Modeling Nutrients in SF Bay

House of Cards or Crystal Ball?

Rusty Holleman Emma Nuss Zhenlin Zhang David Senn

The Nutrient Management Strategy

How are nutrient levels linked to the ecological health of San Francisco Bay?

- **Targeted field campaigns**
- **Monitoring data**
- **Mechanistic models**

Modeling

Limited observations

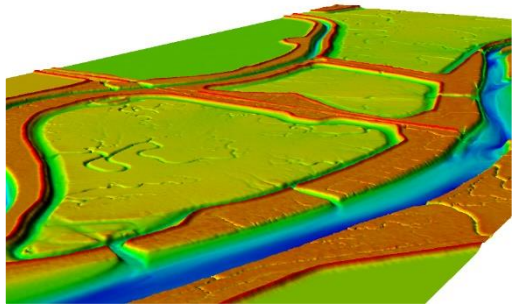
Processes, synthesis

Enable complex predictions

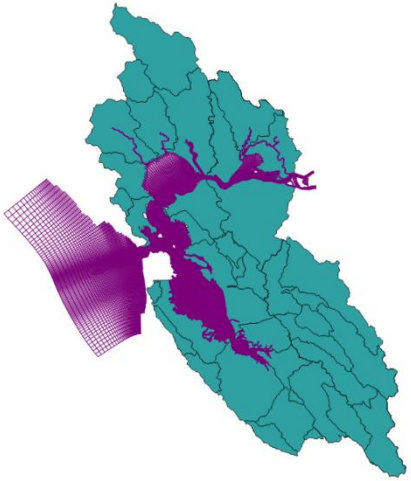
Each piece is an opportunity for weak assumptions!

Outline

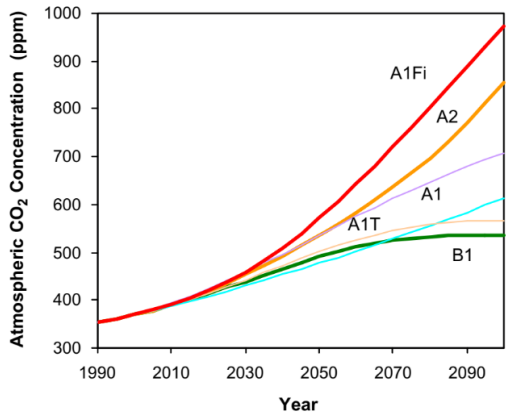
Lower South Bay



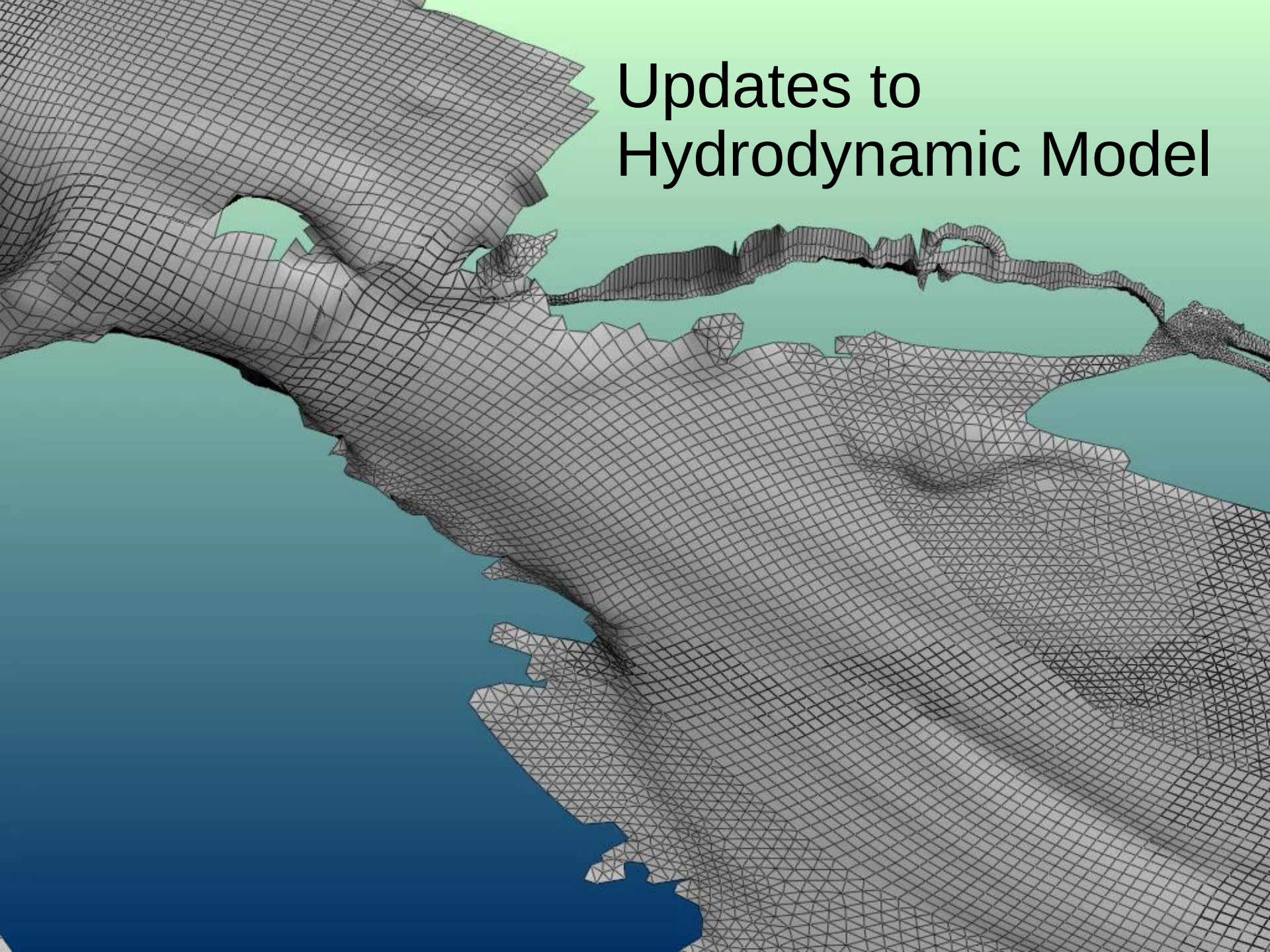
Full Bay Modeling



Risk & Future Scenarios



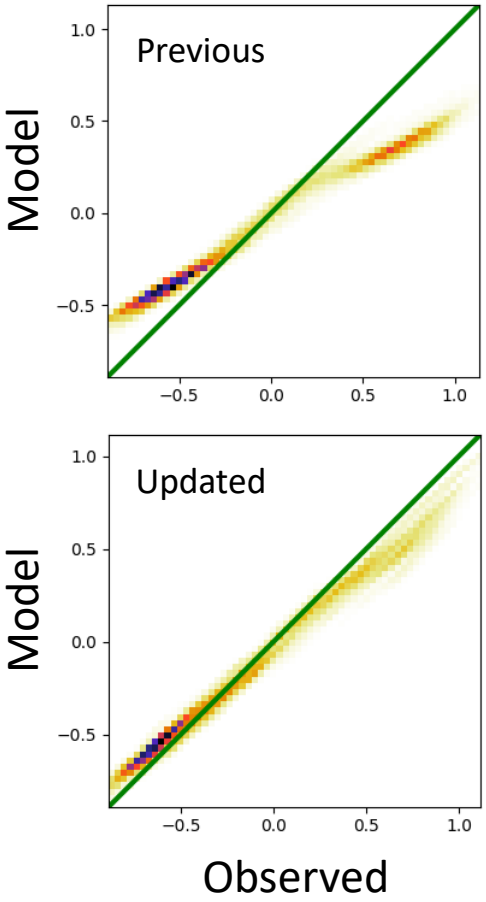
Updates to Hydrodynamic Model



Hydrodynamic Improvements

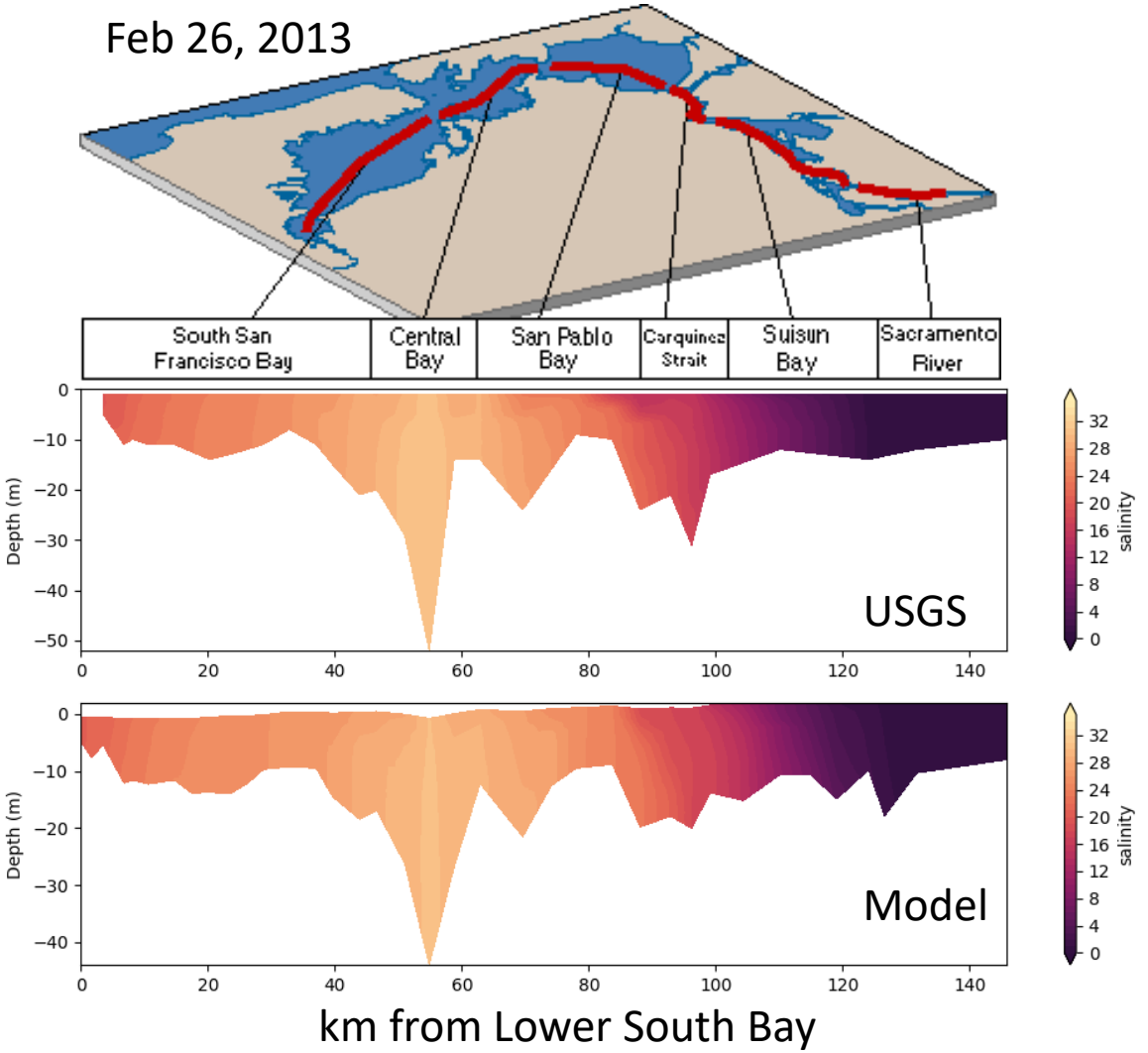
Velocity

NOAA data, Redwood City



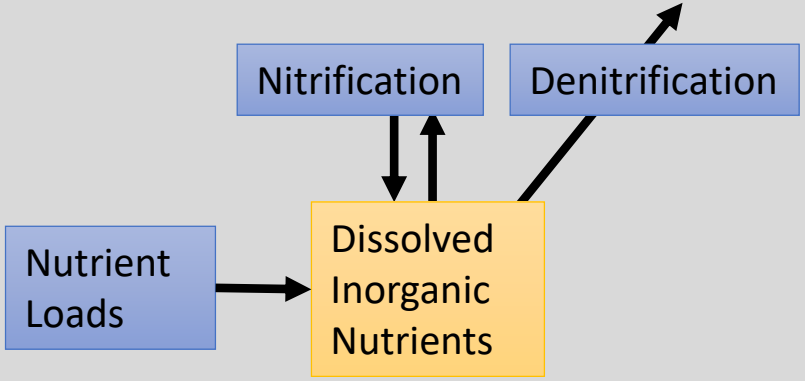
Salinity

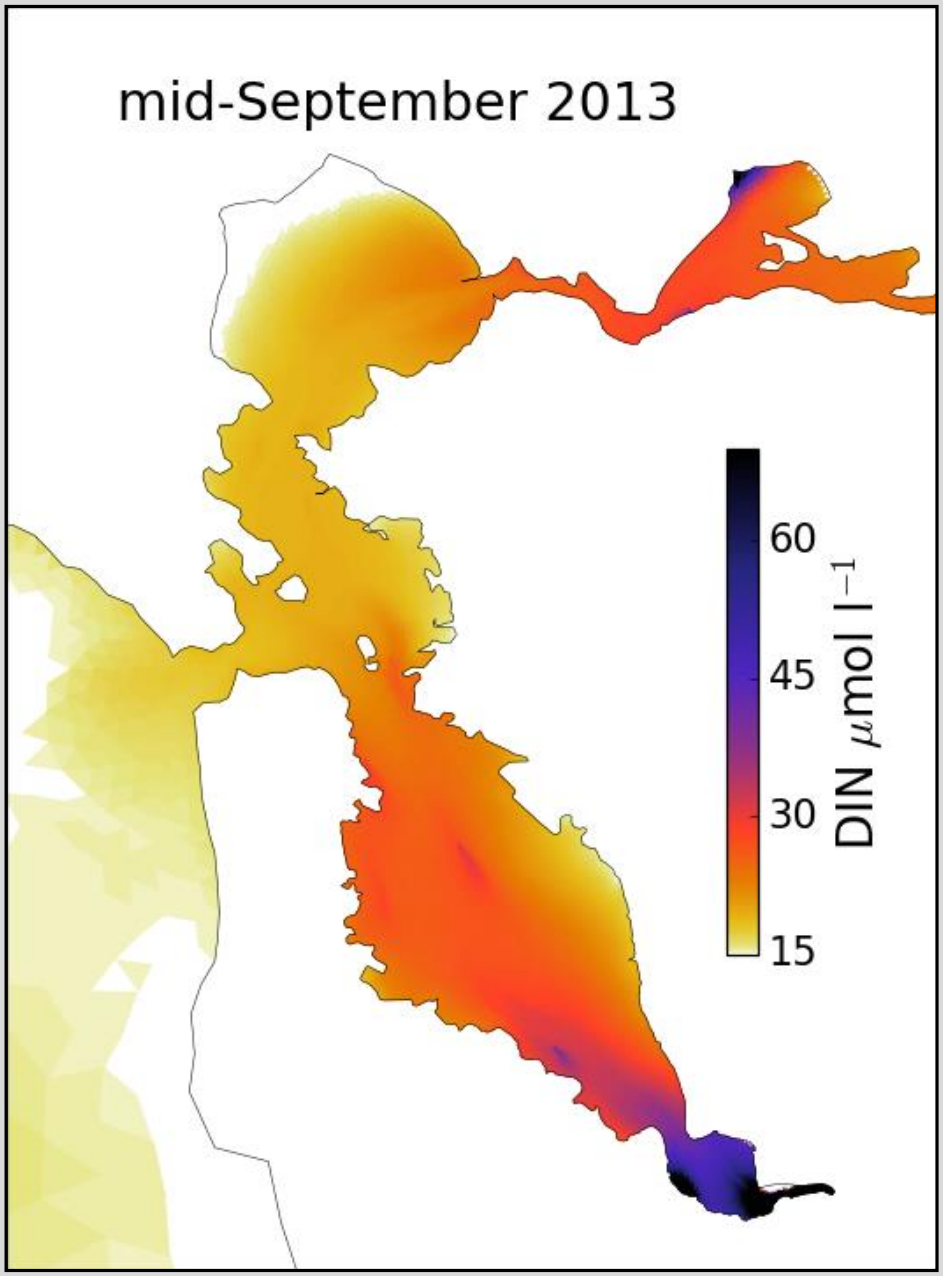
Feb 26, 2013



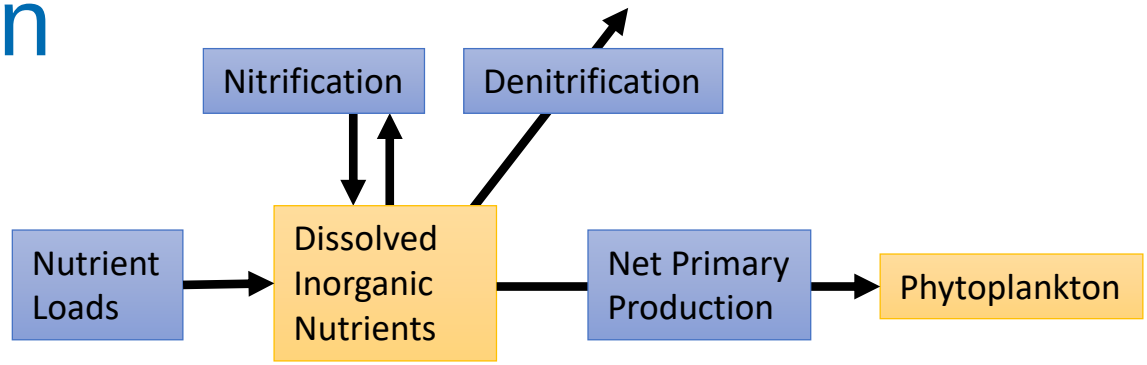
Biogeochemical Modeling

DIN: dissolved inorganic nitrogen



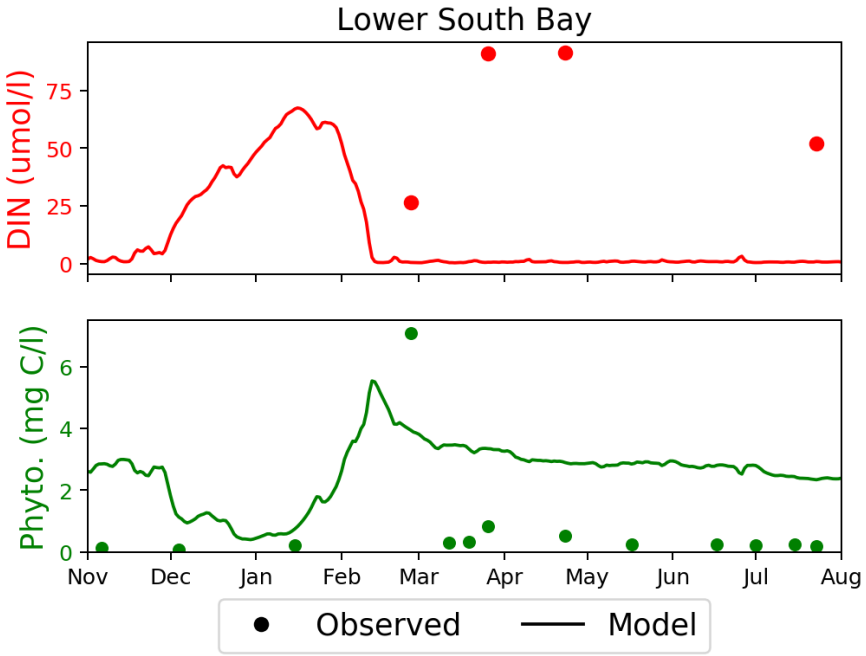


Phytoplankton

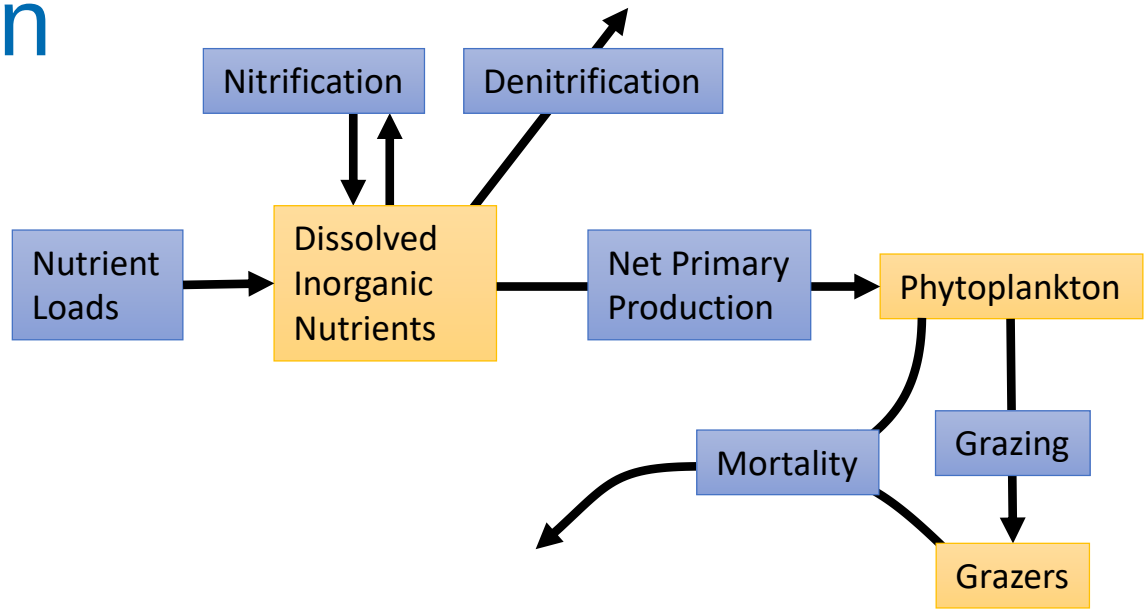


Nutrient limited

High phytoplankton unrealistic

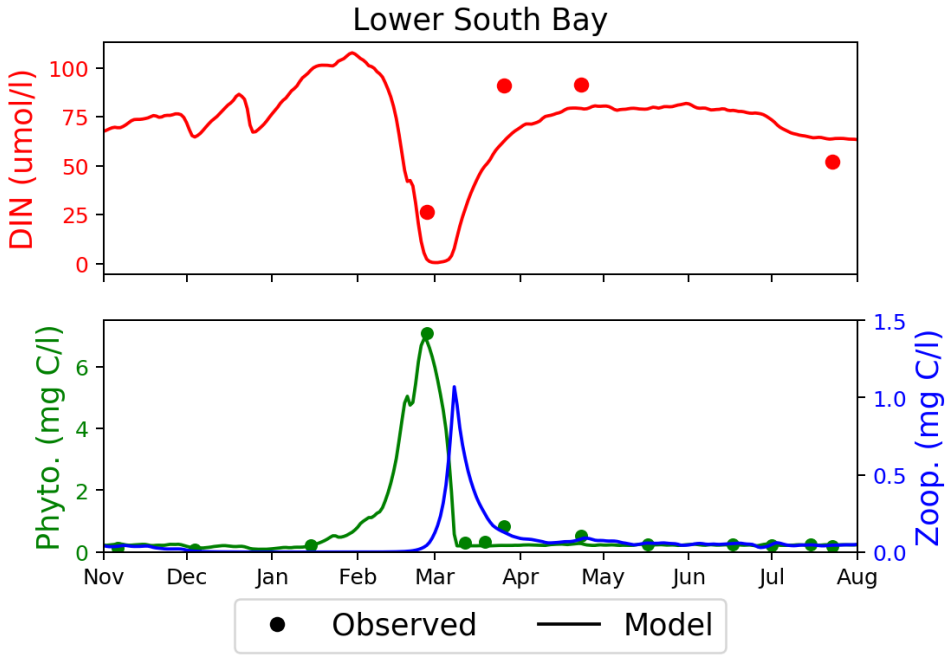


Phytoplankton *and* *Zooplankton*



Grazer and nutrient limited

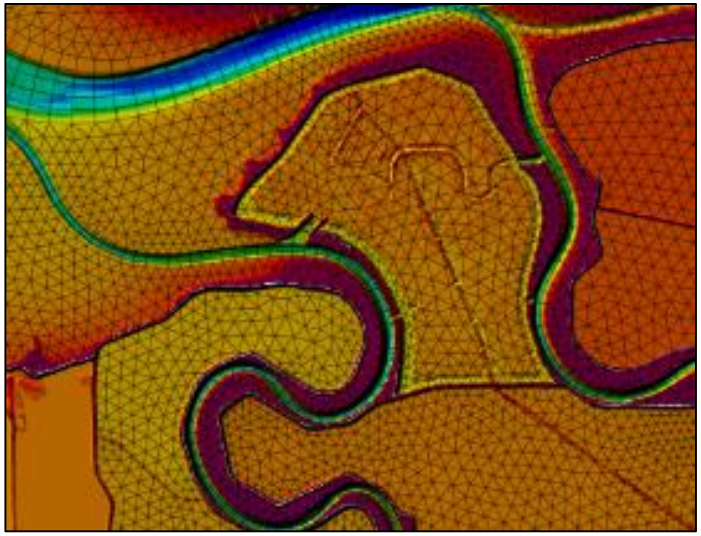
Bloom followed by low phytoplankton

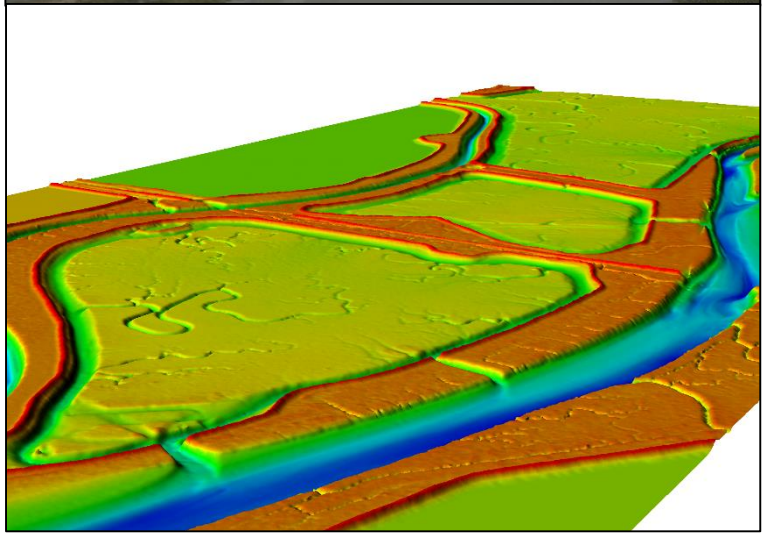


Lower South Bay Hydrodynamics

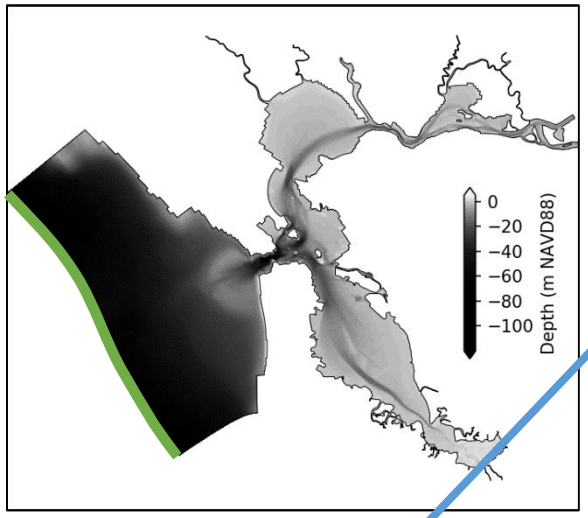
Interaction of LSB margins and the Bay

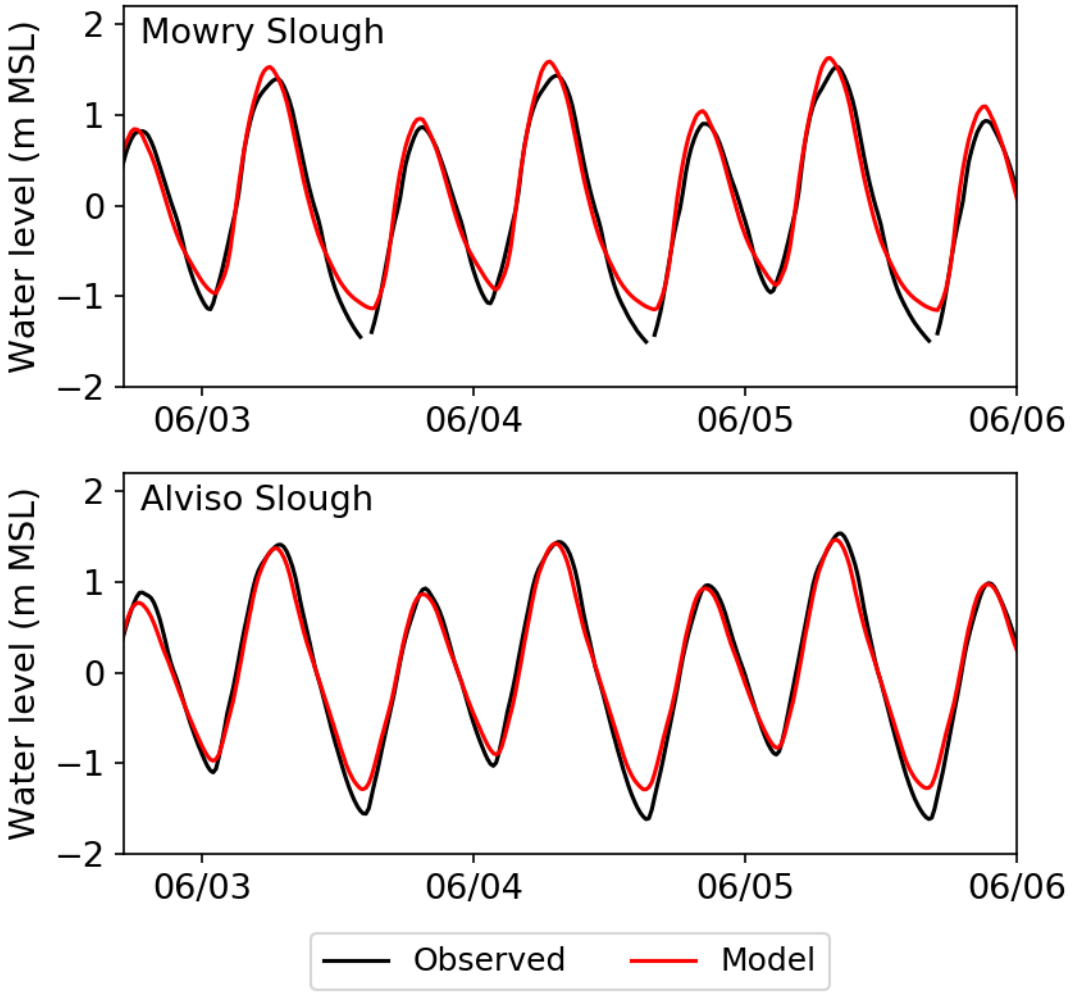
Collaboration with RMA



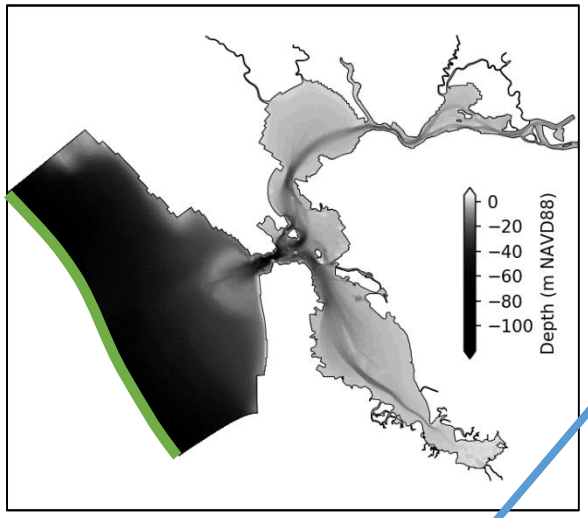


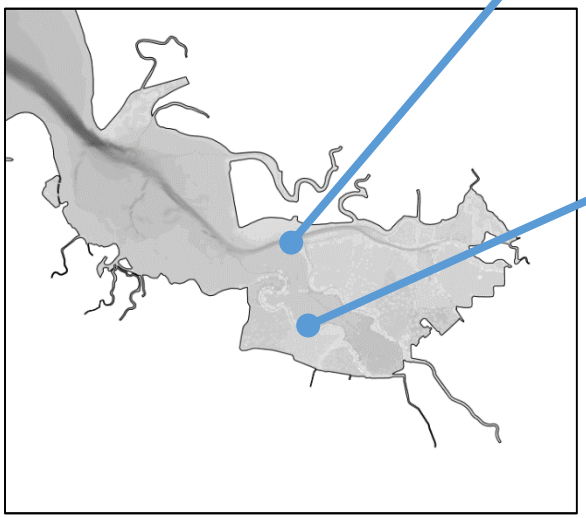
Lower South Bay: Tides

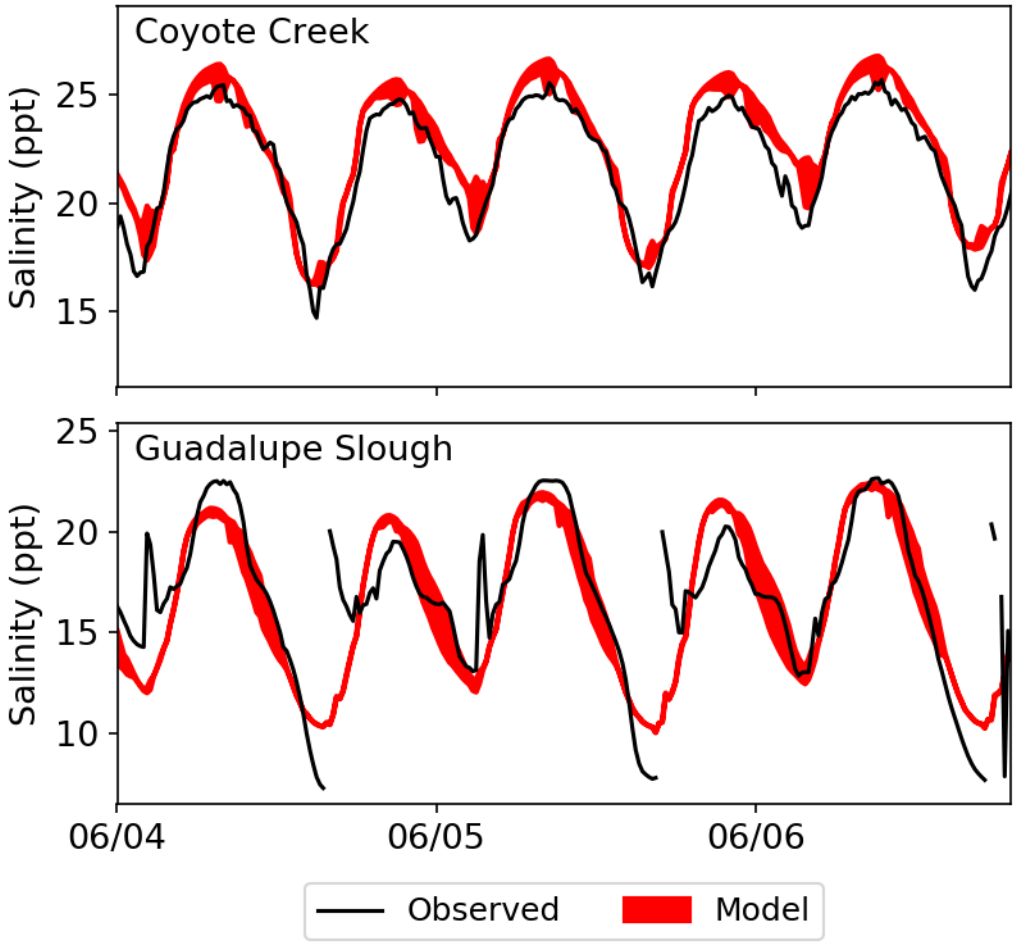




Lower South Bay: Salinity

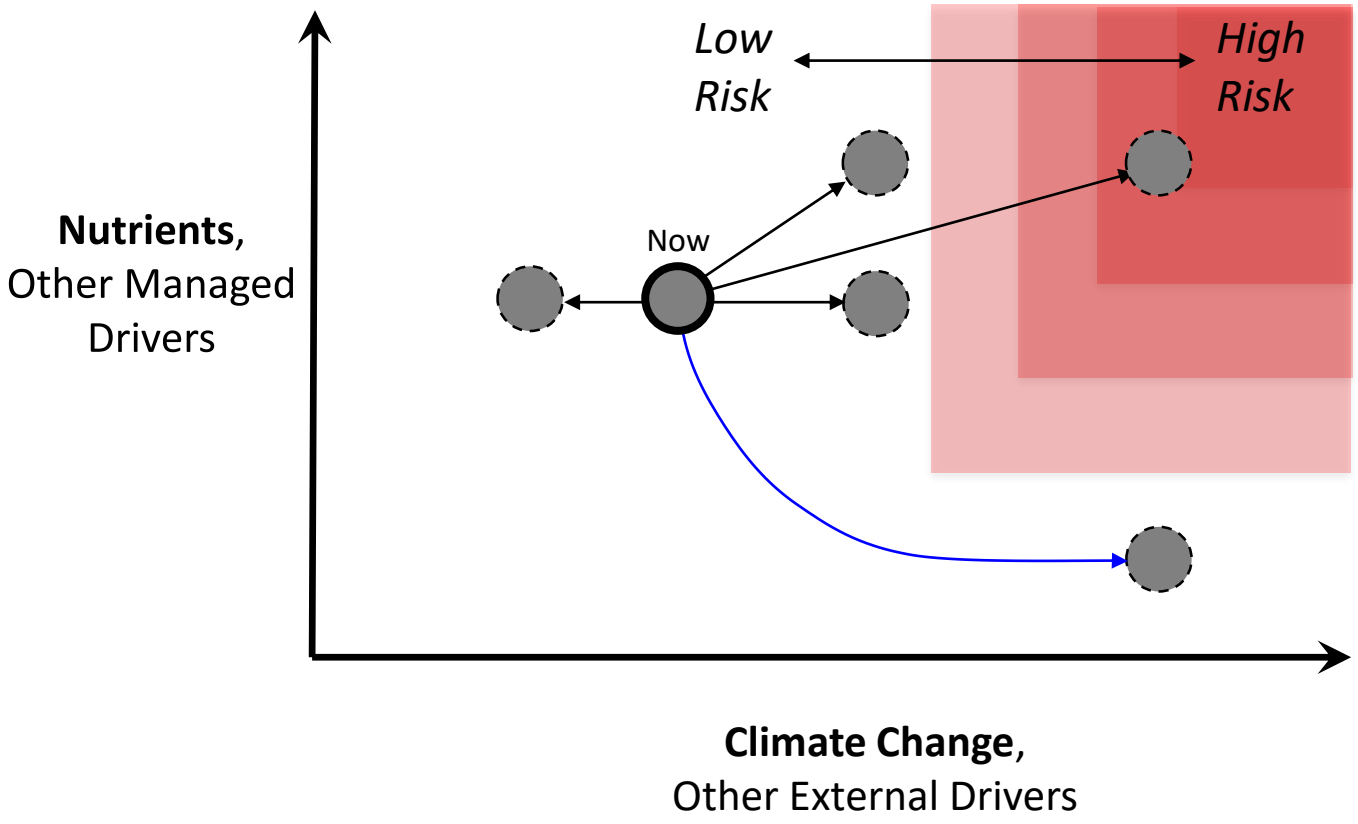




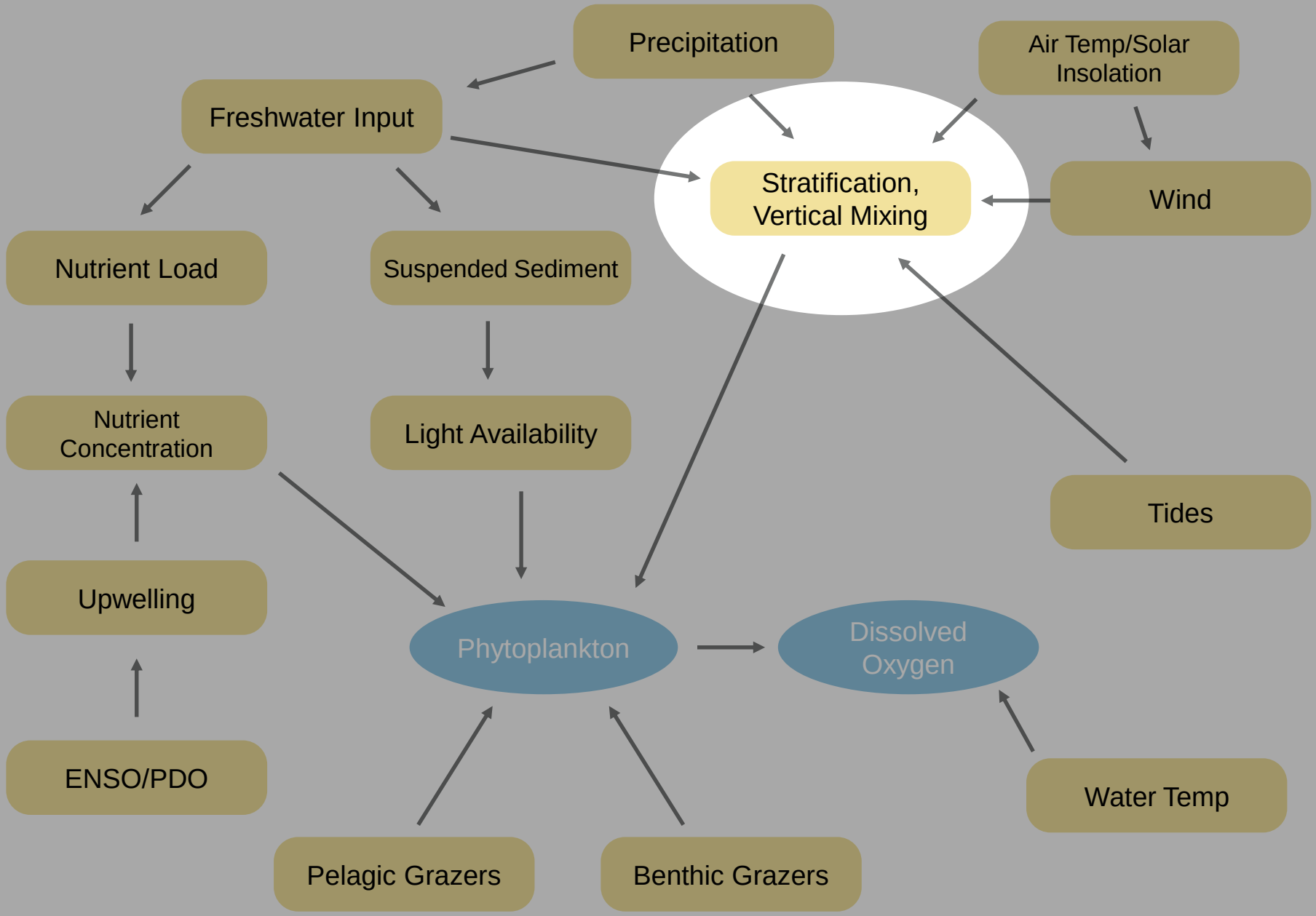


Risk-based Modeling for Future Scenarios

What future conditions are plausible?
How should we manage for the corresponding impacts?



RMP


Precipitation
Air Temp/Solar Insolation
Freshwater Input
Stratification, Vertical Mixing
Wind
Nutrient Load
Suspended Sediment
Nutrient Concentration
Light Availability
Tides
Upwelling
Phytoplankton
Dissolved Oxygen
ENSO/PDO
Water Temp
Pelagic Grazers
Benthic Grazers

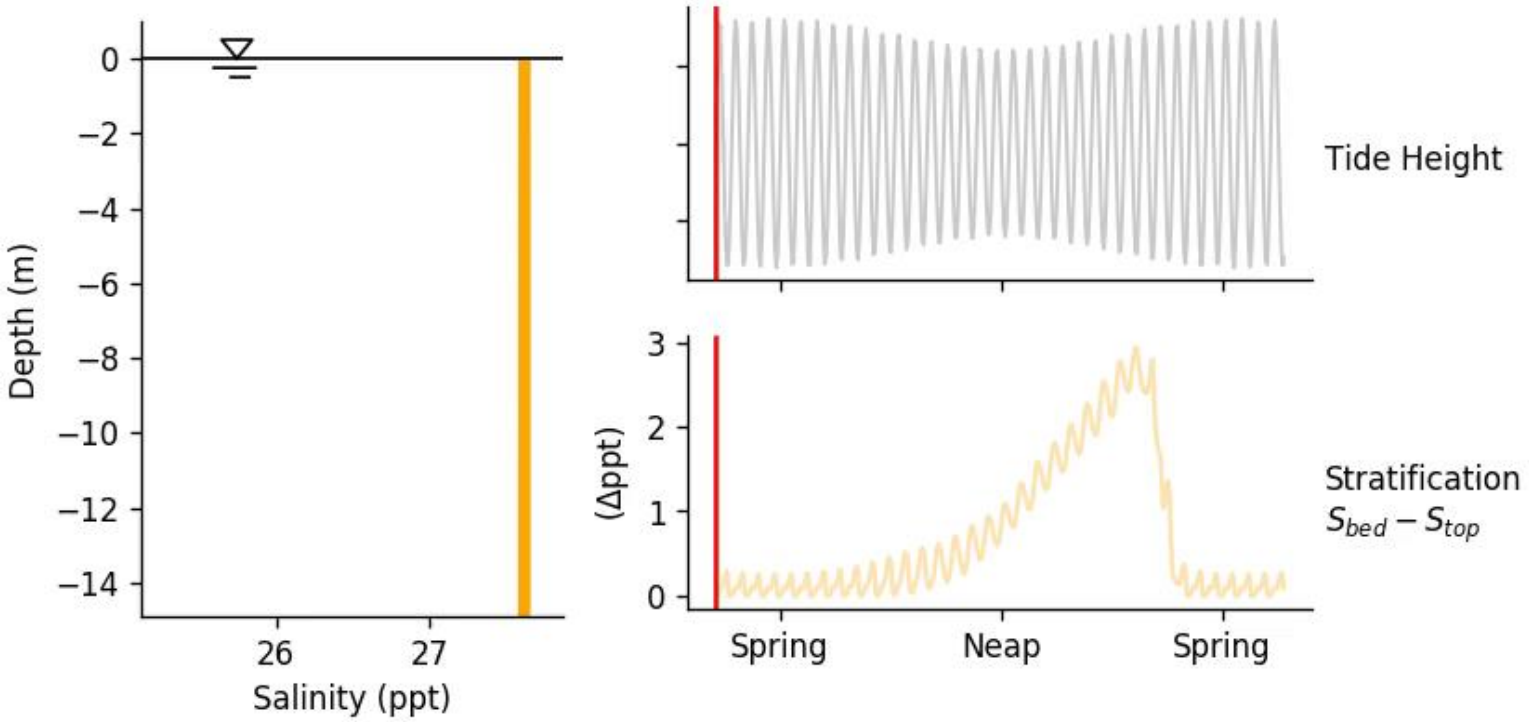
Stratification Modeling

Stratification: when surface waters are distinct and isolated from water lower down.

Hypothesis: persistent stratification enables phytoplankton blooms

Typical in SF Bay:

Flood tide mixes / Ebb tide stratifies



Summary & Next Steps

- Full Bay
  - Hydrodynamics validation
  - Phytoplankton and grazing
  - Starting sediment
- Lower South Bay
  - Wrapping up hydrodynamics
  - Flushing studies
  - Biogeochemistry
- Future Scenarios
  - Drivers and scenarios report
  - Controls on stratification
  - Phytoplankton
- Suisun / Delta
  - Incorporate loads
  - Dominant processes
  - Parallel development with Full Bay model

RMP

Acknowledgements

- RMP, NMS permit fees
- CCCSD
- Palo Alto
- Sunnyvale
- Delta Science Program
- Sacramento Regional
- State Water Board
- EPA, EBMUD
- *USGS*
- *RMA*
- *Deltares*
- *TU Delft / UNESCO IHE*