EnMAP - Environmental Mapping and Analysis Program

Earth Observation Center

New insights into aquatic systems with hyperspectral data: The EnMAP satellite and it's water-related ground segment processors

Nicole Pinnel
and the entire EnMAP Team

Earth Observation Center (EOC)
Deutsches Zentrum für Luft- und Raumfahrt (DLR)

WATER DAYS
SDB Day & EO Technology Conference
4 – 6 October, 2022

Overview

- EnMAP mission and participants, contributions from DLR
- EnMAP Technical Specifications
- Reception, processing and distribution
- EnMAP water-related ground segment processors
- Aquatic application examples

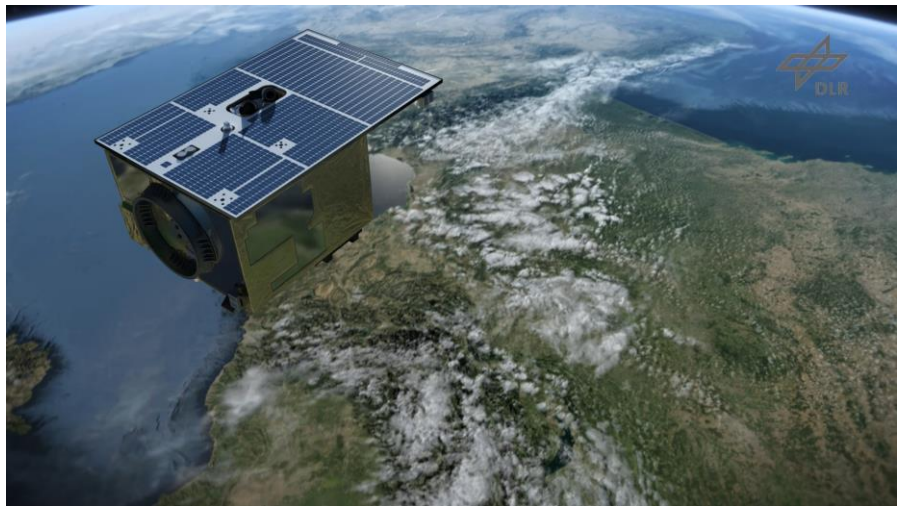
EnMAP Mission

EnMAP ≡ Environmental Mapping and Analysis Program

- Germany's first imaging-spectroscopy satellite-based earth observation mission
- Scientific Pathfinder mission for later operational services (CHIME, SBG)
- Regular provision of high-quality calibrated image products (orthorectification and atmospheric corrections)
- Observation of a wide range of ecosystem parameters,

e.g. Soils, minerals, land degradation

vegetation type and condition water quality



EnMAP Mission Consortium

Project Management
DLR Space Administration

Scientific Principal Investigator
GFZ Potsdam

EnMAP Science Team

Space Segment

Sensor | Platform

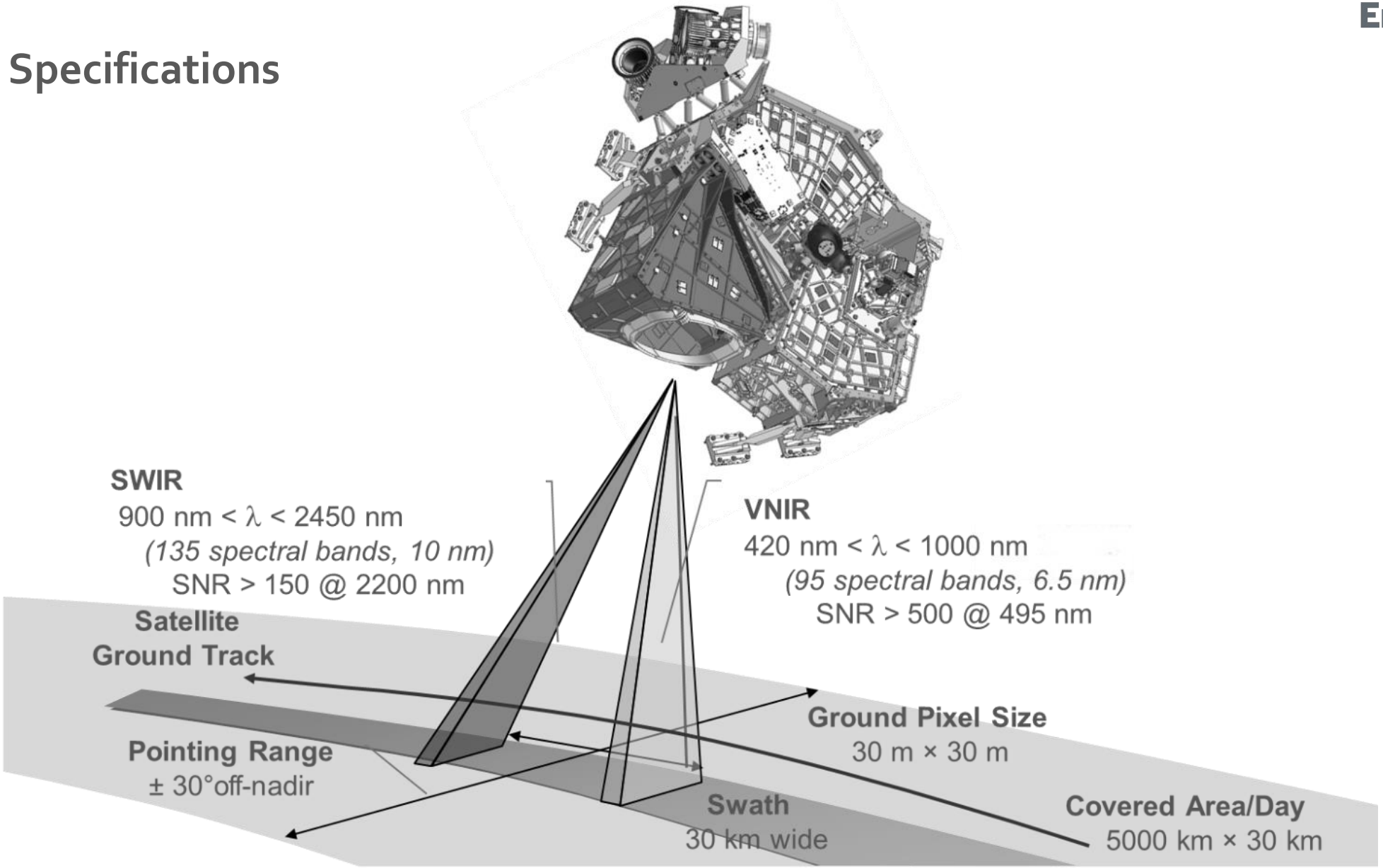
Ground Segment

Operations *DLR-GSOC* | Payload *DLR-DFD* | Processing *DLR-IMF*

- The DLR Space Administration in Bonn is responsible for the overall project management
- The ground segment is formed by the EOC and the GSOC in Oberpfaffenhofen
- Core funding is provided by the Federal Ministry of Economics and Climate Policy
- In addition: Extensive Scientific Exploitation preparation program

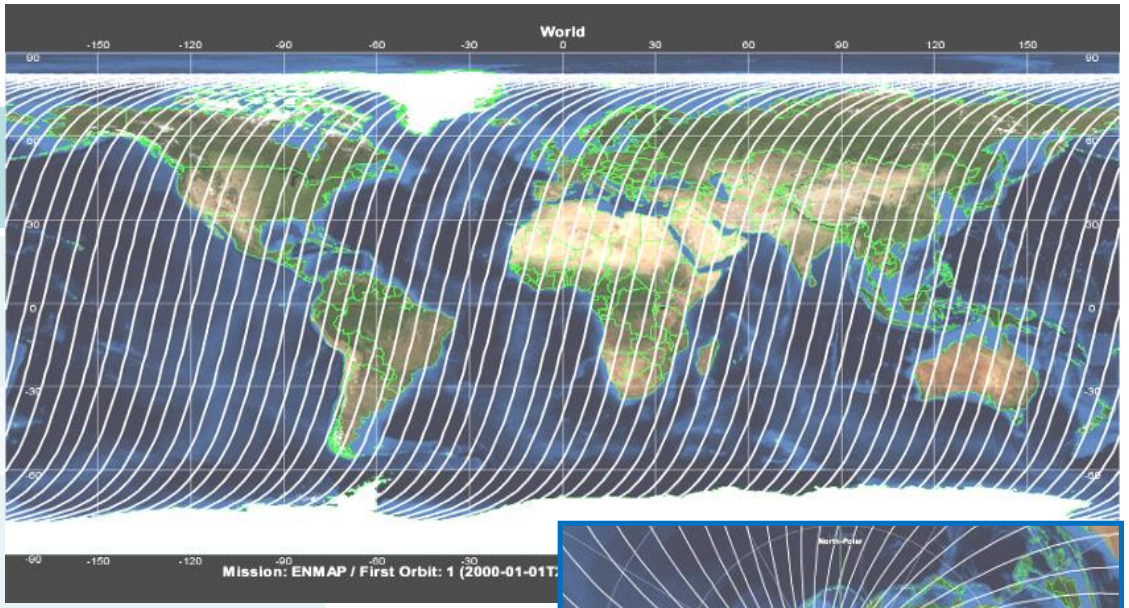
Supported by:
Federal Ministry for Economic Affairs and Climate Action
on the basis of a decision by the German Bundestag

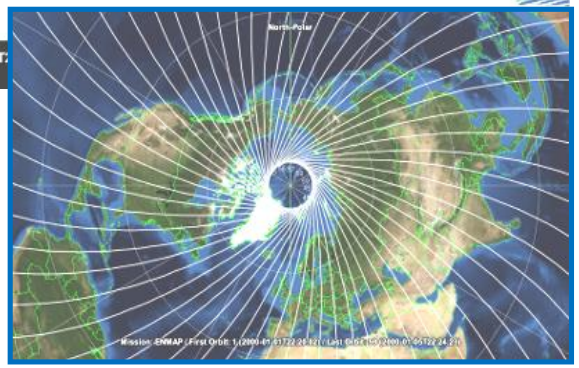
EnMAP Specifications



EnMAP Specifications

Parameter	Value
Target Lifetime	04/2022-04/2027 (currently in production phase)
Satellite (Mass, Dimension)	1000 kg, 3.1 m × 2.0 m × 1.7 m
Orbit (Type, Local Time at Equator, Inclination, Altitude, Repeat Cycle)	Sun-synchronous, 11:00, 98.0°, 653 km, 398 orbits in 27 days
Coverage	74° N to 74° S
Revisit	≤ 4 days (-30° to +30° across-track tilt) ≤ 27 days (-5° to +5° across-track tilt)





1st of April 2022

EnMAP Operation Phases

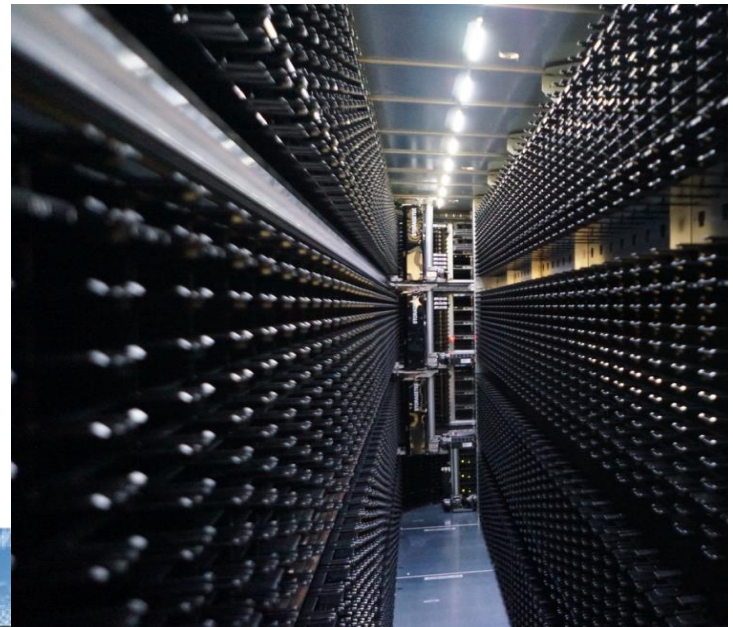
- Launch and Early Orbit Phase(14.04.2022, 2w)
- Commissioning Phase (6 m)
- Routine Phase (5 y)
- De-Commissioning Phase (3 m)

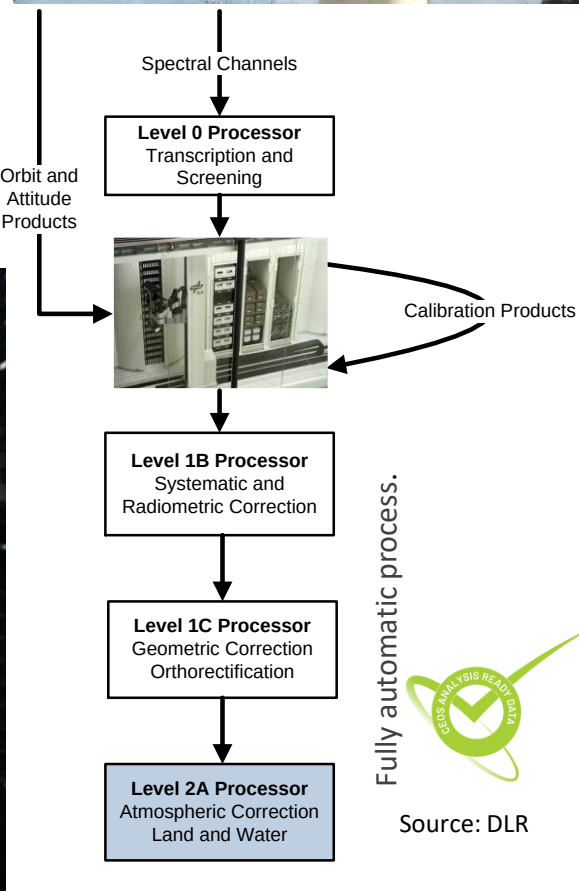
Ground Control Center (GSOC),Oberpfaffenhofen

DFD-Station (Data recieving station), Neustrelitz

GSOC-Station (TMTC), Weilheim

German Satellite Data Archive (D-SDA) und Web-Interfaces





Source: DLR

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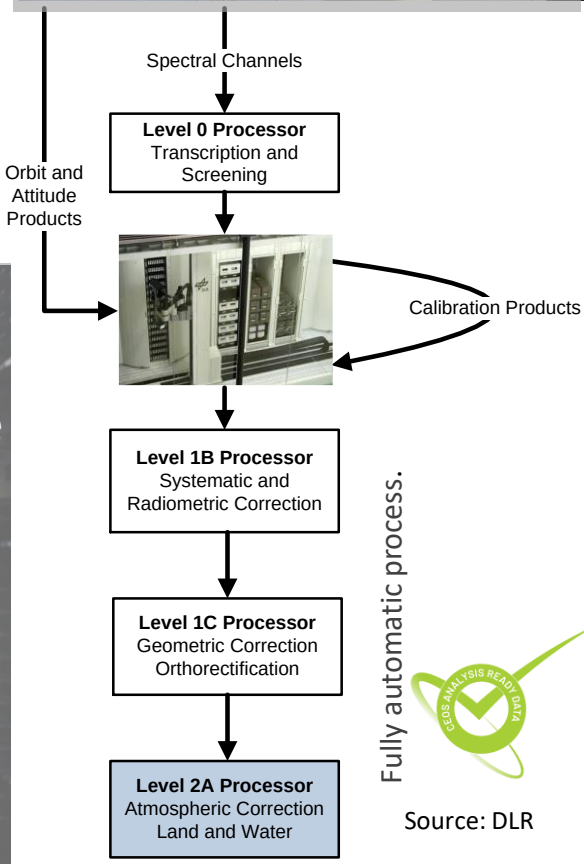
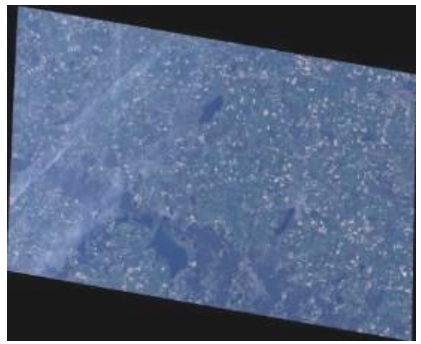


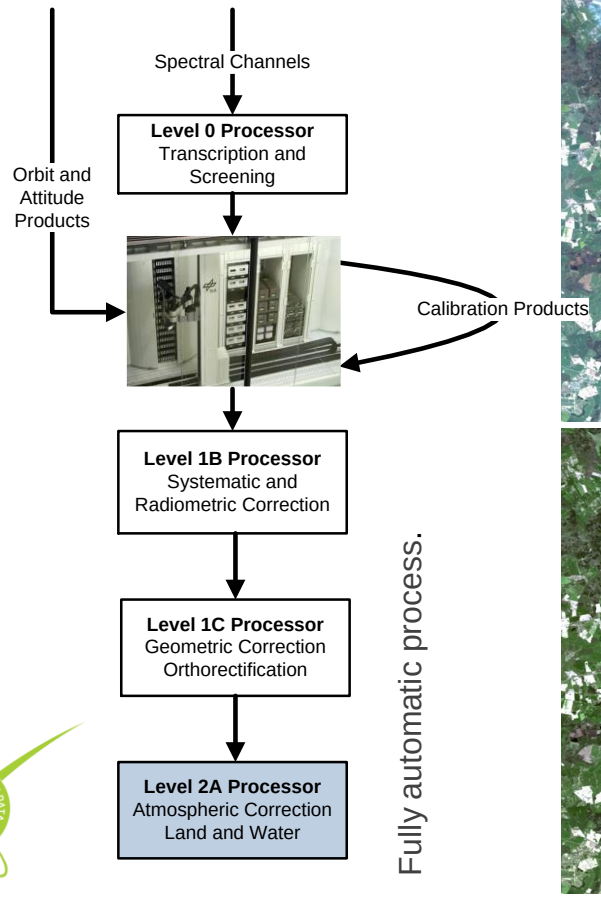
Source: DLR

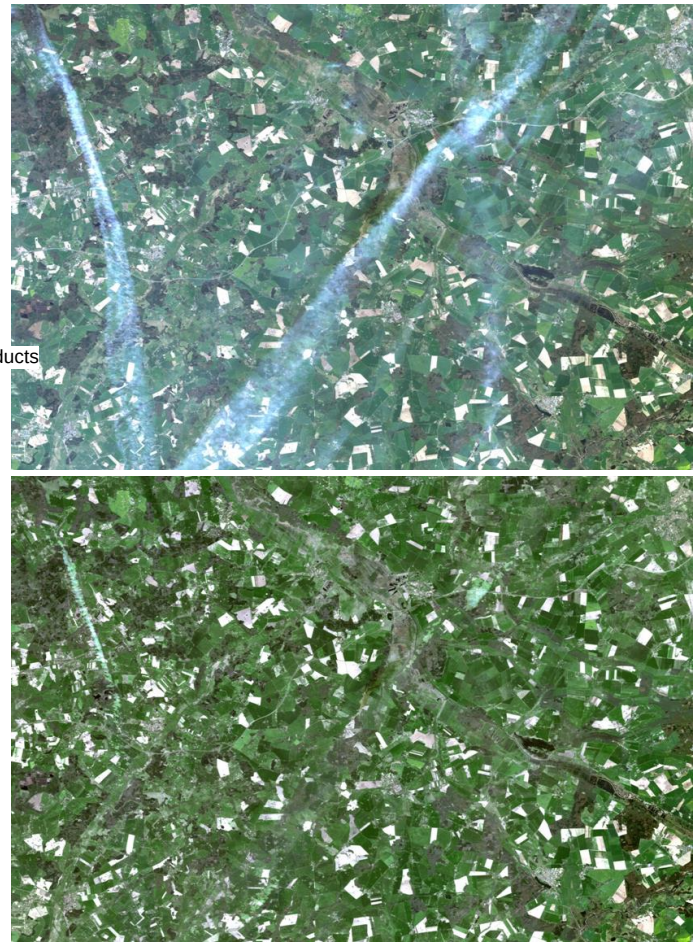
EnMAP Processor, Cal & QC System

- Development of a processing chain for
  - the systematic und radiometric correction (Level 1B)
  - orthorectification (Level 1C)
  - atmospheric correction (Level 2A)
- Calibration of the instrument during operations,
- Quality control of the products.



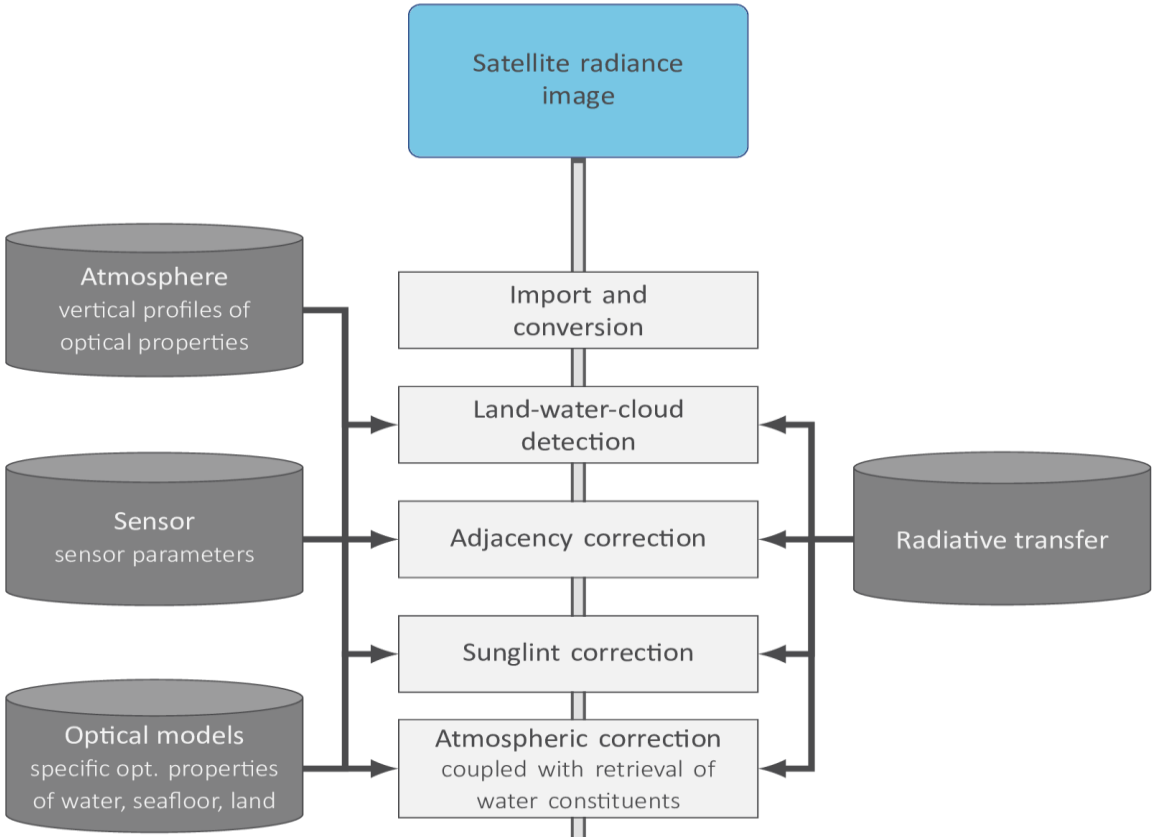
Orthorectification





Atmospheric Correction

EnMAP Water-related Ground Segment Processors

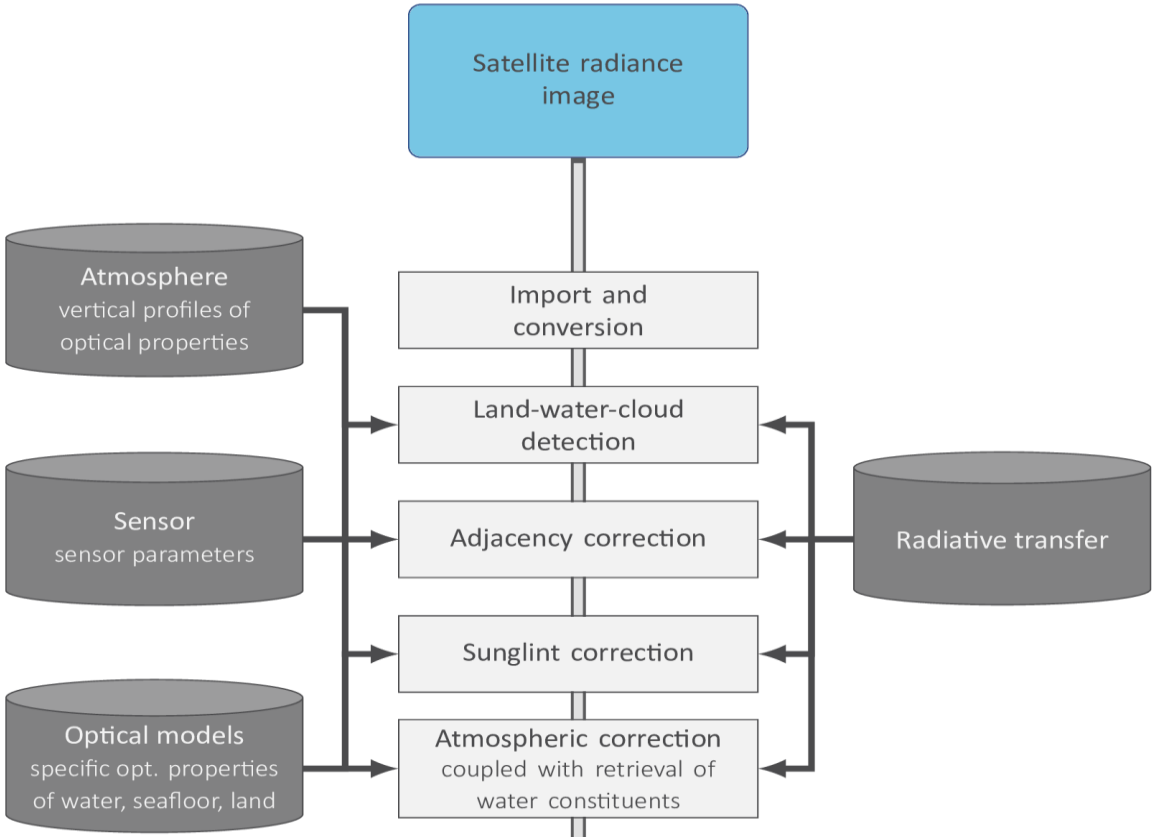


Modular Inversion Processor (MIP)

Fully physics-based processor for EnMAP AC correction over water, includes coupled AC-water retrieval

DLR EOMAP detect more.

EnMAP Water-related Ground Segment Processors



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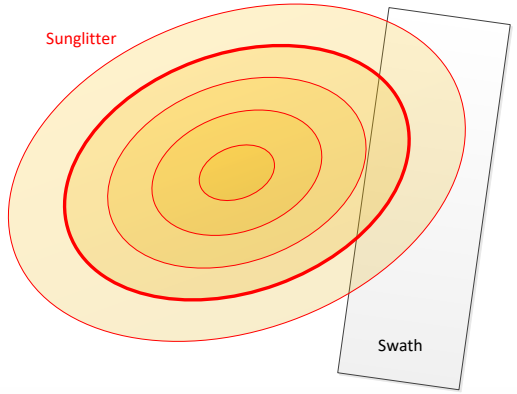
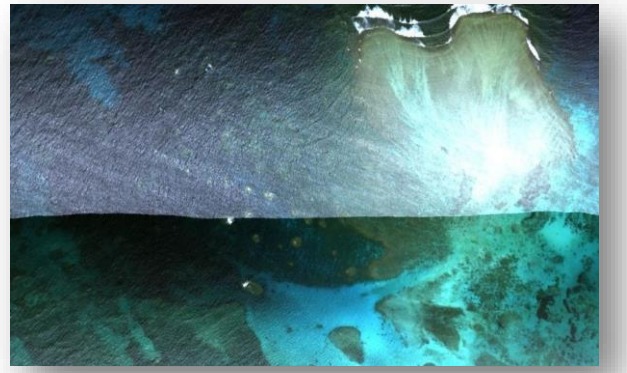


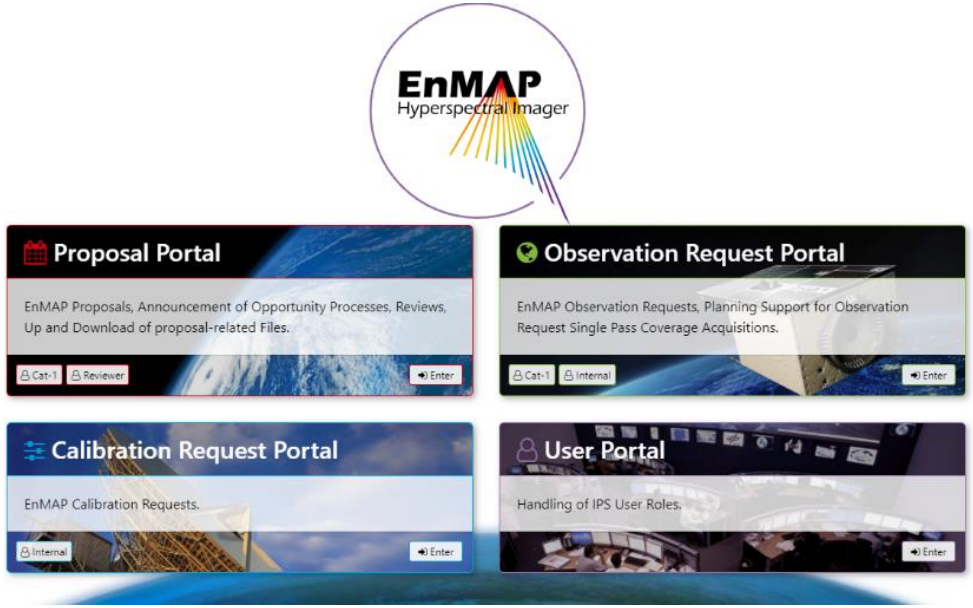


Sunglint avoidance algorithm

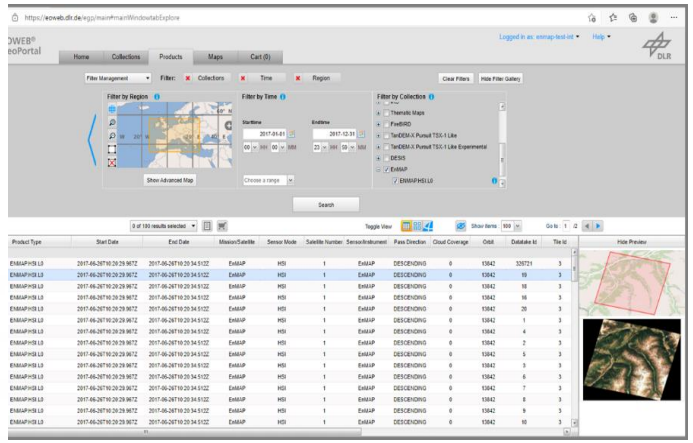
Maximum coverage of areas affected by sunglint will be considered during acquisition planning

EnMAP Users

- Internal User
  - Mission
  - Charter
- *Category I*
  - *Based on science AO*
  - *With proposal*
- Category II
  - Based on Space Administration
  - Without proposal
- Background Mission

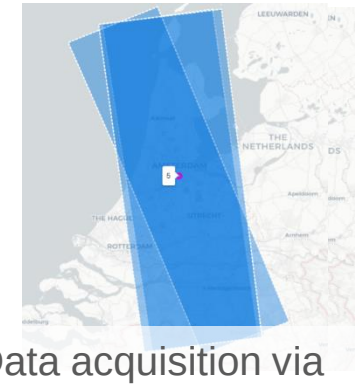


Data access via EOWEB@Geoportal



free and open

Year ops	Quota for Category I	Quota for Category II
1	80%	20%
2	70%	30%
3	70%	30%
4	60%	40%
5	60%	40%

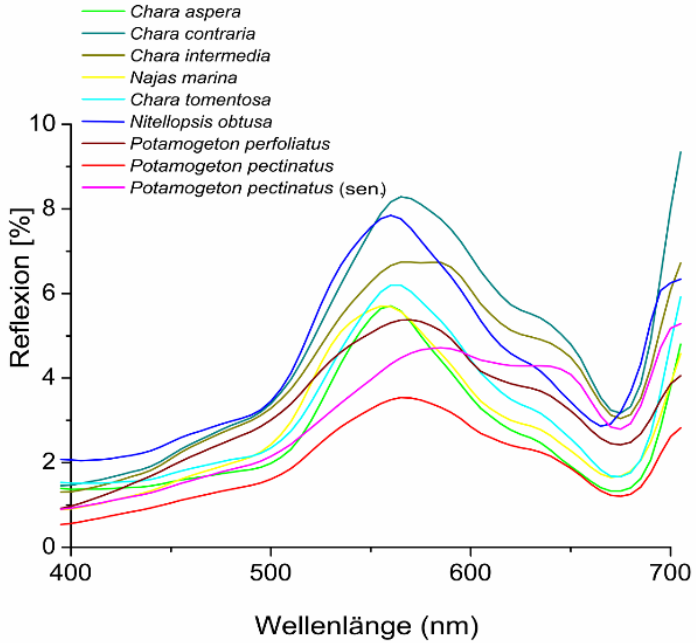


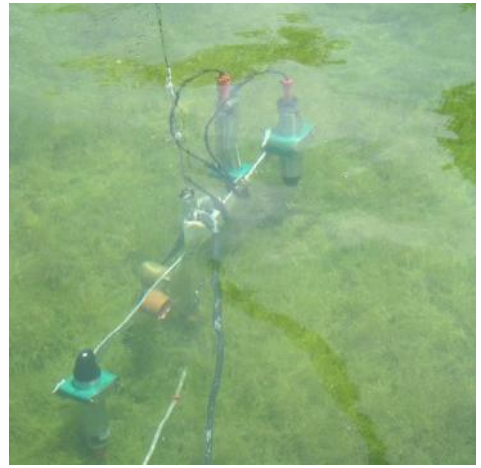
Data acquisition via
EnMAP Instrument Planning Portal

Water Quality Application

Water Quality Application - Submerged Aquatic Vegetation Mapping

Lake Starnberg (Airborne HyMAP Sensor)

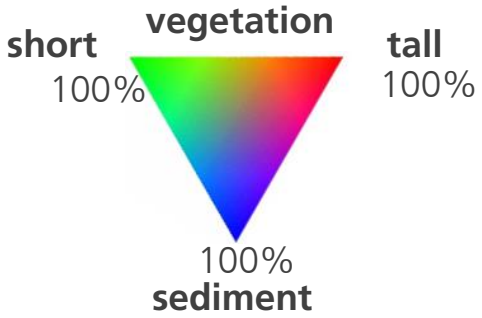


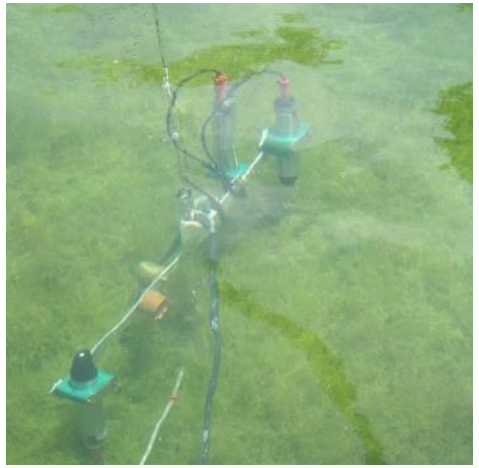


Water Quality Application - Submerged Aquatic Vegetation Mapping

Lake Starnberg (Airborne HyMAP Sensor)

Seafloor coverage [%]





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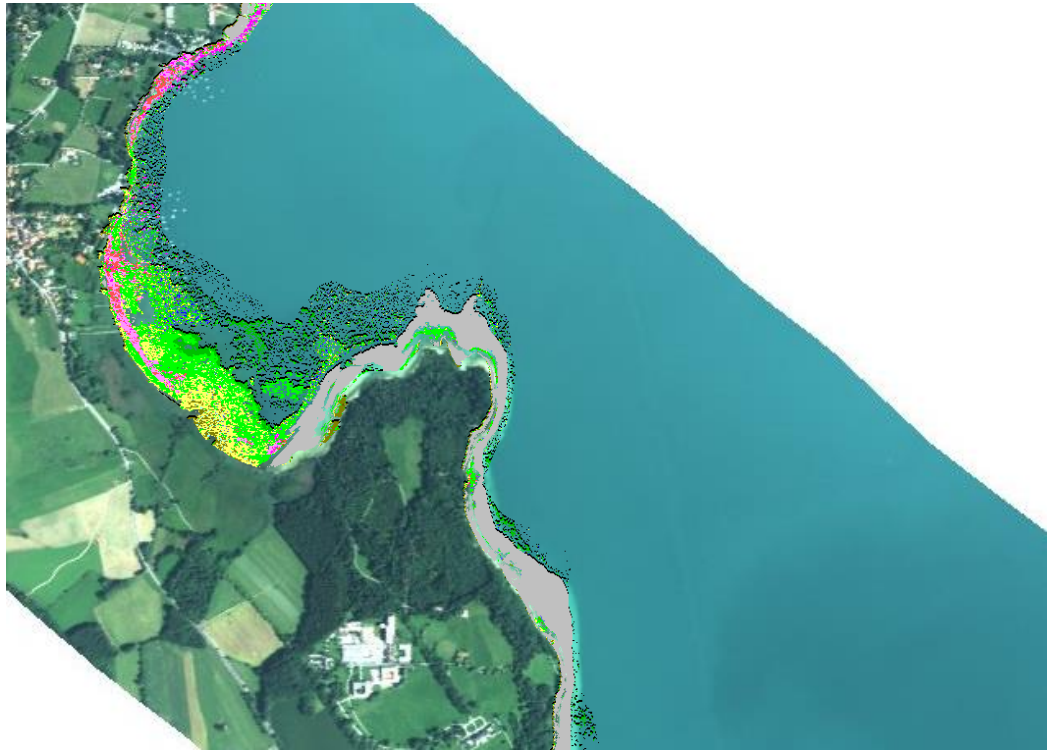
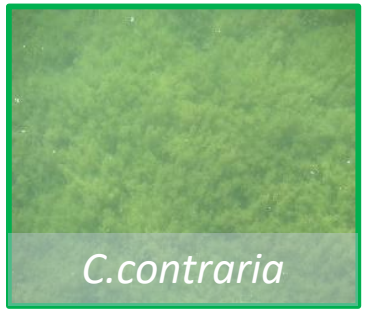
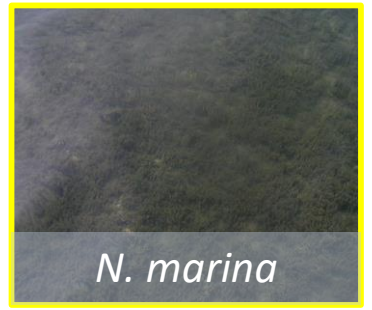


Macrophyte species

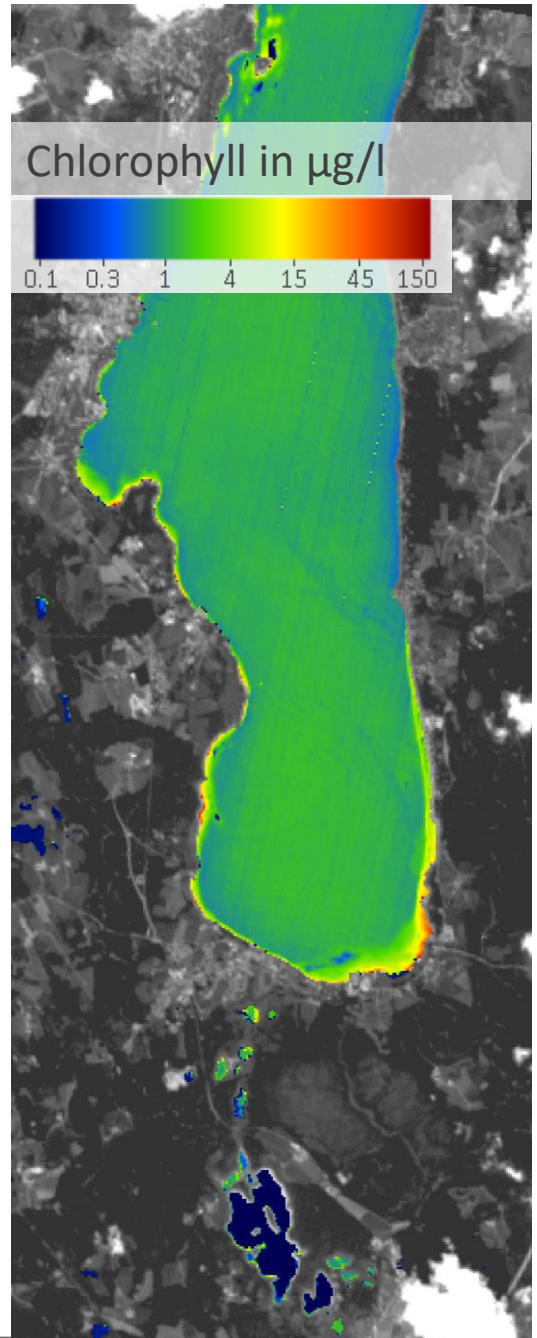
- *P.perfoliatus*
- *P.pectinatus*
- *P.pectinatus* sen.
- *Najas marina*
- *Chara aspera*
- *Chara aspera* sen.
- *Chara contraria*
- *Chara contraria* sen.

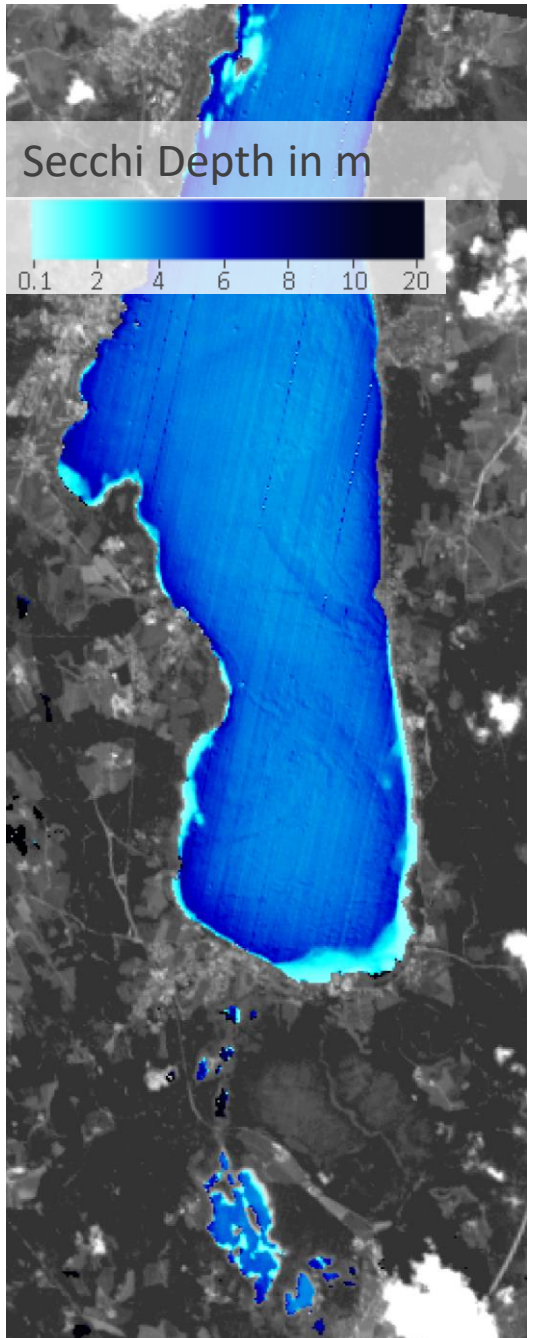
uncovered sediment

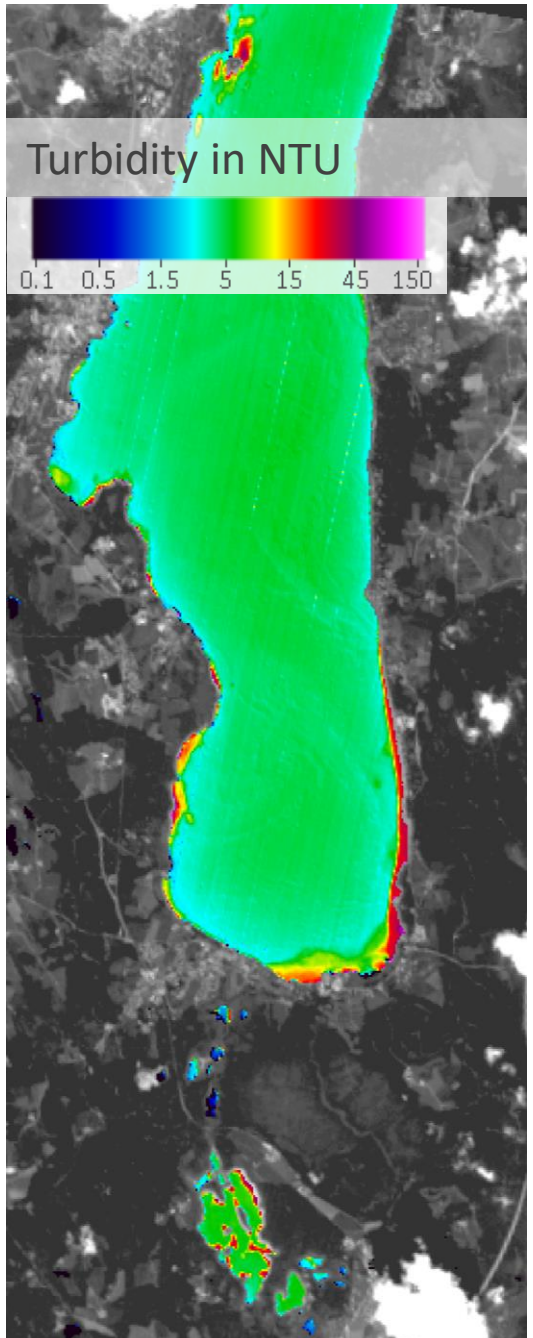




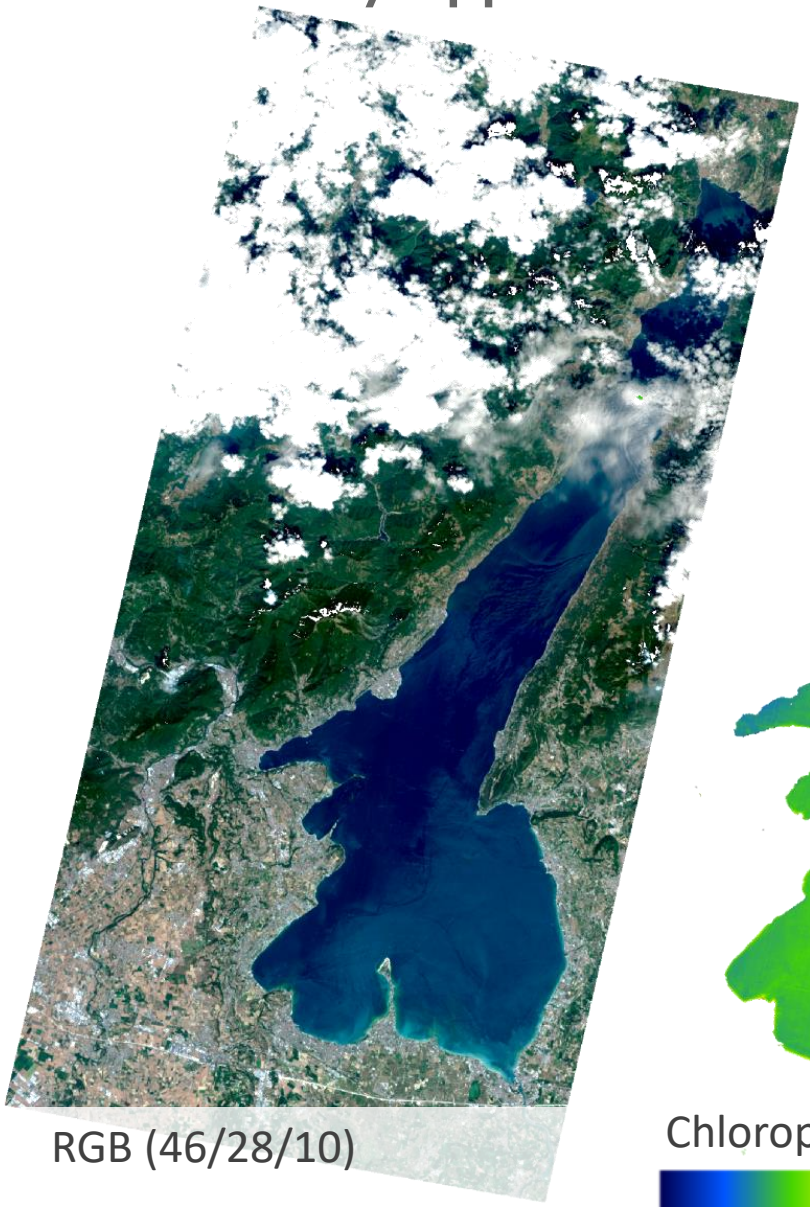
Water Quality Application – Lake Starnberg, Germany, 24.07.2022



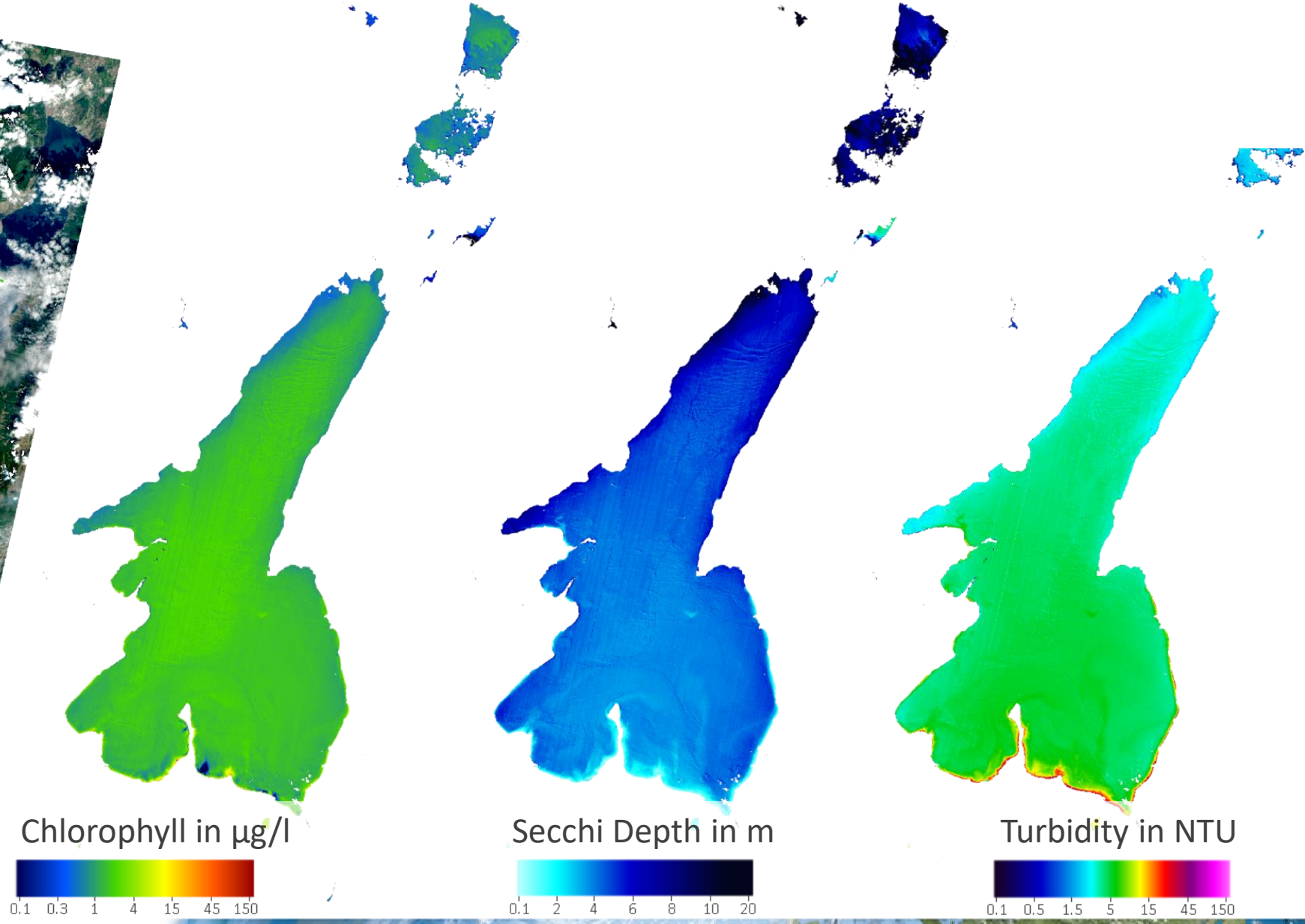




Water Quality Application – Largo di Garda, Italy, 28.07.2022



RGB (46/28/10)



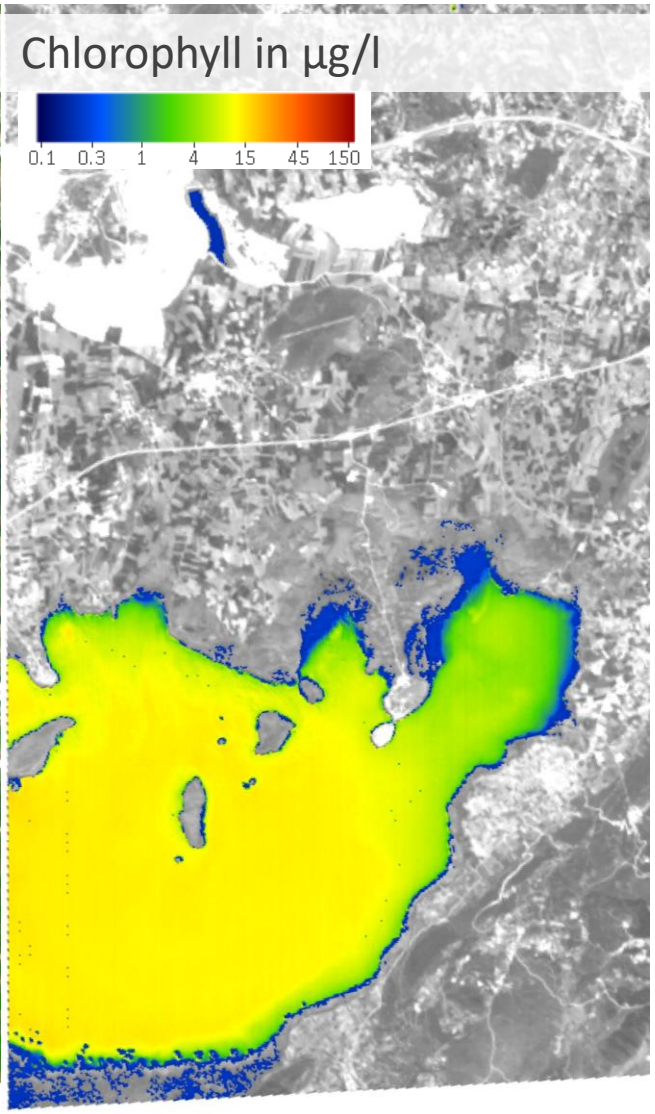
DLR

EOMAP detect more.

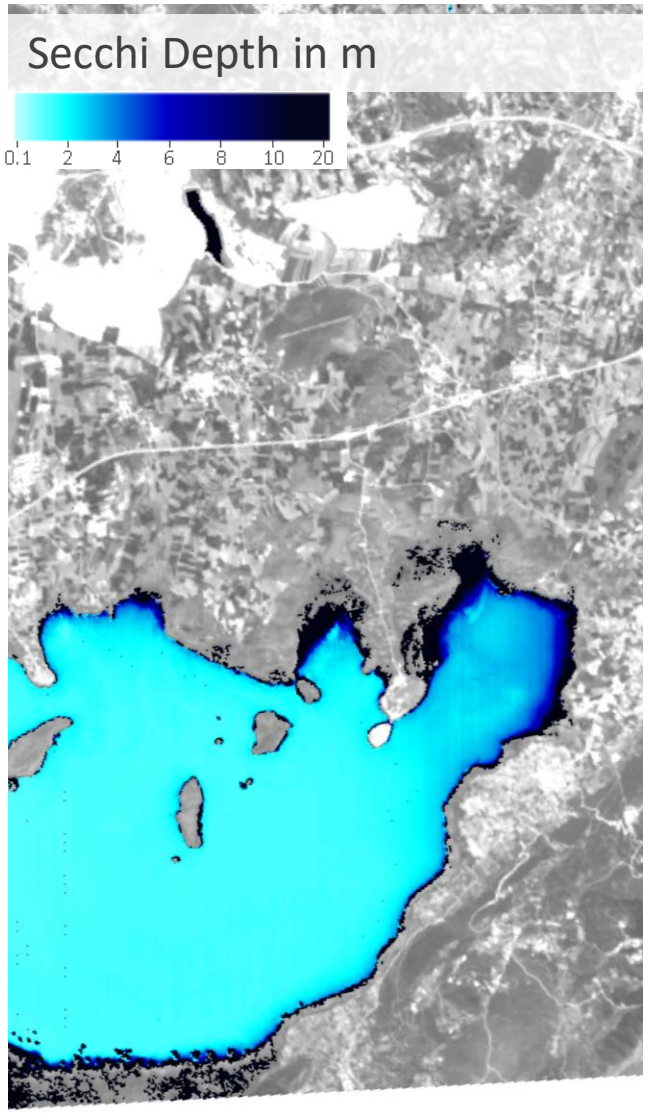
Water Quality Application – Turkey, 04.05.2022

RGB (46/28/10)

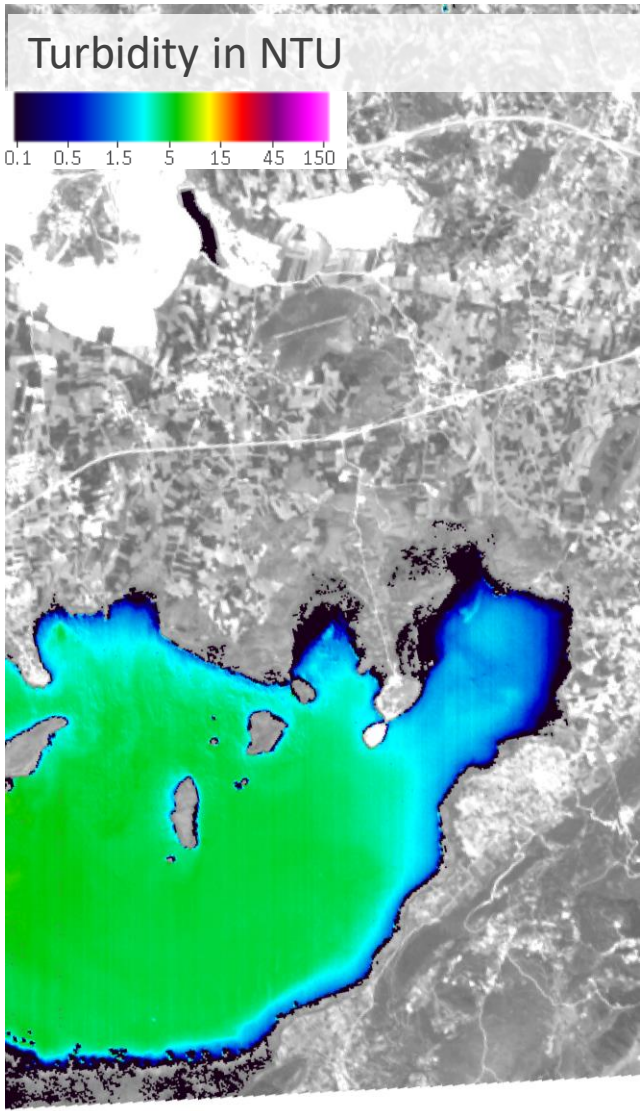
Chlorophyll in µg/l



Secchi Depth in m



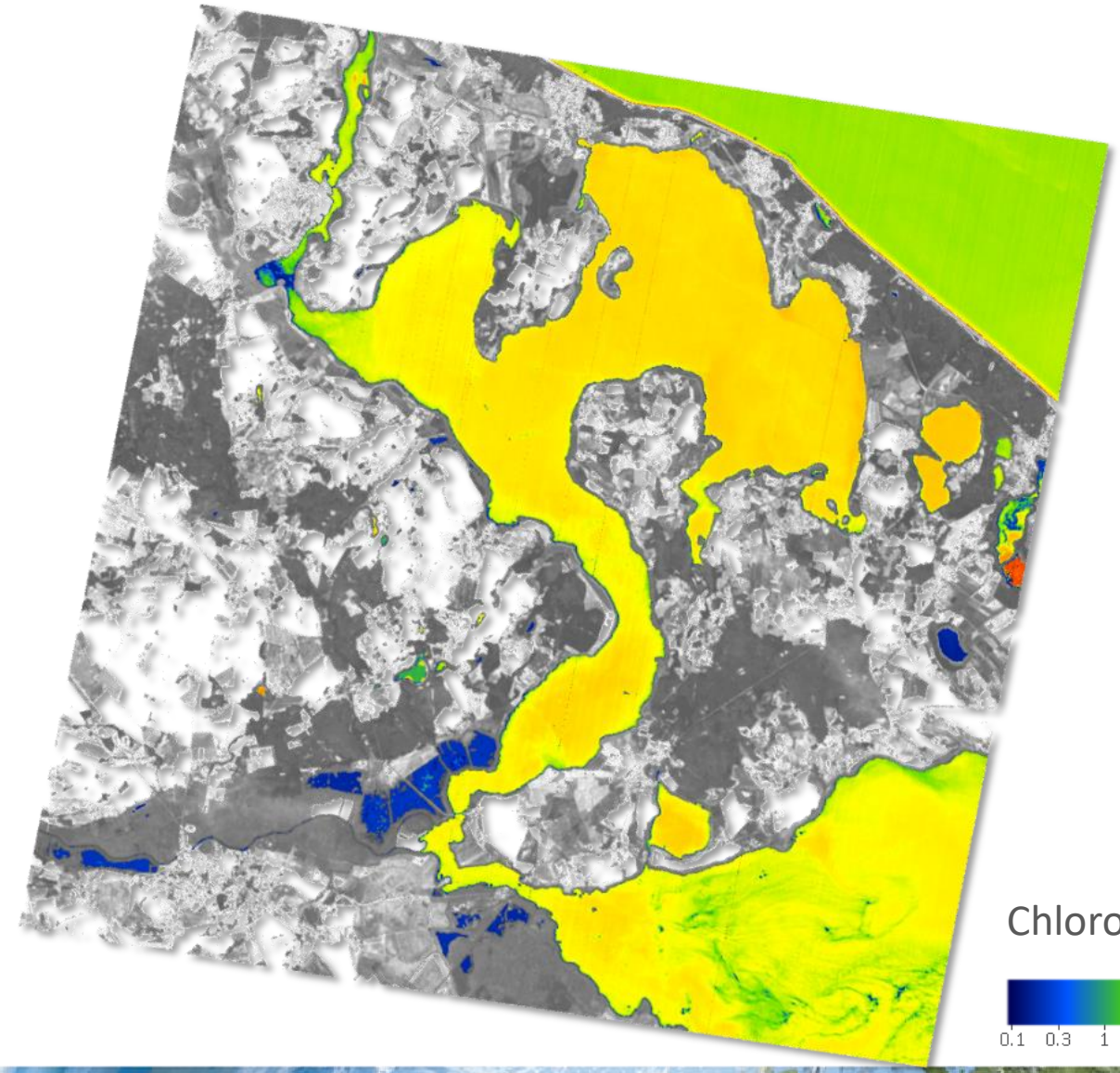
Turbidity in NTU



Water Quality Application – Stettiner Haff (Oder), Germany, 24.07.2022

RGB (46/28/10)

Water Quality Application – Stettiner Haff (Oder), Germany, 24.07.2022



Chlorophyll in µg/l

DLR

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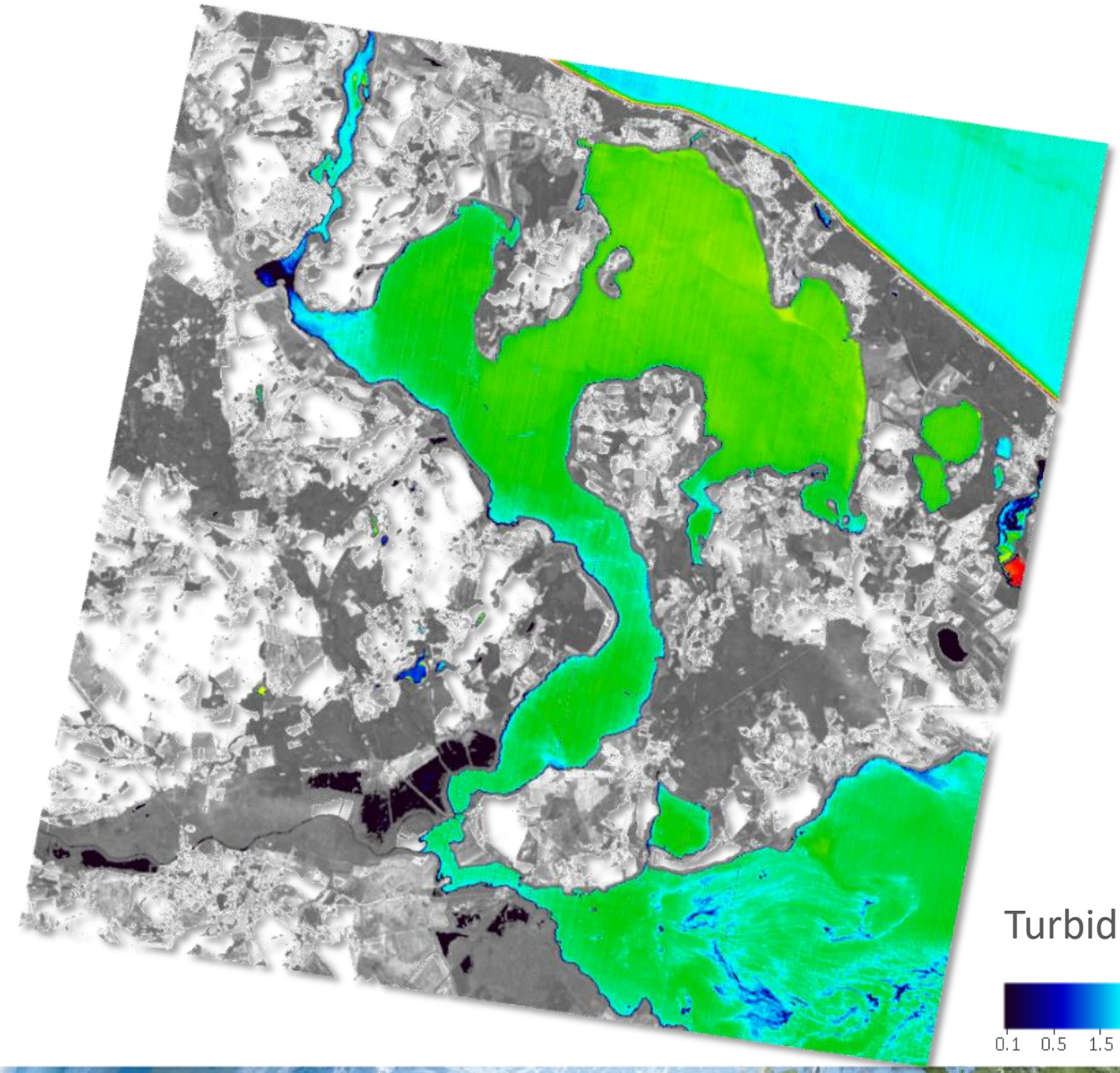

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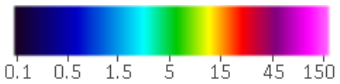

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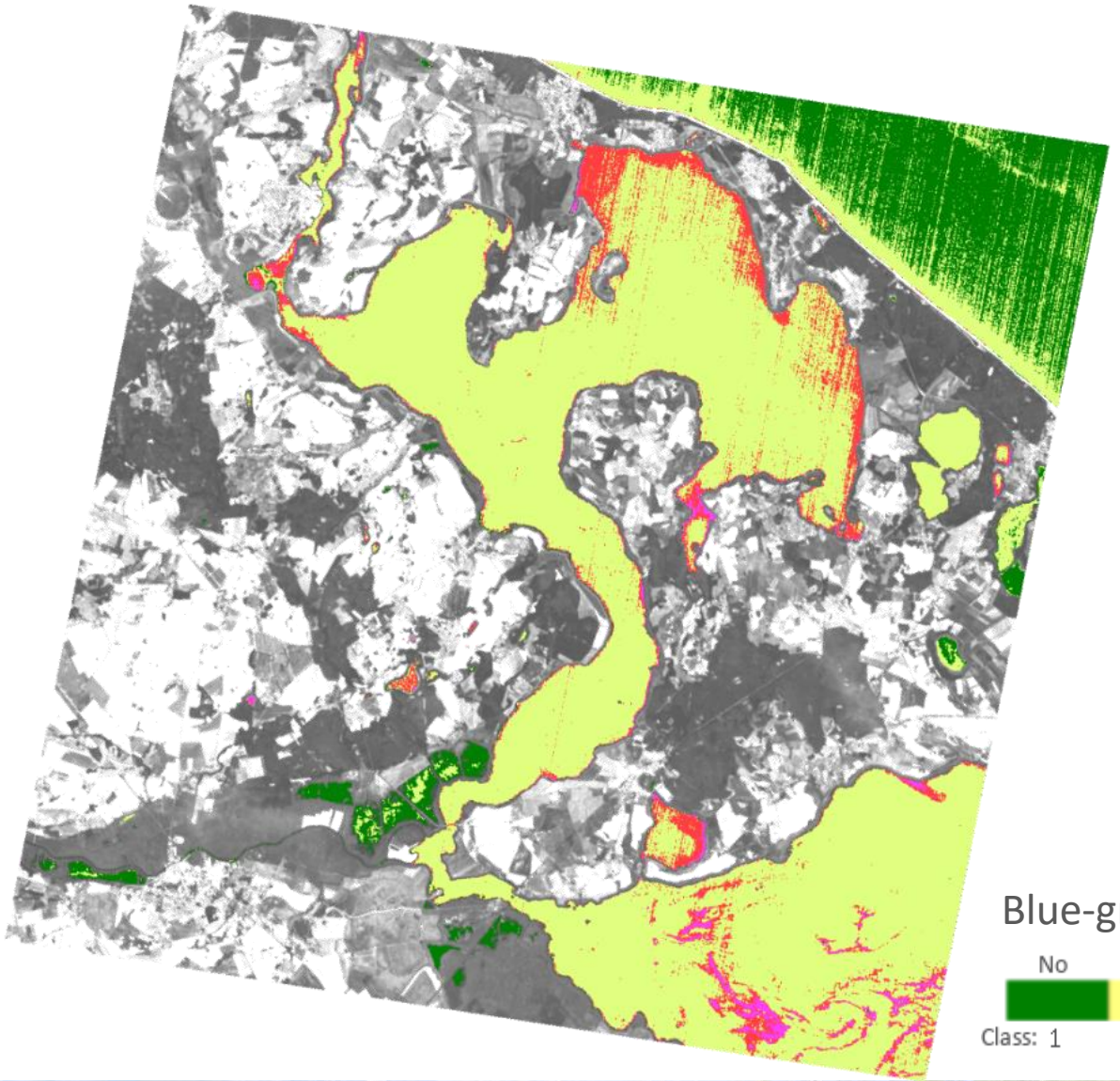
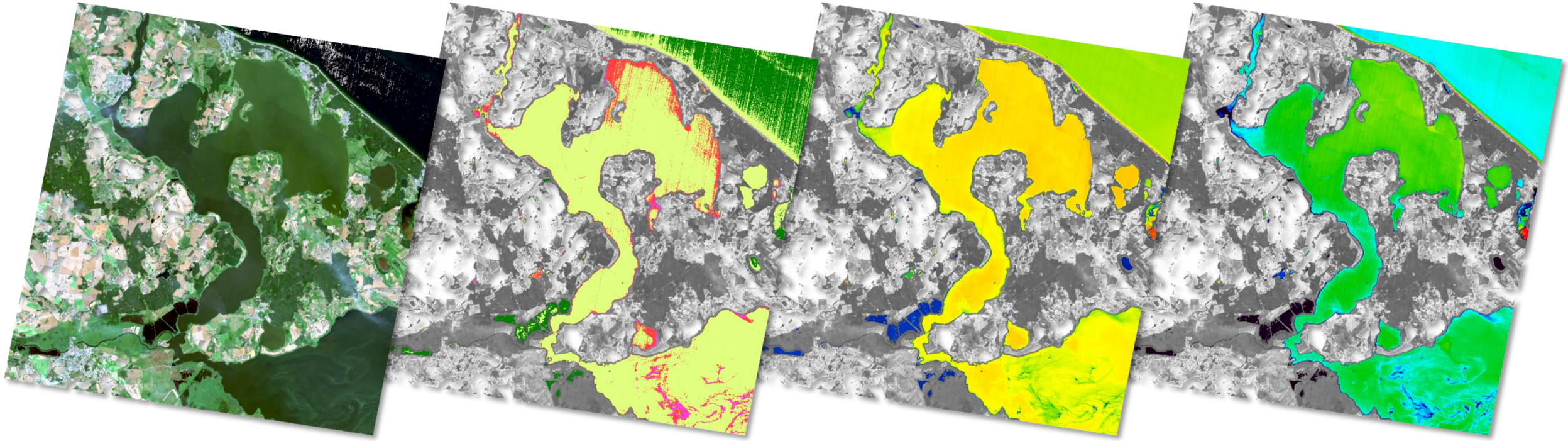
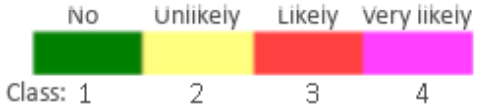


Water Quality Application – Stettiner Haff (Oder), Germany, 24.07.2022

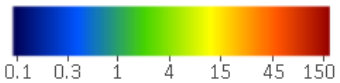


RGB (46/28/10)

Blue-green Algae Probability



Chlorophyll in µg/l



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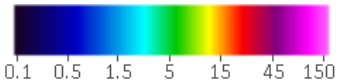


Outlook

Future operational hyperspectral sensors will in future support space-based services with:

- more detectable species and environmental habitats
- quantiative mapping of major phytoplankton species
- improve legislative mapping (e.g. water frame directive (WRRL))
- improve required assessments in times of climate and environmental changes

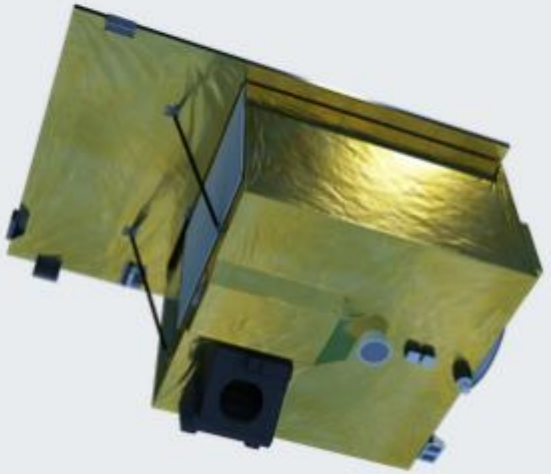
Science Plan
Brochure (english)
Brochure (german)
Flyer
Video (german)

IMAGE GALLERY

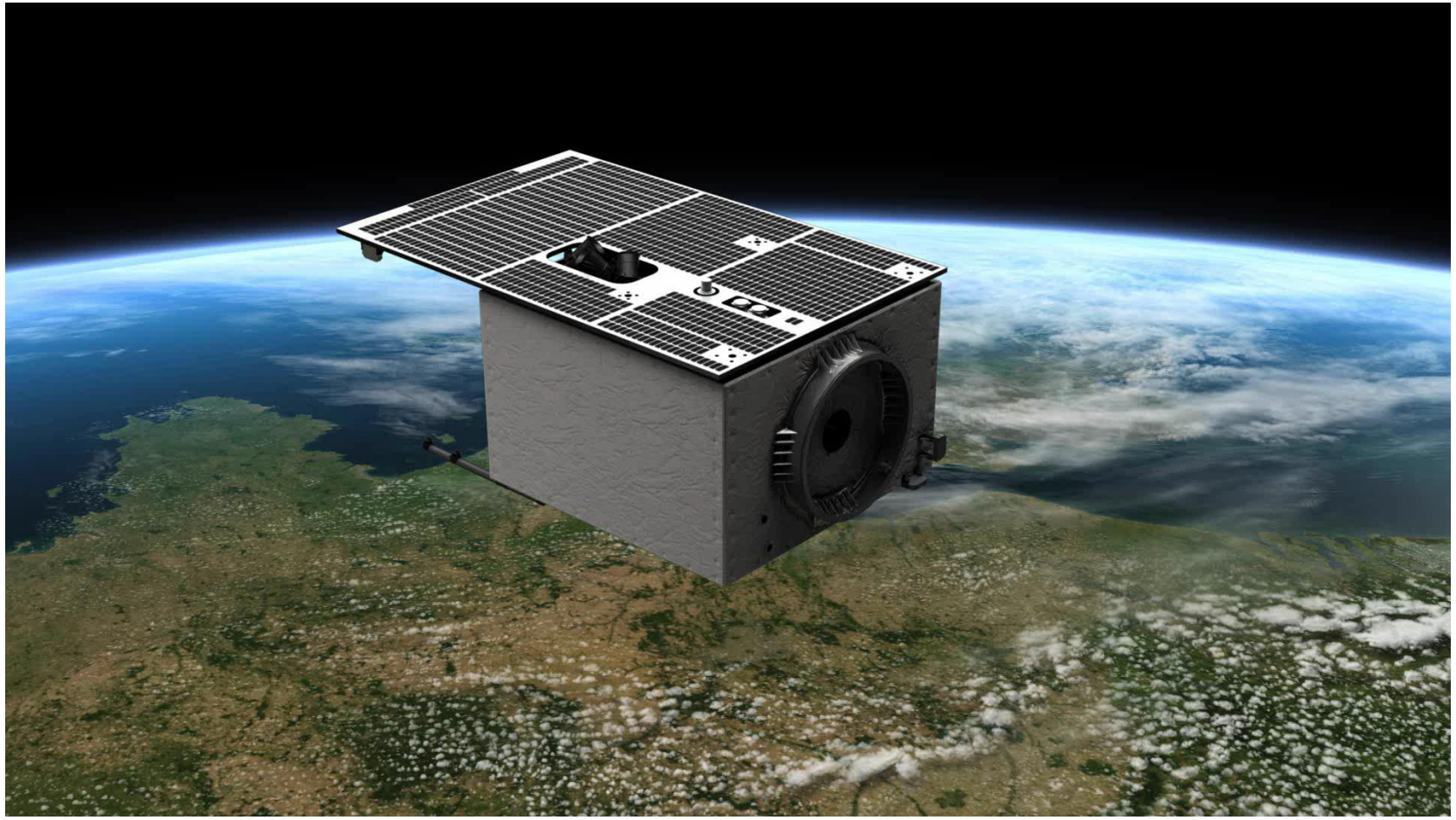
Welcome to EnMAP

The German Spaceborne Imaging Spectrometer Mission

The Environmental Mapping and Analysis Program (EnMAP) is a German hyperspectral satellite mission that aims at monitoring and characterising Earth's environment on a global scale. EnMAP measures and models key dynamic processes of Earth's ecosystems by extracting geochemical, biochemical and biophysical parameters that provide information on the status and evolution of various terrestrial and aquatic ecosystems. For more information about the main objectives and the status have a look at the mission page.



Thank you for your attention!



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www.DLR.de

www.enmap.org

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Federal Ministry
for Economic Affairs
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MISSION **EnMAP**

DLR