CASCaDE: a Scenarios Analysis of the San Francisco Bay-Delta Ecosystem

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U.S. Geological Survey
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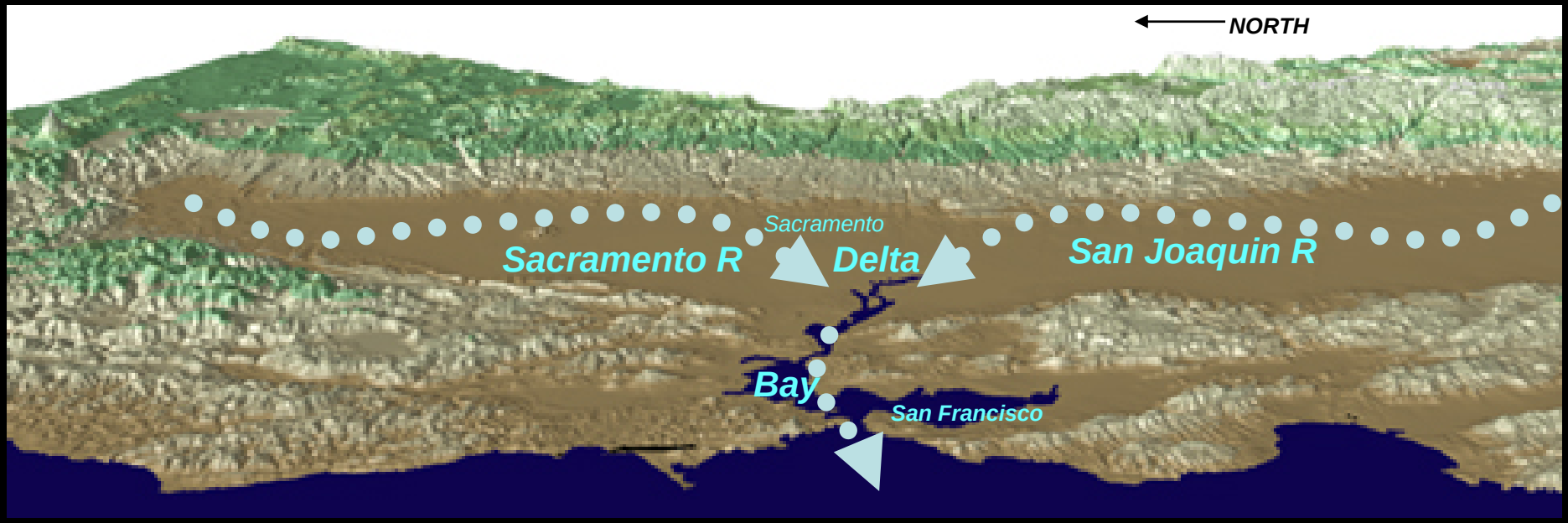
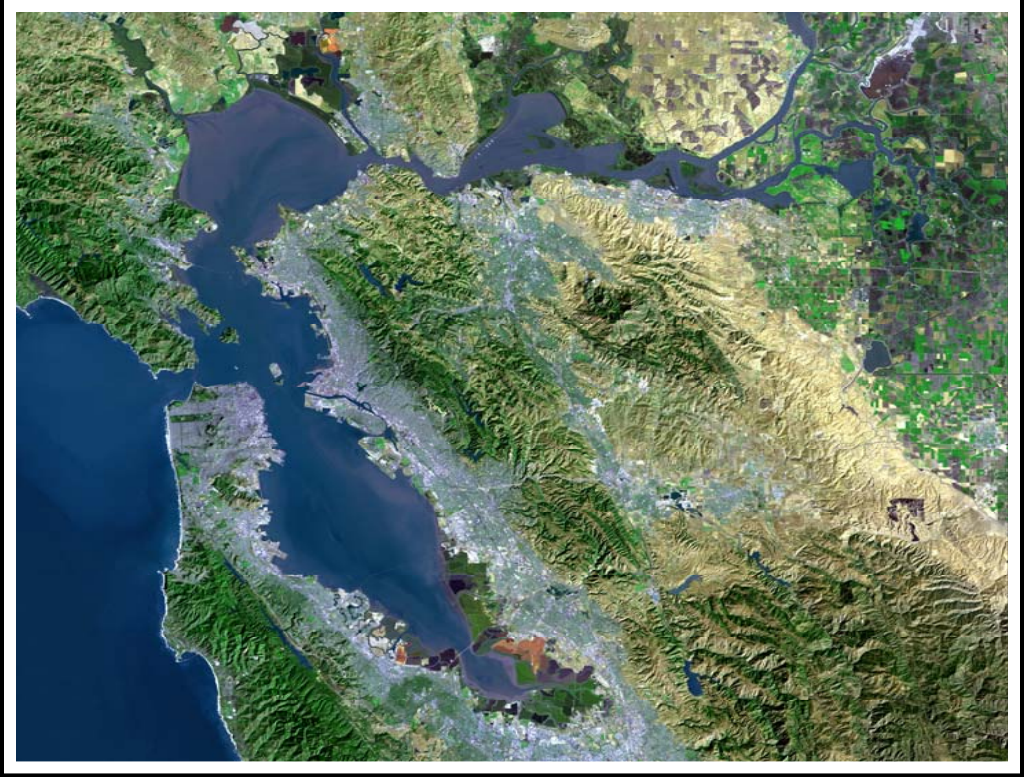
DELTA'S HEALTH IN RAPID DECLINE

FAILING INFRASTRUCTURE:
LEVEES, WATER QUALITY SUFFER AS MONEY AND WILL RUN OUT

ECOSYSTEM IS THREATENED:
DIVERTED WATER PUSHES KEY SPECIES TOWARD EXTINCTION



Computational Assessments of Scenarios of Change for the Delta Ecosystem



Determine how multiple drivers of environmental change would interact to change the Delta and Bay ecosystem

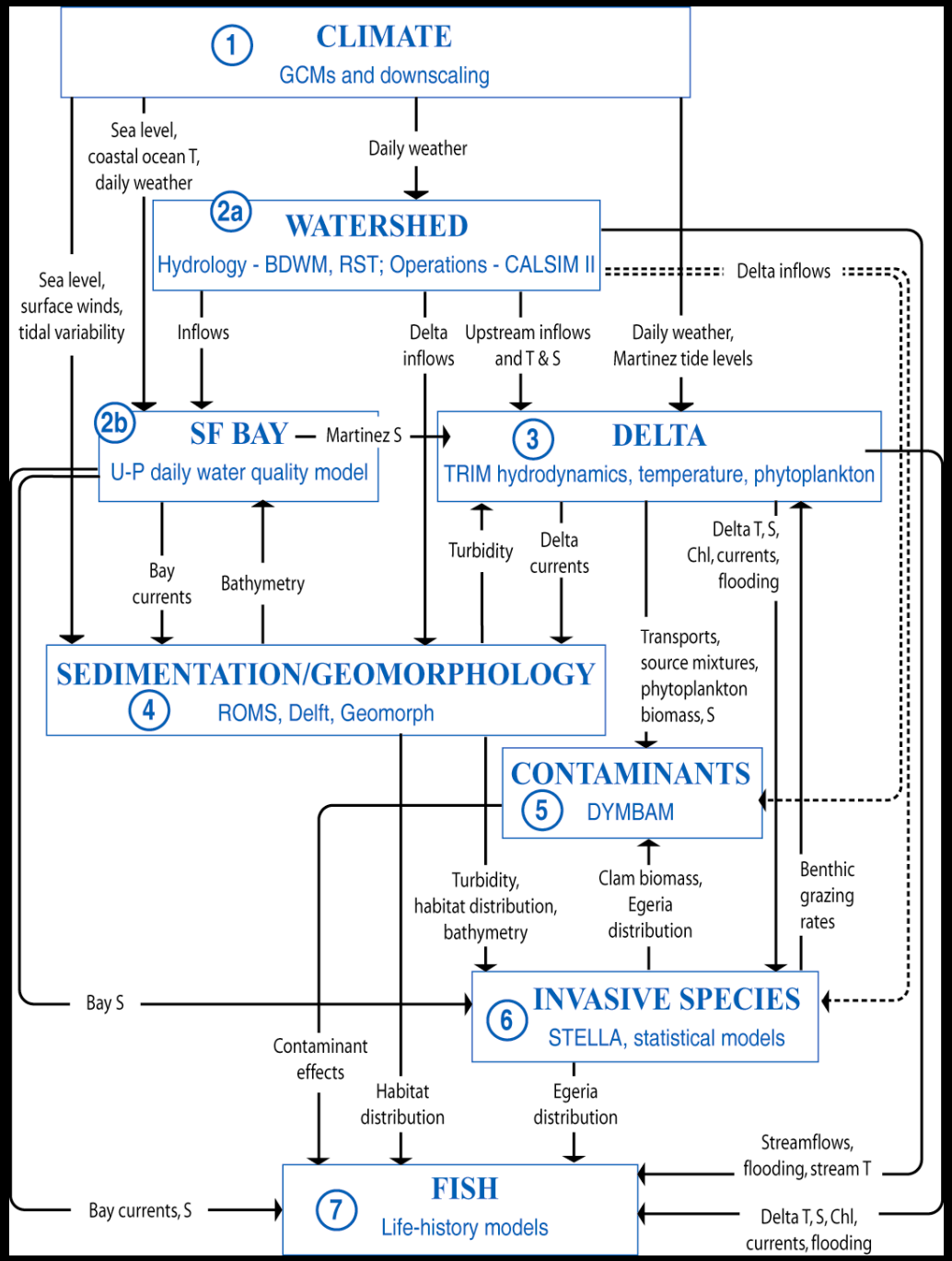
CALFED Bay-Delta Program

USGS
science for a changing world

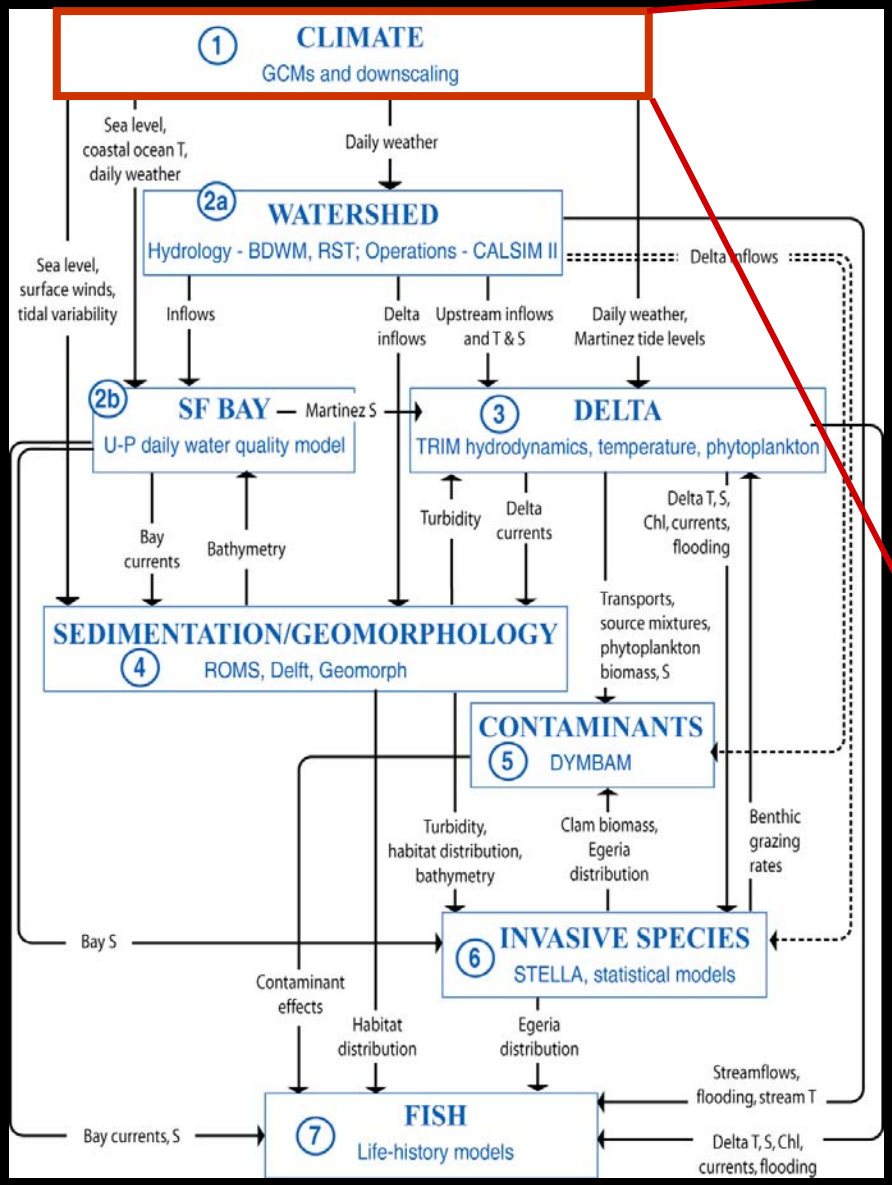
Future scenarios modeling

- How will Delta ecosystem respond to climate change scenarios and anthropogenic forcing?
- Not trying to predict future state, just a scenario of change
- Scenarios less sensitive to parameter errors than absolute predictions

CASCaDE Framework: cascade of model output



CASCaDE's Climate Component



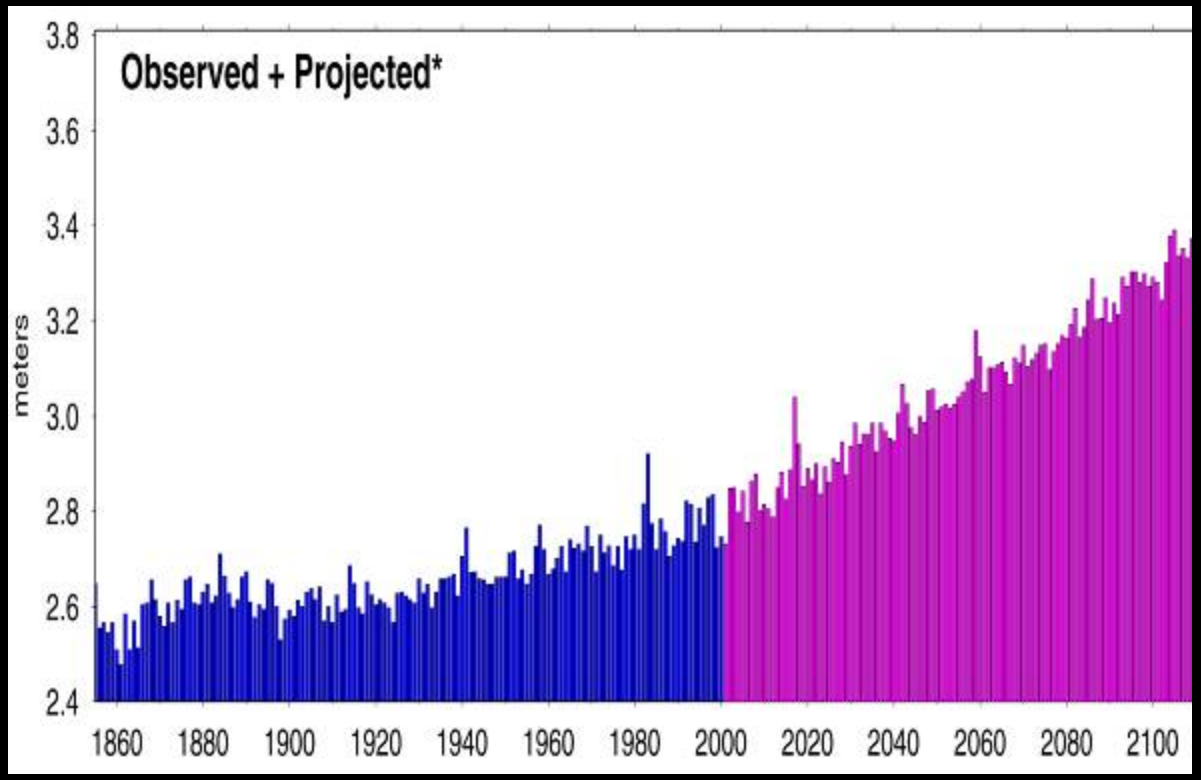
IPCC scenarios
- PCM (A2, B1)
- GFDL (A2, B1)

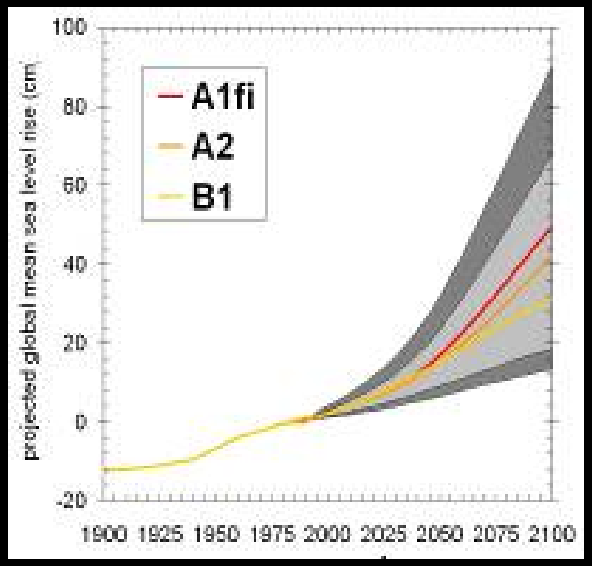
Output refinement
- Constructed analogues
- Downscaling

Outputs
- Precipitation
- Temperature
- Humidity

Global
Climate
Models

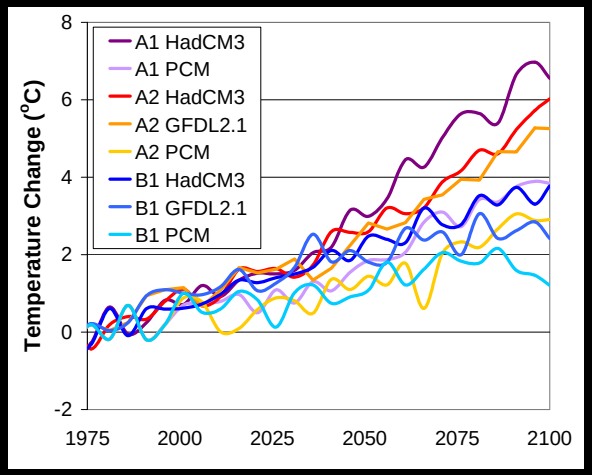
Sea level rise



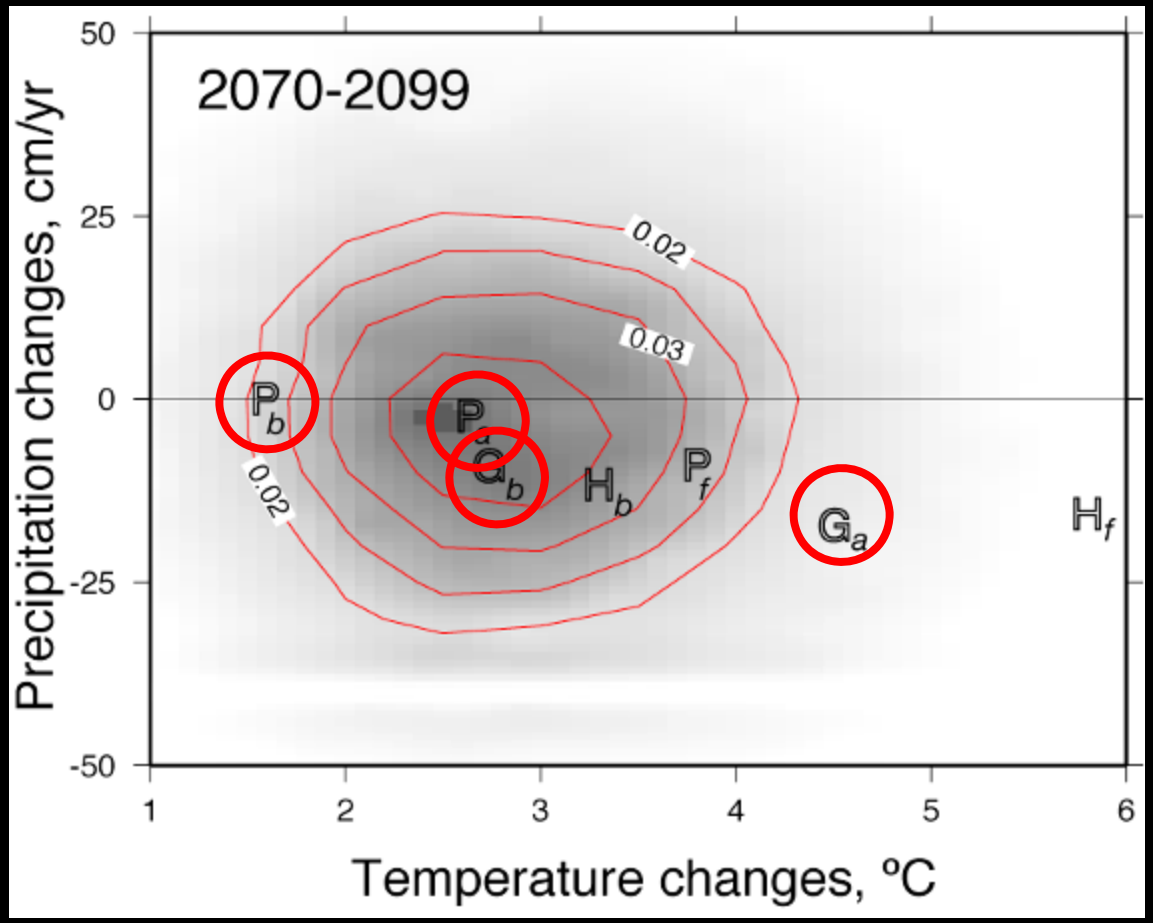


Dan Cayan

Global
Climate
Models



4 Future Scenarios

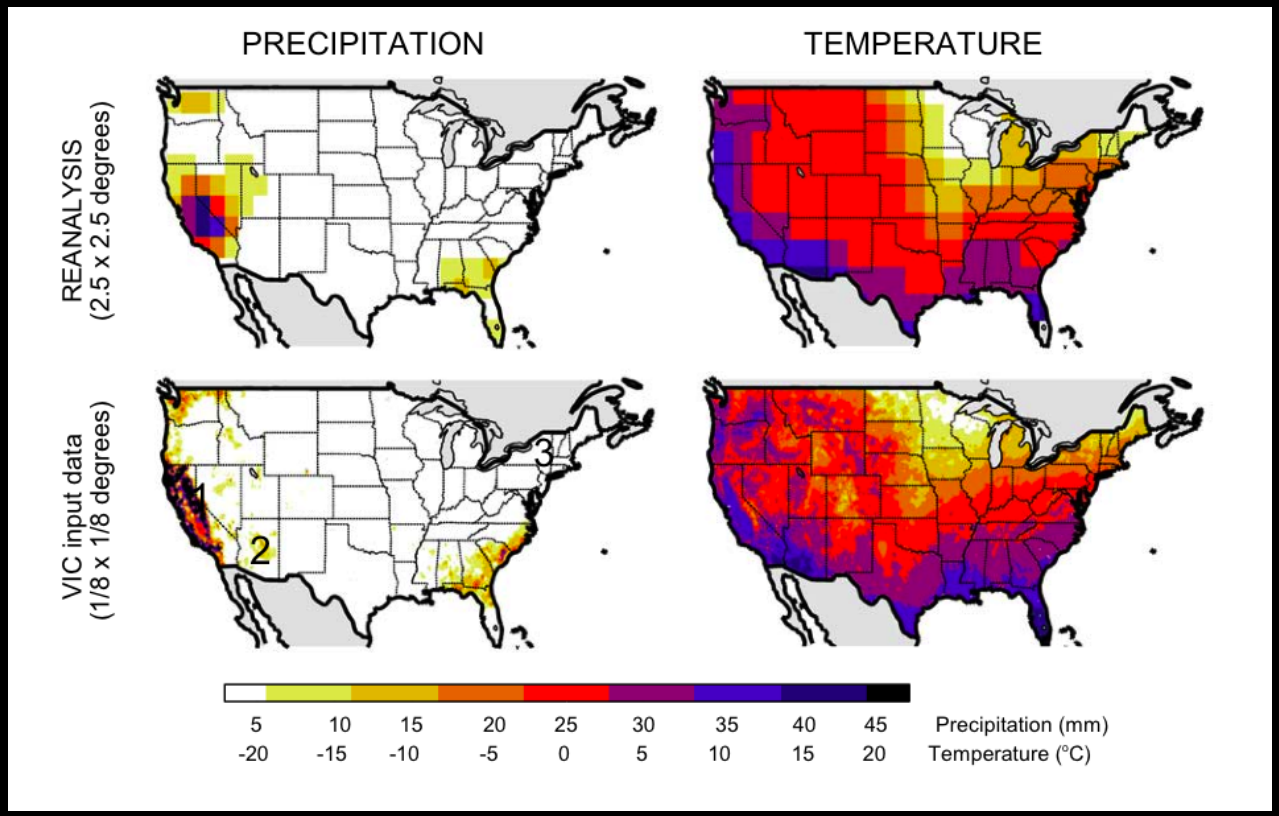


consistent with California Climate Scenarios Assessment, 2006 and 2008

Mike Dettinger, Dan Cayan

Need to downscale daily:

- air temperature
- precipitation
- humidity
- wind
- solar insolation

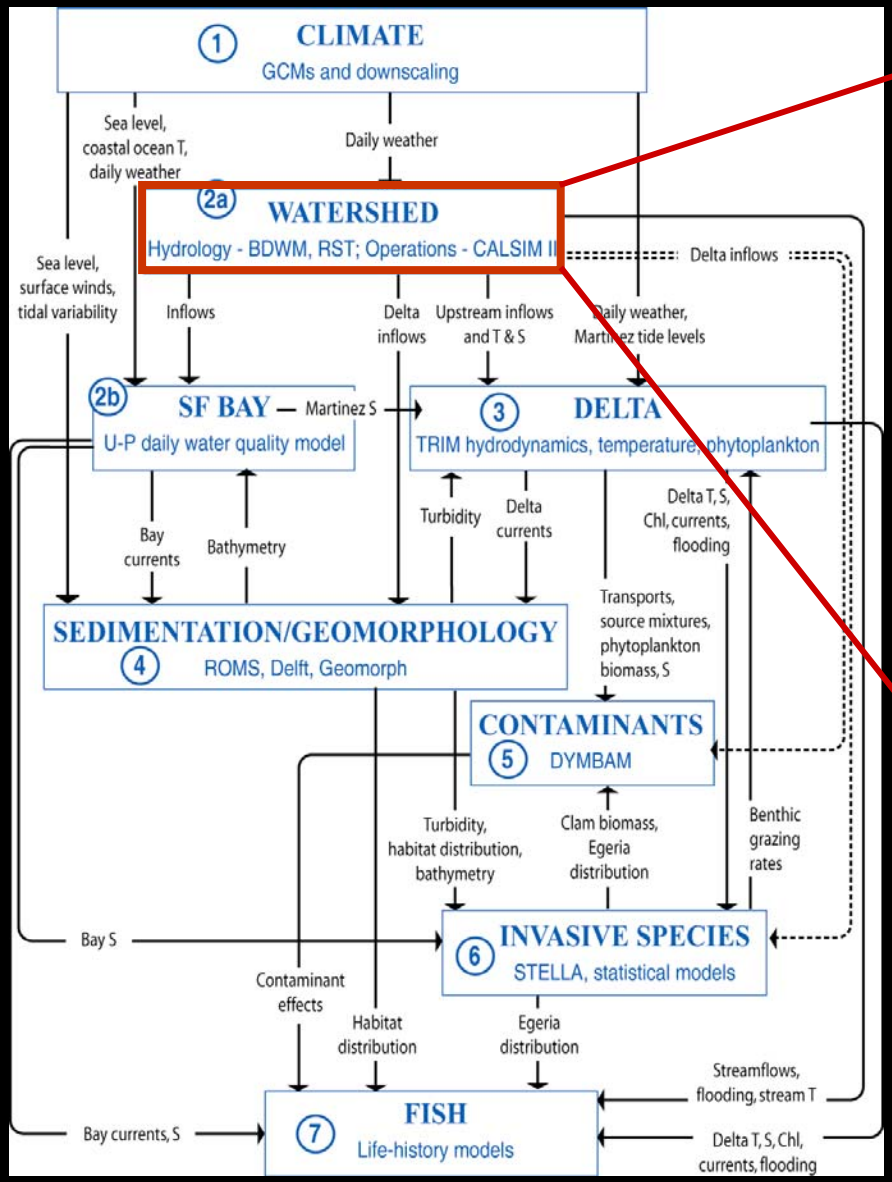


Input:
Lo Res

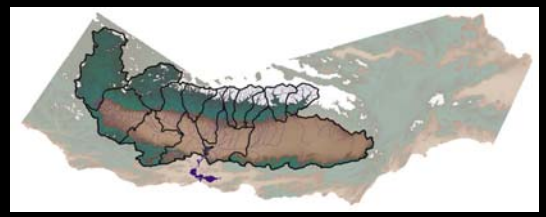
Output:
Hi Res

Hidalgo et al. 2008

CASCaDE's Watershed Component



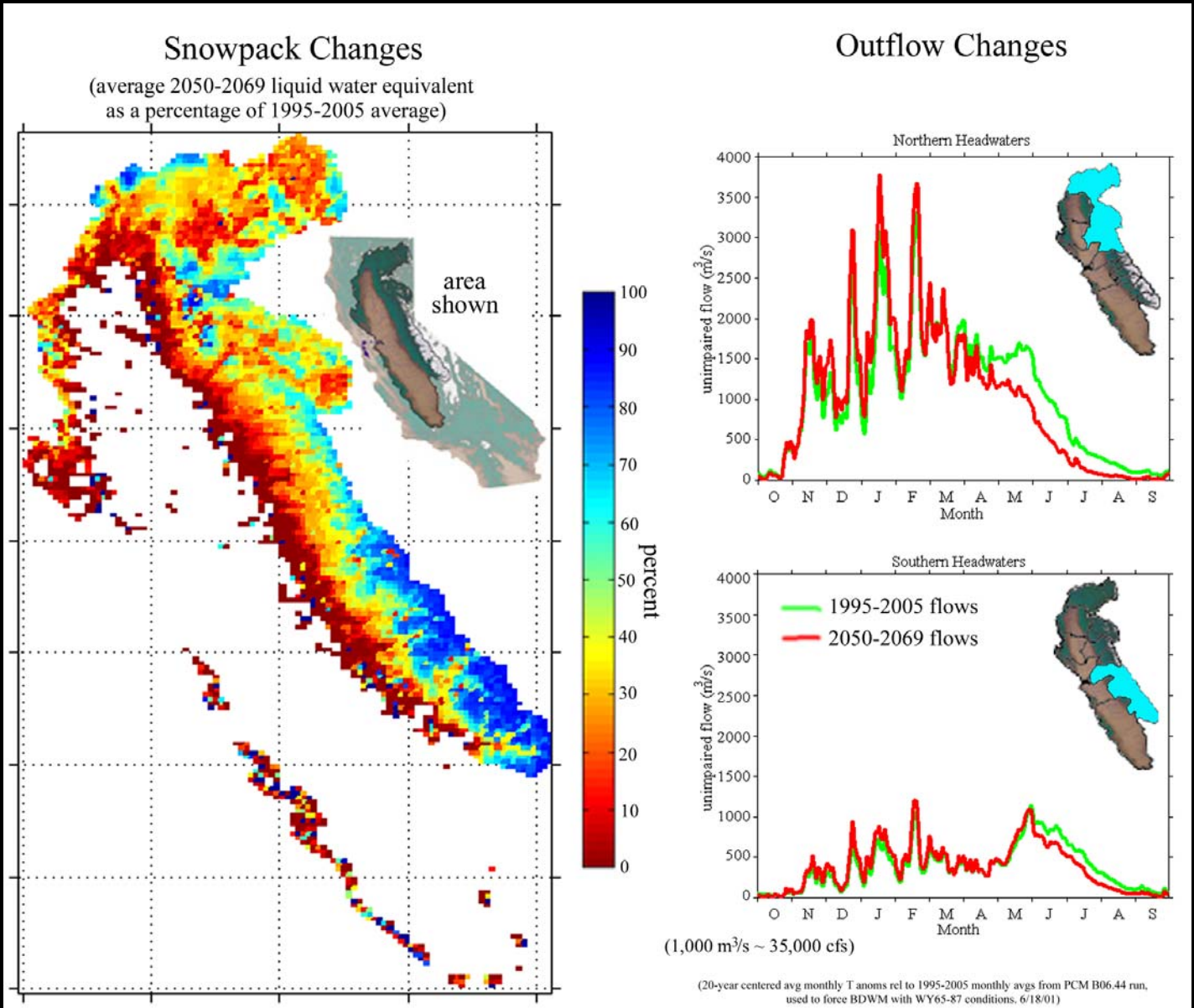
Climate model
- Precipitation
- Temperature
- Humidity

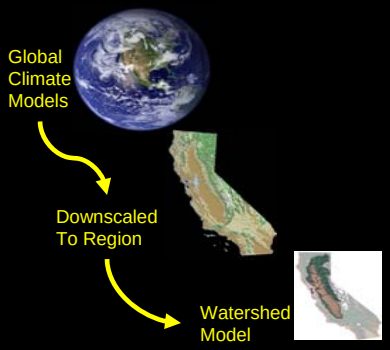


BDWM/CALSIM
- Snowpack
- Runoff
- Management

Outputs
- Reservoir outflows
- Water temperature
- Delta inflows

Snowpack changes by 2060: Knowles et al.





Climate Change
- Precipitation
- Temperature
- Humidity

Population/Demand Change

Freshwater demand patterns
(*e.g.*, from DWR Bull. 160)

Noah Knowles

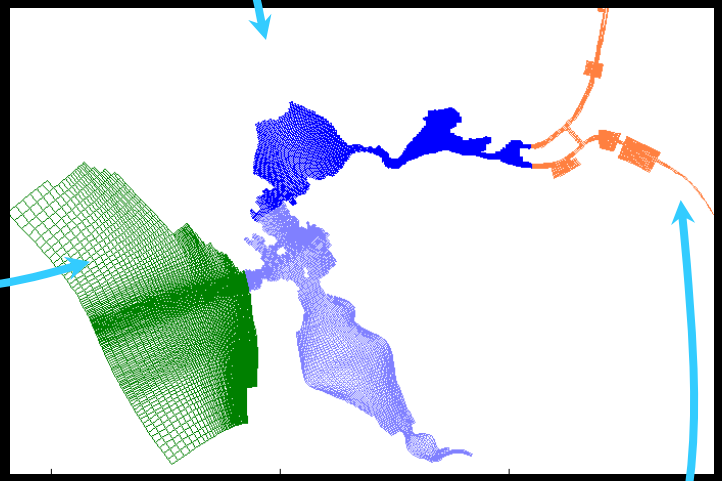
Outputs
- Reservoir outflows
- Stream temps
- Delta inflows

Downscaling and watershed model connect climate to the estuary

Global Climate Models

Weather

Sea level

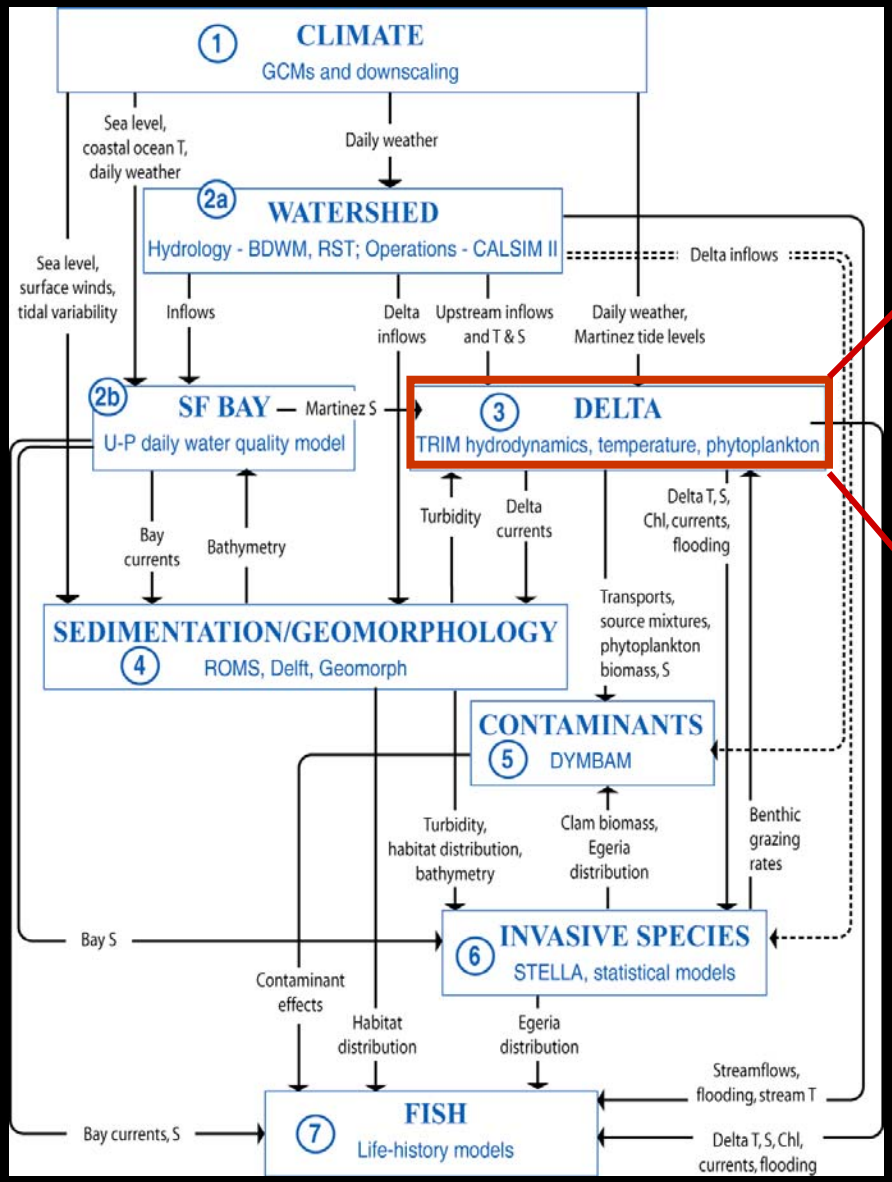


Downscaled To Region

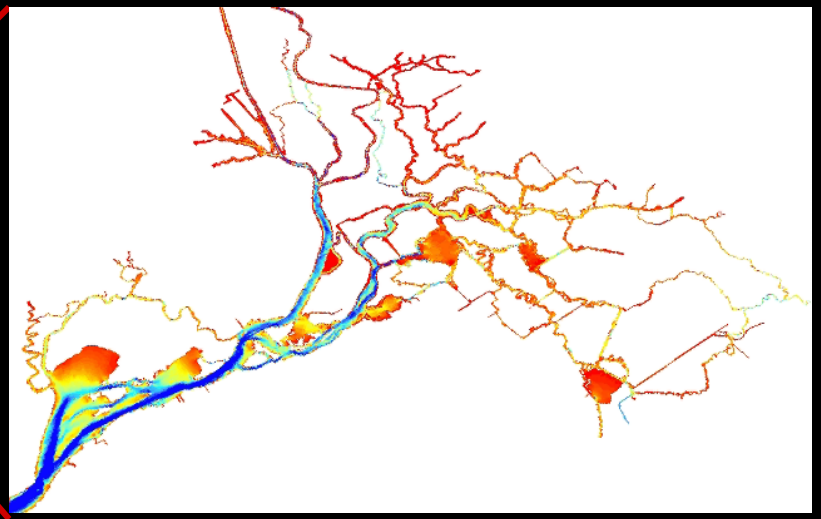
Inflow, T

Watershed Model

CASCaDE's Delta flow and phytoplankton models



Delta TRIM – tidal model



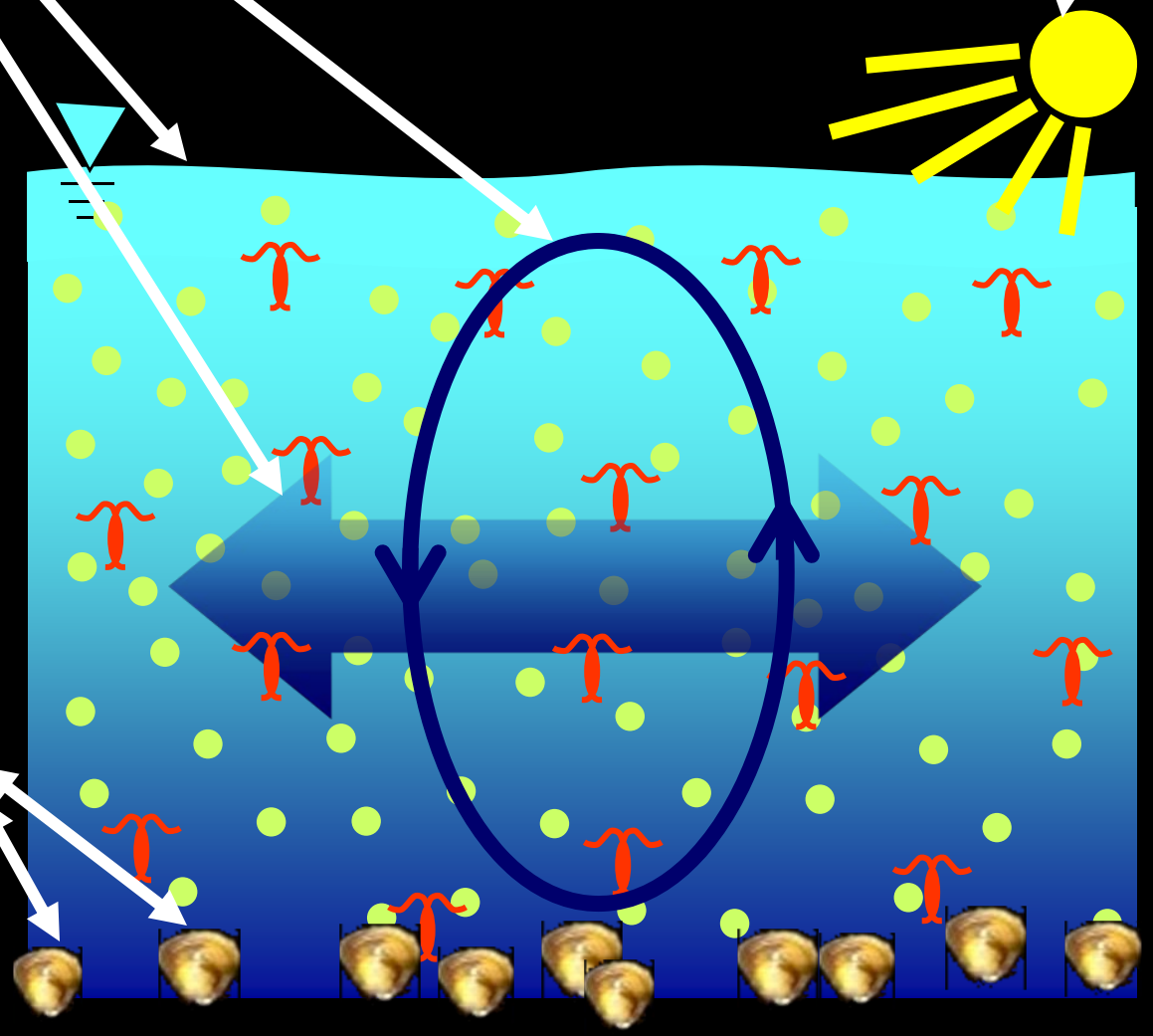
velocities & surface elevation
salinity & temperature
hourly, 50-m resolution

Nancy Monsen

Inputs for Phytoplankton Model

stage, velocity, turb. mixing coeff's *(Delta Hydro. Model)*

photosynthetically active radiation *(Climate models)*

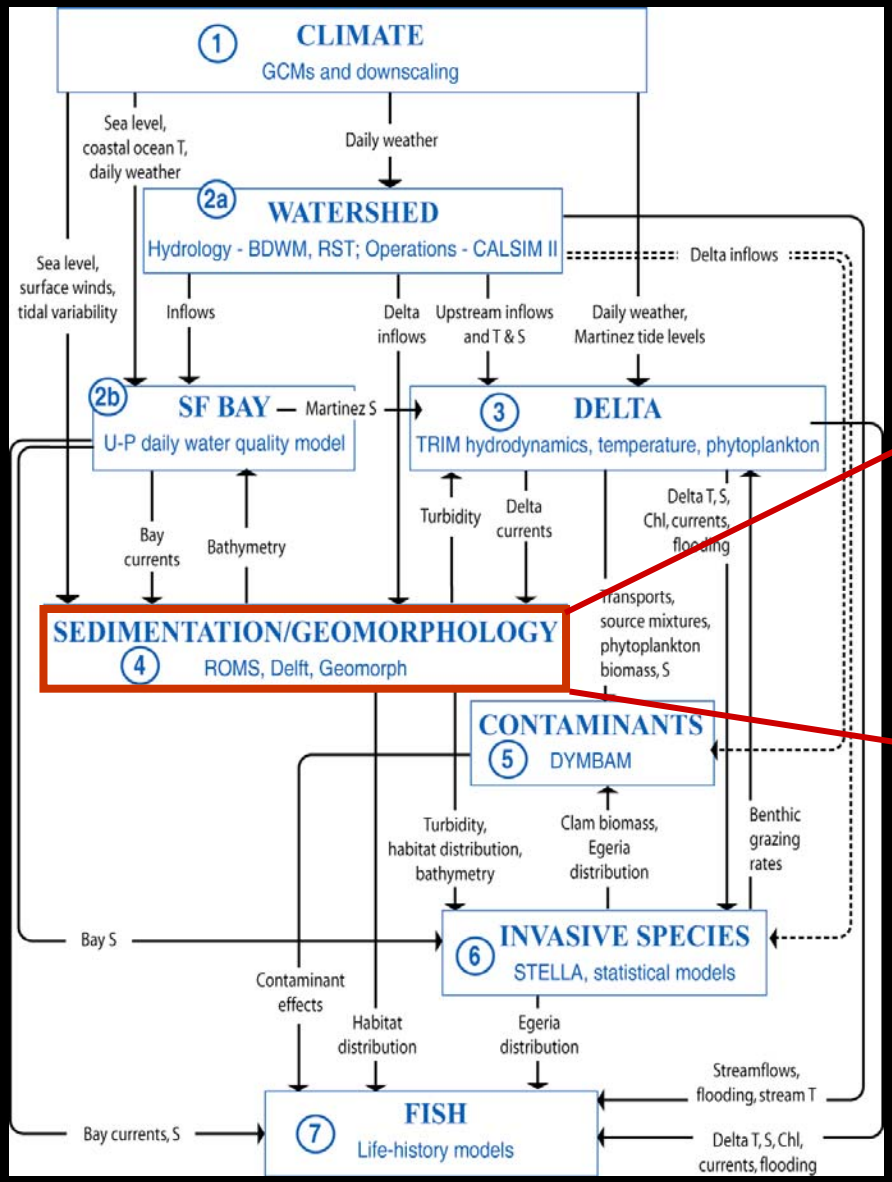


turbidity *(Sediment model)*

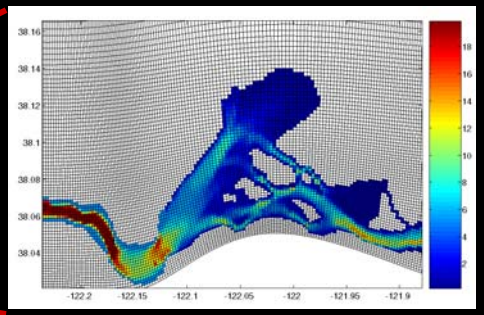
clam grazing rates *(Invasive species model)*

Lisa Lucas

CASCaDE's Geomorphology Models



BDWM/CALSIM
- Delta inflows
- Magnitude
- Timing



ROMS/DELFT3D
- Hydrodynamics
- Sediment transport
- Geomorphology

Outputs
- Depth distribution
- Turbidity
- Habitat distribution

Suisun Bay's subtidal-intertidal habitats

Sea-level rise:

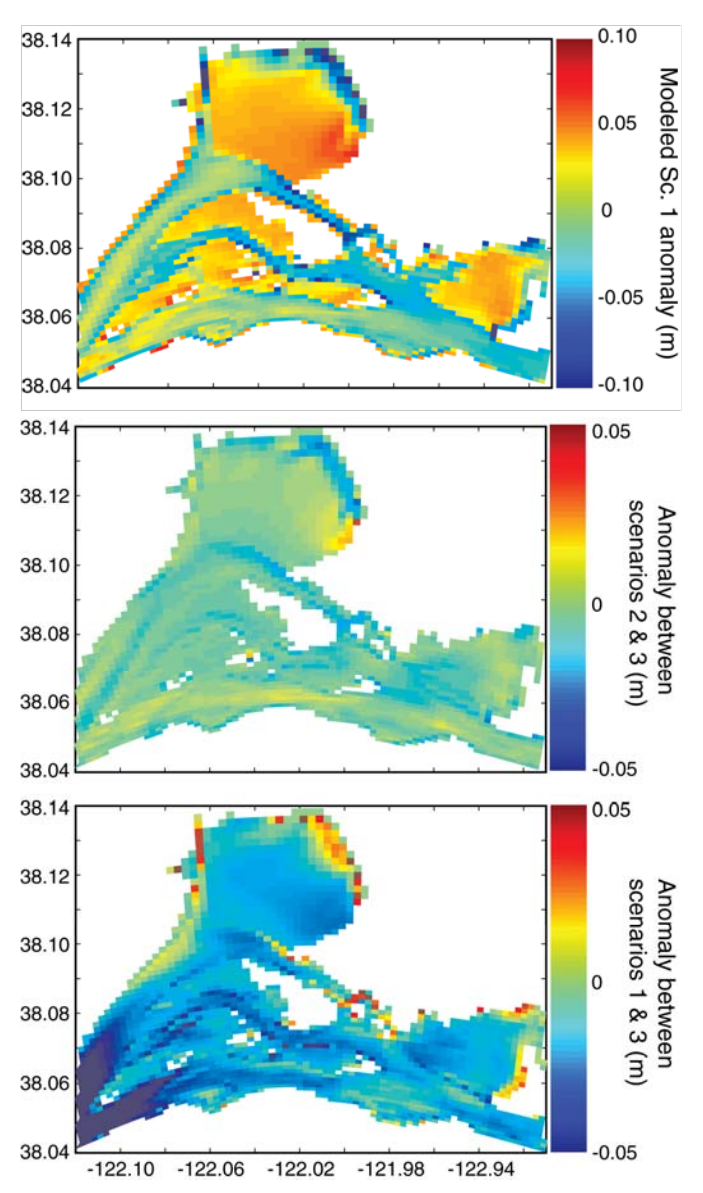
- Increase in water depth reduces wave-induced shear stress
- Less erosion, less redistribution

Warming:

- Minor changes in redistribution

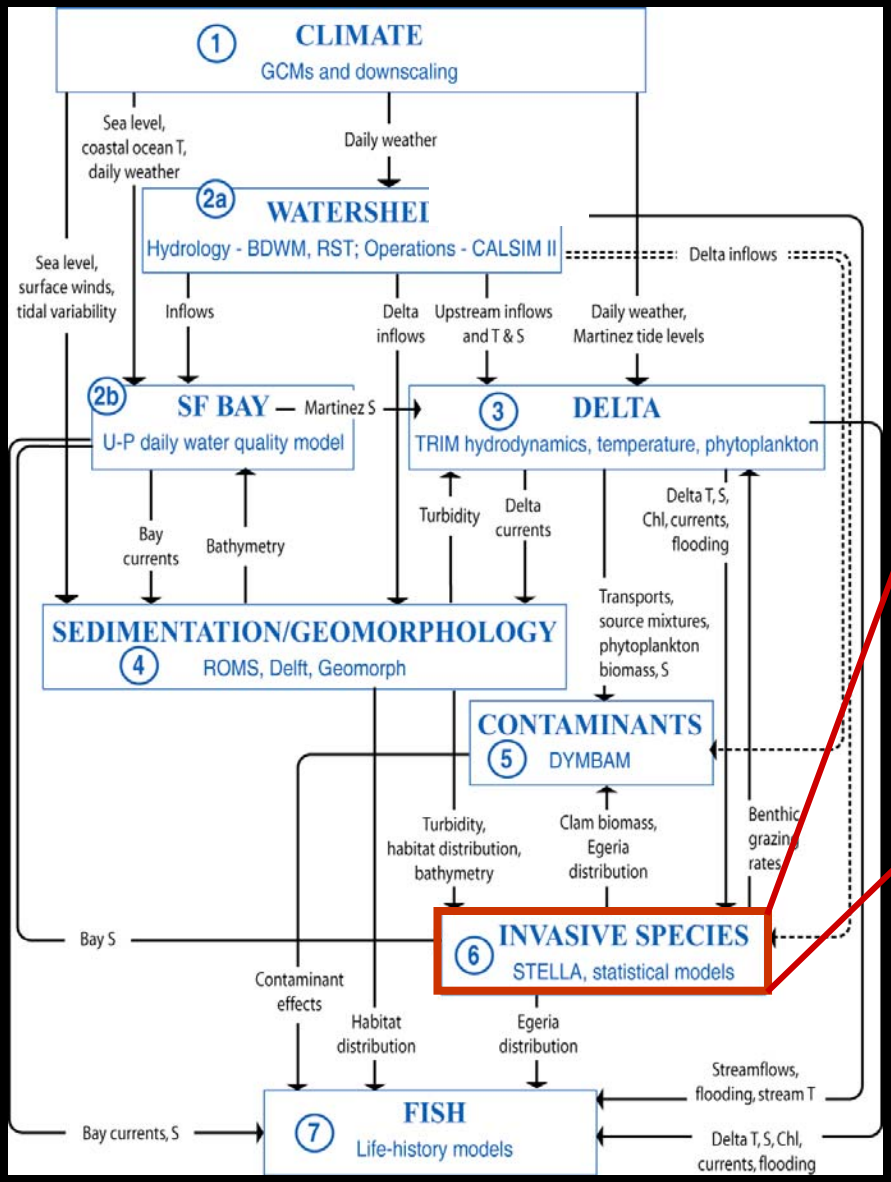
Decreased sediment supply:

- Erosion everywhere except fringes

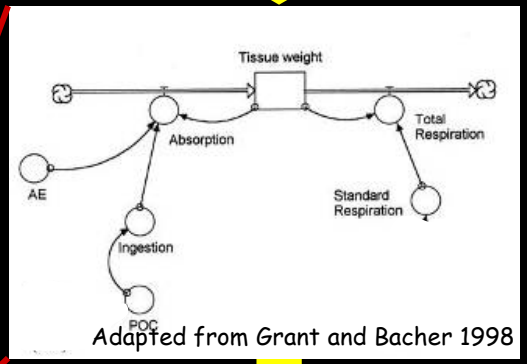


Neil Ganju

CASCaDE's Invasive Species (Clams) Model



BDWM, TRIM, ROMS, DELFT3D
- Phytoplankton
- Temperature
- Salinity
- Depth
- Turbidity



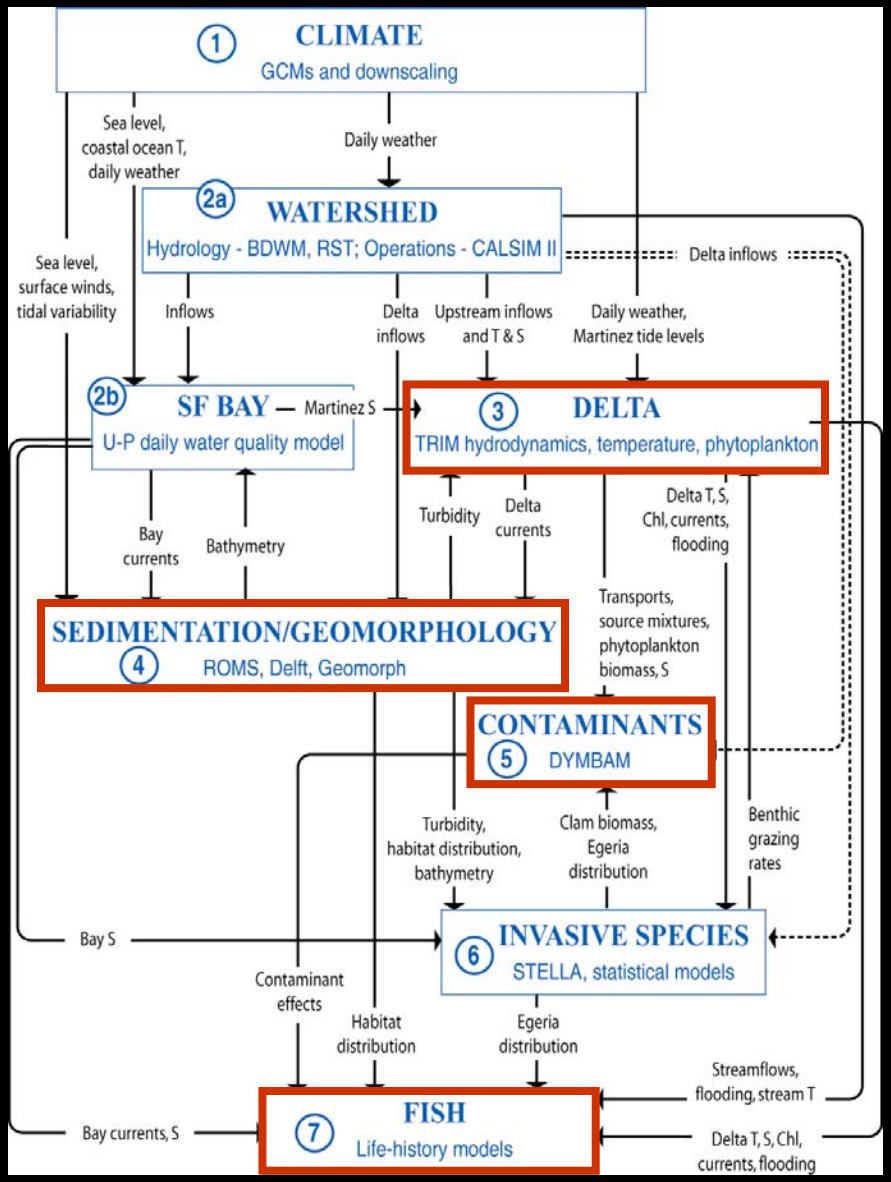
Adapted from Grant and Bacher 1998

Statistical STELLA growth model of clams

Outputs
- Growth rate
- Biomass
- Grazing rate

Jan Thompson

Other CASCaDE Components



Temperature
Wayne Wagner
Mark Stacey

San Pablo Bay Geomorphology
Bruce Jaffe
Mick van der Wegen
Edwin Elias

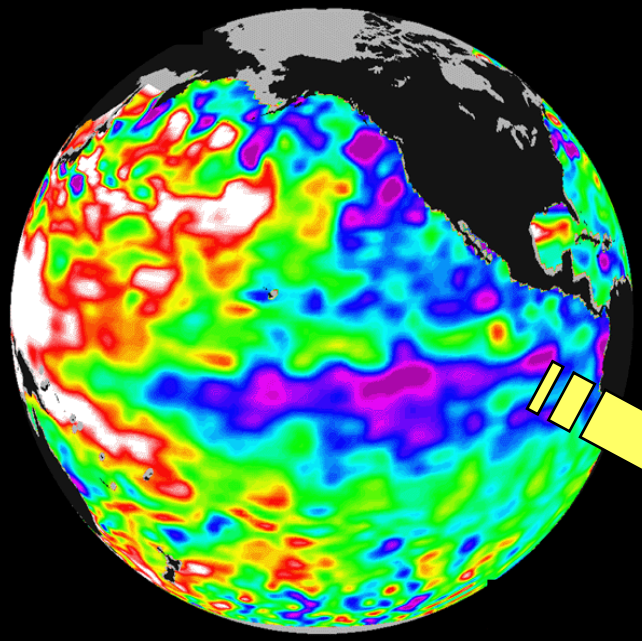
Mercury & Selenium
Robin Stewart
Sam Luoma

Fish
Larry Brown
Bill Bennett
Christa Woodley

Challenges

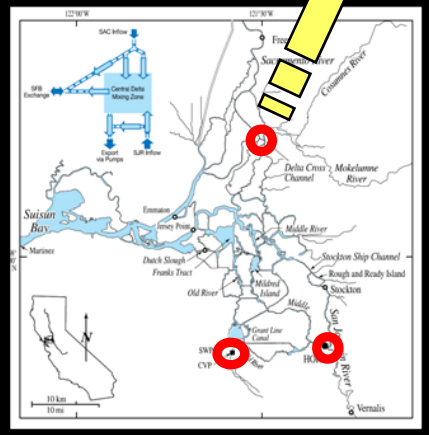
Connectivity to ocean and watershed

Future local and global changes



Global processes cascading down

Local processes propagating up



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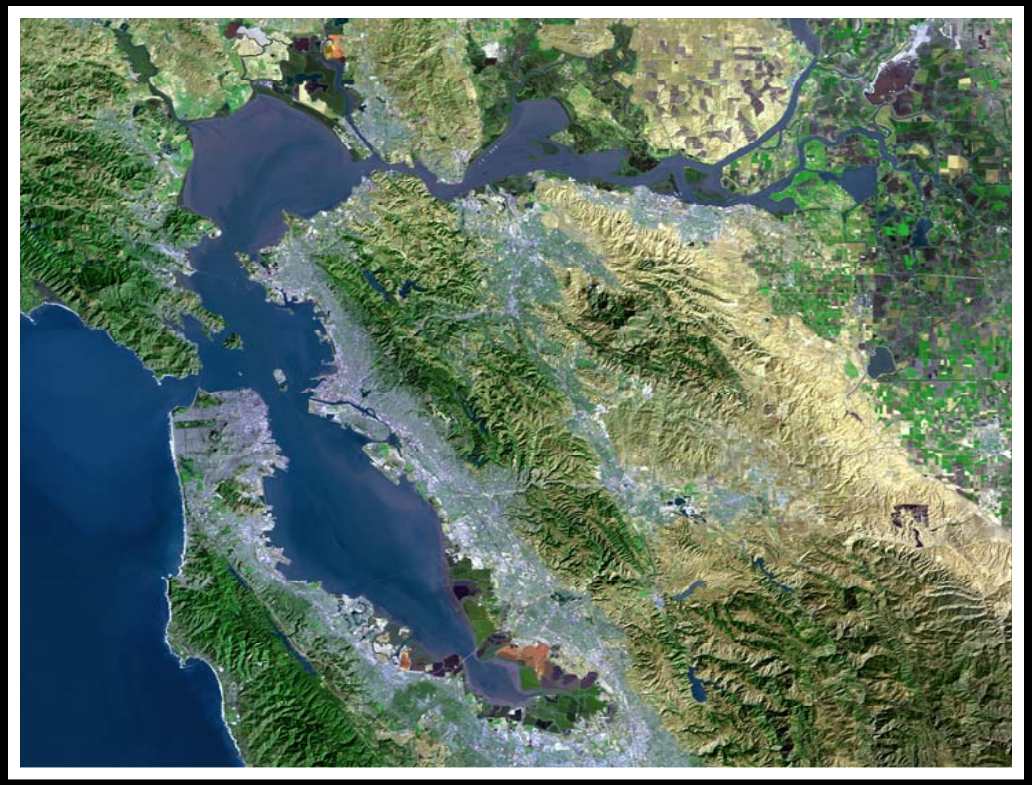

http://sfbay.wr.usgs.gov/cascade

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