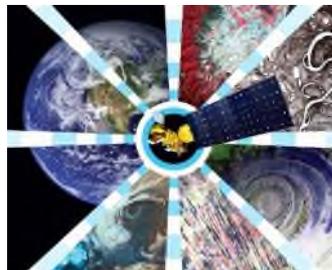


Multispectral Monitoring of New England Freshwater Resources to Assess Turbidity, Algal Blooms, and Water Quality for Enhanced Natural Resource Management

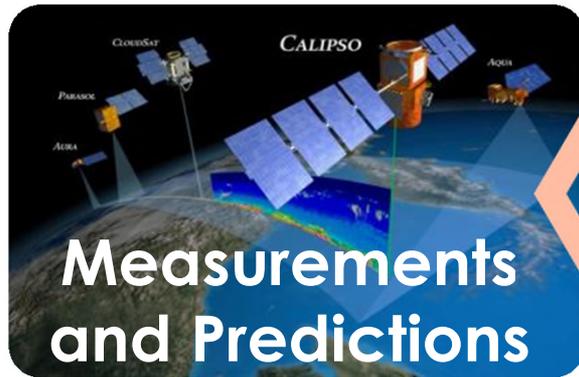


DEVELOP National Program

April 30, 2014



What is DEVELOP?

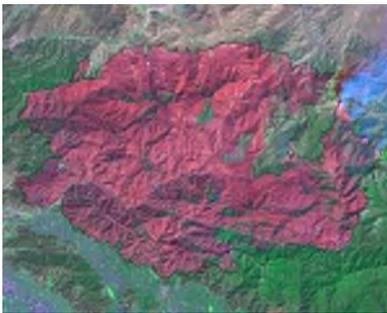


**NASA's Applied Sciences'
DEVELOP National Program**



DEVELOP **addresses environmental and public policy issues** through **interdisciplinary research projects** that **apply the lens of NASA Earth observations** to **community concerns** around the globe. Bridging the gap between **NASA Earth Science** and **society**, DEVELOP **builds capacity** in both **participants** and **partner organizations** to better prepare them to handle the **challenges** that face our society and future generations. With the competitive nature and **growing societal role of science** and technology in today's **global workplace**, DEVELOP is fostering an adept corps of **tomorrow's scientists and leaders**.

Project Characteristics



- ✓ **Utilize** freely available **NASA Earth observations**
- ✓ **Highlight the capabilities** of NASA satellite and airborne Earth remote sensing science and technology
- ✓ Address a **community concern** relating to environmental issues
- ✓ **Partner with local, state, federal and/or international organizations** who can **benefit** from using NASA EOS to **enhance decision making**
- ✓ Meet partner needs by **providing decision support tools**
- ✓ Research is conducted by teams with **diverse backgrounds**
- ✓ Science advisors and mentors from NASA and partner organizations provide guidance
- ✓ All projects culminate in a set of deliverables (technical report, poster, presentation, video, etc.)

Benefits to Partners & End-Users



- Introduction to new methods to augment current practices: **Cost-saving & time-saving**
- Enhanced **decision support** through use of NASA EOS
- **Increased exposure** to NASA Earth Science technologies and capabilities
- Introduction to **NASA's Applied Sciences Program** and its contributions to local communities, the country, and the world
- **Hands-on training** with practical applications of remote sensing and NASA Earth science
- Improved remote sensing and geographic information science (GIS) capabilities
- Interaction with bright and **innovative young professionals**
- Opportunities for **networking with the NASA community**
- **Strong recruiting pool** of early career professionals with a knowledge of Earth observations and their capabilities

Authors

Summer 2013

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Spring 2014

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Thomas Nelson Community College

Community Concerns

- Harmful Algal Blooms (HABs)
- Water Quality
 - Eutrophication
 - Toxin Accumulation
- Economic Impacts



Objectives

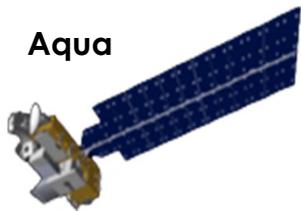
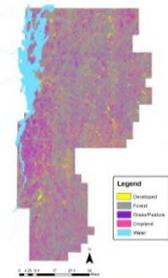


- 1) Show trends in bloom events over time
- 2) Correlate bloom events with regional natural forces
- 3) Establish a set of potential indicators for future blooms

Methodology



**Processing in ERDAS
Imagine:**
Mosaic
Supervised Land Cover
Classification



Aqua



Processing in ArcMap:
Cyanobacteria
Algorithm
Composite Cumulative
Images
Bloom Frequency
Calculation



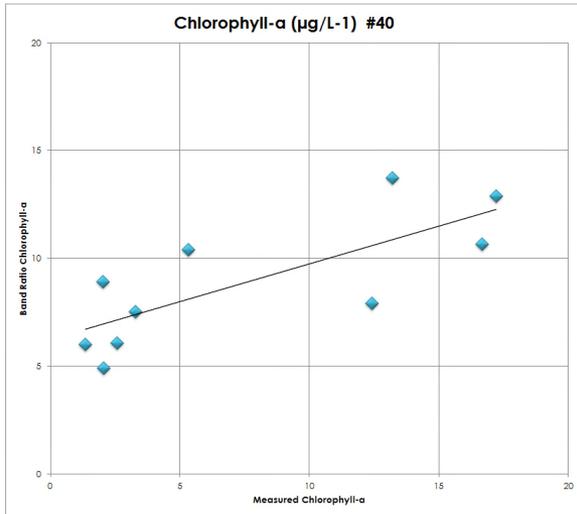
Landsat 7



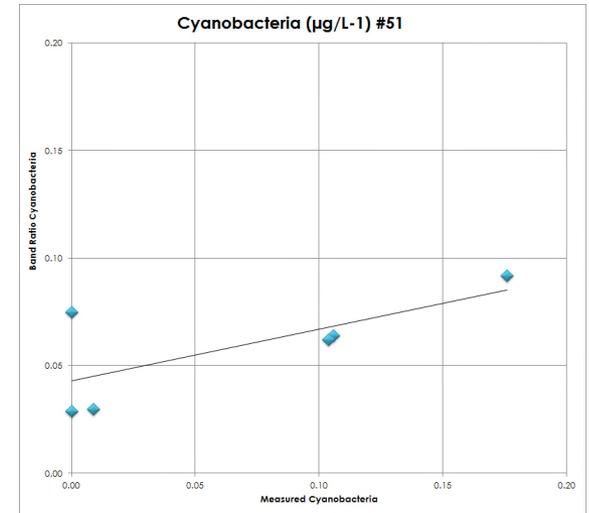
Processing in ArcMap:
Top of Atmosphere
Reflectance
Pigment and Algal
Algorithms
Cloud Mask



Results and Products

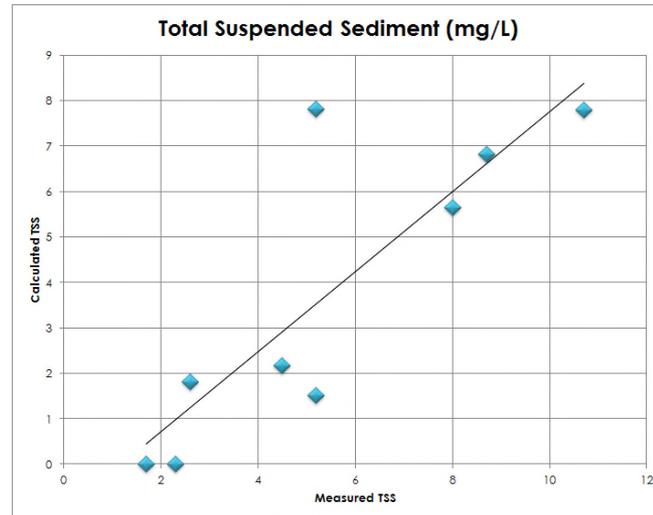


(Left) Scatterplot showing correlation between in situ and calculated values for chlorophyll-a. ($N=10, r=0.76715$)

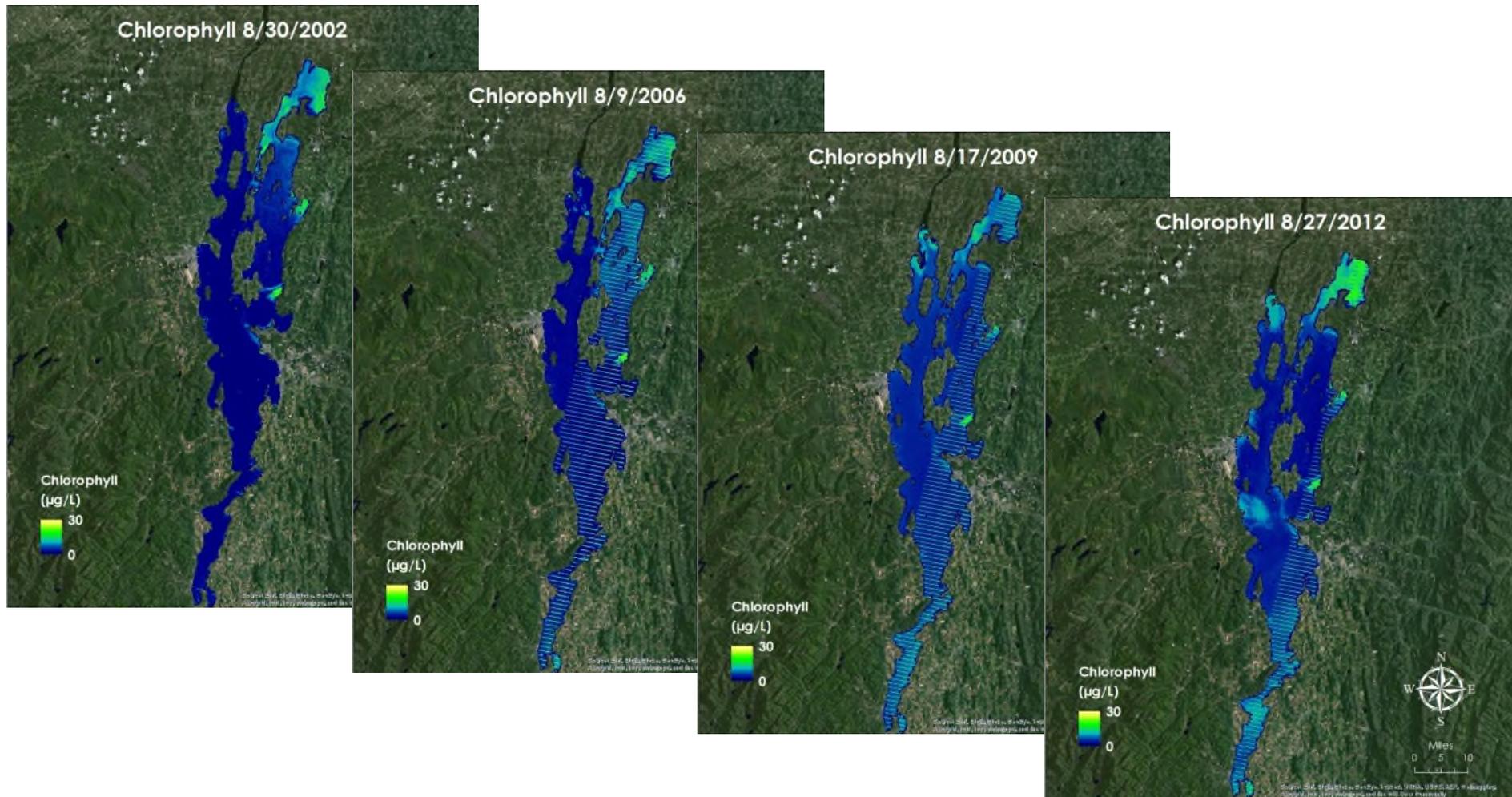


(Above) Scatterplot showing correlation between in situ and calculated values for cyanobacteria ($N=6, r=0.70915$)

(Right) Scatterplot showing correlation between in situ and calculated values for TSS ($N=9, r=0.84074$)

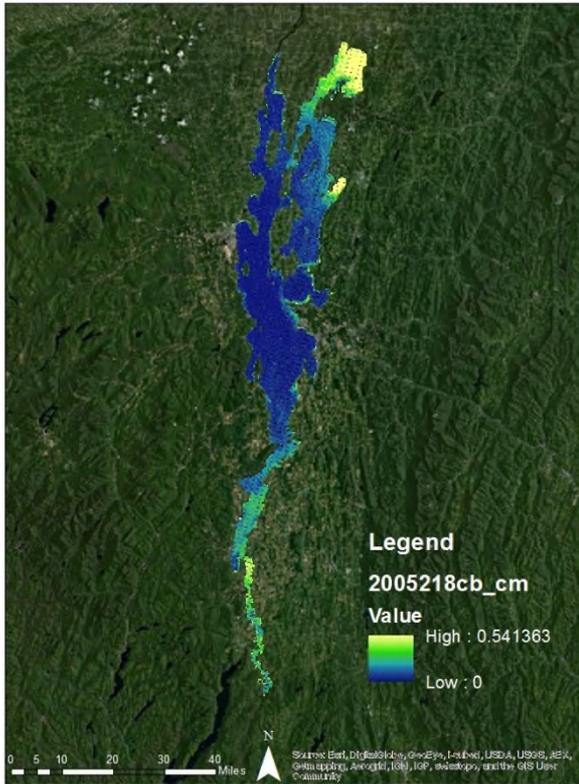


Results and Products

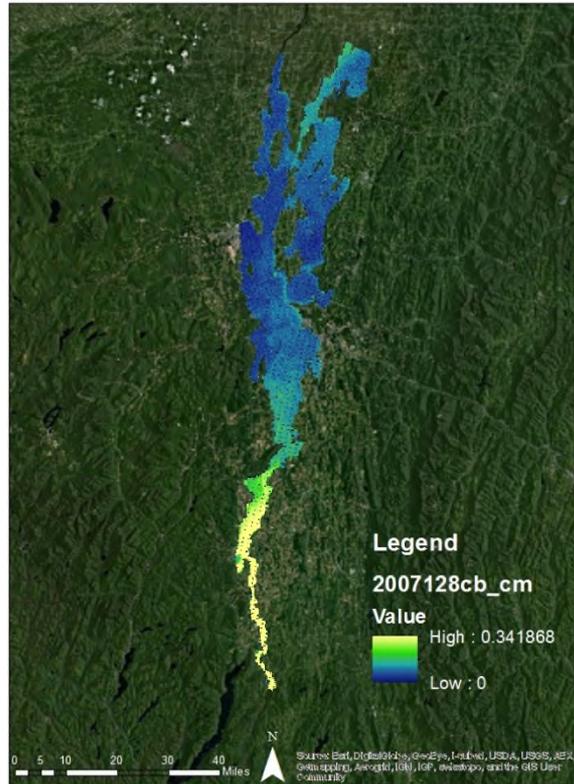


Chlorophyll-a throughout the study period.

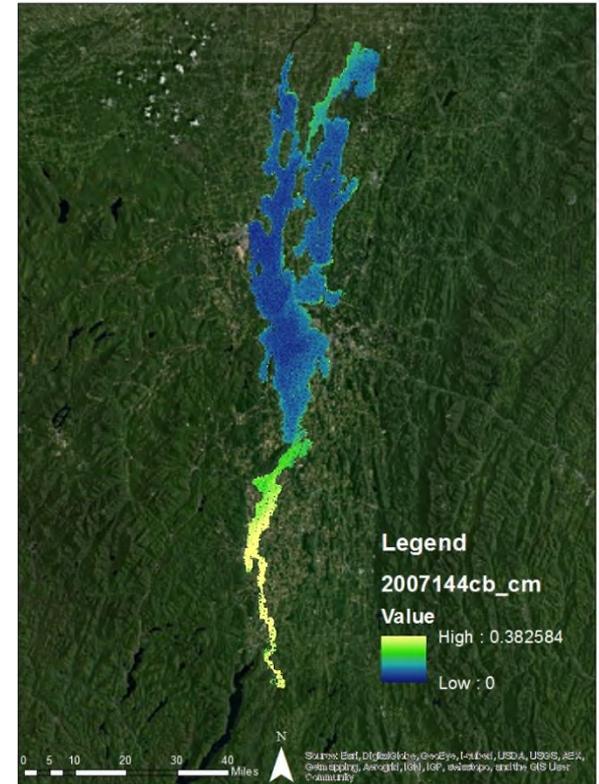
Results and Products



August 6, 2005

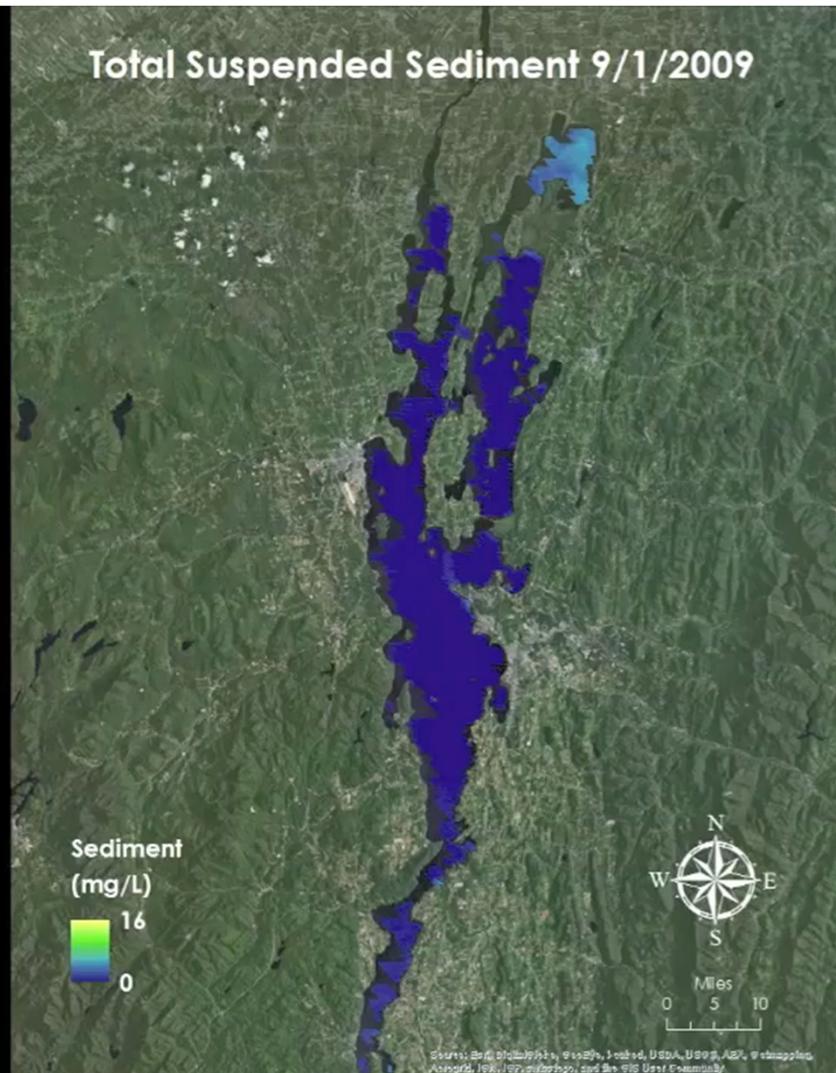


May 8, 2007



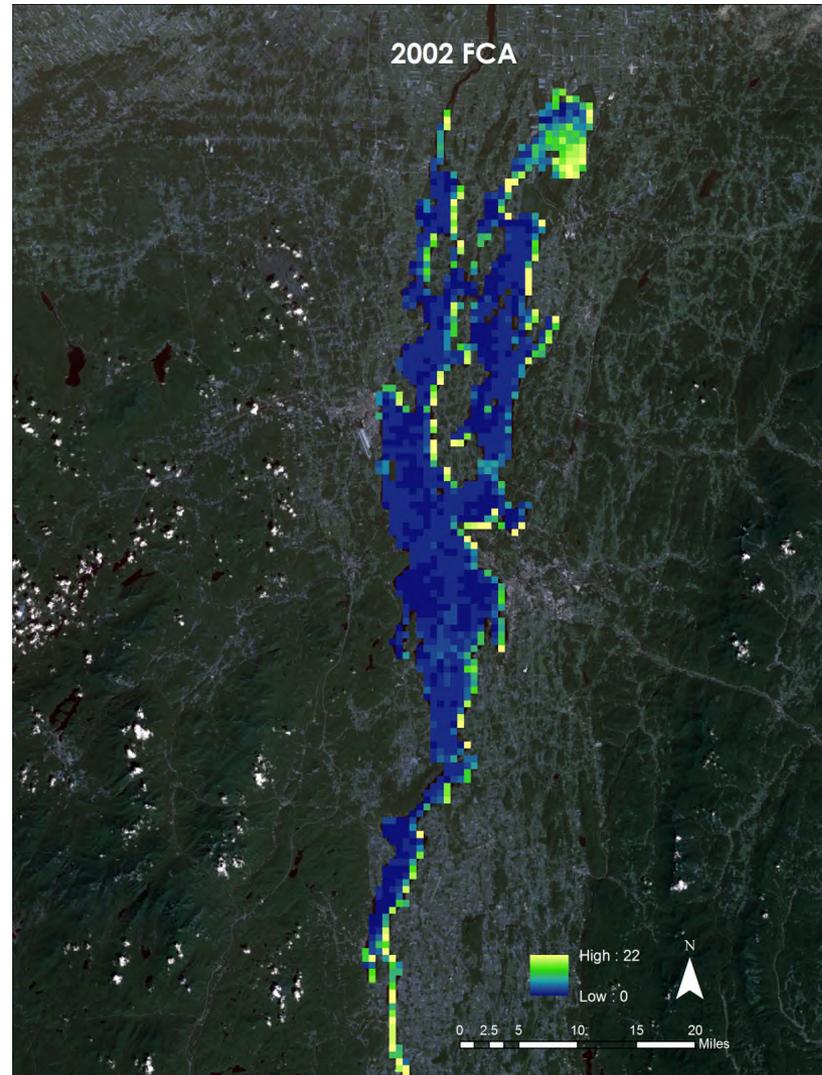
May 24, 2007

Results and Products



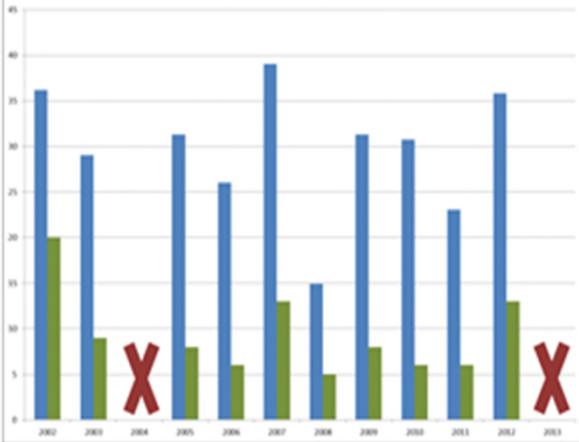
Results and Products

Frequency of cyanobacteria accumulation map for 2002

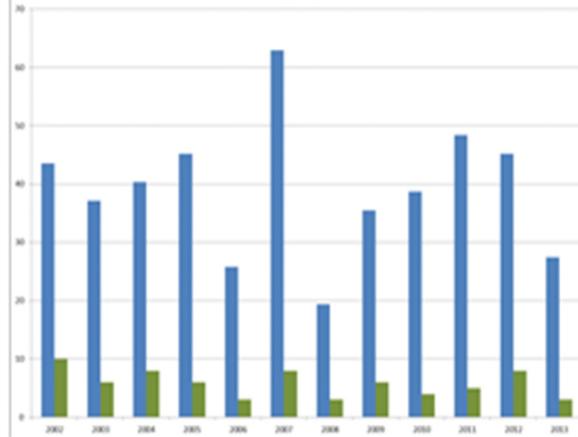


Results and Products

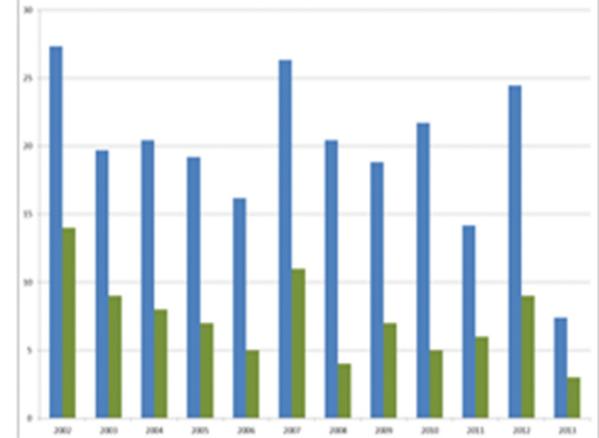
Lake Champlain FCA%



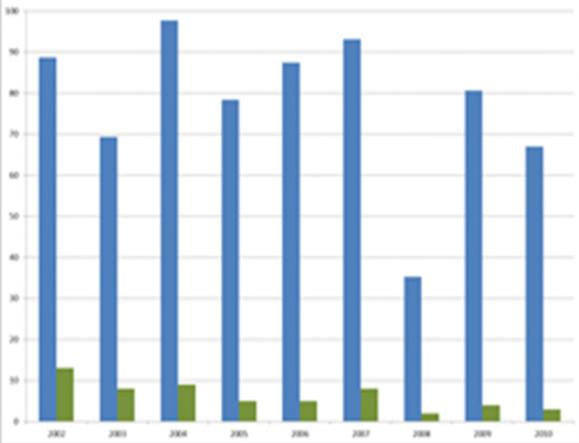
Mallett's Bay FCA %



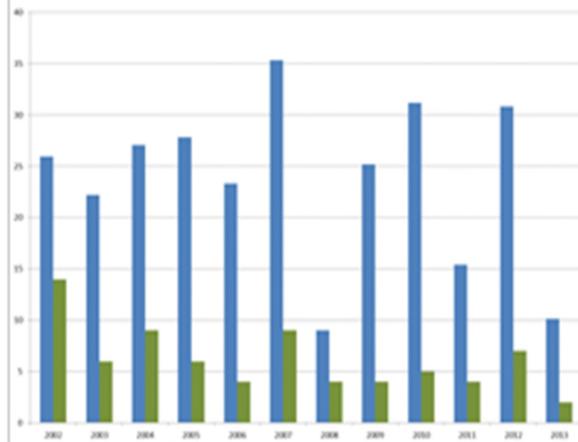
Main Lake FCA%



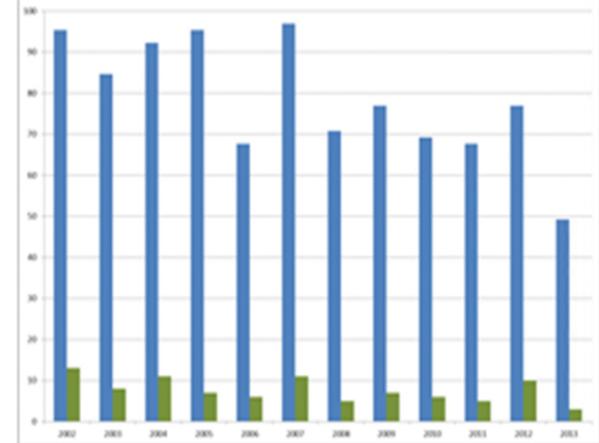
Missisquoi Bay FCA%



Northeast Arm FCA %

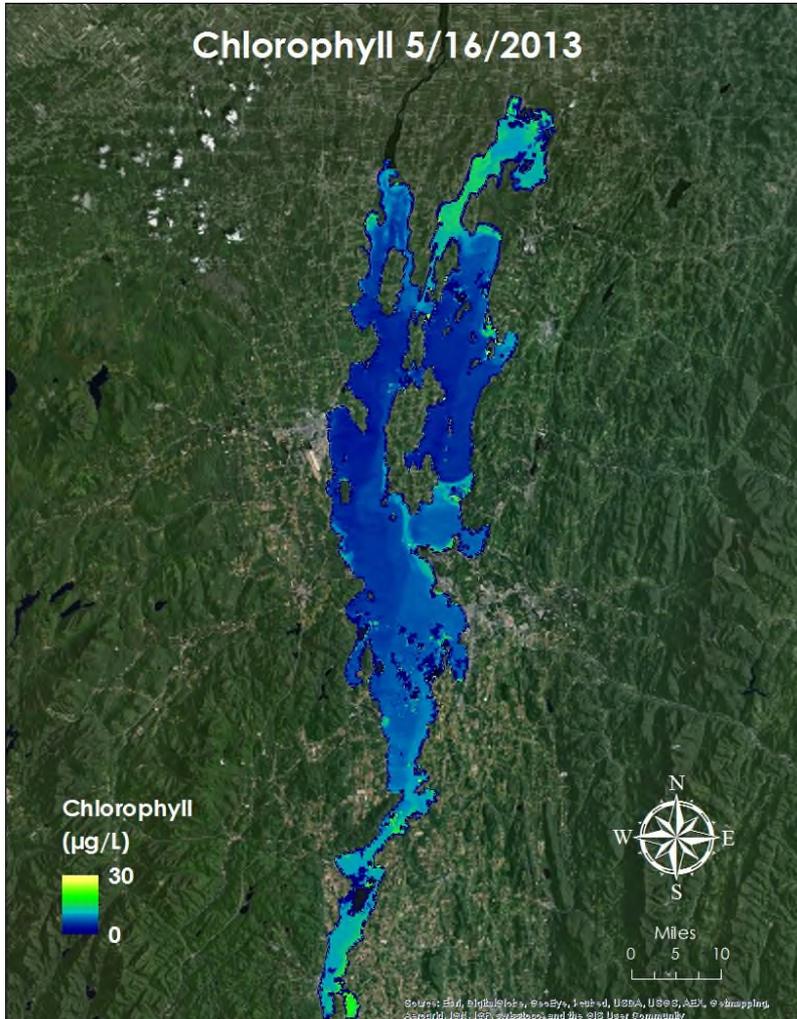


South Lake FCA%



Outcomes for End-Users

Chlorophyll 5/16/2013



Project Outcomes

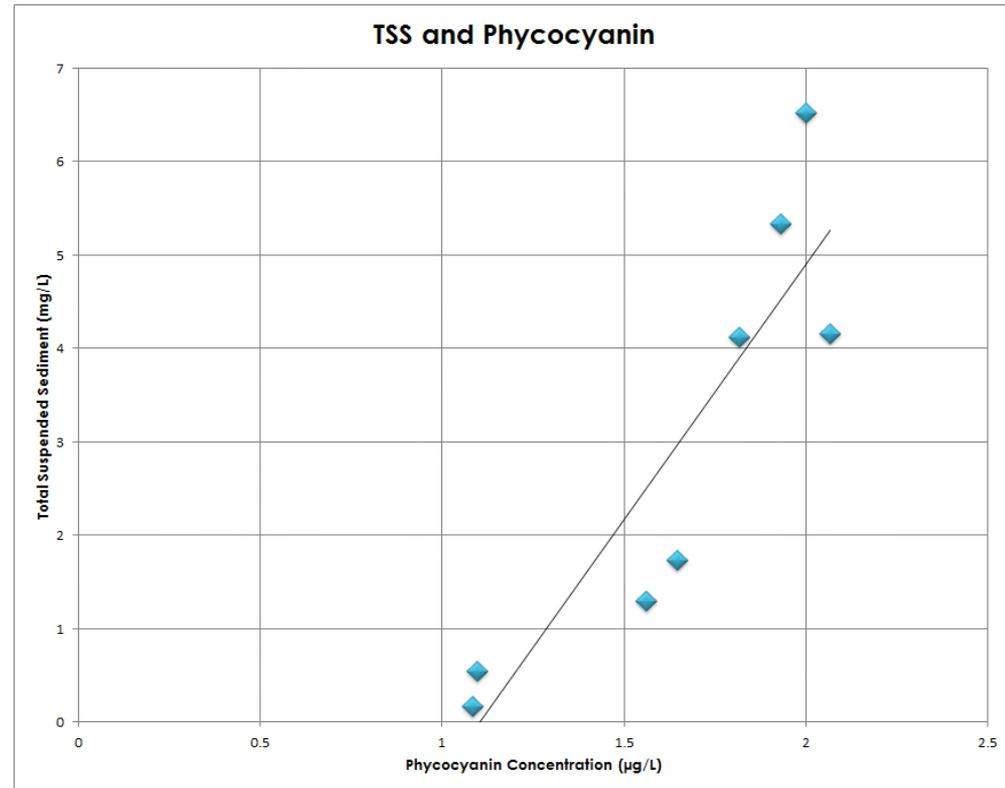
- Term One
 - ✦ Methodology for tracking algae blooms with NASA Earth observations
 - ✦ Ten-year time series of algae blooms and sediment in Lake Champlain
- Term Two
 - ✦ Analysis of land cover change
 - ✦ An evaluation of the change in bloom severity over a decade, compared with environmental factors

Benefit for End-Users

- Consistent, holistic view of the lake
- Visual representation of the relationship between environmental factors and HABs
- Visual tool for influencing public policy

Conclusions

- Correlation with in situ measurements
- Correlation between parameters
- A combination of the two data types provides a valuable tool for water quality monitoring



(Above) Scatterplot showing correlation between calculated values for TSS and phycocyanin (N=8, $r=0.89144$)

Conclusions

- Lag times vary based on environmental conditions
- Effect of environmental factors not absolute
- Other factors may have impact on bloom frequency



Future Work

Expand to include more environmental variables such as wind or insolation

Create model for definite predictions



Lake Champlain Ecosystem Assessment



The Lake Champlain Basin Program

Thank You



DEVELOP National Program

<http://develop.larc.nasa.gov/>

