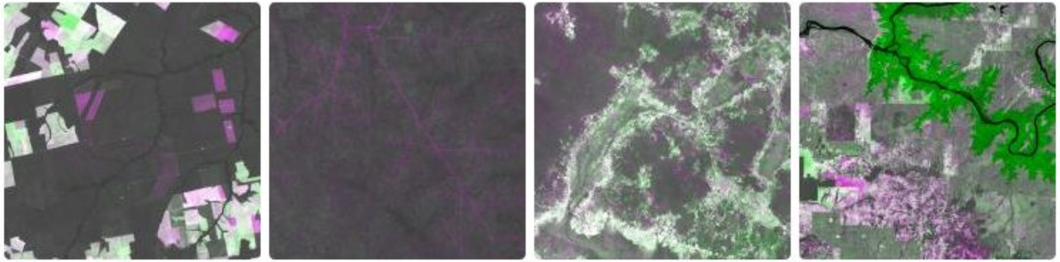
What ?

Sentinel-2 L1C cloud-free composites 2015-2017, 2018, 2019, 2020

Google Earth Engine

https://forobs.jrc.ec.europa.eu/recaredd/map/

Indication for potential annual change



From left: Mato Groso (Brazil), Sanga (Congo), Manyoni (Tanzania), Stung Trene (Cambodia)

- L1C Sentinel-2 A/B
- 20m resolution (pre-computed)
- B11 B8 B4 (SWIR, NIR, RED)
- 4 composites of ~500 GB each
- Pre-computed and ready to use
- Fast web browsing and WMS service
- GeoTiff Download

GEO-GFOI
Virtual Workshop
16-17 June

dario.simonetti@ext.ec.europa.eu

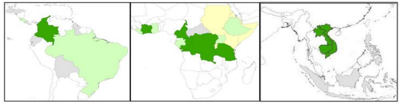
Since January 2016 ….

European Commission

Why ?

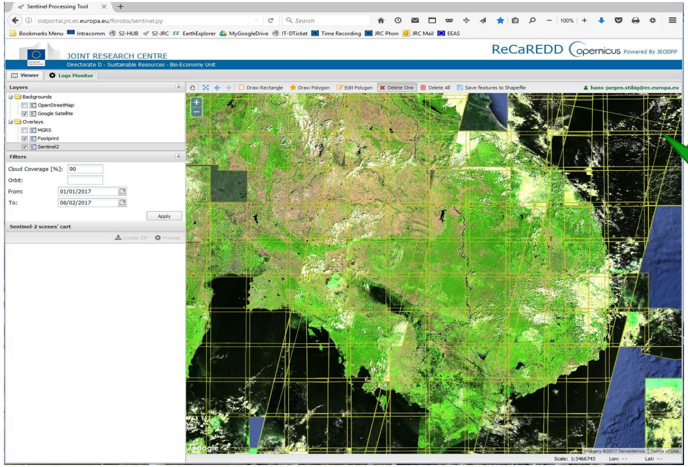
Sentinel-2 web platform for REDD+ monitoring. Online web platform for browsing and processing Sentinel-2 data for forest cover monitoring over the Tropics

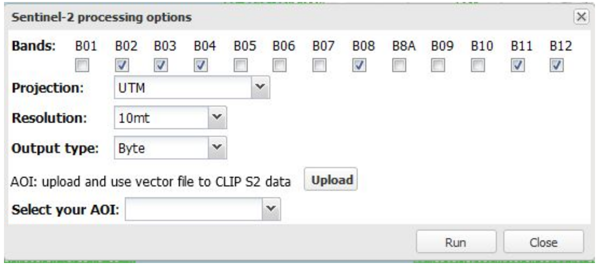
JRC support to ReCaREDD



'focus' countries (active collaboration with test sites)

'associated' countries (sharing, case by case collaboration)



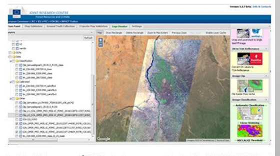


- Filter by AOI, time, Cloud %
- Full resolution custom visualization
- Download only what you see / need

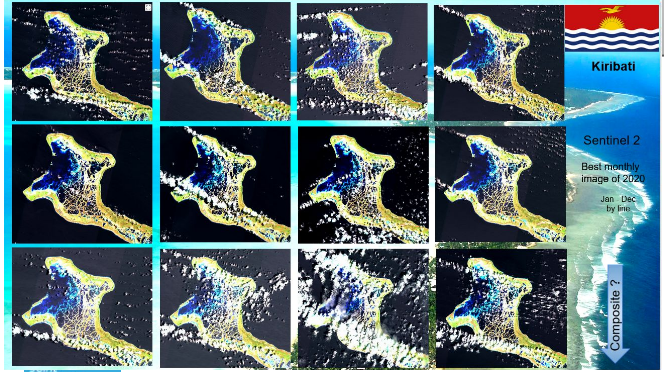
From GB to Mb

REGIONAL CENTRE FOR MAPPING OF RESOURCES FOR DEVELOPMENT

RCMRD becomes the 1st Organization in Africa to Provide Sentinel 2 Data for 10 Countries



Sentinel 2 images of Sudan being processing in the JRC IMPACT tool.



Research Centre

But ...

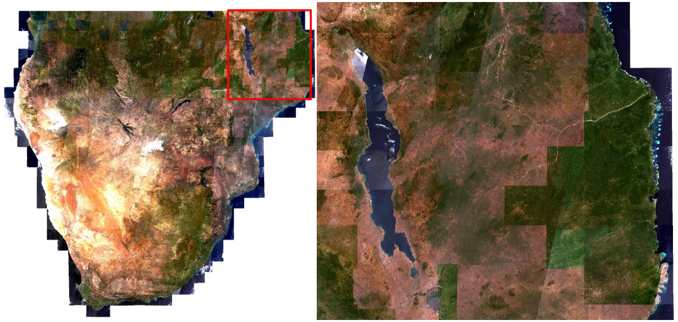
Still single image

Clouds?

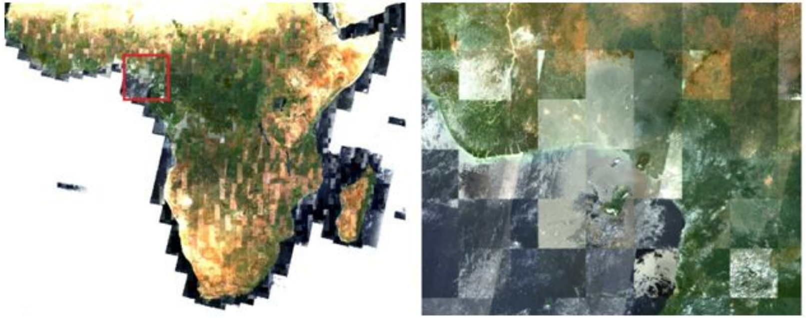
From 2017

Why ?

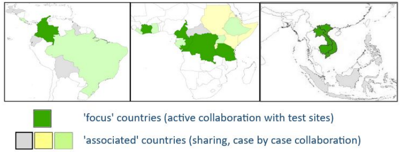
“Provide Remote Sensing Tools and Methods for Monitoring Forest Change in the Context of REDD+"



ESA 10m Sentinel-2A cloud-free composite - Southern Africa 2016

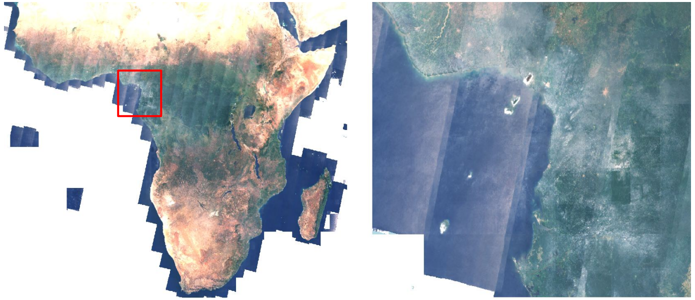


JRC Africa Sentinel-2 L1C 2017 annual composite as proposed by Kempeneers P.

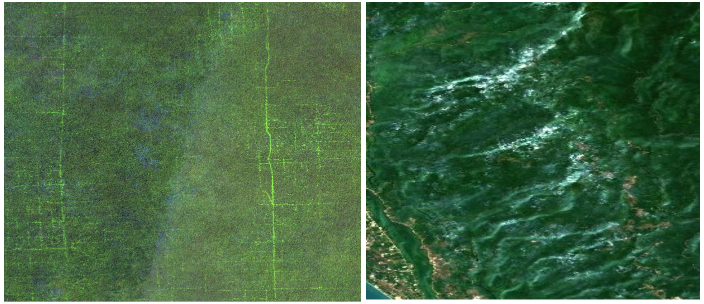


JRC support to

- ReCaREDD,
- REDDCopernicus
- *Intra-ACP*



JRC Global Sentinel-2 L1C 2017-2018 composite as proposed by Corbane C.



S2GM Sentinel-2 L2A composite pics over Central Africa Republic, forest in Ko Chang island (Thailand)

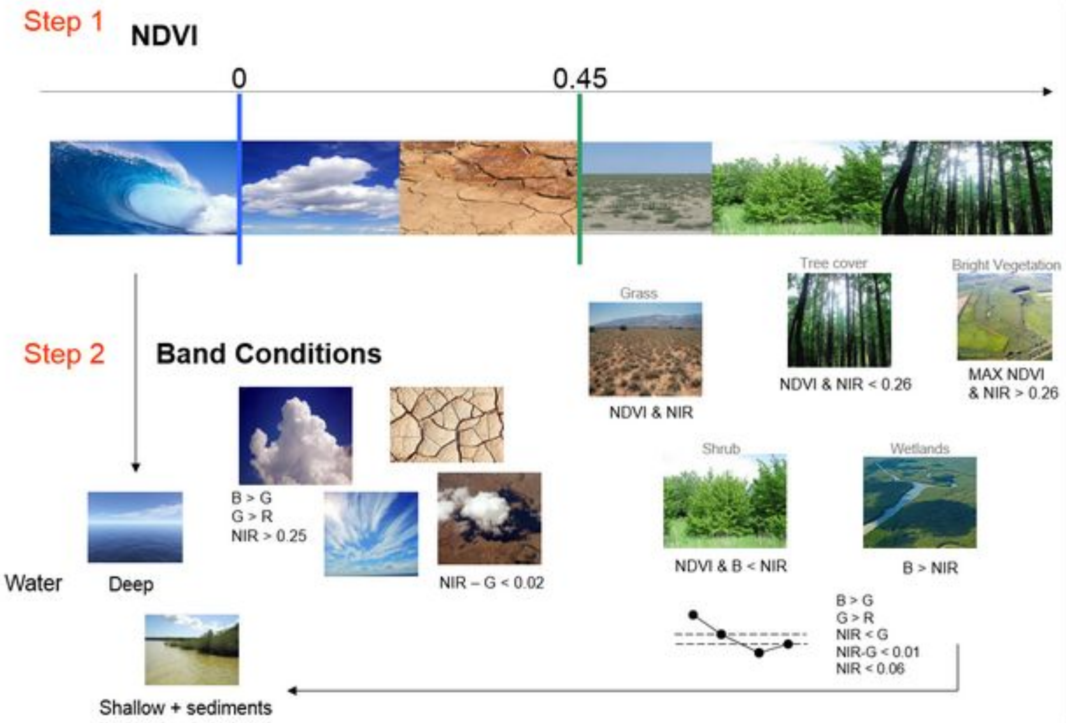
But ...

Available composites are affected by:

- Tiling
- Residual clouds
- L2A overcorrection

How ?

New Cloud - Shadow mask based on pre-defined thresholds based on individual pixel



Class ID	Thematic Classes
WAT (DWAT/SWAT)	Water
CL	Clouds
TCD	Tree Cover Dark
TCL	Tree Cover Light
SHR	Shrub
GRS	Grassland
SPV	Sparse vegetation
OLL	Other Land Light
OLD	Other Land Dark
SV	Shadowed Vegetation
SS	Bare or Shadowed Soil

From 2018

~~Solving~~ Mitigating radiometric issue

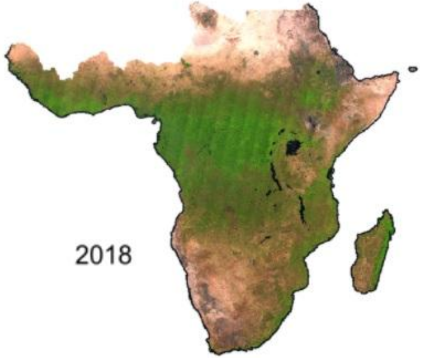
European Commission

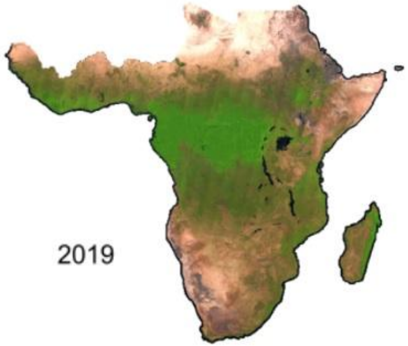
From Raw L1C (2018) & Forest Normalization per MGRS Tile (2019) to Orbit Equalization (2020)

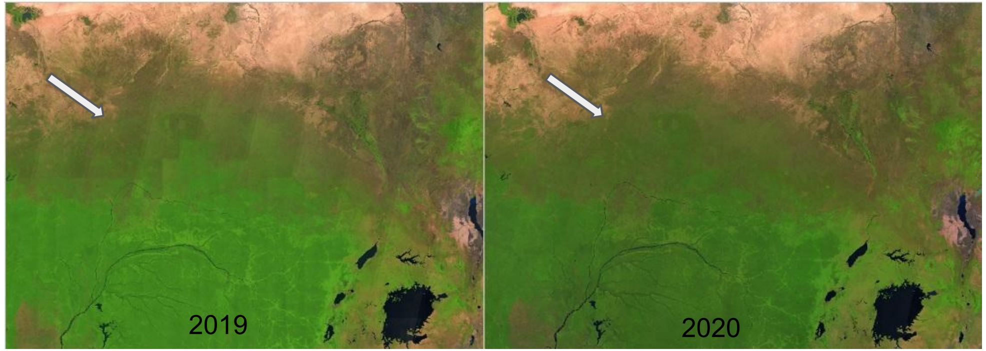
From Raw L1C (2018)
L1C Top of Atmosphere reflectance

Forest Normalization per MGRS Tile (2019)
dark object subtraction using evergreen forest as pseudo invariant feature

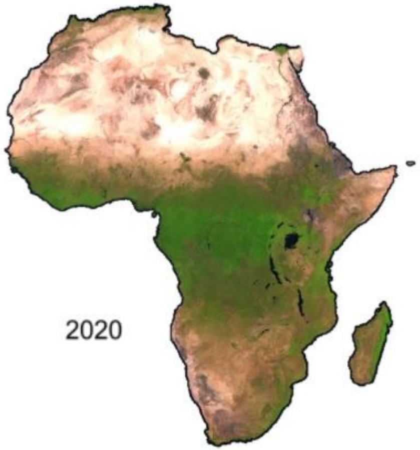
Orbit Equalization (2020)
multiplicative gradient ranging, over humid forest, from -12% to 0% (west-east)

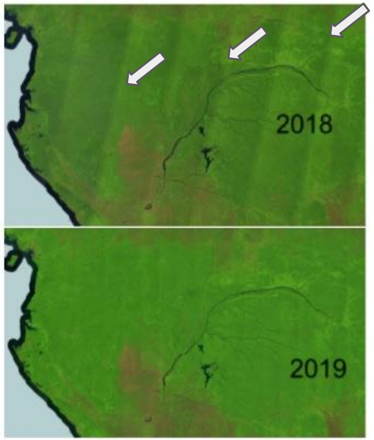


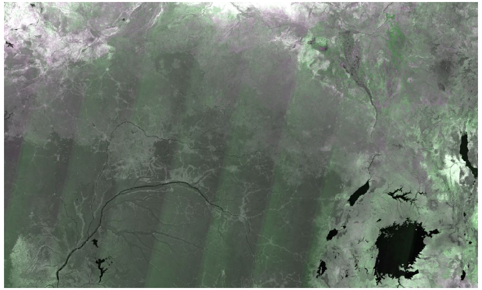




Visible tiling effect on the transition between dense forest and savanna (2019, left) and a smooth correction with the orbit normalization approach (2020, right)





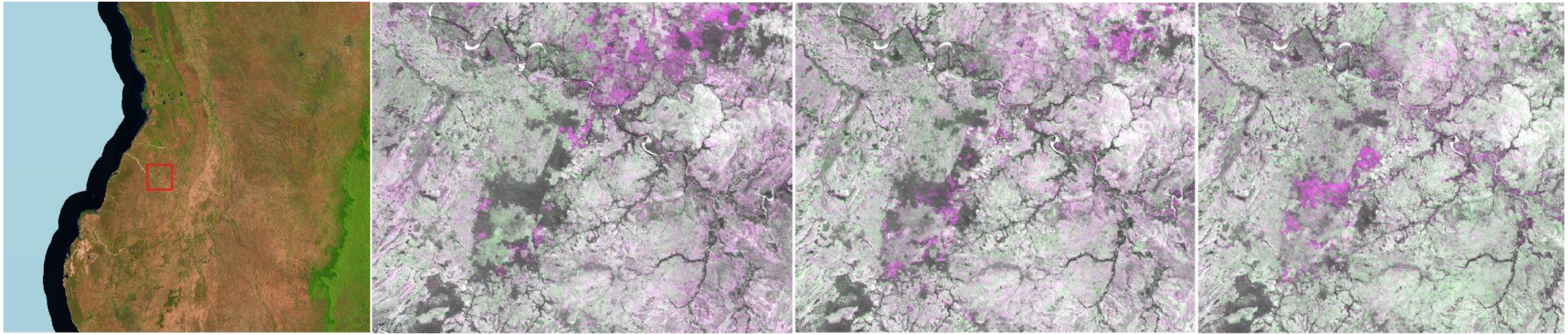


Effect of the orbit correction by subtracting 2018 and 2020. The green gradient shows where correction is more intense (west of each orbits) and where original values are preserved (east)

Joint Research Centre

Spotting annual changes

Malaysia: map, change in 2018, 2019 and 2020. Vegetation loss (violet), gain (green). Vast deforestation propagating from the edge into the forest



Madagascar: map, change in 2018, 2019 and 2020. Vegetation loss (violet), gain (green). Scattered, small scale deforestation

Case Study and Timing: Fires in Brazil 2019

National Institute for Space Research (INPE) reported more than **80,000 fires in August 2019**

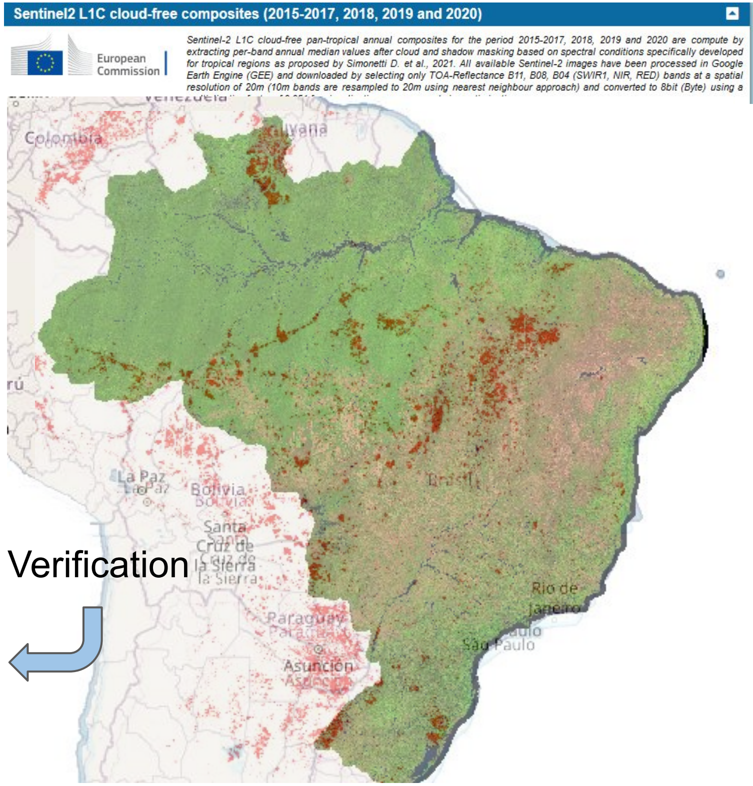
Processed in GEE : 30th Aug
Online map at JRC : 1st Sept

36 tiles
2 days

- 1d processing
- ½d download
- ½d web + overviews

Google Earth Engine

JRC website



Verification

Estimated size: **94 GB**

Start time: 2019-06-01 / 2019-08-30

Temporal period: QUARTER

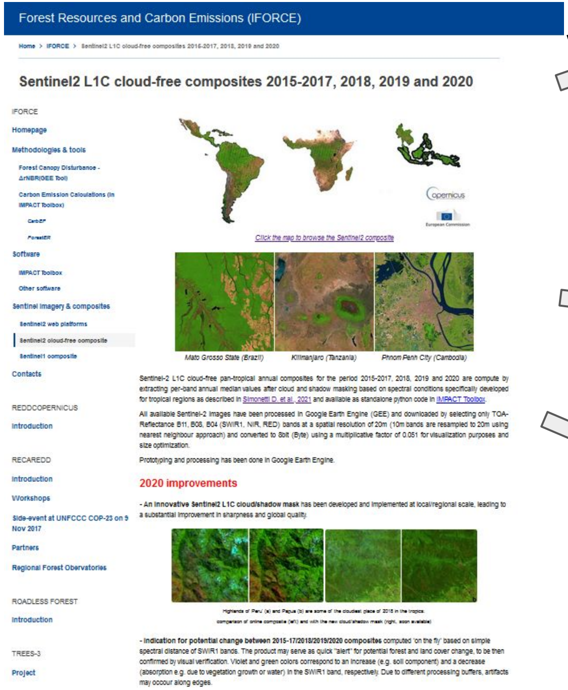
Resolution: 20m

Bands: B04 B08 B11

Rescaled **Byte** 0-255

Joint Research Centre

Info



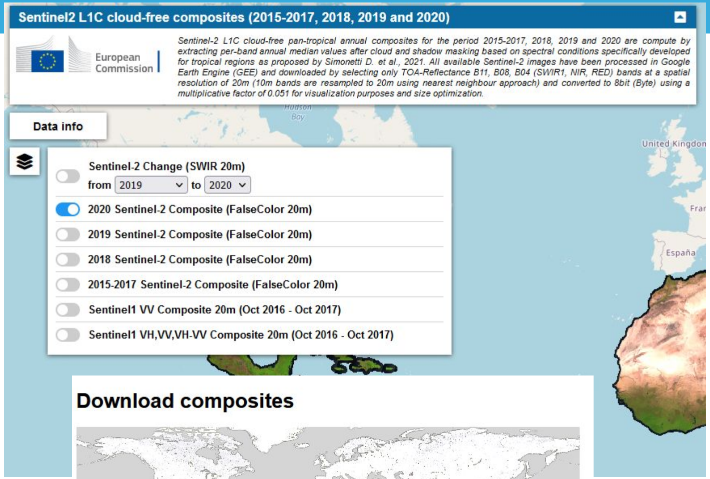
Ref.

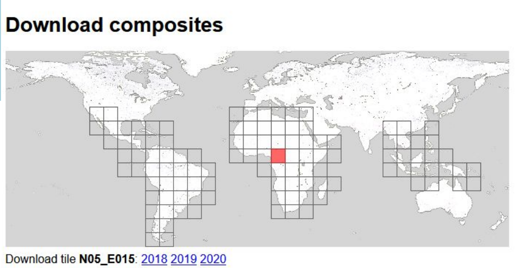
Data in Brief
submitted

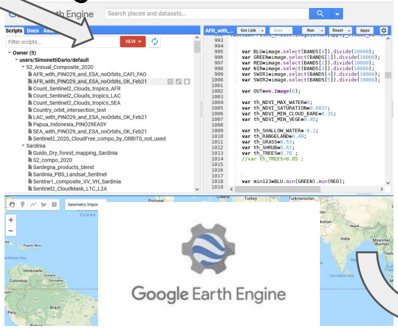
Browse

Download

Customize







porting

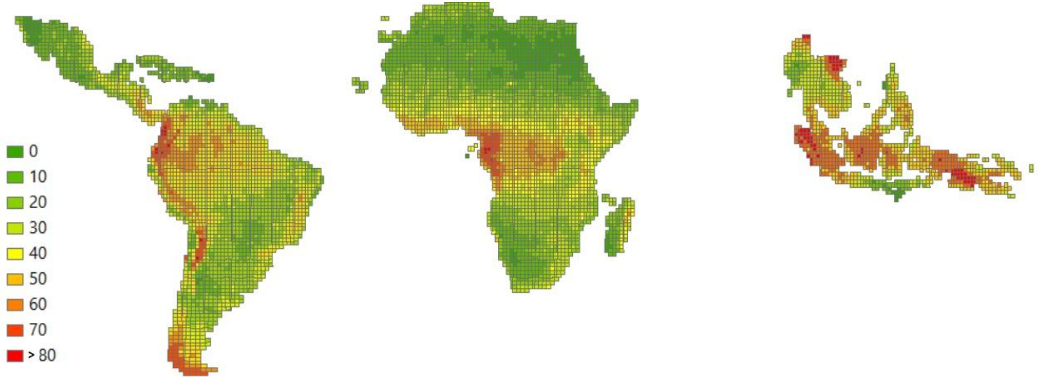
https://forobs.jrc.ec.europa.eu/recaredd/S2_composite.php

European Commission

https://forobs.jrc.ec.europa.eu/recaredd/map/

Joint Research Centre

Extra



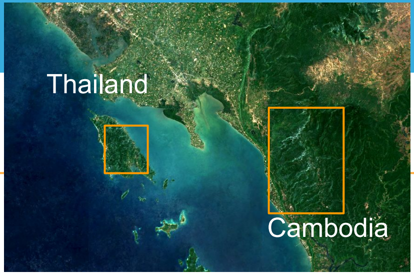
Average cloud cover distribution per MGRS tiles in year 2020 as computed from image metadata

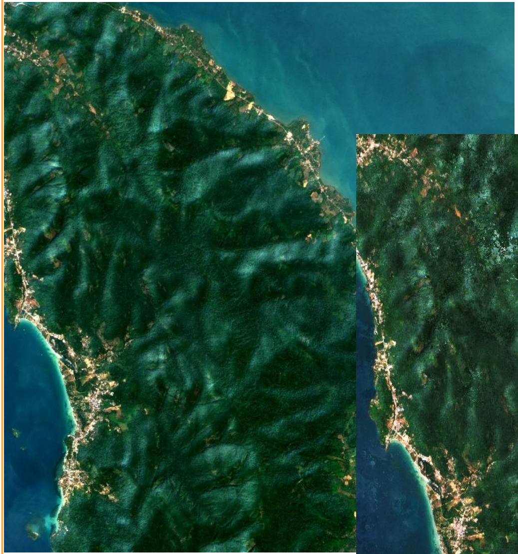
The proposed PINO cloud & shadow mask algorithm has been applied to cloud-prone countries (yellow) while a simple mask based on ESA QA60 band (>=1024) was sufficient in areas with abundance of cloud free images (green).

The former approach is resource (CPU, RAM) demanding hence almost two times slower; however, the average execution time (per orbit, per country) remains within the 2 hours

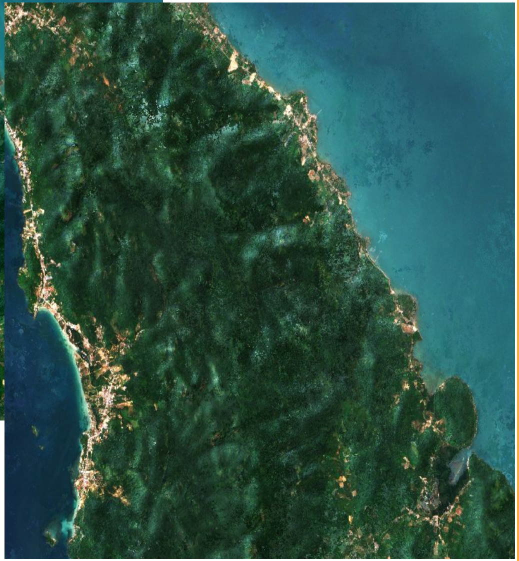
L2A composite 2019

- overcorrection of north facing slopes
- S2GM / any other L2A composite are affected





01 -> 31 Jan



Ko Chang Island, Thailand

Jan / May

01 -> 31 Jan

Cambodia,
Phnum Samkos Wildlife Sanctuary

Jan / May

European Commission

Joint Research Centre

Compositing by orbits

Despite double acquisitions might provide higher chance of getting cloud free observations, pixels laying on the eastern and western side of the adjacent swaths present a considerable spectral difference caused by the BRDF effect, especially over humid forest.

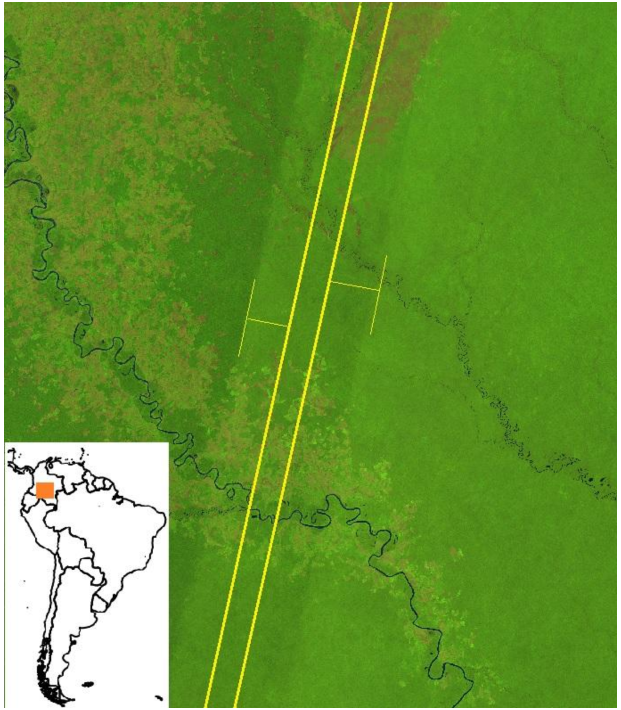
To overcome the heterogeneous spectral response in overlapping areas, the Sentinel-2 L1C collection is processed by orbit. Additionally, an inwards buffer of 8km has been applied to each swath (orbit) geometry.

The yellow lines shows the boundaries of the vector file used in the compositing algorithm in 2019 and 2020 while background shows the raw median composite computed in 2018 and the three distinct zones corresponding to the west, overlaps and east orbits. It is worth noting that compositing by orbit is essential to

a) limit the amount of data to be processed

b) remove tile zig-zag along the edge and

c) guarantee a correct empirical BRDF correction as described hereafter.



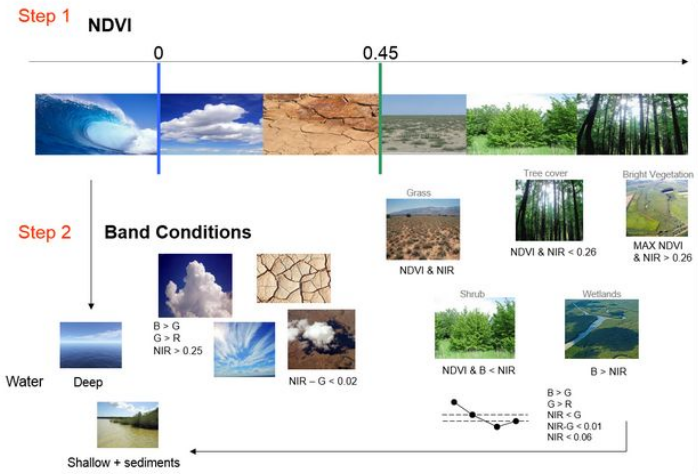
Extra

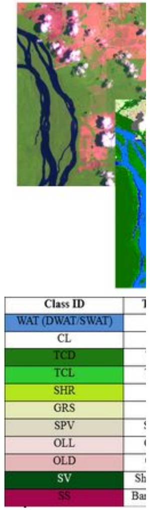
Pixel based classification algorithm

First Results From the Phenology-Based Synthesis Classifier Using Landsat 8 Imagery

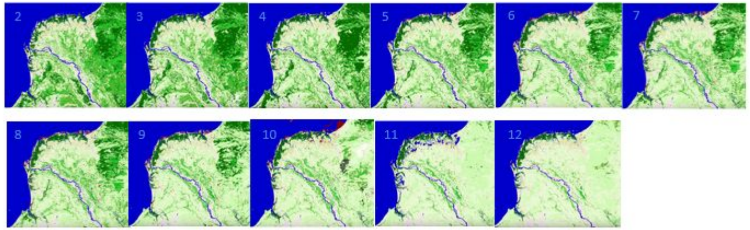
https://ieeexplore.ieee.org/document/7061922

From Automatic Single Date Classification …



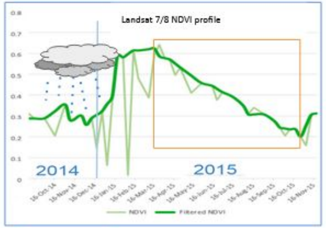


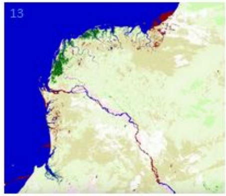
… to multi-date thematic time series analysis



Single-date classification

OUT \ % IN		WAT	SV	TCD	TCL	SHR	GRS	SPV	OLL	OLD	SS
Permanent Water		100									
Seasonal Water		>60	≥ 0	≥ 0	≥ 0	≥ 0	≥ 0	≥ 0	≥ 0	≥ 0	≥ 0
Evergreen Forest			≥ 0	>40	>40	≥ 0	≥ 0				
Evergreen Shrub				≥ 0	≥ 0	>60	<10				
Deciduous Forest			≥ 0	>60			≥ 0	≥ 0	≥ 0	≥ 0	<20
Grassland			≥ 0		<10	≥ 0	>50	≥ 0	<30		
Dark Rocks / Urban									≥ 0	≥ 0	>80
Dark Soil									≥ 0	>80	≥ 0
Light Soil/ Sand								<20	>80	≥ 0	≥ 0





Joint Research Centre

Joint Research Centre

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