PACE Applications to Case II Waters:

Lessons Learned from a Turbid, Pacific Coast Estuary

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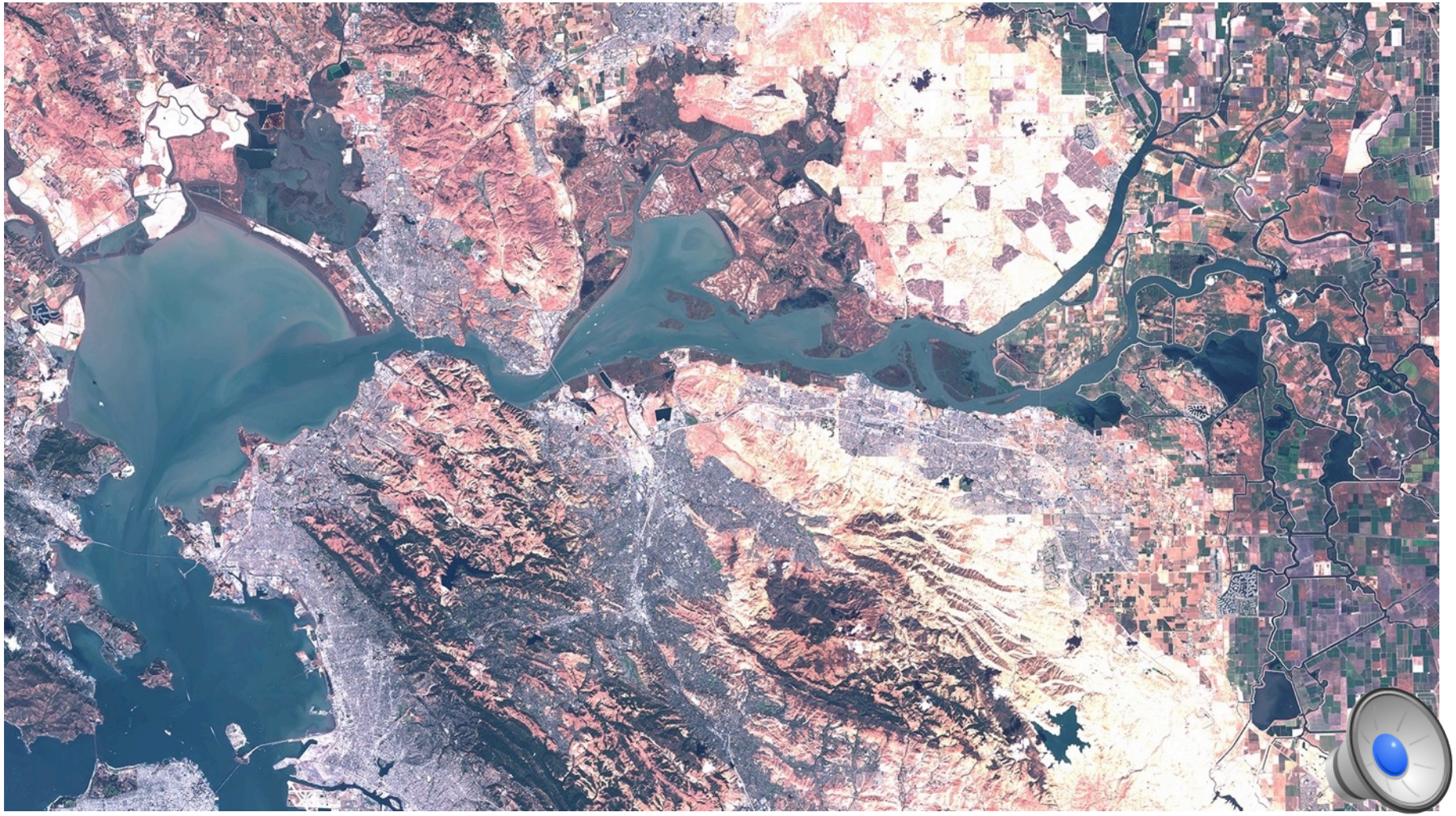
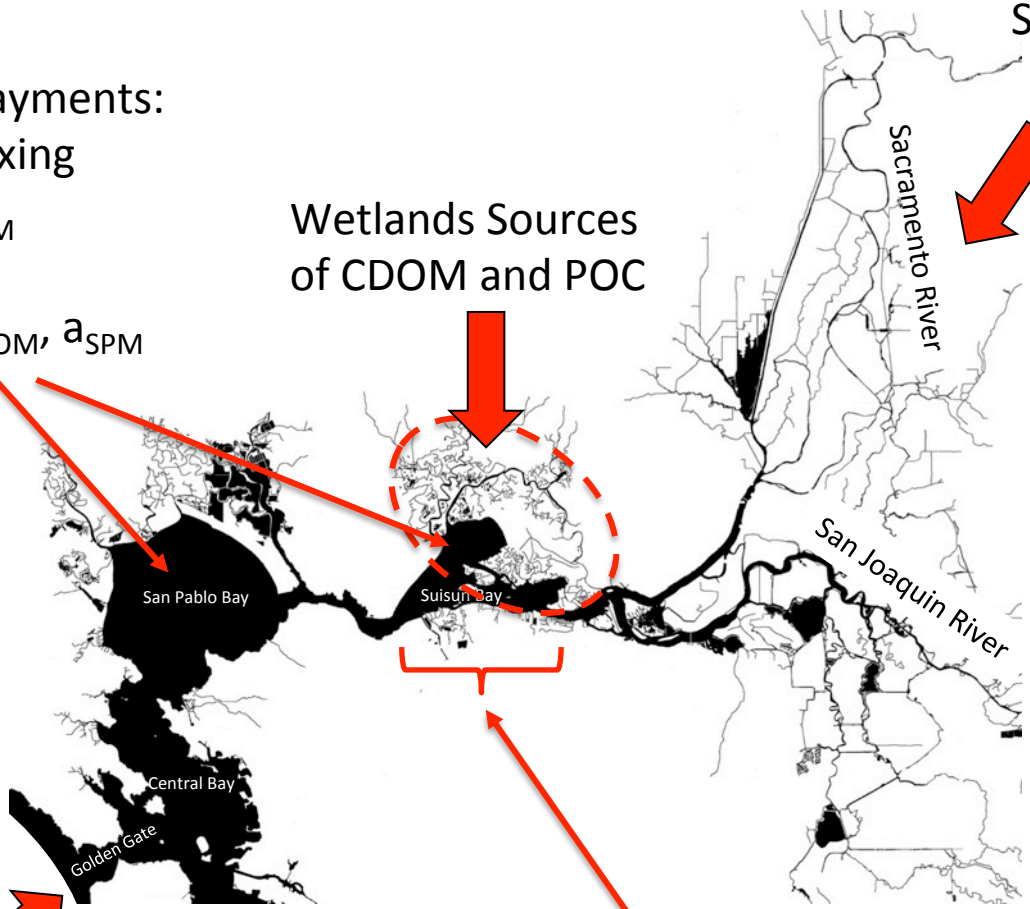


Environmental Overview

Shallow Embayments:
- Wind mixing
- High C_{SPM}
- Low C_{CHL}
- High a_{CDOM}, a_{SPM}

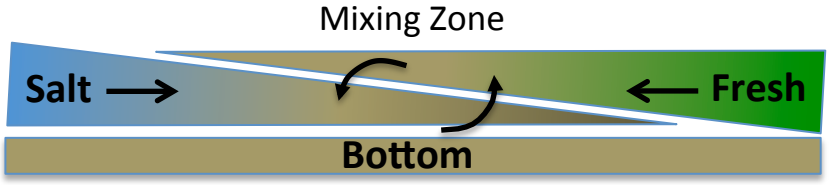
Wetlands Sources of CDOM and POC

Sacramento River:
- Low Salinity
- Low C_{SPM}
- Moderate C_{CHL}
- Moderate a_{CDOM}
- Low a_{SPM}



Coastal Water:
- High Salinity
- Low C_{SPM}
- Moderate C_{CHL}
- Low a_{CDOM}, a_{SPM}

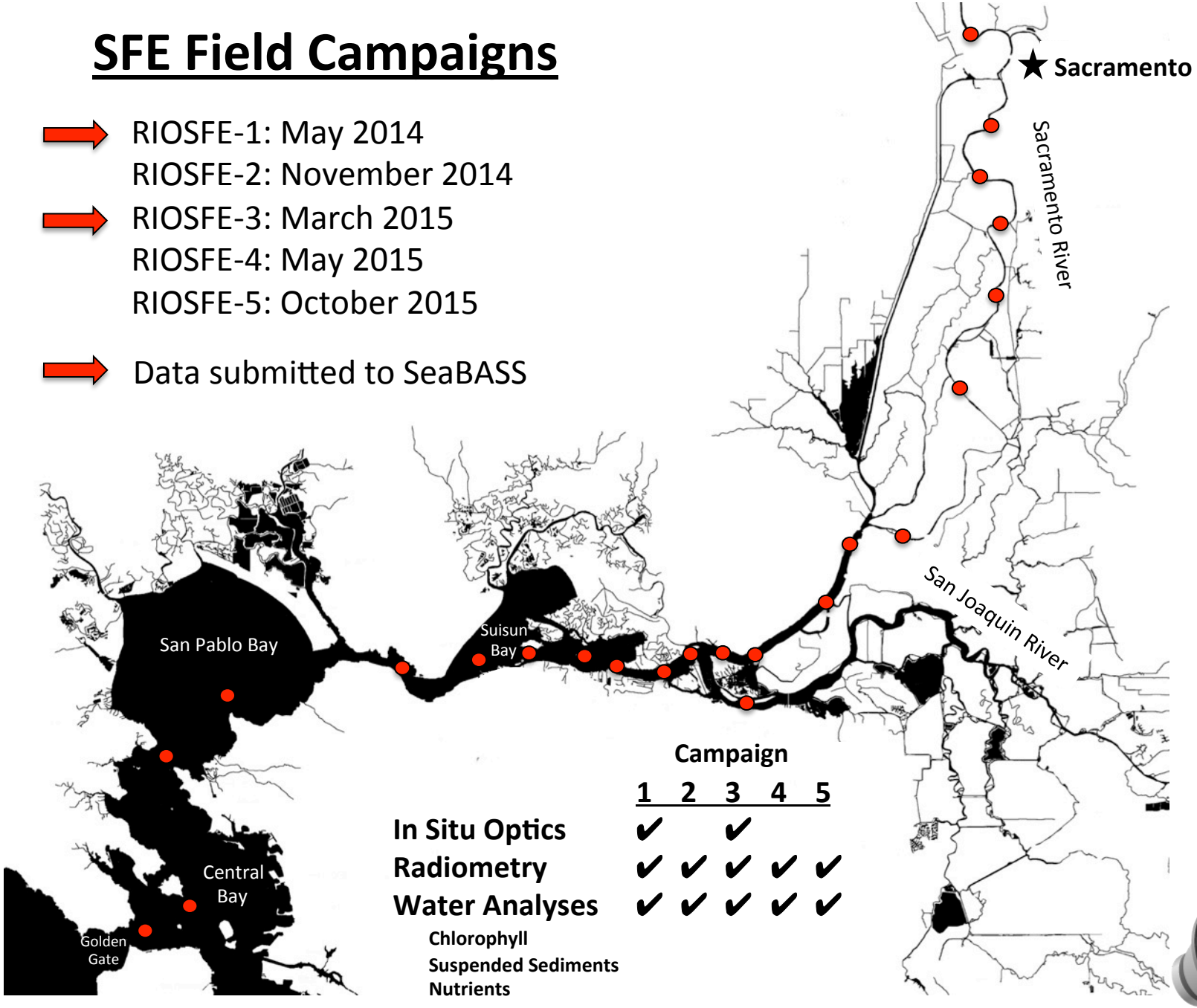
Salt Wedge Dynamics



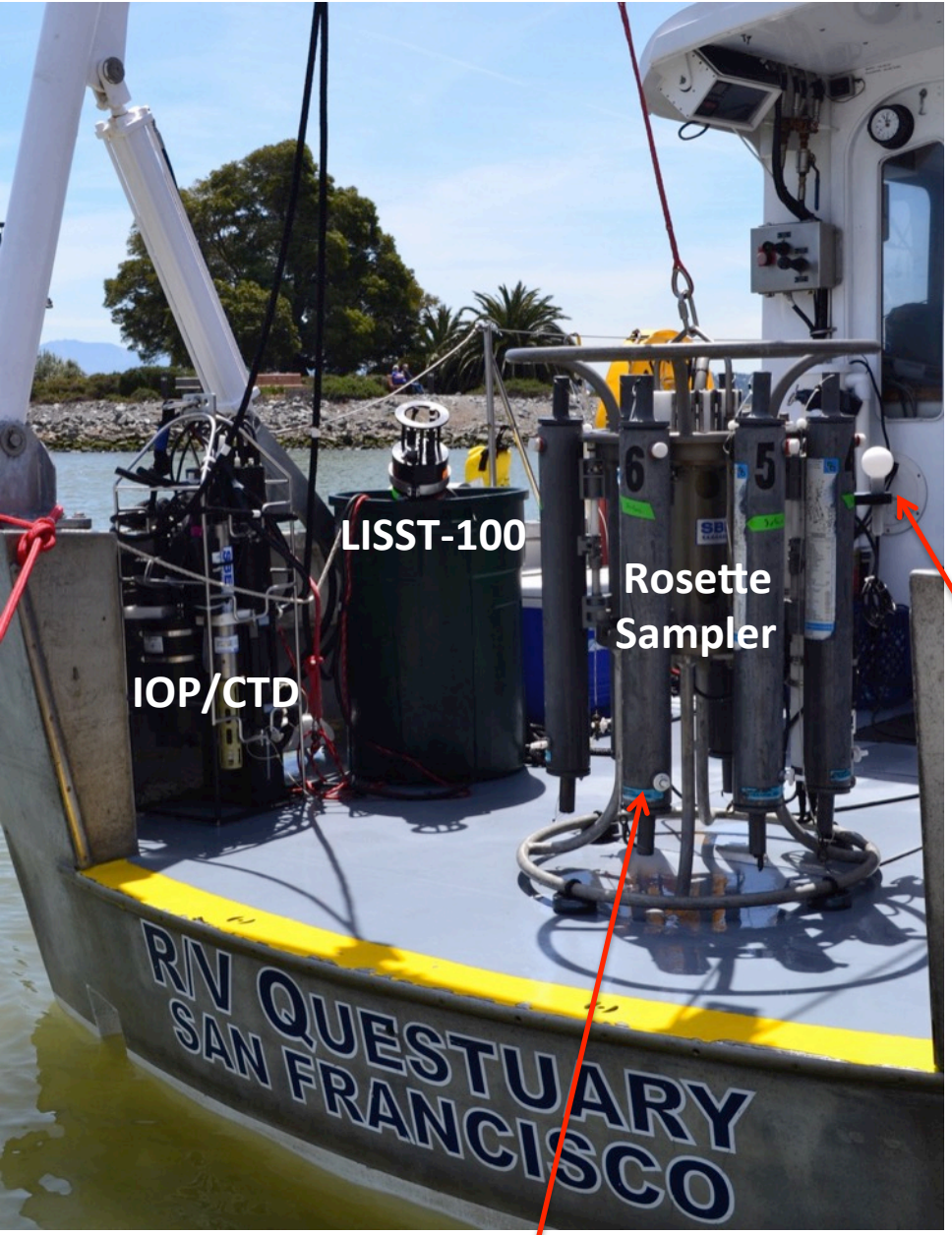
SFE Field Campaigns

- RIOSFE-1: May 2014
- RIOSFE-2: November 2014
- RIOSFE-3: March 2015
- RIOSFE-4: May 2015
- RIOSFE-5: October 2015

- Data submitted to SeaBASS



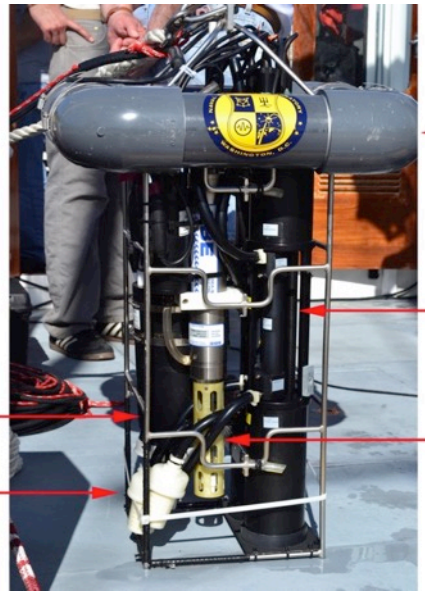
	Campaign 1	2	3	4	5
In Situ Optics	✔		✔		
Radiometry	✔	✔	✔	✔	✔
Water Analyses	✔	✔	✔	✔	✔
Chlorophyll					
Suspended Sediments					
Nutrients					

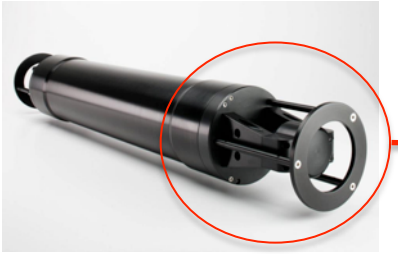


Water samples analyzed for SPM, pigments, and nutrients

In Situ Optics

0.2 μm pre-filter attached to the ac-9



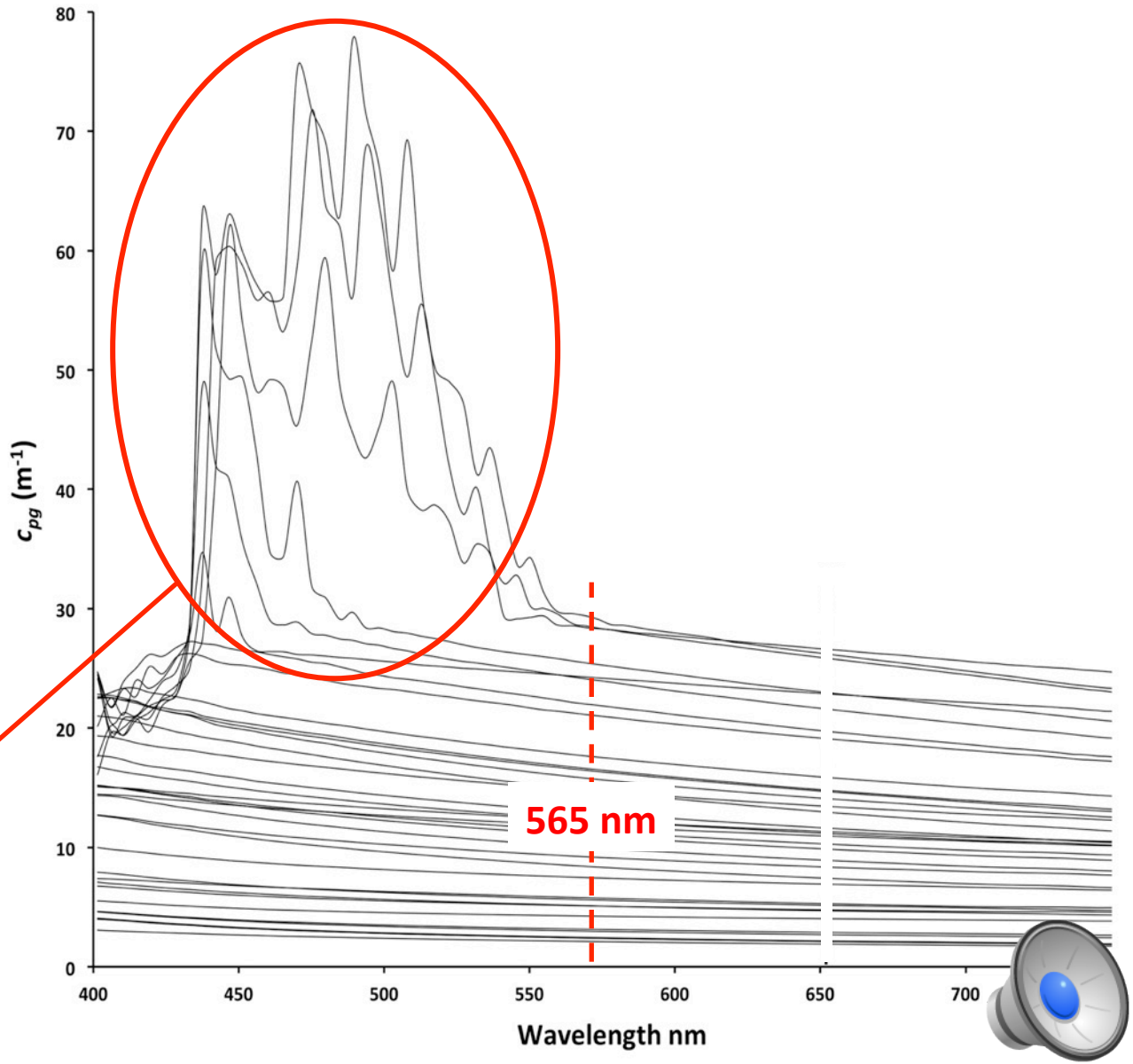


LISST 100x

Above-Water Radiometry (ASD: 380 – 1100 nm)

Data Quality: Beam Attenuation

Secchi depth often less than 1 m!

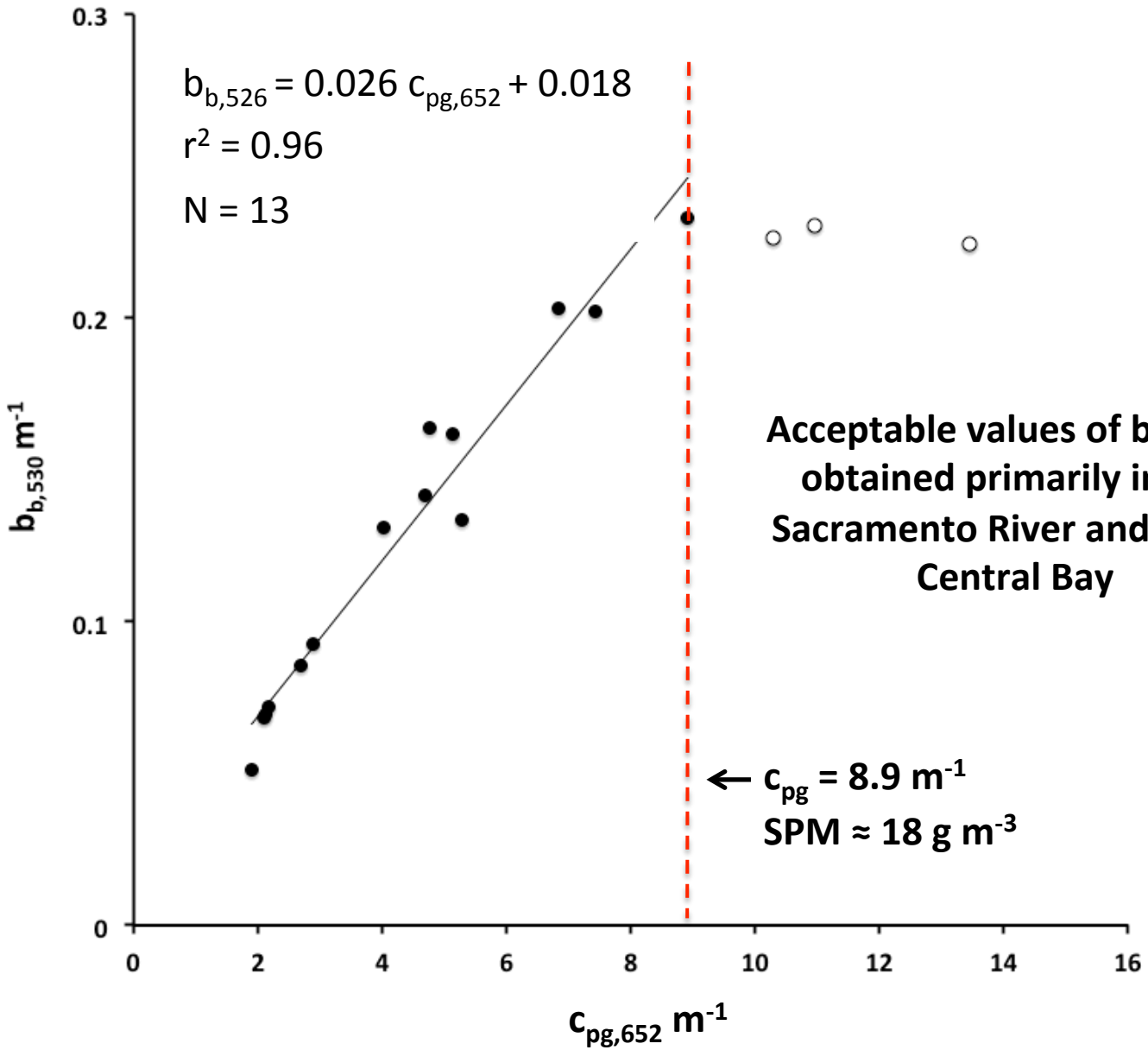


All data where

$c_{pg,652} > 15.8$ m^{-1}

SPM > 33 g m^{-3}

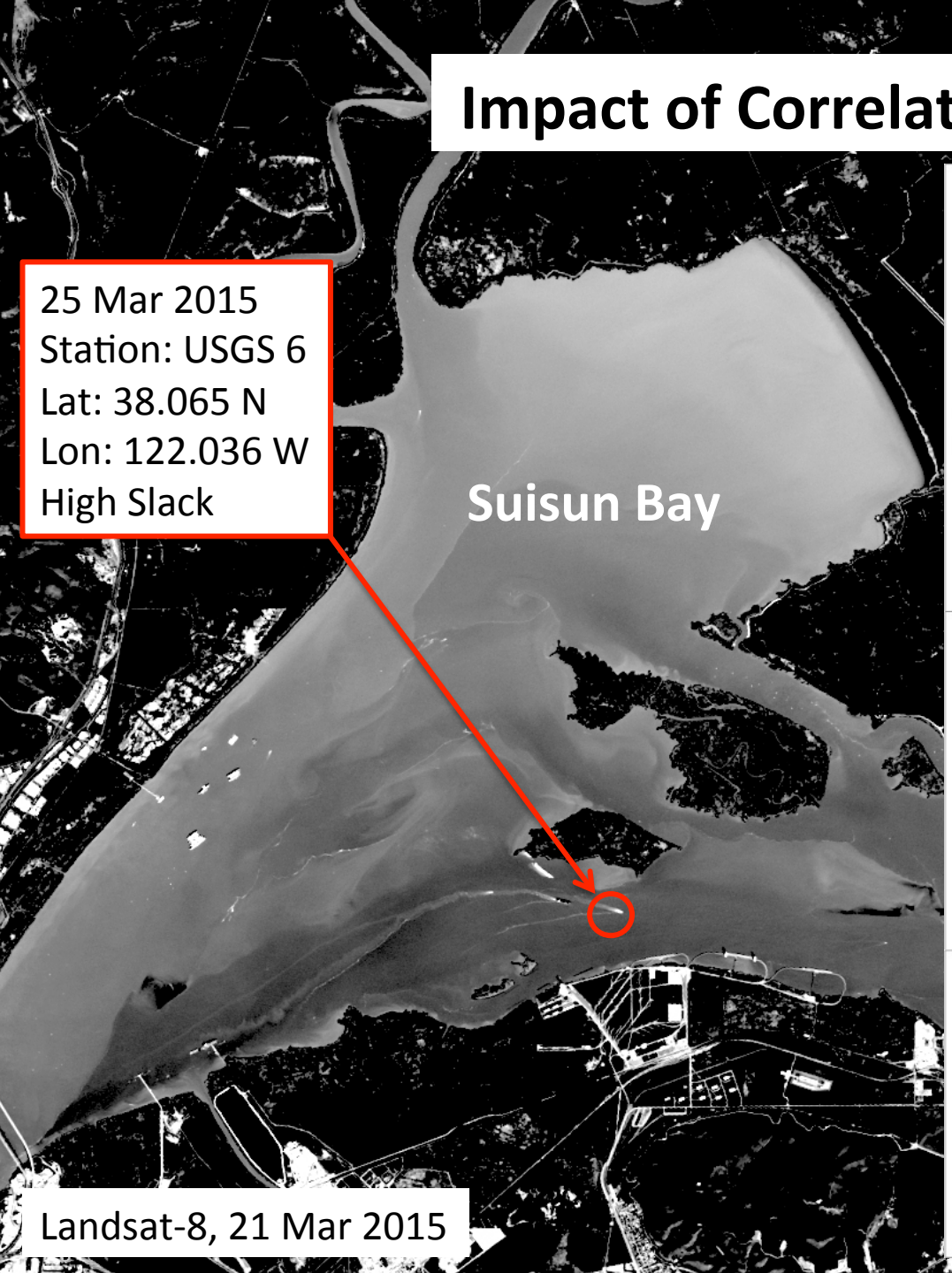
Data Quality: Backscatter

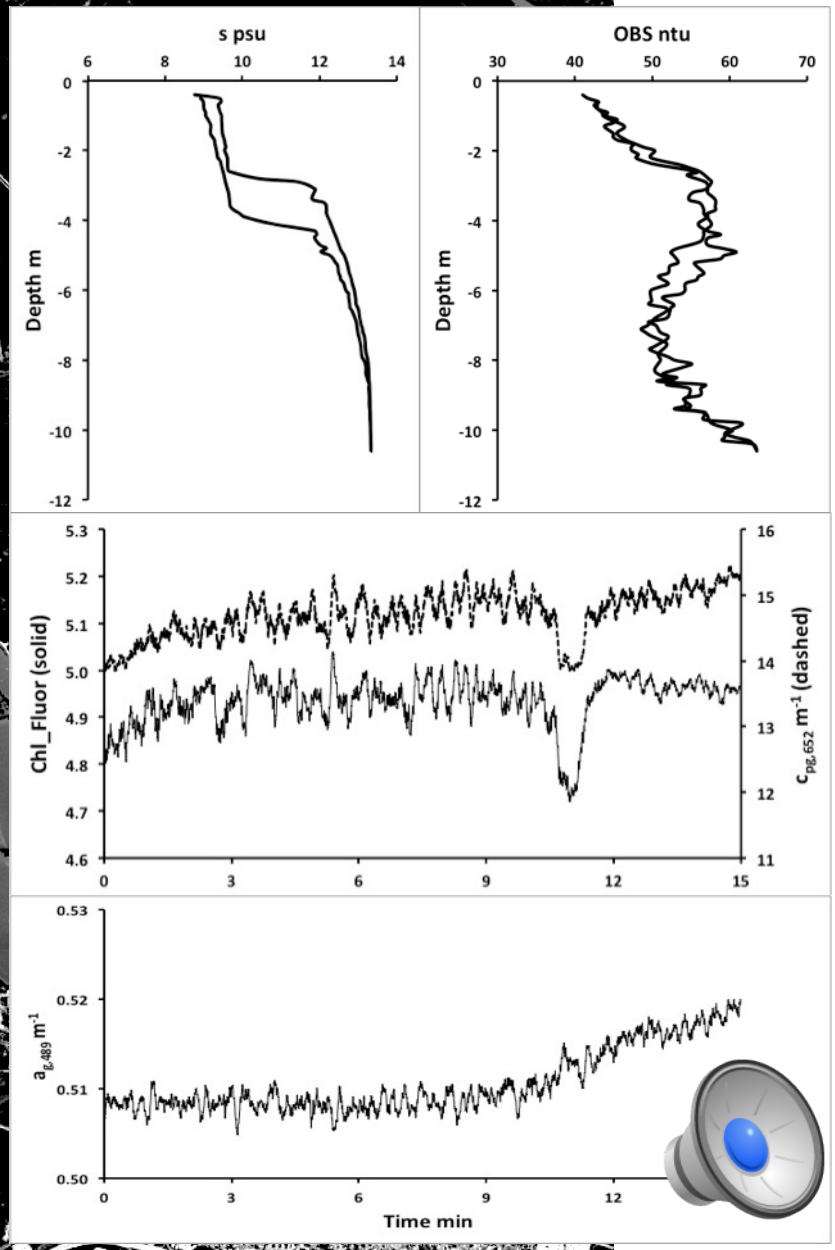


Acceptable values of b_b were obtained primarily in the Sacramento River and in the Central Bay

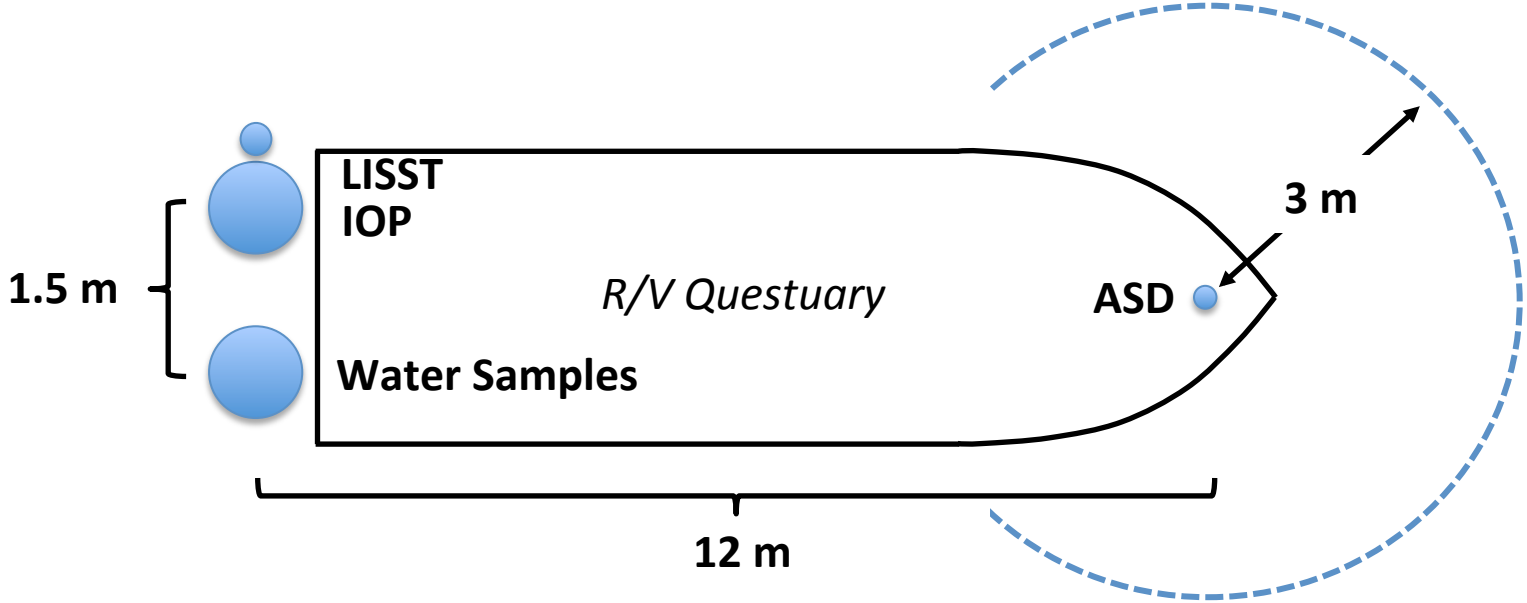
← c_{pg} = 8.9 m^{-1}
SPM ≈ 18 g m^{-3}

Impact of Correlation Scales





Impact of Correlation Scales



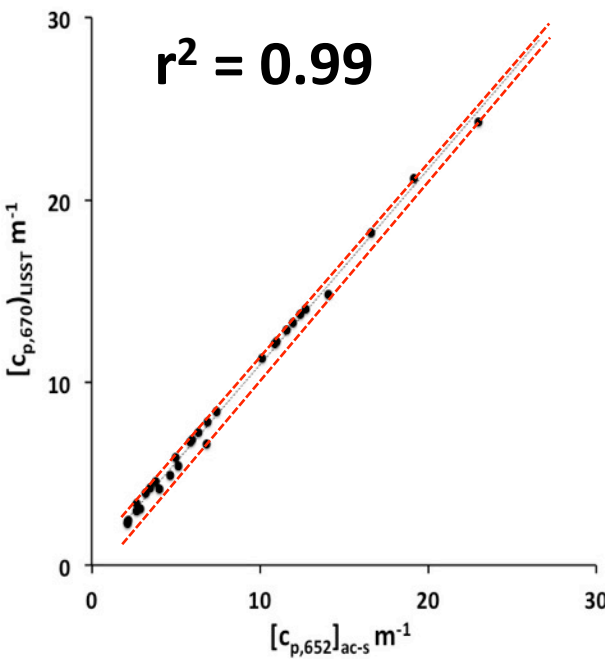
IOP Sensor Package

Water Sampler

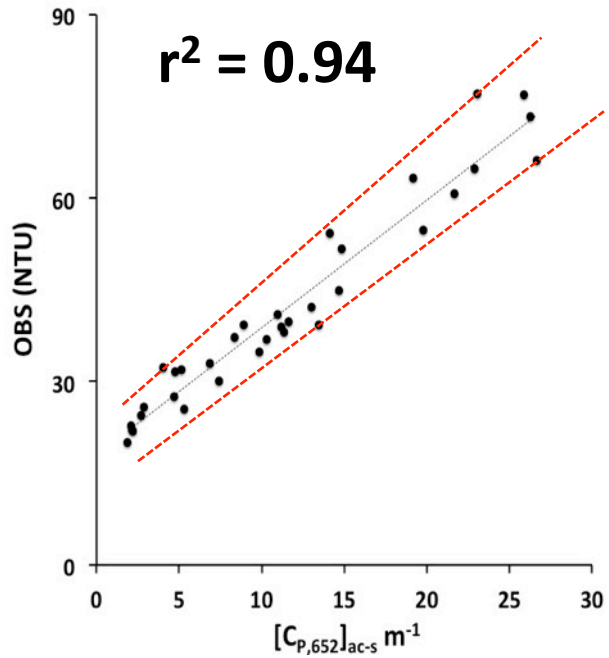
Impact of Correlation Scales: Sensor Spatial Offset

USGS 6, 25 March 2015, Suisun Bay

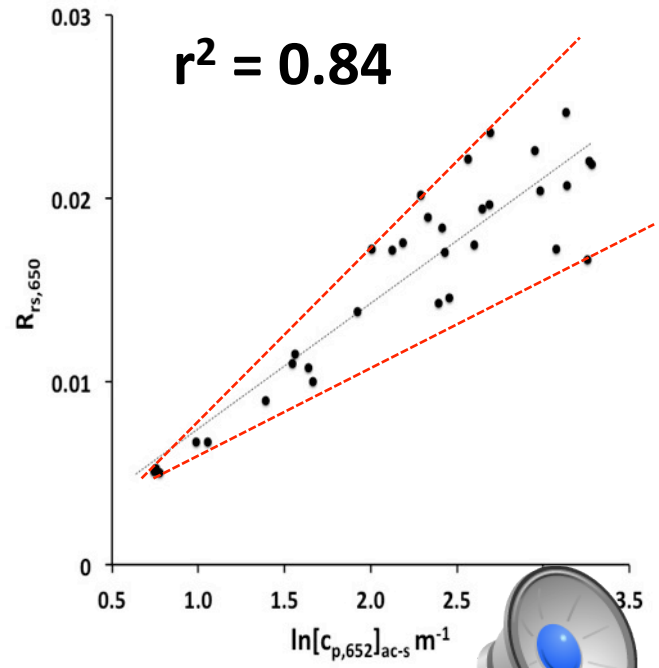
Two in situ sensors on the same platform; Offset ≈ 0.25 m



Two in situ sensors on different platforms; Offset ≈ 1.5 m

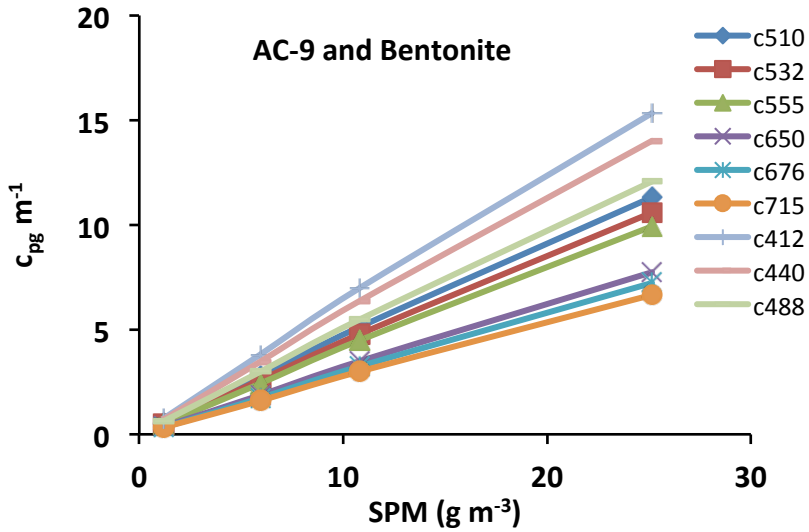


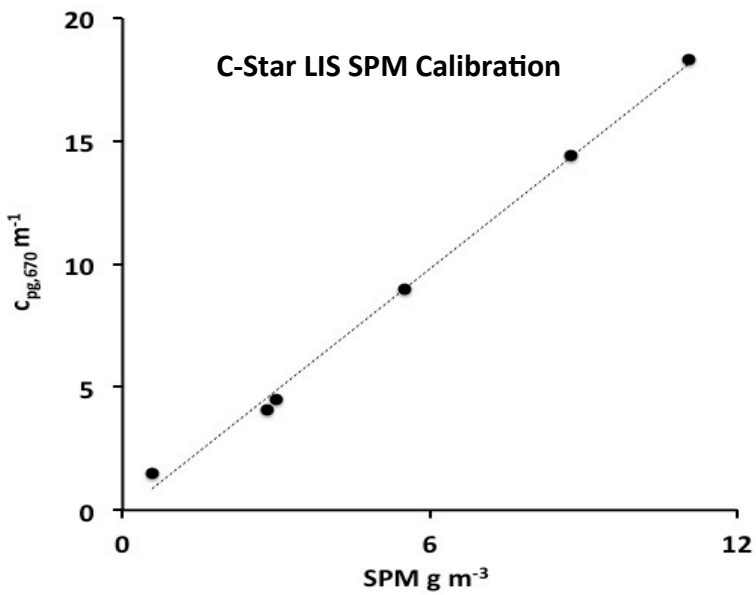
In situ sensor compared with above-water radiometry; Offset ≈ 10-15 m



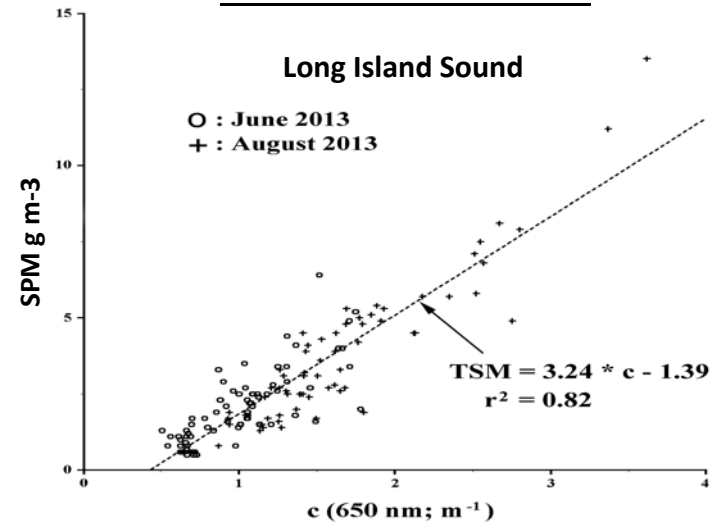
Impact of Correlation Scales: Water Sampling

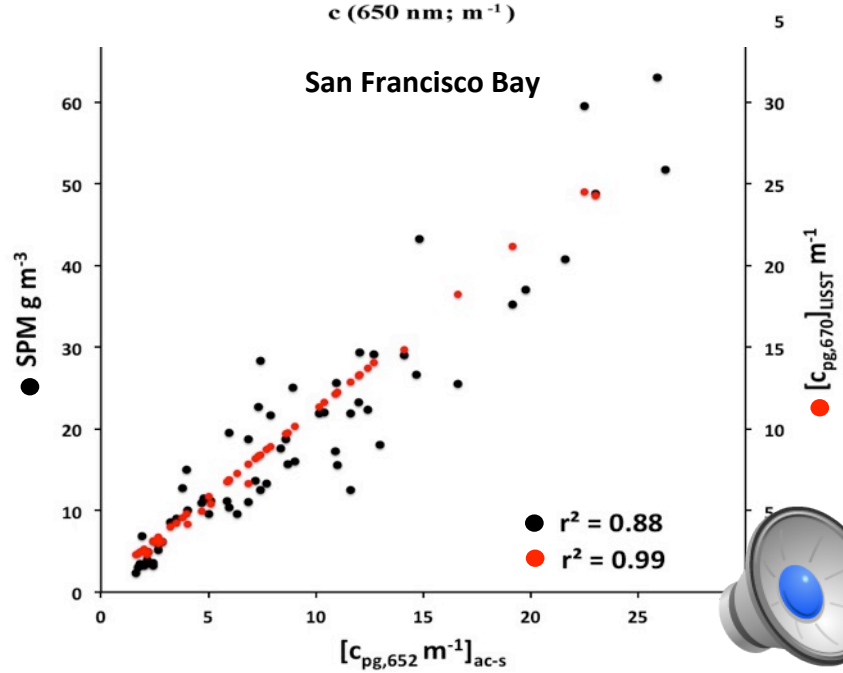
Laboratory Calibrations





Field Observations

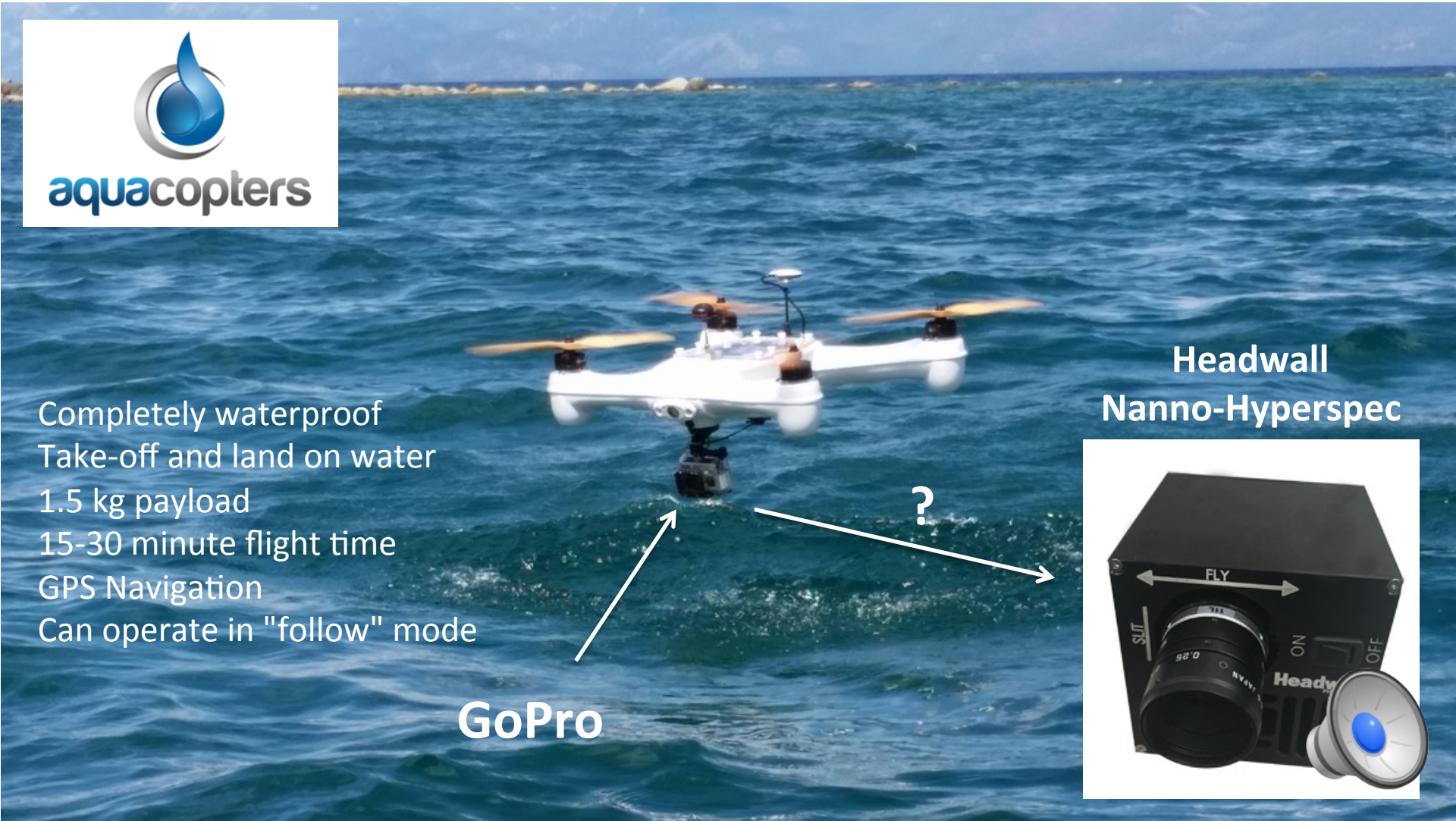




Lessons Learned

Moving Forward

We need to be able to measure water color in high spatial resolution at and around the locations where and when in situ observations and water samples are being collected.



Constituent-Based IOP Model: SFE-O

$$P = C \cdot P' \cdot F$$

	SPM		CHL		CDOM
P	$a_{SPM,489}$ m^{-1}	$b_{SPM,652}$ m^{-1}	$a_{PHY,675}$ m^{-1}	$b_{PHY,675}$ m^{-1}	$a_{CDOM,489}$ m^{-1}
C	C_{SPM} g m^{-3}		C_{CHL} mg m^{-3}		a_{CDOM}/a^{s}_{CDOM} (Bounded by 0 and 1)
P'	a'_{SPM} m^2 g^{-1} = 0.049	b'_{SPM} m^2 g^{-1} = 0.417	a'_{CHL} m^2 mg^{-1} = 0.013	b'_{CHL} m^2 mg^{-1} = 0.125	a^{s}_{CDOM} m^{-1}
F	$\sum_{0}^{3} x_{ai}[\lambda/489]^{i}$ x_{a0} = 19.741 x_{a1} = -43.174 x_{a2} = 32.864 x_{a3} = -8.428	$\sum_{0}^{3} x_{bi}[\lambda/652]^{i}$ x_{b0} = 0.508 x_{b1} = 3.786 x_{b2} = -5.447 x_{b3} = 2.153	$a_{CHL}/a_{CHL,675}$ Stramski et al., 2002	$b_{CHL}/b_{CHL,675}$	$exp^{Sg(489 - \lambda)}$ S_g = 0.0165 nm^{-1}

Manuscript submitted: "*On Modeling Light Within The Northern San Francisco Estuary*