



## **HAZA05 - RUS environment demo: Earthquake deformation with Sentinel-1**

### **THEORY QUESTIONS**

**Q: How can we merge different subswaths (IW1, IW2 and IW3)?**

A: If you want to process more than one subswath at the same time, you first need to apply all processing steps until “TOPSAR-Deburst” in each one separately and then go to Radar → Sentinel-1 TOPS → S-1 TOPS Merge. After you have merged the subswaths, you can continue with the rest of the processing.

**Q: What is the unit of displacement in this exercise?**

A: SNAP uses a default metric unit (meters) for displacement. The pixel information is displayed in the Pixel-info tab.

**Q: What is the difference between intensity\_VH and intensity\_VV?**

A: The difference is the polarization. In the intensity\_VH band the signal is emitted in V (vertical direction) and received in H (horizontal direction) and in the intensity\_VV band it is emitted in V (vertical direction) and received in V (vertical direction).

**Q: If there are no updated orbit files for a product, can we skip the "Apply-orbit-file" step? Will there be any effects?**

A: You can apply this step even if there are no available updated orbit files, yet as far as you select the “Do not fail if new orbit file is not found” option. It will use the orbits included with the original product. The Precise orbits are generally available within 20 days after acquisition while Restituted orbits a few hours later.

**Q: Does vegetation over an area affect the measurement of the displacement?**

A: It depends on the type of vegetation. For grasslands there is no significant decorrelation, while forested area will generally result in strong decorrelation in the signal and possibly introduce artifacts during the unwrapping process.

**Q: How can we convert the Line-Of-Sight (LOS) deformation values to absolute vertical and horizontal ground-surface deformation?**

A: In order to calculate the actual vertical and horizontal displacements, we need to combine results for both ascending and descending passes (we need to use the geometries of the orbits).

**Q: What is the FFT size (Goldstein phase filtering) and why did we use 128 filter?**

A: FFT stands for Fast Fourier Transform. It is the filter applied to reduce the phase noise and is a necessary step before unwrapping the interferogram, since it will enhance the phase smoothing etc. We

used 128 filter to have a more enhanced result. You can try with a 64 filter as well, but the result will be less smooth. By increasing the window size though, local patterns of the displacement field might be smoothed out.

**Q: Why have you checked the "Mask out" area? What is its utility?**

A: The Mask out area operator uses SRTM 3sec water mask to remove pixels that correspond to sea. In this case, we masked out the sea in order not to include these pixels in the processing and introduce unwrapping errors.

**Q: Is "Enhanced spectral diversity" operator necessary for a good interferogram computation?**

A: Enhanced spectral diversity operator contributes in improving coregistration accuracy. It corrects phase shifts between bursts and since these phase discontinuities are also visible in the wrapped interferogram, it is an important operator for a good interferogram computation.

**Q: Is SNAP software suitable only for Sentinel images processing?**

A: No, you can use SNAP software to process images from other missions as well.

**Q: Do you lose phase information by applying Multilook operator to the Phase band?**

A: Multi-looking increases pixel spacing (reduces spatial resolution), though the phase is practically smoothed by averaging over different looks, allowing in most cases enhanced interferometric results. **Q:**

**How large is the difference in the final product using the different interpolation options in the Terrain Correction operator?**

A: It is not very different for our results. By using bilinear interpolation, the processing time is a bit faster than using e.g. bicubic. The different interpolators calculate values based on different neighboring pixels and weighting and thus might affect the final products in terms of e.g. phase smoothing.

**Q: How can we remove low coherence area (e.g. forest)?**

A: If you want to remove some values that correspond to low coherence, right-click on the product and go to Band Maths. For example, if you want to remove areas for which coherence is lower than 0.2, in the expression select the phase band and multiply it by a condition checking if coherence band is  $\geq 0.2$ . In the newly created phase band, all pixels with coherence below 0.2 will be masked out.

```
Phase * (coherence >= 0.2)
```

**Q: How do we read the values of deformation?**

A: There is a color ramp that corresponds to the values of deformation. It varies from red (negative values) to blue (positive values). When we have a negative value, it means that the ground was moved away from the satellite (red - subsidence) and when we have positive values, it means that the ground was moved closer to the satellite (blue - uplift). The deformation mentioned here is in reference with LOS.

**Q: Is it possible to do interferometry with HH polarization?**

A: Yes, in general we prefer to use co-polarizations for such applications (VV or HH) instead of cross-polarization bands (VH or HV).

## OTHER QUESTIONS

**Q: Is it possible to conduct SNAP-StaMPS in RUS service?**

A: SNAP does not support directly SAR time series analysis. Alternatively, it can be used to prepare the interferometric inputs for further processing in StaMPS. You can use StaMPS in the RUS Copernicus Virtual Machines only if you have valid MATLAB license, since it is not provided by default in the service.

**Q: Is there an easy way to download Sentinel 1 images stored in the LTA?**

A: As soon as you click on the “download product” icon of the product you are interested in, a green message will appear informing you that your request for the retrieval of the product has been queued, as long as there is free space in the queue. Add the products you want to download to the cart and check when they will be available for download. Once an image becomes online, it remains available to download for 4 days until it turns offline again.

**Q: Should we mask out a river from our product and if yes how we do it?**

A: Over rivers there will be no phase signal since the coherence on water is practically zero, thus it will not affect our interferometric processing.

**Q: Is this method suitable for landslide monitoring and what RADAR data is useful for landslide monitoring?**

A: The method indicated in this tutorial is not sufficient for land slide monitoring. For that, you need to apply more advanced interferometric techniques like PS or SBAS, using RADAR products.

**Q: Can we use SNAP for time series processing?**

A: Currently the time series tool of SNAP is applicable for single products and not interferometric pairs. However, by following a multi-temporal approach of Sentinel-1 data stack in SNAP you can by post-processing visualize the deformation time series. Alternatively, SNAP can be used to prepare the interferometric inputs for further processing in StaMPS.

## RUS QUESTIONS

**Q: Is the RUS service free?**

A: All the Virtual Machines and services offered by RUS Copernicus are **FREE** for any registered user and are foreseen for non-commercial applications. **As the number of RUS users is strongly increasing, allocation of RUS virtual environments to non-EU (European Union) residents is suspended until further notice. If you are in this case, please do not submit any User Service Request or it will be unfortunately rejected.**

**Q: How do I register for RUS VM?**

A: To register for the RUS VM go to the RUS Copernicus portal and register through the Copernicus Users' Single Sign On. During the activation of the account you will receive one e-mail; your account must be activated by the RUS front desk, therefore please allow few days for the process to be completed. Once your account is active, you can log-in to the RUS platform and go to "Your Dashboard" and click "Request a new User Service". Fill all the required fields to describe the desired VM and your project or specify the training code HAZA05 to repeat the webinar and receive step-by step guide in PDF. It might take up to 2 days for the VM to be provided.

**Q: What are the characteristics of the RUS Virtual Machines?**

A: Depending on your project, you will be classified as level A, B or C. Level A users get up to 1 Tbyte of storage and 1-4 cores of processing capacity. Level B users get up to 10 Tbytes and 1-10 cores. Level C users have available up to 50 Tbytes and up to 40 cores. For the processing of large datasets, (e.g. large time-series), it is possible to make temporary allocations of clusters of VMs (up to 100 VMs i.e. a maximum of 400 cores).

**Q: Is it possible to use other data instead of Sentinel data in the RUS Copernicus VM?**

A: Copernicus data must be a main part of your project when working with the RUS Copernicus VM. Having this condition met, you are allowed to use any other dataset.

**Q: How can I download/upload data from/to the virtual machine?**

A: To download or upload data you can press CTRL+ALT+SHIFT and a tab will appear on the left side of your screen. Go to Devices and navigate to the folder containing the file you wish to download. Alternatively, you can navigate to the folder where you wish to upload data store on your local PC and then click on Upload at the top of the tab, navigate to where your data is stored and click OK.

**Q: Is it possible to access the virtual machines from the command line?**

A: The access to the VM is provided via your browser window as a remote desktop. Unfortunately, at the moment it is not possible to access the VM from command line.

**Q: Where can we find past RUS webinars?**

A: All the material developed by RUS is available on the RUS training website – [www.rus-training.eu](http://www.rus-training.eu)