

An aerial photograph of the San Francisco Bay area, showing the bay's coastline, surrounding hills, and urban areas. The water is a deep blue, and the land is a mix of green and brown. The text is overlaid in white with a slight shadow.

San Francisco Bay Nutrients

San Francisco Bay Stakeholder Advisory Group
(SF Bay SAG) Meeting

June 22, 2012, 9:00 am-2:00 pm

Meeting Goals

- Review status of Regional Nutrient Strategy
- Discuss recommendations for 2013 RMP funding
- Identify priority work/studies for 2103
- Provide feedback on informal SAG survey

Agenda

- Introductions, goals, logistics
- Recap of March meeting
- Comments on Draft Nutrient Strategy
- Proposed projects for 2013 funding
- Lunch (on your own)
- Discuss informal survey results
- Wrap up and next steps

Recap of Last Meeting

- Presented draft elements of nutrient strategy
 - Requested Comments (4 letters received)
- Provided an overview of funded projects
- Discussed organizational structure

Nutrient Strategy: Context

- Builds on clear statement of management decisions and goals
- Overarching work plan needed to guide project activities
- Strategy should represent consensus on science & policy work elements needed to manage nutrients
- Results in blueprint for regulatory decision-making

High Priority Projects Underway

- Conceptual model, scenario development & summary of existing loads (RMP, \$80K)
- Phytoplankton NNE (SWRCB, \$115K)
- Suisun Bay Studies (SWRCB, SFWCA, CCCSD)
- Nutrient strategy support/modeling/Suisun Bay Studies (BACWA, \$300 K)
- Effluent characterization

Revisiting NNE Organizational Structure

- NNE organization part of larger statewide process
- Need for flexible organization to accommodate local culture
 - Different funding agencies, different procedures and expectations for communication
 - Would like one manageable, open/transparent process
- Revisit project organization
- Local facilitator

Timeline

- **Nutrient Strategy**

March 2012

- **Suisun Bay Studies**

- SWAMP Study 2011-2012
 - Sampling and Toxicity Testing
- Collaborative Studies 2012-2014
 - Work Plan

March-May 2012

June 2012

- **Numeric Model Development**

- Work Plan
- Modeling Strategy

June 2012

?? 2012

- **Loading Studies**

- Effluent Characterization 2012-2014
- Small Tributary Loadings
 - RMP/MRP Data Integration

?? 2012

?? 2012

- **Assessment Framework**

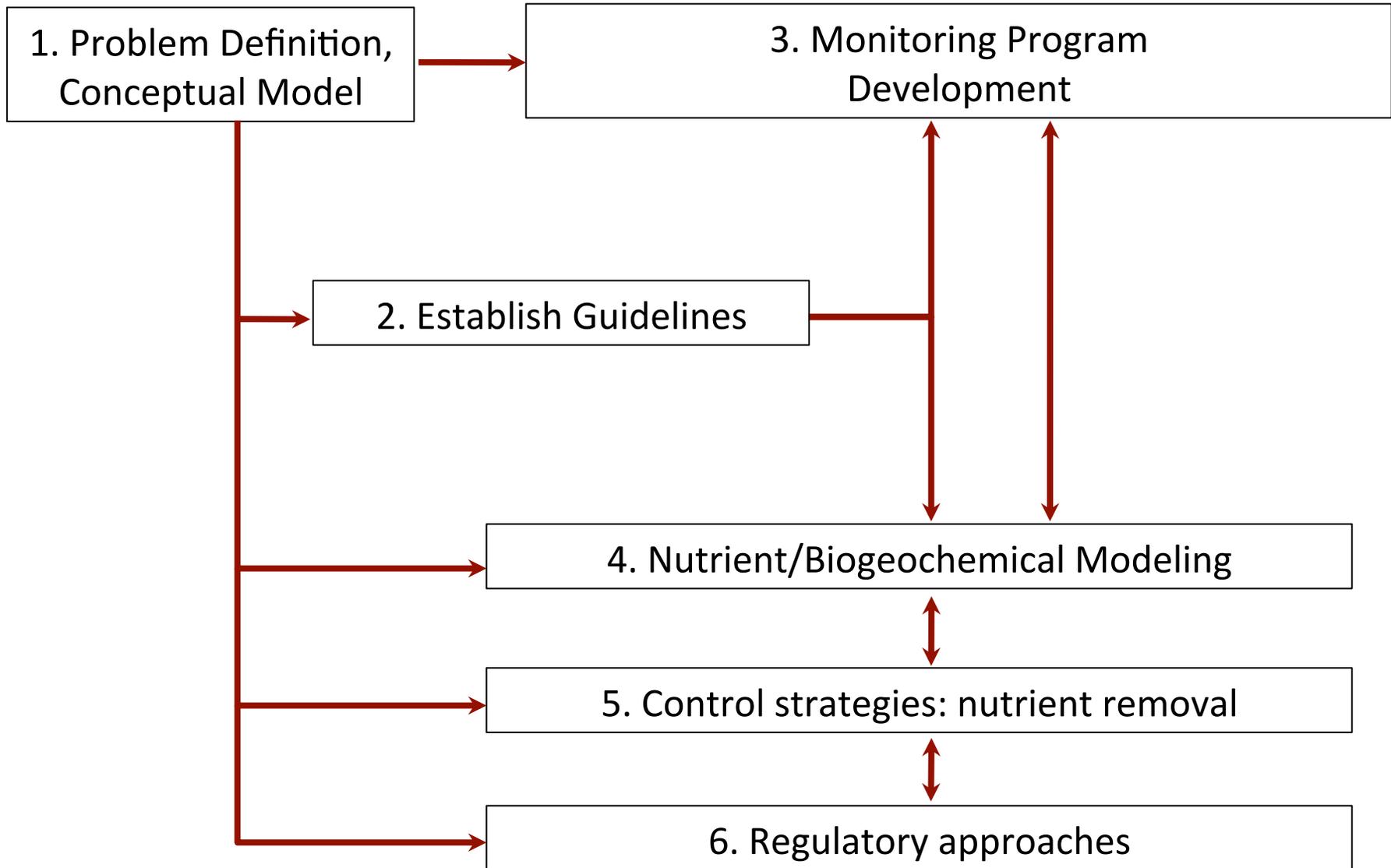
- Delta Plan – Nutrient Objectives

March 2012

Additional Comments? Concerns?

We want to hear your feedback

Draft Nutrient Strategy



Strategy Comments - BACWA/CCCCSD

- 1. Timing of Strategy potentially out of sync with some permit drivers.
- 2. Assessment framework: something before March 2013
- 3. Importance of Peer review - conceptual model, modeling strategy
- 4. Monitoring program – accurate assessment of loads (point, non-point, ocean loads)
- 5. Modeling - support for load-response modeling, creation of model evaluation group, specific input on approach
- 6. Develop objectives after management scenarios
- 7. Control strategies - consider capital planning, nutrient load reductions

Strategy Comments - SRCSD

- 1. Strategy is beginning of solid framework to approach for nutrients
- 2. Coordinate Bay and Delta RMPs
- 3. Develop objectives after management scenarios
- 4. Concerned about listing on 303(d) based on model forecasting
- 5. Difficulty of developing a consensus statement about existing or future conditions

Strategy Comments - SFCWA

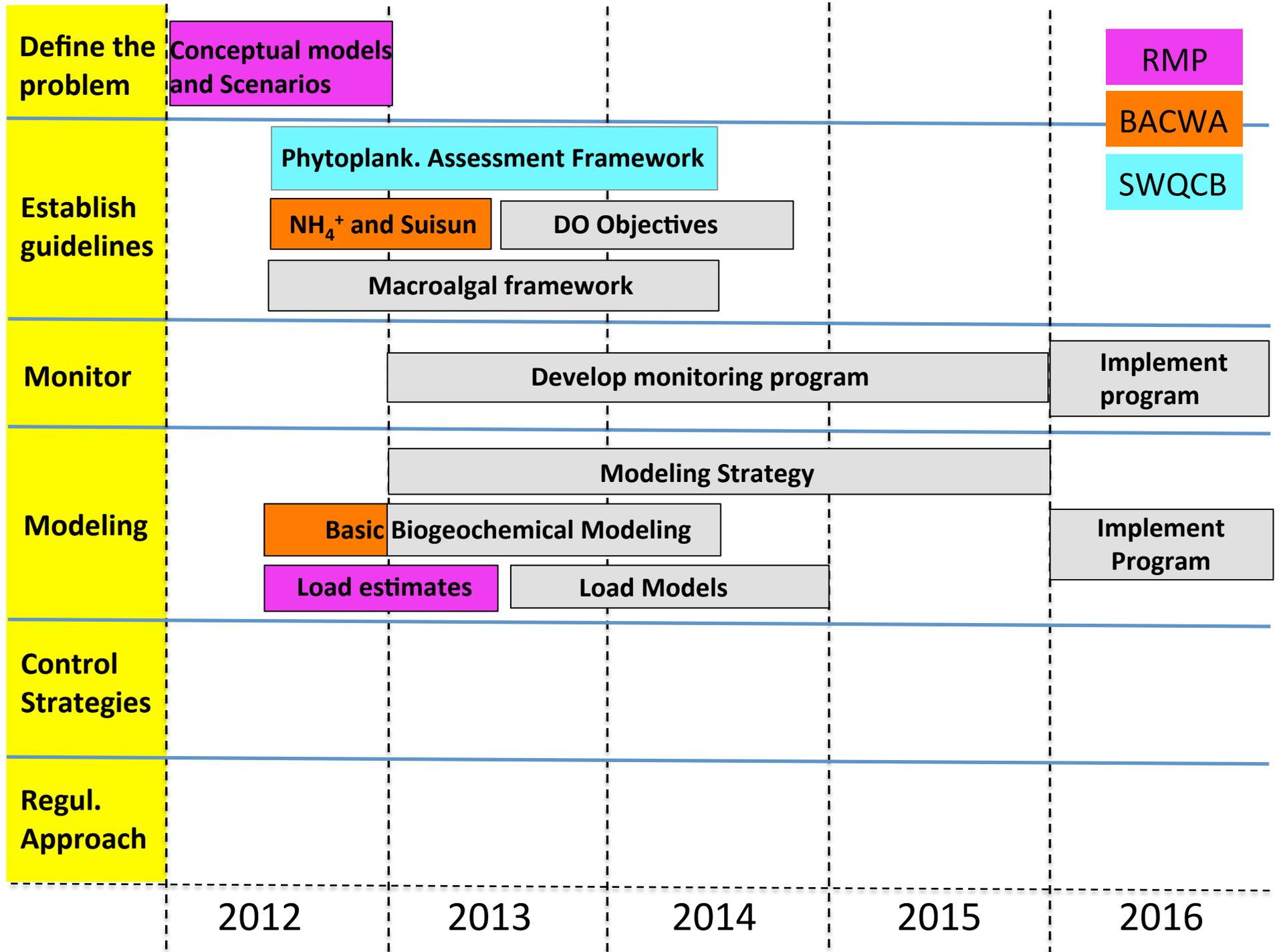
- 1. Supportive of nutrient strategy
- 2. Takes too narrow a view of the nutrient problem - need to think beyond 'classic' eutrophication
- 3. Missing literature: NH₄ inhibition, stoichiometry
- 4. Biogeochemical pathways – more emphasis
- 5. More process-oriented measurements – e.g. direct measures of productivity, diel hypoxia O₂
- 7. Supports evaluation of ammonia objectives
- 8. Monitoring needs to be a high priority, and accelerated
- 9. Consider agricultural sources of loads

Timeline - Strategy



Discussion - Strategy

- Comments, questions, clarifications?
- Next steps



Progress since last meeting

- Conceptual model work
 - Kick-off CM meeting: May 7-8
 - synthesis and drafts underway
 - next technical team meeting: August
 - Draft CM report → September 30 2012
- Loading calculations
 - Calculations for POTWs by Bay segment (rough)
 - Beginning to refine calculations based on historic data
 - Developing approach for stormwater and Delta loads

Progress since last meeting

- Suisun Bay synthesis
 - Data gathering and data analysis
 - Simple 1-box budget for NH₄
 - Beginning to develop detailed scope
- Assessment framework
 - Detailed scope development: Summer 2012
- Informal survey of stakeholders of process and governance completed

Goals of Today's meeting

- Summarize comments on 2012 Nutrient Strategy Draft
- Discuss Priority Projects for 2013
- Review Survey Results
- Key Outputs:
 - Recommendations/feedback: 2013 projects/priorities
 - Identify next steps for process/governance

Funding Priorities 2013

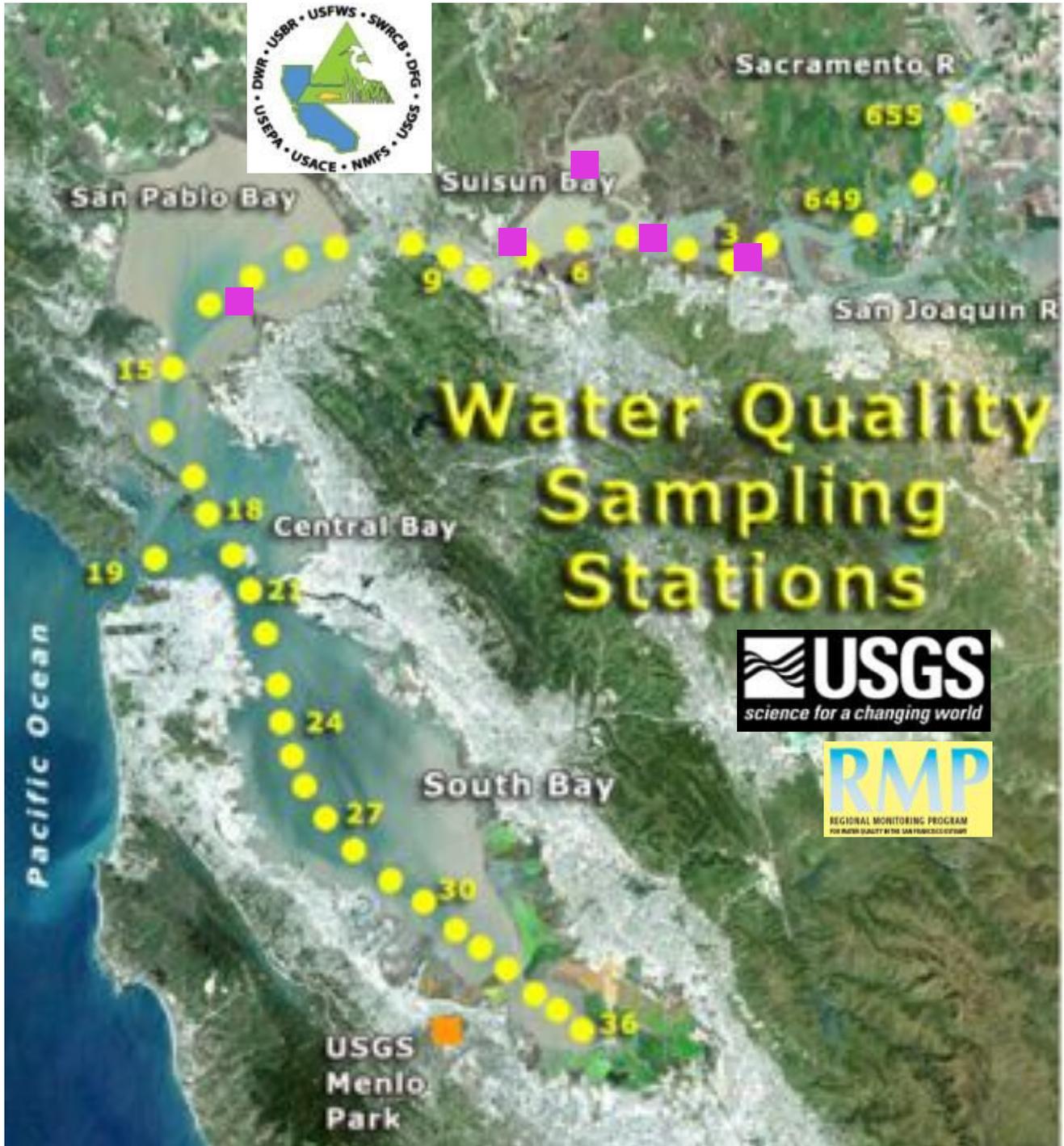
- There are a number of projects that could be considered high priority based on
 - Strategy
 - Feedback on strategy
 - Conceptual Model Technical Team
 - Other stakeholder input
- More costs than funds
- Goal: Feedback on proposed projects for 2013 funding
 - Proposals going to RMP
 - Projects under consideration for funding by other groups

Priority Projects (subset) for 2013

	<u>Work Element</u>
1. Moored sensor pilot study	3
2. Algal phytotoxins	3
3. Nutrient stormwater sampling	3,4
4. Loading study continuation	1,4

Priority Projects (subset) for 2013

	<u>Work Element</u>
1. Moored sensor pilot study	3
2. Algal phytotoxins	3
3. Nutrient stormwater sampling	3,4
4. Loading study continuation	1,4
5. Monitoring program development	3
6. Biogeochemical modeling	4
7. Loads across Golden Gate	1,4
8. Photosynt. effic., and NH ₄ /NO ₃ p.p.	2,3,4
9. Loads to Suisun from Delta	1,4
10. 3D model development	4
11. Assessment framework continuation	2



1969-present

- monthly sampling

- research studies

- RMP support

-1993-present

● USGS

■ IEP

Major Questions Related to Monitoring Program

Scientific

- Parameters to be measured, what spatial/temporal frequency?
- What combination of approaches is needed
 - ship-based, moored sensors, others

Major Questions Related to Monitoring Program

Scientific

- Parameters to be measured, what spatial/temporal frequency?
- What combination of approaches is needed
 - ship-based, moored sensors, others

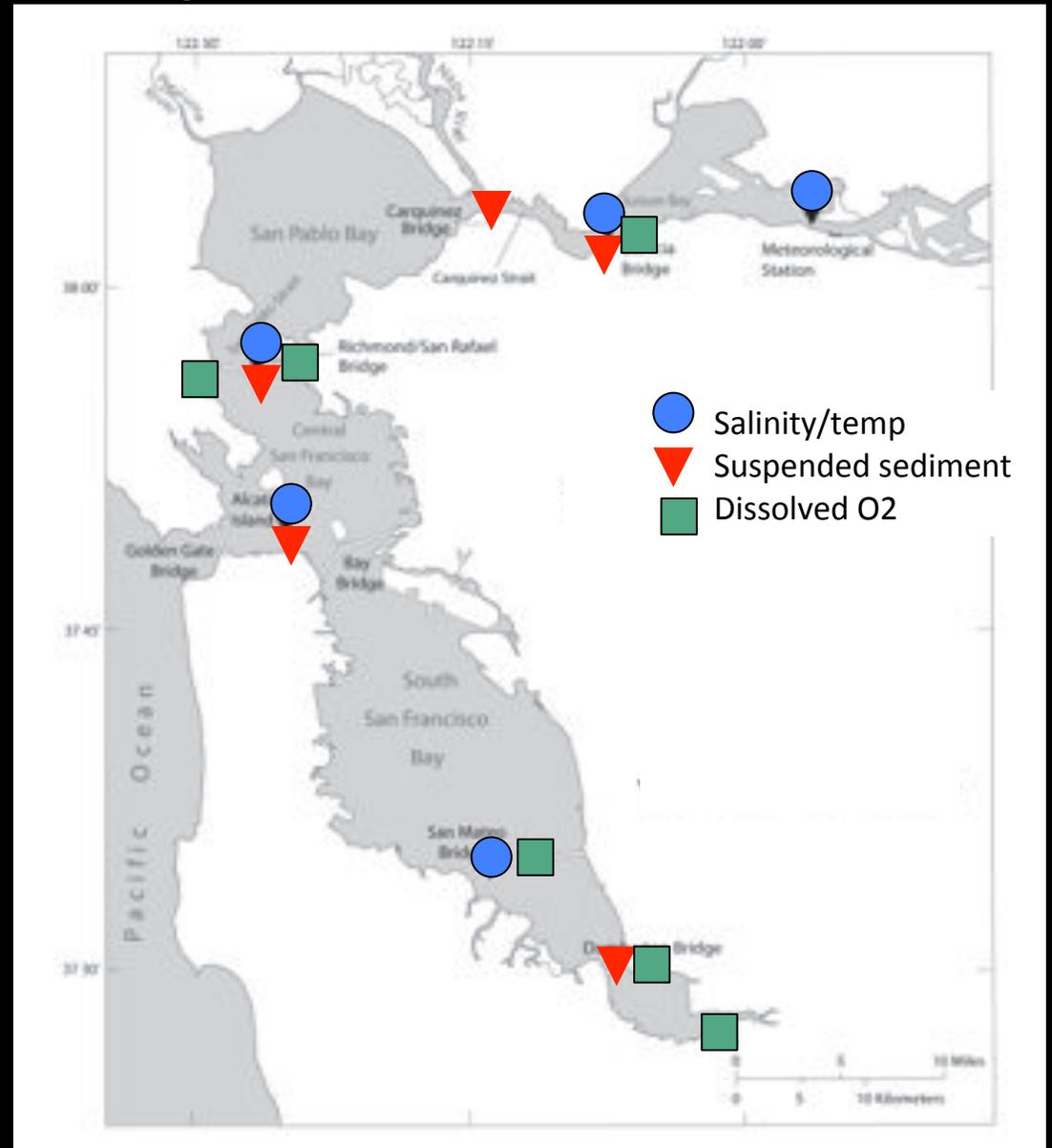
Institutional

- Approx. cost for running the program?
- What institutional agreements need to be established?
 - e.g., continued partnering with USGS, IEP
- Transition timeline?

Current continuous monitoring

Other capabilities???

- chl-a
- nitrate
- Eventual others...
 - FloCAM?



Moored Sensor Pilot Study - Dumbarton Bridge

cost: \$270k (120k RMP, 70k USGS match, 70k other)

PI: J Cloern, D Senn

Objective: Deploy moored multi-sensor platform and develop regional capacity for use as part of monitoring program.

Moored Sensor Pilot Study - Dumbarton Bridge

cost: \$270k (120k RMP, 70k USGS match, 70k other)

PI: J Cloern, D Senn

Objective: Deploy moored multi-sensor platform and develop regional capacity for use as part of monitoring program.

Approach:

- Research, selection
- Calibration, deployment, maintenance
- Co-deploy with existing USGS sensors
- Data analysis, QA/QC
- *Product:* Operating manual and technical memo

Potential Platform

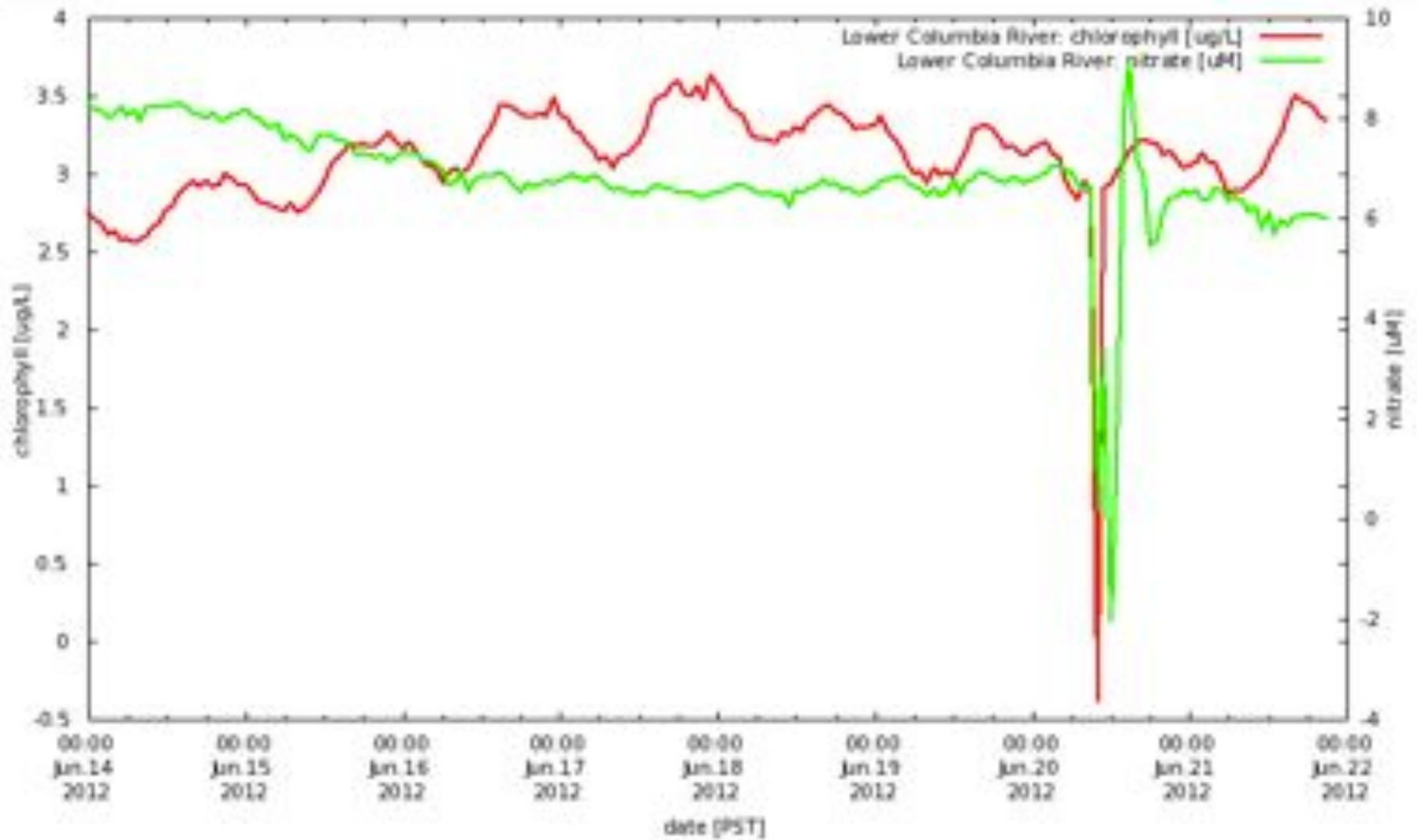
LOBO

- conductivity
- temperature
- dissolved O₂
- chlorophyl
- turbidity
- nitrate

- telemetry
- bio-fouling resistant



Potential Platform



Algal biotoxins monitoring

cost: \$65k (RMP)

PI: R Kudela (UC Santa Cruz)

Objective:

- Characterize the distribution of algal biotoxins in SF Bay
- Calibrate sampler for quantification of ambient concentrations
- Develop approach for use in monitoring program

Approach:

- Deploy Solid Phase Adsorption Toxin Tracking (SPATT) samplers
 - Monthly Transects: *Polaris* flow-through system
 - Dumbarton and Benicia Bridges (30 days)
- Calibrate SPATT through controlled laboratory experiments
- *Product:* Technical report

Algal biotoxins monitoring

cost: \$65k (RMP)

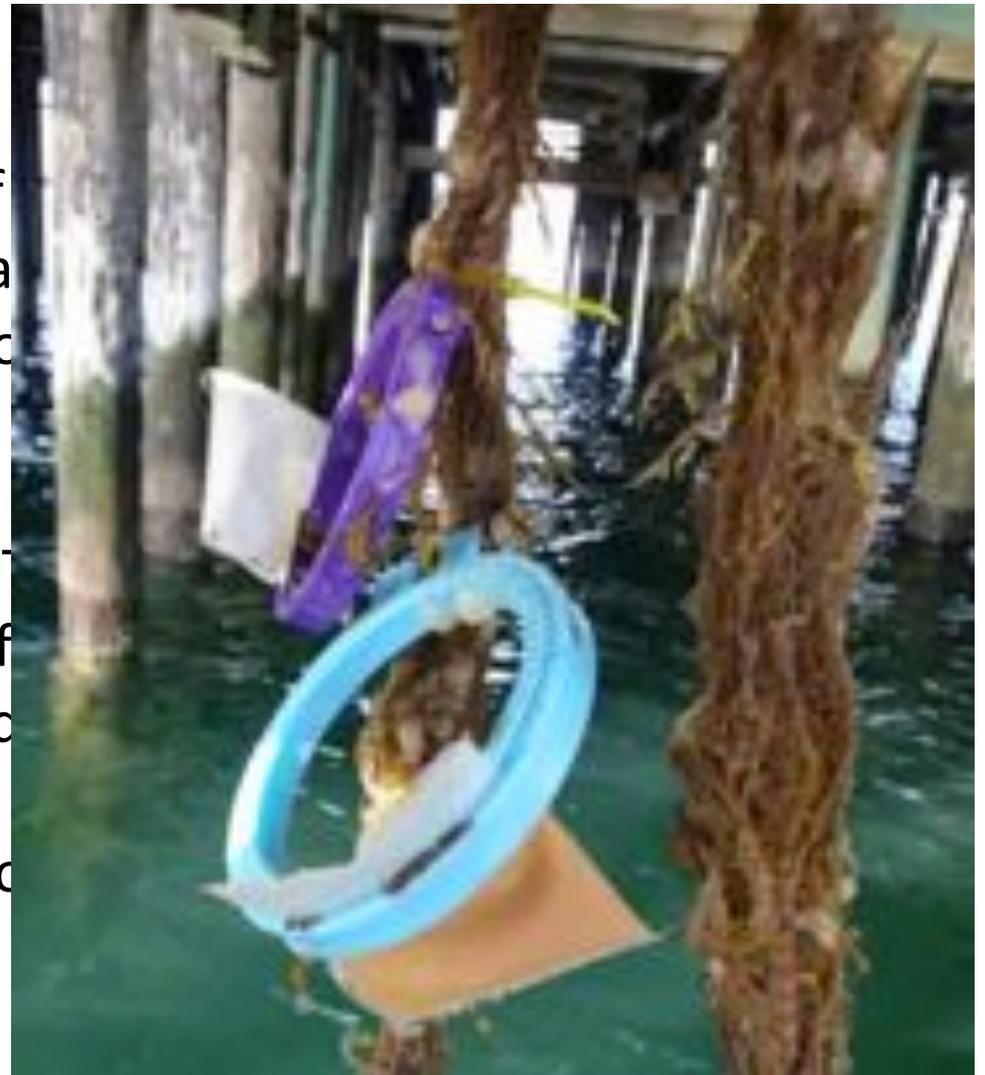
PI: R Kudela (UC Santa Cruz)

Objective:

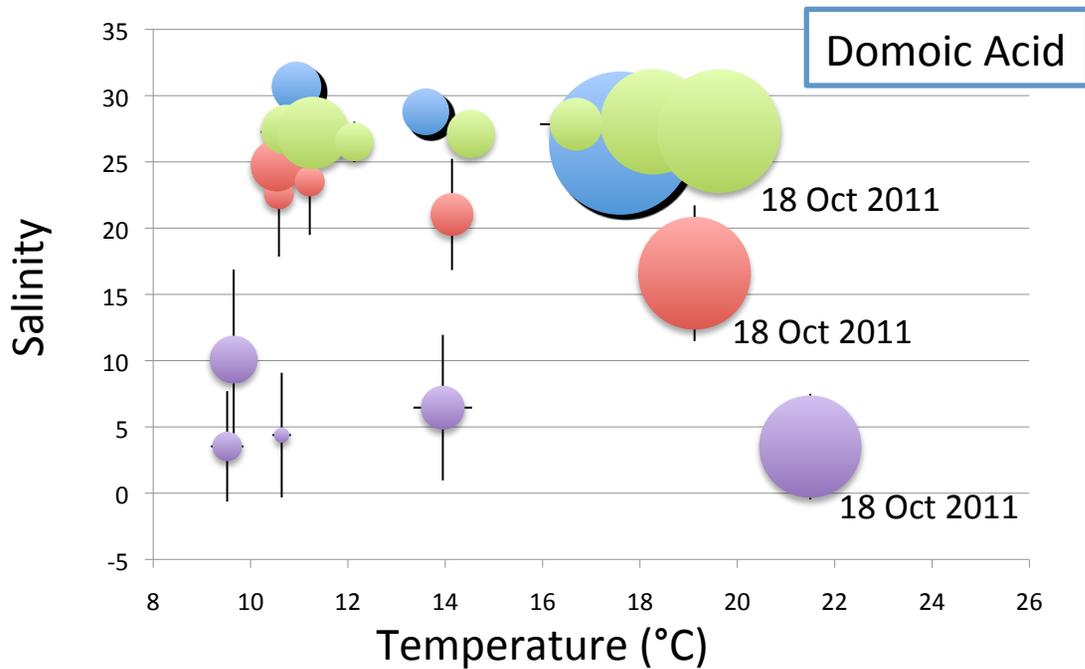
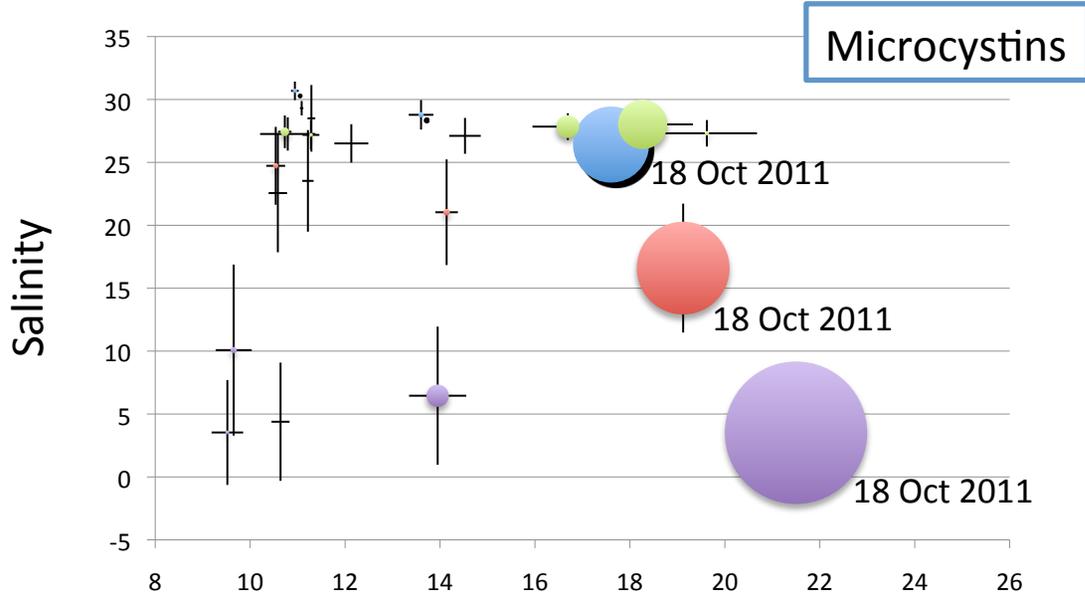
- Characterize the distribution of
- Calibrate sampler for quantifica
- Develop approach for use in mo

Approach:

- Deploy Solid Phase Adsorption T
 - Monthly Transects: *Polaris* f
 - Dumbarton and Benicia Bric
- Calibrate SPATT through contro
- *Product:* Technical report



SPATT concentrations plotted in Temperature-Salinity space



Bubble size = toxin concentration; color corresponds to Bay regions

Bars represent 1 SD for Salinity and Temperature

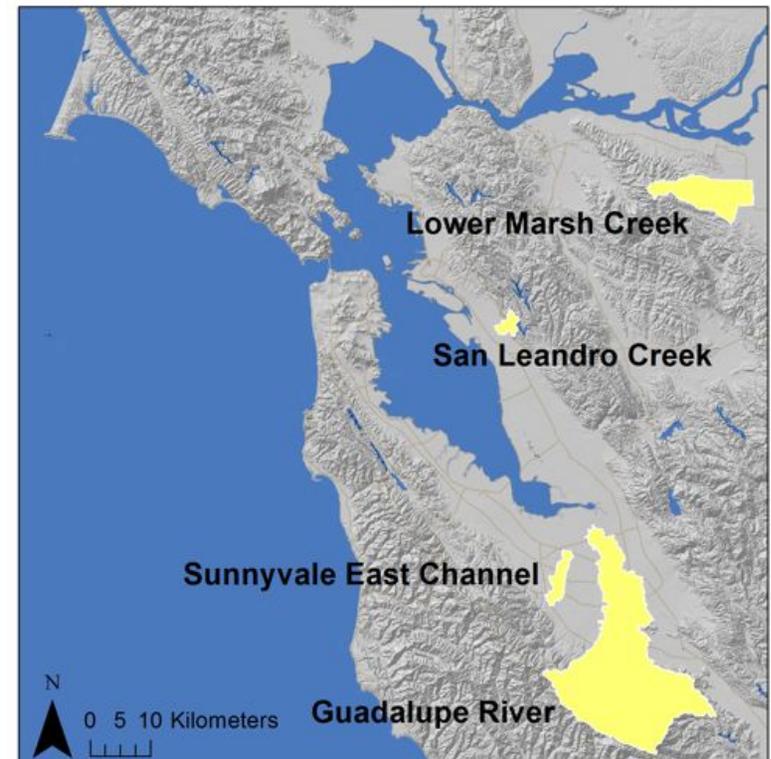
Stormwater nutrient monitoring, 6 watersheds

Cost: \$38k (RMP)

PI: D Senn (for nutrients)

Objective:

- Characterize nutrient concentrations and quantify loads in diverse watersheds



Funding: RMP and BASMAA

Stormwater nutrient monitoring, 6 watersheds

Cost: \$38k (RMP)

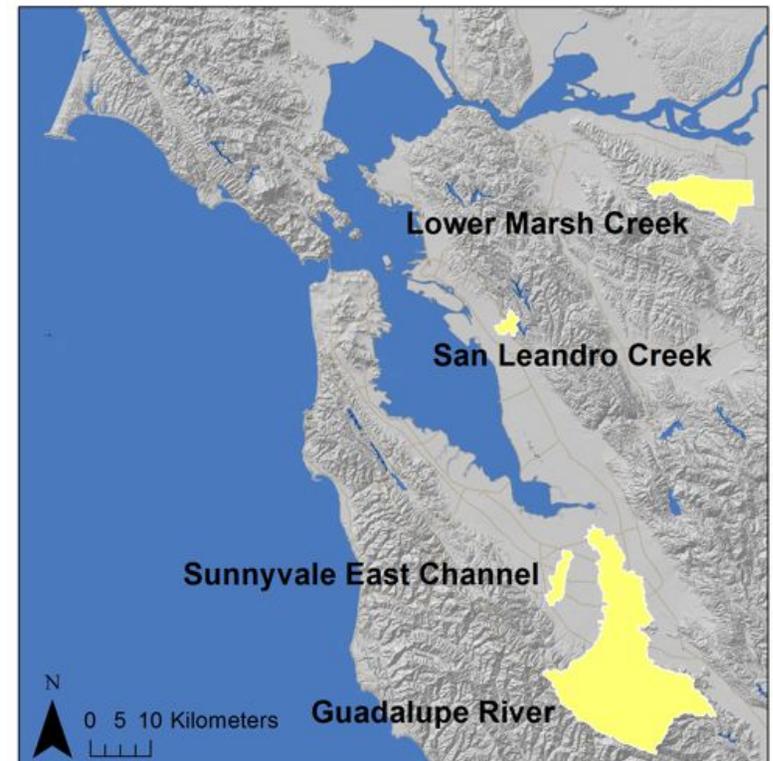
PI: D Senn (for nutrients)

Objective:

- Characterize nutrient concentrations and quantify loads in diverse watersheds

Approach:

- Piggy-back on larger study (leverage >\$300k in fieldwork)
- 6 watersheds, 4 storms
- NO₃, NO₂, NH₄, PO₄, TN, TP
- *Product:* Technical memo



New sites: - North Richmond pump station
- Pulgas

Funding: RMP and BASMAA

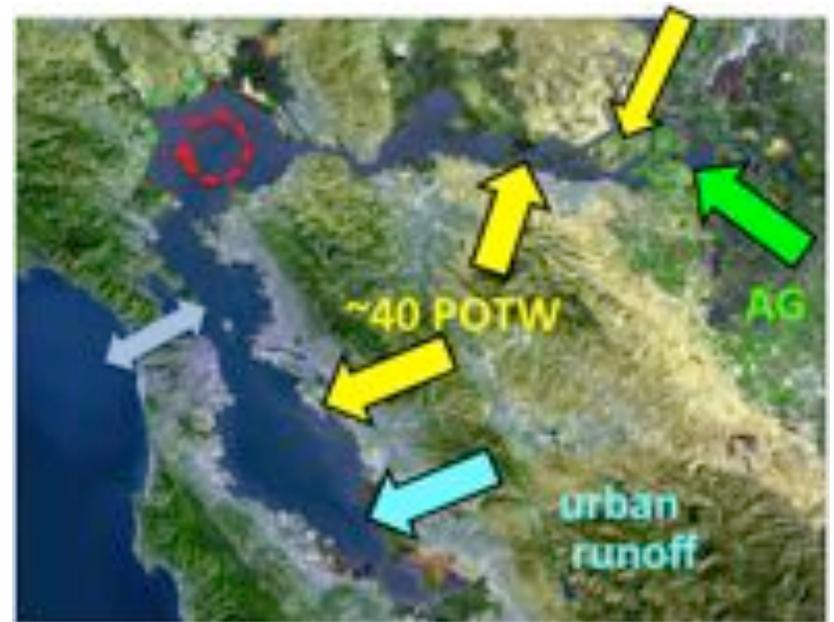
Assess Nutrient Loads to the Bay – continuation

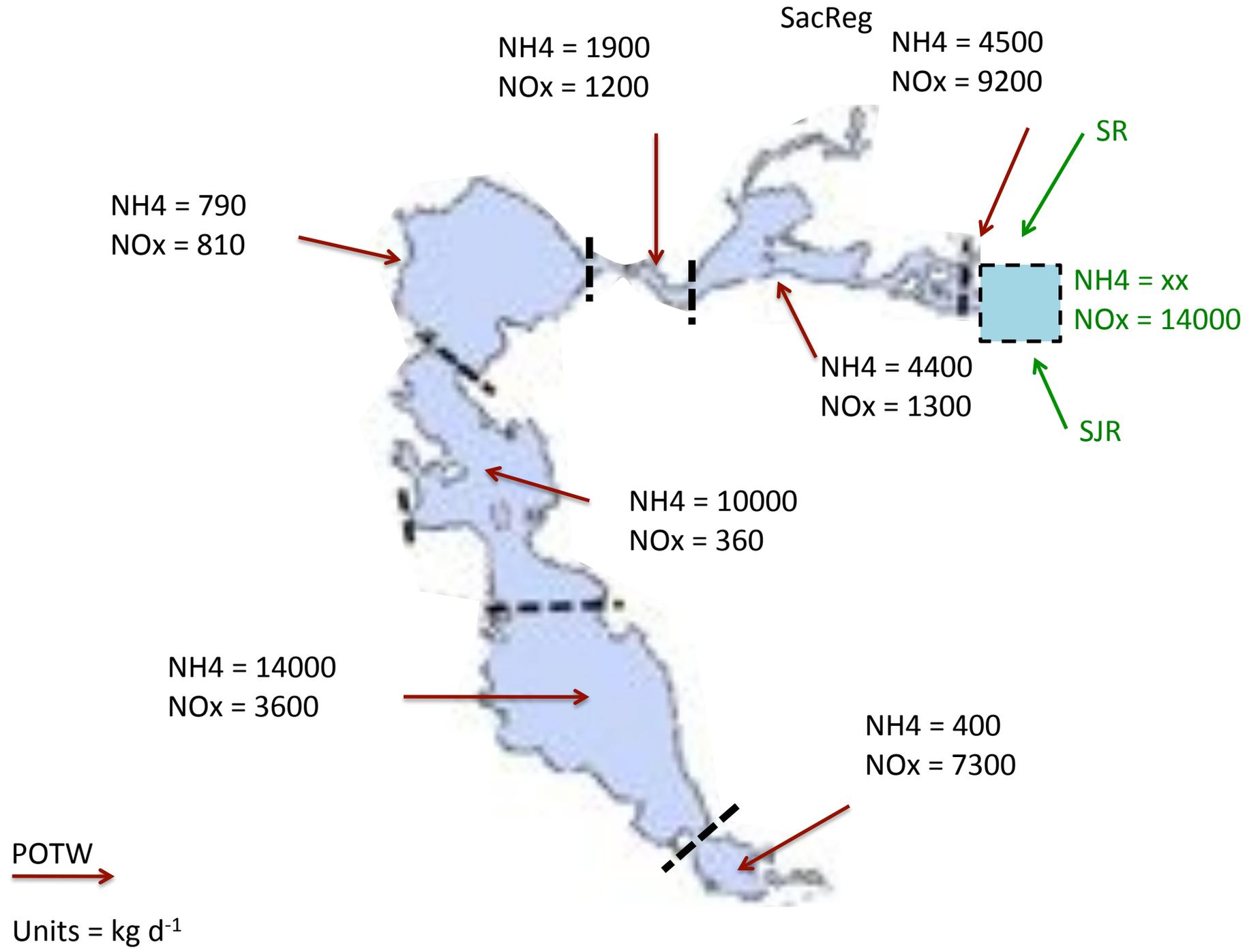
Cost: \$30k (RMP)

PI: D Senn

Objectives

- Assess major nutrient loads and composition
- Characterize variations in space and time
- Identify major uncertainties and data gaps, future work

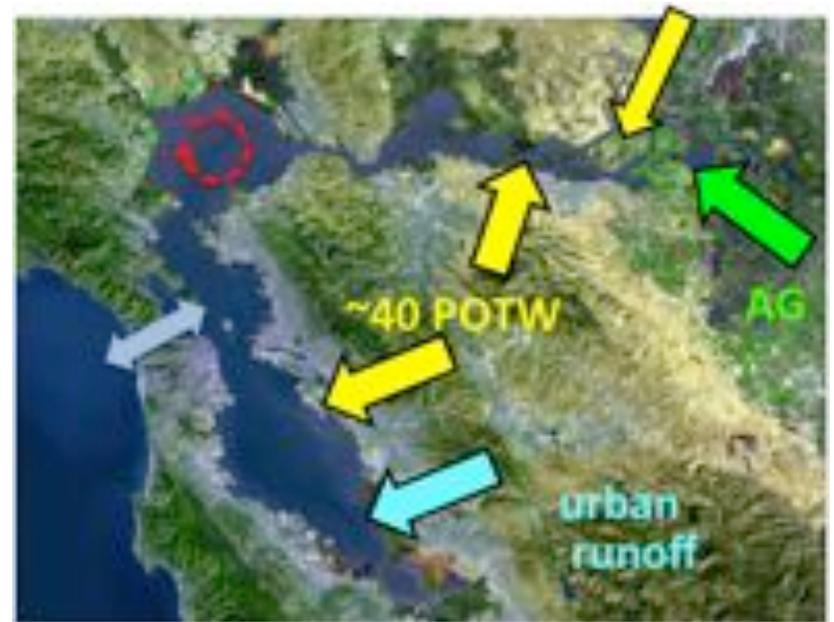




Assess Nutrient Loads to the Bay – continuation

Cost: \$30k (RMP)

PI: D Senn



Approach for Part I & II:

- Refine POTW loads with archived and new effluent data
- Estimating stormwater and groundwater loads
- Initial estimates of GG loads and loads from the Delta
- Characterize variations in space and time
- Identify major uncertainties and data gaps, future work
- *Product:* Technical Report

Discussion of RMP projects

- Agreement on prioritization of these projects?
- Other priorities?

Priority Projects (subset) for 2013

	<u>Work Element</u>
1. Moored sensor pilot study	3
2. Algal phytotoxins	3
3. Nutrient stormwater sampling	3,4
4. Loading study continuation	1,4
5. Monitoring program development	3
6. Biogeochemical modeling	4
7. Loads across Golden Gate	1,4
8. Photosynt. effic., and NH ₄ /NO ₃ p.p.	2,3,4
9. Loads to Suisun from Delta	1,4
10. 3D model development	4
11. Assessment framework continuation	2

Monitoring Program Development I

cost: \$25-50k (Nutrient Group)

PI: D Senn, J Davis, J Cloern (USGS)

Objective: Develop a transition plan for Monitoring Program migration from USGS to RMP

Approach:

- Investigate costs, infrastructure, logistics for various scenarios
- Identify new partners (e.g., IEP)
- Identify institutional agreements, timelines, constraints
- Convene ad hoc advisory committee of stakeholders, regulators, USGS and other partners
- *Product:* Report on migration plan

Biogeochemical Modeling: Suisun and South Bay

Cost: \$300k (BACWA + RMP)

PI: D Senn

Collaborators/Technical Team:

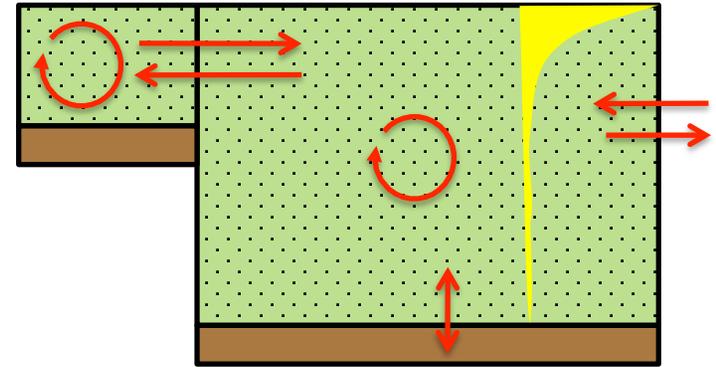
Cloern (USGS), Dugdale (RTC), others



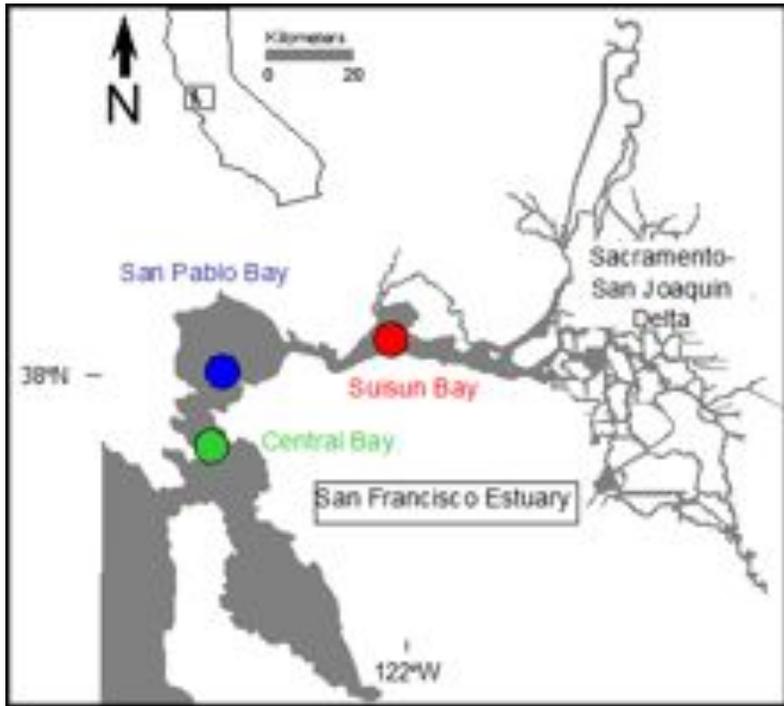
Objective: Develop biogeochemical models to...

- Quantitative data synthesis and nutrient budgets
- Assess relative importance of key processes/drivers
- Sensitivity analysis, identify critical uncertainties and data gaps
- Characterize system response (e.g., chl, O₂) under future scenarios
- Inform monitoring program and special studies

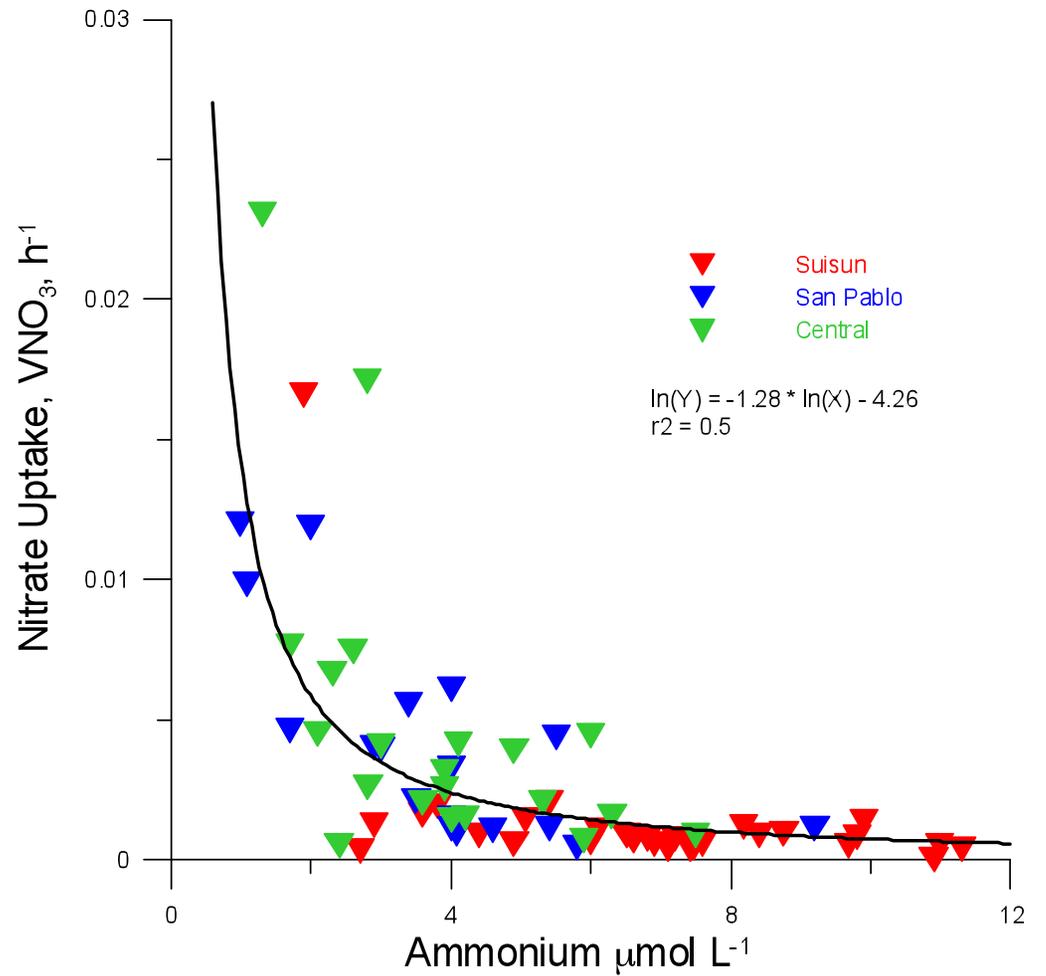
Biogeochemical Modeling: Suisun and South Bay



- flow, tidal exchange (t_{res})
- light limitation
- benthic grazing
- potential inhibition of PP by NH_4^+
- budgets: transformations, sources, and sinks

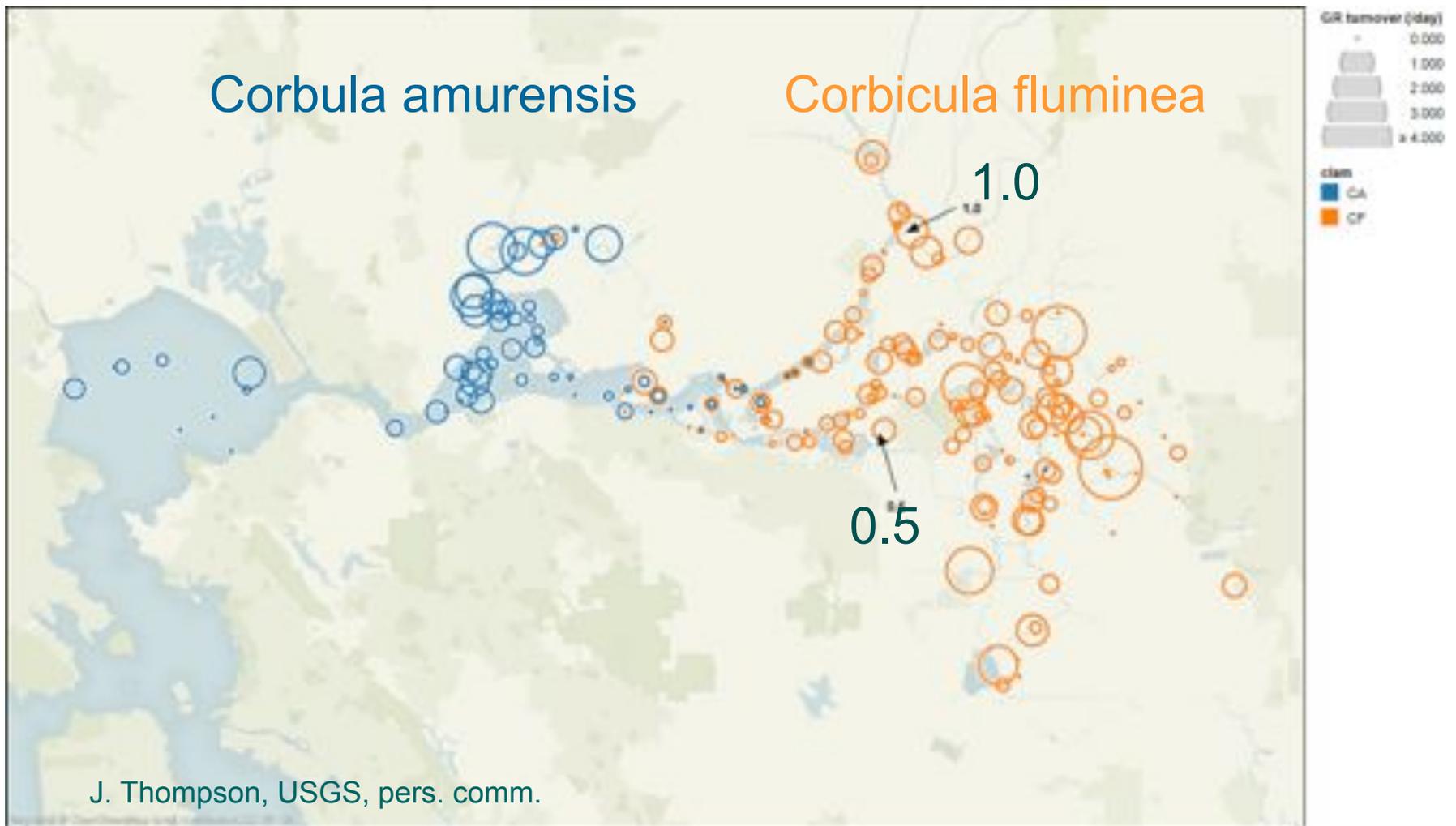


Evidence of NH₄ inhibiting NO₃ uptake



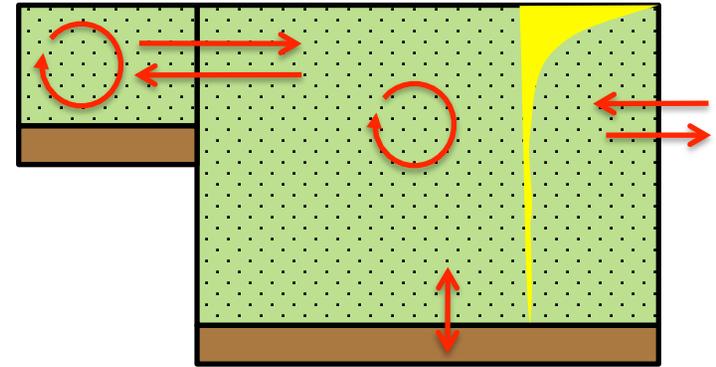
Dugdale et al., 2007

Turnover by grazing clams (d^{-1})
Example: May 2010



source: Kimmerer et al. 2011

Biogeochemical Modeling: Suisun and South Bay



P = phytoplankton biomass

$$V \frac{dP}{dt} = + M_{in} - k_{flush} P V - k_{graze} P V + \alpha_{light} \alpha_{NH4} k_{grow-max} P V$$

$$\alpha_{light}, \alpha_{NH4} < 1$$

Biogeochemical Modeling: Suisun and South Bay

Approach:

- Model development with technical team and WQ modeling and hydrodynamic consultants
- Use hydrodynamic data from other efforts (grid aggregation)
- Open-source model delivered to SFEI, technical group, and stakeholders to perform simulations, test/generate hypotheses
- *Product:* Model, technical report(s)

Nutrient exchange across the Golden Gate

Cost: \$150k (Nutrient Group)

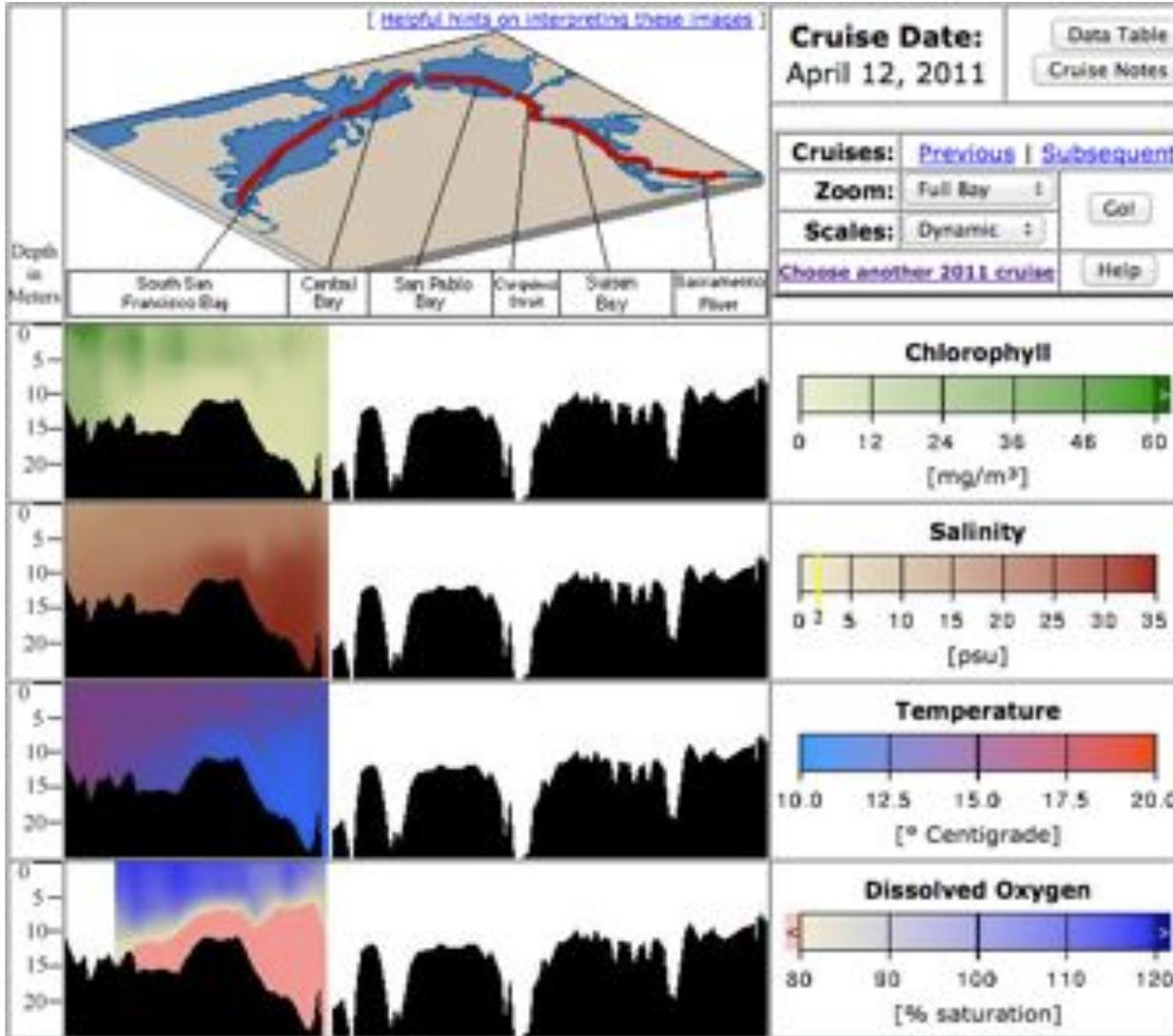
PI: M Stacey (UC Berkeley), J Largier (UC Davis)

- Coastal upwelling: cold, nutrient-rich water. max NO₃ ~ 35μM
- Upwelling strongest during summer months when land runoff is weakest.
- Water at mouth of the Bay transported far into Bay each tidal cycle
 - ocean waters may intrude further as a density-driven lower layer (when stratified).
- These loads could potentially rival anthropogenic loads on any given day (given the Bay's tidal prism volume and upwelled NO₃ levels)

Nutrient exchange across the Golden Gate

Cost: \$150k (Nutrient Group)

PI: M Stacey (UC Berkeley), J Largier (UC Davis)



Nutrient exchange across the Golden Gate

Cost: \$150k (Nutrient Group)

PI: M Stacey (UC Berkeley), J Largier (UC Davis)

Objectives & Approach:

- Develop conceptual model of nutrient delivery from ocean to bay, including factors controlling concentration, intrusion distance and time scales.
- Develop first-order quantitative estimates of nutrient flux from ocean to bay for a variety of scenarios.
 - e.g., using T-NO₃ relationships
- Develop first-order quantitative estimates of the “reach of the ocean” – how far into the bay may ocean nutrients be important?
 - existing 1-D salt intrusion models
- Recommend next steps for refining estimates

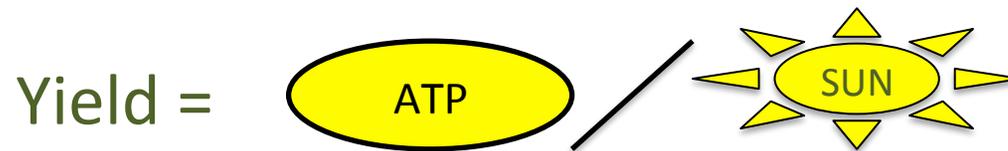
Photosynthesis efficiency and primary production rates on NH₄ vs. NO₃

Cost: \$200k (IEP, SFCWA, others)

PI: R Kudela (USCS)

Partners: M Berg (AMS), Region 2 Board, SFCWA, others

Stress affects photosynthesis



YIELD

- conversion efficiency of light energy into chemical energy for C fixation
- very sensitive to stressors
 - toxicity, changes in irradiance, salinity, temperature, and nutrient limitation

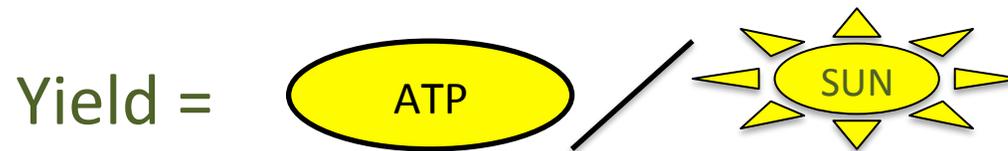
Photosynthesis efficiency and primary production rates on NH₄ vs. NO₃

Cost: \$200k (IEP, SFCWA, others)

PI: R Kudela (USCS)

Partners: M Berg (AMS), Region 2 Board, SFCWA, others

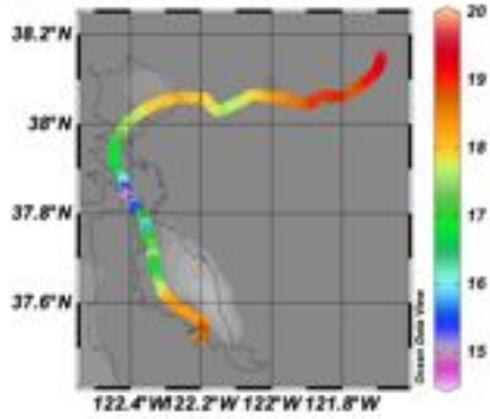
Stress affects photosynthesis



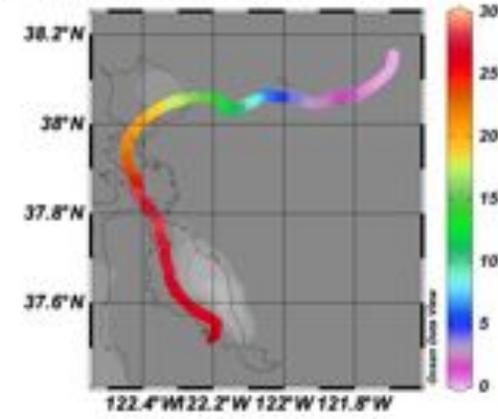
Does stress vary spatially in San Francisco Bay?

If so, what are the underlying causes?

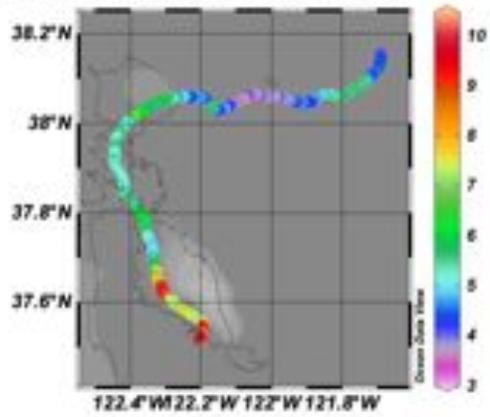
TEMPERATURE



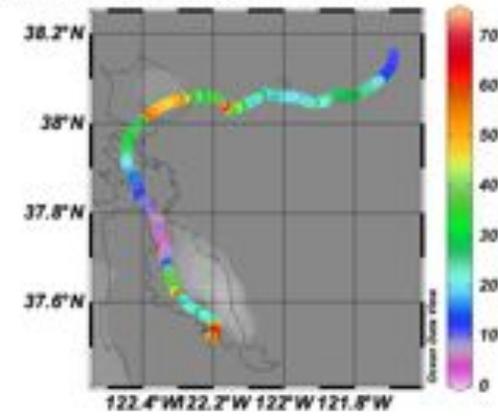
SALINITY



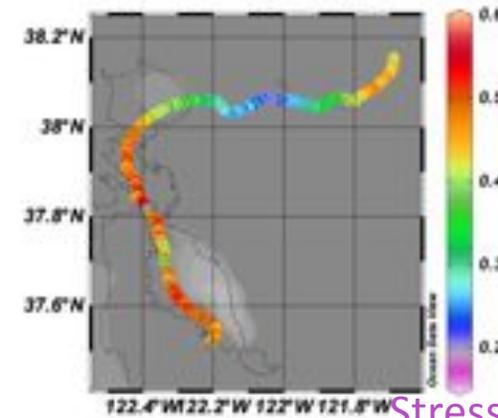
FLUORESCENCE



TURBIDITY



YIELD

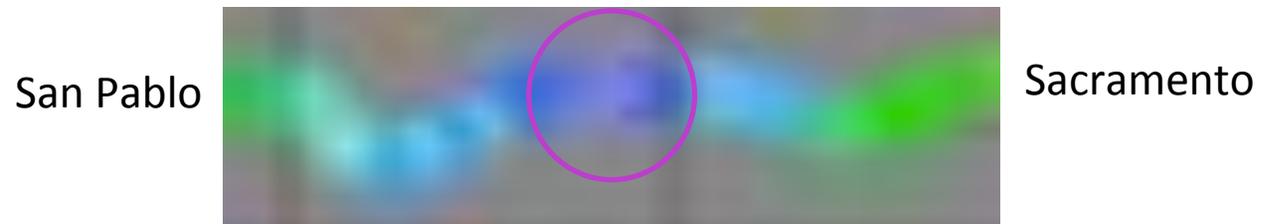


Happy

Stressed

The answer is Yes

- Yield was 3-fold lower in Suisun compared with South and Central Bays with San Pablo falling in-between
- The low-yield region in Suisun was well-defined and originated in the middle of the Bay, dissipating outwards.
- Yield increased moving towards the Sacramento River



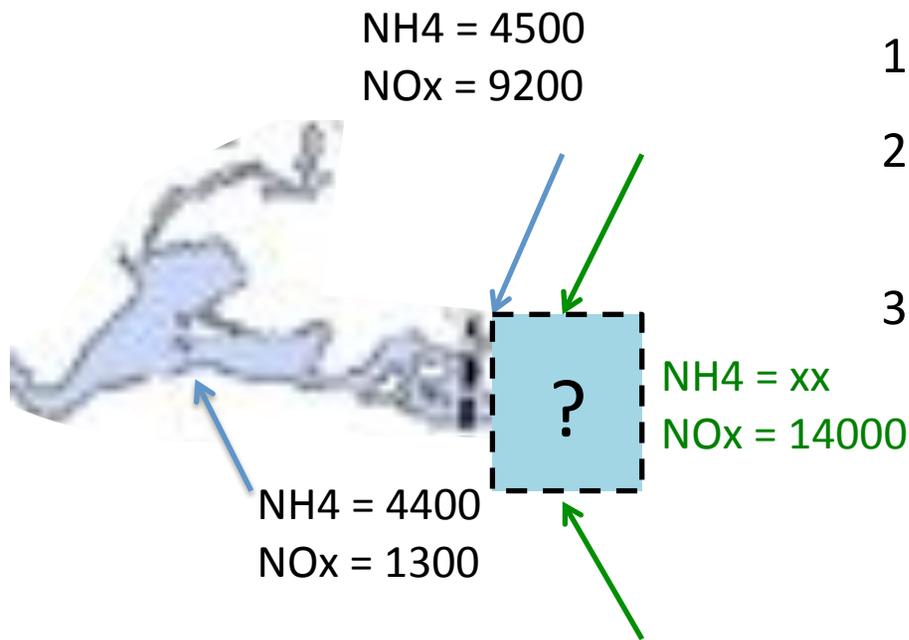
Basin-specific Questions

QUESTION	APPROACH
How big is the Misery Spot in Suisun?	Map areal extent of spot
Does the spot move?	Map several times over the course of a year
Are phytoplankton stressed closer to SAC Regional?	Transect up the Sacramento River past SAC Regional

Phytoplankton physiology-specific Questions

QUESTIONS	APPROACH
Does ammonium inhibit yield, carbon fixation and growth in phytoplankton in Suisun?	Isolate individual phytoplankton species into culture from within and outside the Misery Spot and investigate the effect of varying nitrogen source (NH ₄ , NO ₃) on yield, carbon fixation, and growth under controlled conditions (light, temperature, community composition)
	Perform TIE tests using the same unialgal cultures; add yield measurements

Quantify Central Valley nutrient loads to Suisun Bay as a function of time?

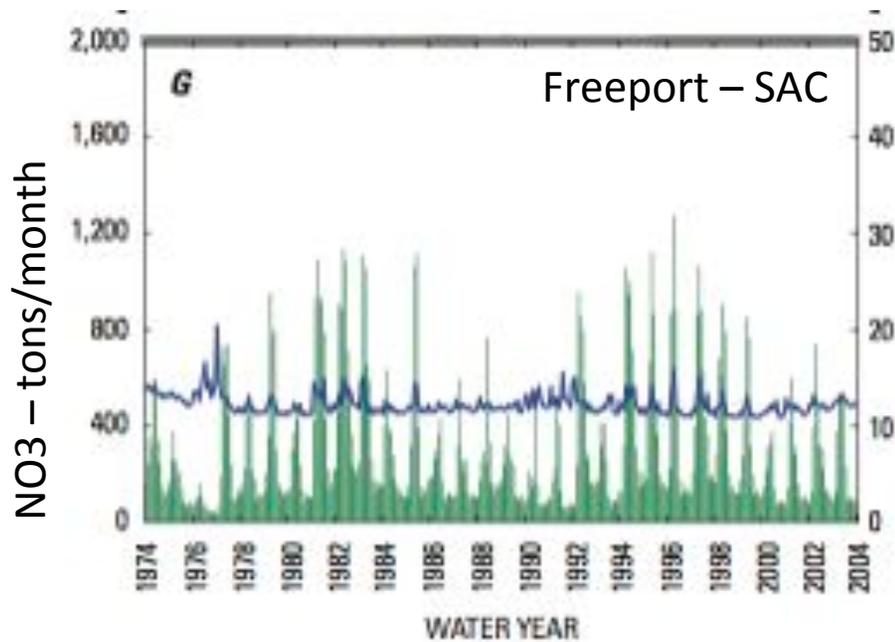


kg d⁻¹

Approach...

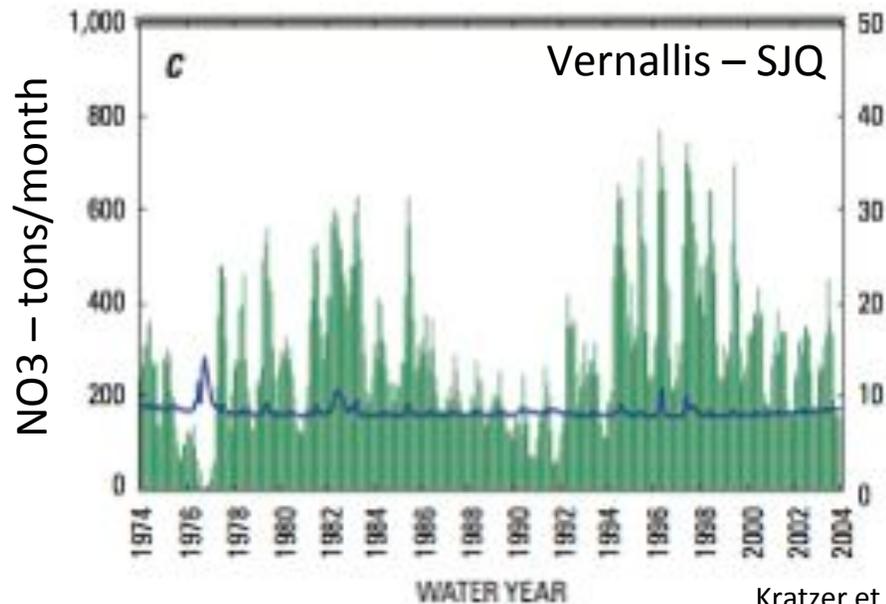
1. Quantify loads arriving at Delta
2. Use monitoring data and flow estimates to quantify loads to Suisun
3. Estimate internal loads, flows, and N mass balance

Still editing

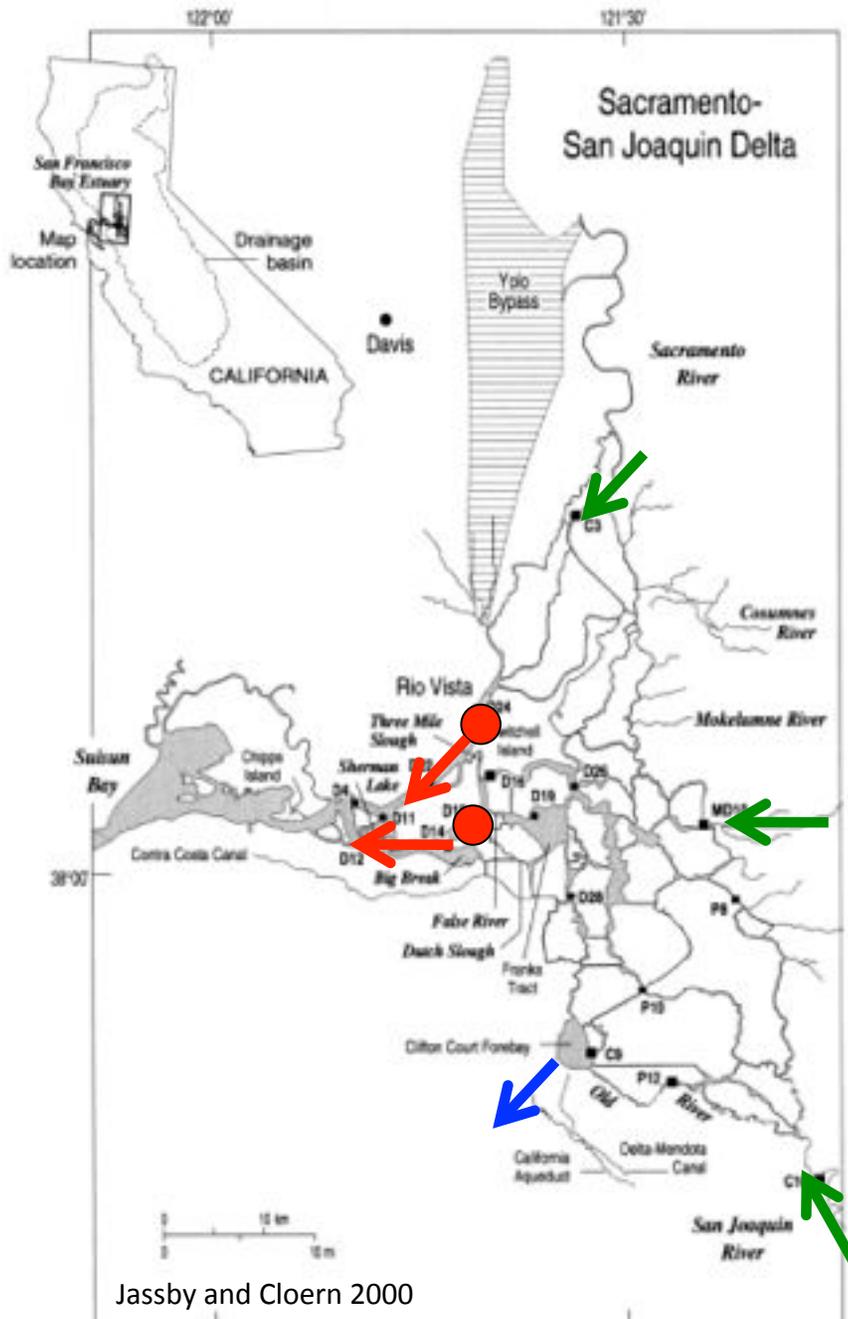


Approach...

1. Quantify loads arriving at Delta
2. Use monitoring data and flow estimates to quantify loads to Suisun
3. Estimate internal loads, flows, and N mass balance



Still editing



Approach...

1. Quantify loads arriving at Delta
2. Use monitoring data and flow estimates to quantify loads to Suisun
3. Estimate internal loads, flows, and N mass balance

4. Loads internally from agricultural are poorly constrained and could be large

1. Constrain with isotopes
2. DICU can be large during certain times (Delta internal consumptive use)

Still editing

3. 250 internal ag pumping, return flows

Volumetric Fingerprinting of Delta Water

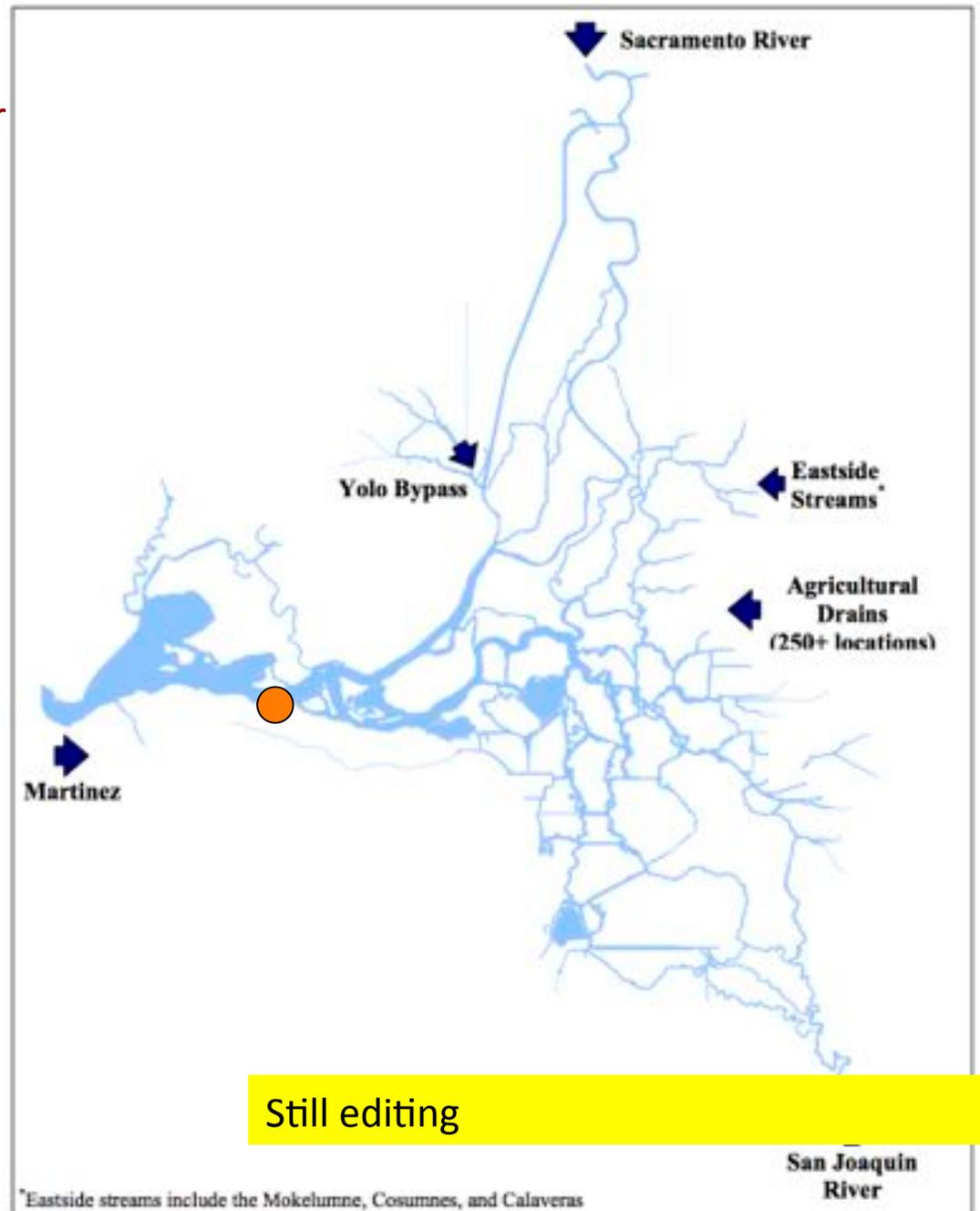
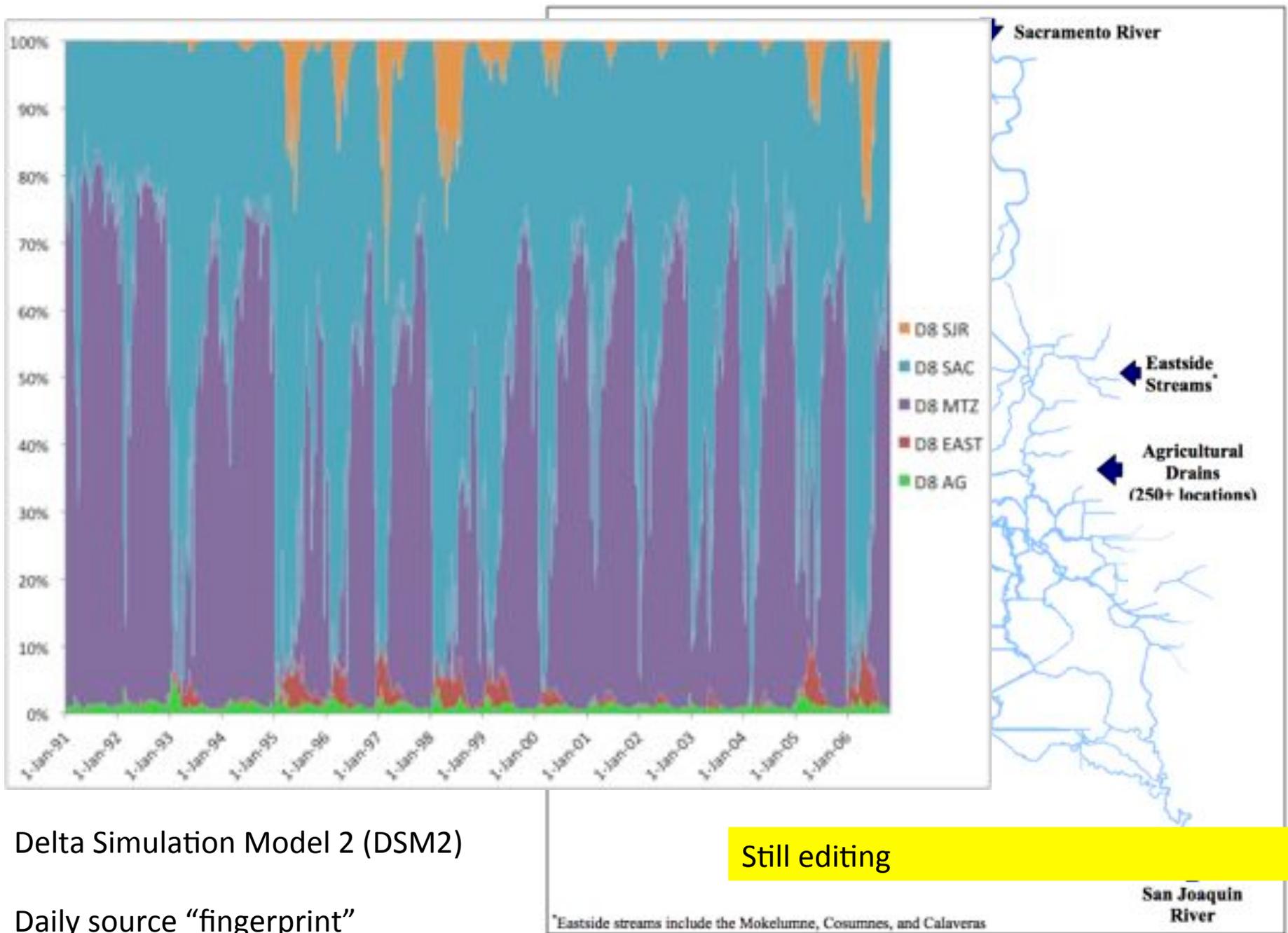


Figure 14.9: Typical Fingerprinting Source Locations for the Sacramento-San Joaquin Delta.



Priority Projects (subset) for 2013

	<u>Work Element</u>
1. Moored sensor pilot study	3
2. Algal phytotoxins	3
3. Nutrient stormwater sampling	3,4
4. Loading study continuation	1,4
5. Monitoring program development	3
6. Biogeochemical modeling	4
7. Loads across Golden Gate	1,4
8. Photosynt. effic., and NH ₄ /NO ₃ p.p.	2,3,4
9. Loads to Suisun from Delta	1,4
10. 3D model development	4
11. Assessment framework continuation	2

Discussion...

Informal Survey Results Overview

- Role of this group: input on study ideas; work product and workplan review; advise regional board
- Time commitment: quarterly
- Technical subcommittee formation: yes
- More formal governance structure: 100% for work and funding priorities

Informal Survey Results Overview cont'd

- Need for outside facilitation to define roles and responsibilities and organization structure: yes
- Funding for outside facilitation: no
- Formal meeting facilitation: no
- State Board as meeting facilitator: yes