Questions & Answers Session 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 Amber McCullum (amberjean.mccullum@nasa.gov) or Juan Torres-Pérez (juan.l.torresperez@nasa.gov).

Question 1: Are there public databases of site-specific and variety-specific crop phenology?
Answer 1: Yes! We will cover these extensively in session 2, so stay tuned! This will include the National Phenology Network, NEON, and more.

Question 2: Can we analyze phenology in India using remote sensing? What are the sensors covering Indian region?
Answer 2: Yes! Many of the satellites and sensors mentioned are global: these include MODIS, VIIRS, AVHRR, Landsat, Sentinel-2, etc. All NASA data is freely available.

Question 3: Can we do it via SAR Data? if yes, then how?
Answer 3: SAR data can be used for vegetation monitoring, however, we will not discuss SAR data in this training. Please see the previous training we provided on SAR monitoring of forests here: https://arset.gsfc.nasa.gov/land/webinars/forest-mapping-sar
This training will only focus on optical, however.

Question 4: How to use ECOSTRESS (Evapotranspiration) for phenology? Can it be used for India?
Answer 4: I believe ECOSTRESS takes measurements over agricultural regions in India. Here is a website where you can view the data locations on a map:
https://ecostress.jpl.nasa.gov/observations
You can also download ECOSTRESS data via the LP DAAC. Please see our lightning webinar on ECOSTRESS for more information about the data and how to access and use:
https://arset.gsfc.nasa.gov/land/webinars/ECOSTRESS

Question 5: What are the value ranges for EVI?
Answer 5: EVI is an index like NDVI, and the values will be within a range of -1 to 1. Anything below 0 is no vegetation. Values closer to 1 is green to indicate healthy vegetation.

Values that may fall outside of the -1 to 1 range could be due to overcorrecting for atmospheric effects.

Question 6: Are SPOT images freely available for non-Europeans?
Answer 6: Yes, I believe they are freely available to anyone. There may be an approval process for SPOT, please check the ESA website. You can find more information here:

- https://earth.esa.int/eogateway/catalog/spot-6-and-7-esa-archive?text=SPOT+data
- https://earth.esa.int/web/guest/data-access/browse-data-products/-/article/spot-6-and-7-archive-and-new

Question 7: Can we monitor a profusely flowering tree through its spectral signature. Can intensity of flowering be monitored?
Answer 7: Vegetation vigor can be estimated using the indices outlined, like NDVI and EVI, which essentially measures vegetation vigor or greenness. If you have ground-based information on leafing and flowing of trees you could then compare these events to the NDVI and/or EVI values measured from the satellite. Please do consider the spatial resolution of data: for example MODIS is 250m-1km, so you will not be able to identify changes in specific trees and relate that to flowering intensity of individual or small stands of trees.

Question 8: I have some questions about the NDVI data.

1) What's the temporal resolution and temporal coverage for the MODIS NDVI data?
2) What's the latest collection?
3) Is the data available for both Terra and Aqua?
4) Where can I download the data?

Answer 8: All of the answers to these questions can be found on the PPT slides on the course website here: https://arset.gsfc.nasa.gov/land/webinars/phenology

Question 9: Should the parameters used at calculating SAVI and EVI vary depending on attributes such as vegetation type?
Answer 9: The standard constants provided for SAVI and EVI are recommended and do not often change according to different vegetation types. Slight modifications can be made, but I would start with those constants given in the presentation. SAVI is great for areas of less vegetation and more bare ground. EVI is useful for more dense biomass.

Question 10: What is the difference between NDMI and NDWI? They are both constructed using the NIR and SWIR as well.
Answer 10: NDMI is generally used for estimating water within vegetation, while NDWI is used to identify water features, like lakes. Sometimes these are used interchangeably, so it can be a bit confusing. I have seen NDMI and NDWI indicated as both using the NIR and SWIR. However, the NDWI is sometimes used as the ratio of green and NIR.

- NDMI is used to determine vegetation water content. It is calculated as a ratio between the NIR and SWIR values in traditional fashion.
    - (NIR - SWIR) / (NIR + SWIR)
    - In Landsat 4-7, NDMI = (Band 4 – Band 5) / (Band 4 + Band 5).
    - In Landsat 8, NDMI = (Band 5 – Band 6) / (Band 5 + Band 6).
- NDWI sometimes used as this ratio: changes related to water content in water bodies, using green and NIR wavelengths, defined by McFeeters (1996):
    - NDWI = (Green − NIR) (Green + NIR)

Question 11: Is there any training for Solar-Induced Chlorophyll Fluorescence (SIF) studies?
Answer 11: The SIF is not something I am familiar with, but it appears that you can obtain these data from the OCO-2. I am not aware of any trainings for this topic, but please see this reference: https://www.sciencedirect.com/science/article/abs/pii/S0034425718300221

Question 12: Why is LAI used?
Answer 12: This is the leaf area index, so you could examine the differences in leaf area throughout the season to identify changes in leaf cover. The LAI identifies the percentage of cover of leaves in a specific area.

Question 13: Why do we absorb very high values in EVI? What does that mean?
Answer 13: EVI has the correction factors that can help deal with issues in oversaturation that we sometimes see in areas of high biomass, like in the Amazon.

Question 14: I want to see if the dust a mine produces affects the surrounding vegetation. In the literature review I have done, the most used index is the NDVI. I've also seen some reference to the fPAR. Would you also consider analyzing the evolution of fPAR? Would it be convenient to use some other index?

Answer 14: Yes, NDVI is the most common. But consider other indices as well as biophysical metrics such as fPAR. It is also important to note that comparisons of these indices to ground-based information is very valuable.

Question 15: How is EVI different from NDVI? What features are better shown with EVI2?
Answer 15: EVI has a few correction factors that help deal with oversaturation issues of NDVI and it also uses the blue band. It is best applied in densely forested regions. EVI2 will be covered in Part 3 of this series. The NIR and RED bands are used in EVI2, so this can be useful if you have an image that does not contain the blue band.

Question 16: Which indices should be used for crop stage identification?
Answer 16: NDVI is common for crops. It can be used to identify growth and as a marker for when harvesting has occurred, which is noted by a sharp drop in NDVI. Evapotranspiration or ET is also commonly used to monitor crops.

Question 17: In which circumstances do we use NDVI, OSAVI, and Triangulated Vegetation Index?
Answer 17: NDVI is the most commonly used vegetation index, SAVI is useful in regions with sparse vegetation cover where a correction factor for the influence of bare ground is applied. I have not used the TVI, but it looks like it also has a correction factor applied, see more here: https://www.sciencedirect.com/science/article/abs/pii/S0034425700001978

Question 18: Is it possible to measure soil quality?
Answer 18: Soil quality will likely need to be measured by ground-based data. The optical satellite sensors mentioned in this training obtain surface reflectance measurements. There are some optical sensors that can distinguish mineral type, but those are often hyperspectral.

Question 19: What is OPeNDAP?
Answer 19: It is a way for users to more readily access remote sensing data, it's provided by the LP DAAC. Look here for more information: https://earthdata.nasa.gov/collaborate/open-data-services-and-software/api/opendap

Question 20: Is an LAI direct product available for any of these satellites/sensors?
Answer 20: Yes. LAI is available from both MODIS (4 day and 8 day composite) and VIIRs (8 day composite). LPDAAC is a good data portal for those: https://lpdaac.usgs.gov/

Question 21: Is MODIS NPP calculated from spectral properties? Can it be calculated with Landsat?
Answer 21: NPP is an algorithm applied to MODIS data, you can find more information here: https://modis.gsfc.nasa.gov/data/dataprod/mod17.php. I looks like you could also derive NPP from Landsat, here is a helpful reference: https://zslpublications.onlinelibrary.wiley.com/doi/full/10.1002/rse2.74

Question 22: How can I apply the phenology evaluation in dry forest monitoring?
Answer 22: The same methods outlined in this presentation can be applied to dry and wet forest systems. Here is a reference referring to a dry tropical system: https://zslpublications.onlinelibrary.wiley.com/doi/full/10.1002/rse2.74

Question 23: When using the various data products for research, do we need to perform georeferencing prior to data analyses?
Answer 23: Ground based data should be used to validate the satellite data.

Question 24: How can we track the phenology for a cash crop which grows underneath the dense tree canopy?
Answer 24: That is difficult to do with satellite-based remote sensing, because the sensors will measure the top of the canopy. Ground-based information or near-surface phenology would be more useful in this situation.

Question 25: Can already created GEE scripts for running these analyses such as you showed in the screenshot be shared with us?
Answer 25: We have not created any GEE scripts for this training. We will introduce some national networks that have code (such as R scripts) available for analysis during session 2. ARSET recently provided a SAR training on Forest Monitoring using GEE and those scripts can be found in the presentation materials on the course website here: https://arset.gsfc.nasa.gov/land/webinars/forest-mapping-sar

Question 26: I am going to see the effect of phenological data in invasive species management. How can phenological data enhance the prediction power of distribution models?

Answer 26: I would suggest the combination of the ground based networks (which we will cover in session 2) with remotely sensed data for invasive species mgmt. Some invasives, like cheatgrass, can be monitored via remote sensing due to its unique maturation properties. However, optical satellite sensors often do not have high enough spectral resolution to differentiate between different types of vegetation. Hyperspectral data and ground based spectral libraries are needed for this.

Question 27: Do you recommend another index like Tasseled Cap?
Answer 27: Yes Tasseled Cap (brightness, greenness, wetness) is often used for vegetation analysis. It is a type of principal component analysis, which is a more advanced technique that we will not cover in this training. Here is a nice overview of NDVI vs Tasseled cap: https://www.geospatialworld.net/article/a-relationship-between-ndvi-and-tasseled-cap-techniques/

Question 28: If the focus of a study is a local level, should we stick with Landsat images for analysis of phenological changes?
Answer 28: This really depends on the size of the area of interest. Remember, Landsat data are 30m spatial resolution, so if you have homogenous vegetation in that large of an area it can be useful. If it is a smaller region, you may need other types of data (commercial, ground-based, etc.).

Question 29: What satellite images can we use to map phenological behavior in our territory (Peru)? What methodology is used?
Answer 29: As mentioned in the lecture, most of the data are freely available globally. Peru may experience difficulties in the use of optical data, due to cloud cover, so SAR data are also useful. You can learn more about SAR data for forest monitoring from our recent training here: https://arset.gsfc.nasa.gov/land/webinars/forest-mapping-sar

Question 30: Is Hyperspectral Dataset freely downloadable?
Answer 30: There is no global hyperspectral data available currently from NASA, but there have been multiple airborne and low earth orbit missions and concepts. One upcoming mission is the Surface Biology and Geology (SBG) mission that is currently in development. The idea for this will be to have hyperspectral data. Also, stay tuned for a potential training on hyperspectral data next year.

Question 31: What would be the best options (sensors and indices) to monitor grassland phenology?
Answer 31: Many of the indices mentioned here are useful for grasslands. We will also provide a case study on the use of VIIRS and Phenocam data for a grassland system in Kansas in session 3, so stay tuned for that.

Question 32: How can carbon cycling be traced with phenology with remote sensing?
Answer 32: Carbon cycling and phenology are closely related. Carbon use efficiency for example is the ratio of GPP and NPP, which we have outlined here. We will not cover carbon cycling in this training, but here are a few resources:
https://www.sciencedirect.com/science/article/pii/S0048969717324464
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2014JG002666
https://www.mdpi.com/2072-4292/11/21/2513/htm

Question 33: Does ECOSTRESS data cover any area in Nigeria?
Answer 33: Please check the ECOSTRESS webpage for a map of locations and for data availability: Here is a website where you can view the data locations on a map:
https://ecostress.jpl.nasa.gov/observations
You can also download ECOSTRESS data via the LP DAAC. Please see our lightning webinar on ECOSTRESS for more information about the data and how to access and use:
https://arset.gsfc.nasa.gov/land/webinars/ECOSTRESS

Question 34: Is it possible to analyze for Guatemala, Peten region in archaeological zone? At what best resolution? (spatial and time)
Answer 34: As we have mentioned, it is important to consider the spatial and temporal limitations of NASA satellite data, and this really depends on the extent of the area you are interested in. Daily data from MODIS and VIIRS at 250 to 1km spatial resolution, or 16-day revisit time from Landsat at 30 m spatial resolution, for example. Archeological mapping via remote sensing is not a speciality of mine, but I know there has been work on this. You also need to consider cloud cover with optical satellites, so radar may be of more interest to you in Guatemala. Check out this previous SAR forest monitoring training here:
https://arset.gsfc.nasa.gov/land/webinars/forest-mapping-sar

Question 35: What vegetation index would you recommend be used to monitor vegetation health (status) over the Alps, meaning a highly rocky and steep terrain but also high in precipitation level?
Answer 35: NDVI is a good starting point, you may want to consider SAVI if there is a lot of bare ground. My recommendation would be to evaluate multiple indices alongside ground-based data. You will also want to consider the effects of snow cover in this region, for this you could use some type of snow index like the NDSI.

Question 36: Are there applications of this data to determine the extent and health of riparian corridors and wetlands?
Answer 36: Sure, these data could be applied to wetlands and riparian areas. You do however, need to consider the spatial resolution and the potential limitations of these data for potentially small total riparian areas. In this case, airborne or drone data may be more useful as the spatial resolution would be much higher.

Question 37: Can we use landsat and sentinel 2 images to calculate indices and monitor desertification and phenology?
Answer 37: Yes! You can apply the indices outlined in this training to those issues. If you have a time series of data, you can track declines in vegetation health that may be occurring due to degradation and desertification. I would also recommend a tool developed by CI called Trends.Earth, which we provided a training on previously, its focused on degradation and SDGs:https://arset.gsfc.nasa.gov/land/webinars/land-degradation-SDGs19

Question 38: What type of field data do you consider essential to measure on the vegetation we are studying?
Answer 38: We will discuss many of the field-based data in session 2, stay tuned!

Question 39: Can we study phenology on the flowering changes of the tree species with respect to seasonal changes?
Answer 39: Yes! We have many examples of this from the National Phenology Network (NPN) that we will provide in session 2, stay tuned!

Question 40: I am trying to compute NDVI from a little area in Colombia using planetscope images, however, I'm not sure about what kind of radiometric I need to use: at sensor or surface reflectance?

Answer 40: NASA provides surface reflectance products from Landsat that have already been atmospherically corrected, so those are a good starting point: https://www.usgs.gov/land-resources/nli/landsat/landsat-surface-reflectance?qt-science_support_page_related_con=0#qt-science_support_page_related_con
They can be found readily on the USGS Earth Explorer: https://earthexplorer.usgs.gov/