



ARSET

Applied Remote Sensing Training

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

 @NASAARSET

El Monitoreo a Gran Escala Usando la Teledetección y la Ciencia Ciudadana

26 de septiembre de 2017

Semana 4

Capacitadoras: Sherry Palacios

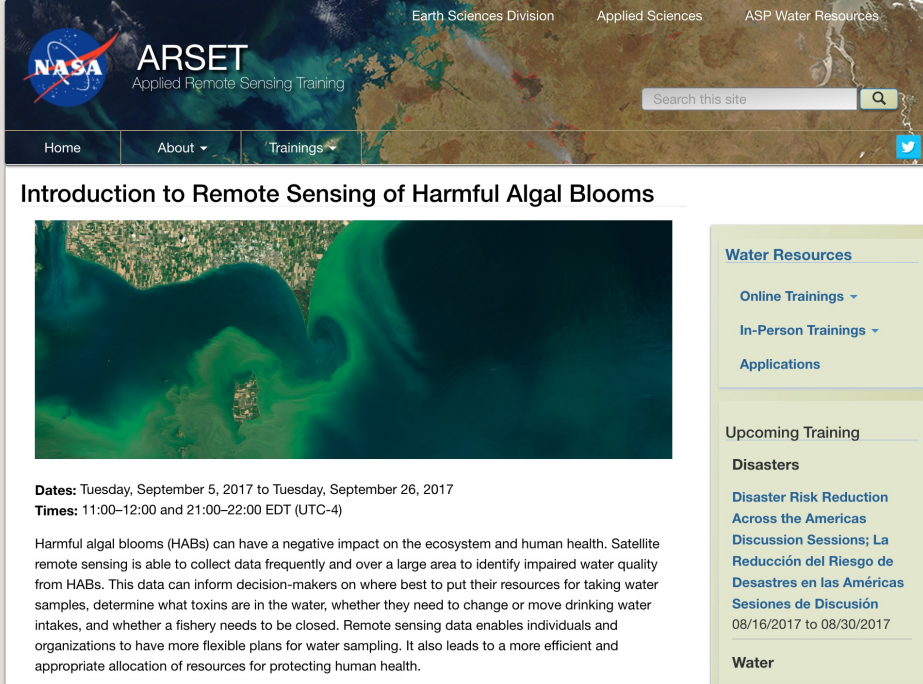
Amita Mehta

Estructura de la Capacitación

- Cuatro sesiones de 1 hora cada una: Los días martes en septiembre (5, 12, 19, y 26)
- Cada sesión se dará dos veces:
 - Sesión A: 11:00 – 12:00 horario Este de EEUU (UTC-4)
 - Sesión B: 21:00 – 22:00 horario Este de EEUU (UTC-4)
- Presentaciones:
 - Vista general de las Floraciones de Algas Nocivas (HABs por sus siglas en inglés)
 - Plataformas y sensores, acceso a datos y procesamiento de datos
 - Entendiendo las HABs en el ambiente costero
 - El monitoreo a gran escala y la ciencia ciudadana
- Dos Tareas a ser hechas en casa: después de las semanas 2 y 4.
- Preguntas y respuestas después de cada sesión y por correo electrónico a las instructoras

Material del curso

Las grabaciones de las sesiones, las presentaciones y las tareas para la casa están disponibles en: <https://arset.gsfc.nasa.gov/water/webinars/HABs17>




Earth Sciences Division Applied Sciences ASP Water Resources

ARSET
Applied Remote Sensing Training

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Home About Trainings

Introduction to Remote Sensing of Harmful Algal Blooms



Dates: Tuesday, September 5, 2017 to Tuesday, September 26, 2017
Times: 11:00–12:00 and 21:00–22:00 EDT (UTC-4)

Harmful algal blooms (HABs) can have a negative impact on the ecosystem and human health. Satellite remote sensing is able to collect data frequently and over a large area to identify impaired water quality from HABs. This data can inform decision-makers on where best to put their resources for taking water samples, determine what toxins are in the water, whether they need to change or move drinking water intakes, and whether a fishery needs to be closed. Remote sensing data enables individuals and organizations to have more flexible plans for water sampling. It also leads to a more efficient and appropriate allocation of resources for protecting human health.

Water Resources

- Online Trainings ▾
- In-Person Trainings ▾
- Applications

Upcoming Training

Disasters

- Disaster Risk Reduction Across the Americas Discussion Sessions; La Reducción del Riesgo de Desastres en las Américas Sesiones de Discusión 08/16/2017 to 08/30/2017

Water

Learning Objectives:

By the end of the training, attendees will be able to:

- identify NASA's Earth Science remote sensing data products for the identification and monitoring of HABs
- describe how coupled remote sensing and modeling approaches are used in decision support tools
- use a selection of NASA Earth Science data tools to monitor HABs

Course Format:

- Four, one hour sessions
- Sessions will be held on Tuesdays in September: September 5, 12, 19, and 26 at 11:00 a.m.-12:00 p.m. or 21:00-22:00 p.m. EDT (UTC-4)
 - [Convert to your local time »](#)
- A certificate of completion will be provided to participants that attend all live webinars and complete all homework assignments

Prerequisites:

Complete [Session 2C: Fundamentals of Aquatic Remote Sensing](#) or have equivalent experience. Attendees that do not complete prerequisites may not be properly prepared for the pace during the training.

Audience:

Local, regional, state, federal, and international organizations interested in using satellite imagery for coastal and ocean applications. Governmental and non-governmental organizations in the public and private sectors engaged in environmental management and monitoring will be given preference over organizations focused primarily on research.

Registration Information:

There is no cost for the webinar, but you must register. Space is limited, and preference will be given to...

Introduction to Remote Sensing of Harmful Algal Blooms

09/05/2017 to 09/26/2017

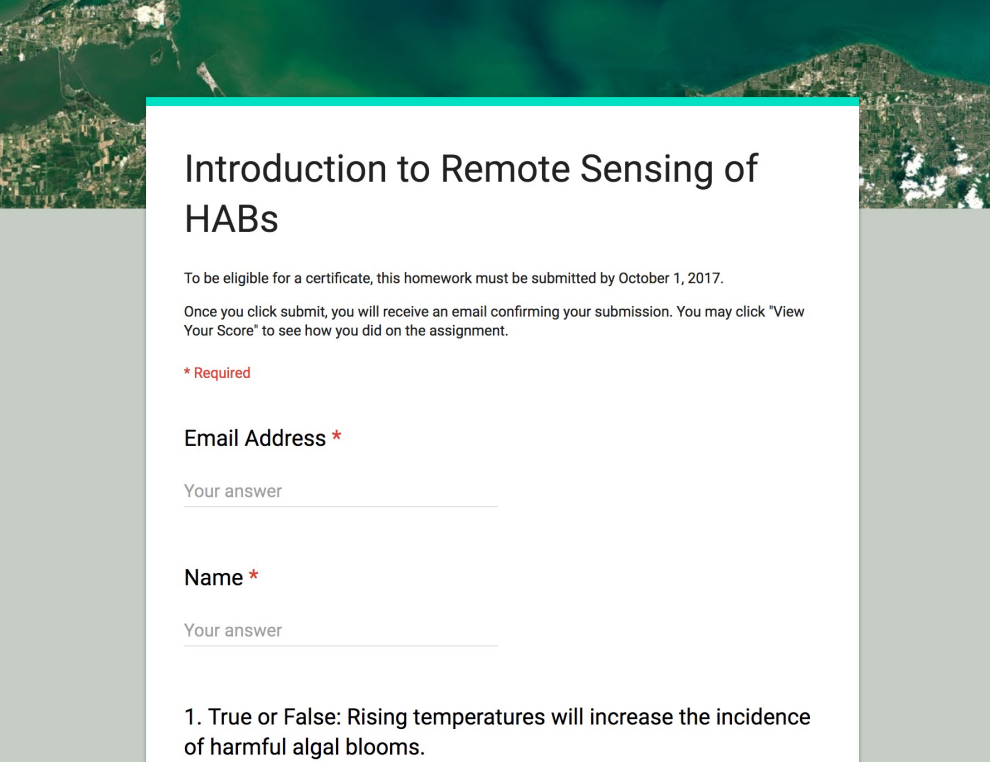
Land

Introduction to Remote Sensing for Scenario-Based Ecoforecasting

09/07/2017 to 09/28/2017

Tarea y certificados

- Tarea
 - **Debe enviar sus respuestas vía Google Form**
- Certificado de Terminación:
 - Asista a todas las sesiones
 - Complete las tareas asignadas dentro del plazo estipulado (accesibles desde la página en línea de ARSET)
 - **Fechas límite de entrega: El 1^{ro} y el 15 de octubre**
 - Ud. recibirá su certificado aproximadamente dos meses después de la conclusión del curso de:
marines.martins@ssaihq.com



The image shows a Google Form titled "Introduction to Remote Sensing of HABs". The form includes instructions about submission deadlines and email confirmation. It features two required input fields: "Email Address" and "Name", each with a "Your answer" placeholder. Below the fields is a question: "1. True or False: Rising temperatures will increase the incidence of harmful algal blooms."

Introduction to Remote Sensing of HABs

To be eligible for a certificate, this homework must be submitted by October 1, 2017.

Once you click submit, you will receive an email confirming your submission. You may click "View Your Score" to see how you did on the assignment.

*** Required**

Email Address *

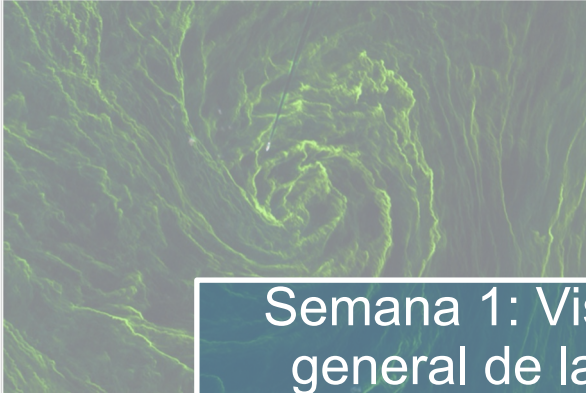
Your answer

Name *

Your answer

1. True or False: Rising temperatures will increase the incidence of harmful algal blooms.

Resumen del Curso



Semana 1: Vista general de las Floraciones de Algas Nocivas



Semana 2: Plataformas y sensores, acceso a datos y procesamiento de datos



Credit: Paul Hillman/NOAA

Semana 3: Las HABs en el ambiente costero



Semana 4: El monitoreo a gran escala

Reseña – Sesión 4

- Repaso de las HABs de las semanas 1, 2 y 3
- Resumen general de las HABs cianobacteriales (cyanoHABs)
- Ejemplos de herramientas para el monitoreo de cyanoHABs en el agua dulce (e.g., HAB Tracker, Great Lakes HAB Bulletin)
- Ejemplos de cómo la ciencia ciudadana puede utilizarse para monitorear HABs
- Cyanobacteria Assessment Network* (CyAN)
– Presentador Invitado: Wilson Salls, EPA



* Red para la Evaluación de Cianobacterias

Photo Credit: Aerial Associates Photography (<http://skypics.com>)

An aerial photograph of a river delta, likely the Mississippi River delta, showing a complex network of waterways and land. A semi-transparent grey rectangle is overlaid on the center of the image, containing text. The text is in a bold, black, sans-serif font. Below the text is a horizontal line.

Repaso de las Semanas 1, 2 y 3

¿Qué son las Floraciones de Algas Nocivas?

“Las floraciones de algas nocivas (Harmful algal blooms, HABs) ocurren cuando las colonias de algas — plantas simples que viven en el mar o en el agua dulce — crecen fuera de control y producen efectos tóxicos o nocivos en las personas, peces, mariscos, mamíferos y aves marinas. Las enfermedades humanas causadas por las HABs, aunque raras, pueden ser debilitantes y hasta mortales.”

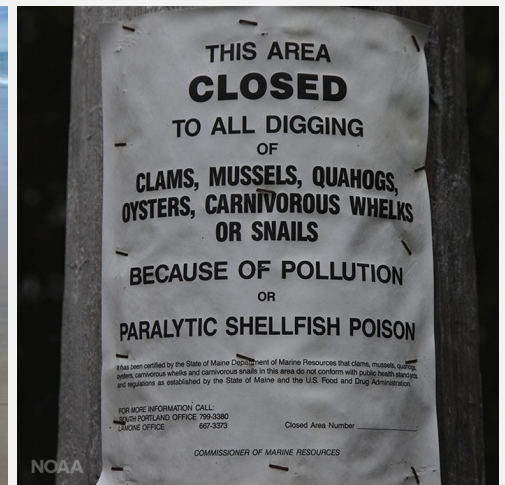
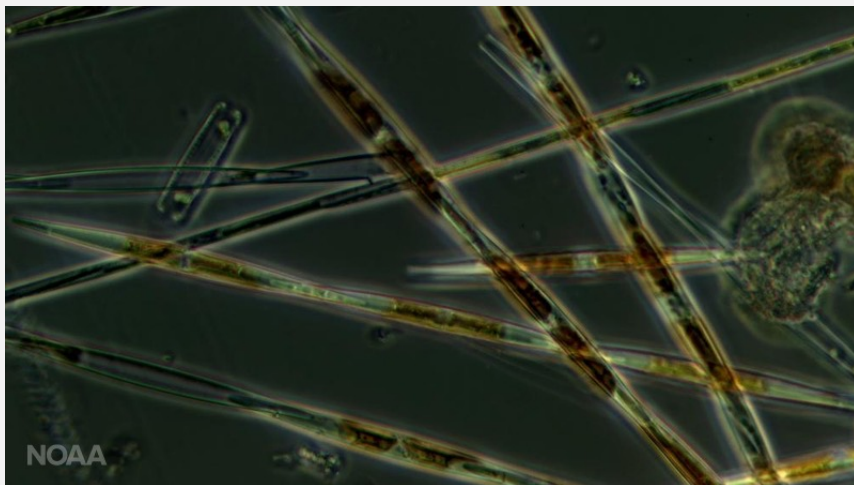


Image credit: <http://www.noaa.gov/what-is-harmful-algal-bloom>

Satélites para el Monitoreo de HABs

- Misiones Satelitales Actuales:
 - Landsat 7 y Landsat 8
 - Terra
 - Aqua
 - Suomi National Polar Partnership (SNPP)
 - Sentinel-2 y Sentinel-3



Acceso a Datos y Herramientas de Procesamiento para el Monitoreo de HABs


- Estas herramientas permiten la búsqueda de datos, la formación, el análisis y/o visualización de conjuntos de datos espaciales y temporales, :
 - OceanColor Web:
<https://oceancolor.gsfc.nasa.gov/>
 - Giovanni:
<http://giovanni.gsfc.nasa.gov/giovanni/>
 - CoastWatch
<https://coastwatch.pfeg.noaa.gov/data.html>
- Software para el Procesamiento y Visualización de datos:
 - SeaDAS:
<http://seadas.gsfc.nasa.gov/>

Resumen

- La teledetección proporciona una cobertura global continua con observaciones consistentes a comparación con las mediciones limitadas de diferentes puntos en la superficie o del muestreo desde las naves
- Las observaciones de la teledetección ópticas y en tiempo casi real de Landsat, Terra/Aqua MODIS, SNPP VIIRS, Sentinel-2 MSI y Sentinel-3 OLCI se usan de manera operativa para el monitoreo cualitativo y cuantitativa de las HABs (Chl y SST)

El Pronosticar Eventos Causados por HABs Ayuda a Predecir los Impactos

NOAA-- HAB Operational Forecast System (HAB-OFS)



Gulf of Mexico Harmful Algal Bloom Bulletin
 Region: Southwest Florida
 Thursday, 29 September 2016
 NOAA National Ocean Service
 NOAA Satellite and Information Service
 NOAA National Weather Service
 Last bulletin: Monday, September 26, 2016

Conditions Report

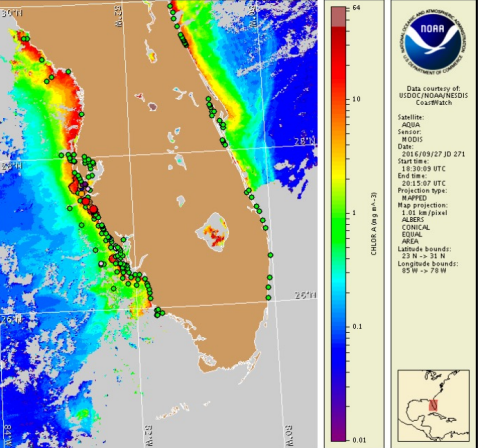
Not present to high concentrations of *Karenia brevis* (commonly known as Florida red tide) are present along- and offshore portions of southwest Florida, and not present in the Florida Keys. *K. brevis* concentrations are patchy in nature and levels of respiratory irritation will vary locally based upon nearby bloom concentrations, ocean currents, and wind speed and direction. The highest level of potential respiratory irritation forecast for Thursday September 29 to Monday, October 3 is listed below:

County Region: Forecast (Duration)
Northern Pinellas: Low (Th-M)
Southern Pinellas: Moderate (Th-Sa), Low (Su-M)
Southern Pinellas, bay regions: Low (Th-M)
Northern Manatee; bay regions: Moderate (Th-M)
Southern Manatee: High (Th-Sa), Moderate (Su-M)
Southern Manatee, bay regions: High (Th-M)
Northern Sarasota: High (Th-Sa), Moderate (Su-M)
Northern Sarasota, bay regions: High (Th-M)
Southern Sarasota: Moderate (Th-M)
Northern Charlotte: Moderate (Th-M)
Southern Charlotte: High (Th-Sa), Moderate (Su-M)
Southern Charlotte, bay regions: High (Th-M)
Northern Lee: High (Th-Sa), Moderate (Su-M)
Central Lee: Low (Th-M)
All Other SWFL County Regions: None expected (Th-M)

Check http://tidesandcurrents.noaa.gov/hab/beach_conditions.html for recent, local observations. Health information, from the Florida Department of Health and other agencies, is available at http://tidesandcurrents.noaa.gov/hab/hab_health_info.html. Reports of fish kills and respiratory irritation have been received from southern Pinellas, southern Manatee, northern and southern Sarasota, southern Charlotte, and northern and central Lee counties.

Analysis

Samples collected along- and offshore the coast of southwest Florida from Pinellas to Collier counties identified not present to 'high' concentrations of *Karenia brevis*, with the highest concentrations still present alongshore and in the bay regions of southern Manatee and northern Sarasota counties (FWRI, MML, SCHED, CCENRD; 9/19-9/27). New sampling indicates up to 'medium' concentrations of *K. brevis* have been confirmed along Passage Key Inlet at Anna Maria Island, spanning the bay regions of northern and southern Manatee County (FWRI; 9/26). Background to 'low b' concentrations are present alongshore northern Pinellas County, alongshore and in the bay regions of southern Pinellas County, alongshore southern Sarasota County, and central Lee County (FWRI; 9/19-9/28). Detailed sample information and a summary of impacts can be obtained through FWC Fish and Wildlife Research Institute at: <http://myfwc.com/redtidestatus>. Reports of slight to intense respiratory irritation and up to heavy associated fish kills have been reported from Coquina Beach alongshore northern Manatee County; Lido Key, Siesta Key, Nokomis, Venice North Jetty, and Venice Beach, in northern Sarasota County; Manasota Beach alongshore southern Sarasota County; Gasparilla Island Bridge and



Satellite chlorophyll image with possible *K. brevis* HAB areas shown by red polygon(s), when applicable. Points represent cell concentration sampling data from September 19 to 28: red (high), orange (medium), yellow (low b), brown (low a), blue (very low b), purple (very low a), pink (present), and green (not present). Cell count data are provided by Florida Fish and Wildlife Conservation Commission (FWC) Fish and Wildlife Research Institute. For a list of sample providers and a key to the cell concentration categories, please see the HAB-OFS bulletin guide: http://tidesandcurrents.noaa.gov/hab/hab_publication/habfs_bulletin_guide.pdf

Detailed sample information can be obtained through FWC Fish and Wildlife Research Institute at: <http://myfwc.com/redtidestatus>

To see previous bulletins and forecasts for other Harmful Algal Bloom Bulletin regions, visit at: <http://tidesandcurrents.noaa.gov/hab/bulletins.html>

- *Karenia brevis* forma floraciones fragmentarias y el impacto puede variar según el lugar
- Para elaborar su pronóstico, el boletín NOAA HAB Bulletin combina:
 - imágenes oceánicas satelitales
 - observaciones de campo
 - modelos
 - informes de salud pública
 - datos de boyas oceánicas

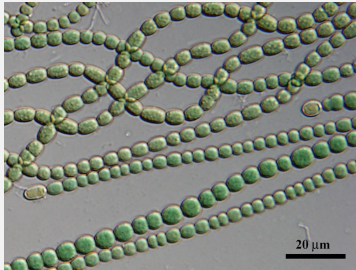
<https://tidesandcurrents.noaa.gov/hab/bulletins.html>;
https://tidesandcurrents.noaa.gov/hab/hab_publication/habfs_bulletin_guide.pdf

An aerial photograph showing a wide river with a prominent cyanobacterial bloom (CyanoHAB) in shades of green and blue. The river flows through a landscape of agricultural fields and urban areas. A semi-transparent grey rectangular overlay covers the central portion of the image, containing the title text.

Vistazo General de las CyanoHABs

Algunos Tipos de CyanoHABs Comunes y Sus Toxinas

Anabaena



anatoxinas
microcistina
saxitoxinas

Aphanizomenon



saxitoxinas
cilindroespermopsinas

Cylindrospermopsis



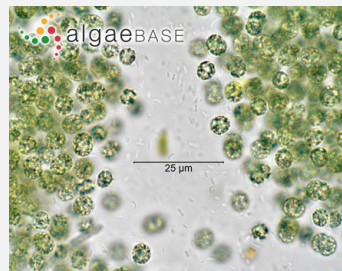
saxitoxinas
cilindroespermopsinas

Lyngbya



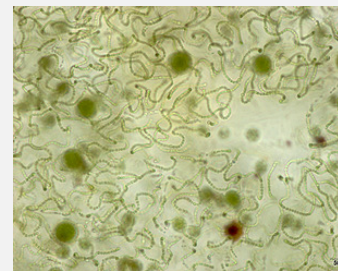
aplisiatoxinas
lingbiatoxina a

Microcystis



microcistinas

Nostoc



microcistinas

Planktothrix



anatoxinas, apsisiatoxinas
microcistinas, saxitoxinas

Neurotoxina
Hepatotoxina
Irritante cutáneo

photo credits: CCLA, C.F. Carter, UNH Center for Freshwater Biology, R. Barone

CyanoHABs – De Cerca



Lago Taihu, China



Lago Pinto, California

credit (L to R): H. Paerl, UNC-Chapel Hill, R.Kelty

El Impacto de la Gestión

Estudio de Caso: Toledo, Ohio (EEUU)

Science News from research organizations

Significant harmful algal bloom predicted in western Lake Erie this summer

Date: July 10, 2014

Source: National Oceanic and Atmospheric Administration

Summary: NOAA and its research partners predict that western Lake Erie will have a significant bloom of cyanobacteria, a toxic blue-green algae, during the 2014 bloom season in late summer. However, the predicted bloom is expected to be smaller than last year's intense bloom, and considerably less than the record-setting 2011 bloom. Bloom impacts will vary across the lake's western basin and are classified by an estimate of both its concentration and how far it spreads.



ENVIRONMENT

Toledo Residents Cut Off From Water Supply After Tests Show Toxins

August 3, 2014 · 1:17 AM ET

THE ASSOCIATED PRESS

SCIENCE

Cyanobacteria Are Far From Just Toledo's Problem



Carl Zimmer

MATTER AUG. 7, 2014

Harmful algal blooms continue to plague Lake Erie, threaten drinking water, fish, pets

18 AM

Updated on August 30, 2017 at 10:22 AM, Posted on August 30, 2017 at 10:20 AM



The algae-clogged waters of Lake Erie's western basin at Maumee Bay State Park east of Toledo produced the growth of cyanobacteria and a toxin called microcystin that can be dangerous for people, birds, fish and pets. (The New York Times file photo)

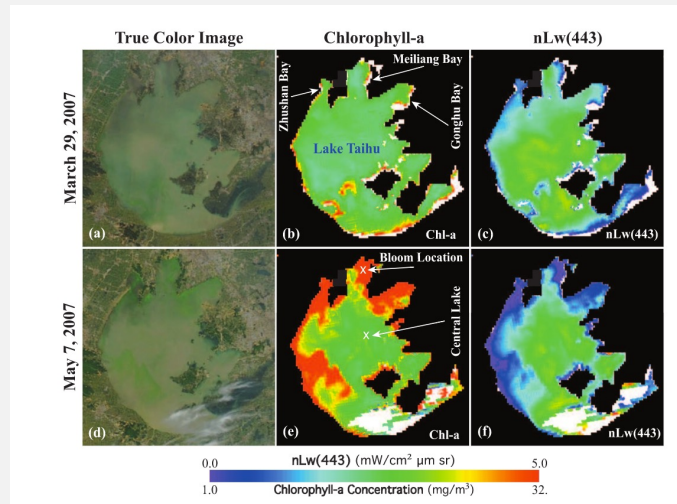


By [James F. McCarty, The Plain Dealer](#), jmccarty@plaind.com

credits: AP, New York Times, Cleveland's The Plain Dealer

La Teledetección de CyanoHABs

Lago Taihu, China

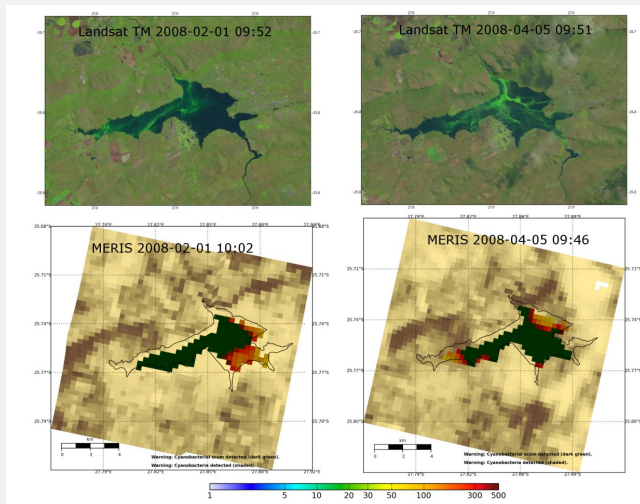


Lago Erie, EEUU



Credits: Lake Taihu (Wang & Shi 2008), Lake Erie (NASA/NOAA-NCCOS)

Represa Hartbeespoort Sudáfrica



Floración de *Nodularia*, Mar Báltico



Credit: Hartbeespoort Dam (Matthews & Bernard 2015), Baltic Sea (http://www.wimsoft.com/Variou_s_HABs/Satellite_detection_of_HABs.htm)

La Teledetección de Floraciones Cianobacteriales

- Concentración de clorofila-a
- Anomalía de clorofila-a
- Algoritmos dirigidos a la ficocianina
- Índice de cianobacterias (Cyanobacteria Index o CI)

Cyanobacteria Index (CI):

Wynne, TT, Stumpf, RP, Tomlinson, MC, Warner RA, Tester, PA, Dyble, J, and Fahnenstiel, GL (2008) 'Relating spectral shape to cyanobacterial blooms in the Laurentian Great Lakes', International Journal of Remote Sensing, 29:12, 3665 – 3672.

Índice de cianobacterias (Cyanobacteria Index o CI)*

$$CI = - SS(681)$$

donde SS es la figura espectral (spectral shape) a 681 nm:

$$SS(681) = nLw(681nm) - nLw(665nm) - [nLw(709nm) - nLw(665nm)] * \frac{(681 - 665)}{(709 - 665)}$$

* example using L2 data for MERIS bands

An aerial photograph showing a river winding through a landscape of agricultural fields and urban areas. A semi-transparent, light blue overlay covers the central portion of the image, containing the title text. The river is a prominent feature, with a distinct bend in the upper right and a straight section in the lower left. The surrounding land is a patchwork of green and brown rectangular plots, typical of farmland. Urban areas with dense building footprints are visible on the left side.

Herramientas para CyanoHABs – Estudios de Caso

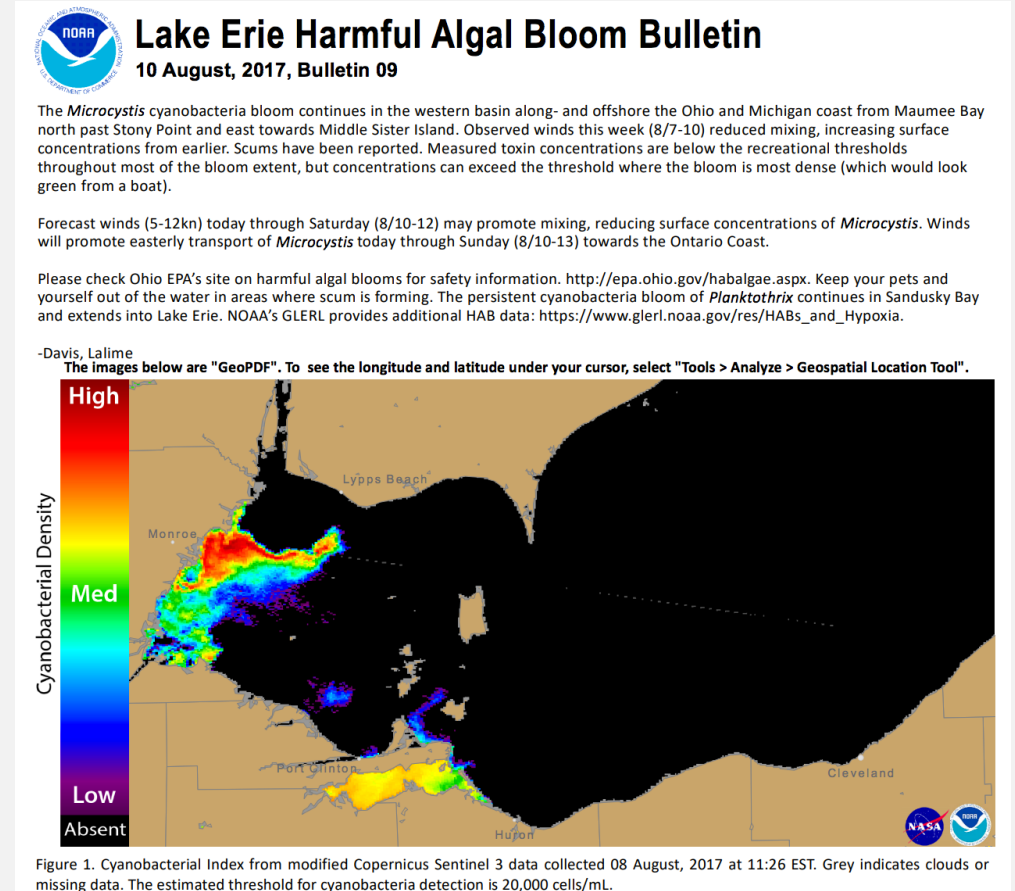
El Pronóstico de la Ubicación de CyanoHABs en el Lago Erie

Sistema de pronósticos “NOAA HAB Operational Forecast System”

- *Microcystis aeruginosa* forma espumas distintivas en la superficie
- El boletín ayuda a pronosticar dónde y cuando las floraciones tocarán tierra
- Para elaborar su pronóstico, este boletín combina:
 - imágenes satelitales
 - observaciones de campo
 - observaciones y modelos de dinámica de fluidos
 - modelos predictivos
 - datos de boyas

<https://tidesandcurrents.noaa.gov/hab/lakeerie.html>

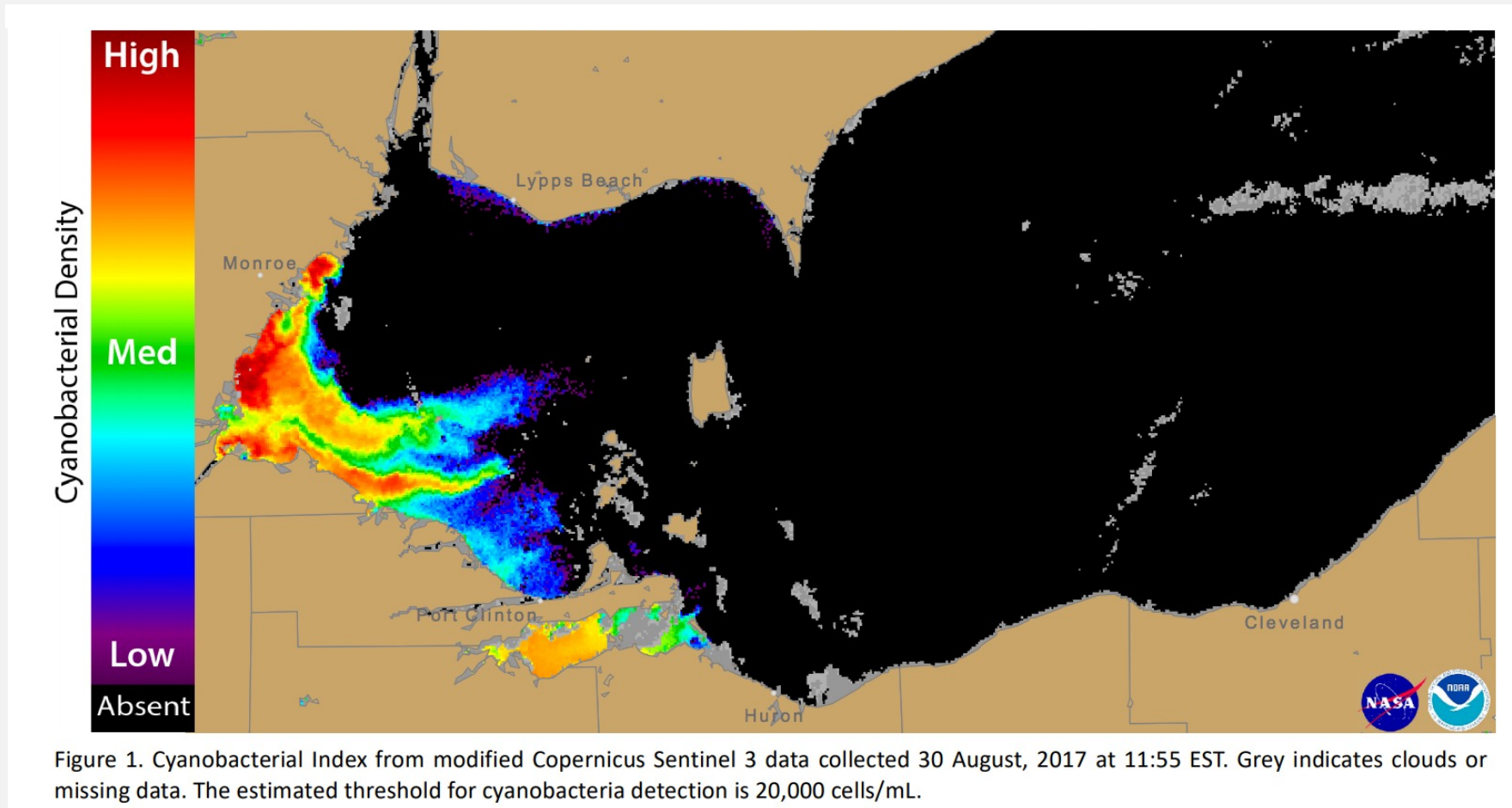
https://tidesandcurrents.noaa.gov/hab/hab_publication/Lake_Erie_HAB_Bulletin_Guide.pdf



Bulletin Credit: https://www.glerl.noaa.gov/res/HABs_and_Hypoxia/bulletin.html

El Pronóstico de la Ubicación de CyanoHABs en el Lago Erie

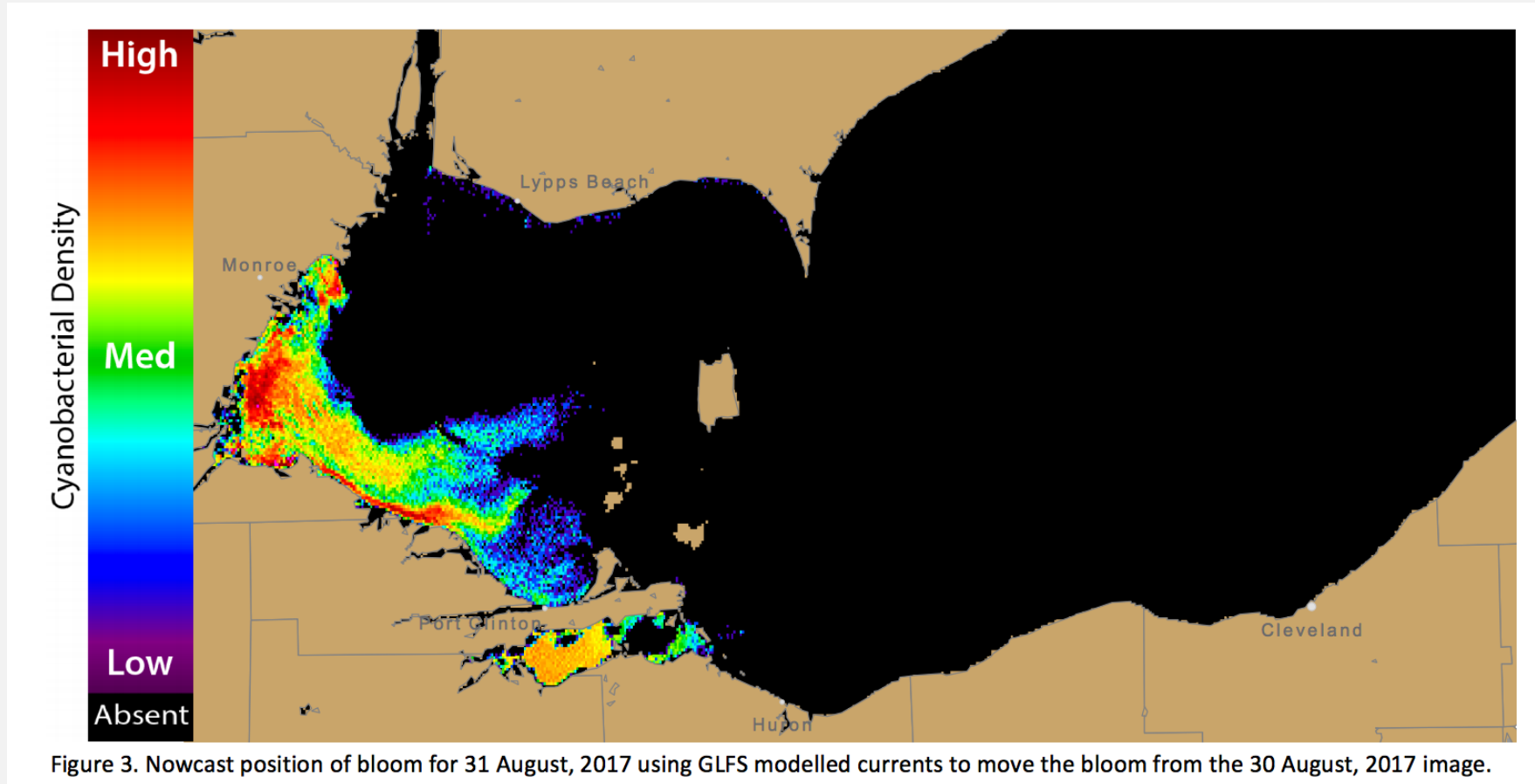
CI de Sentinel-3



<https://tidesandcurrents.noaa.gov/hab/lakeerie.html>

https://tidesandcurrents.noaa.gov/hab/hab_publication/Lake_Erie_HAB_Bulletin_Guide.pdf

El Pronóstico de la Ubicación de CyanoHABs en el Lago Erie 'Actual-nóstico' de una imagen de Sentinel-3

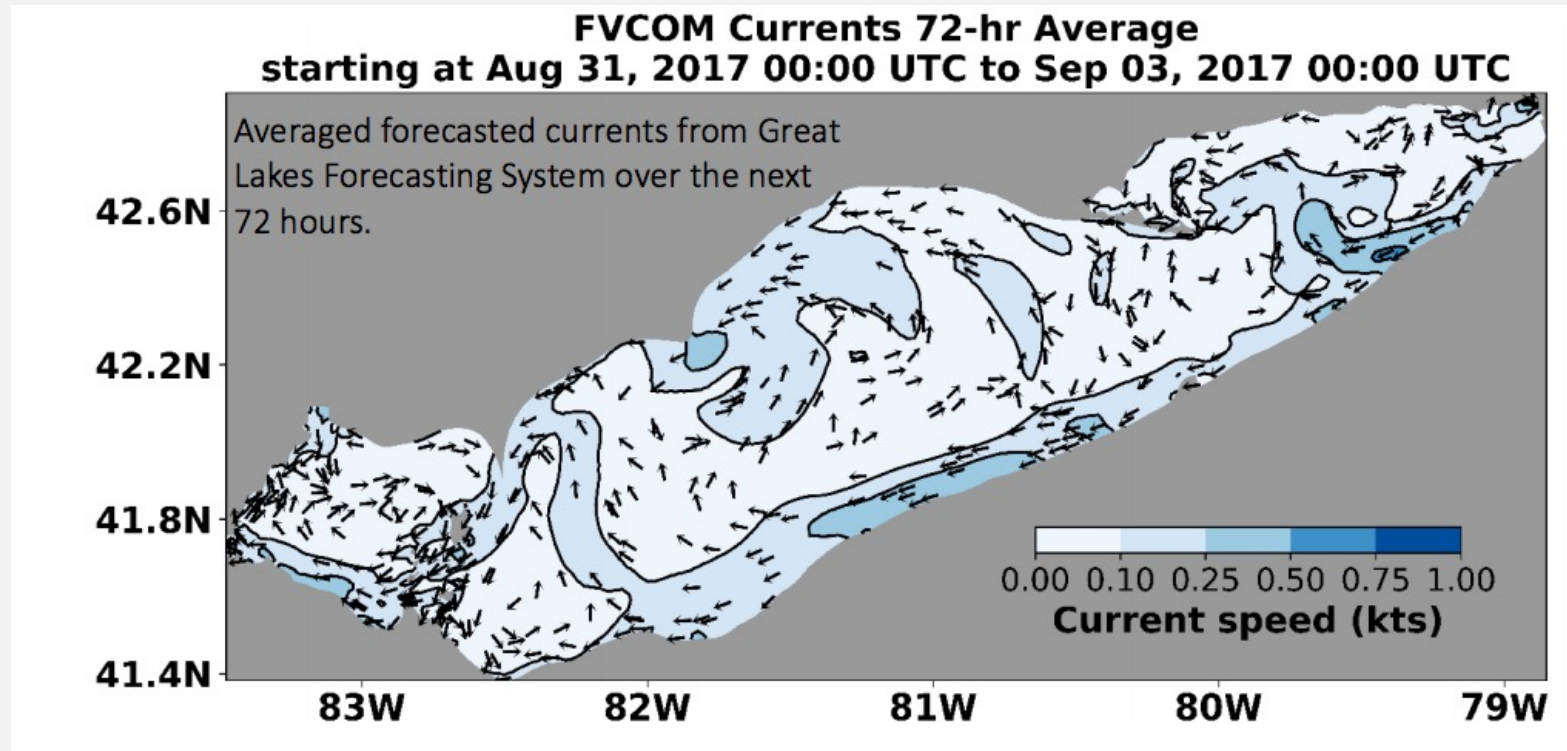


<https://tidesandcurrents.noaa.gov/hab/lakeerie.html>

https://tidesandcurrents.noaa.gov/hab/hab_publication/Lake_Erie_HAB_Bulletin_Guide.pdf

El Pronóstico de la Ubicación de CyanoHABs en el Lago Erie

Pronóstico de Corrientes Superficiaales de 72 Horas

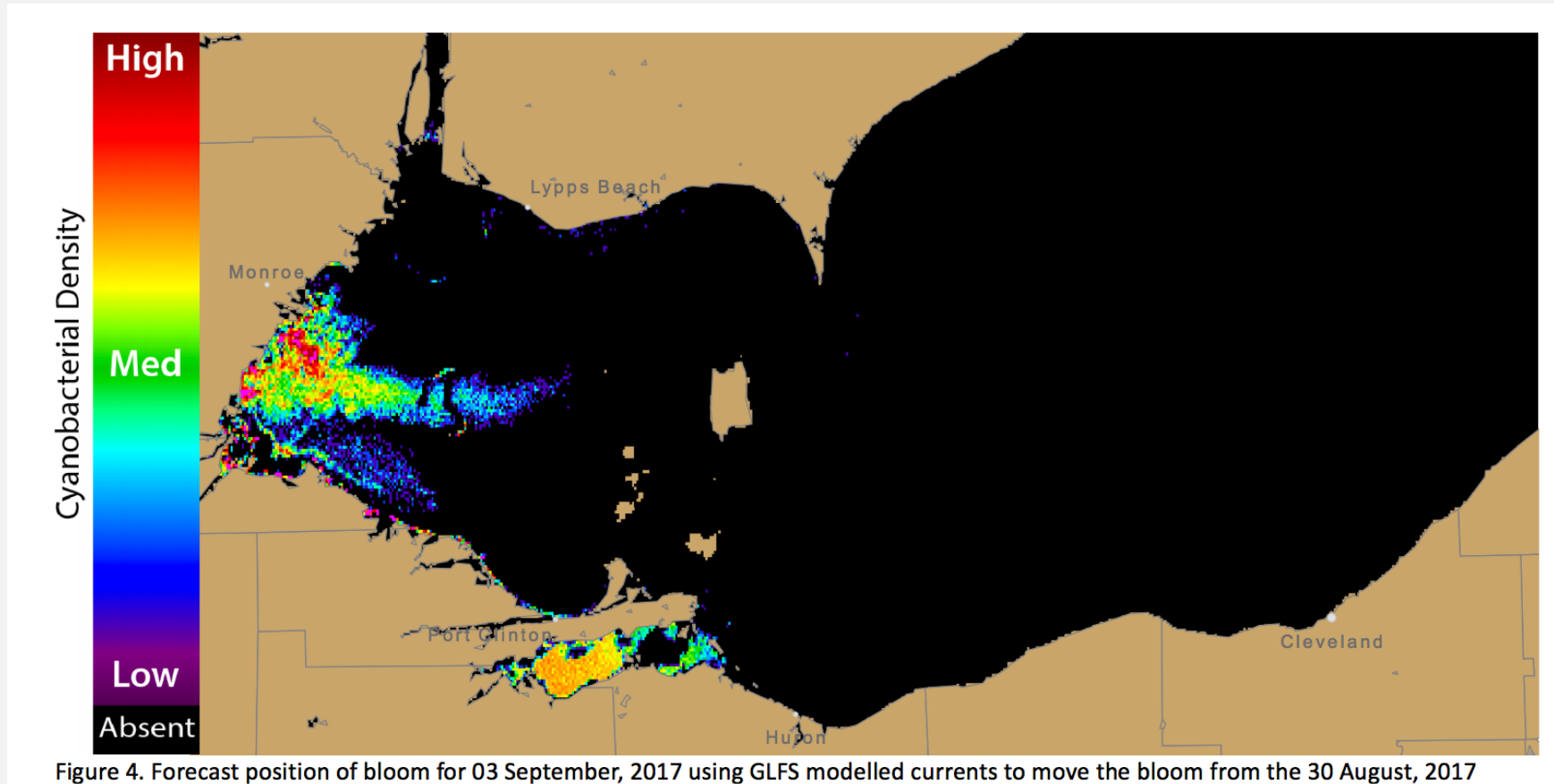


<https://tidesandcurrents.noaa.gov/hab/lakeerie.html>

https://tidesandcurrents.noaa.gov/hab/hab_publication/Lake_Erie_HAB_Bulletin_Guide.pdf

El Pronóstico de la Ubicación de CyanoHABs en el Lago Erie

Pronóstico de CI 72 Horas en el Futuro



<https://tidesandcurrents.noaa.gov/hab/lakeerie.html>

https://tidesandcurrents.noaa.gov/hab/hab_publication/Lake_Erie_HAB_Bulletin_Guide.pdf

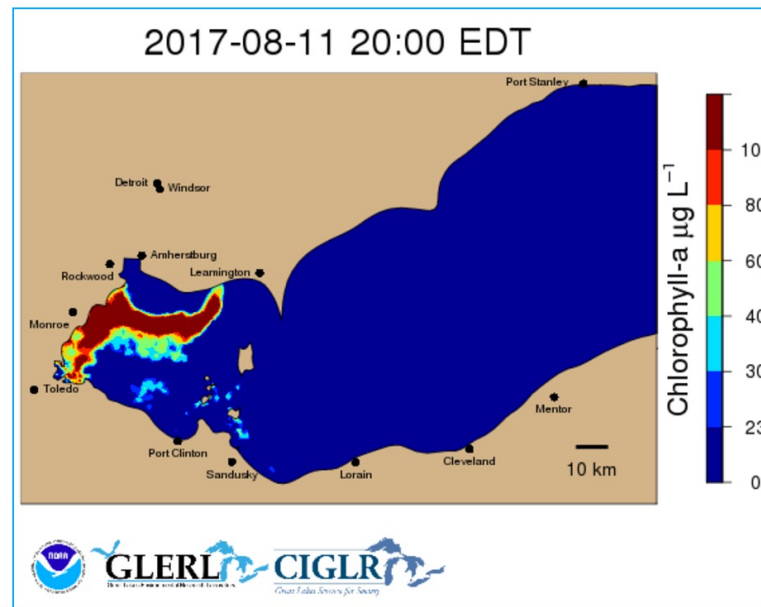
Datos de la Teledetección Acoplados con Modelos Geofísicos Models

Estudio de Caso – HAB Tracker

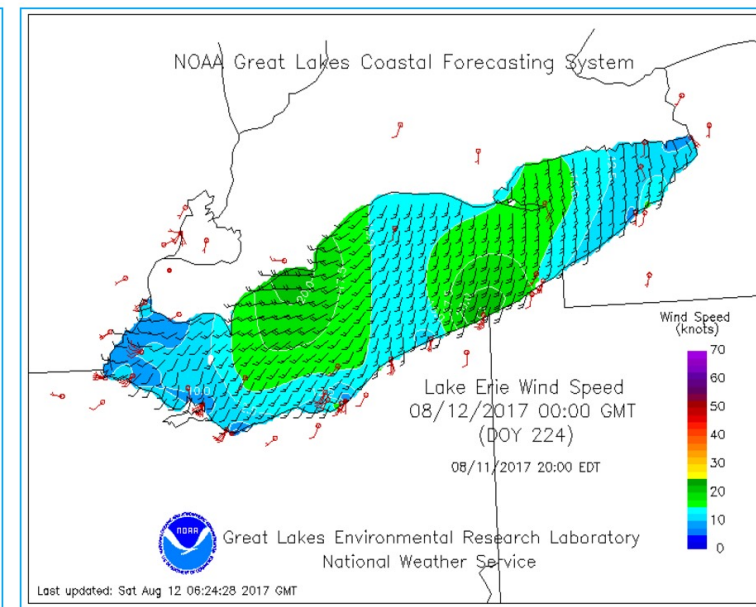
Experimental Lake Erie Harmful Algal Bloom (HAB) Tracker

The upper left panel below shows the HAB Tracker lake surface forecast. The other panels provide additional information on lake conditions. See [panel descriptions](#) below. For more information on the HAB Tracker, visit the [About the Lake Erie HAB Tracker](#) page. For the latest images, refresh your browser and/or clear its cache.

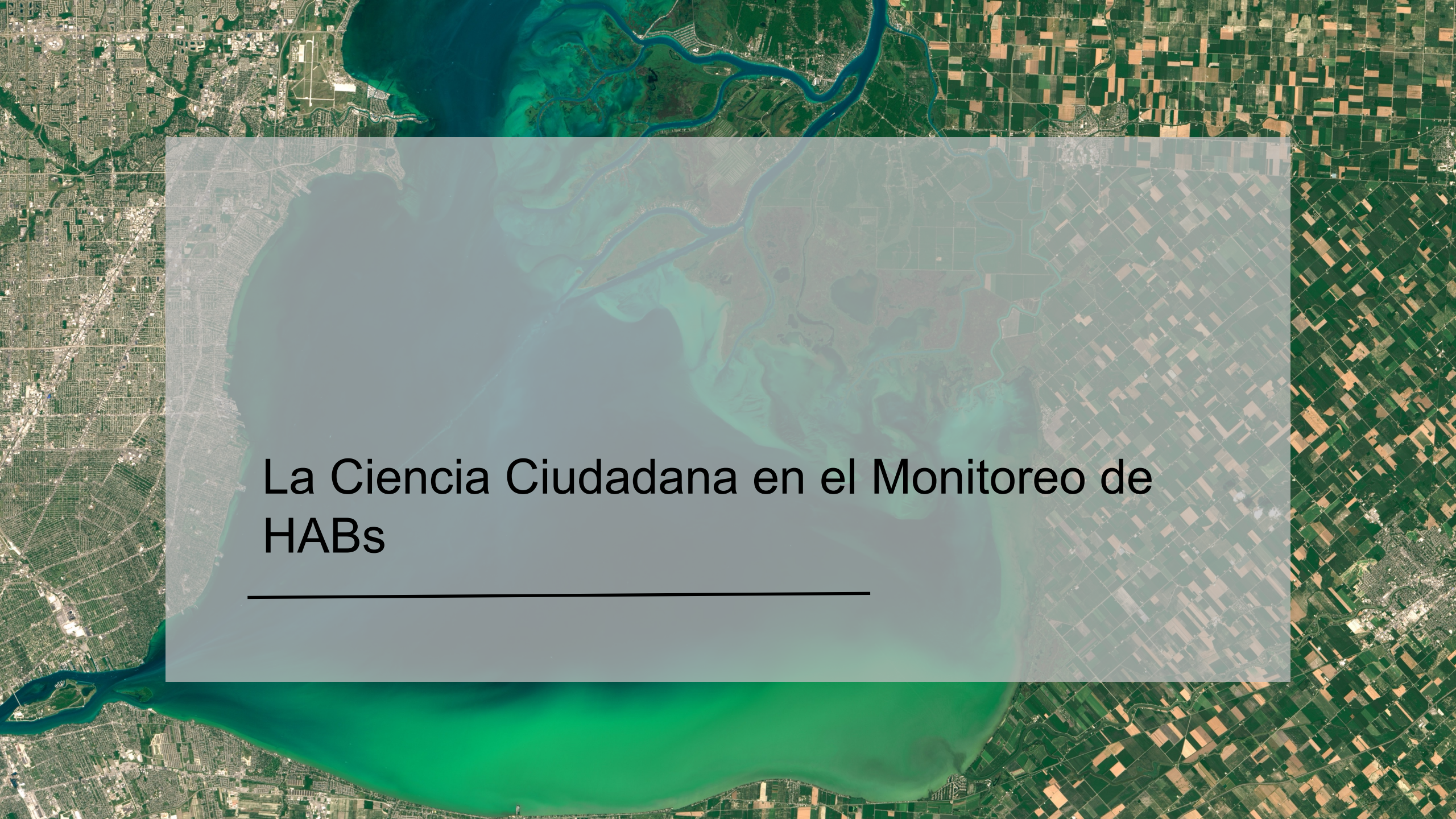
HAB Tracker forecast



GLCFS nowcast & 5-day wind speed forecast



https://www.glerl.noaa.gov/res/HABs_and_Hypoxia/habTracker.html; https://www.glerl.noaa.gov/res/HABs_and_Hypoxia/habTracker_about.html



La Ciencia Ciudadana en el Monitoreo de HABs

Programas de Ciencia Ciudadana

Estudios de Caso

- Phytoplankton Monitoring Network
- Cyanobacteria Monitoring Collaborative
- Pilotos de aviación general recolectando imágenes
- CyAN (Presentador Invitado Wilson Salls)

Phytoplankton Monitoring Network

(Red de monitoreo de fitoplancton)

<https://products.coastalscience.noaa.gov/pmn/>

The National Centers for Coastal Ocean Science is the research office of the NOAA National Ocean Service

NCCOS Phytoplankton Monitoring Network

Home About Us Our Research Projects Publications Products News Where We Work Funding Contact Us

You are here: PMN

Phytoplankton Monitoring Network

Promoting a better understanding of harmful algal blooms by way of volunteer monitoring

[SUBMIT DATA](#) [EXPLORE DATA](#)

Volunteering and Training



Current and Prospective Volunteers: Access everything you need to monitor or to get started monitoring with the PMN. [Schedule a Training Session.](#) [\(more\)](#)

Access Data



Submit current data collections and view historical data. If you have trouble submitting data, please contact [Steve Morton.](#) [\(more\)](#)

Phyto In the News



- [Study Provides Nutrient Reduction Targets to Reach](#)

Mobile Phyto App



Developed by a PMN volunteer, Phyto helps you learn to

INSIDE THIS SITE

- [Overview](#)
- [About the Project](#)
- [In The News](#)
- [Volunteering](#)
- [Image Gallery](#)
- [Data](#)
- [HABs](#)
- [Contact Us](#)

Phytoplankton Monitoring Network


(Red de monitoreo de fitoplancton)

<https://www.ncddc.noaa.gov/website/PMN/viewer.htm>



Cyanobacteria Monitoring Collaborative

<https://cyanos.org/>



The image shows a screenshot of the Cyanobacteria Monitoring Collaborative website. At the top, there is a navigation menu with the following items: OVERVIEW, BLOOMWATCH, CYANOSCOPE, MONITORING, and NEWS. The main content area features a large aerial photograph of a green, textured water body, likely a cyanobacteria bloom. Overlaid on this image is the text "CYANOBACTERIA MONITORING COLLABORATIVE" in large, white, sans-serif capital letters. Below this, in smaller white capital letters, is the text "THREE COORDINATED MONITORING PROJECTS TO LOCATE AND UNDERSTAND HARMFUL CYANOBACTERIA". At the bottom of the main content area, there are three black rectangular buttons with white text: "GET INFORMED", "GET INVOLVED", and "GET IN TOUCH". Below these buttons is a light blue horizontal bar containing the text "We work with citizen scientists, trained water professionals, and the general public to find and study cyanobacteria in waterbodies."

Pilotos de Aviación General como Científicos Ciudadanos

<https://re.grc.nasa.gov/citizen-scientists-track-algal-blooms/>

Citizen Scientists Track Algal Blooms

Harmful algal blooms (HABs) are a global problem.

HABs can pose a serious risk to human health.

Algae are natural components of marine and fresh water flora that perform many roles vital for the health of ecosystems. Cyanobacteria, also known as blue-green algae, are of special concern because of their potential impacts on drinking, fishing, and recreational waters.

General aviation (GA) pilots functioning as citizen scientists can help develop an early warning system to alert communities of ensuing algal bloom along the coastline.

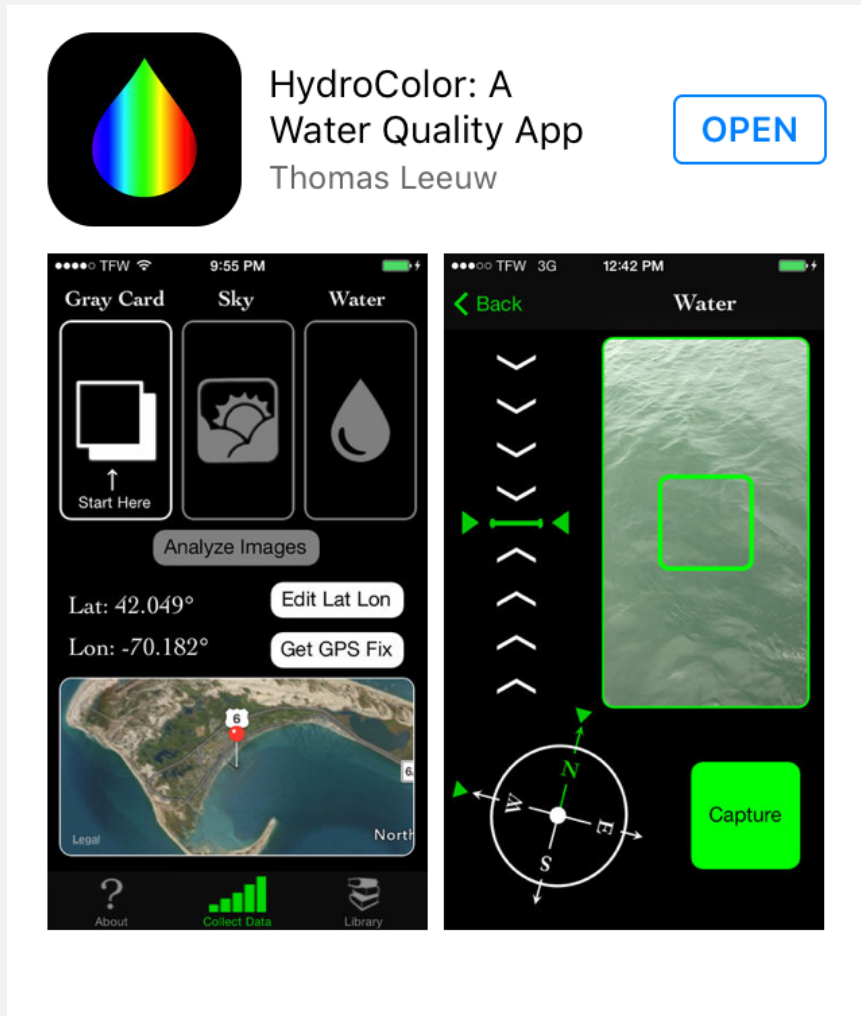
Pilotos de Aviación General como Científicos Ciudadanos

<https://re.grc.nasa.gov/citizen-scientists-track-algal-blooms/>



Herramientas de la Ciencia Ciudadana

Estudios de Caso – Apps!



Midiendo la Reflectancia con un Teléfono Inteligente

HydroColor 

- Estima la reflectancia de teledetección (remote sensing reflectance o R_{rs}) usando las curvas de respuesta espectral del teléfono
- Computa Turbiedad, Materia Particulada Suspendida (Suspended Particulate Matter o SPM) y el coeficiente de retrodispersión a partir de la R_{rs}
- Capacidad “apunte y dispare”
- Disponible para iPhone y iPod Touch

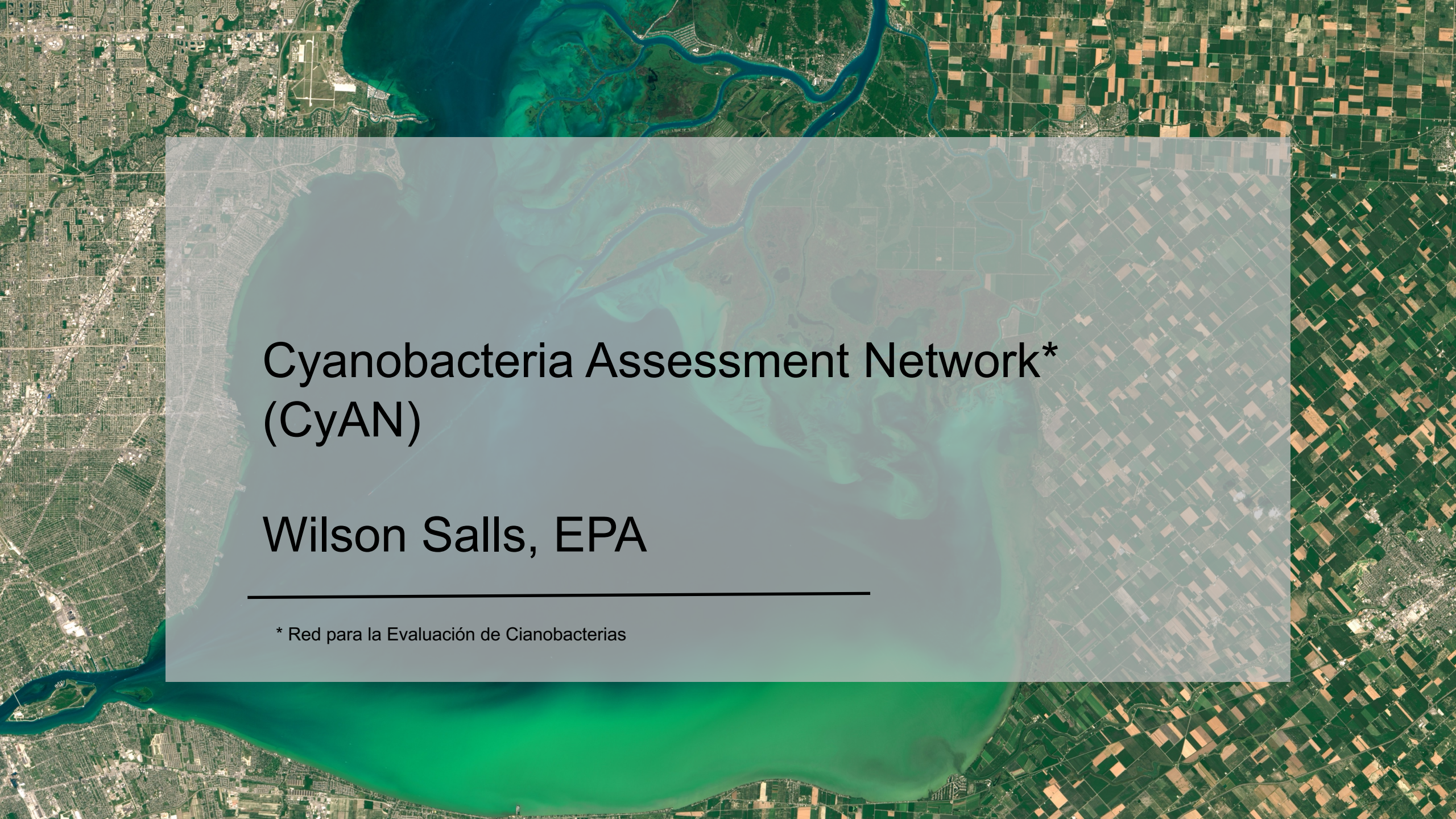
<http://misclab.umeoce.maine.edu/research/HydroColor.php>



Table 1. List of parameters derived by HydroColor along with the estimated uncertainty for each method.

Parameter	Equation	Source	Uncertainty
Remote Sensing Reflectance	$R_{rs} = \frac{L_{water} - 0.028L_{sky}}{\frac{\pi}{0.18}L_{card}}$	Mobley 1999	±15% (mean absolute relative error from figure 4, for all channels)
Turbidity	$Turbidity = \frac{27.7R_{rs}(Red)}{0.05 - R_{rs}(Red)}$	Figure 5	±36% (mean absolute relative error from figure 5)
Suspended Particulate Matter	$\log_{10}(SPM) = 1.02\log_{10}(Turbidity) - 0.04$	Neukermans et al. 2012	±38% (propagation of error in turbidity and the relationship between turbidity and SPM)
Backscatter Coefficient	$r_{rs} = 0.0949\left(\frac{b_b}{b_b + a_p + a_w}\right) + 0.0794\left(\frac{b_b}{b_b + a_p + a_w}\right)^2$ Solved for b_b assuming constant a_p^*	Gordon et al. 1998	±41% (propagation of error in SPM and R_{rs})



An aerial photograph showing a wide river flowing through a landscape of urban areas, green fields, and a large body of water. A semi-transparent grey rectangular box is overlaid on the center of the image, containing text.

Cyanobacteria Assessment Network* (CyAN)

Wilson Salls, EPA

* Red para la Evaluación de Cianobacterias

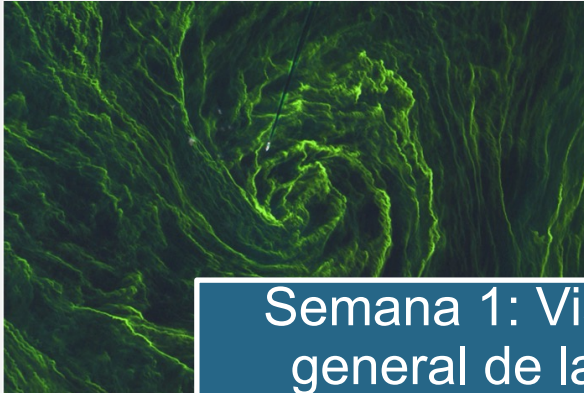
Reseña – Sesión 4

- Resumen general de las HABs cianobacteriales (cyanoHABs)
- Ejemplos de herramientas para el monitoreo de cyanoHABs en el agua dulce
- Ejemplos de cómo la ciencia ciudadana puede utilizarse para monitorear HABs
- Cyanobacteria Assessment Network (CyAN)



Photo Credit: Aerial Associates Photography (<http://skypics.com>)

Resumen del Curso



Semana 1: Vista general de las Floraciones de Algas Nocivas



Semana 2: Plataformas y sensores, acceso a datos y procesamiento de datos



Credit: Paul Hillman/NOAA

Semana 3: Las HABs en el ambiente costero



Semana 4: El monitoreo a gran escala



ARSET

Applied Remote Sensing Training

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

 @NASAARSET

¡Gracias!
