

Automated Earth Observation data discovery and access using open source web frameworks

Main objectives:

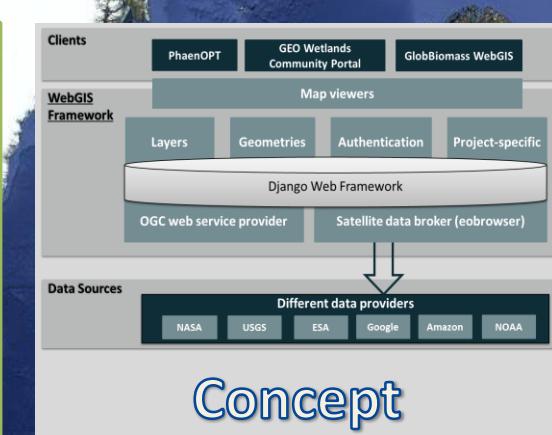
- Develop a generic framework to set up web-based geoportals using existing open source web frameworks
- Publish independent map viewers with centralized data management
- Provide ability to automatize the discovery of multi-source Earth Observation data for individual regions

Software:

- Django Web Framework (Python)
- OpenLayers
- AngularJS

Tools:

- Satellite scene explorer
- ISO-compliant metadata management
- Interactive visualization of geospatial data based on OGC services



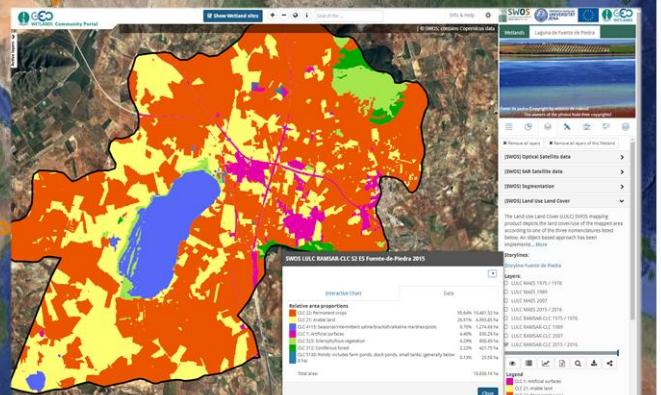
```
from pyEOM import SatelliteBroker
# Register brokering services (ESA Science Hub, USGS Earth Explorer, Sinergis
broker_all = SatelliteBroker(
    esa_scihub=(‘username’, ‘password’, [‘S1*_IW_GRD’]),
    usgs=(‘username’, ‘password’, [‘LANDSAT_MSS’, ‘LANDSAT_TM_C1’, ‘LANDSAT_ETM_C1’],
    sentinelhub=(‘http://services.eocloud.sentinel-hub.com/v1/wfs/*APIKEY*’,
    )

# Search for all scenes based on given geometry (geom_wkt)
scenes = broker_all.search(geom_wkt)

# Optionally do some automated post processing
scenes_meta = broker_all.post_process_results(scenes, min_overlap=0.7) #filter
scenes_meta = broker_all.retrieve_metadata(scenes_meta) #retrieve external me
scenes_meta = broker_all.add_sentinelhub_wms_url(scenes_meta) #add sentinel h

# Export data to GeoJSON file
broker_all.export_results(scenes_meta, ‘test_all10.json’)
```

Python library



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Concept

Clients

PhaenOPT

GEO Wetlands
Community Portal

GlobBiomass WebGIS

WebGIS Framework

Layers

Geometries

Authentication

Project-specific

Django Web Framework

OGC web service provider

Satellite data broker (eobrowser)

Data Sources

NASA

USGS

ESA

Google

Amazon

NOAA

Different data providers

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Backend: Overview

- **Django Web Framework**
 - High-level Python Web framework
 - www.djangoproject.com
 - License: BSD
- **Django extensions**
 - REST Framework
 - REST-based user authentication
 - GeoDjango
- **Django applications developed**
 - General: [Mapviewer](#), [Layers](#), EOBrowser, [Geometries](#)
 - Specific for projects: Wetlands, PhaenOPT

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Backend: Mapviewers

[Back](#)

Enables to publish different geoportal applications from the backend within a single instance of the framework.

Configuration fields:

- Template file
- Base layers
- Layer groups
- Center coordinate
- Permissions

The top map viewer interface displays a global satellite view with orange markers indicating wetland locations. A sidebar on the right lists specific wetland regions with checkboxes. The bottom map viewer interface shows a close-up satellite image of a wetland area, overlaid with a large black polygon and some red features. A sidebar on the right lists validation resources, including various Copernicus HR datasets and SWOS validation data.

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Backend: Layers

Back

- Layers are connected to external services or files
 - OGC services: WMS, WMTS, WFS, TMS, SOS
 - Files: GeoJSON
 - Other services: Bing Maps, Google Maps, OSM

OGC service URL:

Layer name:

OGC service type: *

Image format:

For WMS/WMTS, e.g., image/png, image/jpeg

Attribution:

Attribution / Copyright. To add a link use the following syntax (<http://www.adress.de>, name)

- Each layer need to have further metadata (e.g., title, contact)
 - See slide „Metadata management“

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Backend: Metadata management

[Back](#)

- ISO 19115 metadata need to be included for each layer
- Metadata can be directly integrated into OGC CSW-compliant catalogue (e.g., using pyCSW software)
- Also: ElasticSearch integration

Identifier: * SWOS_FloodReg_L8_FR_Palavasiens_2014

Title: * SWOS FloodReg L8 FR Palavasiens 2014

Abstract: * This file contains a flood regulation capacity map for the geographic area and temporal period as identified below. The data set was created in the framework of SWOS (Satellite-based Wetland Observation System)

Topic category: * climatologyMeteorologyAtmosphere
economy
elevation
environment

Scope: * dataset

Hold down "Control", or "Command" on a Mac, to select more than one.

SWOS FloodReg L8 FR Palavasiens 2014

RESOURCE DESCRIPTION
This file contains a flood regulation capacity map for the geographic area and temporal period as identified below. The data set was created in the framework of SWOS (Satellite-based Wetland Observation System)

TEMPORAL EXTENT
2013-06-03 - 2014-09-26

CATEGORY
Environment

KEYWORDS
Habitats and biotopes
Land Cover

BOUNDING BOX (LAT, LON COORDINATES)
North: 43.832
West: 3.542
South: 43.456
East: 3.978

LINEAGE
Produced in the framework of SWOS based on Landsat OLI satellite data. The result was validated by field data

RESOLUTION
30 meter

ONLINE RESOURCES
<http://swos-service.eu/>

POINT OF CONTACT (DATASET)
Tour du Valat
Contact: Anis Guelmami
Email: guelmami@tourduvalat.org

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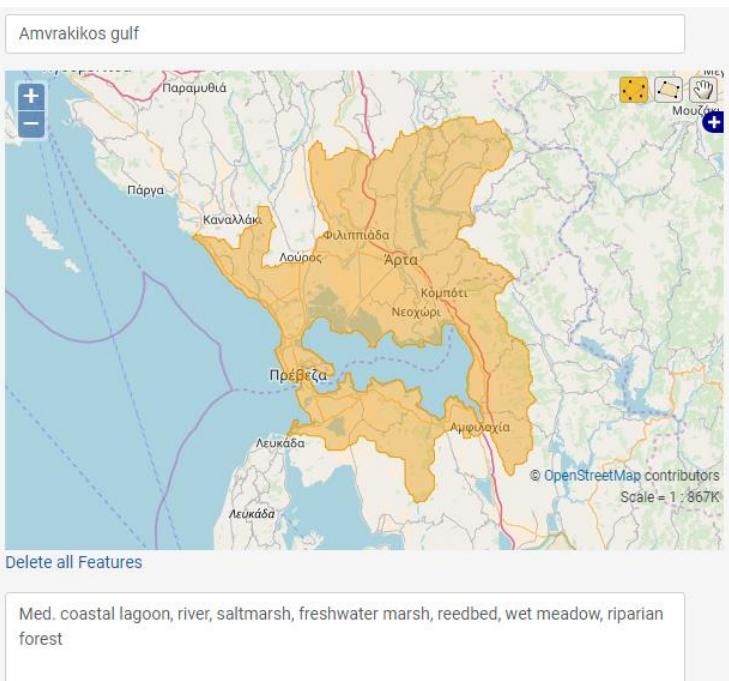
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Backend: Geometries / Regions

Back

Regions (as polygon geometries) can be managed to link further tools that are available for individual areas:

- Search for available satellite data
- Search within GEOSS for this area
- List all images from Flickr
- Calculate statistics on geospatial datasets



Also further metadata related to each region can be managed:

- Country, Size, Ecoregion, Type, Processing parameters

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Satellite data broker

How to find and get access to Satellite time-series data without learning how to use all the different tools and services?

Key issues:

- Different web service specifications need to be known by users
- Different data providers need to be requested individually
- Not any data provider provides all necessary metadata (e.g., thumbnails, browse images, sun angles)
- Additional filter capabilities based on the area of interest are needed (e.g., overlap between area and scene)
- Simple overview charts are missing

→ Solution: Satellite time-series data discovery & access broker

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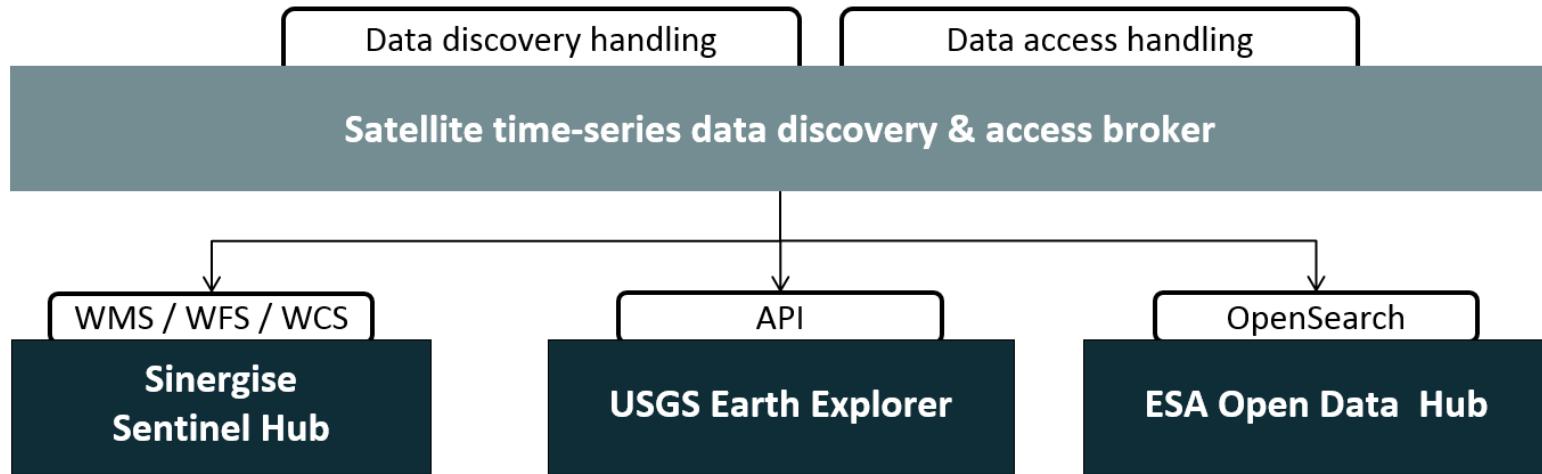


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Satellite time-series data discovery & access broker

Concept of the satellite data broker

Back



- Broker (Python code) is connected to different data providers
- Metadata and download links are unified and made available
- Interactive tools to explore data: Charts and Quicklooks

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Satellite time-series data discovery & access broker

Python library (pyEOM v2)

Back

Example: List all Sentinel-1 data from ESA Open Access Hub, Landsat and Sentinel 2A data from USGS and Landsat 5/7 data from Sentinel-Hub (ESA archive) for a given geometry.

```
from pyEOM import SatelliteBroker
# Register brokering services (ESA Science Hub, USGS Earth Explorer, Sinergise Sentinel-Hub)
broker_all = SatelliteBroker(
    esa_scihub=('*username*', '*password*', ['S1*_IW_GRD*']),
    usgs=('*username*', '*password*', ['LANDSAT_MSS', 'LANDSAT_TM_C1', 'LANDSAT_ETM_C1', 'LANDSAT_8_C1', 'SENTINEL_2A']),
    sentinelhub=('http://services.eocloud.sentinel-hub.com/v1/wfs/*APIKEY*', ['L5.TILE', 'L7.TILE'])
)

# Search for all scenes based on given geometry (geom_wkt)
scenes = broker_all.search(geom_wkt)

# Optionally do some automated post processing
scenes_meta = broker_all.post_process_results(scenes, min_overlap=0.7) #filter based on geometry overlap
scenes_meta = broker_all.retrieve_metadata(scenes_meta) #retrieve external metadata
scenes_meta = broker_all.add_sentinelhub_wms_url(scenes_meta) #add sentinel hub wms links

# Export data to GeoJSON file
broker_all.export_results(scenes_meta, 'test_all10.json')
```

Soon available on Github: <https://github.com/jonas-eberle>

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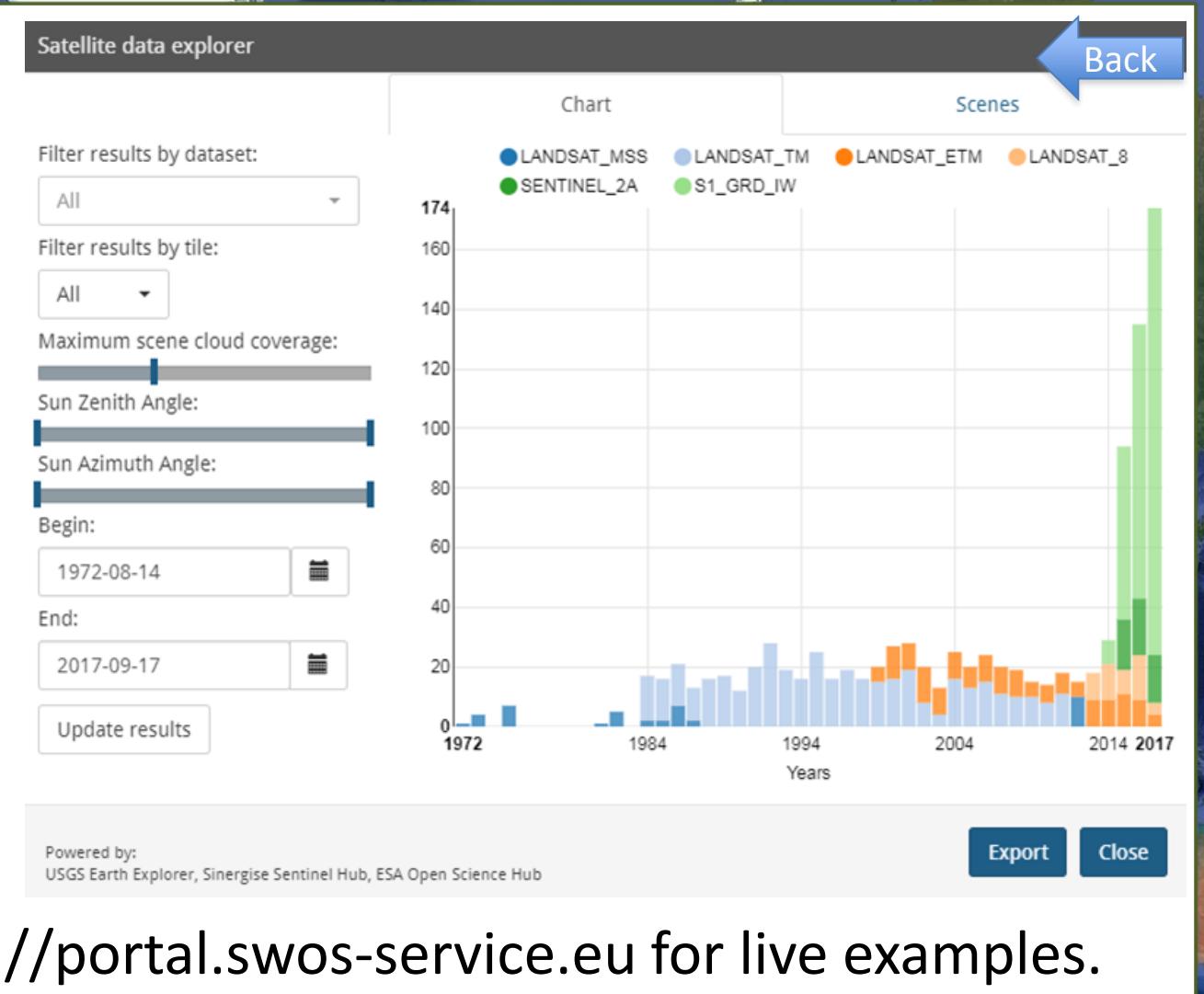


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Satellite time-series data discovery & access broker

Interactive charts based on the results from the satellite data broker.

Automatically generated for each of the wetlands in the SWOS portal.



Please look at <http://portal.swos-service.eu> for live examples.

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Satellite time-series data discovery & access broker

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The screenshot shows a satellite map of a wetland area. A specific region is highlighted in green. A modal window titled "Satellite data explorer" is open, showing a chart and a list of Sentinel-2A scenes. The scenes are listed as follows:

Date	Cloud Coverage (%)	Action
2017-04-04	23.72%	Add SentinelHub WMS
2017-05-04	19.61%	Add SentinelHub WMS
2017-05-24	23.55%	Add SentinelHub WMS
2017-06-06	26.71%	Add SentinelHub WMS
2017-06-06	21.60%	Add SentinelHub WMS

Powered by: USGS Earth Explorer, Senergise Sentinel Hub, ESA Open Science Hub

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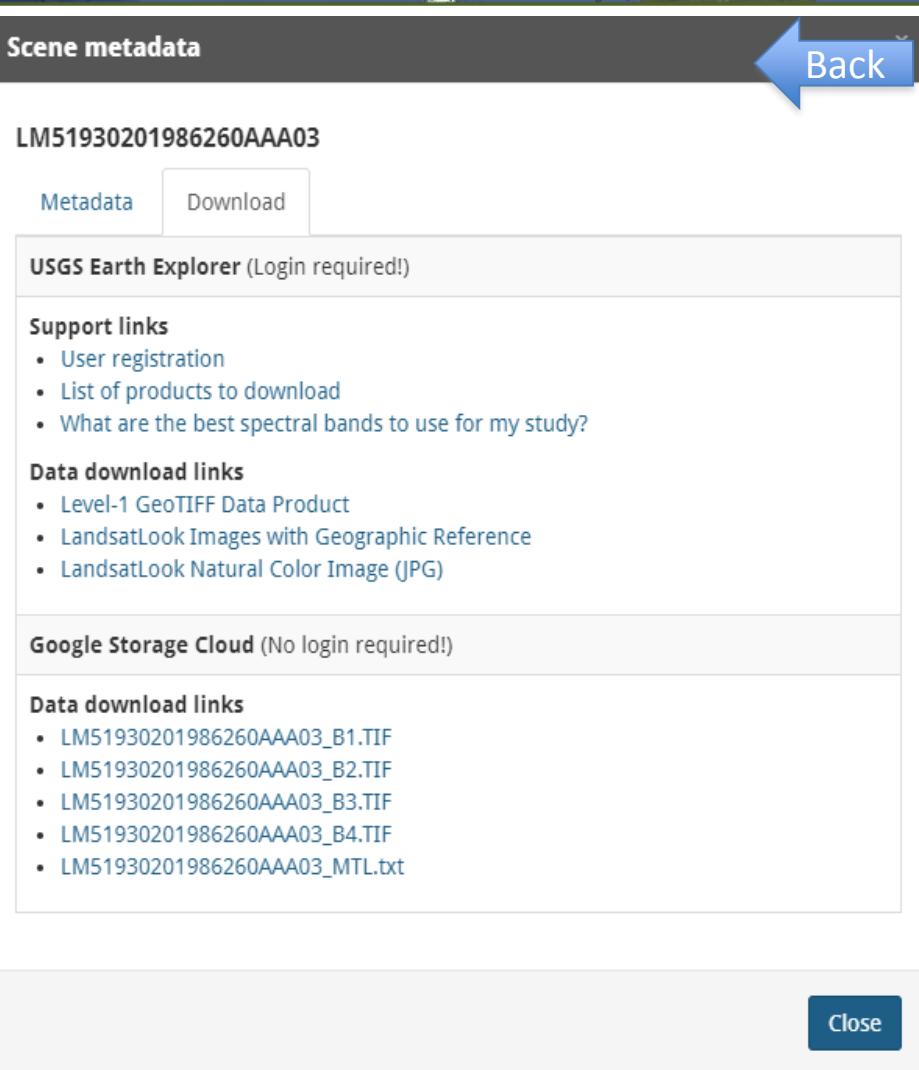


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Satellite time-series data discovery & access broker

Metadata and download links are collected from each of the data providers and stored into a unified metadata structure.

Direct download links are provided based on USGS Earth Explorer, Amazon Web Services, Google Cloud Storage as well as CODE-DE.



The screenshot shows a modal window titled "Scene metadata" for a scene ID "LM51930201986260AAA03". A blue arrow points from the top right towards the "Back" button. The window contains two tabs: "Metadata" (selected) and "Download". Below the tabs, there's a section for "USGS Earth Explorer (Login required!)" which lists "Support links" (User registration, List of products to download, What are the best spectral bands to use for my study?) and "Data download links" (Level-1 GeoTIFF Data Product, LandsatLook Images with Geographic Reference, LandsatLook Natural Color Image (JPG)). Another section for "Google Storage Cloud (No login required!)" lists "Data download links" for five files: LM51930201986260AAA03_B1.TIF, LM51930201986260AAA03_B2.TIF, LM51930201986260AAA03_B3.TIF, LM51930201986260AAA03_B4.TIF, and LM51930201986260AAA03_MTL.txt. A "Close" button is at the bottom right.

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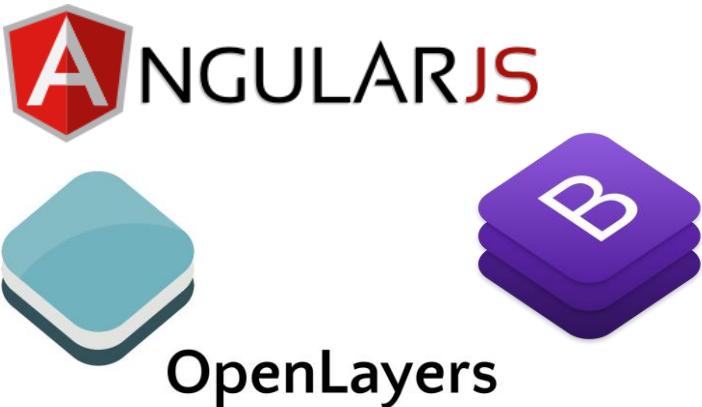


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Frontend development

Software

- AngularJS
- Bootstrap CSS
- OpenLayers



Using REST-based services

- Based on Django REST Framework
- Example requests:
 - Get map viewer configuration
 - Get list of layers
 - Get metadata of layer in different formats (HTML, XML, JSON)

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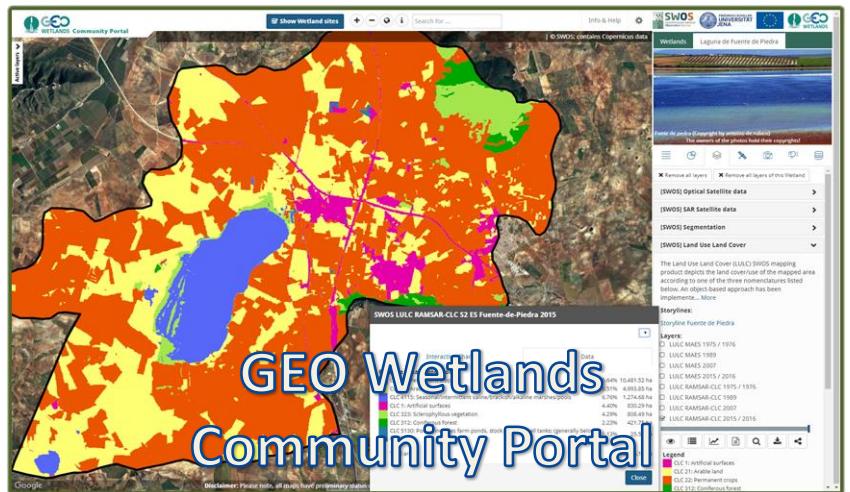
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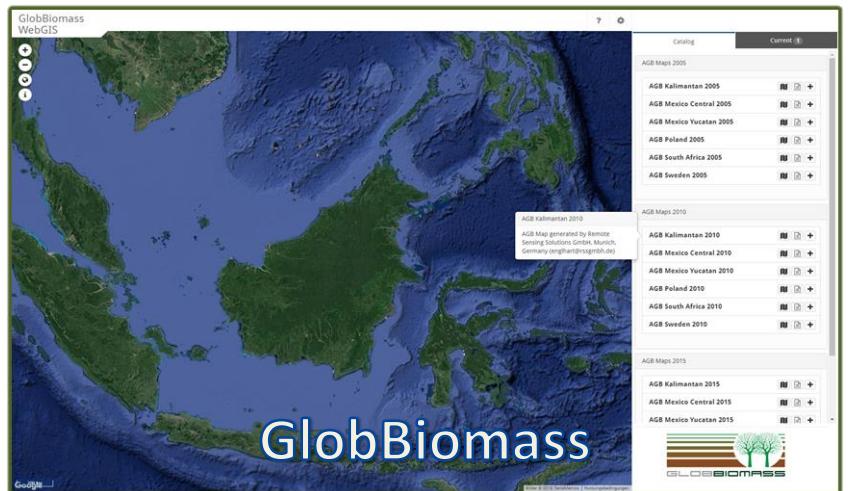


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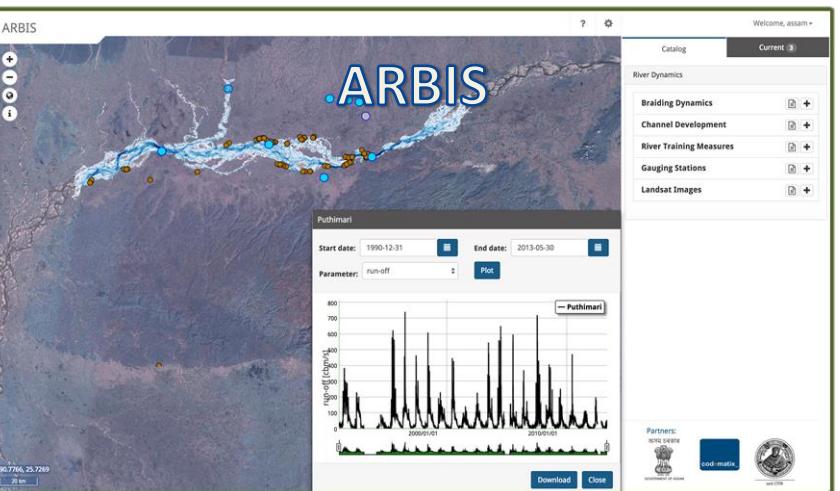
Example usage of this framework



PhaenOPT



GlobBiomass



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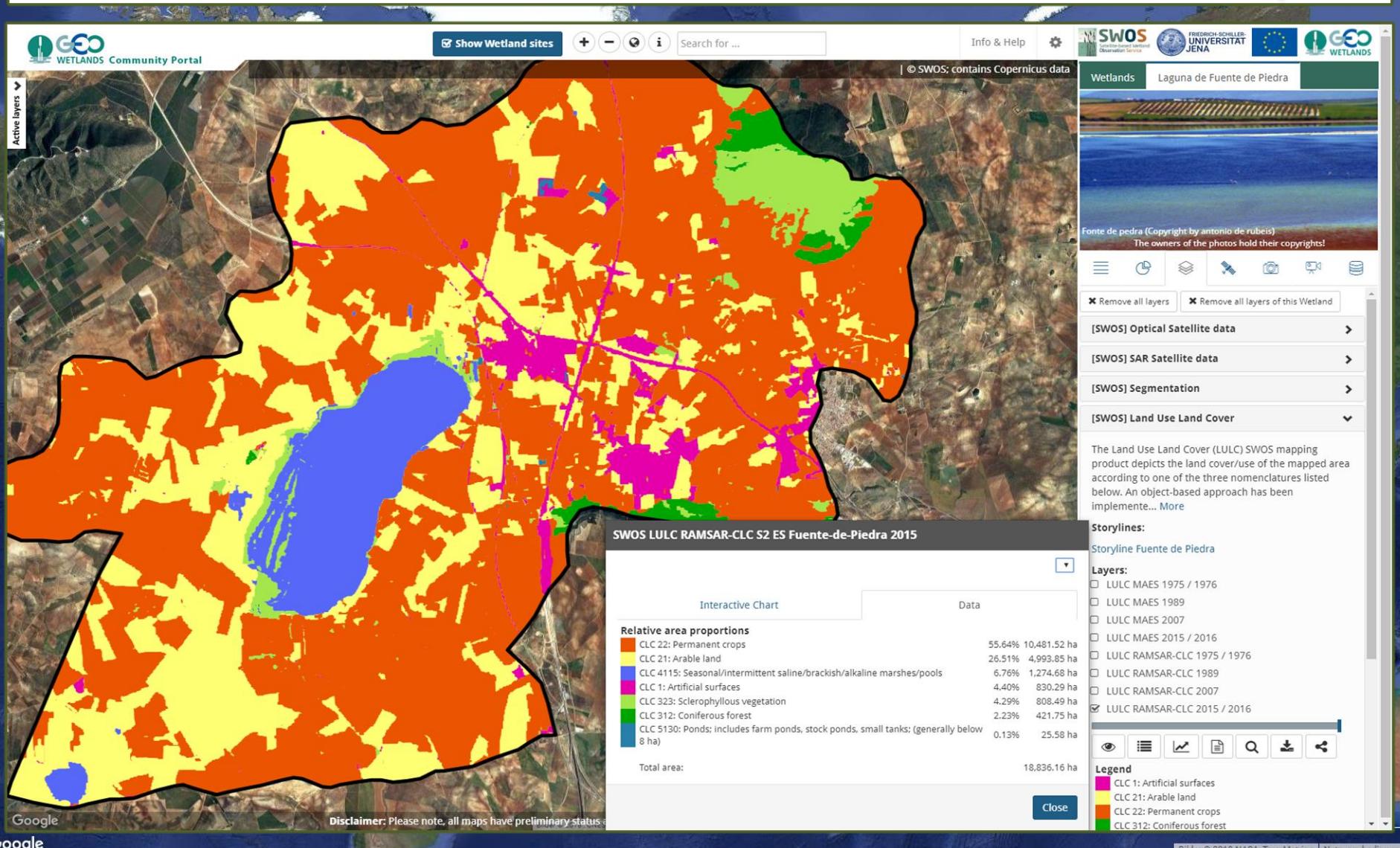
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GEO Wetlands Community Portal

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ASSAM River Basin Information System

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ARBIS

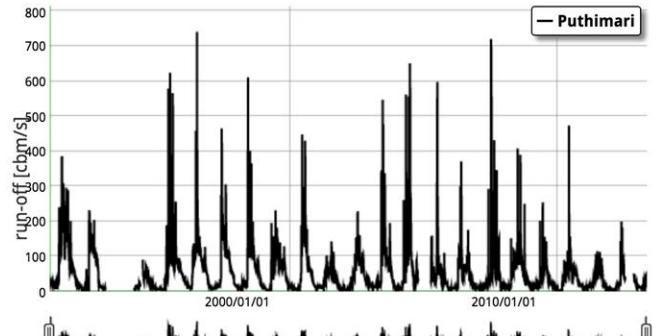


Puthimari

Start date: 1990-12-31 End date: 2013-05-30

Parameter: run-off

Plot



Download

Close

90.7766, 25.7269

20 km

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ESA GlobBiomass WebGIS

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GlobBiomass WebGIS

AGB Kalimantan 2010

AGB Map generated by Remote Sensing Solutions GmbH, Munich, Germany (englhart@rssgmbh.de)

Catalog

Current 1

AGB Maps 2005
AGB Kalimantan 2005
AGB Mexico Central 2005
AGB Mexico Yucatan 2005
AGB Poland 2005
AGB South Africa 2005
AGB Sweden 2005

AGB Maps 2010
AGB Kalimantan 2010
AGB Mexico Central 2010
AGB Mexico Yucatan 2010
AGB Poland 2010
AGB South Africa 2010
AGB Sweden 2010

AGB Maps 2015
AGB Kalimantan 2015
AGB Mexico Central 2015
AGB Mexico Yucatan 2015

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Google

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 GLOBBIOMASS

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PhaenOPT – Web services for vegetation data

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Objectives

- Provide relevant data (in-situ as well as EO-based) for the analysis of vegetation phenology as annual time-series
- Users can extract time-series for their area of interests and compare Earth Observation data with in-situ observations

Additional tools for web framework

- On-the-fly extraction of data from raster time-series
- Link to Jupyter Notebooks to conduct further analysis

Further information

- [See the poster on Friday](#)

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PhaenOPT – Vegetation phenology using EO

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Poster: Friday, 17:30 – 19:00, Session CL 2.15, Hall X4, Poster X4.3

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On-going work and future ideas

On-going work

- Linking Django with Jupyter Notebooks
- Source code cleanup and documentation
- Publish web framework and satellite data broker on Github
- Provide Docker container for web framework

Future ideas

- Integrate processing capabilities based on OGC Web Processing Services

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