2nd South-Eastern Europe GEO Workshop on Integrating Earth Observation Data and Services for monitoring the Environment, protecting the citizens and stimulating the regional economic growth

20 & 21 October 2014
Athens, Greece

ESA and CEOS – Integration & Coordination of EO Data and Information Services

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European Space Agency (ESA)

BEYOND

Greek GEO Office

MARIOLOPOULOS-KANAGINIS FOUNDATION FOR THE ENVIRONMENTAL SCIENCES

GEO GROUP ON EARTH OBSERVATIONS

Agenda

- **Overview of ESA Earth Observation Programmes**
  - **…. and of CEOS**

- **Integration and Delivery of EO Data & Information Services**
  - **ESA framework**
  - **CEOS and GEOSS framework**

Overview of ESA Earth Observation Programmes

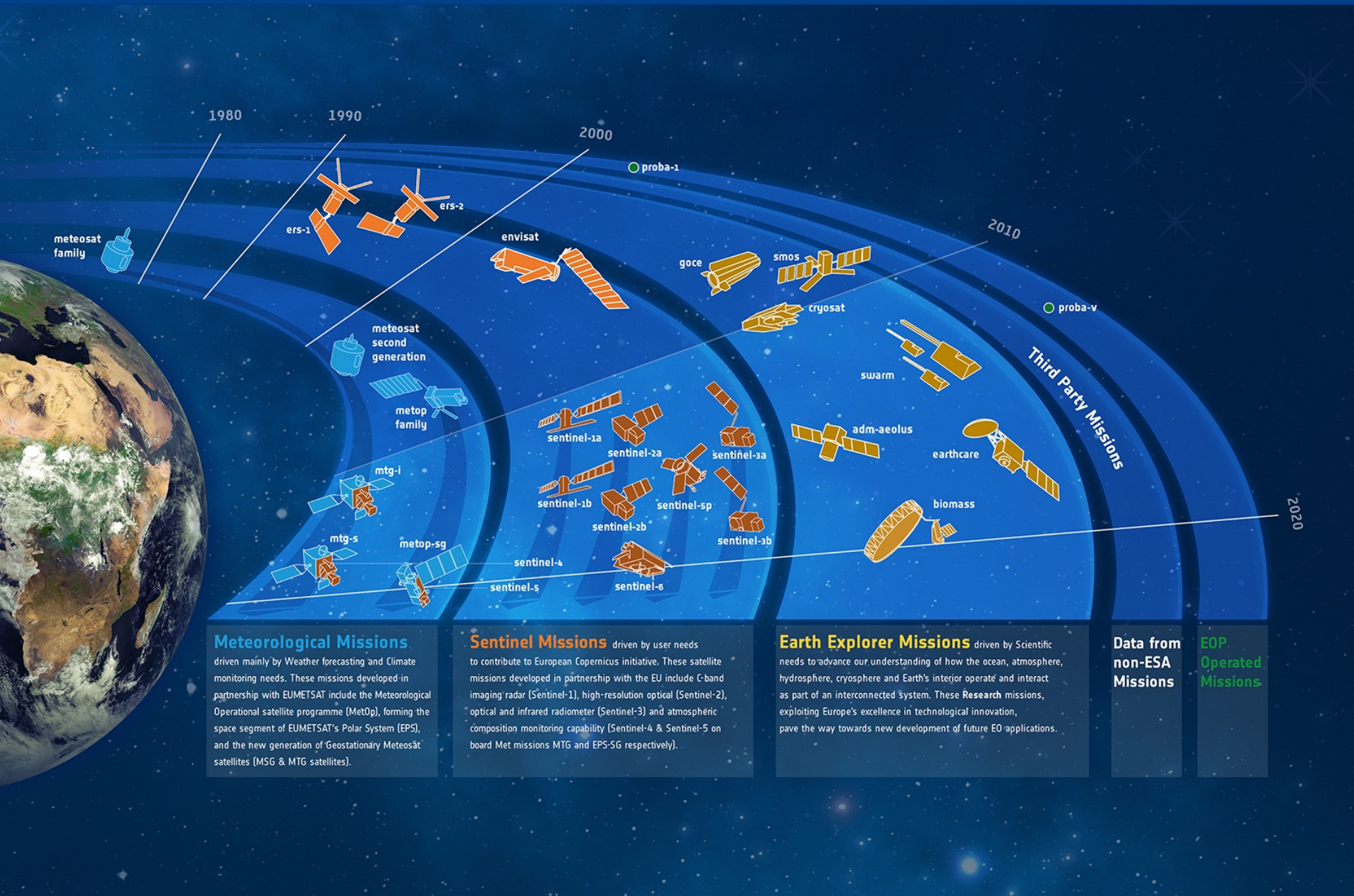
ESA Member States &Cooperating States

- Over 50 years of experience
- 20 Member States and 8 Cooperating States
- Eight sites/facilities in Europe, about 2200 staff
- 4.1 billion Euro budget (2014)
- Over 70 satellites designed, tested and operated in flight
- 18 scientific satellites in operation
- 200th launch of Ariane celebrated in February 2011

European Space Agency

- **4 EO missions** in operation
  - *Incl. Sentinel-1 ; Launch 3 April 2014.*
  - *7 more currently operated by Eumetsat*
- **+3800** user projects worldwide, without Sentinel-1 *(+2000 users registered so far)*
- More than **750 Terabytes/yr** of free data
- **30 partner missions** for which data are disseminated to European users
- More info at **www.esa.int**

Earth Observation Programmes



The Copernicus Programme

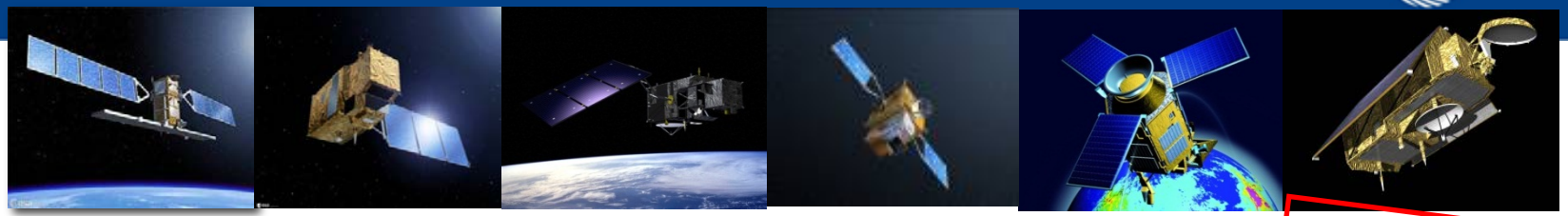
Copernicus (formerly known as GMES) is a European space flagship programme led by the European Union

Copernicus a European contribution to GEOSS

Provides the necessary data for operational monitoring of the environment and for civil security

ESA coordinates the space component

Copernicus Space Component: Dedicated Missions



FIRST LAUNCH
3.04.2014

S1: Radar Mission

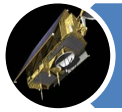
S2: High Resolution Optical Mission

S3: Medium Resolution Imaging and Altimetry Mission

S4: Geostationary Atmospheric Chemistry Mission

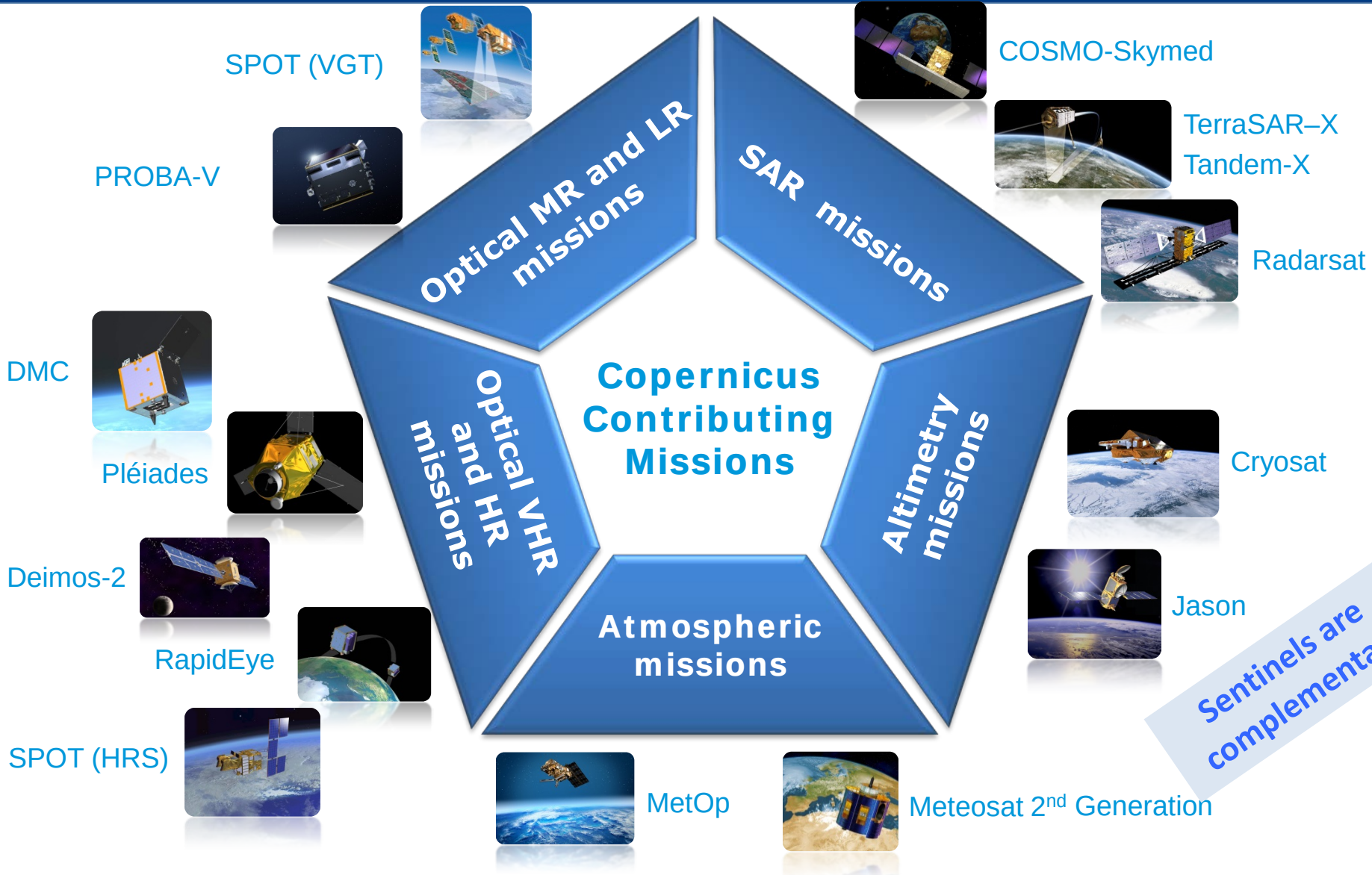
S5P: Low Earth Orbit Atmospheric Chemistry Precursor Mission

S5: Low Earth Orbit Atmospheric Chemistry Mission



S6 (Jason-CS): Altimetry Mission

Copernicus Contributing Missions



CSC Ground Segment and Sentinels Collaborative Ground Segment

The Copernicus Space Component (CSC) Operations concept relies on a **CSC Ground Segment**, with CSC-funded Functions and Elements, providing :

- the primary access to **Sentinel** Missions data as well as
- the coordinating access functions to **Contributing Missions** data
- fulfilling the Sentinels Mission Requirement Documents

This is complemented by **a Sentinel Collaborative Ground Segment**, with non CSC-funded Functions and Elements, providing:

- a supplementary access to **Sentinel** Missions data, i.e. either through specific data acquisition services, or specific data products

1st Collaborative GS Agreement

ESA and Greece signed 1st **Understanding for the Collaborative Ground Segment Cooperation** , in Europe (Athens, 12 May 2014)

Volker Liebig (ESA Director of Earth Observation Programmes) and Kanaris C. Tsinganos (President of the National Observatory of Athens)

Agreement:

- Guarantees access to Sentinel data for Greece
- NOA will set up a '**national mirror site**' for hosting and distributing Sentinel data and products for the derivation of value adding environmental services and information.

Objective: Prof. Tsinganos:

> **"Provide data for priority national activities with a prospect to serve the needs of transnational cooperation between Greece and neighbouring southeastern Mediterranean and Balkan countries, as well as the Black Sea Region."**

CEOS – Background

Since 1984, CEOS is the international forum for the coordination of space-borne EO missions.

31 Member space agencies (EO Data providers) **and 24 international organizations as Associates** (Users of EO data)

Since 2005, CEOS acts as the space arm of GEO

CEOS currently focuses on key areas such as:

- Climate change, deforestation/forest carbon, agriculture/food security, disasters, water cycle,….

CEOS – Support Bodies

- **Chair Team** (currently EUMETSAT)
- **Strategic Implementation Team** (SIT – currently CNES),
- **Secretariat** (ESA, EUMETSAT, NOAA, NASA, MEXT & JAXA),

- **5 Working Groups:**
  - **Calibration/Validation** (WGCV), **Information Systems and Services** (WGISS), **Capacity Building and Data Democracy** (WGCapD), **Climate** (WGClimate), **Disasters** (WGDisasters)
- **7 Virtual Satellite Constellations Teams,**
- **2 Ad Hoc Project Teams** (Forest Monit., Agriculture Monit.)
- **System Engineering Office** (SEO) cross-disciplinary support

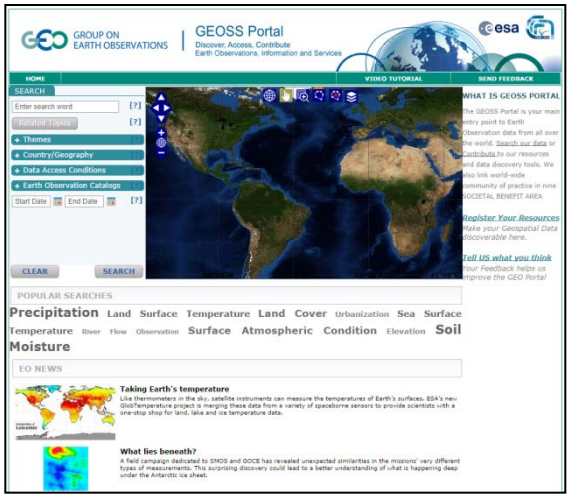
ESA and CEOS's Involvement in GEO

ESA directly involved in GEO or indirectly through CEOS

- ESA & CEOS both Participating Organisations. CEOS space arm of GEO. See www.esa.int & www.ceos.org

Direct: some examples

- ESA developer and operator of GEOSS Web Portal
- Human support in GEO SEC, various Committees and Task Teams



Indirect: some examples

- Global Forest Observations Initiatives (GFOI)
- GEOGLAM (Agriculture Monitoring)
- Disasters

CEOS
Committee on Earth Observation Satellites

Integration and Delivery of EO Data & Information Services

… ESA Framework …

Basic Needs for Users Services

- **Ensure preservation, discovery and access to current and historical missions data records and associated knowledge**

- **Provide transparent and friendly user services, giving access to information relative to several EO missions through a single user interface** (as much as possible)

- **Link to external information systems from ESA's partners** (e.g. National Space Agencies in Europe, CEOS Agencies, GEOSS,…)

- **Optimize development, operations & maintenance costs**

Constraints for Users Services

- **Exploitation of existing ESA's infrastructure for past & current missions and of National Facilities as long as possible to maximize benefit from past investments.**

- **Porting services for past & current missions to technology & infrastructure for new missions, regularly performed but not straightforward :**
  - lack of expertise on past missions & corresponding infrastructure; budgets limitations, ….

- **Use of several standards** (e.g. catalogue interoperability protocols) **at ESA and outside ESA, leads to more complex implementations.**

Not a unique solution

1. **Copernicus Sentinels & Contributing Missions: dedicated and new infrastructure**

2. **Other missions: ESA's missions** (ERS-1&2, ENVISAT, Earth Explorers) **and Third Parties' missions exploited by ESA** (e.g. Landsat)
   - Distributed architecture in Europe, developed over many years to support flying and past missions (ERS-1 launch in 1991, ERS-2 in 1995, ENVISAT in 2002, followed by 4 Earth Explorers: GOCE in 2009, SMOS in 2009, Cryosat in 2010, SWARM 2013)

… Copernicus Sentinels & Contributing Missions

Use Typologies

Copernicus Services

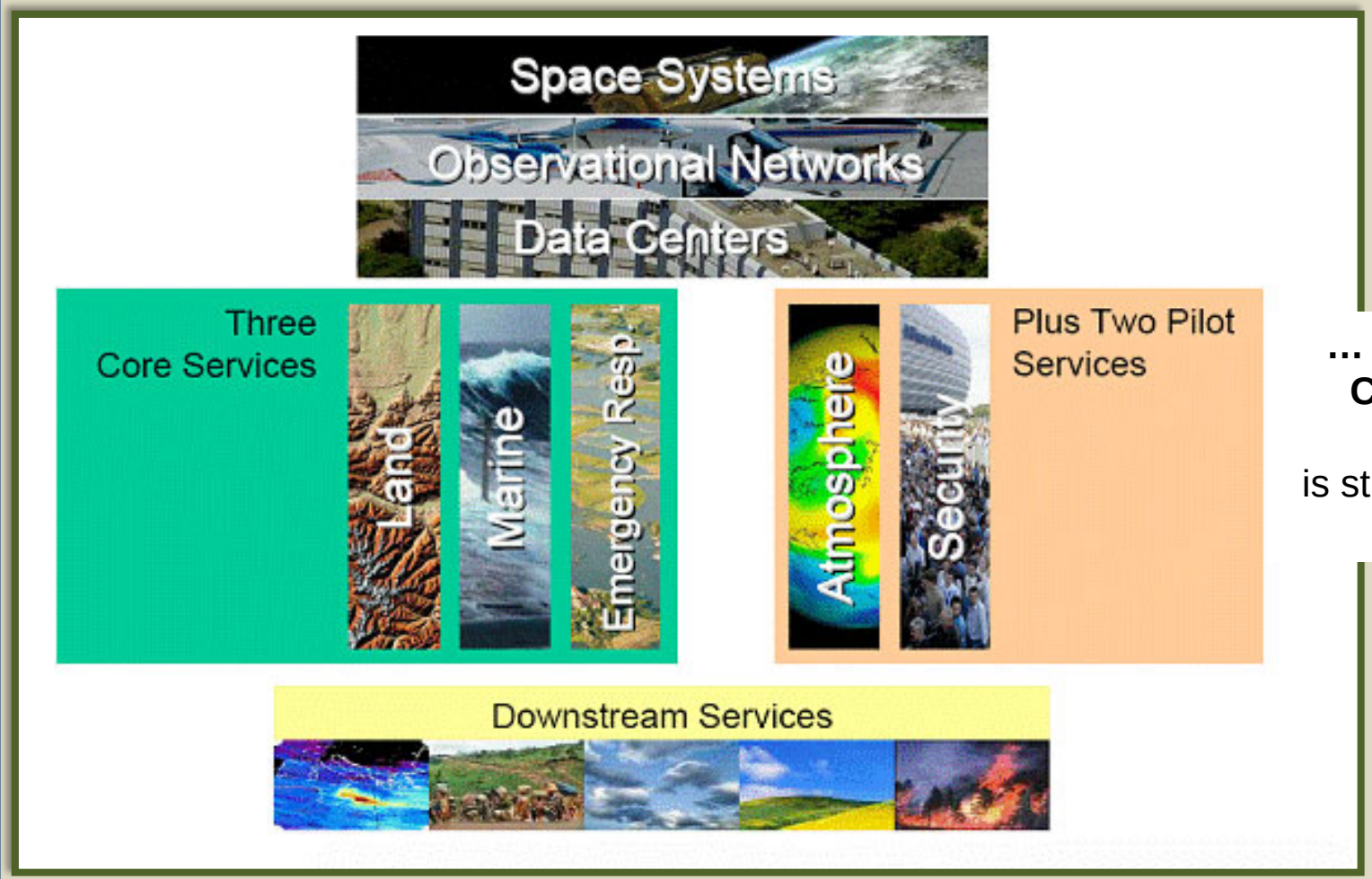
Copernicus Core & Downstream Services

Other EU needs assimilated to Copernicus services e.g. EMSA, EEA, EUSC, JRC

Scientific /Other use	**Science use**	**Public Value Adding use**	**Commercial Value Adding use**
MSs CollGS	**EU/ESA Member States (Collaborative GS) ESA funded R&D projects**		
Int'l Agreements	**International Agreements**		

Users shall have free, full and open access to Copernicus dedicated Sentinel data and Copernicus service information

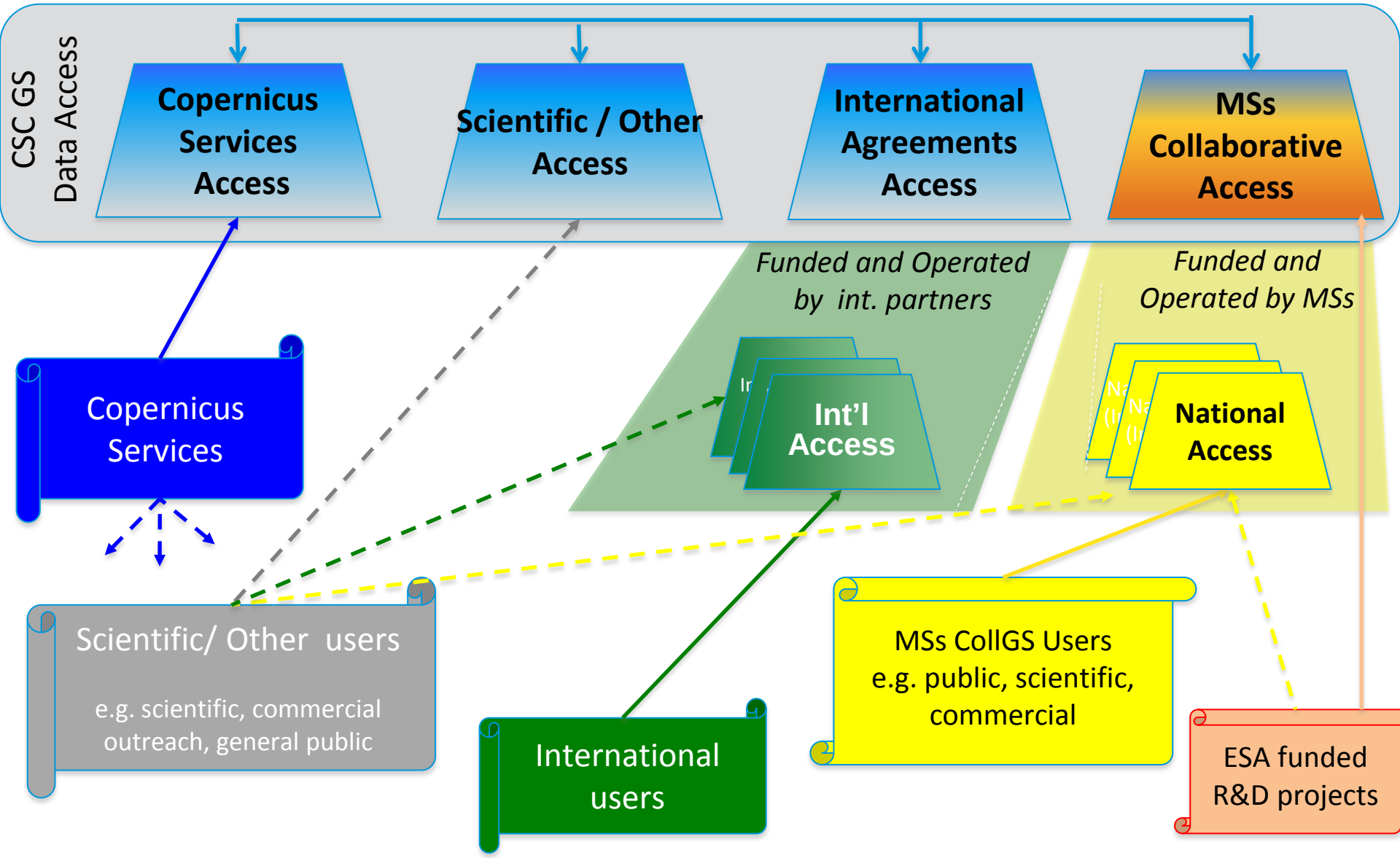
Copernicus Services



… and Copernicus Climate Change service
is still in a development phase.

Courtesy DLR

Data Access – An Engineering View



Data Access – A major undertaking

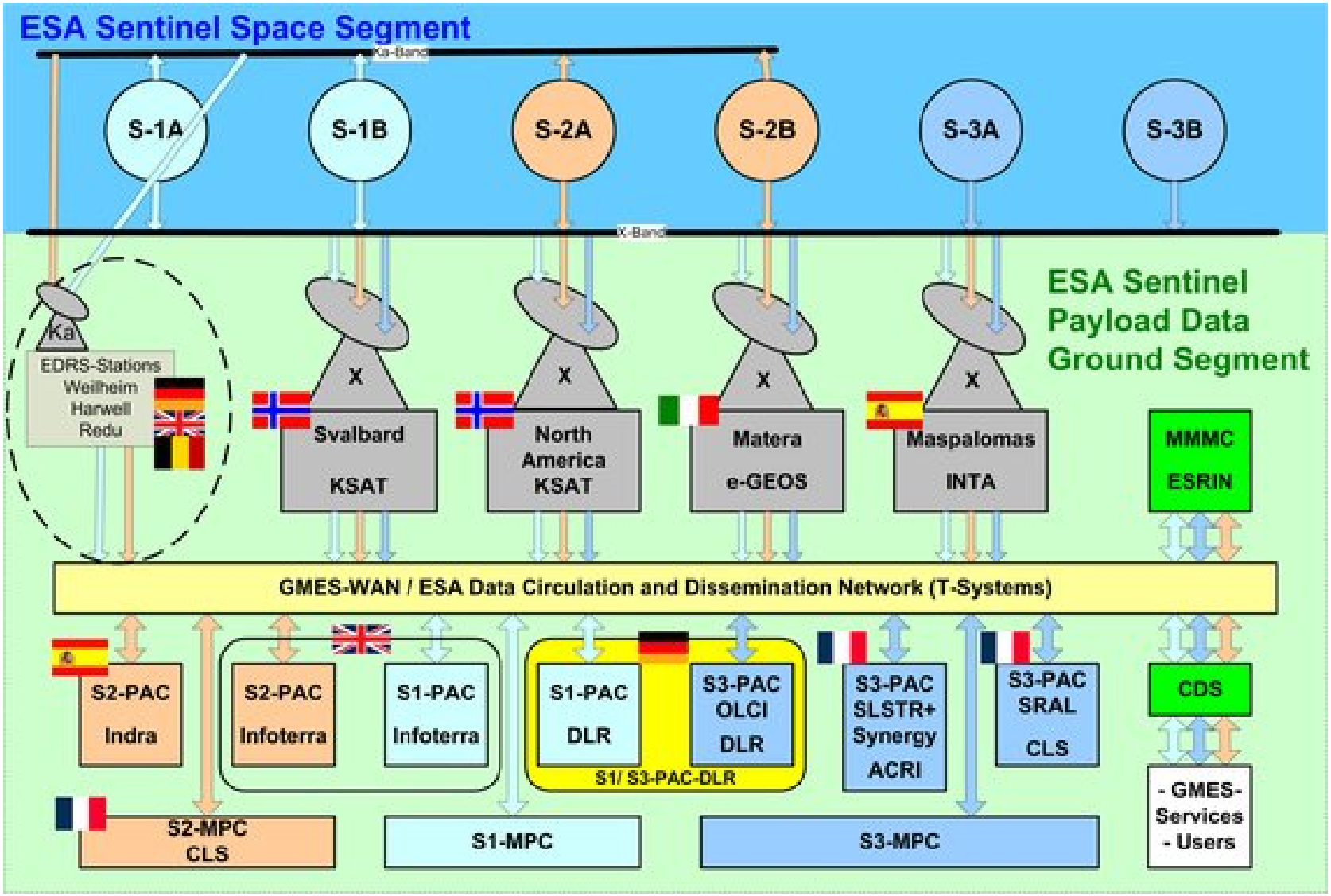
A major European Earth Observation Ground Segment design challenge …

Systematic processing and availability of the complete acquired data ..

➔corresponding to a sustained generation rate (24h/7d) of a continuous stream of ….

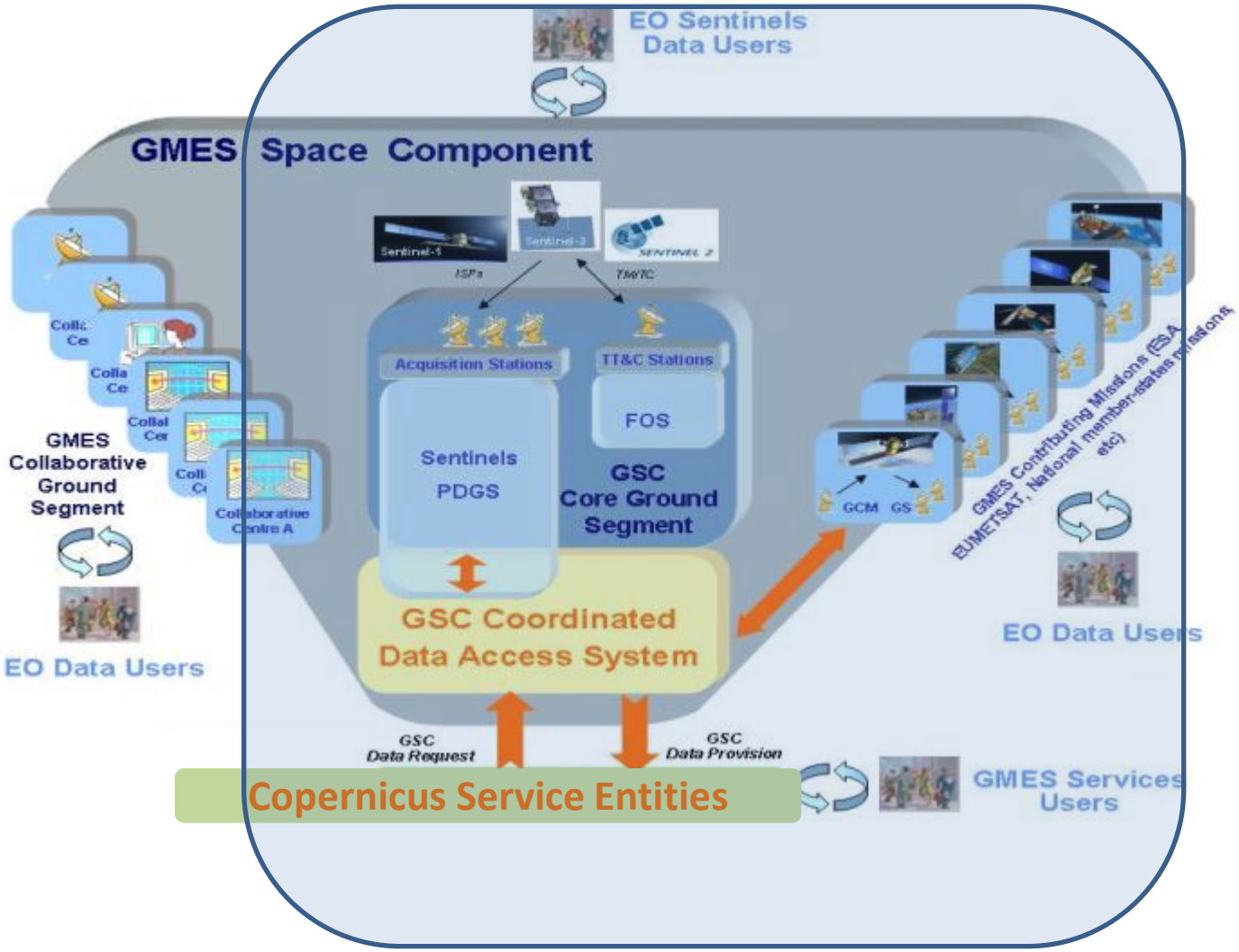
500Mb/s of user products (Sentinel-1,-2,-3 A series) =
5.4 TB/day = equivalent of 1180 DVDs/day !!

Copernicus GS



4 core ground stations in the Copernicus ground segment + European relay satellite system EDRS (Sentinel-1 and Sentinel-2 only)

Copernicus Ground Segment Architecture



Heterogeneous Mission Access (HMA)

ESA Developments & Copernicus Contributing Missions:

- ESA
- DLR
- EUMETSAT
- CNES – Disasters Charter
- VITO
- MDA (RSAT2)
- DMCii
- Astrium GbH (TSX)
- DEIMOS
- E-GEOS
- Astrium France (spot/pleiades)
- RapidEye
- Euromap
- EUSI
- Astrium France (spot 6/7)
- Proba-V
- others

Sentinel 1 Scientific Data Hub

esa

esa

Sentinel-1 Scientific Data Hu

European Commission

home

Welcome to the Sentinel-1 Scientific/O

The Sentinel-1 Scientific Data Hu Sentinel-1 Level-0 and Level-1 user products.
Products are available f

- Strip Map
- Inte

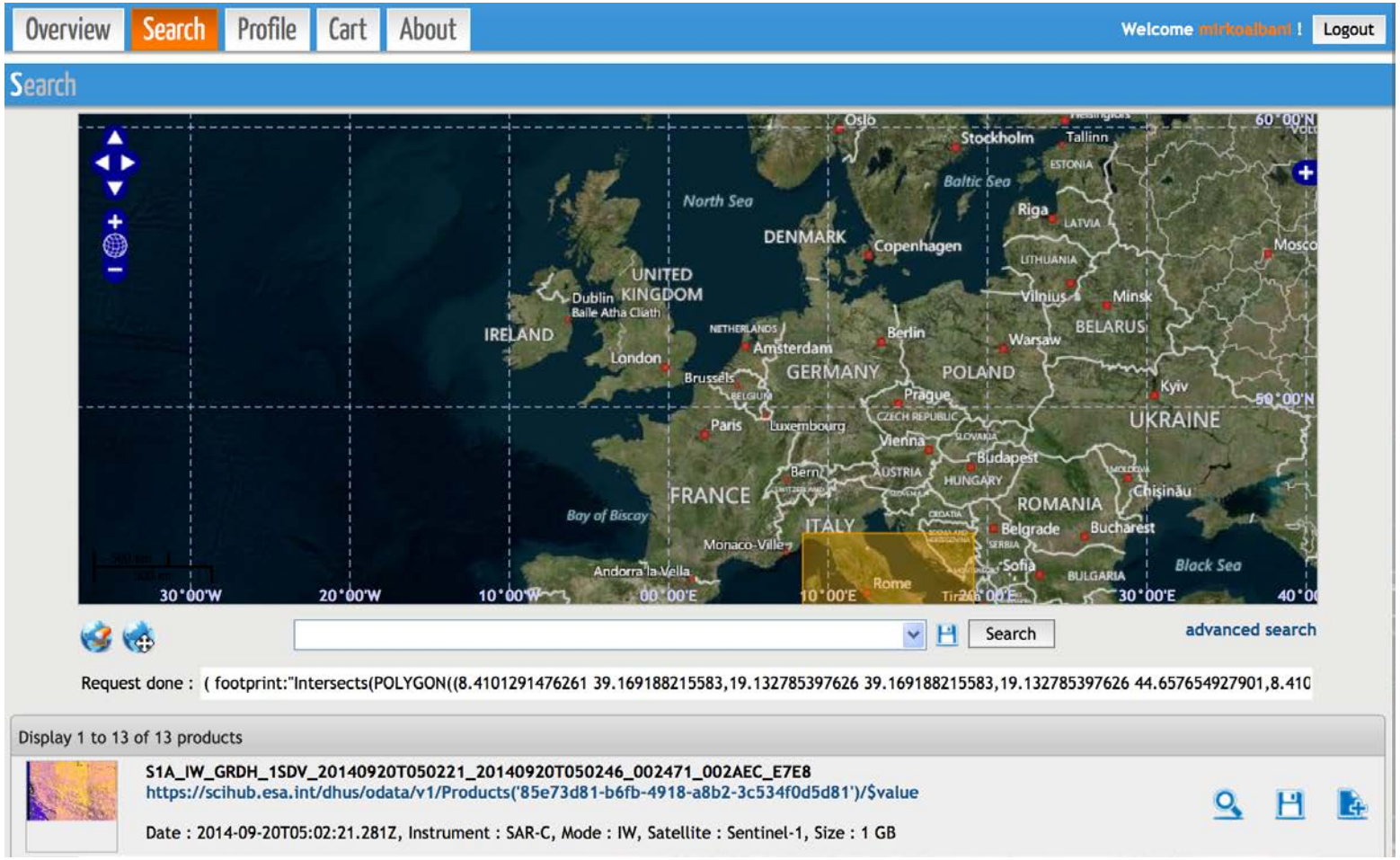
The aintains the latest 2 months of products for download via HTTP.
The ta ve will be reached in progression starting from a rolling period of 2 weeks commencing on the 3rd of O a sample set of orbits are available for download.
A maximu downloads per user is allowed in order to ensure a download capacity for all users.

The Sentinel evel-1 products are preliminary qualified, in particular products are not radiometric calibrated.
Operational product qualification, including absolute radiometric calibration, will continue during the next period.

Open to all Users on 3 October 2014

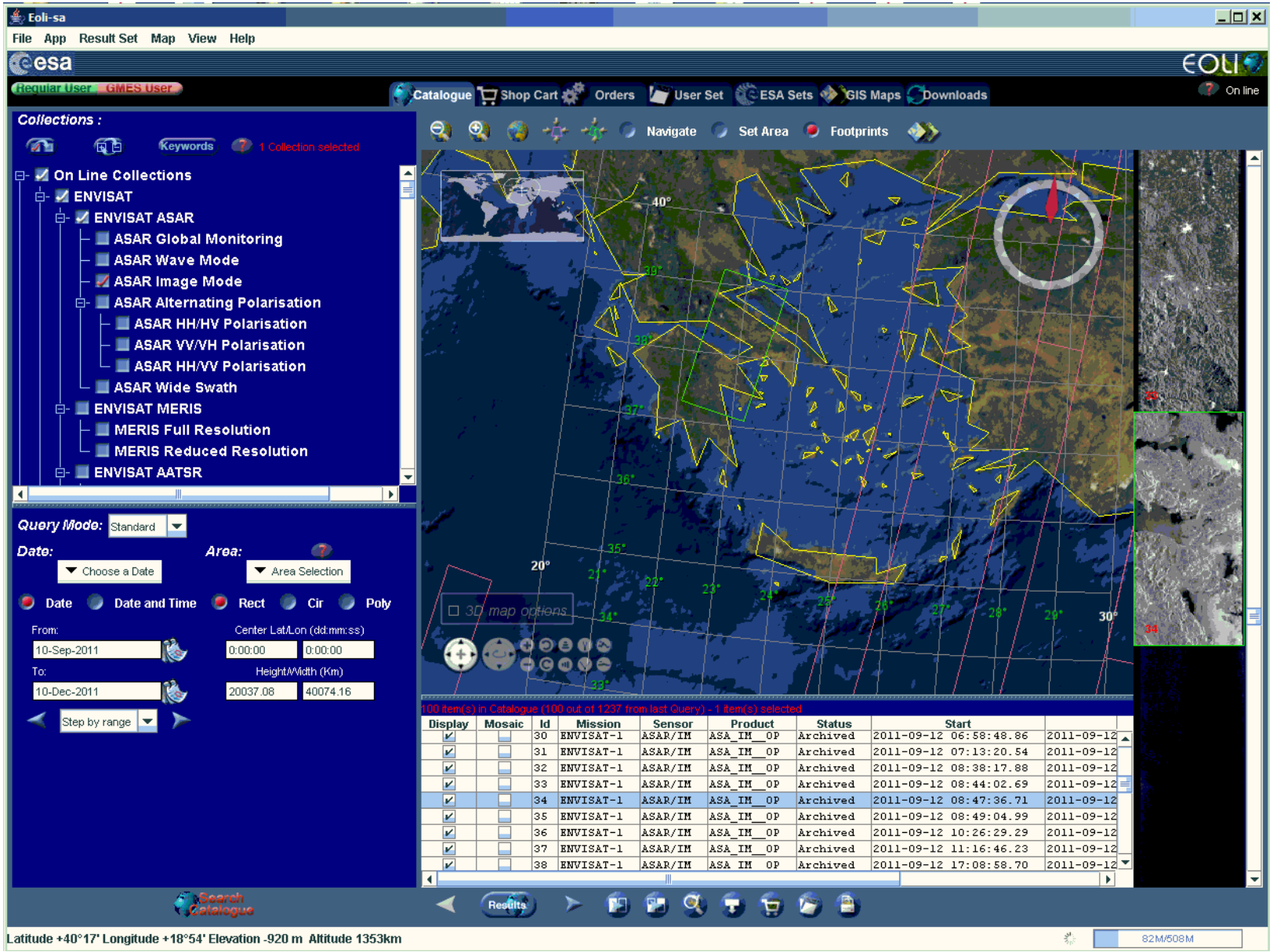
Simple registration to access data

Sentinel 1 Scientific Data Hub



… Other Missions …

EOLI-SA


Eoli-sa
File App Result Set Map View Help
esa
EOLI
Regular User GMES User
Catalogue Shop Cart Orders User Set ESA Sets GIS Maps Downloads
On line
Collections :
Keywords
1 Collection selected
On Line Collections
ENVISAT
ENVISAT ASAR
ASAR Global Monitoring
ASAR Wave Mode
ASAR Image Mode
ASAR Alternating Polarisation
ASAR HH/HV Polarisation
ASAR VV/VH Polarisation
ASAR HH/VV Polarisation
ASAR Wide Swath
ENVISAT MERIS
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MERIS Reduced Resolution
ENVISAT AATSR
Navigate
Set Area
Footprints
Query Mode: Standard
Date:
Choose a Date
Area:
Area Selection
Date
Date and Time
Rect
Cir
Poly
From:
10-Sep-2011
To:
10-Dec-2011
Center Lat/Lon (dd:mm:ss)
0:00:00
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20037.08
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Step by range
3D map options
100 item(s) in Catalogue (100 out of 1237 from last Query) - 1 item(s) selected
Display Mosaic Id Mission Sensor Product Status Start
30 ENVISAT-1 ASAR/IM ASA_IM__0P Archived 2011-09-12 06:58:48.86 2011-09-12
31 ENVISAT-1 ASAR/IM ASA_IM__0P Archived 2011-09-12 07:13:20.54 2011-09-12
32 ENVISAT-1 ASAR/IM ASA_IM__0P Archived 2011-09-12 08:38:17.88 2011-09-12
33 ENVISAT-1 ASAR/IM ASA_IM__0P Archived 2011-09-12 08:44:02.69 2011-09-12
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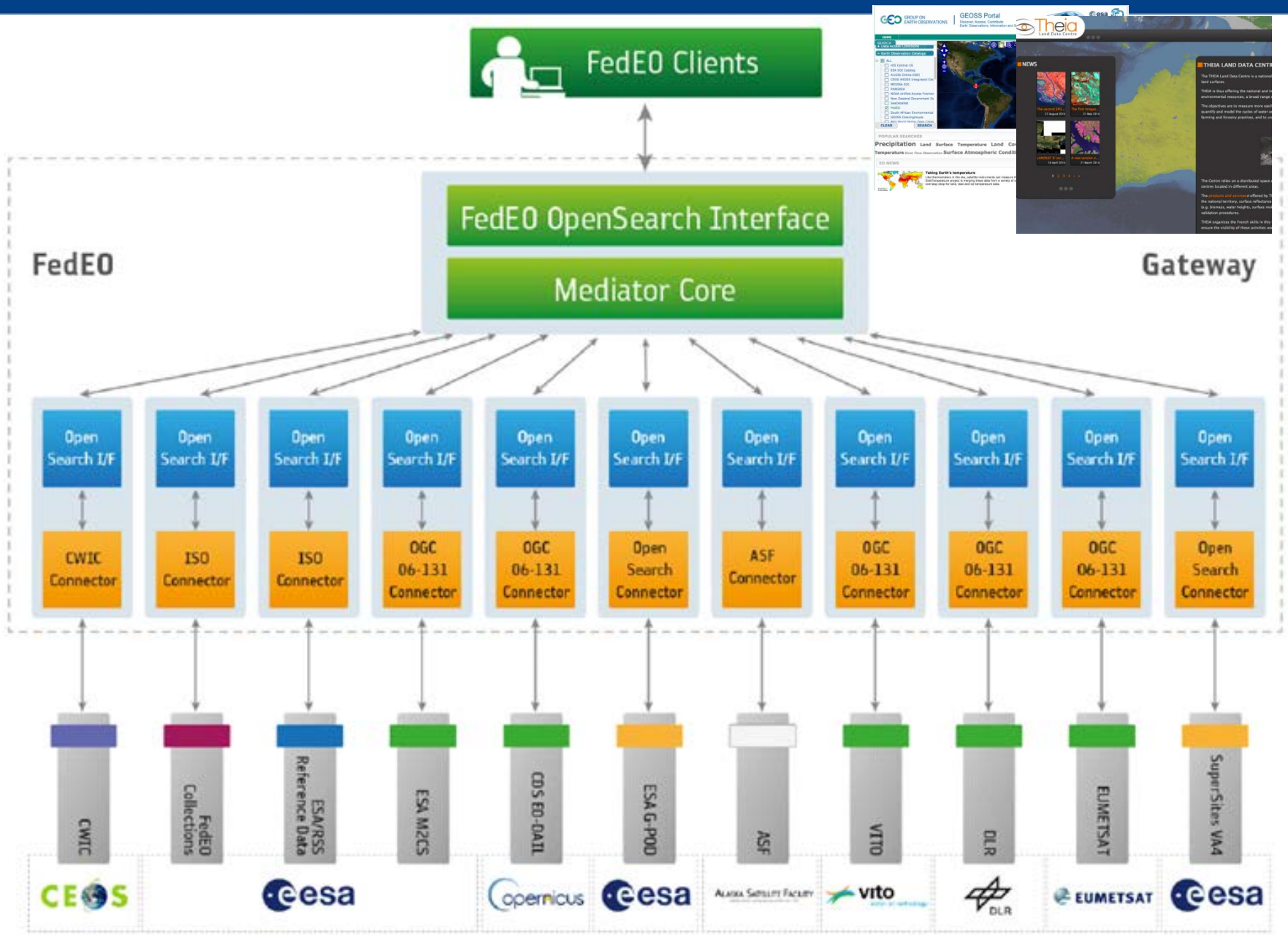
35 ENVISAT-1 ASAR/IM ASA_IM__0P Archived 2011-09-12 08:49:04.99 2011-09-12
36 ENVISAT-1 ASAR/IM ASA_IM__0P Archived 2011-09-12 10:26:29.29 2011-09-12
37 ENVISAT-1 ASAR/IM ASA_IM__0P Archived 2011-09-12 11:16:46.23 2011-09-12
38 ENVISAT-1 ASAR/IM ASA_IM__0P Archived 2011-09-12 17:08:58.70 2011-09-12
Search Catalogue
Results
Latitude +40°17' Longitude +18°54' Elevation -920 m Altitude 1353km
82M/508M

FedEO: Federated Earth Obs. System

- **Provides brokered discovery capability to European & Canadian EO missions data, and access and ordering to a subset.**

- **Implements standard interfaces (e.g. OpenSearch OGC) for an increased number of discoverable and accessible EO data collections, and for interfacing with CEOS Community Catalogues and Clients**

FedEO Brokered Architecture



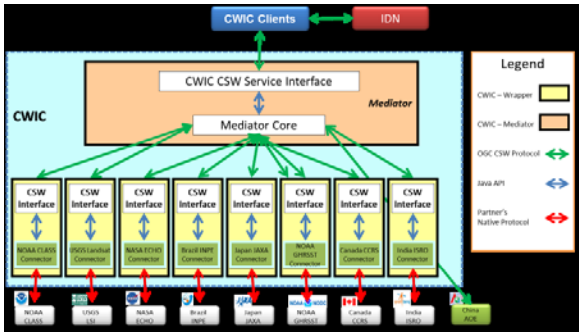
… CEOS and GEOSS Framework …

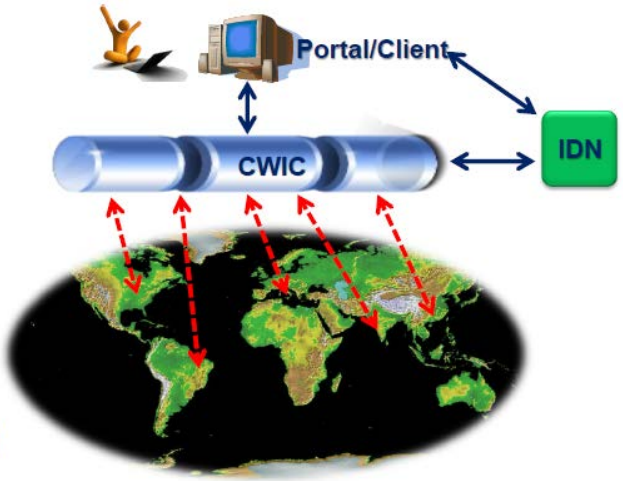
CEOS Interoperability

- **4 main on-going projects related to catalogue interoperability and data access:**
  - **CWIC**
  - **FedEO**
  - **OpenSearch**
  - **IDN**

CWIC and IDN Projects

- **CWIC = CEOS WGISS Integrated Catalog**
- **Federated catalogue for data discovery from multiple EO data centers**
- **+ 86 million individual EO data files can be found and accessed, accessing over 65 collections (data sets)** (as of 2012).
- **Connect to CEOS International Directory Network (IDN) that includes more 30000 registered EO resources (e.g. data sets & services, articles, web sites) over more than 30 years**

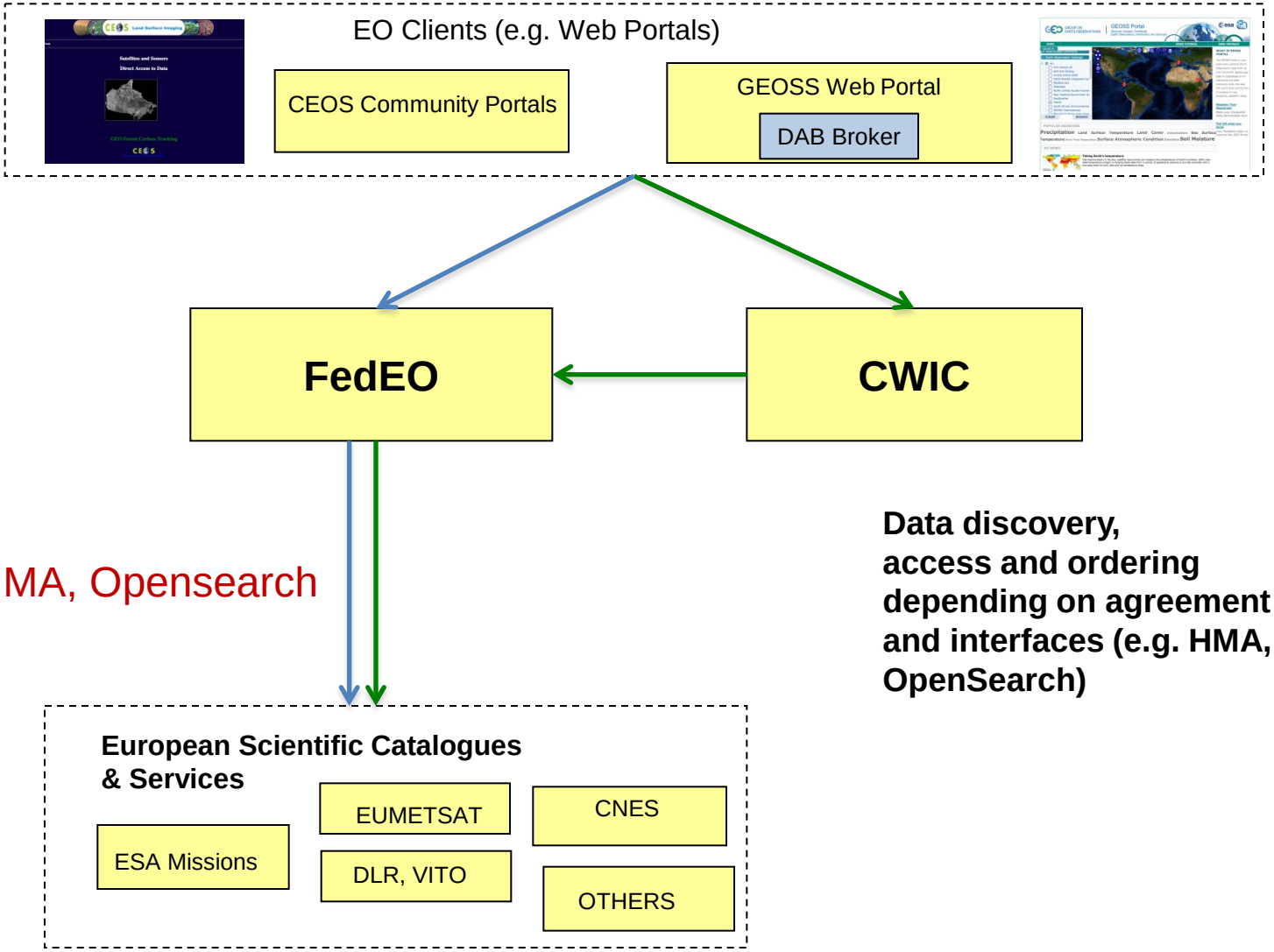




idn.ceos.org

High Level Concept – Scenario 1

European Data in the International Context



High Level Concept – Scenario 2

European Users and projects to European and non-European EO data

Data discovery, access and ordering depending on agreement and interfaces (e.g. HMA, OpenSearch)

FedEO → **CWIC**

HMA, Opensearch

Opensearch

European Scientific Catalogues & Services

- ESA Missions
- EUMETSAT
- DLR, VITO
- CNES
- OTHERS

Non European Scientific Catalogues & Services

- NASA
- NOAA
- USGS
- ISRO
- OTHERS

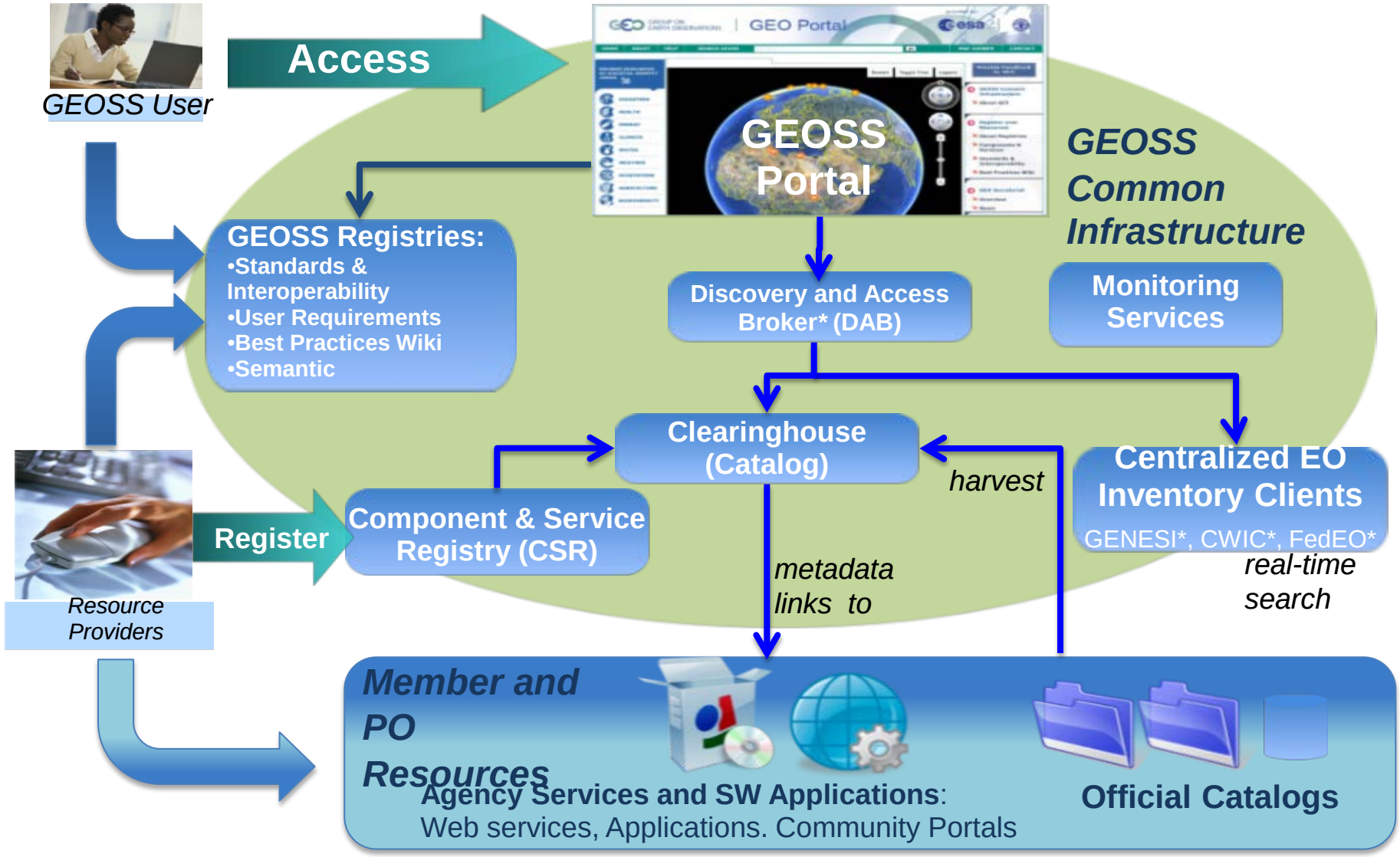
CEOS OpenSearch Project

- Establishes a common CEOS interoperability best practice of OpenSearch to allow standardized and harmonized **access to metadata and data of CEOS member agencies, including CWIC and FedEO communities;**

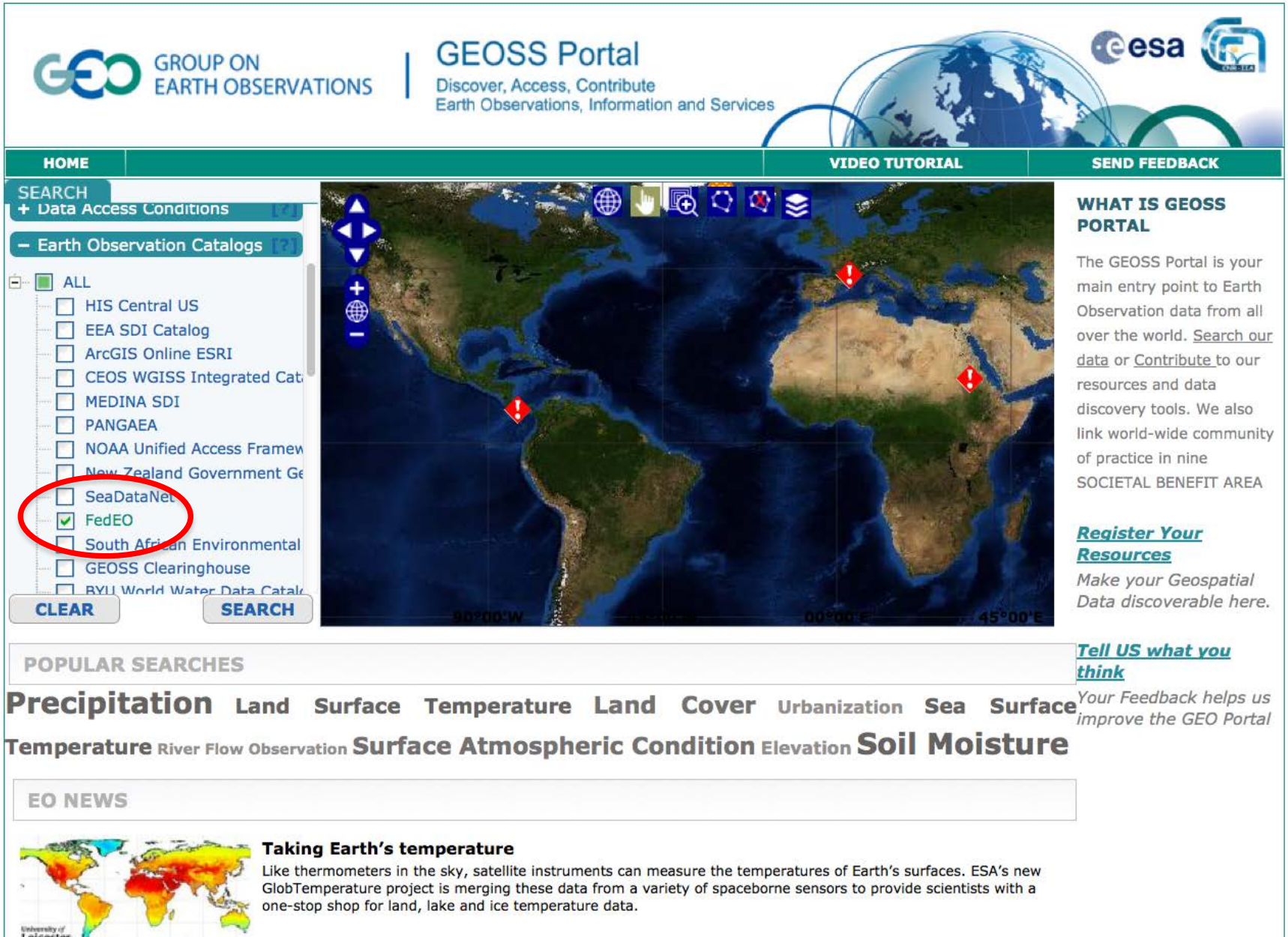
- **Ordering not supported.**

- **Project members**
  - ESA (Europe)
  - NASA (USA)
  - JAXA (Japan)
  - CNES (France)
  - NOAA (USA)

GEOSS Current Architecture



EO Collections discovery/access in GEOSS via FedEO



Athens, Greece

THANK YOU …

QUESTIONS ?

Greece's Attica region

Sentinel-1A radar image from 22 April 2014