# InSAR software

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Montpellier, July 2021

Many well-known InSAR processor available

| Name | Year | Main code | Creator | Note |
|---|---|---|---|---|
| Gamma | 1995 | C | C. Werner | Commercial ($$$) |
| DORIS | 1999 | C++ | R. Hanssen et al. | Open source |
| TRE | 1999 | n/a | A. Ferretti | Service demand |
| ROI_PAC | 2002 | Fortran | JPL | Open source |
| SARSCAPE | 200x | n/a | Sarmap | Commercial ($$) |
| ISCE | 2008 | Python (wrapper from ROI_PAC) | JPL | Open source |
| GMTSAR | 2012 | C | D. Sandwell et al. | Open source |
| SNAP/S1tbx | 2014 | Java (translate from C++ code of DORIS) | ESA | Open source (Most friendly one) |
| TomoSAR | 2014 | C | D. Ho Tong Minh and Y.-N. Ngo | Service collaboration and demand |

SNAP
Sentinel 1 Toolbox
Sentinel 2 Toolbox
Sentinel-3 Toolbox
SMOS Toolbox
Proba-V Toolbox
PolSARpro
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Community
Useful Links


Search...

Home > Toolboxes > Sentinel 1 Toolbox > S1TBX Features

# S1TBX Features

## Supported SAR Missions

- SENTINEL-1, ENVISAT ASAR, ERS-1/2, RADARSAT-2, ALOS-1/2, Cosmo-Skymed, TerraSAR-X/TanDEM-X

## Processors

- All general EO processors from SNAP (Subset, Resample and Band Arithmetic, etc.)
- Absolute calibration (SENTINEL-1, ENVISAT ASAR, ERS 1&2, ALOS, RADARSAT-2, TerraSAR-X, Cosmo-SkyMed)
- Multilooking & speckle (single and multitemporal) filtering
- Precise orbit handling (SENTINEL-1, Doris, Prare and Delft orb.)
- Coregistration of detected and complex products
- Sentinel-1 TOPS interferometry, debursting, slice assembly
- Range-Doppler Terrain Correction
- Radiometric normalization during Terrain Correction
- SAR simulation and Layover and shadow masks
- Simulated SAR Terrain Correction
- Ellipsoid correction, Map Reprojection, Mosaicking
- Ocean tools: basic routines for oil spill detection, ship detection and wind field estimation from SAR data
- Fully integrated and featured InSAR processor (Jlinda) for Strimap and Zero-Doppler focused data
- Quad-Pol and Dual-Pol matrix conversion, speckle filtering, decompositions and classifiers
- Compatibility with PolSARpro Toolbox (Reader, Writer)

seom
scientific exploitation of operational missions

2018

Mapping Urban Areas from Space (MUAS 2018)


EO Open Science 2018


8th Advanced Land Training Course

2017

https://github.com/isce-framework/isce2

# isce-framework / isce2

Watch 22 | Star 87 | Fork 58

Code | Issues 4 | Pull requests 3 | Projects 0 | Wiki | Security | Insights

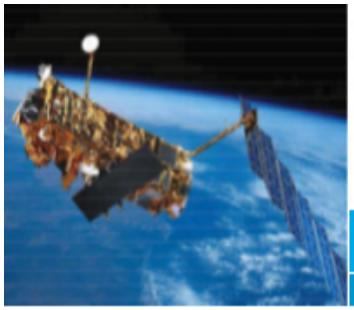
InSAR Scientific Computing Environment version 2

134 commits | 1 branch | 2 releases | 14 contributors | View license

Branch: master | New pull request | Create new file | Upload files | Find File | Clone or download

piyushrpt Merge pull request #55 from asjohnston-asf/mcf_fix ... Latest commit e53e7f4 on 31 Jul

| | | |
|---|---|---|
| .circleci | set the correct required job | last month |
| applications | adding UAVSAR_HDF5_SLC Sensor | 2 months ago |
| components | Restore snaphu_mcf unwrapping option | last month |
| configuration | Fix for importlib has no attribute util | 2 months ago |
| contrib | Fix for importlib has no attribute util | 2 months ago |
| defaults | Adding all files | 8 months ago |
| docker | actual issue is missing libgfortran.so link in /lib64 | 5 months ago |
| docs | StripmapProc: fix typo | 7 months ago |
| examples | Working SICD reader for example RS2 data | 6 months ago |
| library | Adding all files | 8 months ago |
| schema | Adding all files | 8 months ago |
| scons_tools | Adding all files | 8 months ago |
| setup | Adding all files | 8 months ago |
| test | Adding all files | 8 months ago |
| .gitignore | support PIXEL/ALOS1 .gz files | 6 months ago |
| CONTRIBUTING.md | Adding contrib document | 7 months ago |
| LICENSE | Adding all files | 8 months ago |



# Doris

TU Delft

Delft University of Technology

- Home
- Introduction
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- Literature
- Download
- Brain Pool
- Links

The Delft Institute of Earth Observation and Space Systems of Delft University of Technology has developed an Interferometric Synthetic Aperture Radar (InSAR) processor named Doris (Delft object-oriented radar interferometric software). The Doris software can be downloaded *freely* from this site for non-commercial applications (conditions).

Interferometric products and endproducts such as Digital Elevation Models and displacement maps can be generated with this software from Single Look Complex data. Data from the satellites ERS, ENVISAT (first ENVISAT interferogram, 54kB, DEM, 107kB, and perspective view, 177kB), JERS (first JERS interferogram), and RADARSAT (first RADARSAT interferogram) can be processed with the Doris software.

**Introduction** - *24 December 2008*
Introduction to interferometric processing with the Doris software.

**Status** - *24 December 2008*
What's the current status of these pages and the Doris software.

**Literature** - *24 December 2008*
Online publications and InSAR references
FRINGE 2003 presentation,
BAM Earthquake processing overview,
Searchable InSAR literature (bibtex file with ~2100 entries),

**Download** - *13 March 2012*
Access to the Doris software
User manual (html - v4.02 )
User manual (pdf - v4.02 changelog )
User manual (pdf in Chinese - v3.16)

# GMTSAR



## An InSAR processing system based on GMT


David Sandwell - Scripps Institution of Oceanography

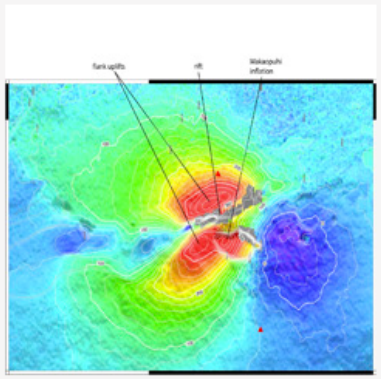
Rob Mellors - San Diego State University

Xiaopeng Tong - Scripps Institution of Oceanography

Meng Wei - Scripps Institution of Oceanography

Paul Wessel - University of Hawaii


Looking for volunteers to develop scripts



GMTSAR is an open source (GNU General Public License) InSAR processing system designed for users familiar with Generic Mapping Tools (GMT). The code is written in C and will compile on any computer where GMT and NETCDF are installed. The system has three main components:

1. a preprocessor for each satellite data type (e.g., ERS, Envisat, and ALOS) to convert the native format and orbital information into a generic format
2. an InSAR processor to focus and align stacks of images, map topography into phase, and form the complex interferogram
3. a postprocessor, mostly based on GMT, to filter the interferogram and construct interferometric products of phase, coherence, phase gradient, and line-of sight displacement in both radar and geographic coordinates.

GMT is used to display all the products as postscript files and KML images for Google Earth. A set of C-shell scripts has been developed for standard 2-pass processing as well as image alignment for stacking and time series. ScanSAR processing is also possible but requires a knowledgeable user. Users are welcome to contribute to this effort. In particular contributions using other scripting languages such as Perl and Python are desired.


CITATION: Sandwell, D. ., R. . Mellors, X. Tong, M. Wei, and P. Wessel (2011), Open radar interferometry software for mapping surface deformation, Eos Trans. AGU, 92(28), doi:10.1029/2011EO280002.

Sandwell, David, Mellors, Rob, Tong, Xiaopeng, Wei, Matt, & Wessel, Paul. (2011). GMTSAR: An InSAR Processing System Based on Generic Mapping Tools. UC San Diego: Scripps Institution of Oceanography. Retrieved from: http://escholarship.org/uc/item/8zq2c02m



ACKNOWLEDGEMENTS: This research was supported by ConocoPhillips, Scripps Institution of Oceanography, and San Diego State University.



© 2010 GMTSAR

sarmap



SARscape

Synthetic Aperture Radar (SAR) systems can acquire data in different ways, such as

- Single or dual channel mode (for instance HH/HV or VV/VH);
- Interferometric (single- or repeat-pass) mode;
- Polarimetric mode (HH,HV,VH,VV);
- By combining interferometric and polarimetric acquisition modes;
- Stereo mode.

Obviously, different acquisition modes are subject to different processing techniques, namely

- **Processing of SAR Intensity**
  The product generation is based on the intensity processing.
- **Interferometric SAR (InSAR) processing**
  The product generation includes the interferometric phase processing.
- **Polarimetric SAR (PolSAR) processing**
  The product generation includes the polarimetric phase processing.
- **Polarimetric-Interferometric SAR (PolInSAR) processing**
  The product generation includes polarimetric and interferometric phase processing.
- **SAR stereo processing**
  The product generation is based on the processing of intensity stereo pair.

# GAMMA REMOTE SENSING



**Software**

- Software News
- System Overview
- MSP Modular SAR Processor
- ISP Interferometric SAR Processor
- DIFF&GEO Differential SAR Processor & Geocoding
- IPTA Interferometric Point Target Analysis
- GEO Geocoding Software
- LAT Land Application Tools
- DISP Display Tools

## GAMMA Software

The GAMMA SAR and Interferometry Software is a collection of programs that allows processing of SAR, interferometric SAR (InSAR) and differential interferometric SAR (DInSAR) data for airborne and spaceborne SAR systems. The software supports the entire processing from raw data to high level products such as digital elevation models, displacement maps, point target analysis and landuse maps. The software is arranged in packages, each dealing with a specific aspect of the processing. → Learn more...

The GAMMA Software runs on any Unix or Linux system as well as on Win32-based platforms (W2K, Windows XP). Recommended OS is Linux. Any distribution should work as long as the GTK toolkit is version 2.8.12 or higher. A nice free distribution is Ubuntu. Both 32- and 64-bit processors are supported on Linux. On Windows and Solaris a 32-bit environment is needed. The GAMMA Software is also known to run on OS-X and other *IX systems. Contact GAMMA if you have special needs.

With its functionality, flexibility, robustness, efficiency, and competitive price, GAMMA software is an excellent solution for demanding processing jobs. This has been demonstrated by license sales to users at many leading institutes world-wide, since 1995. Another distinct advantage of the GAMMA software is the competent user support provided directly by the developers and experienced users of the software and the availability of ad-hoc and training courses.

## Accès aux services

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- **TomoSAR services**
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# TomoSAR platform

We open to provide TomoSAR services to everyone.

contact: Dinh.Ho-Tong-Minh@lrstea.fr

Context :

Numerous space-borne synthetic aperture radar (SAR) sensors are currently operating or will be launched in the near future. Consequently, there is a need to improve our knowledge of SAR data processing for land surfaces applications. In this context, we are implementing **TomoSAR** - a software platform, which will be actively processed from **SAR**, Interferometry SAR, to **Tomo**graphy (so called **TomoSAR**). The possible applications can be as follows:

1. Land displacement and topography (DEM)
2. Agriculture (Land cover, rice, season mapping)
3. Forestry (carbon, biomass, forest, deforestation, Tomography)
4. Urban monitoring (spread, subsidence, tomography)
5. All the demand SAR processing

The TomoSAR is created by D. Ho Tong Minh. This platform is based on the previous works in the frame of his research at the Politecnico di Milano and CESBIO as well as state-of-the-art algorithms published in the literature.

Current support sensors:

1. Spaceborne: **Sentinel-1**, ERS, ASAR, Cosmos SkyMED, TerraSAR, TanDEM-X, ALOS-1/2, Radarsat-1/2, BIOMASS
2. Airborne : SETHI, ESAR, FSAR
3. Stripmap and TOPS modes

Demonstrations :

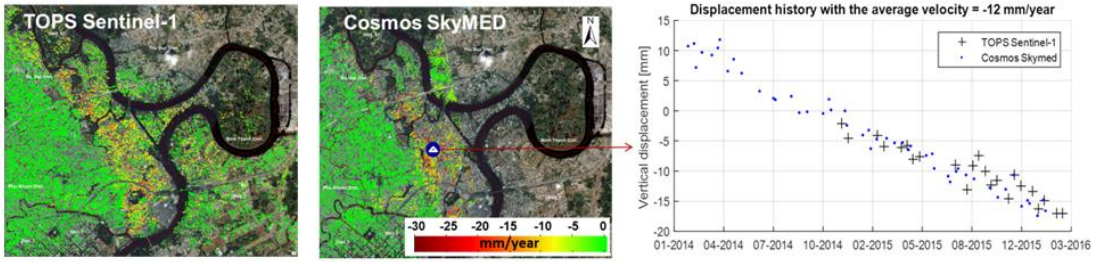
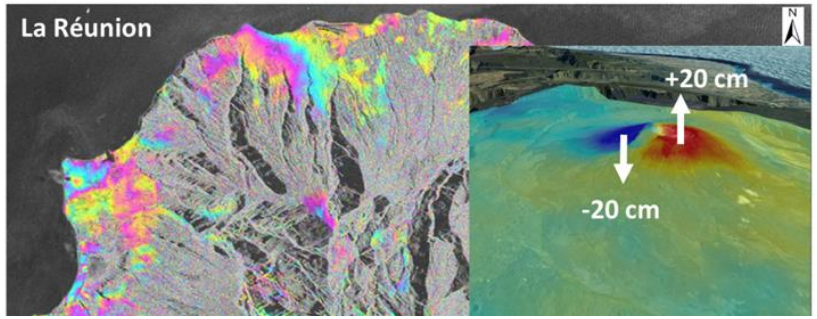



*Figure 1: Good agreement between 23 images TOPS Sentinel-1 C-band and 49 images Stripmap CosmosSkyMED X-band in Ho Chi Minh City. Both are effective to detect the subsidence phenomena in 2014-2016.*



# Time series InSAR software

# Many well-known time series InSAR processor available

| Name | Year | Main code | Creator | Note | Support | APS removal | Accuracy expectation |
|---|---|---|---|---|---|---|---|
| Gamma | 1995 | C | C. Werner | Commercial ($$$) | PS SBAS | Yes | mm/yr |
| TRE | 1999 | n/a | A. Ferretti | Service demand | SBAS PSDS | Yes | mm/yr |
| StaMPS | 2005 | Matlab | A. Hooper | Open source | PS SBAS | Yes | mm/yr |
| SARSCAPE | 200x | n/a | Sarmap | Commercial ($$) | PS SBAS | Yes | mm/yr |
| SARPROZ | 2009 | Matlab | D. Perissin | n/a | PS | Yes | mm/yr |
| TomoSAR | 2014 | C | D. Ho Tong Minh and Y.-N. Ngo | Service collaboration and demand | SBAS PSDS | Yes | mm/yr |
| MintPy | 2018 | Python | F. Amelung et al. | Open source | SBAS | need others | cm/yr |
| Licsbas | 2019 | Python | Y. Morishita | Open source | SBAS | need others | cm/yr |

# SARproZ Home

**SARPROZ** is a very powerful and versatile software that implements a wide range of Synthetic Aperture Radar (SAR), Interferometric SAR (InSAR) and Multi-Temporal InSAR processing techniques.

Main characteristics of SARPROZ:

- User friendly Graphic **Interface**: no coding knowledge is required for standard uses
- Based on **Matlab**: advanced users can very easily develop their own software extensions.
- It can be compiled and it can run independently from Matlab on **any platform** (Unix, PC, Mac).
- Completely **parallelized**: SARPROZ can run on multiple CPU cores or computer clusters automatically.
- Most Satellites/data formats supported, including Sentinel IW (TOPS) data.
- It can be run in **automatic mode** from the command line without graphic interface.

SARPROZ is the best tool for SAR/InSAR data investigation and for detailed infrastructure monitoring.

https://mintpy.readthedocs.io/en/latest/

Docs » Home

Edit on GitHub

# MintPy


The Miami INsar Time-series software in PYthon (MintPy) is an open-source package for Interferometric Synthetic Aperture Radar time series analysis. It reads the stack of interferograms (coregistered and unwrapped) in ISCE, GAMMA, ARIA, SNAP or ROI_PAC format, and produces three dimensional (2D in space and 1D in time) ground surface displacement. It includes a routine time series analysis ( `smallbaselineApp.py` ) and some independent toolbox.

This package was called PySAR before version 1.1.1. For version 1.1.2 and onward, we use MintPy instead.

## 1. Installation

## 2. Running MintPy

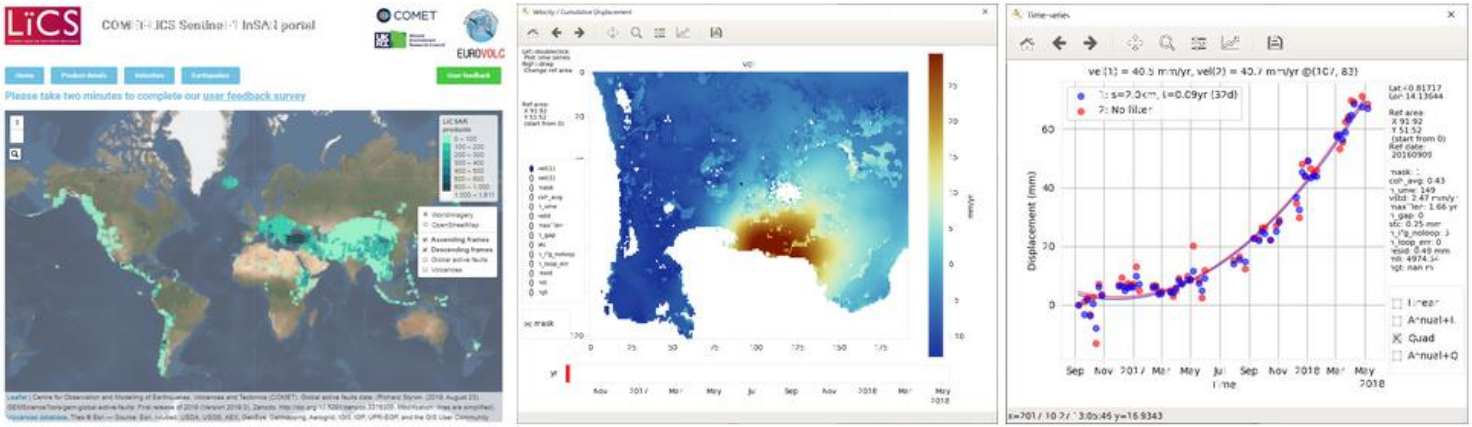
MintPy reads a stack of interferograms (unwrapped interferograms, coherence, wrapped interferograms and connecting components from SNAPHU if available) and the geometry files (DEM, lookup table, etc.). You need to give the path to where the files are and MintPy takes care of the rest!

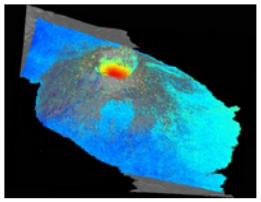
```
smallbaselineApp.py                         #run with default template 'smallbaselineApp.cfg'
smallbaselineApp.py <custom_template>       #run with default and custom templates
smallbaselineApp.py -h / --help             #help
smallbaselineApp.py -H                      #print    default template options
smallbaselineApp.py -g                      #generate default template if it does not exist
smallbaselineApp.py -g <custom_template>    #generate/update default template based on custom temp

# Run with --start/stop/dostep options
smallbaselineApp.py GalapagosSenDT128.template --dostep velocity  #run at step 'velocity' only
smallbaselineApp.py GalapagosSenDT128.template --end load_data    #end after step 'load_data'
```

# LiCSBAS

LiCSBAS is an open-source package in Python and bash to carry out InSAR time series analysis using LiCSAR products (i.e., unwrapped interferograms and coherence) which are freely available on the COMET-LiCS web portal.

Users can easily derive the time series and velocity of the displacement if sufficient LiCSAR products are available in the area of interest. LiCSBAS also contains visualization tools to interactively display the time series of displacement to help investigation and interpretation of the results.





# STAMPS

**A software package to extract ground displacements from time series of synthetic aperture radar (SAR) acquisitions.**

The original version was developed at Stanford University but subsequent development has taken place at the University of Iceland, Delft University of Technology and the University of Leeds.

The package incorporates persistent scatterer and small baseline methods plus an option to combine both approaches.

Andy Hooper
School of Earth and Environment
University of Leeds
Leeds LS2 9JT

**15th August, 2018**

**A new beta release version of StaMPS/MTI (version 4.1b1) is available from Github (extract with `tar -zxvf`).**

**The manual of StaMPS/MTI (version 4.1b1) is available as a pdf file**

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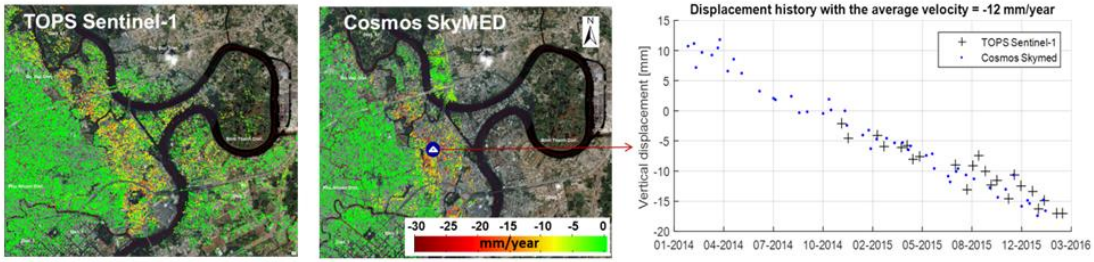


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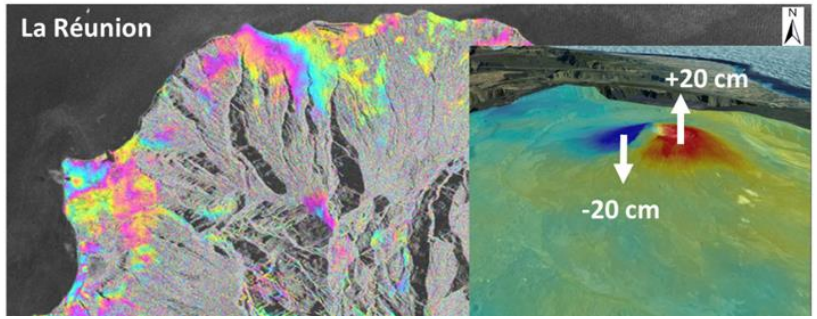

# Combine InSAR and time series software

Native fully support InSAR and time series:

TRE, Gamma, SARScape, TomoSAR

But none of them is free.

Good combination for free:

DORIS to StaMPS

**SNAP to StaMPS (no coding require – this tutorial)**

ISCE to StaMPS

ISCE to MintPy

SNAP to MintPy

TomoSAR platform note:

- *Mostly free service under collaboration:* easiest and fastest one.
- *Final product: history displacement, velocity, accuracy velocity and APS.*
- *Middle product: data to play with StaMPS from step 6.*

# For this tutorial

- HDD space > 50 GB and RAM > 4 GB

- It is recommended to work on Unix-like OS (e.g., Ubuntu, CentOS, Mac). If not, you can use Window. **Prerequisites: basic of terminal commands (e.g., cd, make, and pwd) and variable environment (e.g., source and export)**

- Need python 3 (recommend Anaconda) and Intall *pathlib* by : **pip install pathlib**

- Install SNAP lastest version (http://step.esa.int/main/download/snap-download/) Then Tools/Plugins/Install SNAPHU phase unwrapping

- Install Matlab (minimum version 2015). This is the only not free available software. However, it is free for a trial licensing. Please go to https://www.mathworks.com and click **Download a free trial.** *In practice, when you are getting familiar with the StaMPS script, you can build and execute it without the need of Matlab*. For running StaMPS, we need at least 4 Matlab toolboxes (Parallel Computing, Image Processing, Signal Processing, and Statistics and Machine Learning).

- Install StaMPS (https://github.com/dbekaert/StaMPS/archive/v4.1-beta.zip)

Unzip file and you can find the handbook. Inside the directory: **make** and subsequently **make install**. For Window users, you can use Windows subsystem for Linux**.**

- Install Google Earth for visualisation