

Item #5

# Guadalupe Watershed Model

Michelle Lent, Lester McKee

Presentation to the SPLWG  
May 12, 2011

Item #5

# Overview of timeline

Tasks	Time frame	Status
Develop hydrology model	2008	Completed
Calibrate & validate hydrology model	2008	Completed
Phase I Report	2008-09	Completed
Refine hydrology model	2009	Completed
Develop sediment model	2010-11	Completed
Develop mercury model	2010-11	Completed
Develop PCBs model	2010-11	Completed
External technical model review	2011	Completed
<b>Calibrate &amp; validate sediment, Hg, and PCBs models</b>	2010-11	In progress
Phase II Report	June 11, 2011	In progress (80% done)

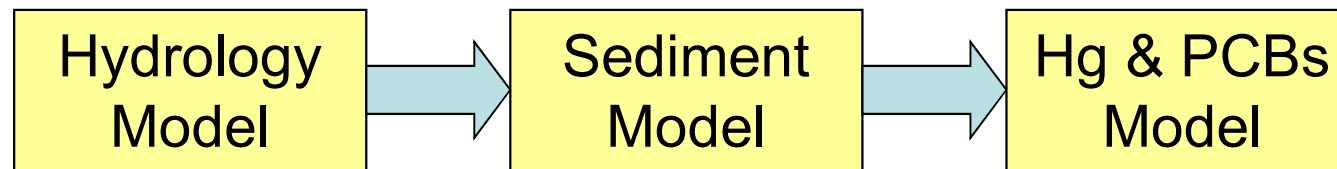
Item #5

# Project objectives & motivation

## Item #5

- Basic Objective:
  - To understand the source, release, and transport of suspended sediment, mercury (Hg) and PCBs from a large urban watershed to San Francisco Bay

- *How?*

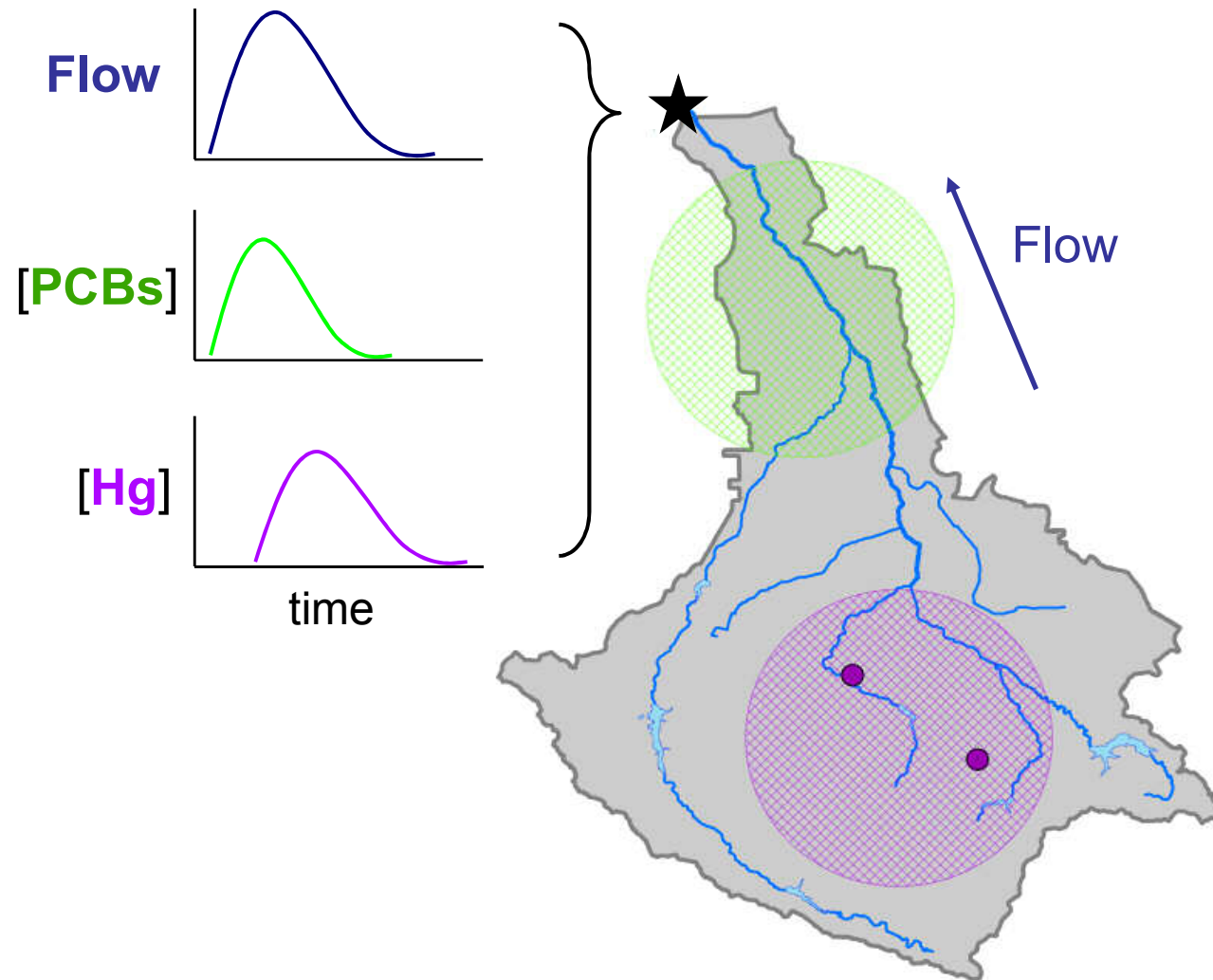


- *Why?*

- Improve accuracy of load estimates
- Determine proportional loads
  - When and from where are constituents transported
- Establish input and calibration parameters for region-wide application
- Assess potential effects of BMPs and land use change

Item #5

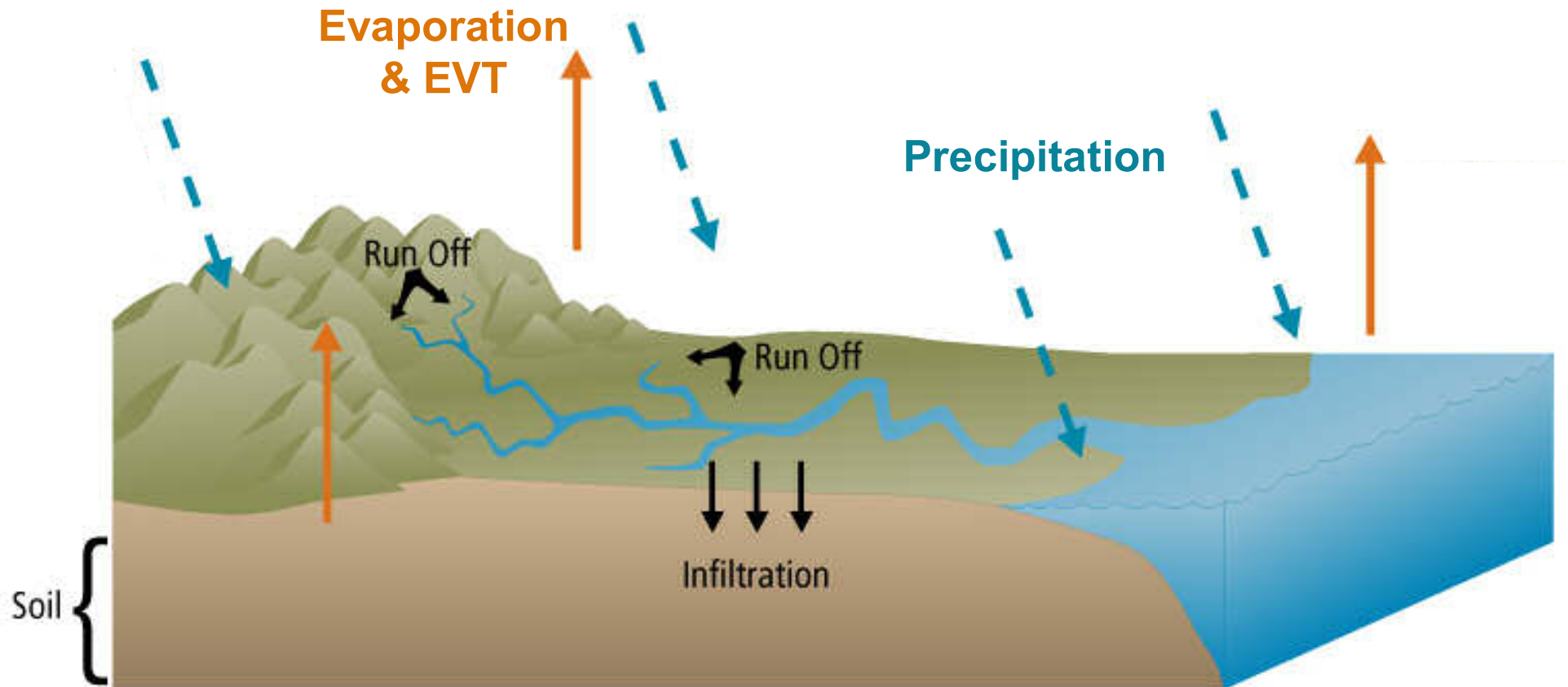
# Why study *source, release, and transport* of Hg and PCBs in Guadalupe Watershed?



Item #5

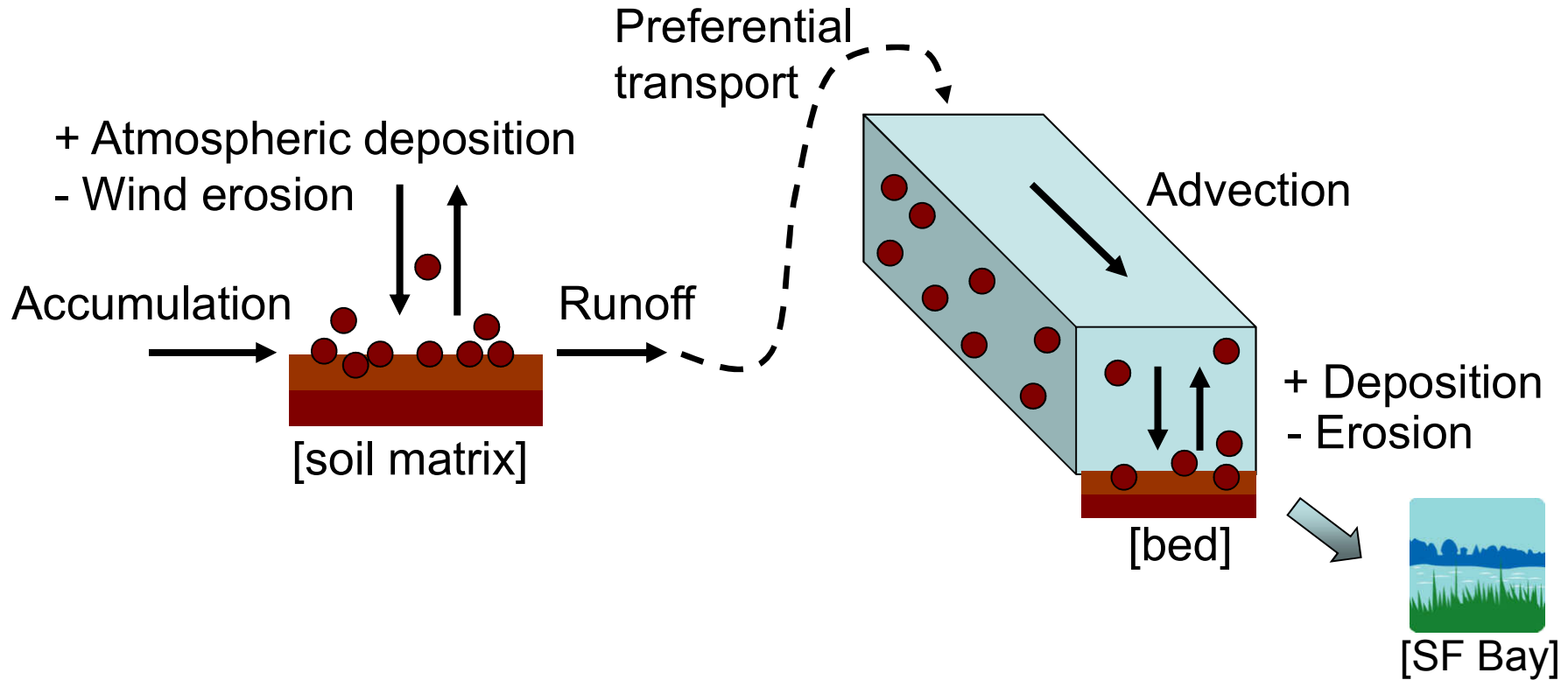
# Overview of model processes

# Hydrology Model



Hydrological Simulation Program - FORTRAN (HSPF)

# Sediment Model

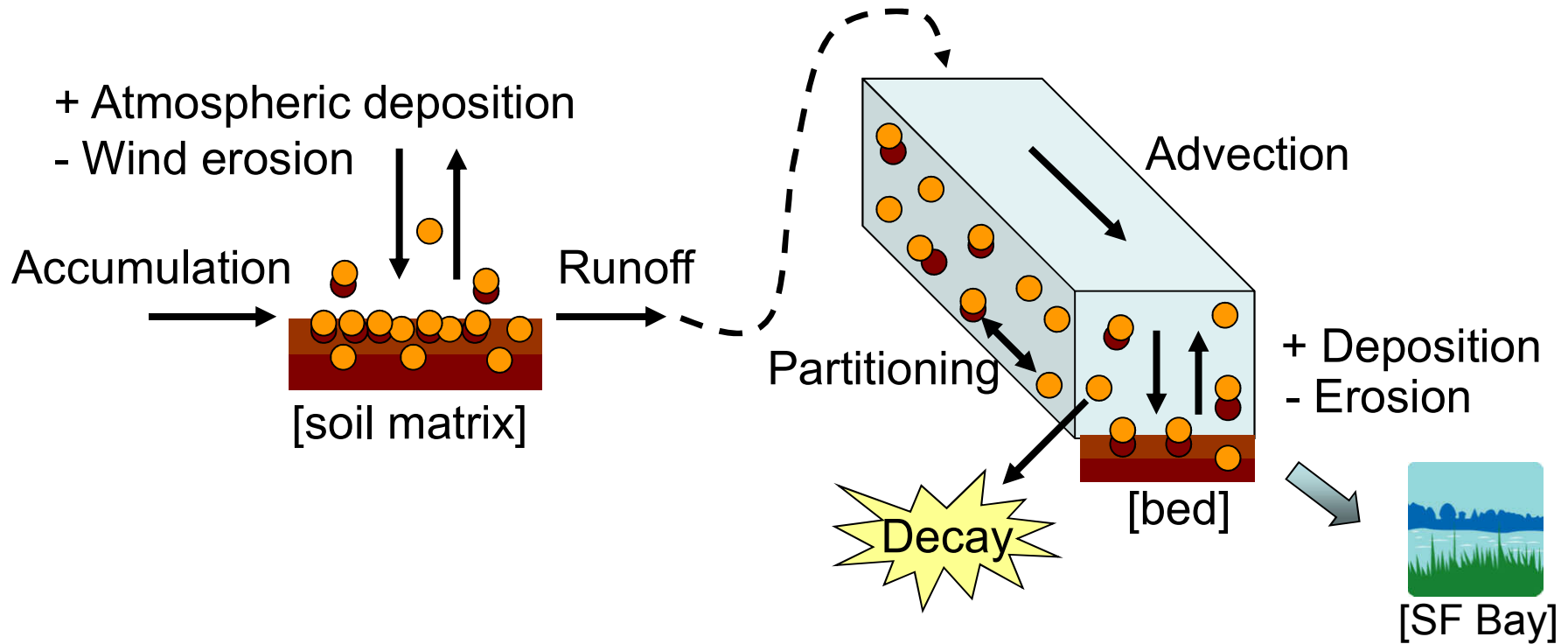


Land-based processes

Reach-based processes



# Contaminant Model

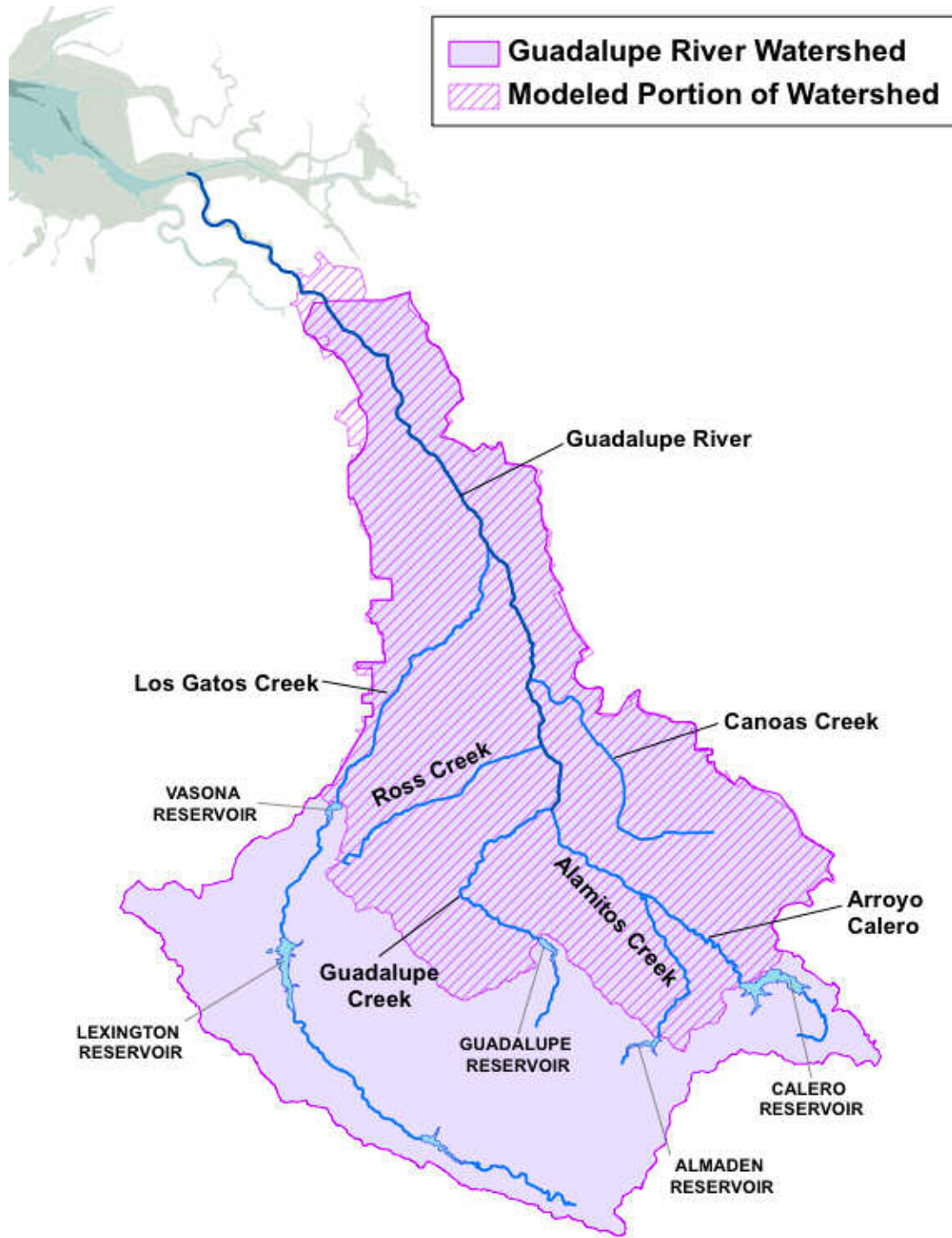


Land-based processes

Reach-based processes

Item #5

# Overview of model development



# Watershed Delineation

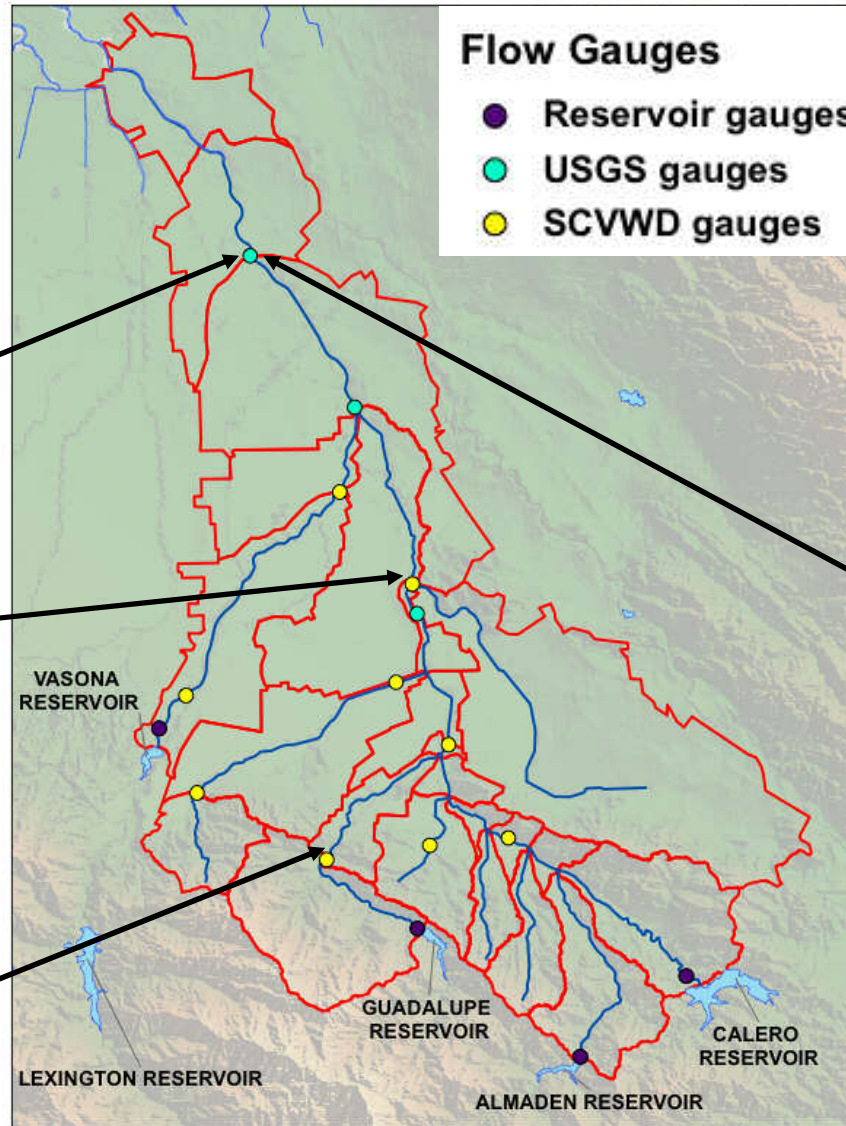
Item #5

Hydrologic  
**calibration** &  
**validation** sites:

Lower  
Guadalupe  
River

Canoas Creek

Guadalupe Creek



Water quality  
calibration and  
validation site:

Sediment  
Calib. WY 2003-05  
Valid. WY 2006-07

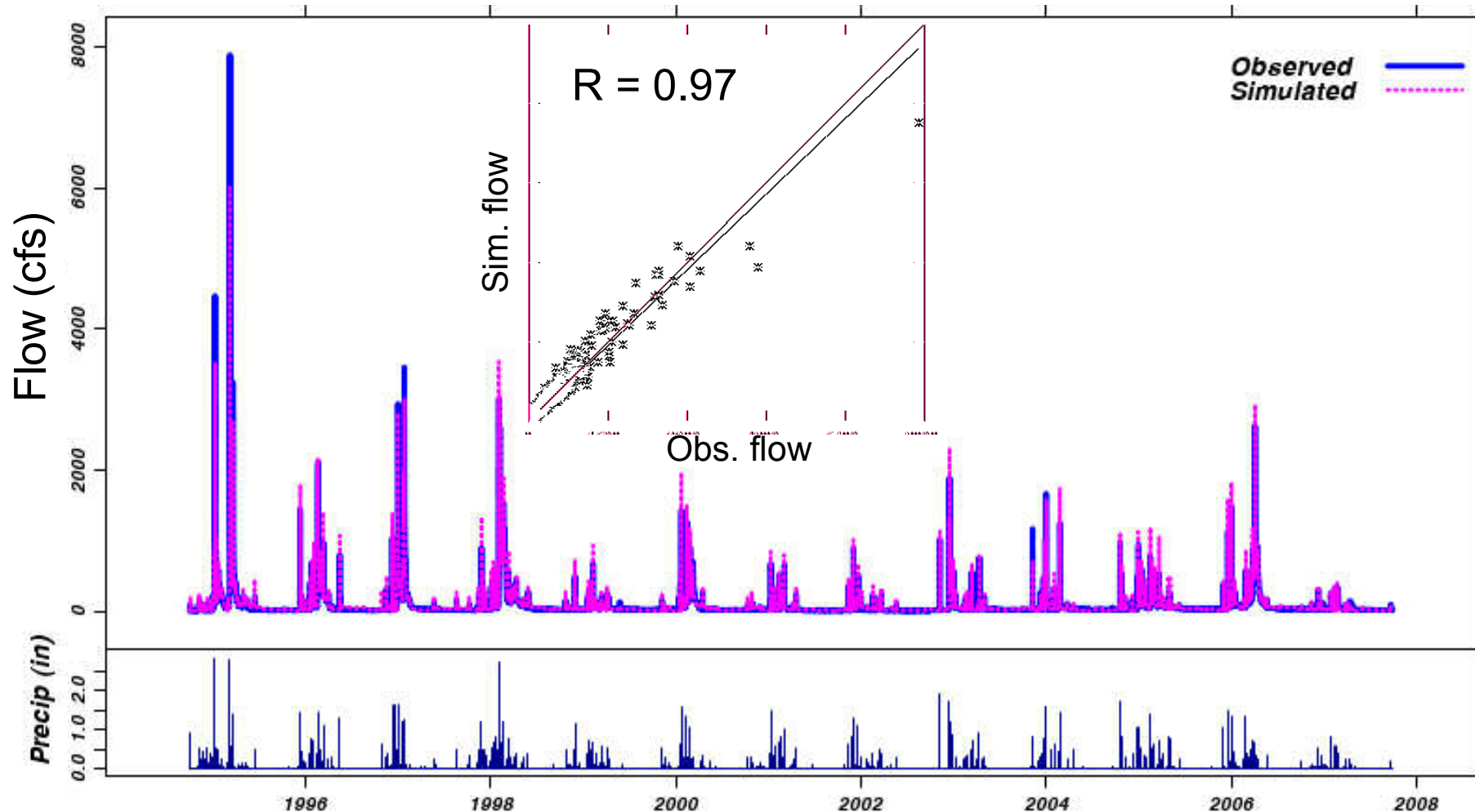
Hg  
Calib. WY 2003-04  
Valid. WY 2005-06

PCBs  
Calib. WY 2003-04  
Valid. WY 2005-06

Item #5

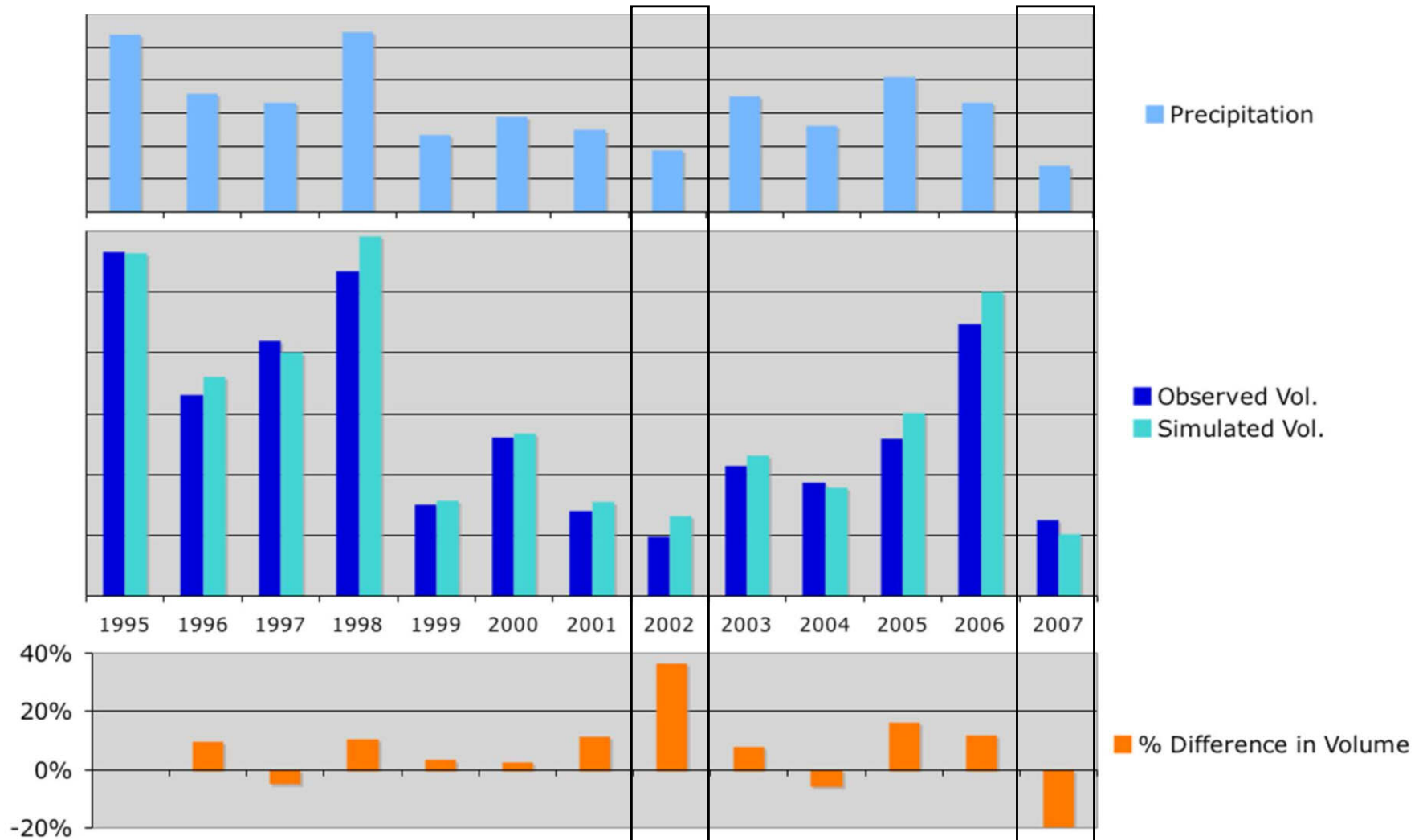
# Example model output (WY1995-2007)

## Guadalupe River daily mean flow with precipitation



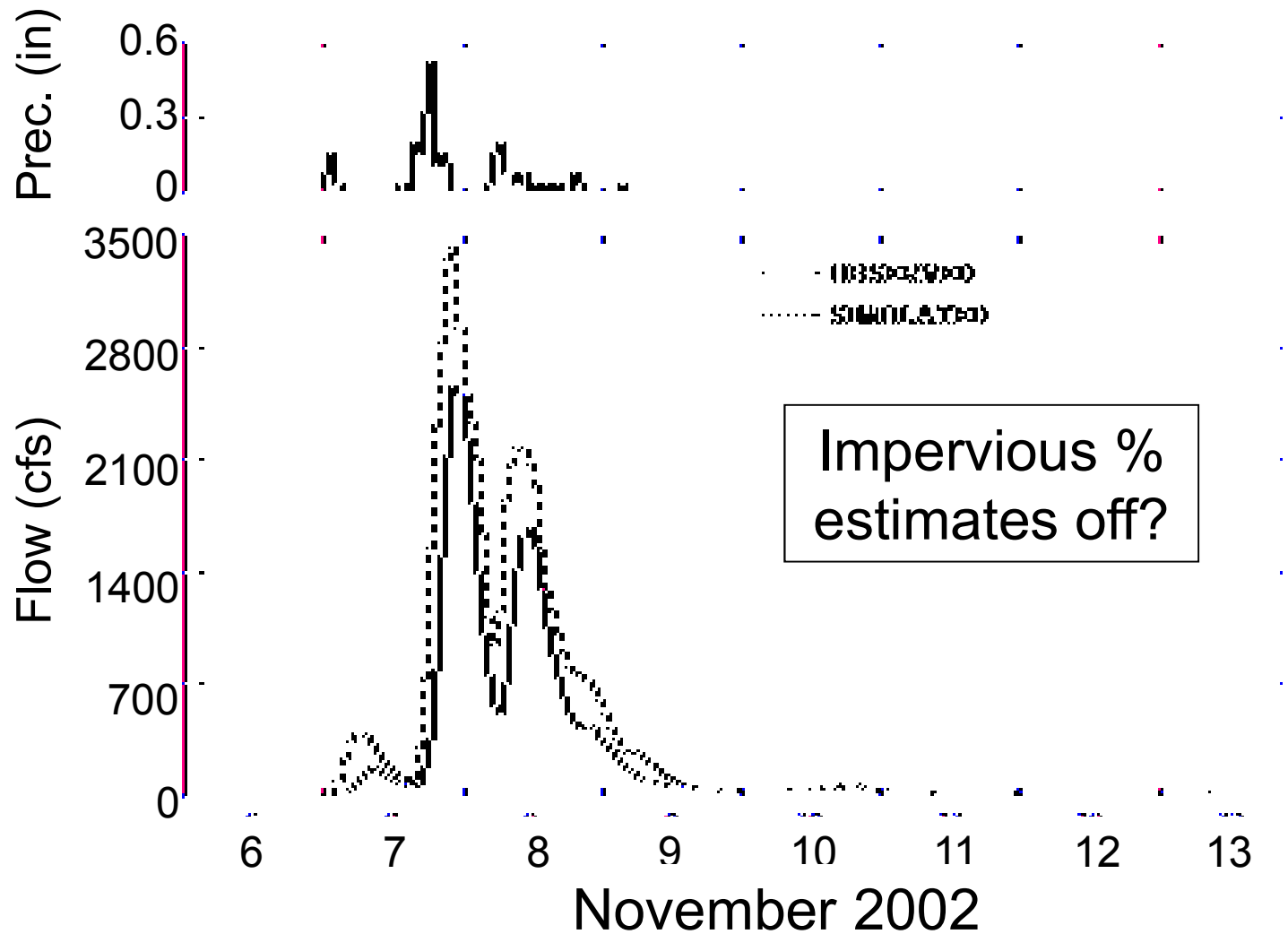
Item #5

# Hydrologic Model Performance: Annual Flow Volumes for Guadalupe River



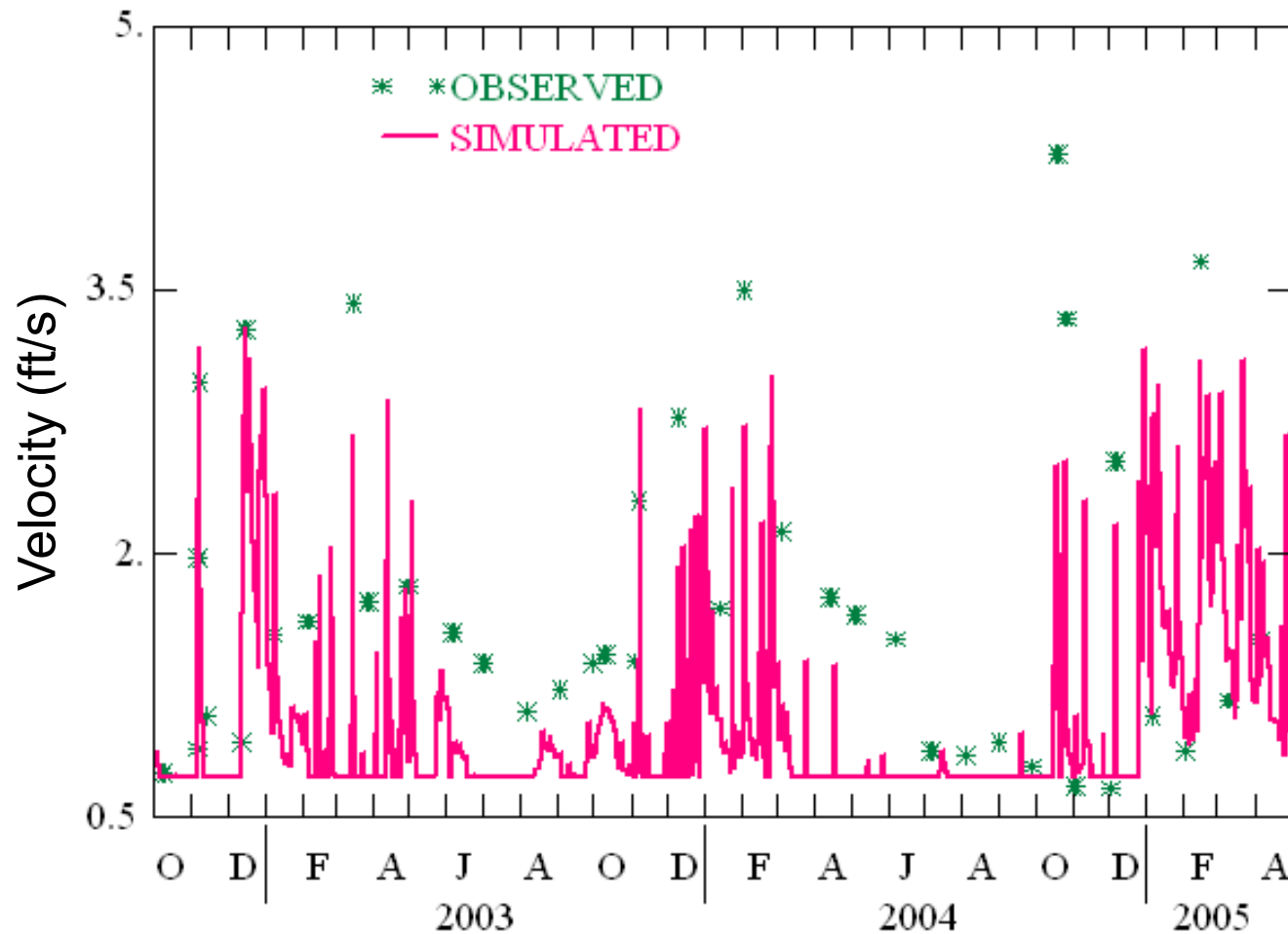
Item #5

# Hydrologic Model Performance: Mean Hourly Flow for Guadalupe River



Item #5

# Hydraulic Model Performance: Mean Daily Velocity for Guadalupe River

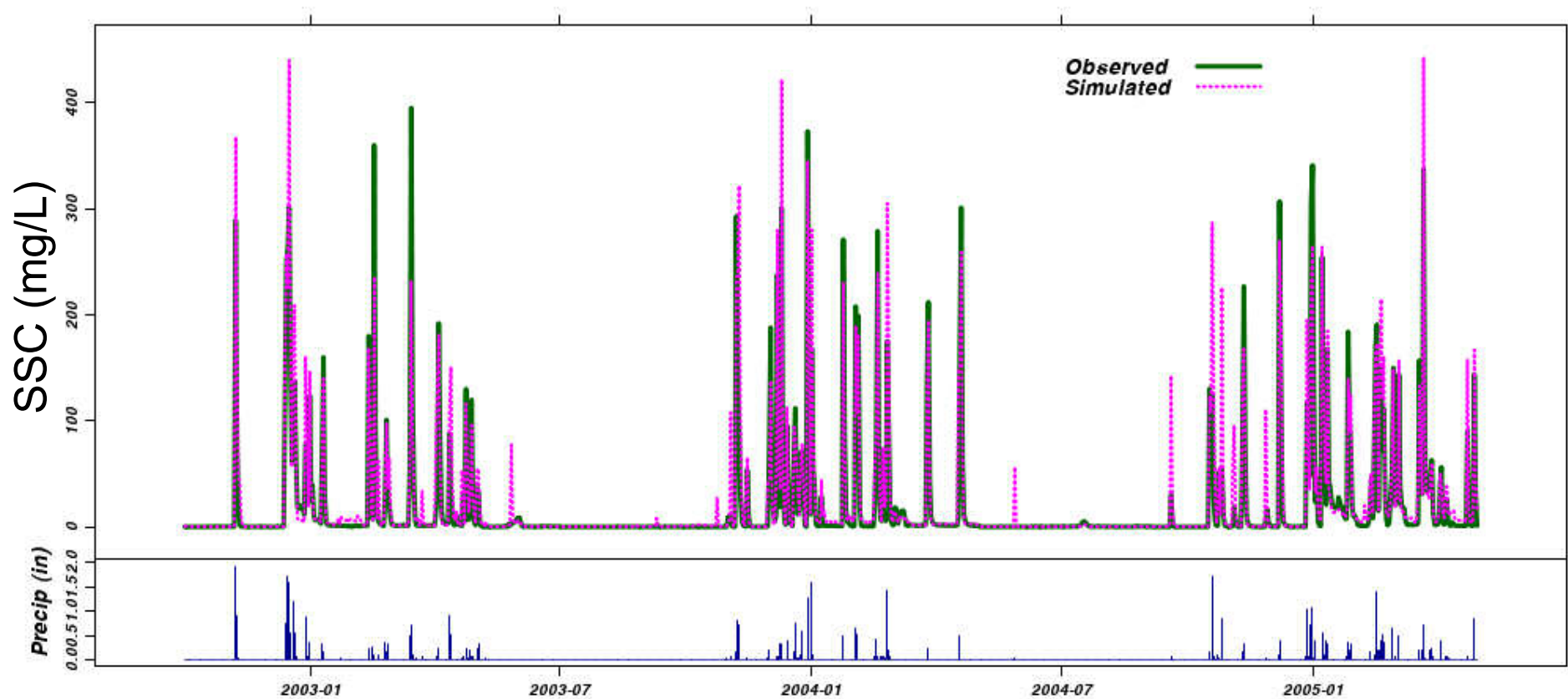




Item #5

# Sediment Model Results: SSC

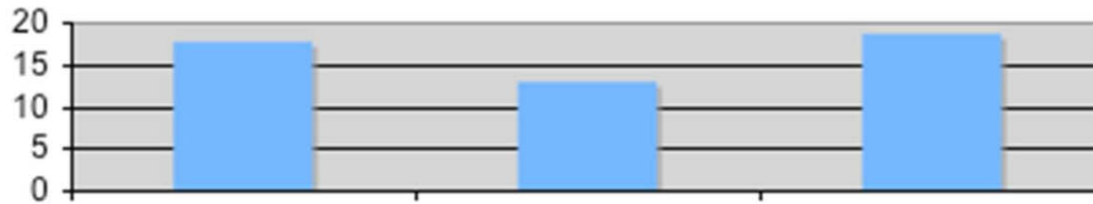
Daily Mean SSC (calibration period)



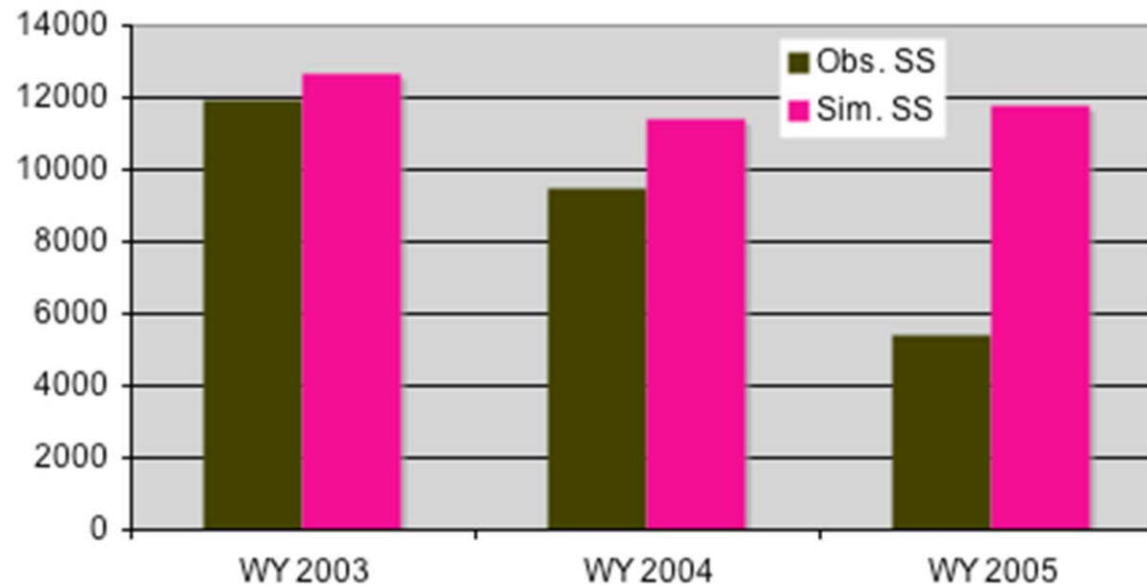
Item #5

# Initial Sediment Model Results: SS loads

Precip.



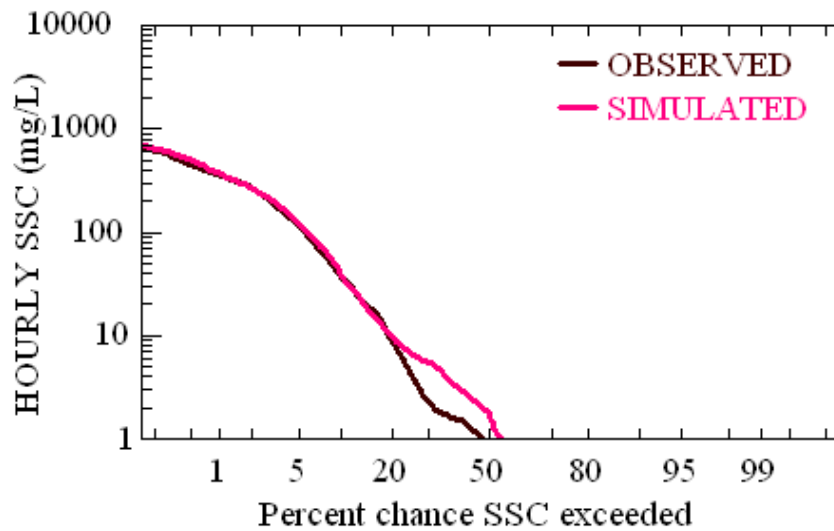
SS loads



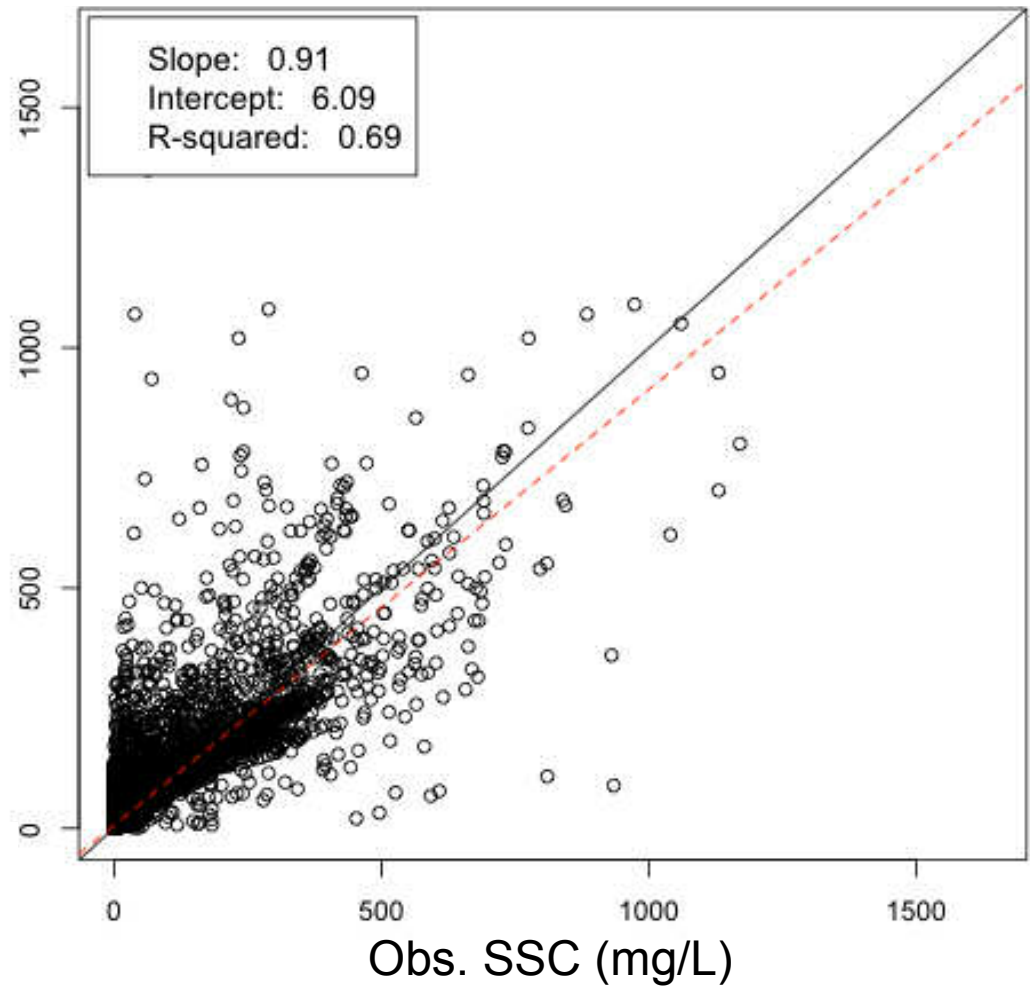
% Diff.



# Hourly SSC



Sim. SSC (mg/L)



- Oversimulating low SSC

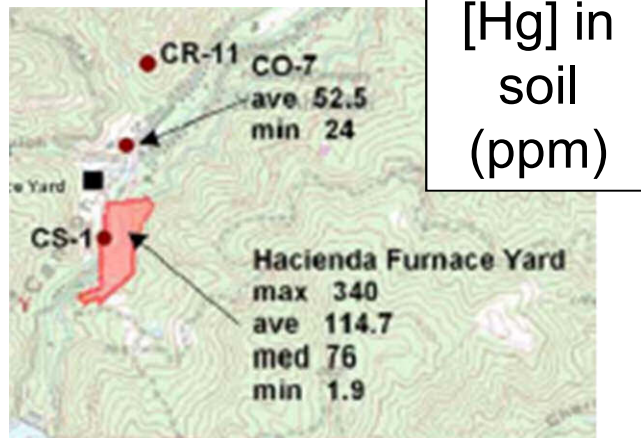
# Approach to modeling Hg & PCBs

- Model simplifications
  - “Lumped” treatment:
    - total-Hg ... no speciation
    - total-PCBs ... no congeners
- Assigning pollutant behavior
  - Partition coefficients
    - using Hg(II) and penta-PCBs values
  - Degradation rates
    - Using total-PCBs values

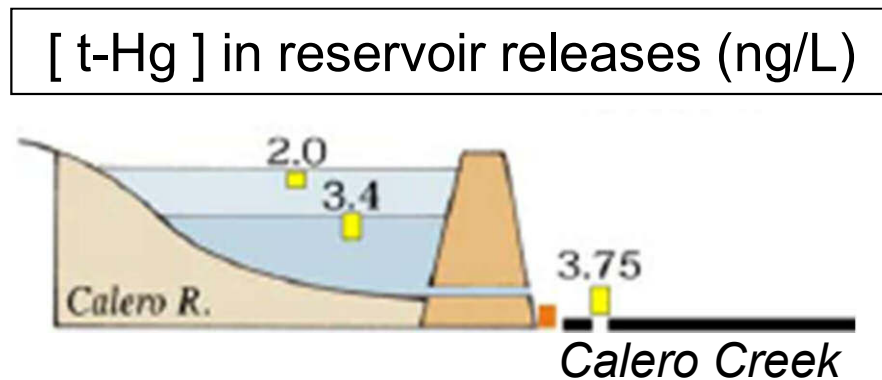
# Approach to modeling Hg & PCBs

- Identifying & assigning sources
  - Concentrations in:
    - watershed soils
    - channel bed sediments
    - reservoir releases
  - Wet & dry atmospheric deposition

## Examples:



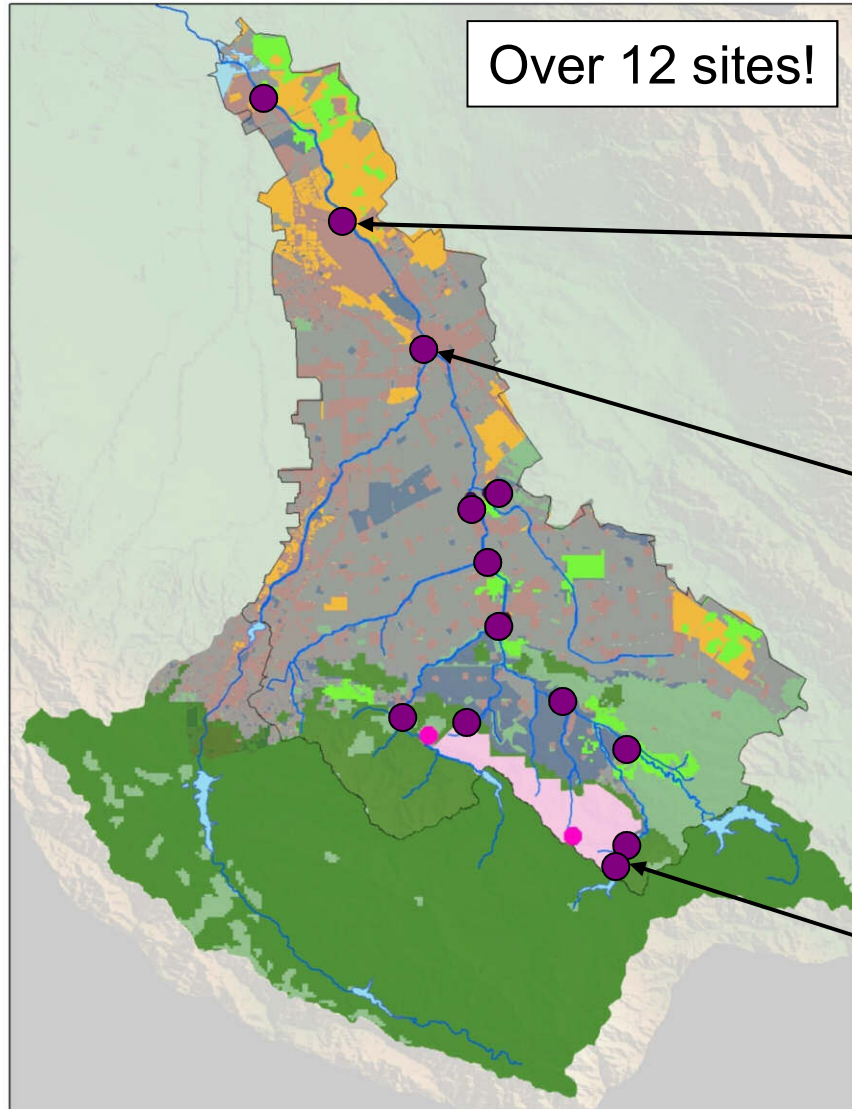
[Hg] in soil (ppm)



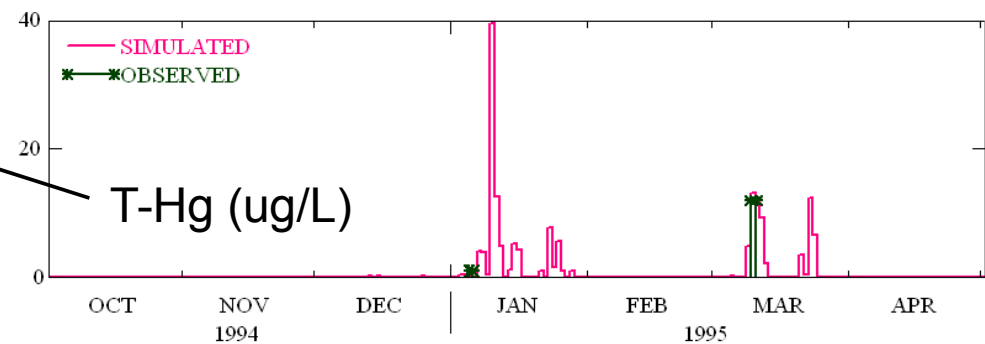
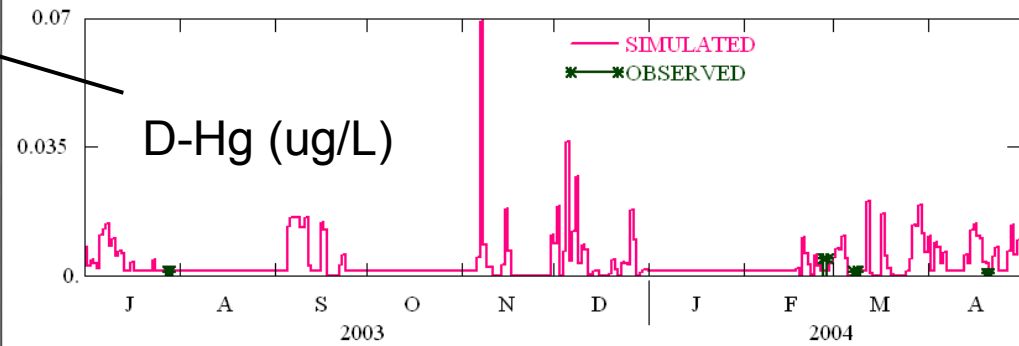
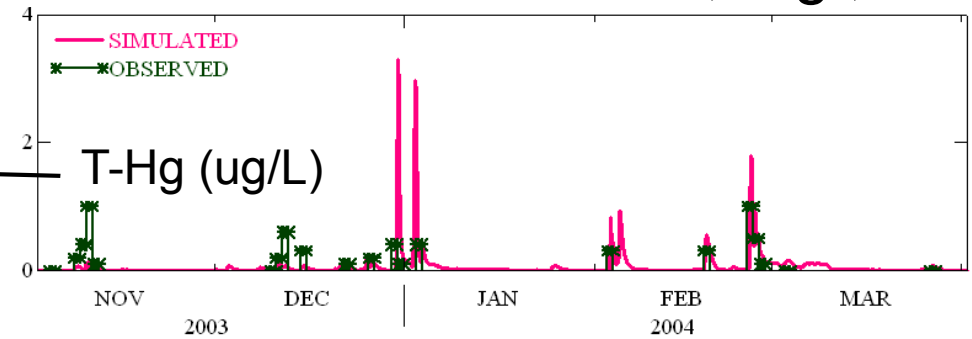
[ t-Hg ] in reservoir releases (ng/L)

Item #5

# Calibrating Hg model

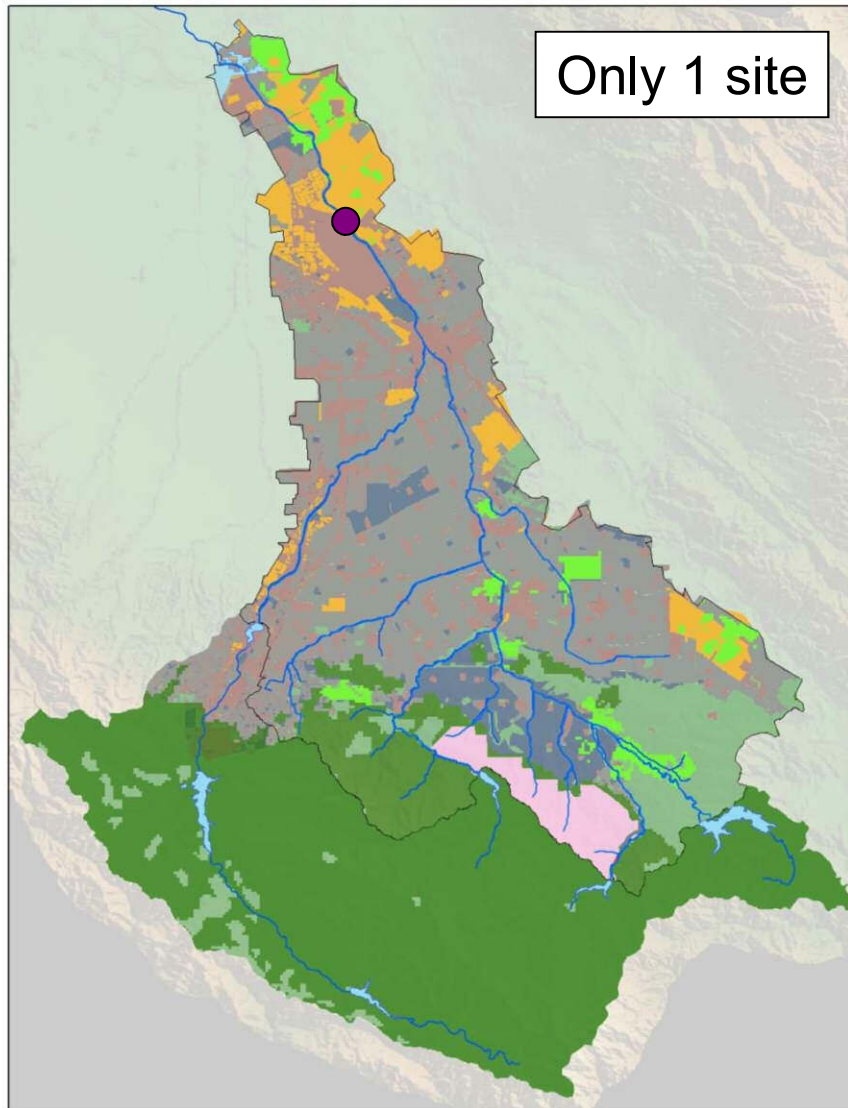


Lots of data to work with, e.g.,

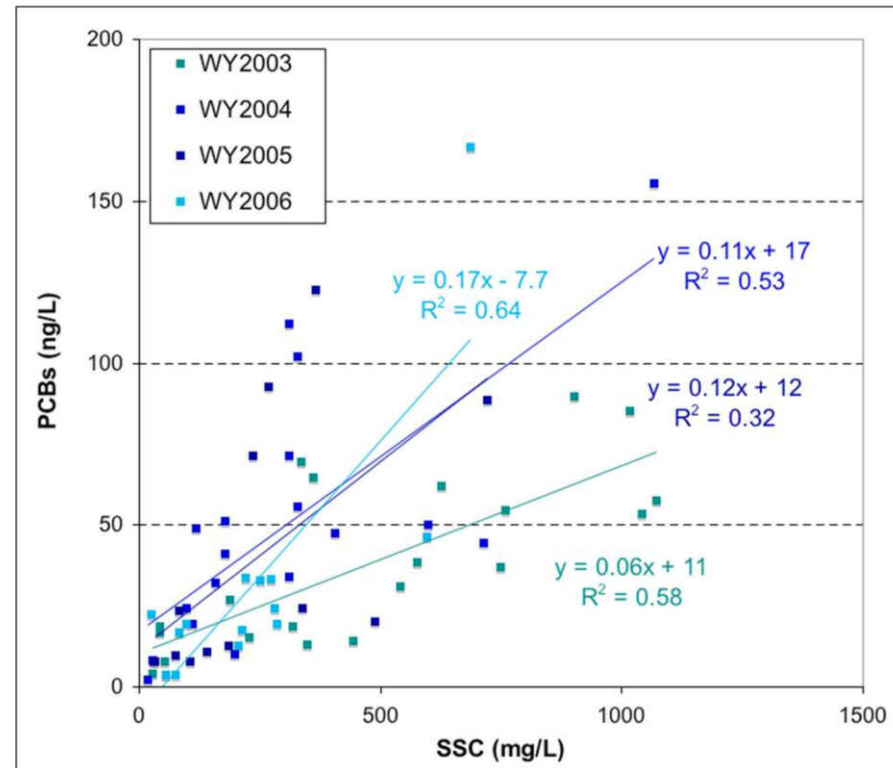


Item #5

# Calibrating PCBs model

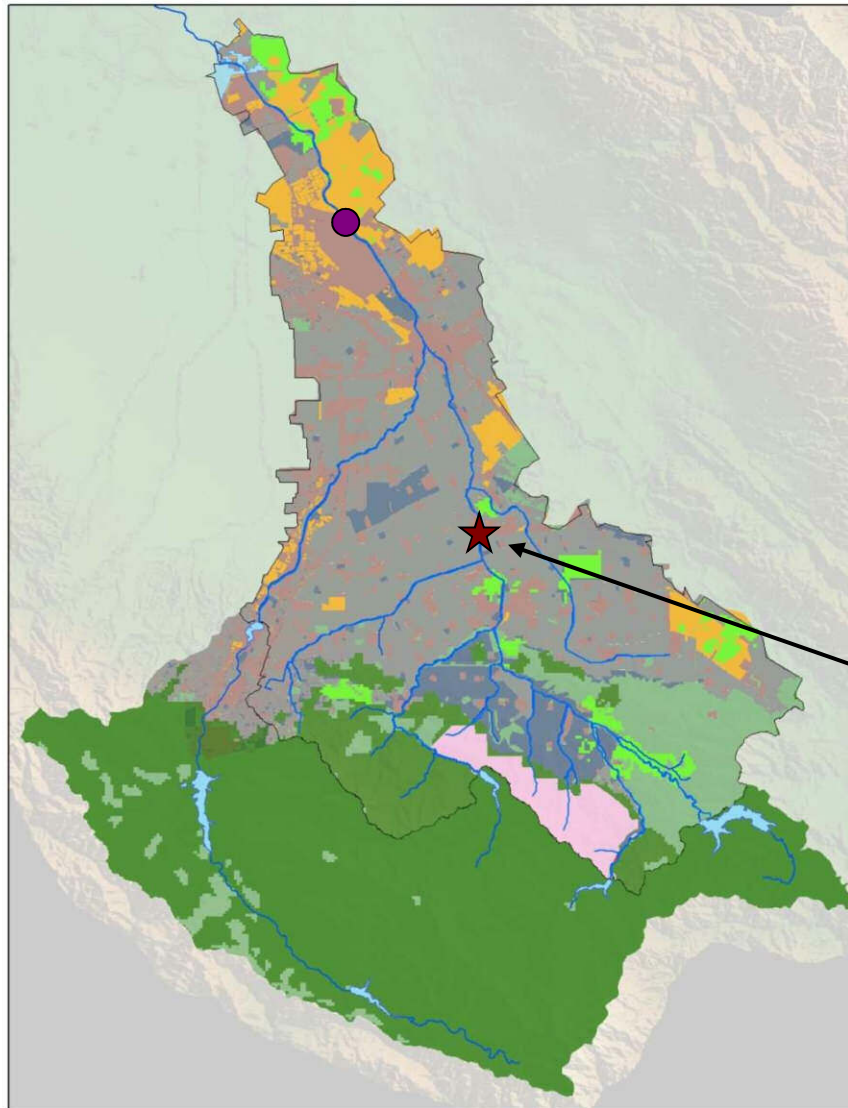


Lots of data (WY2003-06)

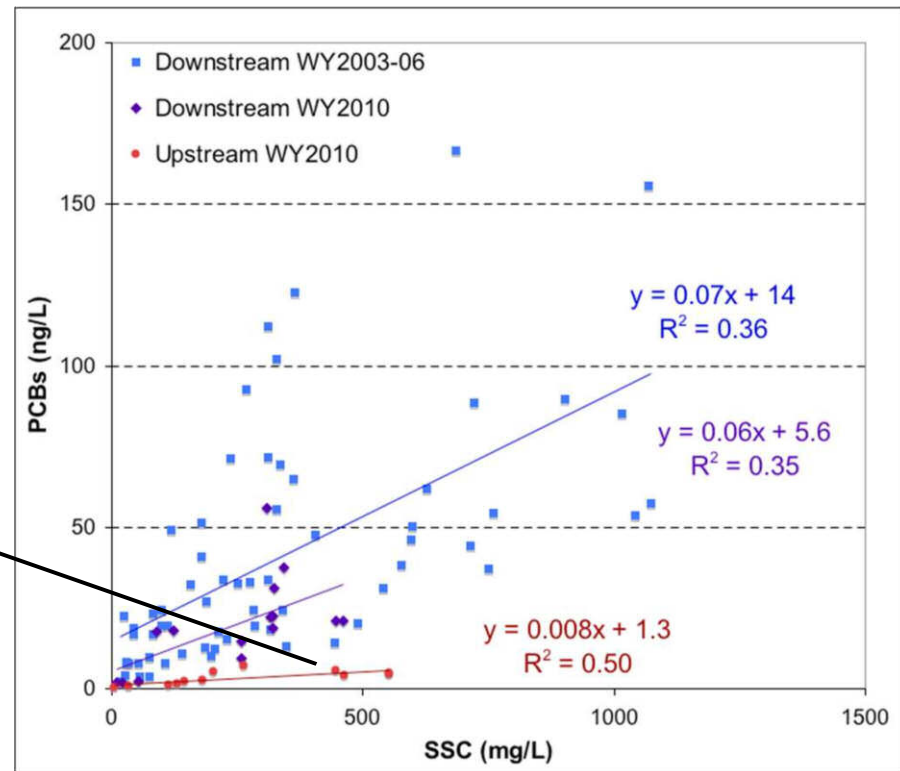


Item #5

# Calibrating PCBs model



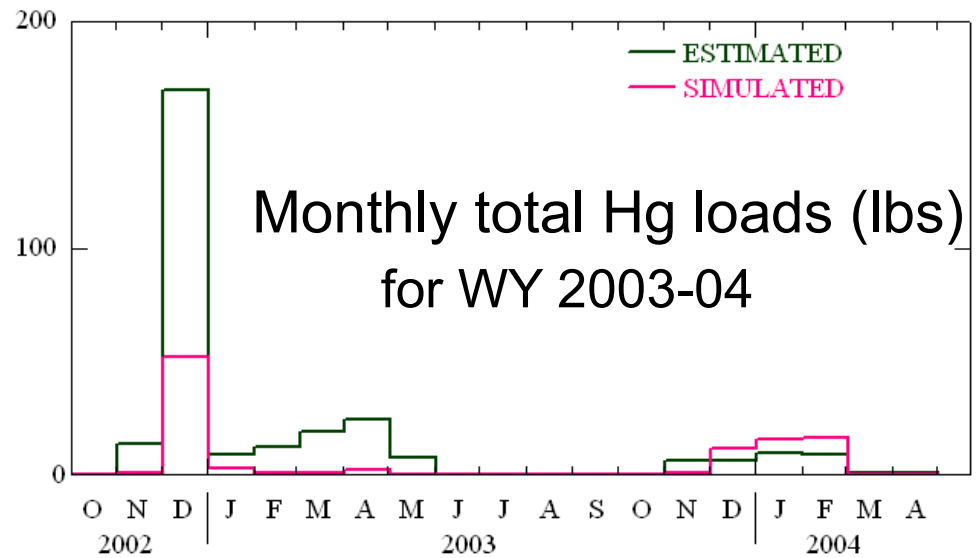
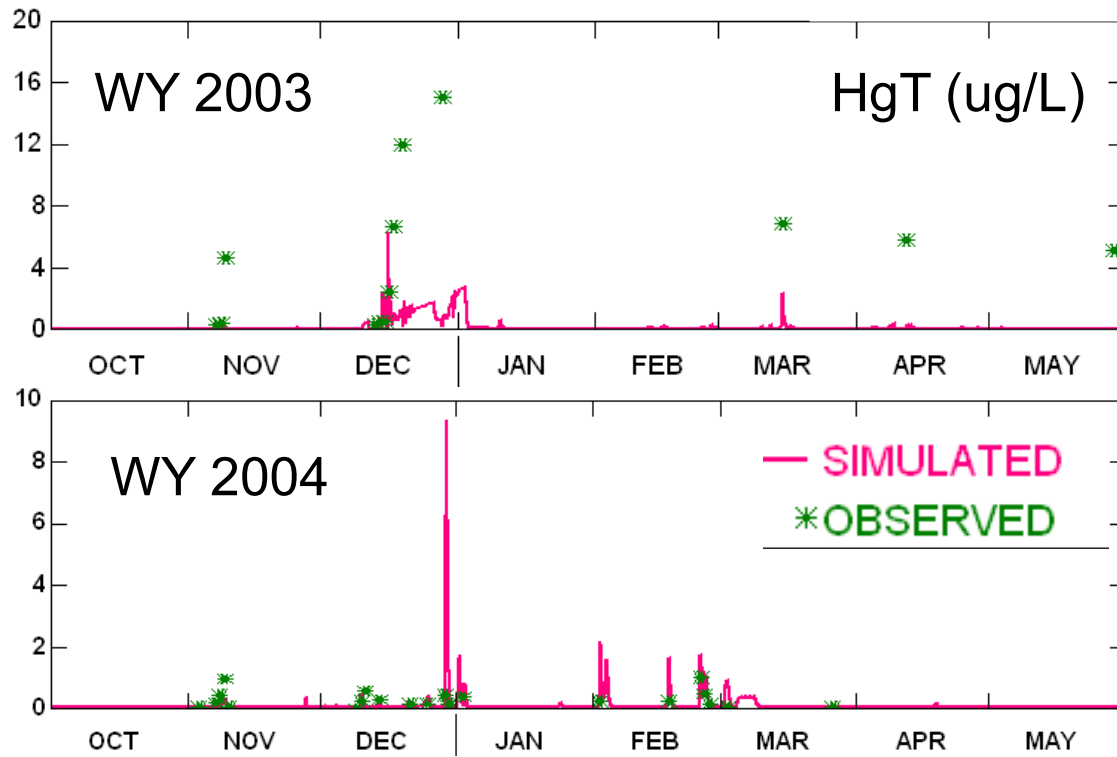
Upstream site added in WY2010



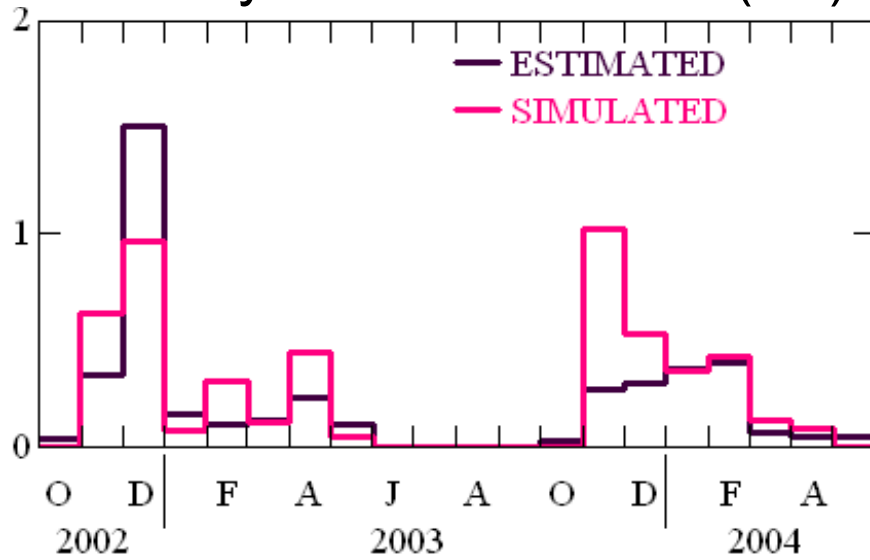
...can use SSC:PCB ratio  
(until model is extended to WY2010)



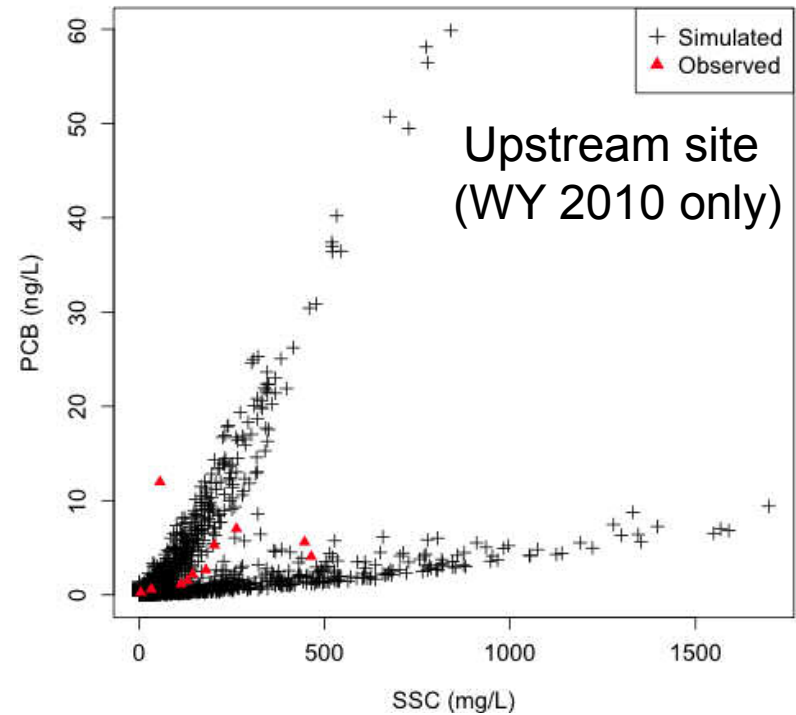
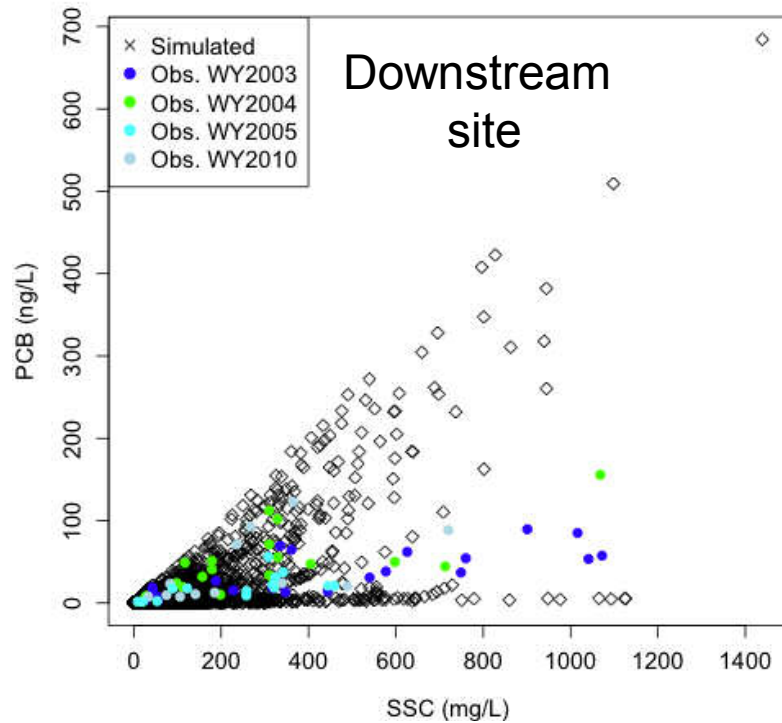
# Hg results



# Monthly total PCBs loads (lbs)



# PCBs results



# Recommendations

- Ground-truth imperviousness estimates
- Improve hydraulic model
  - Obtain stage-volume-discharge-velocity data for tributaries
- Reduce uncertainty on boundary conditions
  - Data gap: SSC and Hg data for reservoir high flow releases, any PCBs data in reservoir releases