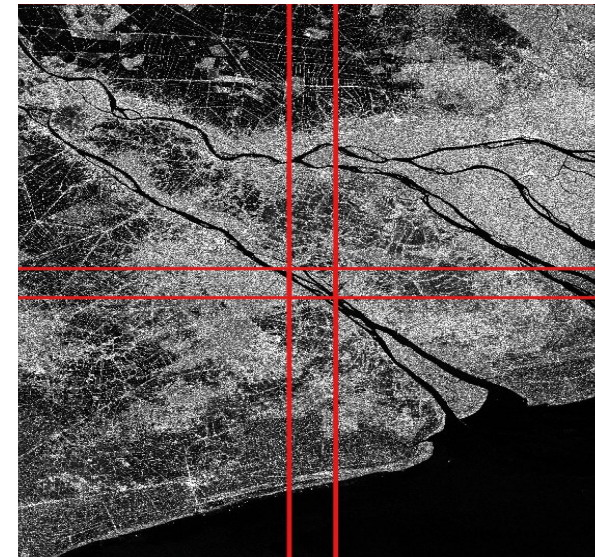# S1TILING
SENTINEL-1 PRE-PROCESSING

V 1.1

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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 -> December 2021)

➤ S1C (December 2024)

➤ 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**

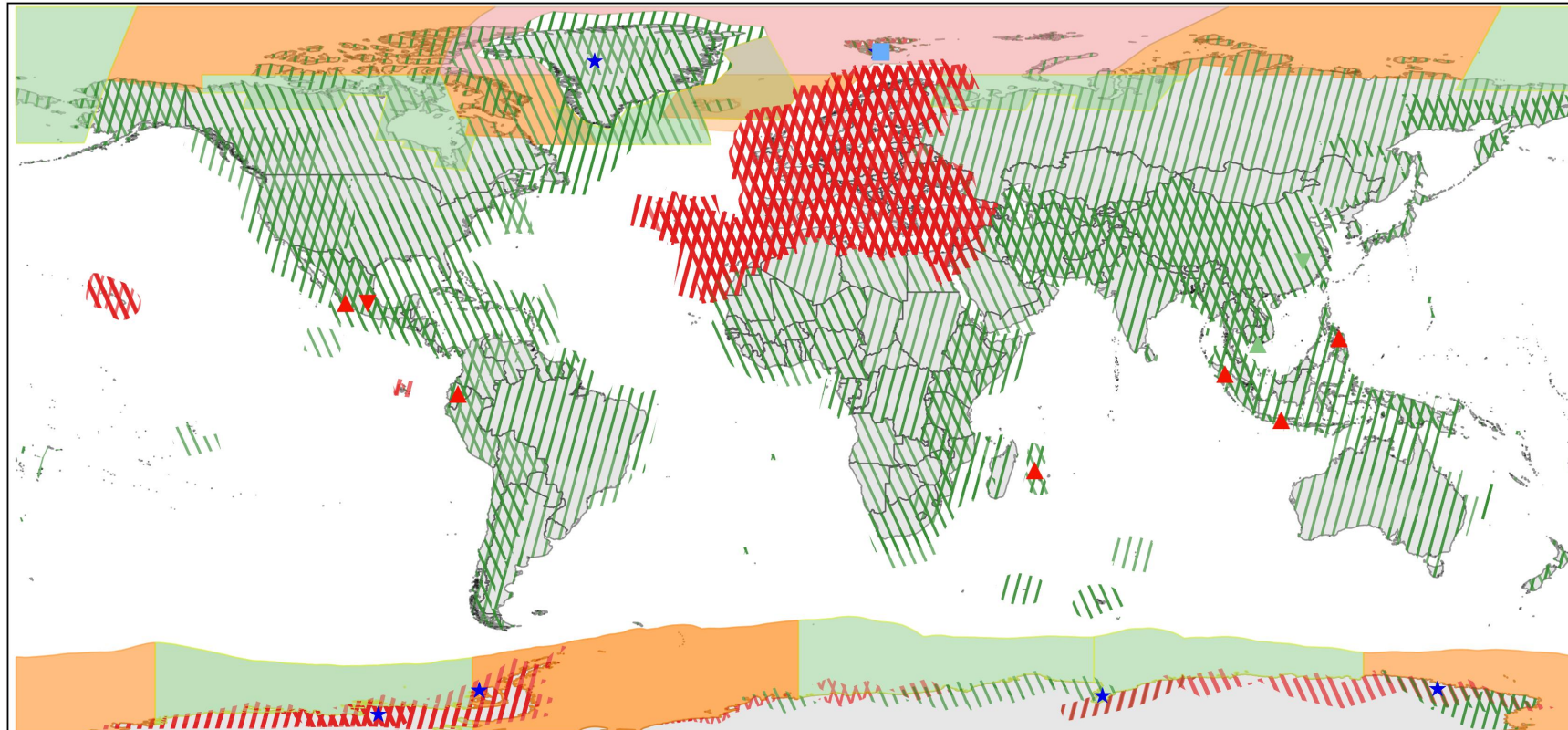❖ **True time-serie data (no loss of data during rainy season)**
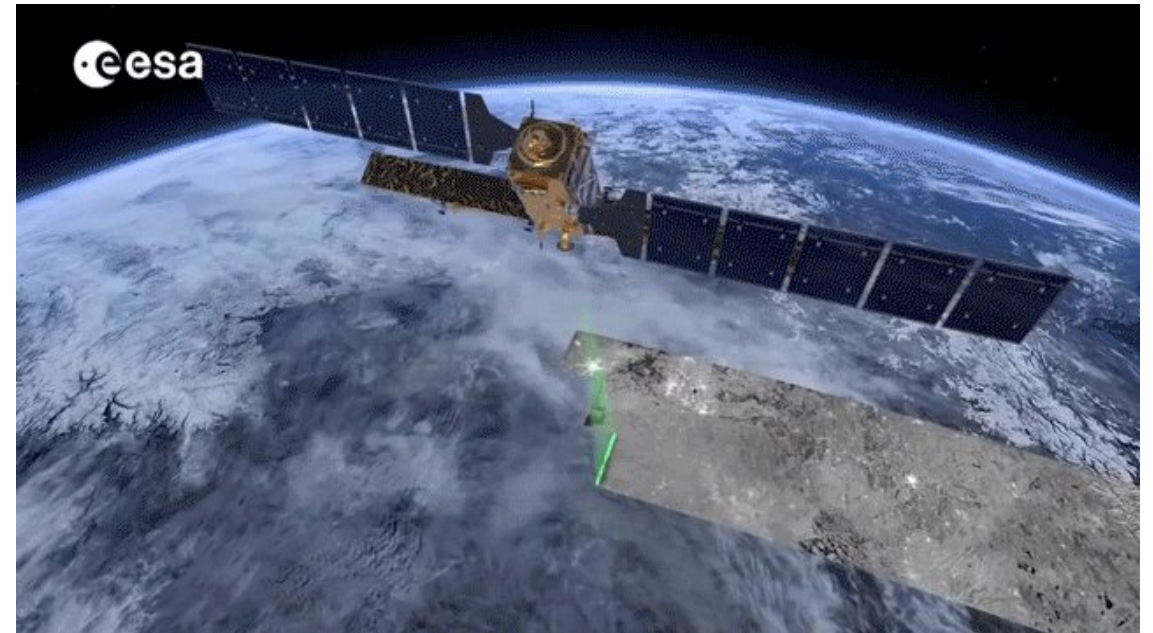
Sentinel-1 Observation Scenario

Sentinel-1 Constellation Observation Scenario: Revisit & Coverage Frequency

sentinel-1

validity start: 05/2019

PASS	REVISIT	FREQUENCY *
ASCENDING	6 days	12 days
DESCENDING		

COVERAGE	FREQUENCY **
1 days	
1-3 days	
2-4 days	

REFERENCE DATA SITES (6d repeat)
- ▲ Highly active volcanism
- ▼ Fast subsidence
- ▲ Short growth cycle, intensive agriculture
- ▼ Fast changing wetlands
- ★ Fast moving outlet glaciers
- ■ Permafrost & glaciers

* coverage ensured from same, repetitive relative orbits
** coverage not considering repetitiveness of relative orbits
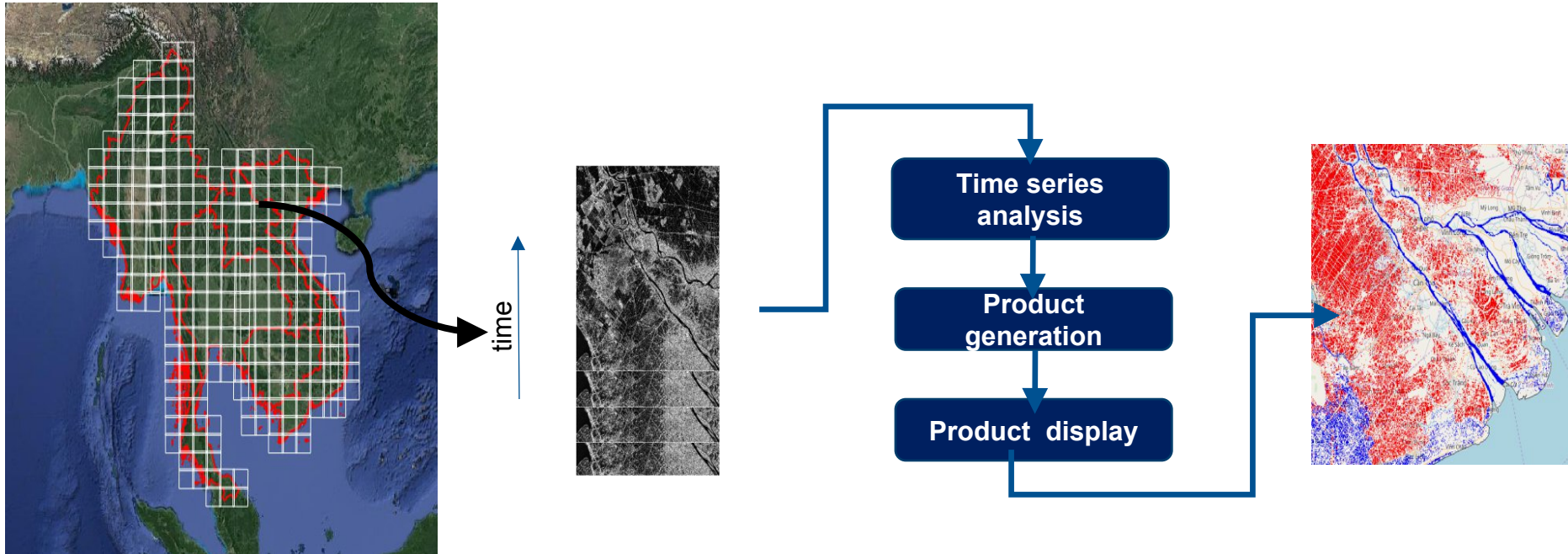
How to use sentinel-1 time series
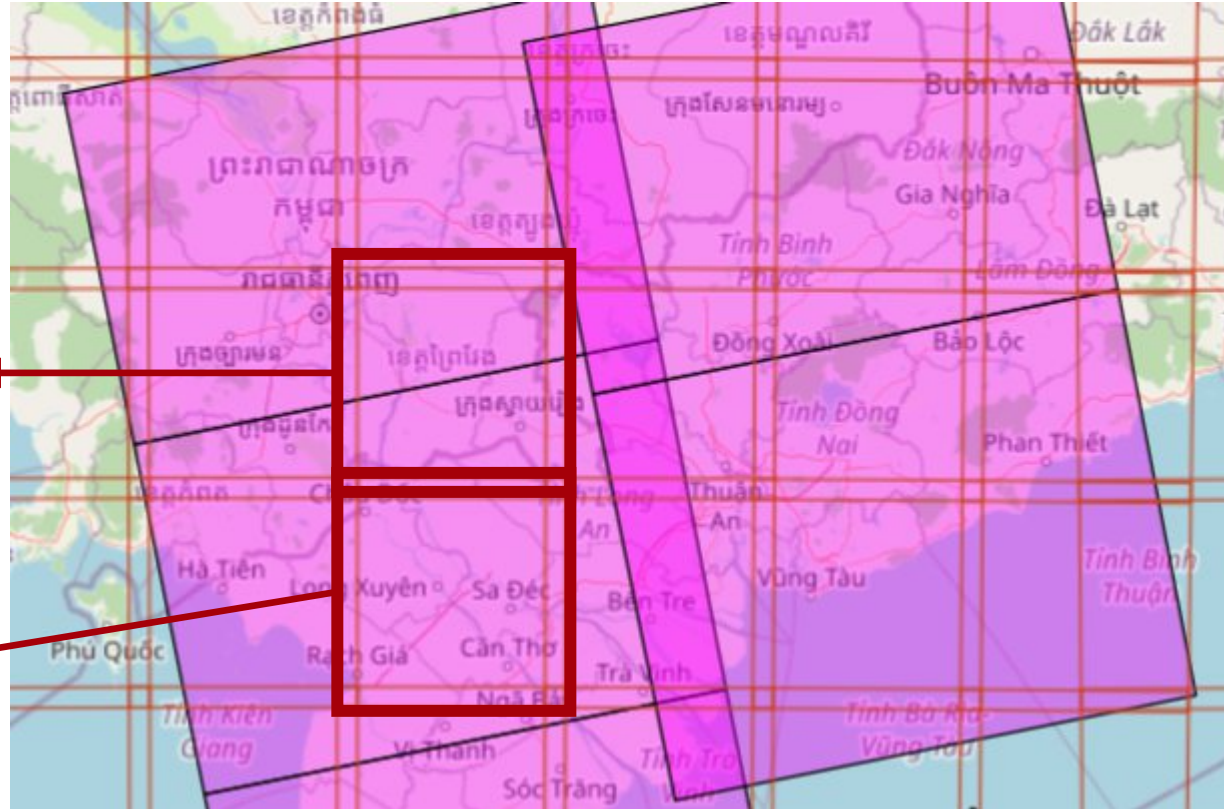
Two major steps:

❖ **1. S1 data pre-processing**

➢ Building the calibrated, orthorectified (GTC), corrected (RTC), 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: 110x110 km
also used for Sentinel-2 products

2 GRD products / date

1 GRD product / date

red: MGRS tiles
purple: GRD products

Processing

peps

Step 1

Downloading

S1 GRD images

Step 2

Calibration, projection, concatenation

Orthoimages

Série temporelle filtrée

Etape 3

Speckle Filering

ROI

S1Tiling pipeline

Pipeline

Calibration → Analyze border → Cutting border → Orthorectification → Mask generation

Calibration → Analyze border → Cutting border → Orthorectification → Mask generation

Mask generation + Mask generation → Concatenation

Ortho-ready images
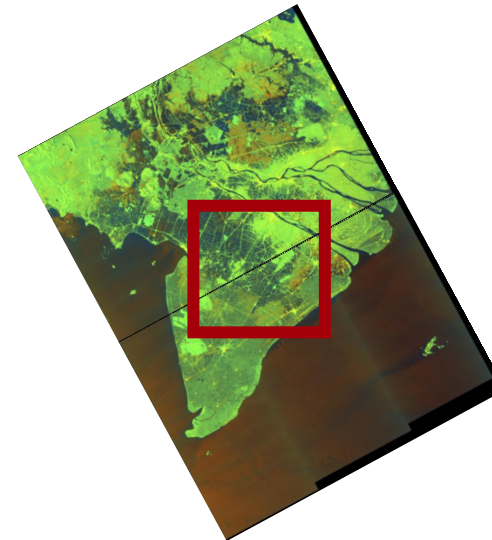
1- Request the product list to be processed (for 1 tile)

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
dem_dir : /work/datalake/static_aux/MNT/SRTM_30_hgt

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

[DataSource]
Download : True
nb_parallel_download: 2

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

tile_to_product_overlap_ratio: 5

[Processing]
Define the type of calibration: gamma, beta, sigma or normlim
Calibration: gamma

Remove thermal noise
remove_thermal_noise: True

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

Tiles: 19LHK, 19PGM

nb_parallel_processes : 5
nb_otb_threads: 2
ram_per_process : 4096

produce_lia_map: True

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
                            explicitely 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 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, masking, ortho, ….)**

 ➢ Pipeline can be executed in memory or with intermediary files writing

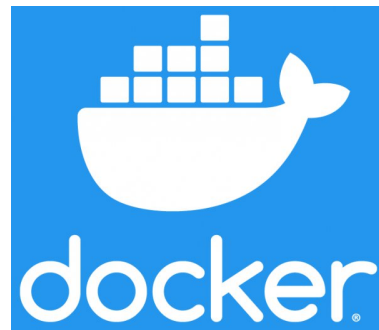❖ **DASK for running pipelines in parallel**

 ➢ 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/

S1Tiling docker image available

User projects

TropiSCO : Near real time deforestation

Brazilian Amazonia, Guiana shield, France, SE Asia, Gabon

- Brazil: 225.000 images
- Gabon: 22.000 images
- SE Asia: 210.000 images
- Guiana Shield: 44.000 images