AMSTer : SAR & InSAR Automated Mass processing Software for Multidimensional Time series

Nicolas d'Oreye[1,2], Dominique Derauw[3,4], Sergey Samsonov[5],
Delphine Smittarello[1], Maxime Jaspard[1], Gilles Celli[1]

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1 *European Centre for Geodynamics and Seismology (ECGS), 19 rue Josy Welter, L-7256 Walferdange, Luxembourg*
2 *National Museum of Natural History (NMNH), 19 rue Josy Welter, L-7256 Walferdange, Luxembourg*
3 *Centre Spatial de Liège (CSL), Avenue du Pré Aily, B-4031 Angleur, Belgium*
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5 *Canada Centre for Mapping and Earth Observation, Natural Resources Canada (NRCAN), 560 Rochester Street, Ottawa, ON K1A 0E4, Canada*

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Toolbox Structure

Nicolas d'Oreye

MasTer Toolbox

Sat. image Download

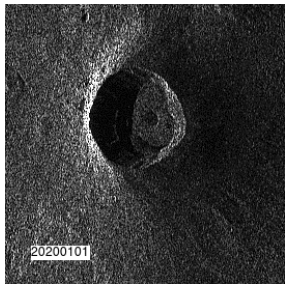
Interferometric processing (AMSTer Engine)

Ampli.

Coh.

Interf.

Defo.



Ampli.

Defo.

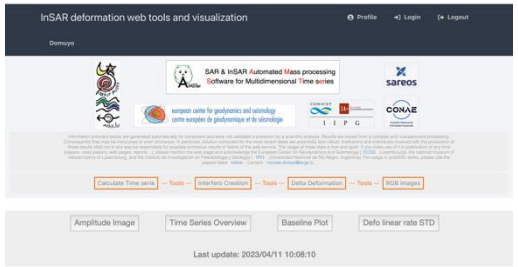
Time Series processing (MSBAS)

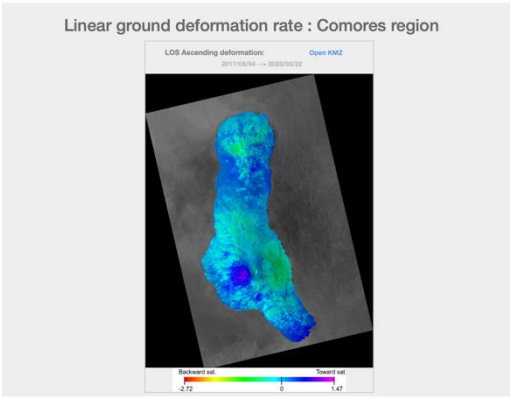
Cumul. defo.

Mean Veloc.

Time series

Web Page(s)





G. Celli

D. Derauw

S. Samsonov

M. Jaspard

N. d'Oreye & D. Smittarello

Structure

Plan:

- **The user manual:**
  - Conventions
  - Architecture
  - Contest…
- **Scripts architecture** (header, hard coded lines..)
- **Organizing the work:**
  - Disk/Directories architecture
  - AMSTer 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

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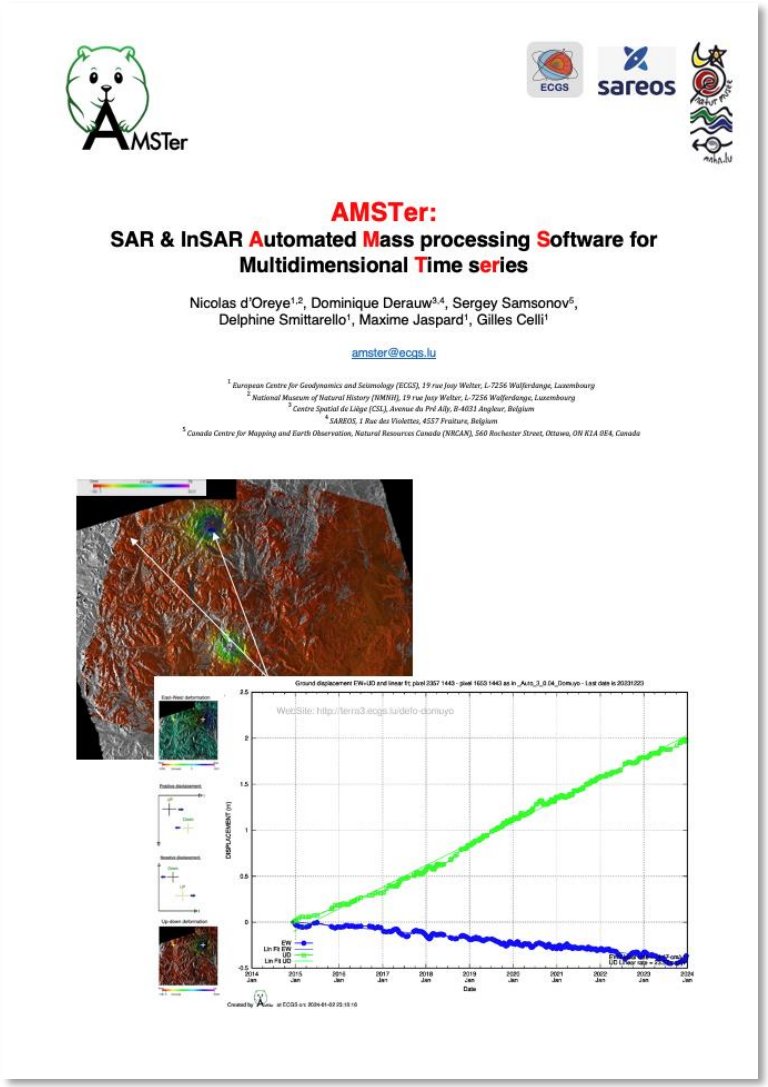
- **Parameters**
- **Ancillary data:**
  - DEM : where, how create, format
  - MASKS : where, how create, format
  - kml: where, why, how create

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

The user manual(s)

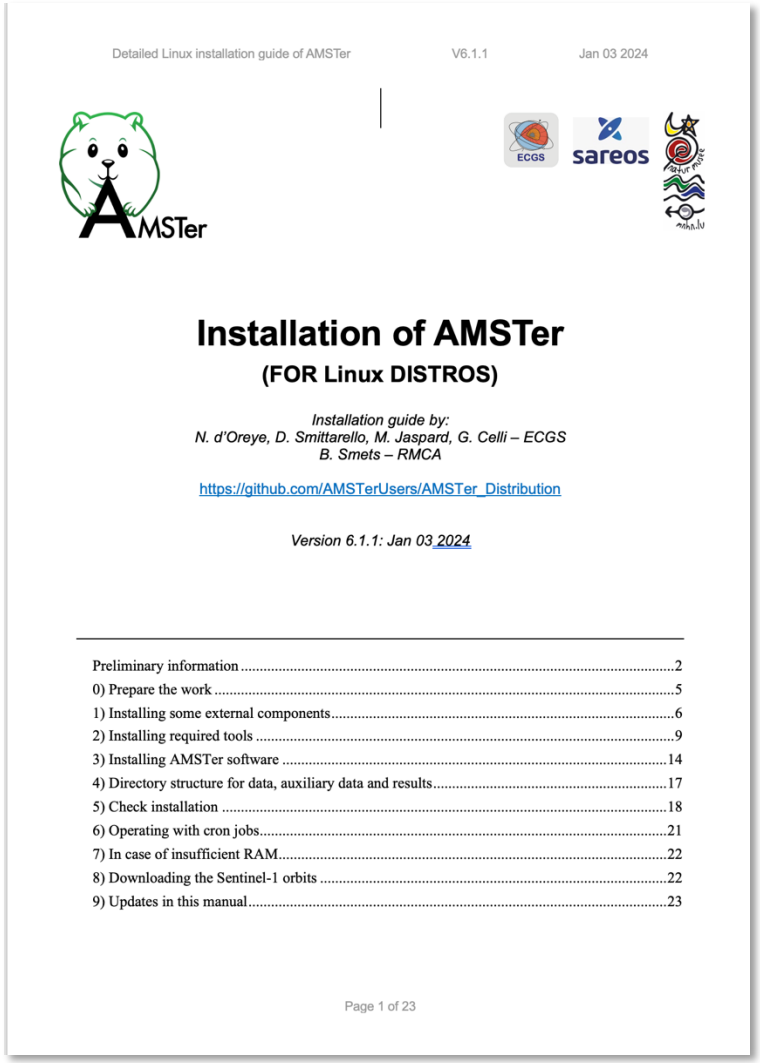


AMSTer_Manual_6.2.docx [or .pdf]

- 250 pages
- Clickable table of contents……(from page3)
- List of figures……..(from page 238)
- Index of scripts, variables, files names…….(from page 241)
- Some references……(from page 250)

Everything should be in there…
➔ Go through the manual to know what exists and where.

The user manual(s)



Detailed Linux installation guide of AMSTer V6.1.1 Jan 03 2024

Installation of AMSTer

(FOR Linux DISTROS)

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

https://github.com/AMSTerUsers/AMSTer_Distribution

Version 6.1.1: Jan 03 2024

Page 1 of 23

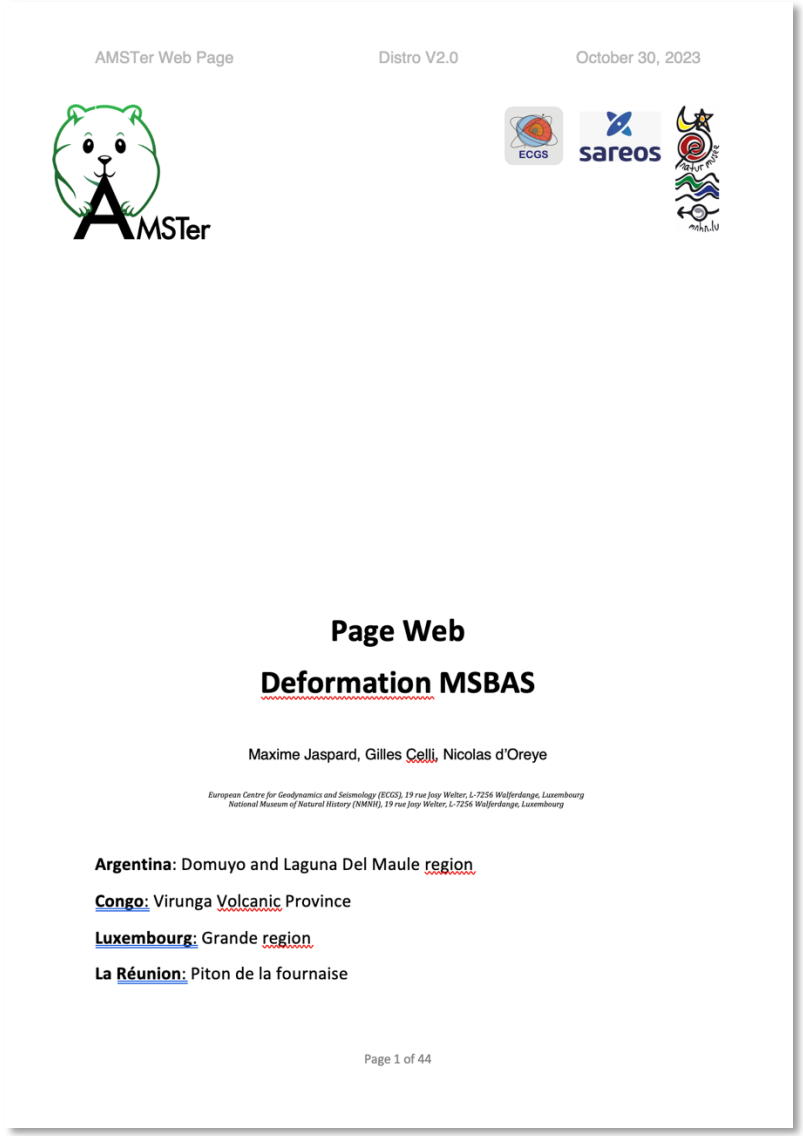
MasTer_Manual_6.2.docx [or .pdf]

- 250 pages
- Clickable table of contents……(from page3)
- List of figures……..(from page 238)
- Index of scripts, variables, files names…….(from page 241)
- Some references……(from page 250)

Install_MasTer_Mac_V6.1.docx [or .pdf]

Install_MasTer_Linux_V6.1.docx [or .pdf]

The user manual(s)



AMSTer Web Page Distro V2.0 October 30, 2023

Page Web

Deformation MSBAS

Maxime Jaspard, Gilles Celli, Nicolas d'Oreye

European Centre for Geodynamics and Seismology (ECGS), 19 rue Joseph Welter, L-7256 Walferdange, Luxembourg
National Museum of Natural History (NMNH), 19 rue Joseph Welter, L-7256 Walferdange, Luxembourg

Argentina: Domuyo and Laguna Del Maule region

Congo: Virunga Volcanic Province

Luxembourg: Grande region

La Réunion: Piton de la fournaise

Page 1 of 44

MasTer_Manual_5.0.docx [or .pdf]

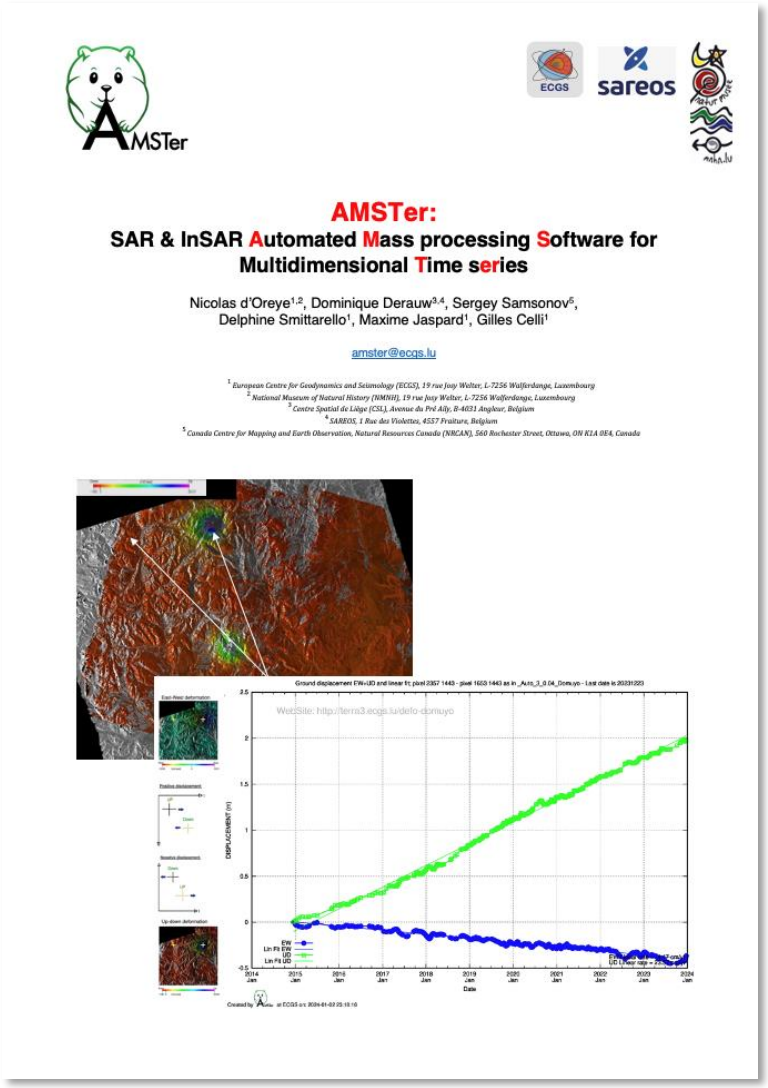
- 216 pages
- Clickable table of contents……(from page3)
- List of figures……..(from page 207)
- Index of scripts, variables, files names…….(from page 209)
- Some references……(from page 216)

Install_MasTer_Mac_V5.0.docx [or .pdf]

Install_MasTer_Linux_V5.0.docx [or .pdf]

Web_tool_V2.0.docx [or .pdf]

The user manual



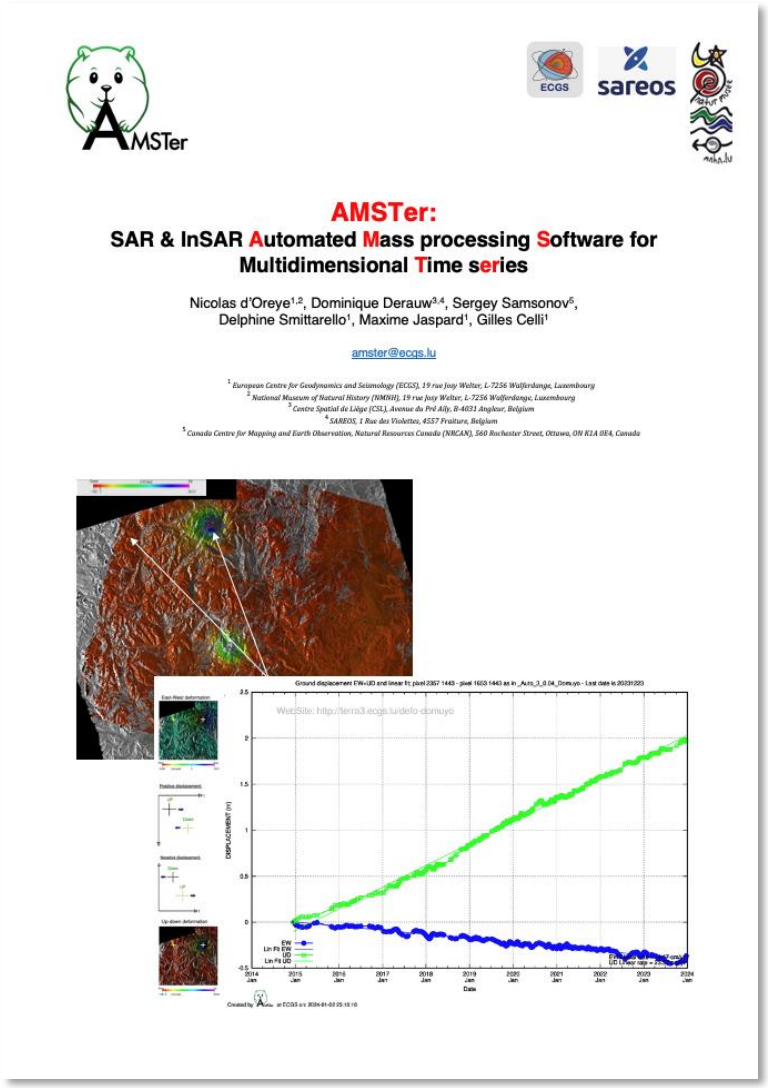
MasTer_Manual_6.2.docx [or .pdf]

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*
- AMSTerEngine 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

ndo@ecgs.lu

The user manual



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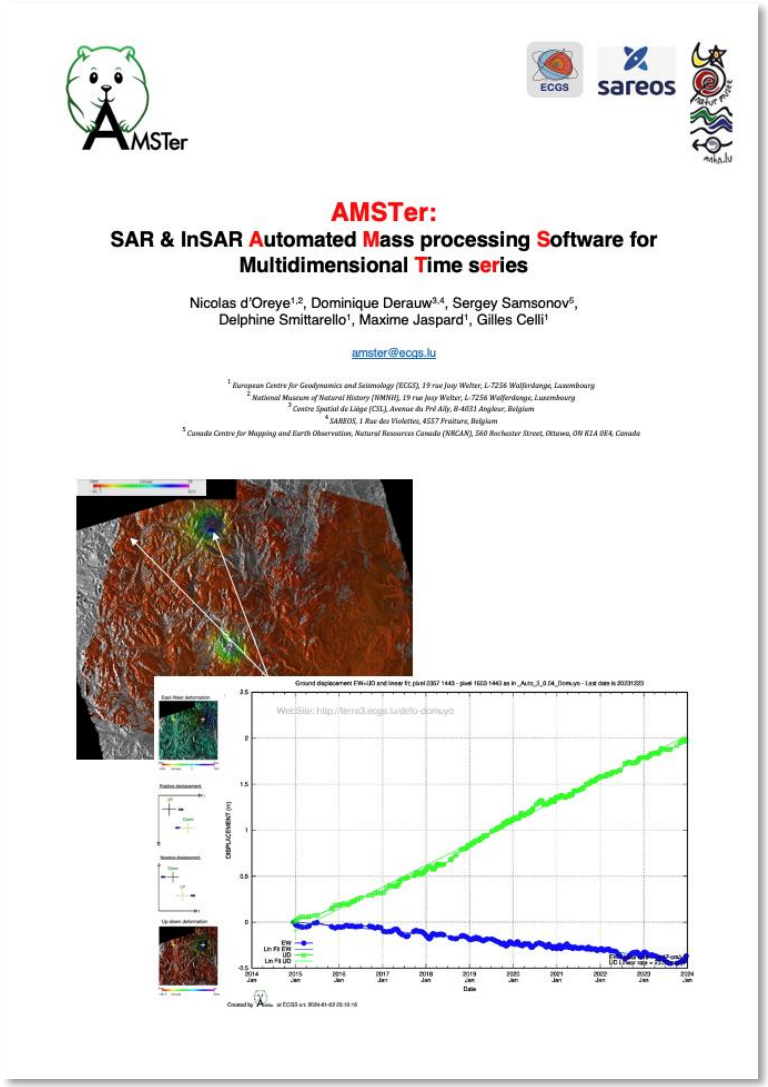
Architecture:

Table of contents

The user manual



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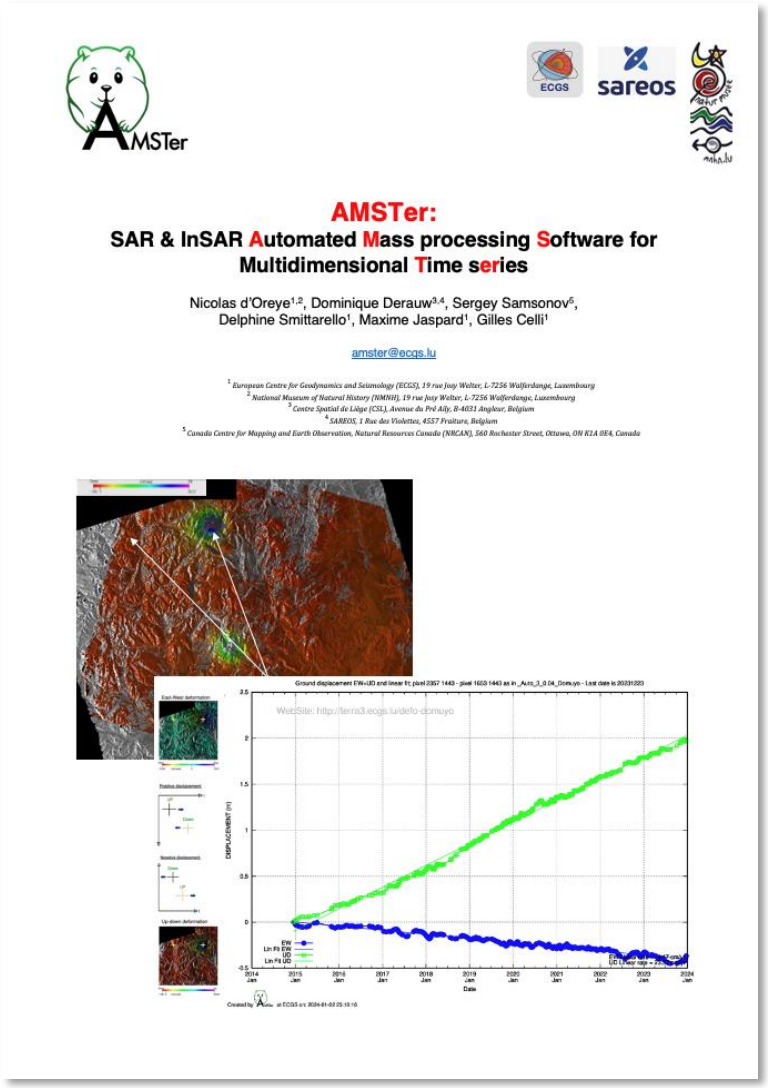
Current status:

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

The user manual



AMSTer

ECGS sareos

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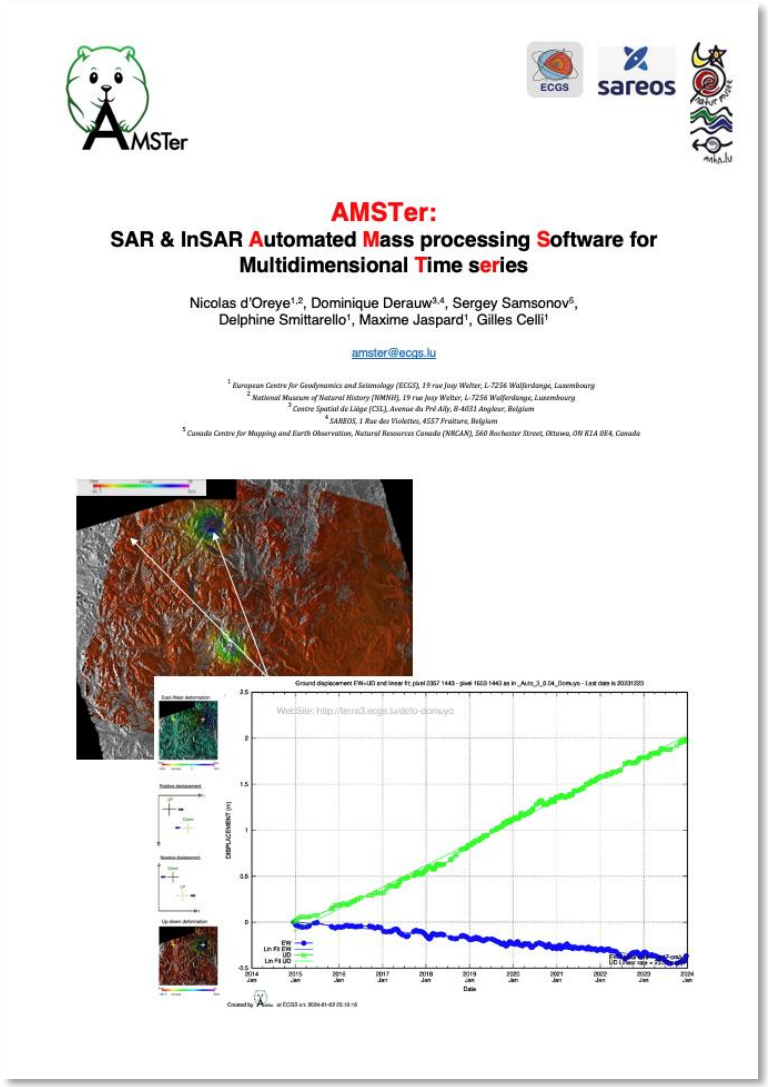
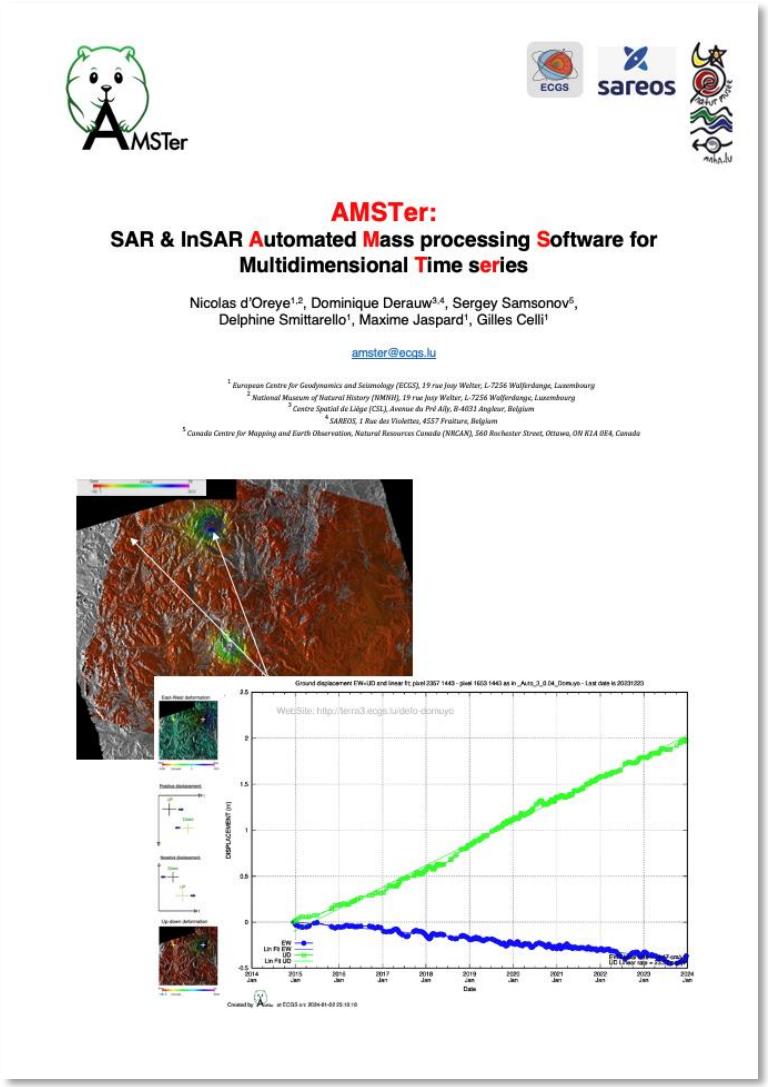


MasTer_Manual_6.2.docx [or .pdf]

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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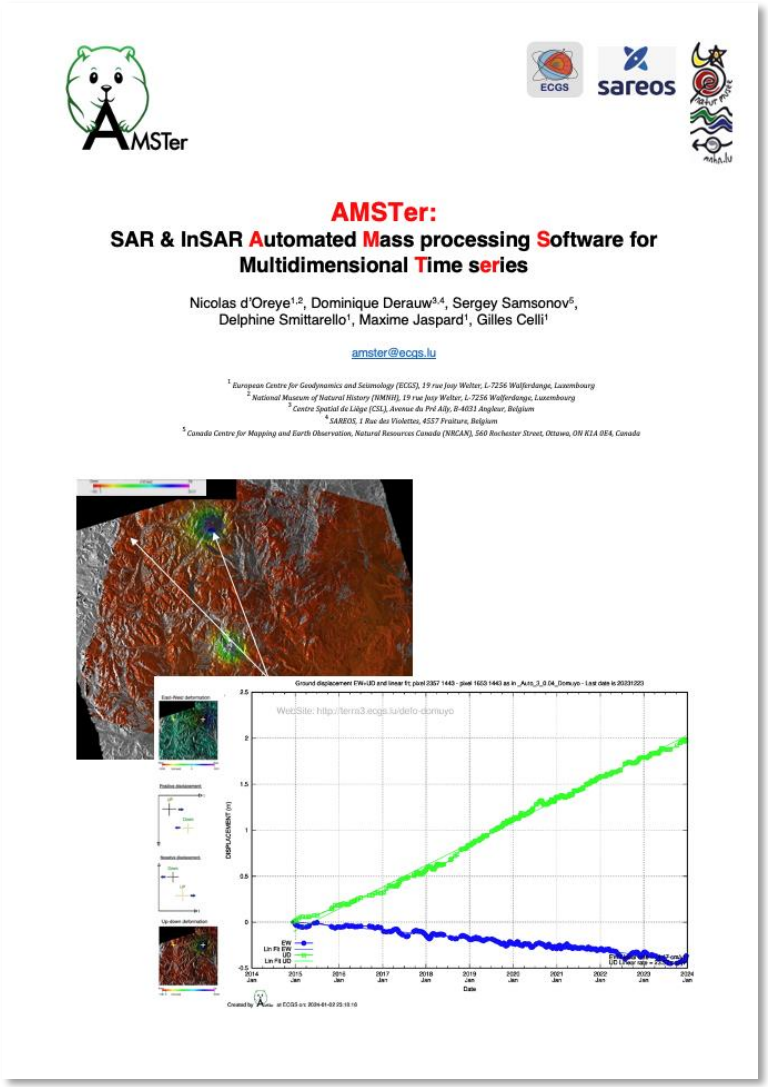
Architecture:

Table of contents

We will see that in a few minutes

The user manual

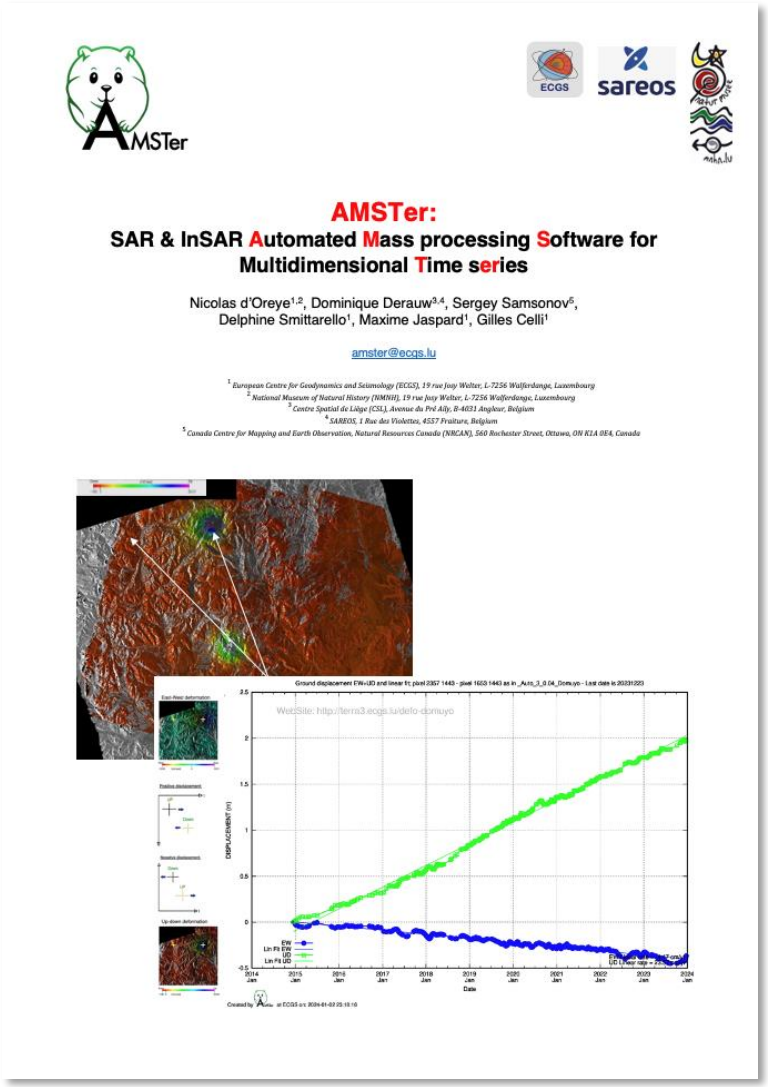


MasTer_Manual_6.2.docx [or .pdf]

Architecture:

Also TSX, TDX, ENVISAT, ERS, RS, PAZ, KOMPSAT, ALOS, SAOCOM, ICEYE…

The user manual

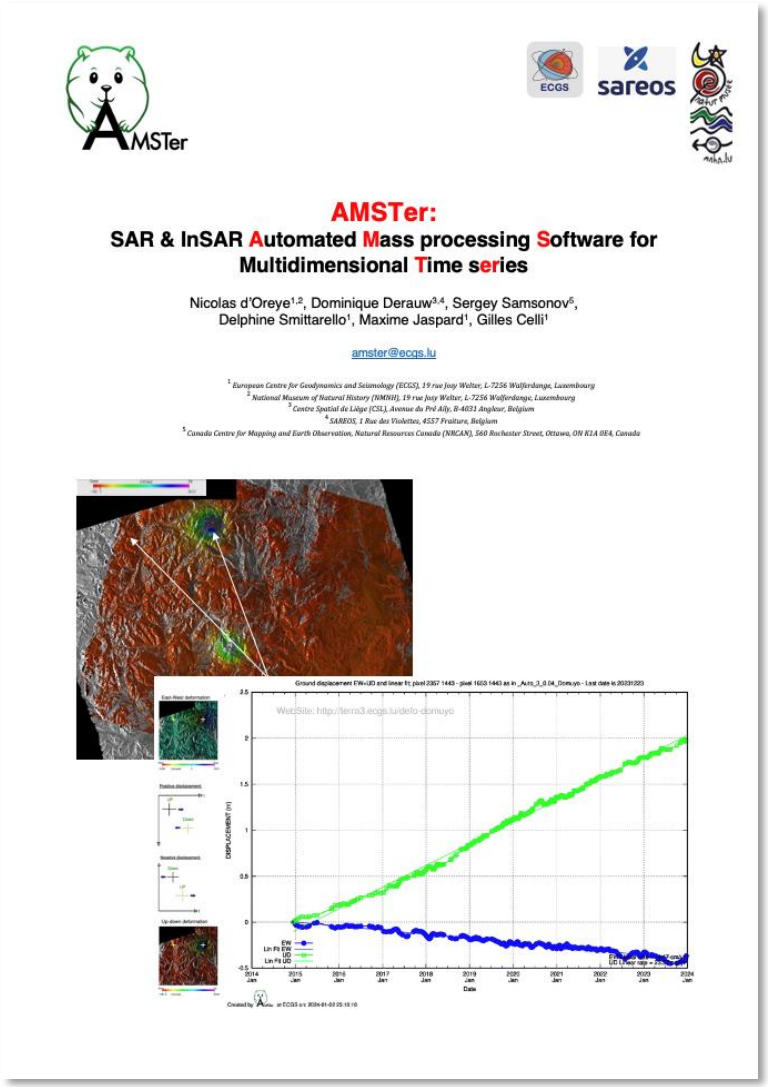


MasTer_Manual_6.2.docx [or .pdf]

Architecture:

See ppt/pdf n° 3

The user manual

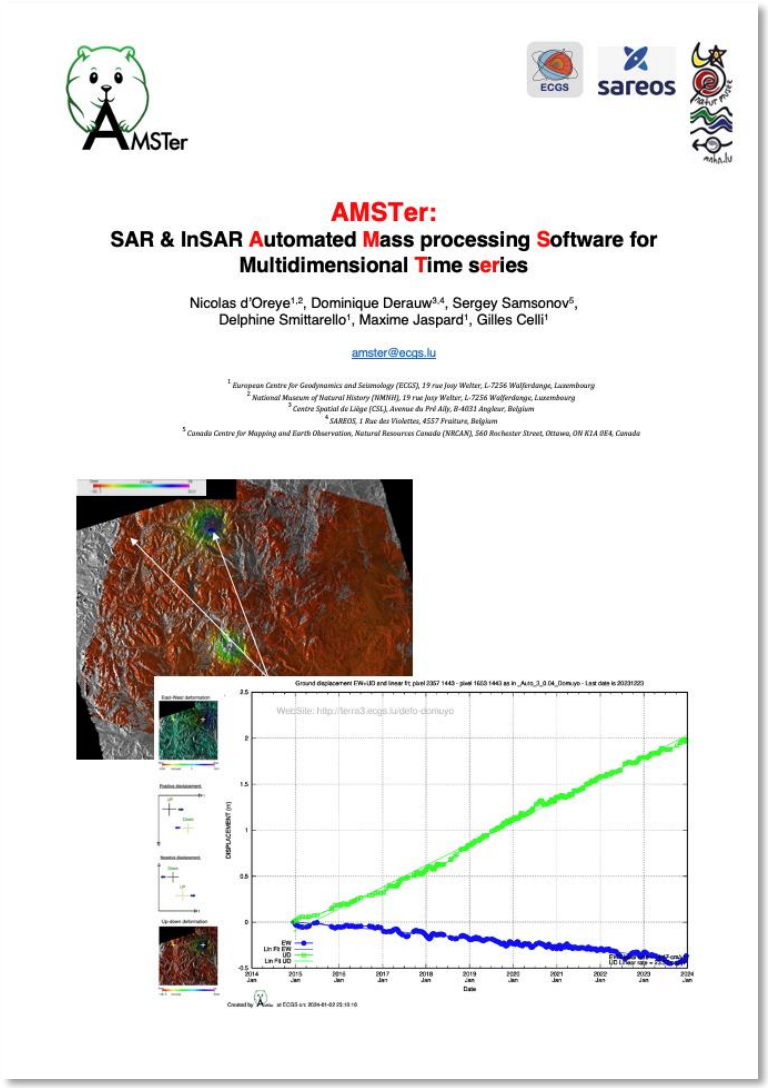


MasTer_Manual_6.2.docx [or .pdf]

Architecture:

See ppt/pdf n° 4

The user manual

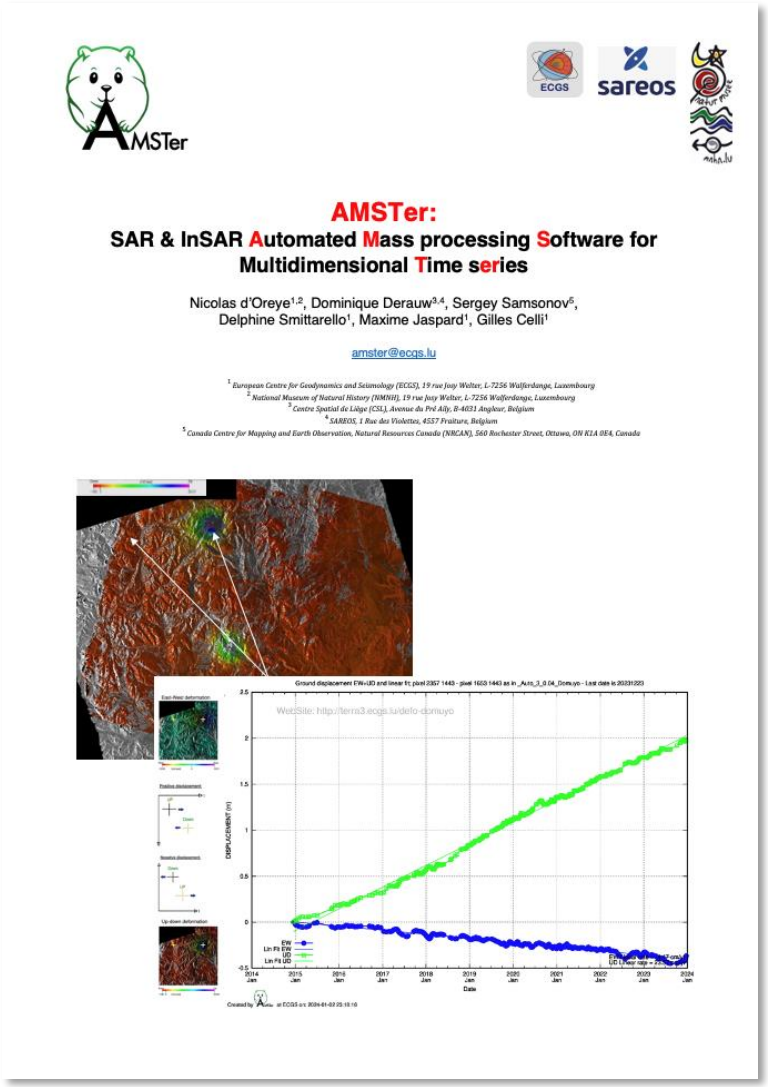


MasTer_Manual_6.2.docx [or .pdf]

Architecture:

See ppt/pdf n° 5

The user manual



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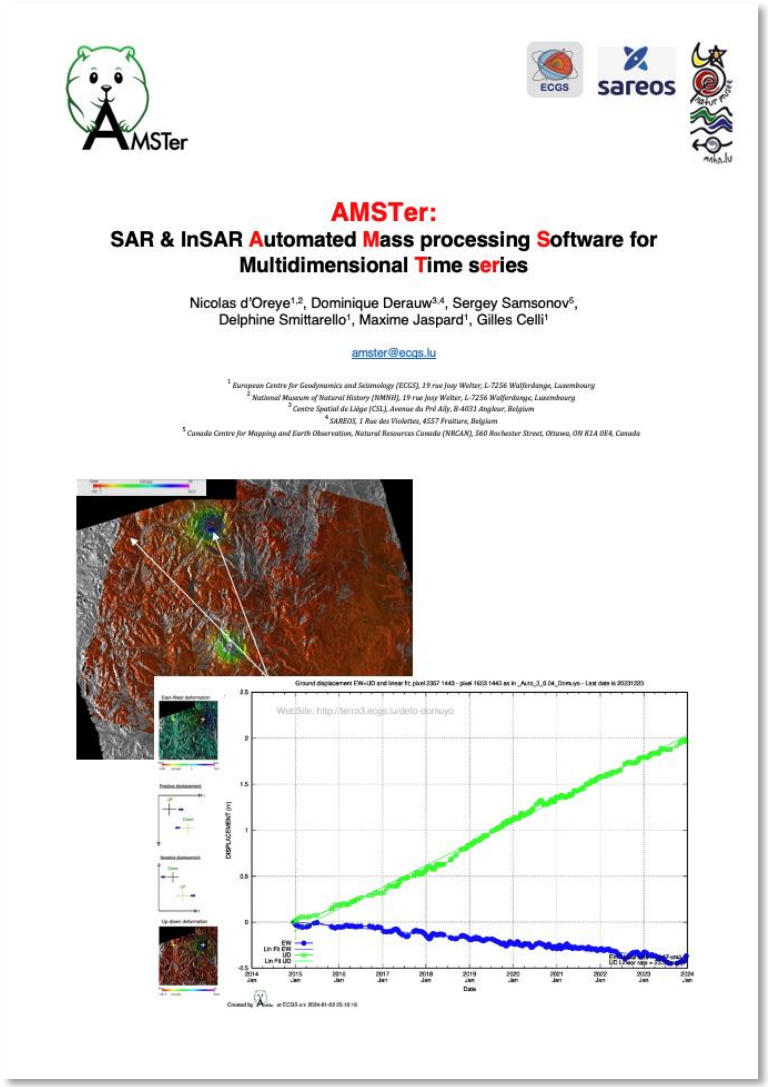
Architecture:

See ppt/pdf n° 7

See ppt/pdf n° 12

The user manual



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MasTer_Manual_6.2.docx [or .pdf]

Architecture:

There is a script for nearly everything…

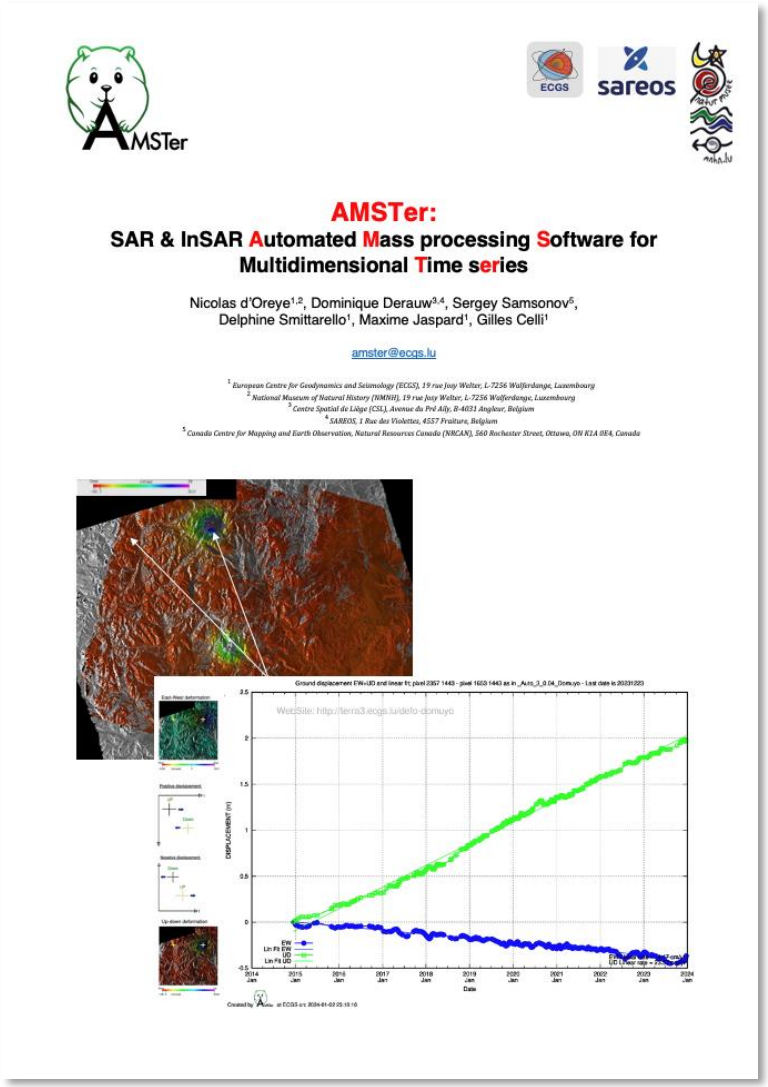
See ppt/pdf n° 10

Etc, etc, etc…

See ppt/pdf n° 10

Etc, etc, etc…

The user manual



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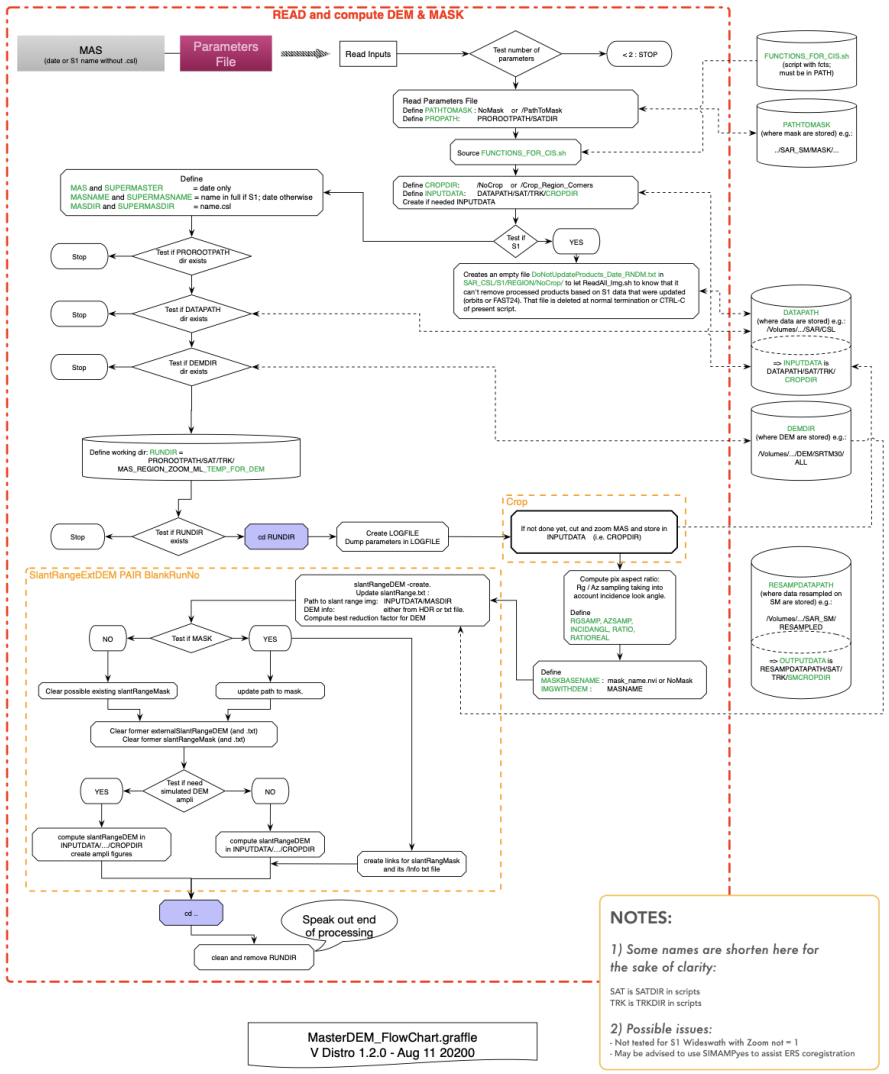
Architecture:

See here after

The user manual



MasTer_Manual_6.2.docx [or .pdf]

Architecture:

Provided only for assistance if need to track the logical path

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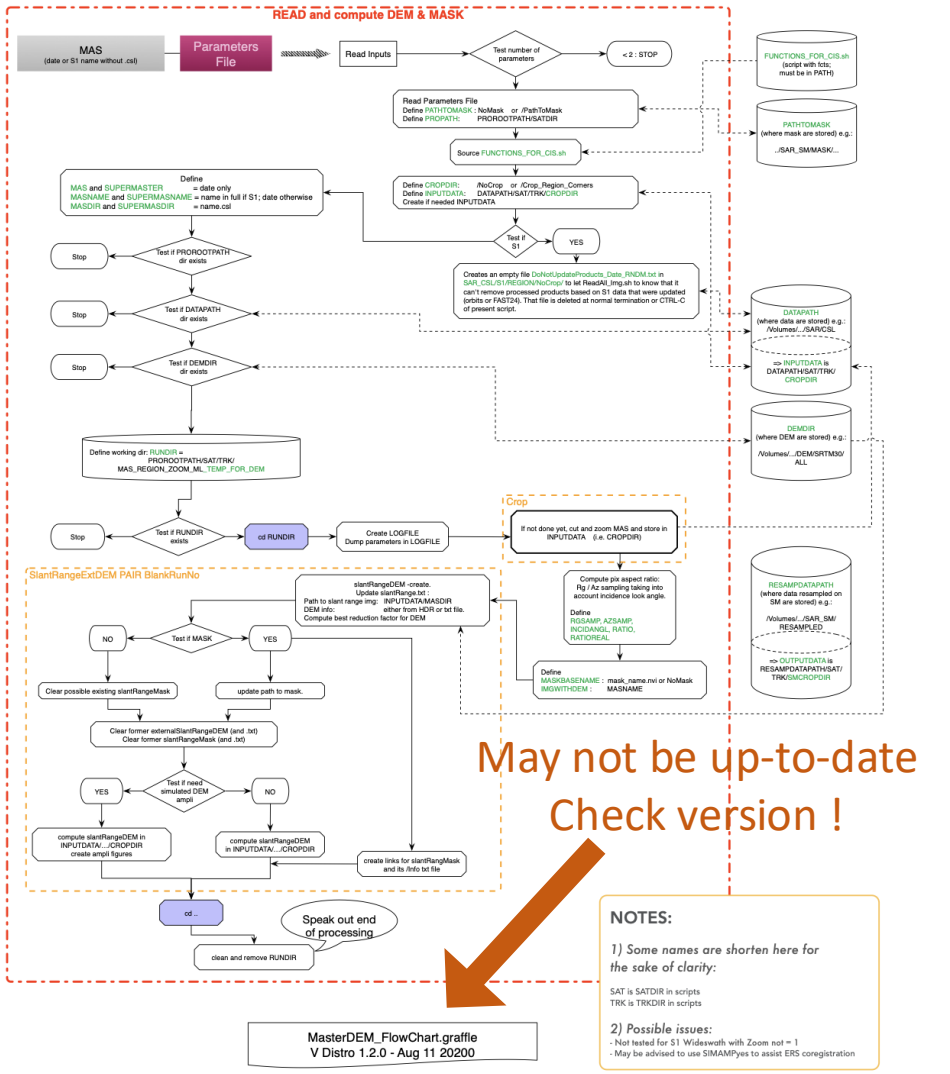
The user manual



May not be up-to-date
Check version !

MasTer_Manual_6.2.docx [or .pdf]

Architecture:

Provided only for assistance if need to track the logical path

ndo@ecgs.lu

The user manual

MasTer Distro V4.2.3 April 20, 2023

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/xmlstarlet 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 Congo
/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

## Domyuo
/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.sh from scihub.copernicus.eu Site:
# List first 10 products since last <n> days, by product type and intersecting an AOI
# https://scihub.copernicus.eu/twiki/pub/SciHubUserGuide/5APIsAndBatchScripting/odata-demo.sh
# https://scihub.copernicus.eu/twiki/do/view/SciHubUserGuide/5APIsAndBatchScripting
#
# See ESA's 'APIs and Batch scripting' webpage:
# https://scihub.copernicus.eu/userguide/5APIsAndBatchScripting
# ----------------------------------------------------------------
# ----------------------------------------------------------------
# Changelog:
# ----------------------------------------------------------------
#

[...]

# - Using Macports curruttls 'tee' command instead of macOS System /usr/bin/tee
# macports curruttls installs in /opt/local/libexec/gnubin/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/doris/NAS-Discs instead of mounting them to /Volumes/SMB_SHARENAME
#   See also: https://useyourloaf.com/blog/using-the-mac-os-x-automounter/
#
# ----------------------------------------------------------------

# Default values
# INGESTION Start and End Date
INGEST_START_DATE="TODAY"
```

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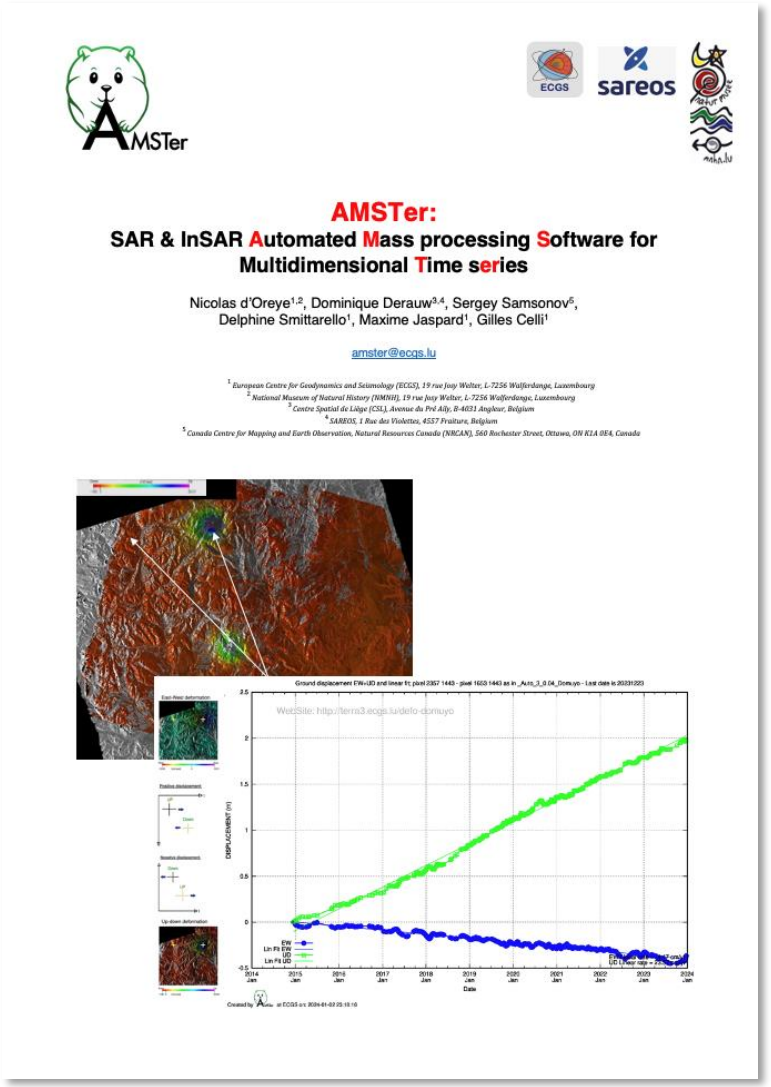
MasTer_Manual_6.2.docx [or .pdf]

Architecture:

Refer to the most recent version of the cron scripts

The user manual



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MasTer_Manual_6.2.docx [or .pdf]

Contest:

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

Structure

Plan:

- **The user manuals:**
  - Conventions
  - Architecture
  - Contest…
- **Scripts architecture** (header, hard coded lines..)
- **Organizing the work:**
  - Disk/Directories architecture
  - AMSTer 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

Scripts architecture

~/SAR/AMSTer/SCRIPTS_MT/SinglePair.sh master (no function selected)

```
#!/bin/bash
# ------------------------------------------------------------------------------
# This script is aiming at starting a new AMSTerEngine processing for every sat data
# It was fully refurbished to work with similar naming as what is present in the
#     InSARParameters.txt files etc... and adapted to the new processing chain
#     making use of data already read in csl format using script Read_All_Img.sh
#
# Parameters : - PRM date or S1 name (accept both date or name for S1)
#              - SCD date or S1 name (accept both date or name for S1)
#              - PRAMETERS file, incl path (e.g. ___V20190710_LaunchMTparam.txt)
#              - COMMENT to be added at the end of dir name where the process is run.
#                Optional unless you want process the pair on a Global Primary (SuperMaster).
#                See next parameter.
#              - SUPERMASTER date (accept both date or name for S1):
#                if need coregistration on a Global Primary (SuperMaster), a 5th parameter
#                with its date is mandatory. A 4th paramerter is then aslo mandatory.
#                It is recommended to use a 4th parameter that includes the date of the
#                Global Primary (SuperMaster). Someting such as _SMyyyyMMdd would be intuitive.
#
# Hard coded: MAXSIGMARGAZ = Maximum value of Sigma (in Range and Azimuth) admitted for successful Fine Coregistration.
#                            If Sigma is larger, it attemps to restart a fine coreg with larger win size
#
# Dependencies:
#    - AMSTerEngine and AMSTerEngine Tools, at least V2020426
#    - PRAMETERS file, at least V20200505
#    - The FUNCTIONS_FOR_MT.sh file with the function used by the script. Will be called automatically by the script
#    - gnu sed and awk for more compatibility.
#    - cpxfiddle is usefull though not mandatory. This is part of Doris package (TU Delft) available here :
#          http://doris.tudelft.nl/Doris_download.html.
#    - Fiji (from ImageJ) is usefull as well though not mandatory
#    - Python
#    - scripts: FLIPproducts.py.sh
#               FLOPproducts.py.sh
#               byte2Float.py
#    - convert (to create jpg images from sun rasters)
#    - bc (for basic computations in scripts)
#    - functions "say" for Mac or "espeak" for Linux, but might not be mandatory
#    - gmt (for inverting deformation if MAS > SLV)
#    - snaphu
#    - masterDEM.sh
#    - linux trap function
#
# New in Distro V 1.0:     - Based on developpement version 15.1 and Beta V5.1.1
# New in Distro V 1.1.1:   - Cope with TDX images. If MAS = SLV, one suppose that they are TX and RX
# New in Distro V 1.1.2:   - Read parameter to allow calibration of S1 images
# New in Distro V 1.2.0:   - Bug correction in case of coreg on Super Master (was missing DORFROMSM=YES when using 5 param.) in line 411
#                          - initInSAR was made with twice the path to Supermaster_Mas in line 613
# New in Distro V 1.2.1:   - output message of mult by mask before interpolation only if mask is requested
# New in Distro V 2.0.0:   - get sampling from SM instead of Mas when using coreg on super master
```

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

```
92  # New in Distro V 6.2 20240228: - Fix rounding pix size when smaller than one by allowing scale 2 before division. Now pix size in real insa
93  #
94  # AMSTer: SAR & InSAR Automated Mass processing Software for Multidimensional Time series
95  # NdO (c) 2016/03/07 - could make better with more functions... when time.
96  # ------------------------------------------------------------------------------
97  PRG=`basename "$0"`
98  VER="Distro V6.2 AMSTer script utilities"
99  AUT="Nicolas d'Oreye, (c)2016-2019, Last modified on Feb 28, 2024"
100
101 echo " "
102 echo "${PRG} ${VER}, ${AUT}"
103 echo "Processing launched on $(date) "
104 echo " "
105
106 # vvv ----- Hard coded lines to check --- vvv
107 source $HOME/.bashrc
108 # ^^^ ----- Hard coded lines to check -- ^^^
109
110
111 MASINPUT=$1               # date or S1 name of Primary image (for S1 : it could be either in the form of yyyymmdd or S1a/b_sat_trk_a/d)
112 SLVINPUT=$2               # date or S1 name of Secondary image (for S1 : it could be either in the form of yyyymmdd or S1a/b_sat_trk_a/d)
113 PARAMFILE=$3             # File with the parameters needed for the run
114 COMMENT=$4                # Comment for naming dir where process is run
115 SUPMASINPUT=$5
116
117 if [ $# -lt 3 ] ; then echo " Usage $0 MAS SLV PARAMETER_FILE _COMMENT(optional) SUPERMASTER(optional) "; exit; fi
118
119 # vvv ----- Hard coded lines to check --- vvv
120 MAXSIGMARGAZ=5   # Maximum value of Sigma (in Range and Azimuth) admitted for successful Fine Coregistration.
121 #                  If Sigma is larger, it attemps to restart a fine coreg with larger win size
122 # ^^^ ----- Hard coded lines to check -- ^^^
123
124
125 # Function to extract parameters from config file: search for it and remove tab and white space
126 function GetParam()
127     {
128     unset PARAM
129     PARAM=$1
130     PARAM=`${PATHGNU}/grep -m 1 ${PARAM} ${PARAMFILE} | cut -f1 -d \# | ${PATHGNU}/gsed "s/ //g" | ${PATHGNU}/gsed "s/ //g"`
131     eval PARAM=${PARAM}
132     echo ${PARAM}
133     }
```

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 tests on the parameters]
- [Some hard coded lines, between vvvv--- and ^^^^---]
- [Some functions, between {}]

Scripts architecture

```
218  XMAX=`GetParam "XMAX,"`                    # XMAX, maximum X UTM coord of final Forced geocoded product
219  YMIN=`GetParam "YMIN,"`                    # YMIN, minimum Y UTM coord of final Forced geocoded product
220  YMAX=`GetParam "YMAX,"`                    # YMAX, maximum Y UTM coord of final Forced geocoded product
221  GEOCKML=`GetParam "GEOCKML,"`              # GEOCKML, a kml file to define final geocoded product. If not found, it wil
222
223
224  REGION=`GetParam "REGION,"`                # REGION, Text description of area for dir naming
225  DEMNAME=`GetParam "DEMNAME,"`              # DEMNAME, name of DEM inverted by lines and columns
226
227  RESAMPDATPATH=`GetParam RESAMPDATPATH`     # RESAMPDATPATH, path to dir where resampled data will be stored
228
229  eval PROPATH=${PROROOTPATH}/${SATDIR}/${TRKDIR}
230
231  source ${FCTFILE}
232
233  # Check OS
234  OS=`uname -a | cut -d " " -f 1 `
235  echo "Running on ${OS}"
236  echo
237
238  # Define Crop Dir
239  if [ ${CROP} == "CROPyes" ]
240      then
241          if [ ${ZOOM} -eq 1 ]
242              then
243                  CROPDIR=/Crop_${REGION}_${FIRSTL}-${LASTL}_${FIRSTP}-${LASTP} #_Zoom${ZOOM}_ML${INTERFML}
244              else
245                  CROPDIR=/Crop_${REGION}_${FIRSTL}-${LASTL}_${FIRSTP}-${LASTP}_Zoom${ZOOM} #_ML${INTERFML}
246          fi
247      else
248          CROPDIR=/NoCrop
249  fi
250
251  # Define Dir where data are/will be cropped
252  INPUTDATA=${DATAPATH}/${SATDIR}/${TRKDIR}/${CROPDIR}
253  mkdir -p ${INPUTDATA}
254
```

All the scripts have :

- [The lecture of the parameters from the parameter file, see e.g. ___V20231026_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/AMSTer/SCRIPTS_MT

Some utilities are in:

$HOME/SAR/AMSTer/SCRIPTS_MT/ zz_Utilities_MT

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

$HOME/SAR/AMSTer/SCRIPTS_MT/zz_Utilities_MT_Ndo

Moreover,

cron scripts are in:

$HOME/SAR/AMSTer/SCRIPTS_MT/_cron_scripts[_*NEW*]

MasTer Orginizer scripts are in:

$HOME/SAR/AMSTer/SCRIPTS_MT/AMSTerOrganizer

Scripts for pairs optimisation module are in:

$HOME/SAR/AMSTer/SCRIPTS_MT/optimtoolbox

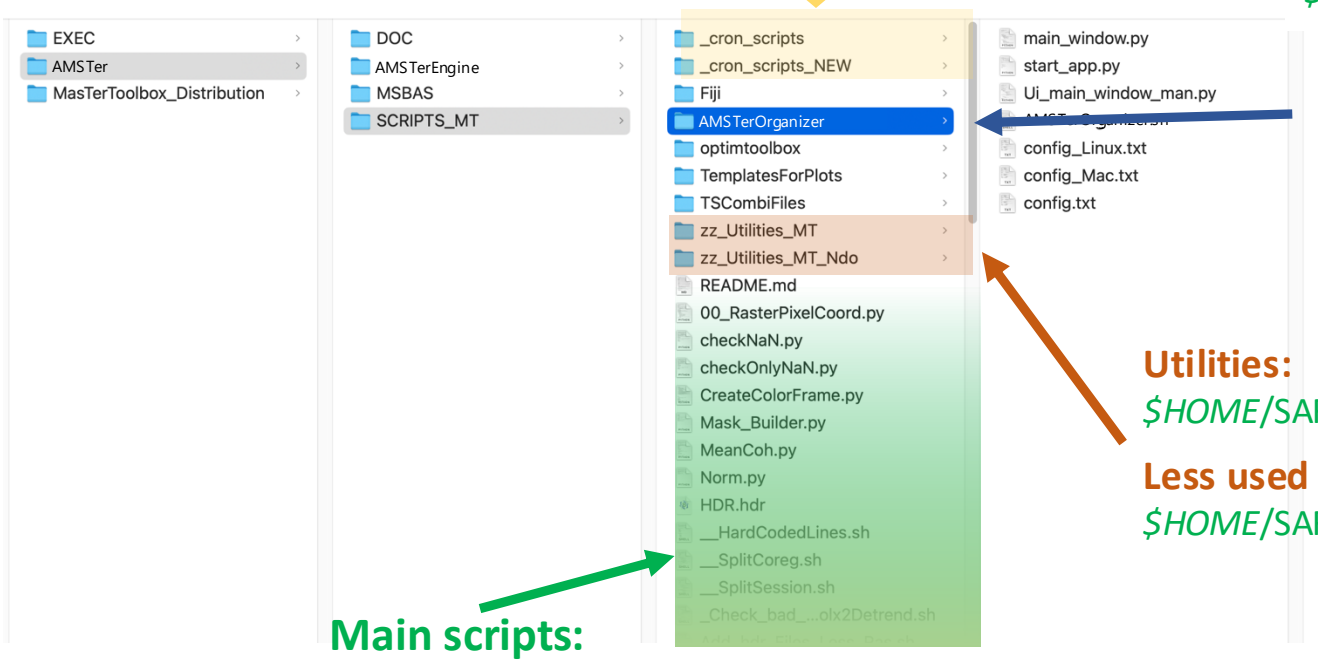
Files for time series plots are in:

$HOME*/SAR/AMSTer/SCRIPTS_MT/TSCombiFiles and *$HOME/SAR/AMSTer/SCRIPTS_MT/TemplatesForPlots

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

$HOME/SAR/AMSTer/SCRIPTS_MT/Fiji

Scripts architecture



Cron scripts:
$HOME/SAR/AMSTer/SCRIPTS_MT/_cron_scripts[_*NEW*]

MasTer Orginizer:
$HOME/SAR/AMSTe /SCRIPTS_MT/AMSTerOrganizer

Utilities:
$HOME/SAR/AMSTer/SCRIPTS_MT/zz_Utilities_MT

Less used utilities:
$HOME/SAR/AMSTer/SCRIPTS_MT/zz_Utilities_MT_Ndo

Main scripts:
$HOME/SAR/AMSTer/SCRIPTS_MT

Moreover,

$HOME/SAR/AMSTer/SCRIPTS_MT/TSCombiFiles **contains files for time series plots.**

$HOME/SAR/AMSTer/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…

Structure

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Organizing the work

AMSTer 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 |__*SAT* |__*REGION_MODE*	SAR |__AMSTer |__SCRIPTS_MT |__cron_scripts |__AMSTerOrganizer |__zz_Utilities_MT |__zz_Utilities_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 AMSTer 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
AMSTerOrganiser.sh (located in SCRIPTS_MT/AMSTerOrganizer).

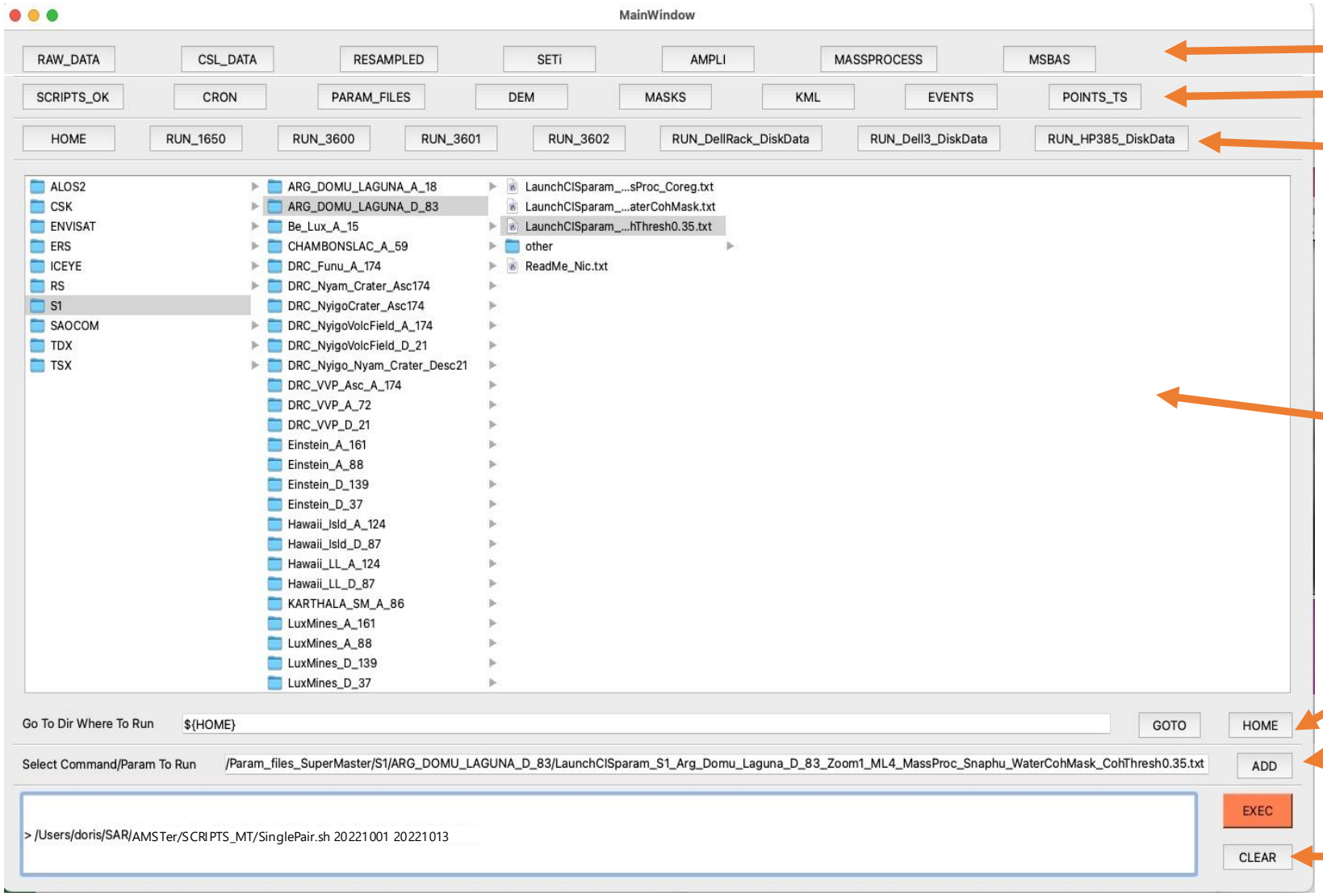
AMSTerOrganiser.sh is configured by editing the file SCRIPTS_MT/AMSTerOrganizer/config_*OS*.txt.

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                # /$HOME/SAR/AMSTer/SCRIPTS_MT
2_CRON                      # /$HOME/SAR/AMSTer/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 = low button 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/HP385RAID5/PROCESS
```

Organizing the work



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

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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

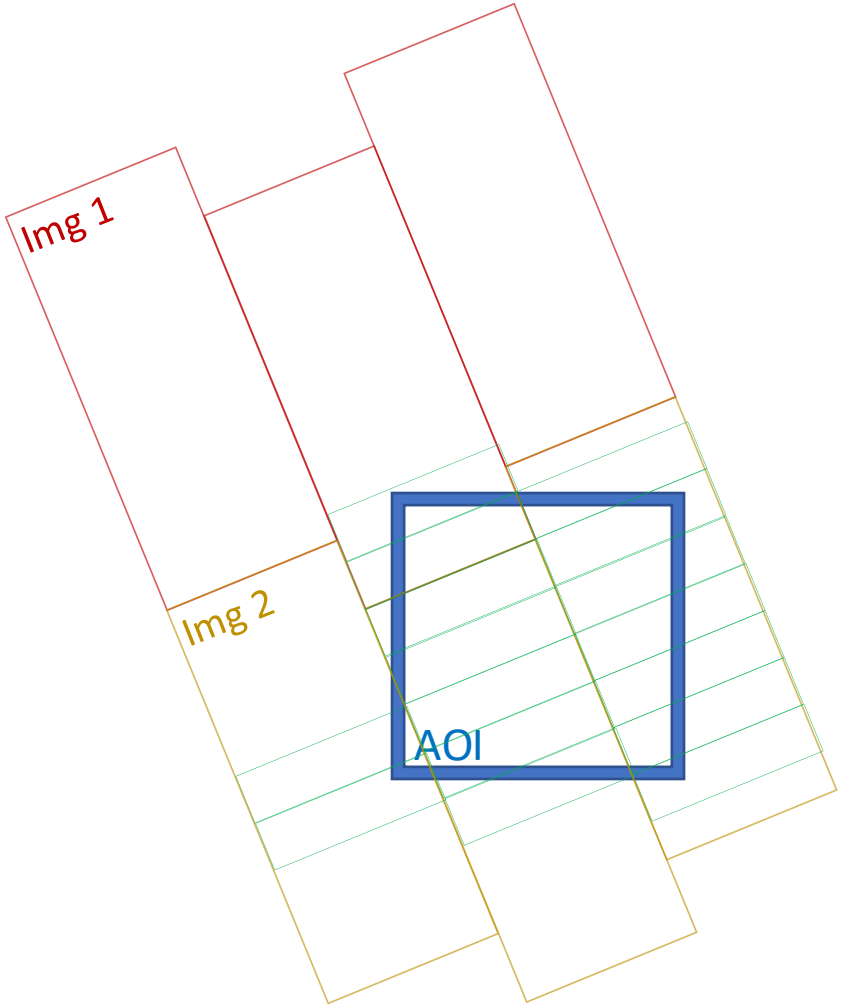
Information about reading the images (see also chapter 2 in manual):

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.

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+ 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/AMSTer/SCRIPTS_MT/___V20231026_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 AMSTer 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 Oct 26 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 Global Primary as selected by Prepa_MSBAS.sh in
                    # e.g. /Volumes/hp-1650-Data_Share1/SAR_SM/MSBAS/Bukavu/seti/setParametersFile.txt
```

Example of LaunchMTparam.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.

Parameters

```
[...]
#
# VERSION Oct 26 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 Global Primary as selected by Prepa_MSBAS.sh in
                    # e.g. /Volumes/hp-1650-Data_Share1/SAR_SM/MSBAS/Bukavu/seti/setParametersFile.txt

# DEM
#########
GreaterRegion       # DEMNAME, name of DEM (in mathematical order). Need txt file in same dir
SIMAMPno            # SIMAMP, compute Simutaled 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 PRIMARY
                    #   It may cause prblm if externalSlantRangeDEM and maybe slantRangeMask are being modified by the first FORCE run.

# CROP
#########
/$PATH_1650/SAR_CSL/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          # PIXSHAPE, pix shape for product : SQUARE, ORIGINALFORM, SQUAREUNITY or ORIGINALFORMUNITY
SIGMANO         # 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
0.4             # COH, Coarse Coherence threshold coregistration
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             # FCOH, Fine Coherence threshold coregistration
24              # 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              # INITPOL, For multi pol images; force polarisation at initInSAR for InSAR processing. If it does not exists it will find the first compatible PRM-SCD pol.
50              # LLRGCO, Lower Left Range coord offset for final interferometric products generation. Used in SinglePairNoUnwrap only for Shadow measurements
50              # 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               # FILTFACTOR, filtering factor for interfero (2 might be too strong when used with POWSPECSMOOTFACT filtering)
1               # POWSPECSMOOTFACT, 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, LatLong, Envi Harris, larger than img) before unwrapping (APPLYMASKyes or APPLYMASKno);
                # Mask for AMSTer Engine < 20230928: 1 = keep, 0 = mask. However, at unwrapping, 0-masked pixels are kept if their coh > COHCLNTHRESH
                # Mask for AMSTer Engine > 20230928: 0 = keep, 1 = always mask, 2 = mask. However, at unwrapping, 2-masked pixels are kept if their coh > COHCLNTHRESH
                # If a mask is requested but no Snaphu, one can also mask manually files with ffa (eg ffa residualInterferogram.HH-HH.f x slantRangeMask)
/$PATH_DataSAR/SAR_AUX_FILES/MASKS/WaterBodies/DRCongo/LakeKivu_LatLong_0keep          # 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 geenration)
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 zero.
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 frazction 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 iterrations
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. Snaphu gives 0 weight at pixels below that threshold.
                    # Moreover, if a mask is used, snaphu (or CIS) also unwraps 0-masked pixels (for AMSTer Engine < 20230928)
                    #         or 2-masked pixels (for AMSTer Engine > 20230928) if their coherence is above COHCLNTHRESH.

# if CIS unwrapping:
0.1                 # FALSERESCOHTHR, 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 iterration for detPhUn (Integer: 1, 2 or 3 is generaly 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.


# GEOCODING
##########
UTM                 # PROJ, Chosen projection (UTM or GEOC – GEOC OPTION IS NOT READY YET)
Forced              # GEOCMETHD, 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),

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

100                 # FORCEGEOPIXSIZE, Pix size wanted eg as you want for your final MSBAS database
                    # 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

########
# PATHS #
########
/$PATH_3601/PROCESS/AS                  # PROROOTPATH, path to dir where data will be processed in sub dir named by the sat name (SATDIR).
/$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

# for coregistration mass processing (required if coresitration on a  Global Primary i.e. 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)
```

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

Only UTM products (except maybe some amplitude time series)

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)

Method to re-grid the geocoded products

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

Structure

Plan:

- **The user manuals:**
  - Conventions
  - Architecture
  - Contest…
- **Scripts architecture** (header, hard coded lines..)
- **Organizing the work:**
  - Disk/Directories architecture
  - AMSTer 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

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)
- AMSTer Engine (AE) 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 AE format exist in directory, the tool will consider only the AE 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 ***agregateSRTMTile*** AMSTer 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 :
     agregateSRTMTiles $PATH_DataSAR/SAR_AUX_FILES/DEM/*DEM_REGION*

2. From another source, using the script ***DEM_Envi_hdr2AMSTer_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_hdr2AMSTer_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 AMSTer format to the Ellipsoid as expected by AMSTer. 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:

AMSTer Engine can mask interferograms at the unwrapping step (see manual § 0.14).

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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  - Deformation time series (+ amplitude time series), web page
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  - DEM : where, how create, format
  - MASKS : where, how create, format
  - kml: where, why, how create

- DONE ! -