

Geoinformational Support

Geo4IRBM

for Integrated River Basins Management



European Space Agency

A grayscale topographic map of a river basin. The map shows a dense network of rivers and streams, with a prominent river flowing from the upper right towards the lower left. The terrain is rugged, with many small tributaries and a complex drainage pattern. A coastal area is visible on the left side of the map.

Copernicus Programme

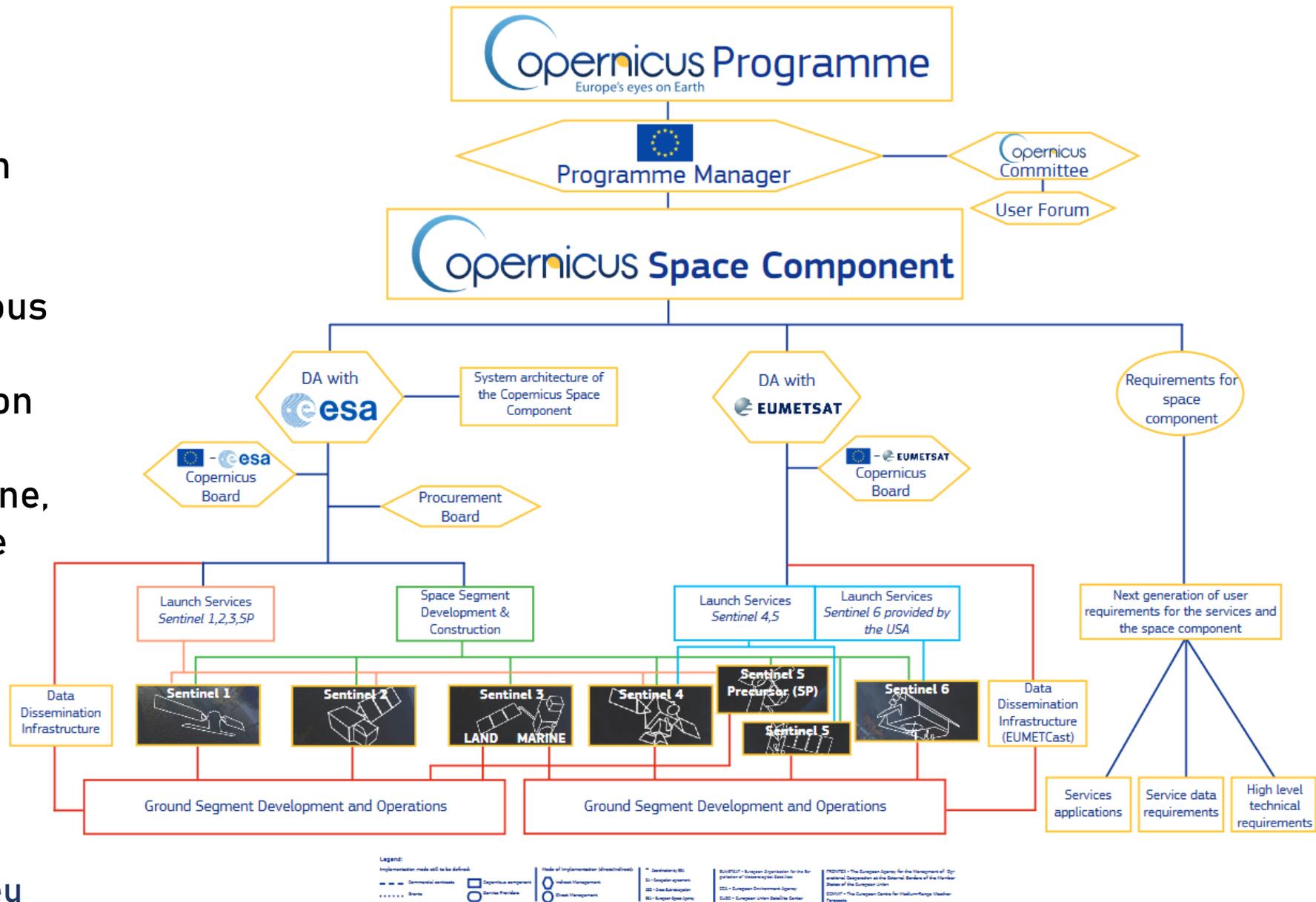
Przemysław Turowski (Topologic)

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



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

Sentinel-1 A/B

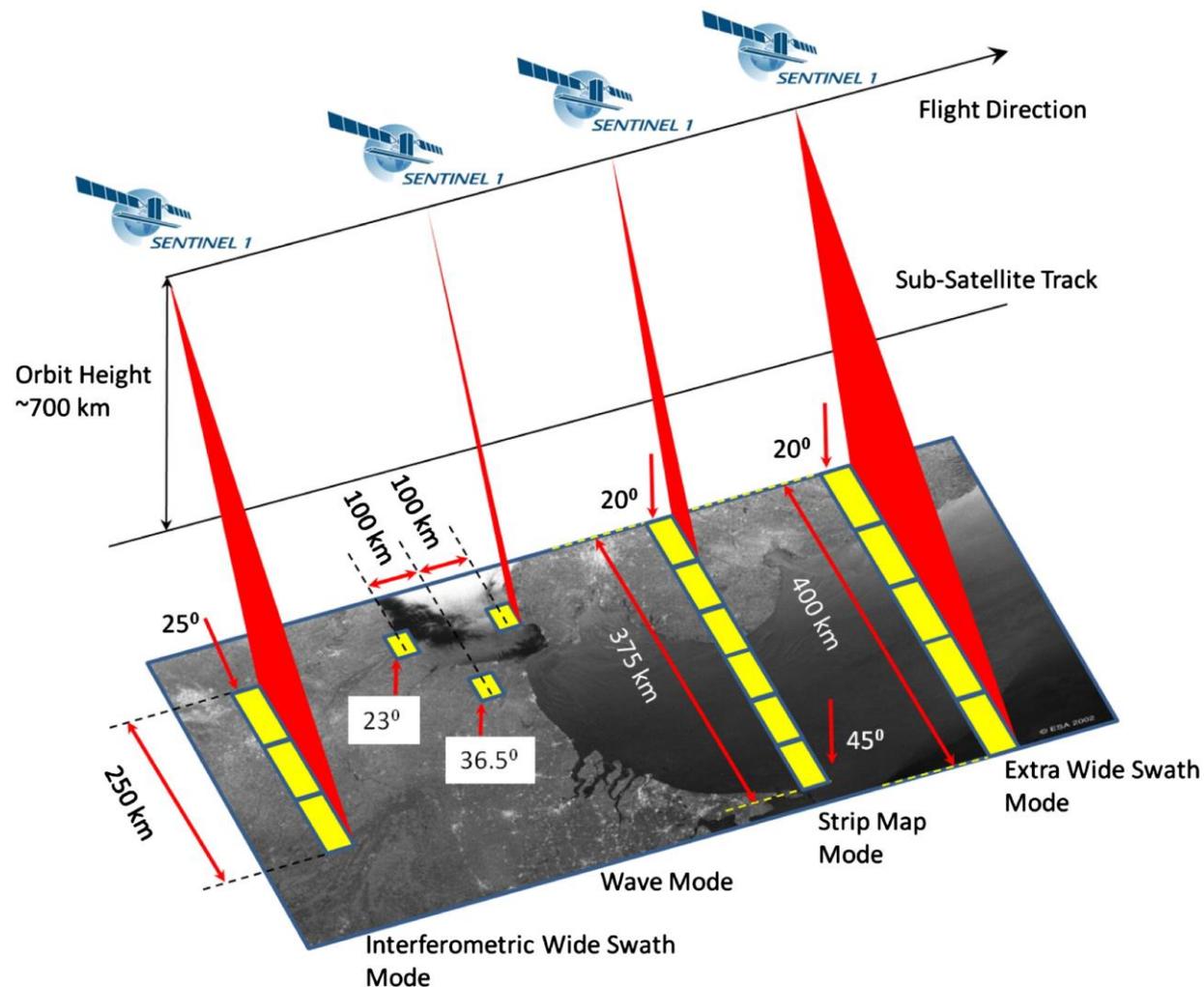
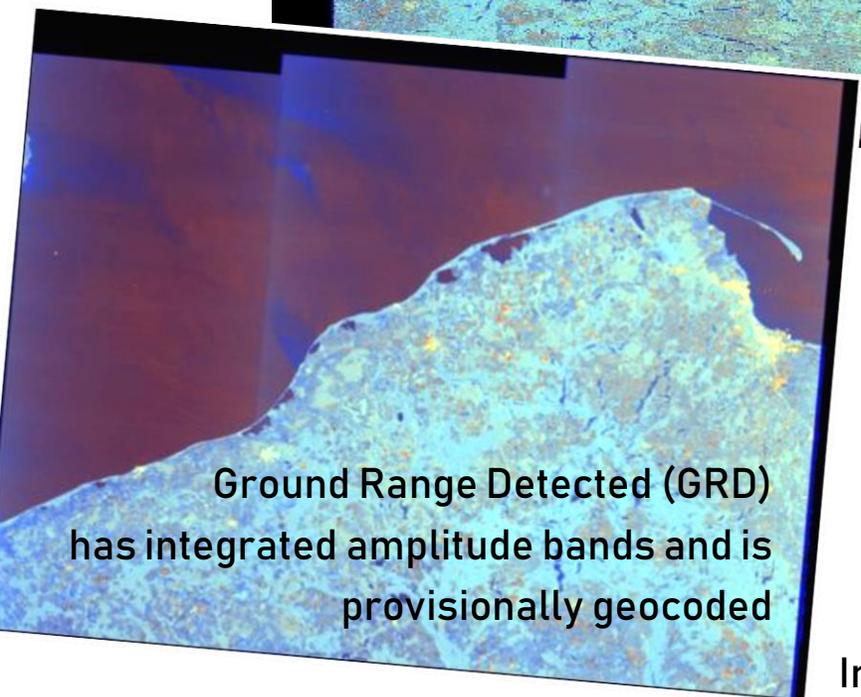
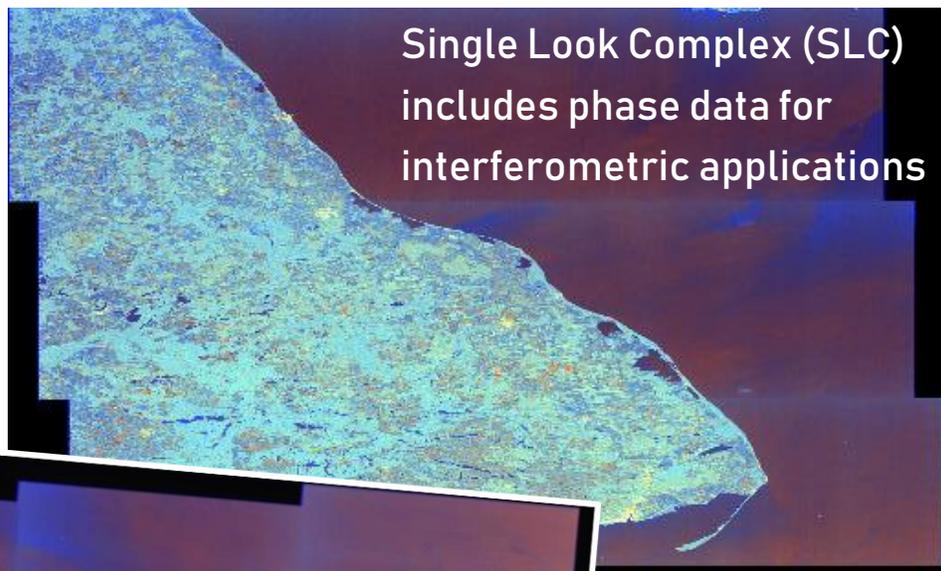
- all-weather, day-and-night supply of imagery of Earth's surface.
- C-band Synthetic Aperture Radar (SAR)
- Supports operation in dual polarisation (HH+HV, VV+VH)
- Sentinel-1A and 1B orbit 180° apart, the mission images the entire Earth every six days
- number of ground stations for rapid dissemination,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



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

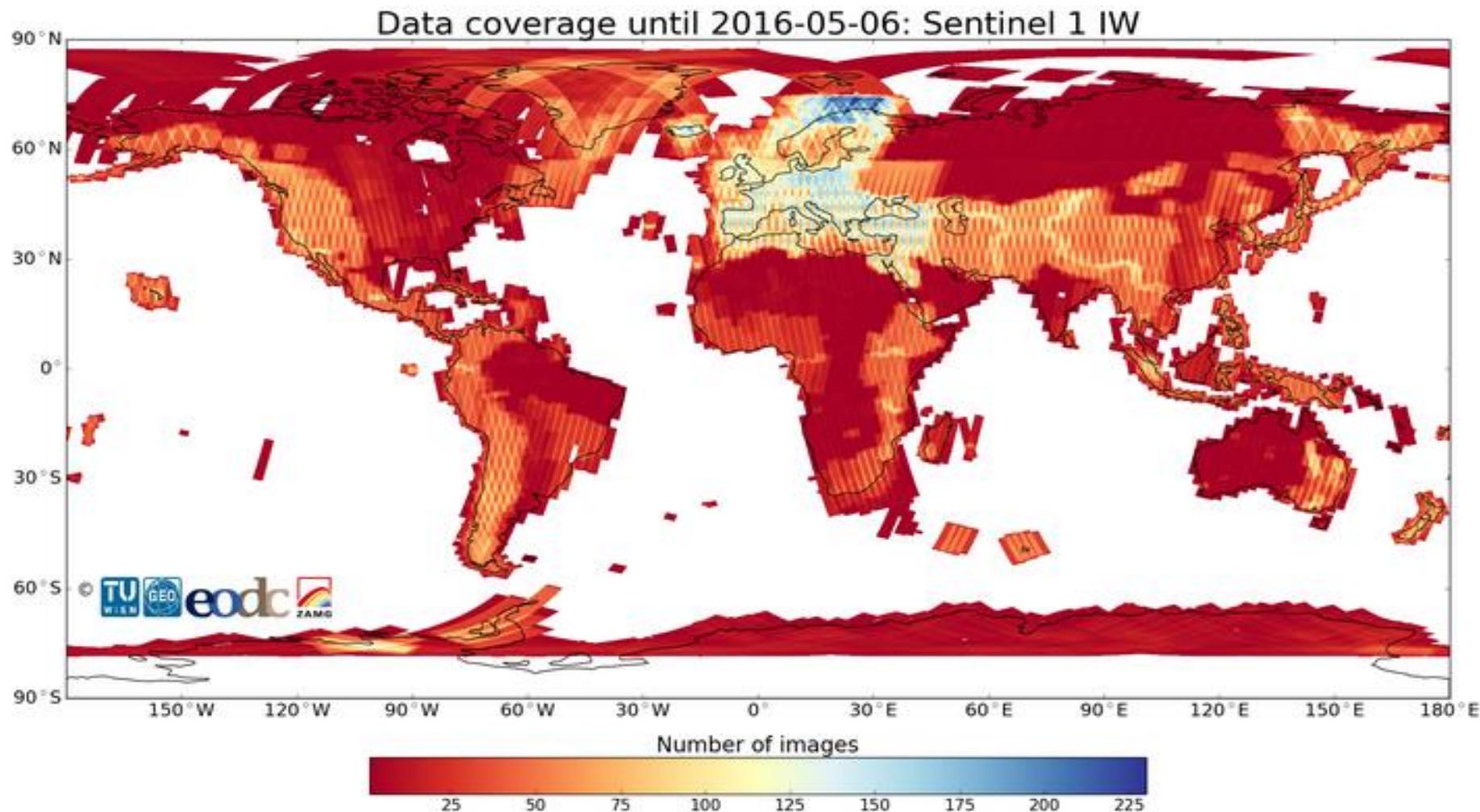


Interferometric Wide Swath (IW) data

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

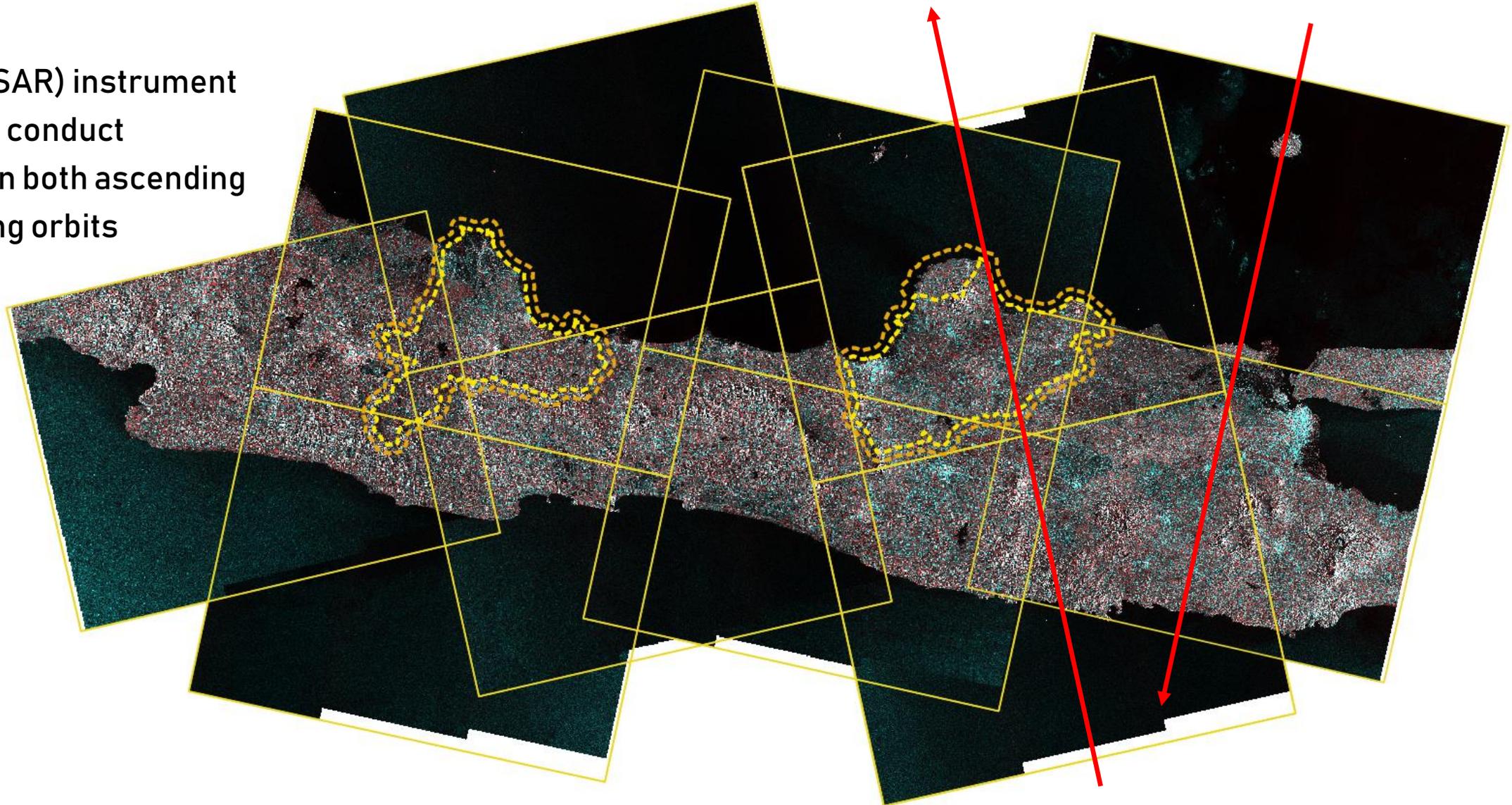
Historical and current acquisition frequency differs between regions and between orbits. Data acquisition frequency improves over time.

The highest frequency of observation is over Europe.



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

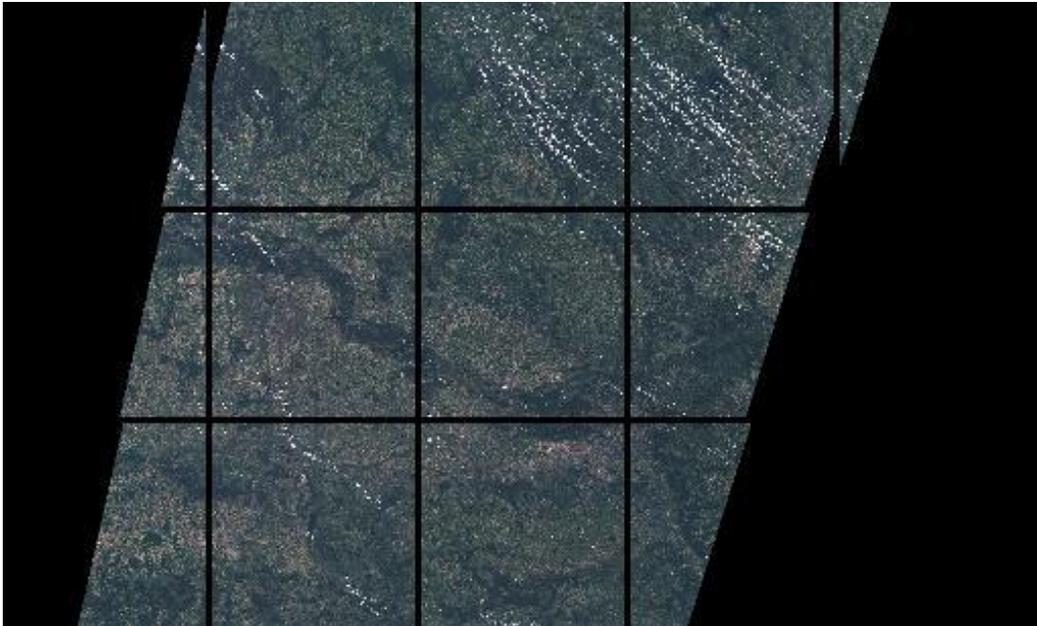
- wide swath high-resolution multispectral imager with 13 spectral bands
- combination of high resolution, novel spectral capabilities
- swath width of 290 km and frequent revisit times
- Sentinel-2A and 2B orbiting 180° apart, the mission images five days at the equator

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



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	60m	2190	180	SWIR
1		443	20	Coastal aerosol
9		945	20	Water vapour
10		1375	30	SWIR - Cirrus

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).



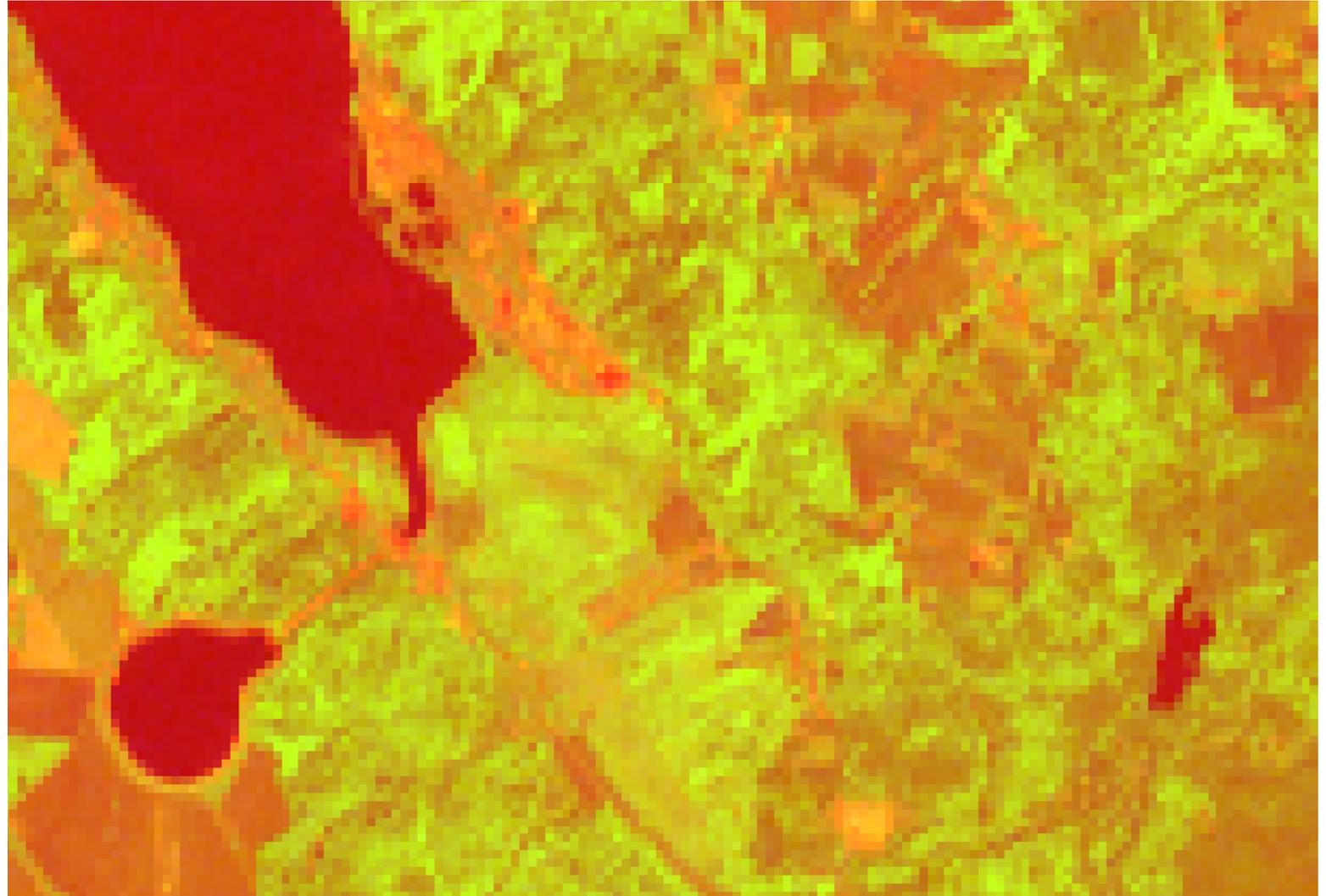
Copernicus programme – Space segment : Sentinel-2 A/B

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

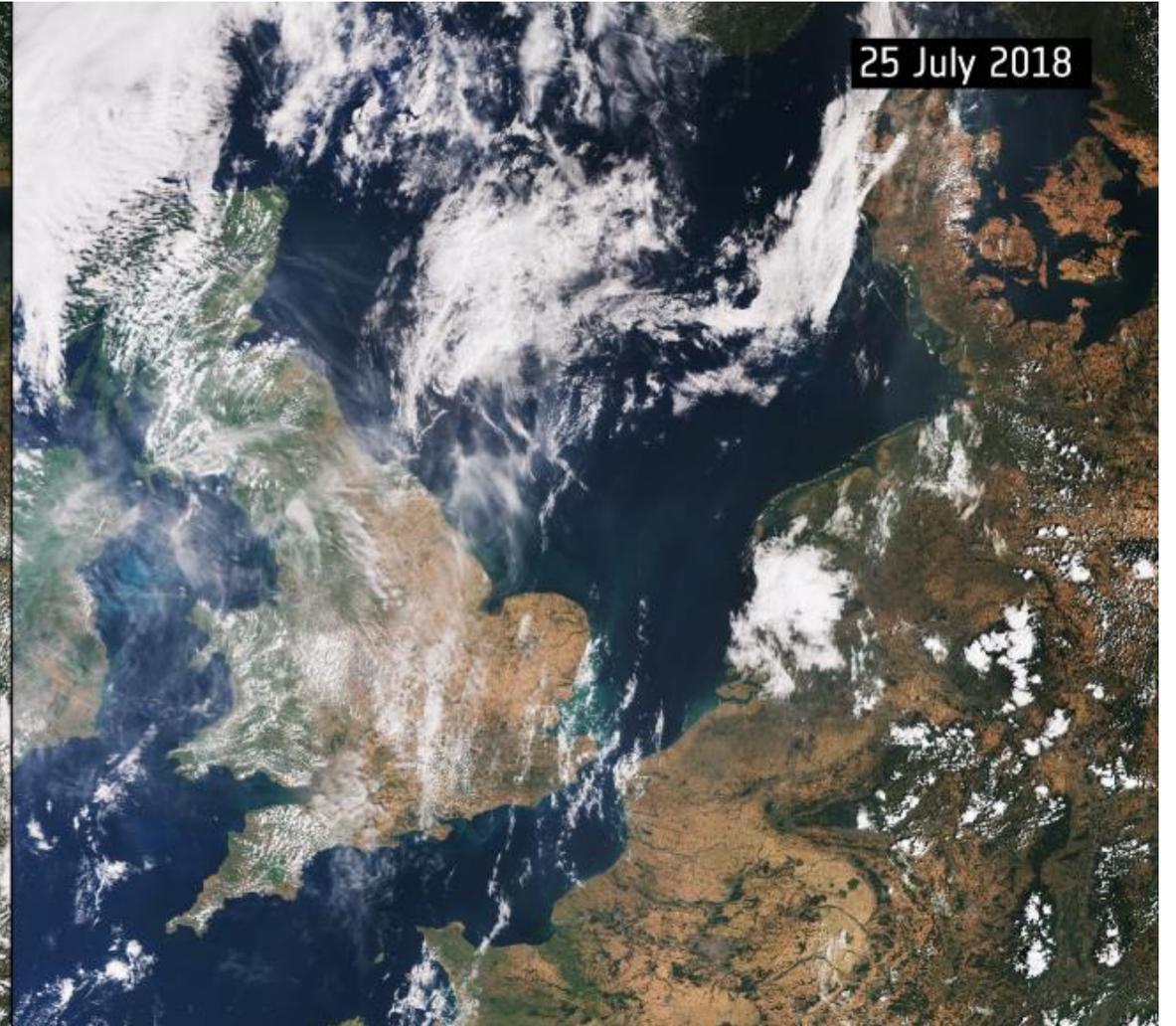
- operated by ESA and EUMETSAT to deliver operational ocean and land observation service
- carries four main instruments:
 - OLCI: Ocean and Land Colour Instrument
 - SLSTR: Sea and Land Surface Temperature Instrument
 - SRAL: SAR Radar Altimeter
 - MWR: Microwave Radiometer.

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.



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



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	0a03, 0a10, 0a17
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	0a18, 0a19
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	0a1

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.



sentinel-5p



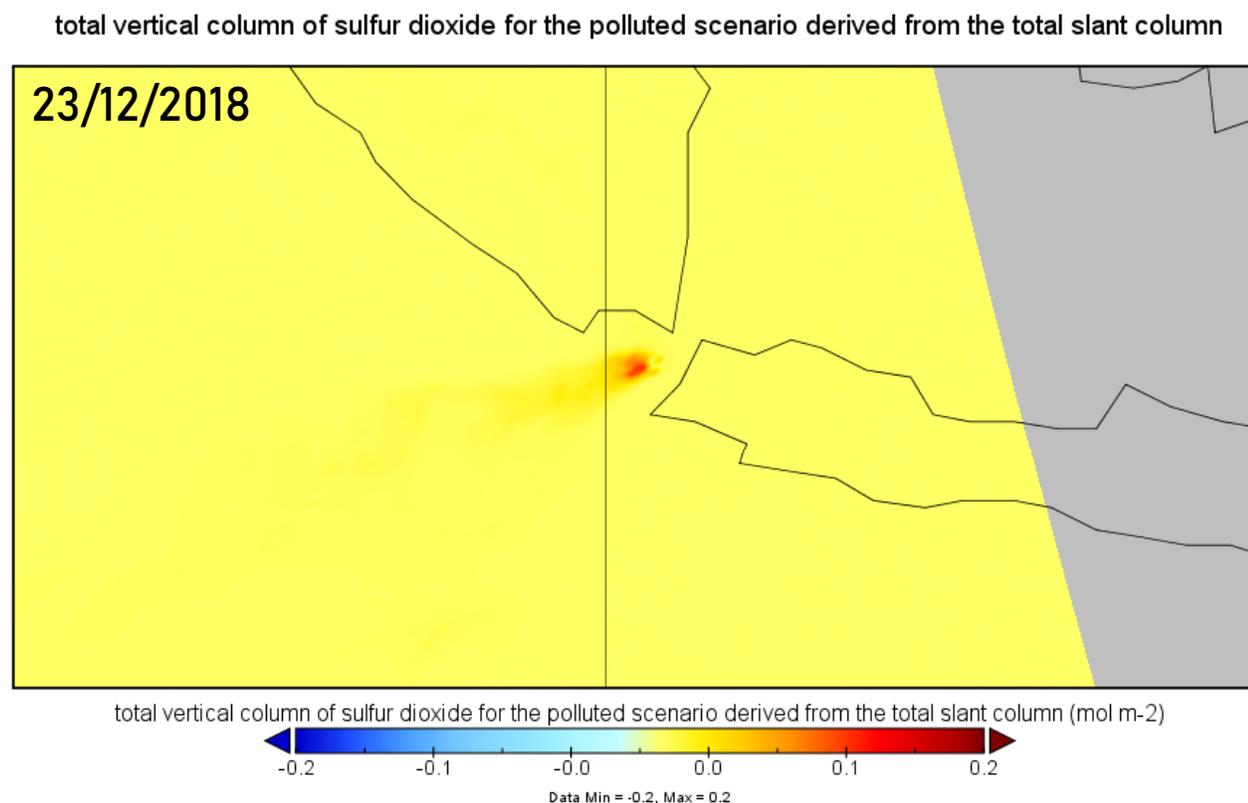
Copernicus programme – Space segment: Sentinel-5P

Level-1B products are:

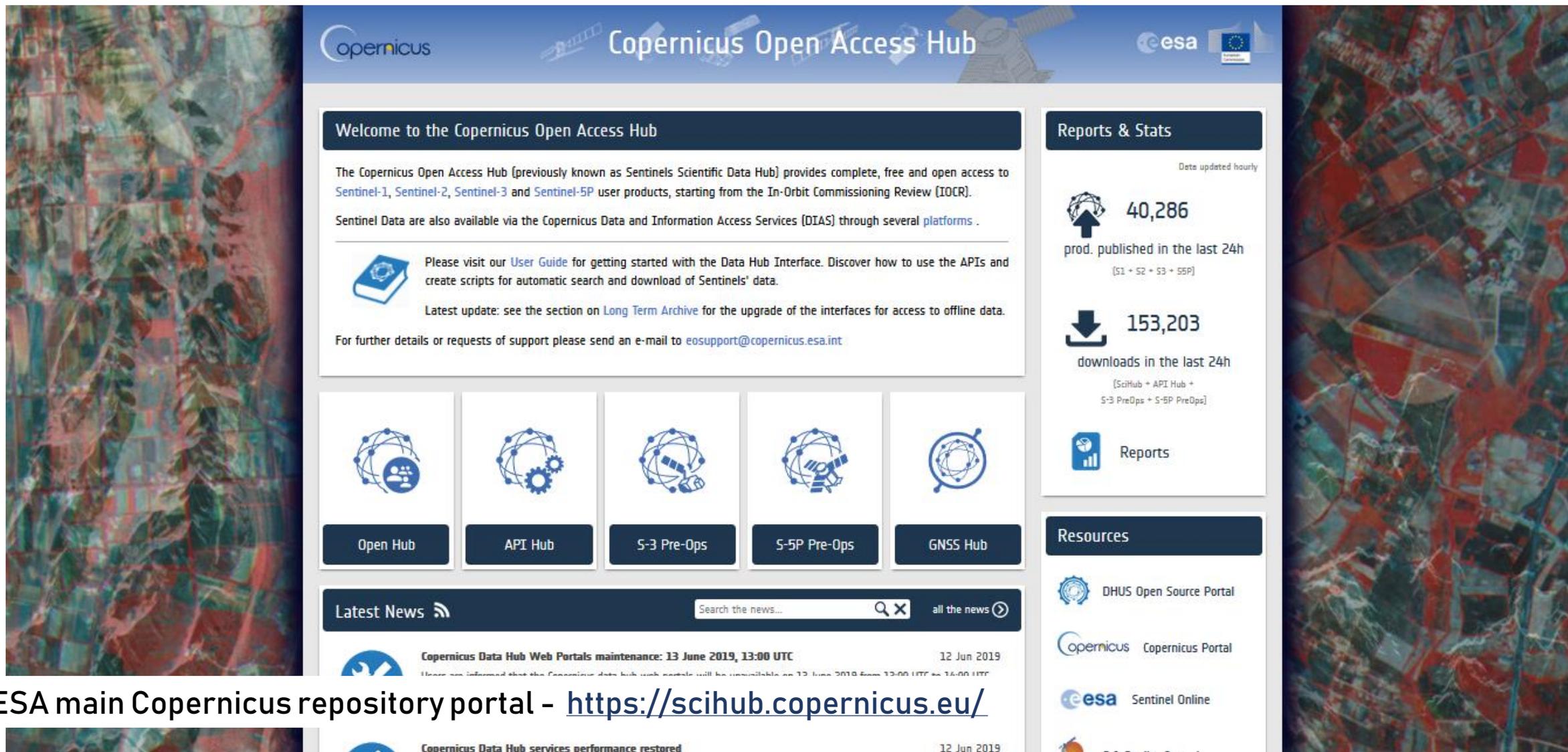
- geo-located and radiometrically corrected top of the atmosphere Earth radiances in all spectral bands, as well as solar irradiances

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)



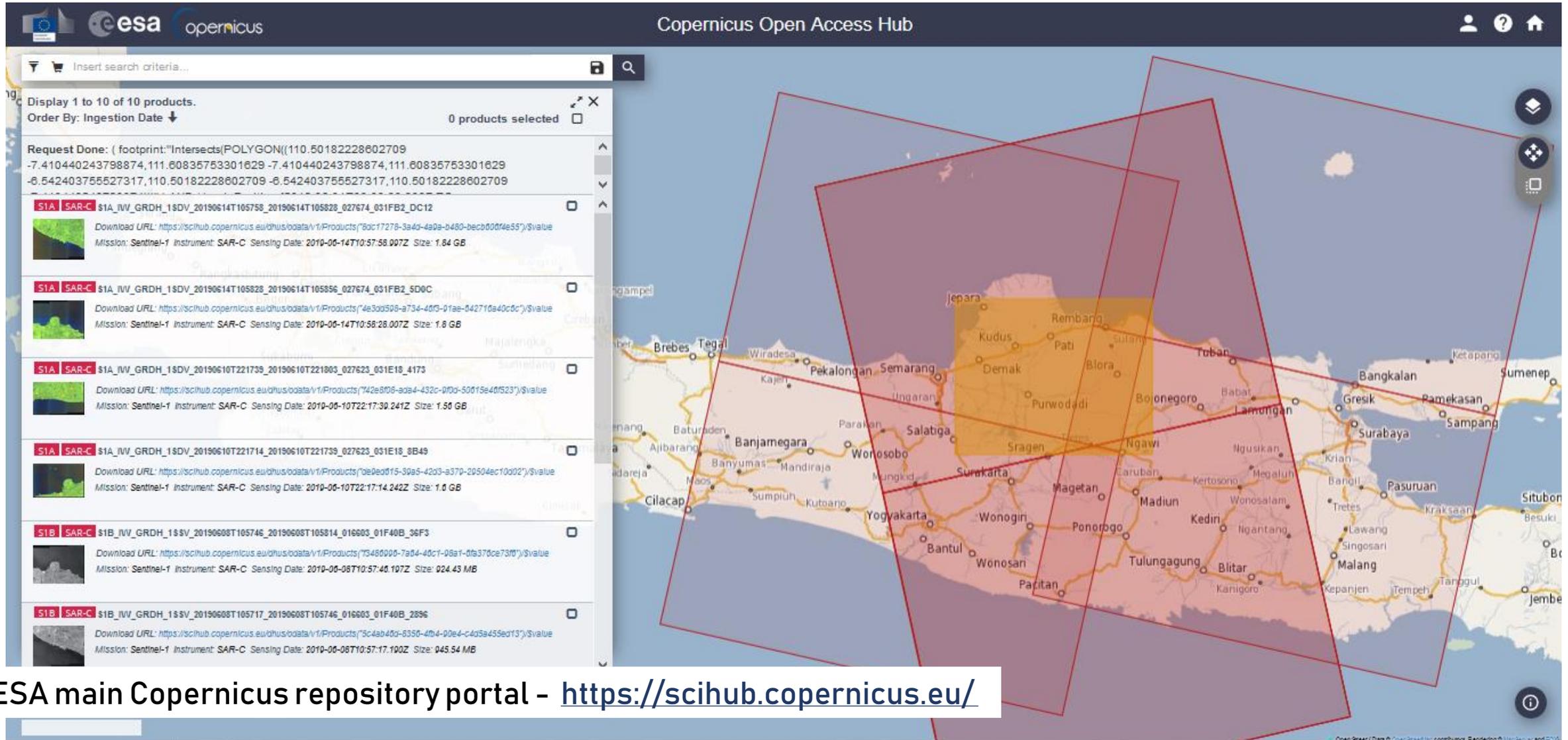
Copernicus programme – Data access and exploitation



The screenshot displays the Copernicus Open Access Hub website. The header includes the Copernicus logo, the text 'Copernicus Open Access Hub', and the ESA and European Union logos. The main content area features a welcome message, a brief description of the hub's purpose, and a link to the User Guide. Below this are five navigation buttons: 'Open Hub', 'API Hub', 'S-3 Pre-Ops', 'S-5P Pre-Ops', and 'GNSS Hub'. A 'Latest News' section is visible at the bottom, with a search bar and a list of news items. On the right side, there is a 'Reports & Stats' section showing '40,286 prod. published in the last 24h' and '153,203 downloads in the last 24h'. Below this is a 'Resources' section with links to 'DHUS Open Source Portal', 'Copernicus Portal', and 'Sentinel Online'.

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

Copernicus programme – Data access and exploitation



The screenshot displays the Copernicus Open Access Hub interface. On the left, a search bar is present with the text "Insert search criteria...". Below it, a list of products is shown, ordered by "Ingestion Date". The list includes details such as "Request Done", "Download URL", "Mission", "Instrument", "Sensing Date", and "Size". The products are categorized by "S1A" and "S1B" and "SAR-C".

On the right, a map of Indonesia is shown with several overlapping red polygons representing the footprint of the SAR-C products. The map includes labels for various cities and regions, such as Semarang, Surabaya, and Yogyakarta.

At the bottom of the screenshot, there is a white box containing the text: "ESA main Copernicus repository portal - <https://scihub.copernicus.eu/>".

Copernicus programme – Data access and exploitation





Log In
Register
Cart (0)

order products using:

show:

collection:

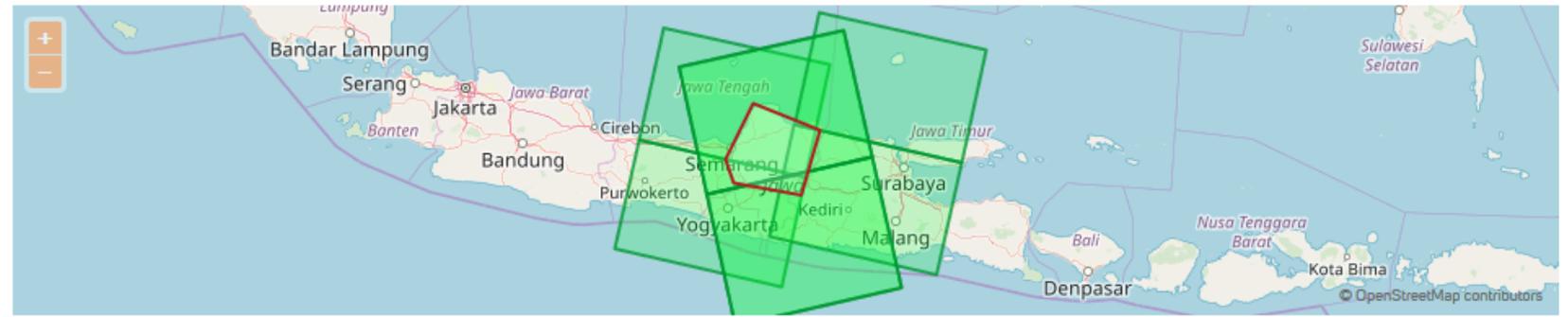
Sentinel-1 ✕

product type: ✕

processing level: ✕

sensor mode: ✕

<https://finder.creodias.eu/resto/api/collections/Sent> ✕ > ↻



search results 1

Title	Observation date	Publication date	Cloud %	File size
S1A_IW_GRDH_1SDV_20190610T221739_20190610T221803_027623_031E18_...	2019-06-10 22:17:39.241	2019-06-11 04:00:53.970575	-	853MB
S1A_IW_GRDH_1SDV_20190610T221714_20190610T221739_027623_031E18_8...	2019-06-10 22:17:14.242	2019-06-11 04:01:04.852611	-	849MB
S1B_IW_GRDH_1SSV_20190608T105746_20190608T105814_016603_01F40B...	2019-06-08 10:57:46.197	2019-06-08 12:58:51.111319	-	536MB
S1B_IW_GRDH_1SSV_20190608T105717_20190608T105746_016603_01F40B...	2019-06-08 10:57:17.19	2019-06-08 12:58:46.923762	-	558MB
S1A_IW_GRDH_1SDV_20190605T220922_20190605T220947_027550_031BE...	2019-06-05 22:09:22.069	2019-06-06 06:52:45.990226	-	993MB
S1A_IW_GRDH_1SDV_20190605T220857_20190605T220922_027550_031BE...	2019-06-05 22:08:57.07	2019-06-06 06:50:15.590406	-	815MB
IA6...	2019-06-02 10:58:27.539	2019-06-02 12:52:28.503543	-	933MB
IA66...	2019-06-02 10:57:58.534	2019-06-02 12:52:58.651764	-	1.01GB

European Commission funded – Data and Information Access Services
 EO data repositories integrated with cloud computing capabilities

Example DIAS platform - <https://creodias.eu/>

31 result(s)

Search
copy as points
copy all as urls
add all to cart
remove all from cart

Copernicus programme – Data access and exploitation





Log In

Register

Cart (0)

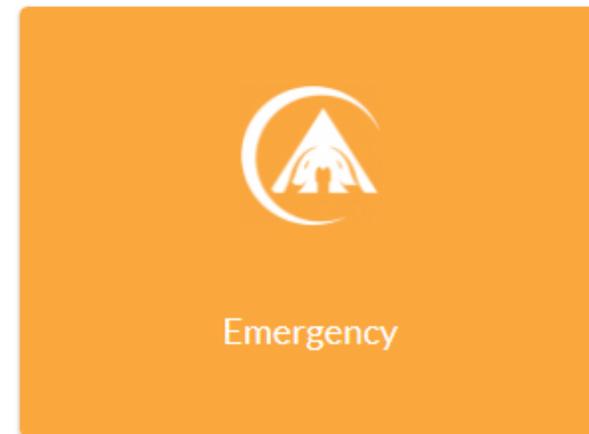
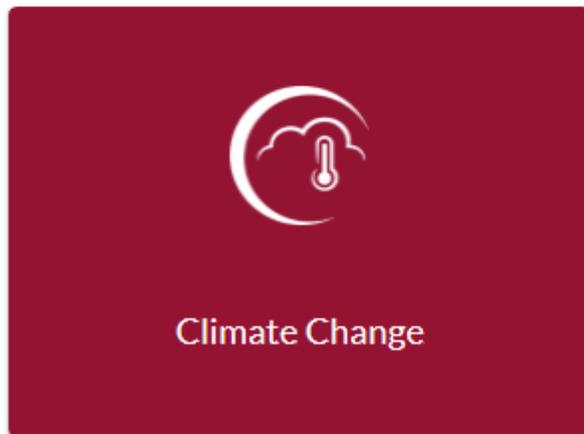
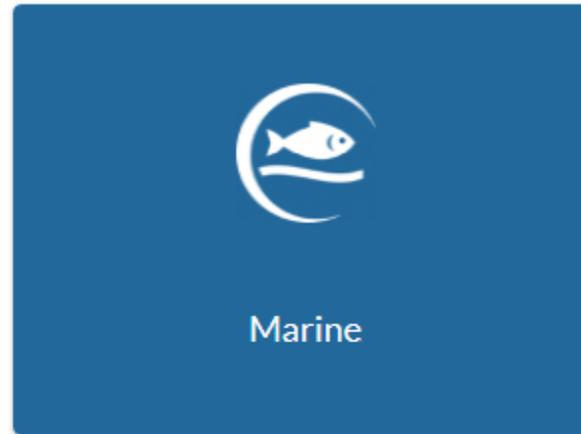
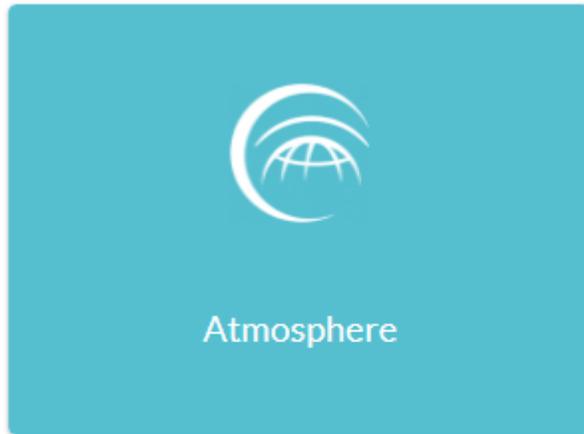
Figure 1 - VM Flavours

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
hm.xlarge	8	64	256
hm.2xlarge	16	128	384
ds			
ds.xlarge	8 (4 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 – EO data and Geoinformational services



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.

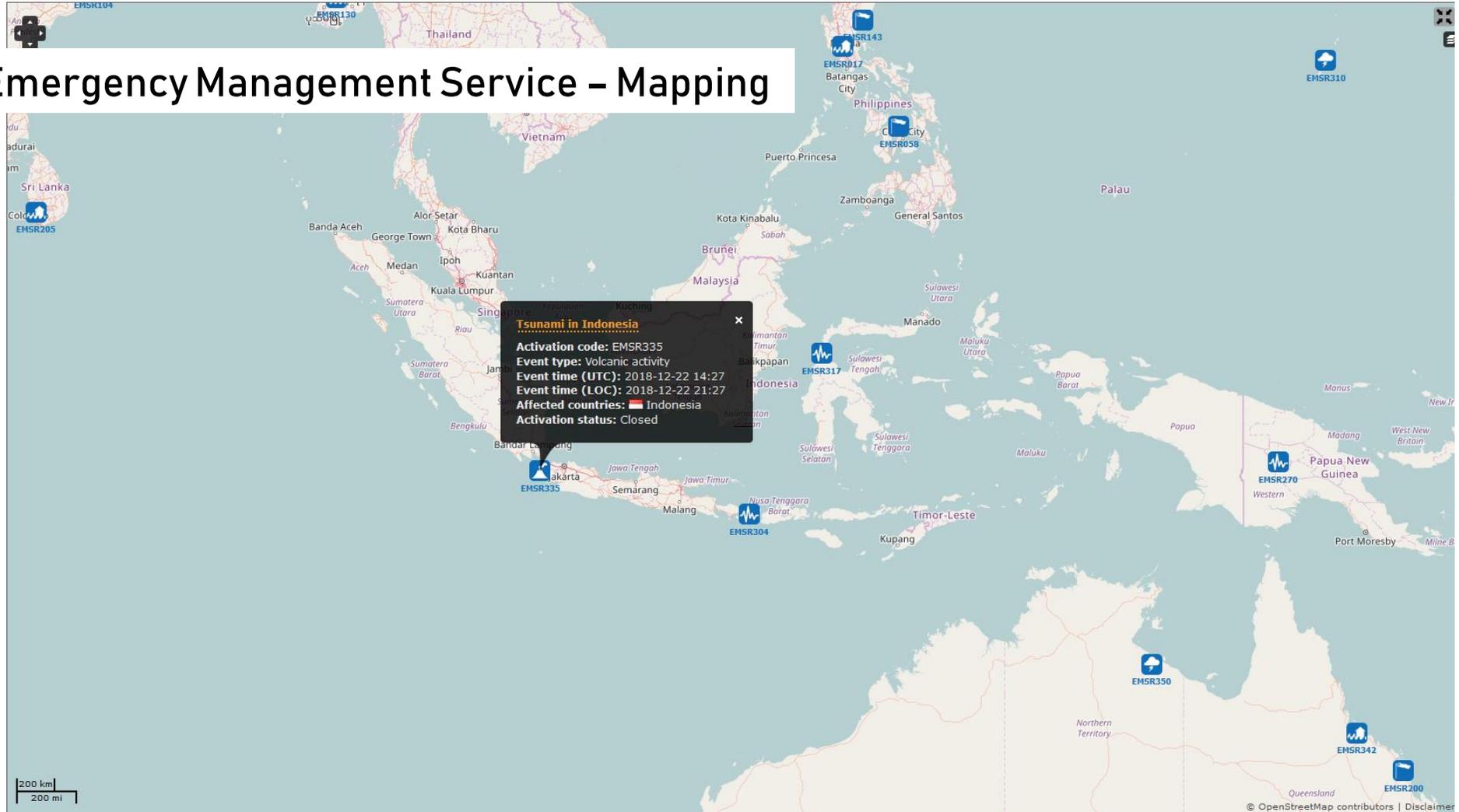
The Copernicus EMS consists of two components:

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).

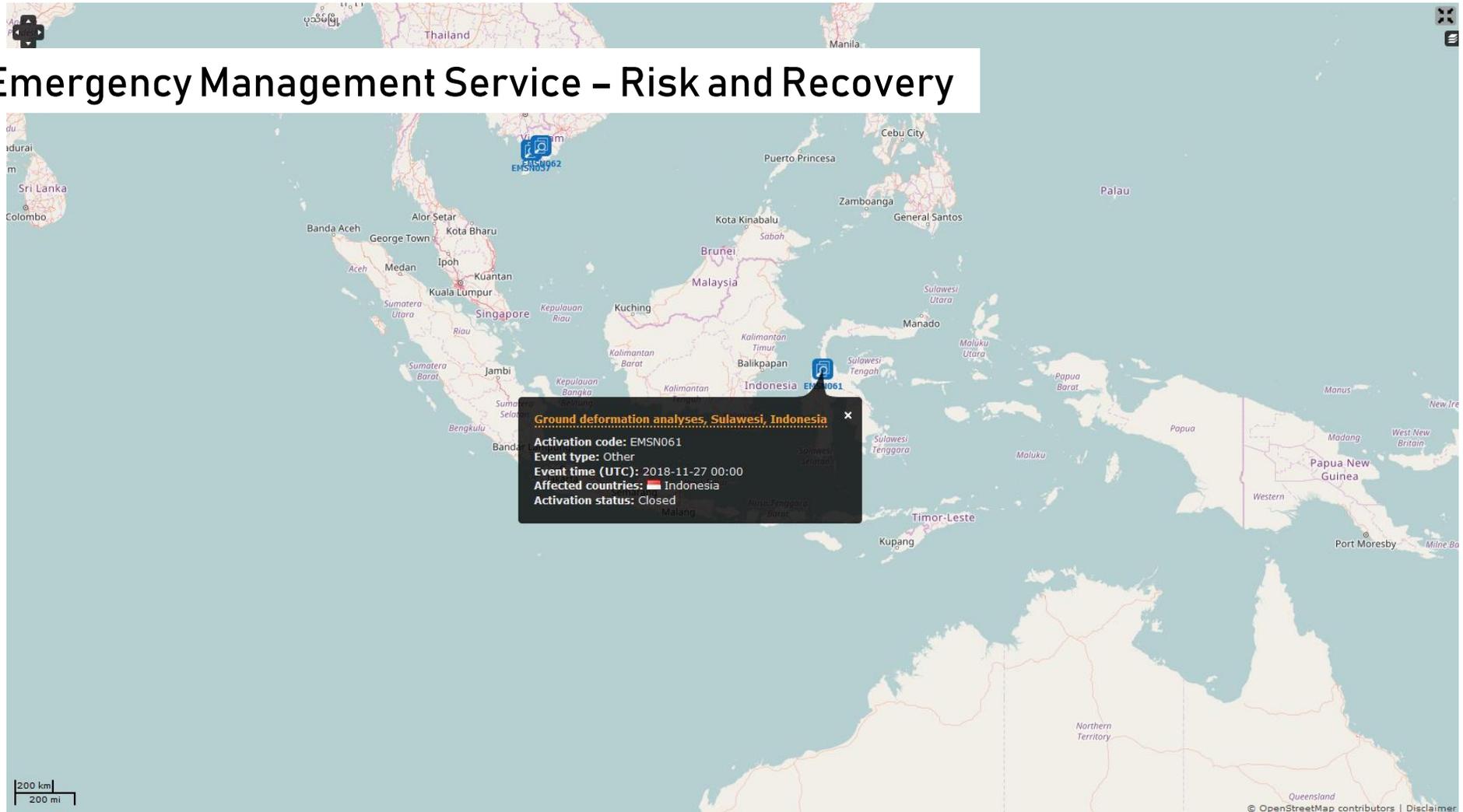
Copernicus programme – EO data and Geoinformational services

Copernicus Emergency Management Service – Mapping



Copernicus programme – EO data and Geoinformational services

Copernicus Emergency Management Service – Risk and Recovery



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.

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	

Copernicus programme – EO data and Geoinformational services

Copernicus Climate Change Service (C3S)

Przemyslaw Turos Logout

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Toolbox editor

Applications Data Documentation

Search for app or example

- ▼ **your workspace**
 - 01 Retrieve data
 - 00 Hello World
- ▼ **examples**
 - 00 Hello World
 - 01 Retrieve data
 - 02 Plot map**
 - 03 Extract time series and plot graph
 - 11 Calculate time mean and standard deviation
 - 12 Calculate climatologies
 - 21 Calculate regional mean and anomalies
 - 31 Calculate trends
 - 41 Calculate GDD
 - 42 Use odo functions
 - 51 Calculate zonal means
 - 52 Format maps to allow visual comparison

02 Plot map Console Your queue

Layout Copy Run

```

1 import cdstoolbox as ct
2
3 layout = {
4     'output_align': 'bottom'
5 }
6
7 variables = {
8     'Near-Surface Air Temperature': '2m_temperature',
9     'Eastward Near-Surface Wind': '10m_u_component_of_wind',
10    'Westward Near-Surface Wind': '10m_v_component_of_wind',
11    'Sea Level Pressure': 'mean_sea_level_pressure',
12    'Sea Surface Temperature': 'sea_surface_temperature',
13 }
14
15
16 @ct.application(title='Plot Map', layout=layout)
17 @ct.input.dropdown('variable', label='Variable', values=variables.keys())
18 @ct.output.figure()
19 def plot_map(variable):
20     """
21     Application main steps:
22
23     - set the application layout with output at the bottom
24     - select a variable name from a list in the dropdown menu
25     - retrieve the selected variable
26     - compose a title
27     - show the result on a map using the chosen title
28
29     """
30
31     data = ct.catalogue.retrieve(
                
```

Plot Map

Variable

Near-Surface Air Temperature

Near-surface air temperature

Near-Surface Air Temperature (°C)

Source : <https://www.copernicus.eu>