Lower Susquehanna Reservoirs in the Phase 6 Watershed Model

Modeling Quarterly Review Meeting

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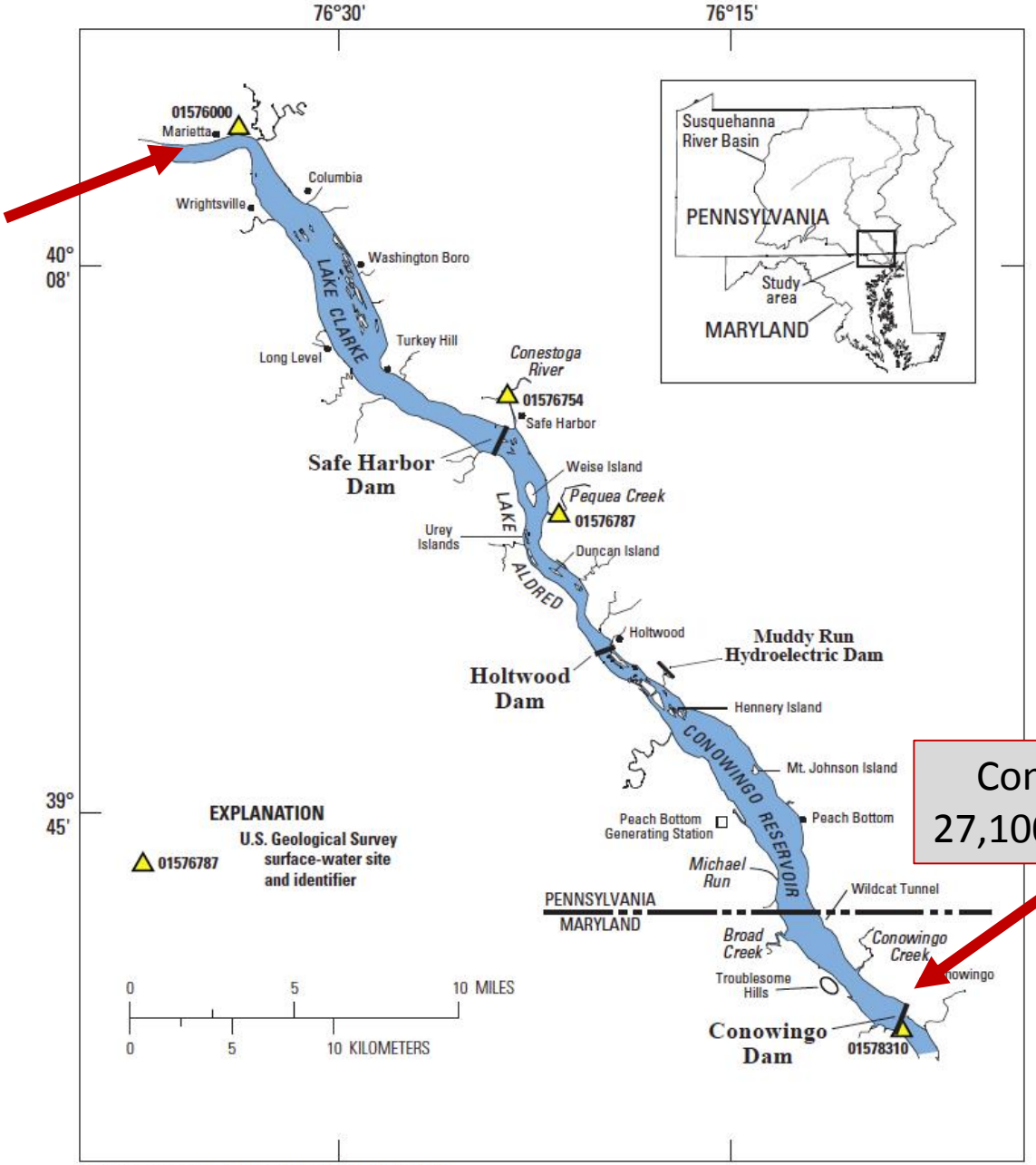
The Reservoir System in the Lower Susquehanna River Basin

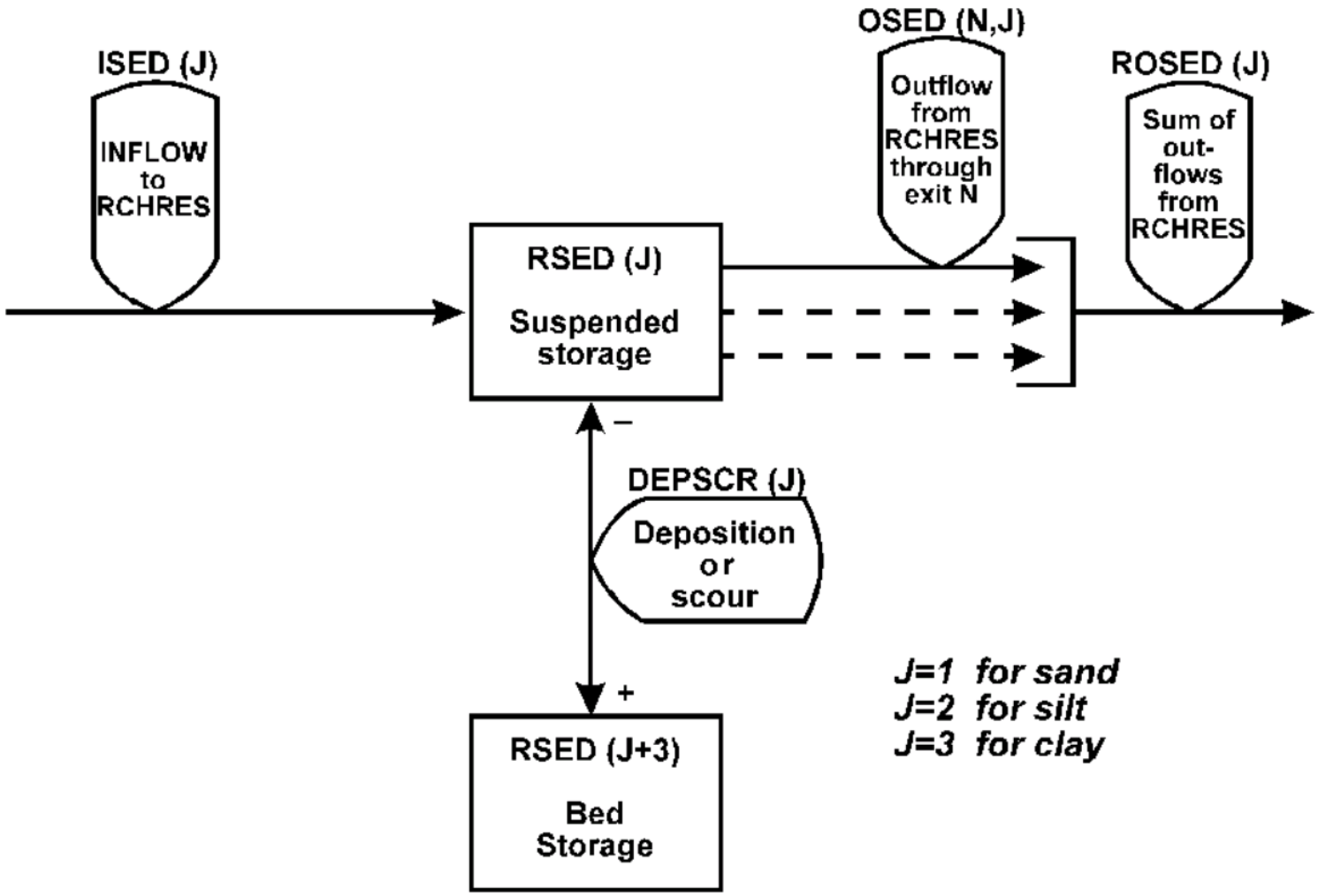
Marietta
25,990 sq. miles



Conowingo
27,100 sq. miles

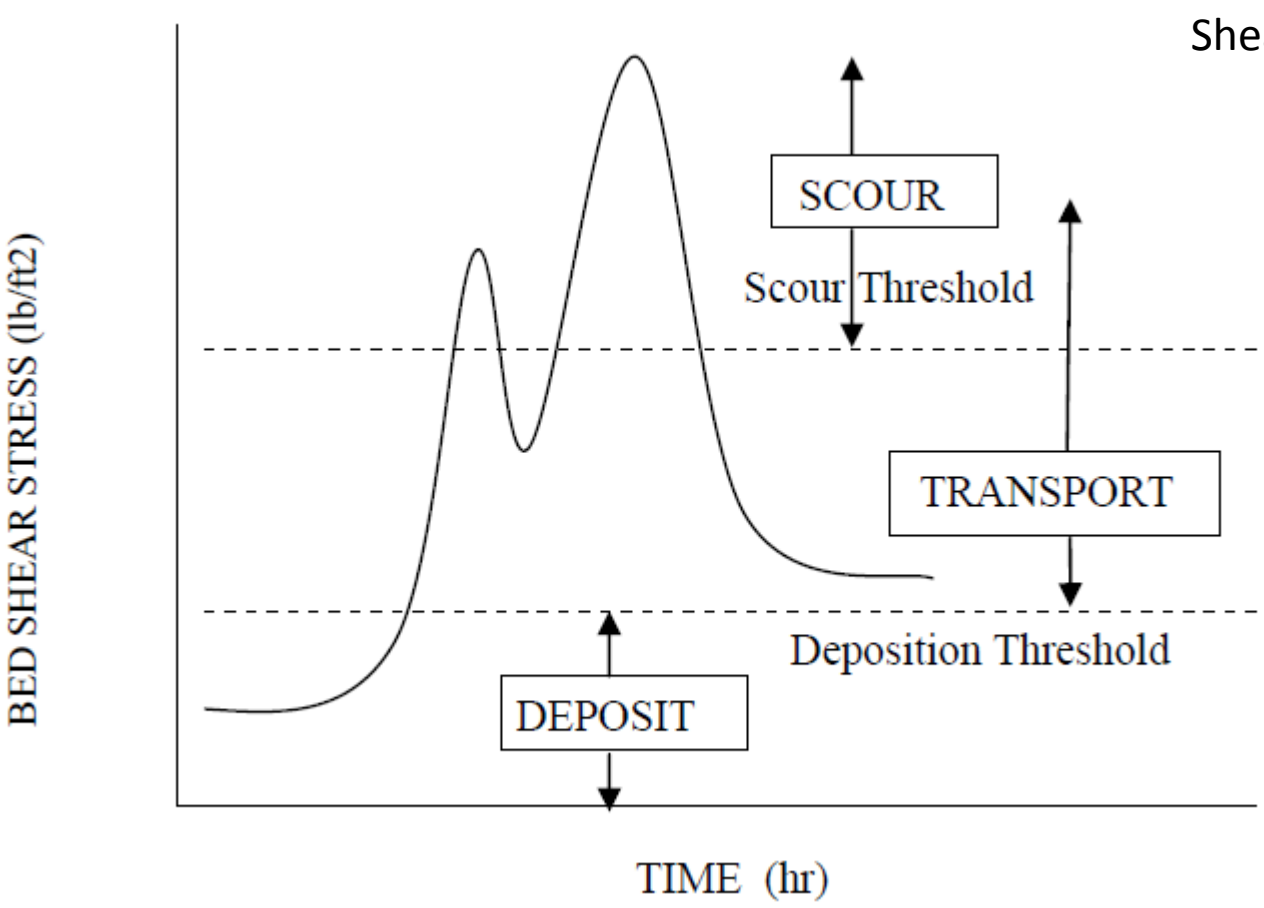
Langland, 2015

HSPF Sediment Transport



HSPF User's Manual

HSPF SEDTRN simulation



Shear Stress

Erodibility

$(Tau/Tau_{CS}-1) * M$

Settling Velocity

$(1-Tau/Tau_{CD}) * W/d$

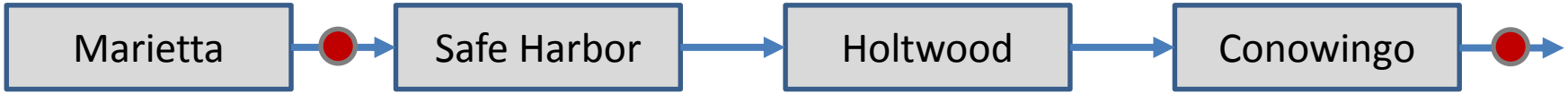
Actual equation expressed as exponential for concentration change

Depth

***Tau_{CD}*, *Tau_{CS}*, *Erodibility*, and *Settling Velocity* are all changeable through time.**

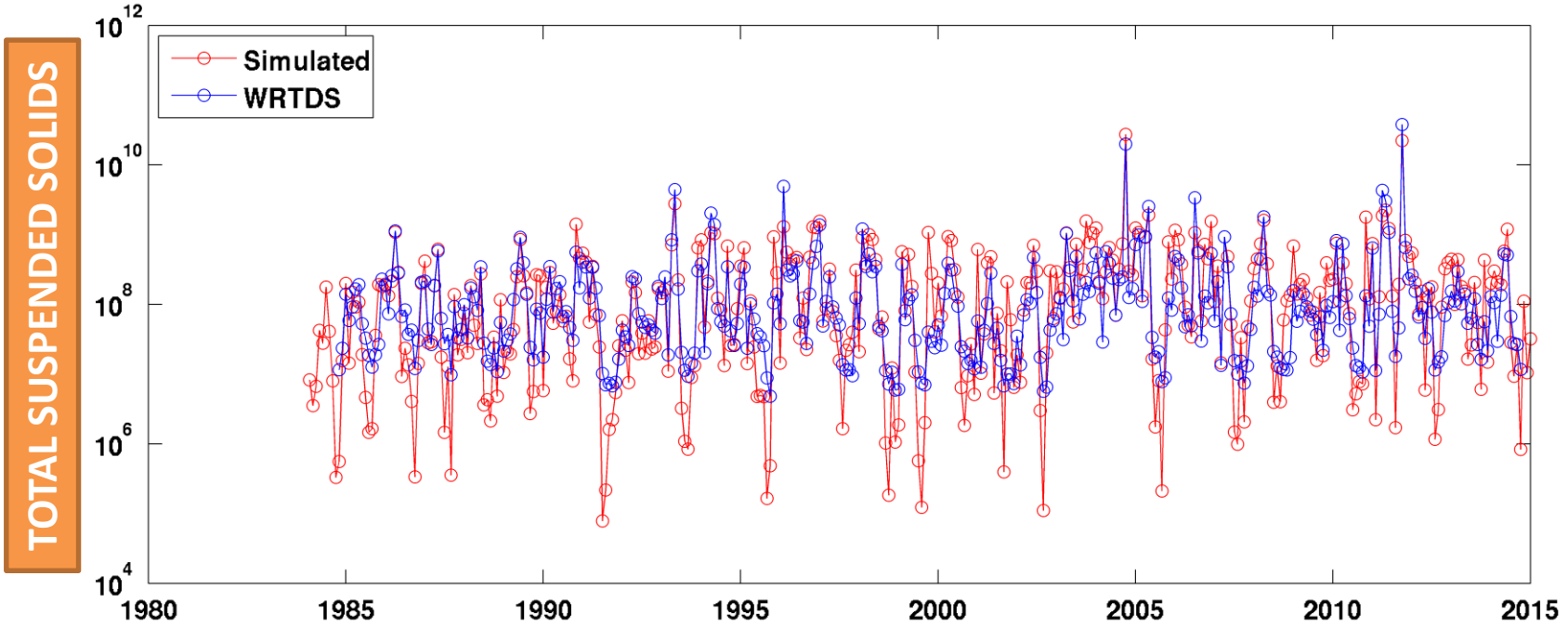
HSPF User's Manual

A mass-balance between Marietta & Conowingo



Transport factors of sand, silt, and clay for the reservoirs

		Safe Harbor	Holtwood	Conowingo
PHASE-6 (1985-2014)	Sand	0.00	0.00	0.00
	Silt	0.99	0.99	0.33
	Clay	0.98	0.98	0.79



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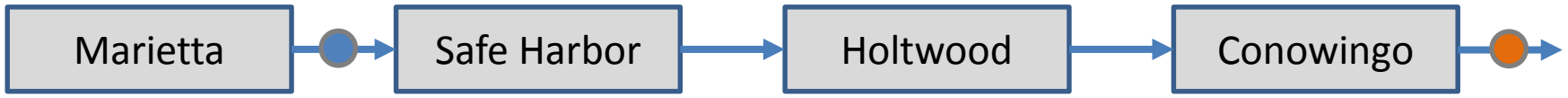

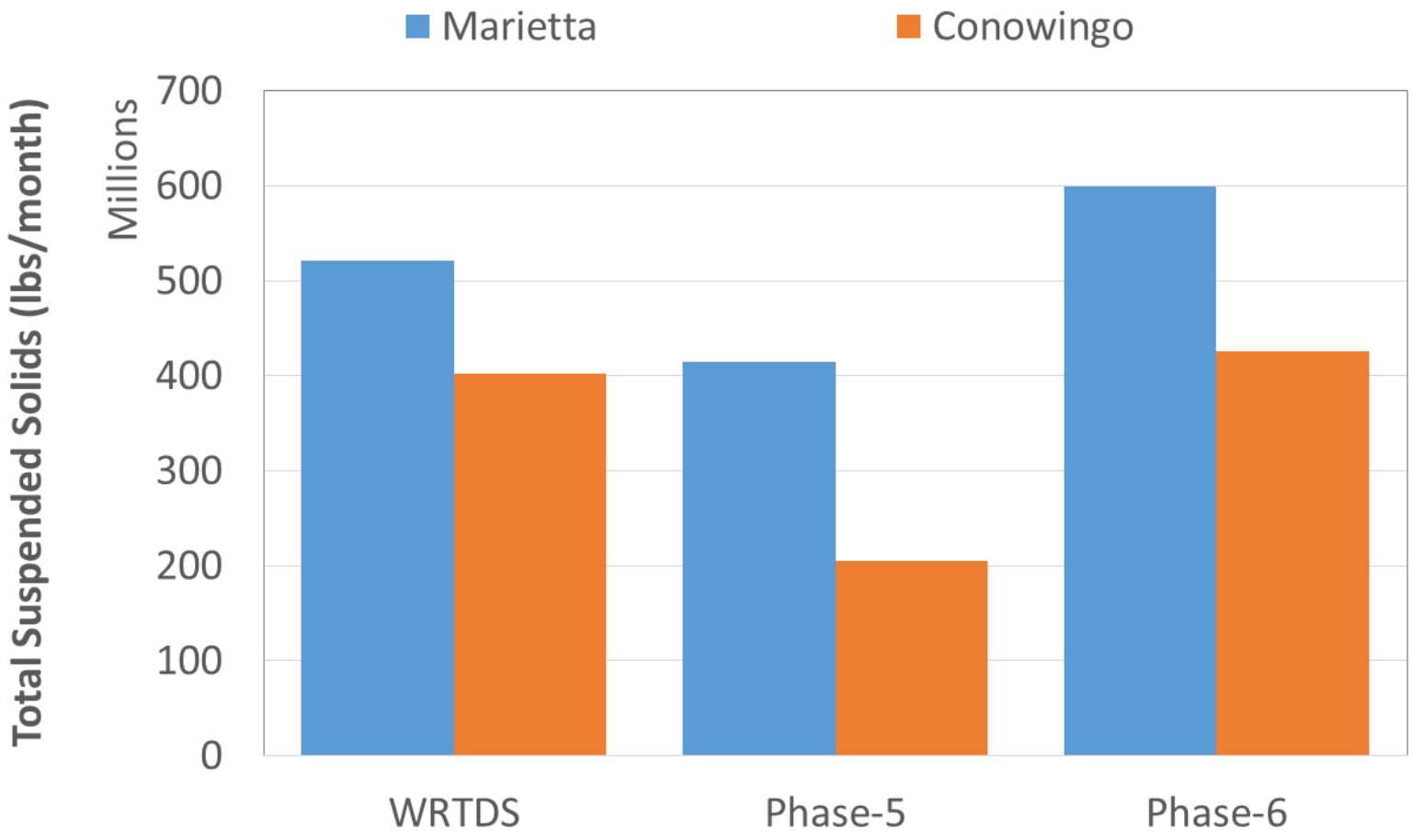

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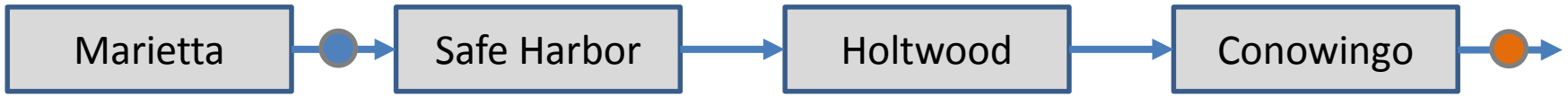
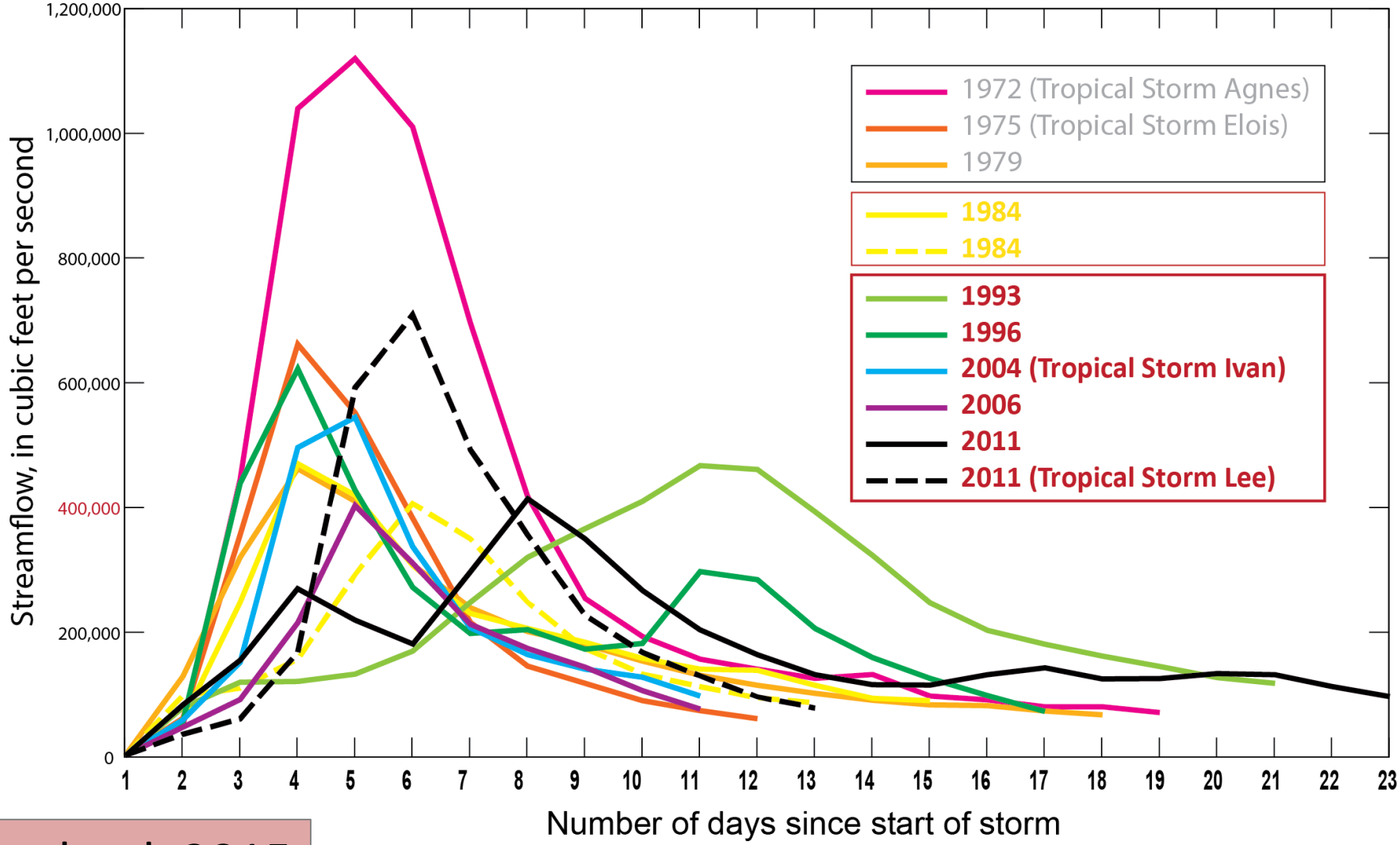
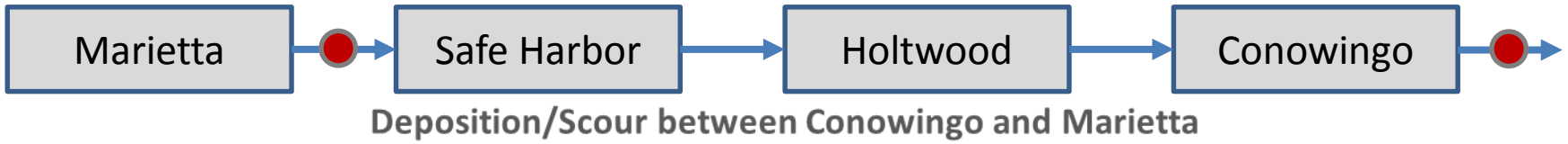
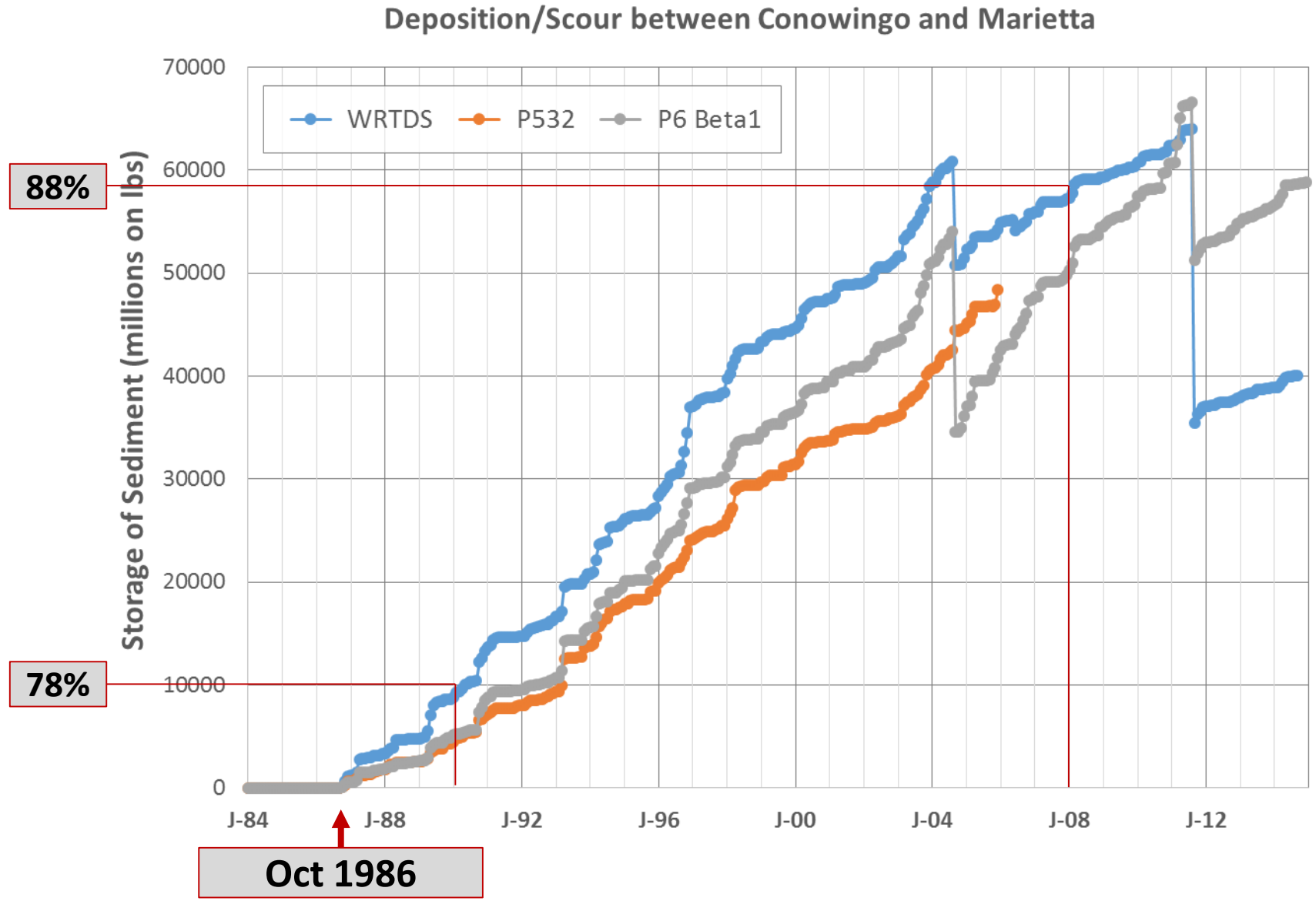


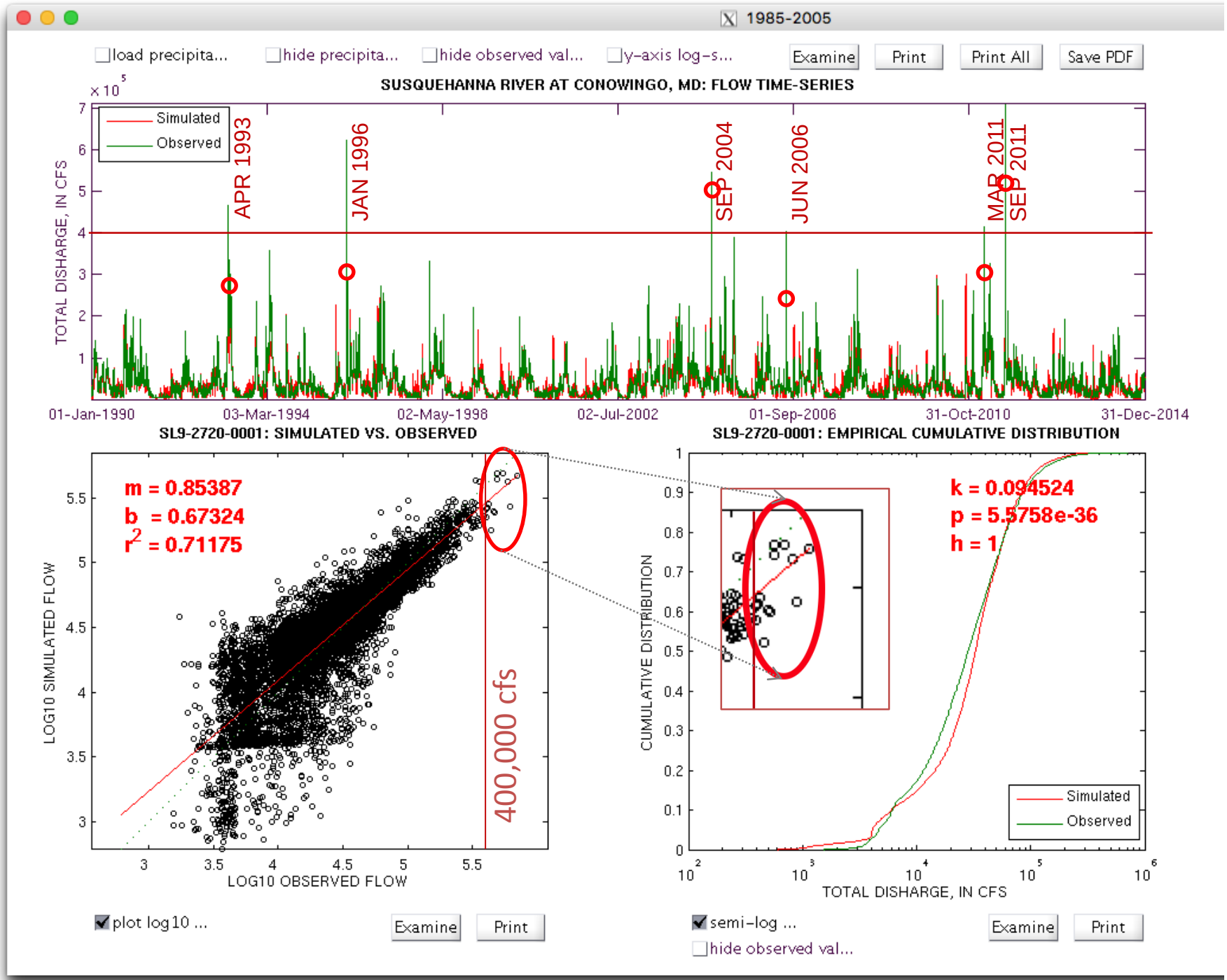


Langland, 2015

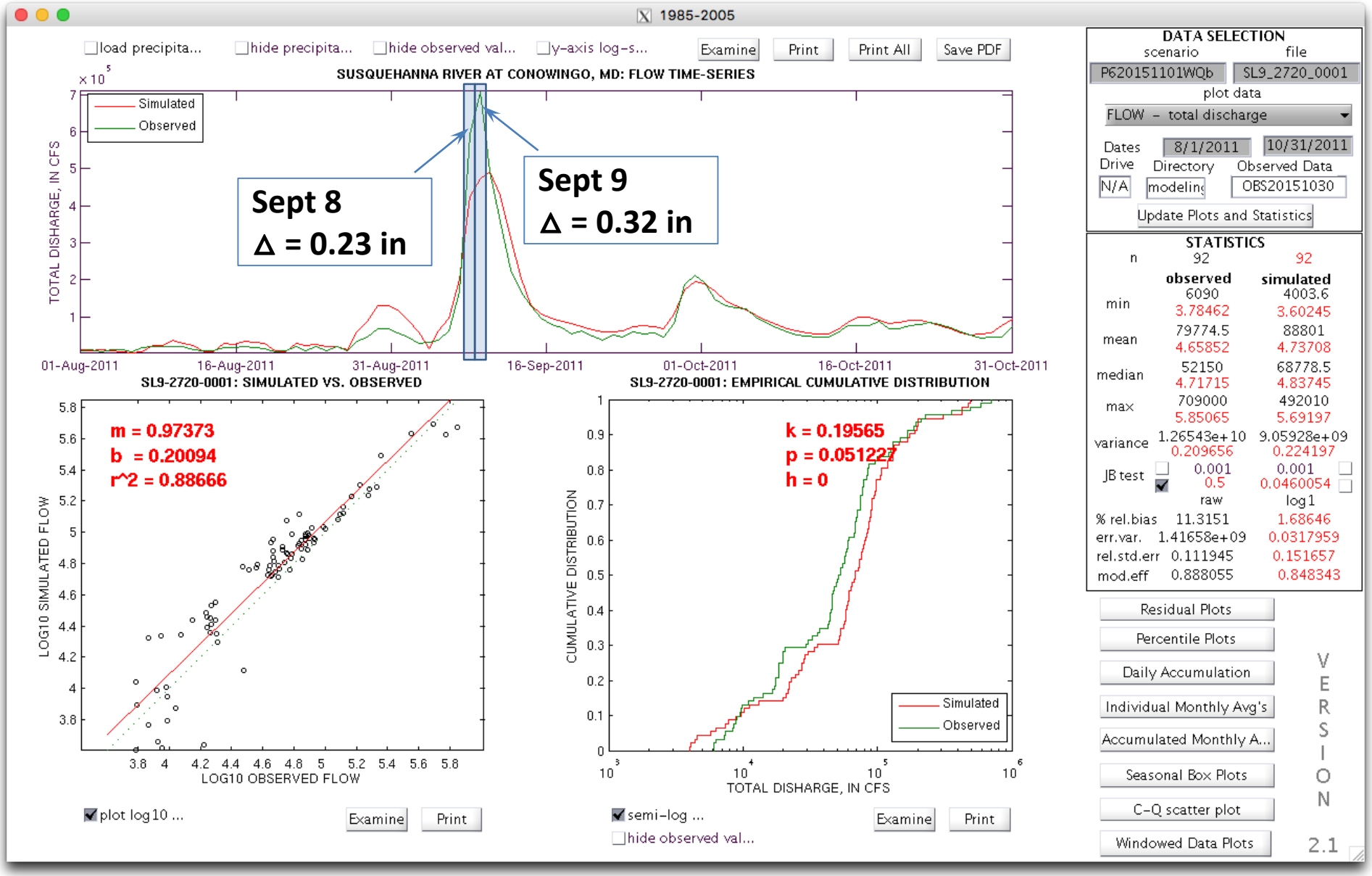
A mass-balance between Marietta & Conowingo

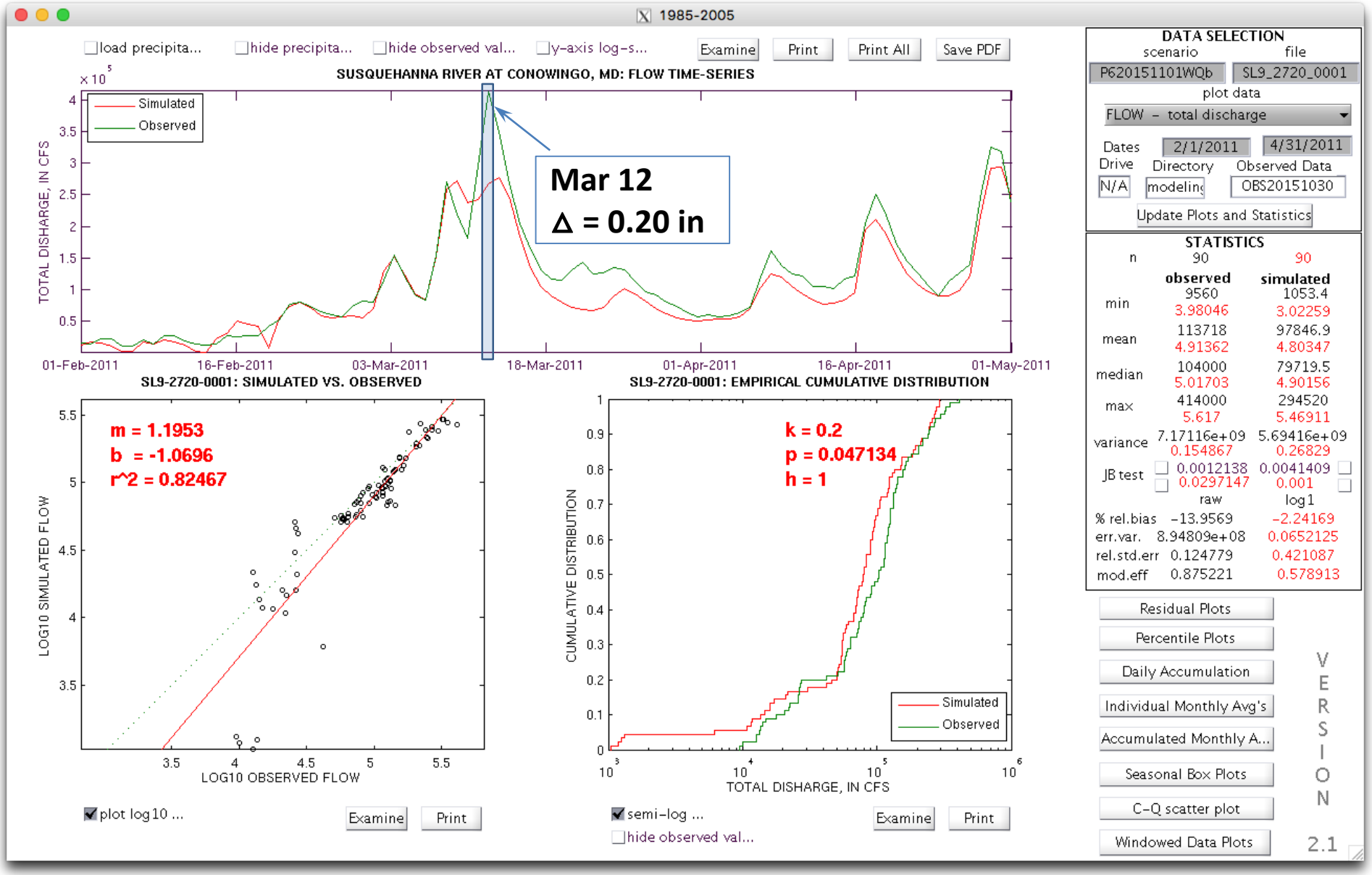





1985-2005
load precipita...
hide precipita...
hide observed val...
y-axis log-s...
Examine
Print
Print All
Save PDF
SUSQUEHANNA RIVER AT CONOWINGO, MD: FLOW TIME-SERIES
x 10^5
TOTAL DISHARGE, IN CFS
Simulated
Observed
APR 1993
JAN 1996
SEP 2004
JUN 2006
MAR 2011
SEP 2011
01-Jan-1990
03-Mar-1994
02-May-1998
02-Jul-2002
01-Sep-2006
31-Oct-2010
31-Dec-2014
SL9-2720-0001: SIMULATED VS. OBSERVED
m = 0.85387
b = 0.67324
r^2 = 0.71175
LOG10 SIMULATED FLOW
LOG10 OBSERVED FLOW
400,000 cfs
SL9-2720-0001: EMPIRICAL CUMULATIVE DISTRIBUTION
k = 0.094524
p = 5.5758e-36
h = 1
CUMULATIVE DISTRIBUTION
TOTAL DISHARGE, IN CFS
Simulated
Observed
plot log10 ...
Examine
Print
semi-log ...
hide observed val...
Examine
Print

Tropical Storm Lee – Sept 4 to 9 2011




1985-2005
load precipita...
hide precipita...
hide observed val...
y-axis log-s...
Examine
Print
Print All
Save PDF
SUSQUEHANNA RIVER AT CONOWINGO, MD: FLOW TIME-SERIES
x 10^5
Simulated
Observed
TOTAL DISHARGE, IN CFS
Mar 12
Δ = 0.20 in
01-Feb-2011
16-Feb-2011
03-Mar-2011
18-Mar-2011
01-Apr-2011
16-Apr-2011
01-May-2011
SL9-2720-0001: SIMULATED VS. OBSERVED
m = 1.1953
b = -1.0696
r^2 = 0.82467
LOG10 SIMULATED FLOW
LOG10 OBSERVED FLOW
plot log10 ...
Examine
Print
SL9-2720-0001: EMPIRICAL CUMULATIVE DISTRIBUTION
k = 0.2
p = 0.047134
h = 1
CUMULATIVE DISTRIBUTION
Simulated
Observed
TOTAL DISHARGE, IN CFS
semi-log ...
hide observed val...
Examine
Print
DATA SELECTION
scenario
file
P620151101WQb
SL9_2720_0001
plot data
FLOW - total discharge
Dates
2/1/2011
4/31/2011
Drive
Directory
Observed Data
N/A
modelin
OBS20151030
Update Plots and Statistics
STATISTICS
n 90 90
observed simulated
min 9560 1053.4
3.98046 3.02259
mean 113718 97846.9
4.91362 4.80347
median 104000 79719.5
5.01703 4.90156
max 414000 294520
5.617 5.46911
variance 7.17116e+09 5.69416e+09
0.154867 0.26829
JB test 0.0012138 0.0041409
0.0297147 0.001
raw log1
% rel.bias -13.9569 -2.24169
err.var. 8.94809e+08 0.0652125
rel.std.err 0.124779 0.421087
mod.eff 0.875221 0.578913
Residual Plots
Percentile Plots
Daily Accumulation
Individual Monthly Avg's
Accumulated Monthly A...
Seasonal Box Plots
C-Q scatter plot
Windowed Data Plots
VERSION
2.1

Summary and Key questions

- Ongoing research of **Safe Harbor** (Lake Clarke) and **Holtwood** (Lake Aldred) using HEC-RAS has potential to inform the parameterization of HSPF simulation and therefore help improve the characterization of dynamic equilibrium.

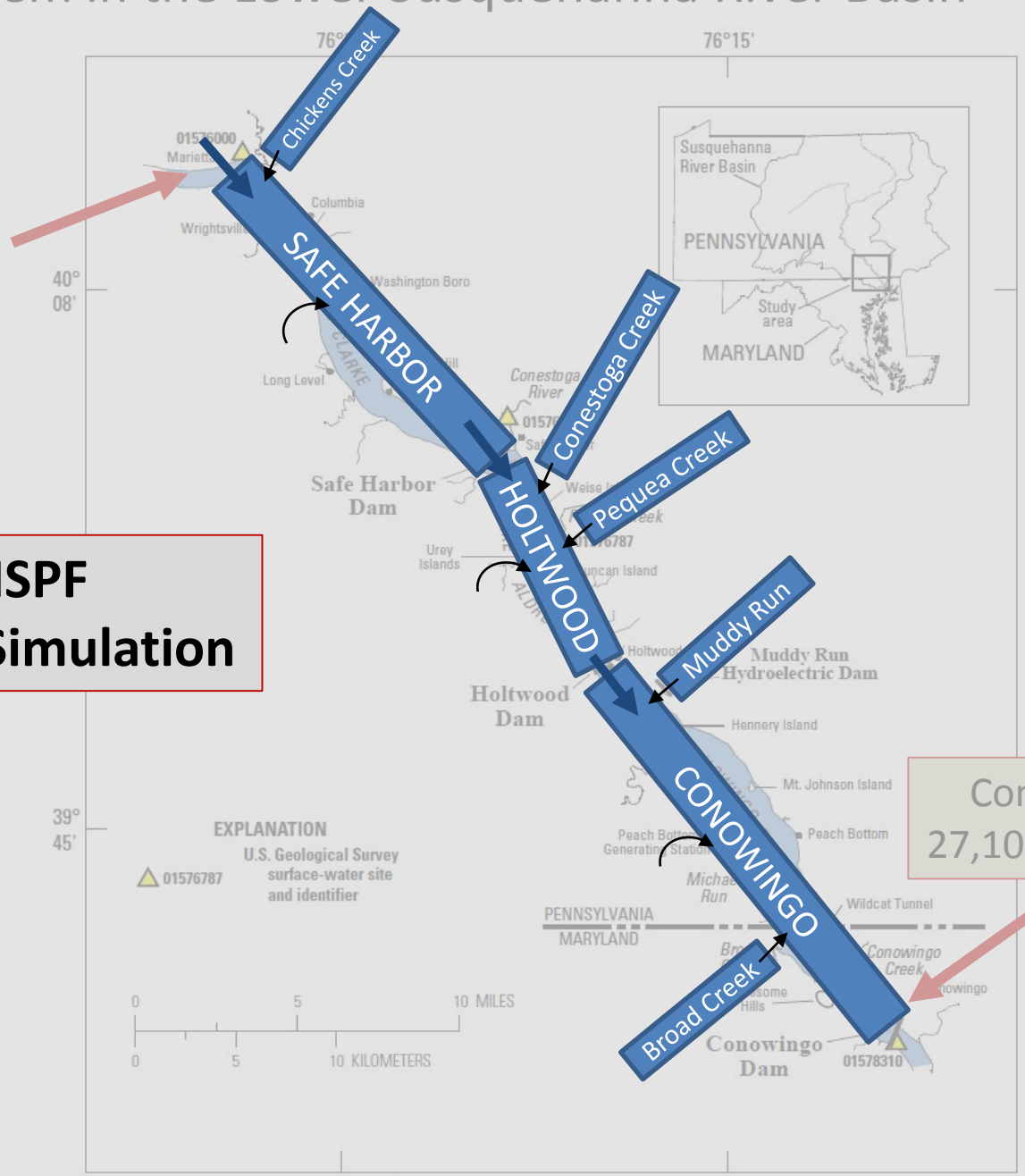
- Phase-6 has potential to simulate scour at the Conowingo for the 6 extreme storms between 1985-2014.

- Should we calibrate (a) rainfall for these 6 extreme events, and/or (b) F-Table to achieve a better capture streamflow peaks?

- There are three likely sources that can help quantify how scour and deposition changes with bathometry

  (a) A synthesis from Langland 2015, (b) WRTDS analysis, (c) Conowingo Pond Mass Balance Model.

The Reservoir System in the Lower Susquehanna River Basin



Marietta
25,990 sq. miles

2D HSPF
Reservoir Simulation

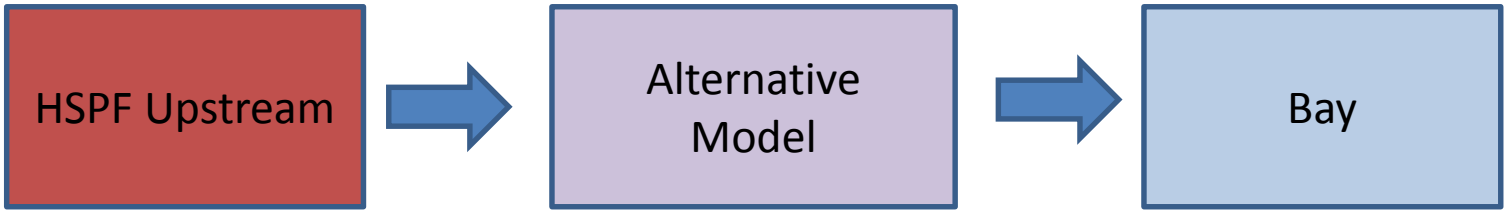
Conowingo
27,100 sq. miles

CBP WSM

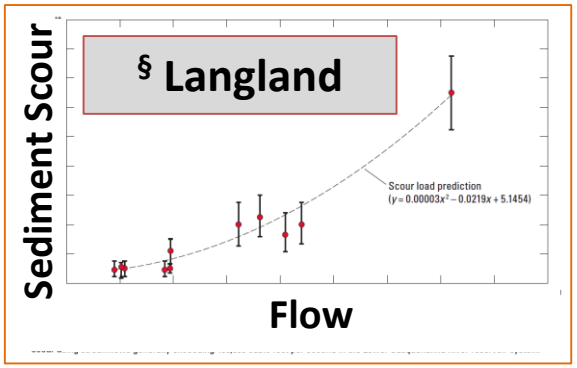
Phase 6 Prototypes

- ***Refine HSPF calibration based on available data.***
- ***Refine HSPF calibration based on the findings from HEC-RAS simulation of Safe Harbor & Holtwood, and Conowingo Pool Mass Balance Model (CPMBM).***

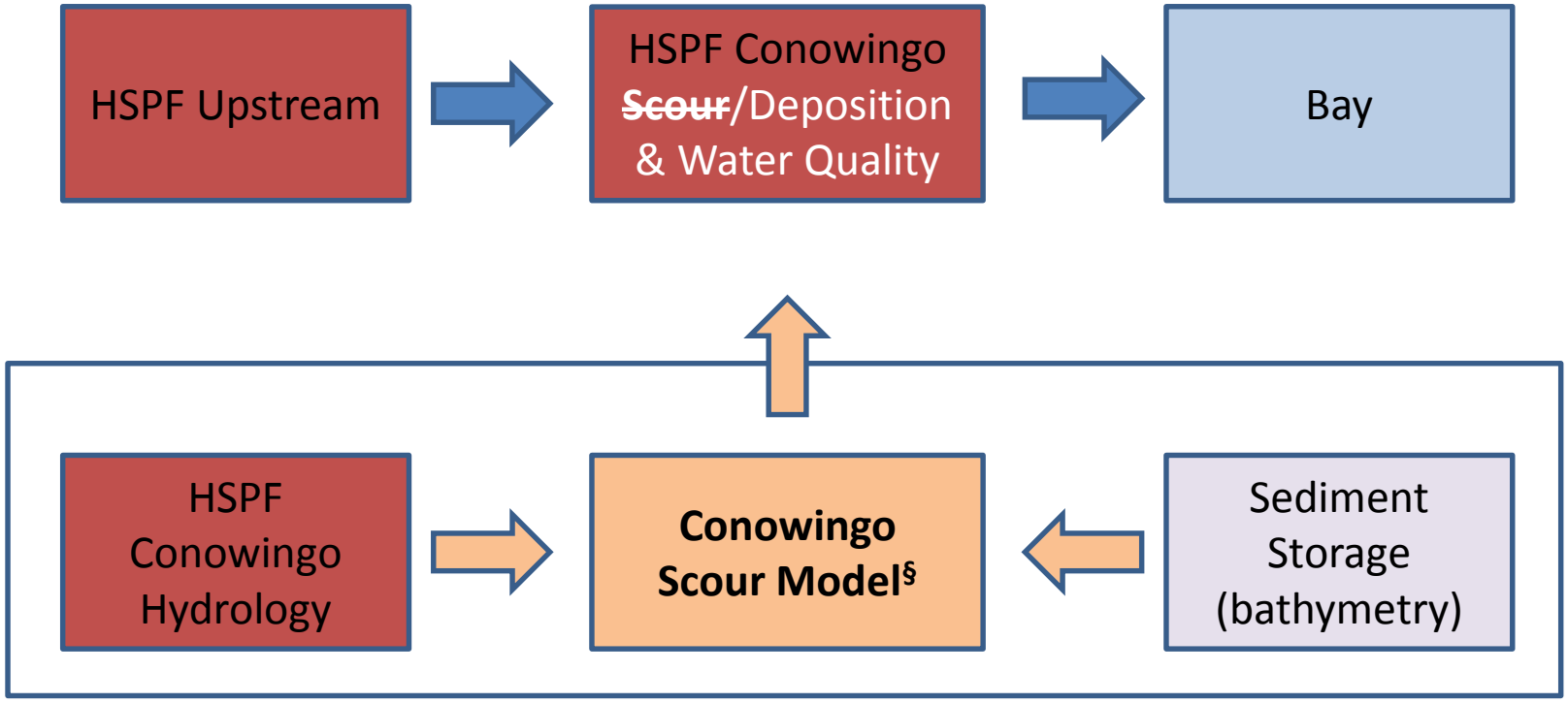
Alternative to HSPF (post 2017 Mid-Point Assessment)



Alternative to HSPF Scour



§ CPMBM



Summary

- The CBP has flexible methods to implement models of the Conowingo
- Need mathematical descriptions of scour and deposition as a function of flow and bathymetry
- The CBP Partnership would be interested in the recommendations from this workshop

Key information needs

- Phase-6 has potential to simulate scour at the Conowingo for the six extreme storms between 1985-2014.
  - How does scour change with the bathymetry? Is there an agreement that its representation in Phase-6 important?
  - How does deposition change with the bathymetry? Is there an agreement that its representation in Phase-6 important?
- Are there any other reservoir infill processes that should be considered in Phase-6 simulation?

Key questions

- Phase-6 has potential to simulate scour at the Conowingo for the 6 extreme storms between 1985-2014.
  - Is there an agreement that *changes in scour* with the bathymetry an important phenomenon to represent?
  - Is there an agreement that *changes in deposition* with the bathymetry an important phenomenon to represent?
- Should we calibrate rainfall during these 6 extreme events?
- Are there any other reservoir infill processes that should be considered in Phase-6 simulation?