Delta Salinity Simulation with DSM2-GTM

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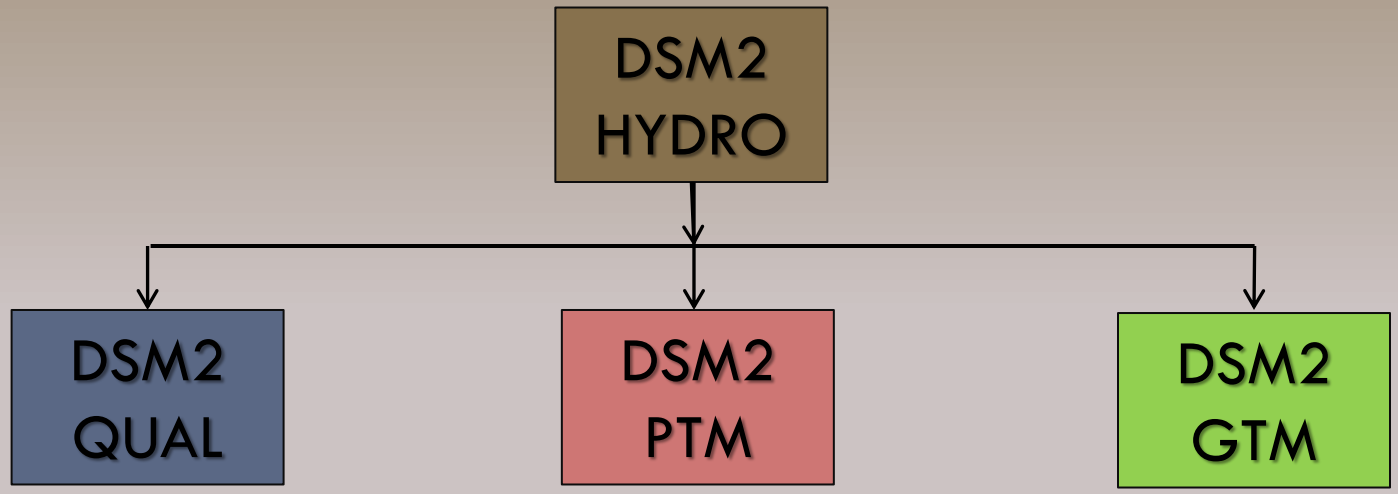
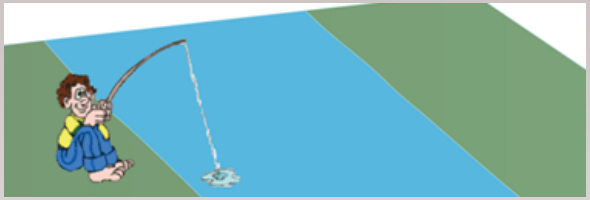
What is GTM?

➔ **G**eneral **T**ransport **M**odel



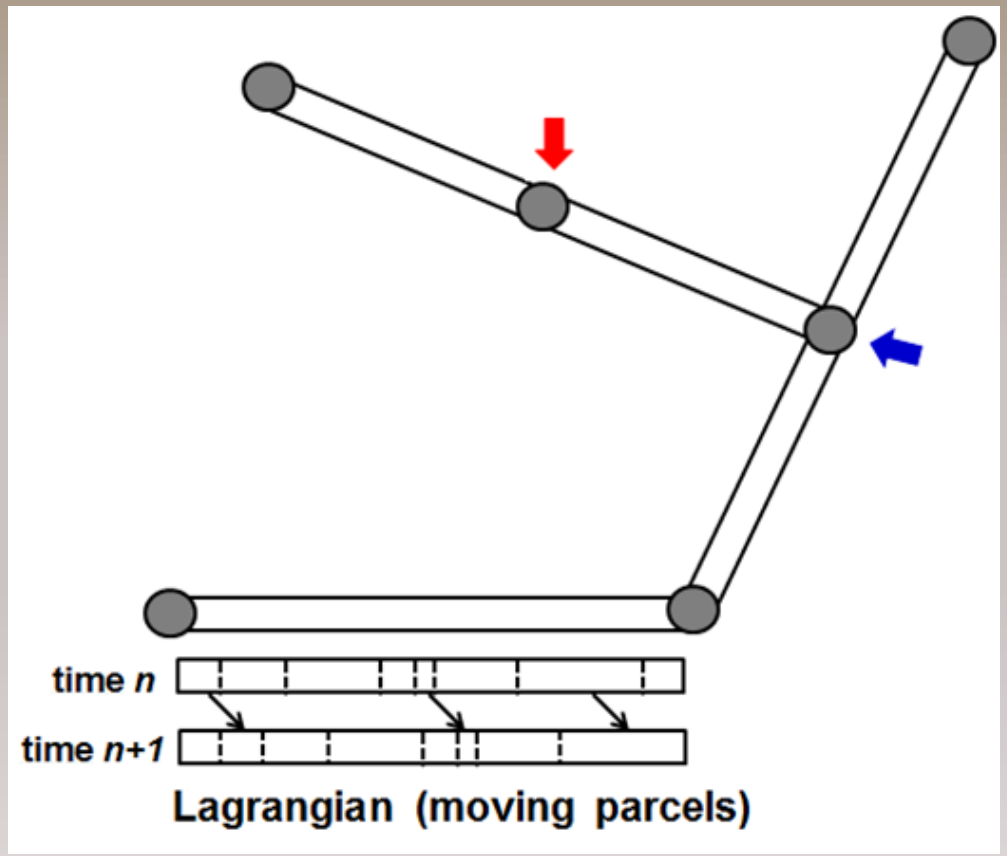
Lagrangian

Eulerian

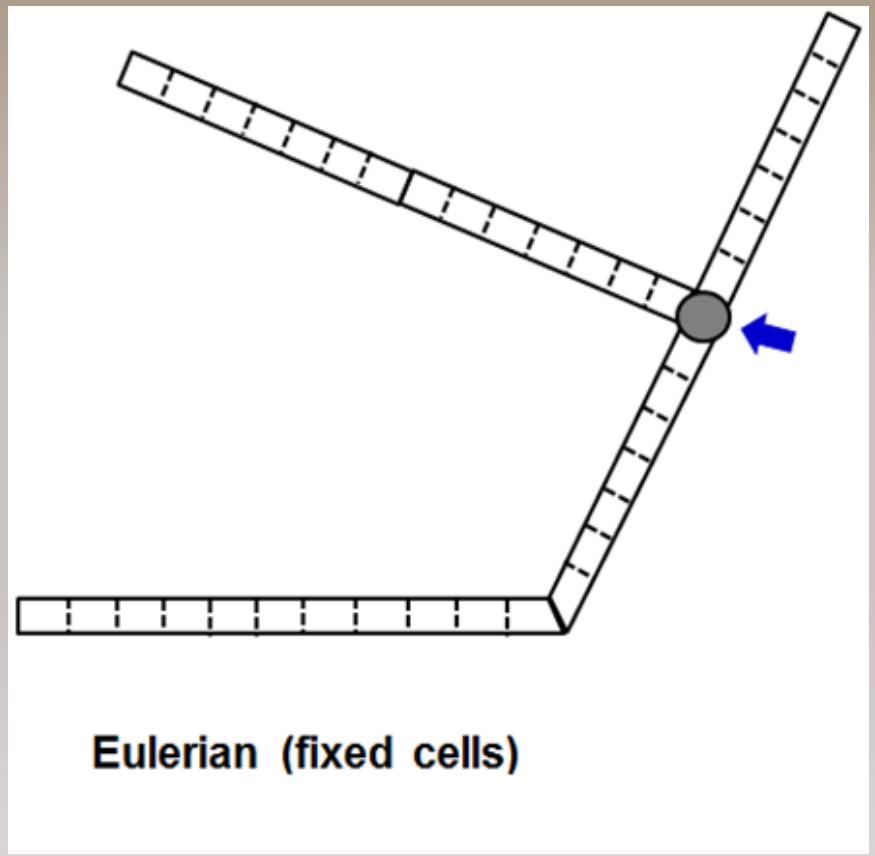


Model Grids

- **DSM2-QUAL (Lagrangian)**



- **DSM2-GTM (Eulerian)**



Current DSM2-QUAL

- Lagrangian frame of reference
  - → Hard to interface with other models
  - → Hard to maintain and implement

Benefits of DSM2-GTM

- Extensibility
  - Sediment Module
  - Dissolved Oxygen Module
  - Mercury Cycling Module
- Visualization
- In-line with DSM2-HYDRO

New Eulerian Transport Scheme

- A Predictor-Corrector Operator Splitting Approach for a single channel network has been developed and tested by:

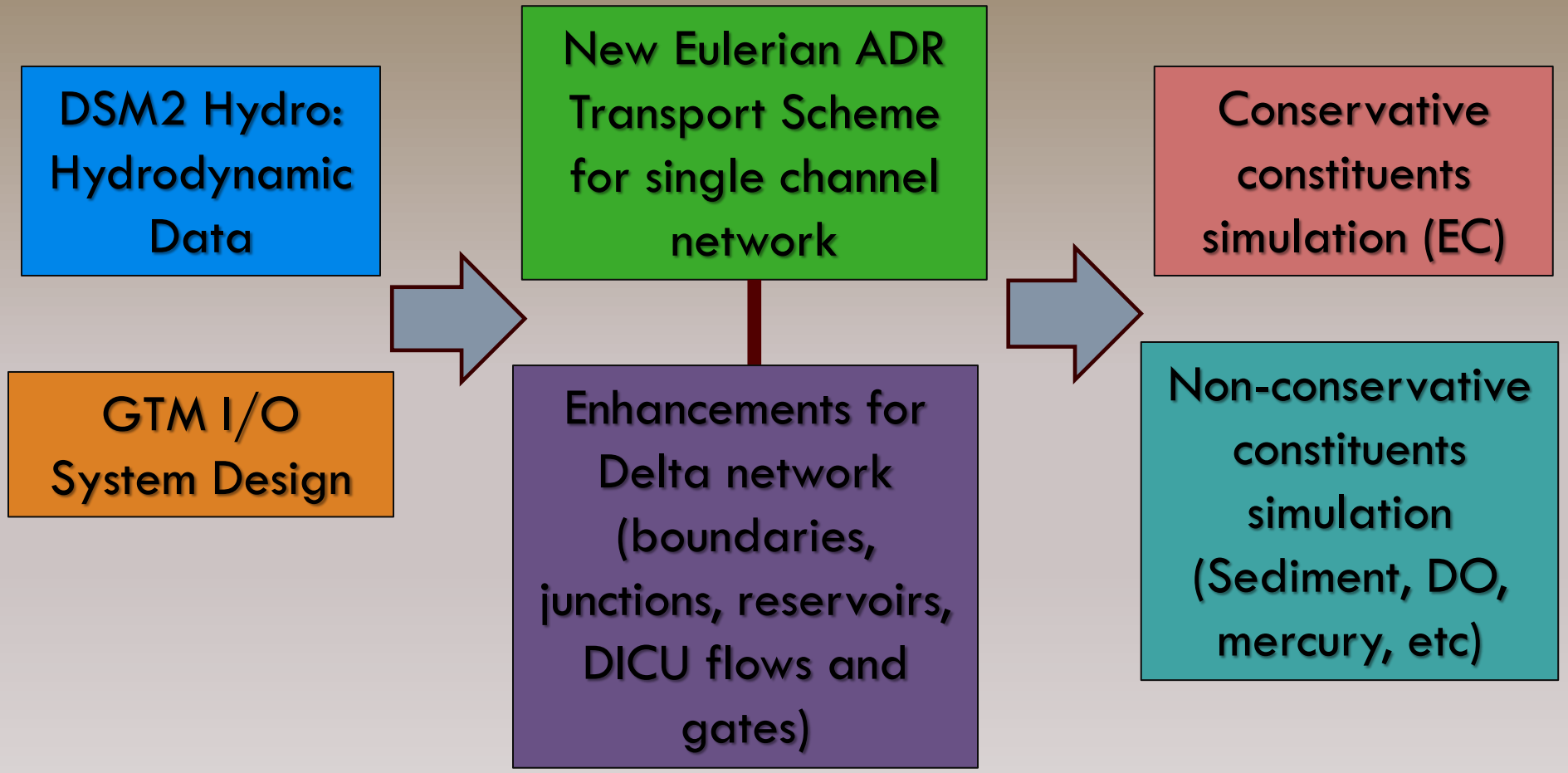
Eli Ateljevich (DWR)

Fabian A. Bombardelli (UC Davis)

Kaveh Zamani (UC Davis)

Jamie Anderson (DWR)

Work Plan for GTM Development



1. DSM2-HYDRO: new HYDRO tidefile

- Spatial: Node → Computational points

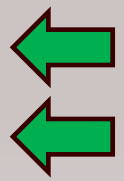
- Temporal: Theta-averaged → Instantaneous

	Current	New
time *t*	$\theta \cdot X_t + (1-\theta) \cdot X_{t-1}$	X_t

2. GTM Input/Output System Design

- Easy transition from QUAL to GTM

```
SCALAR
NAME                    VALUE
  : :                     : : :
gtm_dx                  1000.0
gtm_dt                   5min
END
```



Minimum change in qual.inp

3. GTM Development – Delta Network

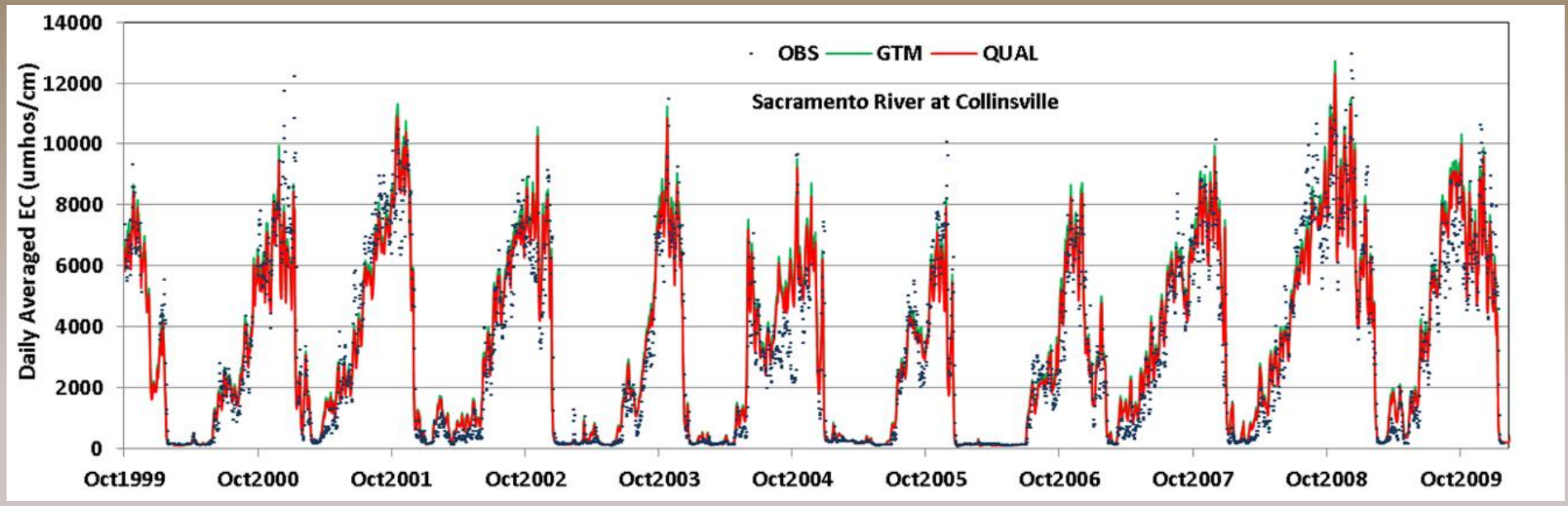
- Add sub time stepping if needed
- Courant-Friedrichs-Lewy (CFL) condition

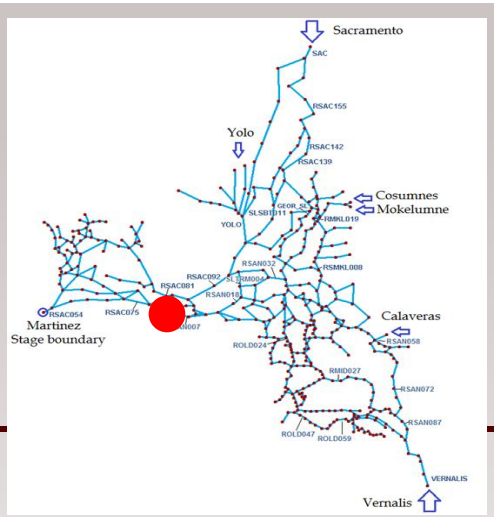
$$CFL = \frac{u\Delta t}{\Delta x} \leq C_{max}$$

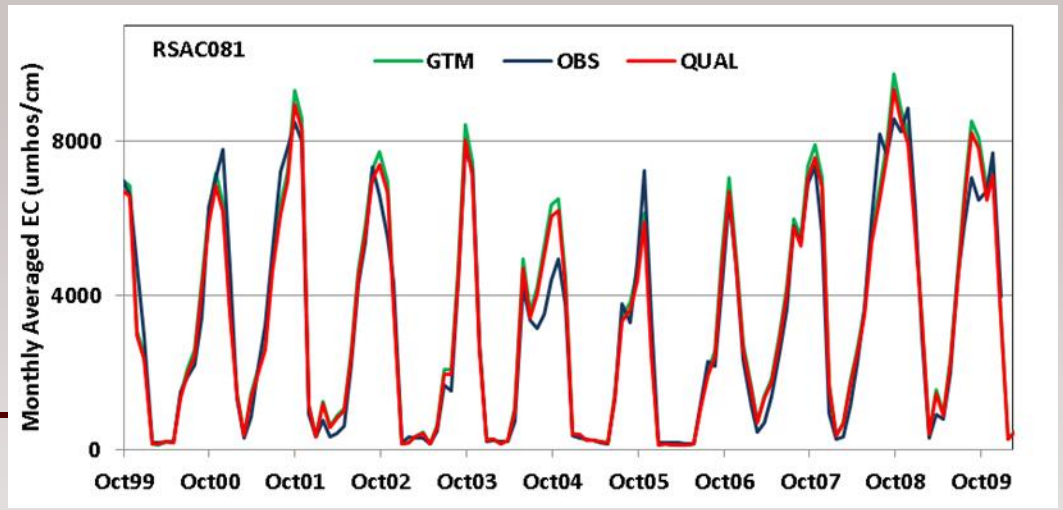
4. Delta EC Simulation

- Used historical setup
- Used dispersion coefficients from Version 8.1 calibration
- Simulation period: Oct 1999 to Oct 2012

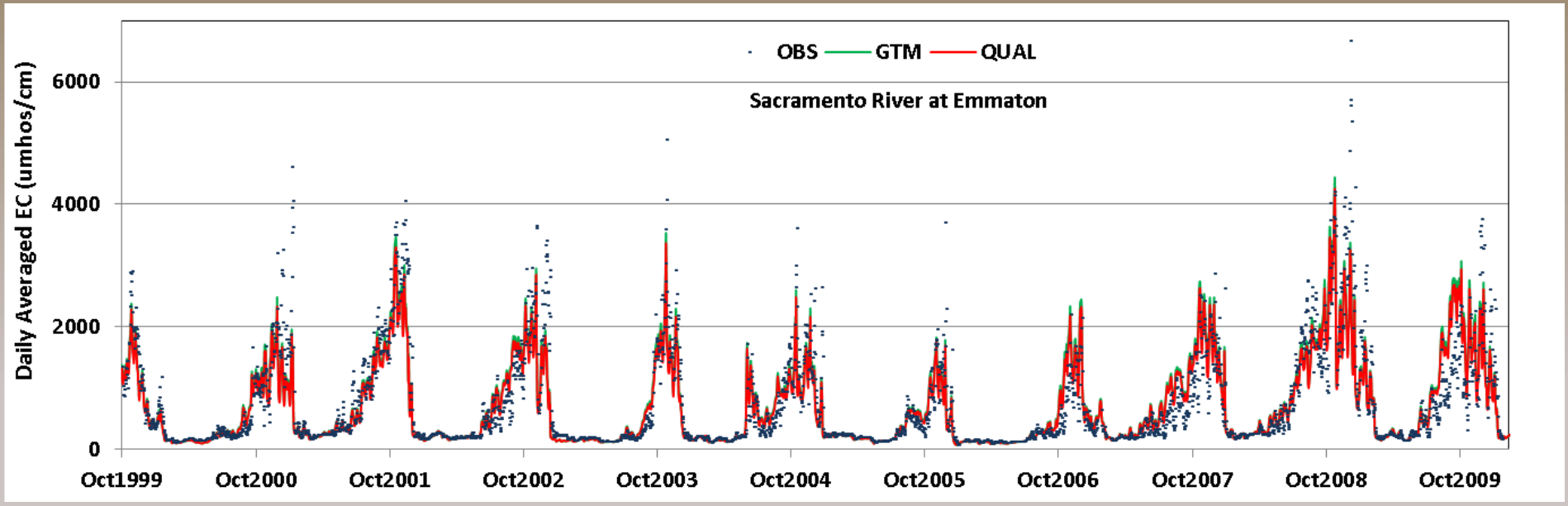
EC results comparison at Collinsville

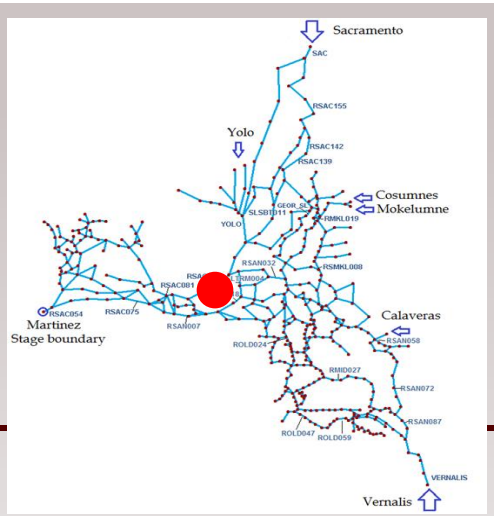


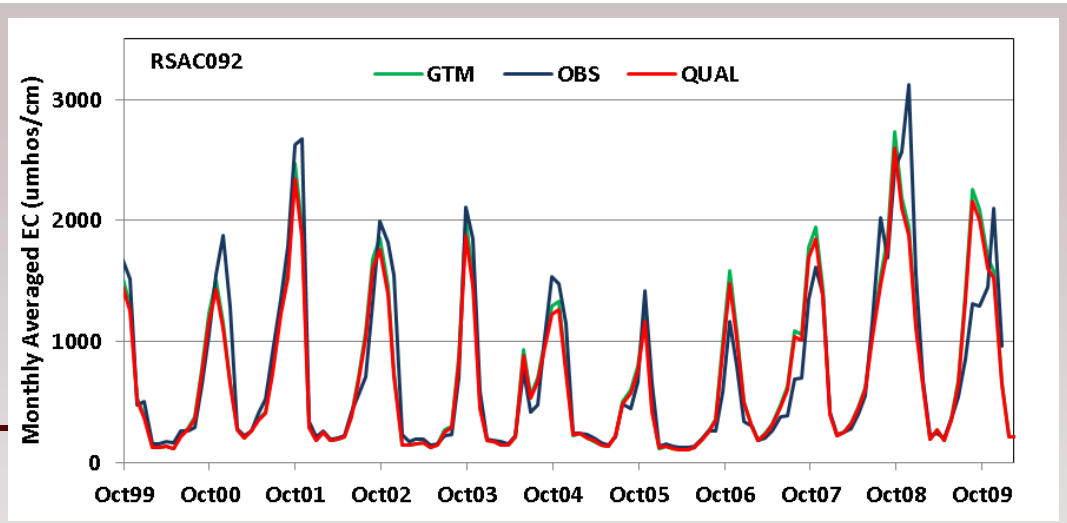




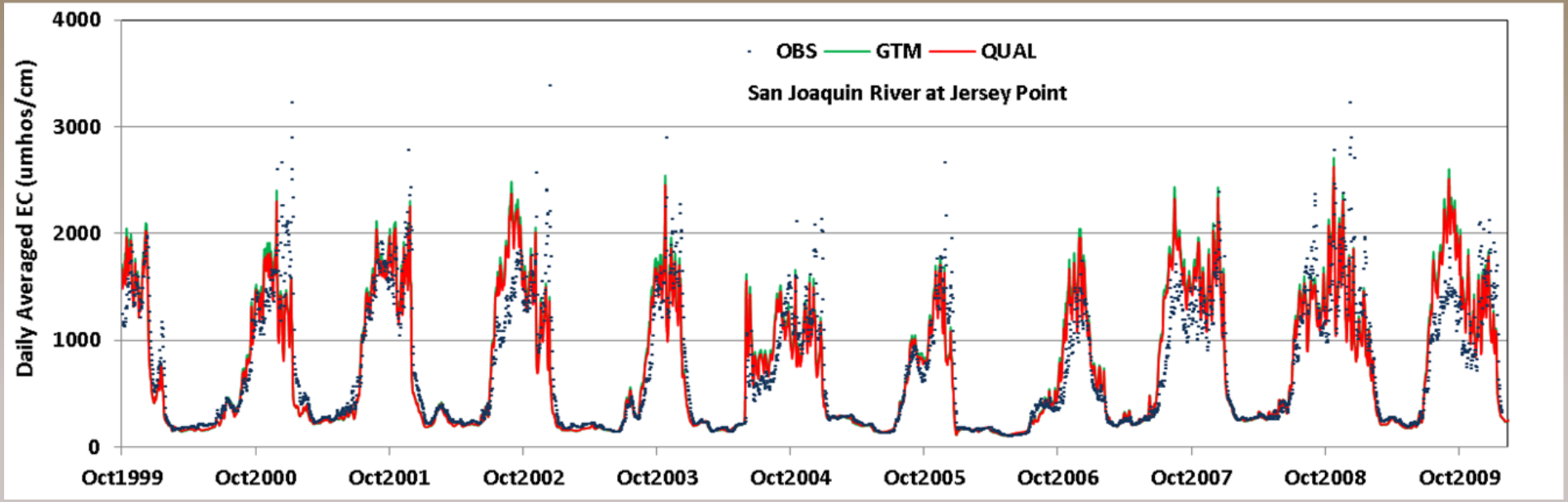
EC results comparison at Emmaton

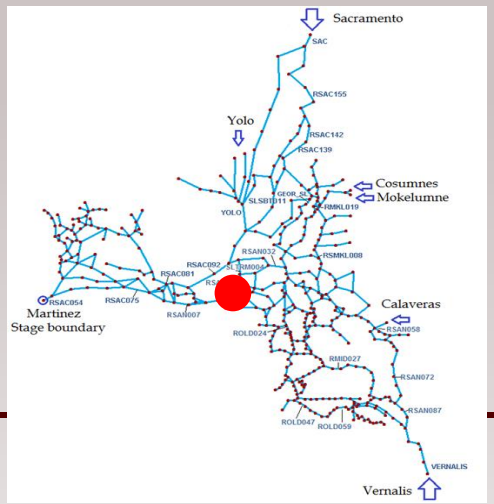


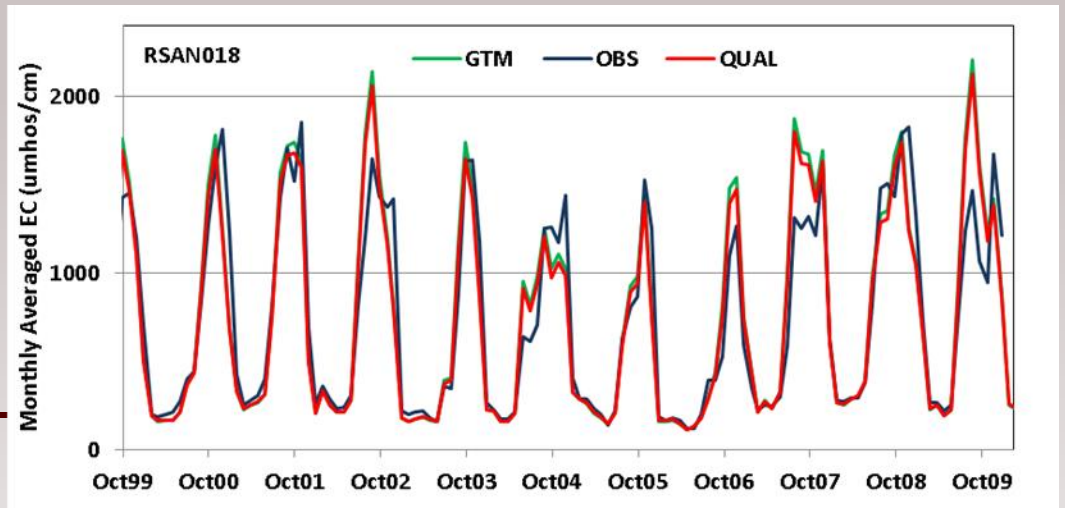




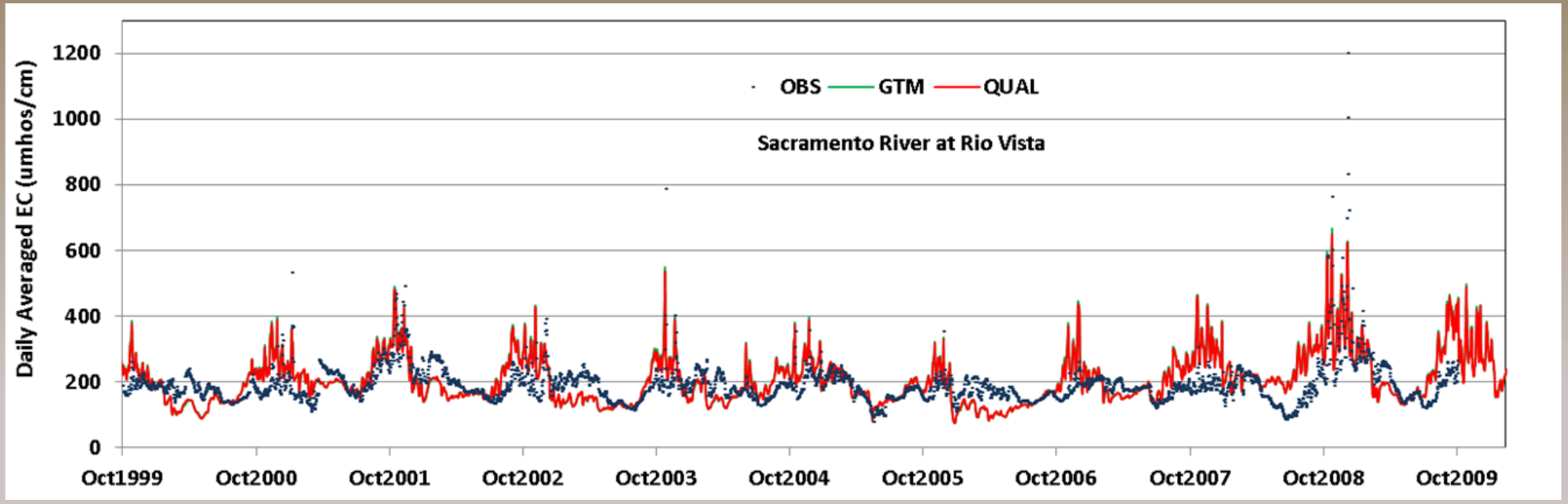
EC results comparison at Jersey Point

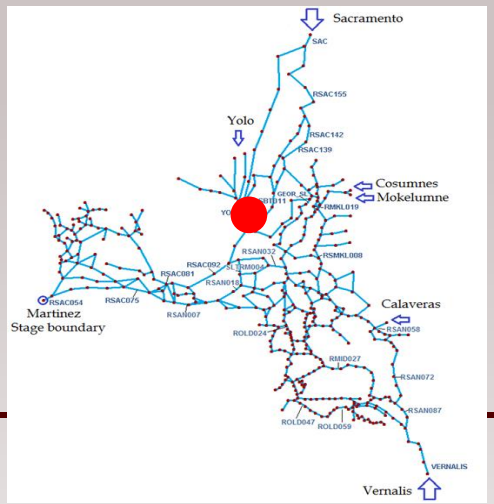


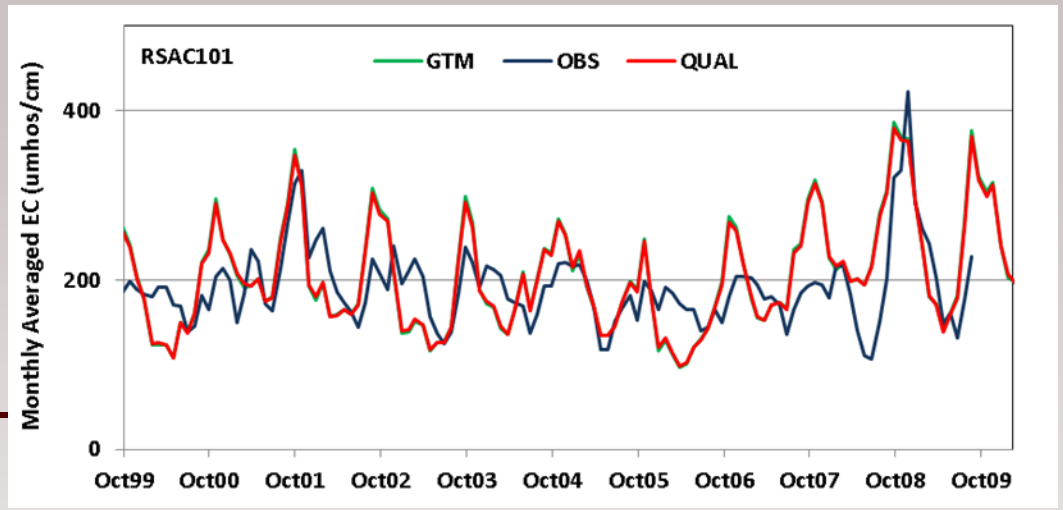




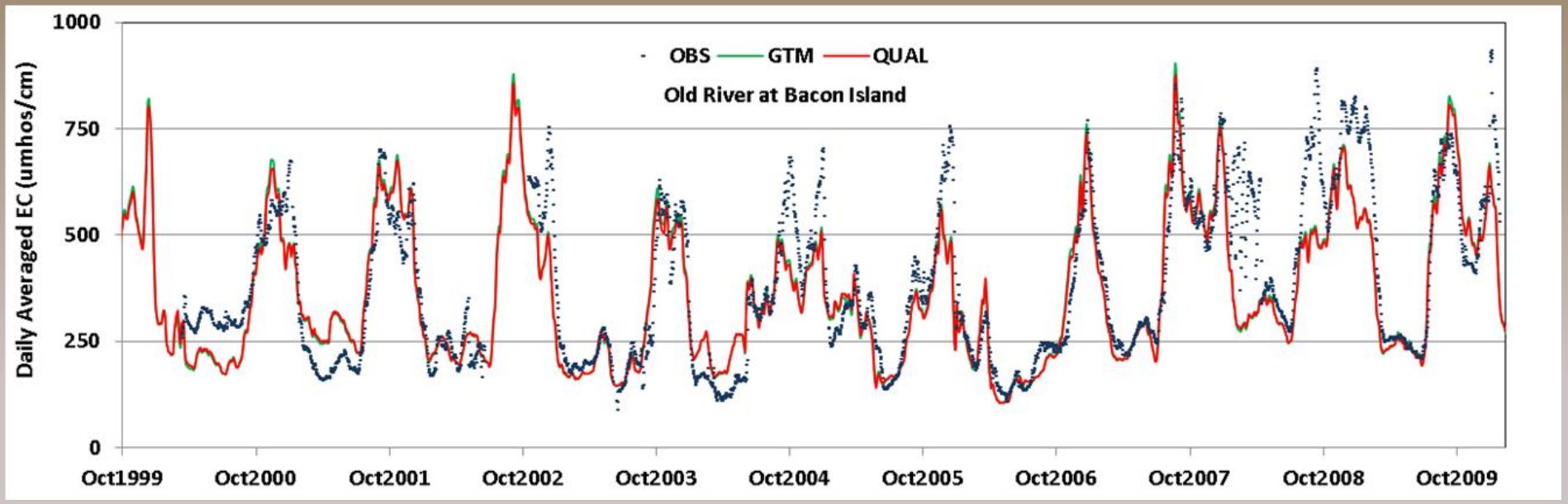
EC results comparison at Rio Vista

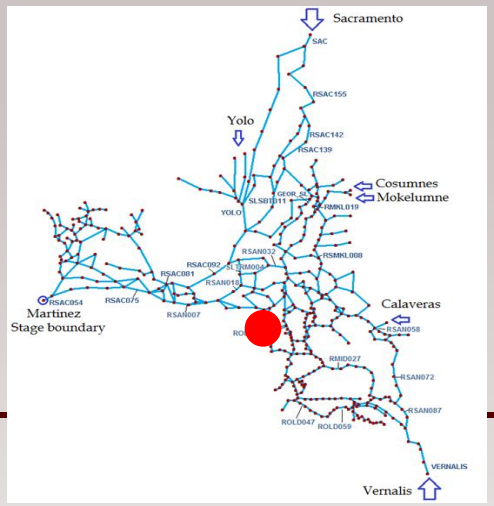


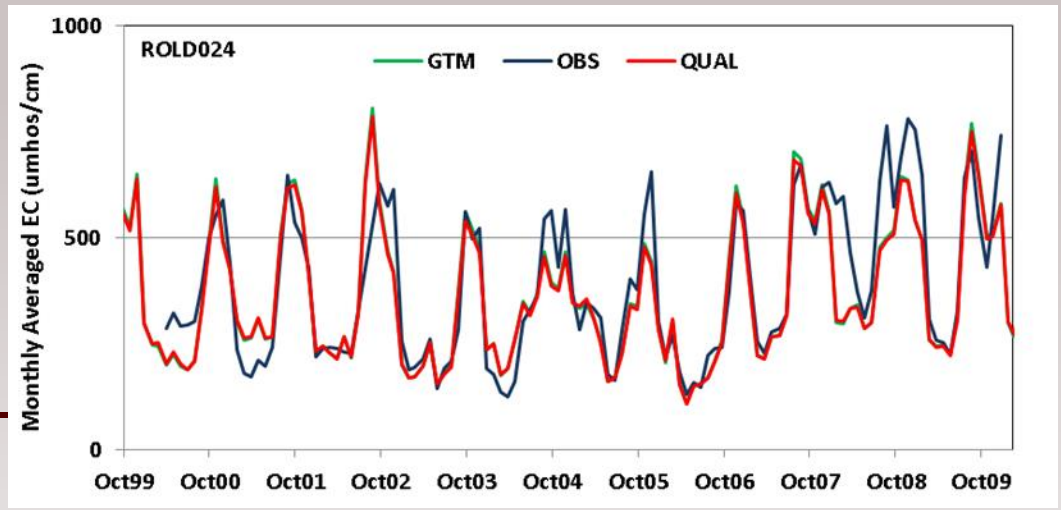




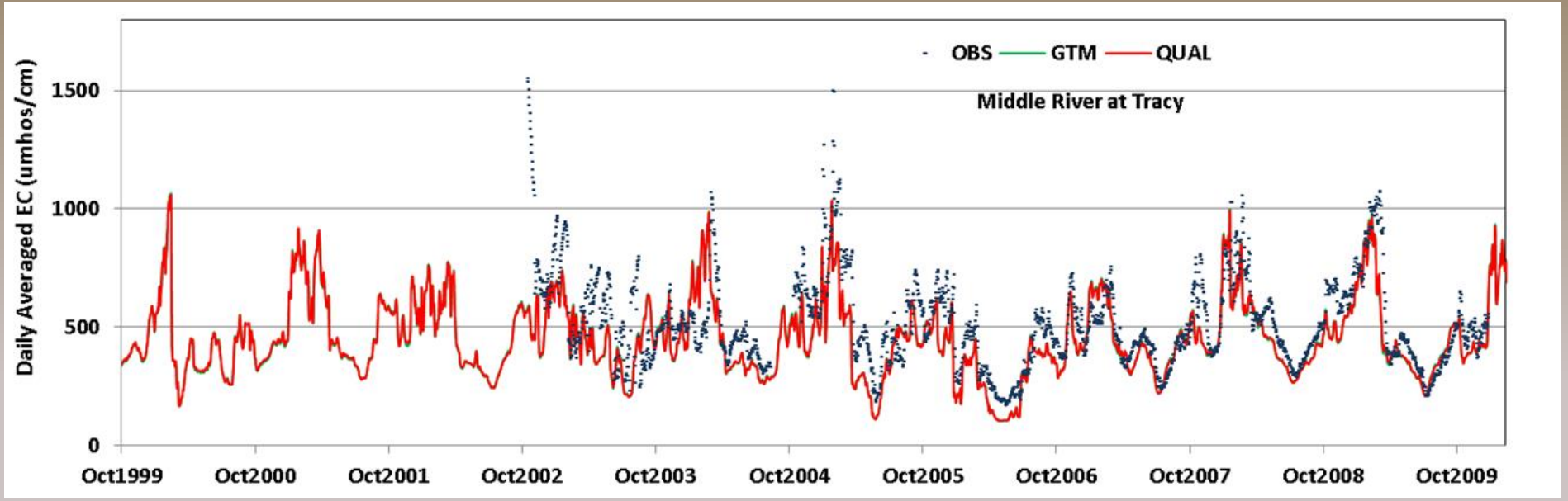
EC results comparison at Old River at Bacon Island

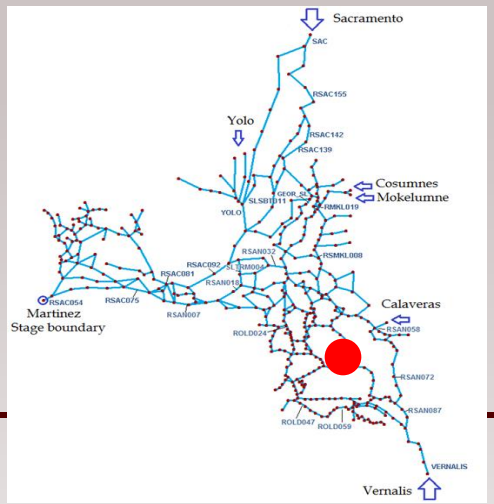


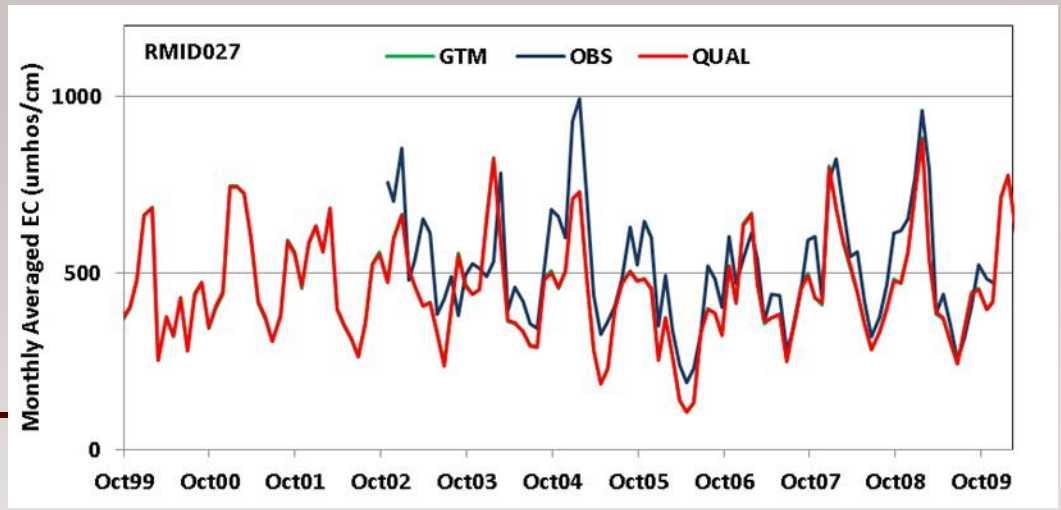




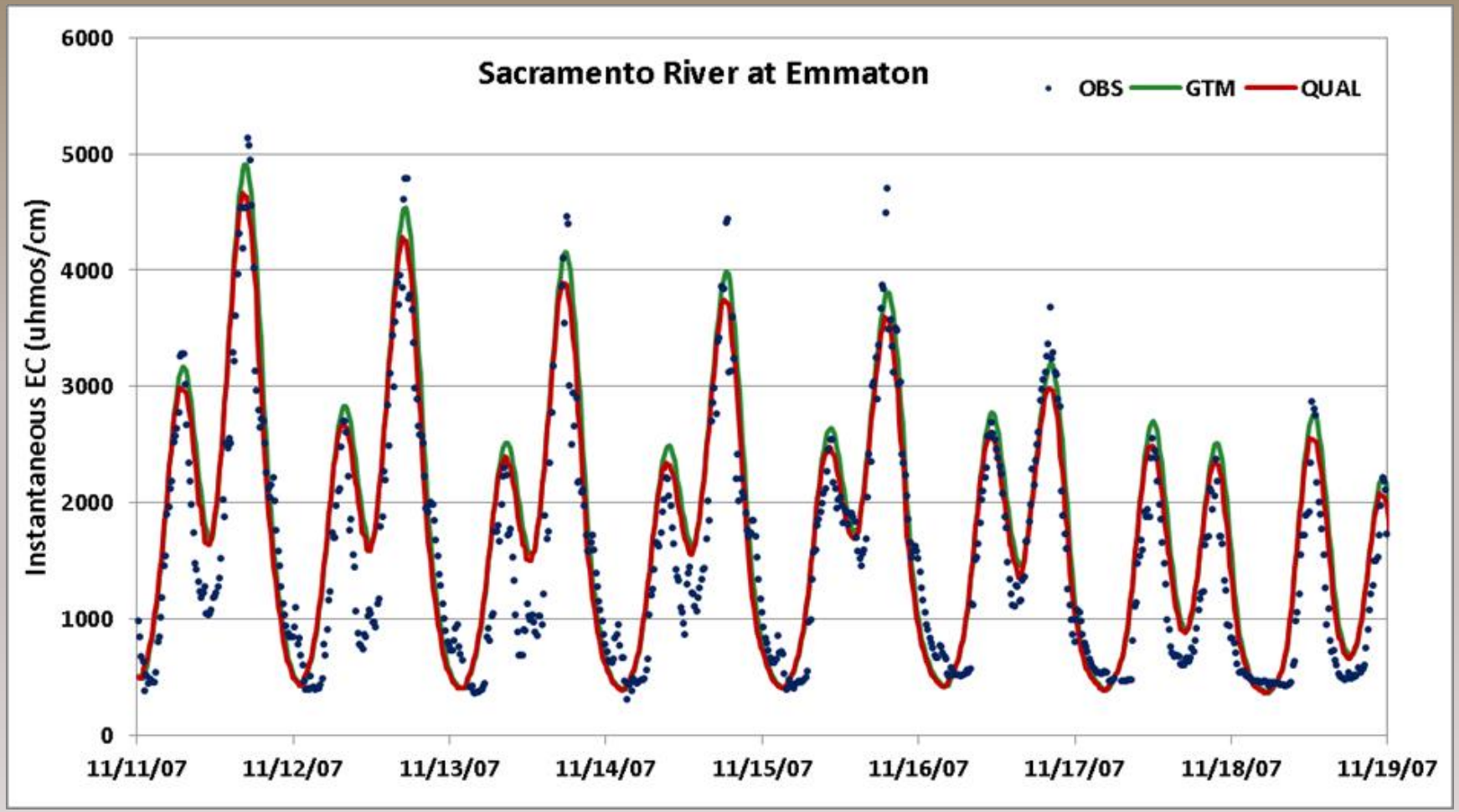
EC results comparison at Middle River at Tracy



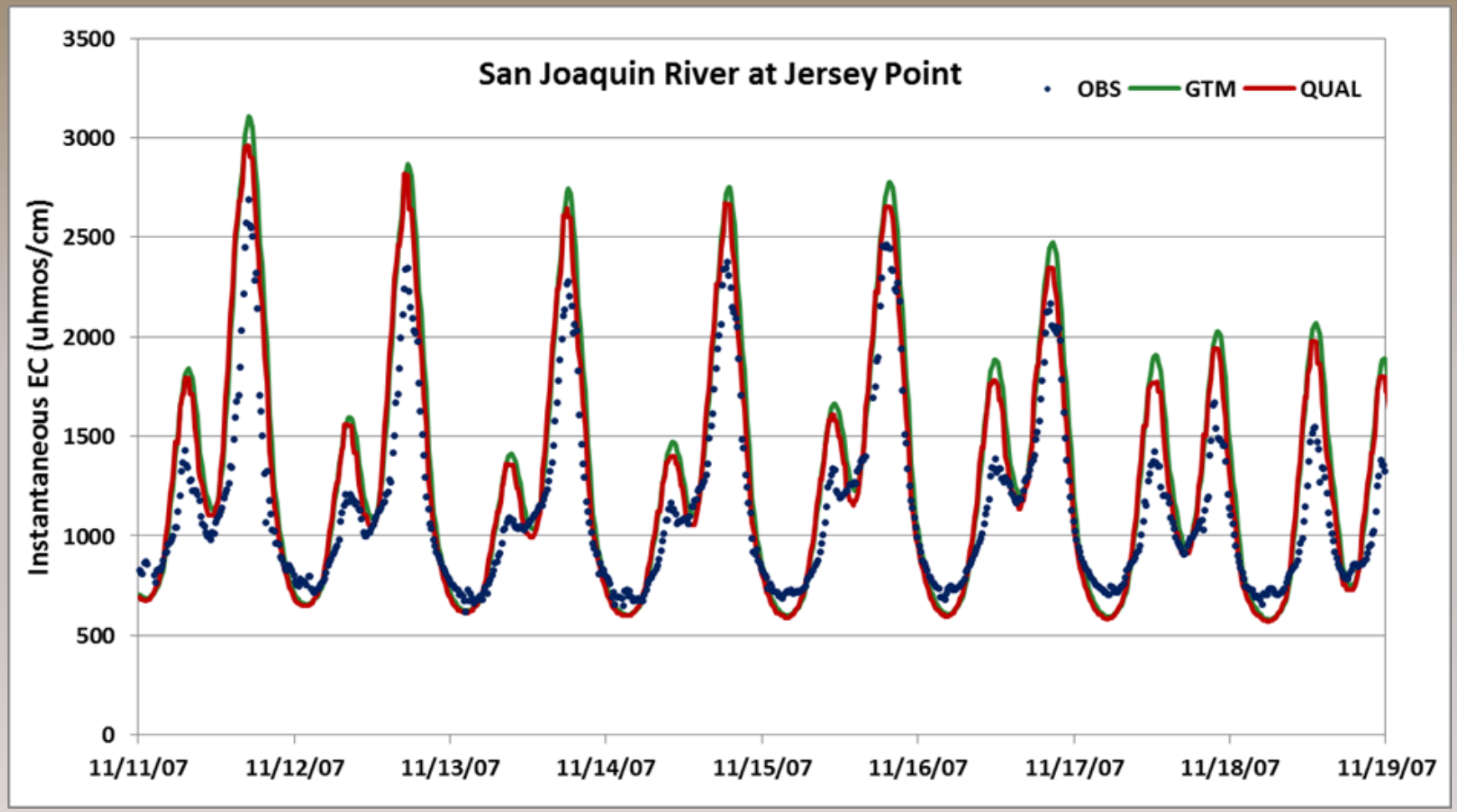




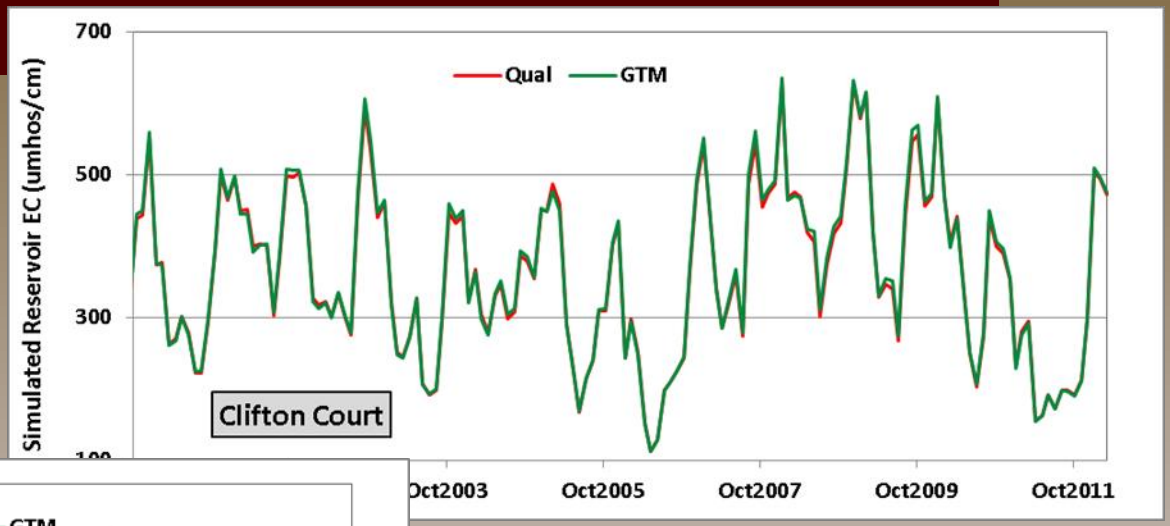
EC tidal results comparison at Emmaton

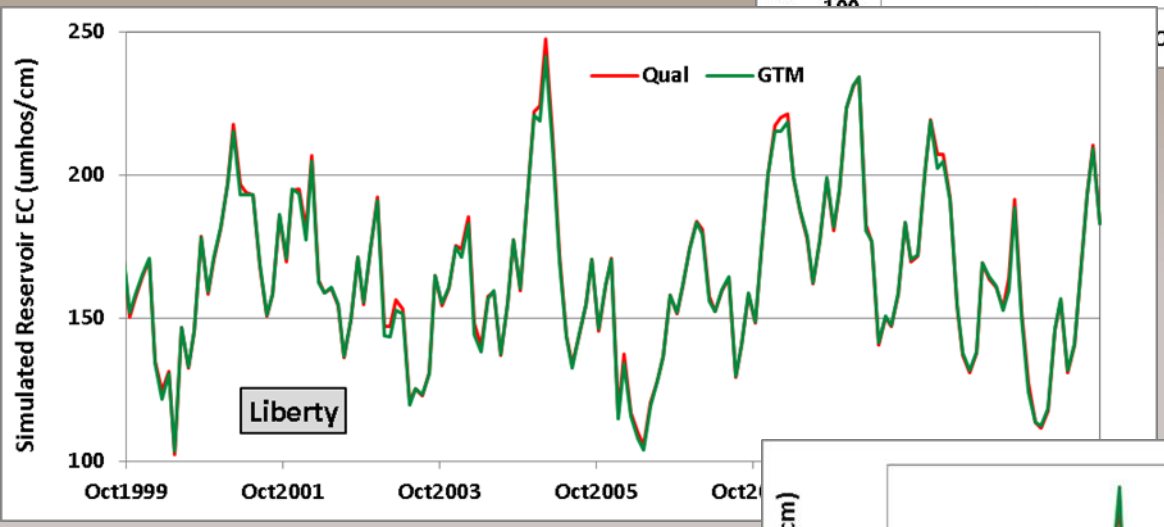


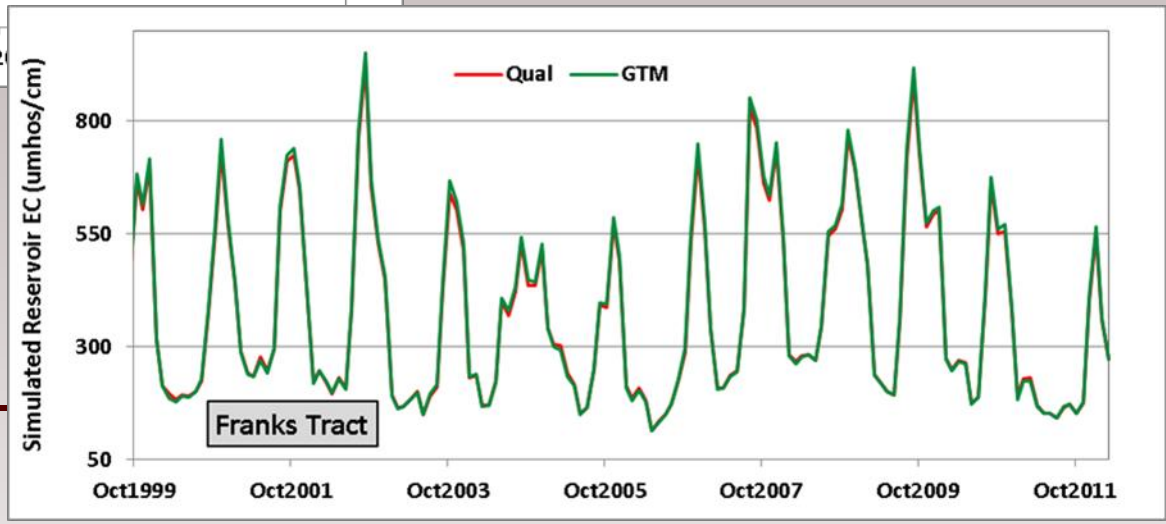
EC tidal results comparison at Jersey Point



Reservoir EC Comparison



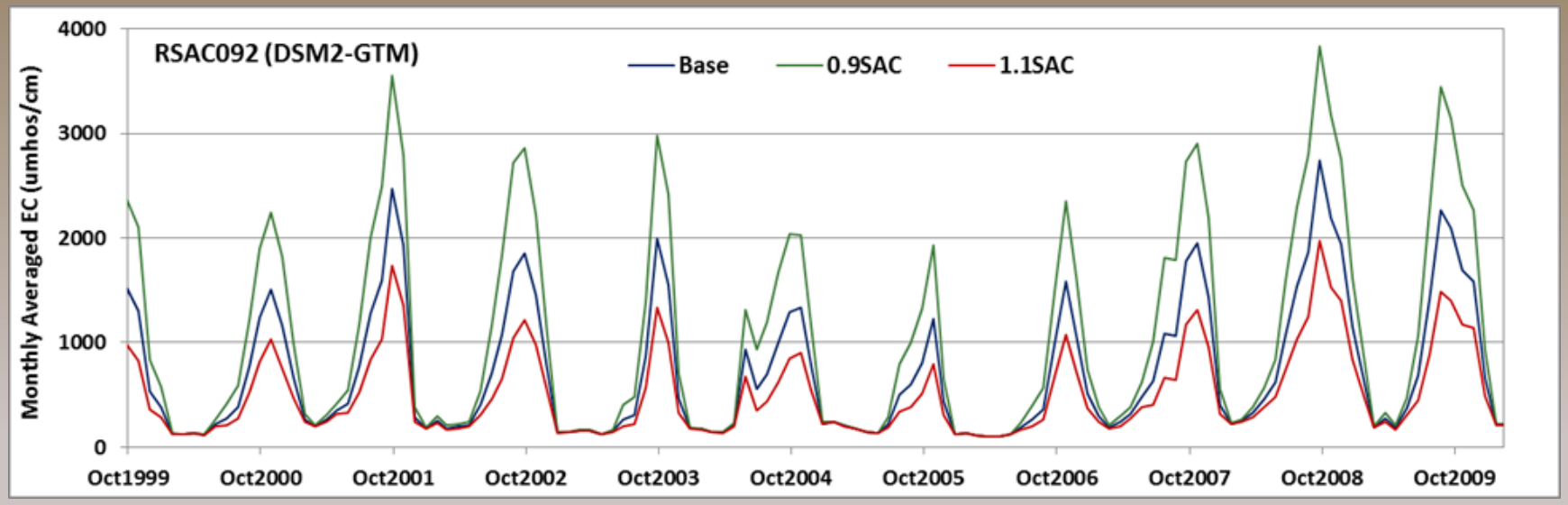


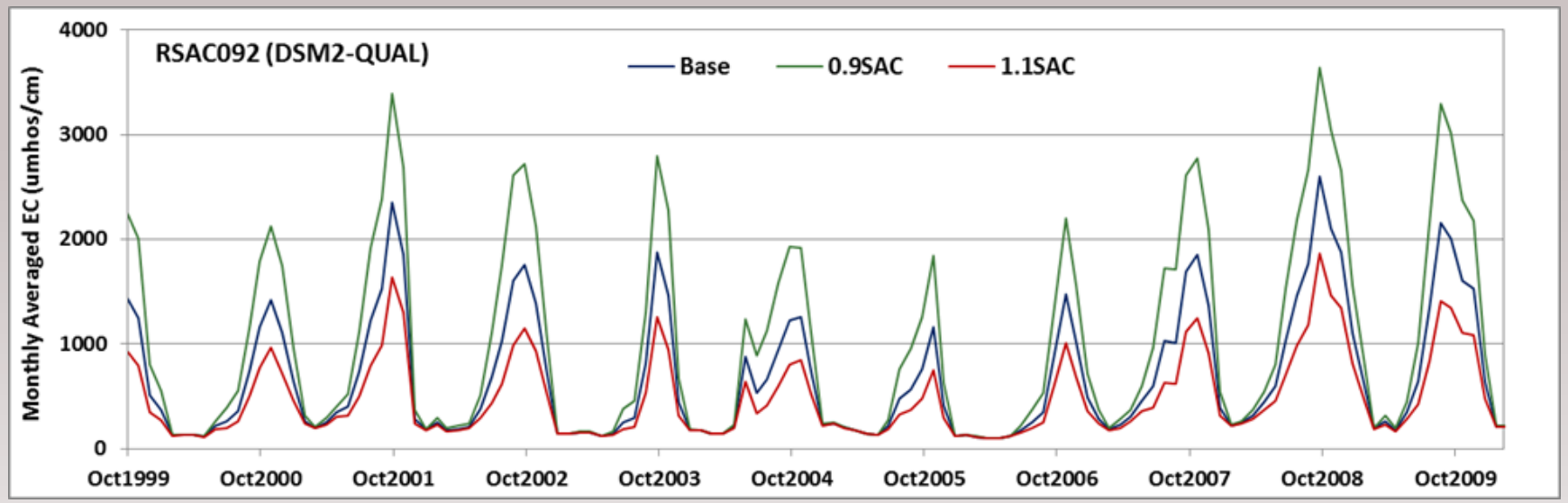


Sensitivity Test

- +/- Sacramento inflow by 10%
- +/- SWP pumping by 10%
- +/- DICU flows by 10%

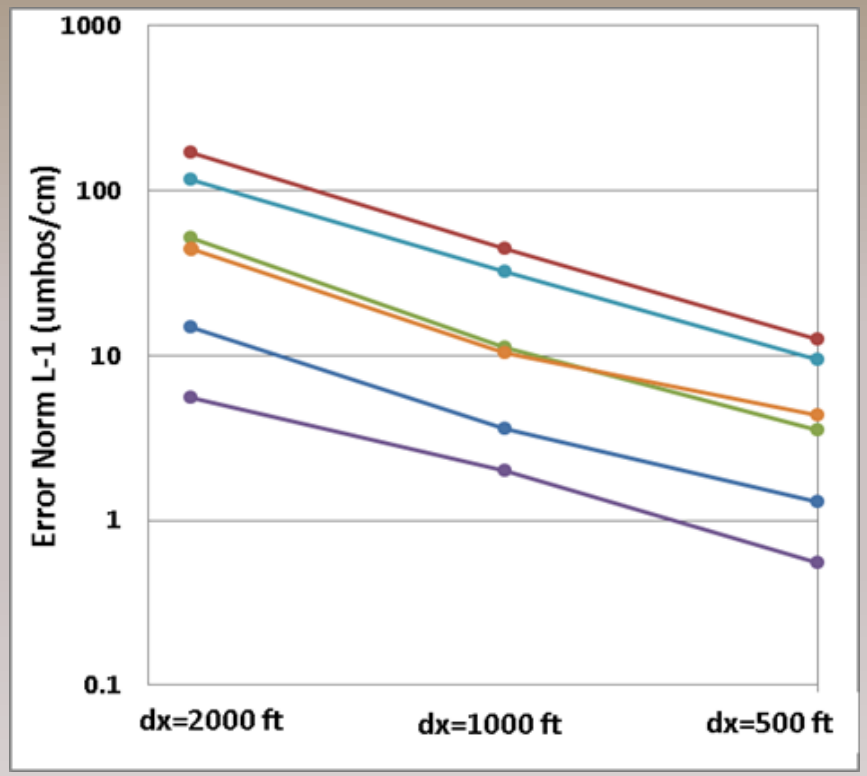
Sensitivity Test (+/- 10% Sac flow)

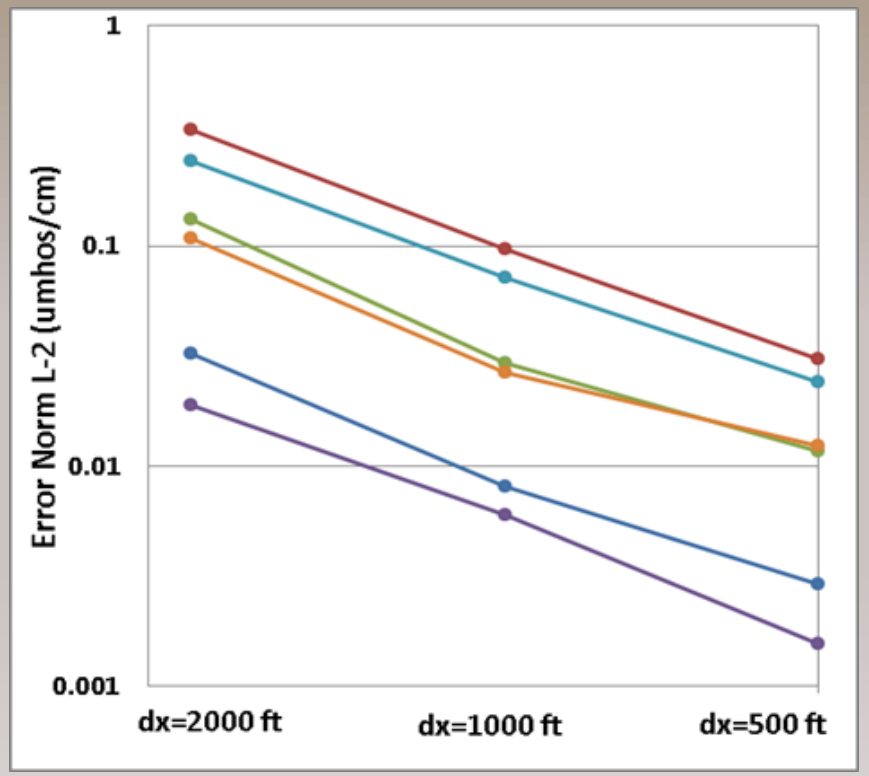




Convergence Test

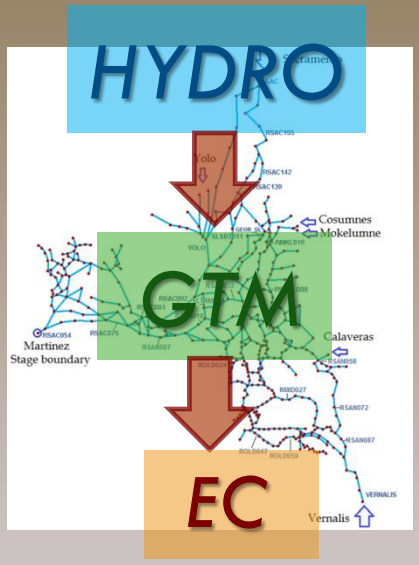
- *Error Norm L-1*
- *Error Norm L-2*



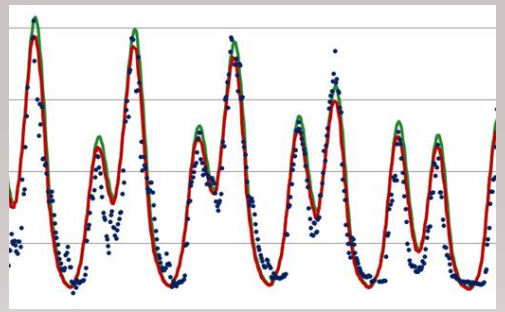


Summary

1. GTM successfully simulates EC for the full Delta using a full cycle of HYDRO and GTM.

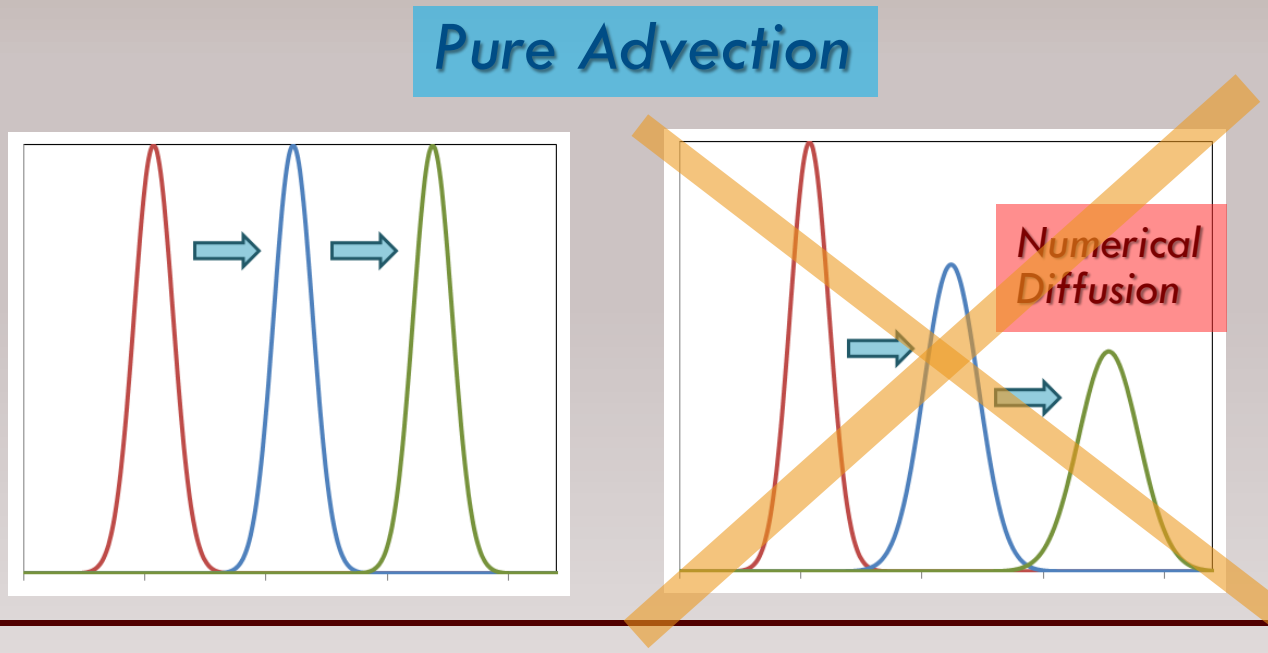


2. GTM shows consistent results compared to QUAL. GTM also matches historical EC data at key locations fairly well.



Summary

3. The numerical diffusion of the new Eulerian scheme is minimal and has been confirmed at field scale.



Summary

4. Sensitivity tests indicate the response from GTM to hydrology is as anticipated.

5. GTM is stable in convergence and over years of simulation. The performance is reasonable.

Ongoing developments

- Adding Suspended Sediment module
- Adding DO (dissolved oxygen) module
- Integrating with mercury cycling module