



Applying C2RCC algorithm to EUMETSAT OLCI products

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EUMETSAT series of short courses: Applying Case 2 Regional Coast Colour (C2RCC) Algorithms to EUMETSAT OLCI Products





“Applying C2RCC algorithm to EUMTESAT OLCI products”

24th October:

- Introduction to OLCI
- The atmospheric problem on complex waters
- In-water retrieval of water quality (WQ) parameters

Demos:

1. Accessing OLCI data: the EUMETSAT Data Store
2. Navigating OLCI data: analysing L1 and L2 with SNAP

25th October:

- The Case 2 Regional Coast Colour Algorithm
- The OLCI product catalogue

Demos:

1. C2RCC (batch) processing with SNAP

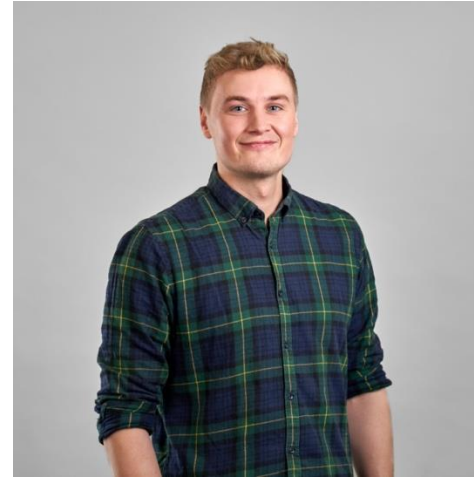
Q & A



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Introduction to OLCI

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²*Universitat de València*

EUMETSAT series of short courses: Applying Case 2 Regional Coast Colour (C2RCC) Algorithms to EUMETSAT OLCI Products

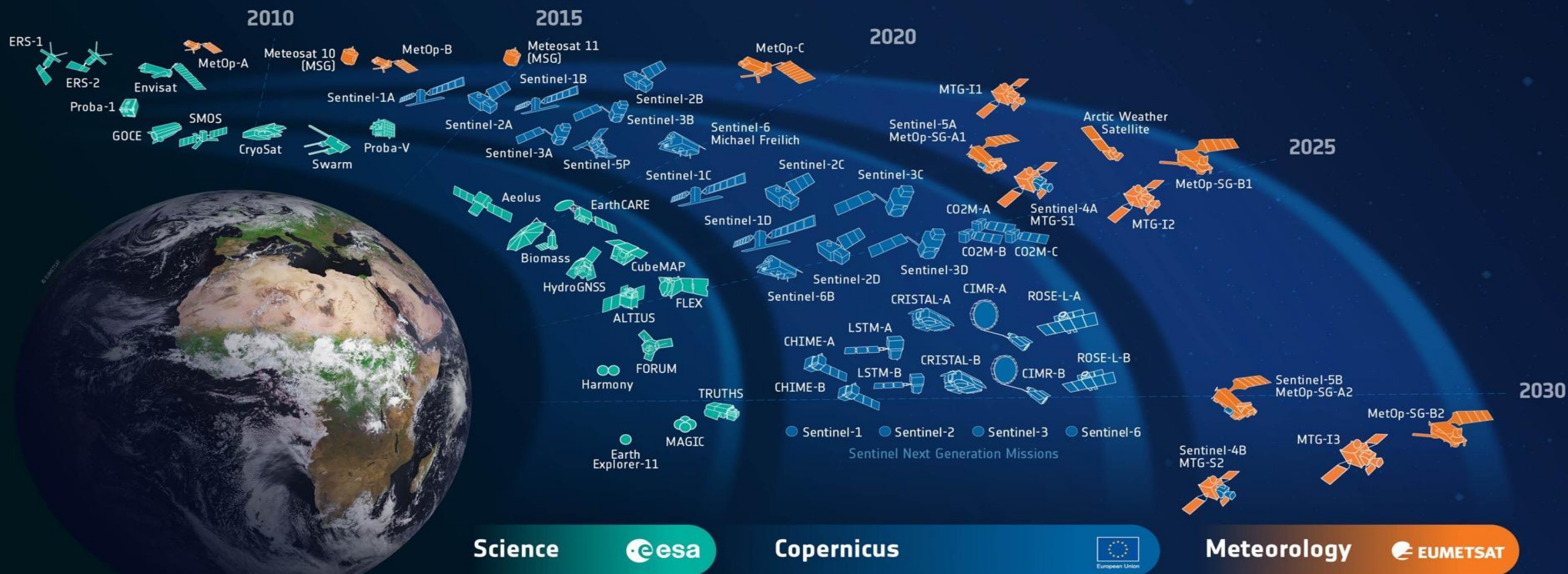




- Introduction about the course
- Introduction to OLCI
- Demo 1: Accessing OLCI from the EUMETSAT Data Store



European Earth Observation missions





Marine missions: Sentinel-3

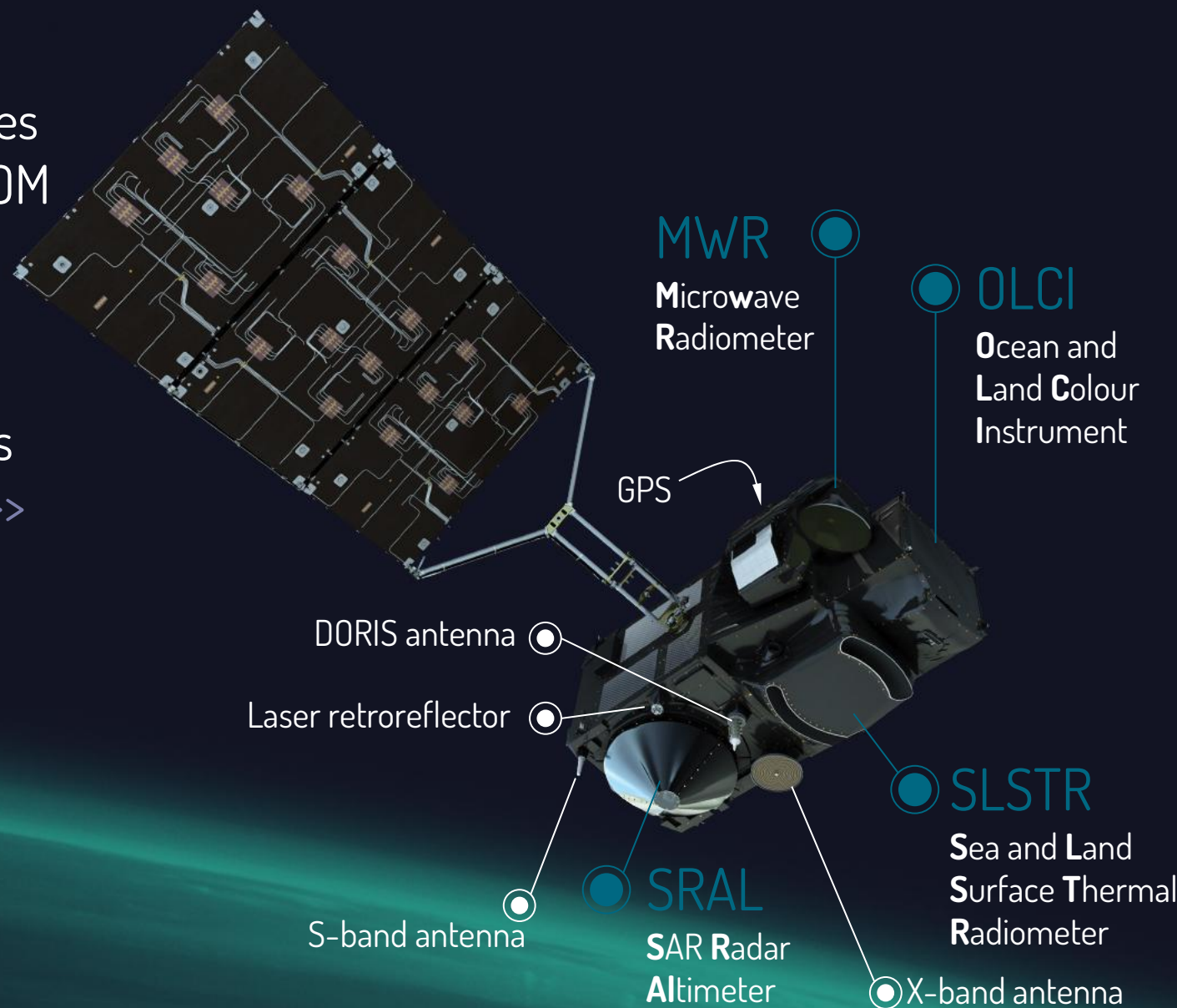
- The “blue” sentinel; suite of ocean observing instruments.
- Main objectives: acquire **sea-surface topography**, **sea surface temperature** and **ocean colour data**.
- Constellation of two platforms:
 - Sentinel-3A launched February 2016
 - Sentinel-3B launched April 2018
- Sun-synchronous 98.65° polar orbit, 27 day cycle.
- Near global coverage; <2 day revisit (**optical**) and <1 day (**thermal**).
- EUMETSAT operates the satellite & provides the marine data stream
 - Level-1 and level-2
 - Main user & provider of level-3, level-4 is Copernicus Marine Service
 - Redistributed (and used) by NOAA

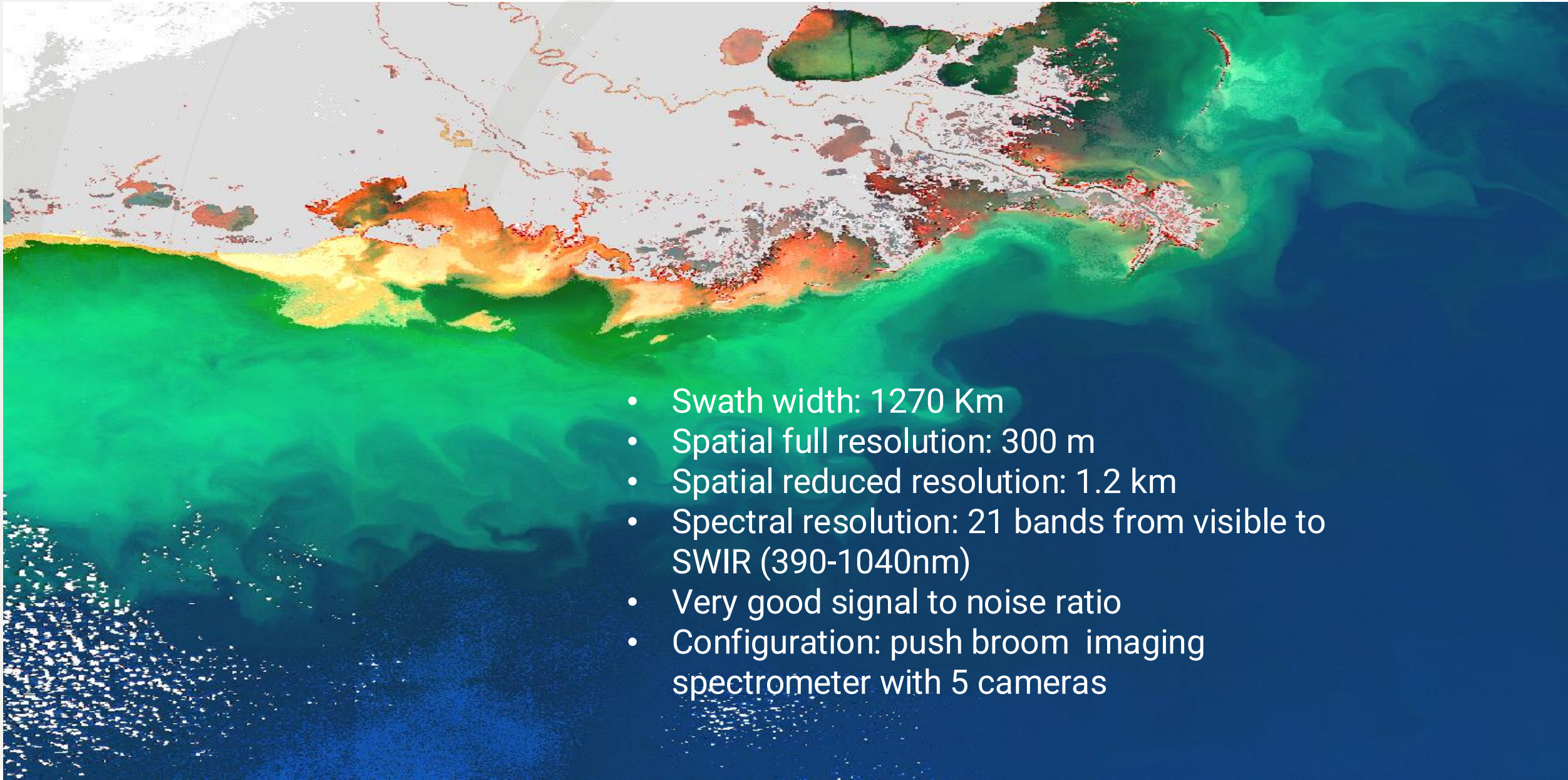




Sentinel-3 instruments and variables

- **OLCI** >> visible radiometry
 - **ocean colour**: radiances & reflectances
 - chlorophyll, suspended sediment, CDOM
 - PAR / kd490
- **SLSTR** >> thermal radiometry
 - radiances & brightness temperatures
 - Sea and sea-ice surface temperatures
- **SRAL / MWR / POD (DORIS/GNSS/LRR)** >> surface topography mission
 - Sea surface height
 - Significant wave height
 - Wind speed





- Swath width: 1270 Km
- Spatial full resolution: 300 m
- Spatial reduced resolution: 1.2 km
- Spectral resolution: 21 bands from visible to SWIR (390-1040nm)
- Very good signal to noise ratio
- Configuration: push broom imaging spectrometer with 5 cameras



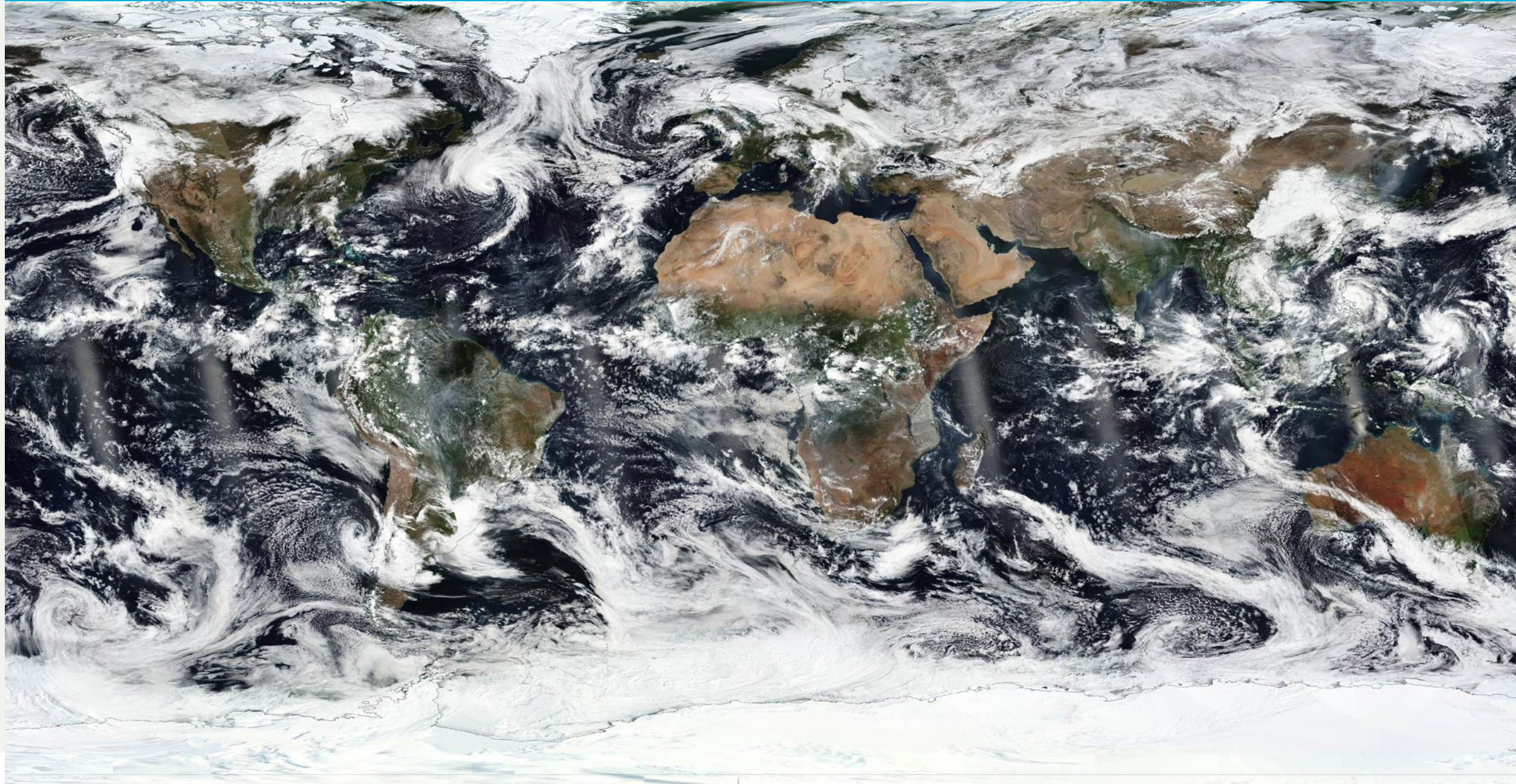
OLCI in movement

www.eumetsat.int





Earth is cloudy!

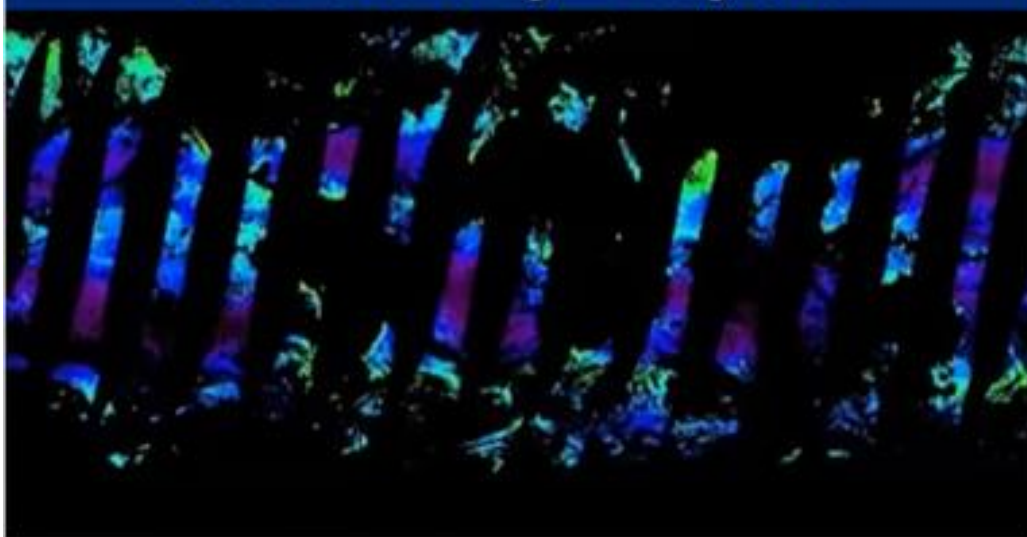




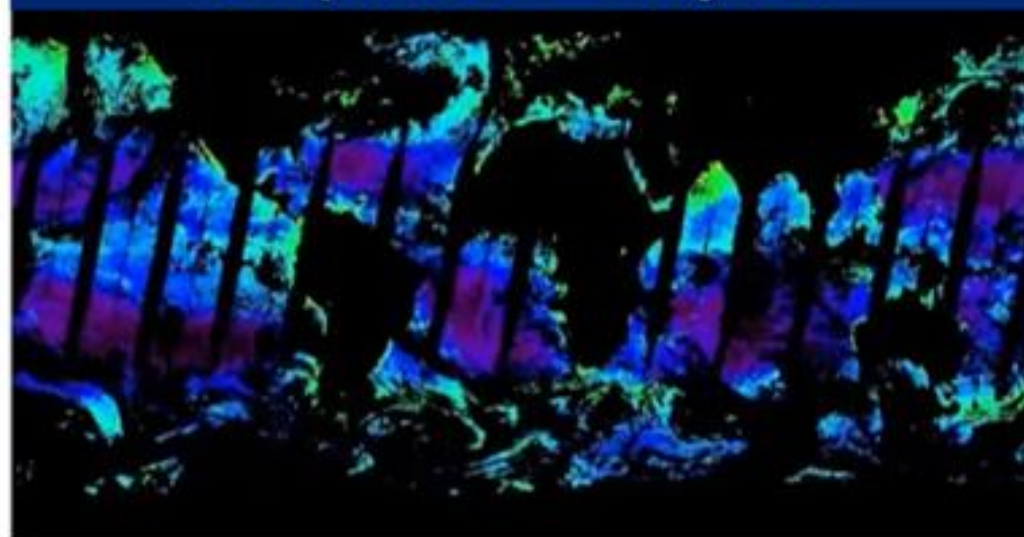
Sentinel-3A and Sentinel-3B constellation

www.eumetsat.int

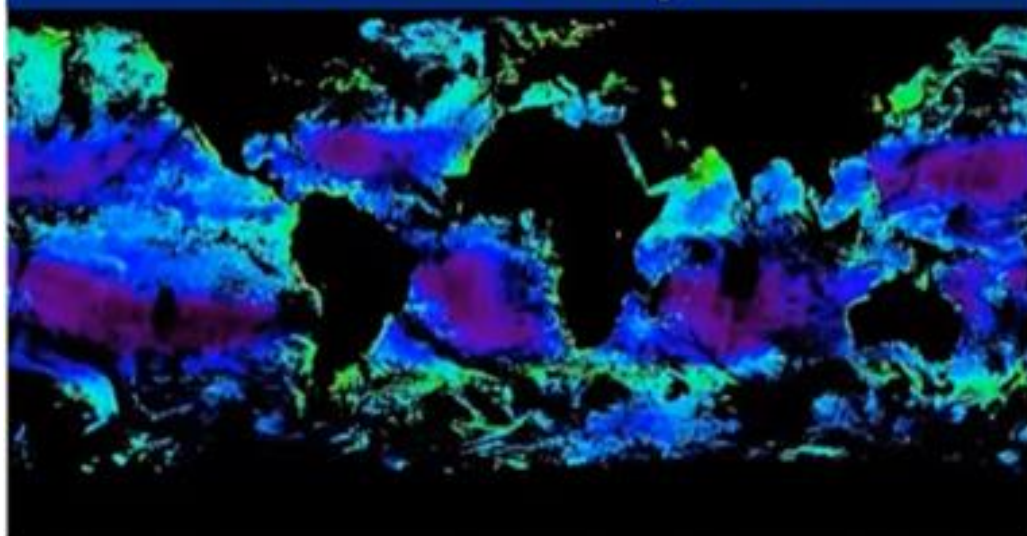
Sentinel-3A only – 1 day OLCI



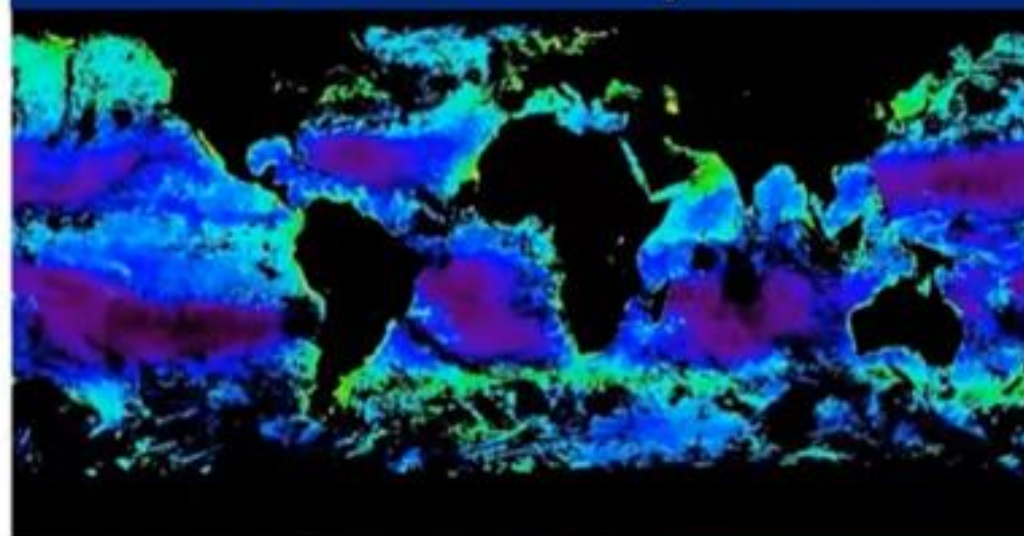
S-3A plus S-3B – 1 day OLCI



S-3A + S-3B – 2 day OLCI

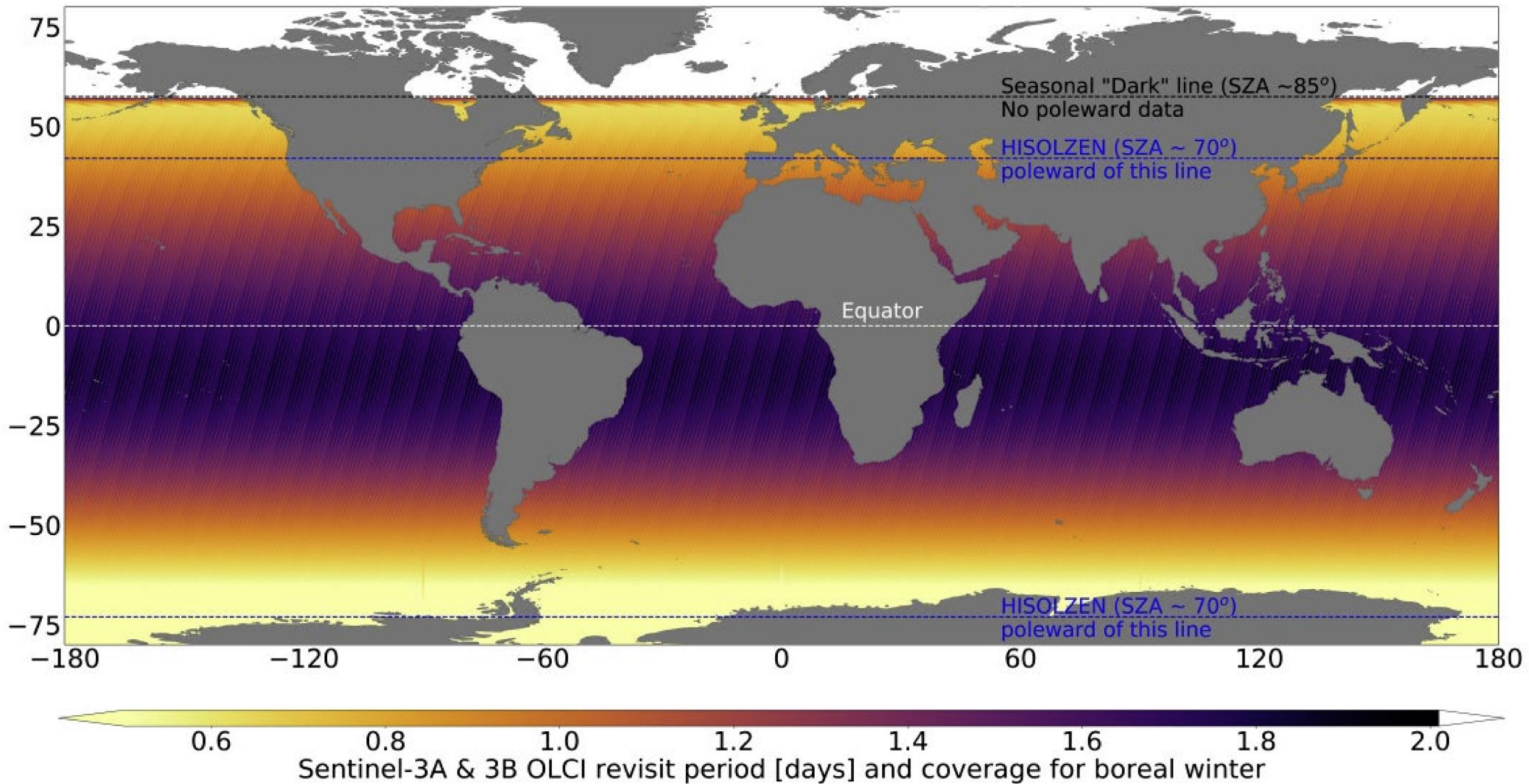


S-3A + S-3B – 3 day OLCI



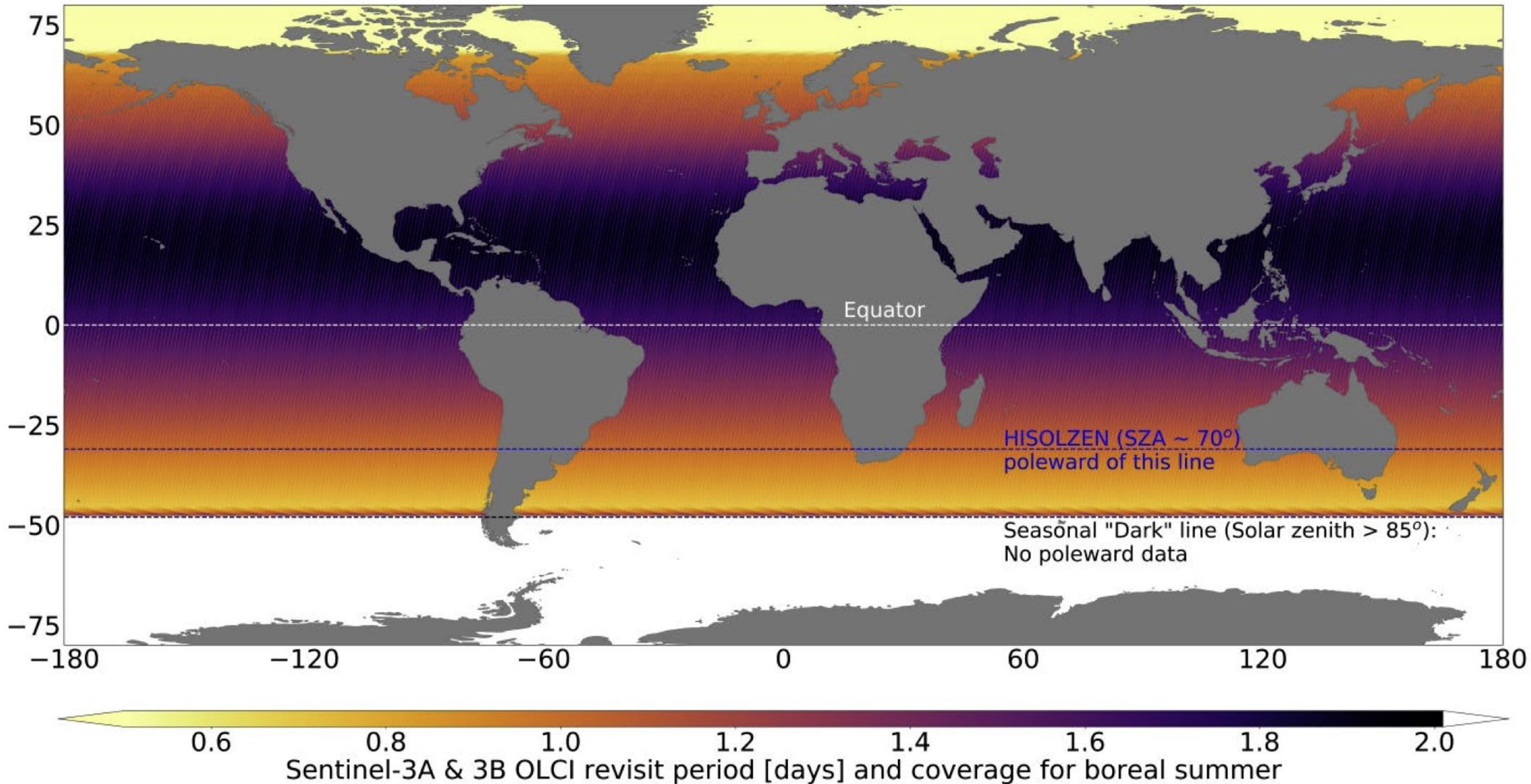


Coverage maps: OLCI Northern Hemisphere Winter





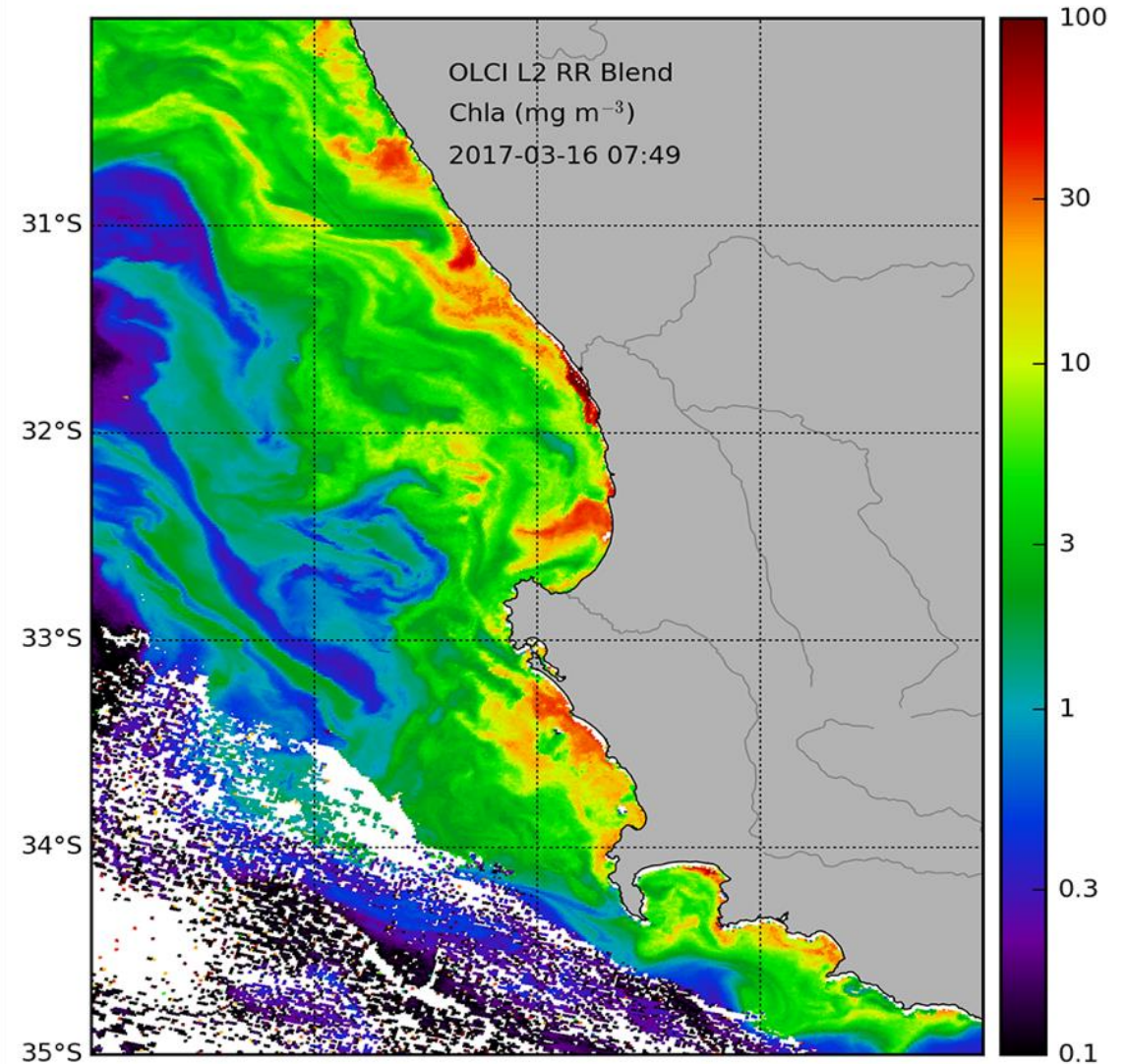
Coverage maps: OLCI Northern Hemisphere Summer





OLCI sensor – Algal Pigment Chlorophyll-a Concentrations:

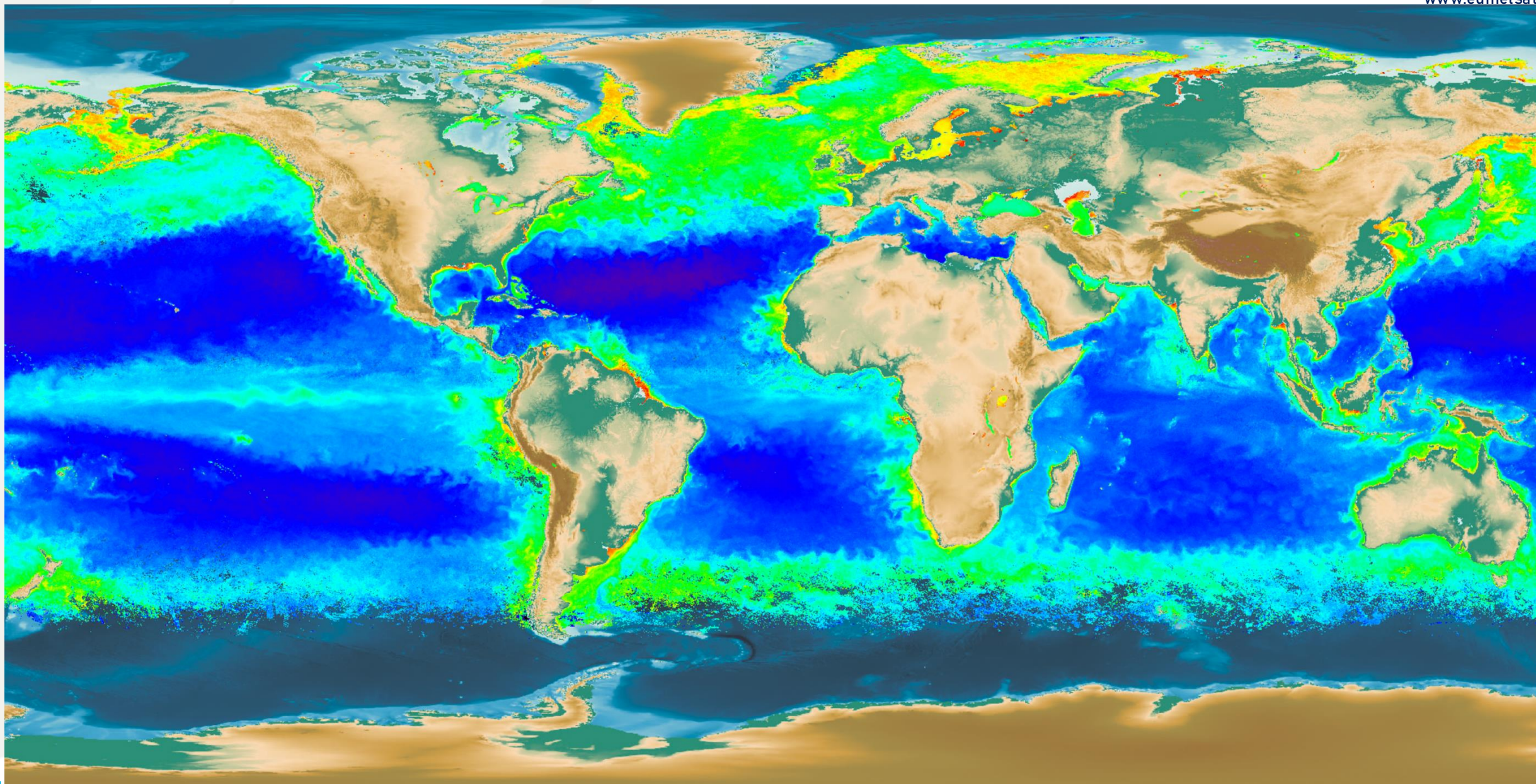
- Full Resolution (FR) 300m
- 21 spectral bands (RGB - SWIR)
- Excellent Signal to Noise Ratio.
- Measures to 1 optical depth; determined by what is suspended in surface waters (and how much).





Chlorophyll-a concentration

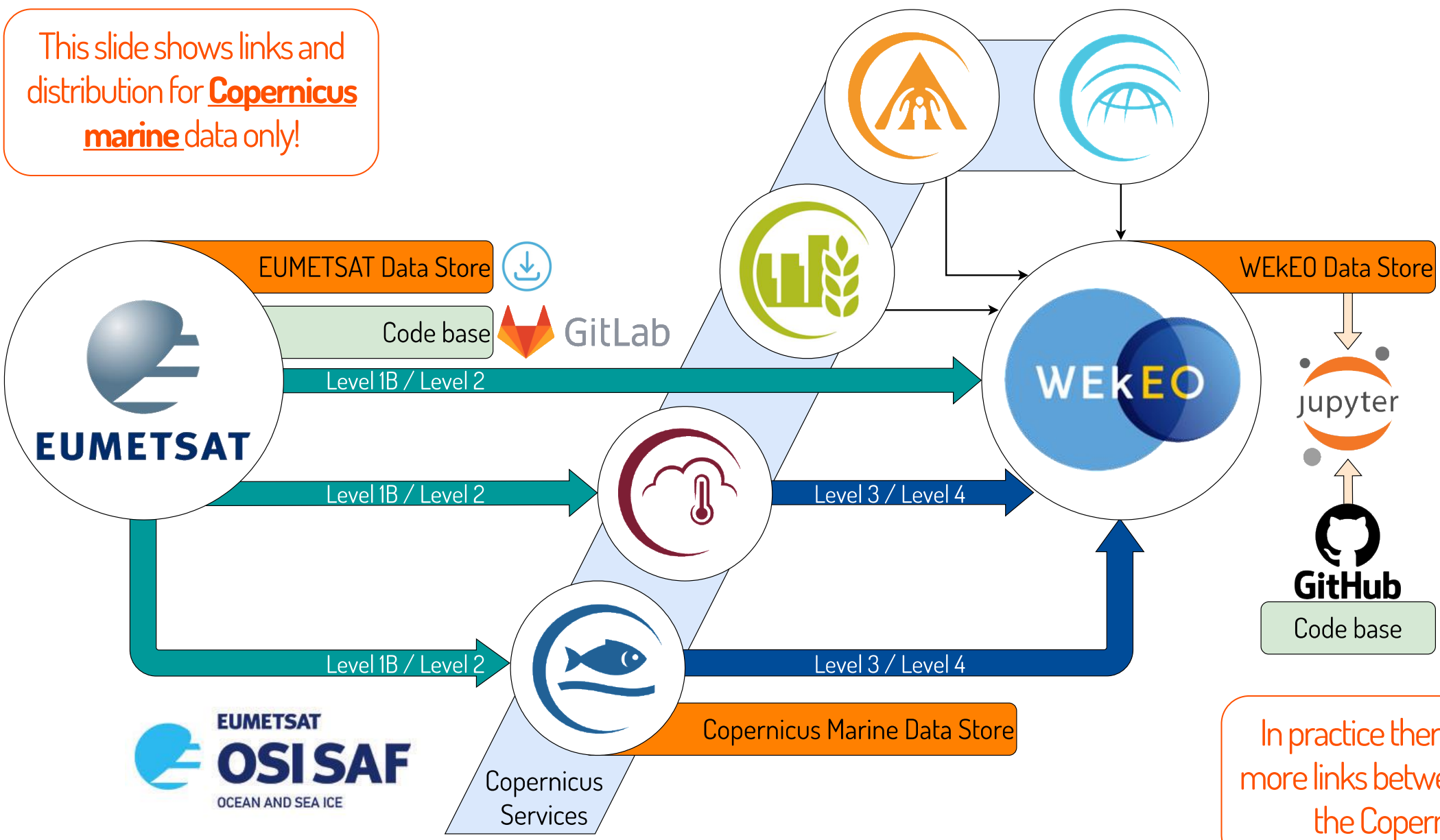
www.eumetsat.int





EUMETSAT Copernicus marine data distribution

This slide shows links and distribution for **Copernicus marine** data only!



In practice there are many, many more links between EUMETSAT and the Copernicus Services



The **EUMETSAT Data Store** provides single point of access to a growing catalogue of EUMETSATs meteorological, climate and ocean data.

- All operational Sentinel-3 data can be accessed.
- Reprocessed data added as reprocessings complete
- For OLCI, a complete level-2 archive is already available.
- Feeds in to WEkEO harmonised data access
- Sentinel-6 reprocessing available, operational feed coming soon.

Data collections

Near real-time products

Historic & reprocessed products

Climate data records

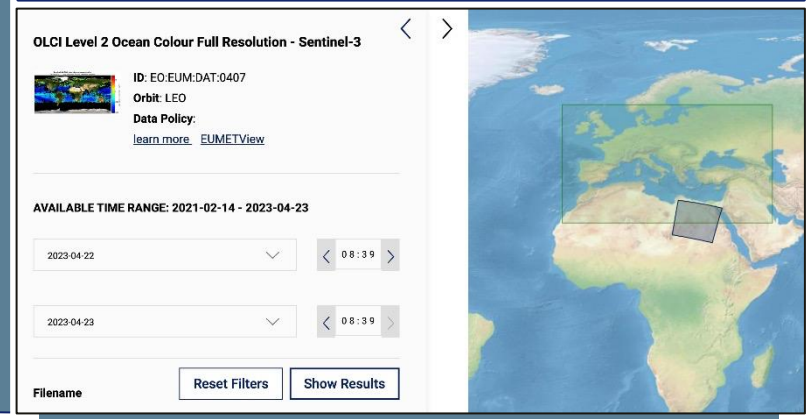
EUMETSAT Data Access Client (eumdac)

Service available at: <https://data.eumetsat.int>



Data Store Interfaces

Online web user interface



1 Browse API

2 OpenSearch API

3 Download API

4 Subscription API



Processing Level	Description
Level 0	Reconstructed, unprocessed instrument and payload data at full resolution, with communications artefacts removed. Not distributed.
Level 1 (a+b+c)	Reconstructed, unprocessed, top-of-atmosphere instrument data at full resolution, time-referenced, and annotated with ancillary information.
Level 2 (+p)	Derived geophysical variables at the same resolution and location as Level 1 source data. Usually atmospherically corrected.
Level 3	Variables mapped on uniform space-time grid scales , usually with some completeness and consistency. Except topography (L4)
Level 4	Model output or results from analyses of lower-level data (e.g., variables derived from multiple measurements, gap filled, temporally aggregated)

NOTE: There are differences in how parts of the remote sensing community define processing levels. And different instruments will include different methods at each level. Look at individual handbooks, product guides, ATBDs etc for more information.



← Pull services Push services →



Viewing your data (WMS / WCS)

EUMETView*



Long term archive

EUMETSAT Data Centre



Copernicus operational and reprocessed data access

EUMETSAT Data store



Data customisation

Data Tailor



Near-real time data delivery via satellite networks

EUMETCast Satellite



Near-real time data delivery via terrestrial networks

EUMETCast Terrestrial

*new generation

Data Store has replaced the CODA and CODAREP services used by many Sentinel-3 users, offering unified access to operational and reprocessed data. It will allow access long time-series of the most up to data products, via a single point without the use of Data Centre in most cases (including to WEkEO).





Demo 1. The EUMETSAT Data Store

WebUI: machine to human


The screenshot displays the EUMETSAT Data Store WebUI. At the top, it shows search results for 'OLCI Level 1B Full Resolution - Sentinel-3'. Below this, there are several panels: a search bar, a list of products with columns for date, time, and status, and a map showing the geographic distribution of the data. The interface is designed for human interaction, with clear labels and intuitive navigation.

API: machine to machine

The screenshot displays the EUMETSAT Data Store API interface. It shows a 'Dataset Access Form' with fields for 'Data URL', 'Global Attributes', and 'Variables'. Below the form, there is a 'JSON API request' window showing a sample request for 'Sea water velocity' data. The interface is designed for machine-to-machine communication, with a focus on providing the necessary parameters and data for API calls.



Demo1. Jupyter Notebooks with EUMDAC (GitLab)

- APIS can be hard to use, so we wrote EUMDAC (EUMETSAT Data Access Client) to facilitate automated data Access.
- Source code available at: <https://gitlab.eumetsat.int/eumetlab/data-services/eumdac> 
- We offer a series of examples showing how to EUMDAC via:
 - Command line (see user guides)
 - Python library – supporting Jupyter notebooks available
- Within the learn-OLCI repository folders we show:
 - Advanced search and filtering options
 - Navigating operational and reprocessed collections to acquire time series
- EUMDAC embedded in ThoMaS toolkit

README.md

etsat.int

EUMDAC - EUMETSAT Data Access Client

EUMDAC is the EUMETSAT Data Access Client. It provides simple access to the EUMETSAT data of all satellite missions. As a Python library, it comes with many methods and helpers to use EUMETSATs APIs and services, like Data Store and Data Tailor. As a CLI, it provides a variety of useful command line utilities for data search, translation and processing.

Please consult the following documentation for more information:

- [EUMDAC User Guide](#) - Installing and using the CLI and library.
- [EUMDAC API Reference](#) - Detailed information on classes, functions, and modules, including method descriptions and parameter usage.

Prerequisites

You will need a python environment to run the library implementation of this code. EUMDAC requires Python 3.7 or higher. We recommend that you install the latest Anaconda Python distribution for your operating system (<https://www.anaconda.com/>). No prerequisites are identified for running the CLI binary.

Installing the EUMDAC library and CLI

Installing with PIP

The EUMDAC Python package is available through [PyPI](#):

```
pip install eumdac
```

Installing with Conda

To install EUMDAC on the Anaconda Python distribution, please visit the [EUMETSAT conda-forge page](#) for install instructions.

```
conda install -c eumetsat-forge eumdac
```

Installing from source

To install EUMDAC from the development source, clone the repository and install it locally.

```
git clone https://gitlab.eumetsat.int/eumetlab/data-services/eumdac.git
cd eumdac
pip install .
```



SNAP SeNtinel Applications Platform





SNAP is

- an ecosystem to analyse, process and communicate Earth Observation data
- an Open-Source Project - github.com/senbox-org
- scalable to run on notebooks up to large production clusters
- used for scientific analysis, operational production and training
- easy to use

SNAP can

- access many satellite-based Earth Observation data products as well as generic raster formats directly in the cloud
- visualise the data in many ways
- analyse data using statistical functions, mathematical operations, correlation, comparison with point and vector data
- process satellite data with instrument specific as well as generic raster data operations
- save sessions and export results in various raster and non-raster formats
- be extended using Java and Python API

SNAP has

- comprehensive documentation - step.esa.int
- > 1 Million users and active community, > 10 000 forum users - forum.step.esa.int
- a long-term commitment of the European Space Agency

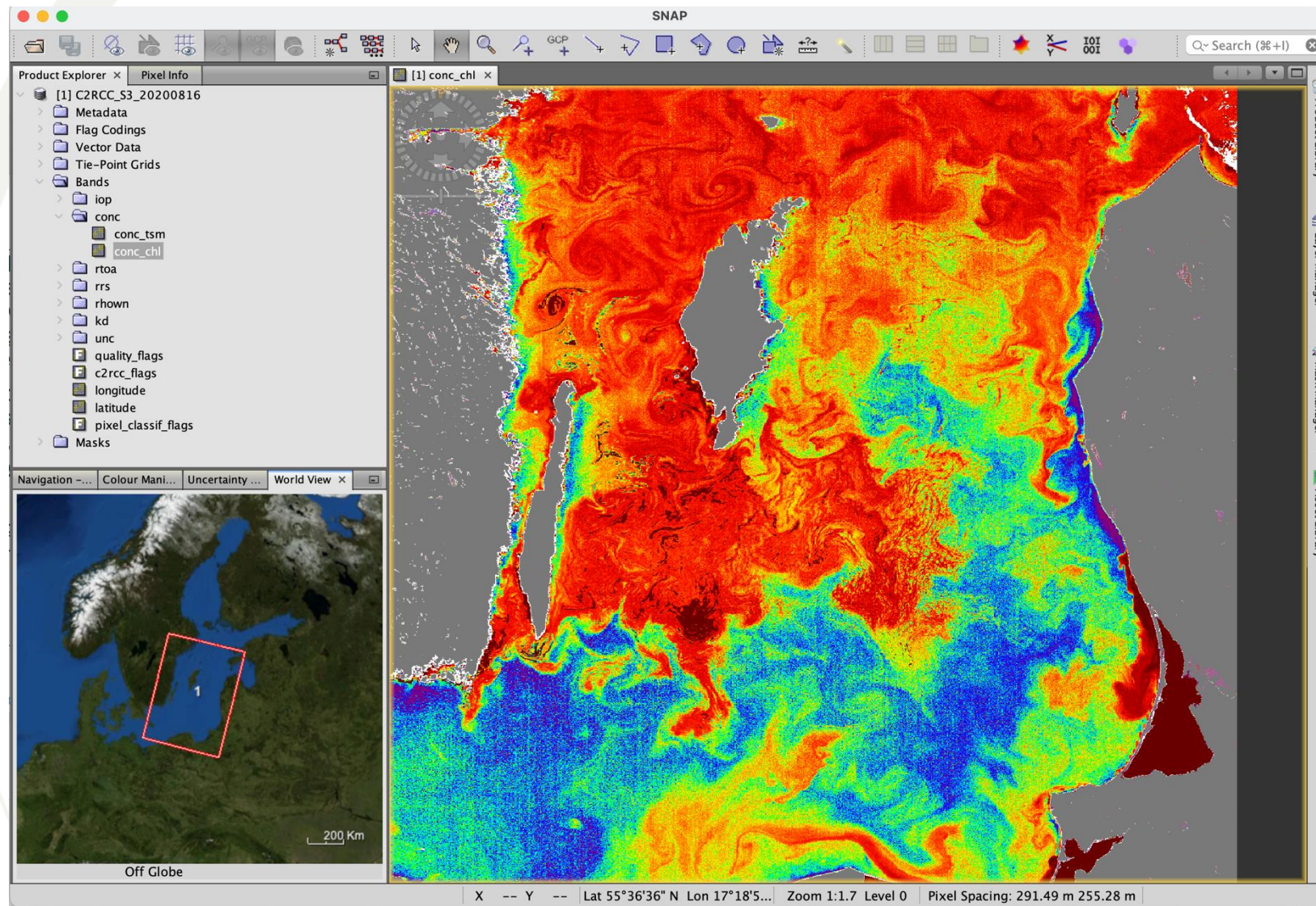




SNAP Desktop is the GUI application which allows access to a large number of EO and generic raster data.

It provides various tools to display the data, and to visually analyse them.

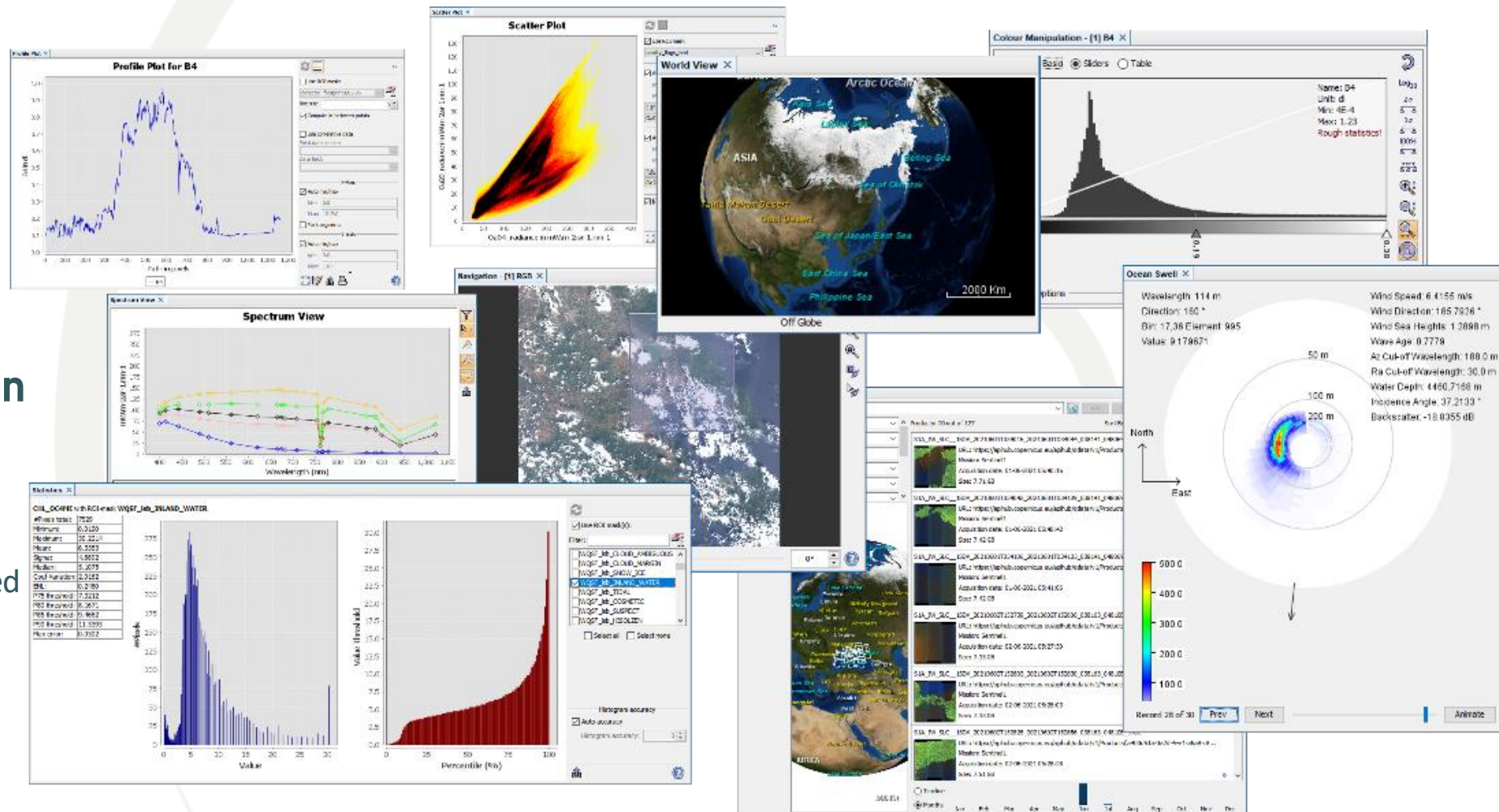
The figure on the right shows the OLCI chlorophyll-a products from C2RCC.





SNAP provides a rich suite of tools for data analysis, including profile and spectrum plots, statistical analysis, extraction of points through time series, and comparison with reference data (match-ups).

The figure shows some of the graphical analysis tools included in SNAP.

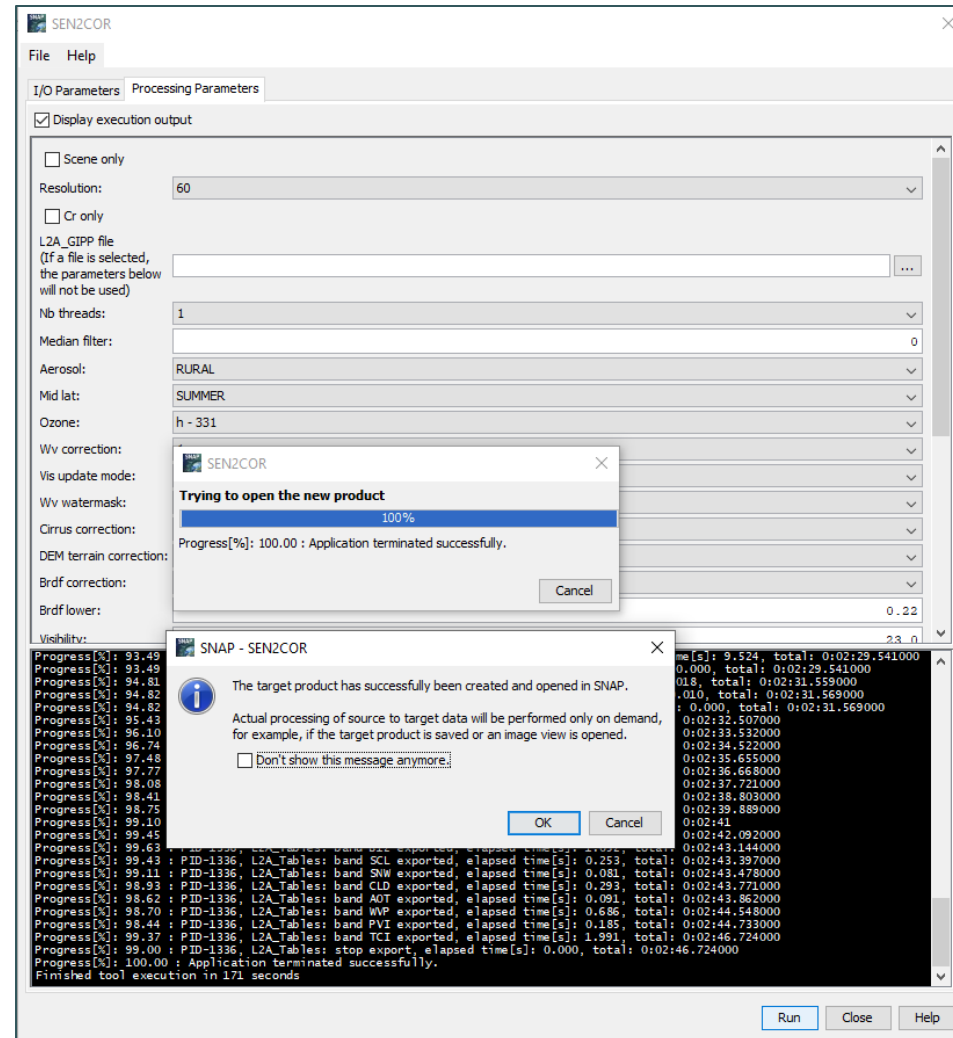


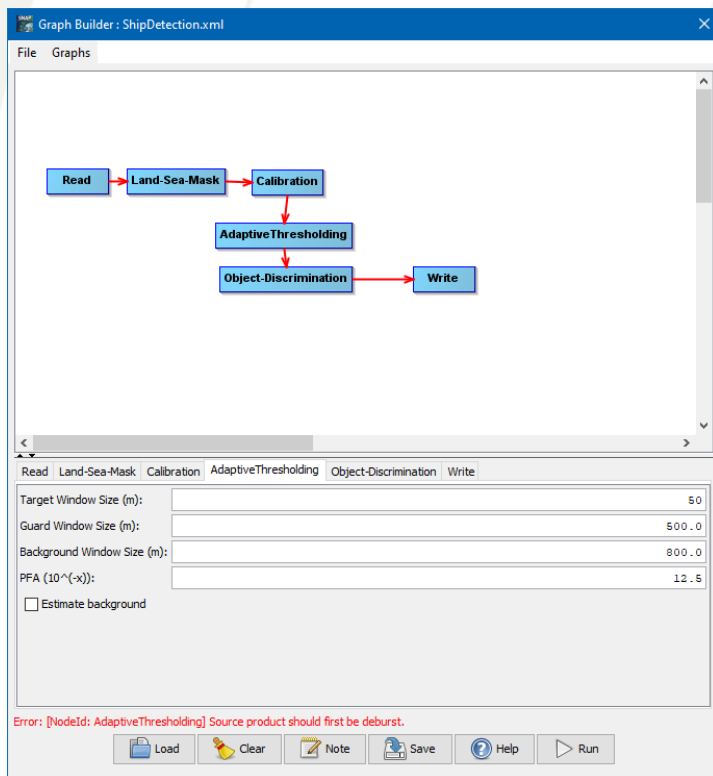


SNAP data processing

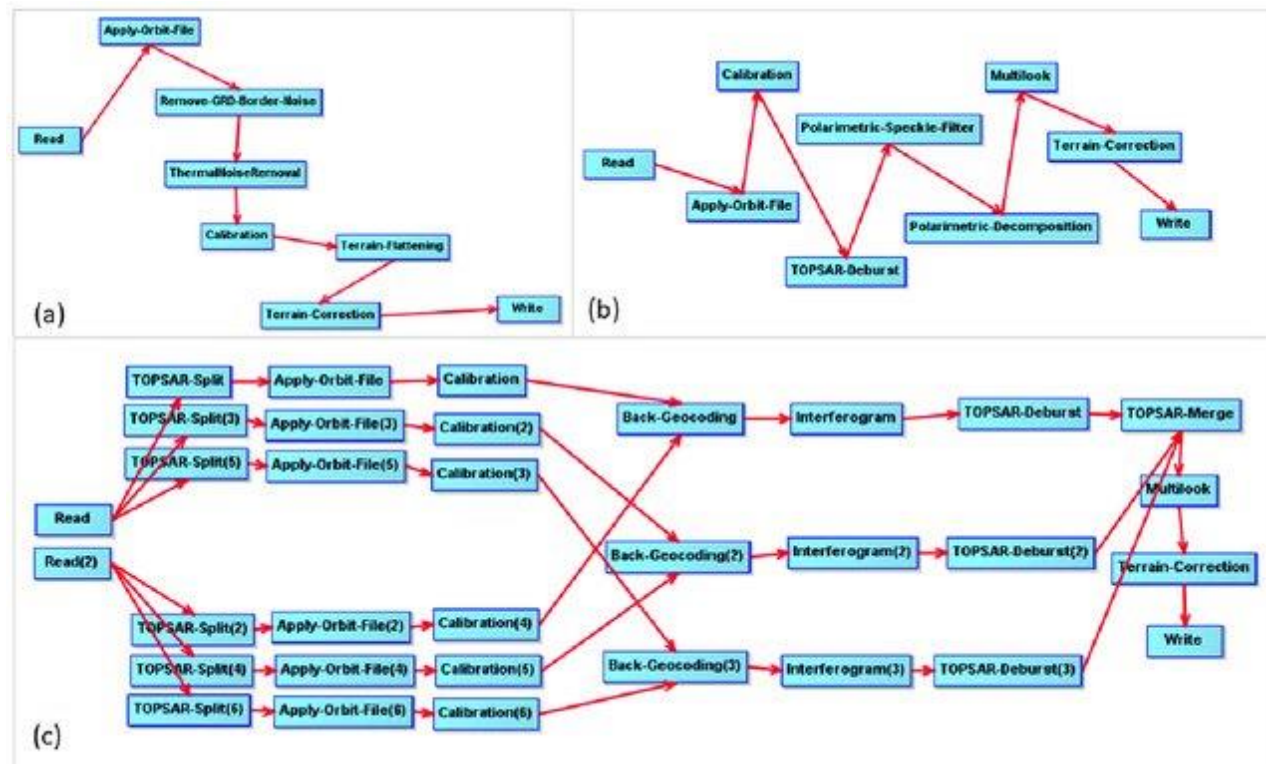
SNAP Data Processors analyse one or more input products and generate a new output product. Processors exist for generic operations such as band arithmetic, map projection or temporal aggregation. SNAP also provides a very large number of thematic processors, e.g. for atmospheric correction, biophysical indices calculation or retrieval of water quality. And SNAP supports special calibration of correction of satellite instruments with dedicated processors.

The figure shows the GUI for the Sentinel-2 Atmospheric Correction Processor sen2cor. The screenshot was taken when the processor was successfully executed. The black background shows the logging information during execution of the processor.





The SNAP graph builder allows to connect SNAP operators in processing graphs. These can be executed locally or in large clusters and cloud systems.



Example: Workflows in the SNAP graph builder tool for producing Synthetic Aperture Radar (SAR) analysis ready data (ARD) products. From Ticehurst, et al (2019). Building a SAR-Enabled Data Cube Capability in Australia Using SAR Analysis Ready Data. Data. 4. 100. 10.3390/data4030100.




User Forum

step forum

all categories ▾ Categories Latest Top


Category Topics

s1tbx 29 / month

 The S1 Toolbox category regroups all threads about the Sentinel-1 Toolbox, as SAR readers or processors.


■ Problem Reports ■ Interferometry ■ Polarimetry ■ StaMPS
■ PyRate ■ snaphu

s2tbx 15 / month

 The S2 Toolbox category regroups all threads about the Sentinel-2 Toolbox as Sentinel-2 product readers and product manipulation, Sentinel-2 processors as L2A processor for atmospheric correction, L3 processor for temporal synthesis, etc.

■ sen2cor ■ sen2three ■ Problem Reports ■ sen2like

s3tbx 2 / month

 The S3 Toolbox category regroups all threads about the Sentinel-3 Toolbox as readers and processors for Sentinel-3 OLCI & SLSTR L1 & L2. Useful information about Sentinel-3 and the data can found at the [S3VT Documentation page](#).









■ Problem Reports

Issue Tracker

SNAP Ihre Aufgaben ▾ Projekte ▾ Filter ▾ Dashboard

Landing Page

Projekte

-  **CHRIS-Box (CHRIS)**
Leitung: Marco Peters
-  **Sentinel-1 Toolbox (SITBX)**
Leitung: Luis Veci
-  **Sentinel-2 Toolbox (SIITBX)**
Leitung: Florian Douzich
-  **Sentinel-3 Toolbox (SIITBX)**
Leitung: Marco Peters
-  **Sentinel Application Platform (SNAP)**
Leitung: Marco Peters
-  **SMOS Toolbox (SMOSTBX)**
Leitung: Tom Block
-  **SNAP Requirements Monitoring (SRM)**
Leitung: Marco Peters
-  **SNAP User Feedback (SUF)**
Leitung: Oana Hogoio

Tutorials

DOCUMENTATION

Tutorials

Found 70 tutorials

- SNAP (GENERAL TOOLBOX USAGE)
- SENTINEL-1 TOOLBOX (SAR APPLICATIONS)
- SENTINEL-2 TOOLBOX (HIGH RESOLUTION OPTICAL APPLICATIONS)
- SENTINEL-3 TOOLBOX (MEDIUM RESOLUTION OPTICAL APPLICATIONS)
- ESA TRAINING COURSES (ESA TRAINING COURSES)
- EXTERNAL RESOURCES (EXTERNAL RESOURCES)
- OTHER (OTHER TUTORIALS)
- ALL (ALL TUTORIALS)**

For Developers

COMMUNITY

Developers

Source code

We are using Git to keep track of code changes, and the source code is available on [GitHub](#). We highly encourage fixes and new features made to the code be submitted to the [GitHub repository](#).

SNAP API Documentation

For developers who want to extend or patch SNAP we provide the Javadoc here:

- [SNAP Engine API Documentation](#)
- [SNAP Desktop API Documentation](#)

License

The Sentinel Toolboxes and full source code is open-source software and is distributed under the [GNU GPL](#).

Wiki

The [Developers Wiki](#) contains valuable resources for getting familiar with the software.

Forum

There is a dedicated section in the [Forum](#) for development-oriented topics.

SNAP Community and Tutorials

<http://forum.step.esa.int/c/s3tbx>
<http://step.esa.int/main/doc/tutorials/>
<https://senbox.atlassian.net/wiki/spaces/SNAP/pages/1898053693/SNAP+FAQs>

SENTINEL-3 TOOLBOX (MEDIUM RESOLUTION OPTICAL APPLICATIONS)

ESA TRAINING COURSES (ESA TRAINING COURSES)

EXTERNAL RESOURCES (EXTERNAL RESOURCES)

OTHER (OTHER TUTORIALS)

ALL (ALL TUTORIALS)

Showing [1 ... 6] from 6

Search for specific tutorials...

 <p>DOCUMENT</p> <p>Data conversion and export for Sentinel-3</p> <p>A short guide on converting and exporting Sentinel-3 data to GeoTIFF format for use in GIS software. This guide is kindly provided by our users lenkafronkova and bek17 in the forum.</p> <p>JUNE 22, 2018 MARPET</p> <p>READ →</p>	 <p>VIDEO</p> <p>Download & Visualise Sentinel-3 Data</p> <p>EUMETSAT shows how to download and visualise their provided Sentinel-3 data with the Sentinel-3 Toolbox.</p> <p>MARCH 1, 2017 ADMIN</p> <p>PLAY →</p>	 <p>DOCUMENT</p> <p>Introduction to Sentinel-3 Toolbox</p> <p>This presentation gives a general introduction to the usage of the Sentinel-3 Toolbox.</p> <p>JUNE 1, 2015 ADMIN</p> <p>READ →</p>	 <p>DOCUMENT</p> <p>Rayleigh Correction Tutorial (S3 OLCI, MERIS, S2 MSI)</p> <p>Introduction to the Rayleigh correction provided by the Sentinel-3 Toolbox. The document gives information on the collocation of Sentinel-3, Sentinel-2 and MERIS.</p> <p>JUNE 16, 2021 ANA B. RUESCAS, DAGMAR MÜLLER</p> <p>READ →</p>	 <p>DOCUMENT</p> <p>S3TBX Collocation Tutorial</p> <p>The tutorial explains how to collocate satellite data and which technical and scientific considerations need to be made. Even the examples focus on the collocation of Sentinel-3, Sentinel-2 and MERIS.</p> <p>OCTOBER 7, 2022 ANA B. RUESCAS, MARCO PETERS</p> <p>READ →</p>
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step forum





Dear SNAP users, ✎ Edit ✕

We would love to have your feedback on your SNAP experience. It would help us to know which are the things that should be improved and taken into consideration for the future, so that you will be satisfied when using SNAP.

Please take an anonymous survey in order to help us helping you:
[SNAP User Survey](#)

Many thanks from SNAP Team!

all categories ▾ **Categories** Latest New (2) Unread (275) Top + New Topic

Category	Topics	Latest
s1tbx  The S1 Toolbox category regroupes all threads about the Sentinel-1 Toolbox, as SAR readers or processors. 5.6k 60 unread ■ Problem Reports 12 unread ■ Interferometry 2 unread ■ Polarimetry ■ StaMPS 3 unread ■ PyRate ■ snaphu 2 unread		Failure to import ICEYE H5 file and solution 0 10h ■ Problem Reports Error while running snaphu-unwrapping 0 11h ■ snaphu COSMO-SkyMed Coreg_ifg_subset Error 10 20h ■ s1tbx Snap2stamps error 239 20h ■ StaMPS Mosaicking of SAR SLC images 0 22h ■ Interferometry NESZ of Radarsat-2 0 22h ■ s1tbx Atmospheric Correction for InSAR 119 23h ■ s1tbx Uav_sar_snap 0 1d ■ snap ps_plot velocity 12 1d ■ StaMPS Phase to displacement theory 0 1d ■ Show Room SNAP software Back-Geocoding Error 0 1d ■ Problem Reports No_intial_PS_candidites (sentinel-1) 0 1d ■ Problem Reports UNITS of sentinel 3 0 1d ■ s3tbx
s2tbx  The S2 Toolbox category regroupes all threads about the Sentinel-2 Toolbox as Sentinel-2 product readers and product manipulation, Sentinel-2 processors as L2A processor for atmospheric correction, L3 processor for temporal synthesis, etc. 2.5k 61 unread ■ sen2cor 16 unread ■ sen2three ■ Problem Reports 7 unread ■ sen2like		
s3tbx  The S3 Toolbox category regroupes all threads about the Sentinel-3 Toolbox as readers and processors for Sentinel-3 OLCI & SLSTR L1 & L2. Useful information about Sentinel-3 and the data can be found at the S3VT Documentation page. 579 21 unread 1 new ■ Problem Reports 3 unread		
snap  This category contains all topic about the Sentinel Toolbox Application (SNAP) not related to a specific Sentinel Toolbox. 2.2k 114 unread 1 new		

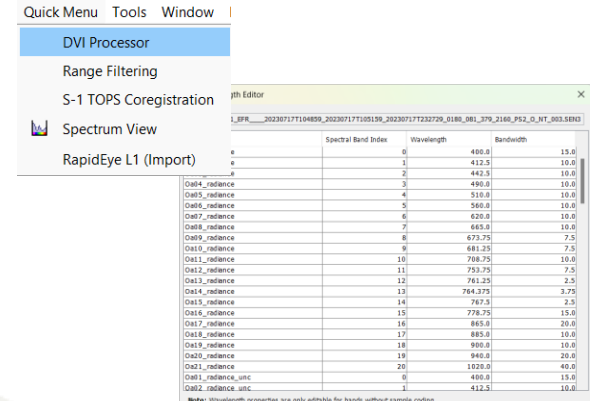


SNAP plugins



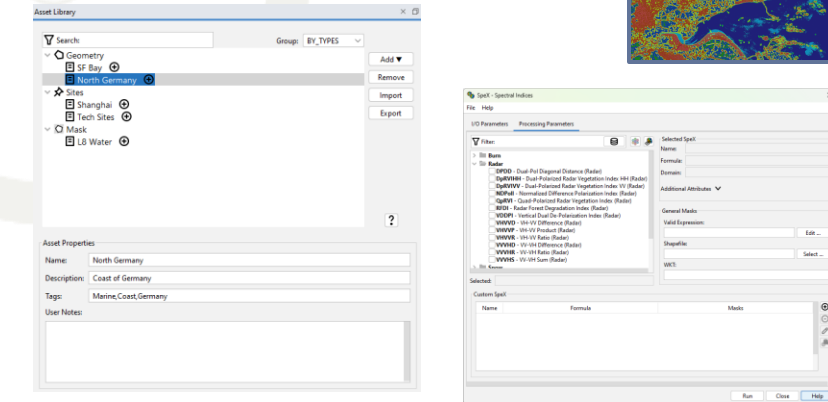
The **Basic Toolbox** (free) provides various tools to ease the daily work and to save valuable time while working with SNAP

- The **Quick Menu** provides quick access to the most often used menu actions.
- The **Band Maths Extensions** Adds new functionalities like access to map coordinates, window calculations, min, max and mean functions, and checking if pixels are invalid.
- The **Wavelength Editor** Allows to edit the wavelength properties of multiple bands and apply the changes to compatible products.



The **Pro Toolbox** provides sophisticated tools to analyse and process data and to retrieve scientific results

- The **Asset Library** allows to manage the resources you most often use like geometries, sites and masks. You can easily add them to your data.
- The **Coastal Map** provides Land-water, coastline and tidal flat indicators and a vicinity indicator for land close to water and water close to land.
- **SpeX** allows you to easily manage and compute spectral indices (>240).



- Super-Resolve Scenes to 5 Meter
- View Geometry Upscaling
- Surface Reflectance Normalisation

Read more in the EOMasters blog:
www.eomasters.org/blog



Dashboard

Data catalogue

Using data

Data access

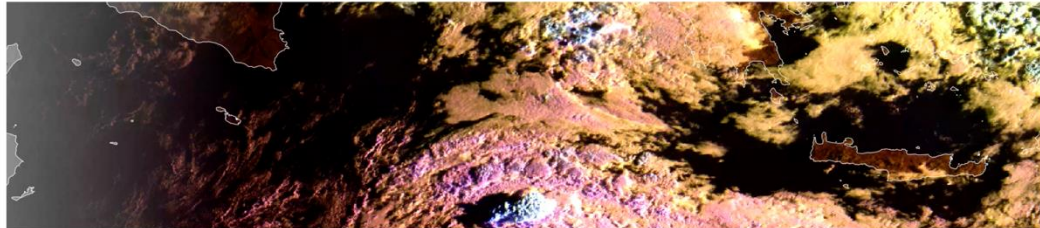
News & events

Search user portal

Welcome to the EUMETSAT User Portal

Keen to start using MTG FCI data?

The new MTG-I1 Flexible Combined Imager (FCI) L1c pre-operational data was released publicly on **24 September**, see example in Figure 1 below. Read the **news story** for full details. The data include 16 normal resolution channels and four high resolution.



Events & notifications

October 2024 View all

Mon	Tue	Wed	Thu	Fri	Sat	Sun
30	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	1	2	3

Using MTG data

- MTG in operations** User guide
V6.J, 14 Oct 2024
Information on the deployment of the MTG services and timelines for the release of operational data.
- Data Store MTG data access guide** User guide
V1.6, 18 Oct 2024
Guide for advanced usage of EUMETSAT Data Store, for users of MTG products, providing detailed information on products and how to download them.
- MTG L1 level 2 data guide** User guide
V1.3, 5 Sep 2024
This guide is aimed at users of the MTG L1 level 2 data. It provides information about the data available and how to access, extract and interpret the data.

News

- Sentinel-3 Altimetry L2P products to be discontinued** Data & service news
1 Jan 2025
Sentinel-3
- New GOI**
12 Nov 2024
A new rain from GOES
- Update c**
12 Nov 2024
A new vers released o

Satellite operation service status

The indicator reflects the timeliness and availability of the data disseminated by EUMETCast. It does not provide an indication of the data quality. For further information on the status of satellite

Getting started

- Exploring the user portal** User guide
V1, 8 Jan 2024
Exploring the functionalities, content and features of the new EUMETSAT User Portal.
- Getting started using data** User guide
V2, 8 Feb 2024
How to find, view, download and use our satellite data.
- Watch the exploring the user portal video** Video
V1, 10 Jan 2024
In this video, Hayley Evers-King takes you on a tour of the user portal and its features.

Case studies

- Monitoring sea-level rise with Sentinel-6** Case study
30 Sep 2024
This case uses Sentinel-6 data to monitor sea-level rise, an important indicator of climate change.
- Hurricane Beryl – first major hurricane of the 2024 season** Case study
28 Jun 2024–9 Jul 2024
Hurricane Beryl rapidly became a Category 5 storm that impacted the Caribbean Islands, Yucatan Peninsula and the Gulf Coast of the US.
- Tropical Cyclone Ialy** Case study
14 May 2024–23 May 2024
After forming in the southwestern Indian Ocean, Tropical cyclone Ialy became first tropical cyclone to ever exist so close to the equator.

- Sentinel-3 altimetry level 2 data guide** User guide
V1.2, 18 Oct 2024
Overview of Copernicus Sentinel-3 SRAL level 2 altimetry processing, products and applications.
- Data Store MTG data access guide** User guide
V1.6, 18 Oct 2024
Guide for advanced usage of EUMETSAT Data Store, for users of MTG products, providing detailed information on products and how to download them.
- Sentinel-3 altimetry level 1 data guide** User guide
V1.1, 18 Oct 2024
Overview of Copernicus Sentinel-3 altimetry instrument, level 1 processing and products.





More information: User Support and Training Resources

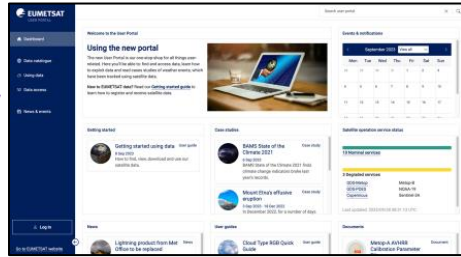
www.eumetsat.int

EUMETSAT Helpdesk

OPS@eumetsat.int

Contact the EUMETSAT helpdesk with any questions about EUMETSAT data products or services

User portal (coming soon)



Copernicus & mandatory missions
Data access

Courses

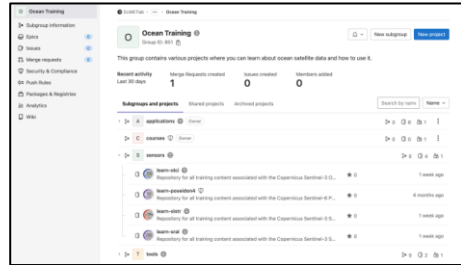


EUMETSAT User Support Resources

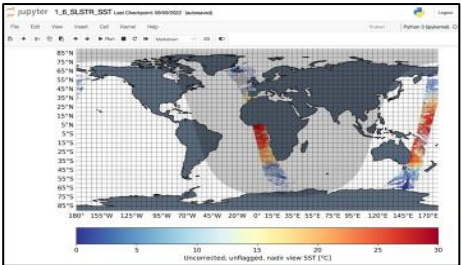
Code distribution



GitLab



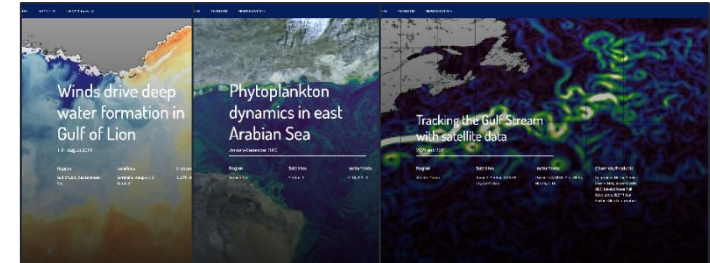
Jupyter Notebooks



Video tutorials



Case studies



Cloud services





Thank you!

Questions are welcome.

Contacts and further information

For information on our training programme

[*training@eumetsat.int*](mailto:training@eumetsat.int)