Questions & Answers Sessions

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.torresperez@nasa.gov) or Amber McCullum (amberjean.mccullum@nasa.gov).

Question 1: Are there unmanned systems for coastal remote sensing?
Answer 1: Yes. There are a number of commercial drones available that have been applied to coastal systems. From basic Phantom type drones with a high resolution camera to more advanced, bigger drones flying other instruments such as multispectral or even hyperspectral cameras. There is still a lot to do in this field. NASA also has a number of UAS that have been used mostly for terrestrial systems but can also be applied to coastal ecosystems.

Question 2: In which deep can this equipement work?
Answer 2: If it refers to the instrument shown in the water, this is an optical package and can be submerged from a boat to several hundreds of meters. It has a number of different instruments to collect information on a number of water column parameters. Water temp, salinity, light absorption.

Question 3: Is there a relationship between sediment and chlorophyll?
Answer 3: No. They are two different water column constituents. Having said that, increases in chlorophyll can also be accompanied by increases in sediment in areas where there is a river influence as usually nutrients are also washed into the coastal waters and this brings an increase in phytoplankton and hence, chlorophyll a.

Question 4: Book on Ocean Optics by Curtis Mobley
Answer 4: https://oceanopticsbook.info/view/introduction/overview

Question 5: Is Kd an aquatic analog to Aerosol Optical Depth (AOD)?
Answer 5: I had not thought about that in that term before but indeed it can be considered an analog. Both parameters depend on the amount of particulates suspended either in the water or in the atmosphere.

Question 6: In case of Remote Sensing Data, is it possible to measure the AOP by optimizing/reducing the environmental effects?

Answer 6: Not really. You can definitely reduce Kd for example by reducing the amount of water column constituents though. Kd gives you an estimate of the transparency of the water. More turbid is higher the Kd. AOP is used to estimate the condition of the water column.

Question 7: Is it difficult to determine live versus dead coral? If so, then why?
Answer 7: It is not difficult. Usually live corals are characterized by their colors (yellow to red or others depending on the species). When corals bleach, they look white because of losing the zooxanthellae or the photosynthetic pigments and since the coral tissue is basically transparent what you are seeing then is the skeleton of the coral but this doesn't mean it is dead. Dead coral usually is rapidly colonized by other organisms such as filamentous or turf algae or even cyanobacteria.

Question 8: What is the difference between TSS and CDOM? Isn't this measuring the same thing?
Answer 8: This was covered in Session 1. In general TSS is related exclusively to suspended particles in water. CDOM is the optically active part of the dissolved organic matter so CDOM is dissolved in the column vs TSS are suspended. They are two different parameters that affect light penetration in the water column. So not measuring the same thing.

Question 9: So river mouths tend to be carrying high sediment plume? Is it a global event or local?
Answer 9: Good question! Usually yes. But it depends on the characteristics of the watershed and the land uses within it. It also may depend on whether the river is channelized or not, steepness of the watershed, whether roads are paved or non paved, etc. Vegetation clearance will bring more sediments to the coastal areas.

Question 10: Can you identify with remote sensing particles of trash based on the thickness of the product (i.e plastic)?
Answer 10: We will cover marine debris next week on session 3. Stay tuned! Maybe not based on the thickness of the product.

Question 11: What is the spatial resolution and temporal resolution of the data available?
Answer 11: This depends on the satellite or sensor. For example, Landsat data has a 30m spatial resolution and 16 day revisit time. MODIS has a coarser resolution (250m-1km) but the data is collected daily. VIIRS is similar to MODIS.

Question 12: Why do different corals differ in spectral signals? Is it because of the amount of zooxanthellae one coral colony has?
Answer 12: Yes, different coral species have different zooxanthellae clades (~20 described so far) and these may vay in terms of their concentration of different pigments. The signal also depends on the structure of the coral's skeleton as internally it may reflect differently depending on whether it has a more dense or light skeleton. Many factors contribute to the difference in spectral signatures.

Question 13: What will be the effect of rising SST on the corals in the relatively cooler ocean basins, north Atlantic for example? Do the corals grow there?
Answer 13: There are corals in the North Atlantic. These are different from those in tropical areas. They are adapted to colder waters and most times are very slow-growing organisms with no zooxanthellae in them. Most appear while in color. In that sense, increased SST may affect them as they are not adapted to higher temperatures. Not much research has been conducted on this topic.

Question 14: Is there any way by which we can measure the bathymetry by observing the height of the waves?
Answer 14: Next week we will cover this topic: shoreline topography and bathymetry and methods to estimate it.

Question 15: A question on the Sea Surface Temperature: how deep is the "surface"? Can SST represent the depth of where coral exists?
Answer 15: Usually when sensors measure SST, it is literally at the surface. The first few centimeters. For corals in tropical areas, temperature does not change much in that 20 - 40 meters of depth to the coral.

Question 16: Can KD be used as well to characterize the small scale benthic components in a complex structured community (i.e. stromatolites, seagrass, sediment with microalgae, and larger algal patches)?
Answer 16: What Kd will give you is a measure of the transparency, not about the components of the benthic community.

Question 17: Could you share some sources that use underwater autonomous vehicles?
Answer 17: Yes, here are some references of our work some years ago in the Caribbean using UAVs to study mesophotic reefs:

https://deepblue.lib.umich.edu/bitstream/handle/2027.42/86034/hsingh-34.pdf?sequence=1
https://www.sciencedirect.com/science/article/pii/S0278434305002232

Question 18: What are the different relevant environmental proxies that help in assessment of Coral Reef Biodiversity Using Remote Sensing?
Answer 18: We covered some of these. Discriminating benthic environments due to the water column. Proxies include Kd, TSS, CDOM, Chl, anything that describes the environment.

Question 19: How can you differentiate coral bleaching caused by increased SST from that caused by eutrophication or disease or water pollution from a remote sensing point of view?
Answer 19: No. You need high spectral and spatial resolution to separate bleached vs. healthy corals, but you cannot tell which caused it from remotely-sensed images.

Question 20: How do you measure salinity using remote sensing?
Answer 20: There are very few instruments that measure salinity. Aquarius from the Argentinian Space Agency (CONAE) is one of the few but it has a 150 km spatial resolution which is too coarse and doesn't work for coastal areas.

Question 21: What are some specific/recommended techniques and tools for water column corrections?
Answer 21: Algorithms exist. Most are based on in situ data. The column can change so in situ validation will be necessary. Here are two classic papers by Lyzenga that can help:
https://www.osapublishing.org/ao/abstract.cfm?uri=ao-17-3-379
https://ieeexplore.ieee.org/abstract/document/1661813

Question 22: The phytoplankton growth is correlated with the metal presence in the ocean especially Iron (Fe). How iron emissions (or any other metal) affect the coastal ecosystem? How can we identify iron present in oceans through satellites?
Answer 22: Iron is one of the limiting elements in the ocean particularly in what relates to phytoplankton. Other metals like Nickel or Copper might be toxic to species. Here's a paper that talks about iron and other water column components and their relationship with phytoplankton as studied with remotely sensed data.
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2001GB001640

Question 23: Can you tell us more about the floating algae index?
Answer 23: Index that was defined by Hu, it was particularly for sargasm. It used 2 bands from MODIS. Here's the citation:
https://www.sciencedirect.com/science/article/pii/S0034425709001710

Question 24: In slide 32 you mention laying black/white tarp - in situ readings for water column correction. How important is this step? Is there any method like dark pixel subtraction for water column correction?
Answer 24: Yes, use can dark pixel subtraction. This tarp was an effort to find a simple method. White target and dark target to apply to the images for correction.

Question 25: Hyperspectral imagery sensors compromise in spatial resolution which leads to mixed pixels formations. Is there any algorithmic approach to correct the mixed pixels into pure pixels? Is there any hyperspectral unmixing tool available for researcher's use to unmix those mixed pixels for better information retrieval from HSI?
Answer 25: Here are two papers related to hyperspectral unmixing for coastal areas:
https://www.mdpi.com/2072-4292/10/8/1208
https://www.spiedigitallibrary.org/conference-proceedings-of-spie/6204/62040H/An-algorithm-to-retrieve-coastal-water-optical-properties-bathymetry-and/10.1117/12.667968.full?SSO=1

Question 26: Does the spectral calibration data need to be collected simultaneously with the satellite imagery in order to be used? Or can the in situ data be used at different times/sites?
Answer 26: It can be used at different times, but the closer the two the better because it ensures you are characterizing the same thing. The presence/absence of water column constituents can change at a very high temporal resolution.

Question 27: How is runoff water related to change in ecology? And how can we relate this?
Answer 27: It would affect benthic tropical coral reefs. The higher the concentration of sediments in the column, the less light penetration. Thus less zooxanthellae photosynthesis and the host (coral) metabolism also becomes affected. Sediment settling atop the coral can affect the delicate coral tissue. Corals have an extremely delicate tissue, this is why WE DON'T TOUCH THE CORAL.

Question 28: How is the hyperPro Profiling Spectroradiometer different from the GER-1500 spectroradiometer? Can you use GER-1500 spectroradiometer to derive Kd?
Answer 28: GER is handheld. Not used to derive Kd. It is for RS reflectance. hyperPro is submerged in the water and used to get the Kd curve.

Question 29: Can you meaningfully derive IOP & AOPs from remote sensing in very shallow coastal waters where the seabed is visible through the water column?
Answer 29: It is very challenging because of the influence of the bottom albedo. Alternatively, you can use pixels outside of the reef contours as proxies.

Question 30: Can you do water column correction from RS image instead of going to the field to check spectral signature by diving when you know the area well (could clearly identify sand/rock areas from RS images)?
Answer 30: You would still need some empirical value to validate your image analysis. If you can not get to the study site, it might be useful to research the literature for correlation factors for waters with similar composition as your study site. Still, this would be an approximation of the real values and it is a source of error that needs to be considered during the analysis.

Question 31: Is there any existing algorithm to do water column correction, before using AVIRIS NG hyperspectral data for studying coral reef systems or prior to, should we have to have in-situ data?
Answer 31: Not yet. Also, remember that both AVIRIS Classic and NG were developed for land-based studies and, while they have been used in coastal studies, this is something to consider.

Question 32: How do you combine images of different resolutions, like the landsat and VIIRS images of the sediment plume you showed in the start of the presentation?
Answer 32: These images were not combined. Simply one was overimposed on the other geographically to show the river plume extension as measured by VIIRS.