Delta RMP Nutrient Symposium

Nutrient Monitoring Collaborations and Partnerships

Nutrient Monitoring Collaborations and Partnerships

3:20 to 3:25

Opening Remarks

Debbie Webster, Steering Committee Co-Chair

Meredith Howard, Steering Committee Co-Chair

3:25 to 3:45

USGS Nutrient Monitoring Program

Brian Bergamaschi, U.S. Geological Survey

3:45 to 4:05

Department of Water Resources Municipal Water Quality Investigations, Interagency Ecological Program, and Environmental Monitoring Program

Ted Flynn, Department of Water Resources

Leslie Palencia, Technical Consultant

4:05 to 4:25

San Francisco Regional Monitoring Program (San Francisco Bay RMP)

Tom Mumley, San Francisco Bay Regional Water Quality Control Board

Opening Remarks

DEBBIE WEBSTER, STEERING COMMITTEE CO-CHAIR

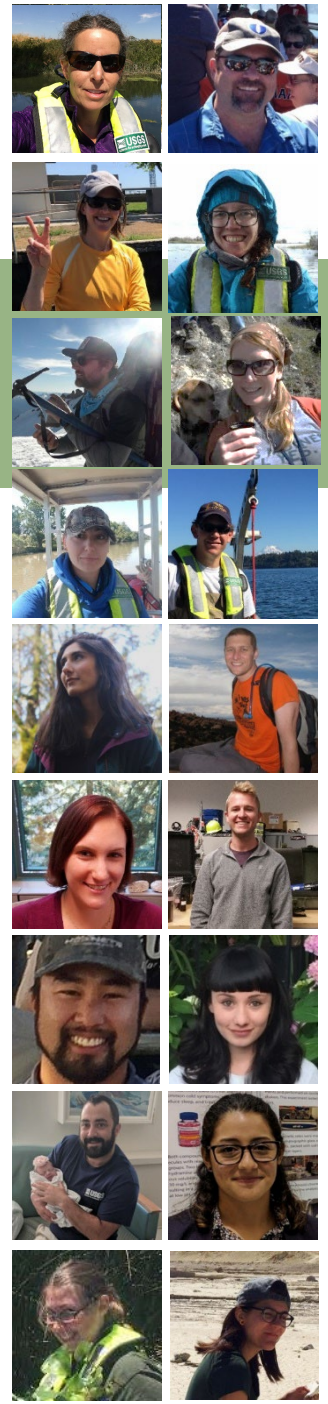
MEREDITH HOWARD, STEERING COMMITTEE CO-CHAIR

NUTRIENT MONITORING COLLABORATIONS AND PARTNERSHIPS, 3:20 TO 3:25 PM

USGS Nutrient Monitoring Program

BRIAN BERGAMASCHI, U.S. GEOLOGICAL SURVEY

NUTRIENT MONITORING COLLABORATIONS AND PARTNERSHIPS, 3:25 TO 3:45 PM



The USGS Nutrient Monitoring Program

Biogeochemistry research group at the California Water Science Center

'a research group with an interest in long-term data,
an active emphasis on improving monitoring technology and practice, and
a focus on high temporal and spatial resolution data collection'

Brian Bergamaschi, Tamara Kraus, Keith Bouma-Gregson, Katy O'Donnell,
Emily Richardson, Kyle Nakatsuka, Ayelet Delascagigas, Chuck Hansen, Jeniffer Soto Perez, Angela Hansen,
Dylan Burau, Crystal Sturgeon, Phoebe Nichols, Balthasar Von Hoyningen Huene
. . . ..and many others

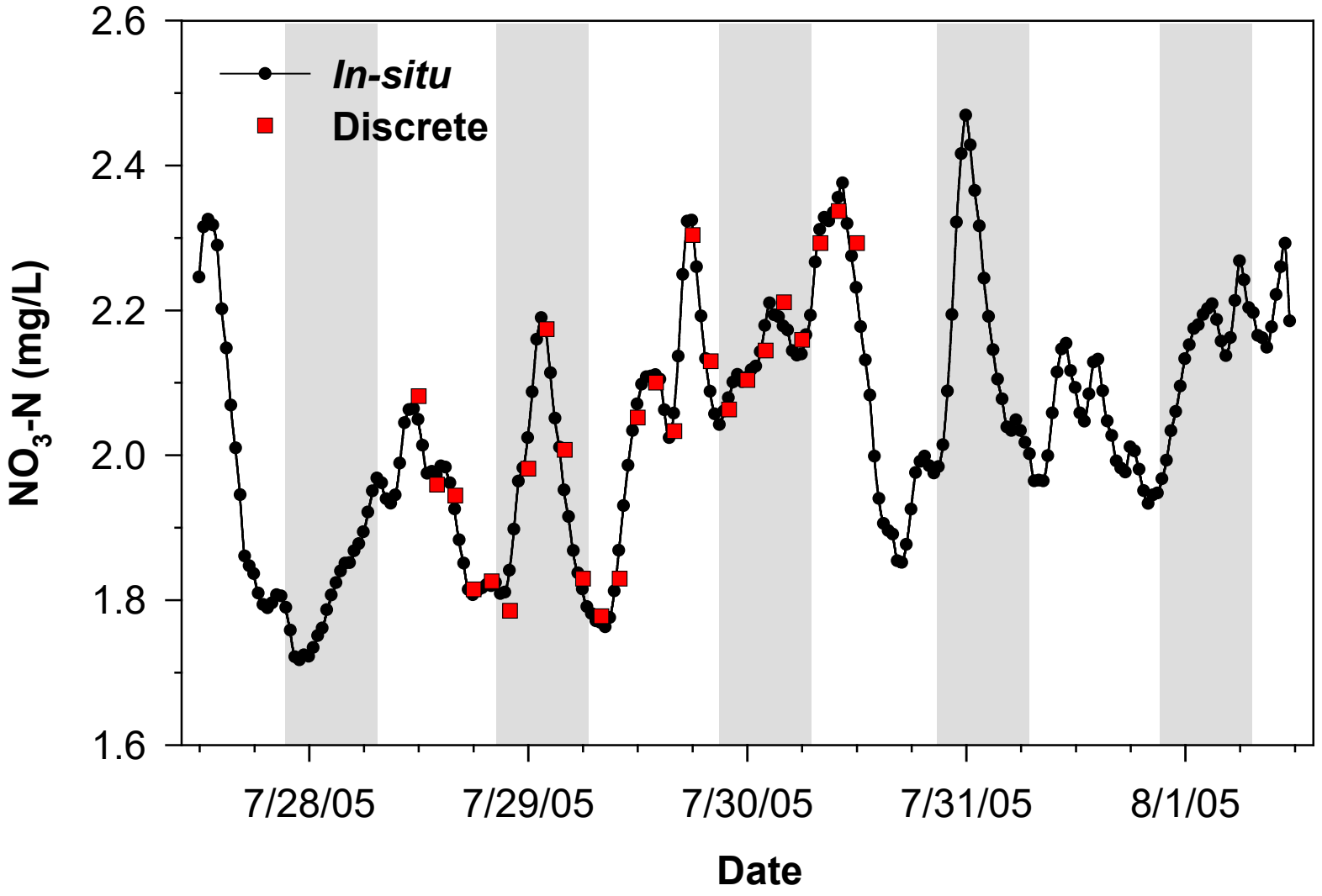
Nitrate Variability – San Joaquin River

Assessing nitrate variability in the San Joaquin River, Crows Landing, CA

Pellerin, B. A., B. D. Downing, C. Kendall, R. A. Dahlgren, T. E. C. Kraus, J. Saraceno, R. G. M. Spencer, and B. A. Bergamaschi. 2009. Assessing the sources and magnitude of diurnal nitrate variability in the San Joaquin River (California) with an in situ optical nitrate sensor and dual nitrate isotopes. Freshwater Biology 54: 376-387.

Nitrate Variability – San Joaquin River

Assessing diurnal nitrate variability in the San Joaquin River, Crows Landing, CA
(Satlantic ISUS nitrate analyzer)

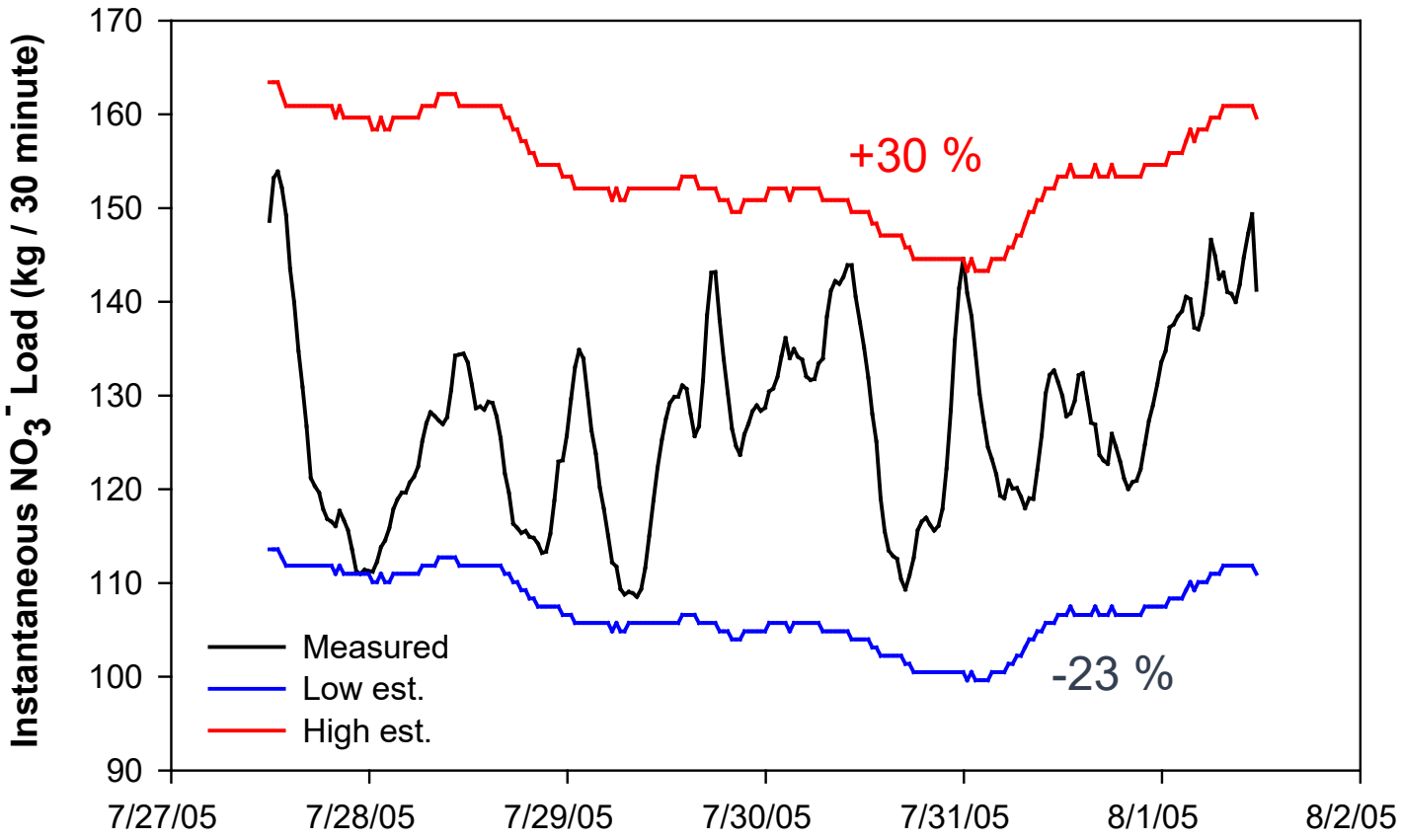


Pellerin et al., 2009

Nitrate Loads – San Joaquin River

Difference in instantaneous and cumulative nitrate load at Crows Landing during the study period. **Daily loads were -23 to +30 % relative to measured load** using continuous data.

	Daily Load (kg nitrate / day)			% Difference	
	Measured	Low est.	High est.	Low est.	High est.
28-Jul	5875	5305	7631	-10	30
29-Jul	6563	5064	7284	-23	11
30-Jul	6160	4956	7130	-20	16
31-Jul	6047	5024	7228	-17	20

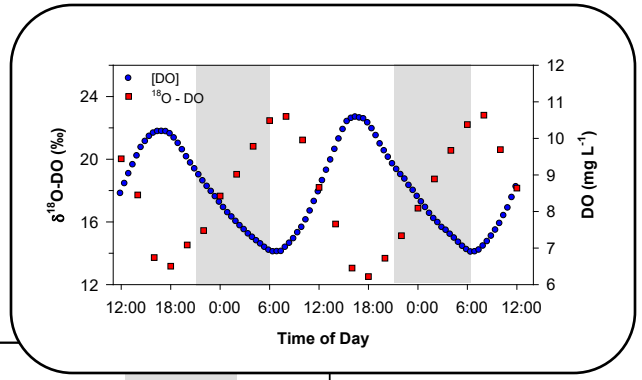


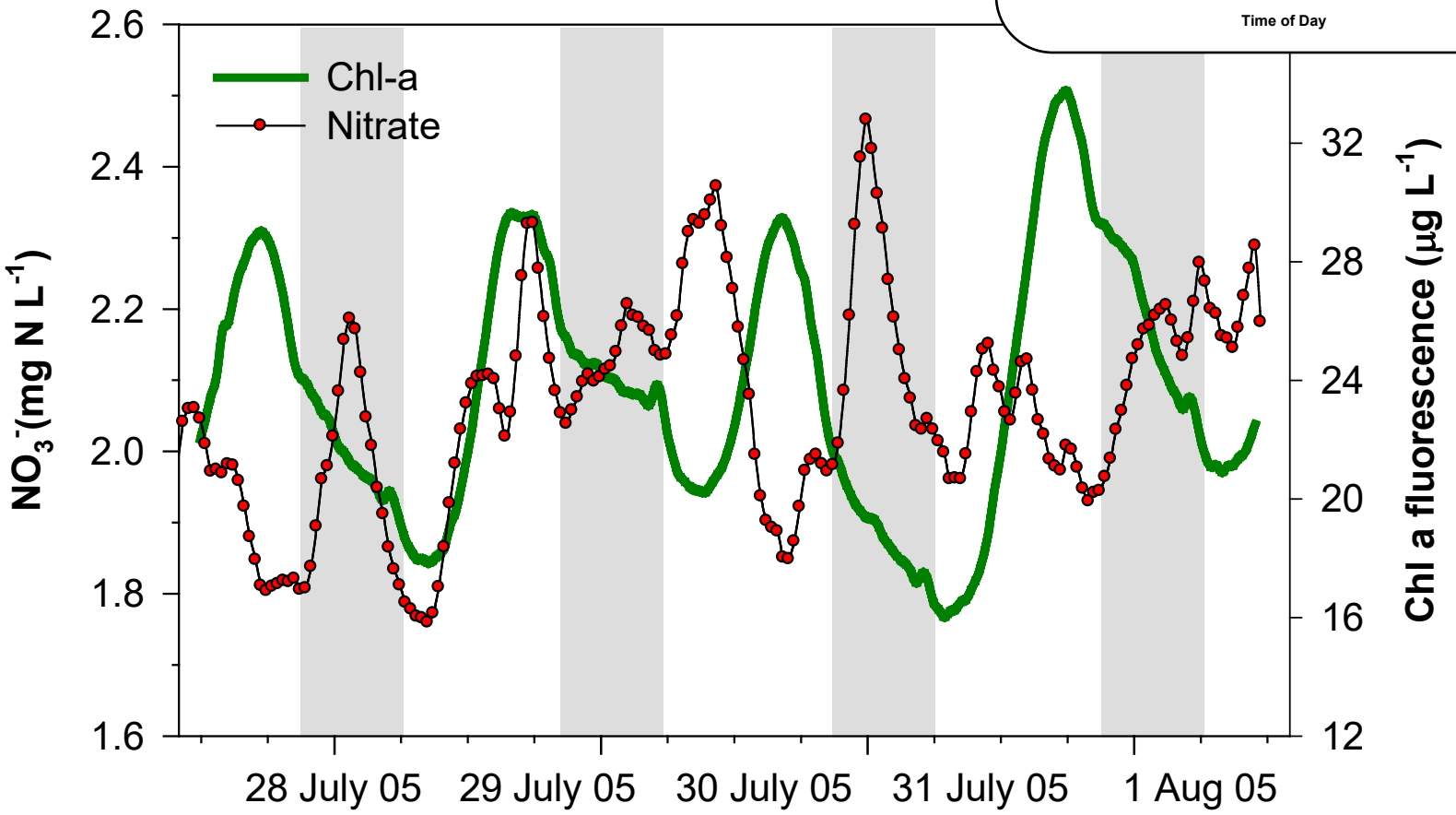
Pellerin et al., 2009

Drivers of nitrate variability - SJR

Combination of discrete and in situ data show high biological activity in the SJR (*right*)

Evidence for link between NO_3^- concentrations and phytoplankton, but other things going on as well.





Pellerin et al., 2009

We are a research group with an active emphasis improving monitoring

- What are rates of nutrient turnover and phytoplankton production in pelagic systems?
- What processes affect chlorophyll-a biomass and nitrate fluxes to the estuary?
- What are rates of wetland exchange and wetland subsidies to pelagic systems ?
- What are rates of benthic exchange and transformation?
- What are rates of carbon cycling in tidal wetlands ?
- How can we improve monitoring technology and practice?

How can we improve monitoring technology and practice?

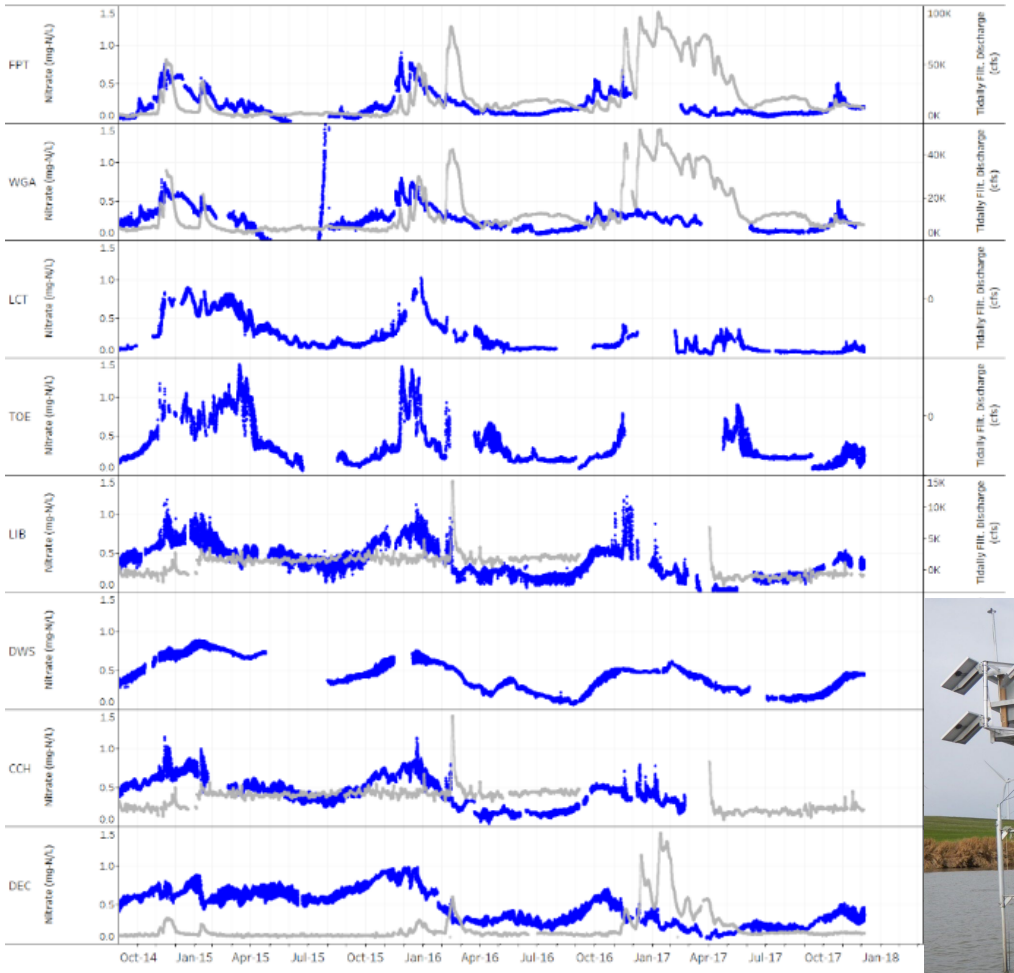
Fixed station monitoring

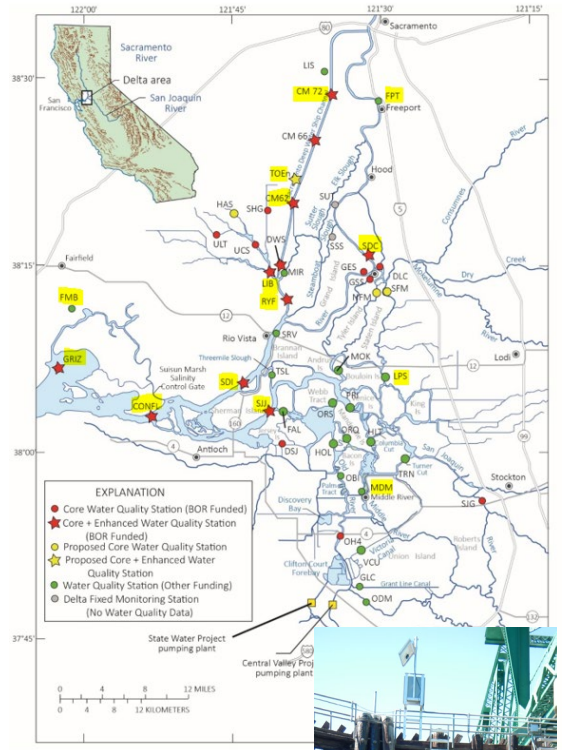
- Located with flow stations
- Stations Multi-parameter stations
- added over time as we learned more
- Sensor testing
  - New nitrate sensors
  - Phytoplankton
  - Ammonium
  - Phosphate
  - Others

Future:

- Fluoroprobes at 5 stations to monitor phytoplankton type as well as abundance
- Add some more stations
- Greater coordination with DWR
- Radiometers
- Sensor testing

Nitrate Discharge





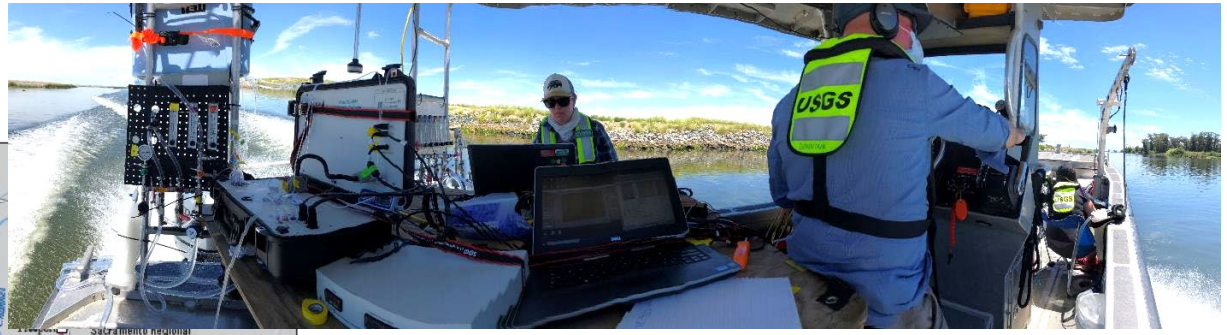
How can we improve monitoring technology and practice?

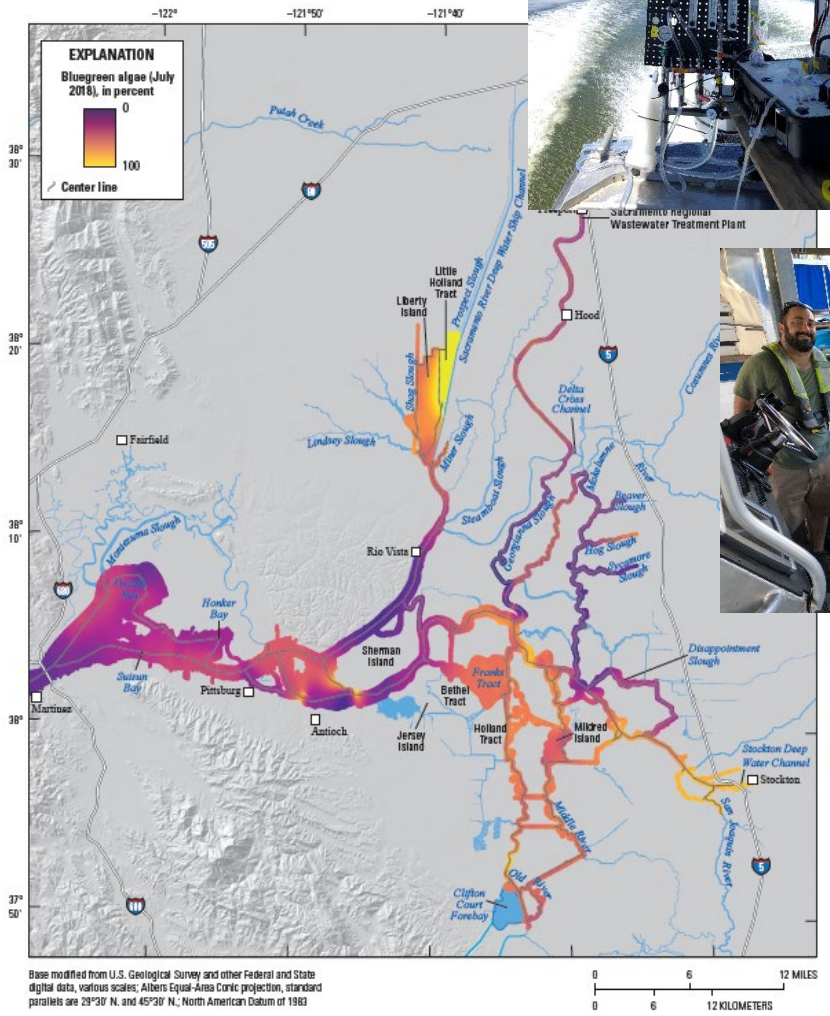
High resolution mapping surveys

- Simultaneous collection of a wide array of water quality and phytoplankton data
- Whole Delta surveys in 2018, 2020, 2021, 2022
- Numerous North Delta Surveys
- Most published and available on ScienceBase and explorable through our web portal

Future:

- No additional Delta-wide surveys are funded
- Explicit use for remote sensing calibration
- Use by models for validation
- Adding measurements of particle quality and food-web accessibility.
- Mercury species (J. Fleck, M. Marvin et al.)
- Dissolved gasses – CO_2, CH_4





Bergamaschi, B. A., Kraus, T. E. C., Downing, B. D., Stumpner, E. B., O'Donnell, K., Hansen, J., . . . Gelber., A. (In Review). Assessing spatial variability of nutrients, phytoplankton and related water quality constituents in the California Sacramento-San Joaquin Delta at the landscape scale: 2018 High resolution mapping surveys. Reston, VA: USGS

Stumpner, E. B., Bergamaschi, B. A., Kraus, T. E. C., Parker, A. E., Wilkerson, F. P., Downing, B. D., . . . Kendall, C. (2020). Spatial variability of phytoplankton in a shallow tidal freshwater system reveals complex controls on abundance and community structure. The Science of the total environment, 700, 134392. doi:10.1016/j.scitotenv.2019.134392

Downing, B. D., Bergamaschi, B. A., Kendall, C., Kraus, T. E., Dennis, K. J., Carter, J. A., & Von Dessonneck, T. S. (2016). Using Continuous Underway Isotope Measurements To Map Water Residence Time in Hydrodynamically Complex Tidal Environments. Environ Sci Technol, 50(24), 13387-13396. doi:10.1021/acs.est.6b05745

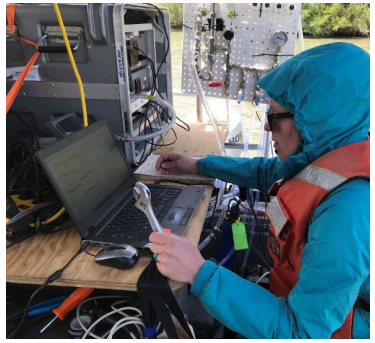
How can we improve monitoring technology and practice?

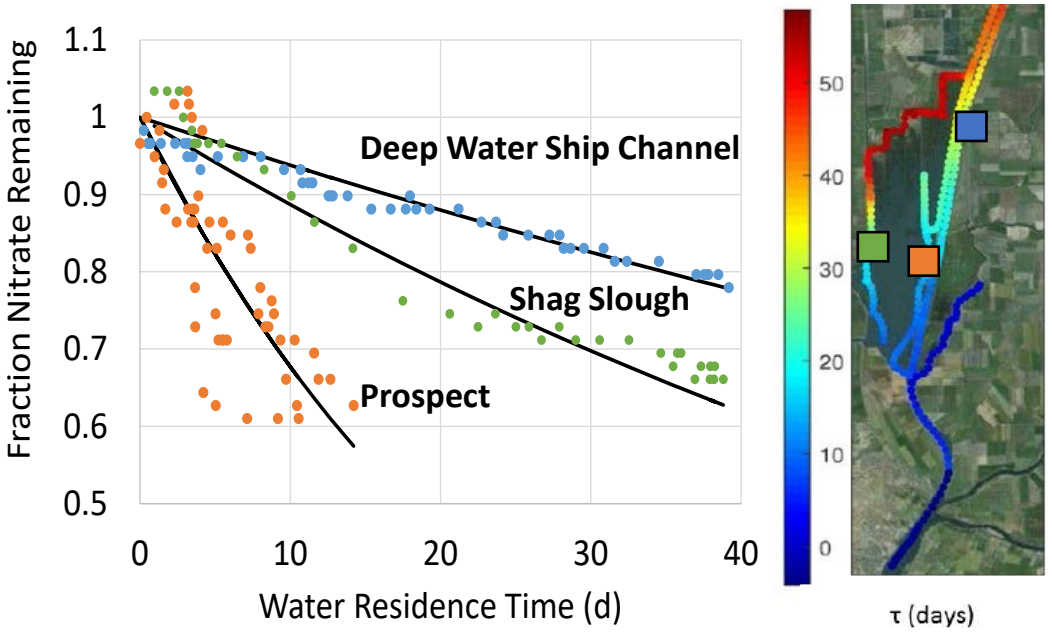
Residence time/water age assessment

- Field measurement of water age
- Can make measurement concurrent with measures of productivity, water quality and phytoplankton.

Future:

- Model calibration/validation (E. Gross, R. Holleman)
- Field studies in the North Delta (w/ R. Holleman, E. Gross)
- Studies in Franks Tract (K. Bouma-Gregson)
- Add additional reactive parameters.





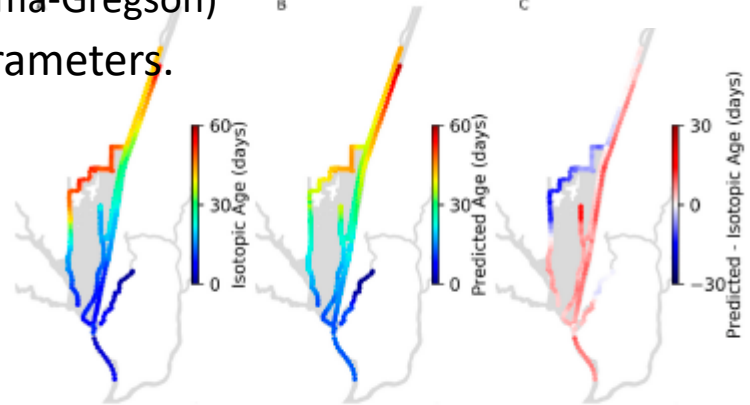


Figure 7. (A) Water age estimated from stable isotope observations; (B) hydrodynamic model predicted water age; (C) difference between predicted and isotopic water age.

Downing, B. D., Bergamaschi, B. A., Kendall, C., Kraus, T. E., Dennis, K. J., Carter, J. A., & Von Dessonneck, T. S. (2016). Using Continuous Underway Isotope Measurements To Map Water Residence Time in Hydrodynamically Complex Tidal Environments. *Environ Sci Technol, 50*(24), 13387-13396. doi:10.1021/acs.est.6b05745

Gross, E., Andrews, S., Bergamaschi, B., Downing, B., Holleman, R., Burdick, S., & Durand, J. (2019). The Use of Stable Isotope-Based Water Age to Evaluate a Hydrodynamic Model. *Water, 11*(11). doi:ARTN 2207 10.3390/w11112207

Kimmerer, W., Wilkerson, F., Downing, B., Dugdale, R., Gross, E. S., Kayfetz, K., . . . Thompson, J. (2019). Effects of Drought and the Emergency Drought Barrier on the Ecosystem of the California Delta. *San Francisco Estuary and Watershed Science, 17*(3). doi:https://doi.org/10.15447/sfews.2019v17iss3art2

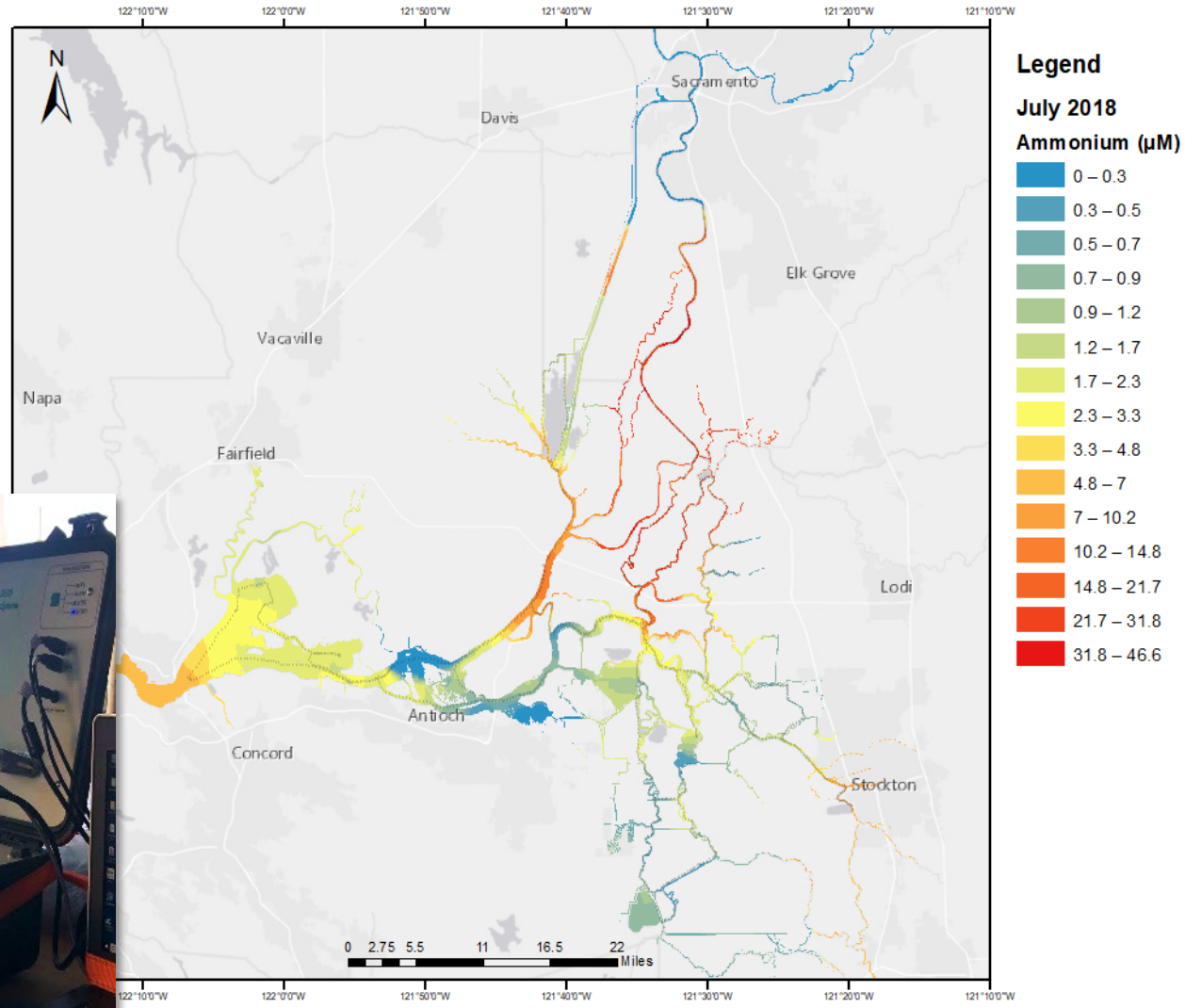
How can we improve monitoring technology and practice?

Continuous high frequency ammonium measurement

- Permits high resolution spatial surveys of ammonium
- Accurate to ecologically-significant levels

Future:

- Publications comprising data analysis
- Continuous fixed station measurements (w/ R.Dugdale, F. Wilkerson)



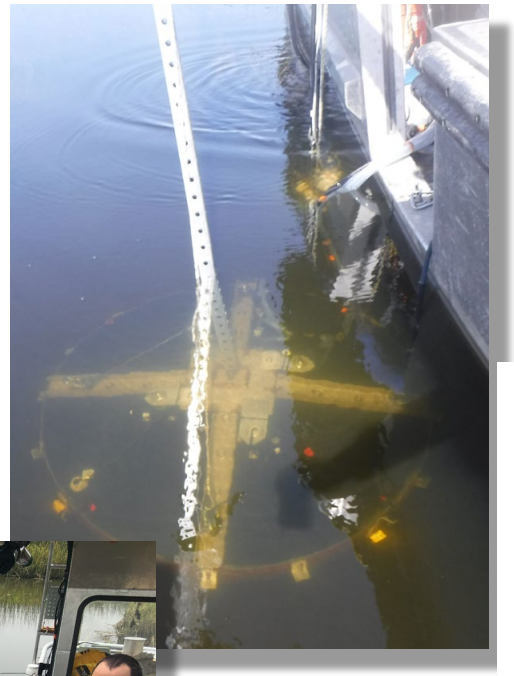
How can we improve monitoring technology and practice?

Sediment-water interactions

- A huge gap in our knowledge
- Thus, a huge gap in our models

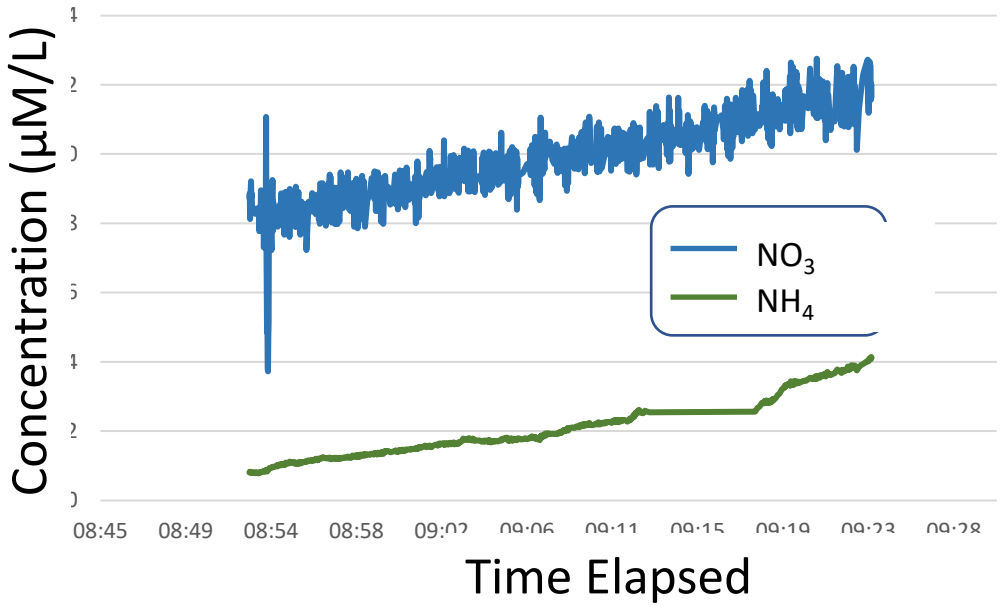
Future:

- No additional work is presently funded
- Publication of study results (T. Kraus)
- Supplement with other measurement types – eddy correlation; resin coring.



Hansen, J. A., Graham, N. J., Kraus, T. E. C., Downing, B. D., O'Donnell, K., and Bergamaschi, B. A. 2018. Improving benthic nutrient flux rate determinations using real-time, field-based high frequency measurements. 10th Biennial Bay-Delta Science Conference, Sacramento CA, September 10-12, 2018.

Hansen J., T. Kraus, B. Downing, N. Graham, K. O'Donnell, B. Bergamaschi, 2019. Improving benthic nutrient flux rate determinations using real-time, field-based high frequency measurements. Association of the Sciences of Limnology and Oceanography (ALSO) Aquatic Science Meeting Feb 23-March 2.



	NO_3	NH_4
Hourly Flux (µmol/m²-h)	501	266
Daily Flux (mmol/m²-d)	12	6

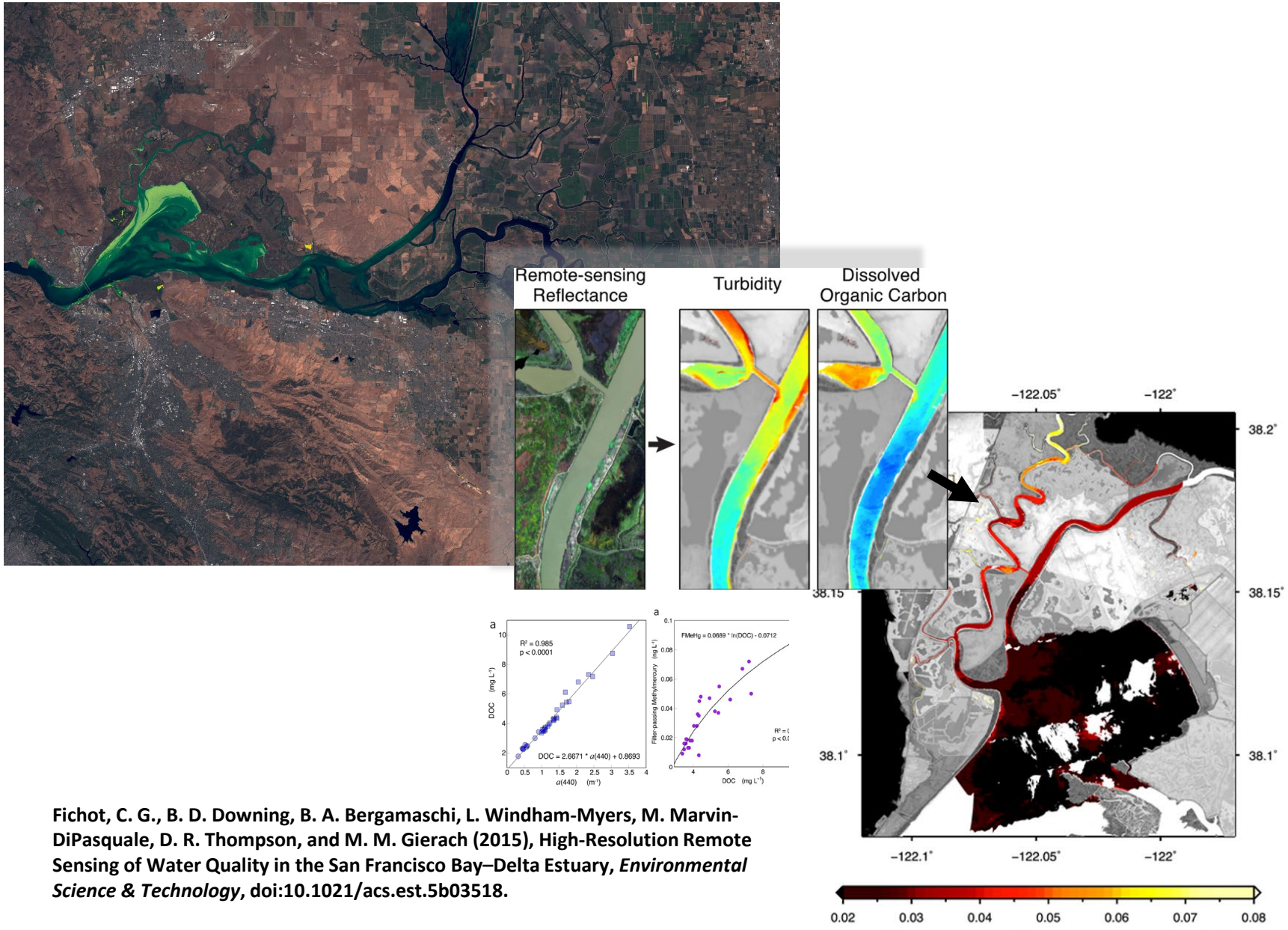
How can we improve monitoring technology and practice?

Remote sensing integration and validation

- Potential to extrapolate measurements in space and time
- New satellites will be much better
- Need better ways to ground-truth water quality data

Future:

- NASA collaboration
- Radiometry studies/ near-field spectral reflectance
- Prototype in DE



Fichot, C. G., B. D. Downing, B. A. Bergamaschi, L. Windham-Myers, M. Marvin-DiPasquale, D. R. Thompson, and M. M. Gierach (2015), High-Resolution Remote Sensing of Water Quality in the San Francisco Bay–Delta Estuary, *Environmental Science & Technology*, doi:10.1021/acs.est.5b03518.

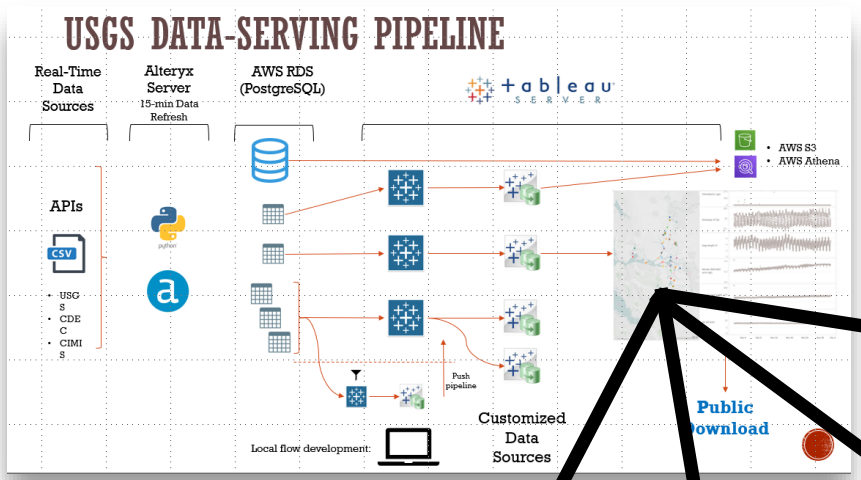
How can we improve monitoring technology and practice?

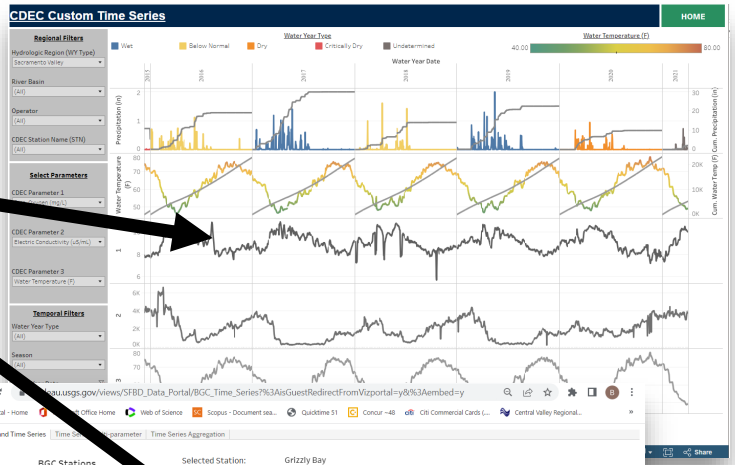
Improved data accessibility and integration across agencies and across data types

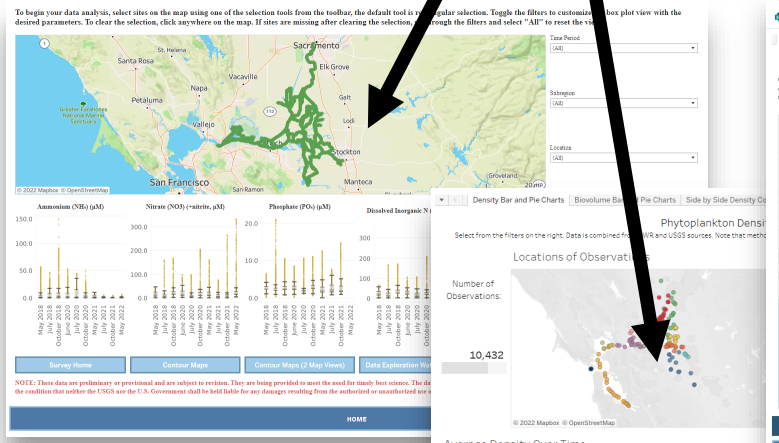
- Need to make data more easily accessible
- Need to integrate it so it is available when needed
- Make data explorable and easily downloadable

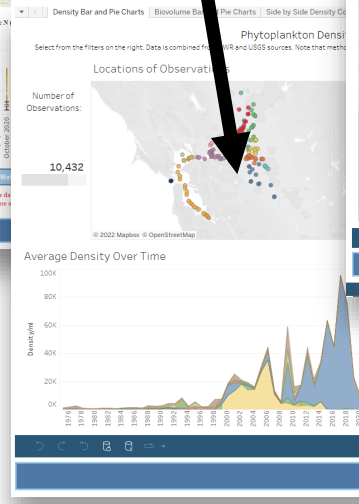
Future:

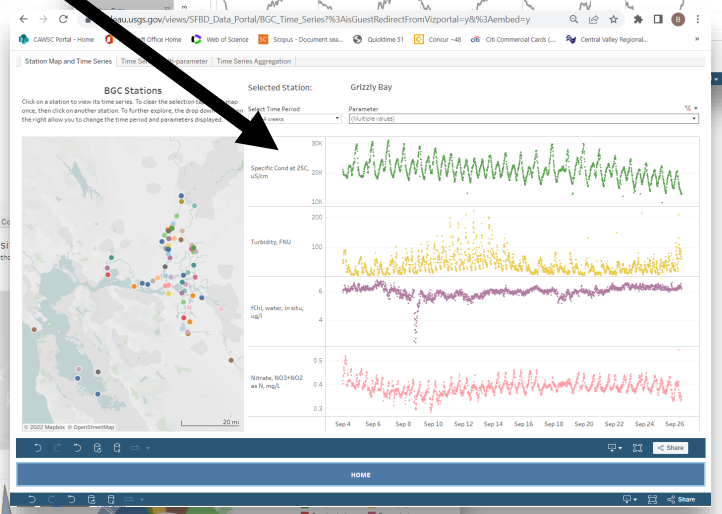
- Little ongoing funding
- Additional data types
- Near real-time models

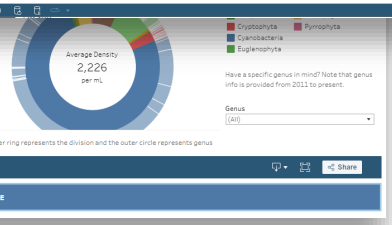












Recommendations

- Rapid response funding
- Reliable long-term funding (MOU?)
- Level research program funding
- Need to support data integration, wrangling and accessibility (as a necessary precursor to ongoing synthesis)
- Support explicit integration of models and monitoring data

Thanks!

bbergama@usgs.gov

Department of Water Resources Municipal Water Quality Investigations, Interagency Ecological Program, and Environmental Monitoring Program

TED FLYNN, DEPARTMENT OF WATER RESOURCES
LESLIE PALENCIA, TECHNICAL CONSULTANT

NUTRIENT MONITORING COLLABORATIONS AND PARTNERSHIPS, 3:45 TO 4:05 PM

CALIFORNIA DEPARTMENT OF WATER RESOURCES

Steady Science, Rapid Change

Ecological Monitoring in 21st Century California

Ted Flynn, Ph.D. (he/his)

PI, Environmental Monitoring Program

Division of Integrated Science & Engineering

Ecological Monitoring, Research, & Reporting Branch

California Department of Water Resources

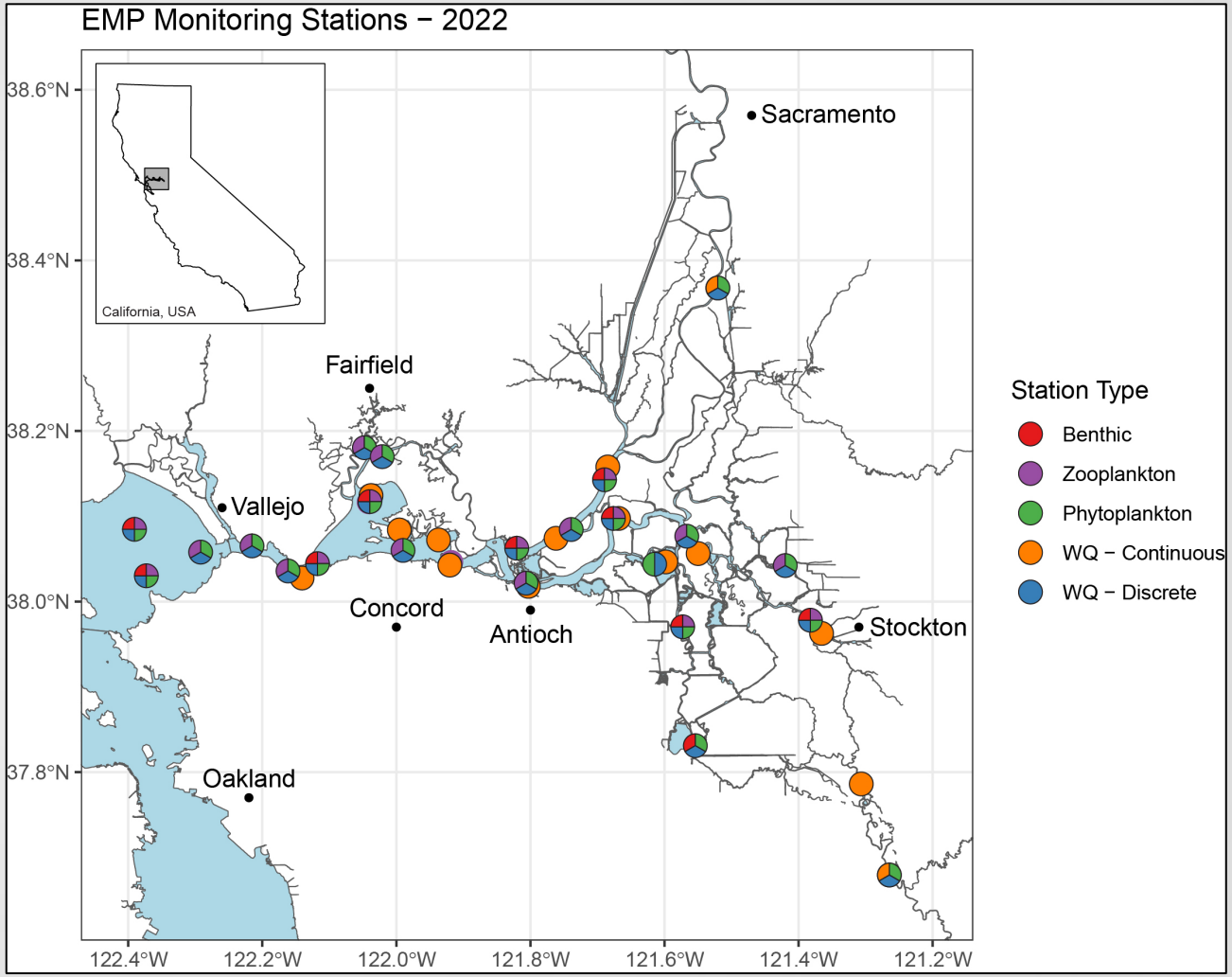
theodore.flynn@water.ca.gov

@TedFlynn

EMP Components

Program Component	# of Stations	Lead Agency
Benthic Invertebrates	10	DWR
Zooplankton	24	CDFW
Phytoplankton	28	DWR
Water Quality – Discrete	28	DWR
Water Quality – Continuous	15	DWR

- DWR & USBR cost-share funded
- D-1641 compliance
- One of the longest-running estuarine monitoring programs in the U.S. (since 1975)
- >23 peer-reviewed publications since 2000



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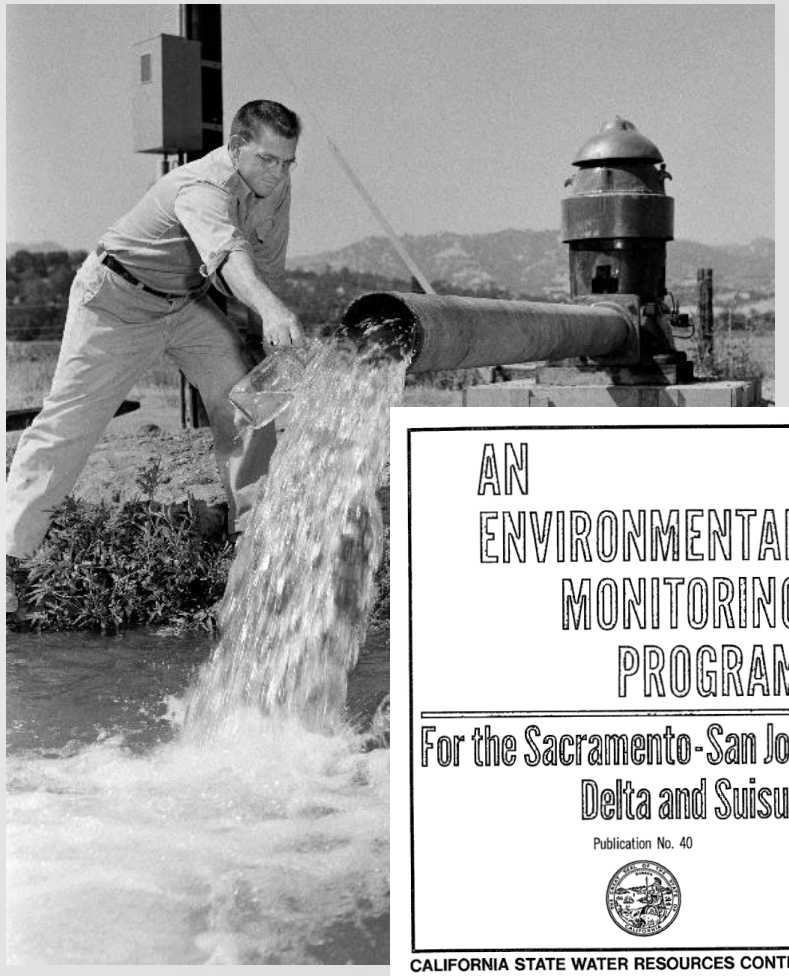
Environmental Monitoring Program

- Regular salinity and DO monitoring in the Delta predate EMP
- SWRCB contracted with the Stanford Research Institute to design a monitoring program in 1969
  - Concern that increased water exports would be detrimental to water quality in the Delta
  - Degraded water quality would impact dependent organisms and have adverse ecological impact
- Report published in 1970, eventually became EMP (records going back to 1975)



EMP – Discrete Water Quality

- Water samples collected and filtered in the field
- Analyses conducted at Bryte Laboratory

Analyte Name	Analysis Method
Total Alkalinity	Standard Methods 2320B
Bromide (dissolved)	EPA Method 300.0
Ammonia (dissolved)	EPA Method 350.1
Calcium (dissolved)	EPA Method 200.7
Chloride (dissolved)	EPA Method 300.0
Silica (dissolved)	EPA Method 200.7
Chlorophyll a	Standard Methods 10200H
Pheophytin a	Standard Methods 10200H
Total Kjeldahl Nitrogen	EPA Method 351.2
Nitrate + Nitrite (dissolved)	Standard Methods 4500-NO3-F
Organic Carbon (dissolved)	Standard Methods 5310C
Organic Carbon (dissolved)	Standard Methods 5310C
Organic Nitrogen (dissolved)	EPA Method 350.1
Ortho-phosphate (dissolved)	EPA Method 365.1
Phosphorus (total)	EPA Method 365.4
Total Dissolved Solids	Standard Methods 2540C
Total Suspended Solids	EPA Method 160.2
Volatile Suspended Solids	EPA Method 160.4

EMP – Continuous Water Quality

- 15 fixed continuous stations
- Data collected by EXO2 water quality sondes across the Delta

Analyte	Sensor Used
Turbidity	EXO Turbidity Smart Sensor
Water Temperature	EXO Cond & Temp Smart Sensor
Specific Conductance	EXO Cond & Temp Smart Sensor
Chlorophyll a	EXO Total Algae PC
pH	EXO pH Smart Sensor
Dissolved Oxygen	EXO DO Smart Sensor
fDOM	EXO fDOM Smart Sensor
Nitrate*	SUNA*, EXO NitraLED UV Sensor*
Cyanobacteria Abundance	bbe Fluoro Probe & PhycoProbe
Green Algae Abundance	bbe Fluoro Probe & PhycoProbe
Diatom Abundance	bbe Fluoro Probe & PhycoProbe
Cryptophyte Abundance	bbe Fluoro Probe & PhycoProbe

*Still in internal testing to assure data quality

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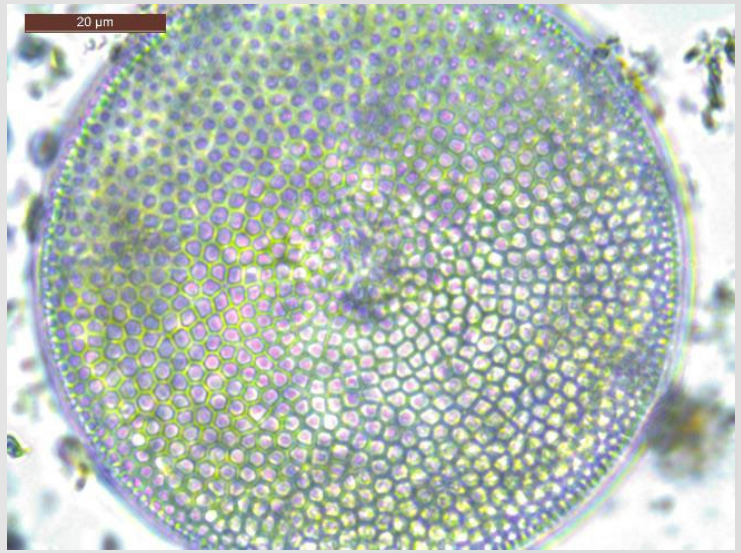
EMP – Biological Monitoring

- Data collected concurrently with water quality
- Benthic Invertebrates
- Phytoplankton
- Zooplankton



Data Availability

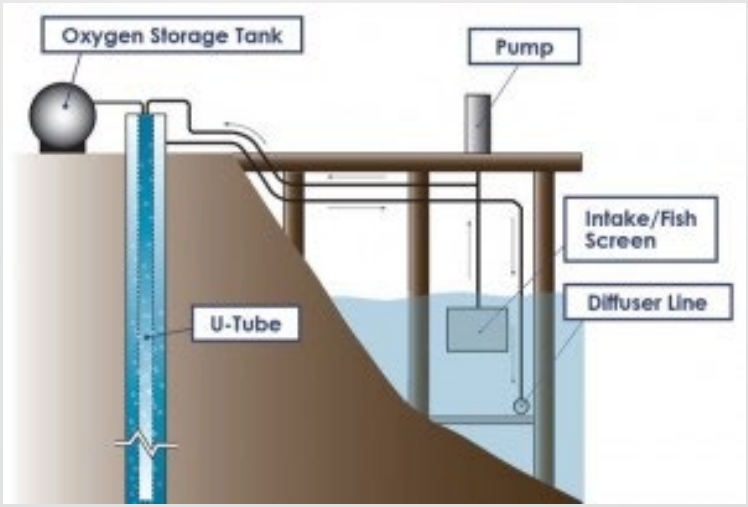
- Real-time water quality through CDEC
  - https://cdec.water.ca.gov/
- Historical data through EDI
  - Discrete Water Quality (doi: 10/f9mq)
  - Zooplankton (doi: 10/g29v)
  - Dissolved Oxygen (doi: 10/gfnq)
  - Benthic Invertebrates (doi: 10/jdrg)
  - Phytoplankton (Coming Soon)
- Online visualization tools
  - EMP phytoplankton data through USGS Tableau
  - Zooplankton synthesis tool (https://deltascience.shinyapps.io/ZoopSynth/)

Active Collaboration Partnerships

- EMP is part of the annual IEP Work Plan
- Collaborates actively in many IEP Synthesis Projects
  - Phytoplankton Synthesis
  - Zooplankton Synthesis
  - Delta Science Program NCEAS Synthesis Working Group
  - Project Work Teams
    - Phytoplankton & Water Quality
    - Bay-Delta Data Science
- Works with Delta RMP funded projects
  - Chlorophyll comparison study (led by Liz Stumpner)
  - Cyanotoxin study (led by USGS)

EMP – Dissolved Oxygen

- Data collected by EMP since 1969
- Led by DWR
- Basin Plan sets limits on DO throughout the year
  - Higher in Sep, Oct, Nov
- One continuous station at Rough and Ready Island
  - Water quality sondes at three depths
    - 1 m, 3 m, 6 m



Stockton Ship Channel

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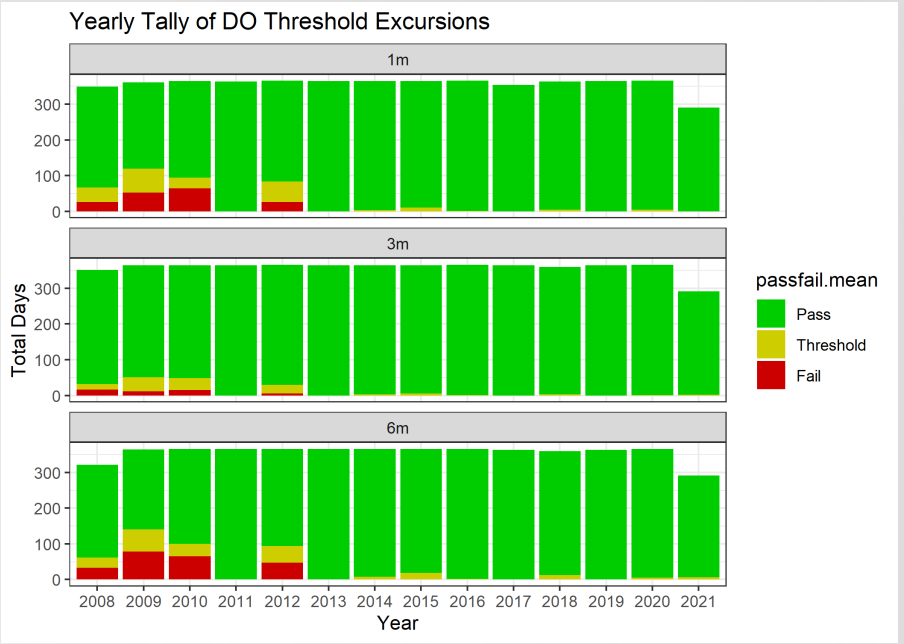
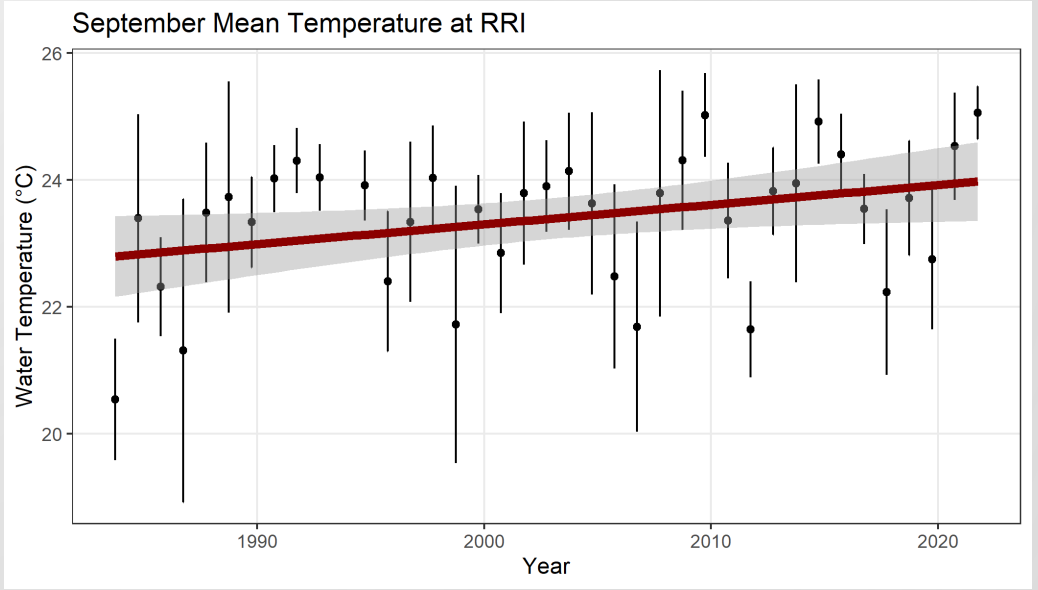
EMP: Dissolved Oxygen

- Installation of aeration facility has improved DO
- Warming temperatures may lead to more DO excursions





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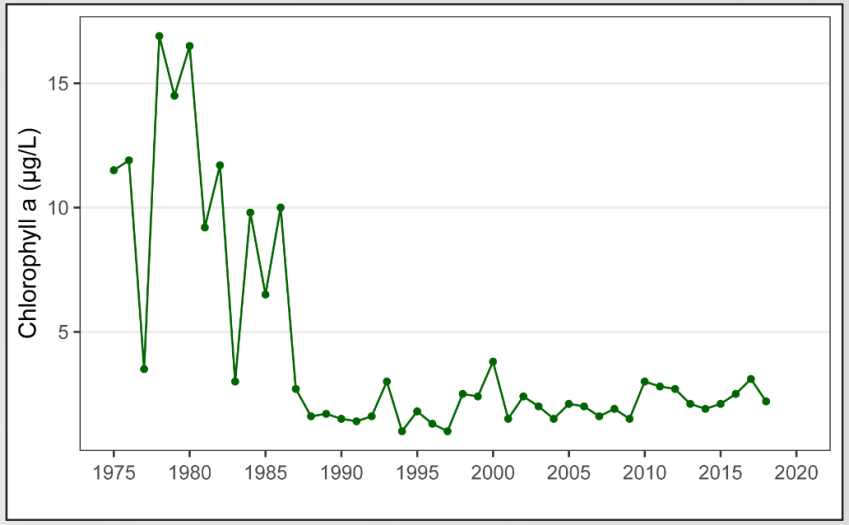
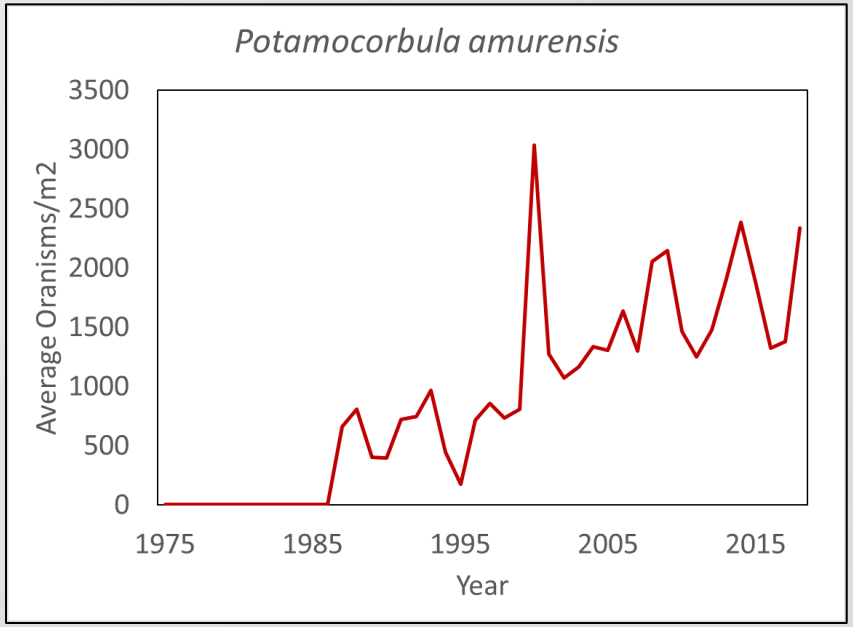
Value of Concurrent Monitoring

- Decline in primary productivity
- Spread of invasive species
- Ecosystem-level insight into things like Pelagic Organism Decline



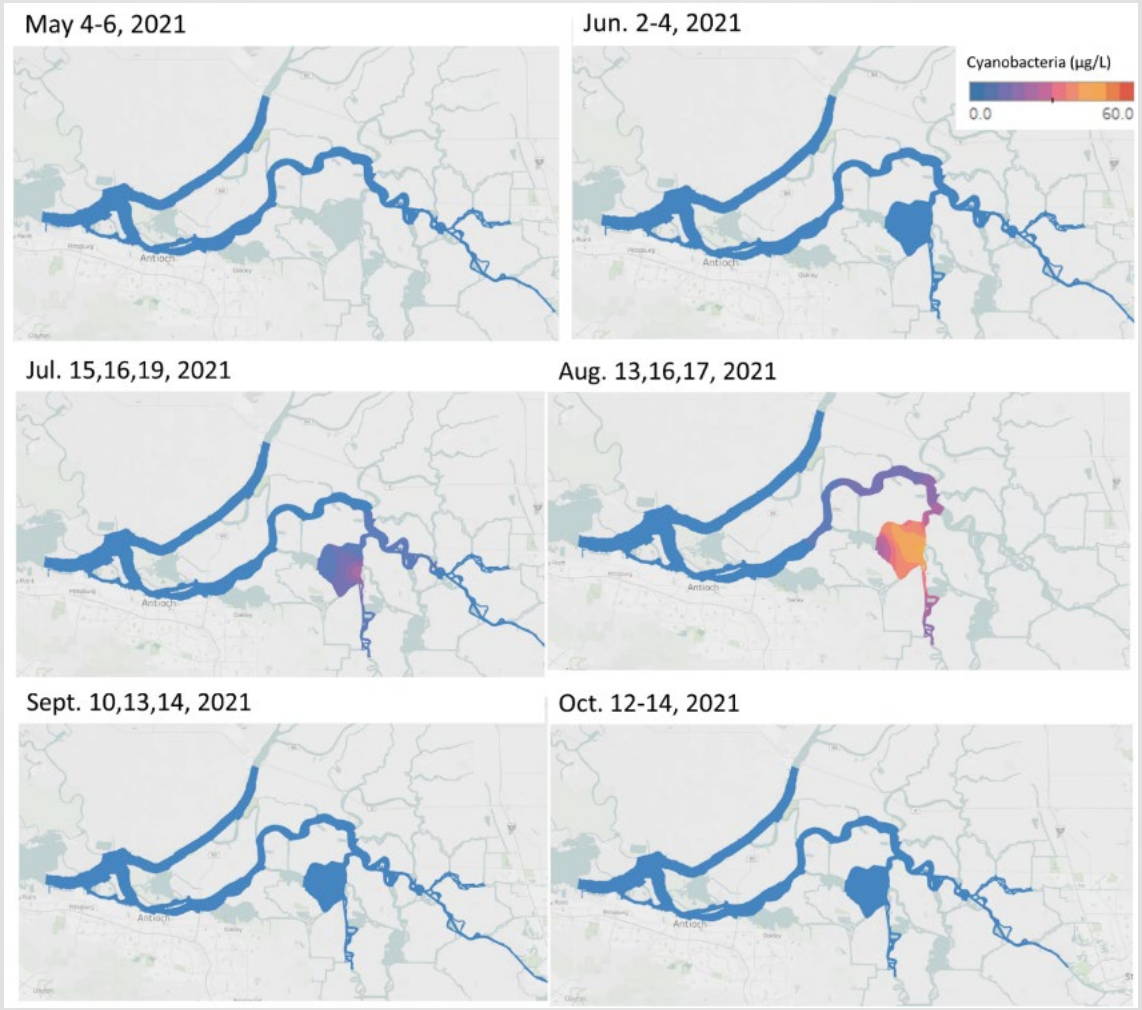


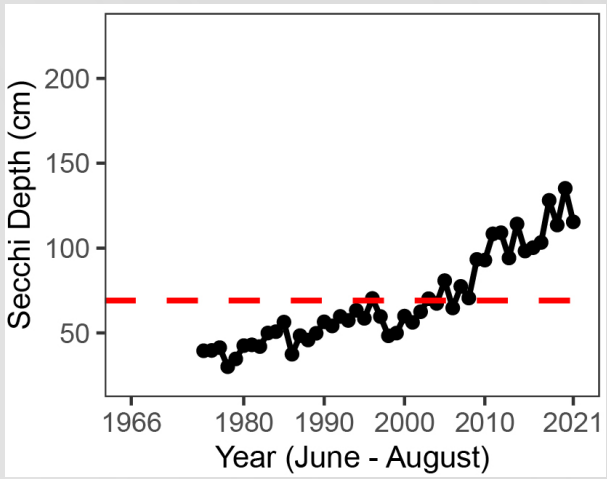
CALIFORNIA DEPARTMENT OF WATER RESOURCES

Harmful Algal Blooms

Microcystis aeruginosa

EMP FluoroProbe Data – Summer 2021



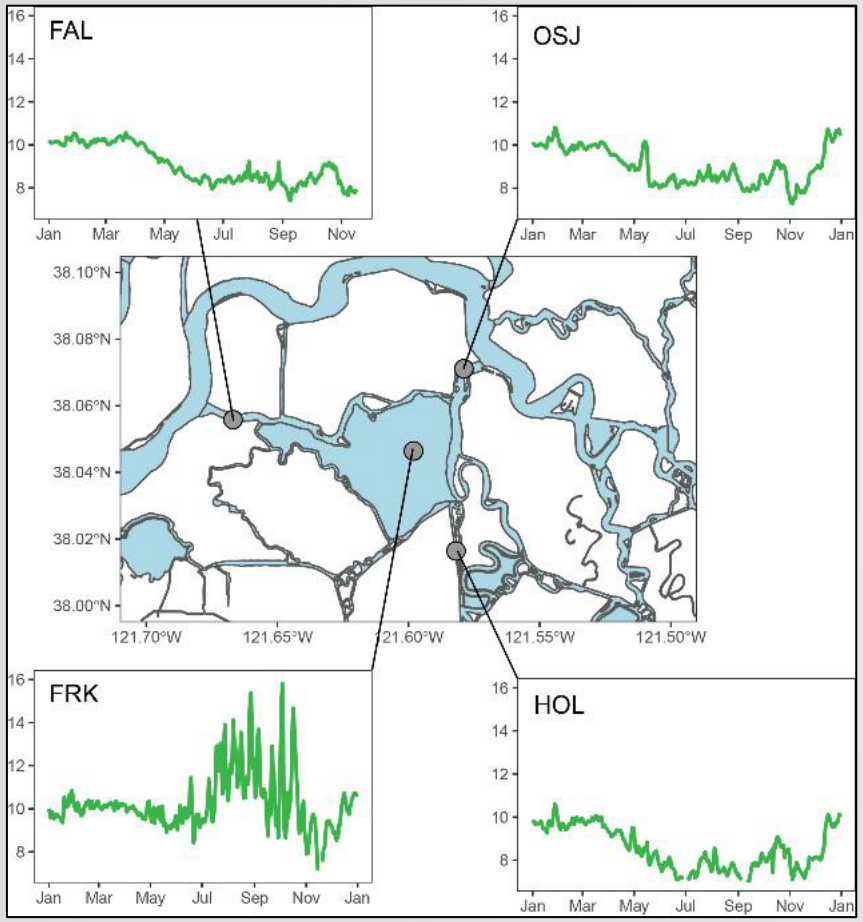


Franks Tract, 2021

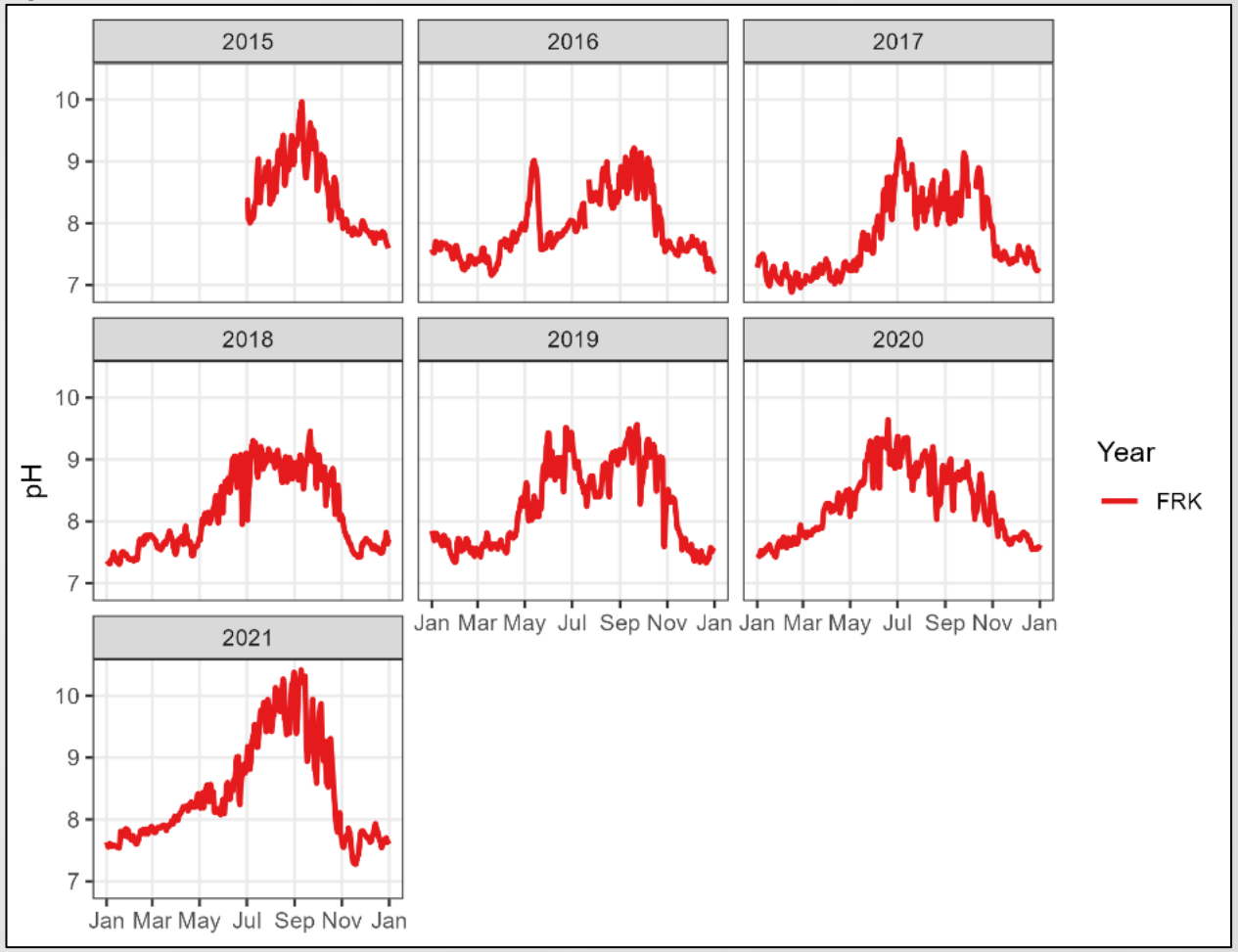
CALIFORNIA DEPARTMENT OF WATER RESOURCES

Water Quality Informs HAB Management

Dissolved Oxygen (2021)



pH



CALIFORNIA DEPARTMENT OF WATER RESOURCES

Acknowledgments

- Funding: USBR, DWR
- EMP Staff, Past and Present
  - Betsy Wells (Benthic)
  - Tiffany Brown (Phytoplankton)
  - Arthur Barros (Zooplankton
  - Morgan Battey (Water Quality)
  - Sarah Perry (Water Quality)
  - Julianna Manning (Water Quality)
  - Scott Waller (Continuous WQ)
  - Nick Van Ark (Boat Captain)
- Other Colleagues
  - Rosemary Hartman, Dave Bosworth, Keith Bouma-Gregson

CALIFORNIA DEPARTMENT OF WATER RESOURCES

USGS science for a changing world

BUREAU OF RECLAMATION

Interagency Ecological Program

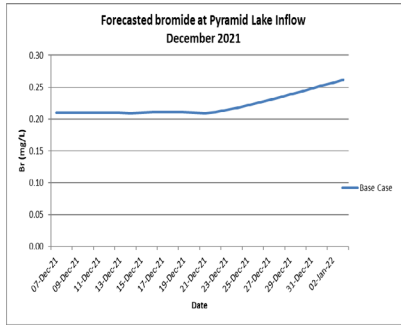
COOPERATIVE ECOLOGICAL INVESTIGATIONS SINCE 1970

MWQI Program Overview

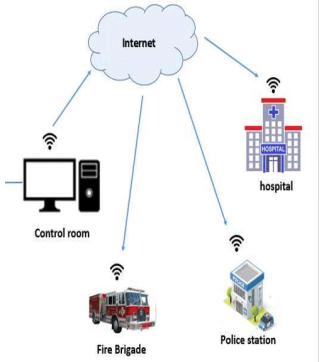
- Municipal Water Quality Investigations Program Established 1990
- Funded by participating urban SWP Contractors

MWQI Program core functions

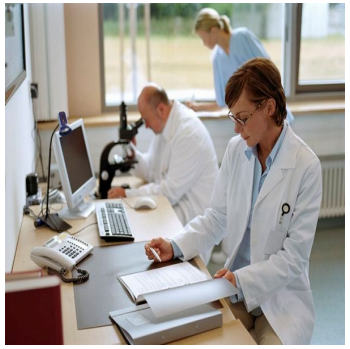
Monitor & Sample



Forecast Water Quality



Disseminate Data & Maintain Database



Scientific Studies

SWP Watershed Sanitary Survey

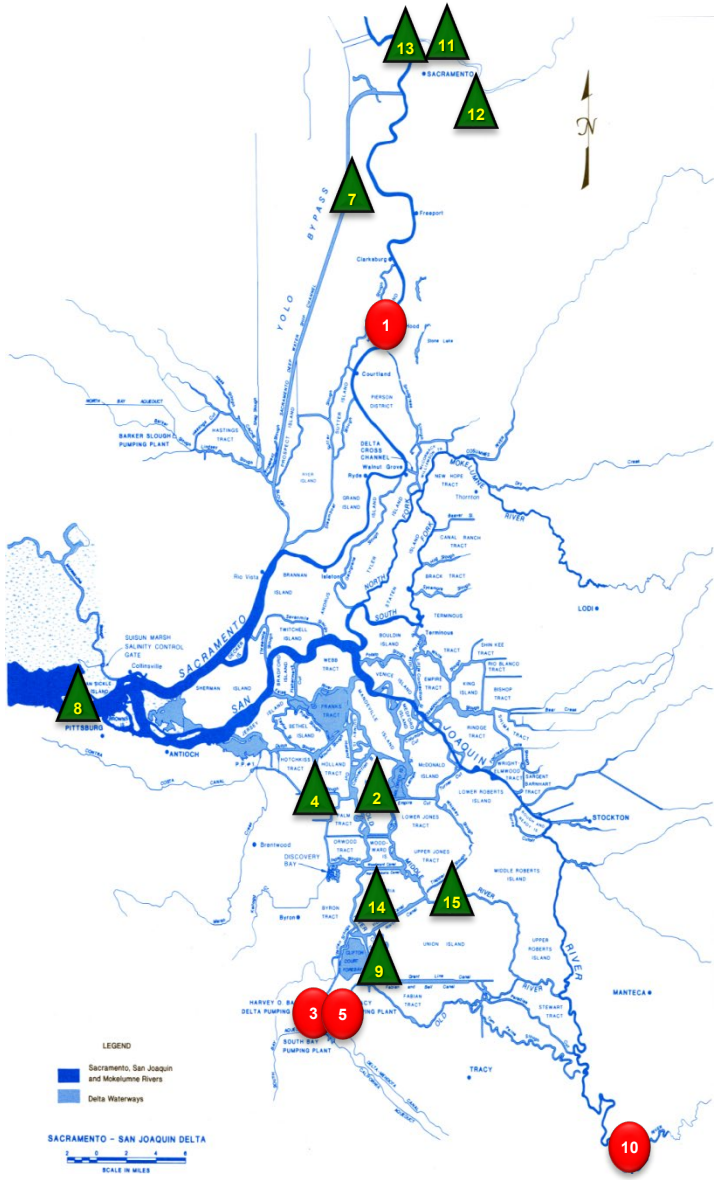
Snapshot of MWQI Program

- The MWQI Program monitors and evaluates water quality in the Sacramento-San Joaquin Delta (Delta) to produce a comprehensive information base for State Water Contractors and other interested parties.
- Real-time monitoring at 5 locations
- Discrete monitoring at 16 locations
- MWQI generated data, incorporated with non-program data, are disseminated daily at the Real-Time Data and Forecasting–Comprehensive Program (RTDF-CP) web site located at: http://rtdf.info/
- Special projects are completed on an as-needed basis

MWQI Program Overview

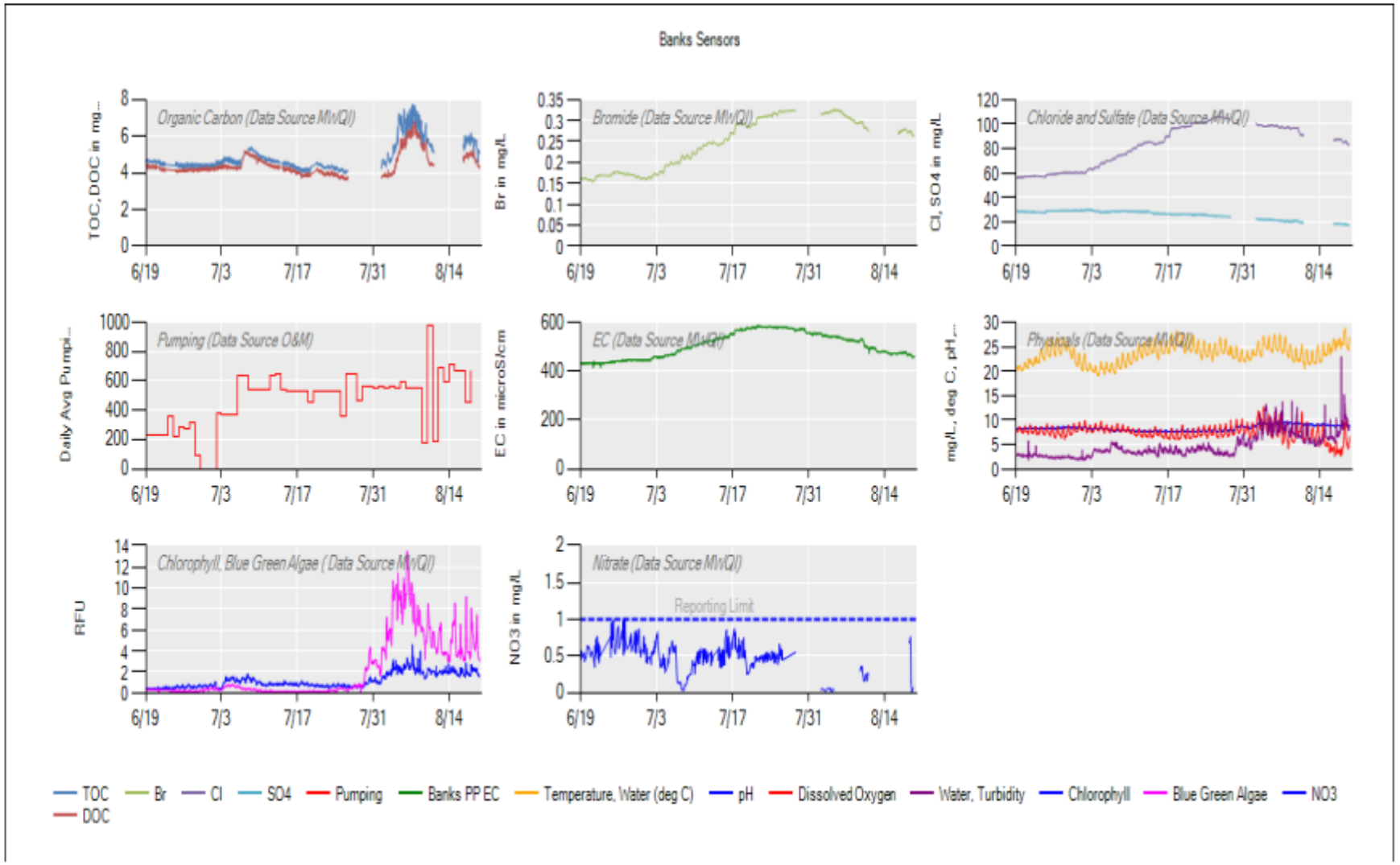
Real-Time Monitoring Stations

- Hood
- Banks
- Jones
- Vernalis
- Gianelli



Discrete Sampling Locations

Example of Real-time Data at Banks PP



MWQI Discrete Monitoring – 16 locations

Table 4. MWQI Program's 2022 Discrete Sampling Stations

#	Stations Name	WDL Stations (ID)	Analytes Collected (M= Monthly, Q=Quarterly, S=Seasonal, F=Flow Based)													
			Std Minerals	Std Nutrients	TOC	DOC	Anions	Chlorophyll	Metals	PTOX Cyanobacteria	Total Suspended Solids	Purgeable Organics	Tate & Odor	Radiological	Pesticides	Herbicides
1	Sacramento River at Hood	B9D82211312	M	M	M	M	M	M	M							
2	Old River @ Rancho Del Rio (D28A) (EMP collecting)	B9D75821344	M	M	M	M	M	M								
3	Banks Pumping Plant at Head-works (MWQI, O&M Collecting)	KA000331	M	M	M	M	M	M	M	S	M	M	W	Q	Q	Q
4	Rock Slough at CCWD Fish Screen (NCRO collecting)	B9C75861385	M	M	M	M	M	M								
5	Jones Pumping Plant at DMC	B9C74781351		M	M	M	M	M								
6	Gianelli Pumping/Generating Plant	ON003050		M	M	M	M	M								
7	Lisbon Weir (Yolo Bypass East Toe Drain) (AES Collecting)	B9D82851352	S	S	S	S	S	S			S					
8	Sacramento River @ Chipps Is-land- D10 (EMP collecting)	B9D80281551	M	M	M	M	M	M			M					
9	Old River at Clifton Court (EMP collecting)	B9D74981334	M	M	M	M	M	M			M					
10	San Joaquin River near Vernalis	B9D74051159	M	M	M	M	M	M	M		M					
11	Natomas East Main Drainage Canal	A0V83671280	F	F	F	F	F	F								
12	American River at E.A. Fairbairn WTP Intake	A0714010	M	M	M	M	M	M								
13	Sacramento River at West Sacra-mento WTP Intake	A0210451	M	M	M	M	M	M								
14	Old River at Station 9	B9D75351342	M	M	M	M	M	M								
15	Middle River at Union Point	B9D75351292	M	M	M	M	M	M								
16	Colusa Ag Drain nr. Sacramento River	A0294500	M	M	M	M	M	M			M					

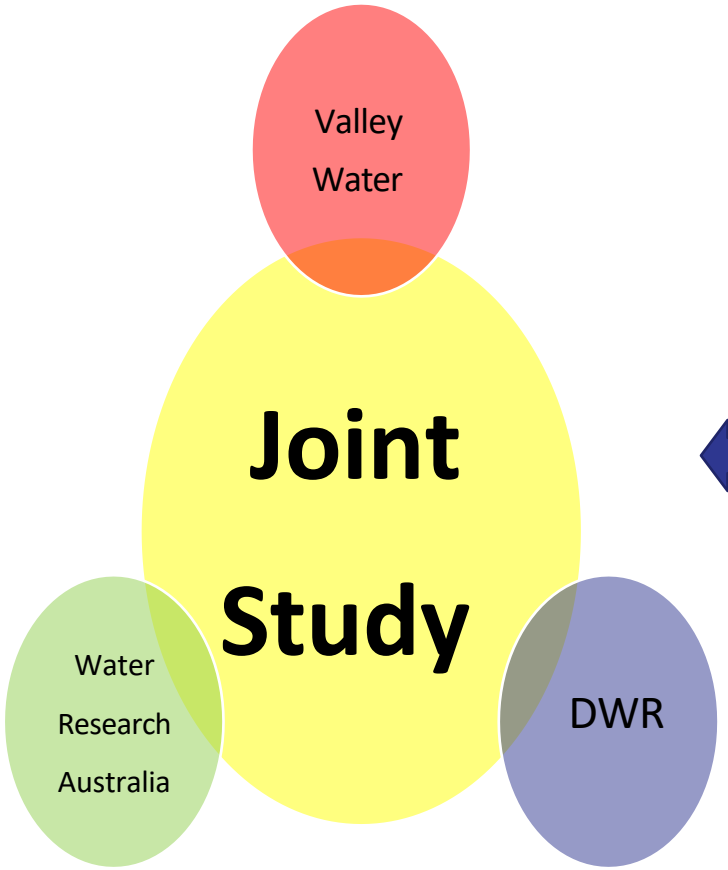
Physical Parameters collected at all sites: Temperature, pH, Turbidity, Dissolved Oxygen, and Specific Conductance

Nutrients are monitored on a monthly basis

Special Projects

- In 2020, MWQI staff installed a real-time ammonia analyzer at the Sacramento River at Hood Station.
- Unfortunately, growth on filter (inside analyzer) occurred on a daily basis, which stripped the nitrogen from the water, reducing the value to zero.
- Options were to make frequent trips to station to replace the filter, or install a whole new pumping and filter system.
- Ammonia analyzer was decommissioned in Sept. 2020 after about one year of testing

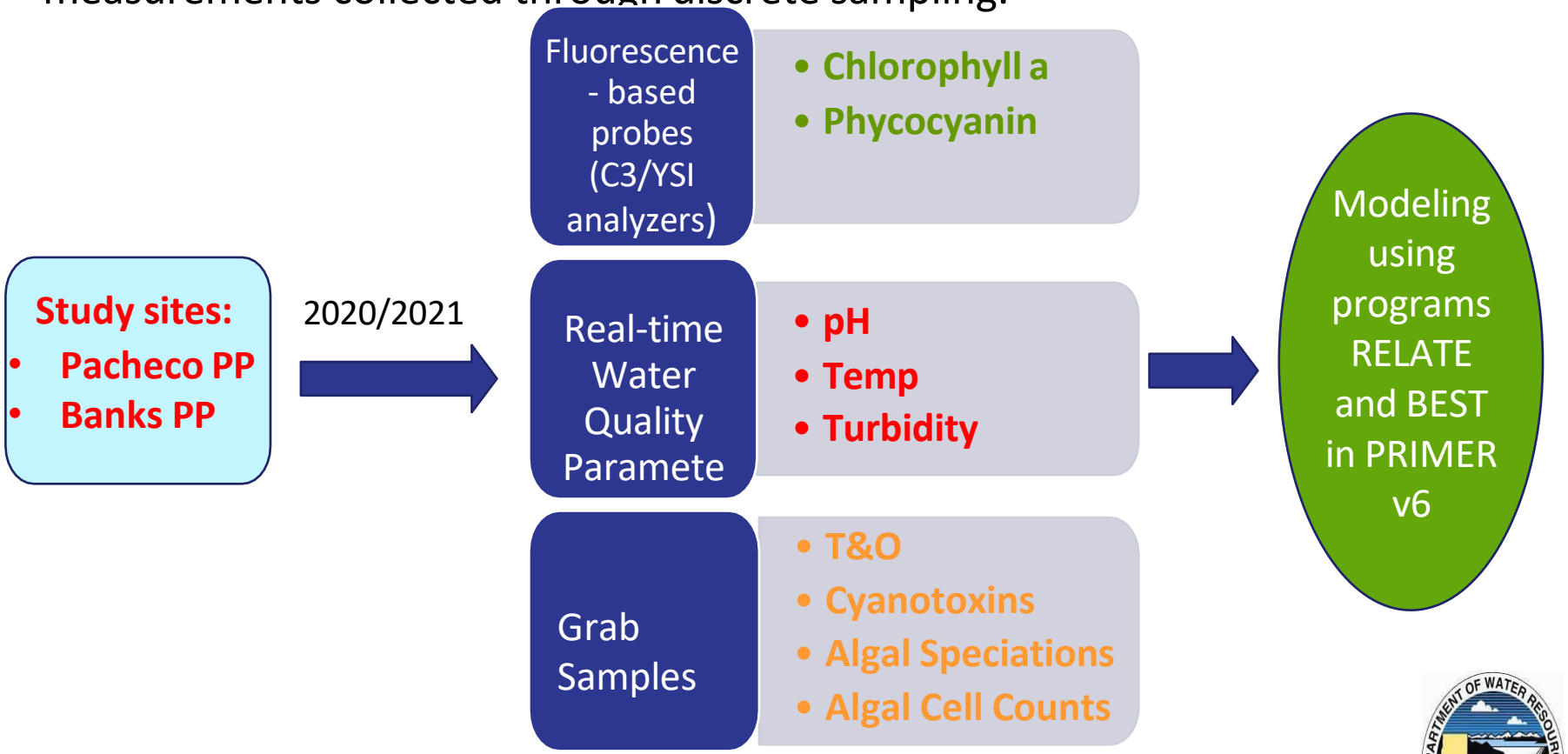
Joint Project



Developing an Early Warning System for Management of Cyanotoxins/T&O in Source Water

Objectives of the Project

Objective 1: to develop a real-time cyanotoxin management trigger by comparing fluorescence- based probe readings to analytical measurements collected through discrete sampling.



Fluorescence-Based Analyzers

Objective 2: Data measured by C3 and YSI will be compared by conducting statistical analysis. In addition, challenges with regards to running, maintaining, and trouble-shooting will be documented.

Turner Designs C3

Turner Designs C3	*YSI* EXO2
• Chlorophyll a, Phycocyanin, Red Chlorophyll • Pacheco PP, Banks PP	• Chlorophyll a, Phycocyanin, FDOM, other WQ parameters • Banks PP, several other stations along the North and South Bay Aqueduct

YSI

Banks Pumping Plant

Valley Water

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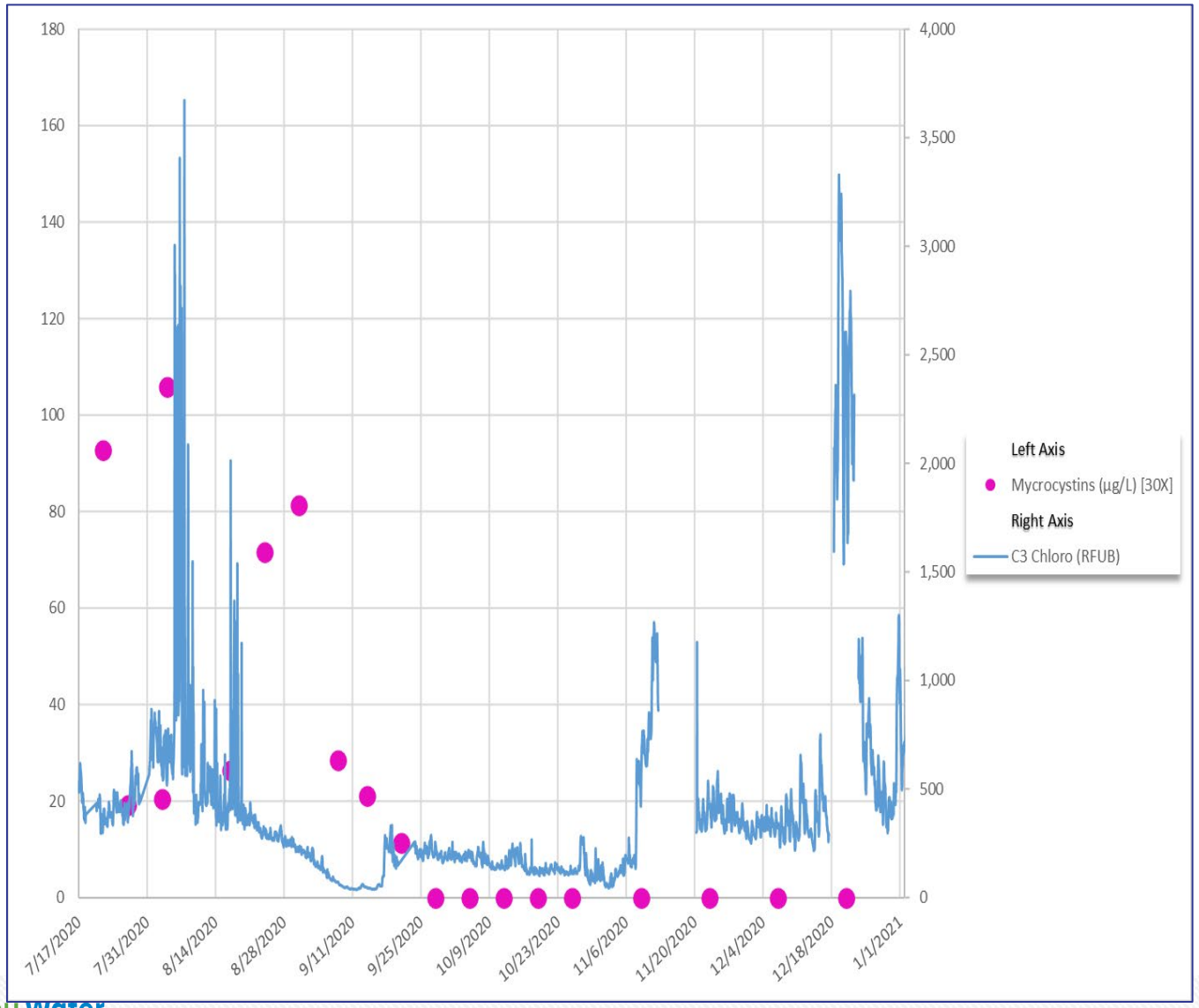
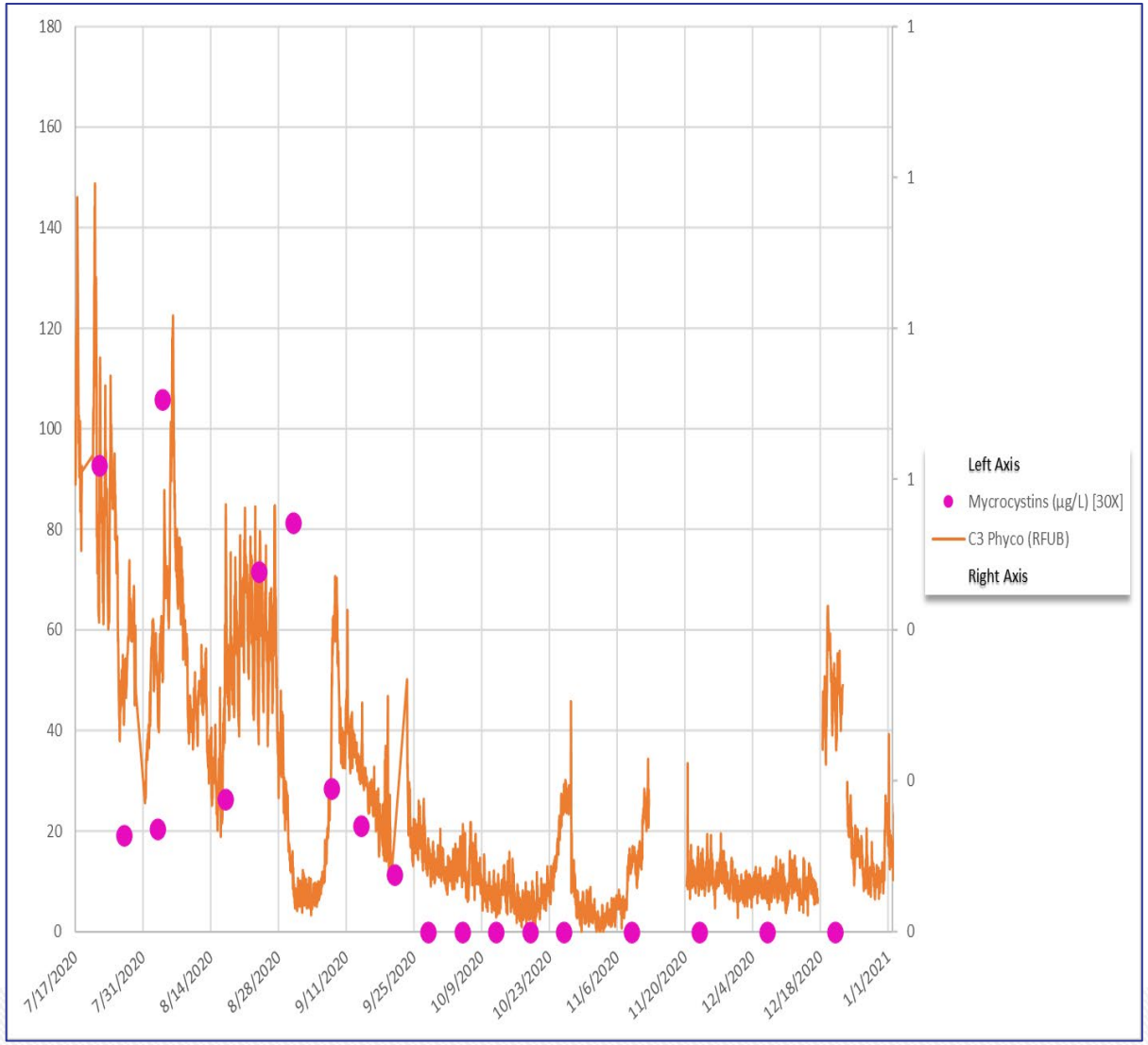
C3 Chlorophyll Readings vs Microcystins Concentrations – Banks PP



Valley Water

DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA

C3 Phycocyanin Readings vs Microcystins Concentrations – Banks PP



Valley Water

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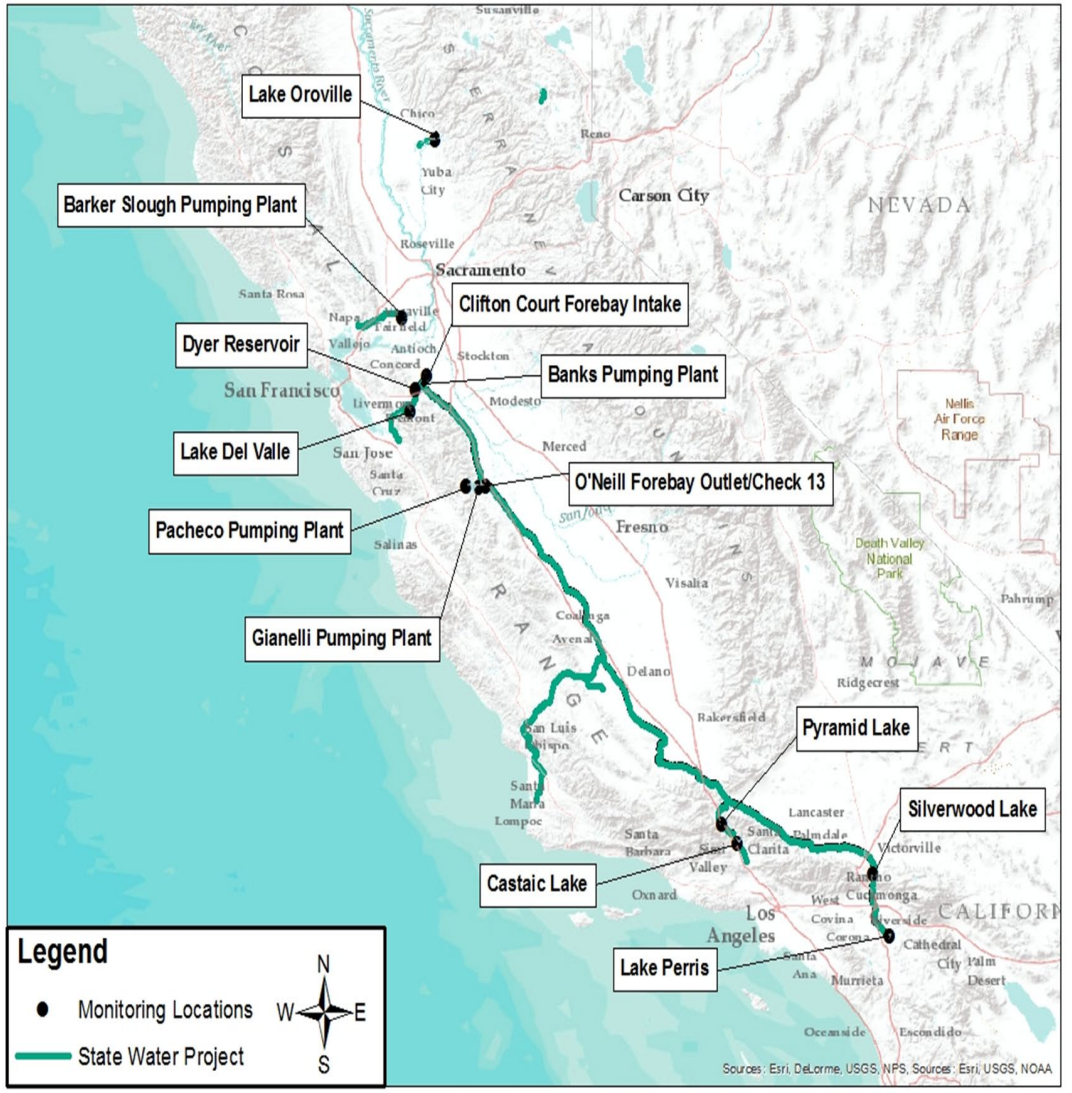
Next Steps

- Complete data analysis
  - Missing Pacheco data has been sent to Taliesin for inclusion in analysis.
  - Corrected grab samples times have been sent to Taliesin. Once corresponding C3 data are used, the regressional fit should improve.
- Final Report by Water Research Australia
- Implement HAB Trigger based on findings?
  - If good correlation between C3 and HAB species is found, next step could be to reinstall C3 and use as warning tool for high HAB species events. At trigger points, additional Algal Speciation/Biovolume samples would be collected to confirm HAB species presence.

SWP Cyanotoxin Monitoring Program Background

- Routine monitoring since 2006
- Monitoring began to inform municipal water customers
  - Water quality monitoring sites and pumping plants
- Program expanded in 2016-2017
  - Recreation areas
  - DWR water treatment plants
- Sample during “algal bloom season” April – October, extended if necessary
- Sampling frequency for WQ sites once monthly Apr-May, twice monthly June - Oct
  - weekly if toxins detected
- Recreation sites sampled weekly Memorial Day – Labor Day



Sample Analysis

- GreenWater Lab
  - Step 1: Potentially toxigenic (PTOX) cyanobacteria screening by microscopy
    - toxin analysis recommendation based on presence of PTOX cyanobacteria and site history
  - Step 2: ELISA or LC-MS/MS to quantify toxins
    - Samples ultra-sonicated to lyse cells and release toxins
    - Microcystins/nodularins
    - Saxitoxin
    - Anatoxin-a
    - Cylindrospermopsin

Sample Collection and Analysis Overview

- Surface water grab sample at recreation sites
  - Sample sent for lab analysis
  - Subset is analyzed with field test strip
- At water quality sites, sample is collected at 1 meter depth or from the raw water tap at the water quality station
  - Lab analysis only
- At DWR-operated water treatment plants, sampling occurs when toxins are detected in the source waterbody
  - Analyzed with drinking water test strips
  - Lab analysis if positive test strip result

San Francisco Bay Regional Monitoring Program (SF Bay RMP)

TOM MUMLEY, SAN FRANCISCO BAY REGIONAL WATER QUALITY CONTROL BOARD

NUTRIENT MONITORING COLLABORATIONS AND PARTNERSHIPS, 4:05 TO 4:25 PM

SF Bay Regional Monitoring Program and Nutrient Management Strategy

DELTA REGIONAL MONITORING PROGRAM NUTRIENT SYMPOSIUM

September 27, 2022

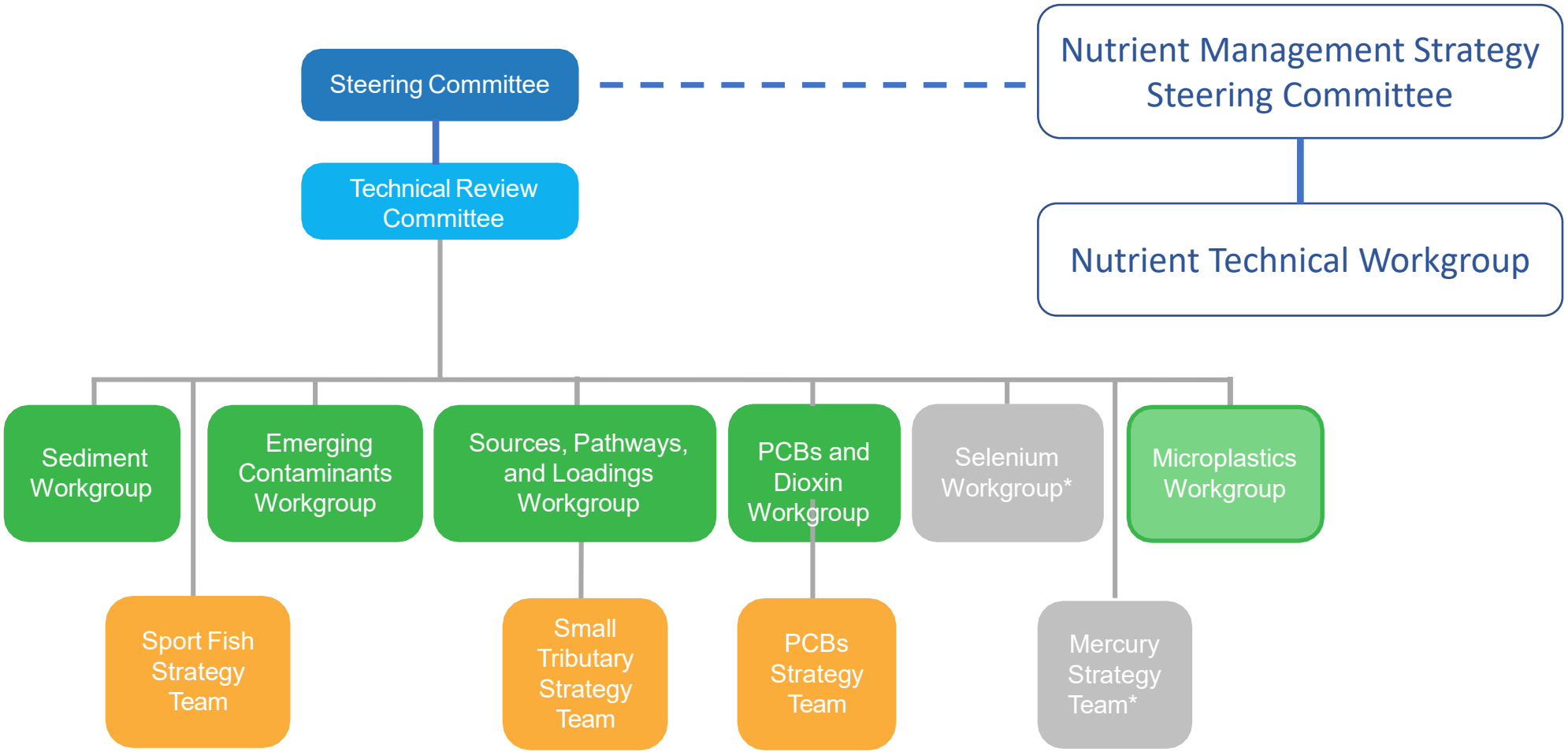
Thomas Mumley
Assistant Executive Officer
SF Bay Water Board

CALIFORNIA Water Boards

SF Bay Regional Monitoring Program

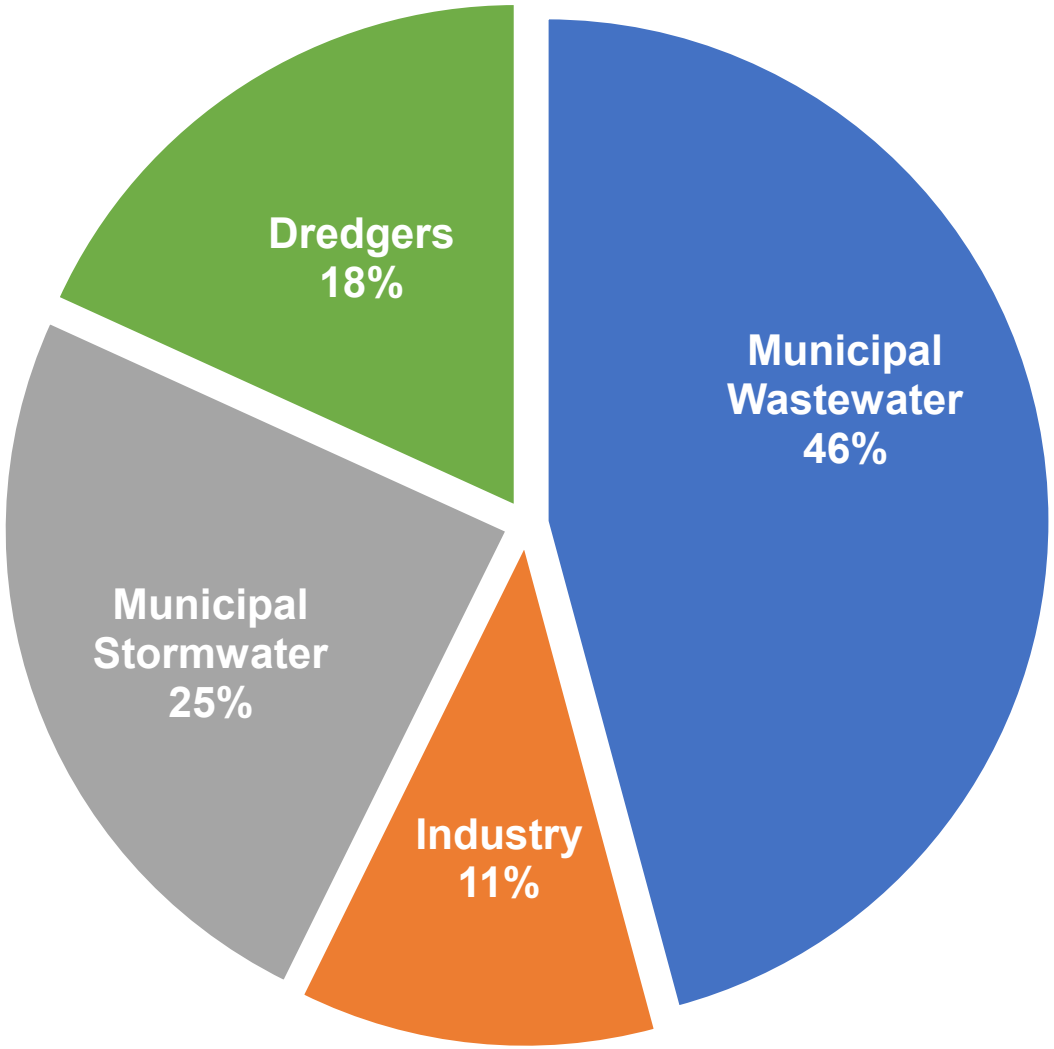
- Legacy contaminants
- Emerging contaminates
- Sediment
- Nutrients

SF Bay RMP Governance Structure



*currently inactive

SF Bay RMP Funding



~$4 million/yr

~$500,000/yr for nutrients

SF Bay NMS Steering Committee

Regulators

- SF Bay and **Central Valley Water** Boards / US EPA

Dischargers

- **Municipal Wastewater** and Stormwater / Industrial Wastewater

Resource Agencies

- NOAA-NMFS / US FWS / CA DFW / CA Ocean Protection Council

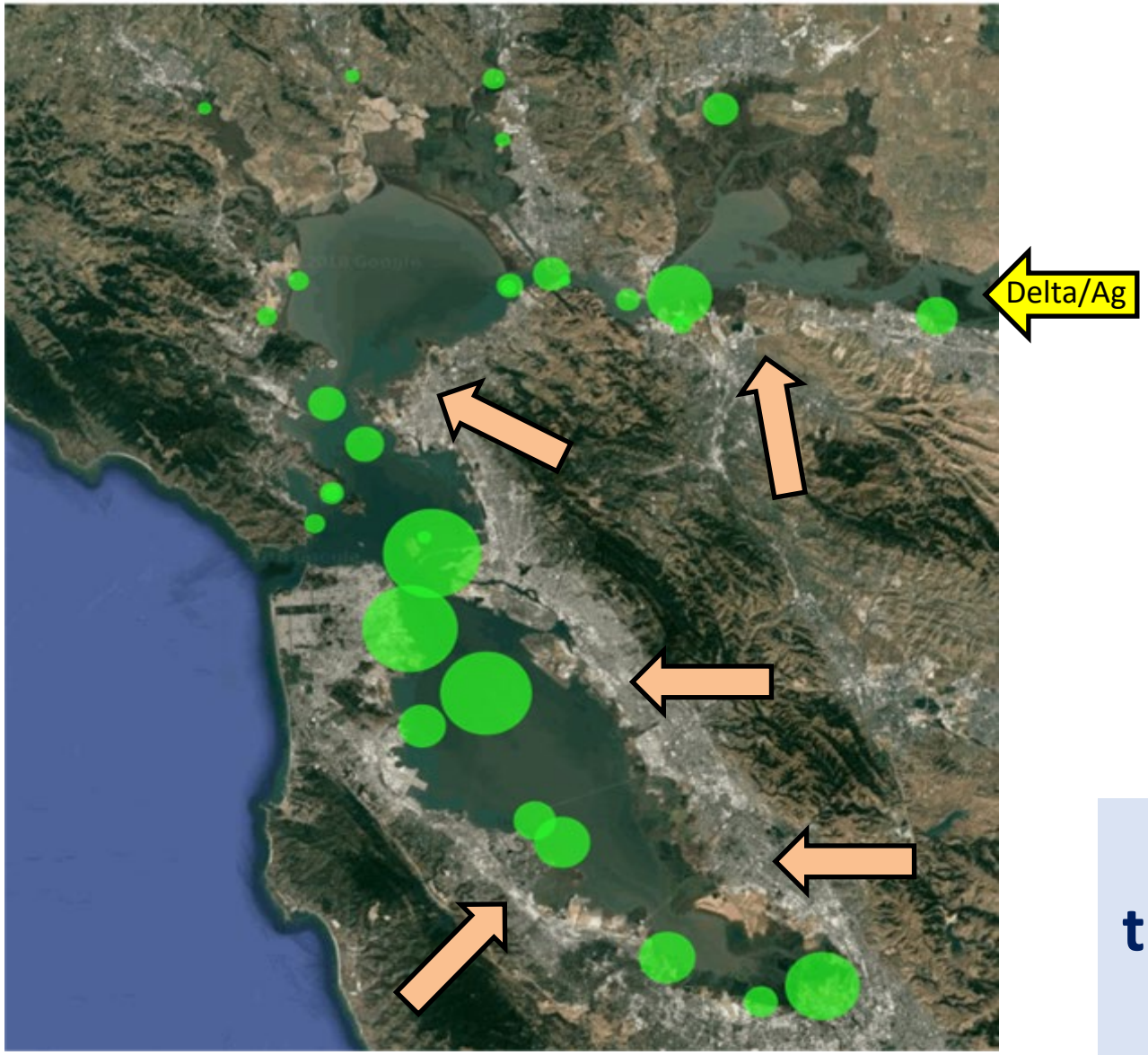
Science and Monitoring Programs

- **Interagency Ecological Program** / **Delta Science Program** / USGS / South Bay Salt Pond Restoration Program

Others

- SF Baykeeper / State and **Federal Contractors Water Agency**

Nutrient Loads to SF Bay



Bay-wide Loads

N: 50,000 kg/d

P: 5,000 kg/d

65% Wastewater

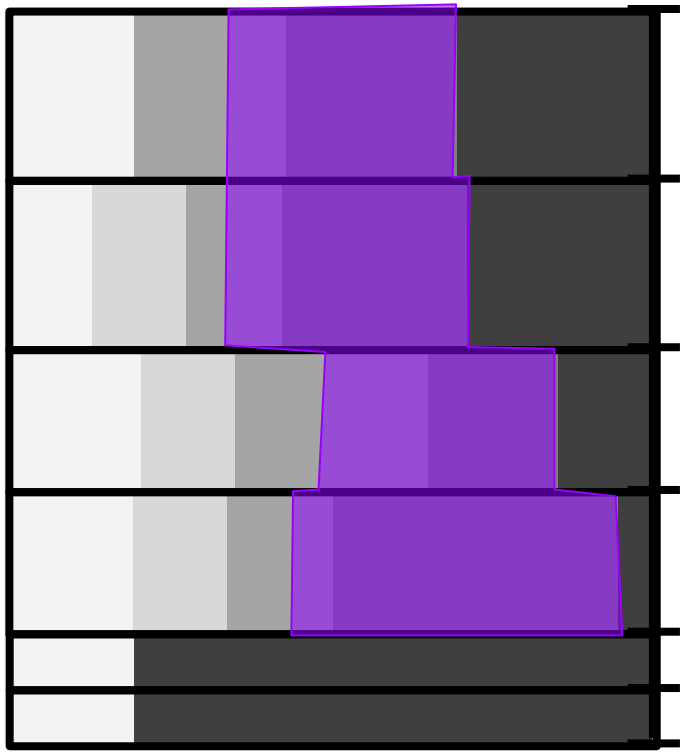
20% Delta/Ag

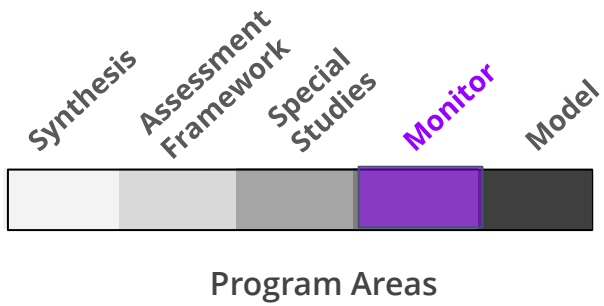
15% Urban runoff

Municipal wastewater treatment plant upgrades > $10 billion

SF Bay NMS Science Plan - Relative Distribution of Funding

Program Area





Science Focus Area

Nutrient Dynamics

Phytoplankton-DO, Open-Bay

Phytoplankton-DO, Lower So Bay sloughs/tidal-creeks

HABs

Coastal impacts

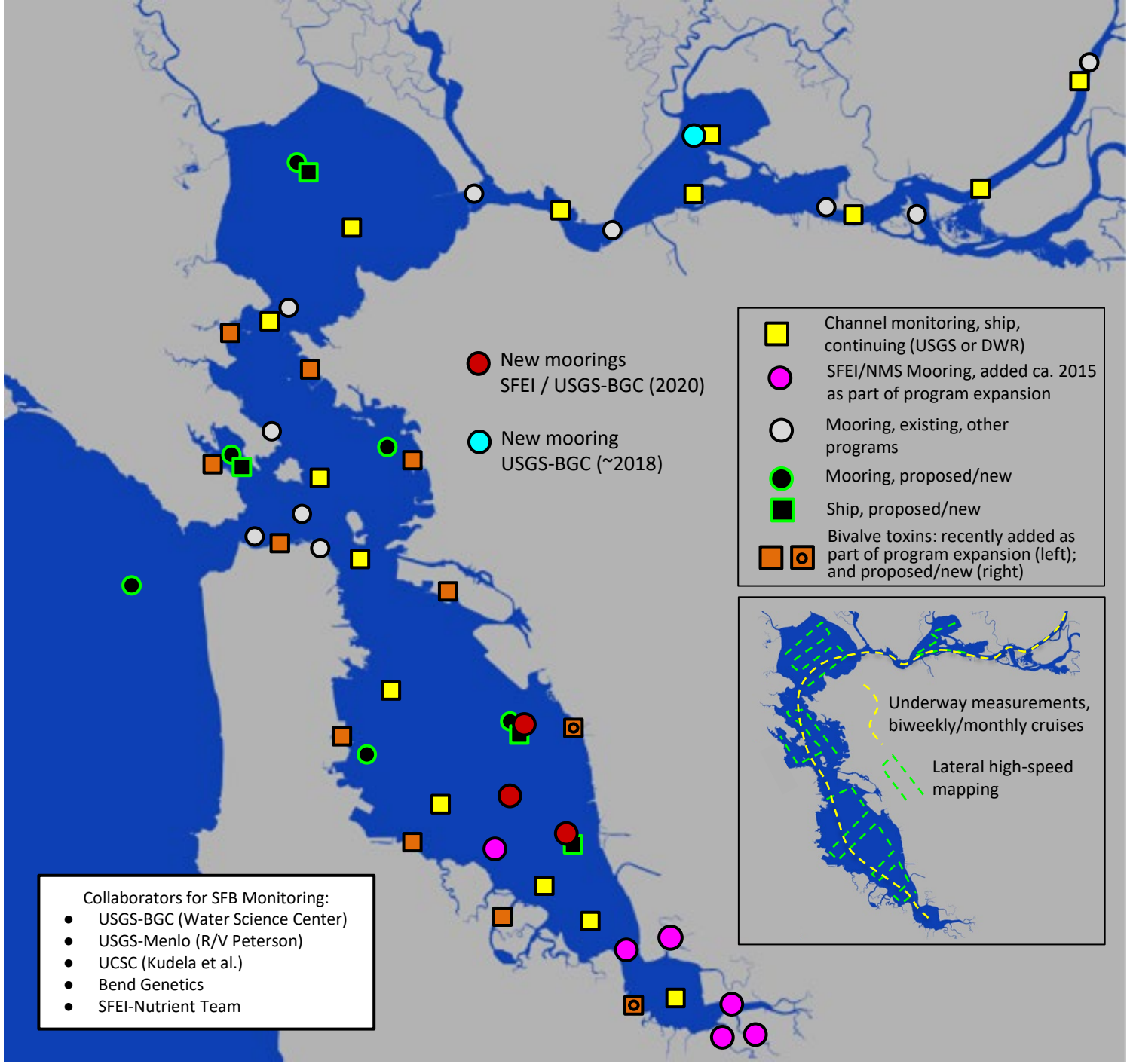
Future scenarios | Risk

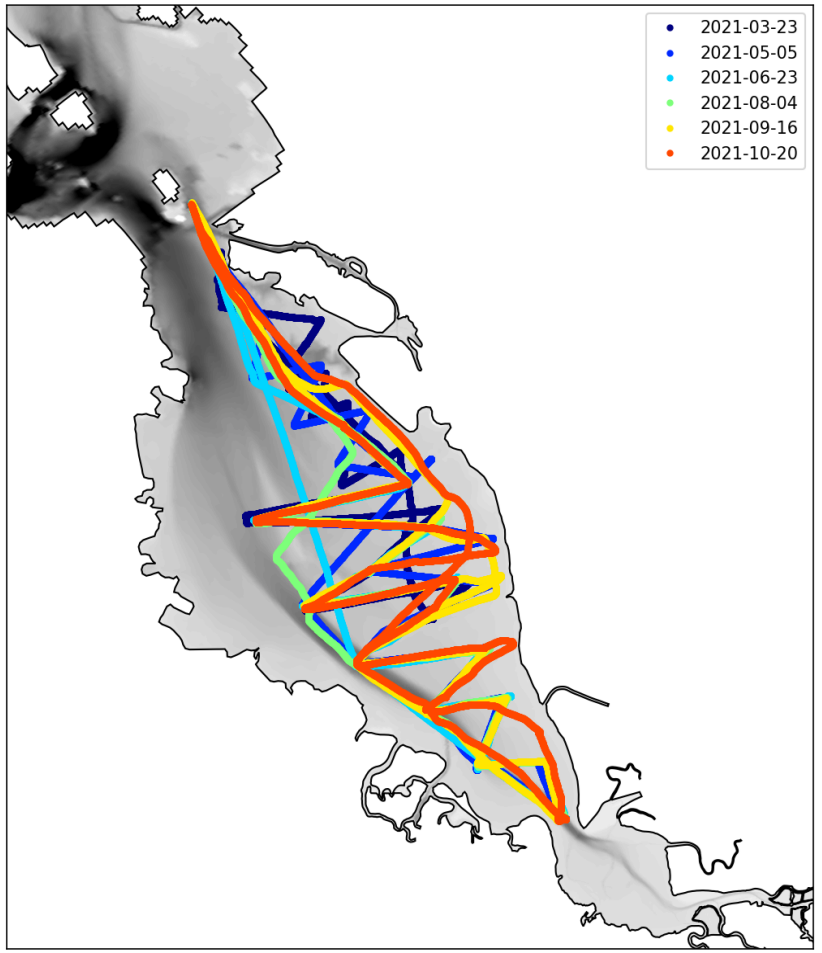
~$3 million/yr

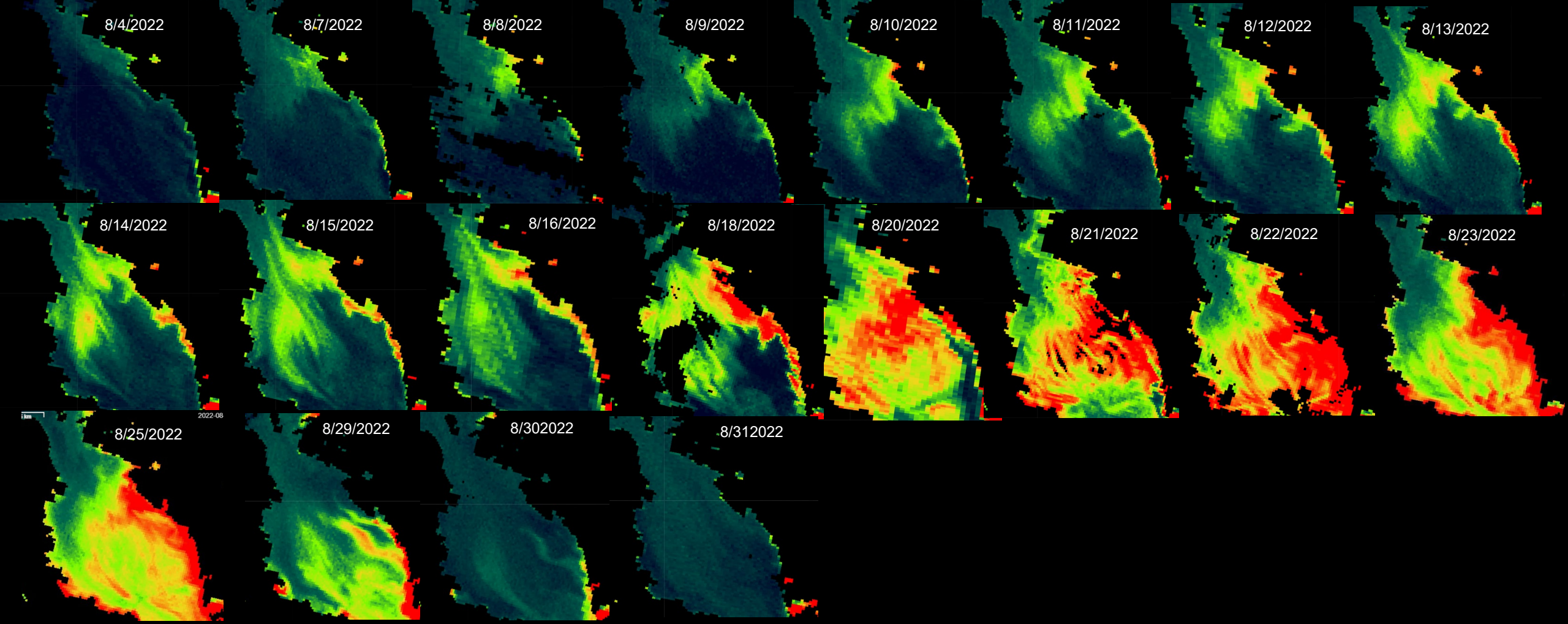
~$2.2 million from BACWA

~$500 thousand from RMP

SF Bay NMS Observation Program







chl-a Sentinel-3; EO Browser using Ulyssys utilities
SFEI/USGS/UCSC, in-prep

SF Bay RMP Annual Meeting

October 3, 2022

contact Martin Trinh at
martint@sfei.org


Plenty of Need and Opportunity
to Communicate
to Coordinate
to Collaborate

Questions and Discussion

NUTRIENT MONITORING COLLABORATIONS AND PARTNERSHIPS, 4:25 TO 4:35 PM

Final Opportunity for Questions, 4:35 to 4:55 PM

Closing Remarks, 4:55 to 5 PM

DEBBIE WEBSTER, STEERING COMMITTEE CO-CHAIR

MEREDITH HOWARD, STEERING COMMITTEE CO-CHAIR