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# Salinity Impact and Water Cost of Sea Level Rise: Initial Estimates and Uncertainties

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# Purpose and Study Focus

- Focus on water quality
- Impact over Delta under an ensemble of high SLR* scenarios
  - Vulnerability of DCP* intakes to salinity (low given net flow)
  - Vulnerability of Delta/regulatory status quo (high for SLR>3-4ft)
- Water cost of compliance: considerations under sea level rise

* Notes:
DCP = Delta Conveyance Project
SLR = Sea Level Rise

| 2040 | | 2050 | | 2070 | | 2100 | |
|---|---|---|---|---|---|---|---|
| 0.5% Probability (Medium-High Risk Aversion) | H++ | 0.5% Probability (Medium-High Risk Aversion) | H++ | 0.5% Probability (Medium-High Risk Aversion) | H++ | 0.5% Probability (Medium-High Risk Aversion) | H++ |
| 1.3 ft | 1.8 ft | 1.9 ft | 2.7 ft | 3.5 ft | 5.2 ft | 6.9 ft | 10.2 ft |

Source: Ocean Protection Council

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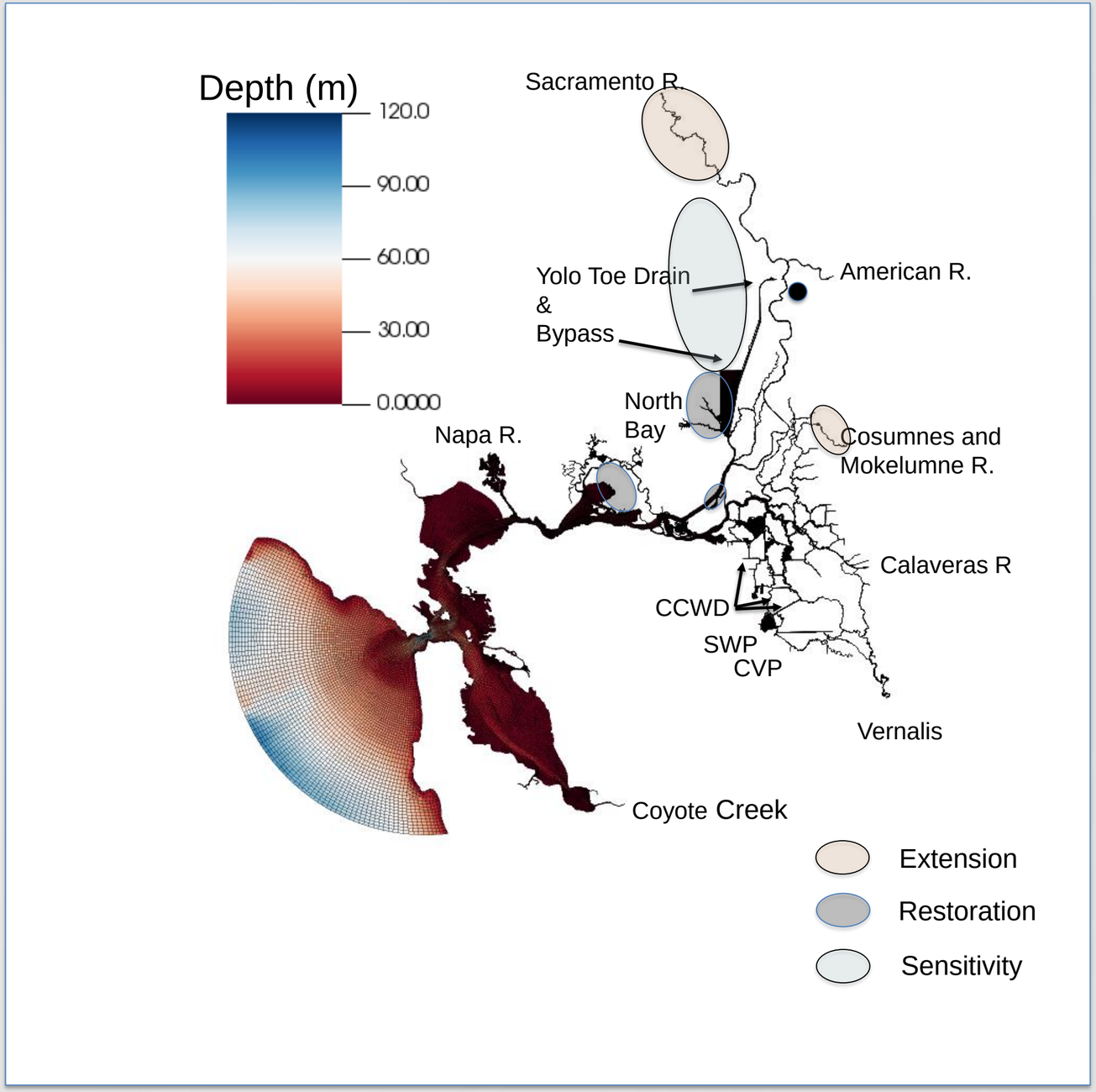
# Bay-Delta SCHISM

- SCHISM model, 3D (VIMS)
- Farallon to Vernalis/Knights Landing Domain
  - 300,000+ nodes, elements
  - 23 vertical levels max
- Major flows, exports, structures, channel depletions
- Approximate benchmark:

  ½ year per day on 144-core cluster

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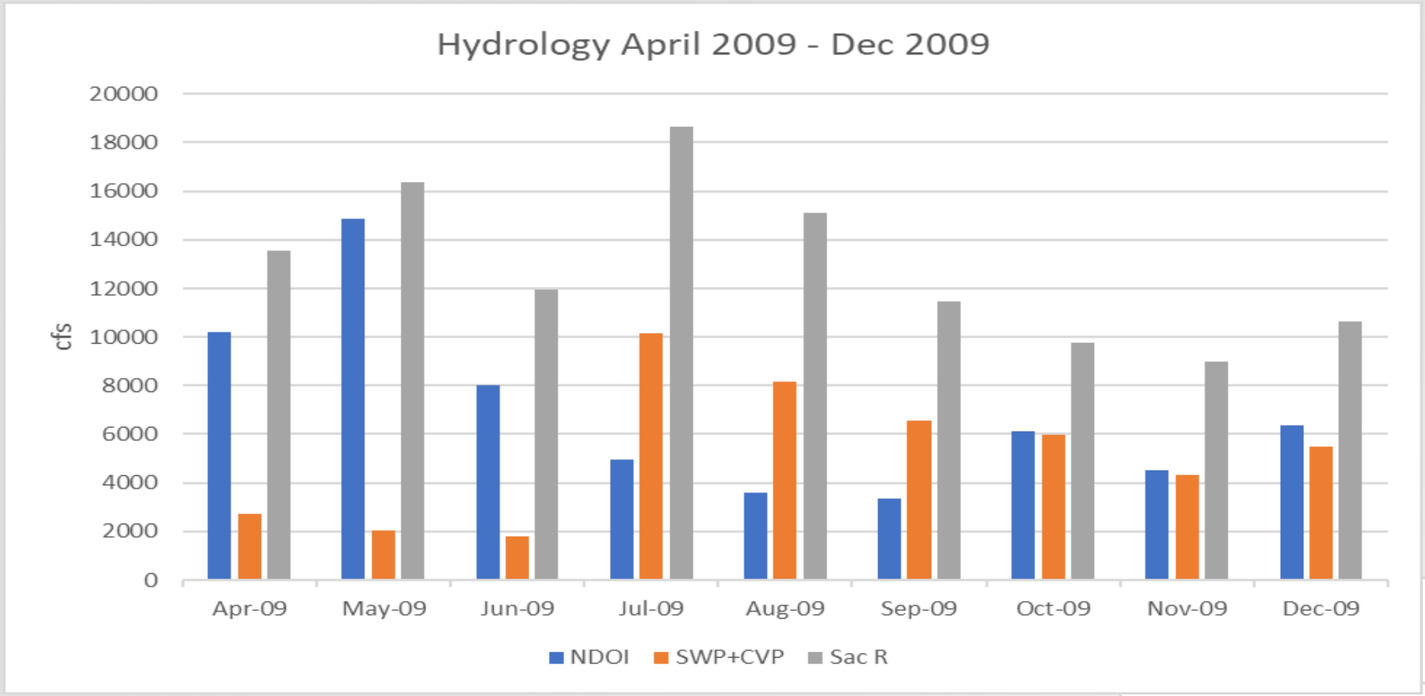
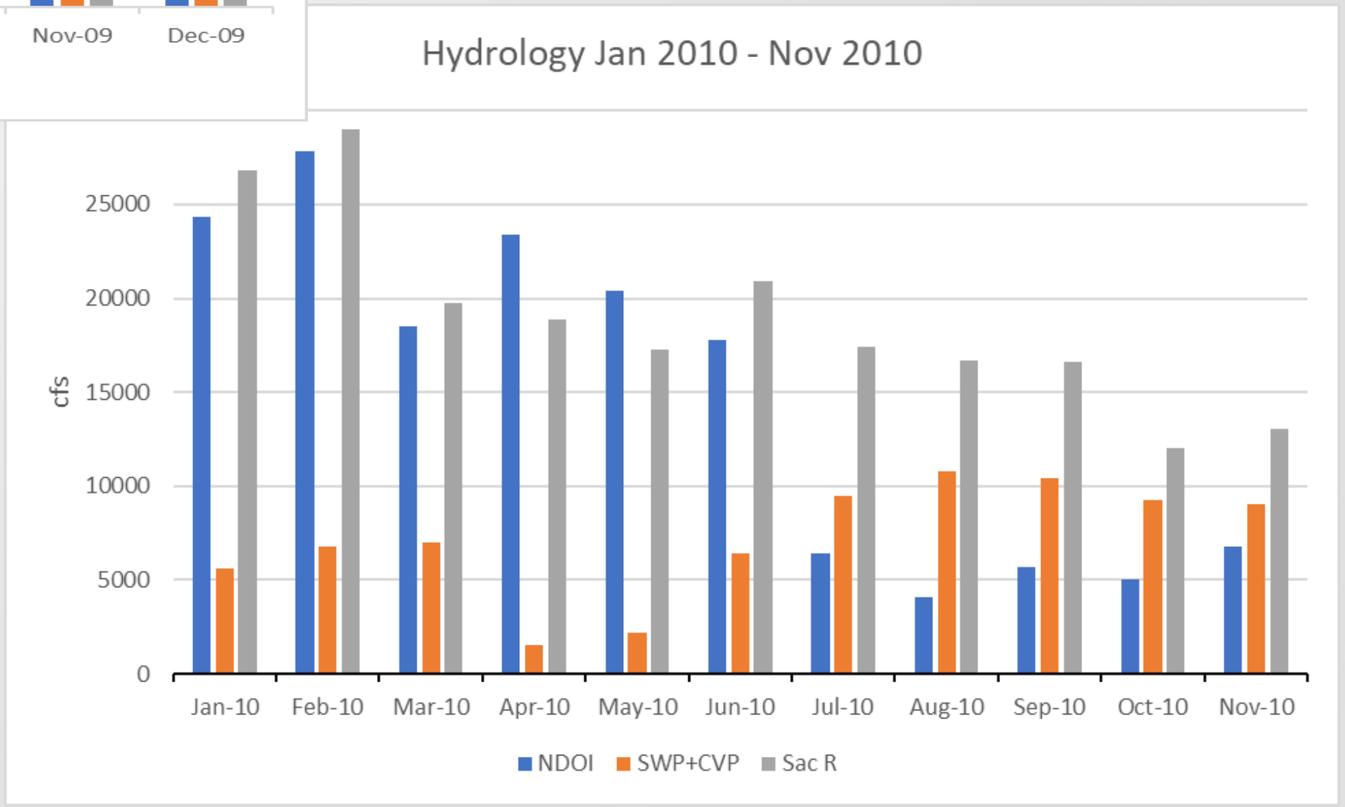
# Study Period and Hydrology

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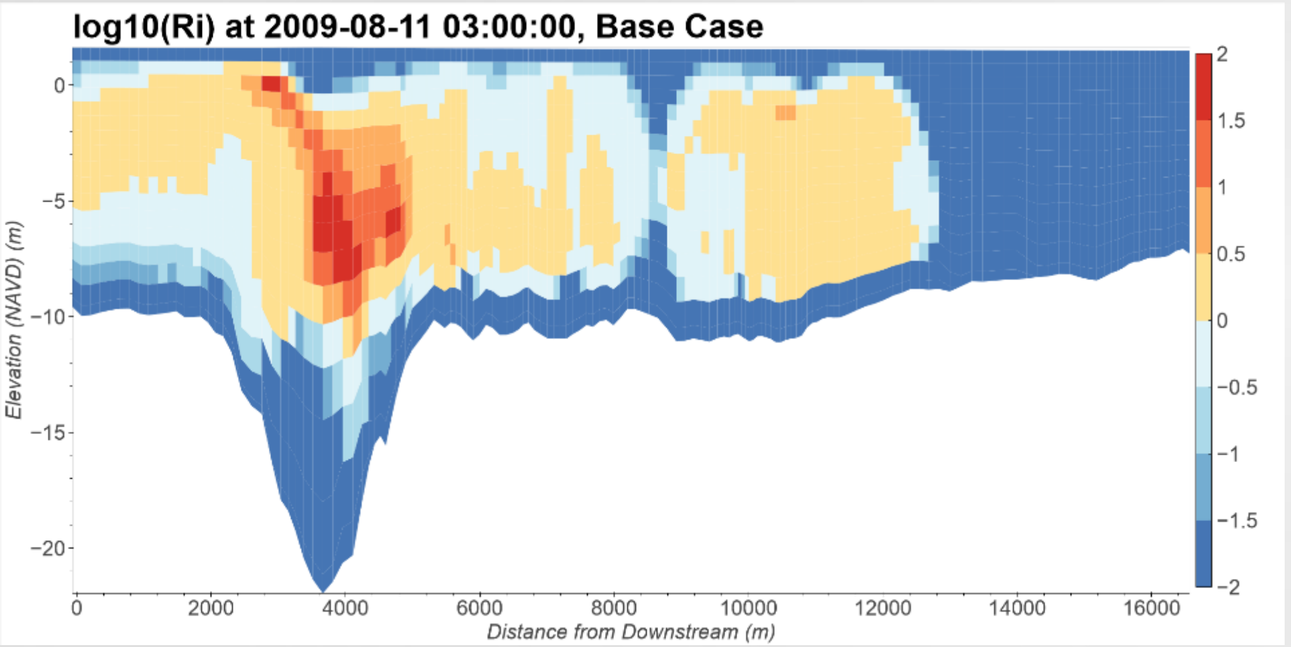
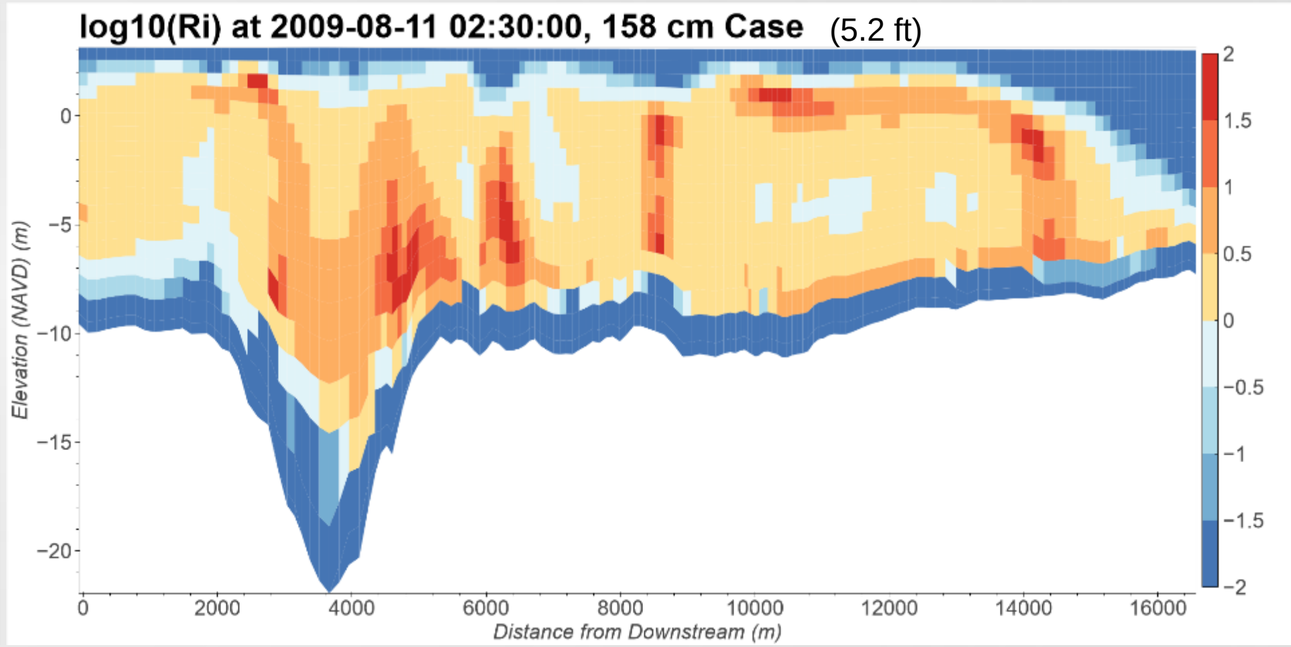
# Methods and Assumptions

- Sea level rise increments from OPC guidelines (1.8 - 2.7 - 3.5 - 5.2 - 6.9 - 10.2 ft)
- Historical geometry and extent
  - “Semi glass wall” No overtopping, but intertidal/flood gets inundated
  - Yolo flooded extensively in sensitivity study
  - Bed geometry is fixed (no geomorphology, ship channel change)
- Current beneficial uses (exports, ag diversions) continue even if absurd
- Bay-Delta SCHISM 3D, hydrodynamics, salinity and temperature:
  - Vertical exchange flow is critical under sea level rise
  - Vertical parameters can set to encourage intrusion
- Variations with and without operational response. Focus was Emmaton
- Sensitivity: Yolo inundation and low background diffusivity.

# Baroclinic Factors

Scales with: Depth  Salinity Gradient,  Flow,  Tides




SCHISM output, ebb tide local Richardson number profiles from Sherman Island extending upstream of Rio Vista.

Richardson number measures stratification and suppression of turbulence divided by shear and generation of turbulence . Ri > 0.25 indicated tendency towards stratification

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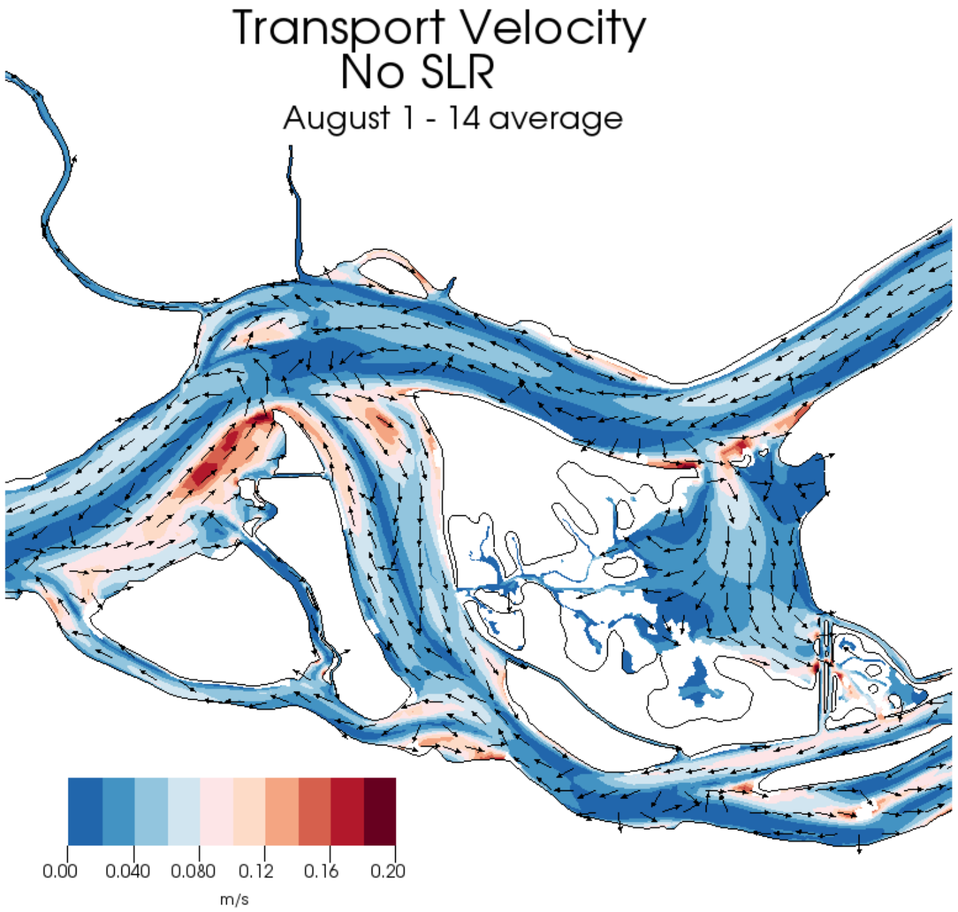
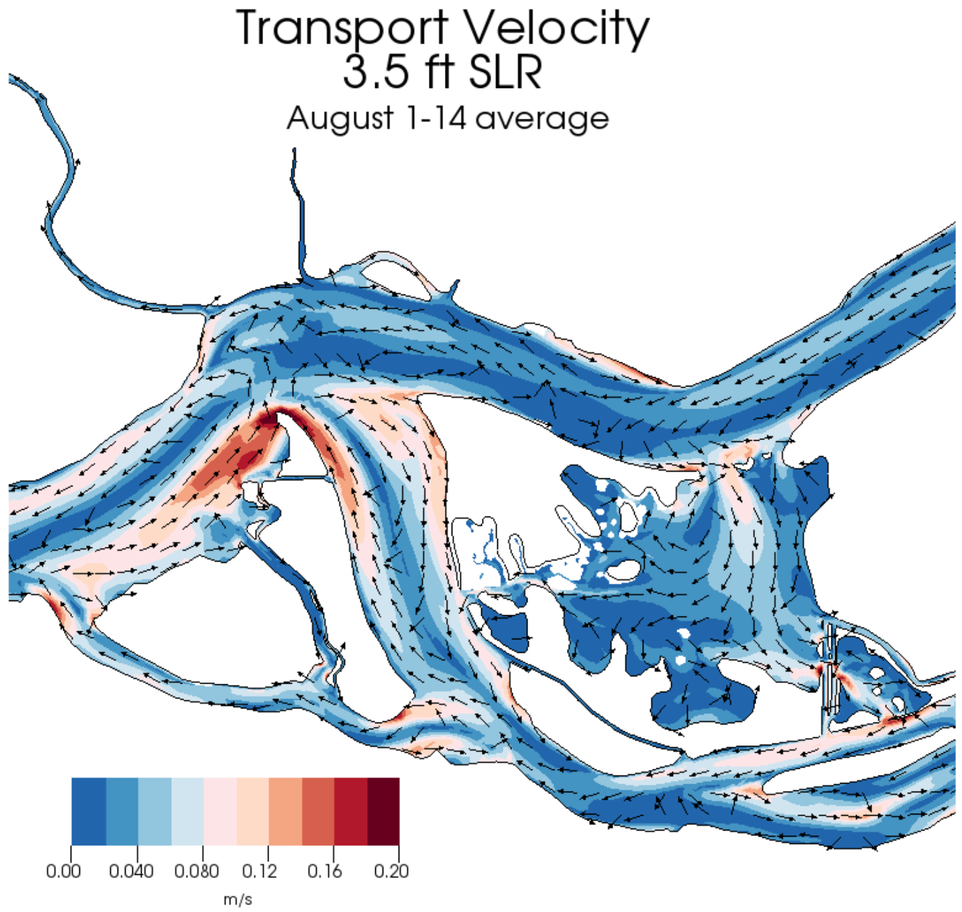
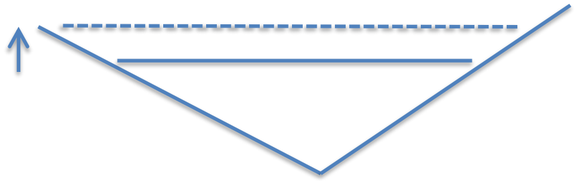
# Barotropic Factors




2009 Simulation Results

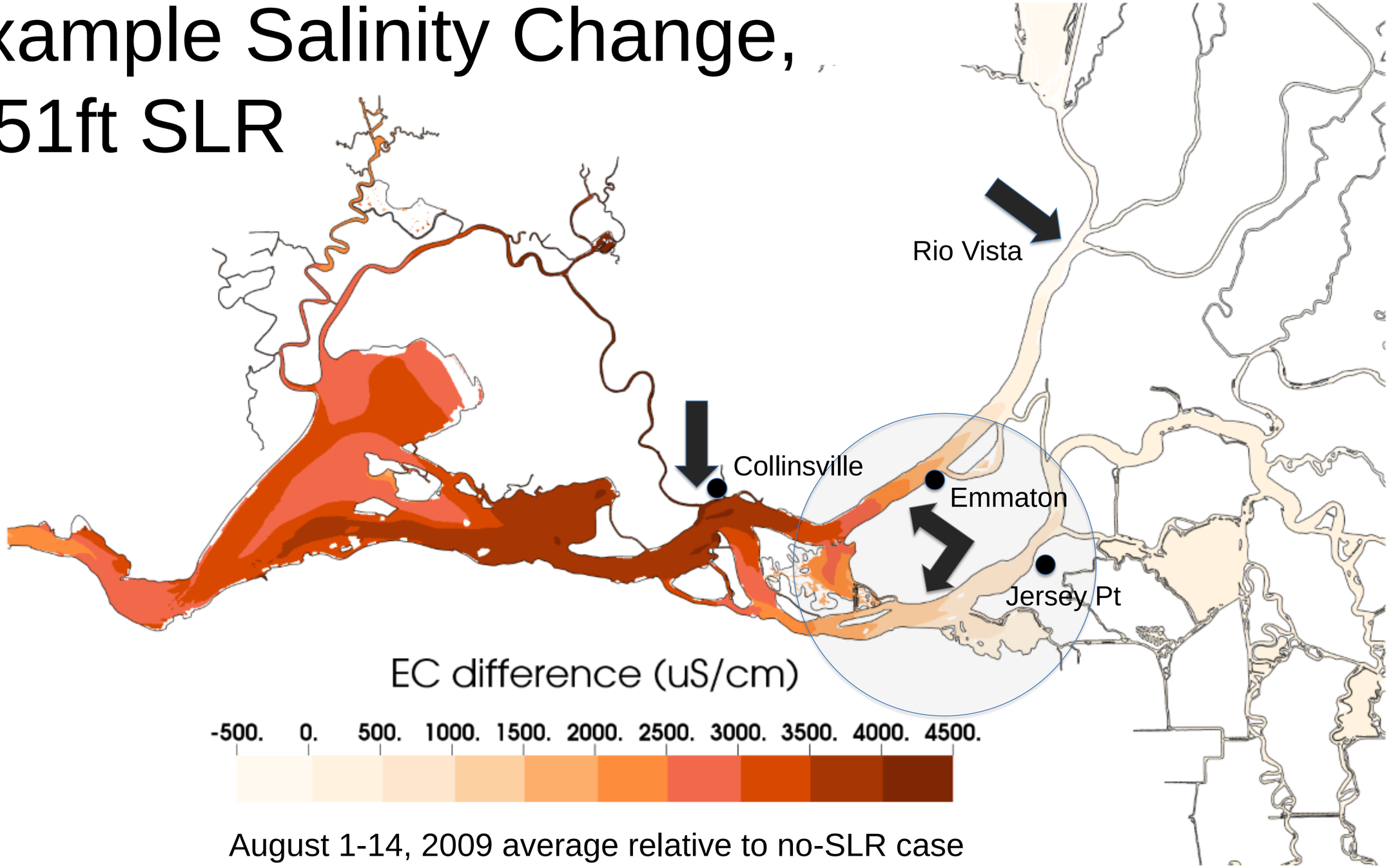


# Variations in Model Assumptions are Amplified by SLR

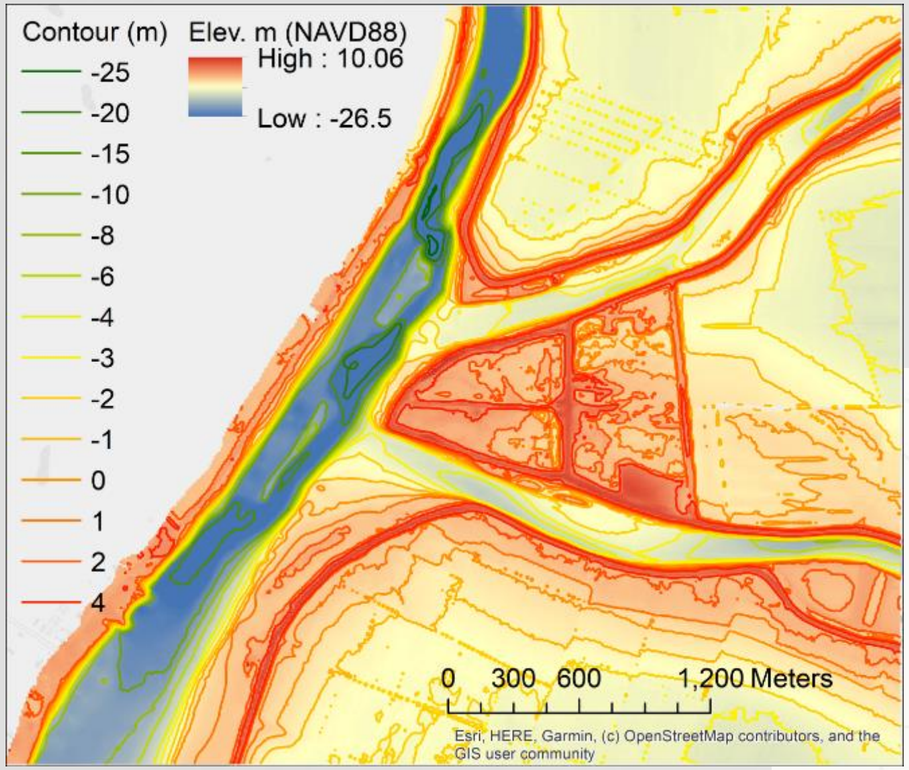
- Many authors manipulate outflow up to 2000cfs.
- Another method is high background diffusivity.
- Higher flow checks salinity intrusion past confluence.

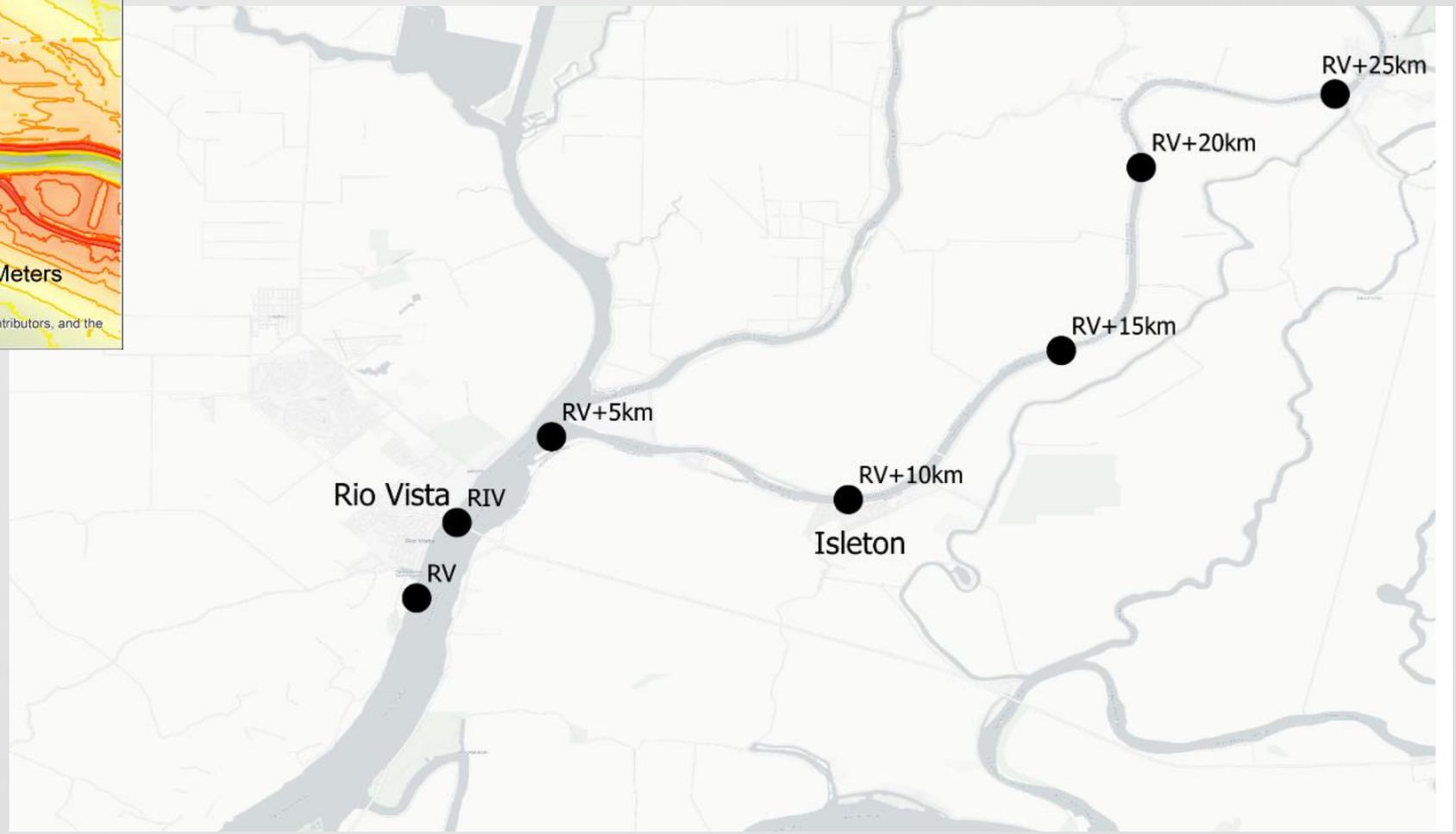
# RESULTS

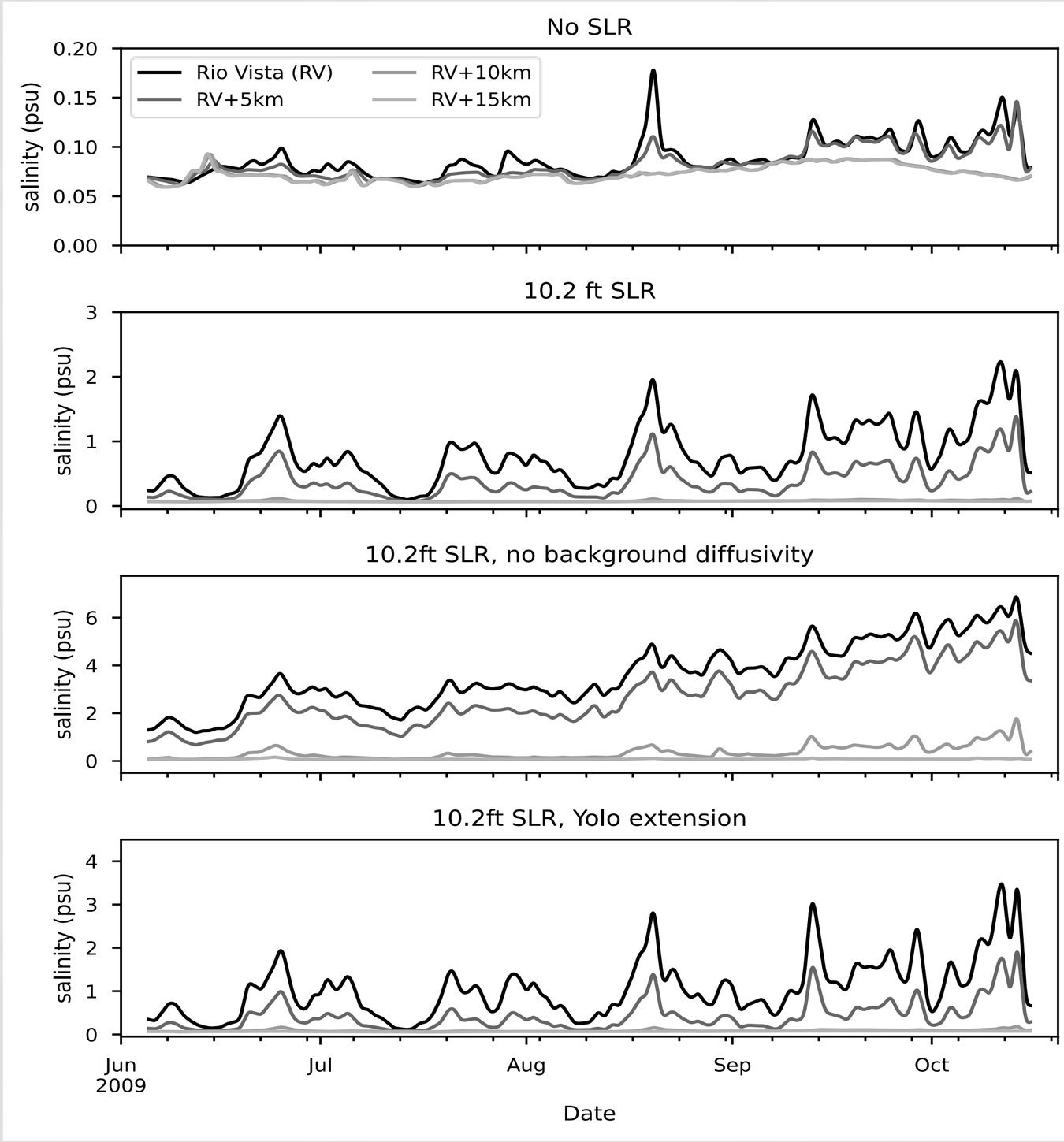
# Example Salinity Change, 3.51ft SLR



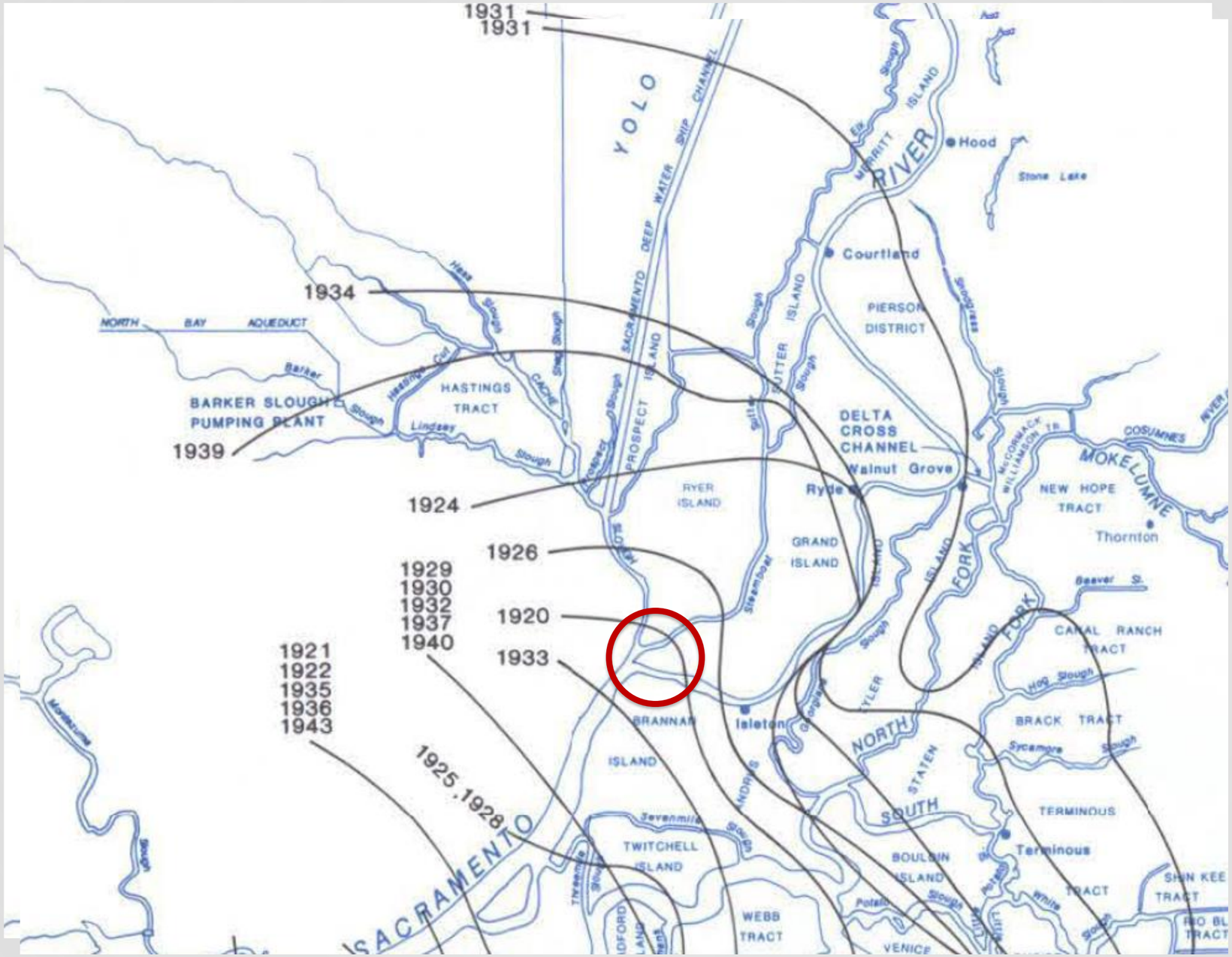

August 1-14, 2009 average relative to no-SLR case


Contour (m)
-25
-20
-15
-10
-8
-6
-4
-3
-2
-1
0
1
2
4
Elev. m (NAVD88)
High : 10.06
Low : -26.5
0 300 600 1,200 Meters
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community


RV+25km
RV+20km
RV+15km
RV+5km
RV+10km
Rio Vista
RIV
Isleton
RV

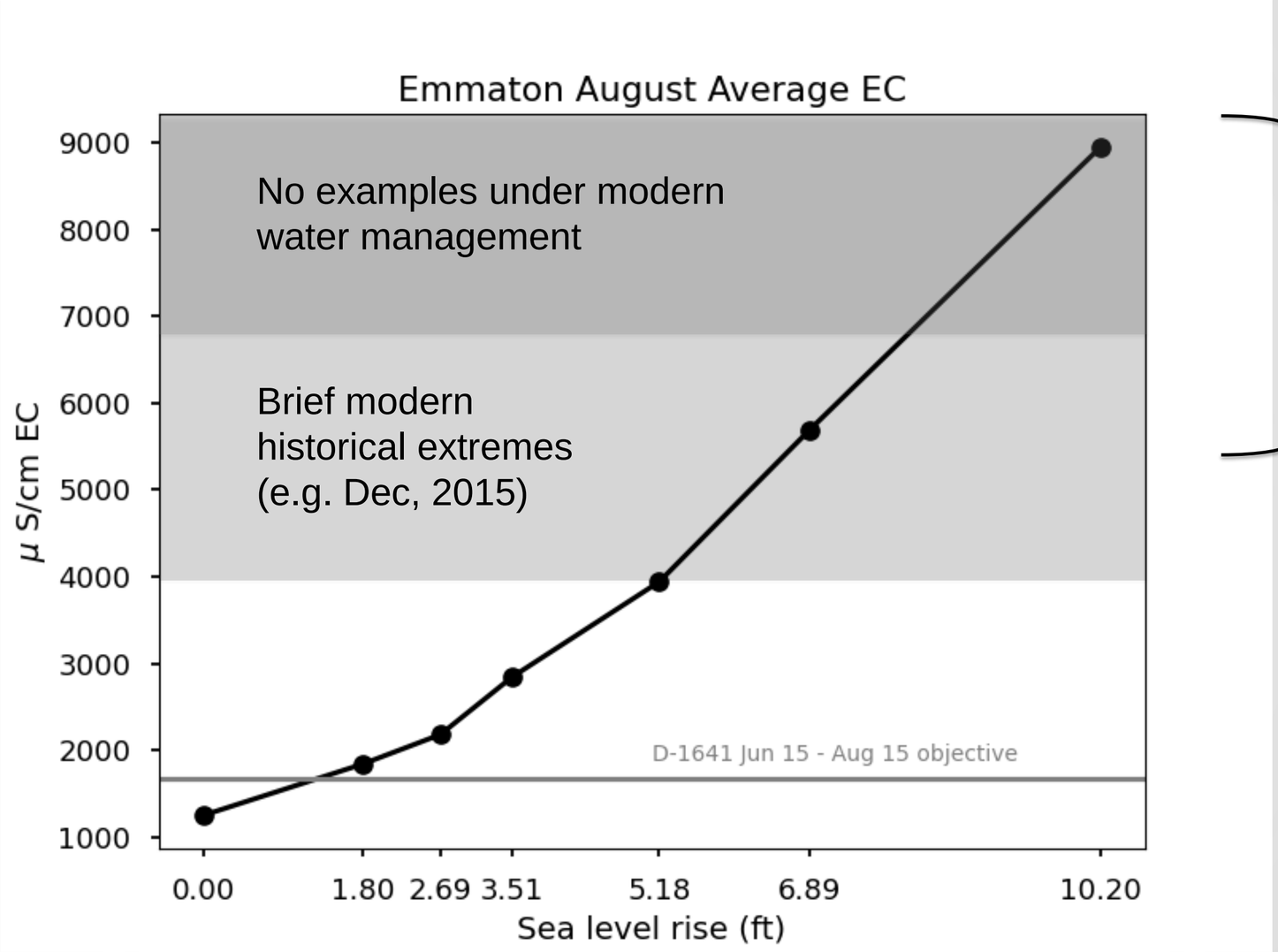



Bay-Delta SCHISM simulation output (tidally filtered)




Contours are 1000 ppm Chloride. Source: Delta Atlas

# Impact: Emmaton August Salinity




Warranty Expired: Geographical and water use assumptions contradicted

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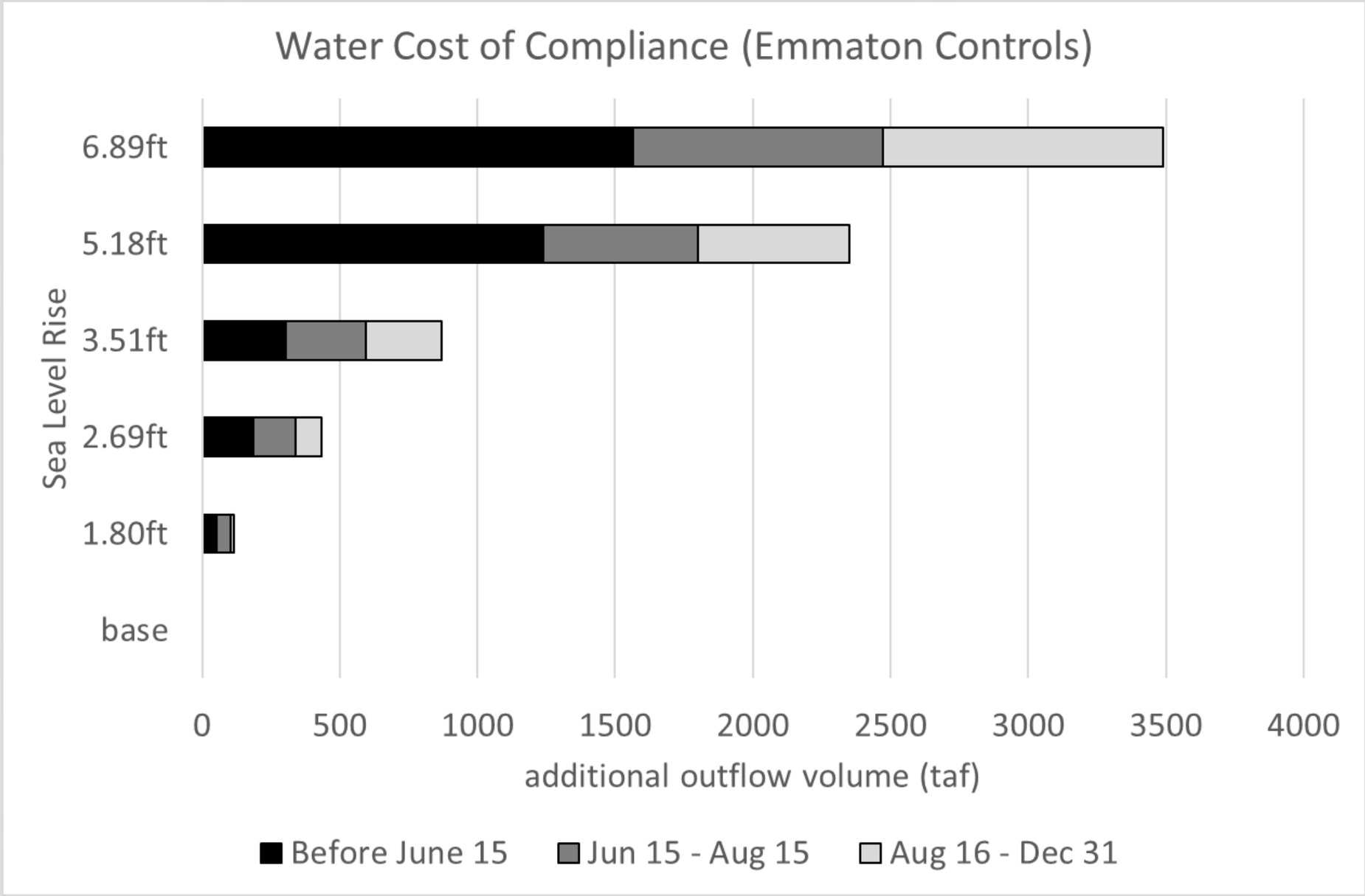


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# Key Points

- DCP Intakes not vulnerable at 10.2ft given historical flow
  - Not very uncertain
- Delta is vulnerable
  - Costly to control with releases
  - Model assumptions affect tipping point
- SLR affects:
  - West (Suisun/Collinsville) more than Delta
  - Emmaton more than Jersey Point

# Questions?

- Eli.Ateljevich@water.ca.gov

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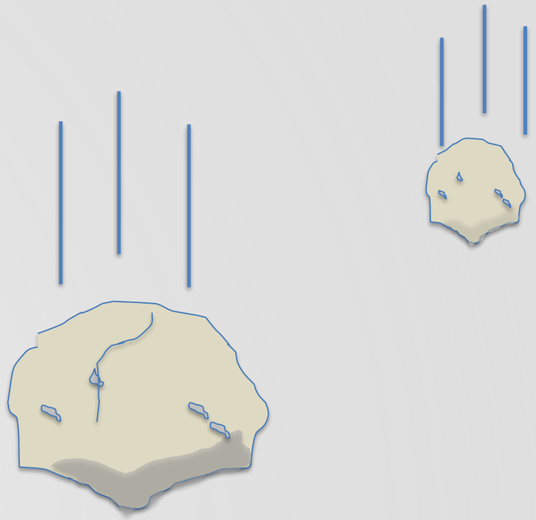

# (WHY) IS SALINITY HIGHER IN A DEEPER ESTUARY UNDER SLR?