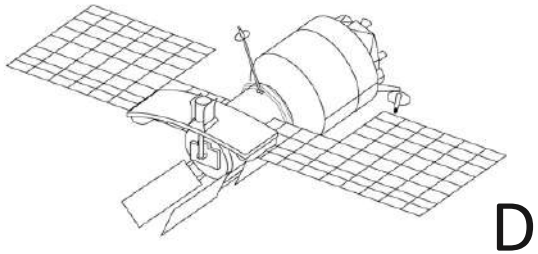
Greece's Collaborative Ground Segment Initiatives



Dr Haris KONTOES

National Observatory of Athens

SENTINEL COLLABORATIVE GS WORKSHOP 2015,
28 May 2015 – Matera

The oldest Greek/SE European Research Institution: 170 years of continuous contribution to research and services to the society

3 Research Institutes: Astronomy and Astrophysics, Space Applications and Remote Sensing
Geodynamics, Environment and Sustainable Development

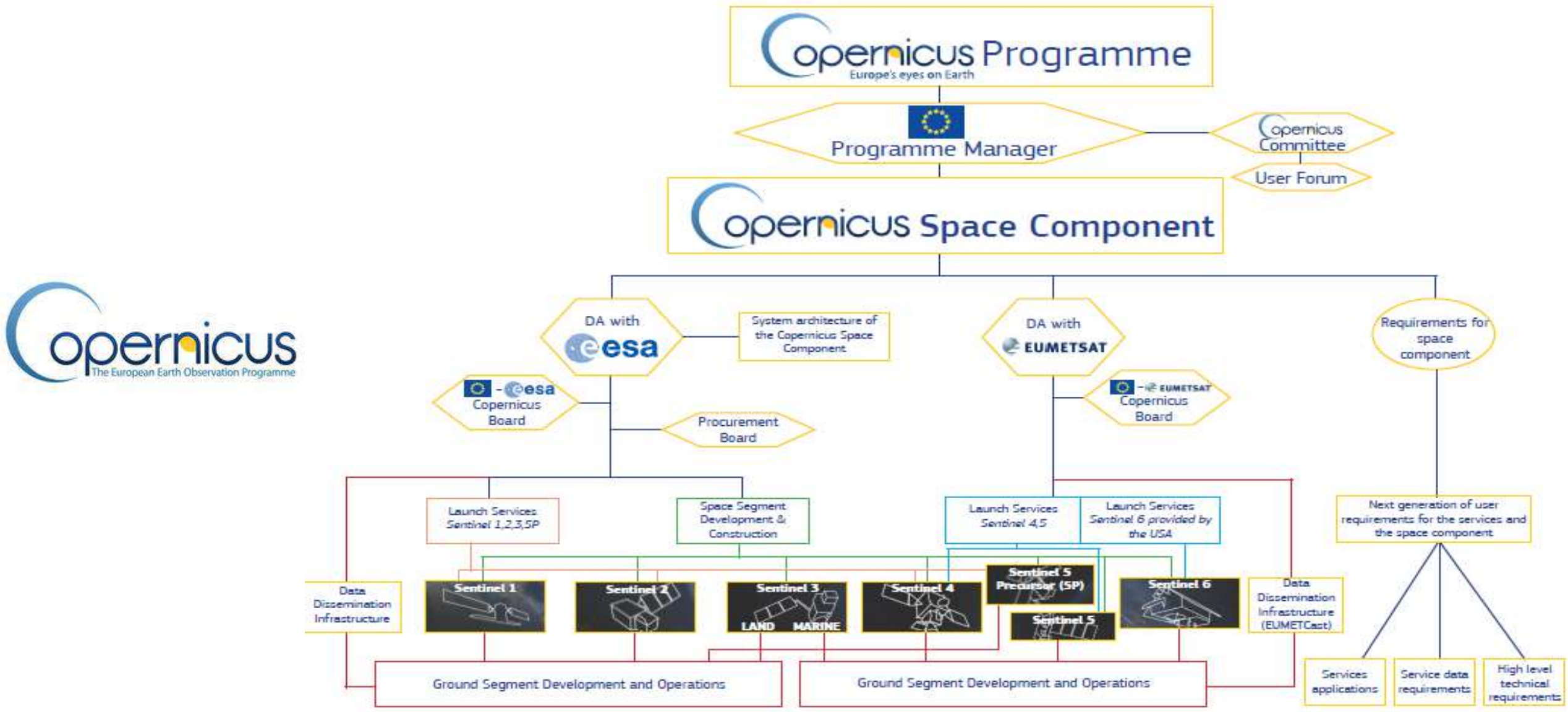
The 1st Collaborative Ground Segment (Mirror Site) for Sentinel satellite missions was signed between ESA and NOA on 12 May 2014

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

Expected min financial benefit sums up to €30bn by 2030

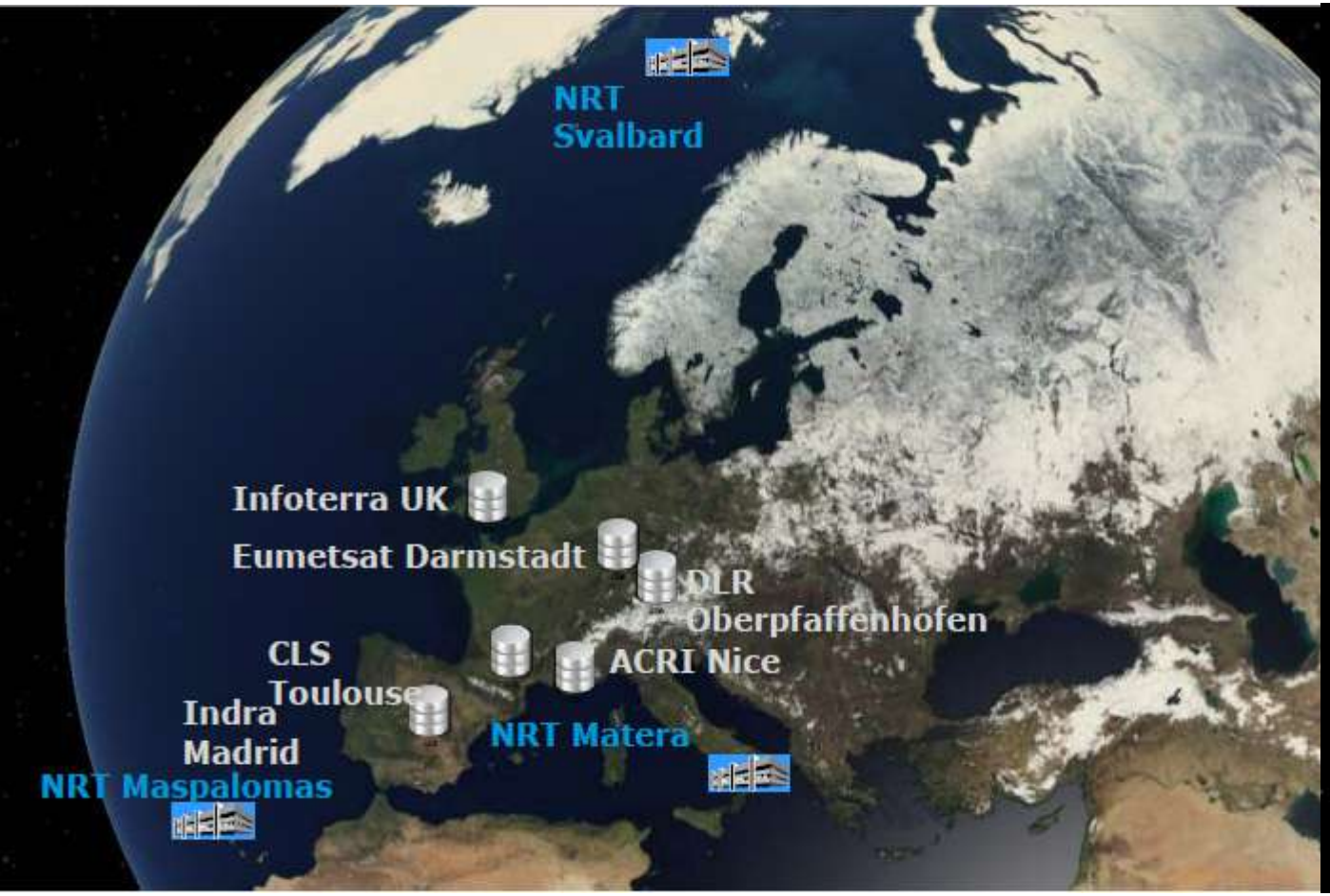
Via the full, free and open Copernicus data policy it is anticipated that cumulative benefits could increase further, leading to benefits in the order of €200bn by 2030

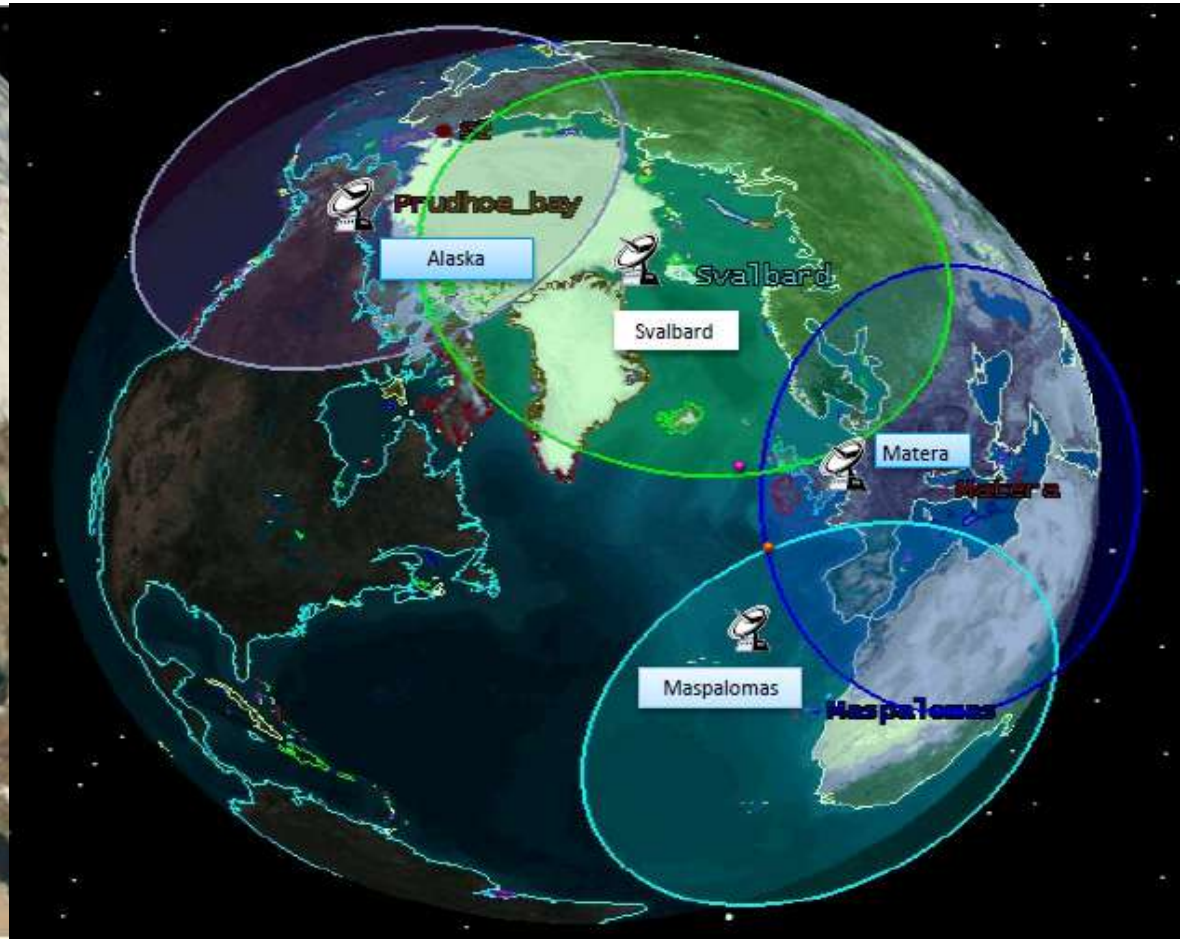
The EU Space Program Copernicus (GMES)



Core vs Collaborative Ground Segment Architecture

- **a GSC Core Ground Segment**, with **GSC-funded Functions and Elements**, providing :
  - the primary access to Sentinel Missions data as well as
  - the coordinating access functions to Contributing Missions data



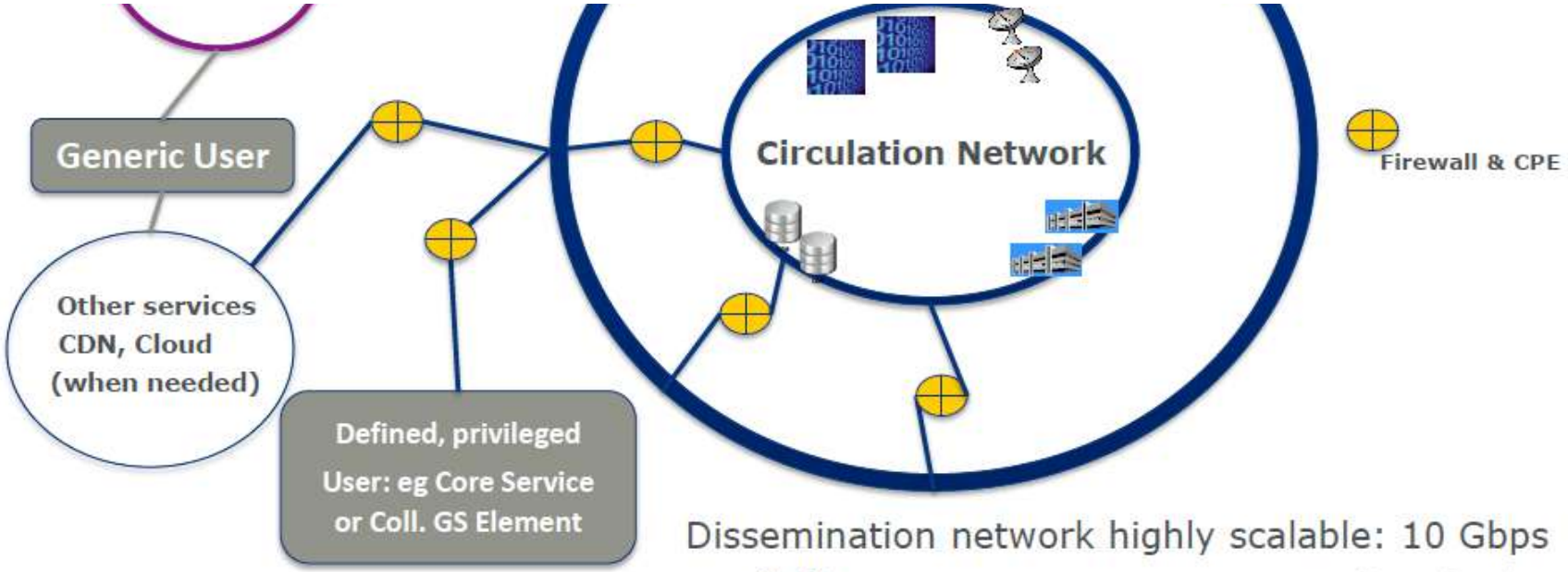


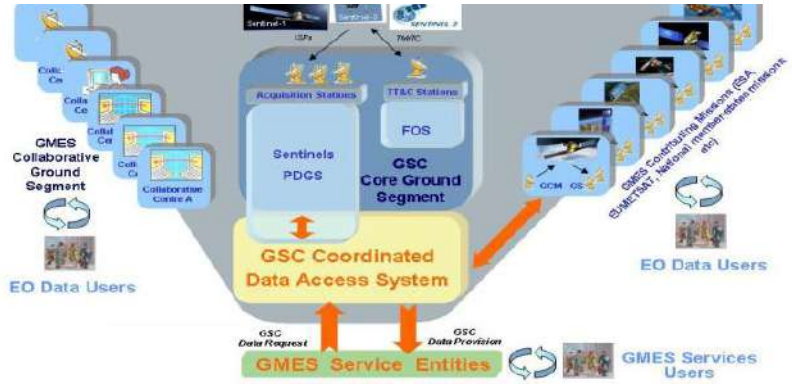
Core vs Collaborative Ground Segment Architecture

- **a GSC (Sentinel) Collaborative Ground Segment**, with **non GSC-funded Functions and Elements**, providing:
  - a supplementary access to **Sentinel** Missions data, i.e. either through specific data acquisition services, or specific data products

DEFINITION OF COLLABORATIVE GROUND SEGMENT MIRROR SITES

- Particular regional or thematic data access nodes and mechanisms, including redistribution services of Sentinels core products systematically received from the Core Ground Segment, deployment of additional pick-up points (e.g. mirror sites)





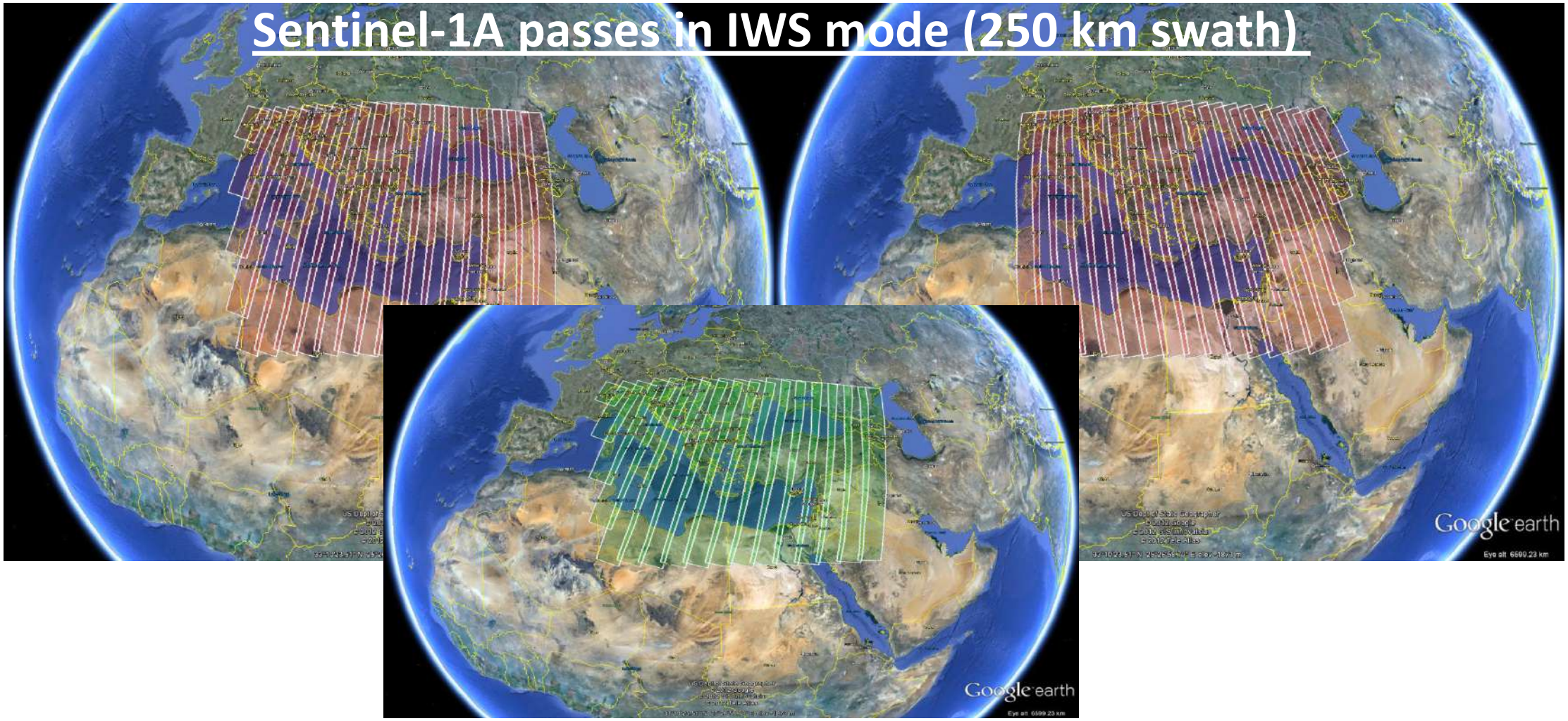
Scope of the Collaborative Ground Segment – Greek Mirror Site

- 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 co-operations.

- The whole project is in line with the on-going 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.

Area of Interest (AOI)



Sentinel-2A ascending passes in IWS mode (250 km swath)

NOA Sentinel Mirror Site - 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 are under installation, configuration, and testing

- 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 ready for testing, and operation by the users

NOA Sentinel Mirror Site – Computational Infrastructure

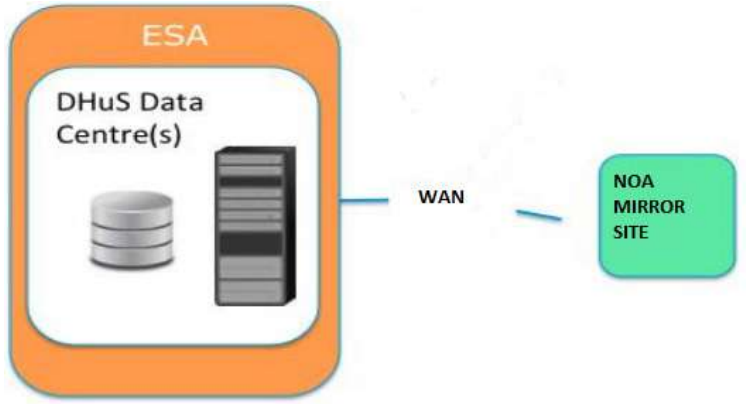
- High-Speed optical links owned by GRNET/GEANT, are used to connect ESA's Data center(s), with NOA's Mirror Site computational infrastructure
- A set of Virtual Machines (VMs), hosted by the Greek Research & Technology Network (GRNET), are configured and ready for use

OS: Ubuntu Linux 14.04 LTS, 64 Bit.

CPU: 1-2 CPU's per VM.

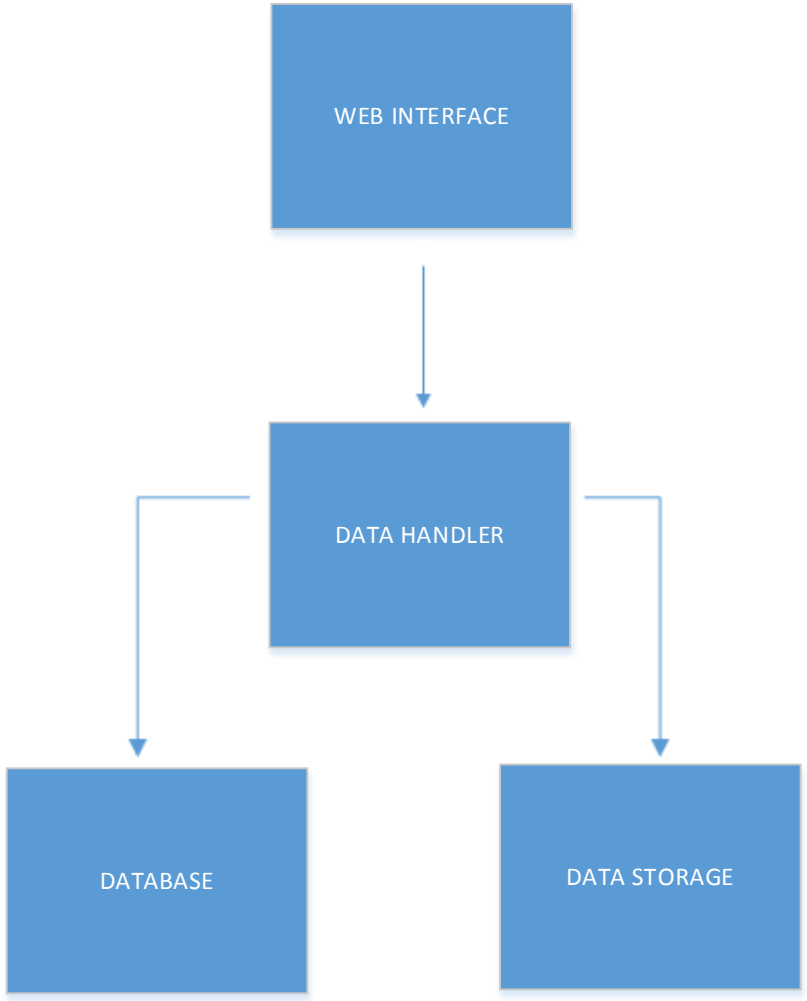
RAM: 2-4 GB per VM.

Static, dedicated IPv4 and IPv6 addresses



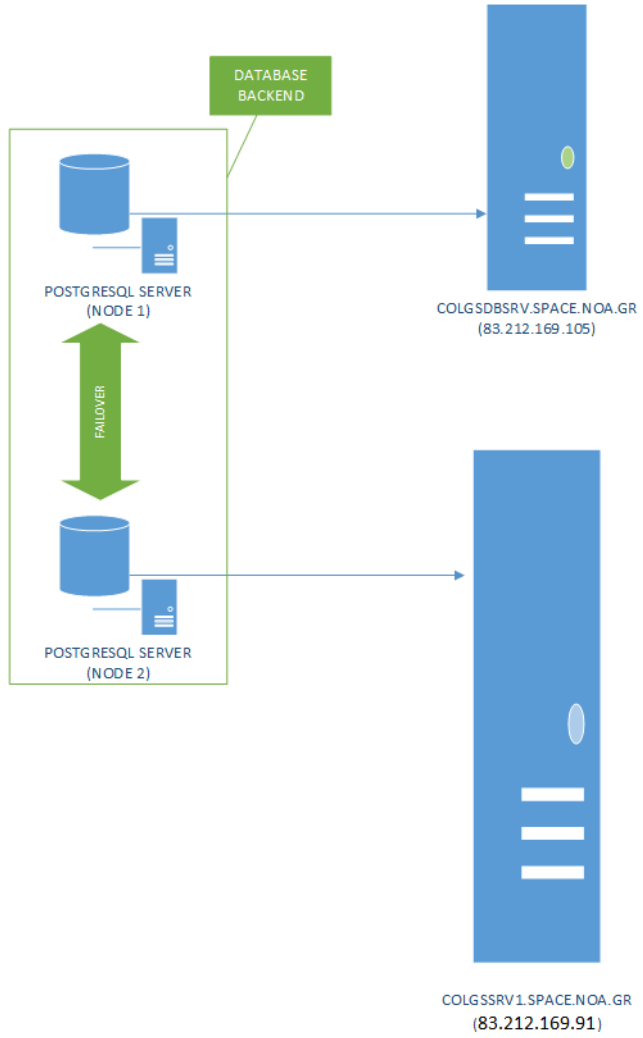
3-Level Architecture

- **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



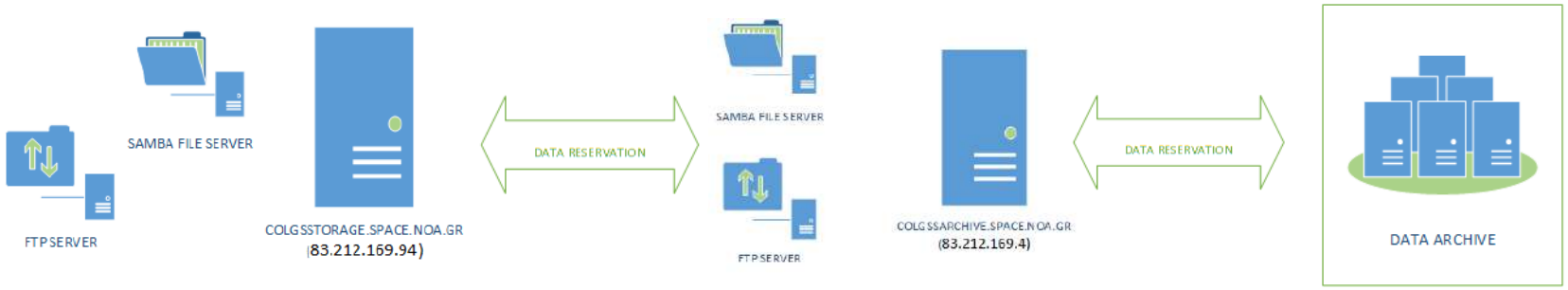
NOA Sentinel Mirror Site - Database Level

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

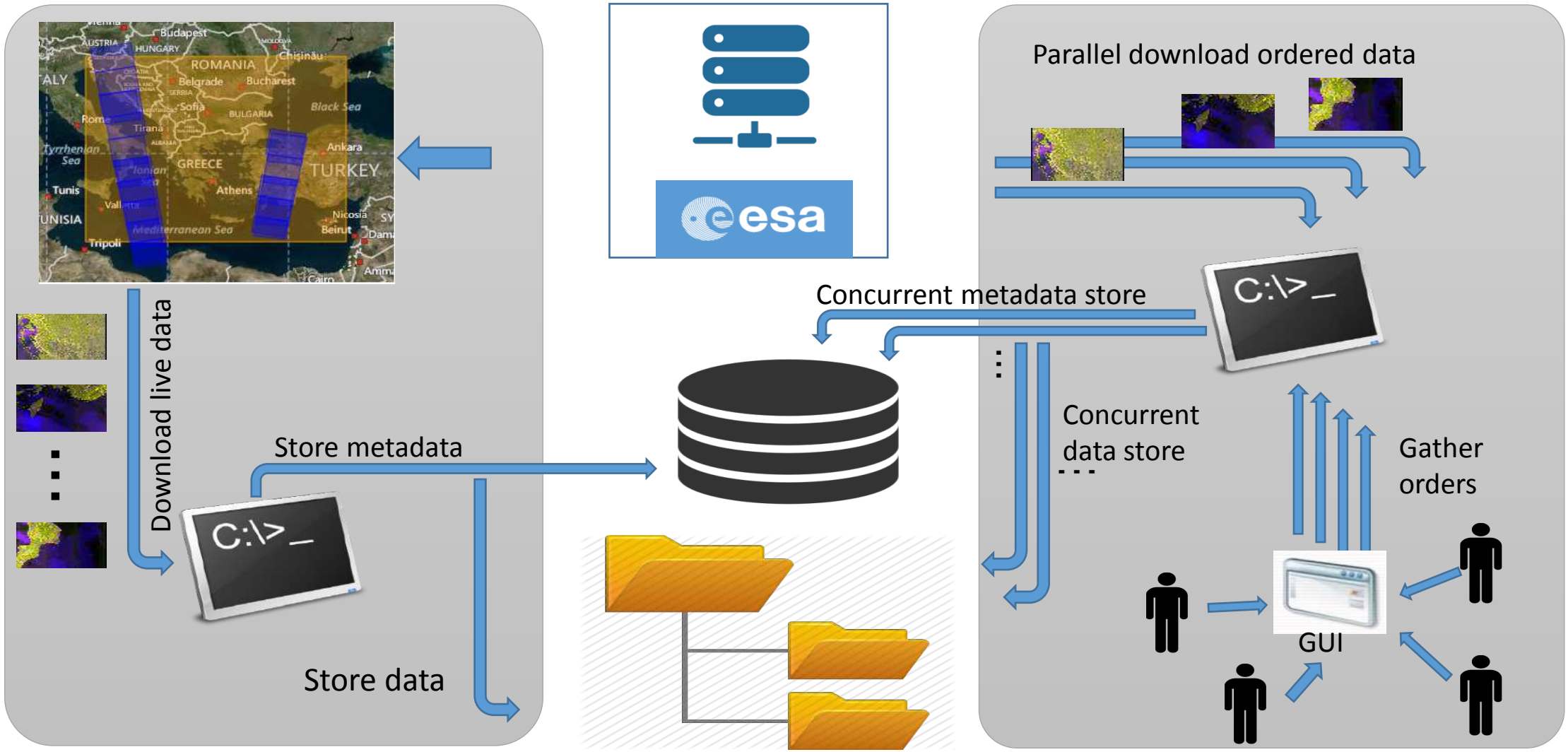


NOA Sentinel Mirror Site – Data Storage Level

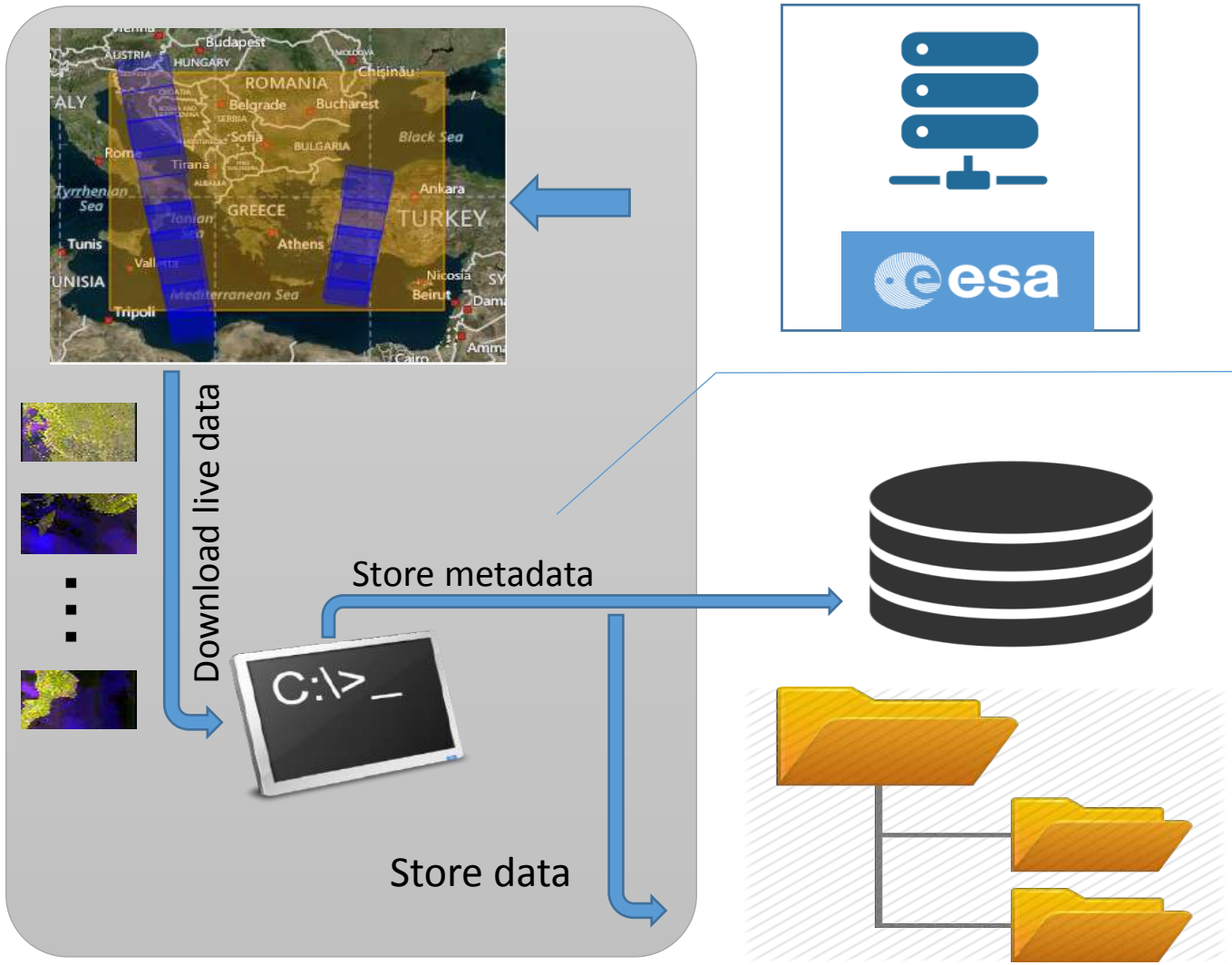
- **"Live"** data are kept in a high-performance, small storage capacity virtual machine (VM)
- **"Non-live"** data are transferred and kept in a second-level storage, in a dedicated VM
- Finally, older (than one month) data will be stored in a tape library/Hard Disk archiving solution



NOA Sentinel Mirror Site Back-end Architecture



NOA Sentinel Mirror Site Back-end Architecture



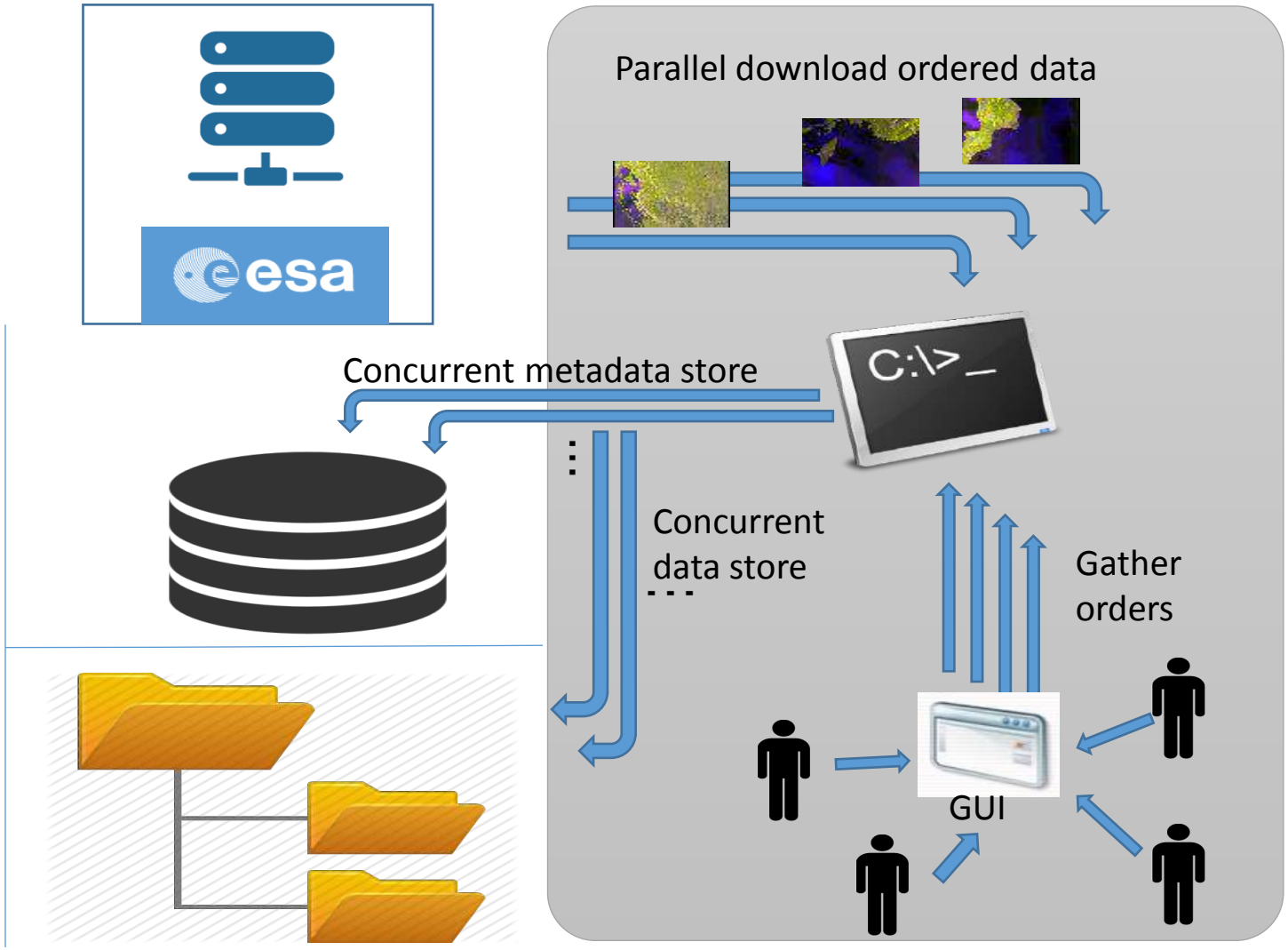
The data synchronizer module:

- Searches the DataHub 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

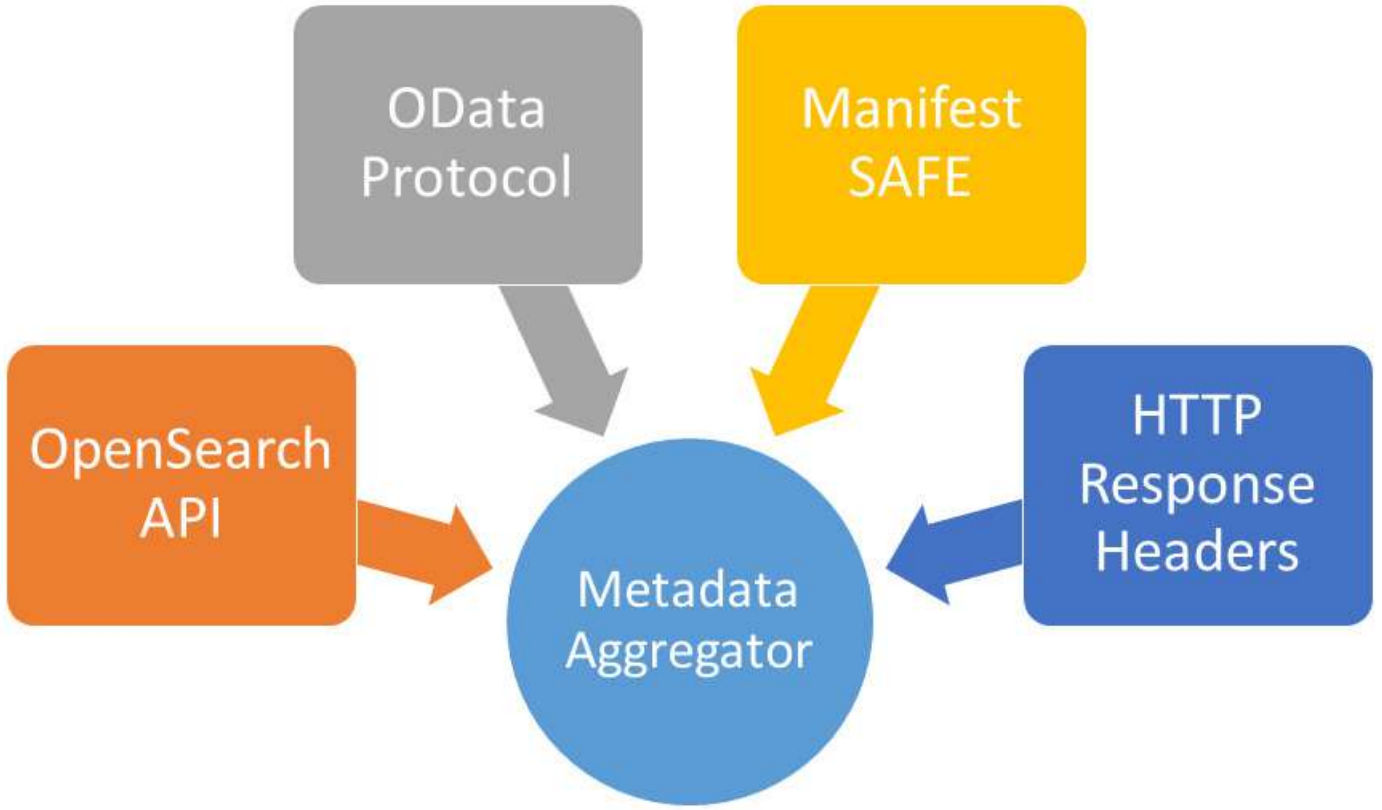
NOA Sentinel Mirror Site Back-end Architecture

The data downloader module:

- Gathers and manages data orders applied via the NOA Mirror Site GUI
- Concurrently retrieves locally older "non-live" Sentinel products
- Informs Users when an order (collection of requested products) is ready, and its component big-data products are available via the NOA Mirror Site facilities and the Mirror Site GUI



- 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.



NOA Sentinel MirrorSite – Issues

- Most of the issues are related with the request and retrieval of the metadata of a Sentinel Product.
  - ✓ **Not a single point of access**. NOA mirror site has to gather the necessary metadata through the XML returned from the **OpenSearch** API, the **OData** protocol and the relative **manifest file**. Each XML file has only part of the aggregate metadata.
  - ✓ **Standard format**. The XML format for **OpenSearch** API differs from the **OData** protocol and the **SAFE** format of the **manifest file**. **Different parsers** were **developed**.
  - ✓ **Standard metadata naming**. There is not a standardized naming convention for the metadata. The name of a specific **metadata field differs** between the XML files (e.g. the name of sensing start metadata field is *beginposition* in the OpenSearch XML file, whereas *startTime* in the manifest file).
- **Missing headers** from an HTTP response that contains the content of Sentinel product that could help us **validate the content** (e.g. etag with the file checksum), **resume a corrupted download** etc. However, most of these issues are currently resolved or under the way to be resolved.

Benchmark Exercise for testing the Dedicated DataHub → NOA Mirror Site Architecture

30 Parallel Transfers

GEANT Network

ESA Dedicated SENTINEL DataHub

Concurrent Downloads	Volume (Gigabytes)	Transfer Time (secs)	Transfer Speed (MBps)	Estimated Transfer Time for 1 GB (sec)	Estimated Transfer Time for 8 GB (sec)
sequential	8	400	20.48	50	400
10	5.47	240	23.33	44	352
20	19.18	600	32.73	31	248
30	47.18	1680	28.76	36	288

GRNet Dedicated VM's

NOA SENTINEL MirrorSite

Benchmark Exercise for testing the Dedicated DataHub → NOA Mirror Site Architecture

30 Parallel Transfers

ESA Dedicated SENTINEL DataHub

GEANT Network

Concurrent Downloads	Volume (Gigabytes)	Transfer Time (secs)
sequential	8	400
10	5.47	240
20	19.18	600
30	47.18	1680

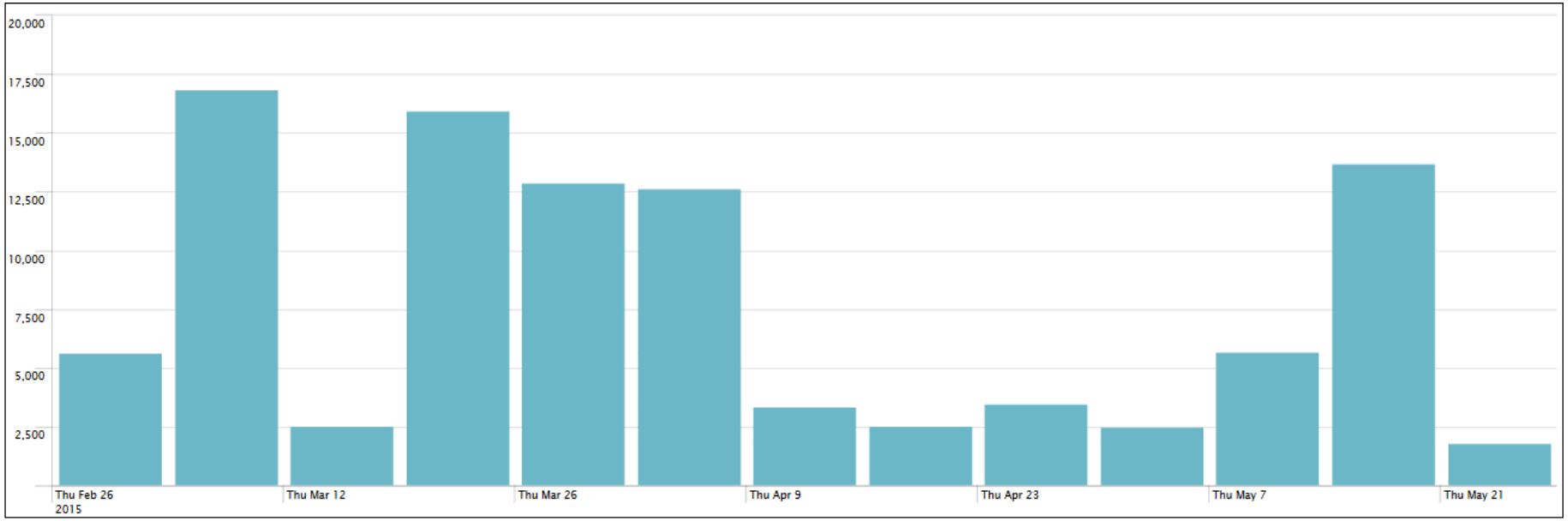
Benchmark results were estimated as more than satisfactory

GRNet Dedicated VM's

NOA SENTINEL MirrorSite

NOA Sentinel MirrorSite - Statistics
Load & Visits

- **Hits/visits per week of operation**: In less than 3 months of operation, Sentinel Mirror Site attracted a significant number of visitors.

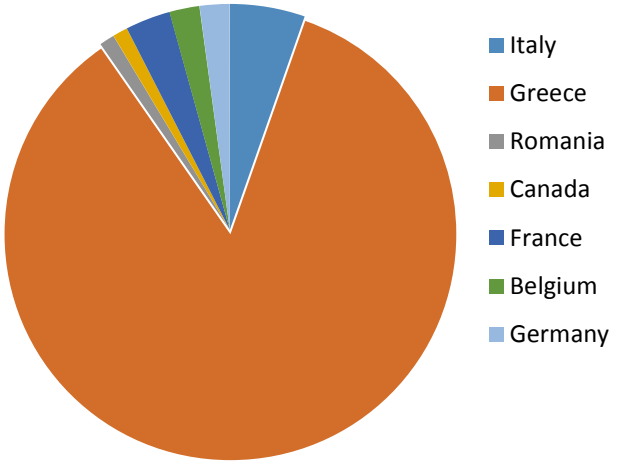


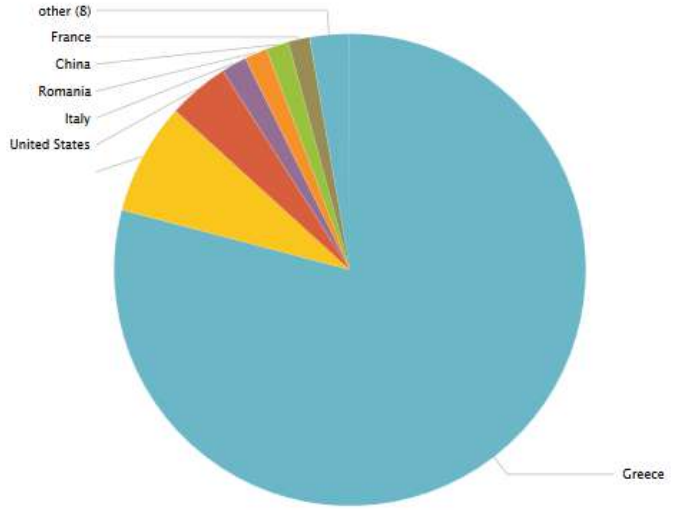
- Spikes were detected **during** and **after** events where mirror site was presented and promoted (e.g. Space Expo).

- Most users come from Greece and also from a number of European countries (France, Belgium, Italy etc.).

- The distribution of IP addresses accessing the Mirror Site indicates that most visits come from the Greek domain, while there is a significant number of international visitors

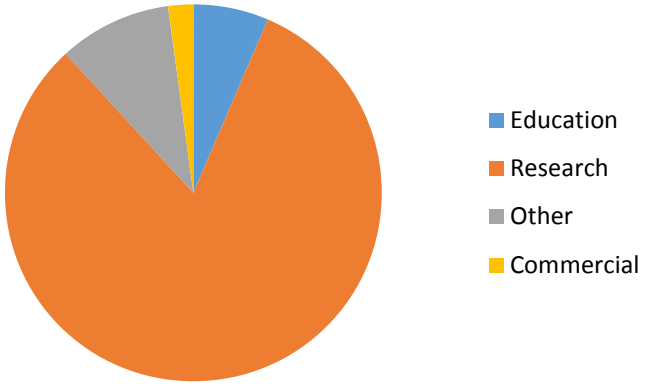
- Need for Mirror Site to be known in larger audiences.

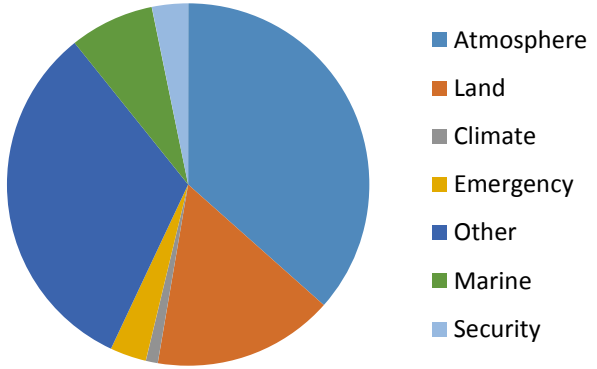




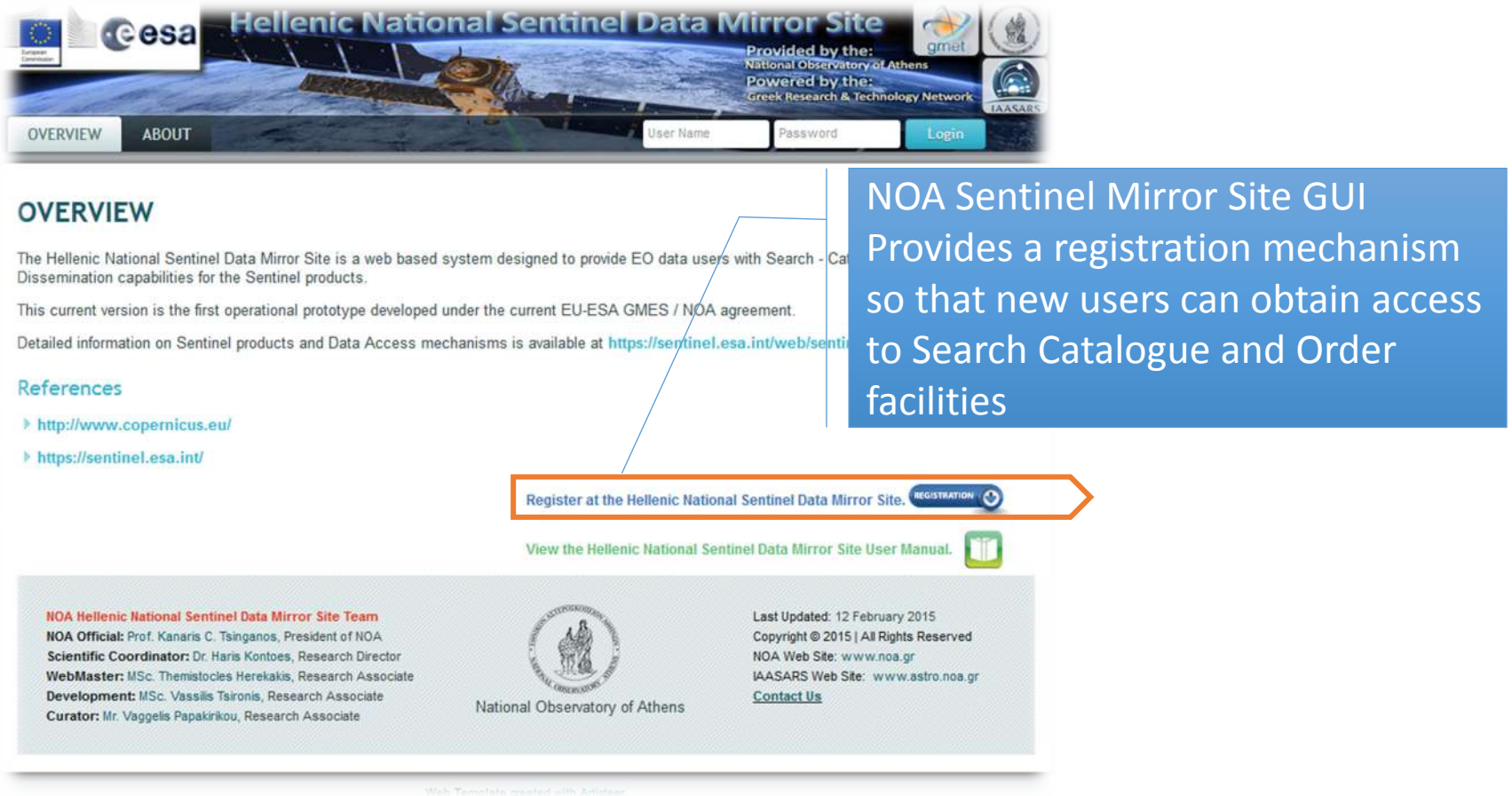
NOA Sentinel MirrorSite - Statistics
Types of Users – Target Groups

- As expected, Sentinel Mirror Site is **popular** amongst the members of the **scientific community**.
- Users who are using Sentinel data for **educational** or even **personal** ("Other") purposes are more than welcomed!
- **Commercial usage** of the data → Still weak, although it's great potential.
- **Atmospheric** and **Land applications** seem to be of primary concern!



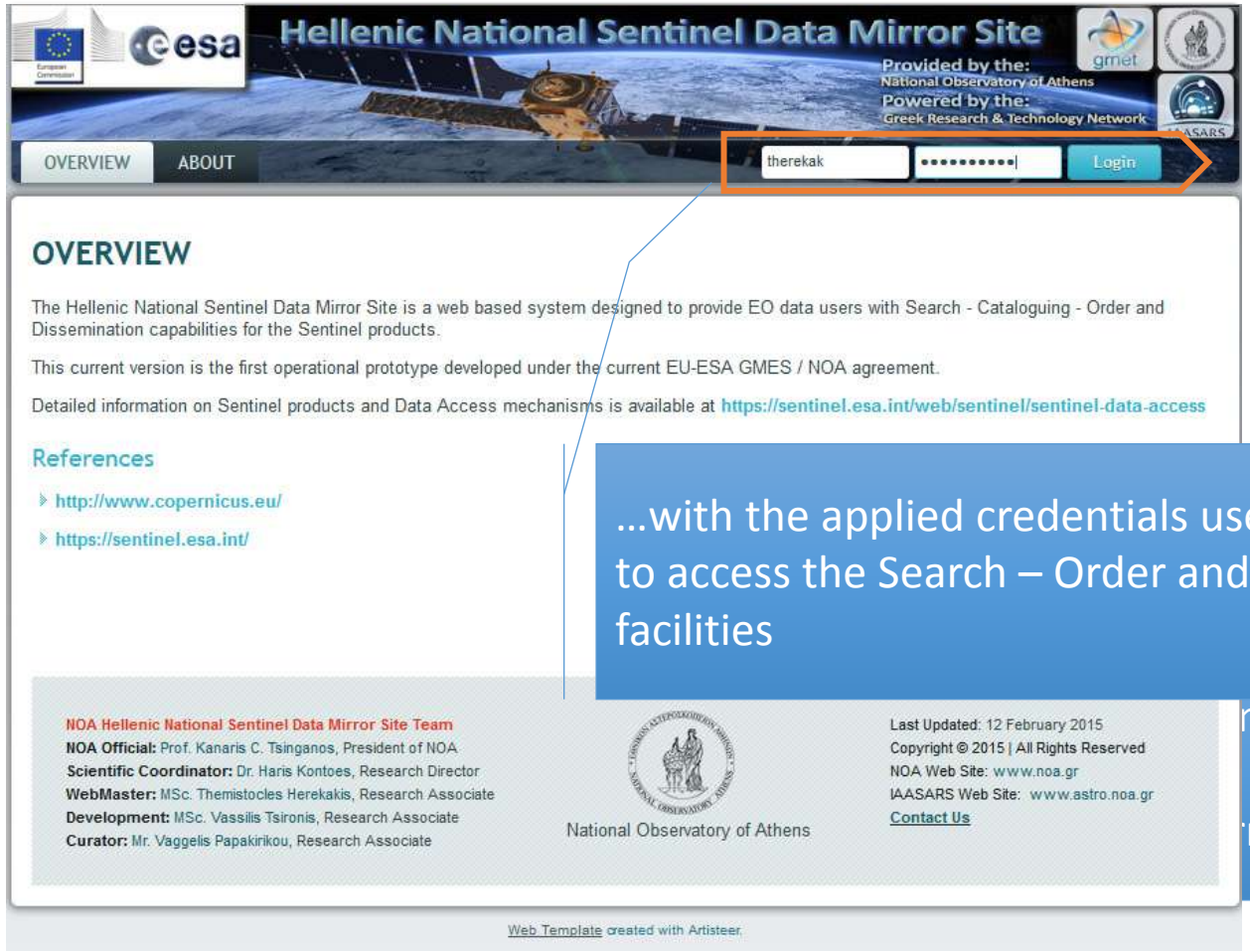


NOA Sentinel MirrorSite GUI



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

NOA Sentinel MirrorSite GUI



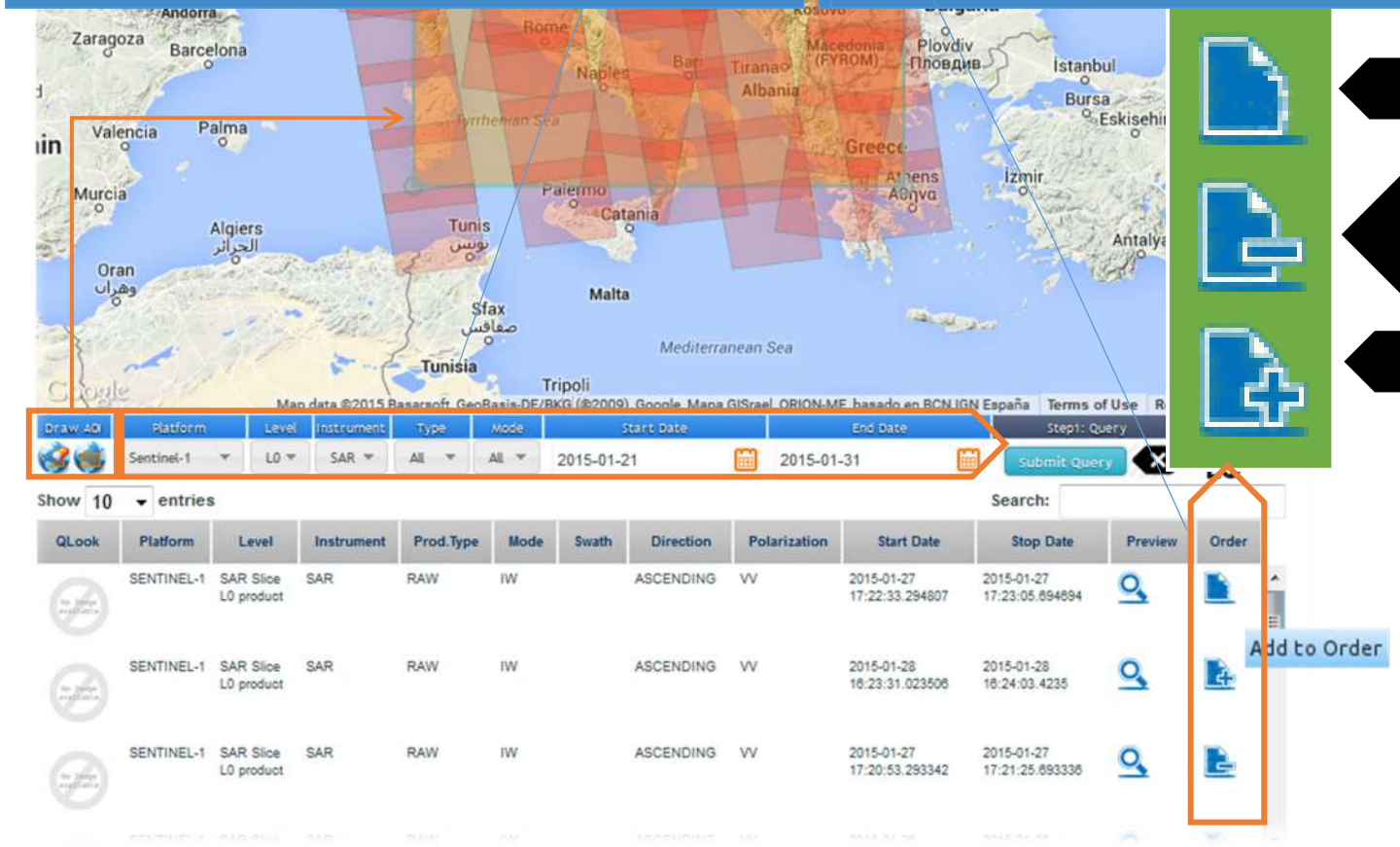
…with the applied credentials users may login to access the Search – Order and Data access facilities

necessary
their account is
rmation

NOA Sentinel MirrorSite GUI

…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…



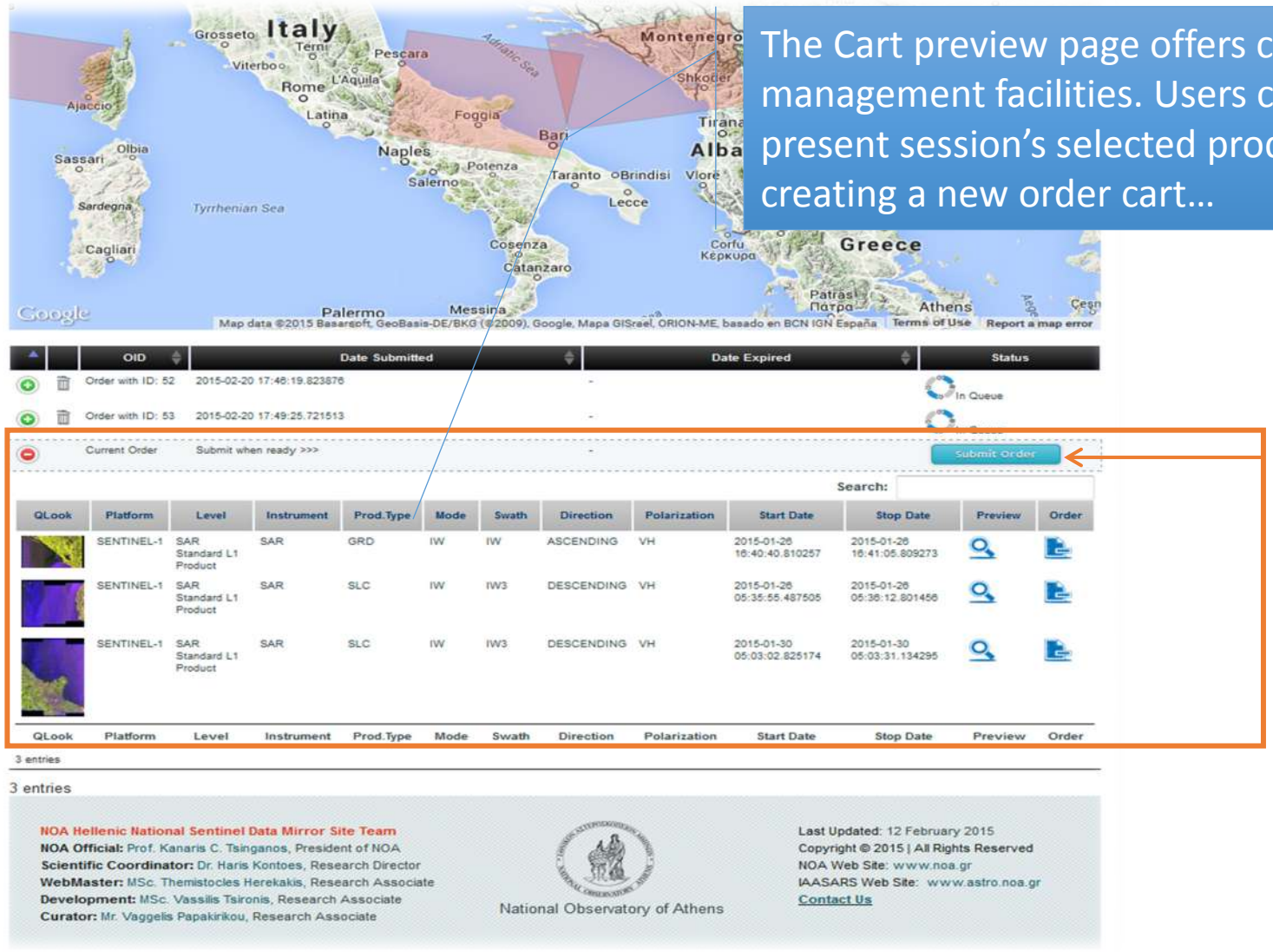
In order

Remove from order

Add to order

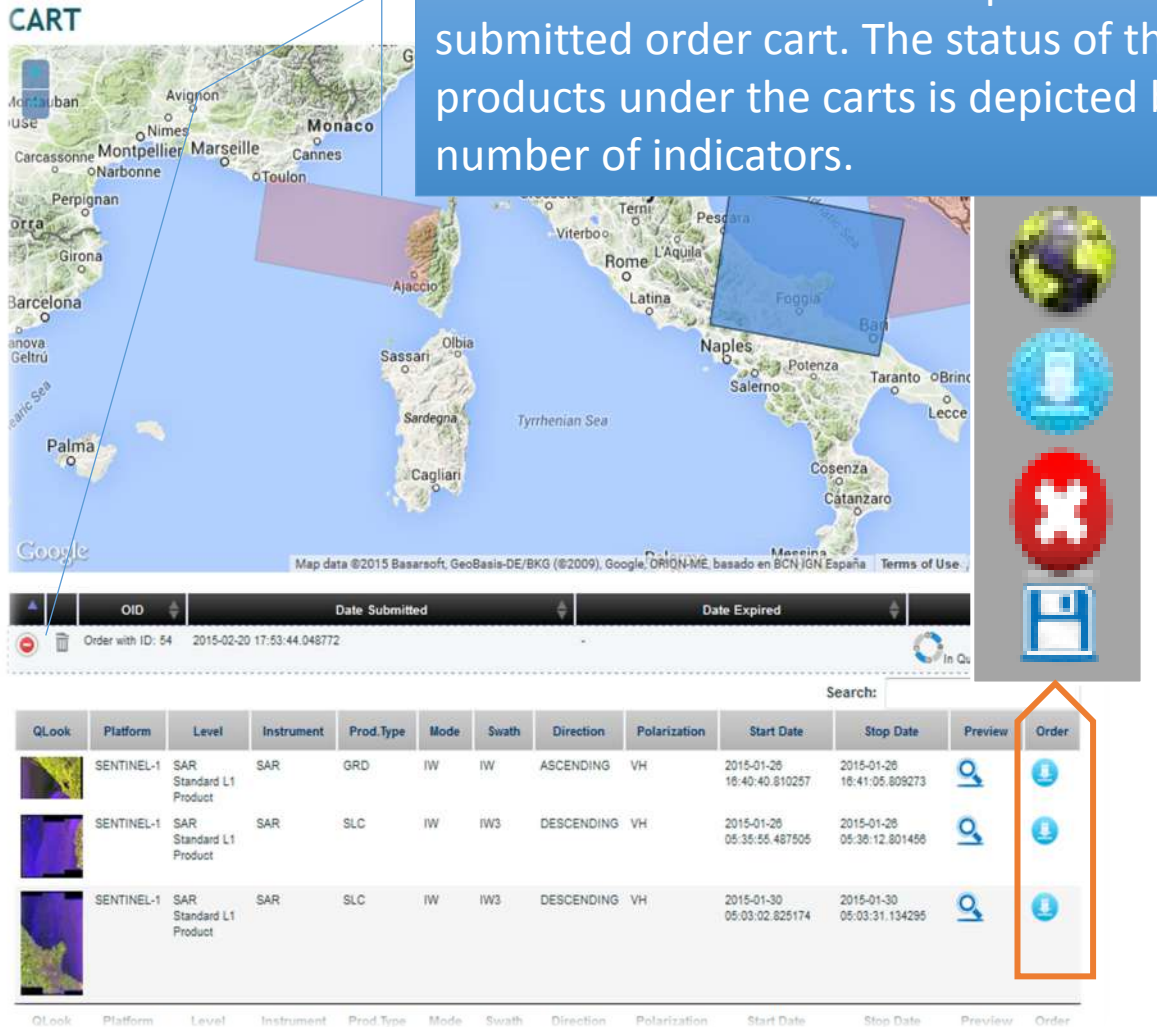
NOA Sentinel MirrorSite GUI

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



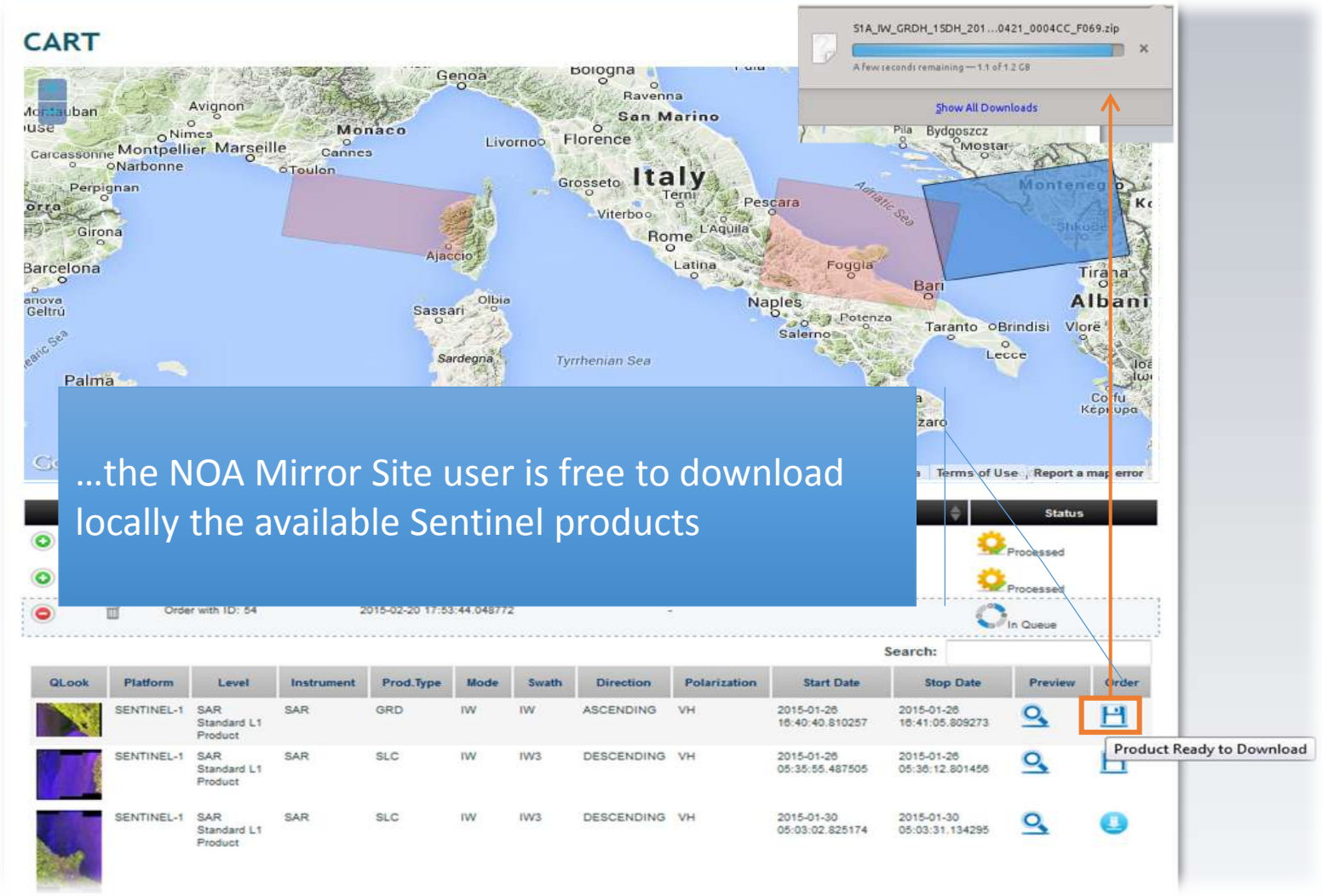
NOA Sentinel MirrorSite GUI

…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.



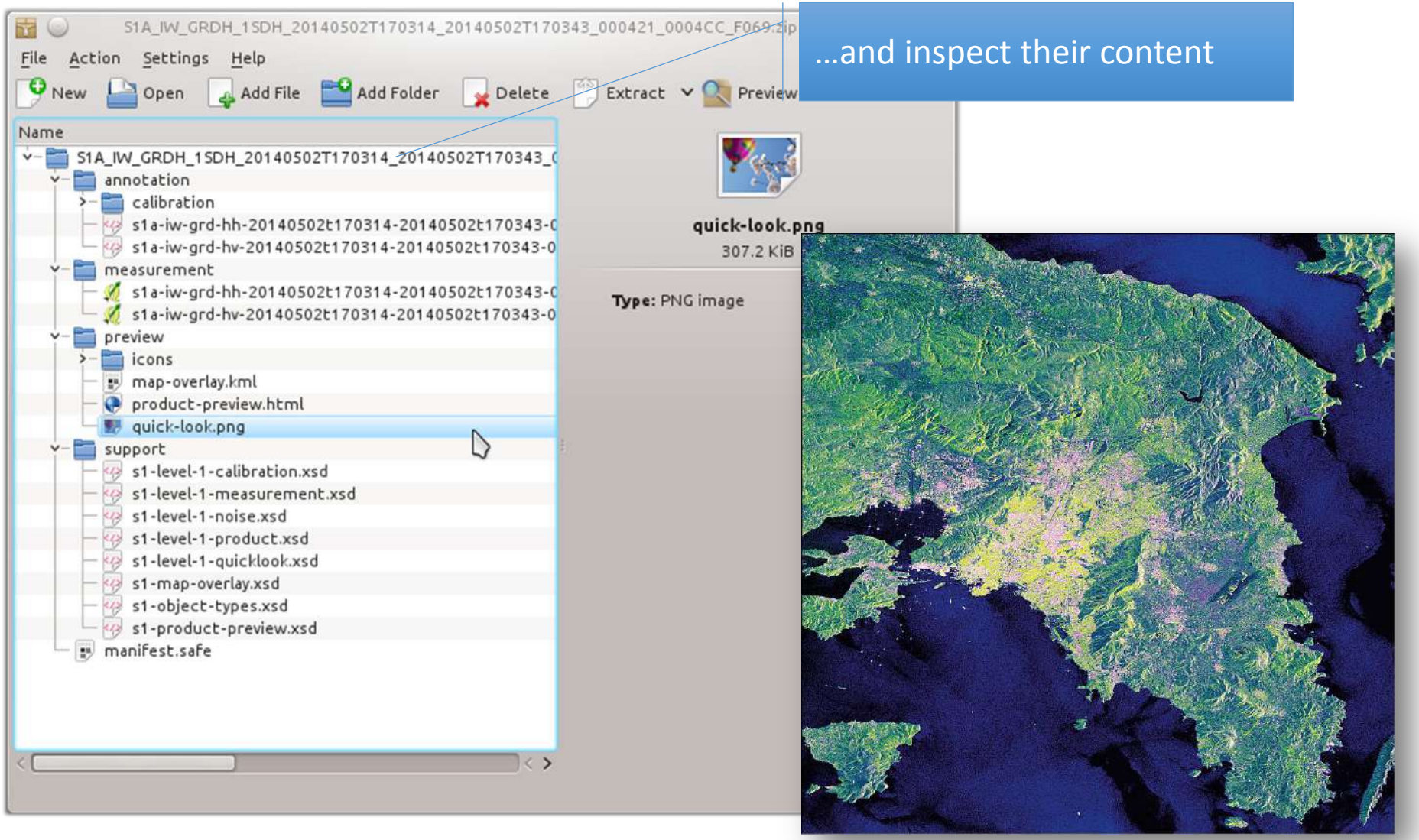
- The product is located at ESA DataHub
- The product is being downloaded
- The product is corrupted
- The product is ready to download

NOA Sentinel MirrorSite GUI



NOA Sentinel MirrorSite GUI

…and inspect their content



Thank you and

any questions?