



## Questions & Answers Part 3 (Session A)

Please type your questions in the Question Box. We will try our best to get to all your questions. If we don't, feel free to email Amita Mehta ([amita.v.mehta@nasa.gov](mailto:amita.v.mehta@nasa.gov)) or Sean McCartney ([sean.mccartney@nasa.gov](mailto:sean.mccartney@nasa.gov)).

**Question 1: Is there any way to simulate a water treatment and determine how many times it will take for a harmful algal bloom to come back in acceptable quantity?**

Answer 1: There are water treatment simulation softwares available. See for example (<https://www.hydr mantis.com/>). There are also schemes for estimating how water quality will change as a result of natural and human-induced pollution (<https://www.epa.gov/ceam/water-quality-analysis-simulation-program-wasp>).

**Question 2: Is there any way to know the location of the lake where the cyanobacteria are concentrated?**

Answer 2: CyAN web app we looked at showed a cyanobacteria count map in the selected lake. Based on remote sensing it is possible.

**Question 3: How to download the Geotiff images for selection location from the CyAN web app?**

Answer 3: On the Cyan App web page go to 'My Locations' (top left), click and select the location of the lake you selected. You will get images in the main window. You can control-click on any image and save it to your computer. The format will be .avif – which you can open in QGIS.

**Question 4: I want to know what are the bands considered for Cyan Index? And also if possible the formula as well.**

Answer 4: Please refer to the CyAN publications for details:  
<https://www.epa.gov/water-research/cyanobacteria-assessment-network-cyan>

**Question 5: I would like to ask whether any processing must be done to compare reflectance images from different dates?**



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Answer 5: When you do atmospheric correction, changing atmospheric conditions affect this process. Therefore, it is necessary to process images for each date before comparing. For qualitative/visual comparison of images you can view RGB images from top-of-atmosphere reflectance data.

**Question 6: I am working on a project that uses drone imagery for water quality monitoring in South Africa. How can I share with you the in situ measurements of my study site?**

Answer 6: You may want to contact GLORIA contributors (you may inquire here: [nima.pahlevan@nasa.gov](mailto:nima.pahlevan@nasa.gov)). Also, there is a forum from NASA Ocean Color group (<https://forum.earthdata.nasa.gov/index.php>) you may want to post this information if anyone is interested in getting the data.

**Question 7: Has there been any testing or parameterization of PACE on lakes or only over ocean?**

Answer 7: PACE pixel resolution is 1 km<sup>2</sup>. Primarily ideal for coastal and open ocean. We will check with the PACE team and get back to you.

**Question 8: If it's impossible to collect in situ data for a lot of small lakes, is there a way to improve the generalizability of a model?**

Answer 8: Unfortunately, no! You can use models developed for other lakes in your area. Even if you do not get accurate quantitative water quality information, if you compare across time you can assess in which part of a lake water quality is changing.

**Question 9: Is there a rule of thumb for a minimum number of in situ measurements to develop algorithms for remote sensing images?**

Answer 9: Larger the number of independent measurement points, better statistical significance can be achieved. But there is no rule as such – in the literature you find <100 points to a few thousand points!

**Question 10: Any suggestions for models of lake CDOM using sentinel-2 MSI?**

Answer 10: You may find this paper useful for this information:  
<https://www.mdpi.com/2072-4292/8/8/640/htm>

**Question 11: Please explain a little more about the co-location concept.**



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Answer 11: Ideally, where and when satellite image is available, within that region and at that time if you can collect in situ data that is a good collocation. But, temporally a few hour window from a satellite overpass is considered good.

**Question 12: Is it possible to use modeled chl-a concentration values (derived from another sensor with co-located in situ data) to derive an algorithm for another sensor (without co-located in situ data)?**

Answer 12: If the sensor bands, bandwidth, and spatial resolution are close you may be able to – but it has to be compared and checked.

**Question 13: Are these algorithms valid in high concentrations of chl-a, such as scums? Is it necessary to apply a different algorithm in these circumstances?**

Answer 13: There is no standard algorithm that works in all cases. Information about several ‘standard’ algorithms for chl-a that NASA has developed can be found here: [https://oceancolor.gsfc.nasa.gov/resources/atbd/chlor\\_a/#sec\\_2](https://oceancolor.gsfc.nasa.gov/resources/atbd/chlor_a/#sec_2)

**Question 14: Is buffering a point vector data the same as interpolating to get a rasterized image?**

Answer 14: Buffering is not the same as interpolation. Interpolation uses estimated values at multiple locations to create a continuous surface that can be used for mapping and analysis purposes. If you set your buffer to an unreasonable distance from the location of in situ collection, greater uncertainties will arise. In the demonstration we buffered to 10 meters to match the spatial resolution of the Sentinel-2 MSI image.

**Question 15: Can this method be applied with water quality in a pond?**

Answer 15: Ponds are generally shallow so bottom reflectance has to be considered in the algorithm. Also, a pond has to be big enough to be resolved by the sensor you are using.

**Question 16: Is there a way in GEE to correct data for sunglint?**

Answer 16: There is publicly available code using Earth Engine to correct for sunglint. Below is a reference with links to code for doing so:

<https://google-earth-engine.com/Aquatic-and-Hydrological-Applications/Benthic-Habitats/>



**Question 17: Is there any part of the GEE code that would need to be changed in order to work for coastal saltwater ecosystems? If so, what are the specific changes that would need to be made?**

Answer 17: You will need to have in situ data to relate with coastal saltwater ecosystems.

**Question 18: What is the atmospheric correction used for the harmonized S2 data being used in this demo?**

Answer 18: To learn about the atmospheric correction used for for S2 data please refer to the User Handbook:

[https://sentinel.esa.int/documents/247904/685211/Sentinel-2\\_User\\_Handbook](https://sentinel.esa.int/documents/247904/685211/Sentinel-2_User_Handbook)

**Question 19: Are there rules of thumb necessary to apply for thresholds in CI, MCI, etc. for when the concentration is high enough that the bloom is likely a scum? Or is it a separate algorithm, like the Floating Algae Index?**

Answer 19: It appears that MCI works in some cases but there are models specifically for scum/high cyanotoxins. The following two papers can provide more information about algorithms and also about limitations of MCI.

- Stumpf et al. (2016): Harmful Algae 54 (2016) 160–173
- [https://www.sciencedirect.com/science/article/abs/pii/S0380133013000555#:~:text=The%20MERIS%20Maximum%20Chlorophyll%20Index%20\(MCI\)%20measures%20the%20height%20of,681%20nm%20and%20753%20nm.](https://www.sciencedirect.com/science/article/abs/pii/S0380133013000555#:~:text=The%20MERIS%20Maximum%20Chlorophyll%20Index%20(MCI)%20measures%20the%20height%20of,681%20nm%20and%20753%20nm.)

**Question 20: Is there a way to mask out the land pixels in the end image products for GEE?**

Answer 20: Yes, there are land and water masks publicly available on GEE. You have to be careful as the spatial resolution for water masks is derived from the MODIS instrument at 250 meters. Alternatively, you can bring in your own mask as an asset (or create your own) and use this for your analysis.

**Question 21: If multiple images are available with in situ match-ups (e.g., the July 15 example), is it better to develop the algorithm for only the image that's a closest temporal match, or use them all and calculate the median value for a given pixel from all of the available images (within a certain time-period around the in situ samples)?**



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Answer 21: Both these approaches have been used. Test for your own application and see what works best in conjunction with in situ data.

**Question 22: Are there plans to launch additional Sentinel-2 satellites (ie. 2C, 2D, etc.)?**

Answer 22: Yes, Sentinel-2C is slated for launch at the beginning of 2024, with subsequent continuity missions planned in the future.

**Question 23: When working with GEE, is it ideal to export the files into another application after producing a final classified image in order to apply color bars and final analysis?**

Answer 23: We provided the ee-palette module in the script which is good for visualization purposes—most forms of analysis can be achieved in GEE as well. If you want to get creative with symbologies and make a nice polished map to share with colleagues, it is advised to export the image into a GIS of your choice for more functionality with annotation, symbology, etc.

**Question 24: How do you collect the GLORIA Western Erie data like TSS, Chlorophyll a, Secchi Depth?**

Answer 24: Data like TSS and chl-a were derived from lab data. We also provided references for GLORIA data in Part 1 of the training series.

**Question 25: I would guess that the average depth of a smaller lake is shallower than a larger lake. With the increasing resolution of satellite imagery, will there ever be a minimum size of resolvable lake based on its likely depth (if bathymetry isn't known), rather than its surface area and the spatial resolution of the satellite sensor?**

Answer 25: It may be possible to come up with models to identify lakes 'resolvable' based on area and depth in future, but currently remote sensing data and radiative transfer modeling are used to correct for depth (bottom reflectance). For example see: <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018EA000539>

**Question 26: Have you incorporated the field measurements in this GEE code? If not, could you please share GEE code that incorporates the field sample and then calculate water quality based on those samples which also provides the**



**RMS or co-relation between field measurements and measurements made by satellite data?**

Answer 26: Yes, the in situ measurements are incorporated in the GEE code. You can find a link to the code on the training page. You can also find a link to the CSV file where we sourced the field measurements on the training page as well.

**Question 27: If we have a list of sampling points from different lakes and the sampling is done in different years, how to automate this process? Is there a function written in JavaScript that does this as far as you know?**

Answer 27: Yes, there is a publication related to this. Please refer to the link below:  
<https://www.mdpi.com/2072-4292/12/20/3278>

**Question 28: Will it be necessary to use codes for cloud masking if we use cloud free image instead of image with cloud coverage?**

Answer 28: If you use Level 2 data, cloud information is available so you can mask accordingly. You can also seek out data without cloud cover.

**Question 29: My Google Earth Engine is not exporting anything to my Google Drive even after uncommenting the lines and making sure my accounts were the same for GEE and Drive. What might be the cause for this, and how can I resolve it?**

Answer 29: Depends on the size of the file you are trying to export. Check the status of the export to see if it is working. With larger datasets, export times can take 20-30 minutes.

**Question 30: How can you get longitude and latitude within the GEE coding without getting from somewhere else?**

Answer 30: In the GLORIA .csv files, there are columns for latitude and longitude. Refer to the sample data from Part 1 of this training series. Clicking on the “Inspector” tab in GEE will also provide you with latitude and longitude in a given area.

**Question 31: How can I get the Google Satellite option in QGIS 3.32.0?**

Answer 31: The plugin “Quick Map Services” will help you here.

**Question 32: When you filter the Image Collection for a specific date the optical images may have a high percentage of clouds but our AOI might be cloud free. So**



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**when you apply a filter it considers the total percentage for clouds in the whole image leaving out some of them that might be useful for AOI. How can you apply filter cloudy granules considering not the entire optical image but just the AOI? Can you check that precisely without checking each date?**

Answer 32: When you cloud mask, each pixel is checked for being cloudy or not cloudy.

**Question 33: Is it possible to derive lake bathymetry using satellite-derived data?**

Answer 33: NASA's IceSAT-2 mission provides this information.

**Question 34: Are there other sensors used to detect/monitor algal blooms, other than optical (multispectral/hyperspectral)?**

Answer 34: There are other sensors provided by European and Korean space agencies.



## Questions & Answers Part 3 (Session B)

Please type your questions in the Question Box. We will try our best to get to all your questions. If we don't, feel free to email Amita Mehta ([amita.v.mehta@nasa.gov](mailto:amita.v.mehta@nasa.gov)) or Sean McCartney ([sean.mccartney@nasa.gov](mailto:sean.mccartney@nasa.gov)).

**Question 1: Pueden explicar la fórmula de CI index en detalle, presentación pÁg 29?**

**Translation: Can you explain the formula of the Color Index (CI) index in detail, presentation page 29?**

Answer 1: Details of CI development can be found here:

[https://oceancolor.gsfc.nasa.gov/resources/atbd/chlor\\_a/#sec\\_2](https://oceancolor.gsfc.nasa.gov/resources/atbd/chlor_a/#sec_2)

\*\*Also, please refer to the papers listed on the site as well.\*\*

**Question 2: Was CI derived using a baseline theory?**

Answer 2: Do you mean baseline requirements for water quality?

**Question 3: Is the estimation of water quality parameters using remote sensing suitable for lakes with depth less than 3m? What does it mean by water clarity in situ data? Also do I need the units of water clarity in situ data?**

Answer 3: Water clarity is how far you can see (light can reach) in a water column.

Secchi Disk Depth is generally used to assess water clarity. Units would be meters of water column.

Lakes with less than 3m depth (very shallow!) would have bottom reflectance affecting water leaving reflectance and would have to be accounted for. Please refer to this study for more information:

<https://www.sciencedirect.com/science/article/abs/pii/S0380133010002546>

**Question 4: What is the relation between Colored Dissolved Organic Matter (CDOM) and the dissolved salts such as  $PO_4$ ,  $NO_3$  and  $NO_2$ ?**

Answer 4: This question is beyond the scope of this training.

**Question 5: Is the data in the .csv following the same format recommended by SeaBASS?**





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Answer 5: SeaBASS has its own format! SeaBASS data are entered as delimited text file (similar to csv) but there is a descriptive header block in SeaBASS unlike in any csv format file

### **Question 6: Can you please explain line 91 in the code?**

Answer 6:

```
var Chla_log10 = Chla.log10().select(['first']).rename(['Chla_log10']);
```

The first part of line 91 defines a variable “Chla\_log10”.

We then pass in the variable defined above “Chla” (lines 84–87) to calculate log10 of Chlorophyll-a.

The code then selects the band for Chlorophyll-a (i.e., “first”) and renames it “Chla\_log10”.

The reason the band was named “first” is because that was the reducer used in line 86 above. (The default name of the band when using a reducer is the name of the reducer used.)

### **Question 7: What bands are used by Sentinel 2 for Chl-a, TSS, and CDOM?**

Answer 7: There are several models based on Sentinel-2 data – they use two or more bands! What we used here for CI are green, blue, and red bands; for TSS we used NIR and red; CDOM uses blue bands. Please see this study:

<https://www.mdpi.com/2072-4292/8/8/640/htm> .

### **Question 8: How can I calculate the mean values of chlorophyll per pixel in the area?**

Answer 8: To get statistics of pixel values in a region of an ee.Image, use `image.reduceRegion()`. This reduces all the pixels in the region(s) to a statistic or other compact representation of the pixel data in the region (e.g. histogram). The region is represented as a Geometry.

[https://developers.google.com/earth-engine/guides/reducers\\_reduce\\_region](https://developers.google.com/earth-engine/guides/reducers_reduce_region)

### **Question 9: Is 6S recommended over Acolite to correct Landsat imagery?**

Answer 9: To my knowledge, 6S is better for correction over land. Acolite is widely used by the water quality community for atmospheric correction.

### **Question 10: Would you use a similar script for Ocean Chlorophyll 4 Algorithm (OC4) but run it in python instead of GEE?**



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Answer 10: For fitting the curve and finding coefficients python would be better. Once you have the coefficients, you can use the OC4 formula in GEE to get Cha.

### **Question 11: How do I subset and create the shapefile from the GLORIA data in Google Earth Engine?**

Answer 11: You can upload a CSV file as an asset in GEE and then use the x/y fields (lon/lat) to derive the locations. More information can be found at the link below:

[https://developers.google.com/earth-engine/guides/table\\_upload#:~:text=WGS84%20is%20as%20sumed.-.Upload%20a%20CSV%20file.on%20your%20local%20file%20system.](https://developers.google.com/earth-engine/guides/table_upload#:~:text=WGS84%20is%20as%20sumed.-.Upload%20a%20CSV%20file.on%20your%20local%20file%20system.)

### **Question 12: Does SeaDas work better for a specific OS? I tried it on Windows and it gives different errors while working with it. Also, do you have any material to work with SST?**

Answer 12: The latest upcoming version of SeaDAS is supposed to work with Windows. In the meantime, you can run a virtual machine running Linux to get SeaDAS running on Windows.

NASA OC Forum: <https://forum.earthdata.nasa.gov/index.php>

We had done a training using MODIS and VIIRS data to get SST values.

<https://appliedsciences.nasa.gov/join-mission/training/english/arset-monitoring-coastal-and-estuarine-water-quality-transitioning>

### **Question 13: Values like Rrs 665 and Rrs 815 for Total Suspended Matter (TSM), are these standard values or do they change depending on the water body being studied?**

Answer 13: They are not standard. Band combinations are used.