Geoinformational Support

Geo4IRBM

for Integrated River Basins Management

esa

European Space Agency

Copernicus Programme

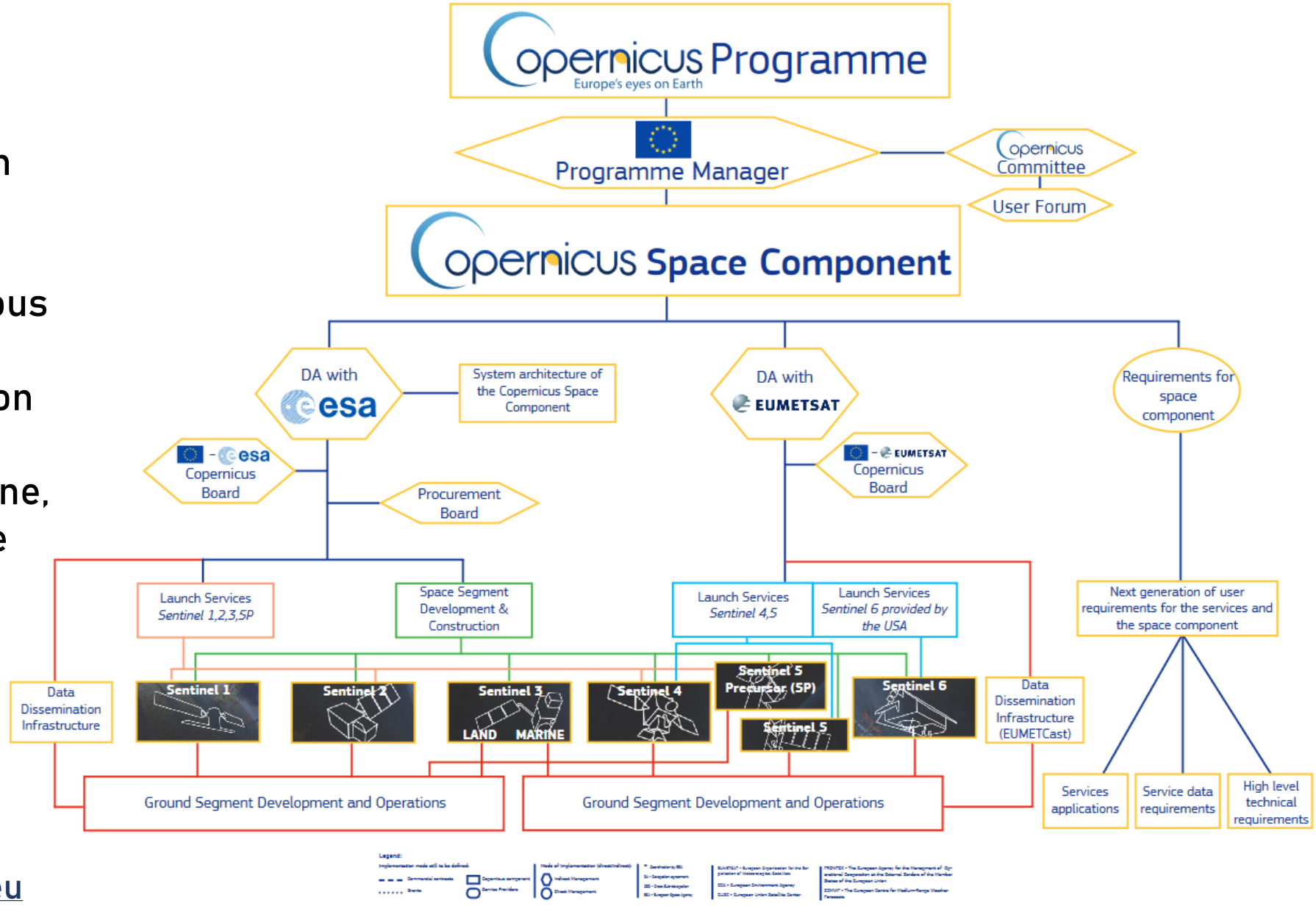
Przemysław Turos (Topologic)

Copernicus programme

The biggest Earth observation programme in the World

Global coverage and continuous data acquisition thanks to versatile satellite constellation

Open EO data, accessible online, also accordingly to innovative cloud computing paradigm



Source : https://www.copernicus.eu

Copernicus programme – Space segment: Sentinel-1 A/B

Sentinel-1 A/B

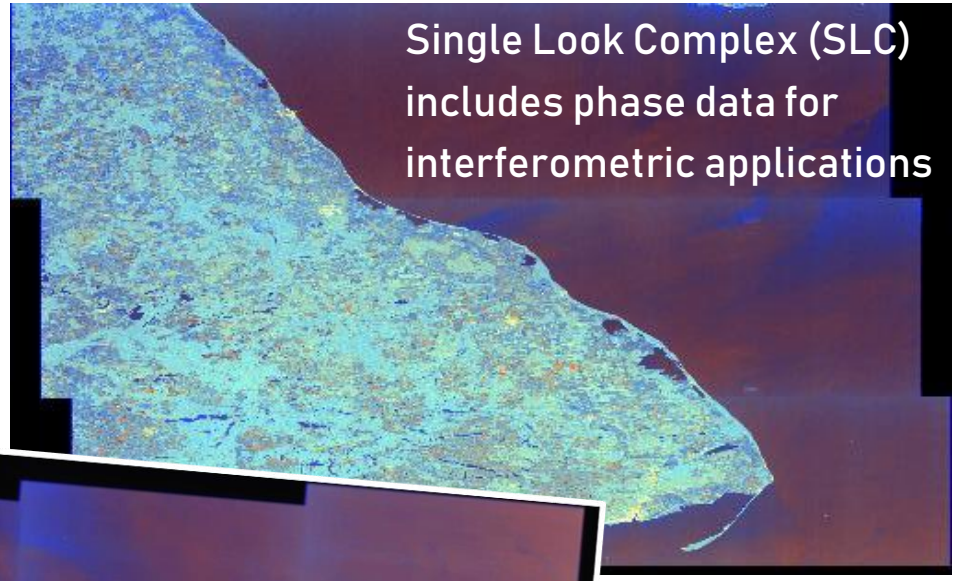
- all-weather, day-and-night supply of imagery of Earth's surface.
- C-band Synthetic Aperture Radar (SAR)
- Supports operation in dual polarisation (HH+HV, VV+VH)
- Sentinel-1A and 1B orbit 180° apart, the mission images the entire Earth every six days
- number of ground stations for rapid dissemination,
- laser to transmission data to the geostationary European Data Relay System for continual data delivery.

Applications:

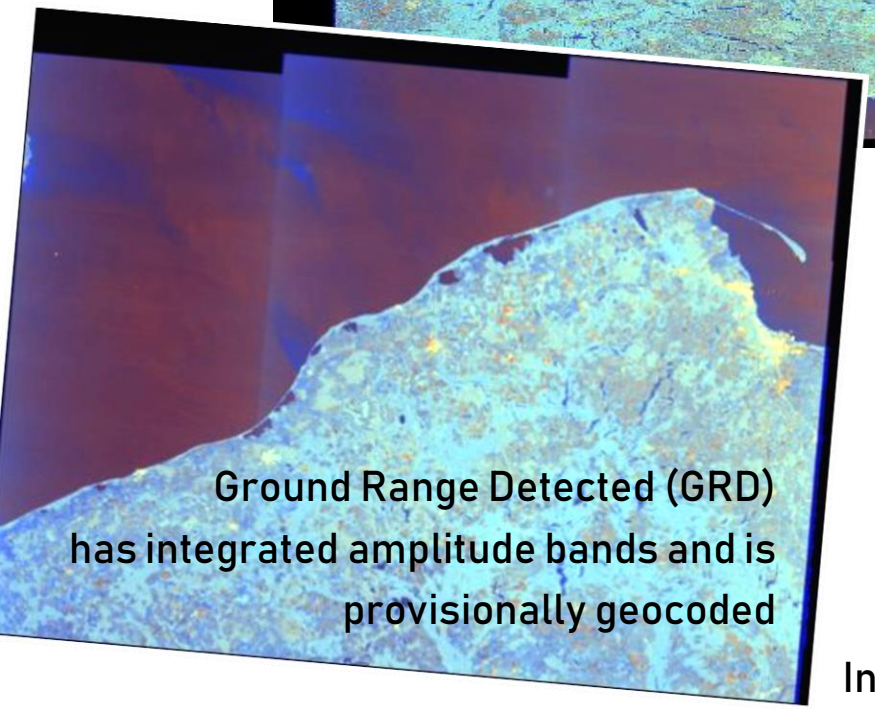
- monitoring of Arctic sea-ice extent,
- routine sea-ice mapping,
- surveillance of the marine environment, including oil-spill monitoring and ship detection for maritime security,
- monitoring land-surface for motion risks,
- mapping for forest,
- water and soil management and mapping

Source : https://sentinel.esa.int

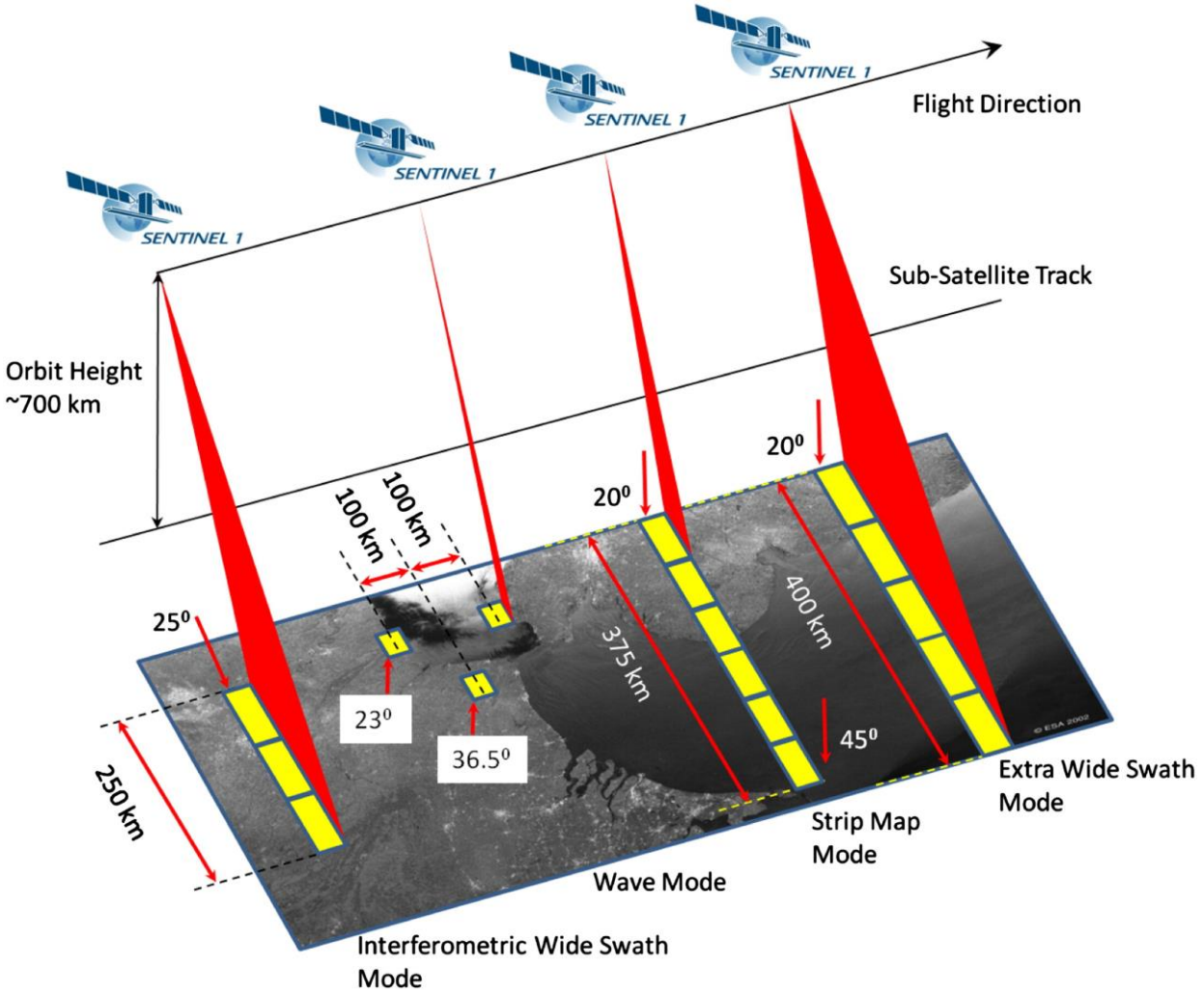
Copernicus programme – Space segment: Sentinel-1 A/B



Single Look Complex (SLC) includes phase data for interferometric applications



Ground Range Detected (GRD) has integrated amplitude bands and is provisionally geocoded



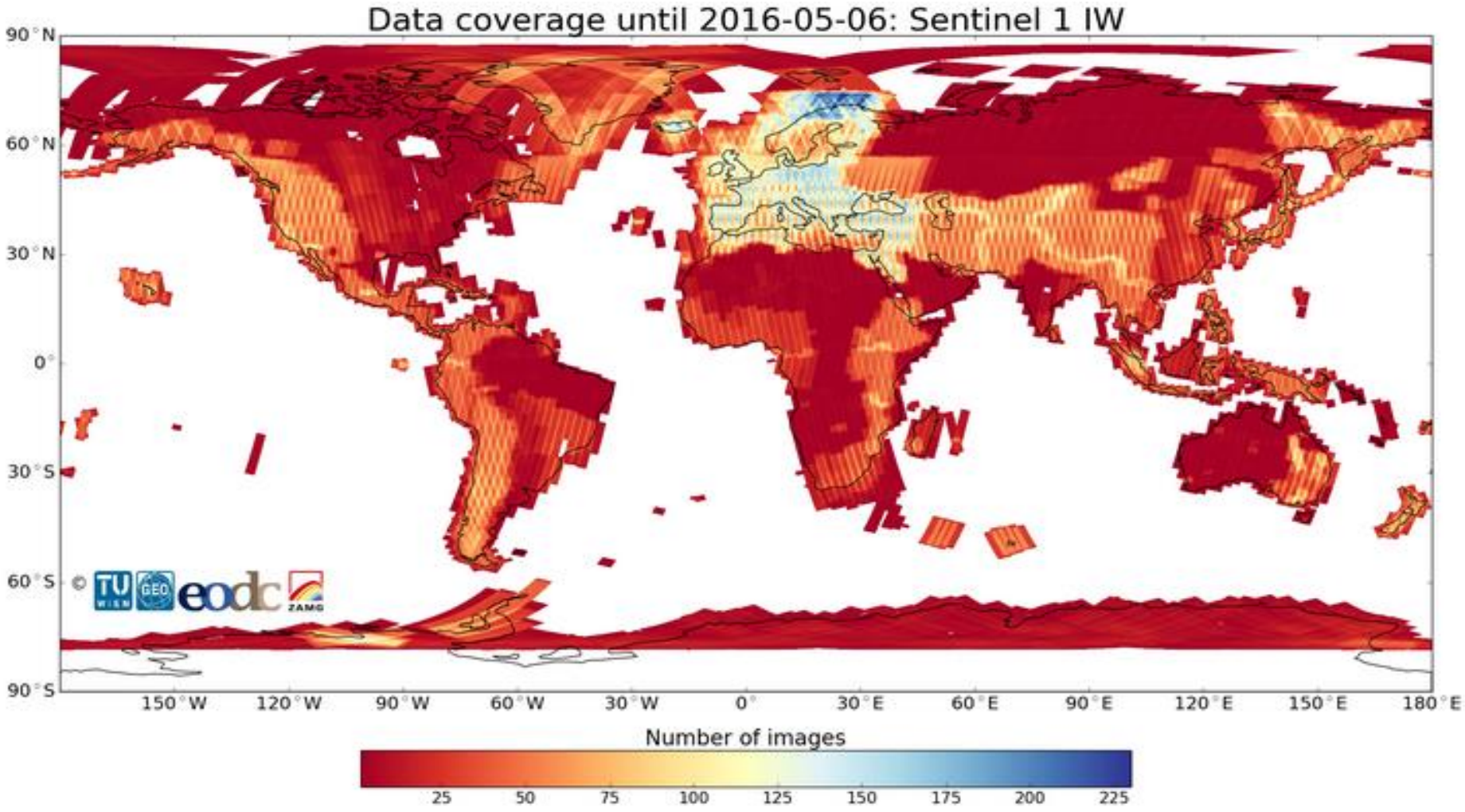
Interferometric Wide Swath (IW) data

Source : https://sentinel.esa.int

Copernicus programme – Space segment: Sentinel-1 A/B

Historical and current acquisition frequency differs between regions and between orbits. Data acquisition frequency improves over time.

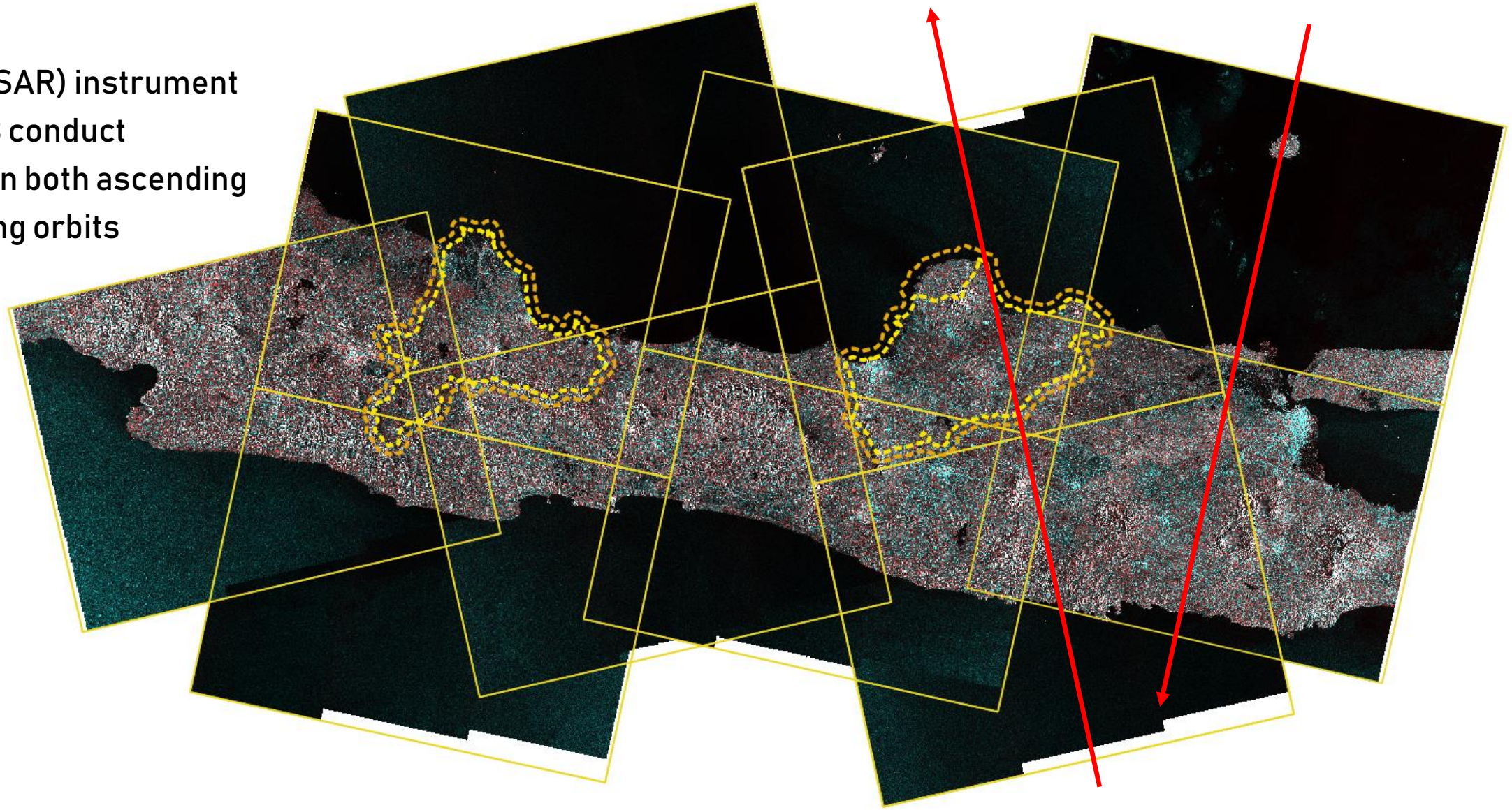
The highest frequency of observation is over Europe.



Source : https://sentinel.esa.int

Copernicus programme – Global monitoring

Using active (SAR) instrument Sentinel-1A/B conduct acquisitions on both ascending and descending orbits



Copernicus programme – Space segment: Sentinel-2 A/B

sentinel-2

Sentinel-2 A/B

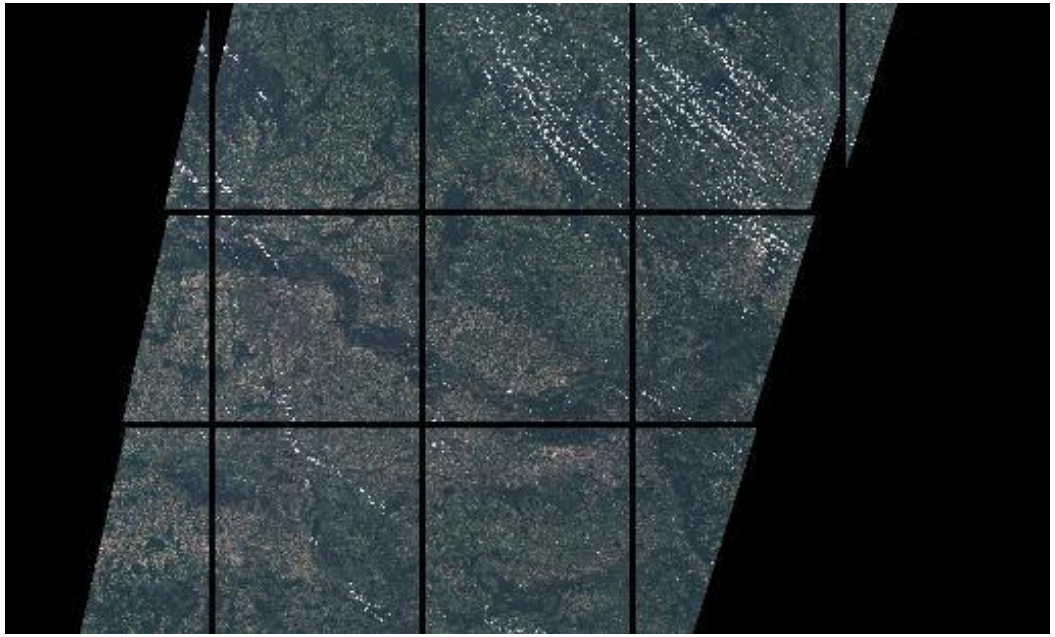
- wide swath high-resolution multispectral imager with 13 spectral bands
- combination of high resolution, novel spectral capabilities
- swath width of 290 km and frequent revisit times
- Sentinel-2A and 2B orbiting 180° apart, the mission images five days at the equator

Applications:

- provide information for agricultural and forestry practices and for helping manage food security.
- determine various plant indices such as leaf area chlorophyll and water content indexes.
- yield prediction and applications related to Earth's vegetation as well as monitoring plant growth
- map changes in land cover and to monitor the world's forests.
- provide information on pollution in lakes and coastal waters
- images of floods, volcanic eruptions and landslides contribute to disaster mapping and help humanitarian relief efforts

Source : https://sentinel.esa.int

Copernicus programme – Space segment : Sentinel-2 A/B



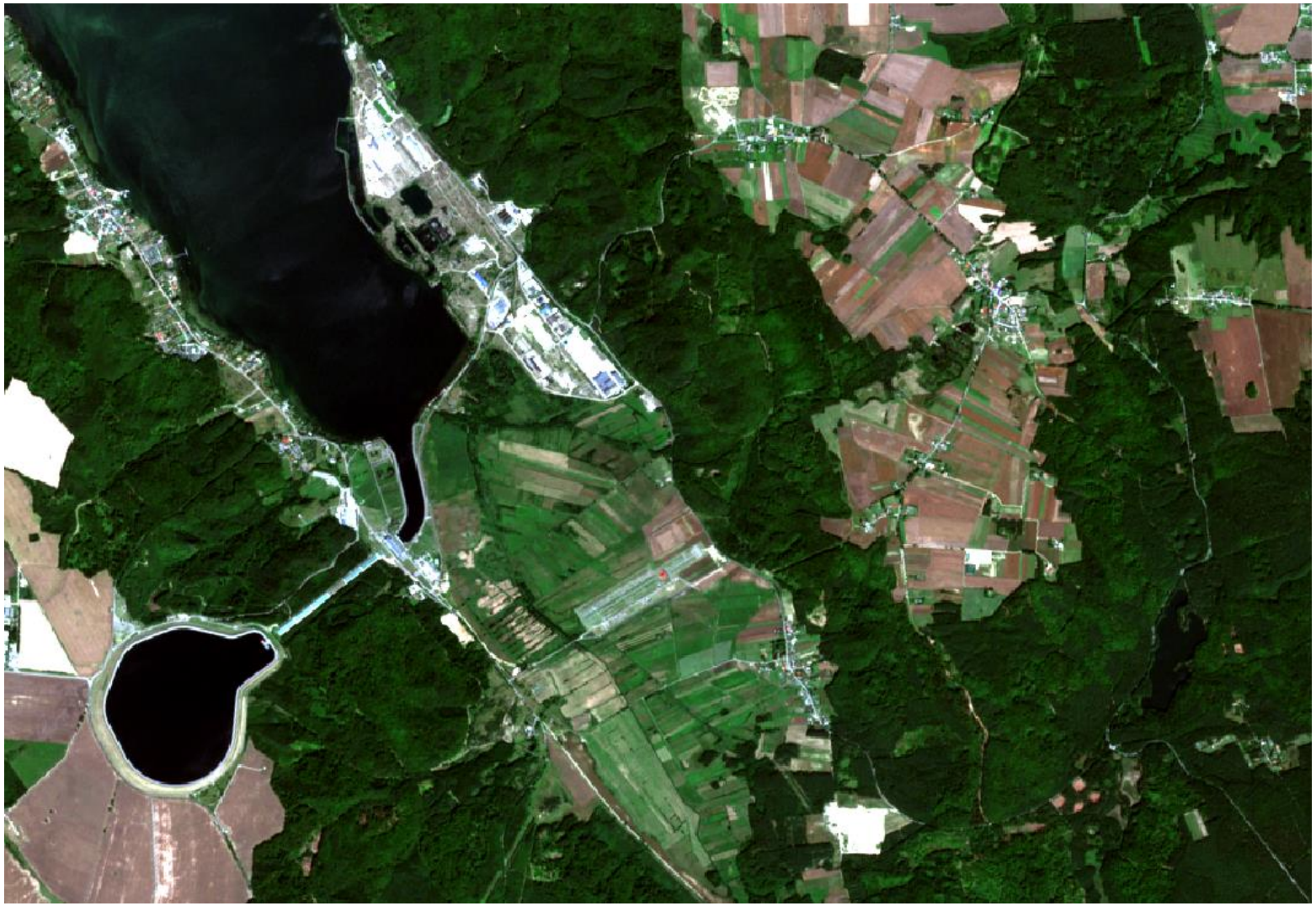
Sentinel-2 MSI data are accessible as orthoimageries in tiles 100x100km.

Band Number	Resolution	Central wavelength (nm)	Bandwidth (nm)	Description
2	10m	490	65	Blue
3		560	35	Green
4		665	30	Red
8		842	115	NIR
5	20m	705	15	Vegetation Red Edge
6		740	15	Vegetation Red Edge
7		783	20	Vegetation Red Edge
8b		865	20	Vegetation Red Edge
11		1610	90	SWIR
12		2190	180	SWIR
1	60m	443	20	Coastal aerosol
9		945	20	Water vapour
10		1375	30	SWIR - Cirrus

Source : https://sentinel.esa.int

Copernicus programme – Space segment : Sentinel-2 A/B

RGB composition of 10m spatial resolution Sentinel-2A bands: B8 (842 nm), B3 (560 nm), B2 (490 nm) (August 3rd 2015, Żarnowiec, Poland).



Copernicus programme – Space segment : Sentinel-2 A/B

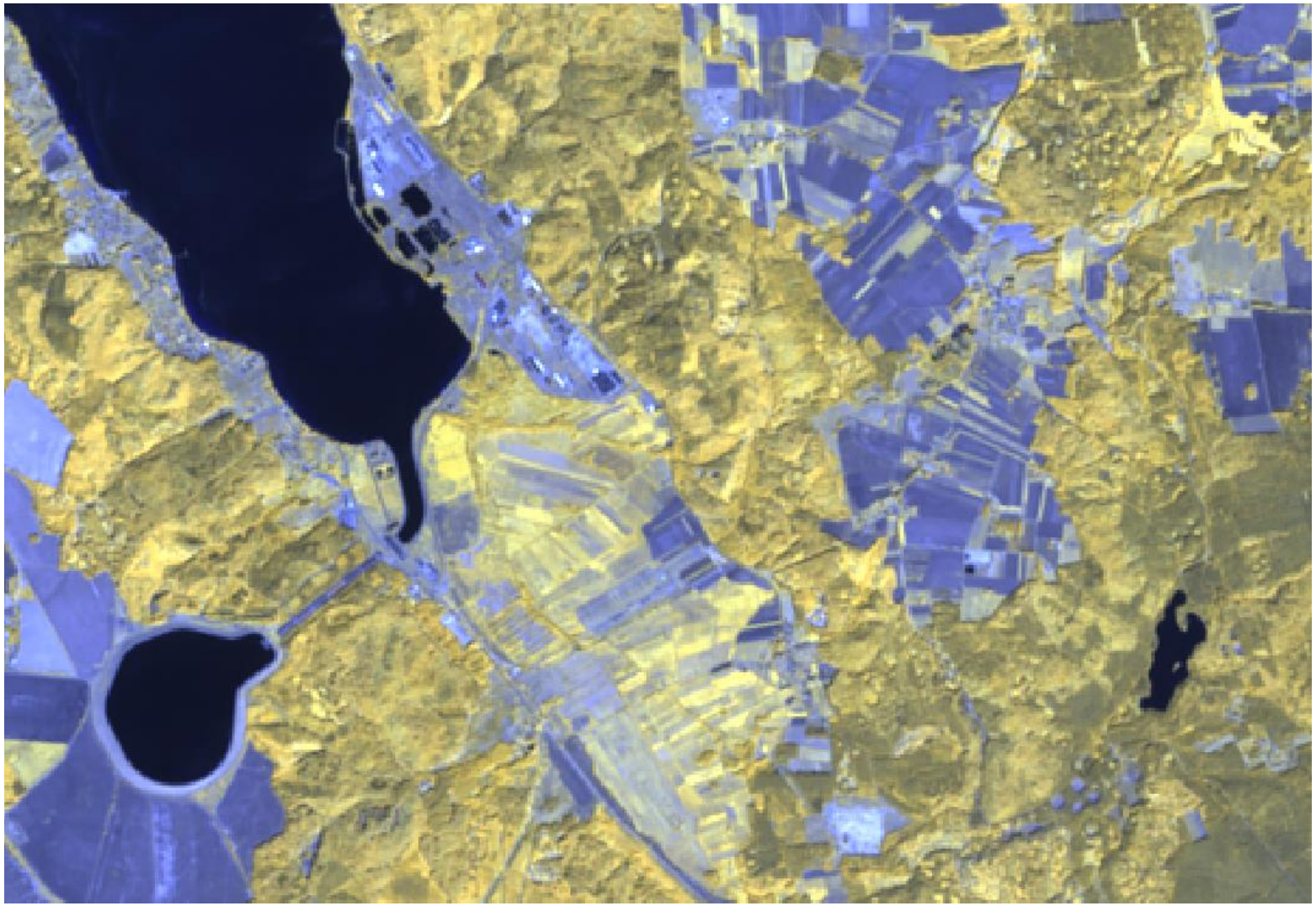
RGB composition of 10m spatial resolution Sentinel-2A bands: B4 (665 nm), B3 (560 nm), B2 (490 nm) (August 3rd 2015, Żarnowiec, Poland).

Copernicus programme – Space segment : Sentinel-2 A/B

RGB composition of 20m spatial resolution Sentinel-2A bands: B8b (865 nm), B11 (1610 nm) and B12 (2190 nm) (August 3rd 2015, Żarnowiec, Poland).

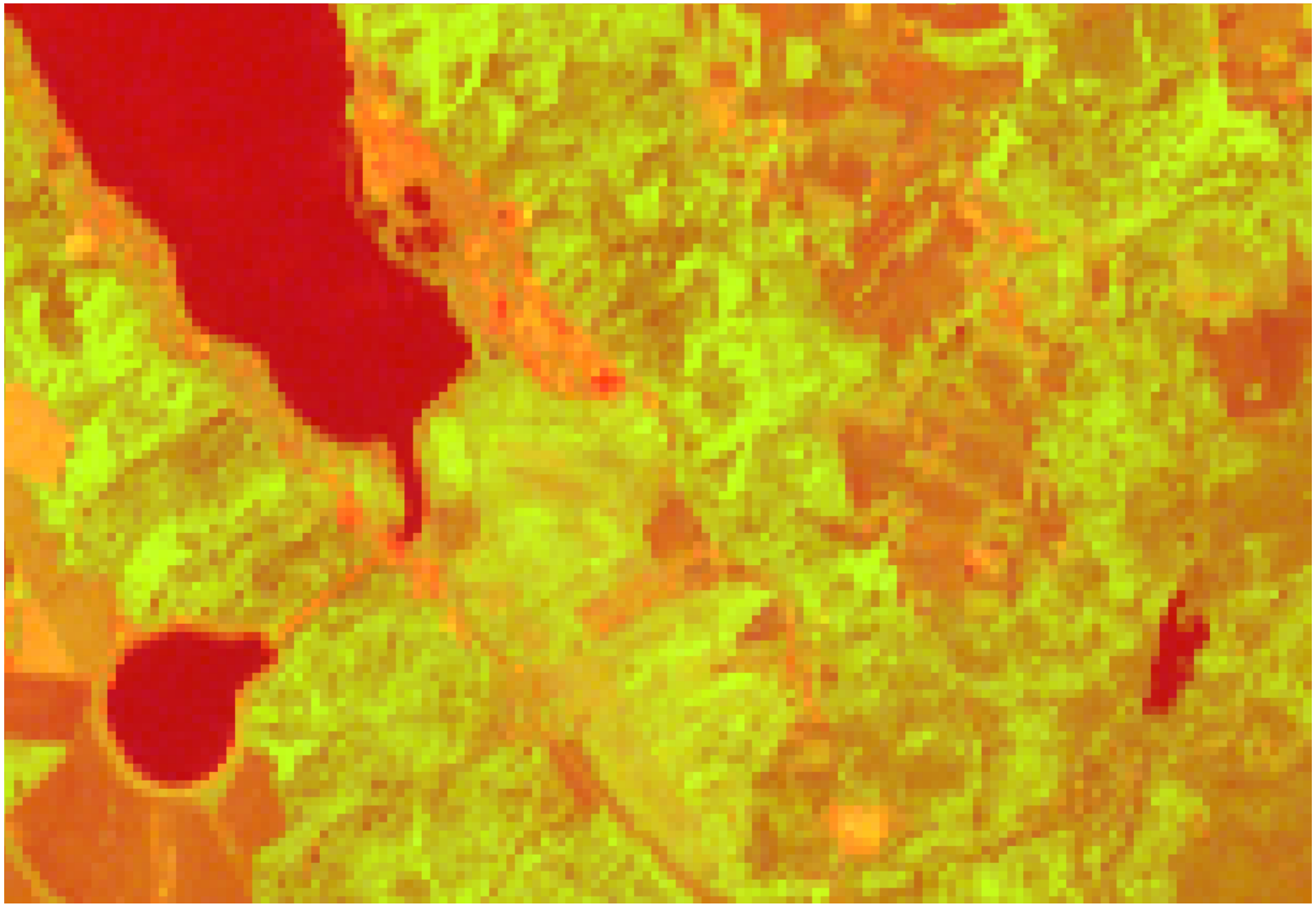
Copernicus programme – Space segment : Sentinel-2 A/B

RGB composition of 20m spatial resolution Sentinel-2A bands: B7 (783 nm), B6 (740 nm), B5 (705 nm) (August 3rd 2015, Żarnowiec, Poland).



Copernicus programme – Space segment : Sentinel-2 A/B

RGB composition of 60m spatial resolution Sentinel-2A bands: B1 (443 nm), B9 (940 nm) and B10 (1375 nm) (August 3rd 2015, Żarnowiec, Poland).



Copernicus programme – Space segment: Sentinel-3 A/B

Sentinel-3 A/B

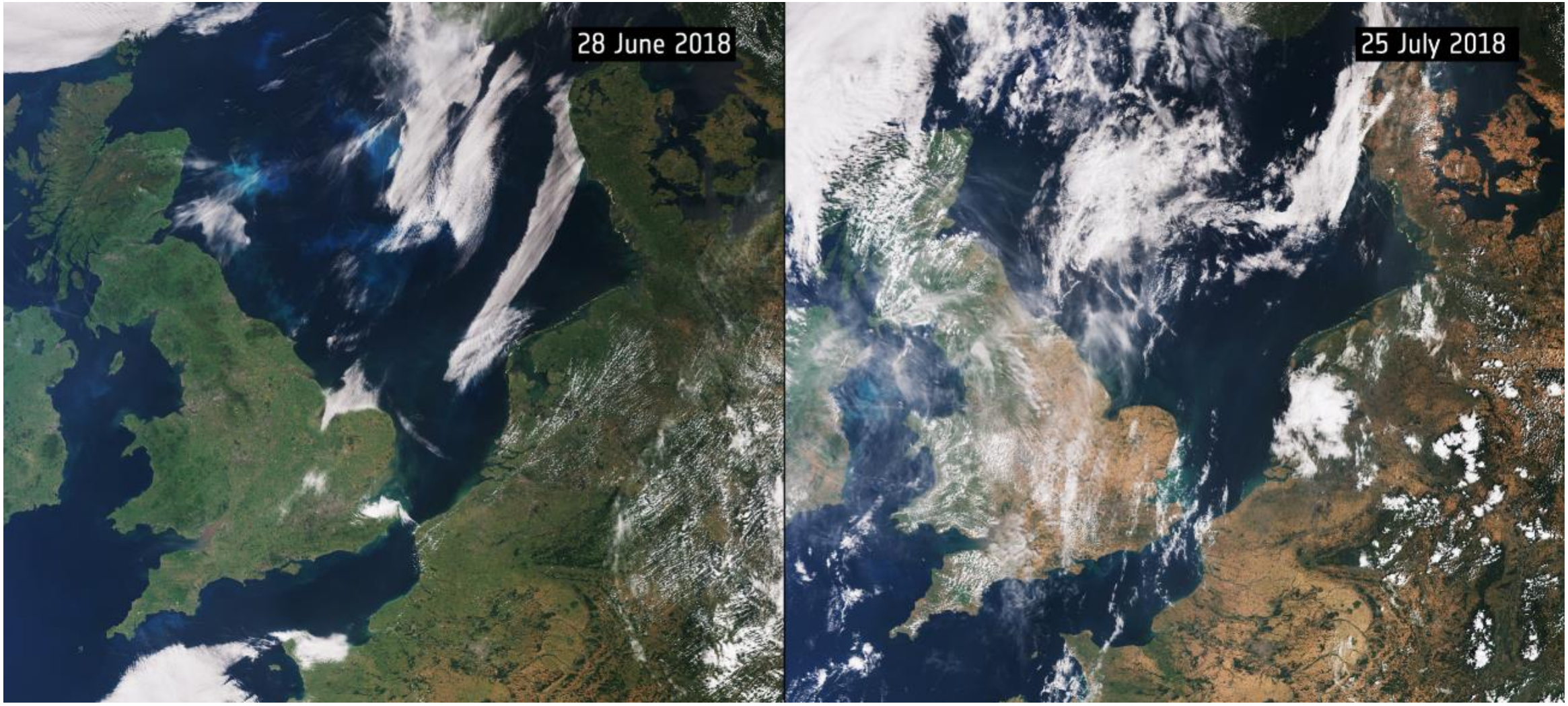
- operated by ESA and EUMETSAT to deliver operational ocean and land observation service
- carries four main instruments:
  - OLCI: Ocean and Land Colour Instrument
  - SLSTR: Sea and Land Surface Temperature Instrument
  - SRAL: SAR Radar Altimeter
  - MWR: Microwave Radiometer.

Applications:

- provides continuity of an ENVISAT-type ocean measurement capability with consistent quality, very high level of availability (>95%), high accuracy and reliability, and in a sustained operational manner including:
- ocean, inland sea and coastal zone colour measurements to at least the level of quality of the MERIS instrument on ENVISAT
- sea surface temperature measurements to at least the level of quality of the AATSR instrument on ENVISAT
- sea surface topography measurements to at least the level of quality of the ENVISAT altimetry system, including an along track SAR capability of CRYOSAT heritage for improved measurement quality in coastal zones and over sea-ice.

Source : https://sentinel.esa.int

Copernicus programme – Space segment: Sentinel-3 A/B



Source : https://sentinel.esa.int

Copernicus programme – Space segment: Sentinel-3 A/B

Level-2 Land products

Variables	Description	Units	Input Bands
OLCI Global Vegetation Index (OGVI)	Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) in the plant canopy	dimensionless	Oa03, Oa10, Oa17
OLCI Terrestrial Chlorophyll Index (OTCI)	Estimates of the Chlorophyll content in terrestrial vegetation, aims at monitoring vegetation condition and health	dimensionless	-
Integrated Water Vapour (IWV)	Total amount of water vapour integrated over an atmosphere column	$kg.m^{-2}$	Oa18, Oa19
RC681 and RC865 5	By-products of the OGVI, the so-called red and NIR rectified reflectances are virtual reflectance largely decontaminated from atmospheric and angular effects, and good proxy to Top of Canopy reflectances.	dimensionless	Oa1

Source : https://sentinel.esa.int

Copernicus programme – Space segment: Sentinel-5P

Sentinel-5P

- The first Copernicus mission dedicated to monitoring our atmosphere
- Carrying the TROPOspheric Monitoring Instrument (TROPOMI) instrument

Applications:

- The Copernicus Sentinel-5 Precursor mission reduces gaps in the availability of global atmospheric data products between SCIAMACHY/Envisat (which ended in April 2012), the OMI/AURA mission and the future Copernicus Sentinel-4 and Sentinel-5 missions.
- perform atmospheric measurements with high spatio-temporal resolution, to be used for air quality, ozone & UV radiation, and climate monitoring & forecasting

Copernicus Sentinel-5 Precursor products are Copernicus services such as the 'Copernicus Atmosphere Monitoring Service' (CAMS) or the 'Copernicus Climate Change Service' (C3S). Decision makers will use the information provided by these services in order to take the right actions on environmental policies from which depends the well-being and security of citizens and future generations.

Source : https://sentinel.esa.int

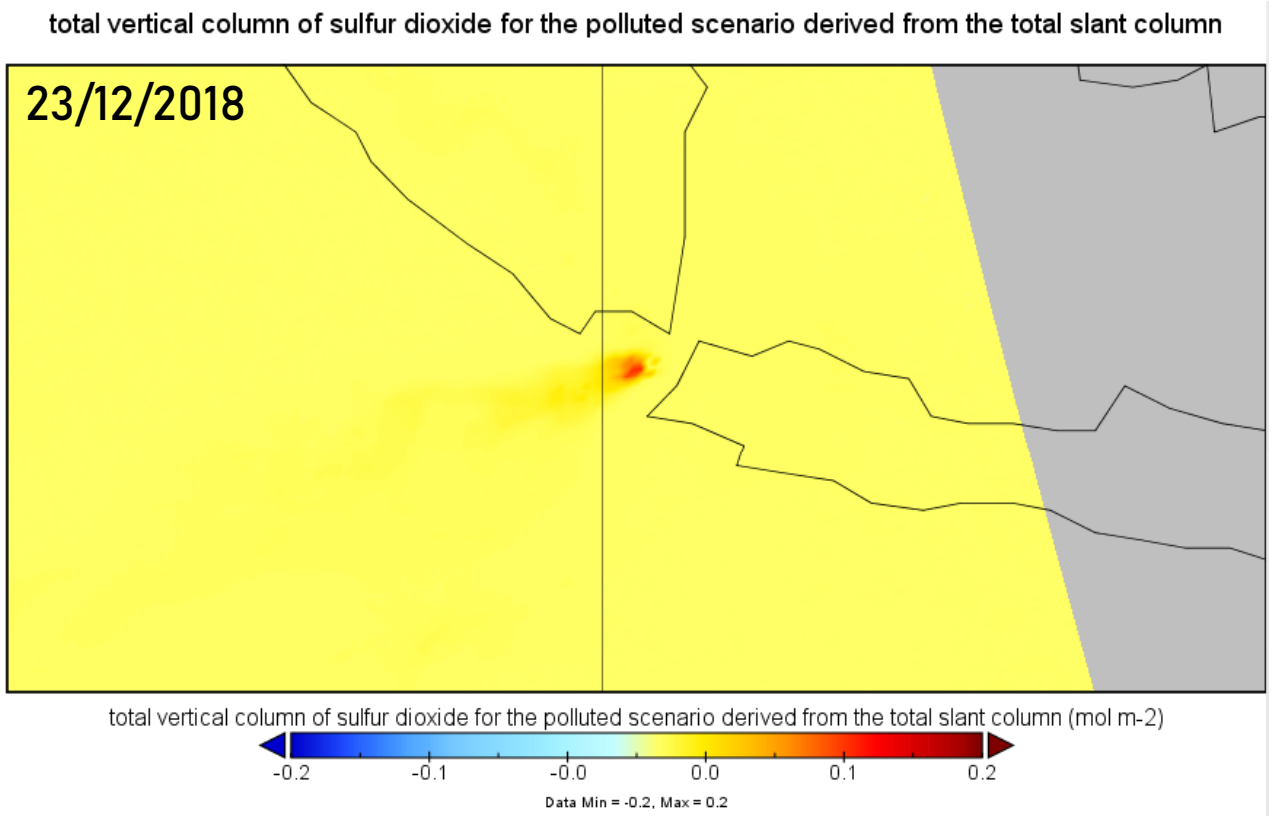
Copernicus programme – Space segment: Sentinel-5P

Level-1B products are:

- geo-located and radiometrically corrected top of the atmosphere Earth radiances in all spectral bands, as well as solar irradiances

Level-2 products are:

- geolocated total columns of ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, formaldehyde and methane
- geolocated tropospheric columns of ozone
- geolocated vertical profiles of ozone
- geolocated cloud and aerosol information (e.g. absorbing aerosol index and aerosol layer height)

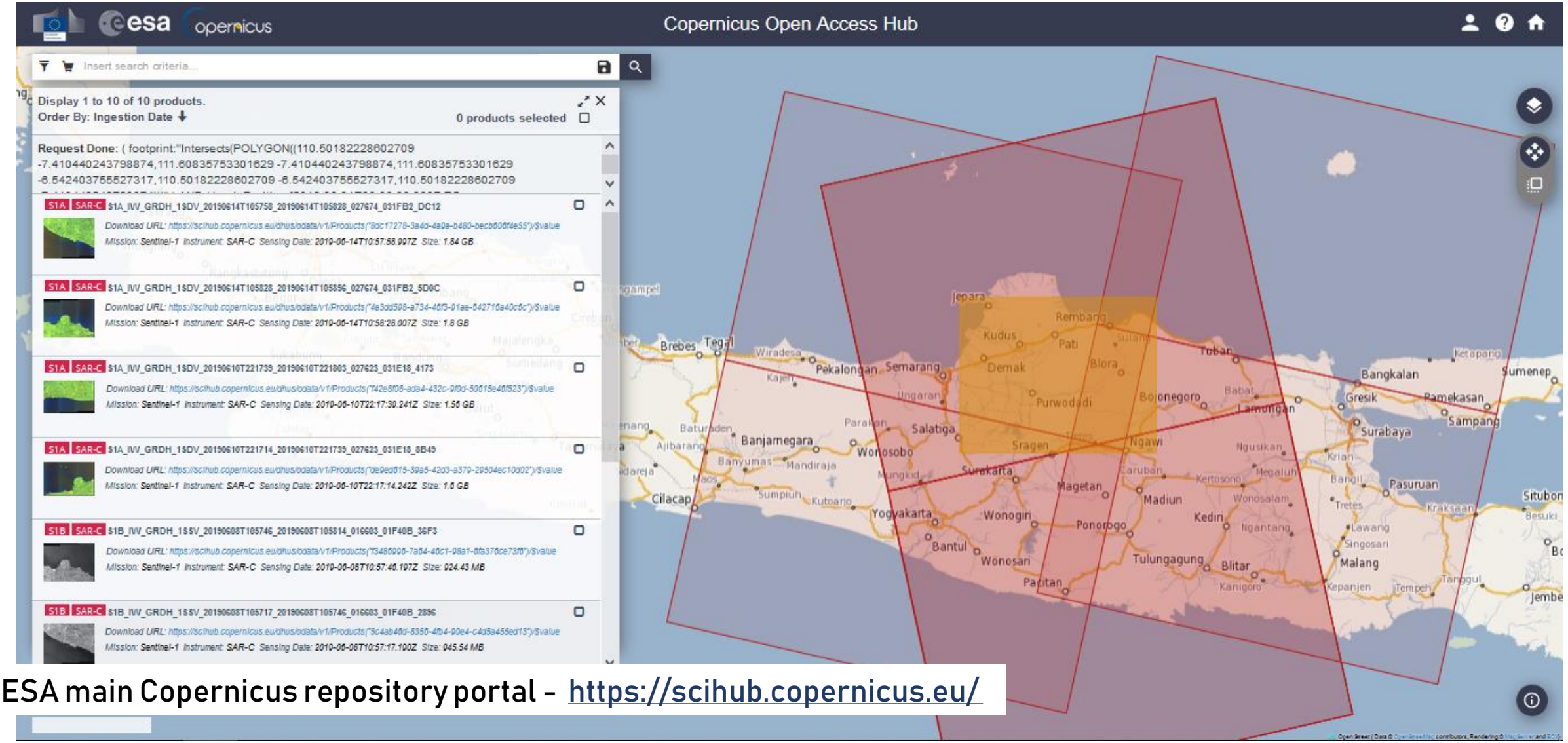


Source : https://sentinel.esa.int

Copernicus programme – Data access and exploitation

ESA main Copernicus repository portal – https://scihub.copernicus.eu/

Copernicus programme – Data access and exploitation



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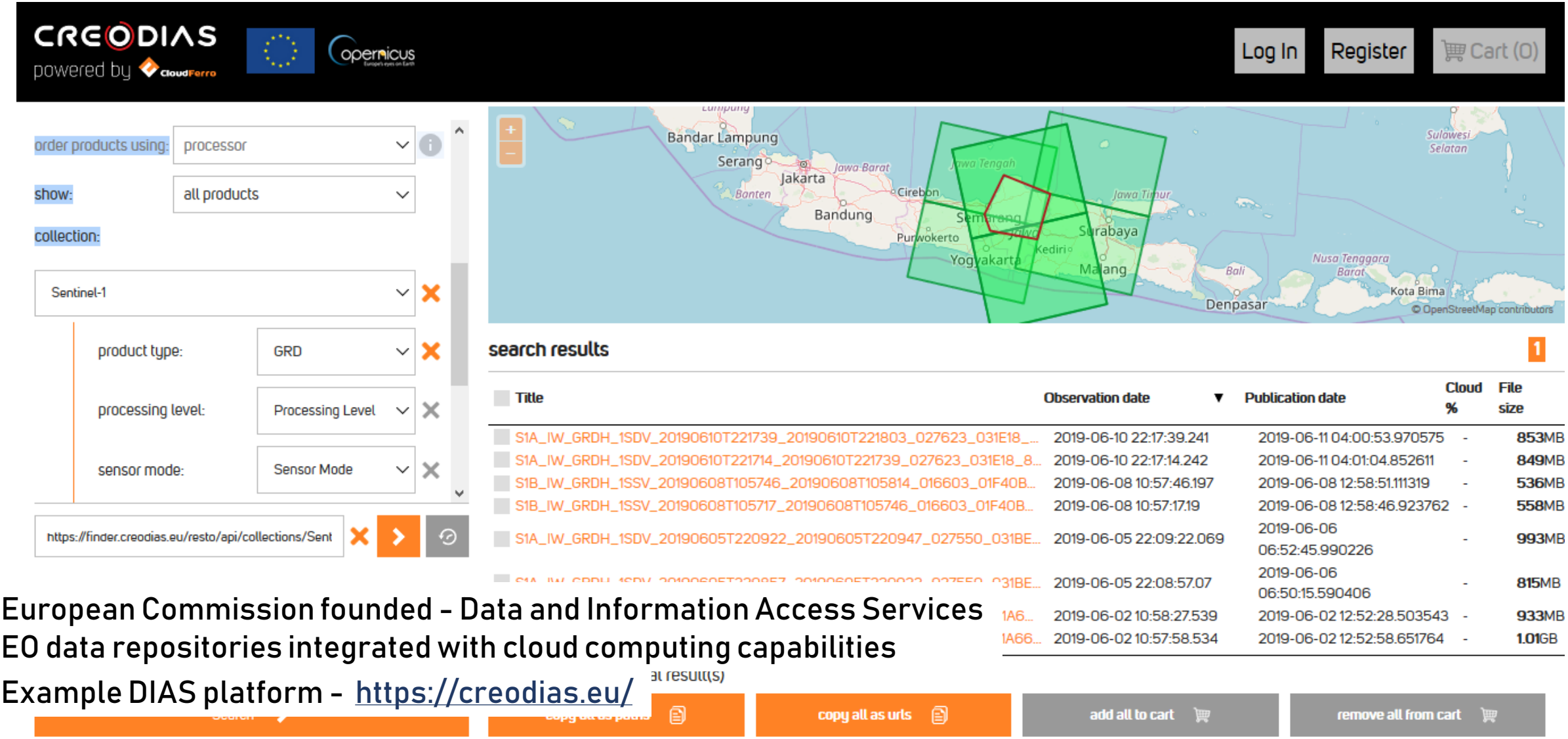
Copernicus programme – Data access and exploitation



European Commission founded - Data and Information Access Services
EO data repositories integrated with cloud computing capabilities
Example DIAS platform - https://creodias.eu/

Copernicus programme – Data access and exploitation

Figure 1 - VM Flavours

eo1	vCore	RAM	local SSD
eo1.xsmall	1	1	8
eo1.small	2	2	16
eo1.xmedium	1	2	8
eo1.medium	2	4	16
eo1.large	4	8	32
eo2			
eo2.medium	1	4	16
eo2.large	2	8	32
eo2.xlarge	4	16	64
eo2.2xlarge	8	32	128
hm			
hm.medium	2	16	64
hm.large	4	32	128
			256
			384
	cores)	54	2 x 500
ds.large	40 (20 cores)	118	2x 1000
ds.large.gpu*	40 (20 cores)	118	2x 1000

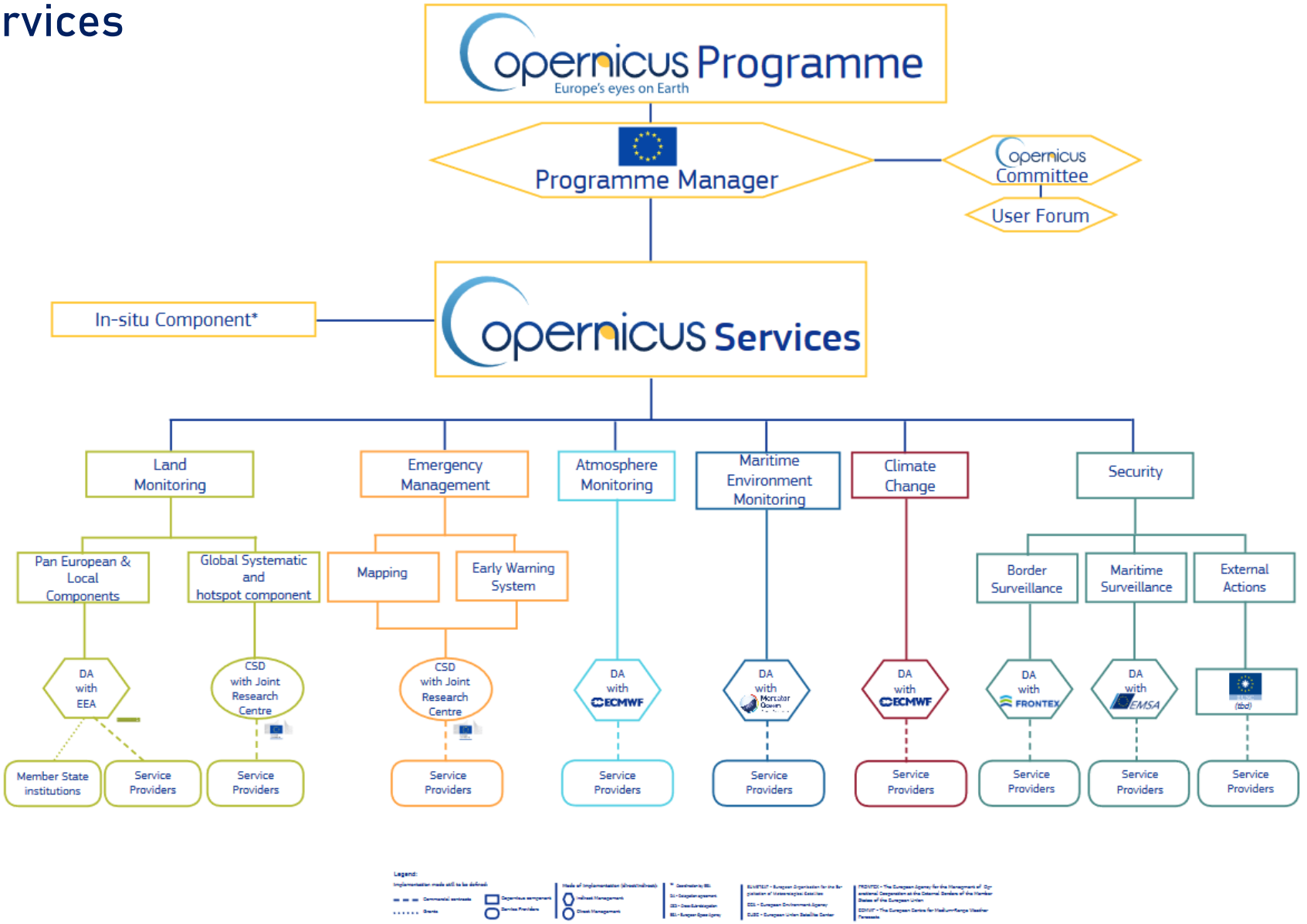
European Commission founded - Data and Information Access Services
EO data repositories integrated with cloud computing capabilities
Example DIAS platform - https://creodias.eu/

Copernicus programme – Services

Address the most important European and global issues like climate change monitoring, environmental resources and citizens safety

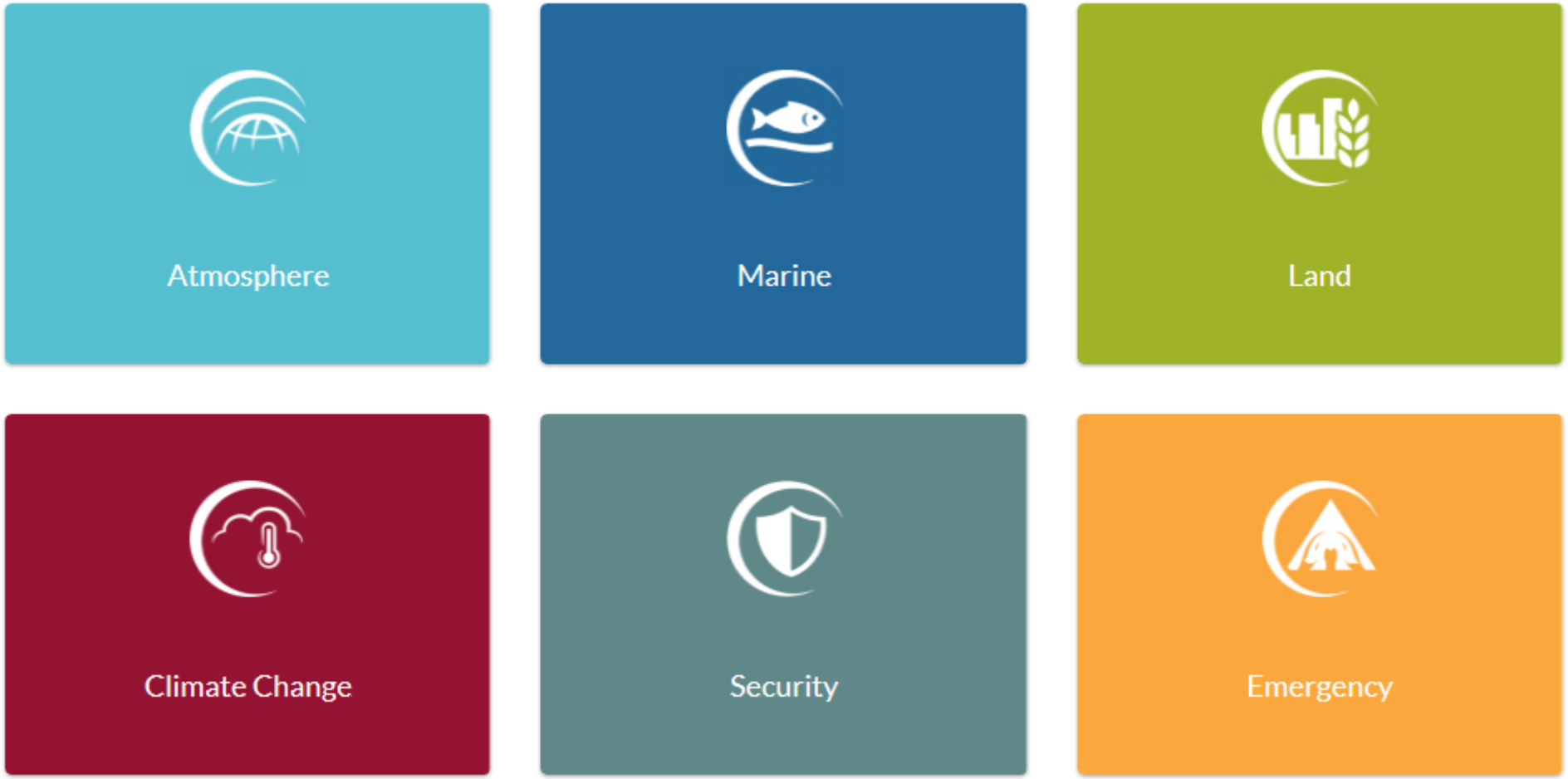
Design to support European administration, international institutions and local end-users

Generated by service providers from science and industry



Source : https://www.copernicus.eu

Copernicus programme – EO data and Geoinformational services



Source : https://www.copernicus.eu

Copernicus programme – EO data and Geoinformational services

Copernicus Emergency Management Service

The Copernicus Emergency Management Service (Copernicus EMS) provides all actors involved in the management of natural disasters, man-made emergency situations, and humanitarian crises with timely and accurate geo-spatial information derived from satellite remote sensing and completed by available in situ or open data sources.
The Copernicus EMS consists of two components:

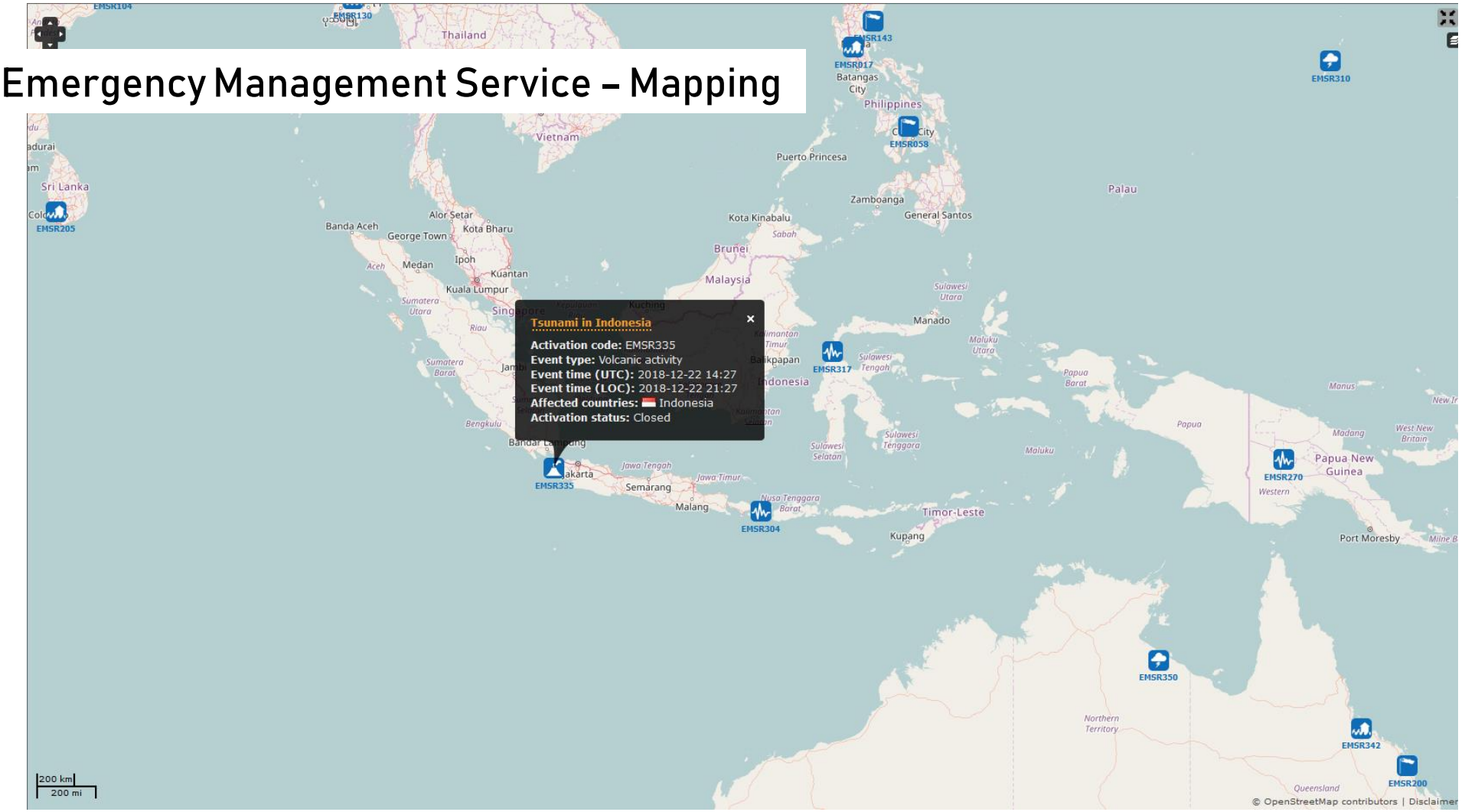
1. a mapping component;
2. an early warning component.

The mapping component of the service (Copernicus EMS - Mapping) has a worldwide coverage and provides the above-mentioned actors (mainly Civil Protection Authorities and Humanitarian Aid Agencies) with maps based on satellite imagery. The service has been fully operational since 1st April 2012 and it is implemented by the European Commission DG Joint Research Centre (JRC).

Source : https://www.copernicus.eu

Copernicus programme – EO data and Geoinformational services

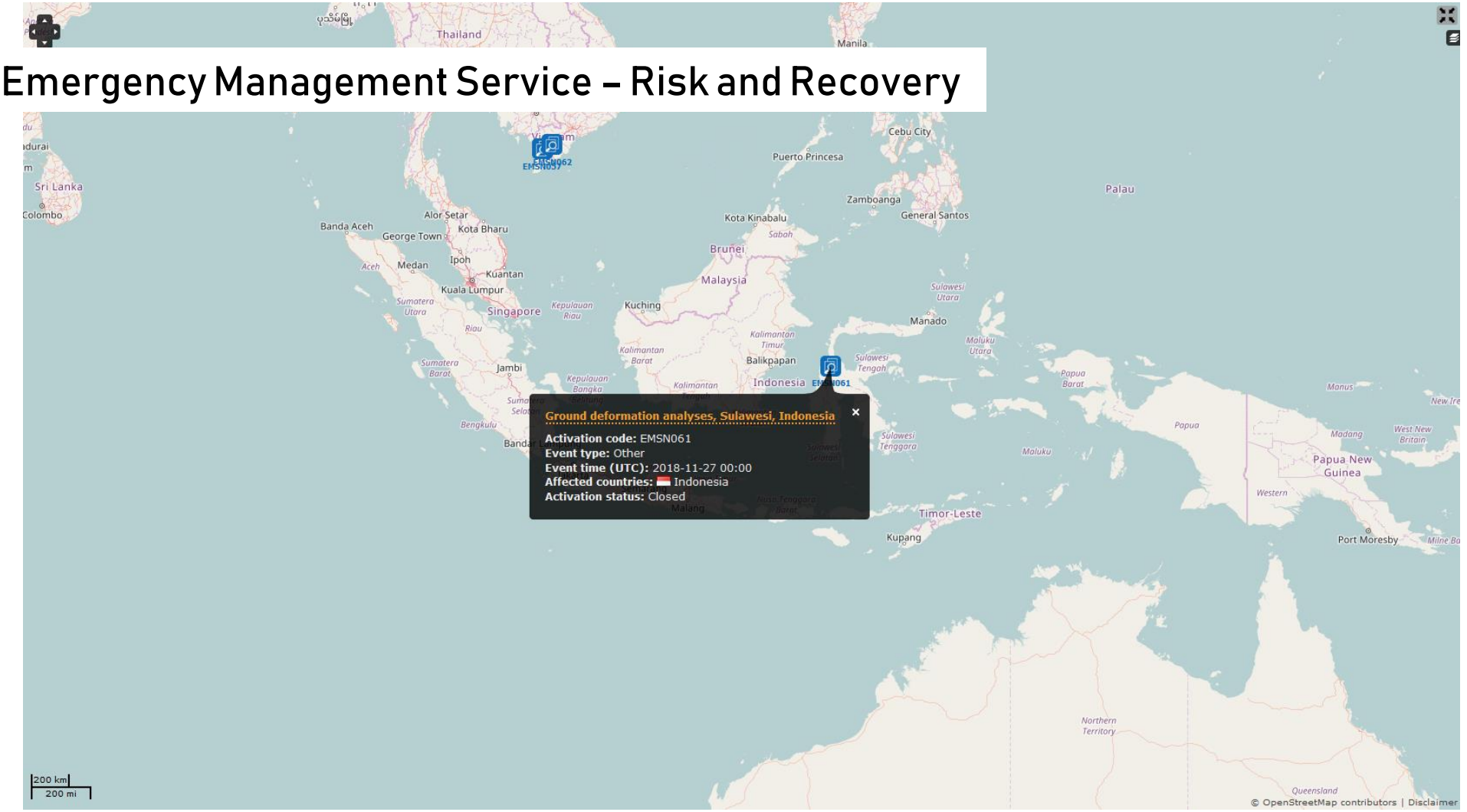
Copernicus Emergency Management Service – Mapping



Source : https://www.copernicus.eu

Copernicus programme – EO data and Geoinformational services

Copernicus Emergency Management Service – Risk and Recovery



Source : https://www.copernicus.eu

Copernicus programme – EO data and Geoinformational services

Copernicus Land Monitoring Service (LMS)

The systematic monitoring of biophysical parameters produces mainly a series of qualified bio-geophysical products on the status and evolution of the land surface. This is produced at a global scale every ten days with a mid spatial resolution and is complemented by a long term time series. The products are used to monitor vegetation, crops, water cycle, energy budget and terrestrial cryosphere variables.
Land cover and land use mapping produces land cover classifications at various level of detail, both within a pan-European and global context. At the pan-European level, these are complemented by detailed layers on land cover characteristics, such as imperviousness, forests, grassland, water and wetness and small woody features.
Thematic hot-spot mapping aims to provide tailored and more detailed information on specific areas of interest, known as hot-spots.
Imagery and reference data provide satellite image mosaic in high and very high resolutions and reference datasets.
In addition to the above-mentioned components, a new European Ground Motion activity is being set up. The activity will measure ground displacements, including landslides and subsidence, as well as deformation of infrastructure.

Source : https://www.copernicus.eu

Copernicus programme – EO data and Geoinformational services

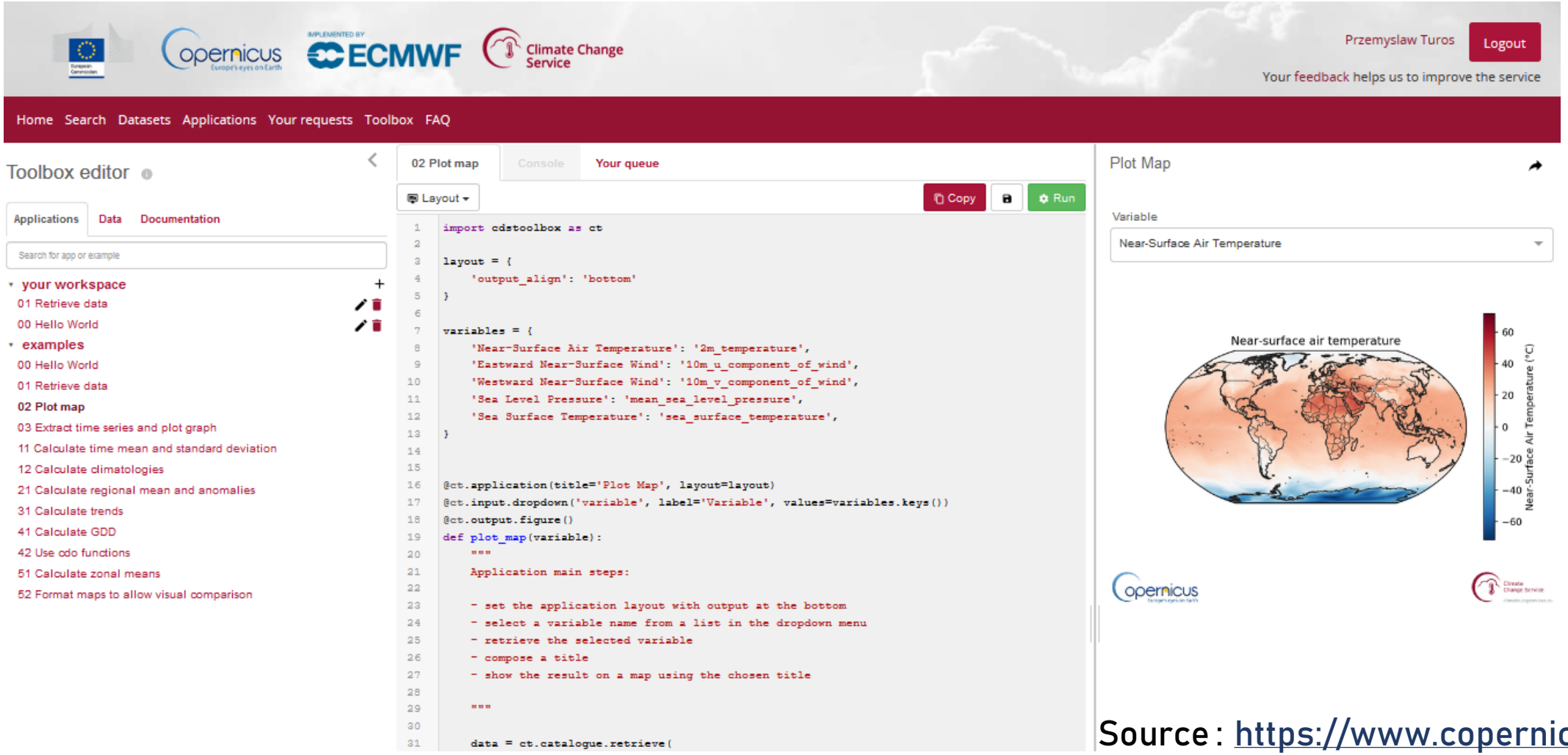
Copernicus Land Monitoring Service (LMS)

Theme	Variable	Spatial Resolution	
		Coarse >=1km	Medium 300m
Vegetation	Fraction of photosynthetically active radiation absorbed by the vegetation	In production	In production
	Fraction of green vegetation cover	In production	In production
	Leaf Area index	In production	In production
	Normalized Difference Vegetation Index	In production	In production
	Vegetation Condition Index	In production	
	Vegetation Productivity Index	In production	
	Dry Matter Productivity	In production	In production
	Burnt Area	In production	In production
	Soil Water Index	In production	
	Surface Soil Moisture	In production	
Energy	Land Surface Temperature	In production	
	Top Of Canopy Reflectance	In production	
	Surface Albedo	In production	
Water	Water Bodies	In production	In production
	Lake Surface Water Temperature	In production	
	Lake Water Quality	In production	
Cryosphere	Lake Ice Extent	In production	
	Snow Cover Extent	In production	
	Snow Water Equivalent	In production	

Source : https://www.copernicus.eu

Copernicus programme – EO data and Geoinformational services

Copernicus Climate Change Service (C3S)



Source : https://www.copernicus.eu