



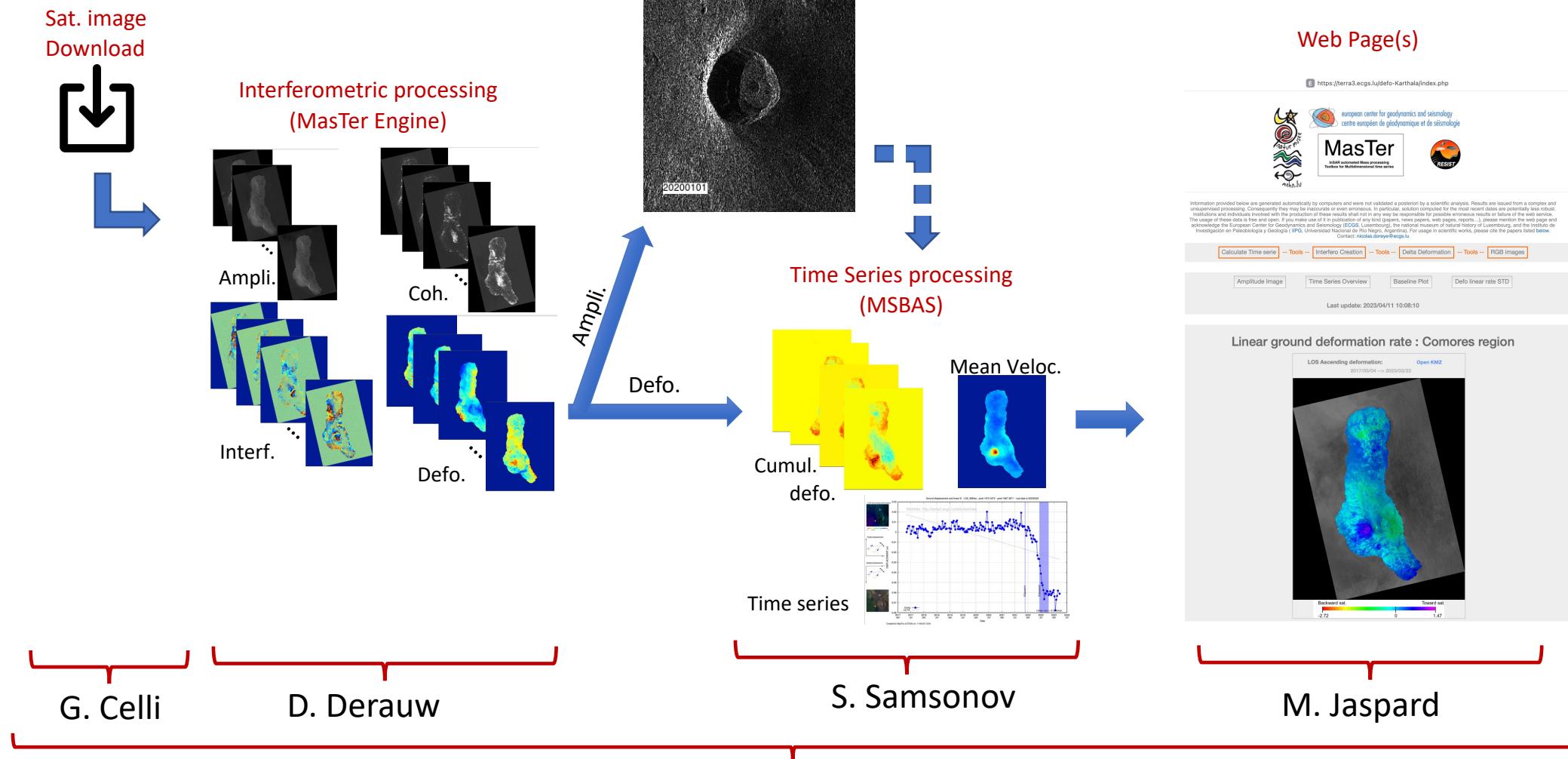
Summer School in InSAR, time series processing and deformation modelling

MasTer Toolbox : structure

Nicolas d'Oreye



MasTer Toolbox



If you need InSAR, Master it

Luxembourg, May 22-26, 2023



Structure

Plan:

- **The user manual:**
 - Conventions
 - Architecture
 - Contest...
- **Scripts architecture** (header, hard coded lines..)
- **Organizing the work:**
 - Disk/Directories architecture
 - MaSTer Organizer
- **Processing steps:**
 - download,
 - read, (baseline computation)
 - Coregistration, InSAR processing, mass processing
 - Deformation time series (+ amplitude time series), web page
- **Parameters**
- **Ancillary data:**
 - DEM : where, how create, format
 - MASKS : where, how create, format
 - kml: where, why, how create

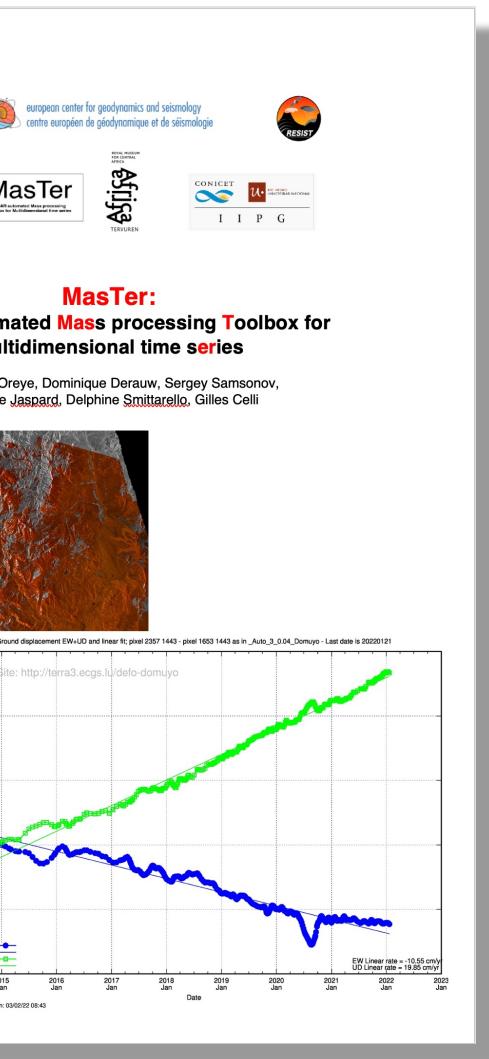


Structure

Plan:

- **The user manuals:**
 - Conventions
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 - Contest...
- Scripts architecture (header, hard coded lines..)
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- Ancillary data:
 - DEM : where, how create, format
 - MASKS : where, how create, format
 - kml: where, why, how create

+ Provide samples (S1 data, DEM, orbits...) to participants



The user manual(s)

Master_Manual_5.0.docx [or .pdf]

- 216 pages
- Clickable table of contents.....(from page3)
- List of figures.....(from page 207)
- Index of scripts, variables, files names.....(from page 209)
- Some references.....(from page 216)

Everything should be in there...

➔ Go through the manual to know what exists and where.



The user manual(s)

Detailed Mac installation guide of MasTer Engine

V4.3

April 21 2023

Installation of MasTer (FOR Mac OS DISTROS)

Installation guide by:
N. d'Oreye, D. Smitarelio, M. Jaspard, G. Celli – ECGS
B. Smets – RMCA

Version 4.3: April 20 2023

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Install_MasTer_Mac_V5.0.docx [or .pdf]



The user manual(s)

Detailed Linux installation guide of MaSTer Engine

V4.3

Jan 09, 2023

Installation of MaSTer (FOR Linux DISTROS)

Installation guide by:
N. d'Oreye, D. Smitarelio, M. Jaspard, G. Celli – ECGS
B. Smets – RMCA

Version 4.3: April 20 2023

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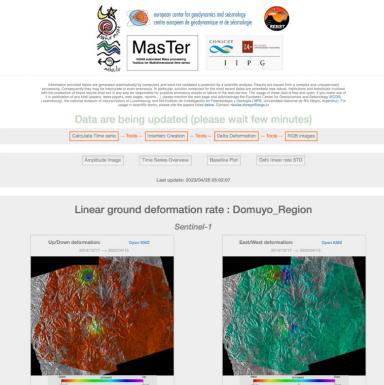
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Install_MaSTer_Mac_V5.0.docx [or .pdf]

Install_MaSTer_Linux_V5.0.docx [or .pdf]

The user manual(s)

MasTer Web Page Distro V1.3 March 20, 2023



Page Web Deformation MSBAS

Maxime Jaspard, Gilles Celli, Nicolas d'Oreye

Argentina: Domuyo and Laguna Del Maule region

Congo: Virunga Volcanic Province

Luxembourg: Grande region

La Réunion: Piton de la fournaise

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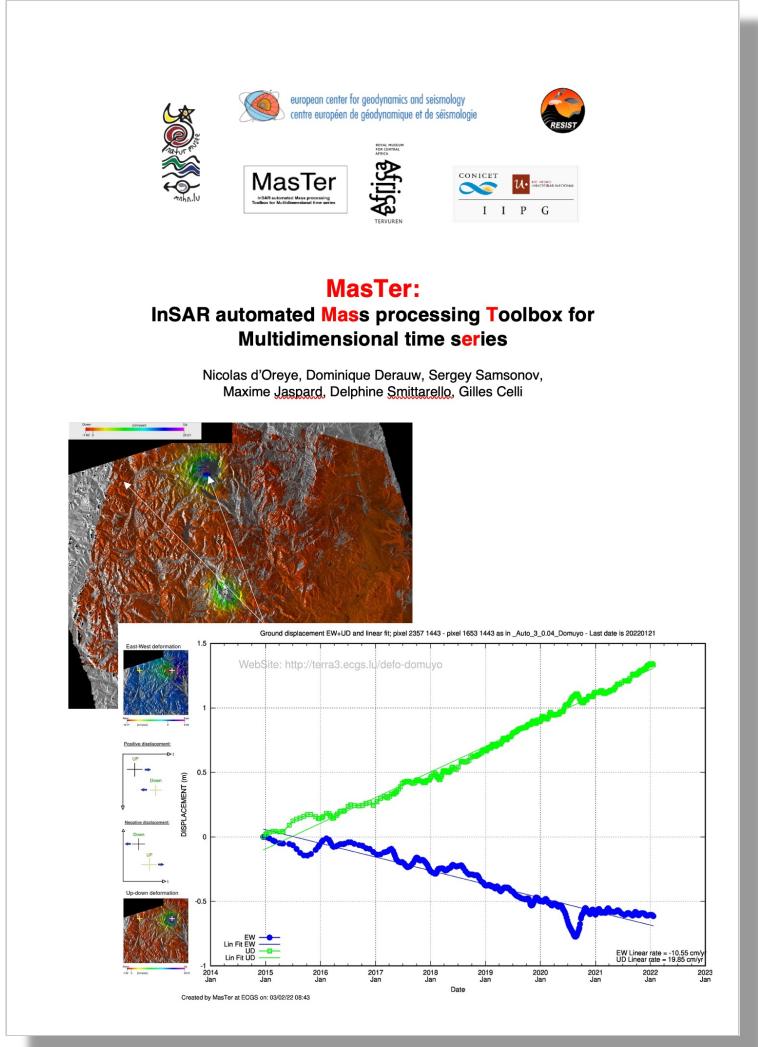
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Install_MasTer_Linux_V5.0.docx [or .pdf]

Web_tool_V1.3.docx [or .pdf]

The user manual



Master_Manual_5.0.docx [or .pdf]

Conventions (hopefully):

- Path are in **green** (“`.../`” at the beginning of a path means “whatever your path starts with”)
- Parameters are in ***italic green***
- External commands or files are in ***italic blue***
- MasTerEngine commands and scripts are in *****bold italic*****
- Some warnings or important remarks are in **red**
- Yellow highlight** is coming soon (hopefully)
- Parameters with square brackets (i.e. `[..]`) show in command lines are optional

The user manual

MasTer:
InSAR automated Mass processing Toolbox for Multidimensional time series

Nicolas d'Oreye, Dominique Derauw, Sergey Samsonov, Maxime Jaspard, Delphine Smitarello, Gilles Celli

East West derivative

Ground displacement EW+UD and linear fit: pixel 2257 1443 - pixel 1653 1443 as in _Auto_3_0_04_Domuyo - Last date is 2020121

WebSite: <http://terra3.ecgs.lu/delfo-domuyo>

DISPLACEMENT (m)

Vertical displacement

Horizontal displacement

Up-down displacement

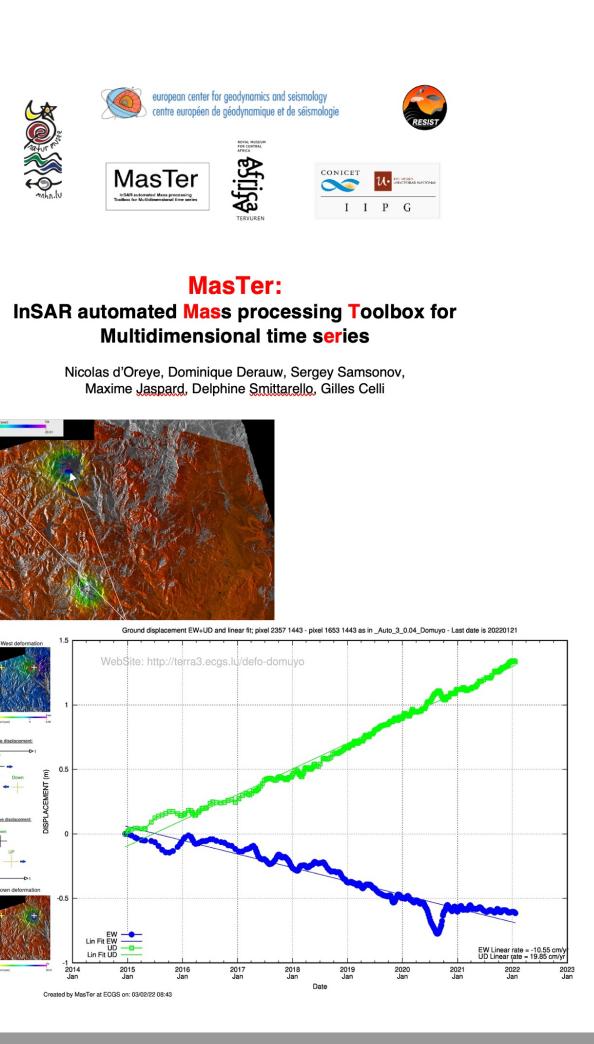
EW linear rate = 10.55 cm/yr UD linear rate = 19.88 cm/yr

Created by MasTer at ECGS on: 03/08/22 08:43

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Current status:

- Constant improvements...
- May happen that some functionalities did not survive updates. Let us know...
- If not enough RAM: may experience problem at geocoding or MSBAS
- Products are provided in UTM

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Nicolas d'Oreye, Dominique Derauw, Sergey Samsonov, Maxime Jaspard, Delphine Smitarello, Gilles Celli

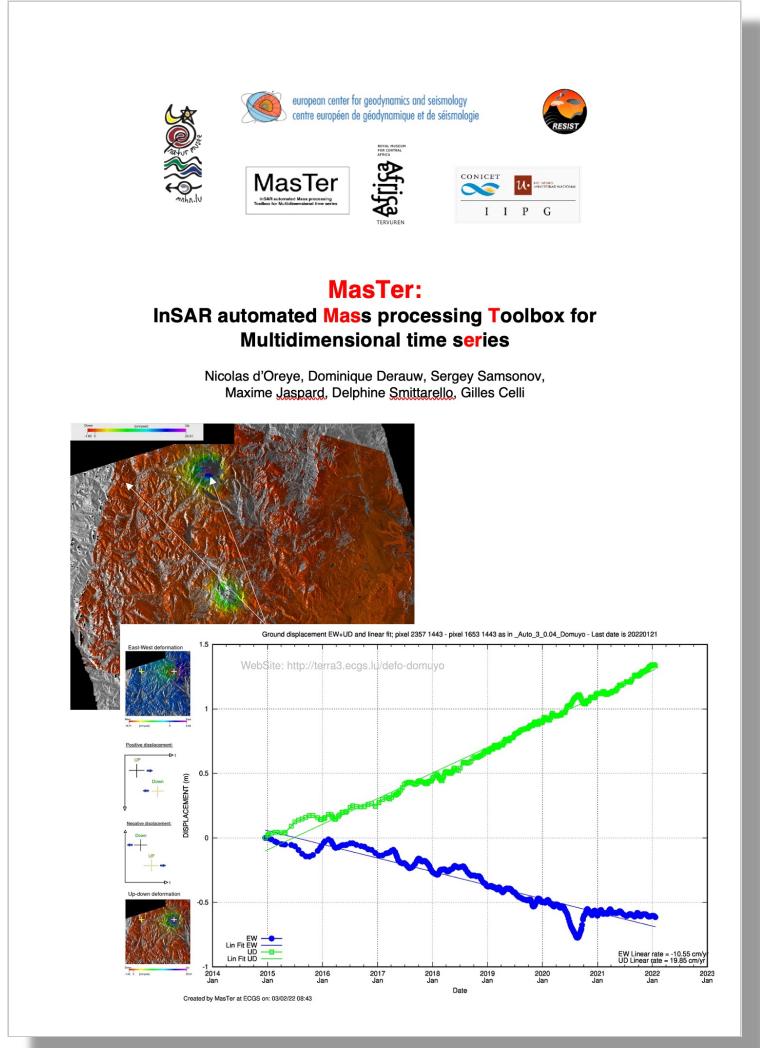
Created by MasTer at ECGS on: 03/08/22 08:43

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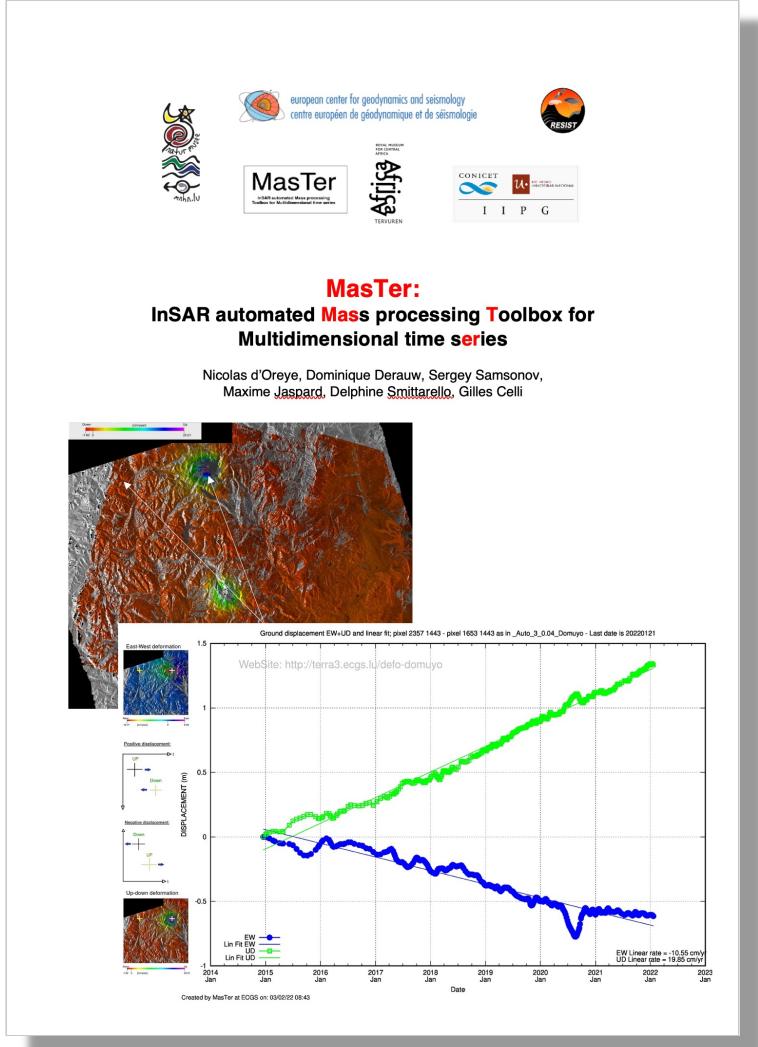


Master_Manual_5.0.docx [or .pdf]

Recommendations:

- Keep same architecture even if not 4 hard drives
- Keep same dir naming convention (& without fancy characters)
- No FAT format hard drive (need symbolic links)
- Do not forget hard coded lines in scripts (see later)

The user manual



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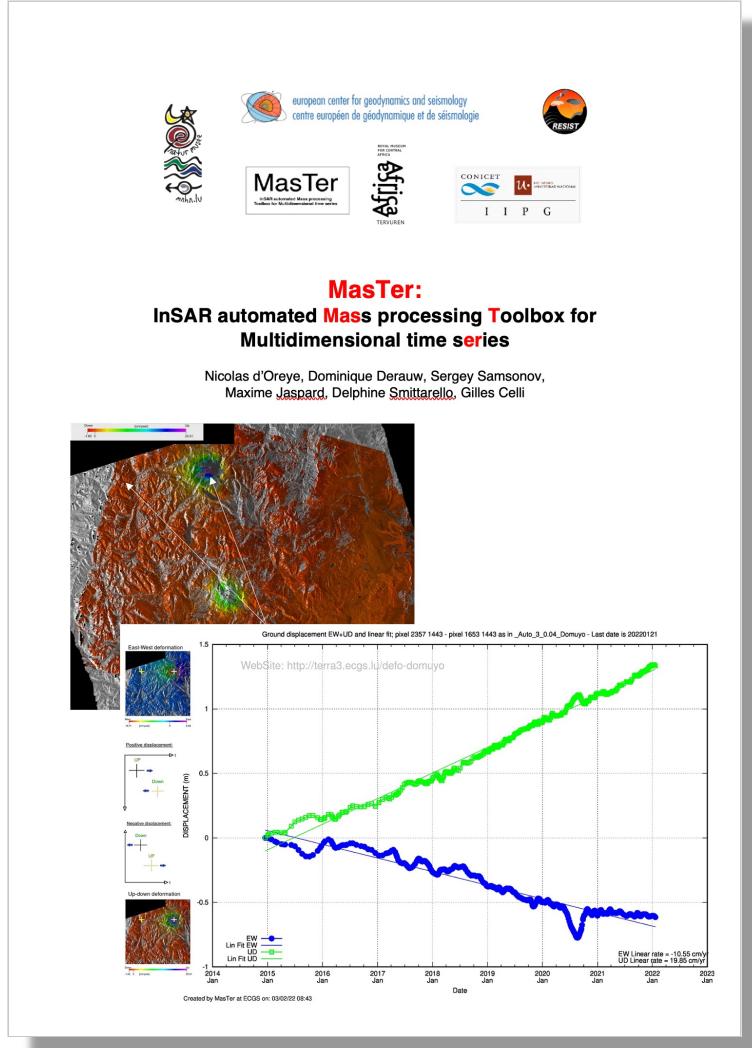
Architecture:

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We will see that in a few minutes

The user manual



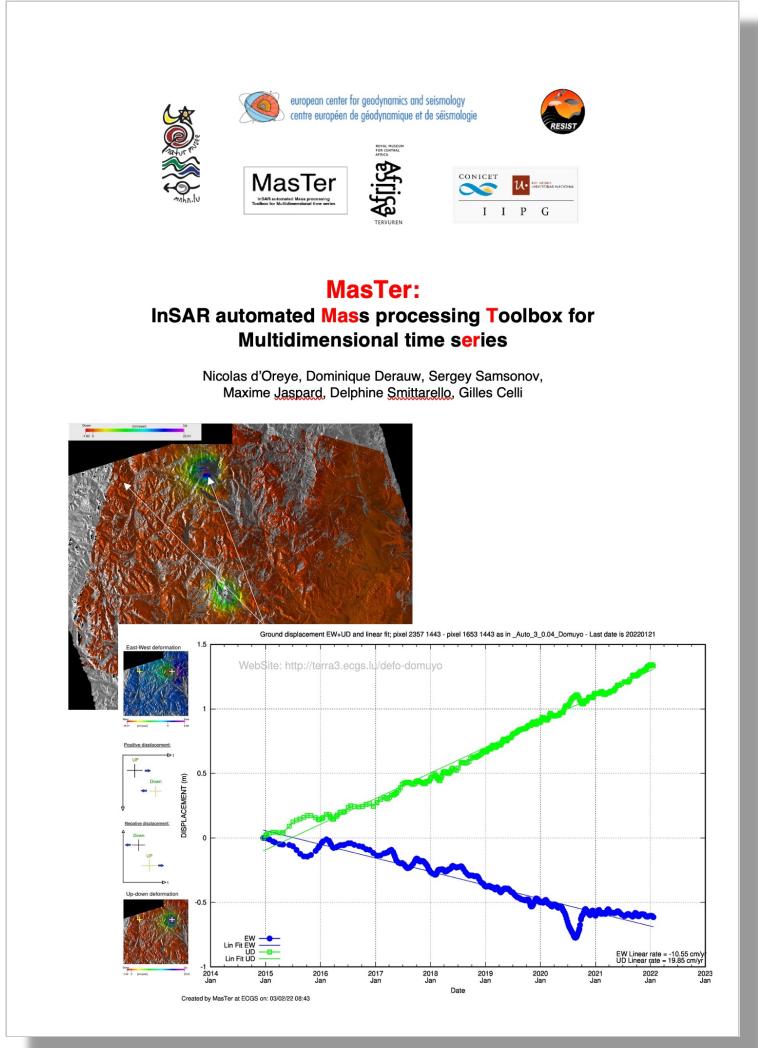
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Also PAZ, KOMPSAT, ALOS, SAOCOM, ICEYE...

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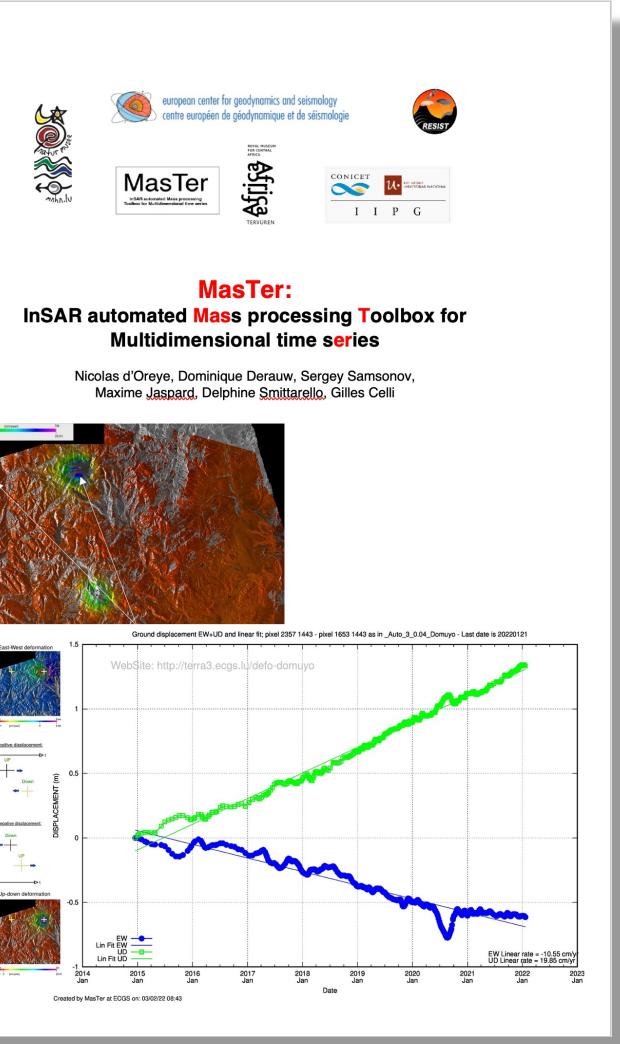


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MasTer:
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RESIST

CONICET

IIPG

TERRA3

AFJIGA

European center for geodynamics and seismology
Centre européen de géodynamique et de séismologie

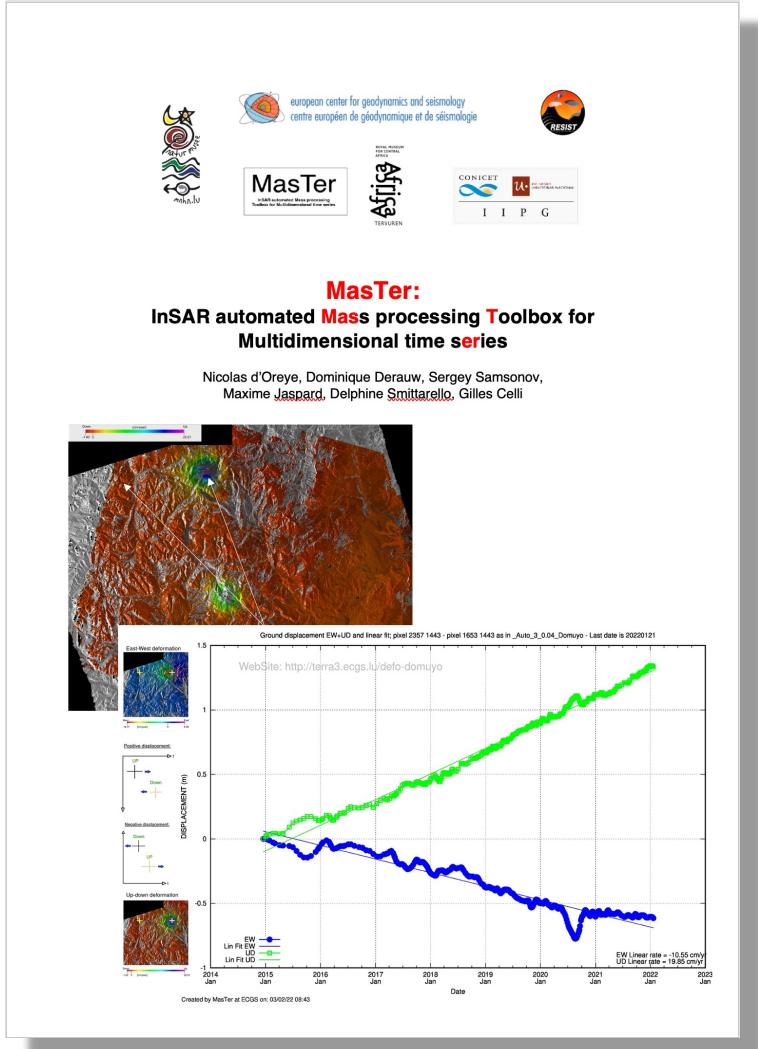
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RESIST

CONICET I I P G

TERUREN

Afifia

European center for geodynamics and seismology centre européen de géodynamique et de séismologie

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Architecture:

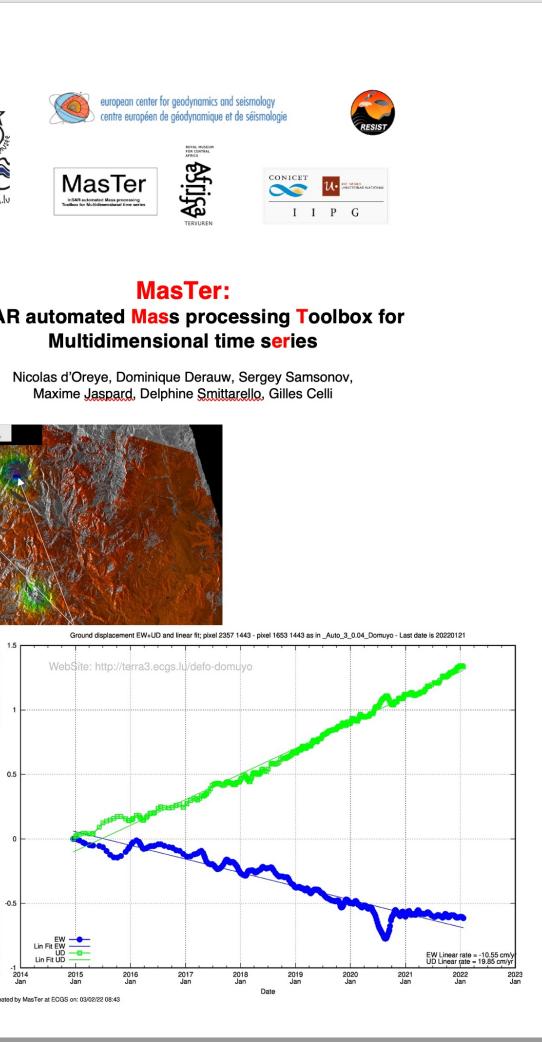
There is a script
for nearly
everything...

Etc, etc, etc...

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Etc, etc, etc...



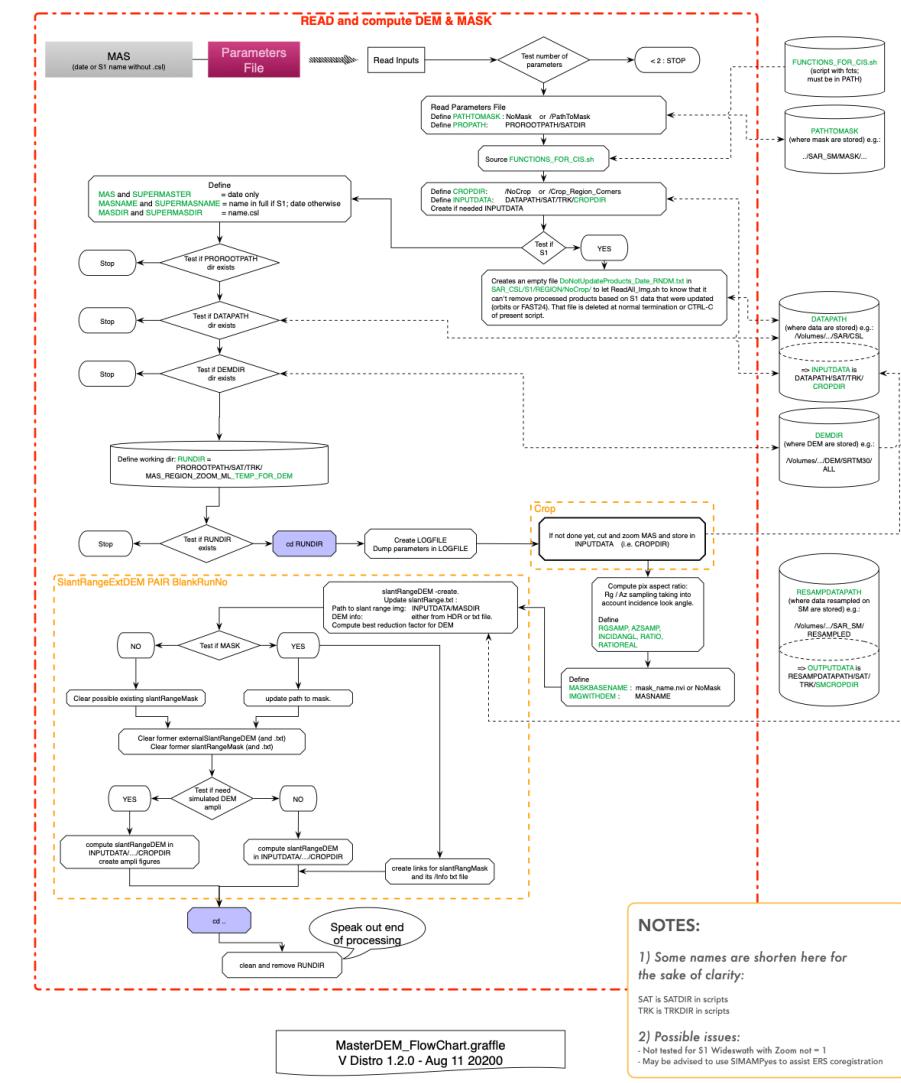
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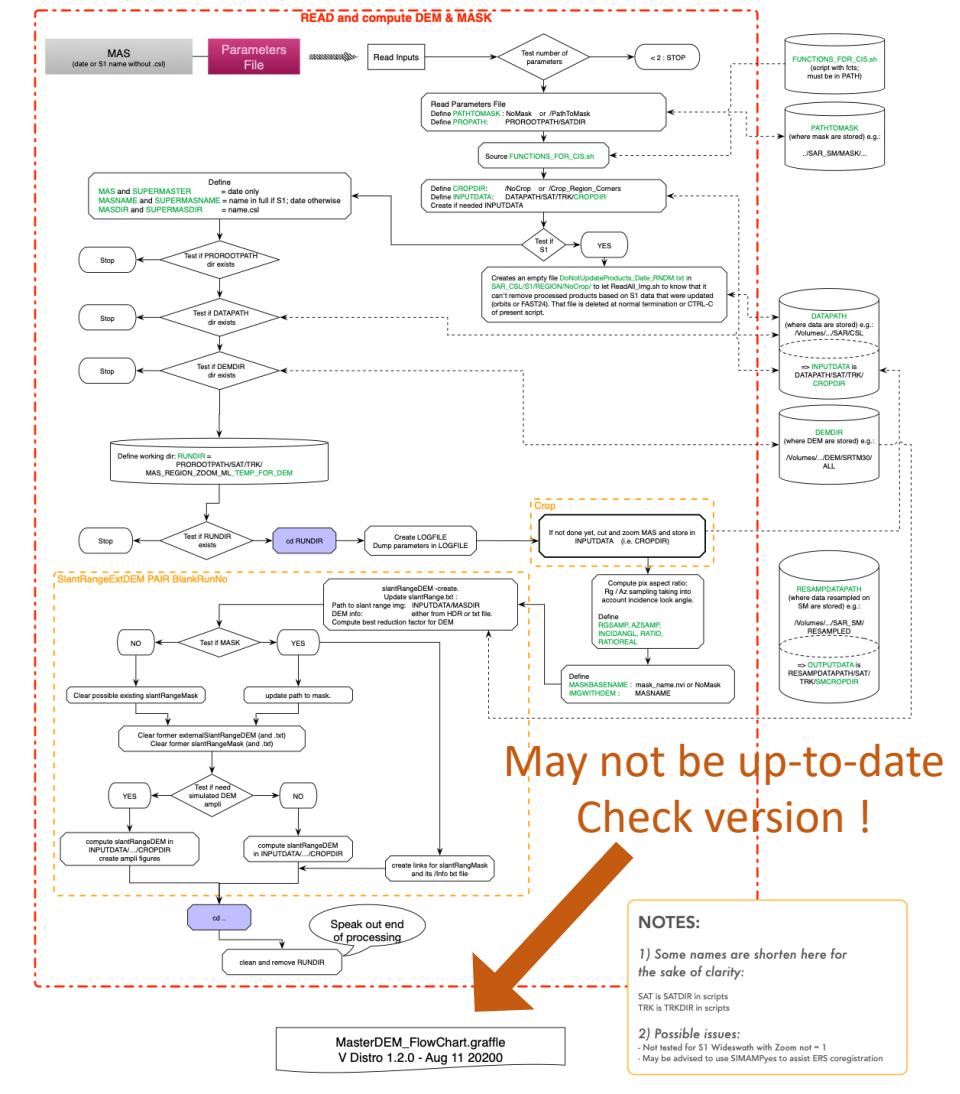


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Provided only for assistance if need to track the logical path



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Provided only for assistance if need to track the logical path



MasTer

Distro V4.2.3

April 20, 2023

The user manual

A.6) Example of full automation

A.6.1) Automatic data download

Special thanks to Gilles Celli who wrote the following two scripts to automatically download data from several regions (Gilles@ecgs.lu):

sentinel1_download_all.sh:

```
#!/bin/sh
# Log:
# 2015.11.0: Added sleep command, or else esa.int will block downloads
# See: https://scihub.esa.int/news/News00040
# This script downloads the satellite image files from ESA-Sentinel 1
# requires /opt/local/bin/xmistarlet and curl (install with macports)
# and the main script: /Users/doris/scripts/sentinel1_downloader_ingestiondate.sh
# Always mount the SMB Disc via Applescript osascript, this avoids writing an empty 'DiscData' Folder to
# /Volumes/
# echo $mount_value
# RD of Co...
/Users/doris/scripts/sentinel1_downloader_ingestiondate.sh --congo --slc --startdate=30-DAYS-AGO --
enddate=TODAY --skipmd5check --deletezip30days
/bin/sleep 180
[...]
## Tristan
/Users/doris/scripts/sentinel1_downloader_ingestiondate.sh --tristan --slc --startdate=10-DAYS-AGO --
enddate=TODAY --skipmd5check --deletezip30days
## Domuyo
/Users/doris/scripts/sentinel1_downloader_ingestiondate.sh --domuyo18 --slc --startdate=10-DAYS-AGO --
enddate=TODAY --skipmd5check --deletezip30days
/Users/doris/scripts/sentinel1_downloader_ingestiondate.sh --domuyo83 --slc --startdate=10-DAYS-AGO --
enddate=TODAY --skipmd5check --deletezip30days
```

sentinel1_downloader_ingestiondate.sh:

```
#!/bin/bash
# Set DEBUG mode with command: set -xv
#set -xv
# Define default options and variables
VERSION="2.9.5"
# -----
# Script to download ESA's Sentinel1 data from ESA-Site Scihub
# See latest news here: https://scihub.copernicus.eu/news/
# -----
# Based on script 'odata-demo.sh' from Scihub Site:
# See odata demo at scihub.copernicus.eu Site:
# Last ID products for a specific product type and intersecting an AOI
# https://scihub.copernicus.eu/twiki/pub/ScihubUserGuide/SAPISAndBatchScripting/odata-demo.sh
# https://scihub.copernicus.eu/twiki/do/view/ScihubUserGuide/SAPISAndBatchScripting
# See ESA's 'APIs and Batch scripting' webpage:
# https://scihub.copernicus.eu/userguide/SAPISAndBatchScripting
# -----
# Changelog:
# -----
# Using Macports coreutils 'tee' command instead of macOS System /usr/bin/tee
# coreutils installs in /opt/local/libexec/macports/tee
[...]
# 2017.07.26 - Version 2.5.1
# - SMB Volumes are no more mounted with mount command:
# Using macOS "automount" feature to automatically mount SMB Volumes
# in /Users/XXXX/NA3-Disc instead of mounting them to /Volumes/SMB.SHARENAME
# See also: http://useyouricar.com/blog/using-the-mac-os-x-automount/
# -----
# Default values
# INGESTION Start and End Date
INGEST_START_DATE="TODAY"
```

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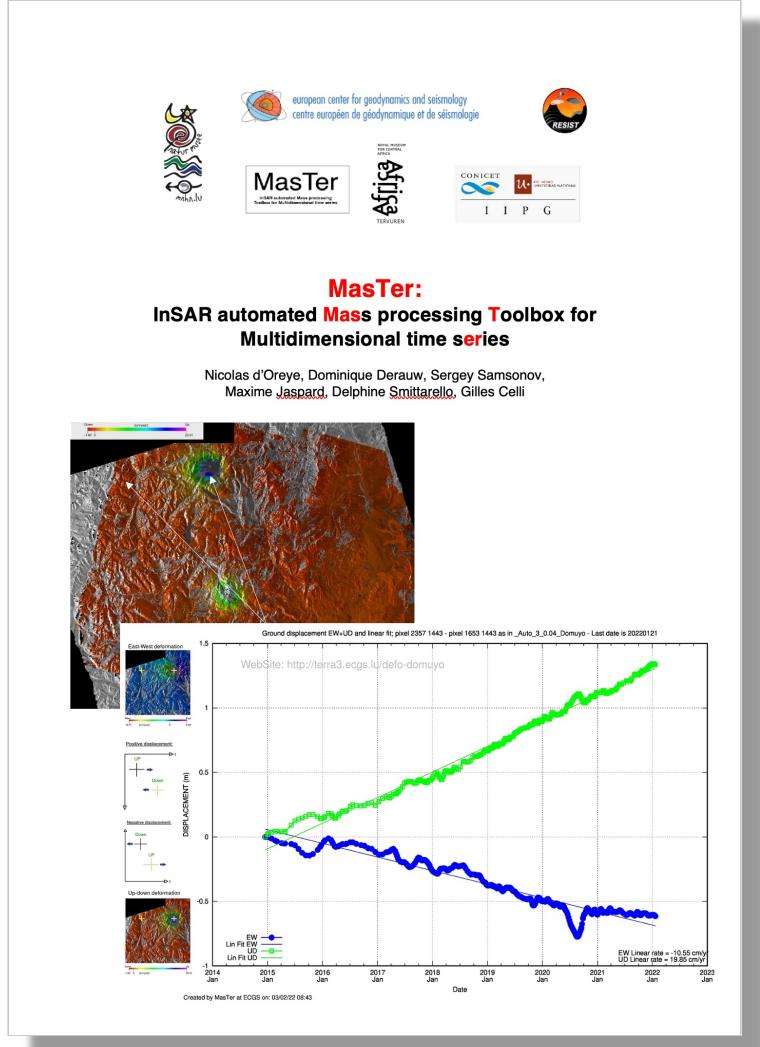
Master_Manual_5.0.docx [or .pdf]

Architecture:

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Refer to the most recent version of the cron scripts

The user manual



Master_Manual_5.0.docx [or .pdf]

Contest:

Whoever finds the most typos or bugs
in the manual gets a beer....





Structure

Plan:

- The user manuals:
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 - DEM : where, how create, format
 - MASKS : where, how create, format
 - kml: where, why, how create

+ Provide samples (S1 data, DEM, orbits...) to participants



Scripts architecture

```
~/SAR/MasTerToolbox/SCRIPTS_MT/SinglePairNoUnwrap.sh < master
1 #!/bin/bash
2
3 # This script is aiming at starting a new CSL InSAR Suite processing for every sat data
4 # It was fully refurbished to work with similar naming as what is present in the
5 # CSL InSARParameters.txt files etc... and adapted to the new processing chain
6 # making use of data already read in csl format using script Read_All_Img.sh
7 #
8 # THIS PROCESSING DO NOT INCLUDE UNWRAPPING AND GEOCODING ON PURPOSE, AND ADD LABEL TO AMPL FIG
9 #
10 # Parameters : - MAS date
11 # - SLV date
12 # - PRAMETERS file, incl path (e.g. ___V20190710_LaunchMTparam.txt)
13 # - COMMENT to be added at the end of dir name where the process is run.
14 #   Optional unless you want process the pair on a SuperMaster.
15 #   See next parameter.
16 # - SUPERMASTER date : if need coregistration on a super master, a 5th parameter
17 #   with its date is mandatory. A 4th parameter is then also mandatory.
18 #   It is recommended to use a 4th parameter that includes the date of the
19 #   supermaster. Someting such as _SMyyyyMMdd would be intuitive.
20 #
21 # If used for creating amplitude images (e.g for shadow monitoring)
22 # there is no need to use a Super Master. The 5th param can be set to NOSM
23 # (actually it is forced to NOSM when use with 7 param).
24 # - LABELX and LABELY: position of date label in amplitude jpg images.
25 #
26 # Hard coded: - MAXSIGMARGAZ = Maximum value of Sigma (in Range and Azimuth) admitted for successful Fine Coregistration.
27 #                 If Sigma is larger, it attempts to restart a fine coreg with larger win size
28 # - Crop function (cutAndZoom with option -e that is without considering latitude and hence poor accurate position. )
29 #
30 # Dependencies:
31 # - MT and MT Tools, at least V20190716
32 # - PRAMETERS file, at least V 20190710
33 # - The FUNCTIONS_FOR_MT.sh file with the function used by the script. Will be called automatically by the script
34 # - gnu sed and awk for more compatibility.
35 # - cpxfiddle is usefull though not mandatory. This is part of Doris package (TU Delft) available here :
36 #     http://doris.tudelft.nl/Doris_download.html.
37 # - Fiji (from ImageJ) is usefull as well though not mandatory
38 # - Python
39 # - scripts: FLIPproducts.py.sh
40 #             FLOPproducts.py.sh
41 # - convert (to create jpg images from sun rasters)
42 # - bc (for basic computations in scripts)
43 # - functions "say" for Mac or "espeak" for Linux, but might not be mandatory
44 # - linux trap function
45 # - __HardCodedLines.sh for the definition of date cell
46 #
47 # New in Distro V 1.0: - Based on developpement version 14.11 and Beta V3.2.0
48 # New in Distro V 1.1: - Offers possibility to calibrate amplitude images
49 # New in Distro V 2.3: - Update to cope with SinglPair.sh V_D2.3.0
50 # New in Distro V 2.4: - allows mapping of zones unwrapped with snaphu
```

All the scripts have :

➤ A shebang as first line (bash or python)

➤ A header delimited by # with

- Aim
- List of parameters
- Maybe some warnings :
 - where to launch the script
 - possible hard coded lines*...
- Dependencies
- List of changes in the new versions

* Hard coded lines are as much as possible merged into a file named
__HardCodedLines.sh, which is sourced at the beginning of the file
if required.



Scripts architecture

```
73 # New in Distro V 5.0 20230830: - Rename SCRIPTS_OK directory as SCRIPTS_MT
74 # - Replace CIS by MT in names
75 # - Renamed FUNCTIONS_FOR_MT.sh
76 #
77 # MasTer: InSAR Suite automated Mass processing Toolbox.
78 # Nd0 (c) 2017/12/29 - could make better... when time.
79 #
80 PRG=$(basename "$0")
81 VER="Distro V5.0 MasTer script utilities"
82 AUT="Nicolas d'Oreye, (c)2016-2019, Last modified on Aug 30, 2023"
83 echo "
84 echo "${PRG} ${VER}, ${AUT}"
85 echo "Processing launched on $(date)"
86 echo "
87
88 # source $HOME/.bashrc
89
90 MASINPUT=$1
91 SLVINPUT=$2
92 PARAMFILE=$3
93 COMMENT=$4
94 SUPMASINPUT=$5
95 LABELX=$6
96 LABELY=$7
97
98 # vvv ---- Hard coded lines to check --- vvv
99 source ${PATH_SCRIPTS}/SCRIPTS_MT/_HardCodedLines.sh
100 # See below:
101 # - SinglePairNoUnwrapDATECELL to define the type of Cell where the date is print on the plots
102
103 MAXSIGMARGAZ=5 # Maximum value of Sigma (in Range and Azimuth) admitted for successful Fine Coregistration.
104
105 # Crop function for non S1 IW : CropAtZeroAlt or Crop (cfr FUNCTIONS_FOR_MT.sh)
106 # CropAtZeroAlt fct performd cutAndZoom with option -e that is without considering latitude and hence poor accurate position.
107 # This is however the default option before June 2022. Take this if you need to keep crop region consistency with former
108 # Crop fct can now adjust the crop based on the mean altitude and corners are more accurate. It requires however a DEM.
109 CROPFCT=CropAtZeroAlt
110 #CROPFCT=Crop
111 # ^^^ ---- Hard coded lines to check --- ^^^
112
113 if [ $# -lt 3 ] ; then echo "Usage: $0 MAS_SLV_PARAMETER_FILE _COMMENT(optional) SUPERMASTER(optional) [position of the jpg date label]"
114
115 if [ $# -eq 7 ] ; then echo " You wanted to change the position of the date label in jpg fig. "; SUPERMASTER="NOSM"; fi # force 5th par
116
117
118 # Function to extract parameters from config file: search for it and remove tab and white space
119 function GetParam()
120 {
121     unset PARAM
122     PARAM=$1
123     PARAM=`${PATHGNU}/grep -m 1 ${PARAM} ${PARAMFILE} | cut -f1 -d \# | ${PATHGNU}/gsed "s/ //g" | ${PATHGNU}/gsed "s/ //g"`
124     eval PARAM=$PARAM
125     echo ${PARAM}
126 }
127
```

All the scripts have :

- A header delimited by # with
 - Some code to output
 - the name of the script,
 - its version and date
 - its author]
- [A line to source the .bashrc]
- The capture of the parameters provided to the script
- [Some hard coded lines, between vvvv--- and ^^^^^---]
- [Some tests on the parameters]
- [Some functions, between {}]

Scripts architecture

All the scripts have :

```

218 XMAX=`GetParam "XMAX,"`  

219 YMIN=`GetParam "YMIN,"`  

220 YMAX=`GetParam "YMAX,"`  

221 GEOCKML=`GetParam "GEOCKML,"`  

222  

223 REGION=`GetParam "REGION,"`  

224 DEMNAME=`GetParam "DEMNAME,"`  

225  

226 RESAMPDATPATH=`GetParam RESAMPDATPATH`  

227  

228 eval PROPATH=${PROROOTPATH}/${SATDIR}/${TRKDIR}  

229  

230 source ${FCTFILE}  

231  

232 # Check OS  

233 OS=`uname -a | cut -d " " -f 1`  

234 echo "Running on ${OS}"  

235 echo  

236  

237 # Define Crop Dir  

238 if [ ${CROP} == "CROPyes" ]  

239 then  

240     if [ ${ZOOM} -eq 1 ]  

241     then  

242         CROPPDIR=/Crop_${REGION}_${FIRSTL}-${LASTL}_${FIRSTP}-${LASTP} #_Zoom${ZOOM}_ML${INTERFML}  

243     else  

244         CROPPDIR=/Crop_${REGION}_${FIRSTL}-${LASTL}_${FIRSTP}-${LASTP}_Zoom${ZOOM} #_ML${INTERFML}  

245     fi  

246 else  

247     CROPPDIR=/NoCrop  

248 fi  

249  

250  

251 # Define Dir where data are/will be cropped  

252 INPUTDATA=${DATAPATH}/${SATDIR}/${TRKDIR}/${CROPPDIR}  

253 mkdir -p ${INPUTDATA}
254
  
```

➤ [The lecture of the parameters from the parameter file, see e.g. [V20230828_LaunchMTparam.txt](#)]

➤ [Sourcing the **FUNCTION_FOR_MT.sh** script, i.e. a sort of library with functions]

➤ [checking the OS]

➤ The code (as commented as possible)



Scripts architecture

Main scripts are in:

`$HOME/SAR/MasTerToolbox/SCRIPTS_MT`

Some utilities are in:

`$HOME/SAR/MasTerToolbox/SCRIPTS_MT/zz_Utilsities_MT`

Some of less used utilities (mostly for “my” specific needs, though might be useful to other users) are in:

`$HOME/SAR/MasTerToolbox/SCRIPTS_MT/zz_Utilsities_MT_Ndo`

Moreover,

cron scripts are in:

`$HOME/SAR/MasTerToolbox/SCRIPTS_MT/_cron_scripts[_NEW]`

MasTer Orginizer scripts are in:

`$HOME/SAR/MasTerToolbox/SCRIPTS_MT/MasTerOrganizer`

Scripts for pairs optiisation module are in:

`$HOME/SAR/MasTerToolbox/SCRIPTS_MT/optimtoolbox`

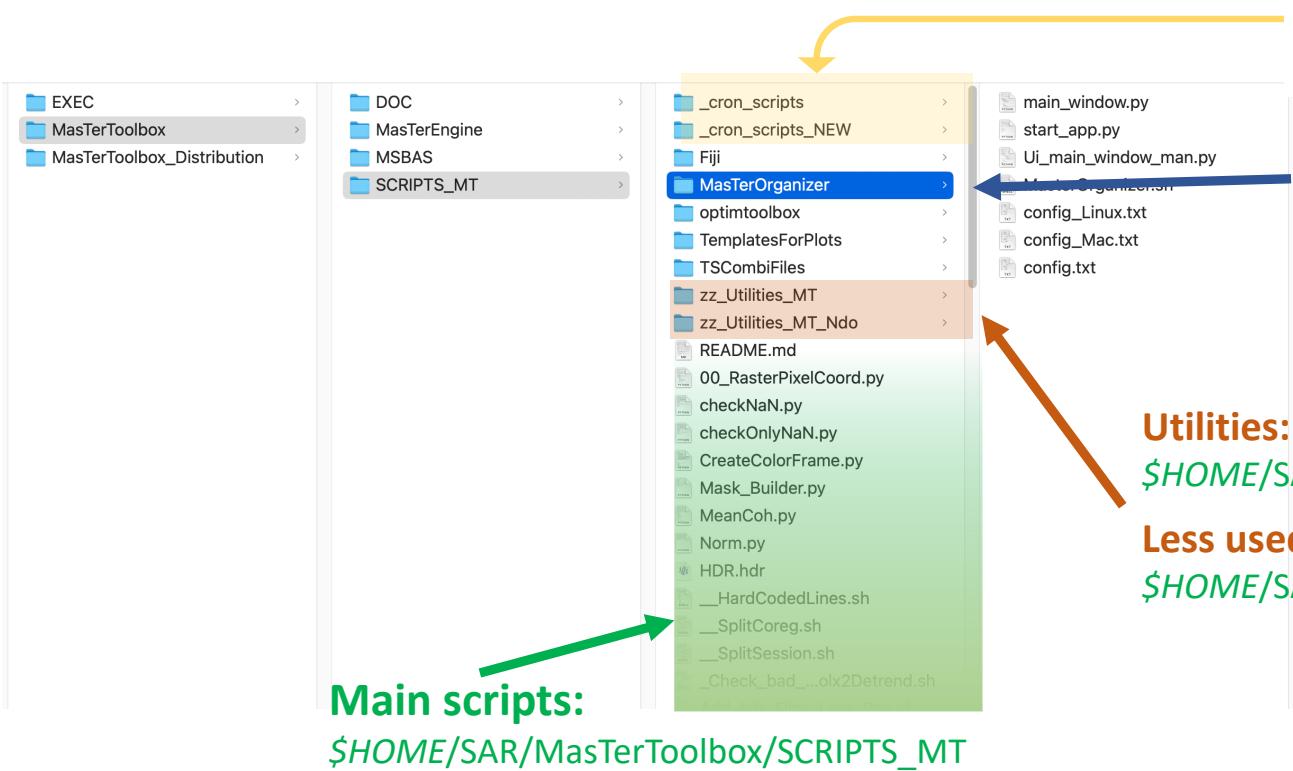
Files for time series plots are in:

`$HOME/SAR/MasTerToolbox/SCRIPTS_MT/TSCombiFiles`

Some Fiji related files for macro (for development) are in:

`$HOME/SAR/MasTerToolbox/SCRIPTS_MT/Fiji`

Scripts architecture



Cron scripts:

\$HOME/SAR/MasTerToolbox/SCRIPTS_MT/_cron_scripts[_ NEW]

MasTer Organizer:

\$HOME/SAR/MasTerToolbox/SCRIPTS_MT/MasTerOrganizer

Utilities:

\$HOME/SAR/MasTerToolbox/SCRIPTS_MT/zz_Utils_MT

Less used utilities:

\$HOME/SAR/MasTerToolbox/SCRIPTS_MT/zz_Utils_MT_Ndo

Moreover,

\$HOME/SAR/MasTerToolbox/SCRIPTS_MT/TSCombiFiles contains files for time series plots.

\$HOME/SAR/MasTerToolbox/SCRIPTS_MT/Fiji contains some Fiji related files for macro (for development).

Note: Don't be afraid if some scripts talk to you...

- **FUNCTIONS_FOR_MT.sh**
- Long names with lots of info...



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Organizing the work

MasTer Toolbox expects the files to be sorted in specific directories.

It will also store automatically the results in dedicated directories, based on your parameters and disk of your choice.

This is probably the most important part to remember: what is where.

If you respect these expected locations in your config, it will run smoothly.

Beware to stay consistent in your naming (e.g. use the same *REGION* and *MODE* description through the architecture).

In the following tables, we show what is expected for a typical architecture:



Organizing the work

Normal processing:

	Raw data	Read data	Baseline tables	Coregistr. on SuperMaster	Mass Processed	MSBAS Time Series
disk	3600	1650	1650	1650	3601	3602
dir	SAR_DATA __S1 __S1_REG-SLC __S1_REG-SLC.UNZIP __S1_REG-SLC.UNZIP_FORMER __YYYY : __SAT __REGION_MODE ..	SAR CSL __SAT __REGION_MODE __NoCrop	SAR SM __MSBAS __REGION __Set1 __Set2 :	SAR SM __RESAMPLED __SAT __REGION_MODE	SAR MASSPROCESS __SAT __REGION_MODE __SM_Crop... __Geocoded __GeocodedRasters __Pair1 __Pair2 :	MSBAS __REGION_DESCRIPTION __Mode1 __Mode2... __zz_EW.. __zz_UD.. __zz_LOS.. __zz_EW_UD_TS..

Ancillary data:

	DEM & GEOID	KML	MASK	Parameters & ORBITS	SCRIPTS	Points & events for Time Series
disk	DataSAR	1650	DataSAR	DataSAR	HOME	1650
dir	SAR_AUX_FILES __EGM __EGM96 __DEM __SRTM30 __ALL __REGION.. __Copernicus __ALL __REGION..	kml __REGION	SAR_AUX_FILES __MASKS __WaterBodies __REGION __FOR_MASKS __SAT __REGION...	SAR_AUX_FILES __ORBITS __S1_ORB __AUX_RESORB __AUX_POEORB __ENV_ORB... __Param_files_SuperMaster __SAT __REGION_MODE	SAR __MasTerToolbox __SCRIPTS_MT __cron_scripts __MasTerOrganizer __zz_Utilitys_MT __zz_Utilitys_MT_Ndo	__EVENTS_TABLES __REGION __Data_Points __REGION

Organizing the work

To assist you to remember where the things are (and to operate the tool), you can use MasTer Organizer.
This is sort of a Graphical User Interface (GUI) developped with *pyqt6*.

It can be opened by launching at the Terminal
(which can be closed after it was launched) the script
MasterOrganiser.sh (located in [SCRIPTS_MT/MasTerOrganizer](#)).

MasterOrganiser.sh is configured by editing
the file
[SCRIPTS_MT/MasTerOrganizer/config_OS.txt](#).

That's where buttons displayed at the top
(separated by light grey line) are named
and their corresponding paths are defined.

Button names are written with a one digit heading
defining the section where it will be displayed

```
8 # MAX_BUTTON (Maximum number Button per line)

# Line 1 = top button area for direct access to data folder (RAW, SAR, AMPLI ...)

1_RAW_DATA          # $PATH_3600/SAR_DATA
1 CSL DATA          # $PATH_1650/SAR CSL
1 RESAMPLED          # $PATH_1650/SAR_SM/RESAMPLED
1 SETi               # $PATH_1650/SAR_SM/MSBAS
1 AMPLI              # $PATH_1650/SAR_SM/AMPLITUDES
1 MASSPROCESS        # $PATH_3601/SAR_MASSPROCESS
1 MSBAS              # $PATH_3602/MSBAS

# Line 2 = middle button area for direct access to scripts folder (cron, script_ok, utilities...)

2_SCRIPTS_MT         # $HOME/SAR/MasTerToolbox/SCRIPTS_MT
2_CRON                # $HOME/SAR/MasTerToolbox/SCRIPTS_MT_cron_scripts
2_PARAM_FILES         # $PATH_1650/Param_files_SuperMaster
2_DEM                 # $PATH_DataSAR/SAR_AUX_FILES/DEM
2_MASKS               # $PATH_DataSAR/SAR_AUX_FILES/MASKS
2_KML                 # $PATH_1650/kml
2_EVENTS              # $PATH_1650/EVENTS_TABLES
2_POINTS_TS           # $PATH_1650/Data_Points

# Line 3 = lowbutton area for direct access to folder from which we want to run scripts (ex: PlotTS.sh ...)

3_HOME                # $HOME/PROCESS
3_RUN_1650             # $PATH_1650/PROCESS
3_RUN_3600             # $PATH_3600/PROCESS
3_RUN_3601             # $PATH_3601/PROCESS
3_RUN_3602             # $PATH_3602/PROCESS
3_RUN_DellRack_DiskData # /Volumes/dellrack_data/PROCESS
3_RUN_Dell3_DiskData   # /Volumes/dell3raid5/PROCESS
3_RUN_HP385_DiskData   # /Volumes/HP385RAIDS5/PROCESS
```



Organizing the work

MainWindow

Normal progression in processing

Ancillary data

Some processing directories on several disks

Displays the content of the directory selected by a button above

Where to go to execute the command

Select/write the command or the parameter to add to the command line

Command line to execute when ready

The screenshot shows the 'MainWindow' of the MasterToolbox application. At the top, there's a menu bar with buttons for RAW_DATA, CSL_DATA, RESAMPLED, SETI, AMPLI, MASSPROCESS, MSBAS, SCRIPTS_OK, CRON, PARAM_FILES, DEM, MASKS, KML, EVENTS, and POINTS_TS. Below the menu is a toolbar with buttons for HOME, RUN_1650, RUN_3600, RUN_3601, RUN_3602, RUN_DellRack_DiskData, RUN_Dell3_DiskData, and RUN_HP385_DiskData. The main area contains a file tree on the left with nodes for ALOS2, CSK, ENVISAT, ERS, ICEYE, RS, S1, SACOM, TDX, and TSX. Under S1, there are numerous sub-directories like ARG_DOMU_LAGUNA_A_18, Be_Lux_A_15, CHAMBONSLAC_A_59, DRC_Funu_A_174, DRC_Nyam_Crater_Asc174, DRC_NyigoCrater_Asc174, DRC_NyigoVolcField_A_174, DRC_NyigoVolcField_D_21, DRC_Nyigo_Nyam_Crater_Desc21, DRC_VVP_Asc_A_174, DRC_VVP_A_72, DRC_VVP_D_21, Einstein_A_161, Einstein_A_88, Einstein_D_139, Einstein_D_37, Hawaii_Isld_A_124, Hawaii_Isld_D_87, Hawaii_LL_A_124, Hawaii_LL_D_87, KARTHALA_SM_A_86, LuxMines_A_161, LuxMines_A_88, LuxMines_D_139, and LuxMines_D_37. To the right of the file tree is a large text area showing the contents of the selected directory. At the bottom, there's a 'Go To Dir Where To Run' input field with '\$(HOME)', a 'GOTO' button, and a 'HOME' button. Below that is a 'Select Command/Param To Run' input field with '/Param_files_SuperMaster/S1/ARG_DOMU_LAGUNA_D_83/LaunchCISparam_S1_Arg_Domu_Laguna_D_83_Zoom1_ML4_MassProc_Snaphu_WaterCohMask_CohThresh0.35.txt', an 'ADD' button, an 'EXEC' button, and a 'CLEAR' button. A blue box highlights the command line input field.



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 - kml: where, why, how create

+ Provide samples (S1 data, DEM, orbits...) to participants



Processing steps

It depends on what you want to do. There is however some common steps:

1. Download the data (see manual)
2. Read the data: *Read_All_Img.sh*

Then if you want to compute a single interferogram for ground deformation measurement or DEM generation:

3. Compute the interferogram and geocoding: *SinglePair.sh*

Then if you want to compute a time series of ground deformation:

3. Compute the list of pairs [and search for the Super Master] (& baseline plot): *Prepa_MSBAS.sh*
4. Coregister every image on the Super Master: *SuperMasterCoreg.sh*
5. Compute all the interferometric pairs: *SuperMaster_MassProc.sh* (maybe perform some preliminary tests with *SinglePair.sh*)
6. Prepare the msbas-required files : *build_header_msbas_criteria.sh*
7. Run the MSBAS inversion: *MSBAS.sh*
8. [Search for most appropriate MSBAS inversion parameters: *test_lcurve.sh*]
9. [Plot some (double difference) time series: *PlotTS.sh* or *PlotTS_all_comp.sh*]
10. [Make your web page to display/share results]

Then if you want to compute a time series of amplitude images:

3. Only in slant range, with a gif [cropped] animation tagged with dates, for all pairs SM-SLV: *ALL2GIF.sh*
or
3. In slant range and in geographical coordinates, for all pairs in a provided list: *MultiLaunch_Ampli_Coh.sh*

See also e.g. automatised procedures in cron jobs provided as examples (they also contains several tools for checking files)

Processing steps

Information about downloads (see also **chapter 1 in manual**):

CSK:

- Often provided all mixed (ascending and descending, different modes etc...)
- Provided with fancy names
- See manual for scripts to assisting in sorting these data :
 - *ReadDateCSK.sh*
 - *Prepa_CSK.sh*
 - *Prepa_CSK_SuperSite.sh*

S1 (IW & SM):

- Need to download the data (see example of script in Toolbox) and store in
[*.../SAR_DATA/S1/S1-DATA-TARGET-SLC*](#)
- Unzip them and store them in a directory named (see manual)
[*.../SAR_DATA/S1/S1-DATA-TARGET-SLC.UNZIP*](#)
(May use *Unzip_S1.sh* to unzip all S1 images from a directory)

TSX/TDX:

- May need *Prepa_TSX.sh* to change the name and check their acquisition modes and/or footprints.
See manual



Processing steps

Information about reading the images (see also **chapter 2 in manual**):

S1 (IW & SM):

- After reading with ***Read_All_Img.sh***, for the sake of efficiency, raw images older than 6 months will be moved from [.../SAR_DATA/S1/S1-DATA-TARGET-SLC.UNZIP](#) to [.../SAR_DATA/S1/S1-DATA-TARGET-SLC.UNZIP_FORMER/yyyy](#)
- ***Read_All_Img.sh*** will NOT attempt to read again images stored in [..._FORMER/yyyy](#) unless you ask him by adding the parameter ***ForceAllYears***. Doing so also force to check updated orbits for images in [..._FORMER/yyyy](#).
- While attempting to read new data, the script will also check if orbits were updated.
Indeed images are provided with preliminary orbits, updated with final ones after 3 weeks.
If a new orbit is available:
 - It will update the image in SAR_CSL
 - It will move the following products already computed with the preliminary orbit
 - The coregistration on the Super Master ➔ in [SAR_SM/RESAMPLED/S1_CLN](#)
 - The mass processed pairs ➔ in [SAR_MASSPROCESS/S1_CLN](#)

providing that you launched ***Read_All_Img.sh*** with the place were resampled and mass processed pairs are stored as parameters

Processing steps

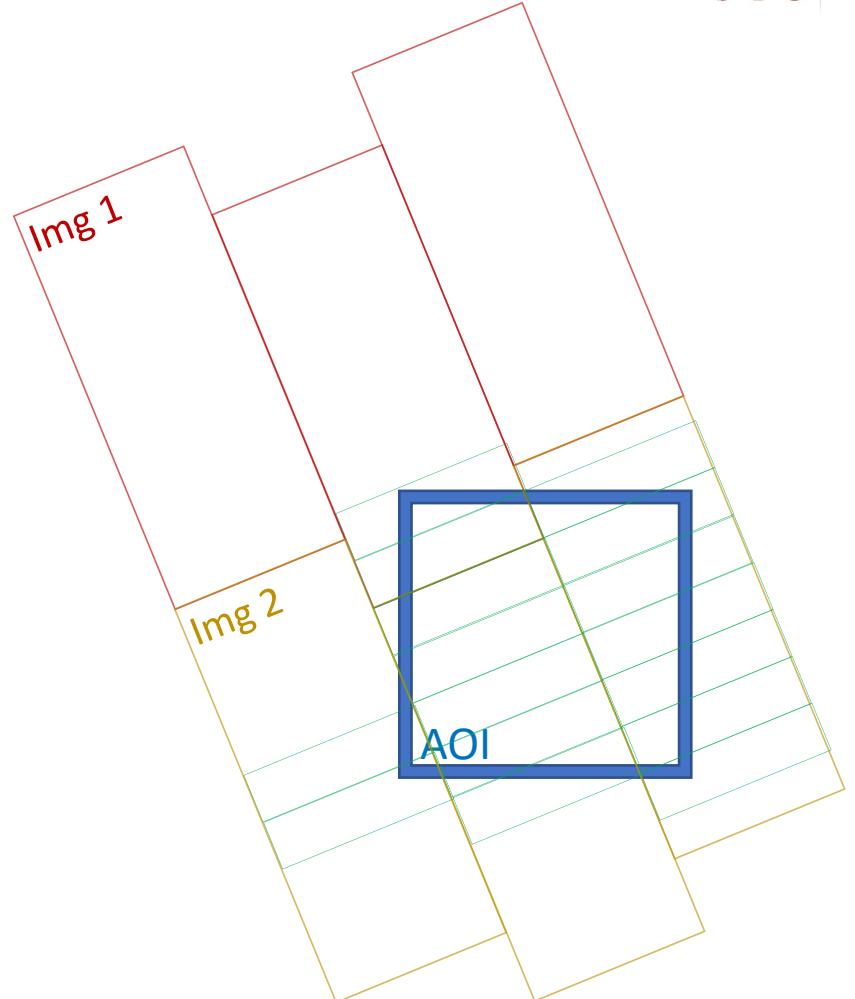
Information about reading the images (see also **chapter 2 in manual**):

S1 (IW & SM):

- Reading S1 **IW** images allows selecting all and only the bursts overlapping an area of interest.

If needed, it will stitch bursts from several frames. The area of interest is provided as a [kml file](#) when running ***Read_All_Img.sh***.

Beware: at processing, if using a kml for cropping, ensure to use the same kml or a smaller one to avoid re-stitching bursts in your pair processing directory (huge waste of time and disk space).





Processing steps

Information about reading the images (see also **chapter 2 in manual**):

S1 (IW & SM):

- Note: Do **not** name two S1 REGION with the same beginning of name followed by an underscore (e.g. do NOT use *REGION* and *REGIONX_TEST*; you can, however, use for instance *REGIONTEST*)
- Several modes of S1 images may be present in *SAR_DATA/S1/ S1-DATA-TARGET-SLC.UNZIP*. After reading them, the script sort the images by mode, e.g in
 - SAR CSL/S1/REGION*
 - SAR CSL/S1/REGION_MODE1*
 - SAR CSL/S1/REGION_MODE2* (where MODEs are eg *A_174*, *D_21* etc...).The first directory, *SAR CSL/S1/REGION*, must contain a link to each image stored in *_MODEs*
- Bad images can be put in *SAR CSL/S1/REGION_MODE1/Quarantained* to be further ignored

Processing steps

Information about reading the images (see also **chapter 2 in manual**):

S1 IW:

- Some tools exist to check the size and number of bursts in S1 image read (e.g. **_Check_S1_SizeAndCoord.sh** and **_Check_ALL_S1_SizeAndCoord_InDir.sh** ; see scripts or manual).

CSK:

- May want to use **ReadModeCSK.sh** to assist sorting CSK modes after reading

TDX & TSX:

- May want to use **SORT_TDX.sh** to assist sorting TDX (Bistatic or Pursuit mode) or TSX images if several footprints are read at the same time. See script or manual.

ENVISAT:

- If data were obtained at the time of their acquisition, it can be read immediately.
- If they were obtained from a recent bulk download at ESA, running **MoveBulkEnvisat_InSubDirs.sh** may be necessary before reading.



Structure

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 - Contest...
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- **Organizing the work:**
 - Disk/Directories architecture
 - MaSTer Organizer
- **Processing steps:**
 - download,
 - read, (baseline computation)
 - Coregistration, InSAR processing, mass processing
 - Deformation time series (+ amplitude time series), web page
- **Parameters**
- **Ancillary data:**
 - DEM : where, how create, format
 - MASKS : where, how create, format
 - kml: where, why, how create

+ Provide samples (S1 data, DEM, orbits...) to participants

Parameters

All the processing is based on a file that contains all the necessary parameters: see template

[.../SAR/MasTerToolbox/SCRIPTS_MT/____V20230828_LaunchMTparam.txt](#). (See manual, **Annexe A.1**)

After a header, it contains the values of the parameters. Each parameter value is followed by “**# STRING**” (where **STRING** is the name of the variable) then some words of explanation about that parameter.

```
# PARAMETERS TO RUN SCRIPT LAUNCHING MasTer Engine.  
# PARAMETERS MUST BE FOLLOWED BY A # AND ITS VAR NAME FOLLOWED BY COMA.  
# (DESCRIPTION, THOUGH THIS IS OPTIONAL)  
# AS READING THIS FILE IS MADE USING FIRST OCCURENCE OF SEARCH CRITERIA,  
# DO NOT ADD TEXT WTH VARIABLE NAME FOLLOWED BY COMA.  
# ALWAYS KEEP THE PATH PARAMETERS AT THE BOTTOM  
#  
# VERSION Aug 28 2023  
  
# AUTOMATIC FIGURES DISPLAY  
#####  
FIGyes      # FIG, option to compute or not the quick look using cpxfiddle  
POPno       # POP, option to pop up figs created with cpxfiddle, or POPno  
  
# DATA  
#####  
S1          # SATDIR, Satellite system (must be the same as dirname structure: RADARSAT, TSX, TDX, CSK, S1, ENVISAT)  
LUX_A_15    # TRKDIR, Processing directory and dir where data are stored E.g. SM/Asc160 (must be the same as dirname structure)  
  
# For mass processing only  
#####  
20170429    # SUPERMASTER, date of the super master as selected by Prepa_MSBAS.sh in  
             # e.g. /Volumes/hp-1650-Data_Share1/SAR_SUPER_MASTERS/MSBAS/Bukavu/seti/setParametersFile.txt  
[...]
```

ATTENTION:

- Values are case sensitive!
- Parameter value must be followed by **# STRING** followed by a **coma**.
- The description that follows the coma is optional though.
- File reading from scripts search for first occurrence of the parameter’s name followed by a coma. Hence, do not put several lines with different values of the same variable.
- Do not add text with the variable name followed by coma in the description.
- Always keep the path parameters at the bottom of the file.

Example of [LaunchMTparam.txt](#)

Parameters

```

[...]
#
# VERSION Oct 25 2022

# AUTOMATIC FIGURES DISPLAY
#####
FIGyes      # FIG, option to compute or not the quick look using cpxfiddle
POPno       # POP, option to pop up figs created with cpxfiddle, or POPno

# DATA
#####
S1          # SATDIR, Satellite system (must be the same as dirname structure: RADARSAT, TSX, TDX, CSK, S1, ENVISAT)
LUX_A_15    # TRKDIR, Processing directory and dir where data are stored E.g. SM/Asc160 (must be the same as dirname structure)

# For mass processing only
#####
20170429    # SUPERMASTER, date of the super master as selected by Prepa_MSBAS.sh in
              # e.g. /Volumes/hp-1650-Data_Share1/SAR_SUPER_MASTERS/MSBAS/Bukavu/seti/setParametersFile.txt

# DEM
#####
GreaterRegion # DEMNAME, name of DEM (in mathematical order). Need txt file in same dir
SIMAMPno     # SIMAMP, compute Simulated Amplitude during Ext Dem Generation - usually not needed (maybe ERS). SIMAMPno or SIMAMPyes
KEEP          # RECOMPDEM, recompute DEM or mask in slant range even if already there (FORCE), or check the one that would exist (KEEP).
              # DO NOT RUN TWO "FORCE" OR A "FORCE" AND A "KEEP" PROCESS AT THE SAME TIME USING SAME MASTER
              # It may cause prblm if externalSlantRangeDEM and maybe slantRangeMask are being modified by the first FORCE run.

# CROP
#####
$PATH_1650/SAR_CSR_S1/LUX/Lux.kml # CROP, CROPyes or CROPno, or for S1, path to kml that will be used to define area of interest.
10000        # FIRSTP, Crop limits: first point (row) to use
8000         # FIRSTL, Crop limits: first line to use
24000        # LASTP, Crop limits: last point (row) to use
12000        # LASTL, Crop limits: last line to use
1           # ZOOM, factor during crop
LUX          # REGION, Text description of area for dir naming

```

Compute quicklook files (SUN rasters) and pop them up
 Name of the satellite.
Beware of name (must be as coded in scripts) !
 Name of the track.
Beware of name (must be as dir names) !
 Date of Super Master (for mass processing only; see [manual § 4.2](#))
 Name of DEM (Path is given at the end of this file)
 KEEP will avoid recomputing DEM in slant range geometry if it exists already. FORCE will do it, even if exist.
 CROPyes or CROPno the image.
 If yes, **for all but S1 IW**, set Crop region in LINES/PIXELS numbers, or with LAT/LONG coordinates.
For S1 IW (not SM !), set Crop region by providing with a kml file instead of CROPyes. Keep it smaller than the one used for reading!
 Zoom factor: oversample the data
 Name to describe the cropped region (also used in dir naming)

Parameters

[...]

```

# AMPLITUDE #####
4          # MLAMPLI, Multilooking factor for amplitude images reduction (used for coregistration - 4-6 is appropriate).
          # If rectangular pixel, it will be multiplied by corresponding ratio.

SQUARE SIGMANO # PIXSHAPE, pix shape for product : SQUARE, ORIGINALFORM, SQUAREUNITY or ORIGINALFORMUNITY
          # CALIBSIGMA, if SIGMAYES it will output sigma nought calibrated amplitude file (for S1 only)

# COARSE COREG #####
64         # CCOHWIN, Coarse coreg window size (64 by default but may want less for very small crop).
          # Can be set to 0 to skip coarse coreg when using god orbit sat such as TSX, TDX and Envisat
          # COH, Coarse Coherence threshold coregistration
0.4
24         # CCDISTANCHOR, Coarse registration range & az distance between anchor points [pix] (eg 24 for large img, 16 for medium and 2-8 for very small crops)

# FINE COREG #####
7          # FCOHWIN, Fine coreg window size (eg 3 for ERS/ENV or 7 for CSK, TSX and RS; must have win of eg 50 pixels; computed on full resol img)
0.5
24         # FCOH, Fine Coherence threshold coregistration
          # FCDISTANCHOR, Fine registration range & az distance between anchor points [pix] (eg 24 for large img, 16 for medium and 2-8 for very small crops)

# INSAR #####
DEFO        # PROCESSMODE, DEFO to produce DInSAR or TOPO to produce DEM (used only in SinglePair.sh)
VV
50          # INITPOL, For multi pol images; force polarisation at initInSAR for InSAR processing. If it does not exists it will find the first compatible MAS-SLV pol.
50          # LLRGCO, Lower Left Range coord offset for final interferometric products generation. Used in SinglePairNoUnwrap only for Shadow measurements
          # LLAZCO, Lower Left Azimuth coord offset for final interferometric products generation. Used in SinglePairNoUnwrap only for Shadow measurements

4          # INTERFML, multilook factor for final interferometric products generation (to multiply to the LARGEST side of the pixel);
          # when used with zoom, it is ML to apply to zommed pixels
1          # FILTFACCTOR, filtering factor for interfero (2 might be too strong when used with POWSPECSMOOTHFACT filtering)
1          # POWSPECSMOOTHFACT, Power spectrum filtering factor (for adaptative filtering) (0 = no filtering; 1 or less is possible though stronger)
2          # COHESTIMFACT, in pixels. Must be similar to INTERFML as far as it is not a ML higher than 5 or 7 non ML for instance. For ML1, if -le 1, will be forced to 2.
          # If INTERFML is larger than 5 or 7, limit anyway COHESTIMFACT to 5 or 7 (Remember: computations load goes as square of win size)

# MASK #####
APPLYMASKyes # APPLYMASK, Apply mask (bytes, 1/0, LatLong, Envi Harris, larger than img) before unwrapping (APPLYMASKyes or APPLYMASKno);
              # If mask requested but no Snaphu, one can also mask manually files with ffa (eg ffa residualInterferogram.HH-HH.f x slantRangeMask)
$PATH_3600/MASKS/LakeKivu_LatLong.envi      # PATHTOMASK, geocoded mask file name and path

[...]

```

Multilooking factor for **COREGISTRATION** only

Shape of final pixel: square for defo. Maybe original for amplitude time series.

S1 IW sigma nough amplitude calibration

Characteristics of coarse and fine coregistration:

- Size of the sub windows
- Threshold (if coh <, not taken into account)
- Distance between subwindows

DEFO or TOPO processing

Preferred polarisation

Corner offset when stacking amplitude image in slant range (see **manual § 3.2**)

Multilooking factor of **interferometric** products

Filters

Coherence estimation factor

Use a mask or not and give its full path

Parameters

```

[...]
# UNWRAPPING
#####
SKIPno      # SKIPUW, SKIPno unwraps and geocode all products, SKIPyes skips unwrapping and geocode only
# available products, Mask geocode only ampli and coh (for mask generation)
SNAPHU       # UW_METHOD, Select phase unwrapping method (SNAPHU, CIS, DETPHUN1ONLY,
# DETPHUN2ONLY, DETPHUN1SNAPHU, DETPHUN2SNAPHU, DETPHUN1CIS, DETPHUN2CIS)

# if snaphu unwrapping:
1.2          # DEFOTHRESHFACTOR, Snaphu : Factor applied to rho0 to get threshold for whether or not phase
# discontinuity is possible. rho0 is the expected, biased correlation measure if true correlation is 0. Increase if not good.
0.9          # DEFOCONST, Snaphu : Ratio of phase discontinuity probability density to peak probability density expected for
# discontinuity-possible pixel differences. Value of 1 means zero cost for discontinuity, 0 means infinite cost. Decrease if prblm.
0.2          # DEFOMAX_CYCLE, Snaphu : Max nr of expected phase cycle discontinuity.
# For topo where no phase jump is expected, it can be set to 0
DEFO          # SNAPHUMODE, Snaphu : TOPO, DEFO, SMOOTH, or NOSTATCOSTS.
ZoneMapYes   # ZONEMAP, if ZoneMapYes, it will create a map with the unwrapped zones named snaphuZoneMap.
# Each continuously unwrapped zone is numbered (from 1 to...)
0.00001      # ZONEMAPSIZE, Minimum size of unwrapped zone to map (in fraction of total nr of pixels)
300          # ZONEMAPCOST, Cost threshold for connected components (zones). Higher threshold will give smaller connected zones
50           # ZONEMAPTOTAL, Maximum number of mapped zones

MultiSnaphuNo # MULTIUWP, MultiSnaphuYes performs recursive snaphu unwrapping (need 4 params below). MultiUnwrapNo
# (or any other string) will perform single snaphu unwrapping
ResidInterfFilt # WHICHINTERF, which interferogram to unwrap, ResidInterf (residual interfero) or ResidInterfFilt (residual interfero filtered)
0.9          # COEFREQ, Coefficient of increase of cut-off frequency
12.5         # CUTINI, Initial cut-off frequency (e.g. 12.5 for a 400x400 image, 10 for a 2200x1500 img)
10           # NITMAX, Max total nr of iterations
0.0627       # COHMUWPTHRESH, coh threshold (between 0 and 1) below which it replaces the phase by white noise
# (corresponding mask will be produced). If set to 0, do not mask with white noise

# if snaphu or CIS unwrapping:
0.25         # COHCLNTHRESH, Coherence cleaning threshold. For snaphu, used if mask is present to create a new mask, i.e.
# with 0<CohClnThreshold<1, all pixels defined by mask + pixels above CohClnThreshold will be unwrapped.
# If set to 1, only pixels defined by mask will be snaphu-unwrapped.

# if CIS unwrapping:
0.1          # FALSEESCOHTHR, False Residue Coherence Threshold: higher is much slower. Use max 0.15 e.g. in crater
3            # CONNEXION_MODE, number of times that connexion search radius is augmented when stable connections are found ; 0 search along all coh zone
3            # BIASCOHESTIM, Biased coherence estimator range & Az window size (do not apply pix ratio)
3            # BIASCOHSPIR, Biased coherence square spiral size (if residual fringes are not unwrapped decrease it; must be odd)

# if DETPHUN unwrapping:
3            # DETITERR, Number of iteration for detPhUn (Integer: 1, 2 or 3 is generally OK)
0.3          # DETCOHTHRESH, Coherence threshold
[...]
  
```

Skip unwrapping or not, which method

Parameters for each unwrapping method...

Map of successfully unwrapped region. Each disconnected region is a new zone.

See manual § 3.4

Parameters

[...]

```
BOTH          # INTERPOL, interpolate the unwrapped interfero BEFORE or AFTER geocoding or BOTH.
DETREND      # REMOVEPLANE, if DETREND it will remove a best plane after unwrapping. Anything else will ignore the detrending.
```

May interpolate **VERY SMALL** gaps in deformation maps before and/or after geocoding or none

```
# GEOCODING
#####
UTM
Forced
```

```
# PROJ, Chosen projection (UTM or GEOC – GEOC OPTION IS NOT READY YET)
# GEOCMETHOD, Resampling Size of Geocoded product: Forced (at FORCEGEOPIXSIZE - mandatory for further MSBAS),
#           Auto (closest multiple of 10), Closest (closest to ML az sampling), ClosestMassProc (Closest even for a Mass Process),
```

Only UTM products (except maybe some amplitude time series)

```
LetCIS
TRI
LORENTZ
1.0
1.0
1.0
1
# RADIUSEMTHD, LetCIS (CIS will compute best radius) or forced to a given radius
# RESAMPMETHOD, TRI = Triangulation; AV = weighted average; NN = nearest neighbour
# WEIGHTMETHOD, Weighting method : ID = inverse distance; LORENTZ = lorentzian
# IDSMOOTH, ID smoothing factor
# IDWEIGHT, ID weighting exponent
# FWHM, Lorentzian Full Width at Half Maximum
# ZONEINDEX, Zone index
```

Force geocoded product to given grid, with given resolution.
MANDATORY when performing MSBAS. Closest will instead provide with geocoded pixel size as close as possible as pixel size in radar geometry (on flat surface)

```
100 # FORCEGEOPIXSIZE, Pix size wanted eg as you want for your final MSBAS database
U32   # UTMZONE, letter of row and nr of col of the zone where coordinates below are computed (e.g. U32)
225000 # XMIN, minimum X UTM coord of final geocoded product
426000 # XMAX, maximum X UTM coord of final geocoded product
5417000 # YMIN, minimum Y UTM coord of final geocoded product
5593000 # YMAX, maximum Y coord of final geocoded product
/$PATH_1650/kml/ # GEOCKML, a kml file to define final geocoded product. If not found, it will use the coordinates above
```

Method to re-grid the geocoded products

```
#####
# PATHS #
#####
/$PATH_3601/PROCESS/MT      # PROROOTPATH, path to dir where data will be processed in sub dir named by the sat name (SATDIR).
/$PATH_1650/SAR CSL/        # DATAPATH, path to dir where data are stored
/$PATH_DataSAR/SAR_AUX_FILES/DEM/SRTM30/ALL    # DEMDIR, path to dir where DEM is stored
/$PATH_SCRIPTS/SCRIPTS_MT/FUNCTIONS_FOR_MT.sh  # FCTFILE, path to file where all functions are stored
```

Path to several directories where to find/store data and results

```
# for coregistration mass processing (required if coresitation on SuperMaster)
/$PATH_1650/SAR_SM/RESAMPLED # RESAMPDATPATH, path to dir where resampled data will be stored
```

```
# for insar mass processing
/$PATH_3601/SAR_MASSPROCESS/ # MASSPROCESSPATH, path to dir where all processed pairs will be stored in sub dir
# named by the sat/trk name (SATDIR/TRKDIR)
```



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- Ancillary data:
 - DEM : where, how create, format
 - MASKS : where, how create, format
 - kml: where, why, how create

+ Provide samples (S1 data, DEM, orbits...) to participants



Ancillary data

The Digital Elevation Model (DEM):

Mandatory for DInSAR, (helpful for TOPO).

Must have the following specificities:

- Referred to ellipsoidal heights, not to the geoid.
- In the mathematical order (i.e. origin = lower left corner ; not the GIS order, which origin = upper left corner)
- MaSTer Engine format = a binary matrix + a header file named with a .txt extension.
- Also accept ENVI format (binary matrix + a header file named with a .hdr extension).
Attention, if ENVI and ME format exist in directory, the tool will consider only the ME format.
- Must be stored in a directory indicated in the [LaunchMTparam.txt](#) file (**do not use a state variable**)



Ancillary data

The Digital Elevation Model (DEM):

How to create it (see manual p. 25) ?

1. Using ***aggregateSRTMTile*** Master Engine function and **srtm tiles**:

- Log to <http://earthexplorer.usgs.gov> (Login and pwd required. Account can easily be created).
- Download the srtm1 tiles in **BIL format**.
- Move the files in a dedicated dir (e.g. **\$PATH_DataSAR/SAR_AUX_FILES/DEM/DEM_REGION**).
- Uncompress the files and delete the zip files. You stay with several subdirs where .bil, .blw, .hdr and .prj files are stored for each tile.
- Ensure you have in your **.bashrc** a state variable named **EARTH_GRAVITATIONAL_MODELS_DIR=\$PATH_DataSAR/SAR_AUX_FILES** and that it contains a directory named **/EGM96** that contains the Geoid file named **WW15MGH.DAC** (downloaded from web).
- Launch the command :
aggregateSRTMTiles \$PATH_DataSAR/SAR_AUX_FILES/DEM/DEM_REGION

2. From another source, using the script ***DEM_Envi_hdr2MasTer_txt.sh***:

- Example with a Copernicus DEM : download the tif tiles
- Merge them with QGIS for instance (Processing toolbox -> GDAL/OGR -> Miscellaneous -> Merge as Float32, BIL or tif)
- Run the following command: ***DEM_Envi_hdr2MasTer_txt.sh YOUR_PATH_TO/Your_COPERNICUS_DEM.tif***
- When the script will ask if “*your DEM referred to the Ellipsoid (E), Geoid (G) or you do not know (Q)*”, answer **G** (for Geoid). It will then refer your Copernicus DEM in MasTer format to the Ellipsoid as expected by MasTer. Indeed, following the Copernicus documentation, the horizontal reference datum is WGS84-G1150; EPSG 4326 and the vertical reference datum is the Earth Gravitational Model 2008 (EGM2008; EPSG 3855), that is EGM2008 geoid undulation values with respect to WGS84.

Ancillary data

The MASK:

MasTer Engine can mask interferograms at the unwrapping step (see [manual § 0.12](#)).

For that, it expects a mask with the following characteristics:

- must be envi Harris (not ESRI) (!)
- zone must be GREATER than image,
- in Lat Long (not UTM !)
- in Bytes, filled with 1 or 0 (no NaN !!)

You can find several scripts to transform files to such a kind of characteristics (see annexes).

Trick:

ESRI: it uses *nrows* and *ncols* for image size. → BAD FORMAT

HARRIS: it uses *lines* and *samples* for image size → GOOD



Ancillary data

The MASK:

Example how create a mask:

Rough procedure to create a mask based on water bodies shape file.

1. Download a shape file
2. Process a **SinglePair.sh** with a **Forced** geocoding (no need to unwrap) on an area larger than the images you will need to mask
3. In **QGIS** import the shape file and a copy (because original file will be changed) of the coherence computed here above
4. RASTERIZE from GDAL toolbox:
 - Input layer = shape
 - Input raster = coherence
 - Fixed value to burn = 2
5. Raster Calculator:
 - If (coherence < 2 , 0 ,1)
 - Save as “mask”
 - Output format = ENVI.hdr (not ESRI !)
 - As Lat Long
 - (if needed, use the gdal command
 - `gdalwarp -of ENVI -t_srs EPSG:4326 UTMfileName LLfileName`
6. Replace NaN with zeros in mask (e.g. using **Nan2zero.py**)
7. Transform floats to bytes (e.g. using **float2byte.py**)
8. Copy the **mask.hdr** as **mask.zeroBytes.hdr**
9. Edit **mask.zeroBytes.hdr** and change “data type = 4” with “data type = 1”

Ancillary data

The kml:

Kml files are needed to

- read some files,
- crop some files,
- define area of interest where to compute e.g. a mean value etc...

Kml files can be creates e.g. with Google Earth:

1. Define a polygon
2. Give it a name and save it
3. Right click on that polygon
4. Click on “Save place as” , select kml (not kmz) and save it in the directroy of your choice

Reminder: With S1 IW, beware to keep same or smaller kml for processing than for reading. See manual § 2.1



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-DONE!-