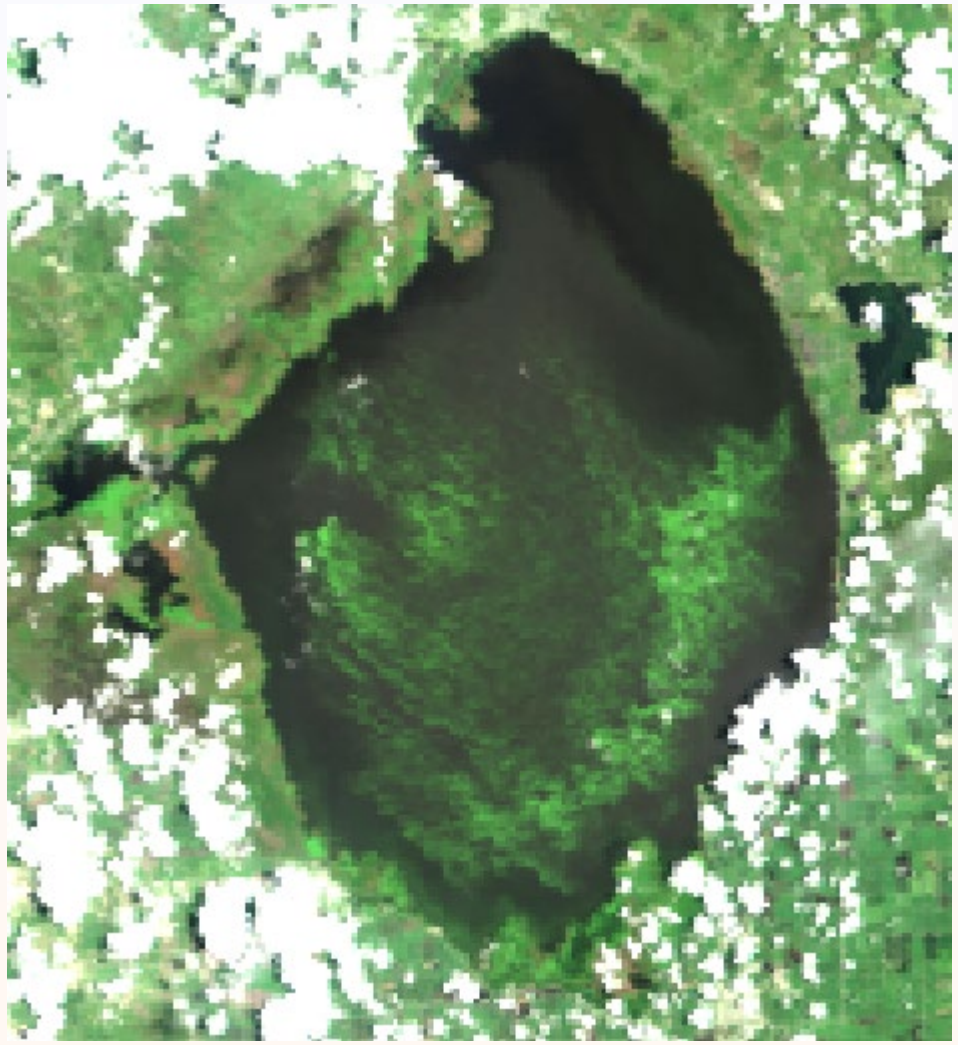
Finding Algal Blooms with Satellite in Lake Okeechobee and the Greater Everglades

Richard Stumpf, NOAA
National Ocean Service



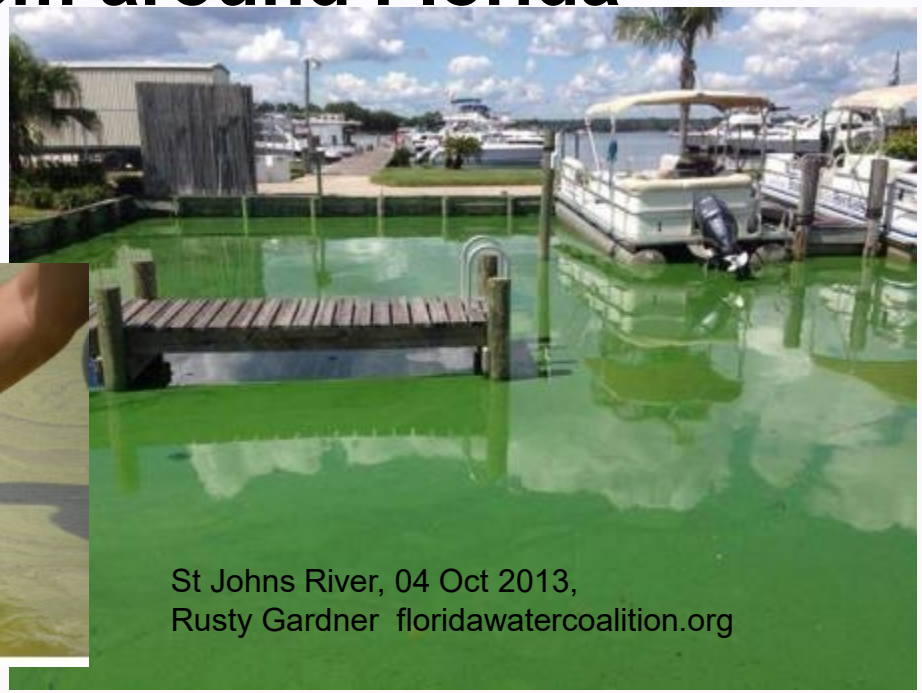
Sentinel-3a 25 June 2016.
Derived from Copernicus (EUMETSAT) data

Lake Okeechobee, 2016
Credit: Nicholas Aumen, USGS

Cyano blooms are a problem around Florida


Lake Apopka, Aug 2015
wftv.com 32068959

Lake Dora, Nara Souza
FFWC


St Johns River, 04 Oct 2013,
Rusty Gardner floridawatercoalition.org


Caloosahatchee River 2008
Audubon Florida


Martin County 2016
(Bob Hogensen)

Lake Okeechobee algae bloom threatens to worsen water woes

SunSentinel

Be smart and respect toxic algae in lakes

Orlando Sentinel News / Lake County News

By Lauren Ritchie · Contact Reporter

COMMENTARY

Algae bloom, bacterial spike close several South Florida beaches

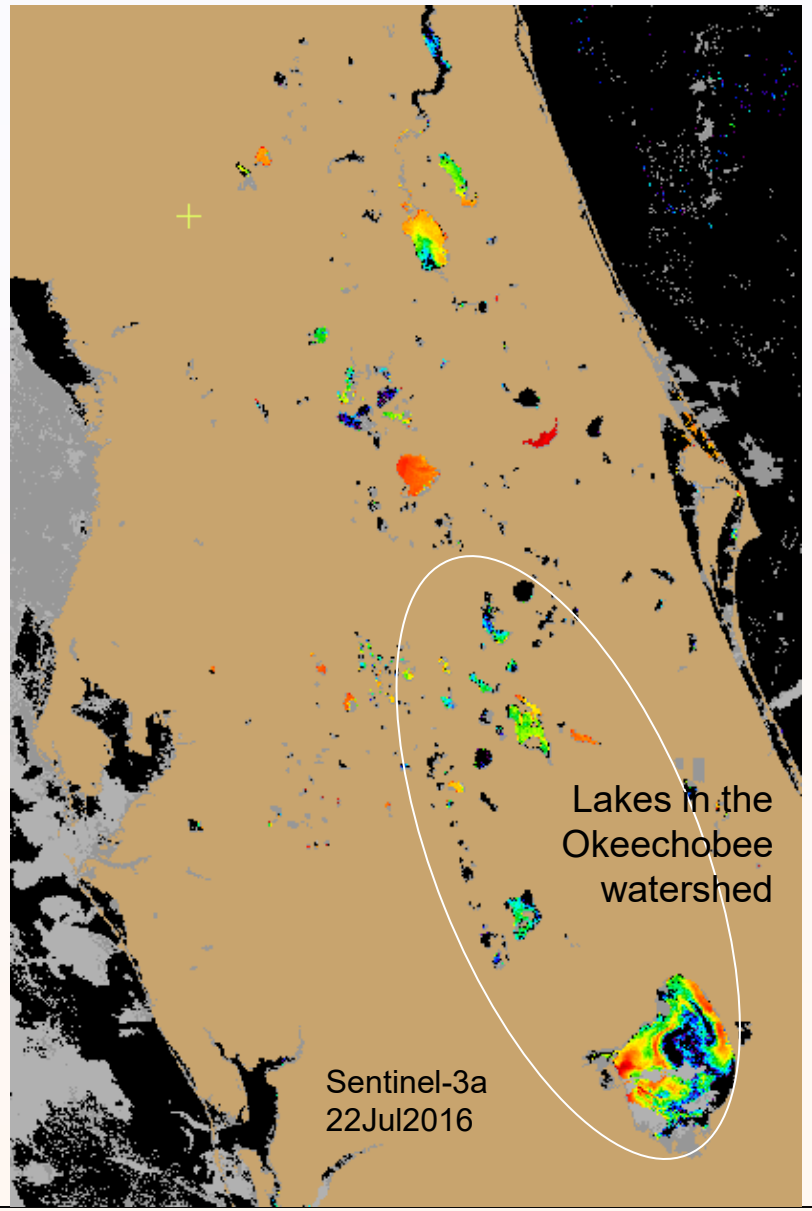
BUSINESS By Jennifer Sorentrue - Palm Beach Post Staff Writer

Updated: 5:39 p.m. Tuesday, June 28, 2016 | Posted: 5:27 p.m. Tuesday, June 28, 2016

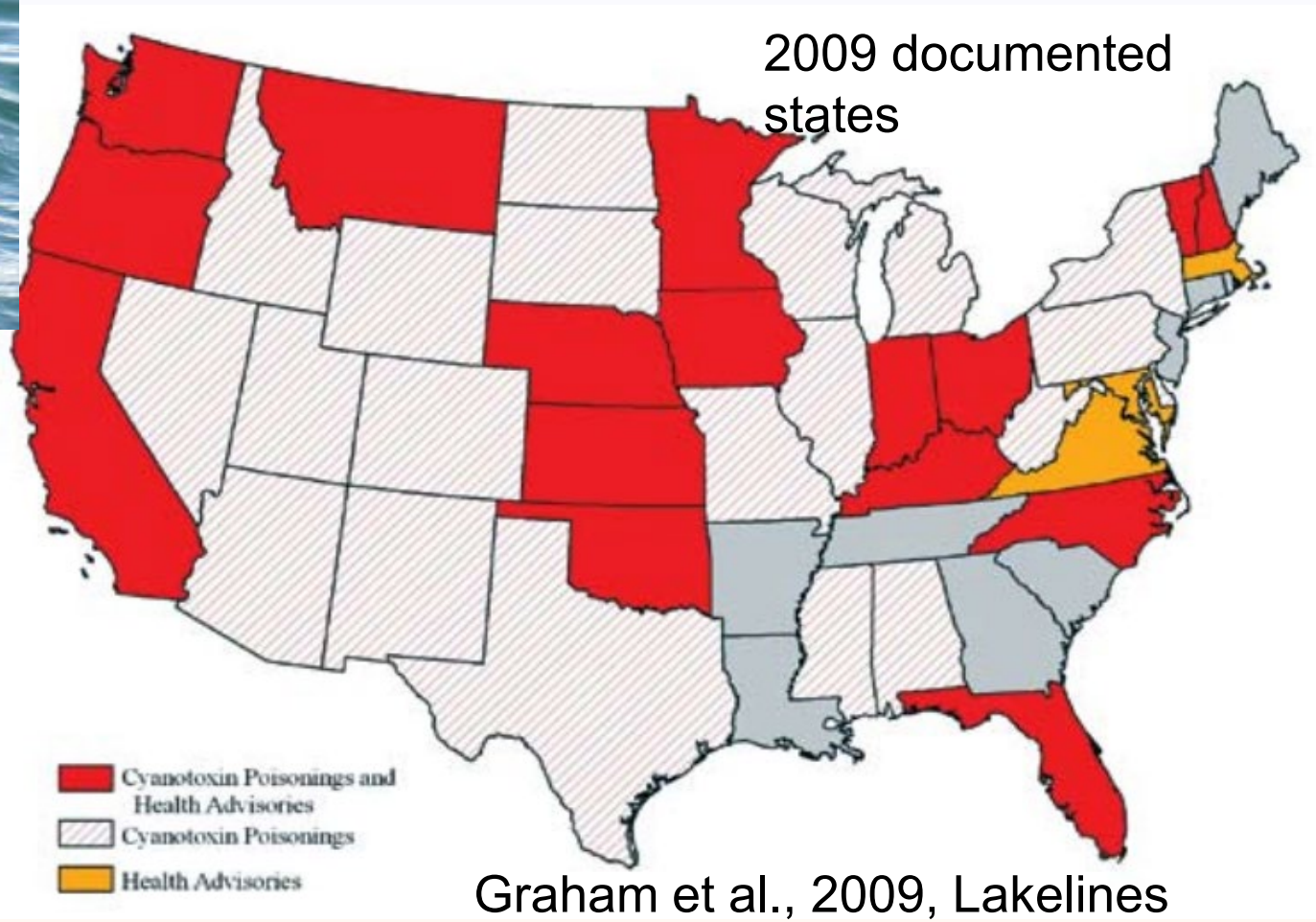
Caloosahatchee slimed: Seasonal nuisance or toxic warning?

Amy Bennett Williams, AWILLIAMS@NEWS-PRESS.COM Published 4:29 p.m. ET May 24, 2016 | Updated 12:02 p.m. ET May 25, 2016

More than Okeechobee



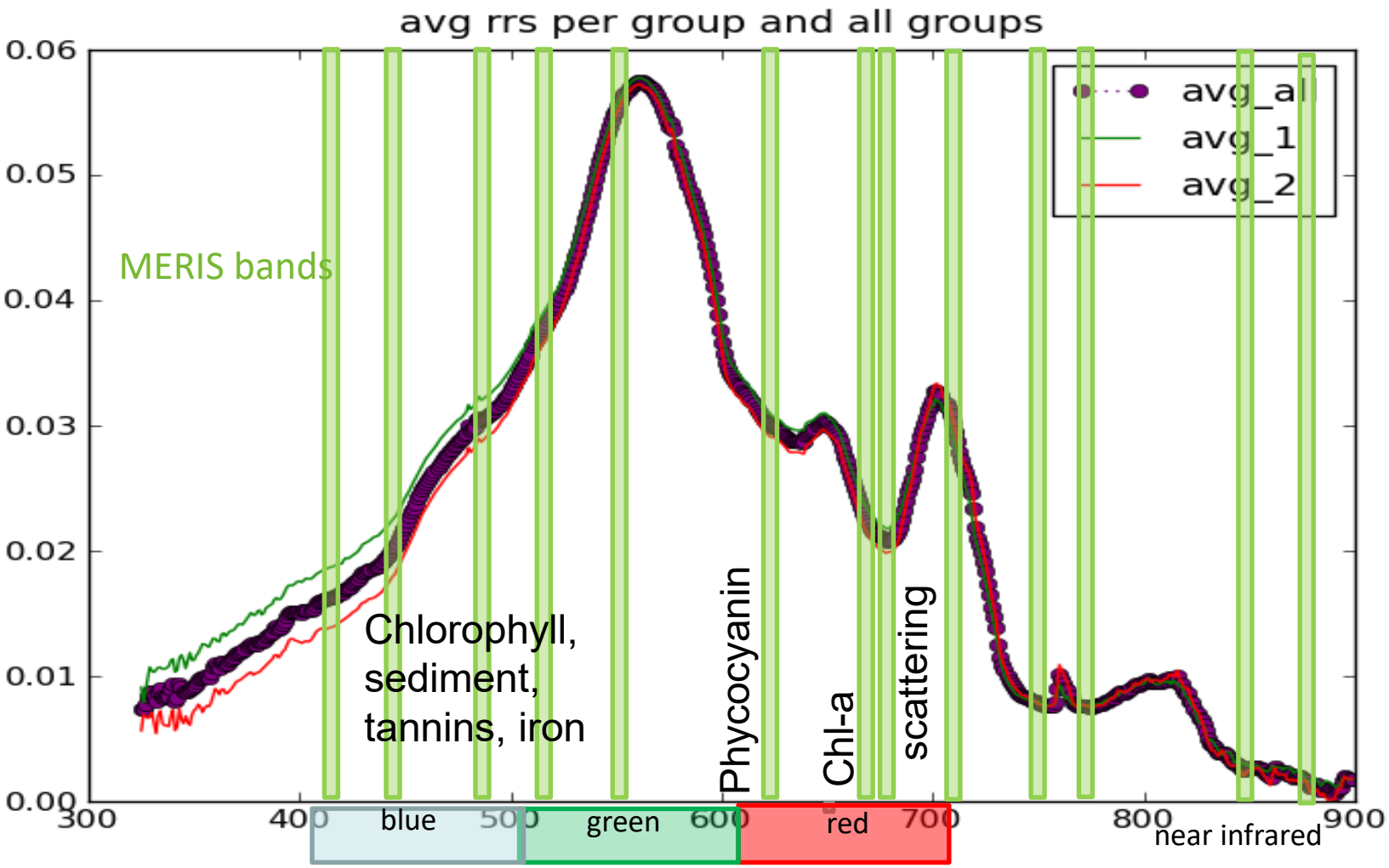
National problem



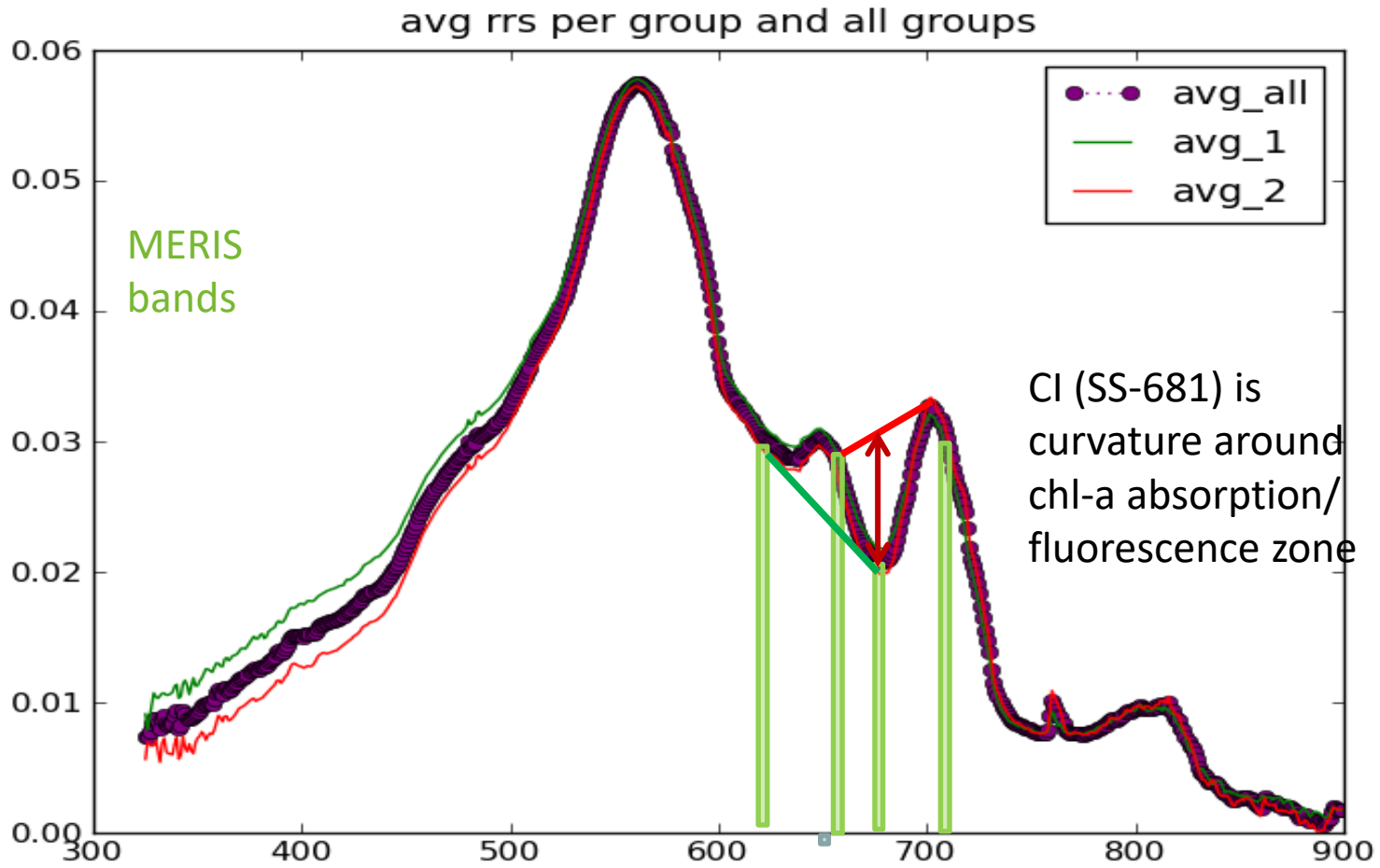
Graham et al., 2009, Lakelines

http://www.oda.state.ok.us/ais/bluegreenalgae.pdf

OLCI (Sentinel-3), and MERIS, bands and reflectance of cyanobacteria

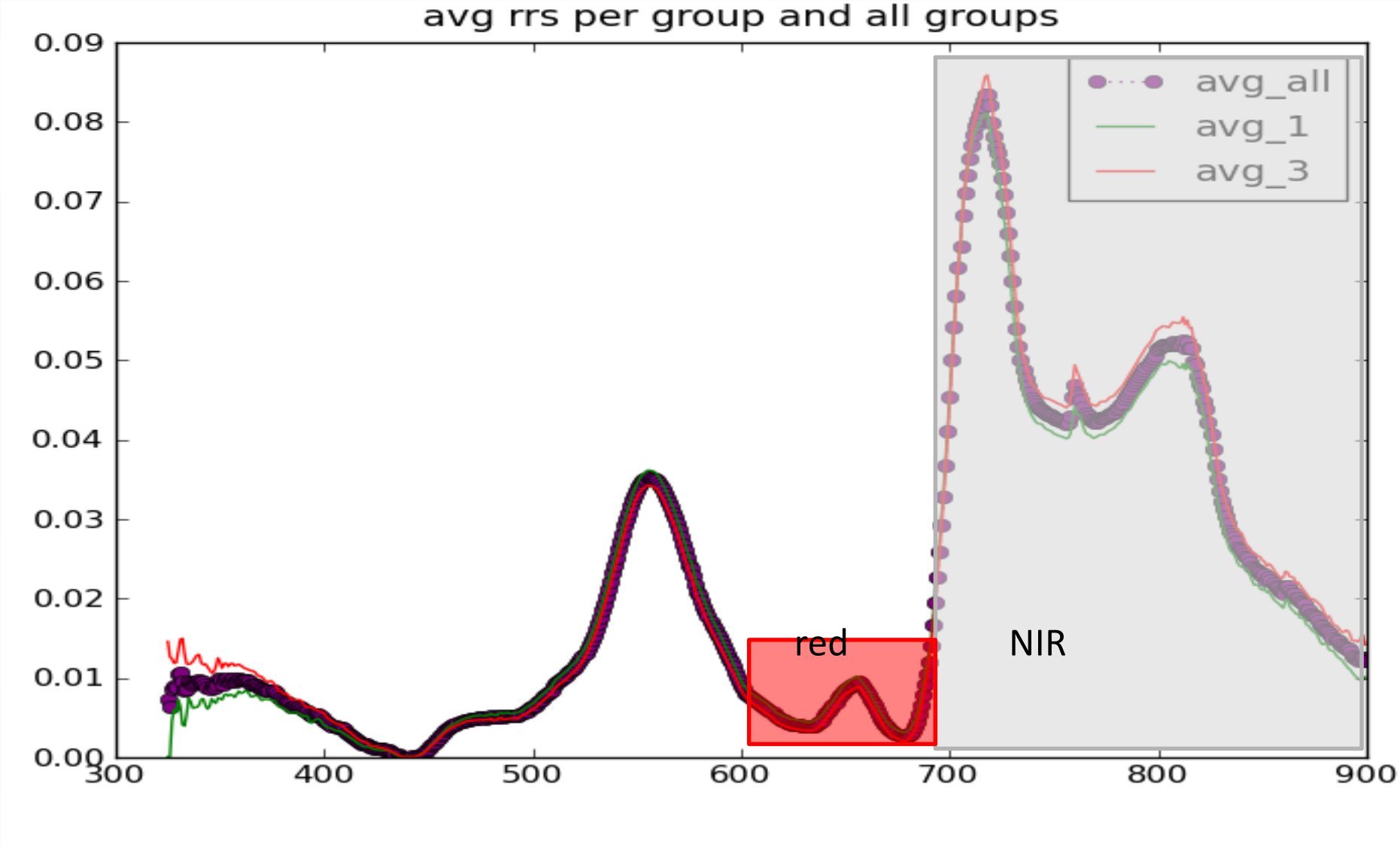


We capture the absorption “curves from chl-a and PC

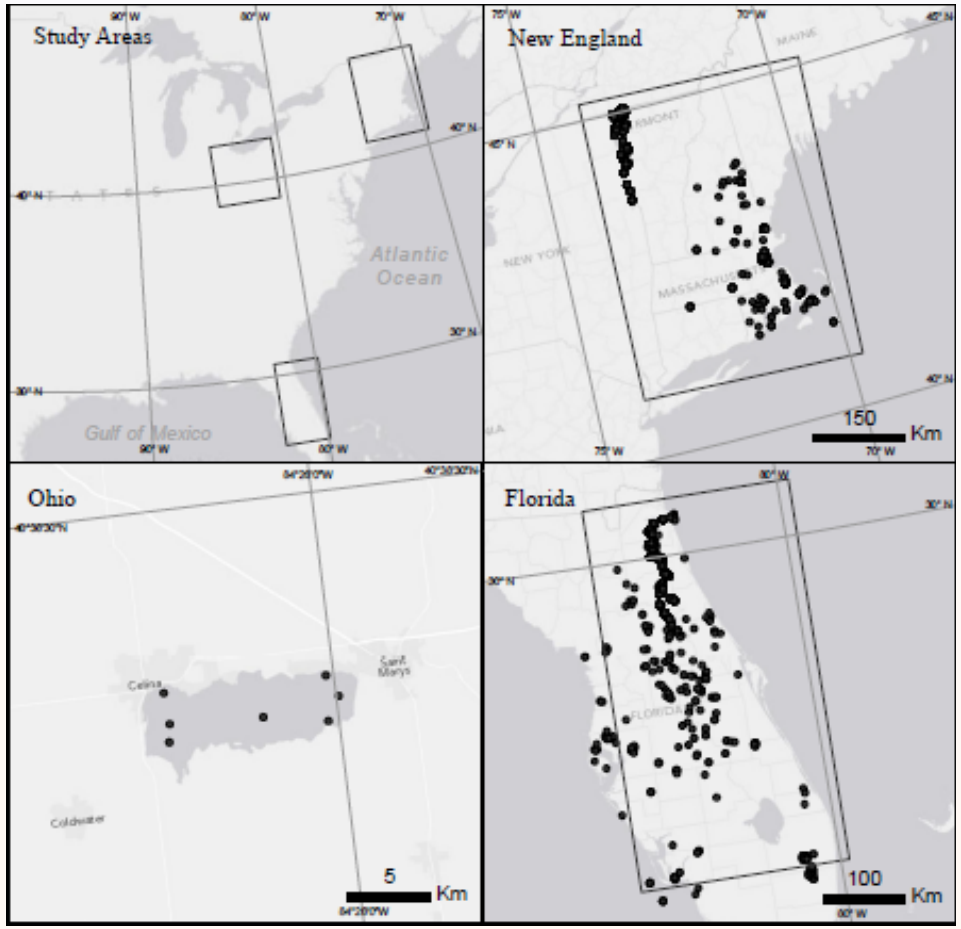


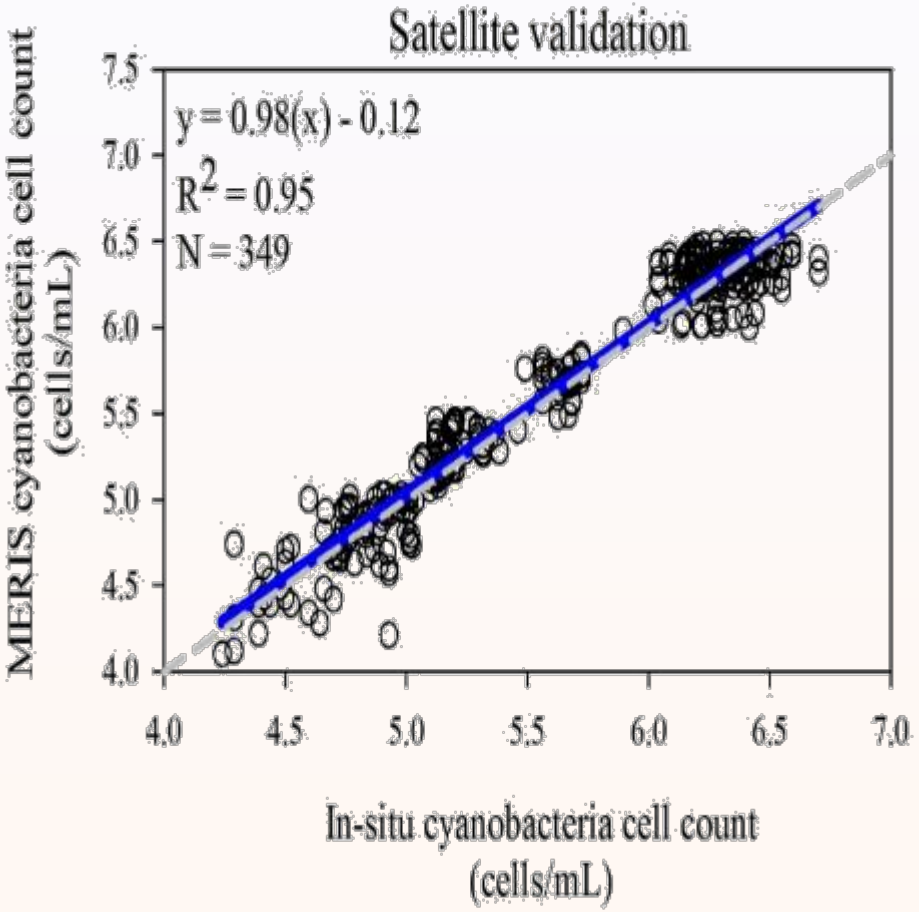
Cyanos have weak chl-a fluorescence, while eukaryotes have strong chl-a fluorescence

Even more interesting when it forms scum.
Need satellite to see near-infared (NIR)



Established of satellite to *Microcystis* cell concentration in Lake Erie. Works elsewhere.





Lunetta, Schaeffer, Stumpf et al. Remote Sensing of Environment

And chlorophyll-a, which we are detecting

Florida lakes

Mean error 5 µg/L

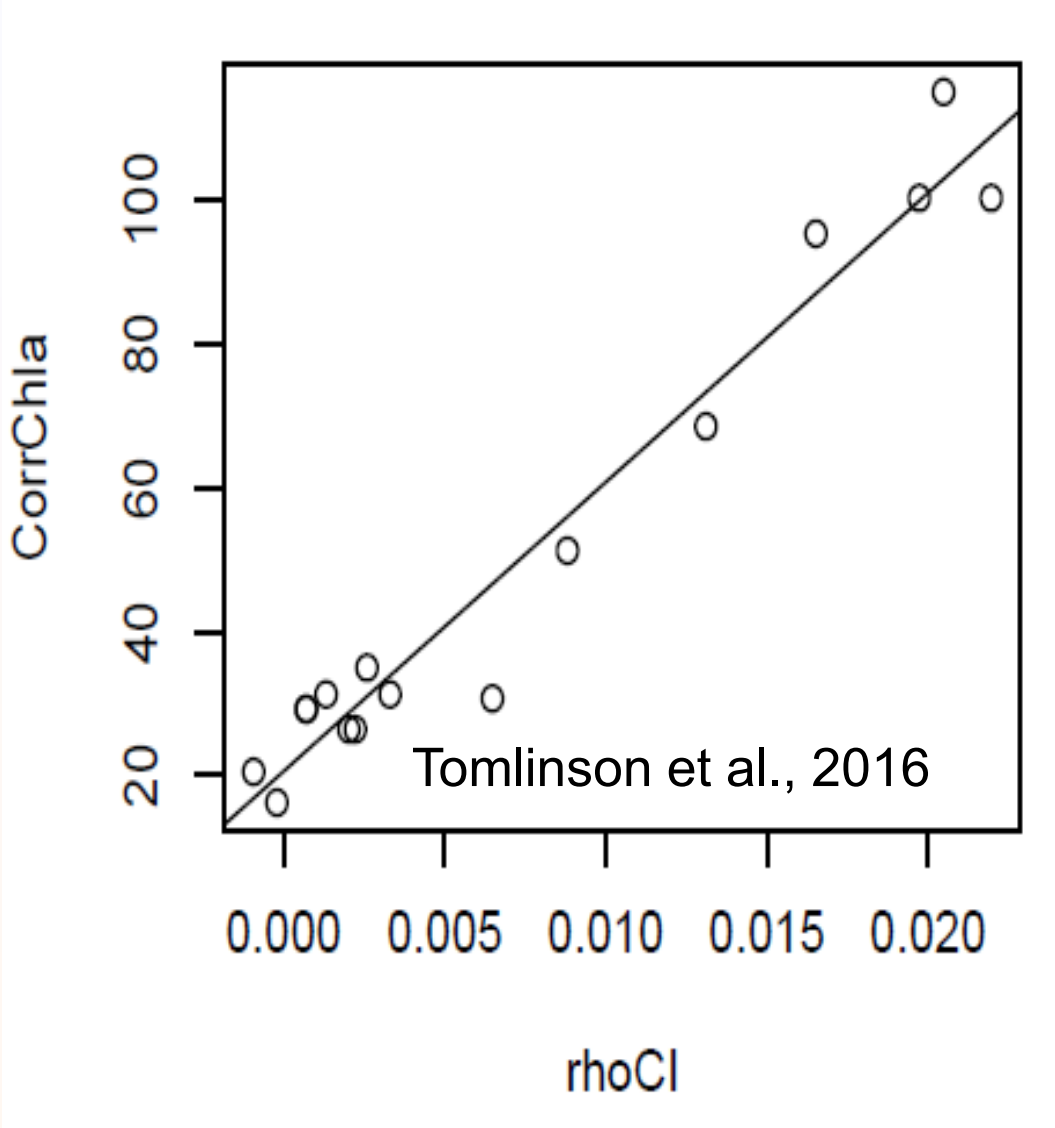
(with St Johns River WMD)

Est chl a =

4020*(*Cl*) + 20

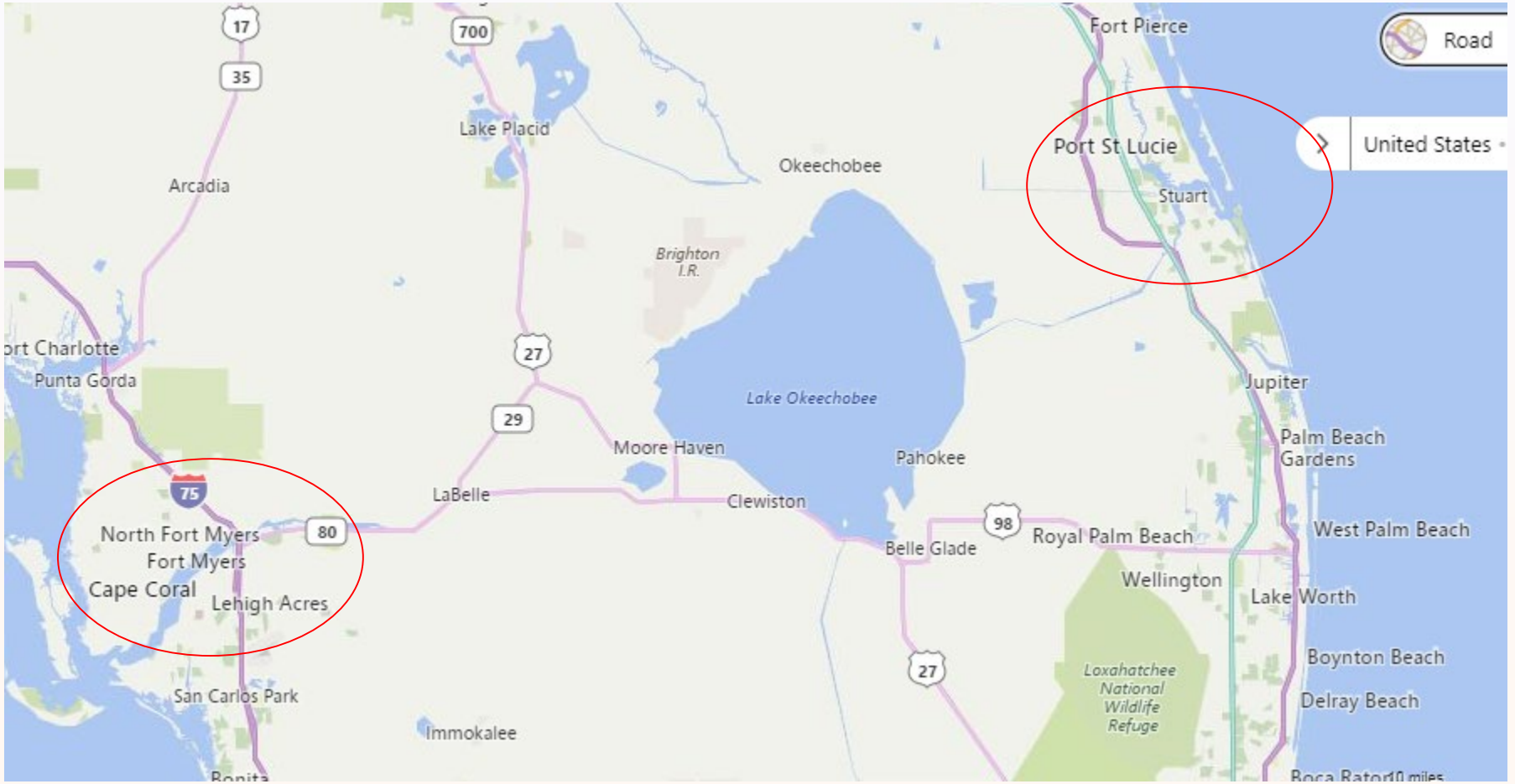
Detection of chlorophyll > 20 µg/L

- (working on > 10 µg/L)

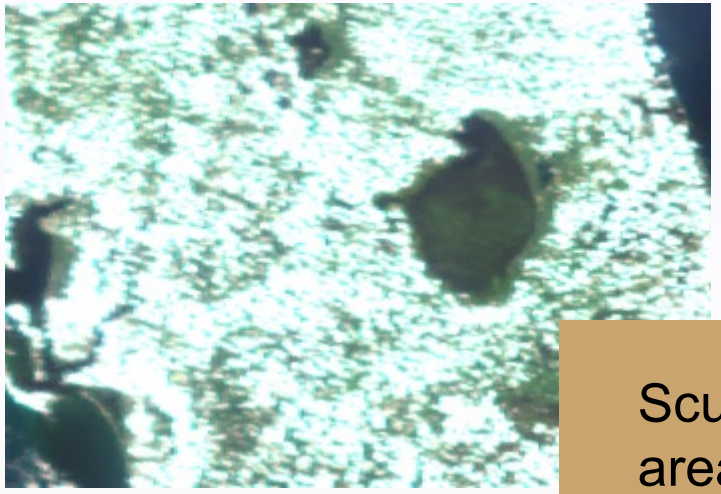


Further Validation in Okeechobee with SFWMD

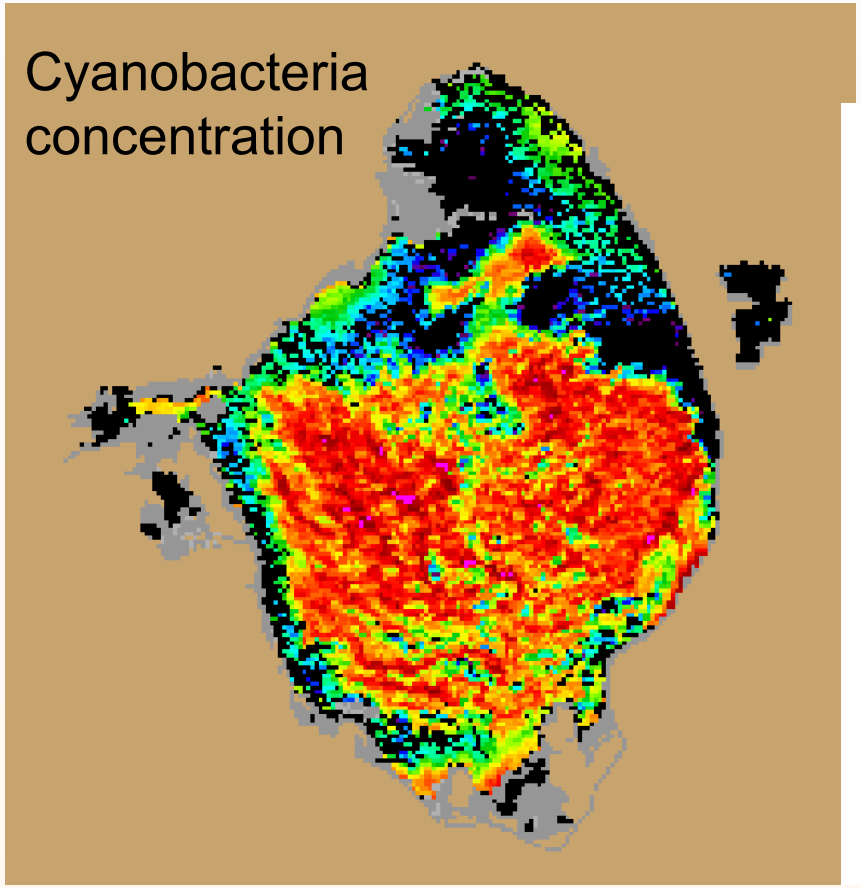
Okeechobee, Caloosahatchee and St Lucie
The two estuaries are at limit of Sentinel-3 detection

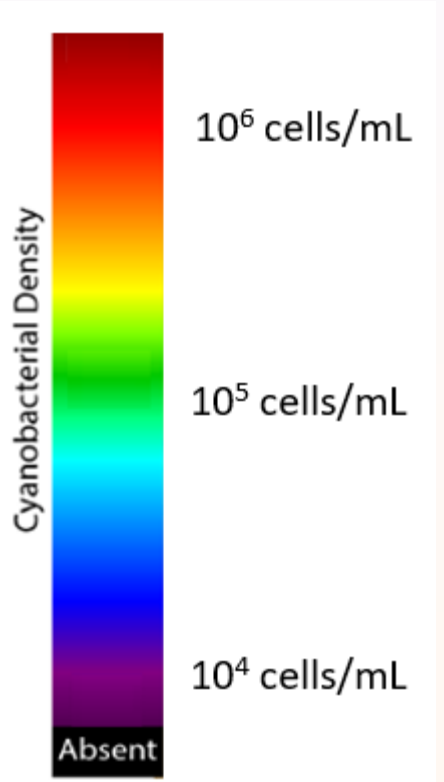


Okeechobee on June 14, 2016



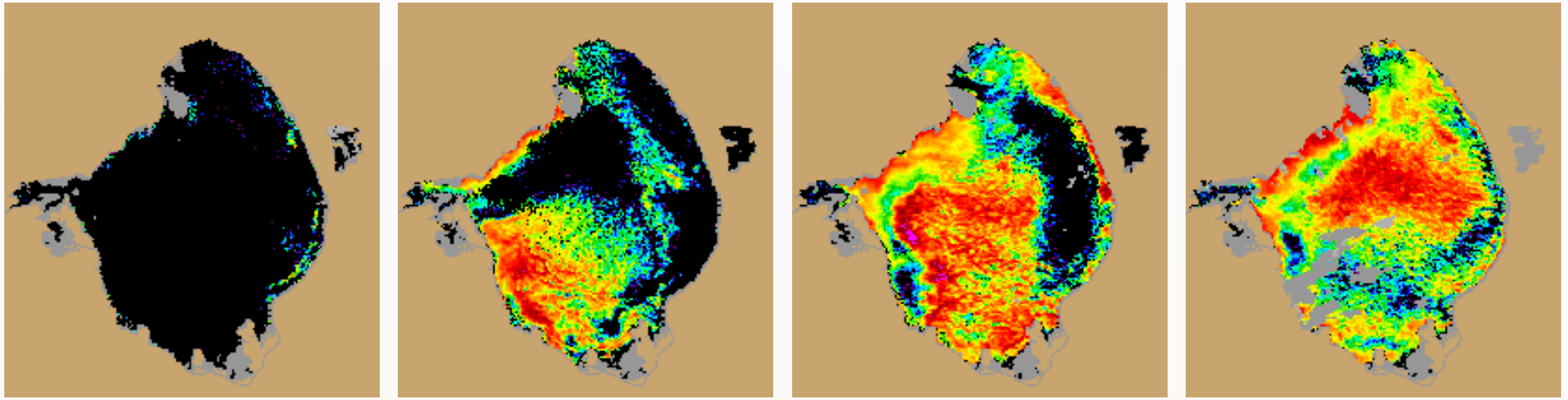
Sentinel-3a
2016-06-14Copernicus
EUMETSAT



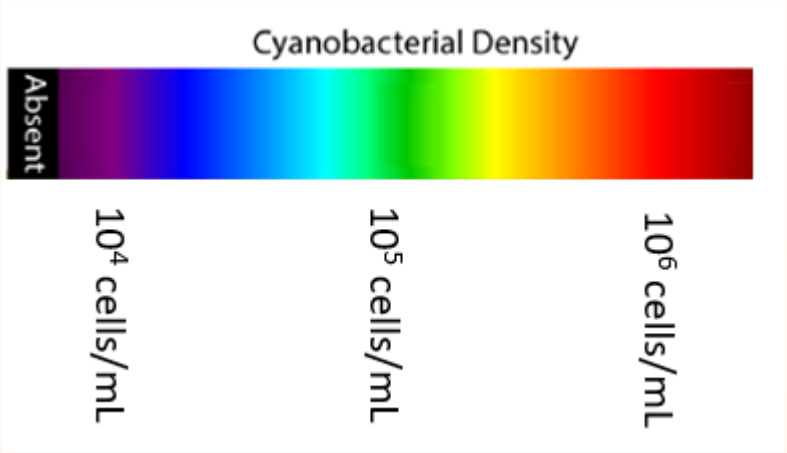


Lake Okeechobee, 2018

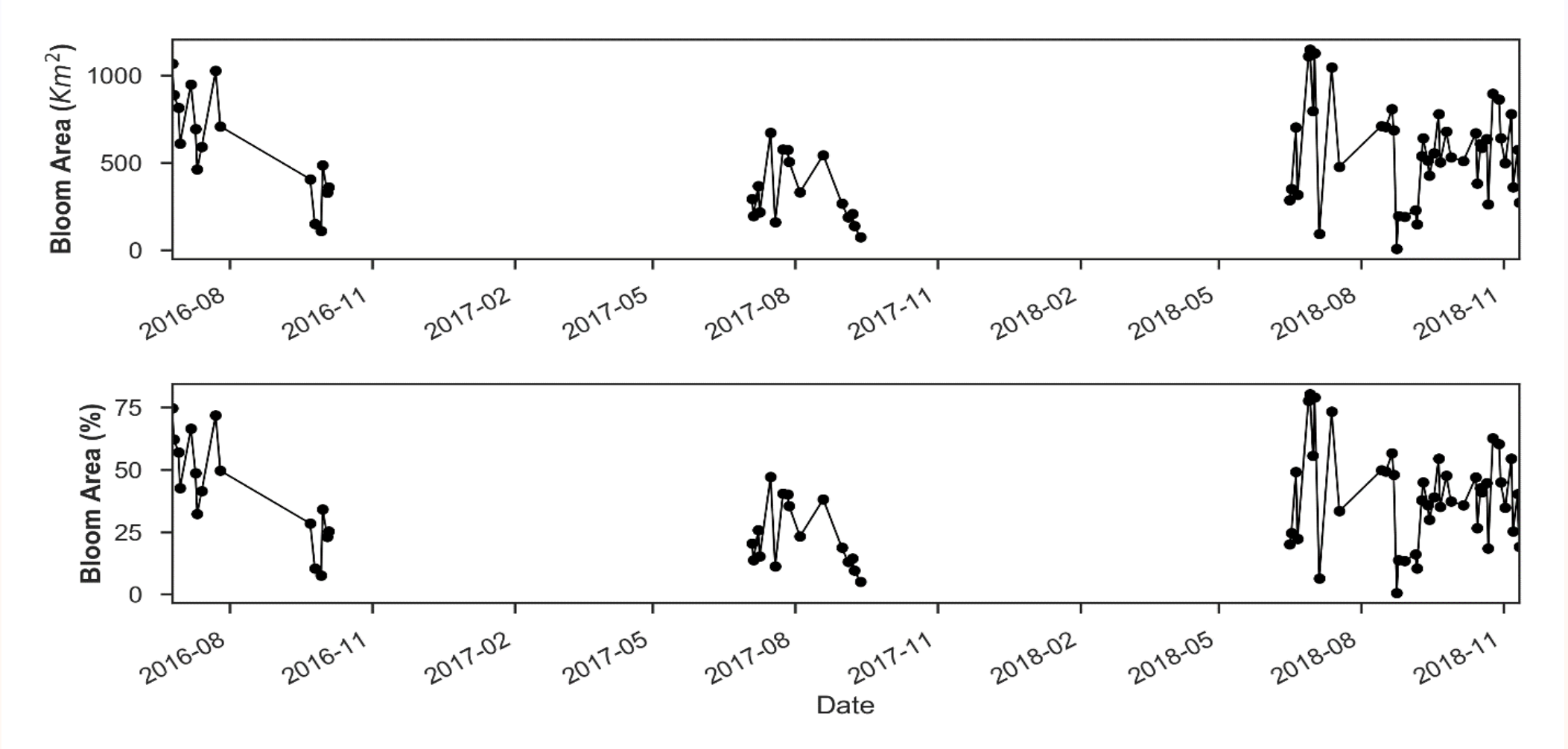
June 12 3% June 20 42% June 24 78% June 28 90%



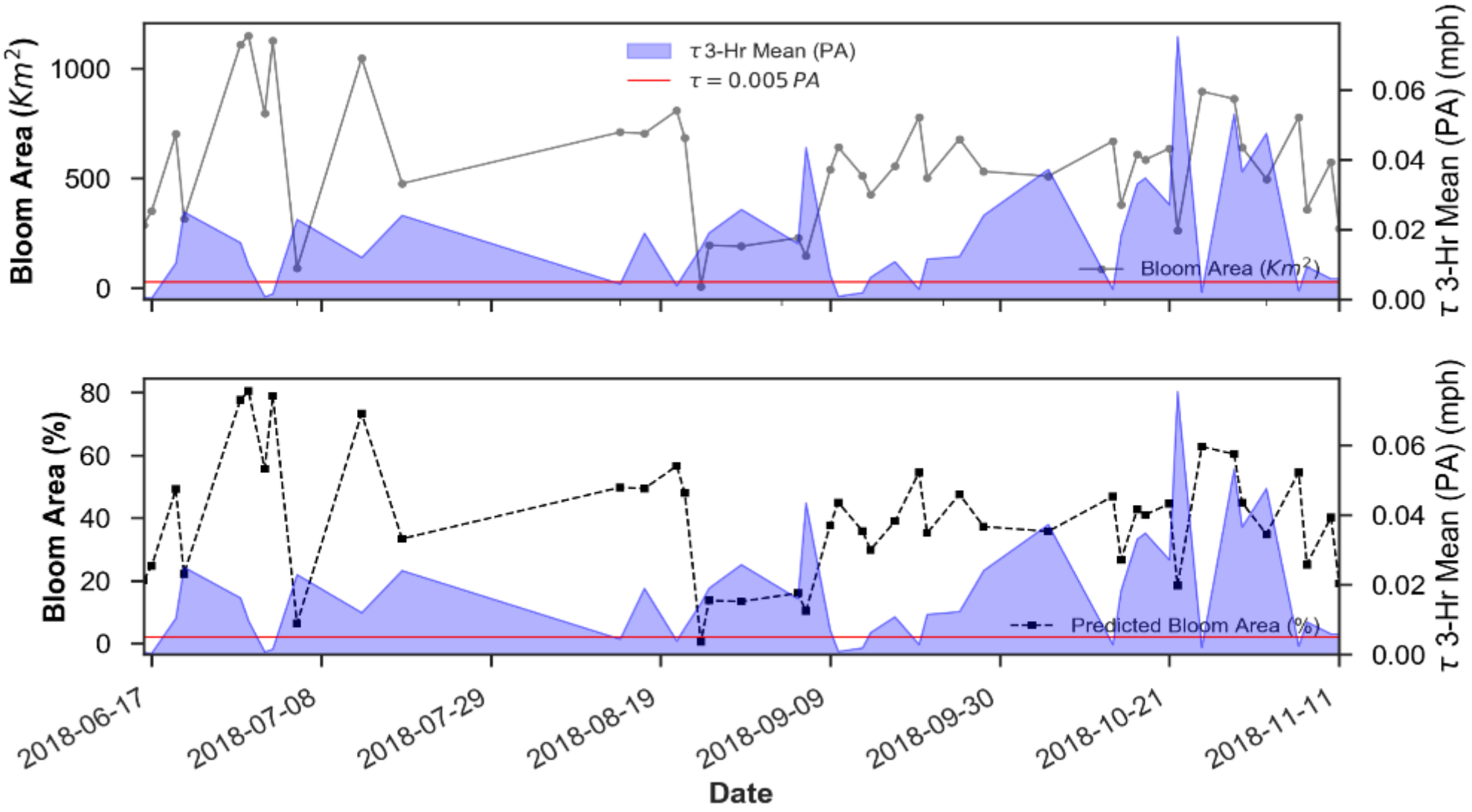
35 km



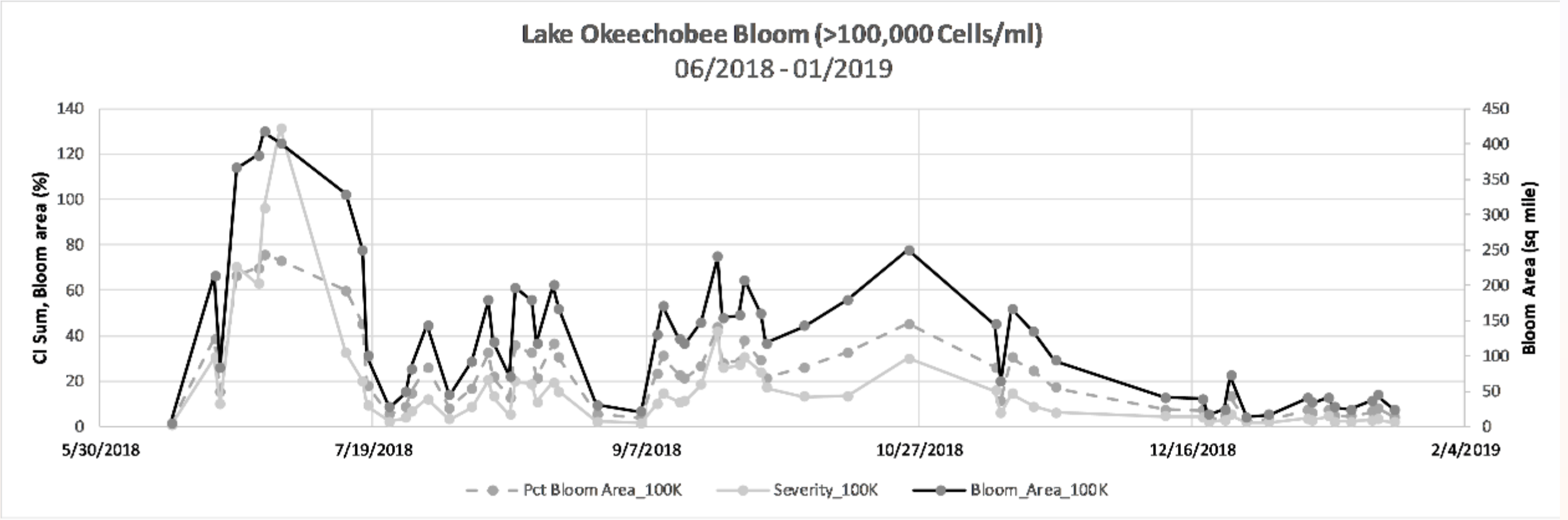
Bloom Area and Percent of Lake Okeechobee



Caution about wind impact.
Surface concentration (and area) change with wind speed



We composite imagery over 7-10 days to compensate for wind (and clouds)



Starting on higher resolution Sentinel-2 Caloosahatchee River Estuary, July 28, 2018

The New York Times

Algae Bloom in Florida Prompts Fears About Harm to Health and Economy

Best satellites for routine observation of cyano blooms

Satellite	Spatial	Temporal	Key Spectral
MERIS 2002-12 OLCI Sentinel-3a 2016 3b 2019 (data pending)	300 m *OK*	2 day *good*	10 (5 on red edge) *good*
MSI Sentinel-2a (2015) 2b (2017)	20 m *OK*	10 day (5 day with 2nd satellite, launch in 2017) *good*	5 (1 red; 2 NIR, 1 in red edge) *OK*

Clouds take out 1/2 to 2/3 of imagery

Some sunglint is not a problem for our algorithms

Minimum resolution, 3 pixels across (2 mixed land/water)

Collaborators and Support

Applied Sciences Program
NASA Earth Science

Ocean Biology and Biogeochemistry

Great Lakes RESTORATION

Copernicus
Europe's eyes on Earth

Sea Grant Florida

UF UNIVERSITY of FLORIDA