Question & Answer Session Part 3

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 Amber McCullum (amberjean.mccullum@nasa.gov), Juan Torres-Pérez (juan.l.torresperez@nasa.gov) or Zachary Bengtsson (bengtsson@baeri.org).

Question 1: is there a specific waiting time required to get data from (HICO, Ocean Color Web, CORAL) ?

Answer 1: There is no wait time when downloading HICO data from OceanColor Web. The entire data archive is available, with single file and bulk download options. Keep in mind, HICO is only available for certain years. CORAL data is still in the processing stage and may not yet be available for all study sites. Some CORAL data is available through OceanColor Web: https://oceancolor.gsfc.nasa.gov/projects/prism-coral/

Question 2: What tool have you used to plot the correlation between HICO and water quality parameters (CTD, Turbidity, CDOM)? How about the degree of alkalinity, ph, salinity?)

Answer 2: If you are referring to a particular image or figure within the slides, we have the associated studies linked on each slide for you to take a look at. Level 2 HICO data products from NASA include data layers that display chlorophyll-a and Kd490 light attenuation, which is a metric for turbidity. These data are derived from algorithms similar to those used when deriving the same metrics from MODIS. Make sure to look through the case studies we have provided to see how hyperspectral data is processed to derive parameters like this.

Question 3: How were you able to extract the different coral spectral signatures?

Answer 3: In the case shown, spectral signatures from corals were obtained using a hand held field spectroradiometer, in this case a SpectraVista GER-1500 but there are other brands out there. Data was collected underwater and the spectroradiometer was inside an underwater housing. Some data, not shown here, has also been collected with the same spectroradiometer but with a fiber optics cable. To correct for atmospheric or water column changes during the data collection, a diffuse panel (Spectralon) is usually used as part of the standard procedures for coral and other benthic components data collection.
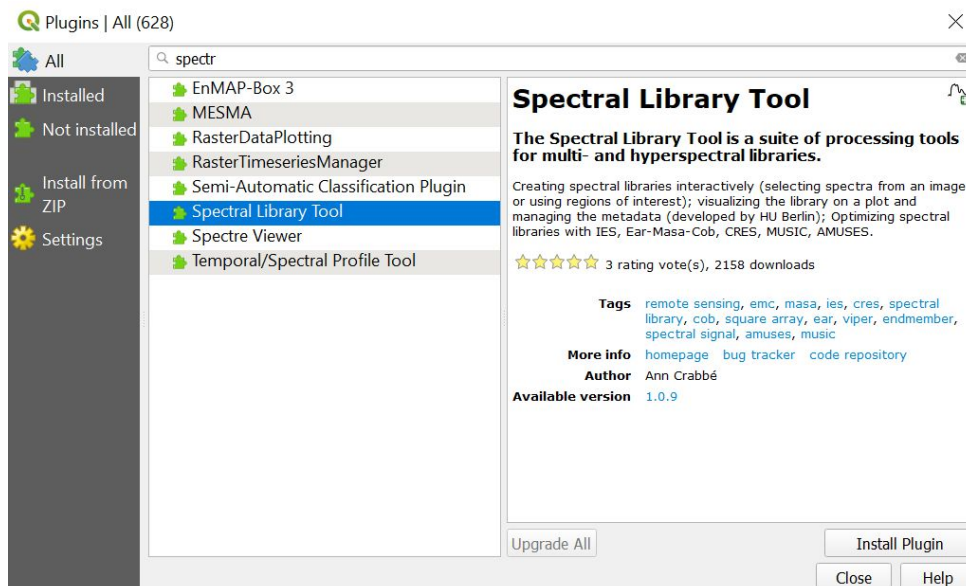
Question 4: Can you tell us more about the conversion of NetCDF format to other format like GeoTiff format?

Answer 4: A NetCDF data file can contain many variables, dimensions, and attributes. The conversion of NetCDF to GeoTiff requires the user to choose which variable/attributes you would like to display. There are a few different tools you can use for this conversion, it can be done in ENVI and SeaDAS. Here are a few other references that may be of interest:

- MODIS tutorial for ENVI: It mentioned hdf conversion here, so I bet the process could be the same for hyperspectral data:
  https://yceo.yale.edu/importing-modis-products-envi
- External HDF conversion tool: While not in ENVI this could also work for you:
  https://hdfeos.org/software/heg.php

Question 5: Apparently Qgis plugin for hyperspectral data .e.g spectral library tool..,Raster data plotting ..are not within the list of plugins.Is there any other way of plugin without interference of the Qgis system?

Answer 5: You will have to install the spectral library plugin yourself. If you are in QGIS, click on Plugins, then Manage and Install Plugins, then type in "spectral" in the search and you will see this to install the plugin. You might want to restart QGIS after you add it.

Question 6: is there a way to get attributes related to hyperspectral features?

Answer 6: Freely available spectral libraries for aquatic hyperspectral data appear to be less common. However, you can use hyperspectral imagery to identify a variety of benthic and water quality features. Similar to multispectral data, algorithms can be applied to hyperspectral imagery to evaluate water quality (chlorophyll, turbidity, etc.). Benthic cover mapping may also rely on the application of algorithms or machine learning. As with all remote sensing, it's a good idea to incorporate in situ or field data from your study area when creating algorithms or validating results of your imagery analysis. Water column corrections will need to be applied often as it keeps changing so timing of the overpass is important for benthic systems.

Question 7: You mention challenges associated with the use of drones to collect hyperspectral imagery. While i'm aware of some challenges, I'd be interested in hearing what challenges you're aware of in relation to this application

Answer 7: These are challenges associated with the platform stability (pitch, yaw, roll), whether it is pointing at the sun or not, sun glint, and others. Also, the sensitivity of the sensors flown with the UAS has to be taken into consideration as in a lot of cases, the UAS just comes with an RGB camera. For UAS's a number of new hyperspectral cameras have been produced but their sensitivity, particularly, for coastal or underwater targets, are still to be determined.

Question 8: How do you know when typical atmospheric correction algorithms are not suitable?

Answer 8: Ideally, you will have access to field or in situ data collected directly from your study area. This data can be used to validate reflectance or other remotely sensed parameters obtained from satellite data. You may be able to find freely available data to do this in SeaBASS:

https://seabass.gsfc.nasa.gov/

You might also notice image artifacts or a high number of missing pixels in your processed imagery if the atmospheric correction algorithm is not appropriate for your data.

Question 9: If you would like to learn more about PACE's hyperspectral capabilities and how to get involved with PACE Applications see our website: https://pace.oceansciences.org/applications.htm

Answer 9: Thanks Erin Urquhart, Applications coordinator for PACE who provided the information!

Question 10: Estimating the absorption maxima for each photosynthetic pigment is possible by calculating the second derivative from the reflectance spectrum. However, there is a shift between in vitro maximal absorption and in vivo absorption for the same pigment. So, does there exist a database to identify the in vivo wavelength for each photosynthetic pigments from second derivative peaks?

Answer 10: This is very true. It is what is known in chromatography as the Hypsochromic shift" where the absorption features change due to the effect of different solvents when extracting the pigments from the sample. There are two books which I have used for many years and have an extensive library of spectra from particular pigments where it shows where these pigments absorb after extraction. The two editions of the Phytoplankton Pigments in Oceanography book edited by Roy et al. which talks about this issue. You may find additional info on this book at: www.cambridge.org/97811070000667

Question 11: Can you please provide references for water column correction?

Answer 11: The classic papers of Lee and Carder among others are very useful as they provide different ways of assessing water column correction. It is important to note that most, if not all, water column corrections are done during the satellite or aircraft overpass since the water column changes constantly. Here's the Lee et al paper of 2001 for water column and bottom derived information from AVIRIS: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2000JC000554
Ocean Optics by Mobley is open online and it is another great source: https://oceanopticsbook.info/view/introduction/overview

Question 12: Hi, could you please say something about passive fluorescence? How it is computed and some applications.

Answer 12: A usual process is to calculate the Line Fluorescence Height which is a relative measure of the amount of radiance leaving the sea surface in the chlorophyll emission band and uses a linear fit between two bands at 667 and 748nm. Here is more info on Fluorescence Line Height: https://oceancolor.gsfc.nasa.gov/forum/oceancolor/topic_show.pl?tid=1313

Question 13: What model of spectrometer was used to collect the in situ data shown in slide 8?

Answer 13: SpectraVista GER-1500. There are others from different companies. This one we have used for more than 20 years and there is a new version of it. This one comes with underwater housing.

Question 14: Slide 8: Coral spectra; is it underwater, or corrected from water absorption?
Answer 14: The spectra was collected underwater with a spectroradiometer enclosed in an underwater housing. The radiometer already comes with a setting particularly aimed at correcting for the use of the housing and a Spectralon panel was used for correction.

Question 15: Is calibration based on ground-truth and/or cross-referencing with other sensors?
Answer 15: Yes this can be done with both, ideally you will calibrate an instrument using ground-based data.

Question 16: Slide 17: Comparison of field and AVIRIS: Is there a water column correction?
Answer 16: Yes. In this case, the researchers at the UPR used a series of underwater tarps to correct for water column effects. This was a relatively shallow site (less than 2m) but the before and after graphs show how even in shallow waters still there is an important influence of the water column even in relatively shallow waters.

Question 17: How were you able to extract the different coral spectral signatures?
Answer 17: See Q 13 above

Question 18: What tools, and input data, would you advise for atmospheric correction? In particular, how do you manage the aerosol content which is probably the most variable and hard-to-determine atmospheric constituent?
Answer 18: I believe most atmospheric correction models will incorporate atmospheric data from the date your imagery was collected to eliminate influences related to daily variations in aerosols. However, you may have to explore additional methods to minimize the influence of aerosols in your data. You may need to avoid the use of pixels that don't pass a certain quality metric, or your atmospheric correction platform may eliminate pixels that cannot be salvaged. Keep an eye out for image artifacts and exclude any data that appear heavily influenced by atmospheric conditions.

Question 19: Is the Hyperspectral data available for the MENA region free?
Answer 19: There is a limited amount of hyperspectral data available in this region. All NASA data is freely available, and you can take a look at the spatially extent of data on NASA OceanColor Web, EarthExplorer, GloVis, and NASA Earthdata.

Question 20: I understand that a satellite is not necessarily decommissioned at the exact planned date; like for QuickScat. If so, how is the decision taken; based on a set of performance indicators?

Answer 20: It depends on how well the sensor is performing and if the data are being used by the community. Generally, satellite sensors last well beyond their planned date, and generally NASA keeps those sensors in operation so long as the sensor is working as planned. Each sensor likely has a set of their own performance indicators and if the data are degraded past a certain threshold, the sensor will be decommissioned.

Question 21: Why do AVIRIS and in situ reflectances diverge more towards the larger wavelength (in the visible range) [slide no. 17]?

Answer 21: This is because of the high absorption of those wavelengths in that particular region (red, NIR). Also, the presence of organic matter has an influence on those regions.

Question 22: Since the number of bands within a given wavelength range is several times higher in Hyperspectral sensors than their multispectral counterparts, will the response of the former be more noisy, comparatively?

Answer 22: Yes, as the wavelength range of each band decreases, the noise will become larger, this is why the signal to noise ratio is important to consider with hyperspectral data.

Question 23: It is convenient if any hands on training on processing of hyperspectral data for any component like seagrass, mangrove, coral etc. Do you consider this issue in this session or future?

Answer 23: We don't have anything like this planned at the moment, but we always like to hear about what trainings you all are interested in. Be sure to take our survey to let us know the advanced topics you would like to see in the future. As more hyperspectral missions are planned and successfully launched, I am sure we will look into holding additional hyperspectral webinars.

Question 24: Are there any recommended portable and lab spectrometers for land applications?

Answer 24: The same ones mentioned in this webinar can also be used for land applications. Ocean Optics have a smaller, less costly version which is connected at all

times to a laptop (not for underwater targets). The GER-1500 and its later versions can be used in land and underwater targets.

Question 25: Slide 25 - For the classification, how did you compensate for varying water absorption?
Answer 25: See Question 11 above

Question 26: Different species of seagrass can be identified with hyperspectral data? i'm in a project for the monitoring of seagrass beds in campeche, Mexico, but there isn't very much data there besides multispectral.
Answer 26: Most times, no. Seagrasses are extremely similar spectrally. They can be distinguished from some types of macroalgae but this is also where spatial resolution of the sensors come into place.

Question 27: You mentioned challenges associated with the use of drones to collect hyperspectral imagery. While i'm aware of some challenges, I'd be interested in hearing what challenges you're aware of in relation to this application.
Answer 27: Cost, georeferencing and coregistration, while the resolution is higher, the spatial coverage is limited, you also need to spend time and resources to be in the field, you must adhere to flight regulations

Question 28: Different species of seagrass can be identified with hyperspectral data? I'm in a project for the monitoring of seagrass beds in Campeche, Mexico, but there isn't very much data there besides multispectral.
Answer 28: Hyperspectral data might be useful for this purpose. But in my experience, differentiating between seagrass species using spectral information is not practically possible. Seagrasses tend to be too spectrally similar to complete this kind of analysis. You are also correct that hyperspectral data is limited and not available for most study areas.

Question 29: What algorithms were used to generate these vegetation type classifications? How was the initial labelling performed?
Answer 29: In the Hati et al paper (2020: https://www.sciencedirect.com/science/article/pii/S111098232030332X) the authors used a mixed of Principal Components Analysis (PCA), K-means Classification and Support Vector Machine for addressing mangrove composition. You may find all the specifics on the paper mentioned above.

Question 30: How can HICO assist coastline monitors watching for cyclones, transmit early warning data to their landlocked (developing country) neighbours (i.e. Mozambique, Zimbabwe etc.)?

Answer 30: Remember, HICO data is only available for certain years (2009-2014). If the idea is to monitor coastlines before and after recent atmospheric events, then we recommend looking for alternate image sources that are currently in orbit.

Question 31 How to get the spectral information of the materials present in ground truth of hyperspectral images?

Answer 31: You will either need to use a field spectroradiometer like the one we mentioned in the webinar or do a search on spectral libraries. One site you may want to explore is SeaBASS: https://seabass.gsfc.nasa.gov/. Whenever you can, we highly recommend collecting the field data during (or within 1-2 hours max) of the satellite overpass, particularly for underwater targets as the water column changes constantly.

Question 32: On animation slide 24, I don't understand how we can see deep sea bottom features disappear around 650nm, and reappear reappearing at longer wavelengths (>800nm), as the water column absorption is stronger in this part of the spectra than in the visible part?

Answer 32: In this particular case, a contrast stretching was applied which enhances those features with low signal. The areas shown after 800nm are most likely very shallow areas, mostly sand, which in fact, usually have a very high reflectance signal through the spectrum. It could also be the case that these particular waters have a very low CDOM concentration and with the image manipulations you can see the bottom, particularly if the contrast is manipulated. Since this is usually done manually, there is a possibility that less contrast was applied when manipulating the 650-800nm regions. To address this issue, in situ irradiance data is also needed.

Question 33: Is any of the SeaDAS available as a Python API? GUI are all well and good but not much use for doing things at scale.

Answer 33: I'm not aware of any Python API for SeaDAS. But you can use command line to batch process imagery in SeaDAS, which essentially allows you to create a pipeline for automating application of data processing steps. Here are some helpful links to get you started:

http://ocean.stanford.edu/research/seadas7.html

https://seadas.gsfc.nasa.gov/help/GptCookbook/gptCookbook.html

Question 34: You mentioned that standard atmospheric correction algorithms might not be ideal in some cases. Can you elaborate and do you have any suggestions for algorithms to use with both hyperspectral and multispectral data?

Answer 34: Most atmospheric algorithms were developed for land applications. Since the water is a much darker target than land systems, the atmospheric algorithms usually have to be modified. A few years ago we published a paper (Palacios et al 2015) where we studied this issue with hyperspectral data:
https://www.sciencedirect.com/science/article/pii/S0034425715300146

Question 35: What might be the differences between processing ocean color or any other imagery data in SeaDAS and in using the Giovanni data portal?

Answer 35: While the Giovanni data portal is a great tool, it is mostly designed for basic data analysis and mapping. I would say that for more advanced processes it is probably desirable to use SeaDAS or another platform either commercial or openly available. Also, there are certain types of data that are not processed in Giovanni at certain levels including HICO data.

Question 36: Is SeaDAS ocean data specific? Or, can it also be used for the terrestrial ecosystems?

Answer 36: SeaDAS was meant for analyzing ocean and coastal systems data. Nonetheless, as demonstrated when you move your cursor over non-masked land areas you will still see the spectral features of those targets. For in-depth analyses of land targets, you may want to explore other alternatives or commonly used software (QGIS, ArcGIS, ENVI, ERDAS, etc.)

Question 37: Is the pre-processing of Hyperspectral data different from Multispectral data? And if it is, how is it different? Please explain. And also, is the pre-processing of AVIRIS-NG different from other hyperspectral data like Hyperion, etc.? Please explain.

Answer 37: While there are similar techniques that need to be applied to all remote sensing data such as radiometric/atmospheric corrections and conversion of radiance values to reflectance, the process will be different depending on the sensor.

- Here is a nice resource for AVIRIS processing:
  https://www.l3harrisgeospatial.com/docs/PreprocessAVIRIS.html
- Here are some overview slides related to Hyperion processing
- Here is a nice comparison of AVRIS and Hyperion (related to mineral mapping, but has a nice overview too):

https://aviris.jpl.nasa.gov/proceedings/workshops/02_docs/2002_Kruse_Hyperion_web.pdf

Question 38: During the demo, you said the data isn't necessarily calibrated to our specific region. What did you mean?

Answer 38: I believe you're talking about where I mentioned the chlorophyll layers available in level 2 data products. All level 2 data products are successfully processed to surface reflectance, so Rrs (surface reflectance) is analysis ready for each of the sites where imagery is available. However, additional information within the NetCDF files, like chlorophyll layers, may not give you an accurate assessment of phytoplankton since the types of phytoplankton, and their associated pigments, vary from ecosystem to ecosystem. This means that you might want to complete your own analysis of environmental parameters using methods appropriate for your study area, which you can proceed with using surface reflectance data included within the level 2 product.

Question 39: The SeaDAS OCSSW remote server has not worked for me for more than a year when I took an ocean watercolor training . I seethat this training uses SeaDAS while the OCSSW remote server is down. Please provide a solution. Thanks

Answer 39: Sorry about the issue. First, I suggest removing and downloading the software again. If you tried that and still doesn't work, you may want to contact the SeaDAS group: https://seadas.gsfc.nasa.gov/client_server/

This issue might also be due to your machine. Mac and Linux are readily able to contact the OCSSW remote server, but I believe the same is not true for Windows. There are additional installation steps necessary for those not using MacOSX or Linux, which can be found here: https://seadas.gsfc.nasa.gov/downloads/
And here: https://seadas.gsfc.nasa.gov/tutorials/installation_tutorial/
You might also have better luck with the newest version of SeaDAS. SeaDAS 8 was made available the day before this session and might be more easily accessible for Windows users. Make sure to read the detailed installation instructions.
SeaDAS 8: https://seadas.gsfc.nasa.gov/downloads/

Question 40: Hi, curious—are there any notebooks showing how these datasets might be processed using Python/R/Matlab?
Answer 40:

- Here is a resource for Python:
  https://towardsdatascience.com/hyperspectral-image-analysis-getting-started-74758c12f2e9
- And another Python: https://pypi.org/project/hypers/
- hyperSpec for R: https://hyperspec.r-forge.r-project.org/
- Hsdar for R: https://www.jstatsoft.org/article/view/v089i12

Question 41: Can we use hyperspectral data to track the morphological evolution of coastal dunes? Are they free to download? Can they give us good results if the area is small?
Answer 41: I suggest looking into Hyperion data which has a 30m spatial resolution. HICO data is slightly coarser or might be too coarse for small dunes. Another alternative might be to do a search on any airborne data that might be available. NASA data is free but commercial data might not be. Also, if it is just to measure the extent of coastal dunes or how they have changed over time, multispectral (but with higher spatial resolution) might just be enough.

Question 42: Which wavelengths do plastic waste absorb? Which satellites have enough resolution to detect plastic waste accumulations on rivers and coast lines?
Answer 42: This will depend on the characteristics of the material. Here's a paper from Acuña-Ruz et al in 2018 that we mentioned earlier in this webinar series (https://www.sciencedirect.com/science/article/pii/S0034425718303730) and also additional information was covered in the Remote Sensing for Coastal Ecosystems webinar from 2020 (https://appliedsciences.nasa.gov/join-mission/training/english/remote-sensing-coastal-ecosystems)

Question 43: How far into the infrared range has coastal hyperspectral (or even multispectral) been explored? SWIR or even LWIR.
Answer 43: This varies with the sensor. For Hyperion, for example, the SWIR bands go from 912nm to 2,395 nm with a 10nm bandwidth. HICO only goes to 900nm.

Question 44: What is the best way to choose appropriate bands?
Answer 44: This will also depend on the target of interest. For photosynthetic organisms, it is important to consider which are the main photosynthetic pigments of these organisms, whether they are chlorophylls, phycocyanin, phycoerythrin, peridinin (in the case of corals). A lot of times, because of the inherent redundancy of hyperspectral data (since there are a lot of bands close to each other), complex

multivariate analyses (PCA, k-means, Support Vector Machine, etc) are needed to choose which bands are more useful than others.

Question 45: The Airborne acquisitions are probably really limited. Is this opportunity only limited to US users, maybe only governmental?
Answer 45: Airborne acquisitions are pretty limited, but are not limited to US users or waters. Usually, researchers must submit requests or proposals to have their study areas sampled in an AVIRIS or other airborne mission. See how the NASA Airborne Science Program flight request process works here:
https://airbornescience.nasa.gov/sofrs/

Question 46: Collecting in-situ hyperspectral signatures is time consuming and often ancillary analysis (sedimentology, chlorophyll content, etc..) is required depending on the analysis objective. Can we use machine learning to select best bands in our in-situ spectras and then use those bands to classify hyperspectral imagery (say, with only in-situ 50 spectras)?
Answer 46: Yes. This is related to Q6 above. Lately, machine learning methods have become more and more useful for selecting adequate bands for studying different targets (land or coastal). Spectral end-member analysis is also useful, particularly when there is a high chance of having mixed pixels in the image such as in complex ecosystems like reefs and others.

Question 47: What are some general atmospheric and water correction models that are used in this field?
Answer 47: Models such as ATREM, FLAASH, 6S and others have been used. Keep in mind, most of these were developed for land data. In a paper we published in 2015, Palacios et al explored the limitations of these atmospheric correction algorithms when dealing with coastal and inland waters. Here's the link:
https://www.sciencedirect.com/science/article/pii/S0034425715300146

Question 48: I noticed in coastal areas hyperspectral literature, subaerial substratum is often classified in broad classes, such as sand, mud, clay. Can we use hyperspectral signatures to determine grain size, or at least discrete classes of grain sizes?
Answer 48: Most likely no. It is important to remember that optical data in particular only shows how the targets reflect the incident light. This might be a theme to explore with other types of remotely-sensed data.

Question 49: Does CORAL library include sand grain size analyses of ground-truth samples? I am doing research on hyperspectral sand. If yes, is the data available?
Answer 49: I don't think so. You may want to communicate with the CORAL team to find out if this was collected. https://coral.jpl.nasa.gov/

Question 50: I am aware that many creatures in the Ocean are yet to be detected. If hyperspectral signals can detect algae and reefs, can we detect other organisms as well? Until what layer/depth in the ocean do these signals reach?
Answer 50: Detecting undiscovered organisms using hyperspectral remote sensing is not very likely. Remote sensing does not usually capture reliable data past shallow depths, and hyperspectral remote sensing in particular relies on the penetration of sunlight through the water column. The spatial resolution of hyperspectral sensors is probably too coarse to identify features you are not already looking for. Hyperspectral data is also only available over certain spatial extents and at a very limited temporal resolution, which is why it is typically only used to gather data on sessile organisms that do not move very much (like coral) or widespread organisms represented in high numbers within the water column (like phytoplankton).

Question 51: Can you send or link references or additional information on the method(s) used to compare and validate satellite imagery to handheld spectrometry data? Was the handheld spectrometry data processed using the same tools as the satellite data?
Answer 51: The paper mentioned by Bell et al (2020) is a good example and contains many useful references. Here's the link:
https://www.sciencedirect.com/science/article/pii/S0034425719306510

Question 52: The coral reef study is impressive... Do you have any projects based on this topic in Countries that have part of their economy based on fishing living in coral reef? I think it could be an interesting topic (sorry maybe is a banal question).
Answer 52: Not banal at all! There are many studies that have been conducted in countries, many small tropical islands, where fishing is one of the main economic sources for the local communities.
Here are some examples: Bertels et al (2008) -
https://www.tandfonline.com/doi/full/10.1080/01431160701408469
Here's a summary paper:
https://www.sciencedirect.com/science/article/abs/pii/S0924224414000648

Question 53: What are some challenges in mapping freshwater plants in or on the boundaries of lakes and rivers using hyperspectral data? Has there been much work done in this area?

Answer 53: There are a number of considerations, including water depth, turbidity, presence of photosynthetic plankton communities, etc, as all of these will affect the retrieval of benthic information in any water body. Also, spatial resolution is crucial since it will impact the area that you can process with a good certainty. Those pixels located at or near the river or lake boundaries will probably have a mixed component of land and water and you will want to avoid those. BTW, we will have a lakes and reservoirs webinar starting next week! Here's the link:
https://appliedsciences.nasa.gov/join-mission/training/english/mapping-and-monitoring-lakes-and-reservoirs-satellite-observations

Question 54: What is the atmospheric correction model and water column correction used for a Level 2 HICO data?

Answer 54: Here's a link to one of the latest technical reports on Atmospheric correction. This one is mentioned on the HICO website as the go-to document for details on atmospheric correction (Mobley et al 2016):
https://oceancolor.gsfc.nasa.gov/docs/technical/NASA-TM-2016-217551.pdf
Also, in the HICO website (https://oceancolor.gsfc.nasa.gov/atbd/rrs/) you may find additional information on the water column correction.

Question 55: Is SeaDAS only for use of coastal data?

Answer 55: SeaDAS was meant for analyzing ocean and coastal systems data. Nonetheless, as demonstrated when you move your cursor over non-masked land areas you will still see the spectral features of those targets. For in-depth analyses of land targets, you may want to explore other alternatives or commonly used software (QGIS, ArcGIS, ENVI, ERDAS, etc).
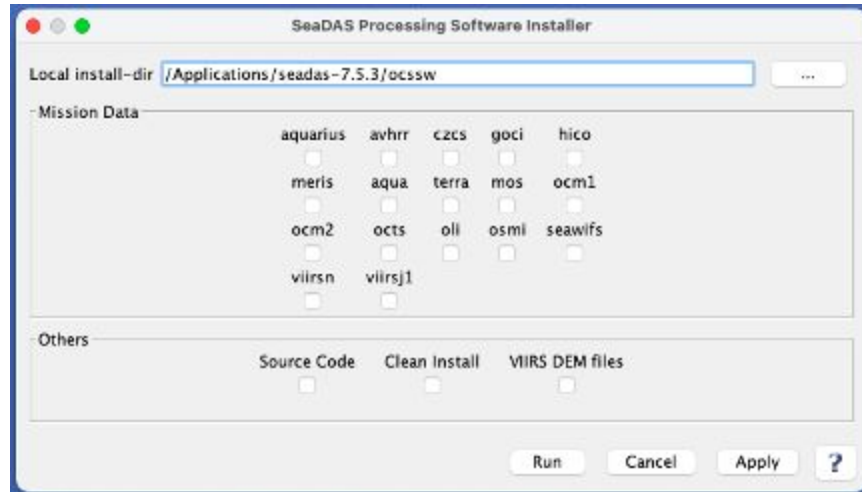
Question 56: How do you remove the effects of clouds/haze before processing the hyperspectral images?

Answer 56: Optical sensors cannot see through clouds. Cloud covered pixels should be removed from analysis. Atmospheric influences should be eliminated during the atmospheric correction process. But certain haze and aerosol effects may persist in your imagery. Pixels like this are typically excluded from analysis. It's important to do thorough visual inspections of your data to identify image artifacts or cloudy areas that should be excluded from your work. A composite with additional overpasses should assist.

Question 57: Can I use SeaDAS for any kind of NetCDF processing from other satellites like OCO-2?

Answer 57: SeaDAS processing components are available for the sensors pictured here in the processing component installation window. You may be able to use SeaDAS for processing data from other sites, but I'm not familiar with how to do this.

Question 58: About the live demo: Can you combine multiple bands to create the true RGB images instead of using 3 narrow bands?

Answer 58: You can produce any band combinations you are interested in within SeaDAS. The RGB tool is just a quick way to represent data. SeaDAS has bandmath functions that can be used to create more complex images with more than 3 bands.

Question 59: Have the HICO data been corrected for the spectral shift problem that existed earlier?

Answer 59: HICO data corrections should mitigate most of the effects of spectral shift. The most recent assessment of HICO data processing I was able to find states that spectral alignment protocols meet or exceed alignment requirements for HICO data.

Question 60: In today's presentation you mentioned HICO imagery may be taken at different times of day and from different angles, making inter comparison of imagery in the same area difficult without additional correction. Are these differences corrected for in the HICO data available on OC website?

Answer 60: All HICO images on the OceanColor website go through the same processing and correction steps. But this does not correct for time differences in which

the data was collected. Geometric corrections that occur during processing may help with differences in angles between images. HICO was mounted on the ISS.

Question 61: Can hyperspectral data can also be used to monitor and observe oceanographic parameters like current, waves, and ebb/flow?
Answer 61: Usually no, But multi has been used to detect oceanographic parameters. Here's a paper where hyperspectral data was used for ocean surface characterization: https://www.osapublishing.org/oe/fulltext.cfm?uri=oe-27-2-1750&id=404147

Question 62: Can hyperspectral data be used in water quality in inland water reservoirs, river banks, and ponds? If so, can you please provide more information on that?
Answer 62: Please refer to Q15 above.

Question 63: Can the HICO data be used in the common remote sensing platforms apart from SeaDas?
Answer 63: Yes, you can process this data with common software platforms. Some common platforms may have difficulty extracting data from the compressed NetCDF files available through NASA OceanColor Web, but you can use SeaDAS (or another platform of your choice) to extract data or export to a new file type for use in a more common platform.

Question 64: Has there been any hyperspectral work looking at coastal wetlands? In particular coastal wetland health and stressors?
Answer 64: Yes. There has been a number of projects all over the world that either use hyperspectral data alone or a combination of multi- and hyperspectral data for studying different aspects of wetland ecology. Here's a review from Adam et al (2011): https://link.springer.com/article/10.1007/s11273-009-9169-z and a more recent one by Li et al (2020) on wetlands affected by man-made constructions: https://www.tandfonline.com/doi/abs/10.1080/2150704X.2020.1734247

Question 65: Does this software allow us to calculate different spectral indexes?
Answer 65: SeaDAS Math Band tools should allow you to calculate spectral indices. Take a look at the SeaDAS Help guide here to learn about the tools available: https://seadas.gsfc.nasa.gov/help/

Question 66: Will there be a webinar focused on mapping and monitoring rivers and streams?

Answer 66: We will have a lakes and reservoirs webinar starting next week which may be applicable! Here's the link:

https://appliedsciences.nasa.gov/join-mission/training/english/mapping-and-monitoring-lakes-and-reservoirs-satellite-observations

Also, here's the link for a webinar we did in 2019 on Freshwater Ecosystems:

https://appliedsciences.nasa.gov/join-mission/training/english/remote-sensing-freshwater-habitats

Question 67: Still do I need to download SeaDAS 8 for HAB studies? Can you explain what "an extension of the ESA SNAP platform" means? Can one get it downloading the latest versions of ESA's Snap?

Answer 67: For this demo we used SeaDAS 7.5.3 on Mac, which is a separate platform from ESA SNAP. SeaDAS 8 was just made available the day before this session. You can locate the version we used for the demo here:

https://oceandata.sci.gsfc.nasa.gov/SeaDAS/installer/7.5.3/

SeaDAS 8 is essentially the full SeaDAS toolbox made available through ESA SNAP. The reason for this is to integrate NASA satellite drivers and ESA's Sentinel-3 toolbox in one place. So with the new SeaDAS, you will be able to readily process both NASA and ESA Ocean Color data in one platform. Please see more detailed installation instructions here:

https://github.com/seadas/seadas-toolbox/wiki/SeaDAS-8.x-Download,-Installation-and-Run-Instructions

In the specific case of HAB studies, either SeaDAS 7.5.3 or SeaDAS 8 should be appropriate (depending on your sensor needs).