Accessing and Processing Brazilian EO Data Cubes with Open Data Cube

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BRAZIL DATA CUBE

FUNDO AMAZÔNIA

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BNDES MINISTÉRIO DA ECONOMIA MINISTÉRIO DO MEIO AMBIENTE PÁTRIA AMADA BRASIL GOVERNO FEDERAL

Brazil Data Cube Project

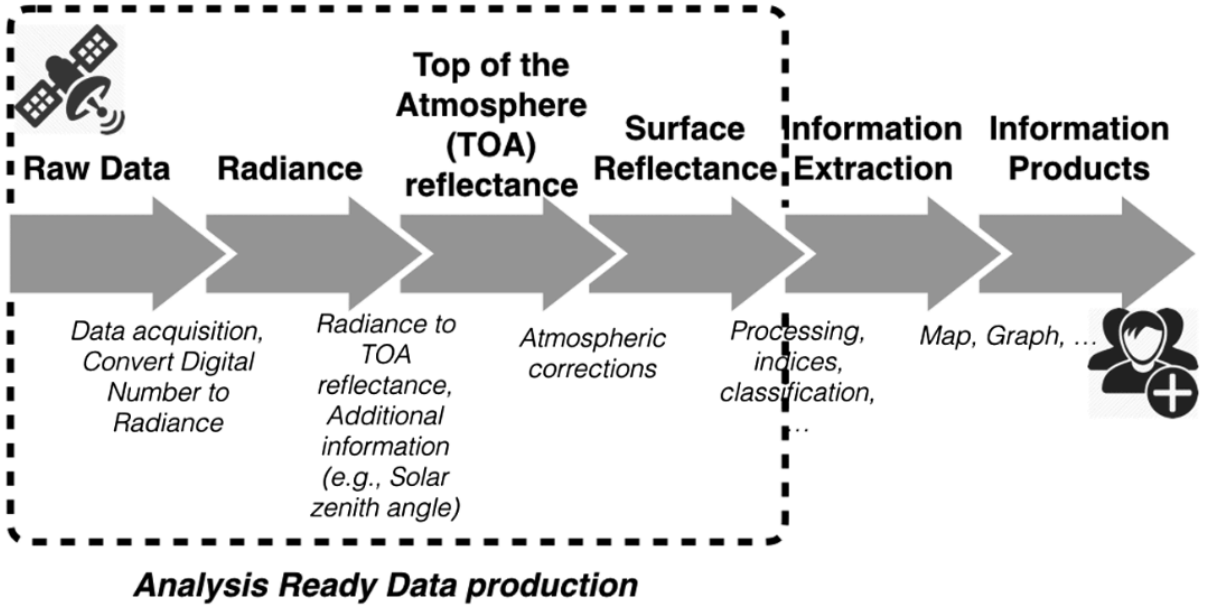
Started in 2019. Developed by INPE.

(Goal 1) *Analysis-Ready Data* (ARD) of medium-resolution satellite images (10 to 60 meters) for all Brazilian territory: CBERS-4, Landsat 8 and Sentinel 2

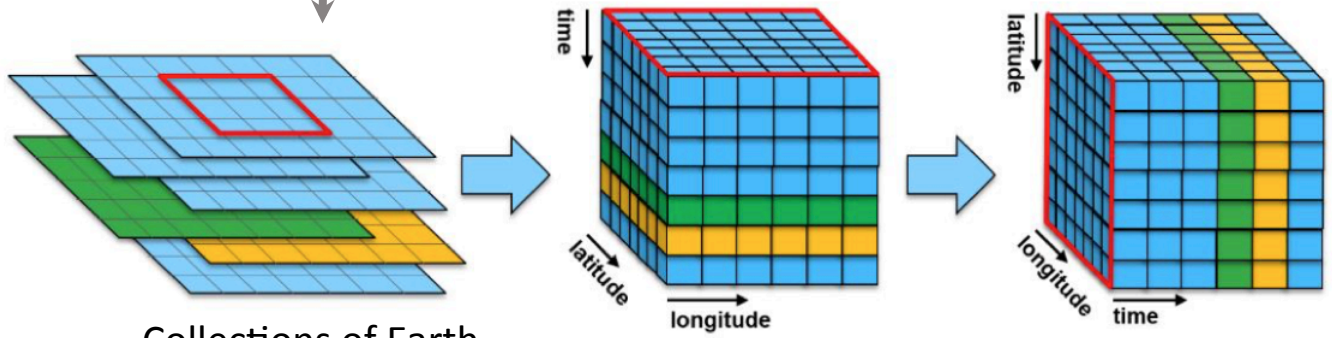
(Goal 2) Multidimensional data cubes from these ARD image collections

(Goal 3) Big data technologies, image time series analysis and machine learning methods

(Goal 4) Land use and cover information for all Brazilian territory.



Source: [Giuliani et al, 2017]



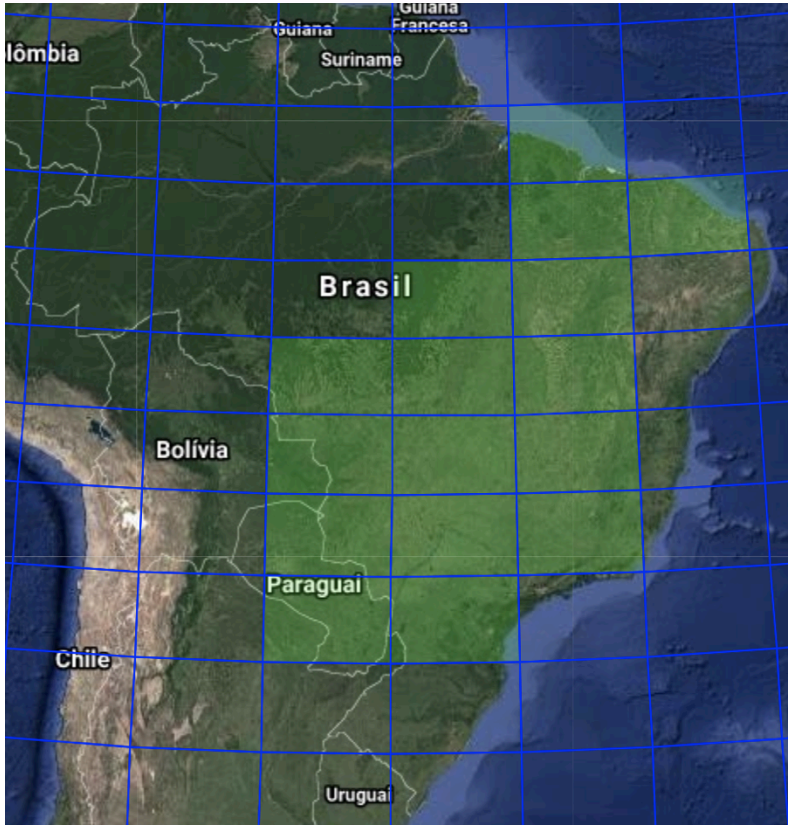
Collections of Earth observation satellite imagens – ARD

Data cubes – four-dimensional array.

Source: [Kopp et al, 2019]

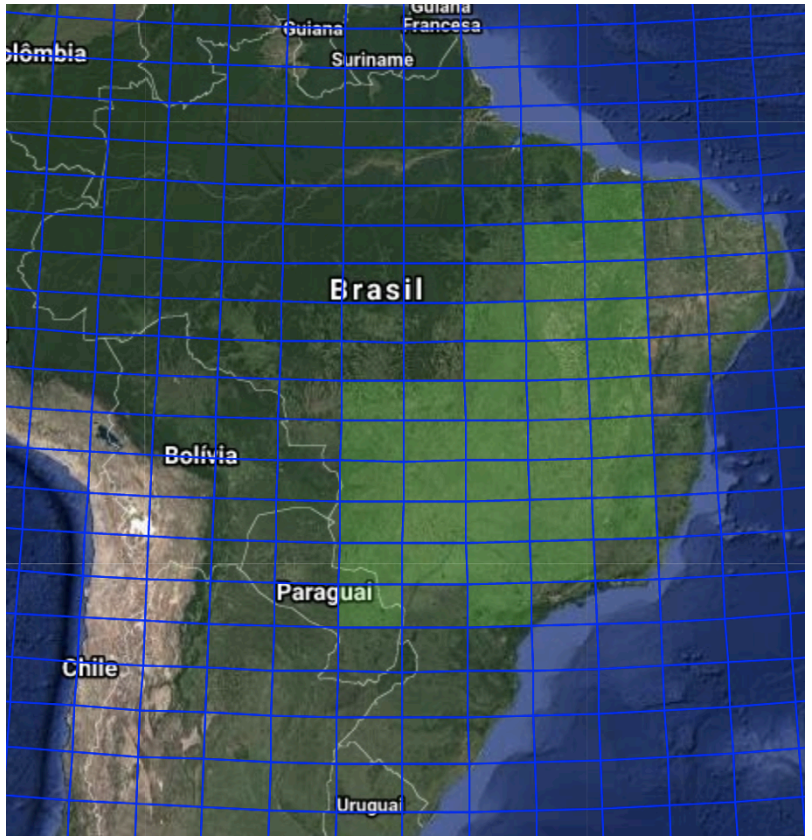
Brazil Data Cube Project

http://brazildatacube.dpi.inpe.br/portal/explore



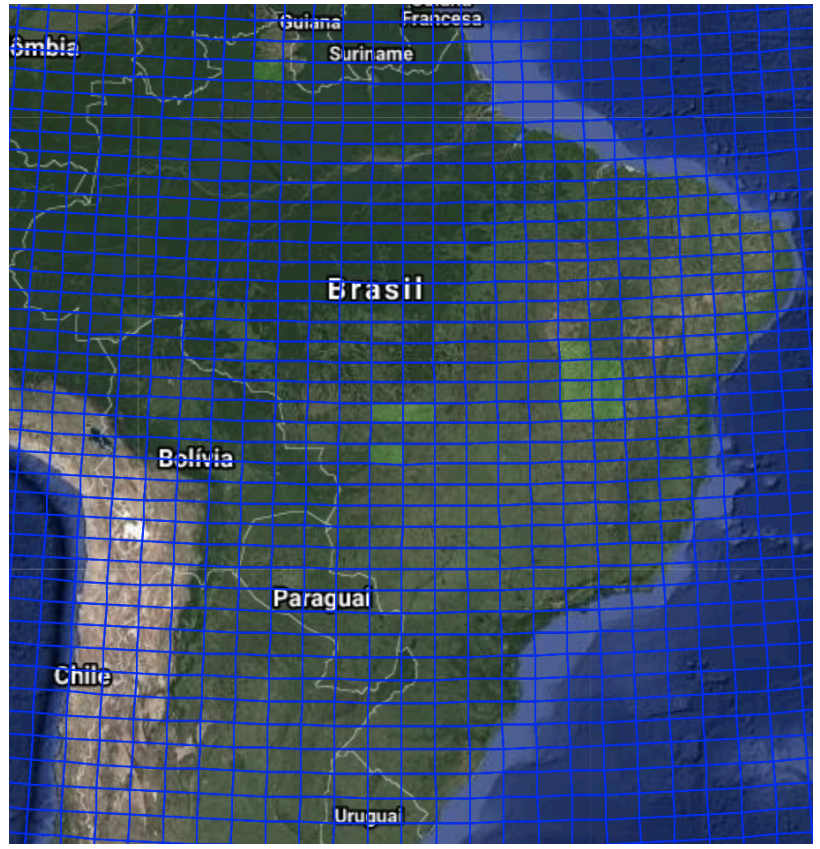
BDC – Large
Each tile: 6 x 4 degrees

CBERS 4/WFI – 64 meters
Each file (band/tile): 170 MB
Each tile: ~ 1 GB



BDC – Medium
Each tile: 3 x 2 degrees

Landsat 8/OLI – 30 meters
Each file (band/tile): 200 MB
Each tile: ~ 2 GB

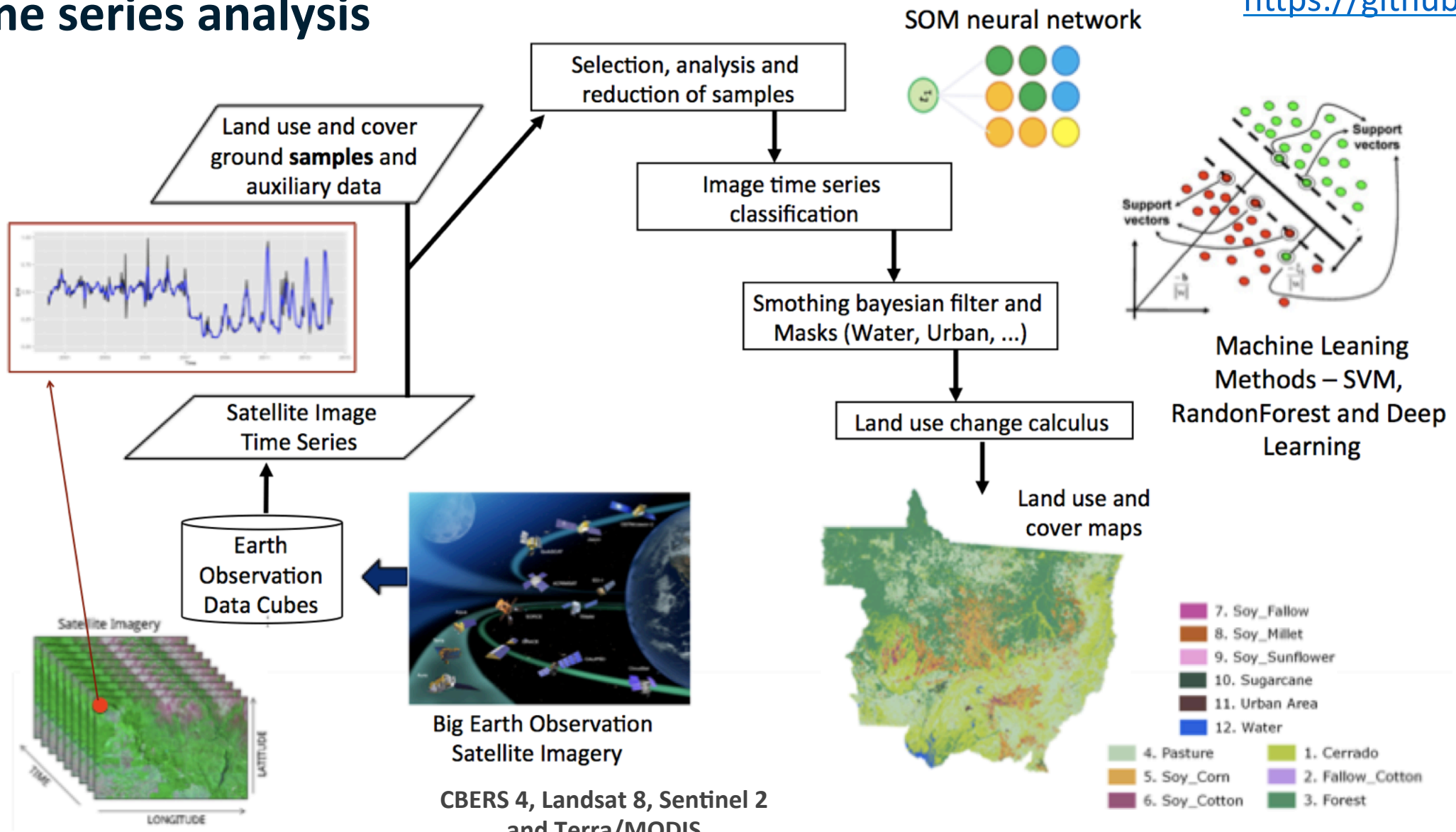


BDC – Small
Each tile: 1.5 x 1 degree

Sentinel 2/MSI – 10 meters
Each file (band/tile): 400 MB
Each tile: ~ 5.4 GB

EO data cubes and satellite image time series analysis

SITS (Satellite Image Time Series) R package:
https://github.com/e-sensing



Data cubes available at:
http://brazildatacube.dpi.inpe.br/portal/explore

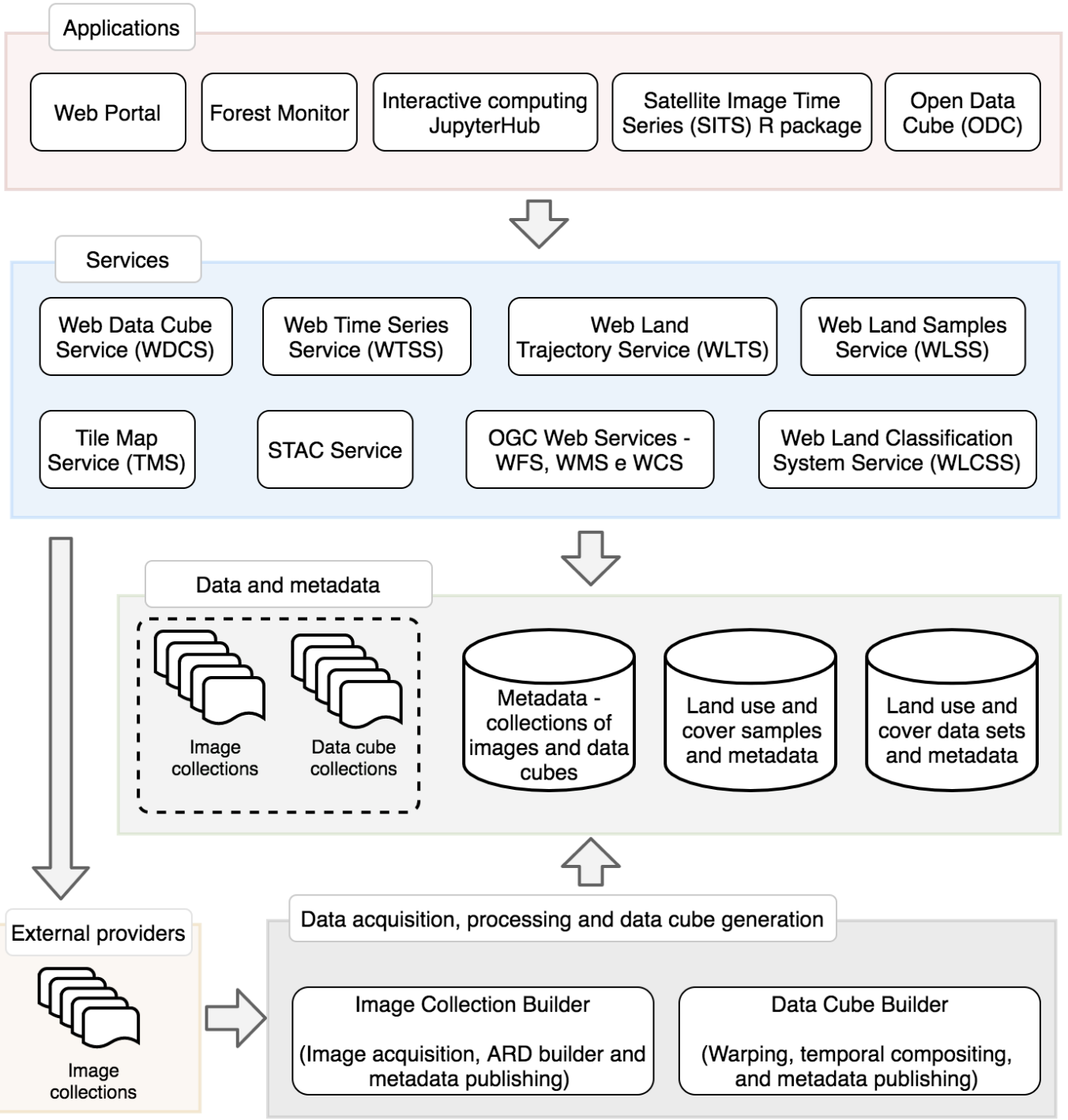
Land use and cover change maps:
https://doi.pangaea.de/10.1594/PANGAEA.899706

BRAZIL DATA CUBE

Open Data and Software Products

Software

Data and metadata

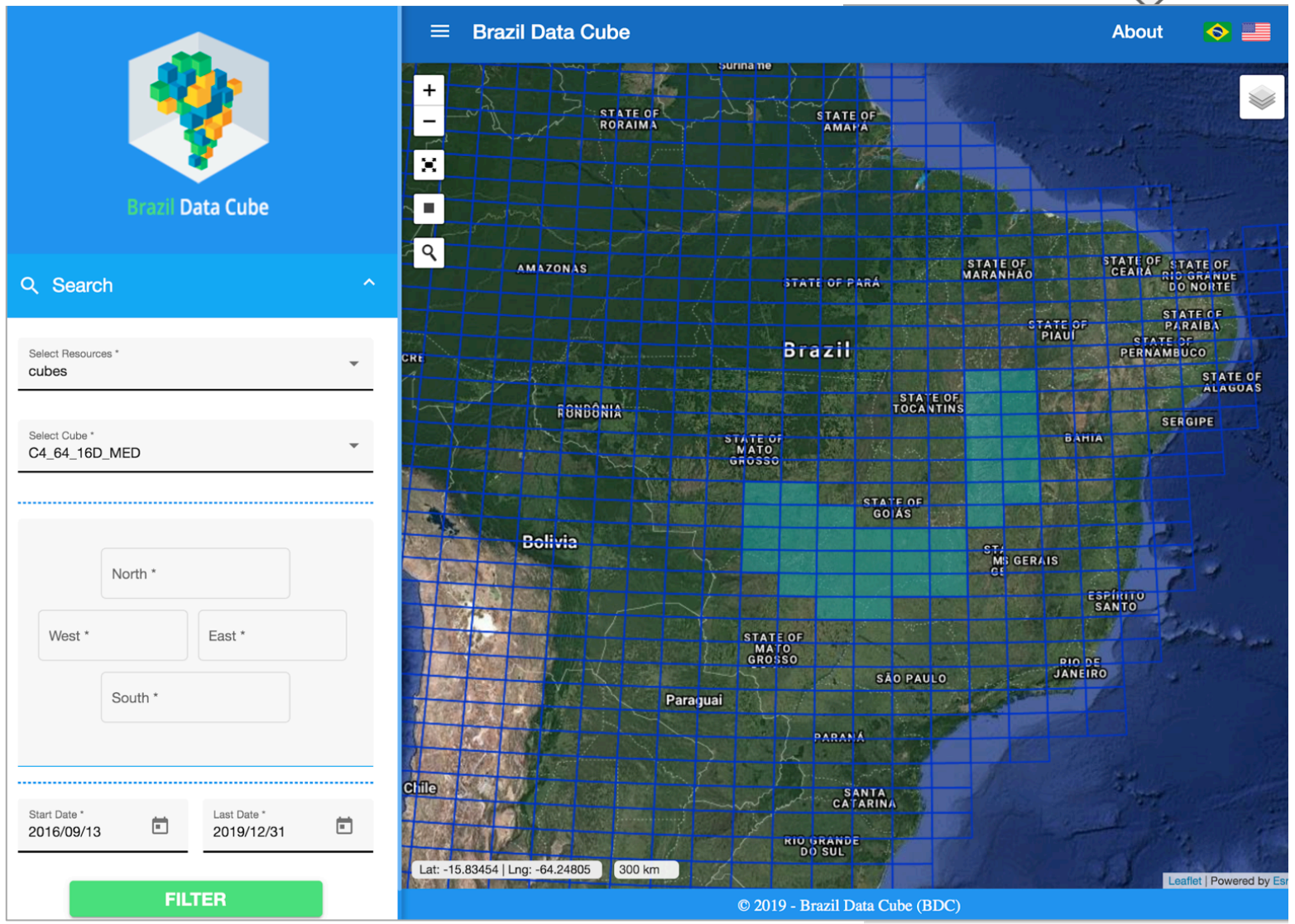


Source:
[Ferreira et al., 2020]

Applications

Web Portal | Forest Monitor | Interactive computing JupyterHub | Satellite Image Time Series (SITS) R package | Open Data Cube (ODC)

http://brazildatacube.dpi.inpe.br/portal/explore



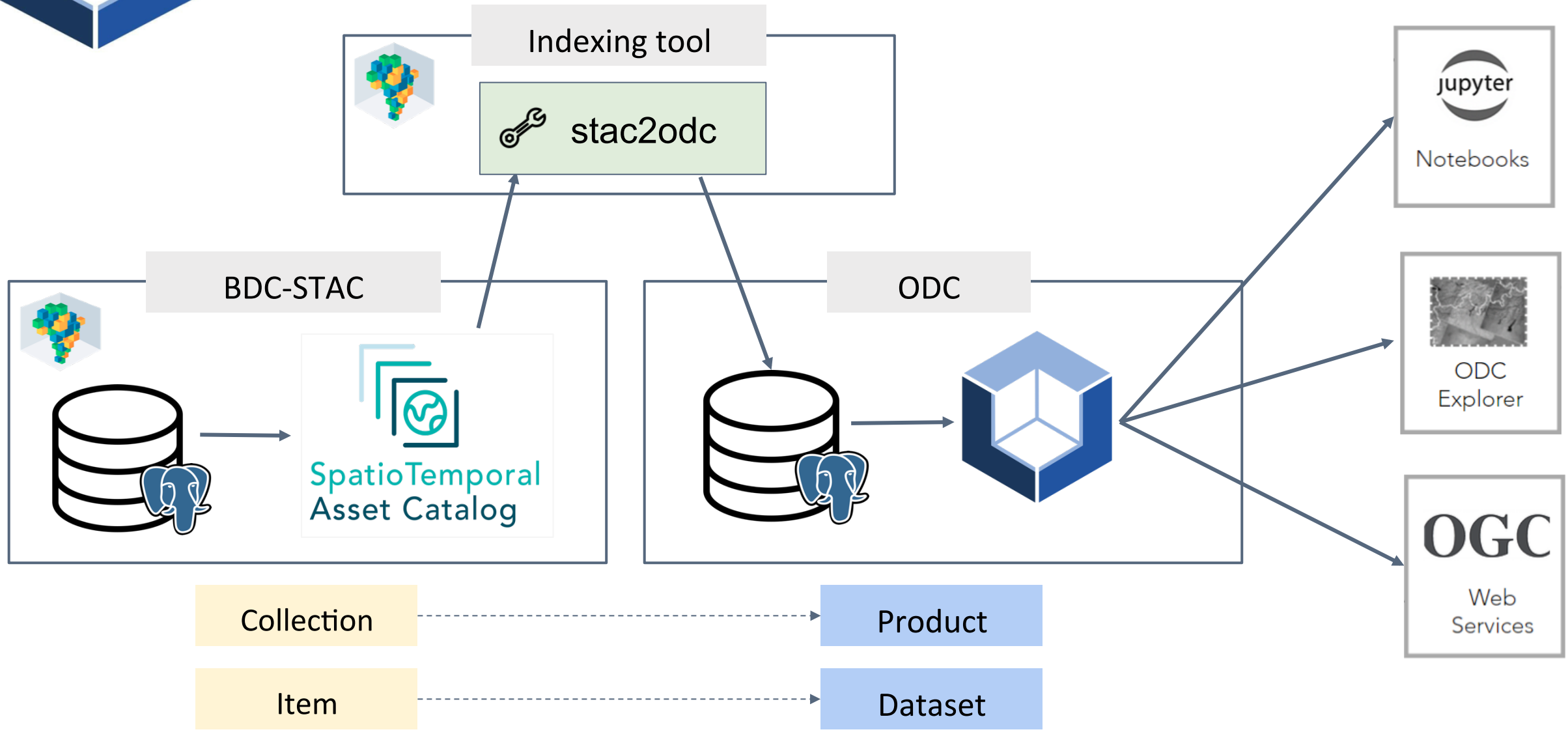
OPEN DATA CUBE

SITS (Satellite Image Time Series) R package:

https://github.com/e-sensing

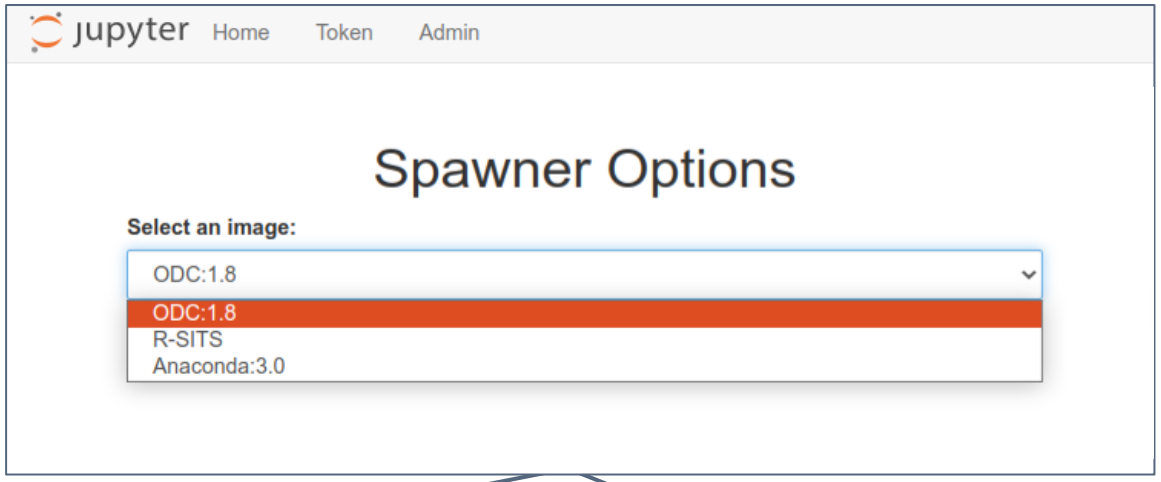
Accessing and Processing Brazilian EO Data Cubes with Open Data Cube

ODC + BDC


Indexing tool
stac2odc
BDC-STAC
SpatioTemporal
Asset Catalog
ODC
jupyter
Notebooks
ODC
Explorer
OGC
Web
Services
Collection
Product
Item
Dataset

ODC + BDC

Jupyterhub



Notebooks

KMeans Clustering - CB4_64_16D_STK_v1

This document presents an example of spectral clustering in the CBERS4 collection (CB4_64_16D_STK_v1) of

> This simple example aims to present how to clustering the data from the BDC stored inside the ODC. To
> BDC-STAC.

In [1]:
```
import datacube
import numpy as np
import matplotlib.pyplot as plt
dc = datacube.Datacube(app='datacube')
```

In [2]:
```
PRODUCT_NAME = "CB4_64_16D_STK_v1"
```

Load CB4_64_16D_STK_v1 product

Initially, an entire scene will be loaded, in a range of specific dates

In [3]:
```
cb4_64_16d_ftile = dc.load(PRODUCT_NAME, measurements = ['red', 'green', 'blue', 'nir'],
                           time = ("2019-12-19", "2019-12-31"), resolution = (64, -64))
cb4_64_16d_ftile
```

Tile Viewer

This document presents a utility that makes it possible to view the BDC tiles that are registered in the ODC.

> To see all the available products, see the BDC-Portal and BDC-STAC.

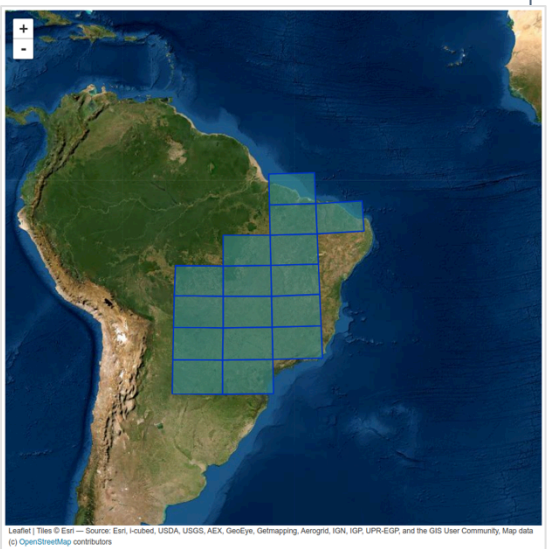
BDC CBERS Tiles

This section presents the CBERS tiles that were registered at the time this example w

In [ ]:
```
dc = datacube.Datacube(app='datacube')
datasets = dc.find_datasets(product = "CB4_64_16D_STK_v1")
```

In [5]:
```
from bdc_utils import bdc_plot_datasets
bdc_plot_datasets(datasets, zoom = 4)
```

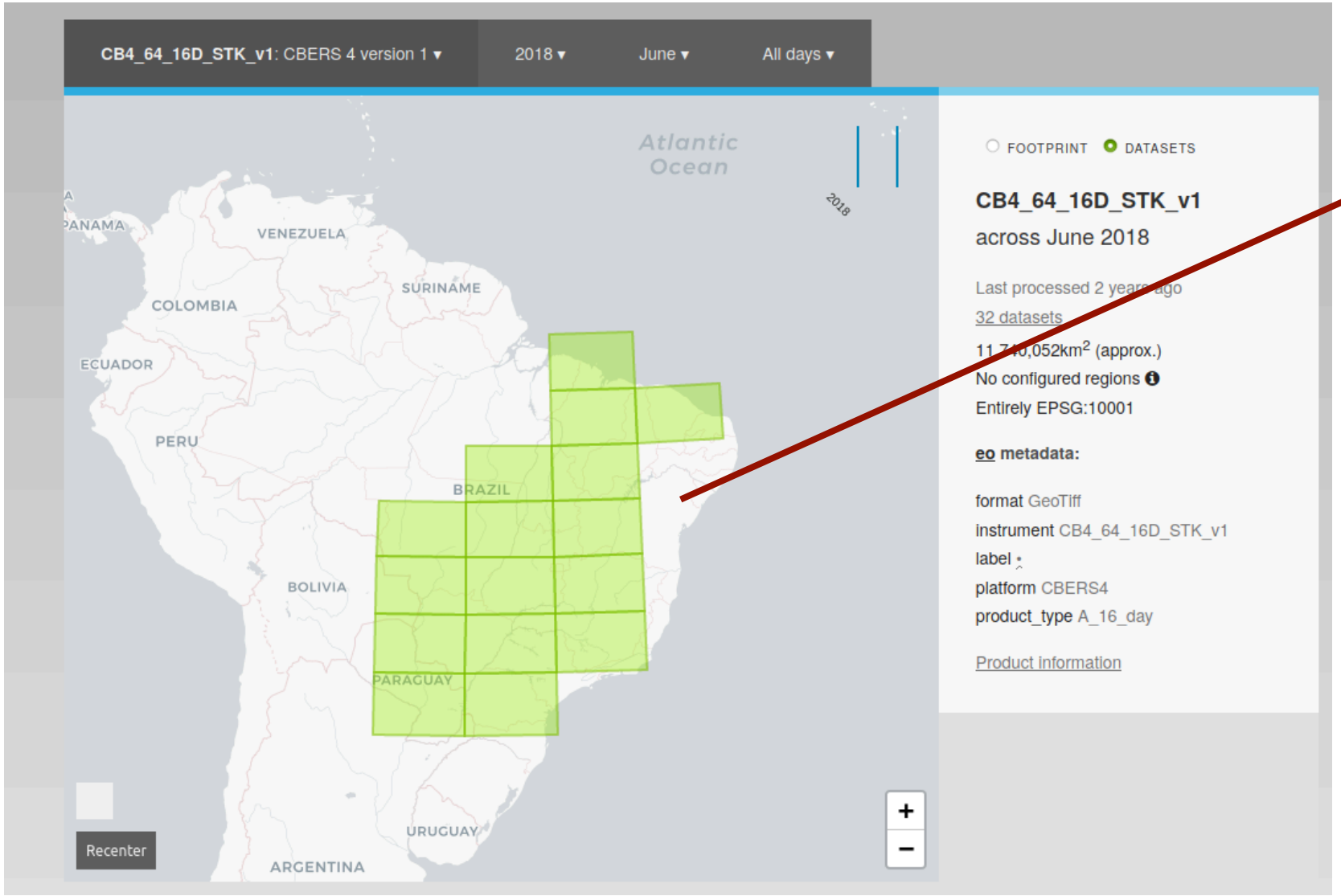
```
Map(center=[-10.967901383824895, -51.143812965446976], control
```



ODC + BDC

ODC Explorer

Open Data Cube Explorer



CBERS 4 data cubes for the Cerrado biome in Brazil

Search CB4_64_16D_STK_

Not secure | brazildatacube.dpi.inpe.br/odc/explorer/datasets/CB4_64_16D_STK_1

OPEN DATA CUBE

CB4_64_16D_STK_1: CBERS 4 version 1 ▾

All years ▾

2020 2019 2018

2017 2016

All

ACQUISITION TIME FROM

01/08/2016

Search

ADD FIELD

-

First 150 results **(query limit)**

Time	Label
2016-01-08 12:00:00	06811f18-c2ab-560a-adf0-e84fde8234cc.yaml
2016-01-08 12:00:00	0935a955-cc2b-5d65-9f0d-01d2df56ab43.yaml
2016-01-24 12:00:00	075e365c-1f24-59de-8bae-90f95a4756c3.yaml
2016-01-24 12:00:00	13eb003f-c396-59c2-8c75-25f34553b7bd.yaml
2016-02-09 12:00:00	09e6a211-df87-589f-b180-ff10c36dd048.yaml
2016-02-25 12:00:00	0640b1cf-b436-538e-b352-84c03c7e0d93.yaml
2016-02-25 12:00:00	07efdba8-2f69-54d3-9b68-58eba8434628.yaml
2016-03-12 12:00:00	05db4587-4fe5-5b5e-8513-af8b2e74526b.yaml
2016-03-28 12:00:00	0514005b-03ce-5fb3-84e8-36c07567aa07.yaml

brazildatacube.dpi.inpe.br/odc/explorer/datasets/CB4_64_16D_STK_1/2020

ODC + BDC

Brazil Data Cube - OGC Web Services (datacube-ows)

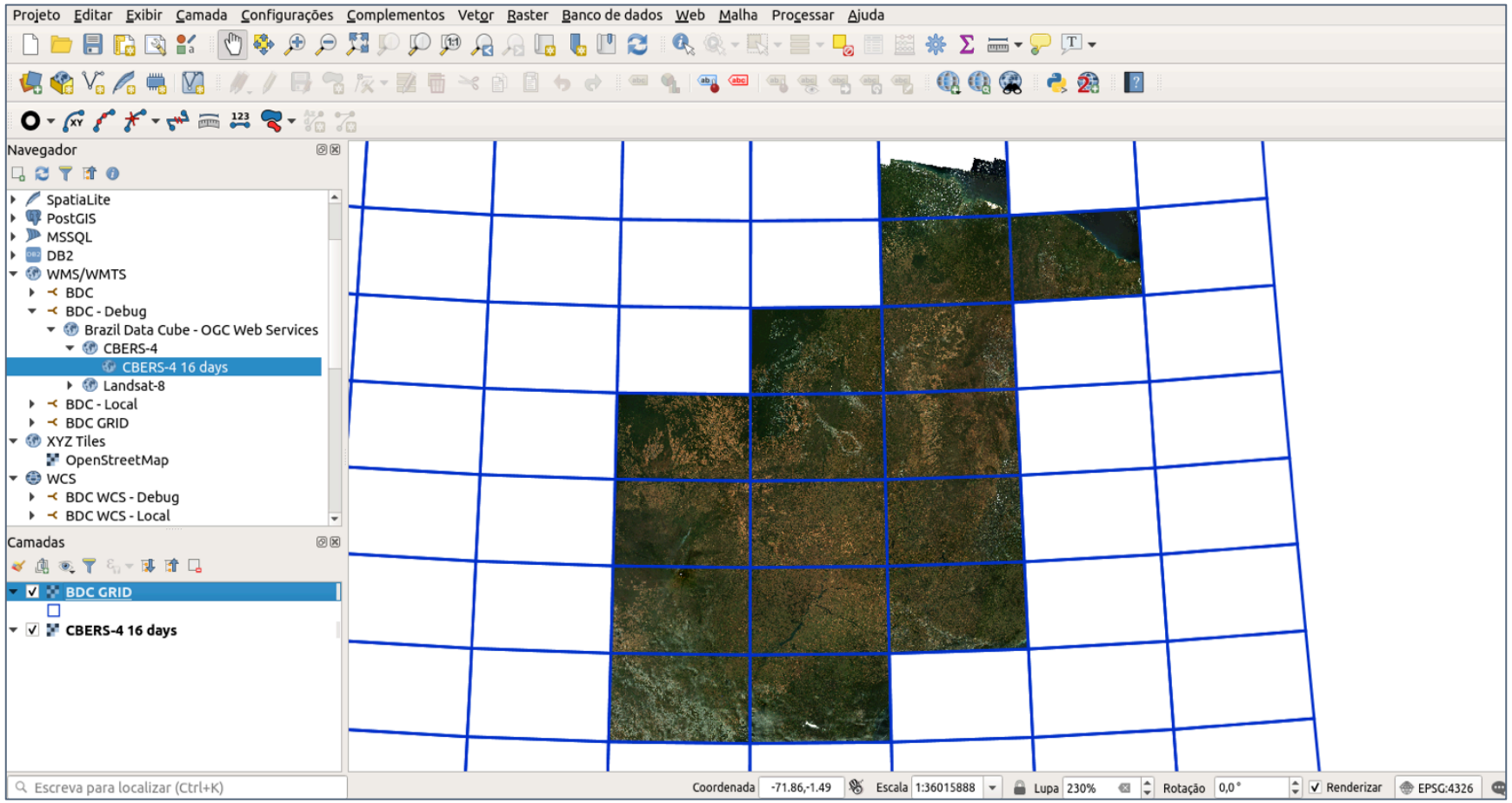
Brazil Data Cube OGC Web Services

This URL is an end-point and is not intended for direct viewing. For more information:

OPEN DATA CUBE Open Web Services (datacube-ows) Repository

OGC Web Services

OGC Services



ODC + BDC

Data Cube OGC Web Services

- http://brazildatacube.dpi.inpe.br/odc/ows/

Data Cube Explorer

- http://brazildatacube.dpi.inpe.br/odc/explorer/

Data Cube STAC (0.9)

- http://brazildatacube.dpi.inpe.br/odc/explorer/stac

Jupyterhub

- http://brazildatacube.dpi.inpe.br/bdc-hub/hub/login

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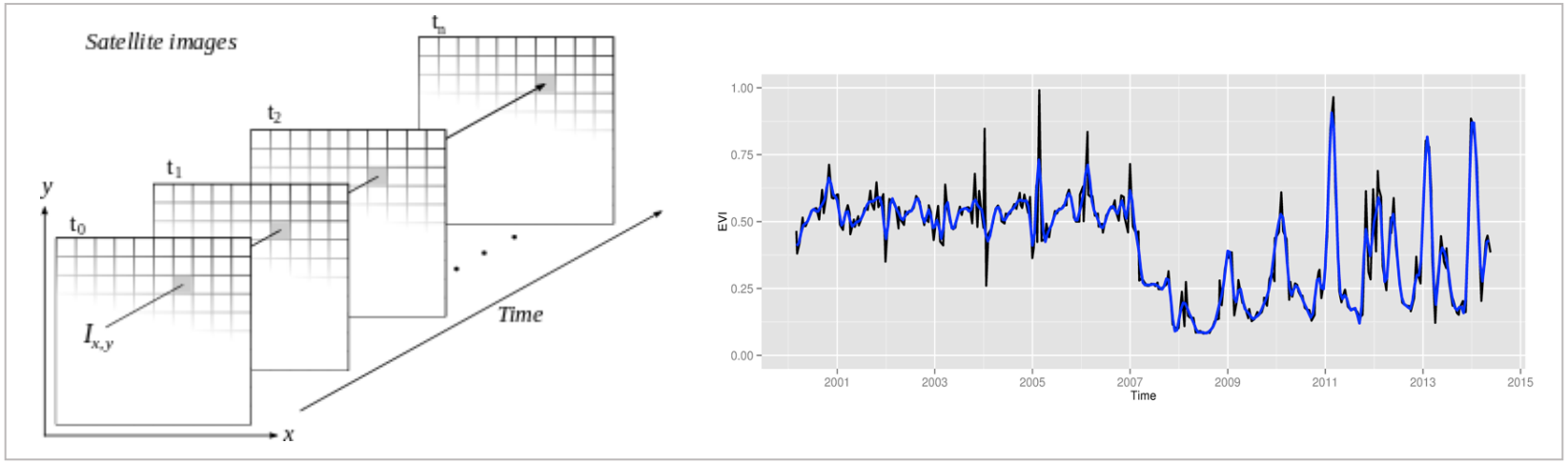
OBRIGADO

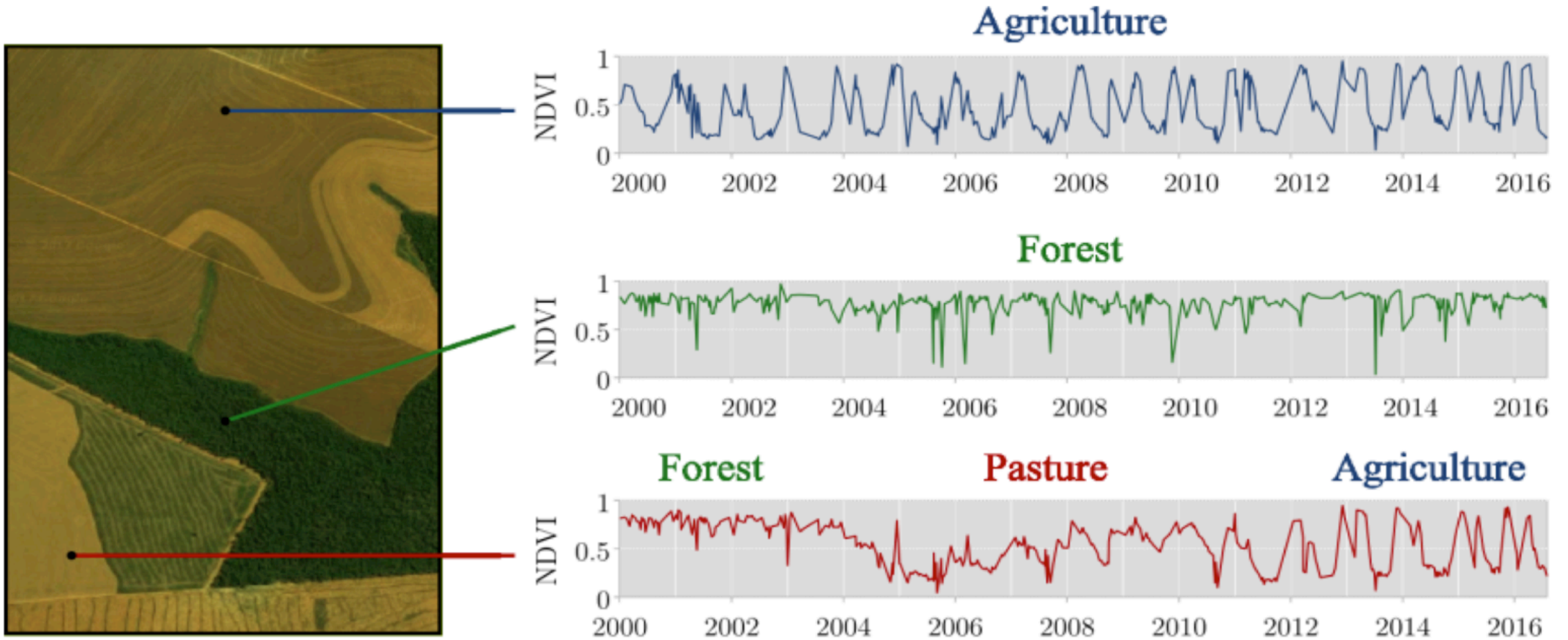
Web page:
www.brazildatacube.org

Twitter:
@BrazilDataCube

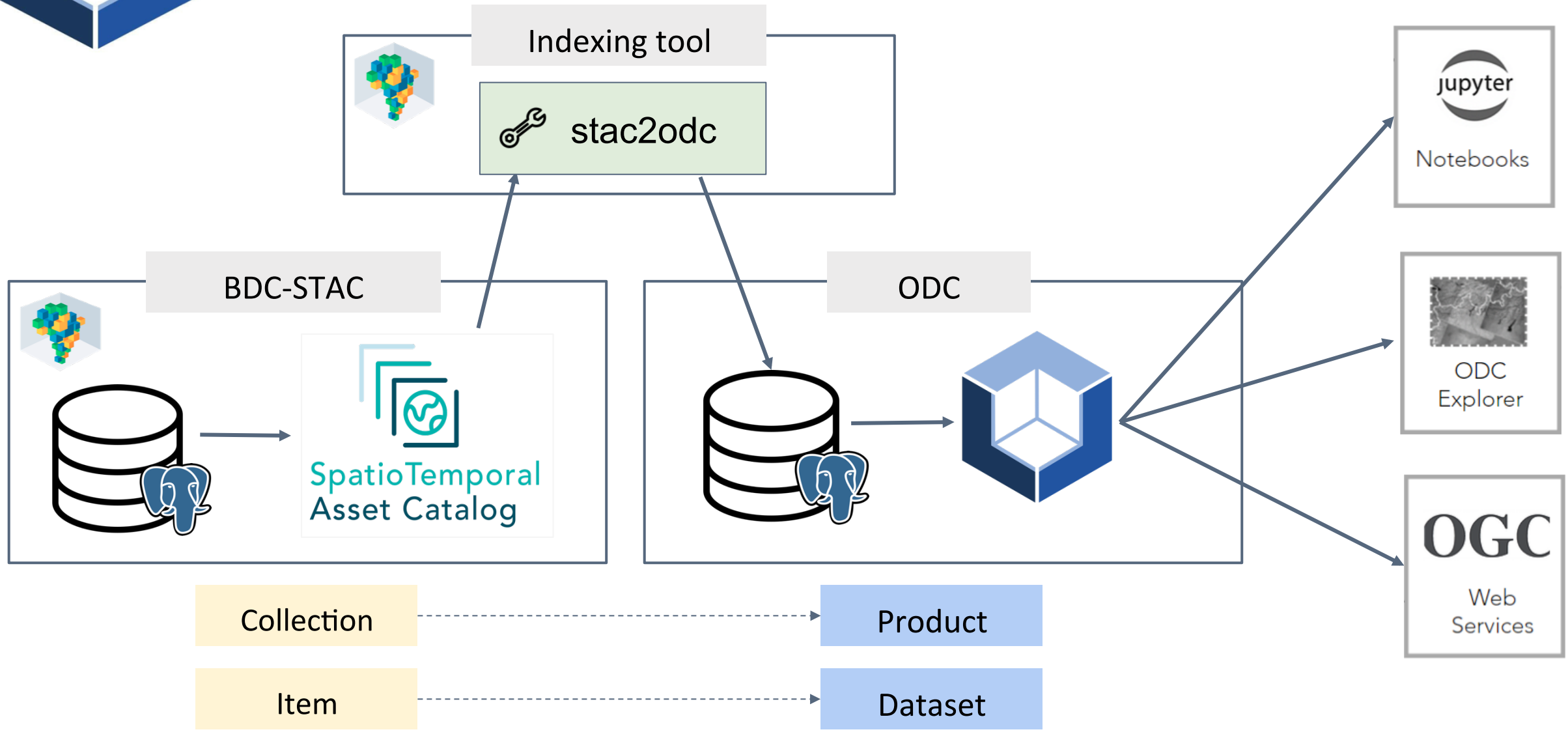
Email:
brazildatacube@inpe.br

Satellite Image Time Series Analysis





ODC + BDC


Indexing tool
stac2odc
BDC-STAC
SpatioTemporal
Asset Catalog
ODC
jupyter
Notebooks
ODC
Explorer
OGC
Web
Services
Collection
Product
Item
Dataset

ODC + BDC

CB4_64_16D_STK_v1.ingest.yaml

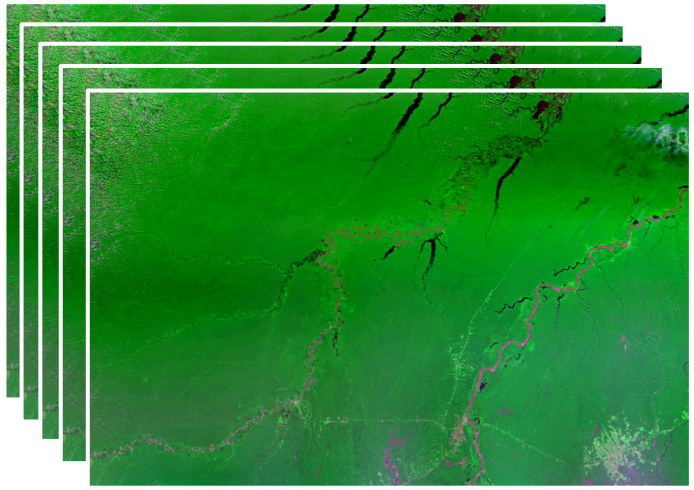
```
source_type: CB4_64_16D_STK_v1
output_type: CB4_64_16D_STK_v1_ingested

description: CBERS-4 ingested data

location: '/data/ingested/'
file_path_template: 'CB4_64_16D_STK_v1_inge

global_attributes:
  title: CBERS 4 ingested
summary: CBERS-4 data product
source: CBERS 4 version 1
institution: INPE
instrument: AWFI
```

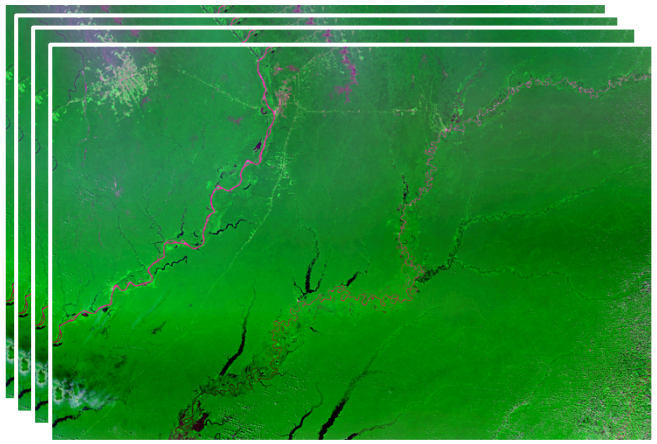
CB4_64_16D_STK_v1



Command Line Tools

OPEN DATA CUBE

CB4_64_16D_STK_v1_ingested



- Tiled
- Reprojected
- Resampled
- NetCDF

Home Page - Select or cre | wgiss-50 - Jupyter Noteb

Not secure | brazildatacube.dpi.inpe.br/bdc-hub/user/vconrado@gmail.com/notebooks/wgiss-50.ipynb

jupyter wgiss-50 Last Checkpoint: a minute ago (unsaved changes)

Logout | Control Panel

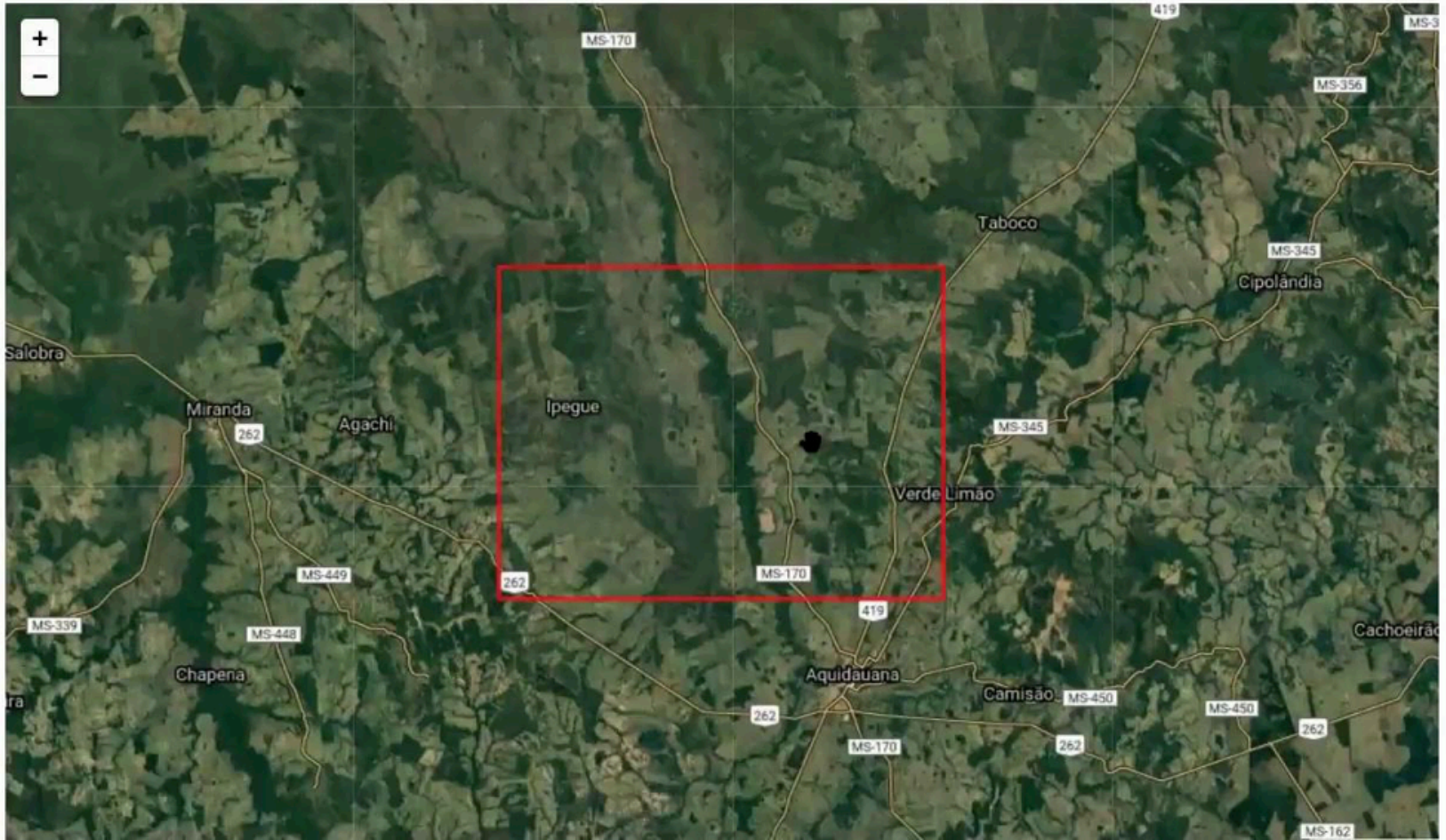
File Edit View Insert Cell Kernel Widgets Help | Trusted | Python [conda env:odc]

Run | Code

Viewing the ROI

In [7]:
```
from examples.utils.data_cube_utilities.dc_display_map import display_map
display_map(latitude, longitude)
```

Out[7]:



CB4_64_16D_STK_1 whole

Not secure | brazildatacube.dpi.inpe.br/odc/explorer/CB4_64_16D_STK_1

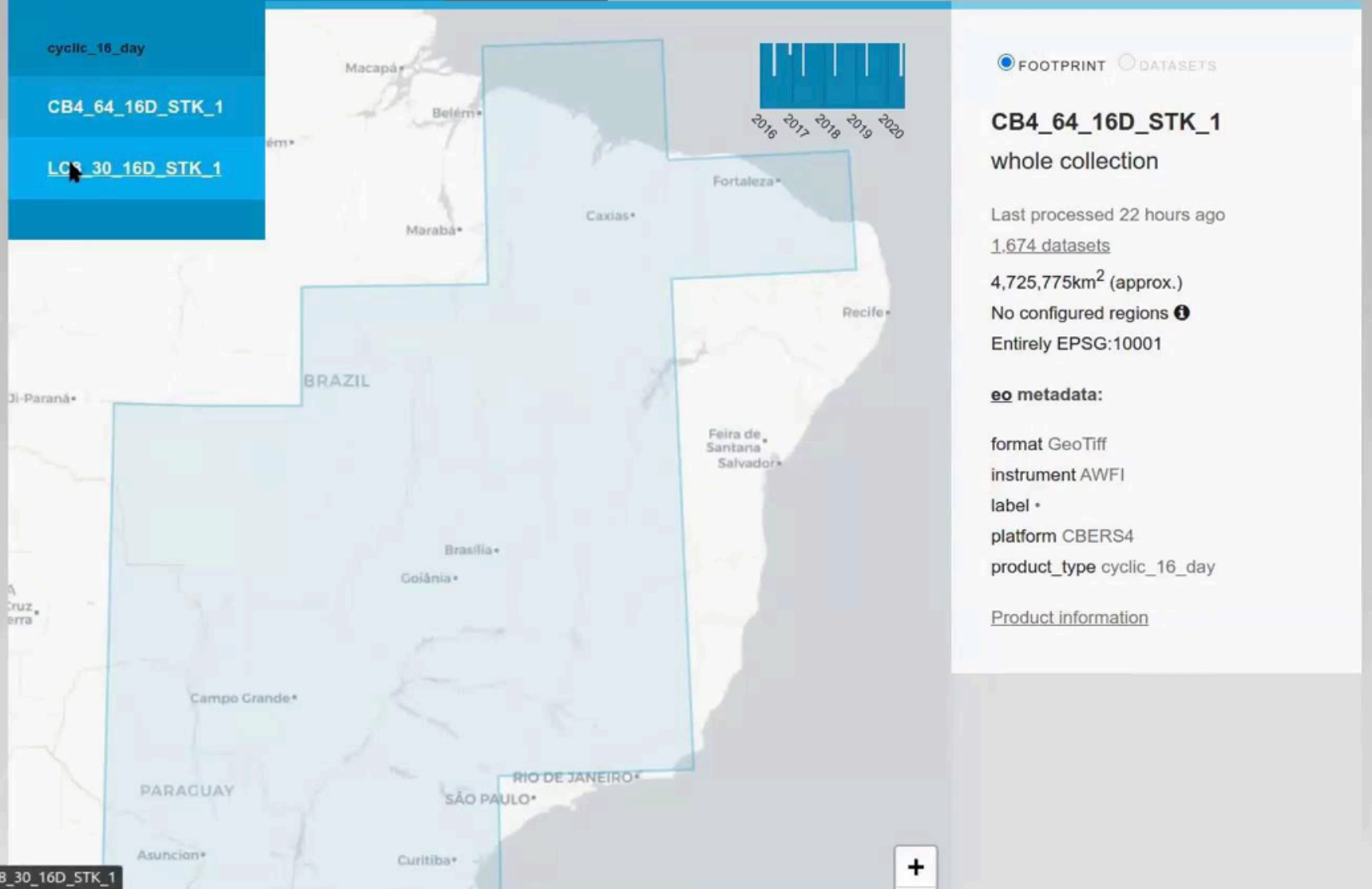
OPEN DATA CUBE

CB4_64_16D_STK_1: CBERS 4 version 1 ▾ | All years ▾

cyclic_16_day

CB4_64_16D_STK_1

LC8_30_16D_STK_1



FOOTPRINT DATASETS

CB4_64_16D_STK_1

whole collection

Last processed 22 hours ago

1,674 datasets

4,725,775km^2 (approx.)

No configured regions

Entirely EPSG:10001

eo metadata:

format GeoTiff

instrument AWFI

label •

platform CBERS4

product_type cyclic_16_day

Product information

brazildatacube.dpi.inpe.br/odc/explorer/LC8_30_16D_STK_1

*Untitled Project - QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh Processing Help

Browser

- Favorites
- Spatial Bookmarks
- Home
- /
- GeoPackage
- SpatiaLite
- PostGIS
- MSSQL
- DB2
- WMS/WMTS
  - BDC WMS
    - Brazil Data Cube - OGC Web Services
      - CBERS-4
        - CBERS-4 (AWFI) Cube Stack 16 days - v001
      - Landsat-8
- XYZ Tiles
- WCS
- WFS
- OWS
- ArcGisMapServer
- ArcGisFeatureServer
- GeoNode

Layers

- CBERS-4 (AWFI) Cube Stack 16 days - v001

Type to locate (Ctrl+K)

Coordinate -52.47,-14.54 Scale 1:8059802 Magnifier 100% Rotation 0,0 ° Render EPSG:4326