Coyote Creek and The Island Ponds:
Tides, Salinity and Suspended Sediment

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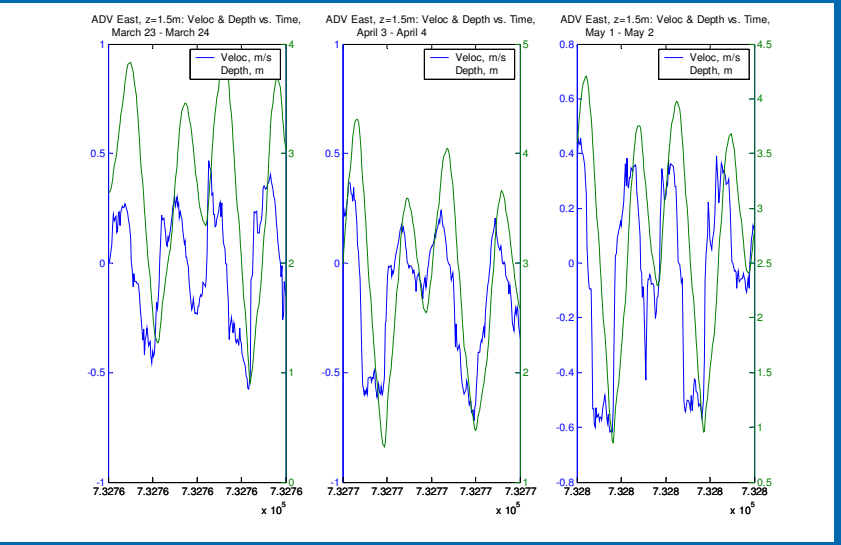
Estuarine Variability and Restoration

- Dynamic environment
  - Tidal stage and currents
    - Phasing set by geometry
  - Salinity
    - Transported by tidal currents
  - Suspended Sediment
    - Transported by currents, cycled with bed
- Interaction between estuary and restoration
  - Exchange occurs with tidal periodicity
  - Phasing, magnitude set by tidal conditions



South San Francisco Bay

- Region south of Dumbarton functions like small estuary
  - Tidal forcing at “mouth” (Dumbarton narrows)
    - Salinity exchange with South Bay
  - Freshwater from various local sources
    - Coyote Creek
    - Guadalupe River
    - Wastewater Returns

- Restoration is at similar scale to entire system
  - How does large-scale restoration interact with existing estuarine environment?

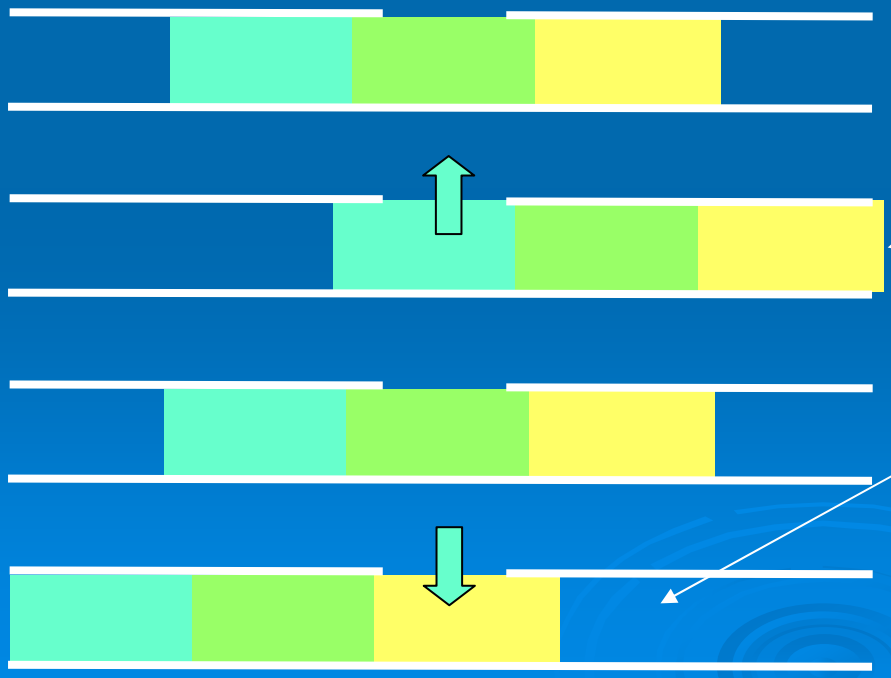
Coyote Creek and the Island Ponds

- Island Ponds and Coyote Creek small-scale analog for Far South Bay
  - Understand interaction between CC and Island ponds as a case study for project as a whole

maps.yahoo.com (beta)

Channel-restoration Interactions

- Timing of exchanges in tidal cycle critical to:
  - Salinity in restored tracts
  - Suspended sediment fluxes to restoration areas
  - Salinity effects in channel



Case I: Standing Wave in Channel

High and low water are slack tides

High water coincides with peak salinity

Low water coincides with lowest salinity

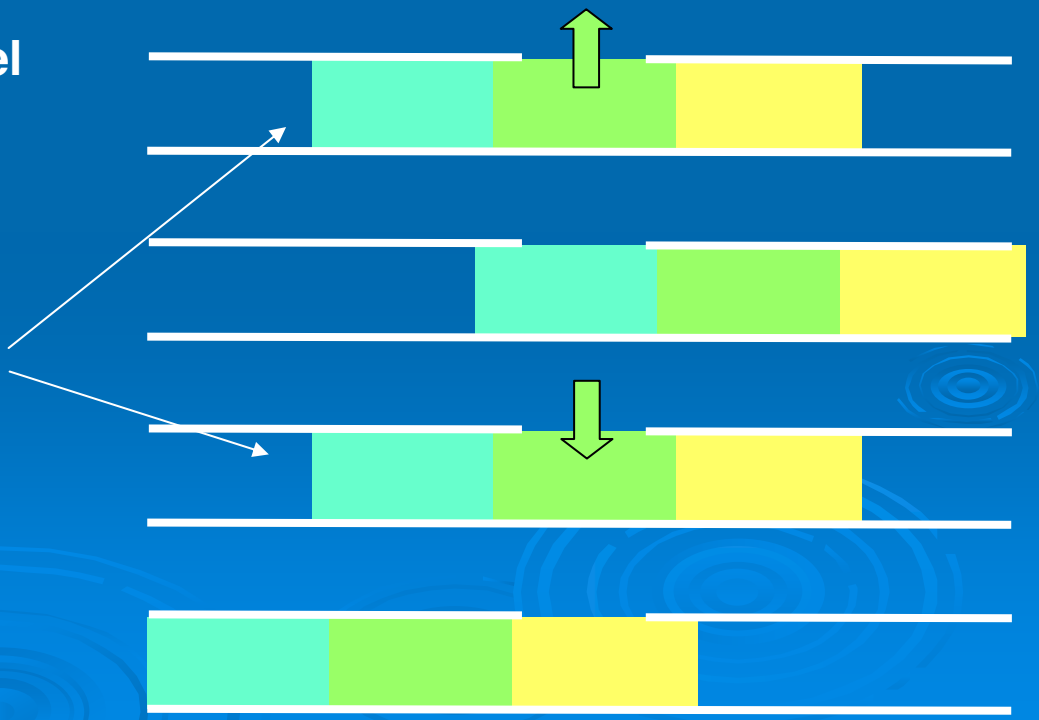
Channel-restoration Interactions

- Timing of exchanges in tidal cycle critical to:
  - Salinity in restored tracts
  - Suspended sediment fluxes to restoration areas
  - Salinity effects in channel

Case II: Progressive Wave in Channel

High and low water are peak flows

High and low water both coincide with intermediate salinity in channel



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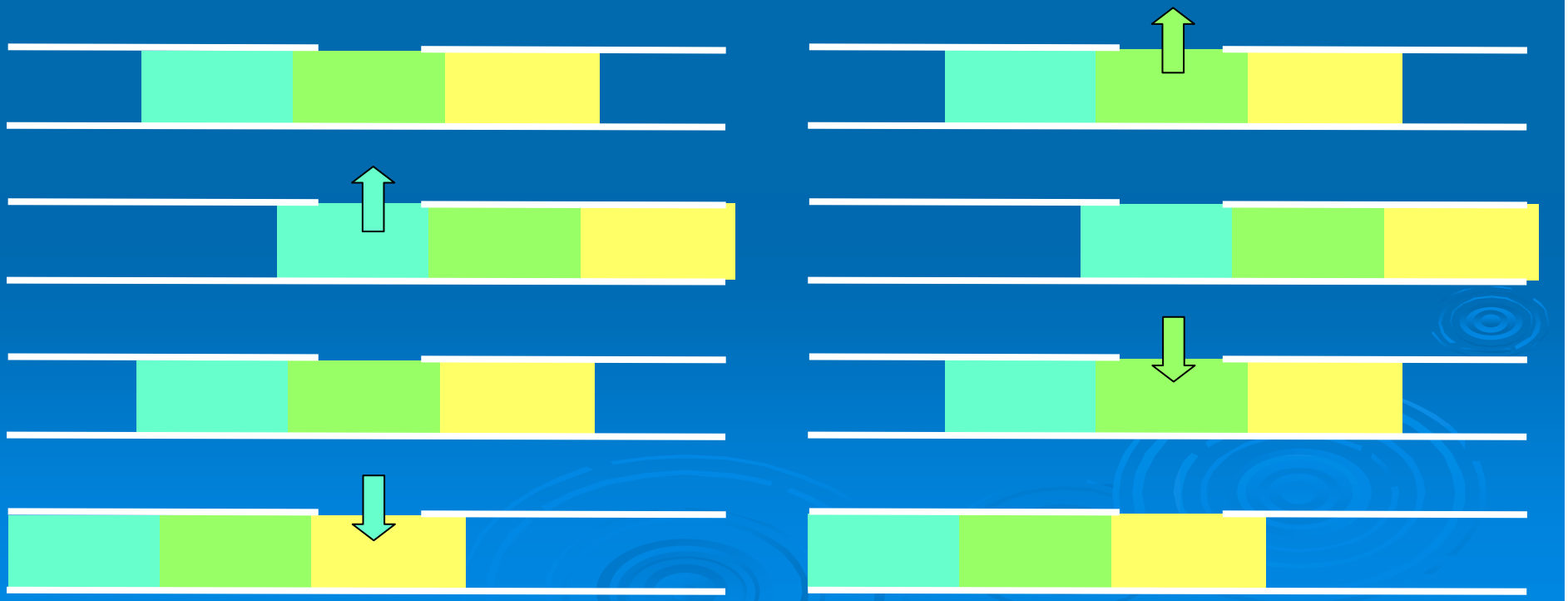


Coyote Creek Study

All Data Extends from March 8 – May 8, 2006

Time Resolution: 3 to 15 minutes

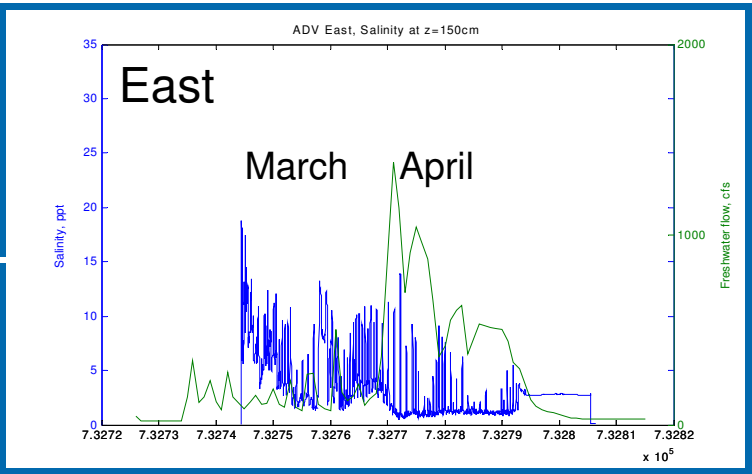
1. West Station:
   - Velocity profile throughout water column (ADCP)
   - Salinity, temperature, depth and SSC
     - 0.3m above the bed
     - Near surface
2. and 3. Center/East Stations:
   - Velocity (at a point), salinity, temperature, depth and SSC
     - 0.5 and 1.5 meters above bed
     - Total depth 2-4 meters

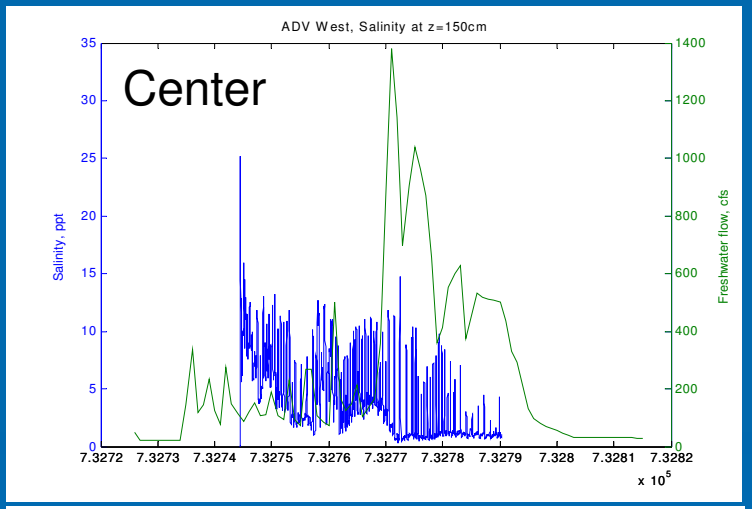
The recovery

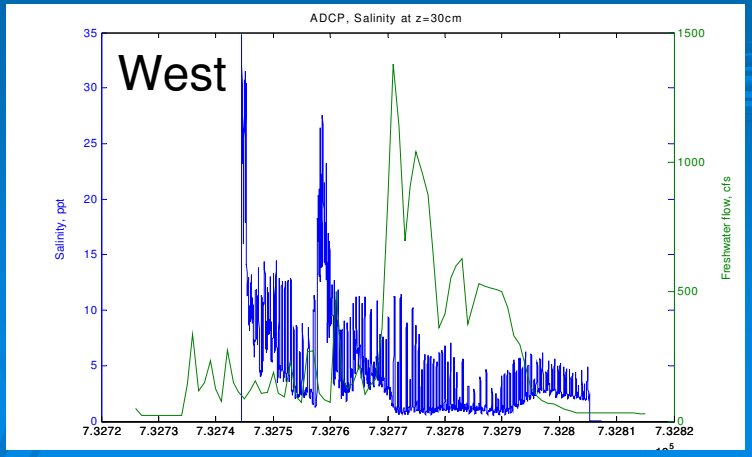
Back at the lab…

Overview

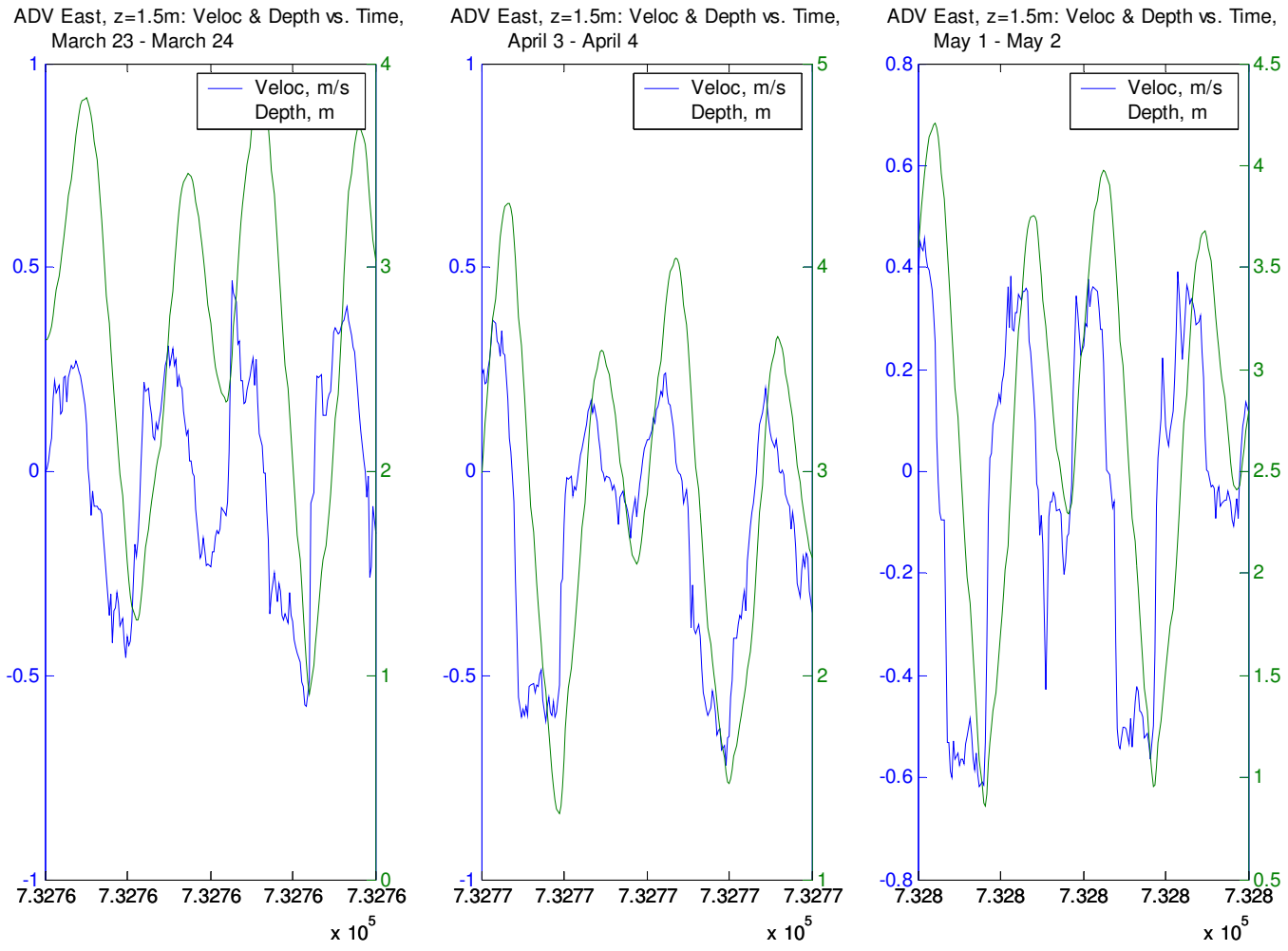
- Intention was to examine effects of restoration
  - But….
- Late March-early April rains
  - Huge freshwater flow
  - Reduced salinities to near zero
    - Large variations remain





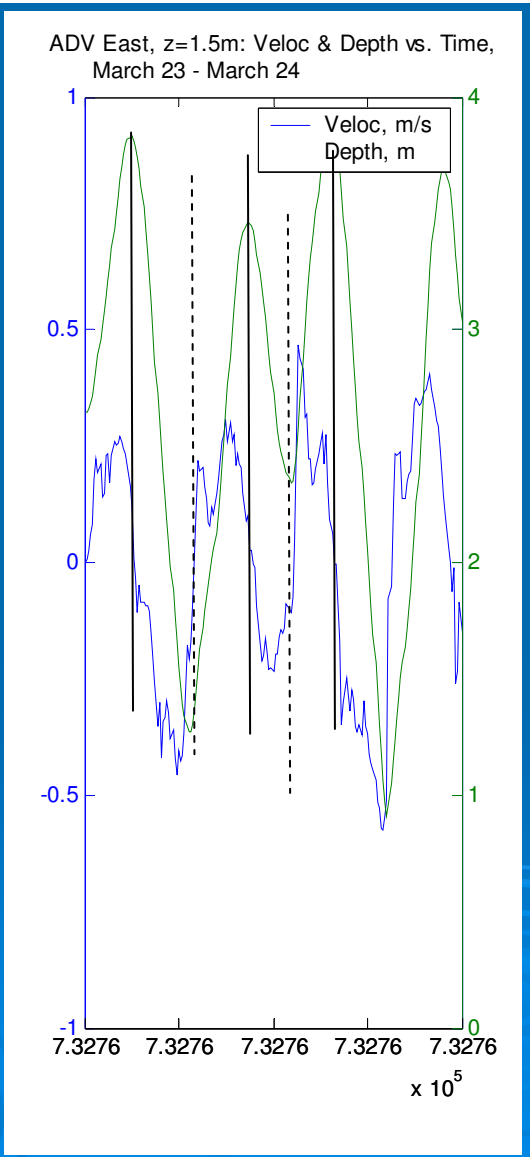


Velocity and Depth in Coyote Creek



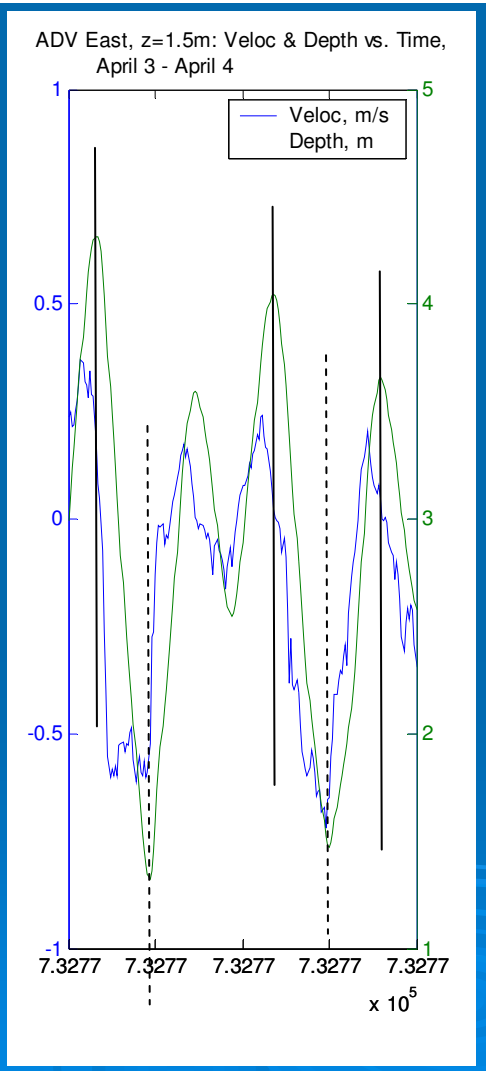
Velocity and Depth: March and May

- Phasing is slightly less than expected
  - High water occurs 30 minutes before end of flood
- Should be associated with near-peak salinity
  - Suspended sediment at high water will be sourced from estuary



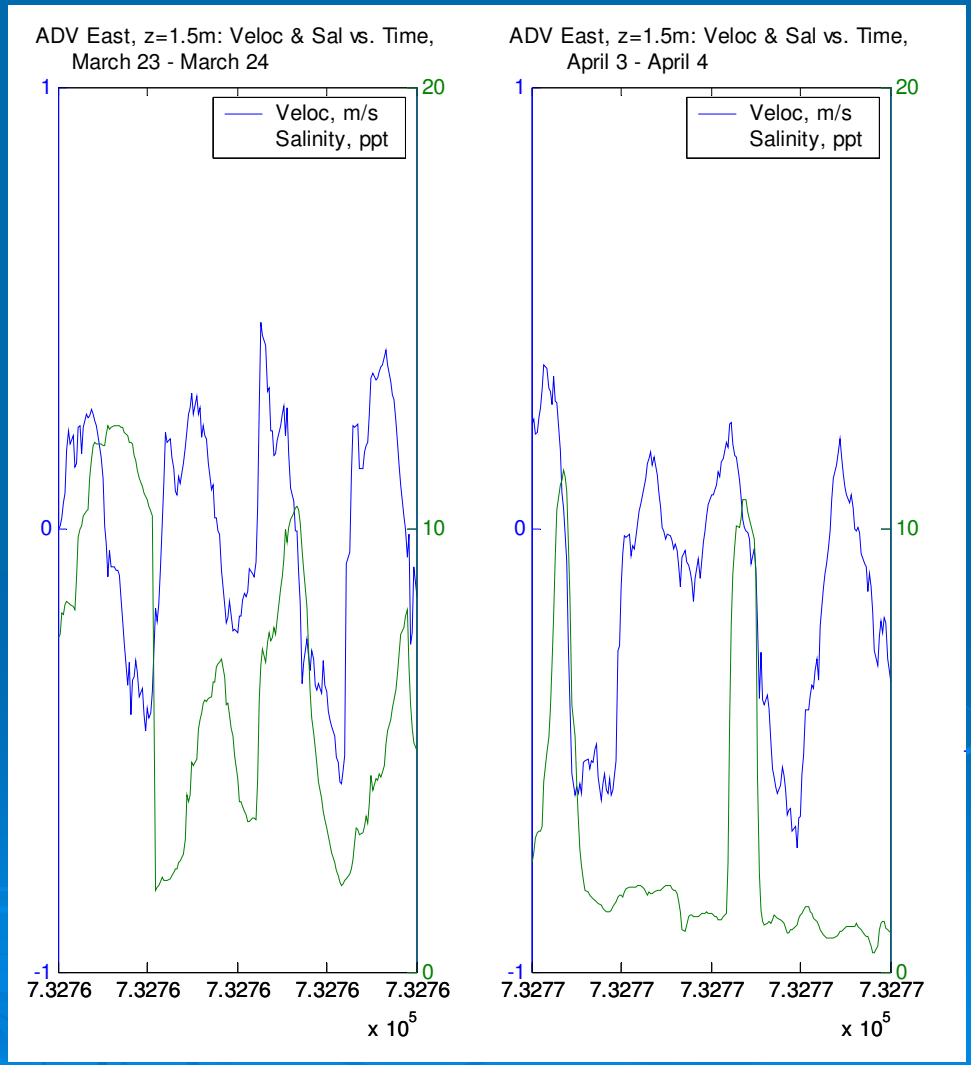
Velocity and Depth: Early April

- Large freshwater flow results in phase shift
  - High/low water occurs 1.5 hours before end of flood/ebb
- More intermediate conditions at high and low water
  - Suspended sediment at high water will be sourced from Coyote Creek (?)



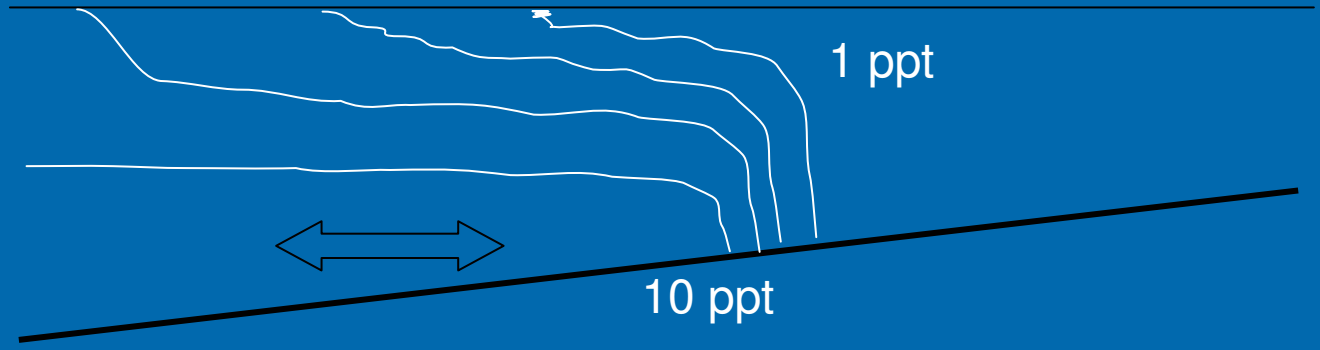
Salinity and Velocity: Coyote Creek

- Large variations in salinity
  - Varies by 10 ppt in tidal cycle
    - 10-20 x's North Bay gradient
    - Large vertical stratification
- Peak salinity at end of flood tide
  - Appears to be advectively dominated
- Peak salinities similar during large flows (early April)
  - Suggests compression of salt gradient, not movement

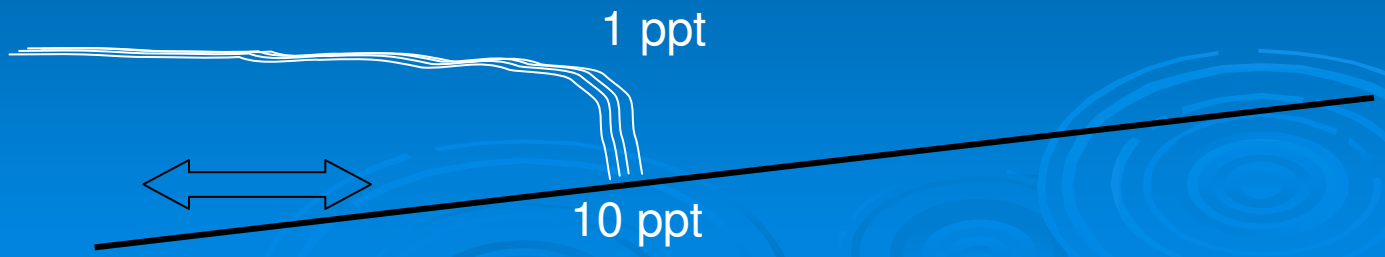


Schematic of salinity distribution

- Moderate Flows

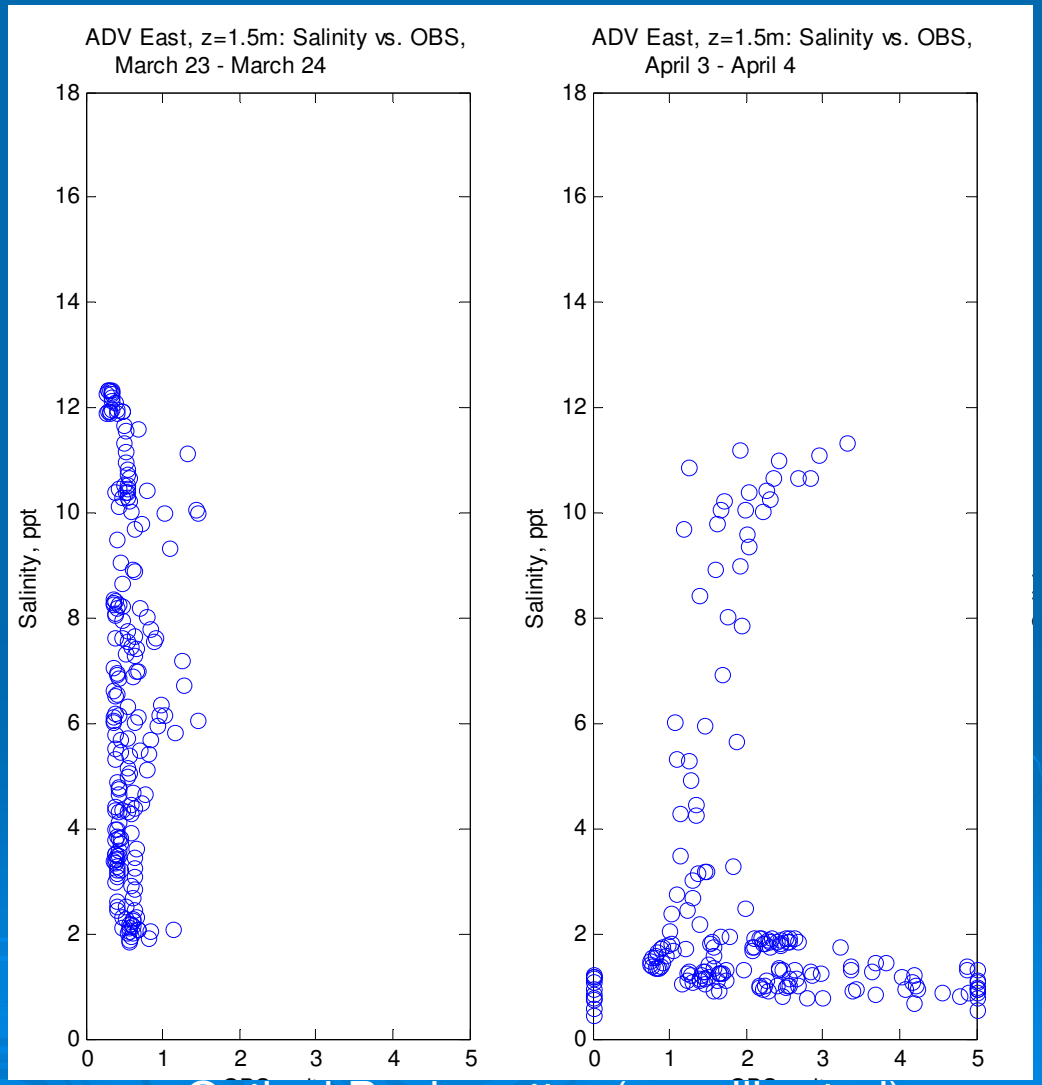


- High Flows



Salinity and Suspended Sediment

- Backscatter highest during freshwater flow
  - Peak values associated with low salinity
    - Occur around low water
  - Secondary peak at highest salinities
    - During flood tide, sourced from down-estuary
- March/May:
  - Moderate backscatter associated with high salinities
    - Around high water
    - Sourced down-estuary



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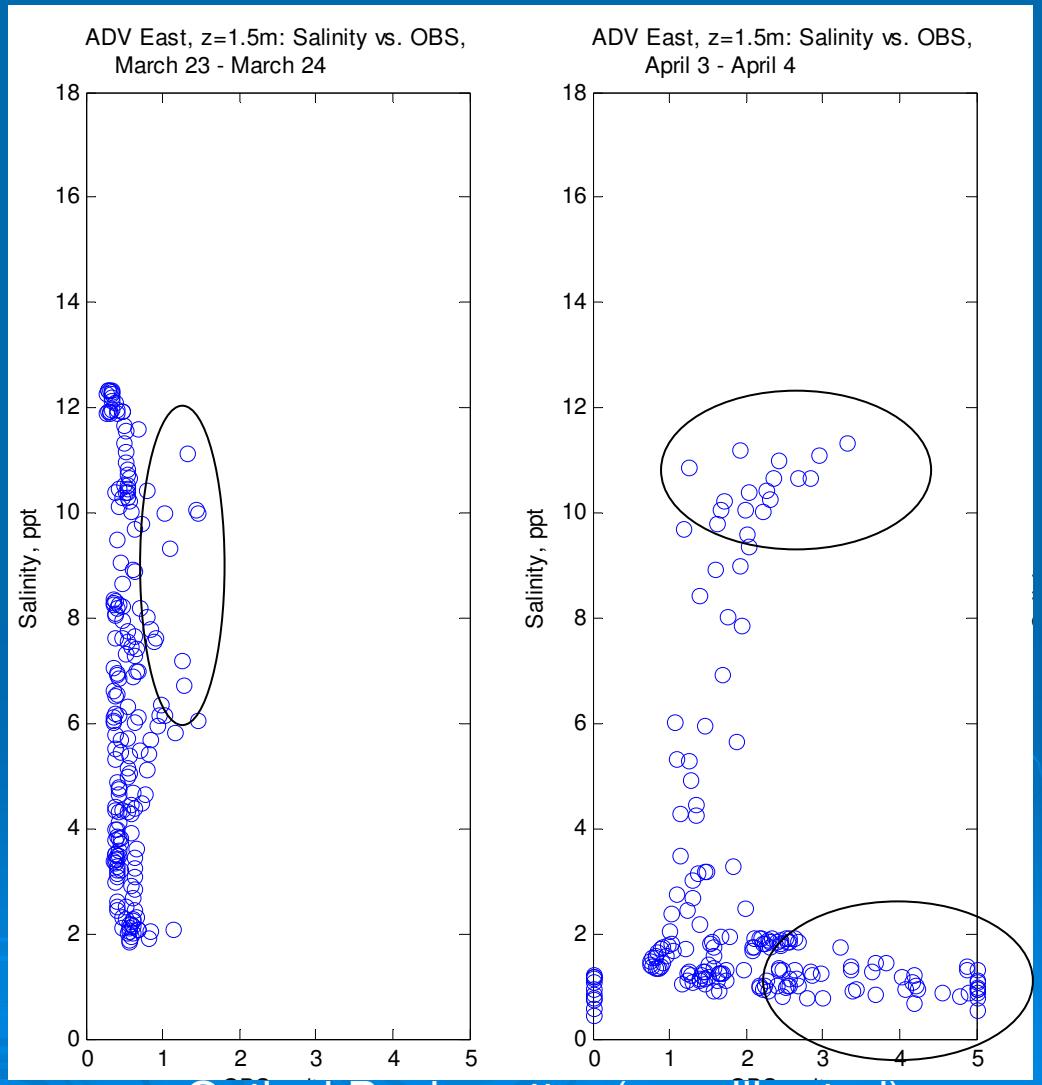

Implications for Exchange: Preliminary

- Slack tides nearly coincide with high and low water, except during large flow events
  - Maximum salinity transported into restoration sites
  - Largest potential for increased salinity in channel
  - Suspended sediment carried onto site is result of flood tide dynamics
    - Sourced down-estuary
- Large flow events alter dynamics
  - Compress salinity field
  - Shift velocities relative to depth
  - Peak suspended sediments associate with low water

Future Directions: Breaches/Modeling

- Detailed study of exchanges through breach
  - Instrumentation similar to Coyote Creek study
    - Deployed in breach, within Pond A21 and in adjoining section of Coyote Creek
  - Duration of 1-2 months
    - Track tidally driven exchanges
      - Timing and magnitude of flows, associated transport

- Hydrodynamic modeling
  - Idealized model of Coyote Creek and Ponds already functional
    - Incorporate actual bathymetry data
    - Extend to Dumbarton Narrows