



Welcome to NASA Applied Remote Sensing Training (ARSET) Webinar Series

Introduction to Water Quality (WQ) Monitoring From Remote Sensing Measurements

Course Dates: 18, 25, November and 2, December 2014
Time: 8 to 9 am and 1 to 2 pm Eastern US time



ARSET : Applied Remote Sensing Training
A project of NASA Applied Sciences

Course Outline

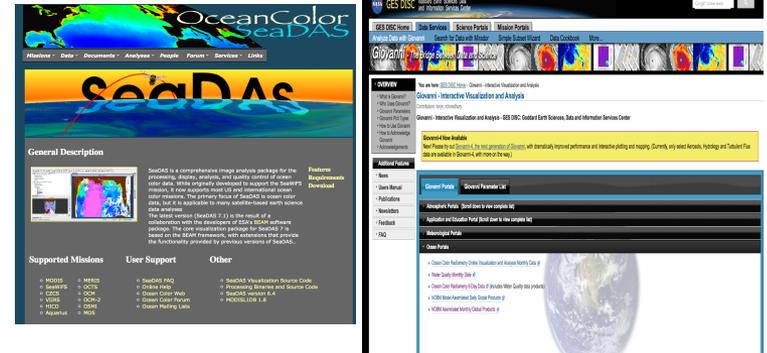
Week 1

Introduction to Remote Sensing of WQ parameters



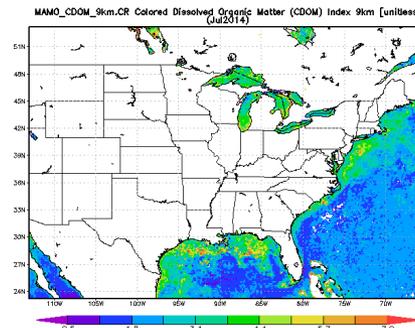
Week 2

NASA WQ Data, Access, and Tools



Week 3

Overview of WQ Monitoring and Case Studies of Monitoring WQ in Selected Water Bodies





Webinar Information

Speakers Today:

Blake Schaeffer (Week-3) Schaeffer.Blake@epa.gov

Africa Flores Africa.flores@nasa.gov

Brock Blevins (ARSET) bblevins37@gmail.com

Amita Mehta amita.v.mehta@nasa.gov



Week 3: Outline

- Overview of remote sensing for water quality monitoring
- SERVIR Water Quality Application: Case Study of Lake Atitlan
- MODIS and Landsat Data Access : Lake Victoria

Guest Speaker: Dr. Blake Schaeffer



Overview of remote sensing for water quality monitoring

NASA Applied Remote Sensing Training
December 2, 2014

Blake Schaeffer
Office of Research and Development
National Exposure Research Laboratory



Contributors

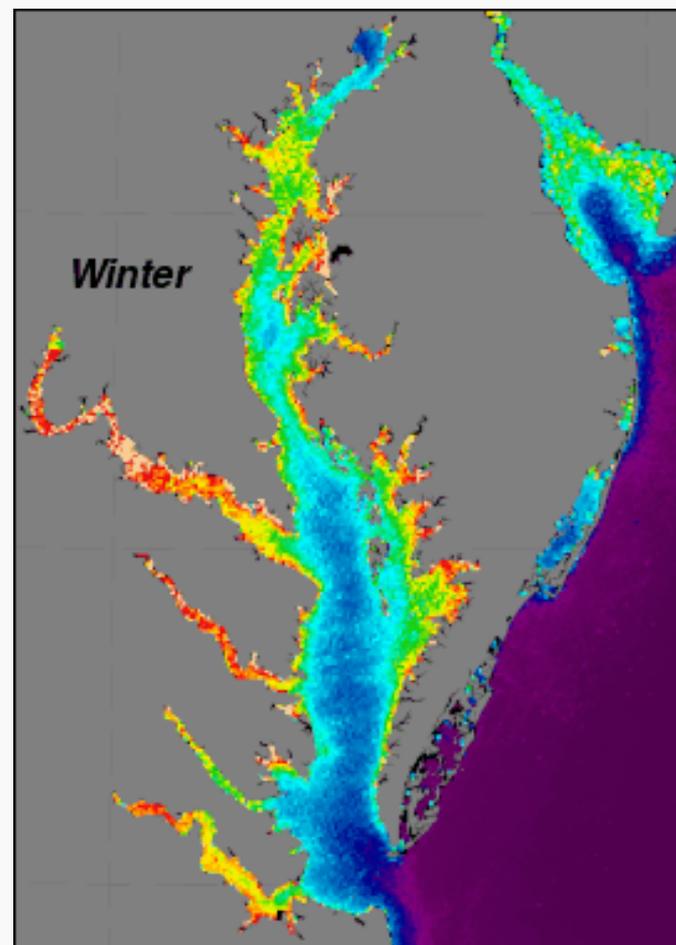
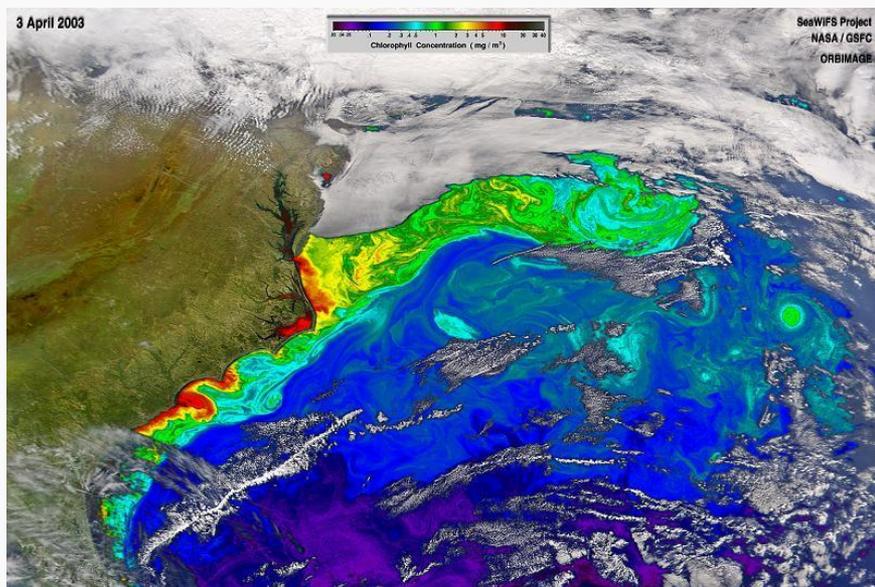
- Steward Bernard CSIR
- Julia Busch Oldenburg
- Carsten Brockmann BC Assoc.
- Arnold Dekker CSIRO
- Paul DiGiacomo NOAA
- Steve Greb WDNR
- Thomas Leeuw Sequoia
- Blake Schaeffer EPA
- Richard Stumpf NOAA
- Andrew Tyler University Stirling



Protect beneficial uses of water

- World Health Organization
 - Collect information on water quality and health.
 - Strengthen capacity to manage water quality.
- United Nations
 - Ensure environmental sustainability.
- World Bank
 - Continued human development, food and energy security, and job creation.
 - Continued economic and social growth.

Ocean and coastal/in-land

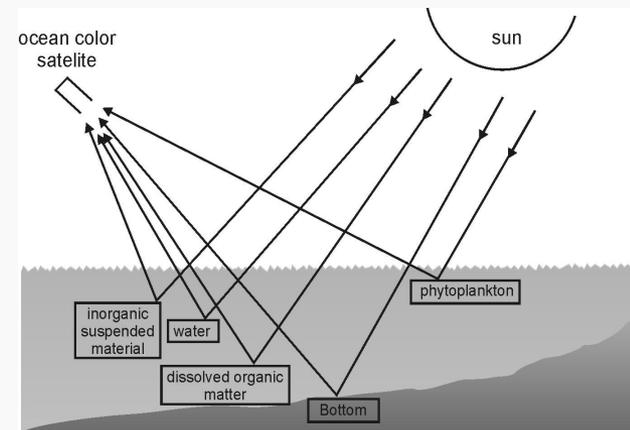




Cost

$$Chl_{MedOC4} = 10^{(0.4424 - 3.686R + 1.076R^2 + 1.684R^3 - 1.437R^4)}$$

Math



Atmospheric Correction



Accuracy



Continuity



Support

| SATELLITE SENSOR SYSTEMS | | PIXEL SIZE (M) | SPECTRAL BANDS (400-1000NM) | REVISIT CYCLE | RAW DATA COST PER km ² (AUD) ^a | WATER QUALITY VARIABLES ^{b,c} | | | | | |
|--|-----------------------------------|----------------|-----------------------------|------------------------|--|--|-----|-----|------|----------------|---------|
| | | | | | | CHL | CYP | TSM | CDOM | K _d | TURB SD |
| Current ocean-coastal low spatial resolution | MODIS | 1000 | 9 | Daily | Free | ● | ● | ● | ● | ● | ● |
| | MODIS | 500 | 2 | Daily | Free | ● | ● | ● | ● | ● | ● |
| | MODIS | 250 | 2 | Daily | Free | ● | ● | ● | ● | ● | ● |
| | MERIS & OCM-2 | 300 | 15 | 2-3 days | Free | ● | ● | ● | ● | ● | ● |
| | VIIRS & JPSS | 750 | 7 | 2x/day | Free | ● | ● | ● | ● | ● | ● |
| Current multi-spectral mid-spatial resolution | Landsat | 30 | 4 | 16 | Free | ● | ● | ● | ● | ● | ● |
| Current high spatial resolution^a | IKONOS, Quickbird, SPOT-5, GeoEYE | 2-4 | 3-4 | On-demand 2-60 days | 5-15 | ● | ● | ● | ● | ● | ● |
| | RapidEye | 6.5 | 5 | Daily | 1.5 | ● | ● | ● | ● | ● | ● |
| | Worldview-2 | 2 | 8 | On-demand | 30 | ● | ● | ● | ● | ● | ● |
| Future ocean-coastal low spatial resolution | Sentinel-3 | 300 | 21 | Daily | Free | ● | ● | ● | ● | ● | ● |
| Future multi-spectral mid-spatial resolution | LDCM | 30 | 5 | 16 | Free | ● | ● | ● | ● | ● | ● |
| Future hyper-spectral | EnMap | 30 | 90 | On-demand | Free (?) | ● | ● | ● | ● | ● | ● |
| | PRISMA | 20 | 60 | 25 days | Free (?) | ● | ● | ● | ● | ● | ● |
| | HySpIRI | 60 | 60 | 19 days | Free | ● | ● | ● | ● | ● | ● |

● Highly Suited ● Suitable ● Potential ● Not Suitable

POC: Arnold Dekker

CHL=Chlorophyll; CYP=cyanobacterial pigments such as cyano-phyco cyanin and cyano-phycoerythrin; TSM=total suspended matter; CDOM =coloured dissolved organic matter; K_d= vertical attenuation of light coefficient; TURB= turbidity; SD=Secchi Disk transparency

SeaDAS

[1] chlor_a - [*C:\Users\bschaeff\Desktop\A2014265183500.L2_LAC_OC] - [Session not saved] - SeaDAS 7.1

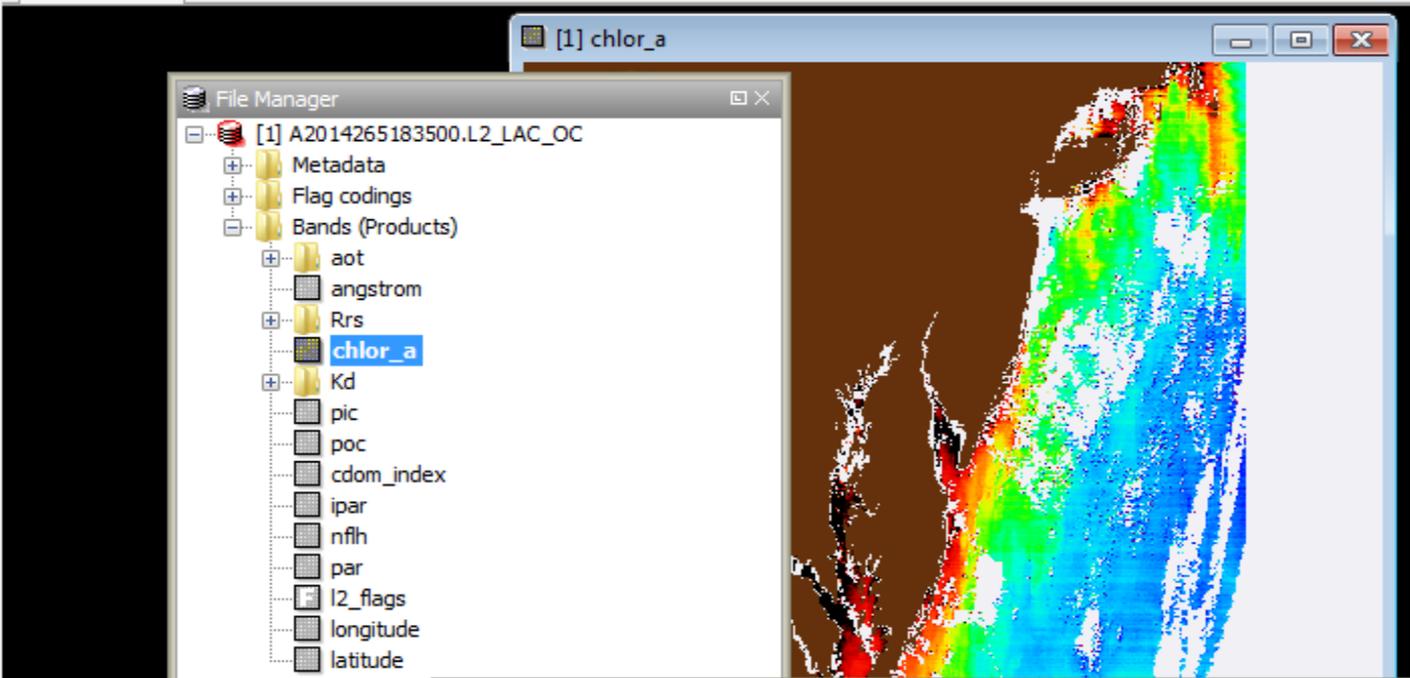
File Edit View Tools Layers Processing Analysis Info Window Help



<http://seadas.gsfc.nasa.gov>

[1] chlor_a x

[1] chlor_a



File Manager

- [1] A2014265183500.L2_LAC_OC
 - Metadata
 - Flag codings
 - Bands (Products)
 - aot
 - angstrom
 - Rrs
 - chlor_a**
 - Kd
 - pic
 - poc
 - cdom_index
 - ipar
 - nflh
 - par
 - l2_flags
 - longitude
 - latitude

Pixel Info

| Bands (Products) | | |
|------------------|------------|--------------------|
| chlor_a | 2.5415041 | mg m ⁻³ |
| longitude | -74.745514 | degrees |
| latitude | 38.85026 | degrees |



Ocean Color Forum

oceancolor.gsfc.nasa.gov/forum/oceancolor/forum_show.pl

OceanColor Forum

Not logged in

Forum Ocean Color Home Help Search Login

Forum

Info Feeds Mark Old

| | Announcements | Posts | Last Post |
|---|---------------|-------|------------------|
| Ocean Color Announcements | | 111 | 2014-06-23 12:36 |
| SeaDAS Announcements | | 77 | 2014-10-03 14:33 |
| Frequently Asked Questions | | Posts | Last Post |
| General Forum Information | | 8 | 2008-04-14 08:41 |
| SeaDAS 7 FAQ | | 1 | 2013-05-30 13:32 |
| SeaDAS 6 FAQ Archive FAQ for SeaDAS 6 | | 38 | 2011-01-17 17:59 |
| Data Products & Algorithms FAQ | | 33 | 2009-08-03 10:22 |
| Data Access FAQ | | 29 | 2013-06-20 14:13 |
| Products and Algorithms | | Posts | Last Post |
| Satellite Data Products & Algorithms | | 5070 | 2014-11-20 19:29 |
| Satellite Data Access | | 3034 | 2014-11-20 11:28 |
| Field Data - SeaBASS | | 71 | 2014-09-16 12:24 |
| SeaDAS | | Posts | Last Post |
| SeaDAS 7 - General Questions | | 1583 | 2014-11-21 08:40 |
| SeaDAS 6.x - General Questions | | 11830 | 2014-11-10 03:11 |
| SeaDAS 6.x Virtual Appliance for Windows | | 386 | 2014-10-28 09:31 |
| MODIS Direct Broadcast Support | | 316 | 2014-08-27 14:57 |
| Non-SeaDAS Packages (e.g. MATLAB, ENVI, GIS, etc) | | 348 | 2013-09-10 15:10 |
| Special Topics | | Posts | Last Post |



CoastColour Processing On-De... x +

www.coastcolour.org/ccprocessing/calvalus.jsp

Google

Show predefined file sets
 Show my outputs and of other users

- MERIS RRG r03 L1b 2002-2012
- MERIS FSG v2013 L1b 2002-2012**

Name: MERIS FSG v2013 L1b 2002-2012
Type: MERIS_L1B
Start Date: 2002-05-16
End Date: 2012-04-07
Region name: global

Show Help

Temporal Filter

No filter
 By date range
Start date: 2008-05-01
End date: 2008-07-31
 By date list
2008-06-01
2008-06-02
2008-06-03
92 days

Show Help

Spatial Filter

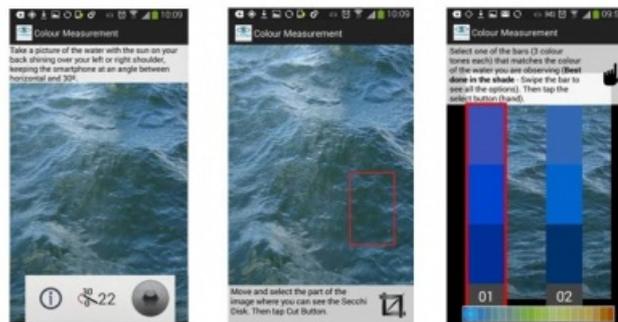
No filter (global) By region

- CoastColour
 - user
 - NCSU
 - region_1**
 - Zepp_Manitowoc



Image: USGS

- Home
- Background
- Water Quality Working Group
- Downloads
- Links



One of the objectives of the **Citclops** project is to produce **applied results** by developing new **applications for mobile devices**, and friendlier and more flexible user interfaces to connect citizens and their associations to policy makers. Picture: Citclops

Contact us

in cooperation with

News

2nd **International Ocean Colour Science (IOCS) Meeting** (16-18 June 2015, San Francisco, USA)

Dr. Mark Matthews wins the 2014 **Copernicus Masters Ideas Challenge** for CyanoLakes

International Geoscience and Remote Sensing Symposium (July 26-31, 2015, Milan, Italy)

Downloads | Geo Water Qu... x GEO - Group on Earth Obs... x +

https://www.earthobservations.org/webinar_wq.php

home > meetings > webinar series

GROUP ON EARTH OBSERVATIONS

what is GEO ▾ what we do ▾ global initiatives ▾ meetings documents how to get involved

GEO Inland and Coastal Water Quality working group Webinar Series

Next Webinar | Future Webinars | Past Webinar Recordings

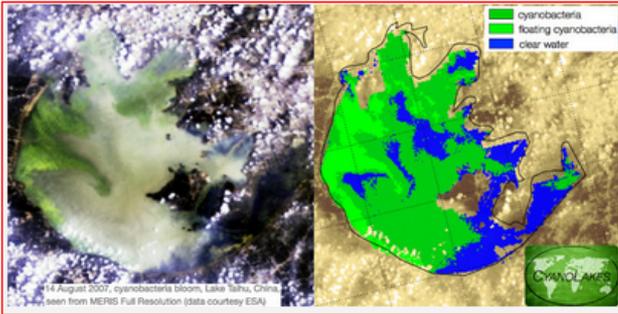
Re-calibration of the MPH algorithm: towards a standard operational product for chl-a and cyanobacteria detection for inland/near-coastal waters

20 November 2014

This webinar was presented by **Dr. Mark W. Matthews** (Department of Oceanography, University of Cape Town, Rondebosch, 7701, Cape Town, South Africa)

Abstract: The talk provided an overview of the maximum peak height algorithm, providing some demonstration and details on new advancements related to the recently released plugin for BEAM (including adjacency effect detection). Results of the validation of the MPH algorithm across a wide range of water types performed in the ESA Diversity II project were presented (courtesy Dr. Daniel Odermatt). The talk discussed the re-calibration exercise for the MPH algorithm, in preparation for a publication. Initial results and approaches were presented from the re-calibration.

Bio: Dr. Mark Matthews is an earth observation scientist specialising in the detection of cyanobacteria from space. He graduated from the University of Cape Town in 2014, and has published 8 first author publications (two monographs) in high impact journals, and received several awards and scholarships. He received an innovation award in 2012 from the CSIR for operational monitoring of cyanobacteria and eutrophication in South African inland waters as well as a 2014 Copernicus Masters Ideas Challenge award. His maximum peak height algorithm has been developed as a plugin for the BEAM software. He has worked as a lecturer at the University of the Western Cape,



14 August 2007, cyanobacteria bloom, Lake Taihu, China
seen from MERIS Full Resolution (data courtesy ESA)

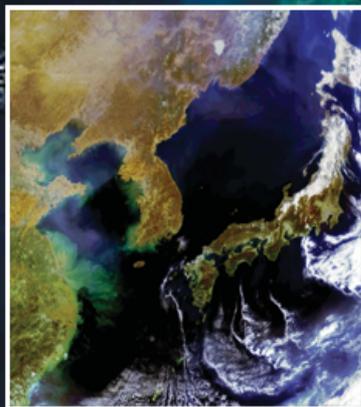


International Ocean-Colour Coordinating Group

An Affiliated Program of [SCOR](#)

[Contact Us](#)

Feature Image



GOCI/COMS image showing Yangtze River discharge near South Korea (click on image for larger view)

Promoting the application of remotely-sensed ocean-colour data through coordination, training, liaison between providers and users, advocacy and provision of expert advice

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International Ocean-Colour Coordinating Group

- Reports
 - Report #3: *Remote Sensing of Ocean Colour in Coastal, and Other Optically-Complex, Waters*

 - Report #TBD: *Harmful Algal Blooms and Ocean Colour*
 - POC Steward Bernard

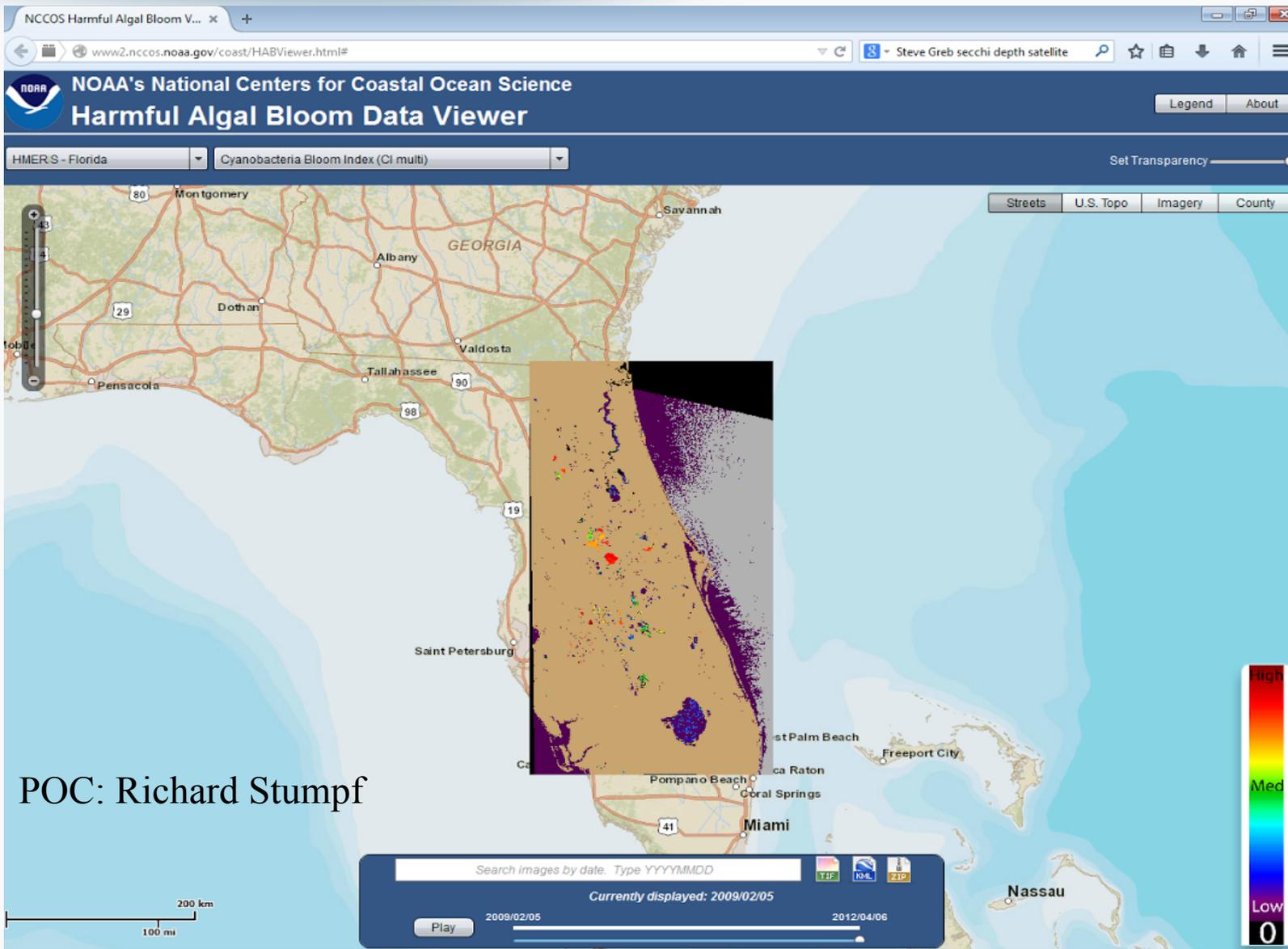
 - Report #TBD: *Earth Observations in Support of Global Water Quality Monitoring*
 - POC Steve Greb



International Ocean Colour Science Meeting 2015

Advancing Global
Ocean Colour
Observations

- San Francisco, USA, 16-18 June 2015
- Theme: *Applications of Ocean Colour from Climate to Water Quality*
- Aim of building a strong global user community for ocean colour science and applications



POC: Richard Stumpf

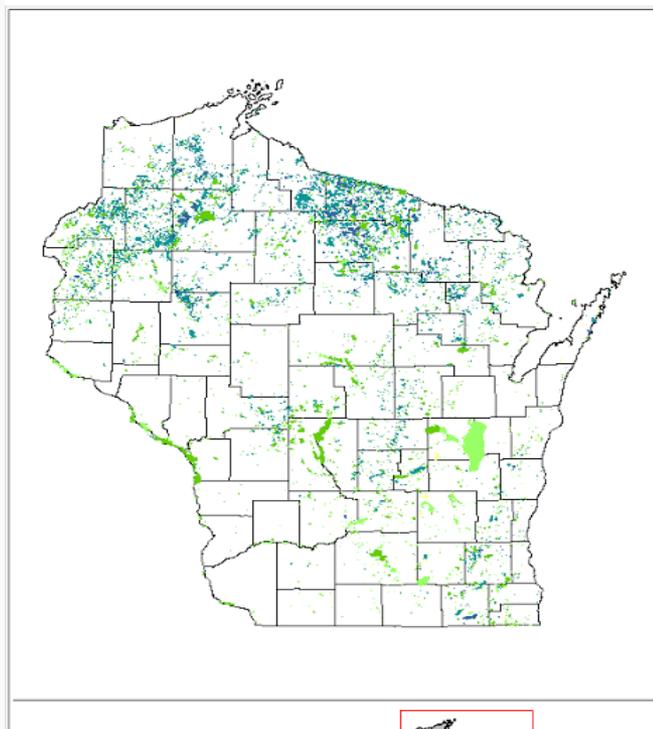


[Statewide](#) :: [New & Press](#) :: [Interactive Map](#) :: [Map Poster](#) :: [About the Map](#) :: [Landsat Lake Images](#)

Wisconsin Lake Clarity - Trophic State

An Indicator of Lake Water Clarity Derived from Satellite Images

[Find Lake by Name \(1999-2001 only\)](#)
[WMS Example Link](#)



Legend

| Trophic State Index | Estimated Secchi Depth |
|---------------------|-----------------------------|
| > 80 | < 0.25 m (< 0.8 ft) |
| 70 to 80 | 0.25 - 0.5 m (0.8 - 1.6 ft) |
| 60 to 70 | 0.5 - 1 m (1.6 - 3.3 ft) |
| 50 to 60 | 1 - 2 m (3.3 - 6.6 ft) |
| 40 to 50 | 2 - 4 m (6.6 - 13.1 ft) |
| 30 to 40 | 4 - 8 m (13.1 - 26.2 ft) |
| < 30 | > 8 m (> 26.2 ft) |

Clearer lakes have smaller trophics state indexes and larger secchi depths.

Map Navigation

Click on the map to:

- zoom in
- recenter
- zoom out

[View Whole State](#)

Map Layers

Choose layers shown:

- Lakes 2003-2005
- Lakes 1999-2001
- County Boundaries
- State Trunk Highways
- State Roads
- Shaded Relief

When you change layers click at the center of the image to redraw the map.

In order to reduce clutter, lake names and roads appear only when you are zoomed in sufficiently. At these zooms shaded relief vanishes.



Diversity II x +

www.diversity2.info

ional ocean color meeting

diversity drylands

Diversity II
Supporting the Convention on Biological Diversity

diversity inland waters

Home | Objectives | Approach | Consortium | News | Products | Meetings | Glossary | Contact

Diversity II - Supporting the Convention on Biological Diversity



Objectives

The Diversity II project will contribute to the work of the Convention on Biological Diversity (CBD) by assessing biological diversity in two important ecosystems of the Earth, **Inland Waters** and **Drylands** using satellite data. The work will be carried out in close collaboration with the User Communities.

Approach

1. Link biodiversity users and Earth Observation experts



User meetings

Workshop on Land Productivity Indicators 7-9 July 2014 in Bonn, Germany »

Lake User Consultation Meeting 19-20 May 2014 in Frascati, Italy »

Prototype products available

- [Prototype products - Drylands »](#)
- [Prototype products - Inland Waters »](#)

POC: Carsten Brockmann



Globolakes - Global Observ... x +

www.globolakes.ac.uk

ional ocean color meeting



Globolakes

Global Observatory of Lake Responses to Environmental Change



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Globolakes



Tweet to @globolakes

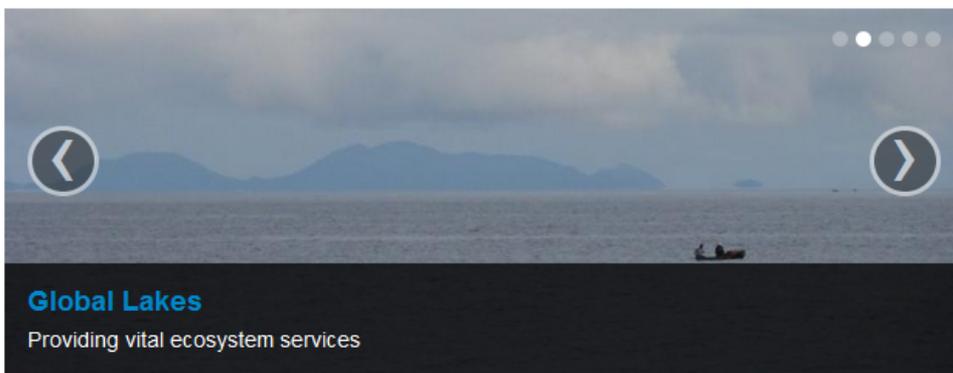
POC: Andrew Tyler



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- GLaSS-S3VT team

Global Lakes Sentinel Services

GLaSS develops innovative tools to prepare for using the upcoming Sentinel-2 and Sentinel-3 satellites to monitor lakes and reservoirs.



Global Lakes
Providing vital ecosystem services

The upcoming satellite constellations Sentinel-2 and Sentinel-3 will provide unprecedented monitoring capabilities for inland waters. However, the large amounts of data they will produce also

Latest News

GLaSS present at the World Lakes Conference

Several GLaSS partners presented at the World Lakes Conference in Perugia, Italy

Read the first GLaSS newsletter

Our first newsletter has just been published

Sentinel 2 for Science Workshop

The GLaSS project was present in the Sentinel 2 for Science Workshop

[More news](#)

Tweets



GLaSS
@GLaSS_Project

18 Nov

GEO Inland and Coastal Water Quality Webinar on Chl-a and cyanobacteria detection for inland waters this Thursday!
[earthobservatory.org/webinars/water](#)

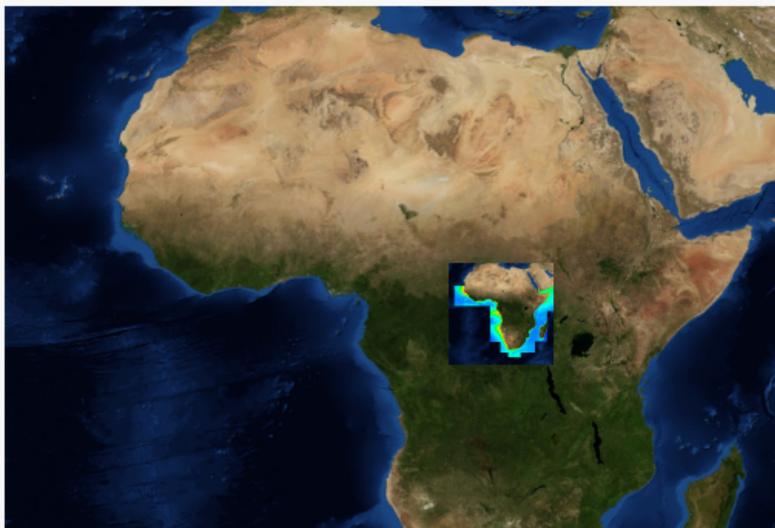
Show desktop



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MRSU: Marine Remote Sensing Unit

Click on the map to view the latest data for a particular region, or click on the mini-map to select the entire region



The MRSU provides all data for free, but we would like you to register first. You only need to do this once, and it will help us to understand user needs better. If you would like data other than those freely available through this site – ask!

This web site is still under development and has not been tested on all browsers. Users are strongly **recommended to use Firefox**.

The MRSU combines the available marine remote sensing expertise of the University of Cape Town (UCT), the Council for Scientific and Industrial Research (CSIR), and Marine and Coastal Management (M&CM). It aims to be a central facility that provides for the operational and research remote sensing requirements for the marine community. This web site is a first step in that direction, and will provide a variety of accessible near-real time and archived remotely sensed data for sub-Saharan Africa, in addition to information on the unit.

The Marine Remote Sensing Unit is a multi-institutional



eoApp Australia

eoapp-au.eomap.com/#

Brazil INPE

EOMAP

eoApp Australia

Turbidity, November 21, 2014

Move

Parameter

- Turbidity: Shallow Water
- Visibility: Shallow Water
- Reef Bathymetry

Date / Period

- Daily
- Monthly

Barrow Island 21-11-2014 05:26

Station Values

- Value: no value
- 30 days average: no value
- Time Series Plot:

For other regions please order [here](#) and get your personalized eoApp

TUR [ETU]

0.1 0.3 1.0 4.0 15 45 150

500 km / 500 mi

Base map True Marble 2km © 2003-2007 Unearthed Outdoors, LLC. All rights reserved. www.unearthedoutdoors.net/global_data/true_marble/download

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157.43359, -6.85059



Advanced Nutrient Monito... x +

www2.epa.gov/water-research/advanced-nutrient-monitoring

EPA United States Environmental Protection Agency

Español | 中文: 繁體版 | 中文: 简体版 | Tiếng Việt | 한국어

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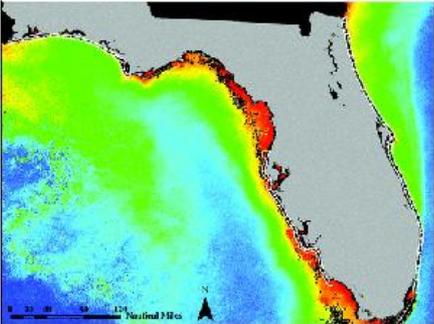
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Water Research Contact Us Share

Advanced Nutrient Monitoring

New technologies are changing the way we monitor pollution levels in the environment. EPA is studying innovative technologies that will measure nutrient pollution in the air and water using satellites, portable and ground remote sensors as well as measurement and model data. These technologies enhance current monitoring activities and also provide cheaper and faster information on nutrients and other pollutants.

One such study conducted in 2011 focused on Florida's coastal waters. The purpose of the study was to evaluate the use of satellite measurements as a way to analyze water quality and to help regulators set standards for nutrient pollution.



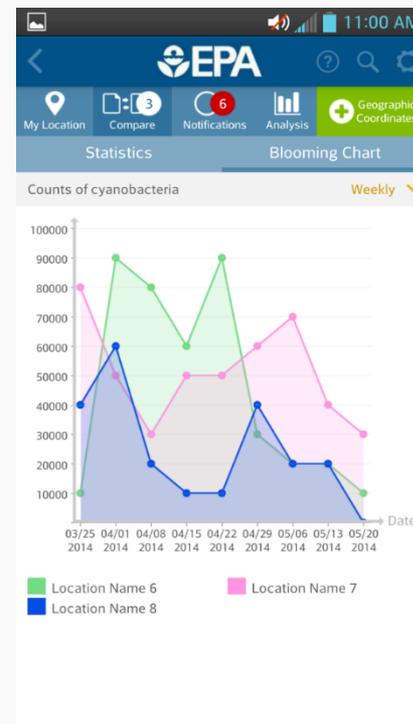
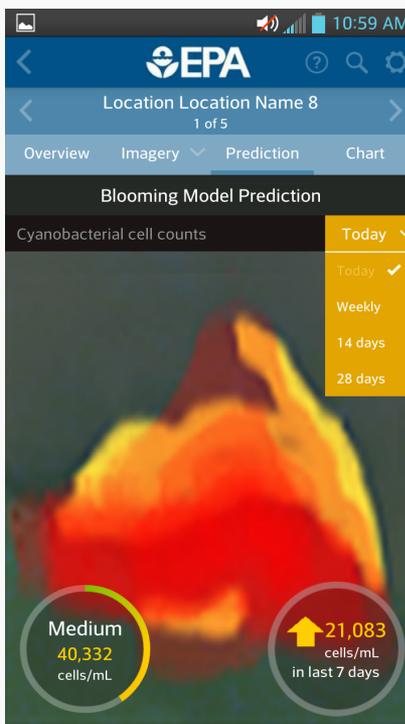
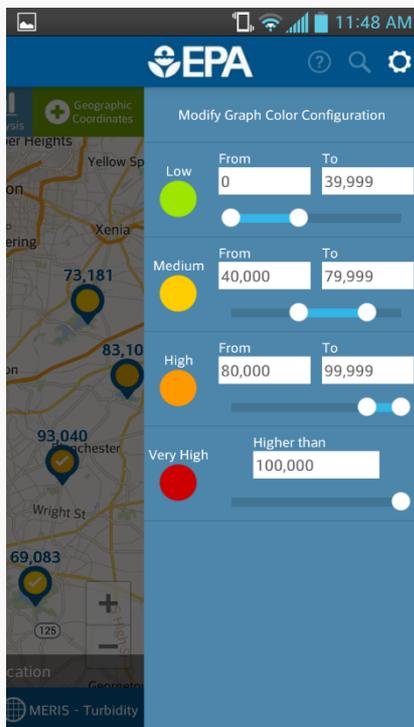
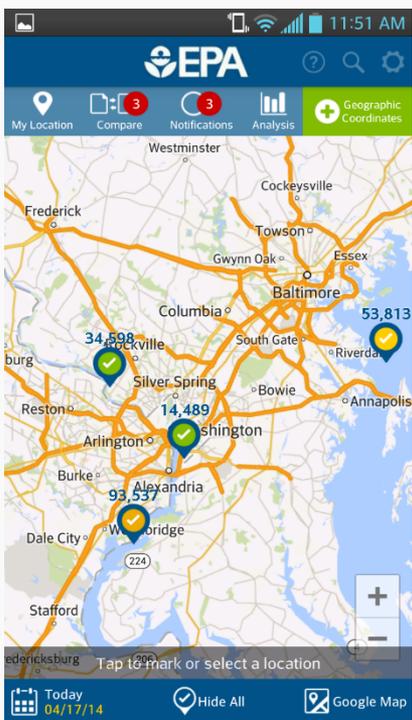
Nutrient pollution, excess nitrogen and phosphorous carried in runoff and other sources from land sparks excessive algal growth in many water bodies, and could also occur in coastal waters. Researchers used the [SeaWiFS](#) satellite to measure the amount of chlorophyll-a, a pigment present in algae, as a way of monitoring nutrient pollution in coastal water.

Researchers compared thirteen year's worth of data from the SeaWiFS satellite to measurements from field studies to see if the satellite's readings could be used to measure water quality. The study showed that this unique application of satellite data for monitoring water quality is effective and could be applied to other satellites and other coastal waters. For more information on this study, see the first link below.

POC: Blake Schaeffer



Crowd Sourced CyAN Mobile Application



POC: Blake Schaeffer



Citizens' Observatory for Coast and Ocean Optical Monitoring



PARTICIPATE

WATER COLOUR

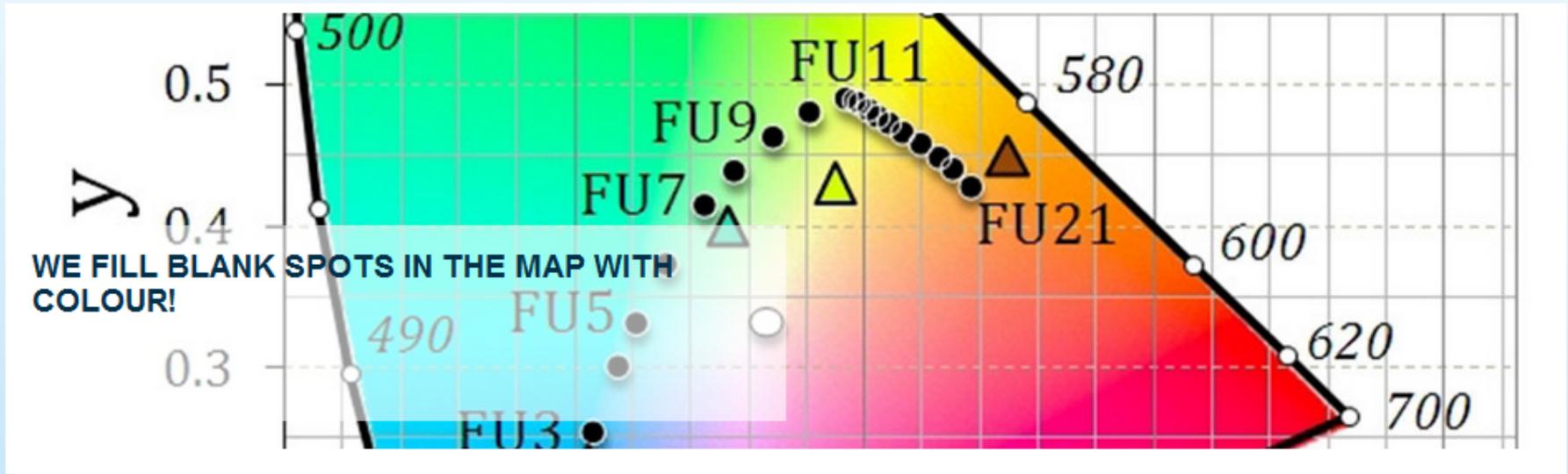
TRANSPARENCY

FLUORESCENCE

TECHNIQUES

EDUCATION

THE PROJECT





Hydrocolor: A Water Qualit... x +

https://www.facebook.com/hydrocolorapp?ref=stream

HydroColor

facebook

Email or Phone Password

Keep me logged in [Forgot your password?](#)

Open menu

Hydrocolor: A Water Quality App is on Facebook.

To connect with Hydrocolor: A Water Quality App, sign up for Facebook today.



Hydrocolor: A Water Quality App
App Page

[Timeline](#) [About](#) [Photos](#) [Likes](#) [Videos](#)

PEOPLE >

101 likes

ABOUT >

HydroColor is a water quality application that uses the iPhone camera to determine the reflectance of natural water bodies.

 **Hydrocolor: A Water Quality App**
October 19

The newest version of HydroColor (iOS 8 compatible) is now on the app store.

Like · Comment

 **Hydrocolor: A Water Quality App**
September 30

POC: Thomas Leeuw



ARTICLE IN PRESS

RSE-09180; No of Pages 8

Remote Sensing of Environment xxx (2014) xxx–xxx

Contents lists available at [ScienceDirect](#)

Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse



ELSEVIER

Editorial

Remote sensing of inland waters: Challenges, progress and future directions

Stephanie C.J. Palmer^a, Tiit Kutser^{b,*}, Peter D. Hunter^c

Balaton Limnological Institute, Hungarian Academy of Sciences Centre for Ecological Research, Klebelsberg K. u. 3, Tihany 8237, Hungary

Estonian Marine Institute, University of Tartu, Mäealuse 14, Tallinn 12618, Estonia

Biological and Environmental Sciences, School of Natural Sciences, University of Stirling, Stirling FK9 4IA, UK



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- Blake Schaeffer (schaeffer.blake@epa.gov)
- Richard Stumpf (richard.stumpf@noaa.gov)
- Andrew Tyler (a.n.tyler@stir.ac.uk)

**NASA SERVIR WQ Application
Case Study: Lake Atitlan
(Africa Flores)**

SERVIR

Water Quality Applications

Africa Flores

2 December 2014

ARSET -Water Quality Monitoring using Remote Sensing Measurements



ICIMOD



adpc

- SERVIR background
- Water quality monitoring using Remote sensing:
 - Lake Atitlan Case Study
 - Overview: Transition from a qualitative to a quantitative analysis using remote sensing measurements



SERVIR Hubs

NASA MSFC/SERVIR
Coordination Office

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NASA Headquarters

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CATHALAC

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ADPC

SERVIR-Himalaya
ICIMOD



Regions where we work



We serve 34 countries.

-
- A dark-themed world map where 34 countries are highlighted in a bright yellow color. The highlighted countries are: Mexico, Guatemala, El Salvador, Nicaragua, Costa Rica, Panama, Belize, Honduras, Dominican Republic, South Sudan, Uganda, Rwanda, Burundi, Zambia, Botswana, Namibia, Ethiopia, Kenya, Tanzania, Malawi, Mozambique, Seychelles, Mauritius, Madagascar, Swaziland, Pakistan, Nepal, Bhutan, Bangladesh, Cambodia, Laos, Myanmar, Thailand, and Vietnam.
- Mexico
 - Guatemala
 - El Salvador
 - Nicaragua
 - Costa Rica
 - Panama
 - Belize
 - Honduras
 - Dominican Republic
 - South Sudan
 - Uganda
 - Rwanda
 - Burundi
 - Zambia
 - Botswana
 - Namibia
 - Ethiopia
 - Kenya
 - Tanzania
 - Malawi
 - Mozambique
 - Seychelles
 - Mauritius
 - Madagascar
 - Swaziland
 - Pakistan
 - Nepal
 - Bhutan
 - Bangladesh
 - Cambodia
 - Laos
 - Myanmar
 - Thailand
 - Vietnam

Coming soon: new hubs and member countries in West Africa

Lake Atitlan Case Study



Lake Atitlan

SERVIR



Qualitative Analysis

Lake's Atitlan Algal Bloom 2009

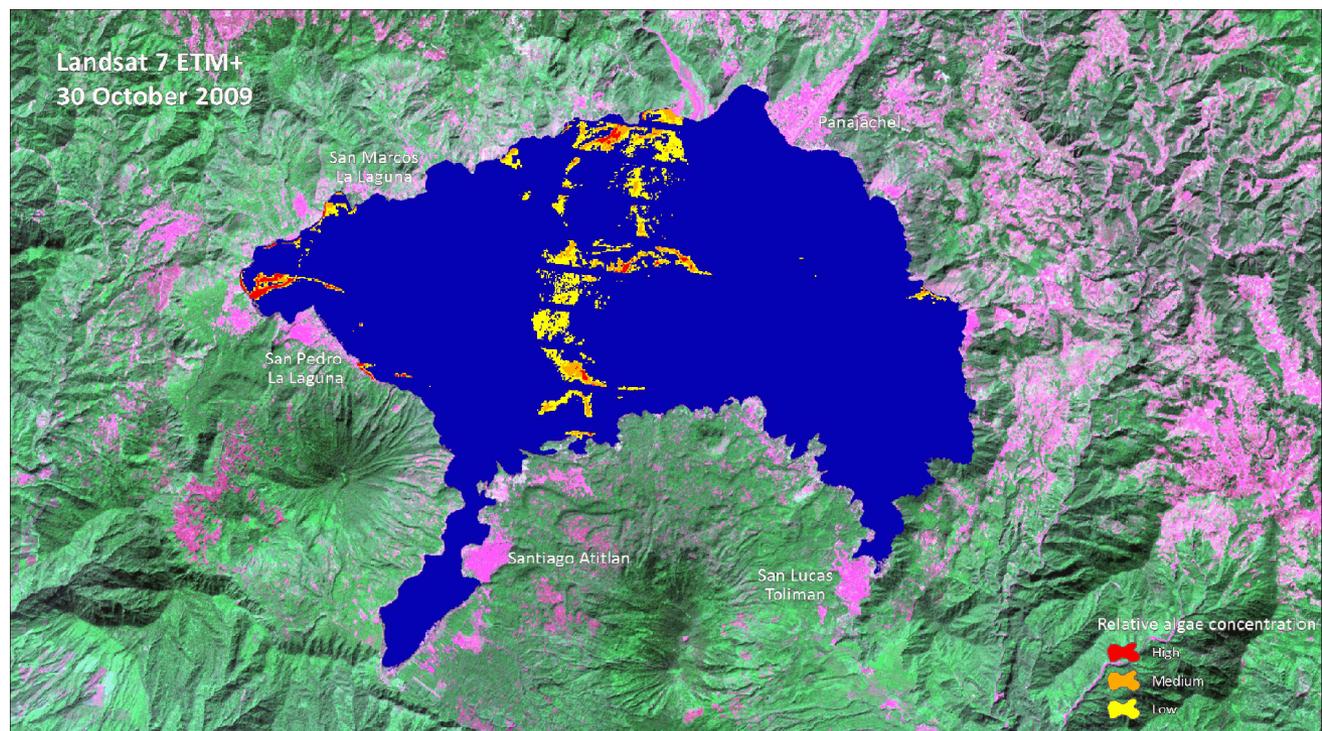
Some of the threats affecting Lake's Atitlan health include:

- Unsuitable agriculture and unplanned development in Atitlan's watershed
- Lack of sewage treatment plants
- Soil erosion and agrochemical runoff into the lake

Unsuitable agriculture

Lack of sewage treatment plants and trash collection systems

Animation Algal bloom identification using Red and NIR bands



In October 2009 an algal bloom of Cyanobacteria started to develop in the lake.

This sequence of images portrays the progress of the algal bloom in the lake from October 30 to the end of December 2009. In order to estimate the area covered by the algal bloom the red and near-infrared bands were used in the multispectral sensors Landsat ETM+, EO-1 ALI and Hyperion, and Terra-ASTER, to take advantage of vegetation's red edge.

Example of a qualitative analysis

Using multiple satellite sensors it was possible to monitor the progression of the algal bloom that affected Lake Atitlan in 2009.

Satellite imagery used:

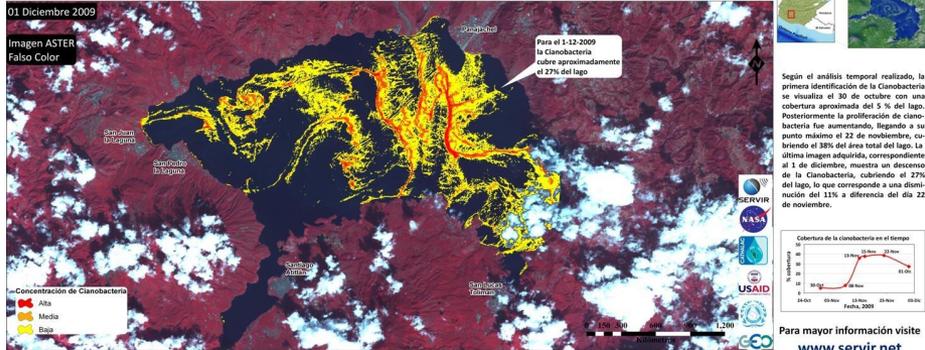
Landsat ETM+, EO-1 Ali and Hyperion, ASTER

The algal bloom reached its peak in November 2009, covering about 40% of the lake's surface area. By the end of December 2009, the presence of algae on the surface of the lake had disappeared. Even though more recent algal blooms have occurred, the bloom of 2009 has been, so far, the largest recorded in Lake Atitlan.

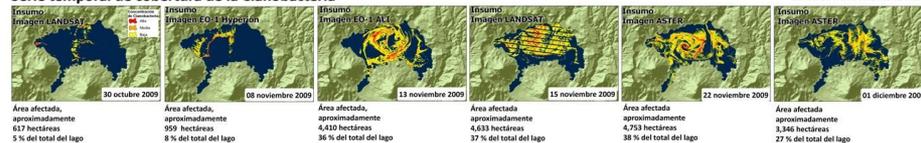
Monitoreo Temporal del Lago Atitlán, octubre - diciembre 2009

Sololá, Guatemala

Elaborado por CATHALAC, 01 diciembre 2009



Serie temporal de cobertura de la Cianobacteria



For more info:

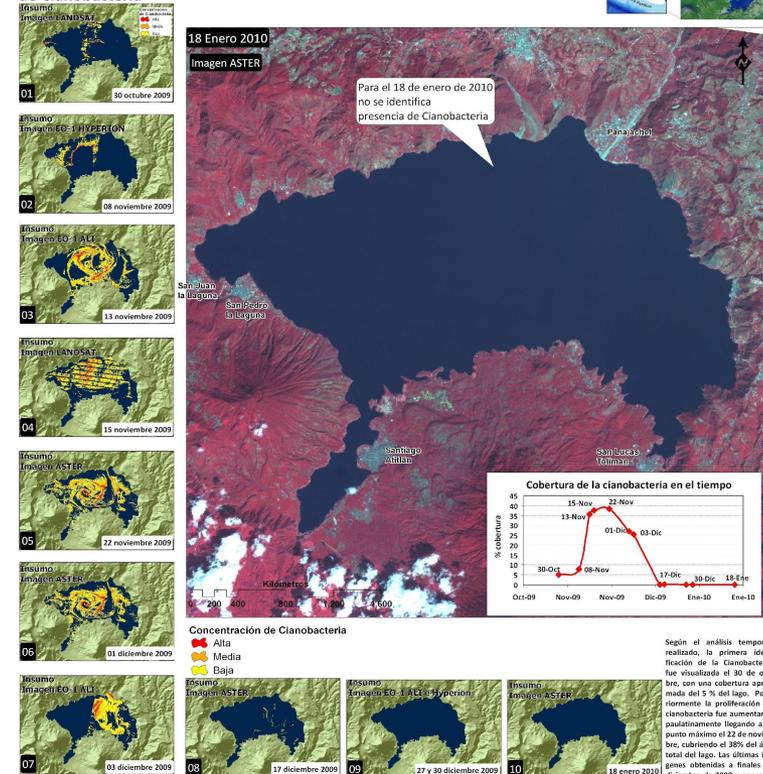
<https://servirglobal.net/Global/Articles/tabid/86/Article/867/satellite-based-lake-monitoring-in-guatemala.aspx>

Monitoreo Temporal del Lago Atitlán, octubre 2009 - enero 2010

Sololá, Guatemala

Elaborado por CATHALAC, 19 enero 2010

Serie temporal de cobertura de Cianobacteria



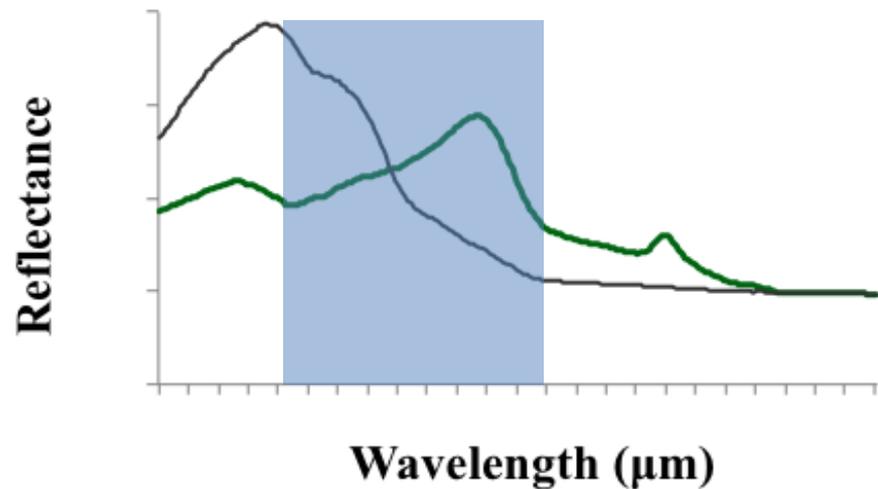
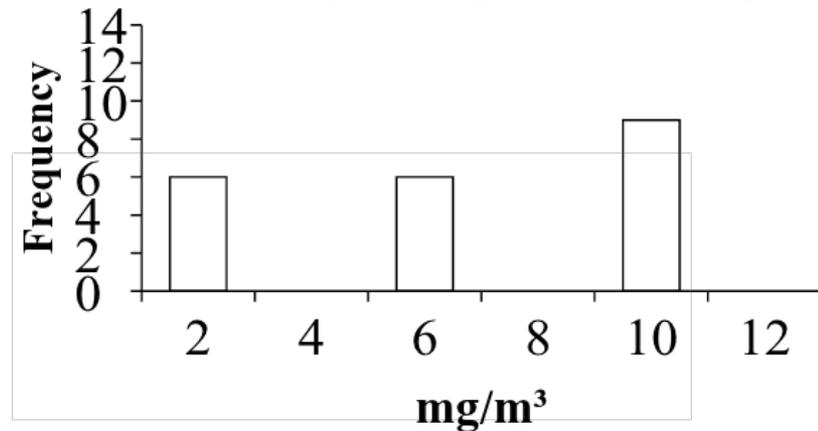
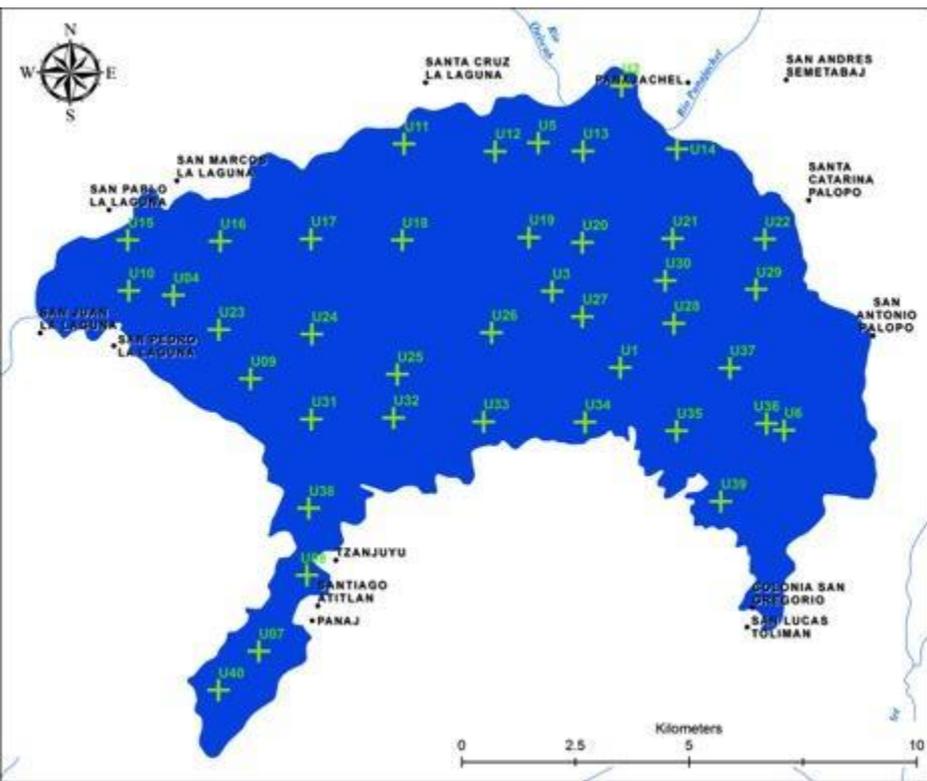
Next steps: Quantitative Analysis



How to estimate *Chl-a* concentrations from remote sensing measurements?

In situ sampling was necessary to transition from a qualitative to a quantitative analysis using remote sensing

- *Chl-a* in situ samples
 - 1.0 – 10.9 mg/m³
 - Data collected during the dry season (Jan-Apr 2013)



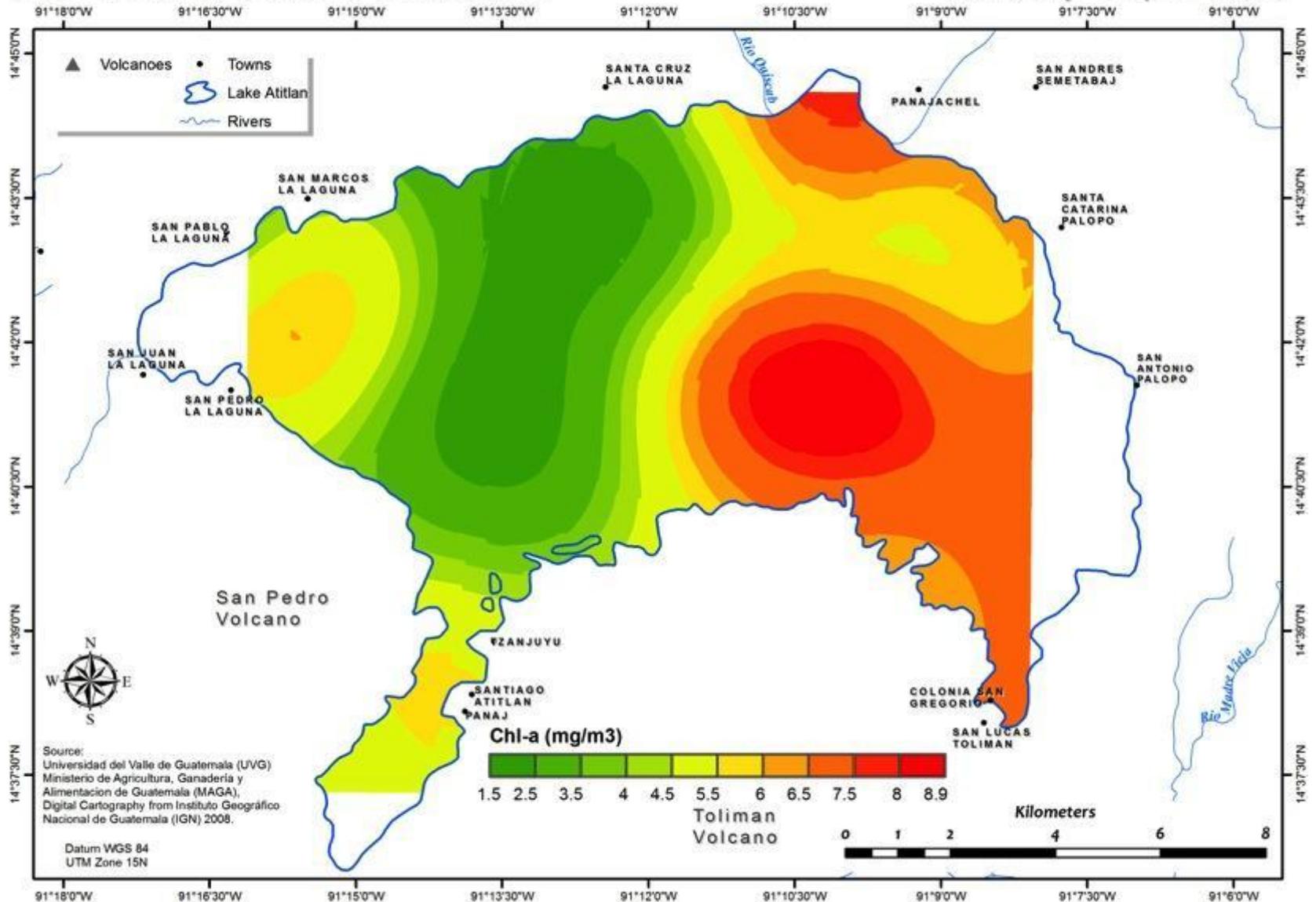
In situ sampling performed by Universidad del Valle and AMSCLAE

Quantitative Analysis

In situ data



Chlorophyll a concentration (Interpolation of in situ measurements)
Lake Atitlán, Sololá, Guatemala
January - April 2013



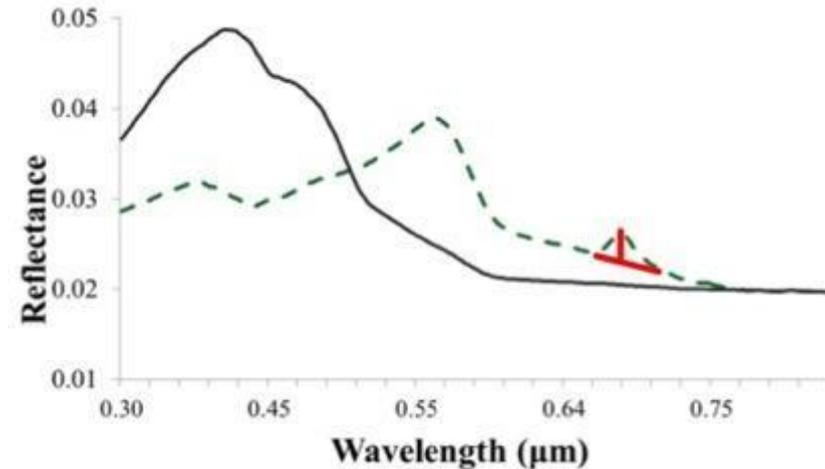
Quantitative Analysis

Developing a *Chl-a* algorithm using Hyperion satellite images and in situ measurements



Methods – Algorithms tested

- Blue/green band ratios
- Red/NIR band ratios
- Spectral shape (3-bands)



Example of algorithm to model Chl-a from remote sensing measurements:

Algorithm

Source

O'Reilly 1998, Werdell & Bailey
2005

$$X = \log_{10} \left(R \frac{443}{555} \right)$$

443 and 555 represent spectral bands

Quantitative Analysis

Developing a *Chl-a* algorithm using Hyperion satellite images and *in situ* measurements



Algorithm development

Test band ratios
and SS

- R^2
- Standard error of estimate

$R^2 =$ 0.5-0.7 blue/green
0.2-0.3 red/NIR
0.3 -0.5 SS (685 nm)

Analysis of variance for
blue/green

- Results are significant
at level 0.01
- F-test

**Selected
band ratio**

- Polynomial
- $\text{Log}(R_{467}/R_{559})$

Summary

- Understand your area of study as much as possible
- Remote sensing measurements can be extremely valuable for water quality monitoring once their limitations are understood
- *In situ* observations are necessary in order to develop remote sensing-based algorithms to estimate quantitative WQ parameters
 - Keep in mind: conditions under which the *in situ* observations were obtained

Thank you!



**MODIS and Landsat Data
for Lake Victoria
(Brock Blevins and Amita Mehta)**

Water Quality Data from Giovanni

GES DISC: Goddard Earth Sciences, Data and Information Services Center
Interactive Visualization and Analysis
<http://giovanni.gsfc.nasa.gov/>



- » **OVERVIEW**
- What is Giovanni?
- Who Uses Giovanni?
- Giovanni Parameters
- Giovanni Plot Types
- How to Use Giovanni
- How to Acknowledge Giovanni
- Acknowledgements

- Additional Features**
- News
- Users Manual
- Publications
- Newsletters
- Feedback
- FAQ

You are here: [GES DISC Home](#) » [Giovanni - Interactive Visualization and Analysis](#)

Giovanni - Interactive Visualization and Analysis

Contributors: [tonyr](#), [rchowdhury](#)

Giovanni - Interactive Visualization and Analysis - GES DISC: Goddard Earth Sciences, Data and Information Services Center

Giovanni-4 Now Available

New! Please try out [Giovanni-4](#), the next generation of Giovanni, with dramatically improved performance and interactive plotting and mapping. (Currently, only select Aerosols, Hydrology and Turbulent Flux data are available in Giovanni-4, with more on the way.)

The image shows a screenshot of the 'Giovanni Parameter List' page. At the top, there are two tabs: 'Giovanni Portals' (selected) and 'Giovanni Parameter List'. Below the tabs, there is a section titled 'Atmospheric Portals (Scroll down to view complete list)'. This section contains a list of data portals, including 'Terra and Aqua MODIS Aerosol Optical Depth (AOD) Level 3', 'Aura OMI Level 2G', 'Aura Microwave Limb Sounder (MLS)', 'Aura High Resolution Dynamics Limb Sounder (HIRDLS)', 'Aura Tropospheric Emission Spectrometer (TES)', 'Earth Probe and Nimbus-7 TOMS', 'Upper Atmosphere Research Satellite (UARS) Halogen Occultation Experiment (HALOE)', 'SeaWiFS Deep Blue Level 3 Long-Term Aerosol Data: Daily', and 'SeaWiFS Deep Blue Level 3 Long-Term Aerosol Data: Monthly'. Below this list are other sections: 'Application and Education Portal (Scroll down to view complete list)', 'Meteorological Portals', 'Ocean Portals', and 'Hydrology Portals (Scroll down to view complete list)'. A red circle highlights the 'Atmospheric Portals' section, and a yellow arrow points to the 'Ocean Portals' section.

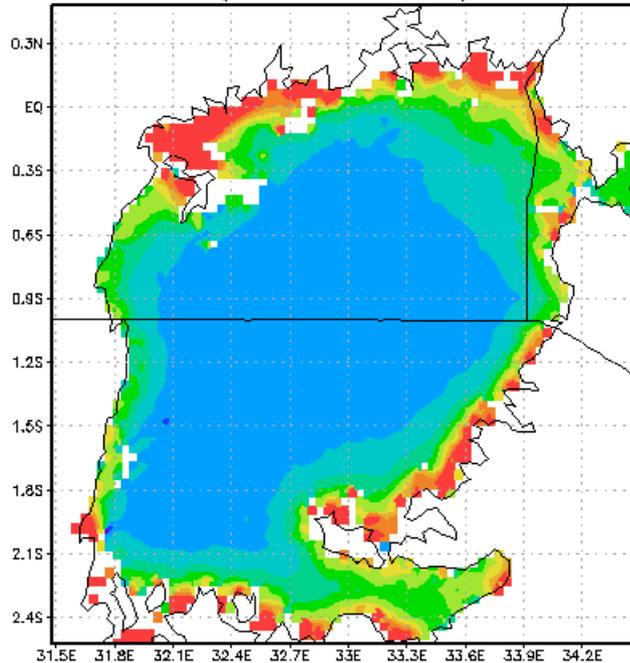
Data Portals

Chlorophyll Concentration (mg/m³) From Aqua MODIS L3 WQ Data

Long Term mean and Monthly Time Series over Lake Victoria
Acquired by using Giovanni

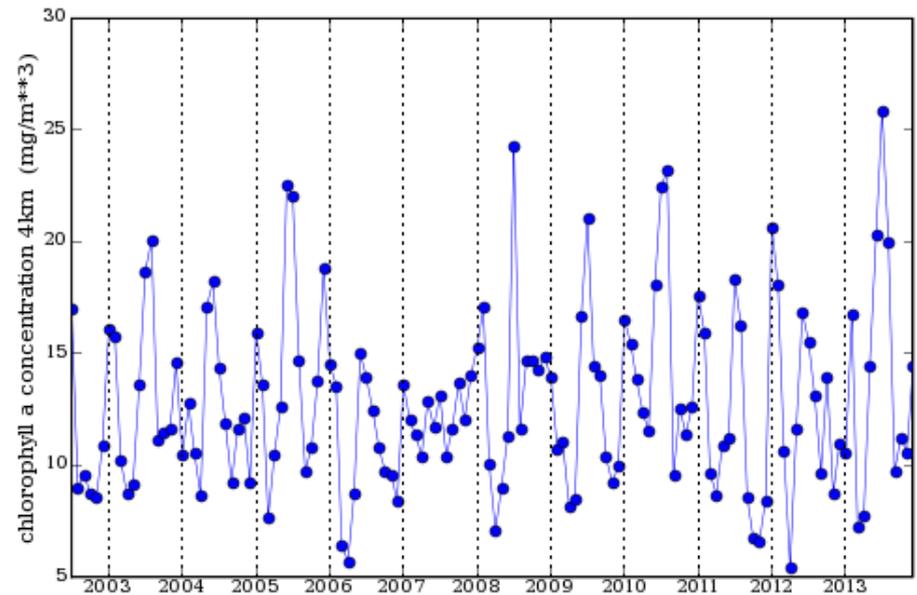
Mean : July 2002-December 2013

MAMO_CHLO_4km.CR chlorophyll a concentration 4km [mg/m**3]
(Jul2002 - Dec2013)



Area-averaged Time series

Area-Averaged Time Series (MAMO_CHLO_4km.CR)
(Region: 31E-34E, 2S-0N)



Substantial Seasonal to Inter-annual Variability

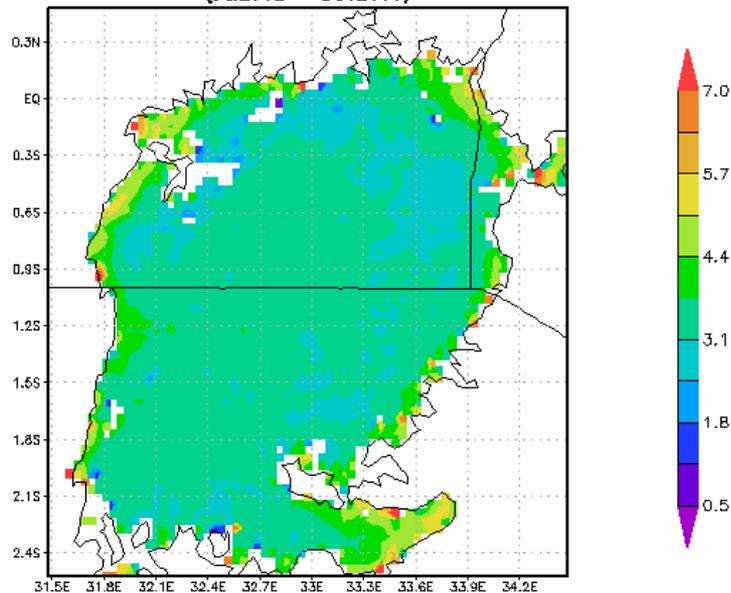
Colored Dissolved Organic Matter Index From Aqua MODIS L3 WQ Data

Long Term mean and Monthly Time Series over Lake Victoria
Acquired by using Giovanni

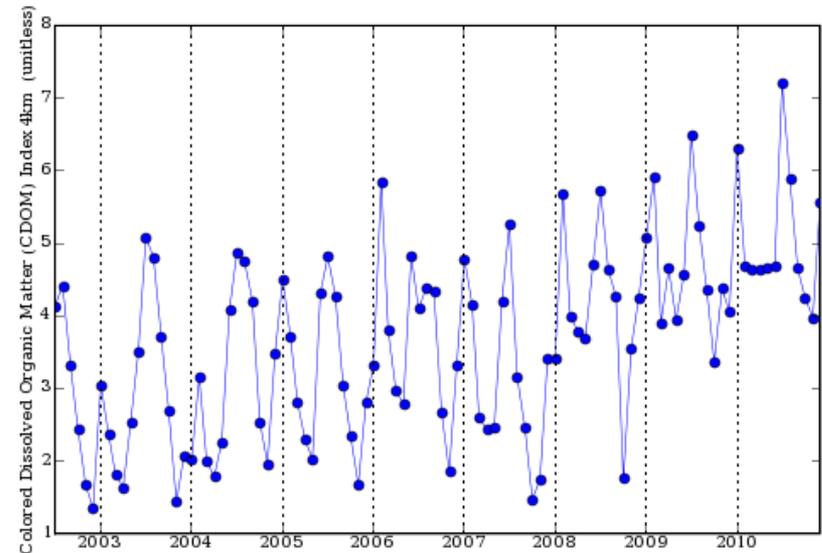
Mean : July 2002-December 2013

Area-averaged Time series

MAMO_CDOM_4km.CR Colored Dissolved Organic Matter (CDOM) Index 4km [unitless]
(Jul2002 - Dec2010)



Area-Averaged Time Series (MAMO_CDOM_4km.CR)
(Region: 31E-34E, 2S-0N)



Increase in CDOM?

Chlorophyll Concentration Data from OceanColorWeb

<http://oceancolor.gsfc.nasa.gov/>

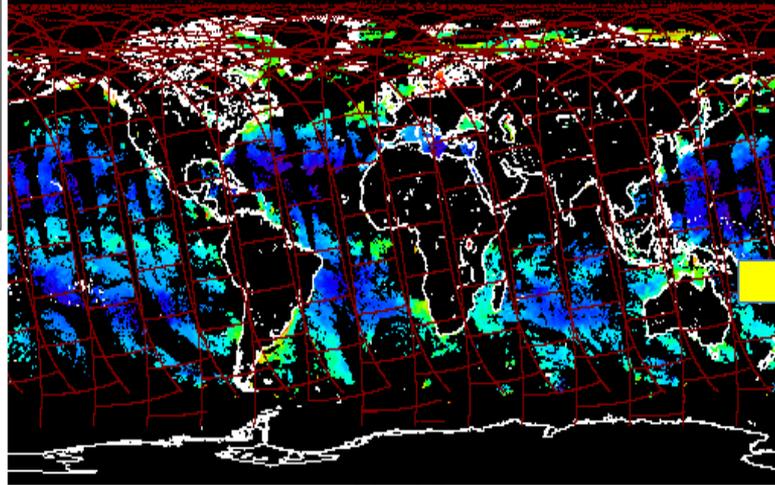
^ < > TC **CHL** SST SST4

Comment

Help

| | | | |
|--|--|---|---|
| SeaWiFS <input type="checkbox"/> GAC <input type="checkbox"/> MLAC | MODIS <input checked="" type="checkbox"/> Aqua <input type="checkbox"/> Terra | MERIS <input type="checkbox"/> RR <input type="checkbox"/> FRS | Select <input checked="" type="checkbox"/> Day <input type="checkbox"/> Night |
| <input type="checkbox"/> VIIRS (NPP) | <input type="checkbox"/> OCTS (ADEOS) | <input type="checkbox"/> HICO (ISS) <input type="checkbox"/> CZCS (Nimbus-7) | |

Tuesday, 16 July 2013
(2013197)



Select one or more regions:

- KerguelenIslands
- LakeBaikal
- LakeErie
- LakeHuron
- LakeLadoga
- LakeMichigan
- LakeOntario
- LakeStClaire
- LakeSuperior
- Lakshadweep**
- Lakshadweep

or specify boundary coordinates or a single location:

N:
W: :E
S:

Find swaths

Radius (km) about map click or about typed-in location:

72
 400
 800
 1200
 1500

Select swaths containing (at least):

any part
 25 %
 50 %
 75 %
 all

Select only scenes having in situ matchups.



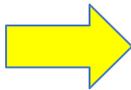
of the area of interest.

Chlorophyll

Display results 10 at a time.

Reconfigure page

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----------|----|----|----|----|----|----|-----------|-----|-----|-----|-----|-----|-----|-------------|----|----|----|----|----|----|---|
| Mission | 2002 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | June 2013 | | | | | | | July 2013 | | | | | | | August 2013 | | | | | | | |
| | 2003 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | S | M | T | W | T | F | S | S | M | T | W | T | F | S | S | M | T | W | T | F | S | |
| | 2004 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | | | | | 1 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | | | 1 | 2 | 3 |
| | 2005 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| | 2006 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | |
| | 2007 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | |
| | 2008 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 28 | 29 | 30 | 31 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | | | | |
| | 2009 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 30 | | | | | | | xxx | xxx | xxx | xxx | xxx | xxx | xxx | xxx | | | | | | | |
| | 2010 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | | | | | | | | | | | | | | | | | | | | |
| | 2011 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | | | | | | | | | | | | | | | | | | | | |
| | 2012 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | | | | | | | | | | | | | | | | | | | | |
| | 2013 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | | | | | | | | | | | | | | | | | | | | |
| | 2014 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | | | | | | | | | | | | | | | | | | | | |



Chlorophyll Concentration From Aqua MODIS

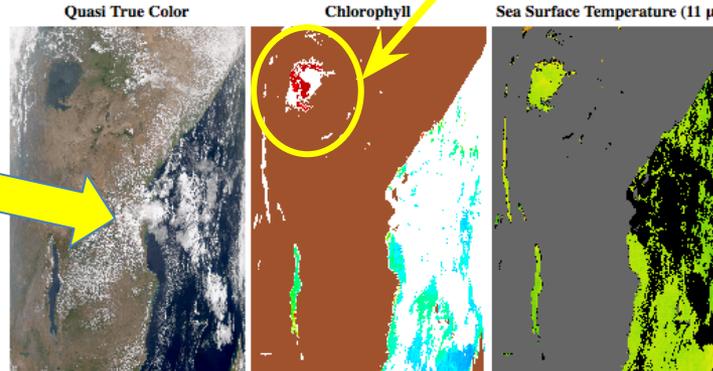
Daily Swath Data Over Lake Victoria
Acquired by using OcenColorWeb



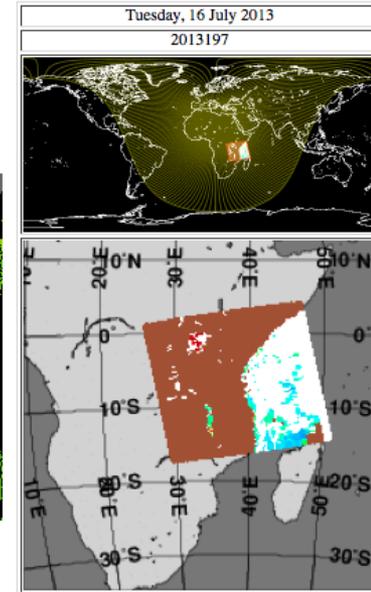
Data Files

[A2013197110500.L0_LAC](#) 313,470,162 bytes
[A2013197110500.L1A_LAC](#) 234,953,405 bytes
[A2013197110500.L2_LAC_OC](#) 32,454,448 bytes
[A2013197110500.L2_LAC_SST](#) 20,043,701 bytes
 (The above hyperlinks point to [compressed files](#).
 Documentation on these products can be found [HERE](#).)

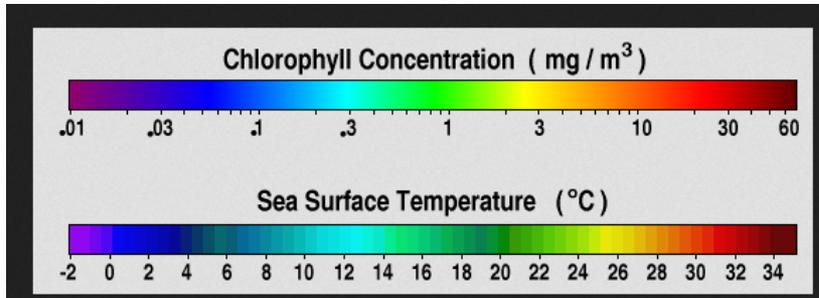
Clouds



July 16, 2013



Search Criteria
 Time Period: Tuesday, 16 July 2013 (daytime)
 Sensors: Aqua
 Area of Interest: LakeVictoria



Landsat Data for Lake Victoria EarthExplorer Demo

EarthExplorer

<http://earthexplorer.usgs.gov/>

USGS
science for a changing world

EarthExplorer

USGS Home
Contact USGS
Search USGS

Page Expires In 1:34:02

Home 1 New System Message

Login Register RSS Feedback Help

Search Criteria Data Sets Additional Criteria Results

1. Enter Search Criteria

To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Address/Place Path/Row Feature Circle

Show Clear

Coordinates Predefined Area Shapefile KML

Degree/Minute/Second Decimal

No coordinates selected.

Use Map Add Coordinate Clear Coordinates

Date Range Result Options

Search from: 01/01/1920 to: 11/25/2014

Search months: (all)

Data Sets » Additional Criteria » Results »

Search Criteria Summary (Show)

Clear Criteria

(46° 35' 56" N, 175° 32' 48" E) Options Overlays Map Satellite

Google

Map data ©2014 Google, INEGI, Imagery ©2014 NASA, TerraMetrics, 1000 km

EarthExplorer

<http://earthexplorer.usgs.gov/>

You must sign in as a registered user to download data or place orders for USGS EROS products.

Sign in using your USGS registered username and password

Username:

Password:

Remember Me

[Forgot your password?](#)

In order to obtain data from EarthExplorer, you must first register and login.

Acquiring Landsat Images

The image shows the USGS Earth Explorer web interface. At the top left is the USGS logo with the tagline "science for a changing world". At the top right, there are links for "USGS Home", "Contact USGS", and "Search USGS". Below the header, the "Earth Explorer" title is displayed, along with a "Page Expires In 1:58:06" timer and navigation links for "Home", "1 New System Message", "Login", "Register", "RSS", "Feedback", and "Help".

The main interface is divided into a left sidebar and a main map area. The sidebar contains a "Search Criteria" section with the following options:

- Search Criteria** (selected)
- Data Sets
- Additional Criteria
- Results

Under "Search Criteria", there is a heading "1. Enter Search Criteria" and a sub-heading "To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range." Below this are several input fields and buttons:

- Address/Place** (selected): Includes "Path/Row", "Feature", and "Circle" sub-options. A search box is present with "Show" and "Clear" buttons.
- Coordinates**: Includes "Predefined Area", "Shapefile", and "KML" sub-options. It has "Degree/Minute/Second" and "Decimal" radio buttons. A message states "No coordinates selected." with "Use Map", "Add Coordinate", and "Clear Coordinates" buttons.
- Date Range**: Includes "Result Options". It has "Search from:" and "to:" fields with calendar icons. The "Search from:" field contains "01/01/1920" and the "to:" field contains "11/25/2014". Below these is a "Search months:" dropdown menu set to "(all)".

At the bottom of the sidebar are buttons for "Data Sets »", "Additional Criteria »", and "Results »".

The main map area is titled "Search Criteria Summary (Show)" and "Clear Criteria". It displays a satellite-style map of East Africa, showing countries like Uganda, Kenya, Rwanda, Burundi, Tanzania, and the Democratic Republic of the Congo. Major cities such as Kampala, Nairobi, Kigoma, and Dar es Salaam are labeled. The map includes a coordinate display at the top right: "(03° 47' 02\" N, 041° 44' 26\" E)". There are also buttons for "Options", "Overlays", "Map", and "Satellite". A scale bar at the bottom right indicates "100 km".

The interactive map interface allows you to span the globe and zoom to your region of interest.

Search Criteria Data Sets Additional Criteria Results

Enter Search Criteria

To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Address/Place Path/Row Feature Circle

Show Clear

Coordinates Predefined Area Shapefile KML

Degree/Minute/Second Decimal

1. Lat: 00° 50' 18" N, Lon: 030° 54' 03" E
2. Lat: 00° 58' 13" N, Lon: 035° 16' 24" E
3. Lat: 00° 03' 01" S, Lon: 034° 53' 59" E
4. Lat: 00° 02' 53' 43" S, Lon: 030° 53' 23" E

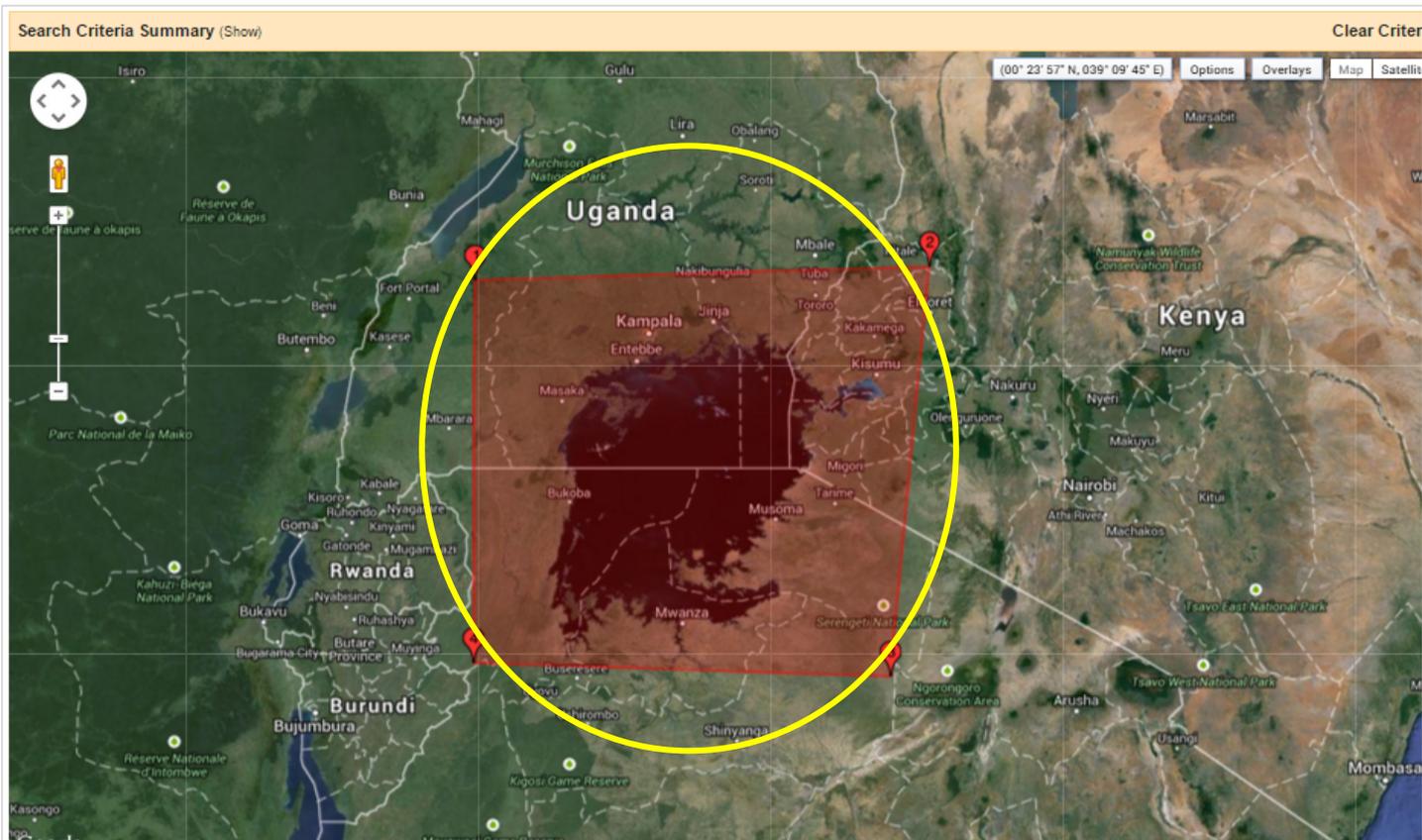
Use Map Add Coordinate Clear Coordinates

Date Range Result Options

Search from: 01/01/1920 to: 11/19/2014

Search months: (all)

Data Sets » Additional Criteria » Results »



Setting your Search Criteria Location:

Select your region of interest by enabling the Coordinates tab and creating a polygon by clicking 4 points on the map

Alternatively, you can search the database for common global features, in this case, Lake Victoria, Uganda/Tanzania, Africa.



Search Criteria | Data Sets | Additional Criteria | Results

1. Enter Search Criteria

To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Address/Place | Path/Row | Feature | Circle

Show Clear

Click on an Address/Place to show the location on the map and add coordinates to the Area of Interest Control.

| Num | Address/Place | Latitude | Longitude |
|-----|-------------------------------|----------|-----------|
| 1 | Lake Victoria | -0.7558 | 33.4384 |

Coordinates | Predefined Area | Shapefile | KML

Degree/Minute/Second | Decimal

i No coordinates selected.

Use Map | Add Coordinate | Clear Coordinates

Date Range | Result Options

Search from: 01/01/1920 to: 11/19/2014

Search months: (all)

Data Sets » | Additional Criteria » | Results »

Search Criteria Data Sets Additional Criteria Results

Enter Search Criteria

To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Address/Place Path/Row Feature Circle

Show Clear

Coordinates Predefined Area Shapefile KML

Degree/Minute/Second Decimal

1. Lat: 00° 50' 18" N, Lon: 030° 54' 03" E

2. Lat: 00° 58' 13" N, Lon: 035° 16' 24" E

3. Lat: 03° 01' 37" S, Lon: 034° 53' 59" E

4. Lat: 02° 53' 43" S, Lon: 030° 53' 23" E

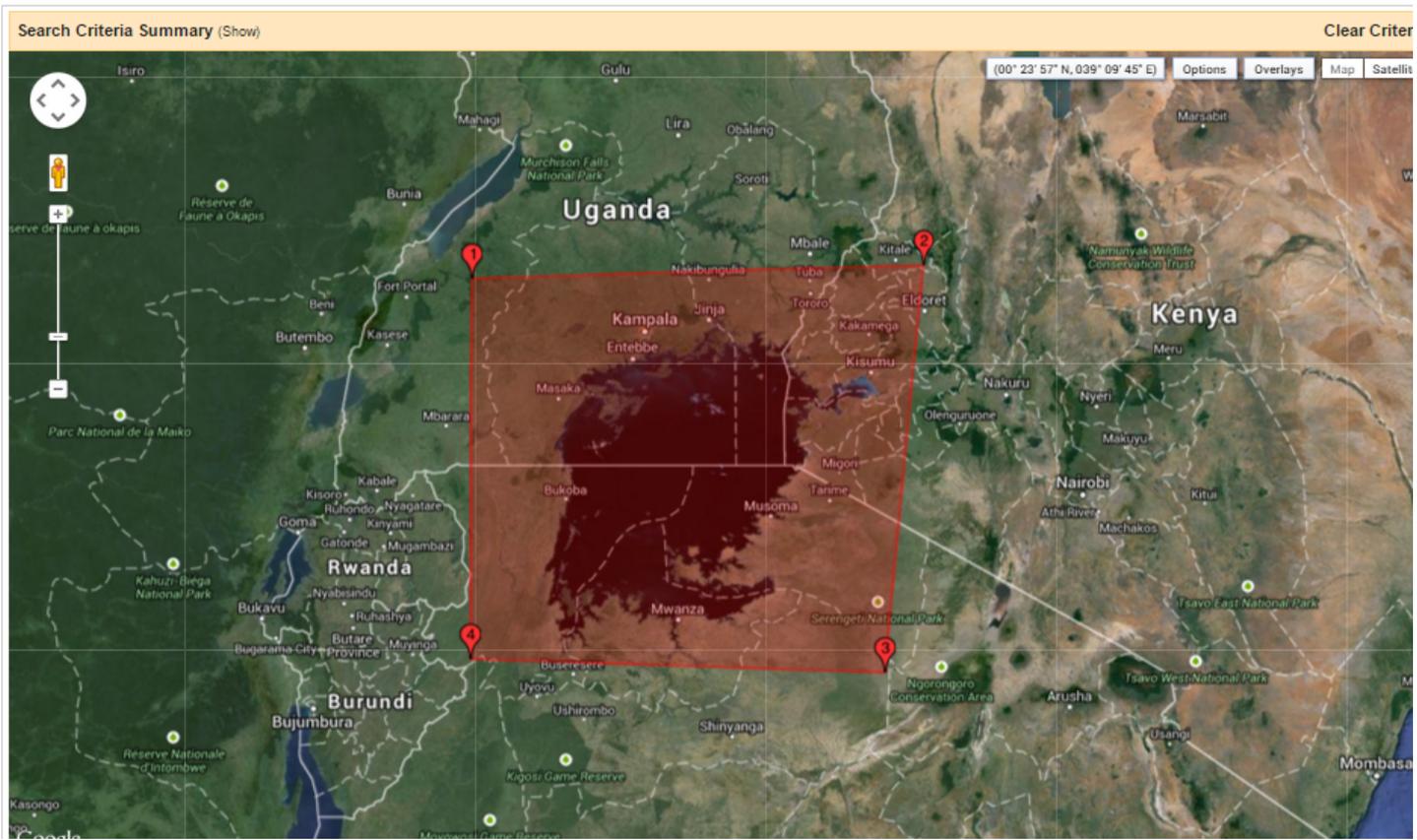
Use Map Add Coordinate Clear Coordinates

Date Range Result Options

Search from: 01/01/1920 to: 11/19/2014

Search months: (all)

Data Sets » Additional Criteria » Results »



**Setting your Search Criteria Date Range:
Type or use the calendar to select the date range of interest**

Open the Data Sets Tab



Search Criteria **Data Sets** Additional Criteria Results

2. Select Your Data Set(s)

Check the boxes for the data set(s) you want to search. When done selecting data set(s), click the *Additional Criteria* or *Results* buttons below. Click the plus sign next to the category name to show a list of data sets.

Use Data Set Prefilter [\(What's This?\)](#)

Data Set Search:

- EO-1
- GEOGLAM
- Global Fiducials
- Global Forest Observations Initiative
- Global Land Survey
- HCMM
- JECAM Sites
- LIDAR
- Land Cover
- Landsat Archive
- L8 OLI/TIRS
 - L8 OLI/TIRS Plus MSS-2
 - L7 ETM+ SLC-off (2003-present)
 - L7 ETM+ SLC-on (1999-2003)
 - L7 ETM+ Intl Ground Stations (Search Only)
 - L4-5 TM
 - L1-5 MSS
- Landsat CDR
- Landsat Legacy
- Landsat MRLC
- NASA LPDAAC Collections
- Orbview-3
- Radar
- Vegetation Monitoring

Clear All Selected Additional Criteria » Results »

Expand the Landsat Archive



Select the Landsat data product of choice

Here we are selecting Landsat 7 ETM+ SLC-off (2003-present)

Open the Additional Criteria Tab (Optional)



You may select specific path and row combinations to include in the search criteria

or

Choose to refine the results to only include scenes with Less than % Cloud Cover



Click Results

Search Criteria | Data Sets | **Additional Criteria** | Results

3. Additional Criteria (Optional)

If you have more than one data set selected, use the dropdown to select the additional criteria for each data sets.

Data Sets:
L7 ETM+ SLC-off (2003-present) ▼

L7 ETM+ SLC-off (2003-present)

Since May 31, 2003, all Landsat 7 scenes have been collected in **SLC-off mode** and will have data gaps.

Landsat Scene Identifier

WRS Path
 to

WRS Row
 to

Cloud Cover

All
Less than 10%
Less than 20%
Less than 30%
Less than 40%

Reset All Criteria | **Results »**

Accessibility | FOIA | Privacy | Policies and Notices

Search Criteria Data Sets Additional Criteria **Results**

4. Search Results

If you selected more than one data set to search, use the dropdown to see the search results for each specific data set.

Note: You must be logged in to download and order scenes

Show Result Controls

Data Set

[Click here to export your results](#)

L7 ETM+ SLC-off (2003-present)

NOTE: A maximum of five hundred Landsat scenes can be requested for download processing at a time. Landsat scenes added over that amount will have to be removed from the Item Basket before submitting the request.

« First < Previous 1 Next > Last »

Displaying 1 - 10 of 100

1



Entity ID: LE71690802014273SG100

Acquisition Date: 30-SEP-14

Path: 169

Row: 80



2



Entity ID: LE71690812014273SG100

Acquisition Date: 30-SEP-14

Path: 169

Row: 81



3



Entity ID: LE71700592014264SG100

Acquisition Date: 21-SEP-14

Path: 170

Row: 80



4

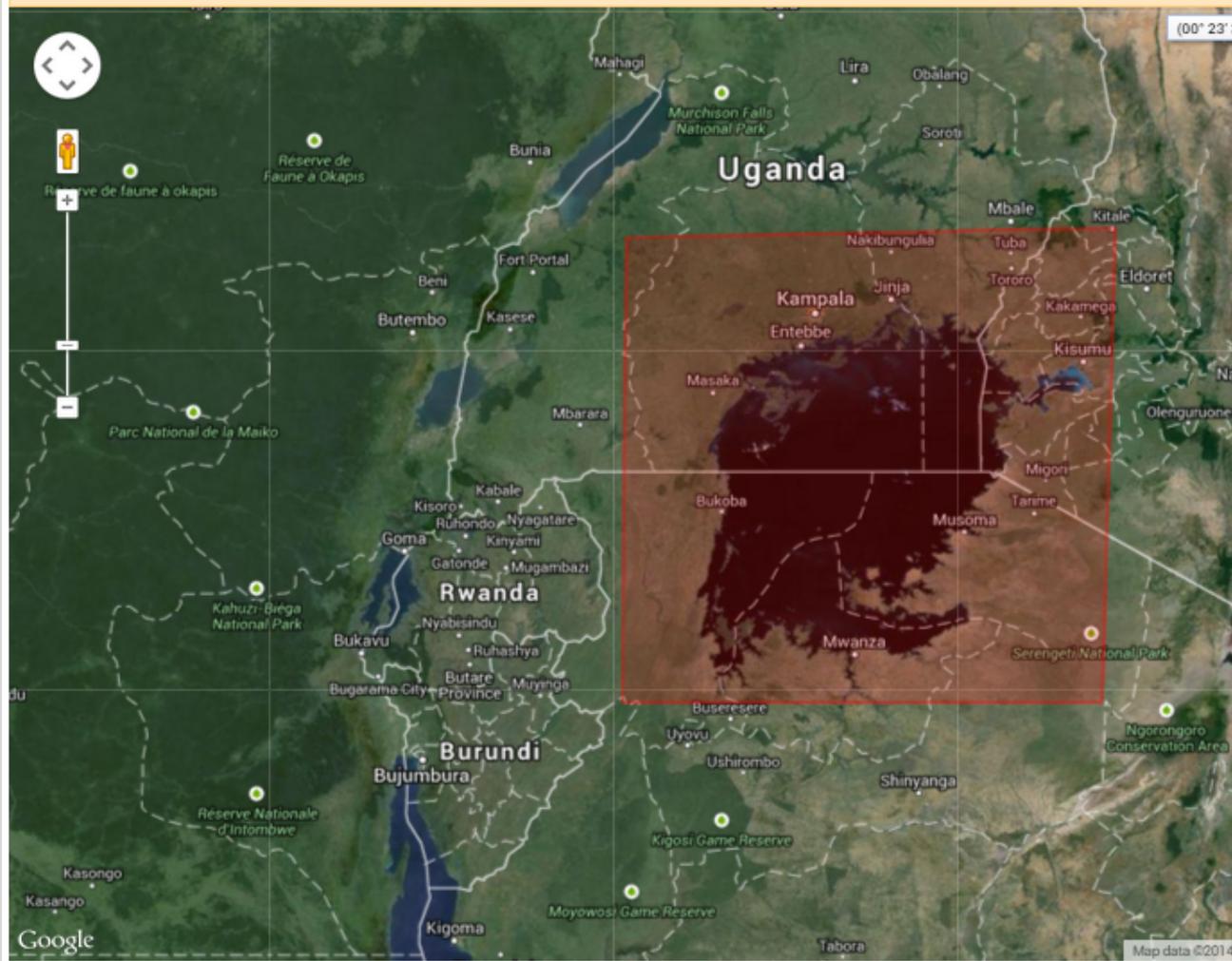


Entity ID: LE71700802014264SG100

Acquisition Date: 21-SEP-14

Path: 170

Search Criteria Summary (Show)

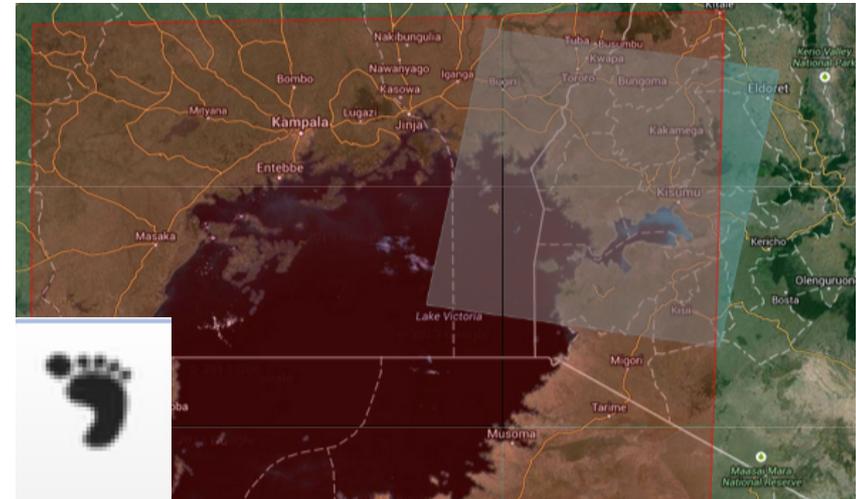


Results will gather and display on the left and display resulting scenes retrieved.

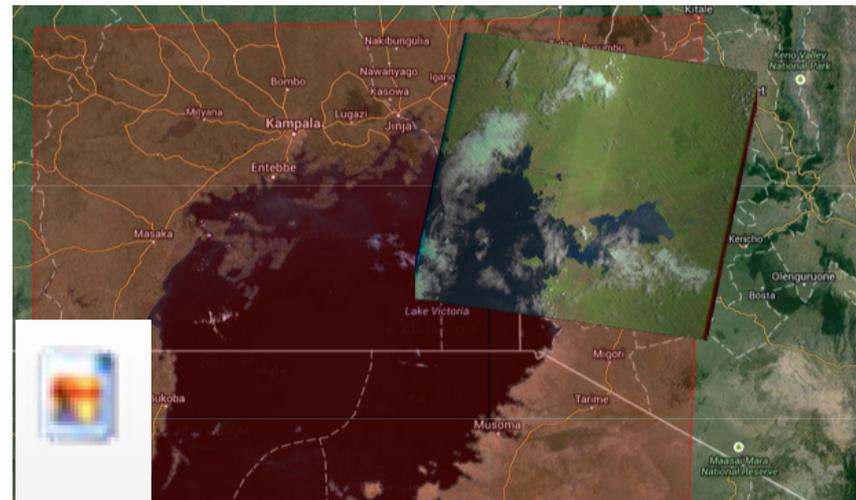


Each result has controls that allows one to:

A. Observe the footprint of the Landsat scene result



B. Observe the Landsat scene in true color



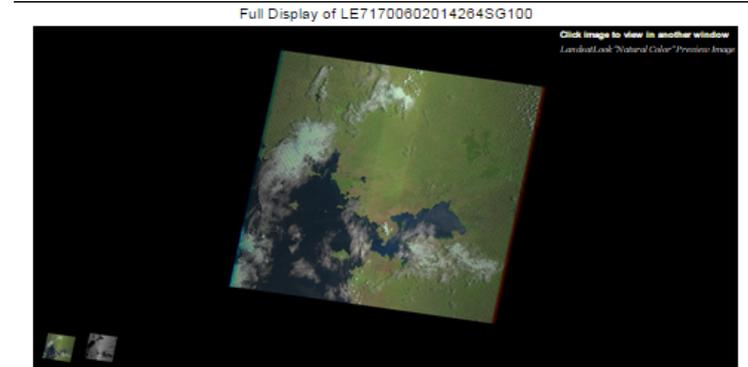
Additionally, you can choose to browse multiple results at once



Review the metadata



These options allow you to be sure you are selecting the correct Landsat scenes to eventually download (by date and geographic extent).



| Data Set Attribute | Attribute Value |
|--|----------------------------|
| Landsat Scene Identifier | LE71700602014264SG100 |
| Sensor Mode | SLM/TM |
| Station Identifier | SG1 |
| Day/Night | DAY |
| WRS Path | 110 |
| WRS Row | 080 |
| Date Acquired | 2014/09/21 |
| Start Time | 2014-264 07:52:39.0714009 |
| Stop Time | 2014-264 07:53:05.8316249 |
| Image Quality VCIQ 1 | 9 |
| Image Quality VCIQ 2 | 9 |
| Processing Software Version | L1GS 12.5.0 |
| Calibration Parameter File | L1C1P 20140701_20140901.08 |
| Cloud Cover | 21.59 |
| Cloud Cover Quad Upper Left | 29.45 |
| Cloud Cover Quad Upper Right | 3.05 |
| Cloud Cover Quad Lower Left | 33.28 |
| Cloud Cover Quad Lower Right | 20.80 |
| Sun Elevation | 64.25279421 |
| Data Type Level 3 | E-TM+ L11 |
| Sun Azimuth | 88.39811023 |
| Full Aperture Calibration | N |
| Gain Band 1 | L |
| Gain Band 2 | L |
| Gain Band 3 | L |
| Gain Band 4 | L |
| Gain Band 5 | L |
| Gain Band 6 VCIQ 1 | L |

Metadata

You may download one scene



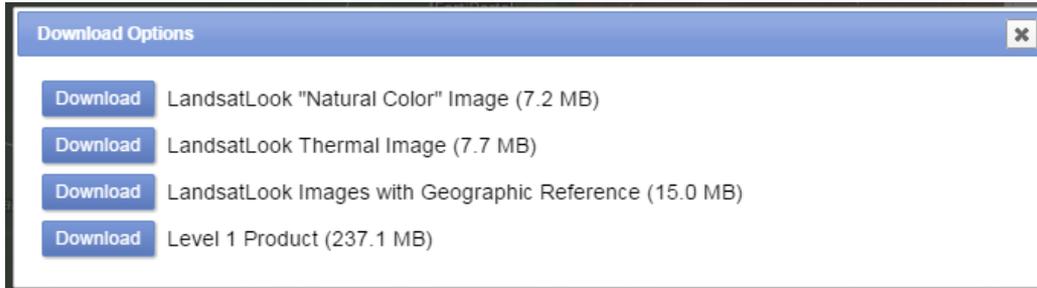
Or select multiple scenes to be placed in a Bulk Download Order (will be placed in your Item Basket)

Download Options:

- LandsatLook "Natural Color" Image (7.2 MB)
- LandsatLook Thermal Image (7.7 MB)
- LandsatLook Images with Geographic Reference (15.0 MB)
- Level 1 Product (237.1 MB)**

To acquire all Landsat bands, choose the Level 1 Product. Level 1 Product links are delivered in an email after placing the order in the "Item Basket"

The data will be delivered in a zipped tar.gz format



Summary

This webinar introduced satellite remote sensing observations useful for Water Quality monitoring

- Water Quality parameters (e.g. Chlorophyll Concentration, Colored Dissolved Organic Matter Index, Euphotic Depth, Temperature, Spectral Reflectances) are available since June 2002 to present from:
 - Aqua MODIS L3 data gridded at 4 km and 9 km (from Giovanni)*
 - Terra and Aqua MODIS L2 swath data at 1 km (from OceanColorWeb)*
 - NPP/VIIRS Chlorophyll Concentration L2 swath at 750 m (from NOAA STAR)*
- Qualitative information about Water Quality properties can be obtained from Landsat/TM,ETM+ and OLI imagery (1972 to present from USGS EarthExplorer, LandsatLook, GloVis) but further processing and algorithm development have to be carried out regionally for more quantitative information from Landsat sensors
- Remote sensing observations are used in Water Quality research and applications for regional decision support activities for in-land lakes, estuaries, and coastal oceans

Summary

This webinar introduced satellite remote sensing observations useful for Water Quality monitoring

- Past Water Quality parameters are available from (Orbview/SeaWiFS, and ENVISAT/MERIS) from OceanColorWeb (1997 to 2012)
- Water Quality properties can be derived from Imagery and spectral reflectance data from experimental, hyper-spectral data from EO1-Hyperion and HICO available upon request from USGS/EarthExplorer and Oregon State University respectively
- Water Quality parameters from NASA Ocean Biogeochemical Model (NOBM) data are available from Giovanni
- **In situ measurements are critical in addition to the remote sensing observations to derive and validate Water Quality parameters**

Remote Sensing Observations: Trade Offs

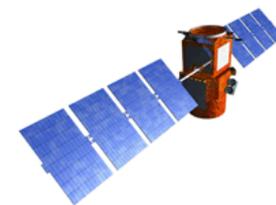
- It is very difficult to obtain extremely high spectral, spatial, temporal and radiometric resolution at the same time
- Several sensors can obtain global coverage every one to two days because of their wide swath width (Terra/Aqua)
- Higher spatial resolution polar orbiting satellites may take 8 – 16 days to attain global coverage (Landsat, EO-1)
- Multiple sources and large amount of data with varying formats
- Data applications may require additional *in situ* measurements and processing

For water quality parameters:

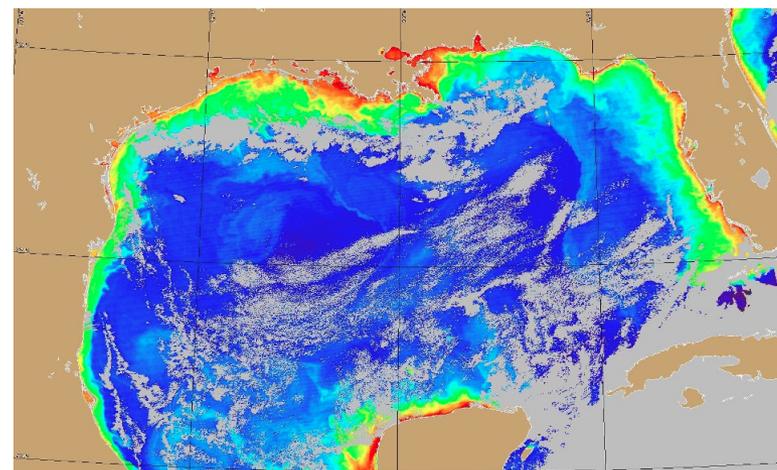
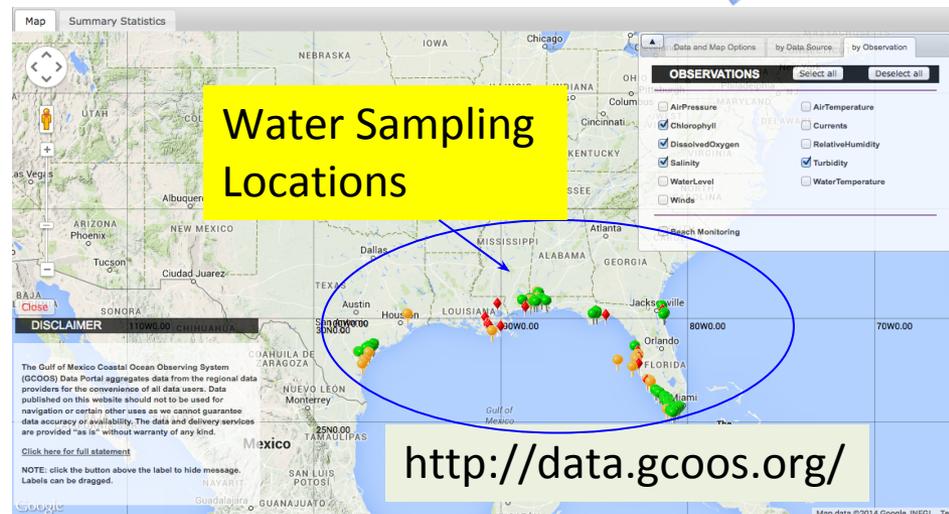
- Spectral reflectance in the presence of clouds may be unsuitable to use
- Atmospheric contribution to the reflectance has to be corrected to get the surface water properties
- Medium-spectral bands data may contain effects of multiple WQ parameters
- Data may contain land contribution



Why use Remote Sensing for WQ Monitoring?



- Provides information where there are no surface-based measurements available and augments where they are
- Provides global/near-global coverage with consistent observations
- Provides continuous coverage in comparison to point measurements



MODIS Aqua satellite image from October 23, 2011, showing areas of elevated chlorophyll a (in red and orange)

Concluding Remarks

- NASA Applied Sciences Program offers 'research to application' opportunities through competitive grants/proposals program (<http://nspires.nasaprs.com/external/>)
- NASA DEVELOP program offers opportunities to utilize NASA products for specific environmental application involving student liaisons (<http://develop.larc.nasa.gov/>)
- **ARSET provides on-line and in-person trainings on Air Quality, Eco Forecasting, Water Resources, and Disasters (Flooding) Management**
- **Introductory and advanced on-line trainings, and in-person trainings focused on specific environmental applications and geographic regions can be requested (<http://arset.gsfc.nasa.gov/training>)**

ARSET Web Page

<http://arset.gsfc.nasa.gov>

Earth Science Division Applied Sciences ASP Water Resources

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Applied Remote Sensing Training

The goal of the NASA Applied Remote Sensing Training (ARSET) is to increase the utility of NASA earth science and model data for policy makers, regulatory agencies, and other applied science professionals in the areas of Health and Air Quality, Water Resources, Eco Forecasting, and Disaster Management.

The two primary activities of this project are webinars and in-person courses.

Webinars (Free)

Webinars are offered throughout the year in all four application areas, generally 4-5 weeks in duration, 1 hour per week. They are intended for those new to remote sensing. For more information and to register please go to the webinars section of the website.

In-Person Courses

ARSET in person courses are a combination of lectures and computer hands-on activities that teach professionals how to access, interpret, and apply NASA data at regional and global scales with an emphasis on case studies. ARSET works with organizations who will host the training for groups within their geographical region, tailoring the curriculum to the needs of the projected participants. NASA does not charge an attendance fee, but attendees must make their own arrangements to travel to the course meeting location.

Skills Taught:

- Search, access, and download of NASA data products and imagery
- Appropriate use and interpretation of satellite imagery
- Visualization and analysis of NASA imagery using NASA, EPA, and NOAA webtools and other resources such as GIS, Google Earth, ArcGIS, RSG, and HDF-Link

ARSET is sponsored by the Applied Sciences Program within NASA's Earth Sciences Division. We would like to thank Nancy Searty, Applied Sciences' Capacity Building Program Manager for her support of this project.

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Water Quality Monitoring Using Remote Sensing Measurements

11/18/2014 to 12/02/2014

Times: Course-I: 8-9 AM, Course-II: 1-2 PM, Course-III: 10-11 AM (Eastern US time)

There are three identical courses offered at three different times

Courses I and II are in English, and Course III is in Spanish

Please sign up for any ONE course.

[Course-I \(8-9 AM, English\) Information and Registration](#)

[Course-II \(1-2 PM, English\) Information and Registration](#)

[Course III \(10-11 AM, Spanish\) Information and Registration](#)

Course Objective: To introduce remote sensing data, their access, analysis, and applications for water quality (WQ) monitoring in coastal oceans, estuaries, and in-land lakes.

Course Agenda:

Week-1: Introduction to Remote Sensing of WQ parameters

Week-2: NASA WQ Data, Access, and Tools

Week-3: Overview and Future Prospects of Remote Sensing of WQ Monitoring and Case Studies of Accessing WQ Data

A certificate will be awarded to participants who attend all three sessions and submit completed homework assigned during the course.

Agenda: [WQ Webinar Agenda](#)

GIS: True

Keywords: [Satellite Imagery](#), [Tools](#)

Instruments: [Aqua](#), [Landsat](#), [MODIS](#), [Terra](#), [VIIRS](#)

Presentations and Recordings

| Week | Date | Title | Presentation | Recording | H |
|------|-------------------|--|--|--|-----|
| 1 | November 18, 2014 | Introduction to Remote Sensing of WQ parameters | Session-1 (English) Session-1 (Spanish) | View Week 1 Recording (English) View Week 1 Recording (Spanish) | N/A |
| 2 | November 25, 2014 | NASA WQ Data, Access, and Tools | | | |
| 3 | December 2, 2014 | Overview and Future Prospects of Remote Sensing of WQ Monitoring and Case Studies of Accessing WQ Data | | | |

Session Presentations and Recordings



Homework Assignment Due by 31st of December

Please use the following link:

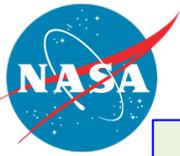
https://docs.google.com/forms/d/1Ub4JvIHEULLqTSST_aUnzHVsdRbDqqotaeCKnWSSutQ/edit?usp=sharing

Certificates will be awarded to the participants who attended all three sessions and submit completed homework



**Sign up to the listserve for more
information and program updates**

<https://lists.nasa.gov/mailman/listinfo/arset>



Webinar Information

Presentation URL: <http://arset.gsfc.nasa.gov/webinar>

Contact for requesting Certificate and more information about the course material

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Thank You!