Question & Answer Session, Part 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), Sean McCartney (sean.mccartney@nasa.gov) and/or Nicolas Grunfeld-Brook (ngrunfeld@conae.gov.ar).

Question 1: Same target, 2 different positions. Is it necessary to be taken at the same time, or could it be at a different time?

Answer 1: Ideally,you will want it to be at the same time from different positions to the target, in this way there would be no temporary decorrelation or atmospheric effects. The STRM DEM was generated using this type of configuration- there were two antennas separated by a fixed baseline. One antenna emitted the electromagnetic pulse and both listened for the response. Normally, there's only one antenna and it's necessary to conduct repeat passes, meaning observations at different times.

Respuesta 1: Para generar DEMs el mejor de los casos sería observar al mismo tiempo desde diferentes posiciones al target, de esta manera no habría decorrelación temporal ni efectos atmosféricos.

El DEM SRTM fue generado este tipo de configuración, se contaba con dos antenas separadas por un baseline fijo. Una antena emite el pulso electromagnético y se escuchaba la respuesta con las dos antenas.

Normalmente se cuenta con una sola antena y se tiene que hacer repeat pass, es decir observar en diferentes tiempos.

Question 2: What is an applicable coherence value and guidelines to determine the critical perpendicular baseline?

Answer 2: The critical baseline is the perpendicular separation in which the geometric coherence is zero.

BW = bandwidth in range

Bperp_critic = lambda * BW_range * SlantRange * tan(Theta_inc - angle_slope) / speed_of_light

Respuesta 2: El baseline perpendicular crítico es la separación perpendicular para la cual la coherencia geométrica se hace cero.

BW = bandwidth in range

Bperp_critic = lambda * BW_range * SlantRange * tan(Theta_inc - angle_slope) / speed_of_ligth

Question 3: Where would you obtain better results if you use more than 2 images?

Answer 3: In the case of using a large enough stack of images, you can remove the atmospheric artifacts and orbital errors effects using more advanced techniques, which is advanced and outside the scope of this webinar. These techniques remove atmospheric effects knowing that they have a very variable behavior over time (high frequencies) and very slow in space (low frequencies).

The effects of orbital errors are removed knowing that they generate ramps in azimuth (errors by non-parallel orbits) and range (errors in the critical perpendicular baseline). Having a stack of images that is large enough we can estimate each of the terms of the interferometric equation statistically, separating each of the contributions.

Respuesta 3: En el caso de usar un stack de imágenes, se pueden remover los efectos atmosféricos y errores orbitales utilizando técnicas más avanzadas, que están fuera del alcance de este curso. Estas técnicas remueven los efectos atmosféricos sabiendo que tienen un comportamiento muy variable en el tiempo (altas frecuencias) y muy lento en el espacio (bajas frecuencias).

Los efectos por errores orbitales son removidos sabiendo que estos generan rampas en acimuth (errores por órbitas no paralelas) y rango (errores en el baseline perpendicular crítico).

Teniendo un stack de imágenes lo suficientemente grande podemos estimar cada uno de los términos de la ecuación interferométrica de manera estadística. Separando cada una de las contribuciones.

Question 4: What does Master and Slave mean?

Answer 4: The master is the reference image. Everything is registered to the master. Slave are the images being registered to the master. With DEM's, it does not matter which image is designated as the master or slave.

Question 5: How does elevation measurements compare with finer methods such as LIDAR and the interferometry method in terms of sensitivity or closest accuracy?

Answer 5: InSAR DEMs are coarser resolution and less accurate than Lidar topographic maps, but they can cover much larger areas than Lidar satellite data is available worldwide.

Question 6: I am really interested in using SAOCOM imagery for my study. How can I get the data?

Answer 6: In order to use SAOCOM images we need to establish certain agreements. You can send emails to our Users Service Unit <atencion.usuario@conae.gov.ar> in order to get more information.

Question 7: I have tried to create a DEM of a forested area, however, the coherence is very low. Do you have suggestions to solve this?
Answer 7: Dense vegetation tends to have strong volumetric decorrelation, so try to use a longer wavelength. Wave action and the features on the surface may still give error.

Question 8: Why do we need the DEM after the phase unwrapping to find the elevation?
Answer 8: Because you do not have a reference. The phase is floating. The DEM acts as a reference to tie into.

Question 9: What is the vertical (elevation) accuracy we can expect processing Sentinel-1 C band?
Answer 9: I am not familiar with Sentinel-1 data, but the accuracy will depend on the filter you use, multilooking. As you filter, you gain accuracy but loose spatial resolution. The elevation accuracy also depends on the baseline. Sentinel-1 satellites are operated with very short baselines, so the vertical accuracy will be poor (probably 10-20 meters).

Question 10: Are there any plans for a training course teaching SBAS/PSI?
Answer 10: Possibly, thank you. It is good to know what the community is interested in.

Question 11: Can you talk a little about the response time given when we request interferometric input images from the main SAR satellites, both for archive/catalog and new acquisitions?
Answer 11: Latency, for Sentinel-1, ESA Copernicus website posts Sentinel-1 images after 24 hours. ASF also has the data, but the delay is a little longer.

Question 12: What are the advantages of an InSAR-generated DEM in comparison to an ASTER-generated DEM?
Answer 12: I am not familiar with ASTER. These are complementary techniques. With ASTER, cloud cover is a challenge (it is optical).

Question 13: Is coregistration of an optical image with respect to a SAR image possible?

Answer 13: Yes, you can coregister when you project the images on the ground. You will need the orbital info to accurately co-register them or you can also manually co-register the images by selecting tie points.

Question 14: Would the horizontal and vertical resolution of the DEM from INSAR be equivalent to the DEM used during the phase-to-height conversion?
Answer 14: The DEM that we generated has a resolution of 10 meters. SRTM has a spatial resolution of 90 meters.

Question 15: Can you give some insight about graph creation in Atmospheric Phase screening correction?
Answer 15: SNAP can be interfaced with a software called STAMPS. Create an interferometric stack .

Question 16: I didn't get good quality IFG by InSAR due to topographic problems. Would the approach by PSI be useful for creating a DEM?
Answer 16: PSI takes pixels that pass certain criteria, so you will not have the entire picture. Natural areas (vs. urban) may work better.

Question 17: It is mentioned that the Baseline, perp for InSAR must be large, while DinSAR should be small. How about for time analysis InSAR such as PScatter InSAR and SBAS?
Answer 17: In the SBAS case, the images used have a small baseline (the name is based on Small-Baseline Subset). For PSI the baseline separation does not matter.

Question 18: Why do we need a DEM to generate a DEM? What if we had no prior/existing DEM for our ROI?
Answer 18: We use the DEM as a reference. If you do not have one, you will need in situ measurements. You will need some sort of reference point.

Question 19: Submitted in Spanish,-- Si necesitamos hacer un DEM de una región con diferentes climas, se deben realizar las adquisiciones buscando las mejores condiciones climáticas? (Translation:) If we need to make a DEM of a region with different climates, should we look for the best climatic conditions for the acquisitions?
Answer 19: When planning acquisitions, try to get the most optimal climatic conditions for the images you select.

Question 20: What alternate sources could we use instead of SRTM 3arc sec DEM to tie the unwrapped phase elevation relative to ground elevation?

Answer 20: There are several other DEMs, SNAP has options. There are ASTER images you can use. SNAP will also allow you to upload your own DEM too.

Question 21: Do the steps for processing shown here apply to Sentinel-1 DEM creation?

Answer 21: The steps differ a little bit due to the fact that Sentinel-1 is TopSAR and here we worked with Stripmap images. The issue with Sentinel-1 is that it tends to have small baselines, which means low sensitivity to elevation.

Question 22: How can I download Sentinel-1A polarization?

Answer 22: You can download S1 from ASF, wide swath comes in VV and VH. Part 1 of the series shows you how to query within GEE.

Question 23: Does Snaphu need to be run in Linux?

Answer 23: The latest version of SNAP has a plugin to run Snaphu in windows.

Question 24: Would it be possible to detect urban destruction (e.g. after an earthquake or bombing) by comparing change between subsequently computed DEMs (before/after)?

Answer 24: You can compute a coherence map with two images covering the event, i.e. one before the earthquake and the other after the earthquake. In regions where urban destruction occurred the coherence will be lost (near zero) due to the temporal decorrelation of the targets. But you have to be careful because coherence could be lost for other reasons too, so coherence near zero doesn't always mean that destruction has occurred.

Question 25: Is the phase delay due to atmospheric disturbance much less in L-band compared to C- and X-bands?

Answer 25: The different wavelengths interact with the different layers of the atmosphere. The phase delay in the ionospheric layer is much larger for L-band than C- or X-band. The phase delay in the troposphere due to water vapor is the same for all wavelengths in meters of range change. The phase delay in radians will depend on the wavelength.

Question 26: Could you tie the InSAR DEM to benchmark (a known elevation ref point) data? I know this is an advanced question, if it can be done.

Answer 26: Yes, you want to tie your DEM to some sort of reference dataset that you know is correct, e.g. other DEM's, in situ measurements, etc.

Question 28: Is the phase delay due to atmospheric disturbance much less in L band compared to C and X band?
Answer 28: This is similar to the previous response. All will interact with the atmosphere in some way or another,

Question 29: Which one is better for generating the vertical movement (taking a case in a forested area) by using DinSAR directly or generating DEM in year1 (minimum temporal baseline) and year2 and then subtracting them?
Answer 29: The accuracy is very different, with DinSAR you are looking at cm, DEM will be on the order of meters. However, in forested areas it is difficult to have good coherence.

Question 30: There are so many sources of errors and factors of decorrelation. How do you minimize these problems before conducting processing?
Answer 30: Choose images close in time and in good climatic conditions. Orbital errors will be an issue.

Question 31: Re: Question 20, is the DinSAR technique only valid for cm level displacement? I.e. phase unwrapping ambiguity cannot be resolved when elevation changes are too large? (above wavelength, maybe)
Answer 31: When you have ambiguities in phase (phase is wrapped) you have to unwrap the DInSAR map and then convert the phase to displacement.

Question 32: What is the final output from the previous example? Is it Digital Surface Model (DSM) or Digital Terrain Model (DTM)?
Answer 32: It depends on the wavelength. This will affect penetration. In this demo, there was minimal vegetation so it is elevation of the actual terrain.

Question 34: How can we change the displacement in meters to displacement in millimeters?
Answer 34: You just change the scale.

Question 35: How do you make different graphs of final displacement maps as the researchers do in their research articles?

Answer 35: Many people use QGIS or GMT (Generic Mapping Tools) to make final figures of displacement maps.

Question 36: How do you remove atmospheric phase disturbances?
Answer 36: This is an advanced topic that is outside the scope of this webinar. The best thing to do is to try to use images with the best climatic conditions to avoid as much as possible different atmospheric conditions.

Question 37: Is it possible to get SAR images used in this tutorial? Or are there other SAR data we can use to go through these steps to generate a DEM?
Answer 37: The data in the tutorial is not open, but Nicolás is trying to get those approved to share. ALOS Palsar data is now open and Sentinel-1 data can be used following a similar methodology presented here. ERS-1 and ERS-2 tandem (1-day separation) data is available from ESA through an online ordering system at no charge.
Respuesta 1: Voy a ver si puedo conseguir acceso a estas imágenes, en principio no son de libre distribución. Sin embargo pueden utilizar imágenes Sentinel-1 de manera libre y gratuita. ALOS y ALOS2 son libres también.