
34NORTH
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Constituent Tracker
SWC/DWR
Briefing 4/5/2022
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https://www.baydeltalive.com
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Talk Outline

- ✓Example of what the constituent tracker does
- ✓Data assimilation in time and space - Salinity Tracking example
- ✓Survey of possible “use cases”

- ✓Initial use case – Tracking Turbidity
- ✓Telling stories by combining constituent tracker heat maps with time series analysis
- ✓Brief description of how the constituent tracker works

- ✓Example of Phytoplankton Bloom Tracking
- ✓Example of importance of tracking salinity in droughts
- ✓Conceptual BDL Time Series Data Access Interface

- ✓Questions

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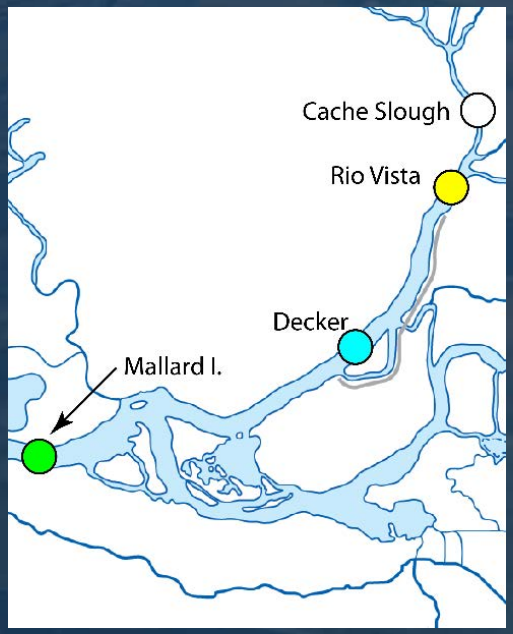
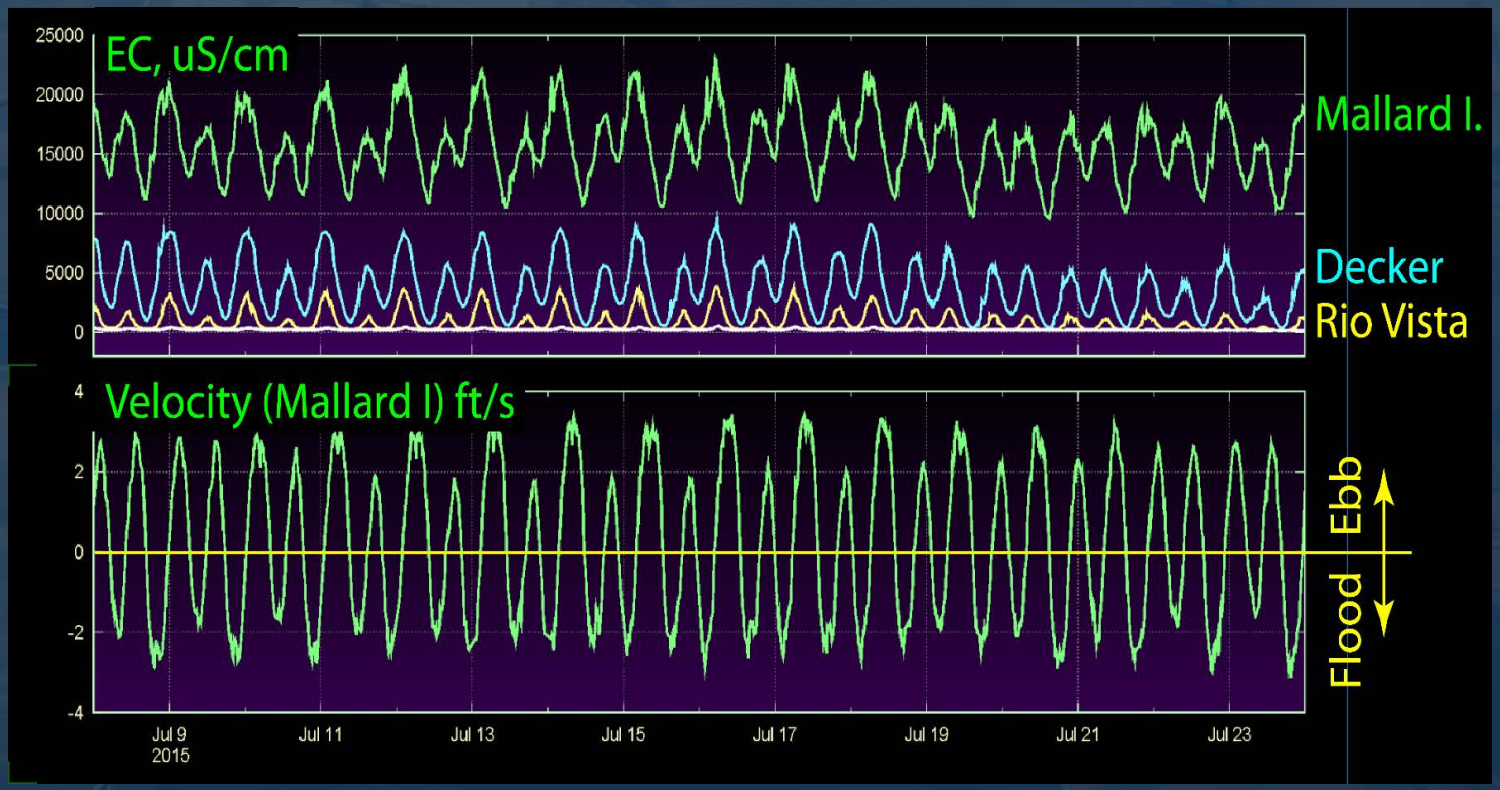
Salinity Intrusion

Time Series example of a WQ field sloshing back and forth with the tides





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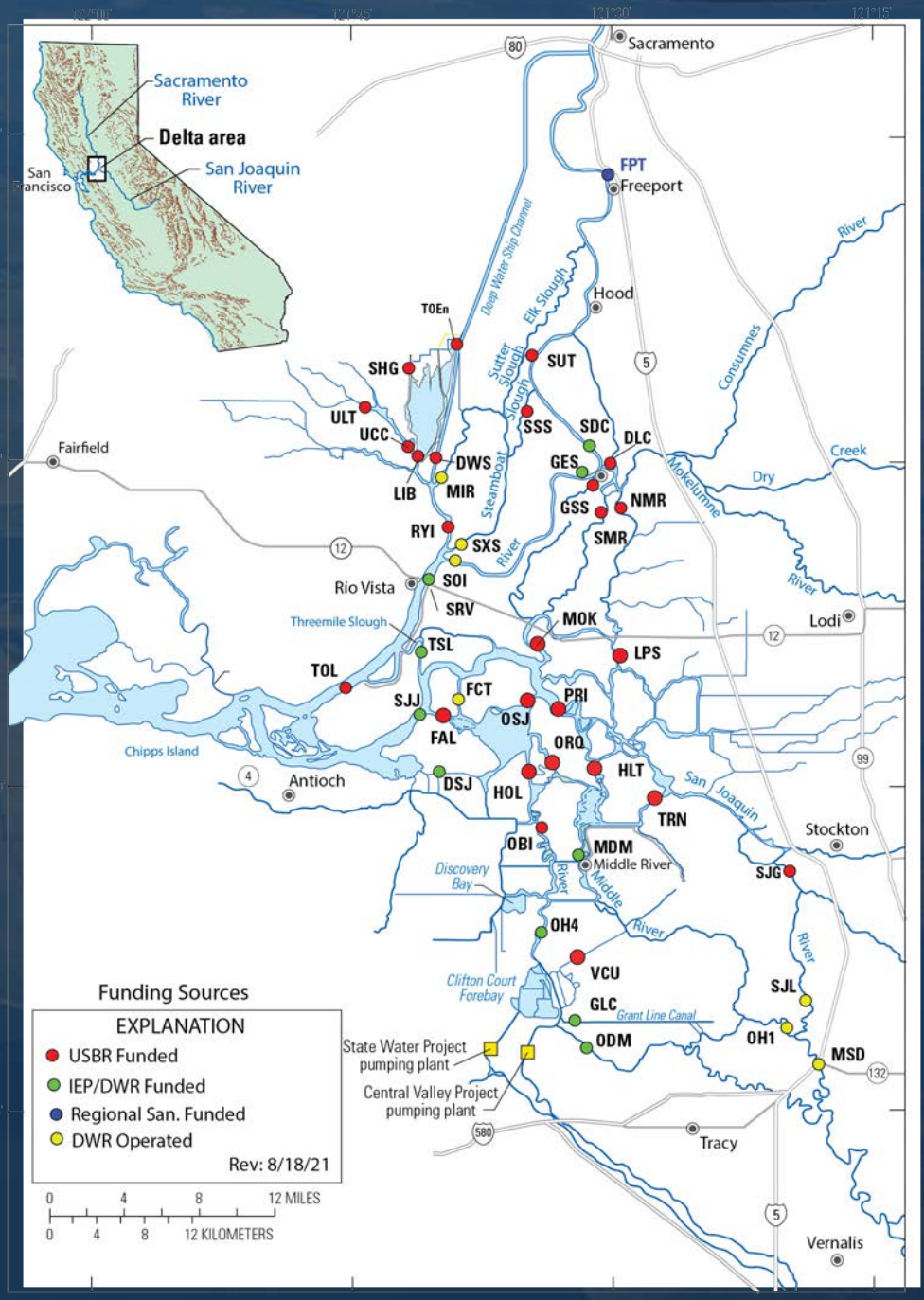
There are over 50 flow/WQ stations
in the Delta

Assimilating and understanding 50 WQ
times series records in time and space
is impossible W/O a tool like the
Constituent Tracker

The Constituent Tracker Combines and
leverages
all the time series Data collected in the Delta

By animating heat maps
of constituent fields



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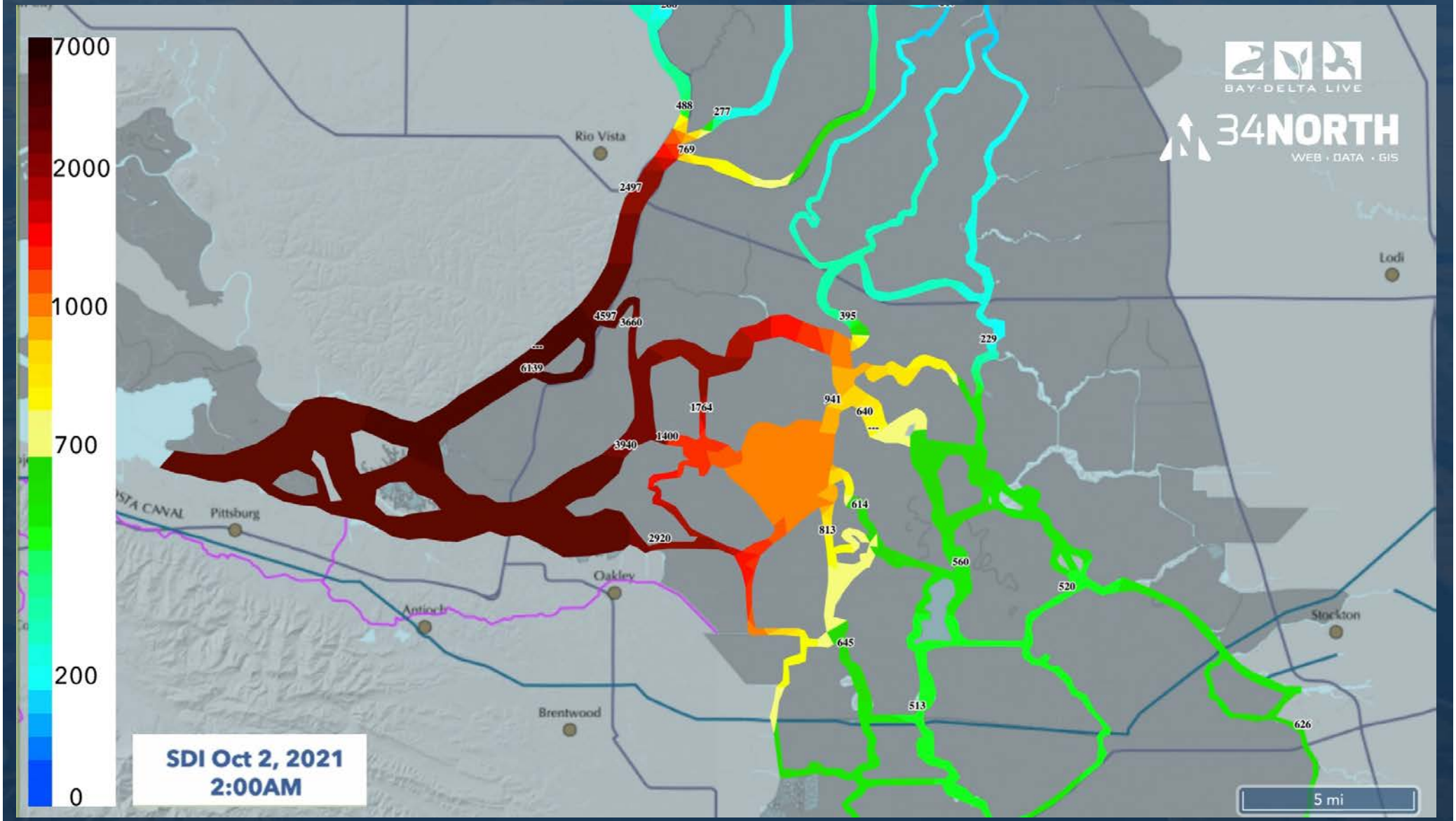
Maximum Flood Tide: Electrical Conductivity Oct 2 to Jan 9



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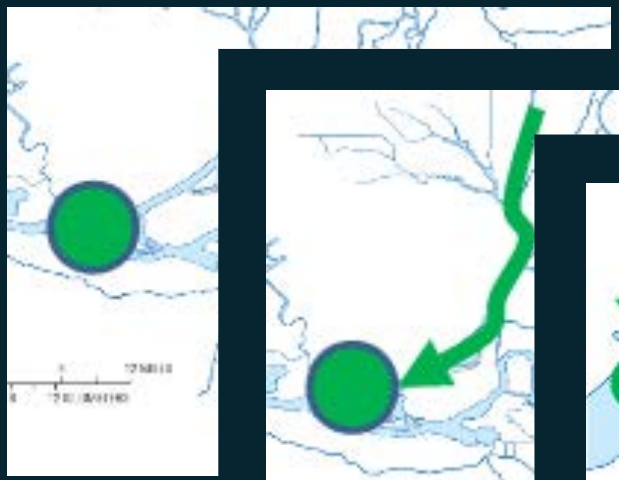
Summary of management challenges (Use Cases) the Constituent Tracker can address

Turbidit

Salinity



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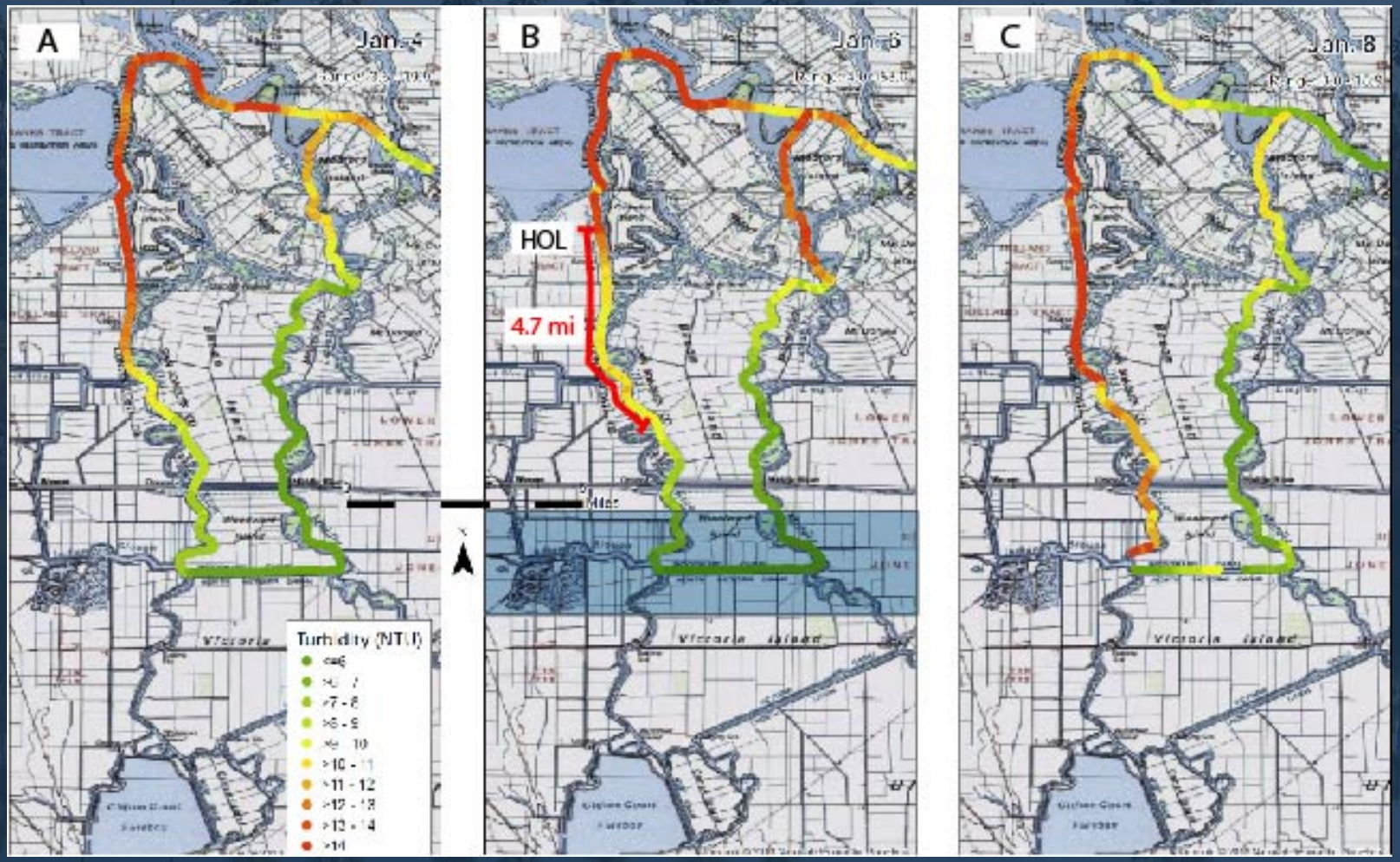
First Application – Turbidity Tracker

DWR's boat-collected turbidity transects were used by smelt working group

Transects can produce spurious (tidally) aliased spatial maps

Transects are expensive and unnecessarily put people at risk



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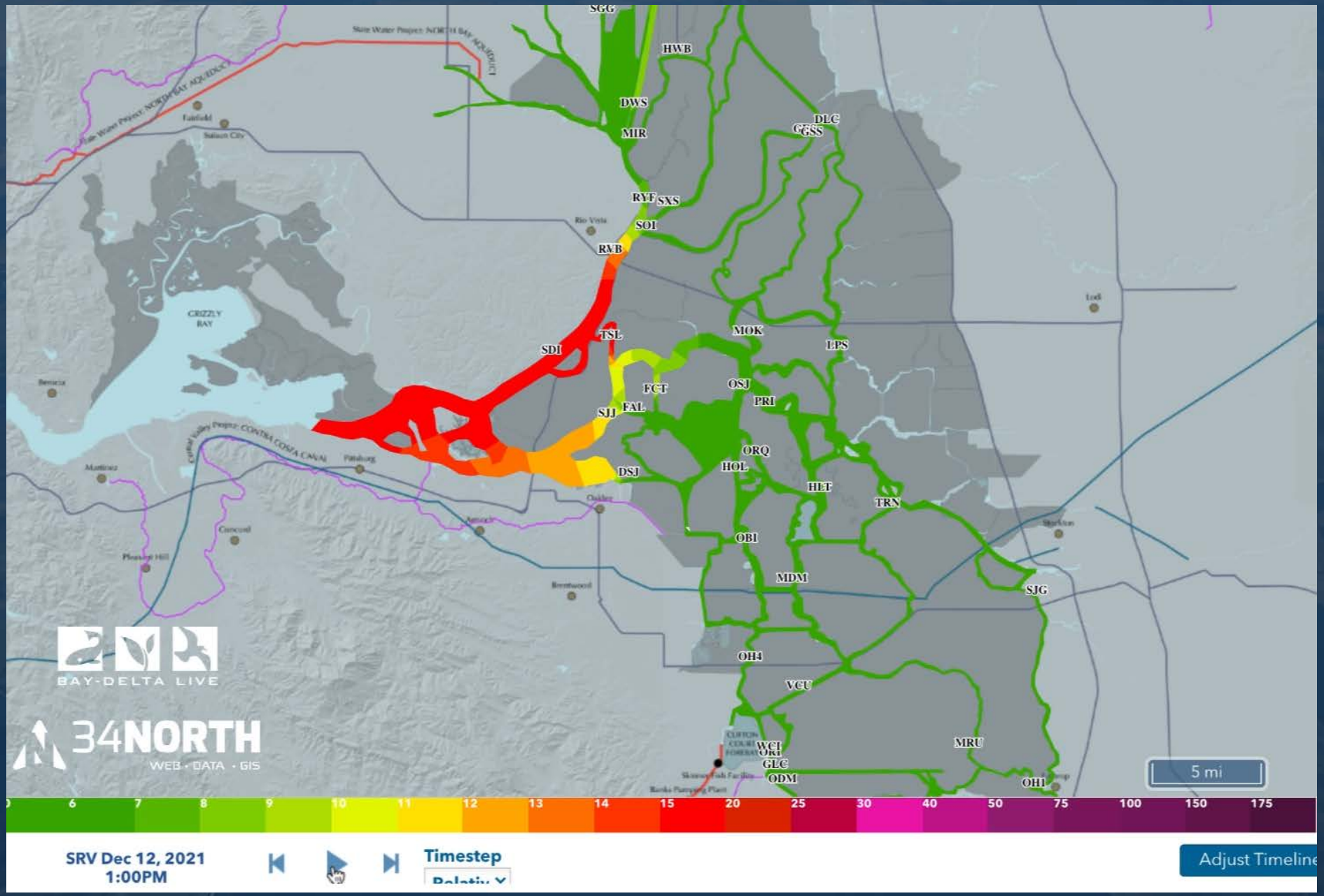
Maximum Flood Tide: Turbidity Dec. 12 to Jan. 9, 2022



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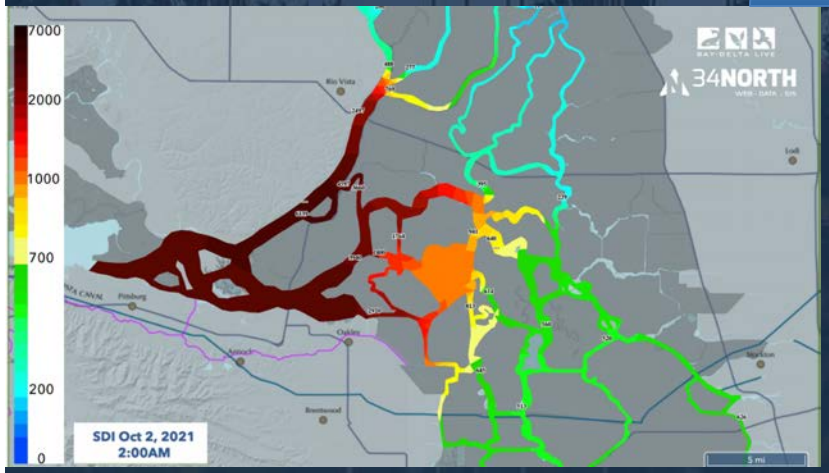
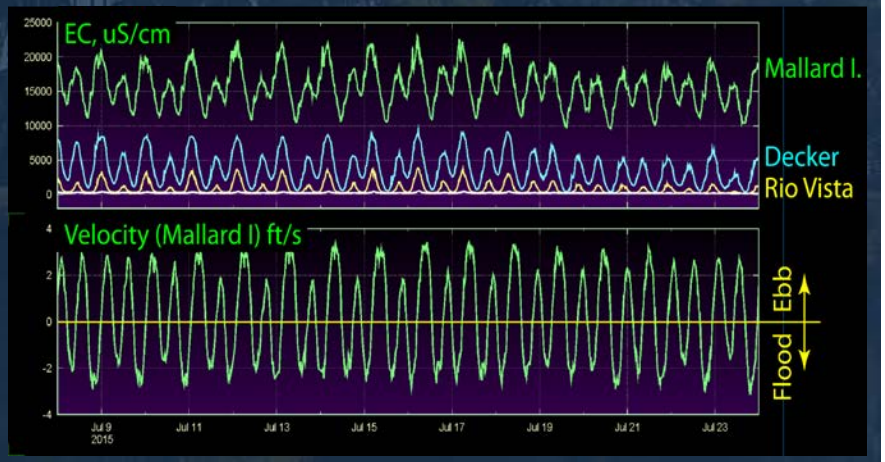
Analytical Approach

Use both the evolution of Spatial Structures (Constituent Tracker)
and time series analysis to uncover, explain and document what is going on





Qualitative
Good for exploratory work
explaining what is happening
to non-experts

Quantitative
Harder to initially see
big picture, for publication in combo
with heat maps

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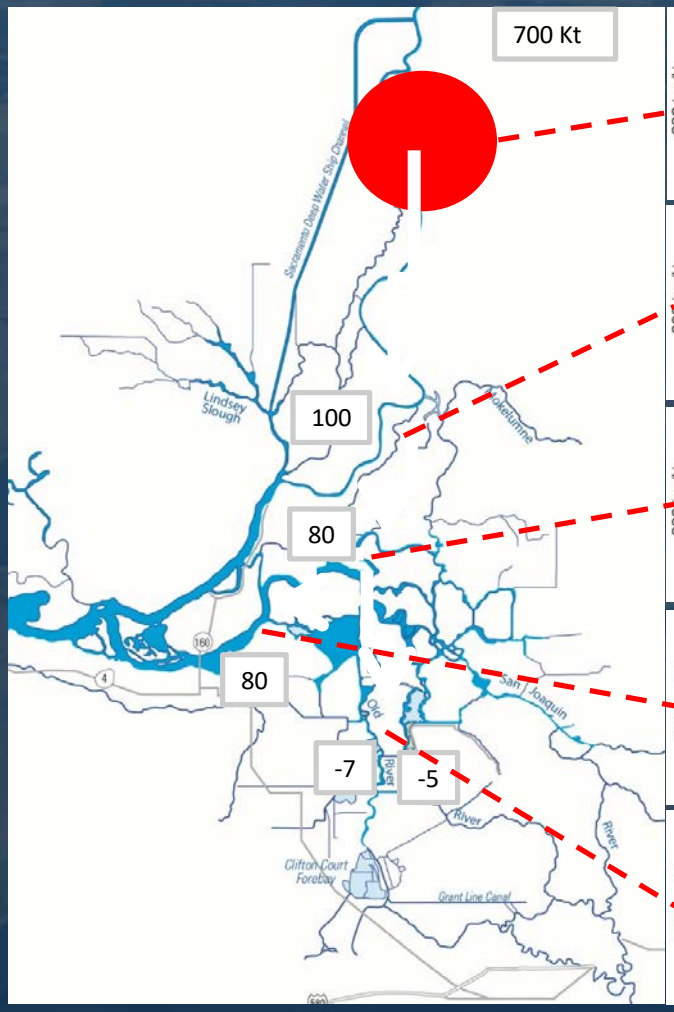
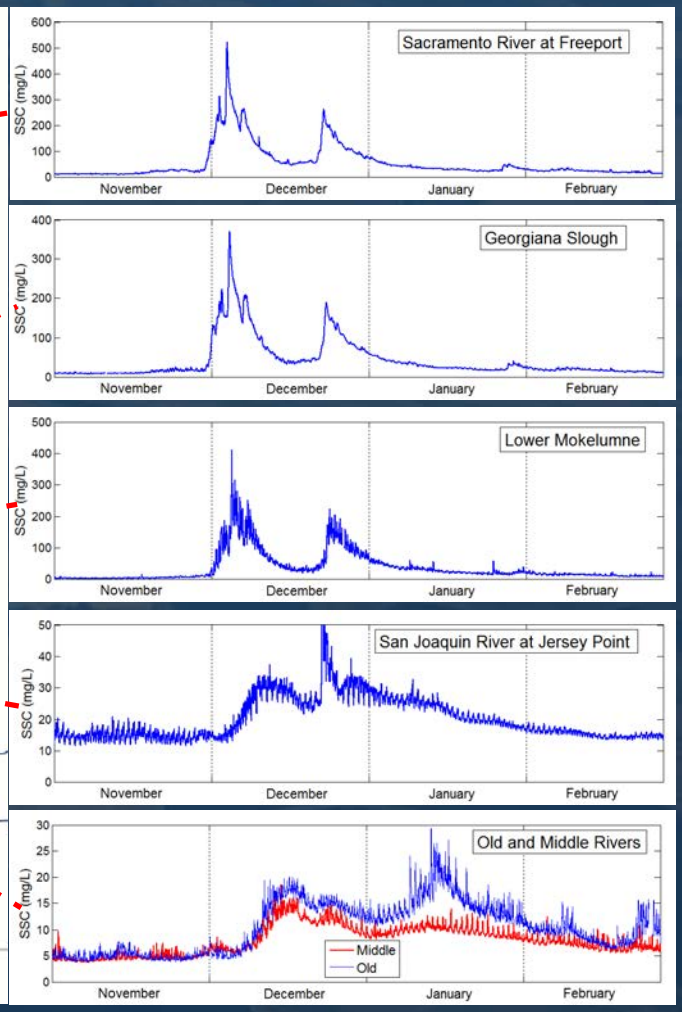
Georgiana Slough is the main source of turbidity in the Central and South Delta

Not the Confluence or 3mi Slough

Kt = thousand metric ton

SSC = Suspended Sediment Concentration





(After Morgan and Wright, 2015)

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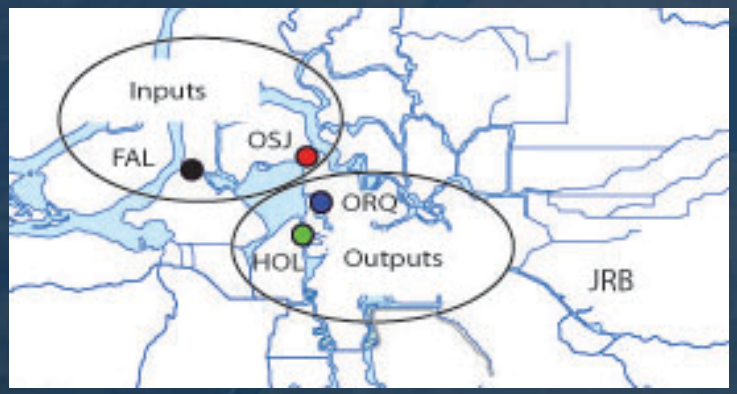
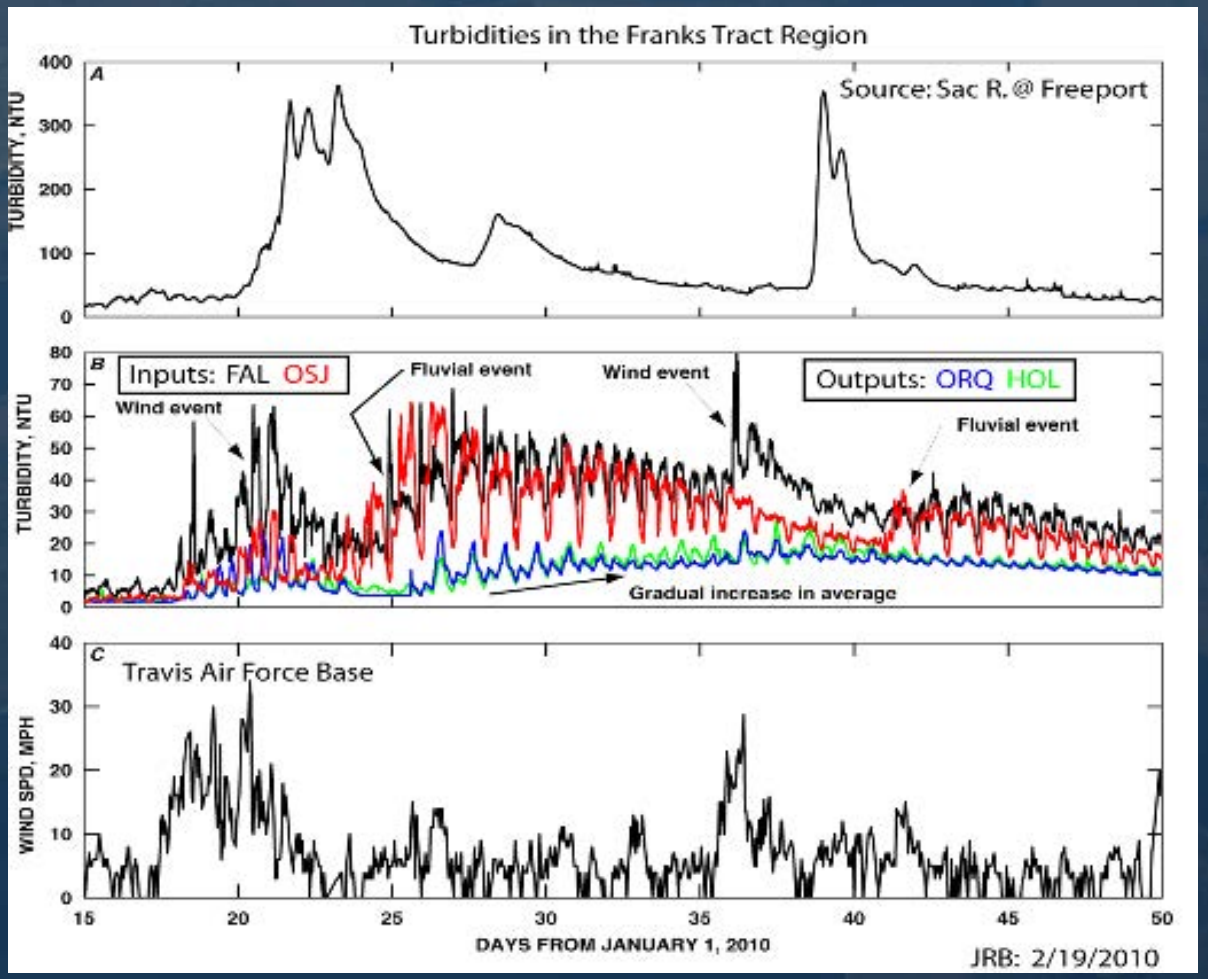
Flooded Islands act like settling basins

Turbidities drop dramatically across Franks Tract





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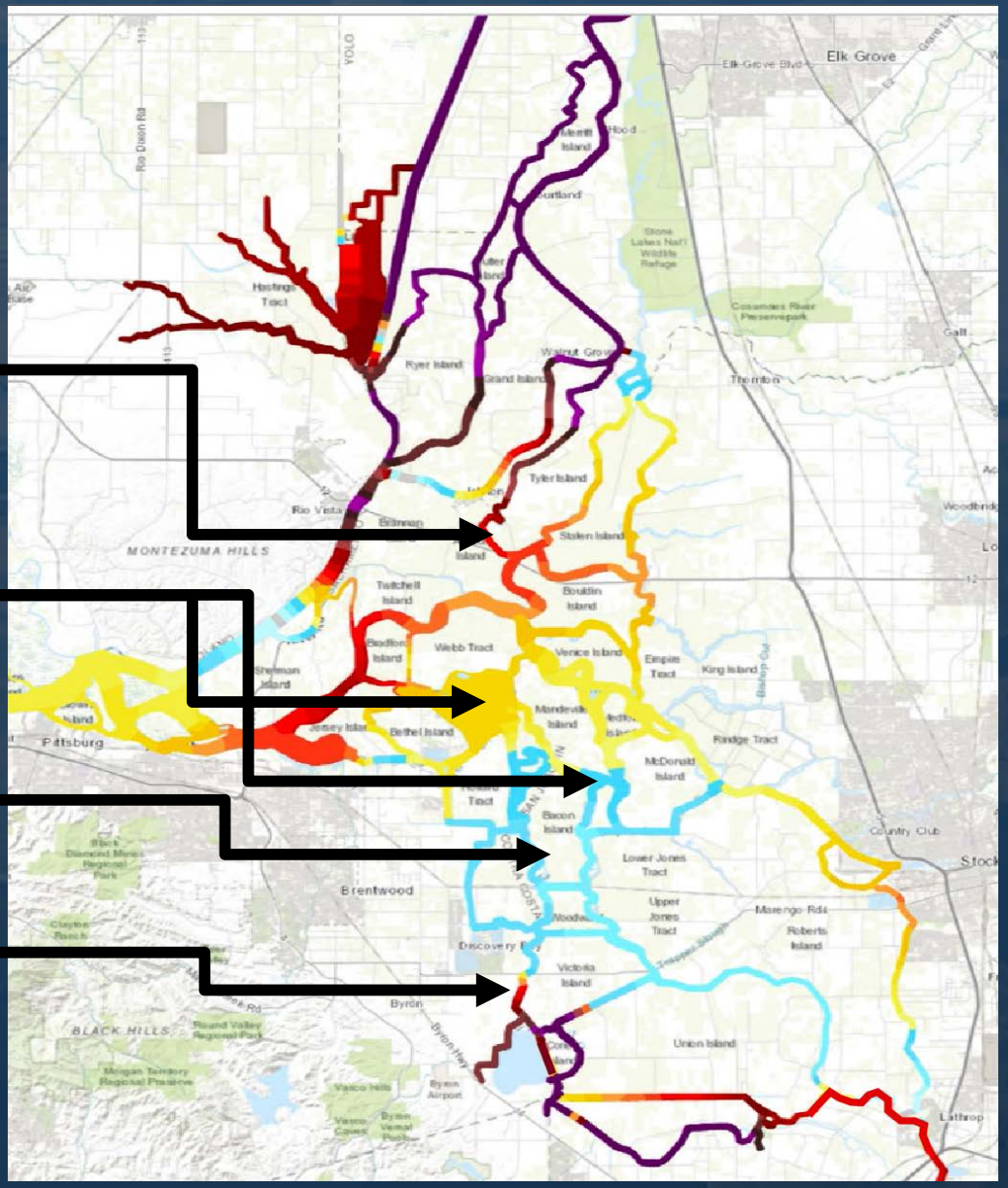
Flooded Islands act like settling basins

Georgiana Slough is the main source of turbidity for the Central and South Delta

Flooded Islands act like settling basins (e.g. Franks and Mildred)

Which creates a clear water region

Turbidity that enters the south Delta from the San Joaquin is mostly exported and does not close the “turbidity bridge”



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Constituent fields can be animated at:

Two timescales

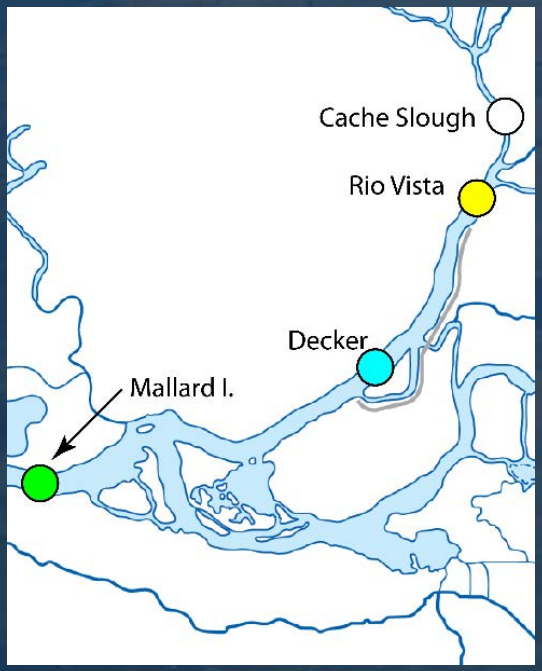
(1) Tidal timescale by plotting 15 min data

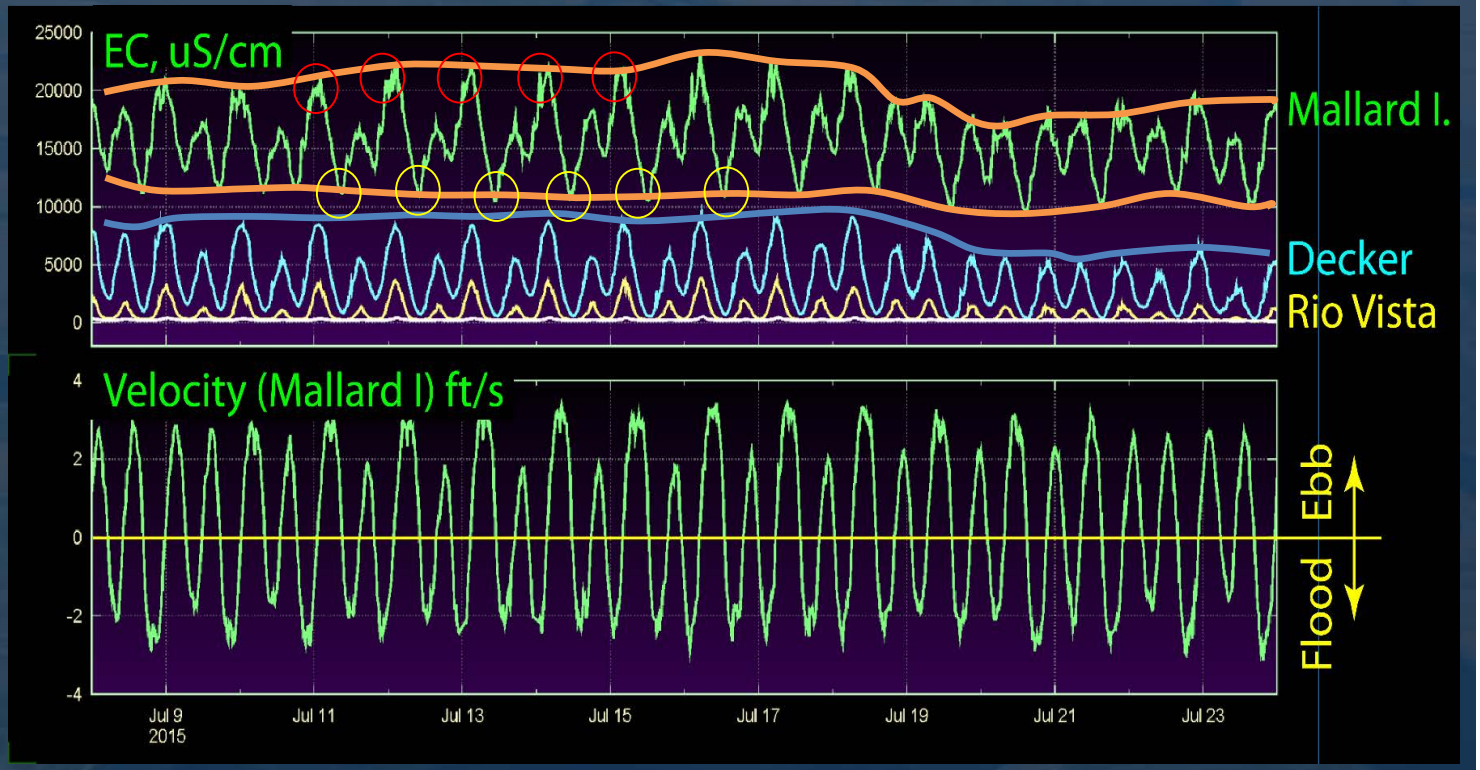
(2) Tidally averaged timescale – constant point in tide at either:

a. Slack after flood (most useful for fluvial sediment tracking, salinity intrusion) or

b. Slack after ebb

Salinity Intrusion – Constant Point in Tide





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Constituent fields can be animated at:

Two Spatial Scales

(1) Linear interpolation between stations

(2) Using an advection algorithm to estimate spatial structure at slack water between stations based on tidal excursion estimated from measured velocity at each site

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What is the tidal excursion?

(Courtesy of John DeGeorge, RMA)

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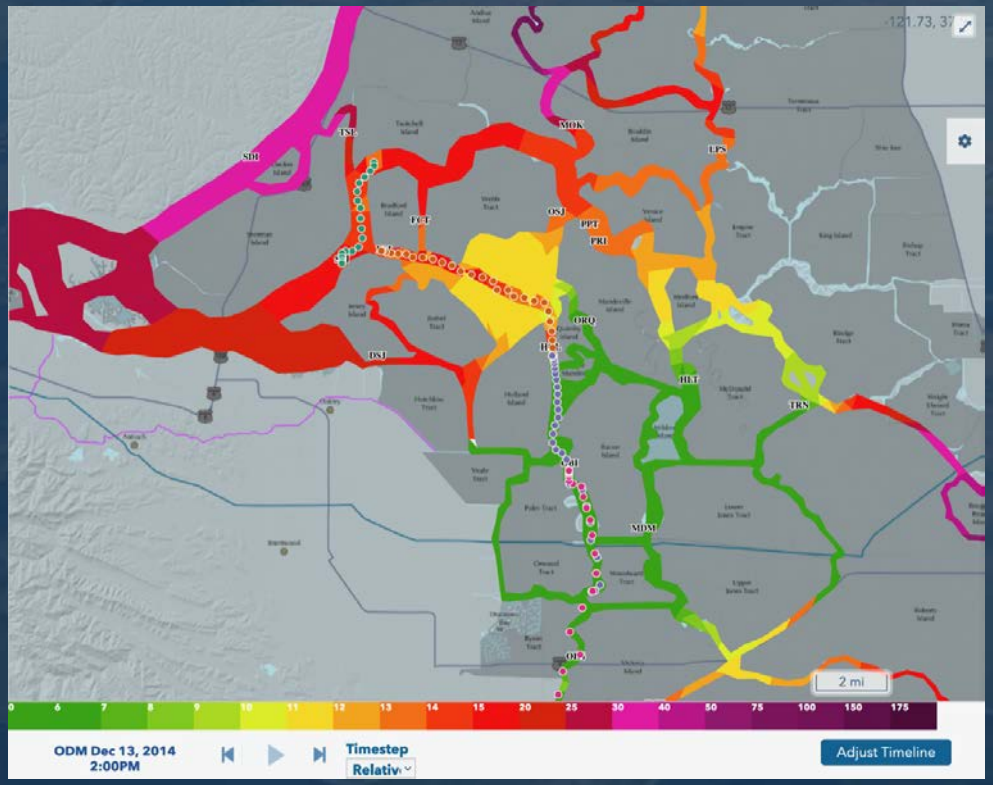
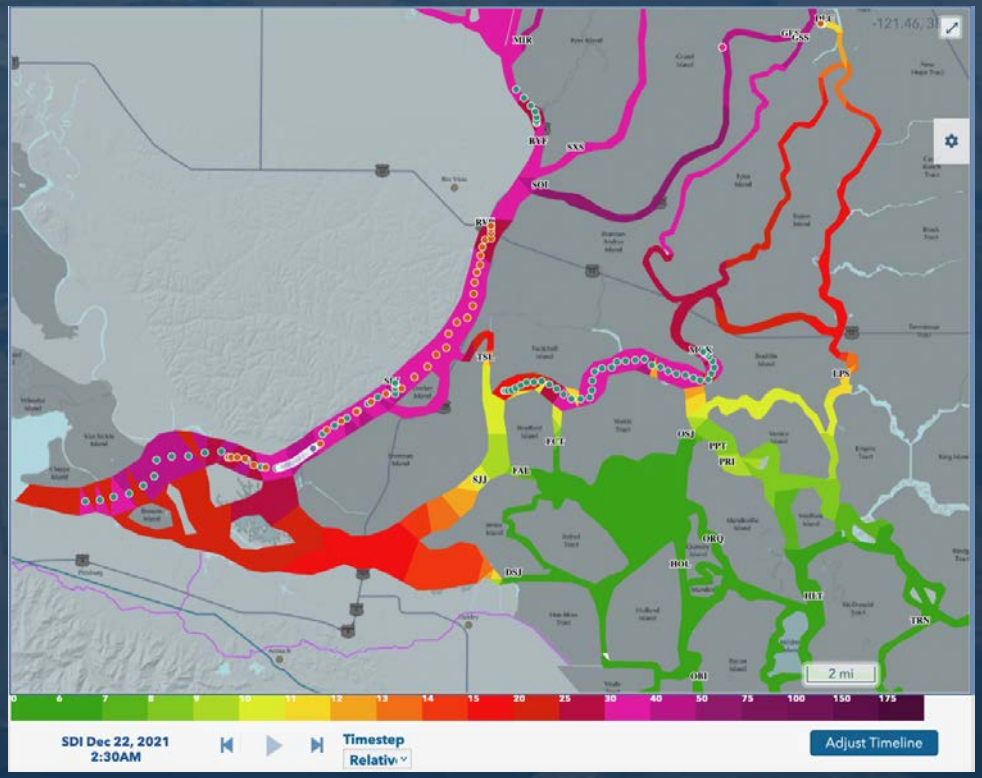
Example Constituent Tracker Tidal Excursions (particle tracks)

In False and Old Rivers
(Flood)



In SJ from Mokelumne
In Lower Sac (Ebb)



Turbidity Heat Maps

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The constituent tracker has a great deal under the hood.. For Example:

Advection Algorithm

Objective: More accurate estimates of the spatial variation between stations is achieved through the 1D adv-dispersion equation

$$\frac{\partial c}{\partial t} = -u(e)\frac{\partial c}{\partial x} + D\frac{\partial^2 c}{\partial x^2} + S$$

Generally, in the Delta
Advection >>Dispersion>>Source/Sinks

$$-u(e)\frac{\partial c}{\partial x} >> D\frac{\partial^2 c}{\partial x^2} >> S$$

Assume pure advection – then correct for timing (advection) errors and dispersion using data assimilation

$$\frac{\partial c}{\partial t} = -u(e)\frac{\partial c}{\partial x} + D\frac{\partial^2 c}{\partial x^2} + S$$

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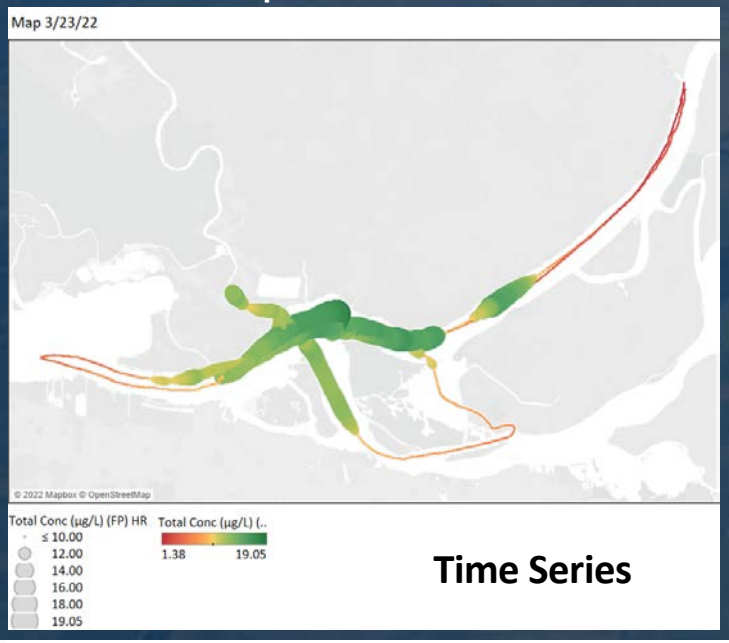
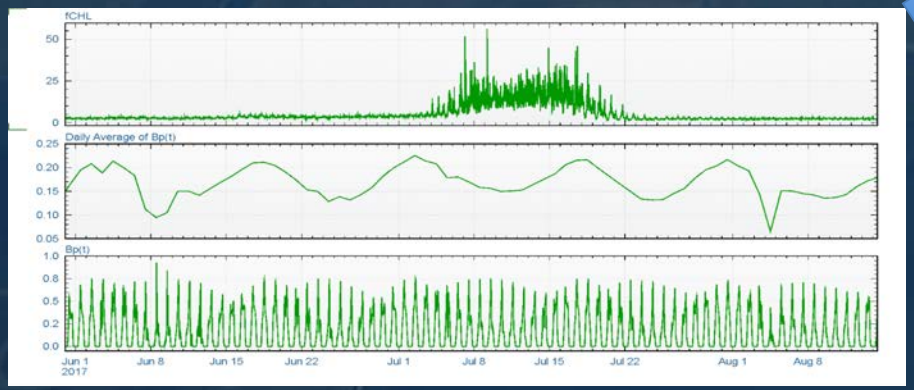
Conceptual example of advection algorithm used on phytoplankton bloom

Example of phytoplankton bloom – Chl mapping in the field

Spatial structure

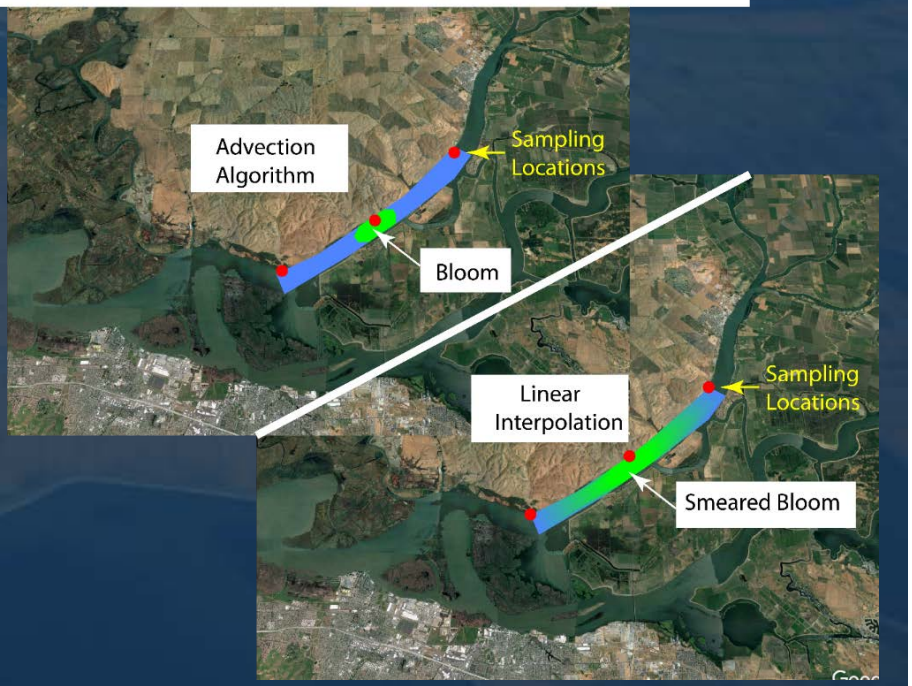


Time Series



Constituent tracker with advection algorithm

Plan to Improve Spatial Resolution



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Importance of Tracking Salinity During Severe Droughts (Like Now!)

Constituent Tracker Snap Shots used to tell a Story

Story
DCC Gate Closures used to meet Rio Vista flow standard
Started salinity intrusion into Franks Tract through Old River

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Constituent Tracker Snap Shots used to tell a Story

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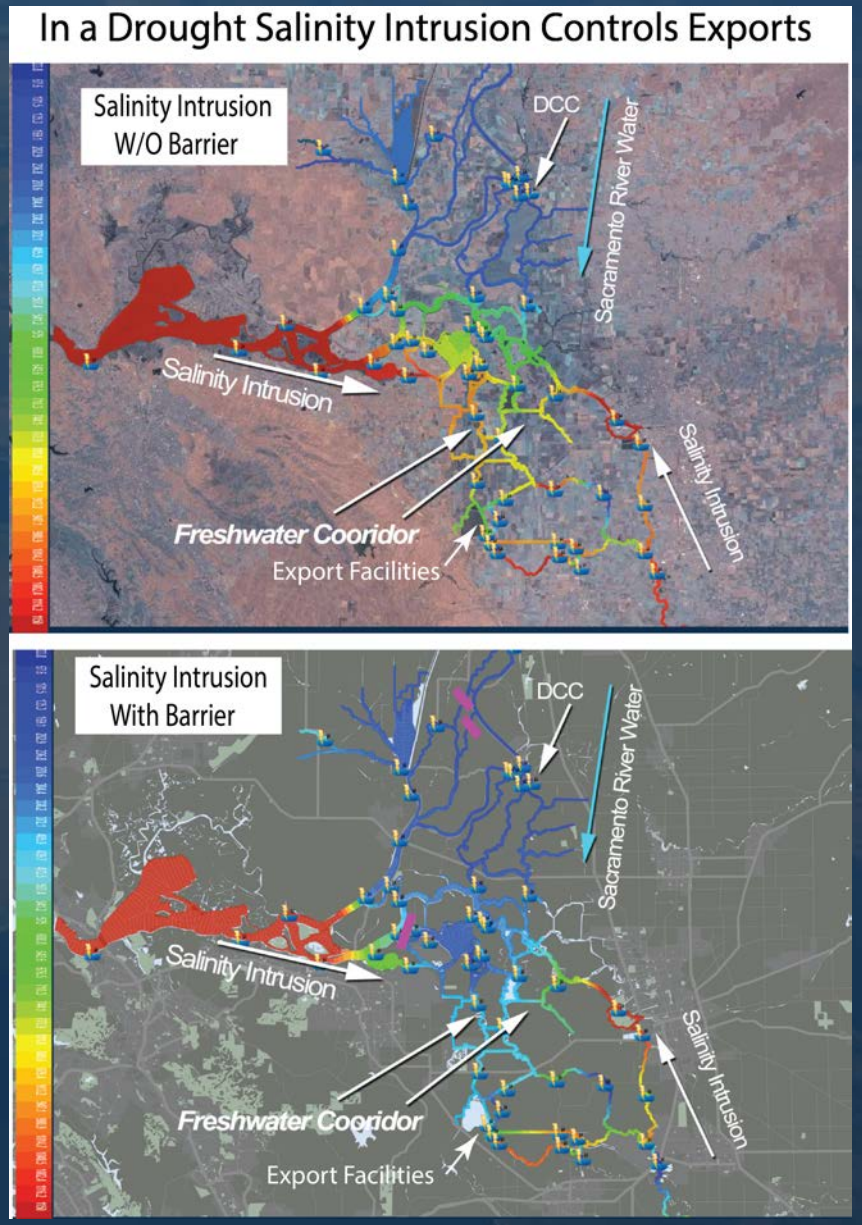
Constituent Tracker Snap Shots used to tell a Story

Salinity Intrusion during droughts puts the SWP and CVP at risk of a complete shutdown

Until Atmos River Occurs



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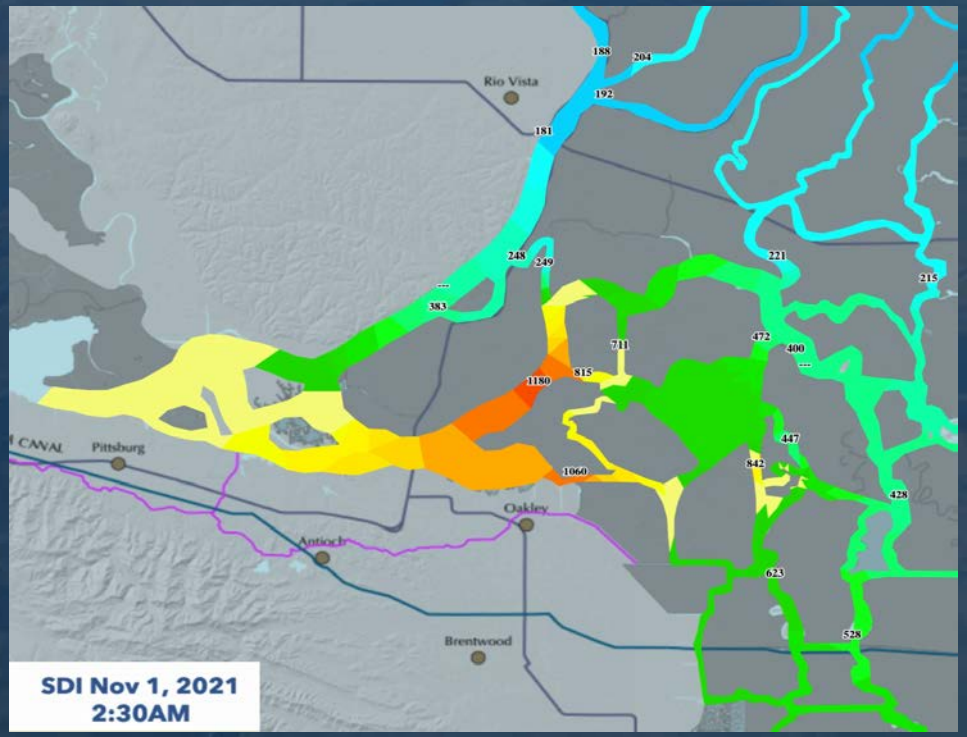
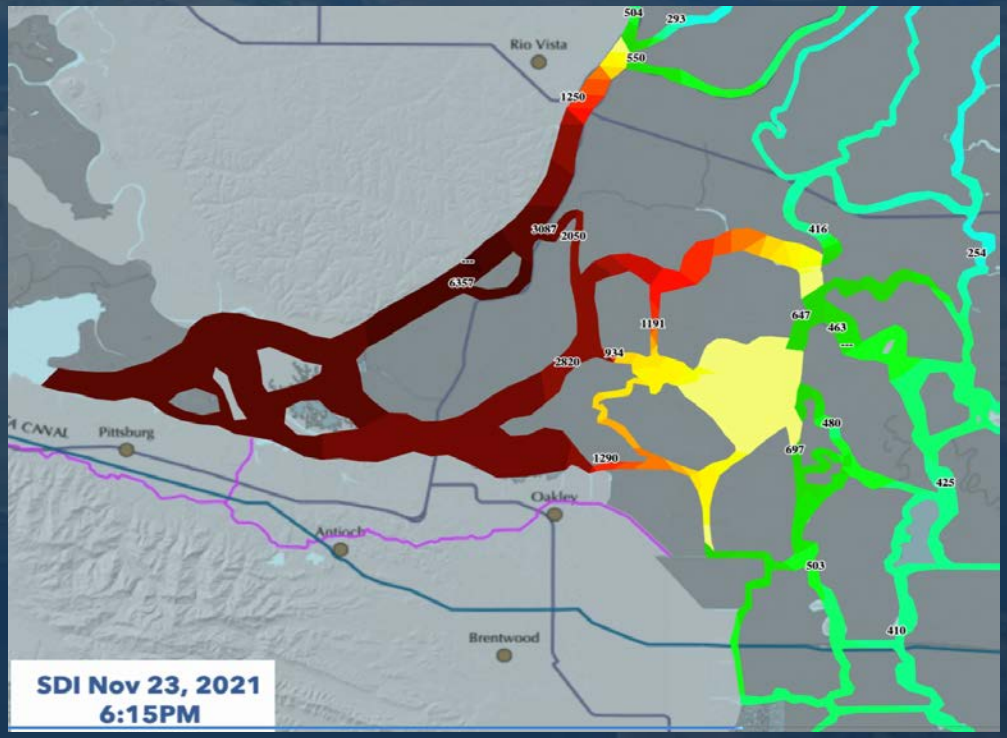
Images from DWR Emergency Drought Barrier Report

Salt Field Shortly After 1st Atmos. River





False River Barrier Doing its Job

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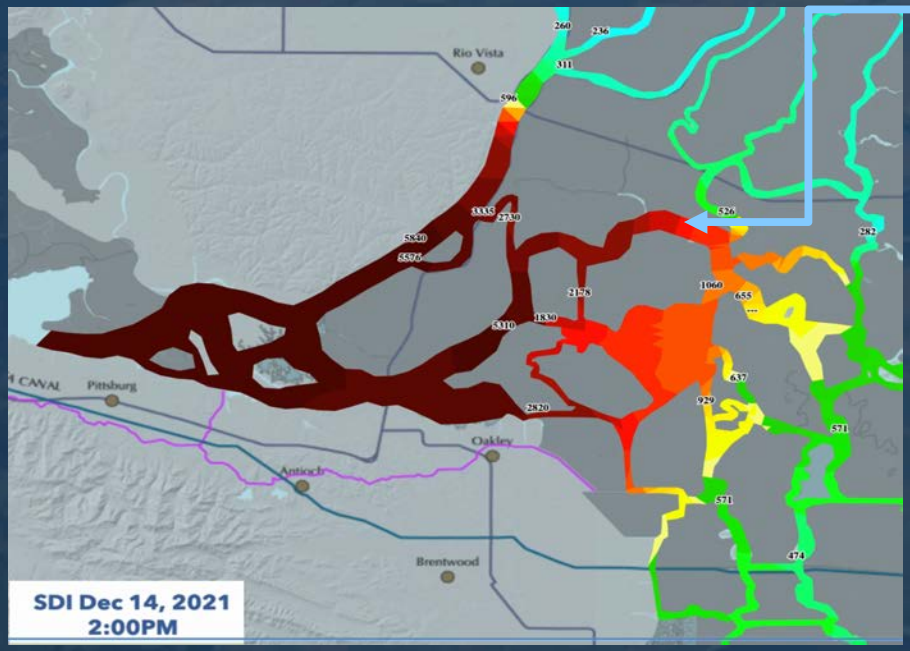
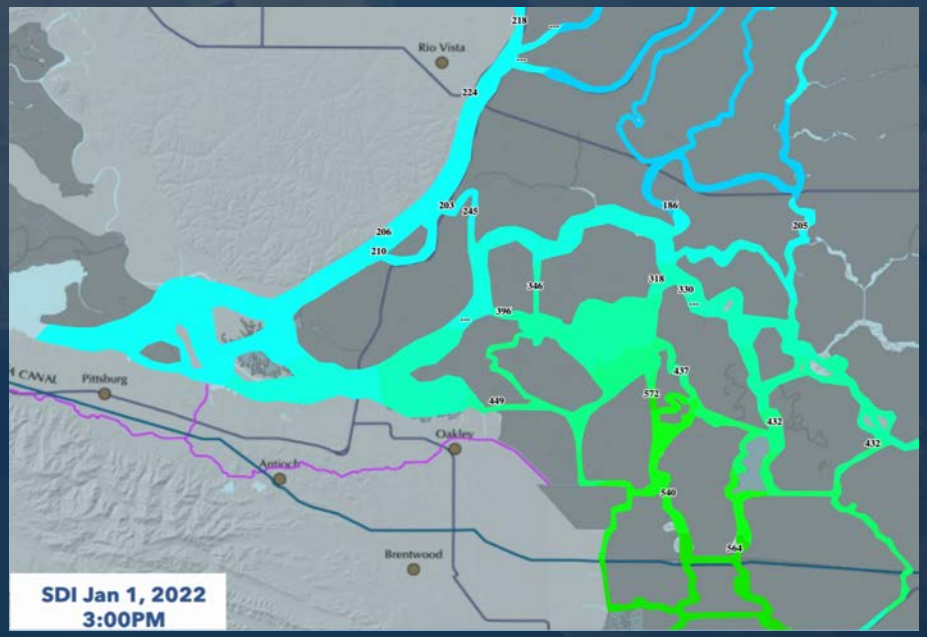
Images from DWR Emergency Drought Barrier Report

Salinity Starting to Intrude into Franks Tract



Salinity intrusion in this reach will determine if exports go offline.
Once salt intrudes past the Mokelumne River in the SJ it will be trapped in the Central Delta.
To forestall this, barriers will be installed in Sutter and Steamboat Sloughs.

Salt Flushed out of system due to Atmos. River



Due to DCC Gate Closures

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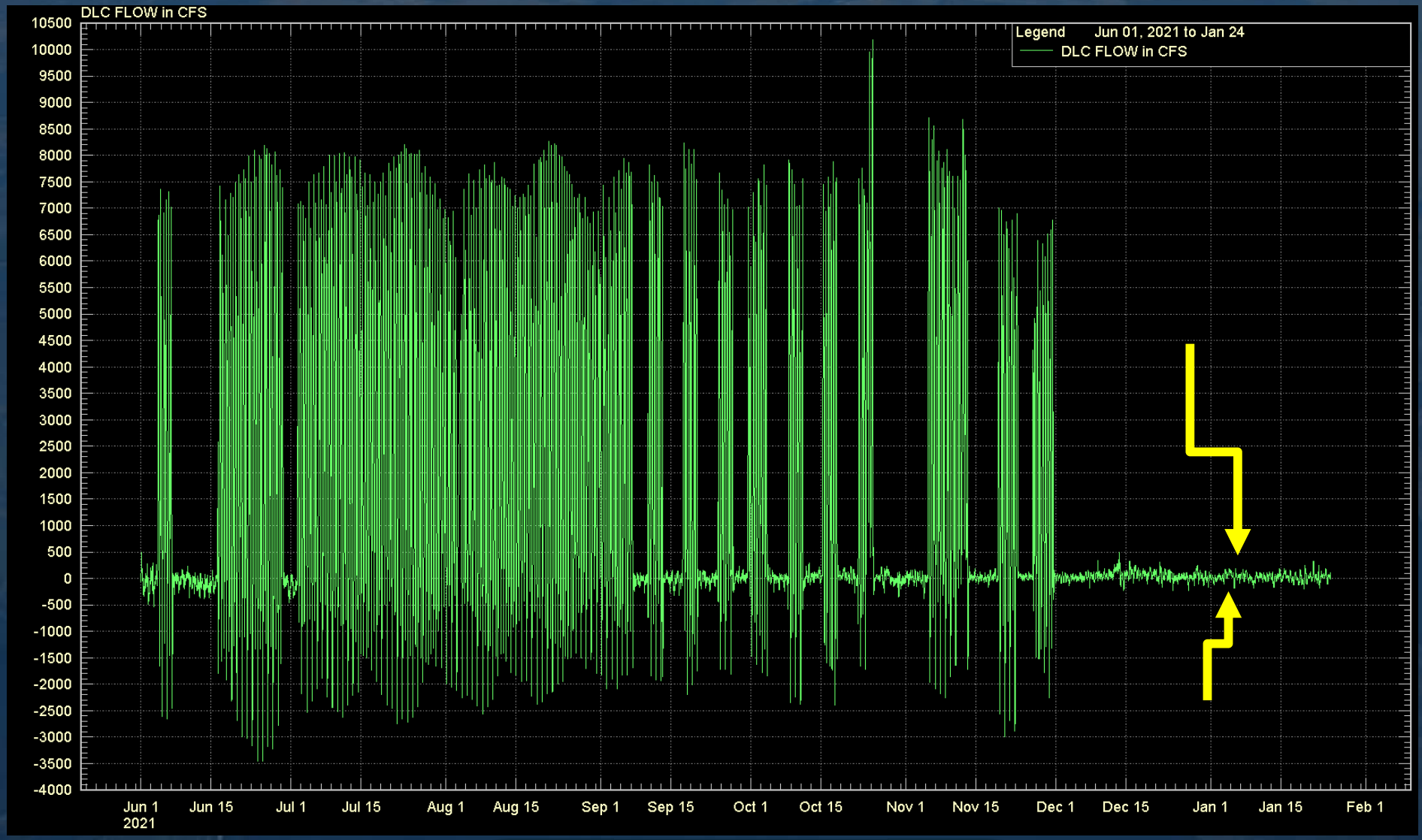
DCC Gate Operations (Discharge Data in DCC)

Increased the rate of salinity intrusion in the SJ toward Old River



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Another example of combining Constituent Tracker heat maps with time series

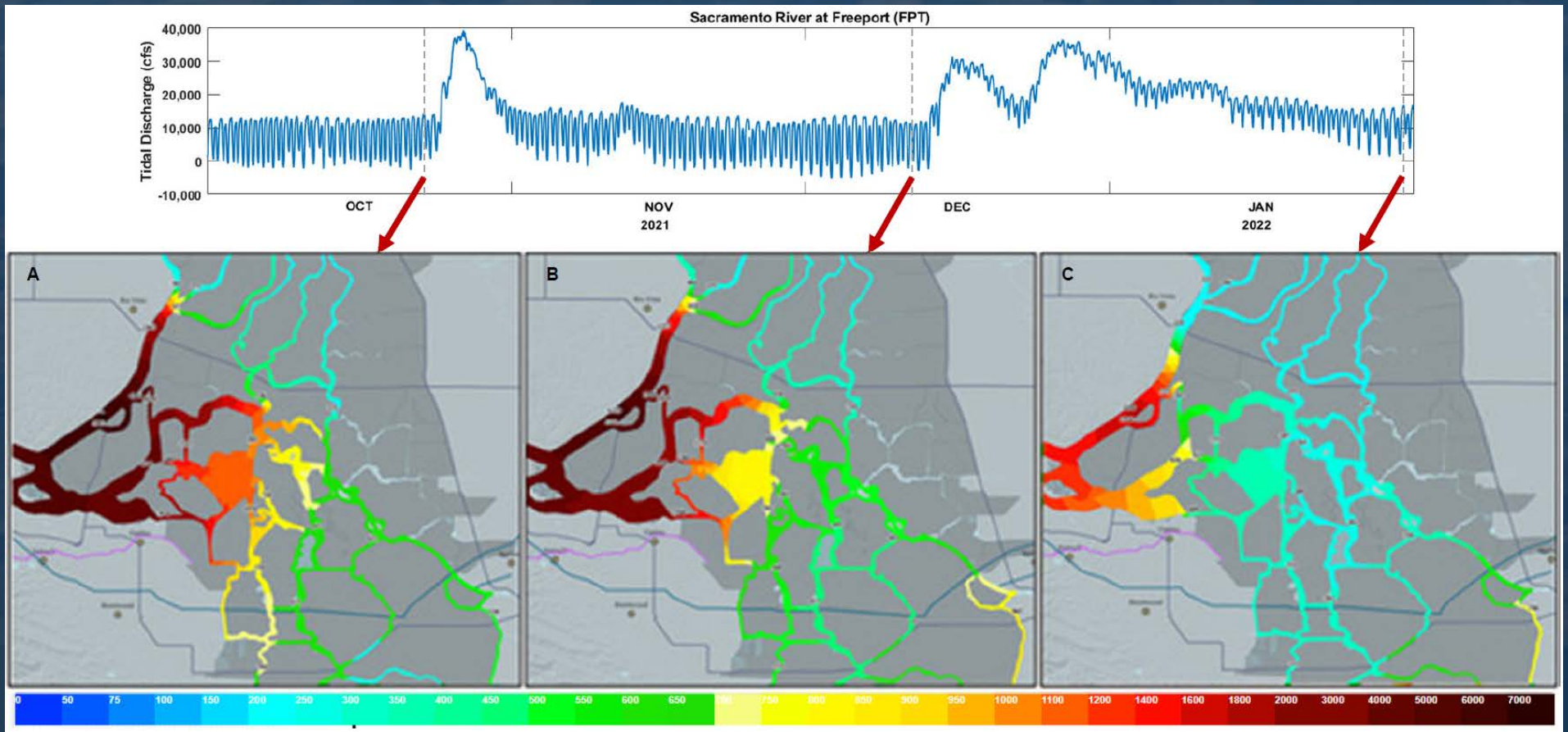
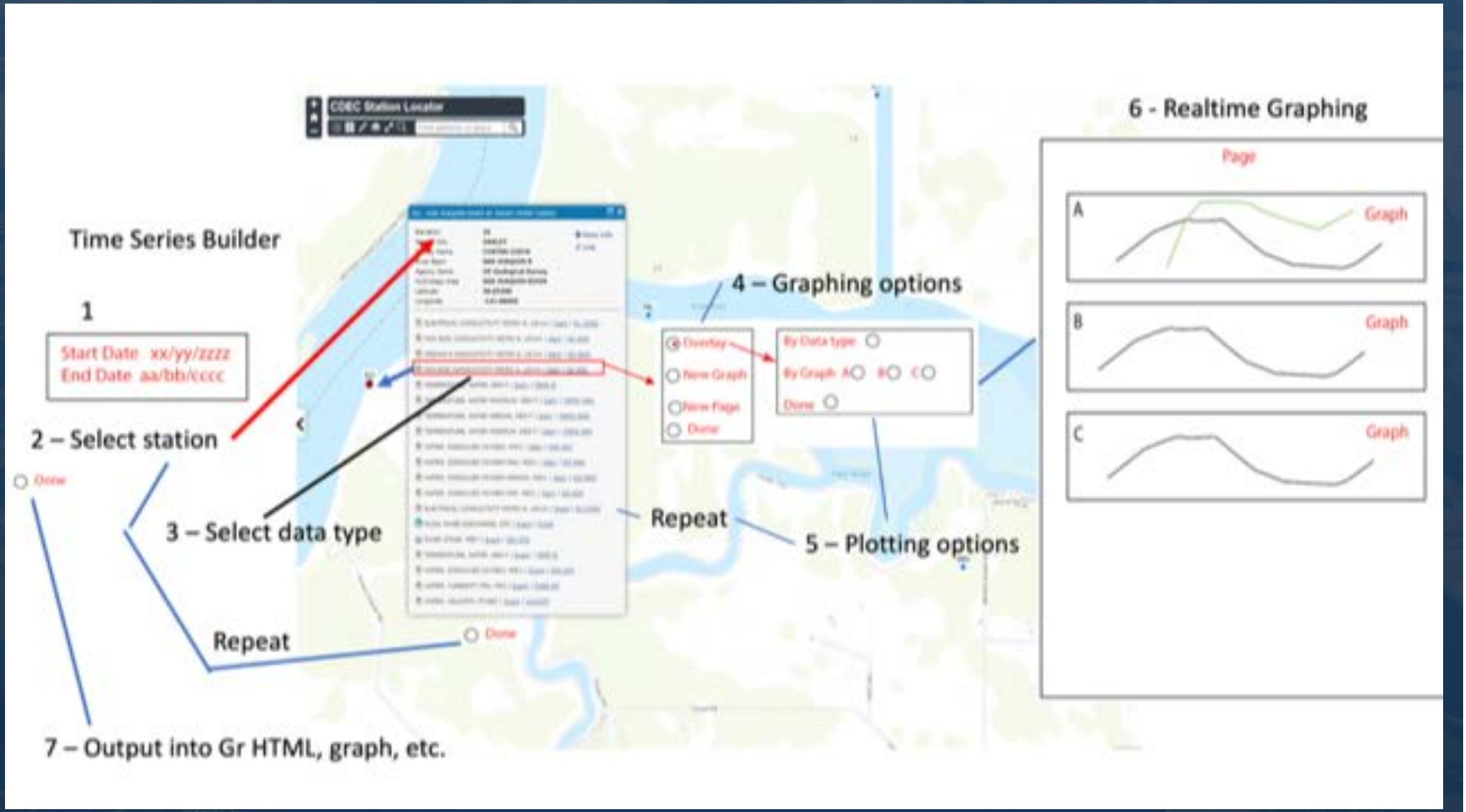


Figure 12. Delta wide salinity conditions (shown as conductivity, uS/cm) captured at slack after flood using the timestamp at SJJ, for October 21, 2021 7:00PM (A), December 11, 2021 1:00PM preceding the heavy December rains and runoff (B), and current conditions at the end of the reporting period - January 31, 2022 4:30PM (C). Maps were acquired from USGS and DWR real-time 15-minute data at https://www.baydeltalive.com/current_conditions/salinity-15-minute-data. These visualizations were developed by 34 North in collaboration with USGS. The graph above the map visualization is showing the tidal flow at the Sacramento River at Freeport indicating the timing of each map A, B, and C.

Conceptual Bay Delta Live (BDL) Time Series Data Access Interface



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Questions, Comments?

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