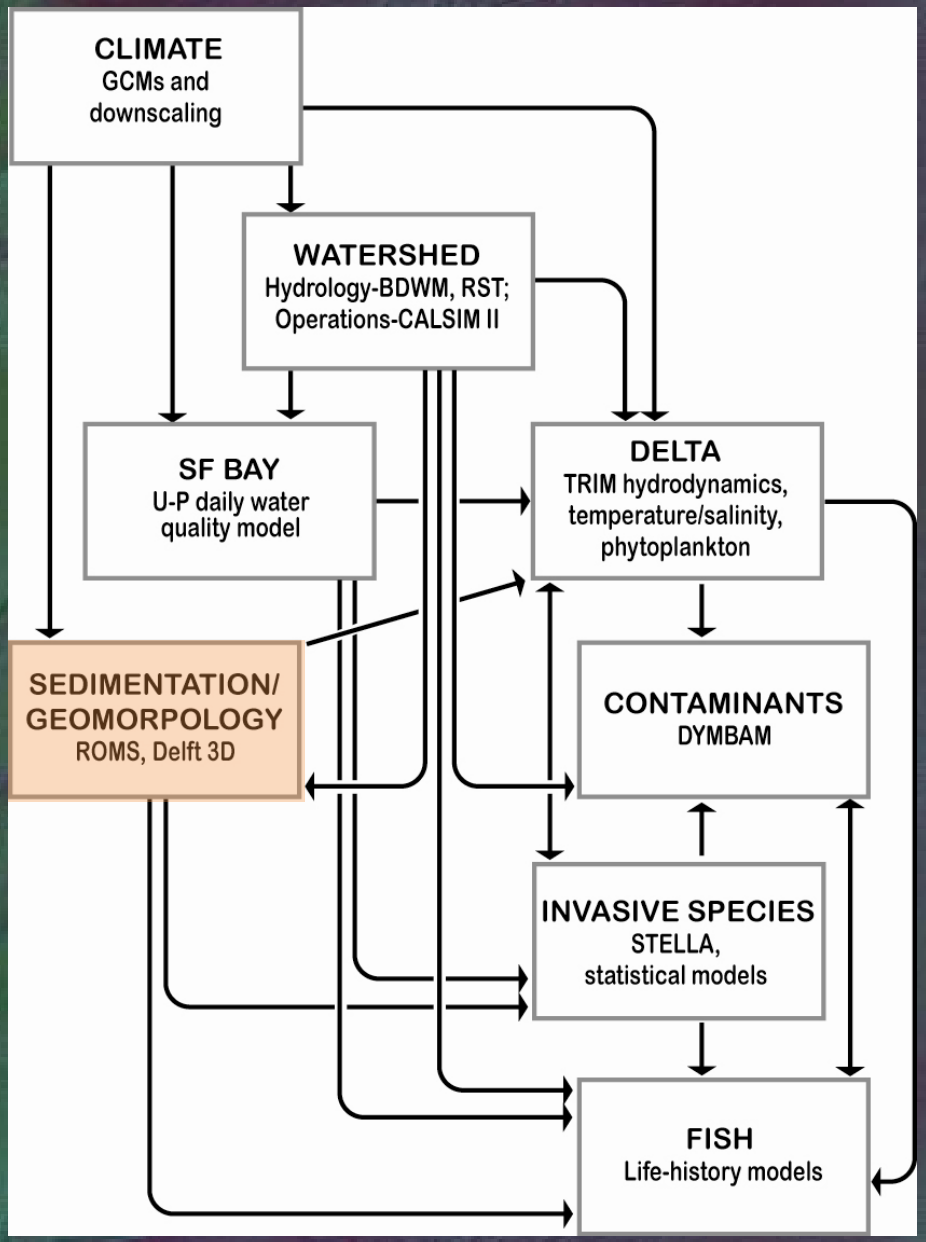
CASCaDE hindcast of bathymetric change in Suisun Bay, 1867-1990: model uncertainty and parameter selection



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Background courtesy of Plymouth Marine Lab

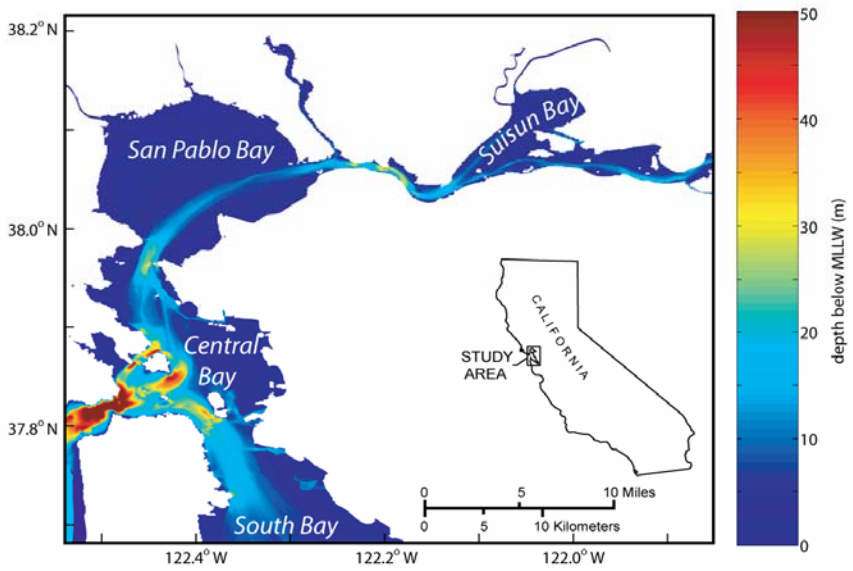
Sedimentation and Geomorphology

Habitat includes:

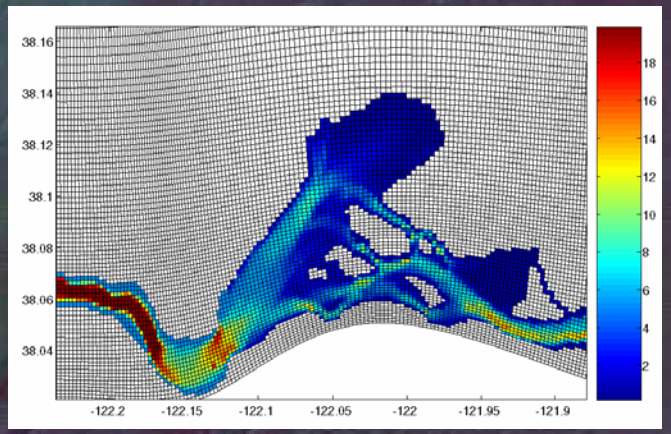
- Water depth = Sea level rise + bathymetric change
- Turbidity

Study Suisun and San Pablo Bays because:

- Ecological significance
- Historical bathymetry available
- Hydraulic mining
- Landward subembayments

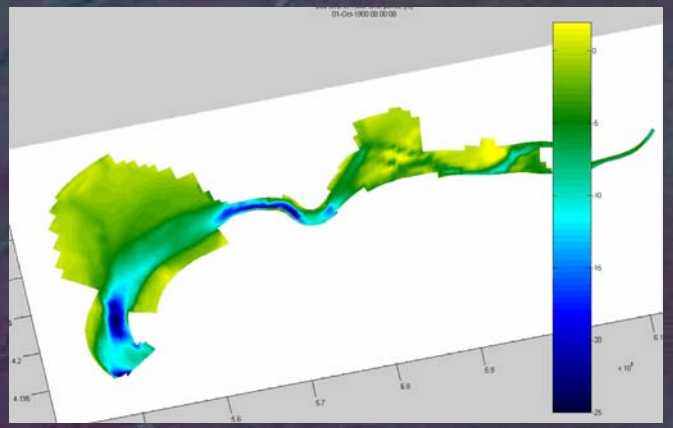


What we have done



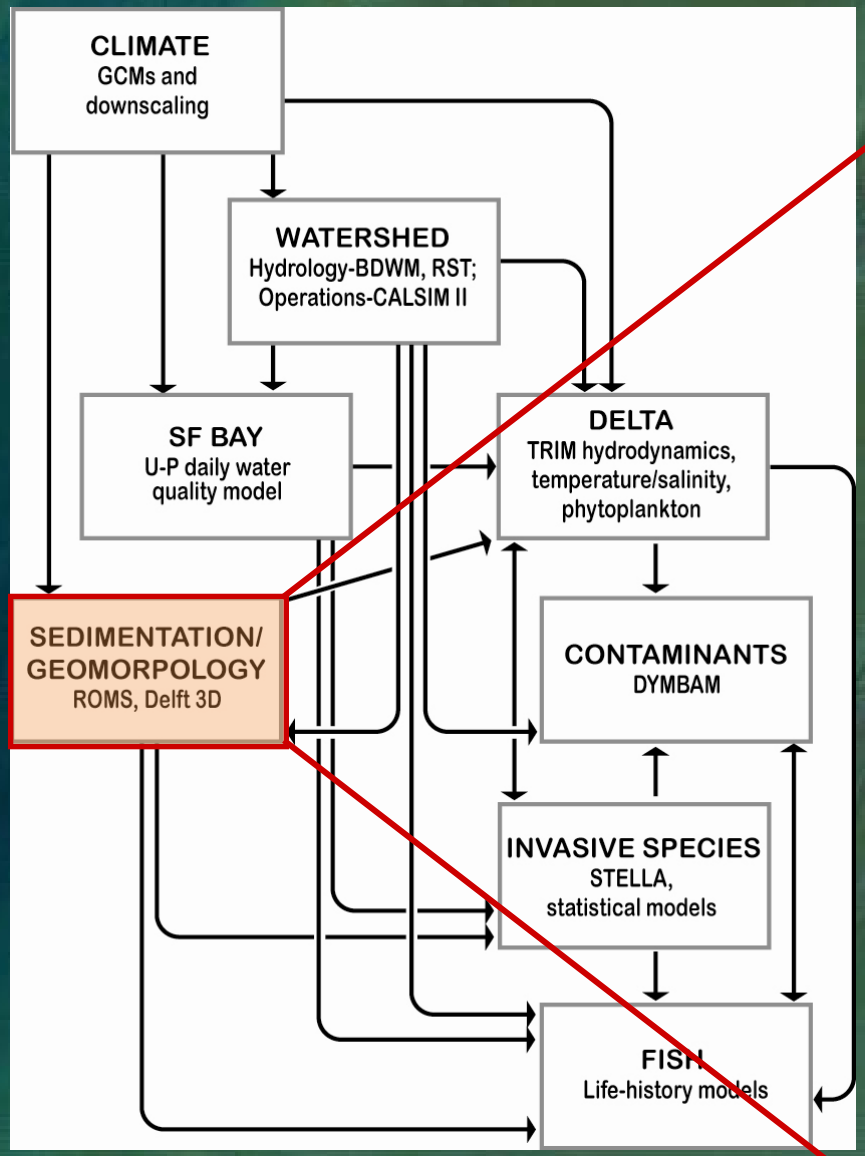
This talk:
- Hindcasting
- Parameter selection
- Model uncertainty
- Initial scenarios

Other work not presented today:
- Landward boundary conditions
- Simulation techniques



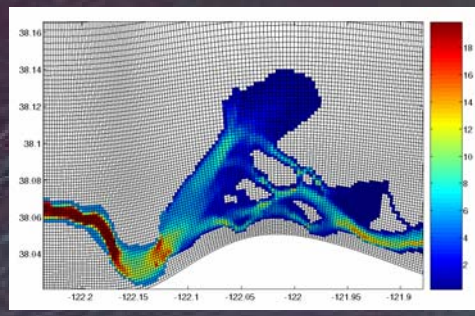
Next talk:
- Full bay model applied to San Pablo Bay

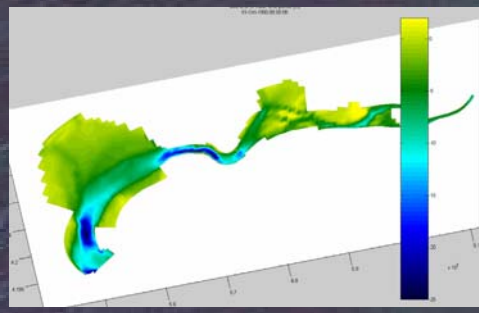
CASCaDE's Sediment Component



BDWM
- Delta inflows
- Magnitude
- Timing

ROMS
Delft3D
- Hydrodynamics
- Sediment transport
- Geomorphology





Outputs
- Depth distribution
- Turbidity
- Habitat distribution

Suisun Bay hydrodynamic/sediment transport model

Regional Ocean Modeling System (ROMS) v. 3.0

Supported by Rutgers, UCLA, USGS

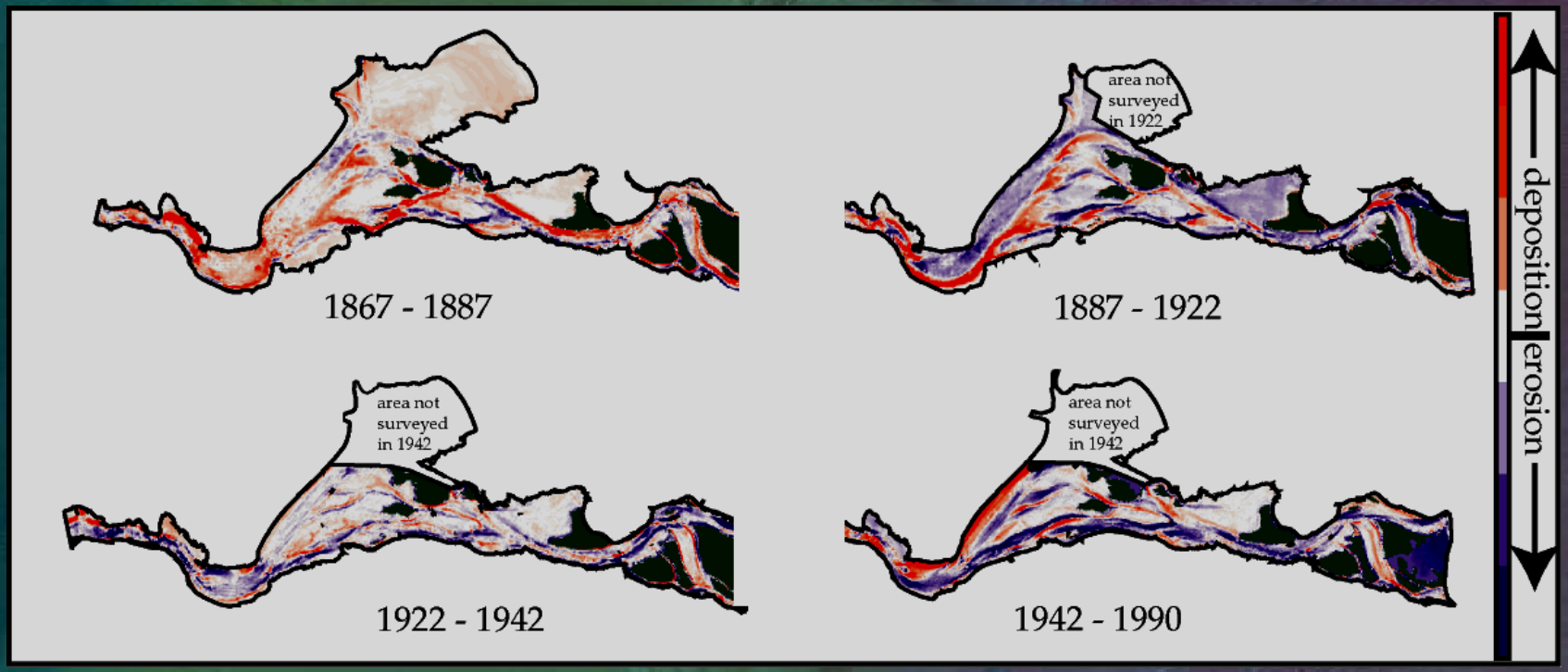
Open-source, community sediment transport model

Solves Reynolds-averaged Navier-Stokes equations in separate 2D and 3D modes

Multiple options for turbulence closure

Runs on ~ 1 min time-step

Historical calibration data for geomorphic model



- Bathymetric change in Suisun Bay, California: Cappiella et al. (1999)
- Affected by transport of hydraulic mining debris (1850-1884)
- Rapid deposition (1867-1887) followed by erosion (1887-1990)
- Rare historical data…we need to simulate these data to test the model

Calibration and parameter estimation

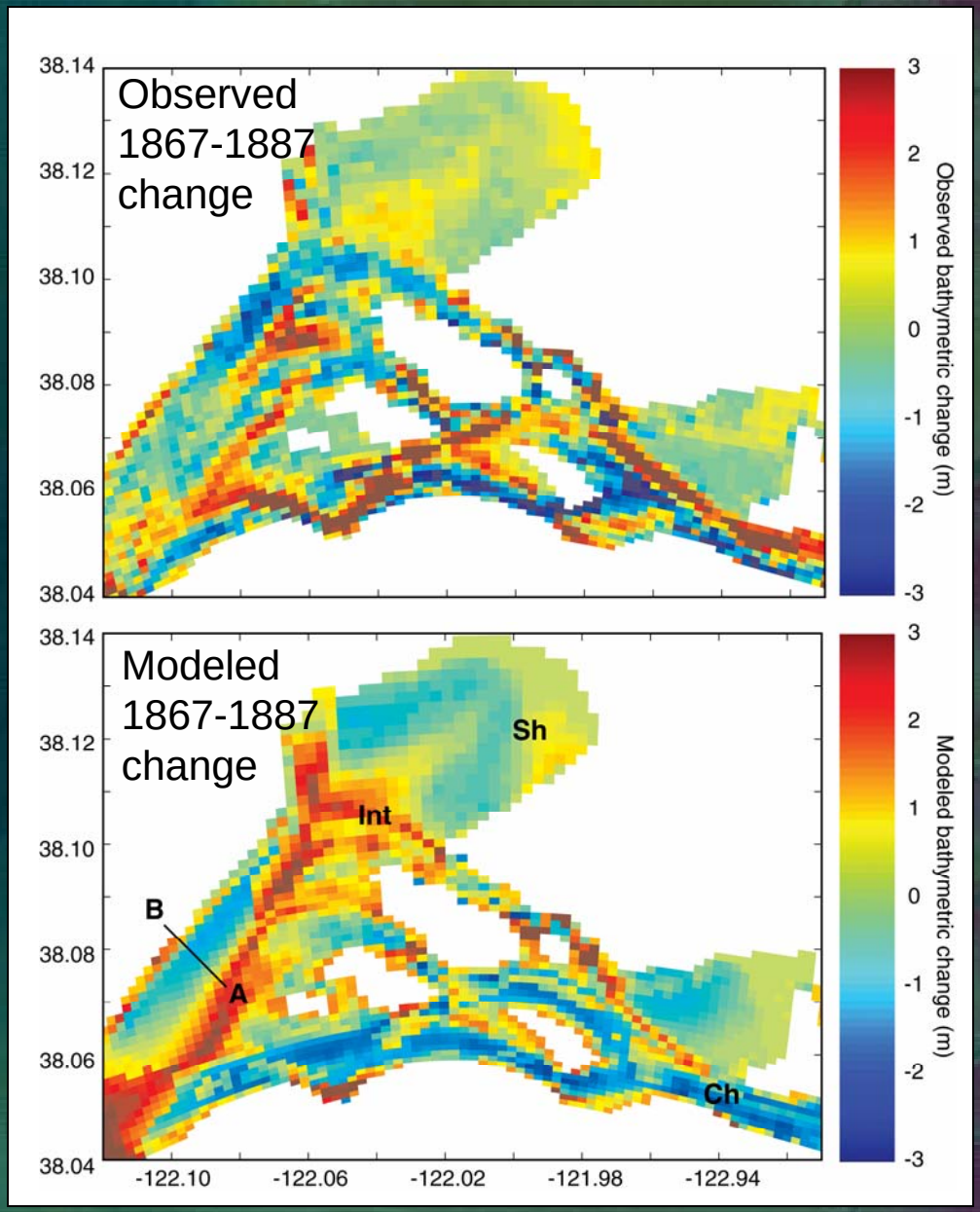
Calibrate model using bathymetric change data

Daily sediment supply from watershed estimated by Ganju et al. 2008

<u>Calibration parameters:</u>

- critical shear stress for each of 2 size classes
- bed density
- wave period

Hindcasting results: qualitative performance



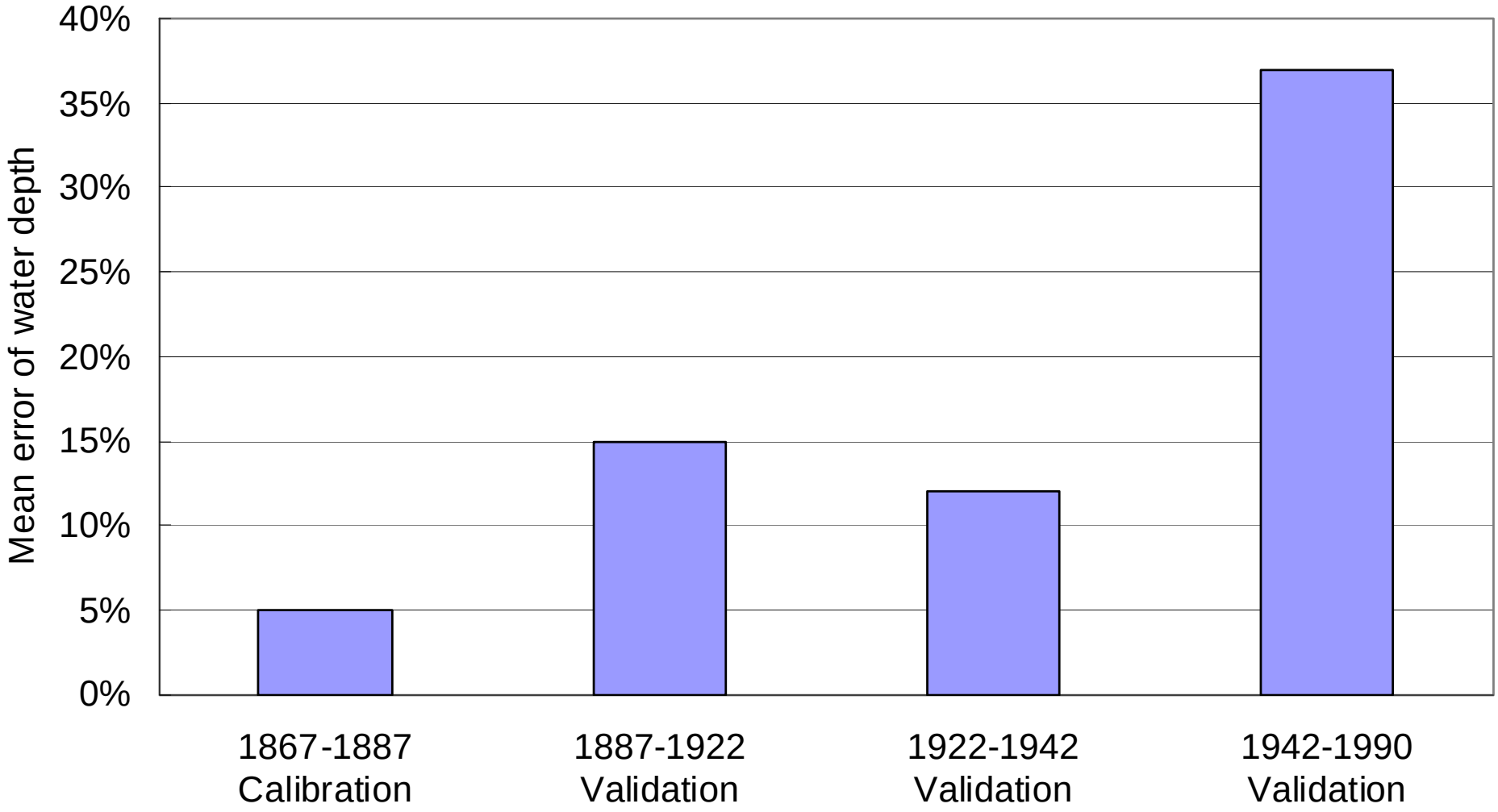
General features

- Deposition in off-channel bays
- Net erosion in northwest channel
- Erosion in landward main channel

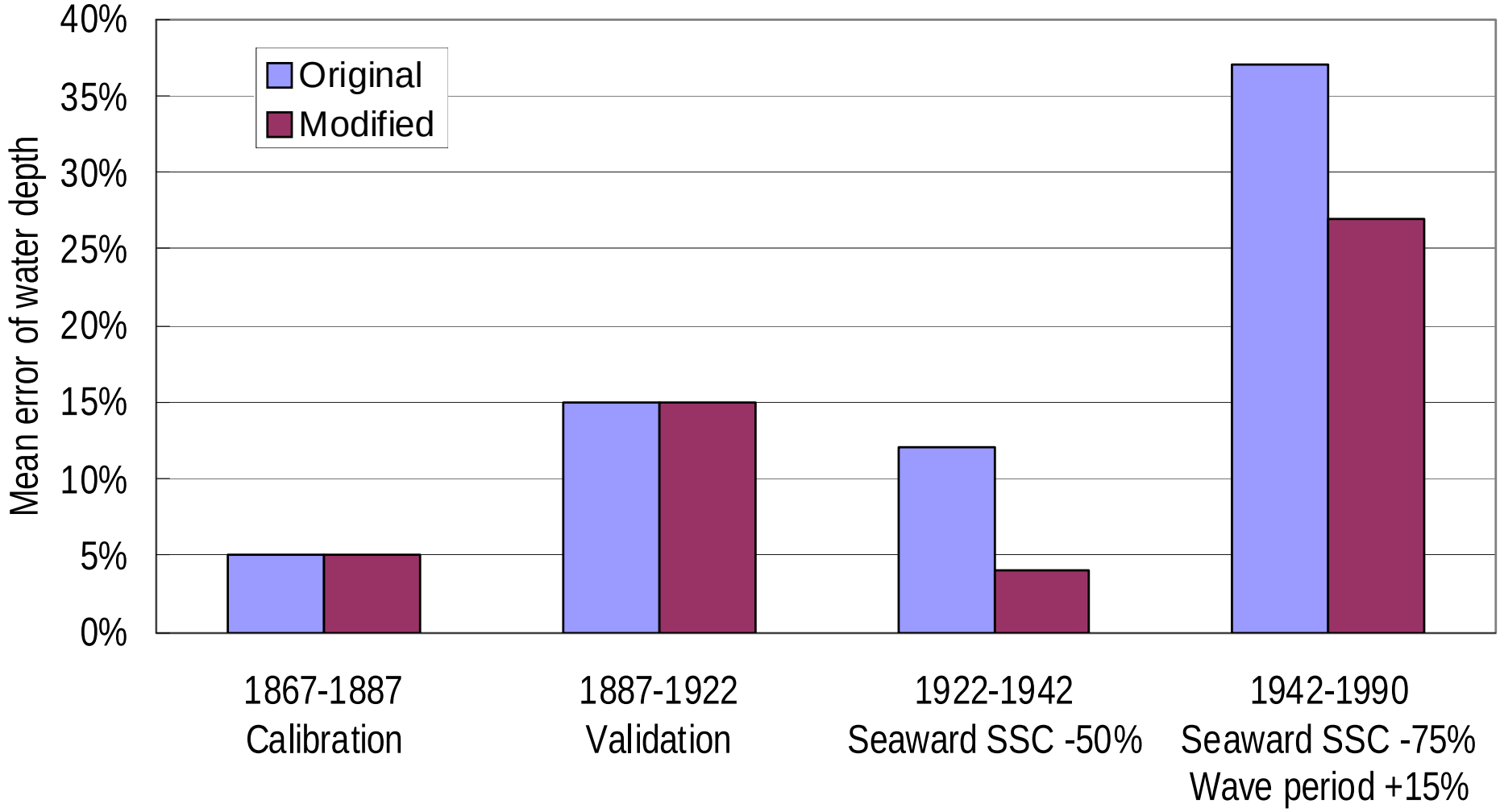
Explanations for areas without agreement

- Grain-size distribution
- Wave model
- Consolidation?
- Benthic processes?

Calibration and validation



Modify seaward SSC for post hydraulic mining decrease



Lessons learned from hindcasting

Seaward boundary condition not stationary:

•Landward dispersive flux is ~2/3 seaward advective flux

Calibration parameters not stationary:

•Changing benthos and source material

Lessons for future scenarios

Simulation of one hindcast period sufficient to determine reasonable parameter values for future scenarios

Chosen parameters are unlikely to be correct

Parameter values are part of the scenario

Analyze difference in scenario model runs: less sensitive

Example 30-year scenarios

<u>Sea-level rise:</u>

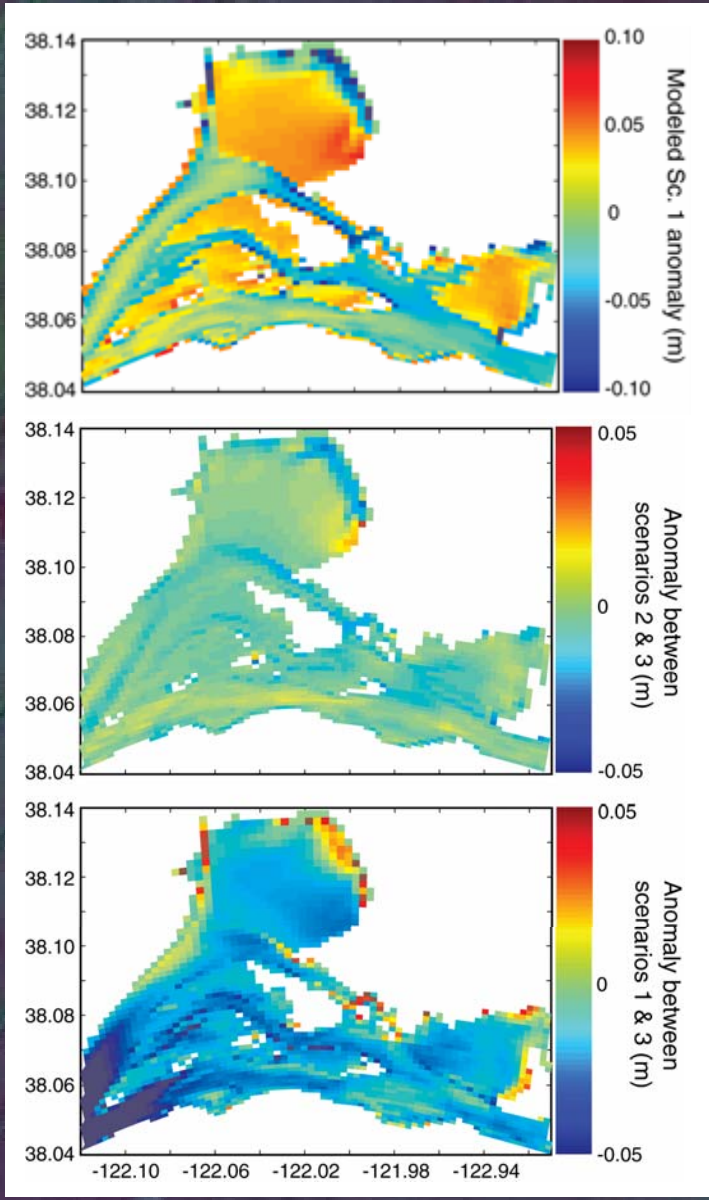
- Increase in water depth reduces wave-induced shear stress
- Less erosion, less redistribution

<u>Warming:</u>

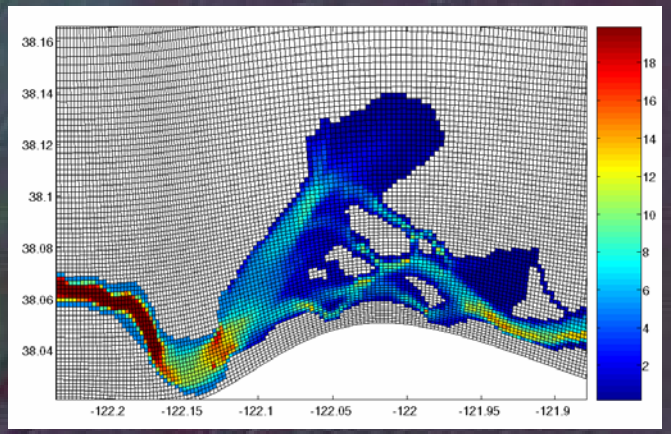
- Minor changes in redistribution

<u>Decreased sediment supply:</u>

- Erosion everywhere except fringes

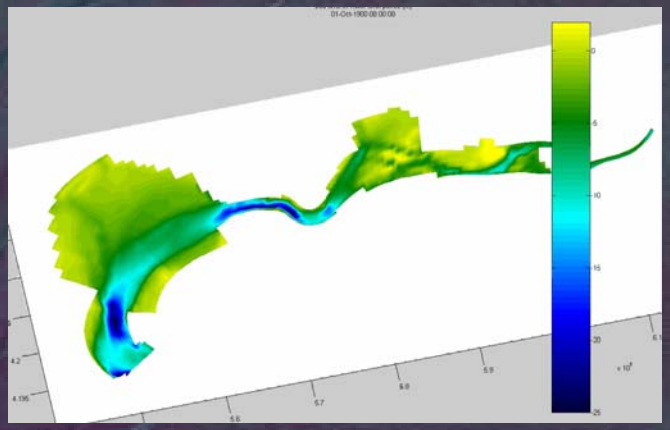


CASCaDE Sedimentation and Geomorphology



Suisun Bay model (this talk):

- Hindcasting
- Parameter selection
- Model uncertainty
- Initial scenarios

San Pablo Bay model (next talk):

- Full bay model applied to San Pablo Bay
- Eliminates seaward boundary problem