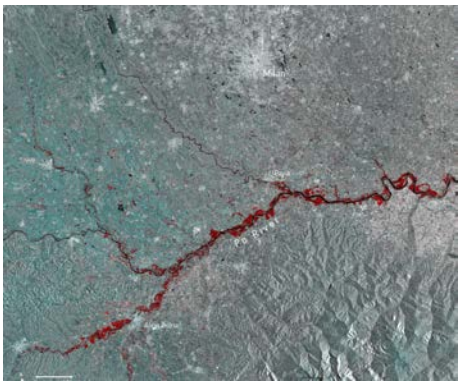
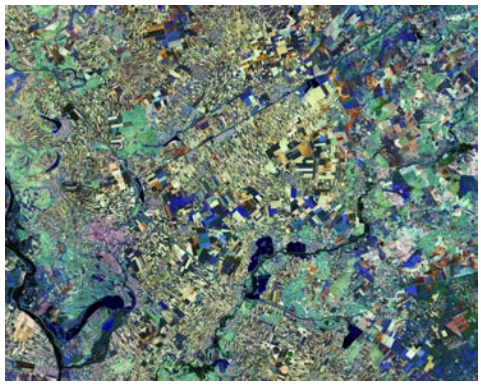
Nutzen und Kosten von Plattformen, Sensoren und Algorithmen im Kontext planerischer Aufgabenstellungen

Damian Bargiel, TU Darmstadt Förderprojekt CORAmaps

TECHNISCHE UNIVERSITÄT DARMSTADT

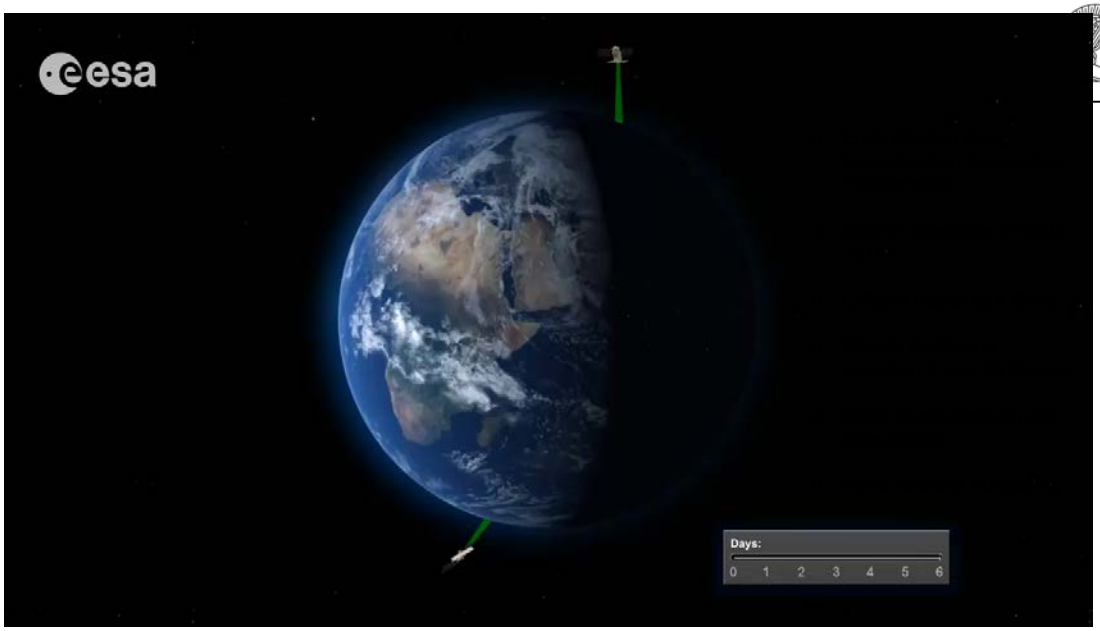




CORAmaps

1

TECHNISCHE UNIVERSITÄT DARMSTADT



Quelle: ESA

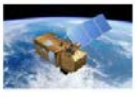
CORAmaps

2

Copernicus

TECHNISCHE UNIVERSITÄT DARMSTADT

Die Europäische COPERNICUS Mission – Eine neue Ära in der Erdbeobachtung


Sentinel 1 Sentinel-2 Sentinel-3 Sentinel-4 Sentinel-5

3

Copernicus

TECHNISCHE UNIVERSITÄT DARMSTADT

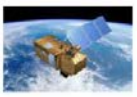
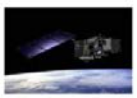
Copernicus Sentinel Data Policy esa

Sentinel Data Policy =

FREE, FULL and OPEN access

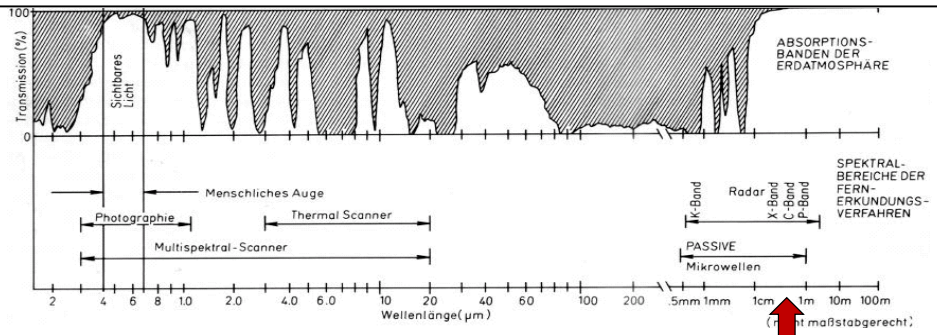
through an easy- to-use internet portal

ESA's Sentinel Data Policy is in coherence with the overall EU Copernicus Data and Information Policy, now in force (Delegated Act)

Sentinel 1 Sentinel-2 Sentinel-3 Sentinel-4 Sentinel-5

4

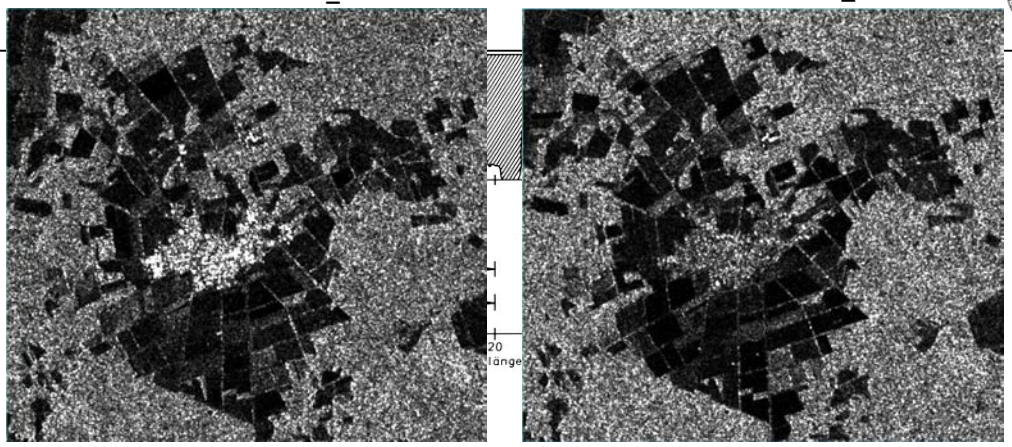


Sentinel 1

5

VV_Polarisation

VH_Polarisation



Sentinel 1

6

Eigenentwickelte Speckle Reduction

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CORAmaps

Dieferentielle SAR Interferometrie - Prinzip

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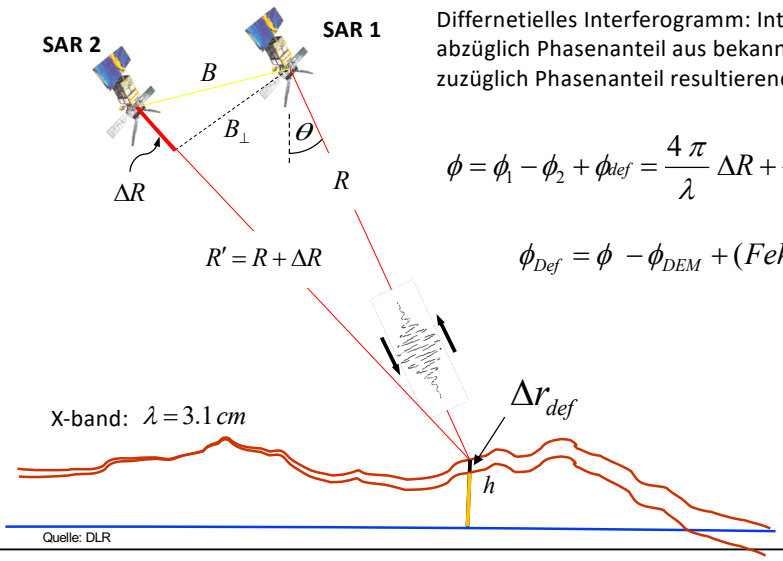


Differnetielles Interferogramm: Interferogramm abzüglich Phasenanteil aus bekanntem Gelände zuzüglich Phasenanteil resultierend aus Deformation

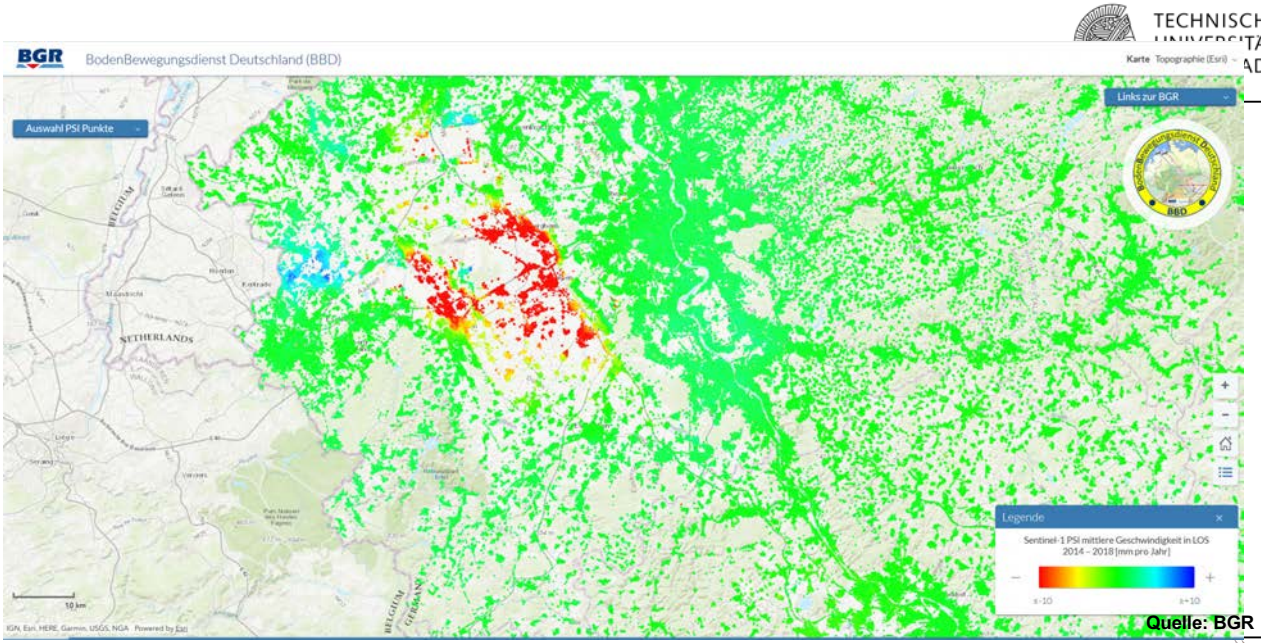
$$\phi = \phi_1 - \phi_2 + \phi_{def} = \frac{4\pi}{\lambda}\Delta R + \frac{4\pi}{\lambda}\Delta r_{def}$$

$$\phi_{Def} = \phi - \phi_{DEM} + (Fehler)$$

CORAmaps

Quelle: BGR

9



Quelle: BGR

10

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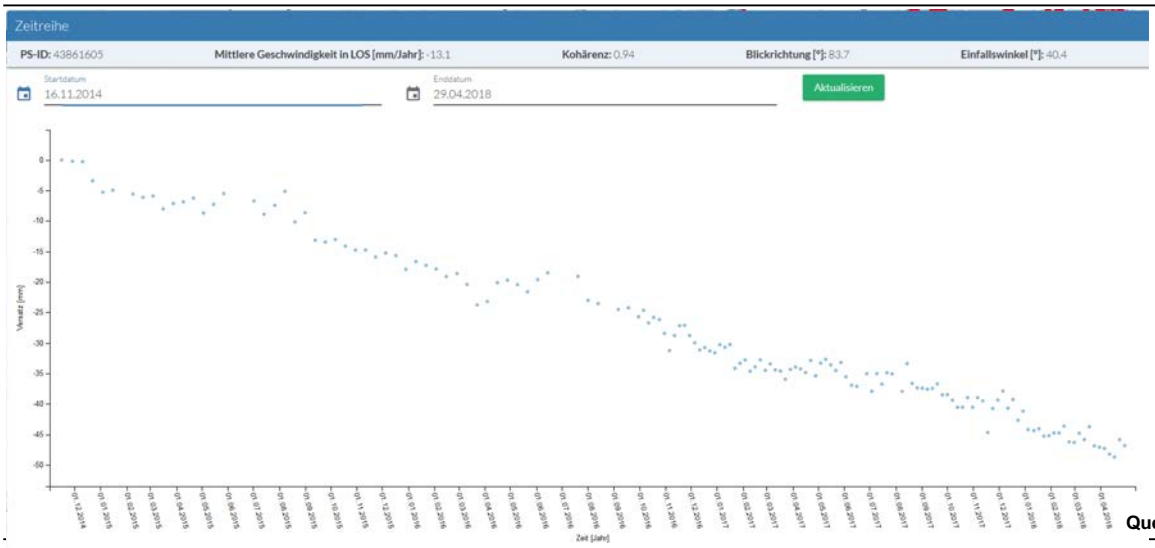

Quelle: BGR

CORAmaps

11

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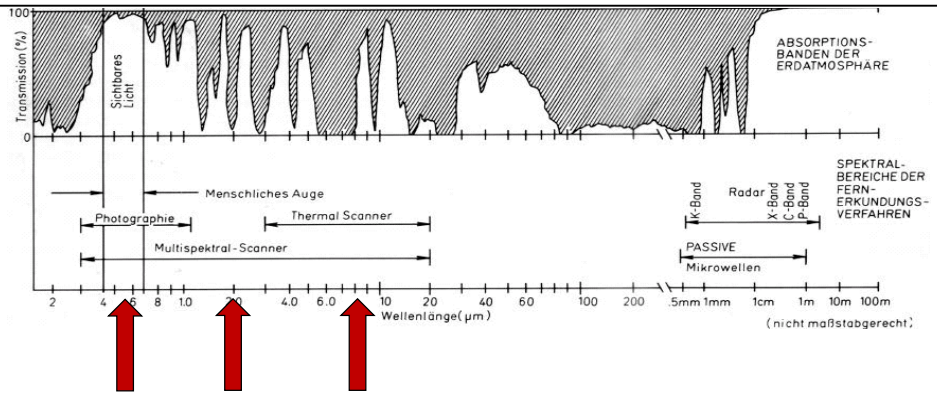
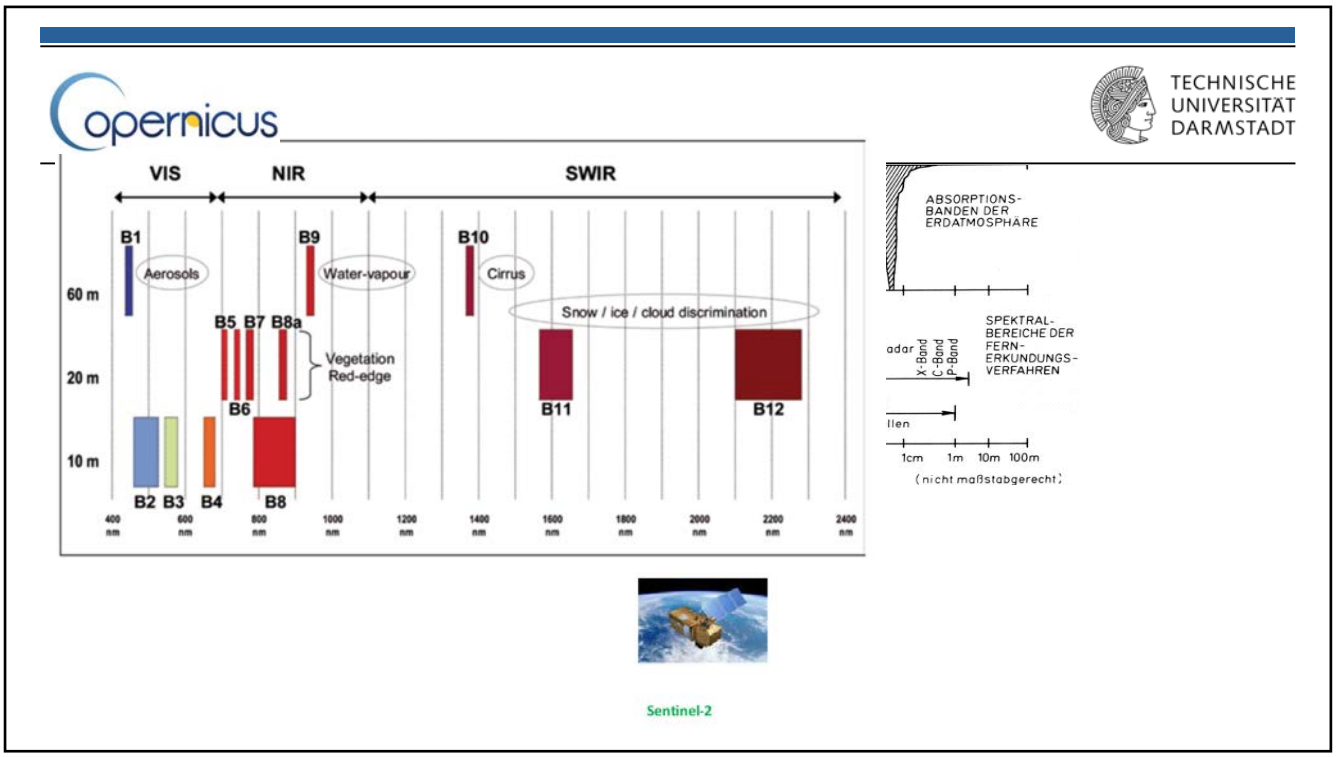
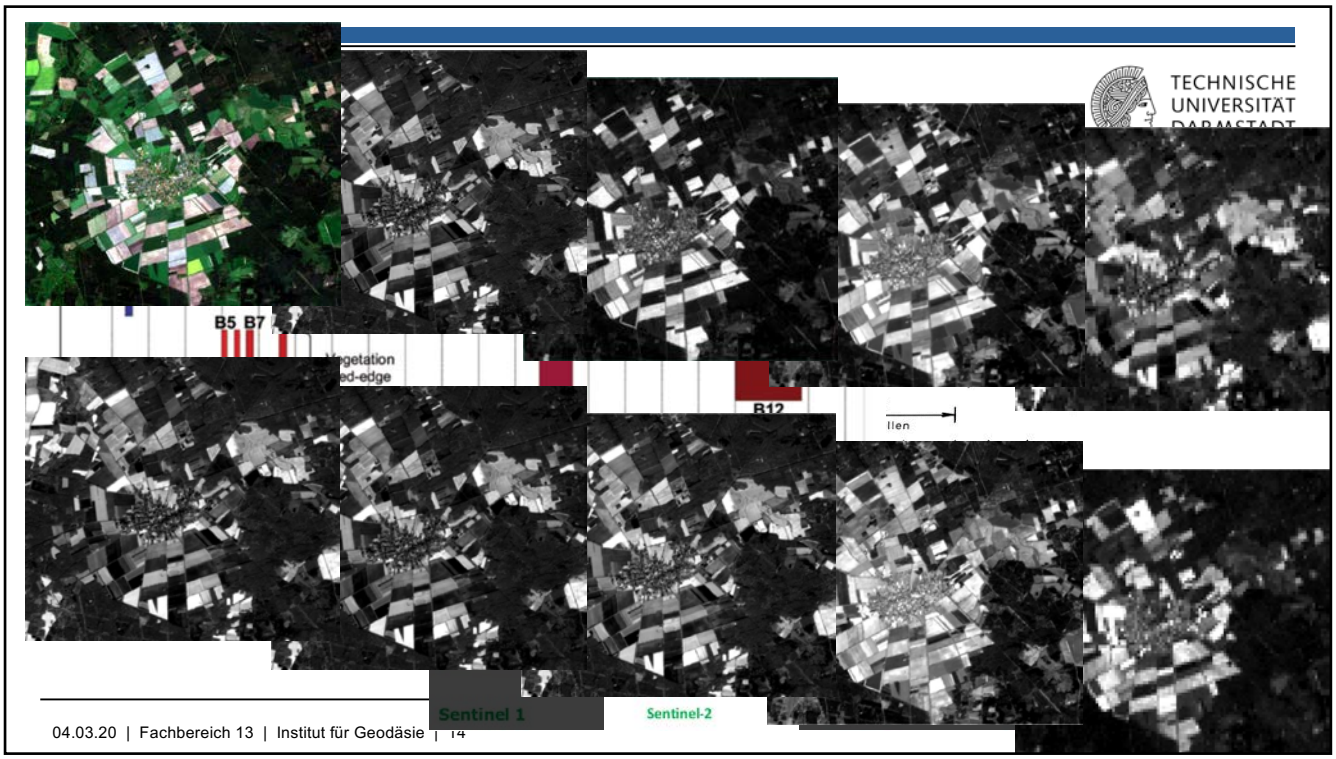


Sentinel-2

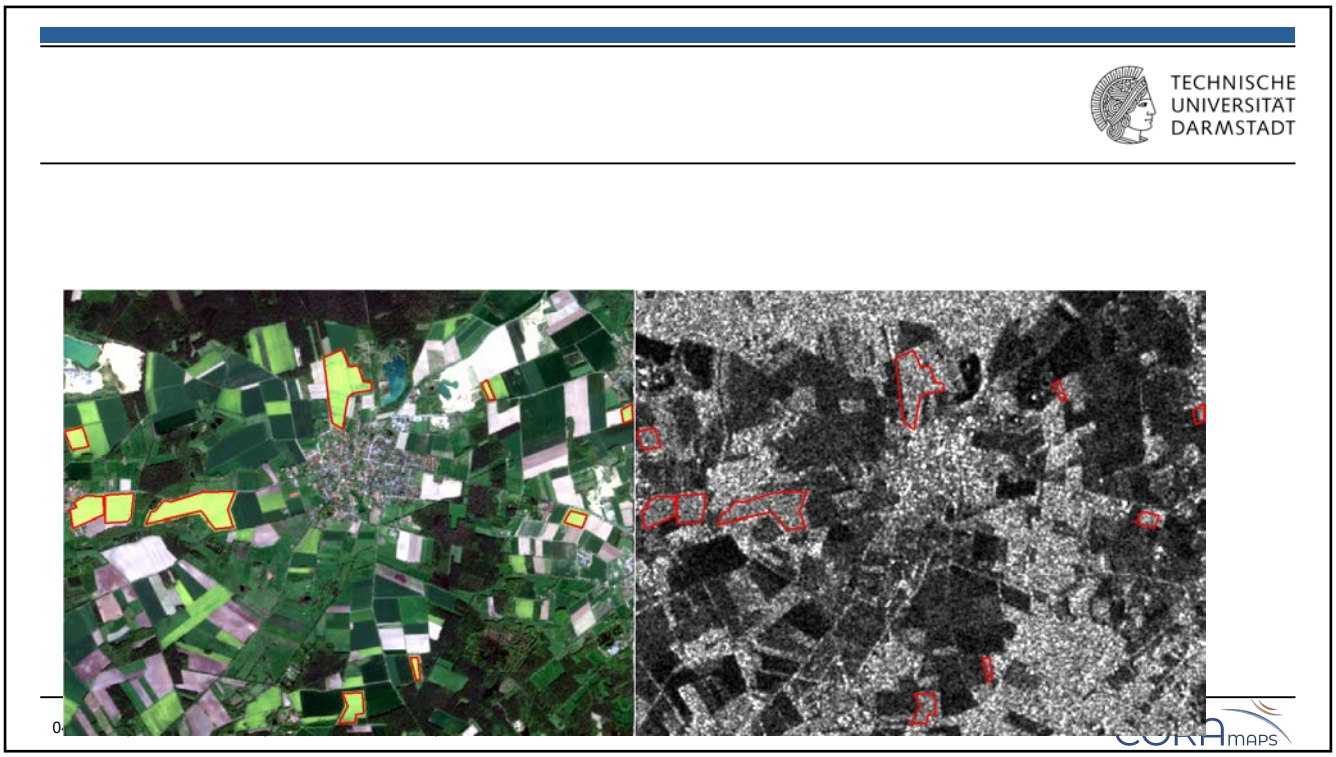
12


Copernicus
TECHNISCHE UNIVERSITÄT DARMSTADT
VIS
NIR
SWIR
B1
Aerosols
B9
Water-vapour
B10
Cirrus
Snow / ice / cloud discrimination
60 m
B5 B7 B8a
Vegetation Red-edge
20 m
B6
B11
B12
10 m
B2 B3 B4
B8
400 nm
600 nm
800 nm
1000 nm
1200 nm
1400 nm
1600 nm
1800 nm
2000 nm
2200 nm
2400 nm
ABSORPTIONS-BANDEN DER ERDATMOSPHÄRE
SPEKTRAL-BEREICHE DER FERN-ERKUNDUNGS-VERFAHREN
X-Band
C-Band
P-Band
1cm
1m
10m
100m
(nicht maßstabgerecht)
Sentinel-2

13


TECHNISCHE UNIVERSITÄT
Sentinel 1
Sentinel-2
04.03.20 | Fachbereich 13 | Institut für Geodäsie | 14

14


TECHNISCHE
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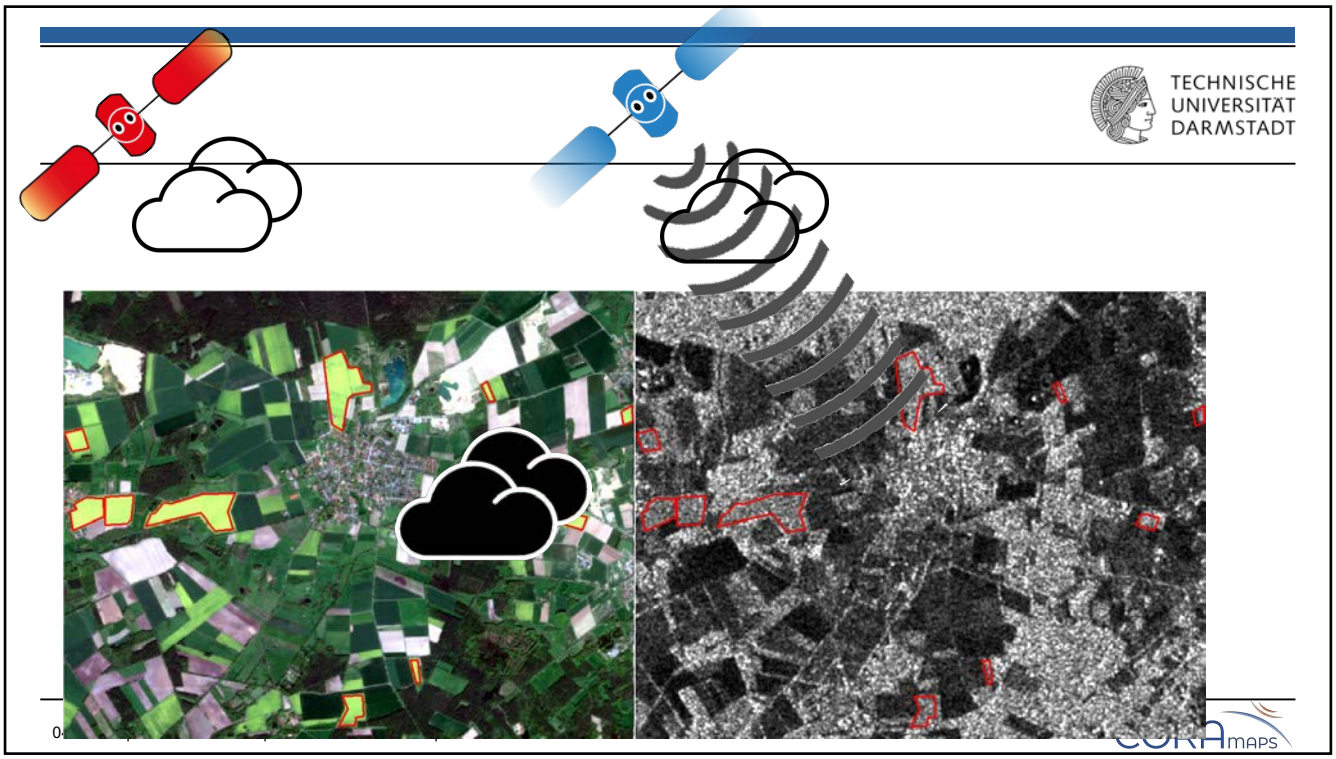
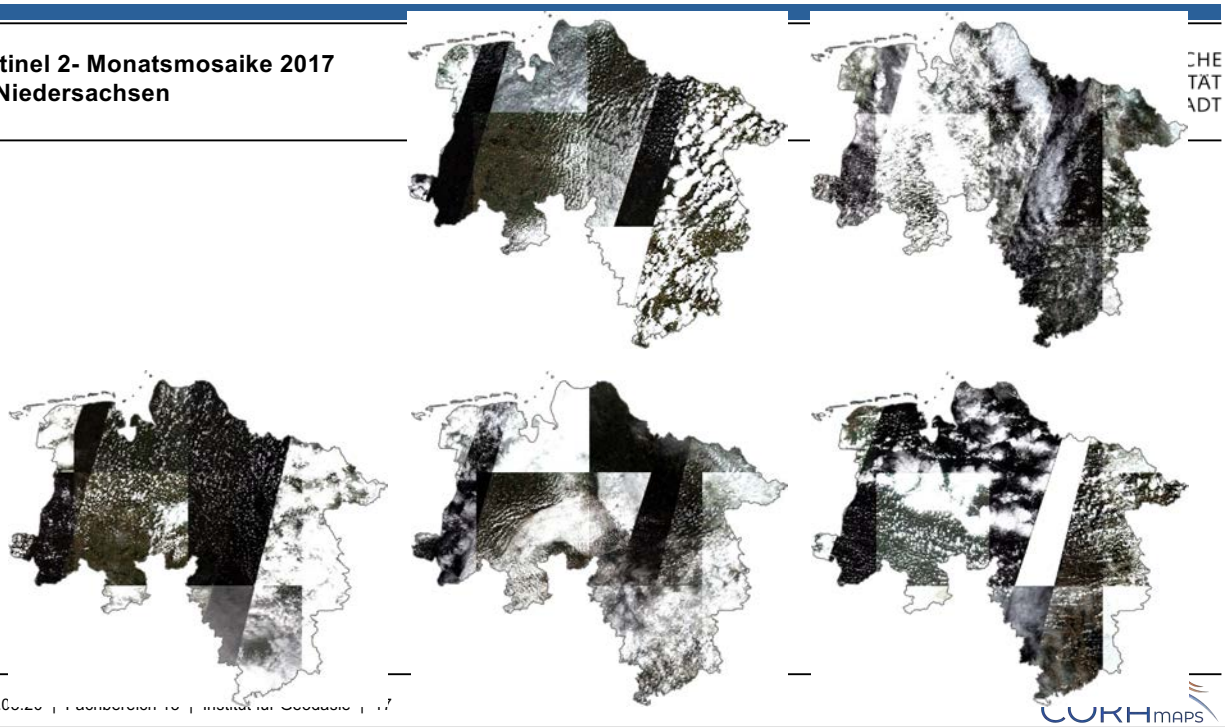
DARMSTADT

15


TECHNISCHE
UNIVERSITÄT
DARMSTADT

16

Sentinel 2- Monatsmosaike 2017 für Niedersachsen



17

Copernicus

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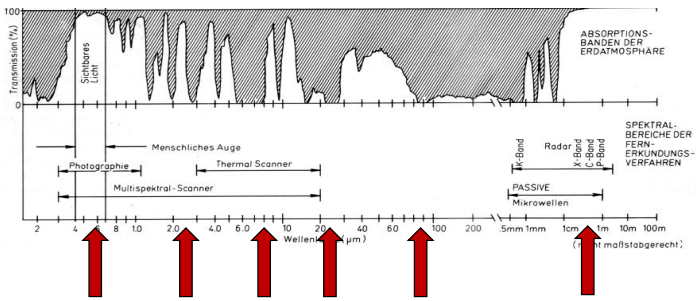
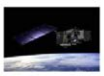




Sentinel-3

18

Sentinel-3 Mission

TECHNISCHE UNIVERSITÄT DARMSTADT

Start des Sentinel-3A am 16 Februar 2016.
Start des Zwillingssatelliten Sentinel-3B am 25 April 2018 (höhere zeitl. Auflösung)

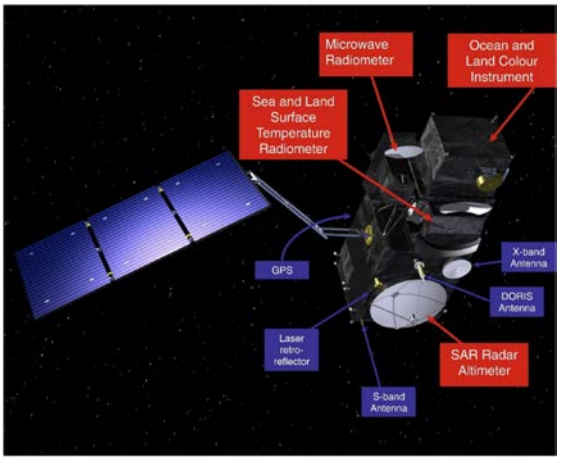
Verfügt über Insgesamt vier verschiedene Instrumente an Bord
Gewicht: 1150 Kg

CORA maps

Sentinel-3

TECHNISCHE UNIVERSITÄT DARMSTADT

- Ocean and Land Colour Instrument (OLCI)
- Sea and Land Surface Temperature Radiometer (SLSTR)
- Synthetic Aperture Radar Altimeter (SRAL)
- Microwave Radiometer (MWR)

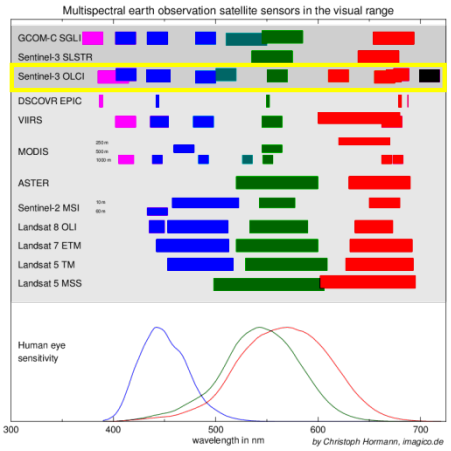


CORA maps

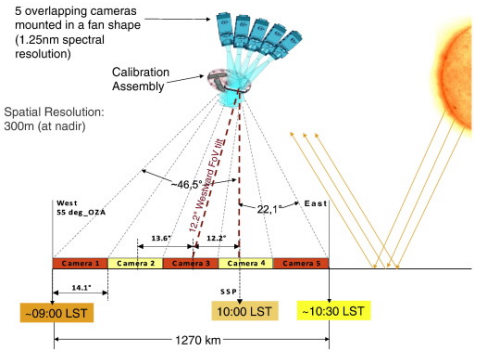
Sentinel-3 - Ocean and Land Colour Instrument (OLCI)

TECHNISCHE UNIVERSITÄT DARMSTADT

- Insgesamt fünf push broom scanner (CCD) mit einer Streifenbreite von 1270 km
- Räumliche Auflösung: max 300m



Quelle: Imagico 2018



Quelle: Donlon et al. 2010, Remote Sensing of Environment

CORAmaps

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Sentinel-3 - Ocean and Land Colour Instrument (OLCI)

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- Spektrale Auflösung: 21 Kanäle (l=400 – 1020 nm)

Band	λ centre [nm]	Width [Nm]	Function
Oa1	400	15	**Aerosol** correction,improved water constituent retrieval
Oa2	412,5	10	Yellow substance and detrital pigments (Turbidity).
Oa3	412,5	10	Chl absorption max., Biogeochemistry, vegetation
Oa4	442	10	High Chl, other pigments
Oa5	510	10	Chl, sediment, turbidity, red tide.
Oa6	560	10	**Chlorophyll** reference (Chl minimum)
Oa7	620	10	**Sediment** loading
Oa8	665	10	Chl (2nd Chl abs. max.), **sediment**, yellow substance/vegetation
Oa9	673,75	7,5	For improved fluorescence retrieval and to better account for smile together with the bands 665 and 680 nm
Oa10	681,25	7,5	Chl fluorescence peak, red edge
Oa11	708,75	10	Chl fluorescence baseline, red edge transition.
Oa12	753,75	7,5	**O2 absorption/clouds**, vegetation
Oa13	761,20	2,5	O2 absorption band/aerosol corr.
Oa14	764,375	3,75	**Atmospheric correction**
Oa15	767,5	2,5	O2A used for cloud top pressure, fluorescence over land.
Oa16	778,75	15	Atmos. corr./aerosol corr.
Oa17	865	20	Atmos. corr./aerosol corr., clouds, pixel co-registration.
Oa18	885	10	**Water vapour** absorption reference band. Common reference band with SLST instrument. **Vegetation** monitoring.
Oa19	900	10	Water vapour absorption/vegetation monitoring (max. reflectance)
Oa20	940	20	Water vapour absorption, atmos./aerosol corr.
Oa21	1020	40	Atmos./aerosol corr.

CORAmaps

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Sentinel-3 - Ocean and Land Colour Instrument (OLCI)

TECHNISCHE UNIVERSITÄT DARMSTADT

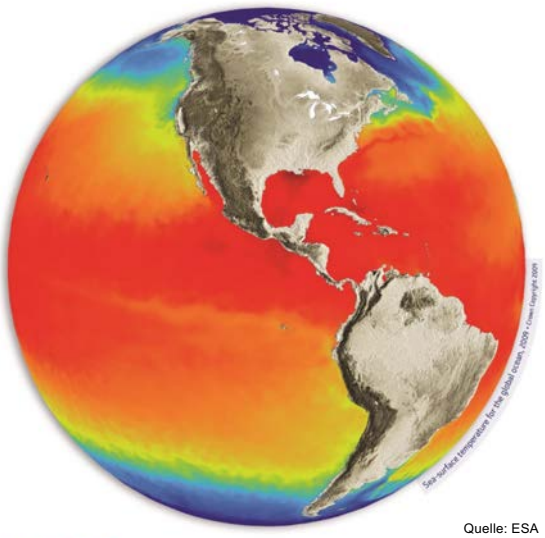
Sentinel 3 OLCI

Testaufnahme vom 01 März 2016

CORAmaps

Sentinel-3: Sea and Land Surface Temperature Radiometer

TECHNISCHE UNIVERSITÄT DARMSTADT

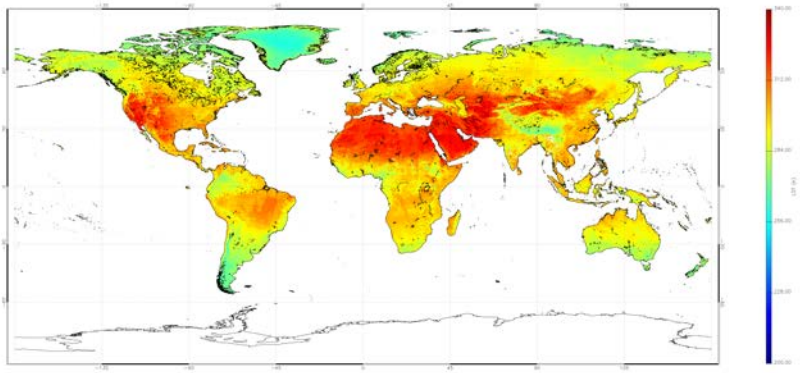


Quelle: ESA

CORAmaps

Sentinel-3: Sea and Land Surface Temperature Radiometer

TECHNISCHE UNIVERSITÄT DARMSTADT



Quelle: ESA

CORAmaps

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Sentinel-3: Synthetic Aperture Radar Altimeter (SRAL)

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- Aktives Radar Altimeter
- Laufzeitmessung mittels Ku Band
- Zusätzliche Ionosphärenkorrekturen durch die Verwendung eines C-Bandes (zweite Frequenz)
- Räumliche Auflösung : max ~ 300 m (SAR-Mode)

CORAmaps

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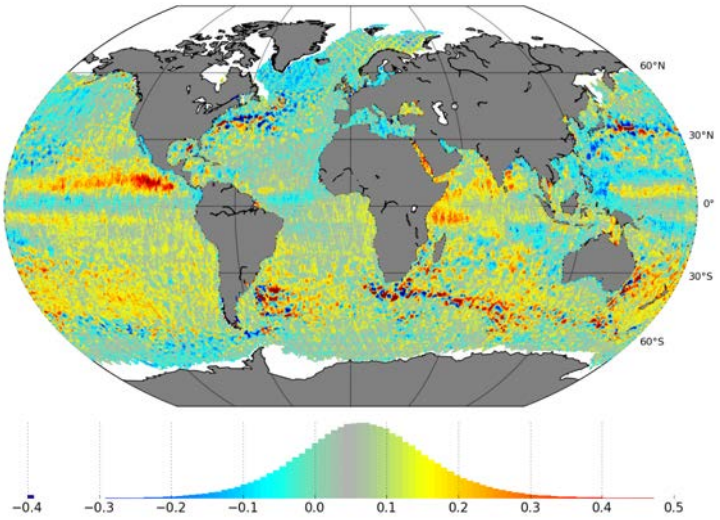
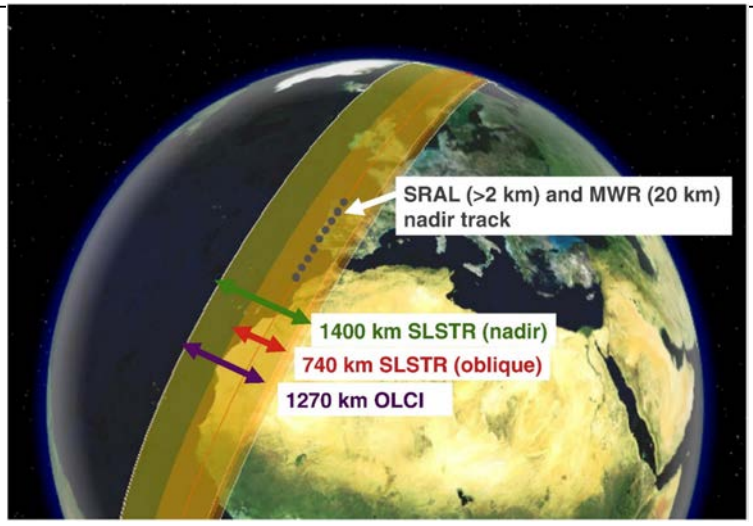
Sentinel-3 SRAL: Zeitl. Variation des Meeresspiegels



Quelle: ESA

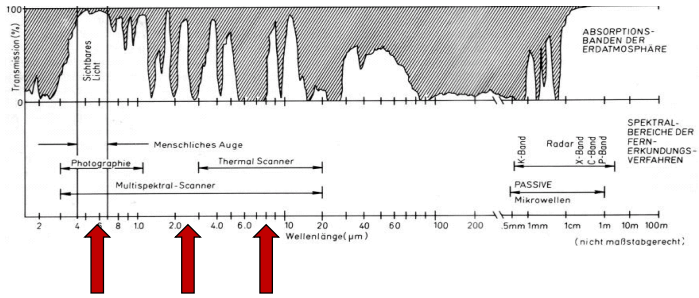
27

Sentinel 3 - footprints



Quelle: Donlon et al. 2010, Remote Sensing of Environment

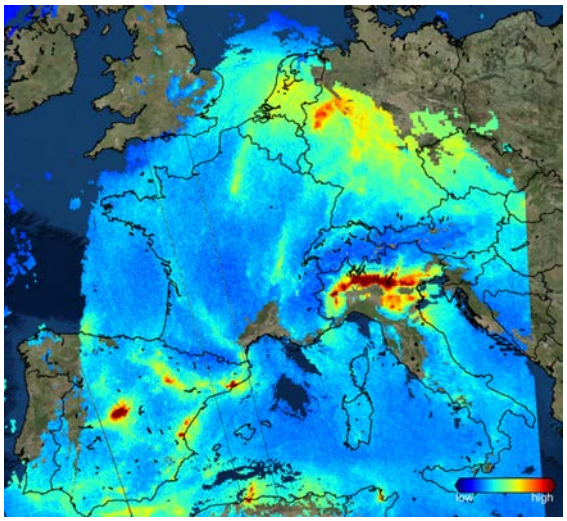
28



Sentinel-5

Sentinel 5 P Anwendungen

Srickstoffdioxid- Konzentration über Europa

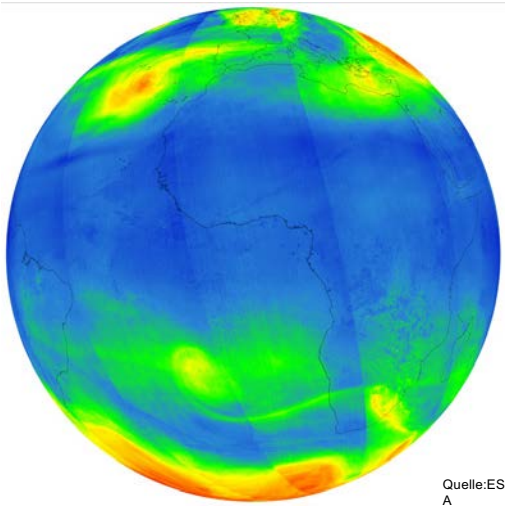


Quelle:ESA

Sentinel 5 P Anwendungen

TECHNISCHE UNIVERSITÄT DARMSTADT

Ozon-Konzentration weltweit



Quelle:ESA

CORA maps

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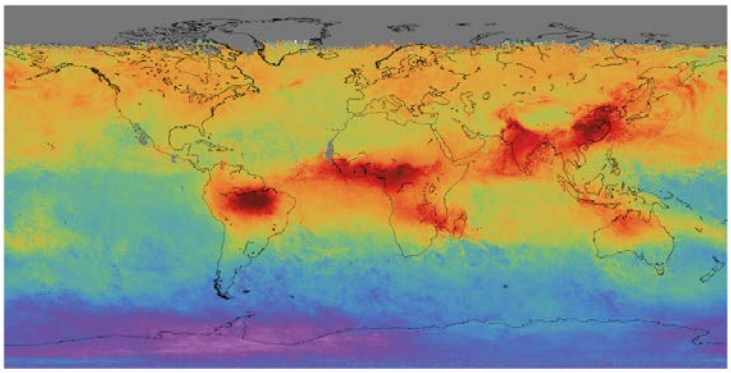
Sentinel 5 P Anwendungen

TECHNISCHE UNIVERSITÄT DARMSTADT

Kohlenstoffmonoxid weltweit



Quelle:ESA

CORA maps

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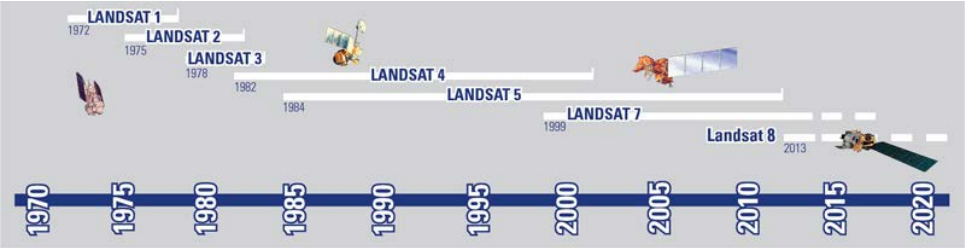
Landsat Satelliten (USA)

TECHNISCHE UNIVERSITÄT DARMSTADT

- seit 1972
- weltweit Bodenstationen
- Vorverarbeitung und Archivierung
- Whiskbroom Scanner
- **Daten kostenlos verfügbar**

http://landsat.usgs.gov/Landsat_Search_and_Download.php



CORA maps

Landsat 8 (seit 2013 im Einsatz)

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Zwei Sensoren an board:

Operational Land Imager (OLI)
Nine spectral bands, including a pan band:

Band 1 Aerosol	(0.43 - 0.45 µm)	30 m
Band 2 Blue	(0.450 - 0.51 µm)	30 m
Band 3 Green	(0.53 - 0.59 µm)	30 m
Band 4 Red	(0.64 - 0.67 µm)	30 m
Band 5 Near-Infrared	(0.85 - 0.88 µm)	30 m
Band 6 SWIR 1	(1.57 - 1.65 µm)	30 m
Band 7 SWIR 2	(2.11 - 2.29 µm)	30 m
Band 8 Panchromatic	(0.50 - 0.68 µm)	15 m
Band 9 Cirrus	(1.36 - 1.38 µm)	30 m

Thermal Infrared Sensor (TIRS)
Two spectral bands:

Band 10 TIRS 1	(10.6 - 11.19 µm)	100 m
Band 11 TIRS 2	(11.5 - 12.51 µm)	100 m

CORA maps

Mission	Organistion	Operation period	swath width (km)	spatial resolution (m)	Temporal resolution	radiometric resolution	Spectral resolution (µm)	Spectral bands
Landsat 1-5	NASA, USA	1972-1992	185	80 (MS), 240 (TIR)	16-18 days	8-bit	0,5-1,1 ; 10,4-12,6	4
Landsat 4,5	NASA, USA	1982-	185	30 (MS), 120 (TIR)	16 days	8-bit	0,45-2,35m ; 10,4-12,5	7
Landsat 7	NASA, USA	1999-	185	15 (PAN), 30 (MS), 60 (TIR)	16 days	8-bit	0,52-0,9 (PAN) ; 0,45-2,35 ; 10.4-12.5	7+PAN
Landsat 8	NASA, USA	2013-	185	15 (PAN), 30 (MS), 100 (TIR)	16 days	16-bit		10+PAN
ASTER	NASA, USA and METI, Japan	1999-	60	15 (VNIR), 30 (SWIR), 90 (TIR)	4-16 days	8-bit (VNIR/SWIR), 12-bit (TIR)	0,52-0,86 ; 1,60-2,43 8,125-11,65	14
TerraSAR-X	DLR, Germany	2007	30 (single Pol) 15 (dual Pol)	0,74- 3,49	11 days		Radar	
RADARSAT-1	CSA, Canada	1995-	45-500	8-100	24 days		Radar	
RADARSAT-2	CSA, Canada	2007-	20-500	3-100	24 days		Radar	
Envisat-1 (MERIS)	ESA	2002-	1150	300(Land), 1200 (Ocean)	35 days	12-bit	0,39-1,04	
IKONOS	GeoEye, USA	1999-	11,3	1 (PAN), 4 (MS)	3-5 days	11-bit	0,526-0,929 (PAN) ; 0,445-0,853	4+PAN
Quickbird	Digital Globe, USA	2001-	18	0,65 (PAN), 2,62 (MS)	2,5-5,6 days	11-bit	0,405-1.053 (PAN) ; 0,43-0.918	4+PAN
GeoEye-1	GeoEye, USA	2008-	15,2	0,41 (PAN) ; 1,65 (MS)	<3 days	11-bit	0,45-0,80 (PAN) ; 0,45-0,92	4+PAN
WorldView-2	Digital Globe, USA	2009-	16,4	0,46 (PAN); 1,85 (MS)	1,1-3,7 days	11-bit	0,45-0,80 (PAN) ; 0,45-1,04	8+Pan
Pleiades	CNSE, France	2011-	20	0,7 (PAN), 2,8 (MS)	<1 day			4+PAN

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Quelle: Imagico 2018

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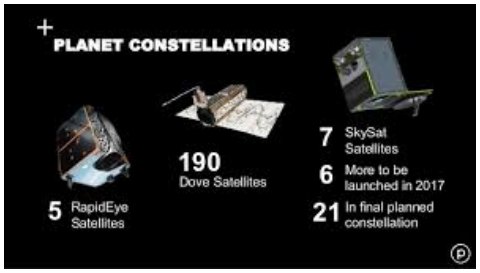
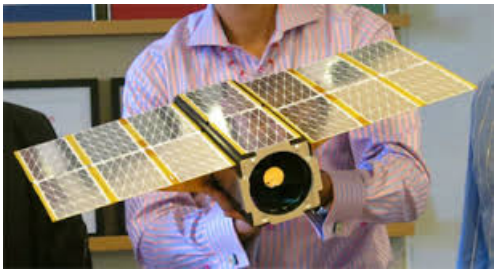


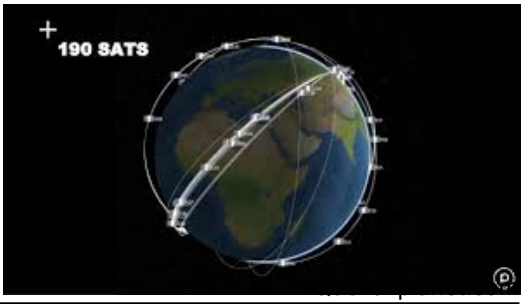


PLANET MONITORING OFFERINGS

PlanetScope and SkySat Monitoring programs can be tailored to fit your needs.

PlanetScope
- Always-on monitoring, daily refresh
- 3.7 meter resolution
- RGB and NIR bands
- Archive since 2009

SkySat
- Image any location up to 2x per day
- 72 centimeter resolution
- RGB, NIR, and Panchromatic bands
- Archive since 2014



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Planet Labs

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PlanetScope (Dove) Satelliten:

Bodenauflösung ~3 Meter

Hohe zeitliche Auflösung

Kosten auf Nachfrage

Erwerb räumlicher Zuschnitte auf Stadtgebiete laut Auskunft von planet möglich

Quelle: planet.com

CORA MAPS

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ICEYE-X

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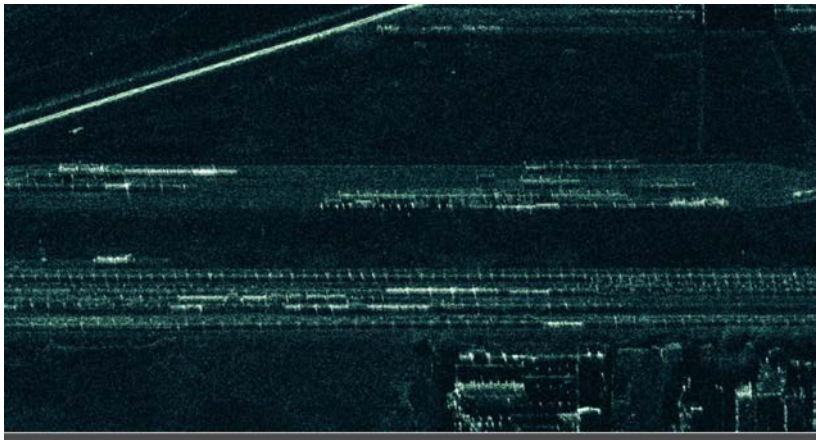

Iceye radar satellite imagery of less than one resolution showing train cars at a depot near Oklahoma City. Credit: Iceye

Skyrocket.de

CORAmaps

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Capella Space

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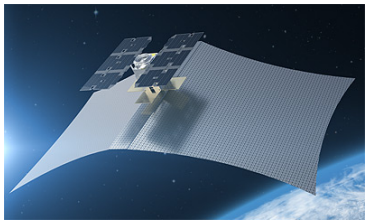

Quelle: capellaspace.com

CORAmaps

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Copernicus

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....und steigende Datenmengen

Sentinel Nutzerprodukte im ESA Data Hub	2014	2015	2016	2017	2018	2019	2020
Jährliche Volumen [TB]	180	966	4.490	6.591	7.250	7.469	8.127
Durchschnittliche Rate [Mbit/s]	194	257	1.194	1.753	1.928	1.987	2.162

4490 TB = 4.490.000 GB

1 DVD = 4,7 GB = 955.319 DVD‘s

Quelle: DLR

Copernicus

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....und steigende Datenmengen

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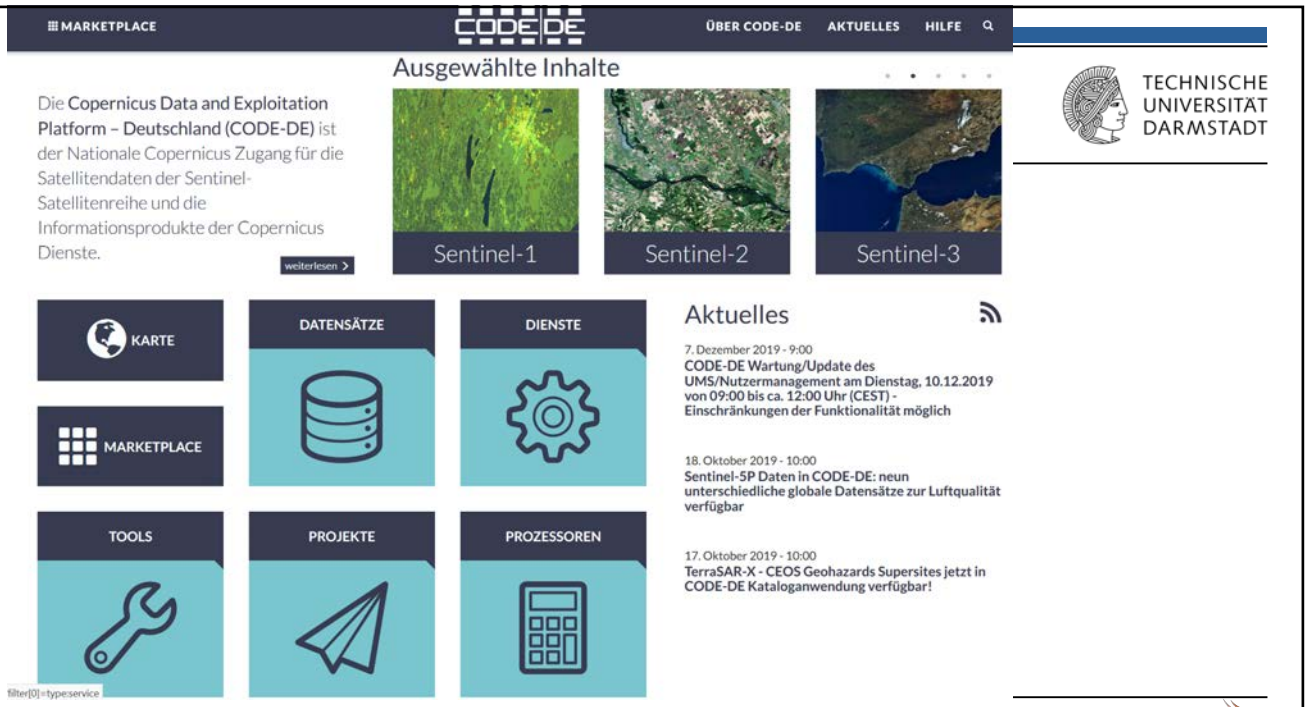
Übertragung der Daten steigt mit zur Verfügung stehender Datenmenge und Nutzerzahl an

Quelle: DLR



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CORA maps

Sentinel 2 Playground

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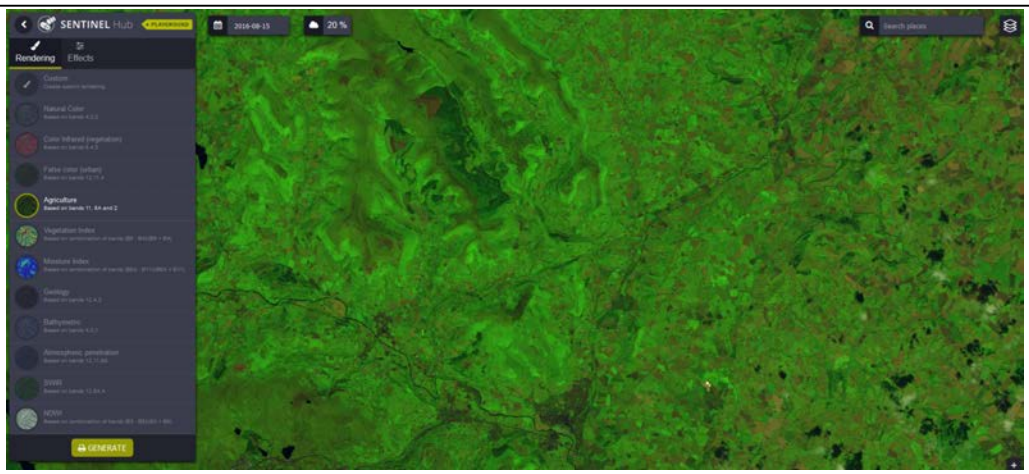

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Services and Tools

Home | Solutions | Services and Tools

FREE TOOLS

Access to a set of services free of charge allowing a first level of Earth Observation Data management:

- Discovery to Search, view and select data in area of interest
- Download selected data
- Service Catalogue to explore and select different data source
- Helpdesk with FAQ and personal support if necessary

ADVANCED TOOLS

Many tools available on Mundi and providing by third party provider insuring a more advanced use of data :

CORA maps

Google Earth Engine

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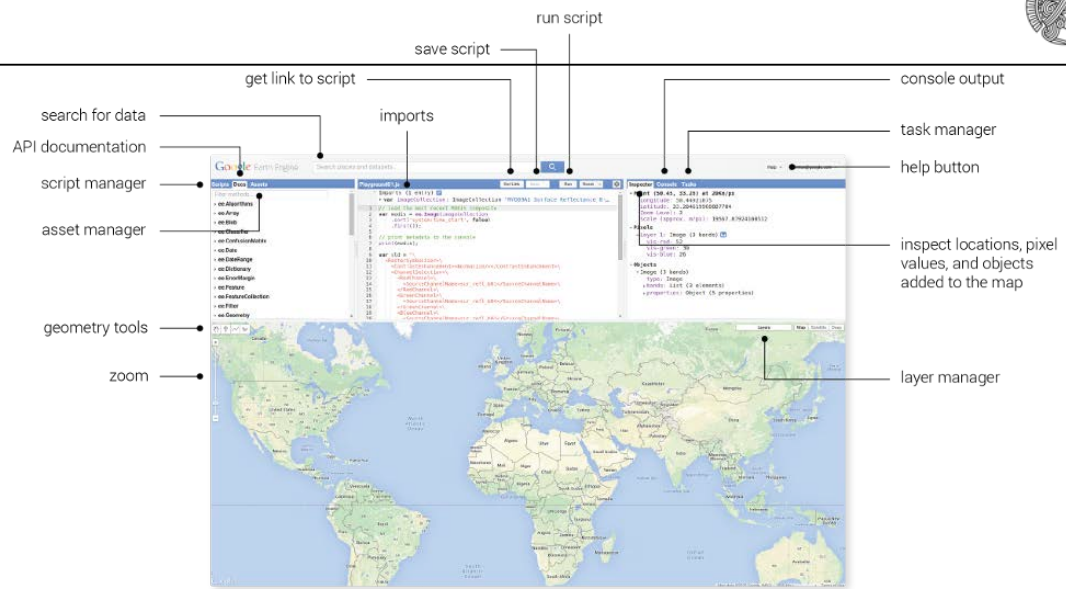

CORA maps

Vielen Dank

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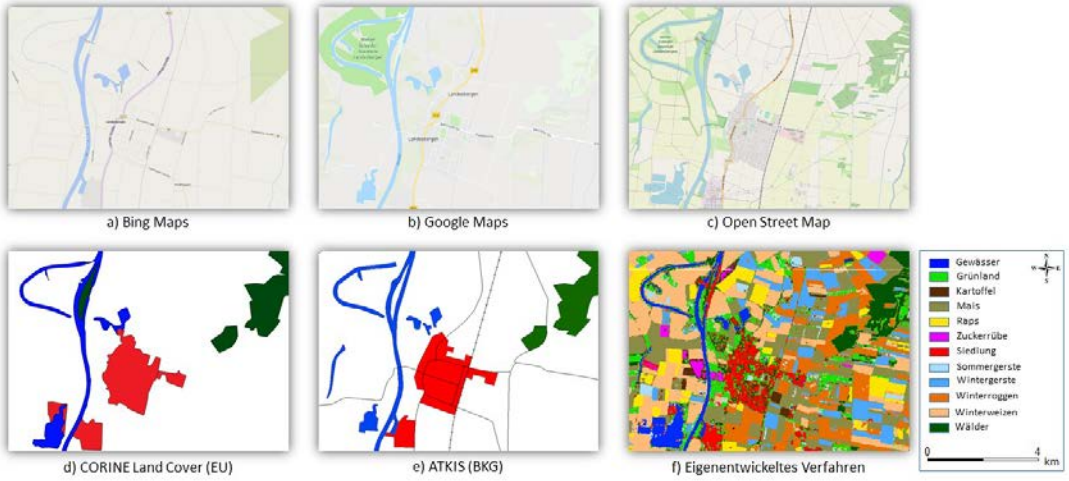

www.coramaps.com

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