Copernicus – Möglichkeiten und Perspektiven für die wissenschaftliche Nutzung

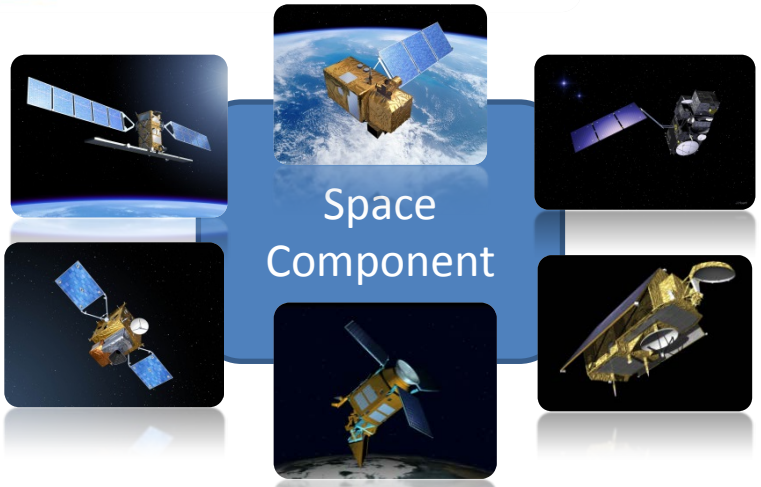
Godela Roßner
DLR Raumfahrtmanagement

5. gemeinsame Jahrestagung der Arbeitskreise Fernerkundung der DGfG und Auswertung von Fernerkundungsdaten der DGPF
Halle, 30.09.2016

Was ist Copernicus?

- EO-Informationssystem für Europa für Umweltschutz und zivile Sicherheit
- Sozioökonomischer Nutzen, Wachstum
- Entwicklung der europäischen Raumfahrt und Dienstleistungsindustrie
- Autonomer Zugang zu Information und Technologien
- Beitrag zu EU Politiken und GEOSS

Copernicus



Copernicus Weltraumkomponente: die Sentinels…


S1A/B: Radar Mission 3 Apr 2014/25 Apr 2016


S2A/B: High Resolution Optical Mission 23 June 2015/2017


S3A/B: Medium Resolution Imaging and Altimetry Mission 16 Feb 2016/2017

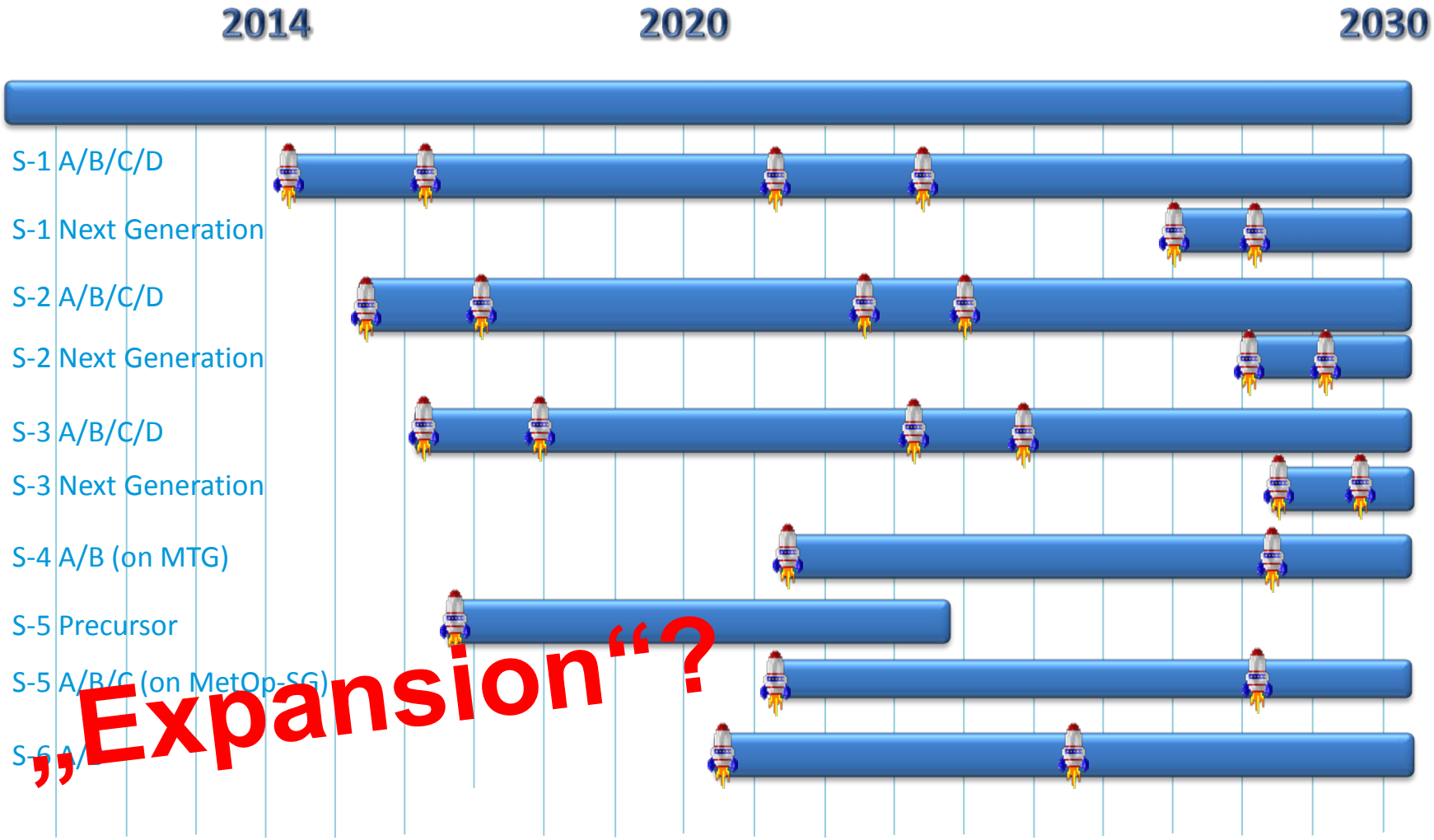

S4A/B: Geostationary Atmospheric Chemistry Mission 2021/2027


S5P: Low Earth Orbit Atmospheric Chemistry Mission 2016

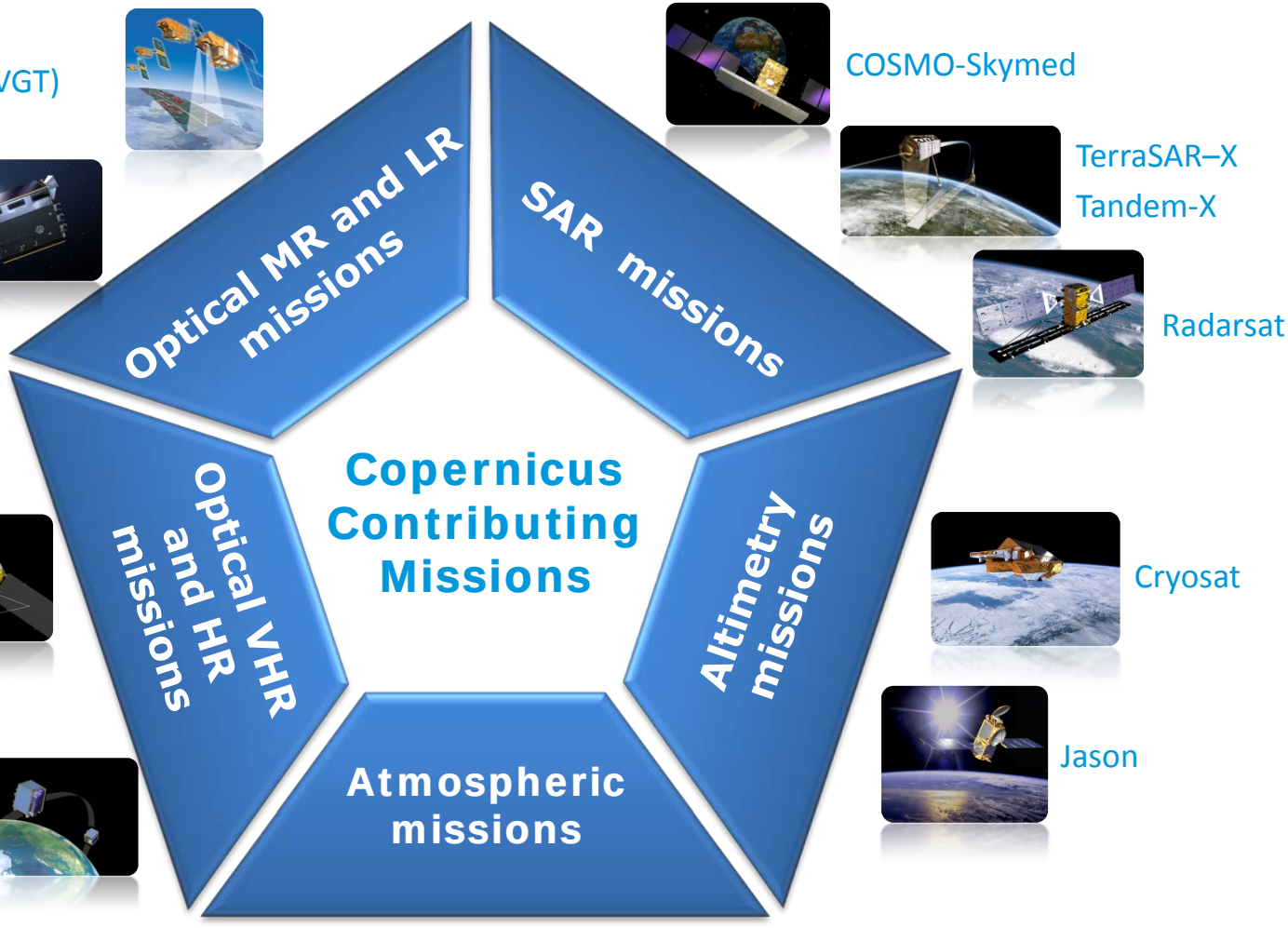

S5A/B/C: Low Earth Orbit Atmospheric Chemistry Mission 2021/2027


S6A/B: Altimetry Mission 2020/2025

… eine langfristig operationelle Perspektive



Copernicus Weltraumkomponente: Contributing Missions



Copernicus Sentinel-1

- **Datenkontinutität zu ERS und ENVISAT**
- **7 Jahre Missionsdauer, Kapazitäten für 12 Jahre**
- **6-Tage Wiederholzyklus am Äquator mit 2 Satelliten**
- **C-Band Radarmission für Ozean- und Landanwendungen sowie Katastrophenhilfe und -management**

Sentinel-1 Aufnahmeplanung

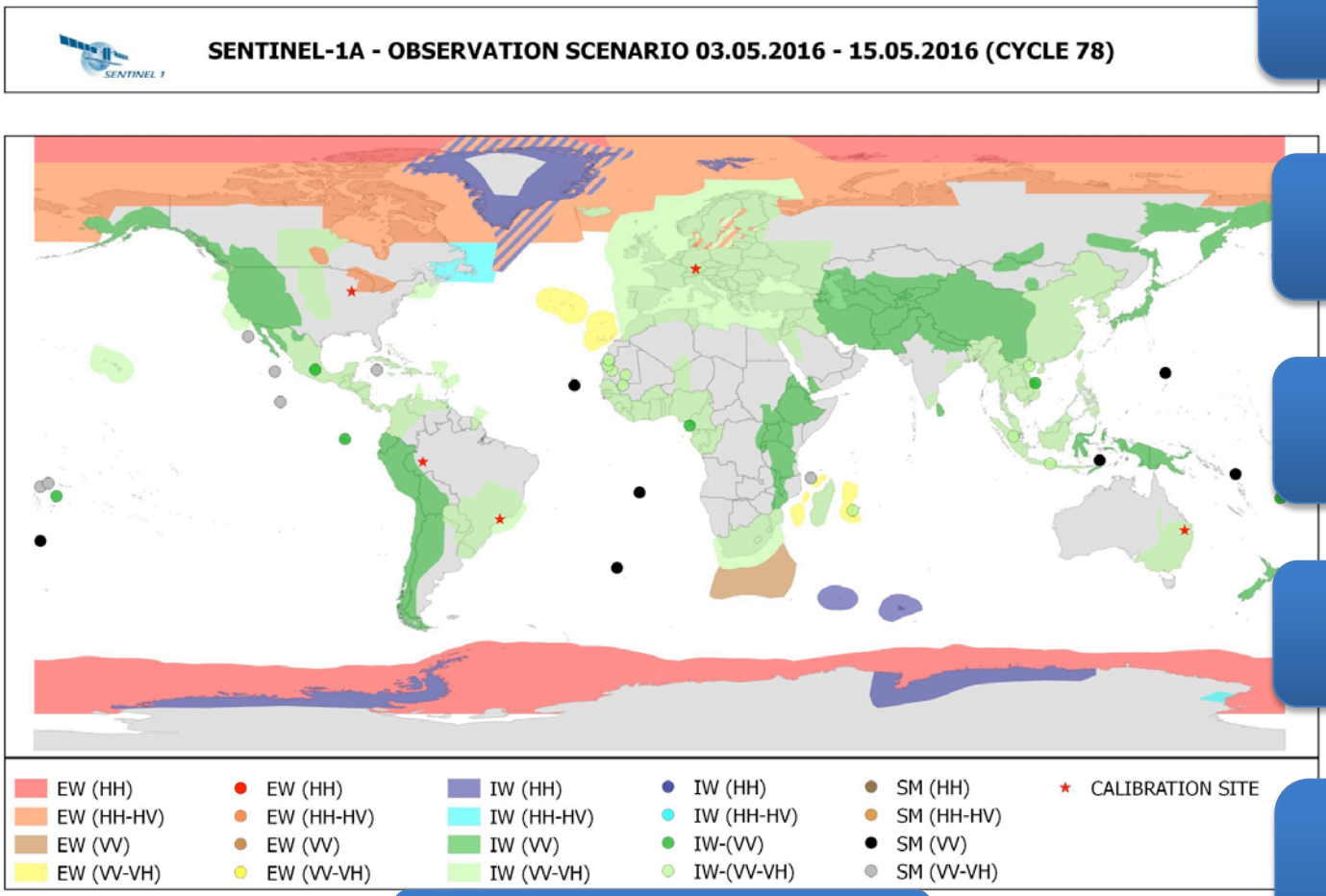
Agriculture

Calibration/validation

Zonal mapping

Tectonic volcanoes Landslides subsidence

Sea state



Forestry

Maritime surveillance

Emergency

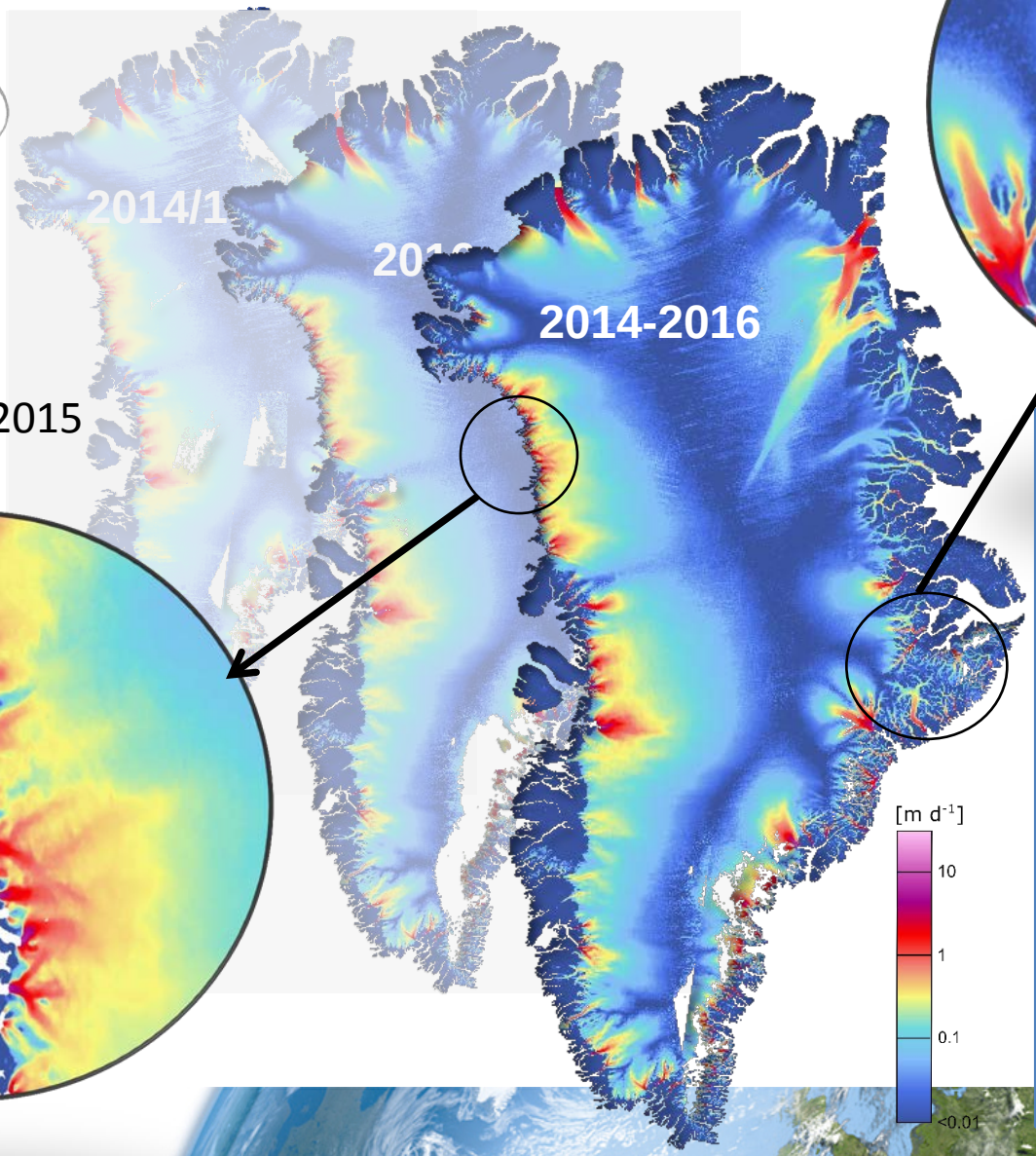
Security

Ice sheets, glaciers, permafrost and snow

Sea-ice, icebergs, lake-ice

https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/observation-scenario

Sentinel-1 Map: Greenland



Nagler et al., 2015

Product:
250m pixel spacing

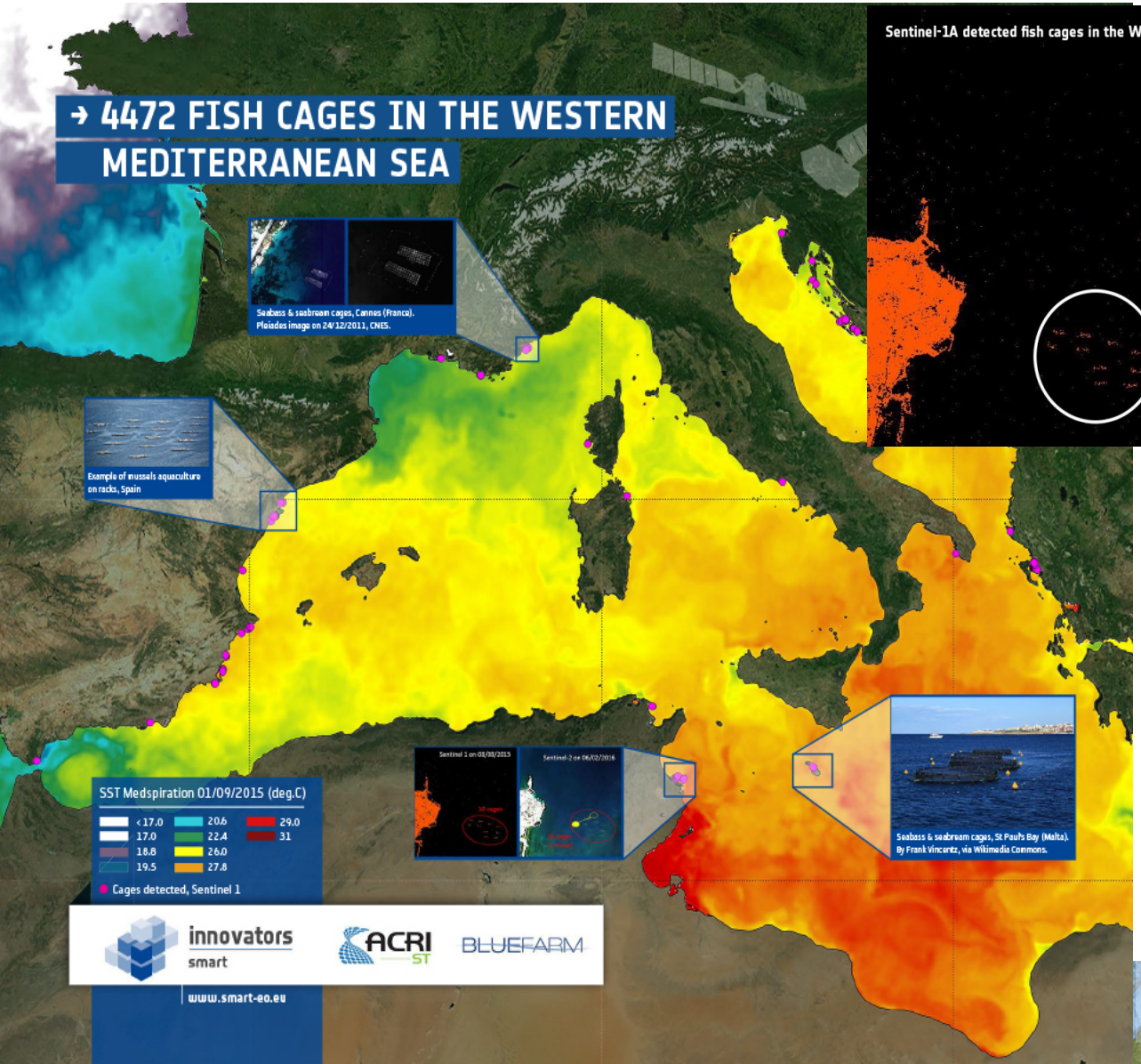
Method:
Offset Tracking

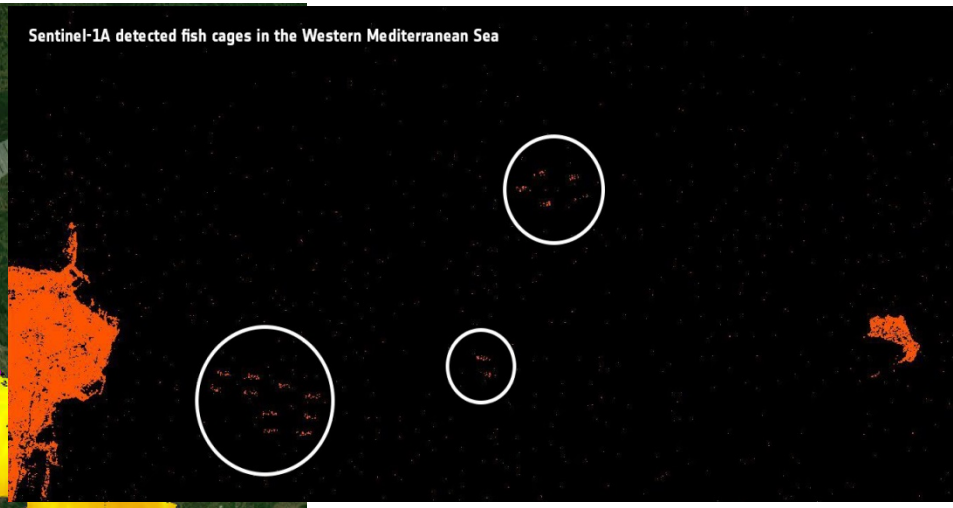
Period
S1 Greenland Campaigns
2015 & 2016
some scenes 2014

Data Source
S1 IWS SLC HH
>3100 Scenes
>67 000 bursts
~330 pairs of tracks (12 d)

Sentinel-1 for Aquaculture

Nearly 4500 cages detected over 6 months

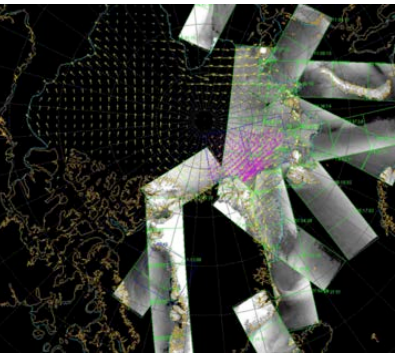


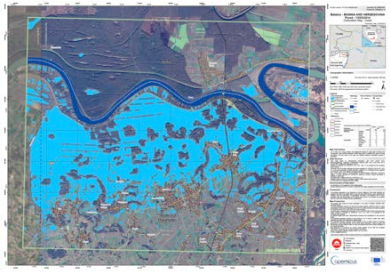


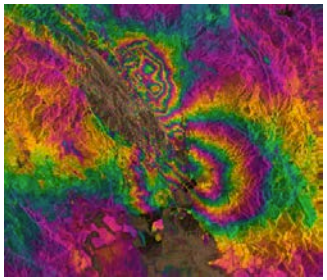
ESA SMART Project (Sustainable Management of Aquaculture through Remote sensing Technology)

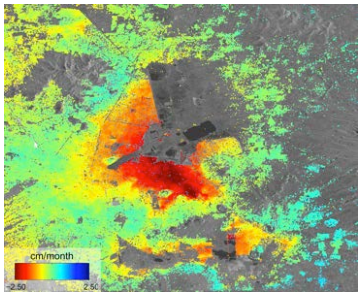
Nearly 4500 fish cages detected in the western Mediterranean Sea by Sentinel-1 and other satellites

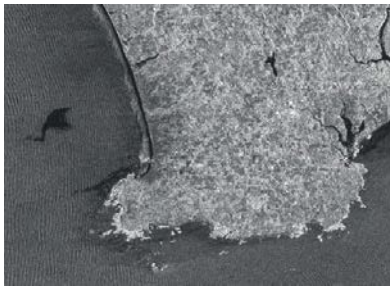
Sentinel-1 Anwendungsmöglichkeiten

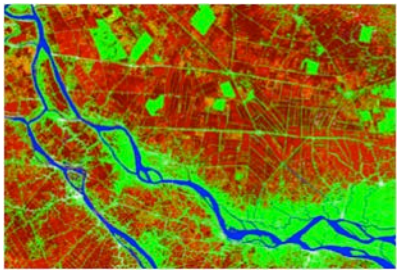


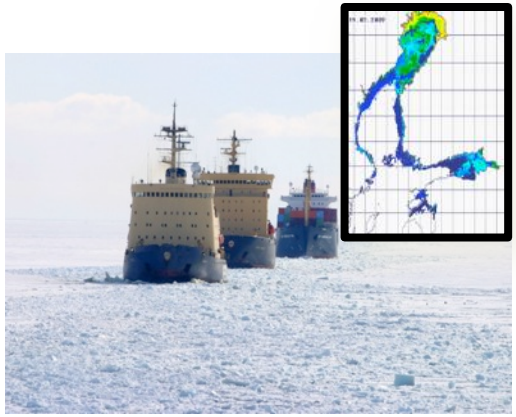


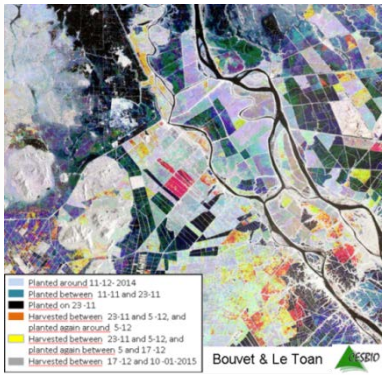


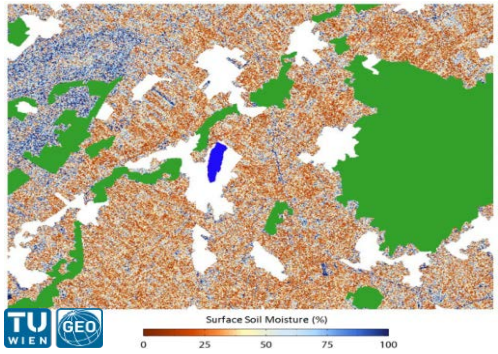








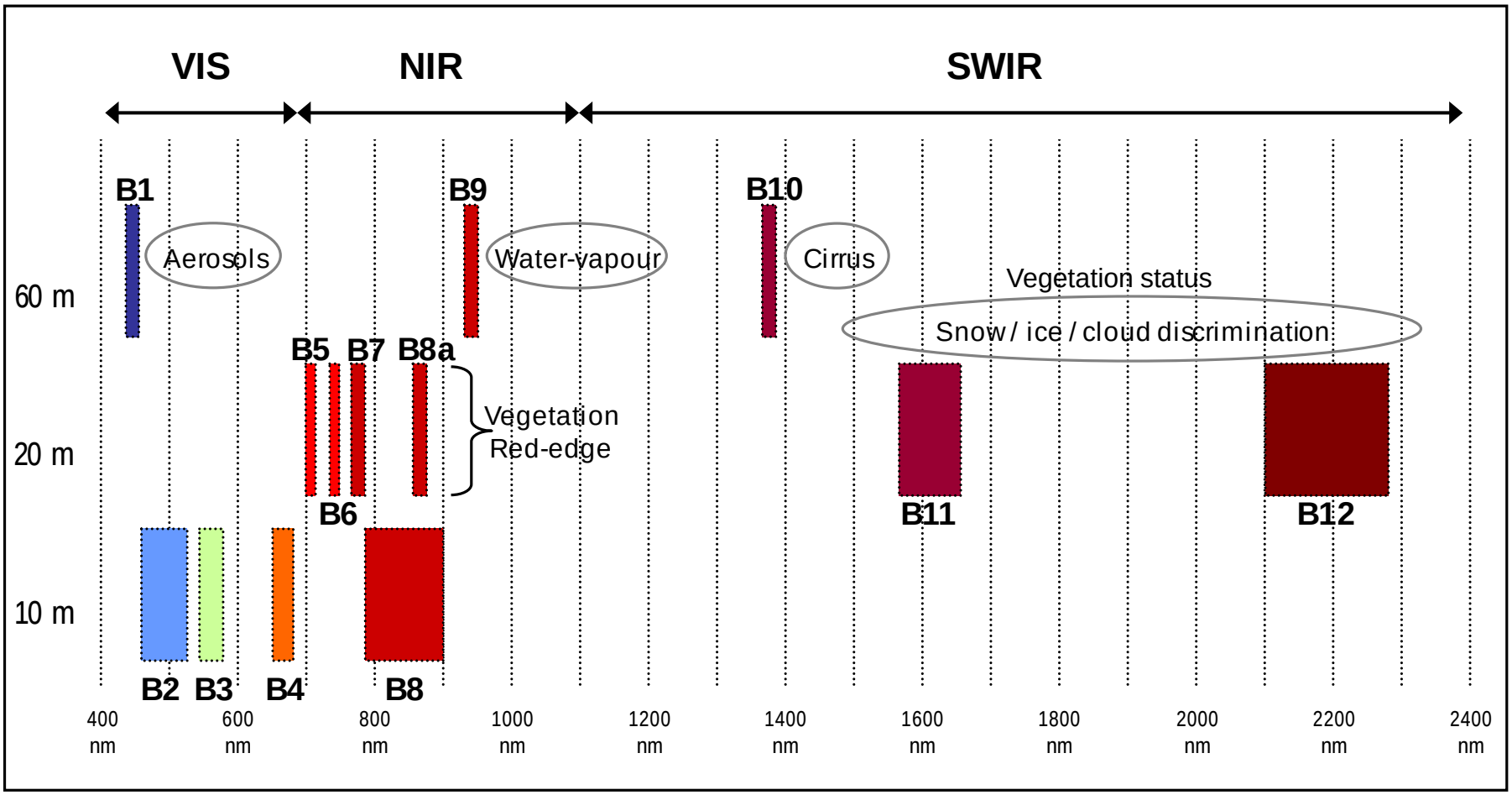




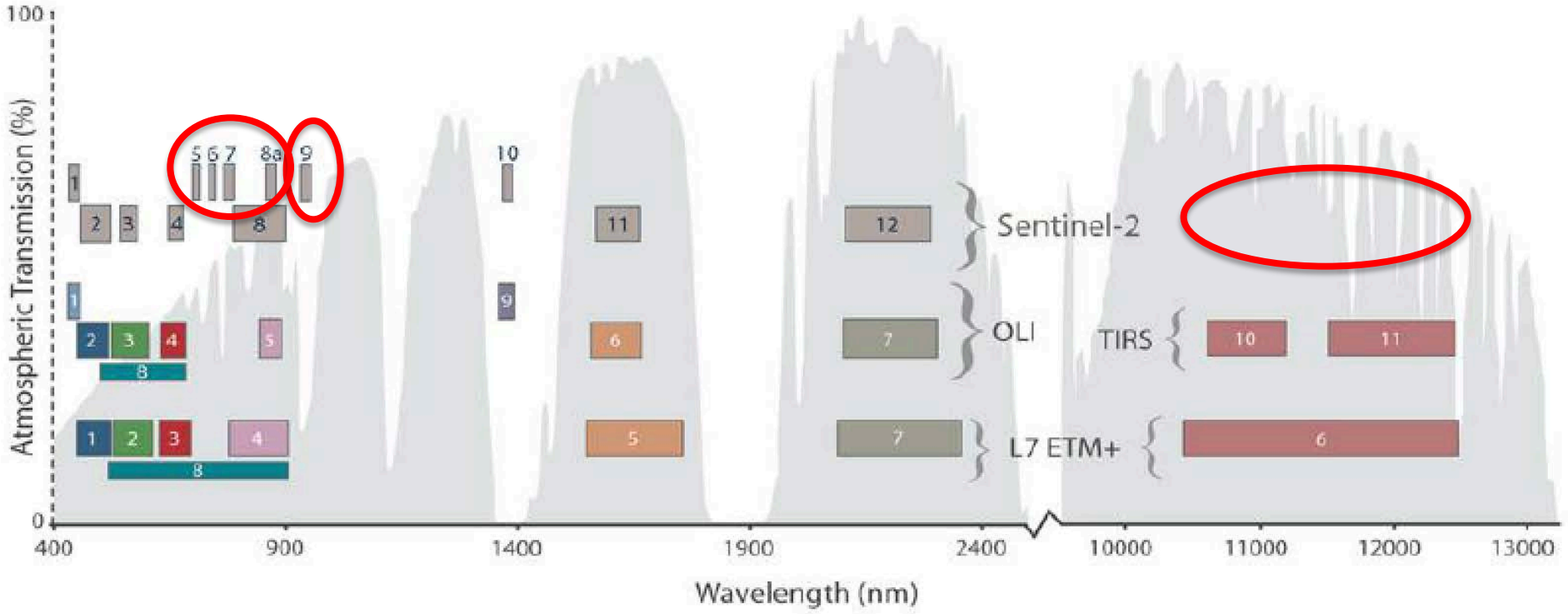
Copernicus Sentinel-2

- 7 Jahre Missionsdauer, Kapazitäten für 12 Jahre
- 5-Tage Wiederholzyklus am Äquator mit 2 Satelliten
- Multispektralinstrument mit 13 Spektralbändern (VIS, NIR & SWIR), mit 10, 20 and 60 m räumlicher Auflösung

Sentinel-2: 13 Spektralbänder



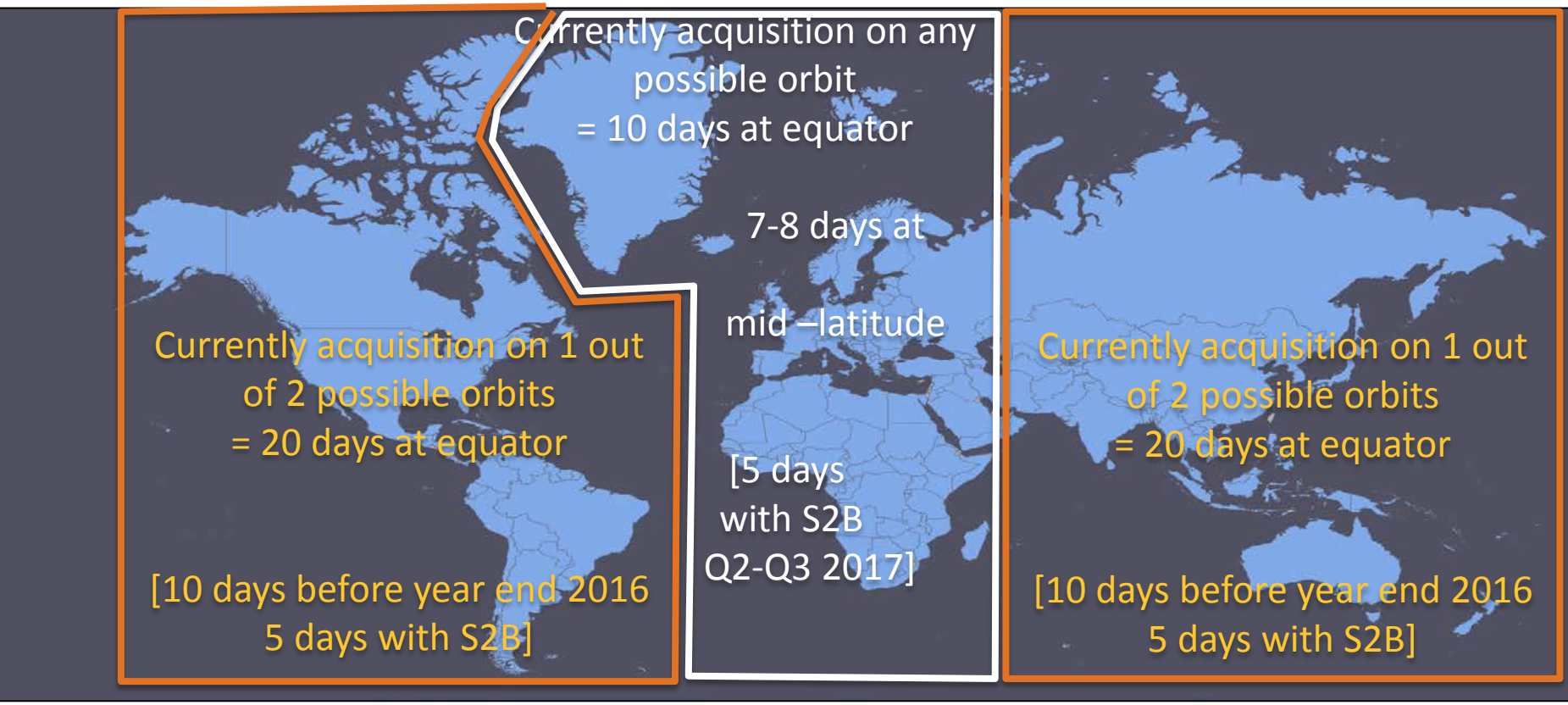
Vergleich von Sentinel-2/Landsat-8 Spektralbändern



Source: http://landsat.usgs.gov/L8_band_combos.php

Pre-flight cross-calibration took place, post-flight campaigns planned

Sentinel-2 Aufnahmeplanung



- ✓ All land surfaces (-56° and +84° latitude);
- ✓ Major (greater than 100 km^2 size) and EU islands;
- ✓ Coastal (20km off the coast)
- ✓ inland waters, Mediterranean Sea and all closed seas;

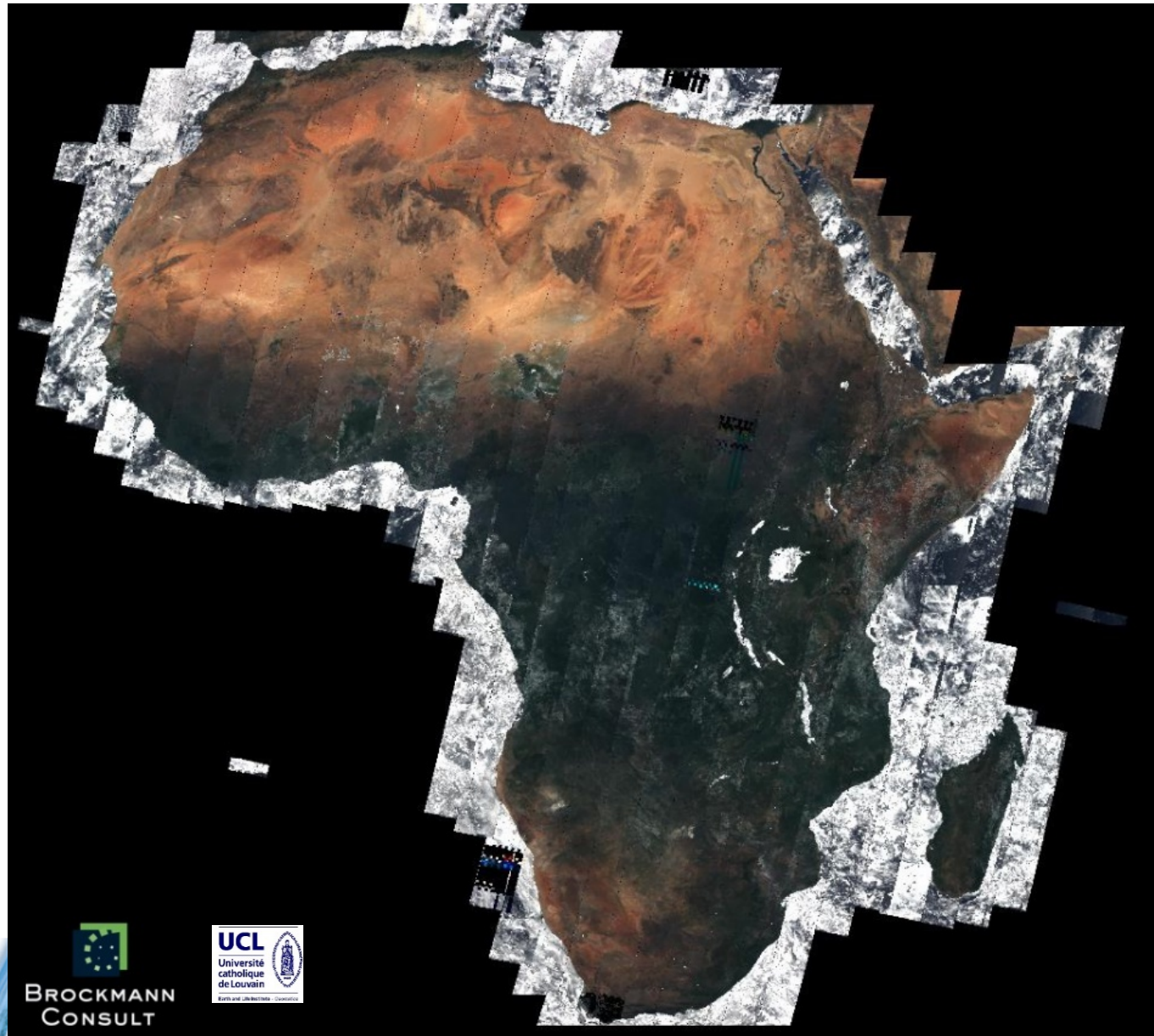
Observation plan KML is published at https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-2/acquisition-plans

First CCI Land Cover Sentinel-2 TOA reflectance composite over Africa

Max-NDVI composite of TOA reflectance

Sentinel-2 images acquired from Jan to April 2016 ***= 4 months of data***

(~32 TByte)



Brockmann Consult

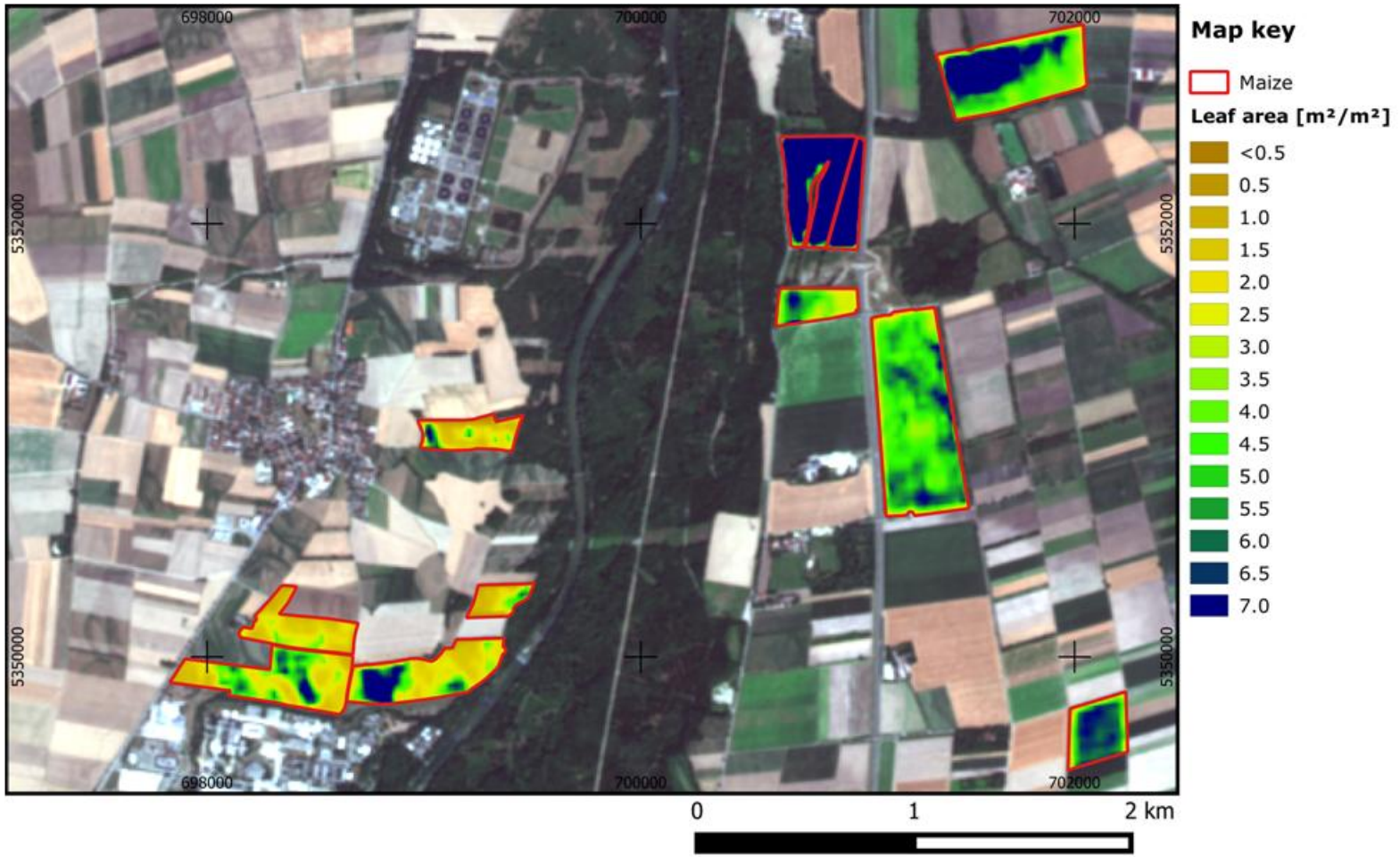
UCL Université catholique de Louvain

Crop Parameter Retrieval over time: S2 and L8

Landsat 8

Jul 24, 2015

Leaf Area

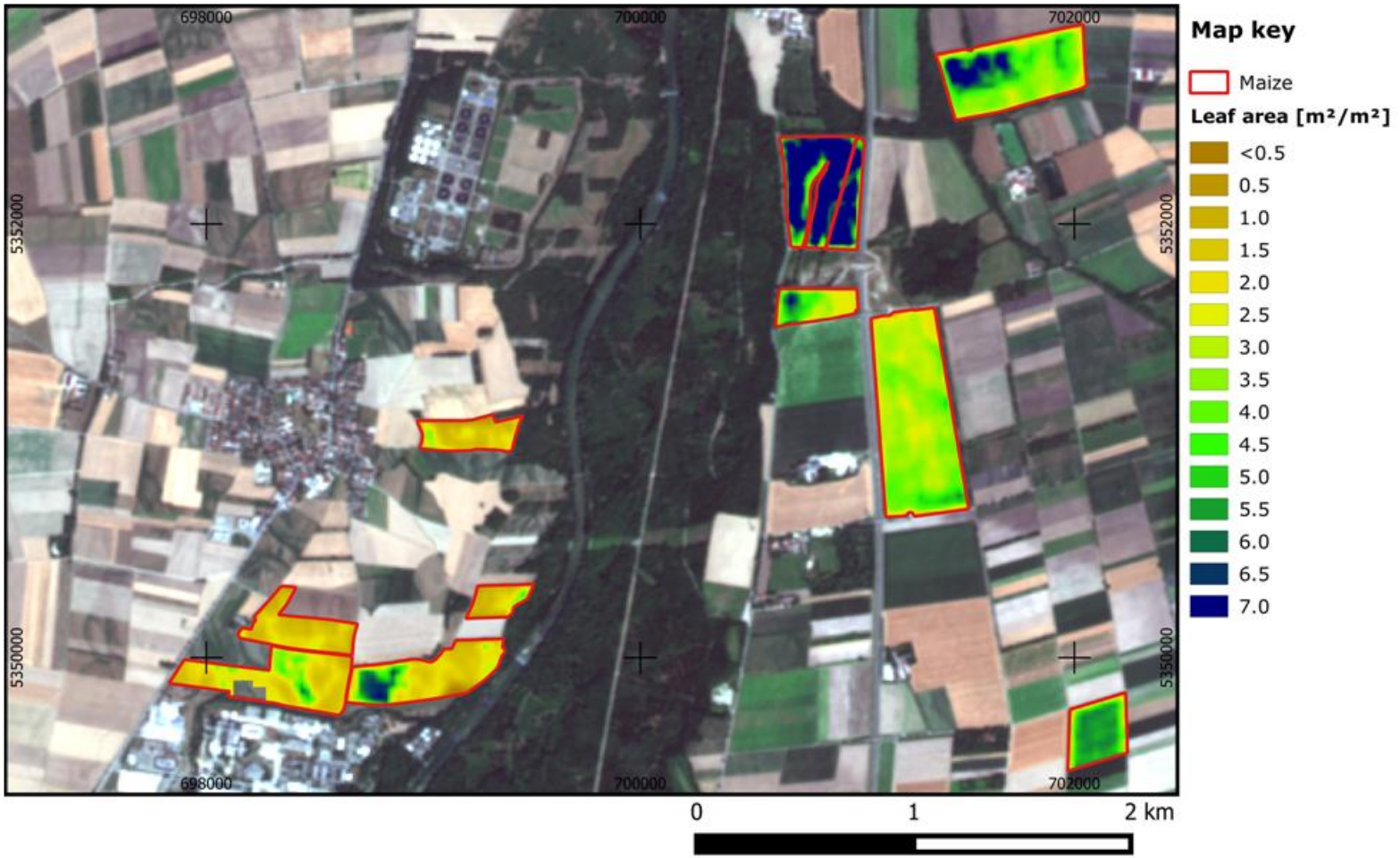


Crop Parameter Retrieval over time

Landsat 8

Jul 31, 2015

Leaf Area



Crop Parameter Retrieval over time

Sentinel-2A

Aug 06,2015

Leaf Area

Crop Parameter Retrieval over time

Sentinel-2A

Aug 13, 2015

Leaf Area

Crop Parameter Retrieval over time

Landsat 8

Sep 01, 2015

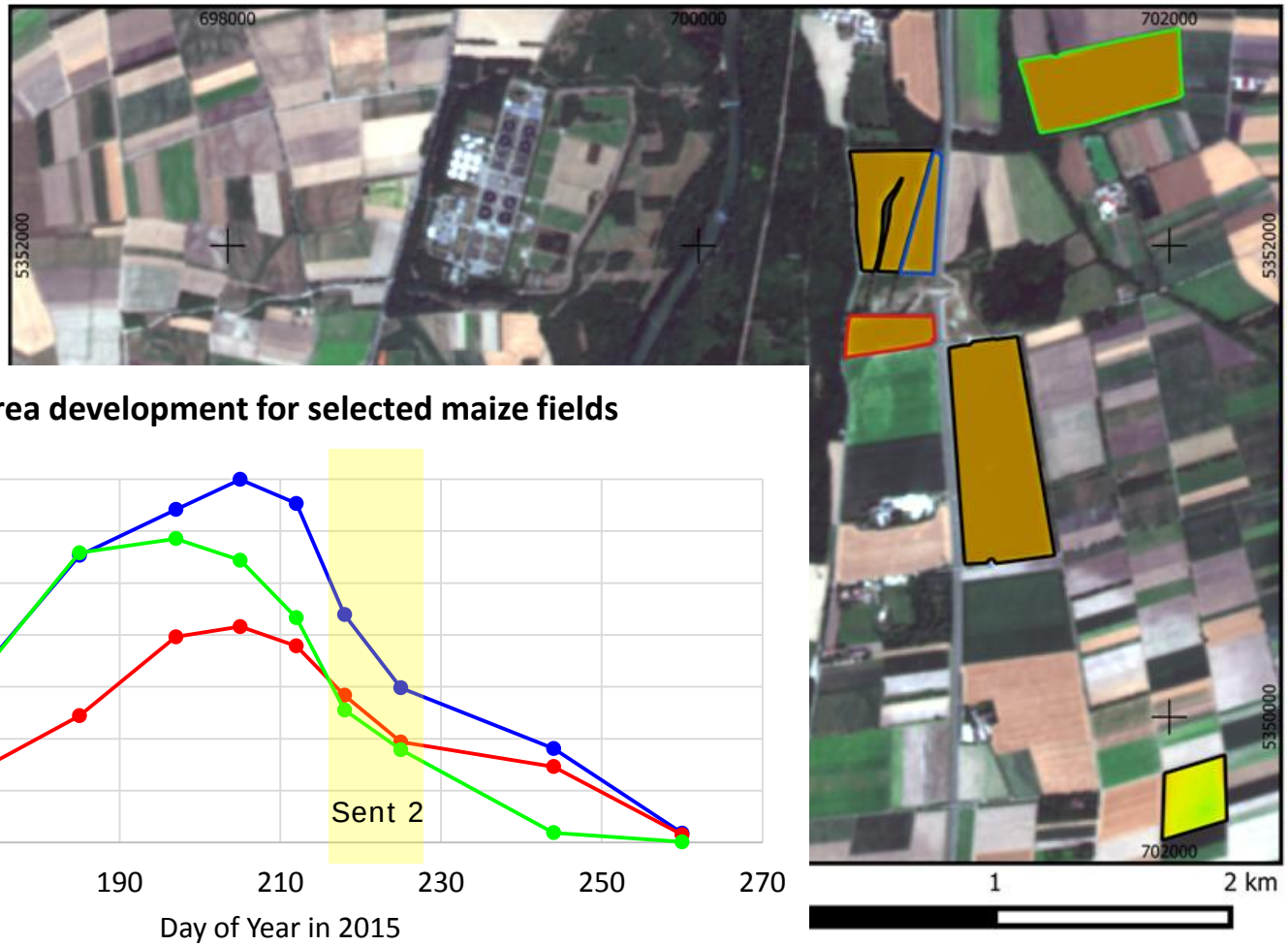
Leaf Area

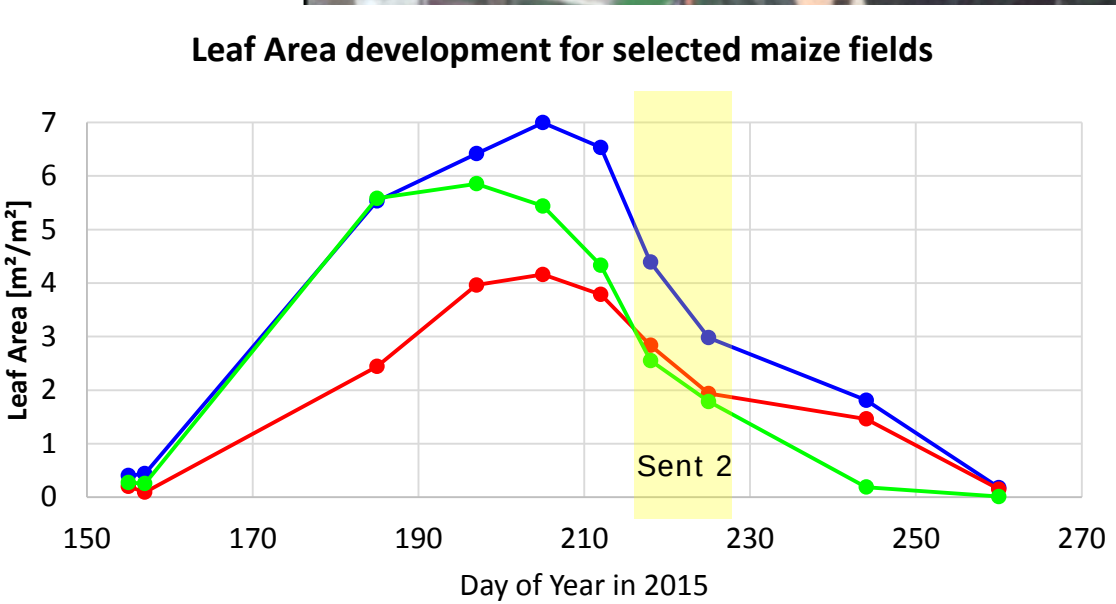
Crop Parameter Retrieval over time

Landsat 8

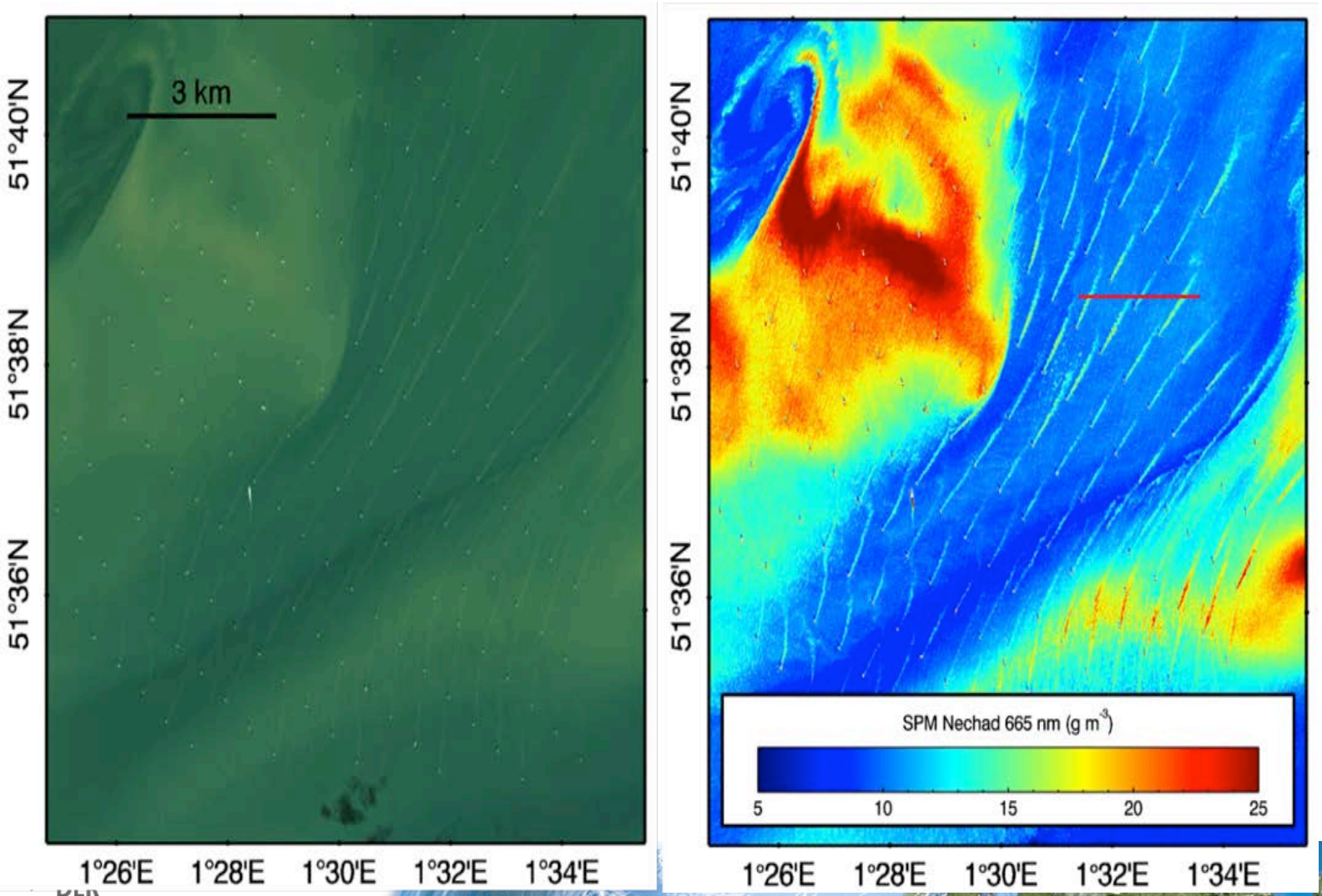
Sep 17, 2015

Leaf Area





Sentinel-2: Erfassung von Schwebstofffrachten im Ärmelkanal



(K. Ruddick; Q.Vanhellemont, RBINS)

Copernicus Datenqualität & Menge …ein Quantensprung

Sentinel-1

- **5** m ground range resolution
- **250** km swath width (Interferometric wide swath mode)
- **6** days repeat cycle (with 2 satellites)
- **2 x 260 Mb/s** downlink data rate
- **7** years design lifetime (consumables for 12 years)

Envisat

- **20** m ground range resolution
- **100** km swath width (Imaging mode)
- **35** days repeat cycle
- Up to **100 Mb/s** space to ground data rate
- **5** years design lifetime

Sentinel-3

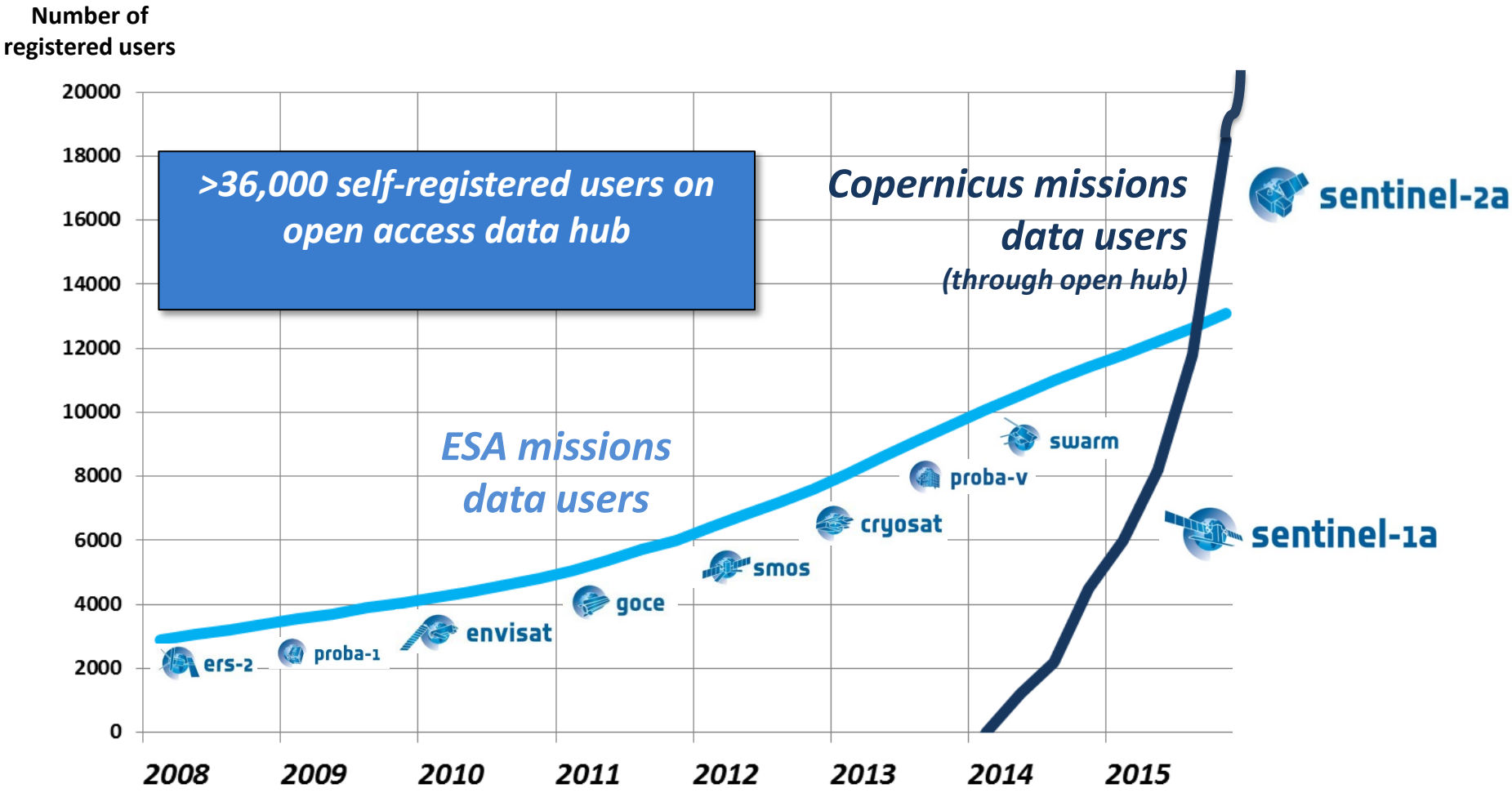
- **21** spectral bands (OLCI)
- **750** km swath width (SLSTR)
- **2.9** cm total range error (sea surface)
- **450 Mb/s** space to ground data rate
- **Nadir SAR** mode
- Reduced **sun glint** by camera tilt (in west direction)

Envisat

- **15** spectral bands (MERIS)
- **500** km swath width (AATSR)
- **3.1** cm total range error (sea surface)
- Up to **100 Mb/s** space to ground data rate
- **No** nadir SAR mode available (RA-2 payload)

	Landsat-8	SPOT-5	Sentinel-2
Launch (most recent)	2013	2002	2015+
Earth Coverage (days)	16	26	5
Swath (km)	185	2*60	290
Multispectral Bands	8 MS + 1 PAN + 1 TIR	4 MS + 1 PAN	13 MS
Ground Resolution (m)	15, 30	5, 10, 20	10, 20, 60

Anstieg der Nutzerzahlen bei der ESA



A steady increase of users
consequence of Data Policy and <u>Mission Operations Concept:</u>
systematic observation, acquisition, processing and dissemination

Datenzugang

Satellitendaten:
www.spacedata.copernicus.eu

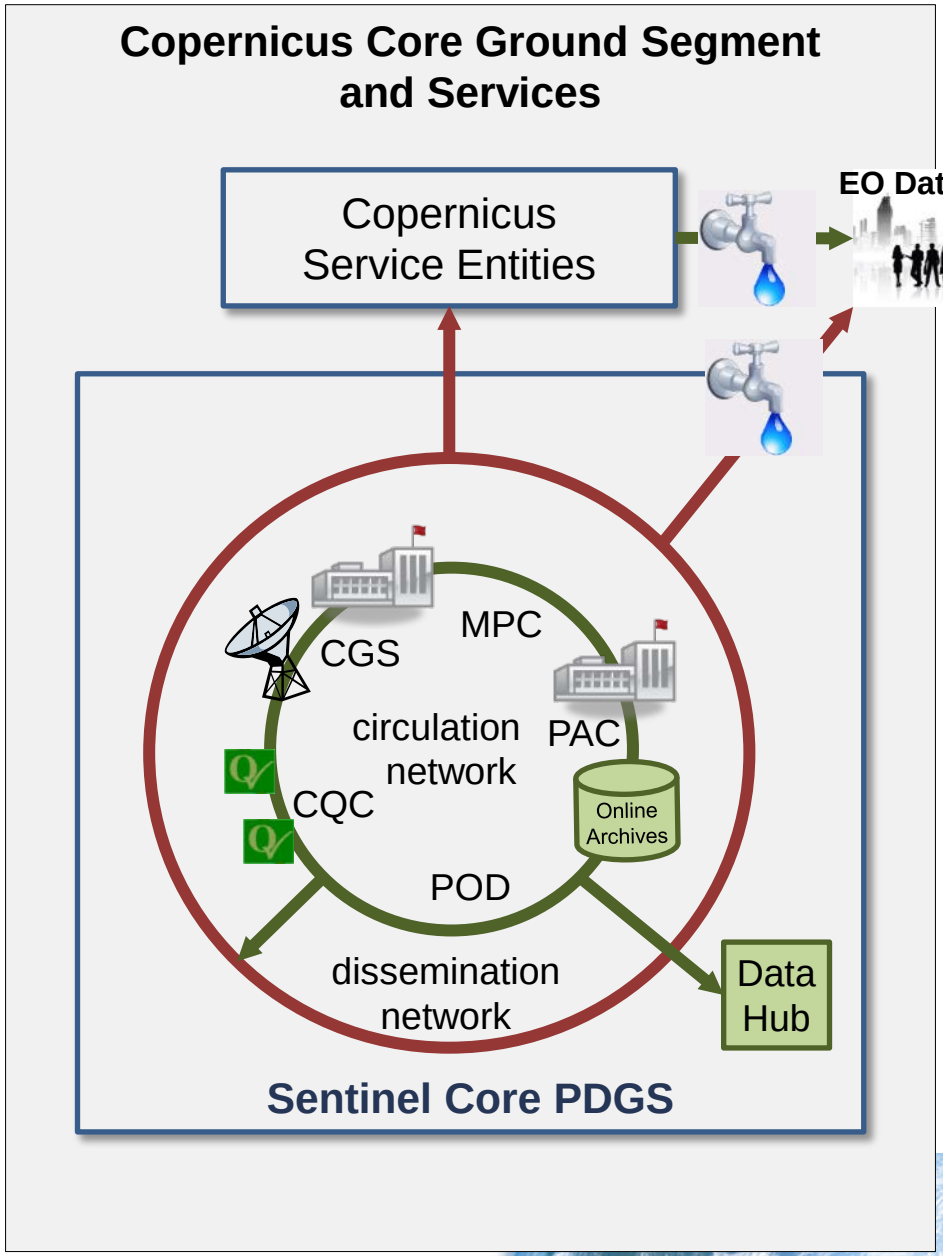
Ab Q4/2016 auch über CODE-DE, Info:
www.d-copernicus.de

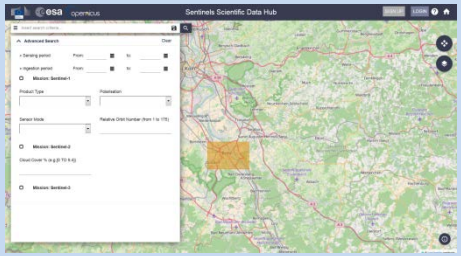
Copernicus-Dienste:
www.copernicus.eu

oder:

www.d-copernicus.de

Woher bekomme ich derzeit die Daten?





Sentinels:
https://scihub.copernicus.eu/dhus

API*:

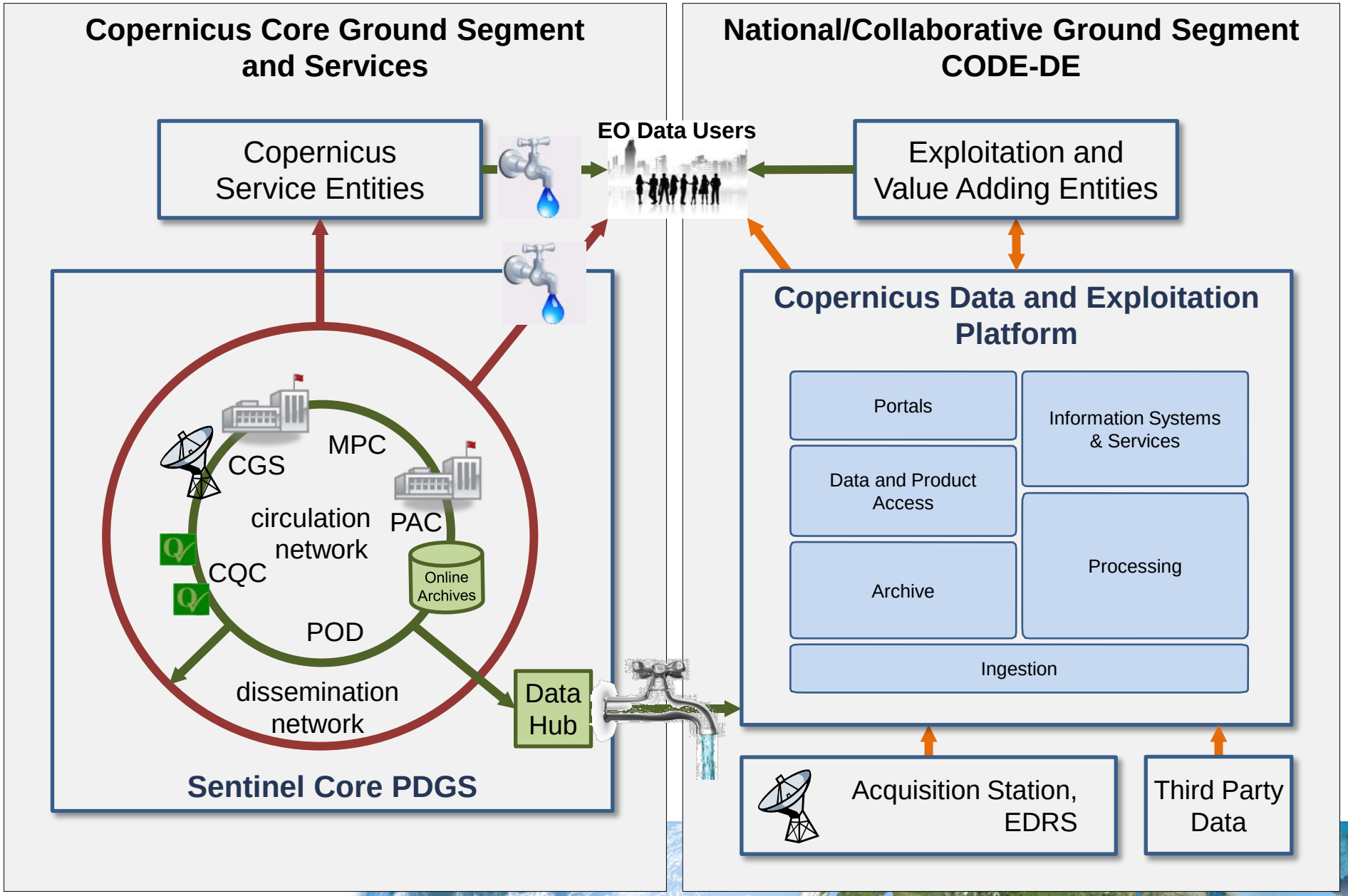
Open Data Protocol (0Data)

Open Search (Solr)

Commission delegated regulation (Nov. 2013):
"**Free** and **open** access to **all** Copernicus data"

* Application Programming Interface

Copernicus Ground Segment Elements und CollGS



Copernicus Data and Exploitation Platform

Copernicus-Data

Contributing Missions

AIRBUS DEFENCE & SPACE

planet.

DLR

Long Term Archive D-SDA

Copernicus-Value Added-Products

TBytes / Jahr	Global	EU	DE
S1	900	75	3
S2	900	75	3
S3	1200	100	4
Summe	*3000*	*250*	*10*

Rolling-Archiv

Data Processing Service incl. Toolboxes, Proc. Modules, Orchestration (User/Service driven)

DLR

Archivkonzept – Rolling Archive und Reload I

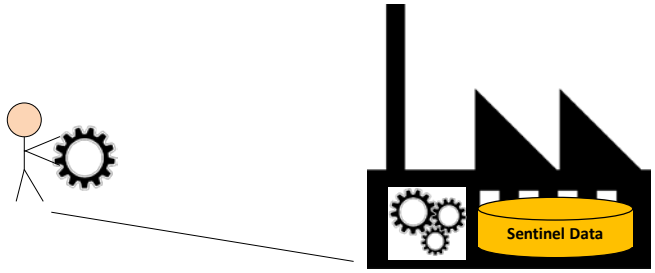
Mission	Level and Product	Size [TB]	Retention Time [Months]		
			Central Europe	Europe	Global
Sentinel-1	**L1 SLC**	**15**	**36**	**12**	**0**
	L1 GRD	**30**	**36**	**12**	**1**
	L2 OCN	**5**	**-**	**-**	**6**
Sentinel-2	L1C MSI	230	36	12	1
Sentinel-3	**L1 OLCI**	**50**	**36**	**12**	**1**
	L2 SLSTR	**50**	**36**	**12**	**1**
	L2 SYN	**10**	**36**	**12**	**1**
	L2 VG	**10**	**36**	**12**	**1**
Sentinel-5p	L1 TROPOMI	100	-	-	1

CODE-DE “Sentinel-Rolling Archive”

Central Europe

- Speicherkonzept wird an die tatsächliche Nutzung angepasst.

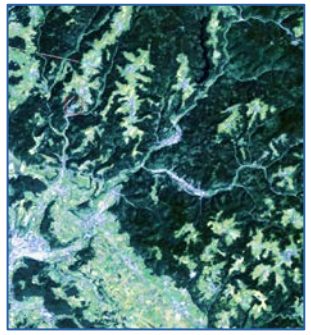
Prozessierungsumgebung



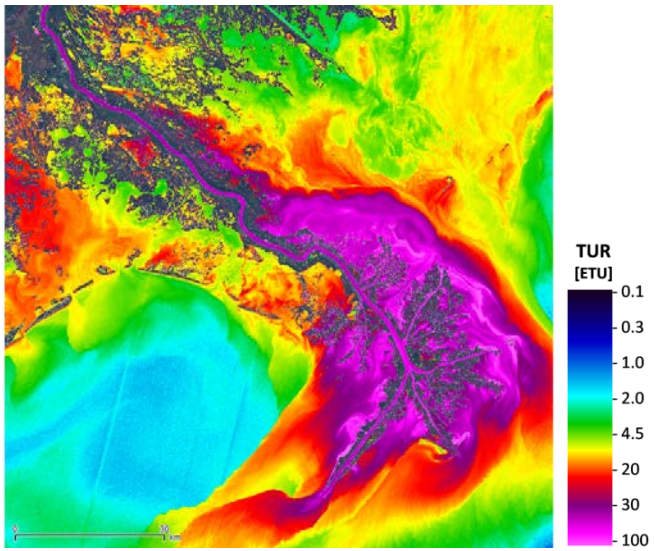
CODE-DE Paradigma: Prozessoren zu den Daten

- Kein Download von großen Datenmengen mehr notwendig.
- Immer Verfügbarkeit der neusten Datensätze.
- Direkte Verfügbarkeit von Tools und Prozessoren.
- Nutzer kann eigene Projekte/Daten/Prozessoren mitbringen und wenn gewünscht anderen zur Verfügung stellen.

Datenprodukte

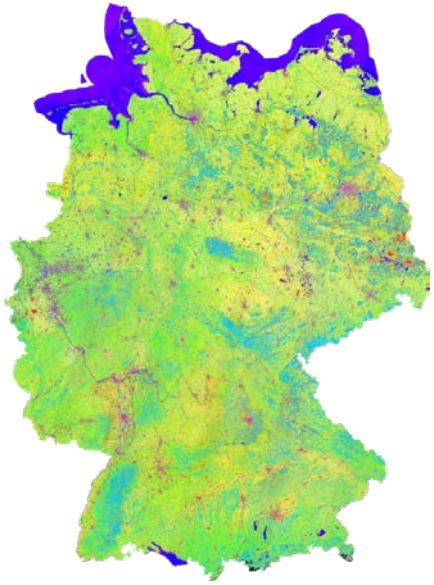


- Wolkenfreies Sentinel-2 Produkt (Deutschland, Update 14-tägig)
- Flexible Kachelung
- Multi-temporale Features (Sentinel-1 + Sentinel-2)
- Wasserqualitätsprozessor



Schwebstoff-Konzentration und Trübung

RGB NDVI max-mean-min 2014-2015



RGB NDBI-max, NDVI-max and NDWI-mean 2014-2015

DLR

CODE DE

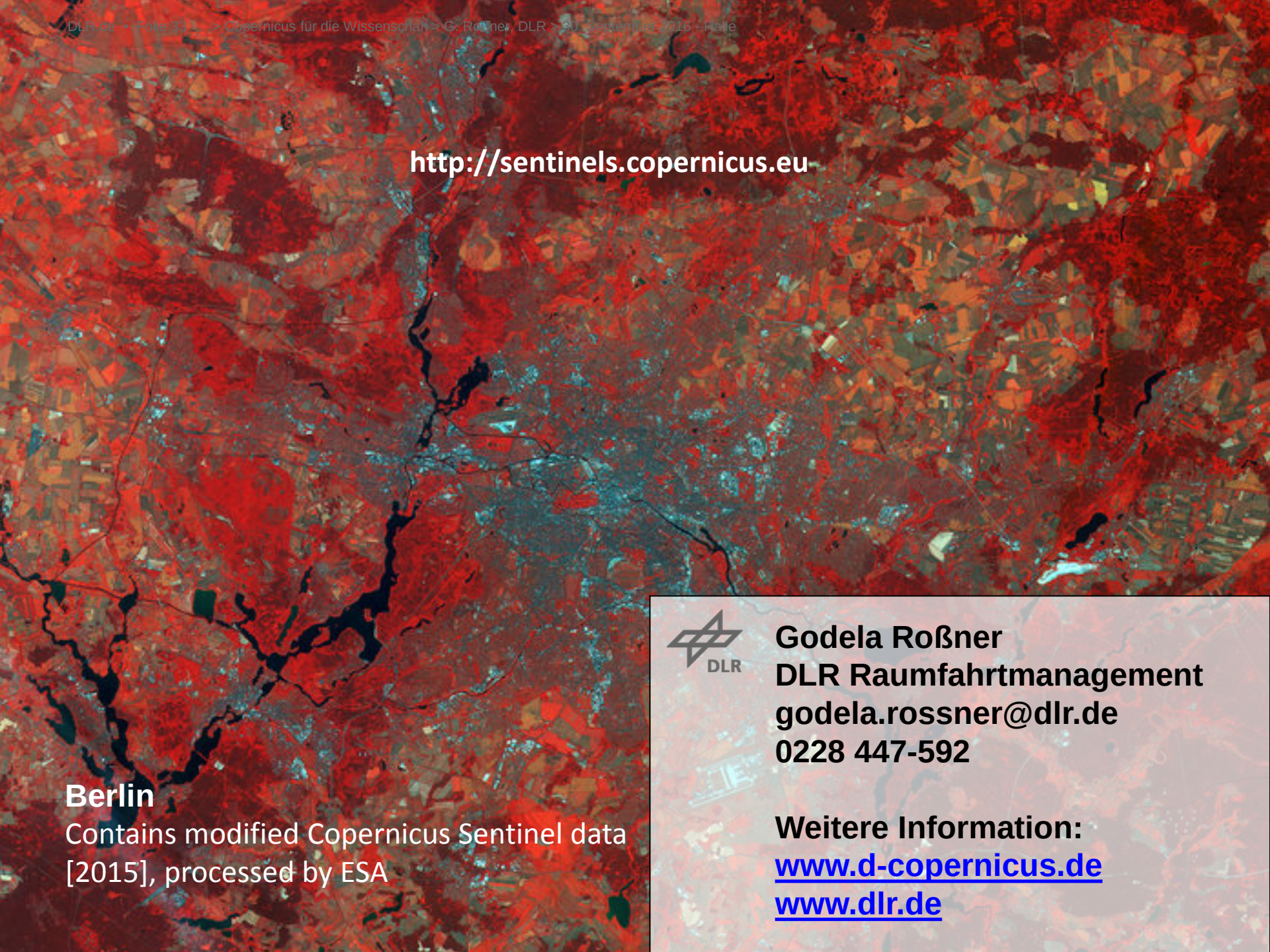
Stand der Beteiligung der deutschen Wissenschaft

Top 5 European Countries for registered users	
Country	# of registrations since the start of operations
Germany	3,233
UK	2,620

- > 3000 deutsche Nutzer für Datenzugang der Sentinels registeriert
- Beteiligung an wiss. Workshops, Konferenzen, etc.
- Förderprogramme der EU und des DLR Raumfahrtmanagements
- Beteiligung an Aufträgen der ESA

- Wissenschaftsworkshop beim Nationalen Forum für Copernicus 2014
- HGF-E&U Ansprechpartner/innen benannt
- Workshop am UFZ (März 2017) zu Fernerkundung

- *Diverse Fördermöglichkeiten:*
  - *Nationales Programm*
  - *BMBF-Programme*
  - *ESA*
  - *EU H2020 Space und andere*



Berlin
Contains modified Copernicus Sentinel data [2015], processed by ESA

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Weitere Information:
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