

Projections of Bay-Delta Hydrodynamics under Future Climate and Hydrology Conditions using a 3D Numerical Model

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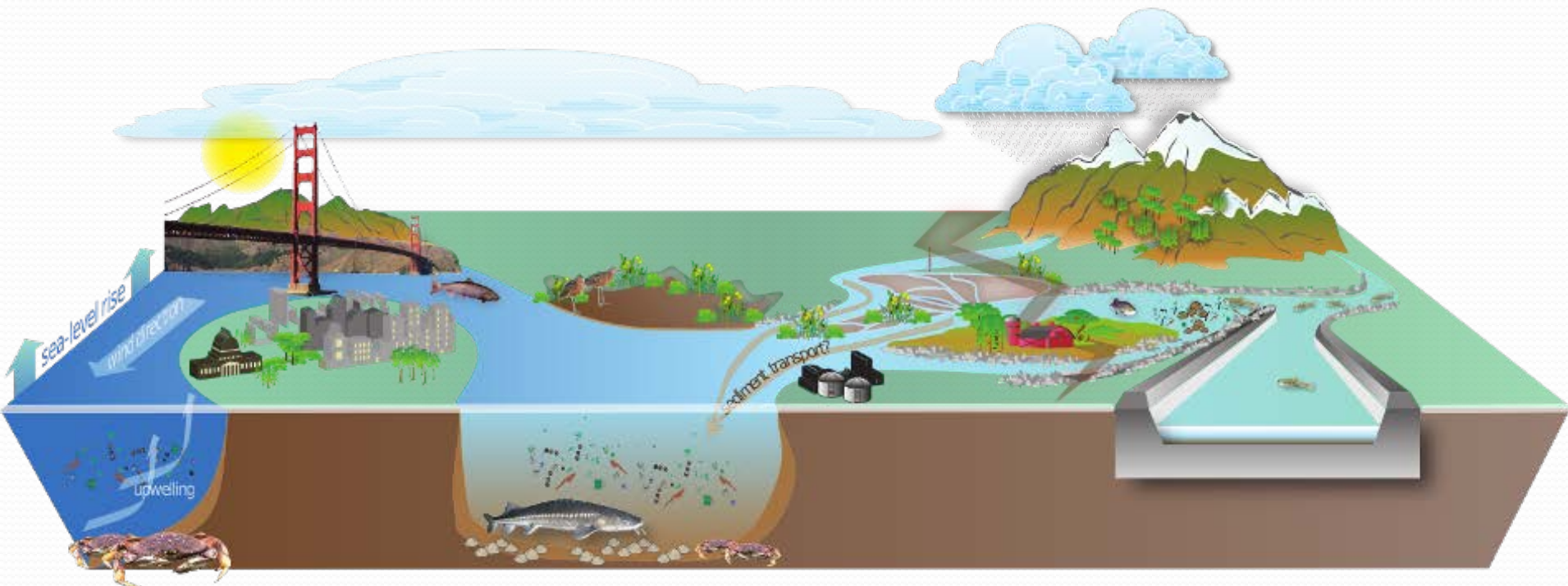
Outline

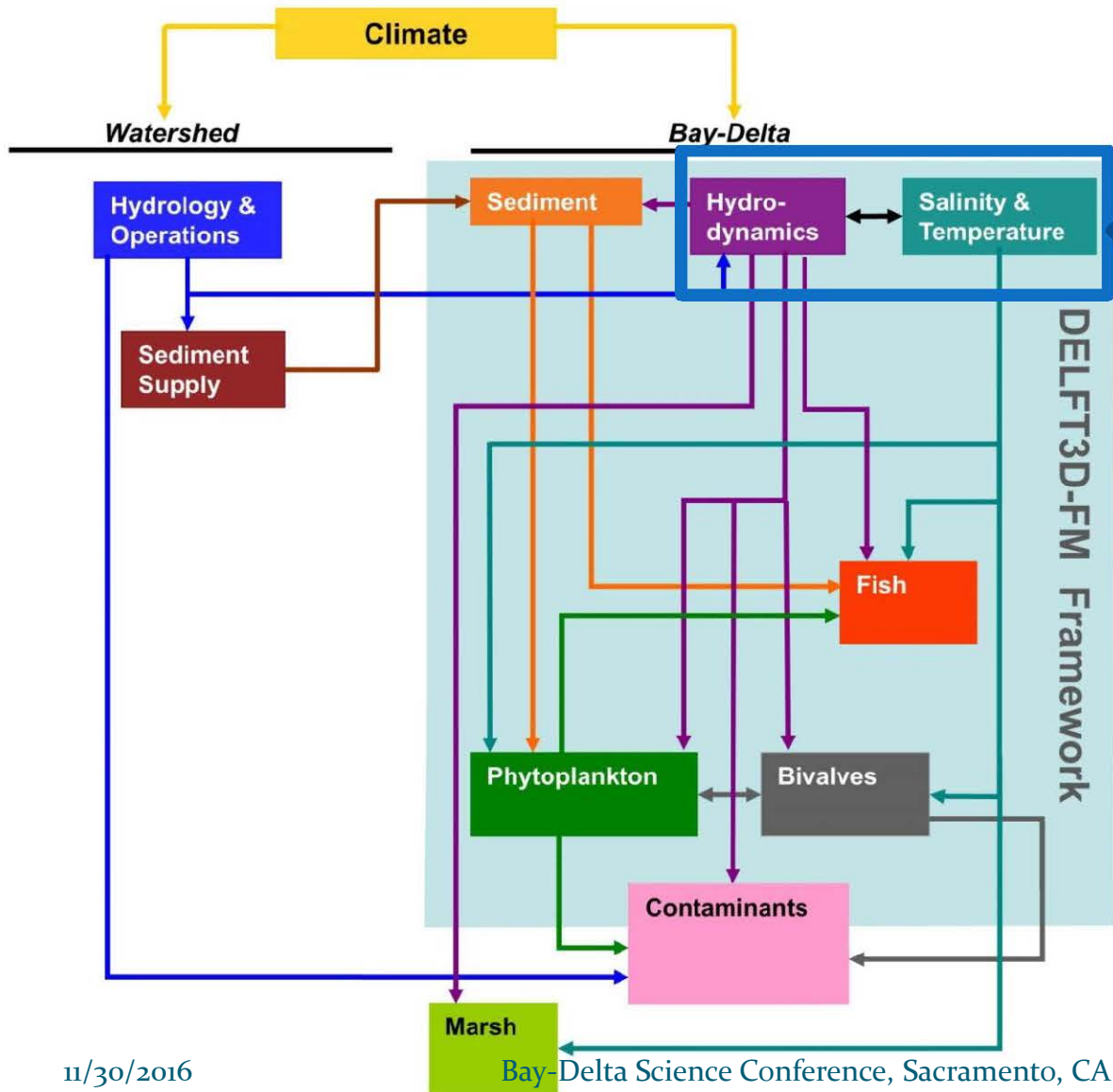
- Motivation
- D-Flow FM Hydrodynamic Model
- Model applications:
 - Historical hindcasts
 - End of century projections
- Future Work
- Stakeholders
- Acknowledgements

Motivation: Projections of Bay-Delta water levels, currents & flows, salinity, water temperature

Hydrodynamics is driven by: climate, watershed, infrastructure

Hydrodynamic Drives: water supply & quality, biogeochemistry, ecology





UC San Diego Delft3D FM



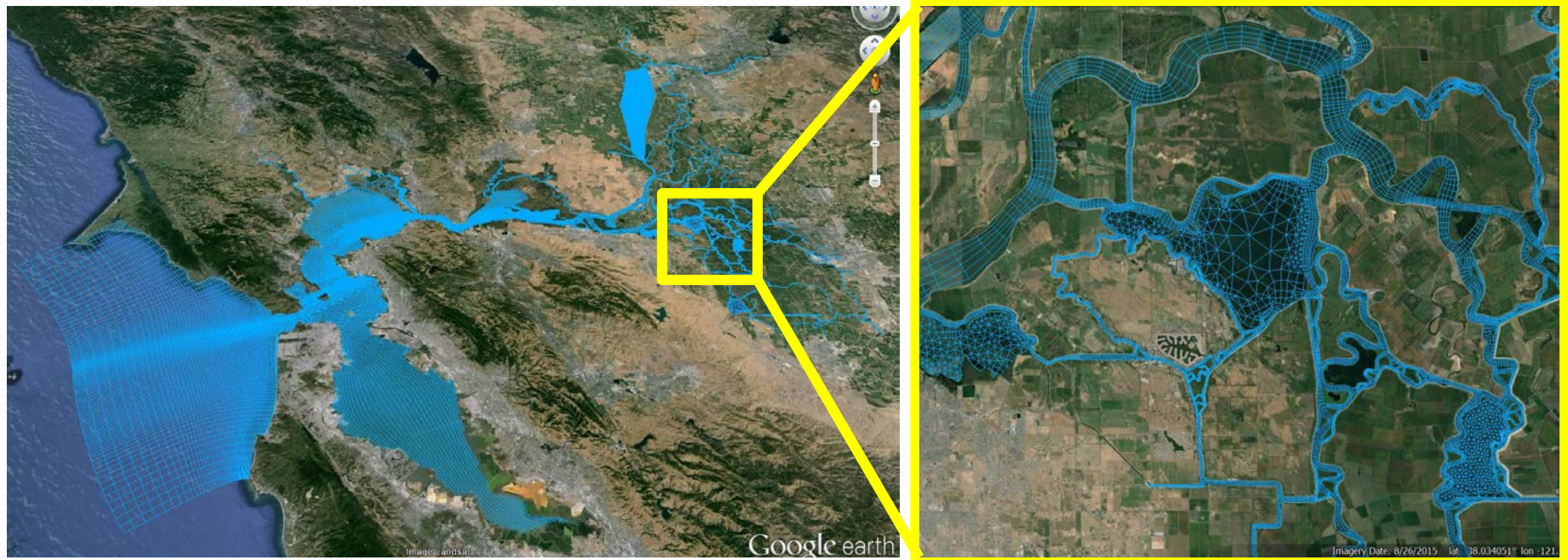
UNESCO-IHE
Institute for Water Education



SAN FRANCISCO
STATE UNIVERSITY

Hydrodynamic Model

- * Software: Delft3D-FM
- * Developed by Deltares, Inc.
- * Unstructured implementation of Delft3D
- * 3D finite volume hydrodynamics, salinity and temperature
- * Couples to water-quality, ecology models



Hydrodynamic Model



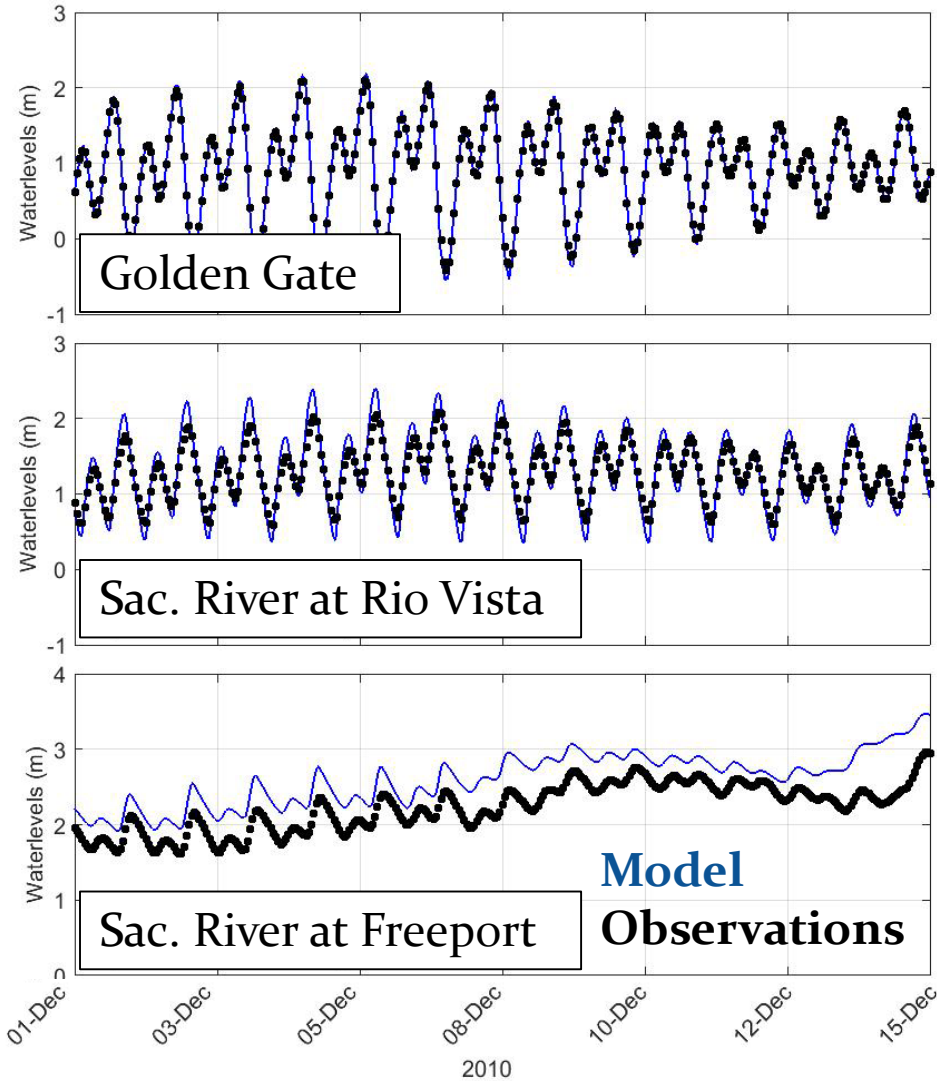
- Tidally-driven waterlevels at Pacific Ocean
- Variable freshwater flows
- Pumps
- Gates and dams
- Atmospheric conditions
- Measurement-based bathymetry
- 10 vertical σ layers

Historical Hindcasts

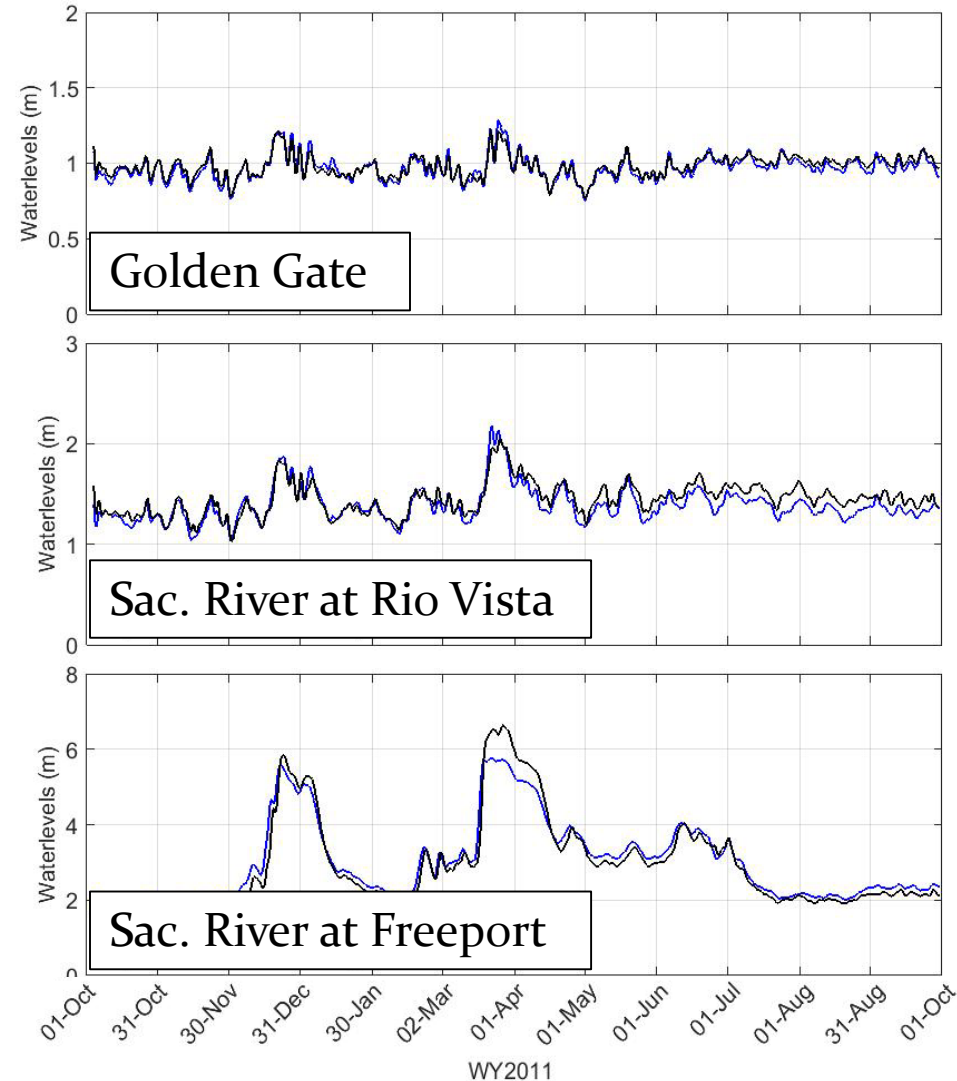
- Objectives:
 - Develop a calibrated & validated model
 - Provide historical drivers to water-quality, bivalve, chemistry and ecology models
- Validation period: WY2011 & 2012
 - Selected for: wide-ranging hydrology, infrastructural operations; wealth of data
 - Parameters of interest: water levels, flows, salinity distribution & intrusion, water temperature characteristics
 - 2 submitted publications

Historical Water levels

Tidal water levels from 01-Dec to 15-Dec, 2010



Tidally filtered water levels for WY2011

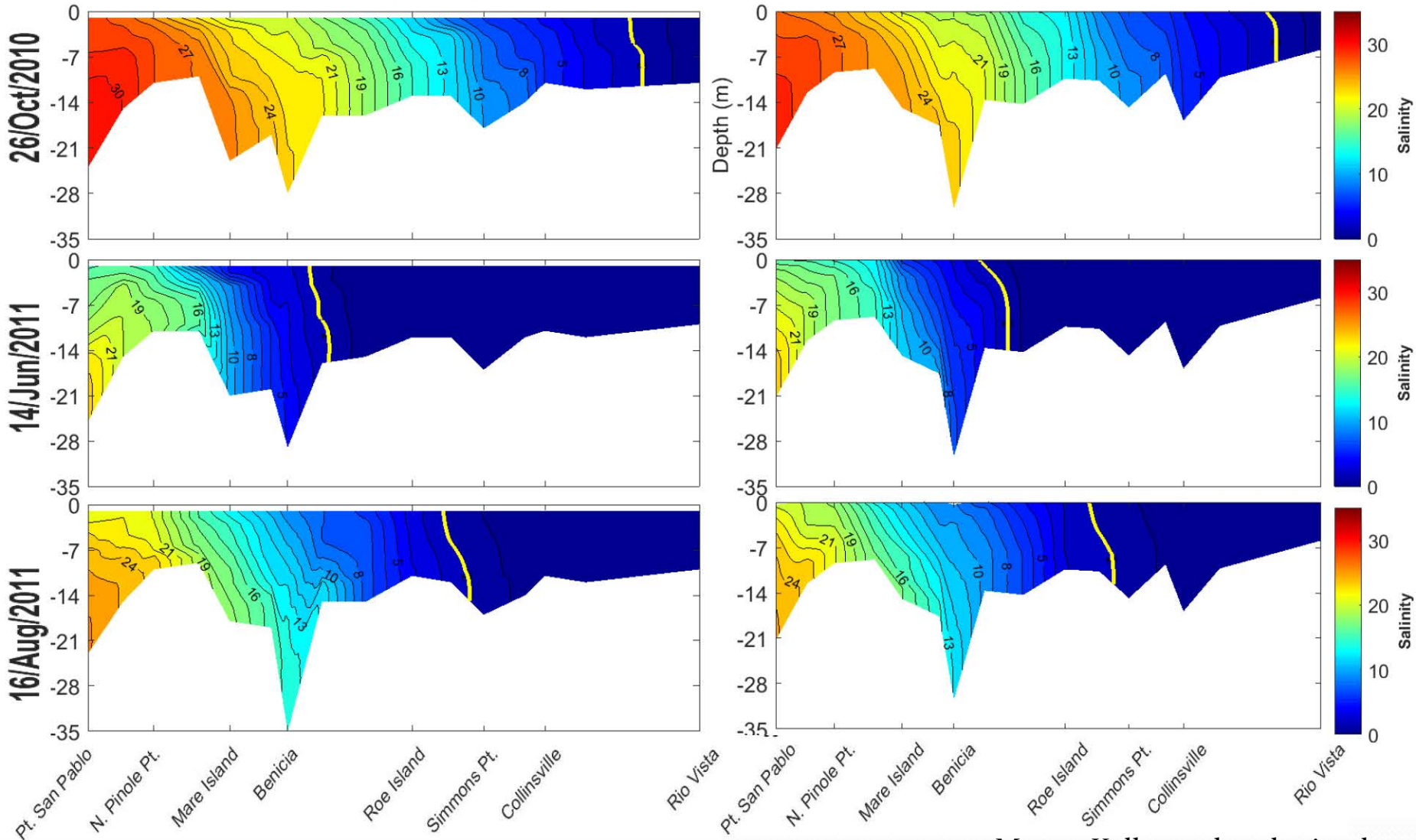


Historical North Bay Salinity Profiles

WY2011

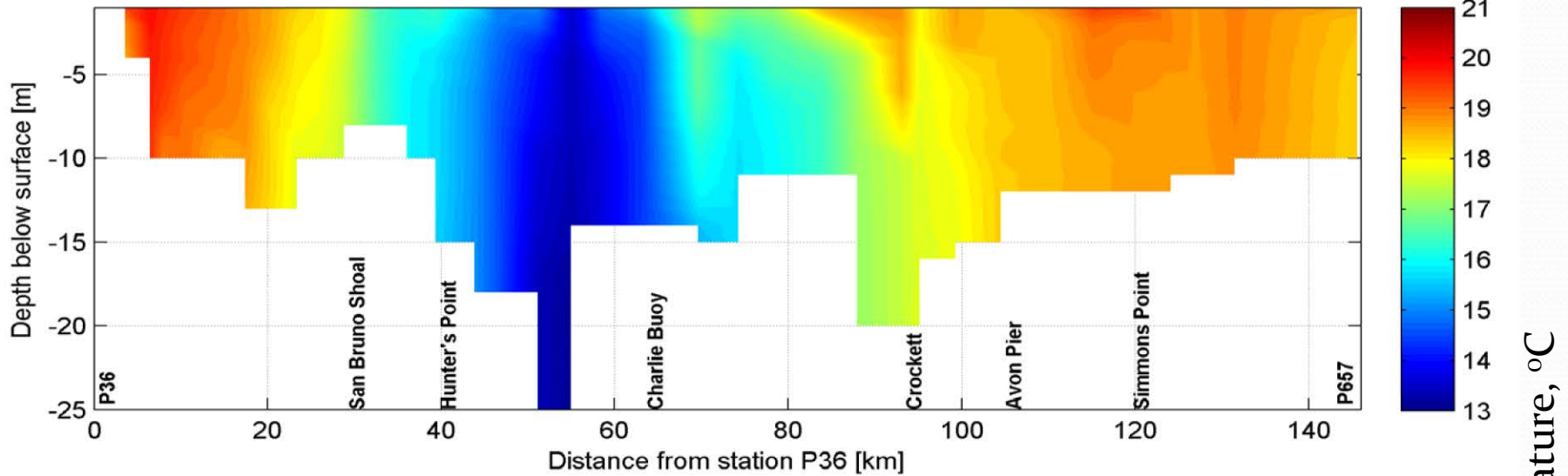
Observations

Model

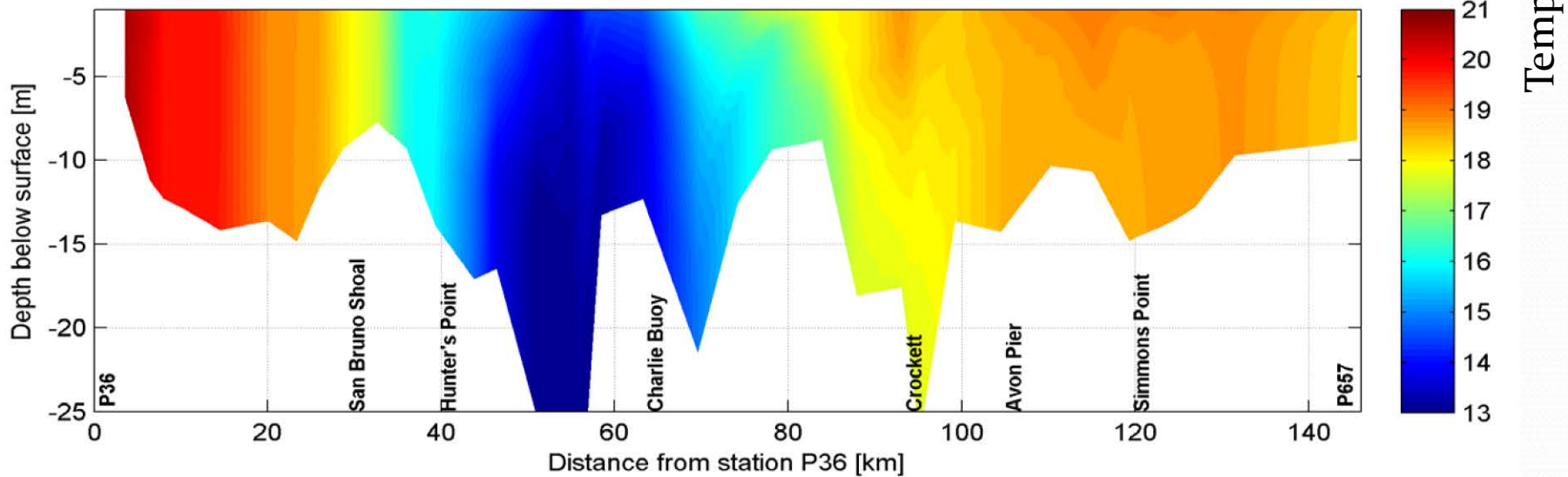


Historical Bay Temperature Profiles

Polaris cruise at 14-Jun-2011



Model result at 14-Jun-2011

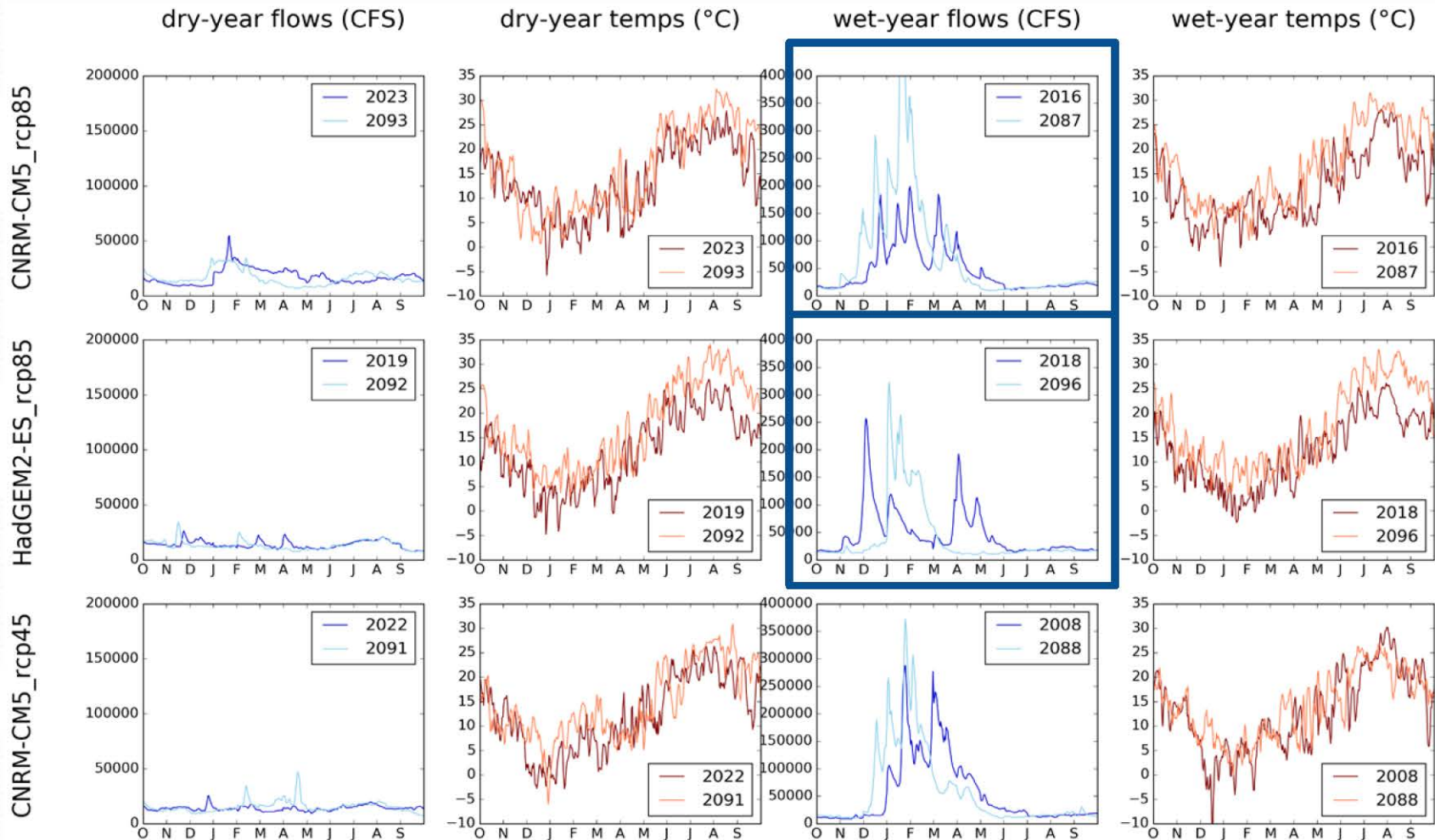


Climate Scenarios

big flow changes

big warming

moderate



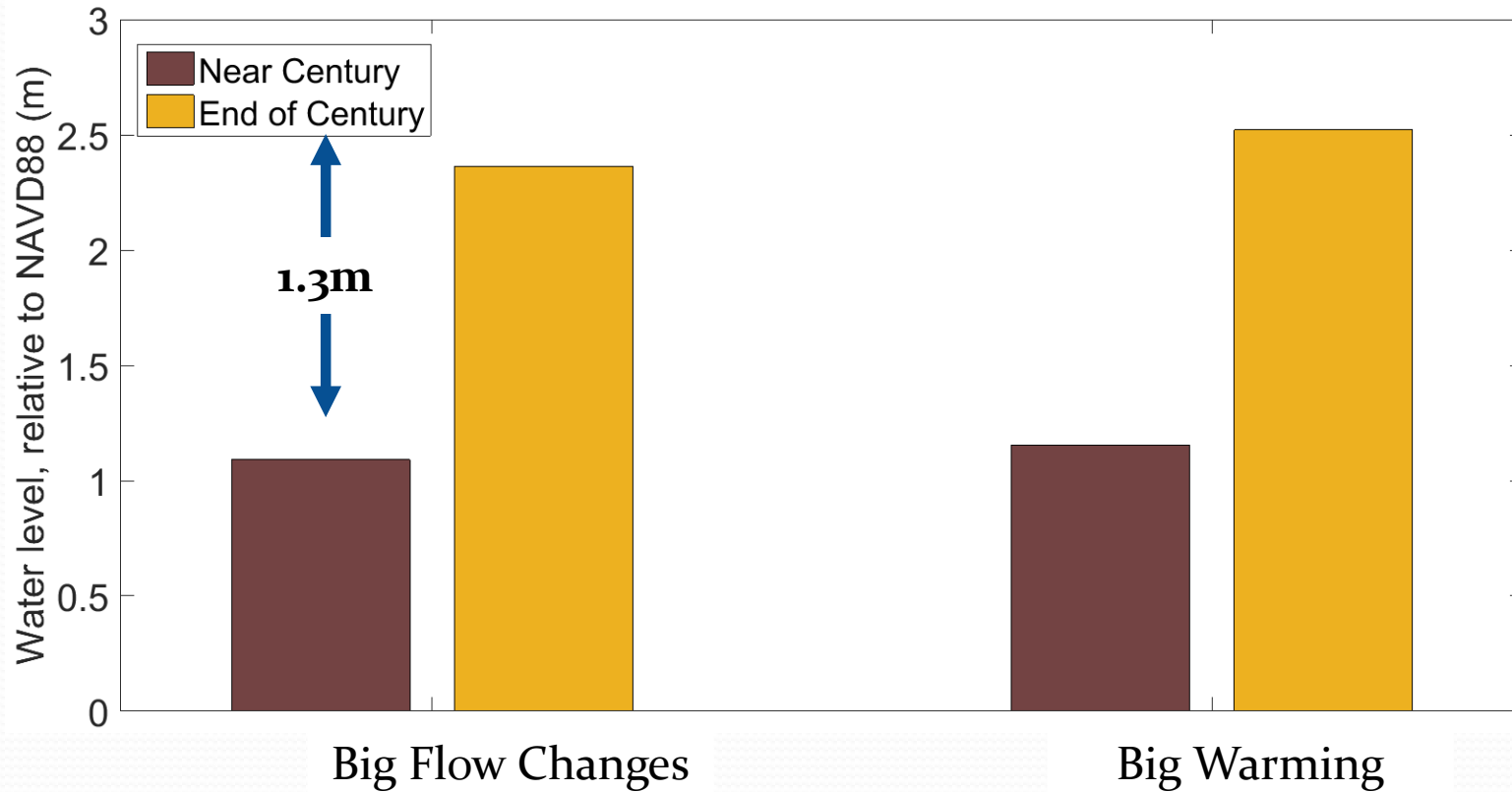
Climate Scenarios

Features of Interest

Parameter	Potential Impact
Mean Sea Level	Flooding
Net Delta Outflow	Water supply, quality
Yolo floodplain inundation	Agriculture, habitat suitability
Salinity Upstream Salinity Intrusion	Water quality, habitat suitability
Temperature Mortality Threshold Temperature	Water quality, habitat suitability

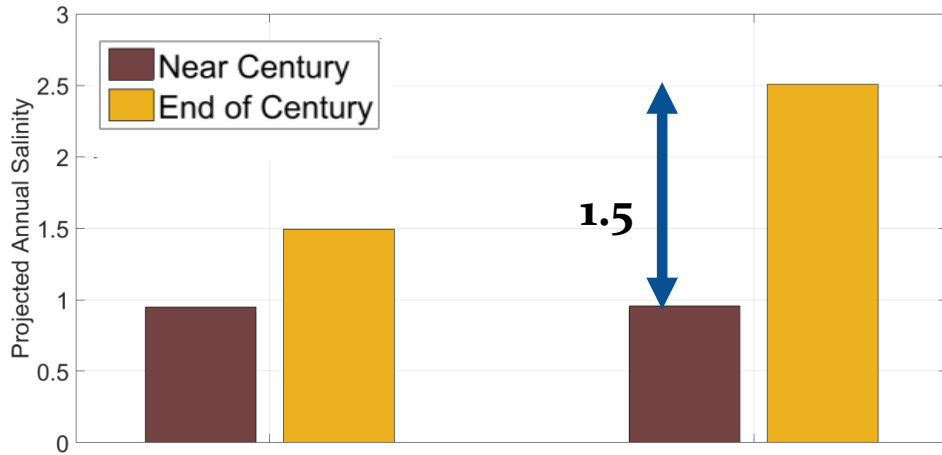
Potential futures: higher water levels...

Golden Gate Bridge Water levels



... and more salty, warmer waters...

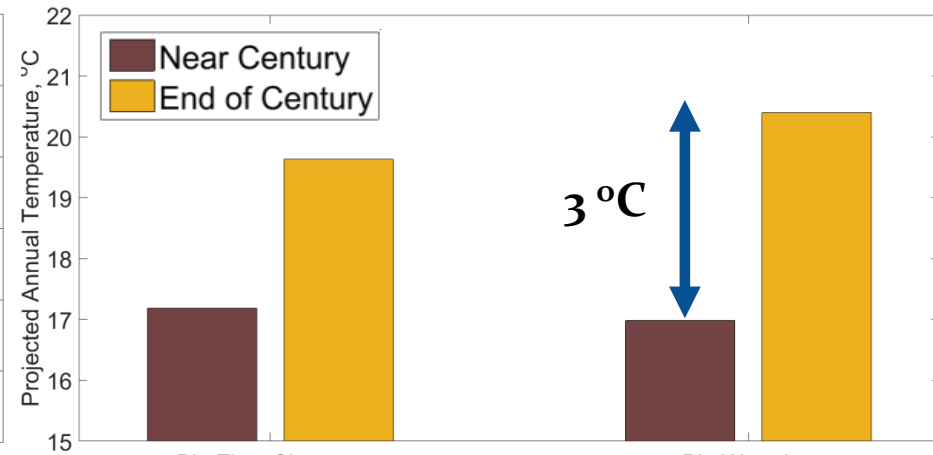
Lower Sacramento River Annual Salinity



Big Flow Changes

Big Warming

Lower Sacramento River Annual Temperature

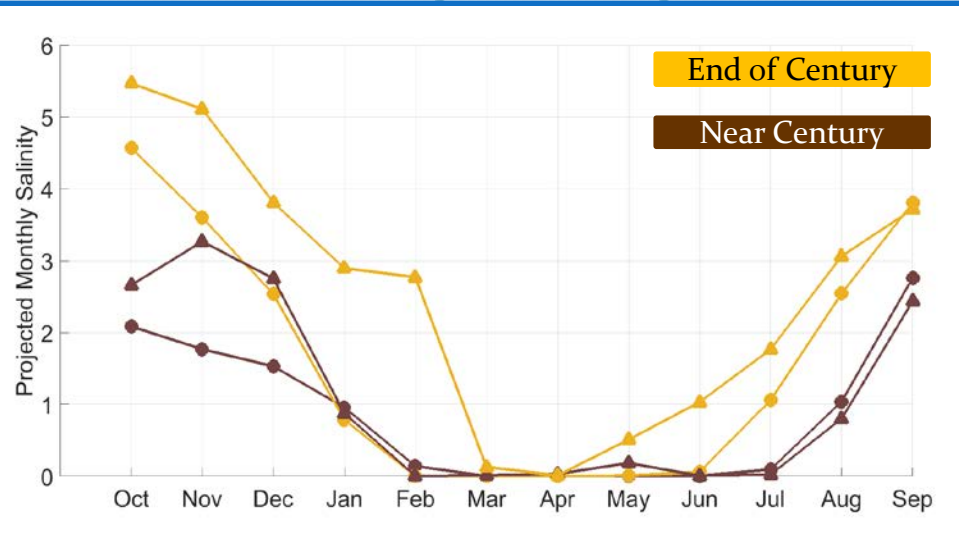


Big Flow Changes

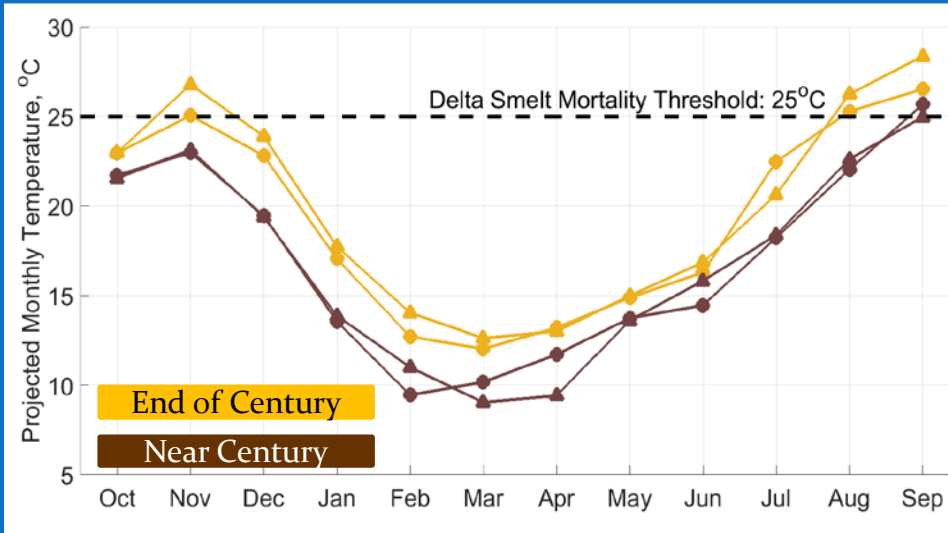
Big Warming

...Annually and monthly.

Lower Sacramento River Monthly Salinity



Lower Sacramento River Monthly Temperature



- Big Flow Changes
- ▲ Big Warming

Future Work

- Existing Infrastructure
 - Exceedance thresholds
- Changes in water-supply infrastructure
- Reconfigured Delta
 - Failed levees
 - Habitat restoration

Stakeholders

- Other CASCaDE members
 - Contaminant transport: James Bishop and others
- Delta biochemistry interests
 - The Delta Doughnut: A Persistent Pattern for Methylmercury Metrics, Thu @ 1:55pm
- San Francisco Estuary Institute
 - Nutrient modeling efforts
- Model and data release:
 - Community Model: <http://www.d3d-baydelta.org/>
 - California Coastal Atlas: <http://californiacoastalatlantlas.net/>

Acknowledgements

Funding

- Delta Stewardship Council/
Priority Ecosystems Science
- San Francisco Bay Nutrient
Management Strategy,
- San Francisco Bay Regional
Monitoring Program

Computing

- USGS
- XSEDE resources at UT Austin

People

- Deltares:
A. v. Dam, S. v.d. Pijl, H.
Kernkamp, M. Jeuken, B.
Jagers, and others
- USGS:
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Team
Water Science Center
- Ed Gross, D. Sereno, R.
Holleman, L. Herdman

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