

# SJR Technical Working Group

May 17, 2005

## SJR DO Modeling

Upstream & Downstream

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**HydroQual**

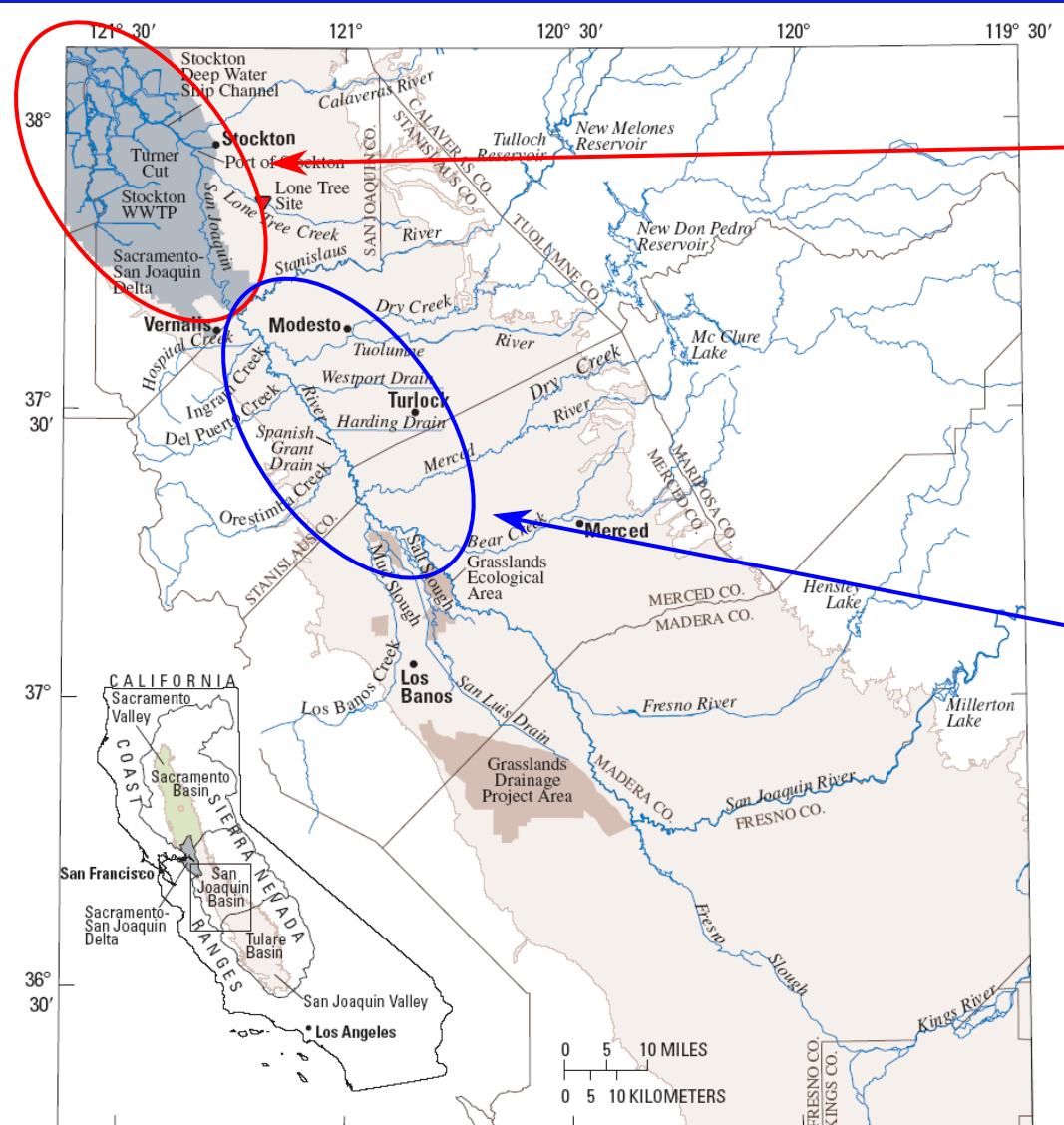


Environmental  
Engineers & Scientists

201•529•5151  
[www.hydroqual.com](http://www.hydroqual.com)



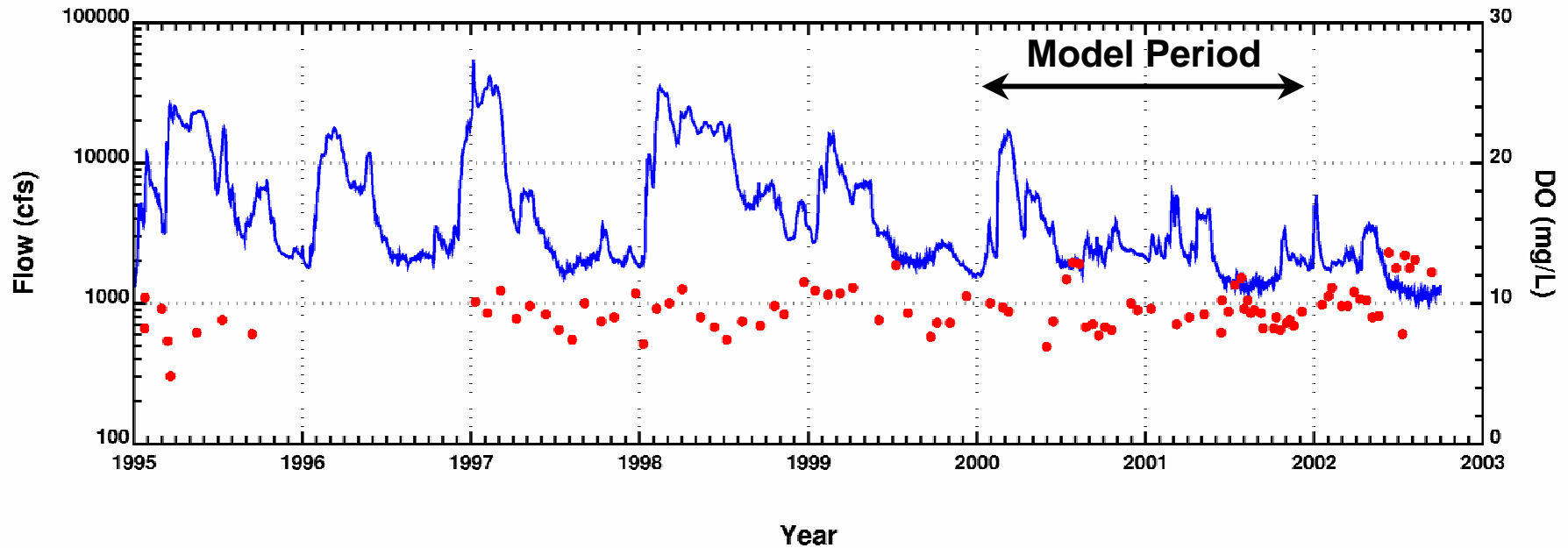
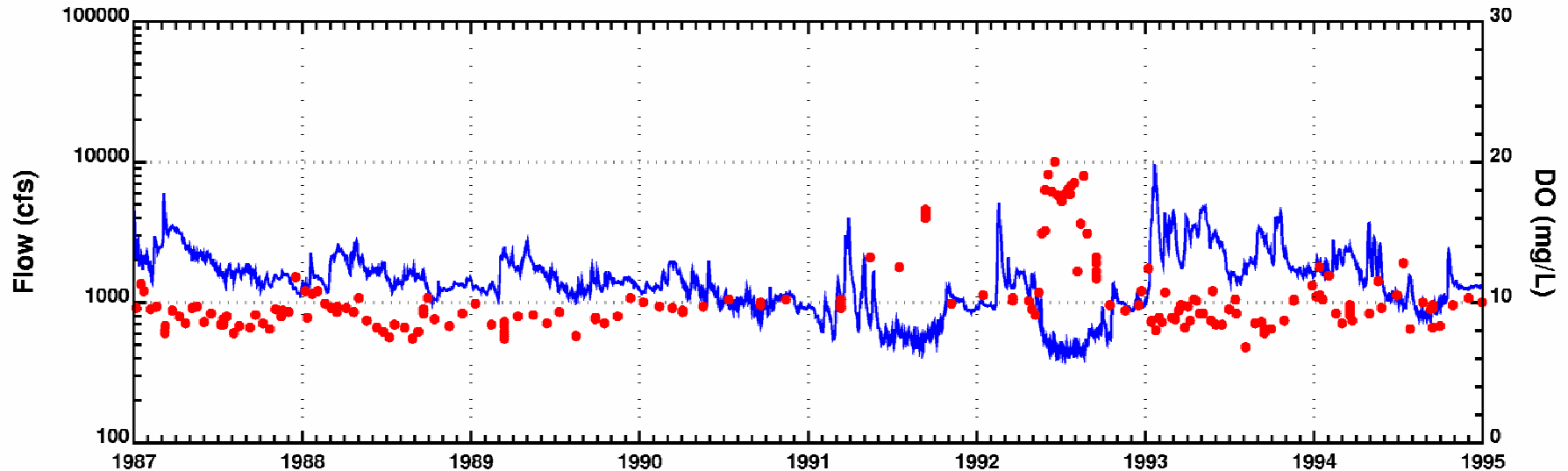
# SJR Models – Study Area



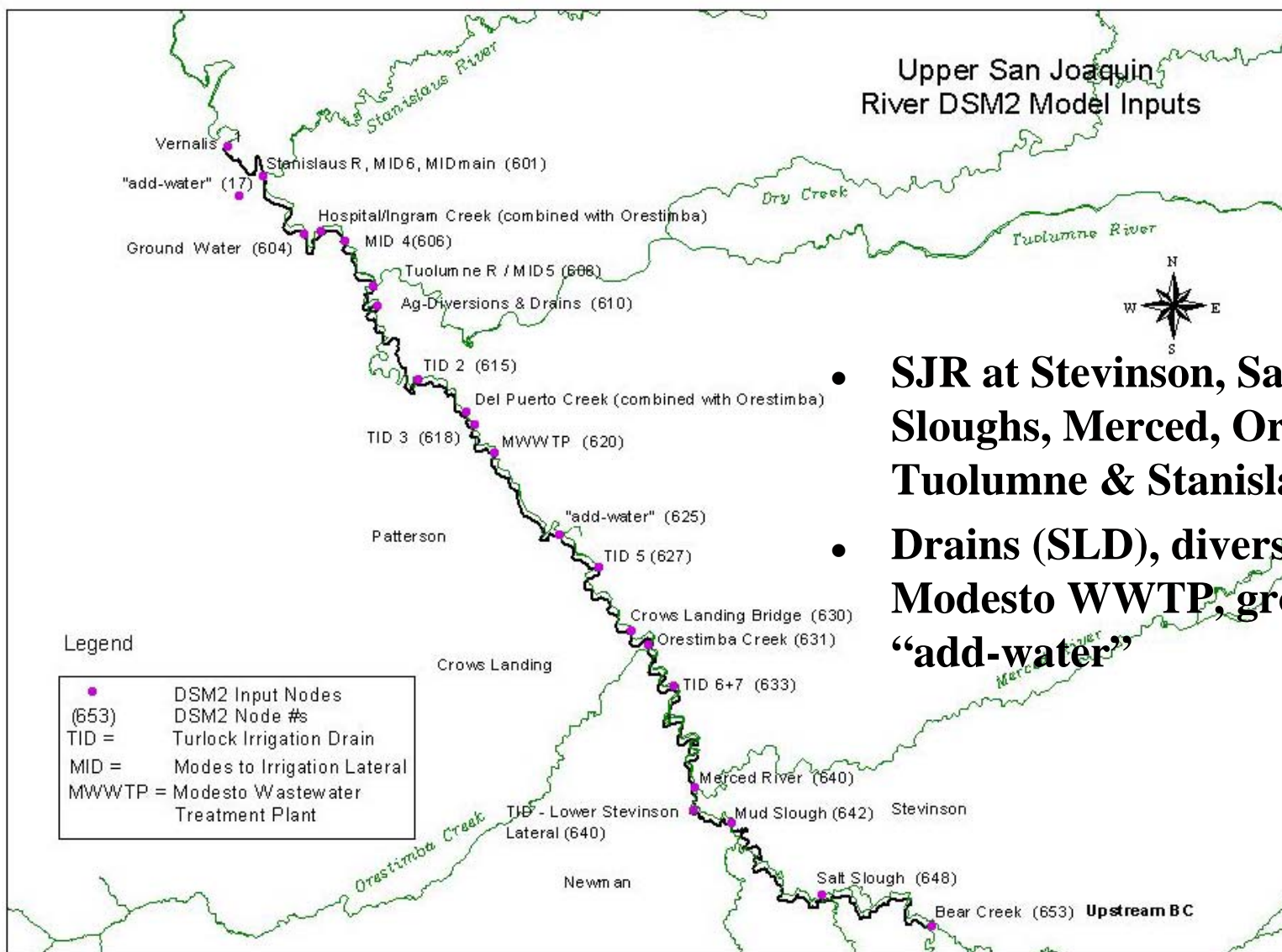
- **Downstream**
  - ◆ **DSM2-delta**
  - ◆ **ECOMSED/RCA**
  - ◆ **Tidal portion from Vernalis to Jersey Island**
- **Upstream**
  - ◆ **DSM2-sjr**
  - ◆ **Free-flowing portion from Stevinson to Vernalis**

Source: Kratzer, et al. (2004)  
USGS WRI-03-4127

# Model Calibration Period



# Upstream SJR – Study Area

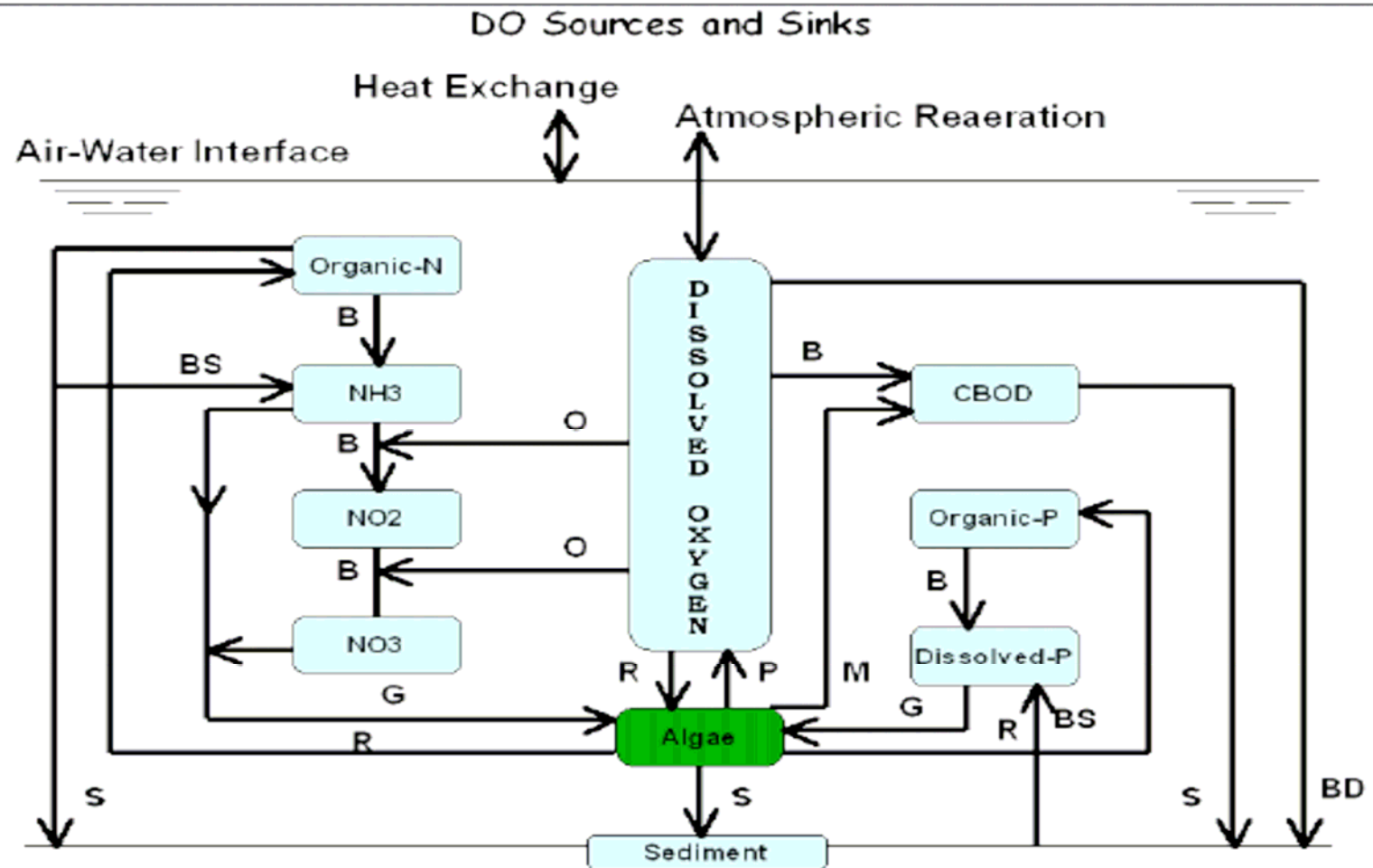


- **SJR at Stevinson, Salt & Mud Sloughs, Merced, Orestimba, Tuolumne & Stanislaus**
- **Drains (SLD), diversions, creeks, Modesto WWTP, groundwater & “add-water”**



# DSM2-sjr Water Quality Model

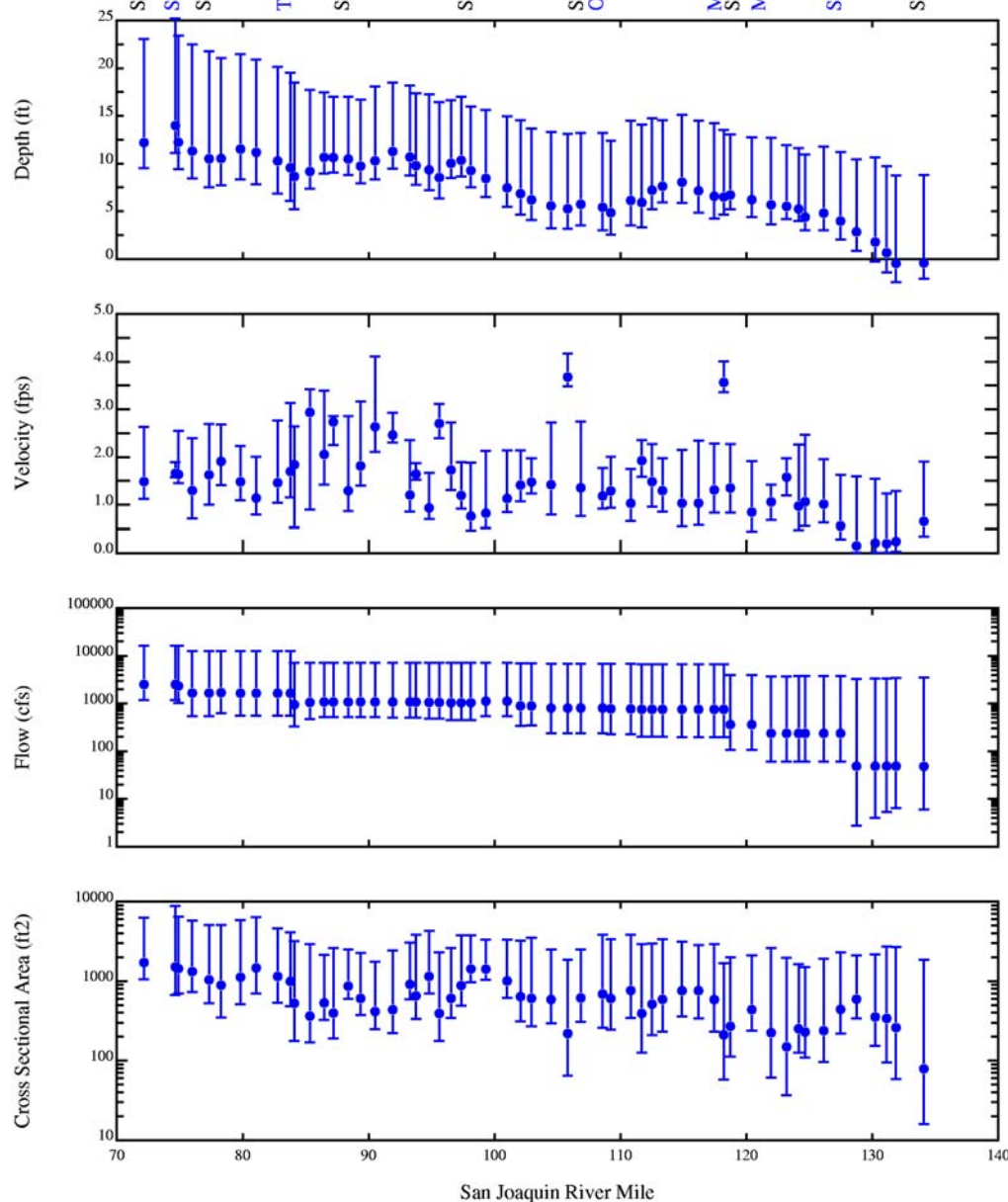
(Source: Rajbandari, 2004)



# Model Inputs

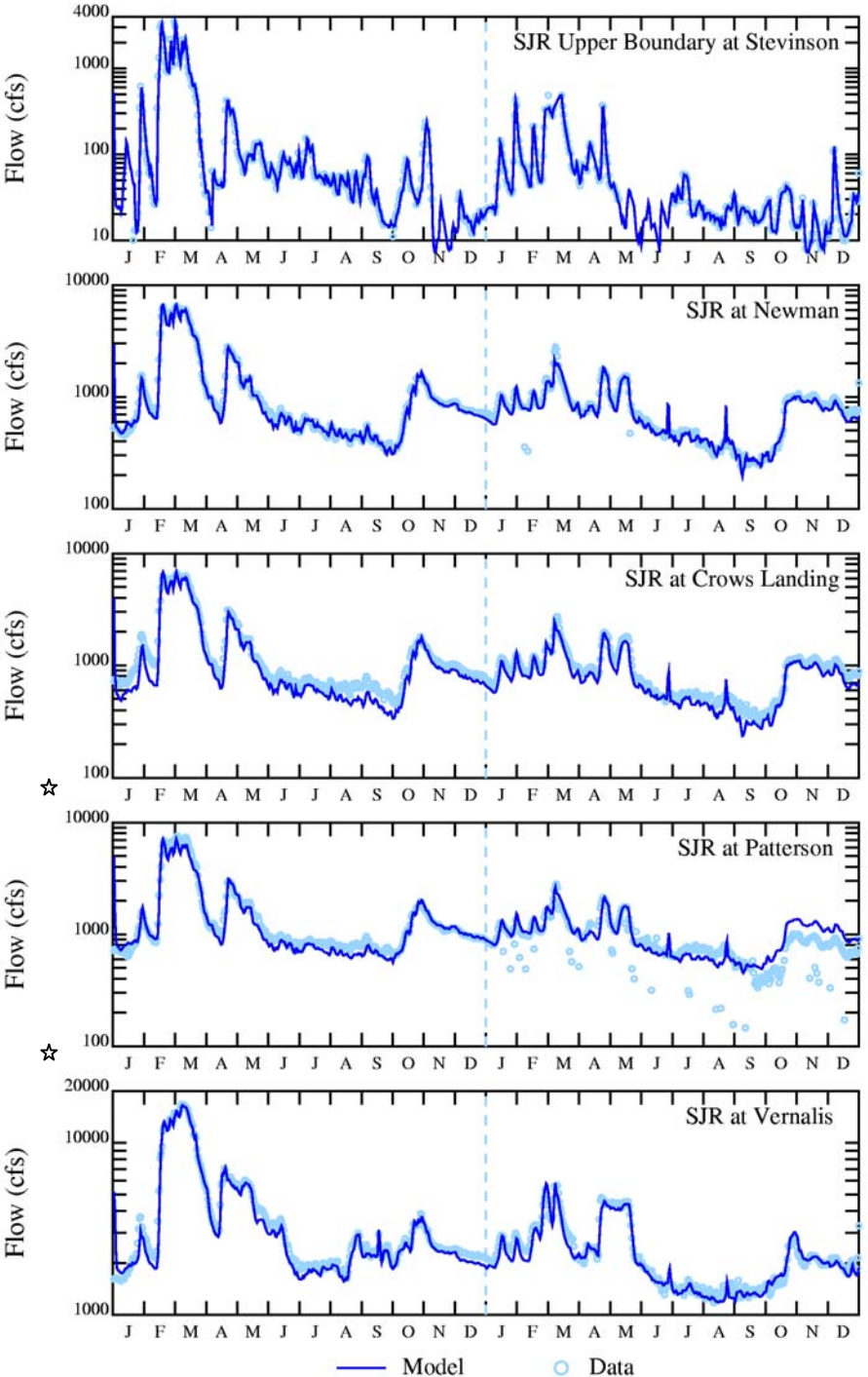
- J&S completed initial calibration of flow & EC
  - ◆ “Add-water” inputs needed for calibration
- Upstream, tributary & river data from:
  - ◆ Data Atlas, USGS (Kratzer et al.) & UC Davis (Dahlgren et al.)
- BODu and decay rates based on LTBOD studies
- Light extinction coefficients based on secchi depth, TSS, chl-a (spatially varying)
- Hourly cloud cover model inputs assigned
- A few code changes completed (Ka, Ke, units)

# Geometry (2000-2001)



- Average & range of model geometry in 2000-2001
- Upstream geometry may still need improvement at low flows
- Caused model instability and smaller timesteps
- H increases from 0-25ft
- CSA ranges from 15-10,000 ft<sup>2</sup>
- U ranges from ~0-4 fps
- Q ranges from 3-20,000 cfs

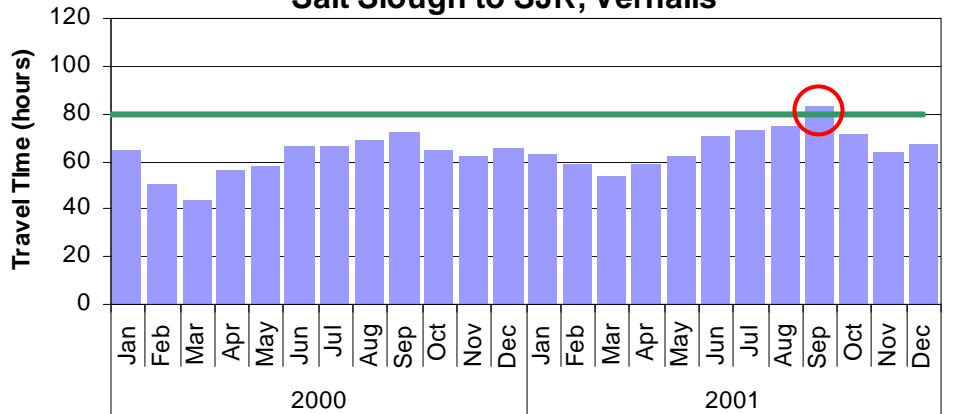
# Flow Calibration (2000-2001)



- “Add-water” needed for good flow calibration at Vernalis
- System complicated by drains/diversions coupled with groundwater inflow
- Better determination of flow balance along length of upper SJR needed (SW/GW/AG)
- Potential GIS delineation/GW modeling could prove useful

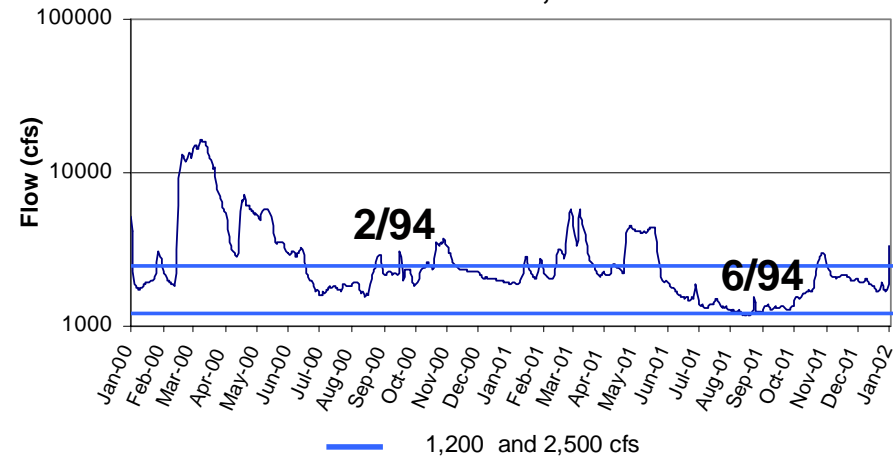
# Comparison to Dye Studies

## Salt Slough to SJR, Vernalis

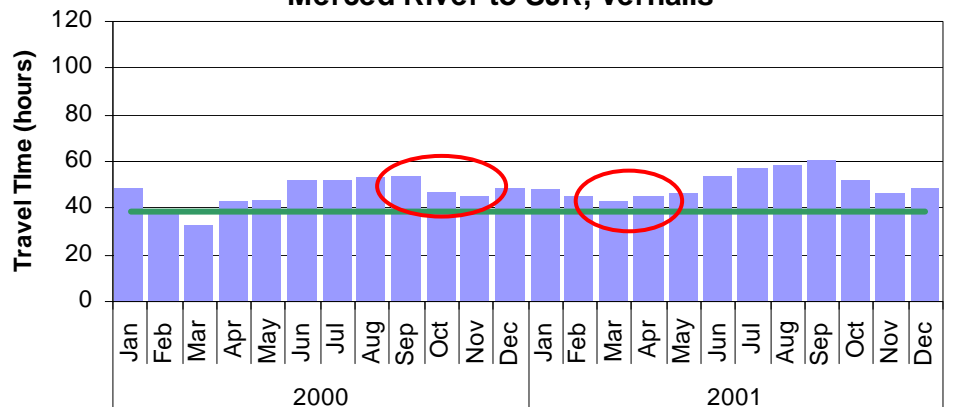


Dye Study Travel Time = 80.1 hrs from Salt Slough at Highway 165 to SJR, Vernalis in June 1994 (Flow at Vernalis about 1,200cfs)

## Model SJR Flow, Vernalis



## Merced River to SJR, Vernalis

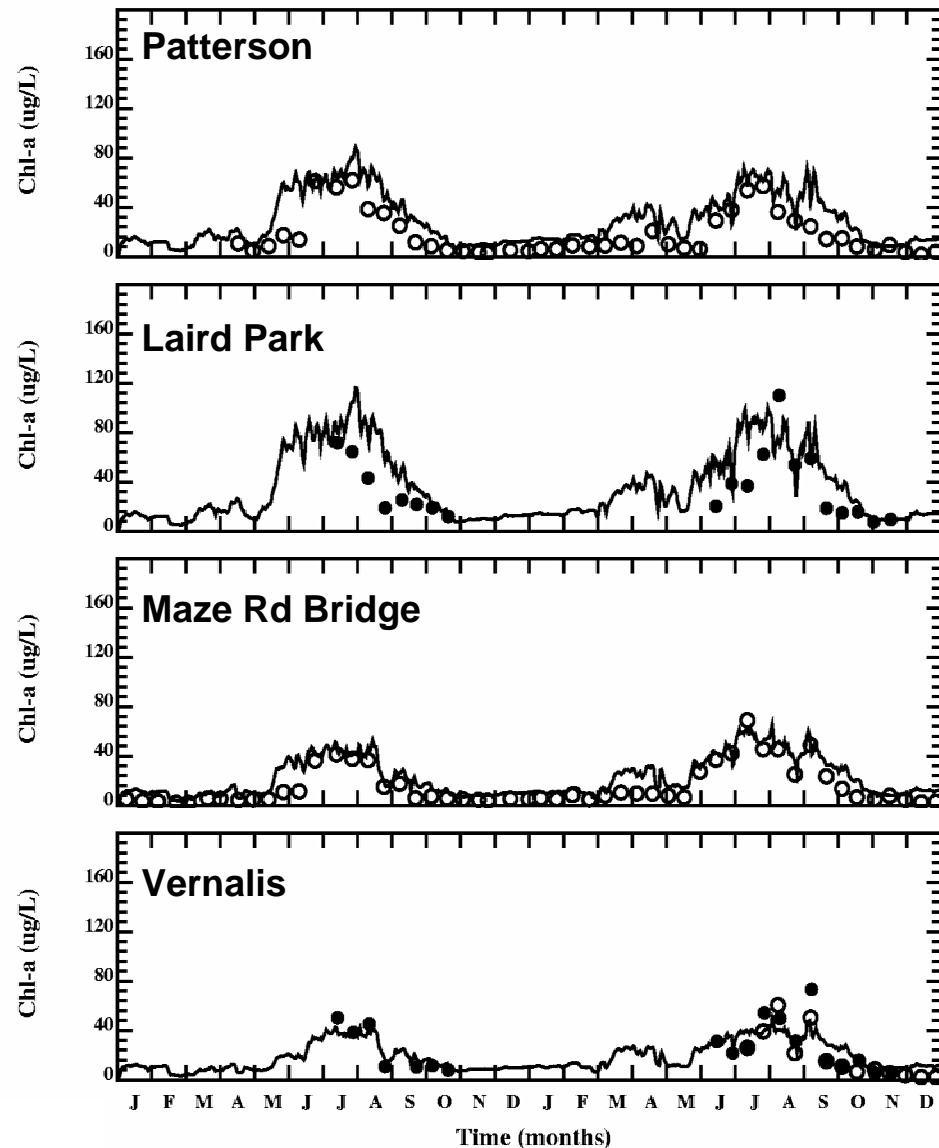
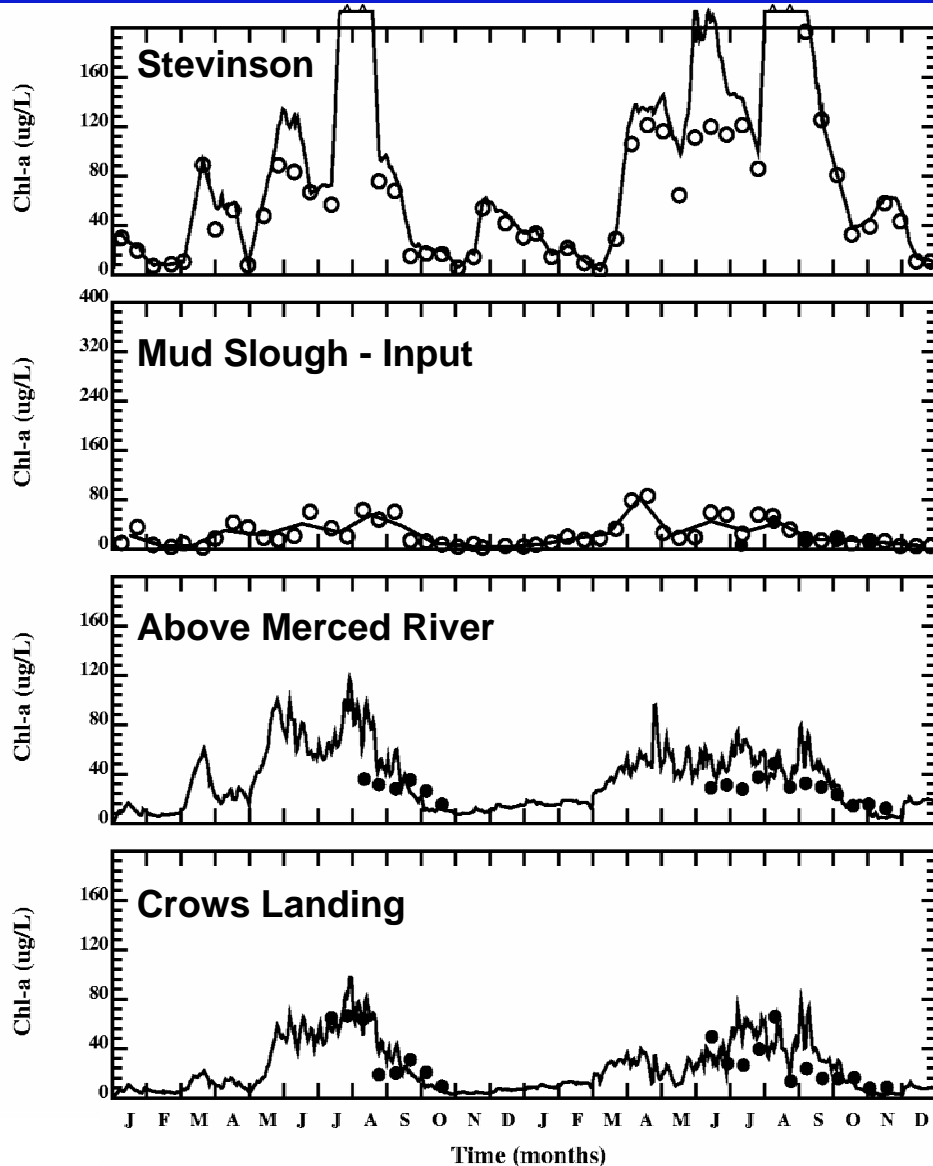


Dye Study Travel Time = 38.5 hrs from Merced River at River Road to SJR, Vernalis in February 1994 (Flow at Vernalis about 2,000-2,800cfs)

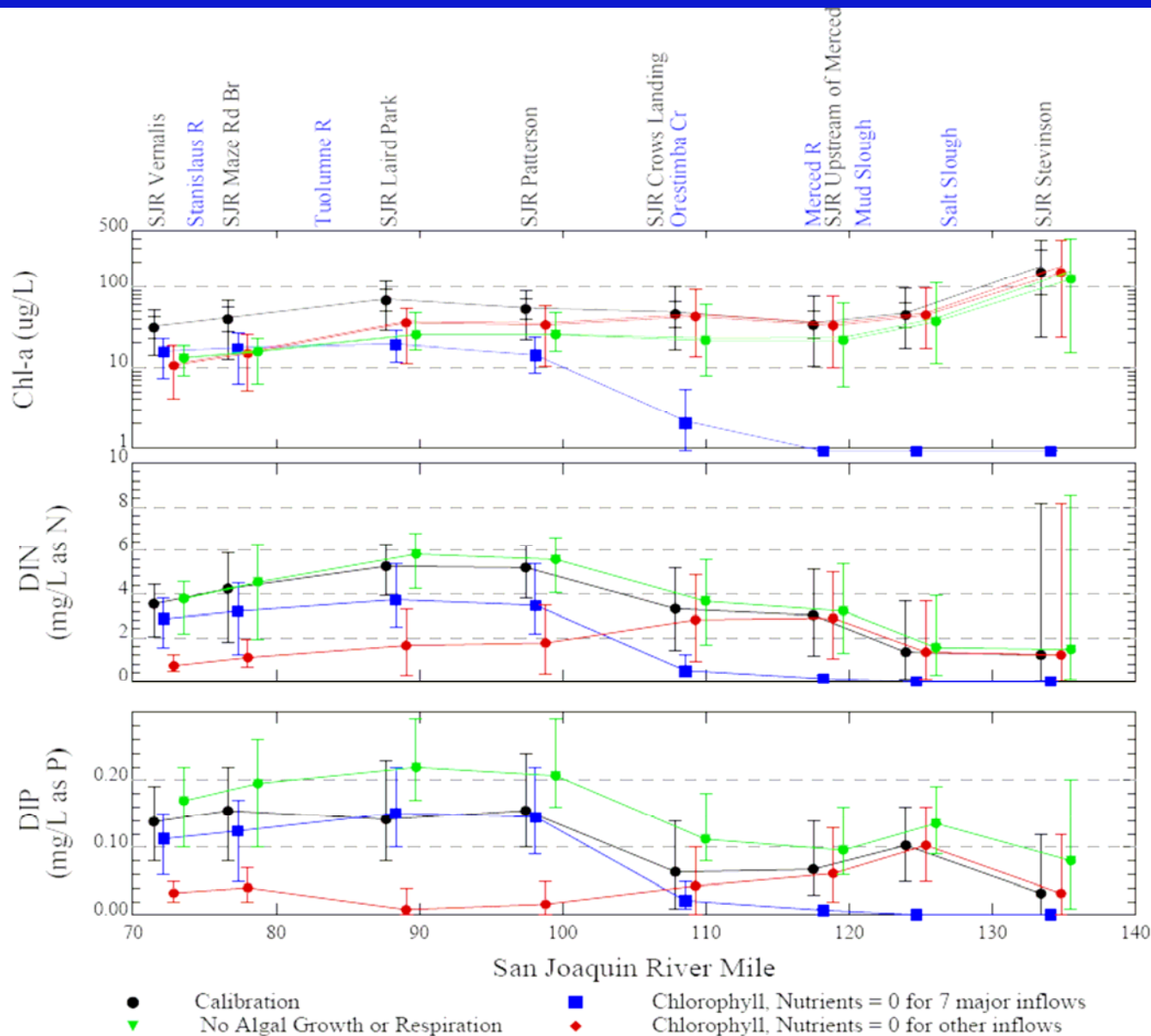
- Model travel time compares well with dye study results at similar river flows

Source: Kratzer & Biagtan  
(1994-1995 Studies)

# Chlorophyll-a Calibration



# Chl-a “Unit Response”



## 3 cases

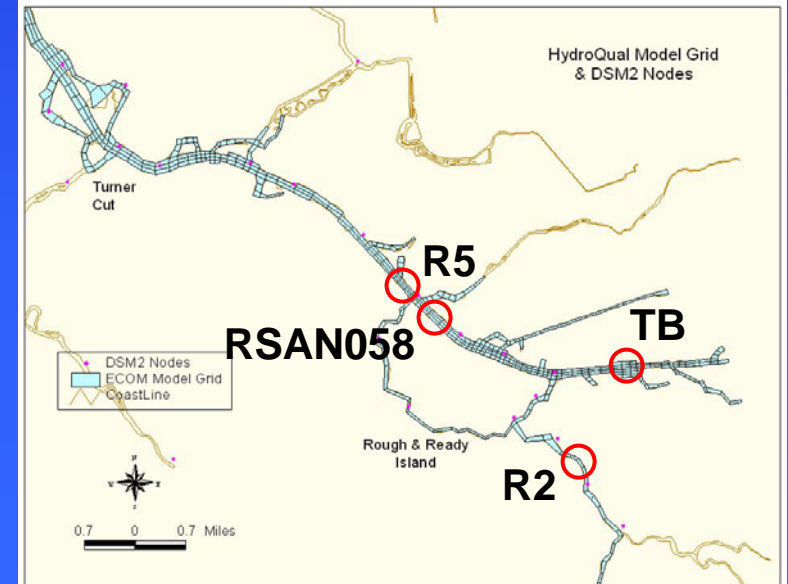
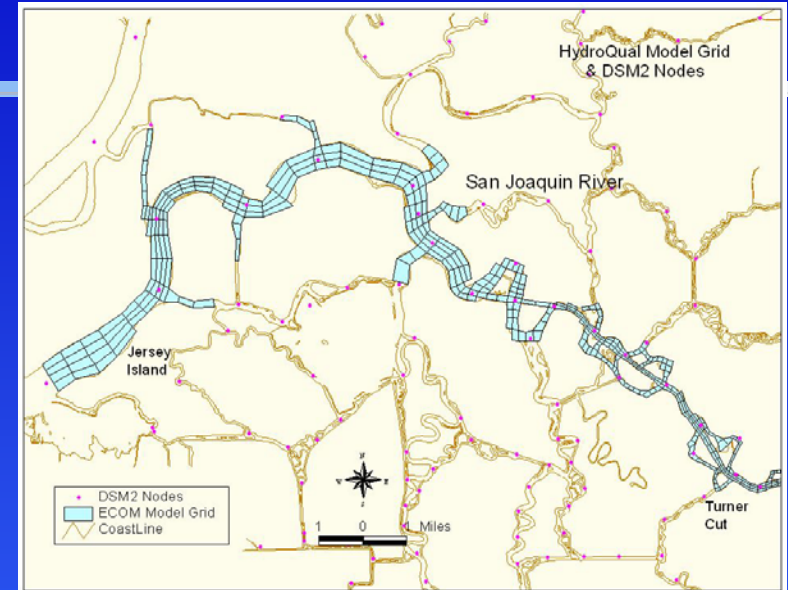
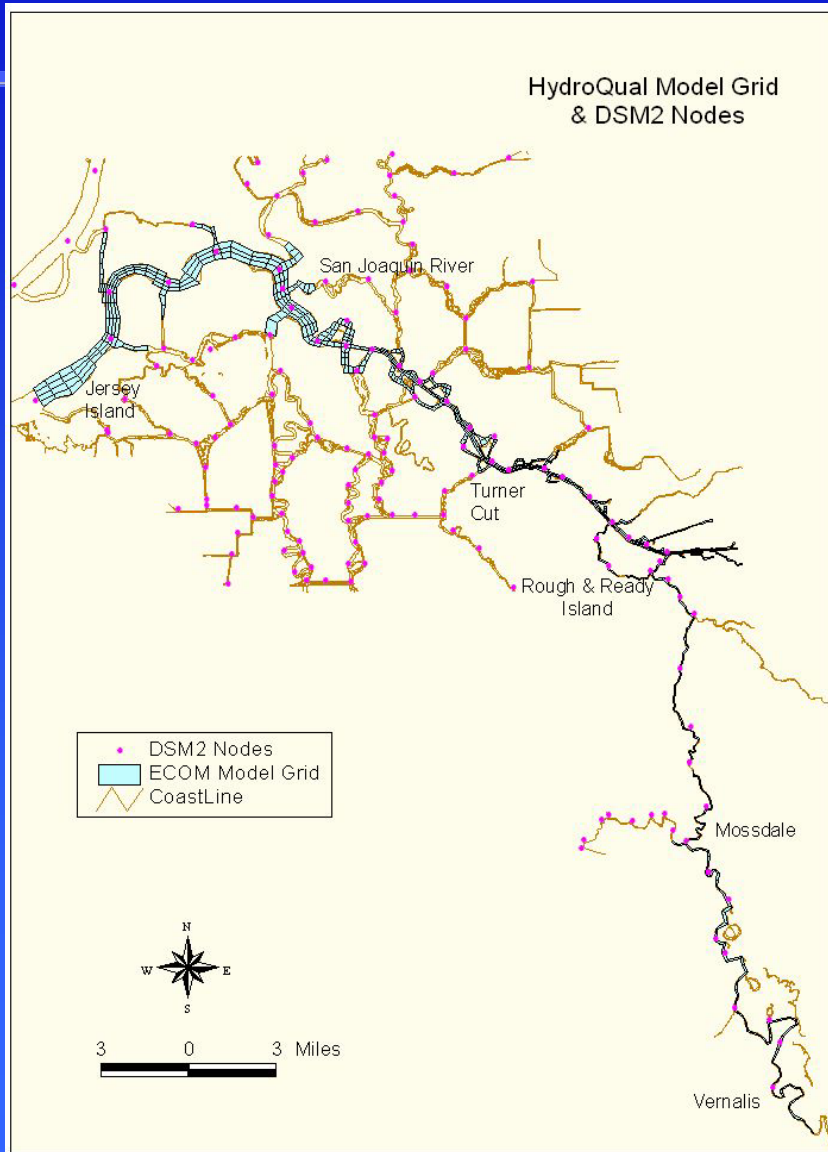
- ◆ Zero tribs
- ◆ Zero other
- ◆ No growth

Chl-a levels  
affected  
different  
spatially

Roughly equal  
impact from 3  
cases at  
Vernalis



# Downstream – Study Area

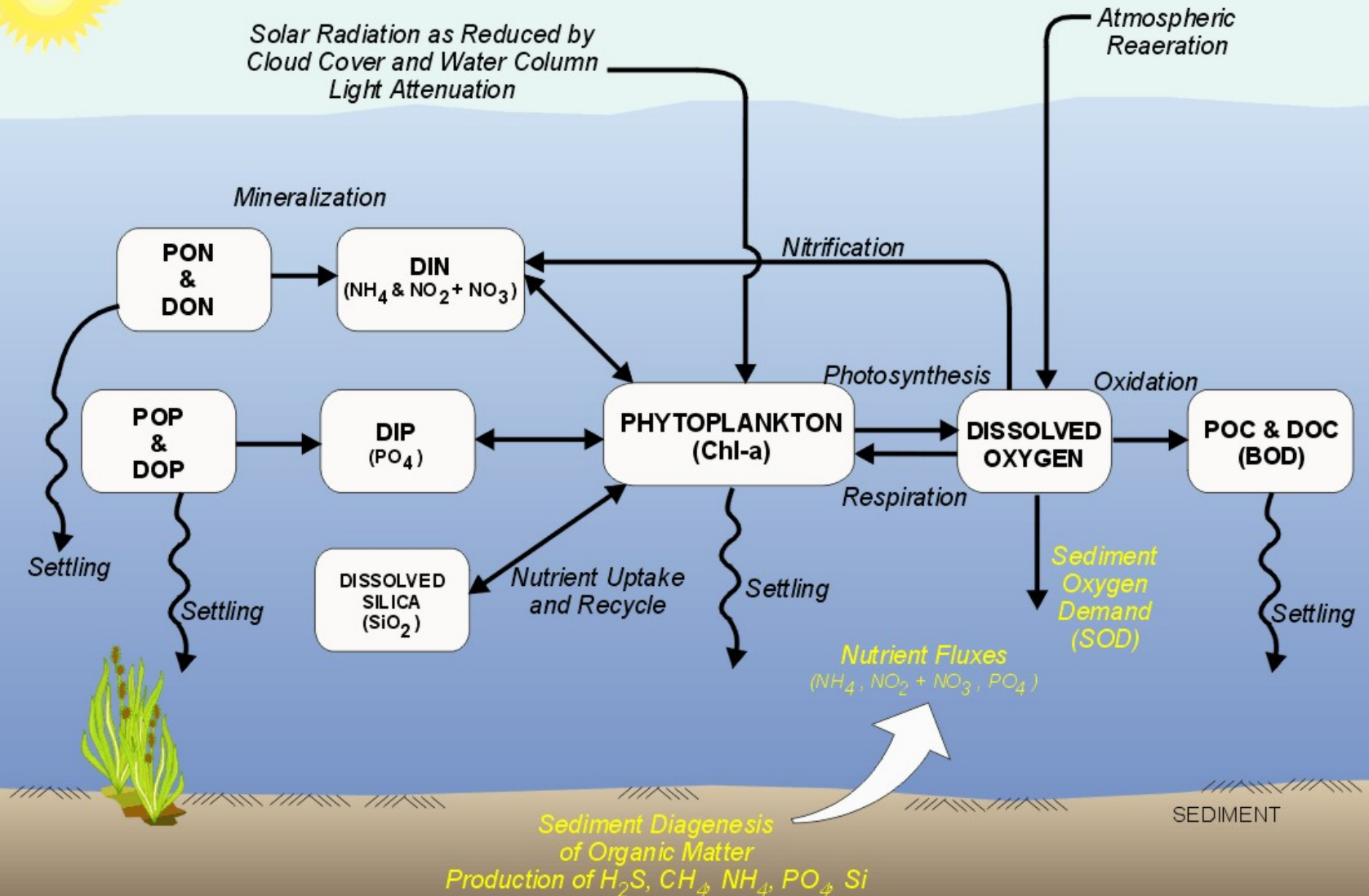


# Modeling Effort

- **Models calibrated/validated from 2000-2001**
- **Hydrodynamic model includes tidal transport and calculation of temperature**
- **Water quality model uses tidal transport and includes the following parameters:**
  - ◆ **EC, BOD, DO, eutrophication (nutrients & phytoplankton), TSS**
- **Models coupled to provide a direct linkage between upstream & downstream water quality calculations**

# Eutrophication Modeling Framework

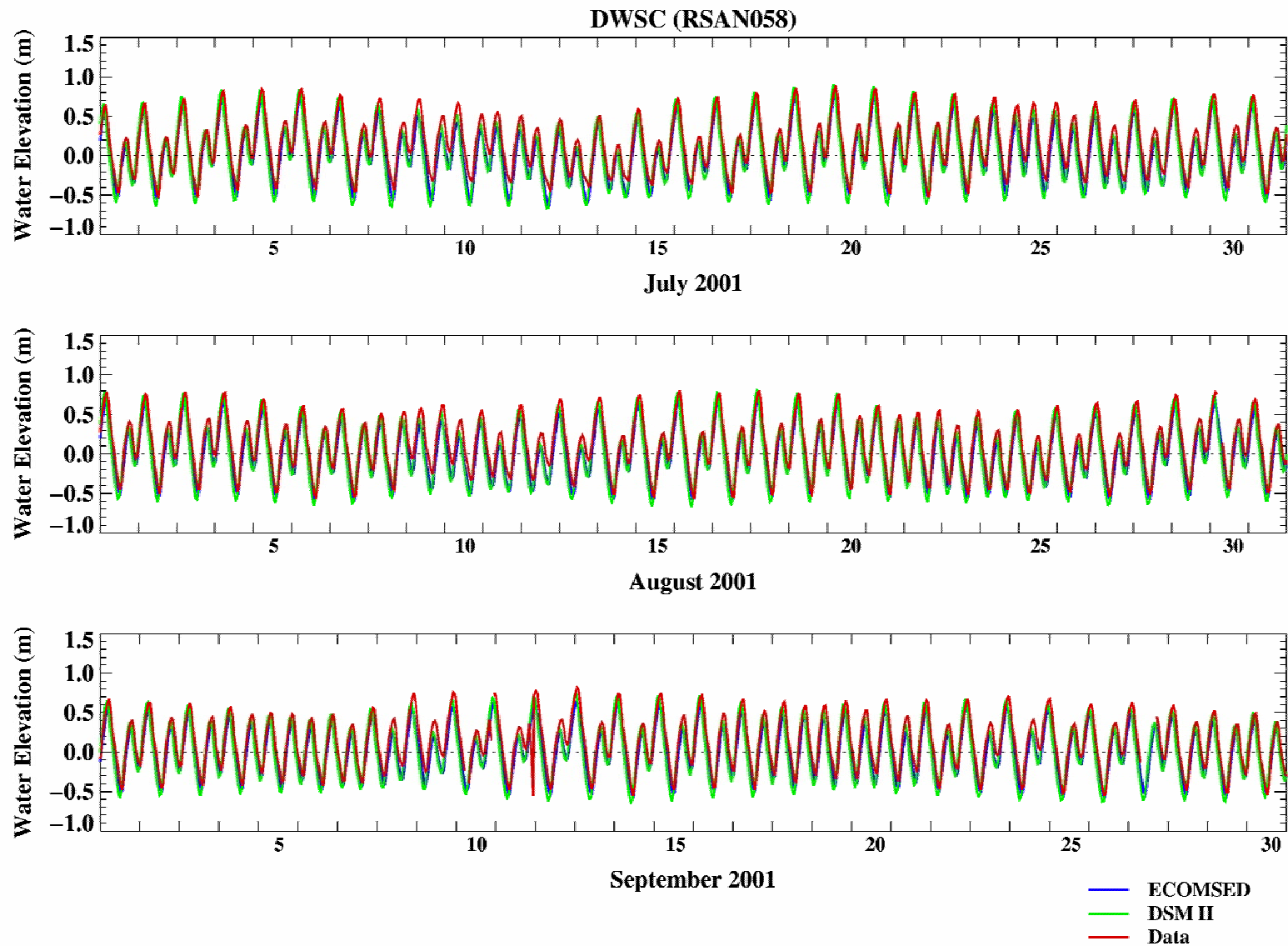
*(Yellow Text Denotes Sediment Flux Model)*



# DWSC Hydrodynamic Modeling

- **Hydrodynamic model calibration done**
  - ◆ **Model output compared to observed stage, flow & temperature**
  - ◆ **Compares well with data and DSM2 output**
  - ◆ **Reproduces daily temperature stratification**
  - ◆ **Further work may be needed in the Turning Basin & also as water quality modeling continues to progress**

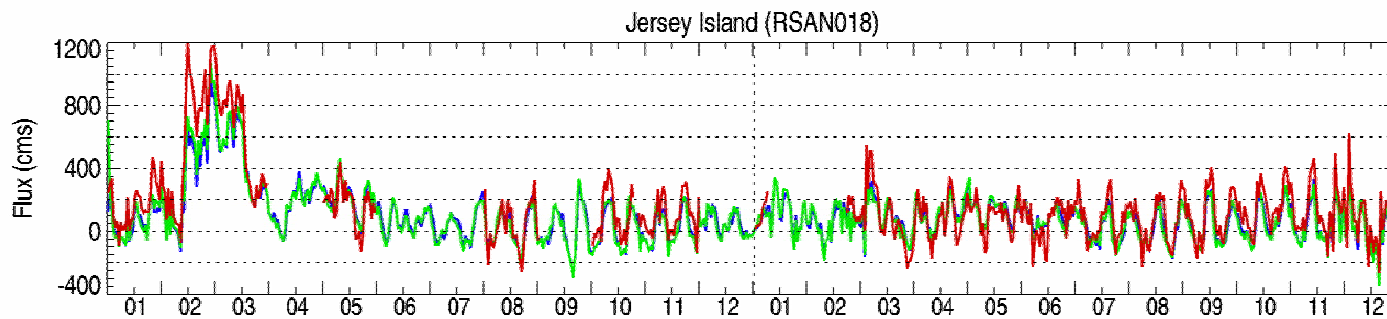
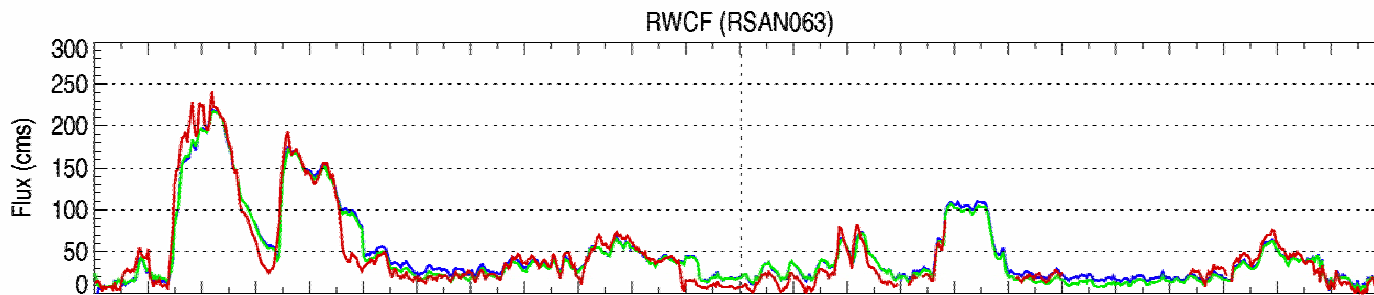
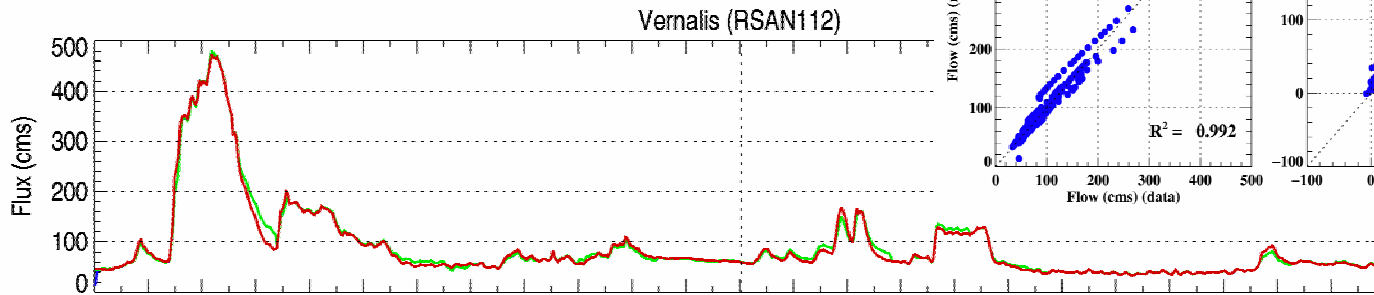
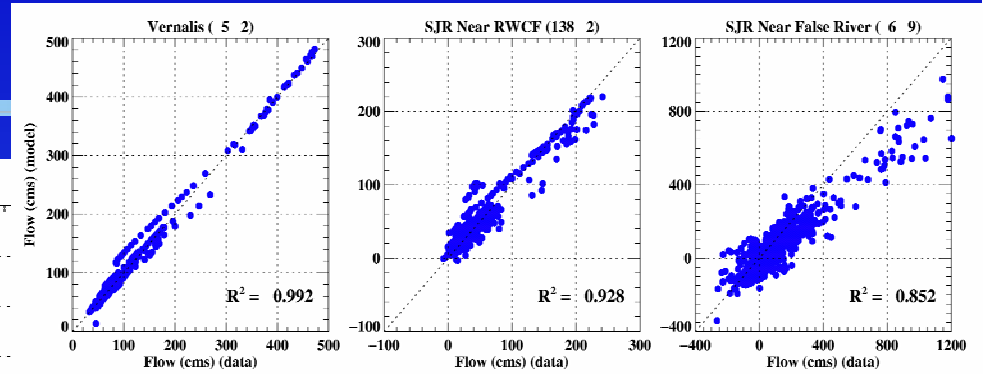
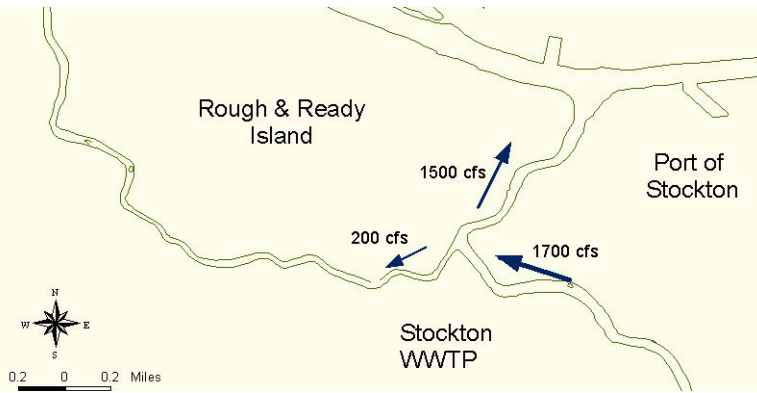
# Elevation Calibration





# Flow Calibration

17



+: downstream  
-: upstream

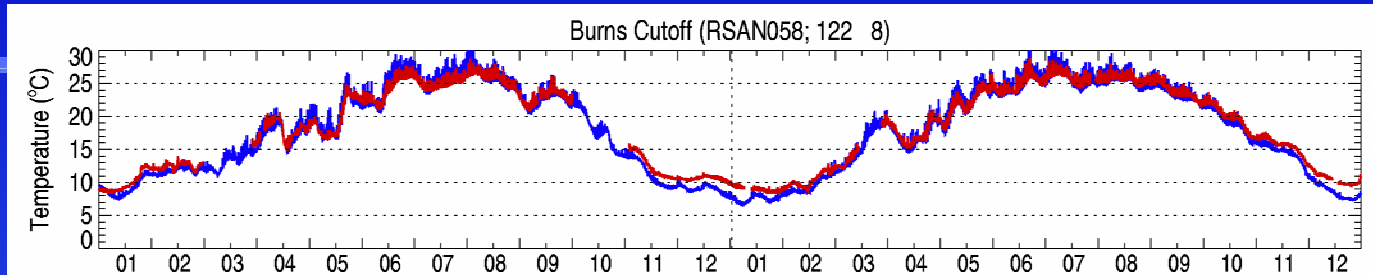
2000-2001

— ECOSMED  
— DSM II  
— DATA



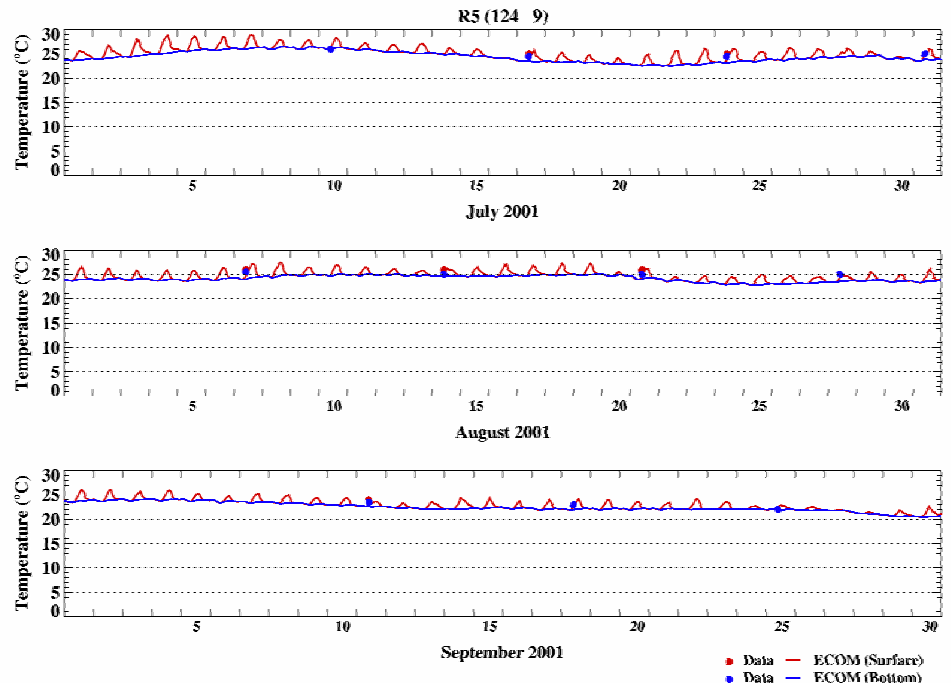
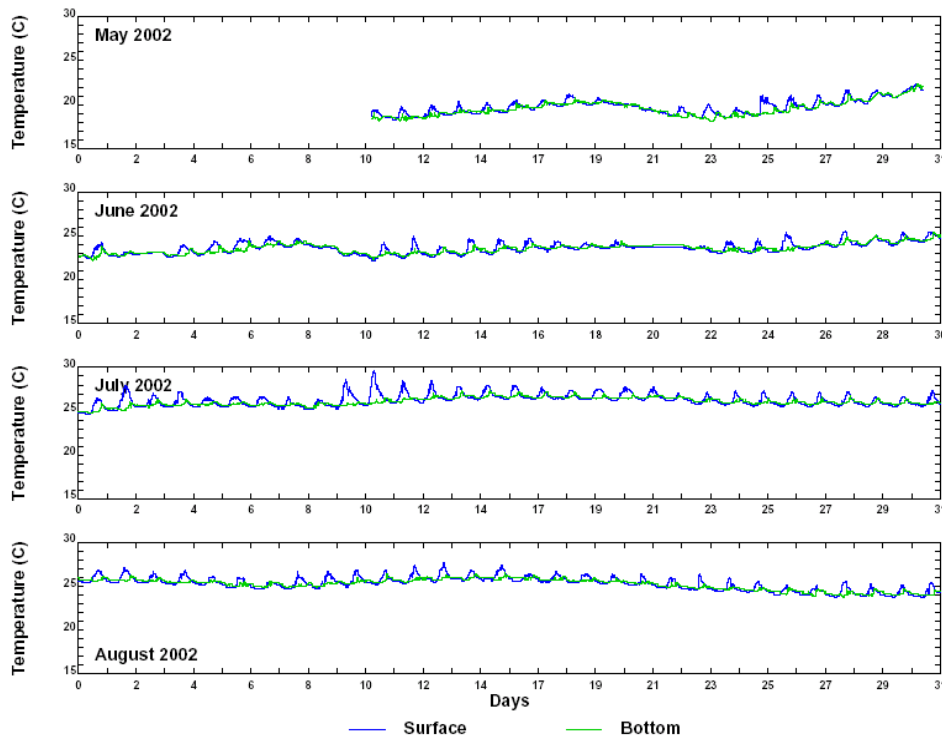
# Temperature Calibration

Red – Data  
Blue - Model



2002 Data near R5

2001 Model near R5

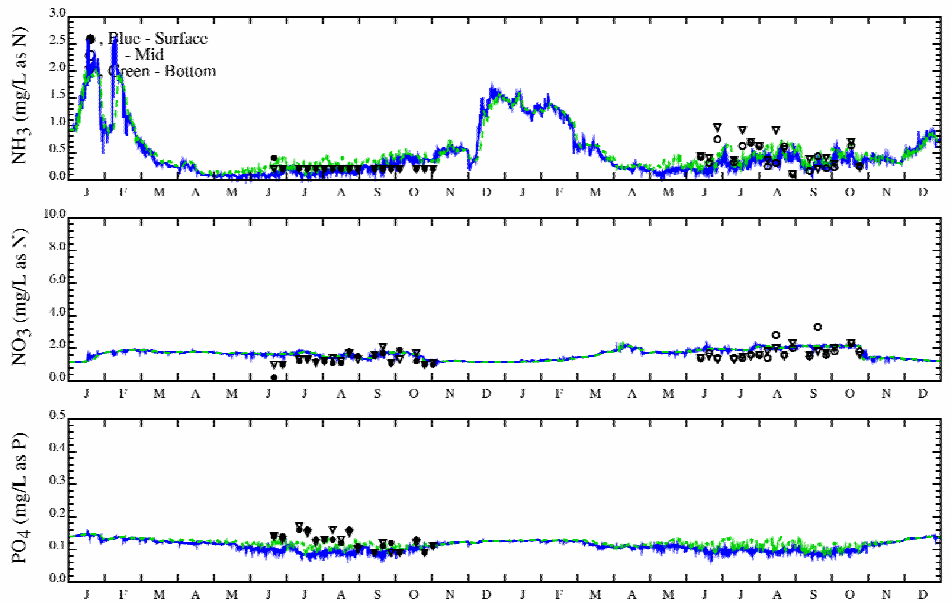
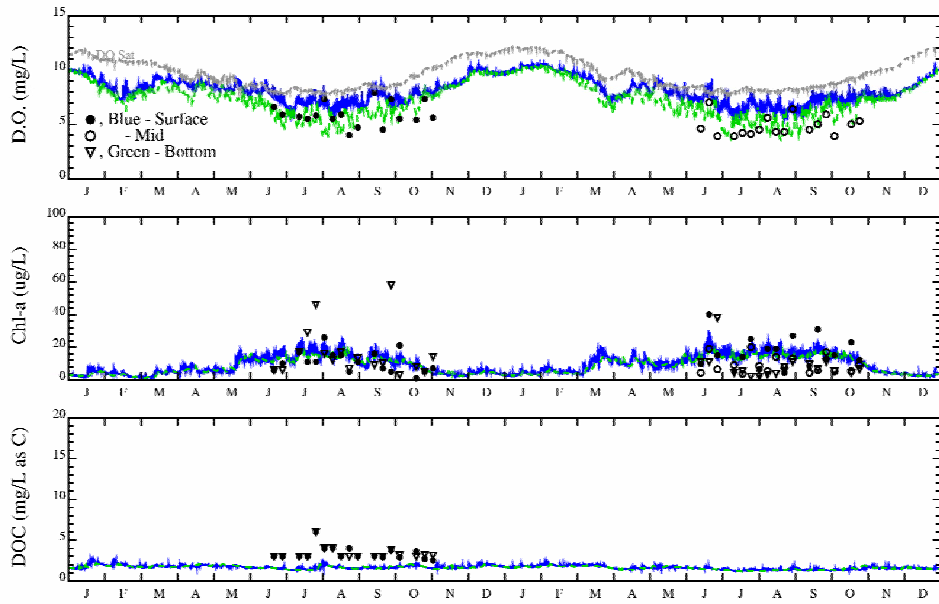




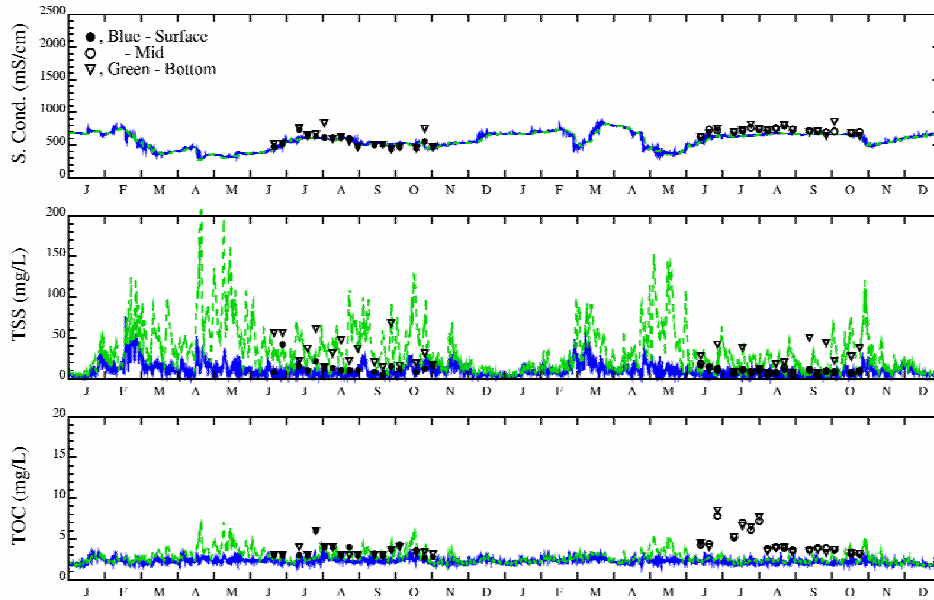
# DWSC Water Quality Modeling

- **Water quality model calibration in progress (needs to be improved):**
  - ◆ **Model output compared to observed DO, BOD, nutrients, chl-a, TSS & EC**
  - ◆ **Focus on reproducing DO stratification & low DO events, algal dynamics**
  - ◆ **Includes a sediment flux submodel**
  - ◆ **Working on post-processor to view output**

# Turning Basin WQ Calibration



San Joaquin River, 2000 & 2001.



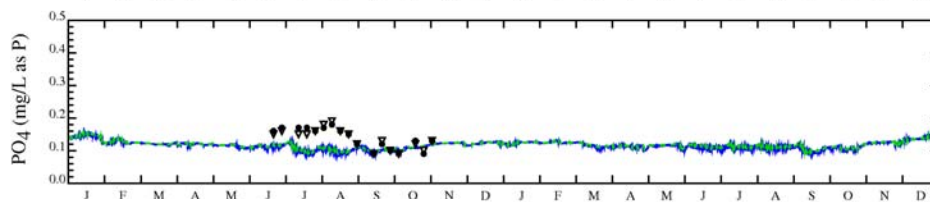
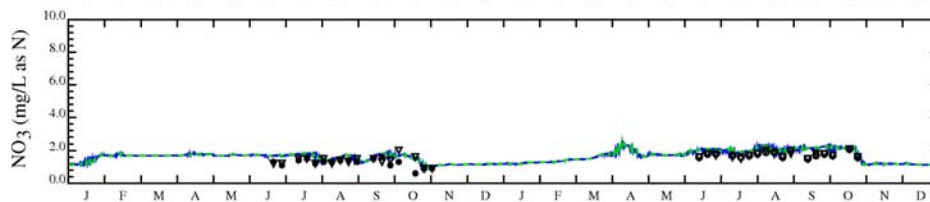
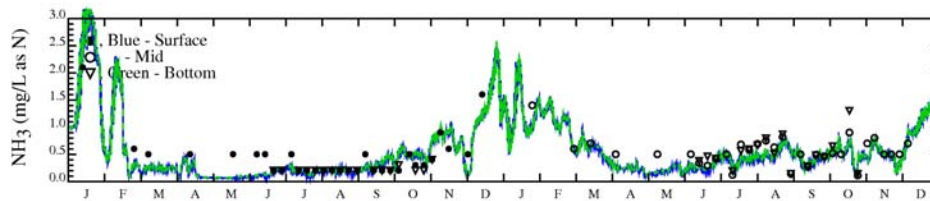
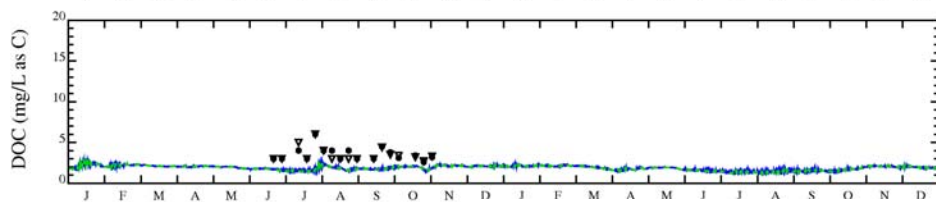
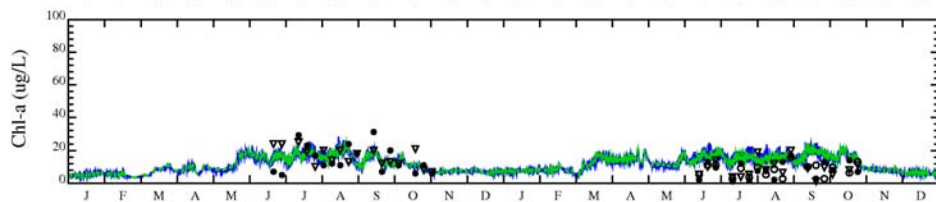
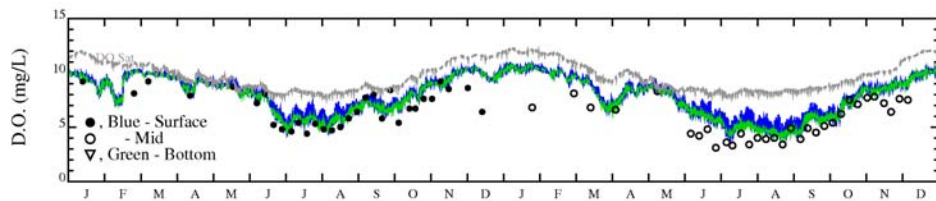
San Joaquin River, 2000 & 2001, Station: SJR at Turning Basin

Station: SJR at Turning Basin

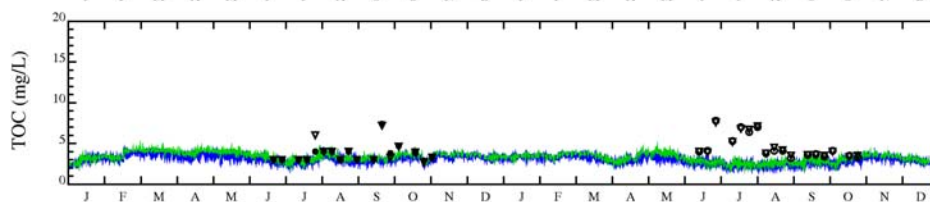
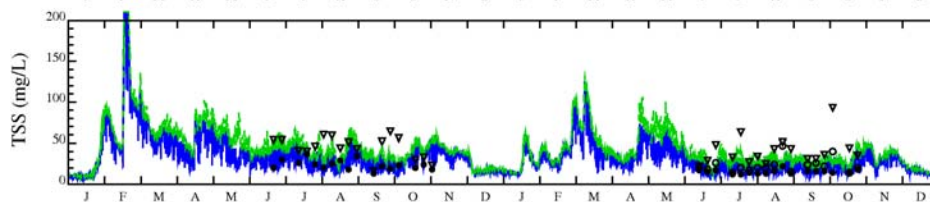
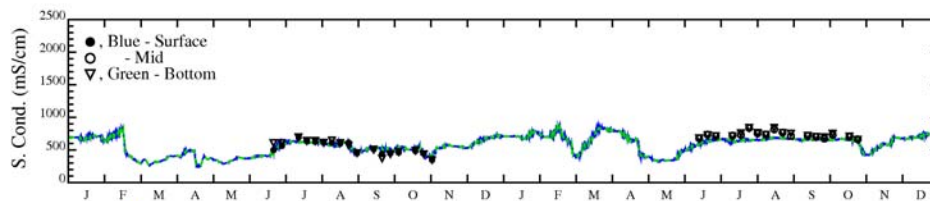
Symbols=Data, Li

Symbols=Data, Li

# R5 WQ Calibration



San Joaquin River, 2000 & 2001,

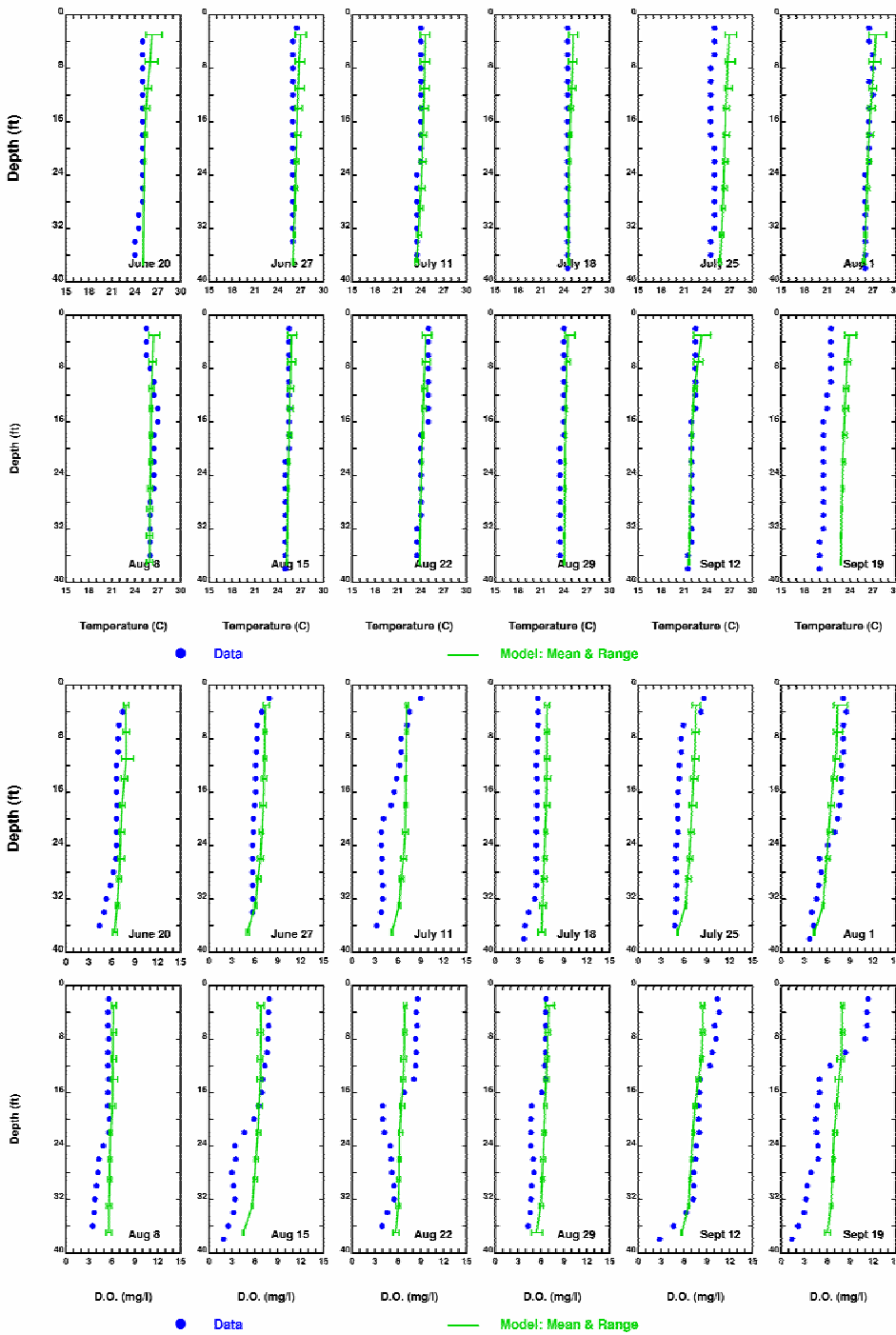


Station: SJR at R5

Symbols=Data, Li

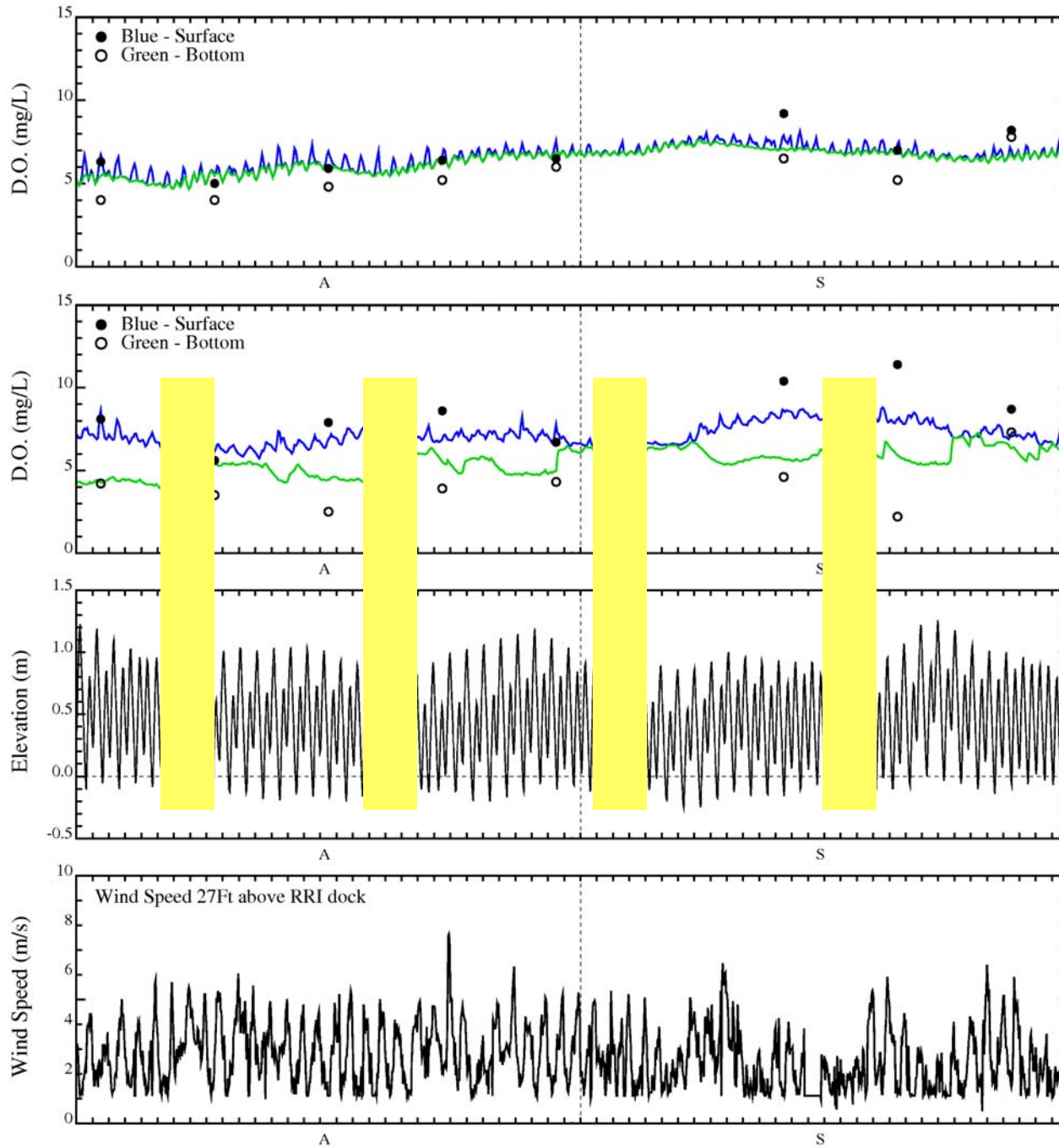
San Joaquin River, 2000 & 2001, Station: SJR at R5

Symbols=Data, Li



San Joaquin River Dissolved Oxygen, Station Turning Basin: June-October 2000

# Turning Basin Vertical DO & Temperature



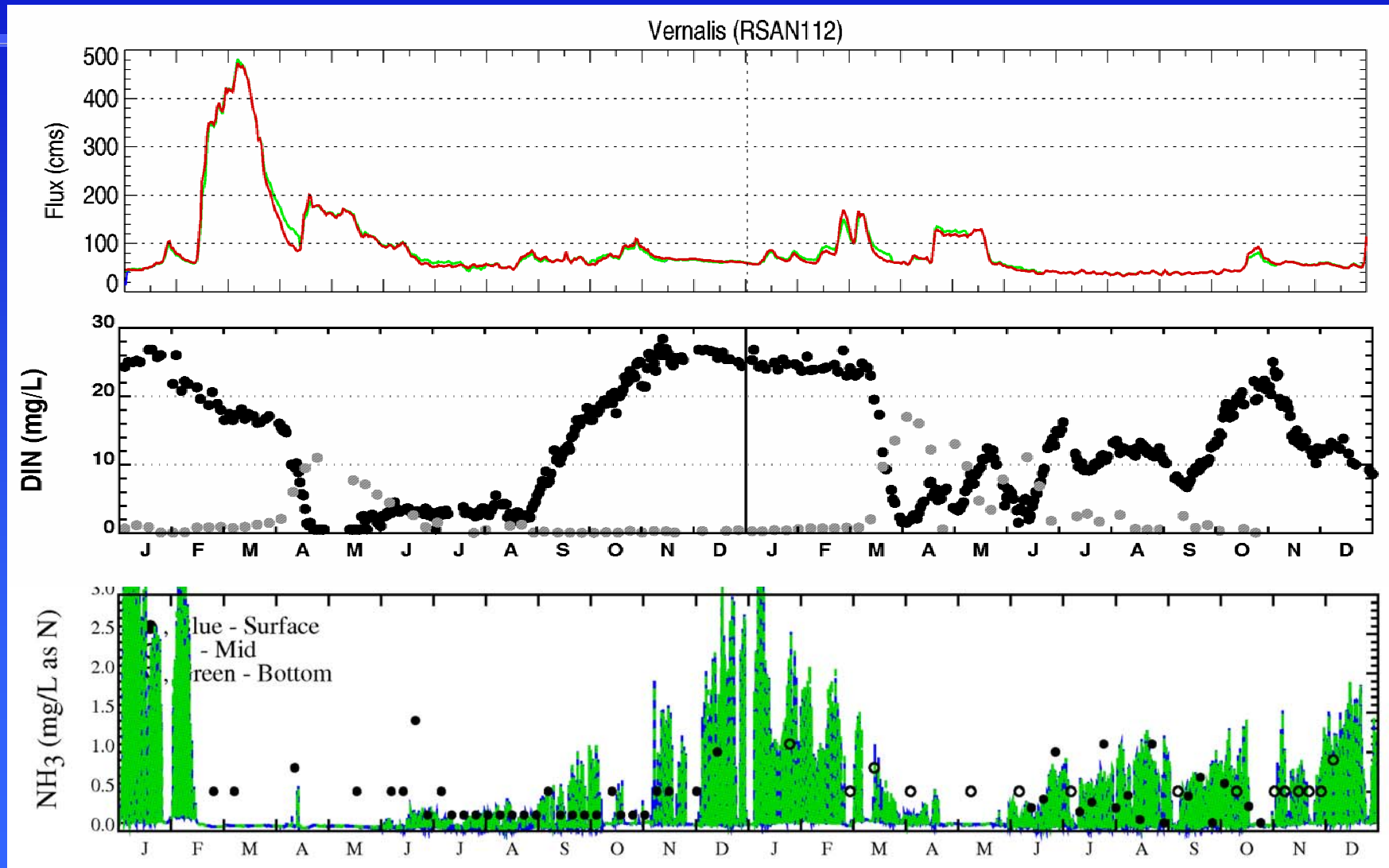
San Joaquin River, 2000 Station: Turning Basin

Symbols=Data, Li

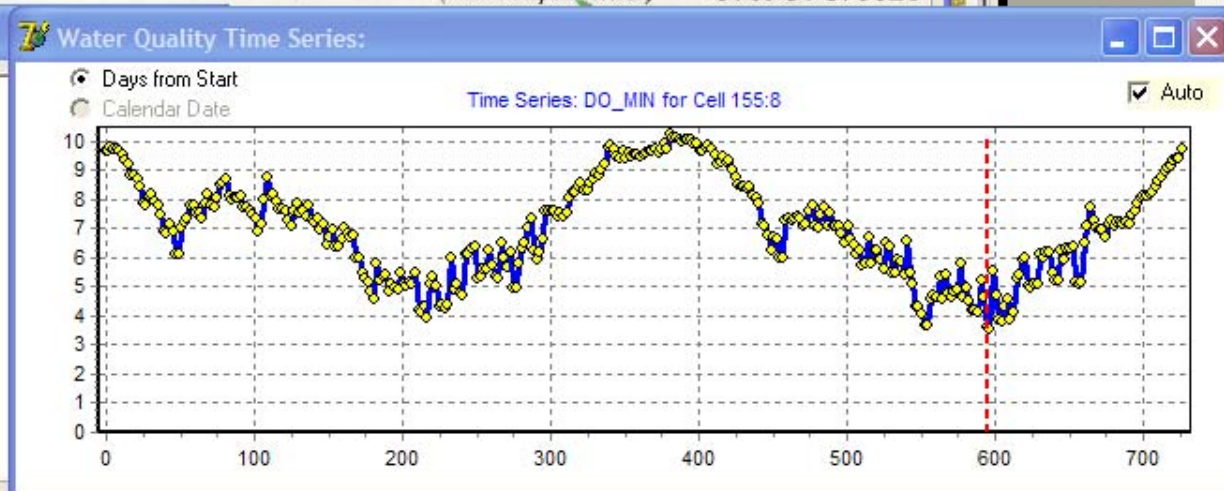
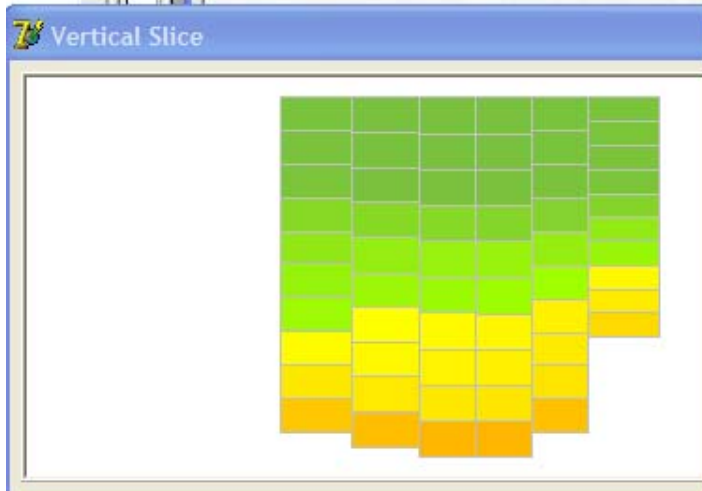
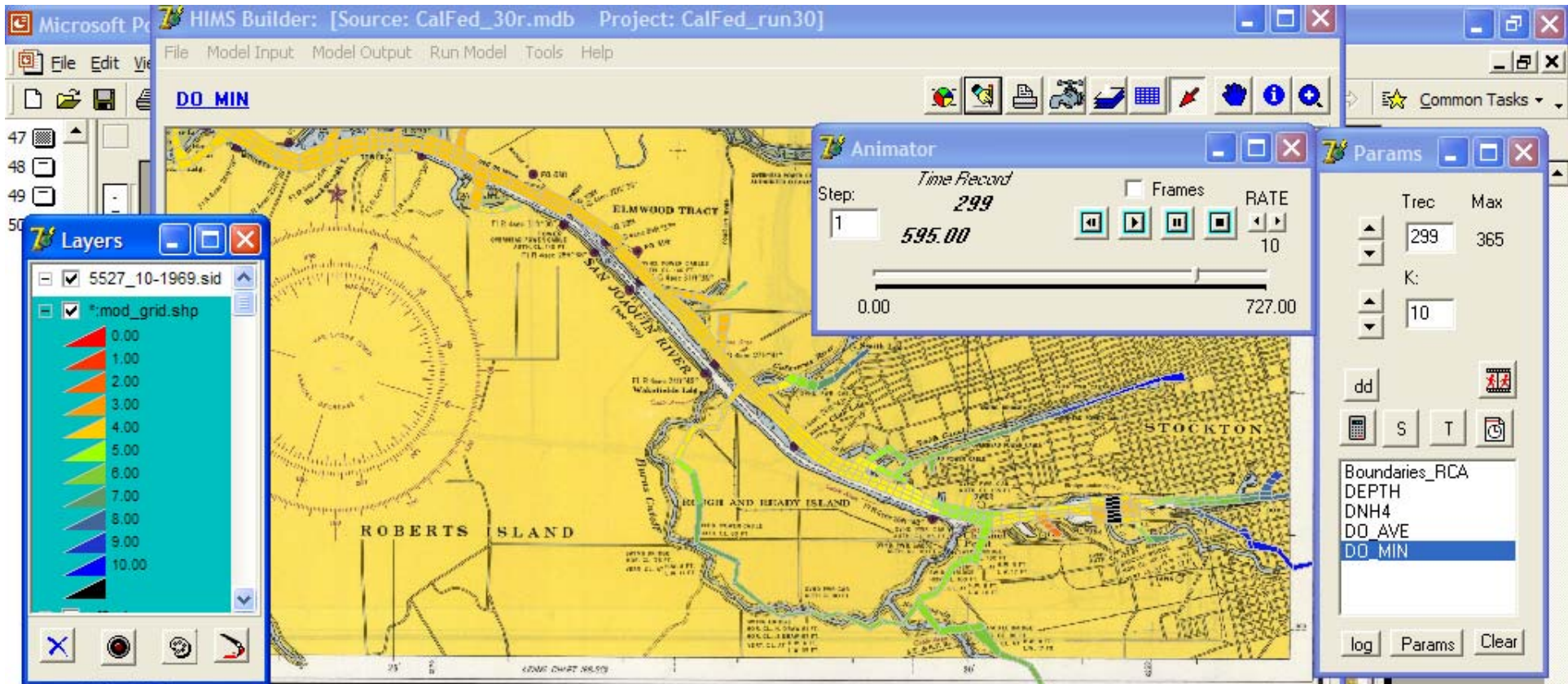
# Stratification & Diurnal DO Variation

- ◆ Spring/Neap
- ◆ Stratified/Mixed

# RWCF & R2 NH3









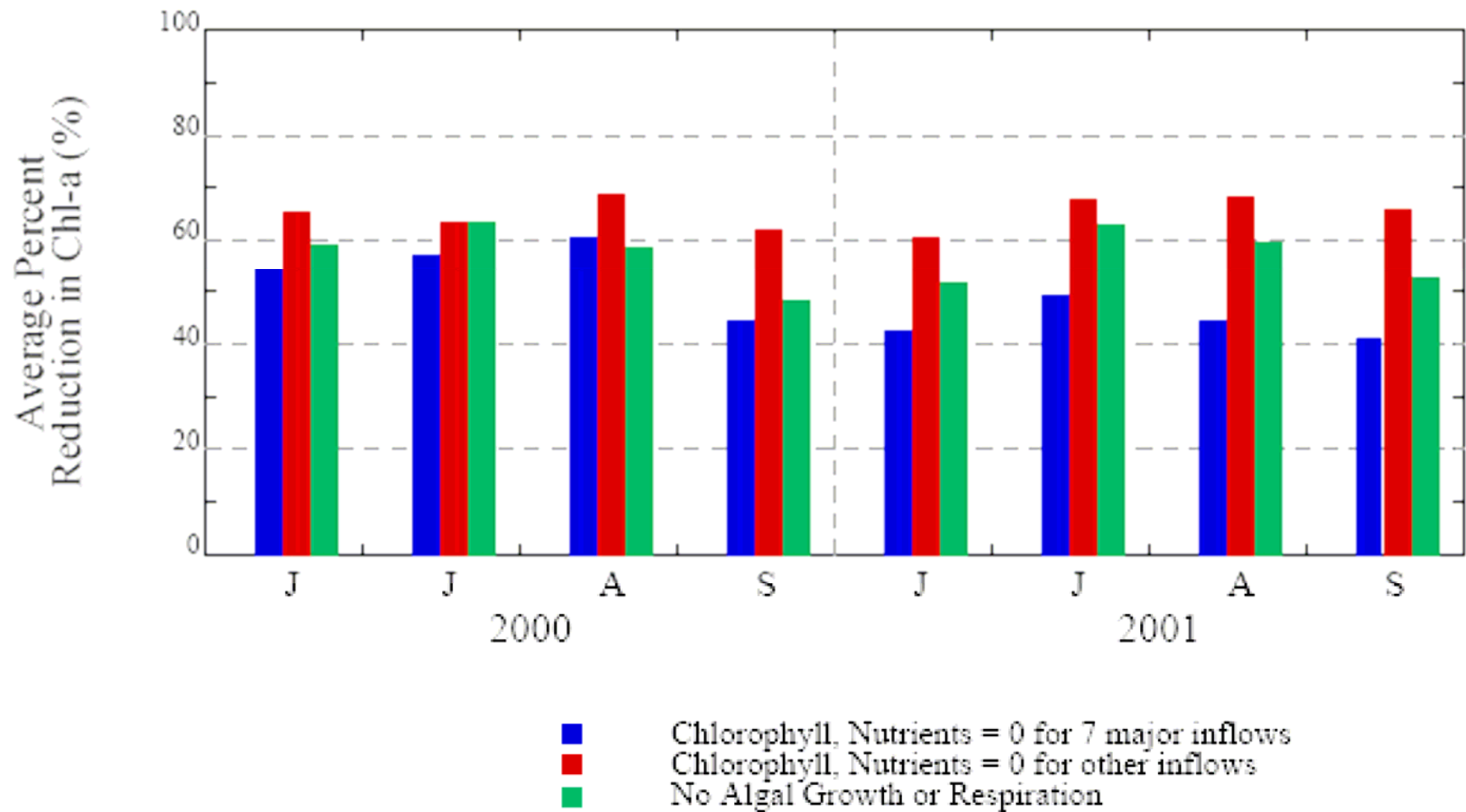
# Summary

- **DWSC WQ Model still needs work to improve DO calibration (spatially & vertically)**
  - ◆ **Upstream POC/DOC, nutrients, oxygen demands**
- **Provides finer temporal & vertical resolution**
  - ◆ **Stratification, diurnal variation, DO components**
- **Can be used to assess DO aeration device impacts (e.g., location, spreading, benefit)**
- **Links upstream & downstream water quality models for assessing management alternatives**

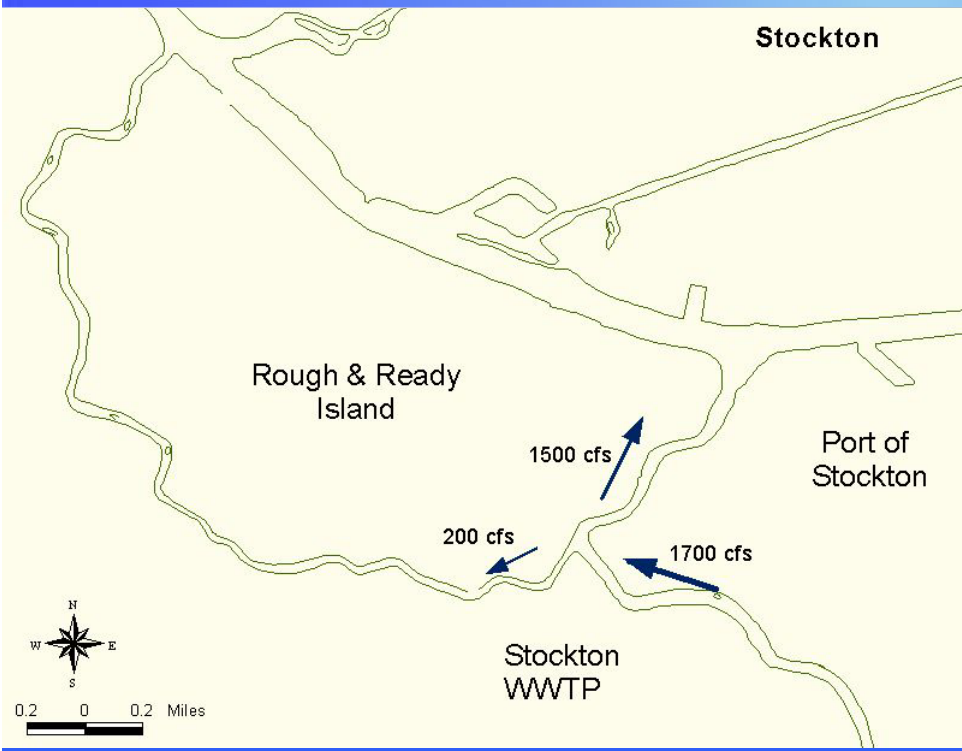
# Questions & Answers

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**Mahwah, NJ**  
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[lderosa@hydroqual.com](mailto:lderosa@hydroqual.com)

# Chl-a “Unit Response” at Vernalis (Summer 2000 & 2001)

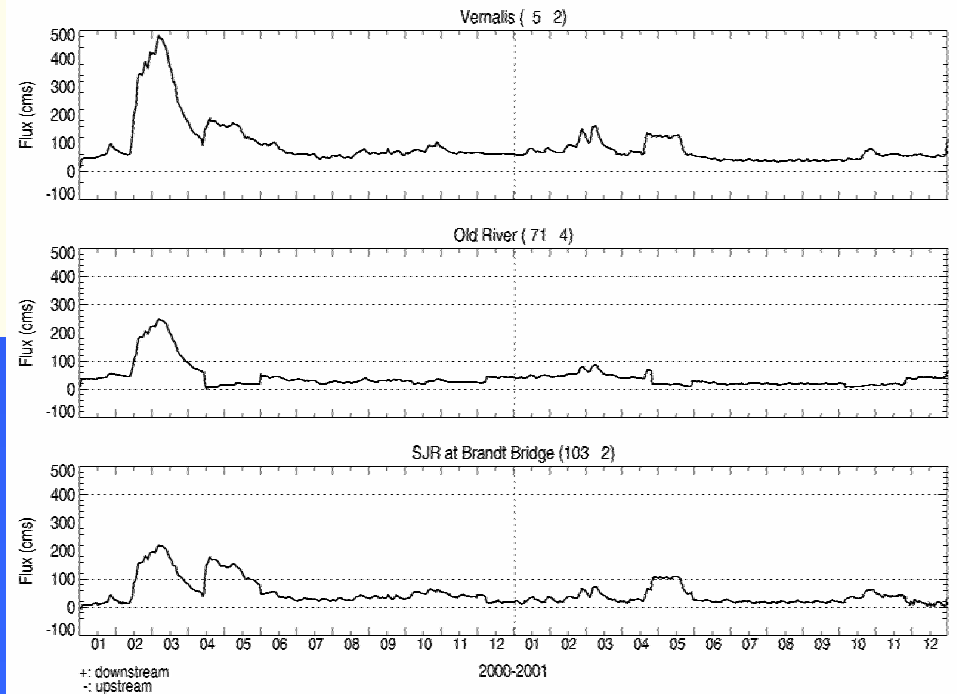


# Flow Splits

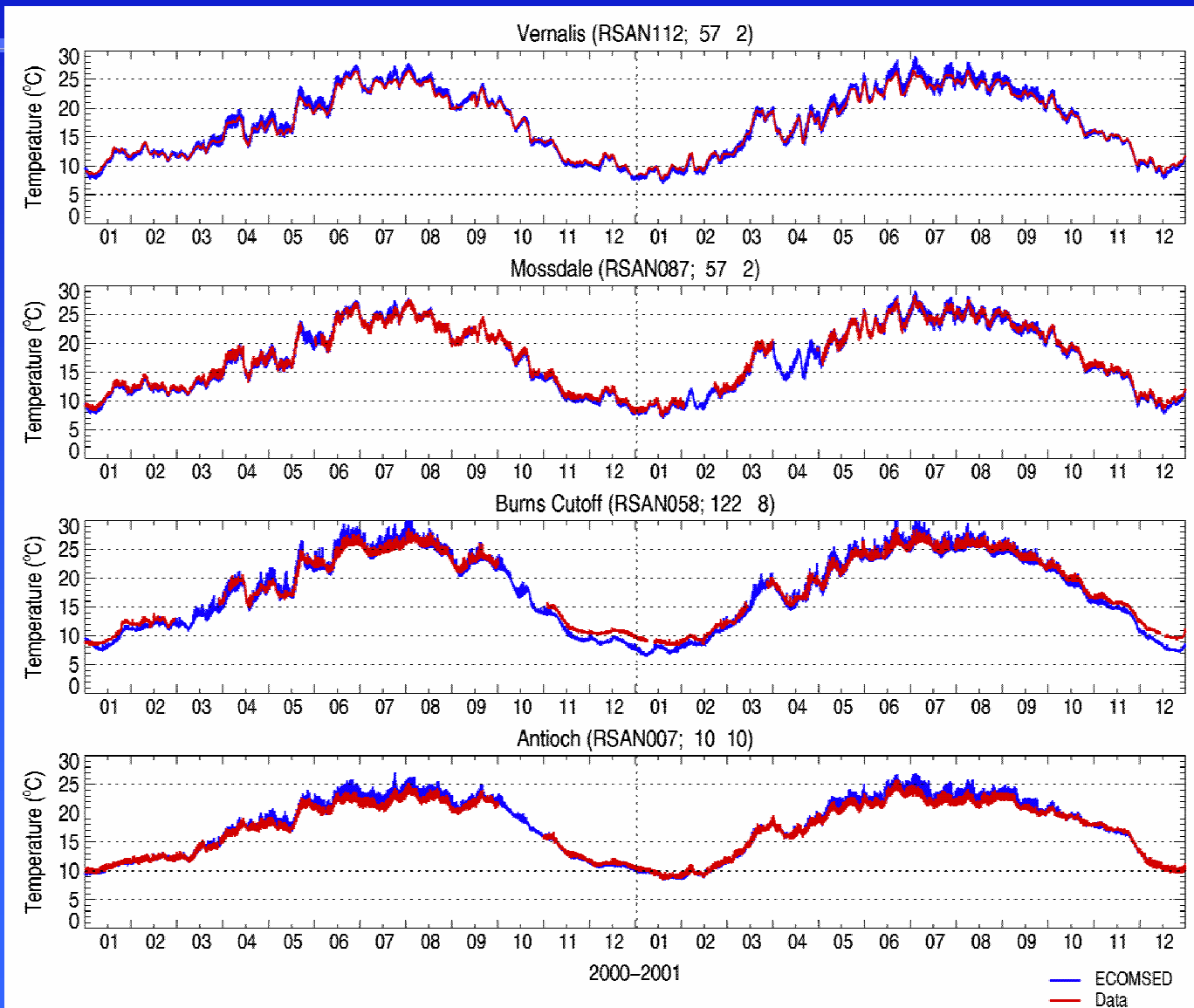


## Burns Cutoff

## SJR/Old River

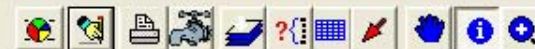


# Temperature Calibration





DEPTH



Model Space

Flash Z/P Legend

