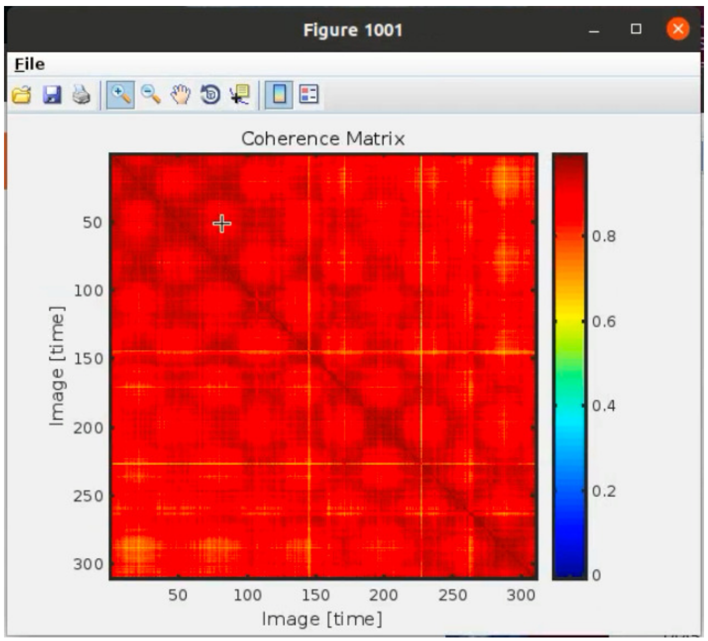
Quasi Persistent Scatterers (QPS) – Basic concepts

- The basic concept of QPS is to improve the results in areas where you have few Persistent Scatterers (PS) (e.g. buildings, rocks, or other pixels with very high reflectivity, amplitude stability index and spatial coherence).
- This approach can work in areas where Distributed Scatterers (DS) are available (e.g. bare soil, very sparsely vegetated areas, etc.).
- Although the pixels of such areas may have low levels of reflectivity or amplitude stability index, it is necessary that a certain level of spatial coherence be present in the area to apply the QPS.
- The QPS approach is the combination of <u>two</u> different main factors:

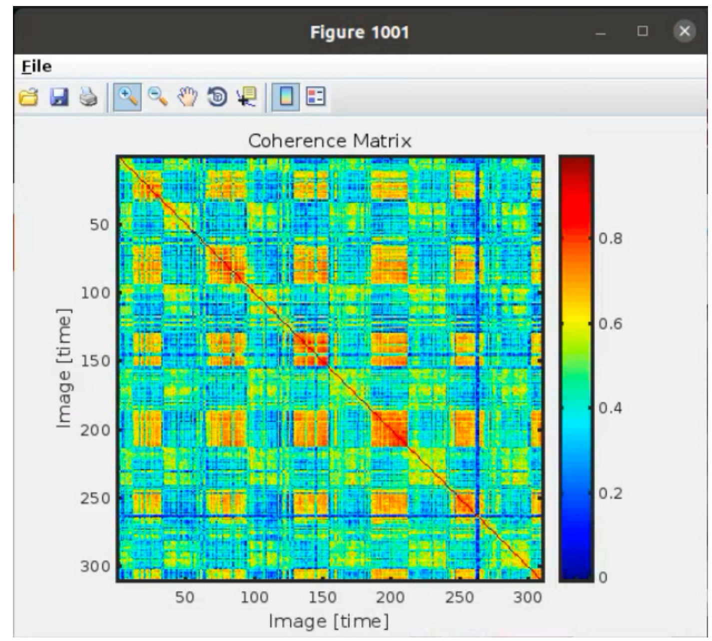
1) the use of a redundant number of interferograms, much higher than those used with the standard Star Graph (PS approach). The best way to test the approach is to use the most redundant graph possible (the Full graph)
2) In the PS approach the phase of the pixels is not filtered. On the contrary for the QPS, we need to increase the signal-to-noise ratio by filtering in space more pixels using one of the different methods available in SARPROZ.

Quasi Persistent Scatterers (QPS) – Basic concepts

- Before starting the QPS procedure, it is appropriate to check the distribution in time of the interferometric (spatial) coherence for some pixels of the area by checking the coherence matrix of such pixels in the "Image classification" tool.



Example of coherence matrix for a pixel with a "Persistent Scatterers" behavior.



Example of coherence matrix for a pixel with seasonal effects. It is possible to try the QPS approach in these cases.

QPS – workflow

- ***<u>Premise</u>***:

We suggest to continue using the standard PS approach (Star graph) to properly estimate the Atmospheric Phase Screen in the APS panel. Once the APSs are correctly estimated and you have run the standard PS analysis in the Multi-Image Sparse Points panel to get the standard PSs, you may now want to increase the number of measurement points by using the QPS approach.
To do this, keep using in the MISP panel the APS previously generated, but applying now the QPS procedure explained below.

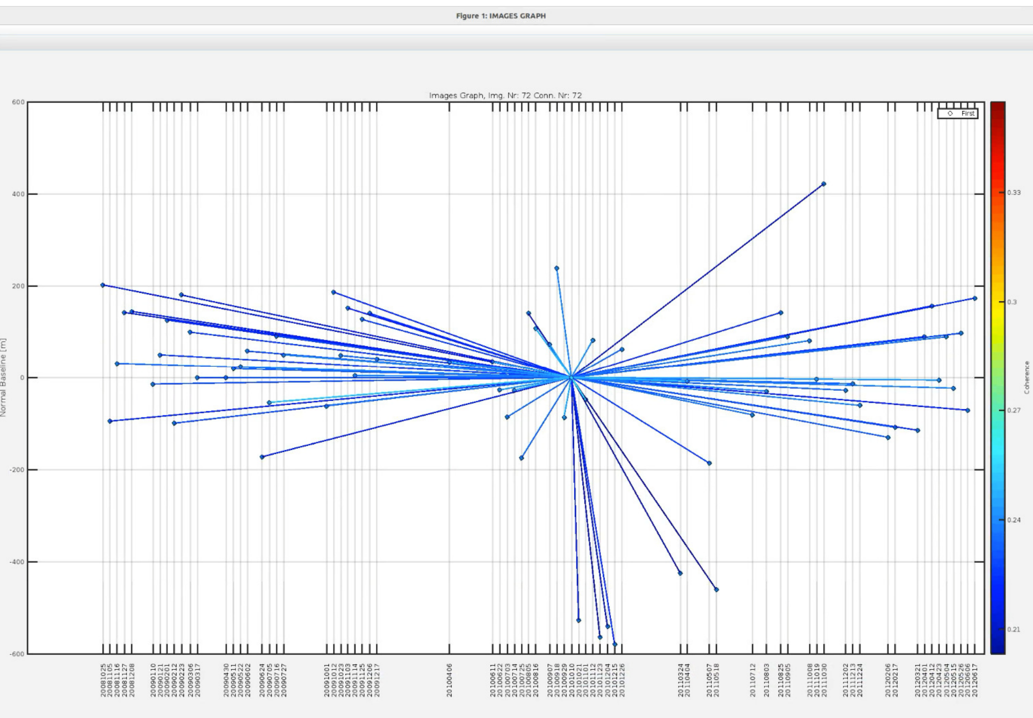
- Select a redundant images graph (e.g. the full graph)
- Generate the interferograms using an appropriate filtering method.
- In the MISP panel, select the points you want to process with the QPS approach (*same as for the PS method*).
- Select the APS you want to use and the reference point (*same as for the PS method*).
- Check “estimate” for the parameters you want to estimate (*same as for the PS method*).
- **<u>In the weights field select “Coherence”.</u>**
- **<u>The previous selection will automatically uncheck “Ext. DEM” (the two options are mutually exclusive)</u>**
- Save and export the results as for the standard PS method.

<u>Important note</u>
<u>For visualization purposes, the example shown is generated in the “Small Area Module” (SAM), but in the SAM, the interferograms previously generated are neglected, thus ignoring the filtering method selected. For this reason, the phase in is filtered during the ”Multi-image InSAR analysis” step using a fixed window, where the user can select the dimension of the window.</u>

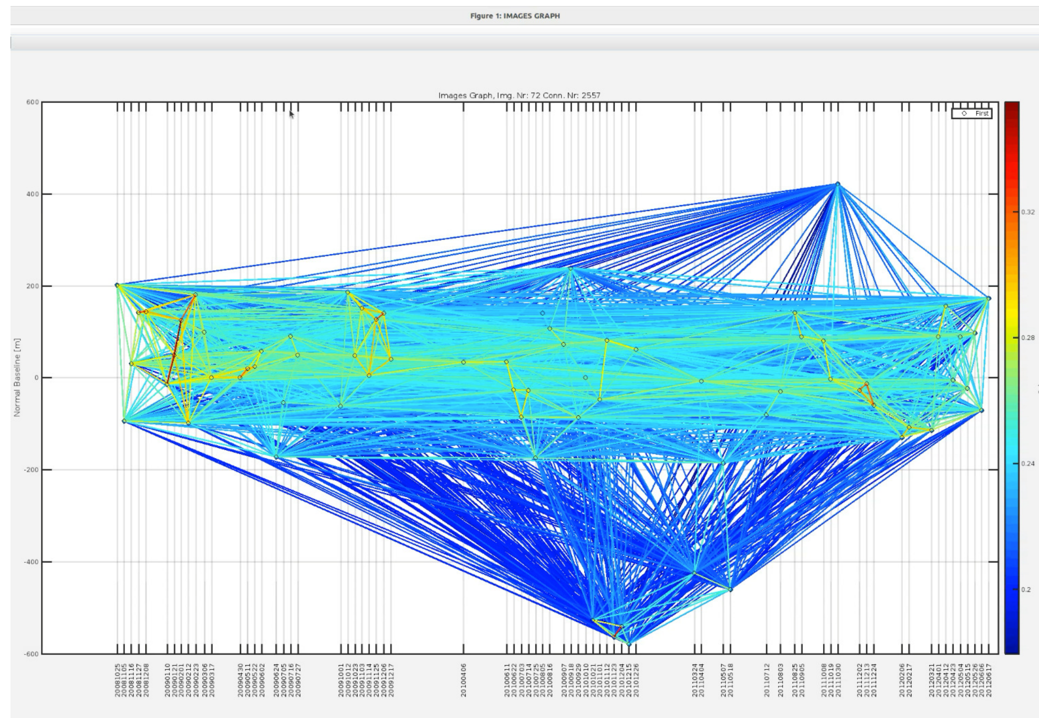
QPS – workflow

Selection of the images graph

Star graph (PS)



Full graph (QPS)



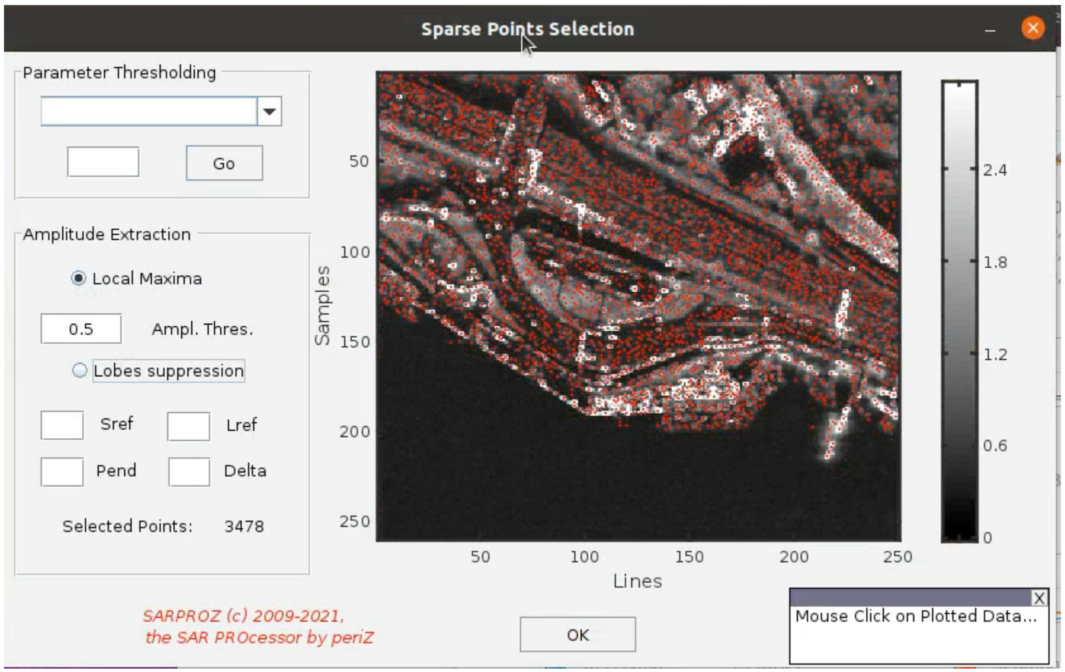
Generations of all the interferograms belonging to the images graph and using a proper filtering method.

Important note

For visualization purposes, the example shown is generated in the "Small Area Module" (SAM), but in the SAM, the interferograms previously generated are neglected, thus ignoring the filtering method selected. For this reason, the phase in is filtered during the "Multi-image InSAR analysis" step using a fixed window, where the user can select the dimension of the window.

QPS – workflow

Once the full graph has been selected. Selection of the points to be processed.



Important note
For visualization purposes, the example shown is generated in the "Small Area Module" (SAM), but in the SAM, the interferograms previously generated are neglected, thus ignoring the filtering method selected. For this reason, the phase in is filtered during the "Multi-image InSAR analysis" step using a fixed window, where the user can select the dimension of the window.

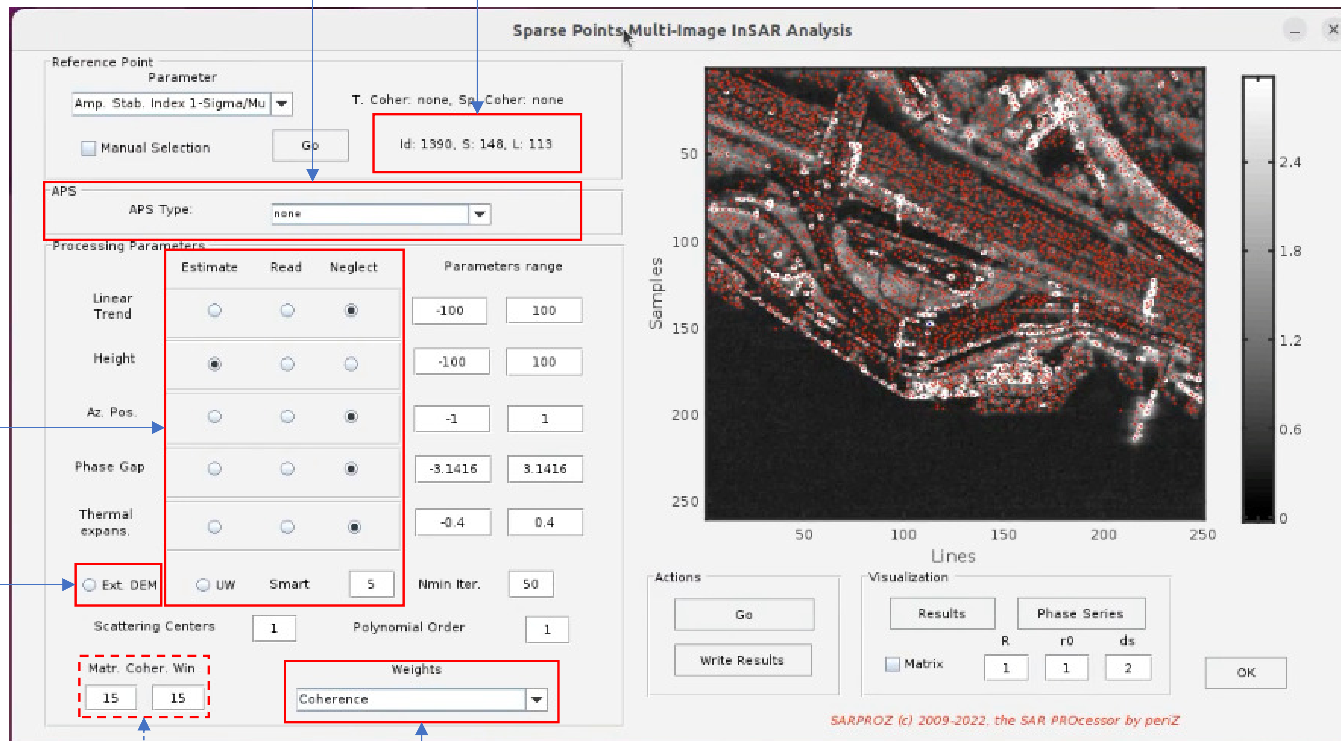
QPS – workflow

Selection of the APS previously estimated. In this case none is selected (we are in Small Area)

Selection of the reference point

Selection of the parameters to estimate. In this case we are running a Smart analysis

Select the coherence as a weight. This will automatically uncheck the Ext DEM option



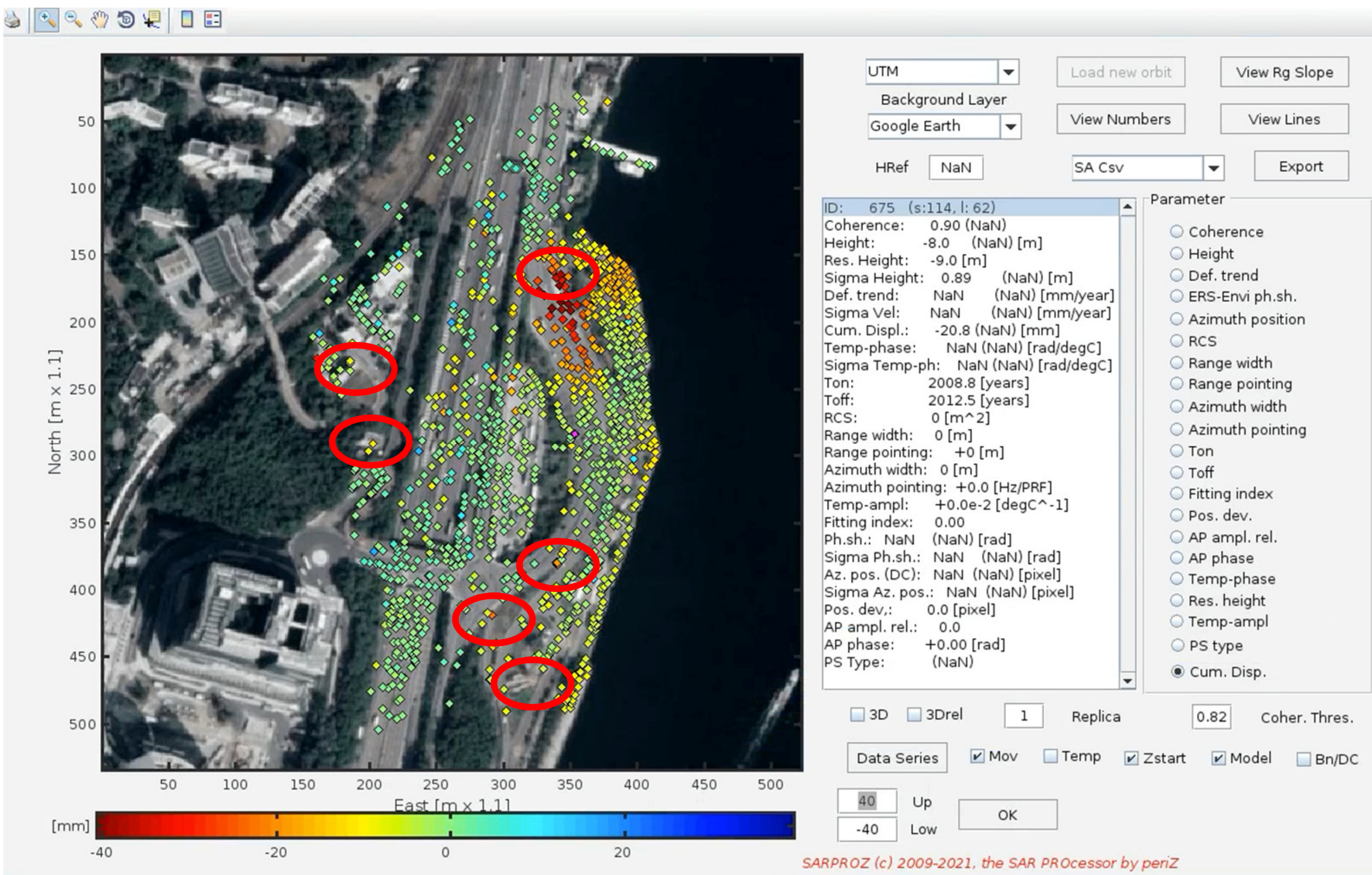
Since we are in Small Area, the interferograms previously generated are not used. The software is going to use the window here selected to filter the phase signal. In the big area analysis this field will be neglected if all the interferograms belonging to the images graph loaded are already generated.

Important note

For visualization purposes, the example shown is generated in the "Small Area Module" (SAM), but in the SAM, the interferograms previously generated are neglected, thus ignoring the filtering method selected. For this reason, the phase in is filtered during the "Multi-image InSAR analysis" step using a fixed window, where the user can select the dimension of the window.

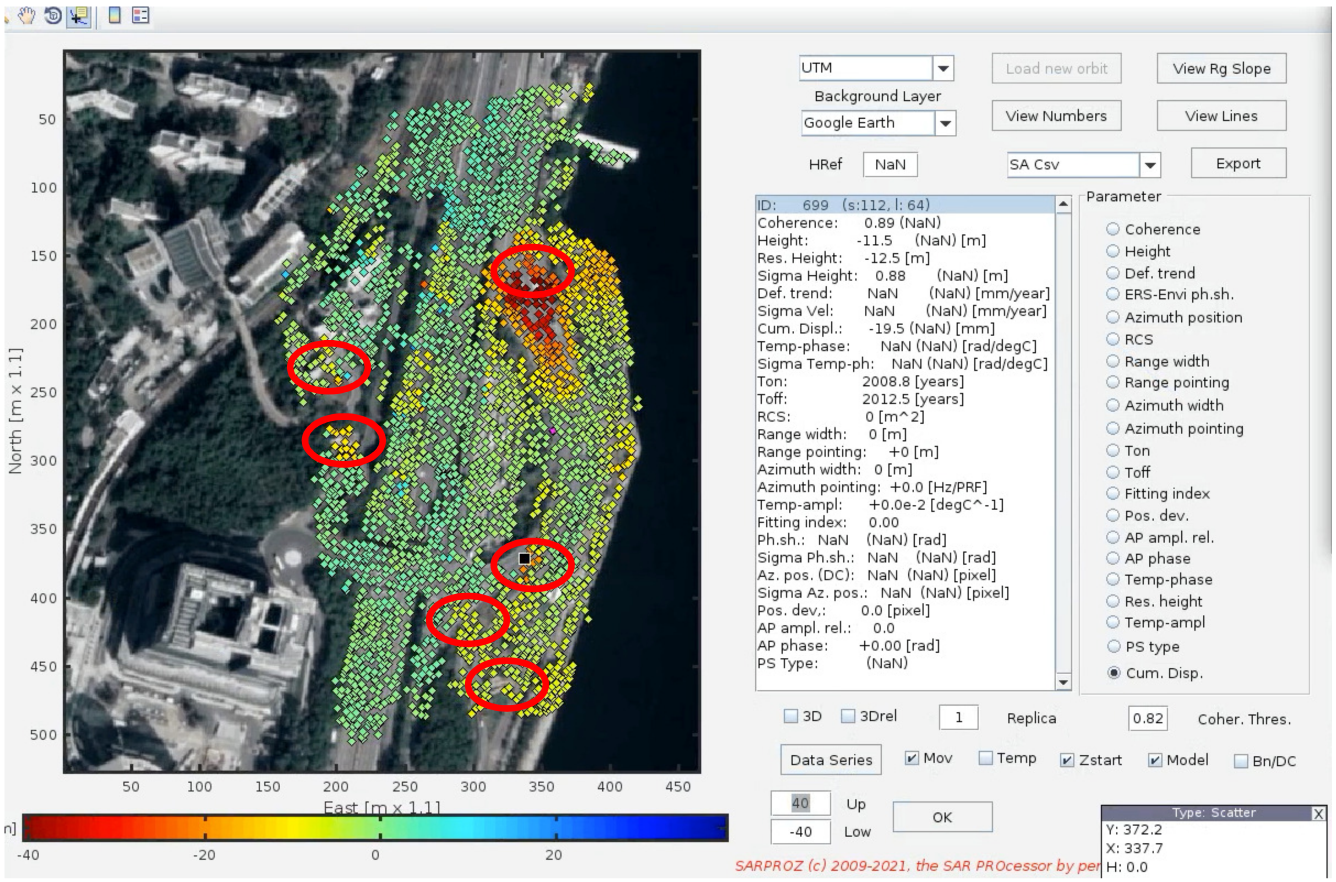
QPS – workflow

Comparison of the results for the same selection of points: PS analysis (Star graph – no weights)



QPS – workflow

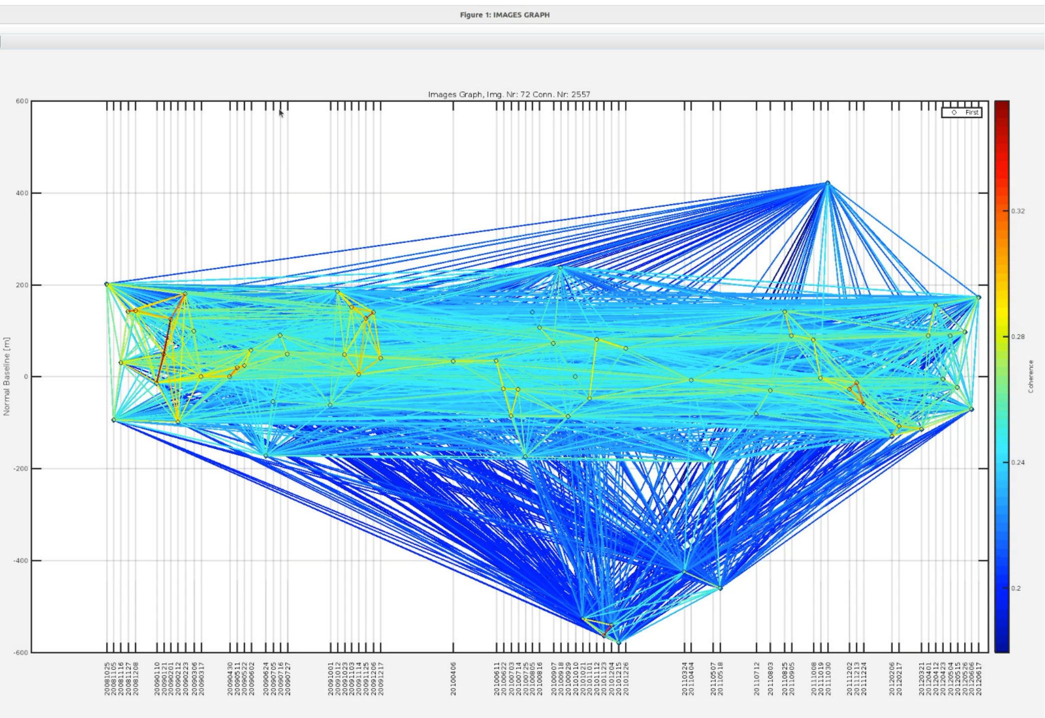
Comparison of the results for the same selection of points: QPS analysis (Full graph – weights coherence)



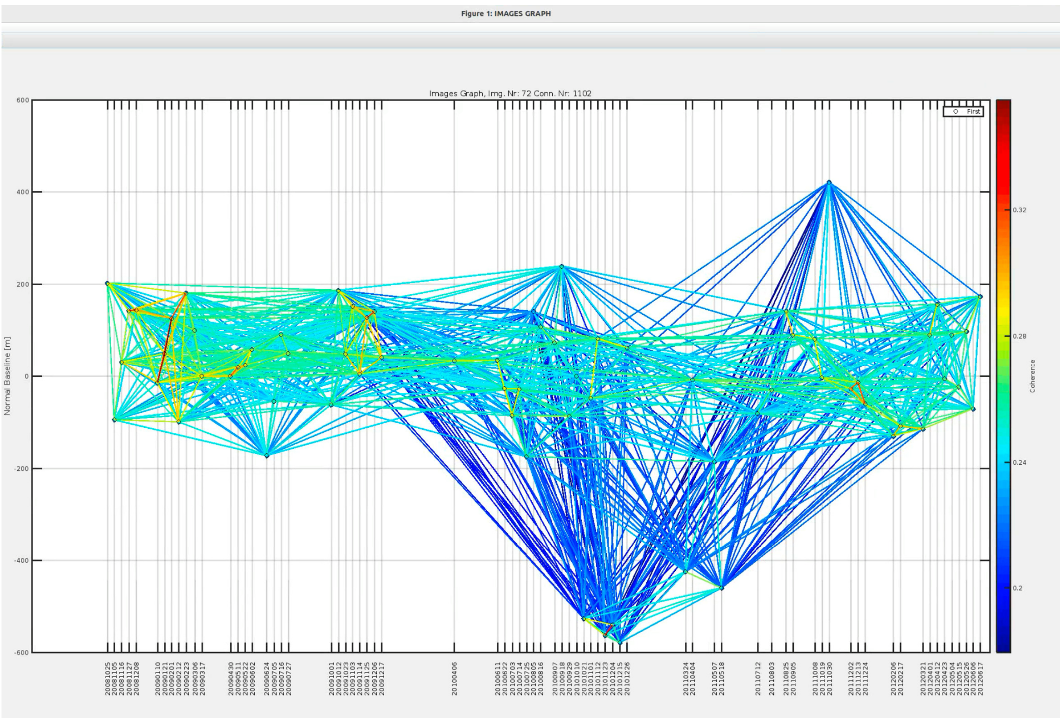
QPS – workflow

Final note on the images graph

Full graph (QPS)



Graph with Bt threshold 365 days



As an alternative to the Full graph, it is possible to reduce the computing needs starting from the Full graph and decreasing the number of connections by selecting a given temporal baseline (Bt) threshold in the graph selection (e.g. 1 year).