Fate and Transport Modeling of Ammonia in the Delta Using DSM2

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Resource Management Associates

Introduction

- Project Objectives -
  - Calibrate/validate DSM2 nutrient model, 1990 – 2008
  - Focus ammonia and temperature
  - Evaluate conceptual model, suggest monitoring program
- Delta Simulation Model-2 (DSM2) - conceptual model for nutrient dynamics
- Model Calibration and Validation -
  - Model boundaries
  - Data availability and quality
- Results – initial calibration and volumetric fingerprinting
- Wrap-up -
  - Model Improvements
  - Future applications

DSM2

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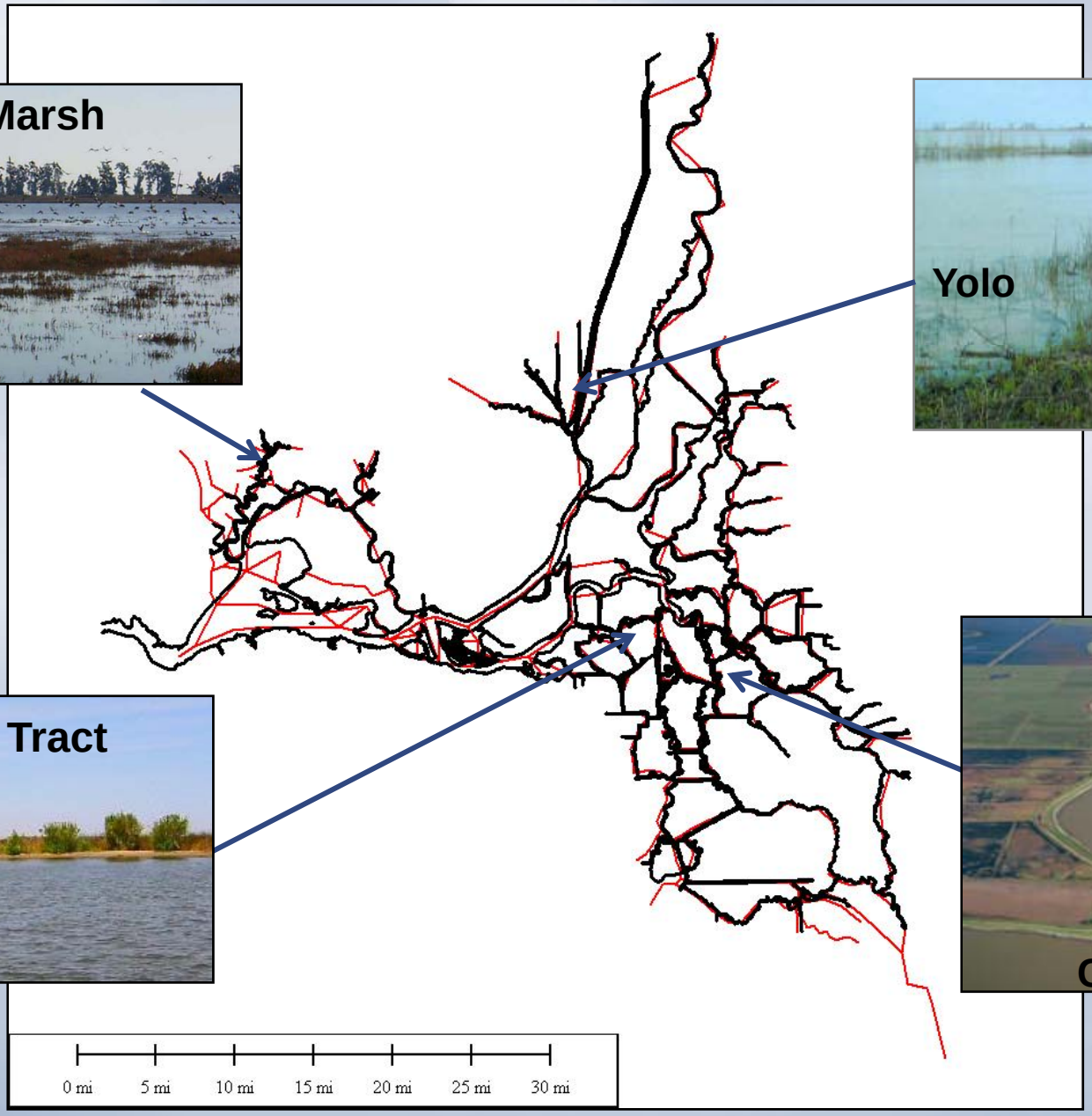
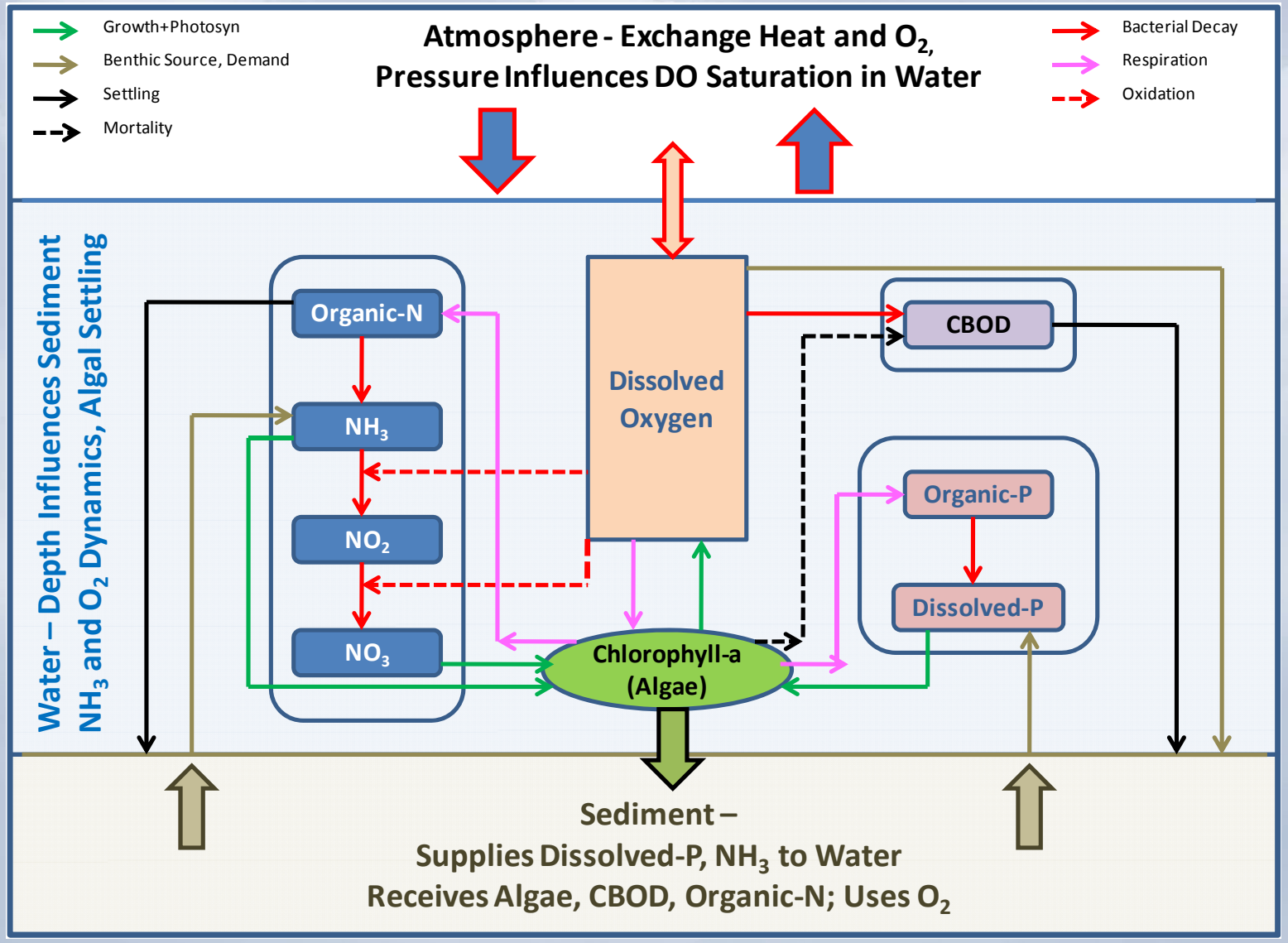
DSM2 Model Domain

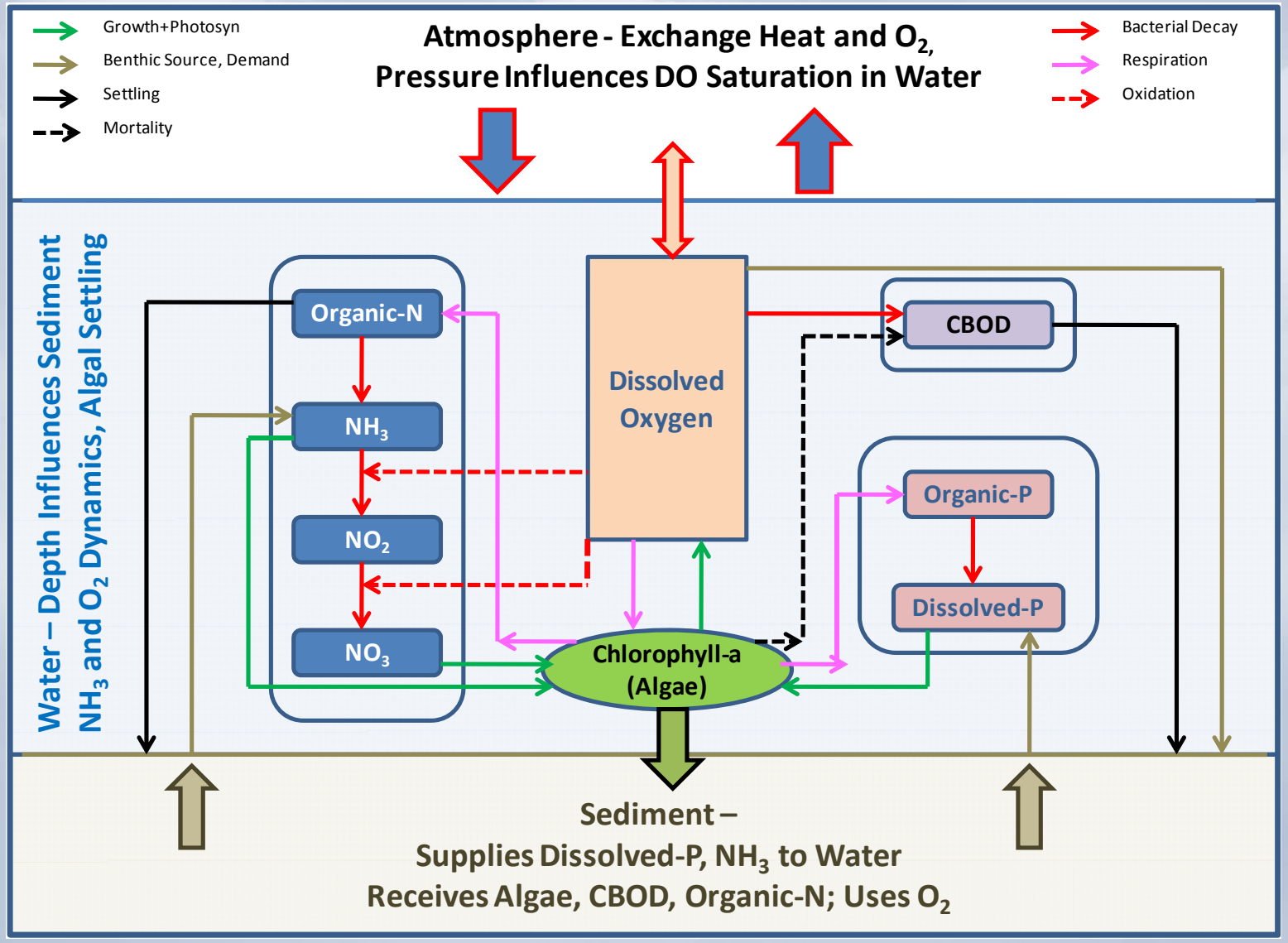


DSM2 Conceptual Model for Nutrients*



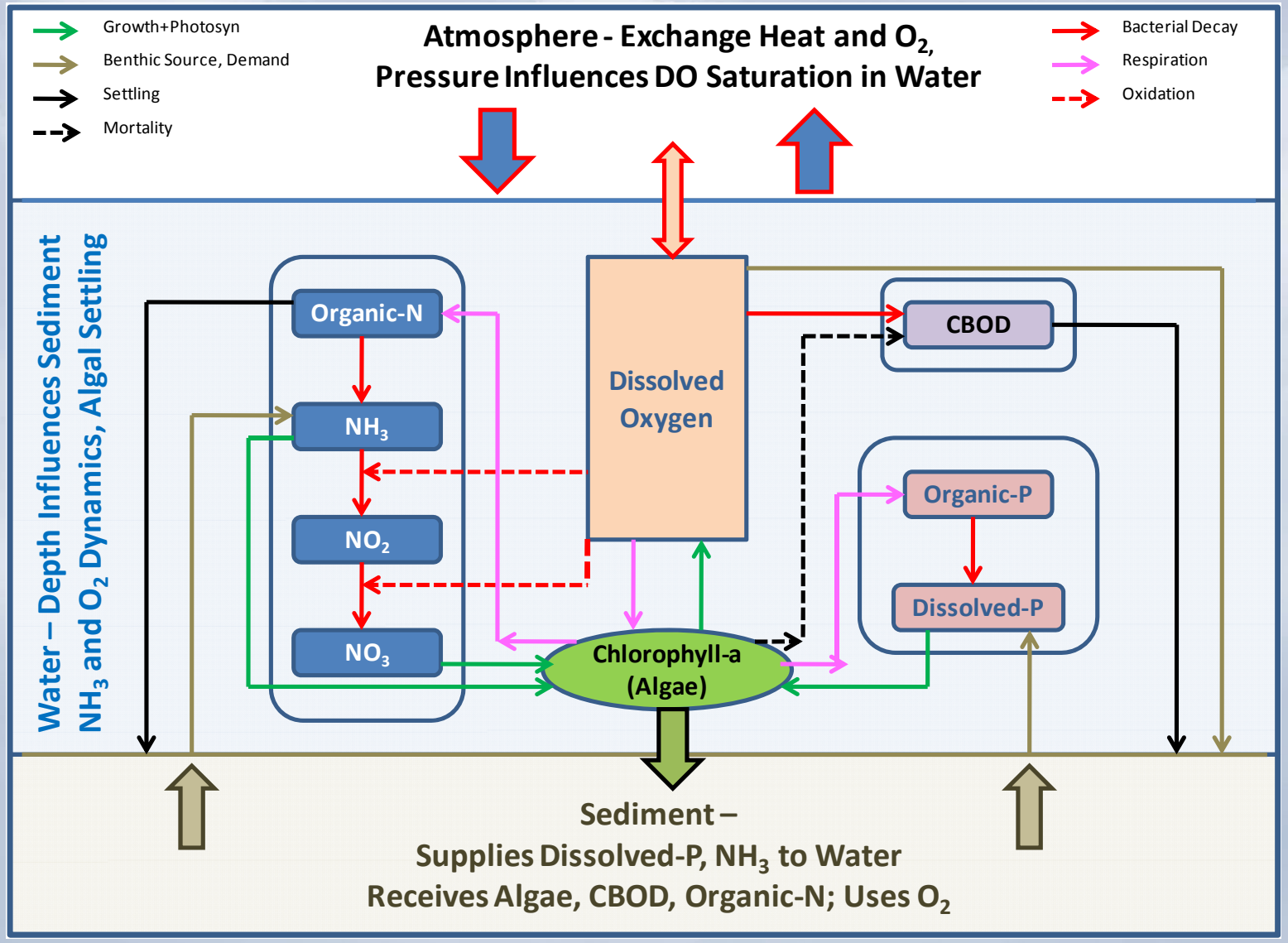
* Ph D thesis Hari Rajbhandari, California Department of Water Resources, Delta Modeling Section

11 equations: 9 Nutrients (shown) + Temperature + Salinity (EC)



8 Main BC*10 Nutrients + 12 Effluent BC *11 Nutrients = 212 Boundary Conditions

11 equations: Parameterization Set in 6 Regions



31 Global Nutrient + 7 Global Meteorology + 15 Regional Rate Coefficients

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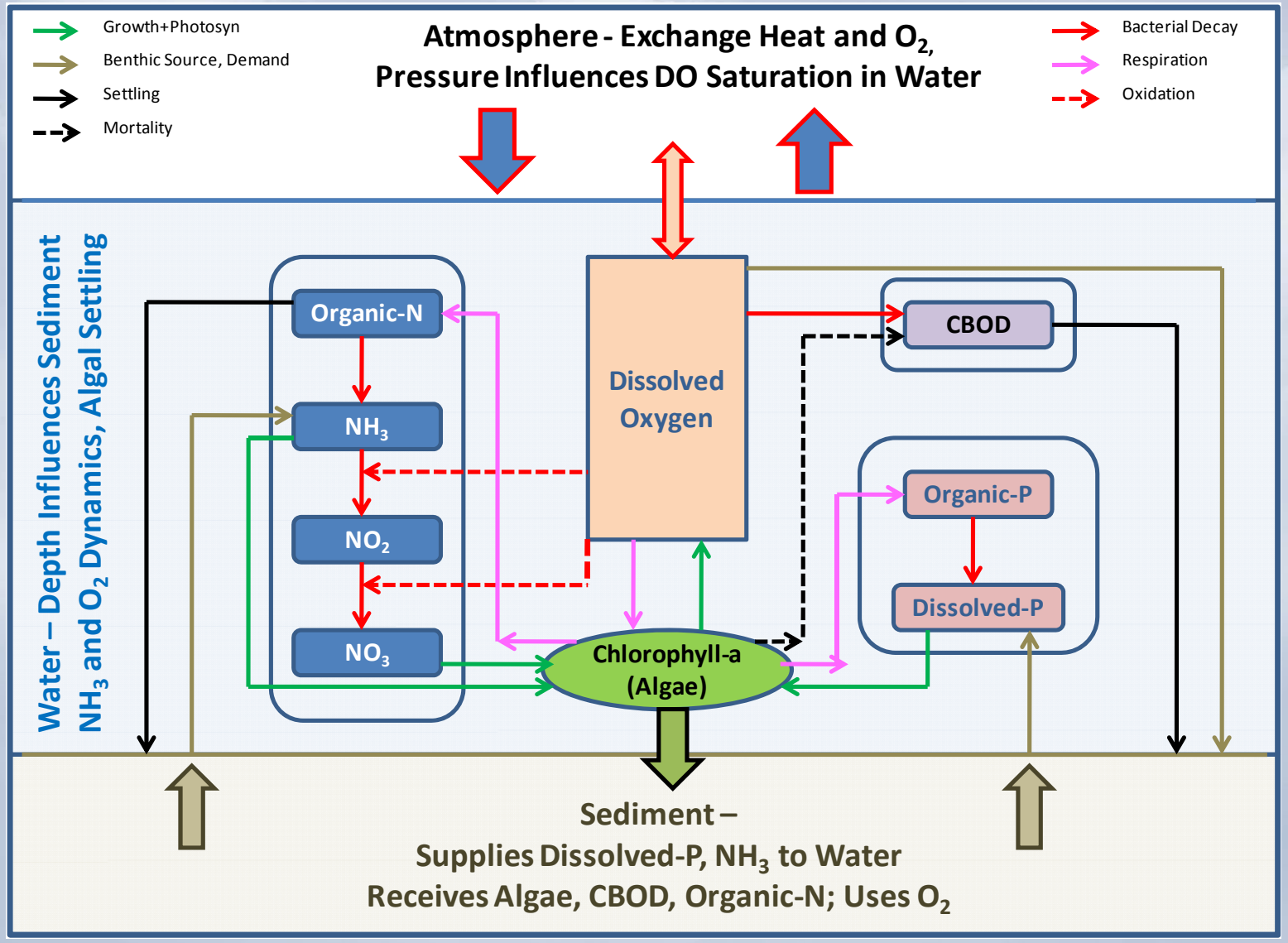

Used: 4 Global Nutrient, 2 Global Meteorology, 8 Rate Coefficients

Calibration/Validation

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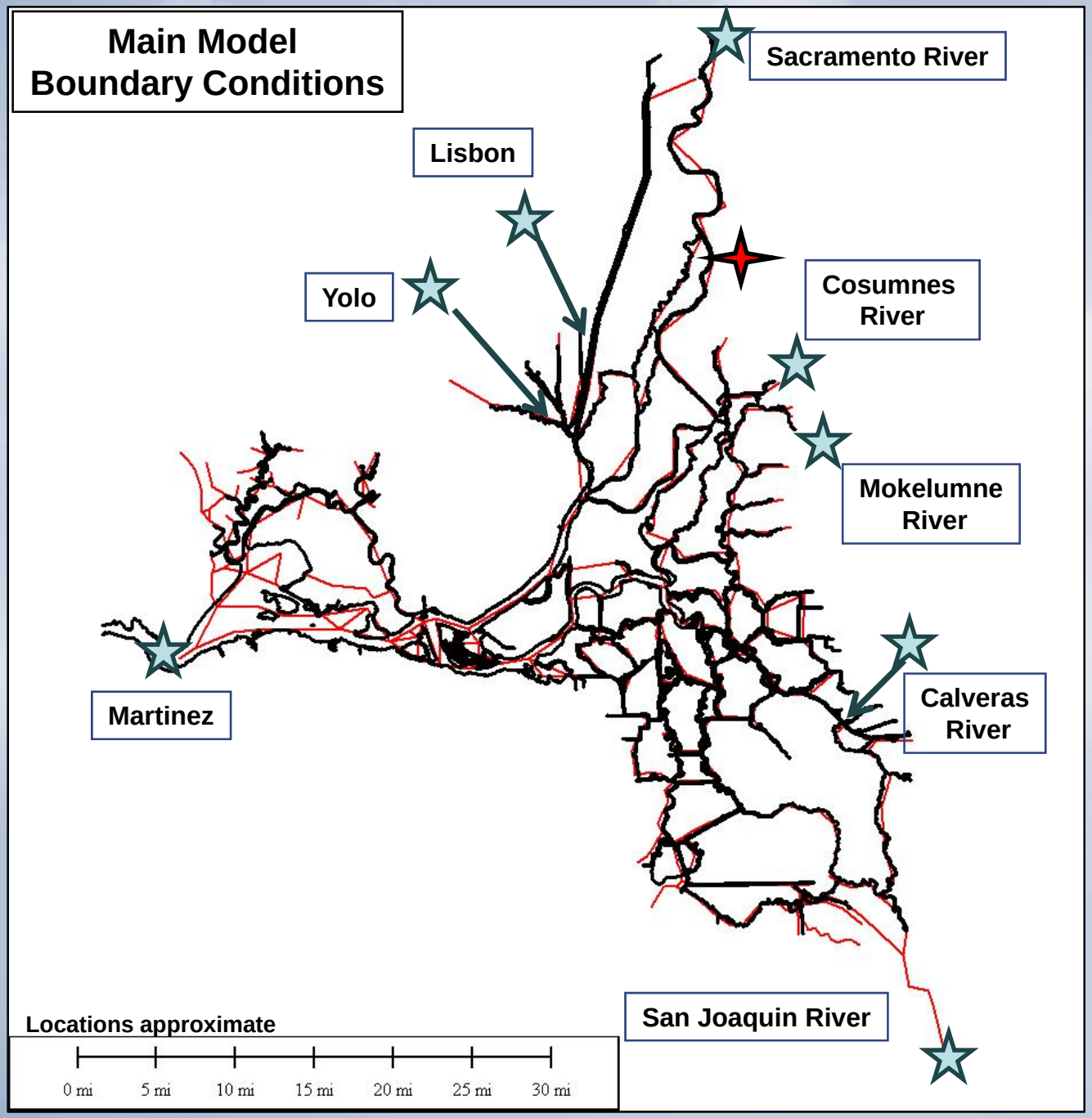
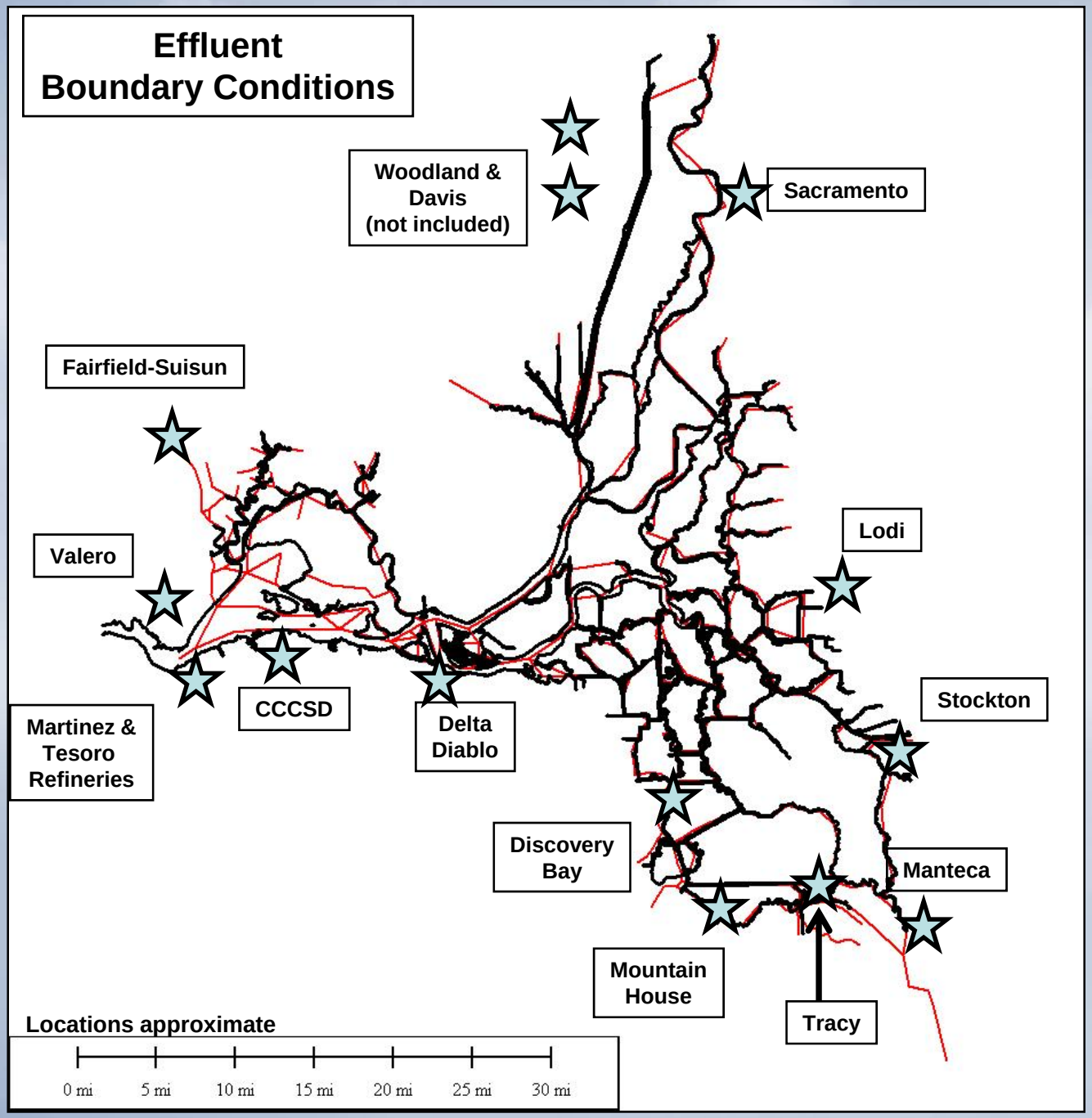
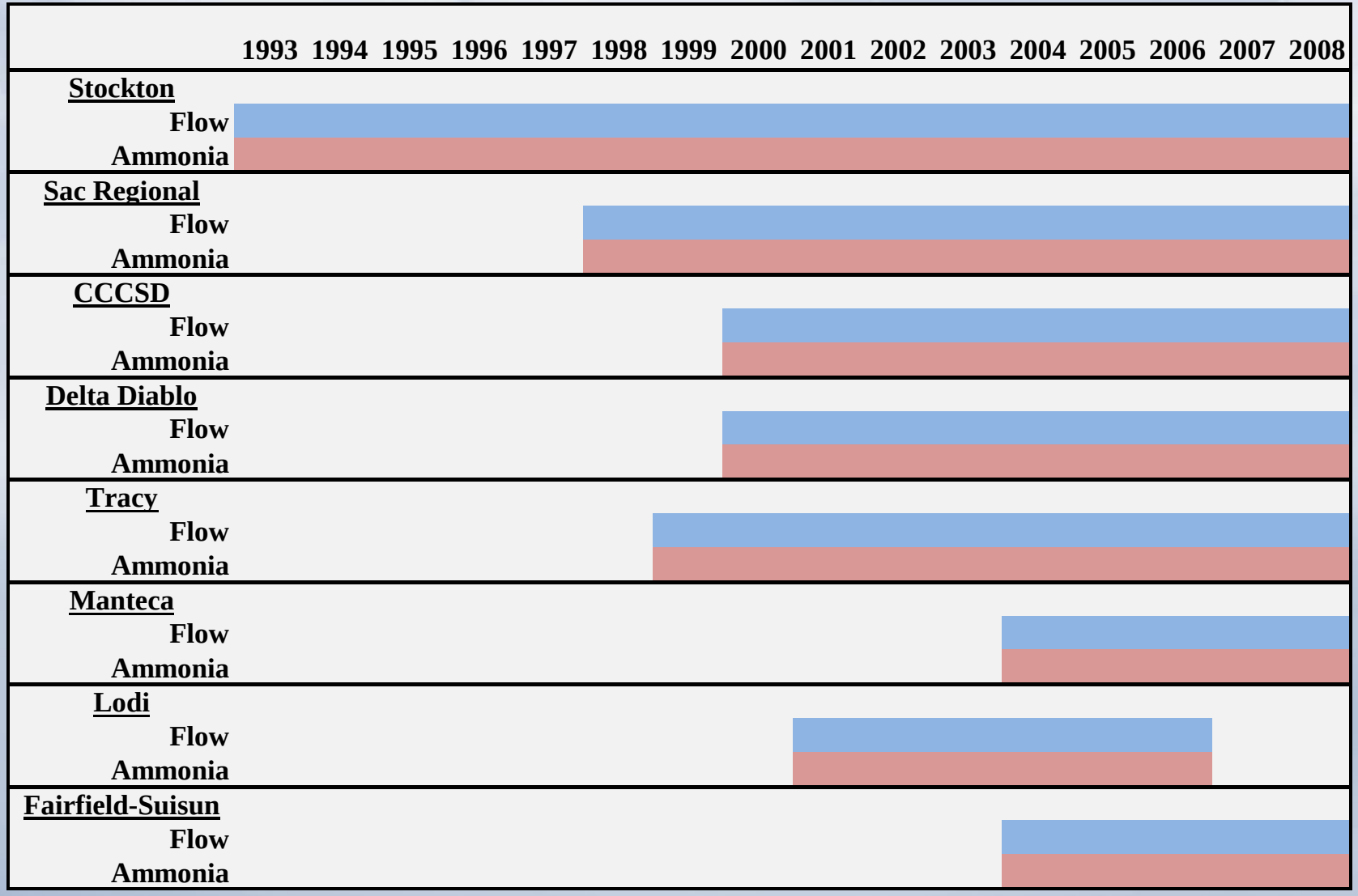


- Nutrient Data Sources:
  - EMP/BDAT
  - USGS
  - CDEC
  - R. Dahlgren, others
- Temporal Scale
  - Irregular monthly for most
  - Hourly – DO and temperature
- Availability:
  - No organic-P
  - No CBOD
  - SAC, SJR, MTZ – all years
  - Toe/Yolo – no data
- BC Locations
  - Sac – data at red star
  - No Yolo, Lisbon
  - Others – near boundary

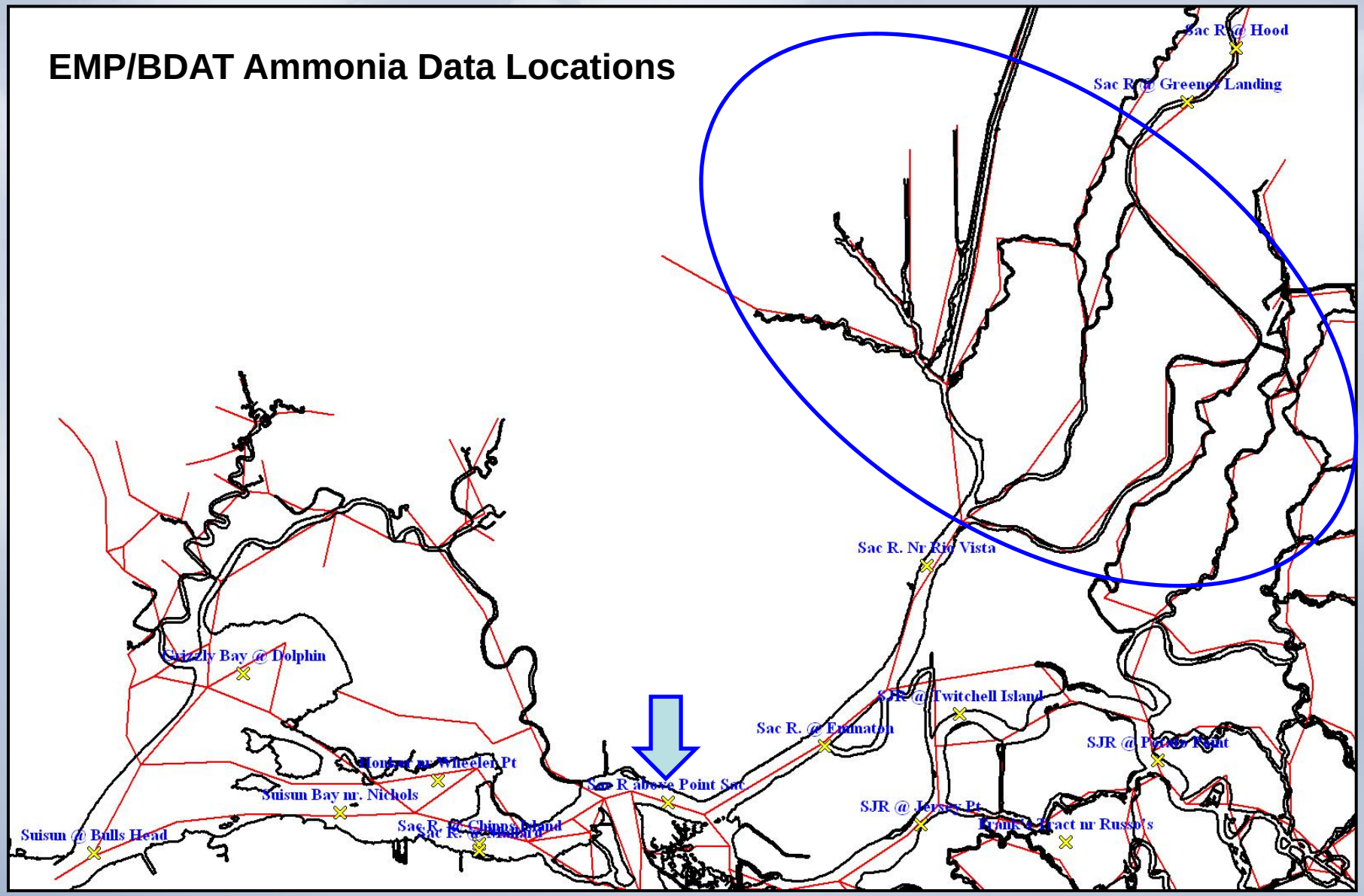


- Effluent Data Sources:
  - Direct from WWTP
  - Regional Boards
  - Pers. communication
- Temporal Scale:
  - Daily – monthly
  - Regular - irregular
- Time Span:
  - Variable by constituent
- Availability:
  - Flow and ammonia – best data
  - No organic-P
  - Others variable

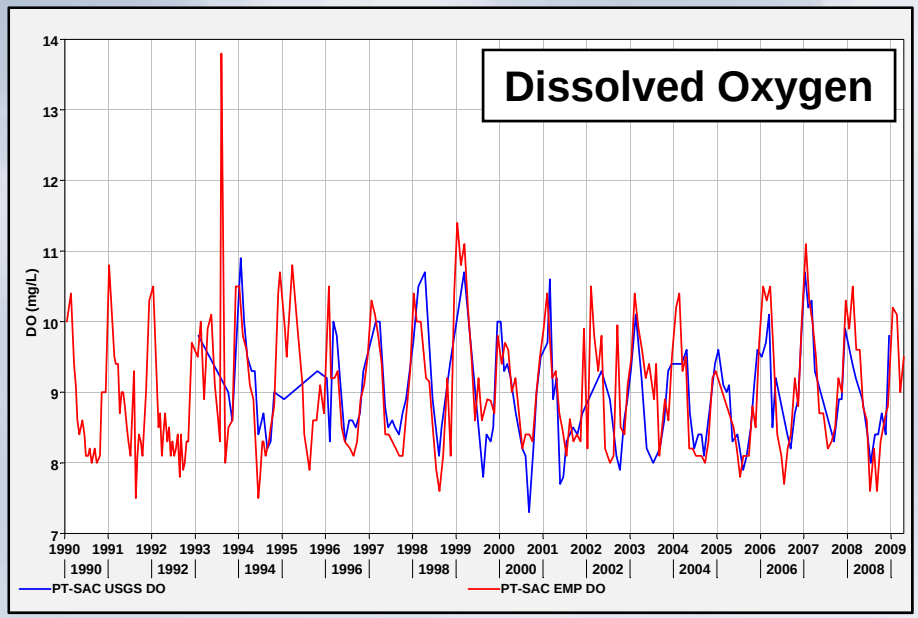
Effluent Flow and Ammonia – Data Availability From Main Sources

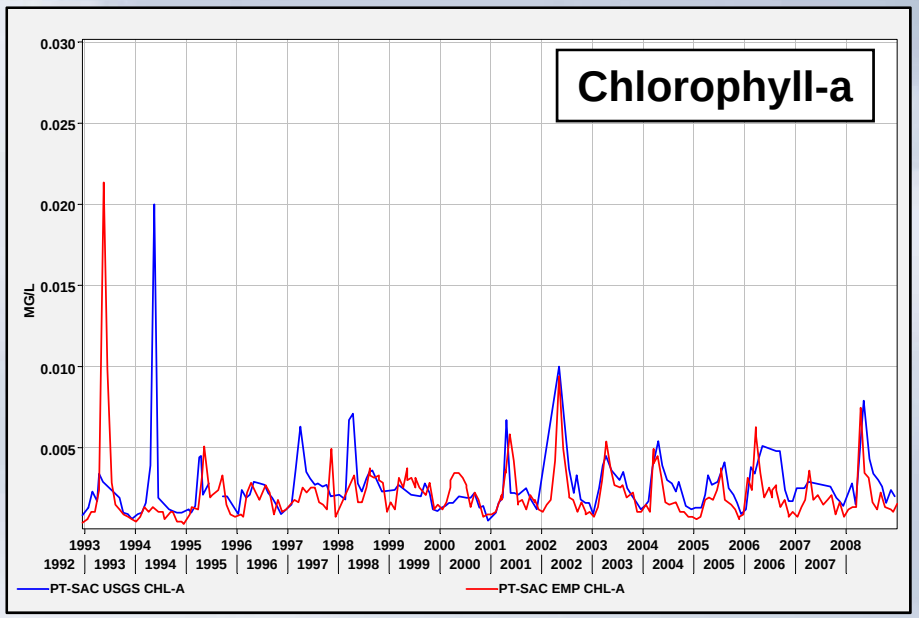


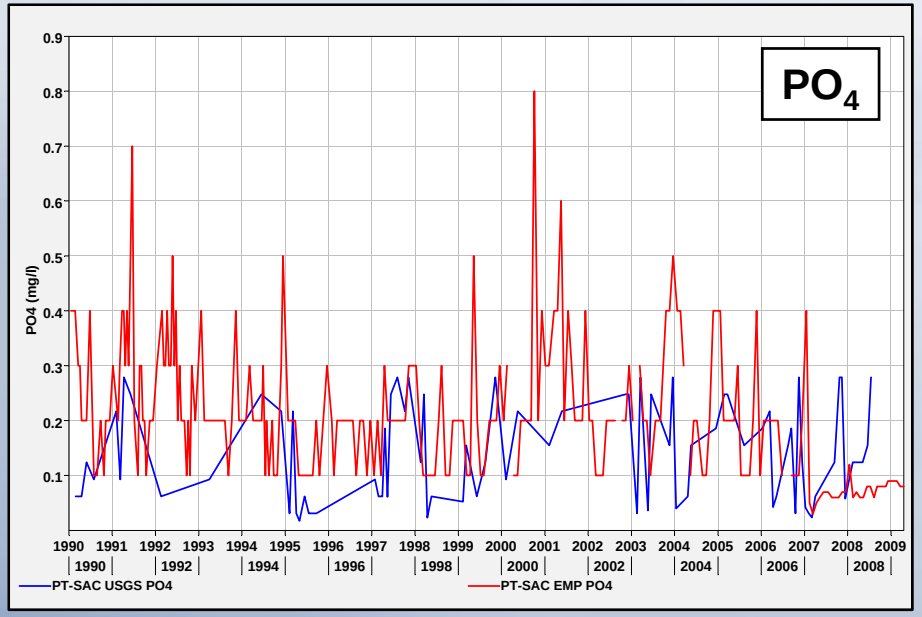
Calibration Data Locations: NW Delta Example

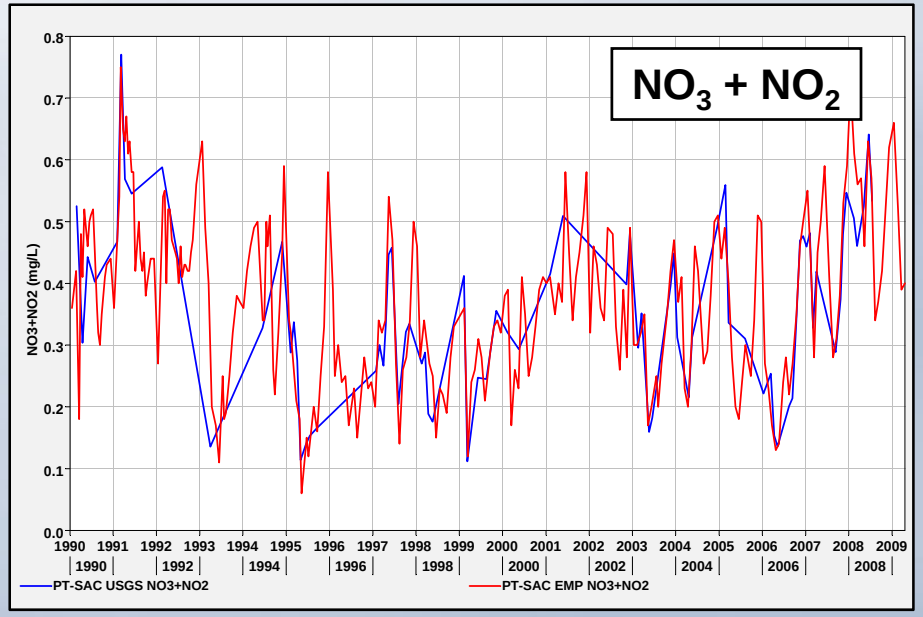


Data Variability – Point Sacramento Example

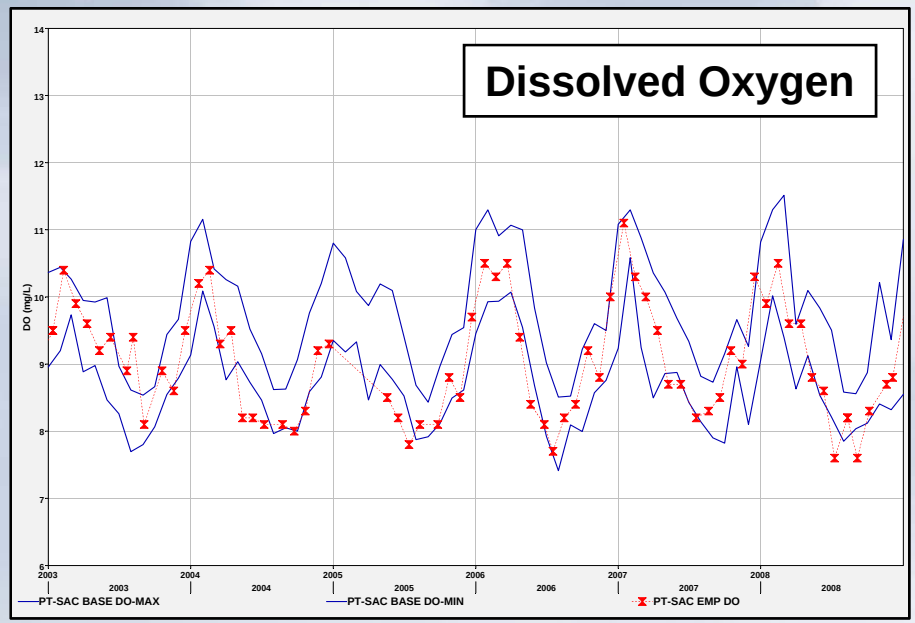


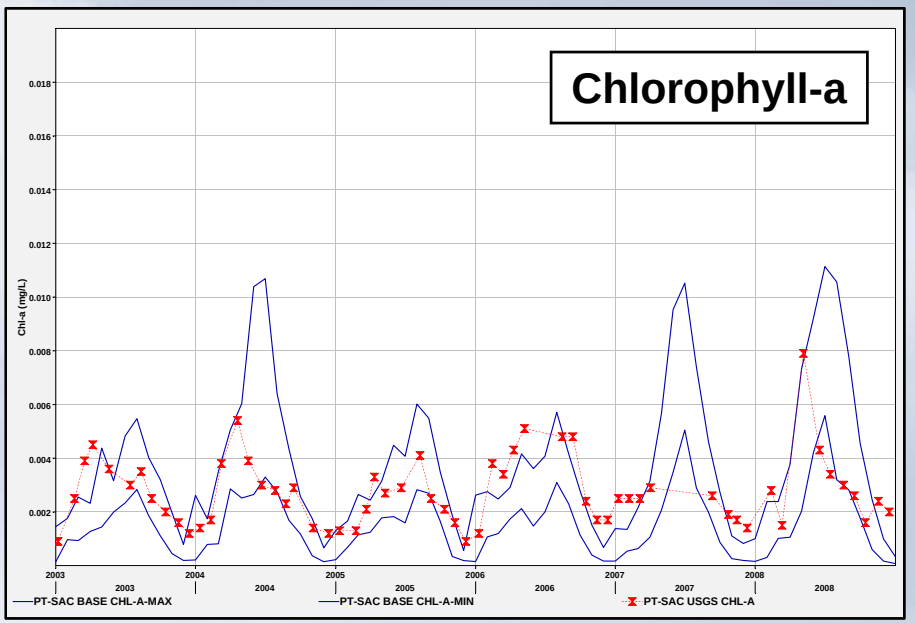


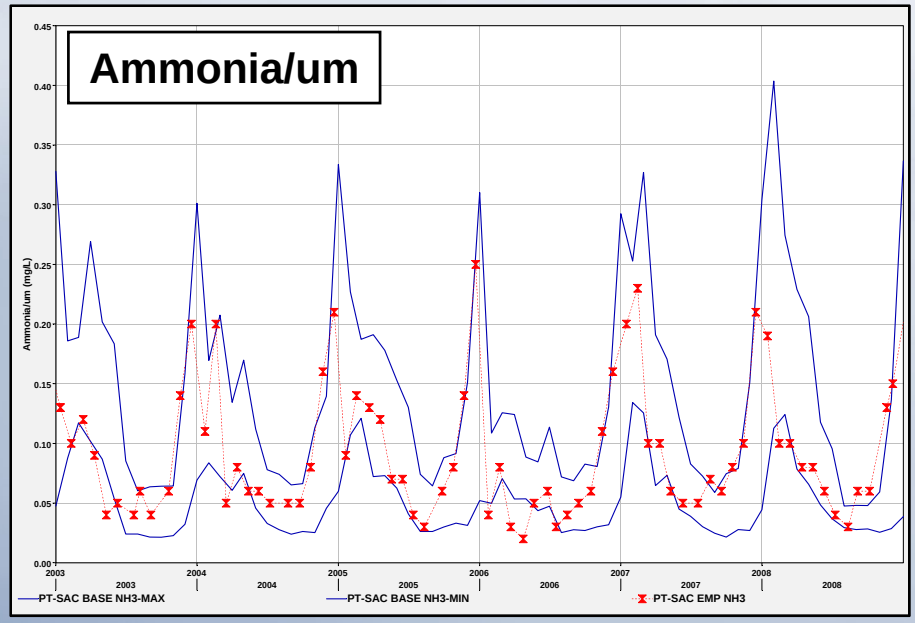


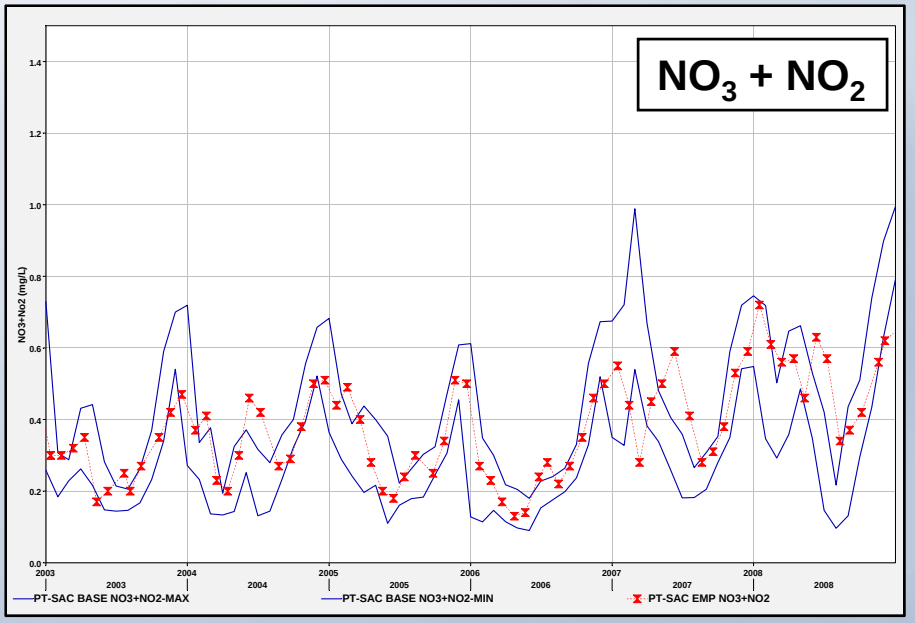


Point Sacramento – Calibration to Date

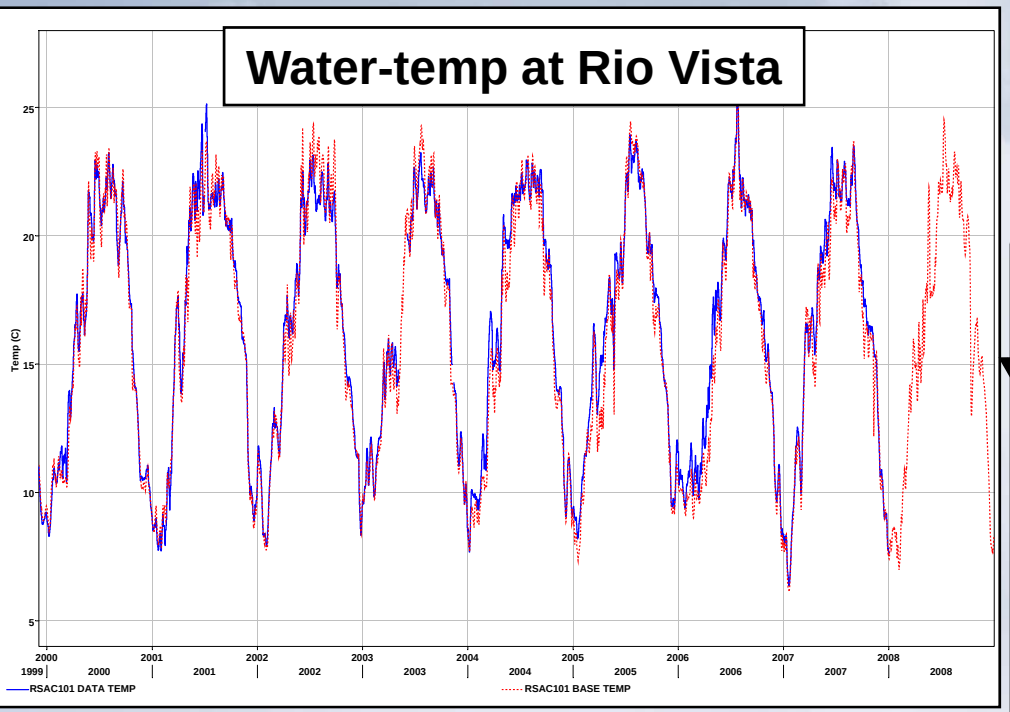


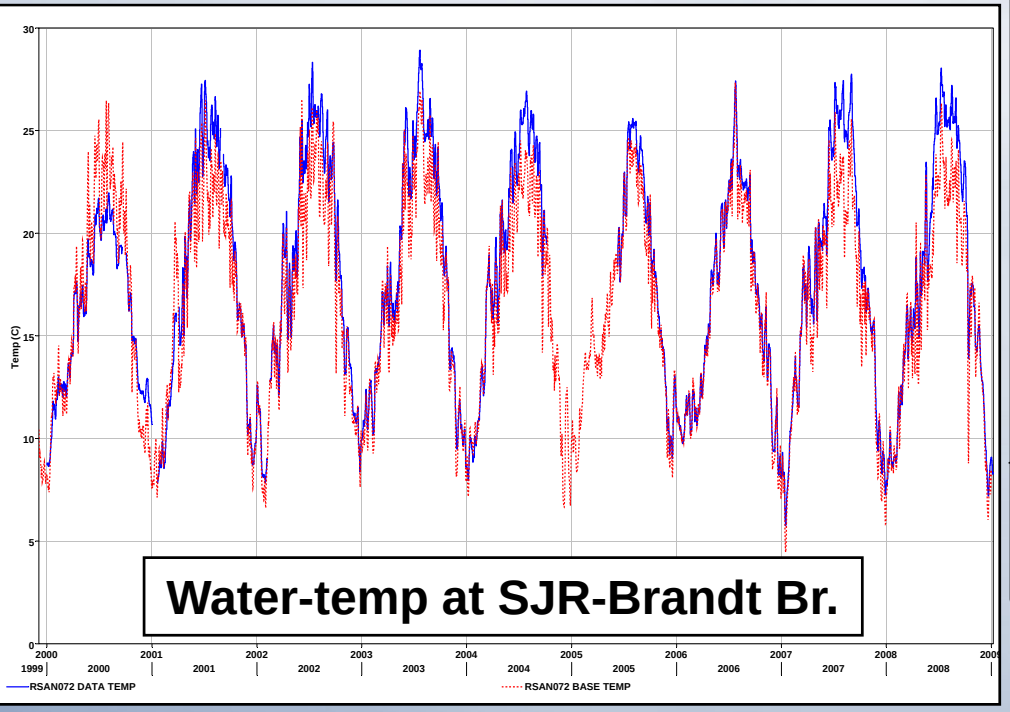


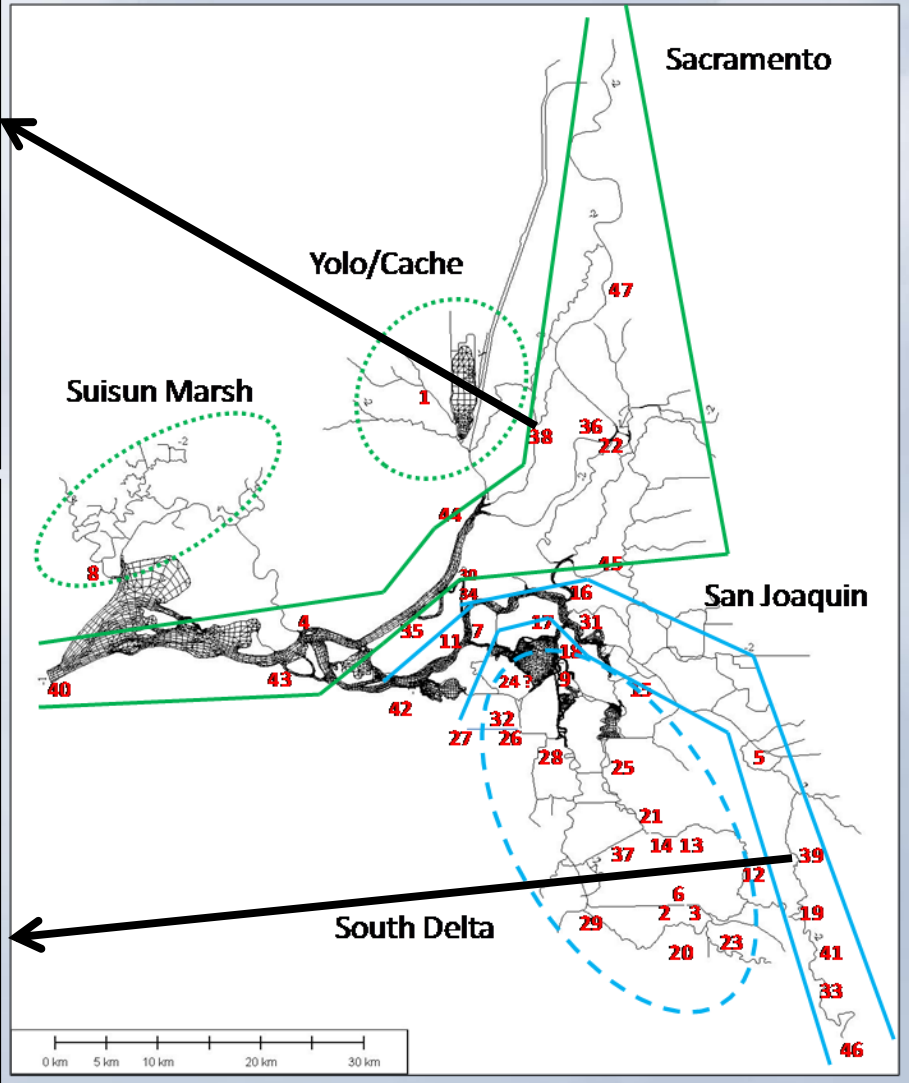




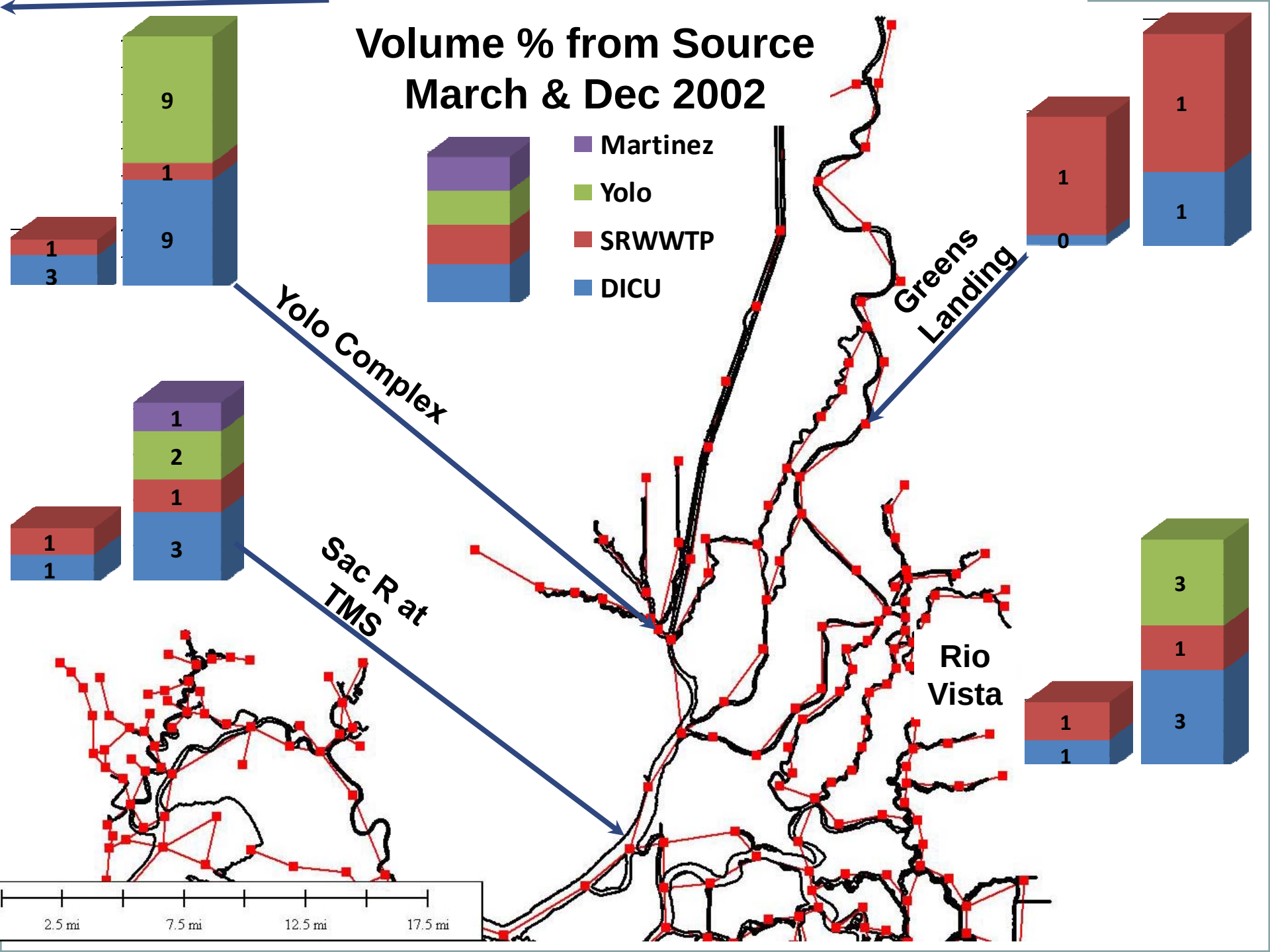
Temperature Calibration – Focus on Sacramento R.

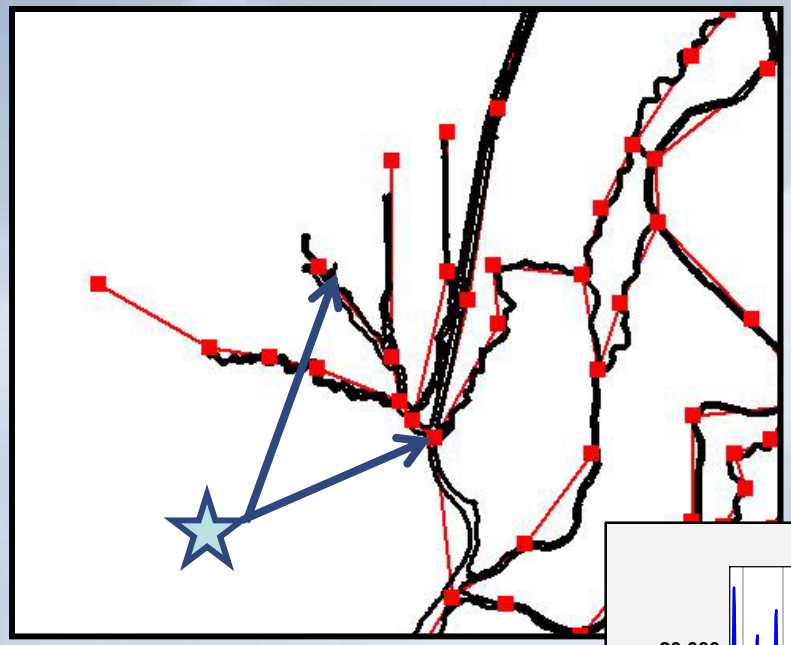




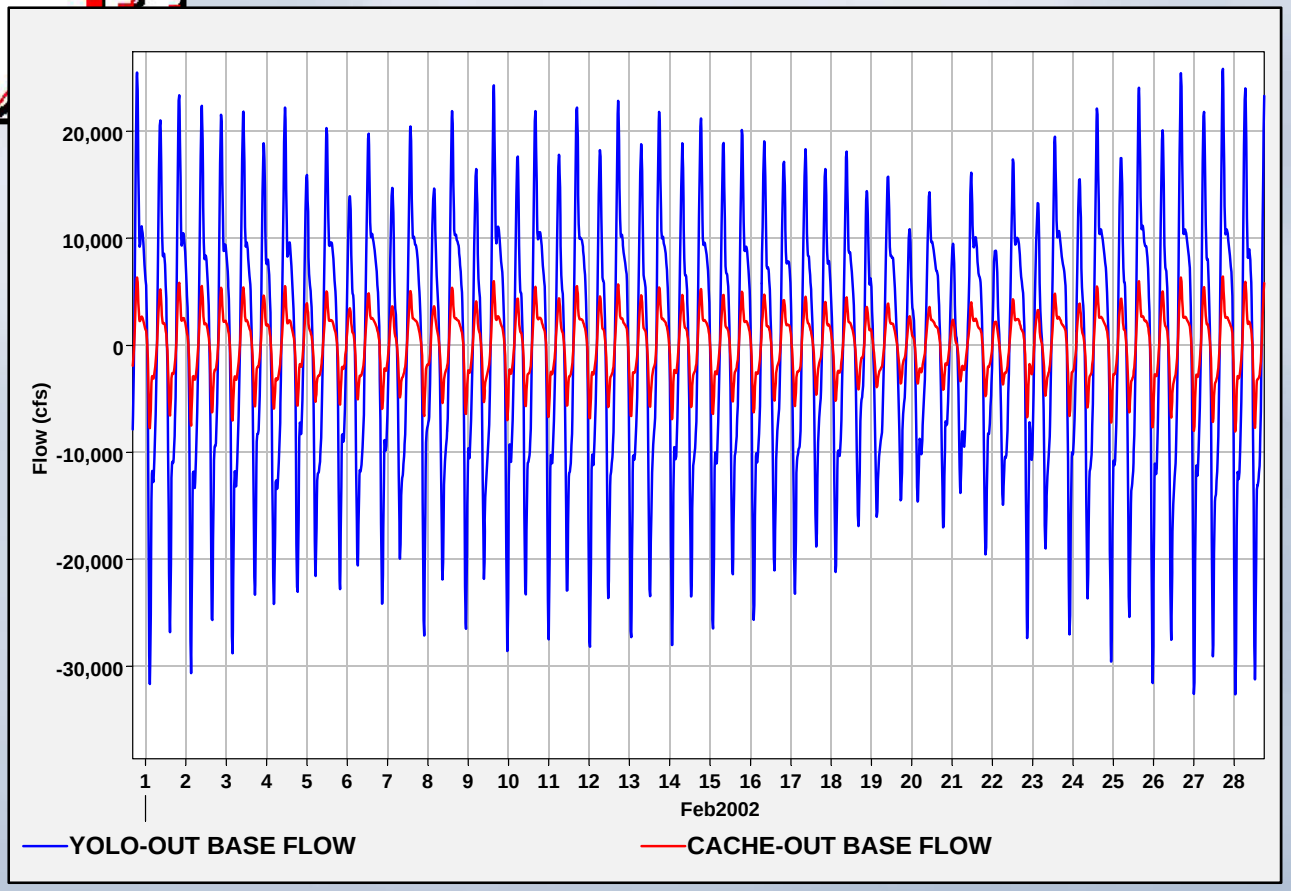


Volume % from Source March & Dec 2002





Modeled Tidal Flow at Two Yolo Locations



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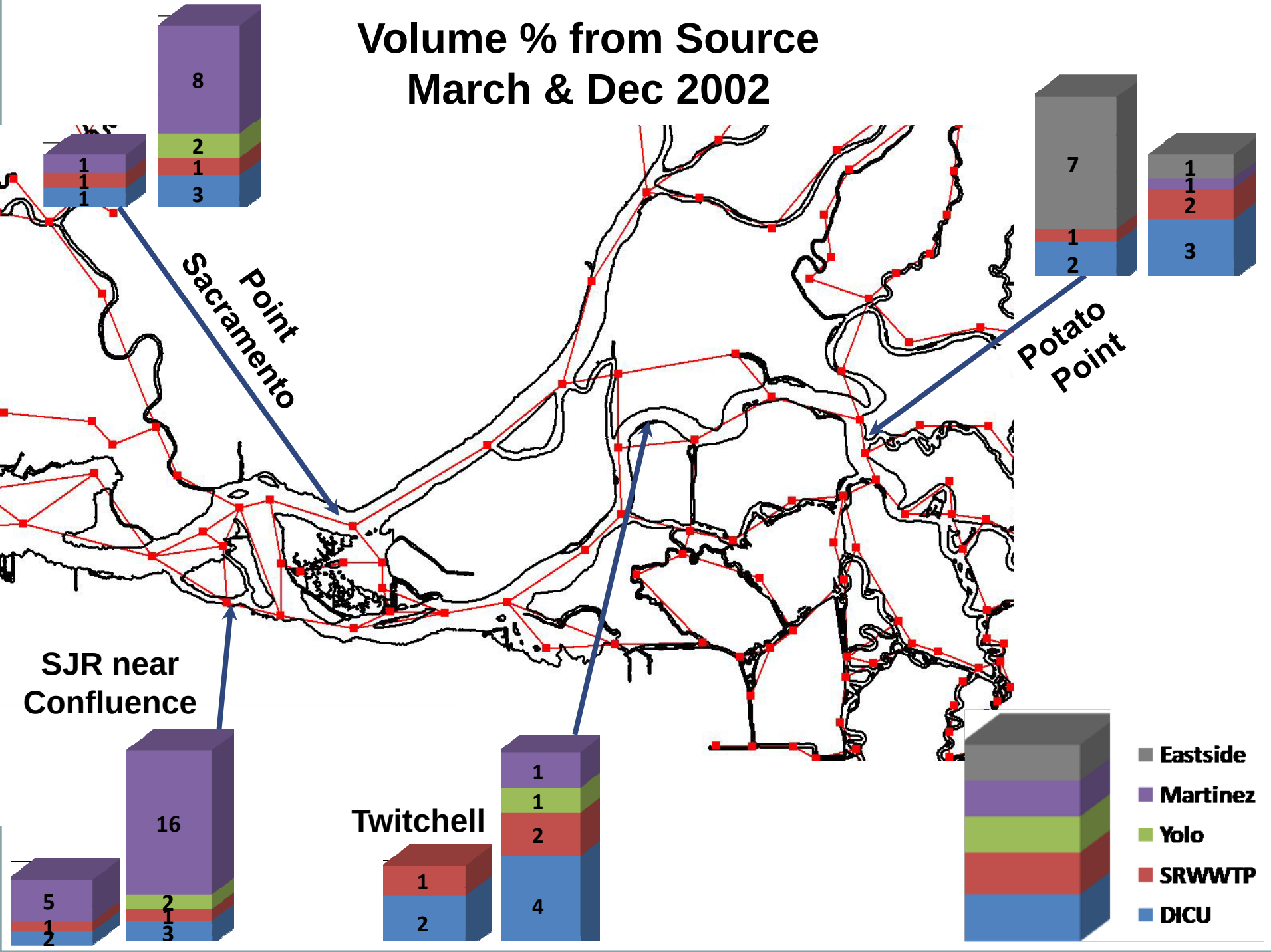
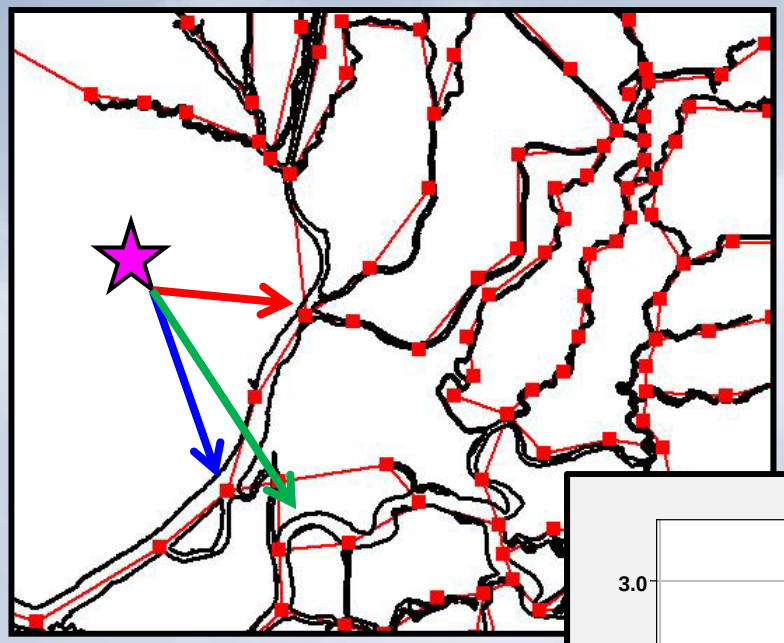
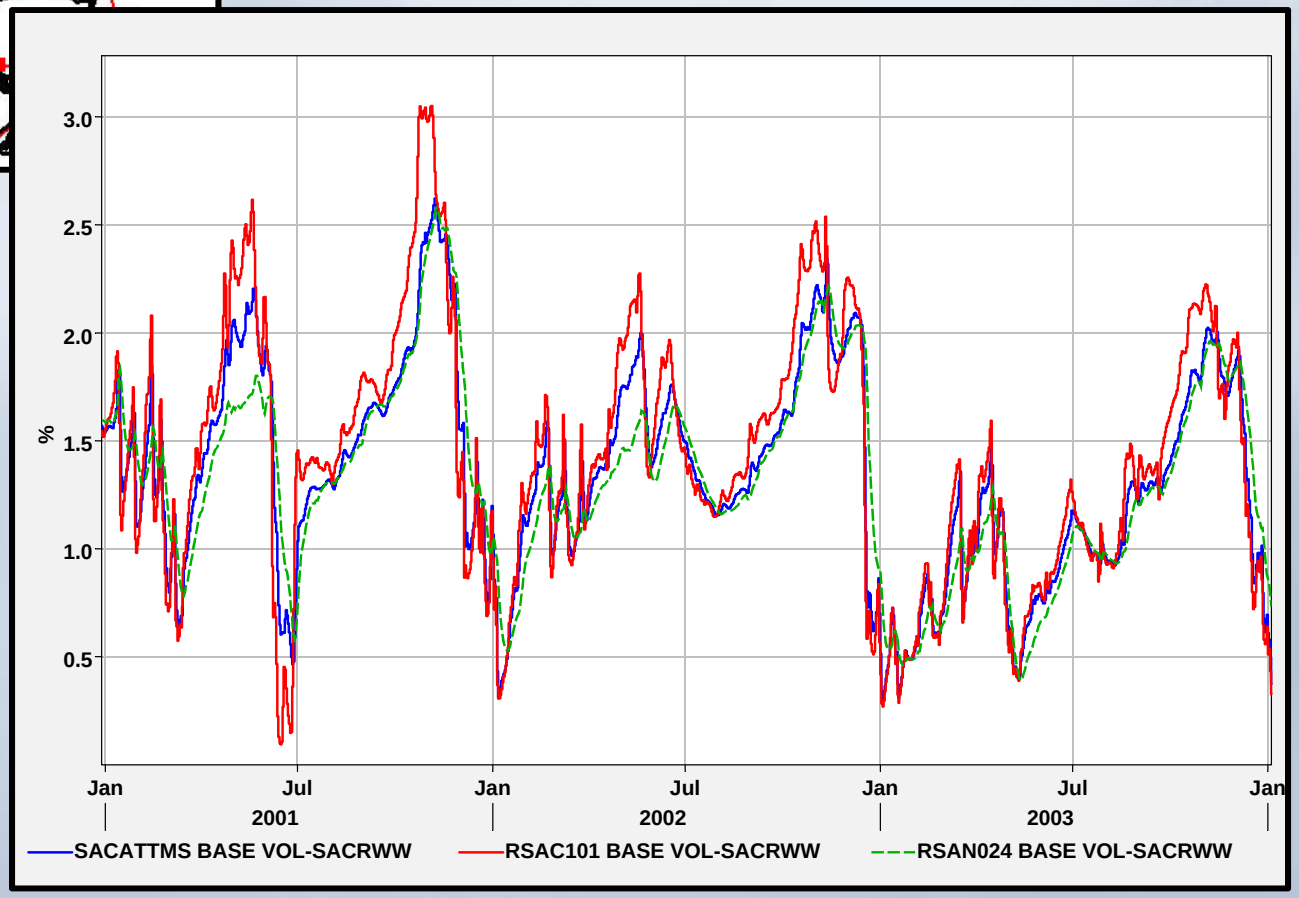


SRWTP Volumes at Three Delta Locations





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Suggested Model Improvements For Ammonia Dynamics

- Temperature
  - Regionalize boundary conditions for meteorology
- Algal dynamics
  - Refine nutrient preferences – tie to concentration ranges
  - Additional algal "groups" – tie to preferred habitat and nutrients
- Additional processes
  - Additional benthic sink for nutrients and/or algae
  - Tie nutrient sinks to other physical parameters such as salinity and temperature dependence (corbicula and corbula)
- Other suggestions?

Summary

- **DSM2 nutrient model calibration to-date:**
  - Surprising good representation of the long-term trends
  - Exceptions: "clams" and events
- **Model sufficiency for ammonia dynamics:**
  - Limited by sparse, irregular boundary condition data
  - Nutrient Model Concept – needs improvement to better model benthic interactions and algal dynamics
  - Volumetric fingerprinting useful for identifying sources
    - Very helpful when combined with modeled concentrations
- **Applications:**
  - Current application – historical model with effluent and focus on ammonia
  - Sensitivity Analysis–
    - Parameters
    - Main boundary conditions
    - Effluent boundary conditions
- **Others?**

Questions?