



## Part 2: Questions & Answers

Please type your questions in the Question Box. We will try our best to answer all of your questions. If we don't, feel free to email Erika Podest ([erika.podest@jpl.nasa.gov](mailto:erika.podest@jpl.nasa.gov)) or Sean McCartney ([sean.mccartney@nasa.gov](mailto:sean.mccartney@nasa.gov)).

### **Question 1: Why do different bands in Sentinel-2 have different resolutions?**

Answer 1: This is due to a combination of reasons, among which we highlight user requirements and data transmission and storage issues.

The amount of data generated by each Sentinel-2 satellite is huge (1.6 TB of data per orbit); and images with higher spatial resolution are larger and they occupy more space. The choice of having bands with different spatial resolutions allows optimizing the spatial resolution based on the type of application/user requirements of that band. For example, agriculture requires higher spatial resolution than atmospheric applications (think about precision farming versus cirrus cloud screening).

### **Question 2: Can I change level-1C to level-2A via SNAP?**

Answer 2: Yes, using Sen2Cor as a SNAP plugin.

### **Question 3: In Slide 15 of the handout bi-linear interpolation pros - image loses sharpness compared to nearest neighbor? Is that a Pro or a Con?**

Answer 3: In terms of image visualization it is a pro because you do not see the original pixel shape, but if you want to perform a time series analysis it is a con because it's going to modify the data by interpolating them.

### **Question 4: How can we best use/analyze Sentinel-2 NDVI time series point data without being biased in removing the data affected by clouds?**

Answer 4: Good question! We assume that sharp decreases followed by sharp increases constitute a very cloudy measurement. But of course, thin clouds will cause a less abrupt decrease, and so they may remain in your series, after your cloud removal approach. On the other hand, you don't want to over-remove measurements, otherwise you lose important



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information. Try to find a compromise, where the end result still looks realistic based on the pattern of development of your crop. Pixels with a bit of clouds are still valuable.

**Question 5: In which application area is the bottom of atmosphere (BOA) data used and why?**

Answer 5: The BOA data are used if you intend to allow comparison between images, to allow repeatable measurements (e.g., ground spectra comparison to satellite observations) and to represent a known physical unit.

**Question 6: During atmospheric corrections or cloud masking removal process, do we lose mathematical information or critical data for Sentinel products? Can we really get insights when cloud coverage is >60-70% or mask the cloud to get valuable information?**

Answer 6: Yes, you can get S2 data with 60-70% cloud coverage and get valuable information by masking the clouds. This is needed when you have to analyse an area covered often by clouds.

**Question 7: What is the range of NDVI for vegetation at different growth stages?**

Answer 7: NDVI goes from 0 to 1. Values above 0.6 indicate that the vegetation is healthy.

**Question 8: Why didn't Sen2Cor give me back the band 8 (NIR) of the Sentinel-2? In Google Earth Engine the images atmospherically corrected don't have the band 8. Why?**

Answer 8: if you process the S2 data using Sen2Cor at 10 m resolution, you will have as output all the 10 m bands (except the B8 because you have the B8A at 20 m) + all the 20 m bands at 20 m and all the bands except B8 and B10 at 60 m resolution. Maybe in GEE they take B8A avoiding B8 to save time and space.

**Question 9: How do I isolate the LAI for a particular crop (e.g., wheat) from the low vegetation LAI data? The low vegetation LAI data could also include grass LAI, right?**

Answer 9: You need in situ measurements to classify and distinguish different crops or to discriminate crops from vegetation. I think that Sophie Bontemps will clarify your doubt during the webinar on 10/19/2021 titled "Biophysical Variable Retrieval using Optical Imagery to Support Agricultural Monitoring Practices".



**Question 10: What are the VIs that can be used to estimate the ecosystem respiration? How confident are such retrievals?**

Answer 10: Maybe you can estimate evapotranspiration. On SNAP you can install an external plugin called SenET <https://www.esa-sen4et.org/>.

**Question 11: How can I calculate the LAI using Sentinel-2 or Landsat-8?**

Answer 11: On SNAP there is a processor called the L2B Processor (shown during the demo) to retrieve LAI from S2 and L8.

**Question 12: Is there a way to correlate Sentinel-2 bands with Sentinel-3 bands, knowing the big difference in resolution?**

Answer 12: Yes, during the demo I will show you how to do it on SNAP. The tool is called “Collocation” and it relies on the geolocation of the satellite, meaning no coregistration is applied.

**Question 13: Can we use Sentinel-3 products for agricultural monitoring?**

Answer 13: Yes. If you have to analyze a large area and you do not care about high spatial resolution, you can use S3 data at 300 m spatial resolution. You will have almost daily acquisitions and you do not have to wait for a 5-day revisit time.

**Question 14: Where can one find all the indices (for all the kinds of crops or other in agricultural yields), like a list and understand how they calculate these indices?**

Answer 14: On SNAP we have several indices, but in the literature you can find a lot with the related equation and implement it on your processing chain.

**Question 15: Can SNAP be used as a replacement of common remote sensing GIS softwares, like ArcGIS, ERDAS, etc.?**

Answer 15: SNAP is an open and free software and it was not created to replace commercial software. It is very useful to preprocess and process remote sensing data, but for complex analysis you have to use ArcGIS, QGIS, etc.

**Question 16: If one uses the "LAI" index for phenology, nitrogen, or disease assessment at the same time, how does one pinpoint each phenomenon using LAI? Or do you need to do**



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**multivariate analysis using a combination of indices? If you could please elaborate more on this I would appreciate it.**

Answer 16: I think that Sophie Bontemps can elaborate a bit more on this topic during the webinar on 10/19/2021 titled "Biophysical Variable Retrieval using Optical Imagery to Support Agricultural Monitoring Practices".

**Question 17: Is the atmospheric correction different using different Sen2Cor versions? If yes, should I only download L1C files and apply the same correction for all?**

Answer 17: No. Different versions of Sen2Cor are related to different S2 data formats. You can download S2 L2A data directly from the Copernicus Open Access Hub (download Sentinel data) <https://scihub.copernicus.eu/>.

**Question 18: Can you recommend a document or website listing the characteristics and purposes of each of the radiometric indices? I want to have a general overview in order to choose the suitable index for my study area analysis (e.g., for the soil salinity analysis).**

Answer 18: I think that Sophie Bontemps can elaborate a bit more on this topic during the webinar on 10/19/2021 (Part 5 of this series) titled "Biophysical Variable Retrieval using Optical Imagery to Support Agricultural Monitoring Practices".

**Question 19: Is there a Python package (or wrapper) for SNAP?**

Answer 19: SNAPISTA is a GPT wrapper for Python. Its goal is to provide an easy and "pythonic" way to write and run SNAP graphs using Python. The documentation and installation guide are at <https://snap-contrib.github.io/snapista/>

**Question 20: Can you still derive the radiometric indices in SNAP even if you downloaded the Sentinel-2 data from GEE?**

Answer 20: Yes, because you will have the possibility to select the input bands to retrieve indices.

**Question 21: With the SNAP readers of other sensors, does the data have to be in a specific format? For example, when we import the S2 images, we can import it as the zipped file directly downloaded from the Copernicus website. However, it doesn't read the S2 image as**



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**well if it is downloaded from NASA's Earth Explorer website. So, for example, if I want to import an L8 image, how would this be imported? Thank you.**

Answer 21: In SNAP you will find several readers dedicated to various satellite data (optical, thermal, radar/SAR, generic format).

**Question 22: Can we create a time series of a variable (i.e., LAI) from multiple images at a point location using SNAP?**

Answer 22: Yes, definitely. Today's demonstration showed how to get started using the Time Series Analysis tool in SNAP.

**Question 23: Are Level 2A products already pre-processed with Sen2Cor?**

Answer 23: Yes, but there are several atmospheric processors available to process S2 data, Sen2Cor is the one used with ESA's Payload Data Ground Segment.

**Question 24: Can you please elaborate on how shapefiles are used to process Sentinel data in SNAP?**

Answer 24: Shapefiles are not used to process S2 data in SNAP. You can import shapefiles in SNAP using the layer manager tool.

**Question 25: Hello why did you resample B2 (10 m) to 10 m?**

Answer 25: Because the resampling is applied to all the bands included in the S2 product. If the bands are already at 10 m they will not be resampled.

**Question 26: What is the accuracy of SNAP in LAI retrieval for different vegetation types such as agriculture, forest, and grassland?**

Answer 26: The LAI has been developed by INRA so the accuracy is the one of that processor.

**Question 27: In the graph builder that was created, it is not clear what Band Math was applied in the second Band math component after the biophysical data was generated. Please explain.**

Answer 27: It was a Band Merge, not a Band Math (merging the inputs bands of Sentinel-2, NDVI, and Biophysical Variables)



**Question 28: What happens if the image is not co-registered?**

Answer 28: If you want to work with time series but you don't want to co-register/collocate images from the stack you need to rely on the accuracy of the geo information included in the product.

**Question 29: What tools and practices should be used when creating mosaics of Sentinel-2 data? How do you achieve the best band value consistency across different mosaic components?**

Answer 29: Atmospheric correction is needed. If you want to have a nice mosaic coming from different acquisitions in time, you can create a cloud mask to remove clouds and specific equations to replace cloudy pixels. An example could be represented by our paper <https://www.mdpi.com/2072-4292/9/7/652>.

**Question 30: Is it possible in the histogram to overlay a ROI on the entire image histogram? It would be useful to be able to see where your ROI "fits" over the entire scene.**

Answer 30: No. We will take this suggestion into consideration for future trainings of SNAP. For now, you can compare two histograms (one for the full image) and then add the ROI mask.

**Question 31: Is it possible to see the r2 Pearson coefficient in a scatter plot in SNAP? I never got it.**

Answer 31: You can display the regression line with related equations and r2 in a correlative plot in SNAP (Analysis/Correlative plot).

**Question 32: By analyzing a field with LAI what values tell me that the crops are less impacted or more impacted with pests?**

Answer 32: I think that Sophie Bontemps can properly answer this question during the webinar on 10/19/2021 (Part 5 of this series) titled "Biophysical Variable Retrieval using Optical Imagery to Support Agricultural Monitoring Practices".

**Question 33: If I want to perform field analyses, how many biophysical parameters should be enough (e.g., Fcover+LAI+Chlorophyll)? Or should I use all for each field?**



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Answer 33: Sophie Bontemps will answer this question in Part 5 of the webinar series on 10/19/21, but at least you could use LAI, NDVI, and S2 red edge positioning index.

**Question 34: How can we make sure that the drop in NDVI in time series is coming from the vegetation state and not from other factors?**

Answer 34: You are correct. Maybe the pixel can be cloudy but you can recognize it in the next acquisition of the time series and you can remove that pixel from your analysis. For this reason atmospheric correction and cloud removal are needed before analysing the time series.

**Question 35: How are the biophysical parameters in SNAP retrieved (e.g., LAI, fAPAR), and what is their quality/precision/reliability? Any limitations in applying them in certain geographical areas?**

Answer 35: The LAI has been developed by INRA so the accuracy is the one from that processor.

**Question 36: How can I select my NDVI threshold to be sure that it is vegetation?**

Answer 36: Values of 0.1 and below correspond to barren areas of rock, sand, snow, and artificial objects. Moderate values represent shrubs and sparse vegetation (0.2 to 0.3), while high values indicate healthy vegetation (0.6 to 0.8).

**Question 37: How do you validate biophysical parameters such as LAI?**

Answer 37: You can validate your results through in-situ measurements of LAI in selected plots along transects randomly selected per field using a LICOR 2200 c Plant Canopy Analyser.

**Question 38: Can I use Sentinel-3 for crop classification?**

Answer 38: Yes, but at a coarser spatial resolution of 300 m. We will discuss this further in Part 5 of the webinar series held on 10/19/21.

**Question 39: What steps should be taken for sloped terrain?**

Answer 39: Use a dedicated high resolution DEM for those areas for terrain correction.





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**Question 40: How often should we obtain imagery? (I know the answer depends.) Cloud cover is not an issue (arid areas), semi-cloud cover, and tropical areas where there is consistent cloud cover that may require SAR?**

Answer 40: Absolutely, yes. SAR can be used also for crop monitoring. In the next few parts we will address the application(s) of SAR for crop monitoring.

**Question 41: Would it also be possible to get better resolution from the thermal band in S3 using a similar approach as the explanation for NDVI?**

Answer 41: Yes, but just in terms of visualization because the information will be interpolated from the original pixels.

**Question 42: Can we use the image after removing the clouds for further analysis? For example, classification, because the pixel value will not be real after the cloud is removed.**

Answer 42: Yes. You can create a mask and use it as a band math input to remove the cloudy pixels.

**Question 43: Are there any other atmospheric correction algorithms/methods similar to SEN2COR within SNAP? Like FLAASH or DOS?**

Answer 43: In SNAP we can also use ICOR from VITO. Please refer to the SNAP website and forum: <https://forum.step.esa.int/t/about-the-icor-category/7335>.

**Question 44: How can we mosaic a large area easily? Such as a district or state?**

Answer 44: Using SNAP or the S2 Global Mosaic service: <https://s2gm.sentinel-hub.com/>.

**Question 45: What is OGVI and how is it calculated? Is it cloud free?**

Answer 45: OGVI is OLCI Global Vegetation Index. For further questions, please refer to this website: FAQ - Sentinel-3 OLCI Technical Guide - Sentinel Online (copernicus.eu): <https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-3-olci/appendices/faq>.

**Question 46: Is it possible to say 'Resampling' for data coming from different sources?**

Answer 46: Yes, but you should coregister them, resampling to a unique spatial resolution.





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**Question 47: Is there a link available to the upcoming ESA global land cover map based on S1 and S2?**

Answer 47: ESA WorldCover: <https://esa-worldcover.org/en>. There will be a webinar on 20 October. Stay tuned.

**Question 48: How would you rate SNAP against other softwares?**

Answer 48: It is very powerful in terms of implementation of the new algorithms, especially for data pre-processing. SNAP also supports most of the main EO missions (optical and SAR). It is open-source and you can also use it through Python, as well as create your own plugins - so the rating is quite high.

**Question 49: Can you please provide more information on Sen2Agri, which is well beyond the scope of this course?**

Answer 49: The Sen2-Agri system is an operational standalone processing system generating agricultural products from Sentinel-2 (A&B) and Landsat 8 time series along the growing season. For example - monthly cloud-free composites of surface reflectance at 10-20 m resolution, monthly dynamic cropland masks, cultivated crop type maps at 10 m resolution for main crop groups and periodic vegetation status maps, NDVI, and LAI. More information can be found on the website of Sen2Agri. Also, you can inquire about it to Sophie Bontemps in Part-5 of this training to be held on 10/19/21.

**Question 50: Can you give the link to the global land use maps you mentioned?**

Answer 50: ESA WorldCover <https://esa-worldcover.org/en>. There will be a webinar on October 20. Stay tuned.

**Question 51: What is the use of super resolution and what is the accuracy?**

Answer 51: Super resolution is a resampling module dedicated to S2.

**Question 52: Can we save time series as data files (.csv, etc.) from SNAP?**

Answer 52: You can save the results from time series analysis in a text file.

**Question 53: Is it possible to pansharpen S3 with S2?**



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Answer 53: In theory, yes, but we do not have this tool on SNAP. The “Collocation Operator” tool is the one closest to it.

**Question 54: Can you please provide guidance on using SNAP features through a line command?**

Answer 54: You can find some tutorials on the SNAP webpage or EO4Society website (GPT-Intro\_MCamuyrano.pdf (esa.int): [https://eo4society.esa.int/wp-content/uploads/2018/12/GPT-Intro\\_MCamuyrano.pdf](https://eo4society.esa.int/wp-content/uploads/2018/12/GPT-Intro_MCamuyrano.pdf)  
Bulk Processing with GPT - SNAP - Confluence (atlassian.net) etc.):  
<https://senbox.atlassian.net/wiki/spaces/SNAP/pages/70503475/Bulk+Processing+with+GPT>

**Question 55: Are VIIRS and Sentinel-3 providing the same kind of images (spatial, spectral, temporal resolutions)?**

Answer 55: Yes, but S3 for optical has a spatial resolution of 300 m, thermal 500 m, and 1000 m.

**Question 56: What is the temporal resolution of Sentinel 2 and Sentinel 3?**

Answer 56: The satellites in the Sentinel-2 constellation provide a revisit time of five days at the equator in cloud-free conditions (one satellite, 10 days). For Sentinel-3, more or less 1 day with the two satellites.

**Question 57: What if S2 and S3 images have different dates? Is it still okay to improve an S3 NDVI image?**

Answer 57: Yes, because we use S2 as master to improve the spatial resolution.

**Question 58: Can we generate Evapotranspiration using Sentinel-2 and Sentinel-3 data at 10 m resolution?**

Answer 58: Yes, using the SenET plugin on SNAP.

**Question 59: Which one is more efficient and accurate: doing the demonstration exercise using Google Earth Engine or using procedures in SNAP?**

Answer 59: If you want to present some analysis using time series, of course GEE is more efficient; however, if we want to explain details about data pre-processing (for example for



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SAR data), it's much more efficient to show it in SNAP because SAR data in GEE are already pre-processed.

**Question 60: Is there any way to use SNAP to remove the clouds that cover the land?**

Answer 60: Yes. You can create a mask and use it as a band math input to remove the cloudy pixels.

**Question 61: Is it better to use bands 3, 4, and 8 for agriculture or all bands?**

Answer 61: All the bands, especially bands the red, red edge, and NIR (from B4 to B8).

**Question 62: Can SNAP be used to run any ML/DL/classification algorithms?**

Answer 62: In SNAP we have some classifiers (e.g., Random Forest). We will improve the list of classification algorithms in the near future.

**Question 63: Can we calculate the biophysical parameters using a band math tool in SNAP? Or maybe outside SNAP, like GEE or other GIS software?**

Answer 63: No. You need the Look Up Table included in the L2B processor developed by INRA.

**Question 64: Is it possible to import a shapefile (sampling points), and then use it for a supervised classification directly without employing pin manager or creating the training sample itself via SNAP?**

Answer 64: No. For the moment, we'll take your suggestion to improve SNAP.

**Question 65: Would it also be possible to get a better resolution on the thermal band in S3 using a similar approach as the explanation for NDVI?**

Answer 65: See Answer 57.

**Question 66: I did not understand the use of BOA data. For example, if I want to use an image with the bottom of atmospheric correction for processing boat identification, will it be better than another image with the top of atmospheric correction?**

Answer 66: No. For this topic you can also use S2 TOA data.



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**Question 67: How do you create a mosaic in SNAP? What do you use for pixel generalization, median, mean, etc.?**

Answer 67: It depends on your purpose. In the literature you can find the right method for your application.

**Question 68: Can we correlate NDVI and S2RED? When is it appropriate to use S2RED?**

Answer 68: NDVI is dedicated to vegetation. S2RED is focused on crops.

**Question 69: If I select only the bands (B2, B4, B8, etc.) when subsetting the product, are the Sen2Cor masks lost? Do I have to use Sen2Cor again on the subsetted image?**

Answer 69: No. You should not lose them because the masks are not subset, just the bands are subset.

**Question 70: Which data (S1, S2, S3) is more reliable for crop monitoring in the rainy season?**

Answer 70: Sentinel-1 data can be used because SAR data is not affected by clouds. However, SAR signals are in general sensitive to dielectric properties, so it might be tricky. Again it depends on your application.

**Question 71: Is there a way in SNAP to download a bulk of images like with the Python script?**

Answer 71: There are some scripts. You can also access the full archive through some platforms such as Amazon. You can also use Sentinel Hub API:

<https://scihub.copernicus.eu/twiki/do/view/SciHubWebPortal/APIHubDescription>.