

CyANWeb Website User's Guide

M. Galvin
Ecosystem Process Division
Center for Environmental Measurement & Modeling
Athens, GA 30605



Contents

Introduction	3
Target Audience:	4
Navigating the CyANWeb Interface	5
Log into the web site:	5
Create New User:	6
CyAN - Home screen navigation:	7
Markers:	8
Markers – adding to the basemap dialog details:	9
Markers – adding to the basemap – coordinate entry:	10
Markers – user configuration settings:	12
Markers – selecting existing map pins.	12
My Locations tab:	13
My Locations → Overview tab:	14
My Locations → Imagery tab:	16
My Locations → Chart tab:	17
Compare tab:	18
Compare → Statistics tab:	19
Compare → Blooming Chart tab:	19
Compare → Map tab:	20
Notifications tab:	21
Usage Tips:	22
Usage Tips for Display Issues:	22
Usage Tip for Access Issues:	22
Getting Help:	22
Understanding the Data	23
Temporal Aspects:	23
Spatial Aspects:	23
Opening Screen Message; Data Issues:	24
What could go wrong?	25
FAQ	28
Disclaimer Statement	30
References	30

Introduction

The Cyanobacteria Assessment Network (CyAN) is a multi-agency (NASA, USGS, NOAA, EPA) project and its mission supports the environmental management and public use of US lakes and reservoirs by providing a capability of detecting and quantifying algal blooms using satellite data records and disseminating this information through CyAN, a mobile application developed and hosted by EPA.

The app provides water quality managers and public health officials with a user-friendly tool that reduces the complexities associated with accessing satellite data to allow fast, efficient, initial assessments across lakes and reservoirs. Data from the European Space Agency (ESA) Copernicus Sentinel-3 satellites Ocean and Land Colour Instruments (OLCI) are used in near real-time to make initial water quality assessments and quickly alert managers to potential problems and emerging threats related to cyanobacteria.

The CyAN mobile app ([Schaeffer et al, 2018](#)) was publicly released in July 2019 and, to-date, is well received by users, gaining a 4.1/5 star rating on [Google Play](#) with 1000+ installs; but CyAN is an app that runs only on Android devices. Android-only is a common complaint. People wanted to run CyAN on their iPhones in the field and on desktops/laptops/tablets in their offices. This project is an effort to reach a much wider user community of a valuable Harmful Algal Bloom (HAB) monitoring tool in waterbodies across the continental U.S.

The initial goal of this project is to replicate, with minimal enhancement, the functional capabilities of the CyAN Android app in a browser-based application. Further, by using modern software technology and tools, design the web interface to be responsive - meaning that it's designed to operate in most web browsers, on most operating systems, and on most devices (desktop, laptop, tablet, phone). A successful implementation of CyANWeb would eventually obviate the requirement of maintaining a separate Android application and supporting infrastructure and provide a clearer, simpler path to maintenance and enhancement of its functionality.

Target Audience:

CyAN app users looking for a desktop alternative to the Android app. CyANWeb is a different interface to the same HAB data provided to the Android app. Minimal enhancements have been implemented to CyANWeb and it is meant to provide the same functionality as the Android app. It is a browser-based interface that has been tested and targeted for desktop browsers. It is certainly possible to use smaller devices to access the web interface (e.g., smart phones and tablets). This document's screenshot images show how the CyANWeb interface looks on desktop browsers. Screenshots will appear differently on smaller device browsers but have the same functionality. Supported browsers include Chrome, Firefox, Opera and Safari. Issues have been identified with Edge (some versions may work, others not) and there is no intent to supporting Internet Explorer. If needed, refer to the EPA CyAN web page and its linked content for further information about the CyAN project:

<https://www.epa.gov/water-research/cyanobacteria-assessment-network-mobile-application-cyan-app>

Navigating the CyANWeb Interface

Conceptually, the web interface is simple to use. Using the basemap, zoom to a freshwater waterbody within the Conterminous United States (CONUS) that you have an interest in and tap or mouse-click the location to create a pin marker. If the marker location has any history of cyanobacteria detected by the OLCI sensors on the Sentinel satellites, the marker color will reflect the most recent cyanobacteria category status. Further capabilities of the web interface will provide access to plots and charts of the location's cyanobacteria history and the satellite data maps (imagery) of the location.

Log into the web site:

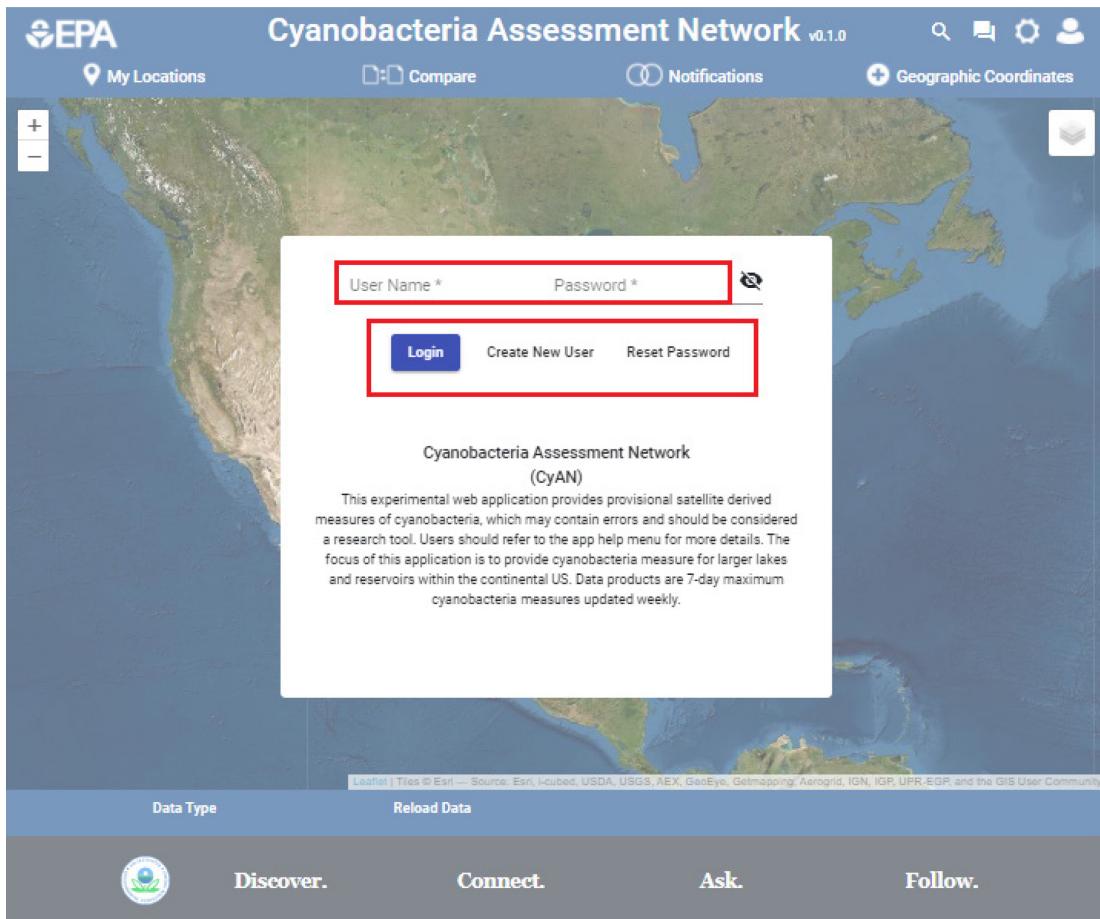


Figure 1 - CyANWeb interface, login.

If you've already registered as a user, simply enter your account name and password to proceed and gain access to the web interface via the *Login* button. Otherwise, select *Create New User*.

If you've forgotten your account password, select *Reset Password* and follow the instruction in the email you'll receive. The email will be sent to the email account you used to register your CyANWeb user account.

Create New User:

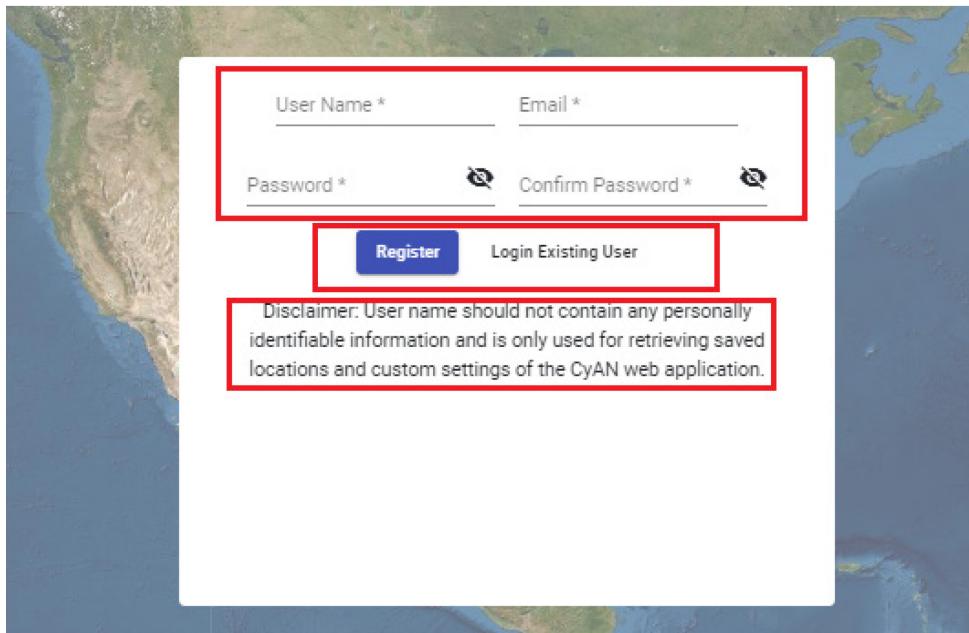


Figure 2 - CyANWeb, create user account

To register a new user account, enter a *User Name*, an *Email* account you want to use, a *Password* and password confirmation. Then select *Register*. You will then be able to login to the web interface with information you provided. Note the caution about using personally identifiable information for your account. CyANWeb accounts are used only for storing your marker locations and user-configurable settings of the interface.

CyAN - Home screen navigation:

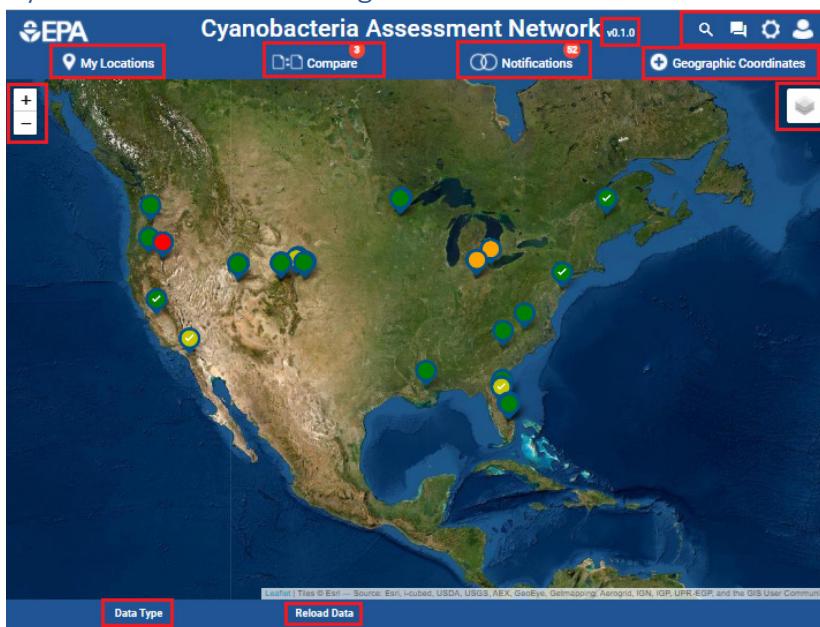


Figure 3 - CyANWeb home screen interface, user controls and information

Controls and their function – along the top of the screen:

- v0.1.0 Informational – tells the user the version number of the web interface. Please report the version should you seek assistance or report issues.
- From left to right, these icons represent location search function, online help to access document, the user settings configuration dialog and user account control.

Controls and their function – second line along top of the screen:

- My Locations Provides access to the list of your marked locations. Selection of a location from the list provides access to detailed history of cyanobacteria for the location, downloadable images, and plots.
- Compare Provides access to the website's compare locations data features. Compare provides access to features to assess differences between locations you've selected.
- Notifications User can view informative messages about new data availability and upcoming system maintenance/security issues that may impact data services.
- Geographic Coordinates A control that provides access to the ability to place map markers through geographic coordinate input.

Controls and their function – within the map area of the screen:

-  A map zoom control allowing users to view locations and data. The zoom function can also be controlled by mouse-wheel adjustment or screen double-tap and/or finger-pinch on haptic devices.
-  Users can choose the basemap to display via this control (Imagery, Street, or Topographic).

Controls and their function – along the bottom of the screen:

-  Users can select this control to view markers and data for either daily or weekly cyanobacteria data.
-  This control is used to refresh the data and imagery for your markers. For the web interface, this is only necessary if new data is loaded to our system while the interface is in-use. Otherwise, data/imagery is updated every time a user logs into the system.

Markers:

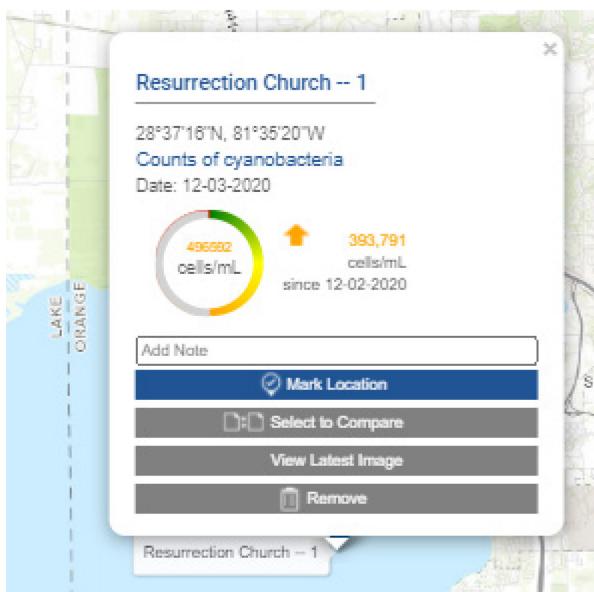


Figure 4- Marker pin dialog, detail

- Adding a marker to a discernable waterbody on the map, either by mouse-click or tapping (haptic devices), gives you a dialog:

- The location's Google Map name (editable). If you want to name the location differently, select the Google Map name and type in your choice. If no cyanobacteria response has been detected, the dialog reports "Unknown Location, Counts of cyanobacteria=0".
- Shows the coordinates of the location.
- Shows the latest cyanobacteria concentration at the location (value inside circle symbol), only if the location has a history of cyanobacteria response. The value displayed may be from the most current data or it may be from a previous date.
- Shows an up/down arrow, value and date indicating a change in concentration.
- A type-in textbox for any notes for the location.
- And options to *Mark Location*, *Select to Compare*, *View Latest Image* or *Remove*.

Markers – adding to the basemap dialog details:

- *Mark Location* adds a pin marker to the basemap. Selecting this results in closure of the dialog and a pin marker with a check symbol being added. The dialog may also be dismissed by selecting the x symbol in the top-right corner of the dialog, or by clicking elsewhere on the basemap. Dismissal of the dialog in these instances result in a pin marker added to the basemap without a checkmark symbol. Checked pin markers may be listed separately in the *My Locations* list; otherwise there is no functional difference between checked and unchecked pin markers.
- *Select to Compare* adds the location to the list of locations you want to view side-by-side. Select two or more locations to use this aspect of the app.
- *View Latest Image* provides a mechanism to view the location's latest tile imagery regardless of detectable cyanobacteria levels at the location.
- *Remove* deletes the pin marker from the basemap.

Markers – adding to the basemap – coordinate entry:

The screenshot shows the Cyanobacteria Assessment Network (CAN) interface. At the top, there is a navigation bar with the EPA logo, 'My Locations', 'Compare' (with a red notification badge), 'Notifications', and 'Geographic Coordinates' (which is highlighted with a red box). Below the navigation bar, there is a search bar with the placeholder 'Enter the latitude and longitude below to find a new location'. To the right of the search bar is a clear button ('x').

On the left side of the main area, there are input fields for 'Latitude' (28, 38, 18 N) and 'Longitude' (81, 37, 28 W). Below these inputs is a dropdown menu labeled 'Units' set to 'Degree-Minute-Seconds' (also highlighted with a red box). Further down are two buttons: 'Select to Compare' (gray background) and 'Mark Location' (blue background).

The main area features a map of Lake Apopka, which is partially blue and partially green. Several orange location markers are placed on the lake, with one specific marker highlighted by a yellow circle and a checkmark. A callout box for this marker contains the text 'Devils Elbow Post Light -- 1' and the date '02-27-2021'. The map also shows surrounding areas including Montverde, Bella Collina Golf Club, and Winter Garden. A legend at the top right indicates a 'Restoration Area'.

Figure 5 - Geographic coordinate entry, resulting dialog on the left.

The screenshot shows the Cyanobacteria Assessment tool interface. At the top, there is a header with the EPA logo, a 'My Locations' button, and a 'Compare' button with a red notification badge showing '3'. Below the header, a text input field prompts the user to 'Enter the latitude and longitude below to find a new location' with a close 'x' button. The main area contains two sets of coordinate input fields. The first set for 'Latitude' has three input boxes containing '28', '38', and '18' followed by a 'N' indicator. The second set for 'Longitude' has three input boxes containing '81', '37', and '28' followed by a 'W' indicator. Below these inputs is a dropdown menu labeled 'Units' with 'Degree-Minute-Seconds' selected. At the bottom of the dialog are two buttons: 'Select to Compare' (gray background) and 'Mark Location' (blue background). The entire coordinate entry dialog is highlighted with a red rectangular border.

Figure 6 - Coordinate entry dialog, detail

Precise pin marker locations may be added to the basemap with coordinate entry. Degree-Minute-Second latitude and longitude values can be used. Select *Units* → *Decimal Degrees* if preferred. After numerical coordinate entry select the *Mark Location* button to add the pin marker to the basemap. Use the *Select to Compare* button to add the pin marker to the basemap and also add the location to the *Compare* list of markers. The coordinate entry dialog can be dismissed using the x symbol in the upper-right corner.

Markers – user configuration settings:

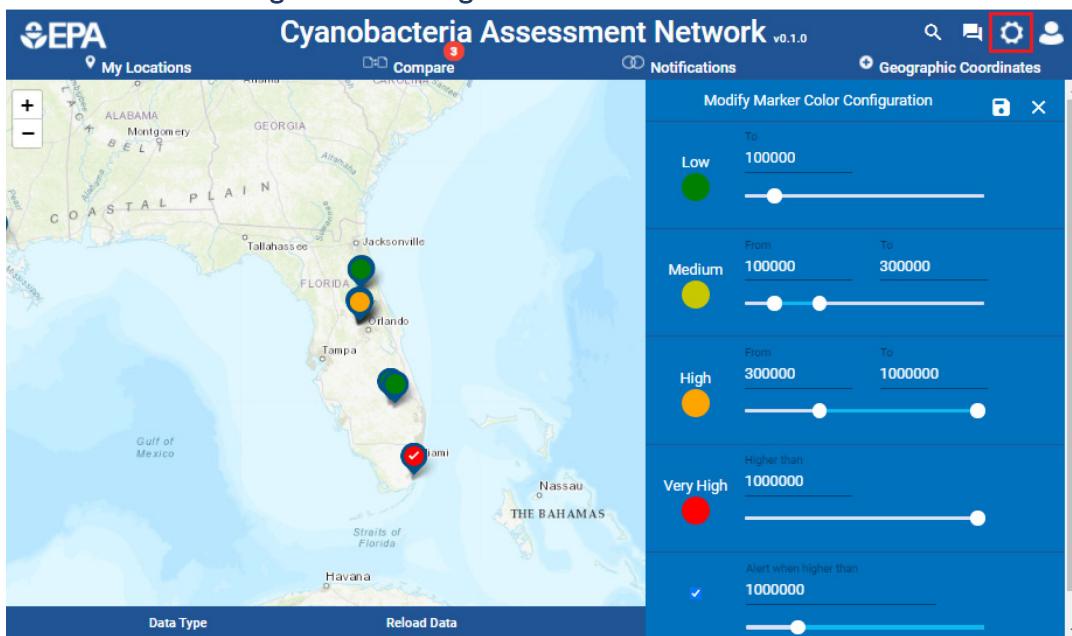


Figure 7 - User configuration controls dialog accessible from the main page gear icon.

- Select the gear icon to access the marker color dialog. The colors used by pin marker symbology and text are binned into four categories of cyanobacteria concentration: low, medium, high, and very high. The default values for these categories are set to World Health Organization limits.
- If you or your organization use different values, you can select the color categories by adjusting the sliders to your preferred values. When the slider does not have the sensitivity required for an exact number, hold the cursor over the number and use the up-down arrows for fine adjustment, or select the numerical value and type in your preferred setting.
- You can also set an *Alert* value that puts a symbol next to markers (within the *My Locations* list of pin markers) that have a current cyanobacteria concentration exceeding the value you set. Select the checkbox and adjust the slider to use this feature.
- Save any adjustments you make to your login account by selecting the diskette symbol at the top of the dialog. Failure to save preferred settings result in reversion to default values the next time you log in to the interface. The dialog can be dismissed by selecting the x symbol in the upper-right corner of the dialog.

Markers – selecting existing map pins

Mouse hover over a marker already placed on the map displays the location name and the date of the most recent cyanobacteria detection. Selecting the existing marker opens the pin marker dialog and allows you to select the *View Latest Image* button to view the latest tile image for the location regardless of the location's current cyanobacteria status. This is a useful method to check the area around the marker for cyanobacteria detections that may not be evident at the marker pin itself.

You can also perform any actions the marker dialog allows; rename the location, add notes, select the location for comparison, remove the marker, and depending on marker check/uncheck status, to either mark or unmark the location. Note that *Unmark Location* and *Mark Location* only changes the check/uncheck location status; it does not remove the marker from the map. As stated before, checked pin markers may be listed separately in the *My Locations* list; otherwise there is no functional difference between checked and unchecked pin markers.

My Locations tab:

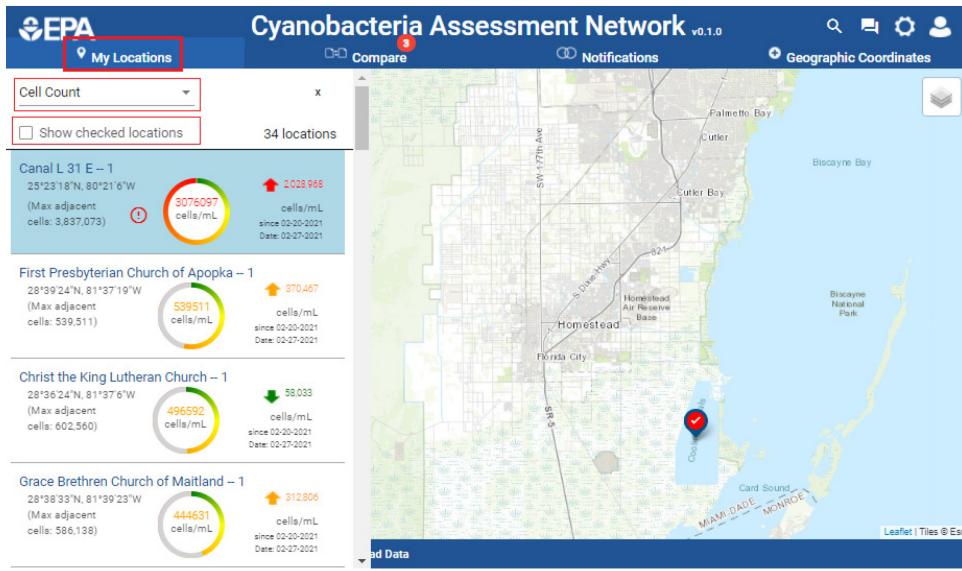


Figure 8 - My Locations tab, list of marked locations

Select the *My Locations* tab to view a list of pin markers you've added to the basemap. The list is sortable by location name or cyanobacteria cell count. You can also exclude locations that are not marked (no checkmark in the pin marker symbol). The list shows:

- Location name, location latitude/longitude, max areal cyanobacteria cell count value about the location (*Max adjacent cells*), color coded symbol and cyanobacteria value (circle symbol with numerical value centered), and a color-coded directional symbol and value representing the change in cyanobacteria concentration since last reading (note the dates provided). Also, note that the basemap shown to the right of the list is interactive; pin markers can be added/removed using the map in this view and zoom/pan is enabled.
- Locations with high cyanobacteria values designated (use the Gear Icon menu slider *Alert when higher than* control). The alert symbol is a red circle with centered ! (exclamation point).
- Select a location list entry to access the location's related imagery and plotted data. The location's *Overview* screen is then displayed.
- Dismiss the location list by selecting the x in the top-right corner of the dialog to return to the full basemap home screen.

My Locations → Overview tab:

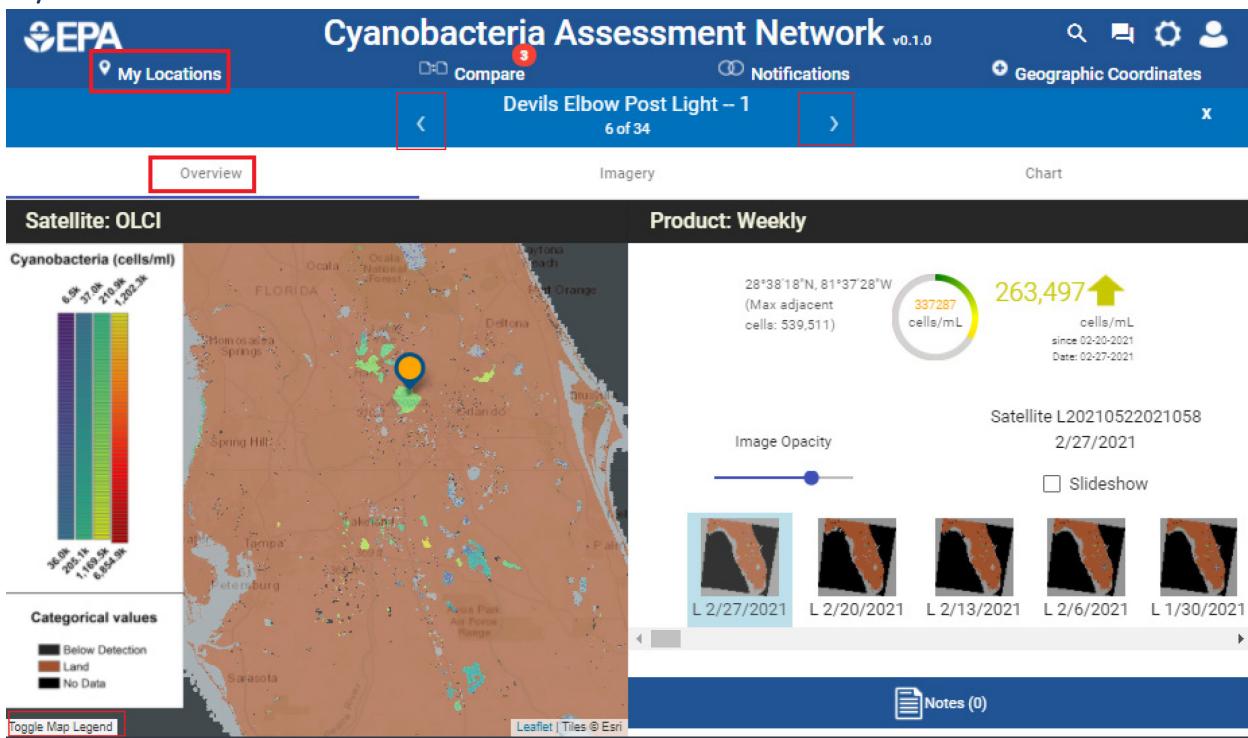


Figure 9 - Location list Overview screen

The Overview screen is composed of five major sections:

- The light blue bar across the top specifying the location name and x tab dismissal button. The location name sits between two controls, < and >, that allow cycling through all the locations you have marked without having to return to the location list. Note that the map and control sections (described below) are synched with the location you switch to.
- A white bar with selectable tabs (*Overview*, *Imagery*, *Chart*).
- A black bar specifying the data source satellite platform (*OLCI*) and the data product being shown (*Daily* or *Weekly*).
- A map section at lower-left showing latest cyanobacteria tile image for the location and location pin marker. The map is pan/zoom enabled but pin markers cannot be manipulated here. To view an image legend, select the *Toggle Map Legend* button in the lower-left of the map area.
- A control section to the right of the map. This section contains:
 - Information and symbology for the location (latitude, longitude, max adjacent cells, change in concentration between cyanobacteria detection dates).
 - An opacity slider that adjusts the visibility of the cyanobacteria data layer overlaying the map.

- The cyanobacteria data layer name and date.
- A *Slideshow* checkbox that when selected sequentially overlays all the available cyanobacteria data layer images for the location on the map. Uncheck the checkbox to pause between images. Or select a thumbnail image to view the data for that associated date.
- A scrollable list of thumbnail cyanobacteria data layer images available for the location; this is a date-oriented list of images that have a cyanobacteria response at the location. Select a thumbnail to overlay that image on the map and show cyanobacteria information for the date the image represents.
- A blue colored *Notes* button that allows adding or editing any user supplied notes for the location.



Figure 10 - User control section of Overview pane, detail

My Locations → Imagery tab:

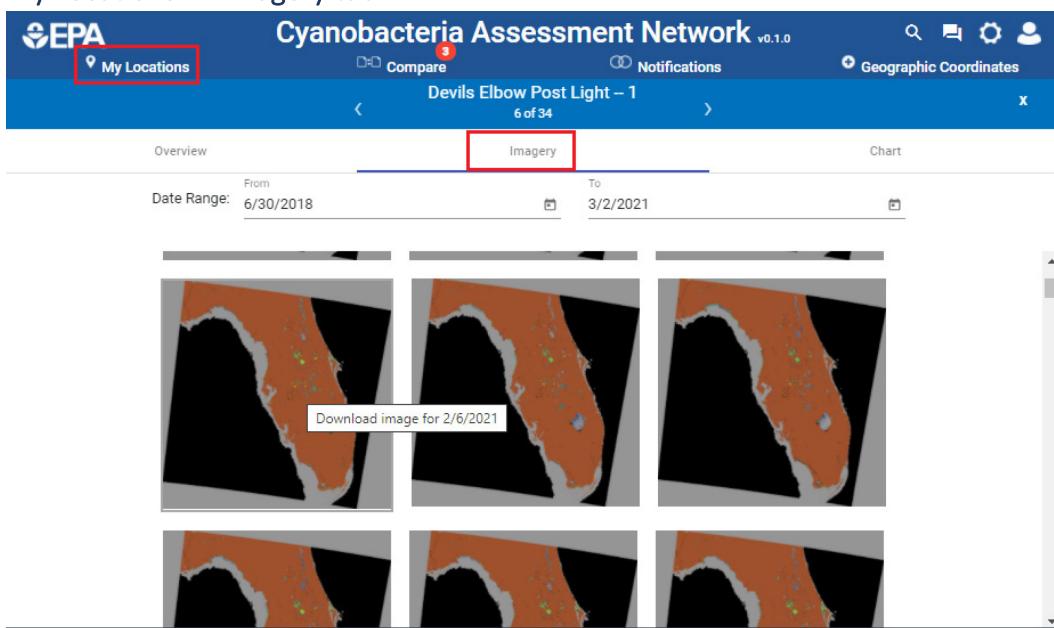
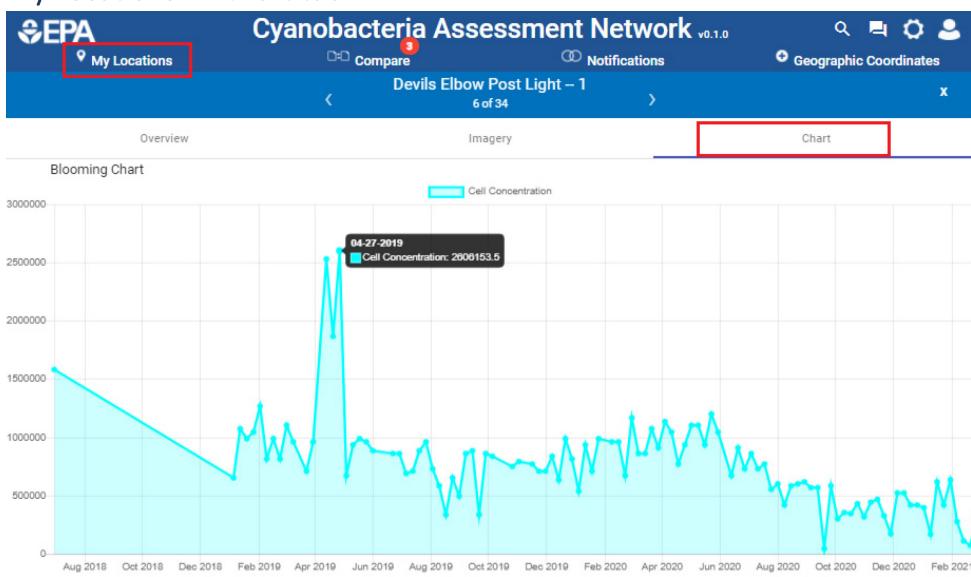


Figure 11 - Location list Imagery screen

- Shows a thumbnail list of data images for the location; the most recent image is at the top-left, earliest at the bottom-right.
- Select a date range to winnow or expand the list of viewable images.
- Use the location control (< and >) to scroll through your list of locations and to access their imagery.
- Select the desired image to download and save to your device. Note that images are geo-referenced TIFF-formatted raster images in Web Mercator projection.

My Locations → Chart tab:



- The chart shows a time-series plot of cyanobacteria levels. The entire stored online record of cyanobacteria level at the location is shown.
- Note: the plot appears continuous through time but it likely is not; non-detects (i.e., below detection level) and missing detects (e.g., clouds) are not stored or shown. Selection of data points within the plot will show a date and cyanobacteria value the data point represents.
- Use the location control (< and >) to scroll through your list of locations.
- Dismiss the location details screens (*Overview*, *Imagery*, and *Chart*) by selecting the x in the top-right corner to return to the full basemap home screen.

Compare tab:

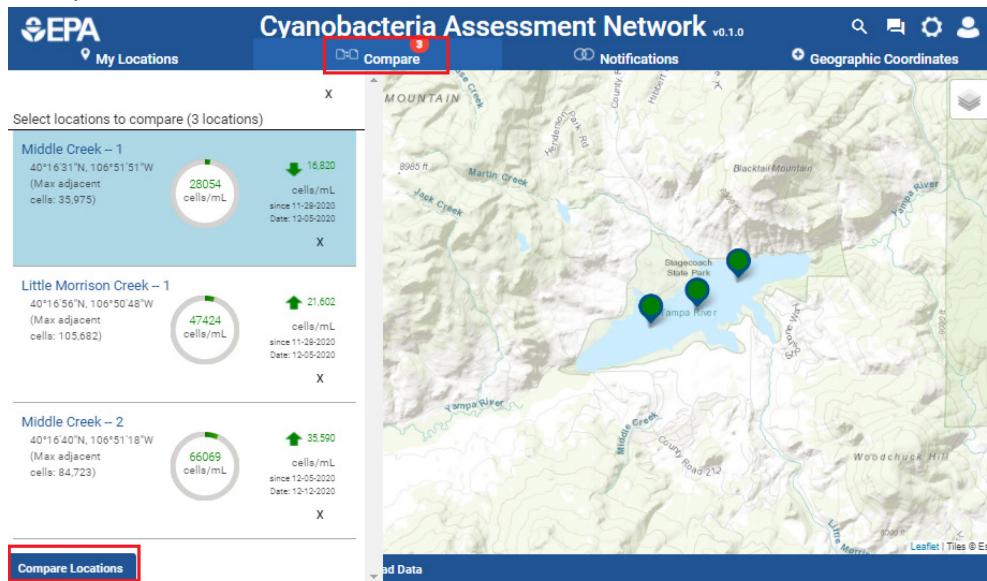


Figure 12 - Compare locations, list of selected locations. Add locations to the list by selecting the marker locations within the map and clicking "Select to Compare".

- Much like the *My Location* tab, the *Compare* tab shows a list of locations. These locations have been user-selected from the Home screen marker location dialog via *Select to Compare*. The location data shown (location name, coordinates, max adjacent, cyanobacteria value, and change in cyanobacteria value/date) are for the most recent data dates available.
- Tap **x** next to a location to remove a location from the compare list.
- Use the lower-left *Compare Locations* button to proceed or **x** in the upper-right of the list to dismiss.

Compare → Statistics tab:

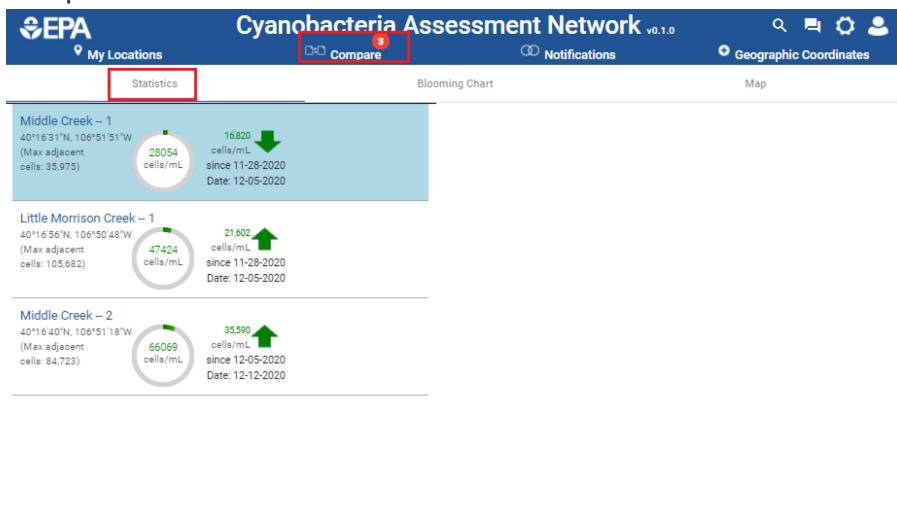


Figure 13 Compare locations, statistics

- The *Statistics* tab repeats the information shown in the *Compare Locations* tab. If necessary, use the scroll bar to view the entire list of information about all locations selected.

Compare → Blooming Chart tab:

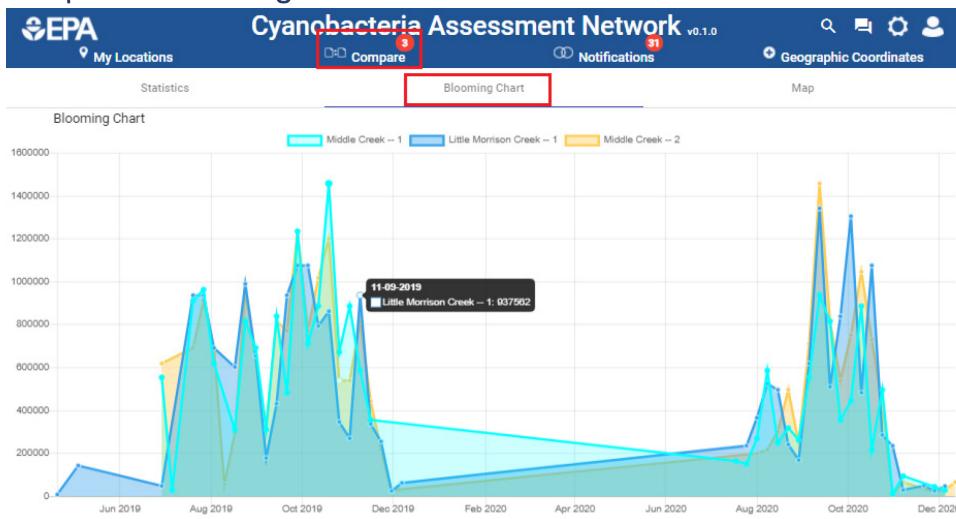


Figure 14 -- Compare locations, blooming chart

Select the *Blooming Chart* tab to see the plot of the cyanobacteria response for all the locations.

- The chart shows the individual location's cyanobacteria response through time. Missing and below detection responses for the locations are not shown.
- Individual location cyanobacteria level traces may be toggled off/on by selecting the location names in the plot title. The plot will adjust to selected locations.
- Mouse hover over data points in the plot to show cyanobacteria level values and date of detection.

Compare → Map tab:

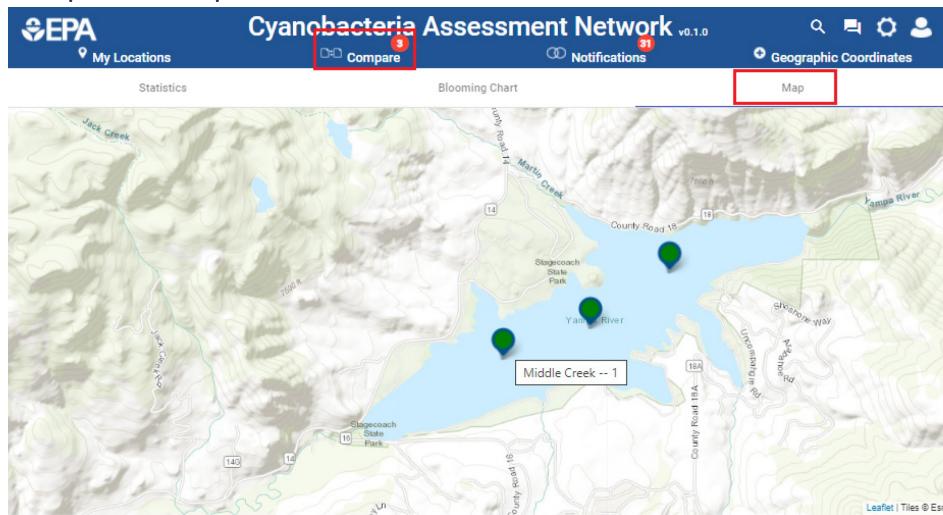


Figure 15 Compare locations, map tab.

The map shows the geographic locations you've chosen to compare. You cannot add/remove markers from the map or access location imagery from here. You can still pan/zoom and change the base map.

Notifications tab:

The screenshot shows the Cyanobacteria Assessment Network (CAN) interface. At the top, there is a navigation bar with the EPA logo, 'My Locations' (with a red notification badge '3'), 'Compare' (with a red notification badge '3'), 'Notifications' (with a red notification badge '31'), and 'Geographic Coordinates'. Below the navigation bar is a map of Lake Apopka and surrounding areas, including Minneola, Montverde, and Winter Garden. Four orange location markers are placed on the lake. To the left of the map is a sidebar titled 'Notifications' which lists several messages:

- New Location Data Available
2021-02-24 17:03:32 (UTC)
New data available for 02-24-2021 12:03 PM EST.
- New Location Data Available
2021-02-25 16:59:05 (UTC)
New data available for 02-25-2021 11:59 AM EST.
- New Location Data Available
2021-02-26 16:05:32 (UTC)
New data available for 02-26-2021 11:05 AM EST.
- New Location Data Available
2021-02-27 16:08:36 (UTC)
New data available for 02-27-2021 11:08 AM EST.
- New Location Data Available
2021-02-28 19:13:00 (UTC)
New data available for 02-28-2021 02:13 PM EST.
- New Location Data Available
2021-03-01 18:03:28 (UTC)
New data available for 03-01-2021 01:03 PM EST.

At the bottom of the sidebar, there is a 'Load Data' button.

Figure 16 - Notifications tab.

Notifications shows a list of messages sent to the community alert users of new data availability, system outages, app version upgrades, issues with data access or other topics of interest that impact the viability of the system.

Usage Tips:

Any location markers you place are automatically saved to your user account. Marker color configurations and location alert level settings, you choose must be saved if they are to be preserved for the next time you access your account. To save, select the diskette symbol at the top of the user configuration dialog.

Data latency may be significant if you've placed a lot of markers (~60), or if your locations have a significantly long history of cyanobacteria response. We now host more than 2 years of weekly data online (Jan 2019 – Feb 2021). Some US waterbodies (e.g., Apopka in FL, Grand in OH) seem perpetually polluted with HABs and it takes some time to retrieve 100+ data records for these types of locations. Please try to be patient with the interface.

Usage Tips for Display Issues:

There are a myriad of screen resolutions and aspect ratios utilized on desktop/laptop systems. We cannot custom code for all possibilities. The best user experience for desktop-based browsers is to maximize the browser window; even then you may encounter styling issues with overlapping visual components that make it difficult to access the individual controls. Try adjusting the zoom level in the browser to minimize overlap but still maintain the ability to easily read the displayed information. Your browser control/configuration menu (browser Settings) will provide access to zoom levels; in Firefox and Chrome shortcut keys for zoom-out and zoom-in are, respectively, "Ctrl–", and "Ctrl+".

Usage Tip for Access Issues:

If you get logged off for usage timeout, log back in. You should not have to revisit the password page to access CyANWeb again if the browser session you are using is still active. If you open a new browser session after you've been timed-out (or logged out), the password page will need to be revisited. If you cannot get past the password page having done so previously, retry after clearing your browser cache. Until such time that EPA approval for public release is achieved, use of the password page is necessary for CyANWeb usage.

Getting Help:

For assistance in using the application, report issues or leave comments, email CyAN@epa.gov

Understanding the Data

The data the Cyan system reports are cyanobacteria concentrations. The data products as delivered by USGS/NASA are Cl_cyano and include chlorophyll-a and phycocyanin in the response of the OLCI satellite sensors ([Coffer et al, 2020](#), [Mishra et al, 2019](#), [Lunetta et al, 2015](#)). Refer to the references for algorithm used for detection cyanobacteria.

Be aware that OLCI weekly/daily data are separate data products the CyAN app/website is capable of handling. The two categories of data are handled separately. Your markers for *Weekly* data do not show if you've selected *Daily*; and vice-versa. Daily data are a snapshot of cyanobacteria at the time of detection, weekly data is a composite of daily maximums collected over a 7-day period.

- The weekly data represents waterbody composite maximum cyanobacteria concentrations derived from 2-3 satellite overpasses per week (Sundays through Saturdays) at each detectable waterbody.
- Weekly data are served by default. Daily data can be selected and viewed. Weekly data are typically available for the previous week by the following Monday. Daily data are uploaded daily; meaning yesterday's data are available today.
- What is a "discernable" waterbody? What is the minimum sized lake? The OLCI data resolution is 300 meters. Is that resolvable? Yes, but a valid cyanobacteria response should be from a 3x3 raster matrix meaning the waterbody should be at least 900x900 meters for the center pixel considered valid. Currently, 2370 waterbodies across CONUS are resolvable.

Temporal Aspects:

The cyanobacteria concentration data reported in the CyAN Android app and the CyAN website are derived from ESA's OLCI instruments on the Sentinel 3a and 3b satellites (S3A, S3B) and are delivered in two temporal classifications: weekly and daily data. Daily data prior to July 2020 were derived from the single S3A and have limited spatial coverage of CONUS. In late July 2020, the S3B satellite data stream came online and because of their separate orbital tracks, the spatial coverage of CONUS became much more extensive.

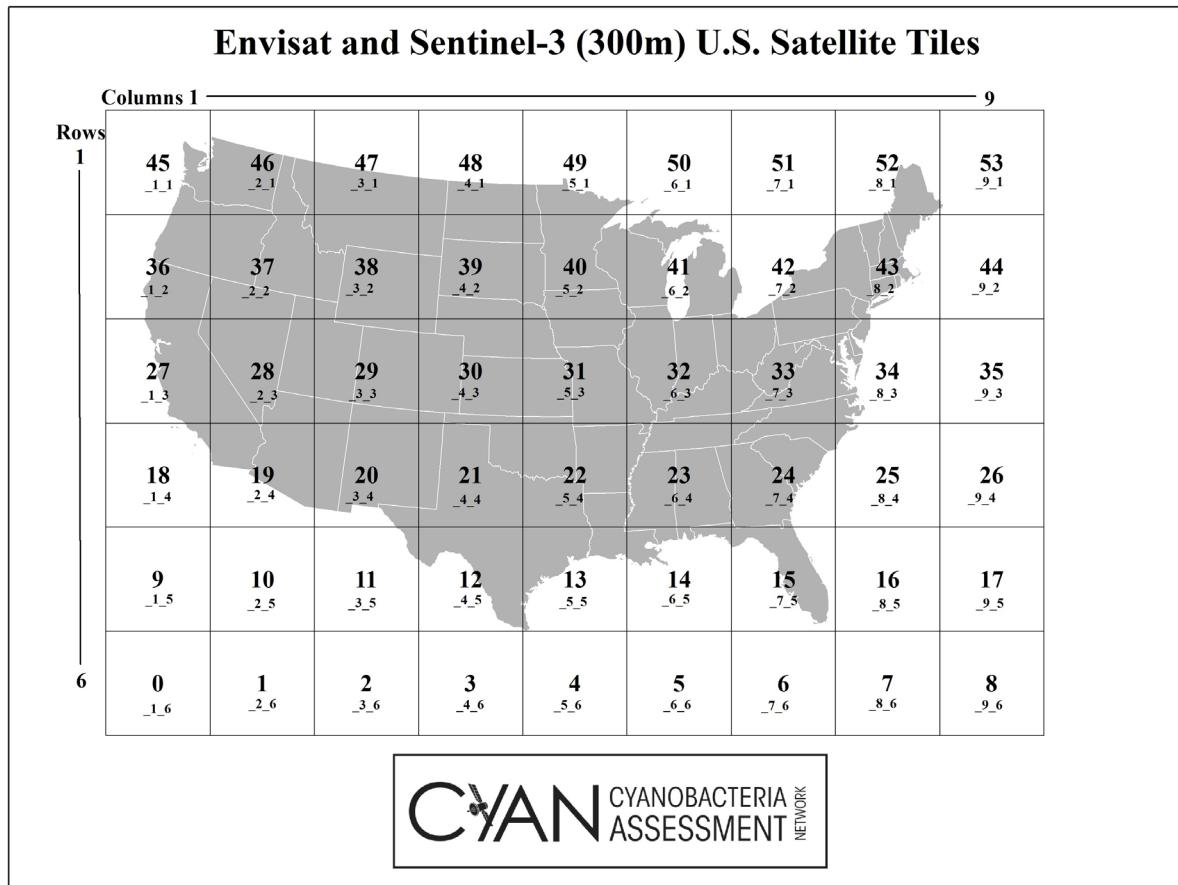
Daily data are simply a snapshot of the cyanobacteria response and are derived from merged S3A and S3B data streams.

Weekly data are a composite of maximum cyanobacteria response from a week-long collection of daily satellite overpasses (Sunday through Saturday). In general, S3A and S3B merged data streams (post July 2020) will have between 2 and 4 observational cyanobacteria responses at each CONUS waterbody location. The maximum cyan response detected within the weekly time span is the value reported at each location.

Spatial Aspects:

Data are delivered from NASA to the EPA in TIFF-formatted raster image files (gridded images). Each image is composed of 4 million grid cells (pixels). Each grid cell represents a 300 x 300-meter area. Each

image is masked for land (and for oceans near the coasts) leaving waterbodies exposed. A waterbody pixel having a cyanobacteria response as detect by the OLCI instruments on ESA's satellites is reported by CyAN. To get CONUS spatial extent, a collection of 37 raster images (tiles) is produced. It is important to note that the value reported is not representative for an entire waterbody; rather it's the cyanobacteria response of the pixel that your location resides in.



- *Figure 17 - Data for 37 of 54 tiles are accessible via the CyANWeb app. Data for non-CONUS tiles are not processed. E.g. – all tiles in row 6 and all tiles in column 9 are absent. Each tile is a Geo-referenced TIFF formatted raster file containing 2000x2000 = 4000000 cells. Each pixel cell represents a 300mx300m area.*

Opening Screen Message; Data Issues:

“This experimental web application provides provisional satellite derived measures of cyanobacteria, which may contain errors and should be considered a research tool. Users should refer to the app help menu for more details. The focus of this application is to provide cyanobacteria measures for larger lakes and reservoirs within the continental US. Data products are 7-day maximum cyanobacteria measures updated weekly and, beginning late July 2020, daily snapshots of cyanobacteria measure updated every day.”

Possible data issues include:

- Near-shore response: mixed land/water pixels; may be reading land vegetation and/or shallow water bottom foliage. Not possible to discount reported concentration entirely as response may be valid due to wind action on a bloom resulting in shoreline accumulation. Data values reported should be considered in context of the local conditions about and within the waterbody. Data reported should be validated in-situ.
- Estuaries: data has not been validated for brine/salt water.
- Rivers: large flowing waterways are not masked and can have a cyanobacteria response. Cyanobacteria response not validated.
- Ice: ice-covered waterbodies have high reflectance that read as a cyanobacteria response to the sensors. This issue has been resolved with delivery of OLCI data v3 (what CyANWeb now serves to the interface).
- Unmasked land: This issue has also been resolved with the delivery of OLCI data v3.
- Dry/ephemeral waterbodies: invalid cyanobacteria response is evident. Resolved in OLCI data v3. These areas now masked.
- A resolvable waterbody is considered to have, at minimum, a 3x3 raster cell matrix size (900x900m) with the center pixel being considered valid. Smaller or irregularly shaped waterbodies (i.e., those not having the minimum 900x900m size) may be evident in the data and their cyanobacteria responses are suspect and open to interpretation. See “Near-shore response” above.

[What could go wrong?](#)

The CyAN/CyANWeb system shows cyanobacteria concentration data when and where the satellite data detects it. What we cannot store, or show, is non-detect events. Why is this important and how can this affect interpretation of the data we serve? How may the information displayed in the interface be misleading? Consider some scenarios:

A – I have a marker in my waterbody, and it is now, for example, red, indicating a very high level of cyanobacteria concentration. Conversely, the marker is categorized in the green, indicating no appreciable HAB level.

Conclusion: my waterbody is currently in a high HAB condition. Conversely, my waterbody is not worthy of immediate concern.

Either conclusion may be true but be cognizant of dates associated with the marker symbology. The last satellite detection level may not represent current conditions. The last detection event may have been yesterday, last week, last month, or even years ago. Dates of detection are evident by mouse hover marker symbols on the basemaps.

B – I have a currently high cyanobacteria concentration detection level reading at my waterbody marker.

Conclusion: the waterbody is toxic and should be avoided.

There is no way to tell from our cyanobacteria data if the bloom is toxic. Cyanobacteria come in many forms; some produce toxins, some do not. The only way to tell is by water sampling and laboratory testing. CyANWeb says absolutely nothing about bloom toxicity. The data are only indicative of the need for toxicity sampling.

C – I have a marker in a waterbody that indicates a cyanobacteria level of concern (example 1).

Conclusion: the waterbody is unfit for recreation (swimming, fishing, etc) or other human usage of the water derived from the waterbody.

Water conditions at a single monitoring marker is not indicative of the state of water conditions throughout the waterbody. A marker indicates the satellite detected cyanobacteria concentration within a 300x300 meter pixel location within the waterbody. If your waterbody is small (900x900m, or smaller), then the marker may indicate the HAB state of the waterbody. If the waterbody is larger, more markers distributed throughout the waterbody are warranted to determine its cyanobacteria state. Cyanobacteria blooms (HABs) are not static, and not uniform in distribution within the bloom area.

D – I have a marker in a waterbody that indicates a cyanobacteria level of concern (example 2).

Conclusion: the waterbody is unfit for recreation (drinking, swimming, fishing) or other human usage of the water derived from the waterbody.

What is the shape of the waterbody you've marked for monitoring? And how close to the shoreline have you placed your monitoring marker? What is the depth of water in your marked waterbody? Cyanobacteria satellite detection may be fooled by a) shallow waters (< 6 ft depth in clear water, less depth in murky water) where non-cyanobacteria bottom vegetation is being detected, and b) by edge effect of shoreline vegetation, so called mixed pixel readings. A "valid" cyanobacteria value is considered to be free of mixed pixel readings and in "deep" water. Your waterbody cyanobacteria cell value should be the center pixel value in a 3x3 raster image (imagery is delivered in 300x300m raster cells) meaning your waterbody should be at least 900x900 meters for the center pixel value to be considered "valid". However, you should not ignore cyanobacteria readings if your waterbody does not meet the 900x900m size due to shape of the waterbody or water depth. Use whatever cyanobacteria readings are provided as a guide for the need of in-situ sampling and testing. The user should know the morphology of their waterbody of interest and use CyAN data accordingly.

E – The time series plots of cyanobacteria level concentrations on location charts and blooming charts (from the compare location) show a continuous increase (or decrease) of concentration through time.

Conclusion: My waterbody is getting worse (or better) for HAB incidence over time.

While the x-axis of the plots (the bottom axis) are linear (meaning time increments on this axis are equal), the data points on them representing cyanobacteria concentrations, are in all probability, not

available for all time intervals. Plot points appear continuous through time because data points are line-connected. However, detections events are rarely evenly continuous through time. Cloud cover occlusion to the satellite sensors may prevent HAB detection at regular intervals. This might best be illustrated when comparing locations; data records may be longer or shorter than the compared location(s) and have different data points before, after, and/or within the timespan of the plot.

FAQ

Q - What is the difference between a *selected/unmarked* location and a *marked* location?

A - Selected locations are the markers that are *unchecked*. These unchecked markers indicate that these locations have not been marked. A marked location will appear on the map as a *checked* marker.

Q - Why are selected/unmarked locations (unchecked pins) useful?

A - Having unmarked locations are useful for one purpose which is that you can differentiate between your priority locations and your non-priority locations by keeping your non-priority locations unmarked and then control whether they appear in the “My Location” list using the “show checked locations” checkbox.

Q - The pin location I selected is an “Unknown Location”.

A - If you mark a location that has no satellite data in the current archive, the CyAN app will return “Unknown Location” and no count information. This is typical in areas extremely close to shore, lakes smaller than can be resolved by the satellite or if you place a pin marker on land.

Q - Why is my data reloading slowly?

A - Reloading data will be dependent on: (1) the speed of your wireless/internet service connection, (2) the number of markers you use, and (3) the number of satellite data records hosted on the servers.

Q - What does “(Max:...)” indicate when comparing locations?

A - The Max value is an attempt to provide a small areal view of the cyanobacteria conditions about the location raster cell. Max is the largest cyanobacteria value in a 900mx900m raster cell matrix about the location.

Q - What is OLCI?

A - OLCI (Ocean and Land Colour Instrument) are sensing instruments on ESA’s Sentinel-3 satellites that are used to detect cyanobacteria in waterbodies. Each Sentinel-3 satellite tile is a Geo-referenced TIFF formatted raster file containing $2000 \times 2000 = 4000000$ raster cells. Each pixel cell represents a 300mx300m area.

Q - When I switch from OLCI-Daily to OLCI-Weekly and vice-versa my pins disappear?

A - OLCI weekly/daily data are separate data products that the CyAN web interface is capable of handling. The two categories of data are handled separately. Your markers for weekly data do not show

if you've selected Daily; and vice-versa. Daily data are a snapshot of cyanobacteria at the time of detection, weekly data are a composite of daily maxima.

Disclaimer Statement

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication.

This application has been approved for release by the U.S. Environmental Protection Agency (USEPA). Although the software has been subjected to rigorous review, the USEPA reserves the right to update the software as needed pursuant to further analysis and review. No warranty, expressed or implied, is made by the USEPA or the U.S. Government as to the functionality of the software and related material nor shall the fact of release constitute any such warranty. Furthermore, the software is released on condition that neither the USEPA nor the U.S. Government shall be held liable for any damages resulting from its authorized or unauthorized use.

References

Blake A. Schaeffer, Sean W. Bailey, Robyn N. Conmy, Michael Galvin, Amber R. Ignatius, John M. Johnston, Darryl J. Keith, Ross S. Lunetta, Rajbir Parmar, Richard P. Stumpf, Erin A. Urquhart, P. Jeremy Werdell, Kurt Wolfe ; *Mobile device application for monitoring cyanobacteria harmful algal blooms using Sentinel-3 satellite Ocean and Land Colour Instruments.*; Environmental Modelling & Software Volume 109, November 2018, Pages 93-103
(<https://www.sciencedirect.com/science/article/pii/S1364815218302482>)

Megan M. Coffer, Blake A. Schaeffer, John A. Darling, Erin A. Urquhart, Wilson B. Salls; *Quantifying national and regional cyanobacterial occurrence in US lakes using satellite remote sensing.*; Ecological Indicators, Volume 111, 2020, 105976, ISSN 1470-160X
(<https://www.sciencedirect.com/science/article/pii/S1470160X19309719>)

Mishra, S., Stumpf, R.P., Schaeffer, B.A. et al. *Measurement of Cyanobacterial Bloom Magnitude using Satellite Remote Sensing.* Sci Rep 9, 18310 (2019).
(<https://rdcu.be/cg6bl>)

Ross S. Lunetta, Blake A. Schaeffer, Richard P. Stumpf, Darryl Keith, Scott A. Jacobs, Mark S. Murphy; *Evaluation of cyanobacteria cell count detection derived from MERIS imagery across the eastern USA,* *Remote Sensing of Environment;* Volume 157, 2015, Pages 24-34, ISSN 0034-4257
(<https://www.sciencedirect.com/science/article/pii/S0034425714002211>)