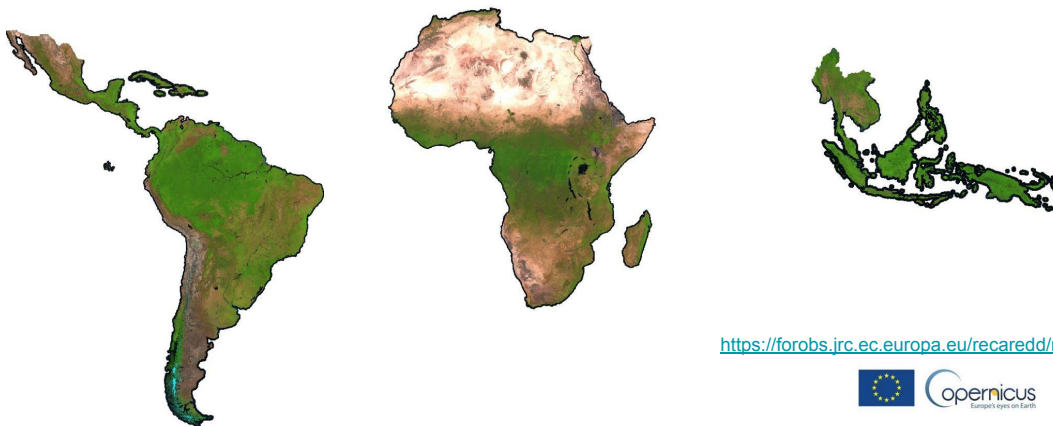


Sentinel-2 L1C cloud-free composites 2015-2017, 2018, 2019, 2020

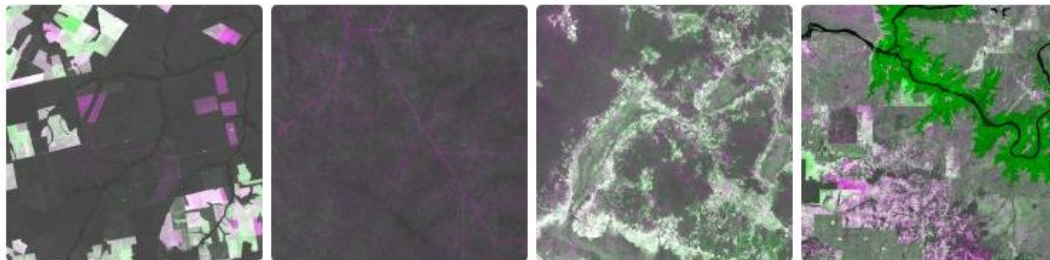


Google Earth Engine



- 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

Indication for **potential annual change**



From left: Mato Grosso (Brazil), Sanga (Congo), Manyoni (Tanzania), Stung Treng (Cambodia)

GEO-GFOI

Virtual Workshop

16-17 June



dario.simonetti@ext.ec.europa.eu

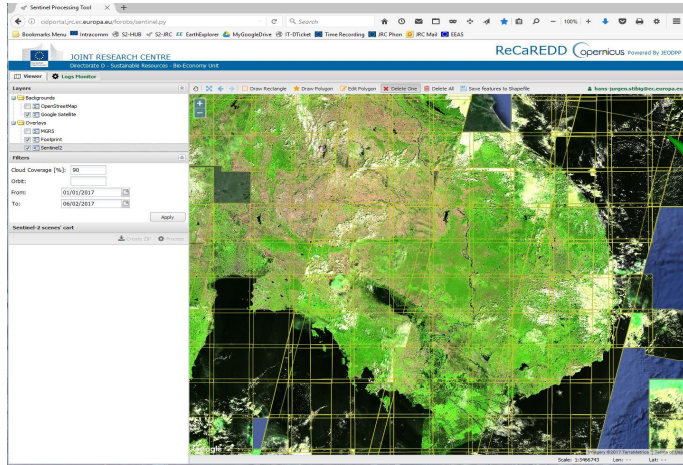
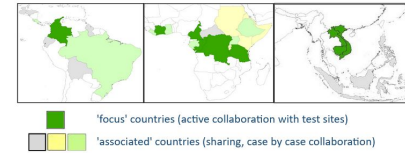
Since January 2016



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

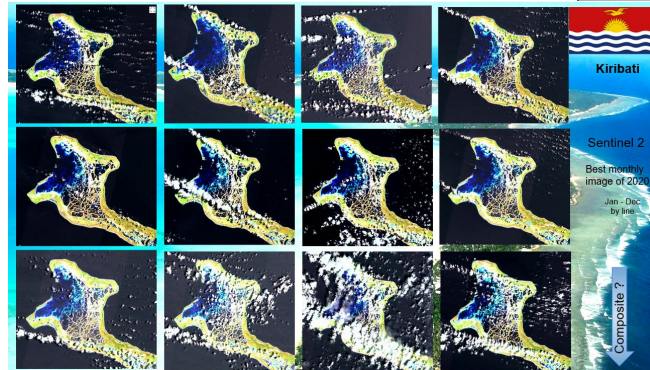
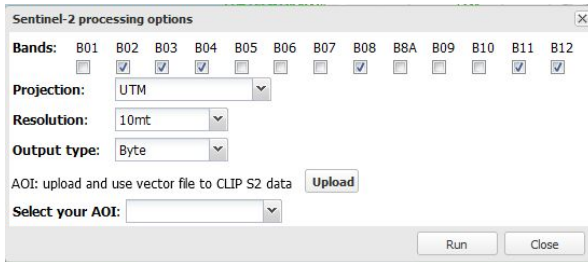
JRC support to ReCaREDD



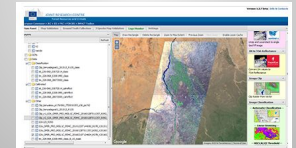
- Filter by AOI, time, Cloud %
- Full resolution custom visualization
- Download only what you see / need



From GB to Mb



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



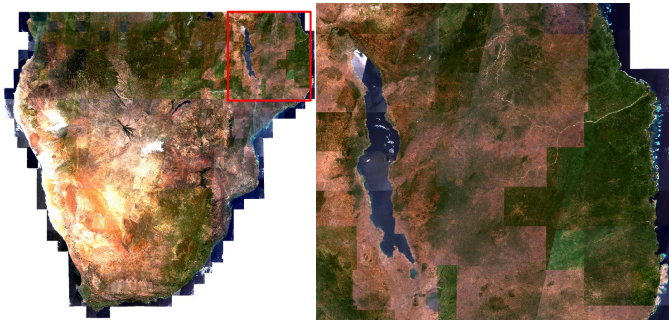
Sentinel 2 images of Sudan being processing in the JRC IMPACT tool.

But ...

Still single image

Clouds?

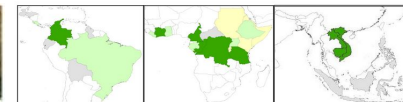
"Provide Remote Sensing Tools and Methods for Monitoring Forest Change in the Context of REDD+"



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



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



■ 'focus' countries (active collaboration with test sites)
 ■ 'associated' countries (sharing, case by case collaboration)

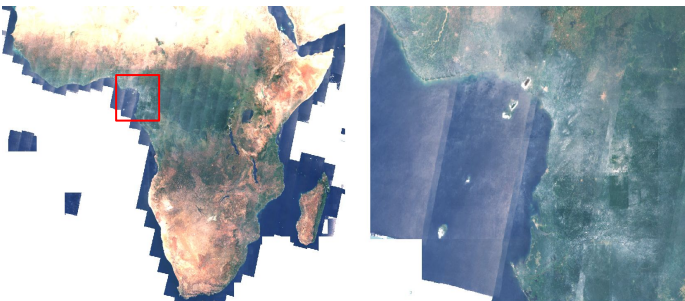
JRC support to

- ReCaREDD,
- REDDCopernicus
- *Intra-ACP*

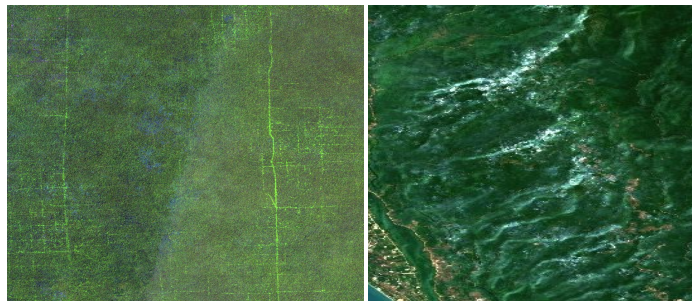
But ...

Available composites are affected by:

- Tiling
- Residual clouds
- L2A overcorrection

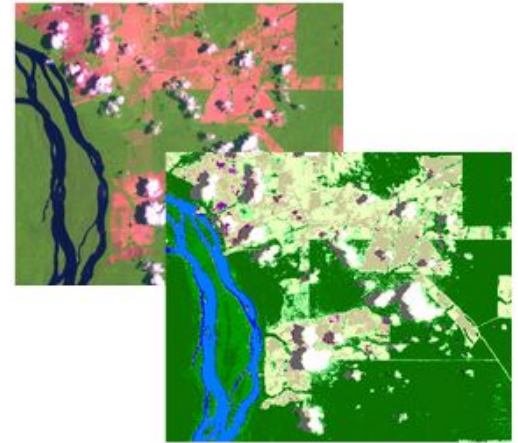
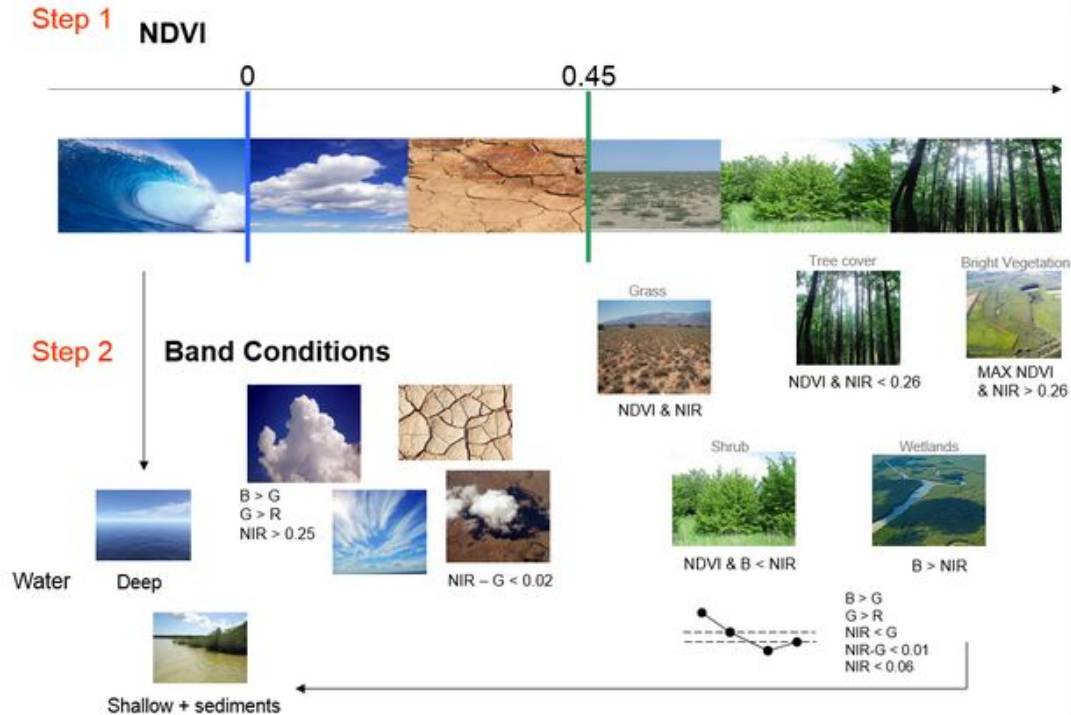


JRC Global Sentinel-2 L1C 2017-2018 composite as proposed by Corbane C.



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

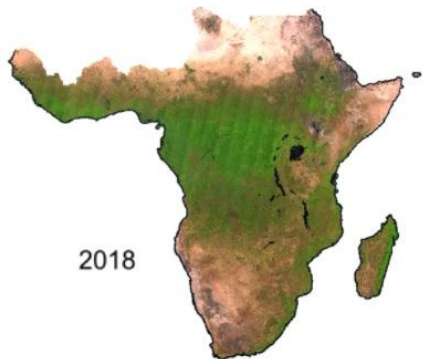
New Cloud - Shadow mask based on pre-defined thresholds based on individual pixel



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 Raw L1C (2018)

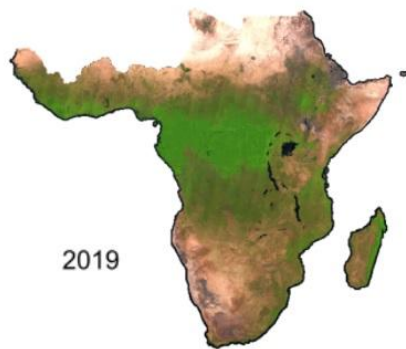
L1C Top of Atmosphere reflectance



2018

& Forest Normalization per MGRS Tile (2019)

dark object subtraction using evergreen forest as pseudo invariant feature

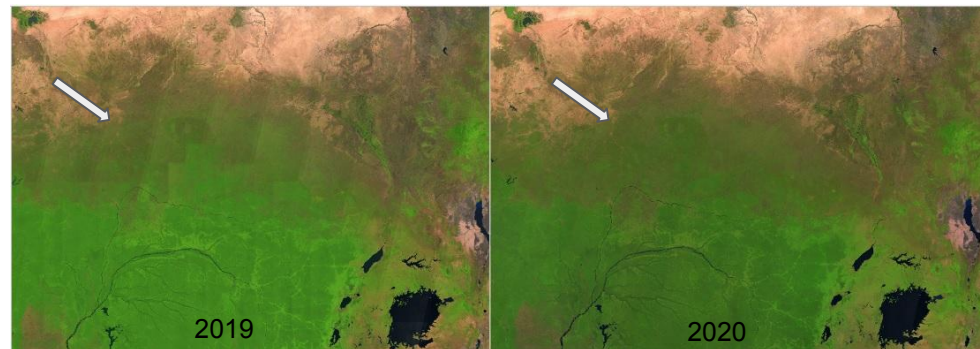


2019

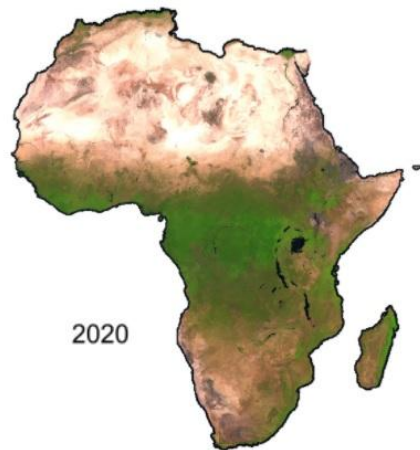
to

Orbit Equalization (2020)

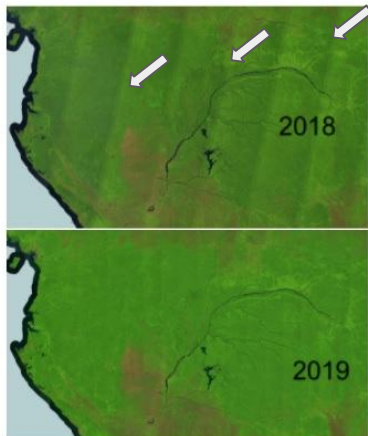
multiplicative gradient ranging, over humid forest, from -12% to 0% (west-east)



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

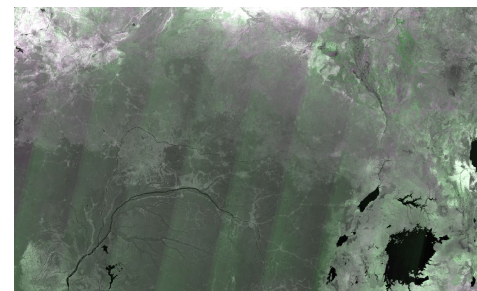


2020

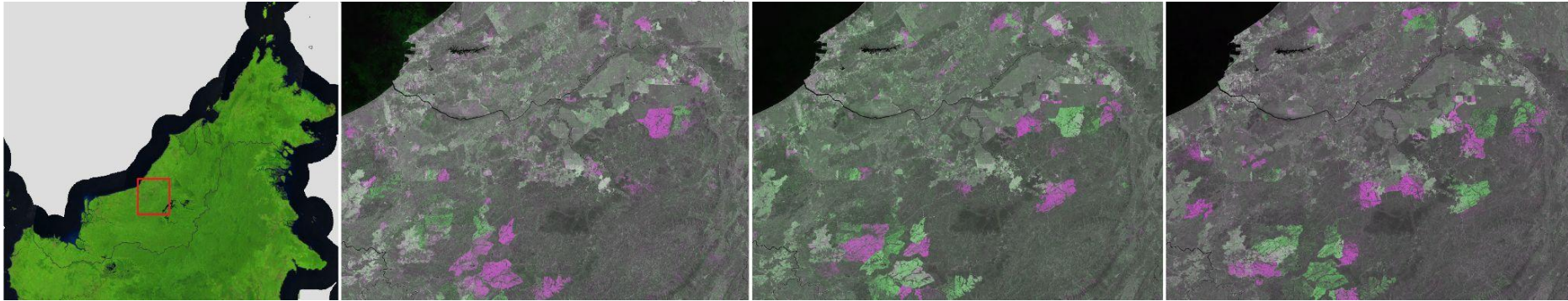


2018

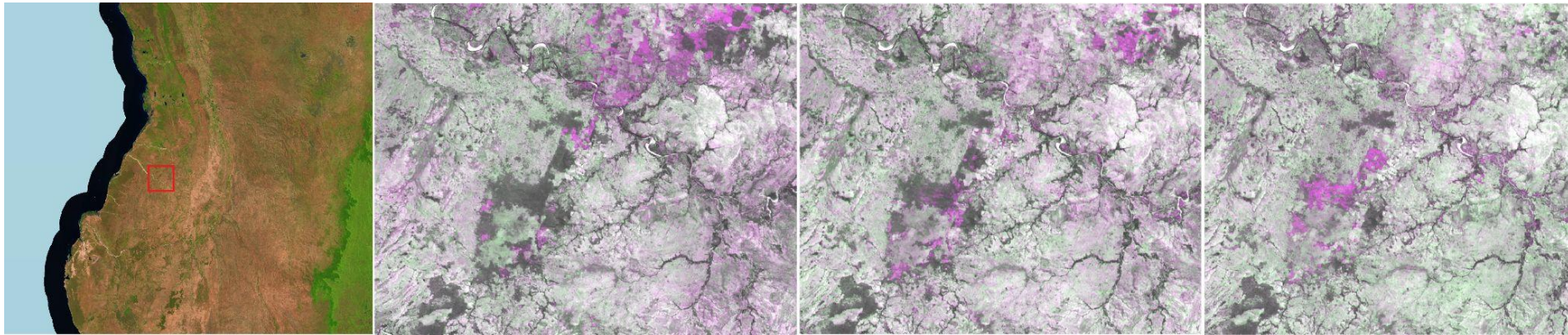
2019



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)



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
- 1/2d download
- 1/2d web + overviews



Google Earth Engine



JRC
website

Estimated size: **94 GB**

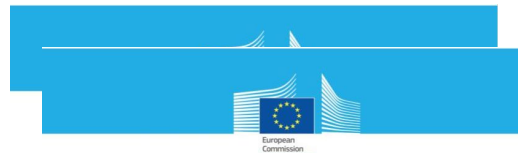
Start time: 2019-06-01 / 2019-08-30

Temporal period: QUARTER

Resolution: 20m

Bands: B04 B08 B11

Rescaled **Byte** 0-255



JRC TECHNICAL REPORTS

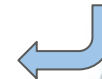
Sentinel2 L1C cloud-free composites (2015-2017, 2018, 2019 and 2020)



Sentinel-2 L1C cloud-free pan-tropical annual composites for the period 2015-2017, 2018, 2019 and 2020 are computed by extracting per-band annual median values after cloud and shadow masking based on spectral conditions specifically developed for tropical regions as proposed by Simonetti D. et al., 2021. All available Sentinel-2 images have been processed in Google Earth Engine (GEE) and downloaded by selecting only TOA-Reflectance B11, B08, B04 (SWIR1, NIR, RED) bands at a spatial resolution of 20m (10m bands are resampled to 20m using nearest neighbour approach) and converted to 8bit (Byte) using a



Verification



Info

Forest Resources and Carbon Emissions (IFORCE)

Home > IFORCE > Sentinel2 L1C cloud-free composites 2016-2017, 2018, 2019 and 2020

Sentinel2 L1C cloud-free composites 2016-2017, 2018, 2019 and 2020

IFORCE

Home page

Methodologies & tools

Forest Canopy Disturbance - JAMPROBE Tool

Carbon Emission Calculations (in JAMPROBE Tool)

Cloud

Forest

Software

IMPACT toolbox

Other software

Sentinel imagery & composites

Sentinel2 web platforms

Sentinel2 cloudfree composite

Sentinel1 composite

Contacts

REDCORE PARTNERS

Introduction

RECARDED

Introduction

Workshops

Side-event at UNFCCC COP-23 on 9 Nov 2017

Partners

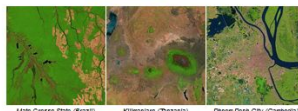
Regional Forest Observatories

ROADLESS FOREST

Introduction

THREES-3

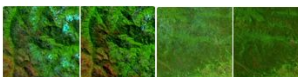
Project



Sentinel-2 L1C cloud-free pan-tropical annual composites for the period 2015-2017, 2018, 2019 and 2020 are computed by extracting per-band annual median values after cloud and shadow masking based on spectral conditions specifically developed for tropical regions as described in [Simoneit et al., 2021](#) and available as standalone python code in [JAMPROBE Tool](#). All satellite Sentinel-2 images have been processed in Google Earth Engine (GEE) and downloaded by selecting only TOA-Reflectance B11, B08, B04 (SWIR1, NIR, RED) bands at a spatial resolution of 20m (10m bands are resampled to 20m using nearest neighbour approach) and converted to 8bit (byte) using a multiplicative factor of 0.001 for visualization purposes and size optimization.

2020 improvements

- An innovative Sentinel2 L1C cloudshadow mask has been developed and implemented at local/regional scale, leading to a substantial improvement in sharpness and global quality.



- Indication for potential change between 2015-17/2018/2019/2020 composites computed on the fly based on simple spectral distance of 0.01 in the SWIR1 band. The product may serve as quick "test" for potential forest and land cover change, to be then confirmed by visual verification. Violet and green colors correspond to an increase (e.g. soil, forest) and a decrease (desorption e.g. due to vegetation growth or water) in the SWIR1 band, respectively. Due to different processing buffers, artifacts may occur along edges.

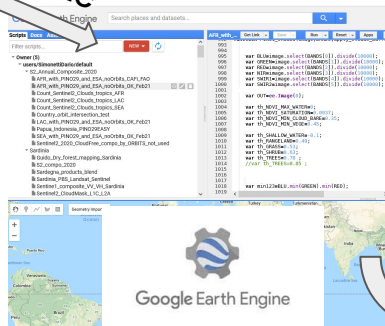
Ref.

Browse

Download

Customize

Data in Brief submitted



Google Earth Engine

Joint Research Centre

Sentinel2 L1C cloud-free composites (2016-2017, 2018, 2019 and 2020)



Sentinel-2 L1C cloud-free pan-tropical annual composites for the period 2015-2017, 2018, 2019 and 2020 are computed by extracting per-band annual median values after cloud and shadow masking based on spectral conditions specifically developed for tropical regions as proposed by Simoneit et al., 2021. All available Sentinel-2 images have been processed in Google Earth Engine (GEE) and downloaded by selecting only TOA-Reflectance B11, B08, B04 (SWIR1, NIR, RED) bands at a spatial resolution of 20m (10m bands are resampled to 20m using nearest neighbour approach) and converted to 8bit (Byte) using a multiplicative factor of 0.001 for visualization purposes and size optimization.

Data info

☐ Sentinel-2 Change (SWIR 20m)
from 2019 to 2020

☒ 2020 Sentinel-2 Composite (FalseColor 20m)

☐ 2019 Sentinel-2 Composite (FalseColor 20m)

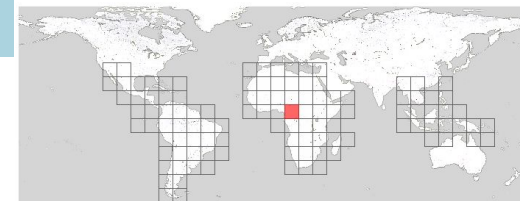
☐ 2018 Sentinel-2 Composite (FalseColor 20m)

☐ 2015-2017 Sentinel-2 Composite (FalseColor 20m)

☐ Sentinel1 VV Composite 20m (Oct 2016 - Oct 2017)

☐ Sentinel1 VH,VV,VH-VV Composite 20m (Oct 2016 - Oct 2017)

Download composites



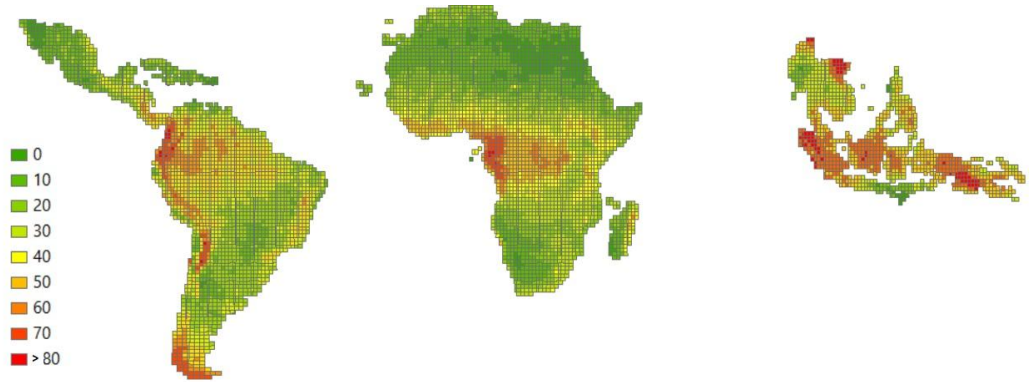
Download tile N05_E015 2018 2019 2020



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

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

Extra



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

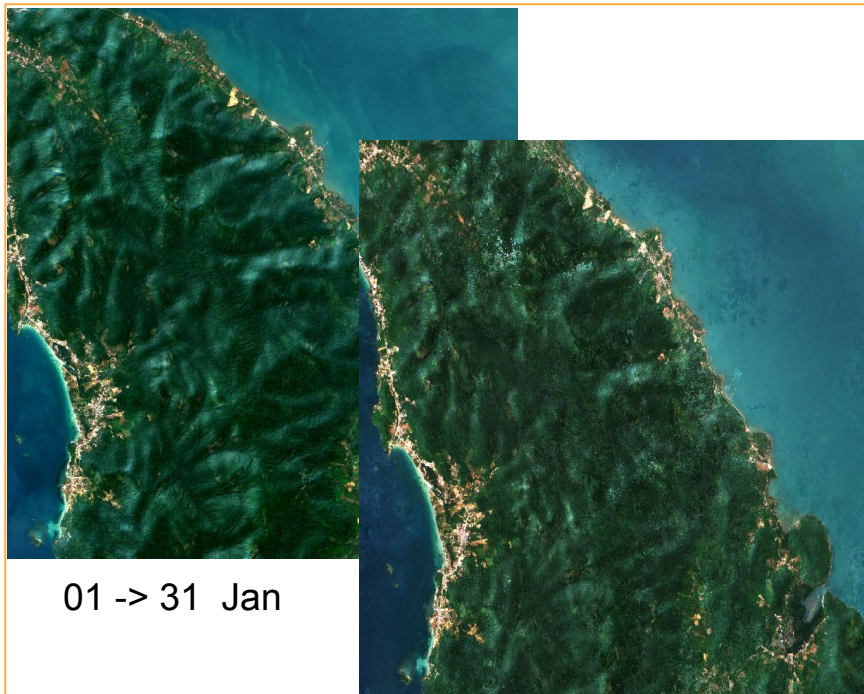
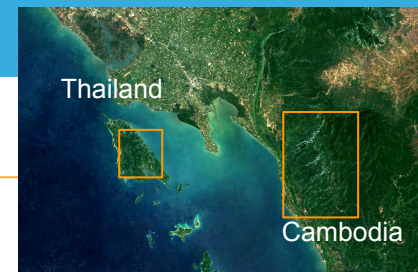
The proposed PINO cloud & shadow mask algorithm has been applied to cloud-prone countries (yellow) while a simple mask based on ESA QA60 band (≥ 1024) was sufficient in areas with abundance of cloud free images (green).

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

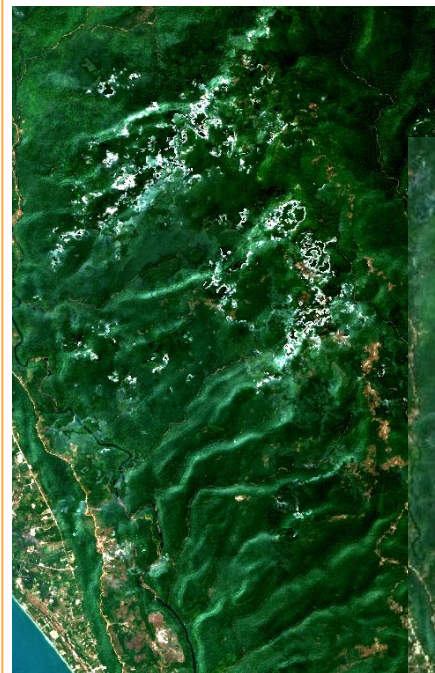


01 -> 31 Jan

Ko Chang Island, Thailand

Jan / May

Joint
Research
Centre



01 -> 31 Jan

Cambodia,
Phnum Samkos Wildlife Sanctuary



Jan / May

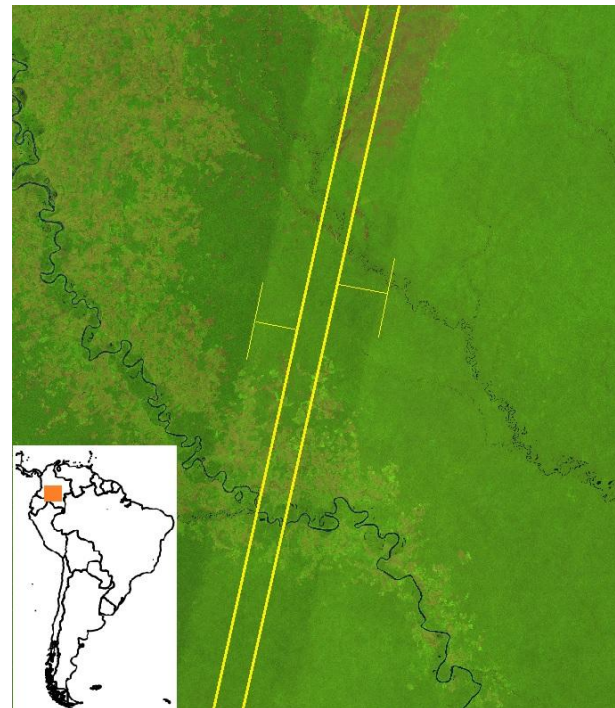
Compositing by orbits

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.



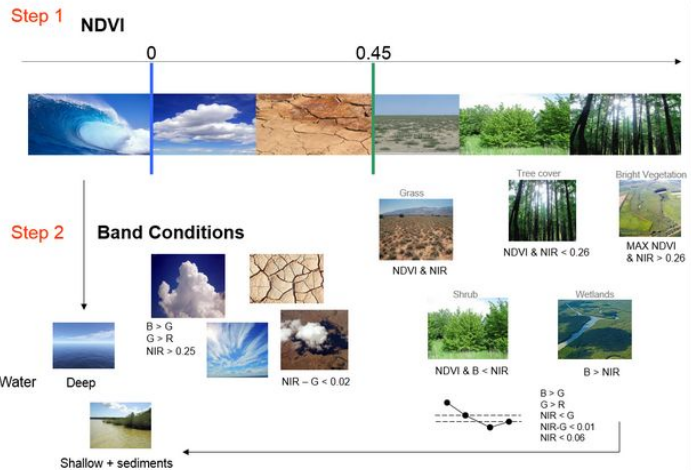
Extra

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 ...



Joint Research Centre

... to multi-date thematic time series analysis

