



2. ESA EO Data Access and resources, including Third Party missions, applications of Copernicus Earth Observation data



ESA EO Data Access and resources

ESA Earth Observation Data Policy

- To stimulate a balanced development of Science, Public Utility and Commercial Applications
- To maximize the use of data from ESA EO satellites



ERS and Envisat

- Free datasets

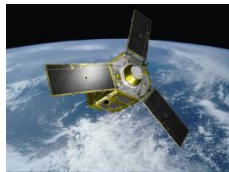
(Free of charge; User registration and acceptance of ESA Terms & Conditions are required → Open access)



Earth Explorers

- Restrained datasets

(Free of charge; User registration, submission of a “Project (Full) Proposal” and acceptance of the ESA Terms & Conditions are required, after its evaluation a quota will be assigned)



ESA Third Party Missions

- Data Policy of individual data providers

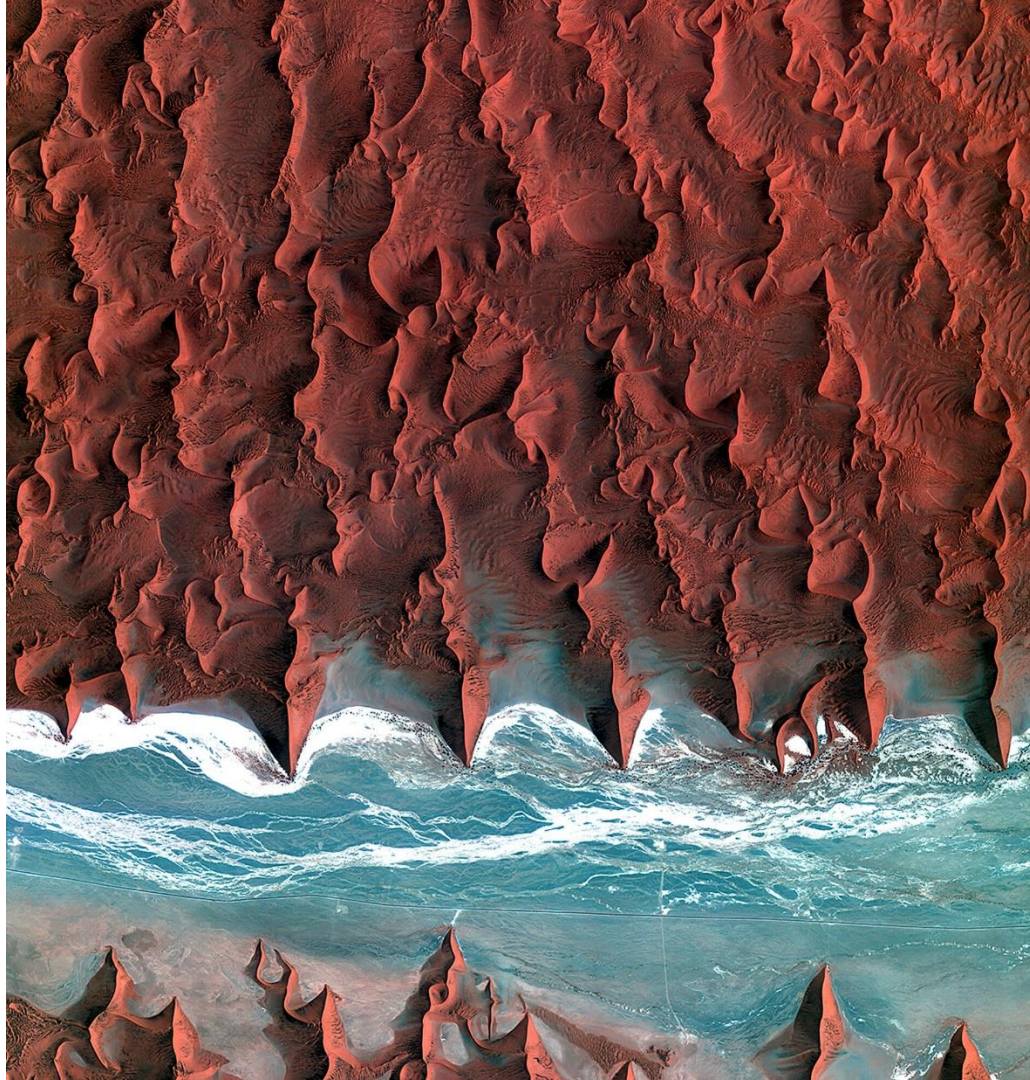
In some case, a reproduction cost (e.g. ALOS) or Specific Restrictions (limitations of quota, geographical restrictions, etc.) to the use of data may be applied for TPM

EO data access

Free open source platforms

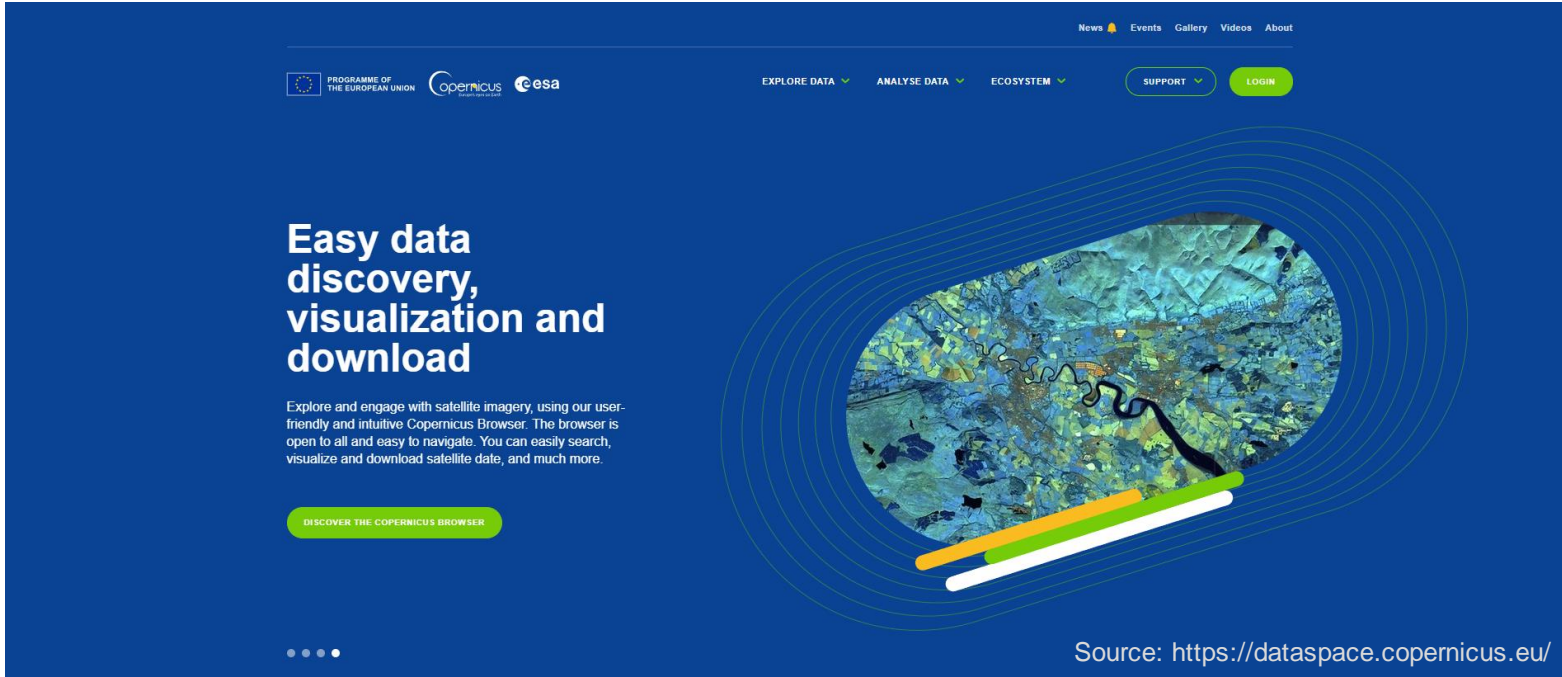
- **Copernicus Open Access Hub**
- Earth System Lab
- ESA Thematic Exploitation Platforms
- Alaska Satellite Facility
- Copernicus Global Land Service
- **Copernicus Data Space Ecosystem**
- **Sentinel Data Access Service**
- USGS Earth Explorer
- Sentinel Application Platform software
- Open Data Cube

Source <https://business.esa.int/sites/business/files/Guide%20-%20Where%20to%20access%20EO%20data.pdf>, https://www.esa.int/ESA_Multimedia/Images/2013/04/Namib_Desert:



Copernicus Data Space Ecosystem

<https://dataspace.copernicus.eu/>



The screenshot shows the homepage of the Copernicus Data Space Ecosystem. The background is a dark blue gradient. At the top right, there are navigation links for News, Events, Gallery, Videos, and About. Below these are dropdown menus for EXPLORE DATA, ANALYSE DATA, and ECOSYSTEM, followed by buttons for SUPPORT and LOGIN. The main content area features the text "Easy data discovery, visualization and download" in large white font. Below this is a paragraph describing the Copernicus Browser and a button labeled "DISCOVER THE COPERNICUS BROWSER". On the right side, there is a large, stylized image of a satellite map with a black line and a green bar overlaid. At the bottom right, the source URL is provided: "Source: <https://dataspace.copernicus.eu/>".

News Events Gallery Videos About

PROGRAMME OF THE EUROPEAN UNION Copernicus esa

EXPLORE DATA ANALYSE DATA ECOSYSTEM SUPPORT LOGIN

Easy data discovery, visualization and download

Explore and engage with satellite imagery, using our user-friendly and intuitive Copernicus Browser. The browser is open to all and easy to navigate. You can easily search, visualize and download satellite data, and much more.

DISCOVER THE COPERNICUS BROWSER

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

- Since 24 January 2023 a new Copernicus Data Space Ecosystem has been launched to provide free and open access to EO data from all Sentinel satellites with new features for visualisation and data processing.

Copernicus Open Access Hub

<https://scihub.copernicus.eu/>

The screenshot shows the Copernicus Open Access Hub website. At the top, there is a blue header with the Copernicus logo, the text 'Copernicus Open Access Hub', and logos for ESA and the European Union. Below the header, there is a 'Welcome to the Copernicus Open Access Hub' section with introductory text. To the right, a 'Reports & Stats' section displays '38,892 prod. published in the last 24h' and '338,550 downloads in the last 24h'. Below that is a 'Resources' section with links to 'DHUS Open Source Portal', 'Copernicus Copernicus Portal', 'ESA Sentinel Online', and 'Sentinel Vision Stories'. At the bottom, there are four icons representing different data products: Open Hub, API Hub, S-5P Pre-Ops, and POD Hub.

Welcome to the Copernicus Open Access Hub

The Copernicus Open Access Hub (previously known as Sentinels Scientific Data Hub) provides complete, free and open access to [Sentinel-1](#), [Sentinel-2](#), [Sentinel-3](#) and [Sentinel-5P](#) user products, starting from the In-Orbit Commissioning Review (IOCR).

Since 24 January 2023 a new [Copernicus Data Space Ecosystem](#) has been launched to provide access to all Sentinel data with new features for visualisation and data processing. Please stay tuned to the news for latest information on the services available and the [roadmap](#) for the full release of all functionalities.

The Copernicus Data Hub distribution service will continue its full operations until the end of June 2023 to allow a smooth migration to the new Copernicus Data Space Ecosystem by all user communities. As from July 2023 and until September 2023, the Copernicus Data Hub distribution service will continue offering access to Sentinel data with a gradual ramp-down of the operations capacity and data offering.

Sentinel Data are also available via the Copernicus Data and Information Access Services (DIAS) through several [platforms](#).

Please visit our [User Guide](#) for getting started with the Data Hub Interface. Discover how to use the APIs and create scripts for automatic search and download of Sentinels' data, with synchronous access to the latest data and asynchronous access to historic data via the API and GUI.

For further details or requests of support please send an e-mail to eosupport@copernicus.esa.int

Reports & Stats
Data updated hourly

38,892
prod. published in the last 24h

338,550
downloads in the last 24h

Reports

Resources

- DHUS Open Source Portal
- Copernicus Copernicus Portal
- ESA Sentinel Online
- Sentinel Vision Stories

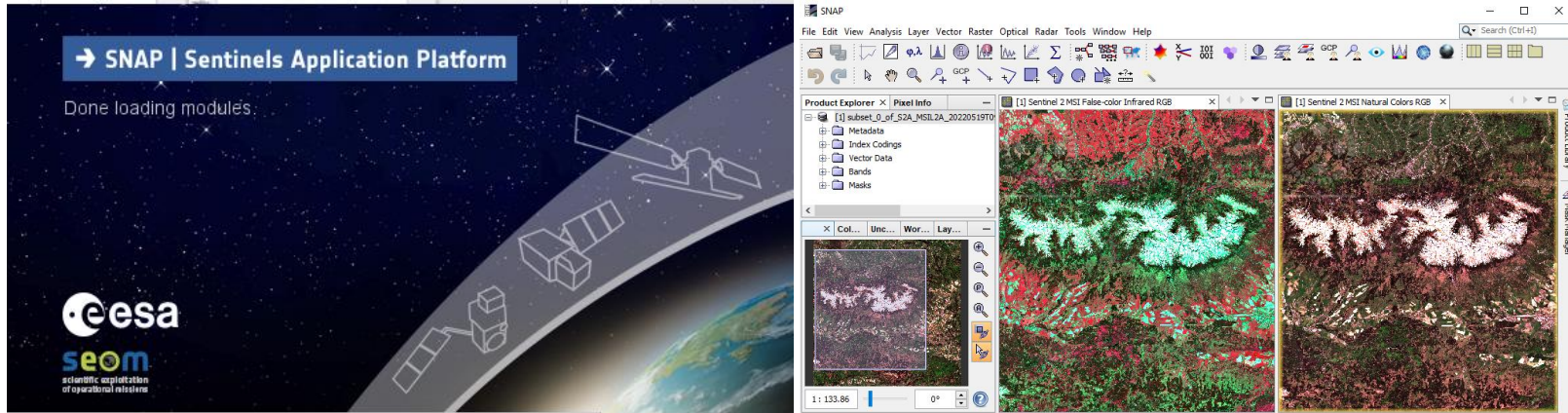
Open Hub API Hub S-5P Pre-Ops POD Hub

- The previous Copernicus Open Access Hub provided complete, free and open access to Sentinel-1, Sentinel-2, Sentinel-3 and Sentinel-5P user products

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

SNAP (Sentinel Application Platform) software

<http://step.esa.int/main/download/snap-download/>



- ESA Sentinel Application Platform (SNAP) is a software toolkit developed by the ESA for processing and analyzing Earth observation data, particularly data from the Sentinel satellites. SNAP is part of the Sentinel Toolbox and is freely available to the public. It provides a user-friendly interface and a comprehensive set of tools also for working with a variety of other remote sensing data.

EO data access

Partially open-source EO platforms

- **EO Browser Sentinel Hub**
- DIAS - Copernicus Data & Information Access Services
- Google Earth Engine
- Earth on AWS



Source:
https://www.esa.int/ESA_Multimedia/Images/2017/03/The_Karavasta_Lagoon_in_Albania_looks_spectacular/

EO Browser - SENTINEL Hub

<https://apps.sentinel-hub.com/eo-browser/>

The image displays two screenshots of the EO Browser interface. The top screenshot shows the search sidebar on the left, which is highlighted with a yellow border. The sidebar includes a search bar, a 'Theme' section, and a 'Data sources' section. In the 'Data sources' section, 'Sentinel-1' is selected with a checkmark, and a yellow arrow points to the 'Advanced search' toggle. Below this, several other data sources are listed with checkboxes. The main map area shows a satellite view of a coastal region with labels for various locations. The top right of the interface features a search bar, a 'Go to Place' button, and several icons for map controls.

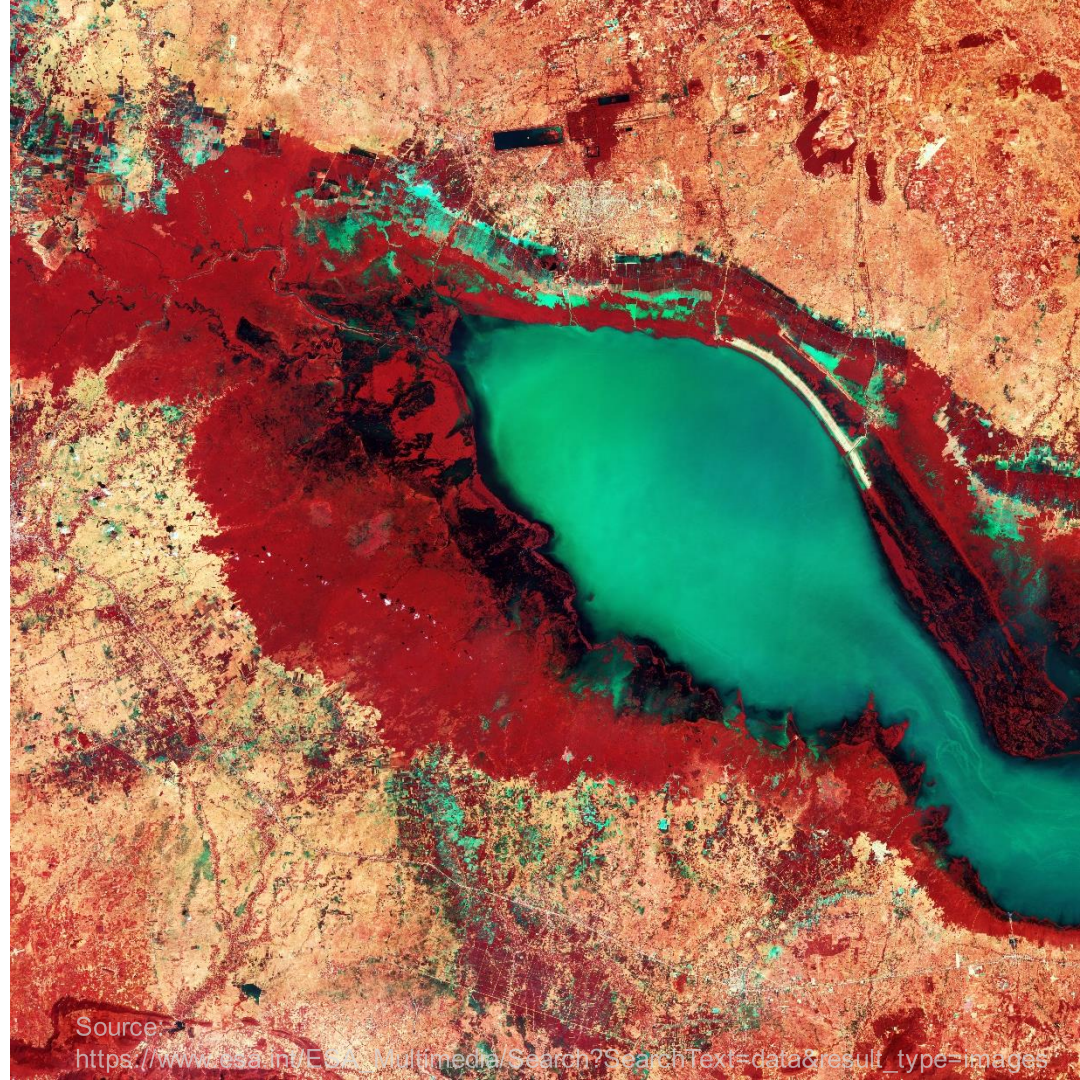
The bottom screenshot shows the same interface but with the 'Dataset: Sentinel-1 AWS-W-VVH' selected. The 'Data sources' sidebar is still visible, but the 'Advanced search' toggle is now turned off. The main map area shows a different satellite view, likely of a different region. The top right of the interface features a search bar, a 'Go to Place' button, and several icons for map controls. The bottom of the interface shows a 'Powered by Sentinel Hub' logo and a version number.

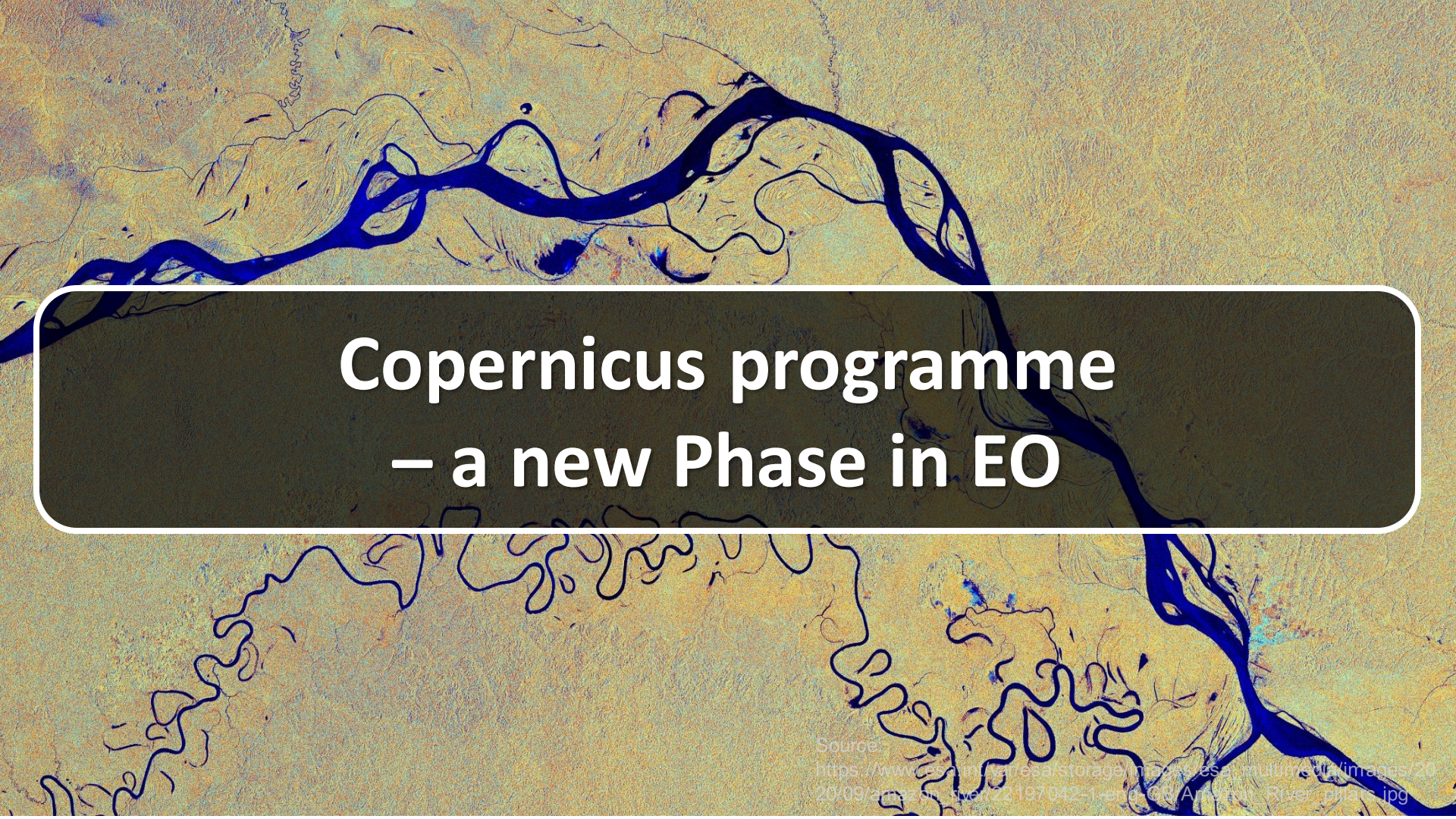
Source: <https://apps.sentinel-hub.com/eo-browser/>

EO data access

Commercial EO platforms

- DigitalGlobe / Maxar
- OneAtlas
- Planet platform
- e-Geos
- Decartes Labs



An aerial photograph of a river delta, likely the Amazon River, showing a complex network of channels and distributaries. The image is overlaid with a dark blue, semi-transparent layer that highlights the main river channel and its immediate branches. The background is a textured, golden-brown color, possibly representing the surrounding land or water. The text is centered in a white rounded rectangle.

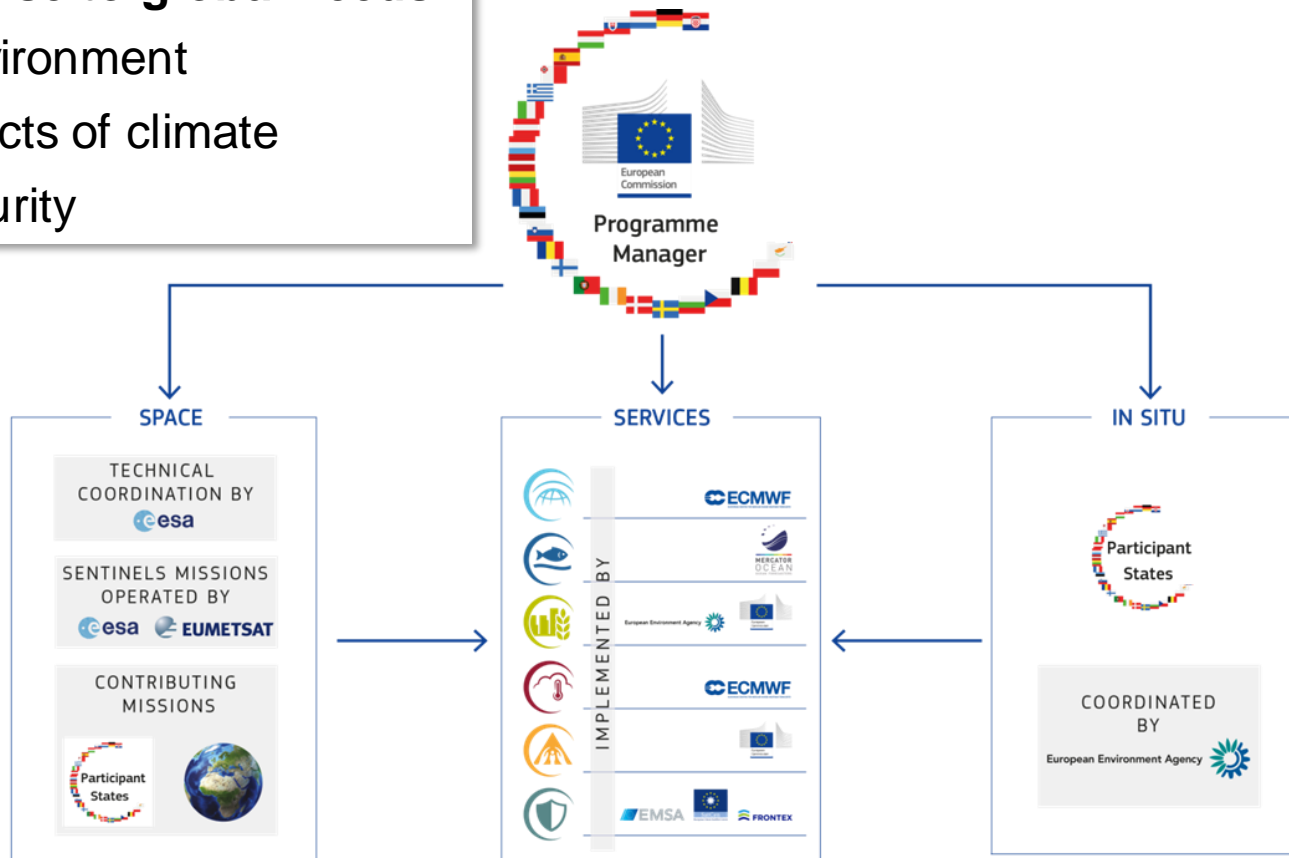
Copernicus programme – a new Phase in EO

Source:
https://www.esa.int/esa/storage/m/esa_multimedia/images/2020/09/20200920_esa_multimedia_20200920_197042-1-esa_08/Amazon_River.png.jpg

Copernicus purpose and architecture

→ **European response to global needs:**

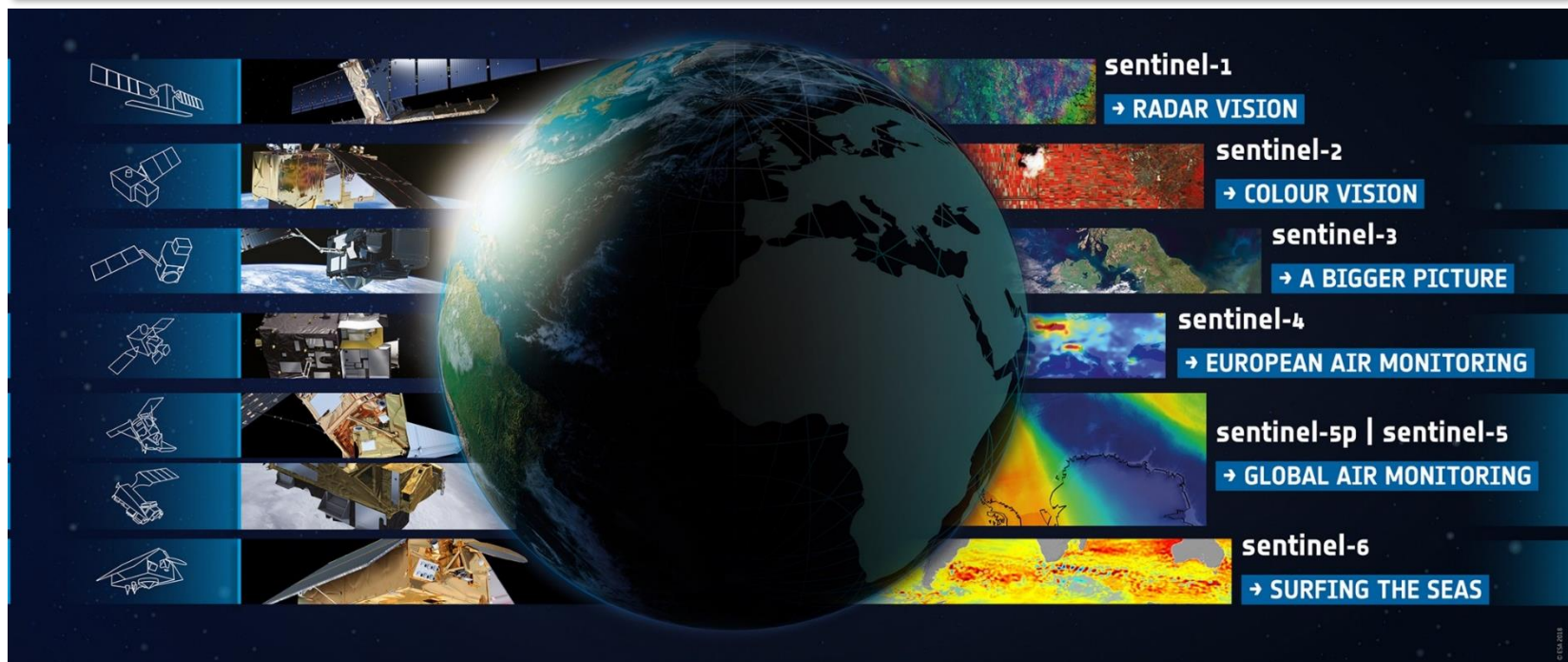
- to manage the environment
- to mitigate the effects of climate
- to ensure civil security



Space component

The Earth observation satellites which provide the data exploited by the Copernicus services are split into two groups of missions:

- **Sentinels** - developed for the specific needs of the Copernicus programme
 - Sentinel-1, -2, -3, -5P, -6, - Sentinel-4, -5



Space component

- Contributing Missions
 - operated by National, European or International organisations
 - already provide a wealth of data for Copernicus services



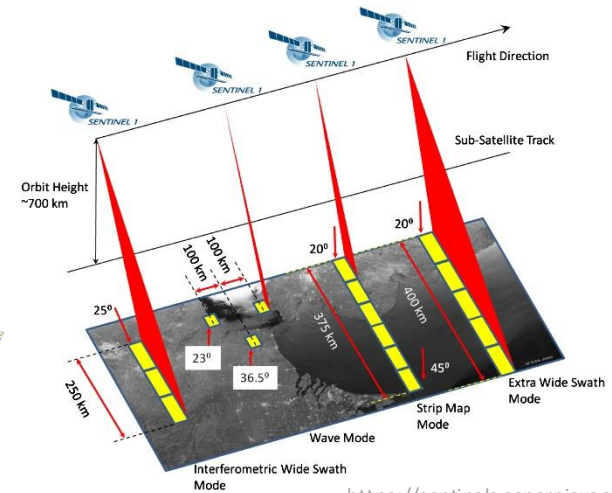
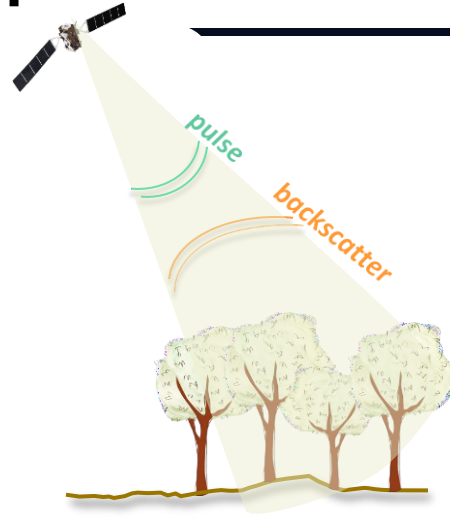
Sentinel-1 – Radar vision

Mission objectives:

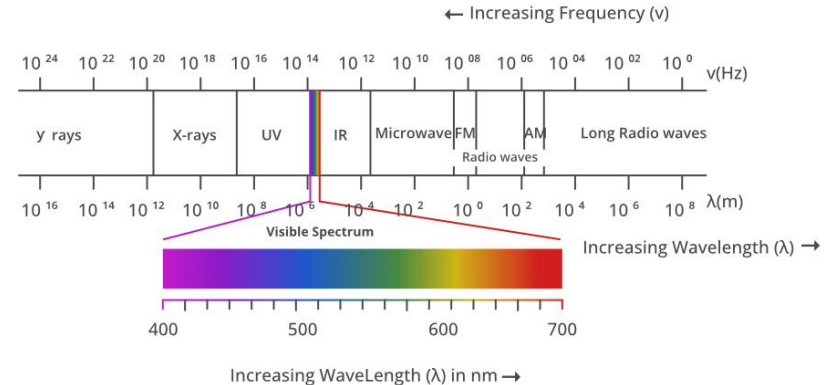
- Marime and land monitoring
- Emergency management

Mission profile:

- C-Band SAR mission at 5.4 GHz
- Multi-polarisation
- Sun synchronous orbit at 693 km mean alt.
- 6 days repeat cycle at Equator with 2 satellites
- 4 operation modes



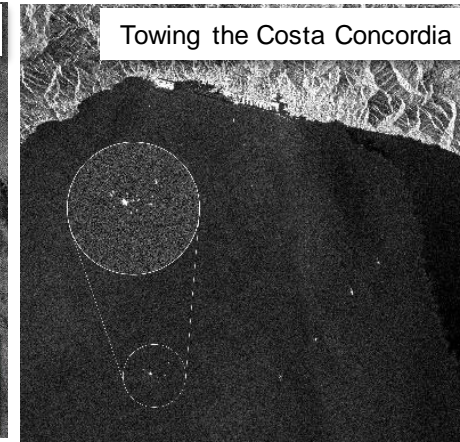
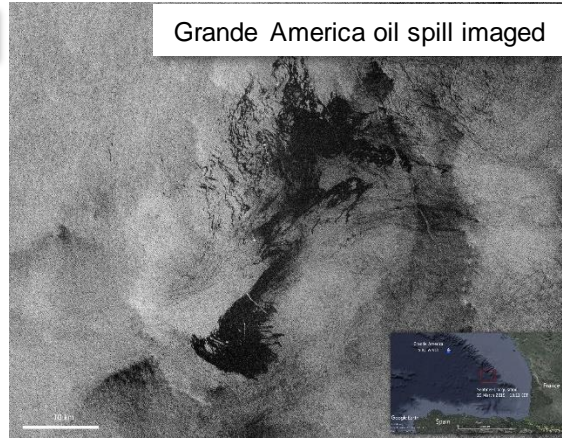
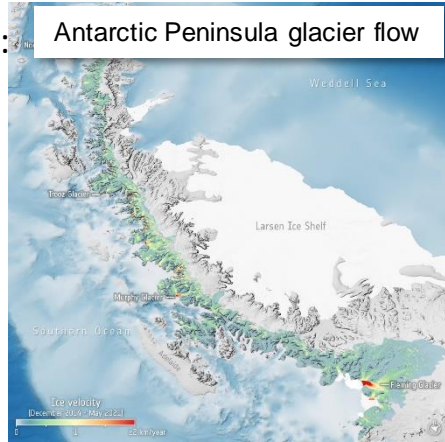
<https://sentinels.copernicus.eu>



Sentinel-1 – Applications

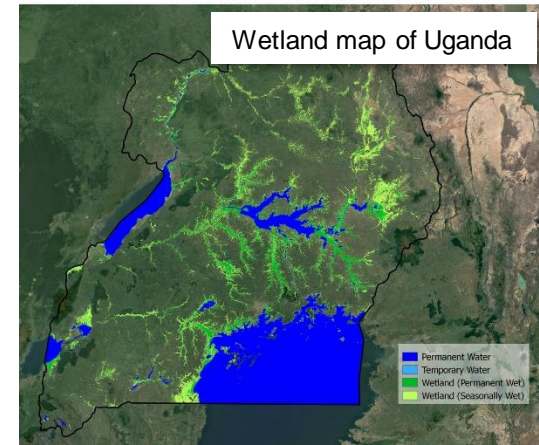
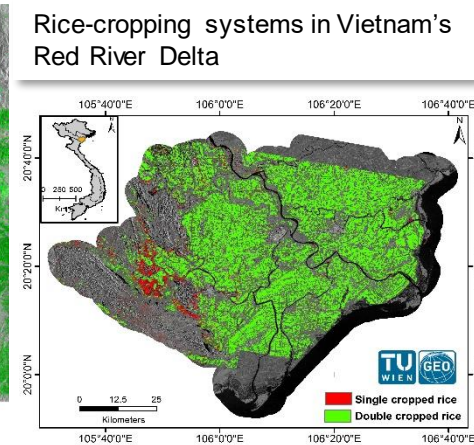
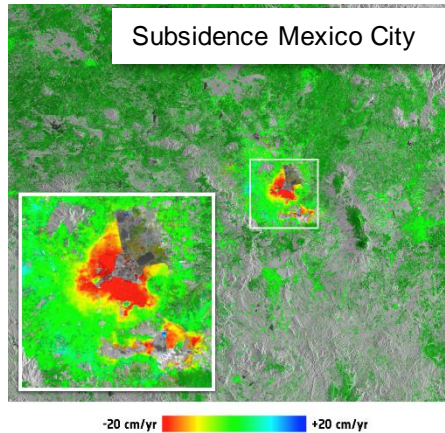
Maritime surveillance:

- Ice Monitoring
- Oil Spill Monitoring
- Ship Detection
- Marine Winds, Etc.



Land monitoring

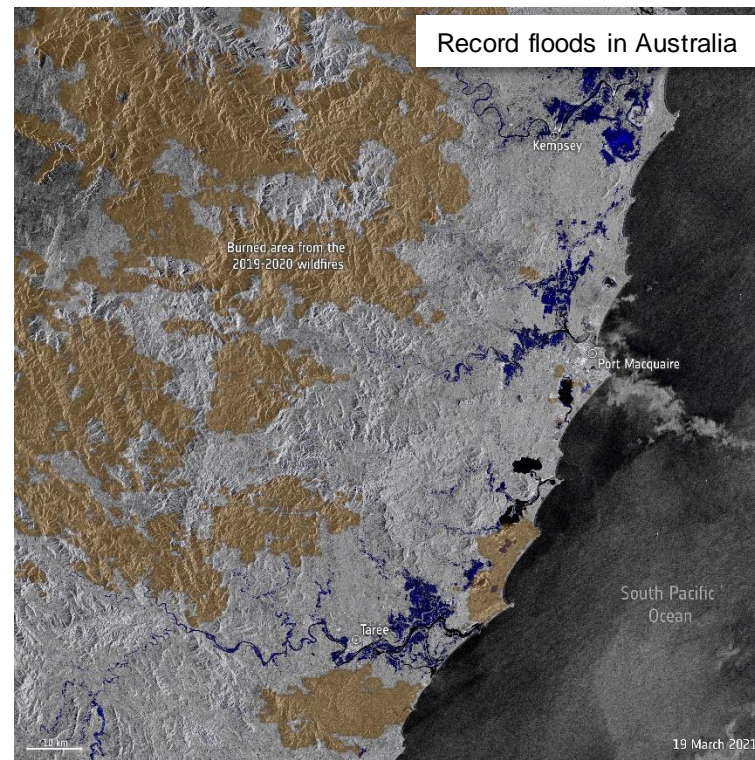
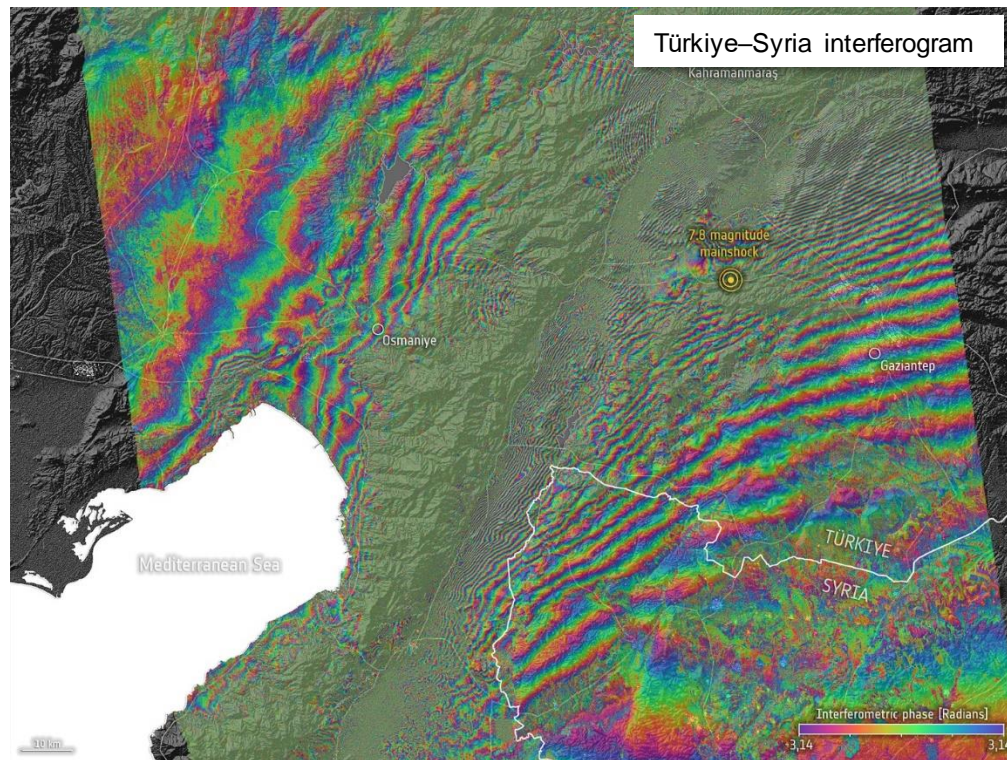
- Forestry
- Agriculture
- Ground deformation
- Urban planning
- Soil Moisture, Etc.



Sentinel-1 – Applications

Emergency management:

- Flood Monitoring
- Earthquake Analysis
- Landslide and volcano monitoring, etc.



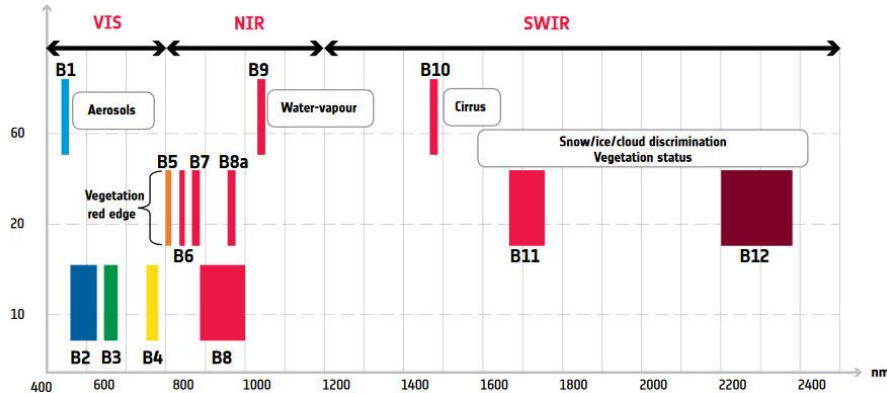
Sentinel-2 – Color vision

Mission objectives:

- Land management
- Agriculture
- Forestry
- Humanitarian relief operations
- Risk mapping and security concerns

Mission profile:

- Multi-Spectral imaging mission
- Sun-synchronous orbit 786 km,
- 290 km swath with 13 spectral bands (VIS, NIR & SWIR), at 10, 20 and 60 m spatial resolution
- 5 day revisit at Equator with 2 satellites



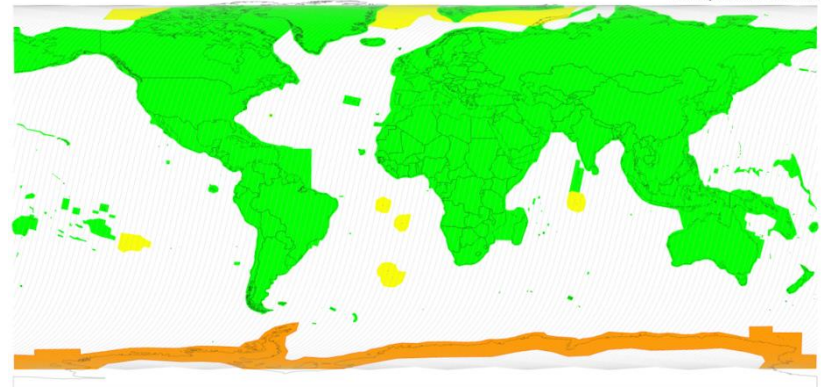
13 MSI bands are optimized for accurate atmospheric correction and vegetation monitoring

Source: http://esamultimedia.esa.int/docs/EarthObservation/Sentinel-2_ESA_Bulletin161.pdf

Sentinel-2 Constellation Observation Scenario: Revisit Frequency



Validity start: June 2022



5 days
10 days
10 days access from alternated tracks

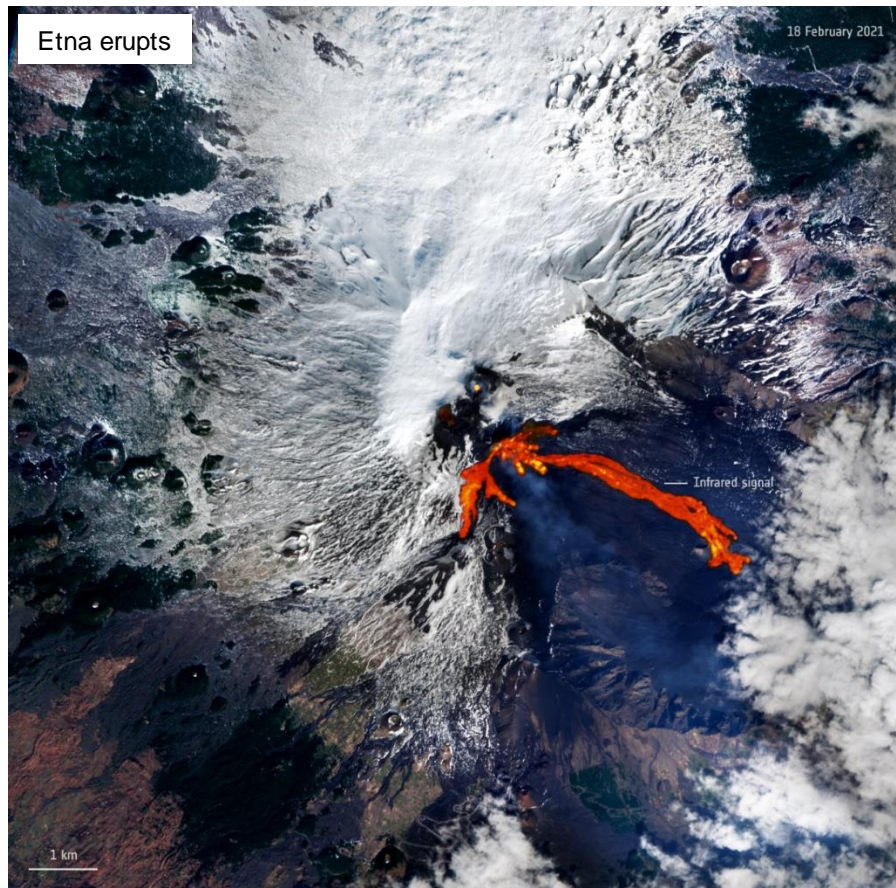
<https://sentinels.copernicus.eu>

Sentinel-2 – Applications

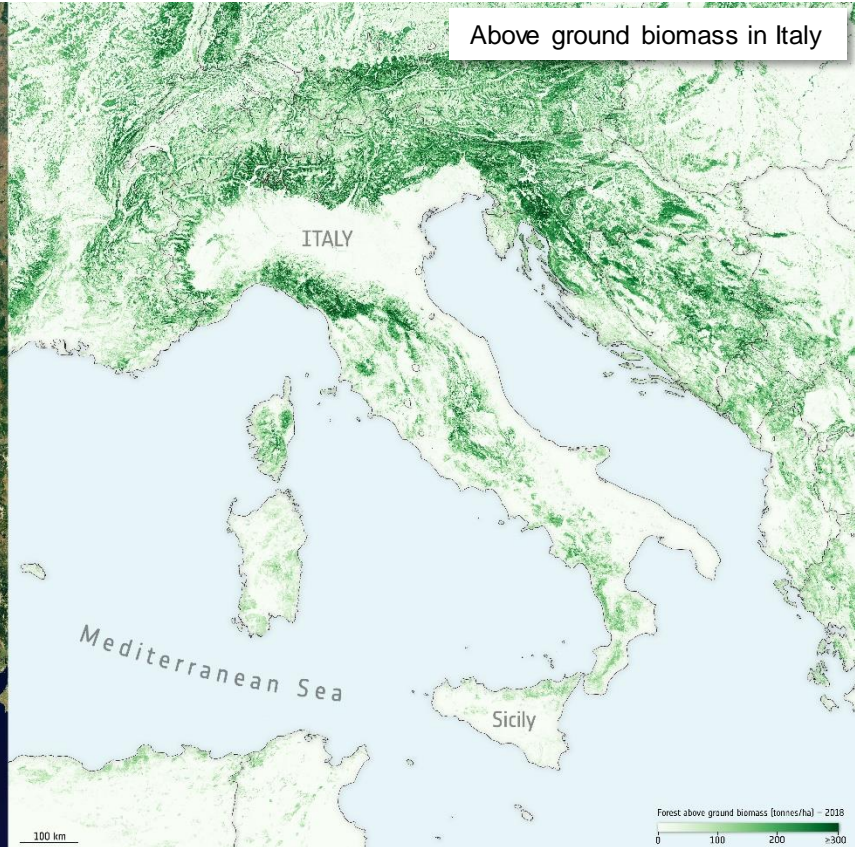
Europe land-cover mapped in 10 m resolution



Etna erupts



Sentinel-2 – Applications

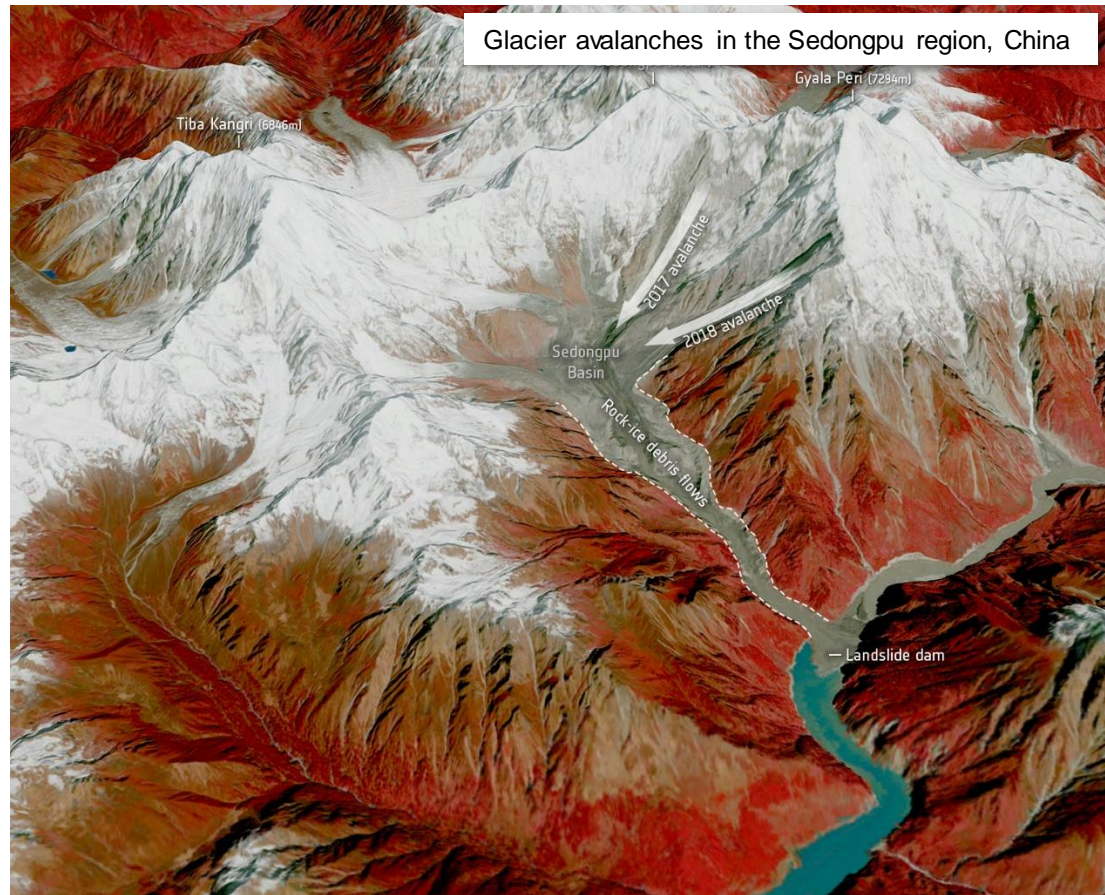


Sentinel-2 – Applications

Rhodes wildfire forces thousands to flee



Glacier avalanches in the Sedongpu region, China



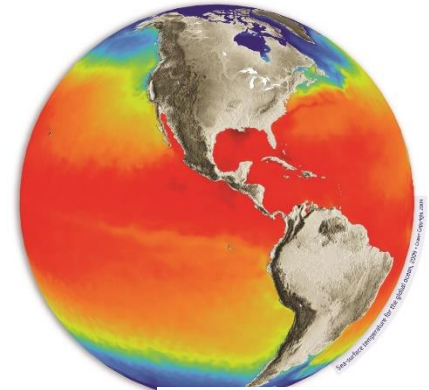
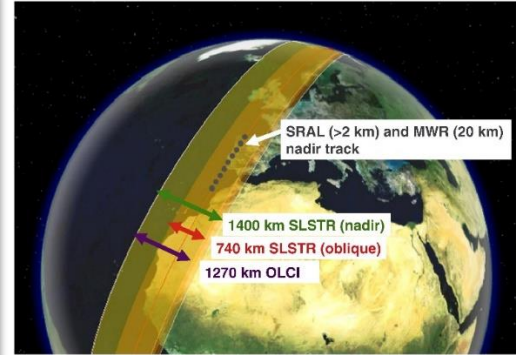
Sentinel-3 – A bigger picture

Mission objectives:

- Ocean, inland sea, coastal zone colour measurements
- Sea surface temperature measurements
- Sea surface topography measurements

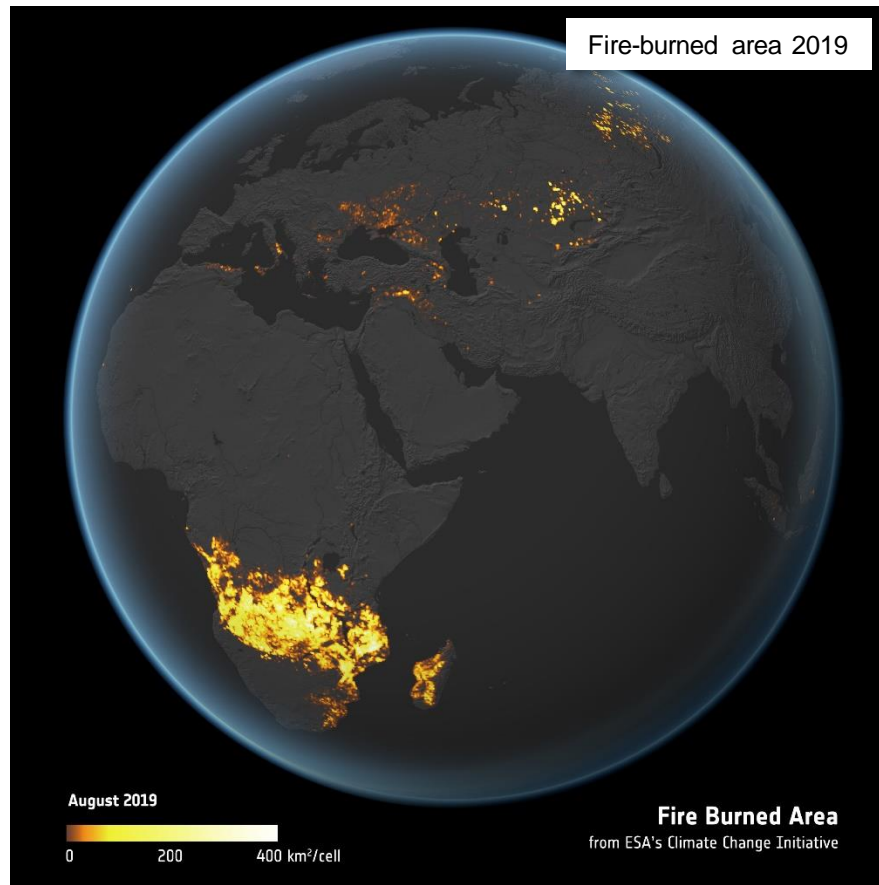
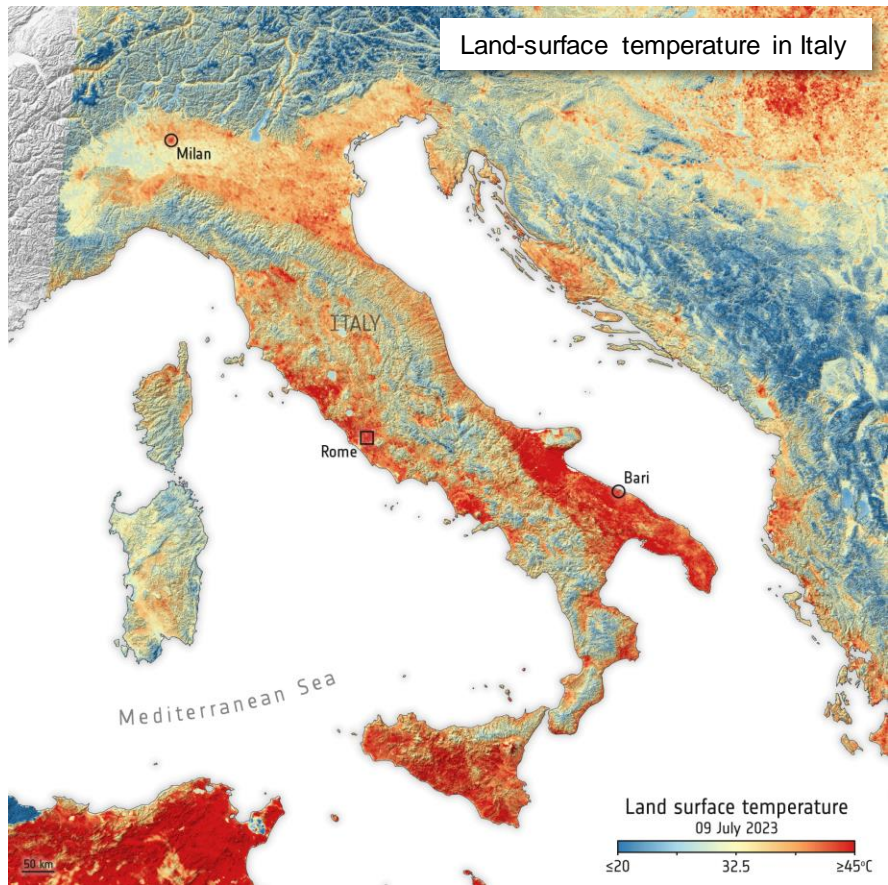
Mission profile:

- Operational mission in high-inclination, low Earth orbit
- Orbital cycle is 27 days
- Ocean and Land Colour Instrument (OLCI),
Sea and Land Surface Temperature Radiometer (SLSTR),
SAR Radar Altimeter (SRAL),
MicroWave Radiometer (MWR)
and Precise Orbit Determination (POD) instruments
- Full performance achieved with 2 satellites in orbit



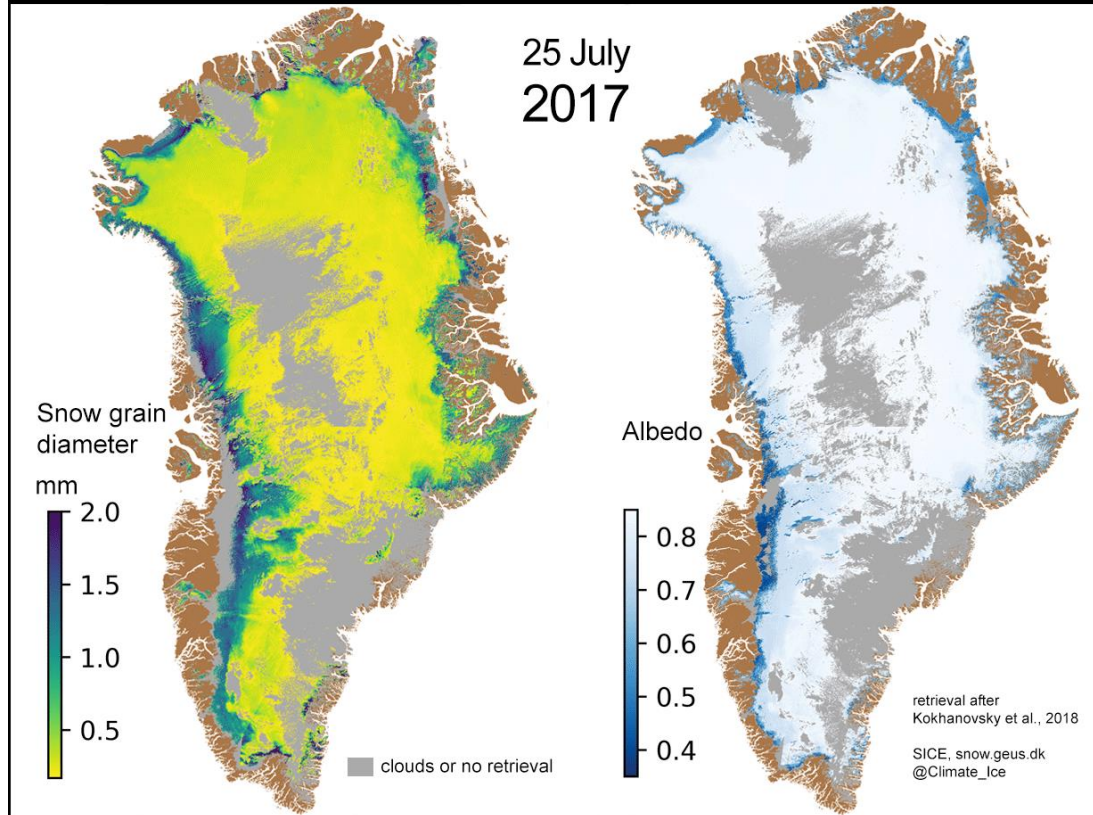
Sea-surface temperature

Sentinel-3 – Applications



Sentinel-3 – Applications

Greenland snow grain diameter and snow/ice albedo
Copernicus Sentinel-3 Ocean and Land Colour Instrument



Greenland snow grain and albedo

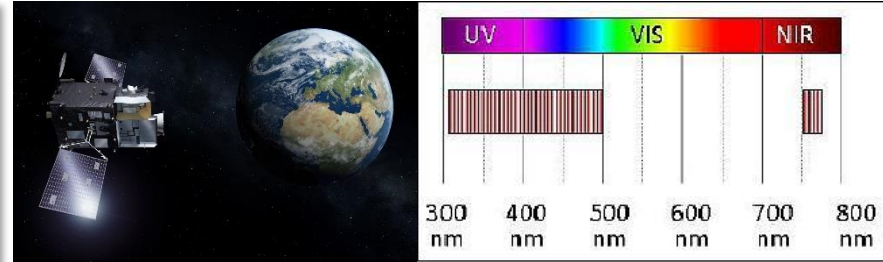
Sentinel-4 – European air monitoring

Mission objectives:

- Observing the diurnal cycle of the tropospheric composition over Europe and North Africa
- Monitoring in particular key air quality trace gases like O₃, NO₂, SO₂, HCHO, CHOCHO, as well as aerosol and cloud properties

Mission profile:

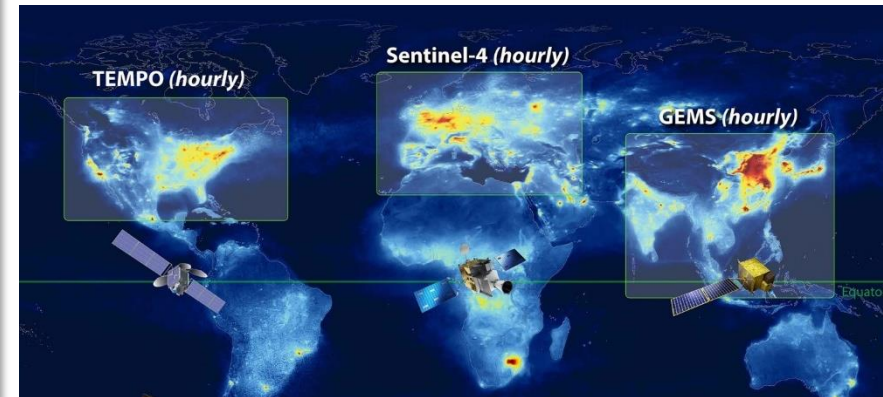
- Passive imaging spectrometer
- Three spectrometric bands: UV (305-400 nm), VIS (400-500 nm) and NIR (750-775 nm)
- Push-broom scanning (scan - E/W direction)
- Spatial resolution: 8x8 km²
- Revisit time: about 60 min



Sentinel-4.

Credits: ESA

Spectral coverage of the UVN Sounder. Credits: ESA



A pioneering new constellation of three space-based instruments has started to take shape to advance global air quality science and monitoring. Credits: NASA

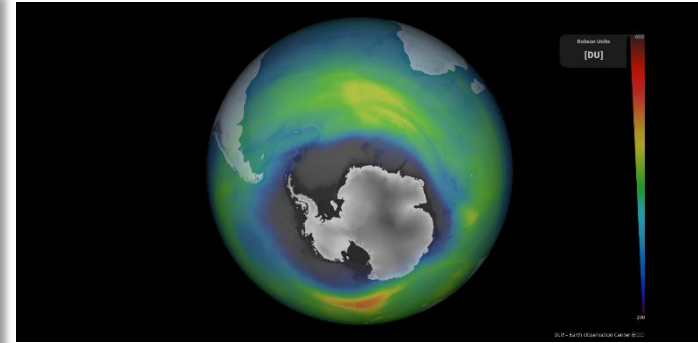
Sentinel-5P - Sentinel-5 – Global air monitoring

Mission objectives:

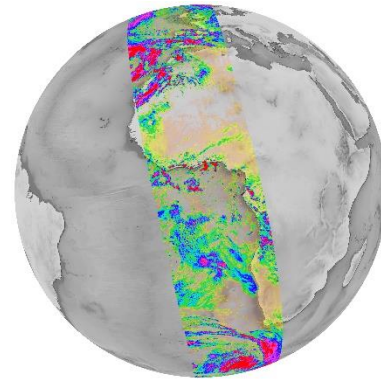
- Measuring, at the Top Of Atmosphere (TOA), the solar radiation reflected by and radiated from the earth
- Monitoring air quality, stratospheric ozone layer and climate change monitoring + forecasting

Mission profile:

- TROPOMI - space-borne, nadir-viewing, imaging spectrometer covering UV and SWIR bands
- Push-broom configuration (non-scanning), with a swath width of ~2600 km on the Earth's surface
- The typical pixel size (near nadir) will be $7 \times 3.5 \text{ km}^2$ for all spectral bands, with the exception of the UV1 band ($7 \times 28 \text{ km}^2$) and SWIR bands ($7 \times 7 \text{ km}^2$).



Ozone hole extension 2022. Credits: ESA

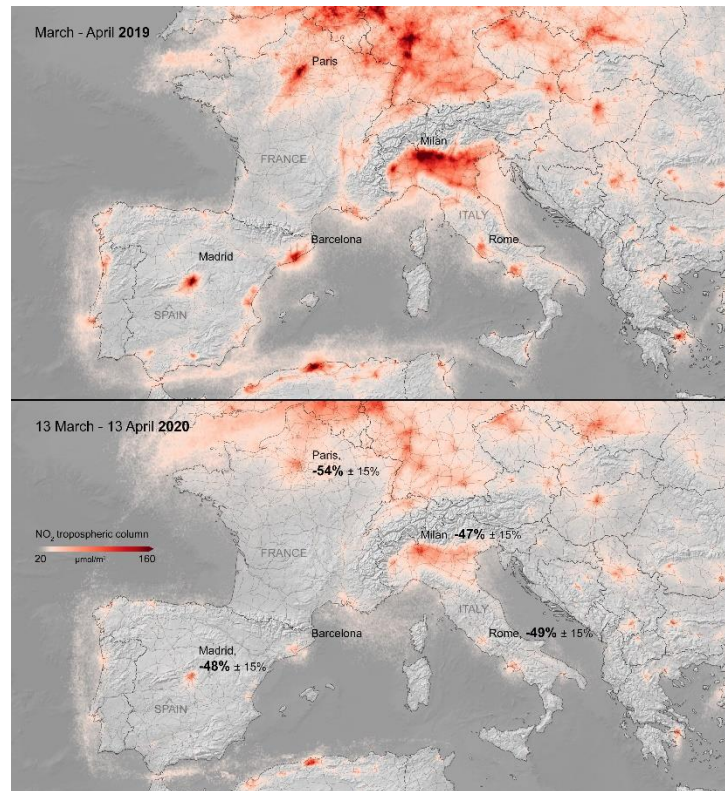


Cloud coverage seen in high resolution with Sentinel-5P. Credits: ESA

Sentinel-5P - Sentinel-5 – Applications

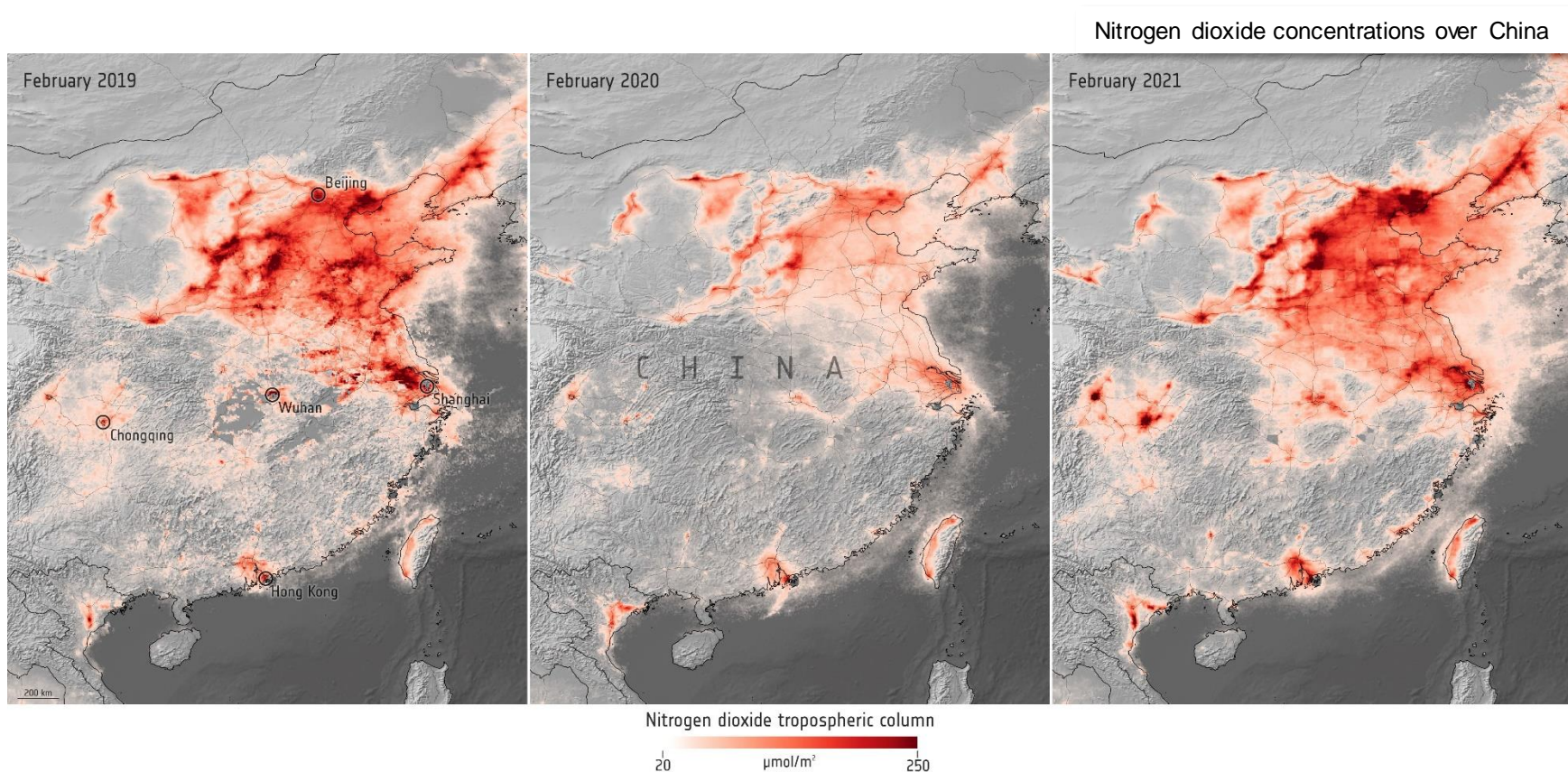


Methane enhancement over Libya



Nitrogen dioxide concentrations over Europe

Sentinel-5P - Sentinel-5 – Applications



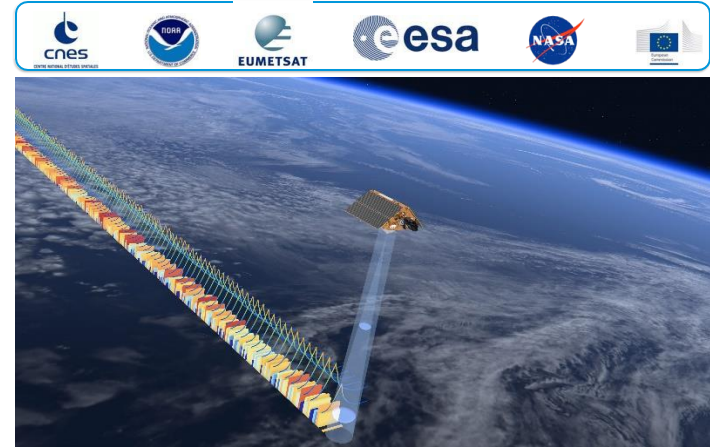
Sentinel-6/Jason-CS – Surfing the seas

Mission objectives:

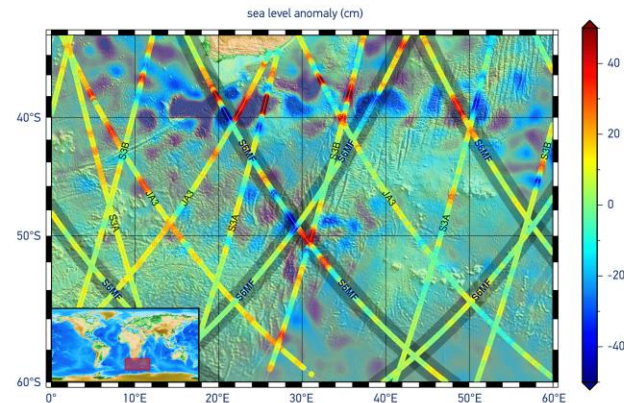
- Provide continuity of satellite altimetry measurements
- The mission will extend this measurement time series to ~2030+
- Reference mission in the CEOS-coordinated virtual constellation of ocean surface topography missions

Mission profile:

- High Resolution altimetry based on unfocused SAR (Synthetic Aperture Radar) processing combined with the conventional Low Resolution Mode (LRM) altimetry;

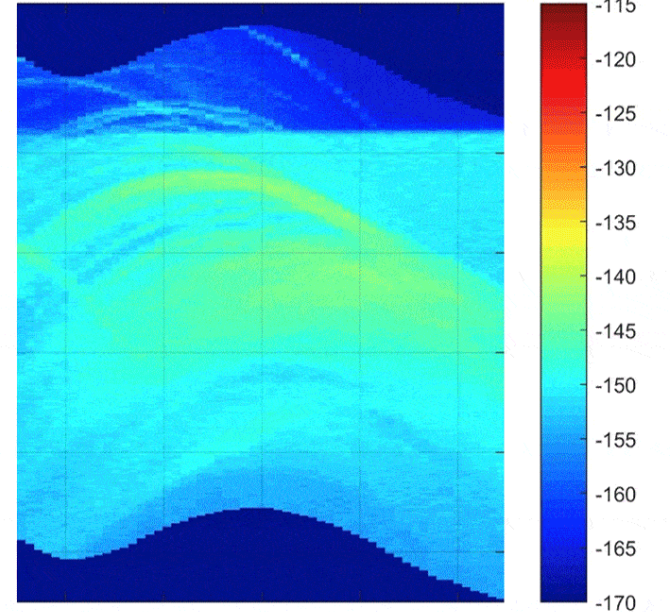
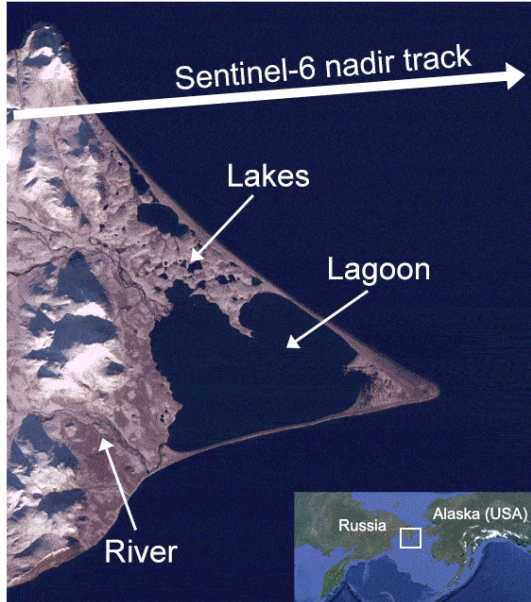


Copernicus Sentinel-6 radar altimeter. Credits: ESA



First sea-level height results from Copernicus Sentinel-6. Credits: ESA

Sentinel-6/Jason-CS – Applications



The images of Russia's Ozero Nayval Lagoon and surrounding rivers show multiple views from Copernicus satellites. The first is a 10-m resolution 'camera-like' image captured on 29 October 2020 by Copernicus Sentinel-2. The image is marked with the ground track of Copernicus Sentinel-6 as it crosses the region. The second is a radar image captured on 29 November 2020 by Copernicus Sentinel-1 in interferometric wide swath mode and processed to 10 m resolution. The lagoon has frozen over and numerous cracks are visible in the ice. Ocean swell and wind sea roughness are also seen in the ocean with some wave reflection and refraction on the southern coastal areas. The next image uses Copernicus Sentinel-6 pulse-limited low-resolution mode data for the same area. In this mode, similar to Jason-3, the strongest radar reflections appear as overlapping parabola features, but no discrimination of the ground can be made. Overlying the third image, the Copernicus Sentinel-6 Poseidon-4 fully-focused synthetic aperture radar image reveals features of the Ozero Nayvak Peninsular in fine detail. Credits: ESA

Service component

Copernicus services – provided free of charge for users:



Atmosphere



Marine



Land



Climate Change



Security



Emergency

Service component - Atmosphere

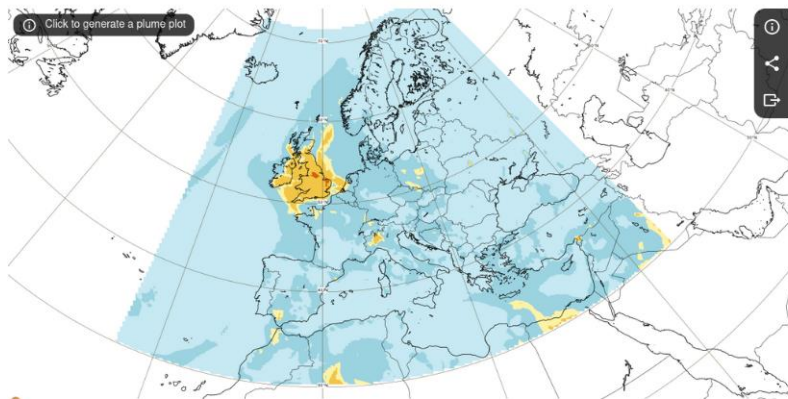


We provide consistent and quality-controlled information related to air pollution and health, solar energy, greenhouse gases and climate forcing, everywhere in the world.

The service focuses on five main areas:

- Air quality and atmospheric composition;
- Ozone layer and ultra-violet radiation;
- Emissions and surface fluxes;
- Solar radiation;
- Climate forcing.:

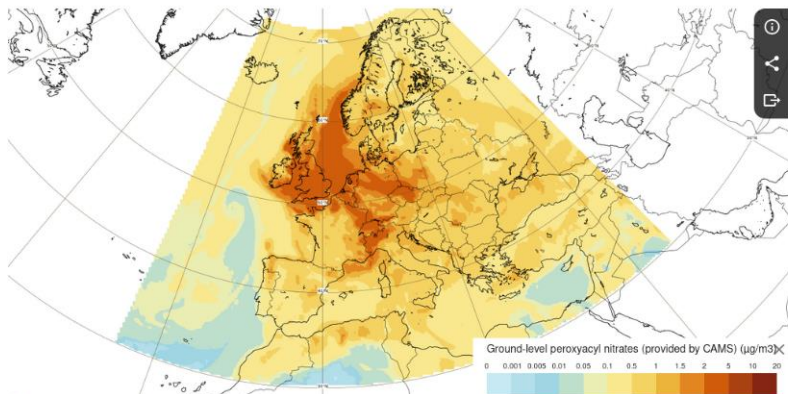
Service component - Atmosphere



Regulated pollutants

Forecasts of the five main air pollutants regulated by the European Union and the World Health Organization air quality standards: nitrogen dioxide (NO₂), ozone (O₃), coarse particulate matter (PM₁₀), fine particulate matter (PM_{2.5}) and sulphur dioxide (SO₂).

[Access the charts >](#)



Other air quality pollutants

European forecasts for other air quality pollutants: ammonia, carbon monoxide, formaldehyde, glyoxal, nitrogen monoxide, non-methane VOCs, peroxyacyl nitrates.

[Access the charts >](#)

Service component - Marine

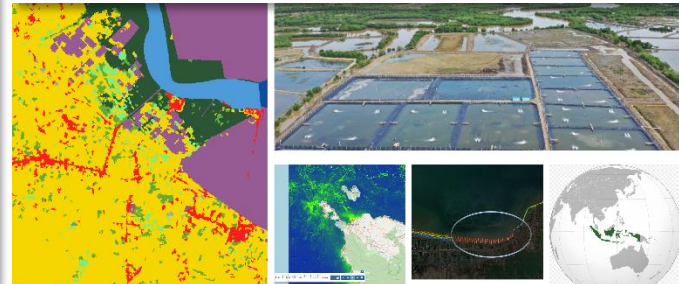
Provides free, regular and systematic authoritative information on the state of the Blue (physical), White (sea ice) and Green (biogeochemical) ocean, on a global and regional scale.

- combating pollution
- marine protection
- maritime safety and routing
- sustainable use of ocean resources
- developing renew. marine energy resources
- supporting blue growth
- climate monitoring, forecasting, etc.



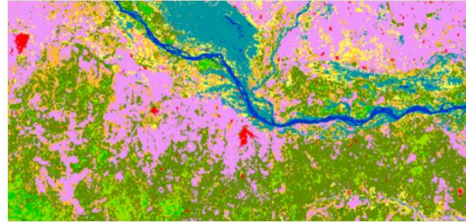
Support to coral reef protection: Coral Guardian.

Rheticus Marine for Water and Food Security
Planning and Investments in Indonesia



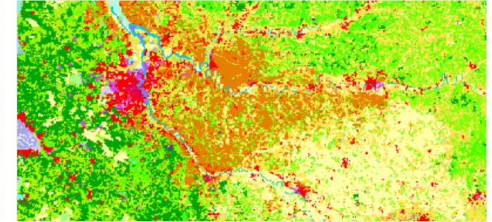
Service component - Land

- The systematic monitoring of biophysical parameters
- Land cover and land use mapping
- Thematic hot-spot mapping
- Imagery and reference data
- Ground motion



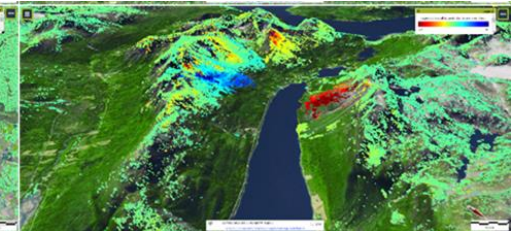
Dynamic Land Cover

The Dynamic Land Cover product provides a primary land cover scheme at three classification levels with class definitions according to the Land Cover Classification System (LCCS) scheme. The product is produced annually, and the actual version of the product (V3.0) is available for the 2015-2019 reference years.



CORINE Land Cover

CORINE Land Cover is a pan-European land cover inventory with 44 thematic classes. Initiated in 1985 (the 1990 reference year) the inventory is available for the 1990, 2000, 2006, 2012 and 2018 reference years including change layers 1990-2000, 2006-2012 and 2012-2018.



Lower left, ground motion in the surroundings of the Hambach surface mine in Germany; lower right, landslides in the slopes of a fjord near Tromsø (Norway).



Thank you for the attention

