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 Jamon Van Den Hoek (vandenhj@oregonstate.edu), Corey Scher (cscher@gradcenter.cuny.edu), or Sean McCartney (sean.mccartney@nasa.gov) .

Question 1: How would muddy water appear in SAR? Can we distinguish it from clear water?
Answer 1: The SAR backscatter return over an open water surface will be most sensitive to the roughness of the water surface. Unless the "muddiness" of the water relates to the roughness of the water surface, SAR will not be very sensitive to the presence or absence of suspended sediment unless it changes the roughness of the surface of the water body.

Question 2: Are SAR damage assessments possible when there's no prior SAR data to compare to for change?
Answer 2: This is a good question. A 'before' event image or baseline would be necessary to conduct a damage assessment.

Question 3: Is it possible to adapt the Python code to Colab, especially HyP3 and Asf-search?
Answer 3: Yes. You can actually open the GitHub Jupyter notebook in Google Colab directly! Here is an example of the first notebook (00_query_task_HyP3.ipynb) in Google Colab. To open a Jupyter Notebook from Github in a Colab environment generally, prepend this URL (https://colab.research.google.com/github) to the location of a Jupyter Notebook on Github.

Question 4: When generating coherence co pol or cross pol channel, which should be considered? / Which polarization channel should be used for coherence and interferogram generation co-pol(VV) or cross pol(VH)
Answer 4: Generally the co-polarized channel is used. In fact, the ASF Vertex Tool does not give us the option to choose a polarization. All InSAR processing at ASF Vertex uses the co-polarized (VV) channel. Refer to our previous trainings on InSAR.

Question 5: If the settlement of urban areas is well structured, SAR image can identify the damages after any war or disaster from scattering change of the damaged building. What about if the settlement of the urban area is not well structured like some of the area (Old Dhaka) of the Dhaka city of Bangladesh? Will it affect the change range or differences of SAR image of the damaged area?
Answer 5: A region with less “coherent clutter” will not be as reliable for coherence change detection compared to built up regions that are highly coherent before a damage event took place. The lower the coherence, the less reliable the data will be and the more difficult it will be to detect change.

Question 6: In the case of Marioupol in Ukraine, it is said to be completely destroyed. Have you done some evaluation of how much decorrelation has appeared? Does it confirm heavy destruction?
Answer 6: Yes. We will be working on making those data available in the not so distant future.

Question 7: What are examples that show how a humanitarian actor has used SAR-based damage assessment? What humanitarian actions have been based on such SAR analyses?
Answer 7: We are still in the early stages of using SAR for humanitarian purposes. In the same way we showcased using SAR for damage assessment, organizations such as the UN would benefit from using SAR in post-damage assessment and as its usage grows, so will the need for this type of analysis.

Question 8: Which polarization channel should be considered for coherence and interferogram generation, co-pol(VV) or cross pol(VH)?
Answer 8: Please see the answer to question 4.

Question 9: Could this technique be used in rural areas?
Answer 9: If there are built-up structures within the rural areas then yes, the method can be used in rural regions.

Question 10: What is the margin of error?
Answer 10: I will refer to Natsuaki, et al. (2018) for more information on the sensitivity and limitations of coherence change detection for mapping of proxy damage.

Question 11: Hi, I am working with the Rohingya Refugee camp. Can I deduct changes before and after a cyclonic event, as the structure is not concrete?

Answer 11: If there is high coherence before the cyclonic event and if there is a change afterwards, then it could be possible to use the method. Refer to question 9. We will also be covering this next session.

Question 12: What is the level of accuracy of InSAR-based damage mapping with reference to the actual damage (for example, a school building)?
Answer 12: The degree in the change of coherence is related to the damage in the area. Again refer to the paper referenced in Q10.

Question 13: Does InSAR detect small scale damages?
Answer 13: Our approach has a 40-meter resolution, so the damage would need to be large enough in extent to affect the 40-meter region or of high magnitude enough to cause a detectable signal in decoherence. In our experience, we were generally not able to detect fine-scale, low severity changes but were able to see large magnitude changes that took place over a small region.

Question 14: I notice the calculation done by the ASF vertex goes to a queue. Is it possible to make the calculations without that service?
Answer 14: InSAR processing can be done without ASF Vertex but we have used the Vertex tool in this example because InSAR processing has the lowest barrier to entry on that platform relative to conducting InSAR analyses locally and with one of the many available toolboxes.

Question 15: Can different species be mapped using SAR images, with ASF-based tools online?
Answer 15: In reference to vegetation species, it is possible for SAR to map these. Depending on the surface characteristics and canopy structure, SAR can help with this. In addition to using SAR, using lidar and hyperspectral data can help as well. Refer to our previous trainings on Crop Classification listed here:
https://appliedsciences.nasa.gov/join-mission/training/english/arset-mapping-crops-and-their-biophysical-characteristics

https://appliedsciences.nasa.gov/join-mission/training/english/arset-agricultural-crop-classification-synthetic-aperture-radar-and

Question 16: What is the reason for using only co pol coherence for interferogram generation?

Answer 16: Polarization refers to the outgoing signal. InSAR using co-pol coherence to aid in surface level analysis. Refer to the SAR Handbook on the NASA Applied Sciences site.

https://hyp3-docs.asf.alaska.edu/guides/insar_product_guide/

Question 17: Is SAR applicable to drone imagery?
Answer 17: Yes! You can have ground based SAR and aerial based SAR as well. It is not limited to satellite imagery.

Question 18: Is there any real time SAR data source freely available?
Answer 18: Sentinel-1 is an example of near real time SAR data that is available freely. NISAR will also provide L-band SAR data from ISRO and NASA.

Question 19: What could be the challenges to run this type of analysis in mountainous regions (such as the Andes)?
Answer 19: Distortions from the complexity of the topography can prove to be a challenge in an area such as the Andes mountains. This topographic complexity will cause geometric distortions in the SAR imagery like shadowing. More information on that here.

Question 20: Based on your knowledge, would it be possible to predict which structures could be damaged in an event of destruction by war?
Answer 20: I don't think SAR could tell us this information better than other sources could. Certain structures are routinely targeted during conflict is dependent on the conflict at hand.

Question 21: Can this be used in land use/land cover change detection in mined areas or forests?
Answer 21: With respect to mining, yes. If the natural landscape is being demolished by man made causes, it can show a low coherence. For mining, substantial disturbance will need to be detected. A multitude of factors are also manipulated during the process of deforestation and land mining. Refer to our previous SAR for Forest Mapping training.

https://appliedsciences.nasa.gov/join-mission/training/english/arset-forest-mapping-and-monitoring-sar-data

Question 22: Does the ASF Vertex tool provide the mapping of flood inundation areas?
Answer 22: To my knowledge (Corey) the ASF Vertex tool does not have an inundated area product directly. SAR data is sensitive to surface water occurrence. But the

Refer to our SAR for flooding training here:
https://appliedsciences.nasa.gov/join-mission/training/english/arset-sar-landcover-applications

Question 23: Can I use SAR for soil moisture quantification? Is 40-meter resolution enough for this kind of analysis?
Answer 23: Sentinel-1 is a C-band sensor and as a result, certain analyses won't make it to the surface. NISAR is an upcoming tool that will help with that.

Question 24: Can SAR detect crop health?
Answer 24: SAR can detect maturation and green up and growth and SAR can measure health in a way through the structure of a crop yield. Also refer to spectral characteristics for more in depth information on health and yield.

Question 25: Using InSAR coherence changes in built up area, is it possible to distinguish damages from changes in construction? And have you encountered false damage detection using this method where a high value was detected but no evidence of building changes (damages or construction) on the ground? What could possibly be the interpretation of such a case?
Answer 25: If an area is under active construction, you will have a low coherence value. Local knowledge and context can be useful for a change in coherence such as with a city lockdown during the COVID-19 pandemic. It is hard to validate destruction in an active conflict zone due to a variety of factors. Even though there are refugees from a conflict, many people still live within a city during a conflict as well and activity is still ongoing. First hand accounts also help to validate damage in an area as well.

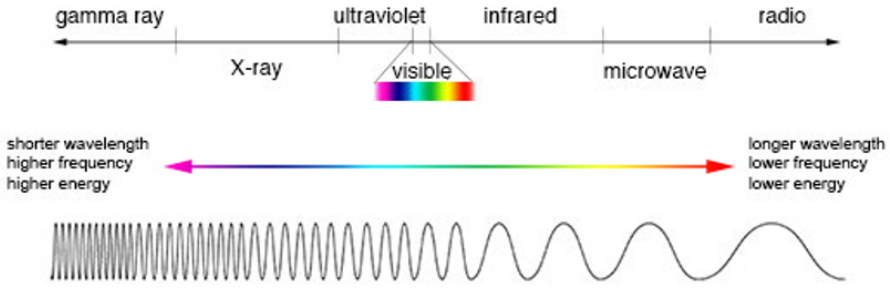
Question 26: Could InSAR be used also to detect mass graves, as well as tanks and troops?
Answer 26: Yes. Reorganization of vehicles can contribute to a change in coherence, not so much movement of individual troops. There is work being done for the detection of mass graves, but it is still experimental.

Question 27: Is it possible to use SAR to map urban growth? Which is a specific kind of change on the land's surface. Because at the same time urban expansion generates changes, the non-urbanized areas around might also change independently. Is it possible to distinguish 'types' of changes with SAR?
Answer 27: Yes. There are several approaches for monitoring urban growth with SAR. If the urbanization is occurring over regions that were previously covered with vegetation, following the urban growth those regions would likely have higher backscatter intensity and also greater InSAR coherence. Decomposition of polarimetric SAR signals has also been used to map urban growth in Tehran, for example.

Question 28: What effects would SAR have in its analysis of Manhattan after the damage of 9/11?
Answer 28: If you had a pre-event coherence image and a coherence image following the 9/11 attacks, in theory a large decrease in coherence would be visible due to the destruction of the World Trade Centers. Here's some info on using lidar to map the aftermath: http://www.nywtc911.com/noaa.htm

Question 29: How would SAR show the increase in nuclear radiation during and after the Russian occupation of Chernobyl?
Answer 29: SAR would not be sensitive to changes in nuclear radiation.

Question 30: Is it possible to get an optical image in the microwave region?
Answer 30: Good question. The optical range includes **visible** light of red, green, and blue light, but these wavelengths are much smaller than the **microwave** wavelengths that SAR is sensitive to. So, we need different sensors to measure each kind of energy.



(from https://www.capellaspace.com/sar-101-an-introduction-to-synthetic-aperture-radar/)

Question 31: Will there be more sources of open-access SAR remote sensing coming online in the near future, complementing the information as recorded in Sentinel-1 data?

Answer 31: Yes! The upcoming NISAR Mission will offer dual-polarized L- and S- band radar data and it will be freely-available and openly accessible.

Question 32: We are going to use InSAR for urban damages to help people. This is against having a clear idea about what we are looking for. If we know what we are looking for then why do we want to find it through InSAR?
Answer 32: In an active conflict, it's quite uncommon to know the full extent and severity of urban damage in near-real time. Proxy damage mapping can constrain the timing and location of specific damage events. By focusing on acute events like these, we can test and validate the use of SAR for detecting damage. We can further extend this kind of analysis by monitoring for urban damage using all available SAR images over time.

Question 33: Hi, maybe you mentioned it already but do we have an idea of the campaigns extents, and next campaigns?
Answer 33: Sentinel-1 has global coverage going back to 2013. Sentinel-1C will offer a 6-day temporal resolution and C-band acquisitions.
The upcoming NISAR Mission will offer dual-polarized L- and S- band radar data and it will be freely-available and openly accessible.

Question 34: Should we select VV, HV or HH for the SAR images for this type of analysis?
Answer 34: ASF Vertex does not give the option to select polarization and defaults to using VV co-polarization.

Question 35: On the latest part, how can we define the volume of destruction (red areas) on the map of Aleppo?
Answer 35: We will not get any estimation of the volume of debris without ancillary data on the structure that was destroyed. LiDAR data (i.e. GEDI) may be able to help with estimating the volume of debris as a result of damage destruction by estimating the change in height of the building.

https://gedi.umd.edu/

Question 36: Do water bodies have low coherence? As slide 31 shows.
Answer 36: Yes. Water on the surface is constantly rearranging due to a variety of factors.

Question 37: How long does it take to get results for on-demand data processing?
Answer 37: Through ASF Vertex you can get results within a matter of hours (using the example of downloading one SAR pair).

Question 38: Are there InSAR applications for vegetated areas? I ask because I am thinking naturally occurring variations over vegetated areas will always lead to low coherence (making all vegetated areas look like they show big changes under InSAR comparisons)? Is this reasoning flawed?
Answer 38: With vegetated area (within C-band), you will have low coherence. There are techniques you can use to mitigate this. Refer to our previous ARSET training in regards to SAR for Forest Mapping here: https://appliedsciences.nasa.gov/join-mission/training/english/arset-forest-mapping-and-monitoring-sar-data

Question 39: Are the Sentinel-1 data available on Google Earth Engine? Is this method possible there?
Answer 39: Sentinel-1 backscatter intensity data are available on Google Earth Engine (GEE). There is no capacity for GEE to process InSAR data. Use ASF Vertex for InSAR processing.

Question 40: In the inputs to ASF you used the Single look (SLC), is there a difference between this and using GRD? What's the difference?
Answer 40: Ground range detected (GRD) data does not contain the complex phase information that SLC data contains. SLC is projected in slant range and has not been multi-looked. GRD data is multi-looked and corrected geometrically to be projected in ground range. More info on the Sentinel-1 HyP3 processing can be found at the ASF product guide webpage.