HARMONIZE

Earth **O**bservation **D**ata **C**ubes **t**uned for **H**ealth **R**esponse **S**ystems

Integrating Earth Observation Data for Enhanced Health Response Systems:

The EODCtHRS component of HARMONIZE Project

Date: 2024/12/06

This work was supported by the Wellcome Trust grant number 224694/Z/21/Z.

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- Principal Investigators
- Fellows funded by the project
- Partners

What is Brazil Data Cube?

Brazil Data Cube is a research and development project that goal is he production visualization and analysis of large volumes of remote sensing images modeled as multidimensional data cubes for the entire Brazilian territory.

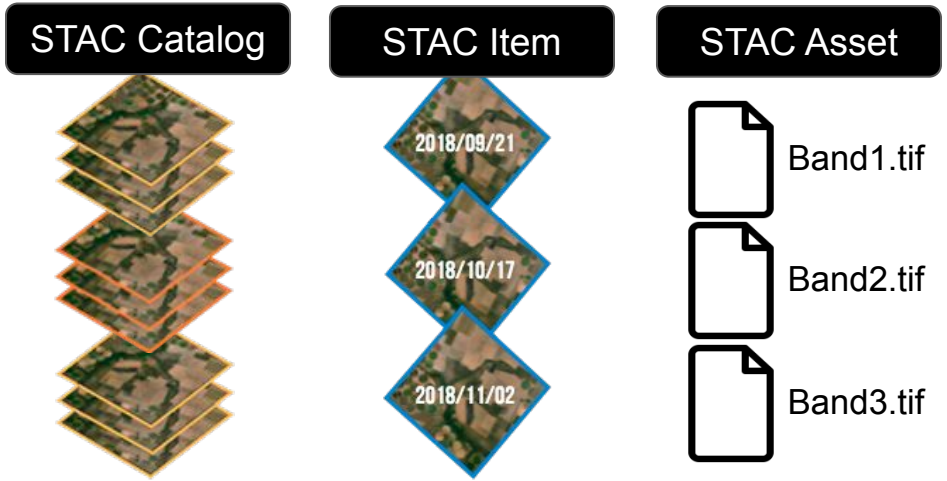
Source: http://www.brazildatacube.org/en/home-page-2

SpatioTemporal Asset Catalog

- Common language to describe geospatial information;
- It standardizes the way geospatial asset metadata is structured and queried;
- Created by several organizations collaborating to improve the interoperable search for satellite imagery;
- **BDC STAC:** Image collections and data cubes produced in the BDC project can be accessed through STAC API;

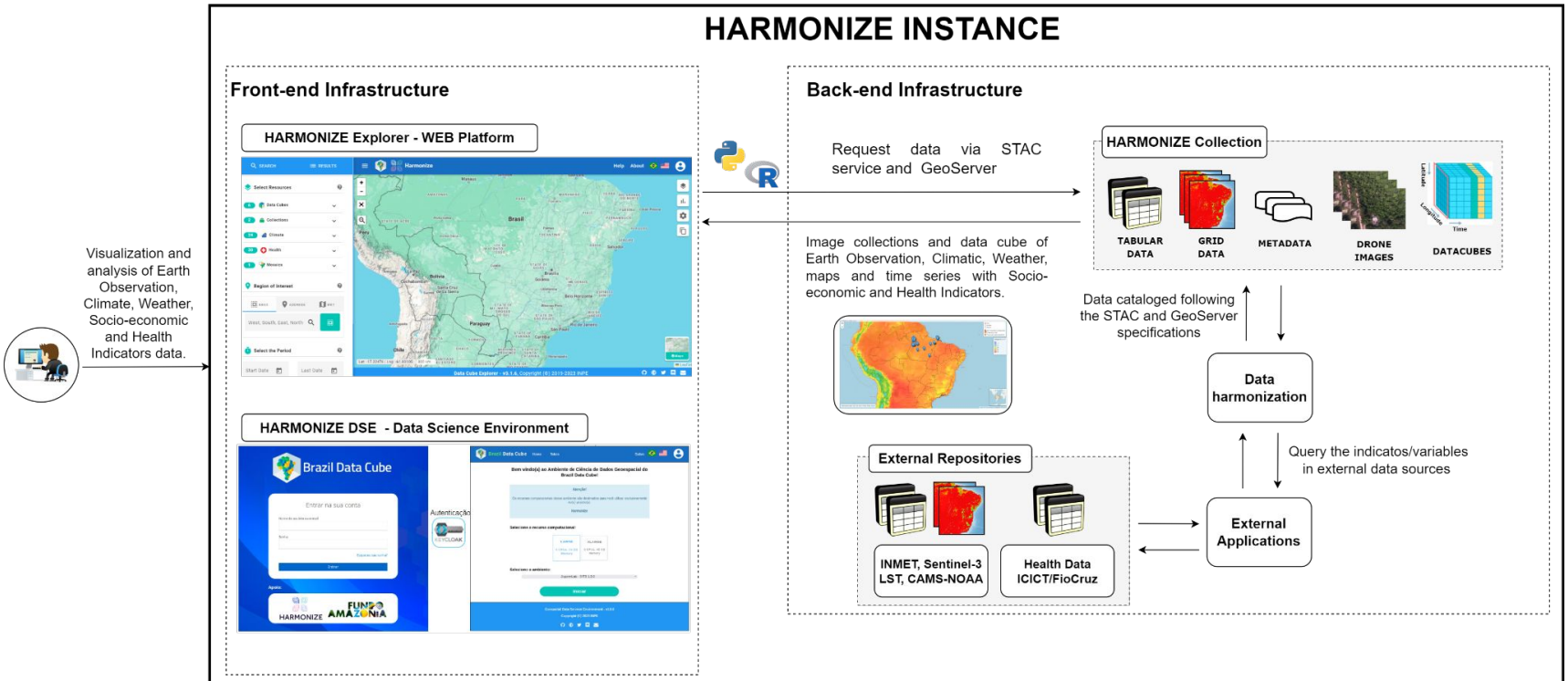
STAC Technologies

- STAC uses JSON format to wrap around any geospatial data.
- Data can be accessed using API packages in R and Python:



HARMONIZE Instance Overview

A technical-scientific concept for data visualization and analysis based on the Brazil Data Cube (BDC) project platform. It comprises a web portal (HARMONIZE Explorer) and a Data Science environment (BDC Lab) that provide mechanisms for manipulating Earth Observation data (Cubes), drone data, health and climate data (indicators).



Instance Modules

The EODCtHRS component of HARMONIZE is composed of six modules:

Module 1 - Drone Data

Module 2 - Health Data

Module 3 - Climate Data

Module 4 - BDC-Lab

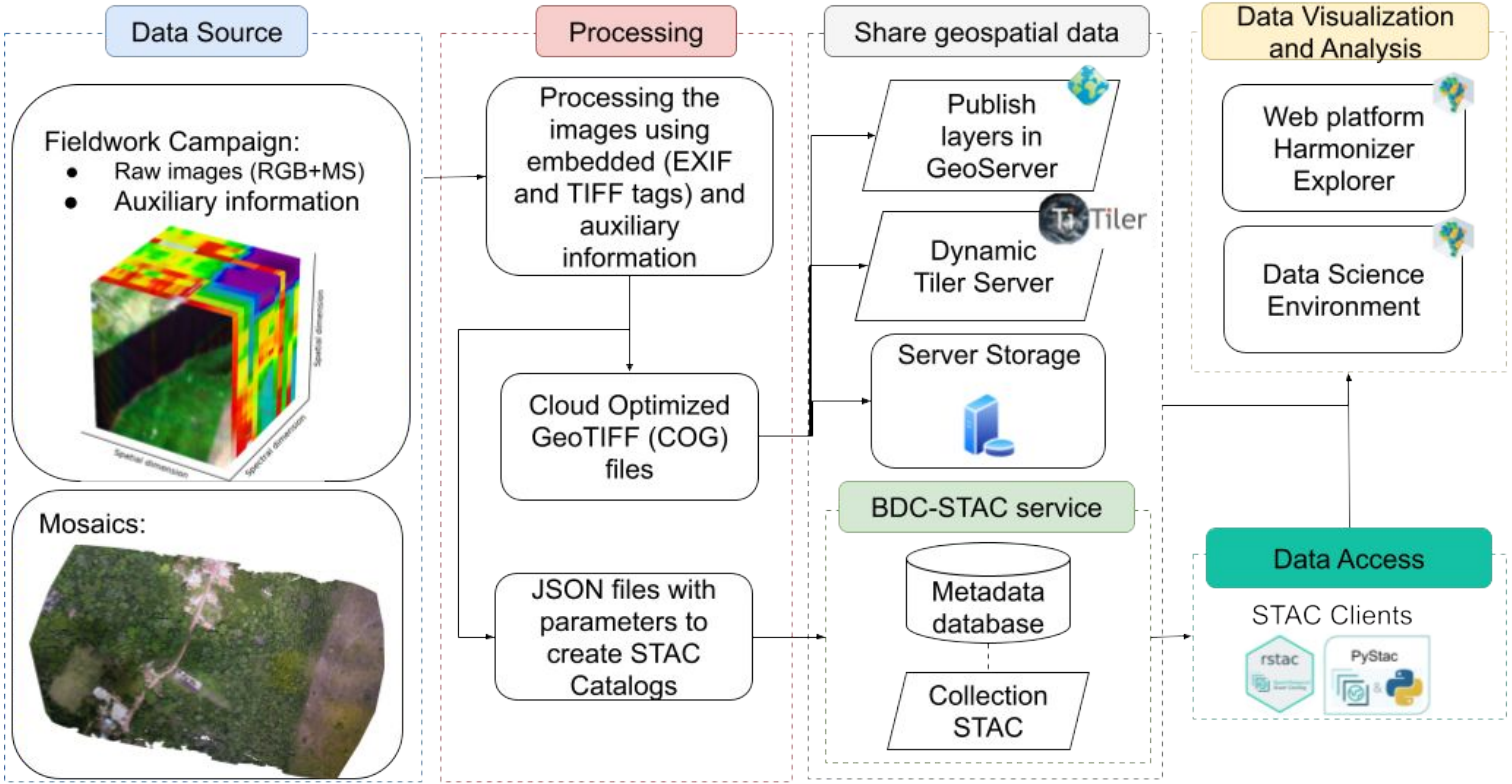
Module 5 - HARMONIZE Explorer

Module 6 - EO Data Cubes

Module 1 - Drone

Module 1 - Infrastructure

Prototype summarizing the main steps for processing raw images and mosaics from drones to produce COG files and metadata, which are available for visualization and analysis based on a BDC-STAC service.



Module 1 - Infrastructure

Drone Images Flow - Input and Output Formats

Input Format

Data format:

- The images must be organized following the protocol established for the data organization after the fieldwork campaign, accompanied by auxiliary files (JSON) with information about the sensor used and flight height

Third's application (OpenDroneMap)

- The images are processed using an open-source application to produce mosaics

Output Protocol: GeoTIFF

Raster files

Interface Python

Output Protocol: Raster (COG)

EODCtHRS Drone Image Processing Algorithm

Input parameters:

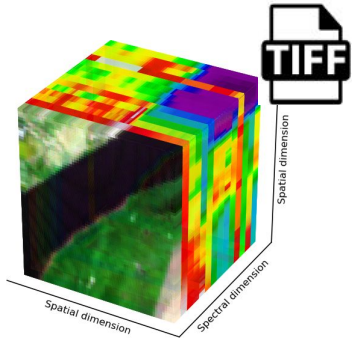
- Directory with files organized according the protocol
- Templates files (JSON) defined for each drone and flight height using STAC specification format for collections of images

Output Format

Drone Images Projected

Output Protocol: COG

Raster files



Multispectral Images (Near Infrared, Red Edge, Red and Green) and NDVI

RGB Images

RGB and Multispectral mosaics

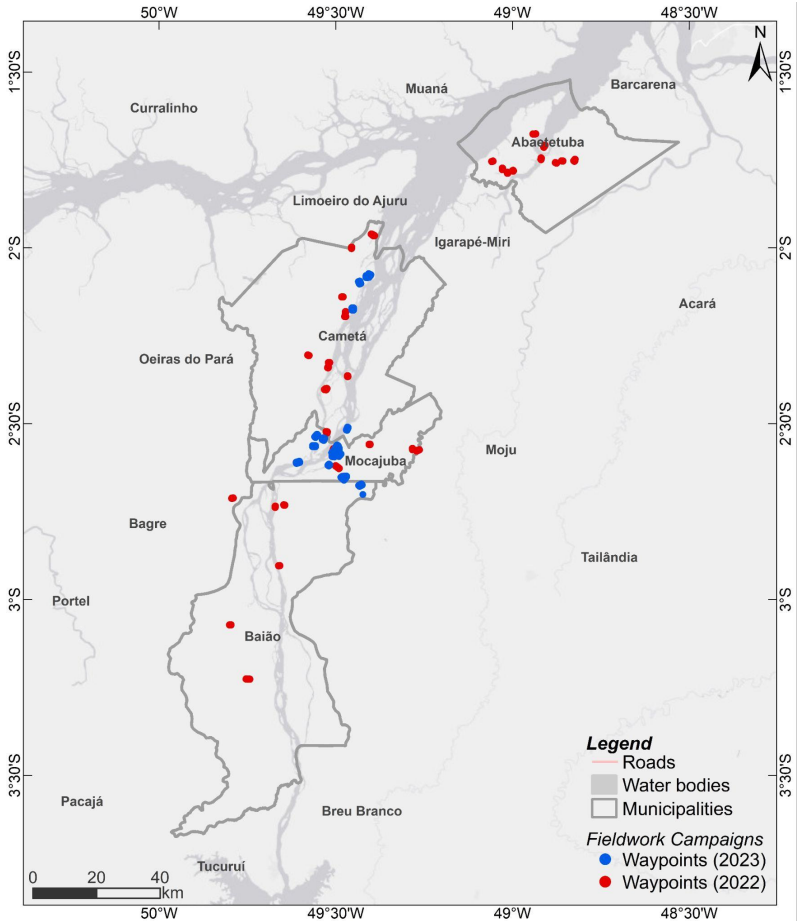
Module 1 - ALPHA R

2022

- 46 flights (RGB mosaics):
  - Flight Height 120 m
- 3044 waypoints (RGB images):
  - Front Overlap Ratio (FOR) = 80%
  - Side Overlap Ratio (SOR) = 70%
- ~15.6 GB of data (raw data)
- Temporal extension:
  - Start - 2022/11/14
  - End - 2022/11/23 (10 days)

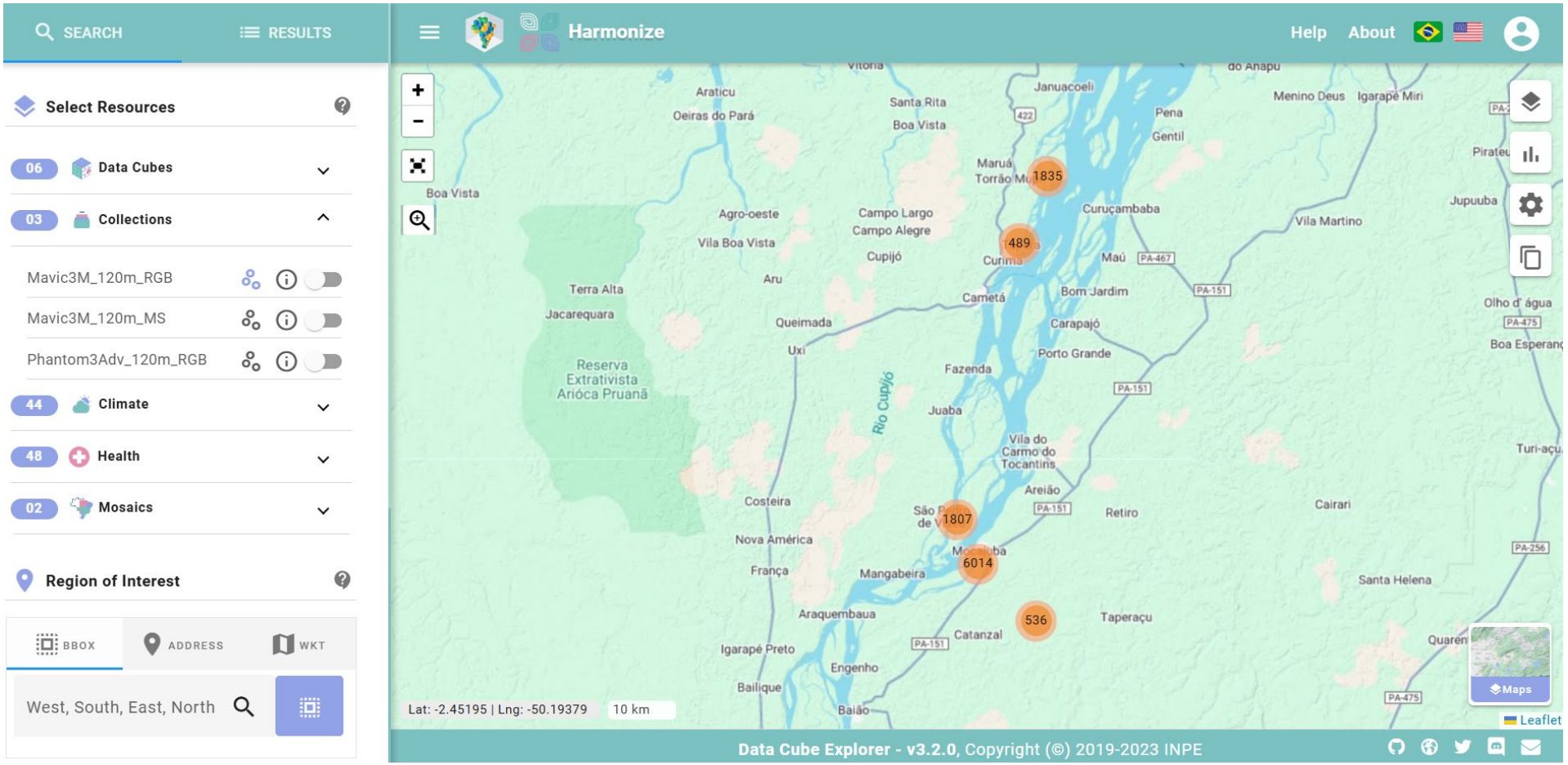
2023

- 23 flights (RGB mosaics):
  - Flight Height 120 m
- 10681 waypoints (RGB, NIR, RE, R, G, and NDVI images):
  - Front Overlap Ratio (FOR) = 80%
  - Side Overlap Ratio (SOR) = 70%
- ~600 GB of data (raw data)
- Temporal extension:
  - Start - 2023/11/07
  - End - 2023/11/14

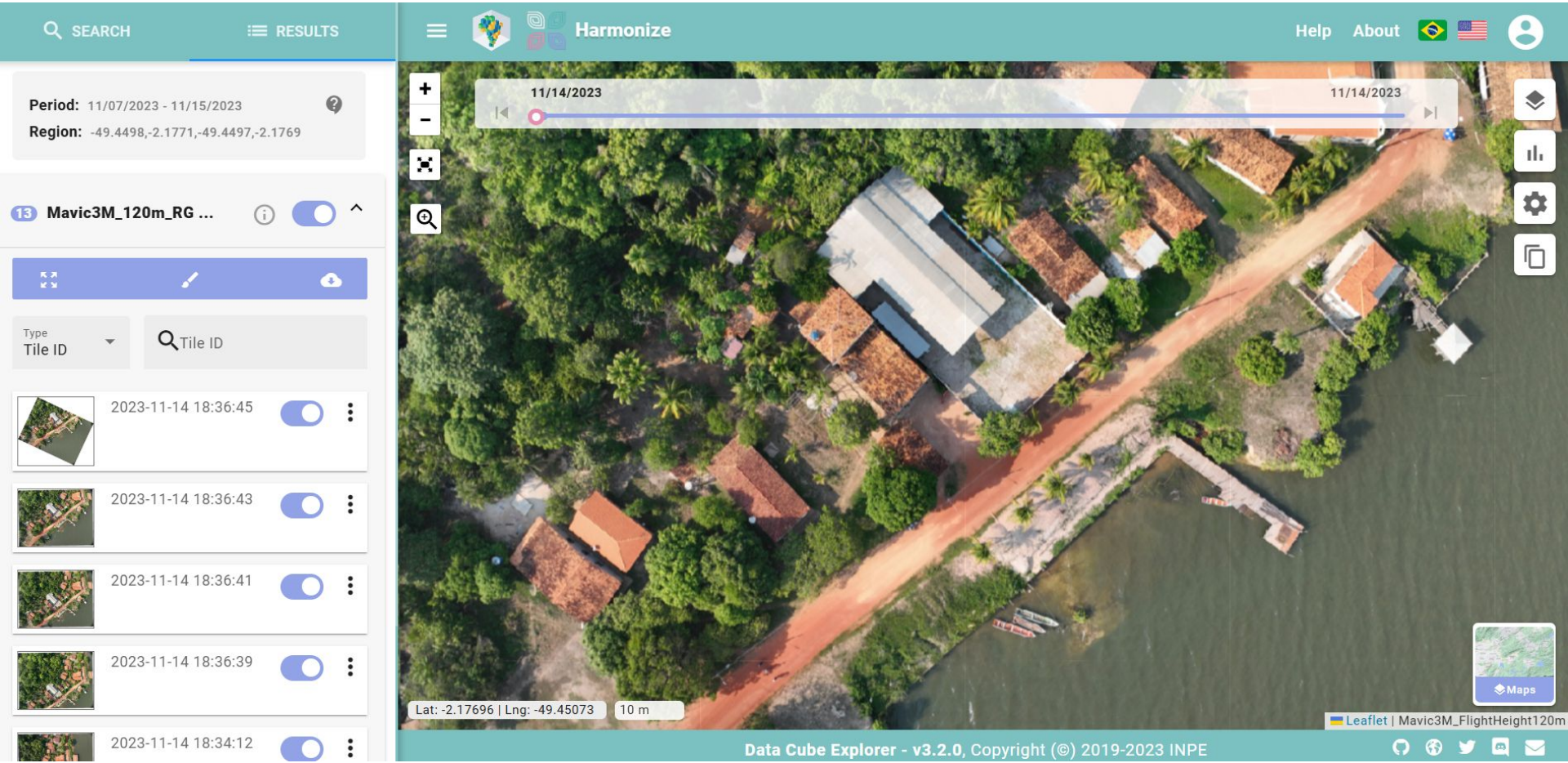


Spatial distribution of ALPHA R version of drone data

Module 1 - ALPHA R at Harmonize Explorer

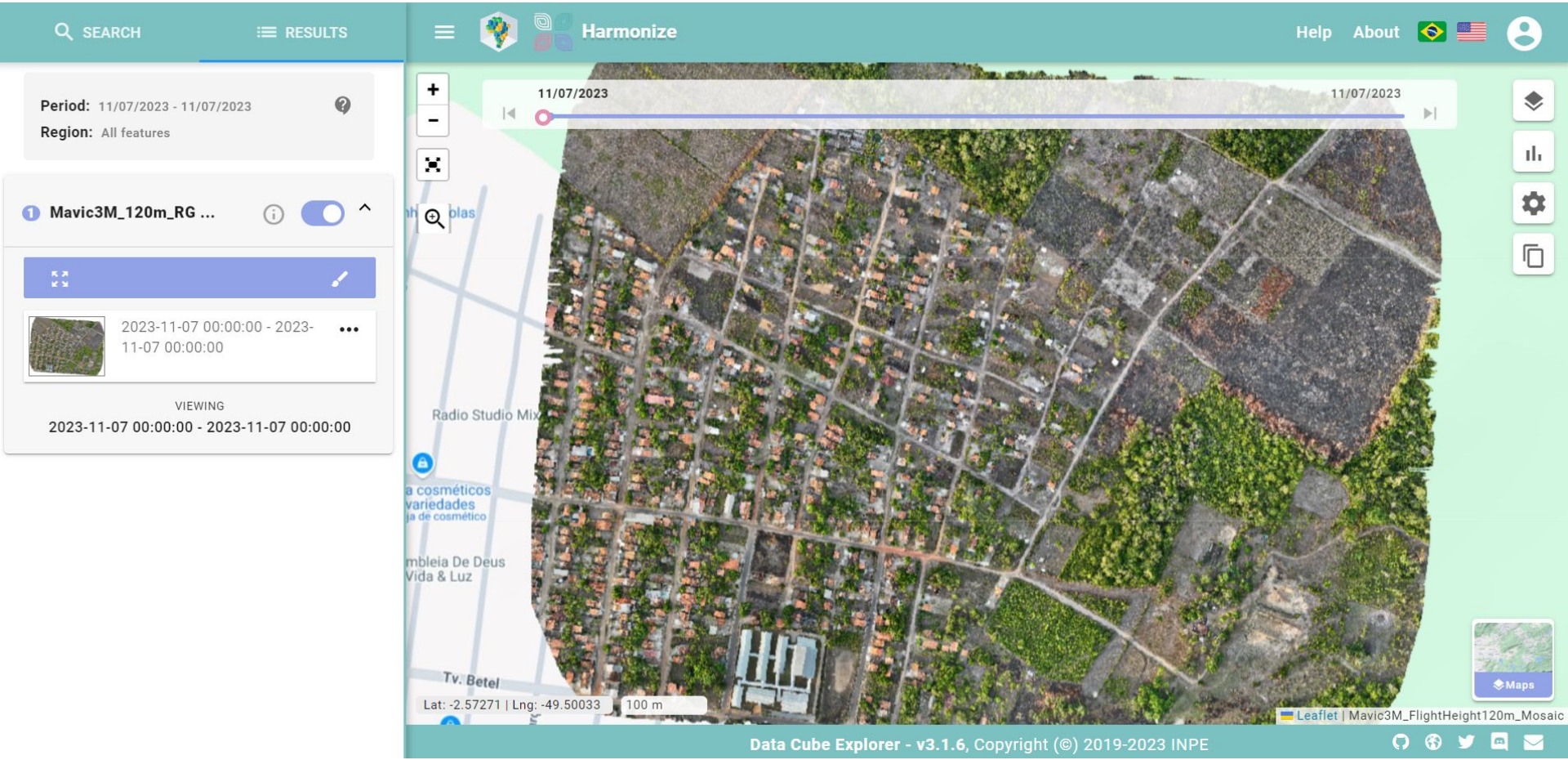


Module 1 - ALPHA R at Harmonize Explorer



The portal with RGB image from Mavic 3M collected at Cametá Tapera locality (Cametá-PA).

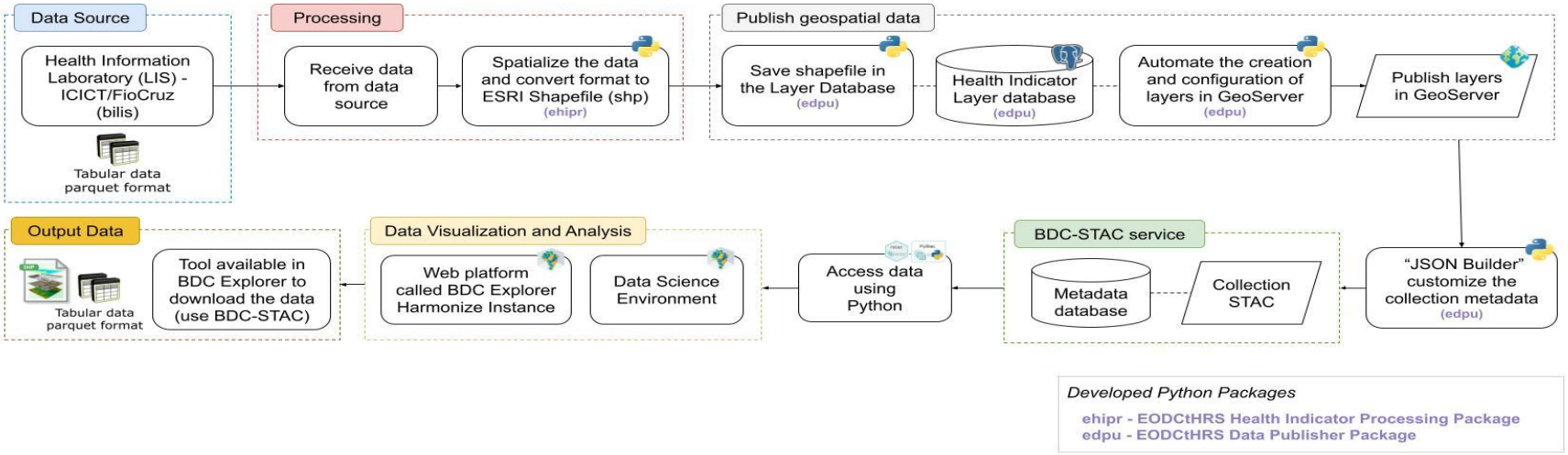
Module 1 - ALPHA R at Harmonize Explorer (Mosaic)



Module 2 - Health Data

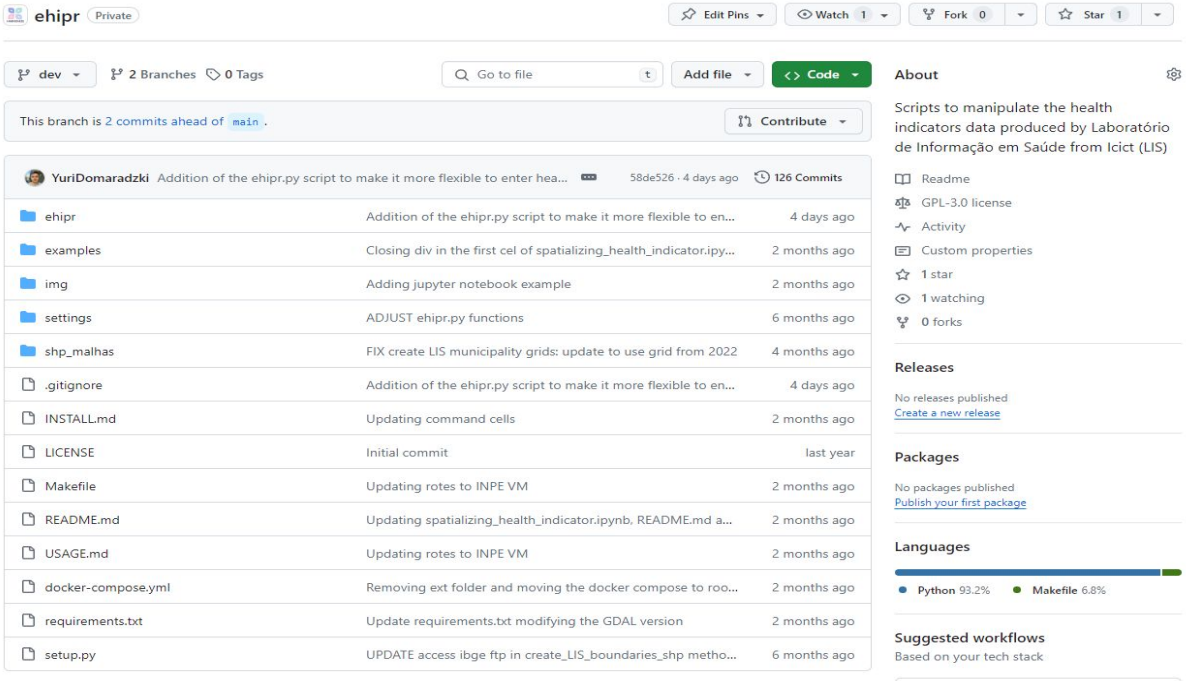
Module 2 - Infrastructure

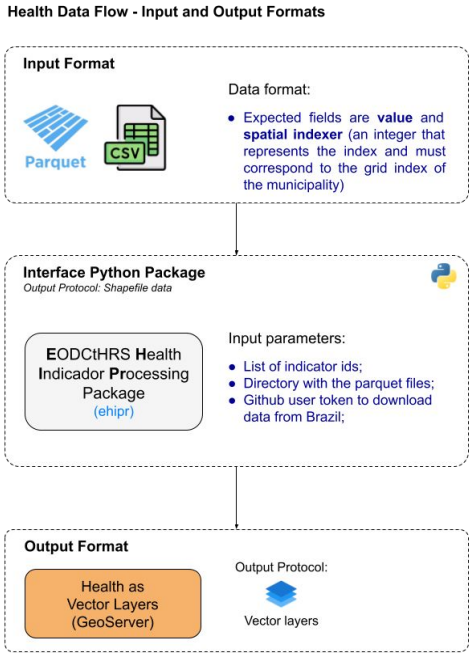
- Architecture of health data integration and dissemination.
- The tasks within the Data Source and Processing blocks were tested using the ehipr package.
- The tasks in the Share of geospatial data and the BDC-STAC service blocks were facilitated through the edpu application.
- In summary, the tasks within the Data Source, Processing, geospatial sharing data, and Catalog service blocks are completed, while the Data Visualization and Analysis block is currently in progress.



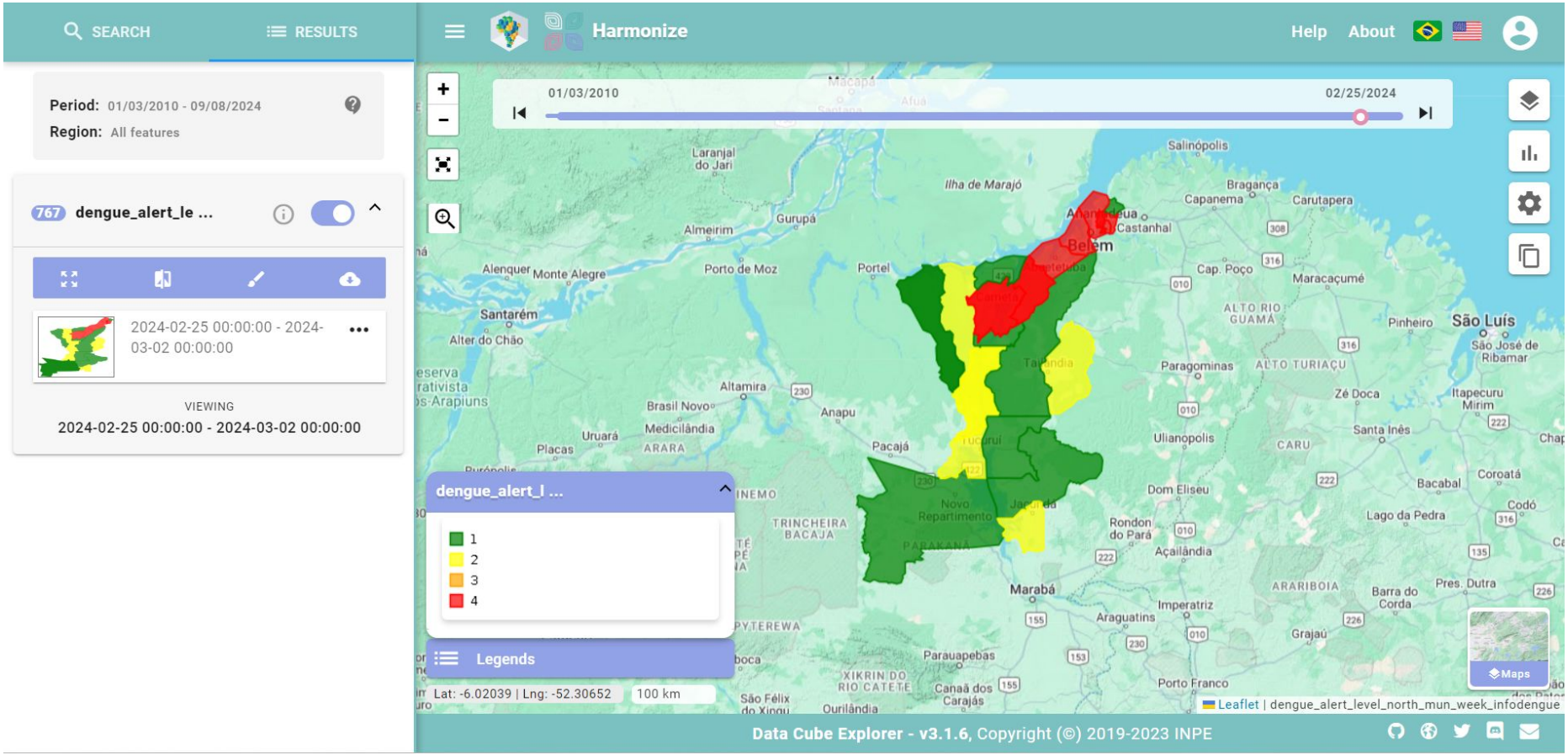
Python package to process health data

EODCtHRS **H**ealth **I**ndicador **Pr**ocessing Package (ehipr) developed by the project's fellows using the Python programming language. This package provides a set of functions aimed at acquiring health indicators, separate it by combining spatial and temporal aggregations, add the spatial component to the data and publish it as a layer in GeoServer and its metadata in STAC using the **E**ODCtHRS **D**ata **Pu**blisher Package (edpu).

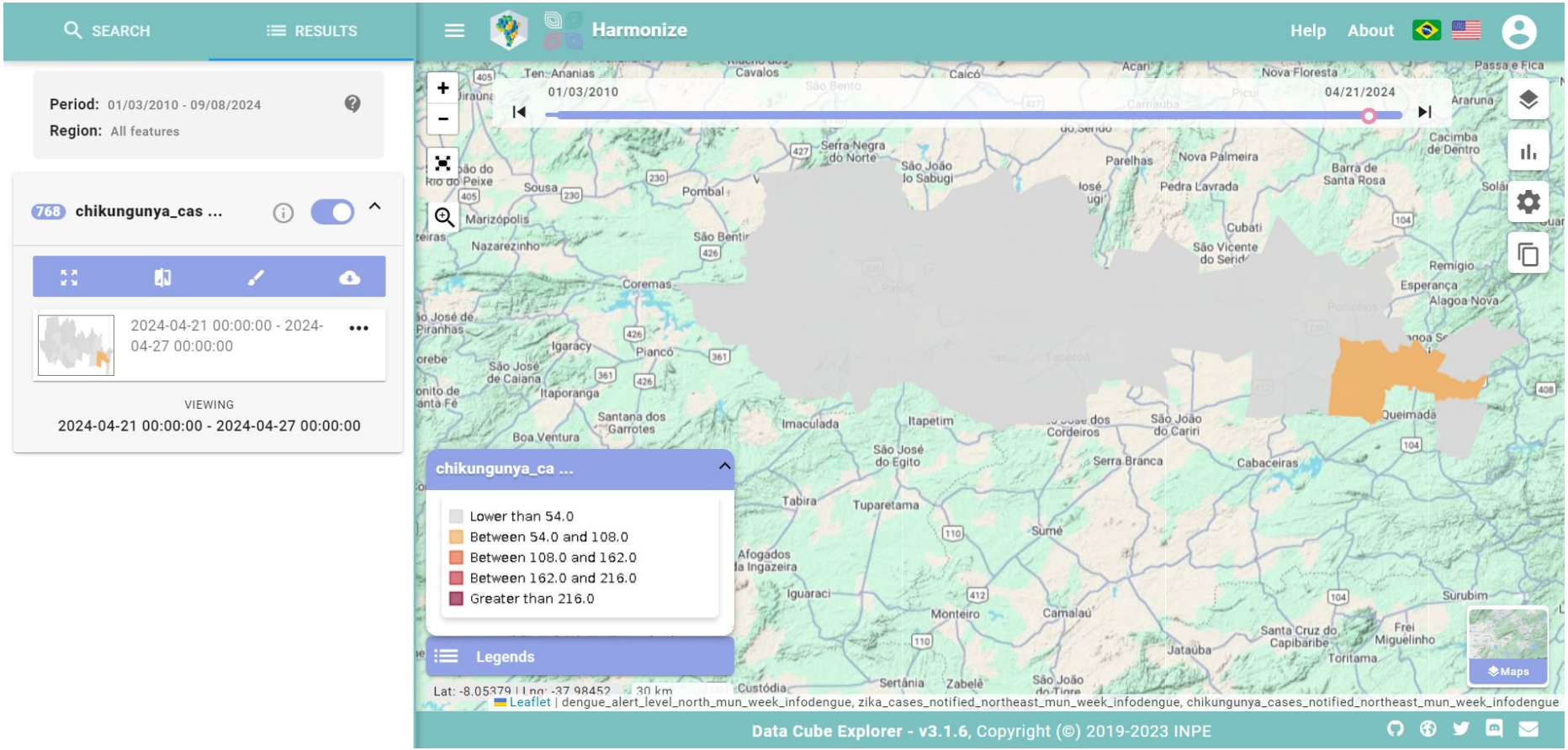




Module 2 - Explorer with Health Data - Dengue Alert Level



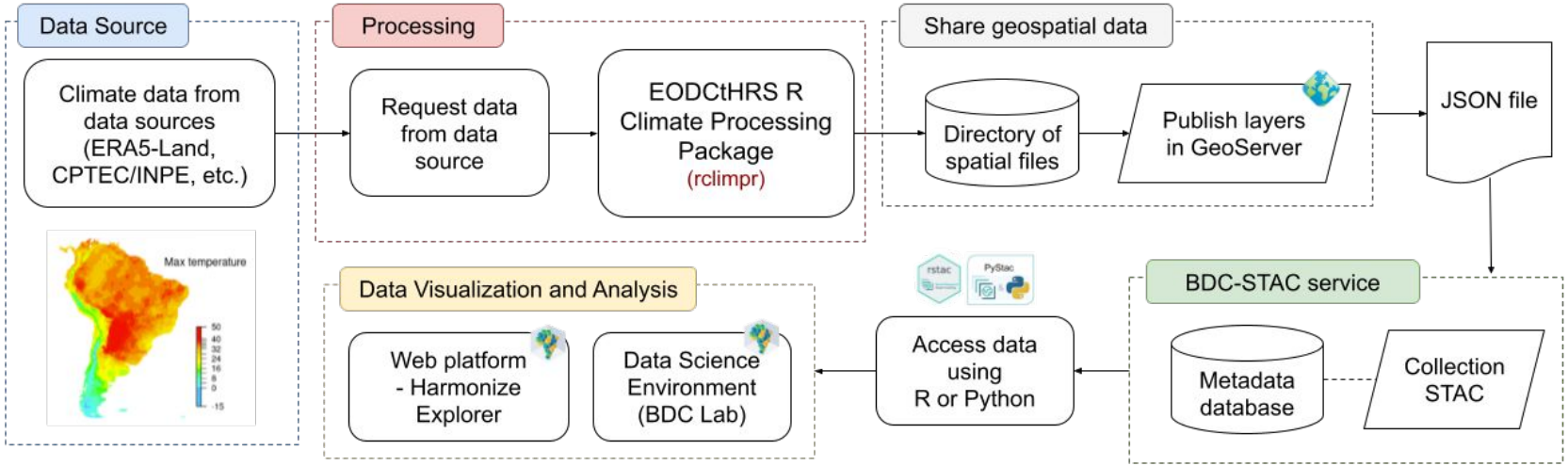
Module 2 - Explorer with Health Data - Chikungunya Notified Cases



Module 3 - Climate Data

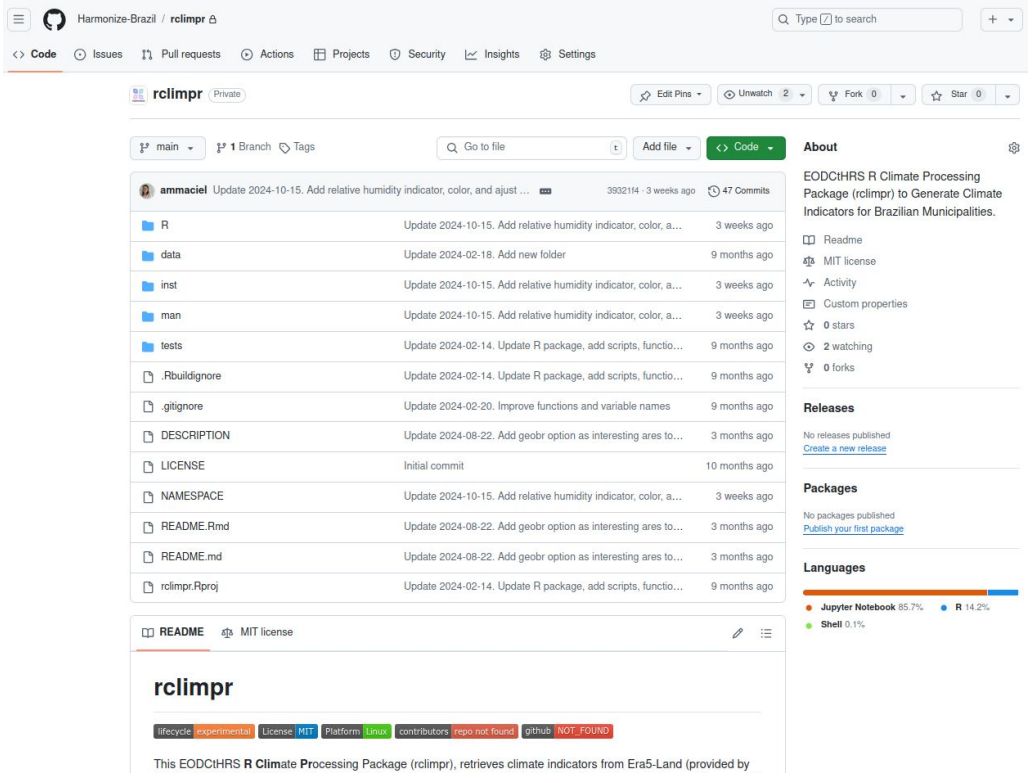
Module 3 - Infrastructure

- Architecture of climate data integration and dissemination.
- The tasks within the Data Source and Processing blocks were tested using the rclimpr R package.
- The tasks in the Share of geospatial data and the BDC-STAC service blocks were facilitated through the edpu application.
- In summary, the tasks within the Data Source, Processing, Sharing geospatial data, and Catalog service blocks are completed, while the Data Visualization and Analysis block is currently in progress.



Module 3 - Infrastructure

EODCtHRS **R Clim**ate **Pr**ocessing Package (**rclimpr**), developed using the R programming language, processes climate indicators from different input data formats, including netCDF, GRIB2, and CSV. It offers a set of functions specifically designed to generate climate indicators.



Climate Data Flow - Input and Output Formats

Input Format

Data format:

- A netCDF or GRIB2 format file with an internal variable representing data aggregated on a daily. Accompanied by auxiliary files such as epidemiological week dates (CSV) and municipality spatial information (Shapefile).

Interface R Package

Output Protocol: Raster (COG) and Vector (Shapefile or GeoJSON)

EODCtHRS **R** **Clim**ate **Pr**ocessing Package (rclimpr)

Input parameters:

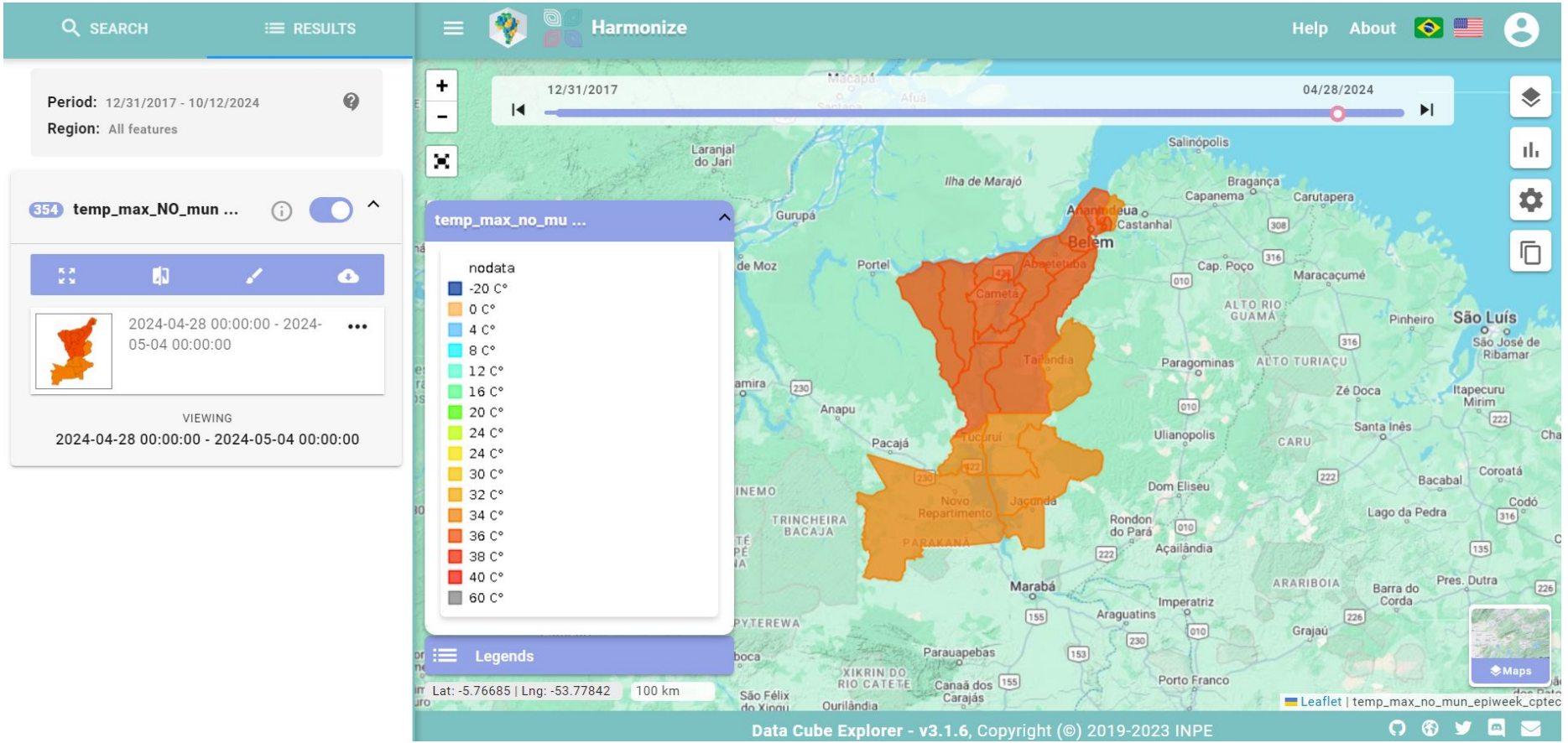
- Directory with an input format files
- Variable
- Temporal aggregation (months or epidemiological week)
- Spatial aggregation (interesting area defined by a Shapefile or municipality code)

Output Format

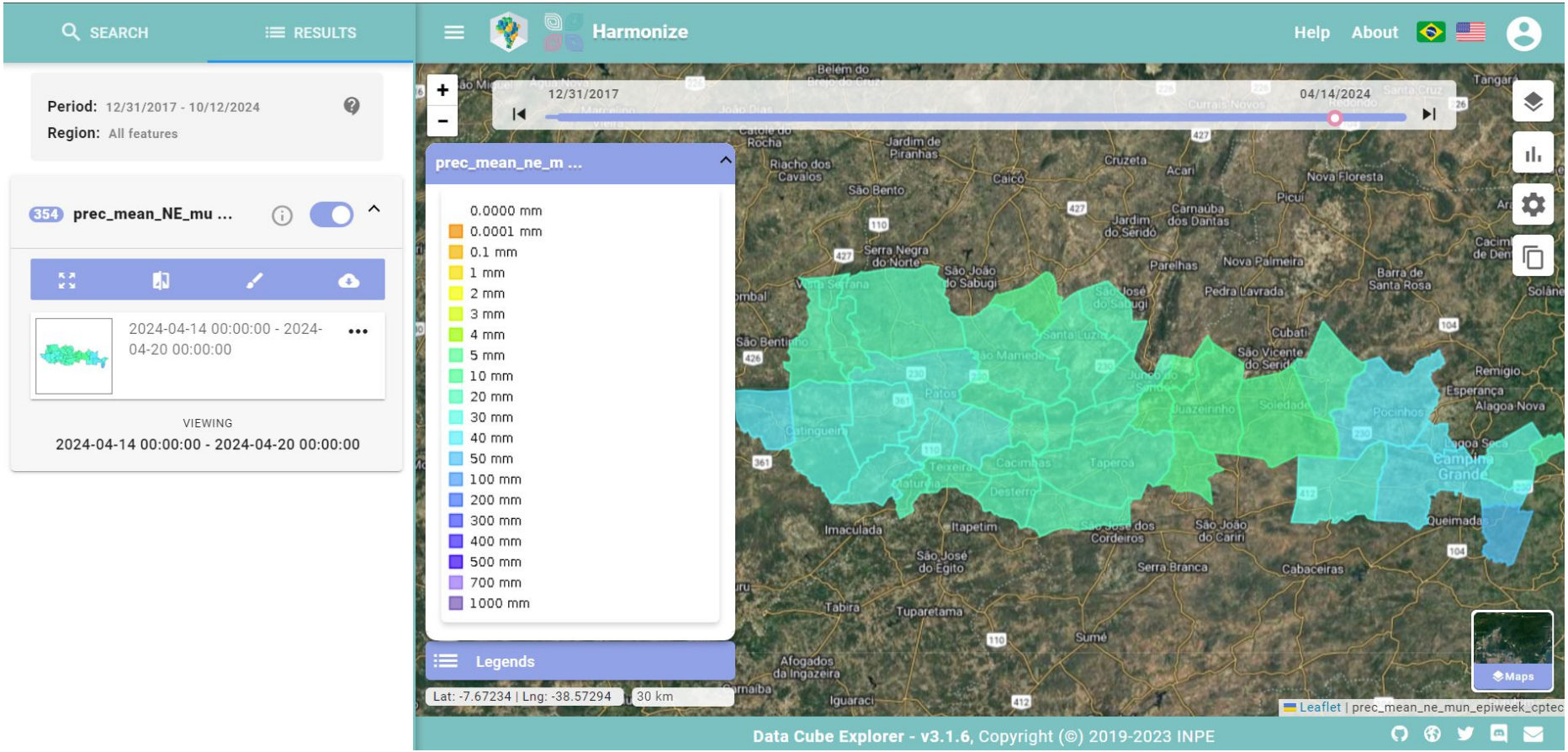
Climate indicators as Raster and Vector files

Output Protocol:

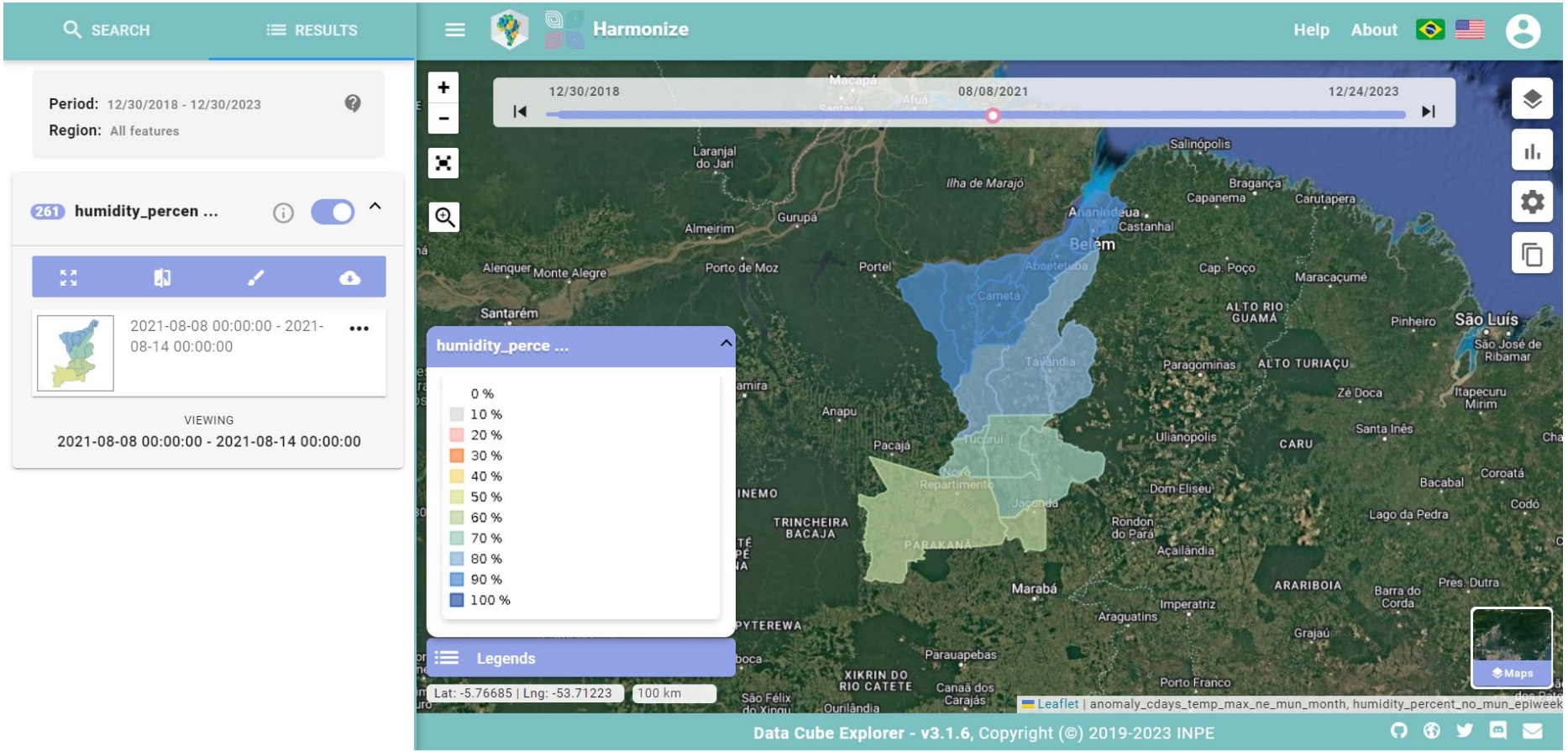
Module 3 - Explorer with Climate Data - Temperature



Module 3 - Explorer with Climate Data - Precipitation

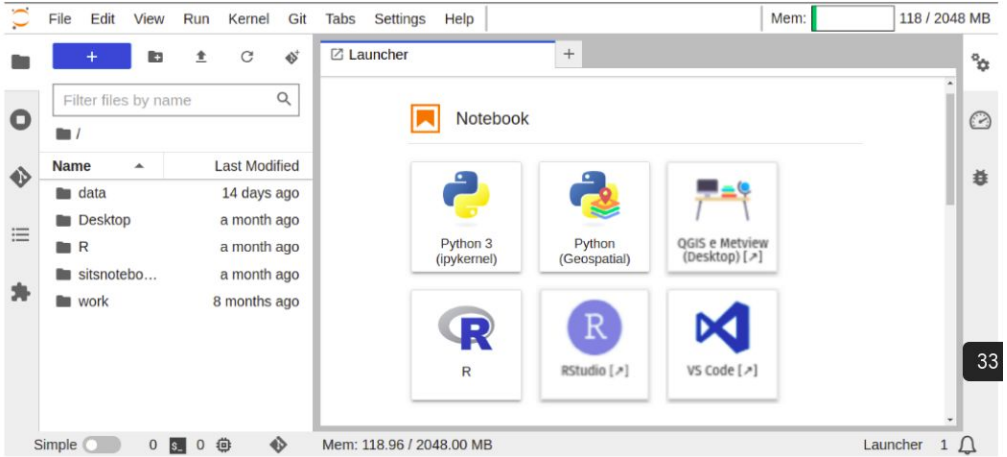


Module 3 - Explorer with Climate Data - Relative Humidity



Module 4 - BDC-Lab

Data science tutorials



BDC-Lab is being used to develop

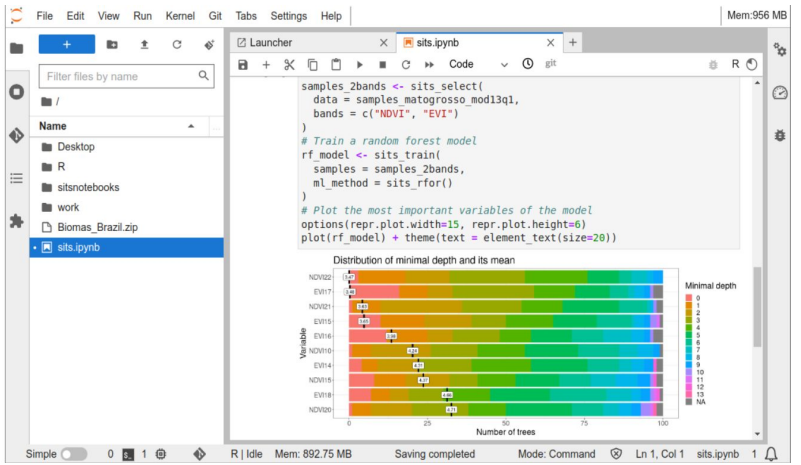
Harmonize data science tutorials using

Jupyter Notebooks.

The objective of these tutorials is to guide users on

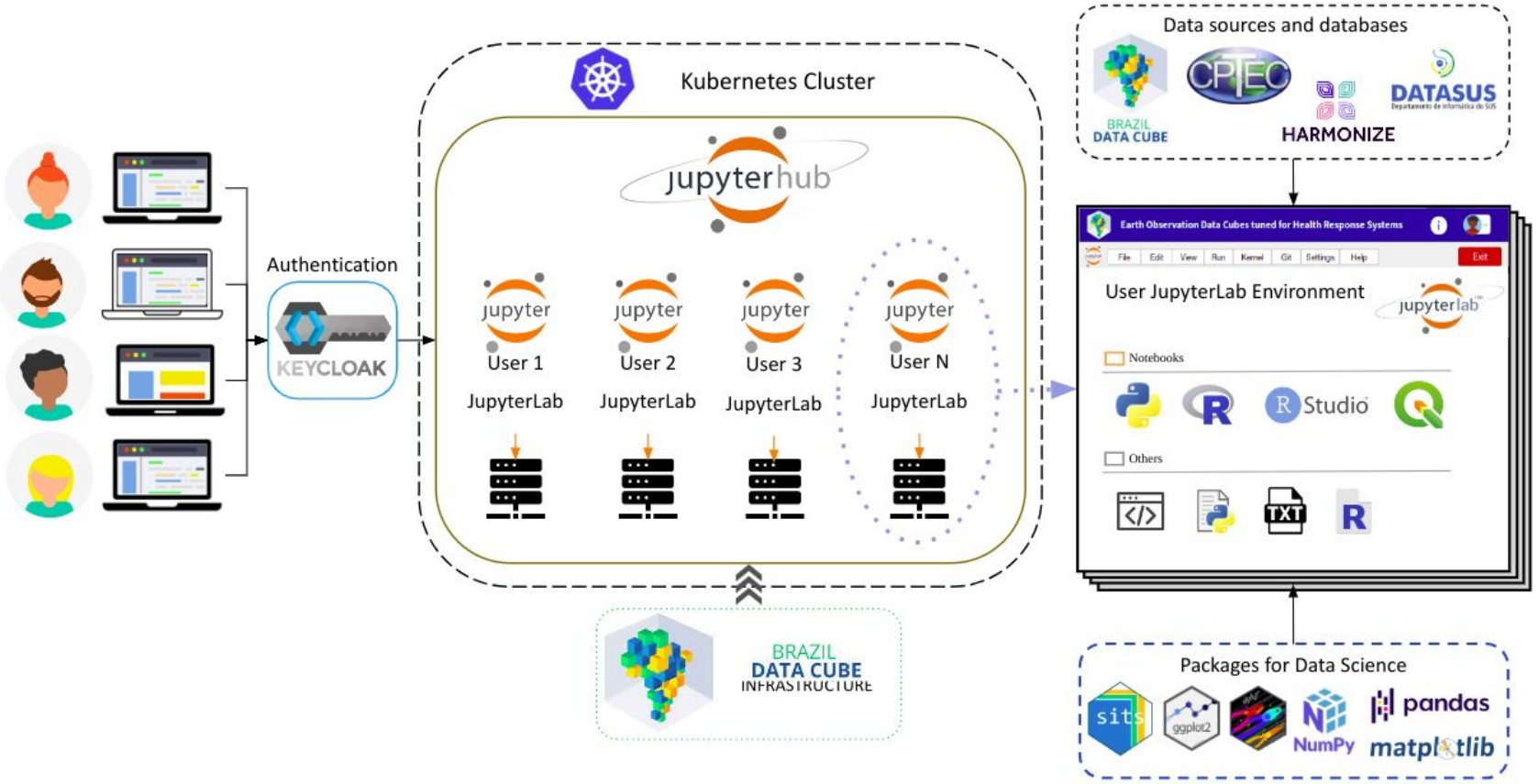
how to access drone, health and climate data and

perform data science analyses.



Data science tutorials

BDC-Lab infrastructure and flow



Data science tutorials

BDC-Lab - updates

Since May 2024, the main tasks and results achieved:

- Release of versions **1.2.1** and **1.2.2**:
  - Interface improvements;
  - Security updates;
  - New processing packages and applications (VSCode and Metview);
- Ongoing Harmonize tutorials for accessing health, drone and climate data;
- Experimental platform being tested by users of INPE projects and partner institutions;

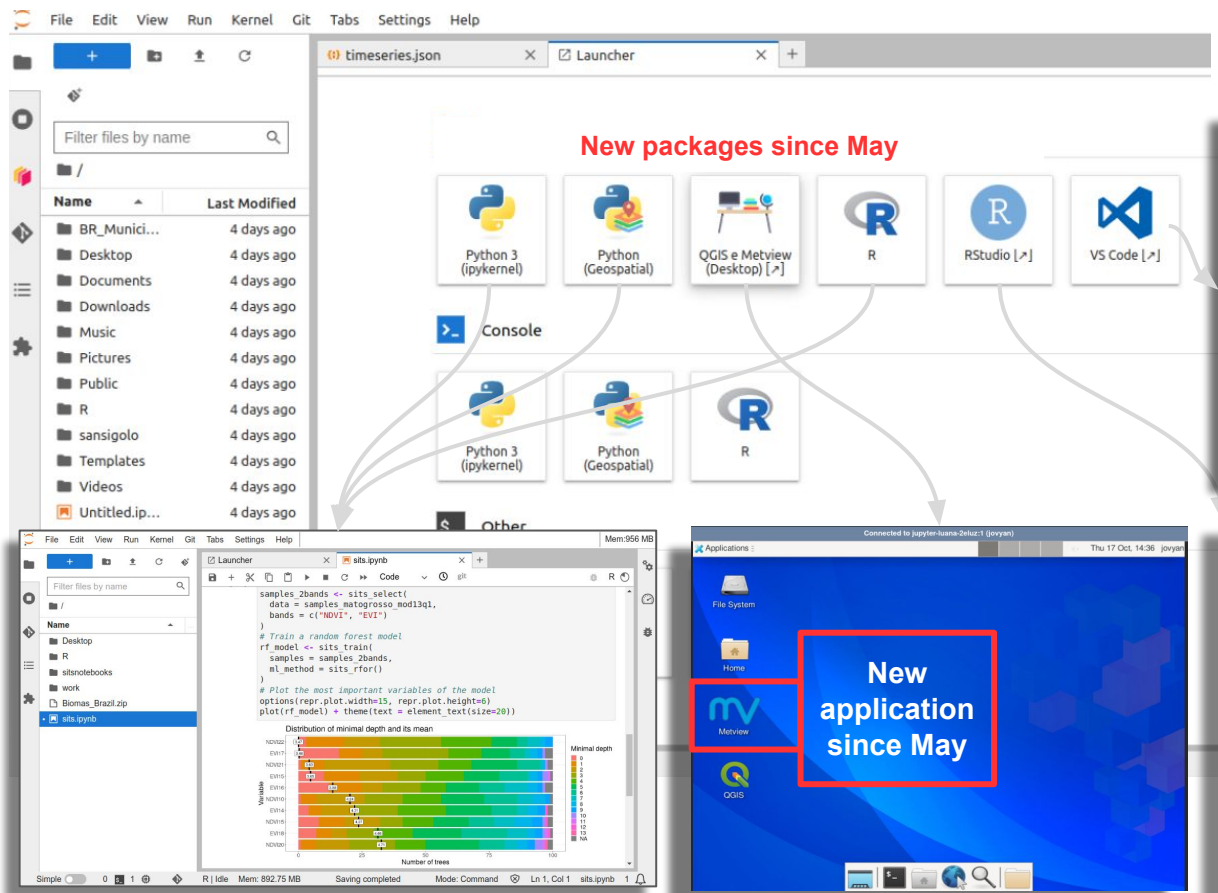
NOTE: BDC-Lab is not a HARMONIZE package/deliverable. It requires a computational infrastructure hosted by INPE.

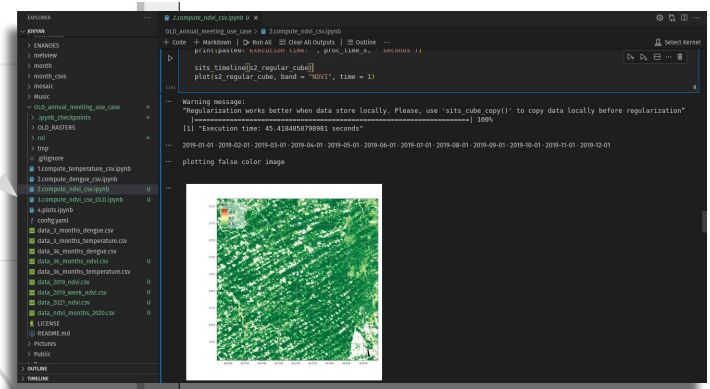
The contributions made to the cross-cutting themes:

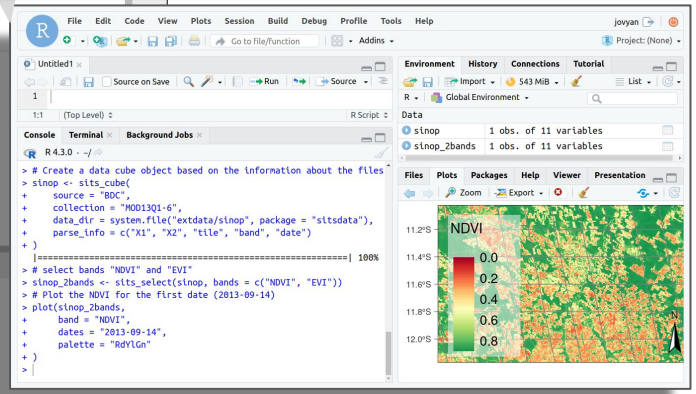
- **Topics related to Harmonize:** BDC-Lab has been used to access EODCtHRS data (tutorials are in progress);
- **Topics related to other projects/institutions:** It has been a tool for generating products by INPE and partner institutions (below)

Data science tutorials

BDC-Lab user session

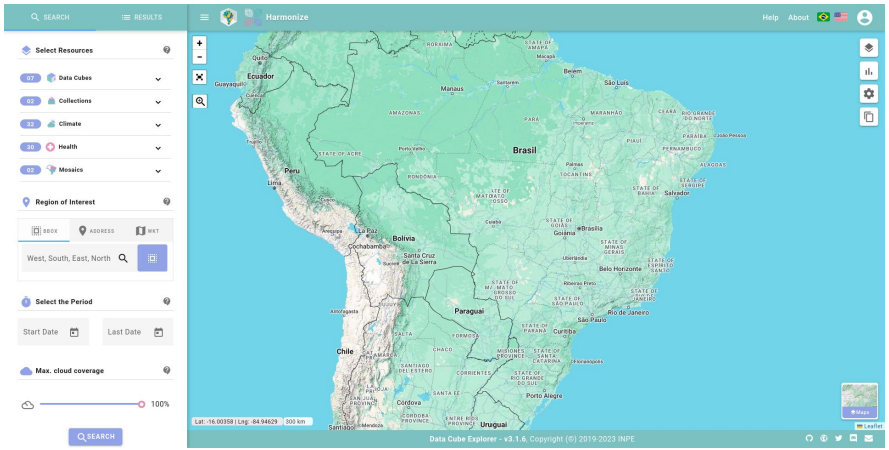






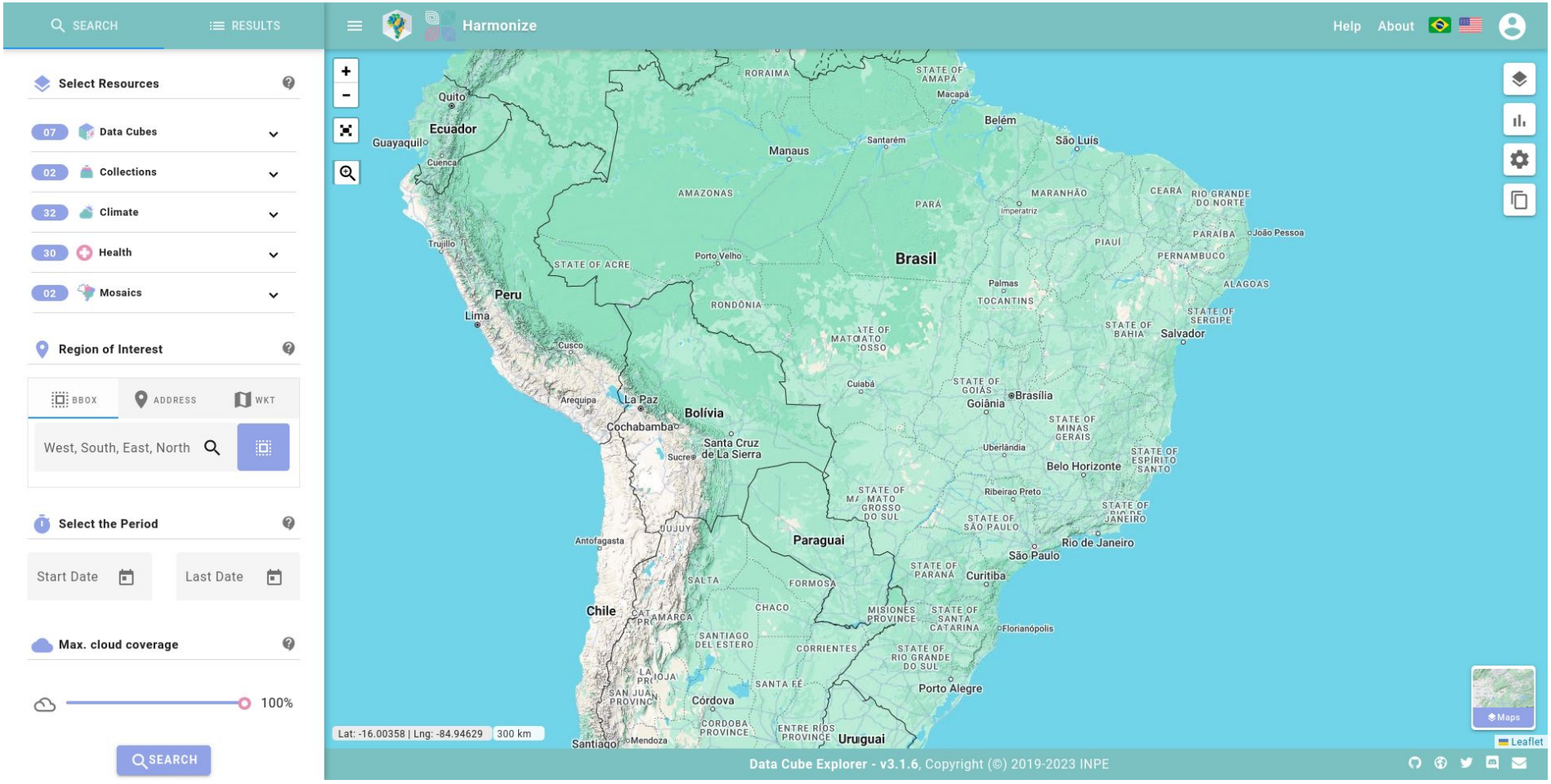
Module 5 - HARMONIZE Explorer

Harmonize Explorer



HARMONIZE Explorer is the web portal for the EODCtHRS component,

It provides features for visualizing data cubes, drone image collections, health data, climate data and drone mosaics.


SEARCH
RESULTS
Harmonize
Help
About
Select Resources
07 Data Cubes
02 Collections
32 Climate
30 Health
02 Mosaics
Region of Interest
BBOX
ADDRESS
WKT
West, South, East, North
Select the Period
Start Date
Last Date
Max. cloud coverage
100%
SEARCH
Quito
Ecuador
Guayaquil
Cuenca
Trujillo
Peru
Lima
Cusco
Arequipa
La Paz
Bolívia
Cochabamba
Santa Cruz de La Sierra
Sucre
Antofagasta
Chile
Paraguai
Uruguai
Santiago
Mendoza
Córdova
Porto Alegre
Manaus
Belém
São Luís
Brasil
Palmas
Salvador
Cuiabá
Goiânia
Brasília
Belo Horizonte
Rio de Janeiro
São Paulo
Curitiba
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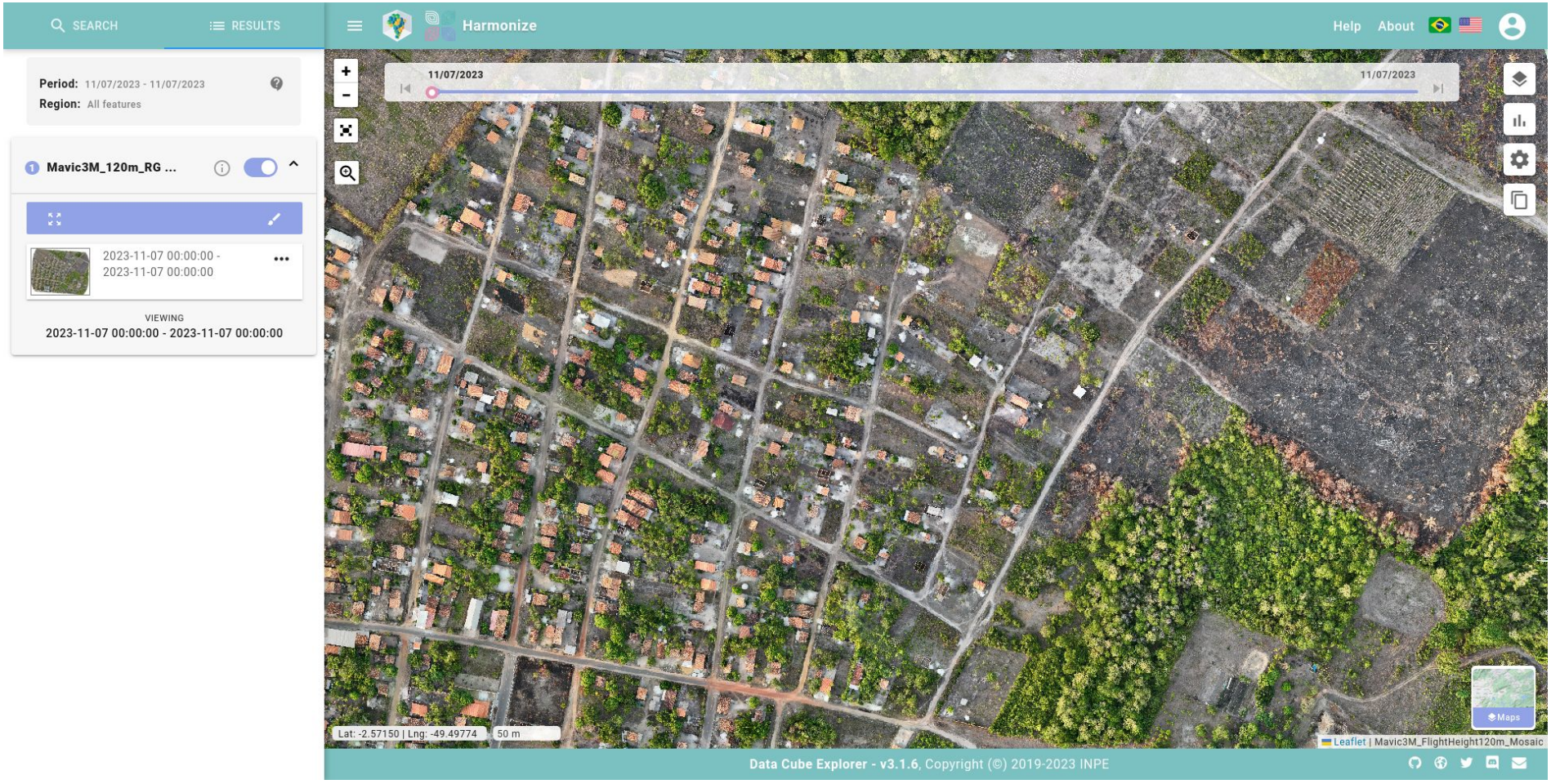
Data Cube Explorer - v3.1.6, Copyright (©) 2019-2023 INPE


SEARCH
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Harmonize
Help
About
Period: 11/07/2023 - 11/07/2023
Region: All features
Mavic3M_120m_RG ...
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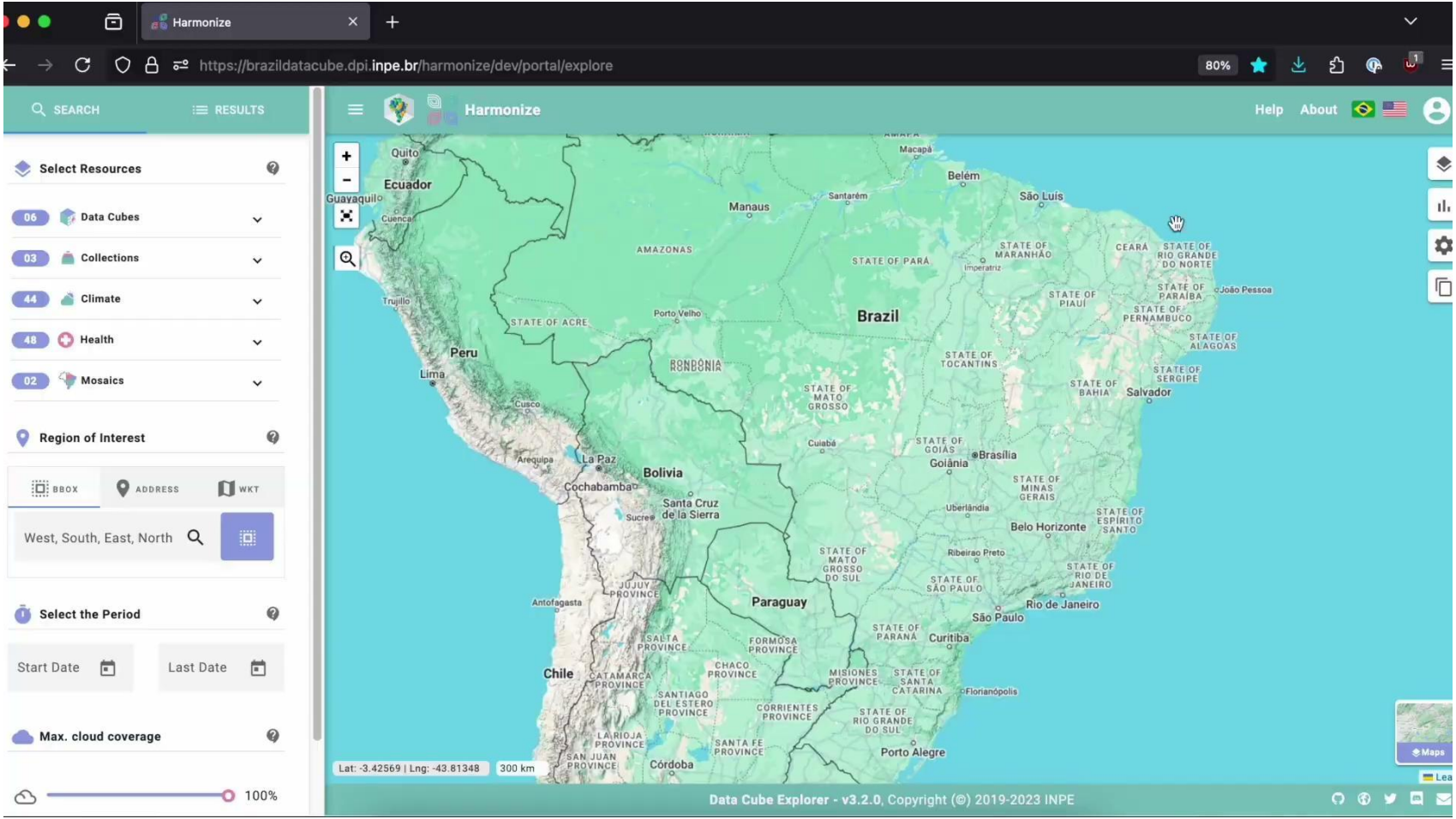
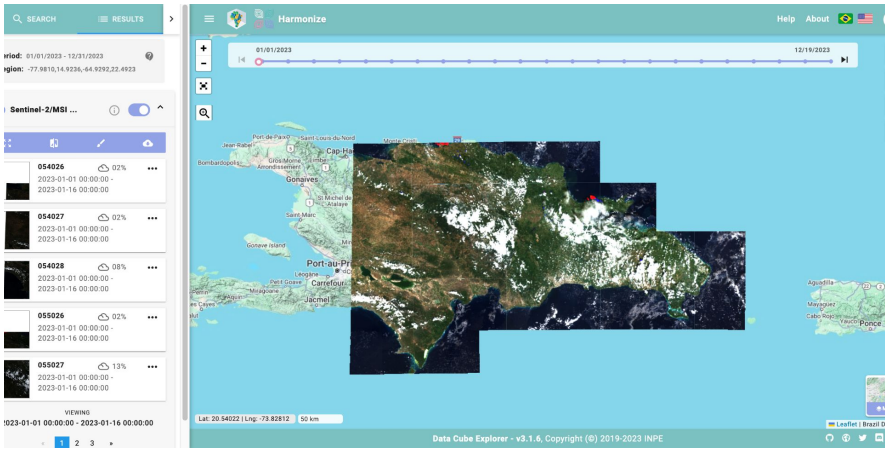
Data Cube Explorer - v3.1.6, Copyright (©) 2019-2023 INPE


Harmonize
https://brazildatacube.dpi.inpe.br/harmonize/dev/portal/explore
80%
SEARCH
RESULTS
Select Resources
06 Data Cubes
03 Collections
44 Climate
48 Health
02 Mosaics
Region of Interest
BBOX
ADDRESS
WKT
West, South, East, North
Select the Period
Start Date
Last Date
Max. cloud coverage
100%
Harmonize
Help
About
Quito
Ecuador
Guayaquil
Cuenca
Manaus
Santarém
Belém
São Luís
AMAZONAS
STATE OF PARA
STATE OF MARANHÃO
CEARA
STATE OF RIO GRANDE DO NORTE
Imperatriz
STATE OF PARAÍBA
João Pessoa
STATE OF PIAUÍ
STATE OF PERNAMBUCO
STATE OF ALAGOAS
Trujillo
Porto Velho
STATE OF ACRE
Brazil
Peru
Lima
RONDÔNIA
STATE OF TOCANTINS
STATE OF SERGIPE
STATE OF BAHIA
Salvador
Cusco
STATE OF MATO GROSSO
Cuiabá
STATE OF GOIÁS
Goiânia
Brasília
Arequipa
La Paz
Bolivia
Cochabamba
Santa Cruz de la Sierra
Sucre
STATE OF MINAS GERAIS
Uberlândia
Belo Horizonte
STATE OF ESPÍRITO SANTO
Ribeirao Preto
STATE OF MATO GROSSO DO SUL
STATE OF SÃO PAULO
STATE OF RIO DE JANEIRO
Rio de Janeiro
Antofagasta
JUJUY PROVINCE
Paraguay
São Paulo
STATE OF PARANÁ
Curitiba
SALTA PROVINCE
FORMOSA PROVINCE
CHACO PROVINCE
Chile
CATAMARCA PROVINCE
MISIONES PROVINCE
STATE OF SANTA CATARINA
Florianópolis
SANTIAGO DEL ESTERO PROVINCE
CORRIENTES PROVINCE
STATE OF RIO GRANDE DO SUL
LA RIOJA PROVINCE
SANTA FE PROVINCE
Porto Alegre
SAN JUAN PROVINCE
Córdoba
Lat: -3.42569 | Lng: -43.81348
300 km
Maps
Data Cube Explorer - v3.2.0, Copyright (©) 2019-2023 INPE

Module 6 - EO Data Cubes

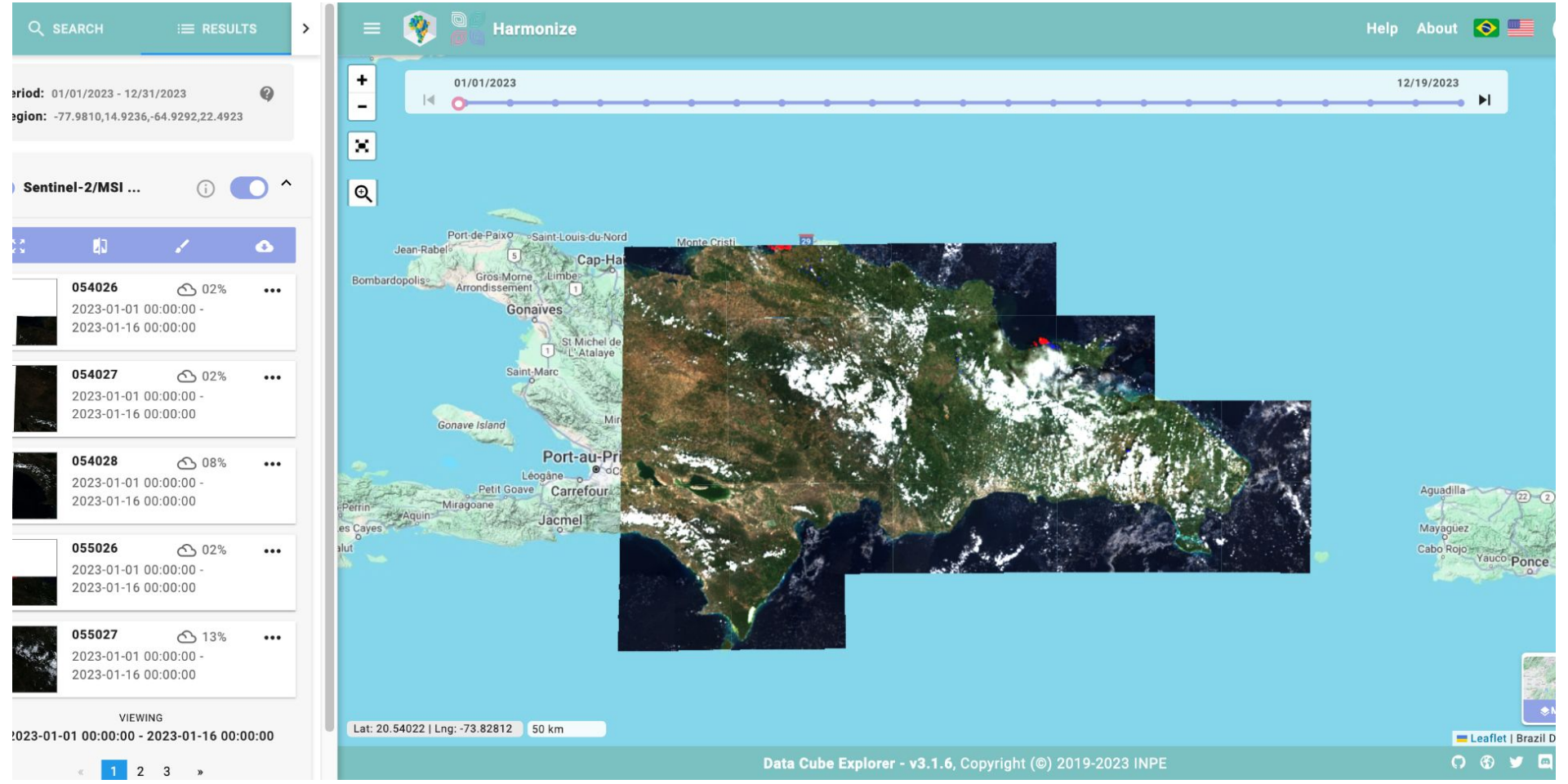
EO Data Cubes - Dominican Republic



One of the activities was the publication of Sentinel-2 data cubes for the Dominican Republic. Unlike the Sentinel-2 and landsat-8 data cubes for Colombia and Peru, external support was needed to generate the grid for the Dominican Republic.

Process:

- Download of ESA Sentinel-2 images
- Creation of S2 cubes for Dominican Republic using Grids.
- Regularization
- Visualization and testing of cubes (private)
- Opening of Data
- Addition to STAC Harmonize catalog.
- Testing in Harmonize Explorer.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2023-01-16 00:00:00
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Harmonize
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12/19/2023
Port-de-Paix
Saint-Louis-du-Nord
Jean-Rabel
Monte Cristi
Bombardopolis
Gros-Morne
Arrondissement
Limbe
Gonaives
St Michel de L'Atalaye
Saint-Marc
Gonave Island
Port-au-Pr
Léogâne
Petit Goave
Carrefour
Miragoane
Jacmel
Aguadilla
Mayagüez
Cabo Rojo
Yauco
Ponce
Lat: 20.54022 | Lng: -73.82812
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Data Cube Explorer - v3.1.6, Copyright (©) 2019-2023 INPE


SEARCH
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Harmonize
Help
About
01/01/2023
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Lat: 18.78542 | Lng: -71.30659
1 km
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Thank you!

Email: gabriel.sansigolo@inpe.br

For more details, visit: https://www.harmonize-tools.org/