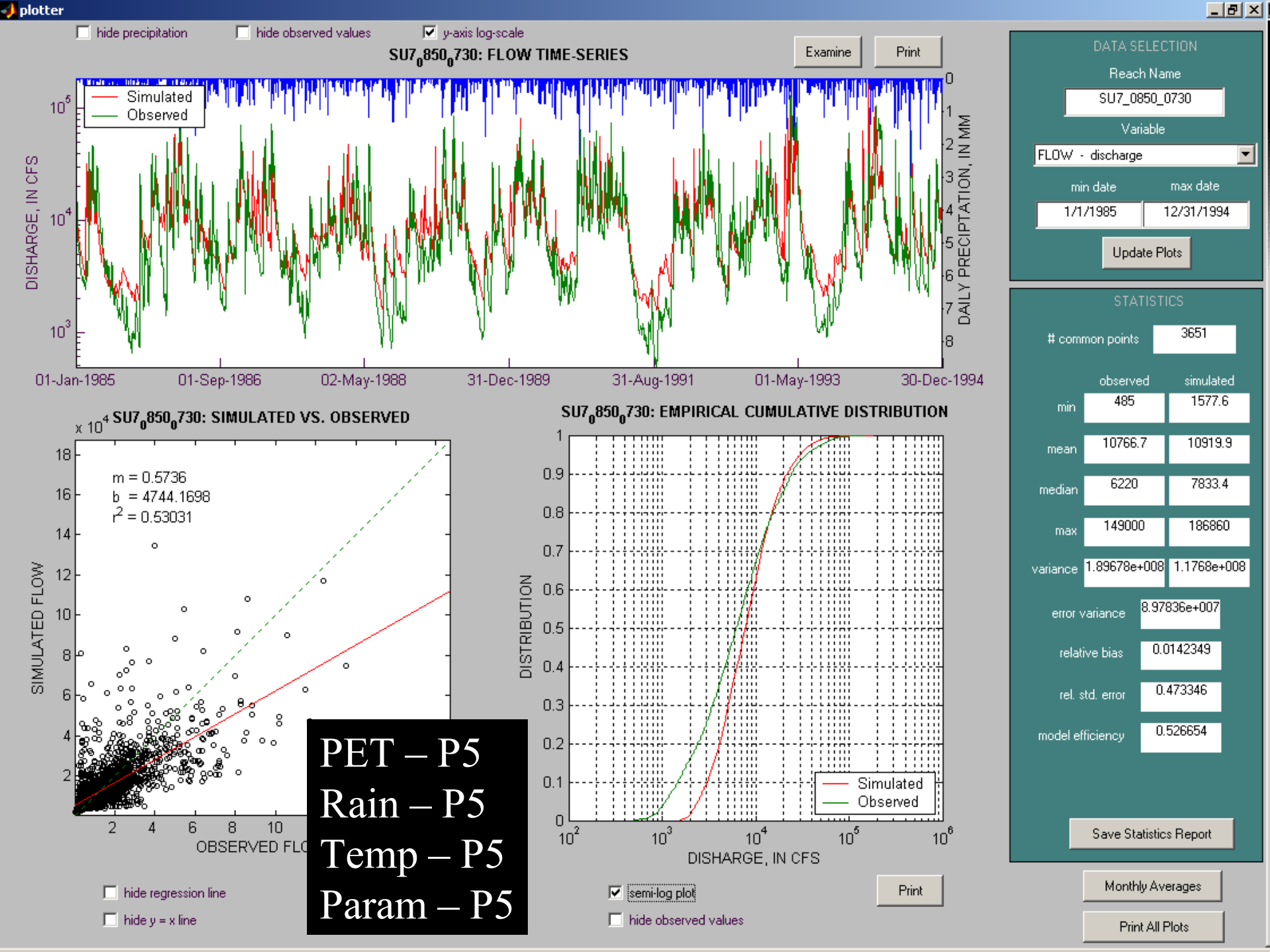
- Rain
  - P4 .079 better than P5
- PET
  - P4 .101 better than P5
- Temperature
  - P5 .038 better than P4
- Parameters
  - P4 .054 better than P5

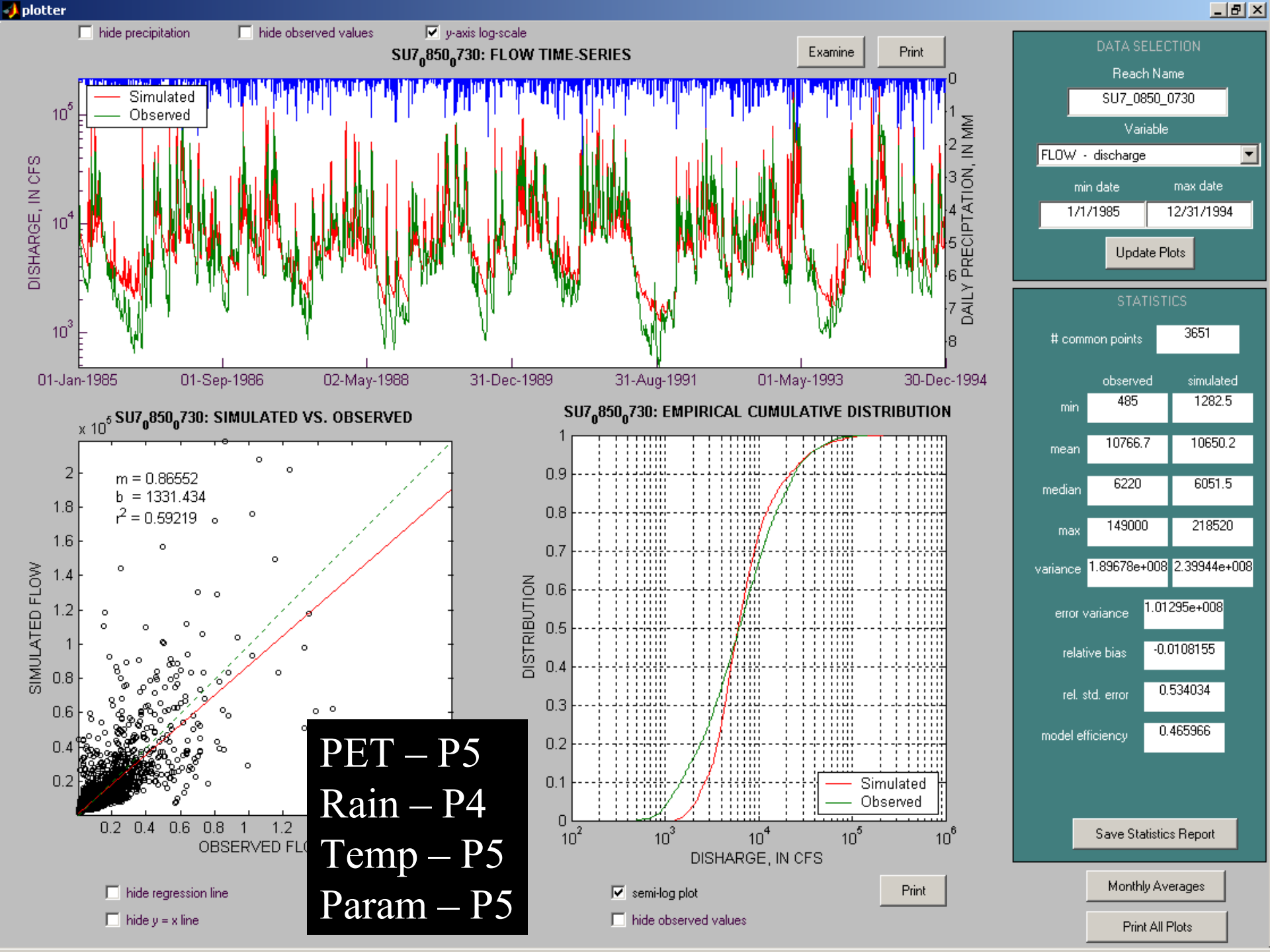
Effect on Log Efficiency (biased)

- Rain
  - P4 .119 better than P5
- PET
  - P5 .131 better than P4
- Temperature
  - P5 .031 better than P4
- Parameters
  - P4 .151 better than P5

Uncalibrated Efficiency




plotter
hide precipitation
hide observed values
y-axis log-scale
SU7_0850_0730: FLOW TIME-SERIES
Examine
Print
Simulated
Observed
DISHARGE, IN CFS
DAILY PRECIPTATION, IN MM
01-Jan-1985
01-Sep-1986
02-May-1988
31-Dec-1989
31-Aug-1991
01-May-1993
30-Dec-1994
DATA SELECTION
Reach Name
SU7_0850_0730
Variable
FLOW - discharge
min date
max date
1/1/1985
12/31/1994
Update Plots
STATISTICS
common points
3651
observed
simulated
min
485
1577.6
mean
10766.7
10919.9
median
6220
7833.4
max
149000
186860
variance
1.89678e+008
1.1768e+008
error variance
8.97836e+007
relative bias
0.0142349
rel. std. error
0.473346
model efficiency
0.526654
Save Statistics Report
SU7_0850_0730: SIMULATED VS. OBSERVED
m = 0.5736
b = 4744.1698
r2 = 0.53031
SIMULATED FLOW
OBSERVED FLO
SU7_0850_0730: EMPIRICAL CUMULATIVE DISTRIBUTION
DISTRIBUTION
DISHARGE, IN CFS
Simulated
Observed
hide regression line
hide y = x line
semi-log plot
hide observed values
Print
Monthly Averages
Print All Plots
PET – P5
Rain – P5
Temp – P5
Param – P5


plotter
hide precipitation
hide observed values
y-axis log-scale
SU7_0850_0730: FLOW TIME-SERIES
Examine
Print
Simulated
Observed
DISHARGE, IN CFS
DAILY PRECIPTATION, IN MM
01-Jan-1985
01-Sep-1986
02-May-1988
31-Dec-1989
31-Aug-1991
01-May-1993
30-Dec-1994
DATA SELECTION
Reach Name
SU7_0850_0730
Variable
FLOW - discharge
min date
max date
1/1/1985
12/31/1994
Update Plots
STATISTICS
common points
3651
observed
simulated
min
485
1282.5
mean
10766.7
10650.2
median
6220
6051.5
max
149000
218520
variance
1.89678e+008
2.39944e+008
error variance
1.01295e+008
relative bias
-0.0108155
rel. std. error
0.534034
model efficiency
0.465966
SU7_0850_0730: SIMULATED VS. OBSERVED
m = 0.86552
b = 1331.434
r2 = 0.59219
SIMULATED FLOW
OBSERVED FL
SU7_0850_0730: EMPIRICAL CUMULATIVE DISTRIBUTION
DISTRIBUTION
DISHARGE, IN CFS
Simulated
Observed
PET – P5
Rain – P4
Temp – P5
Param – P5
hide regression line
hide y = x line
semi-log plot
hide observed values
Print
Save Statistics Report
Monthly Averages
Print All Plots