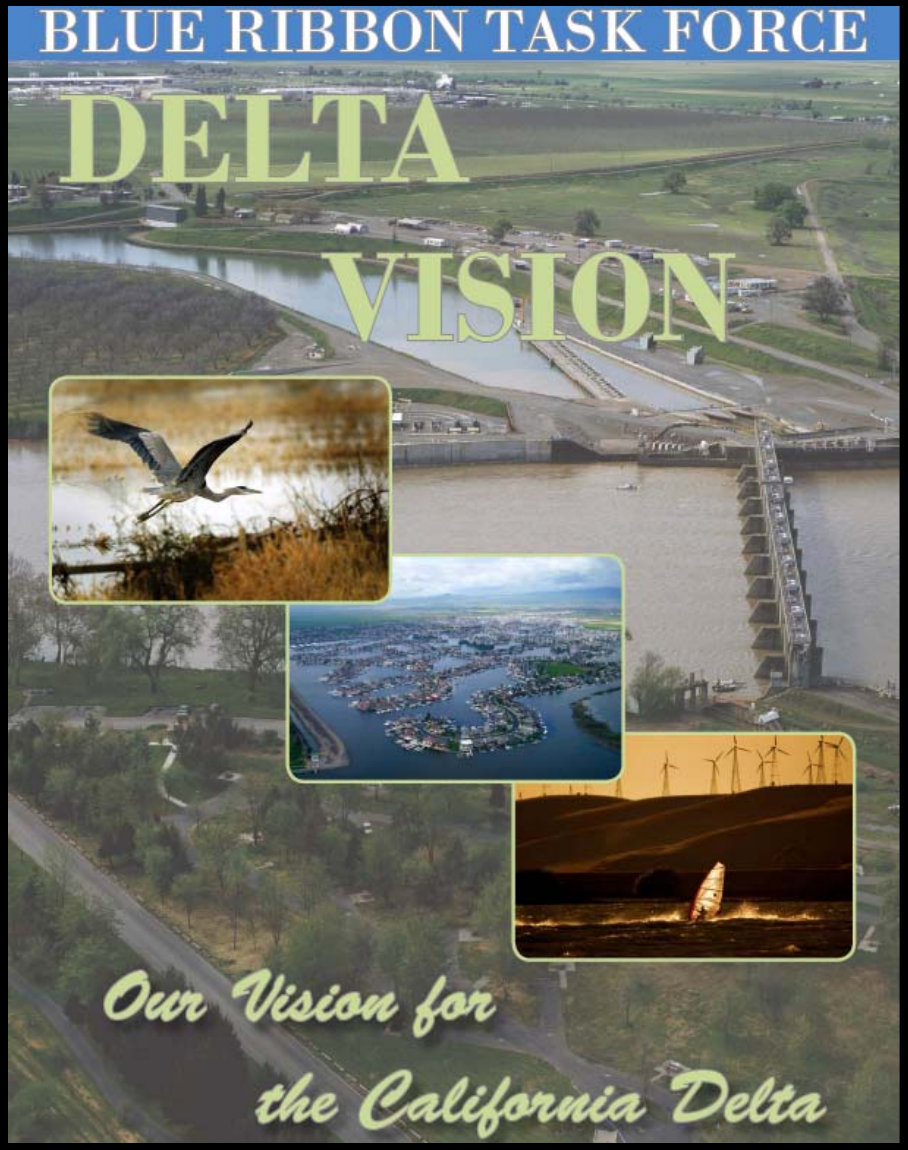
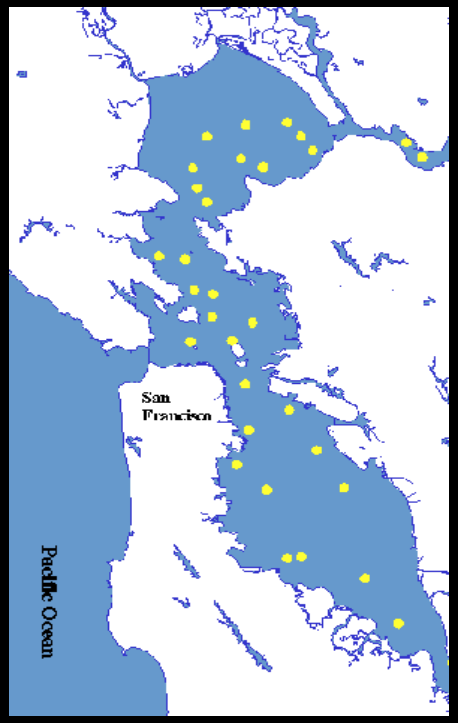


Using models to develop a Long view of the San Francisco Bay-Delta Ecosystem

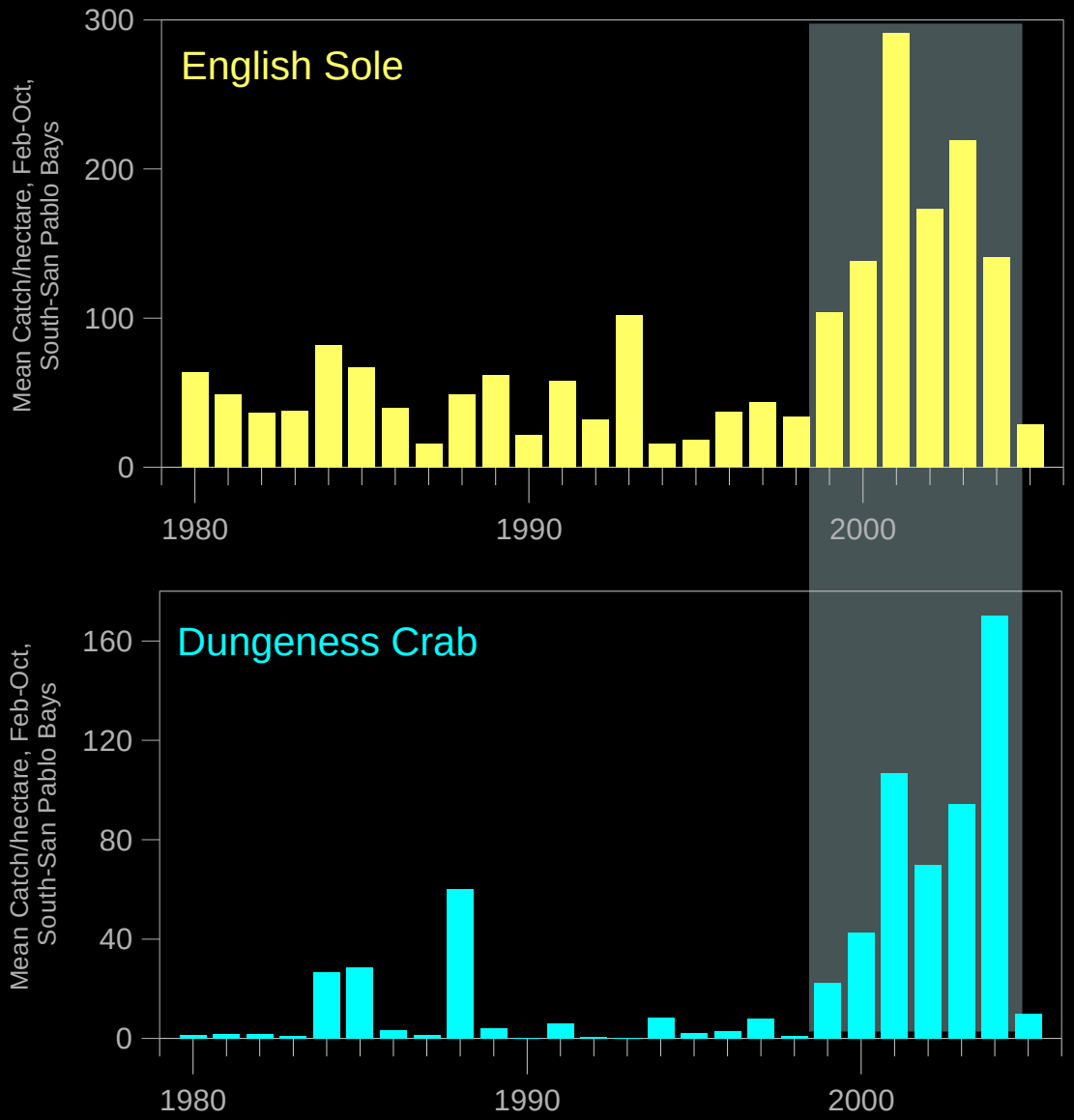
Jim Cloern
USGS, Menlo Park

USGS
science for a changing world

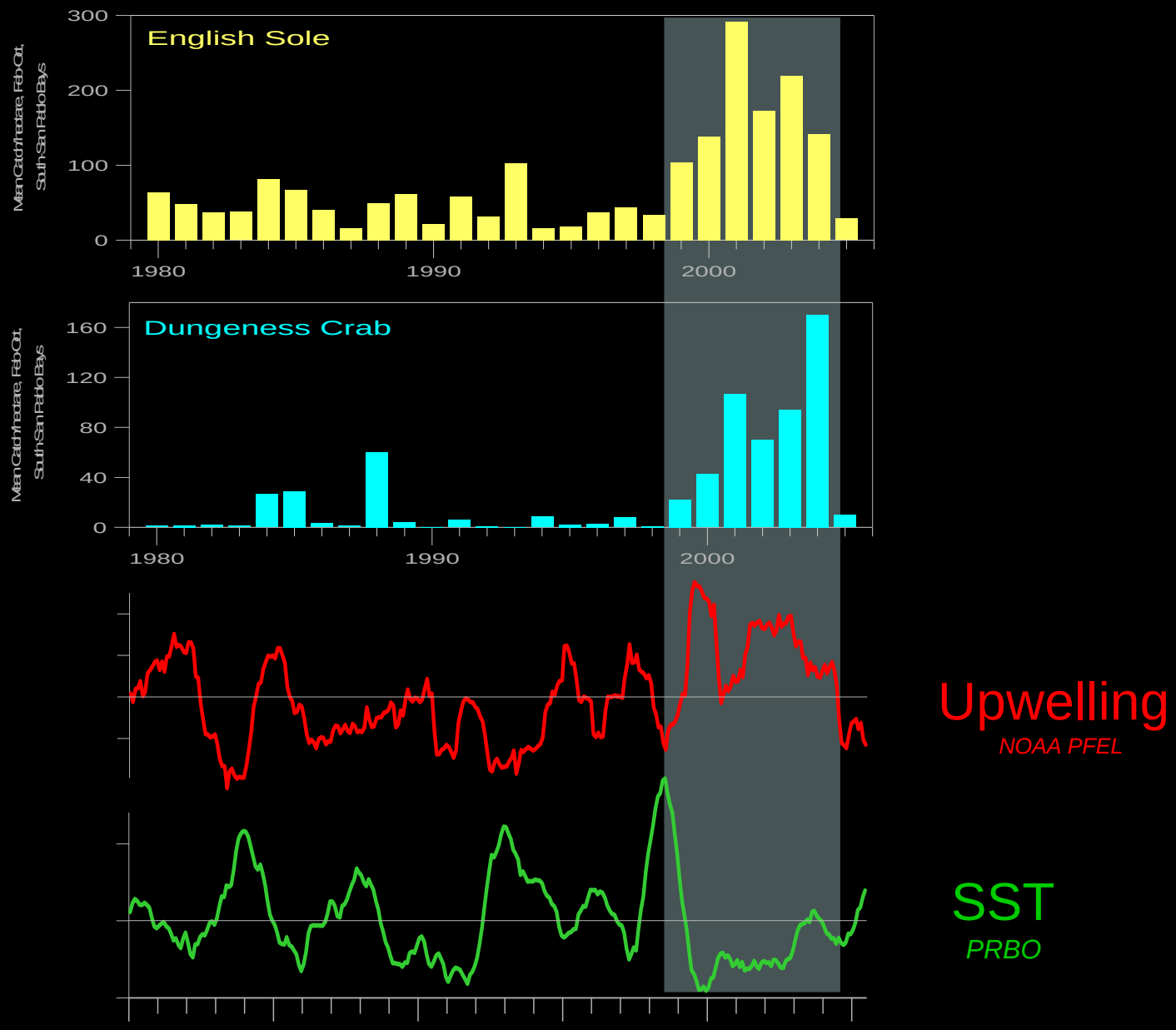
Observations

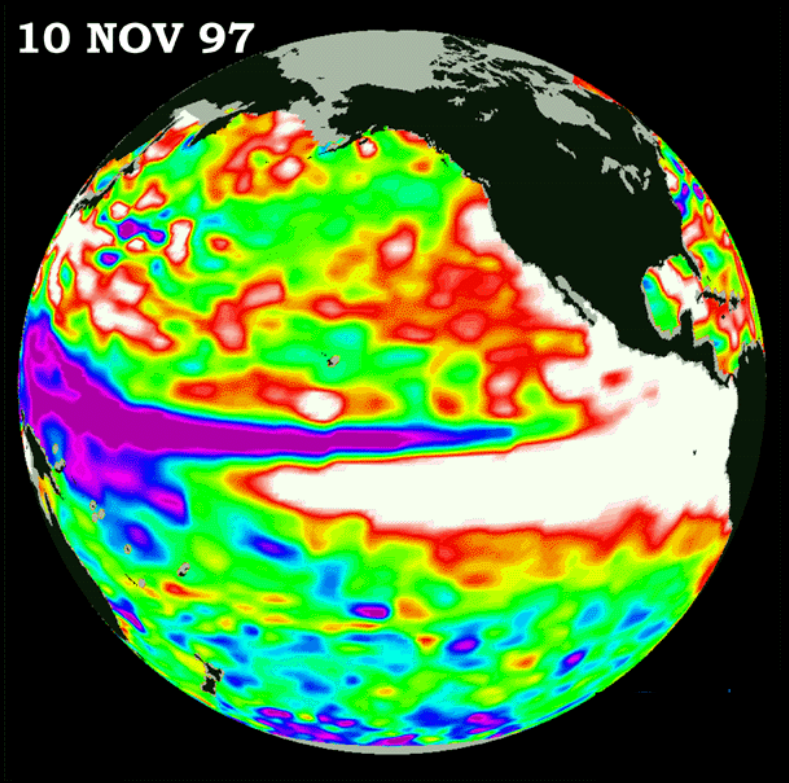


San Francisco Bay Monitoring Program

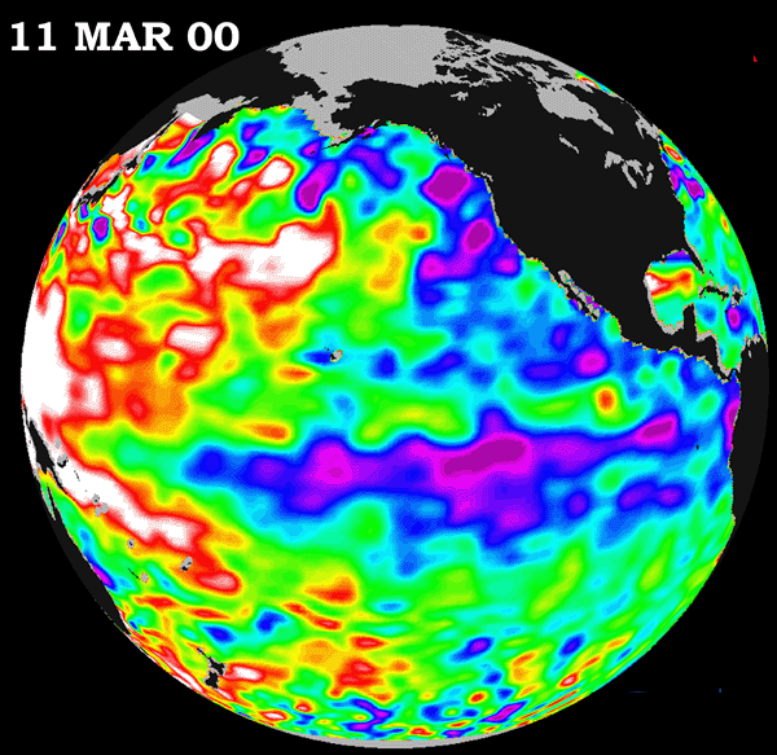


Kathy Hieb, DFG

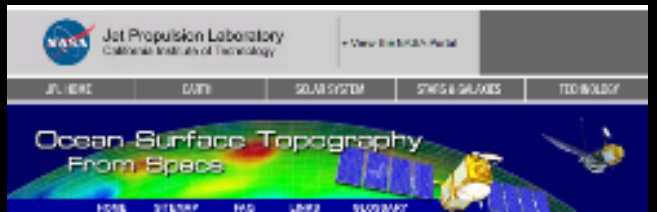

English Sole
300
200
100
0
1980
1990
2000
Dungeness Crab
160
120
80
40
0
1980
1990
2000
Upwelling
NOAA PFEL
SST
PRBO

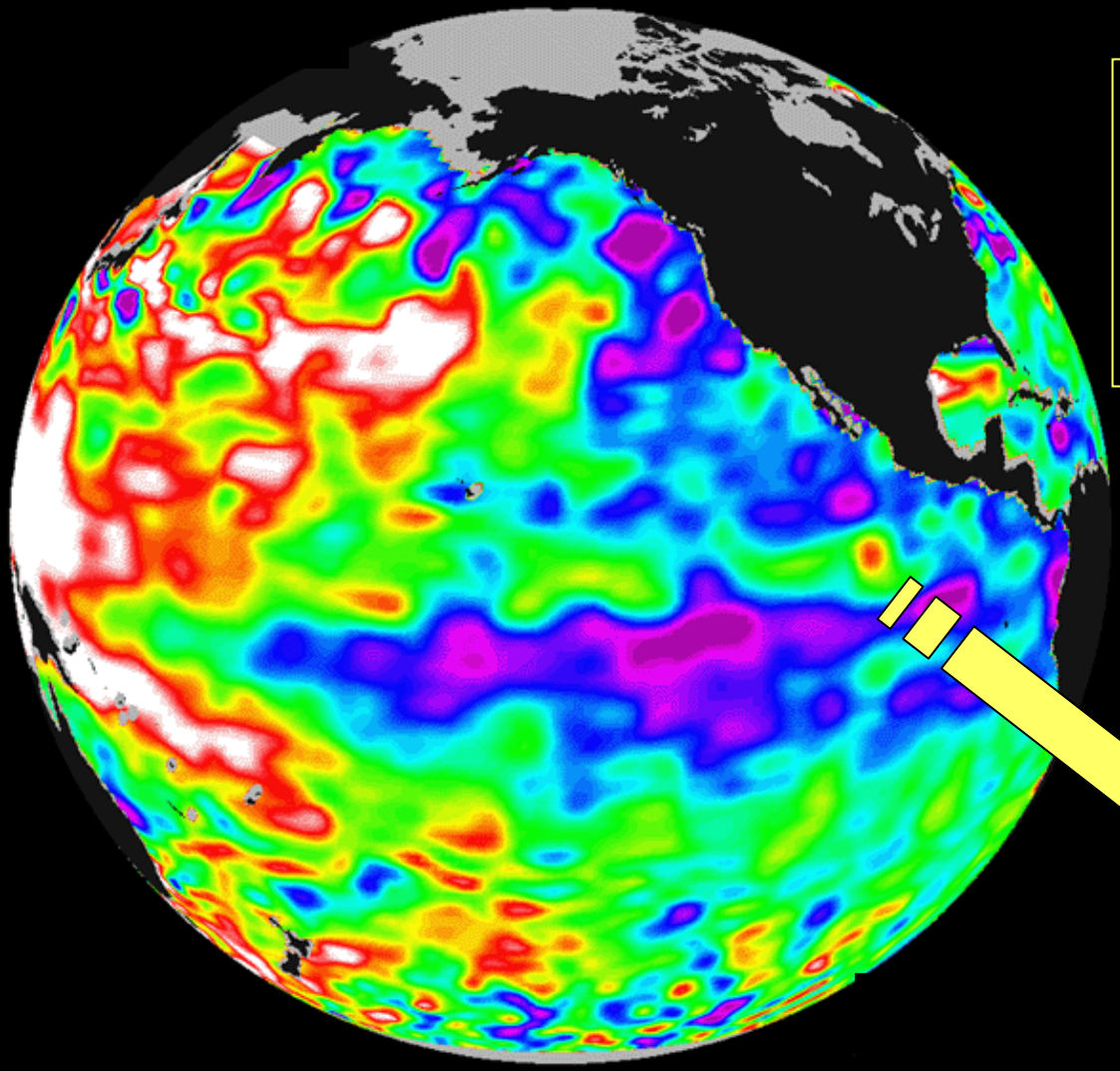


El Niño



La Niña

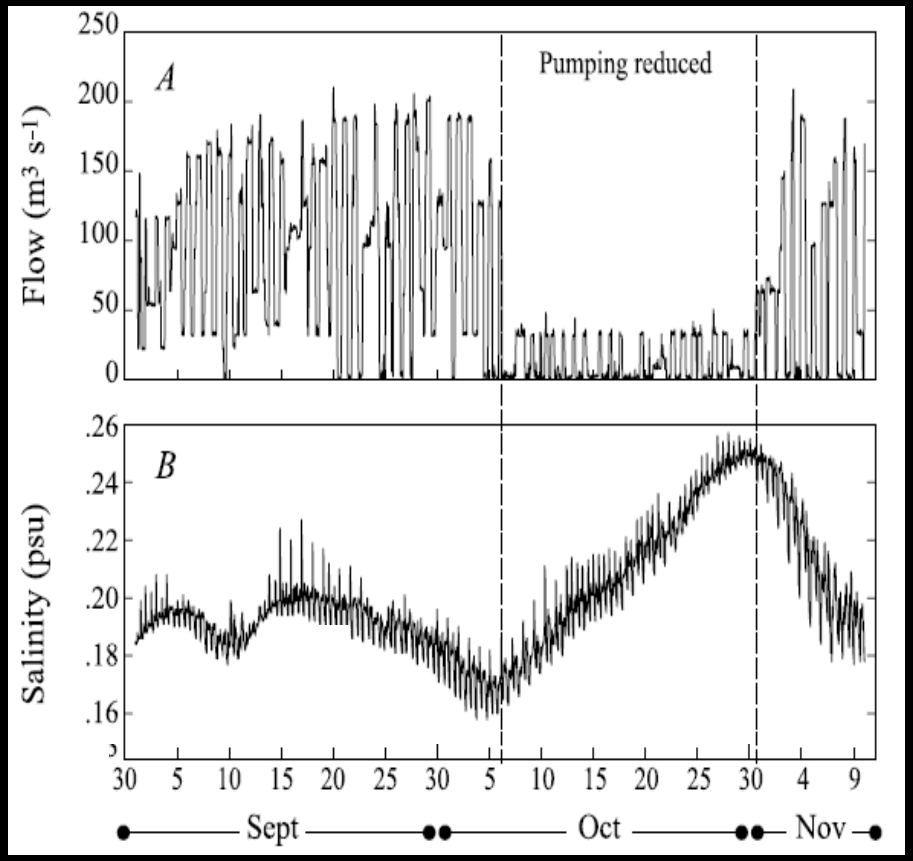


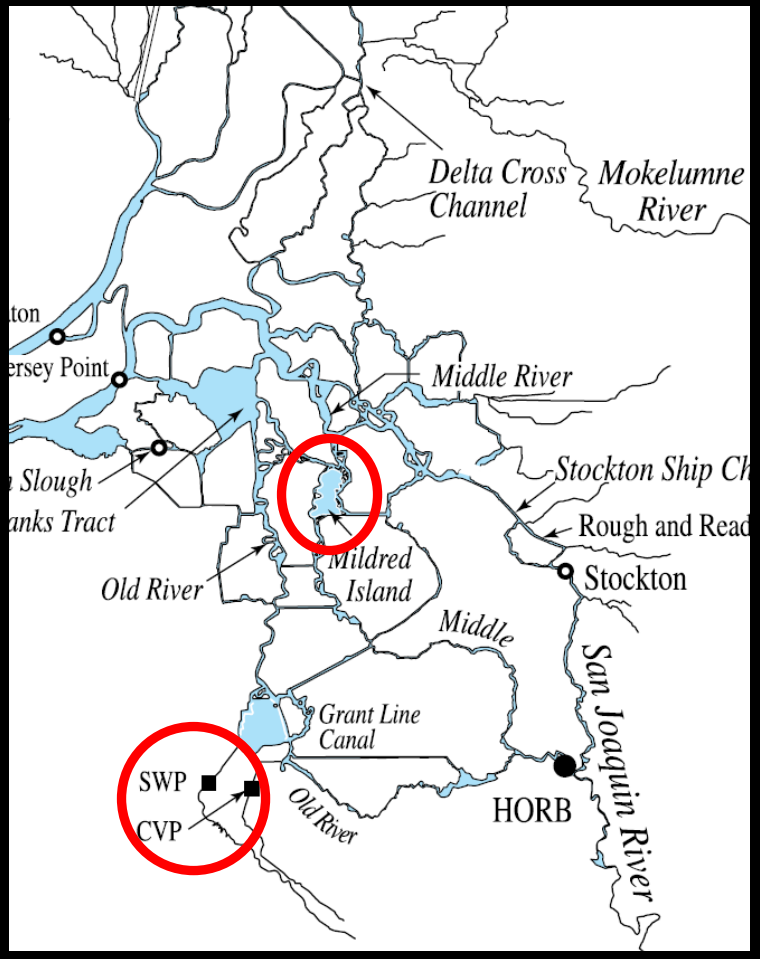


1. Global-scale processes cascade down to the Bay-Delta Ecosystem

2. The Bay-Delta Ecosystem is influenced by its connectivity to the Pacific Ocean

Observations

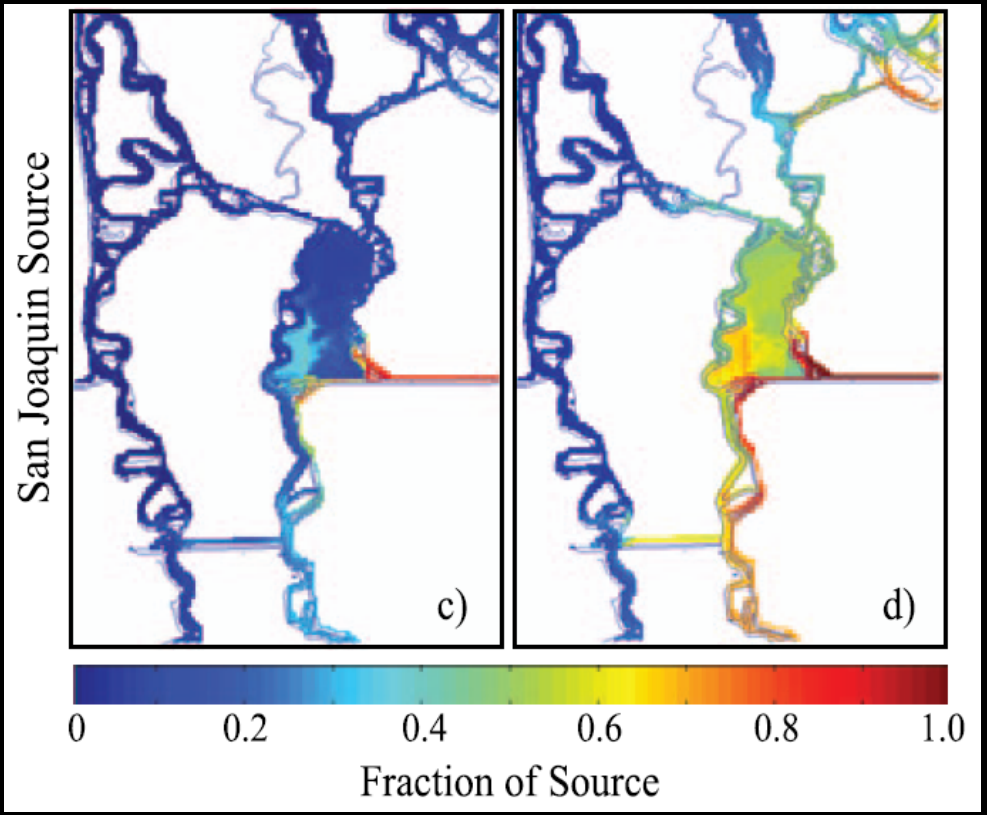




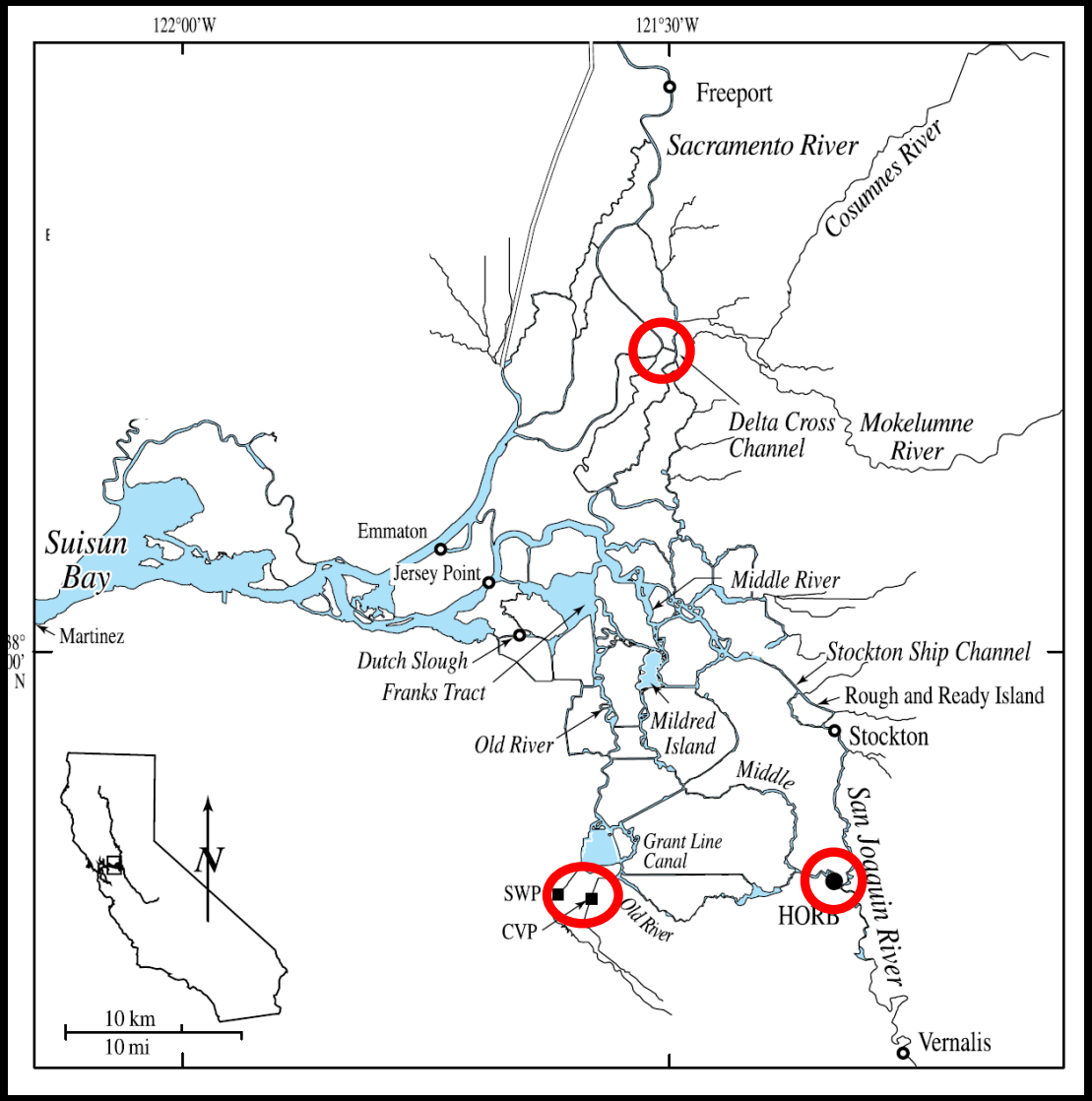
Models

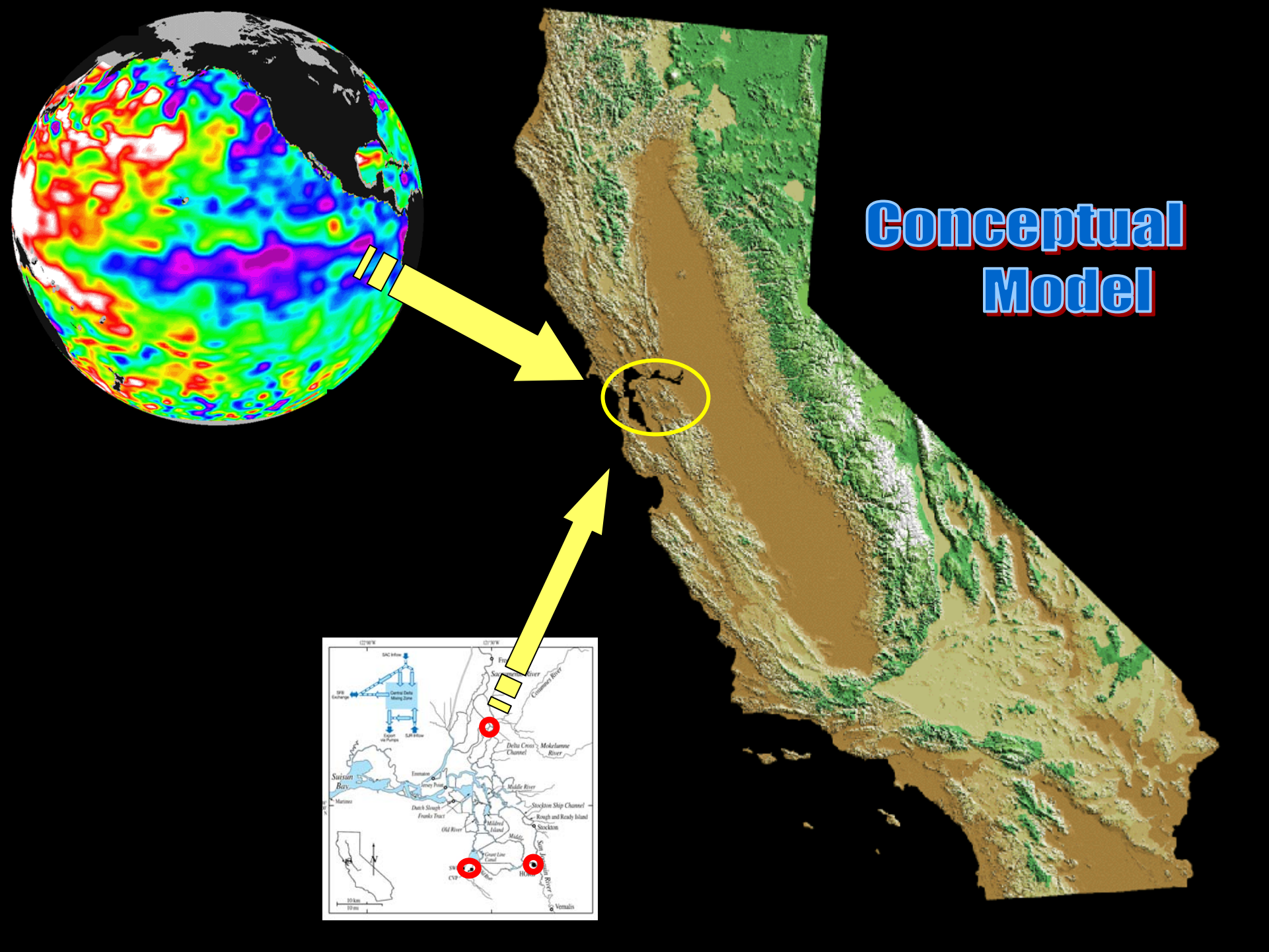
Pumps On
mostly Sacramento

Pumps Off
mostly San Joaquin



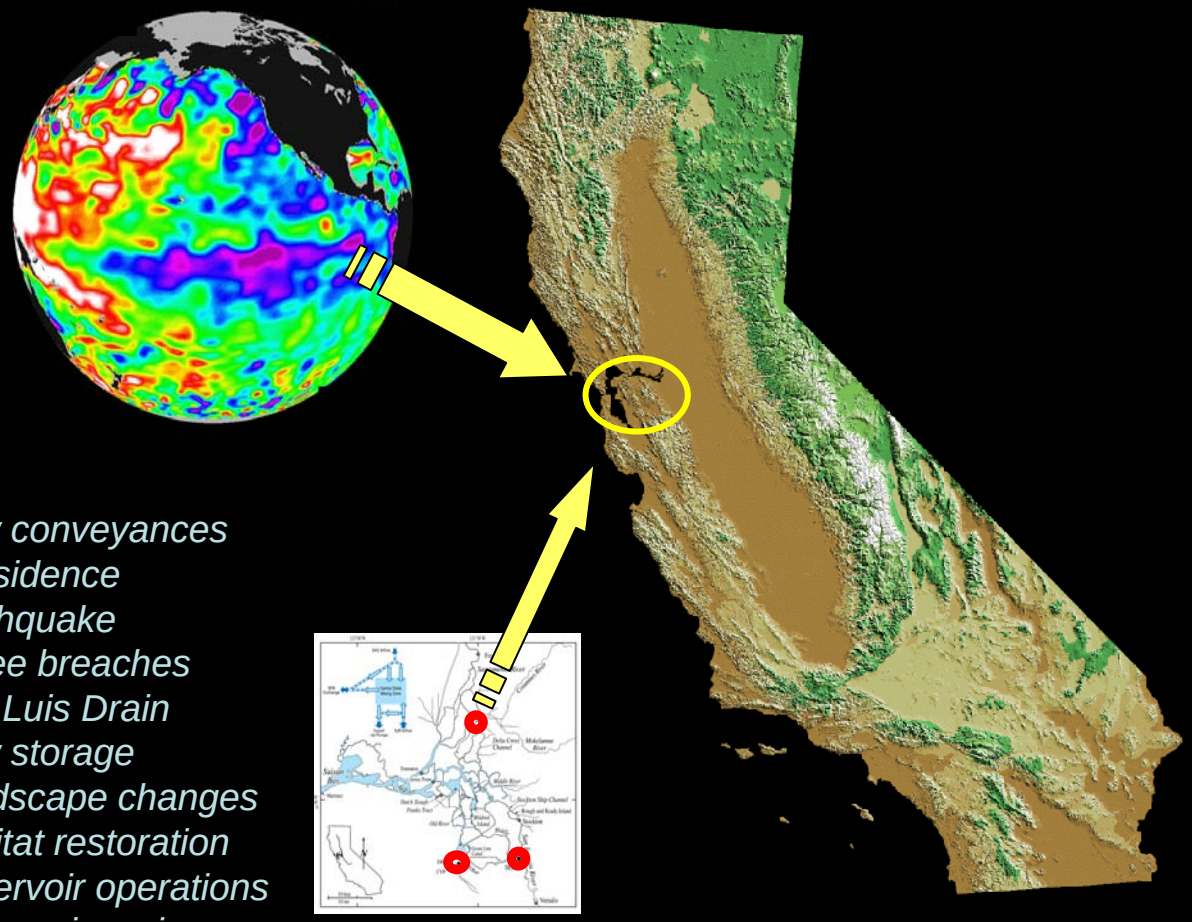
3. Local-scale processes propagate up




Conceptual Model
Suisun Bay
Martinez
Emmaton
Jersey Point
Dutch Slough
Franks Tract
Old River
Middle River
Mildred Island
Grant Line Canal
Delta Cross Channel
Mokelumne River
Stockton Ship Channel
Rough and Ready Island
Stockton
Vernalis
SAC Inflow
SJR Inflow
Export via Pumps
Central Delta Mixing Zone
10 km
10 mi

4. Global- and local-scale processes change continuously

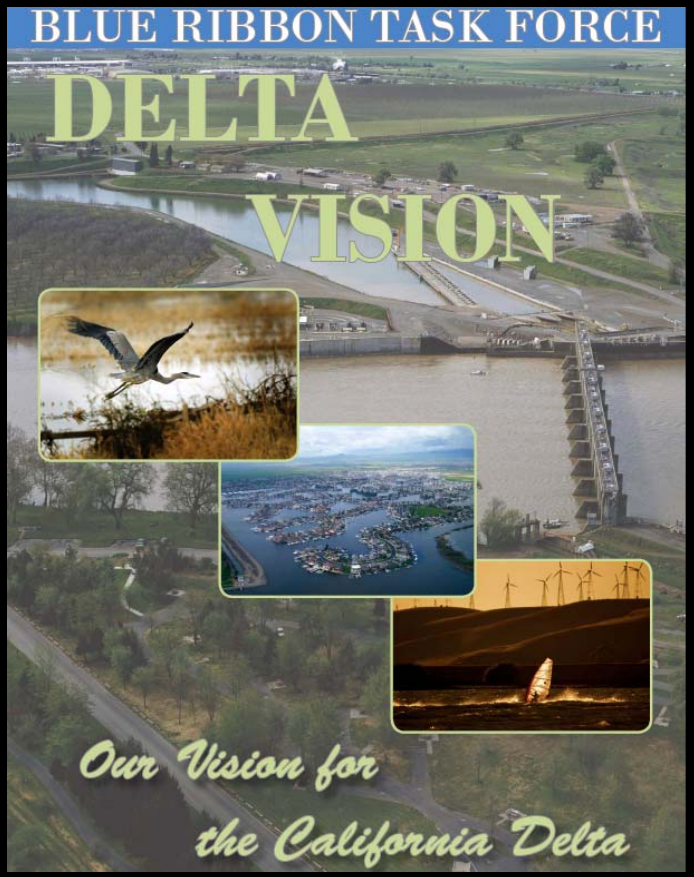
Climate change & sea level rise
- heat waves
- droughts
- snow pack
- seasonal hydrology
- winter storms
- altered wind patterns
- migratory species



New conveyances
Subsidence
Earthquake
Levee breaches
San Luis Drain
New storage
Landscape changes
Habitat restoration
Reservoir operations
Quagga invasion
Flow diversions
Herbicide applications

? How can we integrate

1. global processes cascading down
2. local processes propagating up
3. connectivity across all the Delta's boundaries
4. future changes at local to global scales



Global
Climate
Models

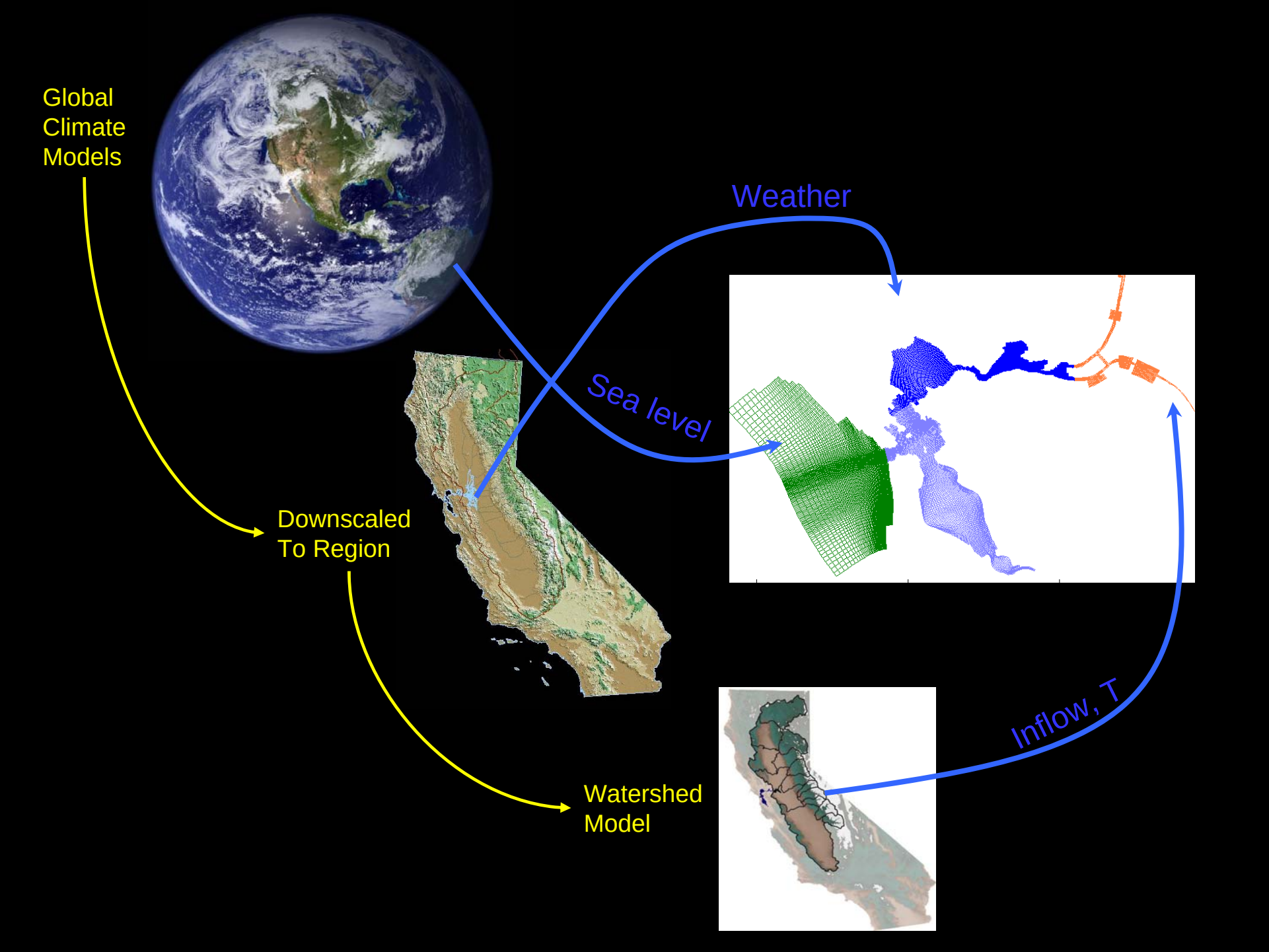
Downscaled
To Region

Watershed
Model

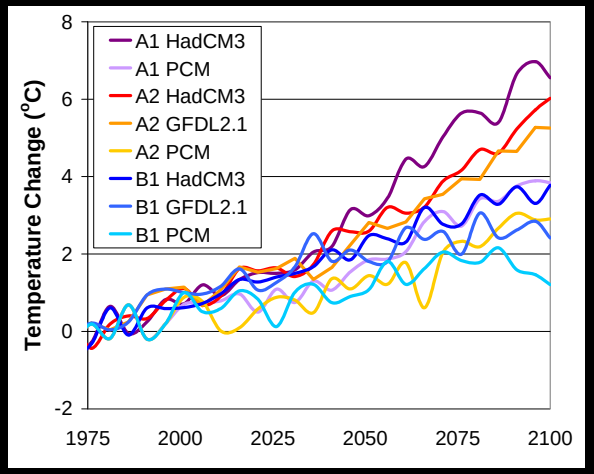
Computational **A**ssessments of **S**cenarios of **C**hange in the **a** **D**elta **E**cosystem

USGS
Priority Ecosystems Science Initiative

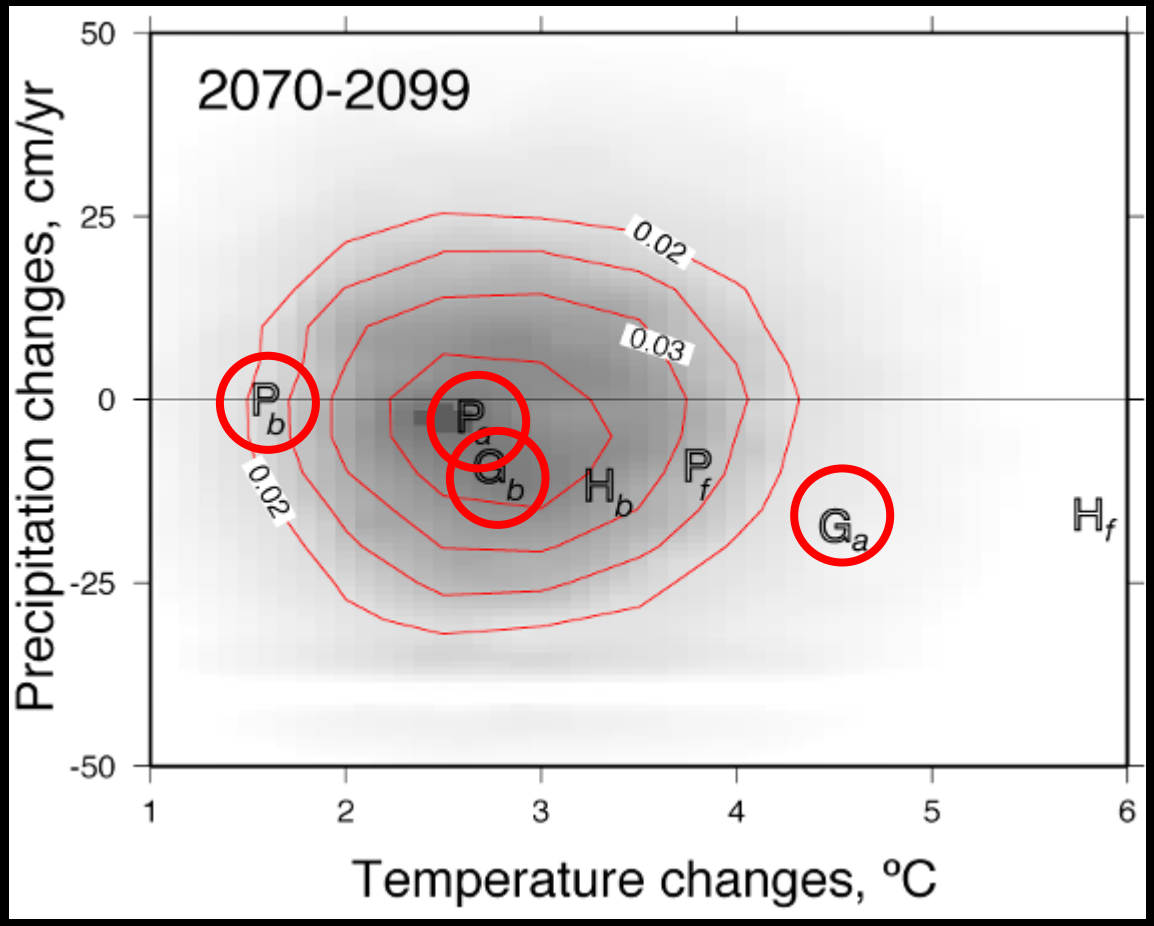
CALIFORNIA BAY-DELTA AUTHORITY
A COLLABORATIVE APPROACH TO RESOURCE MANAGEMENT


Global
Climate
Models
Weather
Sea level
Downscaled
To Region
Watershed
Model
Inflow, T

Global Climate Models

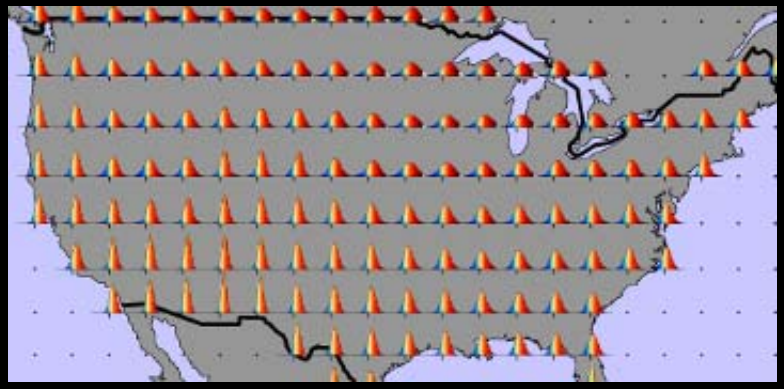


4 Future Scenarios

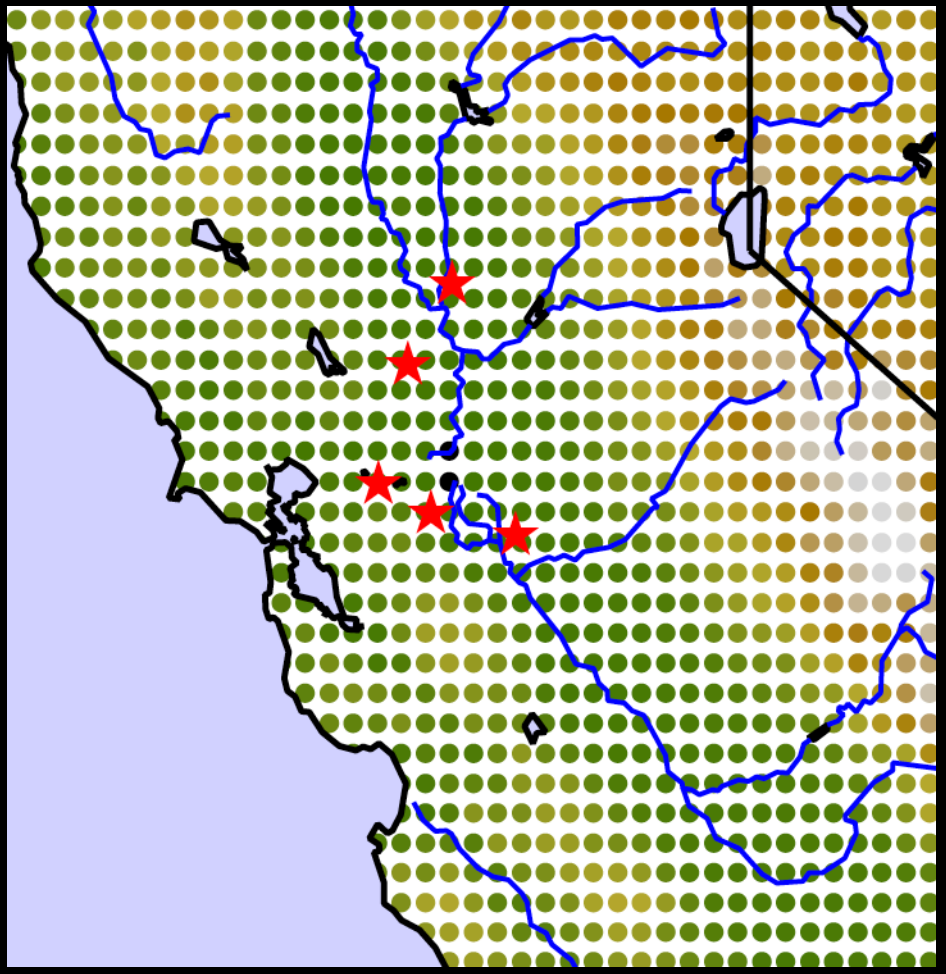


consistent with California Climate Scenarios Assessment, 2006 and 2008

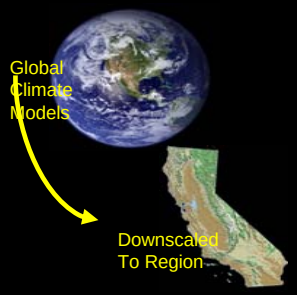
Mike Dettinger, Dan Cayan



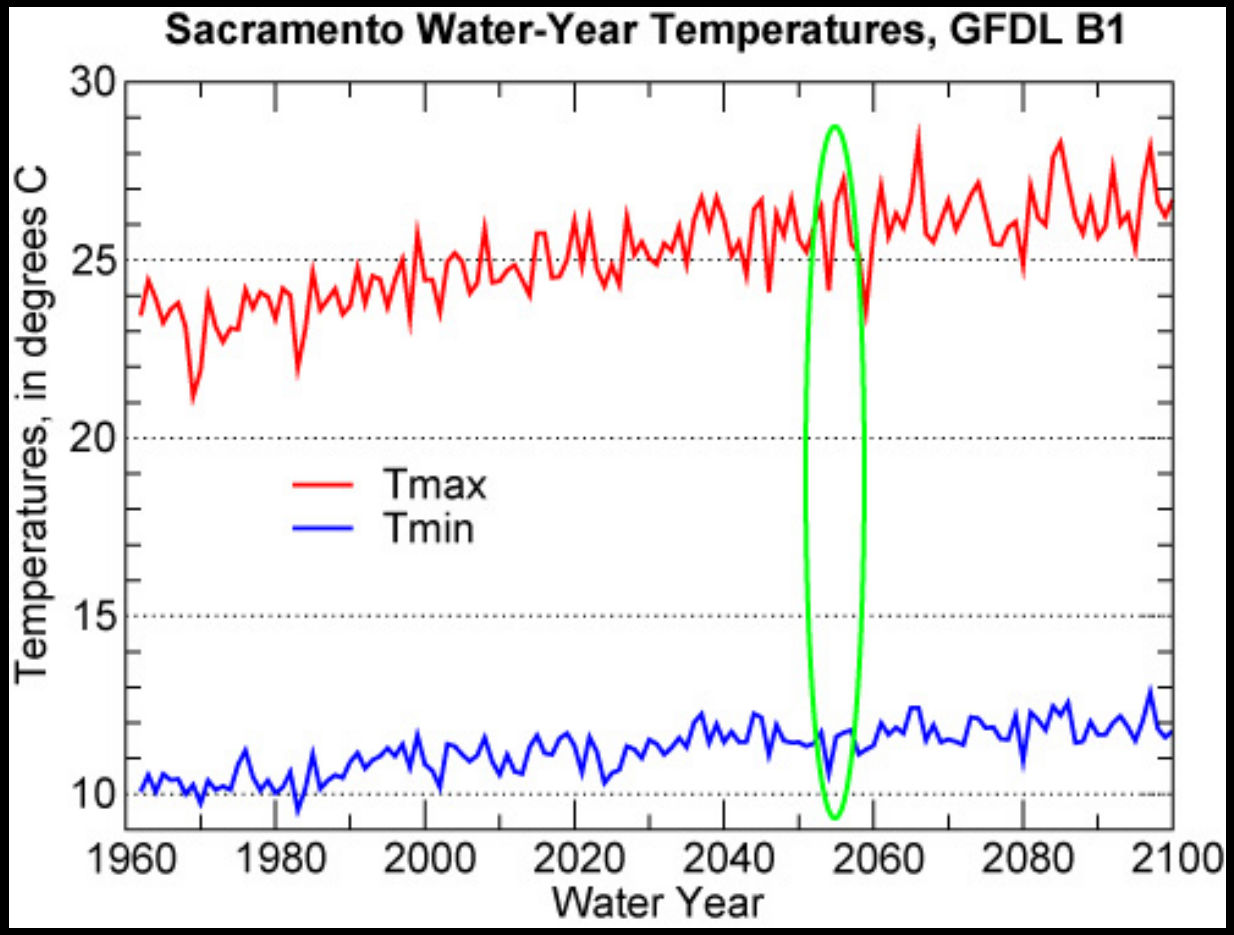
Downscaled daily: air temperatures, precipitation, humidity, winds, solar insolation



Mike Dettinger

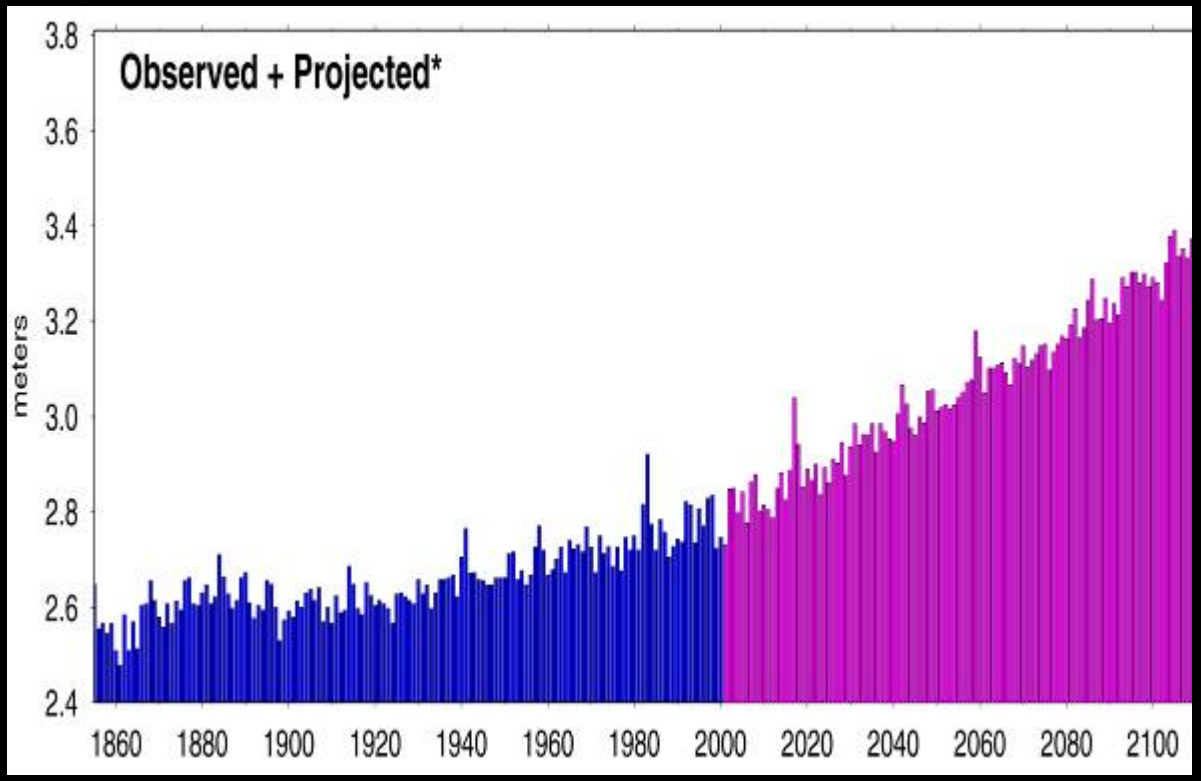


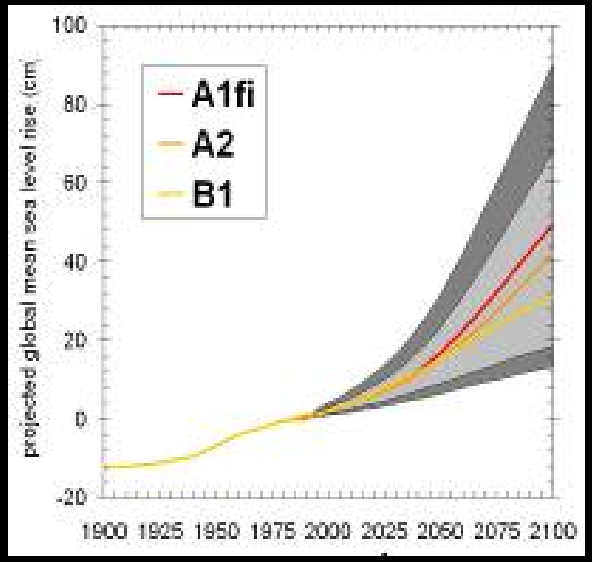
For the 21st century



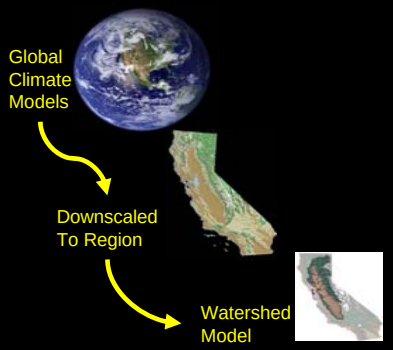
Includes sea level rise

Global
Climate
Models





Dan Cayan



Climate Change
- Precipitation (GCM)
- Temperature (GCM)
- Humidity (GCM)

Population/Demand Change

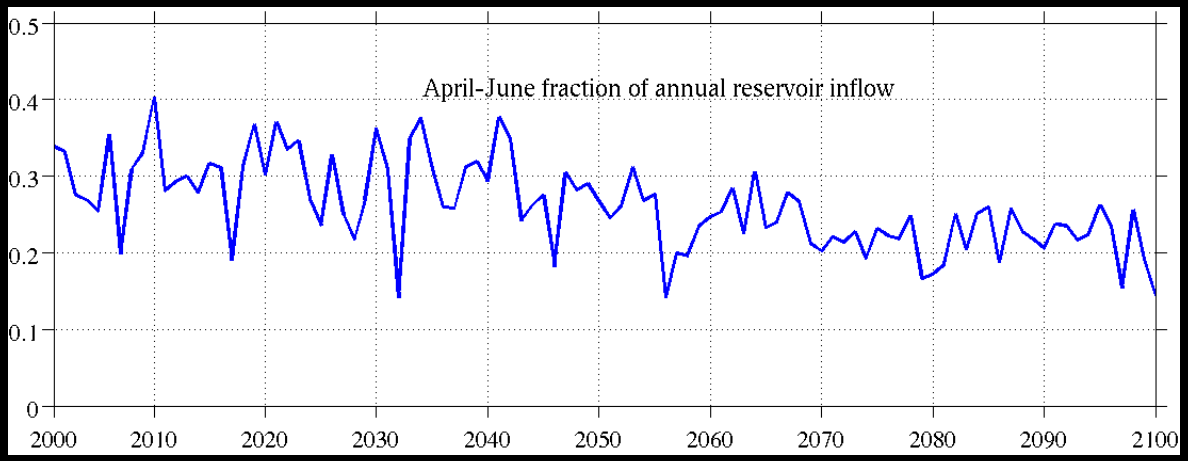
Freshwater demand patterns
(*e.g.*, from DWR Bull. 160)

Noah Knowles

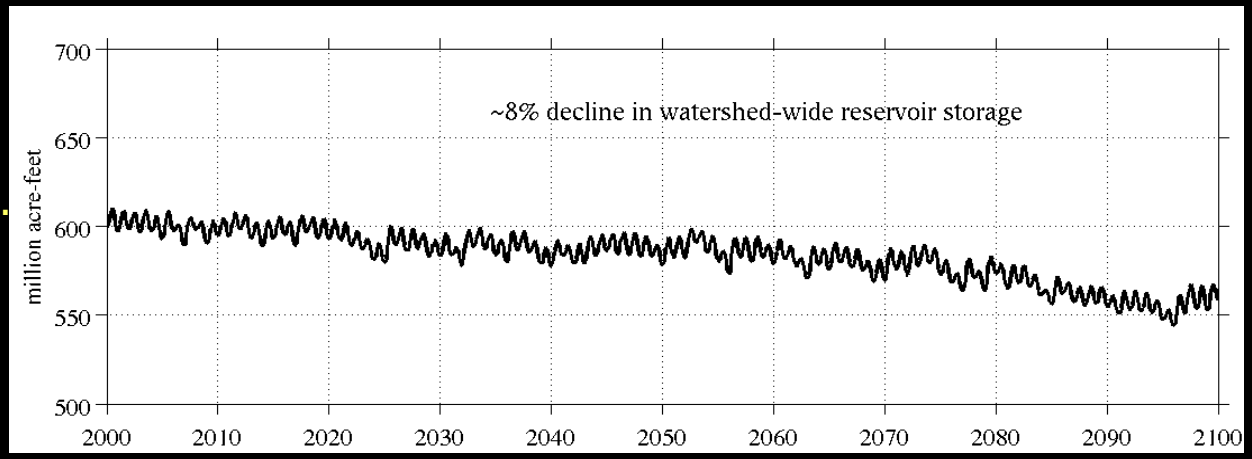
Outputs
- Reservoir outflows
- Stream temps
- Delta inflows

Sample scenario: GFDL-A2

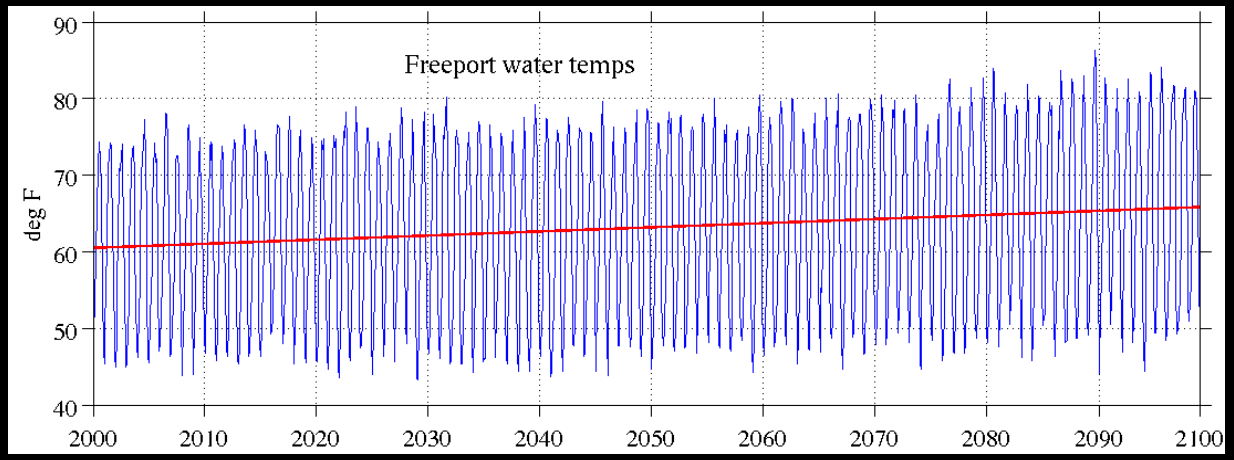
Reduced snowpack means higher winter flood peaks and reduced spring runoff.

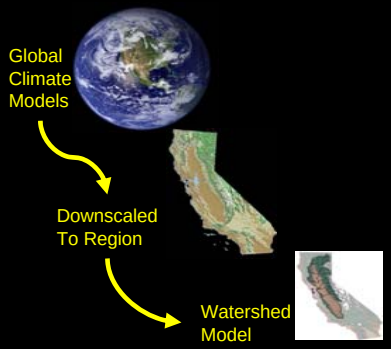


Spring snowmelt runoff is critical for reservoir recharge.

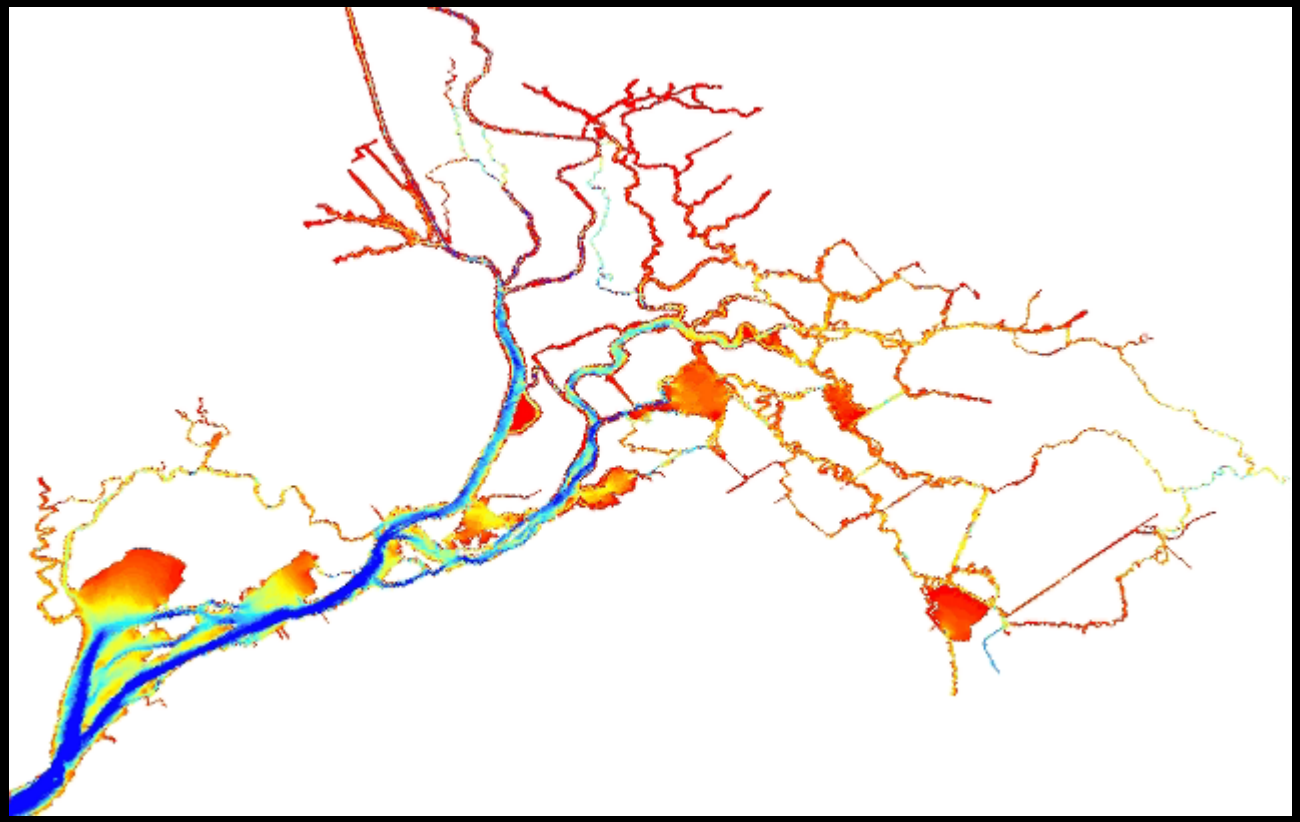


Higher air temperatures and diminished reservoir cold pools lead to higher down-stream water temperatures.

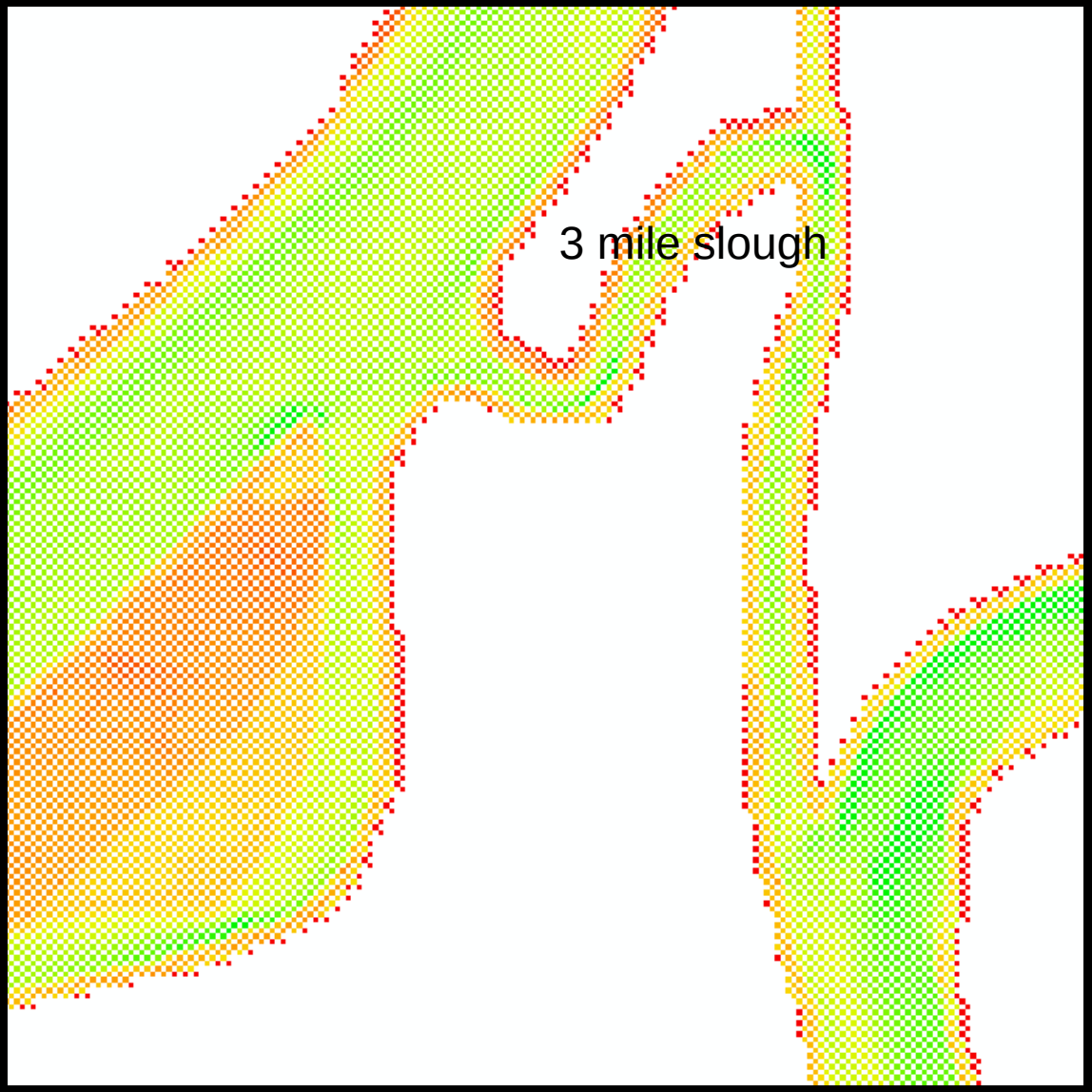




Delta TRIM – tidal model

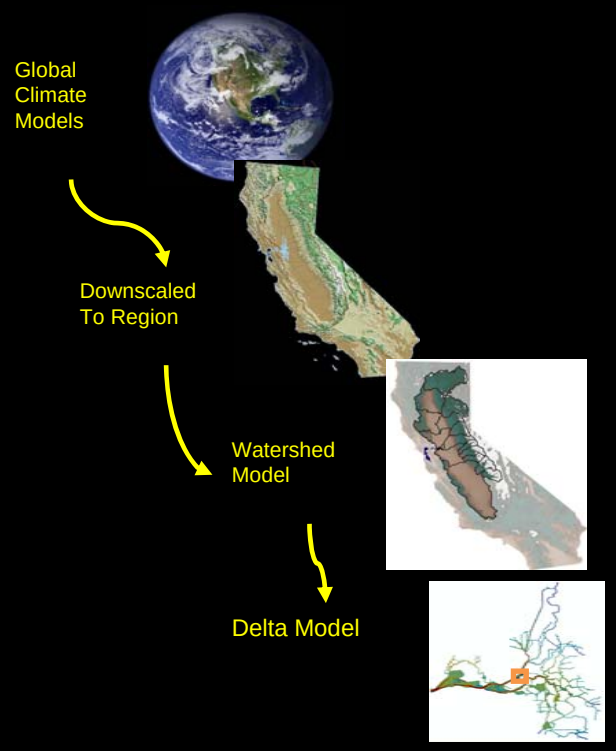


Nancy Monsen



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

Geomorphic Changes in the 21st century



Suisun Bay's subtidal-intertidal habitats

Sea-level rise:

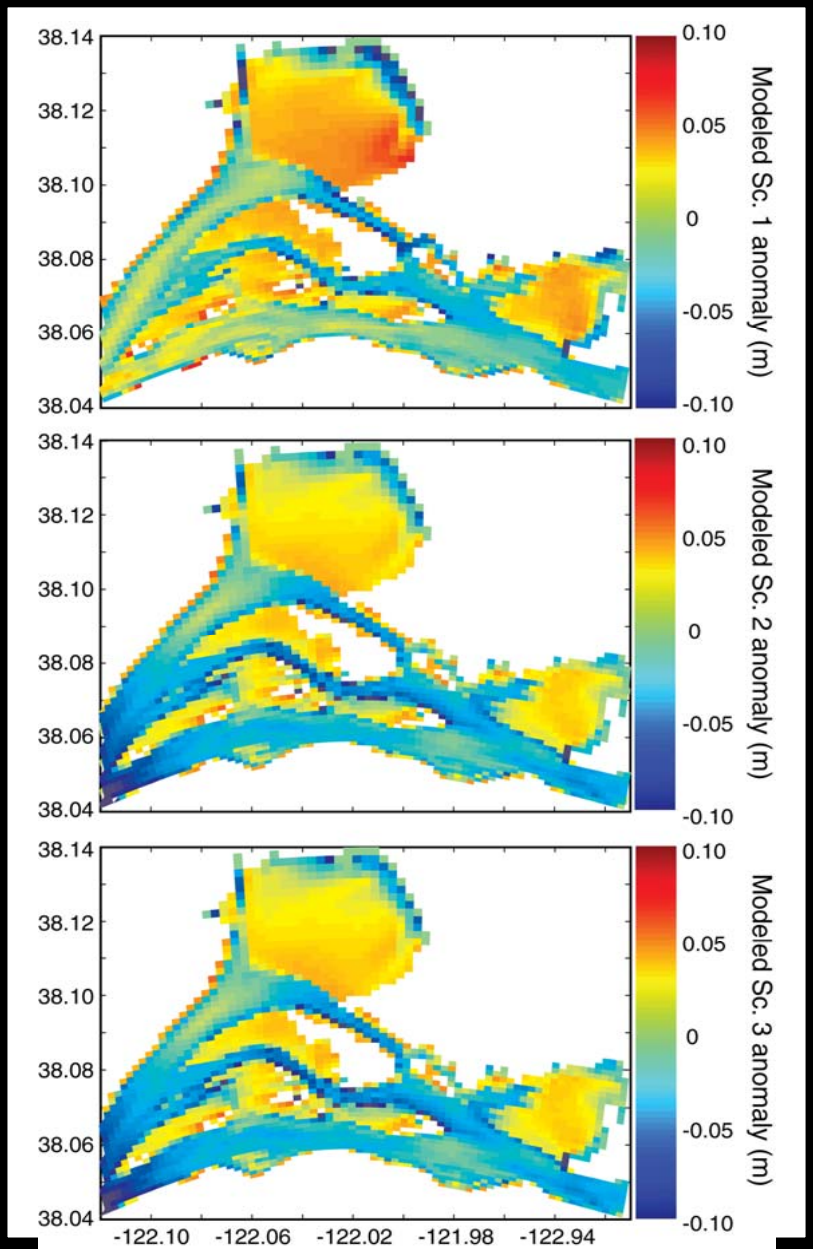
- decreased in wave stress on bed; less redistribution

Warming:

- Minor changes in redistribution

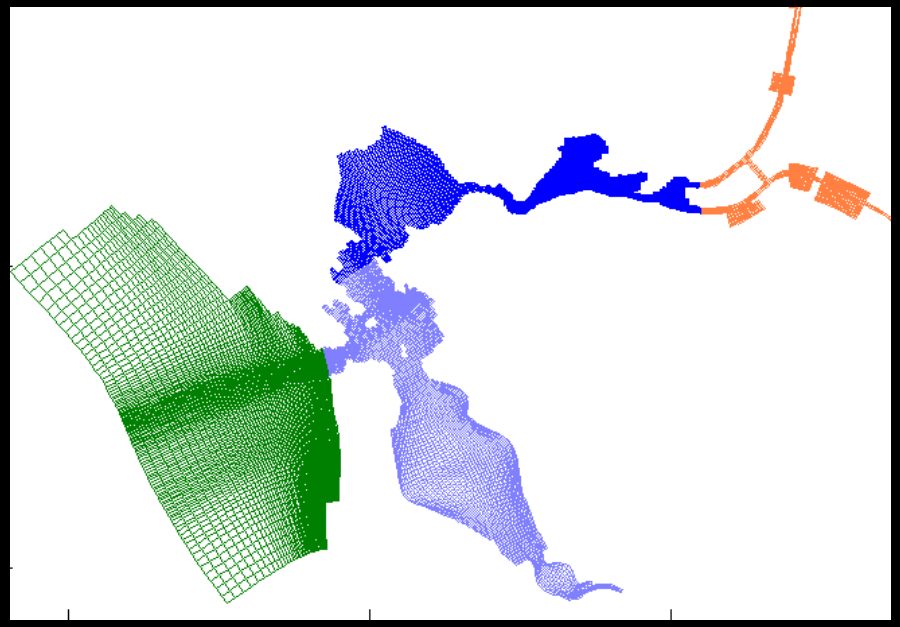
Decreased sediment supply:

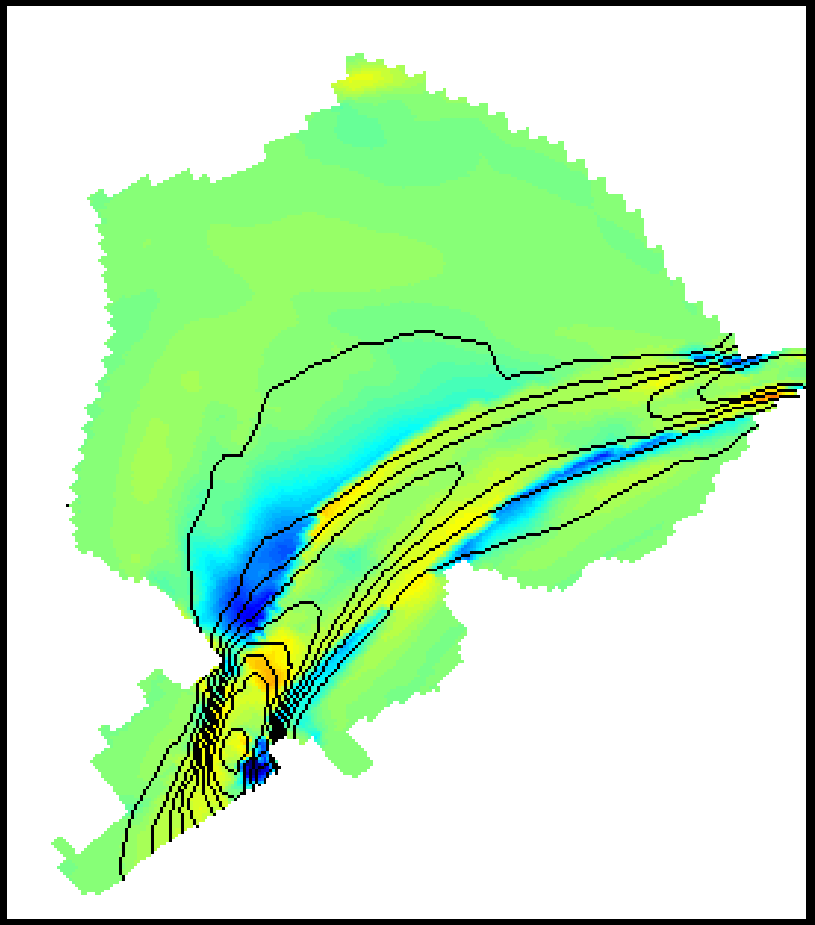
- Erosion everywhere except fringes



Neil Ganju
Dave Schoellhamer

How might sediment budgets and morphology of the Bay change?

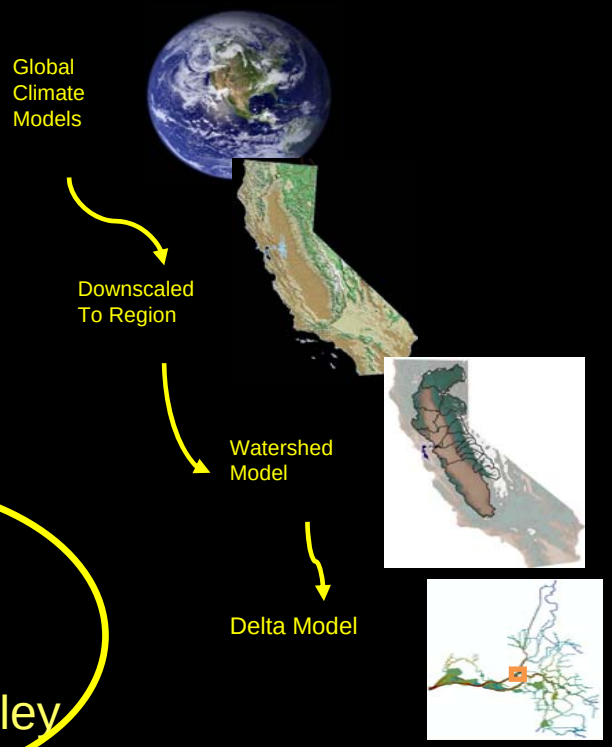




Bruce Jaffe
Mick Vanderwegen
Dano Roelvink

Ecological Changes in the 21st century

Temperature
Wayne Wagner
Mark Stacey



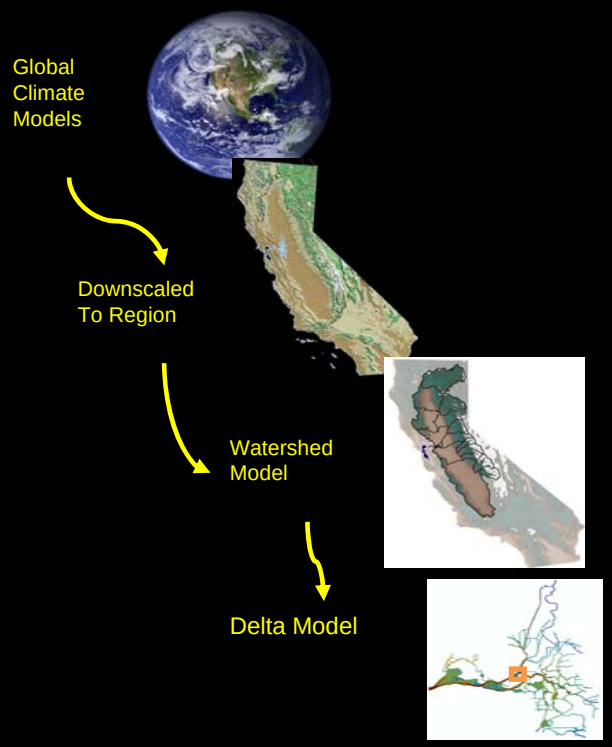
Fish
Larry Brown
Bill Bennet
Christa Woodley

Phytoplankton
Lisa Lucas

Invasive Species
Jan Thompson

Mercury & Selenium
Robin Stewart
Sam Luoma

Next talks …….



Phytoplankton
Lisa Lucas

Invasive Species
Jan Thompson