South Puget Sound Dissolved Oxygen Study

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Dept. of Ecology

Technical Advisory Committee:

- Scientifically knowledgeable people
- Representing full range of interests

Role of the Committee:

- Make recommendations
- Promote education
- Encourage discussions of issues

Ecology’s role is to make final decisions

Role of Advisory Committee

- Review Draft Study Plan
- Review Data as it becomes available
- Scope Modeling Scenarios
- Related Projects

Committee Members:

- Tribal
- Wastewater Treatment Plants
- Conservation District
- Department of Health
- University
- Business Interests
- Environmental Groups
- Municipalities
- Counties
- Federal Government

Example Ground Rules

- Treat each other with respect
- Avoid personal attacks
- Stay on track

etc…

WWTP monitoring meeting

- Ecology is attempting to characterize nutrient concentrations in WWTP effluent
- Difficulties due to variability in effluent
- Hold a meeting solely to discuss a monitoring strategy for WWTPs

South Puget Sound Monitoring and Modeling

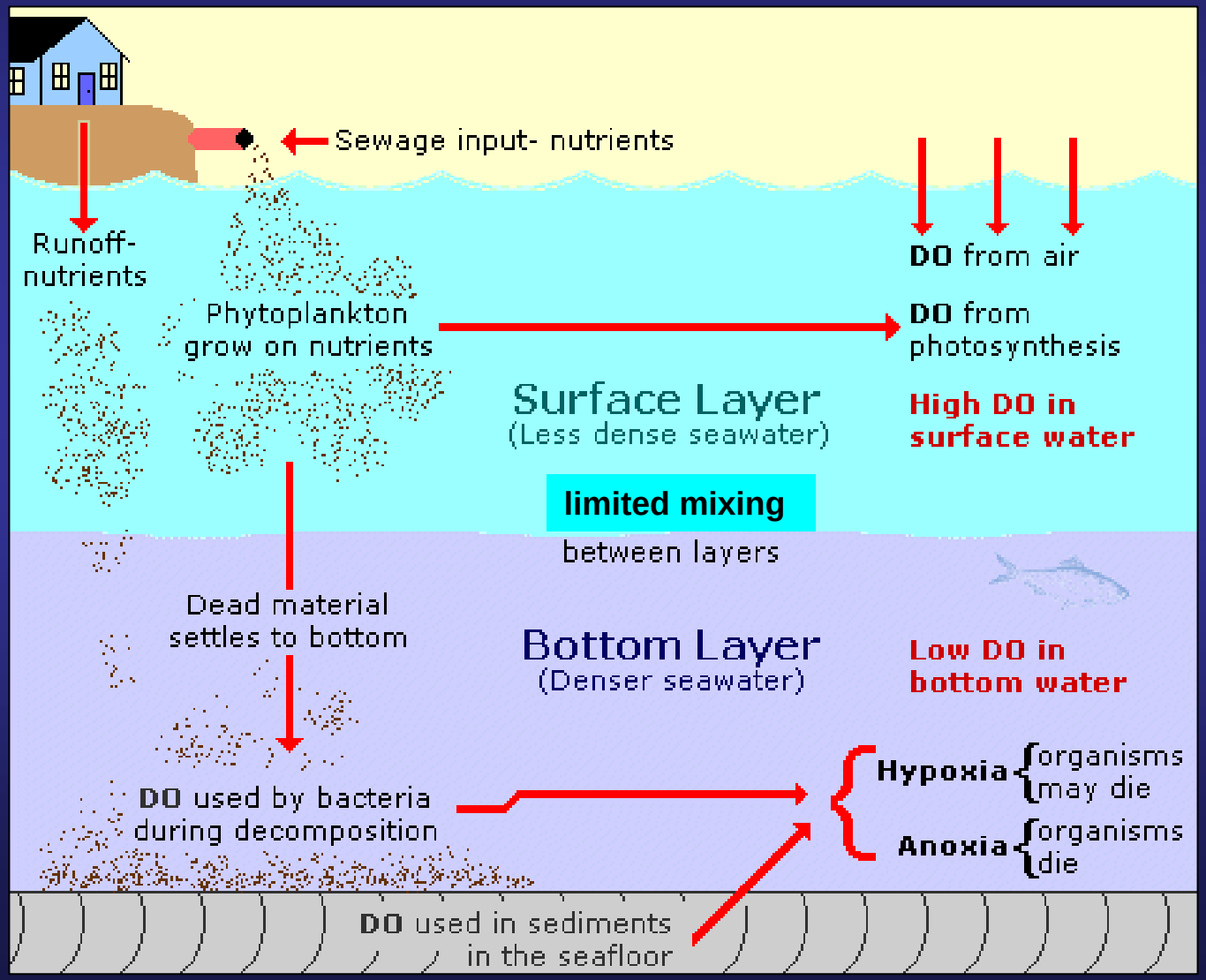
Mindy Roberts (project manager)
Julia Bos (oceanographer)

December 4, 2006

Presentation Overview

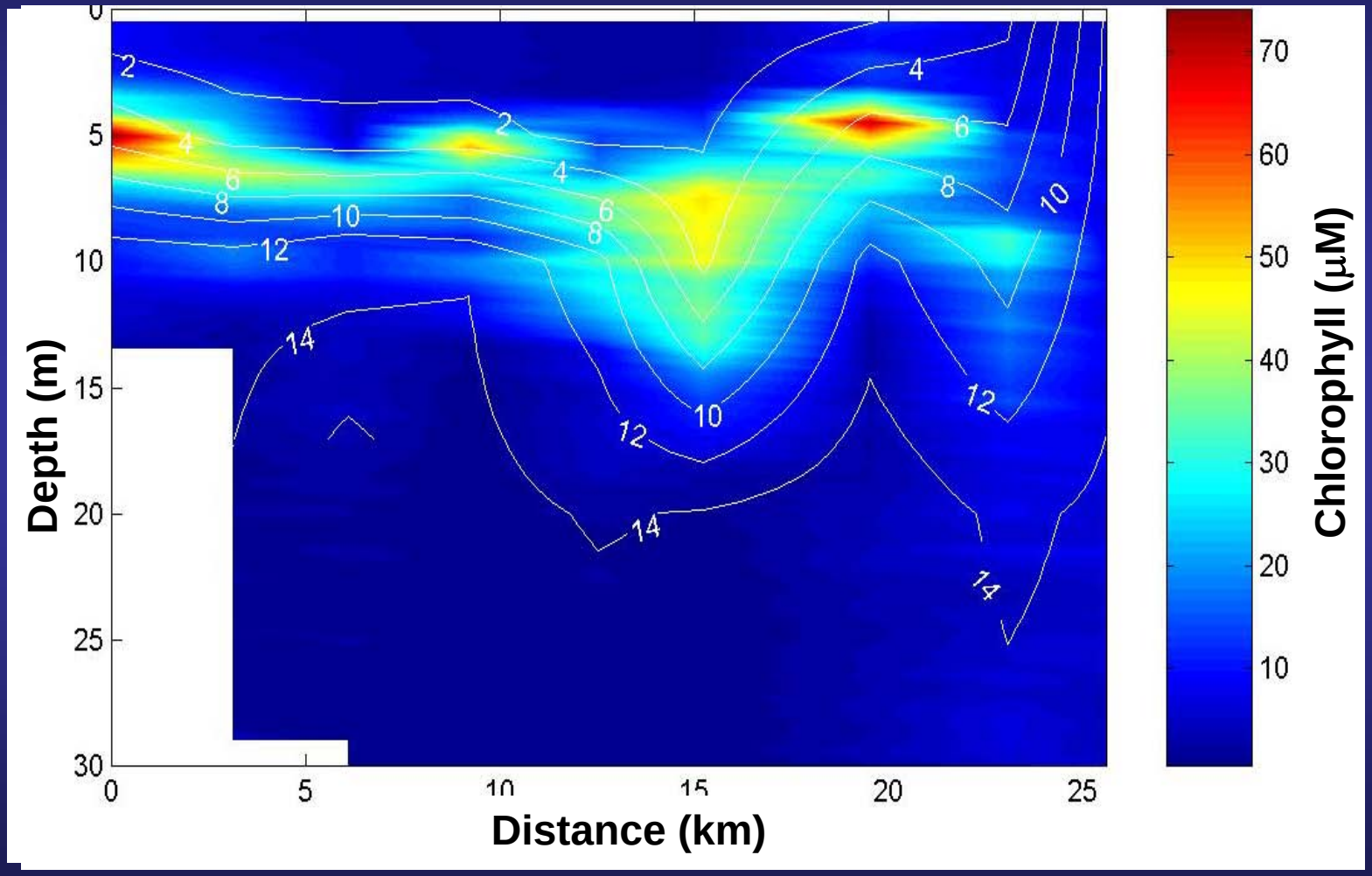
- **Historical context**
  - ***why are we doing this?***
- Project elements (<u>data and modeling</u>)
  - how are we doing this?
- Schedule
  - when are we doing this?

Why do we care about nitrogen?



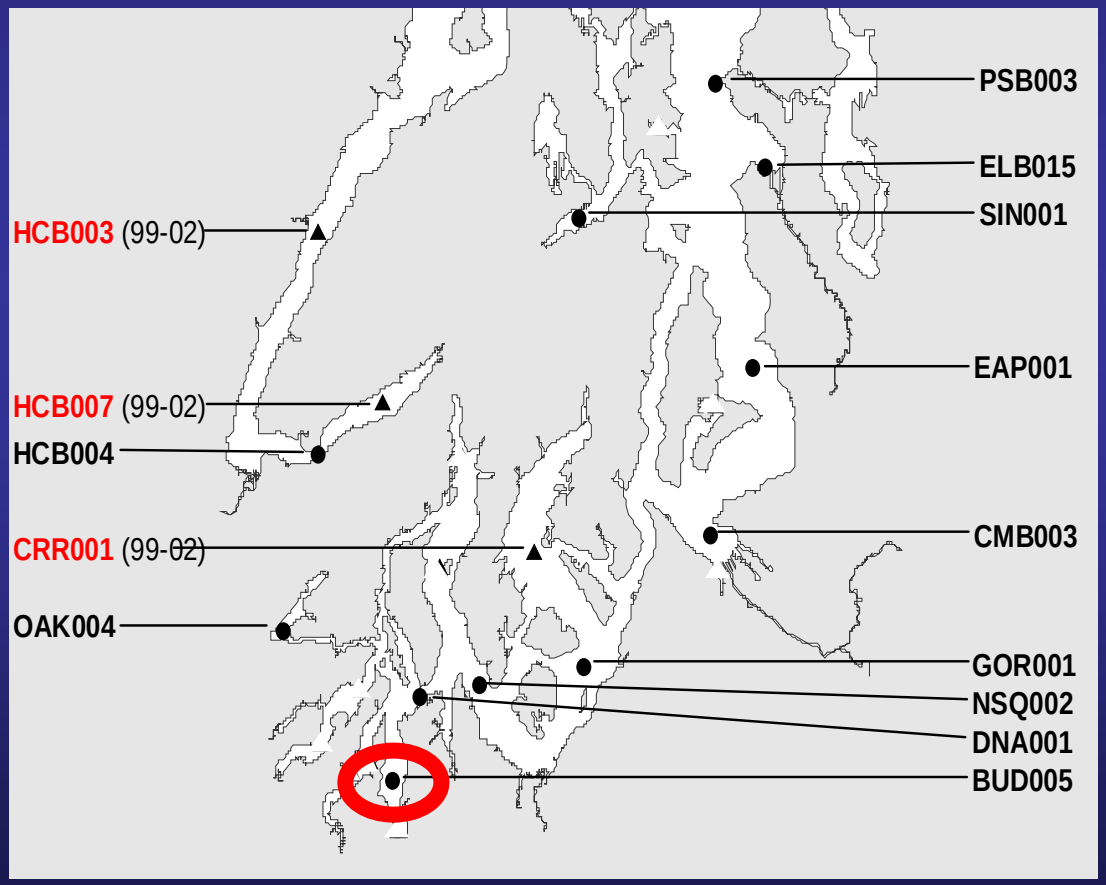
From website: http://omp.gso.uri.edu/

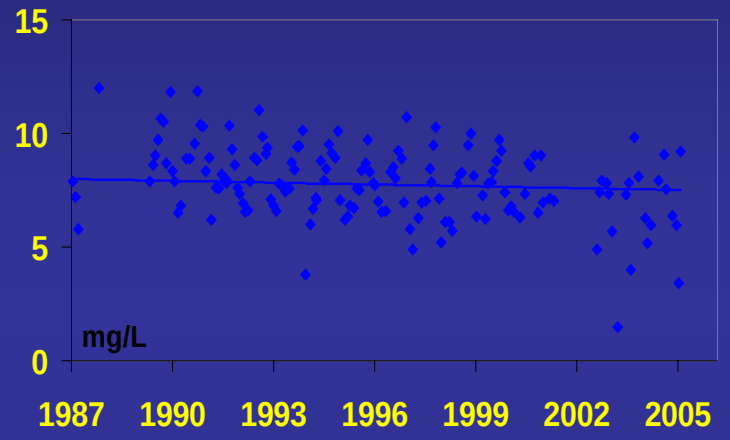
Nitrogen and phytoplankton

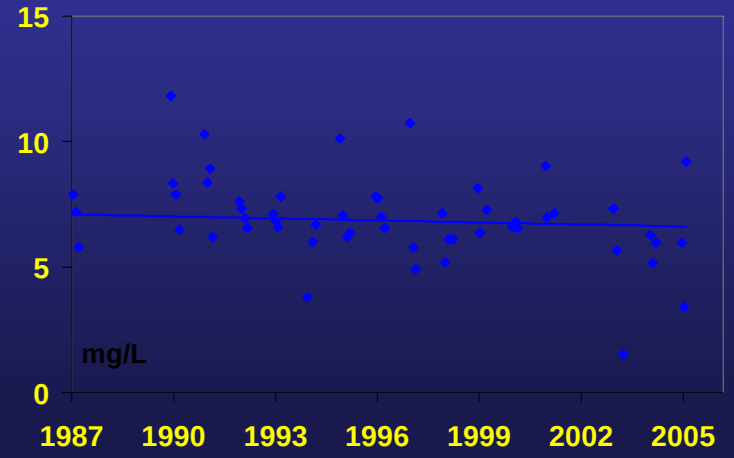


Nitrate (contours) and phytoplankton (color) in Carr Inlet

Historical Marine Monitoring

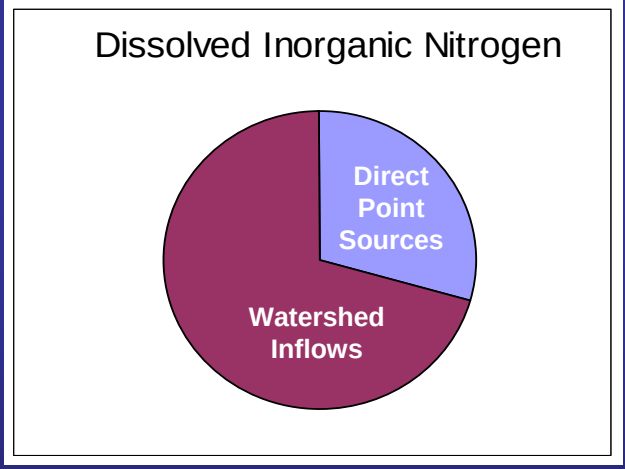


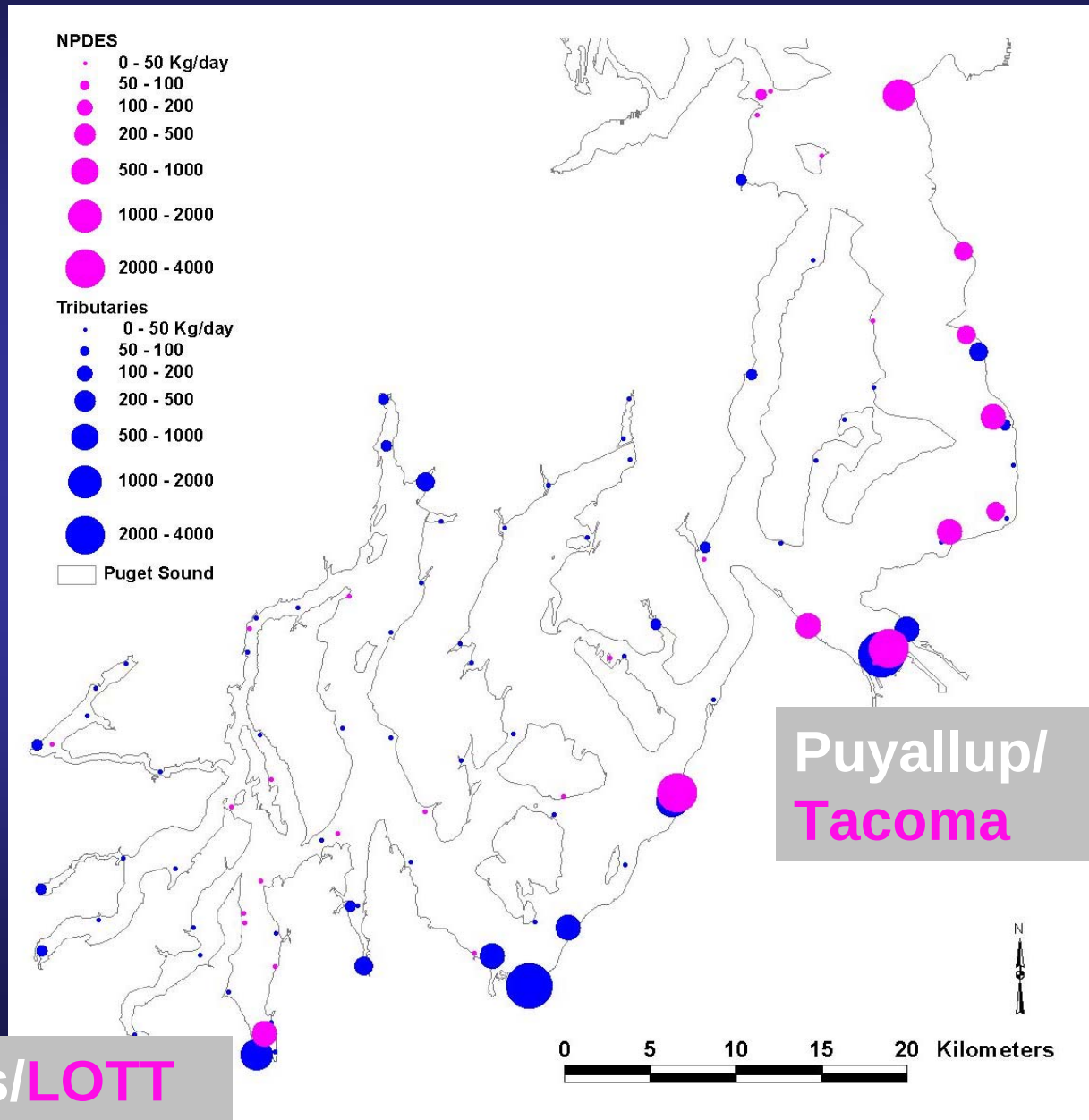




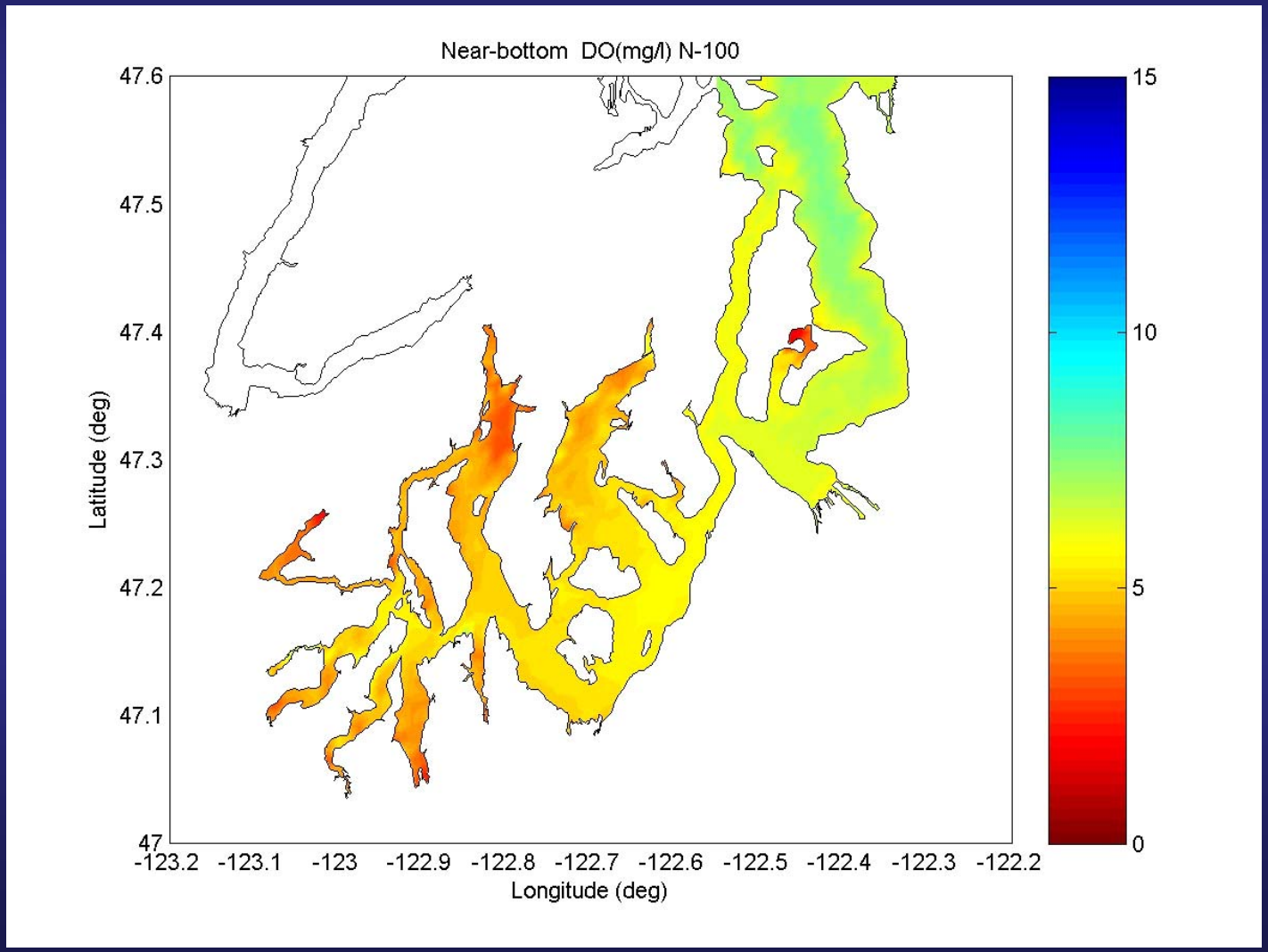
South Puget Sound Phase 1

Point vs. nonpoint





South Puget Sound Phase 1



Presentation Overview

- Historical context
  - why are we doing this?
- Project elements (data and modeling)
  - ***how are we doing this?***
- Schedule
  - when are we doing this?

The process

Input Data

↓

Model Development

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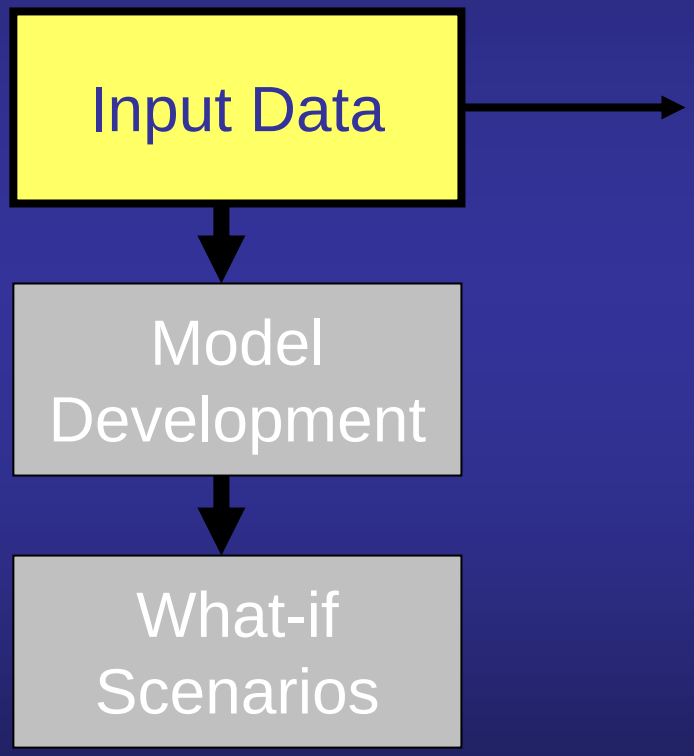
What-if Scenarios

1. Collect data to set up model



- Point source loads
- Nonpoint source loads
  - *Rivers/streams*
  - *Groundwater*
  - *Septic systems*
  - *Fertilizer*
- Atmospheric deposition

WWTP Monitoring

- Supplement DMRs
- Monthly 24-hour composites
  - Sludge dewatering complication
  - BOD, N, P, C, alkalinity, *in situ*
- 17 plants (up to 30 plants for fall 2007)

- *South Sound Phase 1 DIN loads:*
  - *4,200 kg/d (1,700 tons/yr)*

WWTPs currently monitored

- Boston Harbor
- Bremerton
- Central Kitsap
- Chambers Creek
- Gig Harbor
- King County South
- King County West Pt
- Lakota
- LOTT
- Manchester
- Midway
- Port Orchard
- Redondo
- Shelton
- Tacoma Central
- Tacoma North
- Tamoshan

Tributary Monitoring

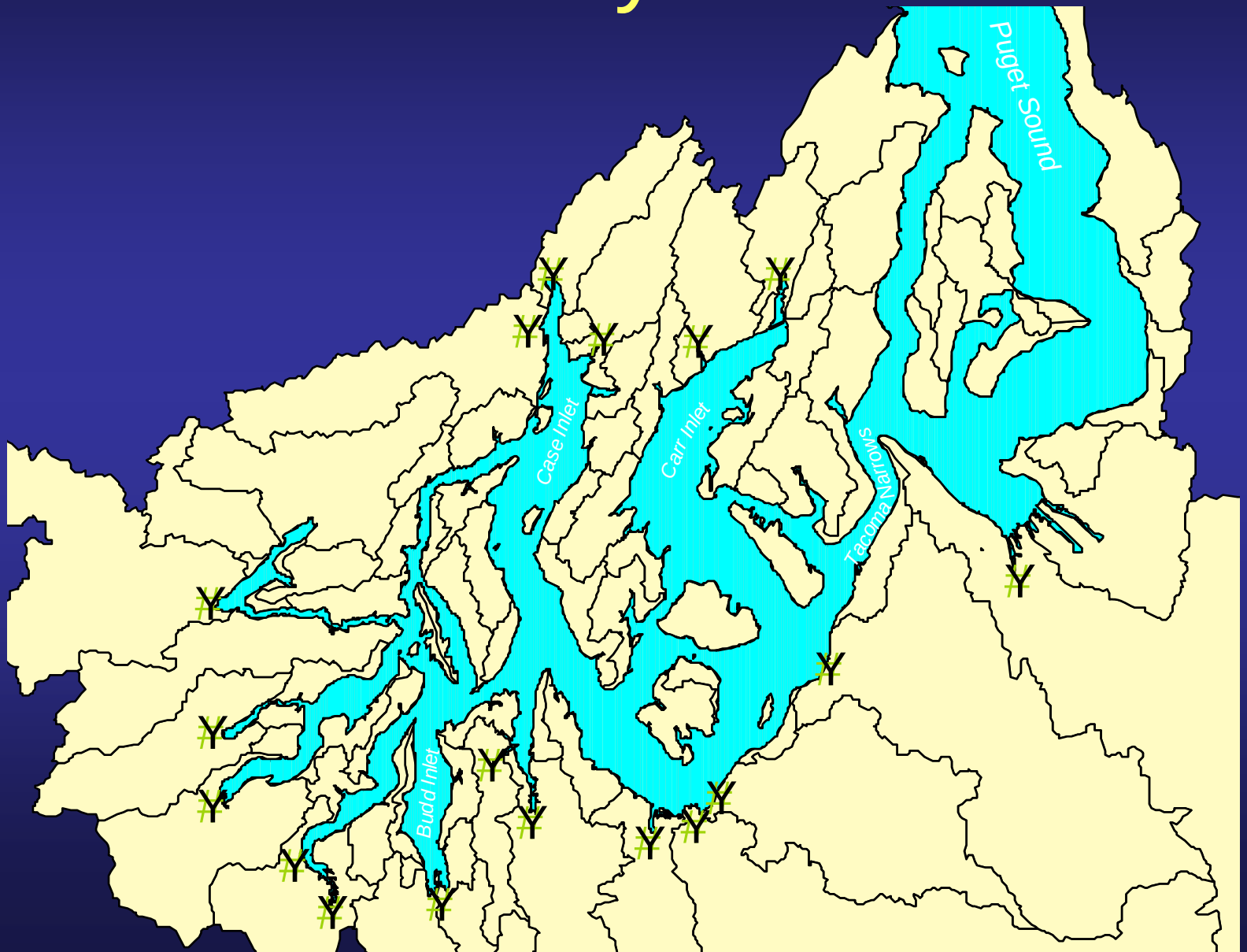
- Ambient monitoring for large rivers
  - Puyallup, Nisqually, Deschutes
- Supplemental monitoring for streams
  - 15 sites (up to 30 stations for fall 2007)
  - monthly grabs (N, P, C, alkalinity, *in situ*)

- *South Sound Phase 1 DIN loads:*
  - *10,000 kg/d (4,000 tons/yr)*

Current tributary monitoring

- Burley
- Chambers
- Coulter
- **Deschutes**
- Goldsborough
- Kennedy
- McAllister
- McLane
- Minter
- **Nisqually**
- Perry
- **Puyallup**
- Rocky
- Sequalitchew
- Sherwood
- Skookum
- Woodard
- Woodland

Tributary Inflows



Septic systems, land cover effects

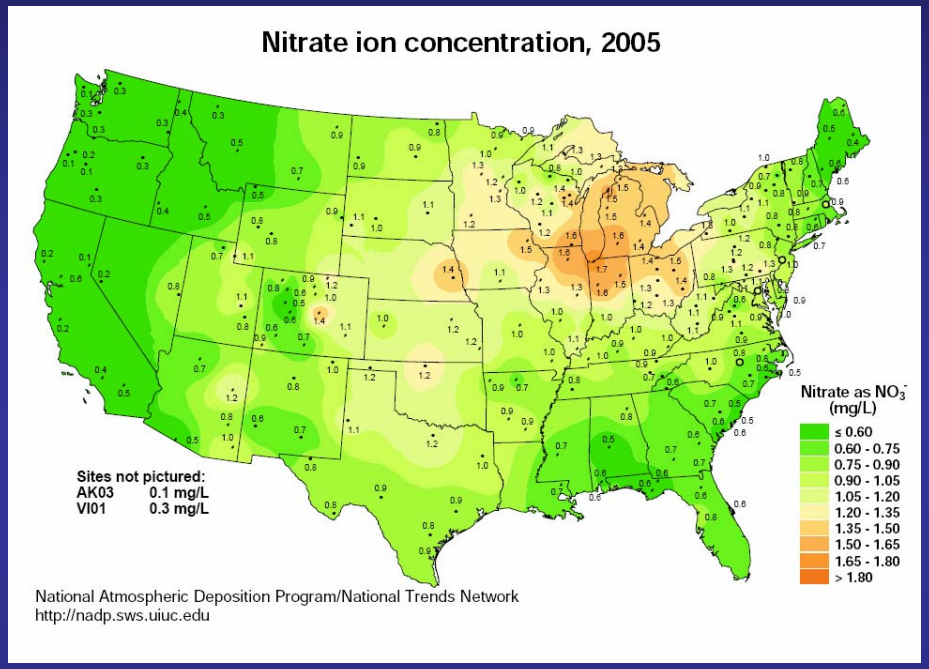
- Included in river and stream monitoring

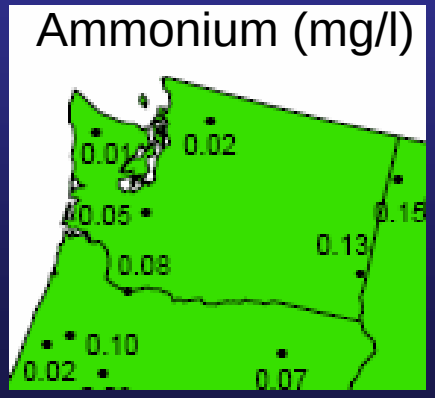
- *South Sound Phase 1*
  - *Existing monitoring networks cover 89% of the watersheds tributary to South Sound*

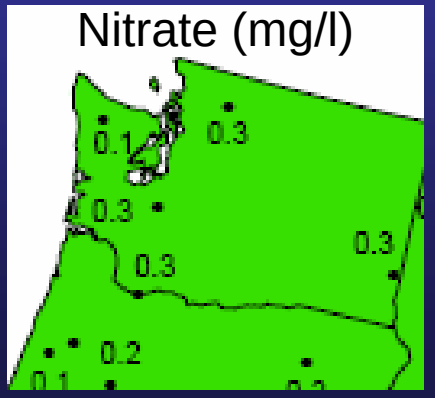
Atmospheric Deposition

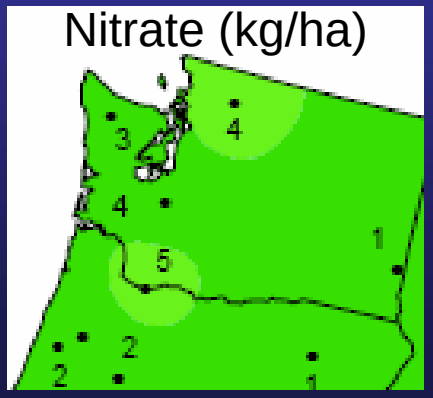
- National Atmospheric Deposition Program
- Hood Canal??

- *South Sound Phase 1 Total Nitrogen loads:*
  - *3 kg/d*
  - *(1.2 tons/yr)*



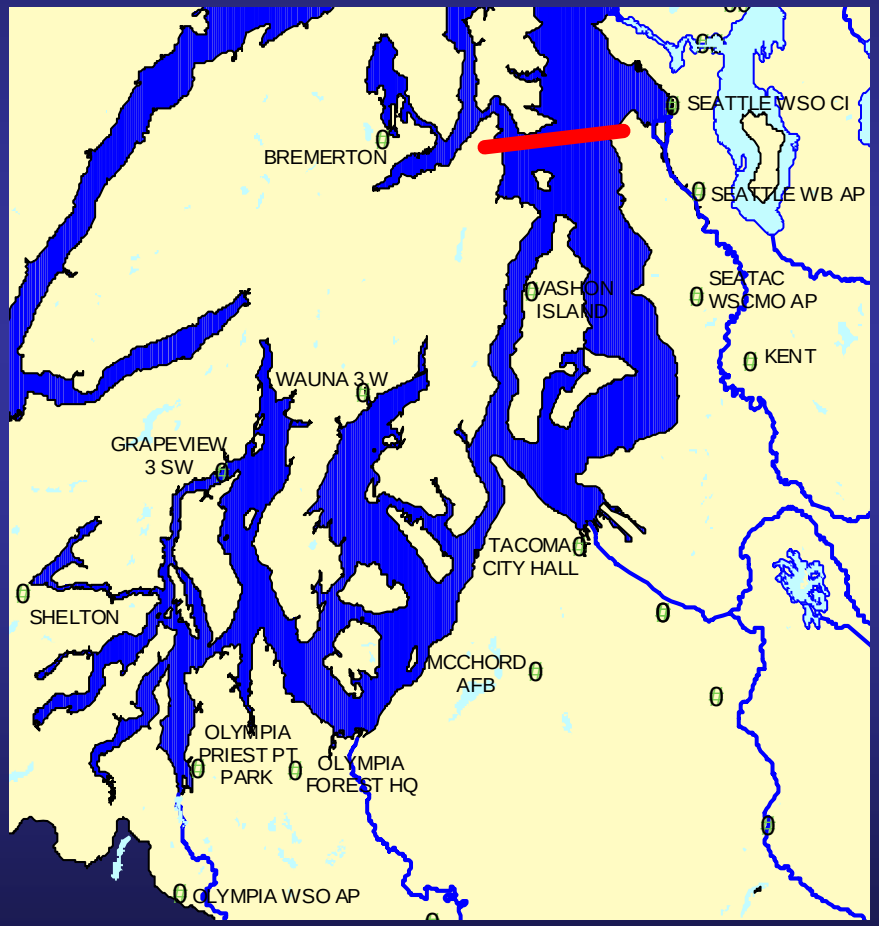






Meteorology

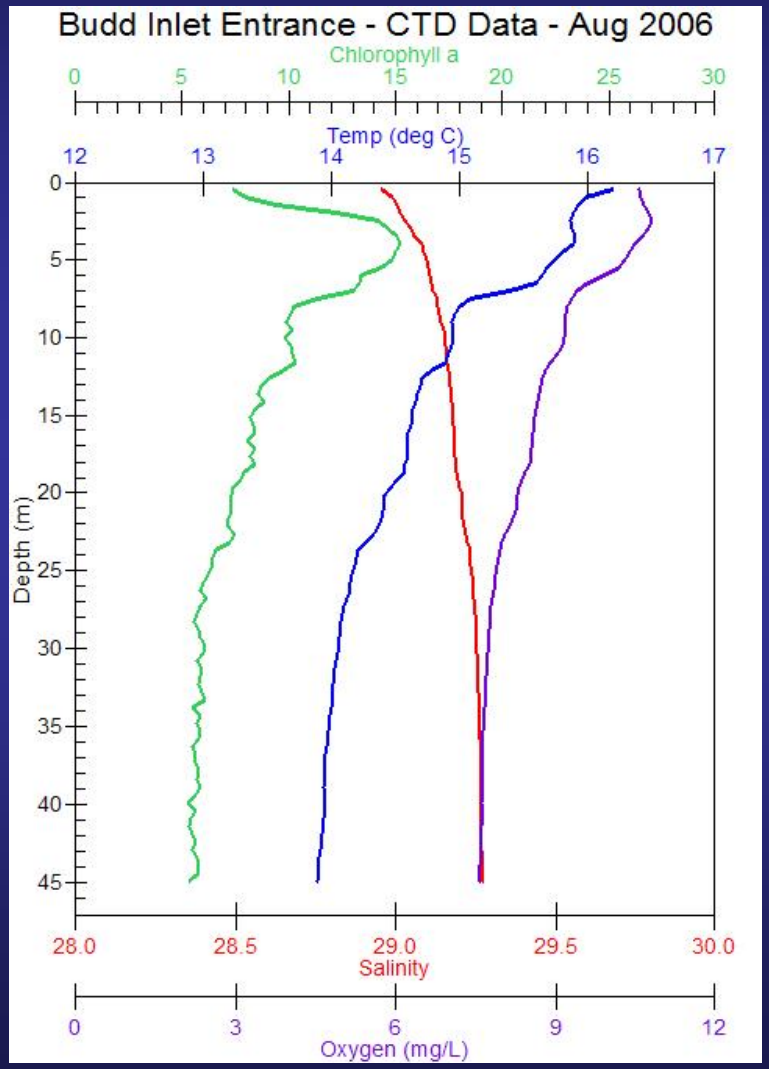
- Wind
- Precipitation
- Cloud cover
- Air temperature
- Dewpoint temperature
- Solar radiation



Available rain data

Open Boundary Conditions

- Tides
- Profiles
  - Salinity
  - Temperature
  - Nutrients
  - Alkalinity
  - Phytoplankton
  - DO
  - pH



(more from Julia)

Other Studies

- Sediment processes
  - Nutrient fluxes between water and sediment
  - $100k placeholder
- Productivity measures
  - Ecology ambient: (more from Julia)
  - Phytoplankton biomass

Other issues

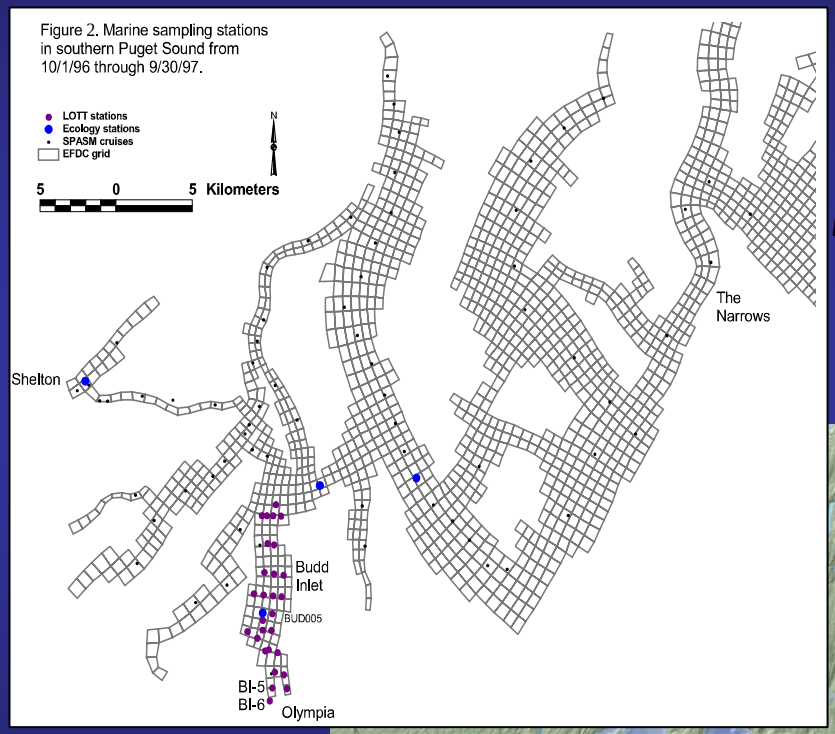
- No watershed modeling planned (next phase?)
- Marinas– information sources?
- No targeted stormwater monitoring (tribs)
- No CSO monitoring (estimates)
- No zooplankton monitoring planned
  - Settling loss term in model

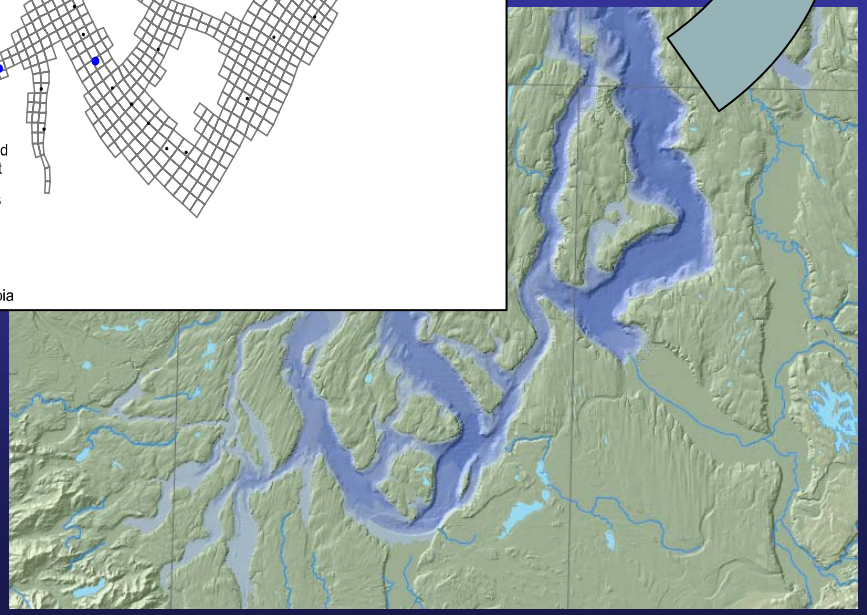
2a. Develop model to represent complex physical structure

Input Data

Model Development

What-if Scenarios





GEMSS

- Generalized Environmental Modeling System for Surface Waters
- Formerly applied to Budd Inlet (LOTT)
- 3-D hydrodynamics and water quality
  - Wetting and drying
  - Sediment processes
  - Vertical migration of dinoflagellates (Budd)
- Graphical user interface for scenarios

2b. Develop model to represent water quality processes

Input Data

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Model Development

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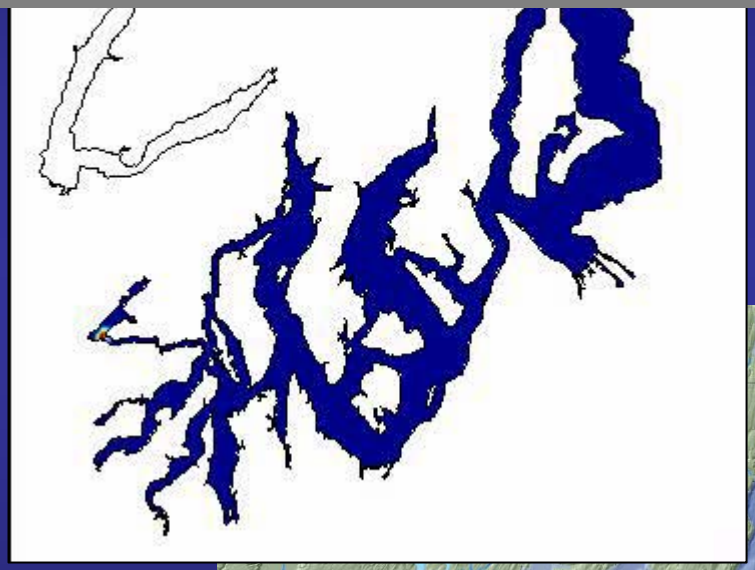
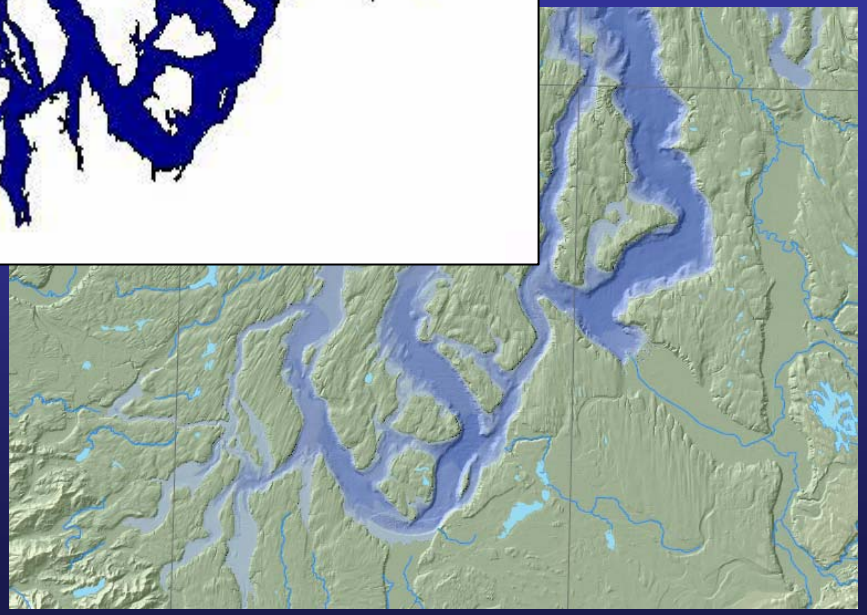
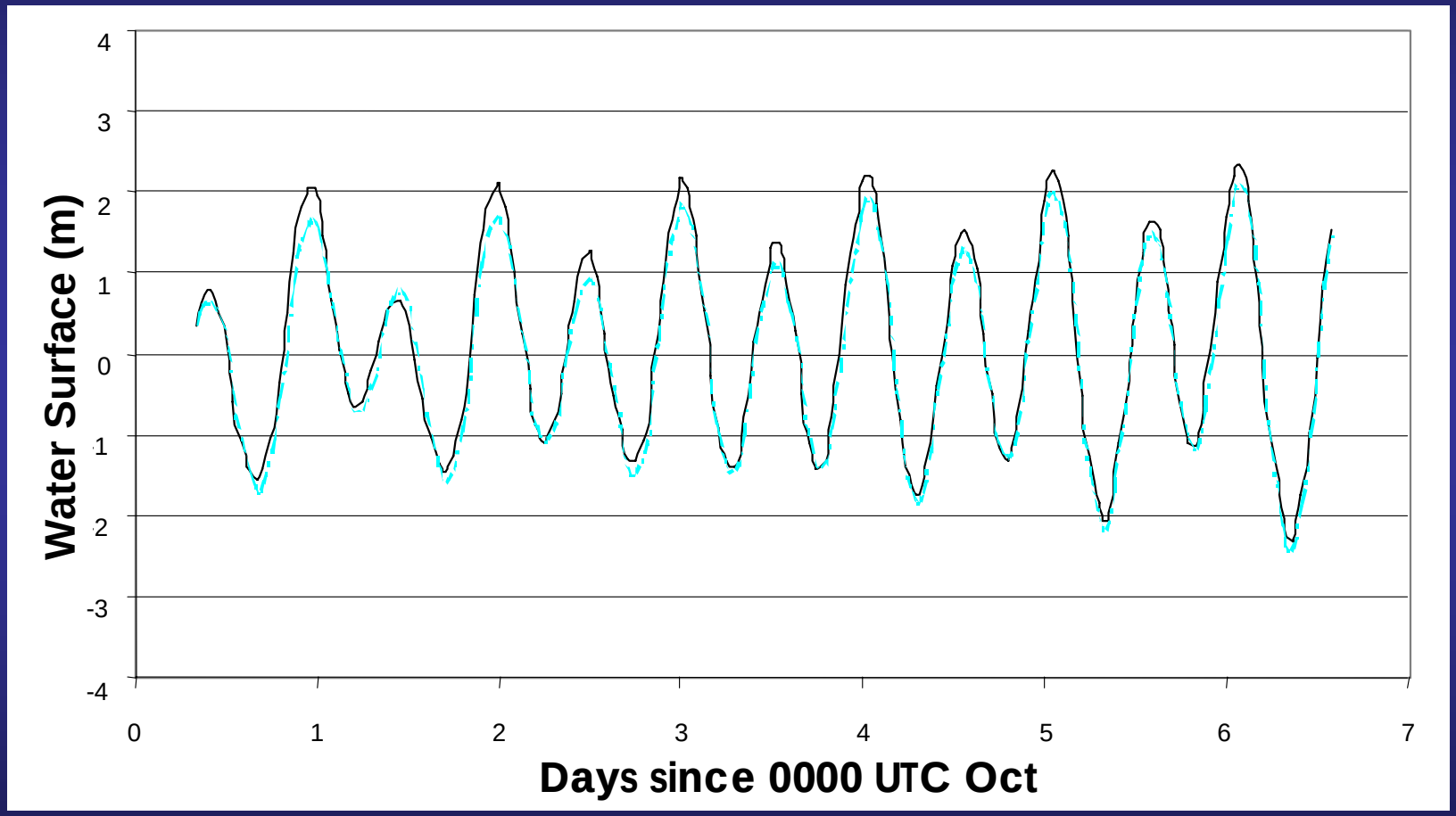
What-if Scenarios

Simulated dye release in Hammersley Inlet



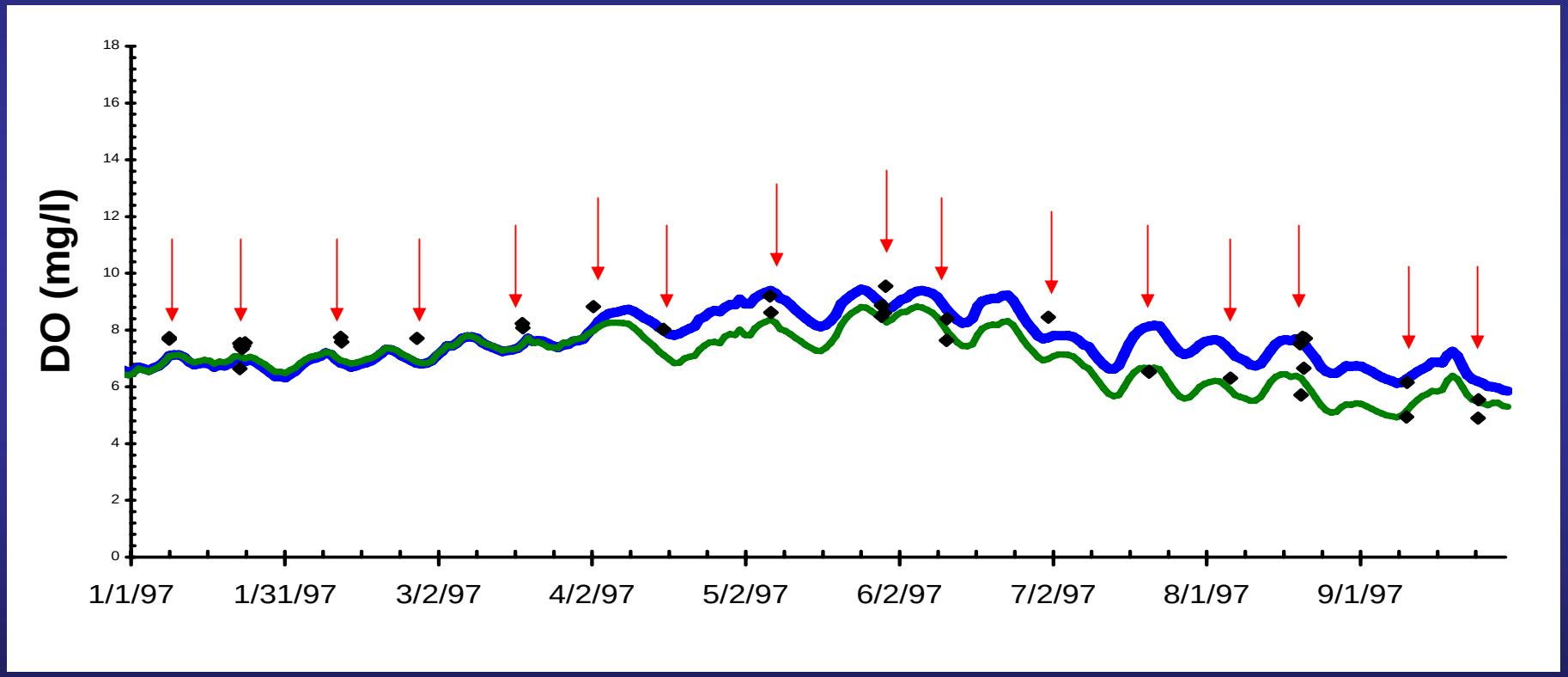


Marine Calibration Data



Water surface elevations (tidal amplitudes)

Marine Calibration Data



Near-bottom dissolved oxygen levels in Budd Inlet

2c. Compare model output to data

Input Data

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Model Development

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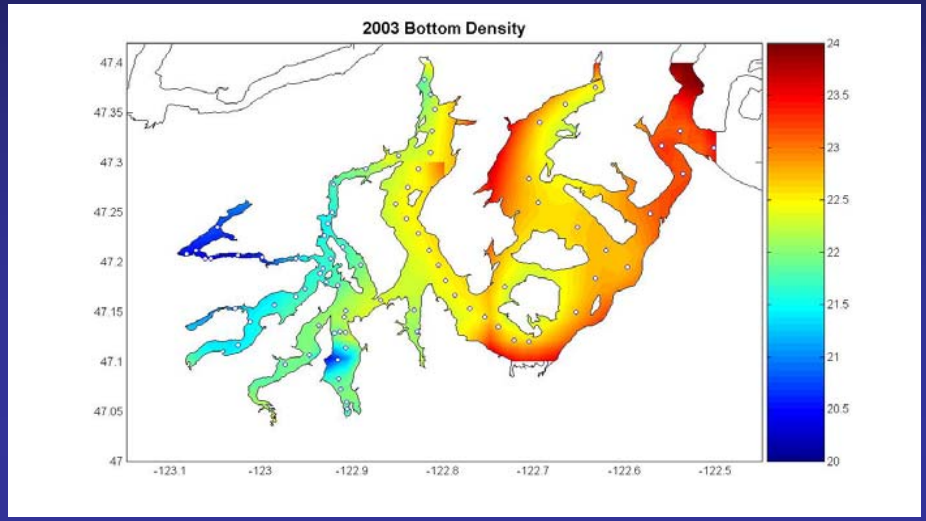
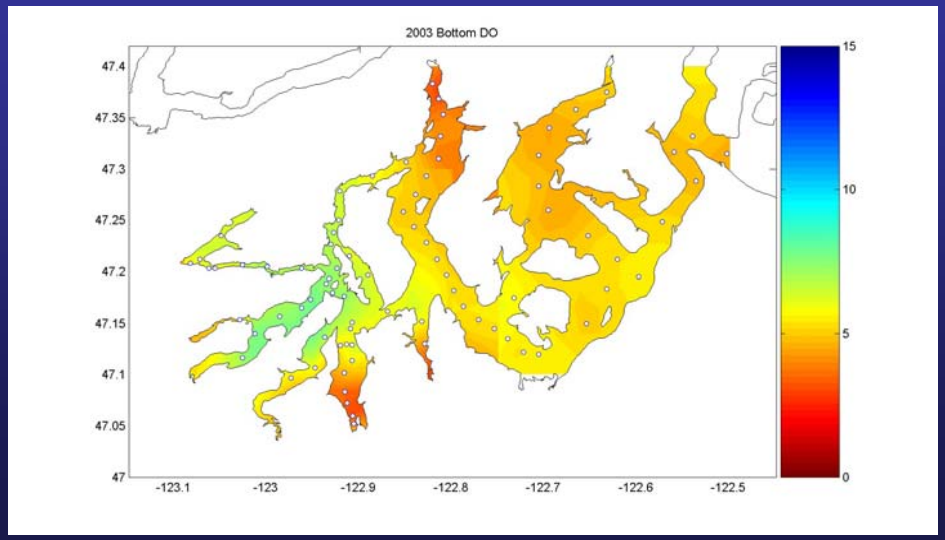
What-if Scenarios

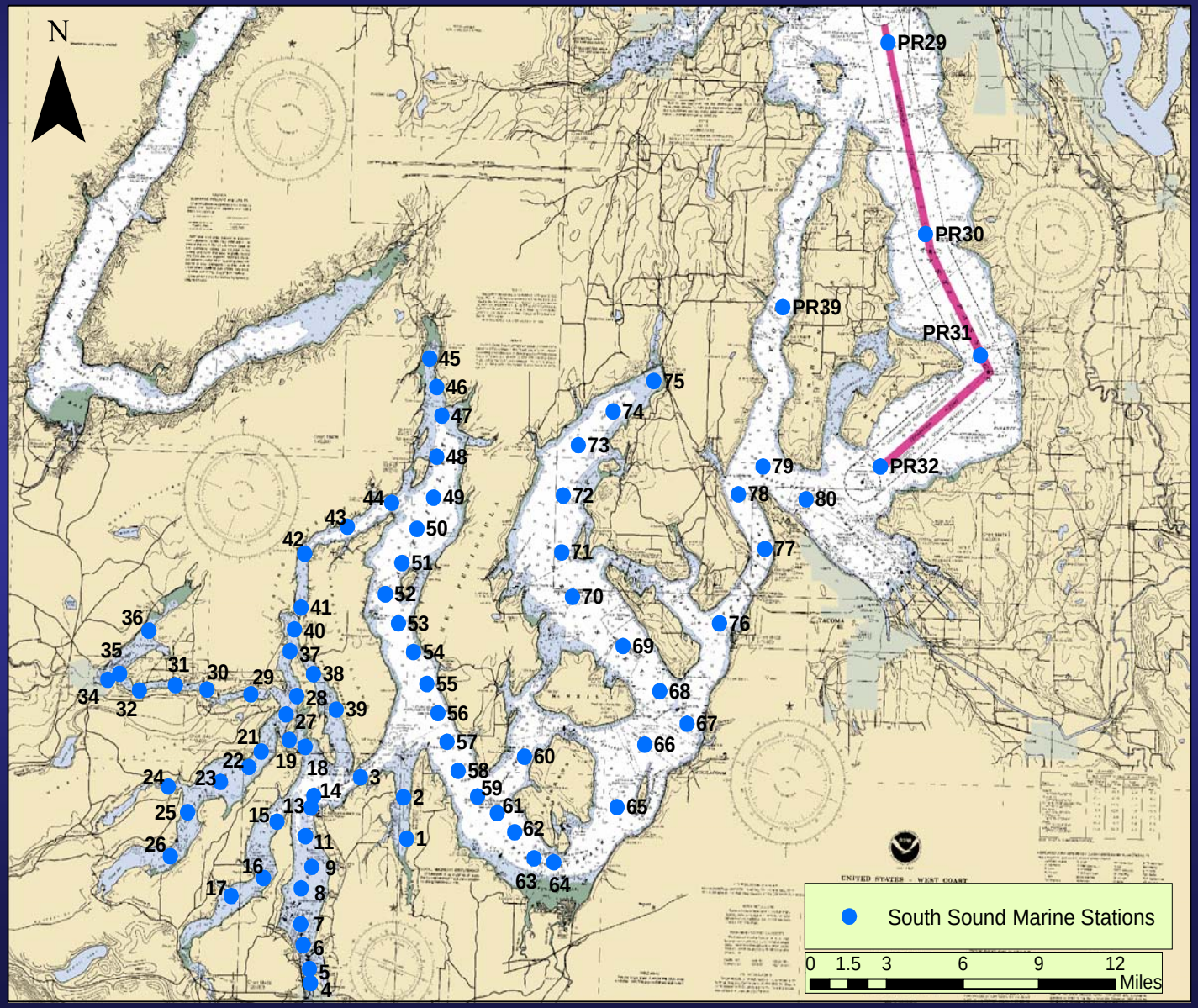




Marine Data

- Ambient monitoring
- Monthly boundary sampling cruises
- Depth profiles
- Grab samples
- Productivity
- Currents (ADCP)

South Sound Marine Stations



Water Column Profiles

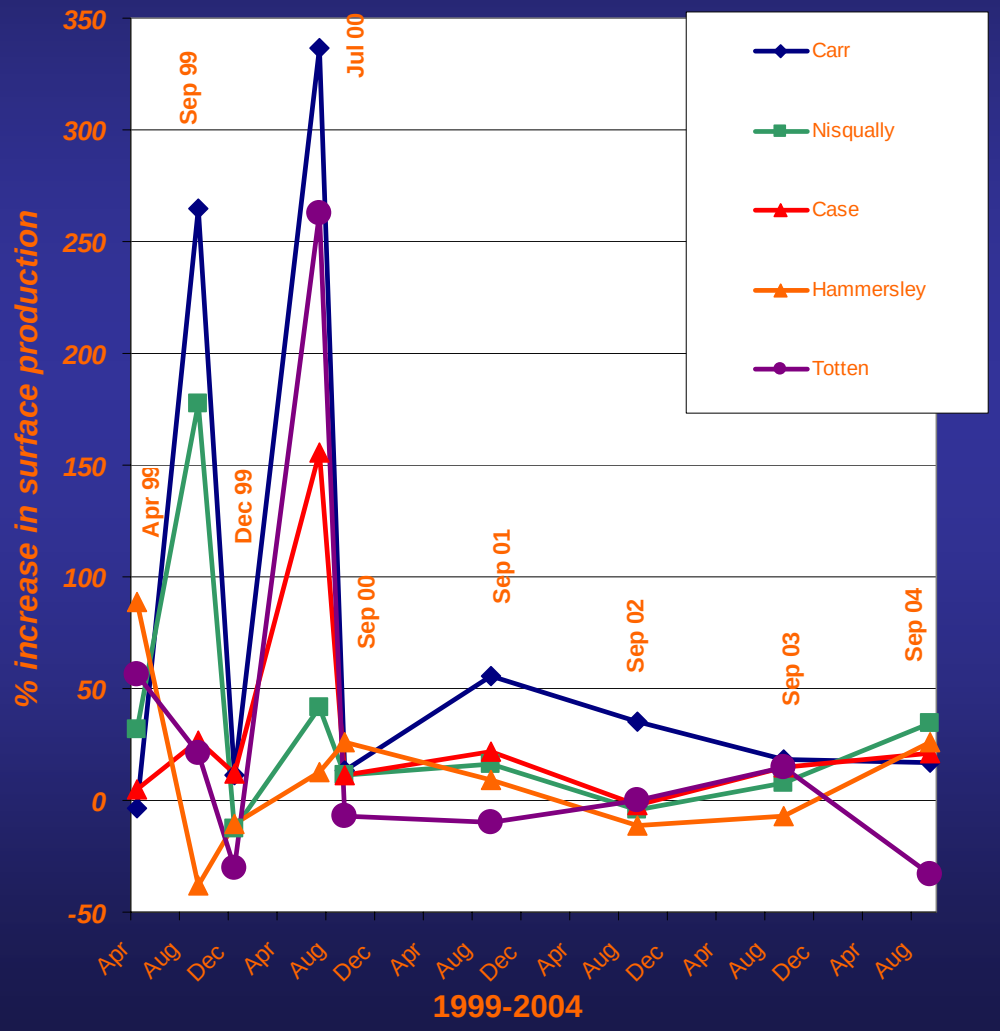
- *Depth intervals: 0.5 m*
- Dissolved Oxygen
- pH
- Temperature
- Salinity
- Density
- Light Transmission
- Photosynthetically Active Radiation (PAR)

Discrete Water Samples

- Depths: 0, 5, 10, 30, 50, 100, 150m, NB
- Nitrogen (total, total dissolved, dissolved inorganic nitrate plus nitrite, ammonium)
- Phosphorus (total, total dissolved, soluble reactive/dissolved inorganic)
- Carbon (total and dissolved organic)
- Silicate
- Algae (Chlorophyll a, phytoplankton biovolume)
- Alkalinity (simulate pH)

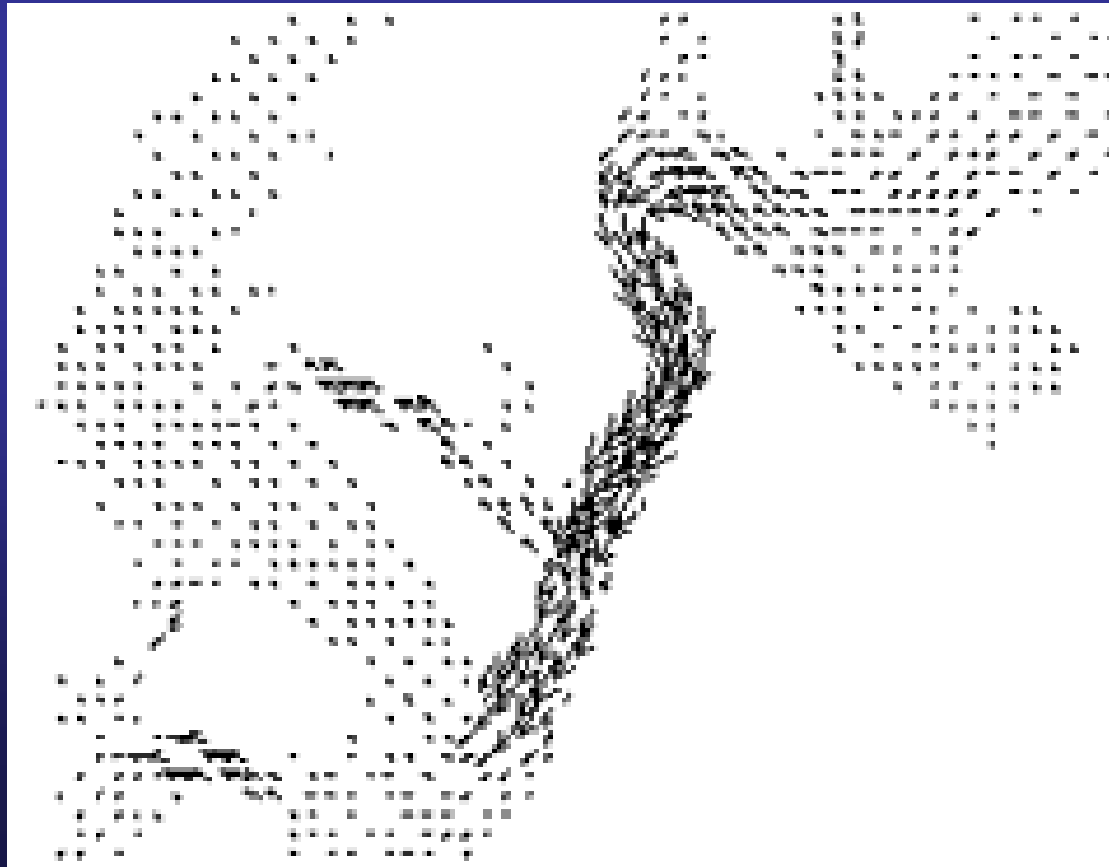
Productivity Studies

- Historical – ^{14}C uptake studies
  - Annually in September
  - Periodically other seasons
- Completed in September 2006
- Planned for April, June & September 2007



Currents (ADCP)

- Short-term deployments
- Profiles to get water column structure
- Key locations



3. Apply model to various what-if scenarios

Input Data

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Model Development

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What-if Scenarios

What if nitrogen loads decrease?

Will South Sound DO levels…

… improve markedly?

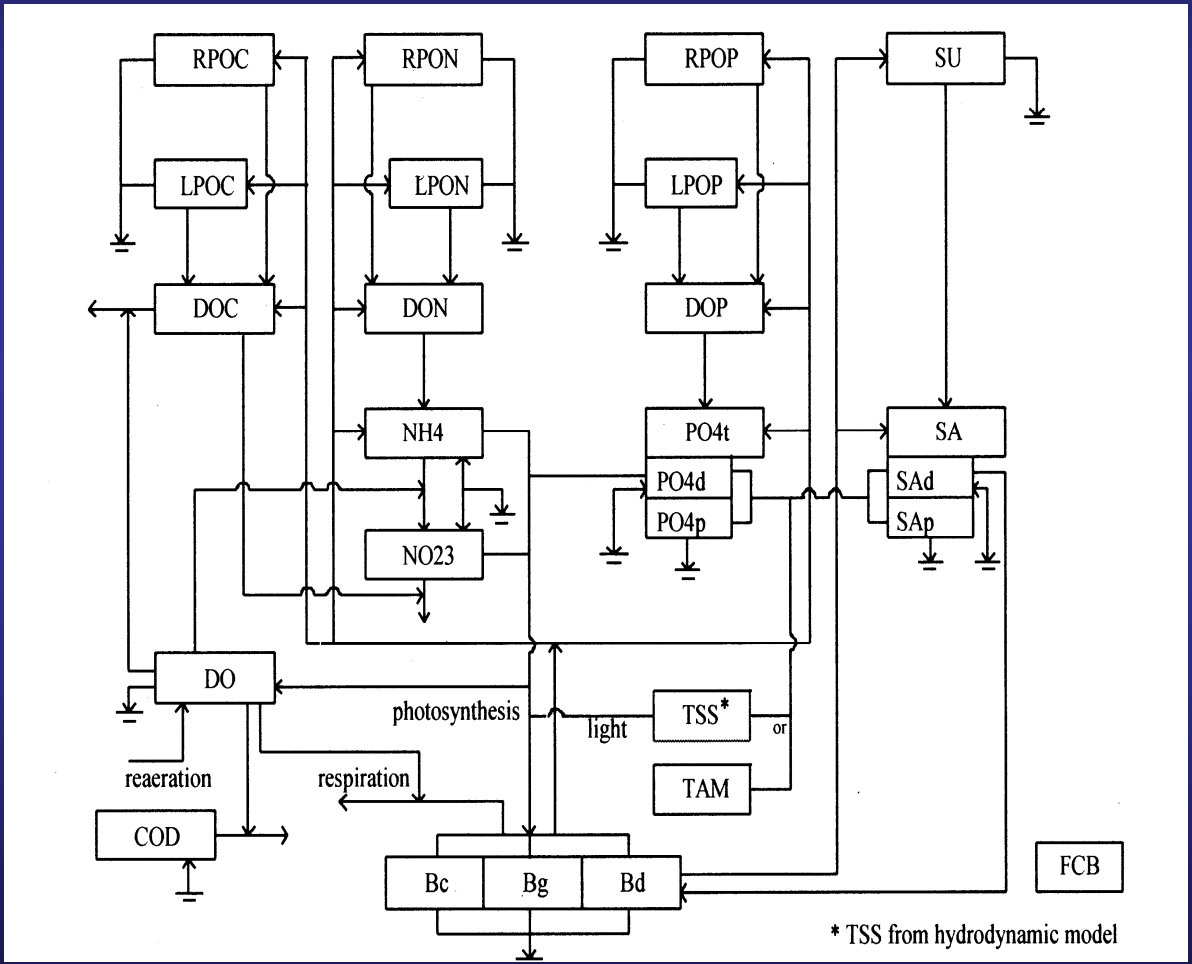
… remain low?

Water quality is complicated…

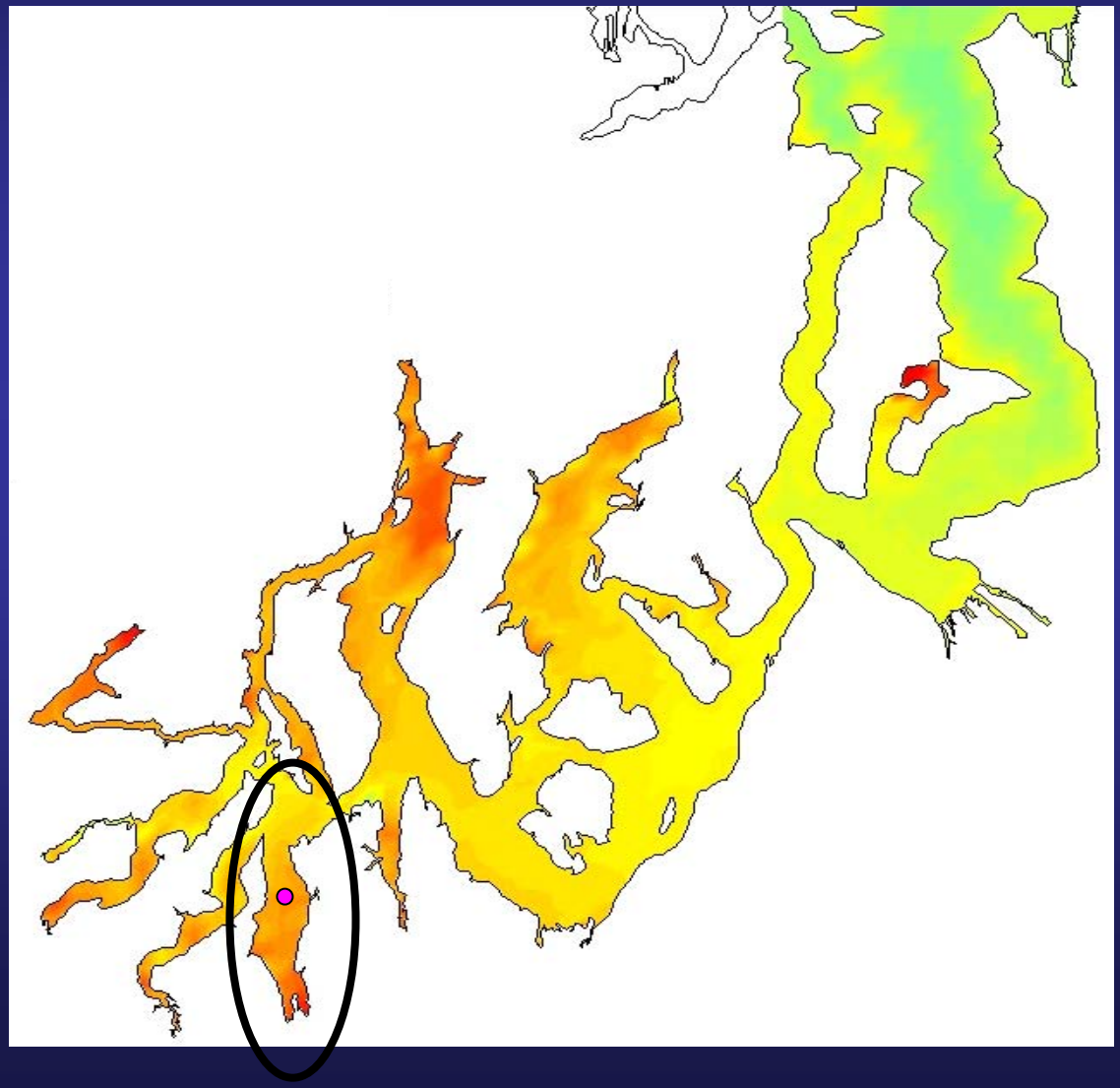
1 pound nitrogen

≠

1 mg/L DO



Models provide more detailed information than data alone



Why models and supplemental data are needed…

- Ambient data– *checking the pulse*

- Supplemental data– *CAT scans*

- Models– *adjusting controls in a flight simulator*

Presentation Overview

- Historical context
  - why are we doing this?
- Project elements
  - how are we doing this?
- **Schedule**
  - ***when are we doing this?***

Expected Schedule

- Prelim data collection *8/06-12/06*
- Data collection *1/07-10/07*
- Model development *2007-2008*
- Potential follow-up activities *>2008*

Next steps

- Quality Assurance Project Plan
  - Experimental design
  - Modeling plan
  - Comments from stakeholders **Dec 2006**
  - Finalize for January 2007 data collection
- Technical Advisory Committee periodic updates

www.ecy.wa.gov/puget_sound

Technical study questions?

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Julia Bos (jbos461@ecy.wa.gov)