California's Surface Water Ambient Monitoring Program (SWAMP)

SWAMP Cyanotoxin Program

Karen Taberski
SF Bay RWQCB

CCHAB meeting
December 18th, 2014

Water Boards

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SWAMP Cyanotoxin Projects

- 2-Day Cyanotoxin Workshop – November 2011 ★
- SCCWRP gathers cyanotoxin data as part of Nutrient Numeric Endpoint contract (NNE) - started Sept. 2014
- Cyanotoxin Strategy (focused on monitoring and assessment)
  - Contracted to Meredith Howard (SCCWRP)
  - Due August 2015
- NOAA projects
  - 2013/14 conduct satellite ground truthing with Ca. data ★
  - 2014/15
    - Training to use satellite imagery (May 5 & 6)
    - List of waterbodies where satellite imagery can detect cyano.
    - Time series for larger lakes
- Projects in development ★

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November 2011 Cyanotoxin Workshop - Recommendations

- **Develop a strategy** - Develop a long-term vision and a strategic plan for statewide coordination for addressing cyanotoxins. (SCCWRP contract to develop cyanotoxin strategy, CCHAB?)
- **Develop and prioritize** multi-agency **management priorities**. (SCCWRP contract to develop cyanotoxin strategy, CCHAB?)
- **Synthesize** existing **information** and **identify data gaps**. (NNE contract)
- **Develop standardized protocols** for sampling and analytical methods. (In development)
- **Develop communication tools** for sharing, accessing, and communicating data and information related to CyanoHABs, such as a web portal. Provide opportunities for exchanging information, such as additional workshops. (In development)
- **Identify the best use of BOG** monitoring and assessment resources and additional partnerships and funding to support the long-term effort. BOG monitoring funds could be applied as seed funding to do initial groundwork. (Ongoing)

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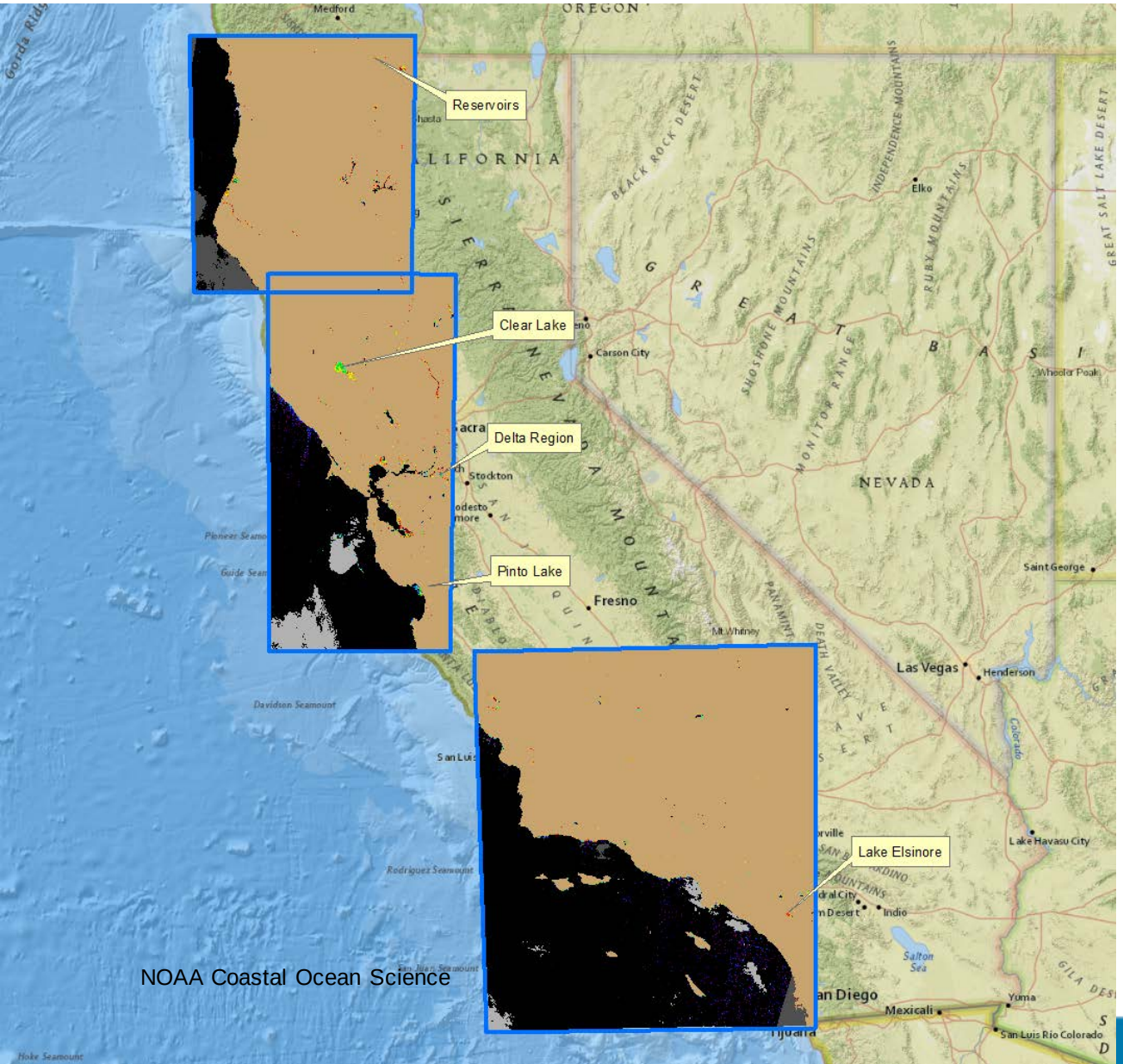
1st NOAA Project - California Lakes

MERIS satellite evaluation of Lakes for HABs



Rick Stumpf

Shelly Tomlinson

Travis Briggs

Tim Wynne

Danielle Dupuy

NOAA Centers for Coastal Ocean Science

For California Water Board (SWAMP BOG)

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June 30, 2014

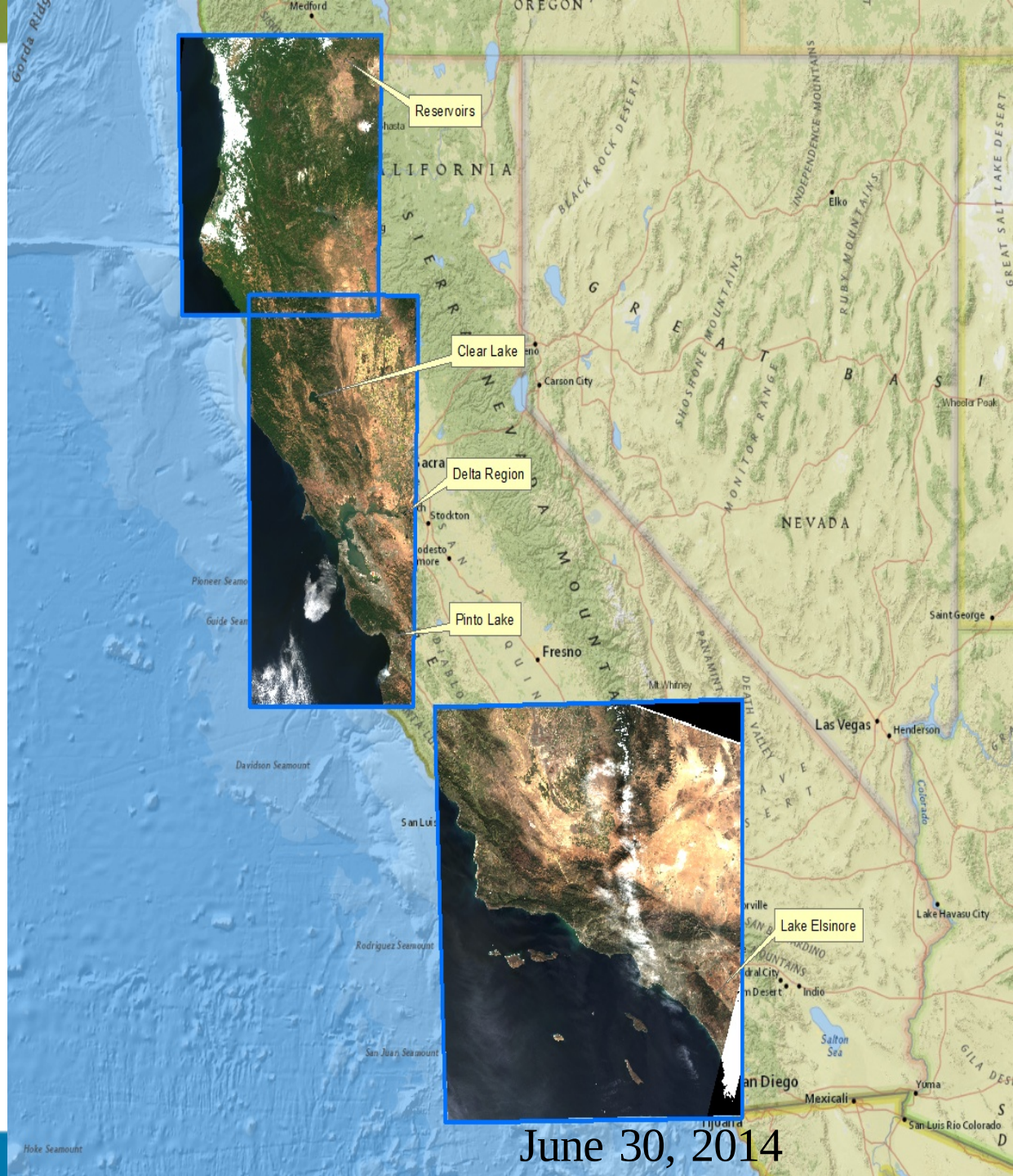
Satellite Comparison for cyano applications

Satellite	Spatial	Temporal	Key Spectral
MERIS (2002-12) OLCI Sentinel-3 2015	300 m	2 day	10 (5 on red edge)
MODIS high res Terra 1999; Aqua 2002	250/500 m	1-2 day	4 (1 red, 1 NIR)
MODIS low res & SeaWiFS	1 km	1-2 day	7-8 (2 in red edge)
Landsat	30 m	8 or 16 day	4 (1 red, 1 NIR)
Sentinel-2 (2015)	20 m	10 day (5 day with 2nd satellite in 2017)	5 (1 red; 2 NIR, 1 in red edge)

Question: Can standard MERIS products identify when lakes have cyanobacteria blooms?

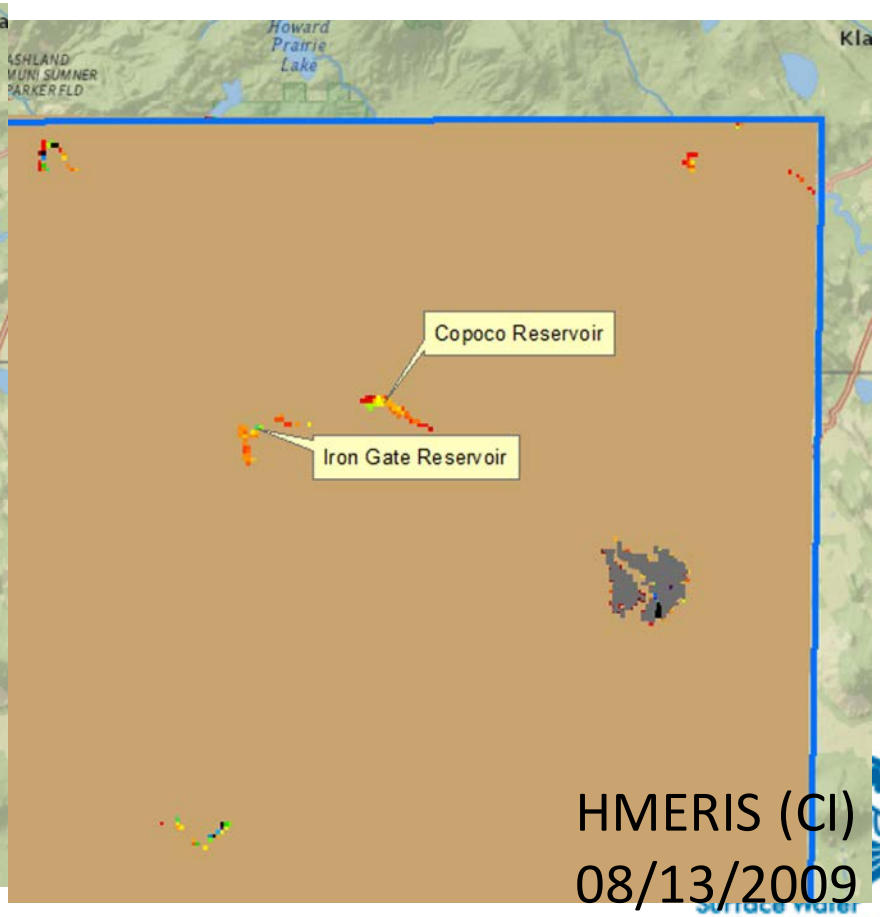
Examine whether MERIS is potentially useful in a set of example water bodies which have had reported blooms (2009-2011)

Limitation - MERIS 300m resolution



Iron Gate & Copco Reservoirs on Klamath

What can be resolved in narrow reservoirs?



HMERIS (CI)
08/13/2009

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Iron Gate & Copco Reservoirs

Combine pixels for analysis.

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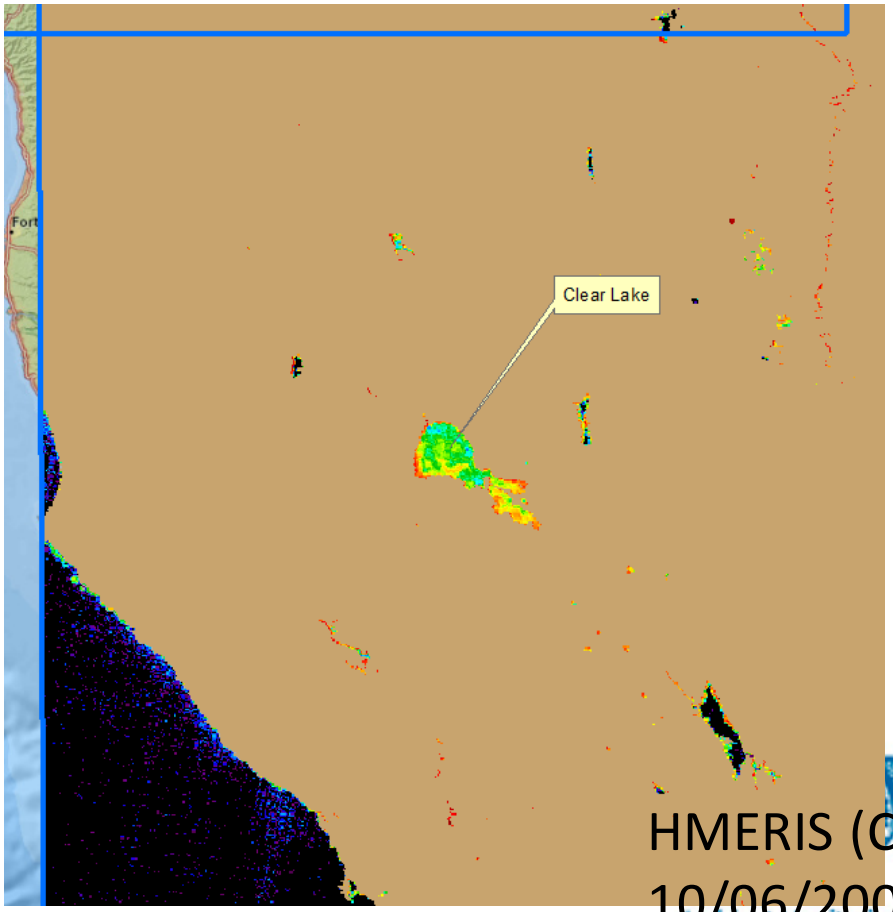
Clear Lake

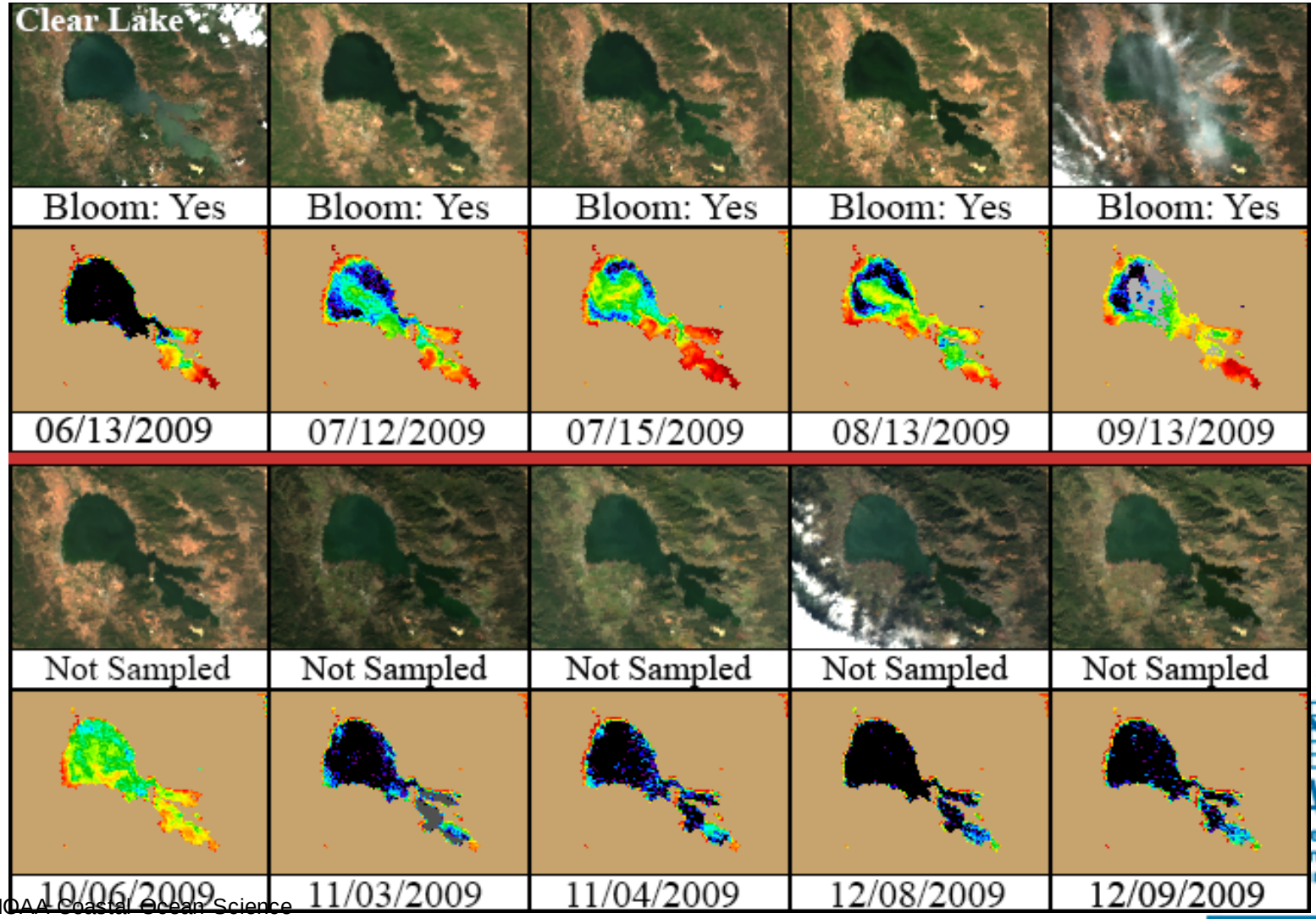
(Adequate size; data available for most of 2009, 2010, and 2011)



HMERIS (CI)
10/06/2009

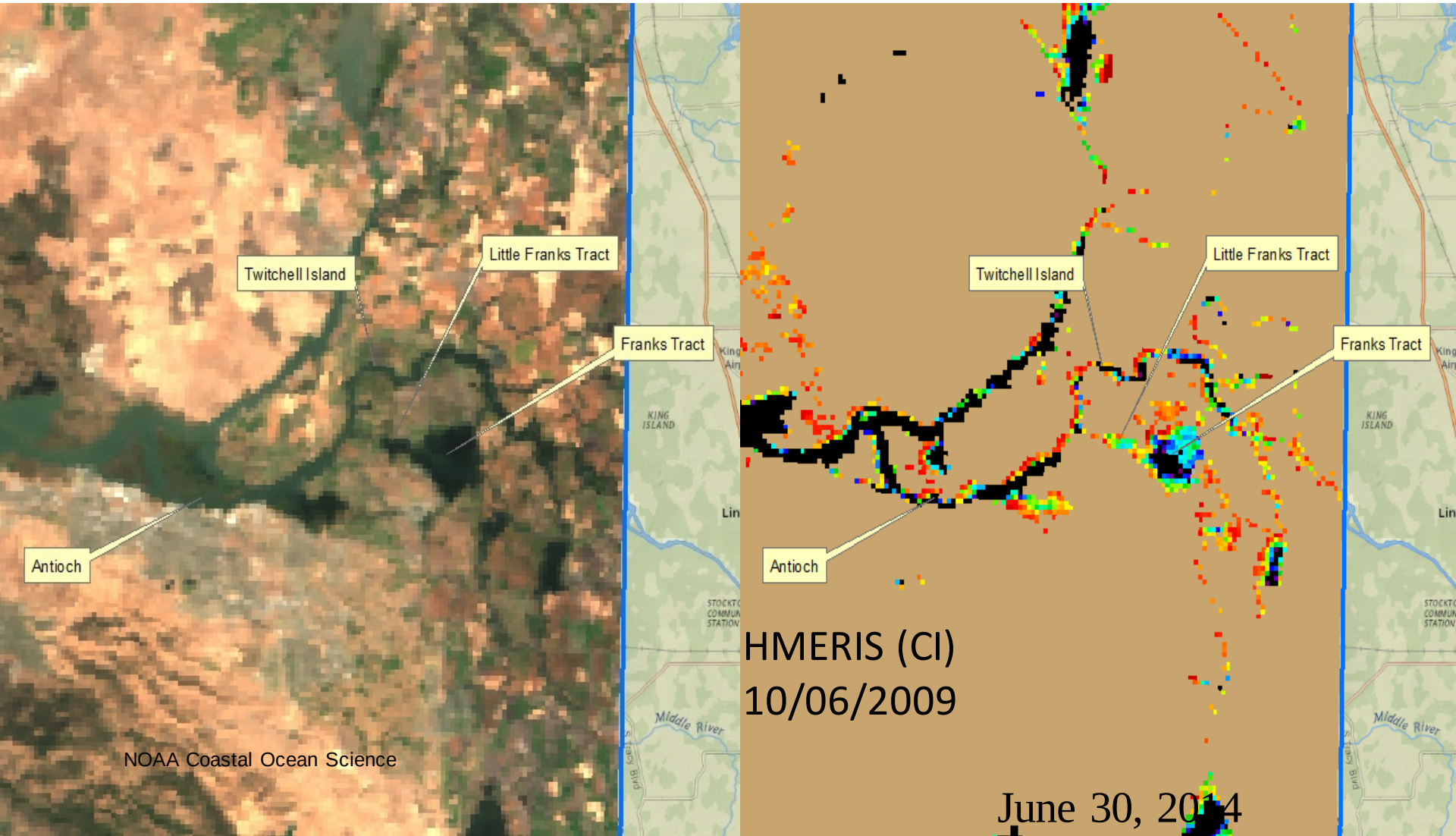
Clear Lake

(Imagery flags a bloom when field data confirms a bloom; bloom disappears during winter, although not confirmed by in situ data).



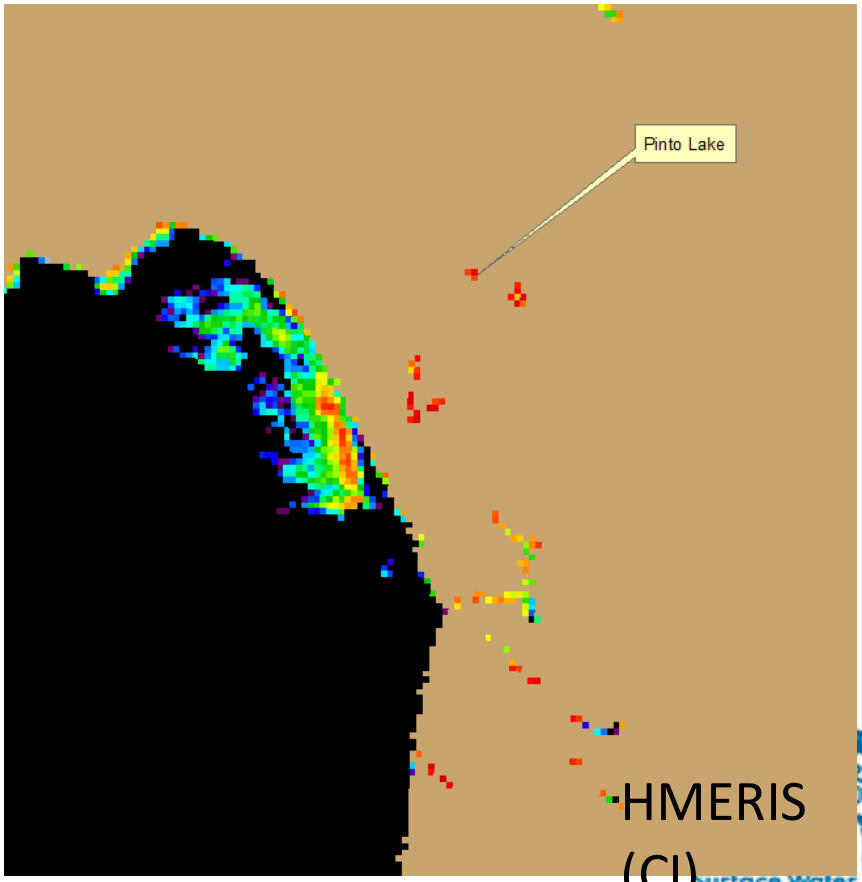
Delta Region

Franks Tract is adequate size; Twitchell Island and Antioch are narrow



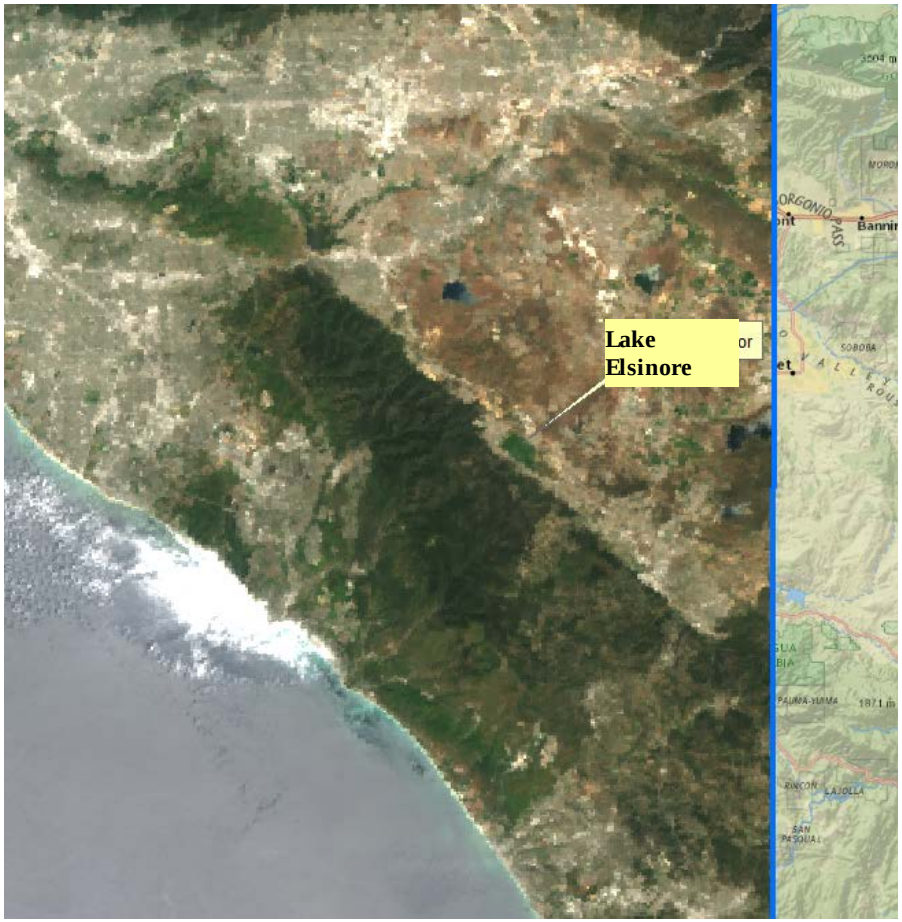
Pinto Lake (Too Small; 3 pixels)

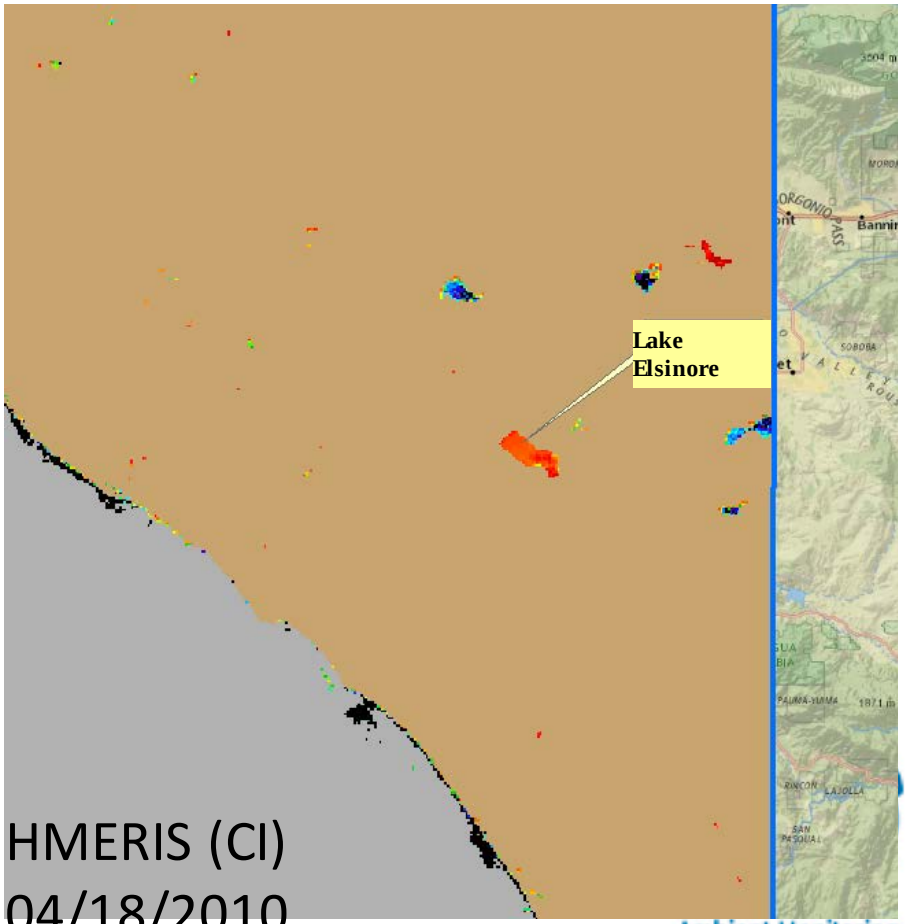
Toxic bloom in Monterey Bay at this time (MBARI & UCSC).



-HMERIS (CI) 10/06/2009

Lake Elsinore
(Adequate size, little field data available)





HMERIS (CI)
04/18/2010

Ambient Monitoring Program

Summary

- MERIS can identify high-chlorophyll cyanobacteria blooms in California lakes.
- Time series assessment: good coverage from 2009-April 2012; thinner coverage from 2002 to 2009.
- The smallest lakes cannot be resolved in individual MERIS scenes.
- Chlorophyll of > 10-20 ug/L (WHO threshold) detectable. (algorithm under study may achieve 3-10 ug/L)
- Use of multiple sensors: 1) ID blooms w/chl a, 2) determine if phycocyanin, 3) determine biomass w/chl a.

Future

- OLCI/Sentinel-3 continues (300 m resolution, frequency 2 days) MERIS coverage after launch in 2015 .
- Potential for higher-resolution (20 m), less-frequent (10 days), chlorophyll w/ Sentinel-2 in 2015 as well as another satellite launch in 2017 that will increase frequency (5 Days)

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SWAMP Projects in Development

- Guidance document (Final March 2016)
  - Field sampling (lakes/reservoirs, rivers, estuaries, freshwater wetlands, marine)
  - Health and safety plan for sampling
  - Performance based QA system for cyanotoxins (ELISA & LC MSMS) & compilation of SOPs for ELISA & LC MSMS methods from the major labs in California
  - Decision tree framework for analyzing cyanobacteria and cyanotoxins for event-response based sampling
- Training – Sampling, health and safety, species ID (Academy) July 2015 & spring 2016
- Laboratory analysis (Ca. F&W – Water Pollution Control Lab)

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SWAMP Projects in Development (continued)

- Satellite monitoring (NOAA)
- Website and database that will hold & display
  - Results from satellite images
  - Bloom information
  - Laboratory data
- Biweekly newsletter in summer/winter monthly (satellite results, bloom information & lab data)
- Real-time communication about blooms (concept in development)

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Joint EPA/NOAA/USGS grant from NASA

- "Cyanobacteria Assessment Network (CyAN) for freshwater systems: an early warning indicator for toxic and nuisance blooms using ocean color satellites"
- The Plan is to start in FY 2015 and end in FY 2020
- By being proactive Ca. could be an early implementer and Beta tester

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Joint EPA/NOAA/USGS grant from NASA

- The Project proposes to use remote sensing technologies (satellites) that can monitor cyanobacteria, chlorophyll-a, and turbidity across the continental US, to:
  - develop a standard approach for identification of algal blooms in large surface waters using satellite imaging;
  - develop a dissemination information system (e.g., mobile app) to provide information about conditions in a satellite-tracked waterbody;
  - document impacts to health, economy, and environmental conditions due to cyanobacteria blooms;
  - integrate efforts of federal agencies to mainstream satellite capabilities into water quality management decisions
  - provide early notification and monitoring of blooms for large water bodies in the continental US.
- Satellites - Landsat, Sentinel (-2 and -3) , VIIRS, PACE, MODIS.

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C-Team (Monitoring and Assessment)

- Lilian Busse (SD RWQCB)
- Karen Taberski (SF Bay RWQCB)
- Karen Worcester (Central Coast RWQCB)
- Terry Fleming and Sue Keydel (U.S. EPA)
- Lori Webber, Jennifer Salisbury, Amy Little (State Water Board)
- Thomas Jabusch and Jay Davis (SFEI)
- Meredith Howard (SCCWRP)
- Clayton Creager (N. Coast RWQCB)
- Chris Foe (Central Valley RWQCB)
- Eric von der Geest (Moss Landing)
- Susan Corum (Karuk Tribe)

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Swamp CyanoTeam

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