An Update on the Ground Segments of the Hyperspectral DESIS and EnMAP Missions

2nd Workshop of the *Collaboration Across Research Fields* in Remote Sensing, 16.-17.10.2024, Karlsruhe

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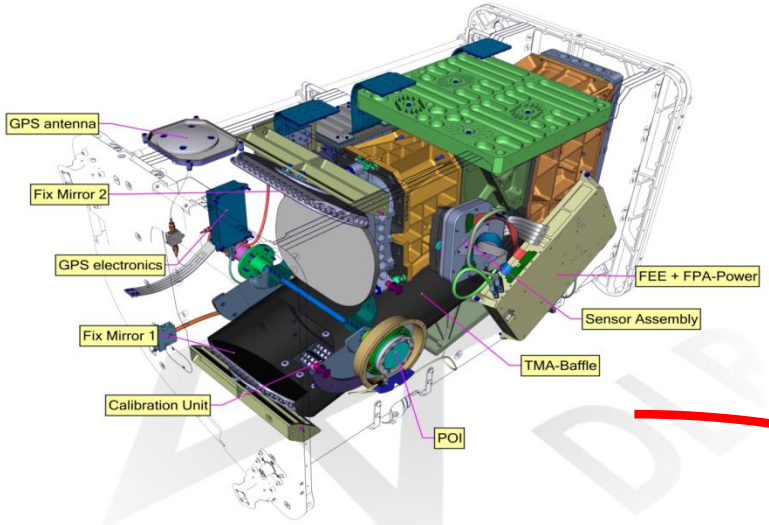
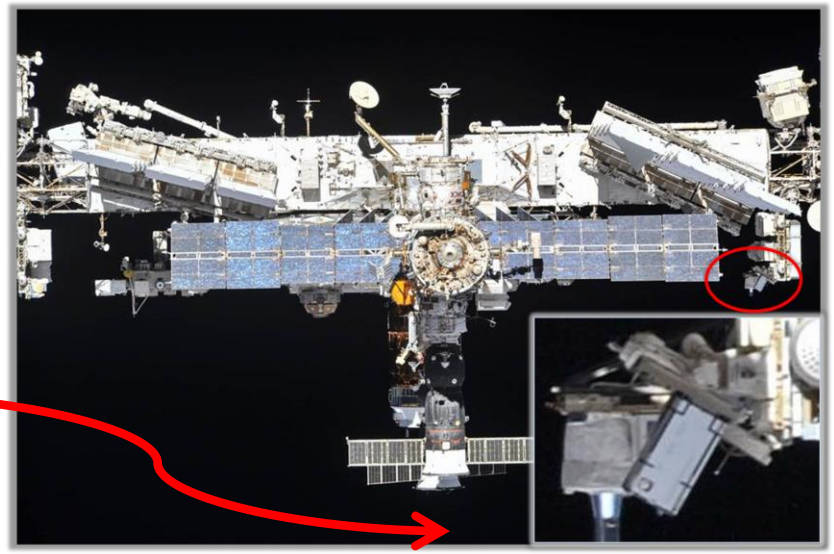
S. Chabrillat, M. Brell, R. Milewski, K. Segl and many other from GFZ Science Segment

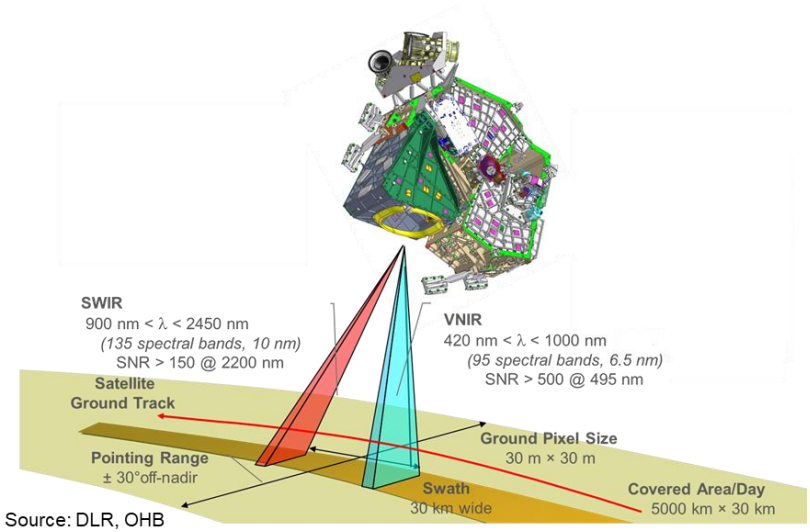
V. Krieger, L. La Porta, U. Knodt and many other from DLR Space Agency

B. Murphy and H. Lester from Teledyne Brown Engineering

Mission Instrument::	ISS/MUSES DESIS	EnMAP HSI (2 instruments)
Off-nadir tilting (across-track, along-track)	-45° (backboard) to +5° (starboard), -40° to +40° (by MUSES and DESIS)	-30° to +30°, 0° (by EnMAP)
Spectral range	400 nm to 1000 nm	420 nm to 2450 nm
Spectral (res., acc.)	2.55 nm, (*)	6.5 nm, 0.5 nm (VNIR), 10.0 nm, 1.0 nm (SWIR)
Radiometry (res., acc.)	13 bits, (*)	14 bits, 5%
Spatial (res., swath)	30 m, 30 km (@ 400 km)	30 m, 30 km
SNR (signal-to-noise)	205 (no bin.)/406 (4 bin.) @ 550 nm	500 @ 495 nm, 150 @ 2200 nm
Instrument (mass)	93 kg	350 kg
Capacity (km, storage)	2360 km per day, 225 GBit	5000 km per day, 512 GBit
In orbit since	2018	2022







Source: DLR, OHB

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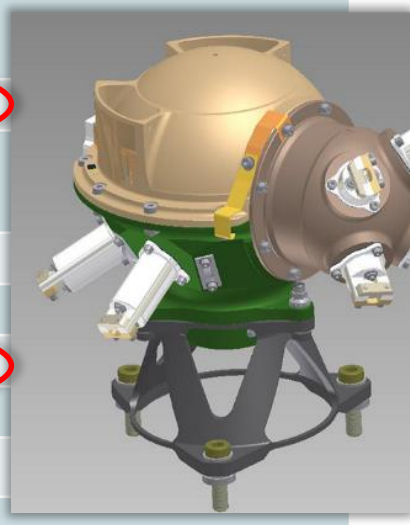

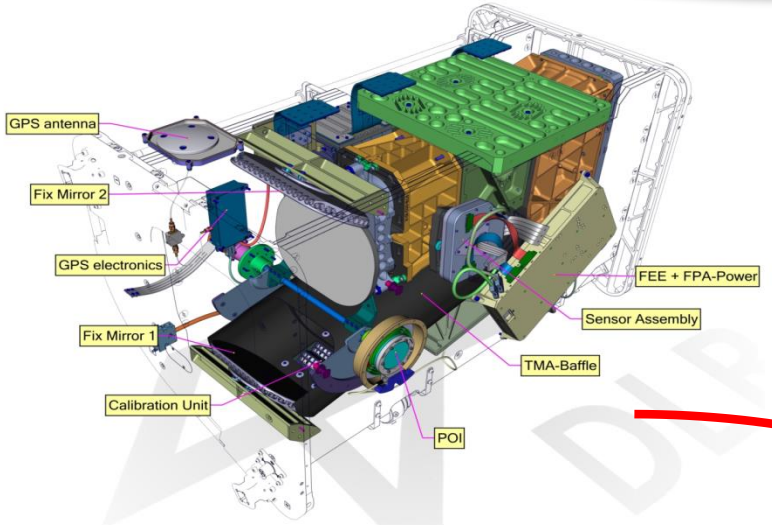

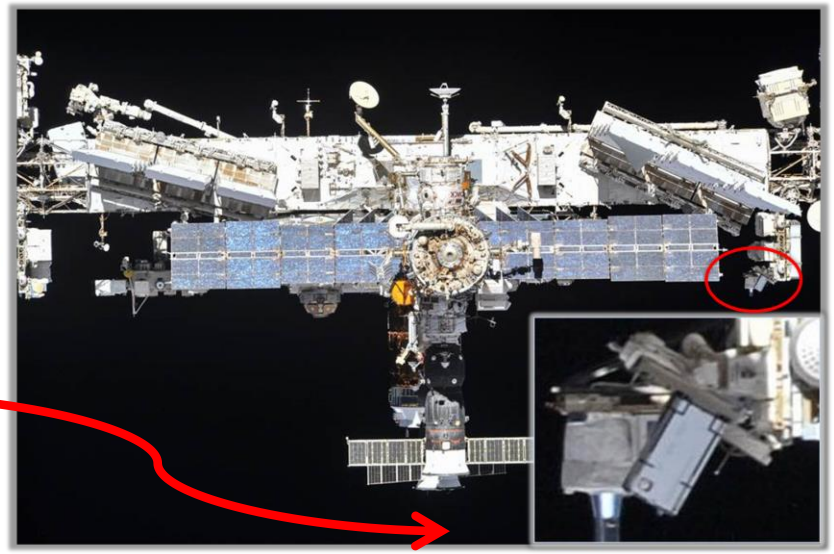

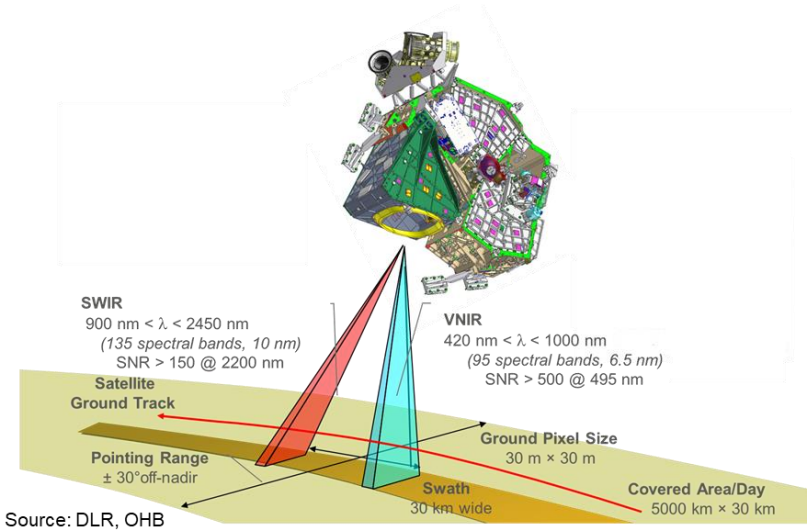

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DESIS Mission Status

Background:

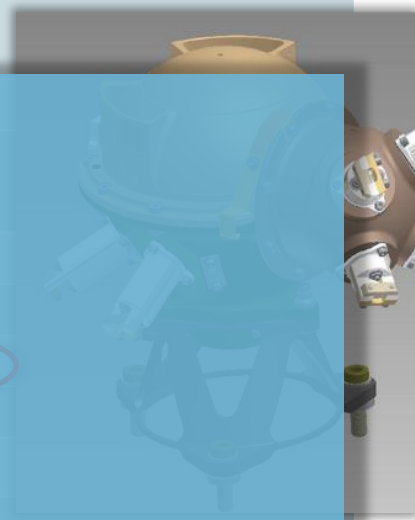
- Teledyne (TBE) responsible for commercial & US users
- DLR responsible for scientific exploitation of the mission

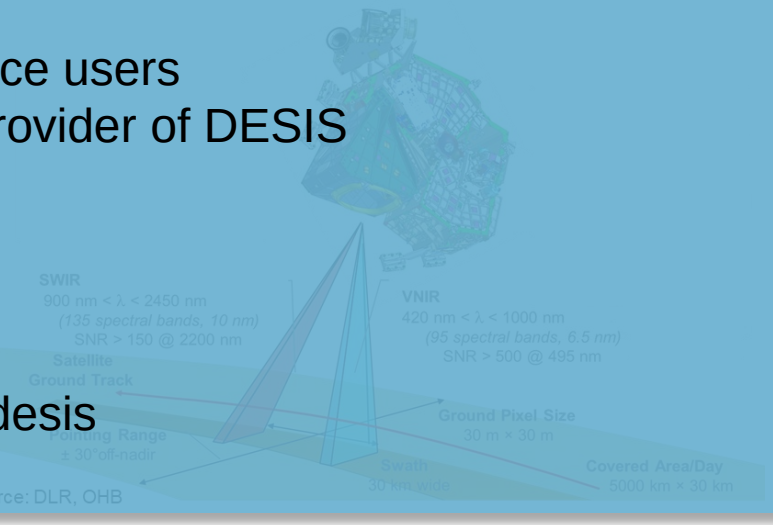
Current Mission Status:

- End of May 2024, TBE stopped archive and acquisition services of the DESIS mission (including the data transfer to DLR)
- DLR continues the archiving and processing services for science users
- Mid of September, TBE has been selected by NASA as data provider of DESIS

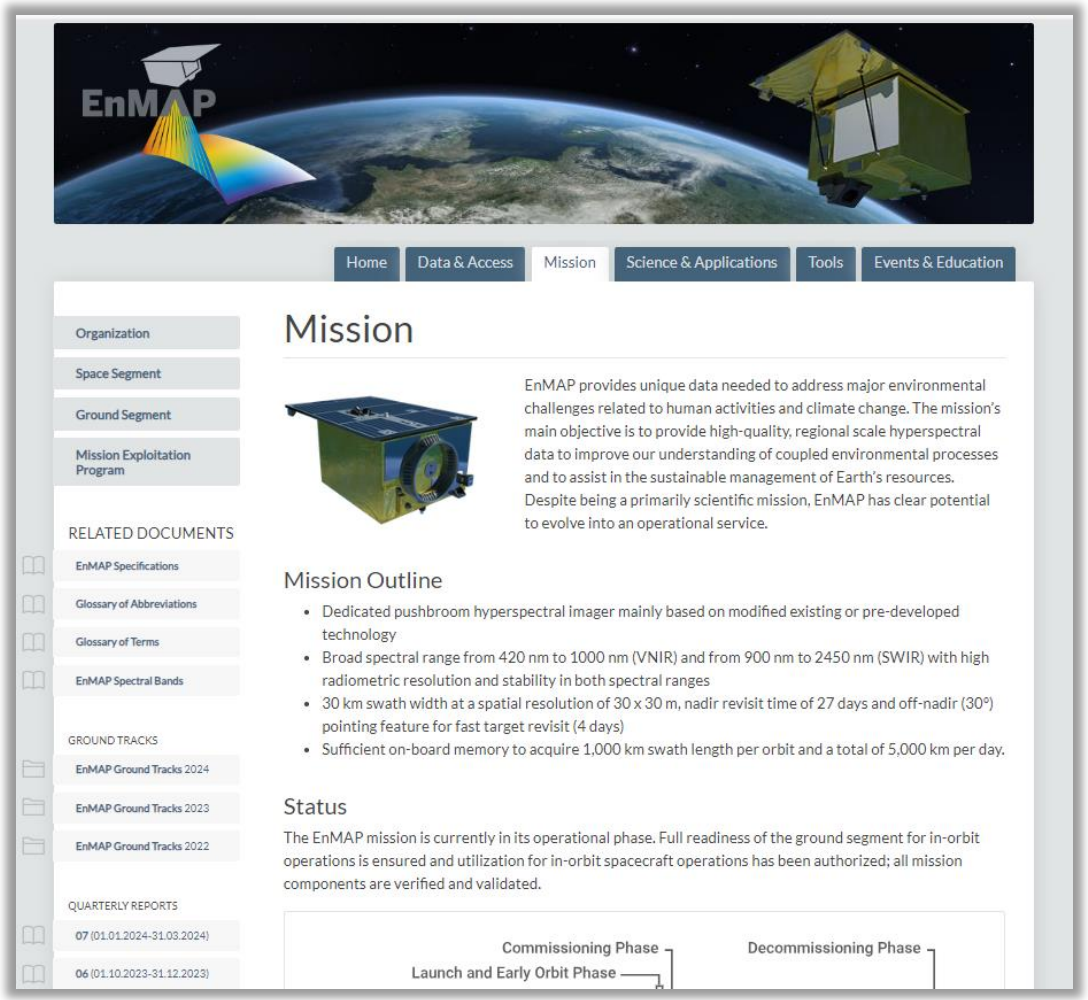
Upcoming:

- TBE services will continue – schedule still unclear.
- DLR informs all scientific users about the change of the status https://www.dlr.de/en/eoc/research-transfer/projects-missions/desis





EnMAP – Online Ressources



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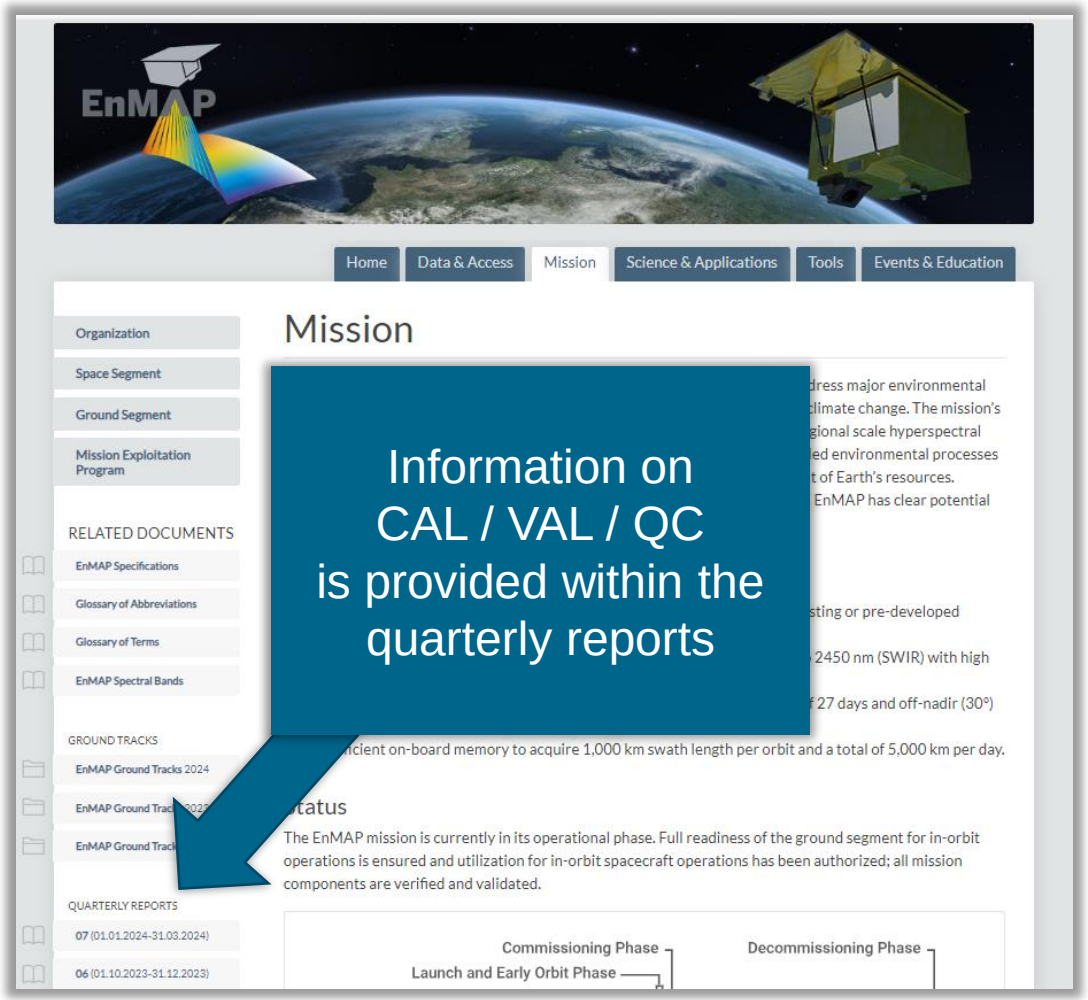
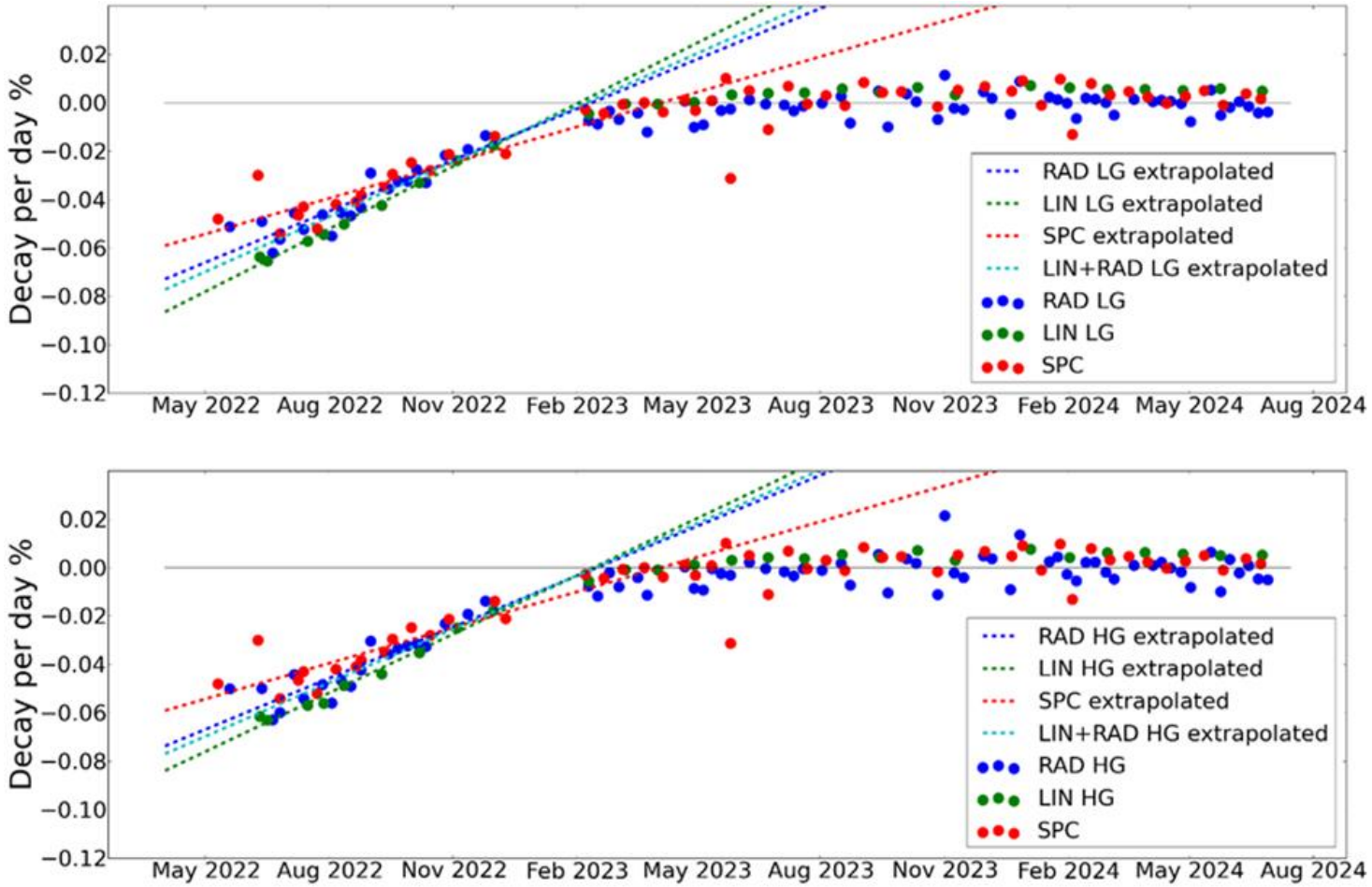


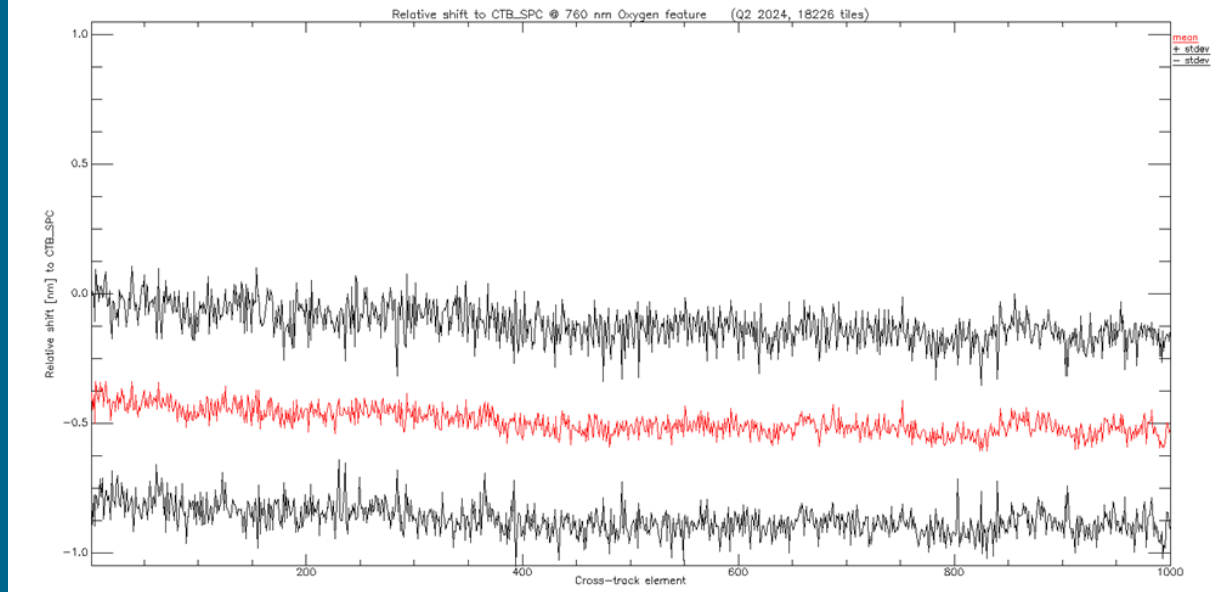
Radiometric Performance

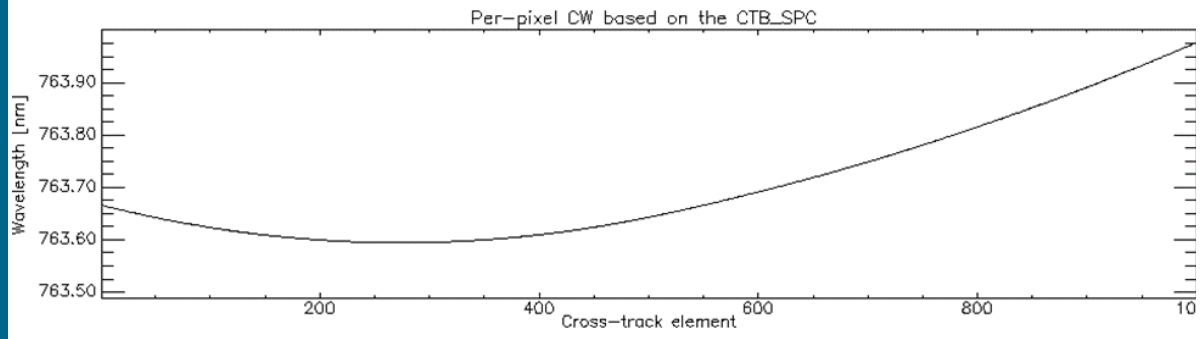


VNIR Decay per day from Lamp (RAD), Linearity (LIN) and Spectral (SPC) measurements for low gain (top) and high gain (bottom)

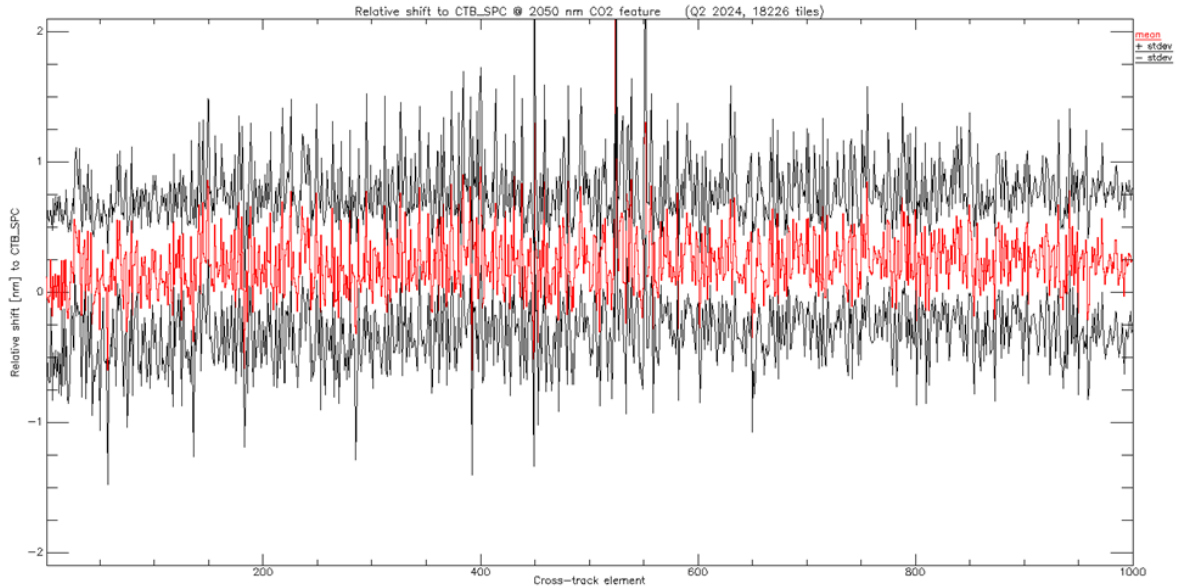
Note: SWIR stable since CP

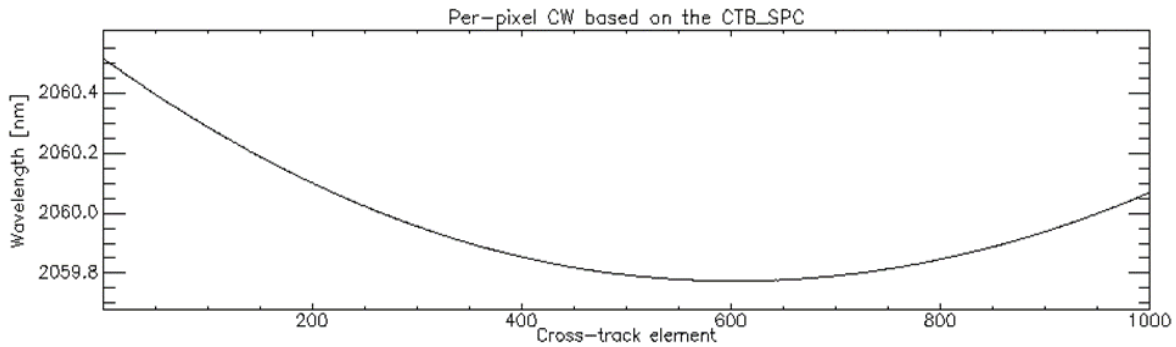
Spectral Performance – Vicarious estimate





760 nm Oxygen feature, 18.226 tiles (Q2, 2024)
Shift w.r.t. nominal CTB_SPC

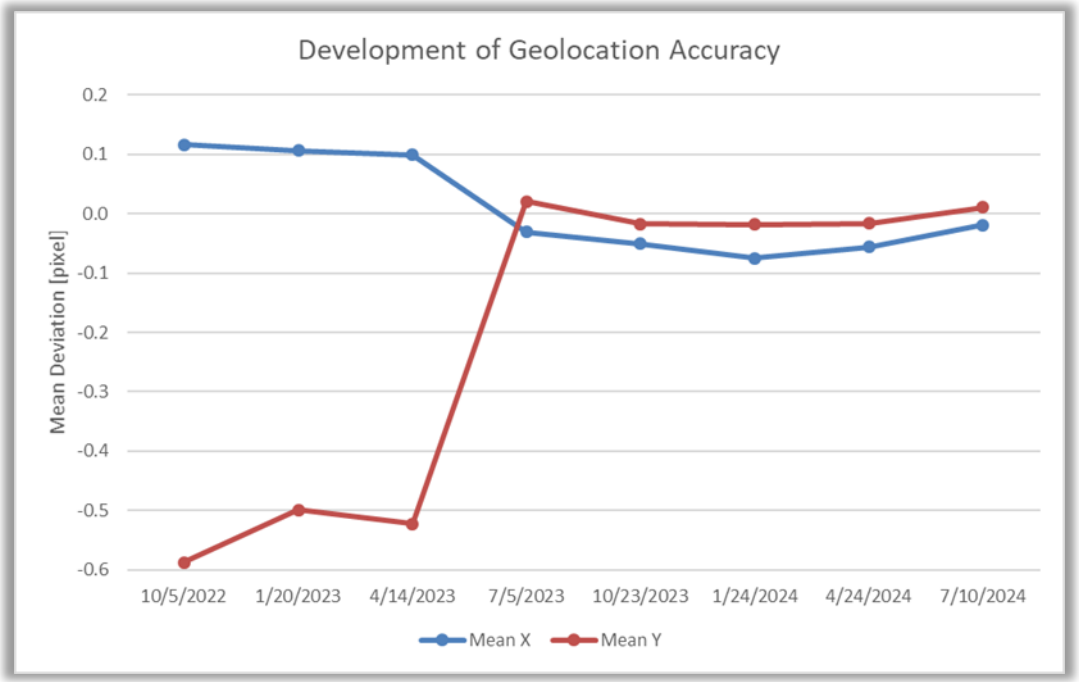


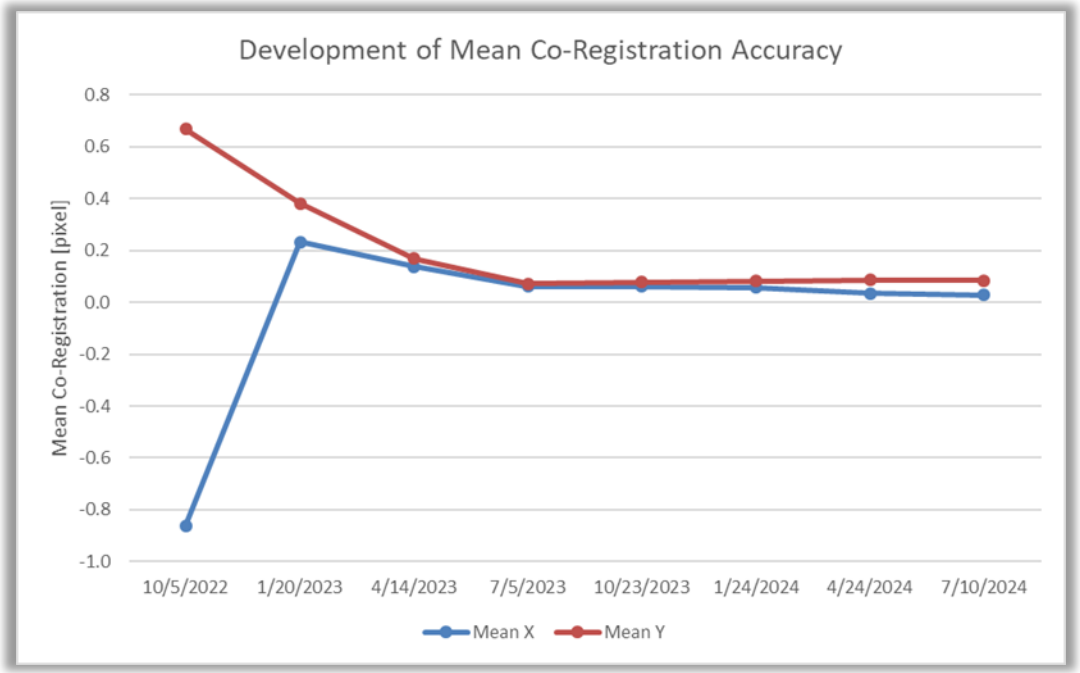


2050 nm CO2 feature, 18.226 tiles (Q2, 2024)
Shift w.r.t. nominal CTB_SPC

Spectral bandwidth (FWHM, Gaussian): 8.9 nm (760 nm) and 8.7 nm (2050 nm)

Geometric Performance





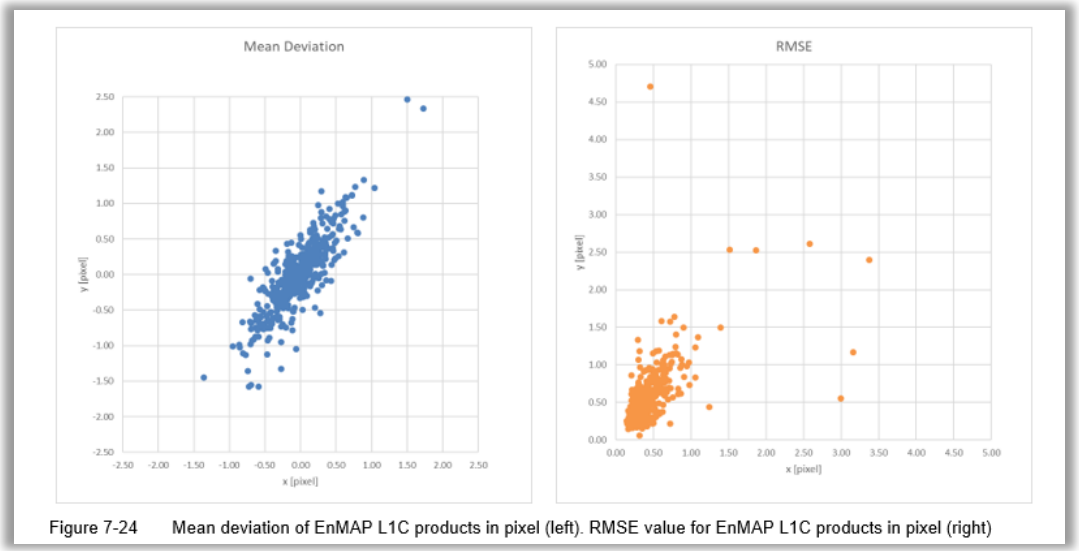
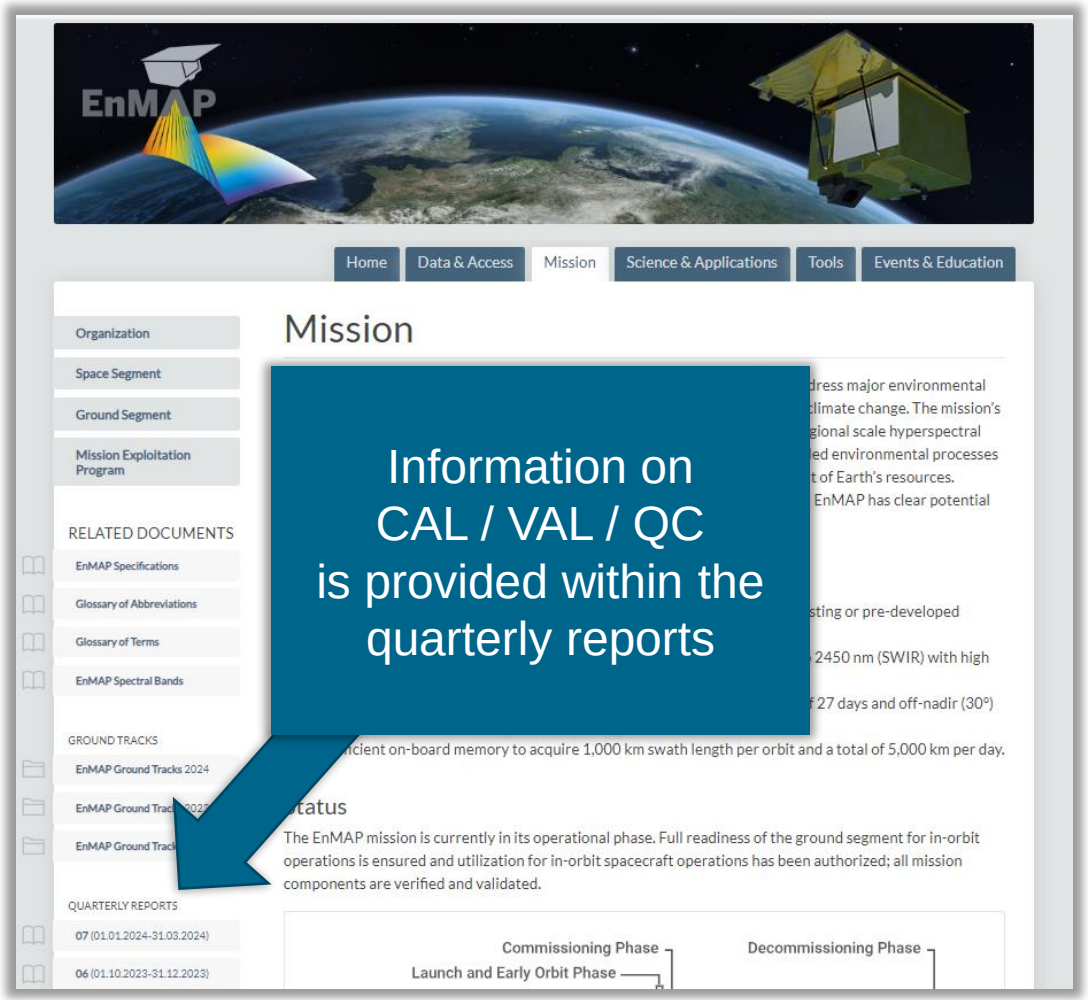


Figure 7-24 Mean deviation of EnMAP L1C products in pixel (left). RMSE value for EnMAP L1C products in pixel (right)

Reference:
Image-to-image matching in L1C (LoS refinement) to global cloud-free S2 reference mosaic (by DLR)

EnMAP – Online Ressources



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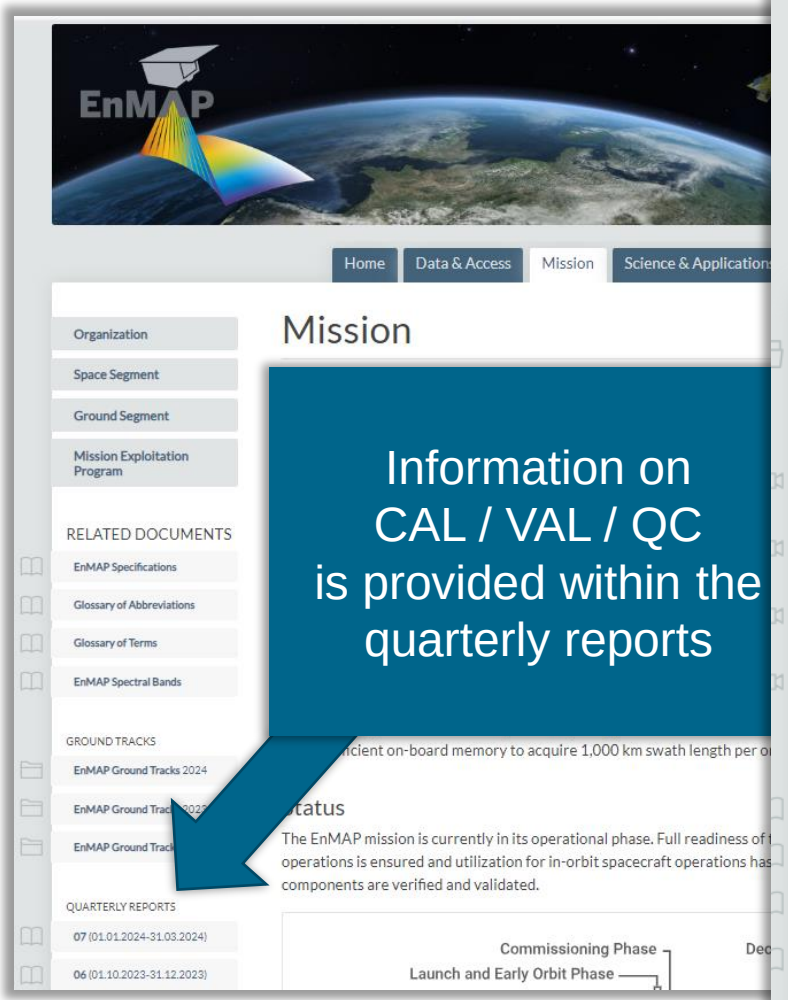
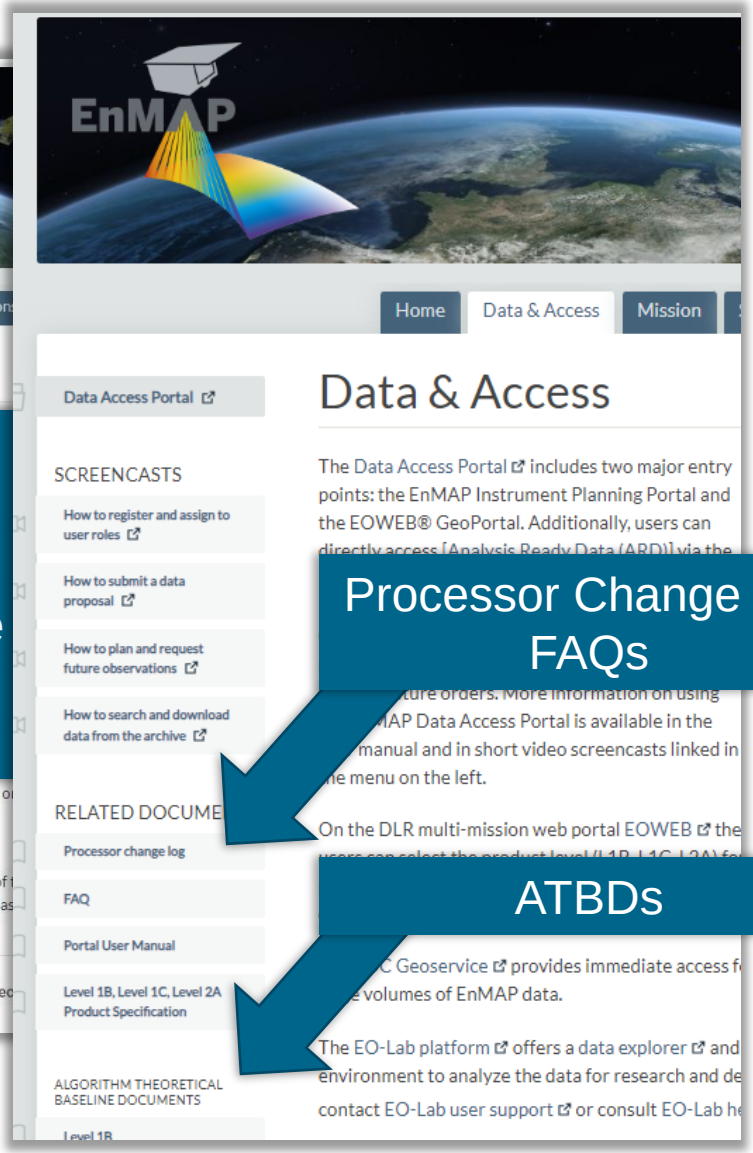
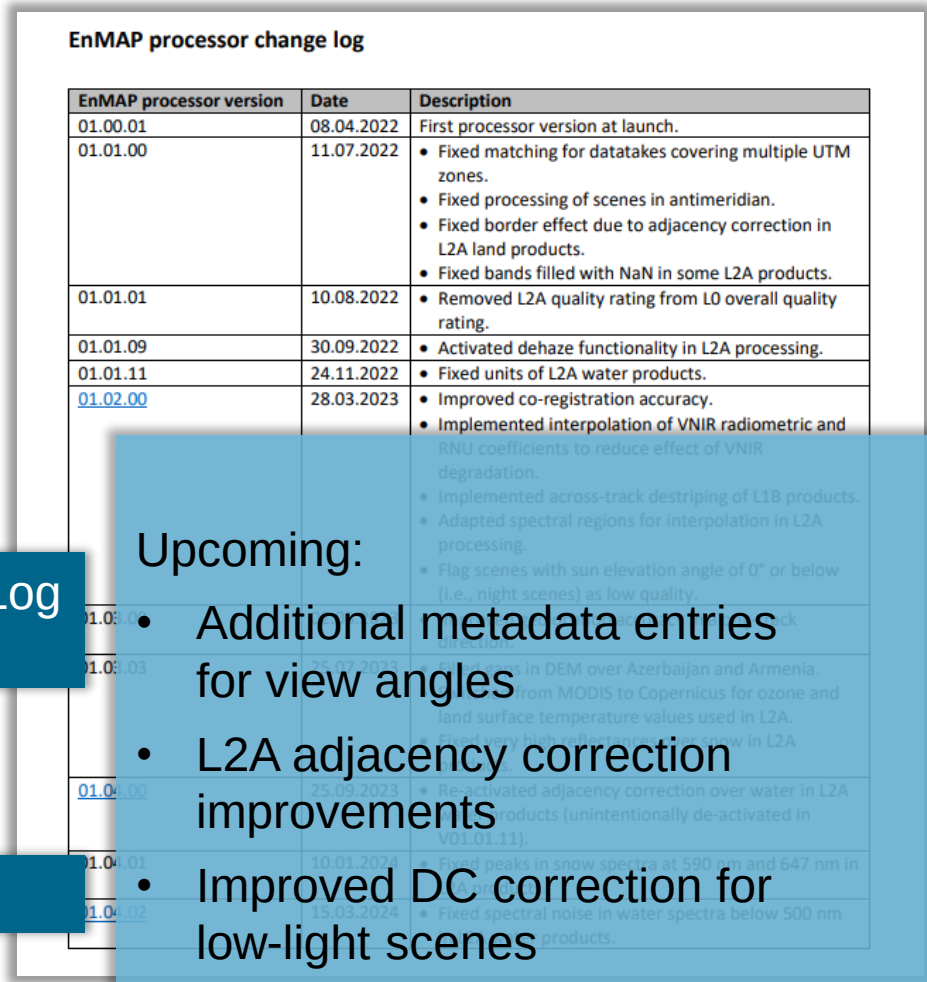


Information on CAL / VAL / QC is provided within the quarterly reports



Processor Change Log FAQs

ATBDs



EnMAP processor change log

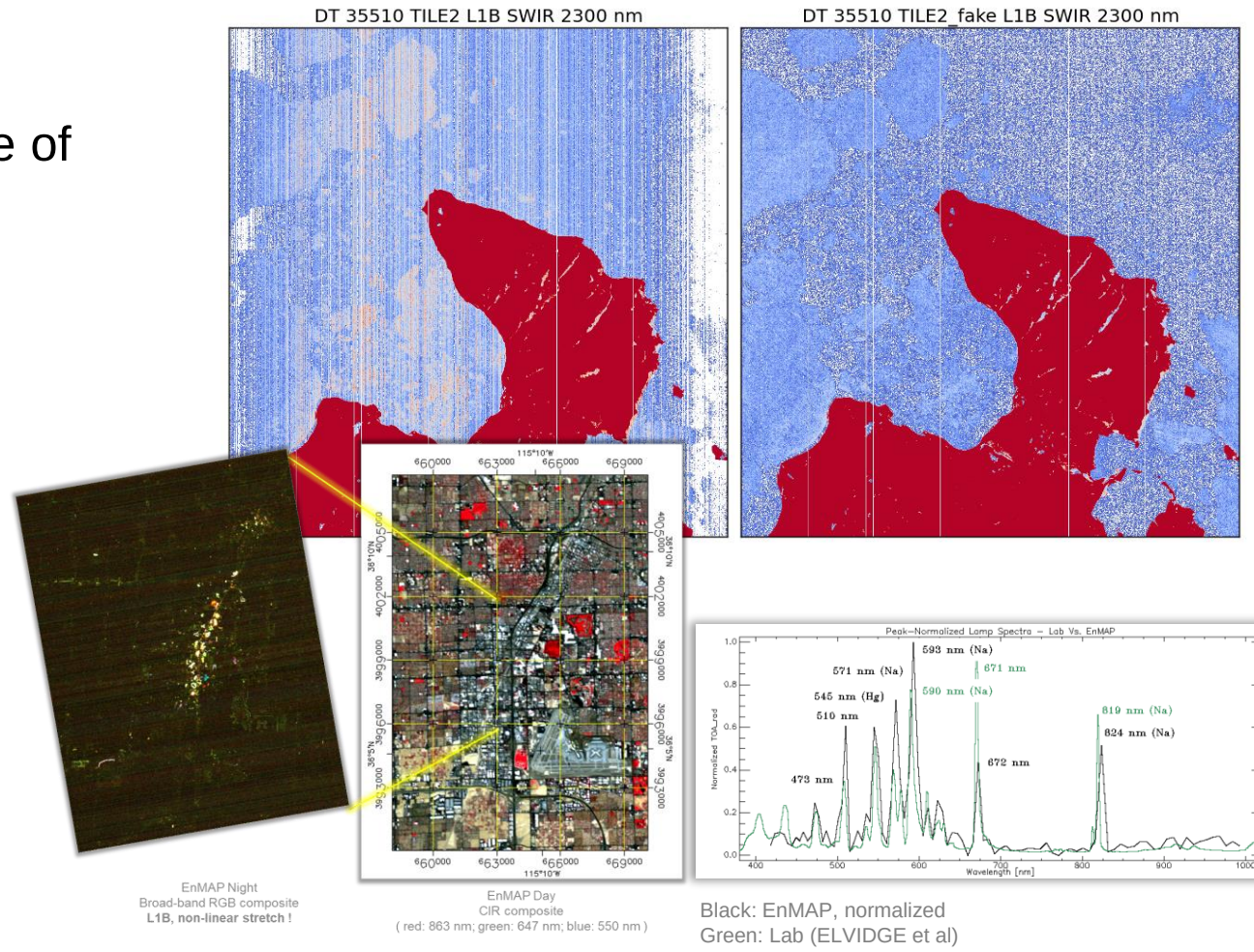
EnMAP processor version	Date	Description
01.00.01	08.04.2022	First processor version at launch.
01.01.00	11.07.2022	• Fixed matching for datatakes covering multiple UTM zones. • Fixed processing of scenes in antimeridian. • Fixed border effect due to adjacency correction in L2A land products. • Fixed bands filled with NaN in some L2A products.
01.01.01	10.08.2022	• Removed L2A quality rating from L0 overall quality rating.
01.01.09	30.09.2022	• Activated dehaze functionality in L2A processing.
01.01.11	24.11.2022	• Fixed units of L2A water products.
01.02.00	28.03.2023	• Improved co-registration accuracy. • Implemented interpolation of VNIR radiometric and RNU coefficients to reduce effect of VNIR degradation. • Implemented across-track destriping of L1B products. • Adapted spectral regions for interpolation in L2A processing. • Flag scenes with sun elevation angle of 0° or below (i.e., night scenes) as low quality.
01.03.00	25.09.2023	• Re-activated adjacency correction over water in L2A products (unintentionally de-activated in V01.01.11).
01.03.01	10.01.2024	• Fixed peaks in snow spectra at 590 nm and 647 nm in
01.03.02	15.03.2024	• Fixed spectral noise in water spectra below 500 nm products.

Upcoming:

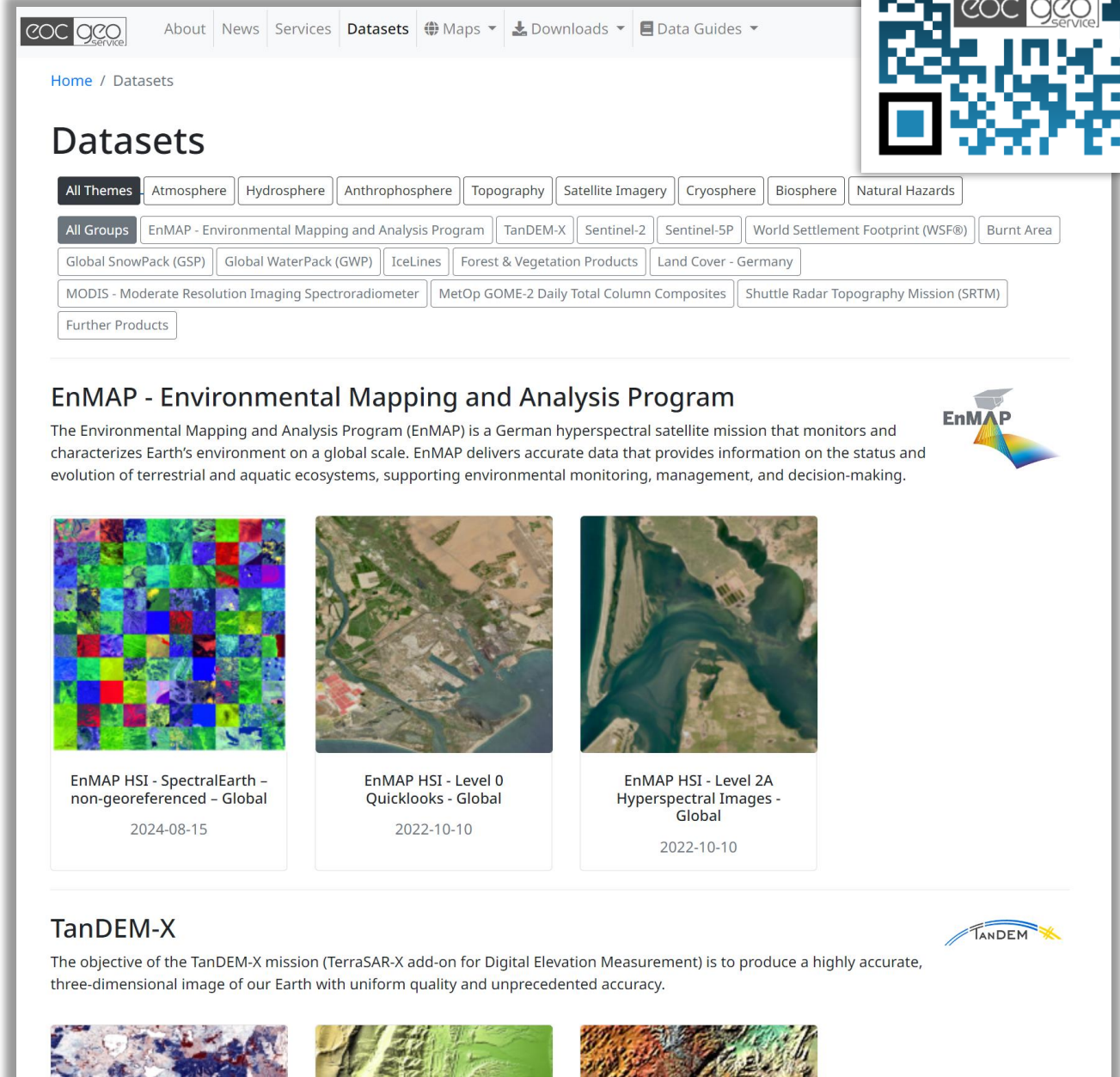
- Additional metadata entries for view angles
- L2A adjacency correction improvements
- Improved DC correction for low-light scenes

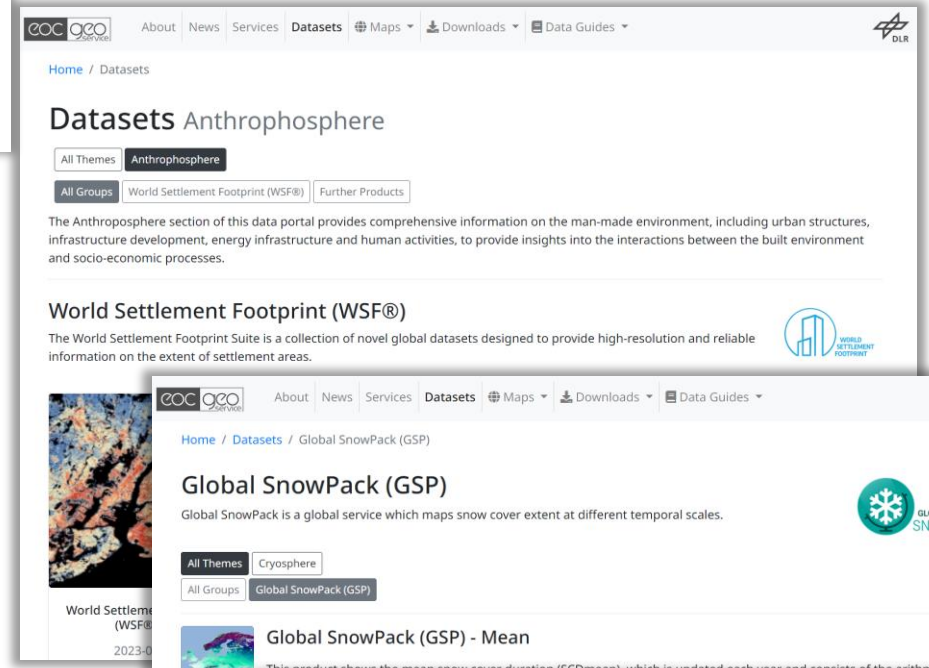
EnMAP – Updates on Processing

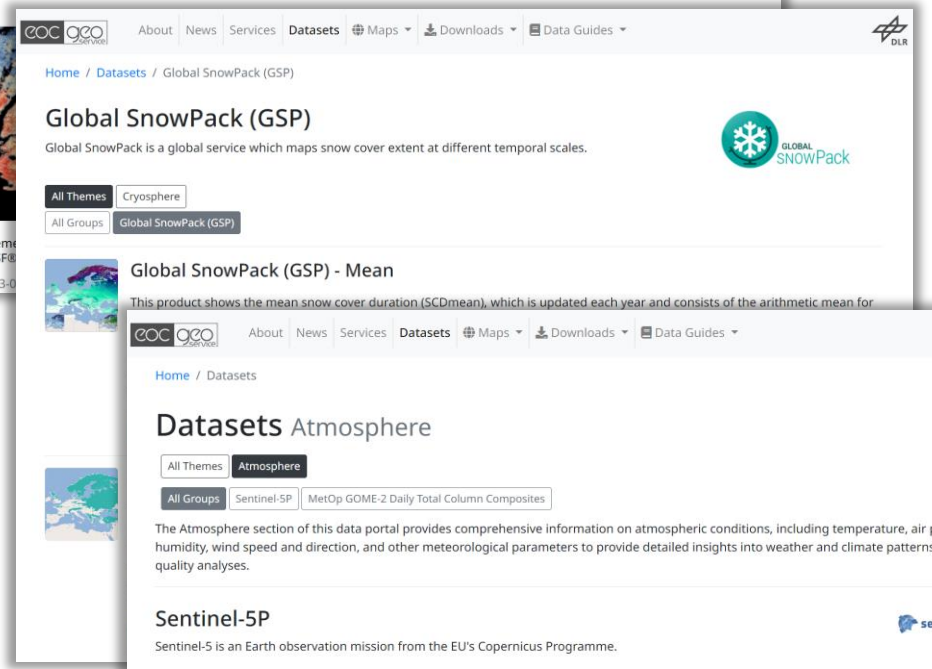
- Improved DC correction for SWIR (mixed gain mode)
  - Issue: for low-light & night scenes slight pattern is visible
    Note: this radiance range is anyway outside of the instrument specifications !
  - Improved correction developed and validation in progress
  - Relative change to old baseline is small:
    - Change in low gain range always <1%
    - For nominal scenes, change in high gain range of ~2%
    - For night & low-rad scenes, local changes of 5% up to 10%



L2A @ eoc geoservice







L2A @ eoc geoservice

Home / Collections / ENMAP_HSI_L2A / items / ENMAP01-____L2A-DT0000006551_20221212T015854Z_003_V010400_20231123T092657Z (html)

ENMAP01-____L2A-DT0000006551_20221212T015854Z_003_V010400_20231123T0926

Parent html json | Collection html json | Item html json | OpenSearch geojson atom/xml O&M

Collection:

Platform: ENMAP
Instrument: HSI
Sensor Type: OPTICAL

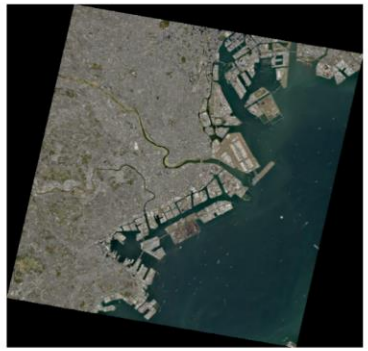
Extents:

Spatial: 139.5202, 35.3692, 139.9265, 35.6887
Temporal: 2022-12-12T01:58:54.846Z / 2022-12-12T01:58:59.38Z

Map:

Footprint

Preview:



Properties:

Parent Identifier: ENMAP_HSI_L2A
Crs: 32654
Created: Nov 23, 2023, 6:32:50 PM
Updated: Nov 23, 2023, 6:32:50 PM
Cloud Cover: 1
Snow Cover: 0
Processing Center: NZ
Processing Level: L2A
Relative Orbit Number: 3750
[CARD4L] Eastern Geometric Accuracy: 1
[CARD4L] Geometric Accuracy Radial Rmse: 2
[CARD4L] Northern Geometric Accuracy: 2
[CARD4L] Specification: SR
[CARD4L] Specification Version: 5.0
[ENMAP] Swir Aorswirb Selected: SWIRA
[ENMAP] Acquisition Configuration: earth
[ENMAP] Acquisition Type: EARTH
[ENMAP] Across Off Nadir Angle: 9.68043151163
[ENMAP] Along Off Nadir Angle: 0.267556625689

Assets:

Metadata metadata

Spectral Image data

Properties: Download

Key: image
Title: Spectral Image
Type: image/tiff; application=geotiff; profile=cloud-optimized
Roles: data
Description: Earth image measurement data covering 1 tile (30x30km) in orthorectified geometry
Link: https://download.geoservice.dlr.de/ENMAP/files/L2A/2022/12/12/DT0000006551/03/ENMAP01-____L2A-DT0000006551_20221212T015854Z_003_V010400_20231123T092657Z-SPECTRAL_IMAGE_COG.TIF

EO Bands:

https://nbviewer.org/github/dlr-eoc/ukis-data-tutorials/blob/main/enmap/enmap_da...

TIMELINE | EnMAP | EnMAP_QC_valrepo... | EnMAP_PMST | EnMAP_Quaternion | RID_Tool | EOC Portal | EOC IT-Info

JUPYTER FAQ

to be drawn about the condition of and changes to the planet's surface.

The 'EnMAP L2A HSI Products'-collection provides all 224 bands as CEOS-ARD data using athmosperic correction over land. L2A Products provide a complete atmospheric correction of the orthorectified EnMAP L1C product. The L1C processor orthorectifies image tiles from the VNIR and SWIR instrument independently. After the orthorectification the two image tiles are co-registered (requirement better than 0.2-pixel size) and form a geometric consistent product over the whole wavelength range. The result of the atmosphere correction is reflectance [in % units] values and pixel classification (quality layers).

One Product consists of the following files:

- ENMAP.HSI.L2A-SPECTRAL_IMAGE
- ENMAP.HSI.L2A-METADATA
- ENMAP.HSI.L2A-STAC_JSON
- ENMAP.HSI.L2A-QL
  - QL_VNIR
  - QL_VNIR_THUMBNAIL
  - QL_SWIR
  - QL_QUALITY_CLASSES
  - QL_QUALITY_CLOUD
  - QL_QUALITY_CLOUDSHADOW
  - QL_QUALITY_HAZE
  - QL_QUALITY_CIRRUS
  - QL_QUALITY_SNOW
  - QL_QUALITY_TESTFLAGS
  - QL_QUALITY_PIXELMASK

This notebook provides informations on how to programmatically access this collection, which is using the UserManagementSystem [UMS] to authenticate users. To execute the script and the terminal commands, a valid eoc account is needed for the requested dataset.

Download using the STAC-API and python

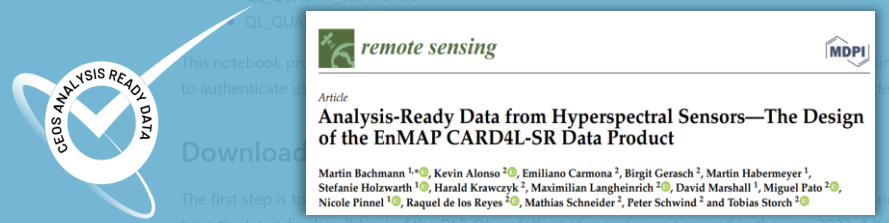
The first step is to connect to the EOC Geoservice STAC API and to query the EnMAP L2A HSI collection. In the first case we query data that have the boundingbox (bbox) of the DLR Oberpfaffenhofen and were acquired in the year 2023. 4 Items will be found. In the second query we have the same bbox and time but add a filter for "enmap:overallQuality" to gain only results with a "nominal quality".

In [8]:
```
from pystac_client import Client

catalog = Client.open("https://geoservice.dlr.de/eoc/ogc/stac/v1/")
collections = ["ENMAP_HSI_L2A"]
bbox = [11.230259, 48.051808, 11.337891, 48.117059] #DLR Oberpfaffenhofen
dates = ["2023-01-01", "2023-12-31"]
parameters = "enmap:overallQuality=0"
```

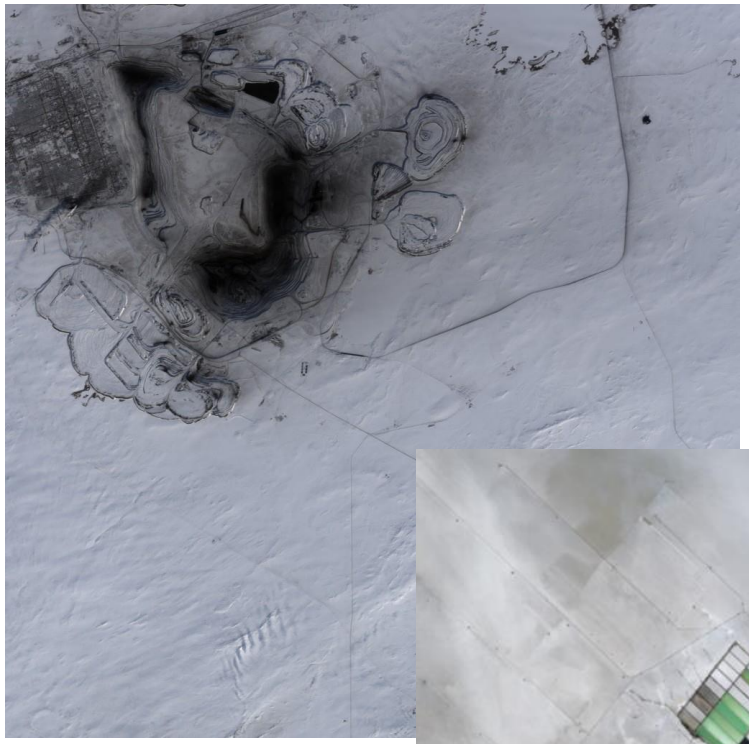
L2A @ eoc geoservice

- geoservice Status:
  - EnMAP: online
  - DESIS: currently in CEOS ARD review, test version running, expected start of production in Q4 2024
- Web services: WCS, WFS, WMS etc., bulk image download possible
- Data format: COG (Cloud-Optimized GeoTIFF)
- STAC Catalogue containing the metadata of the full EnMAP archive
- EnMAP reprocessing to L2A (standard processing) almost finished, all recent data readily available
- Data product is CEOS Analysis Ready Data (ARD)



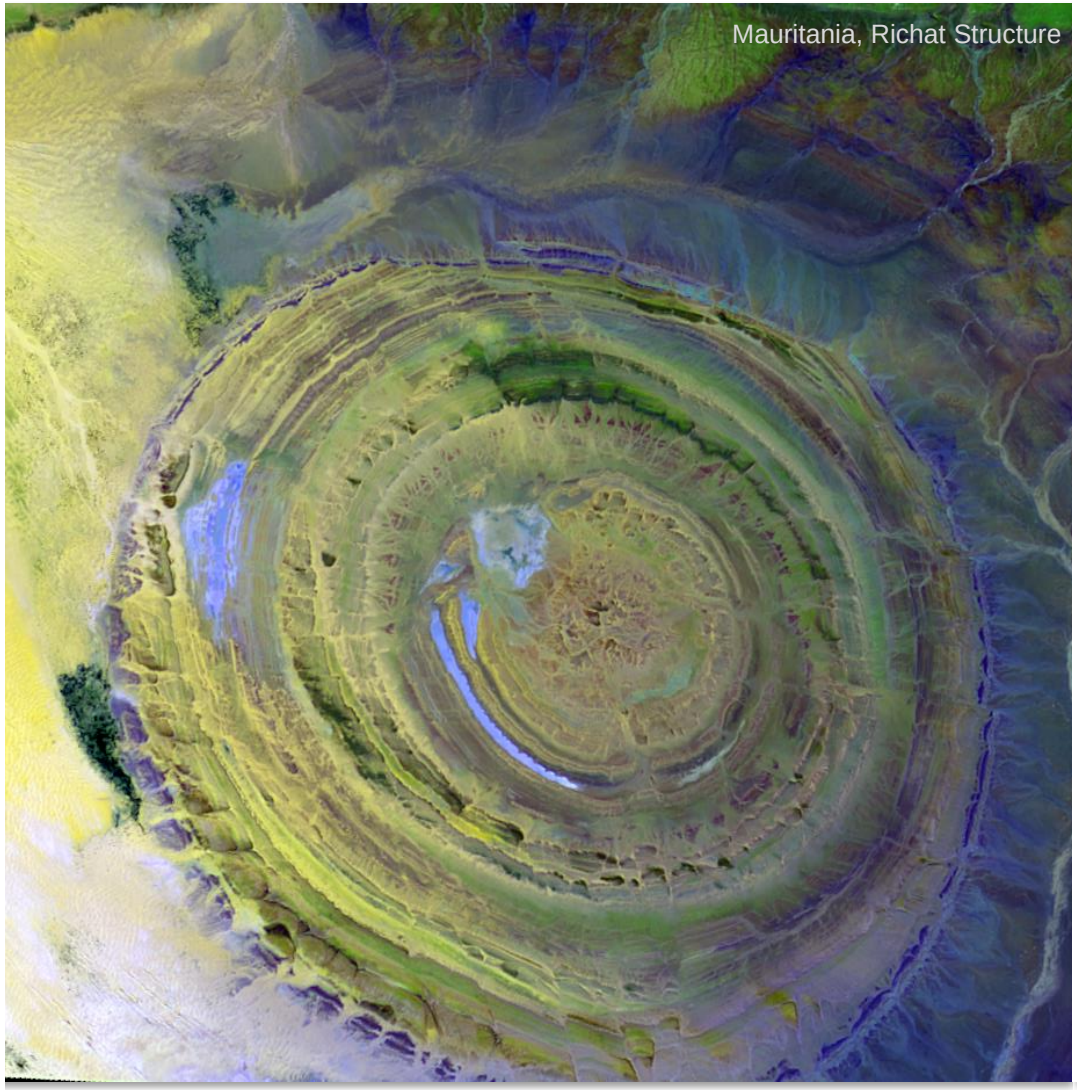
- **EOWEB on-demand processing using latest processor & cal. additionally maintained**

DESIS



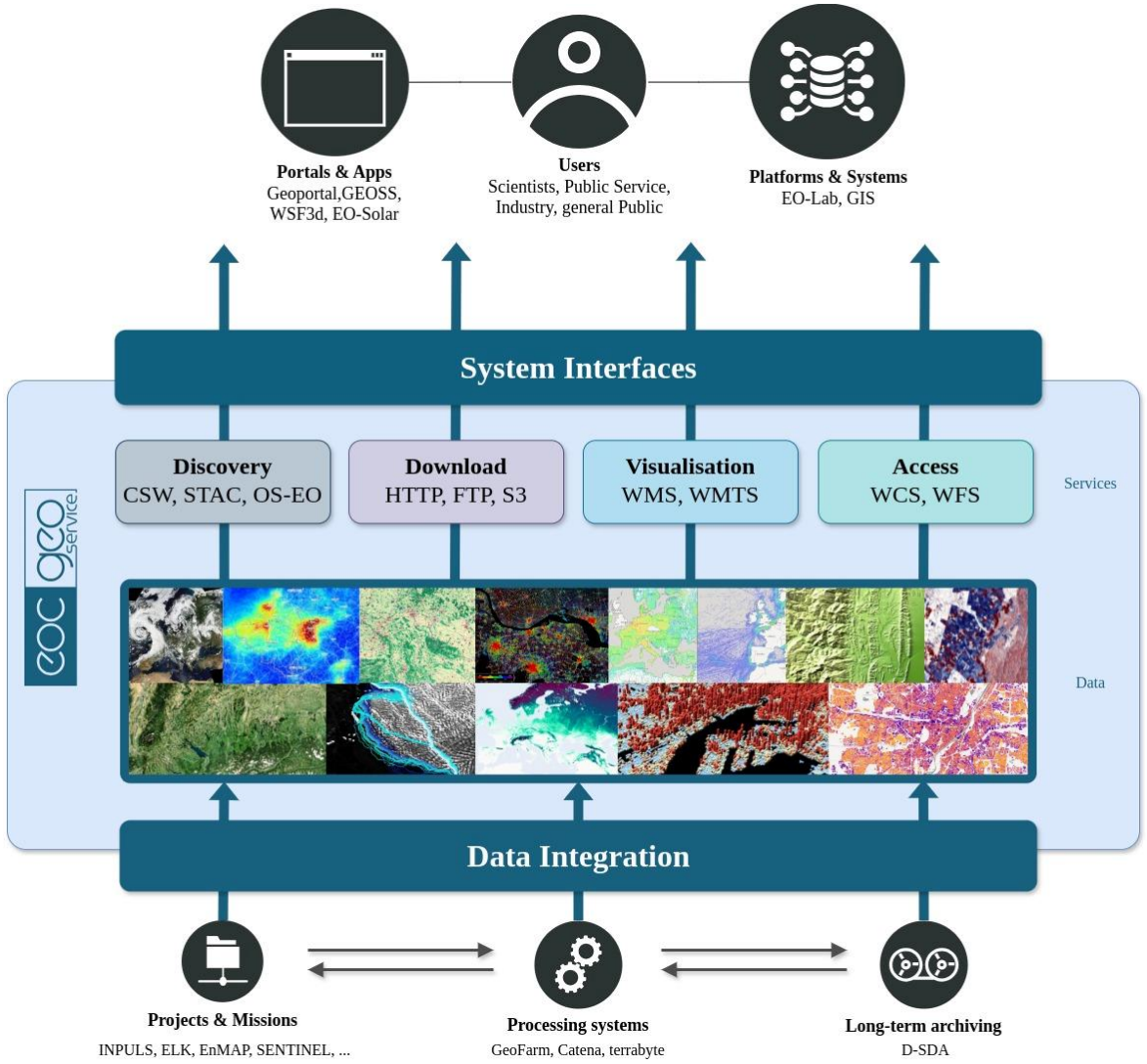
Salar de Uyuni; Bolivia

Coal mine South
East of Ekibastus;
Kazachstan



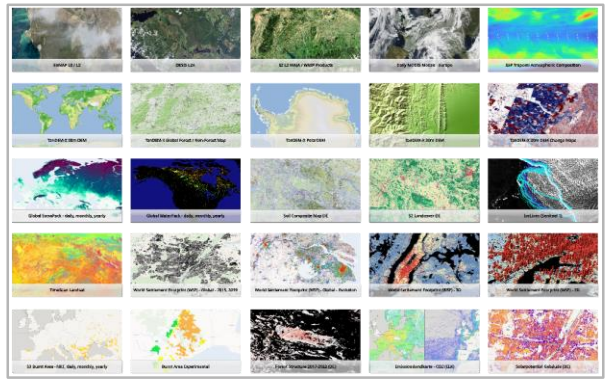
Thank you very much for your attention!

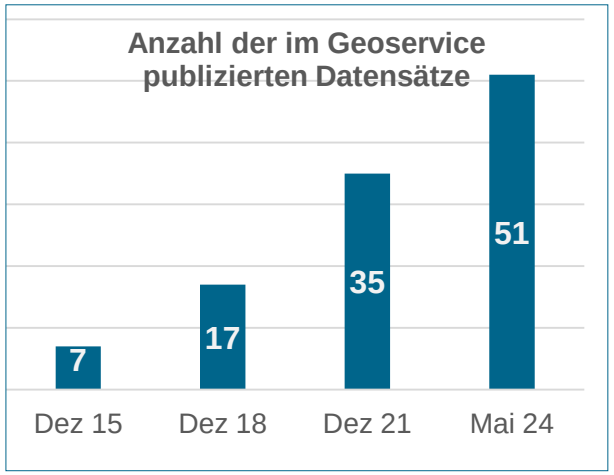
EOC Geoservice

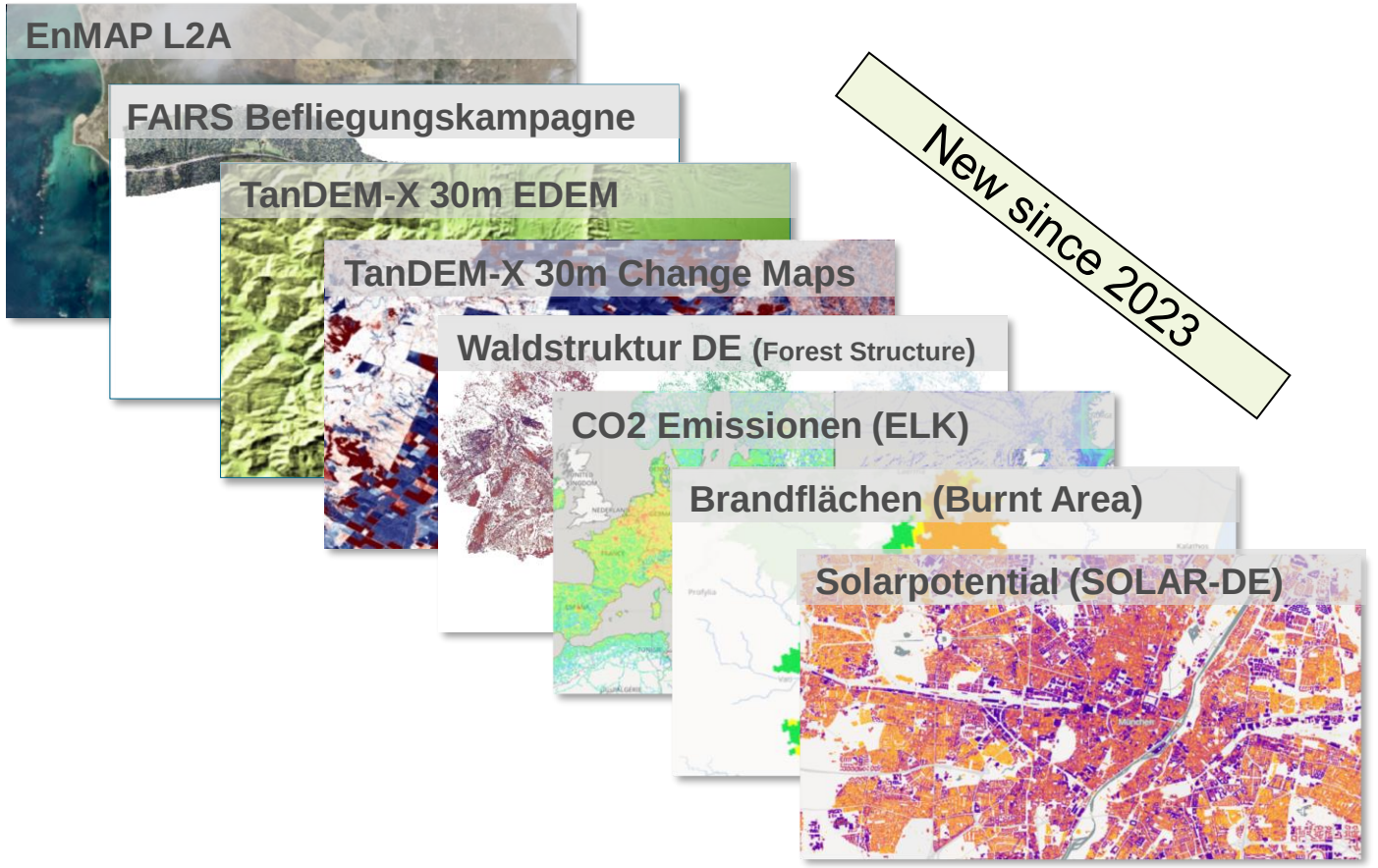


- Wide range of services and products in the field of earth observation and geoinformation
- Map services: Provision of topographic maps, thematic maps and other georeferenced information services.
- Geoweb services: APIs and web services for integrating earth observation data into your own applications.
- Open data policy for the scientific community through compliance with the FAIR principles

EOC Geoservice – Data publication







- Wide range of earth observation data and derived geoinformation products
- Transfer of research results from missions and projects
- Data integration by EOC Geoservice team