Restoration Scenarios and Early Results

John DeGeorge, Ph.D., P.E., Stace Grinbergs, P.E.
Richard Rachiele, Edward Gross, Ph.D.
Resource Management Associates

Eli Ateljevich, Ph.D.
Lily Ann Tomkovic, Ph.D.
Modeling Support Office, DWR

Delta Salinity Management in Drought: Surrogate Development under Drought, Landscape Change and Sea Level Rise

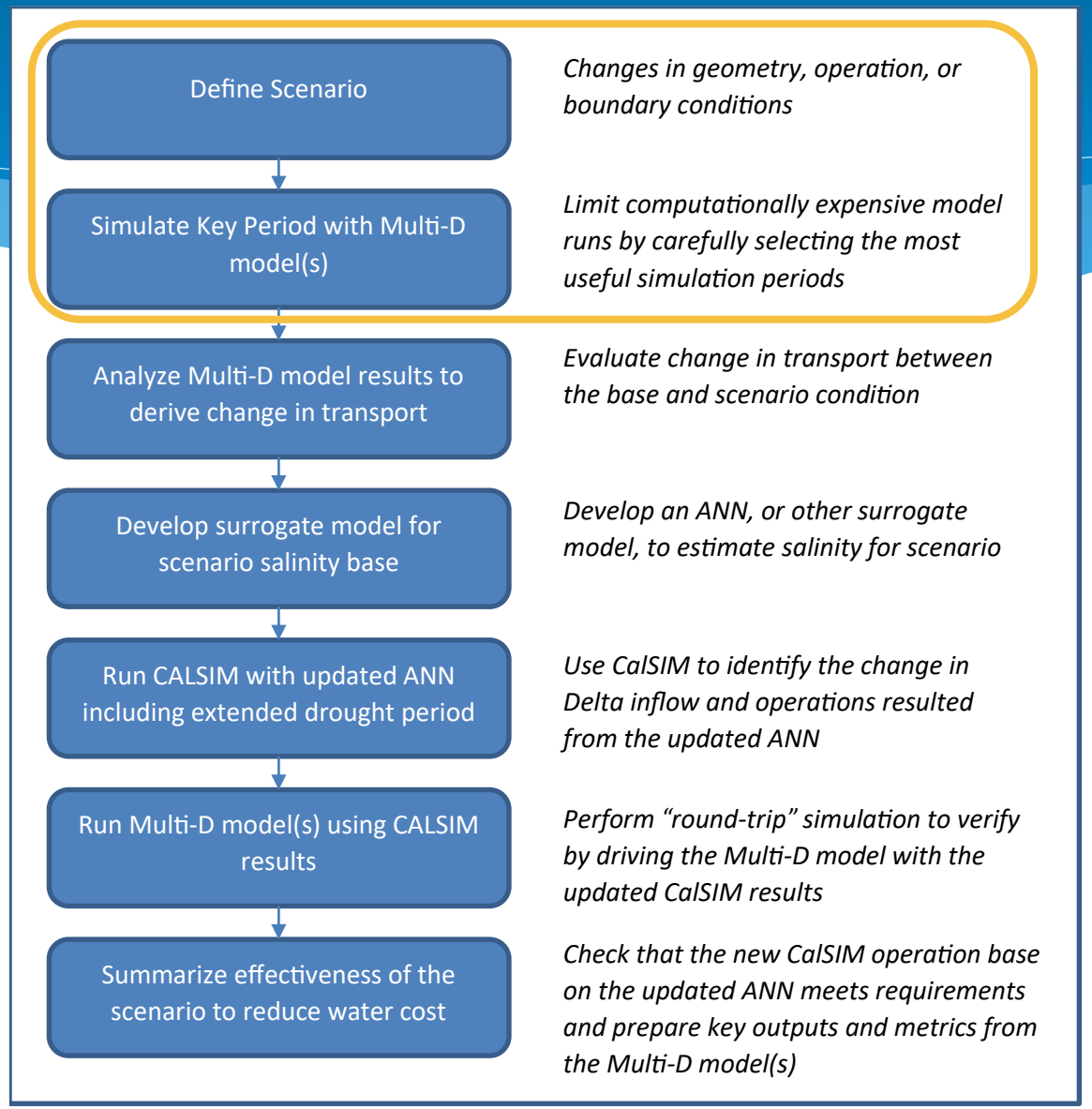
Project Funded by the Delta Stewardship Council

CWEMF Annual Meeting
September 24, 2024

Topics

- Causes of Salinity Intrusion
  - Primary mixing and transport mechanisms
  - Managing Salt Accumulation over the Dry Season
- Scenarios and Early Results

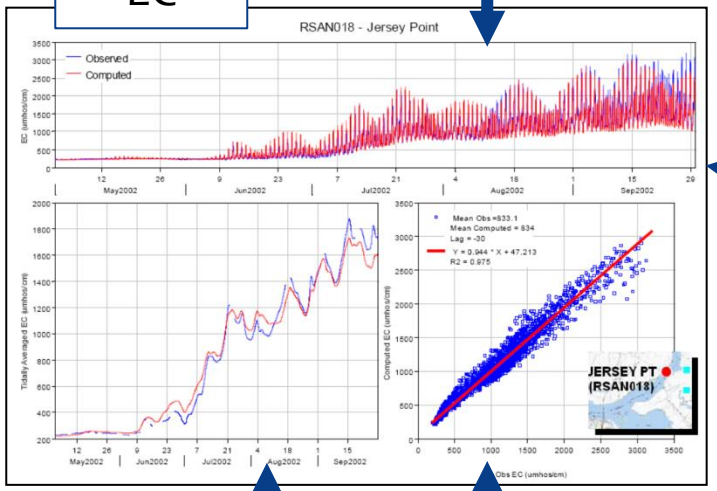
Pilot Project Workflow



Delta Time Series Data
Observed versus Computed…

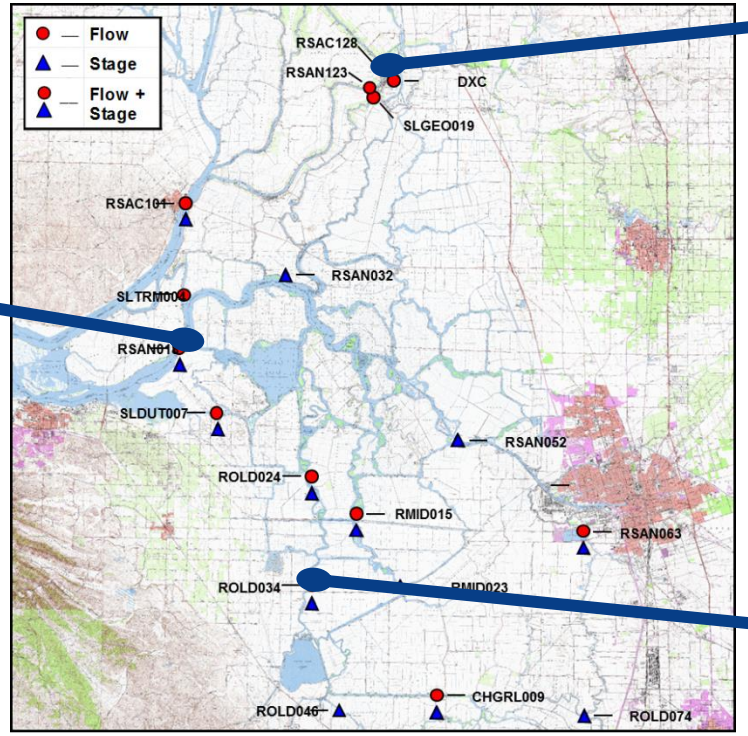
Tidal Time Scale

EC

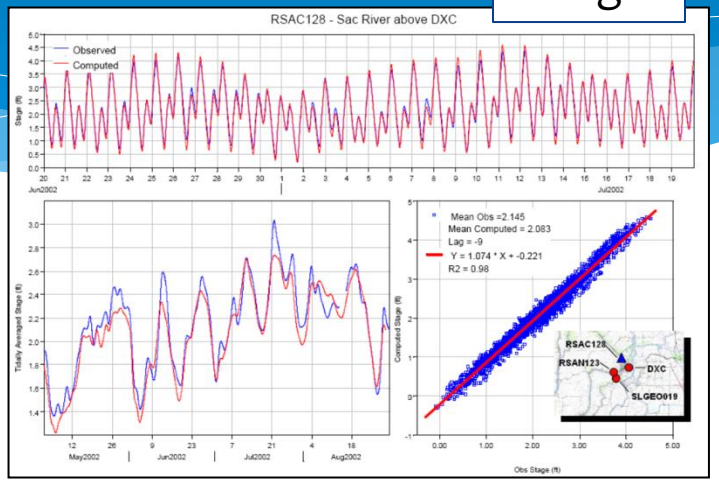


Tidally Averaged Time Scale

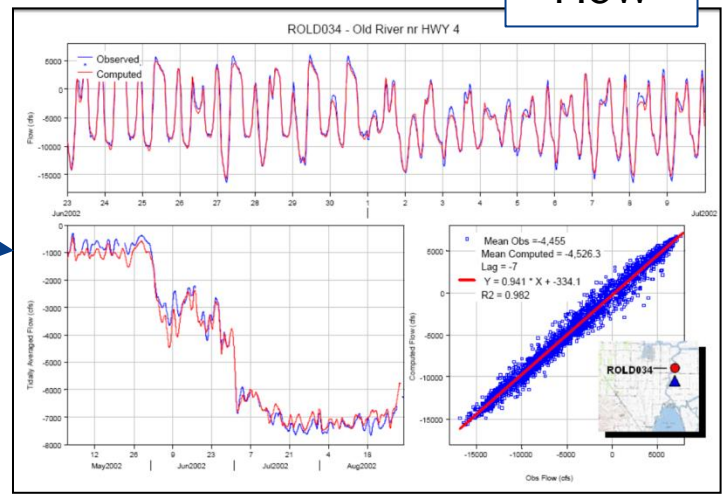
Statistical Comparison



Stage



Flow

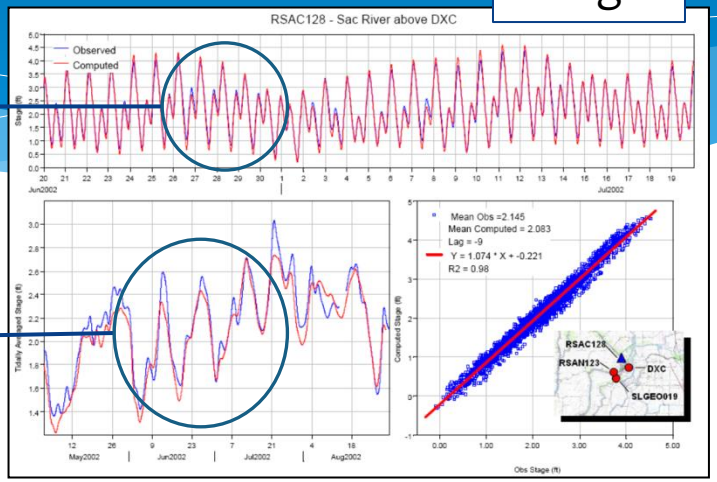


Example plots from RMA Model Calibration, Water Year 2002

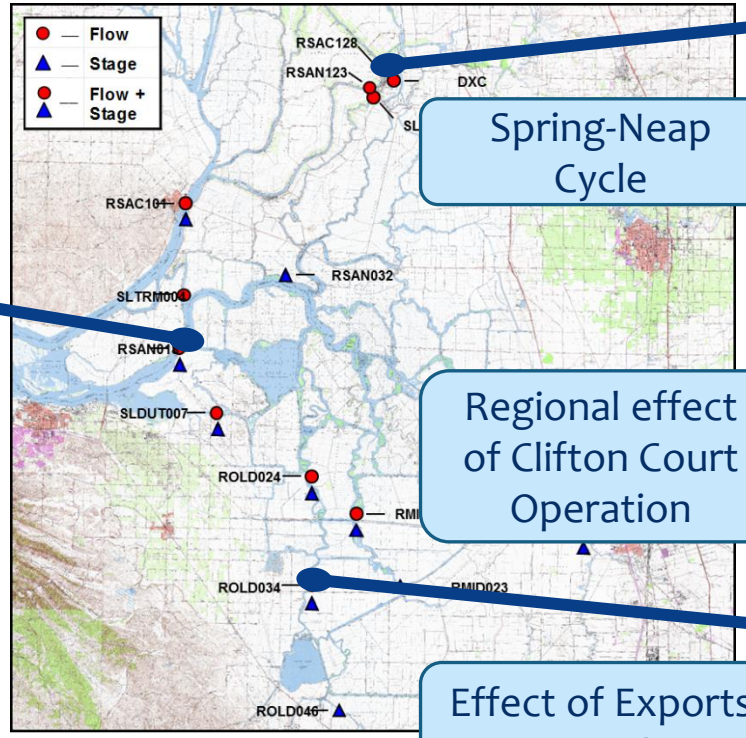
Delta Time Series Data
What can you see in the wiggly lines?

Stage

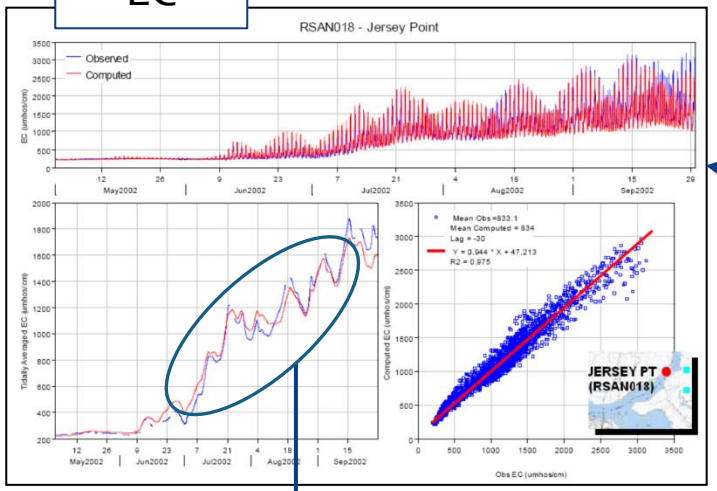
Tide Phase and Amplitude



Spring-Neap Cycle



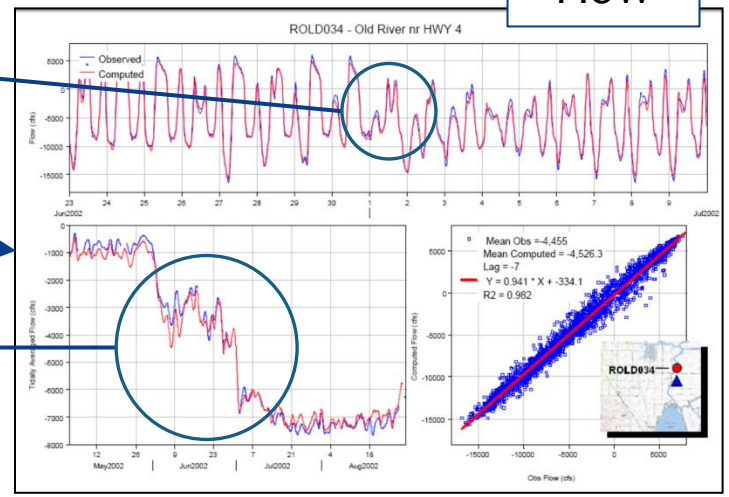
EC



Rate of salt intrusion

Regional effect of Clifton Court Operation

Flow



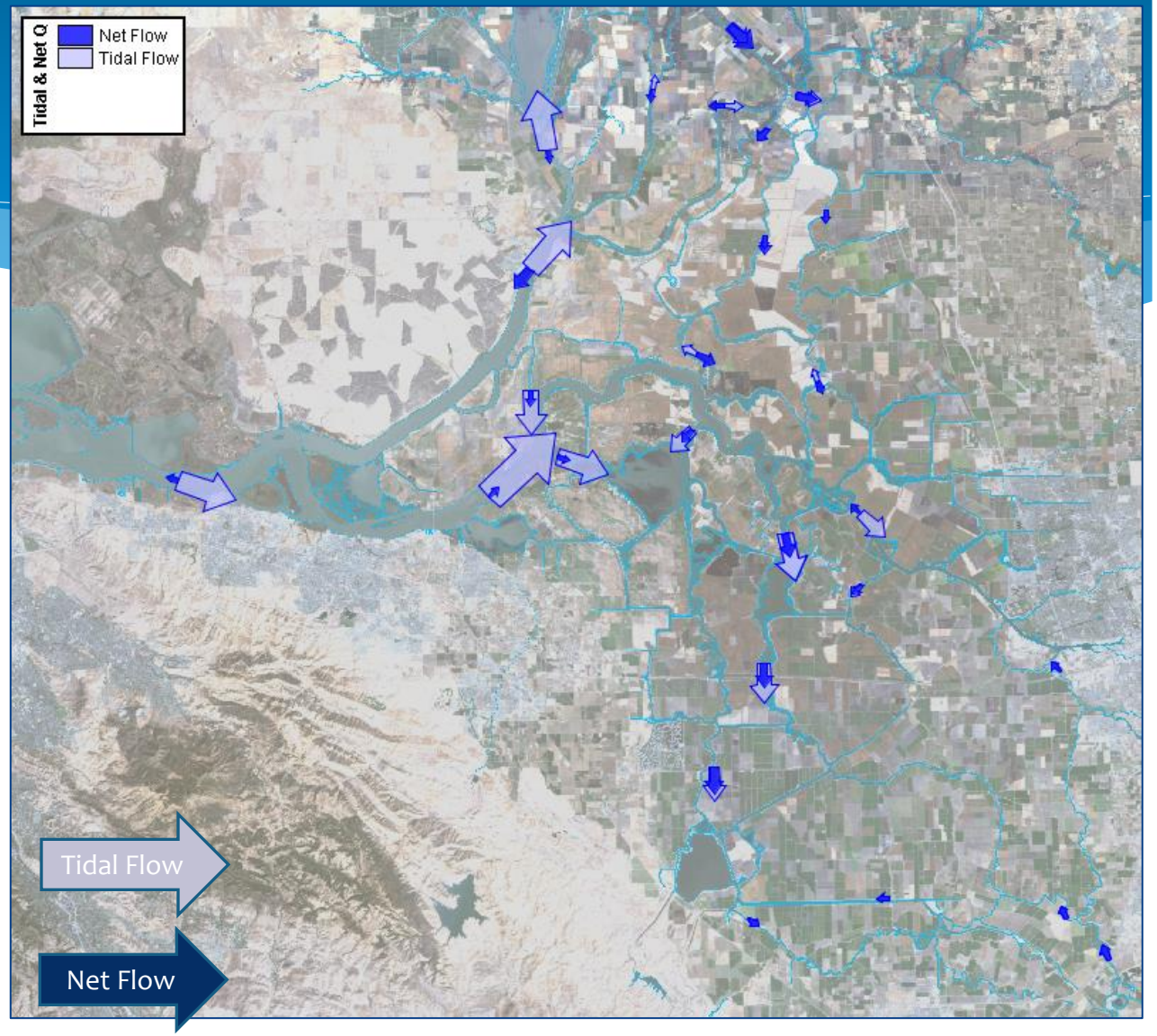
Effect of Exports on net Flow

Example plots from RMA Model Calibration, Water Year 2002

Tidal and Net Flow

Demonstration of increasing river inflows bringing net Delta outflow from 2,000 to 100,000 cfs with typical summer exports (not an historical condition)

- Tidal flows dominate the Western Delta
- Net transport of fresh water from north to south typical of summer and fall operation
- As Sacramento Inflow increases, more of the North Delta becomes riverine
- As San Joaquin flow increases the net flows change from south to north in the southern Delta

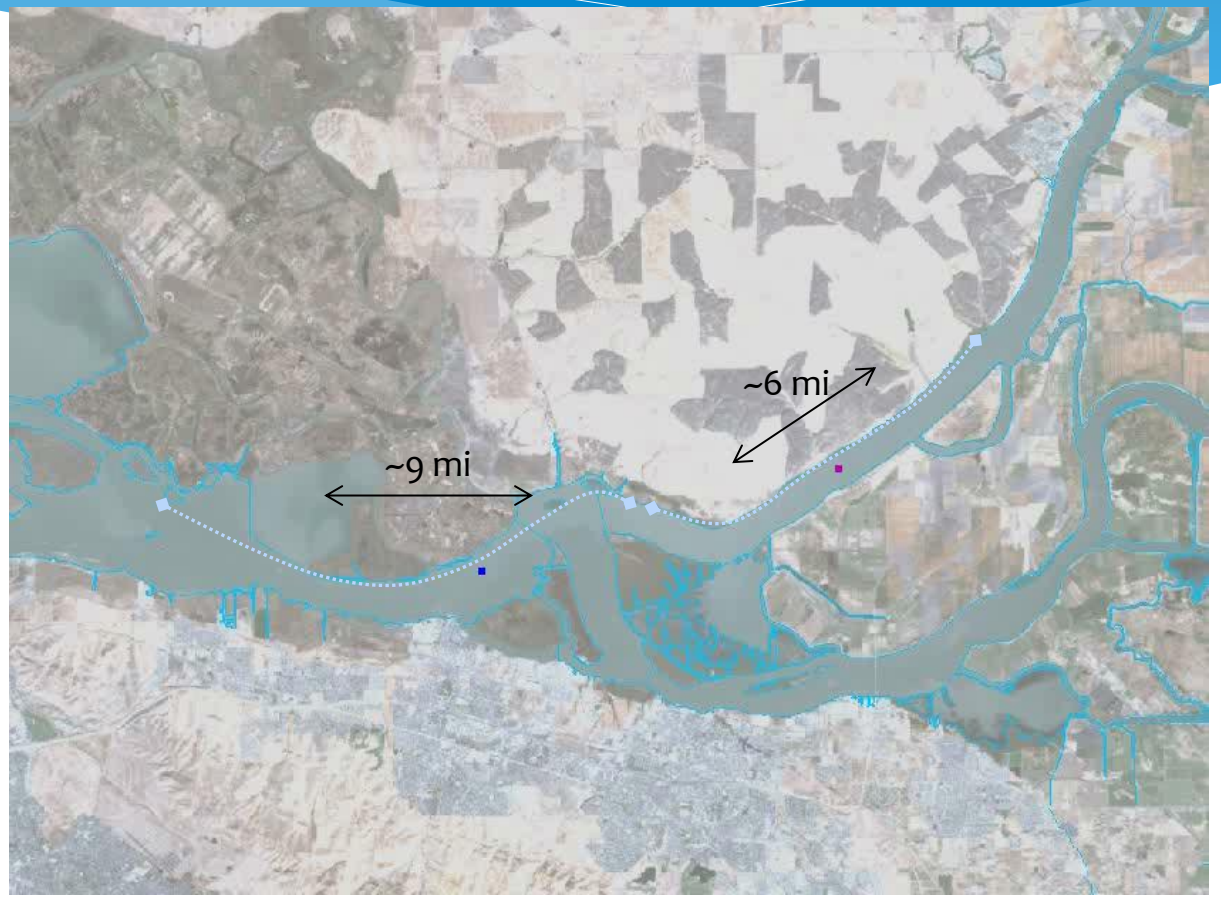


Animation created by Resource Management Associates, using RMA Model results

Excursion and Mixing

Groups of Particles released at two locations on the lower Sacramento River near the center of the channel

- Tidal Excursion is on the order of 6 to 9 miles(!) in this area of the Delta
- The water velocity varies vertically and laterally in a channel
- Turbulent mixing causes a group of particles released at one location experience slightly different velocities causing the group to spread over time



Animation created by Resource Management Associates, using RMA Model results

Excursion and Mixing

Particles released hourly at two cross sections of the lower Sacramento River and stopping after traveling for one tidal cycle

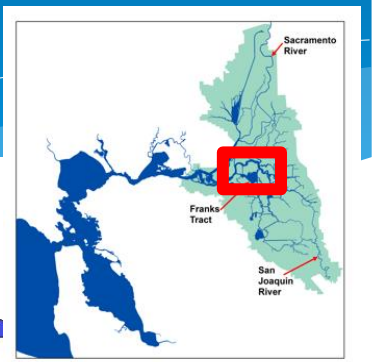
- The distribution of particles after traveling for one tidal cycle (~24.75 hours) illustrates the impact of tidal mixing, one of the key processes that brings ocean salinity into the Delta

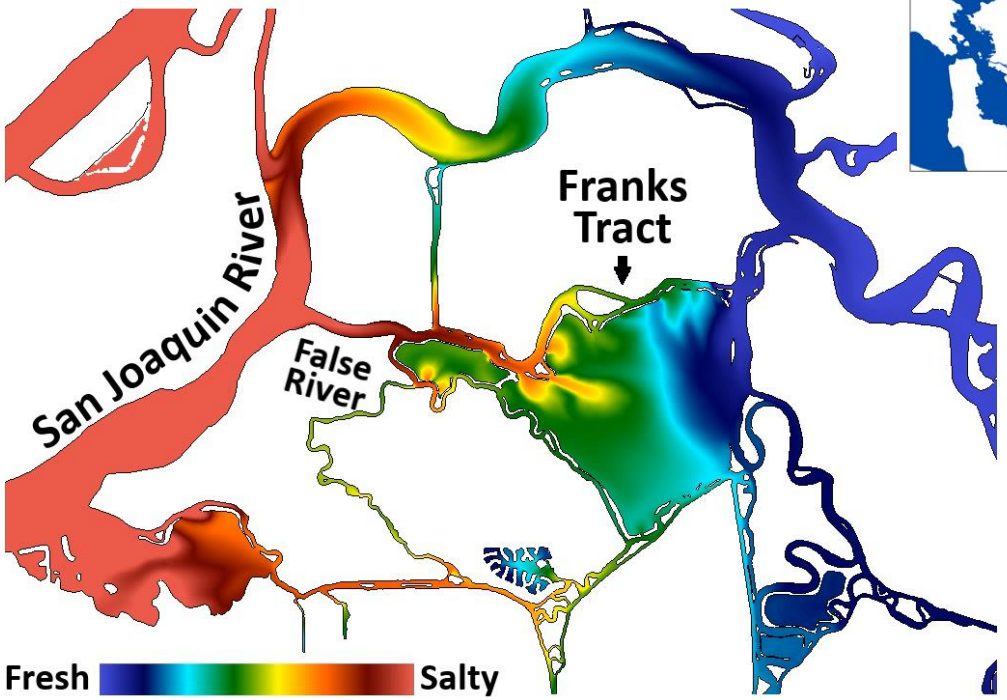
Animation created by Resource Management Associates, using RMA Model results

Salinity

Mixing in the Central Delta during a typical low flow period

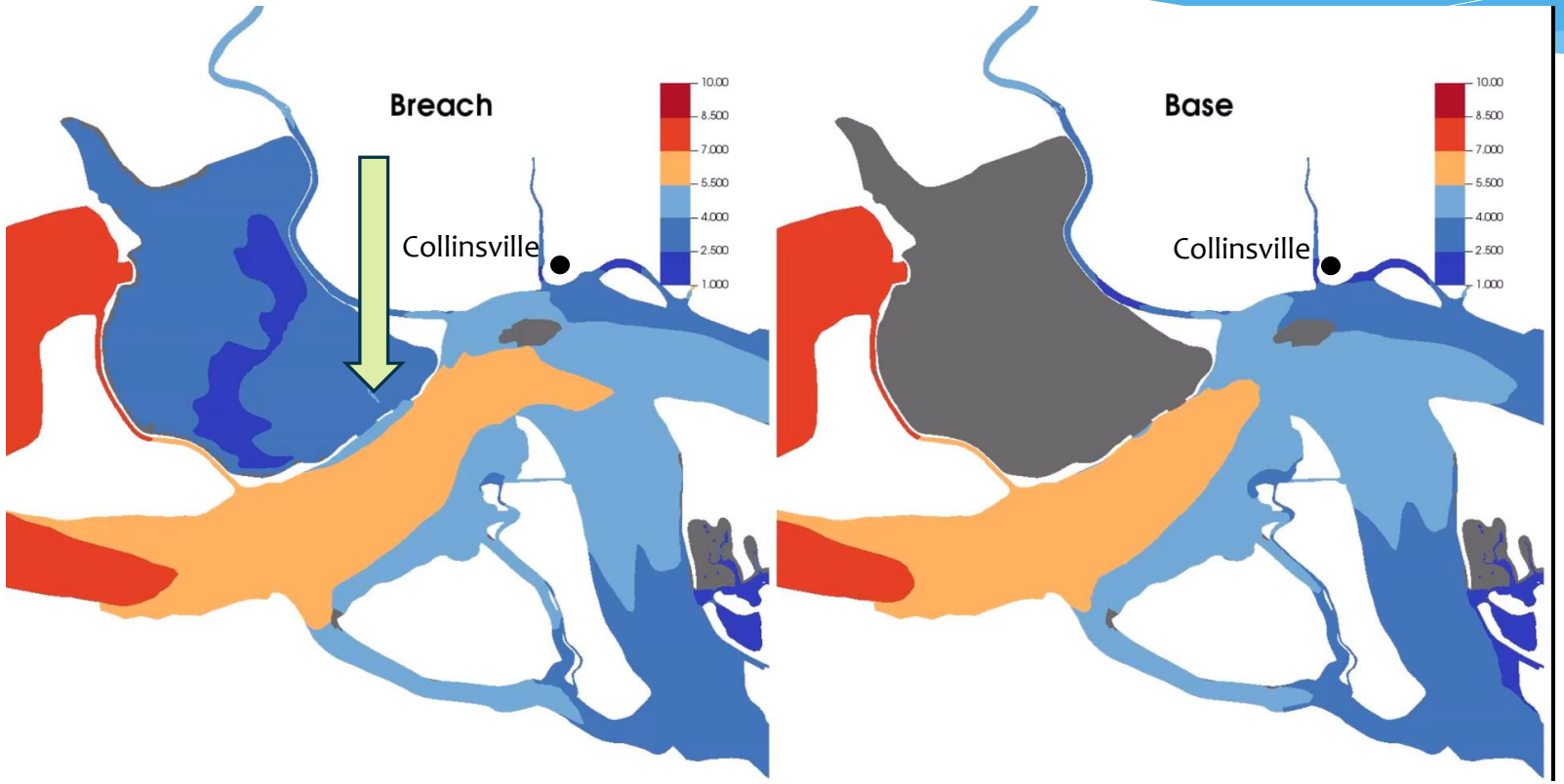
- Fresh water moves from north to south drawn by south Delta exports and in-Delta demand
- Sacramento River water moves through Threemile Slough to the San Joaquin on flood tide
- Tidal flows move higher salinity water from the lower San Joaquin to False River where it is drawn into Franks Tract





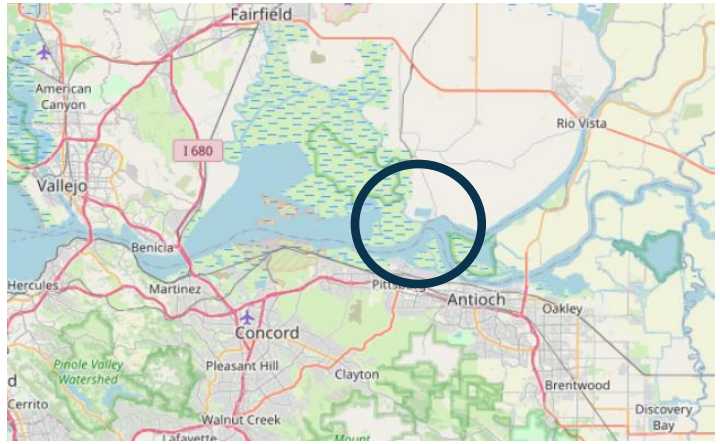
Animation created by DWR Delta Modeling Section, using Bay-Delta SCHISM Model results

Dispersion at Breaches



Van Sickle Island Breach Expanded
Result from Bay-Delta SCHISM

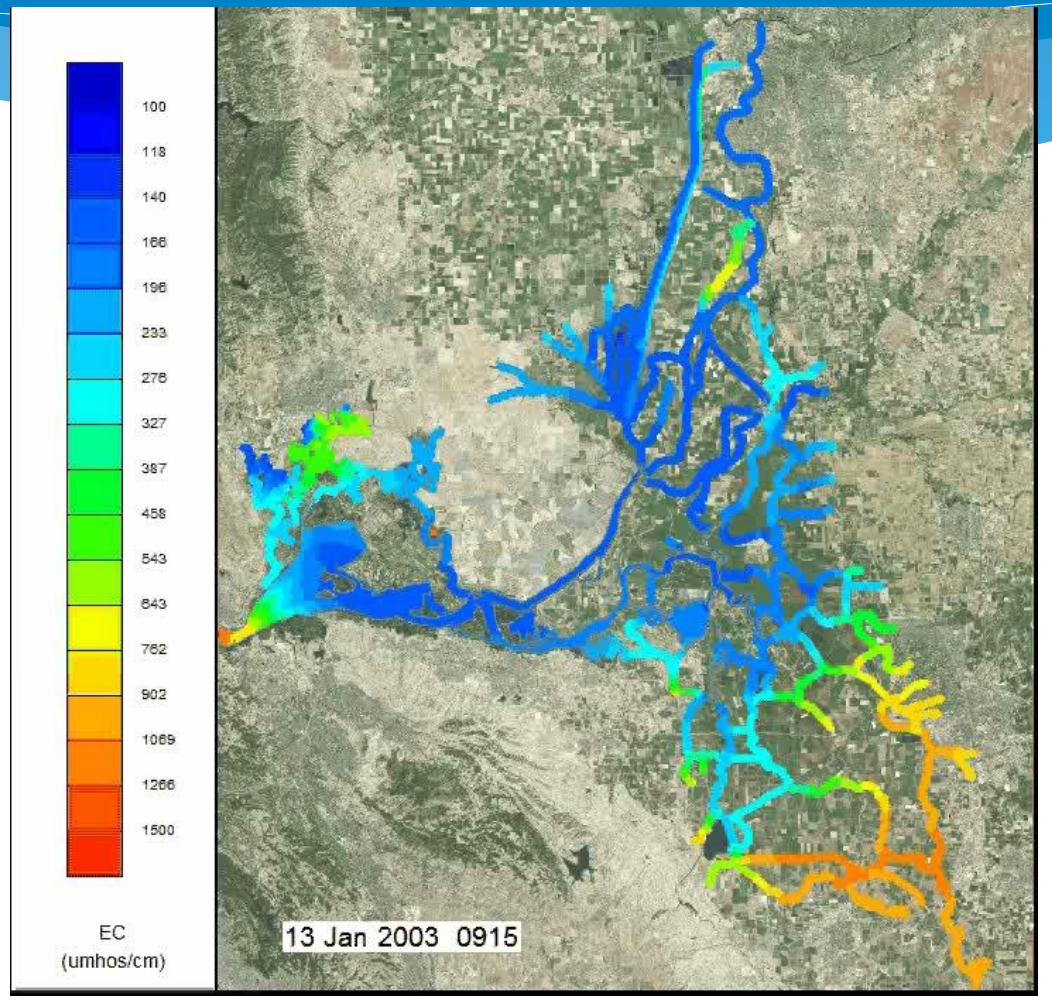
* Asynchronous:
  * Tidal turnaround
  * Concentration
* Cumulative



Salinity Management

Tidally averaged Delta salinity distribution (as Electrical Conductivity)
2002 Historic Conditions

- Sacramento River water drawn into the south Delta by exports
- San Joaquin River inflow typically higher in salt than other tributary inflows
- Salt from the ocean boundary moves slowly eastward over the summer and fall period
- * Net Delta Outflow and Gate Operations are carefully managed to maintain acceptable salinity through the dry season

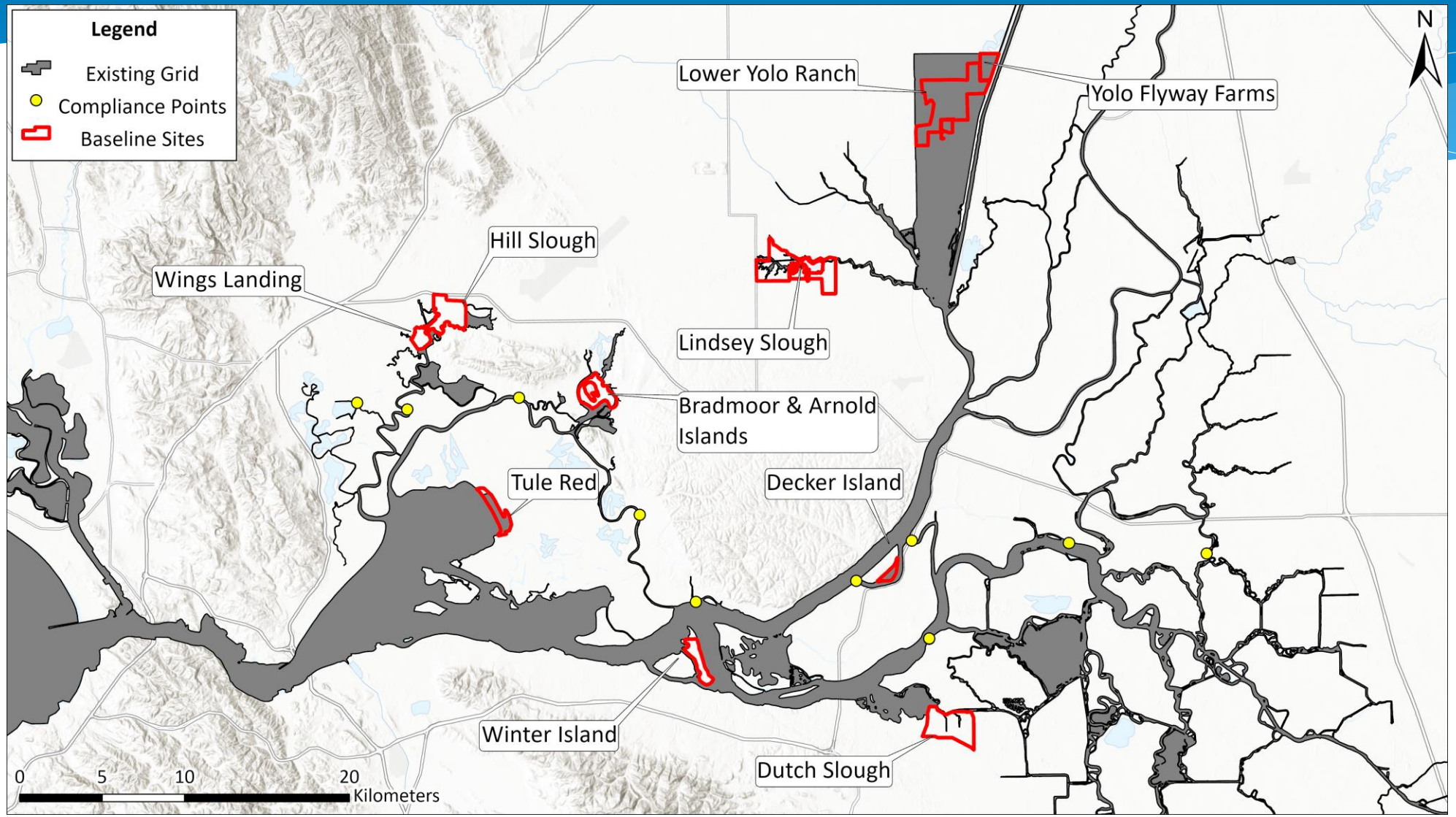


Animation created by Resource Management Associates, using RMA Model results

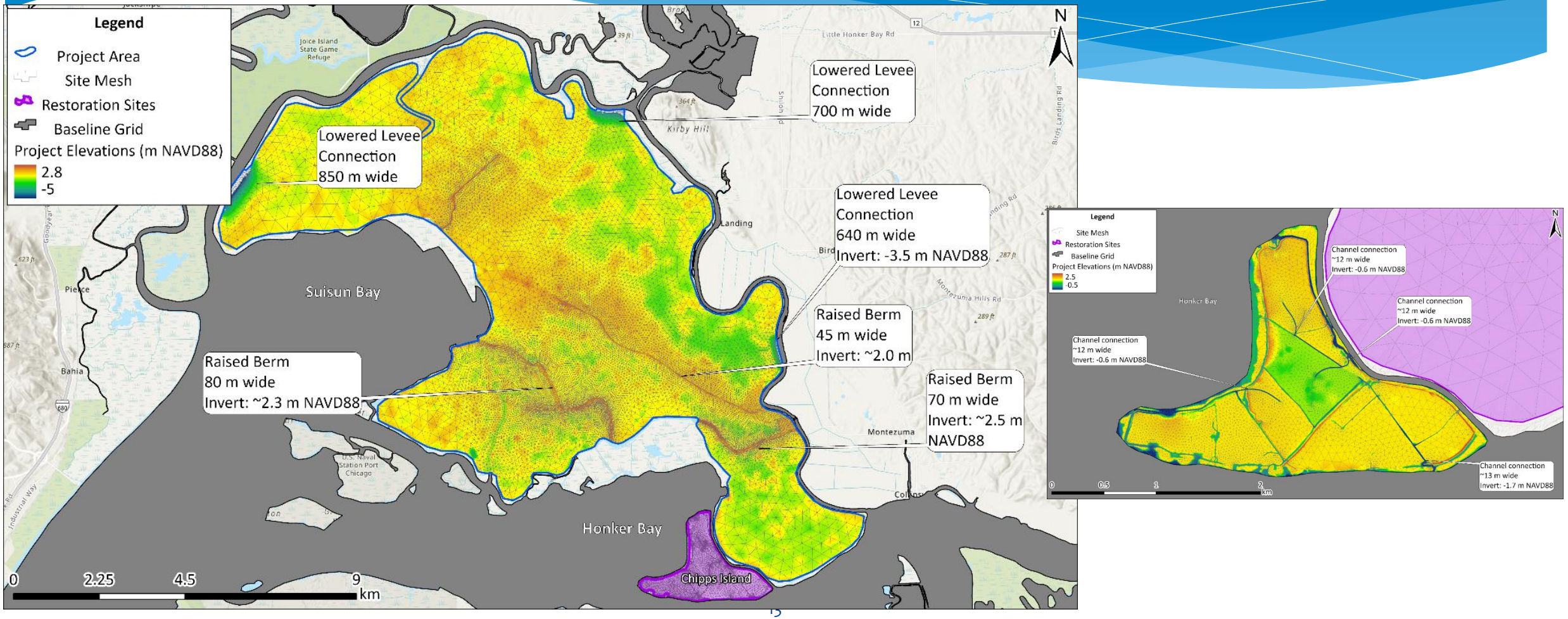
Restoration Scenario Simulations to provide training data and change metrics

* Suisun Marsh
  * Grizzly Island "Bookend" and Chipps Island
* Cache Slough
  * Lookout Slough, Prospect Island, Little Egbert
* Franks Tract
  * Franks Tract Futures Example
* Sea Level Rise (results not shown in this presentation)
  * Base Condition + 3 ft (.91m) SLR

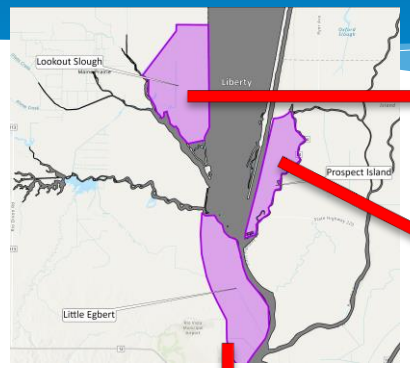
Base Geometry

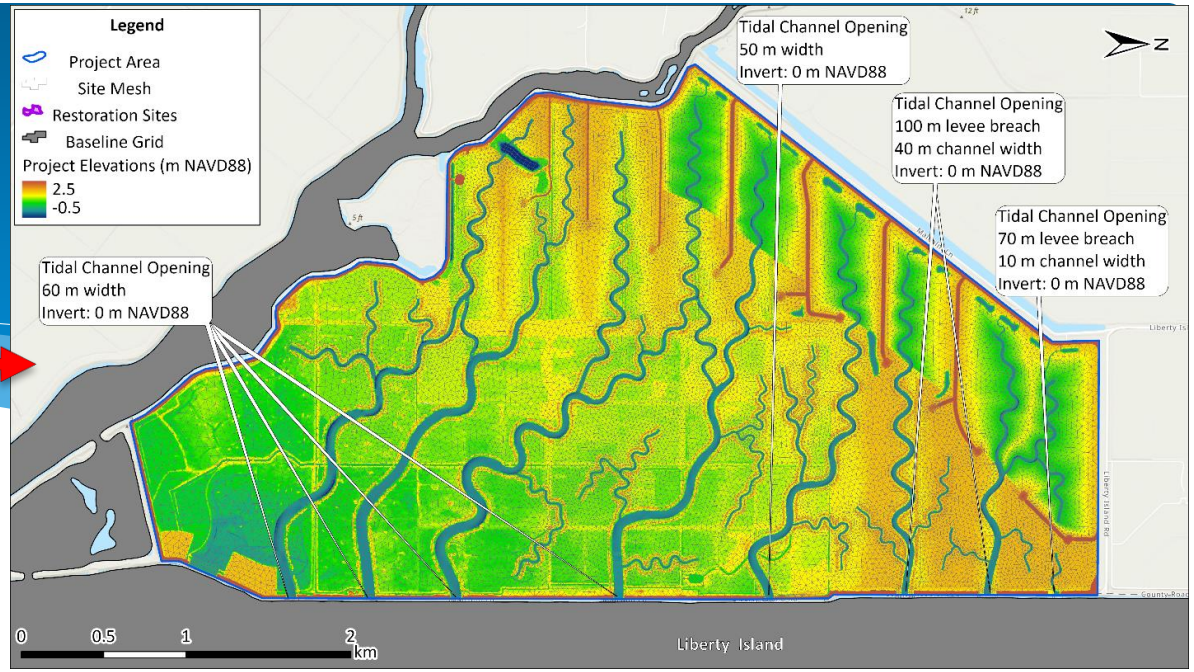


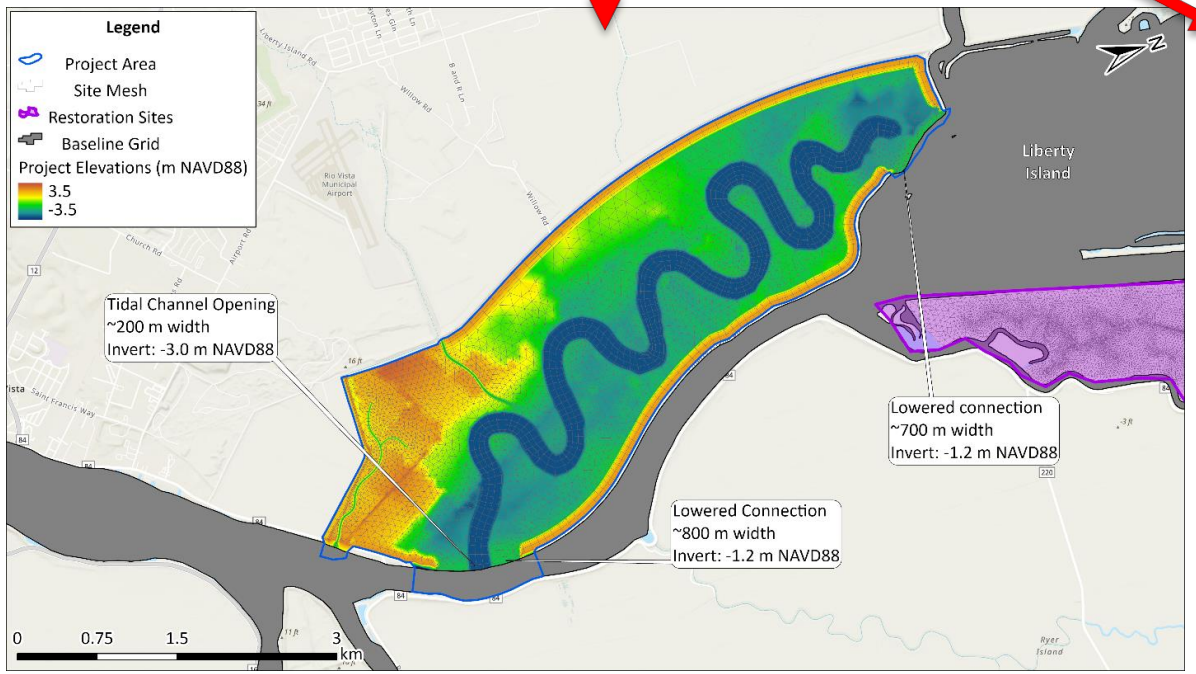
Suisun Marsh Bookend Scenario

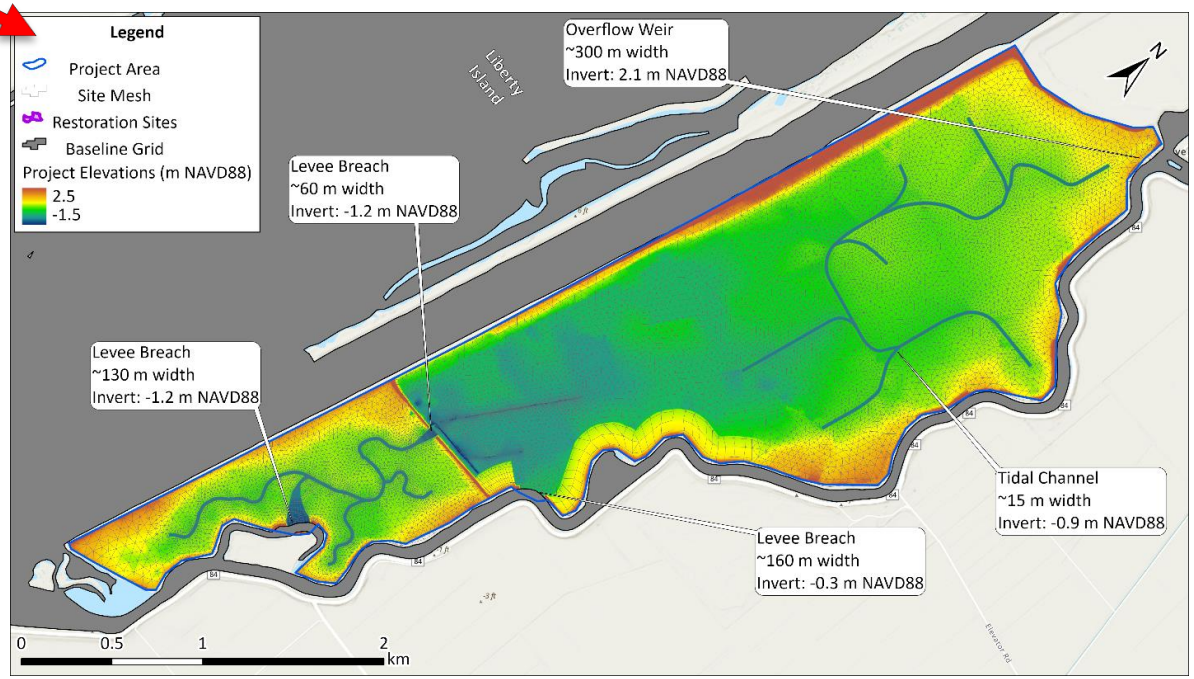


Cache Slough



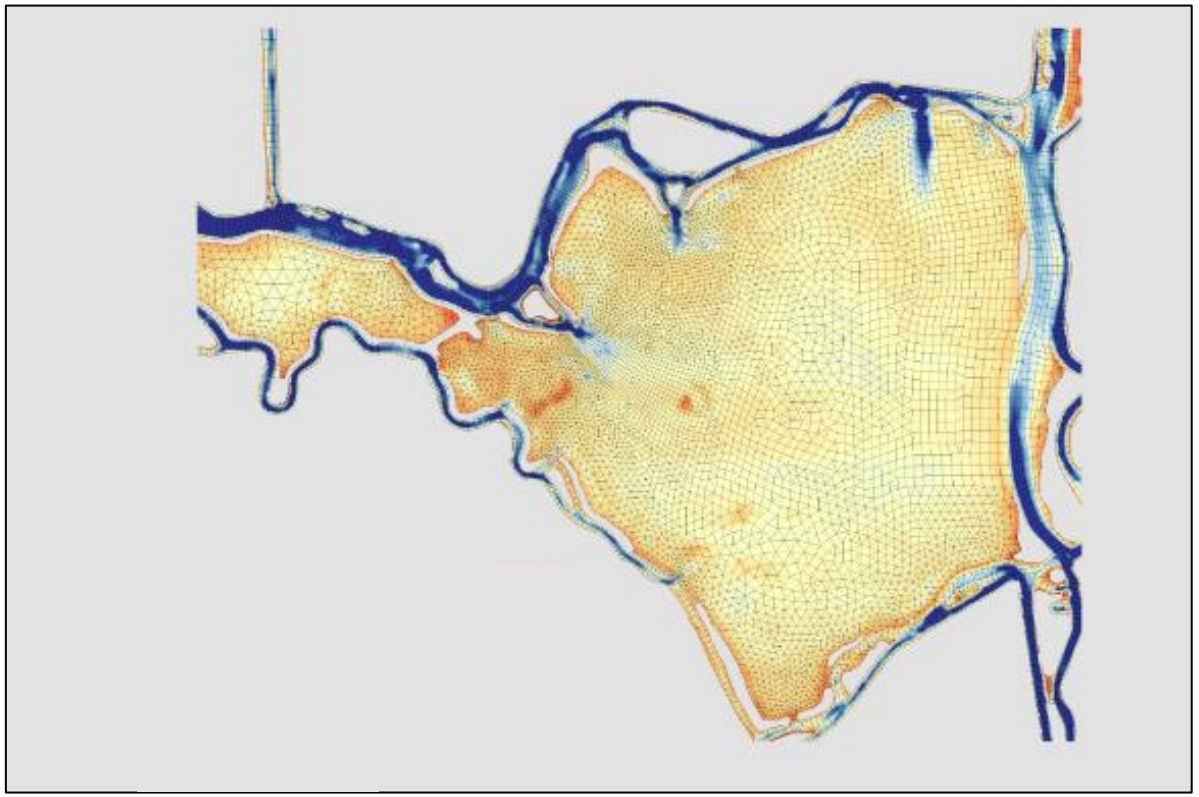




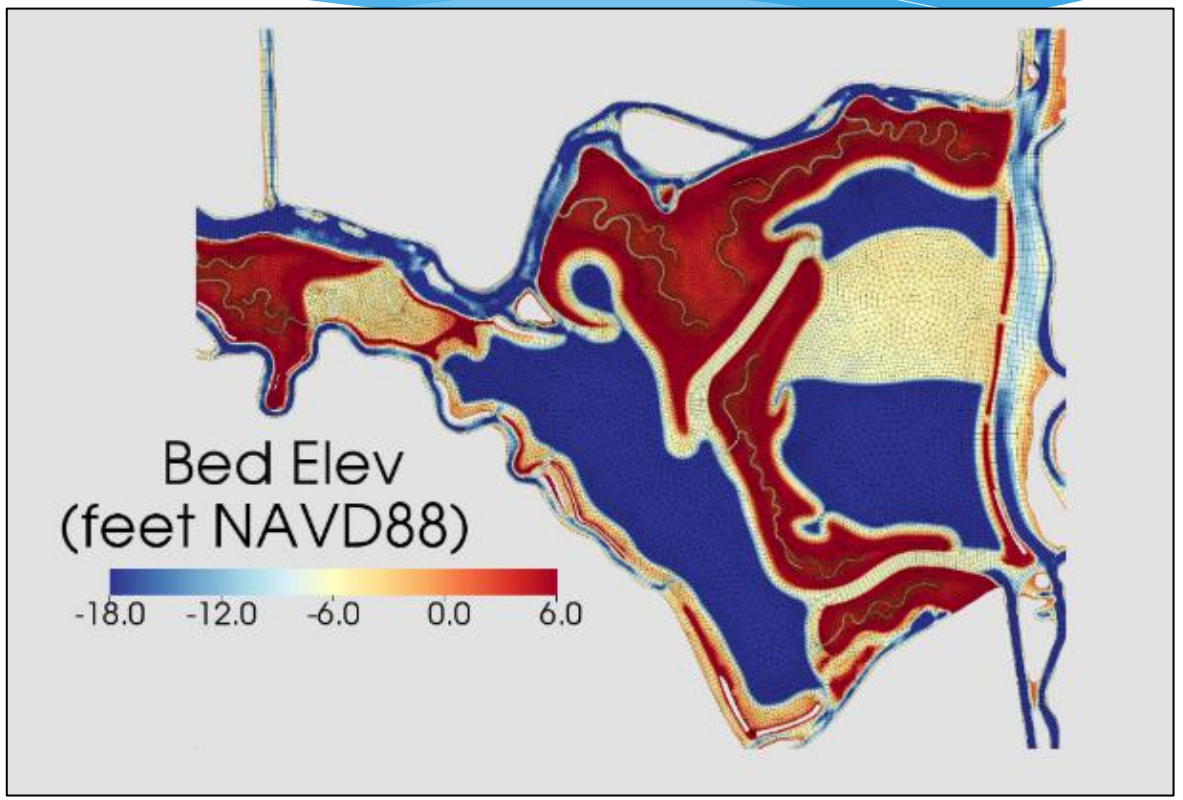


Franks Tract

Current Geometry

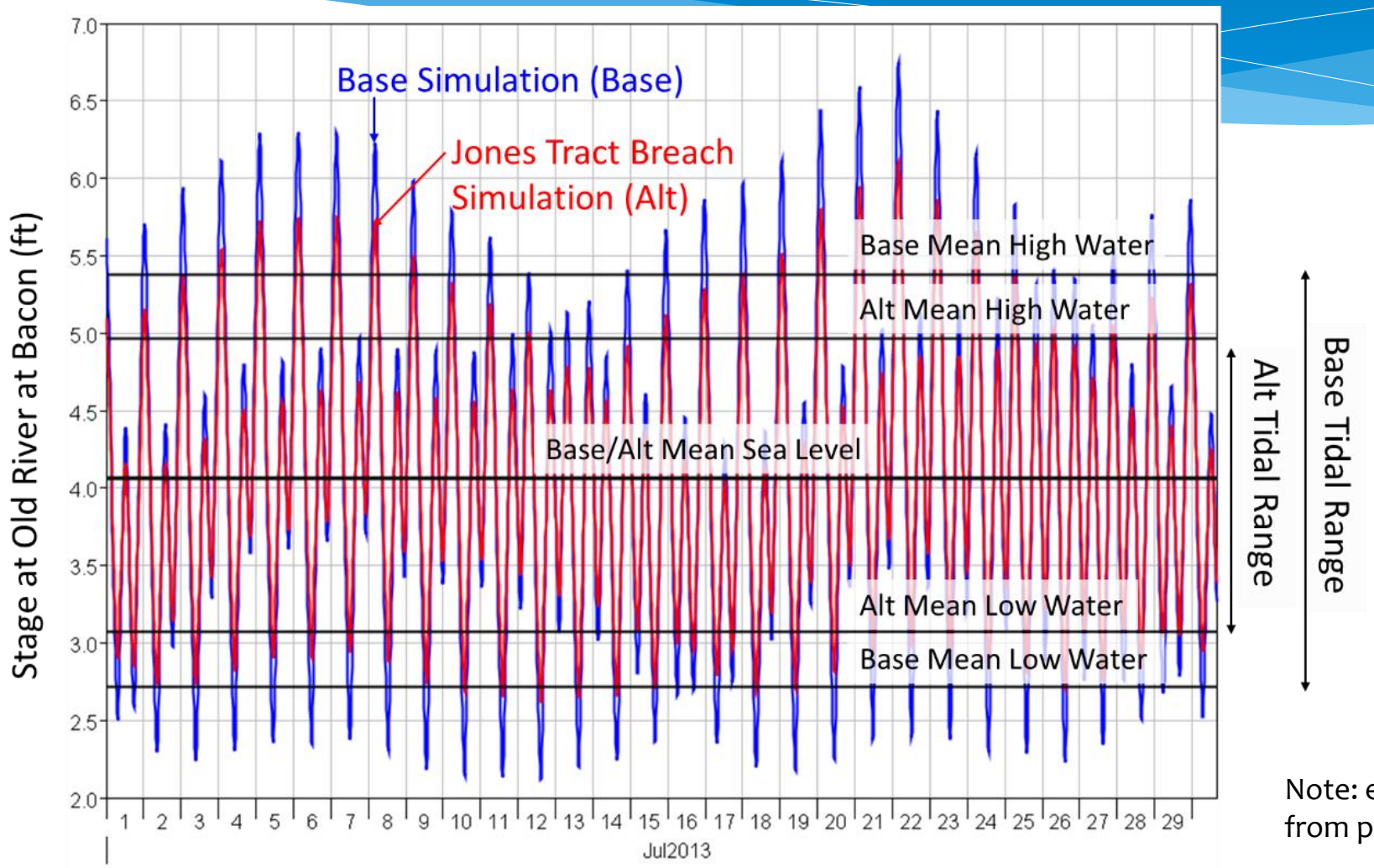


Franks Tract Futures Design Example



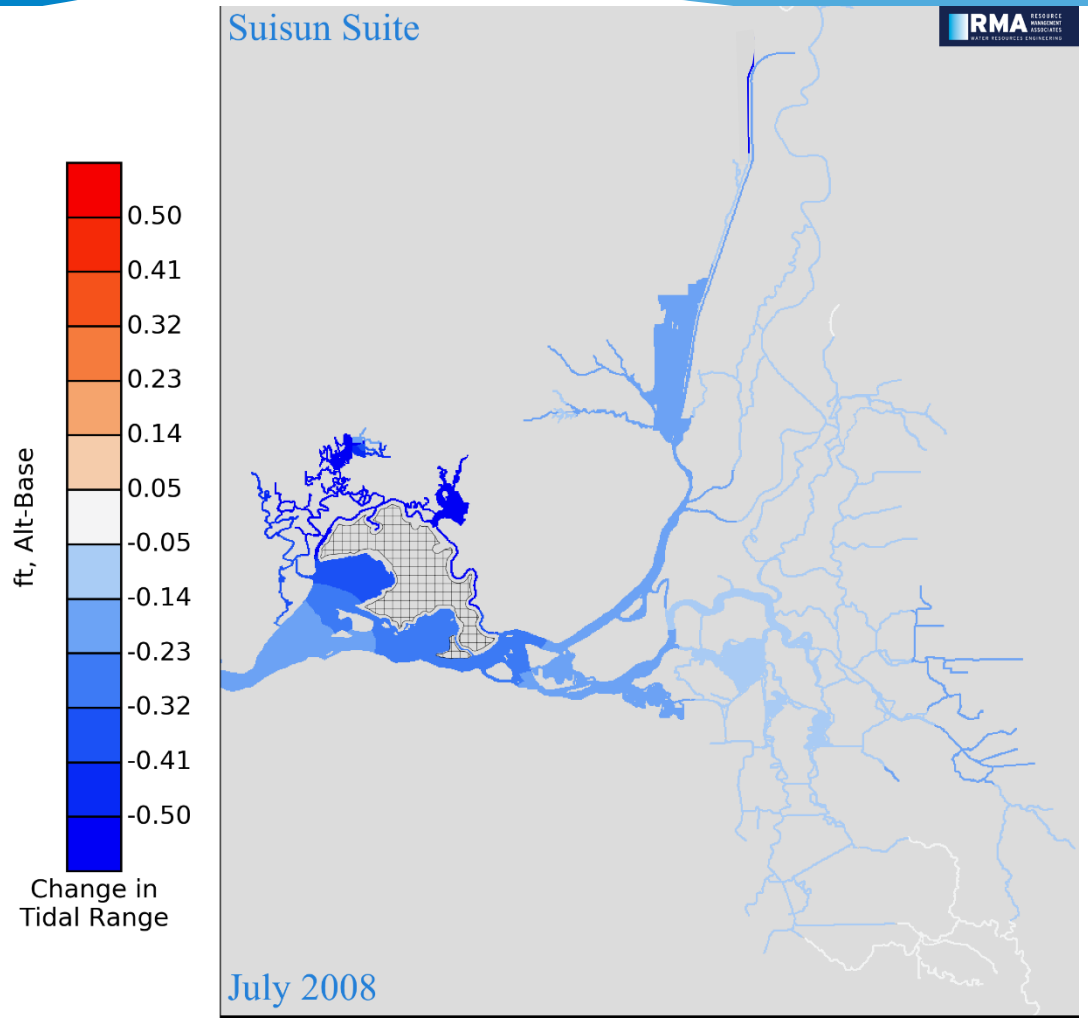
Short Term Hydrodynamic Metrics (Stage)

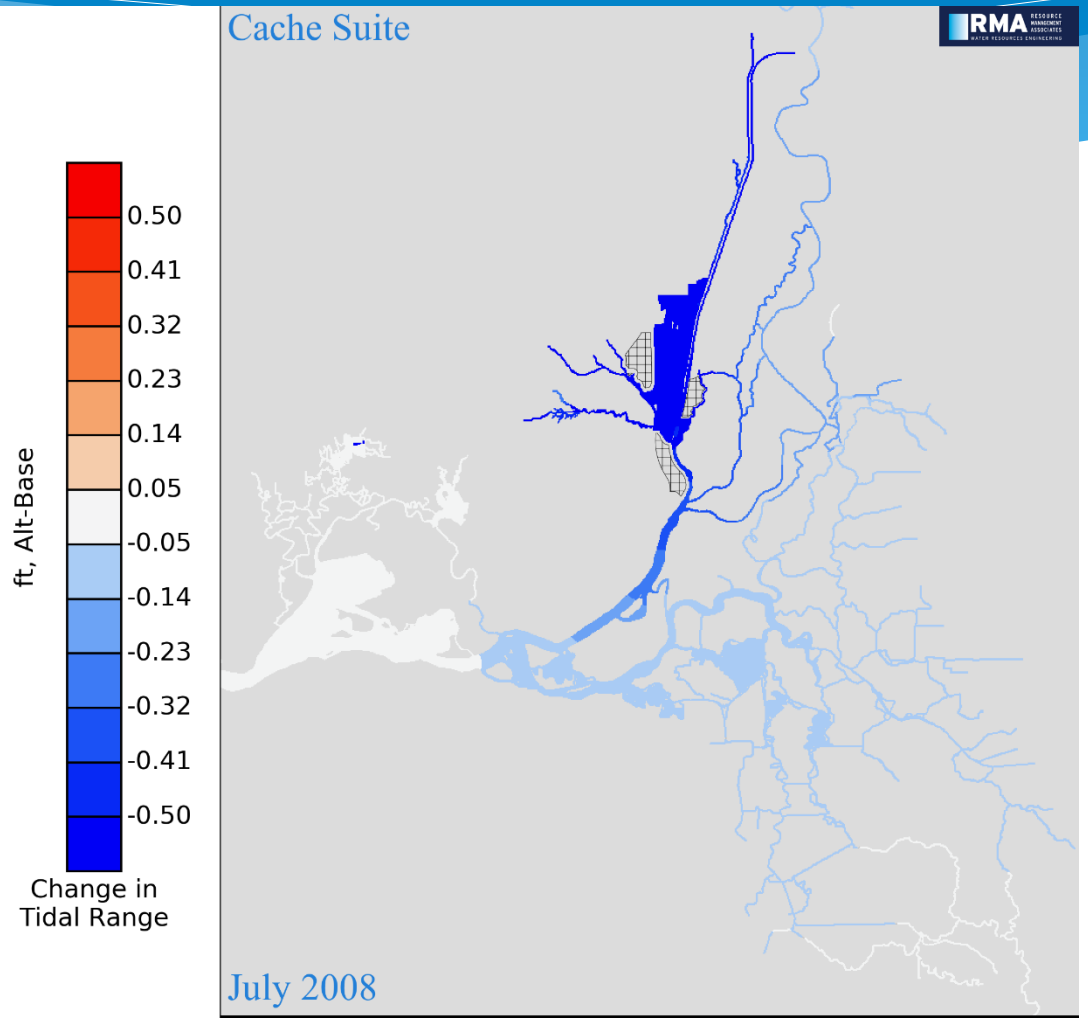
average quantities over a typical summer month



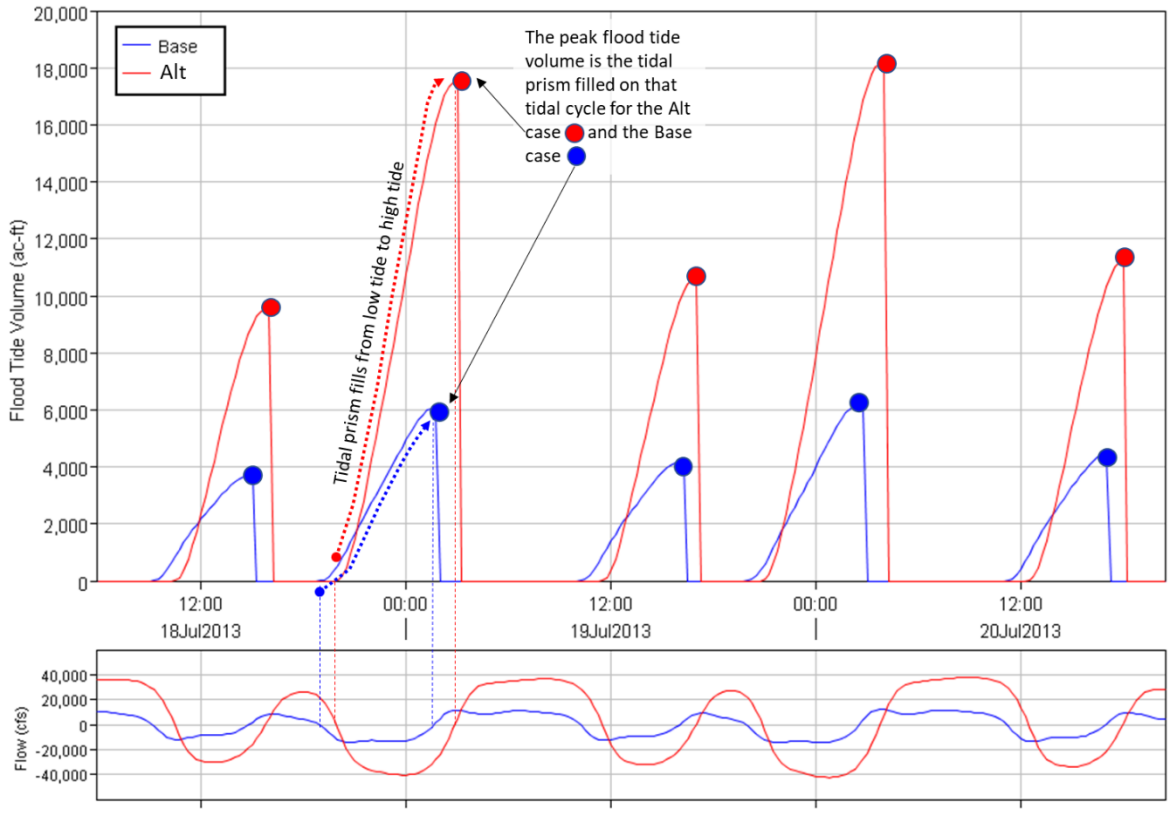
Note: example results from previous study

Change in Tidal Range
Suisun and Cache Restoration Suites

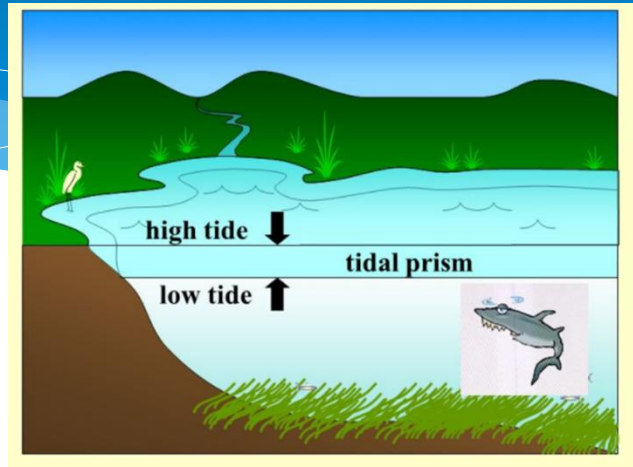


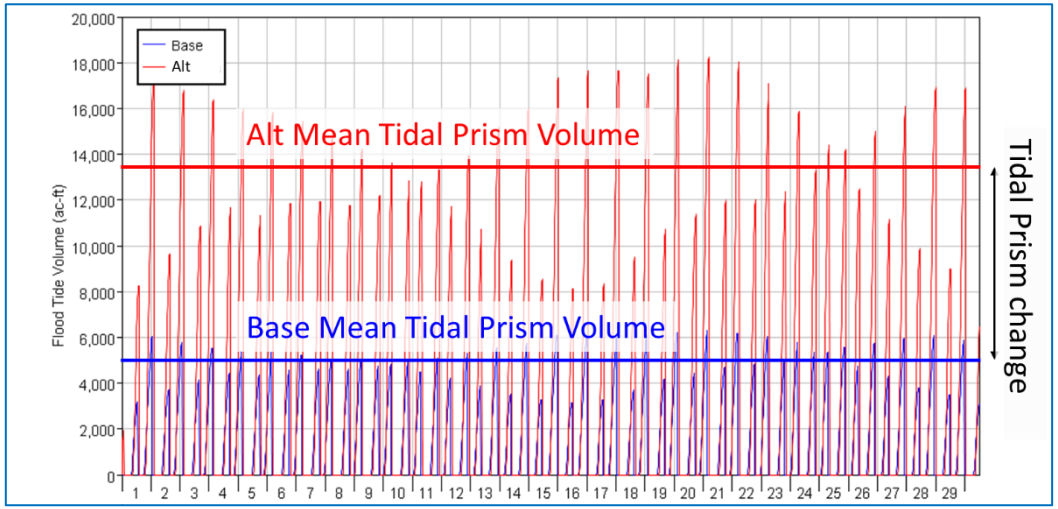


Tidal Prism Metric

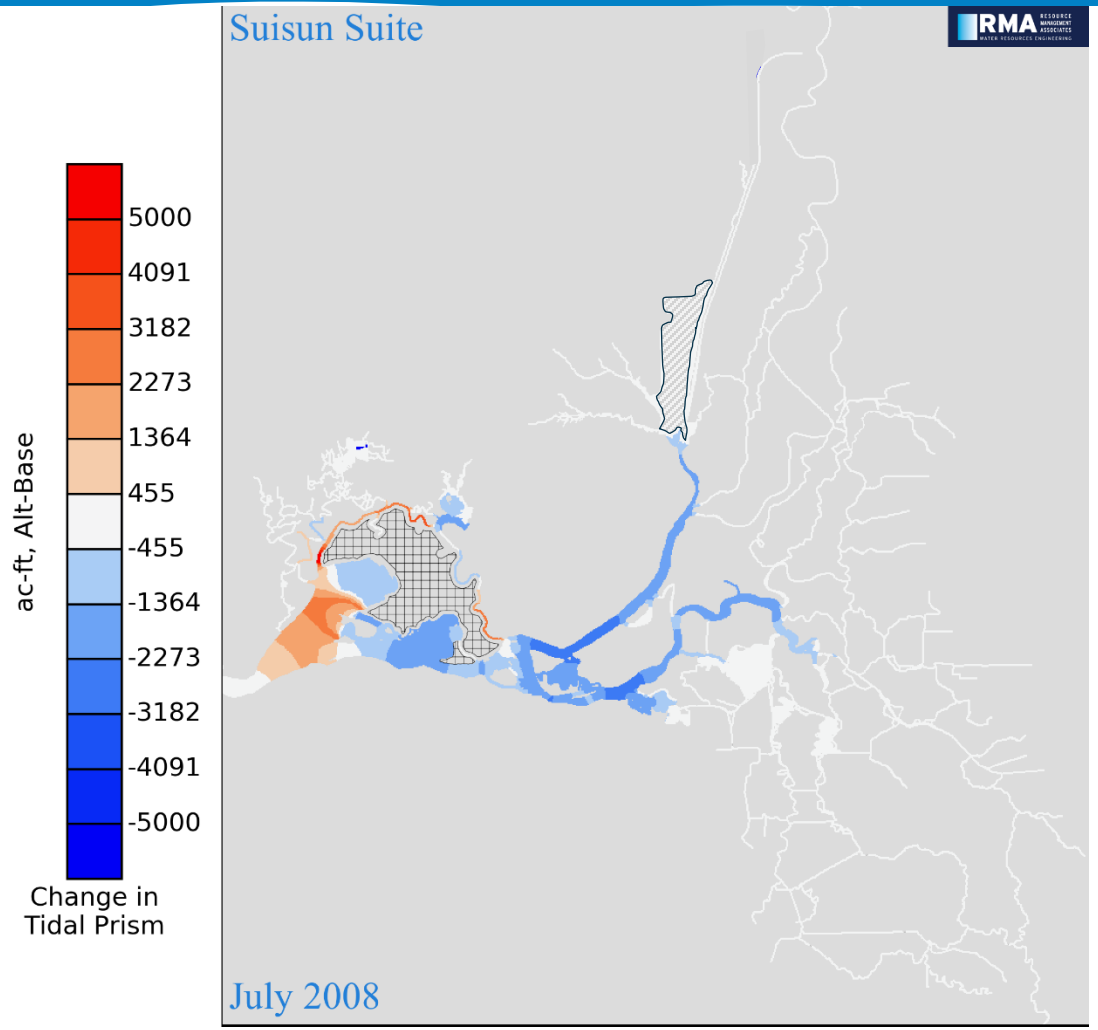


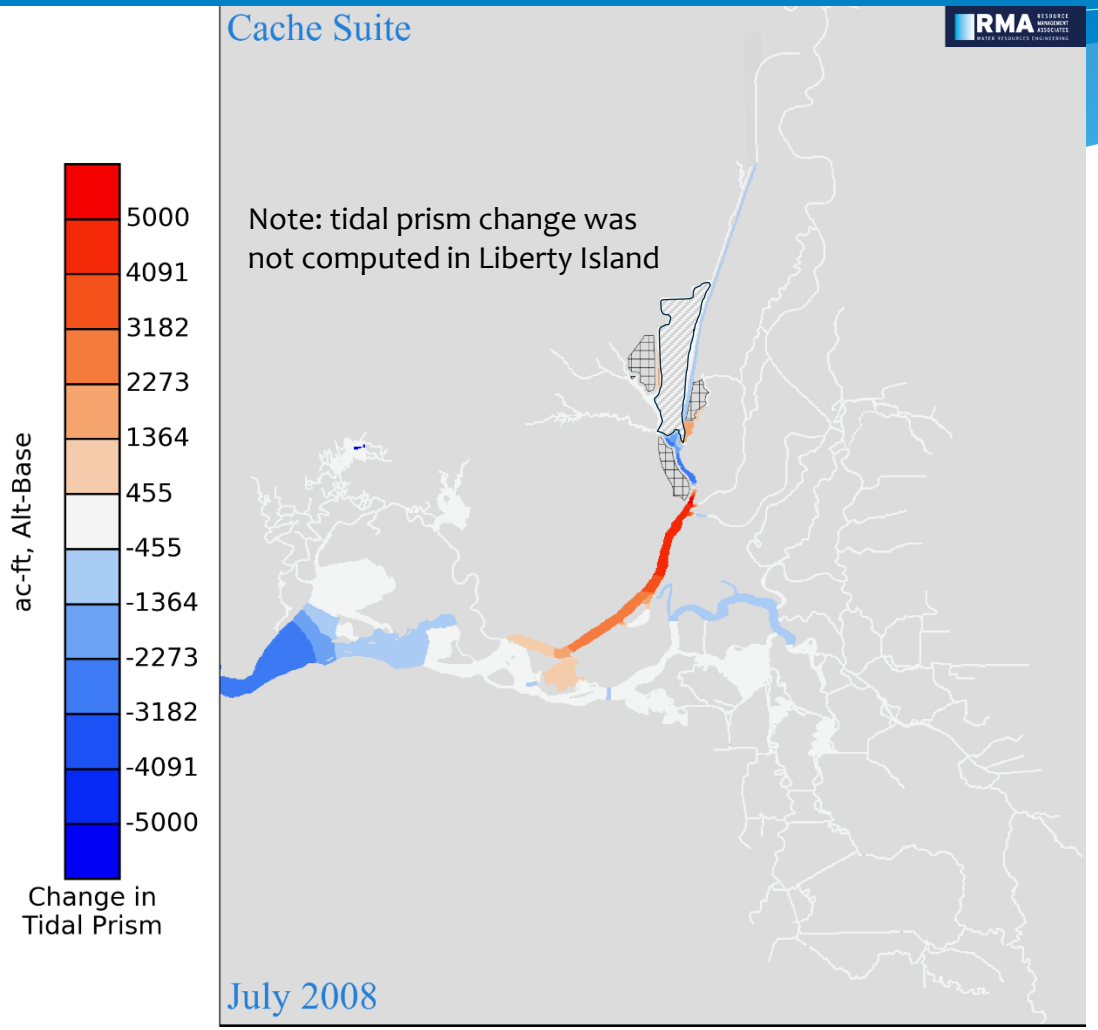
Note: example results from previous study



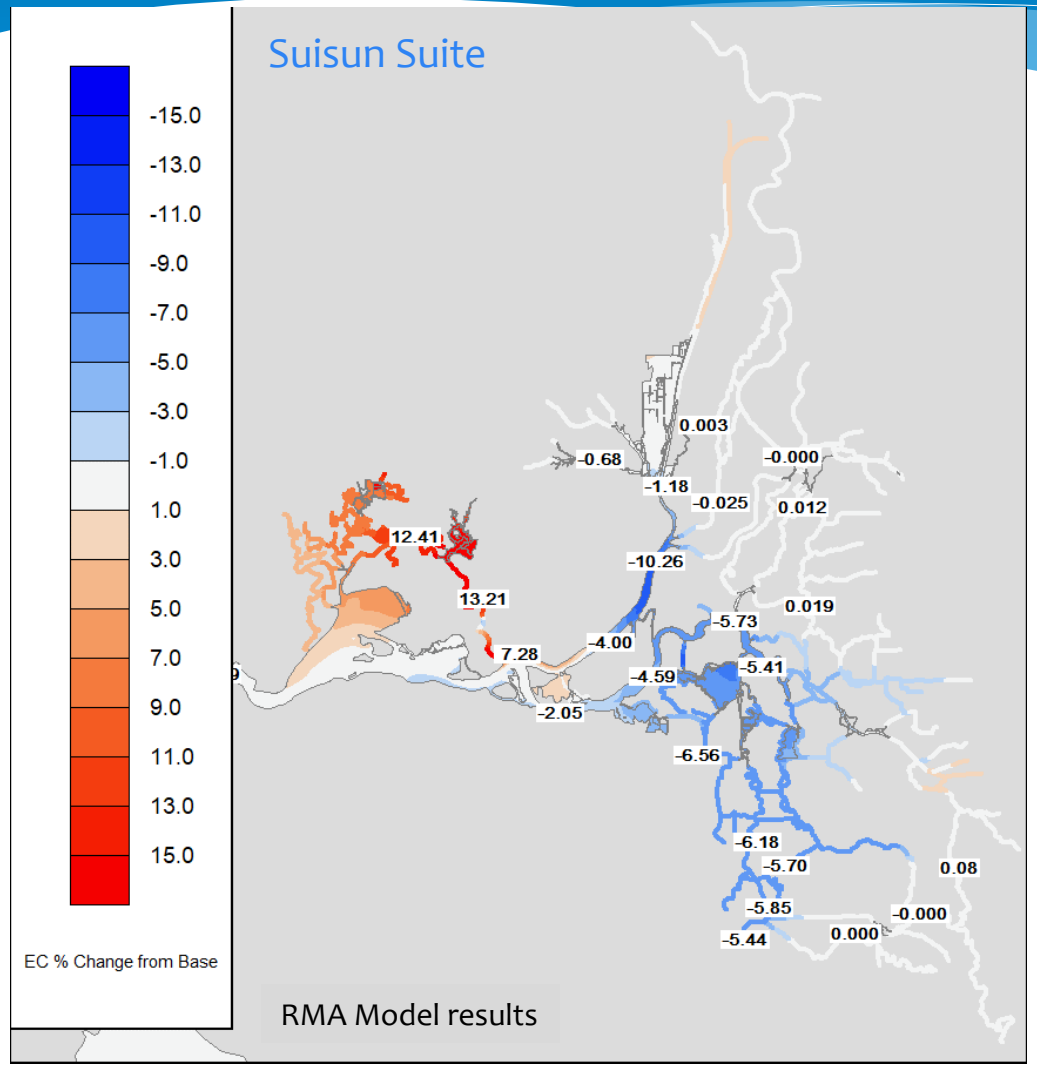


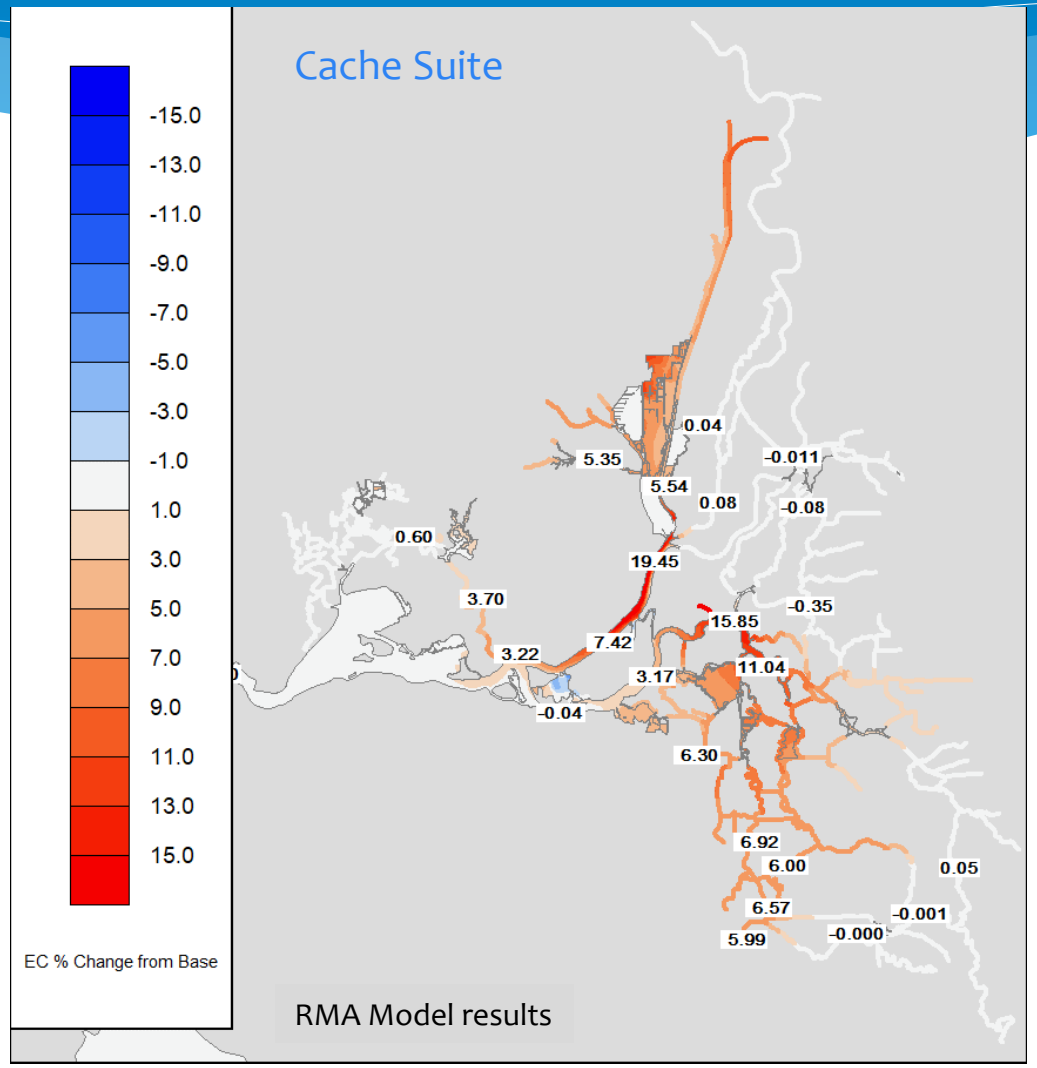
Change in Tidal Prism
Suisun and Cache Restoration Suites



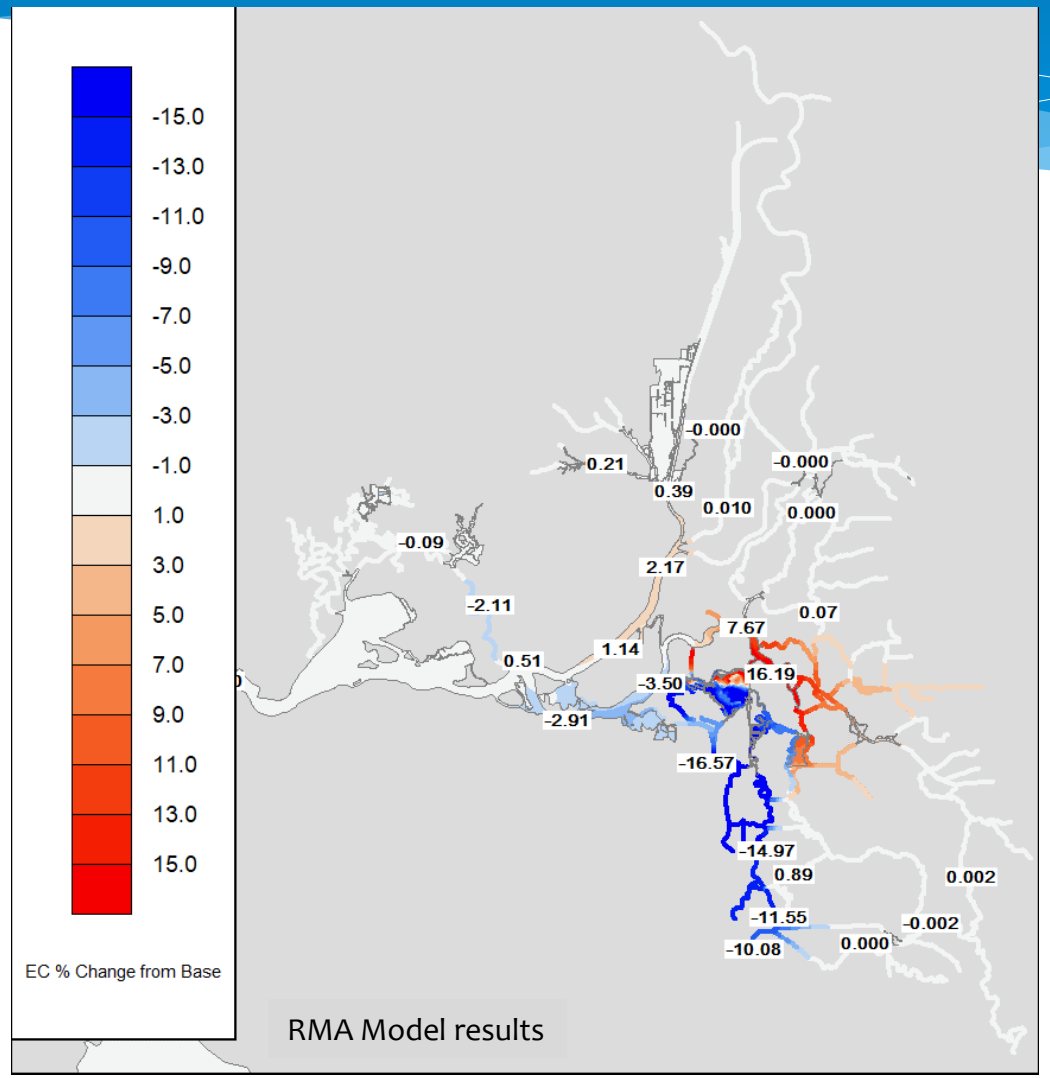


31 day depth-averaged salinity Differences Against Baseline, Case 4 August 2008





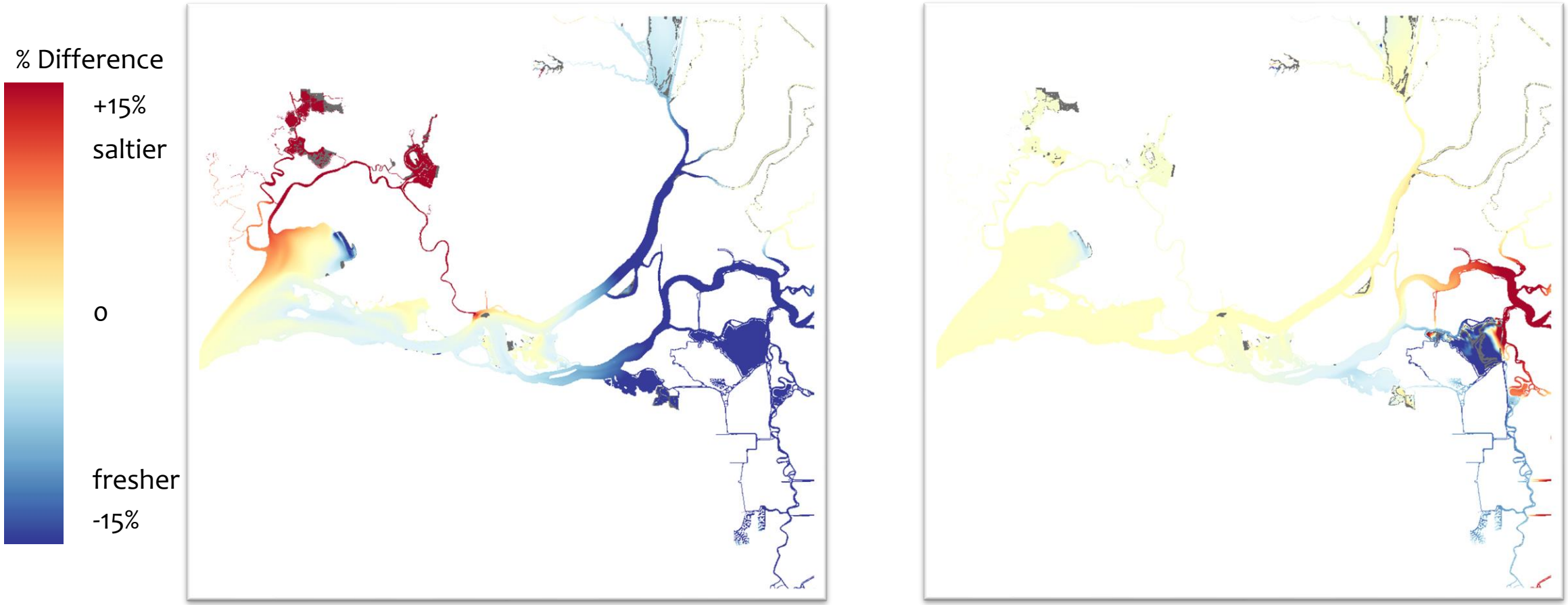
31 day depth-averaged salinity
Differences Against Baseline, Case 4 August 2008



31 day depth-averaged salinity
Differences Against Baseline, Case 4 August 2008

Suisun Suite

Franks Tract



Results from Bay-Delta SCHISM

Progress To Date and Work To Do

- Scenario Selection
  - Cache Suite, Suisun Suite, Cache and Suisun Combined, Franks Tract, Sea Level Rise
- Preparation of Training Boundary Conditions
  - Data sets in use for Multi-D models
- Scenario simulations to provide surrogate training data
  - Underway, nearly complete, QA in progress
- Surrogate Training
  - In progress
- CalSim runs to evaluate water cost change, and final round trip modeling
  - Will begin once alternate surrogates are prepared

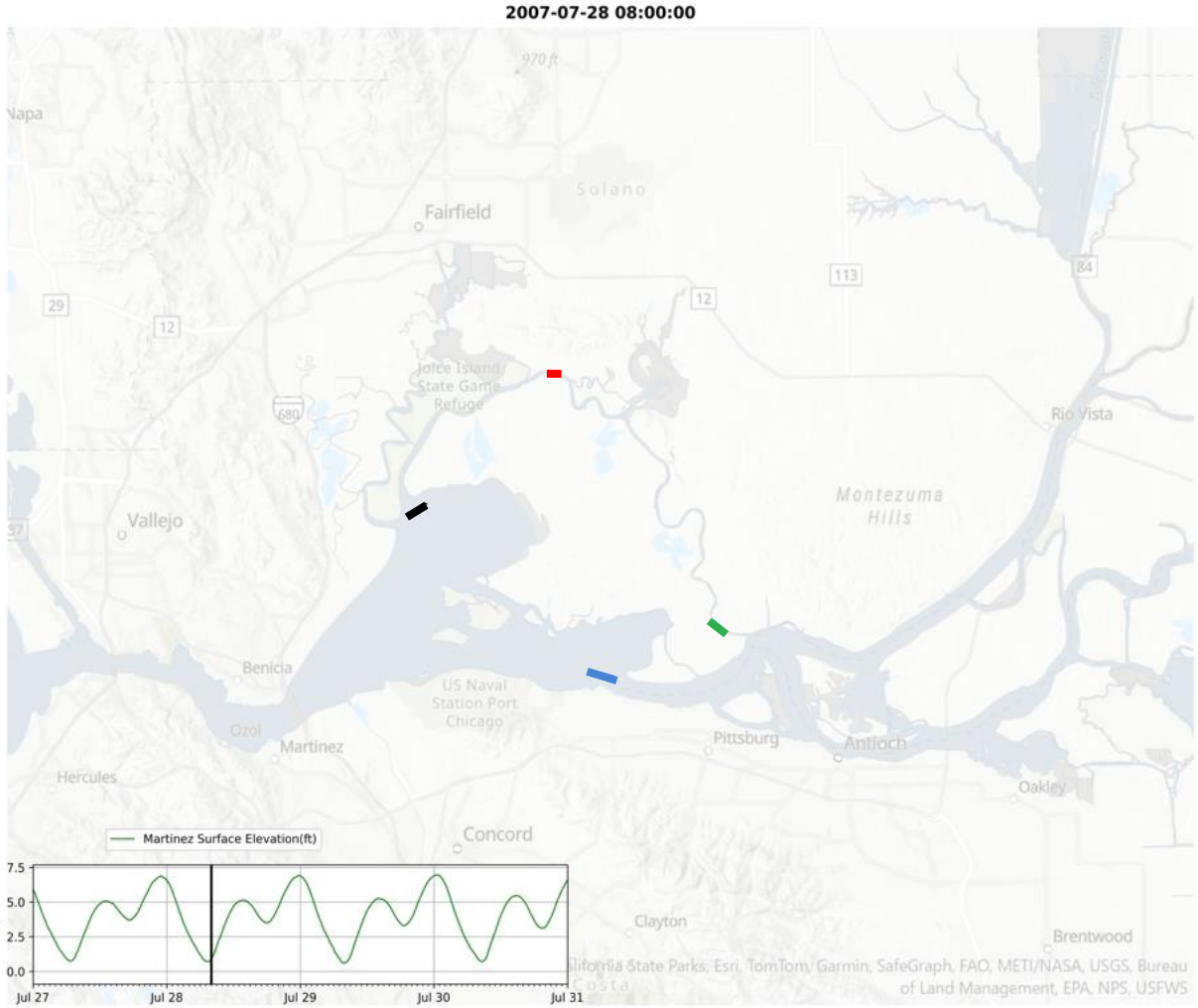

Questions?

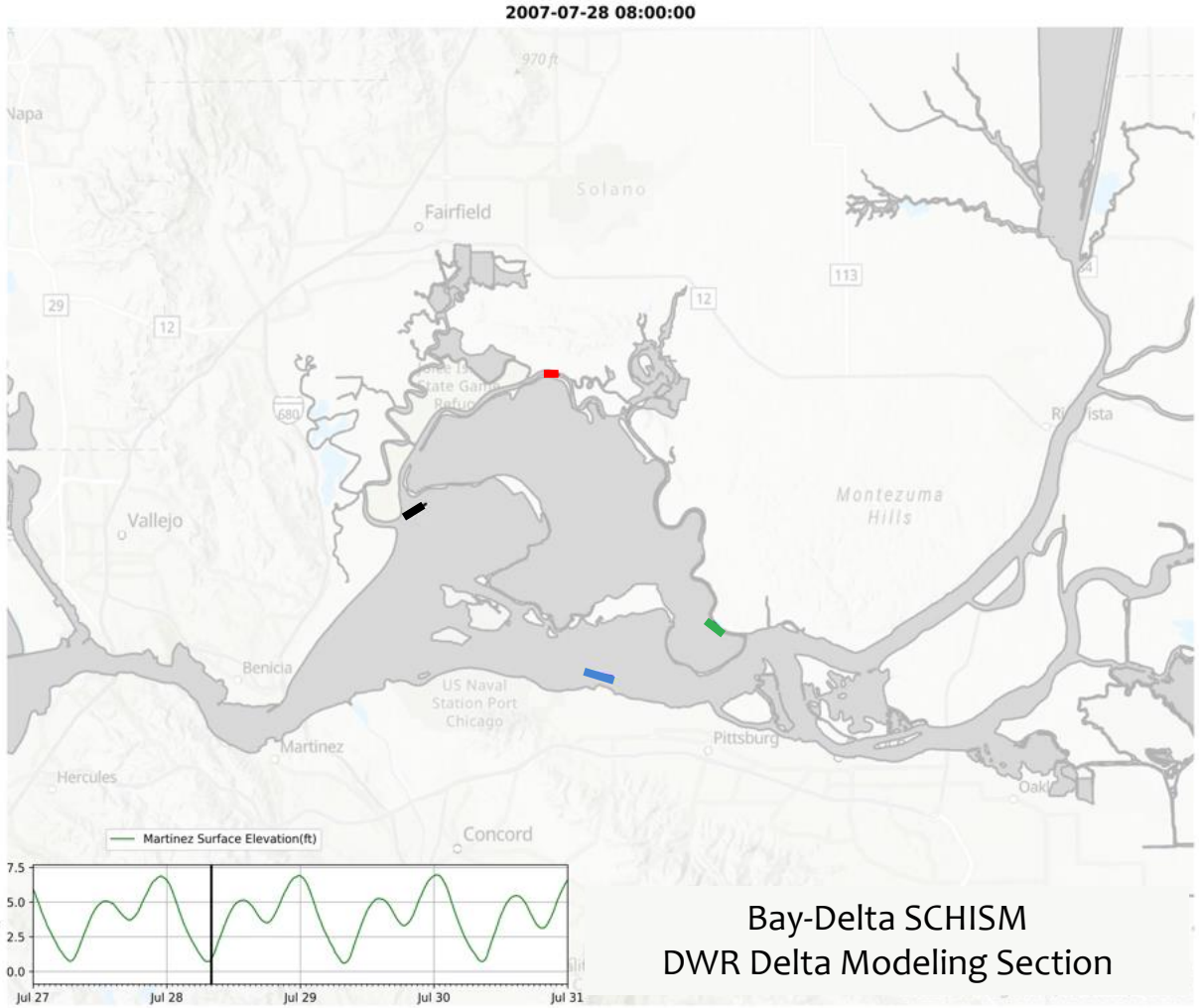
Contact Information

John F. DeGeorge, Ph.D., P.E.
Resource Management Associates, Inc.
4171 Suisun Valley Road, Suite J
Fairfield, CA 94534
(707) 864-2950
jfdegeorge@rmanet.com
www.rmanet.com

Eli Ateljevich, Ph.D., P.E.
California Department of Water Resources
1516 Ninth St, 2-207
Sacramento, CA 95814
(916) 902-6984
Eli.Ateljevich@water.ca.gov

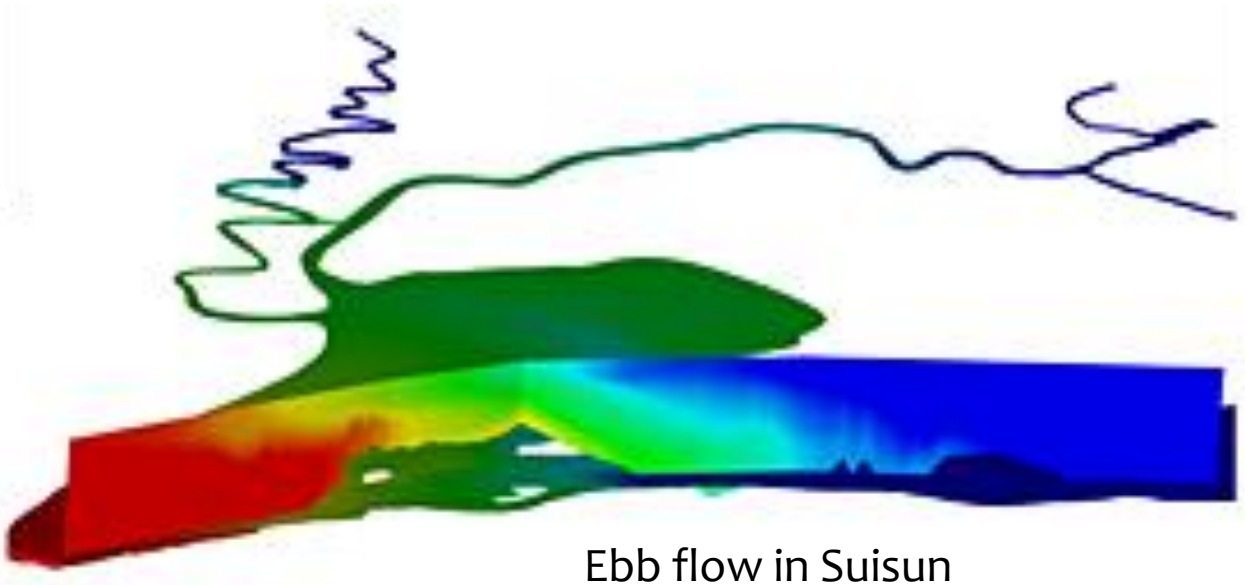
Particle Tracking with and without Delta geometry change



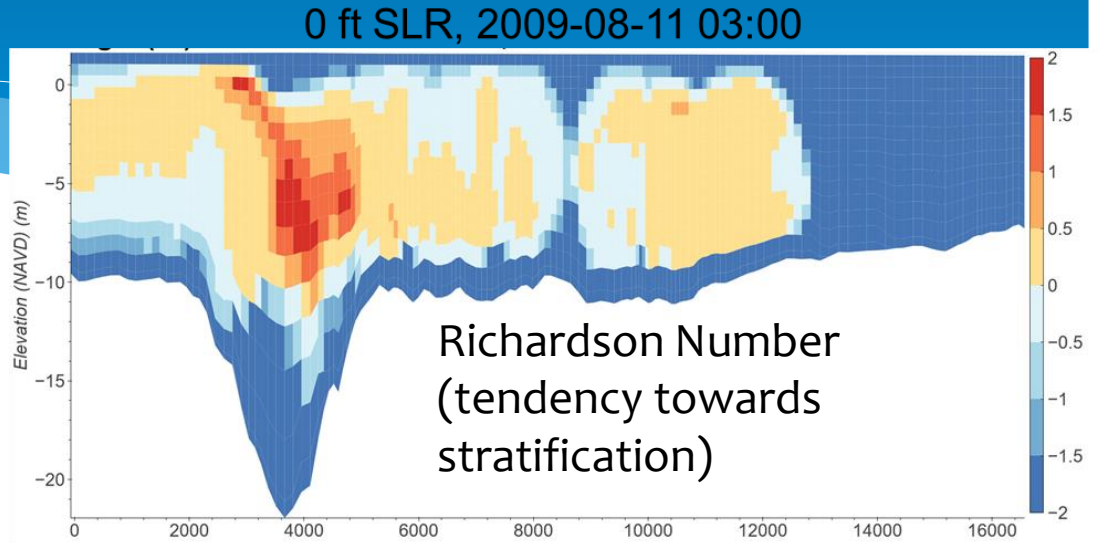


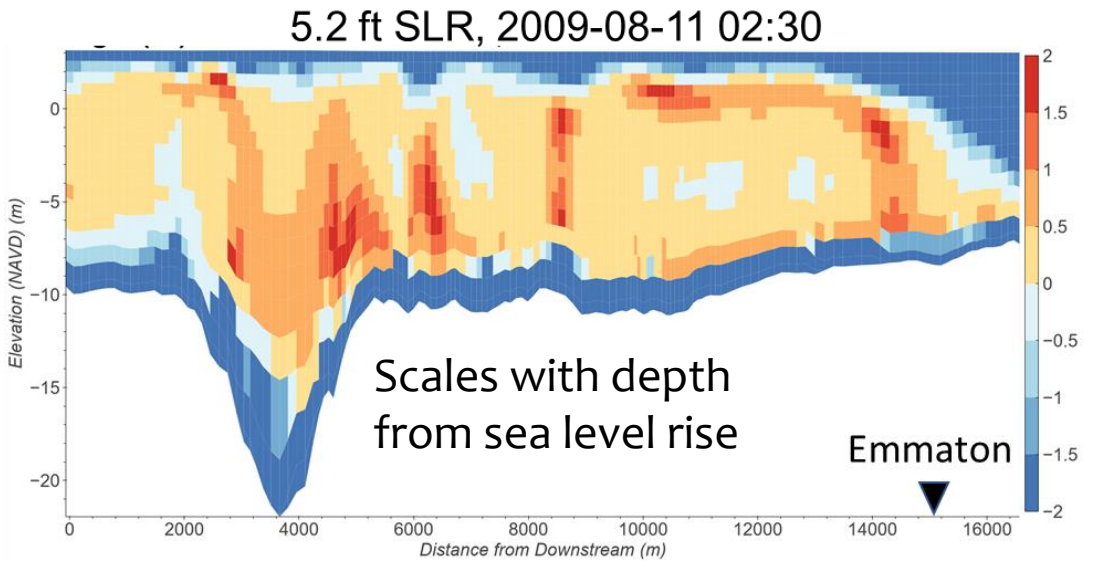
Bay-Delta SCHISM
DWR Delta Modeling Section

Sea Level Change: Density-Driven Mixing



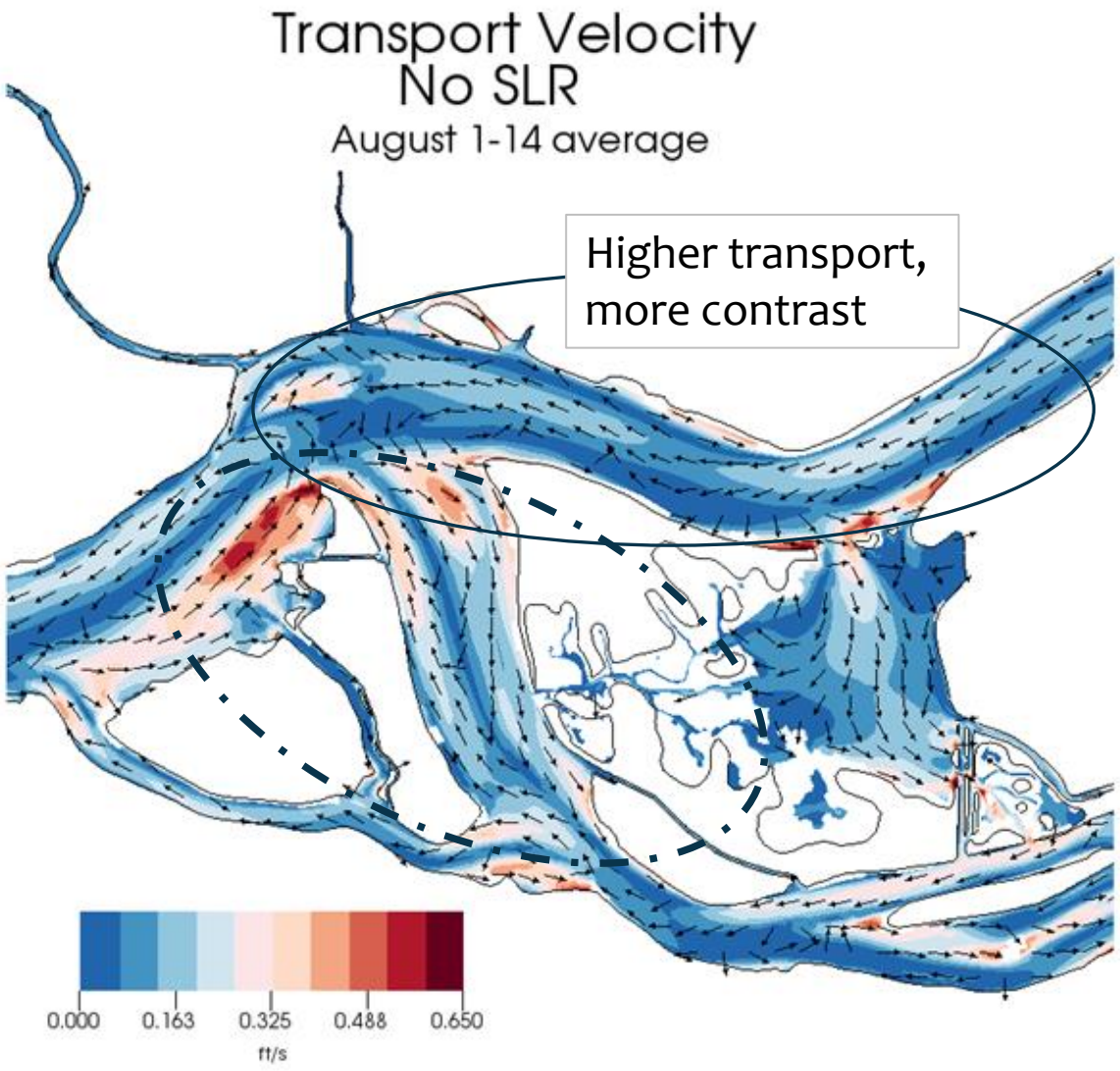
Ebb flow in Suisun Bay with enhanced stratification

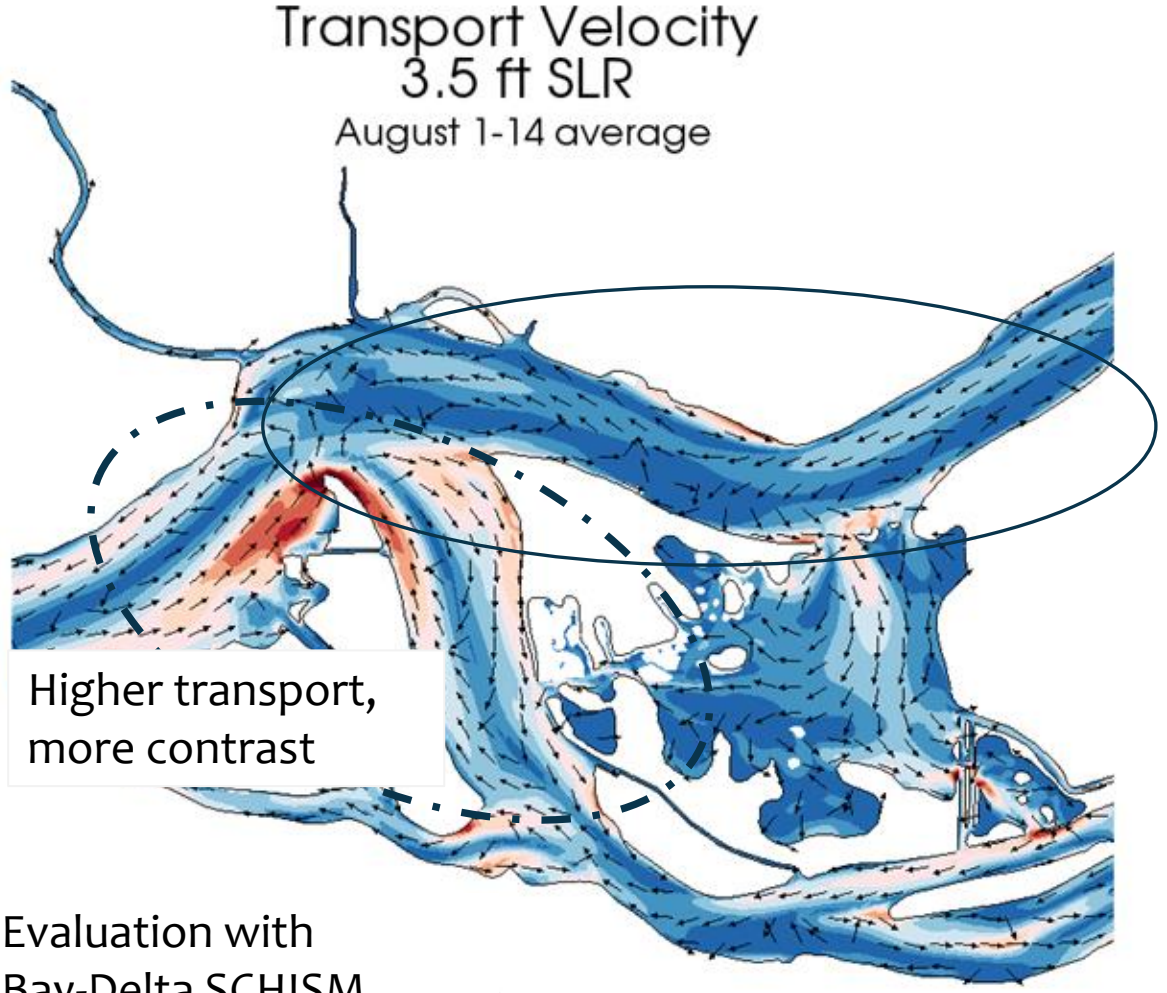




Stratification relevant at both tidally averaged and periodic time scales

Sea Level Change: Horizontal Transport





Evaluation with
Bay-Delta SCHISM