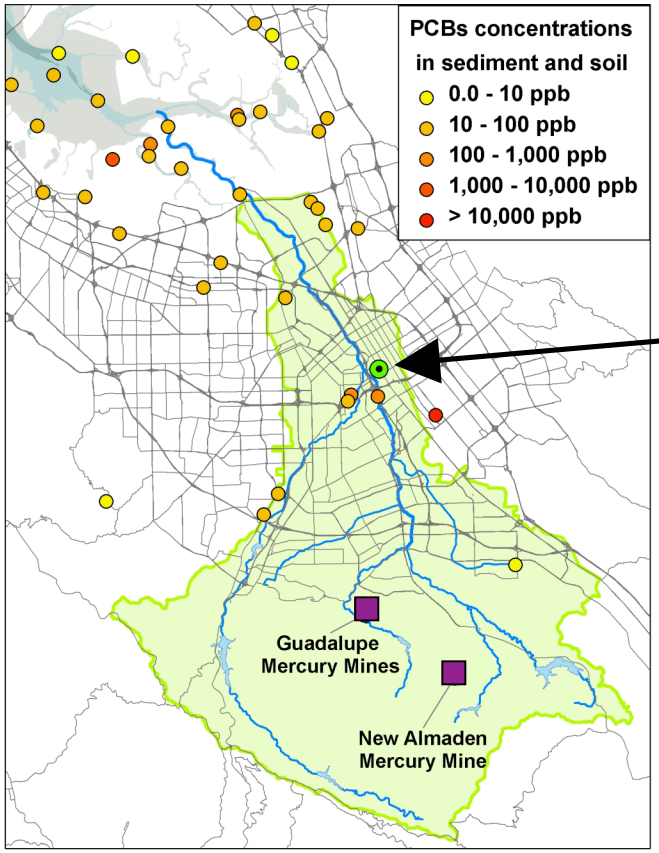
Guadalupe Watershed Model



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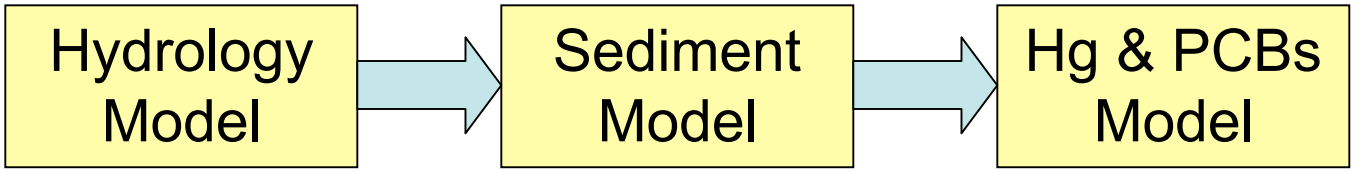
Michelle Lent, John Oram, Lester McKee
San Francisco Estuary Institute

FMA Annual Conference - Sept. 9, 2009

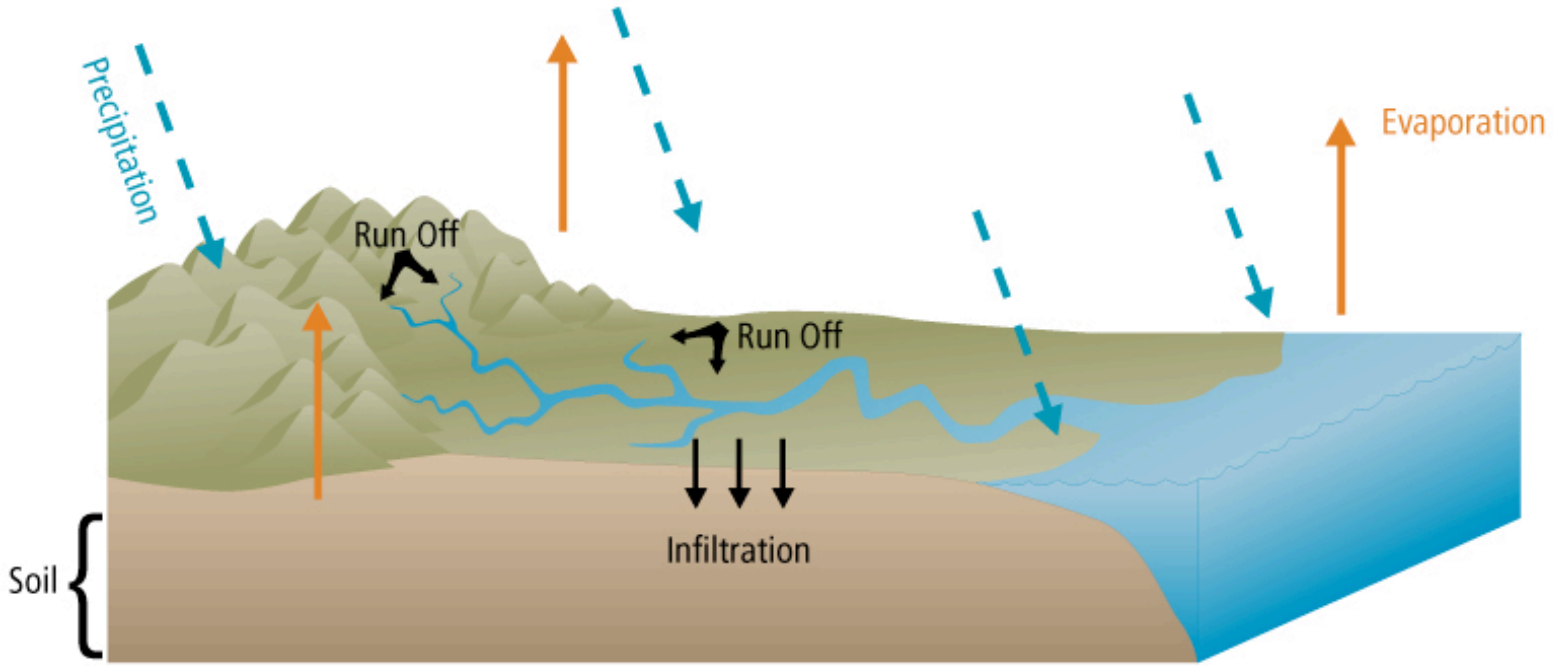
- Basic Objective:
  - To understand the source, release, and transport of suspended sediment, mercury (Hg) and PCBs from a large, mixed land use watershed to San Francisco Bay
- *How?*



- *Why? (or for what purpose?)*
  - Establish model input and calibration parameters for region-wide application
  - Improve accuracy of Hg and PCB load estimations
  - Determine proportional loads
    - When, and from where, are constituents transported
  - Assess potential effects of BMPs, land use change, climate change

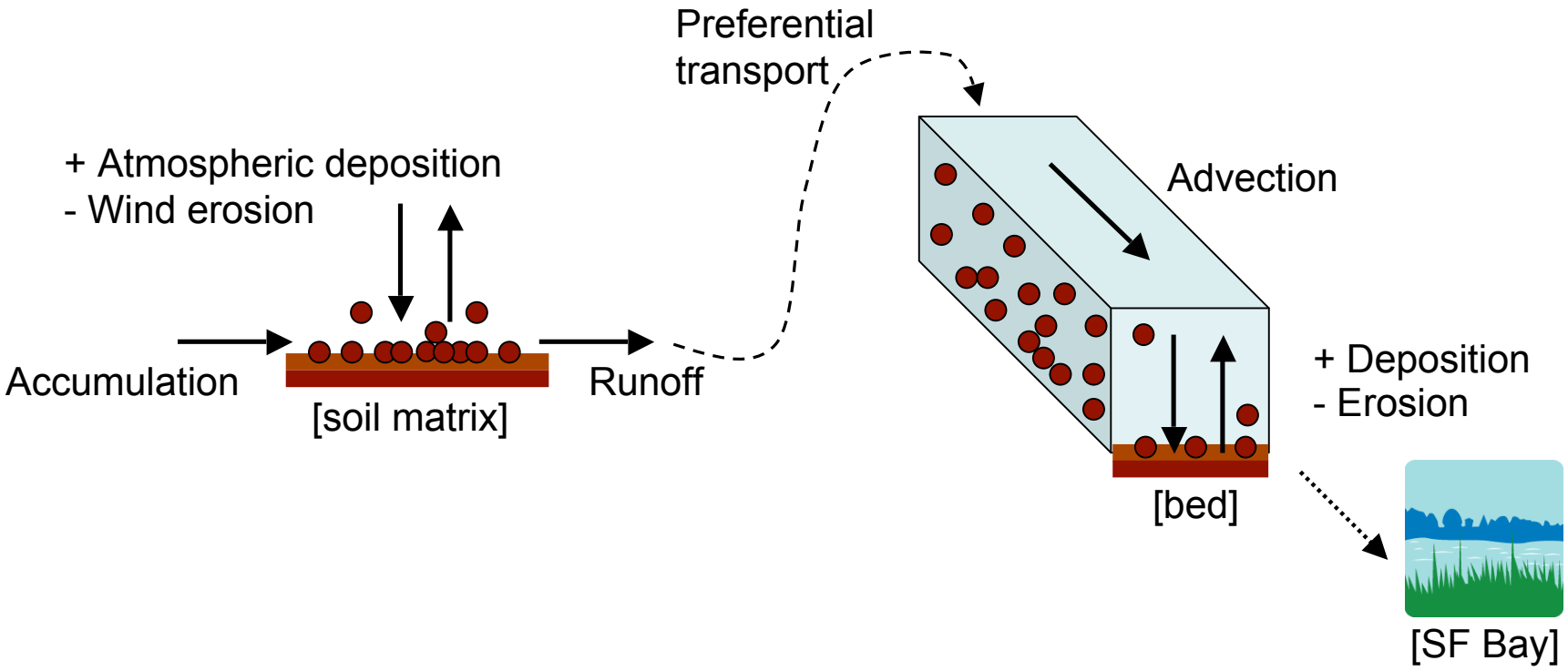
Watershed Modeling Overview

Hydrology Model



Hydrological Simulation Program - FORTRAN (HSPF)

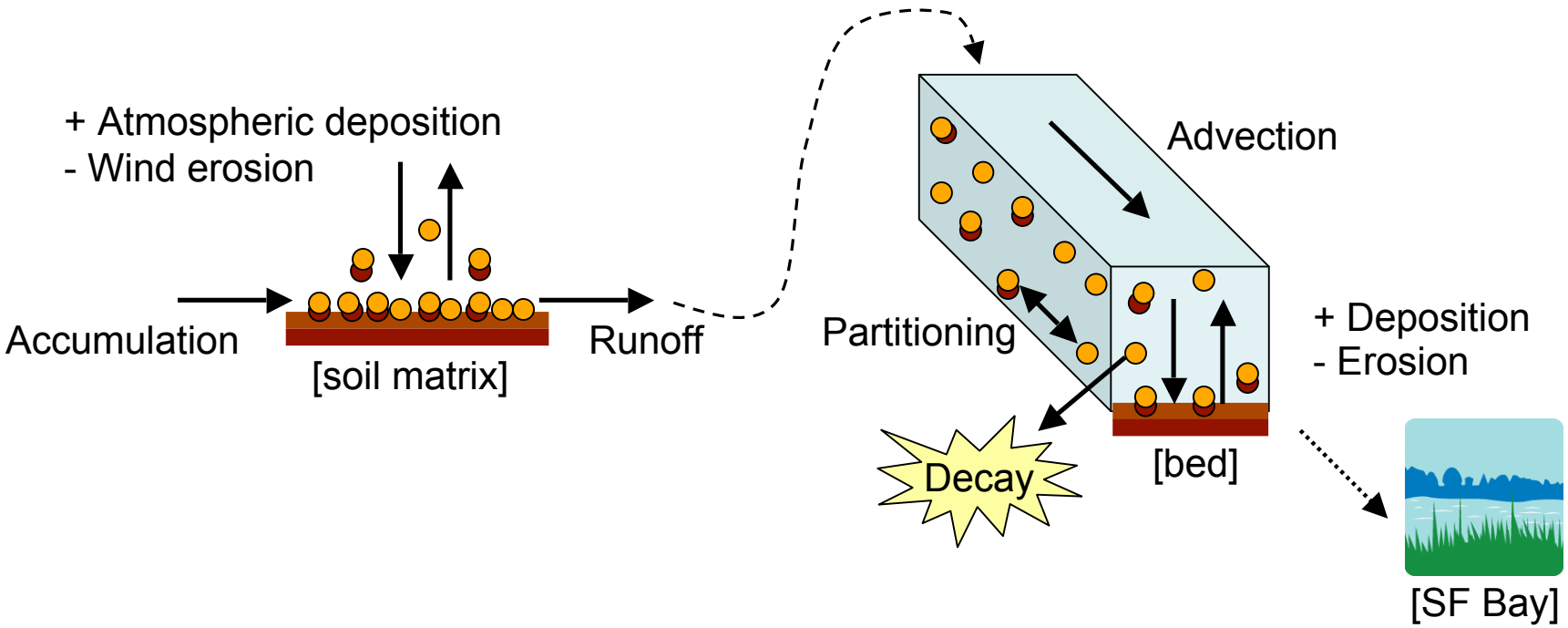
Sediment Model



Land-based processes

Reach-based processes

Contaminant Model



Land-based processes

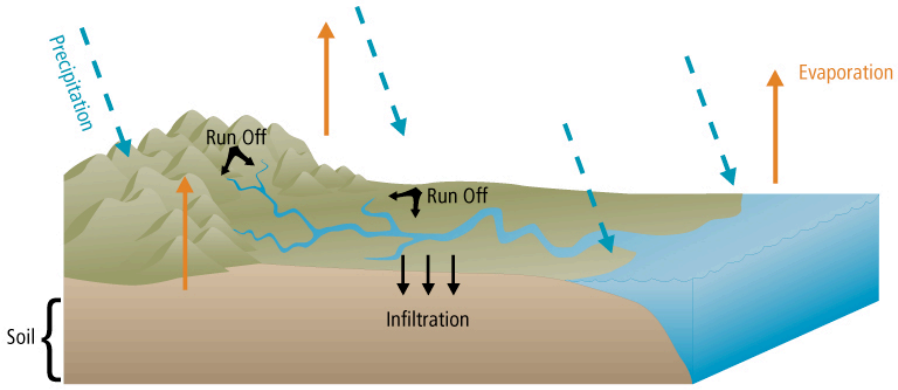
Reach-based processes

Extensive Data Requirements

Meteorological Data
- Precipitation
- Evapotranspiration

Geographic Data
- Topography
- Land use & impervious surfaces
- Soil types

Water Imports/Exports
- Reservoir releases
- Diversions



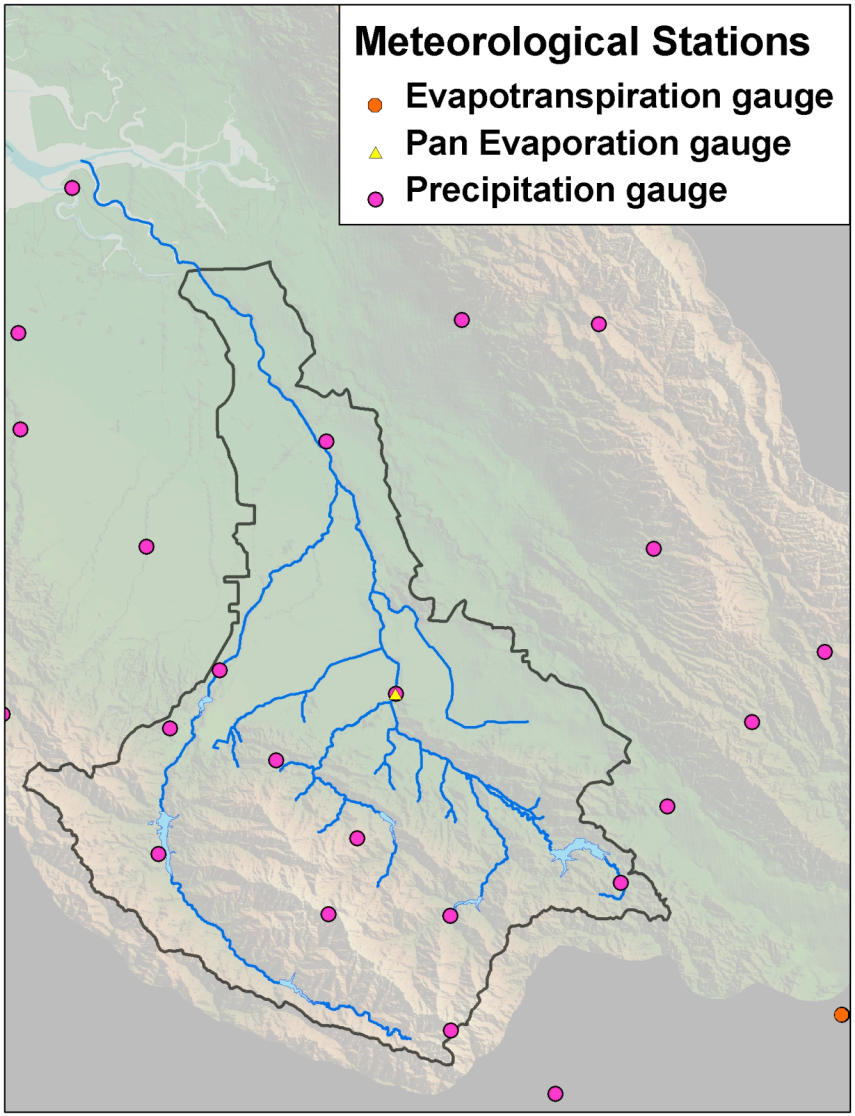
Calibration/Validation Data
- Stream flow
- Suspended sediment concentrations
- Hg and PCBs concentrations

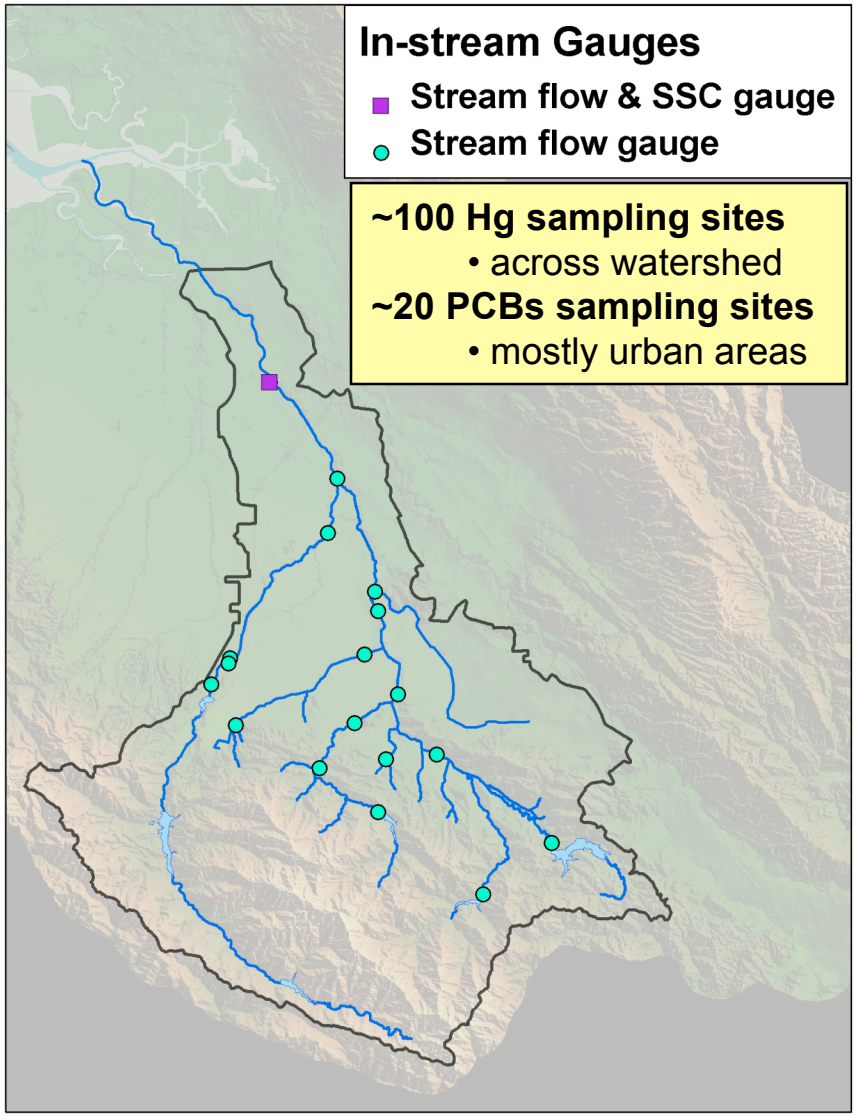
Other Useful Data
- Particle size distribution
- Hg and PCBs concentrations in soil
- Water temperature

…

and so on

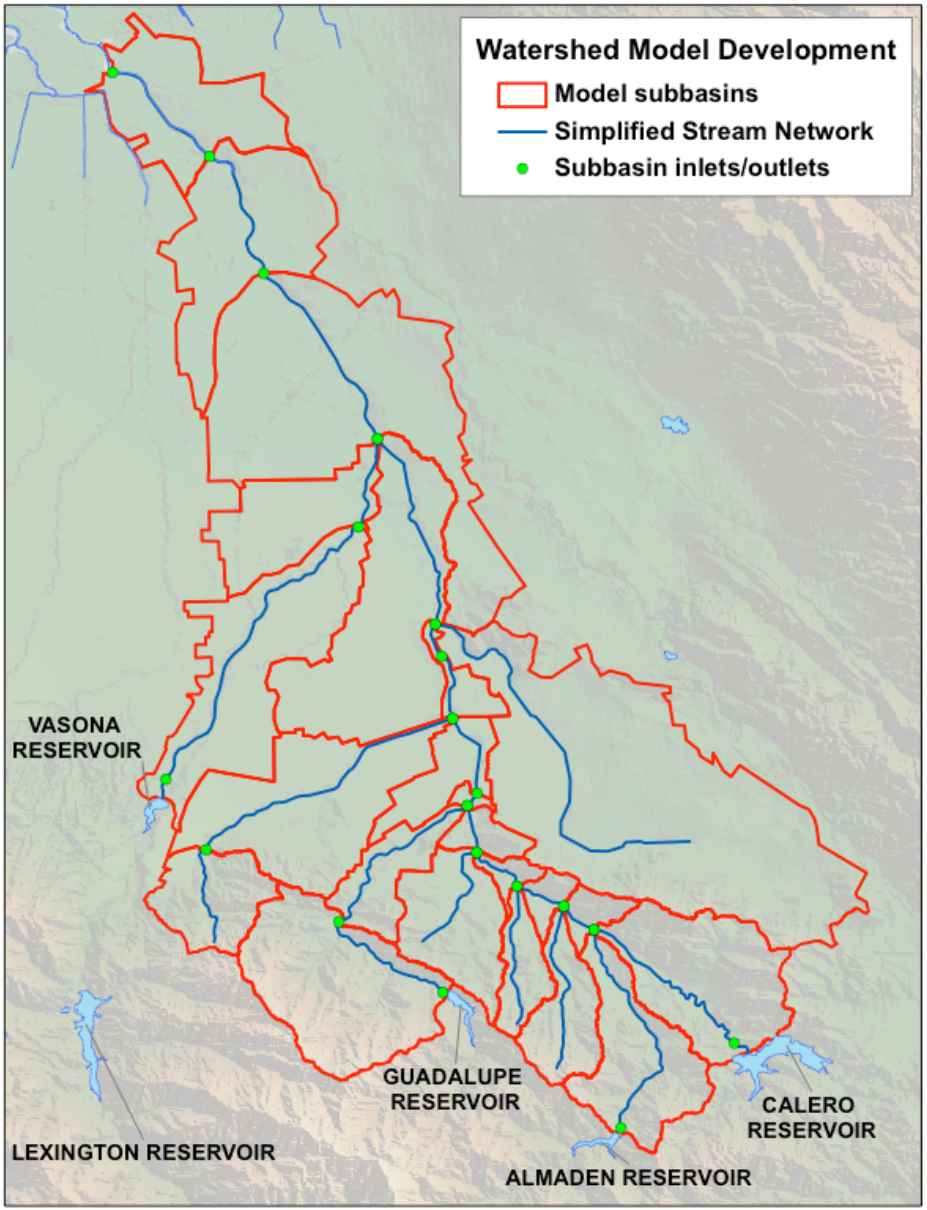
Data Richness of Guadalupe River Watershed





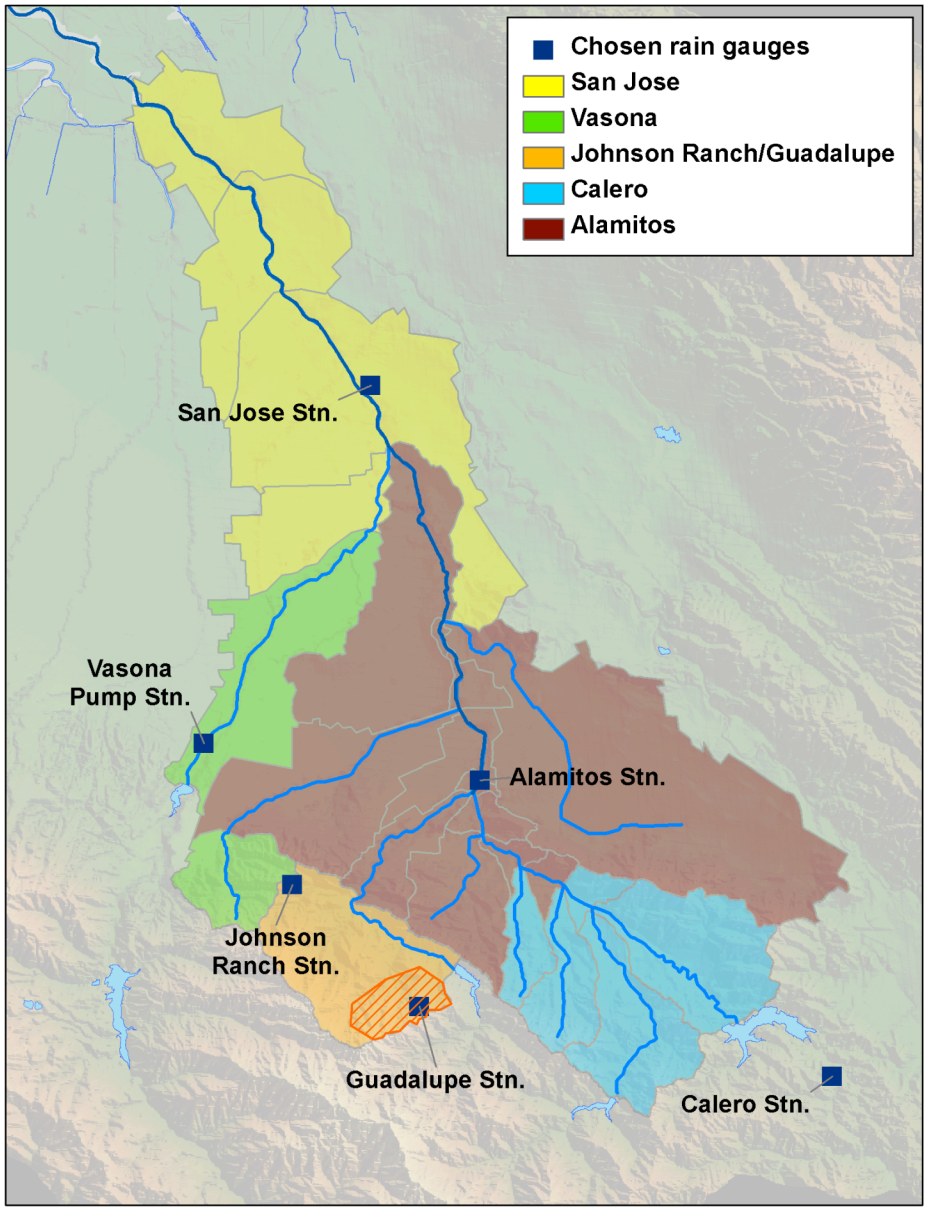
Watershed Delineation

- Defined model boundary
  - Excluded reservoirs (treat as point-source inputs)



Subbasin Delineation

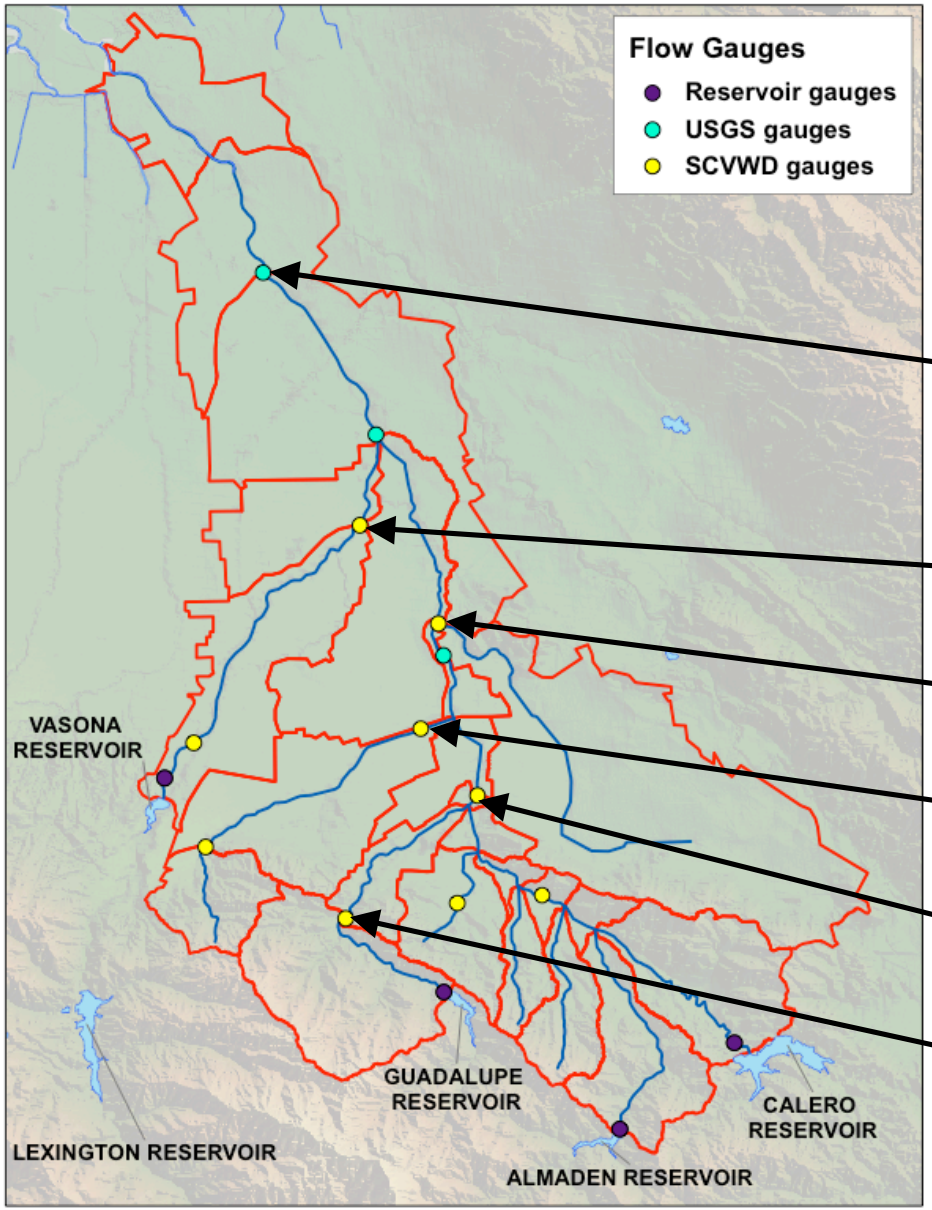
- Defined model output ("pour") points
- Divided up land and reaches into homogeneous units for parameterization



Meteorological Segmentation

- Followed isohyet map
- Elevation >> proximity

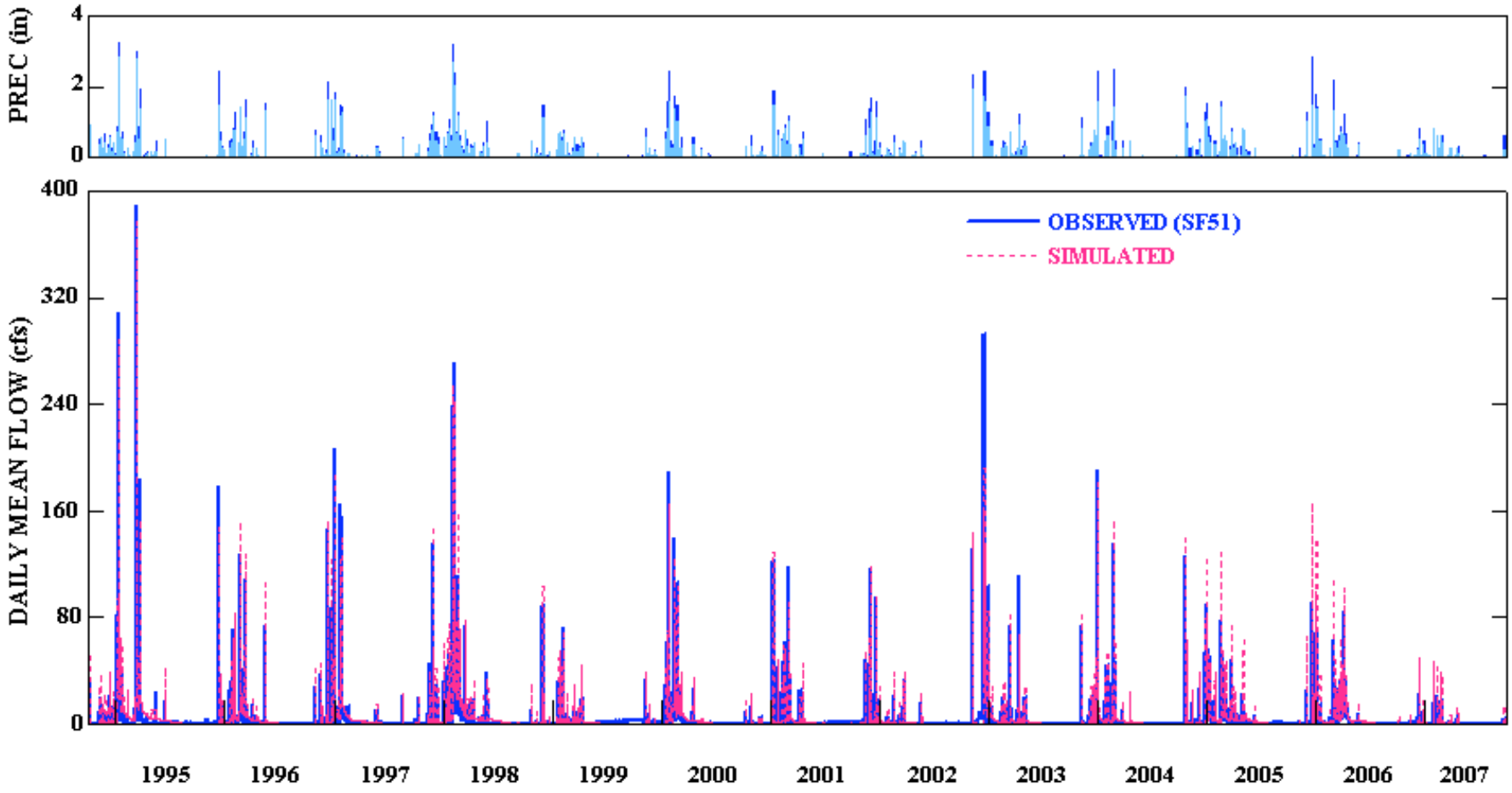
Hydrologic calibration & validation sites:



- Lower Guadalupe River
- Los Gatos Creek
- Canoas Creek
- Ross Creek
- Upper Guadalupe River
- Guadalupe Creek

Example model output

Ross Creek flow with Vasona & Alamitos precipitation



Hydrologic Model Performance: Annual Flow Volumes for Guadalupe River

Water Year	Prec. (in)	Observed Vol. (10^6 cf)	Simulated Vol. (10^6 cf)	% Difference	Rating
1995	26.8	5,651	5,636	-0.3%	Very Good
1996	17.9	3,297	3,609	9.5%	Very Good
1997	16.6	4,188	4,000	-4.5%	Very Good
1998	27.2	5,349	5,905	10.4%	Good
1999	11.6	1,508	1,561	3.5%	Very Good
2000	14.5	2,615	2,681	2.5%	Very Good
2001	12.4	1,394	1,552	11.3%	Good
2002	9.3	968	1,320	36.4%	Poor
2003	17.6	2,148	2,313	7.7%	Very Good
2004	13.1	1,874	1,773	-5.4%	Very Good
2005	20.4	2,590	3,007	16.1%	Good
2006	16.6	4,474	5,000	11.8%	Good
2007	7.1	1,260	1,016	-19.4%	Fair

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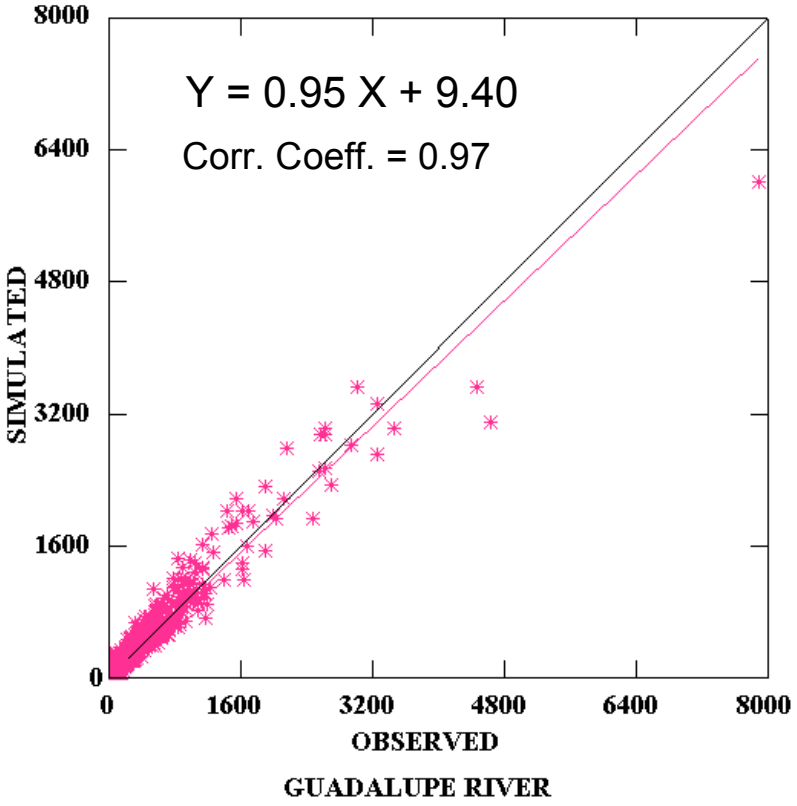
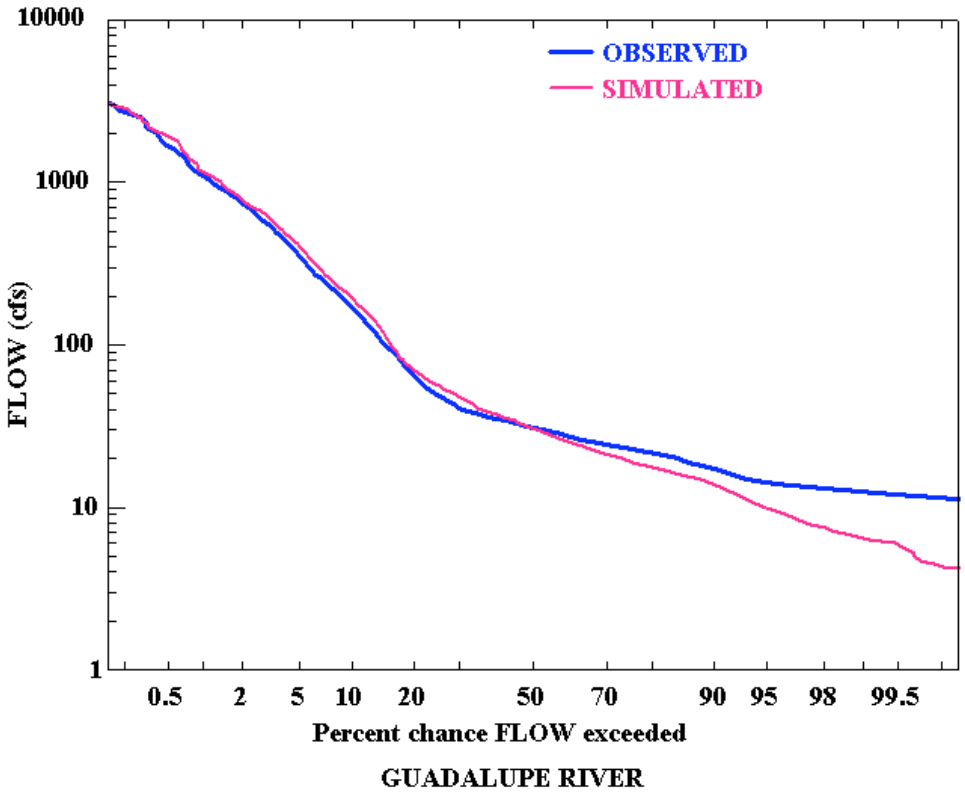
Hydrologic Model Performance: Mean Daily Flow for Guadalupe River

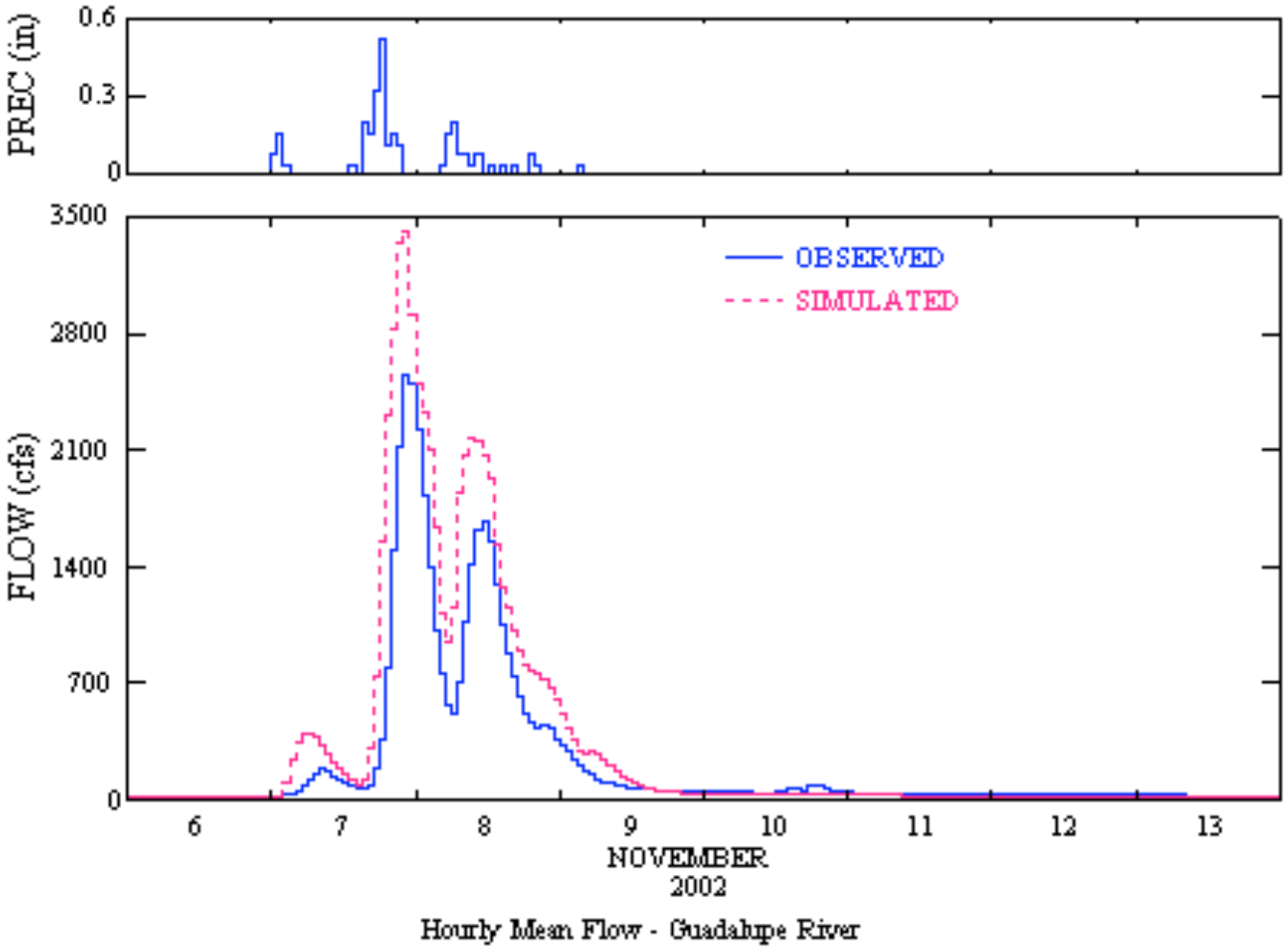
Observed vs. Simulated Mean Daily Flow



Flow Duration Curve

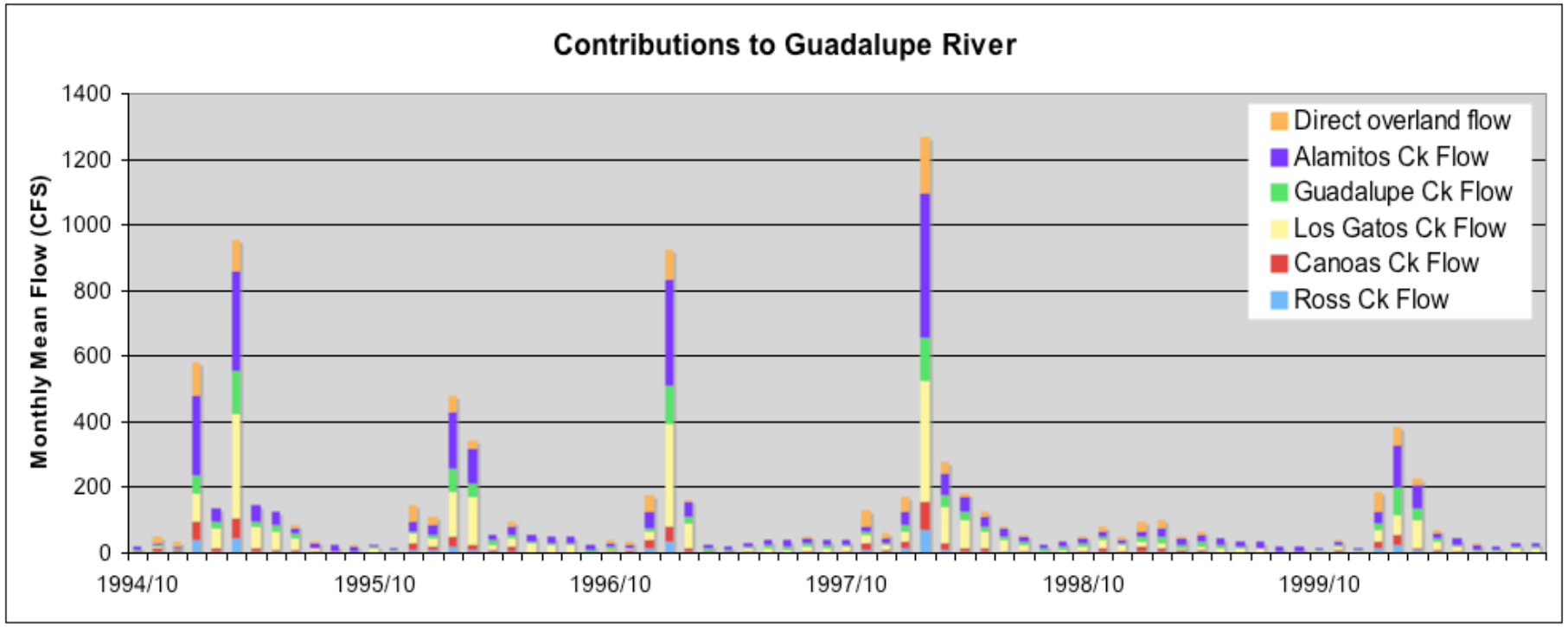


Hydrologic Model Performance: Mean Hourly Flow for Guadalupe River

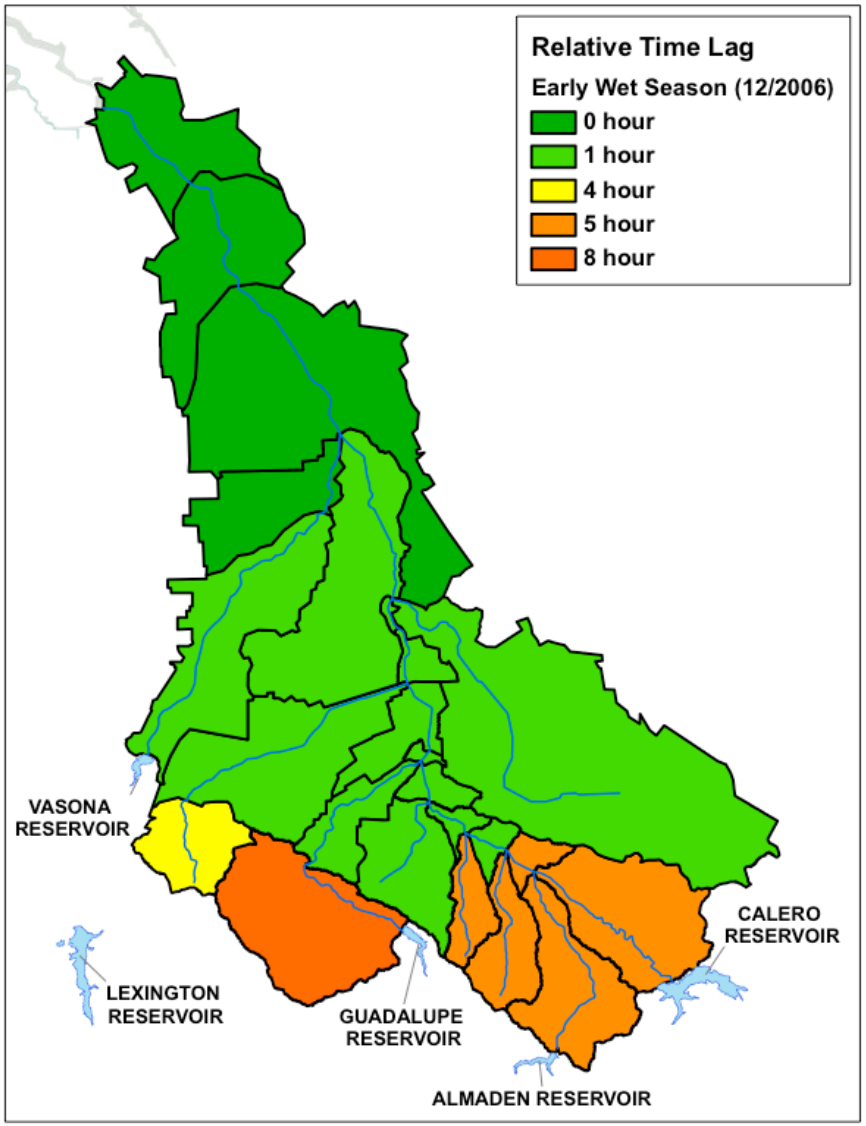


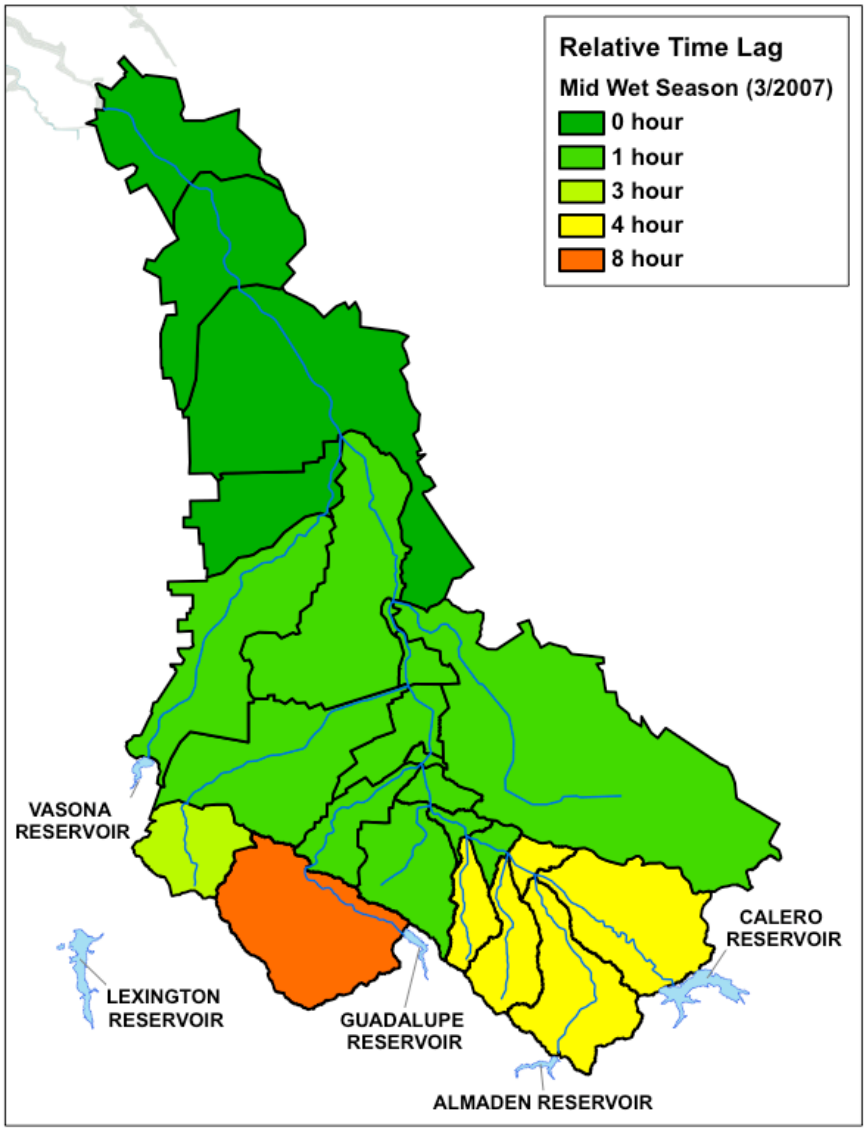
Hourly Mean Flow - Guadalupe River

Hydrology Model Applications

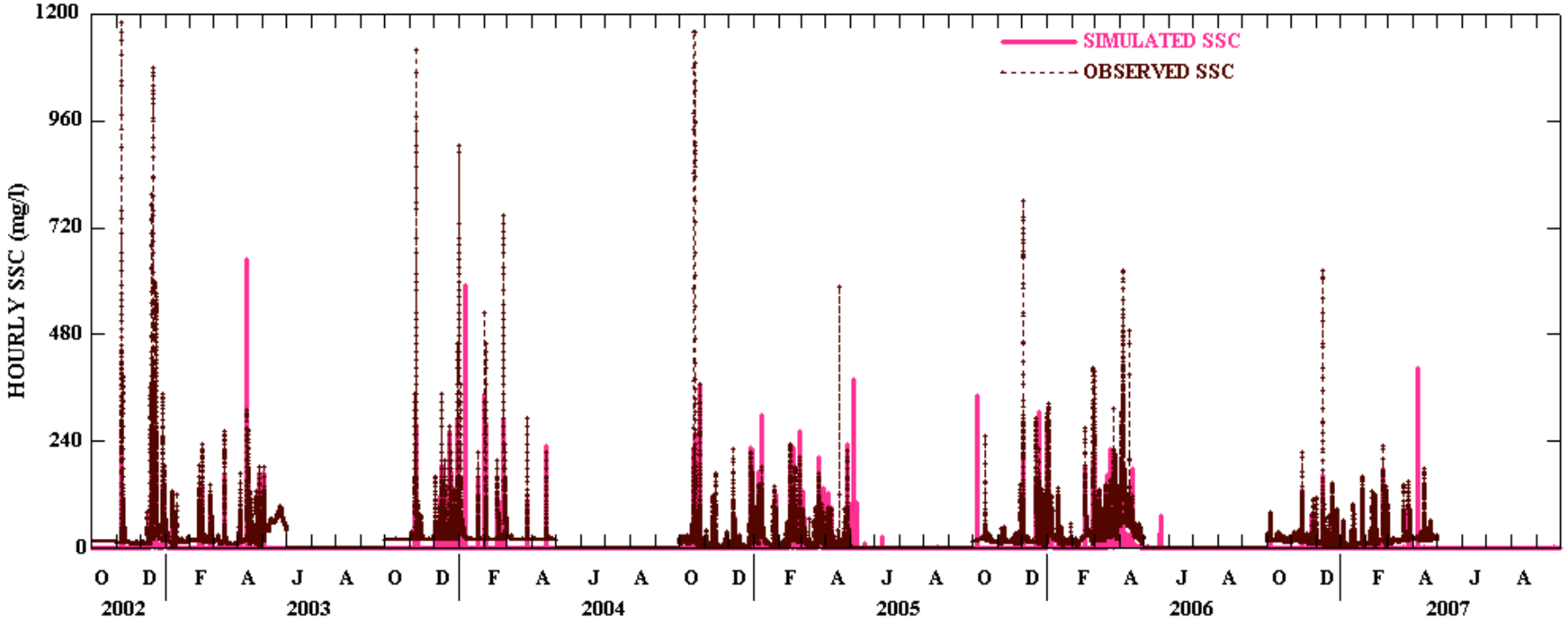


Hydrology Model Applications





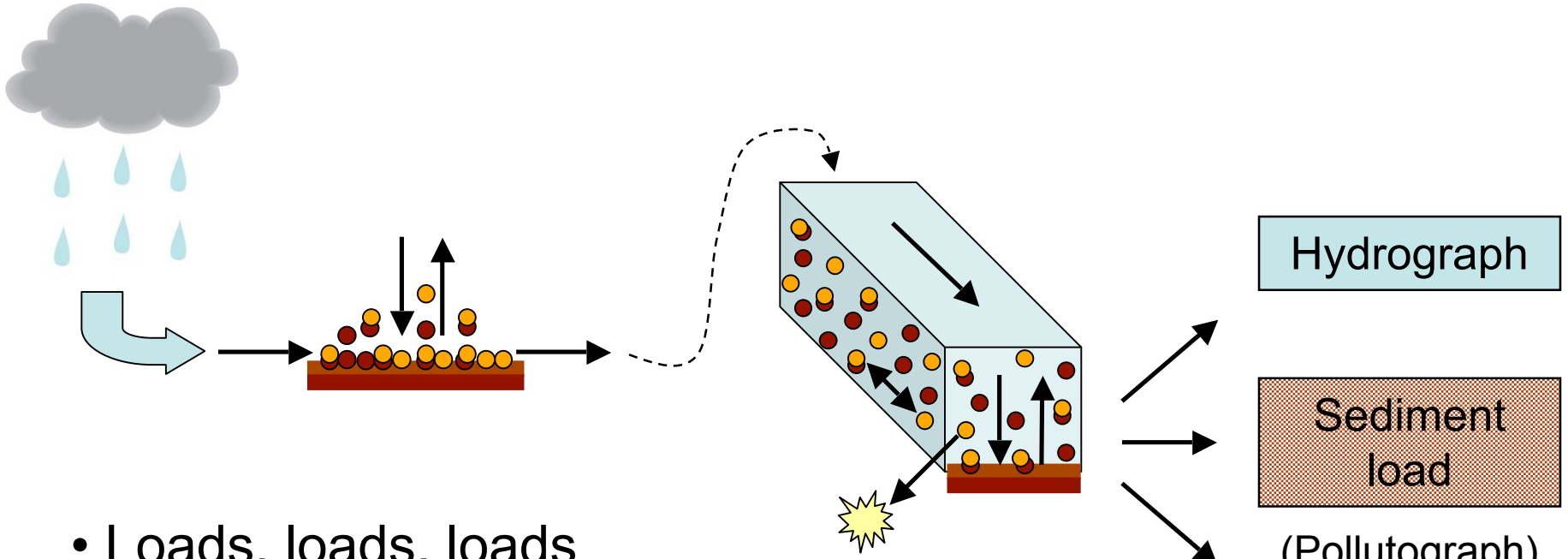
In process of calibrating sediment model…



Next steps

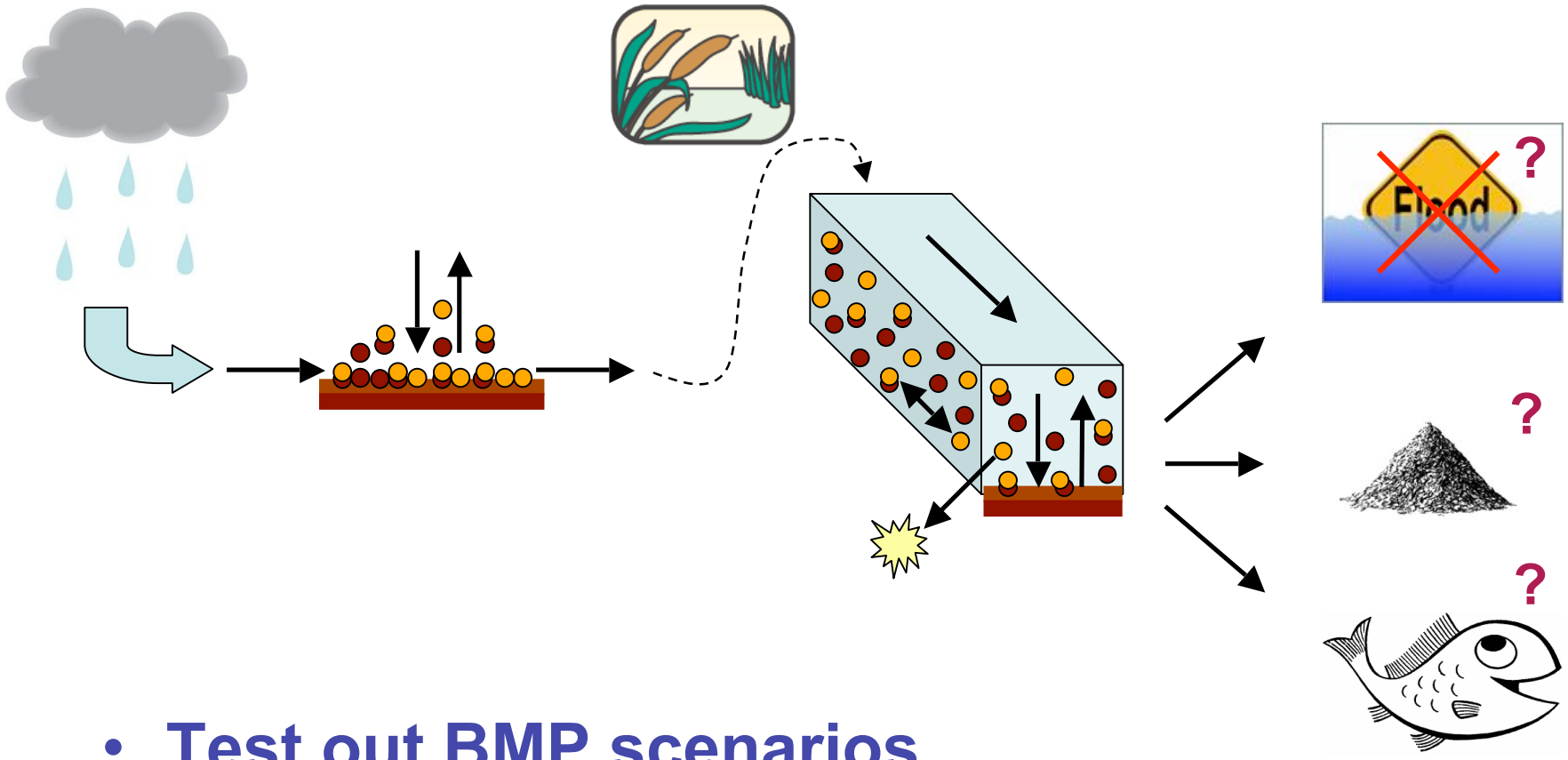
- Extend model to Hg and PCBs
- Calibrate contaminant portion of model

Model Applications



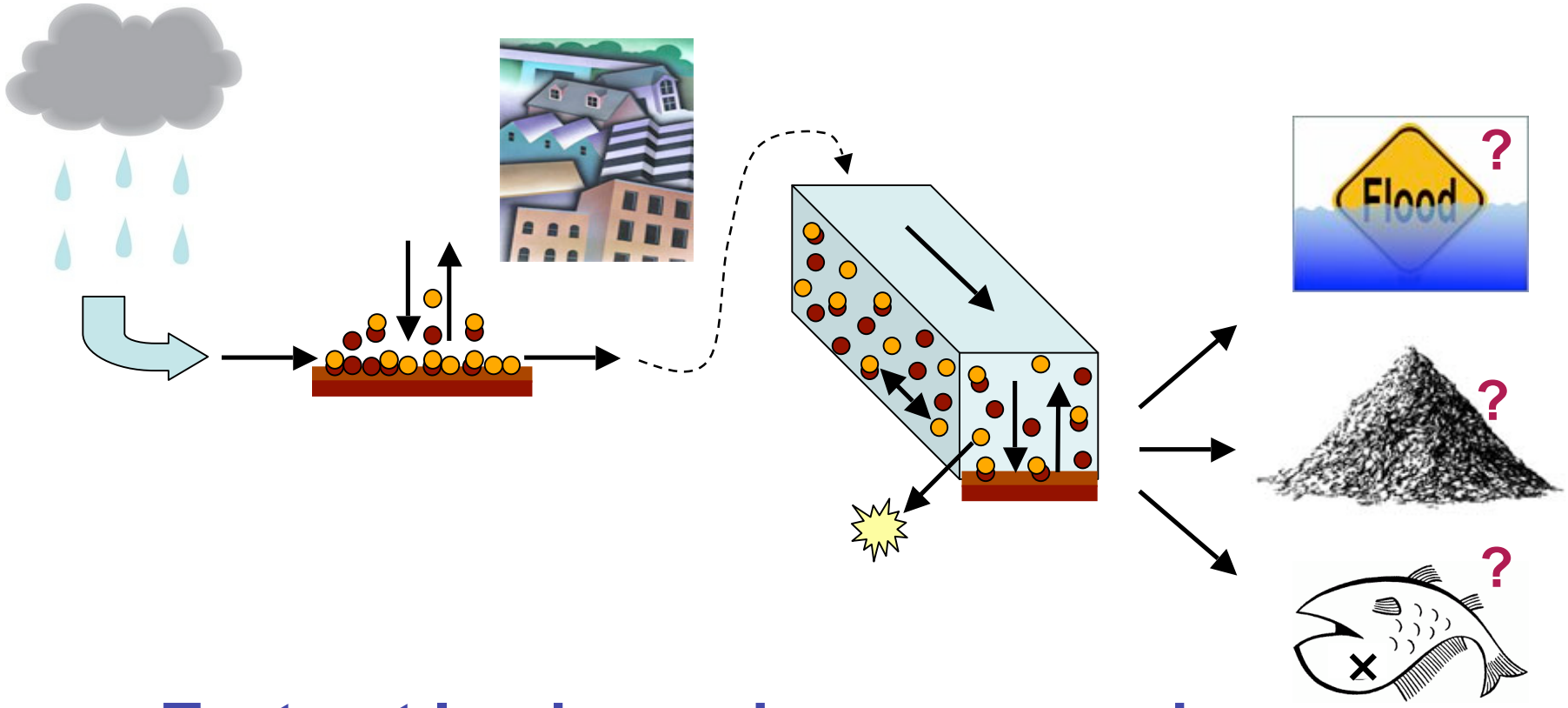
- Loads, loads, loads
  - inter-annual variability
  - spatial resolution (*where*)
  - temporal resolution (*when*)

Model Applications



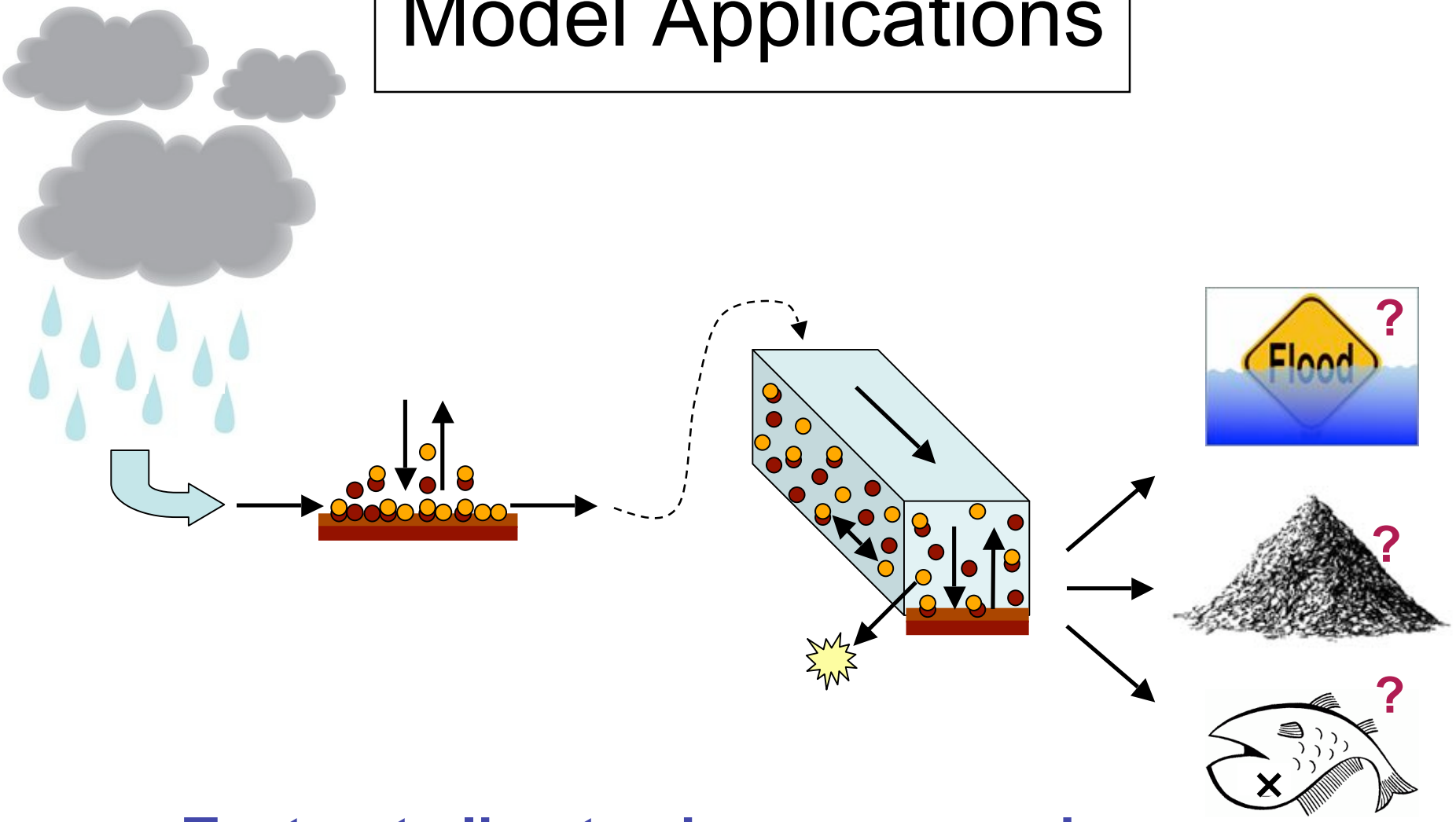
- **Test out BMP scenarios**

Model Applications



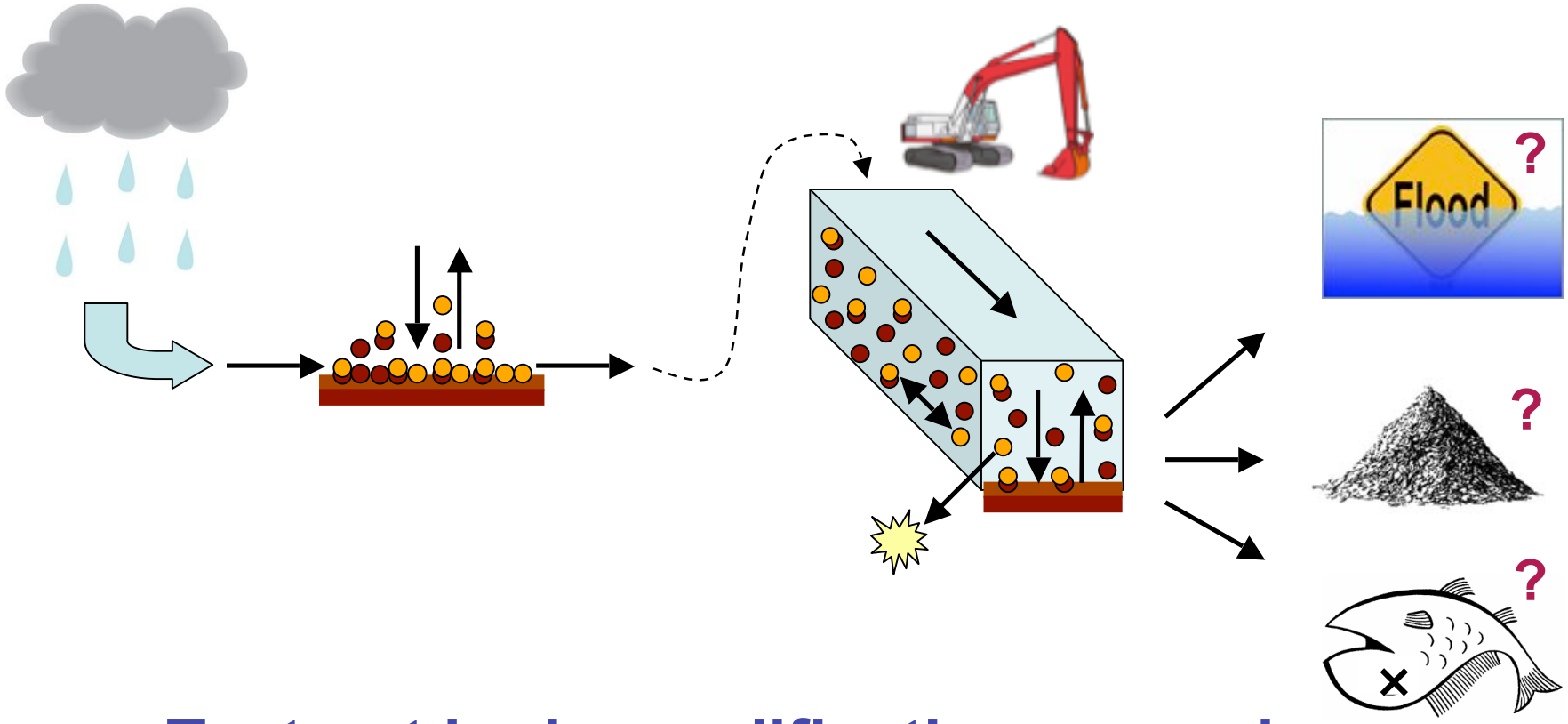
- **Test out land use change scenarios**

Model Applications



- **Test out climate change scenarios**

Model Applications



- **Test out hydromodification scenarios**

Acknowledgements

- SCVWD
- Aqua Terra Consultants
- RMP participants
- SFEI

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