Modeling Nutrients in SF Bay
House of Cards or Crystal Ball?

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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

- Atmospheric CO₂ Concentration (ppm)
  - A1Fi
  - A2
  - A1
  - A1T
  - B1

Year:
- 1990
- 2010
- 2020
- 2030
- 2050
- 2070
- 2090

Values:
- 300
- 400
- 500
- 600
- 700
- 800
- 900
- 1000
Updates to Hydrodynamic Model
Hydrodynamic Improvements

Velocity

NOAA data, Redwood City

Previous

Updated

Salinity

Feb 26, 2013

USGS

Model

km from Lower South Bay
**Biogeochemical Modeling**

**DIN:** dissolved inorganic nitrogen

- **Nutrient Loads**
- **Dissolved Inorganic Nutrients**
- **Nitrification**
- **Denitrification**

Map showing DIN distribution in mid-September 2013, with color gradient ranging from 15 to 60 umol L⁻¹.
Phytoplankton

Nutrient limited

High phytoplankton unrealistic
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

Water level (m MSL)

Mowry Slough

Alviso Slough

-2
-1
0
1
2

06/03 06/04 06/05 06/06

06/03 06/04 06/05 06/06

Observed
Model
Lower South Bay: Salinity
Risk-based Modeling for Future Scenarios

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

[Diagram showingRisk-based Modeling for Future Scenarios with axes for Nutrients, Other Managed Drivers on the vertical axis and Climate Change, Other External Drivers on the horizontal axis. The diagram illustrates a risk matrix with Low Risk and High Risk zones. There are points marked as Now with arrows indicating potential future scenarios.]
Phytoplankton

Dissolved Oxygen

Freshwater Input

Precipitation

Air Temp/Solar Insolation

Wind

Tides

Nutrient Load

Suspended Sediment

Light Availability

Nutrient Concentration

Upwelling

EnSO/PDO

Pelagic Grazers

Benthic Grazers

Water Temp

Phytoplankton

Stratification, Vertical Mixing
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

![Graph showing depth, salinity, tide height, and stratification](image-url)
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
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