

# DEM creation using Sentinel-1 data

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The following instructions are notes for the DEM generation using Sentinel-1 two-pass interferometry.

In our case a large amount of Sentinel-1 imagery had already been downloaded, of the same track and orbit, so we wish to find the best pairs (small temporal difference and a perpendicular baseline of a specific range).

- 1) From the Linux terminal we access the folder containing the images and we produce a text file (filenames.txt) with all the available data

```
ls > filenames.txt
```

- 2) It is desired to keep only the dates of the images in order to produce the pairs with a small temporal baseline. So, in the terminal we type:

```
cat "$filenames.txt" | grep 'S1' | cut -c 18-25 > dates.txt
```

With the command the "filenames.txt" is read, and only the lines with the 'S1' are kept for analysis. Next, from the lines selected, the 18<sup>th</sup> to 24<sup>th</sup> letters (imagery date) are kept and passed to the dates.txt file.

- 3) We can even go as far as sorting the dates using:

```
sort dates.txt > dates_sorted.txt
```

- 4) The commands are written using Python so be sure to install this language to your computer. The same task could have been done using only bash however some might want to run the same process on a Windows environment.

```
from datetime import date, timedelta
f = open('dates_sorted', 'r')
dis = f.readlines()
f.close()

for i in dis:
    d1 = date(year=int(i[0:4]), month=int(i[4:6]), day=int(i[6:8]))
    for z in dis:
        d2 = date(year=int(z[0:4]), month=int(z[4:6]),
day=int(z[6:8]))
        n = d1 - d2
        if n.days == 6:
            print "%r and %r" % (i, z)
```

In the first section the necessary tools are imported and the file with sorted dates is read. More specifically, every line of the dates\_sorted.txt file becomes component of the dis list.

The second part has two loops and an if statement. In the first loop, for every component of the list the attribute d1 is given a date. The same happened on the second loop but for attribute d2. The temporal difference is computed and if it is equal to 6 days an output is given such as:

'20161024 and 20161030'

- 5) Here comes the most time-consuming part. For every pair of the desired temporal baseline we have to import them to the Radar > Interferometric > InSAR Stack Overview tool of SNAP. From there, in order to minimize the noise of the interferogram, only pairs of perpendicular baseline between 100 to 300 meters and high coherence should be chosen.
  
- 6) With the above steps we have concluded to pairs that are capable of producing good DEMs. But which pair would produce the best results?
  - First, we should check that between the acquisitions dates of the pairs, no major earthquake (>4.5M) occurred in the area.
  - Second, no continuous ground motion should be occurring in the area studied. If the motion is at a scale of mm/year it should be neglectable for the few days temporal baseline that is used here.
  - Orbital and instrumental noises should be dealt with in advance or using the images' distributor instructions.
  - Finally, the atmospheric component should be lessened to a minimum.

For all pairs, using SNAP we:

Apply the orbit files to each image

Corregistrate using the 1 sec SRTM

Produce the interferogram

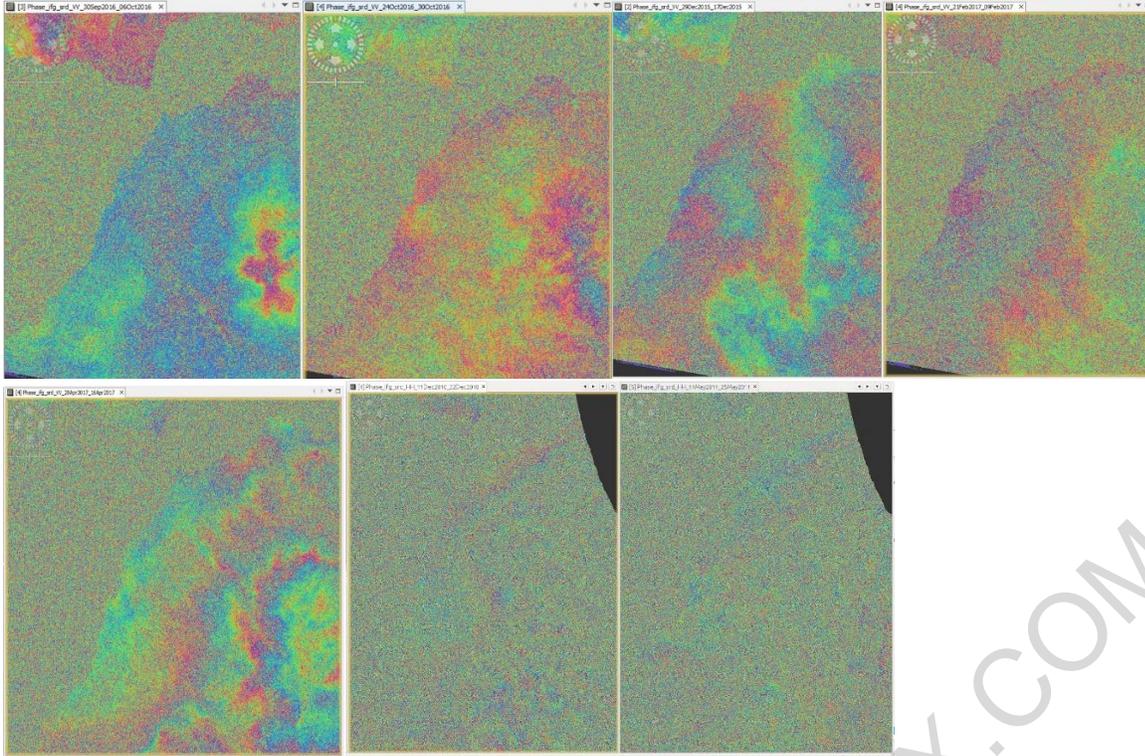
Deburst

Remove topographic phase

Terrain correct the image

Here is illustrated the topographic component of the interferograms. Through experience the producer of the DEM will have to choose the pair of images that make an interferogram with lesser atmospheric components.

Here are some examples of the above procedure showing the topographic component of various interferograms:



7) Once the best pair for the DEM creation is chosen, we apply:

- Goldstein Phase Filtering
- Snaphu Export (wrapped phase)
- Snaphu Import (unwrapped phase)
- Phase to Height
- Range Doppler Terrain Correction

Once the DEM is ready it would be wise to compare it to existing DEMs if they exist. Check this [http://papadopouloalex.com/products/r/dem/knit\\_dem\\_comp.pdf](http://papadopouloalex.com/products/r/dem/knit_dem_comp.pdf) for DEM comparison using free tools.