



Questions & Answers Part 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 Erika Podest (erika.podest@jpl.nasa.gov) or Sean McCartney (sean.mccartney@nasa.gov).

An additional resource can be found here: A Q&A Session on Radar Remote Sensing (or Everything You Always Wanted to Know About SAR)
<https://arset.gsfc.nasa.gov/land/webinars/19-SARQA>

Question 1: Is it possible to use SAR for grassland biomass estimation, and what free sensors/satellites should I use?

Answer 1: Yes, it is possible to use SAR for grassland biomass estimation. I think there are papers out there that have done this type of thing. The best census of this would be something of a lower wavelength - something like C band which is around 5.4 cm. It would be a matter of digging up some research papers to see what kind of techniques have been used for this application. When I talked about C band, the sensor to use there would be from Sentinel-1.

Question 2: How can the HH polarization distinguish between flooded and unflooded vegetation?

Answer 2: HH polarization will penetrate a little further into the canopy. It will detect standing water. What happens when you have standing water under a vegetation canopy is that water acts as a smooth surface. The tree trunks in your vegetation will reflect the energy and cause a double bounce. The energy will reflect from the smooth surface to the trunk and back to the satellite. The backscatter will be very, very bright. That's how you can distinguish flooded areas. HH is better to look at flooded vegetation because it penetrates more through the canopy. You're more likely to reach the surface of the water in areas of high biomass than with VV or VH.

Question 3: Forecasters are worried that the 5G rollout may compromise weather forecasts. Are there similar concerns in relation to other satellite data such as flood mapping etc?



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Answer 3: That's a good question. The 5G frequencies that are being discussed will especially have an impact on atmospheric forecasts. With some radar techniques like interferometric SAR, knowing the amount of water vapor in the atmosphere is very important. You need to know these parameters to make these corrections. Water vapor can distort your datasets. It will have an impact for those specific types of applications. Or it might have an impact for those applications.

Question 4: How does one normalize a SAR image to remove noise caused by the far range and near range effect?

Answer 4: There are techniques - different ways to normalize it. There are publications out there to do this. The best thing is to cut the edges where you've got the extremes on the edges the extreme near range and far range, and work with the center of the image where you don't have that large of a variation. That's the best thing to do. Then you have a smaller area, but the incidence angle variation is not that large within your area.

Question 5: Why does VV polarization show better results than VH polarization in Sentinel-1 data sets of land use/land cover?

Answer 5: I'm not sure I understand this - when you say land use/land cover that's very broad. Sometimes VV is the better polarization if you're looking at, say, identifying specific types of vegetation with a lot of vertical structure. Then VV would be a better polarization. If you're looking at ID'ing vegetation vs. no vegetation, VH is a better polarization. It completely depends on what you want to do.

Question 6: What is the difference between SAR and InSAR. Is the processing and analysis of the two the same?

Answer 6: For SAR, we're using the intensity of the signal - the backscatter. For InSAR we're using the phase of the signal. I didn't show this here, but the processing is a little different. We will have another SAR webinar series sometime in October and we'll be talking about InSAR in that series. It'll be focused on landslides and developing a digital elevation model. In past SAR ARSET trainings, we've also touched on InSAR.

Question 7: What is the major difference between Sentinel 2-A and Sentinel 2-B?

Answer 7: SAR - the Sentinel satellite with a SAR sensor is Sentinel-1. Sentinel 2 has an optical sensor. Sentinel 1-A and -B have the same sensor. It's a C band sensor.



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Each satellite has a 12-day repeat and between the two of them you get a 6-day repeat. But it's the same sensor configuration.

Question 8: How does one process ALOS PALSAR data?

Answer 8: You follow the same steps as processing Sentinel-1 data, the only difference is you don't apply the orbit file. The Alaska Satellite Facility has ALOS PALSAR data in its archive, and that dataset spans from 2006-early 2011. Most of the PALSAR data they have has been radiometrically and geometrically corrected so it's ready to use.

For more information on this, we have a previous webinar series that addresses this <https://arset.gsfc.nasa.gov/disasters/webinars/intro-SAR> (see the recording for Part 3: <https://youtu.be/-xU4oE66pgY>)

Question 9: What does the gamma and palette refer to, when adding images to Google Earth Engine?

Answer 9: The gamma refers to the values and the palette refers to the colors that you want to assign.

Question 10: What is the range in layer band combination? How does one determine the range?

Answer 10: If you go to your code editor and you go under inspector, you can click on your image and see the value of that pixel. You can click around your image to get a sense of the range of the values in your image.

Question 11: How does one assess the values of the pixels, to know the range of the log scale used? How does one know what values to input e.g. min: -15 and max: 0?

Answer 11: (Answer in Q10)

Question 12: Are the features west of the ROI terrain, or clouds?

Answer 12: Not sure I understand Q12. Remember, with SAR you don't have cloud issues. You won't see clouds on SAR images so it's definitely not clouds. It might be terrain.

Question 13: Can you elaborate on why you divide to find the difference of the VH, is it because the values are negative?



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Answer 13: No, the reason I divide is because the values are not linear. They're logarithmic. In order to do a difference, you need to divide.

Question 14: How did you arrive at the threshold value?

Answer 14: Great question - that is trial and error. You go in, look at your values and set the threshold. You can play around with the threshold and you'll see you might capture more flooding but have more noise/errors in the area you're capturing as flooded. You have to play around with the threshold and get a sense for the values in the image.

Question 15: Can you overlay the threshold images with areas and population datasets to create an automatic list of flooded regions as well as at risk populations, disaster managers etc.?

Answer 15: Yes! That's a great point. You can definitely do this. The great thing about GEE is you have a lot of these datasets there, you just need to call them and overlay them. The same way we overlaid the radar image, you can overlay socioeconomic data. You can overlay infrastructure, roads, population. You can overlay a DEM and based on the DEM, identify the flatter regions as the ones more susceptible to flooding. You can do all kinds of really great stuff and it's all on the cloud so you don't have to pull the datasets onto your computer.

Question 16: Is it possible to monitor storm flood in more steep terrain given that they appear for a shorter period? Do you know any examples?

Answer 16: It is possible - the challenge here is the temporal resolution of the satellite. With Sentinel 1-A and Sentinel 1-B you have a temporal repeat every 6 days. If you manage an image before for comparison and at that one time, you may be able to monitor floods. There are issues in areas of complex topography - you may have a layover, shadowing - something that might complicate your signal. That might confuse it with inundated vegetation or open water.

Question 17: How do we export the final output?

Answer 17: So, I talked about the scripts in the docs section - it has a number of functions. If you type "export image" you'll see the instructions on how to run that function. There are different ways to export it - you can export it to drive, to the cloud - you need an account - export it as a GeoTIFF or a raw file or a kmg file - there are different formats you can export.



Question 18: You said that SAR is not good for mapping urban floods, but in the case of Cyclone Idai some of the affected area was in an urban area.

Answer 18: That's a great point - the reason SAR isn't great for mapping urban areas is there's double bounce in built-up areas. When you have water under the vegetation, the signal bounces off the surface to the trunk and is very bright. For urban areas, instead of the signal bouncing off inundated vegetation, you have streets that are smooth surfaces and buildings that are vertical structures. You get a double bounce even if the conditions are not flooded. The street is smooth, and buildings are very vertical, so you get double bounce in urban areas. If a street is flooded, it's still smooth, and you still get double bounce. That's why it's difficult to use SAR in urban areas. But not all urban areas have so many streets. Some cities are full of cement, and others are not so impervious. You've got open areas, parks, all kinds of different land cover within an urban area. So that is why with Idai you can see there was flooding in an urban area.

Question 19: What's the best approach to use SAR for crop classification?

Answer 19: The session next week is on using SAR for crop classification. We have a guest speaker Dr. Heather McNairn from Agrifood Canada who's an expert in looking at SAR for agriculture. The next session will teach you how to use SAR for estimating soil moisture and crop estimation. Even though we covered it in the last SAR training, this is a bit more advanced and you'll learn some new skills.

Question 20: What is the spatial resolution of your result with Sentinel-1?

Answer 20: The Sentinel-1 data is 10 m resolution. However, when you apply the filter, you reduce the resolution. That's always going to be an issue. With radar the actual resolution is not necessarily the final resolution of your product because you'll always have the issue of speckle. In order to reduce speckle, you need to apply a filter, which will reduce your resolution. It depends on how big the window for your filter - the bigger the window, the more you reduce your resolution. In this case, after applying the filter, the resolution was 50 m.

Question 21: Can you recommend an approach to detect flooded areas in mountainous terrain?



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Answer 21: I would say - it's the same approach. But you do need to go back and double check that what's being identified as flooding is indeed flooded and not areas that are shadow or areas that are very bright because of layover or foreshortened.

Question 22: Can we utilize SAR to monitor flooded grasslands?

Answer 22: Absolutely. SAR works very well for that. Sentinel-1 works very well for grasslands for looking at flooded grasslands.

Question 23: Is it possible to have access to the GEE script or slides?

Answer 23: The slides (with scripts) can be found on the training webpage.

Question 24: What is the benefit to processing SAR outside of GEE?

Answer 24: The benefit is that you get to do the processing yourself and you understand the steps. There's something to be said for having an intuitive feel for what needs to be done to the image and what needs to be collected. That's why in the past we started these trainings using the SNAP software, which is the ESA image processing software that's free and open. Now we've moved to GEE. And also - if you have your own processing code, you can apply that. The thing about GEE is you're using what's there - you're depending on the processing steps that they applied. If you have a different algorithm to apply the same processing steps, you can do that yourself.

Question 25: Between the SLC and the GRD images which is the best to use when doing land use classification? And is there a limitation on the number of classes that one may classify?

Answer 25: You want to use the GRD images. They are ground projected and so for doing land use classification you want the images that are already properly projected. The SLC are larger images that are complex, and you'll use those for InSAR. Not really a limit on the number of classes. You'll see very quickly that limitation. You might define 40 classes and you'll see your classifier may not be correctly identifying all of them, so you'd have to clump the classes. It depends on how different your classes are and how many layers of info you have that might aid the classification. If you have multiple polarizations, you'll have a higher rate of success in identifying different classes, as opposed to having just one polarization.



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Question 26: Is it possible to apply the future projection of different scenarios of climate change RCP 4.5 & RCP 8.5?

Answer 26: That's a good question - I think it is possible. If that dataset is on GEE you can certainly apply that. It's a matter of looking through the datasets that are housed on GEE.

Question 27: Why do you apply a threshold to the SAR data?

Answer 27: The reason I applied a threshold is because there was a clear distinction between the before and after. In this case, inundation was open water. When we did the differencing it was - the bright areas were areas that were inundated. When I applied the threshold, I was able to mask all those areas that were inundated.

Question 28: Is it possible to detect change in intertidal mudflat area change?

Answer 28: Not sure what sort of change you're talking about. If you're talking about vegetation growth - if it's vegetation, you'd be able to see this in the SAR images. You'd be able to see the difference between bare mudflats and vegetation growing. This question depends on what sort of change you're looking at.

Question 29: Can one use SAR data for habitat suitability modelling for wildlife?

Answer 29: Of course - this depends on what you mean by habitat suitability modeling. Are you talking about biomass? Perhaps you'll find certain types of animals living in certain types of biomass - we can use SAR for that. Are you looking at ID'ing wetlands - are you identifying birds that make their homes in wetlands? You can use SAR to identify wetlands. You can use SAR for identifying different types of habitats.

Question 30: Is there any way to reduce salt-pepper effect without losing the spatial resolution?

Answer 30: If you have a time series of images, you can do a time series averaging. You wouldn't lose spatial resolution, however, you might lose the information change in the signal across time if you're doing an average. If you're applying a speckle filter on individual images, you will always lose spatial resolution. As you saw in previous SAR trainings, when we use the SNAP software, we applied a speckle filter and SNAP has a number difference filter - there are many different filters out there. Some might do a slightly better job in keeping that spatial detail, but you'll always lose some spatial resolution.



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Question 31: Can InSAR be utilized on Google Earth Engine to detect deformation?

Answer 31: As far as I know - no. You don't have that capability on GEE.

Question 32: There are incident angle band contains in the VV or VV-VH images. How to make use of this incident angle band in the calculation?

Answer 32: The way you do it - this would be more relevant to things like open water - what you want to do is you have to be careful sometimes because the incident angle will have an effect on the backscatter. So you might be looking at the same landcover class or features. Say you're looking at an open water body or forest. That same open water body or forest might look a little different at different incidence angles. You can account for that using the incident angle band information. We didn't use it in this example, but if you're doing land cover classification, you might want to train your classifier to account for incidence angle. Maybe as you're training your classifier, you can say this is forest at 30 degrees incidence, and this is a forest at 45 degree incidence angle.

Question 33: Can SAR be used to identify different species of mangroves?

Answer 33: Yes - I believe there's several publications about this - especially as the different species of mangrove are structurally different. SAR will differentiate them.

Question 34: Is it possible to study urban expansion using SAR? Is Sentinel-1 capable of doing this?

Answer 34: You can certainly use SAR data to look at urban expansion.

Question 35: What is the processing and procedure required for the texture analysis in cases of complex topography?

Answer 35: What you want to do in areas of complex topography is the same as in processing. You want to do a radiometric and geometric correction.

Question 36: Where can we find high resolution images for a local use and can it be used for monitoring irrigation?

Answer 36: Yes - this is going to be covered in the next webinar on how to use SAR for looking at irrigation. The only operational SAR dataset you can access at the moment (that I'm aware of) is Sentinel-1 data. I saw that in one of the comments, someone made an important comment - in the datasets I showed you about satellite sensors that contain SAR and data freely available. RADARSAT-1 is available which is a



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Canadian SAR sensor. They recently opened that dataset. They have over 36,000 historical images available to the public. RADARSAT-1 launched in 1995 and operated for 17 years. So it's quite a bit of data. It isn't operational, but it's a data set you can use for historical analysis or use as a baseline. That dataset can be downloaded through the Canadian Space Agency.