# Questions & Answers Part 1

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 Juan Torres-Pérez (juan.l.torres-perez@nasa.gov) or Amber McCullum (amberjean.mccullum@nasa.gov).

**Question 1: How deep can the satellite look into the water? Is the water depth visualized by satellites the same as the one with naked eye?**
Answer 1: How deep satellite sensors can detect a signal in the ocean depends highly on the concentration of the different constituents within the water column (i.e, phytoplankton, CDOM, particulate matter including sediments, etc.). In coastal areas there is usually a higher influence of these constituents and as such, the depth at which we can detect anything can be more limited. In clear coastal areas (such as those in some parts of the tropics) usually a good estimate for satellite data is about 10-20m depth. In areas more affected by sediments and other factors, this depth is reduced considerably even to centimeters in very turbid waters. In the open ocean, water itself is one of the major factors affecting the penetration of light. As shown, water absorbs heavily in the red and NIR regions and much less in the blue region. This is why we see the open ocean as blue or dark blue.

**Question 2: Please describe the main difference between tidal/salt marsh and sea grass. It is confusing.**
Answer 2: Tidal/salt marsh ecosystems may contain other plant species not necessarily seagrasses. But, in many areas, seagrasses are an important benthic component of salt marshes. Also, in many tropical areas, seagrass meadows or beds can be found separated from the coastline and even associated or connected to coral reef ecosystems. In part 3 we will cover images in Puerto Rico where you can see the seagrass beds are within the coral reef ecosystems.

**Question 3: In Lake Victoria we have an invasive Aquatic Vegetation called hyacinth. I would like to know where we can classify them amongst the 3 Submerged Aquatic Vegetation (SAV) we have discussed**
Answer 3: This is a very interesting question (and not easy to answer!). Hyacinths will have a very similar spectral signal as seagrasses but not necessarily as Sargassum or kelp forests. A starting point is to clarify that all three mentioned are marine species. In the case of kelps and Sargassum (as we will see in the next two sessions) are brown

algae, therefore their spectral signal will be different from that of green plants; they will have a higher reflectance around 600-700nm whereas green plants have a distinctive peak around 550 nm in the green region.

**Question 4: If one is to monitor the rate of degradation of coral reefs, which satellite imagery is most recommended?**
Answer 4: Because of the high heterogeneity of coral reefs, the use of satellite imagery for benthic assessments is a bit hard. Nonetheless, major components like coral, sand and algae, can be discriminated with high spatial (typically from airborne sensors) resolution data. One approach used by many researchers is to use satellite data not necessarily for assessing the condition of the benthic communities but to evaluate the water quality at or around the reefs and use it either as a proxy for reef condition or to correlate it with data collected in the field by divers. Here's a recent paper that we published where we used VIIRS water quality data combined with in situ reef assessments by divers:
https://www.frontiersin.org/articles/10.3389/fmars.2021.720712/full

**Question 5: Data from Terra satellites, and Suomi NPP are released for studies. If so, where do you get them?**
Answer 5: All NASA data are free to users. (Earthdata Search: https://search.earthdata.nasa.gov/). For ocean color data, you can go to the Ocean Color Web (https://oceancolor.gsfc.nasa.gov/) site.
Please see the previous training on MODIS to VIIRS transition where we demonstrated data access. URL:
https://appliedsciences.nasa.gov/join-mission/training/english/arset-monitoring-coastal-and-estuarine-water-quality-transitioning

**Question 6: Which tools are used to diagram 3D spectral?**
Answer 6: Not sure what the participant means by 3D spectral. For benthic mapping, a technique called structure-for-motion was developed some years ago and it uses high resolution photographic imagery collected on site either by divers or ROVs and provides a 3D reconstruction of the bottom. At Ames, the Laboratory for Advanced Sensing developed a technique called fluid lensing which uses NASA's supercomputer and complex algorithms to basically remove the water column from imagery to have a much better definition of the bottom features. We also developed a citizen science tool where users can map coral reefs in 2D or 3D image composites. It is called NeMO-Net.
http://nemonet.info/

**Question 7: How oil spills affect collection of data?**
Answer 7: Oil spills (depending on their extension) will impede the visualization of the bottom features including SAV and others.

**Question 8: Does the NDAVI work even with vegetation in small, shallow lakes for** example?
Answer 8: Yes, it may work. It will depend on the spatial resolution of the imagery particularly if it is a very small lake or river. The pixels can be affected by land cover in the image. Be sure your pixel is only water to avoid mixed signals.

**Question 9: Do you have any plans of conducting training regarding the seagrass detection using machine learning techniques?**
Answer 9: A potential advanced training can include this. Thank you for the suggestion. In the meantime, here's a recent paper that used ML and convolutional networks to assess seagrass beds: https://www.mdpi.com/2072-4292/12/10/1581

**Question 10: Can we use this same approach for Mangrove monitoring?**
Answer 10: As mangroves are coastal most will use NDVI.

Additional information can be found in a previous training, URL: https://appliedsciences.nasa.gov/join-mission/training/english/arset-remote-sensing-mangroves-support-un-sustainable-development

Another webinar using SAR data is: https://appliedsciences.nasa.gov/join-mission/training/english/arset-forest-mapping-and-monitoring-sar-data Here, Session 3 in particular is dedicated to mangrove forests.

**Question 11: What do you think of the use of UAVs and their IR and blue sensors in this kind of survey?**
Answer 11: In part 2 we will discuss the new sensors that have been built for UAV purposes. Consider for UAV data, you may have to perform additional corrections related to the stability of the platform. In part 3 we will cover drones used in Sargassum mapping but with regular high resolution cameras.

**Question 12: Could you please explain the NDAVI index and what this index is useful for? Also, is it  a satellite base index? Can it not be used for Drone base imagery?**

Answer 12: It was developed for satellites. NDAVI (using near IR and blue bands) was used in seagrass mapping. We used this because these seagrasses were very shallow or exposed.

**Question 13: What is the limit depth using a sensor such as Landsat or Sentinel-2 in water? And at what depth will there be vegetation available normally?**
Answer 13: Depending on the clarity of the water. Usually up to about 10 meters for clear waters.

**Question 14: Is it possible to identify the river mouth area's bathymetry using optical or microwave remote sensing techniques? If possible, can you tell me the tool for that analysis and the free data source of NASA?**
Answer 14: Optical data has been used in the past to estimate river bathymetry. Here's a recent reference with a new tool used for these purposes: https://onlinelibrary.wiley.com/doi/full/10.1002/rra.3773 Here's another older reference on the same topic: https://www.sciencedirect.com/science/article/pii/S0034425709000297

**Question 15: Does the presence of Phytoplanktons affect seagrass detection?**
Answer 15: Yes, because both have chlorophyll a as their main pigment. Water quality characterization (CDOM, sediments) may help determine the influence of phytoplankton on the signal received by the sensor.

**Question 16: Is there any expectation that ML algorithms might obviate the need for radiometric corrections (atmo, water column, etc)?**
Answer 16: People are working more and more each day on developing ML algorithms for these purposes but there is still a lot to solve. The atmosphere and water column are in constant change and these types of corrections will always be needed.

**Question 17: I know that there is a point in the ocean that hasn't been explored by human beings. Would it be possible to get images from that part using remote sensing? I think it is called Nemo point.**
Answer 17: No. Remotely-sensed images are limited by the penetration of light in the water column. This is why most times only the first dozens of meters can be assessed even in very clear waters.

**Question 18: To classify this aquatic vegetation do I need to introduce any specific ancillary data to pre-process the data itself? If so, what are those? Which**

**are the best classification techniques or bias-free methods to identify or classify aquatic vegetation?**
Answer 18: Yes, typically data associated with the water column. Sometimes, an additional atmospheric correction is needed for coastal ecosystems depending on the sensor used. There is not a “best” classification method. Usually a supervised classification helps and having local information on the seagrass community (maps, data collected by divers, spectral libraries, etc.) definitely helps when doing the analysis.

**Question 19: What software was used to do supervised classification?**
Answer 19: There are a variety of software to choose from. Some commercial ones like ENVI or TerrSet or freely-available ones like Google Earth Engine.

**Question 20: Has there been any success in mapping seagrass in northern latitudes(e.g. north europe) where turbidity is high? Or is it just not feasible as the signal can not penetrate the water column?**
Answer 22: Yes, here’s an example from France:
https://www.sciencedirect.com/science/article/abs/pii/S0304377009001533
Independent of where (temperate or tropics), the less the penetration of the signal through the water column, the less mapping of characterization will be possible.

**Question 21: Do you need to have spectral signatures for the seagrass species of interest in the local area or just the spectral signature for the seagrass species in general?**
Answer 21: It is always advised to have spectral signals from the local species. This not only helps in identification but also in having an idea of the condition (“health”) of the population during the time of the data collection and satellite overpass.

**Question 22: Can I identify the turbidity level using landsat images?**
Answer 22: Landsat imagery has been used for this purpose. Some references are:
https://www.mdpi.com/2073-4441/9/8/570;
https://www.frontiersin.org/articles/10.3389/fmars.2017.00190/full;
https://www.frontiersin.org/articles/10.3389/fmars.2017.00329/full