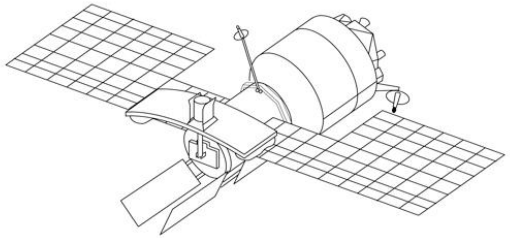
The NOA Ground Segment Facility

The Hellenic Sentinel Data Hub (Mirror Site)

- **Dr Haris KONTOES, prof. Kanaris Tsinganos**
- National Observatory of Athens
- **Dr Xenofon Tsilimparis**

  GRNET (GEANT)

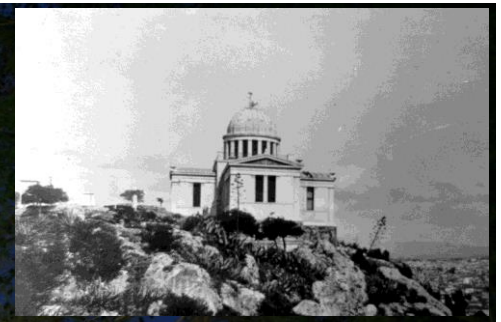


BEYOND

www.beyond-eocenter.eu

ESA National Observatory of Athens Agreement The Hellenic Sentinel Data Hub

The 1st Collaborative Ground Segment (Mirror Site) for Sentinel satellite missions was signed between ESA and NOA on 12 May 2014



Activity in the framework of the
COPERNICUS PROGRAM
The EUROPEAN EARTH OBSERVATION FLAGSHIP PROGRAM (EU/ESA)
http://www.copernicus.eu/

The Hellenic Sentinel Data Hub
Official Announcement

OFFICIAL ANNOUNCEMENT OF HELLENIC MIRROR SITE
ATHENS: 28 MARCH – 5 APRIL 2015

LINK:
HTTP://SENTINELS.SPACE.NOA.GR

Scope of the Collaborative Ground Segment
The Hellenic Sentinel Data Hub (Mirror Site)

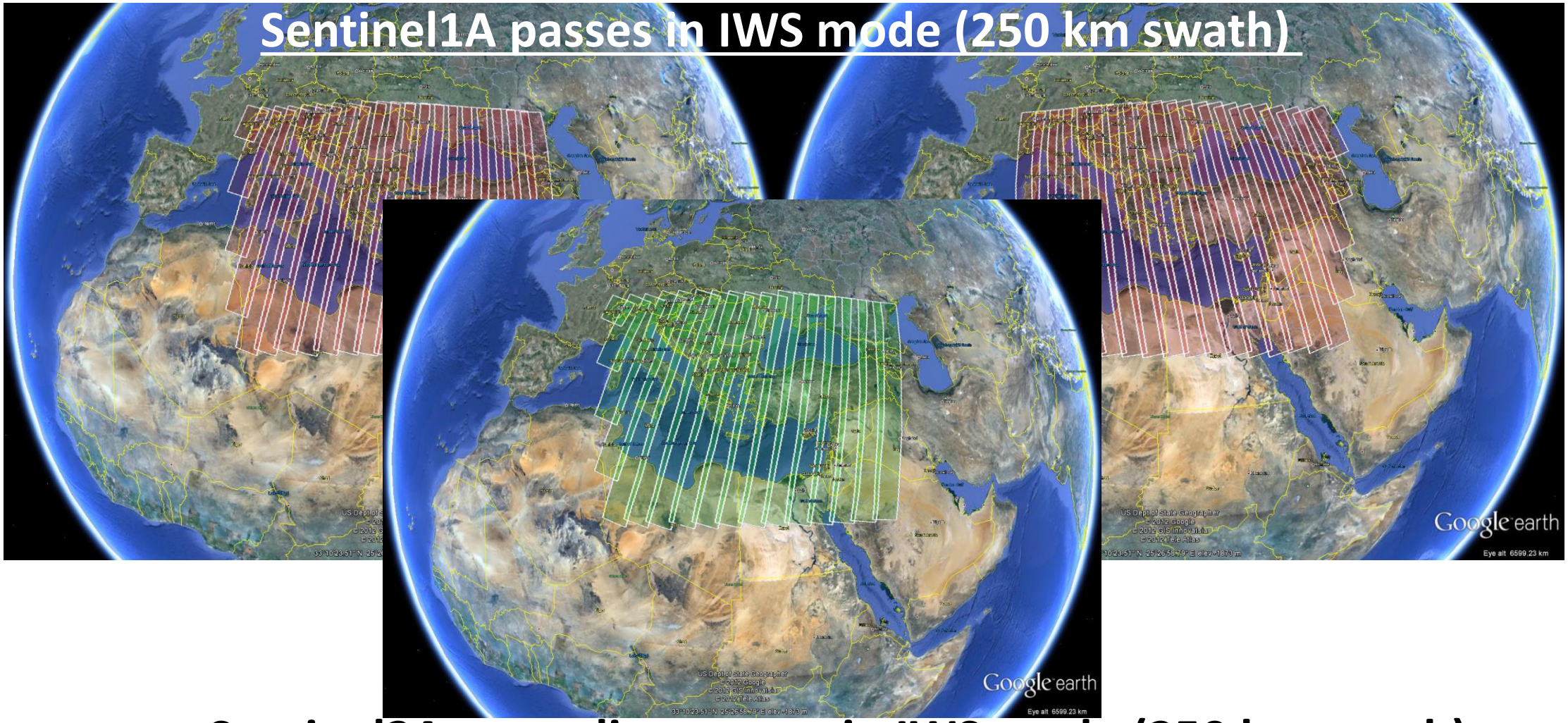
- Built up an additional pick up point **(Mirror Site)** of Sentinel data at the premises of the **National Observatory of Athens (NOA)** in collaboration with the **Greek Research and Technology Network GRNET S.A.** the Greek Partner of the GEANT network.

- **Disseminate Sentinel data and higher level Copernicus products** to the End User & Scientific communities mainly at national level, but also to neighboring South Eastern Mediterranean and Balkan countries on the basis of the existing and/or future transnational needs and cooperations.

- The whole project is in line with the ongoing initiatives and strategic objectives for building at NOA a Center of Excellence for EO based monitoring of the Environment and Natural Disasters and processing of Space Data.

Geographic Area of Interest (AOI)

Sentinel1A passes in IWS mode (250 km swath)



Sentinel2A ascending passes in IWS mode (250 km swath)

Activities Overview

ESA has developed a prototype software, the Data Hub System (DHuS), with the scope to:

- Allow Collaborative Partners to centrally access Sentinel data through a dedicated Hub

NOA → ESA's Collaborative Partner for the use of DHuS software

At NOA/GRNET:

- Computational Infrastructure facilities for downloading and storing Sentinel Data, processing of the data, and running the dedicated Coll GS applications. **Action Completed in June 2015**
- A complete set of software tools for the systematic data download and organized storage, as well as distribution of data via a Web interface is available and is under operation by the users. **Action Completed in May 2015**
- Archiving Infrastructure facilities for physical storage of Sentinel data at the premises of NOA are expected to be available for installation, configuration, and final operation. **Action to be Completed in November 2015**

➢**HighSpeed optical links owned by GRNET/GEANT**, are used to connect ESA's Data center(s), with NOA's Mirror Site computational infrastructure

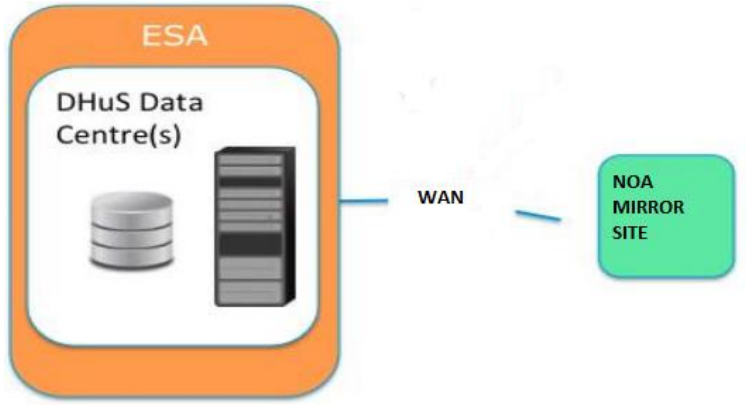
➢A set of Virtual Machines (VMs), hosted by the Greek Research & Technology Network (GRNET), are configured and ready for use

OS: Ubuntu Linux 14.04 LTS, 64 Bit.

CPU: 12 CPU's per VM.

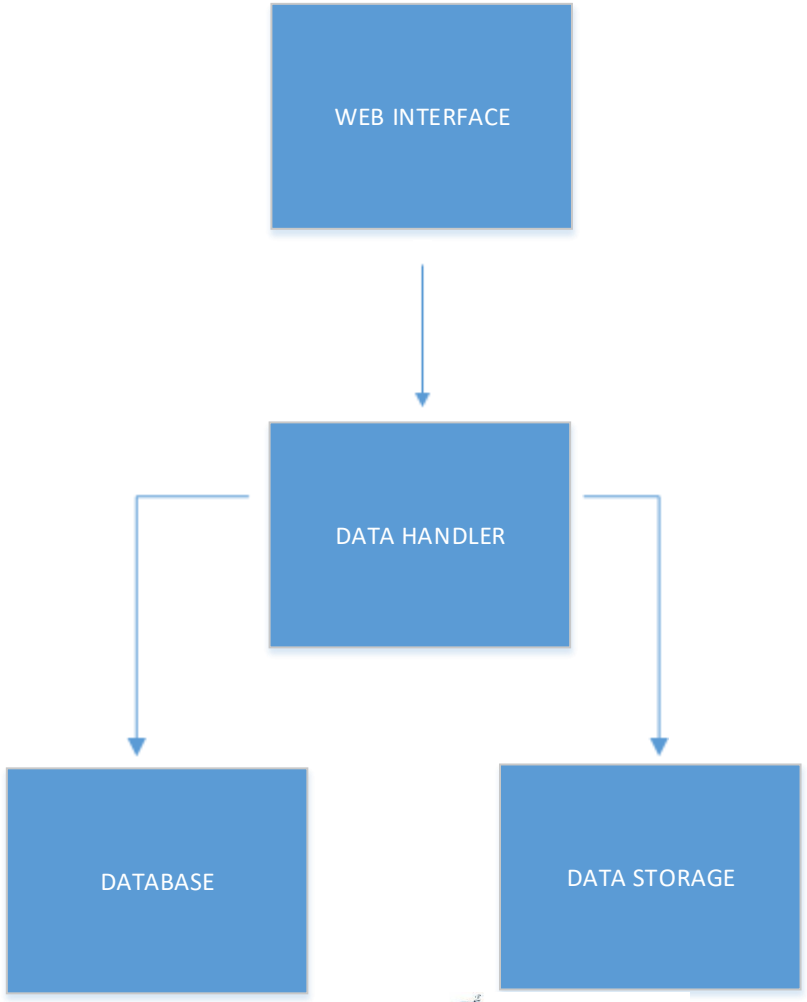
RAM: 24 GB per VM.

Static, dedicated IPv4 and IPv6 addresses



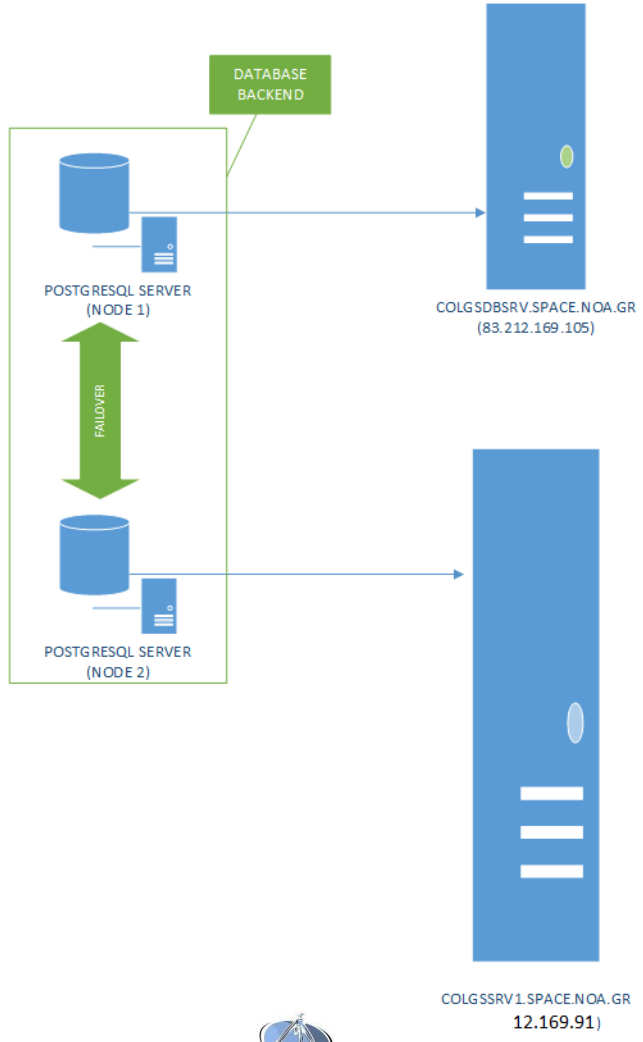
3Level Architecture

- **Web Interface Level 1st**: the user interaction level
- **Data Handling Level 2nd**: The set of scripts that downloads and organizes data
- **Database Level 3rd**: storing metadata and system wide events
- **Data Storage Level 3rd**: physical storage of data

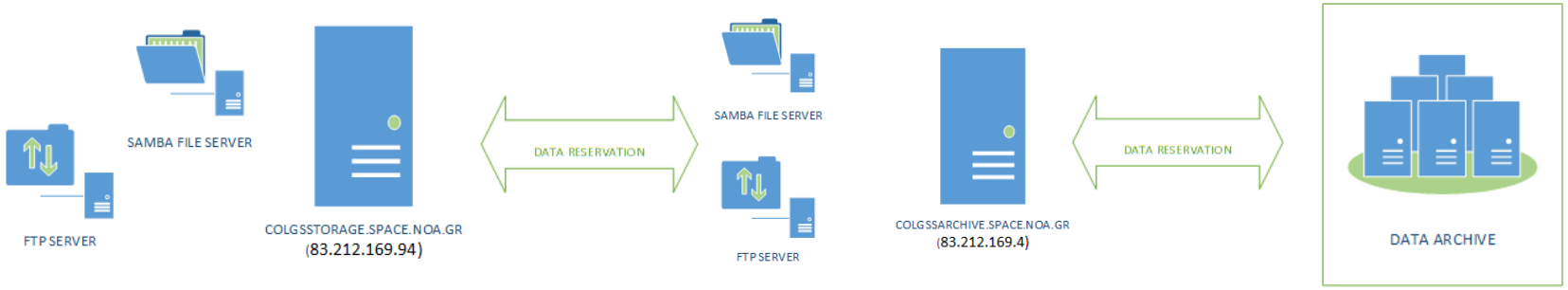


Hellenic Sentinel Data Hub – The Database Level

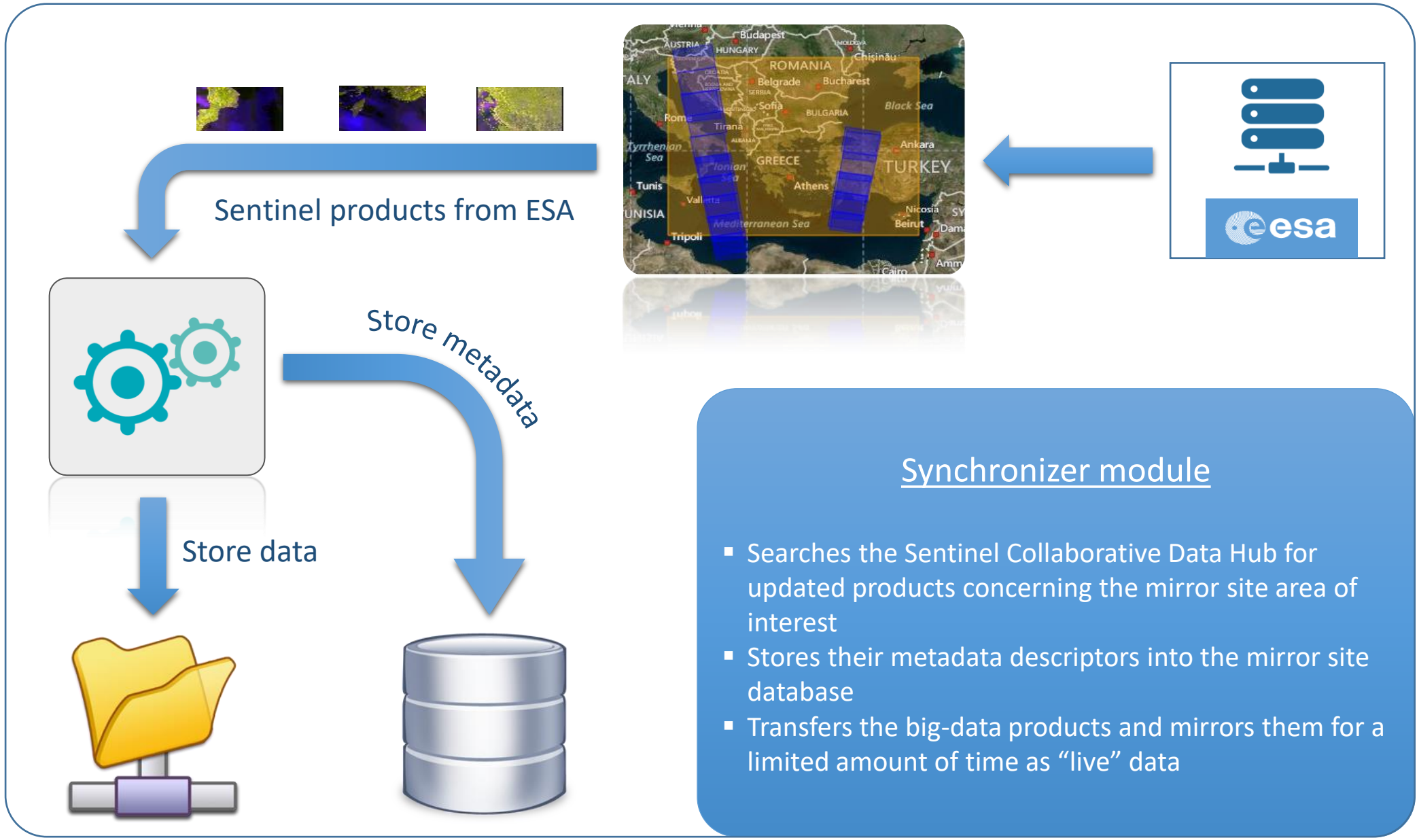
- **Utilization of 2 Database Servers**
  - ✓Main DB
  - ✓Backup DB
- **PostgreSQL 9.3**
- **Data Base scheme easily expandable**
- **Organized in cluster for achieving automatic failover, loadbalancing etc**



- **Week Storage:** data of the week are kept in a high performant, small storage capacity virtual machine (VM)
- **Month Storage:** data of the month are transferred and kept in a second level storage, in a larger storage capacity VM
- **Year Storage:** older than one month data will be stored at NOA premises in a Hard Disk/Tape Library archiving facility



Hellenic Sentinel Data Hub
The Backend Architecture



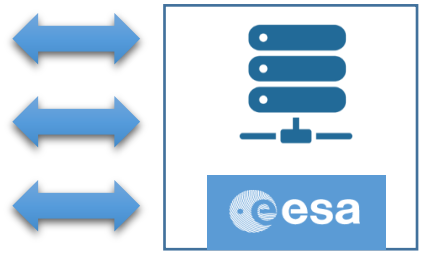
Synchronizer module

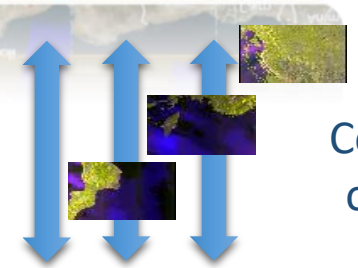
- Searches the Sentinel Collaborative Data Hub for updated products concerning the mirror site area of interest
- Stores their metadata descriptors into the mirror site database
- Transfers the big-data products and mirrors them for a limited amount of time as “live” data

Hellenic Sentinel Data Hub
The Backend Architecture

Downloader module

- Gathers the Mirror Site user requests posed through the GUI in the form of orders (i.e. collections of products).
- Concurrently downloads products that are not lying in the local storage.
- Informs users for the availability of the big data products in order to download them via the Mirror Site facilities and its Web GUI.



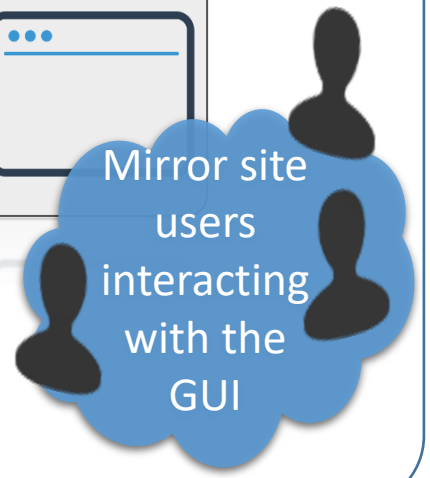


Concurrent download of Sentinel products from ESA

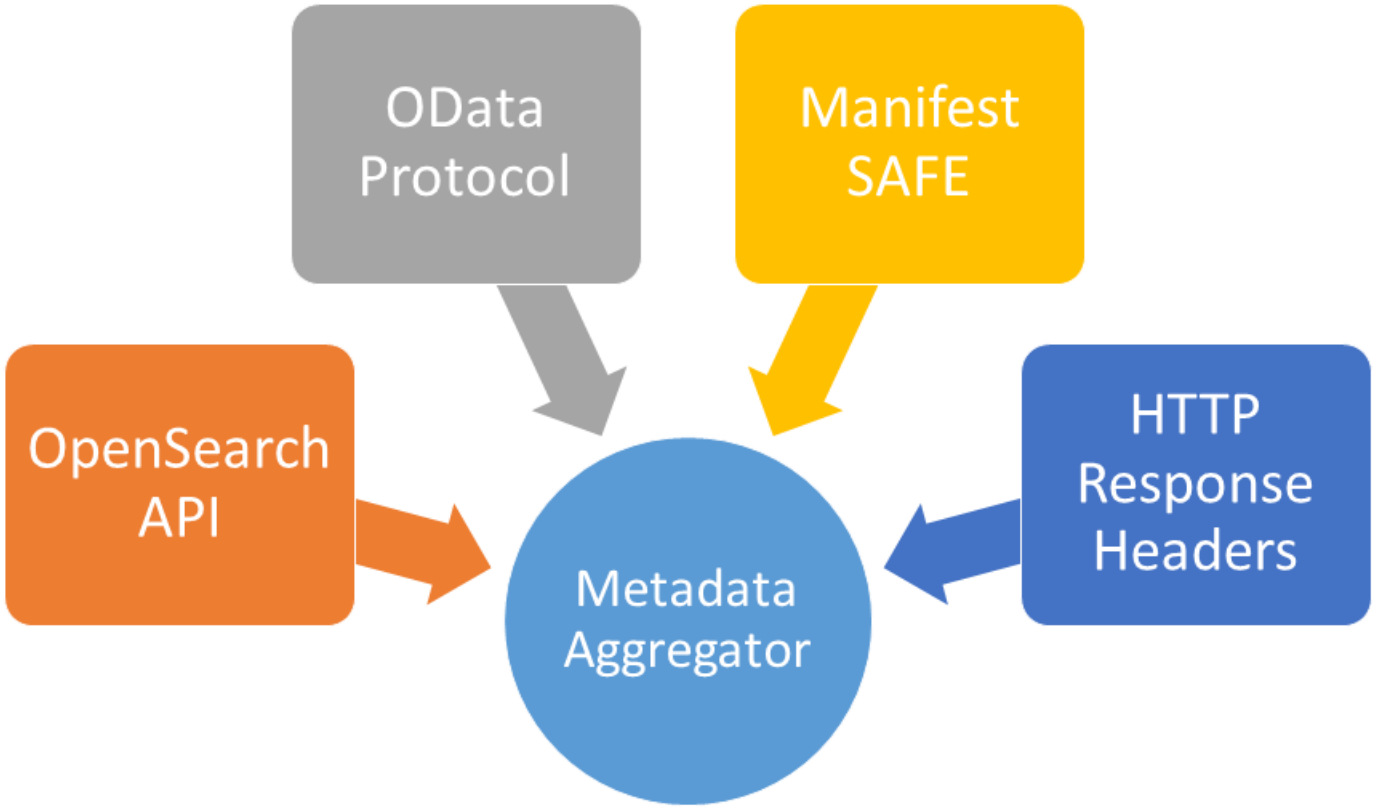
Concurrently store data

Concurrently update metadata

Requests of users for Sentinel products



- Four steps in order to aggregate all the metadata for a Sentinel product:
  1. Get metadata through the ESA's OpenSearch API.
  2. Get metadata through the ESA's OData protocol.
  3. Get metadata from the Product's manifest file in SAFE format.
  4. Use HTTP Response headers.
- Parse metadata.
- Rename metadata.
- Catalogue metadata.



Benchmark Exercise for testing the Dedicated Sentinel DataHub Transfer Rate

30 Parallel Transfers

ESA Dedicated SENTINEL DataHub

GEANT Network

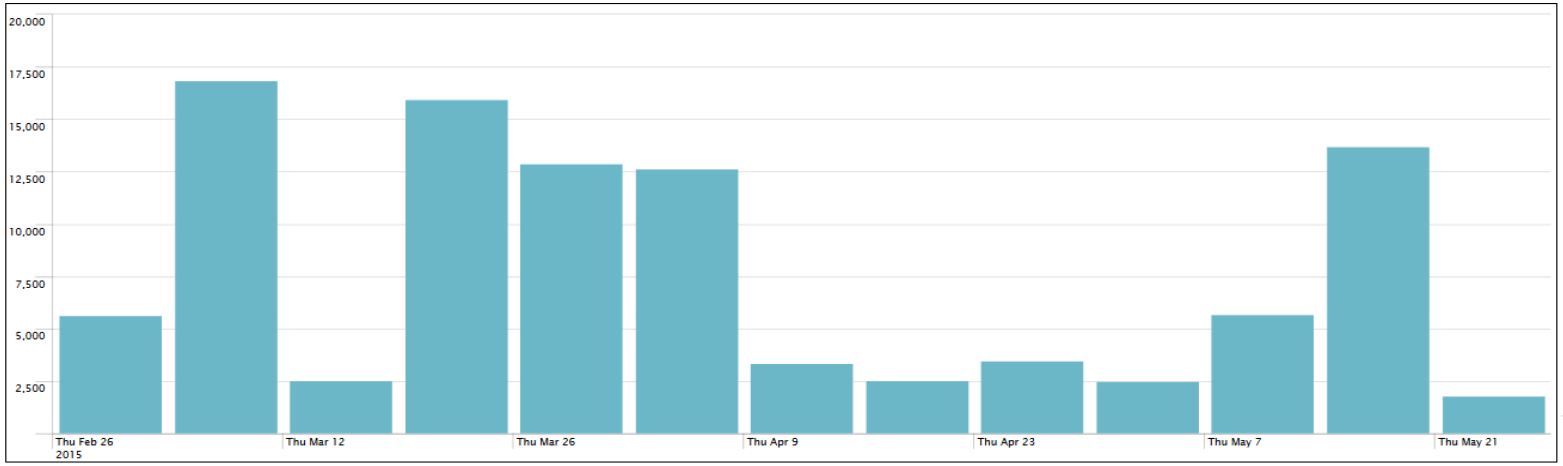
Concurrent Downloads	Volume (Gigabytes)
sequential	8
10	5.47
20	19.18
30	47.18

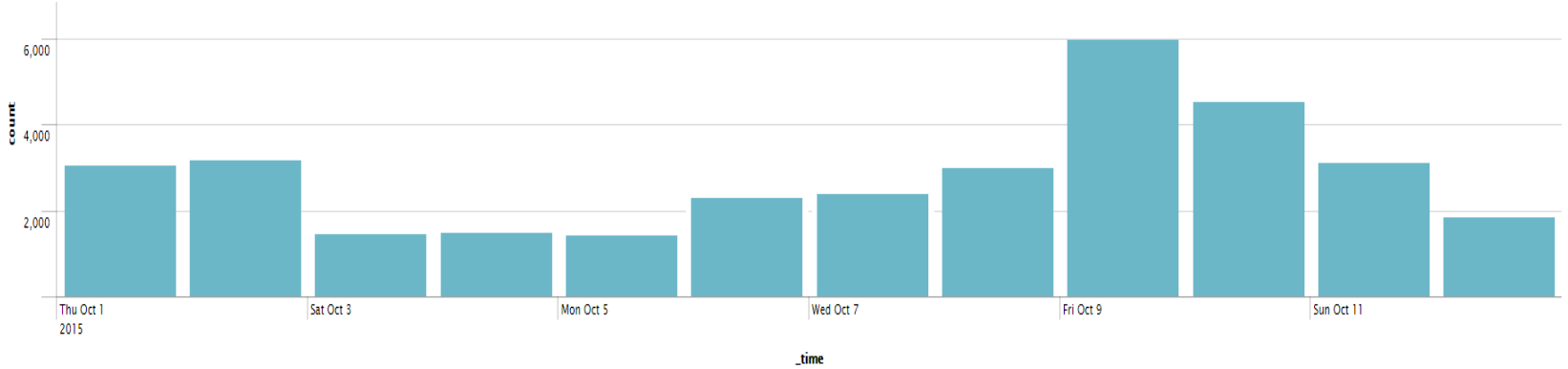
GRNet Dedicated VI

NOA SENTINEL MirrorSite

On Monday 24th November 2014 the NOA Sentinel Mirror Site team received from ESA the URL and the temporal credentials of a dedicated Sentinel DataHub instance in order to benchmark its performance.

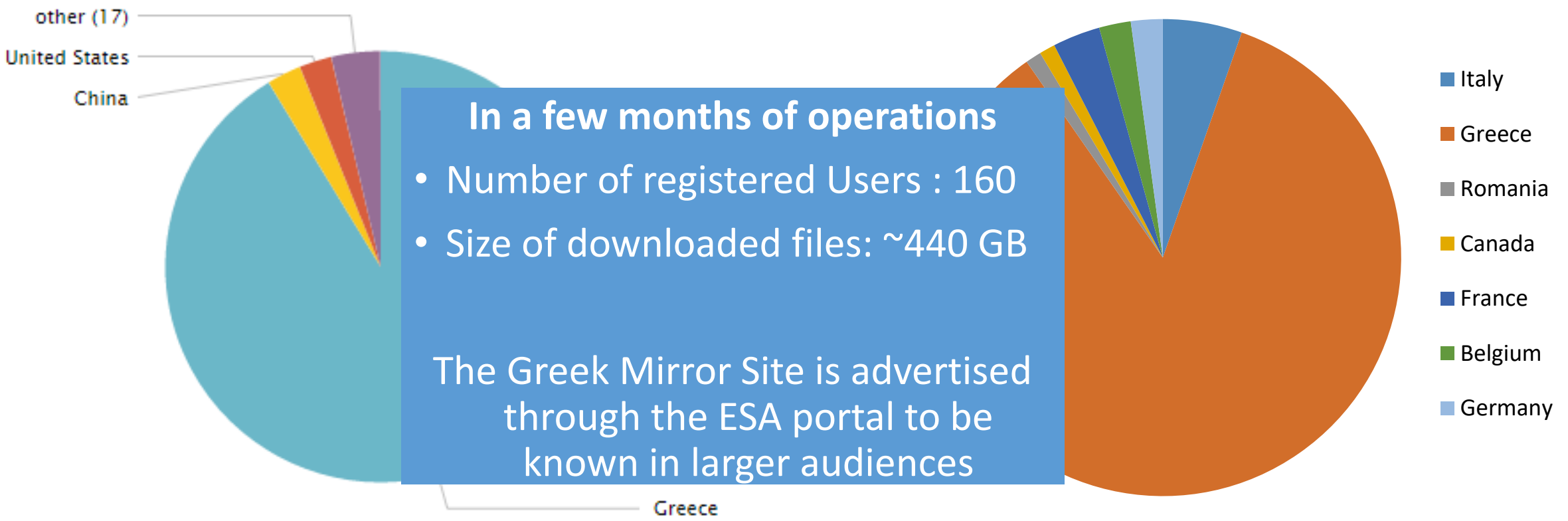
- **Hits/visits per week of operation**: The Hellenic Sentinel Data Hub attracts a considerable number of visitors.





- Spikes were detected **during** and **after** events where the Mirror Site was presented and promoted (e.g. Space Expo).

Hellenic Sentinel Data Hub
Statistics on Users & Data Traffic



In a few months of operations

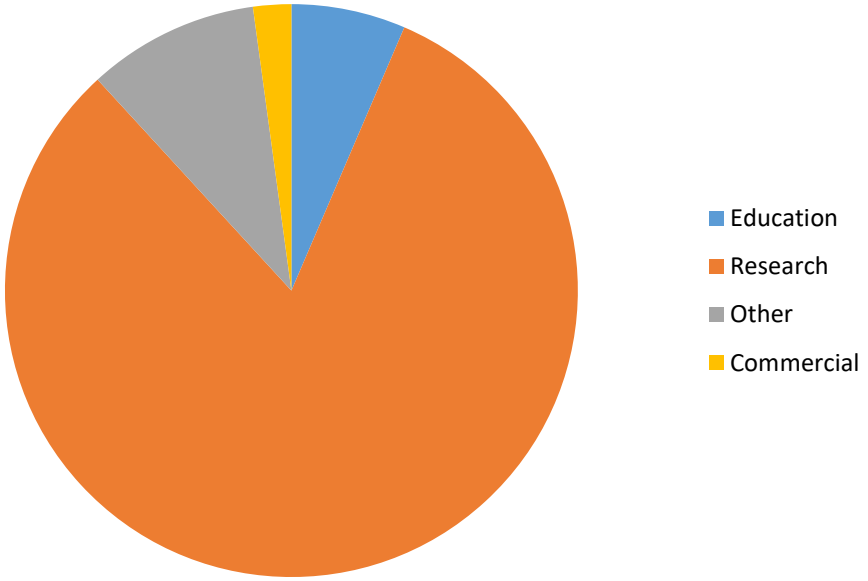
- Number of registered Users : 160
- Size of downloaded files: ~440 GB

The Greek Mirror Site is advertised through the ESA portal to be known in larger audiences

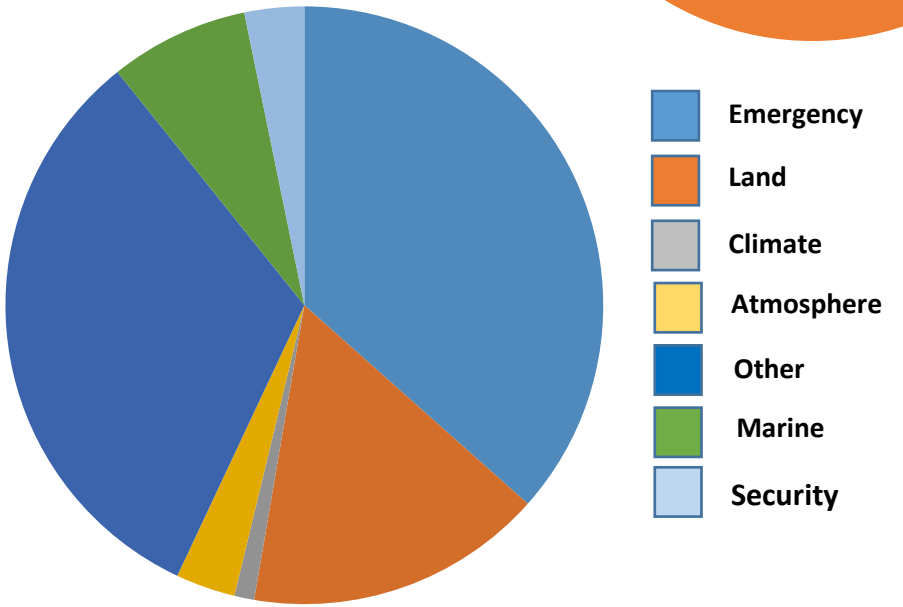
- The distribution of IP addresses accessing the Mirror Site indicates that most visits come from the Greek domain, while there is a considerable number of international visitors
- Most registered users are from Greece but also a number of European and non European countries (France, Belgium, Italy, Romania, Germany, Canada, etc).

Hellenic Sentinel Data Hub
Statistics on Types of Users & Applications

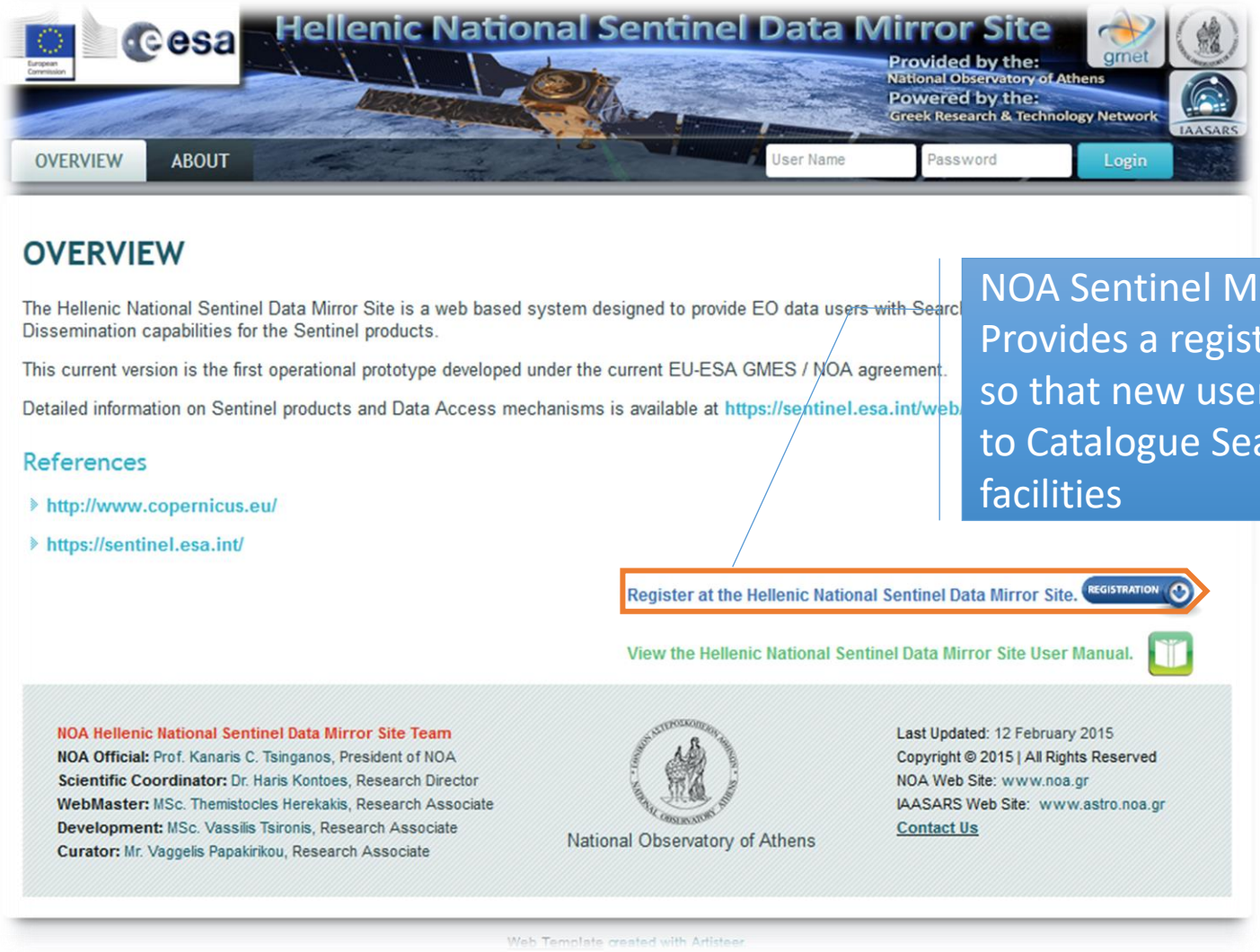
- The Hellenic Sentinel Data Hub is **popular** amongst the members of the **scientific community**



- **Emergency, Land, and "Other" application domains** are ranked between the main fields of Sentinel data use

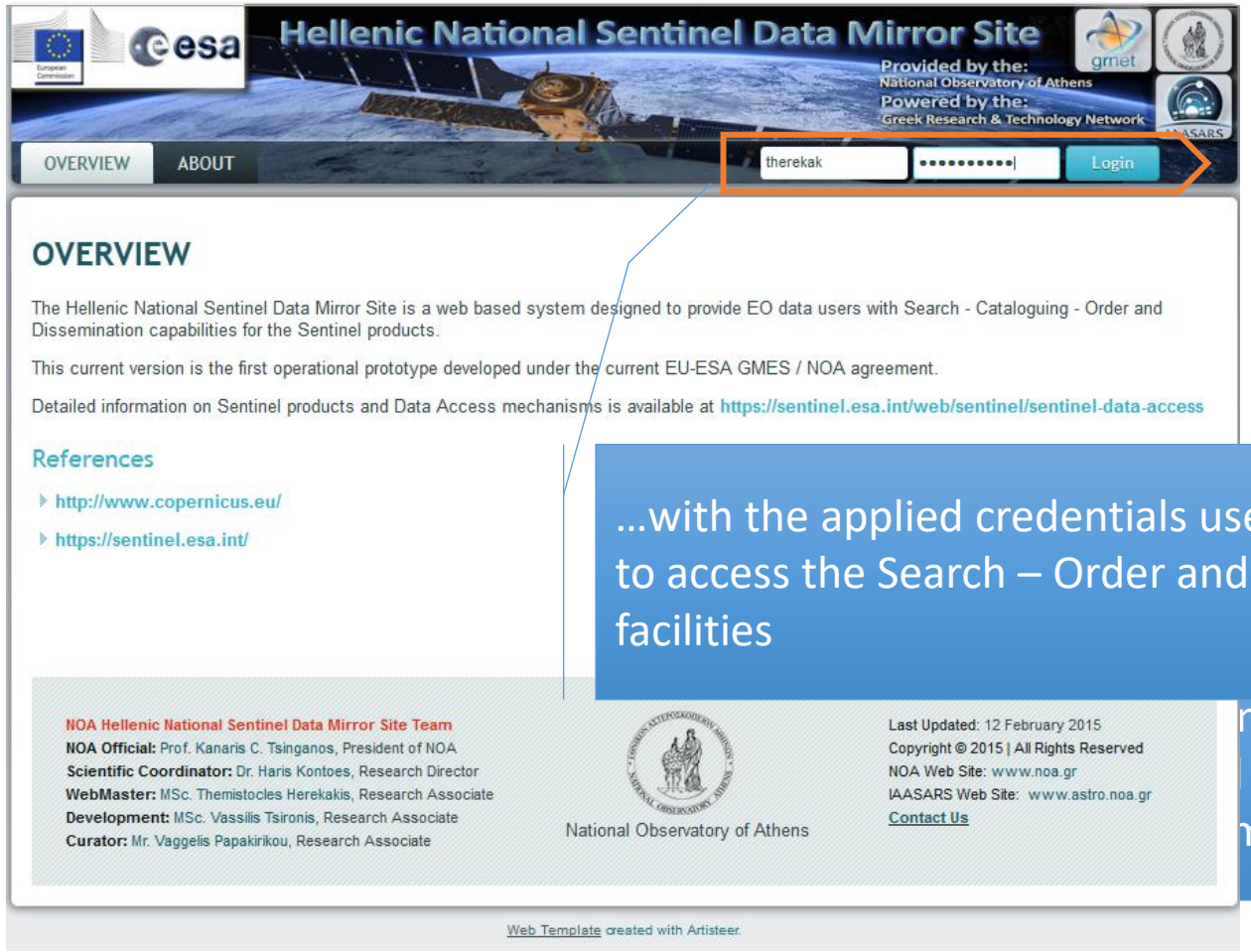


Hellenic Sentinel Data Hub
The GUI Interface



NOA Sentinel Mirror Site GUI
Provides a registration mechanism so that new users can obtain access to Catalogue Search and Order facilities

Hellenic Sentinel Data Hub
The GUI Interface



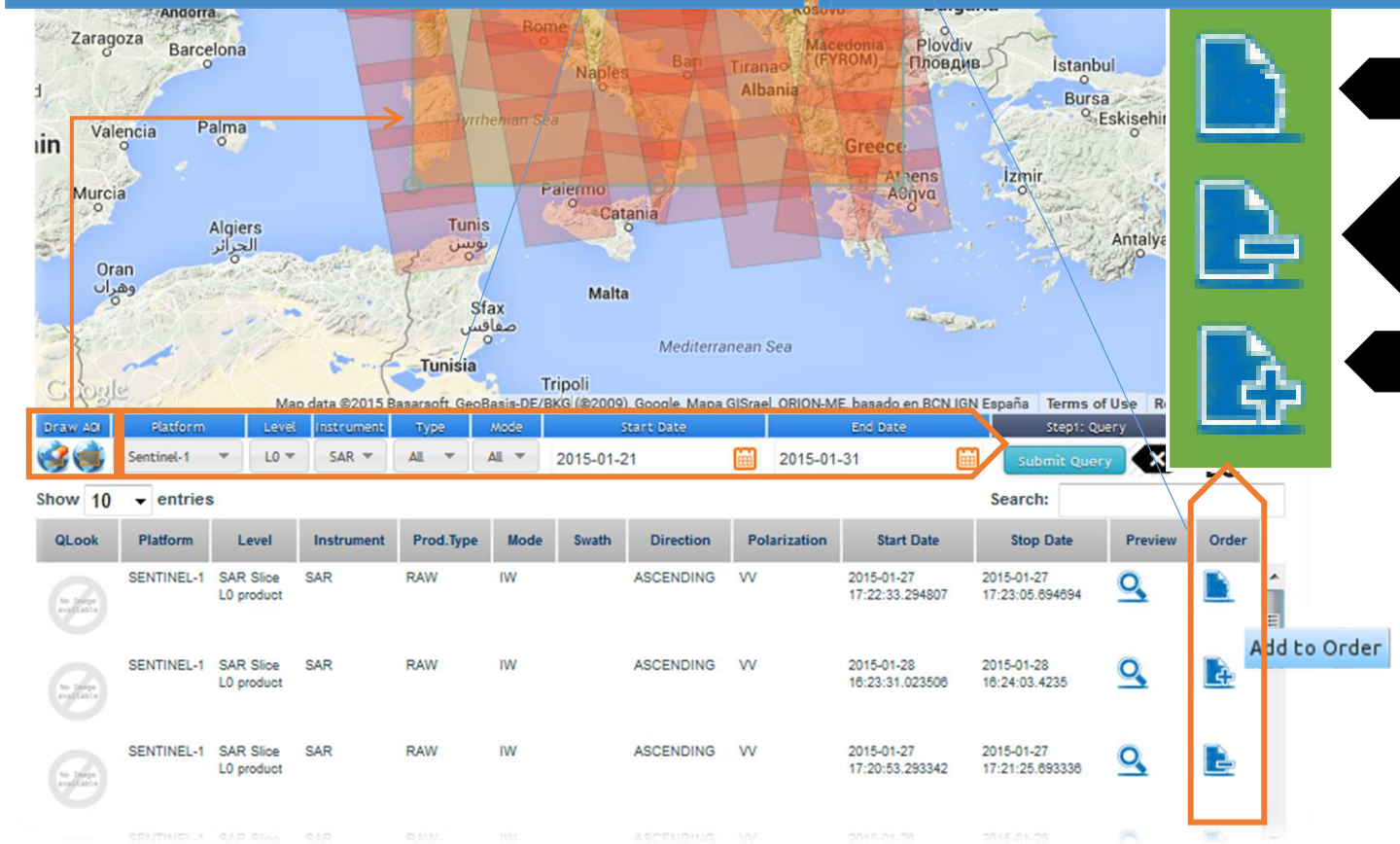
…with the applied credentials users may login to access the Search – Order and Data access facilities

necessary
their account is
mation

Hellenic Sentinel Data Hub
The GUI Interface

…the catalogue of queried products provides more information regarding the spatial coverage, the attributes and their order status.

.. and then by querying the desired date range and product attributes…



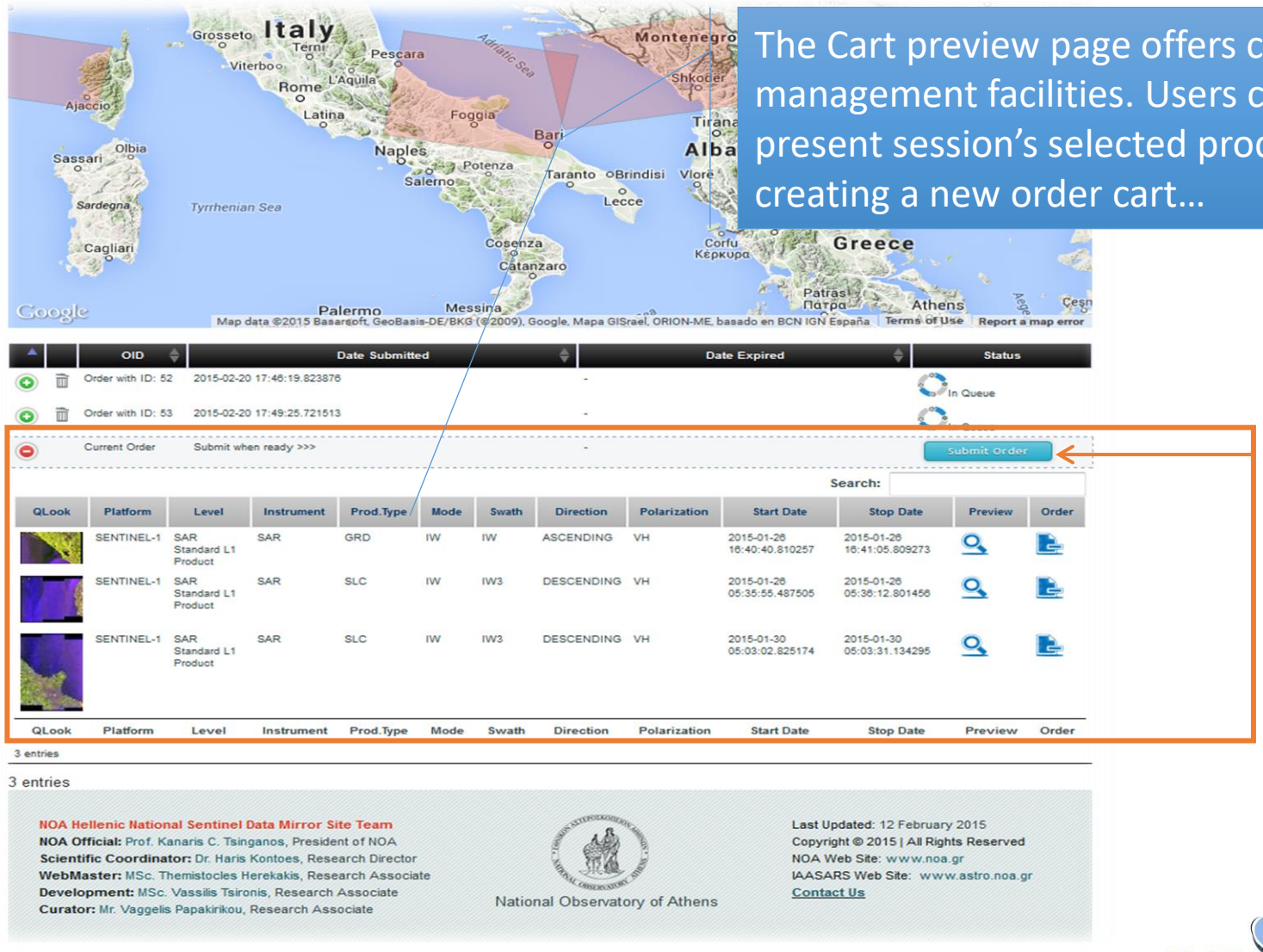
In order

Remove from order

Add to order

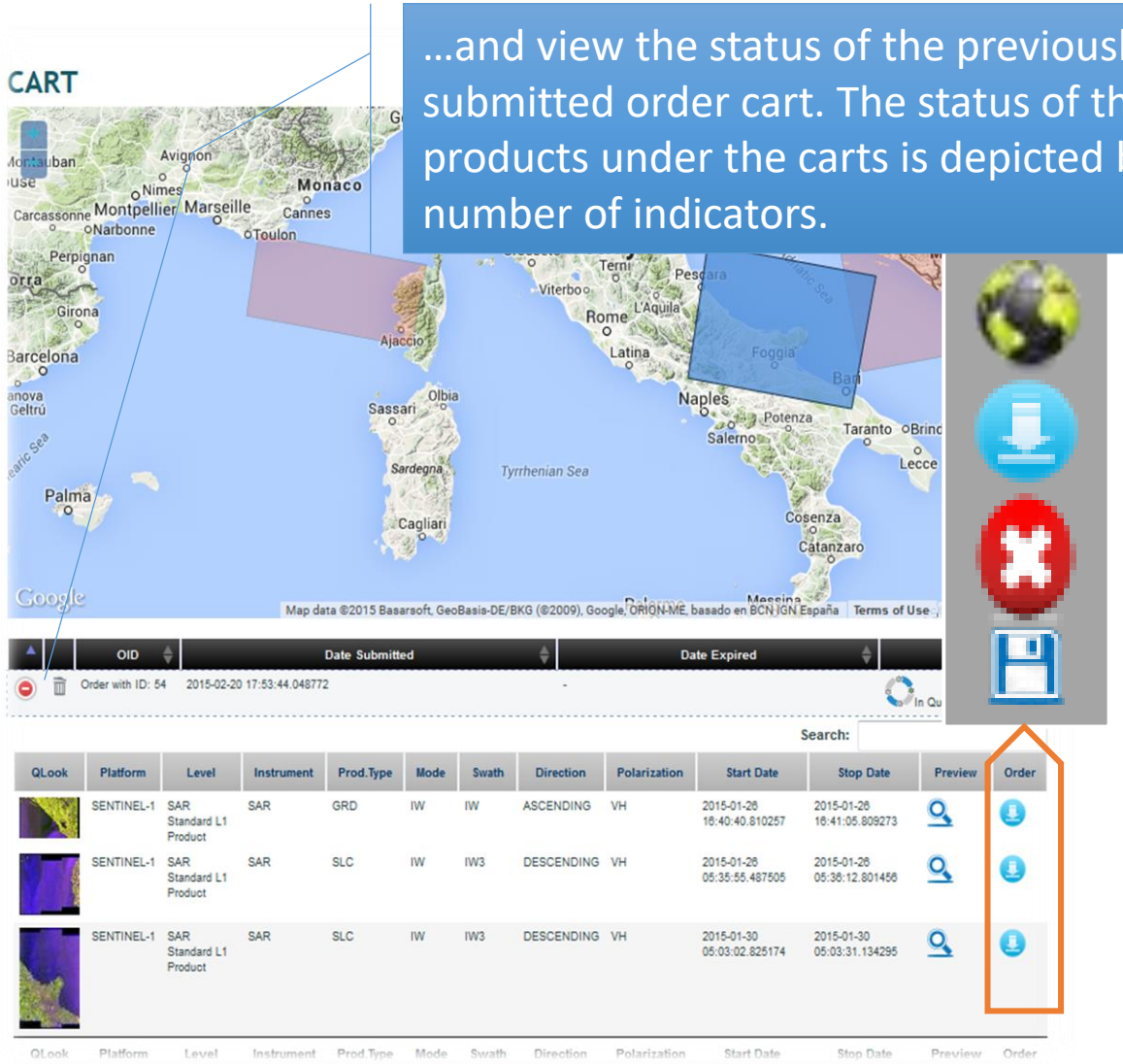
Hellenic Sentinel Data Hub
The GUI Interface

The Cart preview page offers cart management facilities. Users can submit the present session's selected products thus creating a new order cart…



Hellenic Sentinel Data Hub
The GUI Interface

…and view the status of the previously submitted order cart. The status of the Sentinel products under the carts is depicted by a number of indicators.



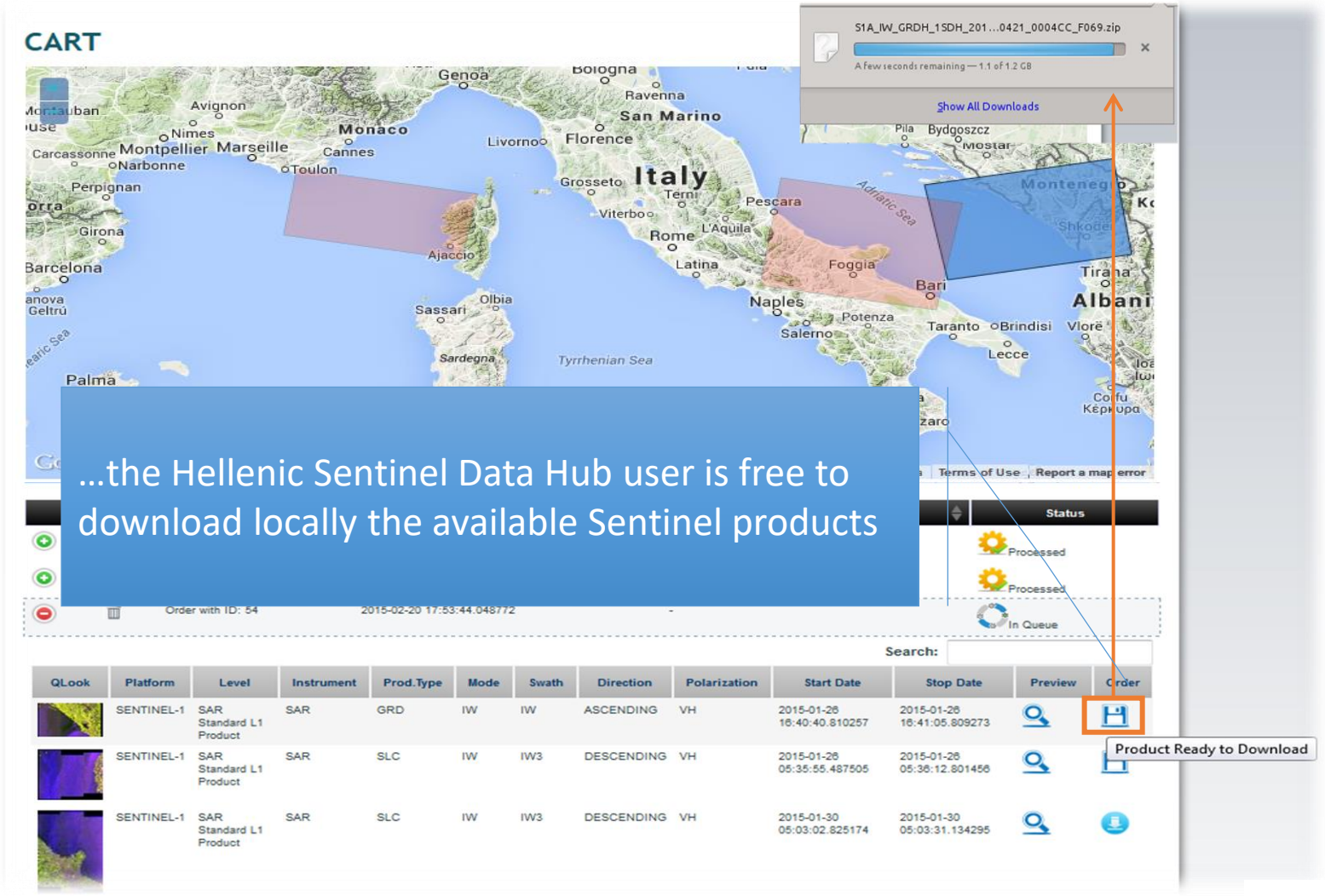
The product is located at ESA DataHub

The product is being downloaded

The product is corrupted

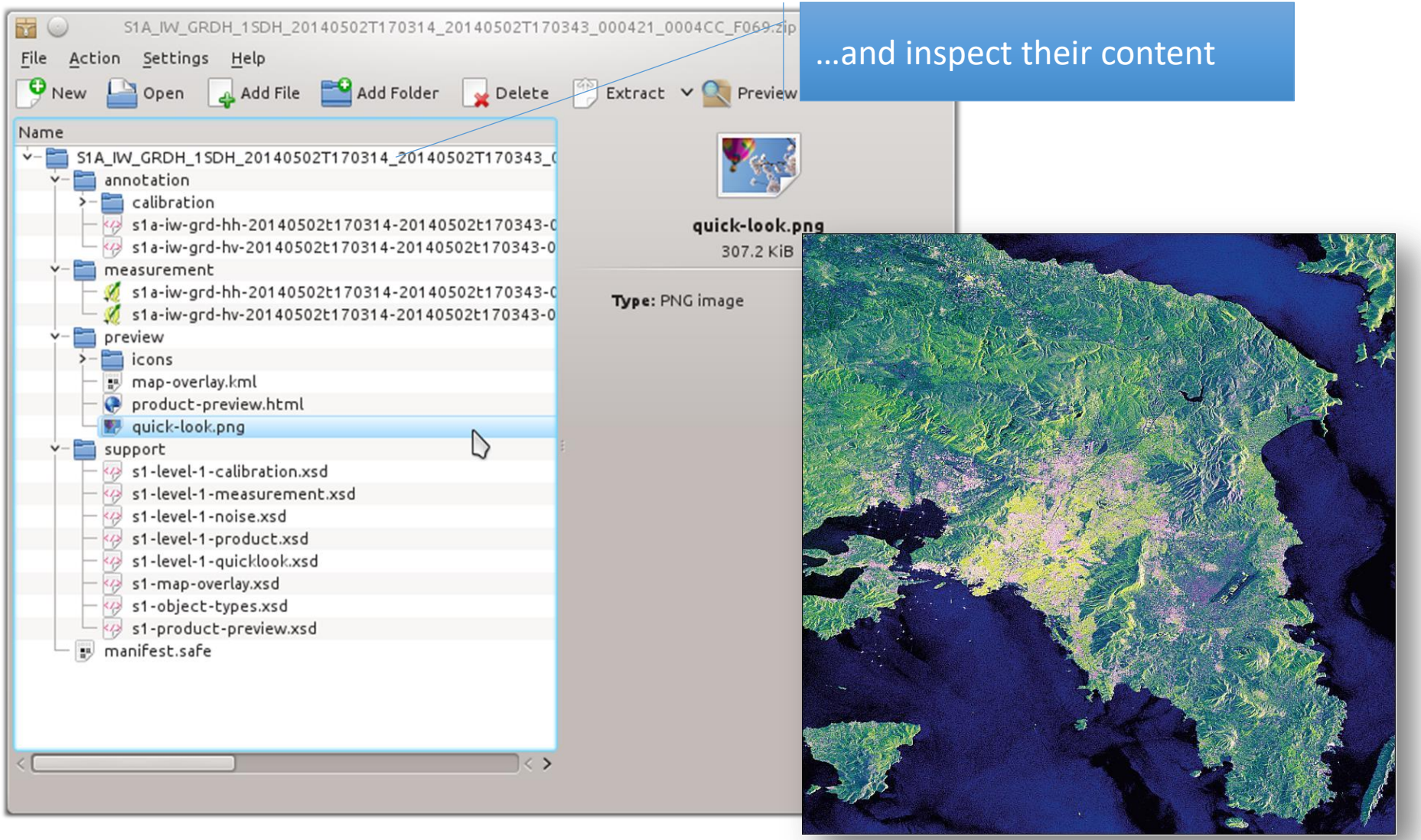
The product is ready to download

Hellenic Sentinel Data Hub
The GUI Interface



Hellenic Sentinel Data Hub
The GUI Interface

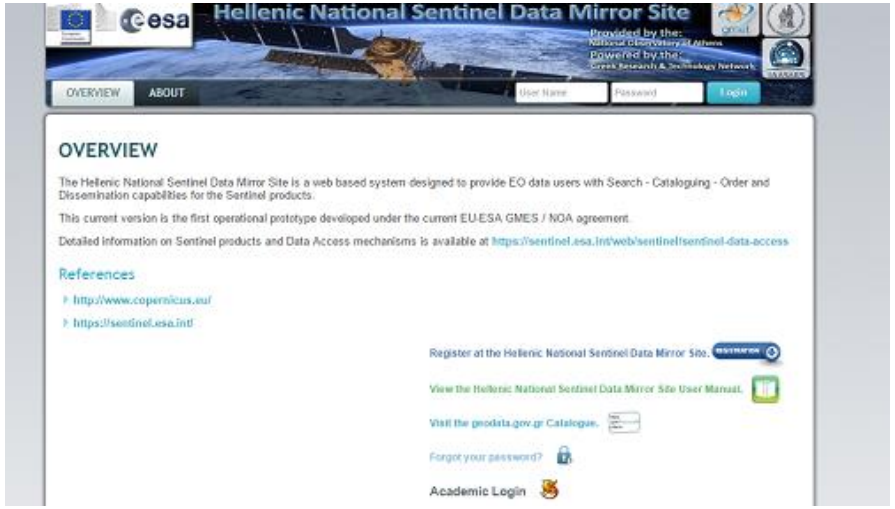
…and inspect their content

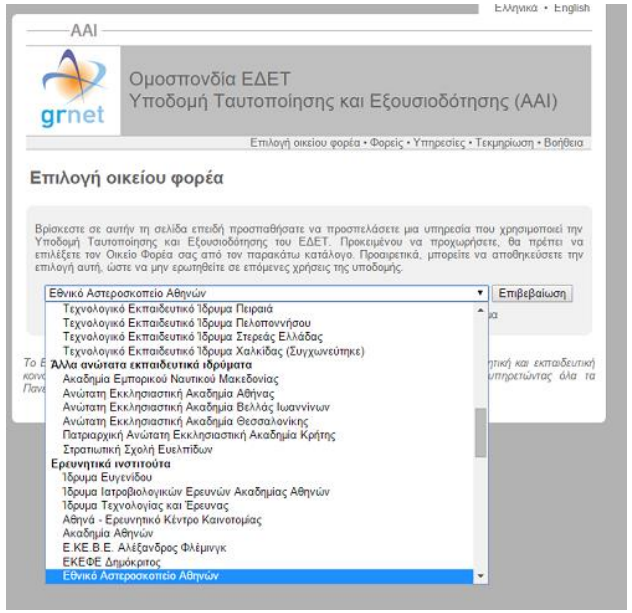


New Collaborative Ground Segment Features

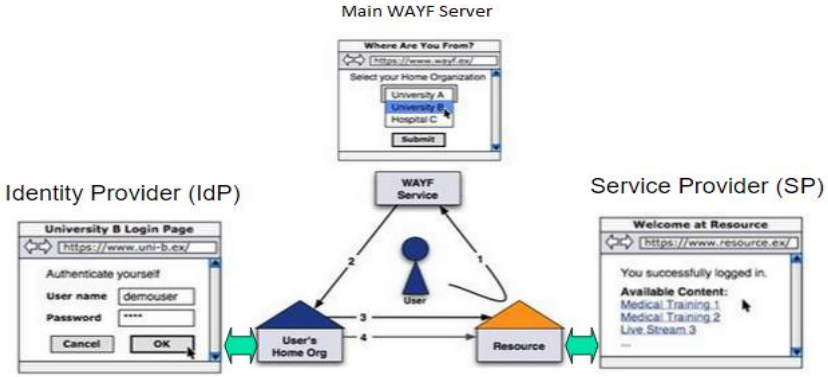
Hellenic Sentinel Data Hub Shibboleth

- The Hellenic Sentinel Data Hub boosts it's popularity by allowing all members of the Greek Academic community (professors, students, researchers) to securely login via their academic credentials.
- The Hellenic Sentinel Data Hub has joined the GRNET's SSO Federation, which is based on **Shibboleth**.
- Enhanced security using secure http (https) connections



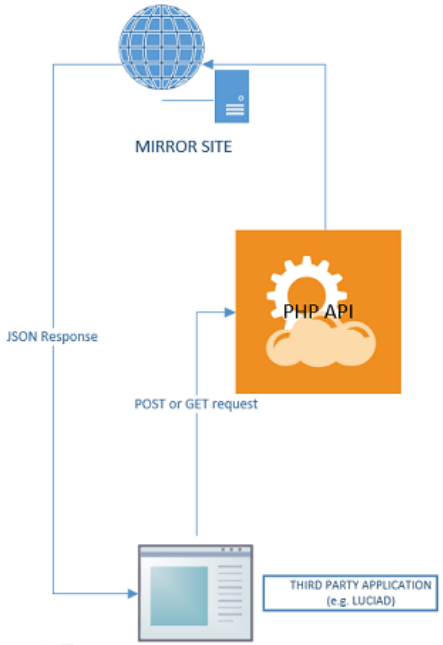


Shibboleth



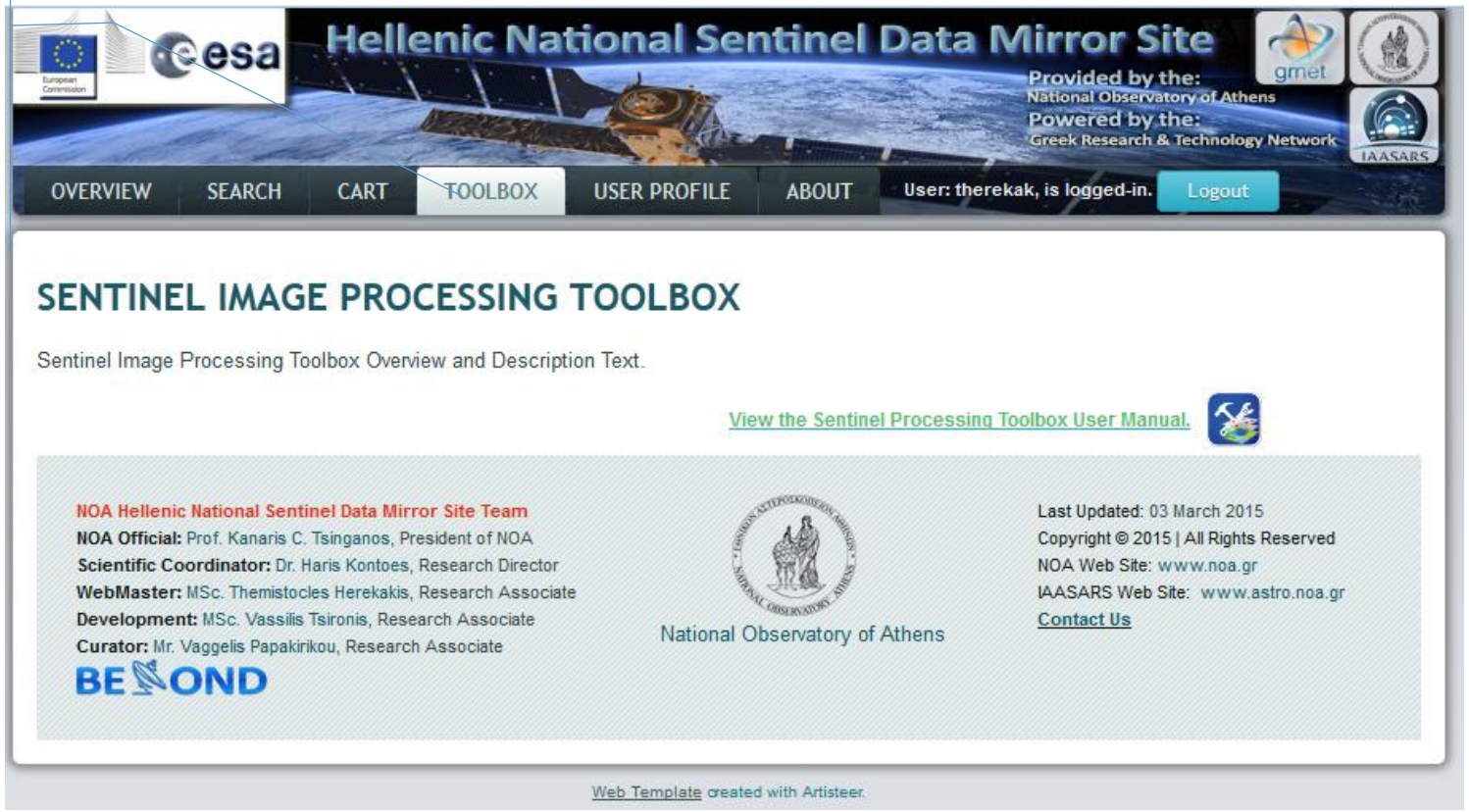
- The Hellenic Sentinel Data Hub also expands it's functionality by exposing a simple API which can be used by third party applications and services.

- All basic functionalities (login, search, order fetching, downloading of already ordered items) can now be performed via HTTP POST and GET requests.



The SENTINEL Image Processing Toolbox application on ~Oceanos

The SENTINEL Image Processing Toolbox application is accessible via the Hellenic Mirror Site and the “TOOLBOX” menu item.



The SENTINEL Image Processing Toolbox application on ~Oceanos

A detailed manual with instructions on how to create on ~Oceanos, Virtual Machines ready to apply the SENTINEL Toolbox algorithms is provided too.

Coll GS applications using the Hellenic SENTINEL Data HUB facility

Collaborative Data HUB

Hellenic SENTINEL Data HUB

Shibboleth.

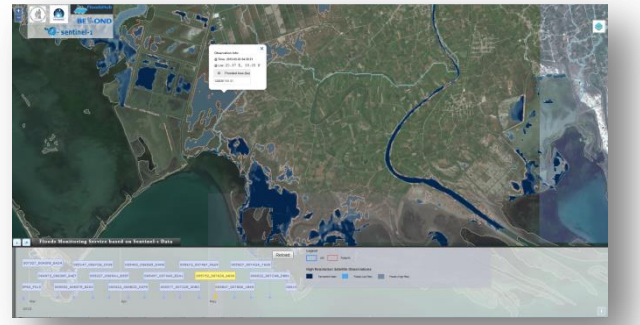
FloodsHUB

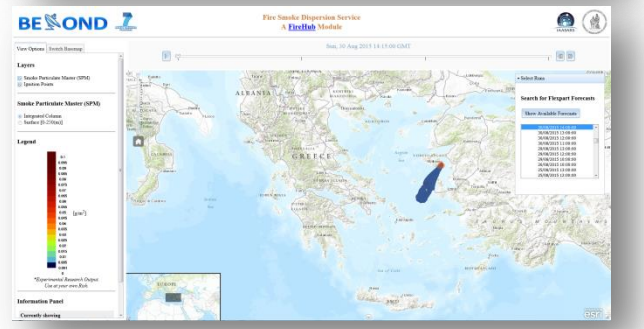
BEYOND Processing Node

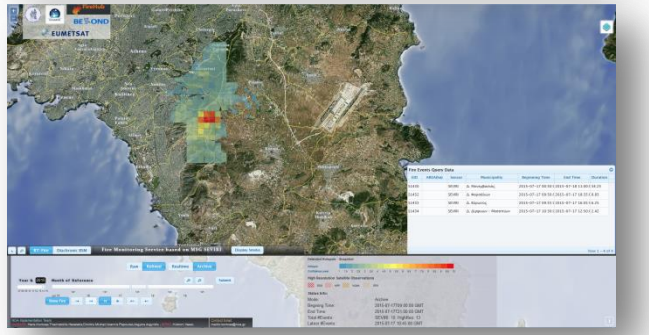
Smoke Dispersion Service

FireHUB

InSAR-Tectonics Velocity Fields



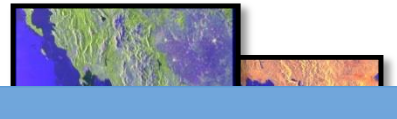




FloodsHUB Architecture

Collaborative Data HUB

Hellenic SENTINEL Data HUB

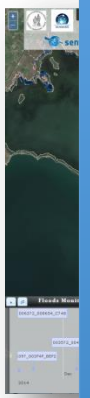


Thresholding & Noise Reduction

E

onic
nalysis
thm

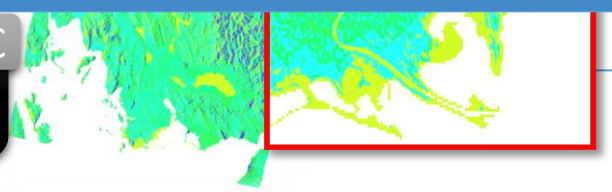
BEYC



hronic
oded
eas

SENTINEL-1 SLC products INPUT

Floods classification algorithm C



Floods post-processing algorithm D

Flooded areas

INVOLVED USERS – SERVICE DESIGN

Regional Civil Protection Authorities

Fire Brigades

Electric Power Organisation

Ministry of Infrastructures

Special Secretariat of Water Resources

ESA DRR using innovative data exploitation methods

PS InSAR Architecture - Deformation velocity fields

Pre-processing

Core multi-temporal processing

INVOLVED USERS – SERVICE DESIGN

National Anti-seismic Organisation

Ministry of Infrastructures

Seismic Rehabilitation Services

Civil Protection

National Geological Mineral Institute

Geodynamics Institute

ESA CEOSS Seismic Platform

1. SAR stacks

4. Scatterers identification

New acquisition

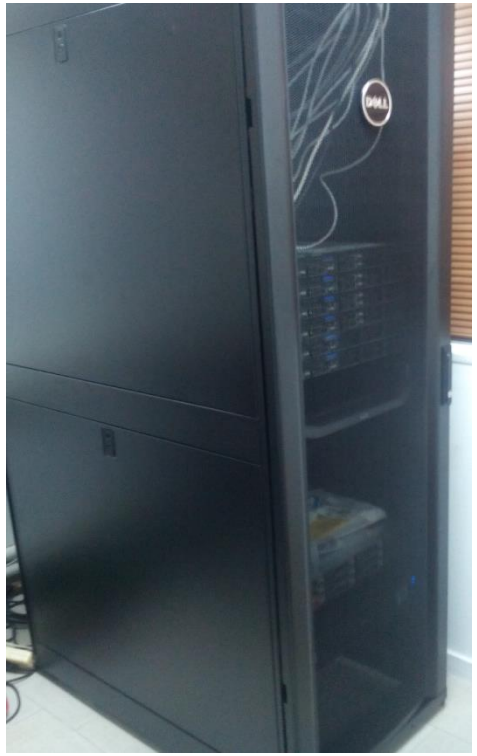
Computational Infrastructure dedicated to the GS operations & Coll GS Applications

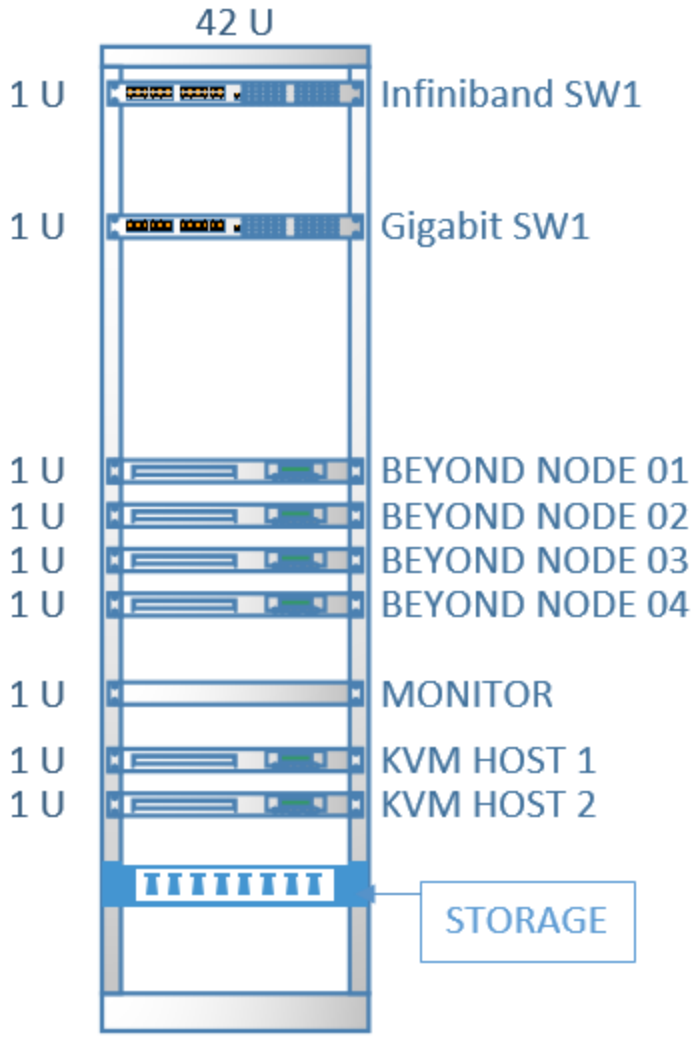
- IAASARS has empowered it's computational infrastructure with high-performance server hardware.

- BEYOND NODE 01-04:
  - Model: Dell PowerEdge R620
  - CPU: 2x Xeon 8 Core
  - RAM: 64GB
  - OS: Centos 6.6 Minimal

- PowerVault MD3400, 12G SAS, 2U-12 drive

- 2 KVM Virtualization Servers
  - Model: Dell PowerEdge R815
  - CPU: 2x AMD Opteron 6128
  - RAM: 512GB
  - OS: RHEL 6.0 64-bit (Dell pre-installed image)





Complementary Ground Segment Facility Joint with the Mirror Site Polar EO Missions

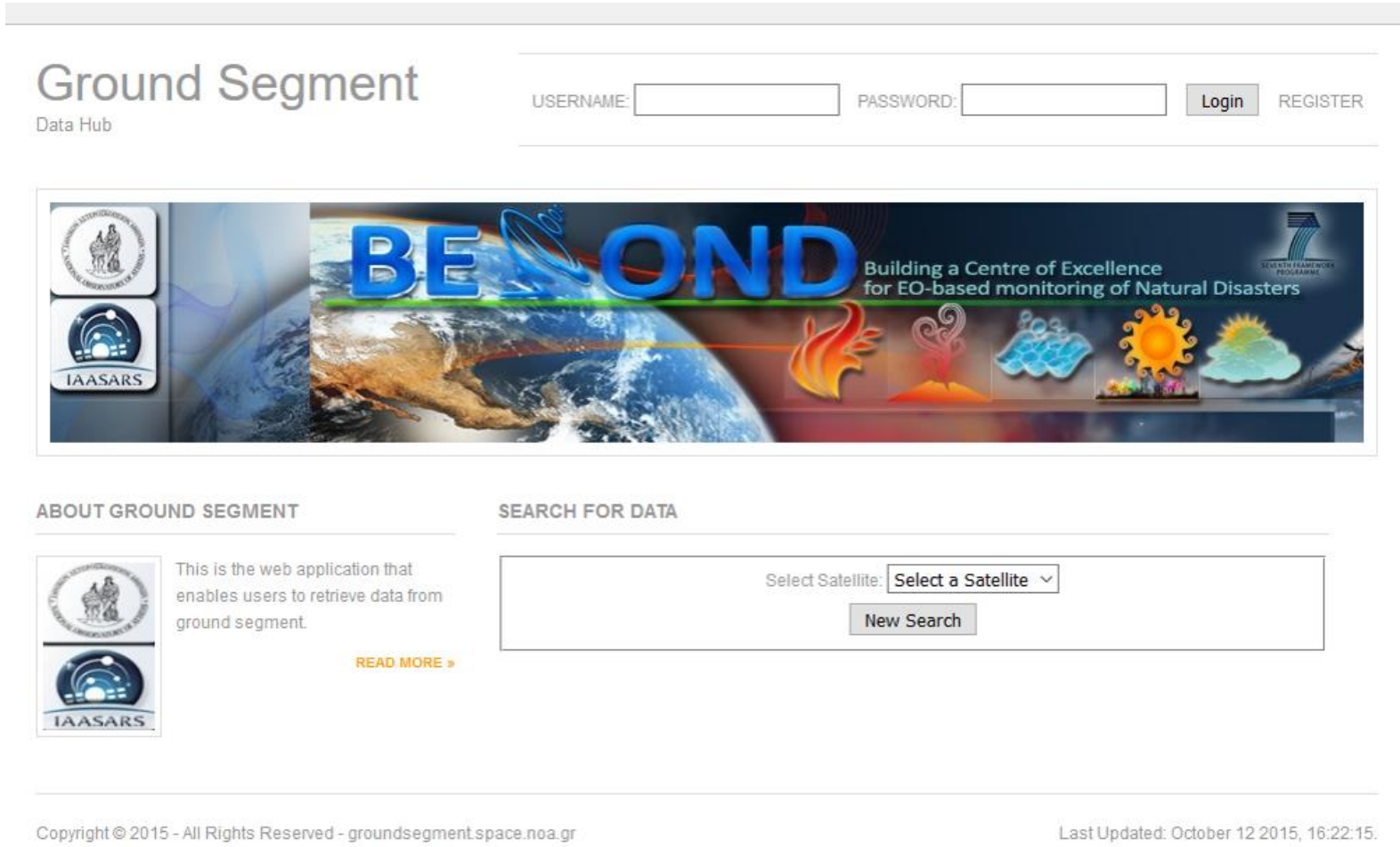
An introduction to complementary GS facilities for Receiving, Cataloguing, Searching, Viewing & Downloading data from contemporary satellites

- The ground segment architecture is based on the N-tier paradigm.
- The 1st tier comprises the ground station and the servers used for acquisition and processing.
- The 2nd tier comprises the datacenter and the backend processes used to extract and store metadata in the catalogues (e.g. Synchronizer process).
- The 3rd tier constitutes the frontend that is used to allow the users to search, view and download products. Ground Segment on the cloud!

Architecture

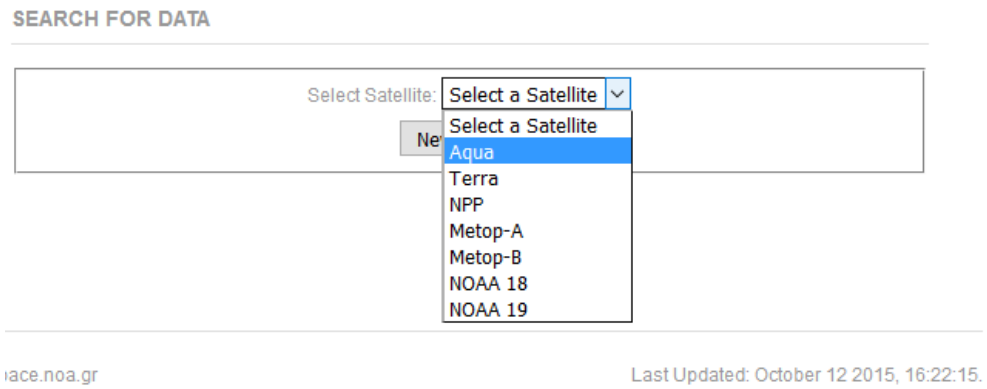
- Web-enabled graphical user interface (GUI).
- User friendly.
- Clean separation with backend functionalities.
- Home page:

  http://groundsegment.space.noa.gr/

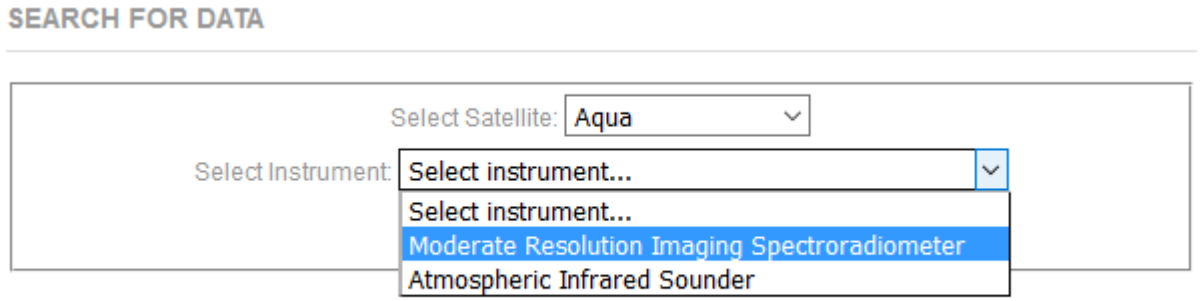


User Interface – Introduction

- Select a satellite:



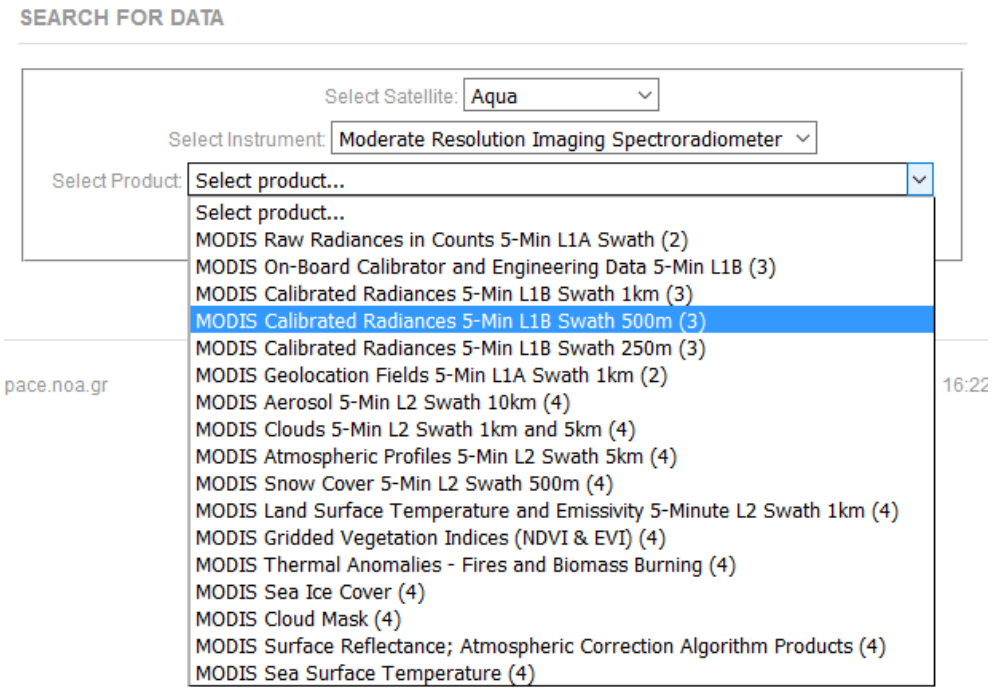
- Select an instrument:



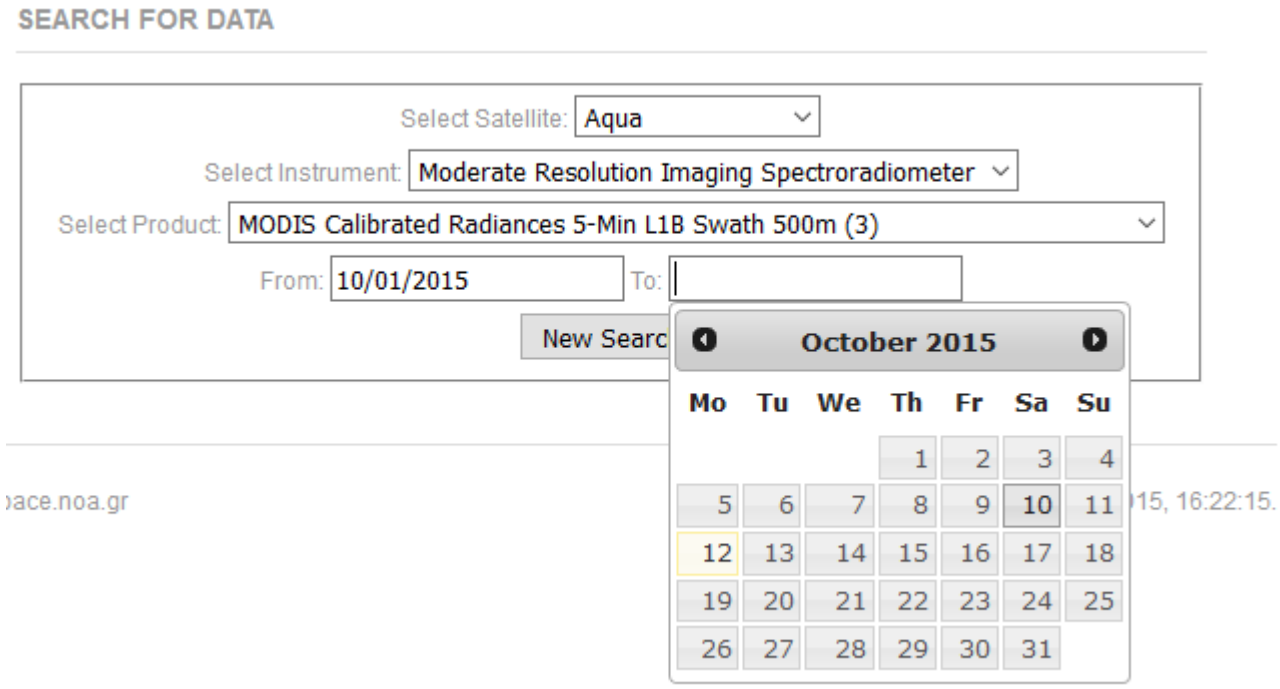
Each selection generates next step's available options.

User Interface – A Search scenario (1)

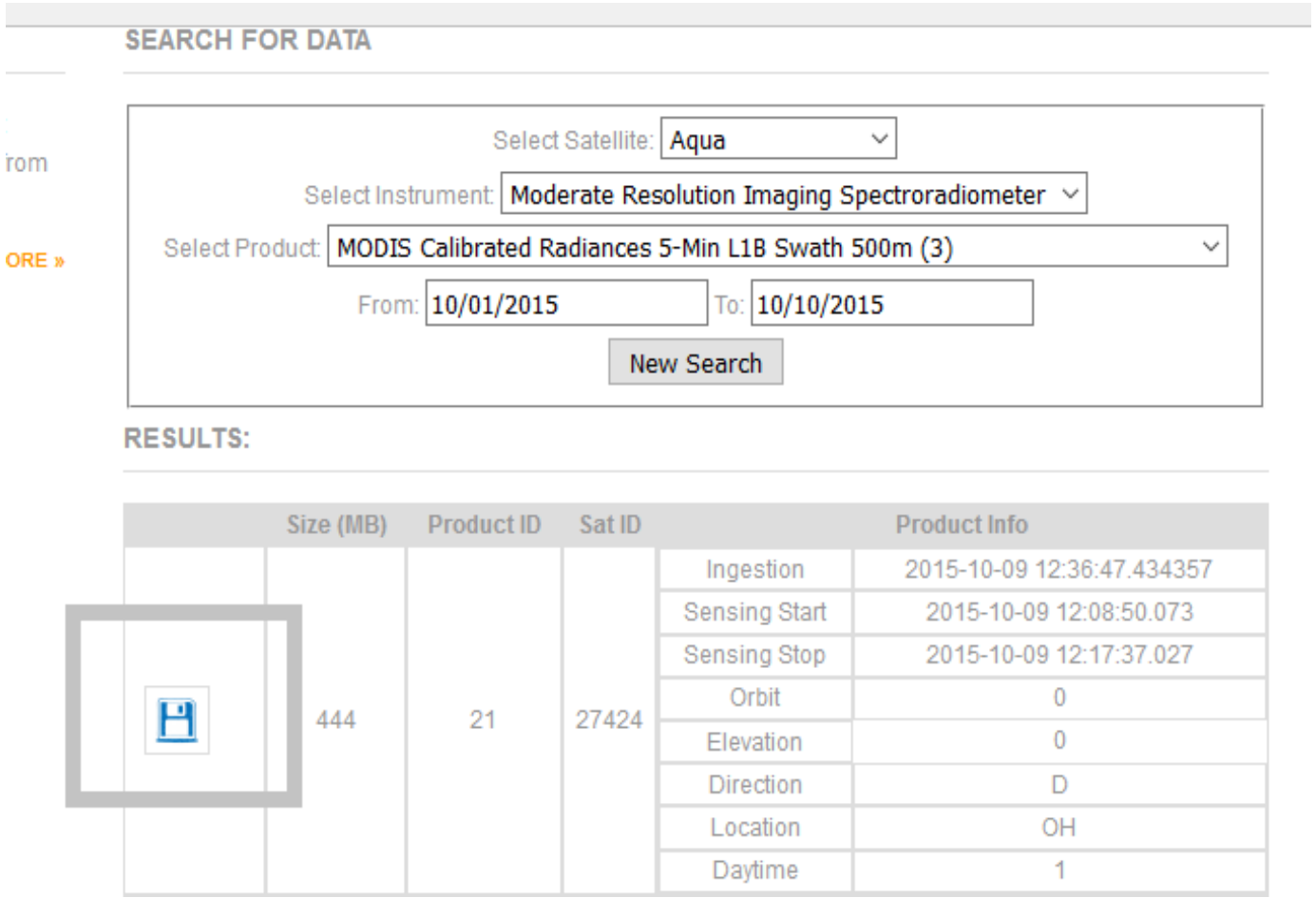
- Select a Product:



- Select a date range to search for products that became available (i.e. ingested) during that range:



User Interface – A Search scenario (2)



- The search function returns a list of the available products, alongside with useful info (metadata).
- Straight-forward download of the product.
- More features to come: more filter options, customized sorting, on the fly compress/download of multiple products etc.

User Interface – A Search scenario (3)

Thank you and

any questions?