Questions & Answers Session 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 Erika Podest (erika.podest@jpl.nasa.gov), Amber McCullum (amberjean.mccullum@nasa.gov) or Juan Torres-Peréz (juan.l.torresperez@nasa.gov).

Question 1: Would the methodology be the same for wetlands?
Answer 1: Yes. In fact, it is more straightforward for inland wetlands because you do not have the effect of tides for which to account. Mangroves are a mixed type of vegetation, hence methods aren't as straightforward. Backscatter increases up to a certain point as biomass increases, then backscatter decreases. Wetlands are less complicated, as you can apply the same methods and get more consistent results.

Question 2: Is it suitable to use Sentinel-1 to assess flooding areas and/or tree height within the urban environment?
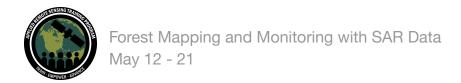Answer 2: S-1 is not going to penetrate as much through vegetation hence you will not detect inundated vegetation in areas where the vegetation is dense. In urban areas flooded vegetation can be detected but it is challenging because parcels of vegetation tend to be small in urban areas and hence you might need higher resolution than Sentinel-1 to detect them. Another challenge is that double-bounce backscatter is characteristic of flooded vegetation and urban areas and it is difficult to differentiate them.

Question 3: How do PolInSAR and TomoSAR work in Tree height estimation?
Answer 3: We will cover forest height estimation in our last session on Thursday.

Question 4: On slide 20, why are there two HHs in the 3band composite image? Is one of the HHs an L-Band and the other a P-Band?
Answer 4: The reason there are 2 HH is because we are looking at an image from one date, and we are creating an RGB so we need to put something in the 3rd band. You can also use a ratio of HH/HV for the blue band, however, for visual interpretation purposes it is easier to do an RGB of HH/HV/HH.

Question 5: How do we come up with the table in slide 23?

Answer 5: The table comes from the SAR Handbook chapter 6, Table 6.1. from NASA SERVIR. Several published sources were used to assemble that table.

Question 6: If we look at the concept of "antenna pattern", then is it right that in a given swath of homogenous land cover, the mid-range of the illuminated swath will have slightly higher backscatter values than near range and far range will have the least when compared to mid and near?
Answer 6: Yes, but has already been corrected when you process. It is part of the radiometric calibration that has been applied to the Sentinel-1 images on GEE. Incidence angle has a greater effect on image brightness (if the incidence angle range is large) than the antenna pattern.
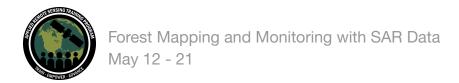
Question 7: Is it possible to access Google Earth images as well in GEE for validation purposes while performing your classification? If yes, what code should we use?
Answer 7: I'm not sure. I do agree that having that capability would be useful. I would suggest loading Landsat or Sentinel-2 images (similar to how Landsat images were loaded over the area of interest delineated in demo 2) over your area of interest and overlaying it over your classification results

Question 8: JAXA's officials said in late 2019 that they will make the ALOS-2 data free. Is there an update on that?
Answer 8: Not that we know of as of today. But they said they will, which will be great for L-Band global Data!

Question 9: Can SAR predict mangroves as healthy or damaged?
Answer 9: You can use SAR to detect the health of a mangrove or if there has been degradation to a mangrove only as related to changes in its structure. If there has been cutting of the mangrove or if there has been loss in biomass or foliage due to environmental stressors then you might be able to detect it using radar.

Question 10: To perform a Landcover classification using Sentinel-1 and Landsat-8, for example, is 20 samples of approx. 1000m2 of ground truth too little?
Answer 10: That should be fine. If you are not certain, if you do not have enough ground truth, cut out ⅓ and check for accuracy to determine if you need more sampling.

Question 11: I'm finding that SNAP creates a bunch of large-sized temp files that quickly clog up the hard drive. Is there a way to automatically flush these temp files after a project?
Answer 11: I don't know. It is an issue. Sentinel Toolbox has a user forum that you can refer to for your question.

Question 12: Is it possible to map the lost forest between 2010 (PALSAR-1) and 2020 (Sentinel-1)? Is it necessary to resample the Sentinel-1 from 10 m to 25 m to be compatible with the PALSAR-1?
Answer 12: Using 2 different bands: they have different wavelengths so you will get slightly different info. The best approach if using 2 different bands, keep in mind the information content is different (due to the penetration difference). You will easily detect deforested areas between the two but if one area has been partially deforested then L-band will have a higher likelihood of detecting it rather than C-band and at that point you would be comparing apples to oranges.
You would need to resample Sentinel-1 to match the Palsar resolution.

Question 13: Are there any constraints with respect to storage size restrictions for uploading files?
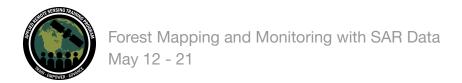Answer 13: Yes, 10GB is the limit. There is more info here:
https://developers.google.com/earth-engine/image_upload

Question 14: Why not use the ALOS World 3D-30 DEM instead of the SRTM since we're using ALOS PALSAR? Or is it not available in GEE?
Answer 14: You can try that too. We did calculate biomass at the end using C-Band derived from SRTM. The equation would need to be modified to use ALOS world since that DEM was derived using optical data, which does not penetrate through the vegetation.

Question 15: Can we use this tool (palsar mosaic) to analyze other vegetation types, not only mangroves, but other forest/plants?
Answer 15: Yes, of course. But if you are looking at things that are dynamic (fire scar, etc.), you will lose that information in a global mosaic. The nice thing about the Palsar global mosaics is that one of the layers included is the date of acquisition of each pixel, which is useful to know the seasonality of the time of acquisition (e.g. if the leaves were on or off).

Question 16: Why do we use Gamma0 here but we used Sentinel1 Sigma0 previously? Is one better/more appropriate than the other? How do you make this decision? Finally, could you explain a bit more about beta0, gamma0 and sigma0?

Answer 16: That is the way the data was processed. Sentinel-1 was processed as Sigma0 and the PALSAR global mosaics were processed as Gamma0.

Beta naught is the reflectivity per unit area in slant range which is dimensionless - this means that reflectivity has not been corrected for incidence angle.

Sigma naught is the radar cross section, which takes into account the incidence angle (from the metadata).

Gamma naught is the radar cross section, which takes into account the local incidence angle through a DEM.

The following page has a nice illustration of the differences:

https://forum.step.esa.int/t/radiometric-geometric-correction-workflow/2540/71

If your terrain is flat then sigma and gamma naught will not differ, however if there is topography then you will want to go with gamma naught.

Question 17: Why did you first convert the images to dB and only after that clip them? Wouldn't it be faster to clip them first and convert later?

Answer 17: Yes, the reason we did that here is because I wanted to show you how to look at the global data at the end of the demo.

Question 18: How do I know which range is best for starch image? why min 5,max 40?

Answer 18: I'm not sure what you mean by "starch image". The min 5, max 40 is in reference to SRTM and stretched accordingly for visualization purposes only. You can set this range by trial and error. For example, you can go to the inspector tab and click anywhere on your image to see the value of that particular pixel. This helps have an idea of the range of values in the image, which you can then use to specify the min/max histogram stretch when visualizing the image.

Question 19: With regard to exporting the final map, the map has to have the basic elements of a map: such as North arrow, grid, scale bar, and legend. So, how do we export our final map with the mentioned basic elements from GEE?

Answer 19: Here is some code you can adapt that shows you how to include a map scale:

https://gis.stackexchange.com/questions/269660/exporting-an-image-with-a-scale-bar-in-gee

https://code.earthengine.google.com/424a3a0b56d576bbece6869f2d776dcb

https://code.earthengine.google.com/217f419c1aa0175e1048b67fb457f6e4?as_external

Also, some of the forums on those links might have answers to further questions about features and capabilities of GEE.

Question 20: Is it possible to repeat all these steps using only the SNAP toolbox?
Answer 20: Yes you can repeat all of these steps on the SNAP Toolbox, which can deal with vector files. You would have to download all of the images to your desktop however.

Question 21: Do we have to be concerned about the coordinate system or the projection of .shp before we load it in google earth engine? Is there any adjustment we are supposed to do for the .shp file for a particular region?
Answer 21: Not they we are aware of.

Question 22: I think the backscattering of Mangroves is similar to other vegetations with similar canopy. If So, how do we map a particular vegetation separately? Are there any criteria used to distinguish the different vegetation types?
Answer 22: Yes, radar backscatter of mangroves can be similar to other vegetation classes and it can be difficult to separate mangroves from bordering inland forests. You could use polarization to try to separate different mangrove classes. You can also try applying texture to see if you can separate mangroves that are structurally different.

Question 23: You mentioned that the co-registration of the images is not perfect, are there ways to correct this, or is the offset so small (and systematic) that it is not necessary to correct?
Answer 23: It is definitely not perfect and the co-registration errors will affect your derived product. You can correct for these coregistration issues by doing a manual coregistration, where you select the same points in both images (the image to correct and the image you want to coregister to) and then apply a stretch to the image you want to correct. I have done this with ENVI but I am not sure whether something like SNAP or QGIS has such capability. Some softwares can automatically find the same points in both images both often you have to manually adjust them to make sure they align.

Question 24: How can you obtain metrics from the ratio step? For example, how can you quantitatively determine the percentage gained/lost in biomass from 2007 to 2017?

Answer 24: In the first part of this series, we showed how to determine statistics. You can apply a polygon over an area to determine statistics.

Question 25: Can I apply the same techniques to riparian vegetation mapping?
Answer 25: Yes, you can apply a similar technique. For mapping, you want to run a classifier. See the Part 2 of this series for that method.

Question 26: Which sensor would you recommend for mapping coral reefs? Deepwater coral excluded.
Answer 26: That is outside of the scope of my expertise. You would need an optical sensor for your analysis. NASA JPL had a project mapping coral reefs.
https://coral.jpl.nasa.gov

Question 27: Can I use Earth Engine to download the data in netcdf format?
Answer 27: You can only export as GeoTIFF.

Question 28: Wouldn't it be better to use the PALSAR DEM that has a higher resolution than the SRTM DEM?
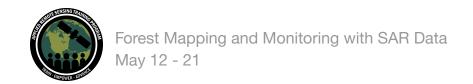Answer 28: Please see question 14.

Question 29: How do we define the formula to find the threshold loss/gain?
Answer 29: There is a bit of trial and error in finding these thresholds. Take the std dev and multiply by 2 then subtract that from the mean loss to set the initial threshold. You may need to adjust depending on your results. Do the same for the gain except you add the stdvx2 to the mean gain.

Question 30: It seems like it could be problematic to manually grab the values and calculate your thresholds. How can we access the mean/stdev objects within the stats filters to calculate thresholds using a function?
Answer 30: I wanted you to understand how to calculate the functions, but this can be automated.

Question 31: Do you expect these areas of loss of mangroves identified are due to human activity or are these areas lower elevations and have been affected by even a modest rise in sea levels?
Answer 31: I think that most of it may have been lost to human activity. Loss to sea level rise, you would have to start with an area you know is lost to sea level rise and look at the results.

Question 32: Can the same method be applied in grasslands and shrublands? If yes, what do we need to change apart from the study area (in terms of theory)?
Answer 32: If you are looking at grassland/shrublands, you will want to use Sentinel-1, C-Band data because the shorter wavelength is more sensitive to the shorter vegetation. You'll want to use a classifier to classify these types of vegetations. If you want to look at their change then yes, you can apply a threshold. You will need to recalculate the threshold.

Question 33: Rather than apply thresholds, might an unsupervised classification be better...with, say, 10 classes or so?
Answer 33: An unsupervised classification may be better to identify the classes in your image. Here we are looking at change. As long as you can capture the change over time, that may be a viable method.

Question 34: Can these biomass calculation methods for mangroves be used for terrestrial forest ecosystems?
Answer 34: There is something similar for terrestrial forest ecosystems. In the SAR Handbook from NASA SERVIR, there is a chapter on Forest Biomass. Those methods are based on the ones that were used in this demo.
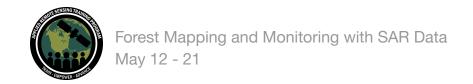
Question 35: How accurate are these data to use in commercial projects?
Answer 35: It depends on the accuracy requirements for the commercial project. The change maps need to be validated with reference data in order to assess their accuracy. The above ground biomass estimates are really just ballpark figures. You'd need a high resolution DEM to have a more accurate assessment of biomass.

Question 36: Hi, can we use sentinel C-band for above ground biomass estimation in a dense canopy forest?
Answer 36: Sentinel-1 C-band is not a good sensor for estimating biomass in a dense forest because the signal is going to saturate at a low biomass level. You'll want to use L-band for calculating biomass in a dense forest. I suggest reviewing the SAR Handbook chapter on biomass estimation.

Question 37: What's the difference when using the ascending or descending orbits in SAR time series analysis?
Answer 37: The viewing geometry is going to be different between ascending and descending.

Question 38: Is there an automated way to correct the offset of the images from different years?

Answer 38: Please refer to question 23.

Question 39: How can you decide scale in the calculation of the statistics of a polygon?

Answer 39: I am not clear about this question. I think the question refers to the size of the polygons selected and in such case you want to select multiple polygons that are as representative of the class you are wanting to characterize as possible.

Question 40: How do we know if we need to multiply the standard deviation by 2 or by 1.5 to define the threshold? Is there any rule?

Answer 40: No there is not a rule. As mentioned, you do have to do some trial and error to find the right threshold.

Question 41: Is it possible to use SRTM to estimate vegetation height in places with higher elevation? (It seems that using SRTM for estimating mangrove height works because we know the ground's at 0 m asl.)

Answer 41: Yes, there have been some efforts from people using DEMs to estimate vegetation height by using a bare earth DEM and SRTM and subtracting the two. The idea is that SRTM C-band does not penetrate all the way through the canopy (penetrates about ⅓ of the vegetation height) and is a measurement of vegetation height plus an offset. This is subtracted from the bare earth elevation to determine vegetation height.
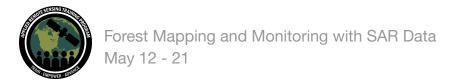
Question 42: Is it possible to use ALOS DEM to calculate mangrove biomass?

Answer 42: Yes it is possible but you need to account for that in the equation, since ALOS used optical data to generate the DEM.

Question 43: How did we arrive on the calibration factor?

Answer 43: That is provided by JAXA. This is a standard calibration factor that is applied to all PALSAR and JERS-1 images.

Question 44: What is the formula you used for biomass calculation? Is it a global allometric equation for mangroves? Could you elaborate?

Answer 44: The formula is a general allometric equation relating SRTM to canopy height and aboveground biomass (Simard et al., 2019).

Basal area weighted height: Hba ~ 1.08*SRTM

Maximum canopy height: Hmax ~ 0.93*1.7*SRTM

Aboveground Biomass: B ~ 3.25*Hba 1.53

The allometric equation for SRTM: B=3.25*Hba 1.53, where Hba = 1.08*SRTM, and the equation becomes 3.25*(1.08*SRTM)1.53

Further details are provided in the SAR Handbook, chapter 6:

https://servirglobal.net/Global/Articles/Article/2674/sar-handbook-comprehensive-methodologies-for-forest-monitoring-and-biomass-estimation

Question 45: Do you have any recommendation for the choice of the threshold in the case of amazonian forest?

Answer 45: You can start with the same approach that was presented in this demo but you will have to adjust your threshold based on trial and error.

Question 46: Can you explain why you have to use absolute values when the elevation is 0 or negative?

Answer 46: Yes. You will get a complex number otherwise.

Question 47: Is it appropriate to use Sentinel-1 or Sentinel-2 data in urban area development (pre and post development scenarios)? Also, can this tool be used to analyze the quality of water in a wetland/stream?

Answer 47: Optical is a better sensor to look at urban development as well as water quality.