INSAR_G2S

An automatic script to export interferograms generated by GMTSAR into StaMPS

(suitable for Sentinel1A/B SLC dataset)

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INSAR_G2S is automatic GMTSAR bundled scripts acted as InSAR Processor before running the InSAR time series analyis using StaMPS.

Required Softwares

- GMT
- GMTSAR
- StaMPS

- When using this program please reference Isya et al., 2018:

  Isya, N. H.; Riedel, A.; Riedel, B. & Niemeier, W. Comparison of Power Law Tropospheric Correction for Time Series InSAR Application Wissenschaftlich-Technische Jahrestagung der DGPF und PFGK18 Tagung in München, Deutschen Gesellschaft für Photogrammetrie,Fernerkundung und Geoinformation e.V., 2018, 483 - 50

How to use INSAR_G2S

- Set INSAR_G2S scripts to your shell environment

  cd ~

  pico .bashrc

- Add these commands on your bashrc and save it

  export INSAR_G2S=/home/isya/STAMPS/INSAR_G2S

  export PATH=$INSAR_G2S:"$PATH"

- Replace or add files from **gmtsar_matlab** to **StaMPS/matlab** directory

  - stamps.m (replace the old file)

  - ps_load_initial_gmtsar.m (add file)

  - sb_load_initial_gmtsar.m (add file)

INSAR_G2S overview

```
isya@hermes:/media/isya/649d6fa0-f505-4c78-9eb5-78d4aec5c2f3/Celle$ INSAR_G2S.sh

Usage: INSAR_G2S [step] [parameter_with_path_directory]

  Script to pre-process SAR data and export to STAMPS format

  example : INSAR_G2S 1 /home/isya/3d_disp/param_INSAR_G2S.txt

  Step: Data Preparation -->
        1  Prepare the directory arrangement
        2  Prepare the POE data
        3  Prepare the EAP data
        4  Preprocess SAR data: Compute Baseline and Alignment
        5  Create a configuration of master-slave for SM or SB network

        Interferogram Generation -->
        6  Project DEM to radar coordinates
        7  Generate Interferogram (Real and Imaginary format) [SM | SB]
        8  Overview the sample of amplitude and phase file on Google Earth (optional)
        9  Cut the interferograms based on ROI (optional) [SM | SB]

        GMTSAR2STAMPS (PS Method) -->
        10 Create Amplitude Dispersion Index
        11 Convert GMTSAR result to be able processed by STAMPS PS
        12 Fix the result of PS Candidates (PS)

        GMTSAR2STAMPS (Small Baseline [SB] Method) -->
        13 Create Amplitude Difference Dispersion Index
        14 Convert GMTSAR result to be able processed by STAMPS SB
        15 Fix the result of PS Candidates (SB)


isya@hermes:/media/isya/649d6fa0-f505-4c78-9eb5-78d4aec5c2f3/Celle$
```

Guidelines:

Step 0

- Create a main folder which all of the processing will be run.

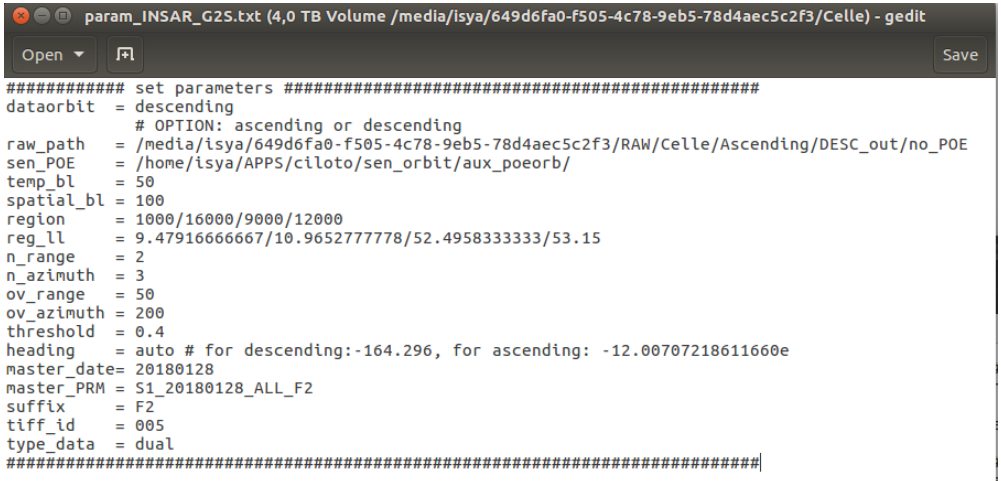
  $ mkdir yourproject

- Copy a template of param_INSAR_G2S.txt in the “yourproject” folder

Explanation of param_INSAR_G2S.txt

dataorbit = the orbit direction (could be ascending / desecending)
raw_path = the full path directory of your SLC SAR data (ZIP files)
sen_POE = the full path directory of POE Sentinel-1 files, inside this directory S1A and S1B has to be splitted into two folders (S1A and S1B folder)
temp_bl = the maximum limit of temporal baseline
spatial_bl = the maximum limit of spatial baseline
region = the region of interest (radar coodinates)
reg_ll = the region of interest (geographic coodinates)
n_range = number of patches in range
n_azimuth = number of patches in azimuth
ov_range = overlapping pixels between patches in range
ov_azimuth = overlapping pixels patches in azimuth
threshold = threshold of amplitude difference dispersion (0.4-0.6 is reasonable)
heading = heading angle or azimuth direction for Sentinel-1, see metadata super master file (default=**auto** or e.g, Asc = -12.00707218611660e ; Dsc = -1.6799e+02)
master_date= date of super master
master_PRM = the name of master PRM
suffix = sub-swath number (e.g F1, F2, F3)
tiff_id = number of tiff (e.g 001, 002, ..)
type_data = type of polarization (could be single or dual)

param_INSAR_G2S.txt example -->



Note:
For Step 1-7, region and region_ll can be let empty “-”
region_ll will be used on step 8
region will be used on step 9

Guidelines:

Step 1 – 5 are a process of “Data Preparation”

(For the data preparation steps, they are suitable for Sentinel-1 dataset. If you want to process other sensors (e.g., ALOS, ERS, etc), You need to manually modify the scripts.)

- Step 1 ; Prepare the directory arrangement

  Run Step 1 on “yourproject” folder

  $ INSAR_G2S 1 /home/isya/yourproject/param_INSAR_G2S.txt

  It will create batch_asc or batch_dsc folder (depends on your orbit direction data)

- Step 2 ; Prepare the POE data

  Run Step 2 on “yourproject” folder

  $ INSAR_G2S 2 /home/isya/yourproject/param_INSAR_G2S.txt

  If POE files are located on your local storage type $ yes

  If you don’t have POE files, the program will automatically download them type $ no

- Step 3 ; Prepare the EAP data

  Run Step 3 on “yourproject” folder

  $ INSAR_G2S 3 /home/isya/yourproject/param_INSAR_G2S.txt

  It will create “topo” directory inside batch_”orbit” directory. Please save **dem.grd** file in topo directroy.

  dem.grd could be downloaded from https://topex.ucsd.edu/gmtsar/demgen/

Guidelines:

Step 1 – 5 are a process of “Data Preparation”

- Step 4 ; Preprocess SAR data: Compute Baseline and Alignment

  Run Step 4 on “yourproject” folder

  $ INSAR_G2S 4 /home/isya/yourproject/param_INSAR_G2S.txt

  PRM, LED and SLC files will be generated in raw directory

- Step 5 ; Create a configuration of master-slave for SM or SB network

  Run Step 5 on **batch_”orbit”** folder

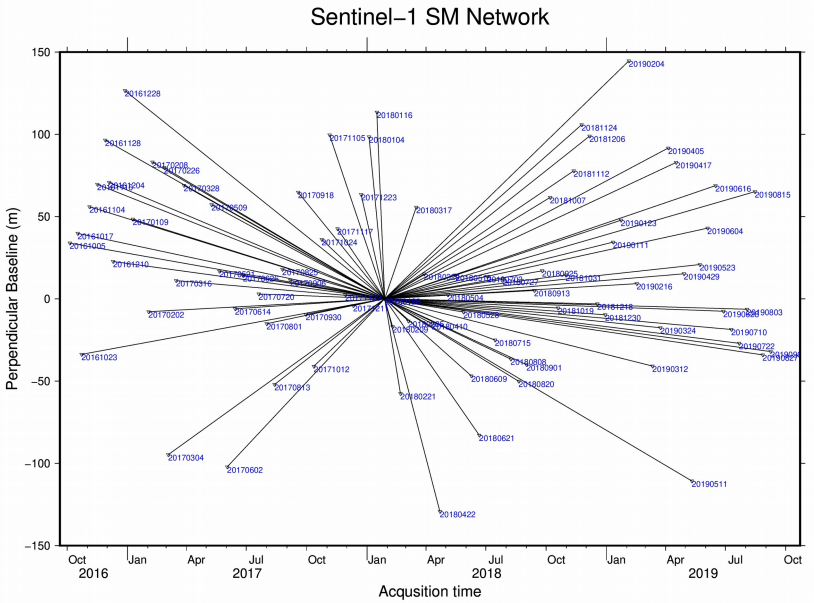
  $ INSAR_G2S 5 /home/isya/yourproject/param_INSAR_G2S.txt

  There are two network options : Single Master (SM) or Small Baseline (SB)

  If you want to work with PS method, type $ SM

  If you want to work with SB method, type $ SB

Example for the generated files from Step 5



baseline_pair_SM.ps

intf_SM.in (4,0 TB Volume /media/isya/649d6fa0-f505-4c78-9eb5-78d4aec5c2f3/Celle/batch_dsc) - gedit

Open Save

```
S1_20180128_ALL_F2:S1_20161005_ALL_F2
S1_20180128_ALL_F2:S1_20161017_ALL_F2
S1_20180128_ALL_F2:S1_20161023_ALL_F2
S1_20180128_ALL_F2:S1_20161104_ALL_F2
S1_20180128_ALL_F2:S1_20161116_ALL_F2
S1_20180128_ALL_F2:S1_20161128_ALL_F2
S1_20180128_ALL_F2:S1_20161204_ALL_F2
S1_20180128_ALL_F2:S1_20161210_ALL_F2
S1_20180128_ALL_F2:S1_20161228_ALL_F2
S1_20180128_ALL_F2:S1_20170109_ALL_F2
S1_20180128_ALL_F2:S1_20170202_ALL_F2
S1_20180128_ALL_F2:S1_20170208_ALL_F2
S1_20180128_ALL_F2:S1_20170226_ALL_F2
S1_20180128_ALL_F2:S1_20170304_ALL_F2
S1_20180128_ALL_F2:S1_20170316_ALL_F2
S1_20180128_ALL_F2:S1_20170328_ALL_F2
S1_20180128_ALL_F2:S1_20170509_ALL_F2
S1_20180128_ALL_F2:S1_20170521_ALL_F2
S1_20180128_ALL_F2:S1_20170602_ALL_F2
S1_20180128_ALL_F2:S1_20170614_ALL_F2
S1_20180128_ALL_F2:S1_20170626_ALL_F2
S1_20180128_ALL_F2:S1_20170720_ALL_F2
S1_20180128_ALL_F2:S1_20170801_ALL_F2
S1_20180128_ALL_F2:S1_20170813_ALL_F2
S1_20180128_ALL_F2:S1_20170825_ALL_F2
S1_20180128_ALL_F2:S1_20170906_ALL_F2
```

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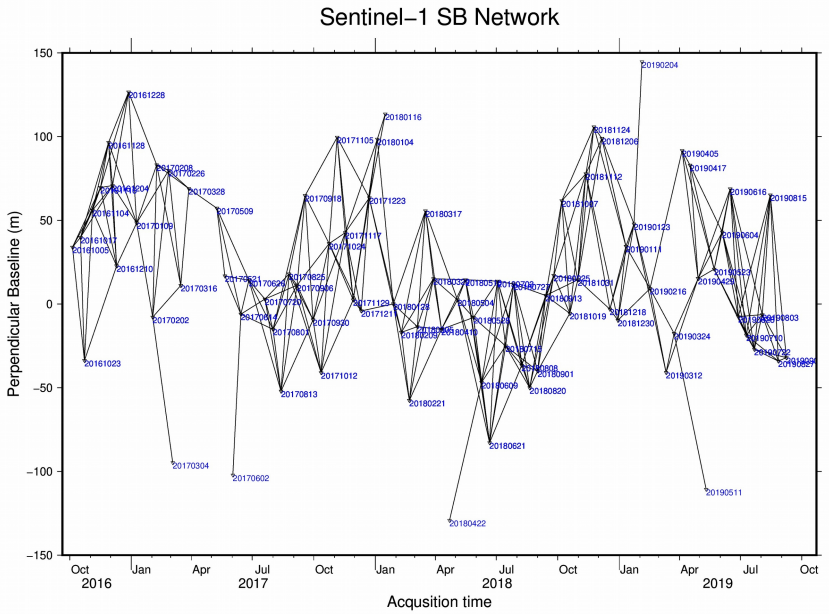
intf_SM.in



baseline_pair_50_100.ps

intf_SB.in (4,0 TB Volume /media/isya/649d6fa0-f505-4c78-9eb5-78d4aec5c2f3/Celle/batch_dsc) - gedit

Open Save

```
S1_20190604_ALL_F2:S1_20190616_ALL_F2
S1_20190604_ALL_F2:S1_20190628_ALL_F2
S1_20190604_ALL_F2:S1_20190710_ALL_F2
S1_20190604_ALL_F2:S1_20190722_ALL_F2
S1_20190616_ALL_F2:S1_20190628_ALL_F2
S1_20190616_ALL_F2:S1_20190710_ALL_F2
S1_20190616_ALL_F2:S1_20190722_ALL_F2
S1_20190616_ALL_F2:S1_20190803_ALL_F2
S1_20190628_ALL_F2:S1_20190710_ALL_F2
S1_20190628_ALL_F2:S1_20190722_ALL_F2
S1_20190628_ALL_F2:S1_20190803_ALL_F2
S1_20190628_ALL_F2:S1_20190815_ALL_F2
S1_20190710_ALL_F2:S1_20190722_ALL_F2
S1_20190710_ALL_F2:S1_20190803_ALL_F2
S1_20190710_ALL_F2:S1_20190815_ALL_F2
S1_20190710_ALL_F2:S1_20190827_ALL_F2
S1_20190722_ALL_F2:S1_20190803_ALL_F2
S1_20190722_ALL_F2:S1_20190815_ALL_F2
S1_20190722_ALL_F2:S1_20190827_ALL_F2
S1_20190722_ALL_F2:S1_20190908_ALL_F2
S1_20190803_ALL_F2:S1_20190815_ALL_F2
S1_20190803_ALL_F2:S1_20190827_ALL_F2
S1_20190803_ALL_F2:S1_20190908_ALL_F2
S1_20190815_ALL_F2:S1_20190827_ALL_F2
S1_20190815_ALL_F2:S1_20190908_ALL_F2
S1_20190827_ALL_F2:S1_20190908_ALL_F2
```

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intf_SB.in

Guidelines:

Step 6 – 9 are a process of "Interferogram Generation"

- Step 6 ; Project DEM to radar coordinates

  Run Step 6 on **batch_"orbit"** folder

  $ INSAR_G2S 6 /home/isya/yourproject/param_INSAR_G2S.txt

- Step 7 ; Generate Interferogram (Real and Imaginary format)

  Run Step 7 on **batch_"orbit"** folder

  $ INSAR_G2S 7 /home/isya/yourproject/param_INSAR_G2S.txt

  There are two network options : Single Master (SM) or Small Baseline (SB), based on your option on Step 5

  If you want to work with PS method, type $ SM

  If you want to work with SB method, type $ SB

Guidelines:

Step 6 – 9 are a process of "Interferogram Generation"

- Step 8 ; Overview the sample of amplitude and phase file on Google Earth (optional)

  Run Step 8 on **batch_"orbit"** folder

  $ INSAR_G2S 8 /home/isya/yourproject/param_INSAR_G2S.txt

- Step 9 ; Cut the interferograms based on ROI (optional) [SM | SB]

  Run Step 9 on **batch_"orbit"** folder

  $ INSAR_G2S 9 /home/isya/yourproject/param_INSAR_G2S.txt

  There are two network options : Single Master (SM) or Small Baseline (SB), based on your option on Step 5

  If you want to work with PS method, type $ SM

  If you want to work with SB method, type $ SB

- Step 8 and 9 are optional.

  If you want to save your computer storage, run step 8 to define your ROI on radar coordinates and step 9 to cut real and image files based on a certain region.

  Remember to set **region_ll** before running step 8

  After you could define radar coordinates based on the KML overview, set **region** before running step 9, 10, ….

Guidelines:

If on Step 5 you choose SM option, then run step 10 – 12

Step 10 – 12 are a process of "GMTSAR to STAMPS for PS method"

- Step 10 ; Create Amplitude Dispersion Index

  Run Step 10 on **batch_"orbit"/stack** folder

  $ INSAR_G2S 10 /home/isya/yourproject/param_INSAR_G2S.txt

  In raw folder, scatter_SM.grd (Amplitude Dispersion) is generated.

- Step 11 ; Convert GMTSAR result to be able processed by STAMPS PS

  Run Step 11 on **batch_"orbit"/stack** folder

  $ INSAR_G2S 11 /home/isya/yourproject/param_INSAR_G2S.txt

  It will create PS directory and generate interferograms result based on StaMPS format.

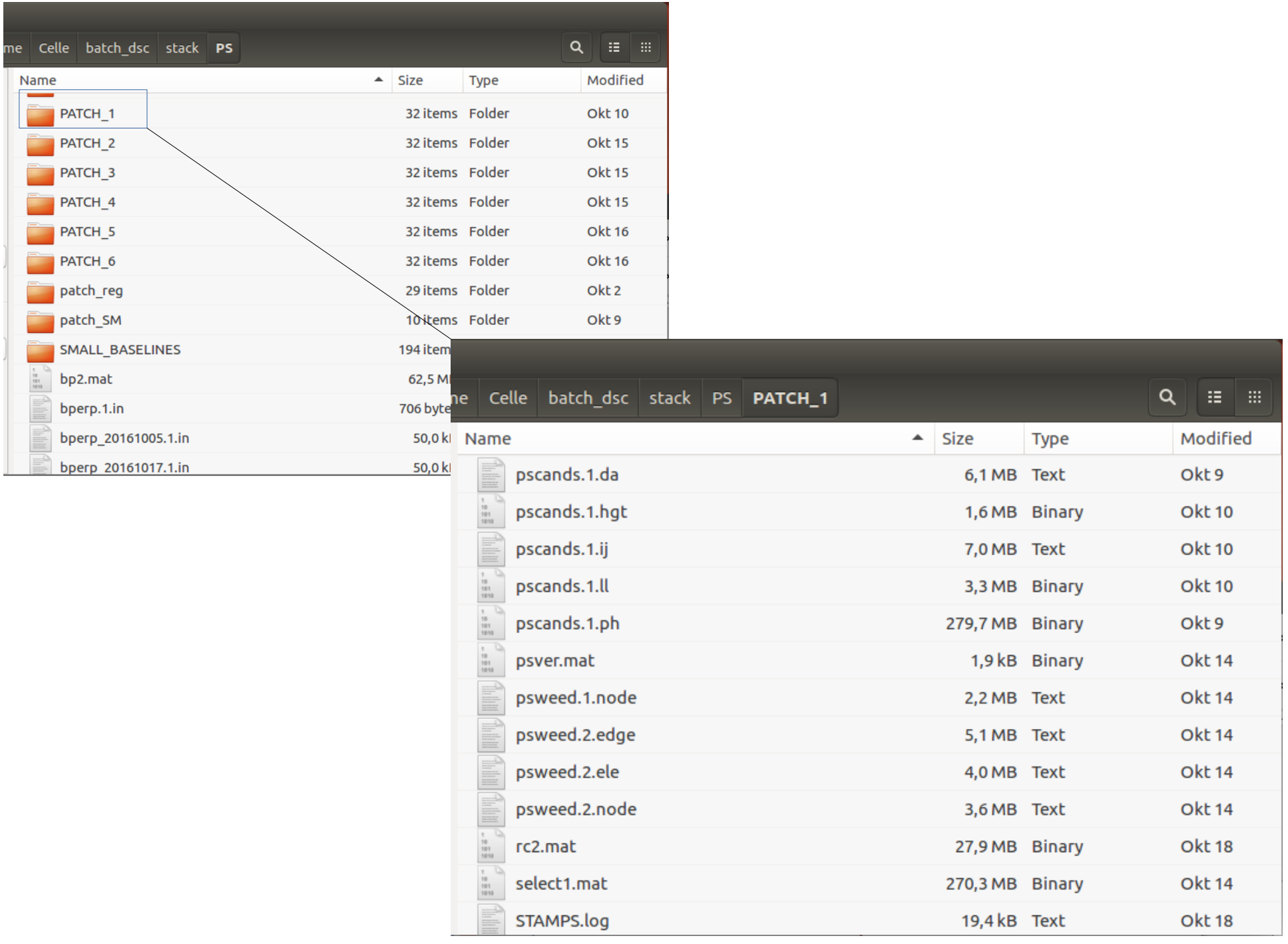
- Step 12 ; Fix the result of PS Candidates (PS)

  Run Step 11 on **batch_"orbit"/stack/PS** folder

  $ INSAR_G2S 11 /home/isya/yourproject/param_INSAR_G2S.txt

  This step is to rewrite pscands1.ll and pscands.hgt to have the same size matrix.

GMTSAR to StaMPS result [PS Method]



Guidelines:

If on Step 5 you choose SB option, then run step 13 – 15

Step 13 – 15 are a process of "GMTSAR to STAMPS for SB method"

- Step 13 ; Create Amplitude Difference Dispersion Index

  Run Step 10 on **batch_"orbit"/stack** folder

  $ INSAR_G2S 10 /home/isya/yourproject/param_INSAR_G2S.txt

  In raw folder, scatter_SB.grd (Amplitude Difference Dispersion) is generated.

- Step 14 ; Convert GMTSAR result to be able processed by STAMPS SB

  Run Step 14 on **batch_"orbit"/stack** folder

  $ INSAR_G2S 14 /home/isya/yourproject/param_INSAR_G2S.txt

  It will create PS/SMALL_BASELINES directory and generate interferograms result based on StaMPS format.

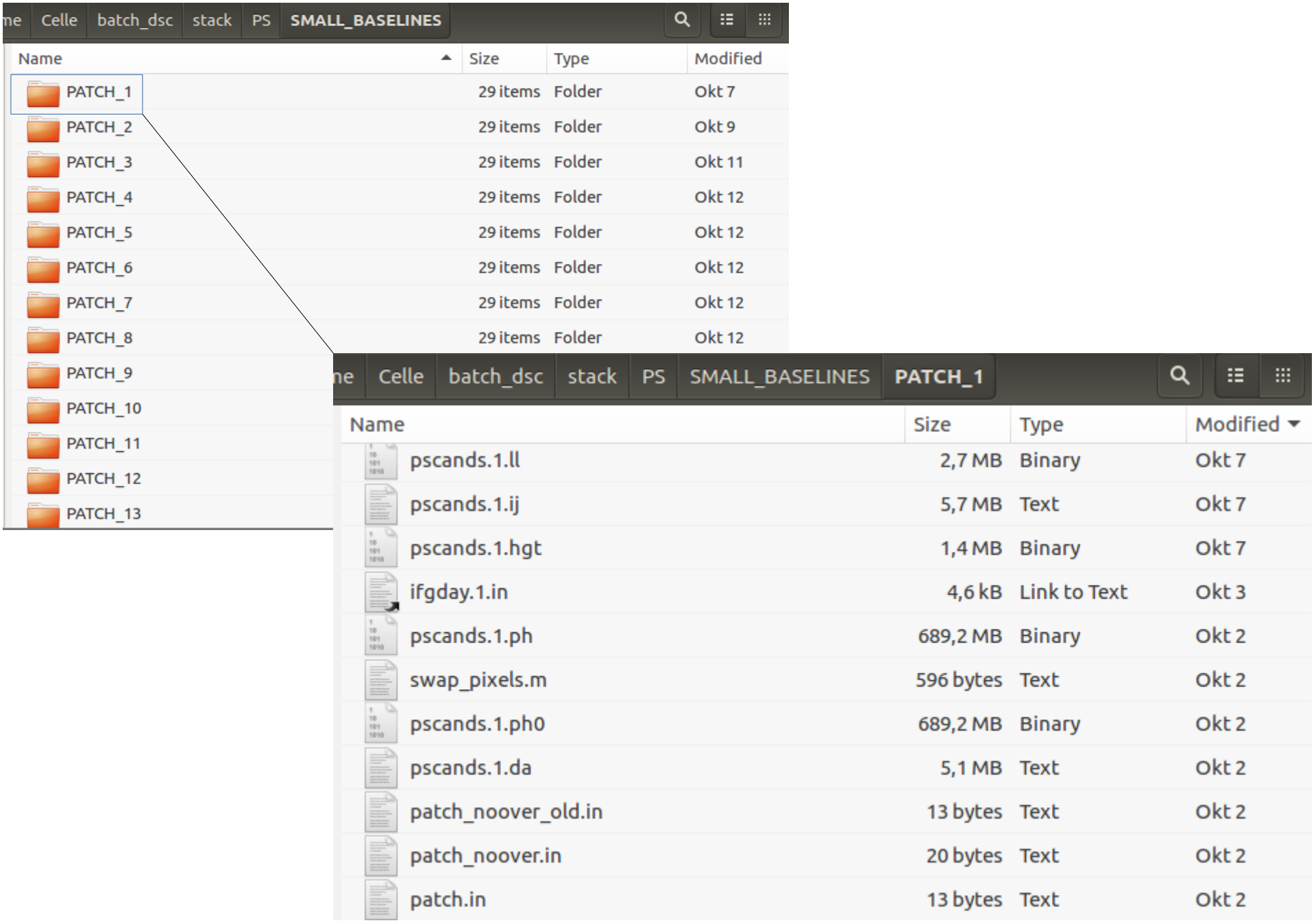
- Step 15 ; Fix the result of PS Candidates (SB)

  Run Step 11 on **batch_"orbit"/stack/PS/SMALL_BASELINES** folder

  $ INSAR_G2S 11 /home/isya/yourproject/param_INSAR_G2S.txt

  This step is to rewrite pscands1.ll and pscands.hgt to have the same size matrix.

GMTSAR to StaMPS result [SB Method]



StaMPS Processing

- After you sucessfully convert all of files from GMTSAR to StaMPS format, now you can run the PS/SB InSAR processing on Matlab.
- Run StaMPS step by step

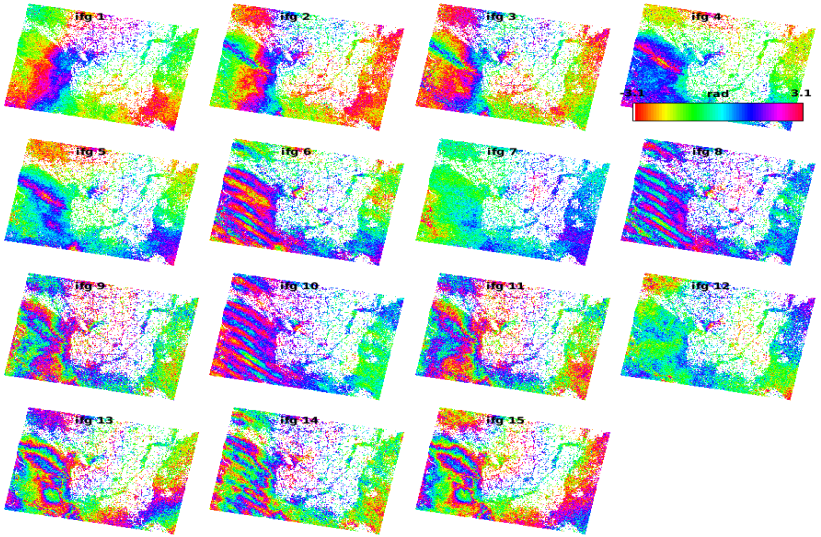
  >> stamps(1,1)

  >> stamps(1,2) etc
- Or all steps

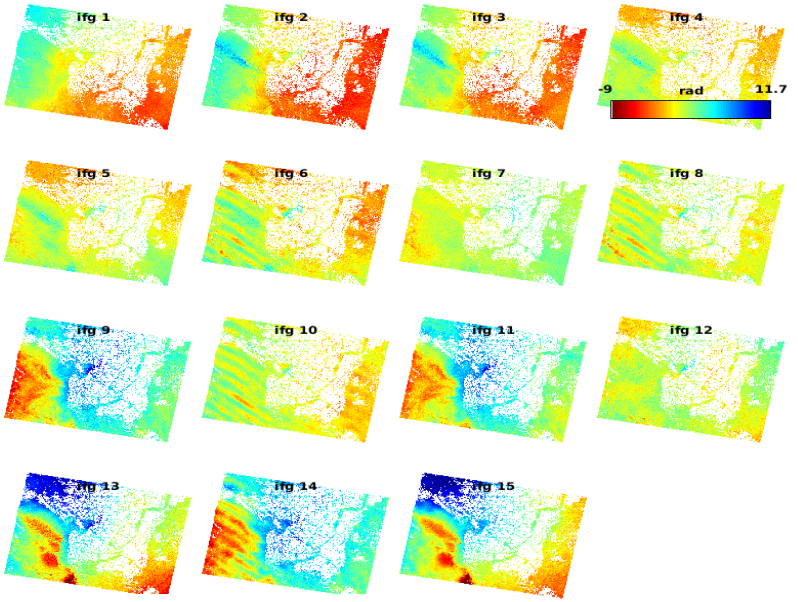
  >> stamps(1,5)

  >> stamps(6,7) etc

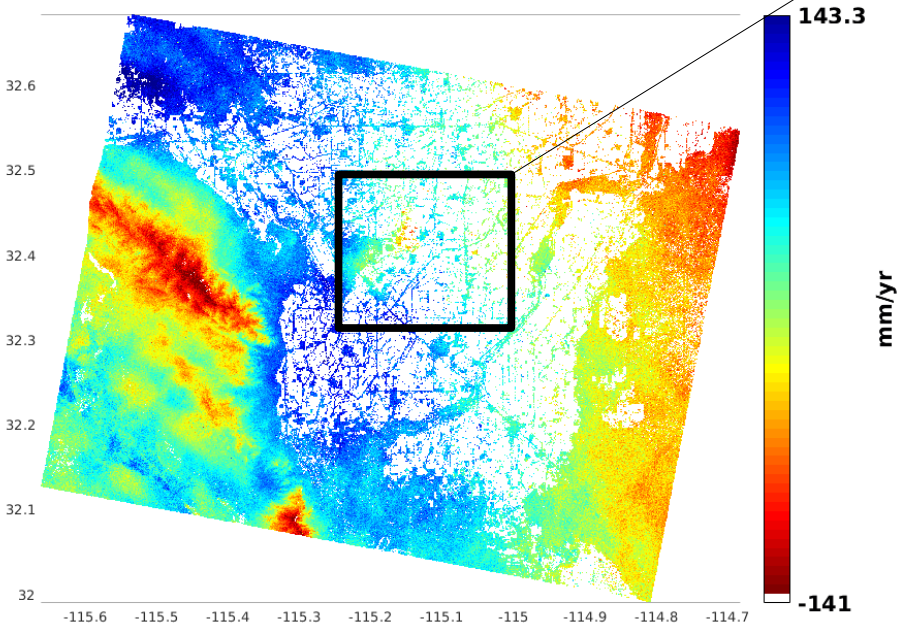
STAMPS result overview (SB method)
Location: Cerro Prieto, Mexico



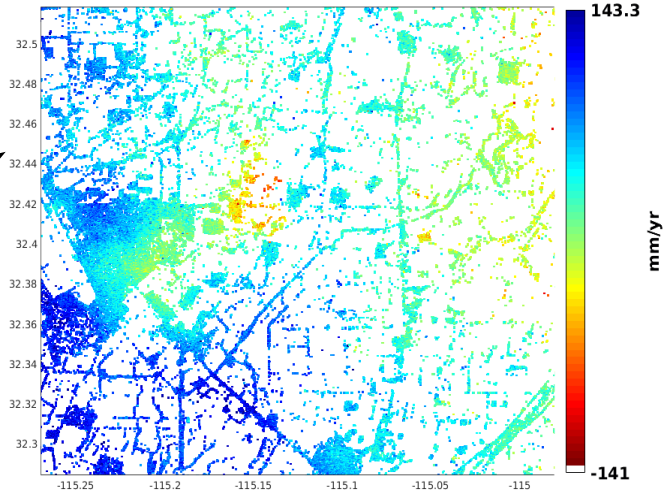
wrapped interferograms

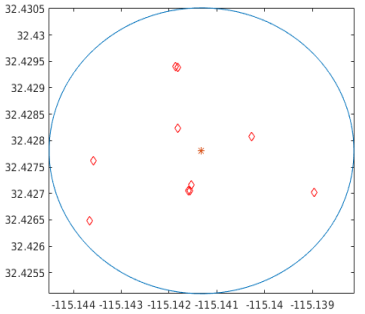


unwrapped interferograms

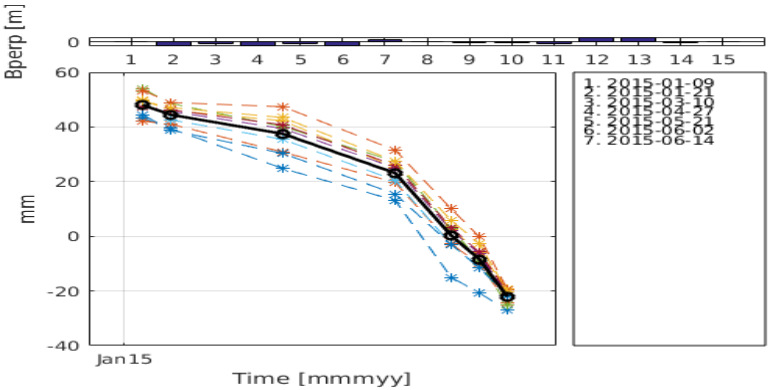


mean velocity (SM network inversion) for V-DO plot

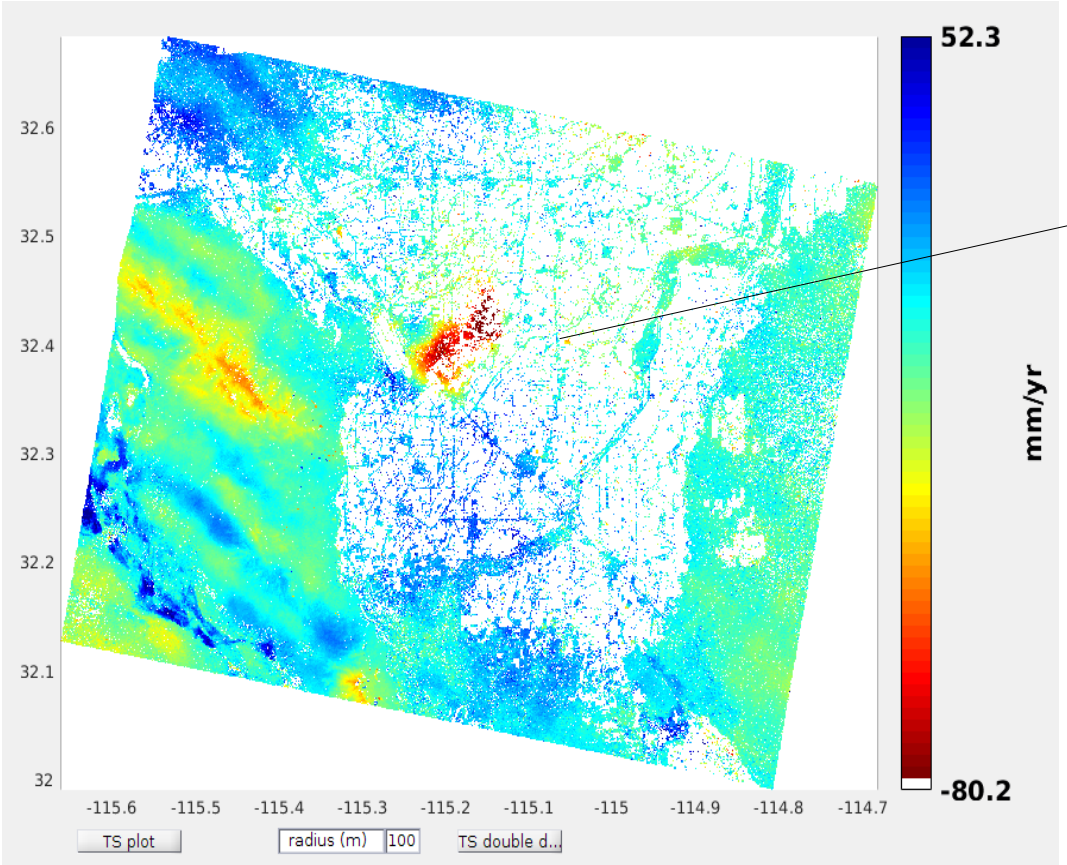


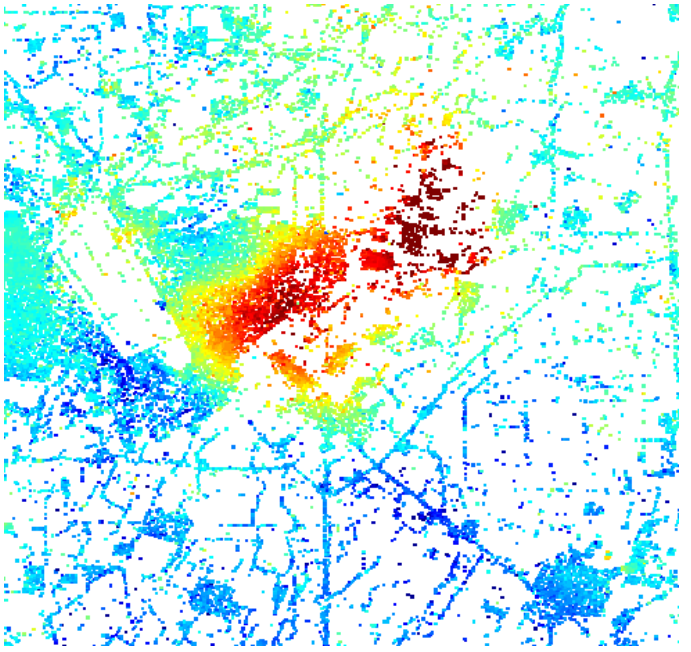


Time series PS scatters



STAMPS result with (set merge_resample_size = 100)





mean velocity (SB network inversion) for v-do plot
(small letters for v-do)