

S1TILING

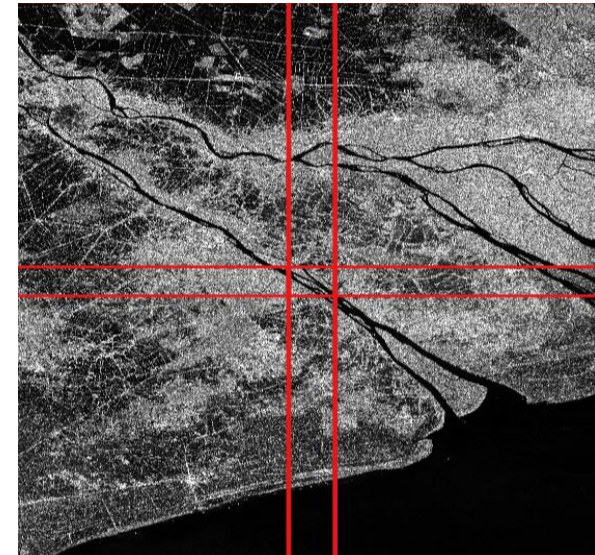
SENTINEL-1 PRE-PROCESSING



V0.3

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Objectives

- ❖ **Sentinel-1 was the first SAR system providing free data on large time and space domain**
 - New opportunities for research and business
- ❖ **Generic processing chain for Sentinel-1 time series**
 - Building ready-to-use times series of Sentinel-1 images (Analysis Ready Data)
 - Need for many projects
 - Open-source and OTB based
- ❖ **Focused on efficient processing for large time series and large areas**

Sentinel-1 Observation Scenario

Two satellites (S1-A and S1-B) with a C-band Synthetic Aperture Radar payload.

- S1A (October 2014) and S1B (September 2016)
- 12-days repeat cycle (6 days with 2 phased satellites)

- ❖ **Full and systematic coverage of lands**
- ❖ **Dual polarizations**
- ❖ **All-weather sensor: Not sensitive to clouds**
- ❖ **True time-serie data (no loss of data during rainy season)**

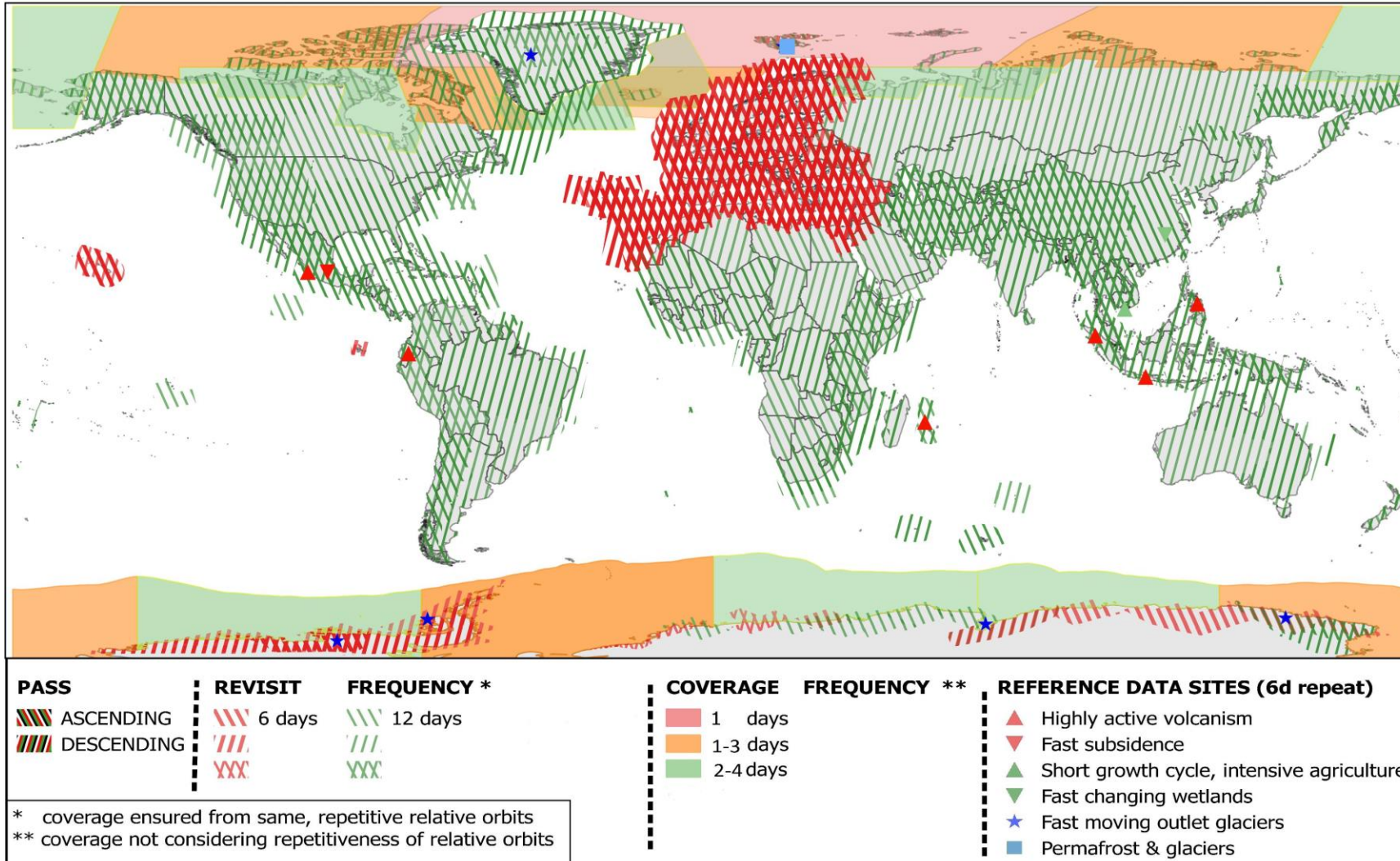


Sentinel-1 Observation Scenario

Sentinel-1 Constellation Observation Scenario: Revisit & Coverage Frequency



validity start: 05/2019



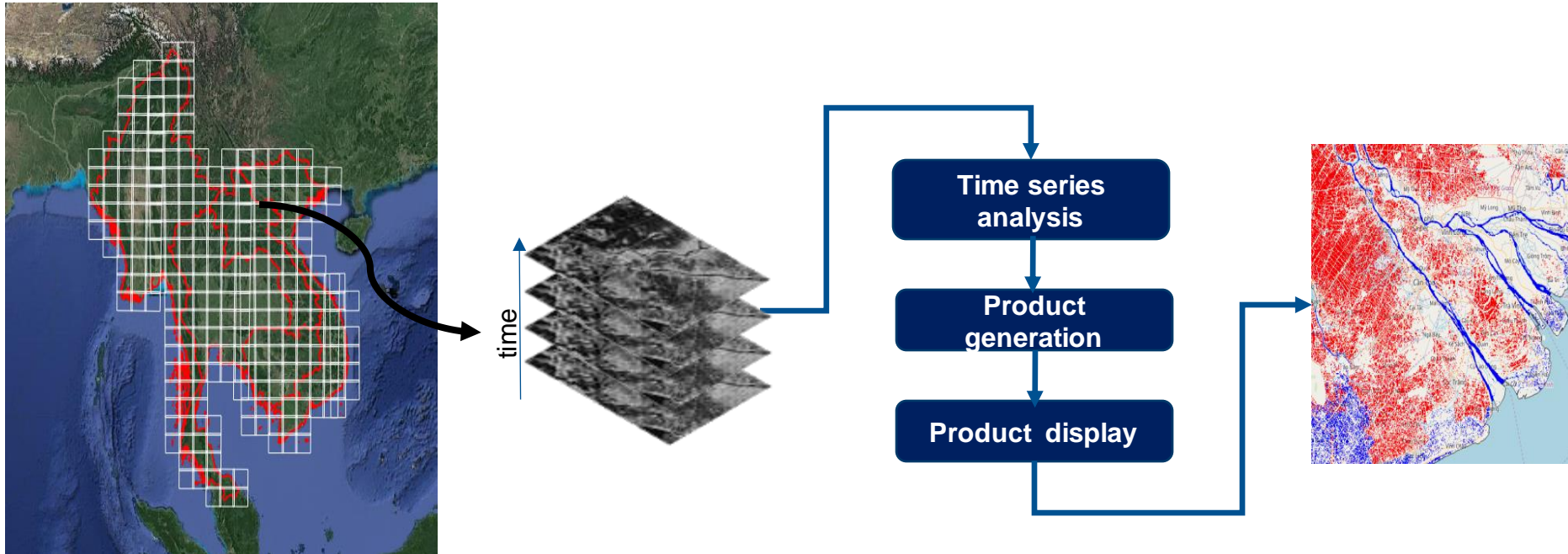
How to use sentinel-1 time series

Two major steps:

- ❖ **1. S1 data pre-processing**

- Building the calibrated, orthorectified, speckle filtered time series over the area of interest (as in datacube)

- ❖ **2. Time series analysis for product generation**



S1tiling: an ARD Processing Chain for S1

Multipurpose

- ❖ No geographic limitation
- ❖ Fully customizable

Operationnal

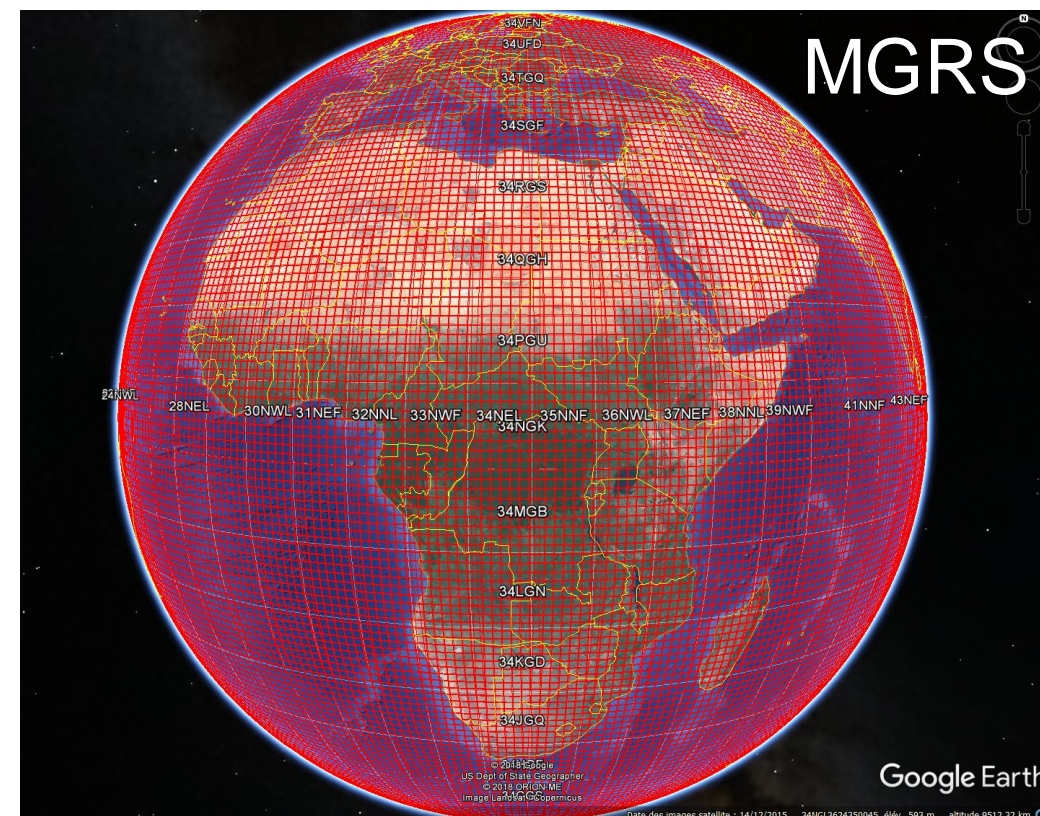
- ❖ Pipeline of processings
- ❖ Automatic processing, error management, optimized restarting
- ❖ Optimal disk management

Portable

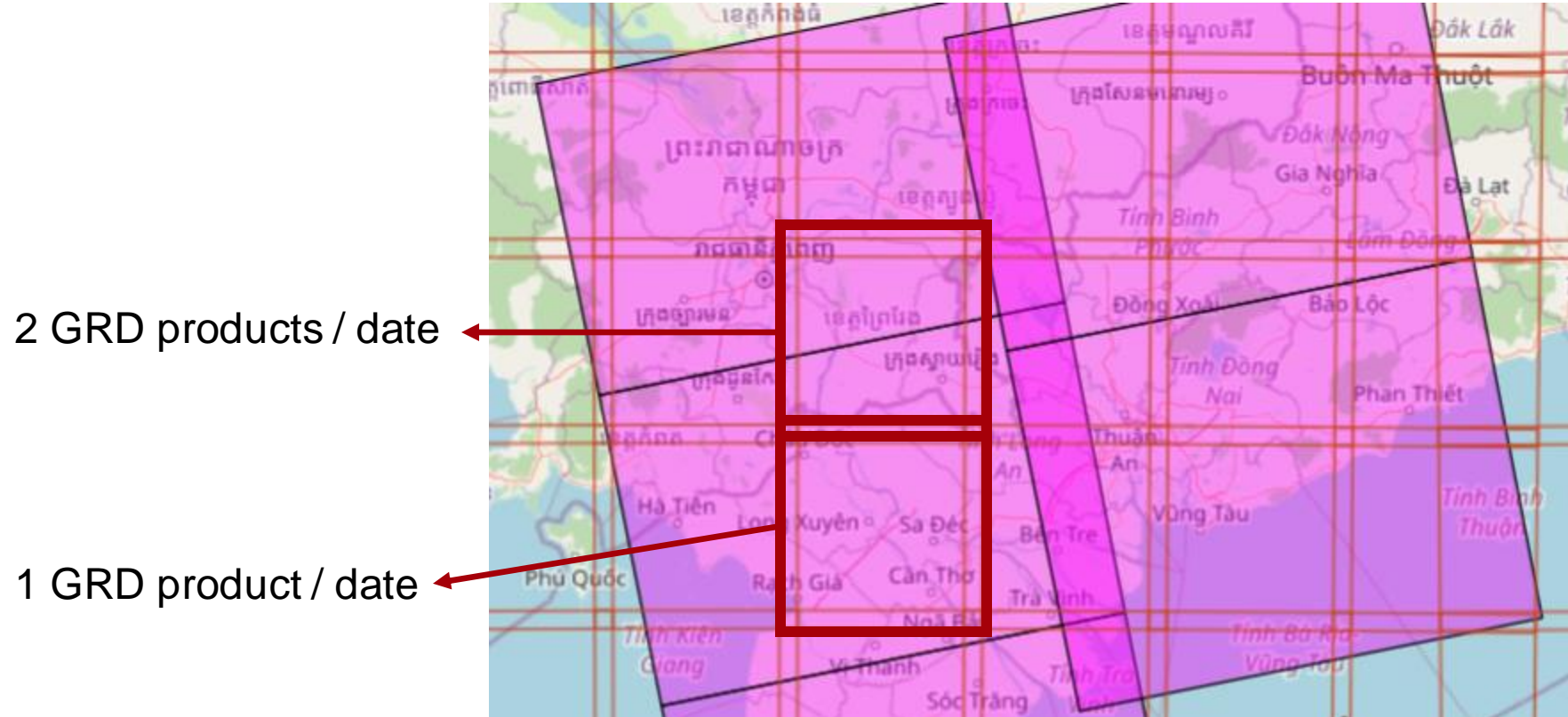
- ❖ From laptop to high-performance cluster
- ❖ Developed with open source softwares
- ❖ Easy installation

Efficient

- ❖ Parallel processing (multiprocesses and multithreading)

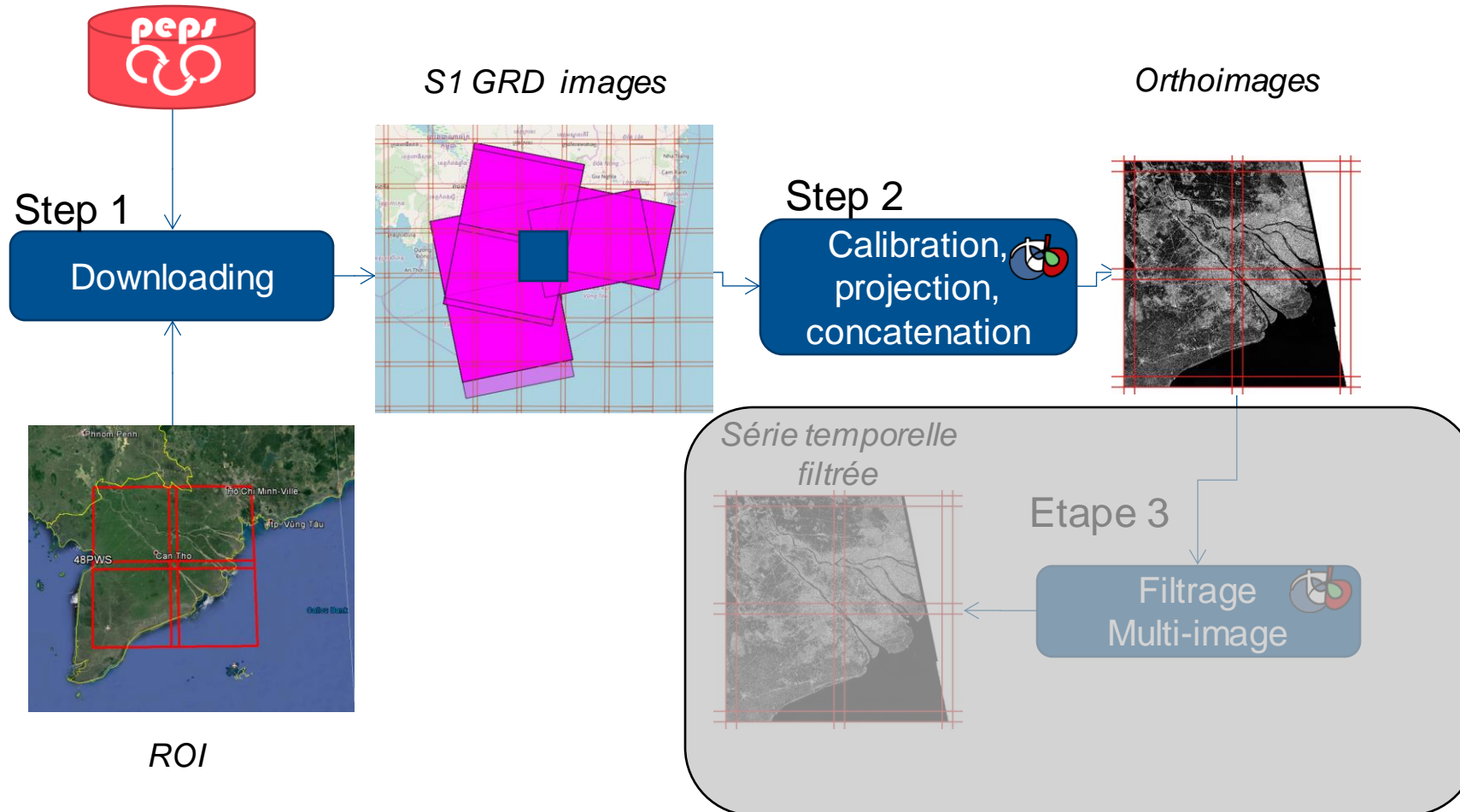


MGRS tile: 120x120 km
also used for Sentinel-2 products

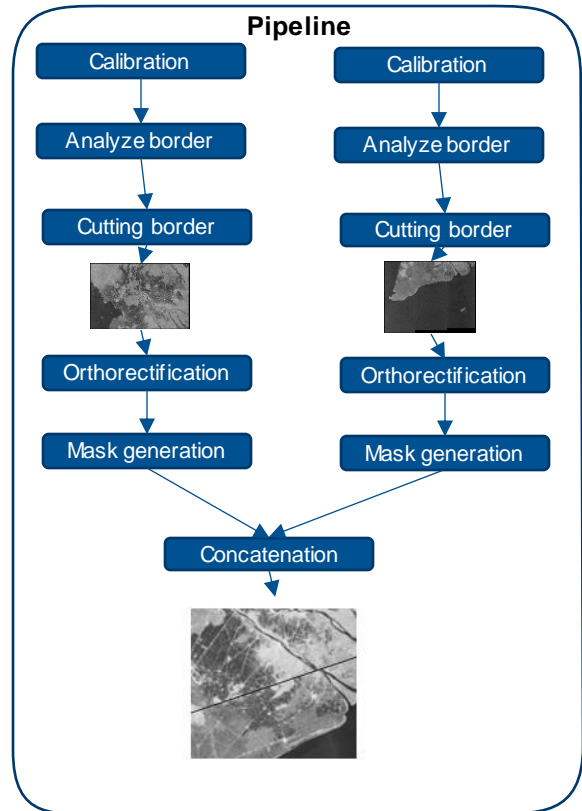
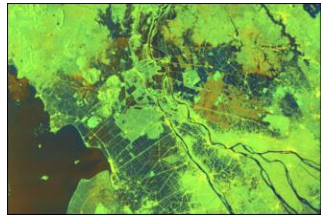


red: MGRS tiles
purple: GRD products

Processing

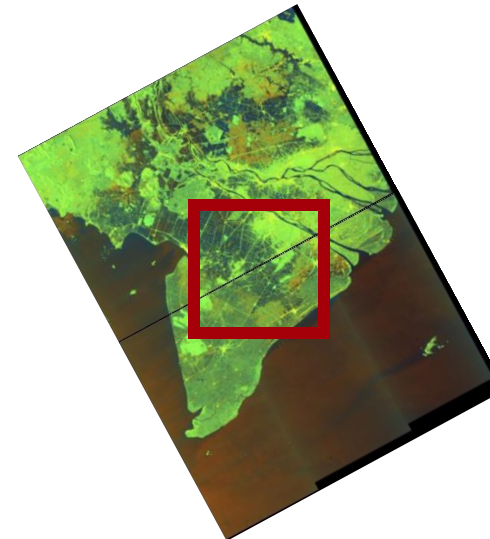


S1Tiling pipeline



Ortho-ready images

- 1- Request the product list to be processed (for 1 tile)
- 2- Analyze and build the task tree
- 3- Download products to be processed
- 4- Execute the processing pipelines into Dask



How to use it ?

[Paths]

```
# Path for result tiled images
output : /work/scratch/koleck/data_out

# Path to store the S1 images to be processed
s1_images : %(TMPDIR)s/s1tiling/S1

# Path to SRTM files
srtm : /work/datalake/static_aux/MNT/SRTM_30_hgt

# Path to a temporary file
tmp : %(TMPDIR)s/s1tiling
```

[DataSource]

```
Download : True

#ROI_by_coordinates : 0.897 43.921 2.338 43.128
ROI_by_tiles : ALL

polarisation : VV-VH
first_date : 2020-01-07
last_date : 2020-01-09
```

[Processing]

```
# Define the type of calibration: gamma or
sigma
Calibration: gamma

# Remove thermal noise
remove_thermal_noise: True

# Pixel Size (in meters) of the output images
OutputSpatialResolution : 10.

Tiles: 19LHK, 19PGM
# TilesListInFile : list_of_tiles.txt

nb_parallel_processes : 5
nb_otb_threads: 2
ram_per_process : 4096

mode : debug logging
```

How to use it ?

Usage: S1Processor [OPTIONS] CONFIG_FILENAME

On demand Ortho-rectification of Sentinel-1 data on Sentinel-2 grid.

It performs the following steps: 1. Download S1 images from S1 data provider (through eodag) 2. Calibrate the S1 images 3. Orthorectify S1 images and cut their on geometric tiles 4. Concatenate images from the same orbit on the same tile 5. Build mask files

Parameters have to be set by the user in the S1Processor.cfg file

Options:

--version	Show the version and exit.
--cache-before-ortho / --no-cache-before-ortho	Force to store Calibration Cutting result on disk before orthorectification. BEWARE, this option will produce temporary files that you'll need to explicitly delete.
--searched_items_per_page INTEGER	Number of products simultaneously requested by eodag
--dryrun	Display the processing shall would be realized, but none is done.
--debug-otb	Investigation mode were OTB Applications are directly used without Dask in order to run them through gdb for instance.
--watch-ram	Trigger investigation mode for watching memory usage
--graphs	Generate SVG images showing task graphs of the processing flows

How to use it ?

Output: one folder per tile

47PRP 47QPV 47QQF 47QRE 48PTT 48PUS 48PVQ 48PWA 48PWV 48PXT 48PYS 48PZC 48QTF
48QUE 48QUL 48QVJ 48QWH 48QXF 48QYD 48QZJ

For each tile:

```
s1a_48PYS_vh_ASC_128_20180701t110305.tif  s1a_48PYS_vh_DES_120_20180712t223707.tif
s1a_48PYS_vv_DES_018_20180705txxxxxx.tif  s1b_48PYS_vh_DES_018_20180723txxxxxx.tif
s1a_48PYS_vh_ASC_128_20180713t110306.tif  s1a_48PYS_vh_DES_120_20180724t223707.tif
s1a_48PYS_vv_DES_018_20180717txxxxxx.tif  s1b_48PYS_vh_DES_018_20180804t224455.tif
s1a_48PYS_vh_ASC_128_20180725t110307.tif  s1a_48PYS_vh_DES_120_20180805t223708.tif
s1a_48PYS_vv_DES_018_20180729t224509.tif  s1b_48PYS_vv_DES_018_20171008txxxxxx.tif
s1a_48PYS_vh_ASC_128_20180806t110307.tif  s1a_48PYS_vv_ASC_128_20171010t110303.tif
s1a_48PYS_vv_DES_018_20180810txxxxxx.tif  s1b_48PYS_vv_DES_018_20171020txxxxxx.tif
s1a_48PYS_vh_DES_018_20171002txxxxxx.tif  s1a_48PYS_vv_ASC_128_20171022t110304.tif
s1a_48PYS_vv_DES_120_20171009t223704.tif  s1b_48PYS_vv_DES_018_20171101txxxxxx.tif
```

Inside S1Tiling

S1Tiling writing in Python 3

- ❖ **EODAG for data provider management**
 - Access to many data provider
 - Catalog request and downloading
- ❖ **OTB for building in-memory pipelines (calibration, remove-border, masque, ortho,)**
 - Pipeline can be executed in memory or with intermediary files writing
- ❖ **DASK for running pipelines in parallel**
 - Only on one computer node



Distribution

Sources: <https://gitlab.orfeo-toolbox.org/s1-tiling/s1tiling>

PiPy: <https://pypi.org/project/S1Tiling/>

Documentation: <https://s1-tiling.pages.orfeo-toolbox.org/s1tiling/latest/>

Esay installation procedure:

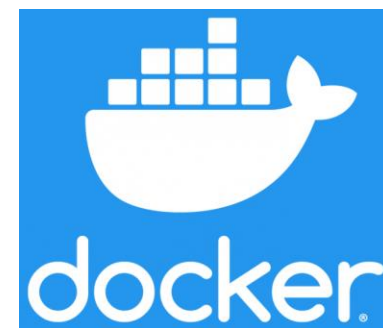
```
module load conda
```

```
module load OTB/7.4-python3.7.2
```

```
conda create -n s1tiling python=3.7.2
```

```
conda activate s1tiling
```

```
pip install s1tiling
```



S1Tiling docker image available

User projects

TropiSCO : Near real time deforestation

Guiana shield 700 000 km² / ~ 4 years => 80 000 images

South-East Asia : 1 230 000 km² / ~4 years => 143 000 images

WorldCereal: Global cropland monitoring

1 500 000 km² / 1 year

Use of Sentinel-1 and Sentinel-2 images

