Extension of Linked Watershed, CH3D and ICM Models from 2002 to 2011:

A Prototype P6 Model to Support Shallow Water Study

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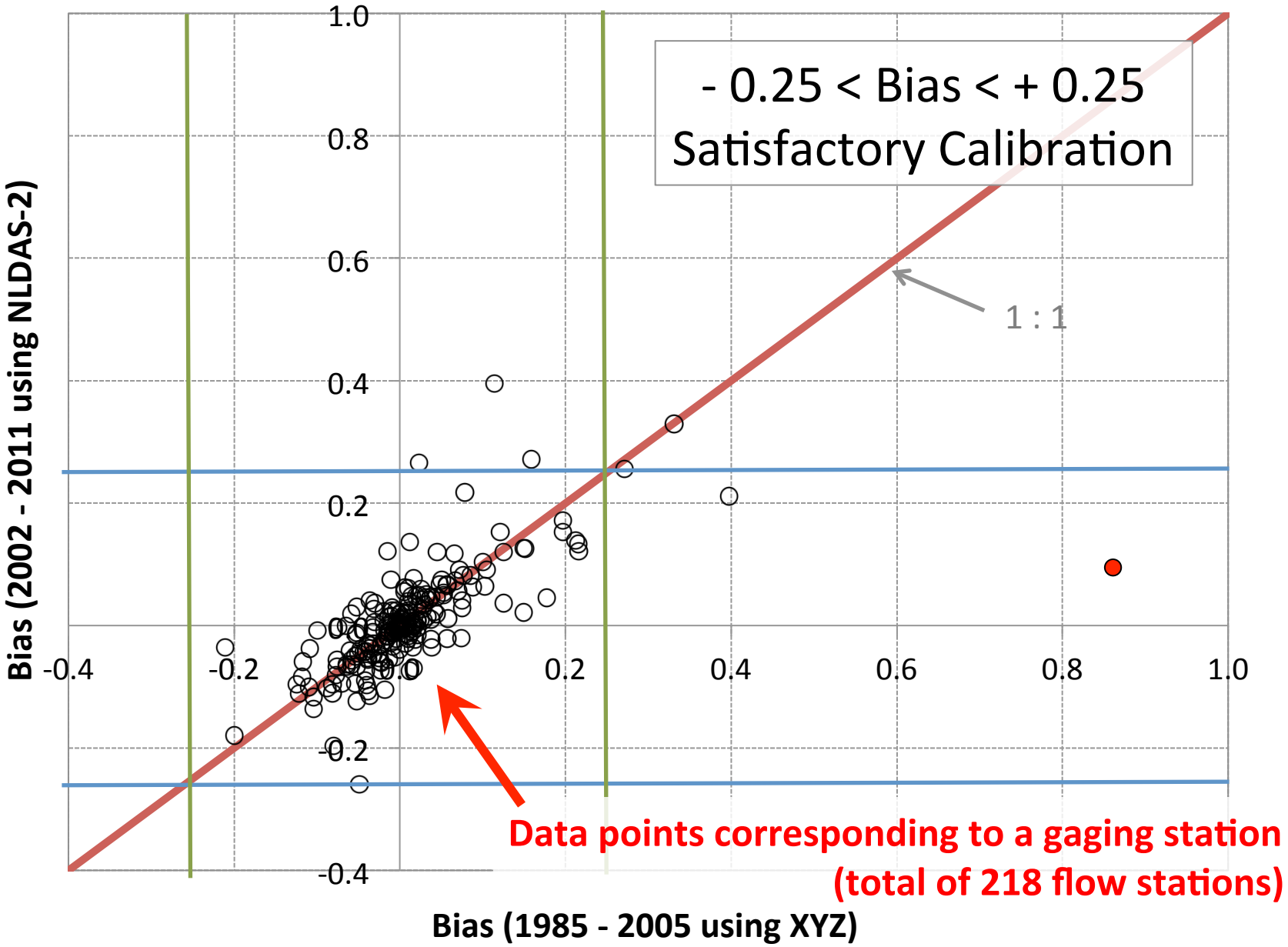
Background and Outline

- Climate forcing parameters (precipitation, temperature, potential evapotranspiration) were derived based on NLDAS-2
- Point-source and Septic datasets were extended
- Yactayo updated the observation records for flow, nutrient and sediment at all of the gaging stations used in Phase 5.3.2
- Diversions data were estimated using 2001-02 record
- Atmospheric deposition (wet and dry) data were ported from XYZ to NLDAS-2 precipitation dataset

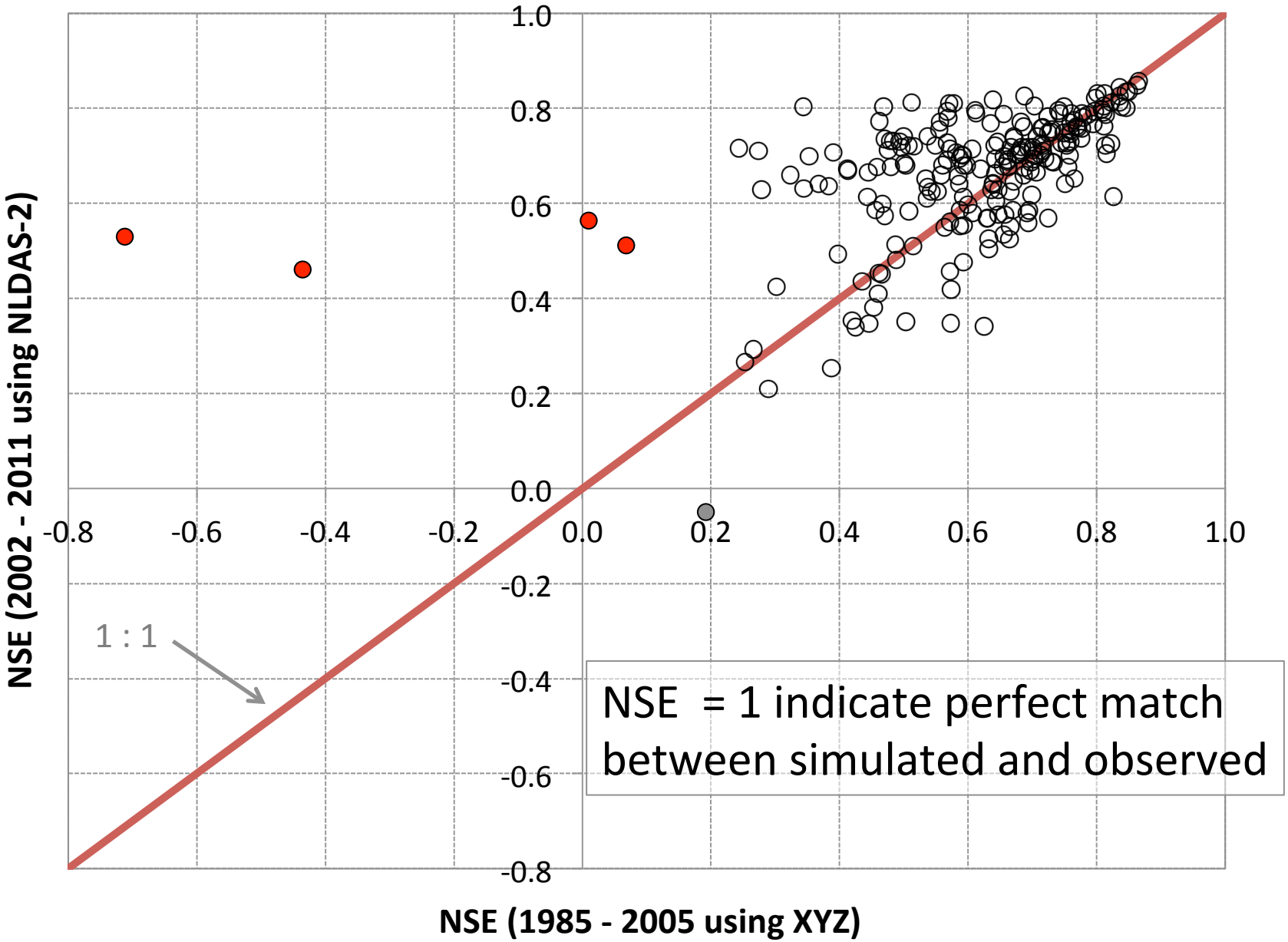
- **Hydrology Calibration**
- **Sediment Erosion/Wash-off Calibration**
- **Nutrient (N & P) Calibration – a PQUAL only version**
- **River Water-Quality Calibration**

Hydrology Calibration

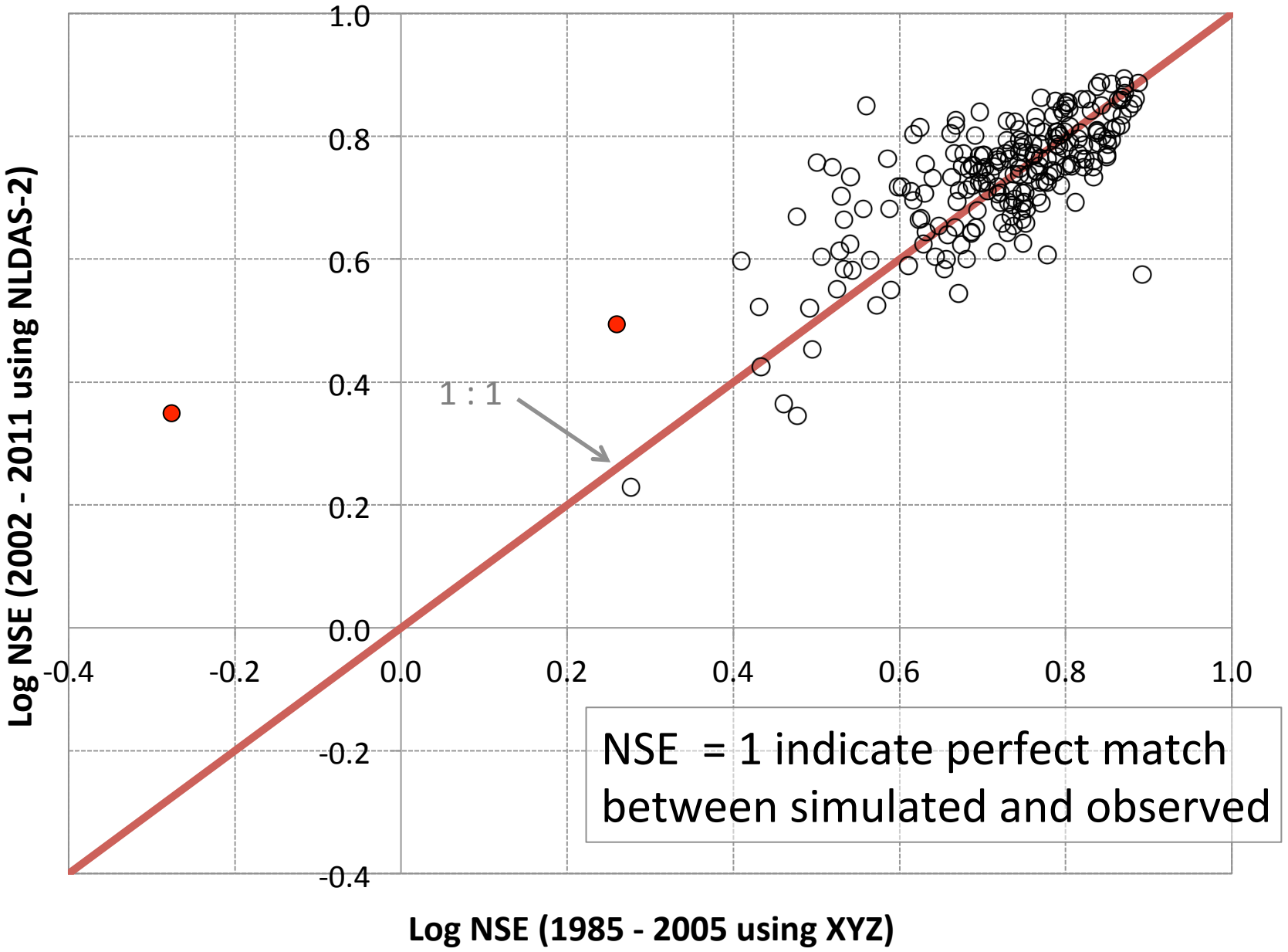
Flow Statistics: Bias



Flow Statistics: Nash-Sutcliffe Efficiency (NSE)



Flow Statistics: "Log" Nash-Sutcliffe Efficiency



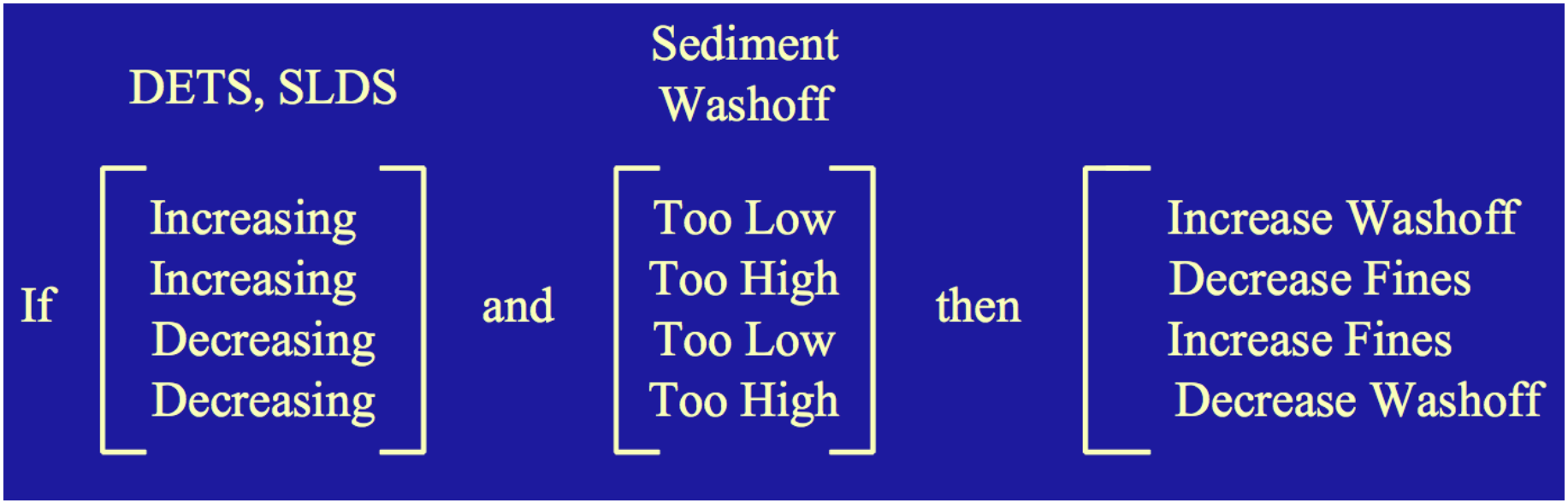
Sediment Erosion/Washoff Calibration

- Sediment calibration for each land-use is done independently at each land-segment to match an a-priori long-term target (tons/acre/yr)

- Although all of the 25 pervious land-uses were calibrated, in this discussion we will use forest [**FOR**] land-use as an illustrative example

Sediment Limiting vs. Transport Limiting?

Guidelines for Parameter Adjustment …



http://water.epa.gov/scitech/datait/models/basins/upload/Lecture-10-Sediment-Processes-NPS-I.pdf

Equations used in Land Sediment Module

- Accumulation / Attachment

$$DETS(t) = DETS(t\text{-}1) \times (1.0 - AFFIX) + NVSI$$

- Sediment Detachment

Det. Coefficient

Det. Exponent

$$DET = DELT60 \times (1\text{-}CR) \times SMPF \times KRER \times (RAIN/DELT60)^{JRER}$$

- Sediment Transport

Trans. Coefficient

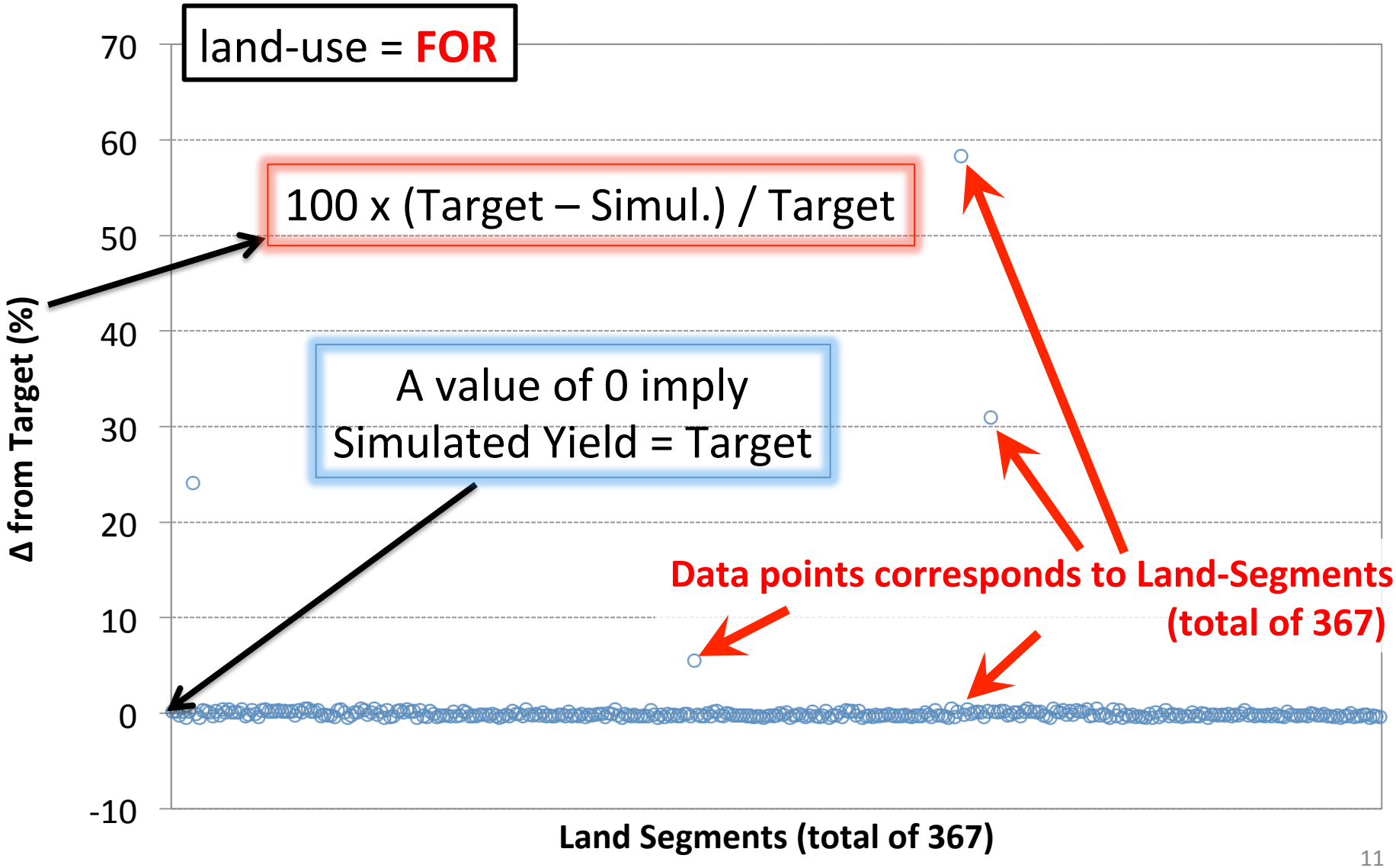
Trans. Exponent

$$STCAP = DELTA60 \times KSER \times ((SURS + SURO)/DELT60)^{JSER}$$

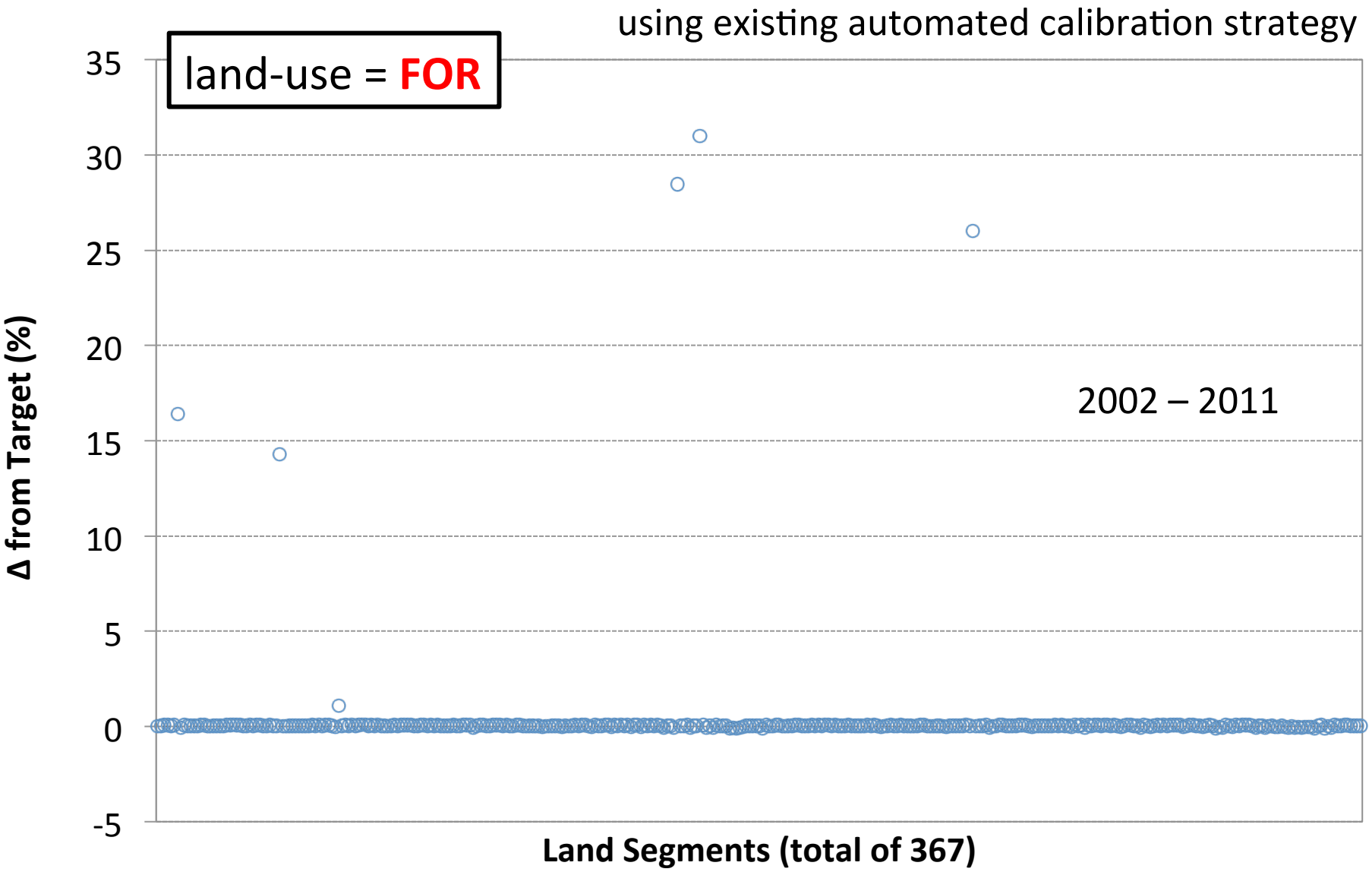
http://water.epa.gov/scitech/datait/models/basins/upload/Lecture-10-Sediment-Processes-NPS-I.pdf

Existing Calibration in Phase 5.3.2 *

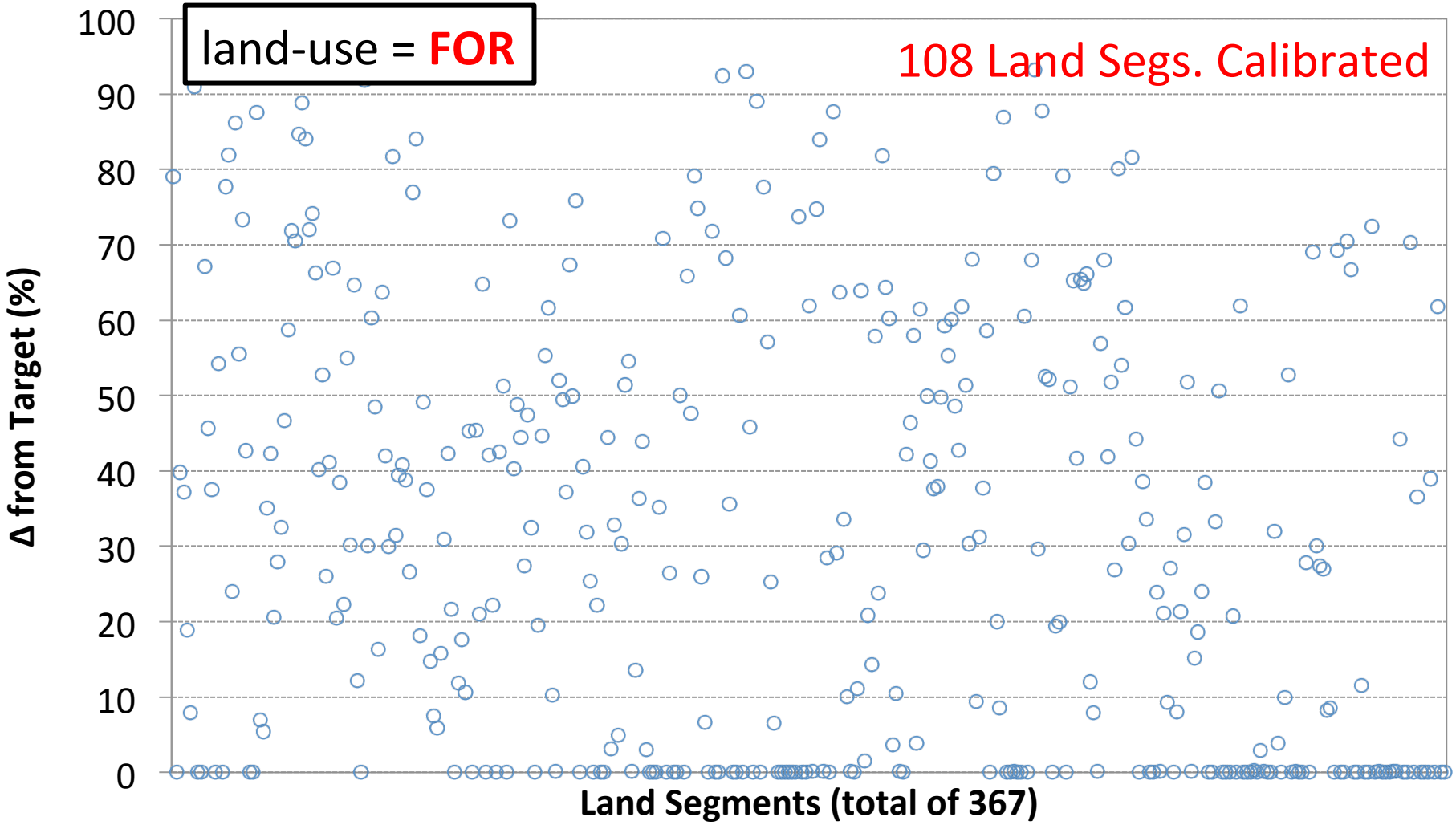
* uses Precip & Met data derived using XYZ method



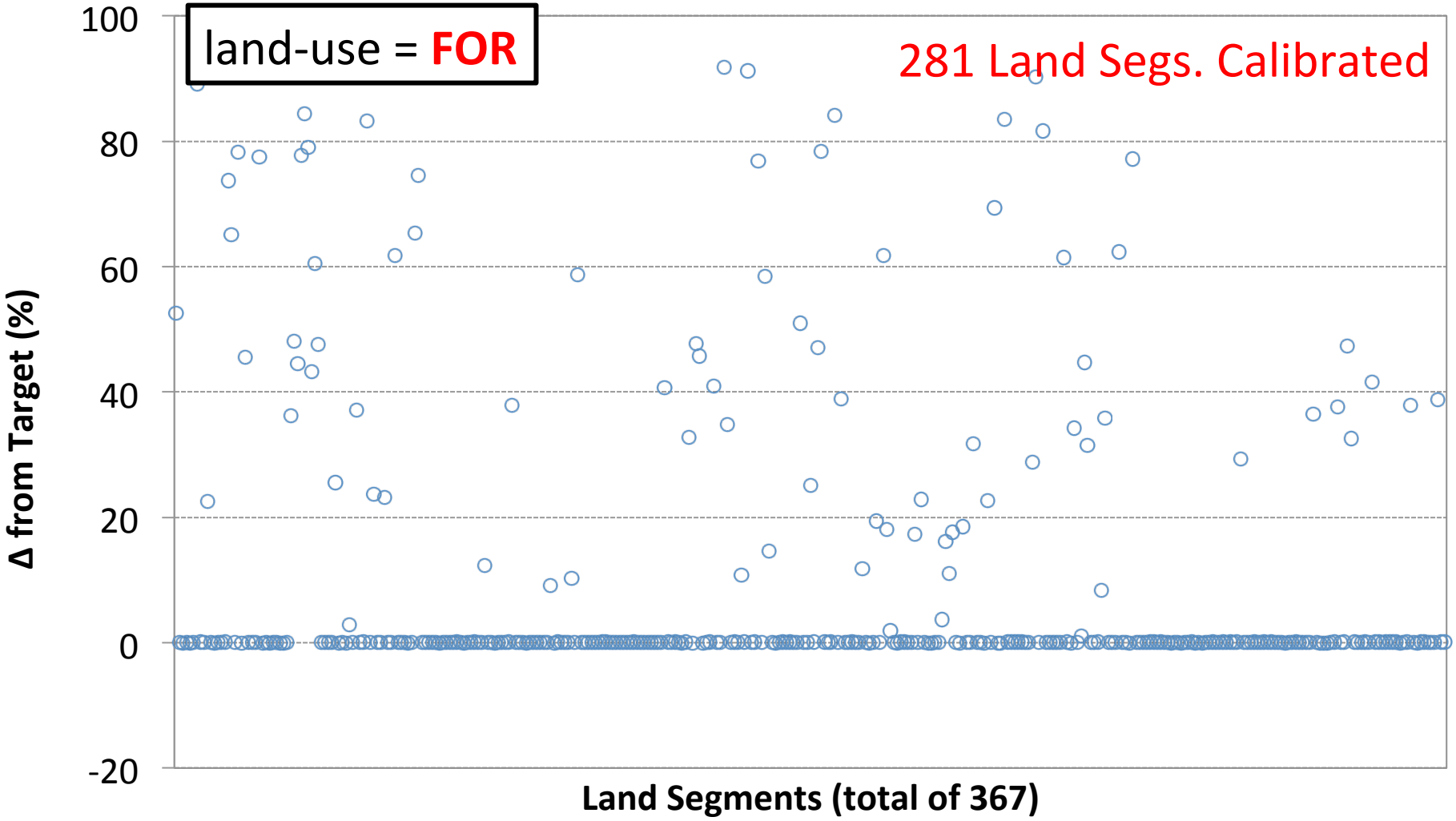
Calibration of model that uses NLDAS-2



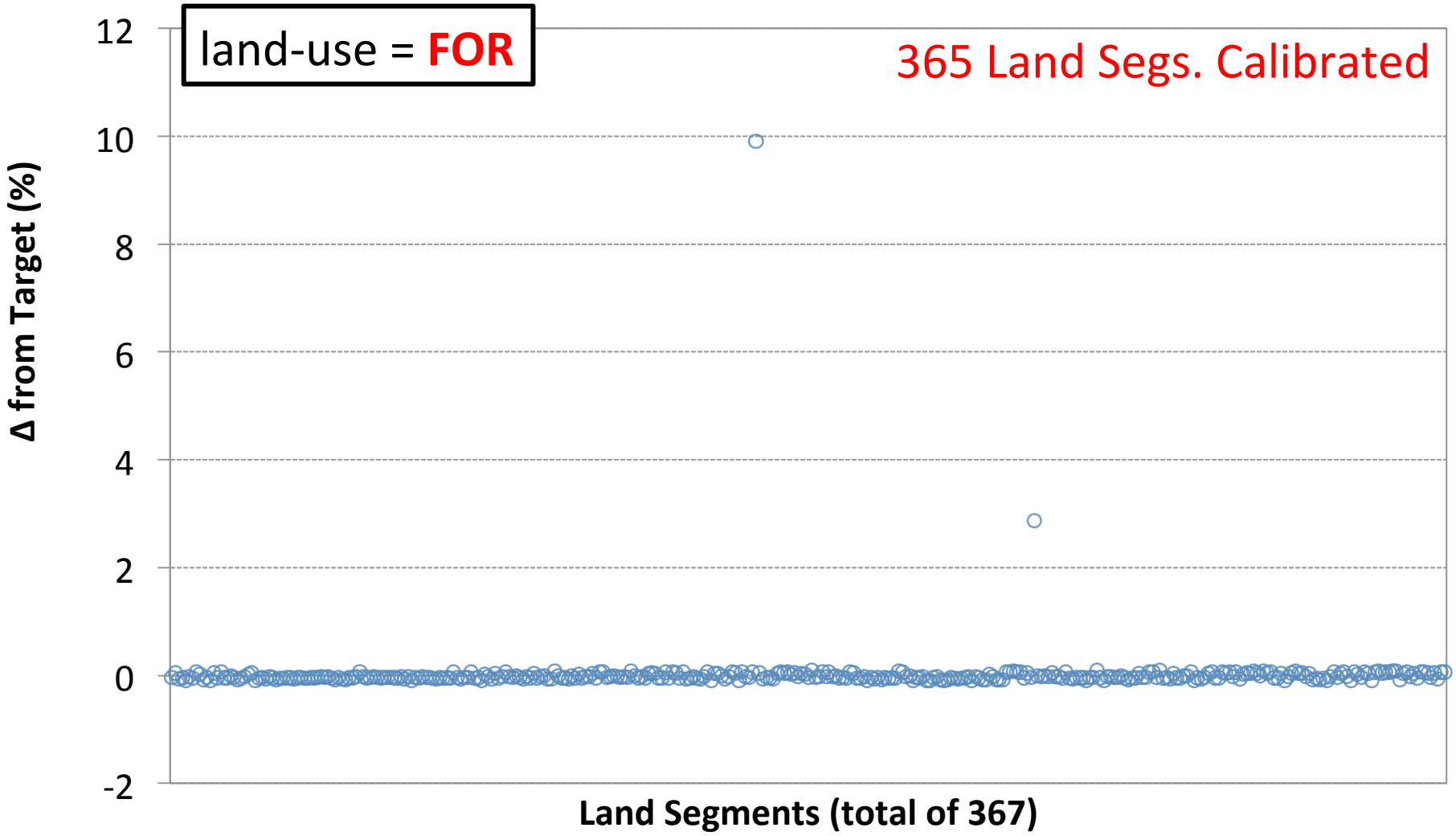
KSER [0.1,10], KRER [0.05,1] & KS/KR=10



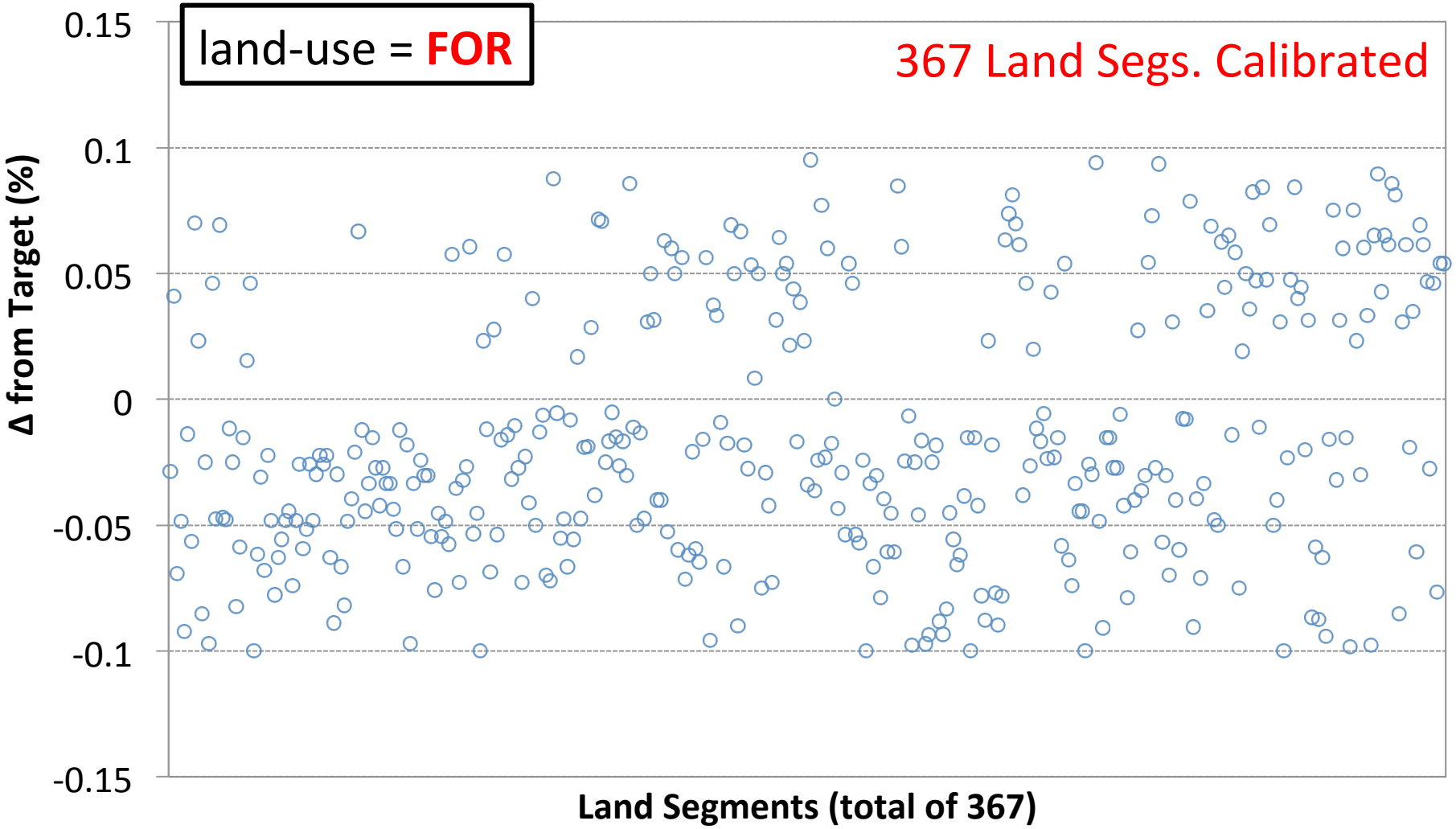
If KRER = 1 Then JRER = 1.0
Optimize KSER | KRER



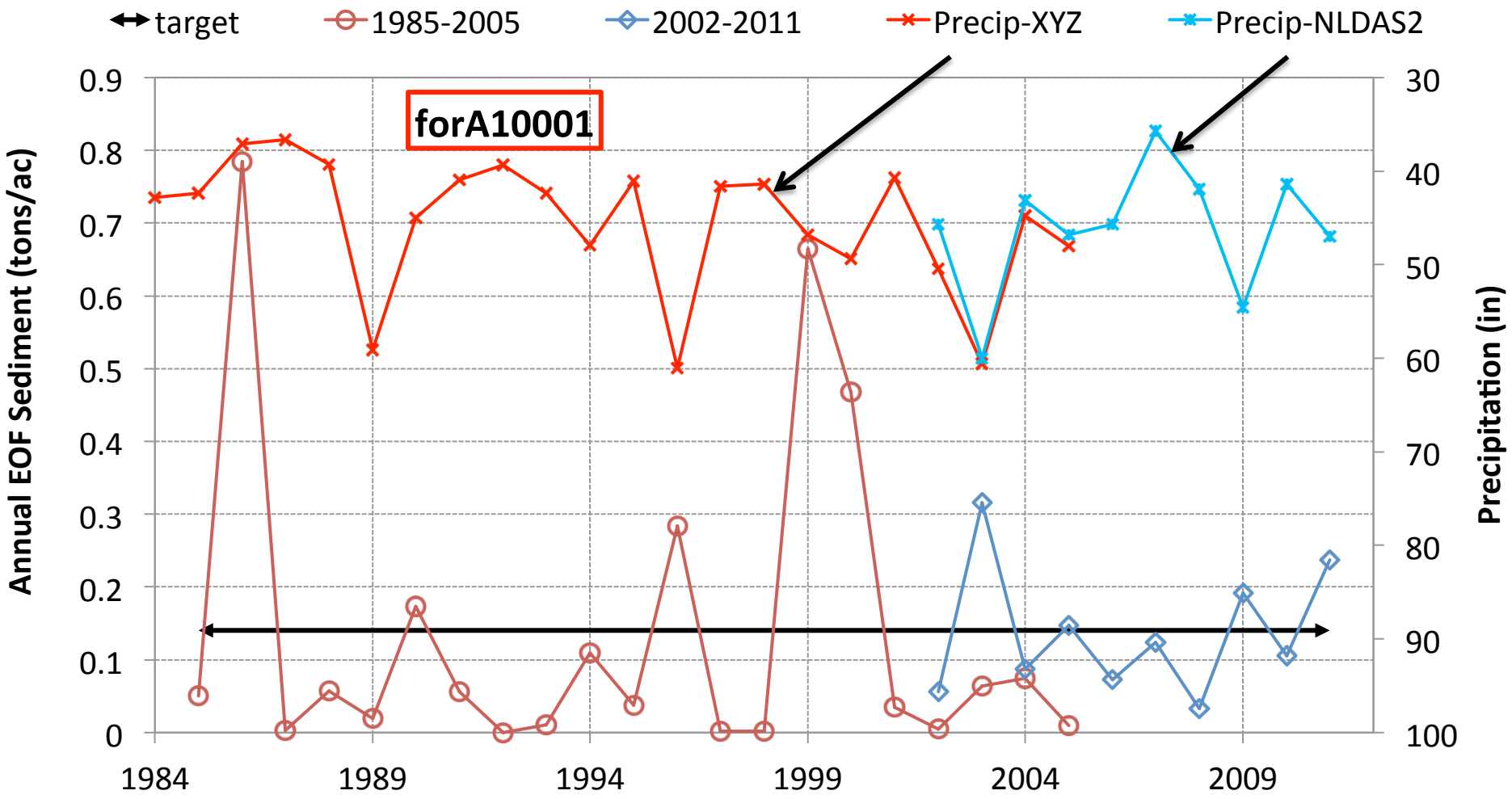
If KSER = 1 Then JSER = 1.0
Optimize KSER | KRER



Expand KSER range only for remaining un-calibrated segments



Simulated Annual EOF Loads



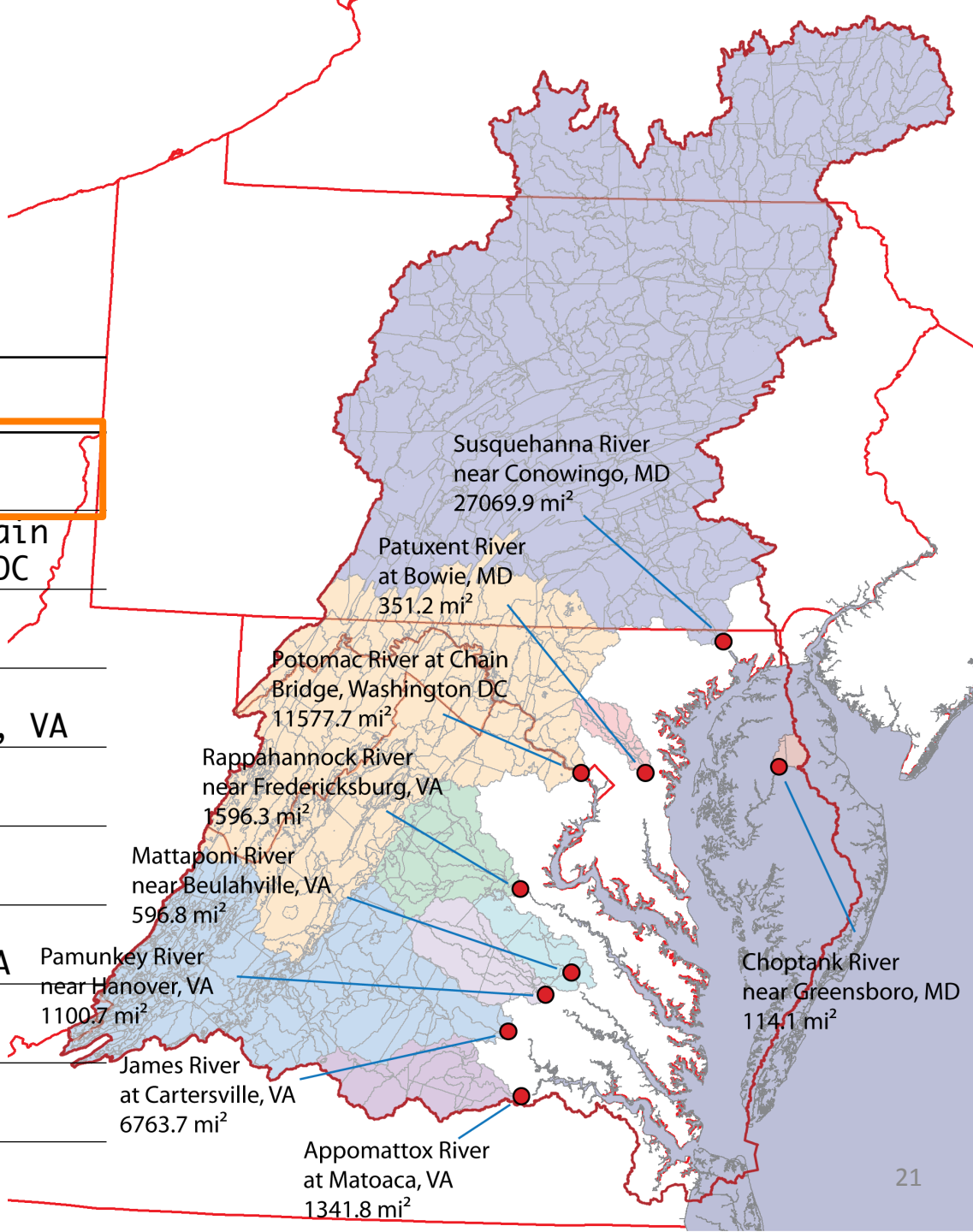
Nutrient (N & P) Calibration:
a PQUAL only version

- All land-uses were simulated using PQUAL
- Targets were updated based on simulated loads in phase-5.3.2 calibration for the land-uses that were simulated using AGCHEM
- Targets were updated for the nutrient species:
  - SLON, SNH4, SNO3, SRON, & SPO4
  - BLON, BNH4, BNO3, BRON, & BPO4
- Automated calibration process used in phase 5.3.2 was used to calibrate Land-seg :: Land-use

River Water-Quality Calibration

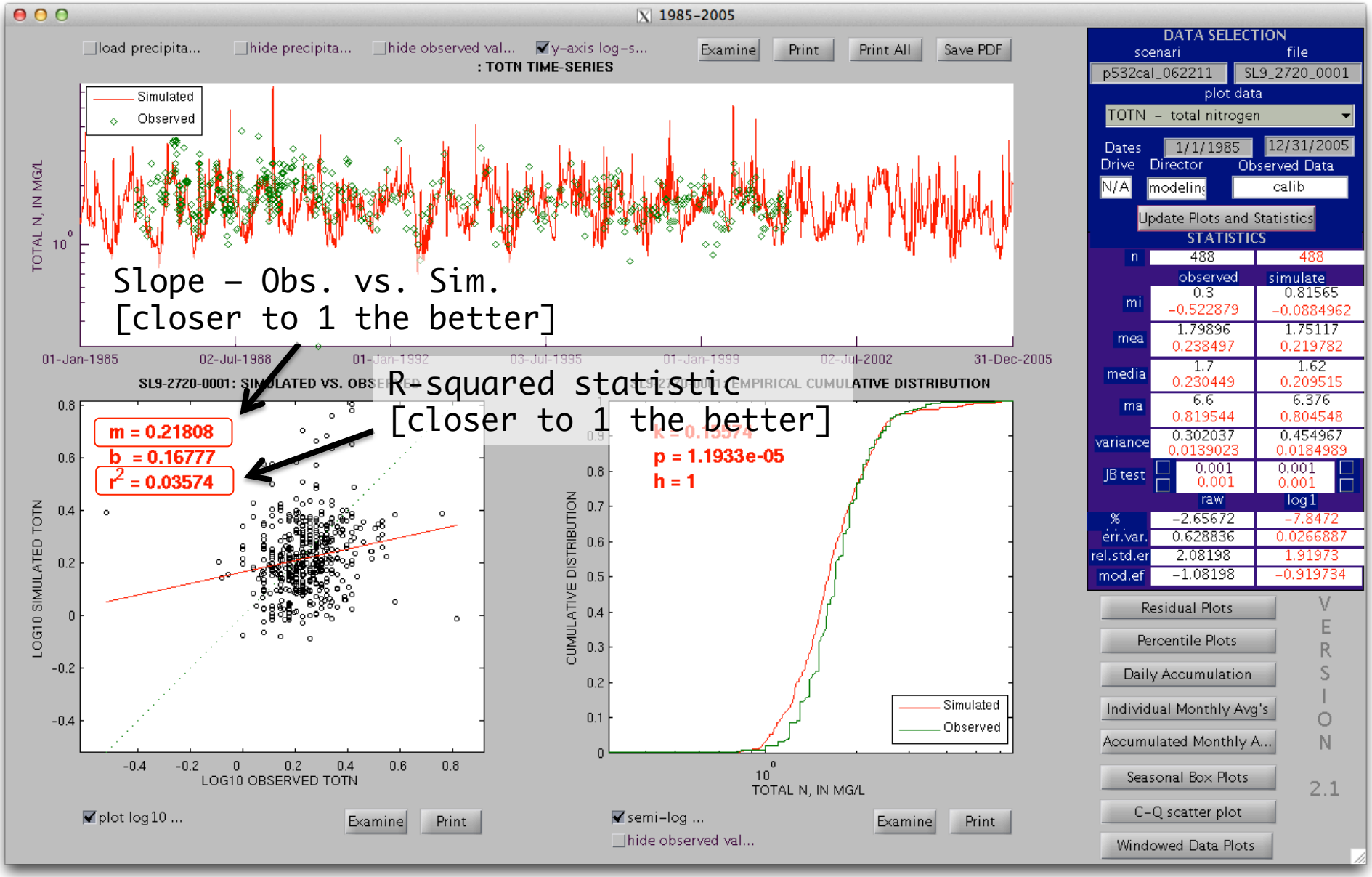
River Input Monitoring (RIM) Stations

Observation	River
SL9_2720_0001	Susquehanna River near Conowingo, MD
PM7_4820_0001	Potomac River at Chain Bridge, Washington DC
JL7_6800_7070	James River at Cartersville, VA
RU5_6030_0001	Rappahannock River near Fredericksburg, VA
JA5_7480_0001	Appomattox River at Matoaca, VA
YP4_6720_6750	Pamunkey River near Hanover, VA
YM4_6620_0003	Mattaponi River near Beulahville, VA
XU3_4650_0001	Patuxent River at Bowie, MD
EM2_3980_0001	Choptank River near Greensboro, MD



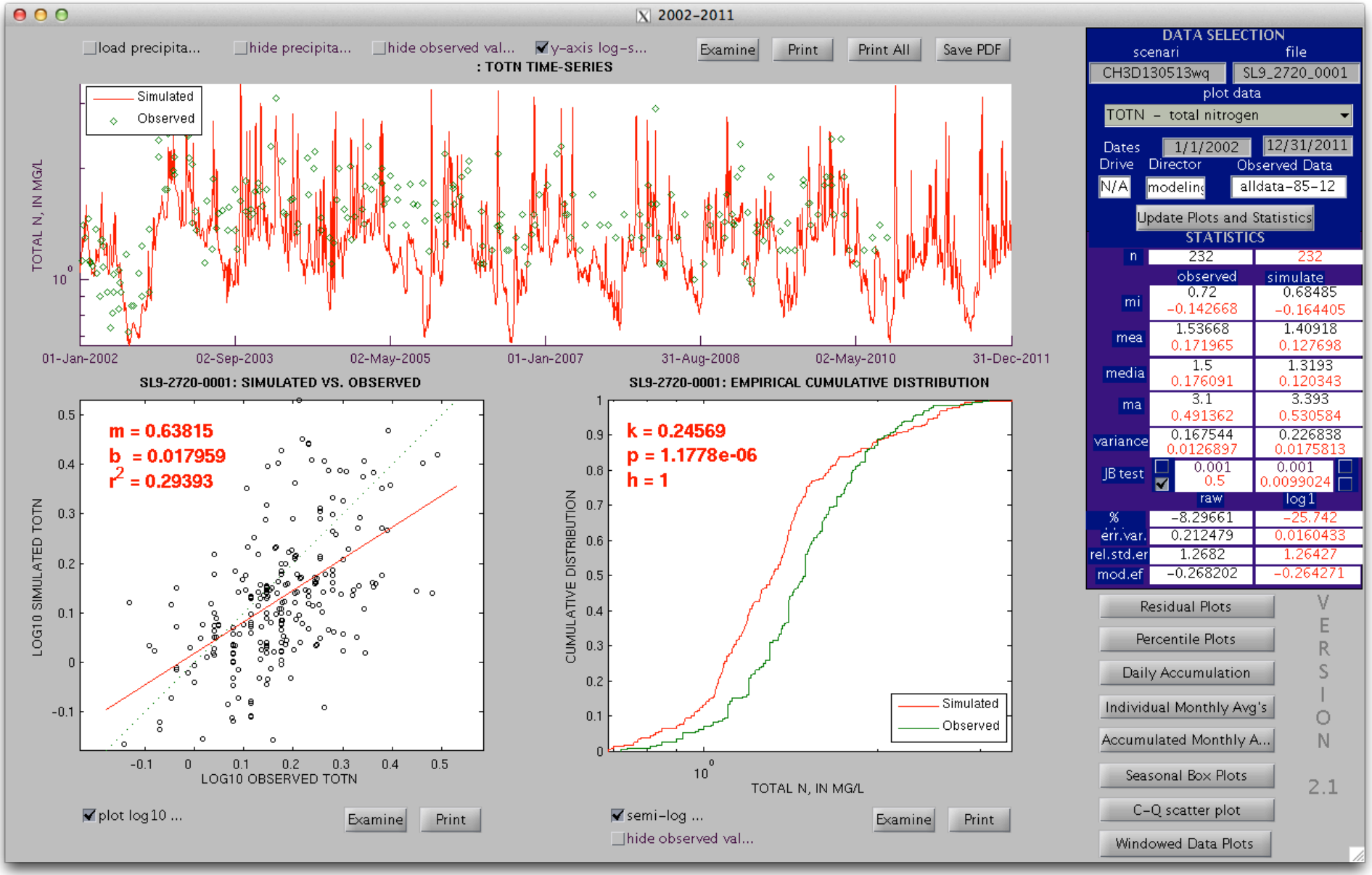
TOTN : : 1985 – 2005

Susquehanna River near Conowingo, MD



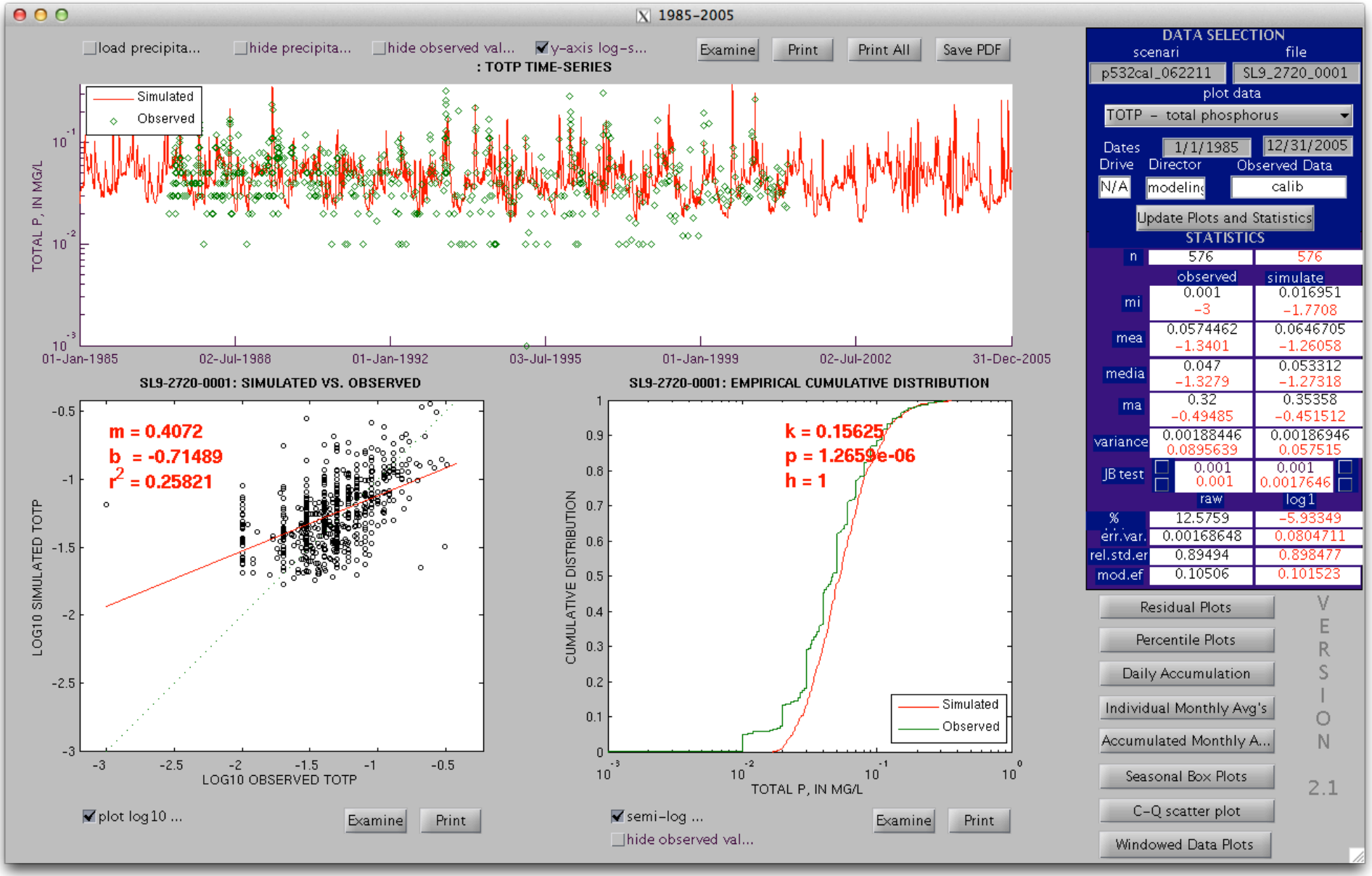
TOTN : : 2002 – 2011

Susquehanna River near Conowingo, MD



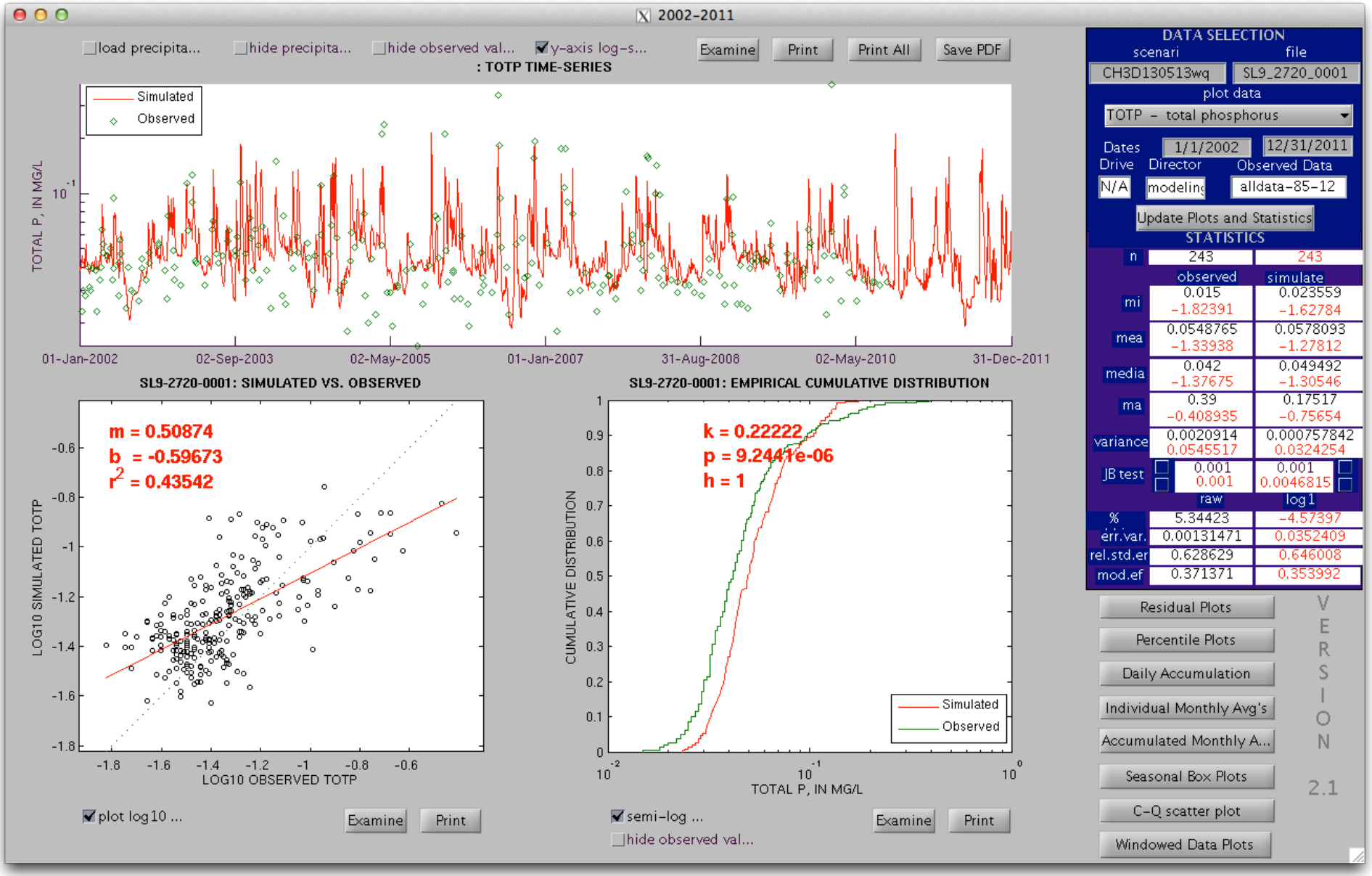
TOTP : : 1985 – 2005

Susquehanna River near Conowingo, MD



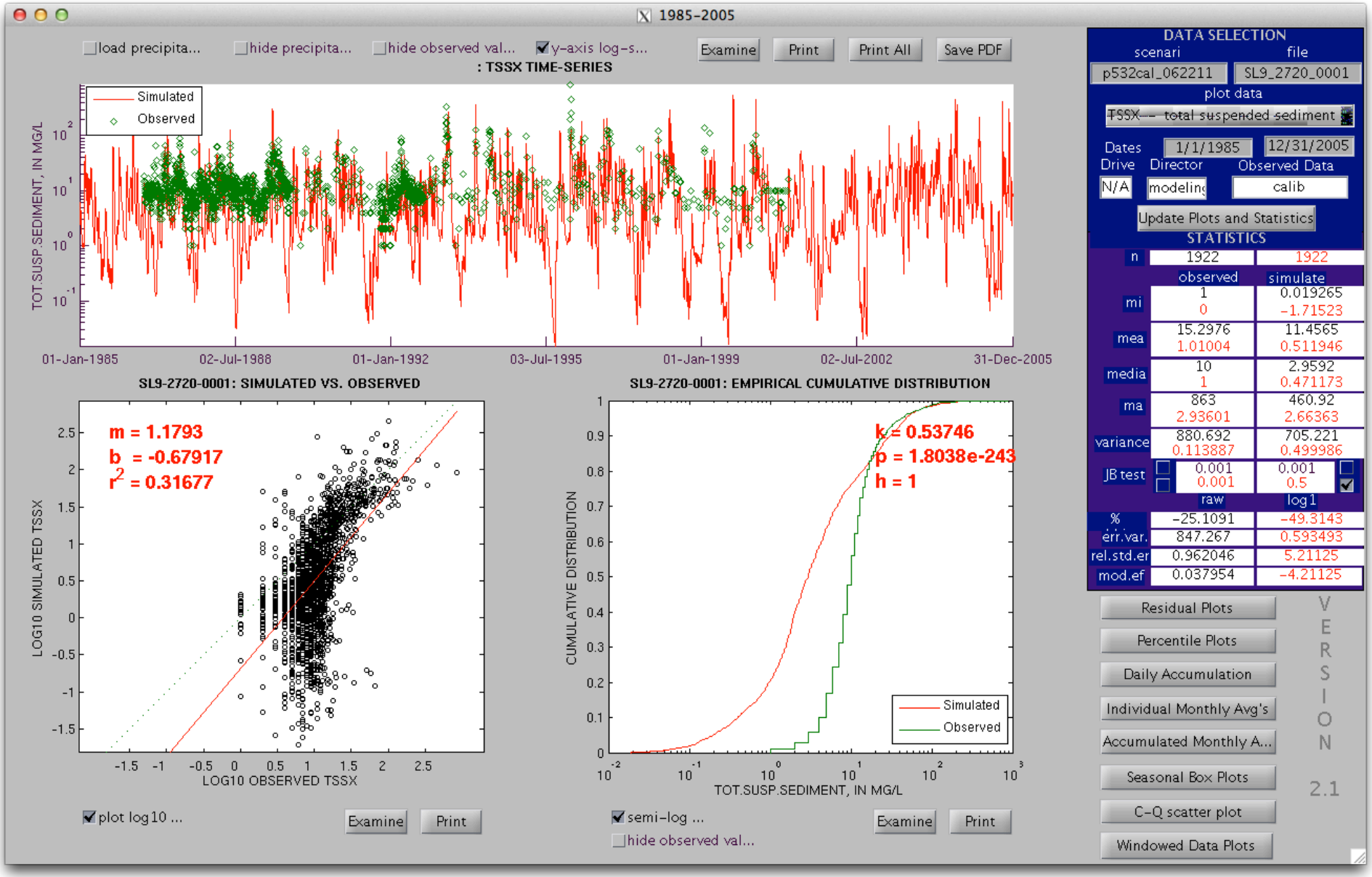
TOTP : : 2002 – 2011

Susquehanna River near Conowingo, MD



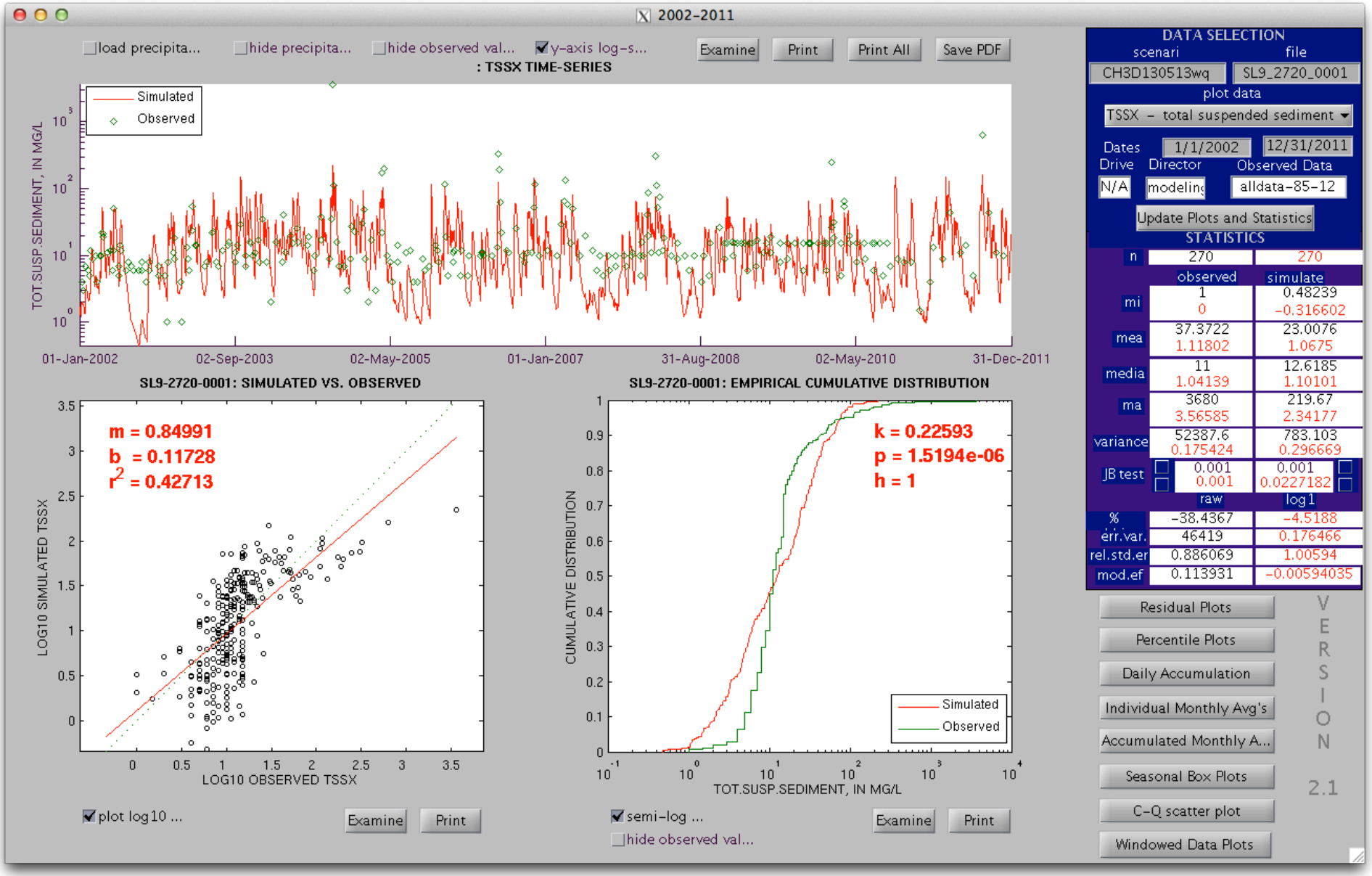
TSSX : : 1985 – 2005

Susquehanna River near Conowingo, MD



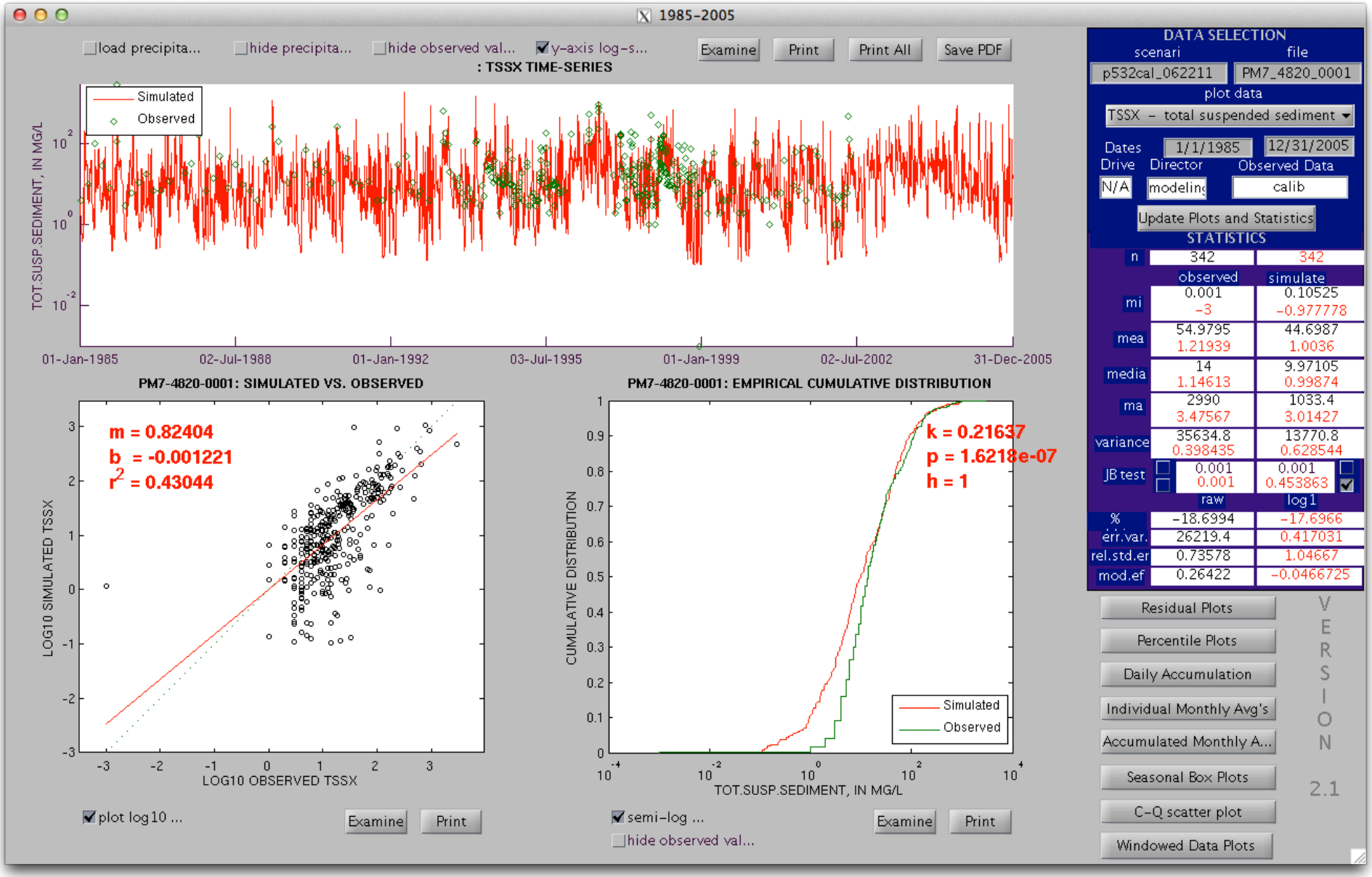
TSSX : : 2002 – 2011

Susquehanna River near Conowingo, MD



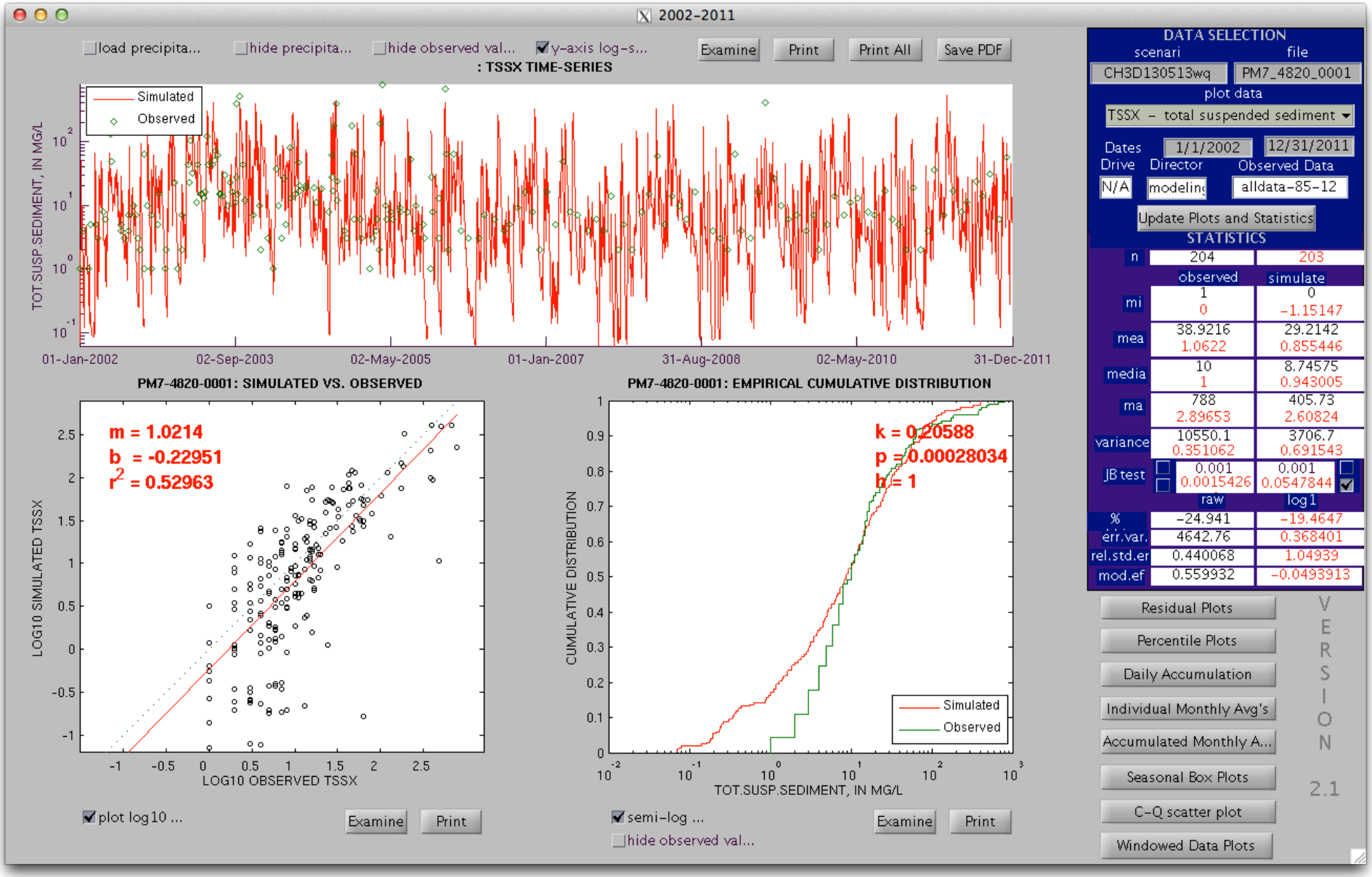
TSSX : : 1985 – 2005

Potomac River at Chain Bridge, Washington DC



TSSX : : 2002 – 2011

Potomac River at Chain Bridge, Washington DC



Slope (Obs. vs. Sim.) at RIM Basins

River Name	Area	TOTN		TOTP		TSSX	
	(mi^2)	85-05	02-11	85-05	02-11	85-05	02-11
Susquehanna River near Conowingo, MD	27070	0.21808	0.63815	0.40720	0.50874	1.17930	0.84991
Potomac River at Chain Bridge, Washington DC	11578	0.19472	0.55289	0.57285	0.62565	0.82390	1.02140
James River at Cartersville, VA	6764	0.51053	0.98847	0.35162	0.77303	1.37960	1.36810
Rappahannock River near Fredericksburg, VA	1596	0.51457	0.63862	0.53489	0.88087	1.05690	1.05370
Appomattox River at Matoaca, VA	1342	0.27828	0.04251	0.57904	0.83353	0.81224	0.96788
Pamunkey River near Hanover, VA	1101	-0.00810	0.15548	0.39547	0.74324	1.04690	0.93826
Mattaponi River near Beulahville, VA	597	-0.12363	-0.25885	0.56207	0.32085	1.22630	1.11730
Patuxent River at Bowie, MD	351	0.54115	0.43056	0.33534	0.42945	1.20970	1.31960
Choptank River near Greensboro, MD	114	0.01735	0.14657	0.44979	0.31459	1.05330	0.93458

R-squared Statistic at RIM Basins

River Name	Area	TOTN		TOTP		TSSX	
	(mi^2)	85-05	02-11	85-05	02-11	85-05	02-11
Susquehanna River near Conowingo, MD	27070	0.03574	0.29393	0.25821	0.43542	0.31677	0.42713
Potomac River at Chain Bridge, Washington DC	11578	0.03066	0.15548	0.27099	0.43003	0.43044	0.52963
James River at Cartersville, VA	6764	0.18548	0.36507	0.09502	0.42364	0.53028	0.64195
Rappahannock River near Fredericksburg, VA	1596	0.33226	0.47227	0.52240	0.77995	0.51633	0.65423
Appomattox River at Matoaca, VA	1342	0.02930	0.00059	0.25220	0.27766	0.33010	0.44017
Pamunkey River near Hanover, VA	1101	0.00003	0.01111	0.16698	0.34692	0.54826	0.56630
Mattaponi River near Beulahville, VA	597	0.00664	0.03096	0.08424	0.07909	0.35246	0.35765
Patuxent River at Bowie, MD	351	0.27041	0.12406	0.16312	0.42100	0.48735	0.61922
Choptank River near Greensboro, MD	114	0.00017	0.02528	0.19244	0.16101	0.22342	0.19108

River Input Monitoring (RIM) Stations

River Segment	Observation	River	Area (sq.mi)
SL9_2720_0001	SL9_2720_0001	Susquehanna River near Conowingo, MD	27069.9
PM7_4820_0001	PM7_4820_0001	Potomac River at Chain Bridge, Washington DC	11577.7
JL7_7070_0001	JL7_6800_7070	James River at Cartersville, VA	6763.7
RU5_6030_0001	RU5_6030_0001	Rappahannock River near Fredericksburg, VA	1596.3
JA5_7480_0001	JA5_7480_0001	Appomattox River at Matoaca, VA	1341.8
YP4_6750_0001	YP4_6720_6750	Pamunkey River near Hanover, VA	1100.7
YM4_6620_0001	YM4_6620_0003	Mattaponi River near Beulahville, VA	596.8
XU3_4650_0001	XU3_4650_0001	Patuxent River at Bowie, MD	351.2
EM2_3980_0001	EM2_3980_0001	Choptank River near Greensboro, MD	114.1