Questions & Answers Session 1

Please type your questions in the Question Box. We will try our best to answer all your questions. If we don't, feel free to email Amita Mehta (amita.v.mehta@nasa.gov), Sean McCartney (sean.mccartney@nasa.gov) or Juan Torres-Pérez (juan.l.torres-perez@nasa.gov).

Question 1: Can the Cyanobacterial Index be used as a proxy for chlorophyll-a in turbid waters?
Answer 1: Chlorophyll-a concentration is found to be associated with Cyanobacteria harmful algal blooms but non-algal turbidity can also affect phytoplankton biomass -- Ch-a. Cyanobacterial indices take into consideration the part of the spectrum where specific pigments, like phycocyanin, reflect. Here's a recent paper by Zhang et al (2017) with useful information to separate chlorophyll a from cyanobacteria: https://www.frontiersin.org/articles/10.3389/fmars.2017.00124/full

Question 2: In dynamic coastal environments where the inland flux is very high, what is the lower acceptable accuracy level? Can seasonal retrieval algorithms perform better than a single algorithm?
Answer 2: Acceptable accuracy level will depend on the research question to be answered. If the area is very dynamic, then yes, it is convenient to do seasonal sampling, if possible, and you might need slightly different algorithms for each season (rainy vs. dry seasons; low/high tides, etc). It is also dependent on your area of research as well.

Question 3: If the regression value between ground sample value and surface reflectance from satellites is low, what can be the possible reasons behind it?
Answer 3: Different factors might affect this. Typically, water samples are from a specific point but the satellite pixel covers a much larger area. For example, for MODIS and VIIRS pixels are in the order of 250m-1km depending on the band. The atmospheric correction algorithm chosen can also affect the accurate retrieval of satellite-based data. Here's a link to a paper by Palacios et al (2015) that talks about the influence of different atmospheric correction algorithms on remotely-sensed water

quality retrieval, particularly phytoplankton functional types.
https://www.sciencedirect.com/science/article/pii/S0034425715300146

Question 4: Is it possible that chlorophyll-a value is high but the HAB is not visible on the water surface?
Answer 4: It could be possible since HABs are variable and depend on the type of organism producing these. Sometimes other parameters such as the concentration of different nutrients might be more indicative of particular HABs.

Question 5: What is variable C in the remote sensing reflectance formula involving IOP and AOP?
Answer 5: C is a correction factor which is sensor dependent.

Question 6: What are the challenges of characterising Chlorophyll-a in case 2 waters through satellite remote sensing?
Answer 6: In complex water CDOM and suspended particles both affect Ch-a. Several studies have attempted to develop algorithms to get Ch-a in Case 2 waters -- we will share a few references here.

Question 7: How does one solve the problem with Landsat 7 scan line corrector-off for time-series analysis? If the striping lines are replaced by lines from different time acquisition then the time-series analysis won't be valid.
Answer 7: There is no easy way around this. You can still use Landsat 5 (pre-2013) or Landsat 8 to avoid the issue completely. You may want to explore the link below:
https://www.usgs.gov/media/files/landsat-7-scan-line-corrector-processing-algorithm-theoretical-basis

Question 8: In order to improve the spatial resolution of data, is it possible to assess coastal water quality using fusionned images (pansharpened)?
Answer 8: Pansharpened data have been used, primarily in experimental and commercial uses -- still a research question.

Question 9: Can the same remote sensing techniques that are/will be shared in these webinars for Monitoring Coastal and Estuarine Water Quality, be of any use for

monitoring water quality of inland wetlands such as the ones present within the boreal forests of Canada?
Answer 9: It is dependent on the size of the wetland itself. Refer to our previous webinar on Remote Sensing of Coastal Ecosystems: https://appliedsciences.nasa.gov/join-mission/training/english/arset-remote-sensing-coastal-ecosystems
We also did a webinar on Remote Sensing of Freshwater Habitats and it contains a number of useful references as well: https://appliedsciences.nasa.gov/join-mission/training/english/arset-remote-sensing-freshwater-habitats

Question 10: The coastal waters having a lot of freshwater influx are always turbid, and the reviewers always raise questions against the accuracy of satellite data using. What should I do in that case?
Answer 10: Yes, this is why water quality accuracies in coastal waters are challenging! Having in situ measurements -- frequent and dense near coastal zones to develop algorithms and validate satellite -- based water quality parameters would help.

Question 11: Can I use the SNAP tool for processing ocean color data as a replacement for SeaDAS?
Answer 11: Both SNAP and SeaDAS are based on Beam.

Question 12: How effective are these satellite images to identify the nature of suspended sediment particles in the estuarine environments?
Answer 12: If the idea is to retrieve sediment particle size or composition, this is usually not possible with satellite data. There are not many algorithms available for total suspended sediments. Here's a recent paper that describes how to retrieve TSS in coastal waters: https://www.sciencedirect.com/science/article/pii/S0034425720301383

Question 13: Why are we using the "Ocean Color" portal? Why not use the platform of Google Earth Engine?
Answer 13: You can use GEE -- since the Ocean Color portal is specifically for these data we chose that.

Question 14: Is there a page with examples of the scripts to download and process images in Python or R?
Answer 14: There are scripts, but we will have to look further into specific ones. Rather than using Python, we are using a GUI.

Question 15: I would like to know if we need to keep these files ready for the next session?
Answer 15: Not for this training. We will be conducting a more advanced webinar with more hands-on demonstrations in the fall so stay tuned.

Question 16: In case of turbid waters which wavelength can be used for detection of chl-a and turbidity? How is turbidity different from suspended sediments?
Answer 16: There is not an easy way to measure suspended sediments exclusively, that is why we use more parameters. To learn how turbidity is different from suspended sediments, refer to the link below:
https://www.fondriest.com/environmental-measurements/parameters/water-quality/turbidity-total-suspended-solids-water-clarity/

Question 17: In terms of resolution if you have to pick one, which one would that be: Spectral, spatial or temporal?
Answer 17: For algorithm development, spectral and spatial resolution would be more useful. Temporal resolution is useful when looking for specific features. In situ data can also help with all three as well. It is also dependent on your overall research question and what it is you are looking to accomplish within your work.

Question 18: Are the methods used in this presentation being used in inland water monitoring?
Answer 18: Yes, they are used in inland waters also. ARSET did a webinar to get water quality in inland lakes:
https://appliedsciences.nasa.gov/join-mission/training/english/arset-integrating-remote-sensing-water-quality-monitoring-program

Question 19: Is the Landsat 7 (15m) spatial resolution data readily available?
Answer 19: All Landsat data are openly available. To gain 15 m spatial resolution you will need to pansharpen the image(s).

Question 20: With this satellite is it possible to cover the region around Angola?
Answer 20: Yes, MODIS and VIIRS are global datasets.

Question 21: How does one deal with 'NaN' value data, especially for match-up analysis of Chl-a?
Answer 21: Atmospheric correction as well as other factors like cloud cover and shallow water can potentially lead to a null value.

Question 22: In the demonstration of how to get data, the last part involves a lot of commands. Are these provided in the link one receives in their email?
Answer 22: The links are provided in the email. You will get access to the manifest (text document), which will provide you with the link to download the compressed data and decompress using the appropriate software.

Question 23: Do you think accurate time series prediction for water quality parameters is possible? As these parameters change drastically over time and also in space.
Answer 23: You can do that if you have sufficient training data to make an efficient algorithm.

Question 24: Are the data from MODIS and VIIRS free from atmospheric interference/noise?
Answer 24: No, they have to be corrected.

Question 25: Can we measure salinity and CDOM in shallow inland lakes that are 6 meters (20 feet) deep and 6 miles long?
Answer 25: If you have in situ data, you can develop an algorithm. With a lake this size, there is not a mission that we know of that deals with salinity.

Question 26: Can we take real time monitoring at night?
Answer 26: At night, it is not possible.

Question 27: While developing the algorithm, how can we compensate when we miss one ocean colour component (e.g., CDOM in situ observation)?

Answer 27: If you are familiar with the water quality of the area you are analyzing, you can. It would be complicated to figure it out independently of that.

Question 28: How is point data incorporated into spatial data for water monitoring?
Answer 28: If a pixel covers that point, they are incorporated. We will go more in detail in a more advanced webinar series later this year.

Question 29: How does one verify an oil leak and algal bloom?
Answer 29: They both will have different spectral characteristics. An oil leak is very dark and algal blooms reflect in different wavelengths.

Question 30: Why do we use MODIS data for water quality analysis? Why not use Sentinel data because it has better spatial resolutions?
Answer 30: Sentinel can be used for near real time monitoring, but over time MODIS is more optimal. Landsat also has a long time series (>20 years) as well, but has narrow swaths and low temporal resolution.

Question 31: Does it make sense to apply data from these satellites and methodology on an area less than 5 square kilometers?
Answer 31: If you have 3 pixels in a lake to measure water quality, it is possible. Sentinel can be used for an area such as this for near real time monitoring.

Question 32: To follow up on question 3 (*If the regression value between ground sample value and surface reflectance from satellites is low, what can be the possible reasons behind it?*): does this mean that grab samples can be used with sensor data to understand longer influences? (Example: a pollution source that is changing water quality over time due to a spill but may also be dissipating quickly.)
Answer 32: In reference to Q3, parameters such as satellite overpass are important as well as in situ data on the site. If there is cloud cover over the site, you will get low values.

Question 33: Can we measure eutrophication using remote sensing?
Answer 33: You can! It is typically measured or estimated in terms of concentration of chlorophyll-a as normally, phytoplankton concentration will increase in high nutrient areas.

Question 34: Does chlorophyll-a and CDOM interfere with one another in the data? How can you tell them apart when they are the same color or wavelength?
Answer 34: Chlorophyll reflects more in the green region of the spectrum but products such as the fluorescent line height (FLH) had been used with success to separate both components. Here's a paper by Hu and Feng (2016) about it: https://www.spiedigitallibrary.org/journals/journal-of-applied-remote-sensing/volume-11/issue-1/012003/Modified-MODIS-fluorescence-line-height-data-product-to-improve-image/10.1117/1.JRS.11.012003.full?SSO=1

Question 35: Why are Aqua MODIS products used more for SST and chlorophyll-a than Terra MODIS products? Is there something wrong with the satellite antenna or something?
Answer 35: Nothing wrong with Terra. In this case, it is mostly related to the specific time of the day for the Aqua overpass.

Question 36: How much has the amount of plastic debris in coastal waters affected remote sensing responses/interpretations? Also, is there any potential for identifying floating plastics using VIIRS?
Answer 36: I am not sure if plastic debris can be seen from satellite imagery. We will provide a few links to studies in relation to this. See Acuña-Ruz et al 2018 and Garaba and Dierssen 2018. Here are some useful references:
Garaba & Dierssen (2018):
https://www.sciencedirect.com/science/article/pii/S0034425717305722
Garaba et al (2018): https://pubs.acs.org/doi/abs/10.1021/acs.est.8b02855
Acuña-Ruz et al (2018):
https://www.sciencedirect.com/science/article/pii/S0034425718303730

Question 37: How much of a time interval should be considered between collecting data in situ with a satellite overpass? It is not always possible to collect the same date and time of data in situ with a satellite overpass. Sometimes high cloud coverage also affects remote sensing data.
Answer 37: There is a window of only a few hours in regards to collecting in situ data after the satellite overpass.

Question 38: Because water catchment areas in the UK and in many other parts of Europe are relatively small, would the current MODIS and VIIRS products be ineffective as a monitoring tool?
Answer 38: Depending on the size of these catchments, the spatial resolutions of both MODIS and VIIRS might not be enough and there might be a good chance of mixed land/water pixels. In this case, it might be better to explore other missions with higher resolutions such as Landsat or Sentinel.

Question 39: What is the advantage of finding the Euphotic Depth and FLH, and is there a way of finding the salinity from remote sensing?
Answer 39: The euphotic depth relates to the presence/absence of dissolved and particulate matter in the water column and as such it is an important parameter when estimating vertical attenuation. The FLH has proven to be an effective way of estimating algal blooms in diverse water types, particularly in waters with a high concentration with CDOM. Here's a paper by Hu and Feng (2016) about the topic: https://www.spiedigitallibrary.org/journals/journal-of-applied-remote-sensing/volume-11/issue-1/012003/Modified-MODIS-fluorescence-line-height-data-product-to-improve-image/10.1117/1.JRS.11.012003.full?SSO=1
So far, there are not that many satellite missions that estimate salinity. Aquarius is one of them but the spatial resolution is not great for coastal or estuarine waters (1x1 degree). Here's a link to the Aquarius website: https://podaac.jpl.nasa.gov/dataset/AQUARIUS_L3_SSS_SMI_ANNUAL_V5

Question 40: Is there any potential for obtaining estuarine bathymetry data from VIIRS data?
Answer 40: There has always been a limitation on the use of multispectral imagery for bathymetric purposes. This not only applies to VIIRS but other multispectral sensors in general. Here's a recent paper from Wei et al (2020) that explored new approaches for extracting bathymetric data but for coral reef and seagrass areas in Florida. The authors compared several sensors including VIIRS: https://www.sciencedirect.com/science/article/pii/S0034425720304053