Exercise 2: Interferogram of Napa Earthquake

Sarproz processing tutorial series

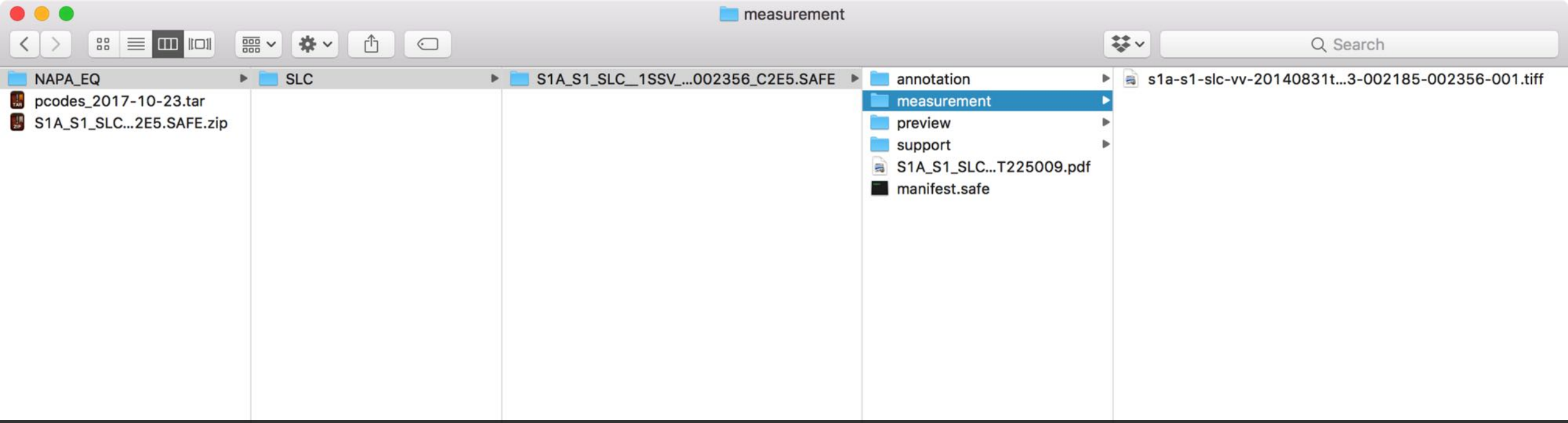
By Yuxiao QIN

Downloading Sample Data

- Sample Data, Texas Houston, 2017 August Flood:
  - ~~ftp://johndoe:psinsar12138@128.46.174.159/data/TX_FLOOD/~~ SEE BELOW
    - **To download, manually copy & paste this URL into Google Chrome's address bar.**
    - In addition, you can use a ftp app, such as FileZilla. Manually enter the address, username and password.
  - Two data taken separately on 2017-Aug-05 and 2017-Aug-29 are included in the sample data.
  - Reference: https://www.wikiwand.com/en/Hurricane_Harvey

- Sample Data, Napa, California, 2014 August Earthquake:
  - ~~ftp://johndoe:psinsar12138@128.46.174.159/data/NAPA_EQ~~ SEE BELOW
  - Two data taken separately on 2014-Aug-07 and 2014-Aug-31 are included in the sample data.
  - Reference: http://www.wikiwand.com/en/2014_South_Napa_earthquake

!! the links above are no longer working
please find the data hereafter:
TEXAS FLOOD: https://my.pcloud.com/publink/show?code=XZtlbE7ZvXKViLSdGrY6RlgY55UQ9uNXFRpk
NAPA EARTHQUAKE: https://my.pcloud.com/publink/show?code=XZ1DnU7ZtMAo6EHeMopShqpY5keOnS2z1Ikk

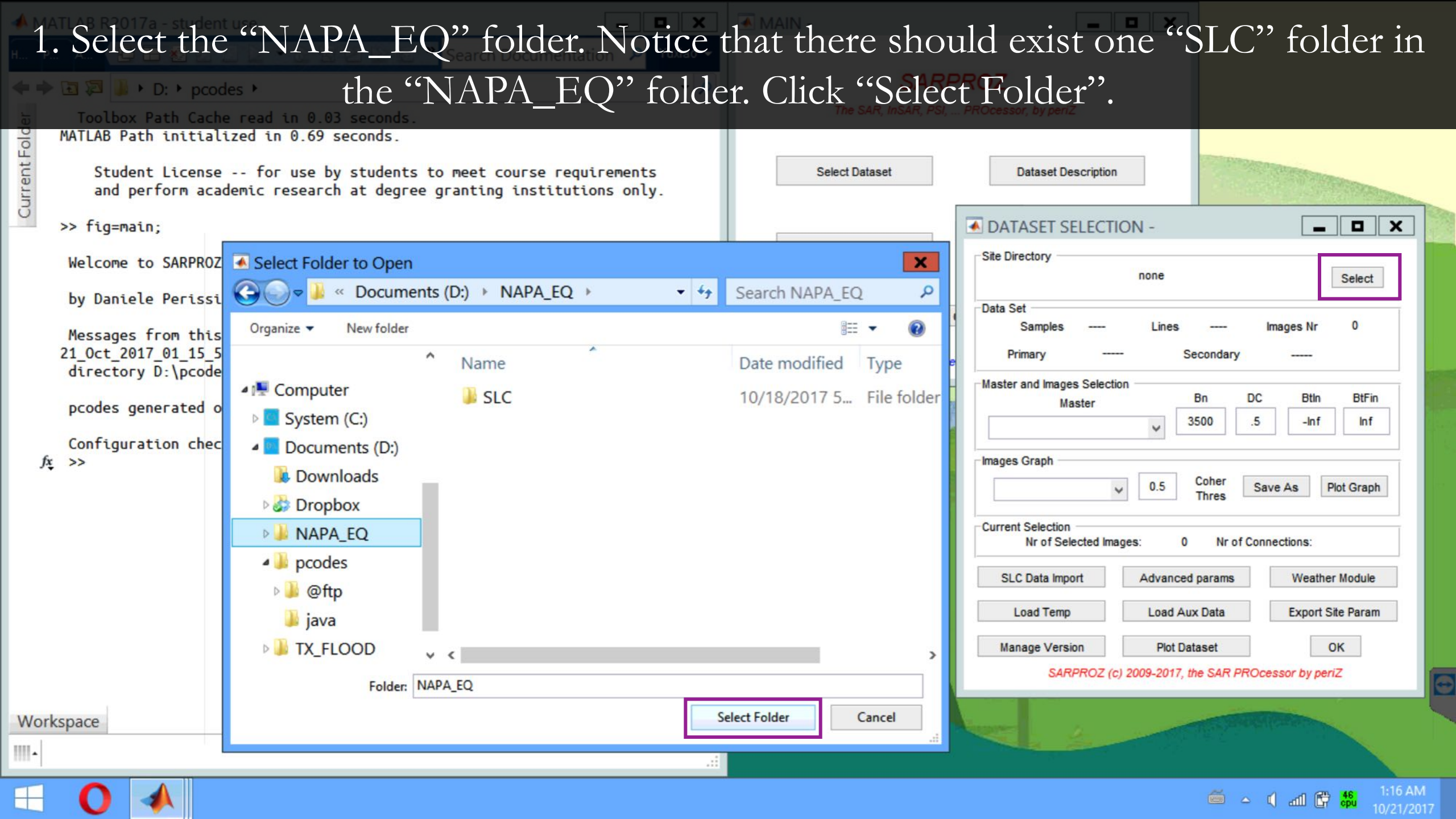


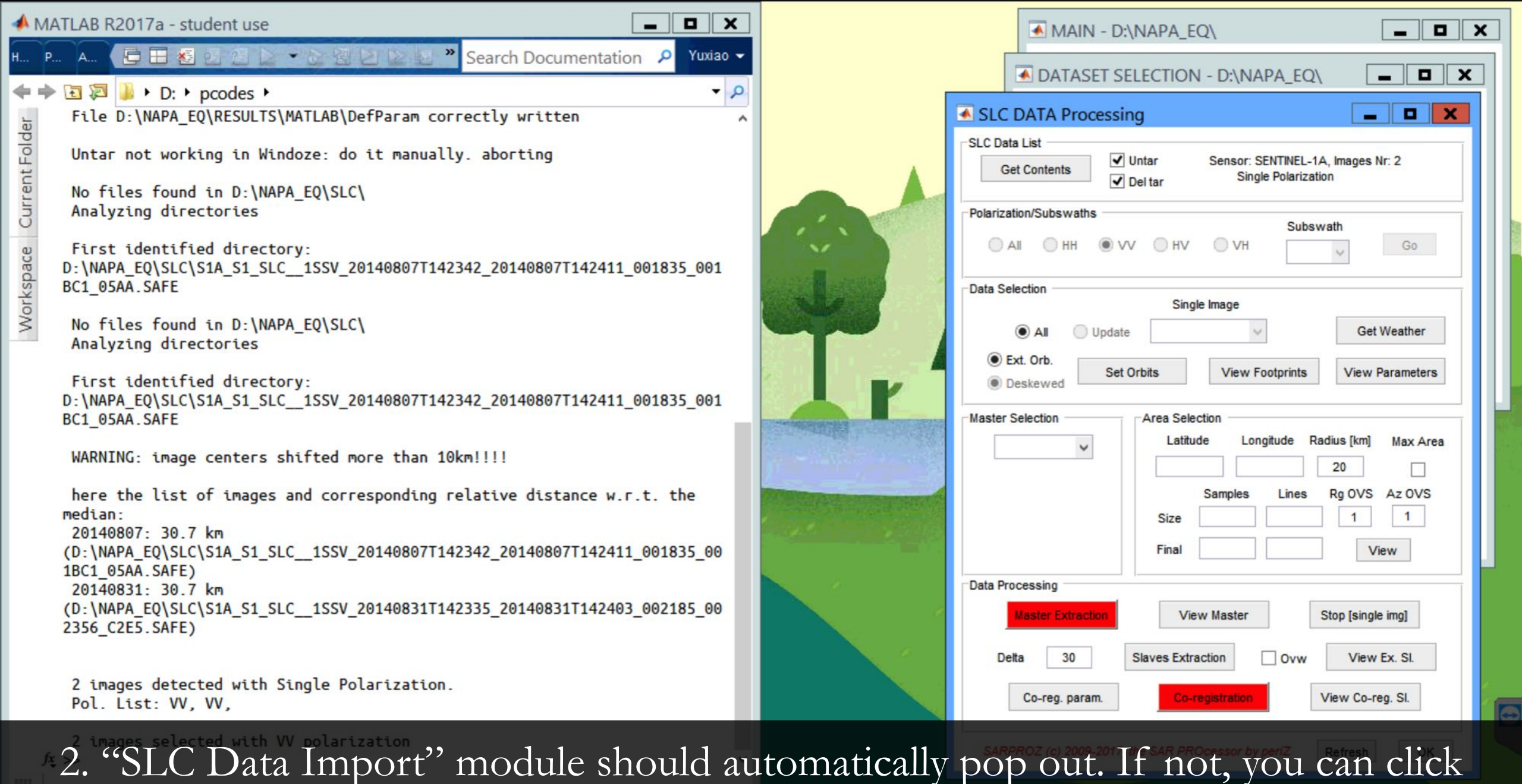
1. When you downloaded the sample data, you need to manually extract the compressed file. Please make sure after you extracted the compressed file, you have the EXTACT folder structure AS SHOWN ON THIS PAGE. Delete the compressed file afterwards to save space.

2. PLEASE LEAVE AT LEAST 2.7GB AVAILABLE FOR THIS LAB. (Later you will be instructed to delete unnecessary files during the process, but at one point you must have 2.7GB on disk to process all data!)

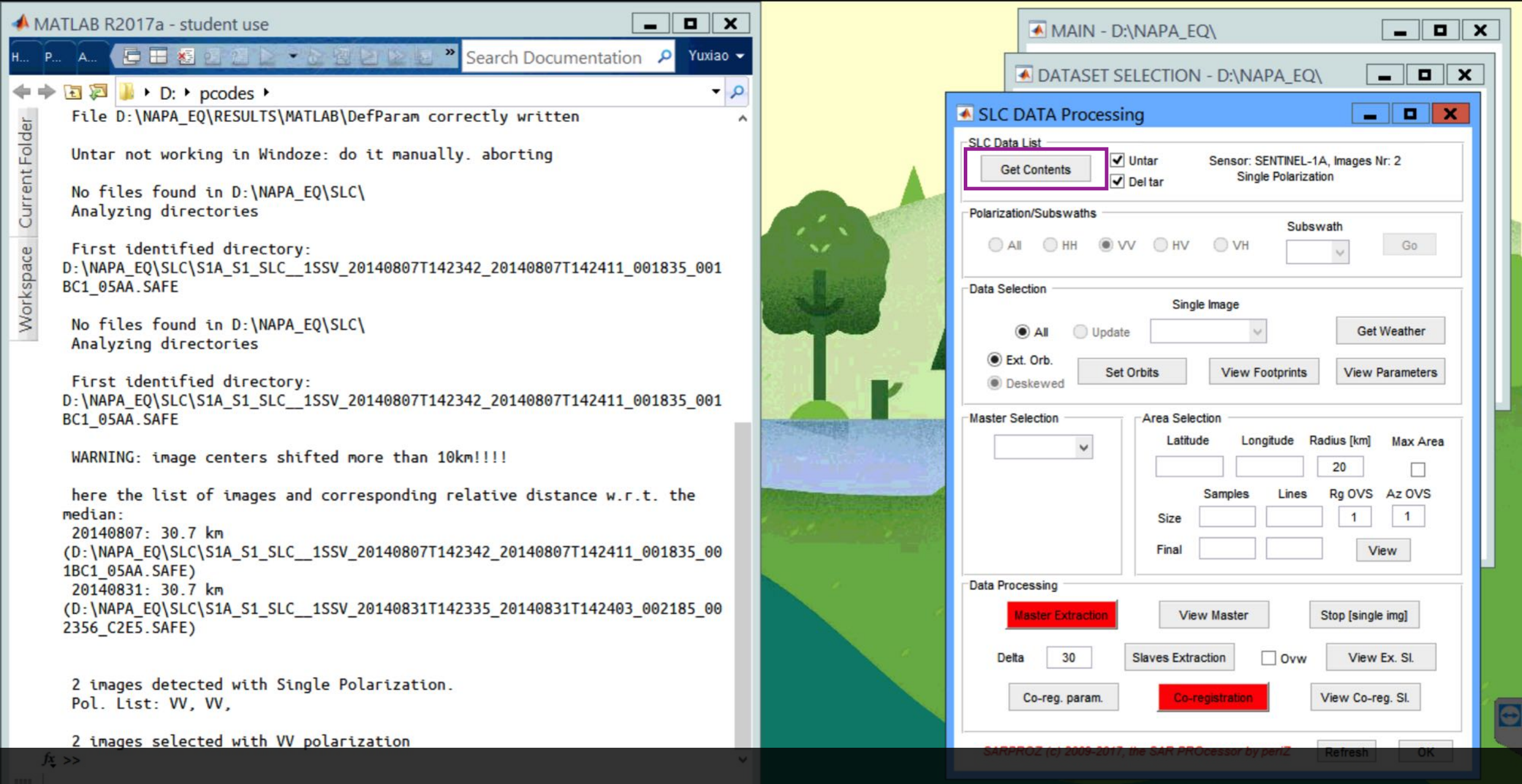
Part 1: Import
Synthetic **A**perture **R**adar (SAR)
Single-**L**ook **C**omplex (SLC) data

1. Select the "NAPA_EQ" folder. Notice that there should exist one "SLC" folder in the "NAPA_EQ" folder. Click "Select Folder".

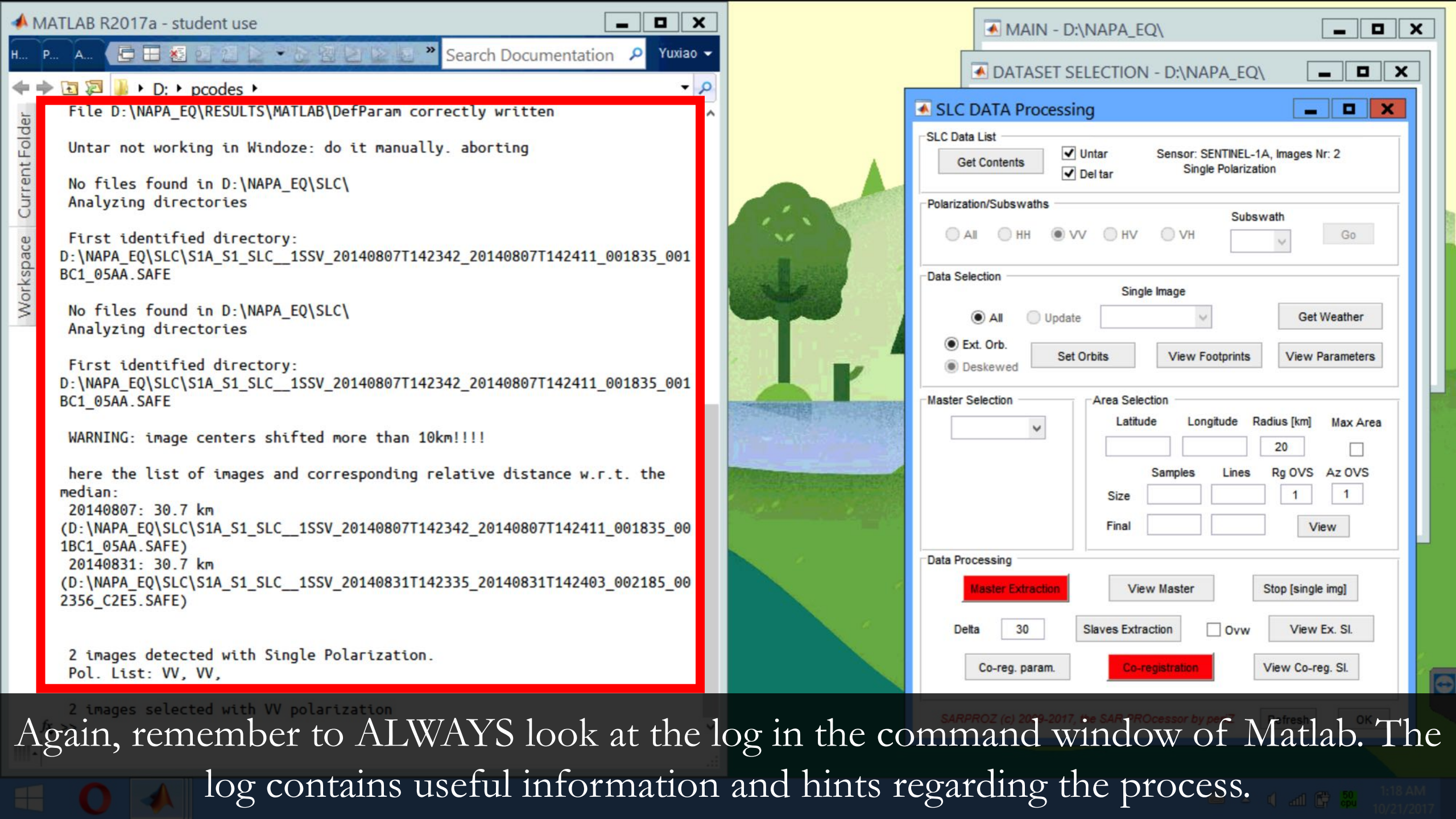




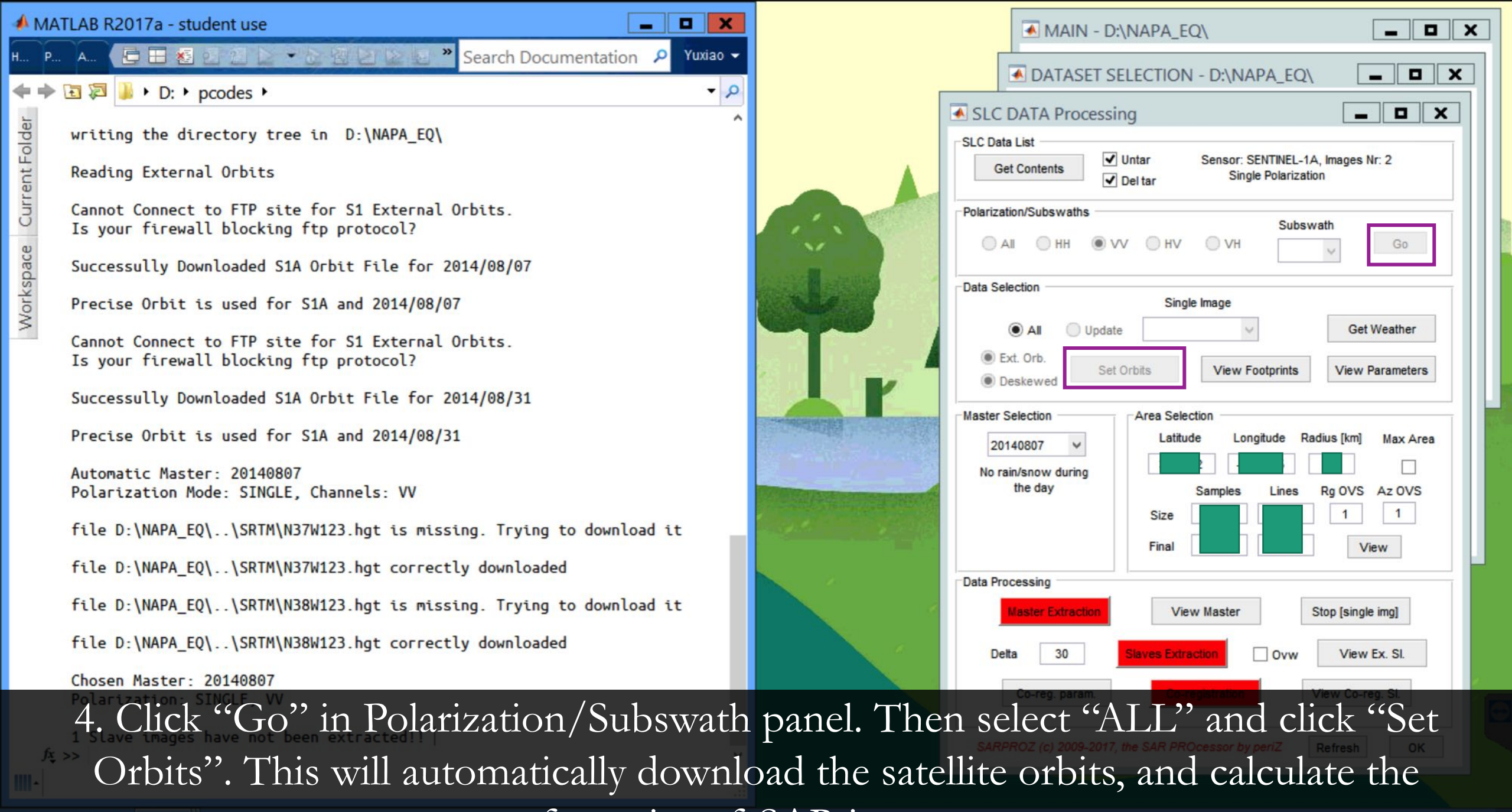
2. “SLC Data Import” module should automatically pop out. If not, you can click “SLC Data Import” after you select the data.



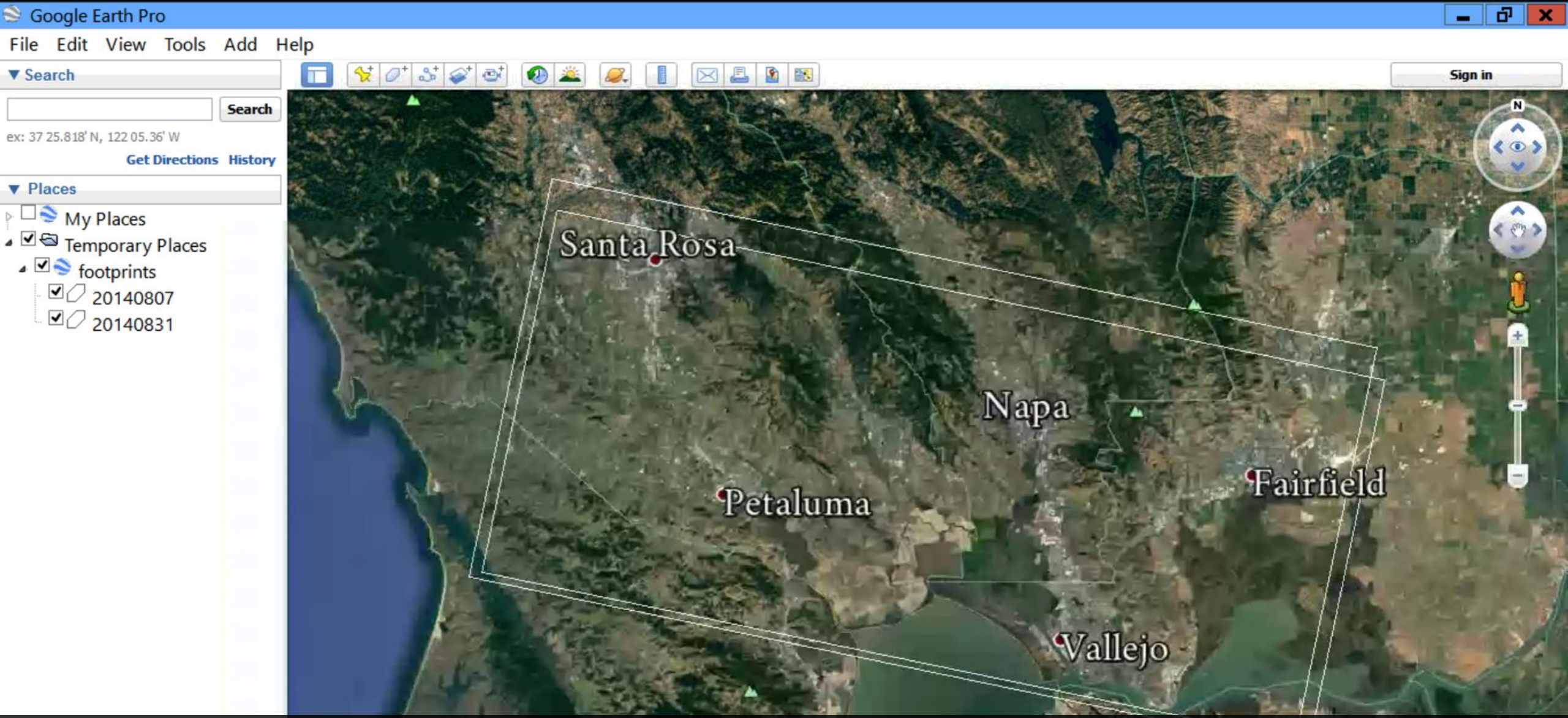
3. Click “Get Contents” to read in data parameters.



Again, remember to ALWAYS look at the log in the command window of Matlab. The log contains useful information and hints regarding the process.



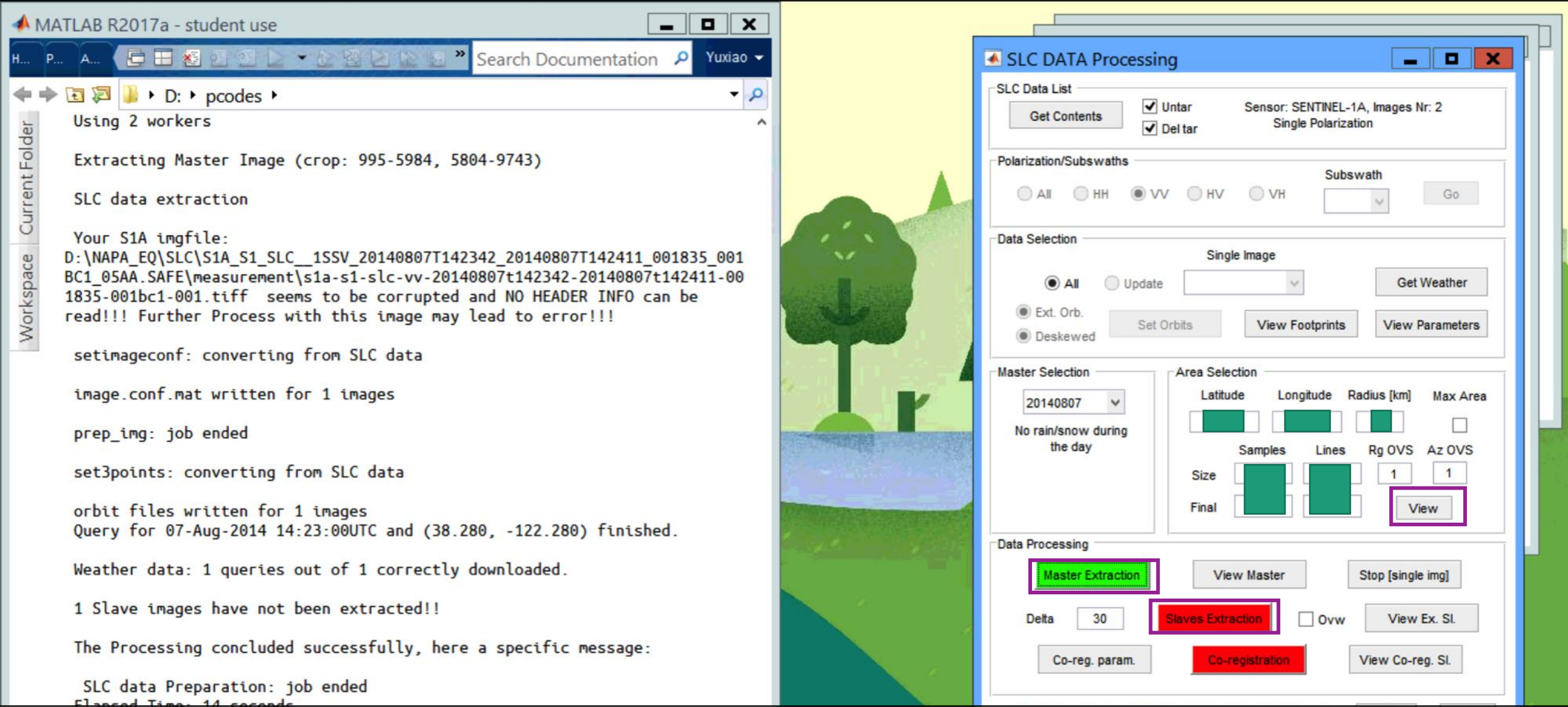
4. Click “Go” in Polarization/Subswath panel. Then select “ALL” and click “Set Orbits”. This will automatically download the satellite orbits, and calculate the footprint of SAR images.



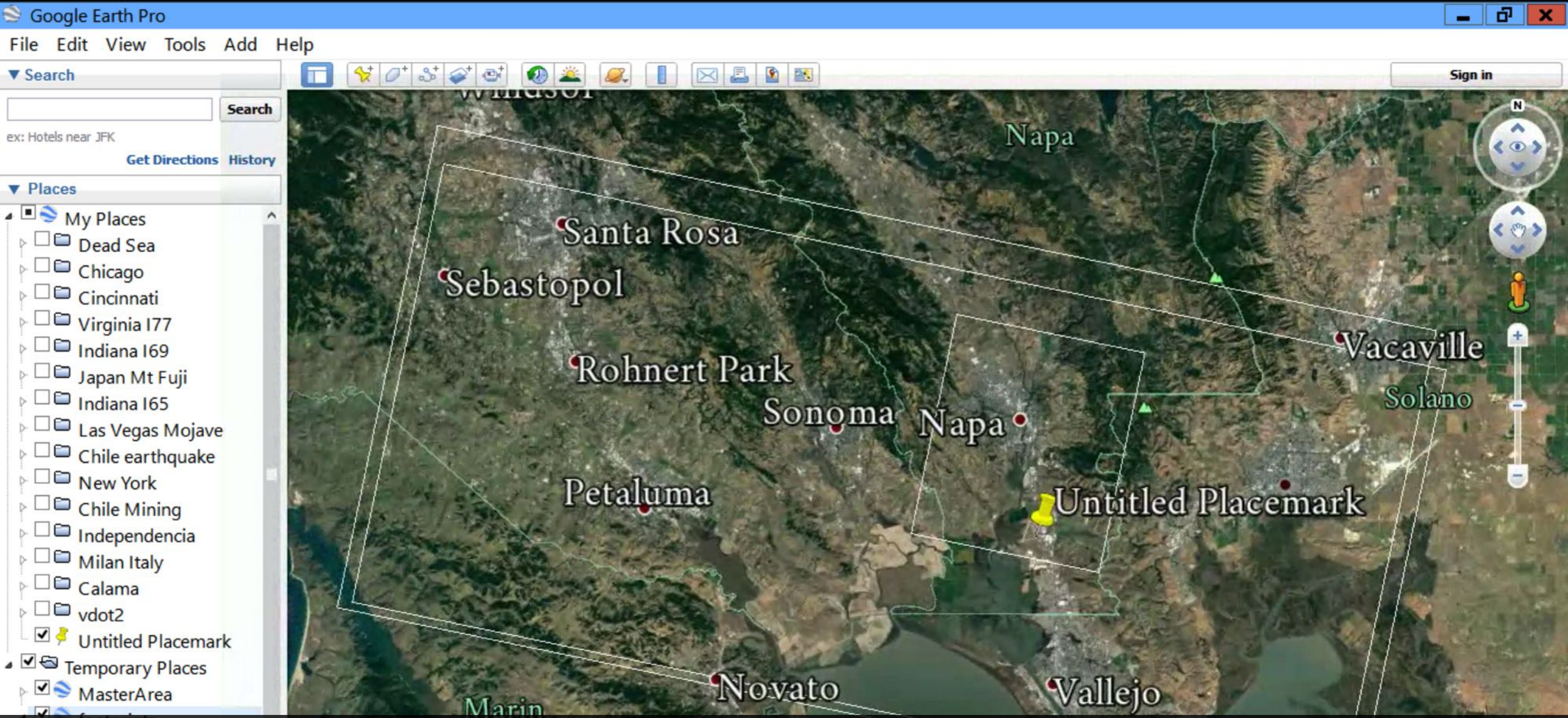
Click "View Footprints" to see the footprints of your image(s) on Google Earth. If Google Earth do not start automatically, Go to "NAPA_EQ/RESULTS/GEO/" and double click "footprints.kml" to open.

Select your own Area of Interest (AOI)

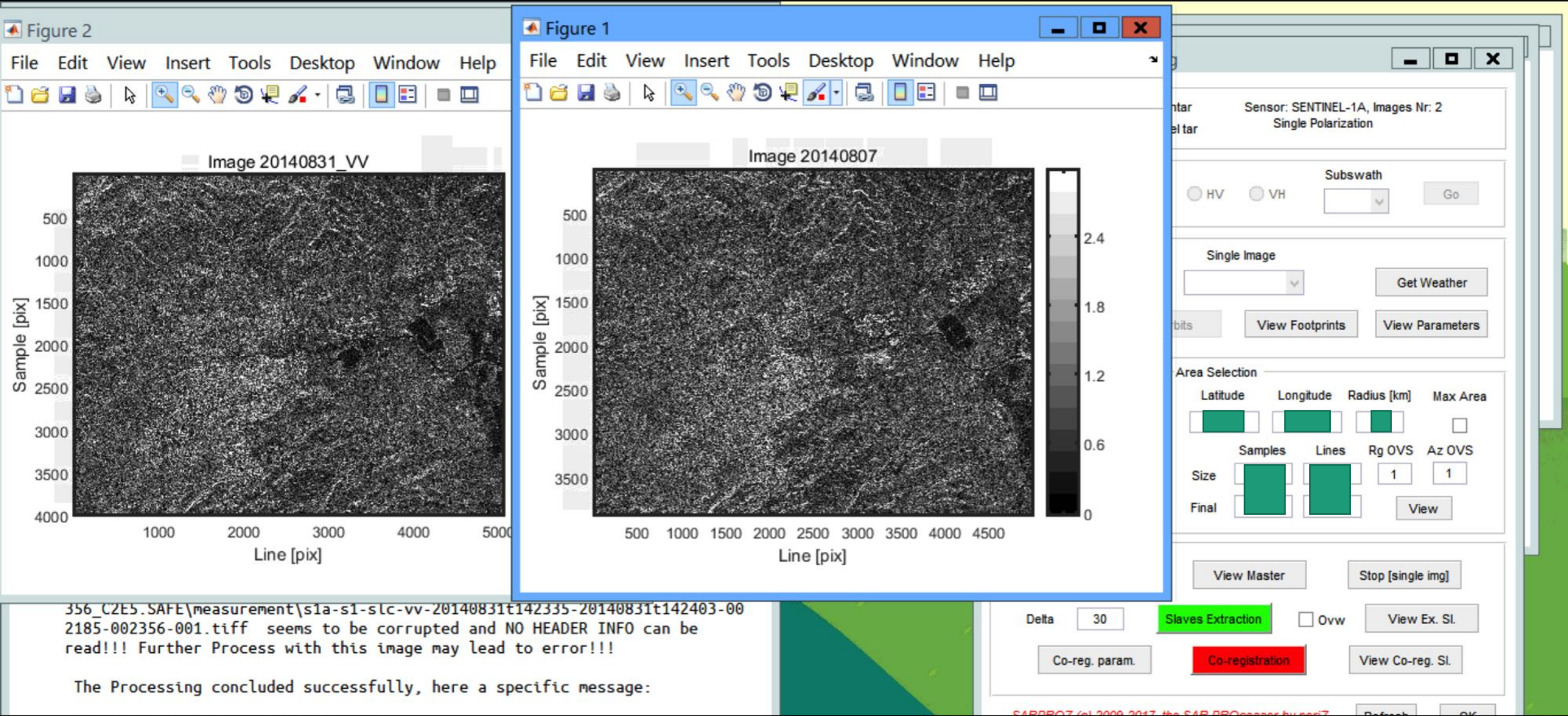
1. In this tutorial, you are asked to select your own AOI by putting down your own AOI center latitude, longitude and area radius.
2. You are asked to select an area close to the earthquake center, which is located at NAPA.
3. Select a center coordinates:
   - Limit your latitude between 38.2° and 38.3°;
   - Limit your longitude between -122.4° and -122.2° (a negative sign just means the west hemisphere);
   - Limit your range between 8km and 14km (a sufficient area is required to analysis the flood. On the other side, due to disk space restriction, you need to limit the size of extracted area).
   - Your AOI should centered around NAPA with the above restriction.



5. In "Area Selection", input your value for latitude, longitude and radius based on the info from previous page. You can click "View" to see your selected AOI. The larger your processing area, the longer it takes to process.

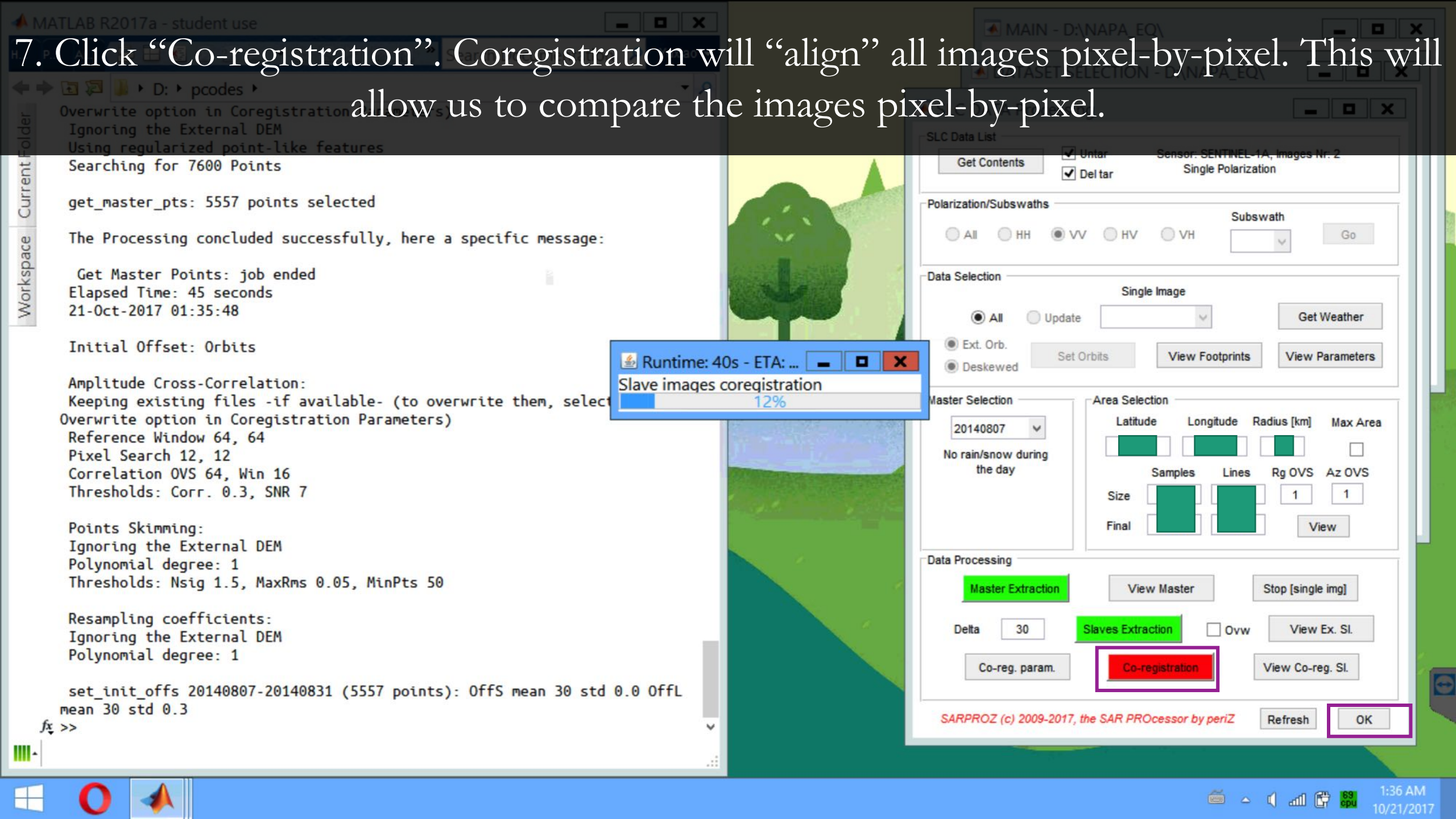


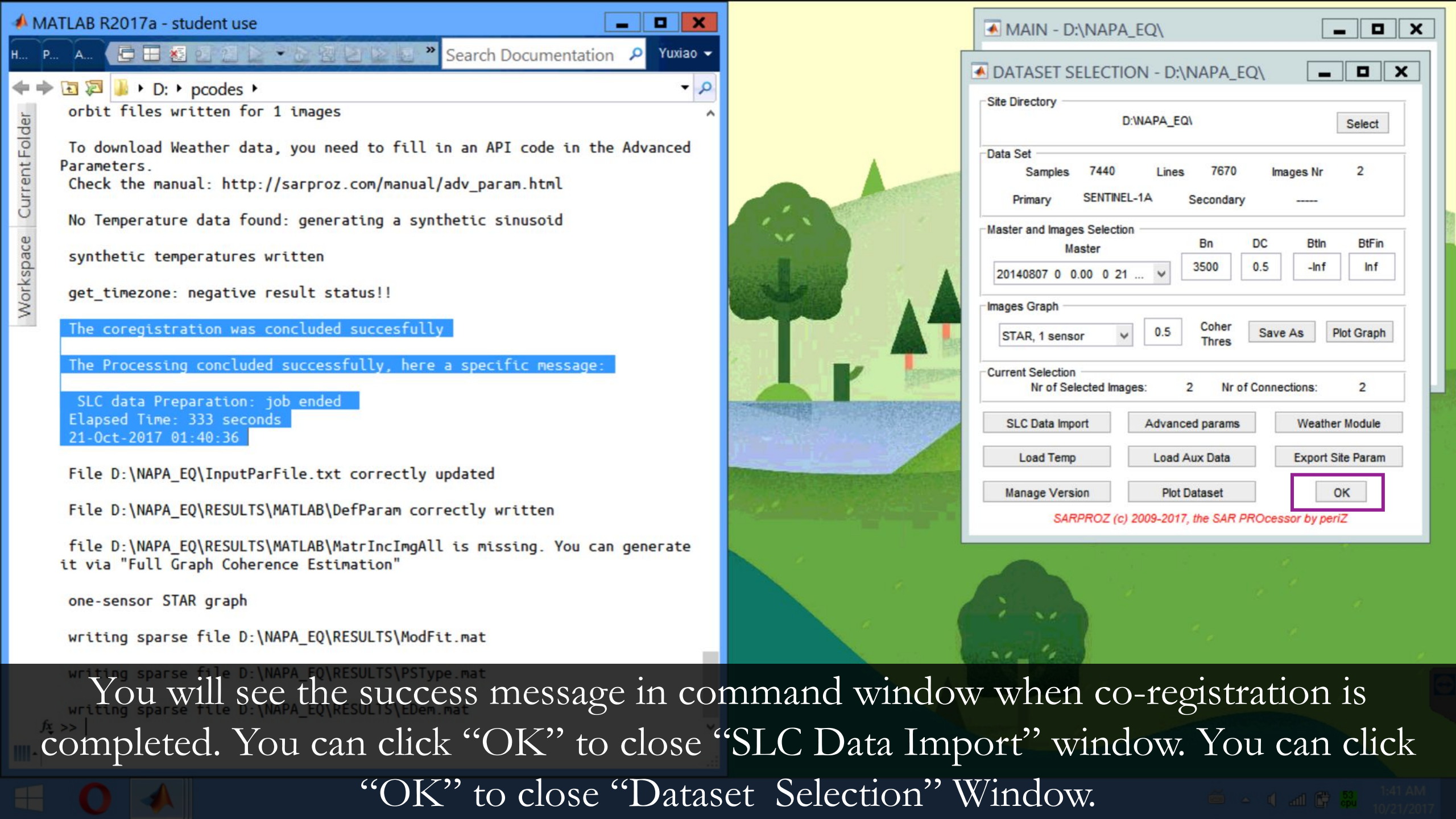
Click "View" to see the area you have selected (to process). If Google Earth do not start automatically, Go to "NAPA_EQ/RESULTS/GEO/" and double click "MasterArea.kml" to open.



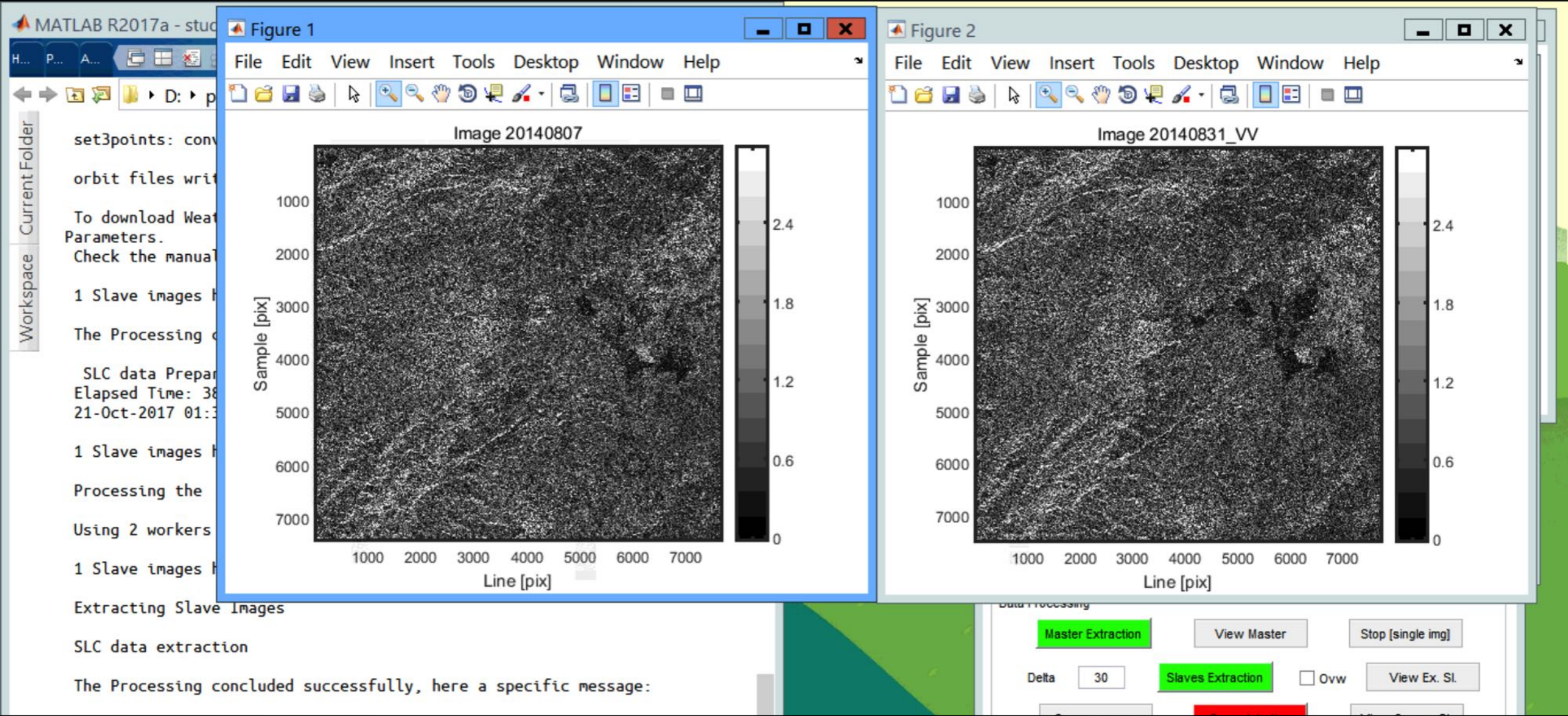
6. In sequence, click “Master Extraction” and “Slave Extraction”. You can also click “View Master/Slave” to view the SAR image. When the process is finished, the button will turn to green from red.

7. Click “Co-registration”. Coregistration will “align” all images pixel-by-pixel. This will allow us to compare the images pixel-by-pixel.

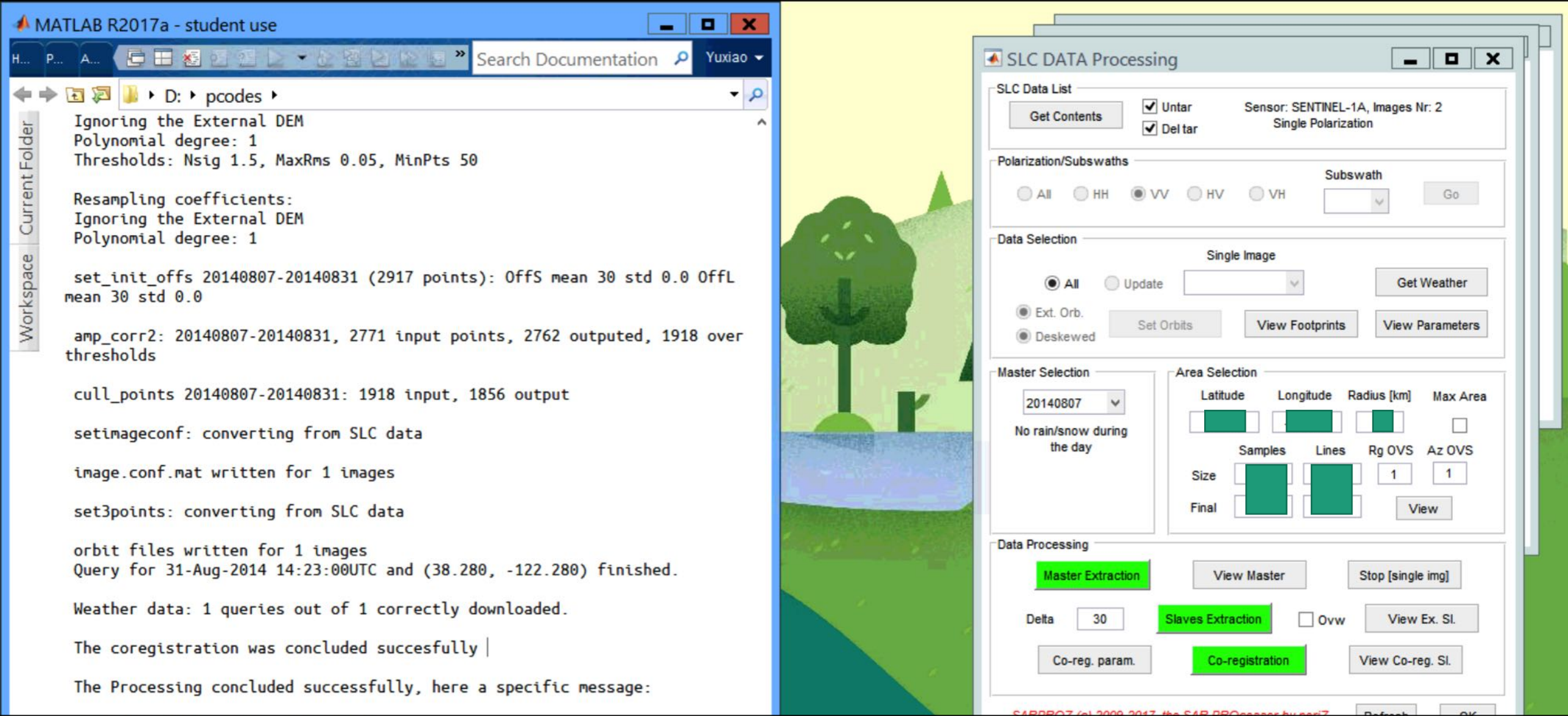




You will see the success message in command window when co-registration is completed. You can click "OK" to close "SLC Data Import" window. You can click "OK" to close "Dataset Selection" Window.

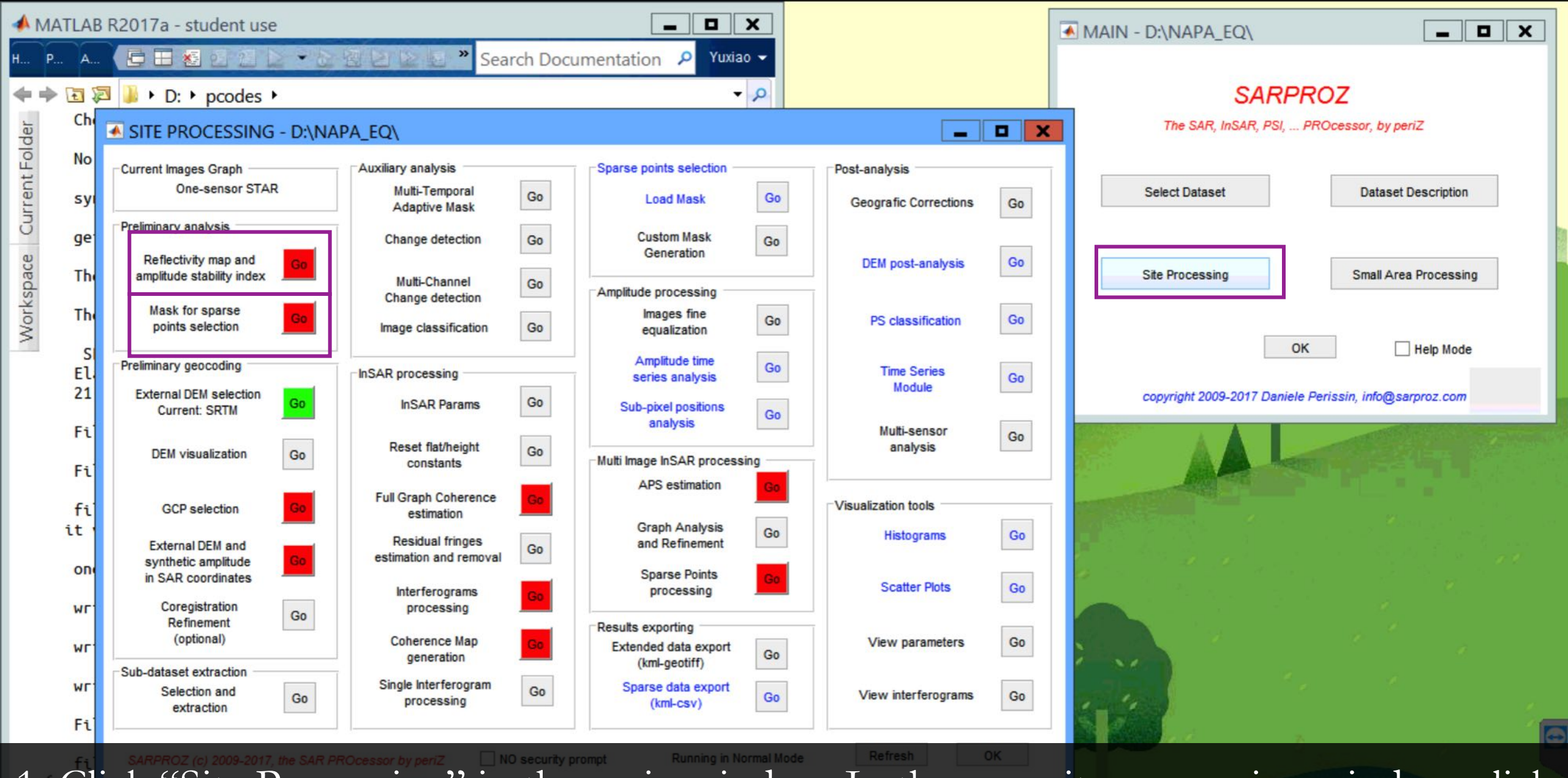


You can also check a ".jpeg" format of the SAR images in "NAPA_EQ/FITTED" folder.

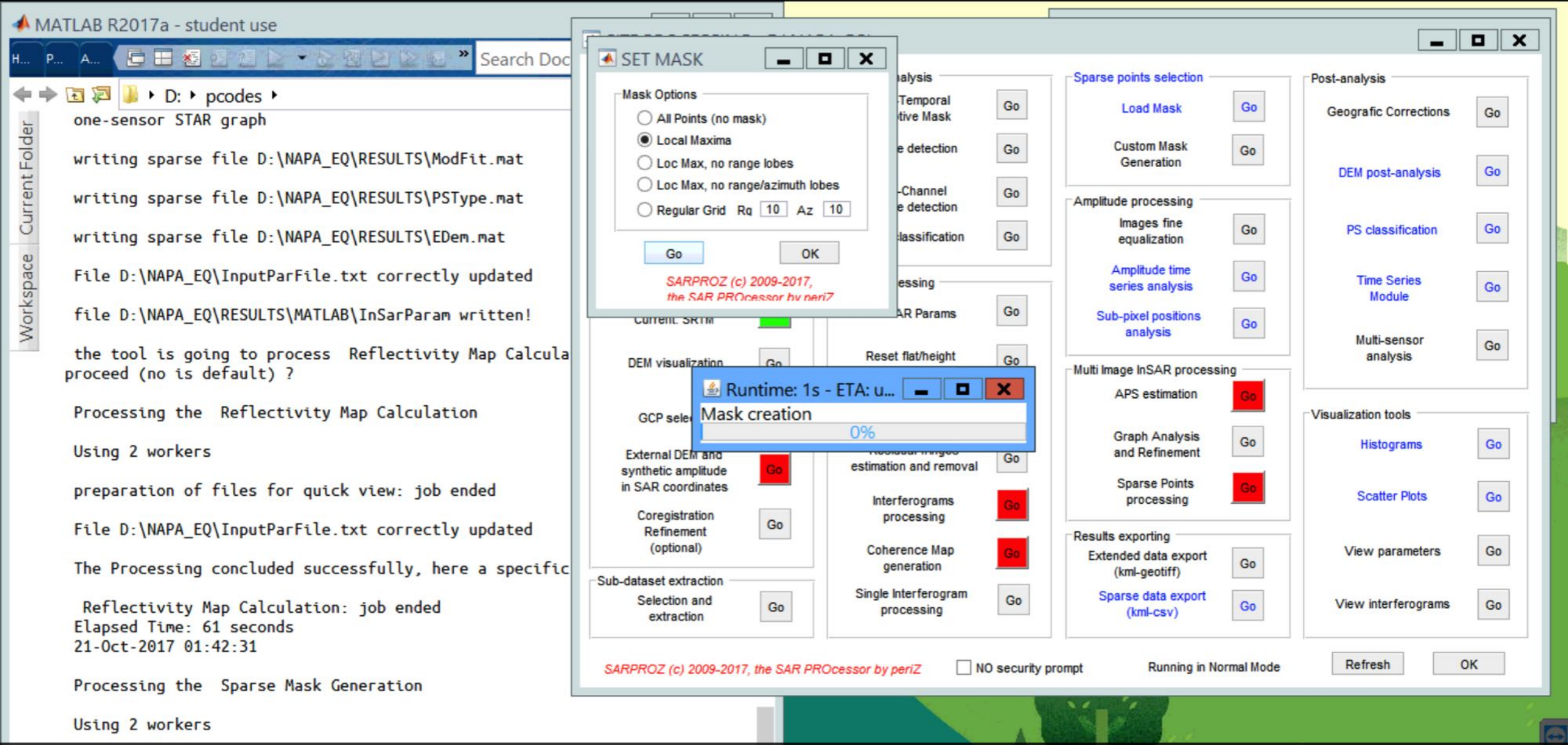


At this point, to save space, you can delete (or move to an external disk of yours) the whole "SLC" folder. This will save you ~1.7GB space. If later you need to reprocess everything, you can download the data from ftp again.

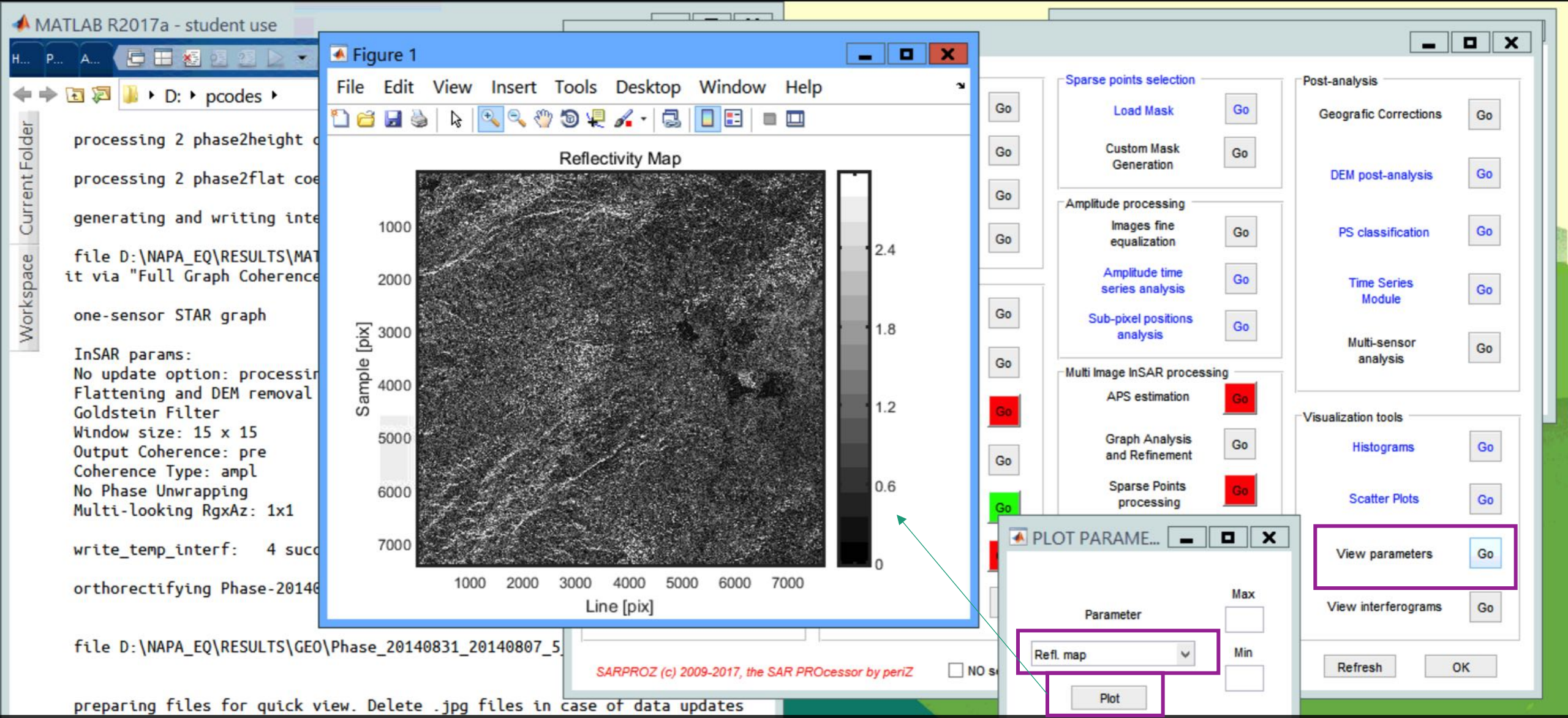
Part 2: Pre-process for generating interferogram



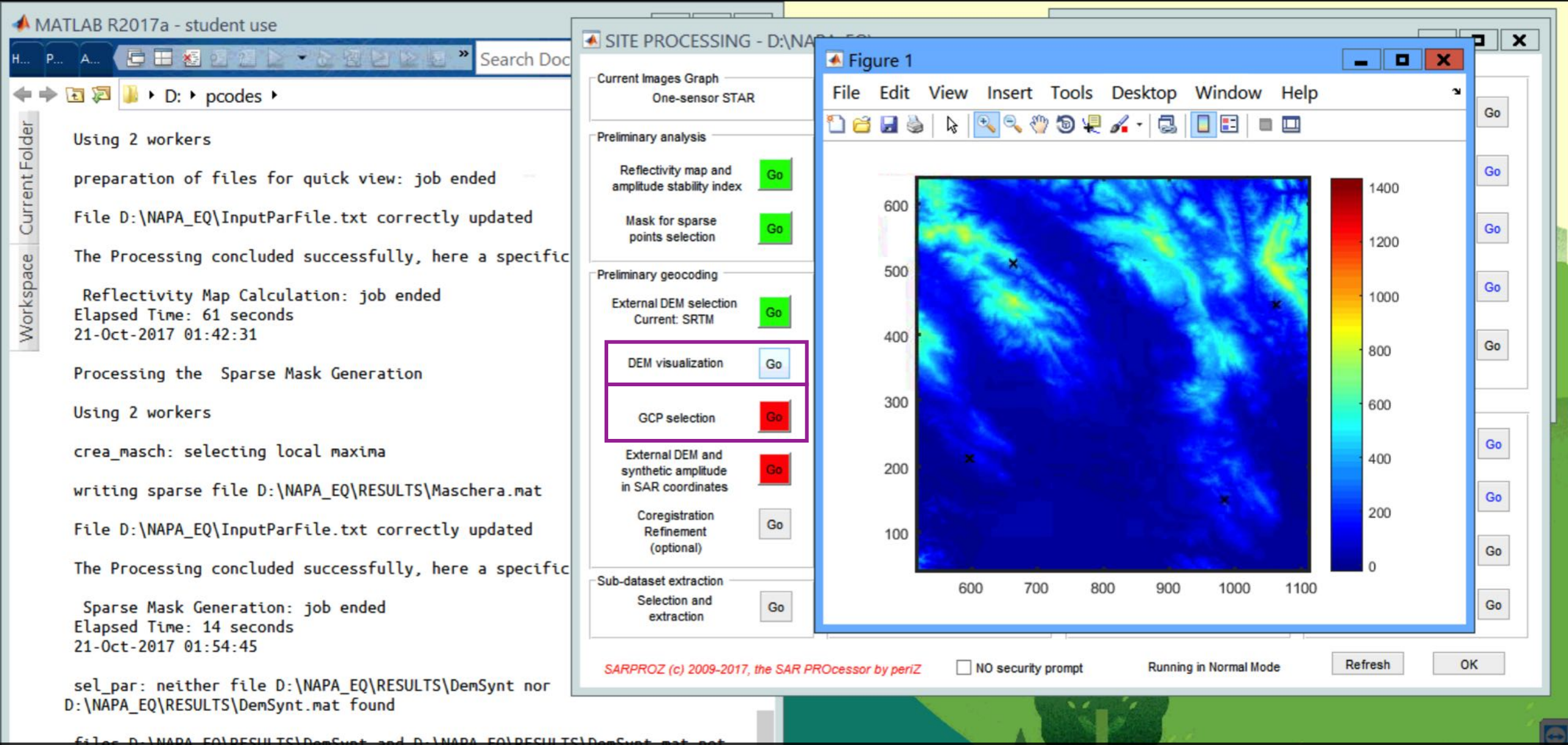
1. Click “Site Processing” in the main window. In the new site processing window, click “Reflectivity map and amplitude stability Index” to generate reflectivity map.



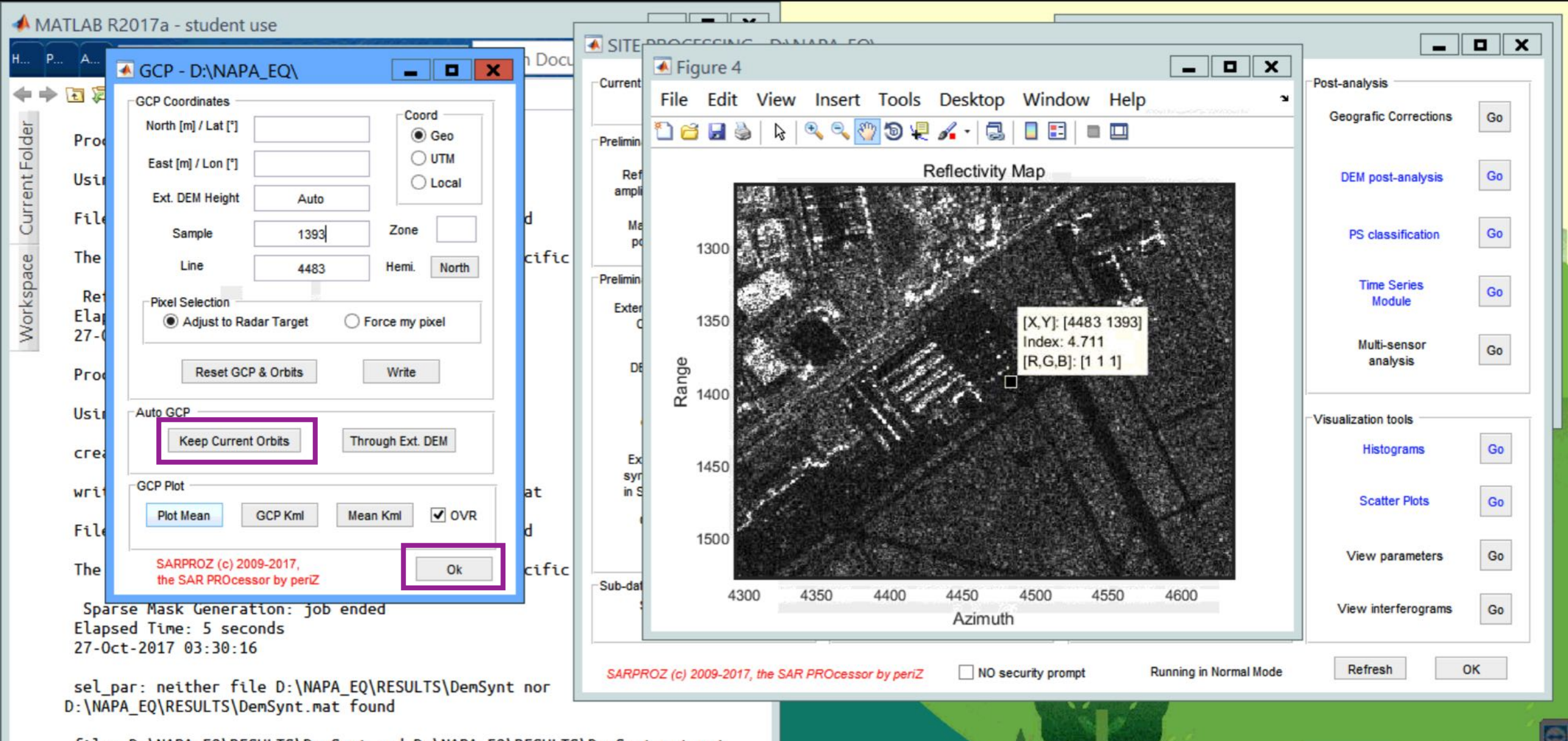
2. Click “Mask for sparse points selection” and Click “Go” in the new popped up window. Click “OK” to close the window when it is finished.



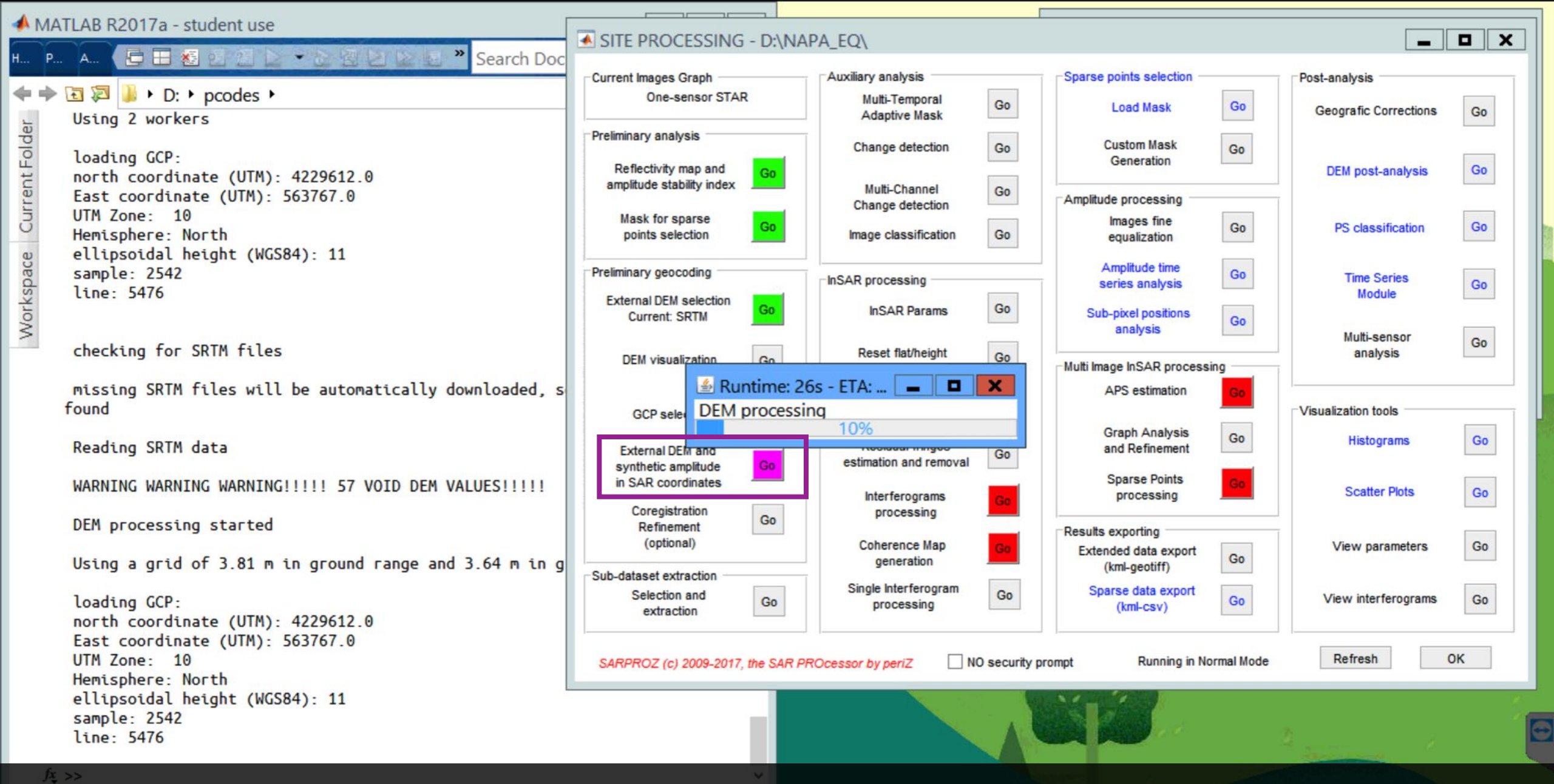
You can click "View Parameters" in visualization tools panel. Then select "Refl. Map" in parameter and click "plot" to plot it. You can also go to "NAPA_EQ/RESULT" and open "MeanFirst.jpg" to check the jpeg format of reflectivity map.



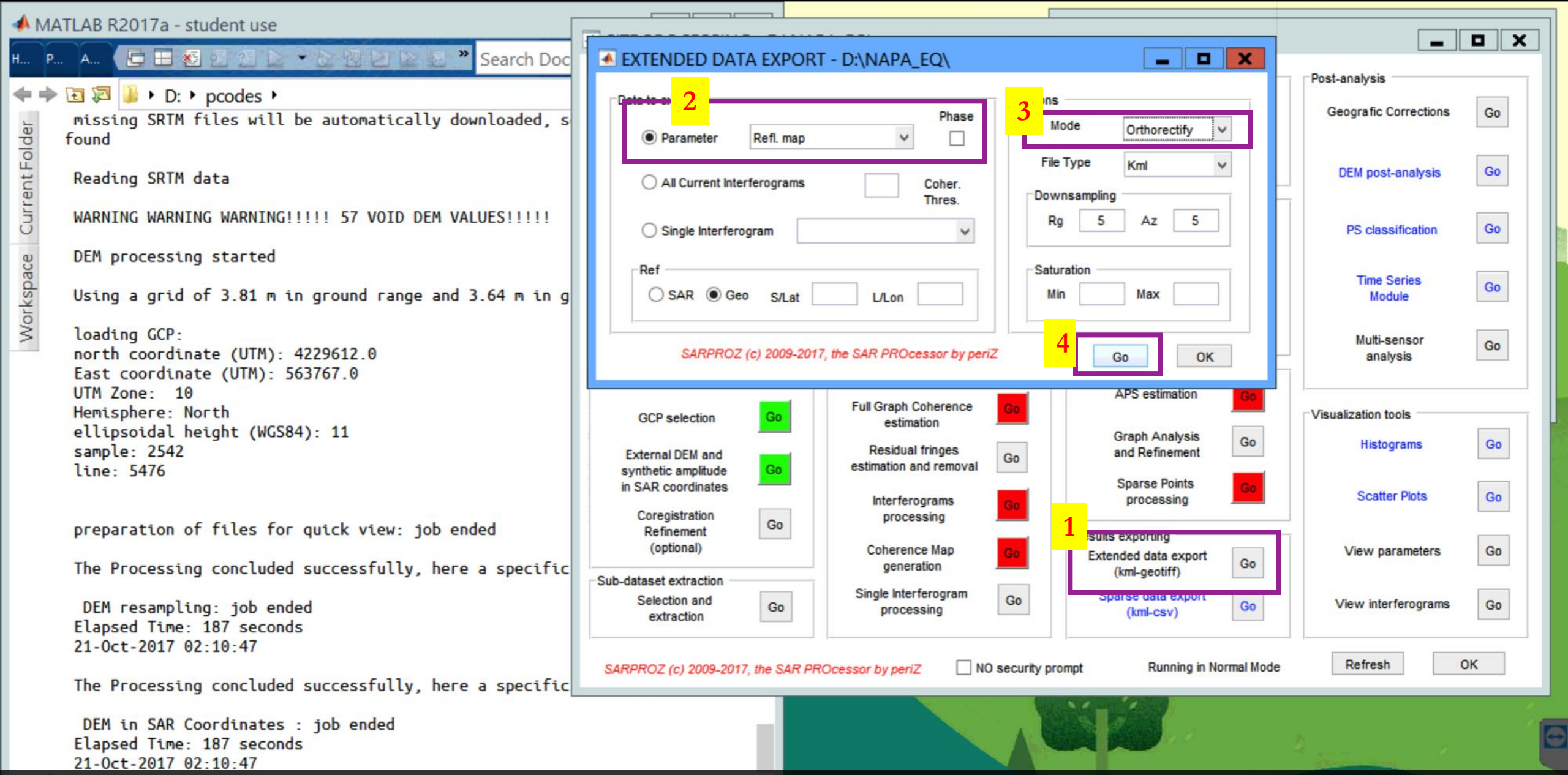
3. Click "DEM Visualization" to visualize the DEM inside your area of interest (AOI). The four black cross indicates the four corner of AOI.



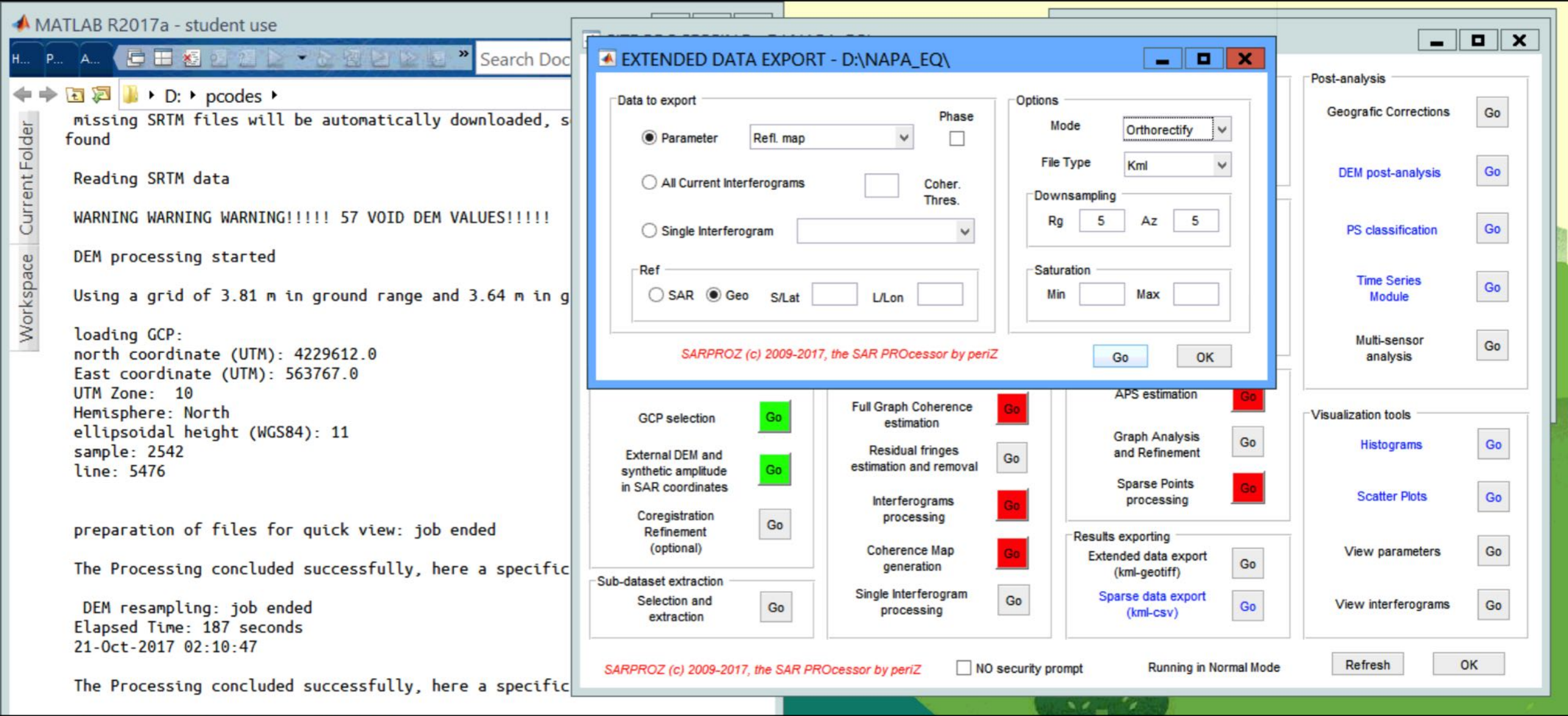
4. Click “GCP Selection”. In “Auto GCP” Panel, click “Keep Current Orbits”. When the process is finished, click “OK” to close the window.



5. Click “External DEM and synthetic amplitude in SAR coordinates”.

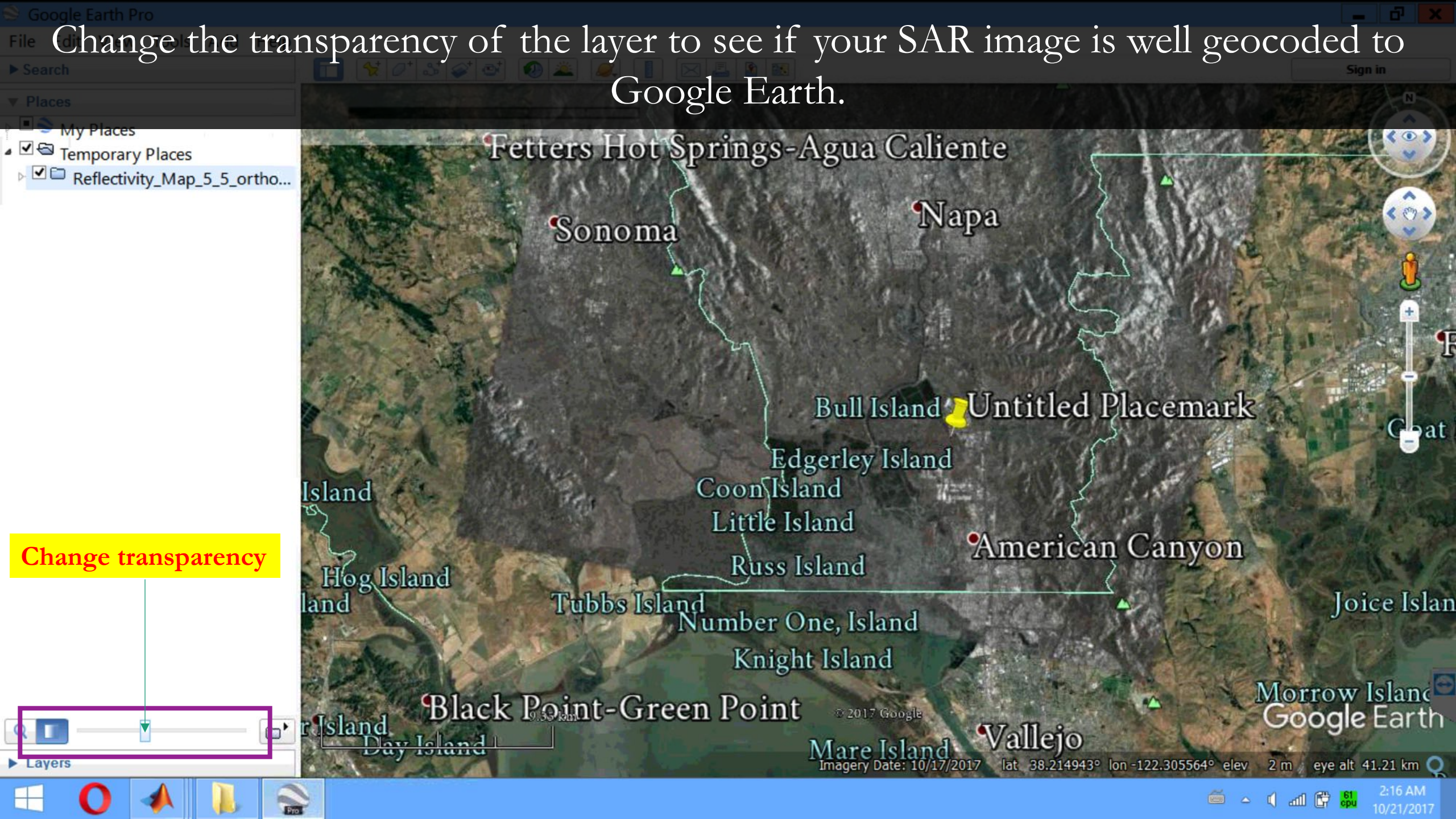


10. CHECK THE CORRECTNESS of your GCP: Geocode your reflectivity map to Google Earth. Click "Extended data export" in "Results exporting" panel.



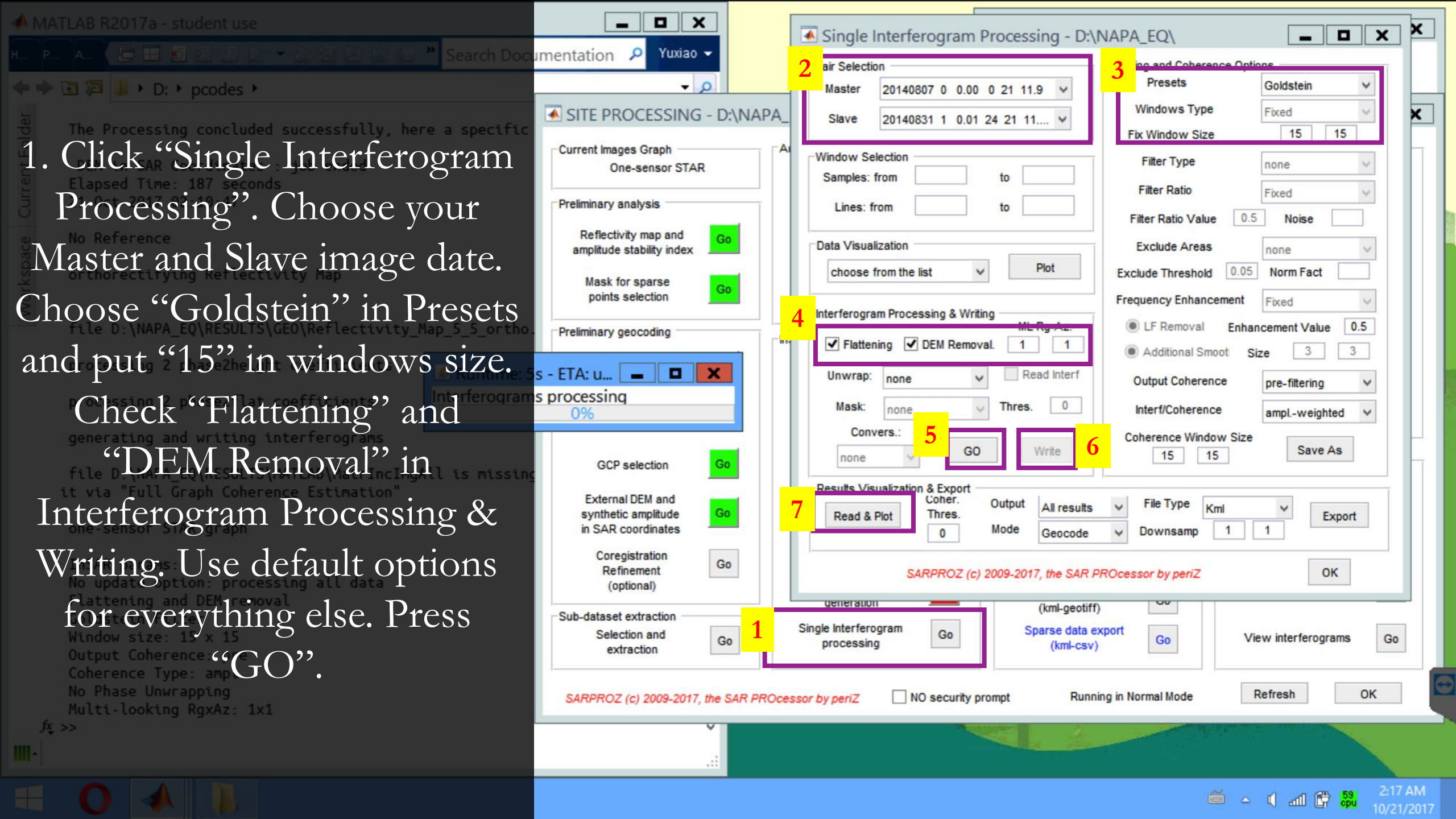
Choose “Refl. Map” in Parameter; Choose “Orthorectify” in Mode, Press “Go”. If your Google Earth does not start automatically, go to “NAPA_EQ/RESULTS/GEO/” and open “Reflectivity_Map_5_5_ortho.kmz”.

Change the transparency of the layer to see if your SAR image is well geocoded to Google Earth.

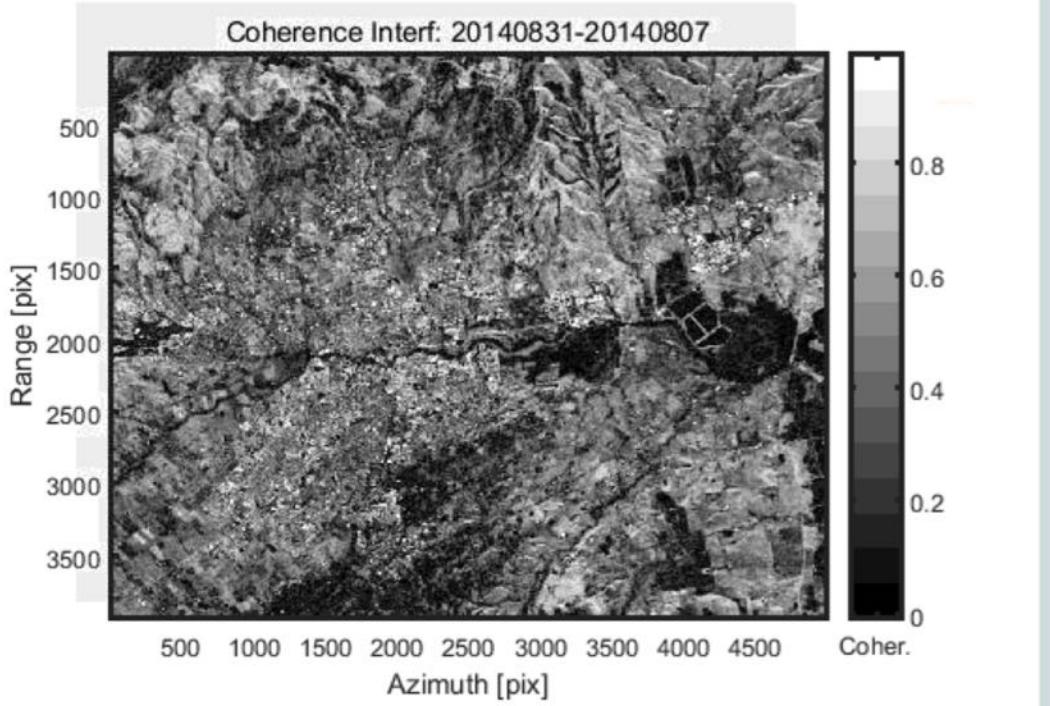


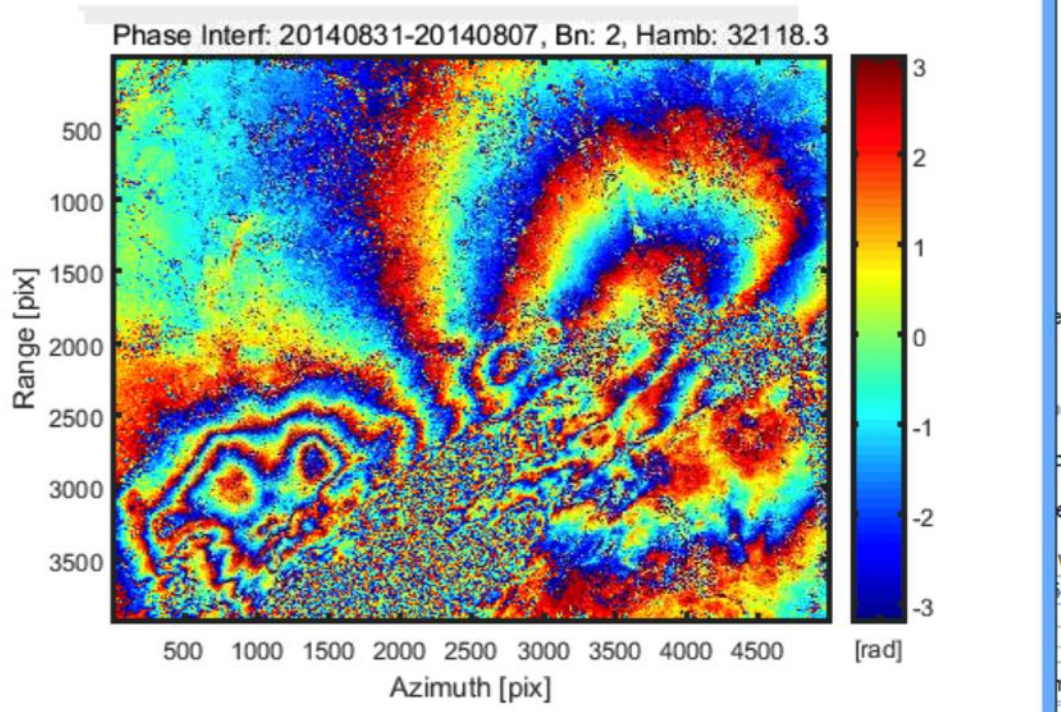
Part 3: Generate Interferogram

1. Click “Single Interferogram Processing”. Choose your Master and Slave image date. Choose “Goldstein” in Presets and put “15” in windows size. Check “Flattening” and “DEM Removal” in Interferogram Processing & Writing. Use default options for everything else. Press “GO”.



2. Click "Write" after process complete. Click "Read & Plot" to plot the interferogram and the corresponding coherence map.






```
Goldstein Filter
Window size: 15 x 15
Output Coherence: pre
Coherence Type: ampl
No Phase Unwrapping
Multi-looking RgxAz: 1x1

write_temp_interf:   4 successfully moved file(s)
fx >>
```

SARPROZ (c) 2009-2017, the SAR PROcessor by periZ

NO security prompt

Running in Normal Mode

Refresh

OK

Export

Save As

Noise

Norm Fact

Enhancement Value

Size

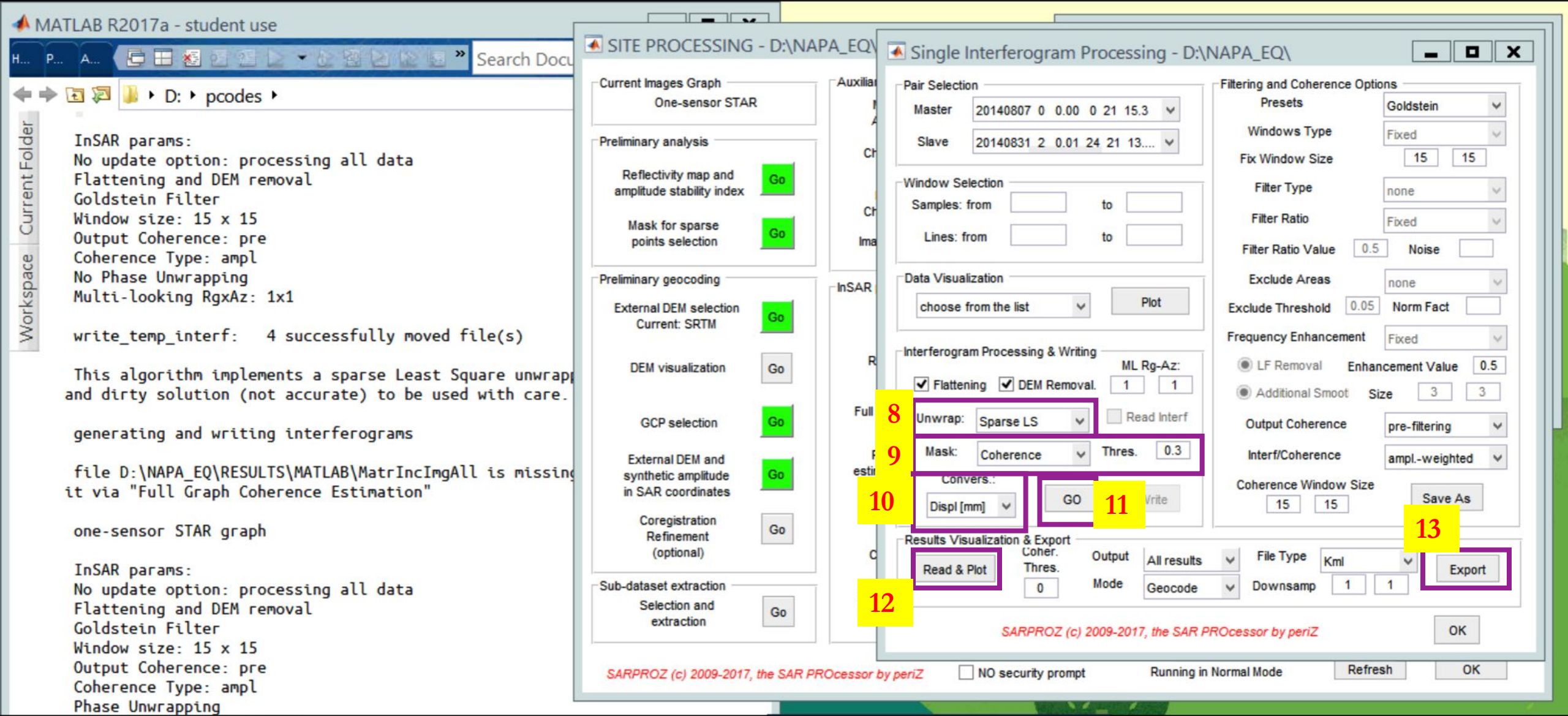
Goldstein

none

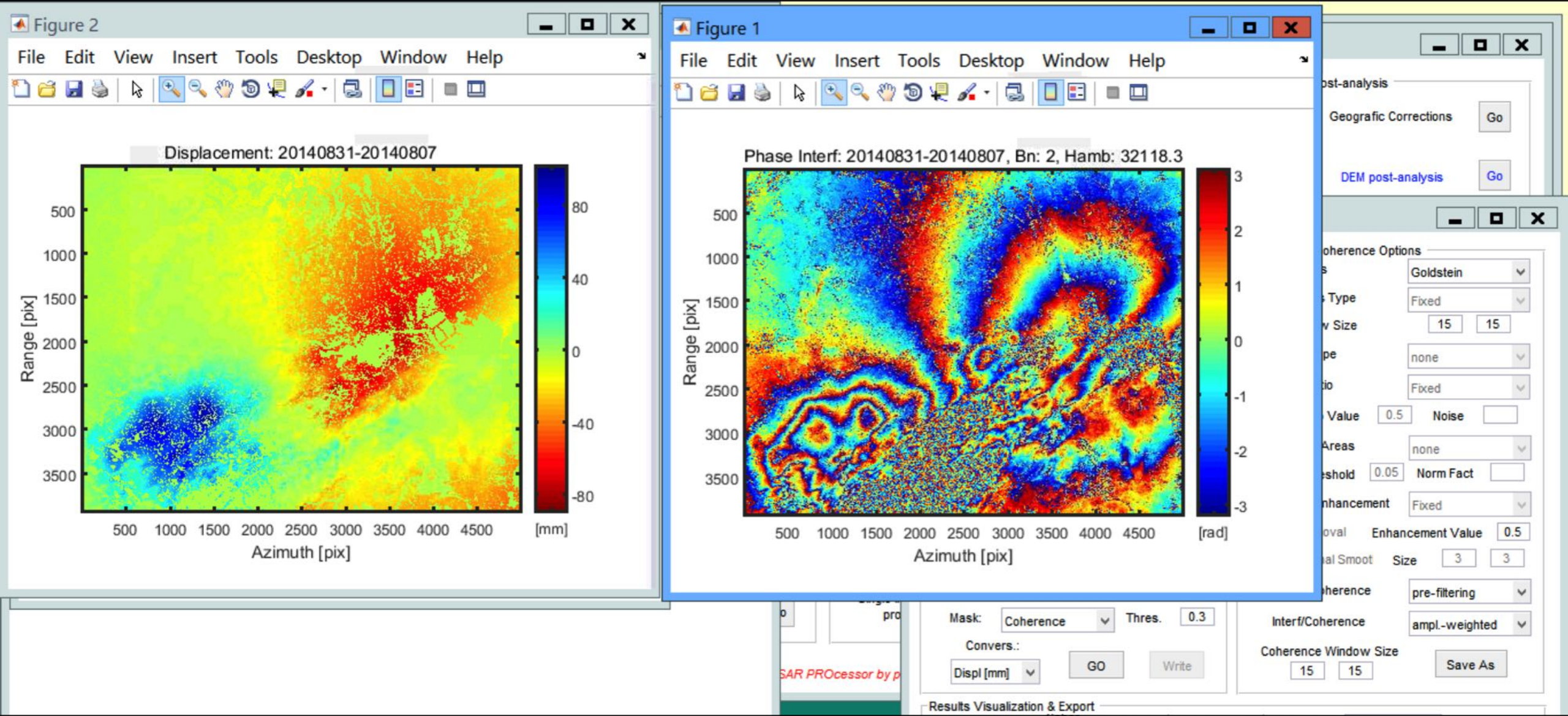
Fixed

pre-filtering

ampl.-weighted

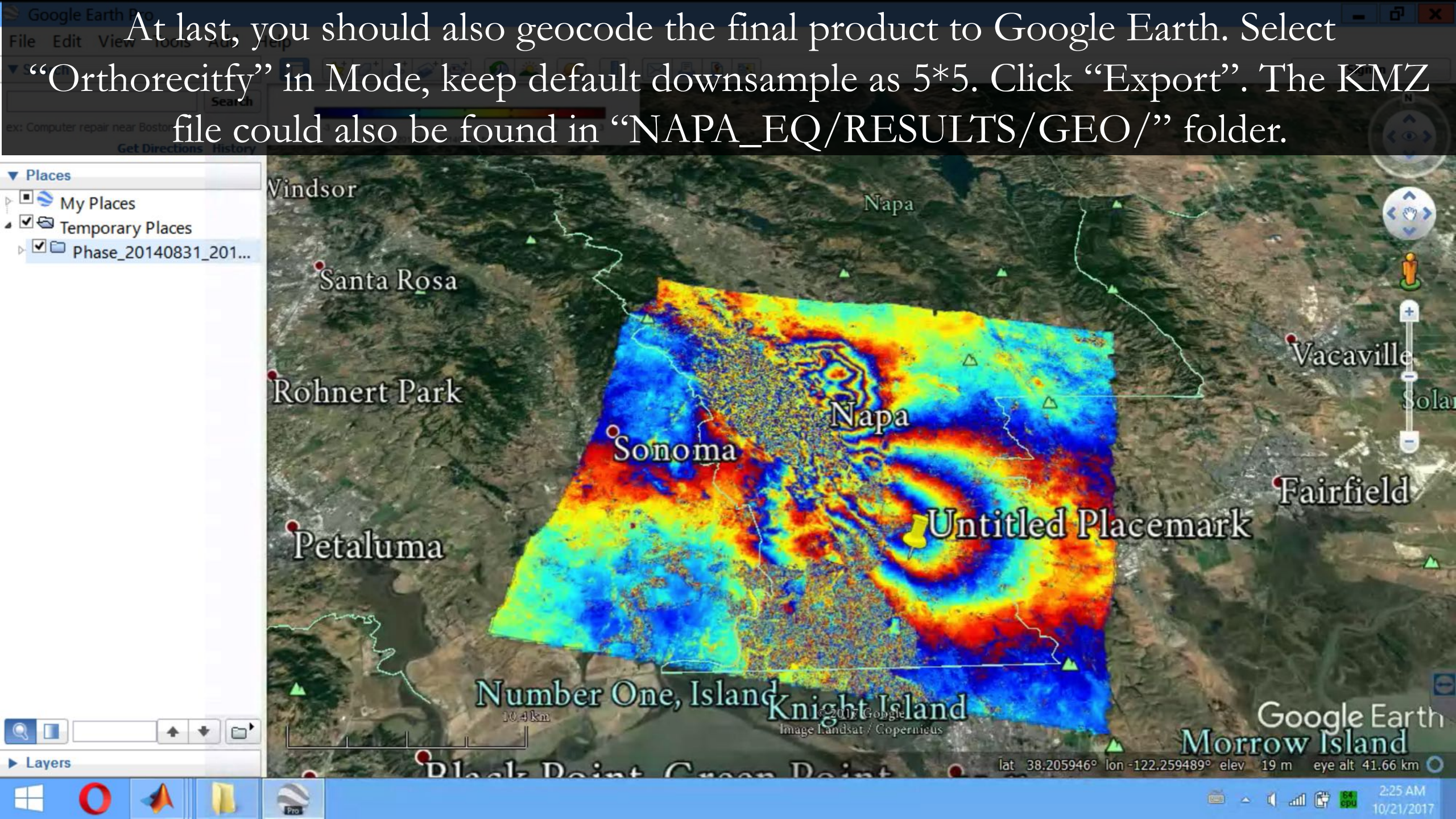


3. At last, we want to unwrap the interferogram. Select “Sparse L(east) S(quare)” for Unwrap. Select “Coherence” for Mask and input “0.3” as threshold. Select “Displacement [mm]” for Conversion. Click “GO” again to run interferogram unwrap.



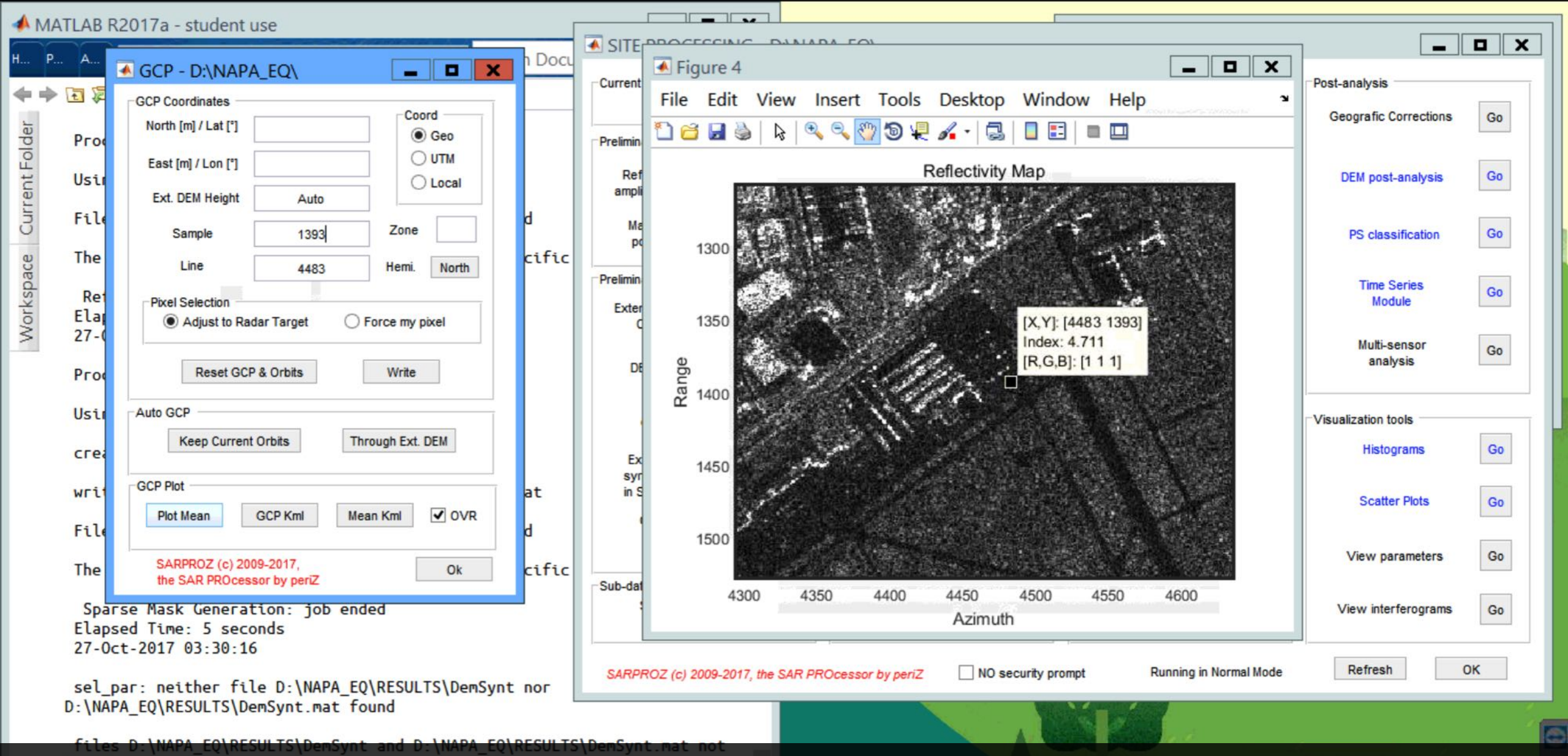
Click on "Read & Plot" again to plot the unwrapped interferogram. Compare it with the wrapped one. Please pay special attention to the colorbar scale.

At last, you should also geocode the final product to Google Earth. Select "Orthorecitfy" in Mode, keep default downsample as 5*5. Click "Export". The KMZ file could also be found in "NAPA_EQ/RESULTS/GEO/" folder.

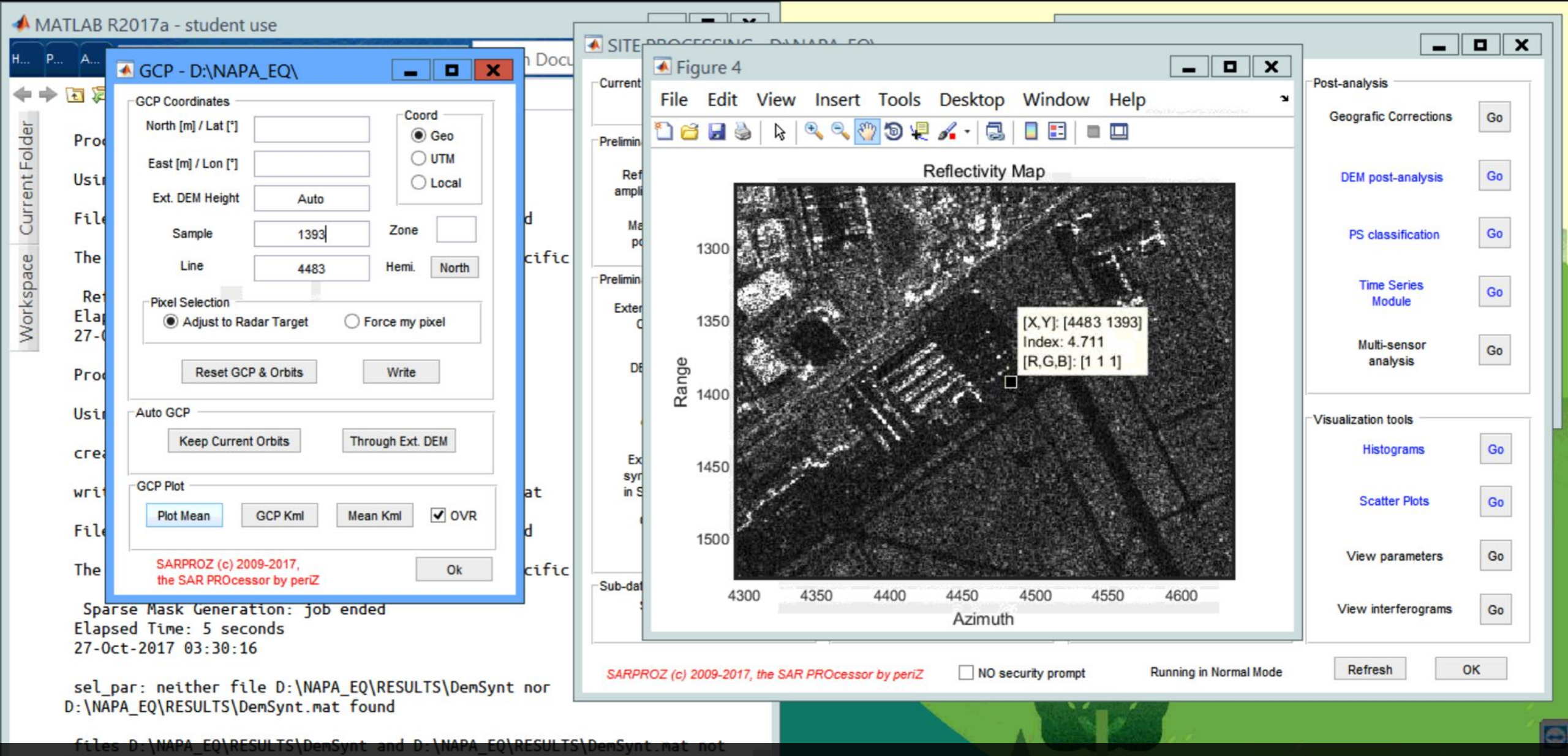


(Optional)
Manually Geocode your SAR Image

- You need to geocode our SAR image to latitude/longitude coordinates, and show it on Google Earth.
- One ground control point (GCP) is required.
  - You need to search carefully for one target that appears both on SAR image and Google Earth (Optical Imagery).
  - You need to find the corresponding SAR coordinates AND lat/lon coordinates.
  - You need to input the two coordinates system for your GCP.
- A guide will be provided for this one.

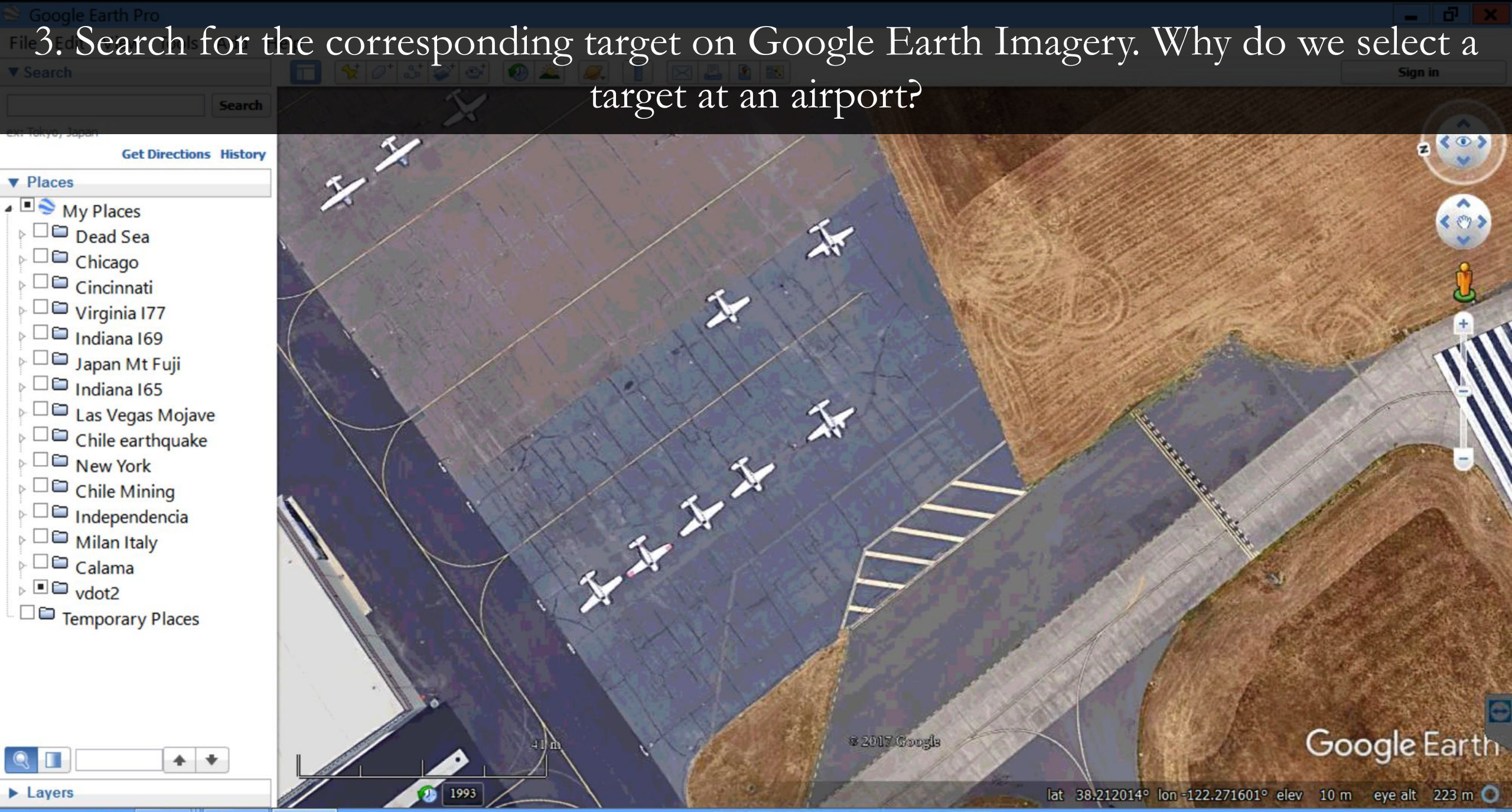


1. Click “GCP selection” to open this module. You can click “Plot Mean” to view the reflectivity map you just generated.

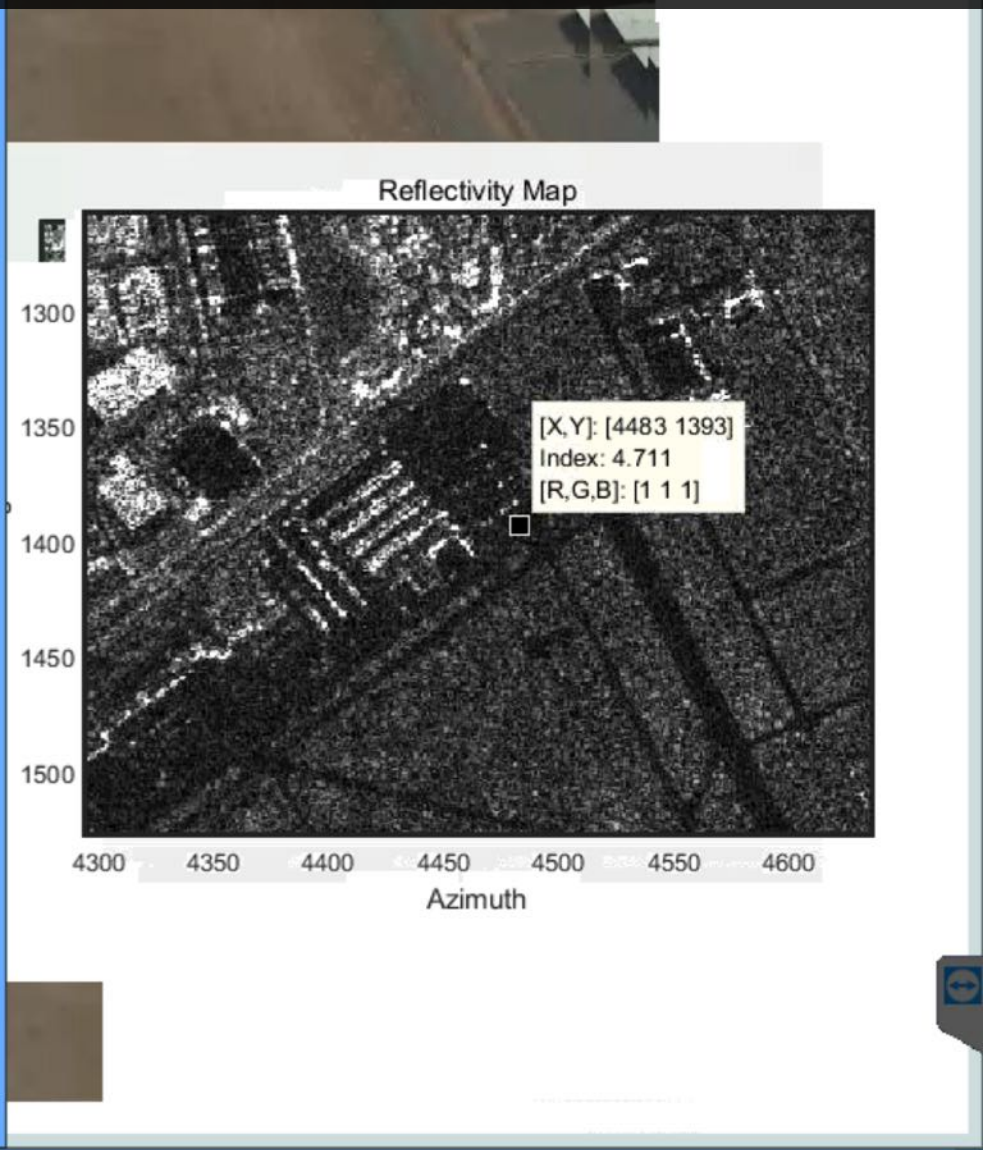


2. Search for isolated bright points in SAR image. You can also browse the "MeanFirst.jpg". In this case, a target at (4483,1393) is selected for you.

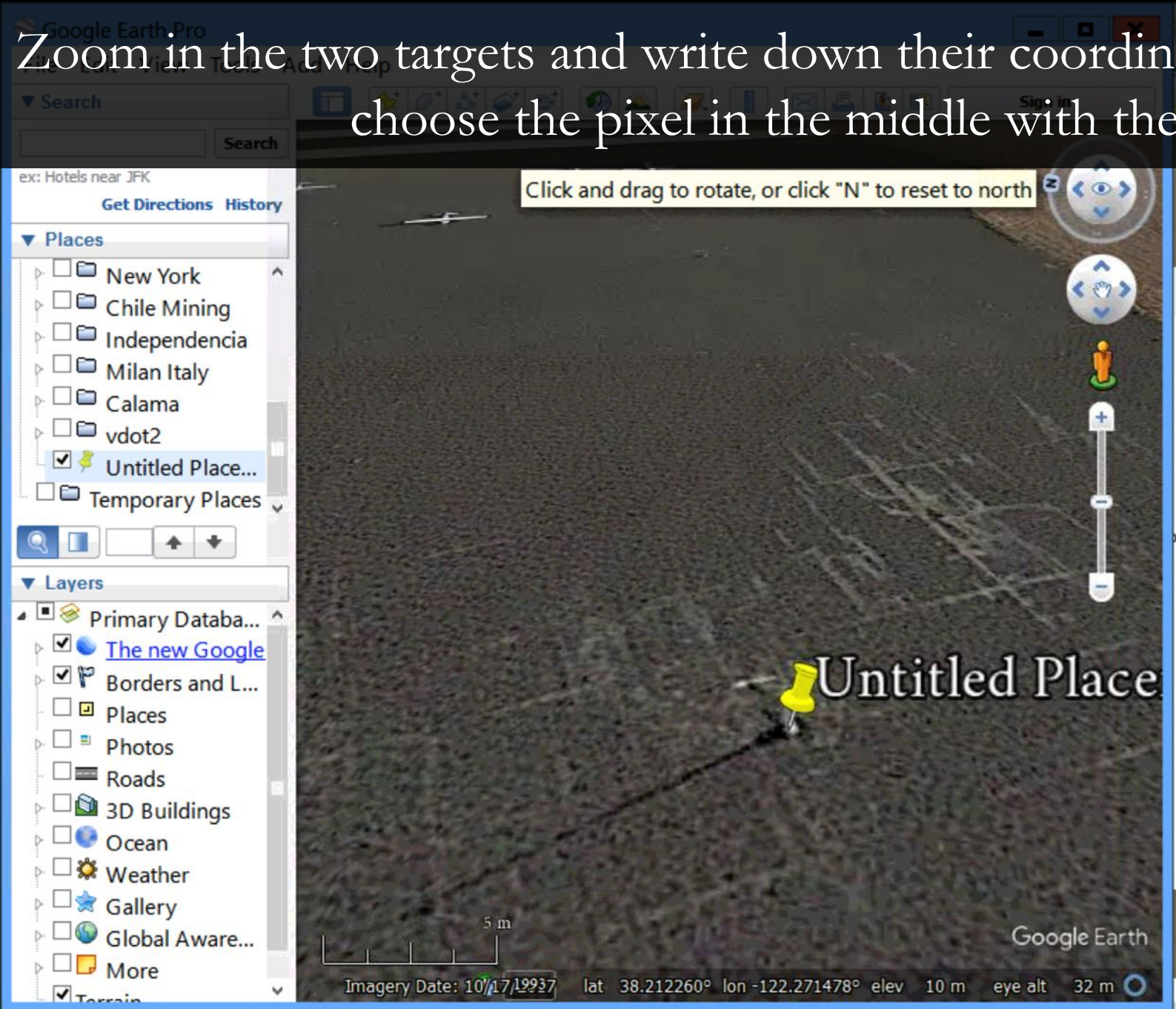
3. Search for the corresponding target on Google Earth Imagery. Why do we select a target at an airport?

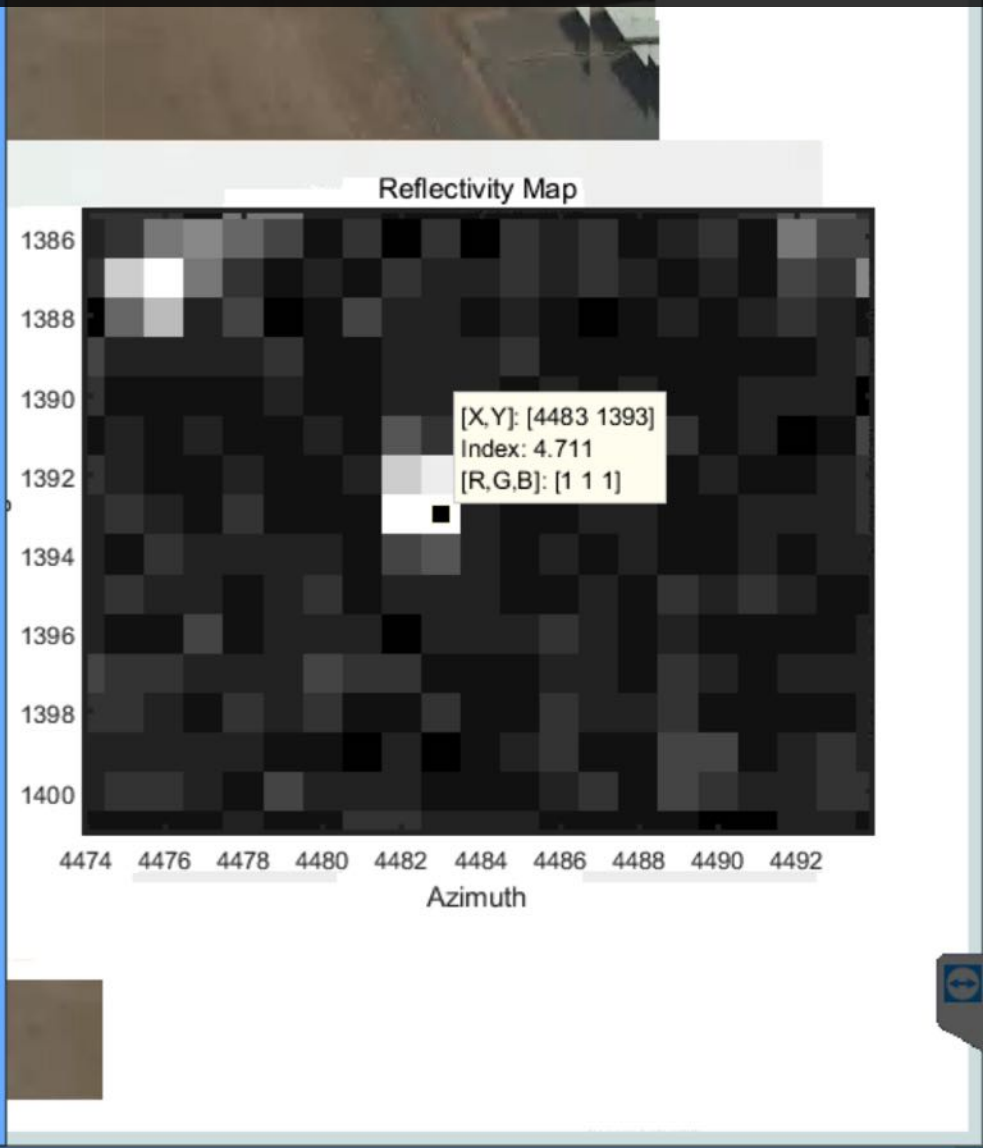


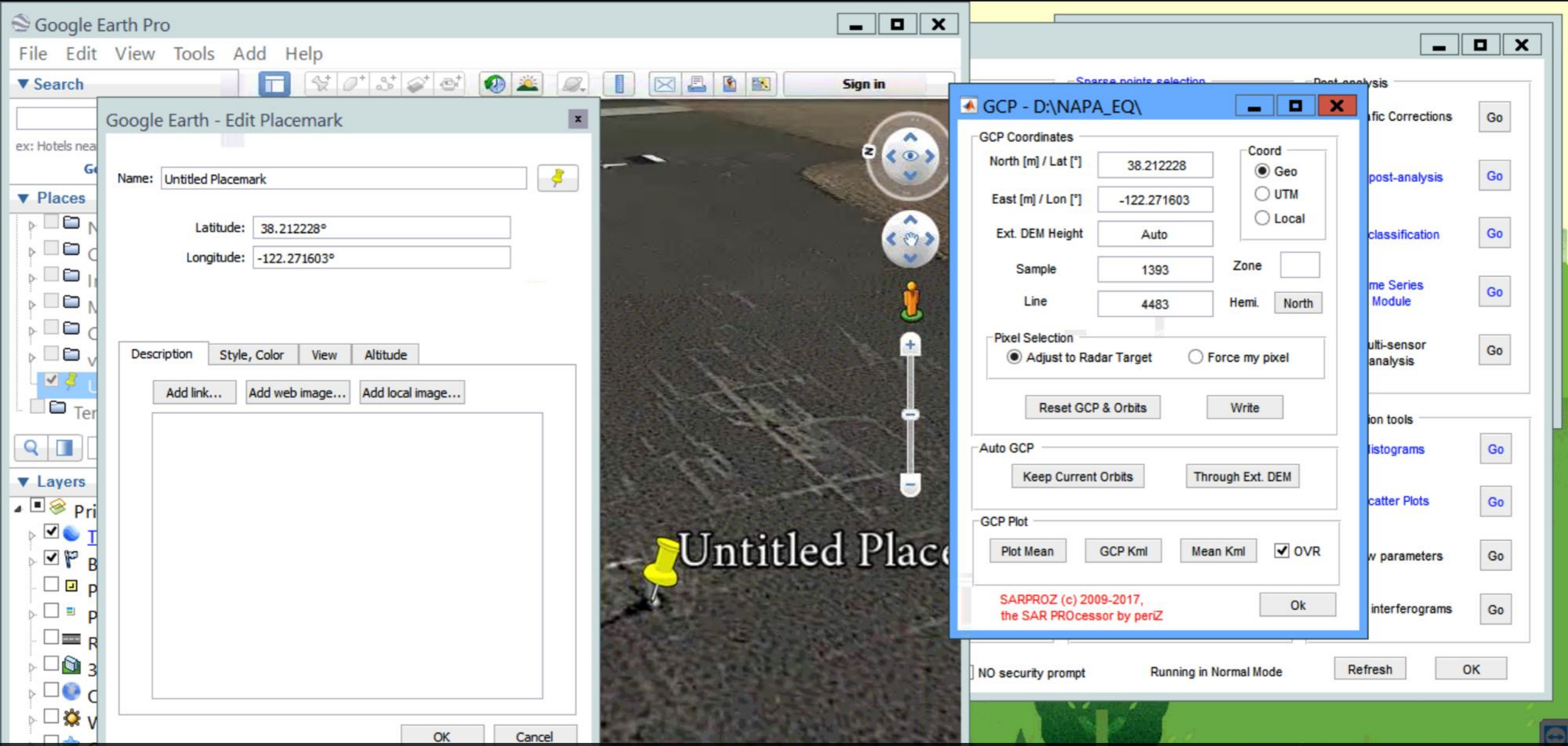
4. Compare the GCP that shows on a SAR imagery and an optical imagery. Remember to uncheck "3D Buildings" in "Layers" in side panel of Google Earth.



Zoom in the two targets and write down their coordinates. In the case of SAR imagery, choose the pixel in the middle with the highest intensity.







5. Input the lat/lon coordinate and sample/line coordinate that you wrote down for the target. Then click “Write”.

Bye