Application of Hyperspectral Remote Sensing to Cyanobacterial Blooms in Inland Waters

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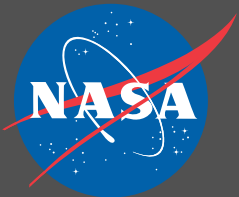Liane Guild, Sherry Palacios, Juan Torres

NASA Ames Research Center

David Austerberry

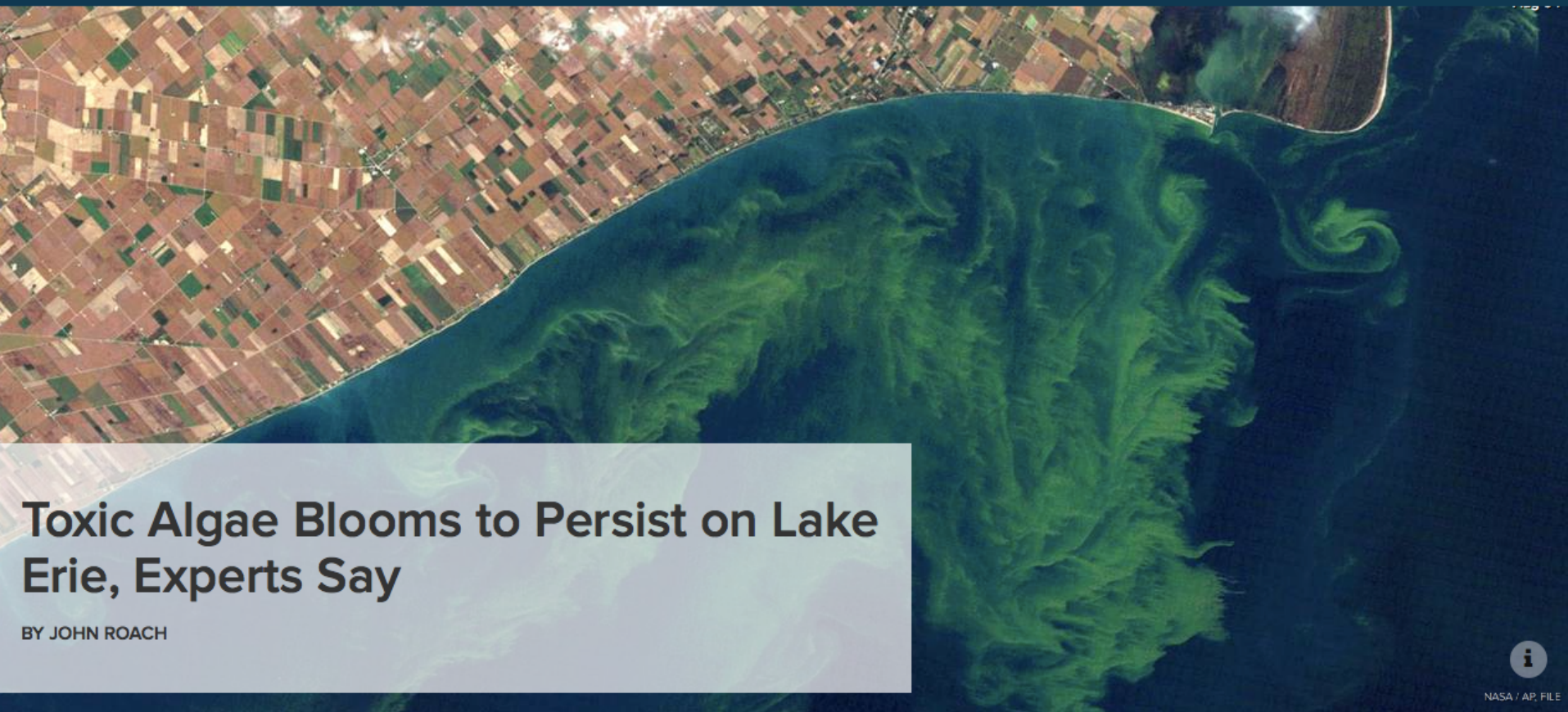University of Michigan

Emma Accorsi

Emory University

2014: Year of the Blue-Green Algae

California is NOT Lake Erie
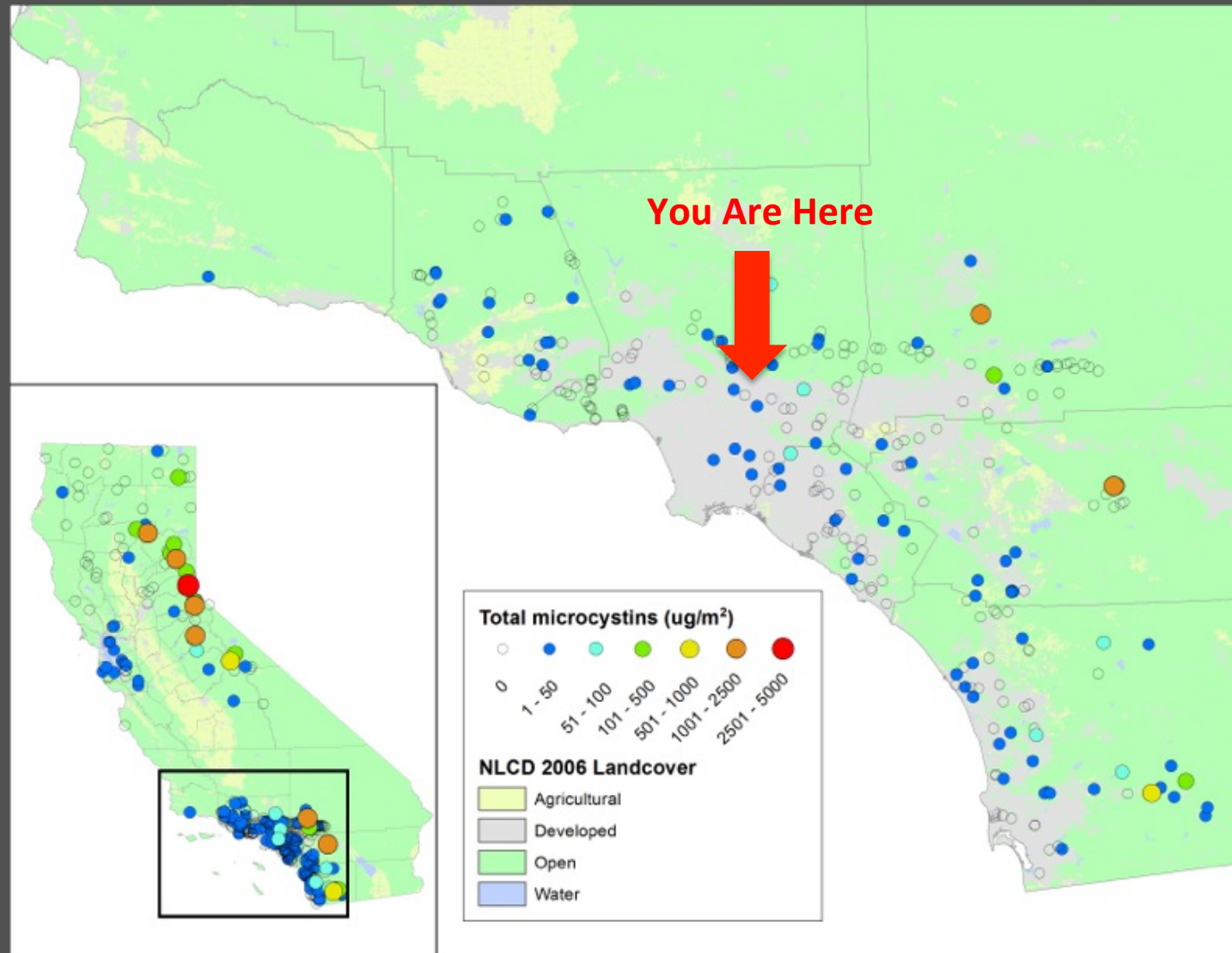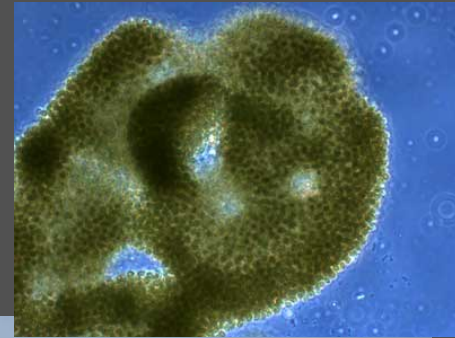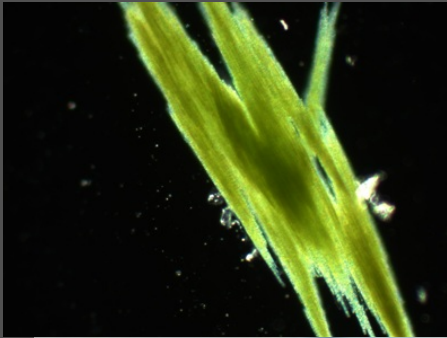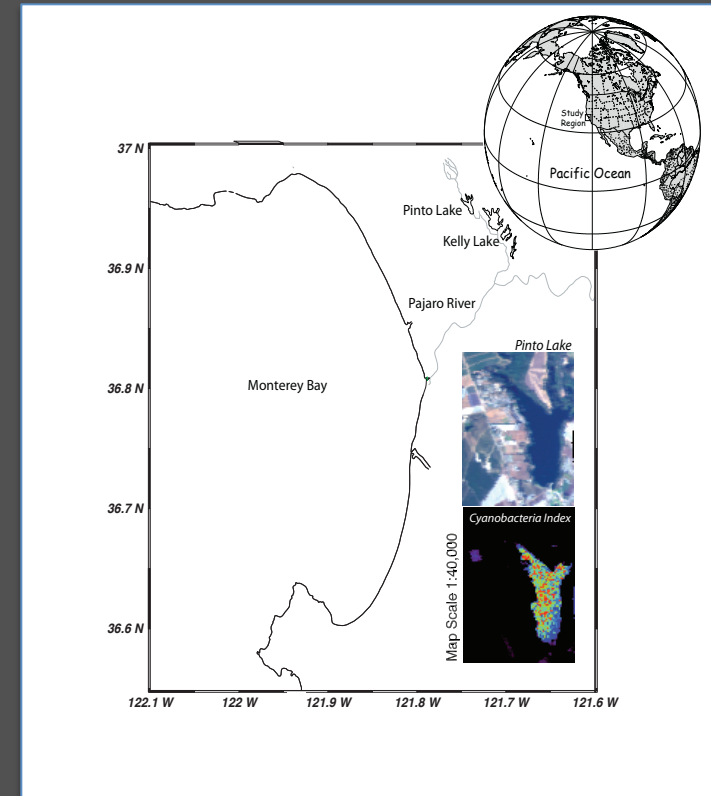
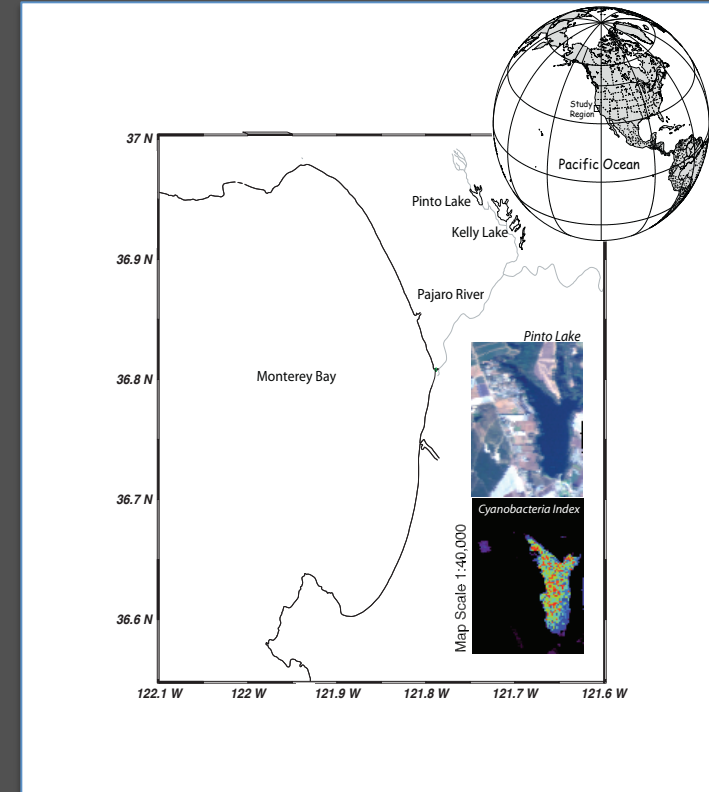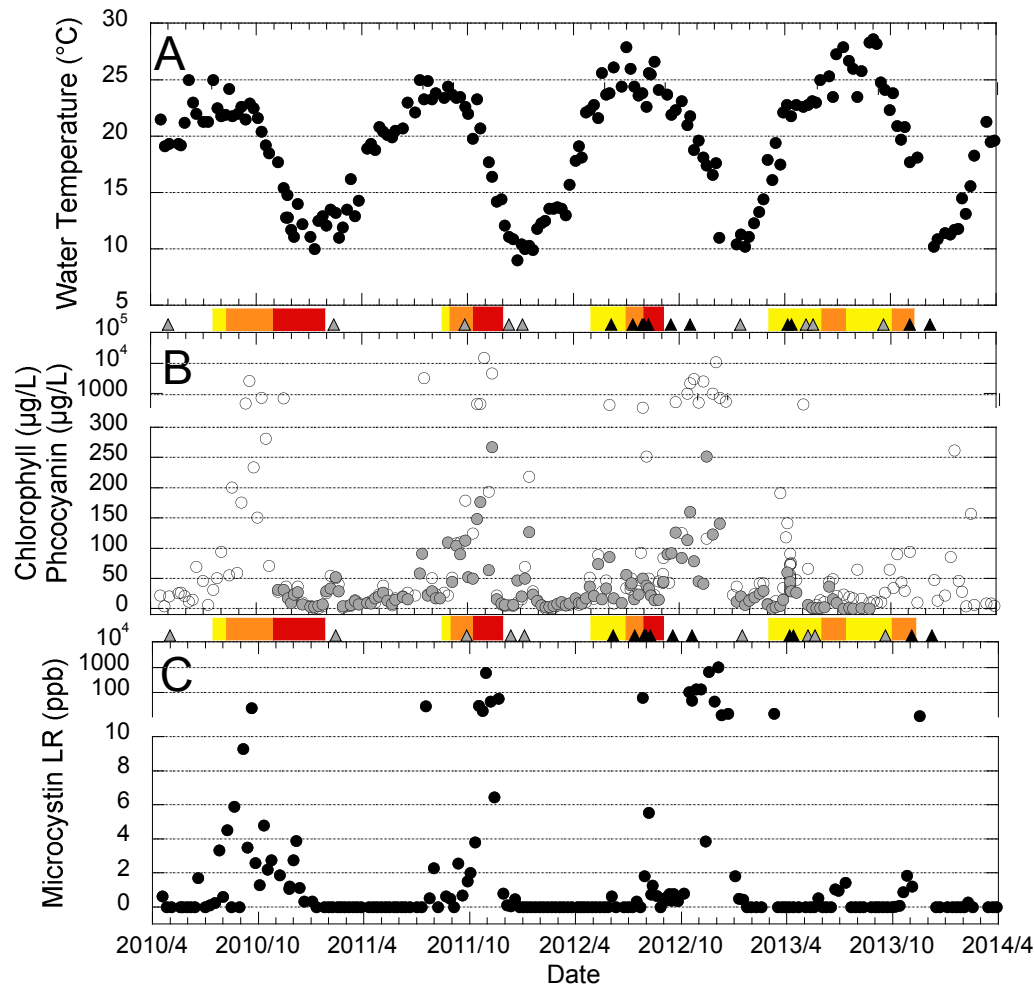# Challenge: two optically similar species

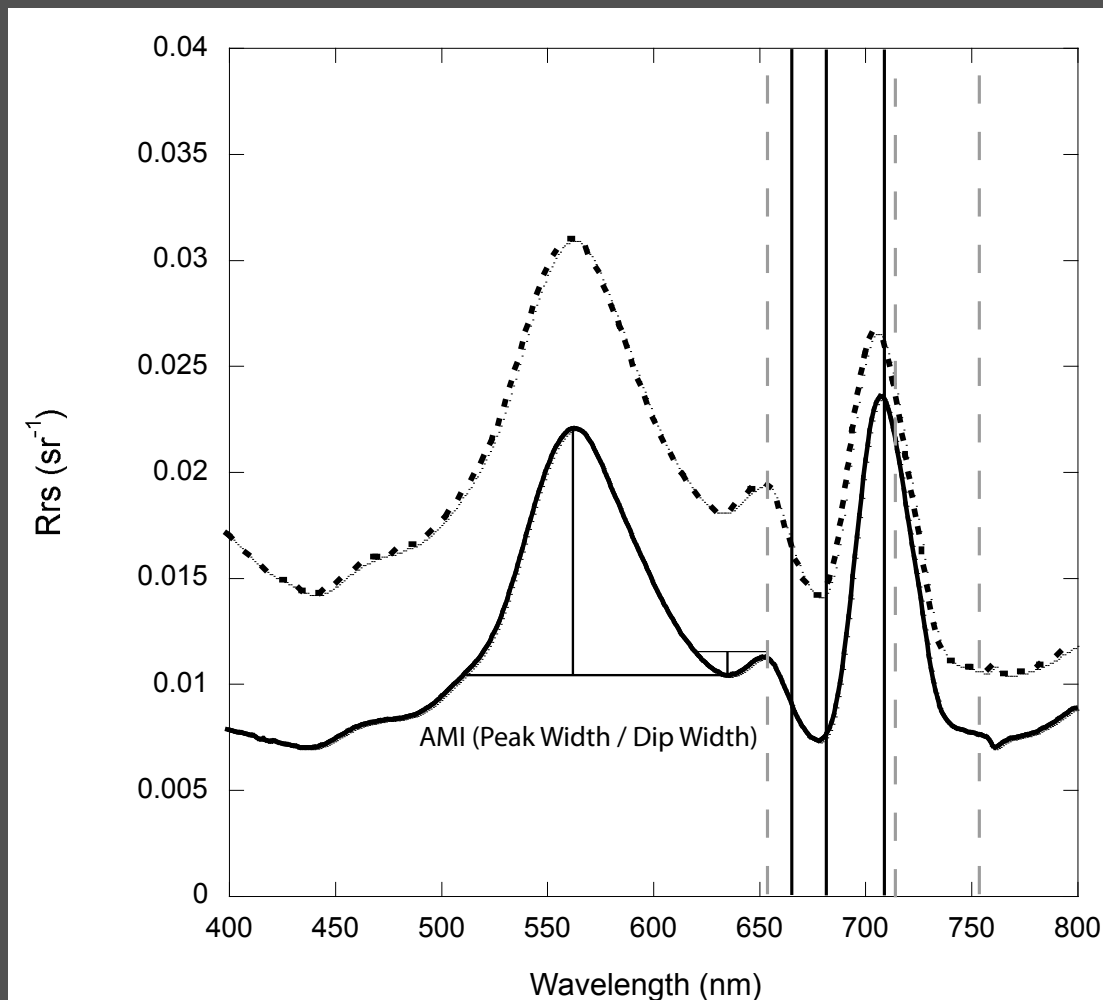*Aphanizomenon flos-aquae*

Microcystis spp.

Pinto Lake, Our Favorite Toxic Cesspool

Pinto Lake, Our Favorite Toxic Cesspool
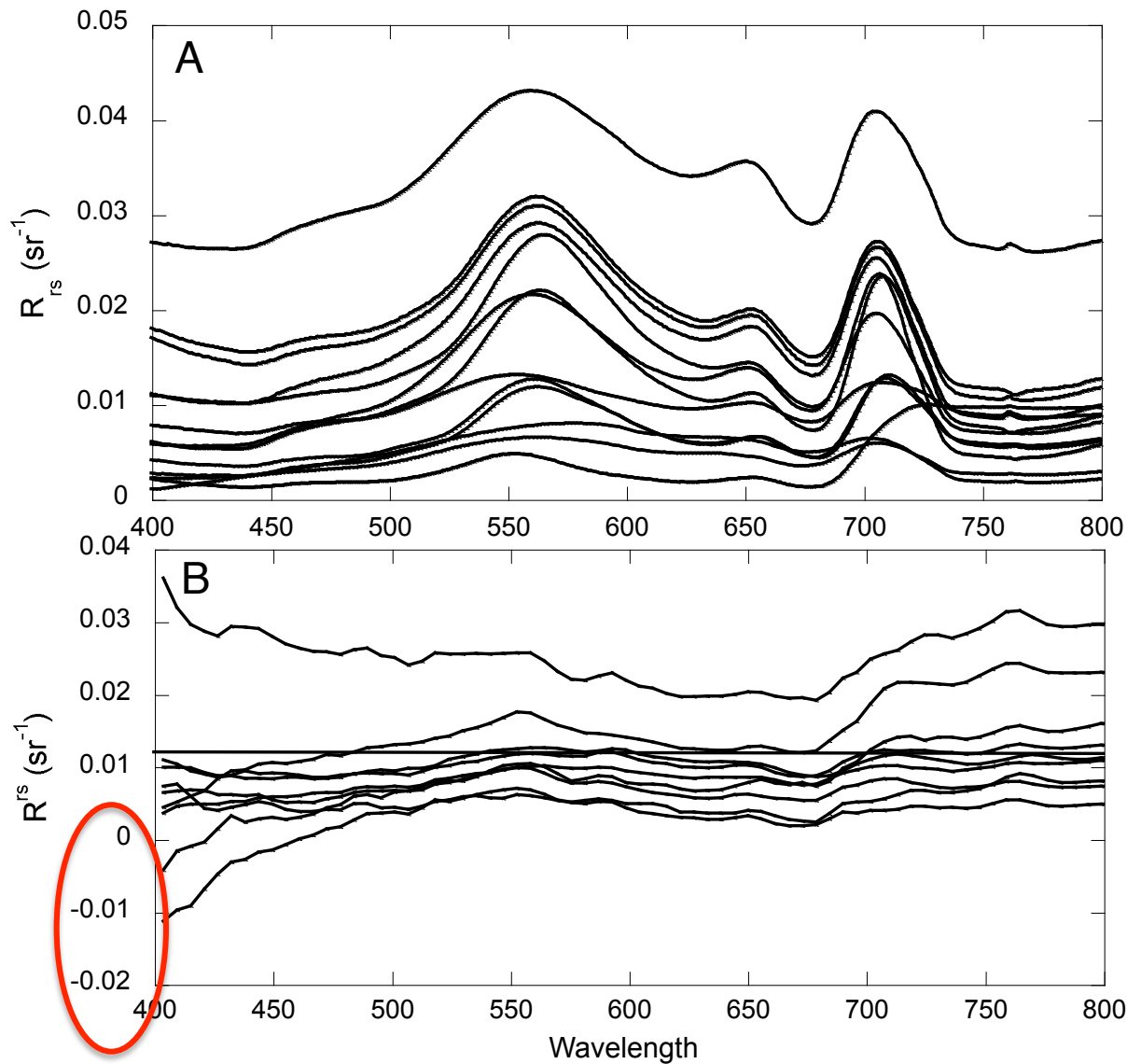
Detecting Blue-Green Algae

Several algorithms have been developed, including the Cyanobacterial Index (CI) and various phycocyanin absorption methods.

We generalized the spectral shape methods to take advantage of hyperspectral data, and also developed a Scattering Line Height (SLH) algorithm which works with almost any sensor, including MASTER
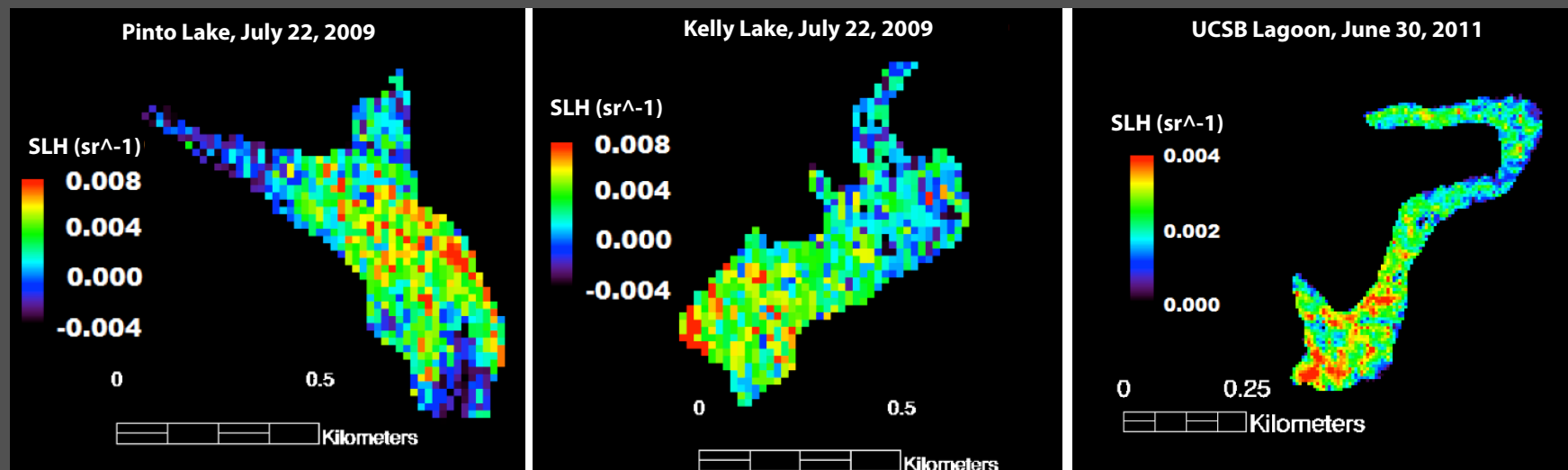
Spectral Data

ASD & GER validation data
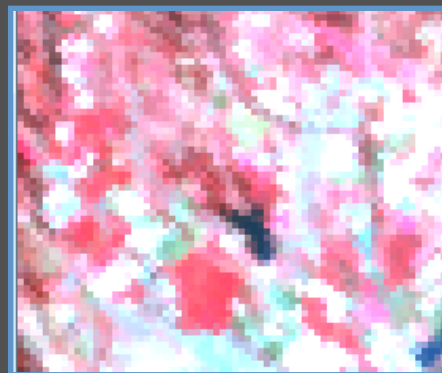
Hyperspectral Imager for the Coastal Ocean (HICO)

~ 100 m pixels, processed using standard (minimal optimization) Tafkaa atmospheric correction
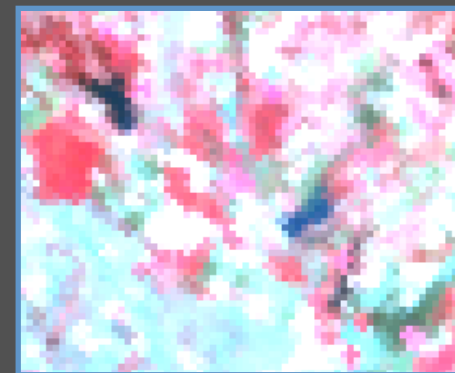
Remote Sensing Data

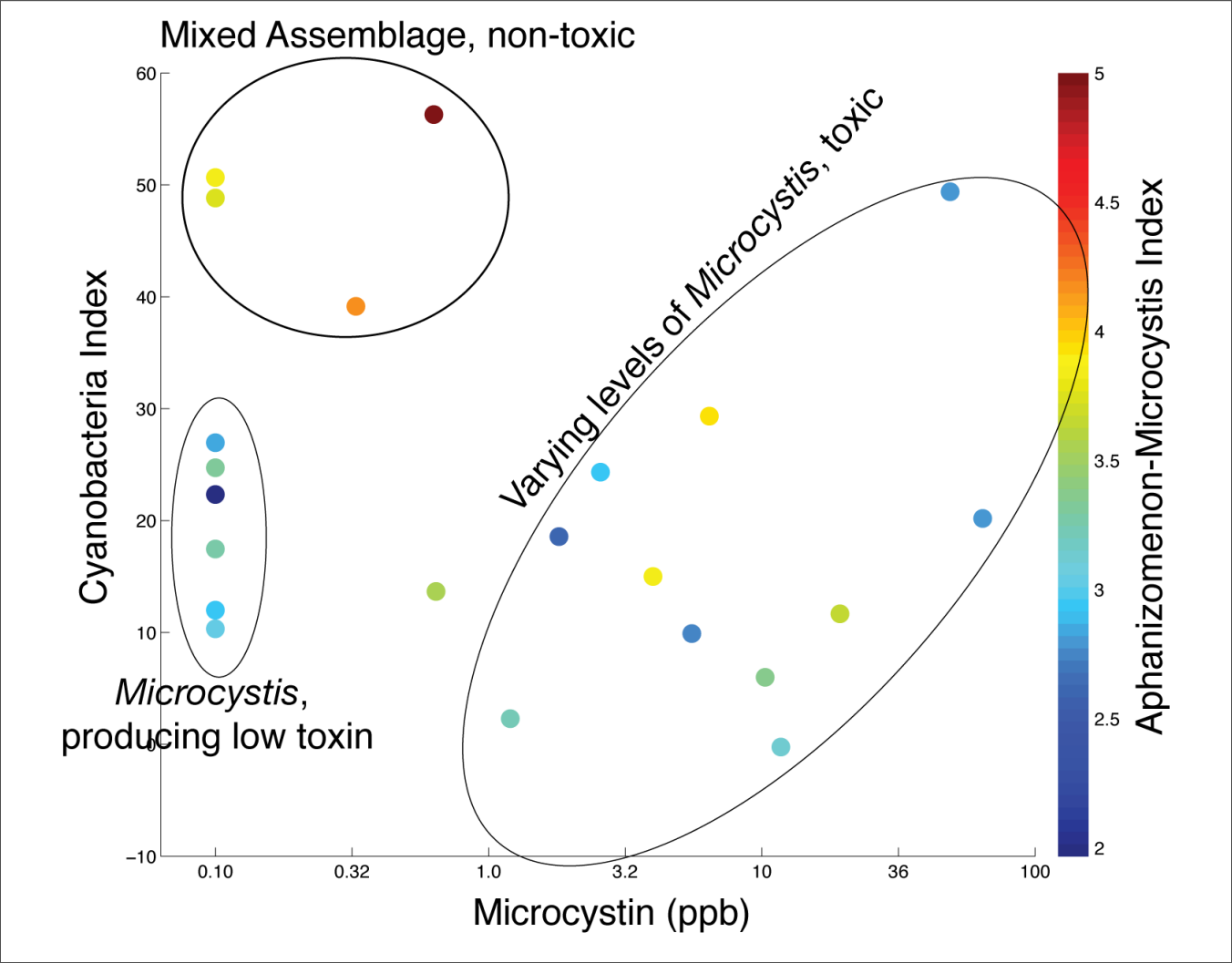Application with MASTER

Application with HICO

Pinto Lake

Kelly Lake

Predicting Toxic BLooms
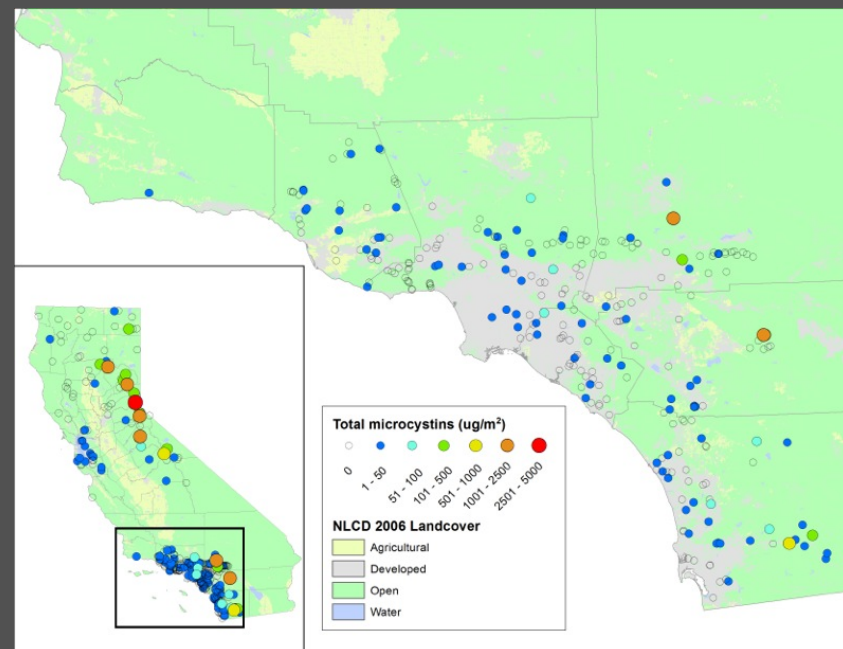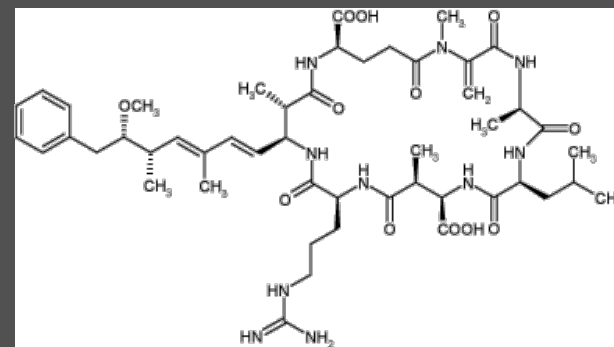
Real-Time Application

State of California sets Action Level of 0.8 ppb for drinking water or recreational exposure

Mouse studies suggest nasal inhalation is 12x more potent than direct consumption
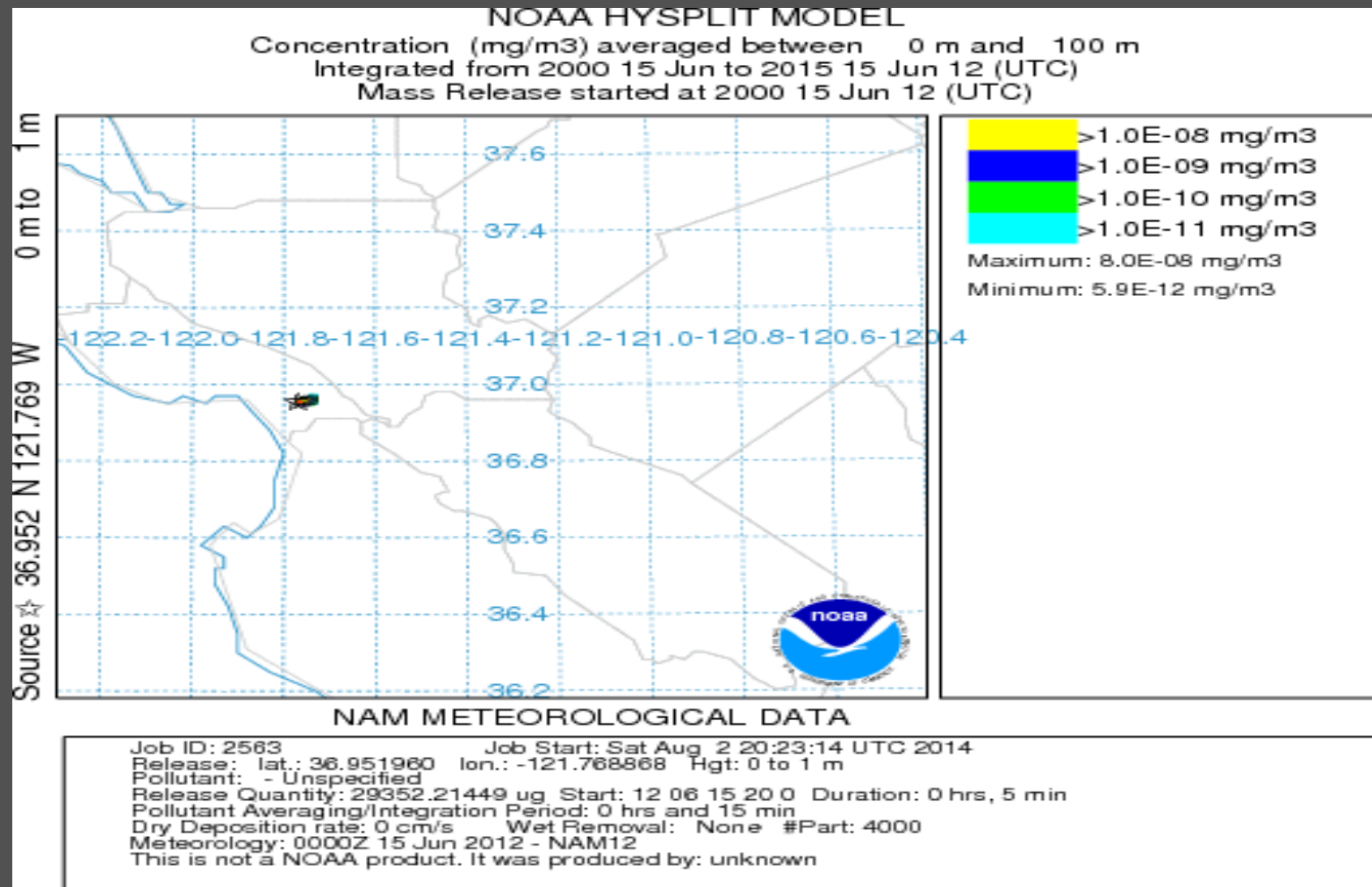
Very little known about aerosolization, but studies suggest it is possible

First Order Question: What happens if we get a highly toxic bloom in an urbanized area?
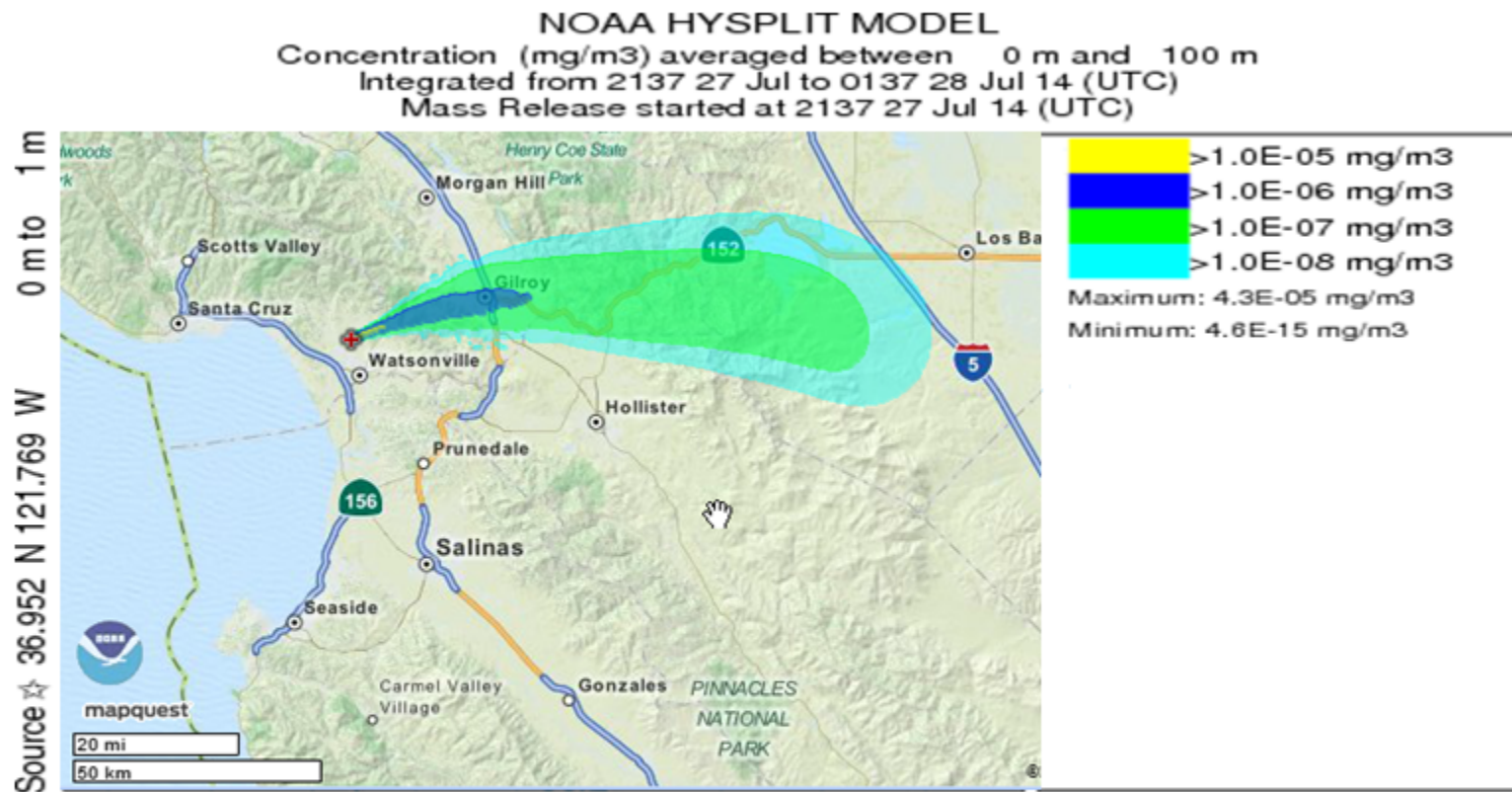

Total microcystins (ug/m²)

0   1 - 50   51 - 100   101 - 500   501 - 1000   1001 - 2500   2501 - 5000

NLCD 2006 Landcover
- Agricultural
- Developed
- Open
- Water

Predicting Impacts Downwind

Pinto Lake Highly Toxic Bloom

Predicting Impacts Downwind

Predicting Impacts Downwind

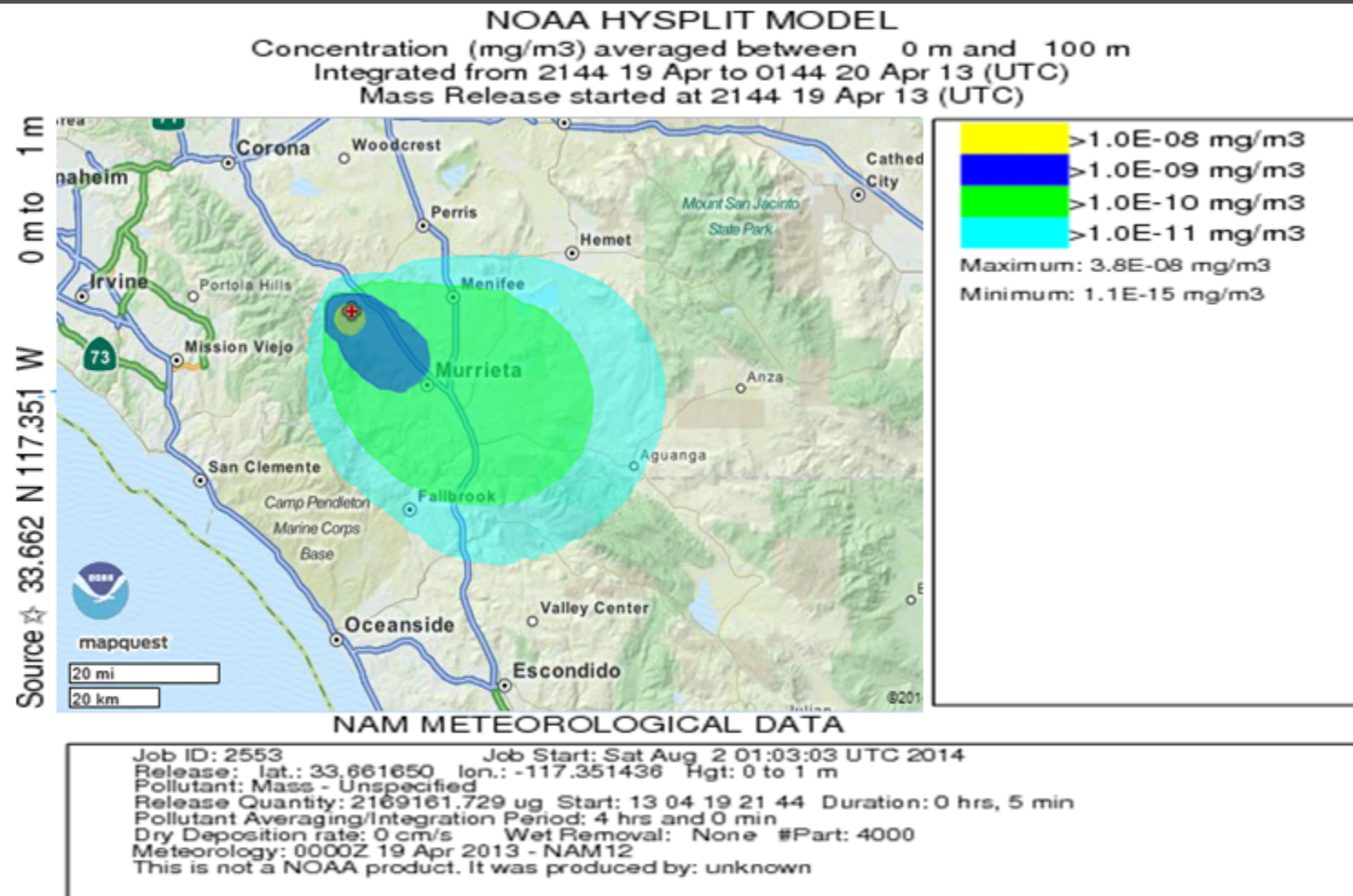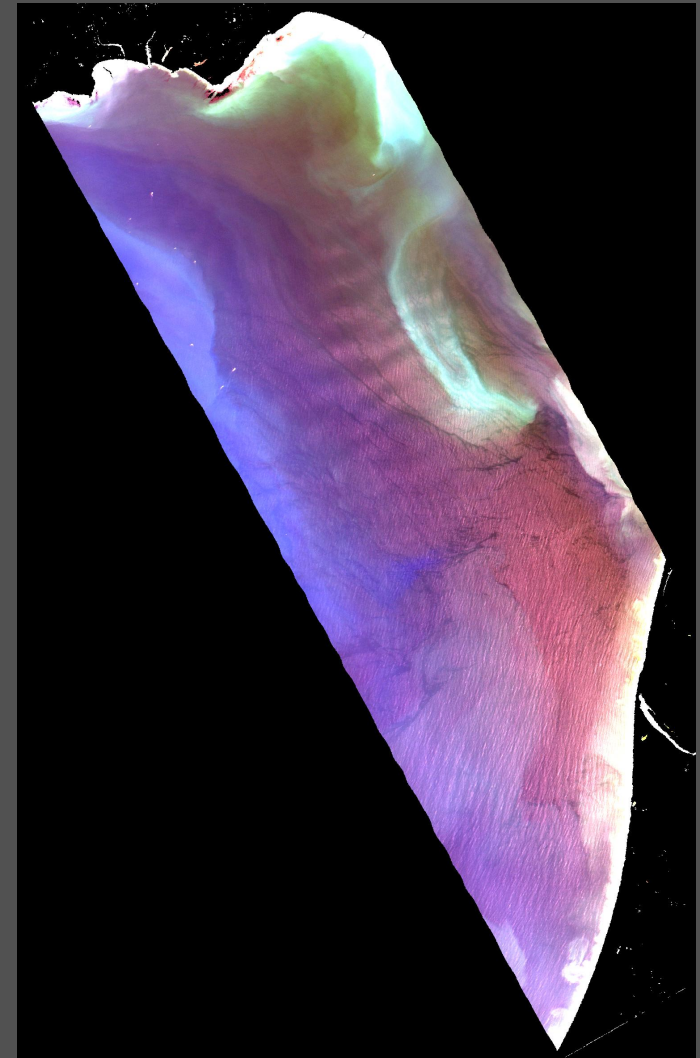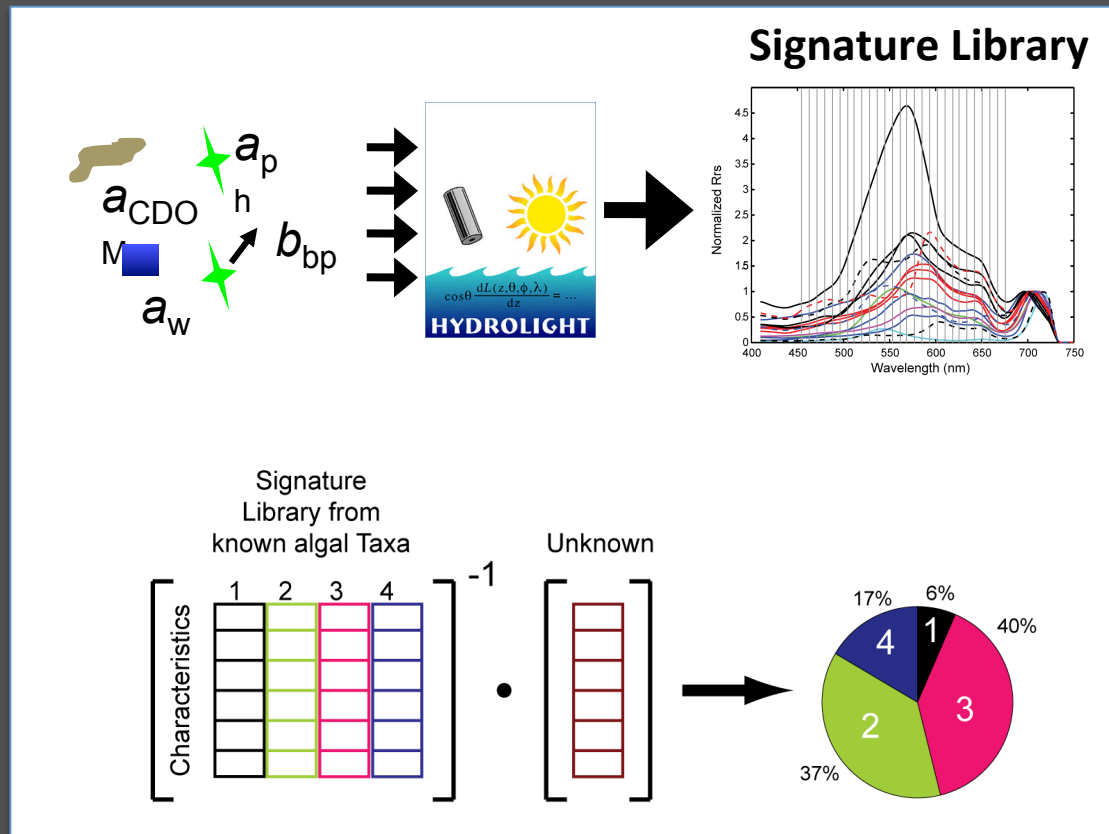*Lake Elsinore, Identified from HyspIRI Imagery*
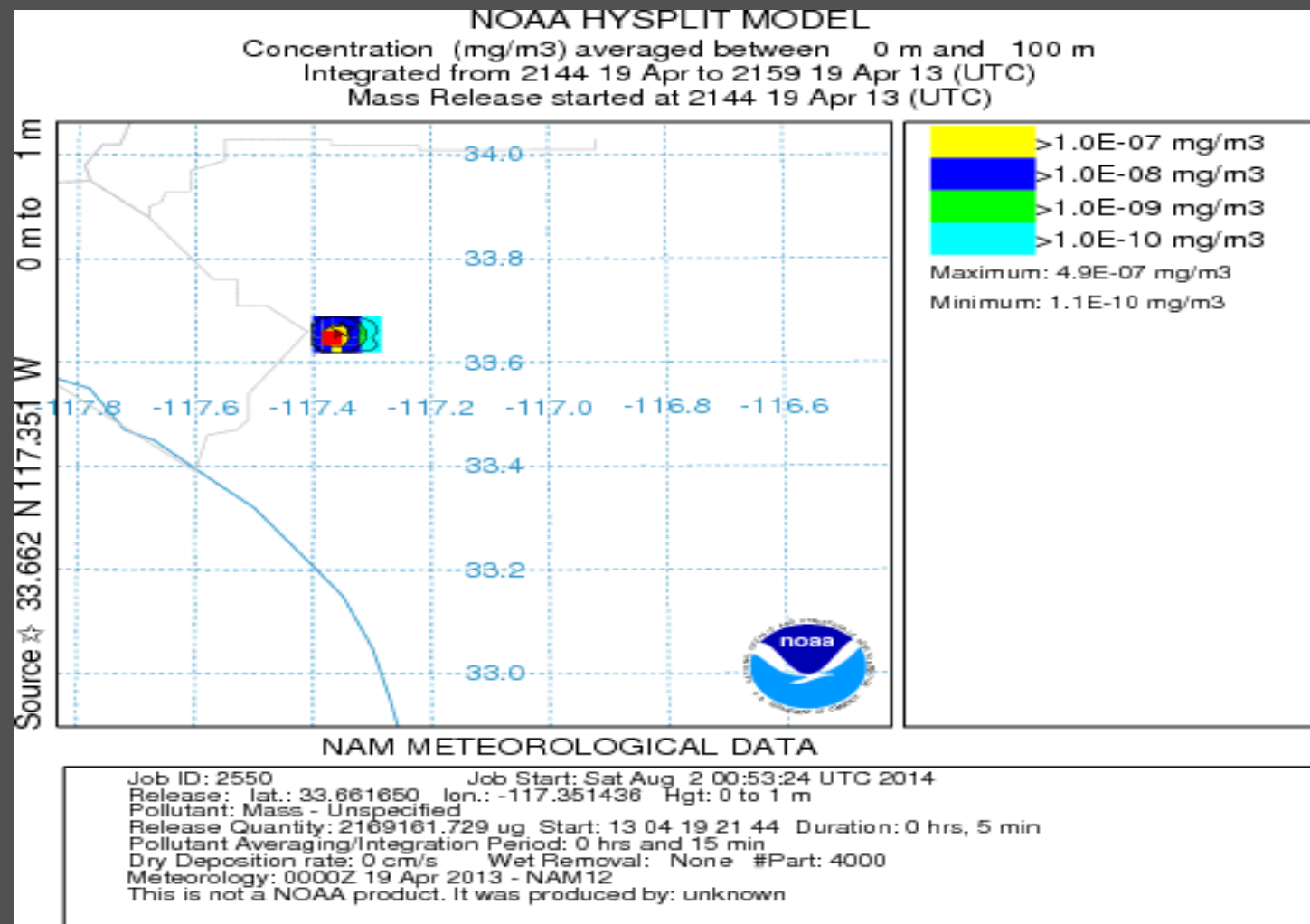
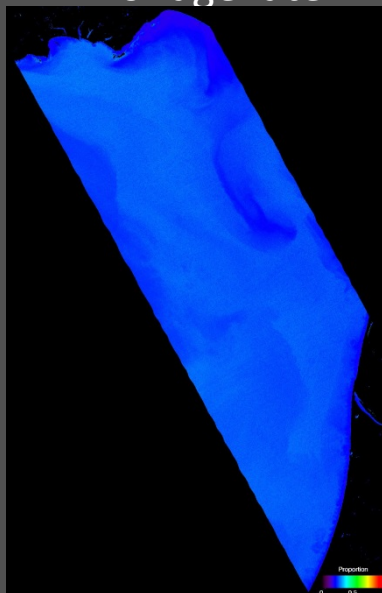# Predicting Impacts Downwind

Brief Update on PHYDOTax

Monterey Bay: 10 Apr 2013
Flightline: f130410t01p00r10
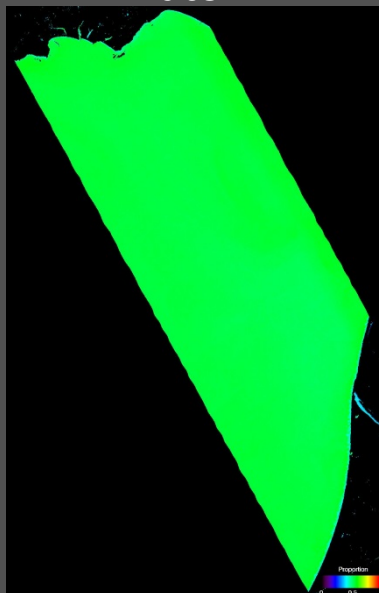Atmospheric Correction: Empirical Line from 9/29/2014
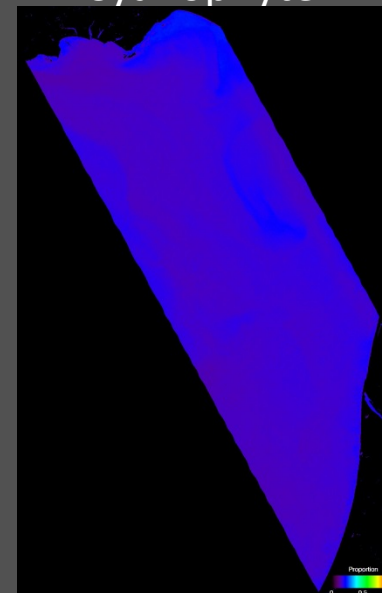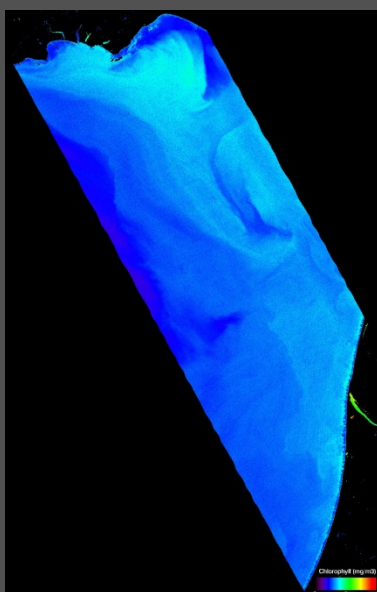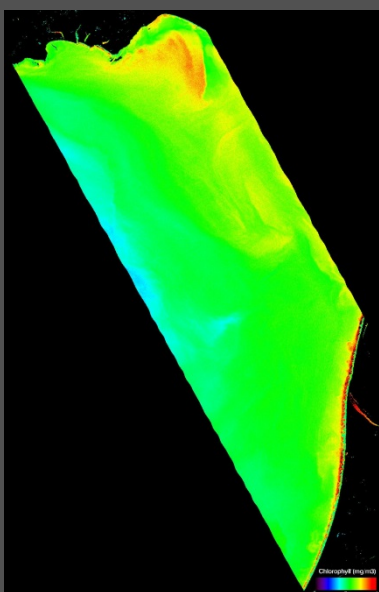
Proportions AVIRIS 10 Apr 13

Dinoflagellate

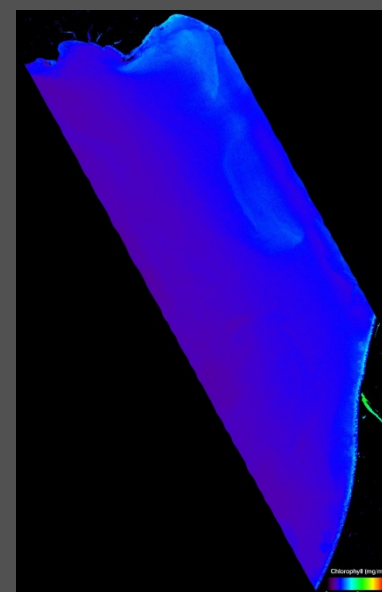## Diatom

Cyanophyte

Taxon-specific Biomass

Dinoflagellate

Diatom

Cyanophyte

Summary

Challenges

- In many regions,potentially toxic cyanobacterial blooms are ephemeral and associated with small waterbodies
- We cannot spend weeks/months optimizing data quality

Progress

- We have successfully extended spectral shape algorithms to multiple sensors
- We can separate non-toxic and toxic species, providing predictive capability
- HyspIRI-like simulations (HICO, MASTER, AVIRIS) demonstrate applicability

Opportunities

- Given more time, we can successfully apply more sophisticated PFT algorithms, such as PHYDOTax, to these data
- PRISM and AVIRISng data provide a framework for refining PHYDOTax specifically for inland waters
- State of California is initiating a Remote Sensing program for inland waters

Thank You!

Collaborators:

- David Thompson, JPL

- Michelle Gierach, JPL

- Ian McCubbin, JPL

- Stan Hooker, GSFC

- John Morrow, Biospherical Instruments

- The HyspIRI, MASTER, and AVIRIS teams

Funding:

- NASA HyspIRI Project (Woody Turner)

- NASA HQ20 Project (Paula Bontempi)

- NASA Student Airborne Research Program (Rick Shetter)