H2020-TWINN-2015. Grant Agreement no 691936	
Project full title:	Remote Sensing Science Center for Cultural Heritage
Project acronym:	ATHENA
Work Package	WP4
Deliverable	D4.4 Material from 1st workshop

	**H2020-TWINN-2015** **Grant Agreement no 691936** This project is funded under the **EUROPEAN COMMISSION** in the Framework Programme for Research and Innovation (2014-2020).
Call:	Work programme **H2020** under **"Spreading Excellence and Widening Participation", call: H2020-TWINN-2015: Twinning** (Coordination and Support Action).
Project full title:	**Remote Sensing Science Center for Cultural Heritage**
Project acronym:	**ATHENA**
Work Package (WP):	**WP4**
Deliverable (D):	**D4.4 (Material from 1st workshop)**
Due date of deliverable:	**April 2016** **(Month 4 of the project)** — **Version: 1**
Author(s):	**Diofantos G. Hadjimitsis, Argyro Nisantzi, Vasiliki Lysandrou, Athos Agapiou, Kyriacos Themistocleous**
Contributor(s):	
Start date of project:	**1/12/2015** — Duration: **36 months**

Dissemination Level		
PU	Public	✔
CO	Confidential, only for members of the consortium (including the Agency Services)	

Document Sign-off				
Nature	**Name**	**Role**	**Partner**	**Date**
DRAFT	Diofantos G. Hadjimitsis Argyro Nisantzi Athos Agapiou Vasiliki Lysandrou Kyriacos Themistocleous	Work Package Leader	CUT	22/04/2016
REVIEWED	Gunter Schreier	Partner 2	DLR	25/04/2016
APPROVED	Diofantos G. Hadjimitsis Argyro Nisantzi Athos Agapiou Vasiliki Lysandrou Kyriacos Themistocleous Gunter Schreier	WP Leader / Partner 2	CUT, DLR	26/04/2016

Work Package: 4 – Training and knowledge transfer Deliverable: D4.4 – Material from 1st workshop				
Sections to be protected	**Description**	**Owner**	**Access Rights**	
			Period	**Type***
none				

Summary

The specific deliverable summarizes the material related to the first workshop of the project entitled as 'Copernicus Contribution to Cultural Heritage'. This include actions prior to the workshop, such as the agenda prepared, as well as material deriving from the workshop per se (such as the presentations that took place), the list of participants etc.

Table of Contents

1. Introduction

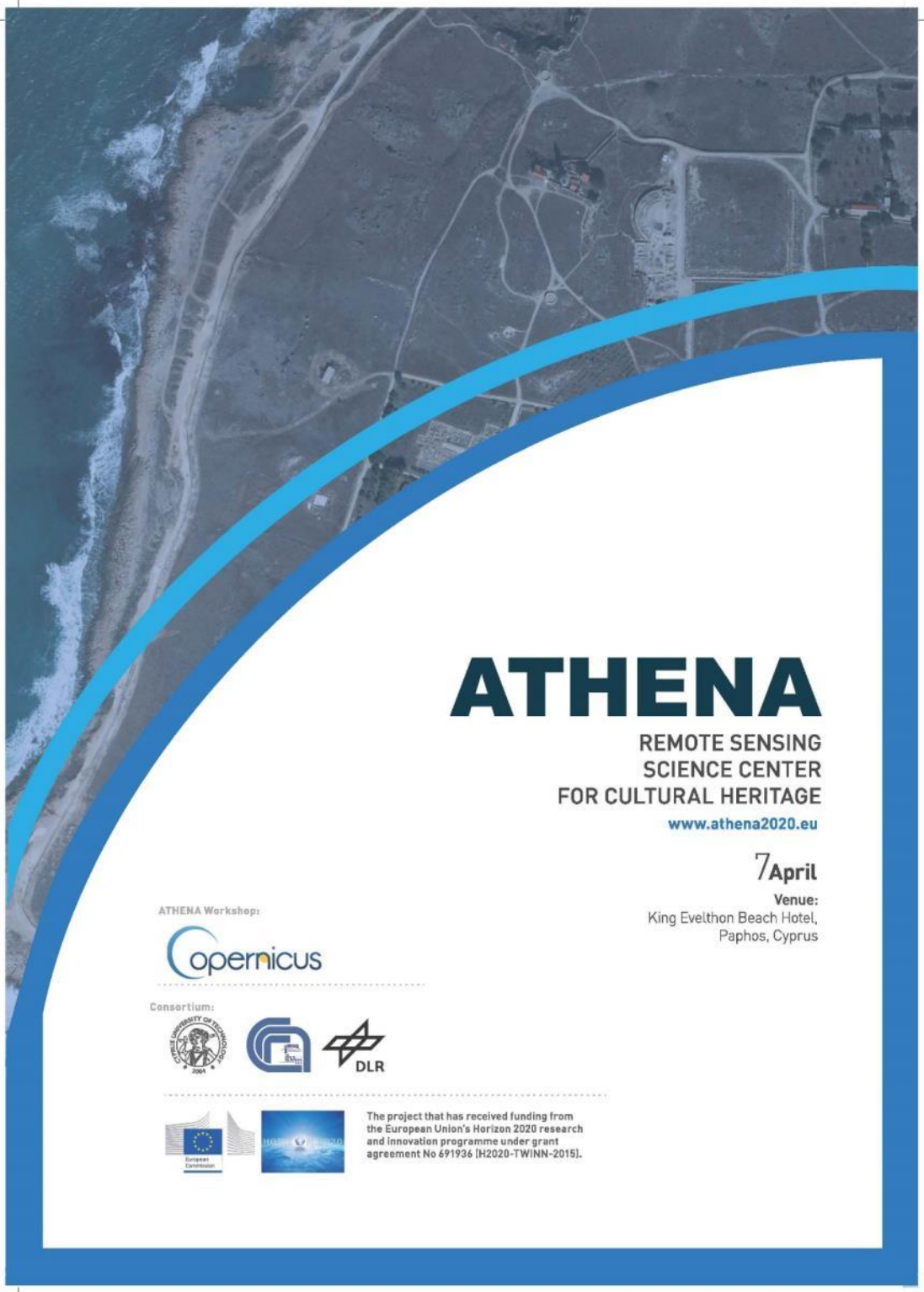
The 1st Workshop of ATHENA project has been succesfully accomplished in line with the timeline of the project. The Workshop was lead by partner 2 (DLR) and hosted by Partner 1 (CUT-Project's coordinator) in cooperation with the Cyprus Remote Sensing Society during the '4th International Conference on Remote Sensing and Geoinformation of Environment' - RSCy2016 held in Paphos, Cyprus.

The topics of the aforementioned conference and of the workshop are related, thus the partners of ATHENA project decided to host the workshop during the conference, in order to attract more scientists interested on the subject, an added value for the workshop, as well as for further dissemination of the ATHENA project to the internaitonal scientific community and to local stakeholders.

The workshop entitled 'Copernicus contribution to Cultural Heritage', was a full day workshop (see agenda below) that concluded with interesting discussions and comments for future work.

The workshop was advertised on the conference website (*www.cyprusremotesensing.com/rscy2016*) as well as through e-mails to the remote sensing community, local and international institutions (to over 8,000 e-mails) and all the participants of the conference.

2. Agenda of the workshop



[Workshop]
Copernicus contribution to Cultural Heritage

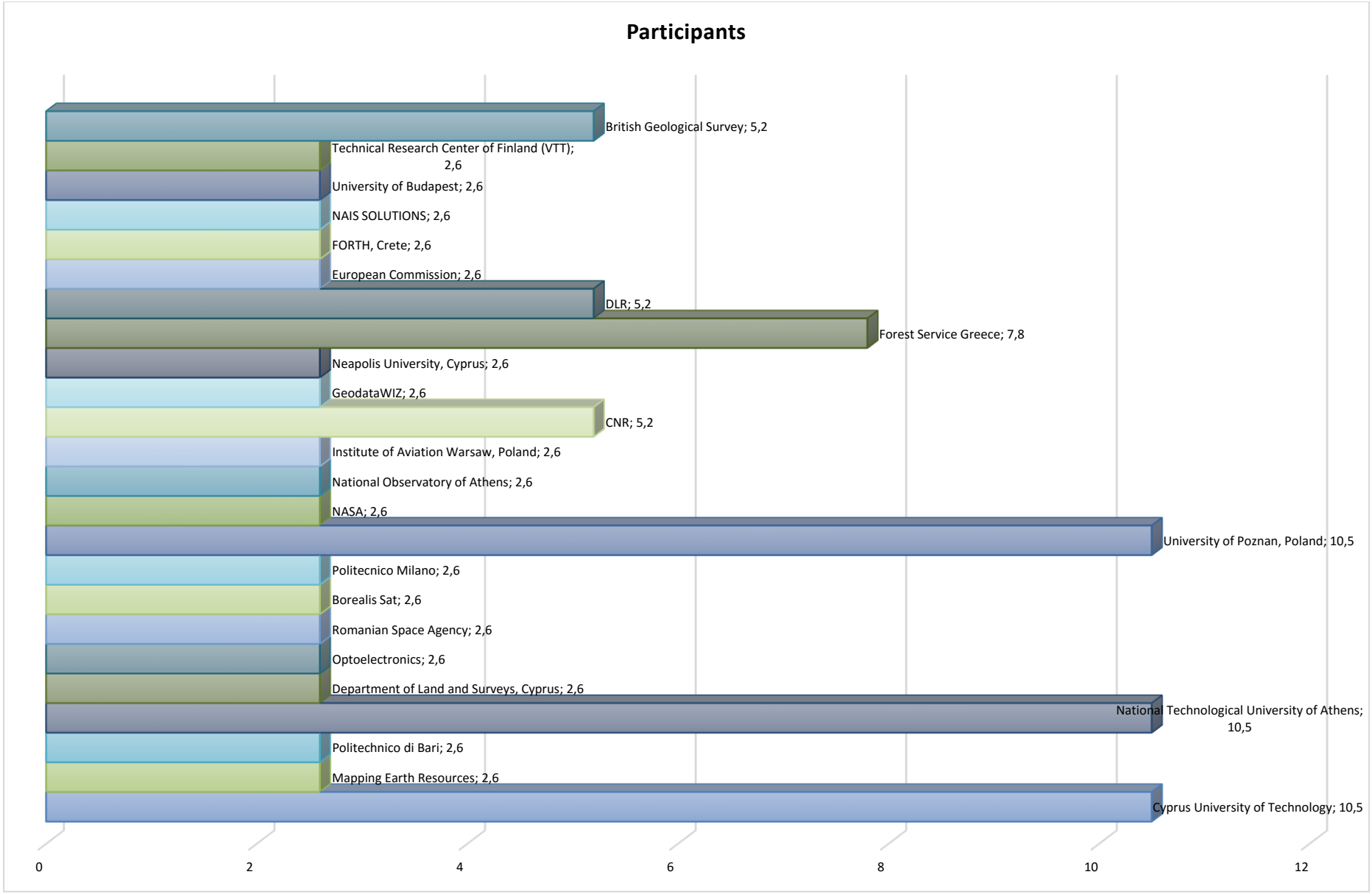
Time	Topic	Speaker
9:30	Welcome and Introduction to the Workshop	Gunter Schreier, DLR
9:45	Overview of Copernicus Framework, policy and strategy	Sakellaris HOURDAS, EC
10:15	The Copernicus Space Component Sentinels and Core Ground Segment	Simon Jutz, ESA
10:45	A Copernicus Ground Segment – Example of DLR Core and collaborative ground segment	Gunter Schreier, DLR
11:00	Coffee Break (available for registered participants)	
11:30	Overview of European Earth Observation missions	Gunter Schreier, DLR
12:15	Access to Copernicus Data and Contributing Missions	Simon Jutz, ESA
12:45	First Q & A session	
13:00	Lunch (available for registered participants)	
14:30	German EO mission contributions to Copernicus and DLR Copernicus projects	Gunter Schreier, DLR
15:00	Overview of the Copernicus Security Service	Rui MENESES, EC
15:30	Summary and potential contributions of Copernicus to preserve the world cultural heritage	Gunter Schreier, DLR
16:00	Coffee Break (available for registered participants)	
16:30	Round Table Discussion, Q&A from the participants	All speakers, moderator: Gunter Schreier
17:30	End of Workshop	

Consortium:
- Cyprus University of Technology (CY)
- National Research Council (IT)
- German Aerospace Centre (DE)

3. List of Participants

During the Copernicus Workshop, 38 individuals participated from various European and international institutions , representing both the academia, industry and research centers. The percentage of the participants from each institutions represented is indicated shown below.

Universities/ Institutes	**%**
Cyprus University of Technology	10.5
Mapping Earth Resources	2.6
Politechnico di Bari	2.6
National Technological University of Athens	10.5
Department of Land and Surveys, Cyprus	2.6
Optoelectronics	2.6
Romanian Space Agency	2.6
Borealis Sat	2.6
Politecnico Milano	2.6
University of Poznan, Poland	10.5
NASA	2.6
National Observatory of Athens	2.6
Institute of Aviation Warsaw, Poland	2.6
CNR	5.2
GeodataWIZ	2.6
Neapolis University, Cyprus	2.6
Forest Service Greece	7.8
DLR	5.2
European Commission	2.6
FORTH, Crete	2.6
NAIS SOLUTIONS	2.6
University of Budapest	2.6
Technical Research Center of Finland (VTT)	2.6
British Geological Survey	5.2


Participants
British Geological Survey; 5,2
Technical Research Center of Finland (VTT); 2,6
University of Budapest; 2,6
NAIS SOLUTIONS; 2,6
FORTH, Crete; 2,6
European Commission; 2,6
DLR; 5,2
Forest Service Greece; 7,8
Neapolis University, Cyprus; 2,6
GeodataWIZ; 2,6
CNR; 5,2
Institute of Aviation Warsaw, Poland; 2,6
National Observatory of Athens; 2,6
NASA; 2,6
University of Poznan, Poland; 10,5
Politecnico Milano; 2,6
Borealis Sat; 2,6
Romanian Space Agency; 2,6
Optoelectronics; 2,6
Department of Land and Surveys, Cyprus; 2,6
National Technological University of Athens; 10,5
Politechnico di Bari; 2,6
Mapping Earth Resources; 2,6
Cyprus University of Technology; 10,5
0
2
4
6
8
10
12

H2020-TWINN-2015 - Remote Sensing Science Center for Cultural Heritage - A T H E N A
1st Workshop
Topic: Copernicus contribution to CH-
Accomplished by: DLR
Thursday, 7th April, 2016
Hosting institution: Cyprus University of Technology, Limassol – Cyprus – RSCy2016 conference, Paphos - Cyprus

List of participants

A/A	NAME	INSTITUTION	CONTACT DETAILS	SIGNATURE
1	Athos Agapiou	Cyprus University of Technology	athos.agapiou@cut.ac.cy	
2	Argyro Nisantzi	Cyprus University of Technology	argyro.nisantzi@cut.ac.cy	
3	Branka Cuca	Cyprus University of Technology / POLIMI	branka.cuca@cut.ac.cy	
4	Vijay Vohora	Mapping Earth Resources Ltd. UK.	vijay.vohora@mappingearth.com	
5	ANTONIO NOVELLI	POLITECNICO DI BARI	ANTONIO.NOVELLI@POLIBA.IT	

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 691936

6	Charalabos Ioannidis	National Technical University of Athens Greece	cioannid@survey.ntua.gr	
7	Kleanthous Chrysanthi	Department of Land and Surveys	chkleanthous@dls.moi.gov.cy	
8	Yiannis Vacanas	Cyprus University of Technology	yiannis.vacanas@cut.ac.cy	
9	SAVASTRU DAN	National Institute of R&D for OPTOELECTRONICS	dsavas@inoe.ro	
10	POENARU VIOLETA	ROMANIAN SPACE AGENCY	violeta.poenaru@rosa.ro	
11	Antonia Moropoulou	National Technical University of Athens	amoropul@central.ntua.gr	
12	Elisavet Tsilimantou	National Technical University of Athens	eltsilim@mail.ntua.gr	
13	ΣΠΥΡΟΣ ΠΙΤΣΙΛΛΙΔΗΣ	Borealis Sat	operations@borealissat.com	
14	LUIGI BARAZZETTI	Politecnico di Milano	luigi.barazzetti@polimi.it	
15	Łukasz Banaszek	University in Poznań	lukas.banaszek@wp.pl	
16	WŁODZIMIERZ RĄCZKOWSKI	University of Poznań Poland	wlodekra@amu.edu.pl	

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 691936

17	Tikuoti Kostylko	University of Poznan	mkos@amu.edu.pl	
18	Aleksandra Wilgocka	National Museum in Szczecin / University of Poznan	a.wilgocka@muzeum.szczecin.pl	
19	VINCE AMBROSIA	NASA APPLIED SCIENCE PROGRAM / CA. STATE UNIV. - MONTEREY BAY	VINCENT.G.AMBROSIA@NASA.GOV	
20	Iphigenia Keramitsoglou	National Observatory of Athens	ik@noa.gr	
21	Krzysztof Skocki	Institute of Aviation Warsaw, Poland	krzysztof.skocki@ilot.edu.pl	
22	Rosa [illegible]	CNR - IMAA	ROSA.LASAPONARA@IMAA.CNR.IT	
23	NICOLA MASINI	CNR - IBAM	N.MASINI@IBAM.CNR.IT	
24	Armin Schmidt	GeodataWIZ	A.Schmidt@GeodataWIZ.com	
25	Andreas Georgopoulos	N.T.U.A	drag@central.ntua.gr	
26	Julia Georgi	Neapolis University of Pafos, Cyprus	j.georgi@nup.ac.cy	

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 691936

27	Elisavet Konstantinidou	Forest Service of Drama, Greece	elizcon@hotmail.com	
28	Ftika Zoe	Forest Service of Elassona, Greece	Ftikazoi@hotmail.gr	
29	Spyros Zigkiris	Forest Service of Limni Evia Greece	daslimni@otenet.gr	
30	Gunter Schreier	DLR-EOC	gunter.schreier@dlr.de	
31	Thomas Krauß	DLR - EOC	thomas.krauss@dlr.de	
32	Sakellaris HOURDAS	European Commission - DG GROW	sakellaris.hourdas@ec.europa.eu	
33	Poulicos Prastacos	FORTH	poulicos@iacm.forth.gr	
34	ANTONIO MONTELEONE	NAIS	antonio.monteleone@nais-solutions.it	
35	Judit Bartholy	Eötvös Lorand UNIVERSITY, Budapest, HUNGARY	bartholy@caesar.elte.hu	
36	Oleg Antropov	VTT	oleg.antropov@vtt.fi	

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 691936

37	FRANCESCA CIGNA	[illegible] BRITISH GEOLOGICAL SURVEY	fcigna@bgs.ac.uk	[illegible]
38	DEODATO TAPETE	" "	deodato@bgs.ac.uk	[illegible]
39				
40				
41				
42				
43				
44				
45				
46				

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 691936

4. Presentations during the workshop

All presentations of the Workshop can be found in Annex 1.

4.1 Welcome and Introduction to the workshop - Gunter Schreier, DLR

4.2 Overview of Copernicus - Sakellaris Hourdas, EC

4.3 The Copernicus Space Component Sentinels and Core Ground Segment - Simon Jutz, ESA

4.4 A Copernicus Ground Segment - Example of DLR Core and collaboration ground segment - Gunter Schreier, DLR

4.5 Overview of European Earth Observation missions - Gunder Schreier, DLR

4.6 German EO mission contributions to Copernicus and DLR Copernicus projects - Gunter Schreier, DLR

4.7 Overview of the Copernicus Security Service - Rui Meneses, EC

4.8 Summary and Potential contributions of Copernicus to preserve the world cultural heritage - Gunder Schreier, DLR

5. Minutes of the workshop

Main Issues and results from the discussion with the Participants ATHENA Copernicus Workshop Paphos, Cyprus, April 7th 2016

Minutes: Compiled by Gunter Schreier, DLR as part of the ATHENA project

Background

The workshop is within the series of workshops and trainings of the ATHENA Twinning project funded by H2020. The workshop was conducted during the Fourth International Conference on Remote Sensing and Geoinformation of Environment RSCy2016.

The ATHENA Workshop is a one day general introduction to the European Copernicus Earth observation program, focusing on the topics of the H2020 ATHENA project, such as:

- Preservation and monitoring of Cultural Heritage
- Archaeological research
- Protection from archaeological looting
- Eastern Mediterranean region

The German Aerospace Center (DLR) - ATHENA twinning partner - alongside guest speakers from European Space Agency (ESA) and the European Commission (EC) presented aspects of Copernicus programme, such as:

- Sentinel space segment
- Contributing missions and access to the Copernicus data
- Core and collaborative ground segment
- Data policy and access to the data
- Core Services with focus on those of relevance for ATHENA

Major Points of Discussion and Results

The following issues were discussed at the end of the workshop, during a one hour discussion with the participants

- **General Issues on Copernicus**

Amongst others, the following general issues were raised during the discussion:

- Access to Copernicus Data: The access to Sentinel data will be improved on a European scale by the new initiative of the European Commission to better coordinate and merge core and collaborative data access points;

- Access to contributing mission data: this data is purchased by the Commission/ESA with a certain license to be used for the Copernicus Core Services. Under certain restrictions the data can be used by H2020 projects and governmental agencies:

- **European representation of World Heritage Sites and Archaeological issues:**

The areas and services in Copernicus are represented by European Agencies (not necessarily Agencies of the Commission) and European Interest groups. Based on a legal procedure, the Commission has entrusted to these agencies the resources to conduct parts of the Copernicus programme, including the Copernicus Core Services. For instance, the civil security services have been delegated to FRONTEX, EMSA and SatCen (from mid of 2016 onwards). At the present moment, it seems that there is no single body (e.g. a European wide agency) dealing with cultural heritage and specifically with World Heritage Sites in Europe. Participants noted that on the international scale there are several interest groups such as CIPA and ICOMOS which are indeed active and have European members. However, no organization specifically dealing with European interests in this matter was known to the participants at the time of the discussion (few comments and players have been mentioned afterwards [1]).

- **Arguments for including World Heritage Monitoring in Copernicus**

Several arguments to promote the inclusion of WH Monitoring into Copernicus were discussed. In the end, these arguments need to be tangible in terms of bringing a socio-economic benefit. These arguments include:

- Tourism: There are Pro's and Con's for encouraging tourism to preserve WHS
- Cultural heritage: at times when the European Society raises the issue of "European Identity" and "European Culture", relevant cultural sites in Europe (including WHS) should be monitored for their better preservation, preventive maintenance and management
- Security: Looting and illegal trading of archaeologic artefacts can be a significant source of funding for criminal and terrorist groups
- Holistic approach: cultural heritage, especially archaeological sites, include large portions of land. They should be observed on a larger geographical scale in order to

[1] E.g. **Joint Programming Initiative (JPI) on Cultural Heritage and Global change** coordinated by the Italian Ministry for Cultural Heritage and Activities (http://www.jpi-culturalheritage.eu/about-us-2/vision/). As well as a recent (September 2015) resolution of European Parliament entitled **"Towards an integrated approach to cultural heritage for Europe"**

consider all possible threats and to provide a more complete monitoring based on a holistic approach.

- **Interest of the European Commission to include World Heritage Monitoring in the Copernicus Core Services:**

The European Commission representative (who unfortunately couldn't make it to the workshop due to the closure of the Brussels airport), issued a written statement:

1) There has been a growing interest in the use of satellite observation for monitoring cultural heritage, in particular seen the conflicts in the middle East and the difficulty in assessing damage in-situ.
2) Monitoring of Cultural Heritage - particularly related to damage assessment in conflict zones - will be one of the services accessible through SEA (Support to EU External Actions) as from mid-2016.
3) Until then, in specific cases it could be possible to use the Copernicus Emergency Management Service, to provide reference material also in support to the EU External Action Service and Regional desk officers.
4) We are keen in developing further contacts with the R&D community to explore how satellite observations, merged with other sources of information, may help us to increase awareness and contribute to the preservation of our World cultural heritage.

This statement was the basis for further discussion on how World Heritage Monitoring (WHM for short) can be embedded in the Copernicus Core Services and which of the current services would be best to implement WHM.

It should be noted that the European Agencies, executing the Core Services, are also contracting the generation of the maps and products to industrial consortia by an open tender procedure. Academia might be involved in definition of the products, in validating the results and supporting European geo-information industry.

- **Defining a future WHM Service**

Prior to including WHM into the Copernicus Core Services, several issues need to be addressed. These include:

- Organizing a European consensus on this issue, especially with the national representatives in the Copernicus User Fora
- Engaging the end-users (e.g. national and regional institutions engaged in WHS preservation and management)

- Identifying which products or services need to be conducted and which sites (in Europe: all, use the UNESCO WHS list?, outside Europe) need to be monitored
- Defining a common metrics and procedures for the products and services
- Defining a calibration and verification procedure

- **Further ways ahead**

The issues raised during the ATHENA Copernicus Workshop can be considered a basis at the European level. Further action needs to be taken to imbed the idea of a permanent and funded European service at the Copernicus level. These actions include stakeholder consultation and possible initial small case studies to identify the major points, some of them also raised during this workshop.

6. Photos from the Workshop


ATHENA


ATHENA


RSCy2016
ATHENA

ANNEX

PRESENTATIONS OF THE WORKSHOP

Presentations during the workshop

1 Welcome and Introduction to the workshop - Gunter Schreier, DLR

"Copernicus contribution to Cultural Heritage"

H2020-TWINN-2015 ATHENA project:

Remote Sensing Science Center for Cultural Heritage

Workshop

Gunter Schreier (Gunter.Schreier@dlr.de)
Deutsches Fernerkundungsdatenzentrum
Earth Observation Center
DLR-DFD, Oberpfaffenhofen
April 7th, 2016

DLR

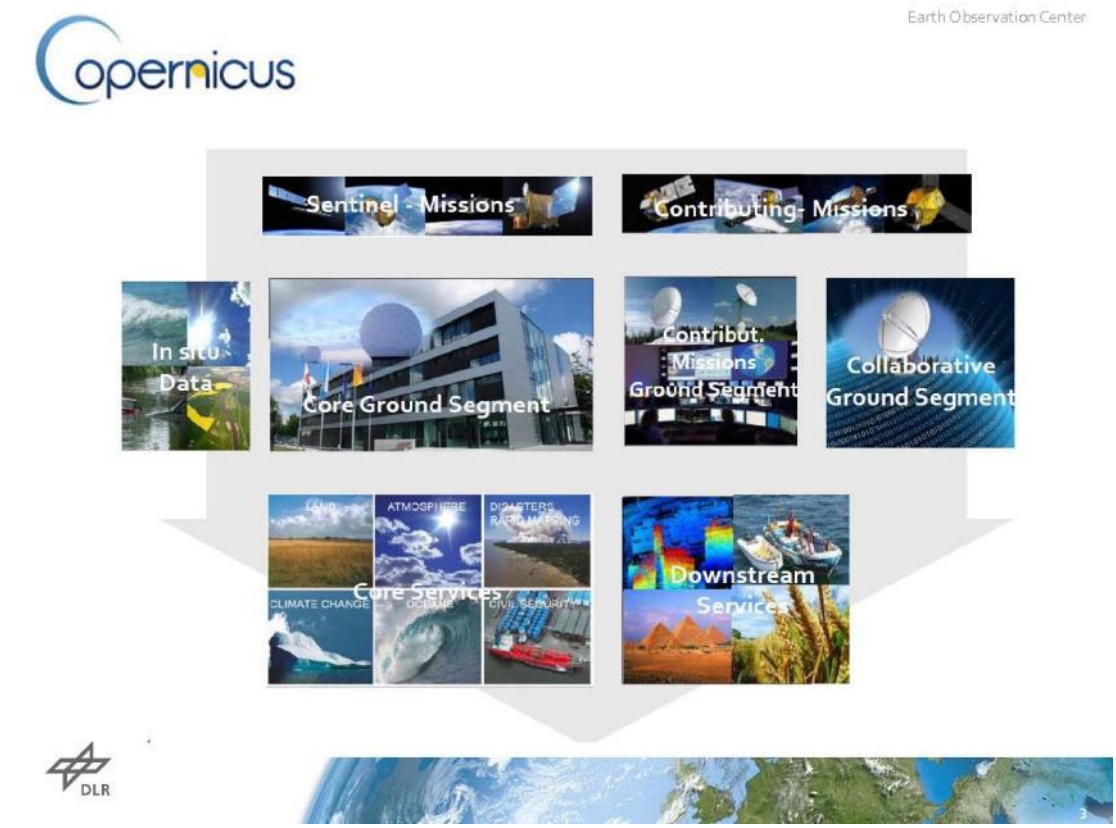
Earth Observation Center

GALILEO

The European Earth Observation Programme

Copernicus
The European Earth Observation Programme

DLR


Copernicus
Earth Observation Center
Sentinel - Missions
Contributing Missions
In situ Data
Core Ground Segment
Contribut. Missions Ground Segment
Collaborative Ground Segment
Core Services
Downstream Services
DLR


LAND
ATMOSPHERE
DISASTERS RAPID MAPPING
World Heritage
CLIMATE CHAN
'IL SECURITY


Baal Temple Palmyra
Earth Observation Center
AFP Photo/ Süddeutsche Zeitung
DLR
5


Baal Temple Palmyra
Earth Observation Center
AFP Photo/ Süddeutsche Zeitung
DLR
6

ATHENA. Remote Sensing Science Center for Cultural Heritage

– aiming to establish a Center of Excellence in the field of Remote Sensing for Cultural Heritage in the areas of Archaeology and Cultural Heritage
  – through the development of an enhanced knowledge base and innovative methods.
– twinning the existing Remote Sensing and Geo-environment Research Laboratory at the Cyprus University of Technology (CUT) with
  – Institute of Archaeological and Architectural Heritage, National Research Council of Italy (IBAM- CNR)
  – German Aerospace Centre – Earth Observation (DLR).
– aligned with the Smart Specialization Strategy of Cyprus
– positioned in the region of eastern Mediterranean, abound in WHS sites
– facilitating collaborations with experts of the Archaeology and Cultural Heritage

ATHENA. Work Packages

– WP 1 Project Management
– WP 2 International RS research applied on CH, innovation agenda and best practices assessment
– WP 3 Evaluation of gap and capacity development
– WP 4 Training and knowledge transfer
– WP 5 Promotion of the centre locally and internationally
– WP 6 Dissemination and exploitation

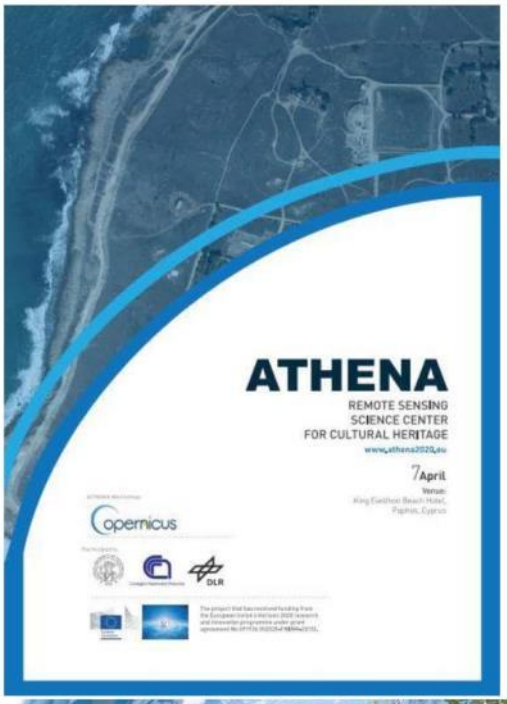
Earth Observation Center

ATHENA

Copernicus Workshop

7 April 2016

Paphos Cyprus



DLR

9

Earth Observation Center

Workshop: Copernicus contribution to Cultural Heritage

Fourth International Conference on Remote Sensing and Geoinformation of Environment RSCy2016

The ATHENA Workshop is an one day general introduction to the European Copernicus Earth observation program, putting specific focus on the topics of the H2020 ATHENA project, such as:

- Preservation and monitoring of Cultural Heritage
- Archaeologic research
- Protection from archaeological looting
- Eastern Mediterranean region

The German Aerospace Center (DLR) - ATHENA twinning partner - alongside guest speakers from European Space Agency (ESA) and the European Commission (EC) will present aspects of Copernicus, such as:

- Sentinel space segment
- Contributing missions and access to their data
- Core and collaborative ground segment
- Data policy and access to the data
- Core Services with focus on those of relevance for ATHENA

DLR

10

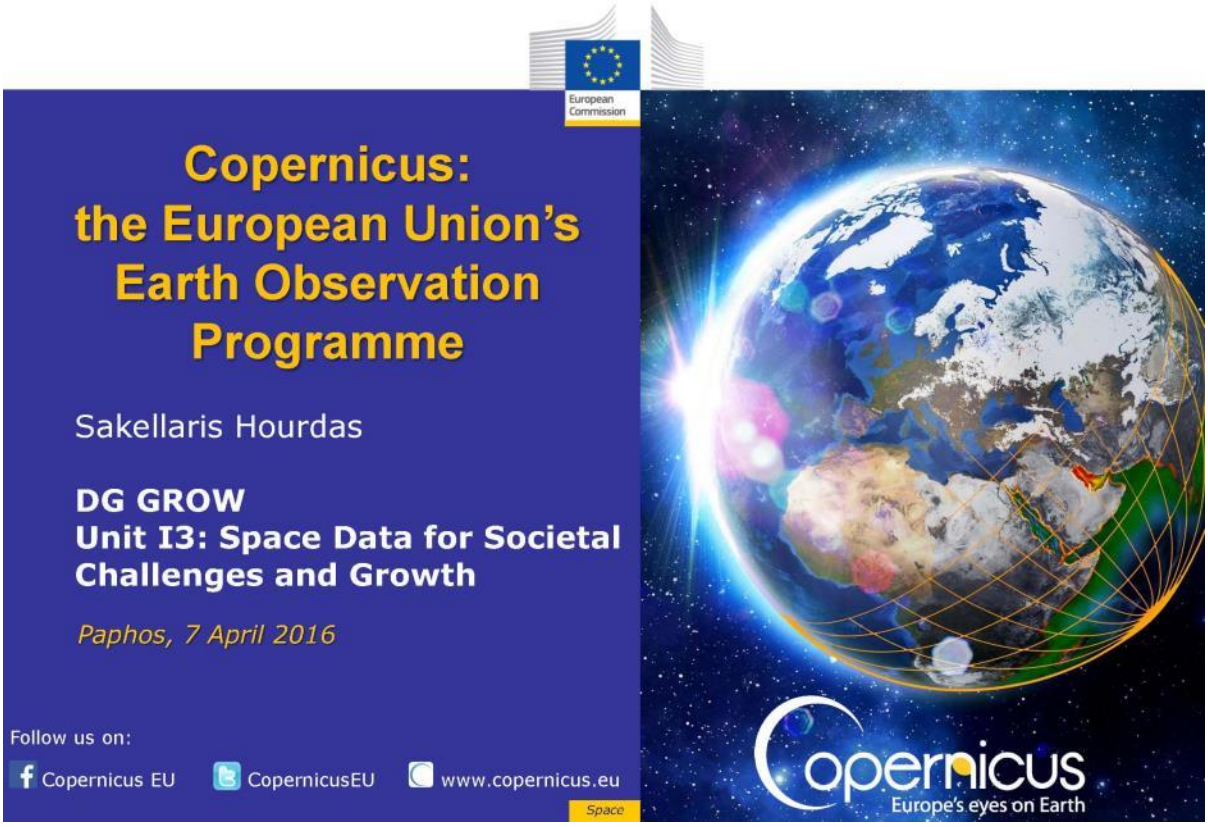
Earth Observation Center

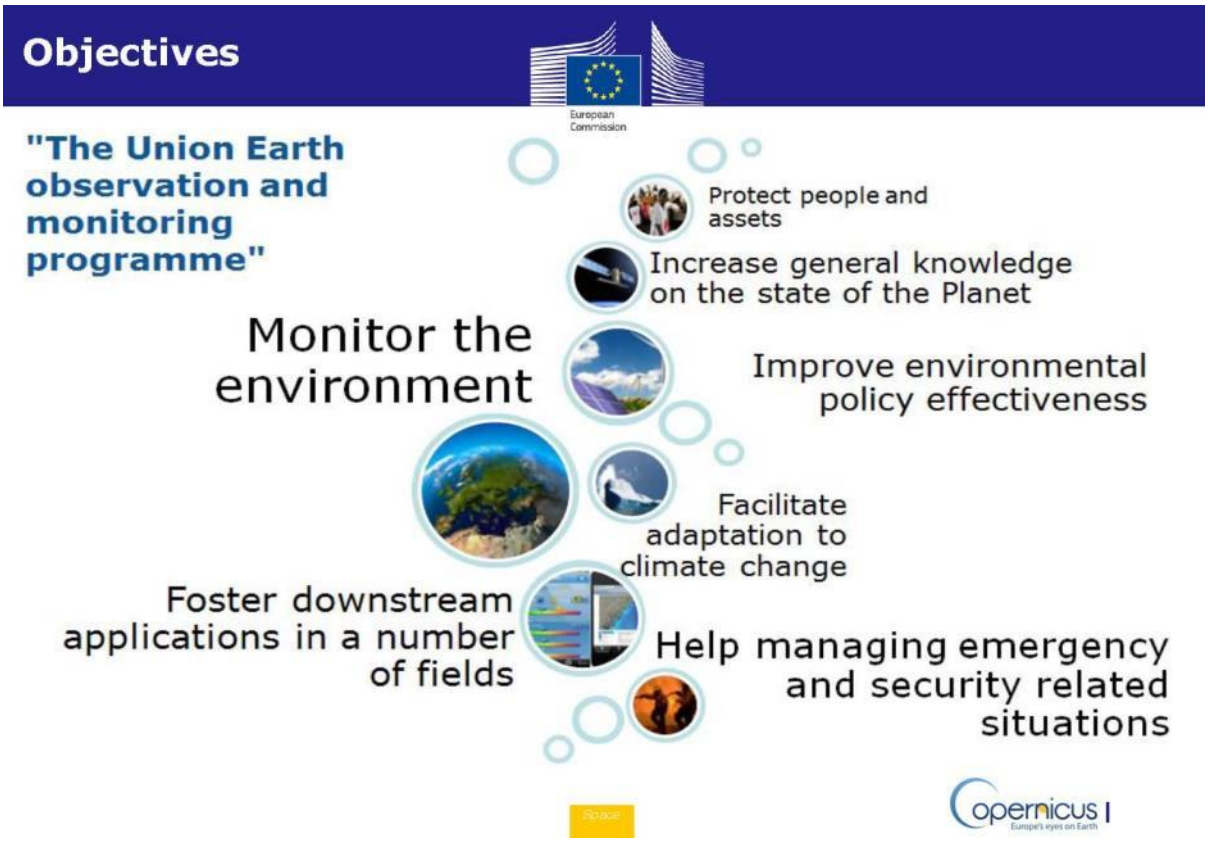
Time Table

Time	Topic	Speaker
9:30	Welcome and Introduction to the Workshop	Gunter Schreier, DLR
9:45	Overview of Copernicus Framework, policy and strategy	Sakellaris HOURDAS, EC
10:15	The Copernicus Space Component Sentinels and Core Ground Segment	Simon Jutz, ESA
10:45	A Copernicus Ground Segment – Example of DLR Core and collaborative ground segment	Gunter Schreier, DLR
11:00	Coffee Break	
11:30	Overview of European Earth Observation missions	Gunter Schreier, DLR
12:15	Access to Copernicus Data and Contributing Missions	Simon Jutz, ESA
12:45	First Q & A session	
13:00	Lunch (available for registered participants)	
14:30	German EO mission contributions to Copernicus and DLR Copernicus projects	Gunter Schreier, DLR
15:00	Overview of the Copernicus Security Service	Rui Meneses, EC
15:30	Summary and potential contributions of Copernicus to preserve the world cultural heritage	Gunter Schreier, DLR
16:00	Coffee Break	
16:30	Round Table Discussion, Q&A from the participants	All speakers,
17:30	End of Workshop	

DLR

2 Overview of Copernicus - Sakellaris Hourdas, EC



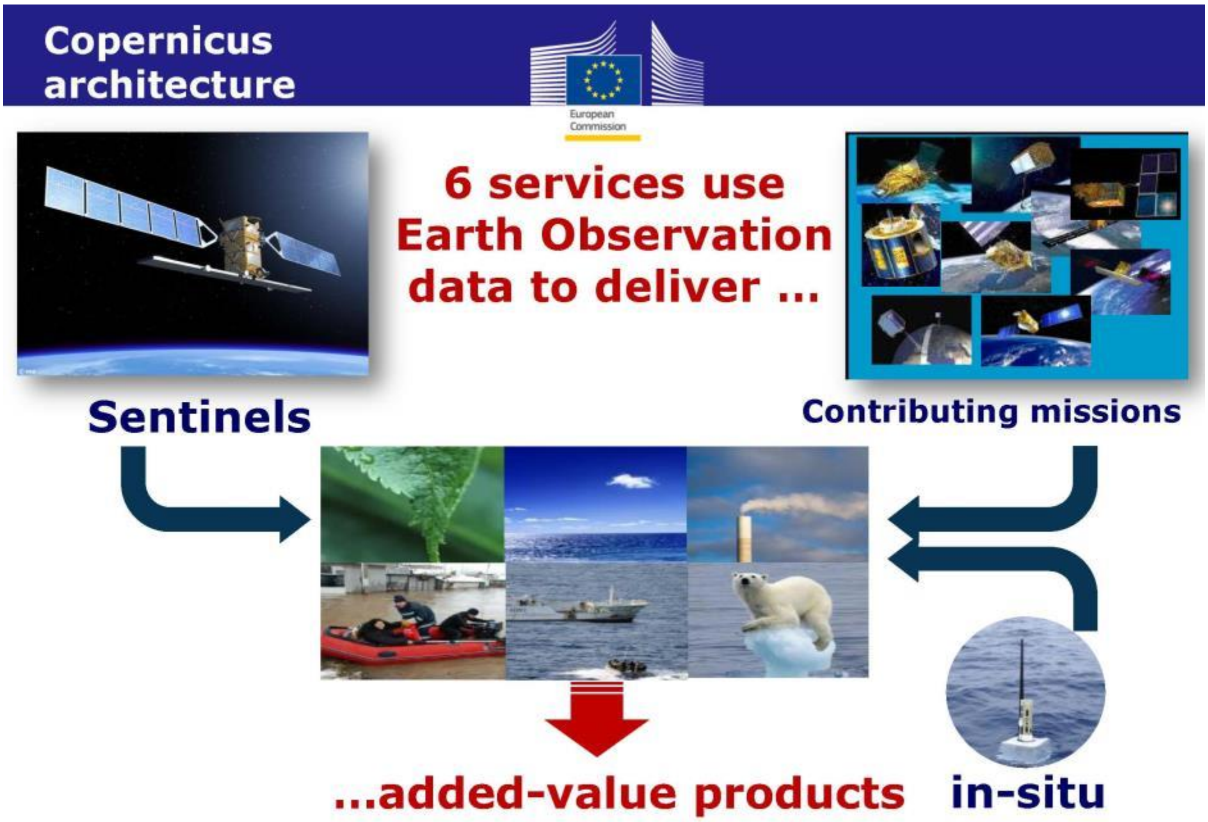


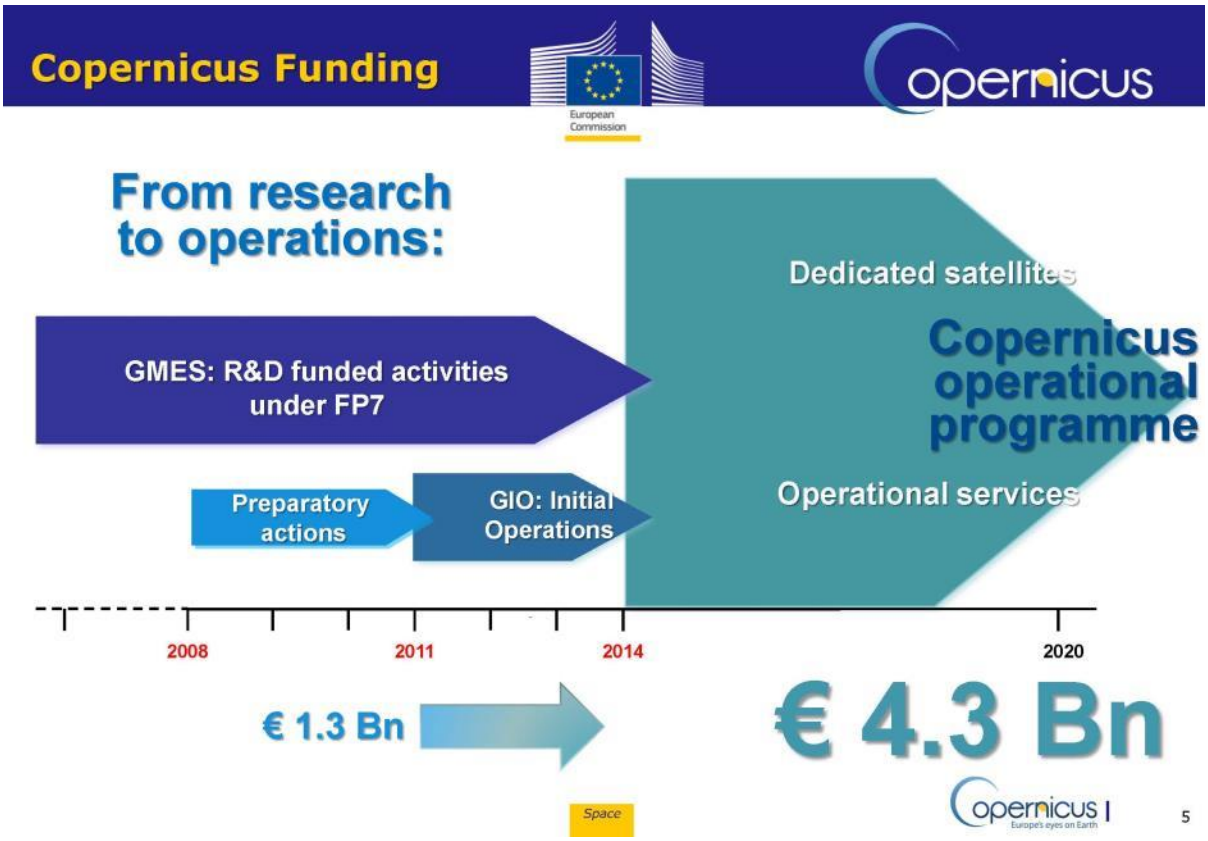
Copernicus in Brief

- **The Copernicus programme** is a cornerstone of the European Union's efforts to monitor **the Earth** and its many ecosystems, whilst ensuring that its citizens are prepared and protected in the face of **crises** and **natural or man-made disasters**.
- The Copernicus Programme is a tool for **economic development** and a driver for **digital economy.**
- The Copernicus programme places a world of insight about our planet at the disposal of citizens, public authorities and policy makers, scientists, entrepreneurs and businesses on **a full, free and open basis**.

Space

Copernicus Europe's eyes on Earth | 3




Copernicus Funding
European Commission
opernicus
From research to operations:
Dedicated satellites
GMES: R&D funded activities under FP7
Copernicus operational programme
Preparatory actions
GIO: Initial Operations
Operational services
2008
2011
2014
2020
€ 1.3 Bn
€ 4.3 Bn
Space
opernicus
Europe's eyes on Earth
5


Copernicus Space Component: Dedicated Missions
European Commission
esa
S1: Radar Mission
S2: High Resolution Optical Mission
S3: Medium Resolution Imaging and Altimetry Mission
S4: Geostationary Atmospheric Chemistry Mission
S5P: Low Earth Orbit Atmospheric Chemistry Precursor Mission
S5: Low Earth Orbit Atmospheric Chemistry Mission
S6 (Jason-CS): Altimetry Mission
FIRST LAUNCH 3.04.2014
FIRST LAUNCH 23.06.2015
FIRST LAUNCH 16.02.2016

European Commission

Sentinel-1A mosaic over Europe, generated using 400 scenes acquired from May to July 2015. Processing involved radiometric calibration, multi-looking, terrain correction at 120 m resolution, and spatial mosaicking using ESA's SNAP/Sentinel-1 Toolbox.

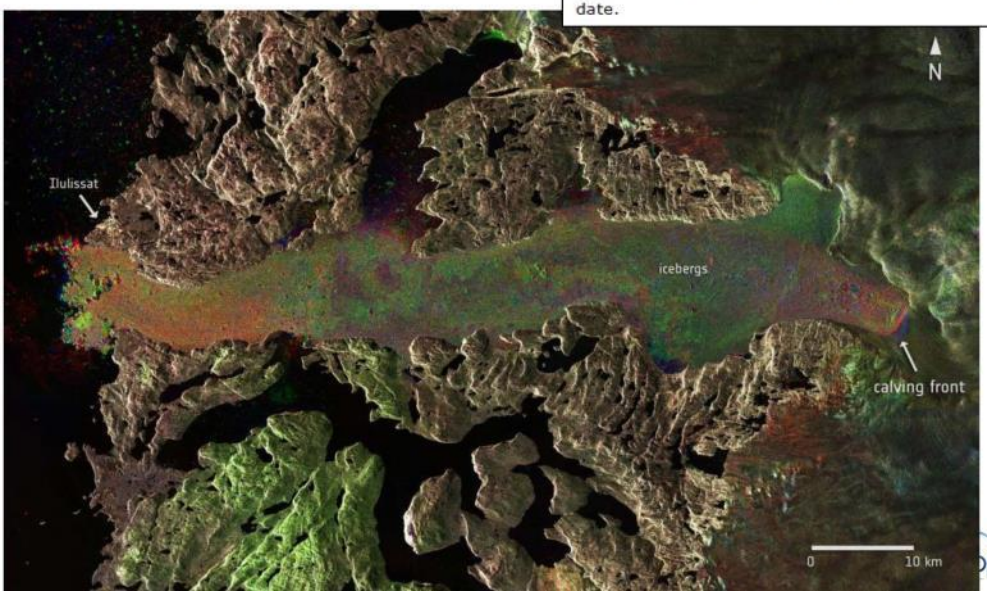
Space

Copernicus Europe's eyes on Earth 7

European Commission

Radar images from Sentinel-1A captured the Jakobshavn glacier in western Greenland before and after a massive calving event, which took place between August 14th and August 16th 2015.

The image composite includes different Sentinel-1A images from July 27th, August 13th and 19th. The red, green and blue indicate the position of the calving front and other dynamic features on each respective date.

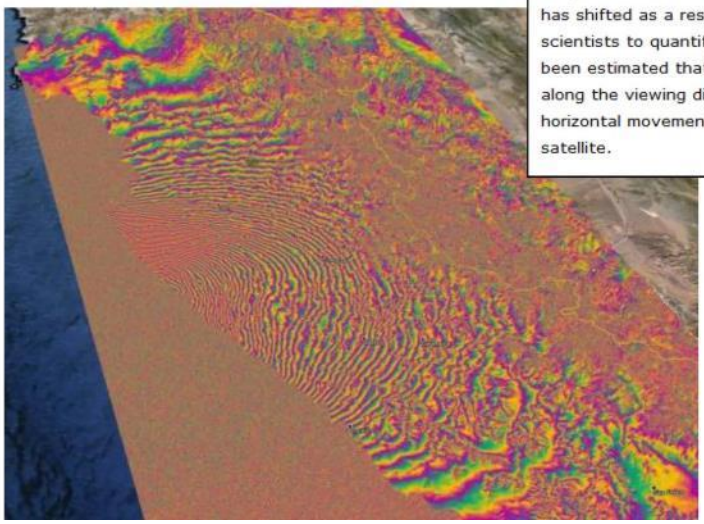


Copernicus Europe's eyes on Earth 8

European Commission

On September 16th 2015, an 8.3 magnitude earthquake struck the coast of central Chile, triggering tsunami warnings and coastal evacuations. Lasting three minutes, this powerful earthquake occurred along the boundary of the Nazca and South American tectonic plates.

By combining Sentinel-1A radar scans from August 24th to September 17th, the rainbow-coloured patterns in the image show how the surface has shifted as a result of the quake. 'Interferograms' such as these allow scientists to quantify ground movement. By counting the 'fringes', it has been estimated that the earthquake caused a displacement of 1.4 m along the viewing direction of the radar observation. In addition, a 0.5 m horizontal movement is estimated along the flight direction of the satellite.



opernicus | 9

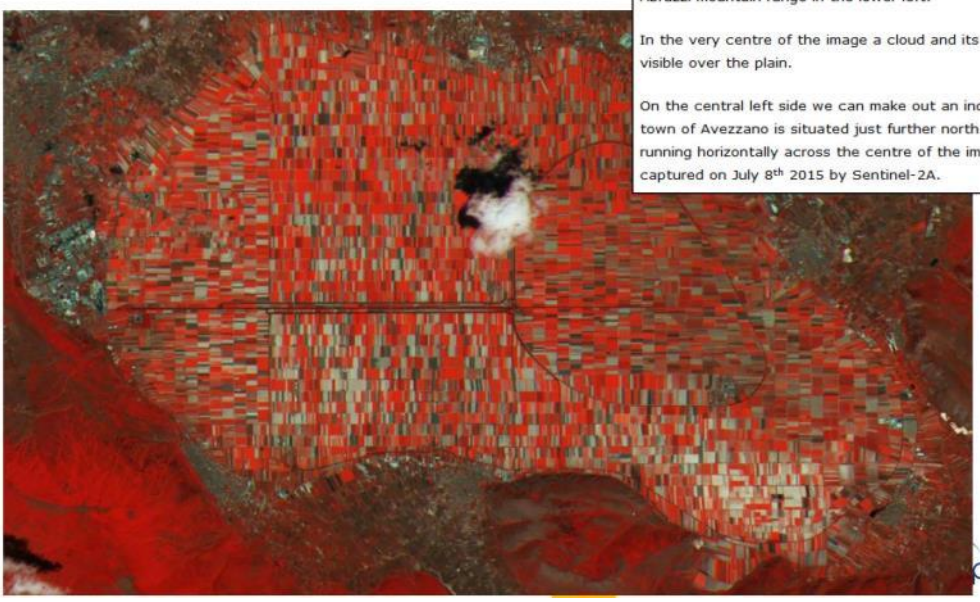
European Commission

This Sentinel-2A false colour image shows agricultural structures in the Abruzzo region of central Italy.
The varying shades of red and other colours across the entire image indicate how sensitive the satellite's multispectral camera is to differences in vegetation cover and chlorophyll content. This is used to provide key information on the vegetation health.

For this image, the brighter reds indicate more photosynthetically active vegetation, as seen in many of the fields and along the Roveto Valley Abruzzi mountain range in the lower left.

In the very centre of the image a cloud and its shadow are clearly visible over the plain.

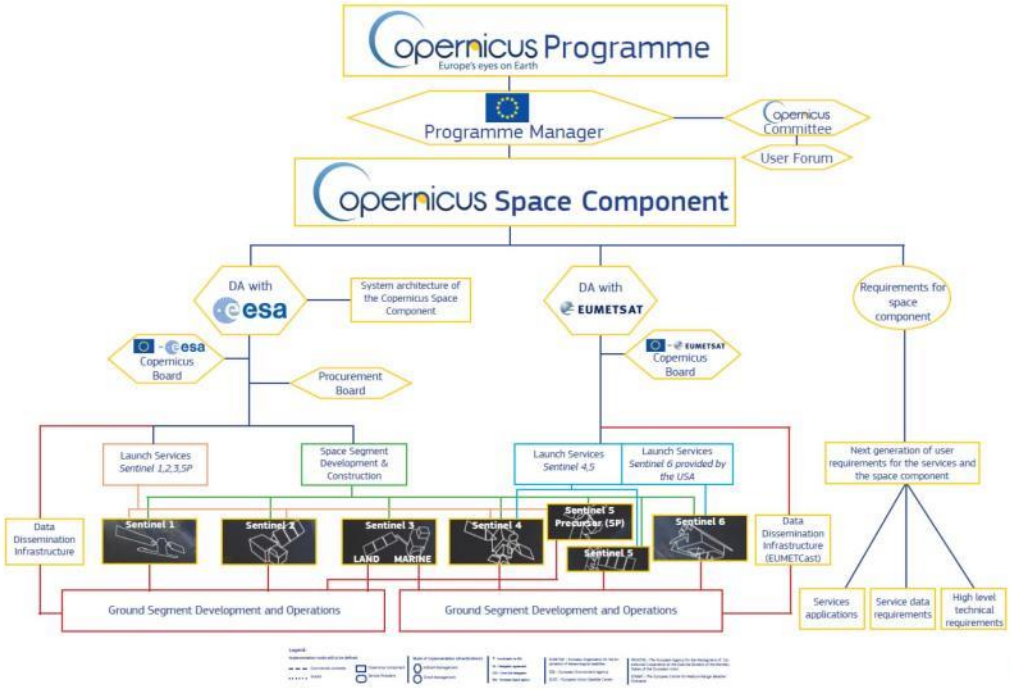
On the central left side we can make out an industrial area, whereas the town of Avezzano is situated just further north. A canal is clearly visible running horizontally across the centre of the image. This image was captured on July 8th 2015 by Sentinel-2A.



opernicus | 10

Infrastructures Governance

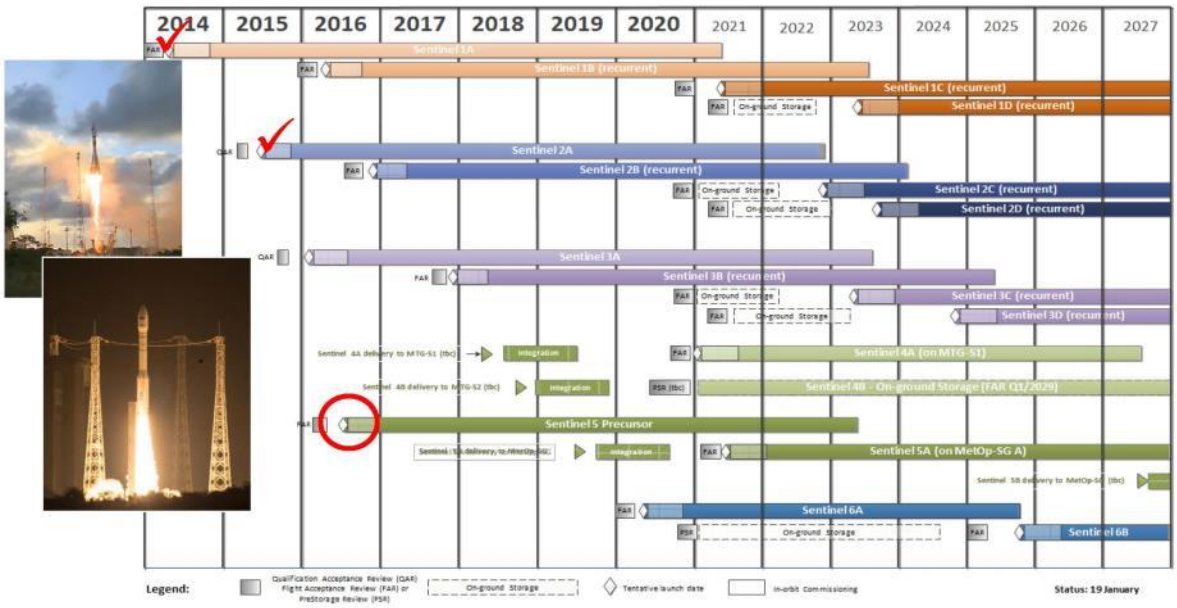
European Commission



11

Continuity of observation

European Commission



Space

Copernicus Europe's eyes on Earth

Requirements for Next-Generation Copernicus Space Component

- The Commission has overall responsibility for "collecting the user requirements for the second generation Copernicus Space Component and delivering to ESA a User Requirements Document by mid-2017" (EU-ESA Copernicus Agreement, Article 4, point i).
- To this end, the Commission has awarded a contract and commenced a user-driven study with the purpose of defining:
  - future user requirements for next generation
  - service specifications update in response to future user requirements
  - service data requirements in response to updated service specifications
  - high-level technical requirements

Space

Copernicus | 13

Timeline

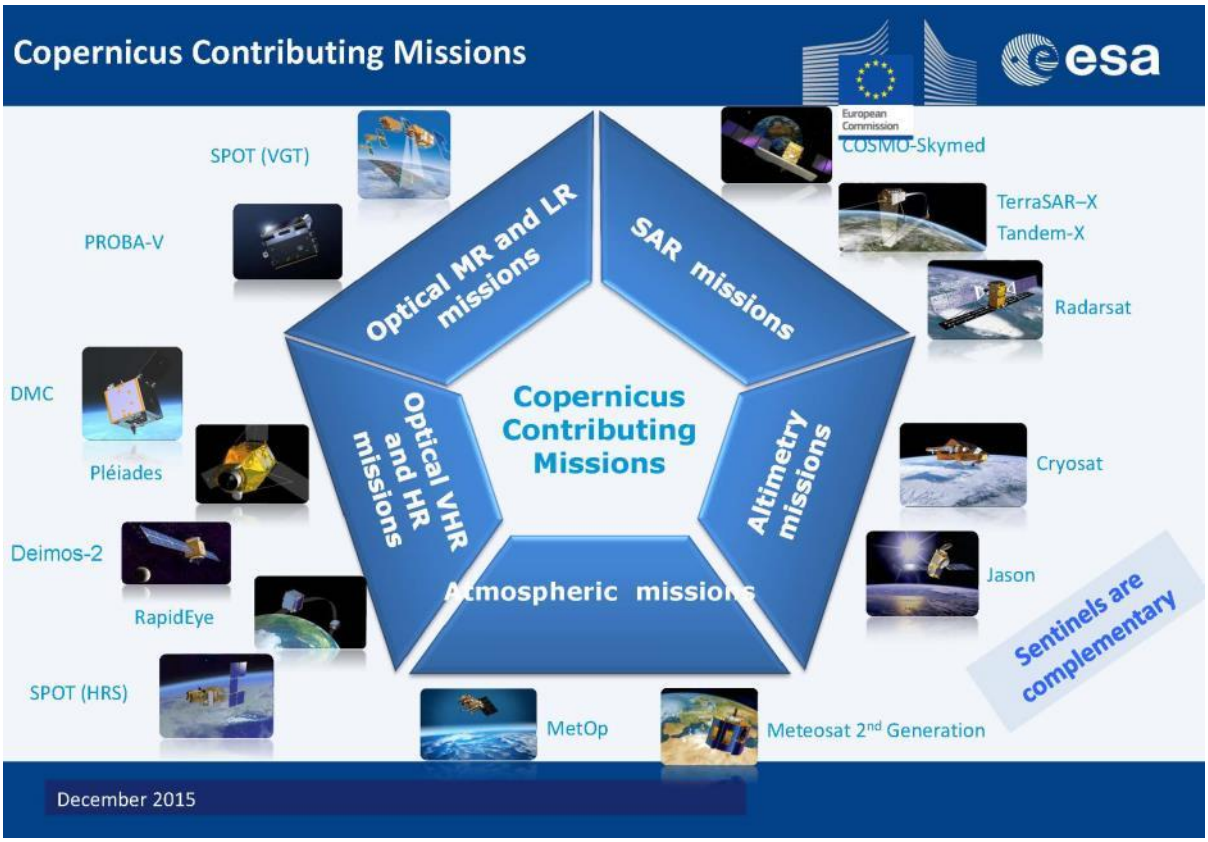
- Beg. 2017: Commission starts weighing in political/financial priorities as the user-driven study is being finalised. Beginning of consultation process with Committee, ESA, EUMETSAT and other entrusted entities.
- 1st Quarter 2017: End of the user-driven study (up to high level tech reqs)
- Mid-2017: Set of requirements delivered to ESA
- After mid-2017: Consultation process continues as ESA, with contribution by EUMETSAT, proceed to the conversion of high level reqs to specific technical reqs.
- Based on the established requirements framework, as well as taking into account the political, financial and technological constraints, ESA, with contribution by EUMETSAT for relevant areas, shall provide the MRD.

Space

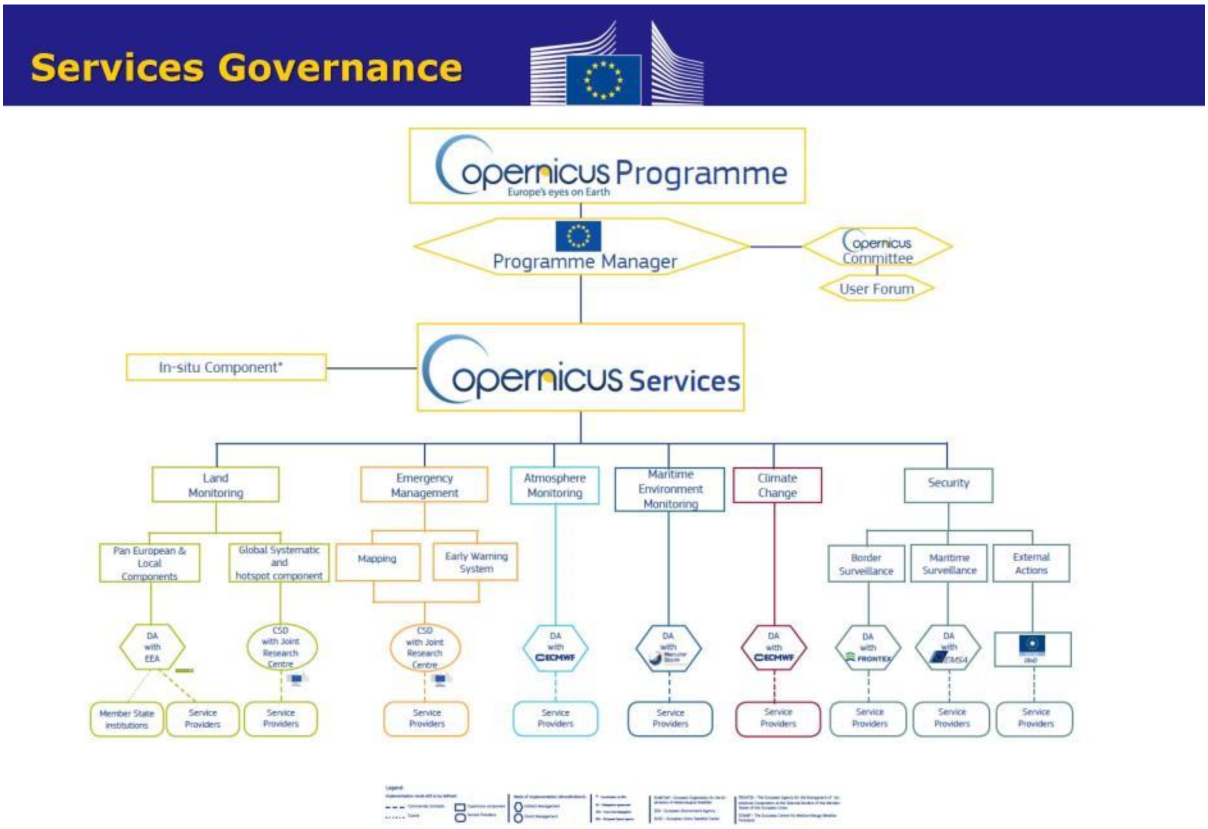
Copernicus | 14

Copernicus Call for Interest

- If you are, or are interested in becoming a user of Copernicus data or service information, we sincerely would appreciate your time and effort in completing our "call for interest" survey:
  http://www.copernicus.eu/copernicus-call-for-interest
- The results will be used to identify existing users and potential users who are willing to participate in one way or another to the collection and analysis of Copernicus user needs.




6 operational Services
Monitoring the State of the Earth System Environment ...
Copernicus Land Monitoring Service
Copernicus Marine Environment Monitoring Service
Copernicus Climate Change Service
Copernicus Atmosphere Monitoring Service
Copernicus Emergency Management Service
Mapping Component
Early Warning Component
Copernicus Security Service
... cross-cutting Thematic Services
Copernicus Europe's eyes on Earth

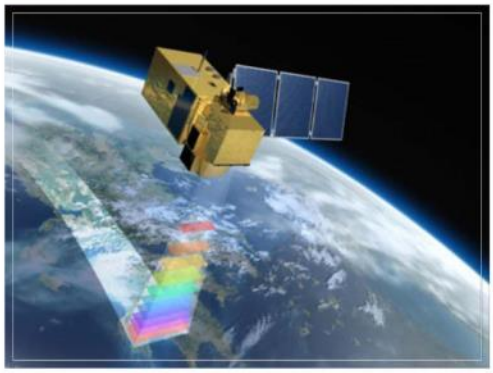

Services Governance
Copernicus Programme
Programme Manager
Copernicus Committee
User Forum
In-situ Component*
Copernicus Services
Land Monitoring
Emergency Management
Atmosphere Monitoring
Maritime Environment Monitoring
Climate Change
Security
Pan European & Local Components
Global Systematic and hotspot component
Mapping
Early Warning System
Border Surveillance
Maritime Surveillance
External Actions
Service Providers
Member State institutions

European Commission

Copernicus Data

★ Copernicus collects, processes, and archives **massive amounts of data** (approx. 8 Terabyte/day or almost 3 Petabyte/year when Sentinels-1, -2 and -3 are fully operational).

★ Dedicated **Sentinel-data** and **Copernicus information** are being made available on a **full, open and free-of-charge** basis.



Space

Copernicus | 19 Europe's eyes on Earth

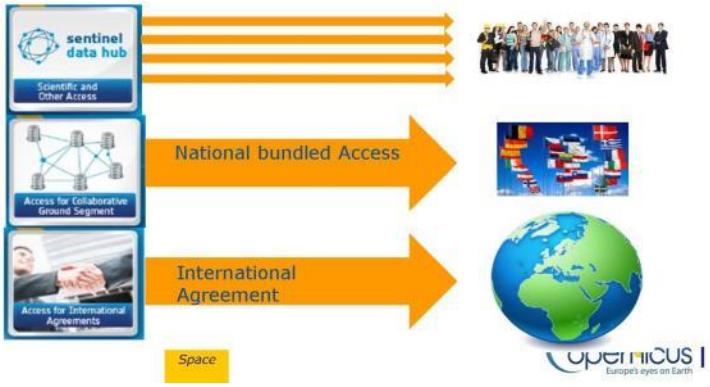
Sentinel Data Access

European Commission

esa EUMETSAT

Copernicus = Open and free access to all, with assured performance

Coupled with tailored access to Sentinel data



Space

Copernicus | Europe's eyes on Earth

Economic and Societal value added

- Copernicus constitutes a **cornerstone of the broader EU space and industrial policy**, and will generate **significant economic and social benefits.**
- **Driver** for research, innovation and the creation of highly skilled jobs, with direct and indirect **benefits for the EU economy.**

48,000 direct and indirect jobs being created over the period 2015-2030.

- The bottom-line can be summarised as follows:
  - Cost per EU citizen = ~€1,07/year;
  - Every €1 spent generates a return of ~€3,2;
  - Expected minimum financial benefits by 2030 of ~€30 bn. on Europe's GDP;
  - An estimated 50.000 jobs will be maintained or created over the next 15 years.

Space

Copernicus | 21

Summary key points and Copernicus in the Juncker priorities

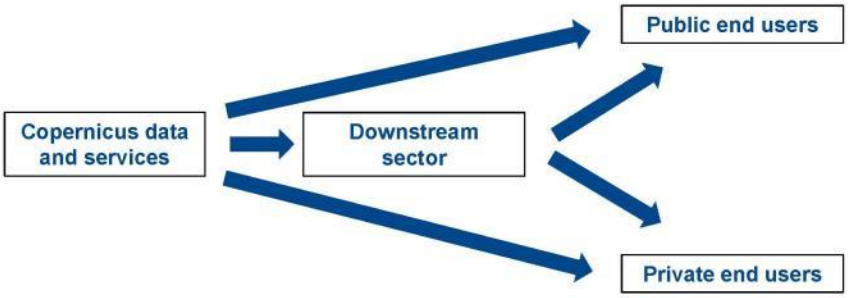
- A New Boost for Jobs, Growth and Investment;
- A Connected Digital Single Market;
- A Deeper and Fairer Internal Market with a Strengthened Industrial Base;
- Towards a New Policy on Migration;
- A Stronger Global Actor

Space

Copernicus | 22

User & Market Uptake

1. Providing users with **easy access and use of the data**
2. Fostering adoption of new business models in the **downstream sector**
3. Improving **uptake of end users** (both public and private)



Space

Copernicus | 23 Europe's eyes on Earth

Relevant for many sectors!

MAIN DOWNSTREAM INDUSTRIES END USERS BASED ON THE EARSC TAXONOMY

Space

Copernicus | 24 Europe's eyes on Earth

European Commission

Where do YOU come in?

- Provide EO Value Added Services
- Some examples/ideas:
  - Develop simple applications for single use cases
  - Applications that are browser based or on mobile devices
  - Applications that use maps as the central user interface
  - More user-friendly services
- Have a brilliant idea/business plan but need funding?
  - Apply for EU Funds
  - H2020
  - Structural funds

Space

Copernicus | 25 Europe's eyes on Earth

European Commission

2017 call topics

Earth observation

Indicative budget: **19.5 M€**
Deadline: March 2017

Space

Earth observation

27

Earth observation calls for proposals: summary

'Space' WP 2016/2017		
	2016	2017
Call for proposals	Indicative budget (M€)	Indicative budget (M€)
EO-1-2016/2017: **Downstream applications**	**9.85**	**12.0**
EO-2-2016: **Downstream services for public authorities**	**3.0**	**-**
EO-3-2016: **Evolution of Copernicus services**	**9.0**	**-**
EO-4-2017: **EO Big Data Shift**	-	**7.5**
Sub-total EO-2016/2017	21.85	19.5
COMPET-2-2017: **Competitiveness in Earth observation mission technologies**		**7.0**
Total EO related 'Space' (2016/2017)	**21.85**	**26.5**

Related Earth Observation activities

28

Societal Challenge 2

Blue Growth – demonstrating an ocean of opportunities (H2020-BG-2016-2017):

- BG-9-2016: An integrated Arctic observing system
- BG-12-2016: Towards an integrated Mediterranean Sea Observing System

Sustainable Food Security – resilient agri-food chains (H2020-SFS-2016-2017):

- SFS-43-2017: Earth Observation services for the monitoring of agricultural production in Africa

Societal Challenge 5

Climate Action, Environment, Resource Efficiency and Raw Materials – Earth Observation (H2020-SC5-2016-2017):

- SC5-18-2017 - Novel in-situ observation systems
- SC5-19-2017 - Coordination of citizens' observatories initiatives
- SC5-20-2016 - European data hub of the GEOSS information system

Competitiveness of the European Space Sector: Technology and Science (H2020-COMPET-2017):

- COMPET-2-2017: Competitiveness in Earth observation mission technologies

SME Instrument (H2020-SMEInst-2016-2017), although not dedicated uniquely to Earth Observation, is particularly well suited for SMEs addressing space based applications

- SMEInst-04-2016-2017: Engaging SMEs in space research and development
- SMEInst-12-2016-2017: Boosting the potential of small businesses in the areas and priorities of Societal Challenge 5

Related Earth Observation activities

29

'SC2' + 'SC5' WP 2016/2017	
	2016/2017
Societal Challenge 2: Blue Growth – demonstrating an ocean of opportunities (H2020-BG-2016-2017)	Indicative budget (M€)
BG-9-2016: **An integrated Arctic observing system (RIA)**	**15.0**
BG-12-2016: **Towards an integrated Mediterranean Sea Observing System (RIA)**	**8.0**
Societal Challenge 2: Sustainable Food Security – resilient agri-food chains (H2020-SFS-2016-2017)	Indicative budget (M€)
SFS-43-2017: **Earth Observation services for the monitoring of agricultural production in Africa (RIA)**	**10.0**
Societal Challenge 5: Earth Observation (H2020-SC5-2016-2017)	Indicative budget (M€)
SC5-18-2017 - **Novel in-situ observation systems (RIA)**	**15.0**
SC5-19-2017 - **Coordination of citizens' observatories initiatives (CSA)**	**4.6***
SC5-20-2016 - **European data hub of the GEOSS information system (RIA)**	**10.0**
Total EO related in SC2 and SC5 (2016/2017)	**58.0**

* *This amount corresponds to three topics, among which SC5-19-2017 (not included in the total).*

Space

30

Are there opportunities to participate in the operational provision of Copernicus services until 2020?

Horizon 2020 is not funding activities which are providing operational Copernicus services.

You may find ways to contribute to the operational service provision by answering to invitations to tender of the Copernicus services

These are pre-announced on EU TED portal (http://ted.europa.eu/TED)

See www.copernicus.eu – Link to Tenders and Grants

Space


European Commission
Thank you
Copernicus
Europe's eyes on Earth
Follow us on:
Copernicus EU
CopernicusEU
www.copernicus.eu
Space
32
European Commission


SME Instrument and Fast Track to Innovation
THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

Space

SME Instrument

33

European Commission

SME Instrument phases

Space

SME Instrument

34

European Commission

SME Instrument evaluation process

- Remote evaluation
- At least 4 **evaluators** per proposal => Balancing knowledge of industry/technology ,market, finance
- Not more than one evaluator from the applicant's country
- Applicant can exclude 3 evaluators
- **Short Time to evaluate** :
  - **Ph 1**: Time to evaluate 2 months+1 month time to grant= **3 months**
  - **Ph 2**: Time to evaluate 4 months+2 month time to grant= **6 months**
- No consensus meeting
- Standardised but detailed feedback
- Median rating

Space

SME Instrument

35

Evaluation process

- Remote evaluation
- At least 4 **evaluators** per proposal => Balancing knowledge of industry/technology, market, finance
- Not more than one evaluator from the applicant's country
- Applicant can exclude 3 evaluators
- **Short Time to evaluate**:
  - ✓ **Phase 1**: Time to evaluate 2 months+1 month time to grant= **3 months**
  - ✓ **Phase 2**: Time to evaluate 4 months+2 month time to grant= **6 months**
- No consensus meeting
- Standardised but detailed feedback
- Median rating

Evaluation criteria

3 criteria:

- ✓ Possible economic impact
- ✓ Excellence in innovation
- ✓ Implementation

Space

SME Instrument

Phase 1 - Concept & Feasibility Assessment

- **€50.000 in EU funding**
- **Feasibility study**
- **Initial 10 page business proposal to be drafted**
- **6 months in duration**

Space

SME Instrument

European Commission

Phase 2 – Innovation Project

- Between €0.5M & €2.5M of EU funding
- Develop project through innovation strategy
- Draft a more developed 30 pages business plan
- 1-2 years in duration

Space

SME Instrument

European Commission

Phase 3 – «Commercialisation»

- No stand-alone phase!
- No direct funding
- Business coaching
- Facilitate access to risk finance
- Additional support & networking opportunities
- SMEs "Business Club"

Space

SME Instrument

39

European Commission

First lessons learnt

Unsuccessful proposals were

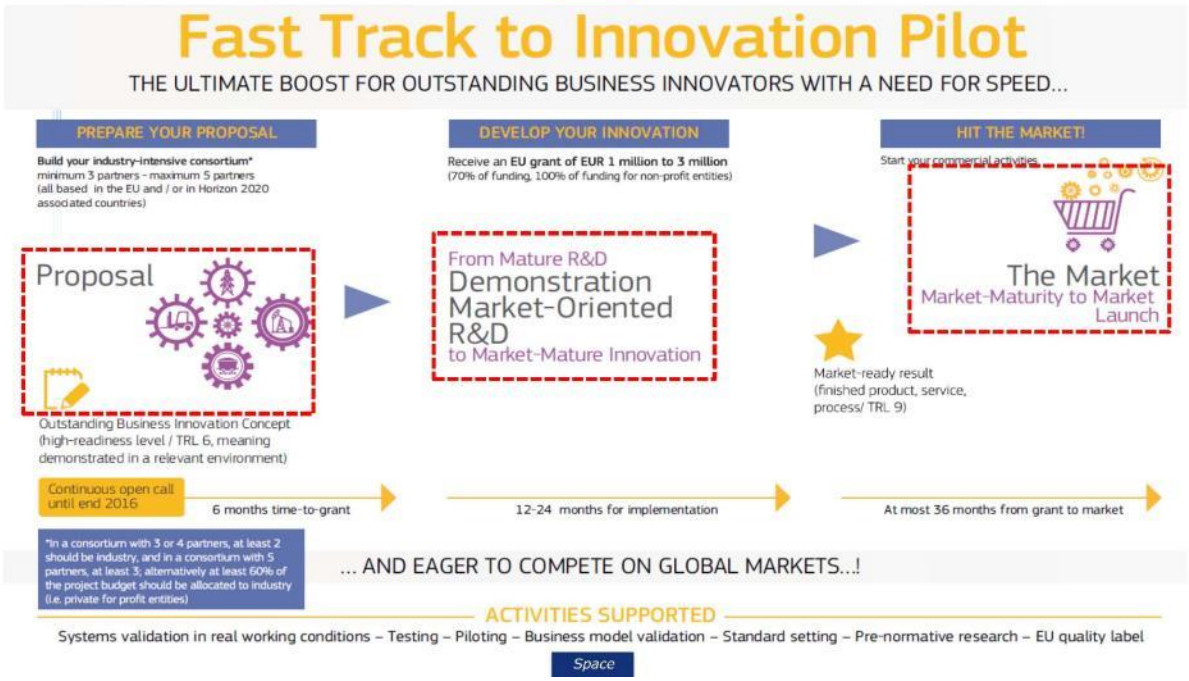
- Too much focused on the project, not on the market opportunity
- Without convicing description of the company
- Without enough information on competing solutions
- Not innovative enough
- Without commercialisation concept (TRL too low)
- Just trying ones' luck

Space

Fast Track to Innovation

40

European Commission



Space

Fast Track to Innovation

41

FTI key features

- Follows bottom-up logic (within SC and LEITs)
- One common call, permanently open, 3 cut-offs per year
- Time-to-grant 6 months
- Budget: 200 M€ for 2015/2016 (100 + 100) — ca. 100 projects with average EU contribution of 2 M€
- Funds innovation actions (70%), grant up to 3 M€
- Allows consortia of min. 3, max. 5 members — mandatory industry involvement
- Proposals shall include a business plan (market development strategy)
- Impact criterion has higher weighting in evaluations
- Future of pilot (beyond 2016) only decided after full evaluation

Space

Fast Track to Innovation

42

FTI Pilot – Industry Involvement

- Industry-intensive consortia from EU or Associated Countries meaning:
- Either 2 out of 3-4 partners are "industry" (= private for profit)
- Or 3 out of 5 partners are private for profit
- Or 60% of the budget (= total estimated eligible costs) is to be allocated to consortium partner(s) from industry
- Subcontractors allowed but the core must be in the partners
- SMEs and first-time industry applicants particularly welcome

Why participate?

- Proof of your market potential
- Funding 70% (100% for not-for-profit entities)
- Enjoy higher visibility at EU level (communication about projects, by European Commission)

Space

Fast Track to Innovation

43

FTI Pilot – Timeline

Cut-off dates 2015	29/4/2015	1/9/2015	1/12/2015
Cut-off-dates 2016	TBD	TBD	TBD

April 29, 2015 - First intermediary call deadline
End of August, 2015 → First results from evaluation sent to applicants

September 1, 2015
Second intermediary call deadline
End of October 2015 → First Grants signed

December 1, 2015 Third intermediary call deadline & results of September call known

Space

Fast Track to Innovation

44

FTI Pilot – Useful Information

- Participant Portal:
  http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/9096-ftipilot-1-2015.html
- Work Programme:
  http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-fast-track_en.pdf
- Beneficiaries
  https://ec.europa.eu/easme/sites/easme-site/files/FTI-projects-2015_participants%20websites_corrected.pdf

Space

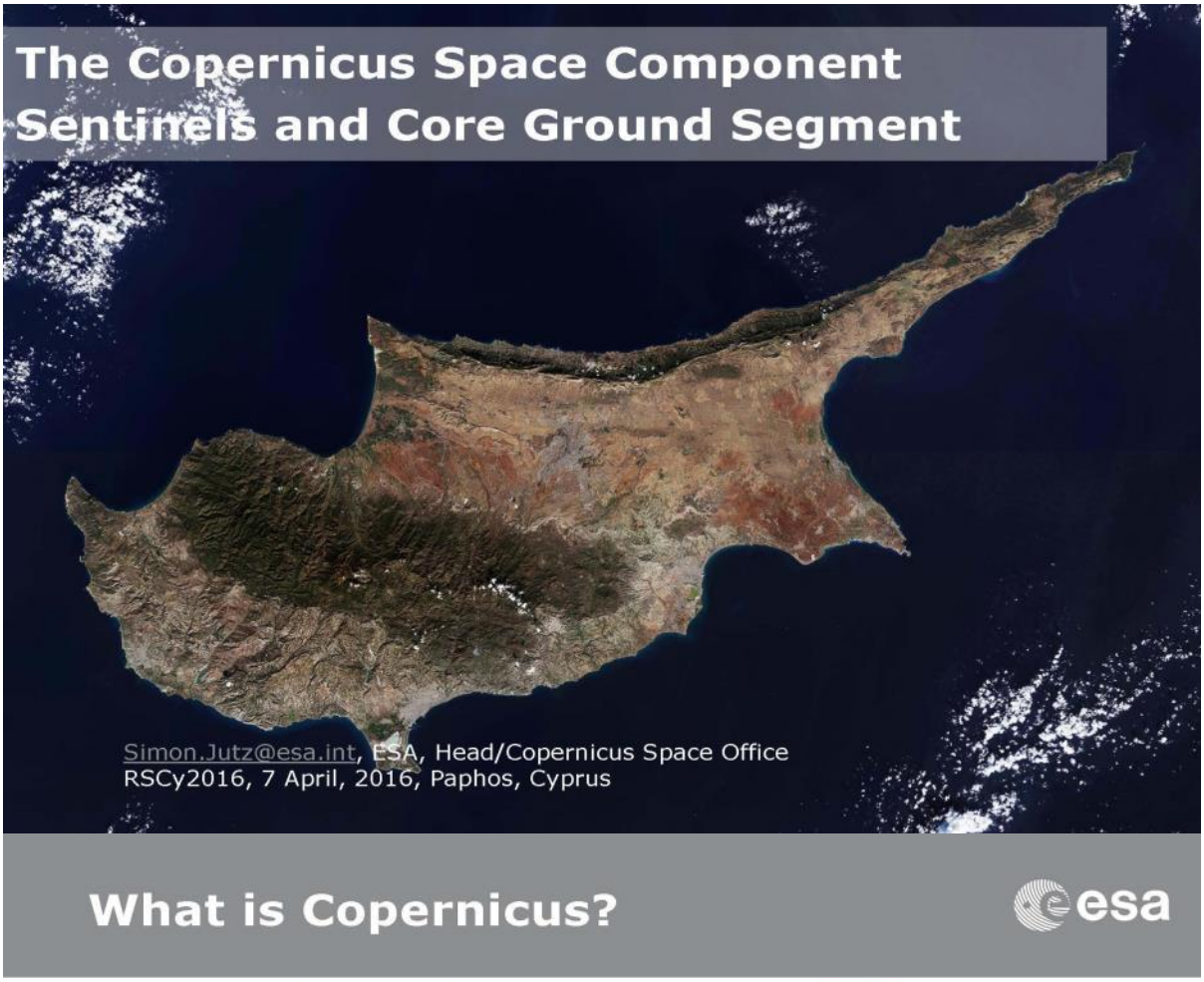
SME Instrument and Fast Track to Innovation

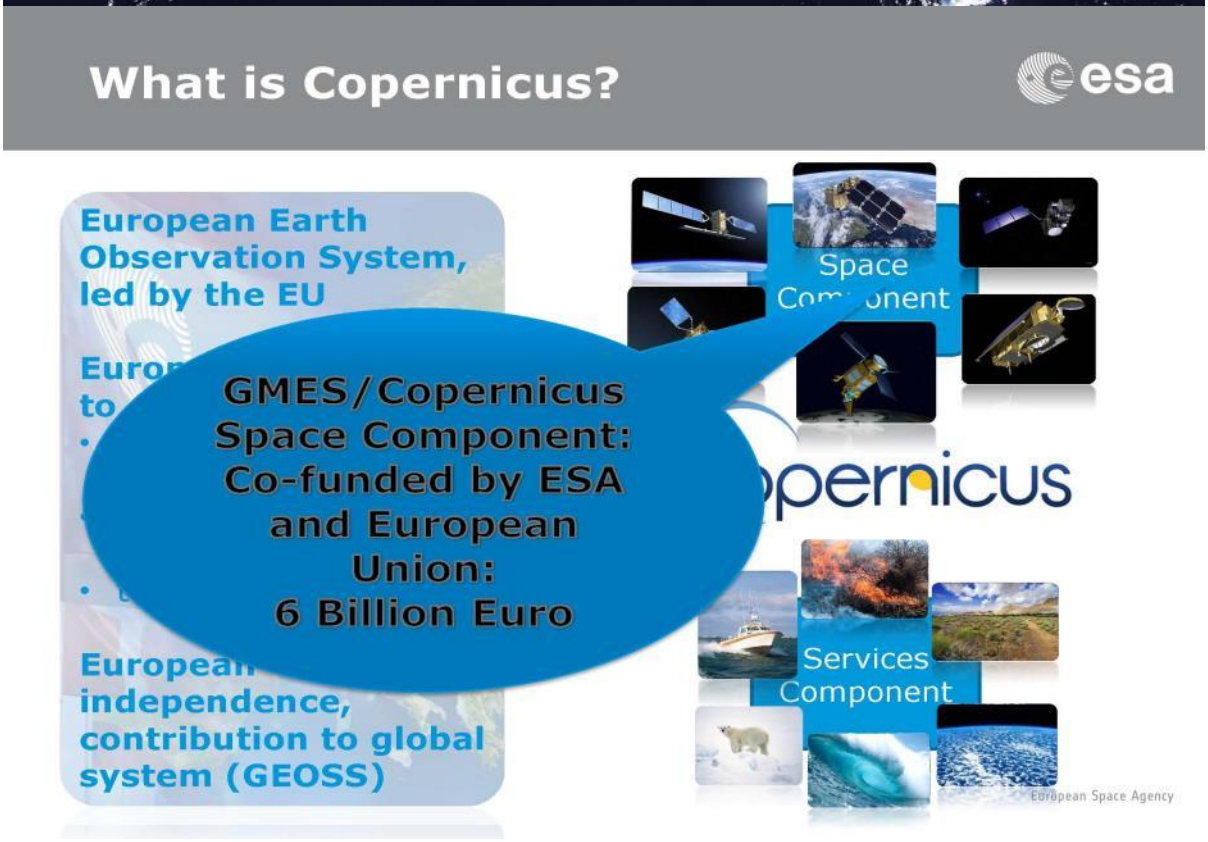
SME Instrument and Fast Track to Innovation: summary

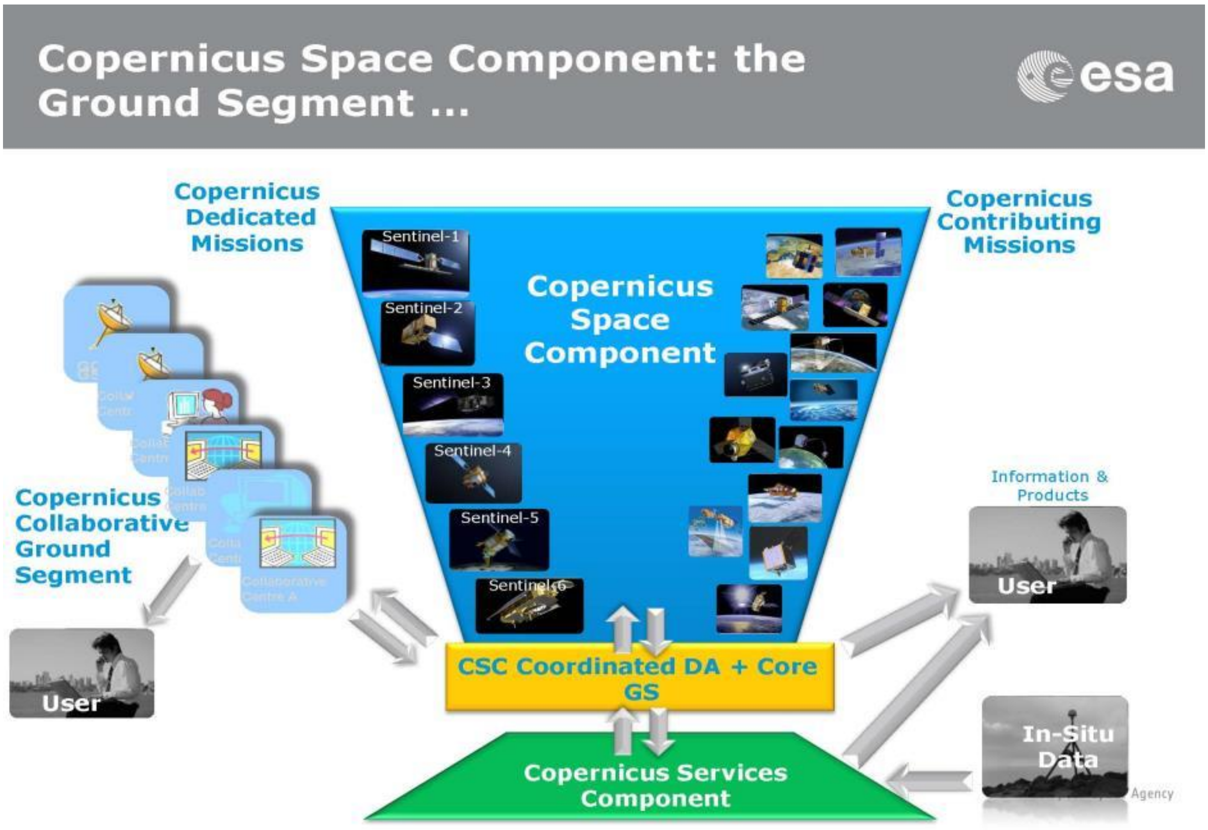
WP 2016/2017		
	2016	**2017**
Call for proposals	Indicative budget (€ million)	Indicative budget (€ million)
SMEInst-04-2016-2017: **Engaging SMEs in space research and development**	**11.37**	**12.60**
Fast Track to Innovation	**3.40**	-

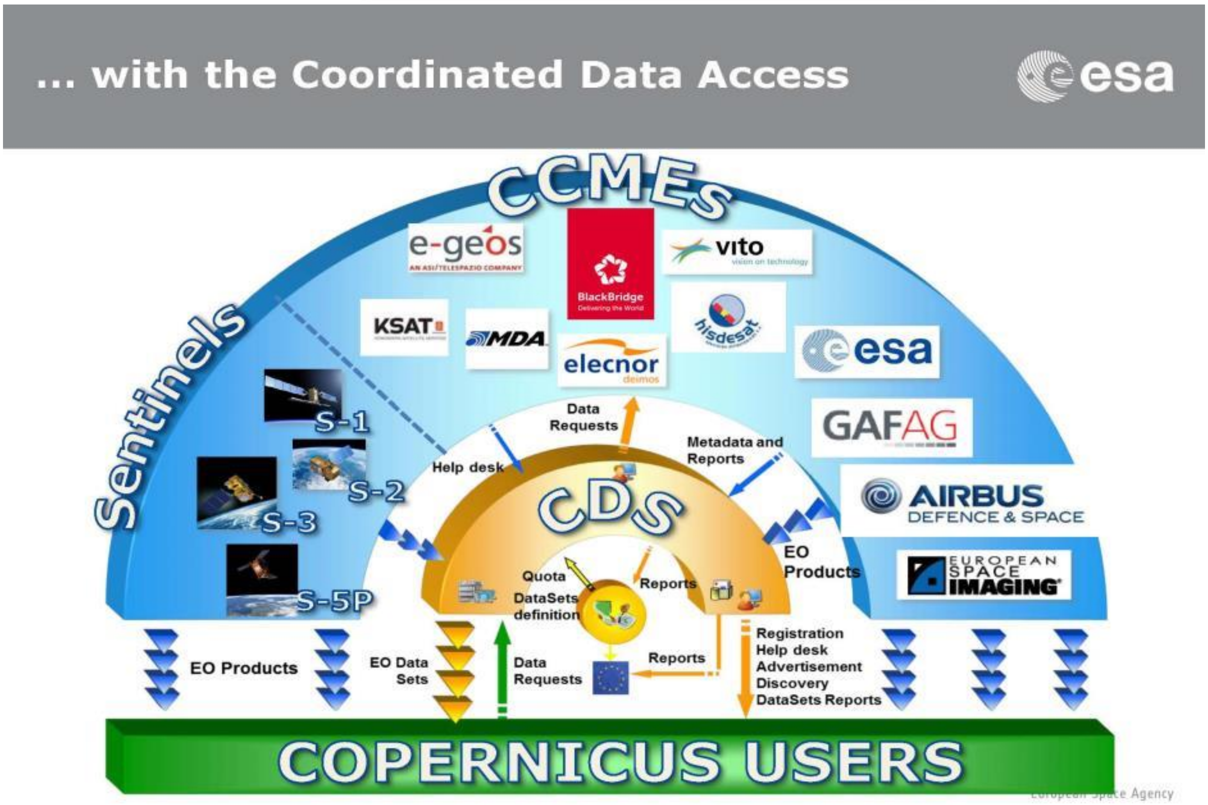
Space

3 The Copernicus Space Component Sentinels and Core Ground Segment - Simon Jutz, ESA






Copernicus Space Component: the Ground Segment ...
esa
Copernicus Dedicated Missions
Copernicus Contributing Missions
Copernicus Space Component
Sentinel-1
Sentinel-2
Sentinel-3
Sentinel-4
Sentinel-5
Sentinel-6
Copernicus Collaborative Ground Segment
Information & Products
User
User
CSC Coordinated DA + Core GS
Copernicus Services Component
In-Situ Data


... with the Coordinated Data Access
esa
CCMEs
Sentinels
e-geos
BlackBridge
vito
KSAT
MDA
elecnor deimos
hisdesat
esa
GAFAG
AIRBUS DEFENCE & SPACE
EUROPEAN SPACE IMAGING
S-1
S-2
S-3
S-5P
CDS
Help desk
Data Requests
Metadata and Reports
EO Products
Quota
DataSets definition
Reports
EO Products
EO Data Sets
Data Requests
Reports
Registration
Help desk
Advertisement
Discovery
DataSets Reports
COPERNICUS USERS

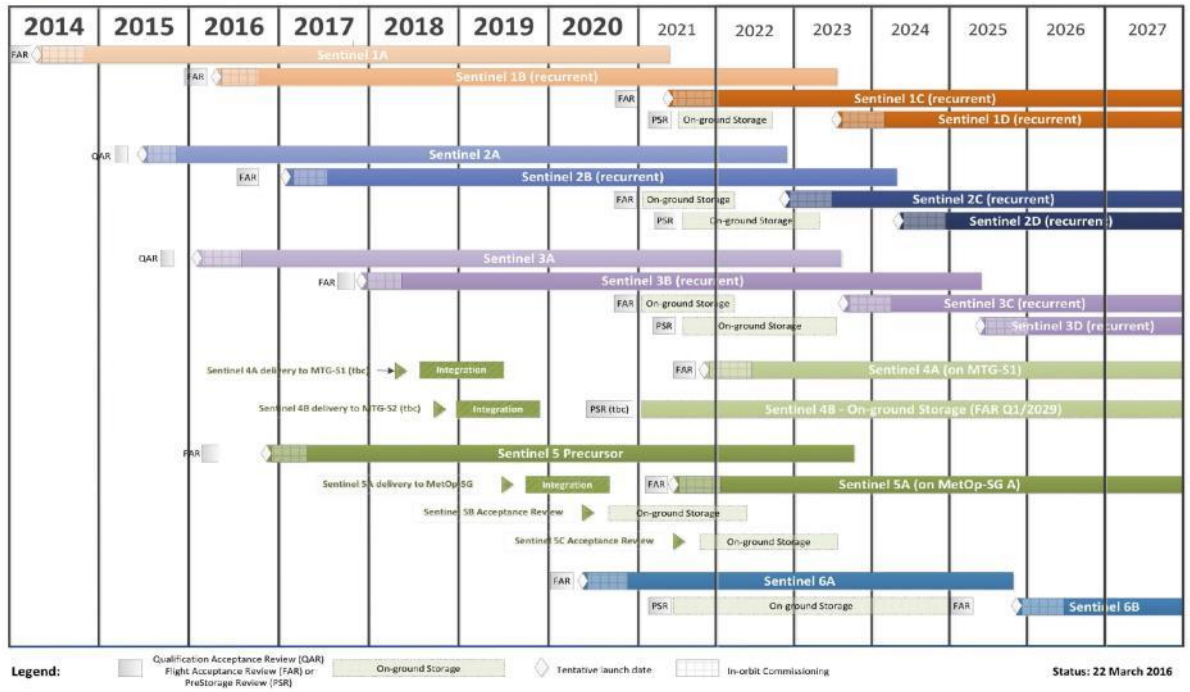
Copernicus Space Component: the Space Segment with the dedicated Sentinels …

- **S1A/B:** Radar Mission — 3 Apr 2014/22 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

European Space Agency

… with a long-term operational perspective

Copernicus Constellation Deployment Schedule




Sentinel–1 mission
esa
Sentinel-1A launched on April 3, 2014
Constellation of 2 satellites in the same orbit, embarking a C-band SAR
6 days repeat cycle at Equator (with 2 satellites) with daily coverage of high priority areas, e.g. Europe, Canada, shipping routes
Applications include: Marine, Ice and Land Monitoring, Maritime surveillance, Terrain stability monitoring, Emergency mapping for humanitarian aid during crises
Link to Sentinel-1 Web pages
http://www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/Sentinel-1
European Space Agency


Athens, Sentinel-1A, 22-Apr-2014
esa

Sentinel–2 Mission

Link to Sentinel-2 Web Pages
http://www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/Sentinel-2

European Space Agency

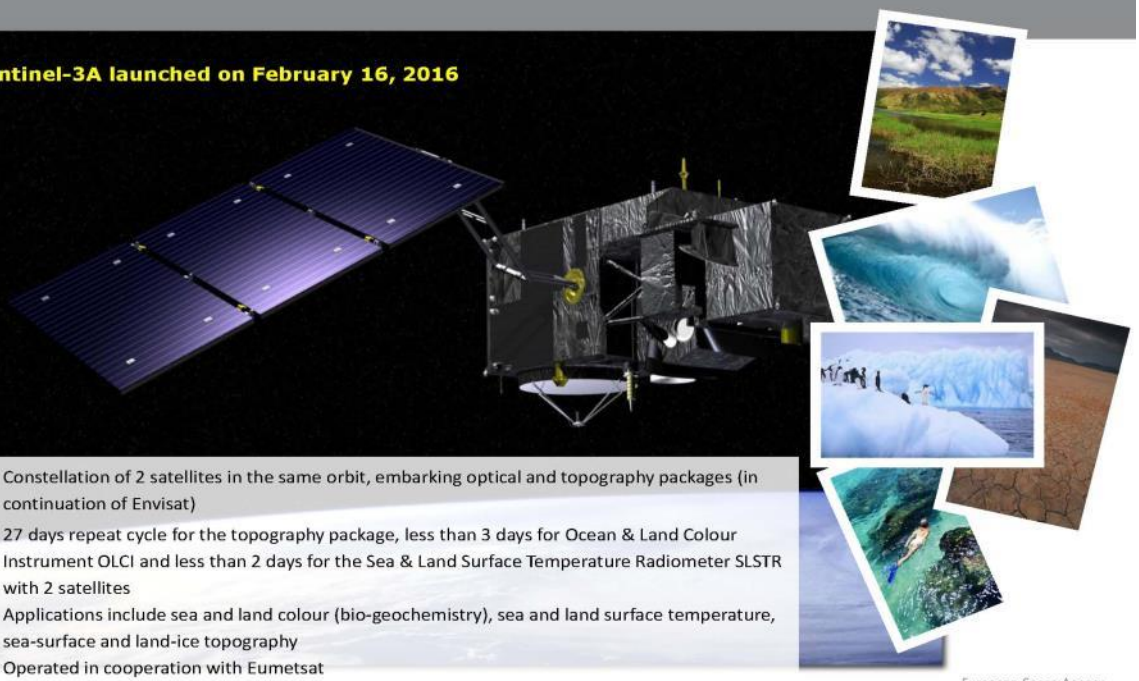
Paphos, Sentinel-2A, 22-Dec-2015

European Space Agency

Sentinel–3 Mission

esa

Sentinel-3A launched on February 16, 2016



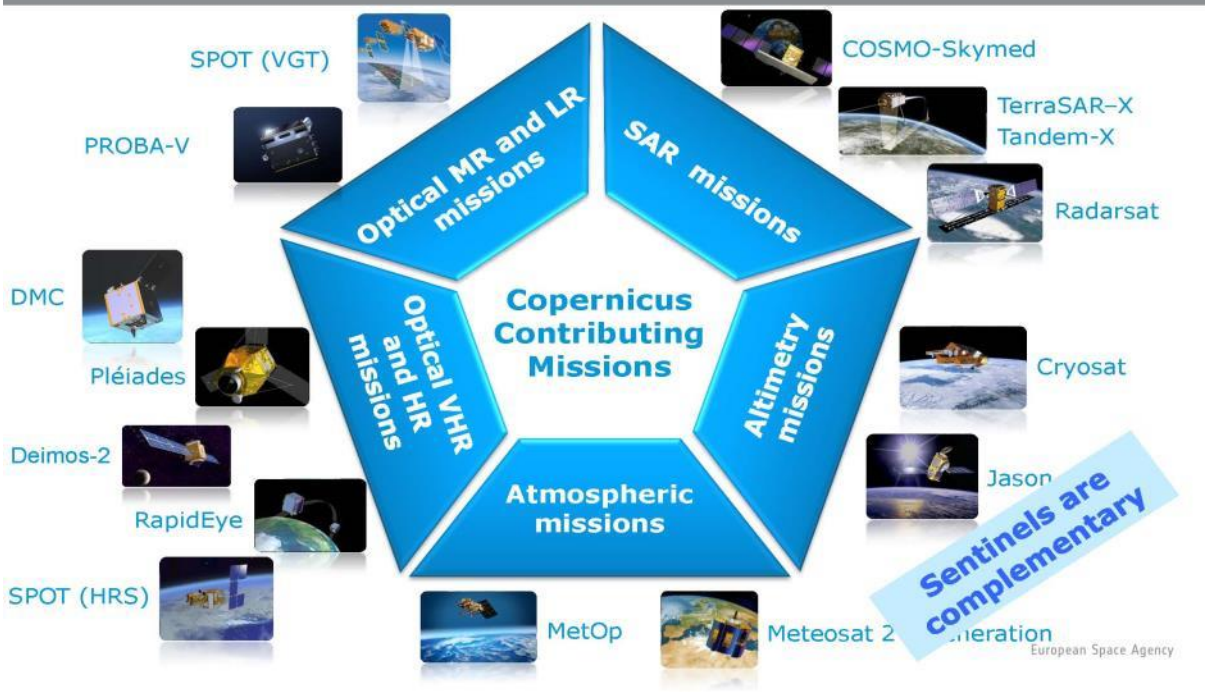
- Constellation of 2 satellites in the same orbit, embarking optical and topography packages (in continuation of Envisat)
- 27 days repeat cycle for the topography package, less than 3 days for Ocean & Land Colour Instrument OLCI and less than 2 days for the Sea & Land Surface Temperature Radiometer SLSTR with 2 satellites
- Applications include sea and land colour (bio-geochemistry), sea and land surface temperature, sea-surface and land-ice topography
- Operated in cooperation with Eumetsat

European Space Agency

Sentinel-3A: First Images from OLCI, 01-Mar-2016

esa

Copernicus Contributing Missions



Exhaustive list of Copernicus Contributing Missions

Mission Group 1 - SAR VHR1-MR1	Mission Group 2b - Optical VHR1/2	Mission Group 2 - Optical HR1/2	Mission Group 3 - Optical MR1/2	Mission Group 4/5 - Atmospheric missions
ALOS/PALSAR	*AURIGA*	ALOS/AVNIR-2*	CryoSat*	ERS*
COSMO-SkyMed	*BLACKSKY Constellation*	DEIMOS-1	ERS*	Envisat*
ERS*	DEIMOS-2	*INGENIO*	Envisat*	GOSAT*
Envisat*	Dubaisat-2	Landsat-5/Landsat-8	Proba-V	ODIN*
Kompsat-5	*GeoEye-1*	*PERSEUS*	ResourceSat-1/ ResourceSat-2	
PAZ	*INGENIO*	Proba		
RADARSAT-2	IRS-P5/CartoSat	RapidEye Constellation		
RISAT	Ikonos	ResourceSat-1/ ResourceSat-2		
TerraSAR-X, TanDEM-X	*KHALIFASAT*	SPOT-4, SPOT-5, SPOT-6/7		
	Kompsat-2	TH constellation		
	Kompsat-3	UK-DMC2		
	Pleiades-1A/1B			
	QuickBird-2			
	SPOT-5, SPOT-6/7			
	SkySat			
	TH constellation			
	WorldView-1/ WorldView-2			
	WorldView-3			
	WorldView-4			

*Supplied by ESA

Italic bold: Availability date depending on launch or integration with CSCDA

Core and Collaborative Ground Segment

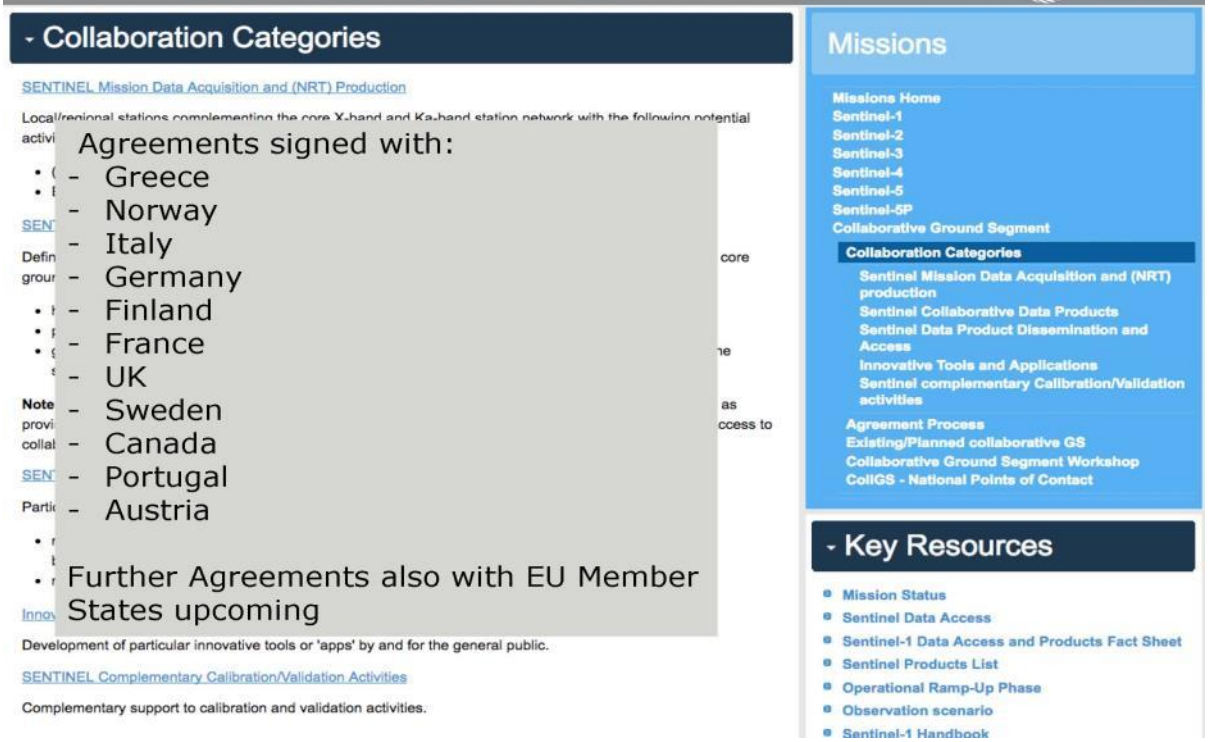
The Copernicus Space Component (CSC) Operations Concept relies on a Ground Segment consisting of:

- **A CSC (Core) Ground Segment**, with CSC-funded Functions and Elements, providing :
  - the primary access to **Sentinel** Missions data as well as
  - the coordinating access functions to **Contributing Missions** data
  - fulfilling the Sentinels Mission Requirement Documents

- **a Sentinel Collaborative Ground Segment**, with non CSC-funded Functions and Elements, providing:
  - a supplementary access to **Sentinel** Missions data, i.e. either through specific data acquisition services, or specific data products
  - the frame for cooperation

European Space Agency

sentinel.esa.int/web/sentinel/missions/collaborative/categories



Sentinels Operations Strategy

Main objectives of the Sentinels operations strategy:

- Reliable provision of data to Copernicus users
- Ensure systematic and routine operational activities

Sentinels operations approach:

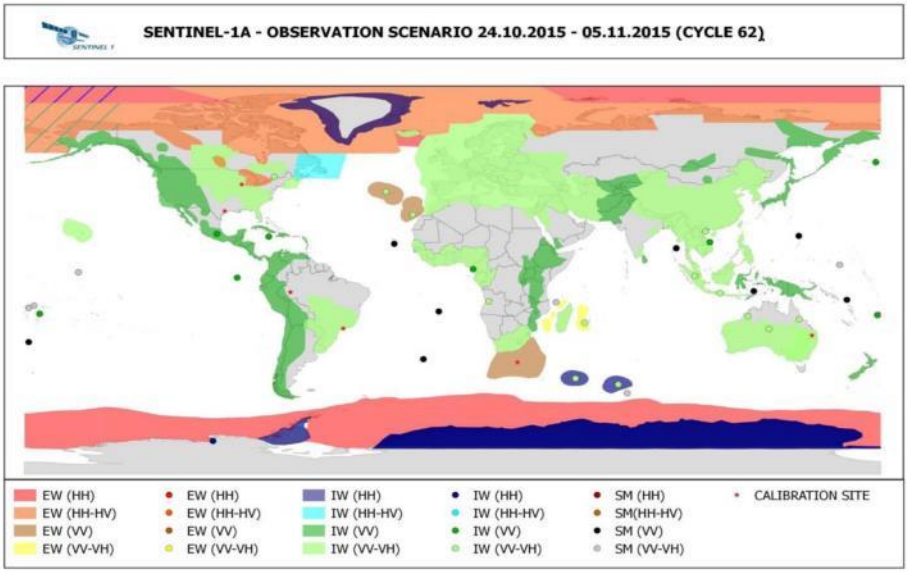
- Sentinels are operated via a **pre-defined background** observation and downlink plan
  - Scenario is updated on a regular basis (e.g. 6 to 12 months) taking into account evolution of user needs

- All Sentinels acquired data is **systematically downlinked and processed** to generate a predefined list of **core products** within specific timeliness
  - Typically within 3 hrs after sensing for Near-Real Time, and within 24hrs after sensing for Non-Time Critical

European Space Agency

Sentinel-1 Observation Scenario - Example

Observation plan is published in Sentinel On-line portal in advance wrt execution



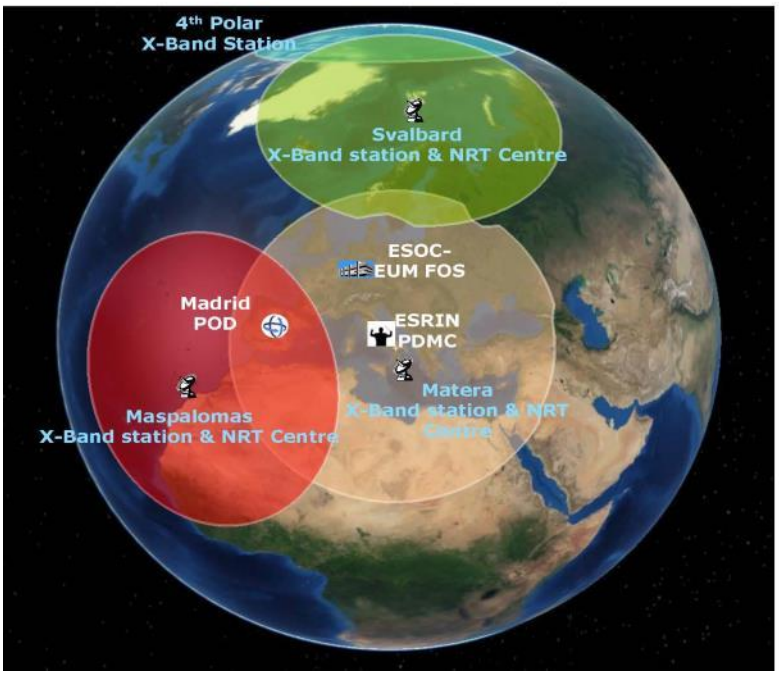
ropean Space Agency

Sentinel-2 Observation Scenario - Overview

- The Sentinel-2 **baseline observation scenario in routine phase will systematically cover all land surfaces** between 56° South latitude (Cape Horn in South America) and 84° North latitude (north of Greenland), including also
  - **Major islands** (greater than 100 km2 size), EU islands and all the other small islands located at less than **20 km from the coast**line
  - The **whole Mediterranean Sea** as well as all inland water bodies and closed seas

European Space Agency

CSC Ground Segment Layout



- **Fight Operations Segment (FOS)**
- **X-Band Stations & Near Real Time Processing Centre (CGS)**
- **Payload Data Management Centre (PDMC)**
- **Precise Orbit Determination Service (POD)**
- **Ka-band User Ground Stations (part of EDRS Service)**

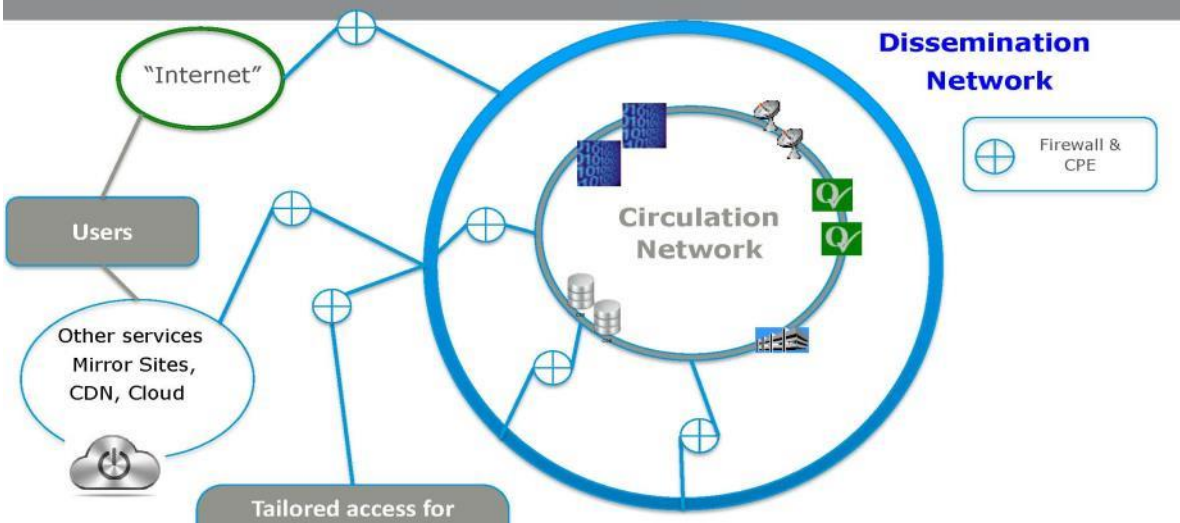
European Space Agency

CSC Ground Segment Layout

Archive and Offline Processing Centre Mission Performance Centre (MC)

European Space Agency

Ground Circulation and Dissemination Network



Network Infrastructure highly scalable (10 Gbps)

Centralised data pick-up point

European Space Agency

Copernicus Data Policy

Sentinel Data Policy =
FULL, FREE, OPEN access

- **ESA Sentinel Data Policy** (Sep 2013) and **EU Delegated Act** on Copernicus Data and Information Policy (Dec 2013)
- Main principles of Sentinel data policy:
  - **Open** access to Sentinel data by anybody and for any use
  - **Free** of charge data licenses
  - Restrictions possible due to technical limitations or for security reasons

European Space Agency

Copernicus Data Access

sentinels.copernicus.eu

European Space Agency

PRAGUE 09-13 MAY 2016

esa

living planet symposium | PRAGUE 09-13 May 2016

Main Objective:
Presentation of Exploitation Results based on ESA Earth Observation Measurements

Important Dates:

Deadline for abstract submission	16 October 2015
Notification of Acceptances	End January 2016
Issue of Preliminary Programme	February 2016
Opening of Registration to the Symposium	February 2016
Release of the Final Programme	at the symposium
Submission of Full Papers	at the symposium

Themes:
Atmosphere, Oceanography, Cryosphere, Land, Hazards, Climate and Meteorology, Solid Earth/Geodesy, Near-Earth Environment, Methodologies and Products, Open Science 2.0

http://lps16.esa.int

esa

Thanks for your attention!

ESA Copernicus website
http://www.esa.int/copernicus

EC Copernicus website
http://copernicus.eu

European Space Agency

4 A Copernicus Ground Segment - Example of DLR Core and collaboration ground segment - Gunter Schreier, DLR

A Copernicus Ground Segment –

Example of DLR

Core and collaborative ground segment

Earth Observation Center

DLR

German Aerospace Center

- Research Institution
- Space Agency
- Project Management Agency

- Aeronautics
- Space Research and Technology
- Transport
- Energy
- Defence and Security

DLR

Earth Observation Center

Locations and employees

8000 employees across
32 institutes and facilities at 16 sites

Offices in Brussels, Paris,
Tokyo and Washington.

DLR Executive Board


Pascale Ehrenfreund - Chair


Klaus Hamacher - Vice Chairman
Administrative and technical management


Gerd Gruppe – Space Administration


Hansjörg Dittus – Space Research and Technology


Rolf Henke – Aeronautics Research

DLR

Earth Observation Center

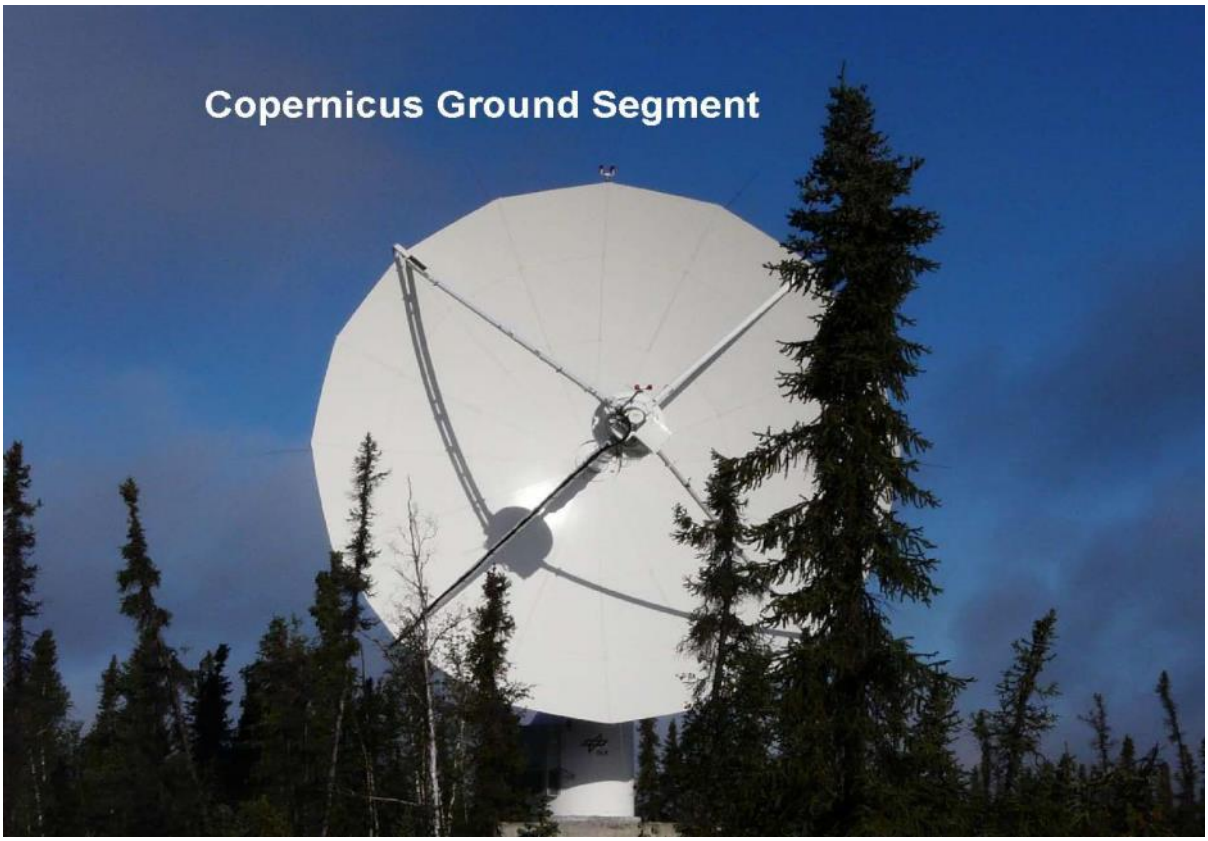
DLR Space Research and Technology

- Space exploration
- Zero gravity research
- **Earth observation**
- Communication and navigation
- Space transport
- Technology of space systems

DLR

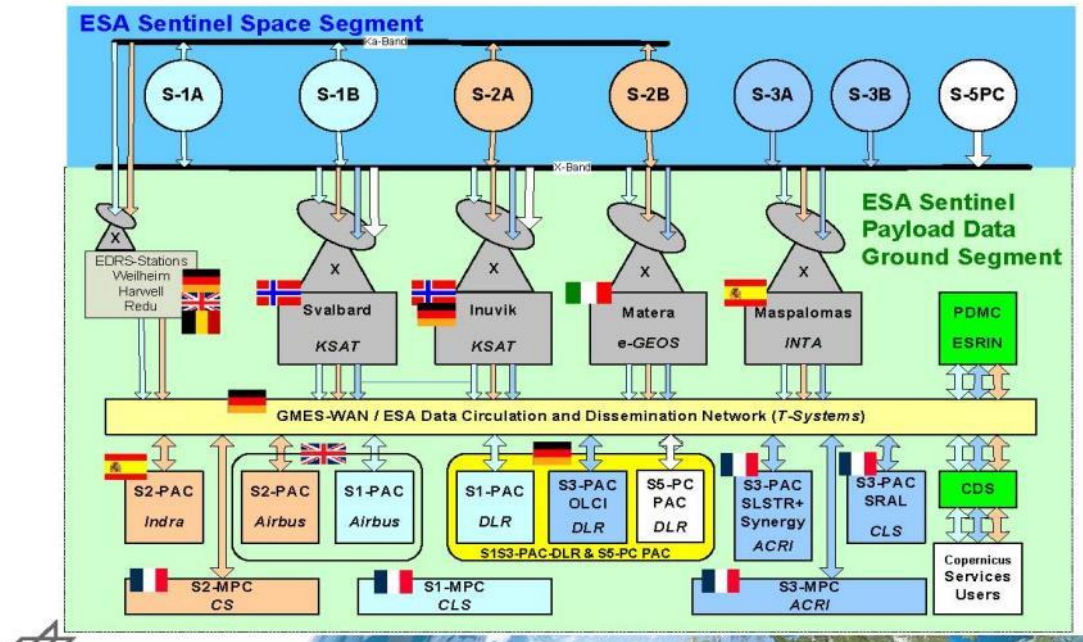
- 2.000 employees - 245.000 qm terrain - Connected to airport

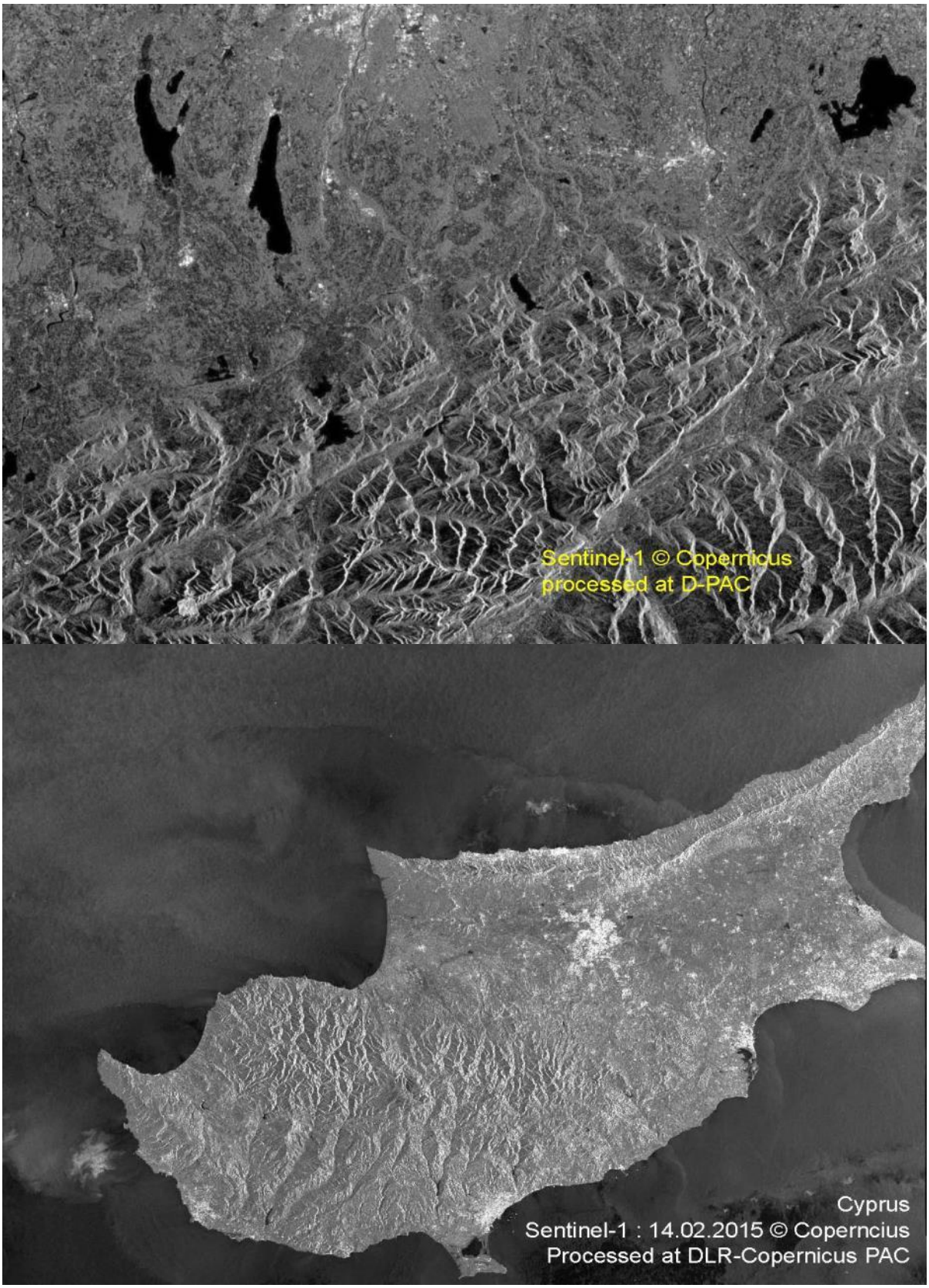
DLR



Earth Observation Center

Copernicus Core Payload Data Ground Segment

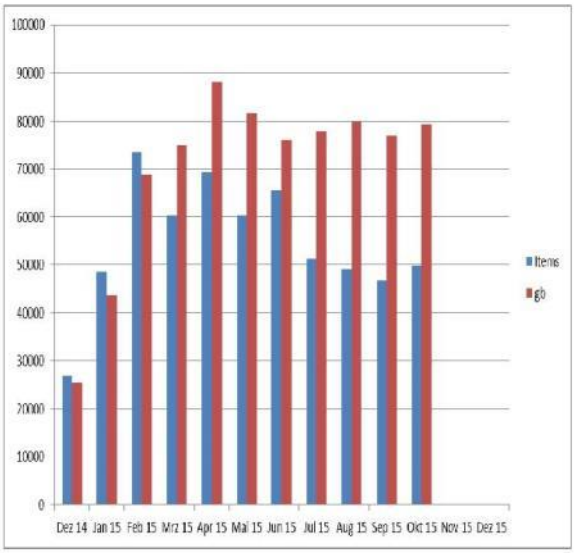



Sentinel-1 © Copernicus
processed at D-PAC
Cyprus
Sentinel-1 : 14.02.2015 © Copernicus
Processed at DLR-Copernicus PAC

Earth Observation Center

DLR Sentinel-1 PAC: LTA Service – Performance Statistics

- Sentinel-1A LTA operations at DLR-PAC from 8 Dec. 2014 until 31 Oct. 2015
  - **601,900 products**
  - **772,700 GB (755 TB)**
  - daily average:
    2,360 GB (2.3 TB)
    1,830 products
  - **~ 1PB/yr**
- Upcoming satellite launches will increase the data volume significantly by
  - 2016: S1A + S1B : **11 TB/day**
  - 2016: Sentinel-3A (OLCI): **0.8 TB/day**
  - 2017: Sentinel-3B (OLCI): **0.8 TB/day**
  - **~4,6 PB/yr**



DLR-PAC (Sentinel-1 PAC#2): Monthly LTA Ingestion Dec 2014 – Oct 2015

DLR

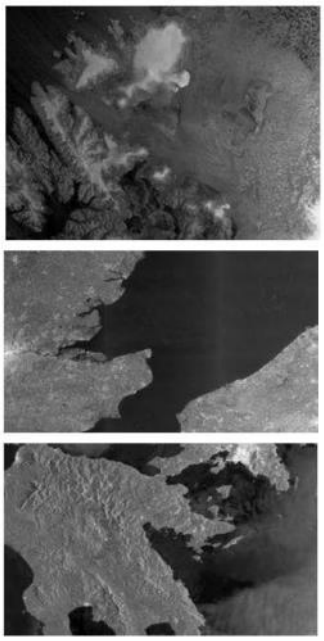
13 /11

Earth Observation Center

1 Million Gigabyte Sentinel-1 data at DLR PAC – Feb 12, 2016

In only 14 months, one million gigabytes or one petabyte of data from the European radar satellite Sentinel-1 were acquired, processed and archived at DLR's Earth Observation Center. Sentinel-1 is the first of a whole fleet of European earth observation satellites with various sensors and specializations. On behalf of ESA, EOC manages the Sentinel-1 / Sentinel-3 OLCI Processing and Archiving Centre. The Sentinels represent a milestone in the European earth observation programme, also with respect to the availability of earth observation data in Europe. The Sentinels cause a dramatic increase in the amount of data to be processed and archived.

Accordingly, more than 750,000 Sentinel-1 data sets, from raw data sets to Level-0 products to value-added Level-2 products, have already been safeguarded in the EOC long-term data archive. The amount of data stored since December 2014 for this one mission alone is equivalent to all the radar data from the Envisat satellite that were generated and processed during its mission lifetime of over ten years.

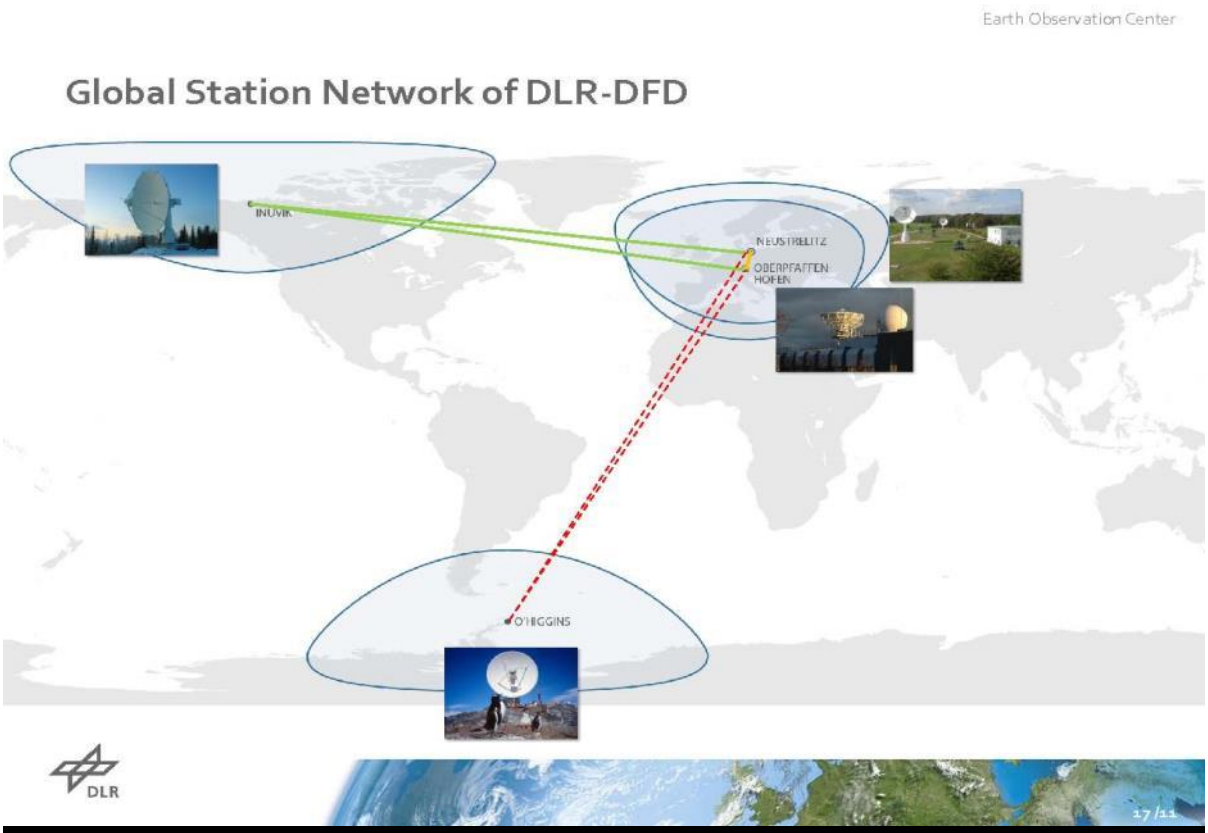


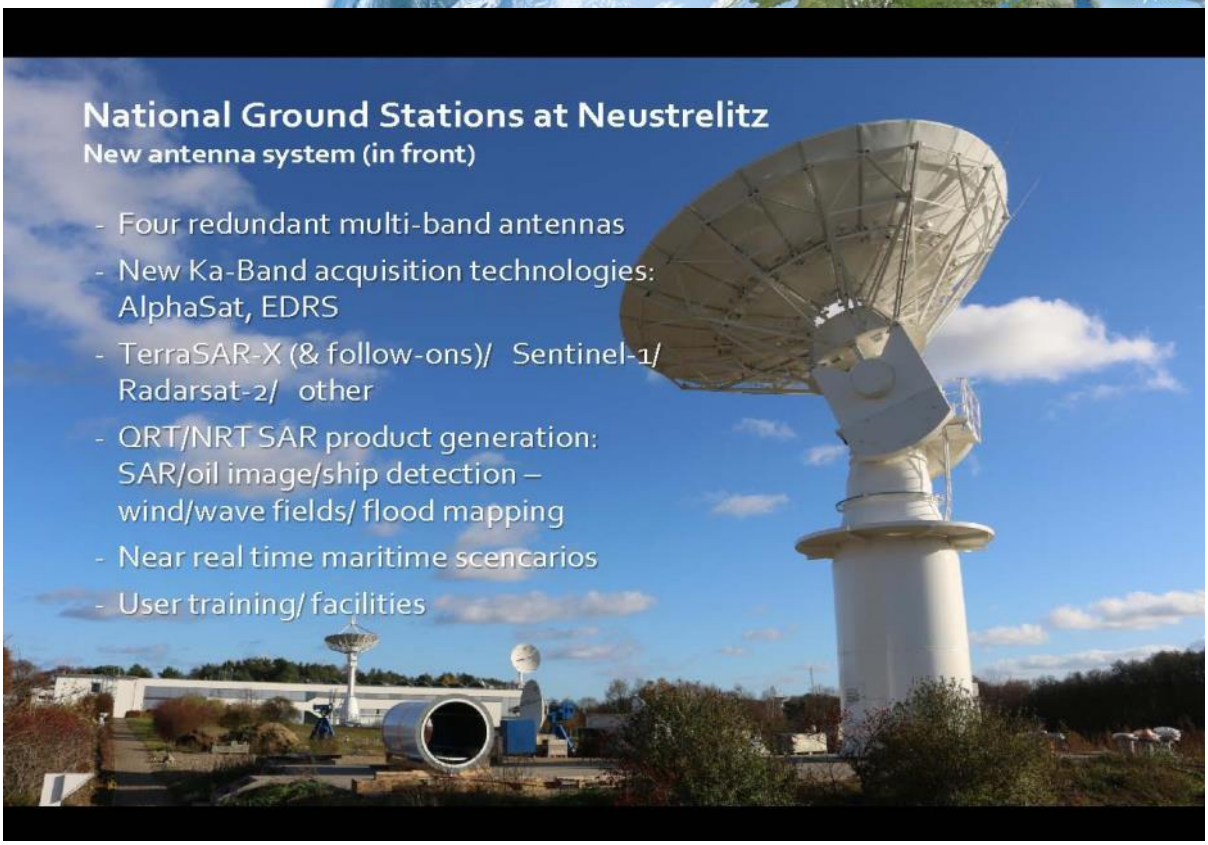
DLR

14 /11

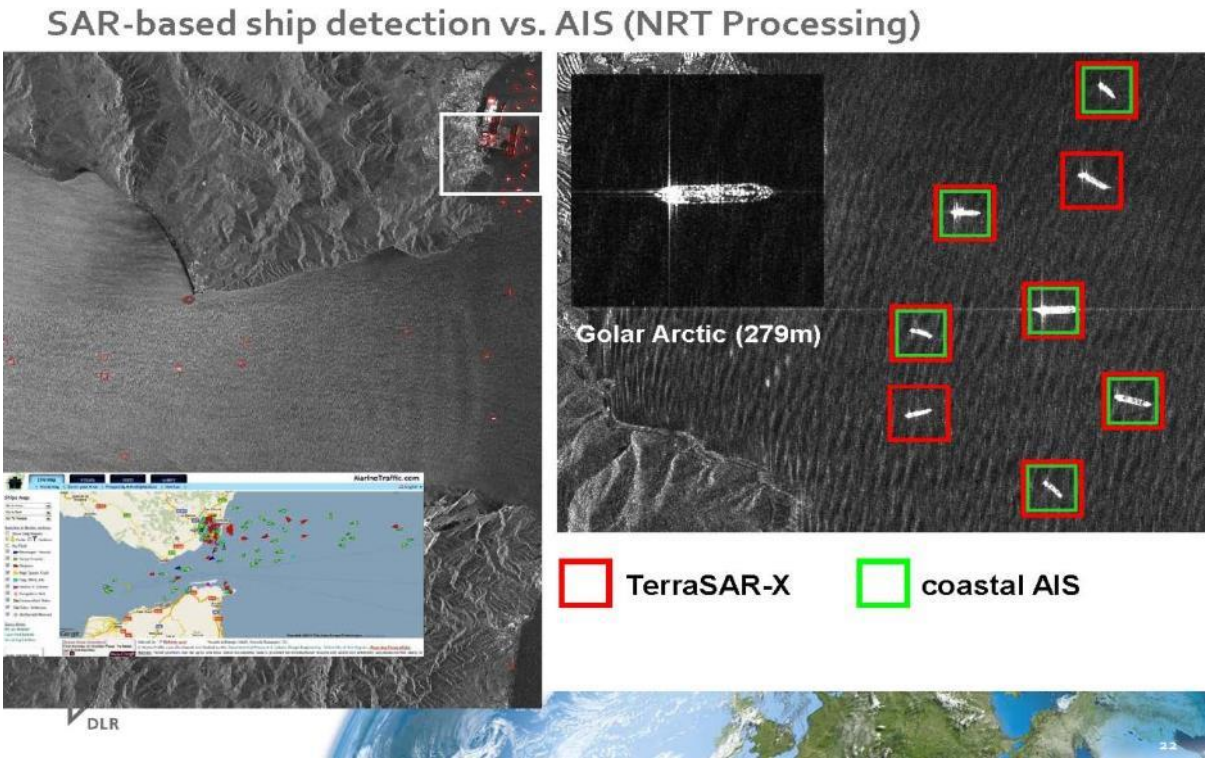
German Copernicus Collaborative Ground Segment
(as agreed with ESA)

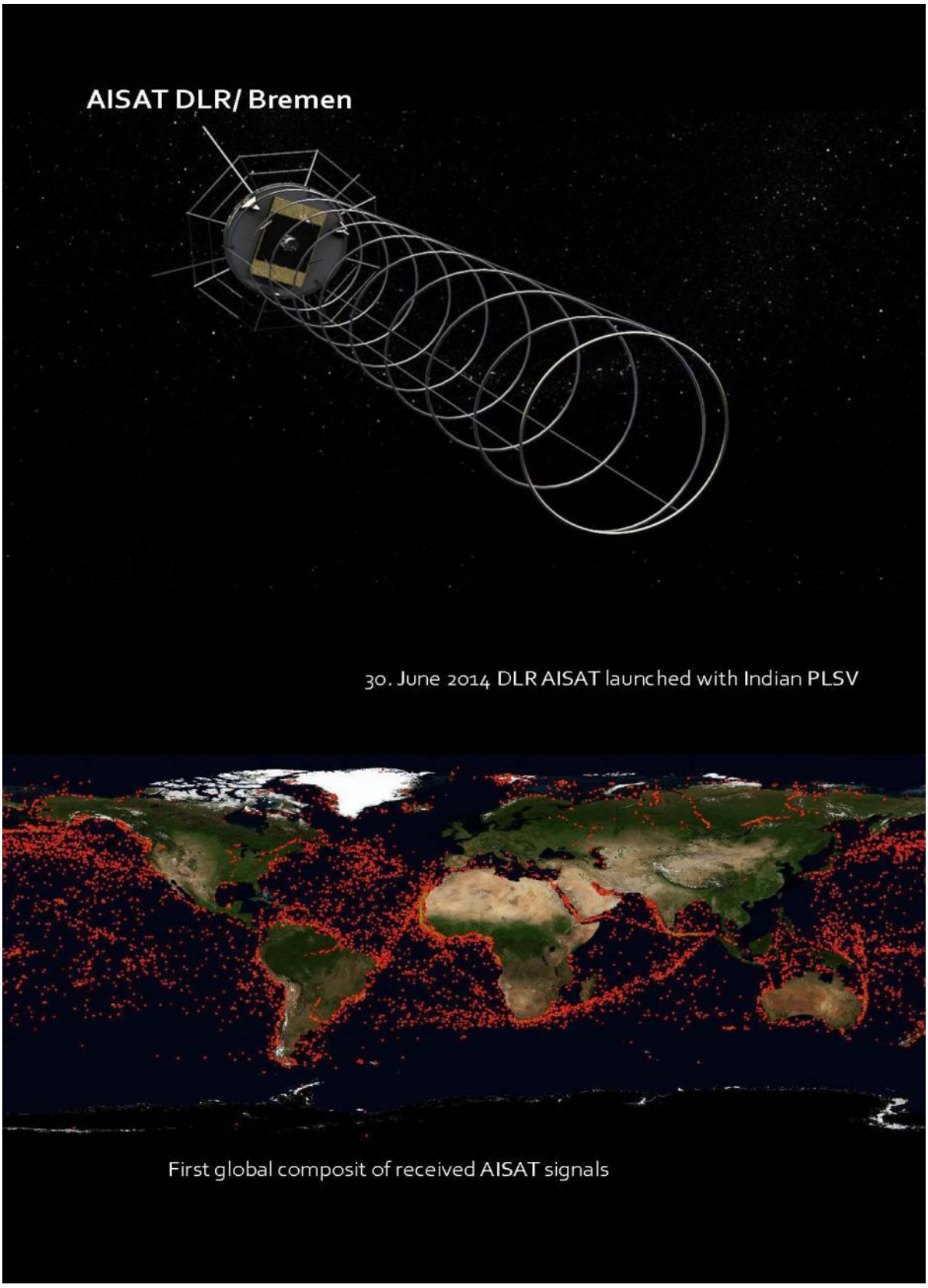
- Quasi Real Time (QRT) Sentinel-1 SAR data acquisition for maritime security
  - X-Band & EDRS
  - …at DLR Neustrelitz
  - …at O'Higgins/Antarctica & Inuvik, Canada
  - … and Sentinel-2 & -3 on QRT demand
- National Sentinel-Data access portal and massive data processing
  - National portal CODE-DE (contracted by BMVI)
  - DLR perspective: German Copernicus Center

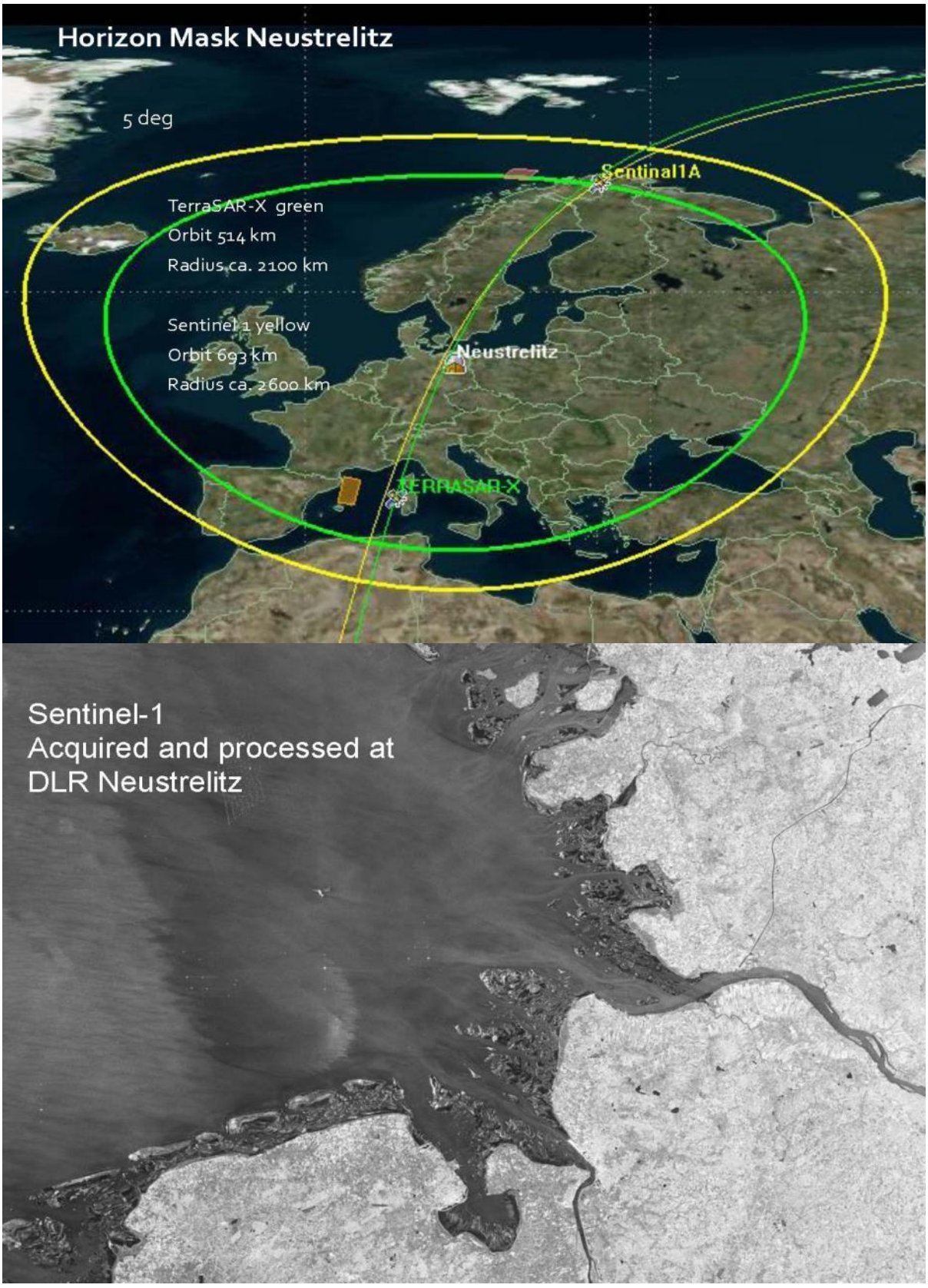

Earth Observation Center
Global Station Network of DLR-DFD
INUVIK
NEUSTRELITZ
OBERPFAFFEN-HOFEN
O'HIGGINS
DLR
17 /11


National Ground Stations at Neustrelitz
New antenna system (in front)
- Four redundant multi-band antennas
- New Ka-Band acquisition technologies: AlphaSat, EDRS
- TerraSAR-X (& follow-ons)/ Sentinel-1/ Radarsat-2/ other
- QRT/NRT SAR product generation: SAR/oil image/ship detection – wind/wave fields/ flood mapping
- Near real time maritime scencarios
- User training/ facilities

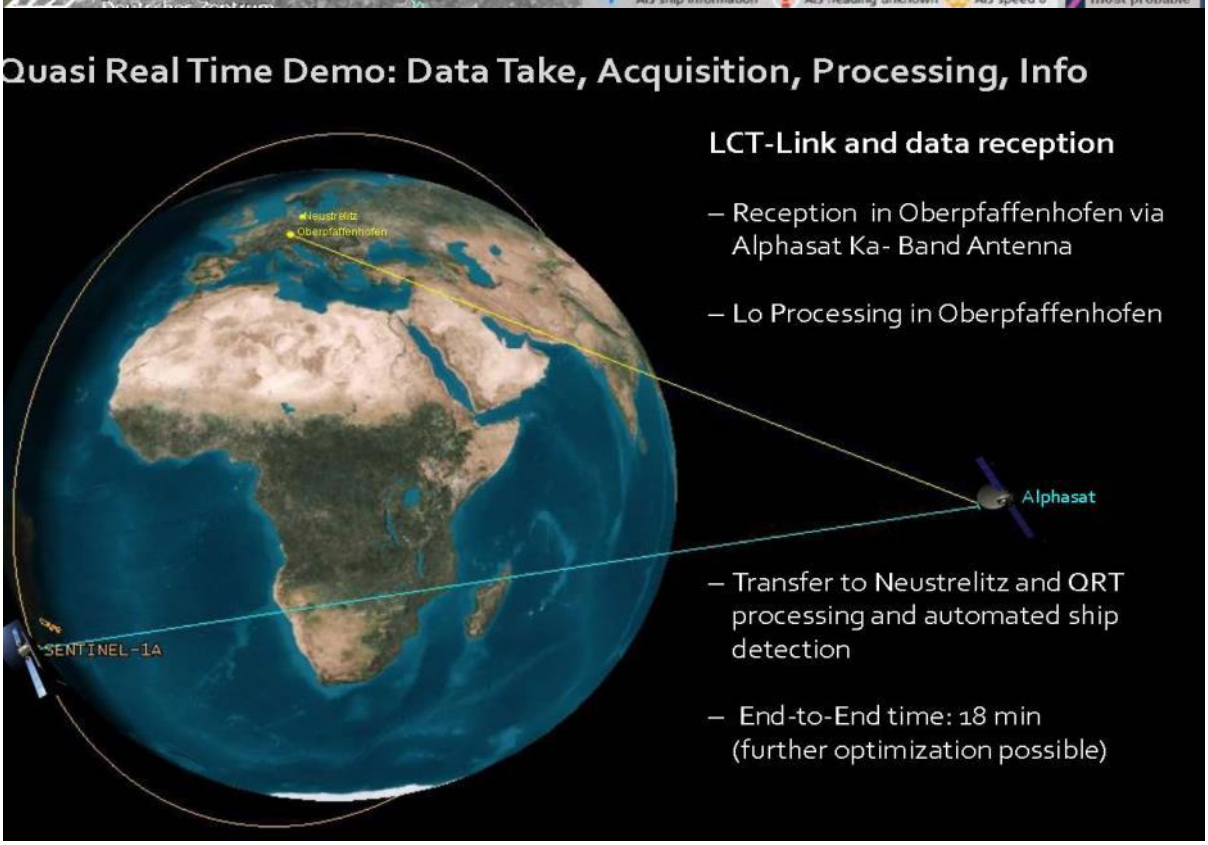
Earth Observation Center

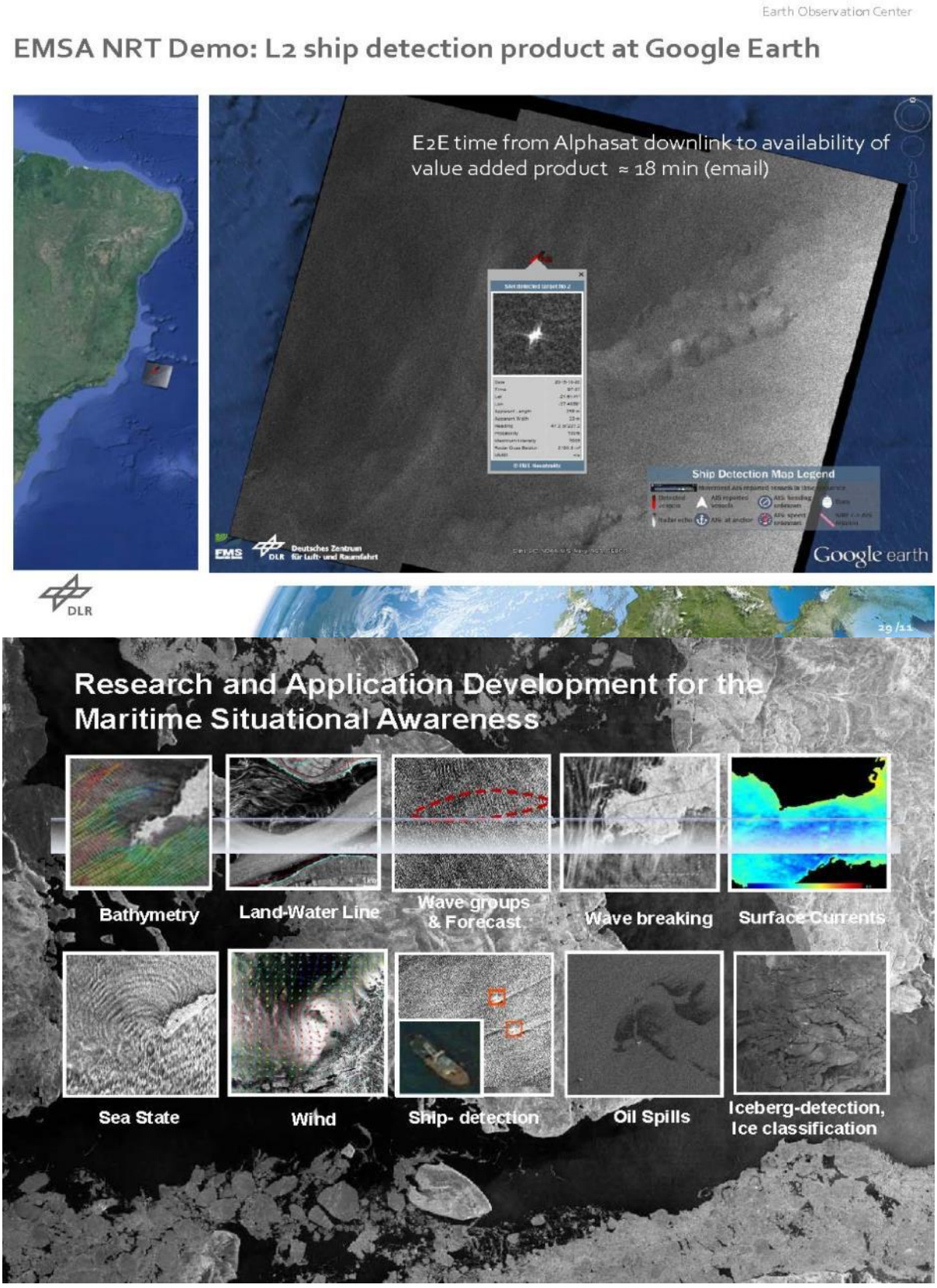


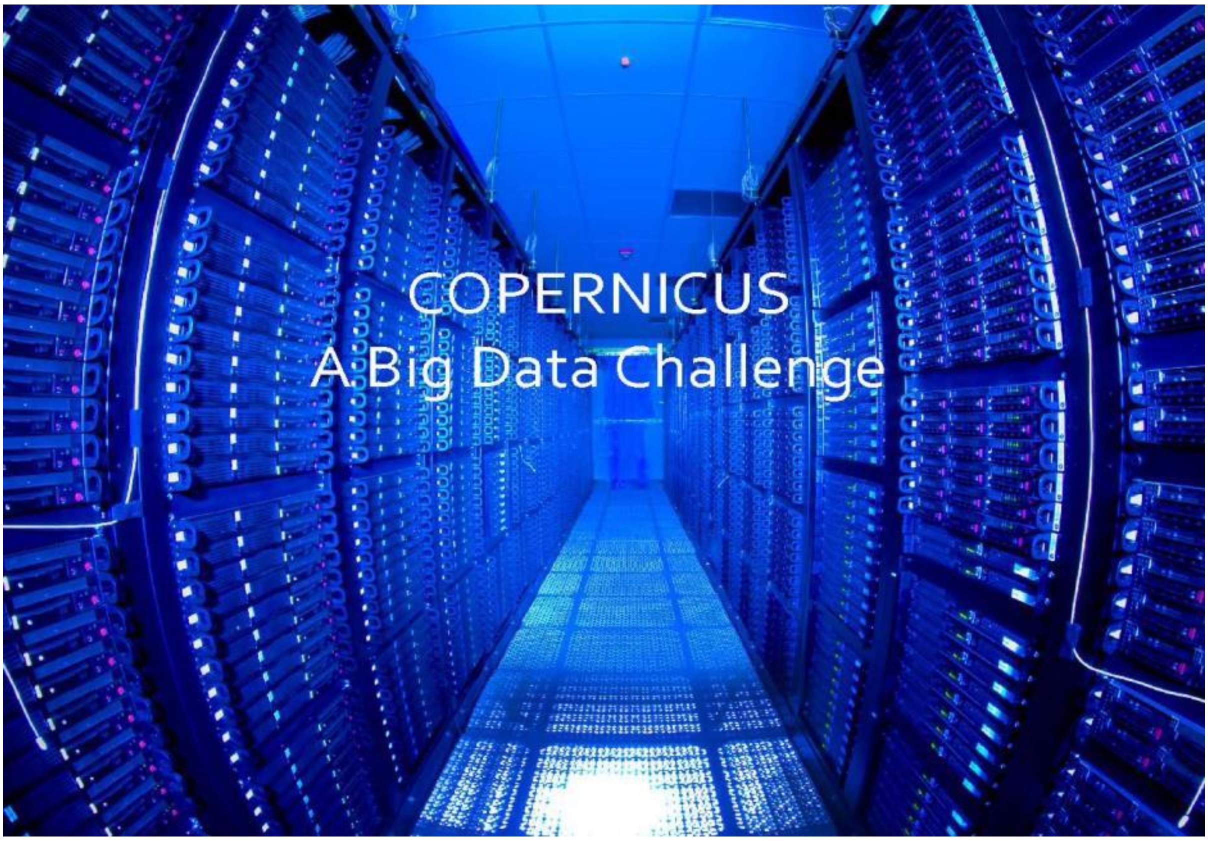

AISAT DLR/ Bremen
30. June 2014 DLR AISAT launched with Indian PLSV
First global composit of received AISAT signals


Horizon Mask Neustrelitz
5 deg
Sentinal1A
TerraSAR-X green
Orbit 514 km
Radius ca. 2100 km
Sentinel 1 yellow
Orbit 693 km
Radius ca. 2600 km
Neustrelitz
TERRASAR-X
Sentinel-1
Acquired and processed at
DLR Neustrelitz


MAERSK HOUSTON #35
#31 CLIPPER SKAGEN OLGA 4002
OOCL NAGOYA
#32
#37
#36 BLUE LOTUS
HARTZI
CLAMOR SCHULTE
PILOTTENDER BORKUM
ELBE PILOT
FLINTERCARRIER
TRANSNJORD
HOOGE
#38
CARINA
KERET
ALCEDO
WISAFOREST
#40
TRANSNJORD
#45
#42
Scharhörn
ECL CHALLENGER #43
#57
ECL CHALLENGER
#51
#44
#41
#47
#48
MAERSK JEFFERSON
#53
#58
#56
HOEGH TROPICANA
#52
#65
#59 WESER PILOT
2112131
#61
APOLLO LUPUS
#63
#64
#60
ITAL ORIENTE
#74 HOGELAND
#62
BAD BRAMSTEDT
UTVIKEN
#66
BAD BRAMSTEDT
HOGELAND
#82
#75
#77
#80 UTVIKEN GEOPOTES14
#96
#109
#88
#94
#90
#84
#85
#81
Spiekeroog
SEELOWE
#83
#86
#114
SPIEKEROOG IV
Spiekeroog
#99
LAPPLAND
LAPPLAND
#97
#95 NORDSEE
HARLINGERLAND
#113
#117
SEELOWE
#102
#106
#111
#118
#120
#119
#116
Mellum
#121
#122
SPIEKEROOG3
WANGEROOGE
ALEXANDER V HUMBOLDT
#124
#125
SPIEKEROOG1
SPIEKEROOG1
#126
MAP LEGEND
view of extrapolated movement at time of acquisition + 1 hour
calc. relations
SAR based detection
AIS speed unknown
SAR to AIS n:1
AIS to SAR n:1
AIS ship information
AIS heading unknown
AIS speed 0
most probable


Quasi Real Time Demo: Data Take, Acquisition, Processing, Info
LCT-Link and data reception
– Reception in Oberpfaffenhofen via Alphasat Ka- Band Antenna
– Lo Processing in Oberpfaffenhofen
Neustrelitz
Oberpfaffenhofen
Alphasat
SENTINEL-1A
– Transfer to Neustrelitz and QRT processing and automated ship detection
– End-to-End time: 18 min (further optimization possible)

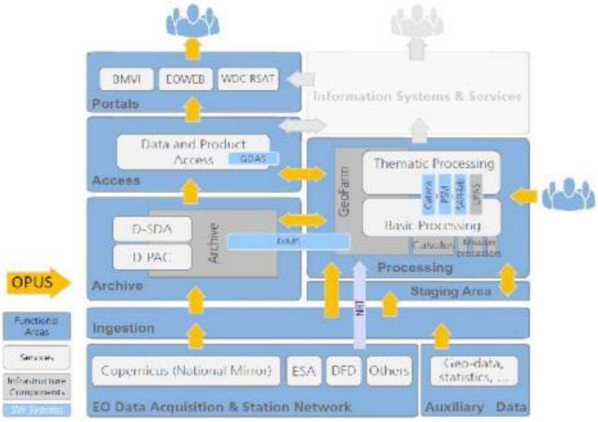

Earth Observation Center
EMSA NRT Demo: L2 ship detection product at Google Earth
E2E time from Alphasat downlink to availability of value added product ≈ 18 min (email)
Ship Detection Map Legend
Deutsches Zentrum für Luft- und Raumfahrt
Google earth
DLR
29 /11
Research and Application Development for the Maritime Situational Awareness
Bathymetry
Land-Water Line
Wave groups & Forecast
Wave breaking
Surface Currents
Sea State
Wihd
Ship- detection
Oil Spills
Iceberg-detection, Ice classification

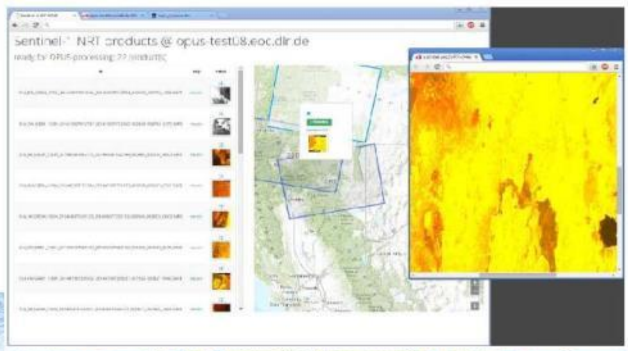


OPUS-COPERNCIUS

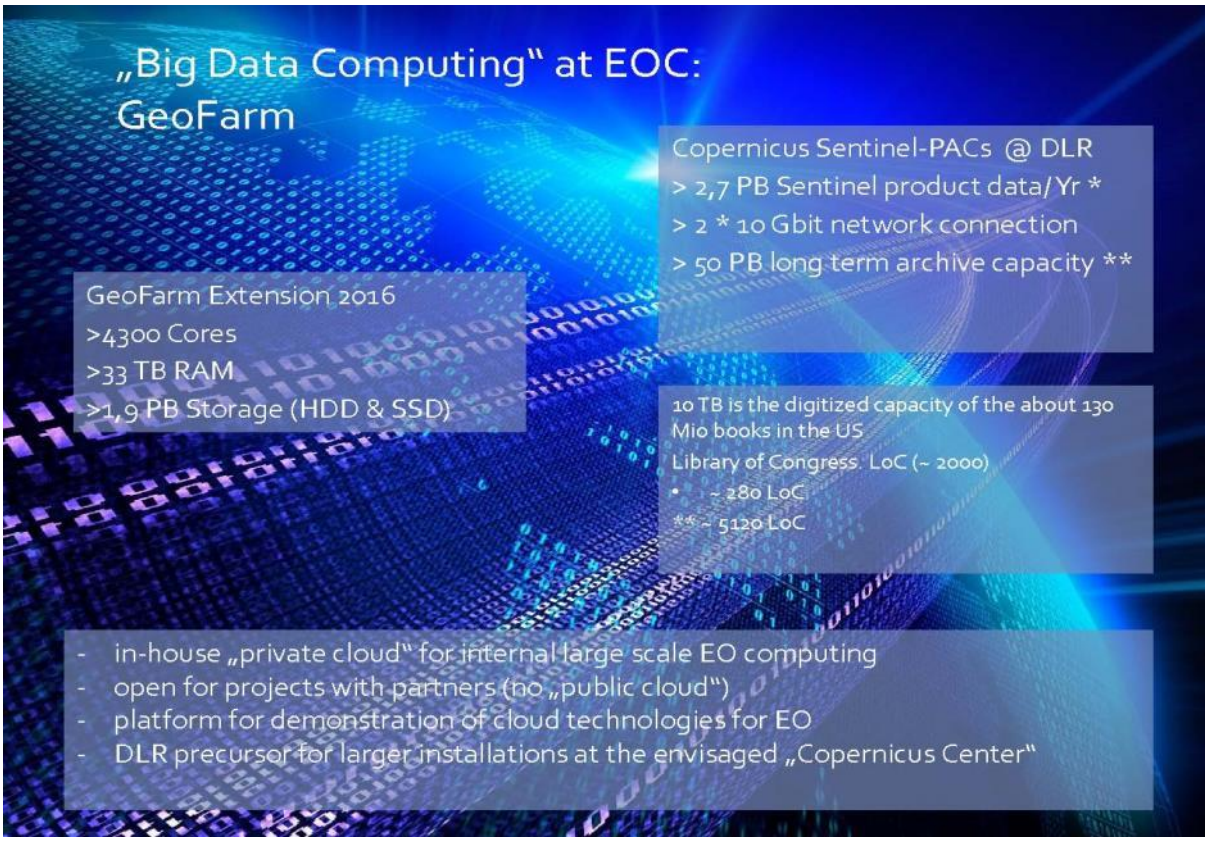
- OPUS – Demonstration of data access and collaborative data processing/value adding with industry partners
- Use of Sentinel and contributing mission data for real-world applications
- Automated „Big Data Computing" using GeoFarm
- Executed by EOC and supported by Bavarian ministry of economy

BROCKMANN CONSULT
CLOUDEO
EOMAP
GAFAG

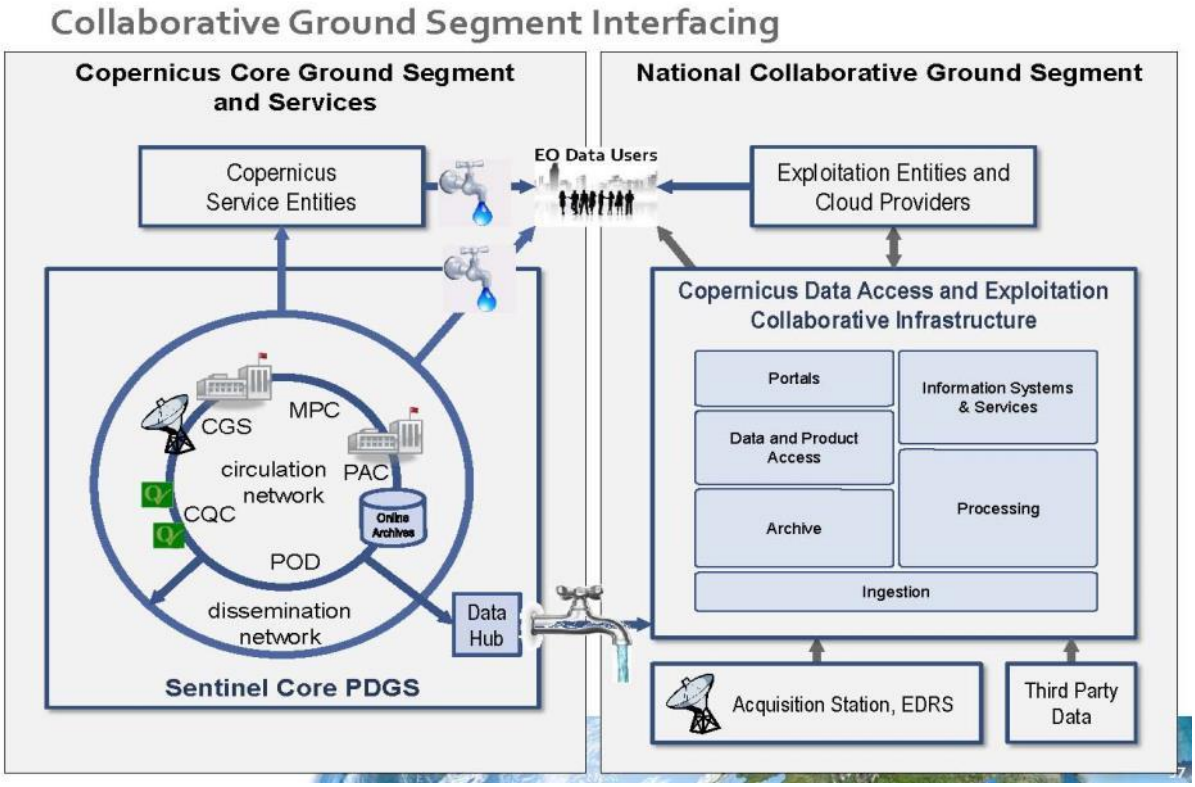




DLR



Earth Observation Center

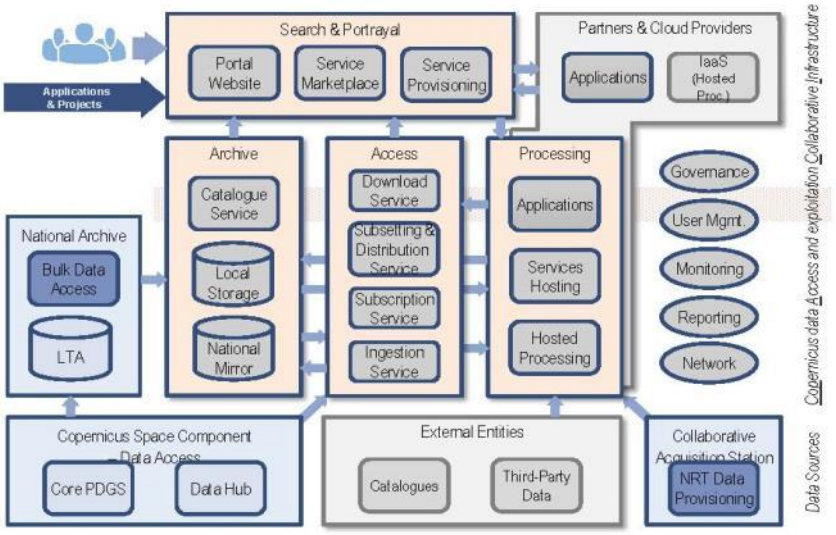


Copernicus Collaborative Infrastructure National Data Portal

Earth Observation Center

- Realized as part of the German national collaborative ground segment
- Project lead: DLR-Space Management
- Funded by German Federal Ministry of Transport and Digital Infrastructure

Bundesministerium für Verkehr und digitale Infrastruktur



Architecture & layout as proposed by DLR-EOC and industrial partners

DLR

Earth Observation Center

German Copernicus Center – Architectural Vision

pier 7 architekten düsseldorf

DLR

5 Overview of European Earth Observation missions - Gunder Schreier, DLR

ion Center

Copernicius Contributing Missions

Mission Group 1 - SAR VHR1-MR2	Mission Group 2b Optical VHR1/2	Mission Group 2 Optical HR1/2	Mission Group 3 Optical MR1/2	Mission Group 4/5 Atmospheric missions	Others
ALOS-PALSAR	*AURIGA*	ALOS-AVNIR-2	Proba-V	ERS-1/2	CryoSat
COSMO-SkyMed Constellation	*BLACKSKY constellation*	Deimos-1	Resourcesat-1, Resourcesat-2	Envisat	SMOS
Envisat	Deimos-2	*INGENIO*	Oceansat-2 *	GOSAT	ERS-1/2
ERS-1/2	Dubaisat-2*	Landsat-5 Landsat-7 Landsat-8	Sentinel-3 **	ODIN	Envisat
Kompsat-5	GeoEye-1	*PERSEUS*			Sentinel-3 **
PAZ	*INGENIO*	Proba			
RADARSAT-2	IRS-P5 CartoSat	RapidEye Constellation			
RISAT-1 *	Ikonos-2	ResourceSat-1, ResourceSat-2			
Sentinel-1	*KHALIFASAT*	SPOT-4, SPOT-5, SPOT-6-7			
TerraSAR-X, TanDEM-X	*Kompsat-2*	Sentinel-2			
	Kompsat-3	TH constellation *			
	Pleiades-1A/1B	UK-DMC2			
	QuickBird-2				
	SPOT-5, SPOT-6/7				
	SkySat				
	TH constellation*				
	WorldView-1, WorldView-2				
	WorldView-3				
	Worldview-4				

(*Available during Q1 2016 **Available during Q3 2016 after commissioning)

Table 2 Missions made available in Data Warehouse Phase 2

DLR

Earth Observation Center

France

– SPOT AstroTerra

– Pleiades

– Venus

– MERLIN

DLR

SPOT Series of Satellites

Start of commercial Earth Observation

PPP between CNES and Spot Image (ASTRIUM)

Then highest geometric resolution available (not classified)

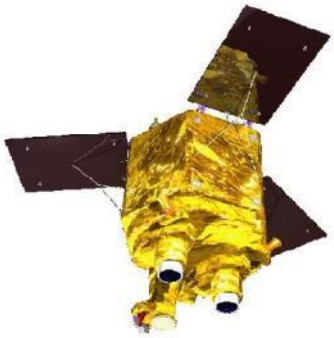
Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft

Deutsches Fernerkundungsdatenzentrum

Earth Observation Center

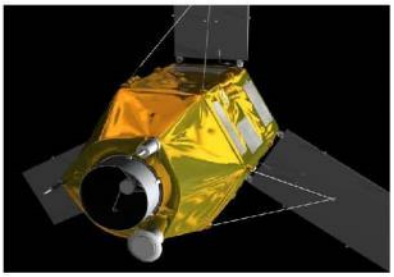
SPOT-6, SPOT-7 Mission status (Astroterra programme)

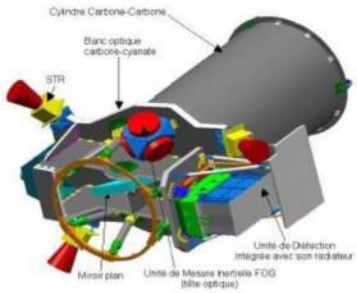
- Spot Image owner* and exclusive distributor
- SPOT-6 launched 9 September 2012 and SPOT-7 launched 30 Juni 2014
- 694km sun synchronous orbit
- High resolution (2mPAN, 8mMS)
- Simultaneous PAN and MS acquisitions
- 4 spectral bands B, G, R, NIR
- Swath 60km
- * In December 2014 Airbus struck a deal with Azerbaijan, which transfers ownership of Spot-7, renamed Azersky, to Azercosmos



Pleiades (F)

- Owner
  - CNES
  - Dual use/ French Military (ca. 5%)
  - Commercial distribution by SPOT Image (ca 95% of mission capacity)
- Partner
  - Italy / Cosmo (ORFEO)
- Constellation
  - Two active satellites
- Lauch date
  - Dec 17, 2011 (Pleiades 1a); Dec 2, 2012 (Pleiades 1b)
- Prime Instrument
  - High resolution optical imager
- Resolution/swath
  - 0,7 m pan (res. to 0,5m) & 4* 2,0 m ms / ~ 20km swath





Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft

Deutsches Fernerkundungsdatenzentrum 8


Pleiades:
San Francisco
Pleiades:
Gizeh

Earth Observation Center

Venµs (F - ISR)

- Owner
  - CNES/ ISA (Israel Space Agency)
- Purpose
  - Vegetation and Environment monitoring on a New MicroSatellite
  - Imaging of global vegetation
- Lauch date
  - 2016 (Kourou)
  - altitude of 720 km for 2½ years (science mission) and 410 km for 1 year (technology mission)
- Prime Instrument
  - Superspectral camera
  - 12 spectral bands
  - 5,3 m @ 27,5 km & 3 m @ 13km swath

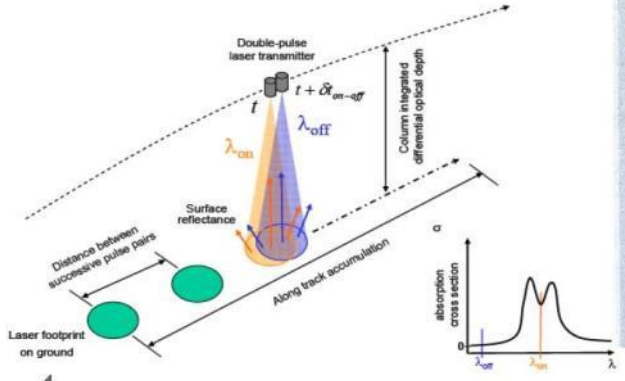
Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft

Deutsches Fernerkundungsdatenzentrum 13

Earth Observation Center

France – German Climate monitoring mission: MERLIN

- Jointly between CNES und DLR
- Start: 2018
- Bus and mission control: CNES
- Instrument & processors: DLR
- Joint payload data ground segment and scientific evaluation



German Chancellor Angela Merkel (left) and French President Nicolas Sarkozy

France, Germany To Build Methane-monitoring Craft

France and Germany said Feb. 4 they would jointly build an Earth observation satellite to measure atmospheric concentrations of methane, a contributor to the greenhouse effect linked to global warming, to be launched by 2014.

Meeting in Paris as part of a joint government summit led by French President Nicolas Sarkozy and German Chancellor

meeting, the two governments said they were "determined to improve Ariane 5," a likely reference to a new upper stage for the vehicle that European governments are expected to decide in late 2011 or 2012. Contracts for the early development of this upper stage are already under way.

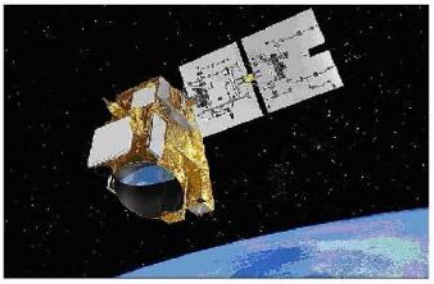
"Nonetheless, we are also conscious

DLR

Earth Observation Center

MERLIN Parameter

- CNES Myriade Bus
- DLR Instrument: IPDA (Integrated Path Differential-Absorption) LIDAR
- CH_4 (Methane) Total column at 50 km resolution globally

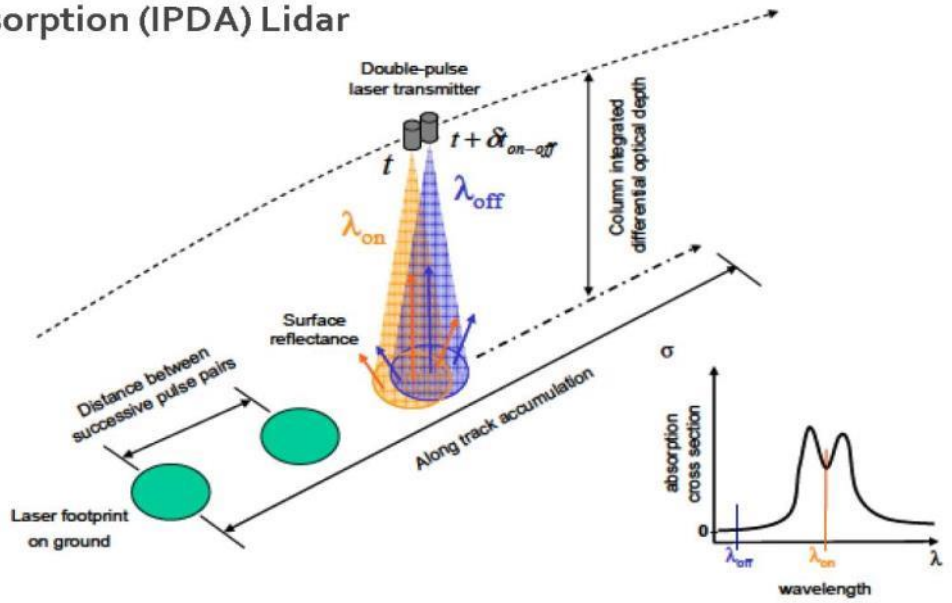


Laser pulse wavelength	λ_{on} : 1645.552 nm λ_{off} : 1645.846 nm
Pulse energy	9 mJ
PRF (Pulse Repetition Frequency) for double pulses	12 Hz
Pulse length	20-30 ns
Power consumption	57 W
Instrument mass (incl. electronics & harness)	32.5 kg

DLR

Earth Observation Center

Measurement Method: Integrated-Path Differential Absorption (IPDA) Lidar



DLR

Earth Observation Center

Italy

– Cosmo-Skymed

– Prisma

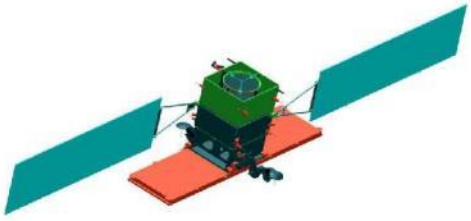
DLR

17

Cosmo SkyMed (I)

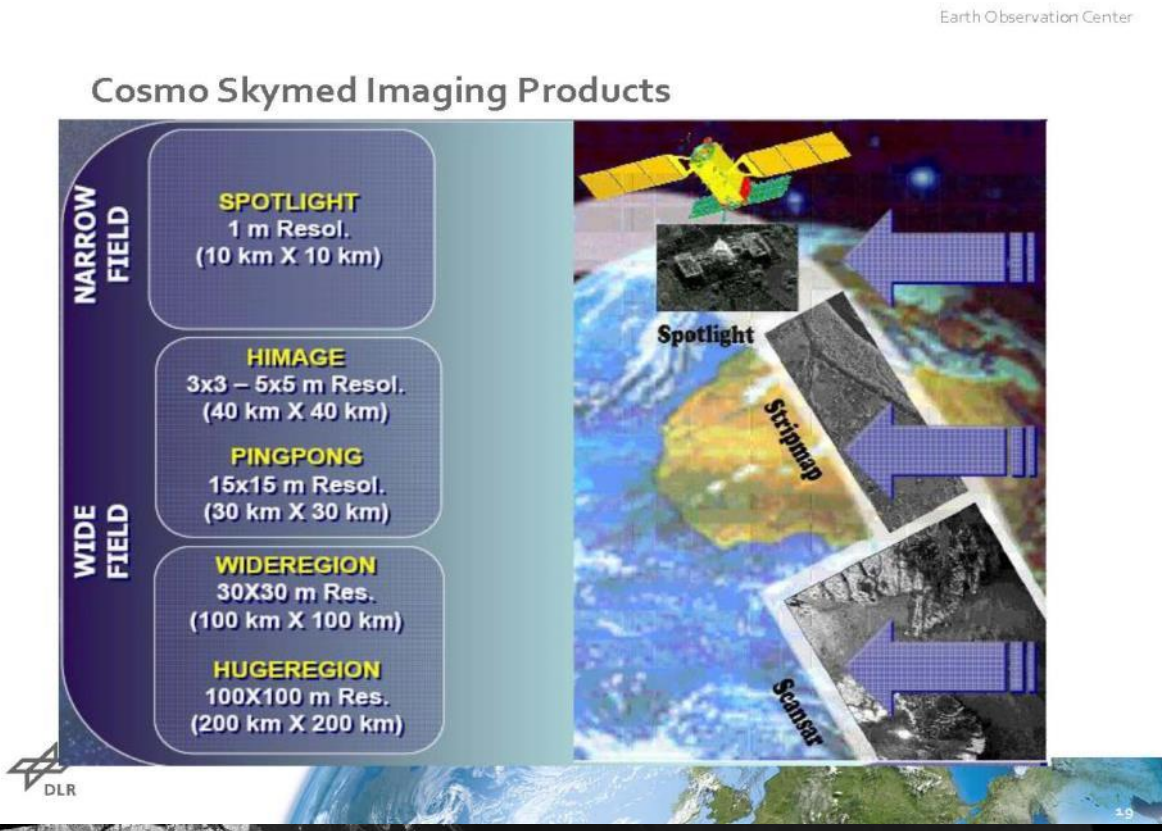
- Owner
  - ASI
  - Military and commercial use
  - E-GEOS/ Matera, I, as commercial distributor
- Partner
  - France (Pleiades)
  - Argentina (SIASGE = 2 L Band SAR)
- Constellation
  - 4 active satellites in 2 orbital planes
- Lauch dates
  - 7 June, 8 Dec 2007, 24 Oct 2008 5 Nov 2010
- Prime Instrument
  - X-Band SAR, single and dual polarizations
- Resolution/swath
  - Ultra Spotlight ~ 0,5m
  - Spotlight ~ 1 m
  - HUGEREGION 100 m / 200 km

e-geos
AN ASI/TELESPAZIO COMPANY



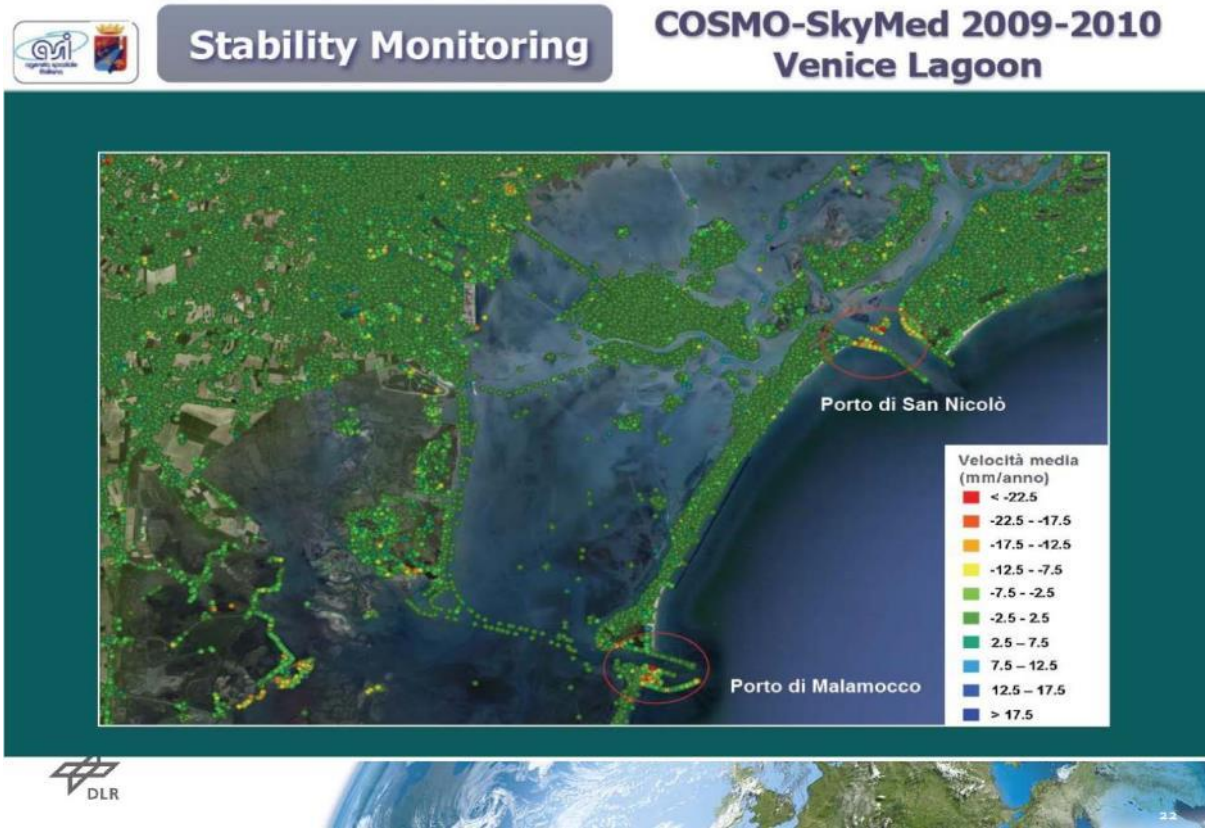
DLR Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft

Deutsches Fernerkundungsdatenzentrum 18


Earth Observation Center
Cosmo Skymed Imaging Products
NARROW FIELD
SPOTLIGHT
1 m Resol.
(10 km X 10 km)
WIDE FIELD
HIMAGE
3x3 – 5x5 m Resol.
(40 km X 40 km)
PINGPONG
15x15 m Resol.
(30 km X 30 km)
WIDEREGION
30X30 m Res.
(100 km X 100 km)
HUGEREGION
100X100 m Res.
(200 km X 200 km)
Spotlight
Stripmap
Scansar
DLR
19


The Po Delta,. COSMO-SkyMed-1 5m resolution

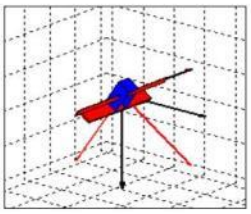

MAPPING: ITALY STRIPMAP MOSAIC
TRENTINO ALTO ADIGE
FRIULI-VENEZIA GIULIA
VALLE D'AOSTA
LOMBARDIA
VENETO
PIEMONTE
EMILIA ROMAGNA
LIGURIA
TOSCANA
MARCHE
UMBRIA
ABRUZZO
LAZIO
MOLISE
CAMPANIA
PUGLIA
BASILICATA
SARDEGNA
CALABRIA
SICILIA
16 DAYS PASSAGES (INTERFEROMETRIC ACQUIS.)
ASC./DESC. PASSAGES


Stability Monitoring
COSMO-SkyMed 2009-2010
Venice Lagoon
Porto di San Nicolò
Porto di Malamocco
Velocità media
(mm/anno)
< -22.5
-22.5 - -17.5
-17.5 - -12.5
-12.5 - -7.5
-7.5 - -2.5
-2.5 - 2.5
2.5 – 7.5
7.5 – 12.5
12.5 – 17.5
> 17.5
DLR

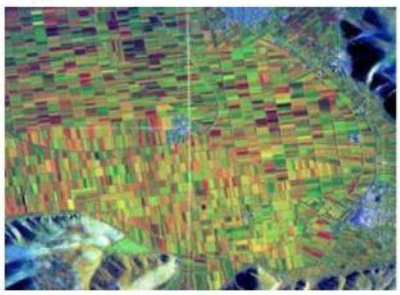
Earth Observation Center

COSMO-SkyMed Second Generation

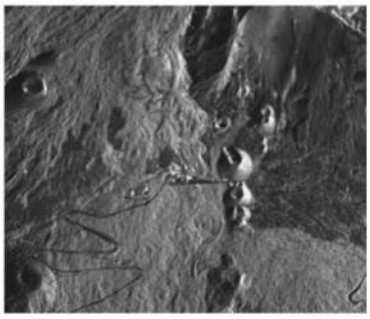
Robust and innovative planning algorithm



Satellite agility:
Right2Left 6 -> 3 min



Full polarimetric capability (QUAD-pol) DUAL-pol currently available in Ping-Pong on COSMO-SkyMed.



Spatial resolution & Geolocation Up to 2 times better than COSMO-SkyMed for specific acquisition mode.

Source: ASI presentation, CEOS 2015

DLR

Earth Observation Center

COSMO-SkyMed Second Generation

- **CSG satellites will replace the CSK satellites that reached the end of life**
- **With the launch of the first CSG satellite planned in 2017 and the second one year later, CSG will provide operational continuity at least until 2025**

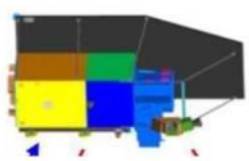
Source: ASI presentation, CEOS 2015

DLR

Earth Observation Center

PRISMA (I)

- Owner
  - ASI
  - PRecursore IperSpettrale della Missione Applicativa
- Lauch date
  - 2018 (tbc)
  - LEO SSO, 620km, 10.30 LTDN
  - 3+2 years lifetime
- Instrument
  - PAN camera (400-700 nm)
  - HYP camera composed of
    - VNIR (400-1010 nm)
    - SWIR (920-2500 nm)
- Resolution/swath
  - Hyperspectral: 30 m/ 30 km
  - PAN: 5 m/ 30 km



DLR

Earth Observation Center

Spain

- SEOSAT – INGENIO
- SEOSAT - PAZ

DLR

Earth Observation Center

SEOSAT (INGENIO) (ES)

–Owner
- – Spanish Earth Observation SATellite
- – CDTI: Center for the Development of industrial technology
- – Project managed by ESA

–Lauch date
- – 2016 (tbc)
- – 670 km orbit; 10:30 LTDN
- – 3+2 years lifetime

–Instrument/ Res/ Swath
- – PAN camera @ 2,5 m res / 30km
- – 4 MS bands @ 10 m res / 60 km

DLR

Earth Observation Center

SEOSAR (PAZ) (ES)

–Owner
- – X-Band SAR high resolution
- – Owner: HISDESAT
- – Dual use

–Lauch date
- – 2016 (tbc)

– Satellite
- – Based on TerraSAR-X with Spanish complements

–Instrument/ Res/ Swath
- – Same as TerraSAR-X
- – With improved resolution

–Constellation and marketing with TerraSAR-X

DLR

Earth Observation Center

United Kingdom

- DMC
- TopSAT
- DMC3
- NovaSAR

Earth Observation Center

Disaster Monitoring Constellation, DMC (UK)

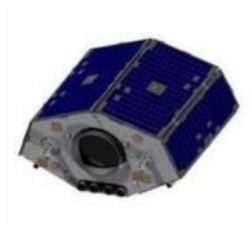
- Owner/Operator
  - Surrey Satellite Technology (SSTL)
  - DMC international
  - International Partners
- Constellation
  - Constellation of satellites owned by partners
- Instrument/ Res/ Swath
  - PAN camera @ 4 m res / up to 24km
  - 4 MS bands @ 32 - 22 m res / up to 670 km

ALSAT-1
BEIJING-1
NigeriaSat-1
BILSAT
UK-DMC
Deimos-1 (2008)
UK-DMC2 (2008)
NigeriaSat-2 (2009)

Earth Observation Center

Disaster Monitoring Constellation operational satellites

Country Operator	Designation	Type	Imager	Launch
Nigeria NASRDA	Nigeriasat-NX	SSTL-100i	22m MS	2011
Nigeria NASRDA	Nigeriasat-2	SSTL-300	2.5m Pan 5m MS 32m MS	2011
UK DMCii	UK-DMC2	SSTL-100i	22m MS	2008
Spain Deimos	Deimos-1	SSTL-100i	22m MS	2008
China BLMIT	Beijing-1	SSTL-150i	32m MS 4m Pan	2005



Disaster Monitoring Constellation retired satellites

Country Operator	Designation	Type	Imager	Launch
UK SSTL	UK-DMC	SSTL-100i	32m MS	2003
Nigeria NASRDA	Nigeriasat-1	SSTL-100i	32m MS	2003
Turkey BILTEN	Bilsat-1	SSTL-150i	26m MS 12m Pan	2003
Algeria ASAL	Alsat-1	SSTL-100i	32m MS	2002

DLR

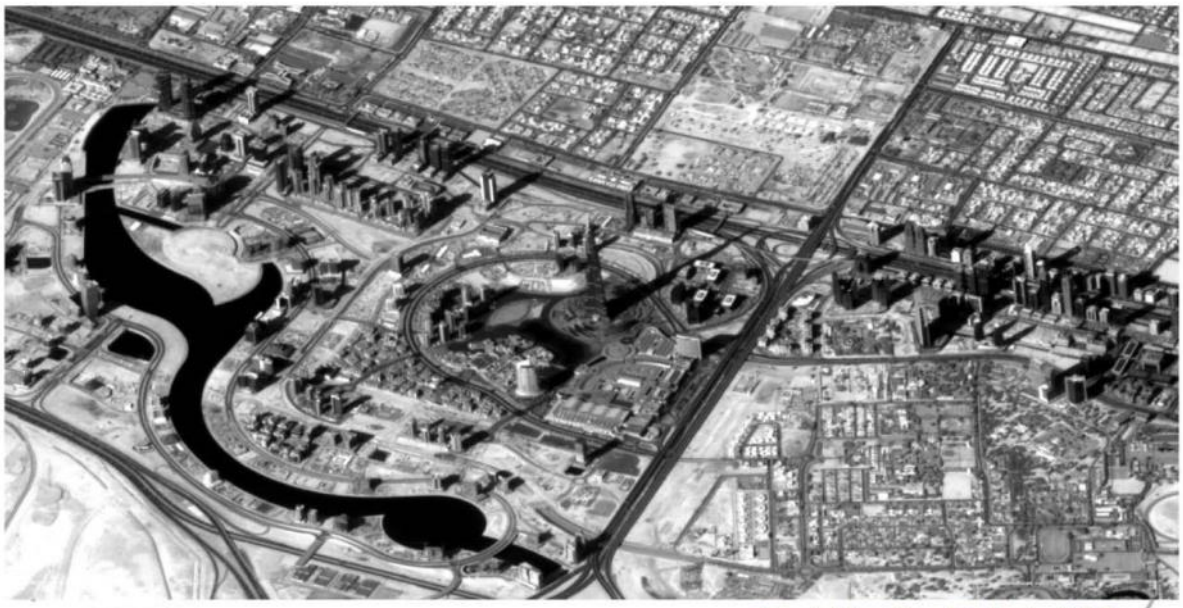
Earth Observation Center

The dying Dead Sea, Middle East - Mar 04 - UK-DMC

Kiev, Ukraine - September 05 - UK-DMC

DLR

Earth Observation Center



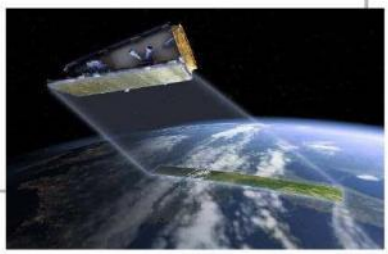
Burj Khalifa, Dubai, UAE
NigeriaSat-2

gscb
DLR

Earth Observation Center

Evolution of DMC Services

- DMC3
  - Constellation of 3 optical satellites
  - 1m Panchromatic
  - 4m Multispectral (Blue, Green, Red, NIR)
  - Owned and operated by DMCii
  - Currently in production by SSTL-UK
  - Launch ETA 2014
- NovaSAR
  - S-Band
  - 6m, 20m, and 30m imaging modes
  - HH, HV, VH, VV polarisations
  - First SAR satellite built by SSTL-UK
  - First SAR dataset distributed by DMCii
  - Launch ETA 2014



gscb
Ground Segment Coordination Body
DLR

Earth Observation Center

Canada

– Radarsat-2
– Radarsat Constellation (RCM)

Earth Observation Center

RADARSAT-2

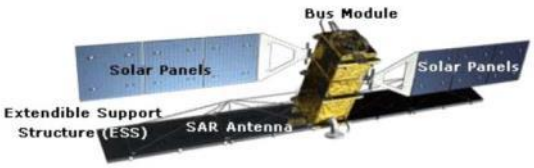
Mission Information	
Launch Date	December 14, 2007
Lifetime	7 year minimum

Operator	
Owner	MDA Corporation, Canada
PPP	With Canadian Space Agency

Orbit Information	
Geometry	near-polar, sun-synchronous
Altitude	798km
Inclination	98.6 degrees
Repeat cycle	24 days

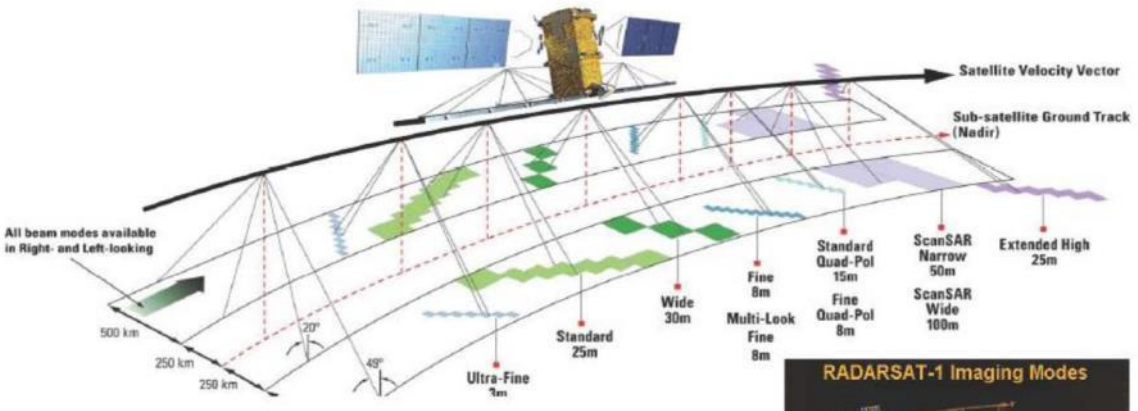
Radar Instrument Characteristics	
Frequency Band	C-band (5.405 GHz)
Channel Polarization	HH, HV, VH, VV

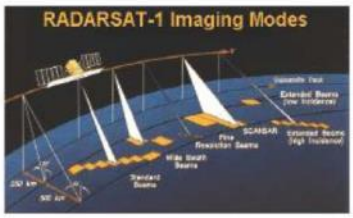
Product Characteristics	
Resolution	3 m – 100 m



Earth Observation Center

Radarsat-2 imaging modes

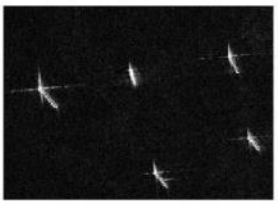




RADARSAT-2

DLR

Earth Observation Center

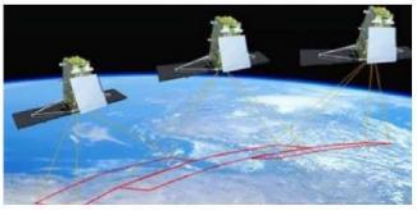


Vancouver, British Columbia, Canada
RADARSAT-2, Ultra-Fine
January 6, 2008

DLR

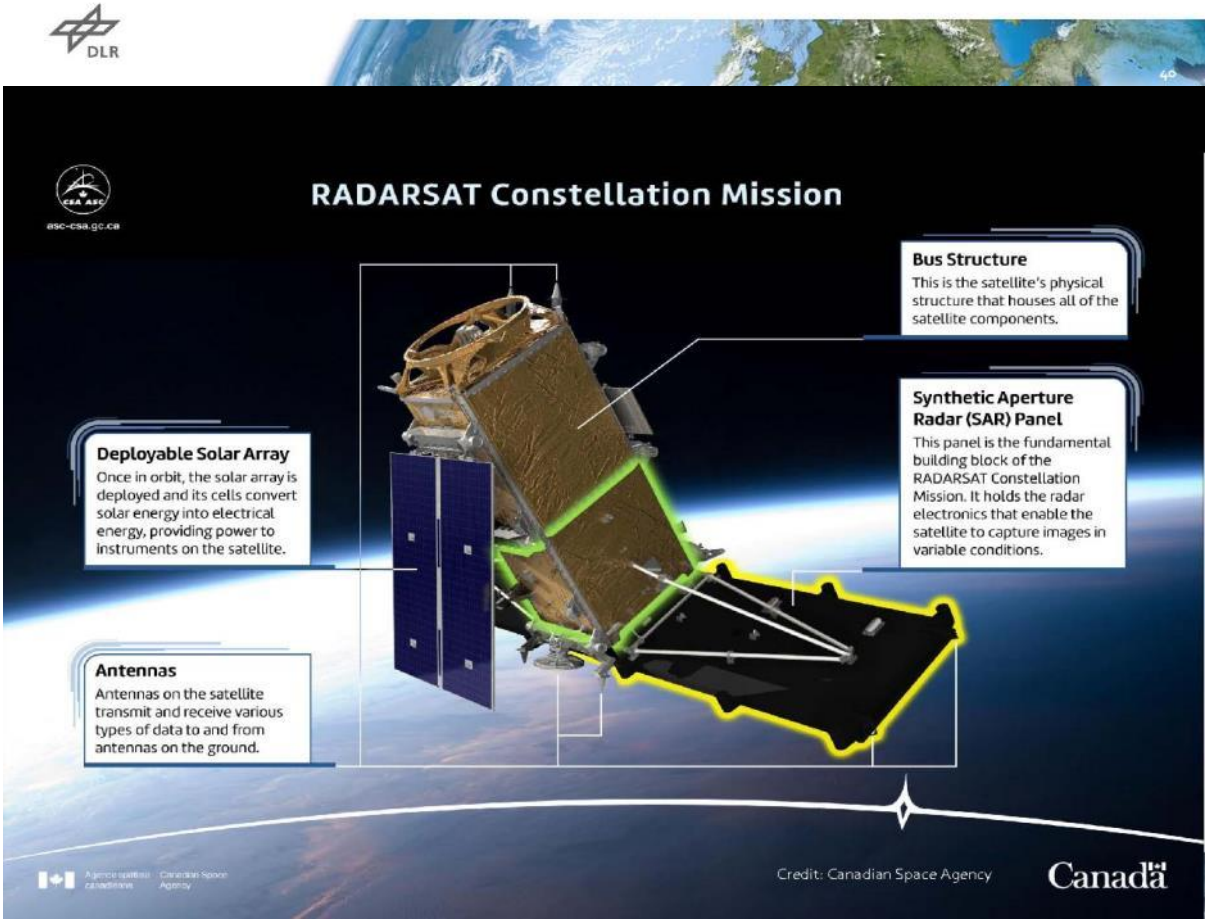
Earth Observation Center

Radarsat Constellation Mission

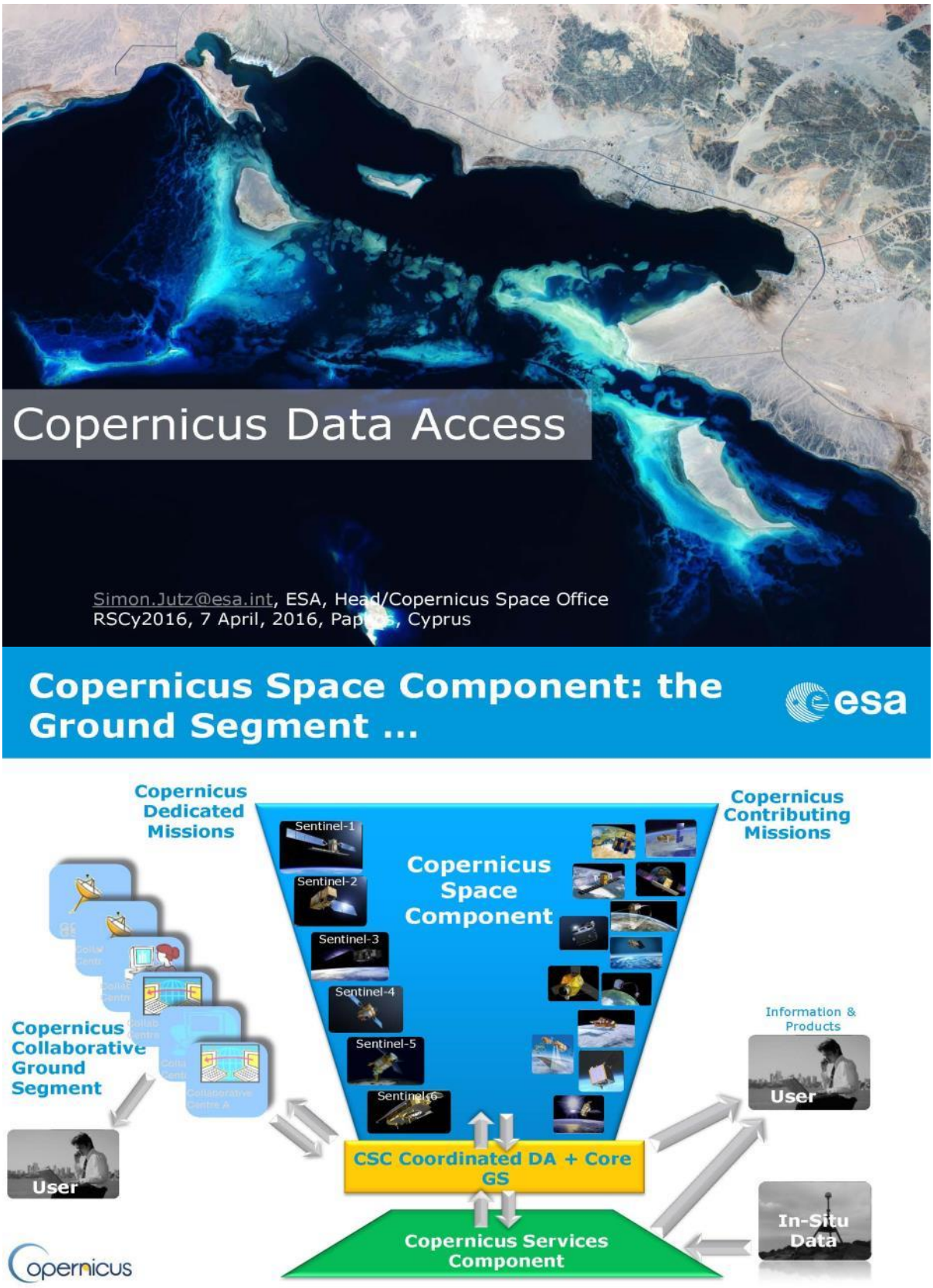


- Owner
  - Canadian Space Agency
  - Dual use
- Lauch date
  - Single launch in 2018
    7 years design lifetime
  - 600km SSO
- Satellites
  - Constellation of 3 C-Band SAR satellites
  - Based on Canadian SmallSat (1.400kg)
- Instrument
  - C-Band SAR, full polarization
  - Various imaging modes:
    - Spotlight: 1 * 3 m @ 14 km swath
    - Very low resolution: 100m @ 500km swath
  - Daily global coverage capability @ 50m res.
  - AIS on board

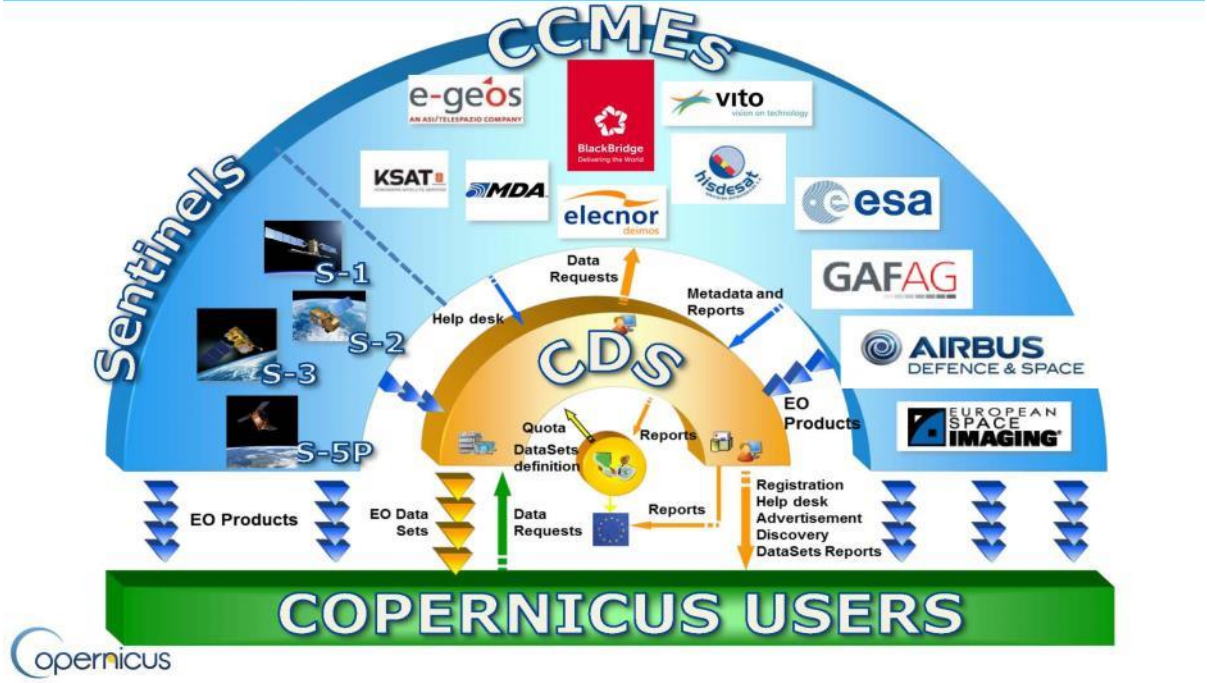
DLR



4.5 Access to Copernicus Data and Contributing Missions - Simon Jutz, ESA


Copernicus Data Access
Simon.Jutz@esa.int, ESA, Head/Copernicus Space Office
RSCy2016, 7 April, 2016, Paphos, Cyprus
Copernicus Space Component: the Ground Segment ...
esa
Copernicus Dedicated Missions
Copernicus Contributing Missions
Sentinel-1
Sentinel-2
Sentinel-3
Sentinel-4
Sentinel-5
Sentinel-6
Copernicus Space Component
Copernicus Collaborative Ground Segment
Information & Products
User
User
CSC Coordinated DA + Core GS
Copernicus Services Component
In-Situ Data
opernicus

… with the Coordinated Data Access



Sentinel Data Access - Overview

- The Copernicus Space Component Ground Segment data access is ensuring that **at any point in time any user has access to all available Sentinels core products**
  - List of Sentinel baseline core products agreed with the Commission and published on the Sentinel Online portal (sentinels.copernicus.eu)

- Access to Sentinel **products** is made available via dedicated data hubs:
  - Users can self-register to the data hubs
  - All core products of the last months of data is accessible via “rolling archives”
  - Data download via terrestrial network (output rates up to 10 Gbps)

- In addition, access to full **Sentinels long-term archive** will be made progressively available **to all users** (before removing products from data hubs rolling archives)
- Access to archive activated after approximately 1st year following each Sentinel’s IOCR

copernicus

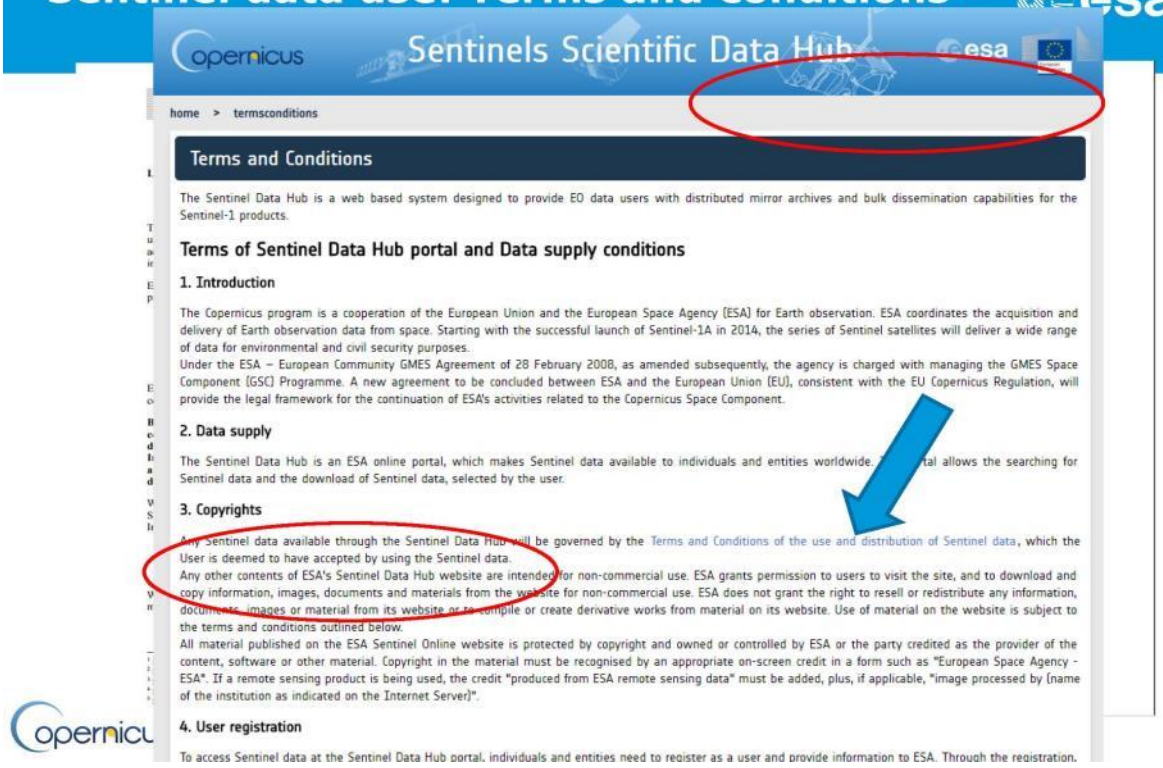
Copernicus Data Policy

Users shall have **free, full and open** access to Copernicus dedicated Sentinel data and Copernicus service information

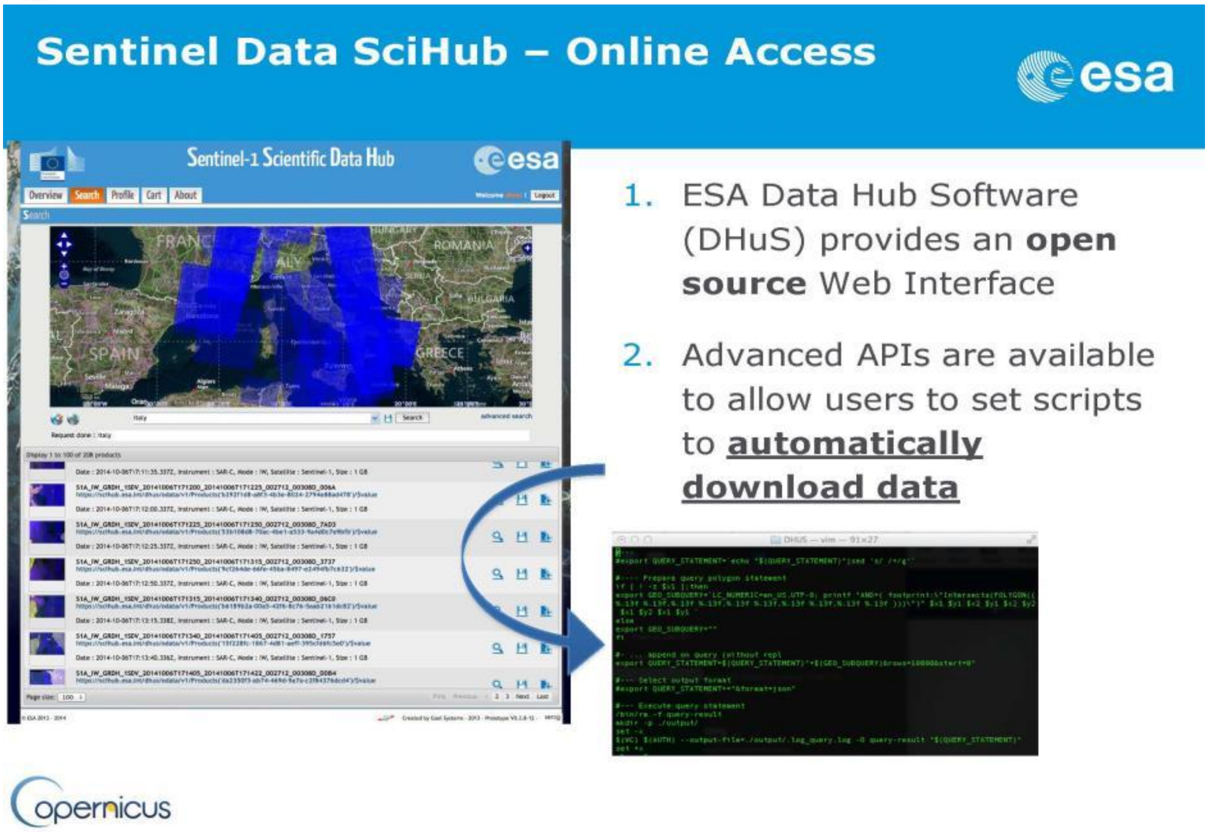
The **CSC Ground Segment architecture implements this policy**, and includes an **evolutionary approach** to further enhance the data exploitation by the broad user community

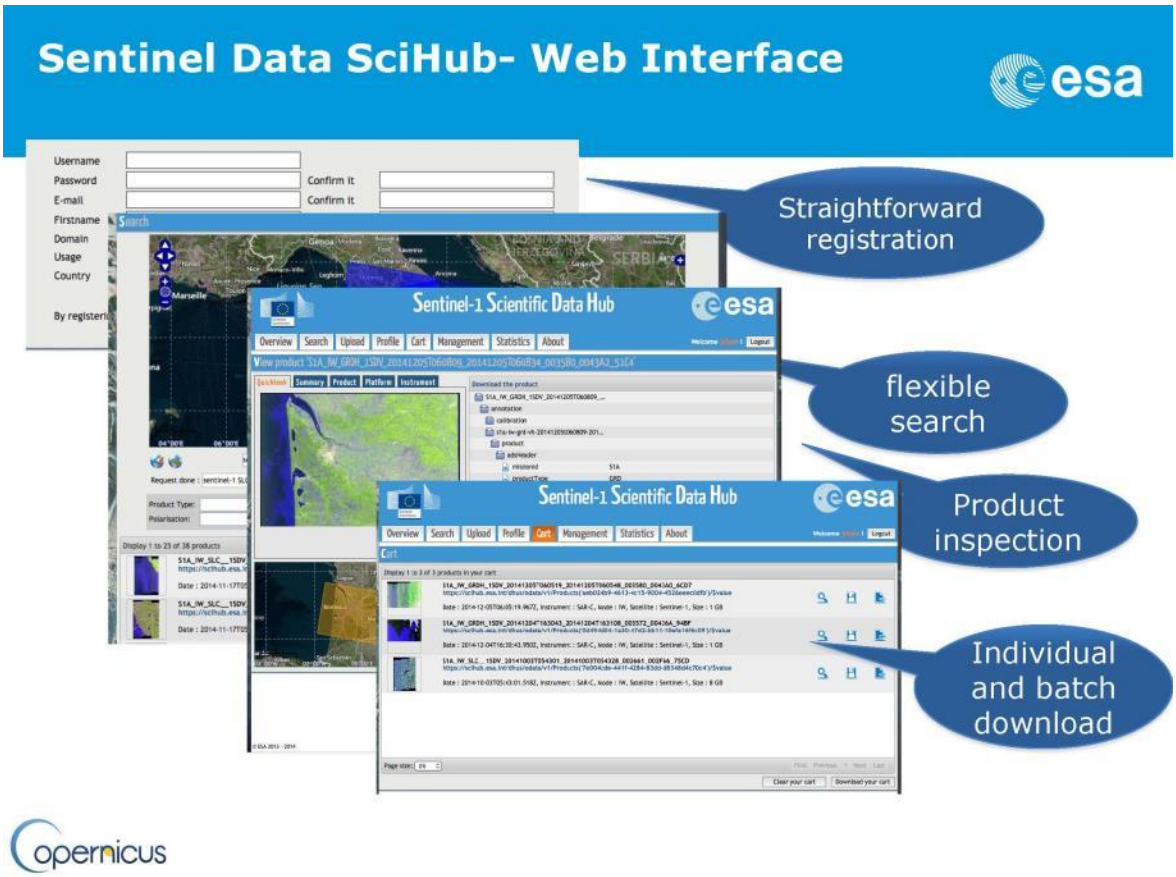
The CSC Ground Segment features **dedicated data access infrastructure solutions,** tailored to the needs of the various use typologies

Sentinel data use: Terms and conditions




Sentinel Online -
http://sentinels.copernicus.eu
esa
Sentinel Online
OPEN AND FREE
sentinel data hub
Scientific and Other Access
opernicus
...cess for ...ernicus Services
COMING SOON
Access for International Agreements
Access for Collaborative Ground Segment
click to access data
Sentinel Missions
Thematic Areas
EU Copernicus
ESA Copernicus
Observing the Earth
Earth Online
CSCDA
Disasters Charter
ESA Climate Change Initiative
Ground Segment Coordination Body (GSCB)
copernicus


Sentinel Data SciHub – Online Access
esa
Sentinel-1 Scientific Data Hub
Overview Search Profile Cart About
1. ESA Data Hub Software (DHuS) provides an open source Web Interface
2. Advanced APIs are available to allow users to set scripts to automatically download data
copernicus


Sentinel Data SciHub- Web Interface
esa
Straightforward registration
flexible search
Product inspection
Individual and batch download
Sentinel-1 Scientific Data Hub
Overview
Search
Upload
Profile
Cart
Management
Statistics
About
Copernicus


https://spacedata.copernicus.eu/
esa
copernicus
space component data access
Contact Us
About CSCDA
You are logged in as bhoersch
Logout
Register
Copernicus Users
Data Offer
How to Access Data
Data Provision Status
Explore More
Core DSs
Additional DSs
Welcome to the CSCDA Portal
This Portal presents the services offered within the Copernicus Space Component Data Access system (CSCDA) context. It explains the user's eligibility, data offer, data access mechanism and user support and is the entry point to the Copernicus User's Personal Area. Further to this, the Portal provides full visibility of all Copernicus Contributing Missions (CCMs) and the status of data provision.
DEDICATED SENTINEL MISSIONS
The Sentinels are a series of Earth observation satellite missions developed for the specific needs of Europe's Copernicus programme.
Read more
Latest News
Discover the new Mercator Ocean Journal celebrating its 20 years anniversary
A new Sentinels Data Hub for the Copernicus Services is in operations
Release of Data Warehouse phase 2 Data Access Portfolio v2.0
Rise and shine for Sentinel-3A
Availability of products under VHR_IMAGE_2015
Operational News
CDS Infrastructure - Planned maintenance beginning on Monday 1st February
The Sentinel Data Dissemination Service

Data Ware House Phase 2: Core Data Sets

Optical HR Pan Europe coverage (HR_IMAGE_2

Continuation of pan-European land services, including production of High Resolution Layers (HRL) on land co EEA and Member States. This dataset could also partia

Read more

European HR2 Multitemporal Coverages (EUR_HR2_MULTITEMP)

Continuation of previous pan-European land services and land use/land cover mapping efforts. Multitemporal agricultural studies and crop classification. The objective of the wall-to-wall Multitemporal HR2 image acquisition is to cover the entire AOI on a monthly basis during the 2015 vegetation period.

Read more

Optical VHR multispectral and panchromatic co (VHR_IMAGE_2015)

Land local component applications for hotspots, i.e. sp European level (EEA39) (land cover over riparian zone monitoring, monitoring of coastal areas, risk areas, pro Land Parcel Identification…) and at national level.

Read more

VHR1-2 Urban Atlas 2012

Mapping for city planning at local scale

Read more

European optical MR1 composites (MR_IMAGE_

Pan-European land services and EFFIS. Intra-seasona production of High Resolution Layers (HRL) on land co EEA and Member States, in particular for vegetation rel characteristics, such as grasslands or semi-natural veg

Read more

SAR HR2/MR1 Worldwide coverage (HR2-MR1_SAR_GLOBAL)

Global Land coverage from Sentinel-1A

Read more

Optical MR2 Worldwide coverage (MR_OPTICAL

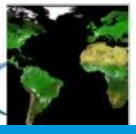
Global Land, for the production of bio-geophysical para

Read more

Sea Ice Monitoring HR1/MR2 SAR (SAR_SEA_ICE)

Sea ice monitoring to support marine activities and data assimilation for ice and weather forecast models.

Read more



Optical LR worldwide coverage (LR_OPTICAL_G

Global Land, for the production of bio-geophysical para

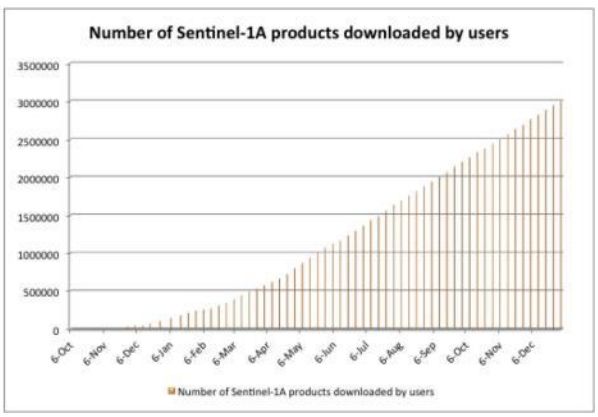
HR1/HR2 Optical Worldwide coverage (HR1/HR2_OPTICAL_GLOBAL)

Global Land Coverage from Sentinel-2A

CSC operations status: Data Access Statistics

esa

- Access to Sentinel-1 and Sentinel-2 products to all users open as of 3rd October 2014 and 3rd December 2015 respectively
- Users and Products Statistics (status 24 March 2016)
  - 28.000 registered users. This represents a 50% increase in the last quarter
  - 464.000 Sentinel-1 and 19.000 Sentinel-2 products available for download
  - More than 3.8 million products downloaded, representing approx. 4.7 PB of data
  - On average **30 TB of products are disseminated daily,** each product is accessed 10 times



Common User Service Charter

❑ An overall user service charter for Copernicus Space Component data access:

User REGISTRATION and MANAGEMENT	Management of user accounts
DISCOVERY Service	Dataset and product search + visibility of planned acquisitions
VIEW Service	Visualization of browse image
DOWNLOAD Services	Interactive Download via web browser or the Download Manager.
EMERGENCY Service	Opening of an emergency "dossier" upon user call and management of data collection (tasking, selection from archive). **Restricted to eligible users**
DATASET GENERATION Service	Generation of geographical/temporal data collections according to pre-defined interest/application
HELP DESK Service	Support and communications to users including dedicated Web Portal. Management of inquiries, feedback, and suggestions.
RSS and HOSTED PROCESSING Services	Research Support Service and Hosted Processing Service operations **Provided according to specific governance criteria**

Conclusions: Data Access continuous evolution

❑ The Copernicus Space Component data access **is based on 3 main pillars**

- ✓ Latest data availability from online rolling archives
- ✓ Access to long term data archive
- ✓ Reduce download needs – bring the users to the data

❑ The Copernicus Space Component data access **is in continuous evolution**

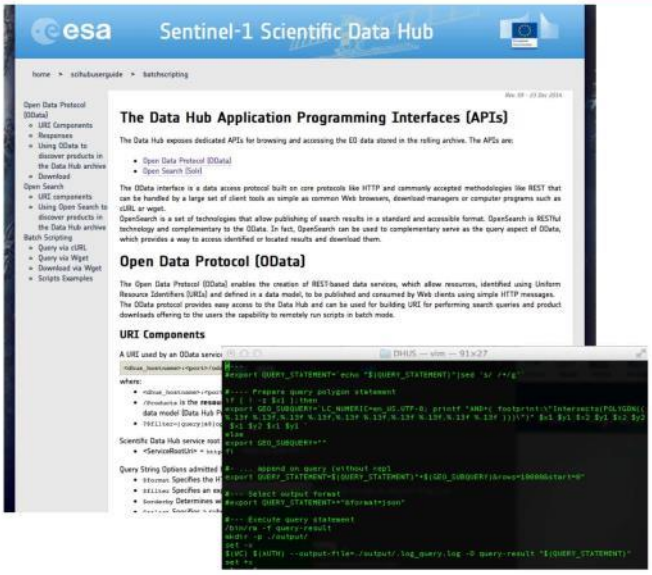
- ✓ To adapt to evolving user scenario and needs
- ✓ To introduce latest IT technologies
- ✓ To implement a continuous performance improvement process

❑ The Copernicus Space Component data access **enhancements**

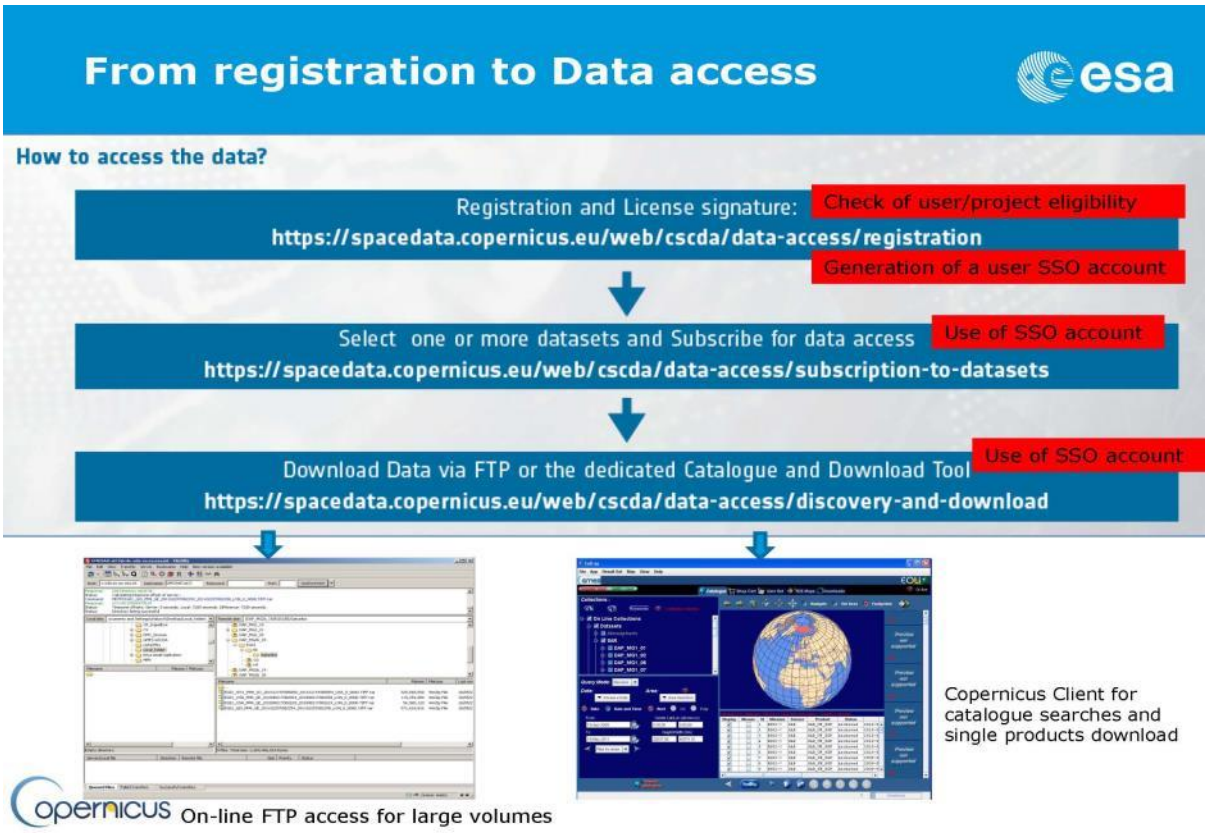
- ✓ Are coordinated with the Commission via a change management process defined in the EU-ESA Copernicus Agreement
- ✓ Need to guarantee agreed performances measured via specific KPIs
- ✓ Shall not compromise the overall reliability, performances and network security

Interested In More?

Open Access – Programming Interface



1. Cross platform Application Programming Interface compatible with many programming styles
    a. Script, Java, App …
2. Simple Authentication
3. OpenSearch
4. OpenData
5. Example scripts available for download


From registration to Data access
esa
How to access the data?
Registration and License signature:
https://spacedata.copernicus.eu/web/cscda/data-access/registration
Check of user/project eligibility
Generation of a user SSO account
Select one or more datasets and Subscribe for data access
https://spacedata.copernicus.eu/web/cscda/data-access/subscription-to-datasets
Use of SSO account
Download Data via FTP or the dedicated Catalogue and Download Tool
https://spacedata.copernicus.eu/web/cscda/data-access/discovery-and-download
Use of SSO account
Copernicus
On-line FTP access for large volumes
Copernicus Client for catalogue searches and single products download

6 German EO mission contributions to Copernicus and DLR Copernicus projects - Gunter Schreier, DLR

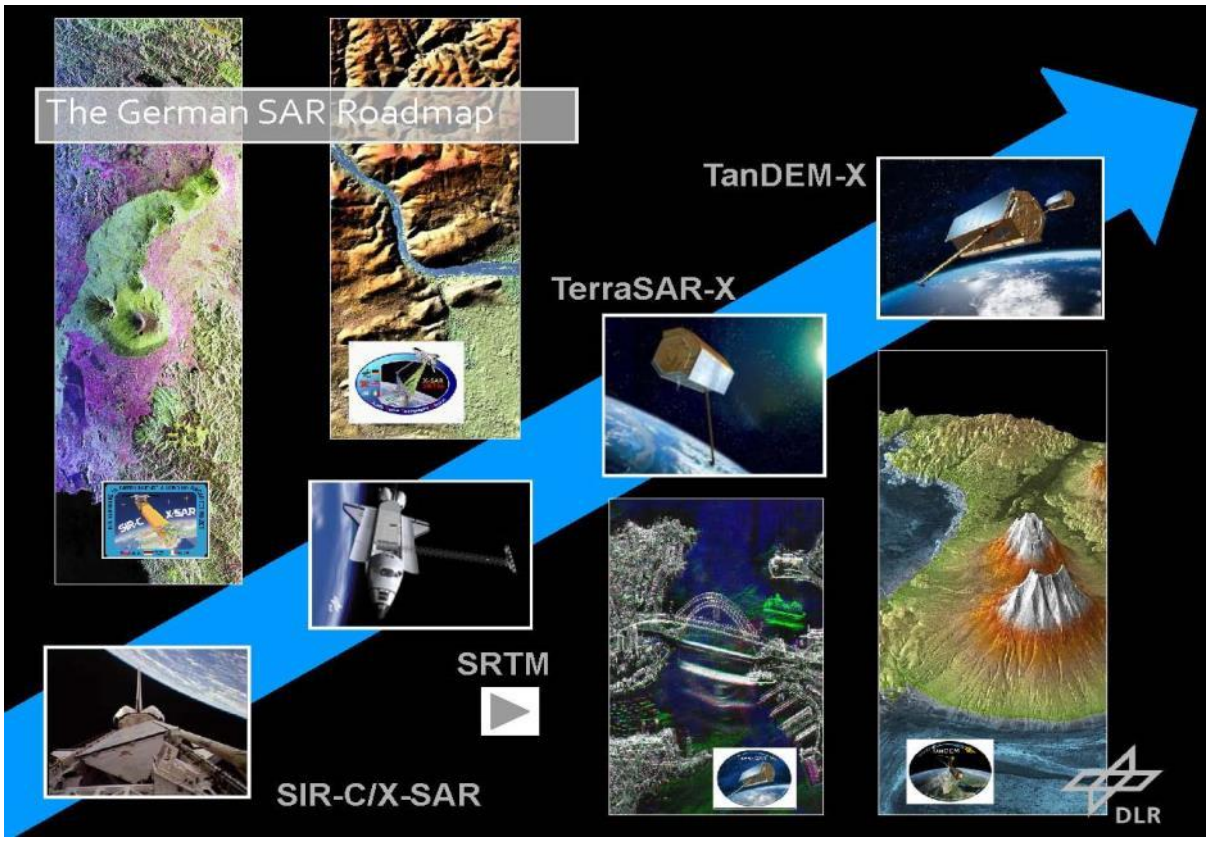
German EO mission contributions to Copernicus and DLR Copernicus projects

Earth Observation Center

Germany

- TerraSAR-X
- TanDEM-X
- Tandem-L
- RapidEye
- EnMAP
- MUSES
- FireBird

DLR



Earth Observation Center

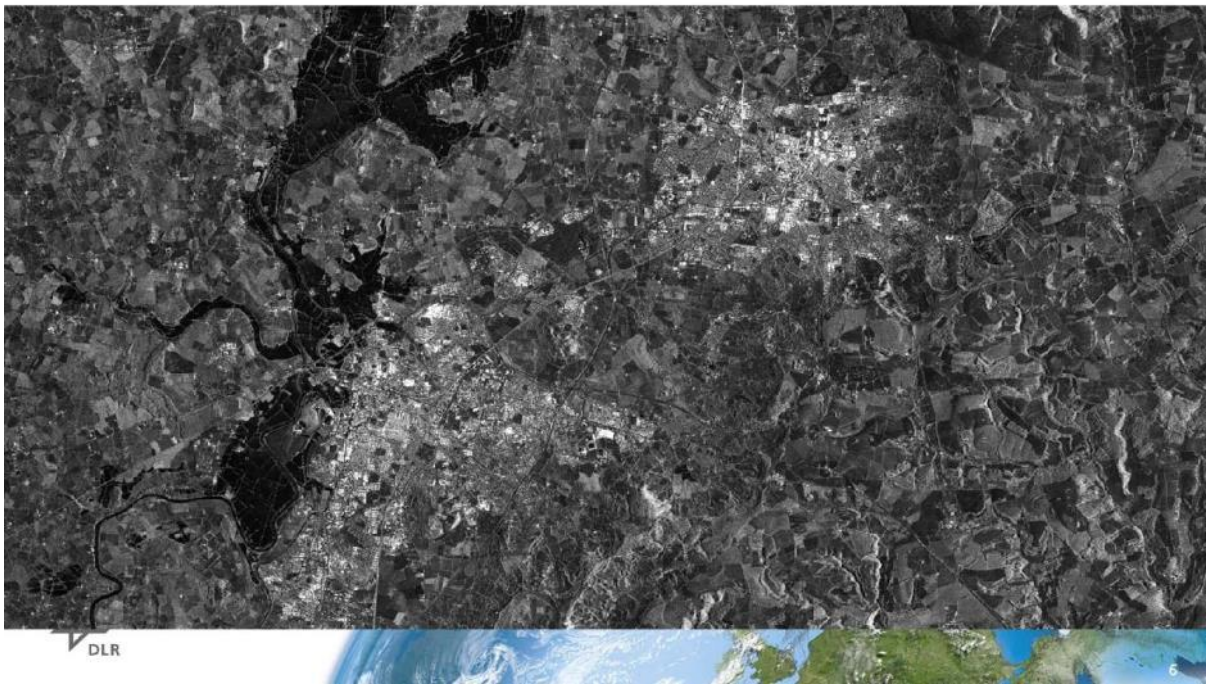
TerraSAR-X Radar Imaging Satellite

Earth Observation Center

First TerraSAR-X Data Take Area as seen by MODIS

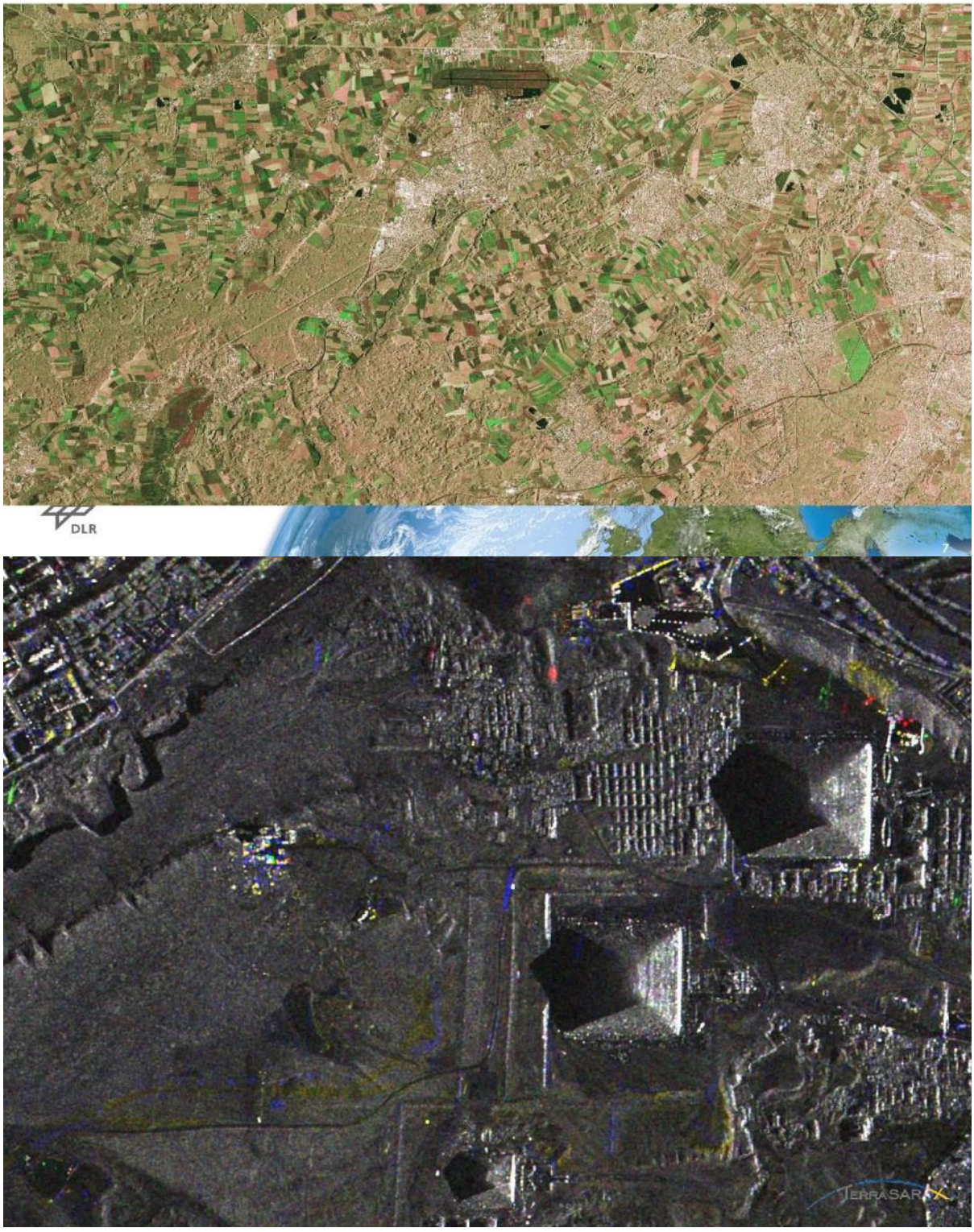
Earth Observation Center

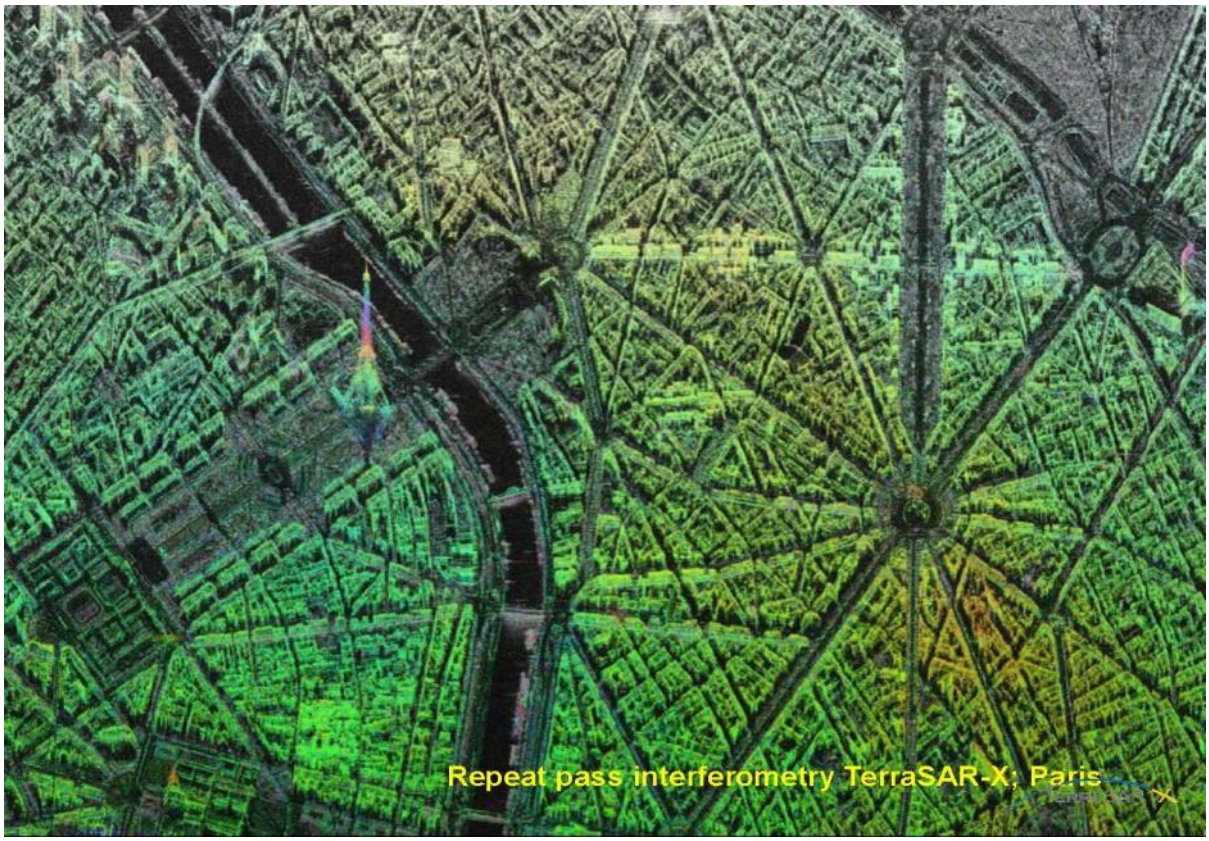
... and with TerraSAR-X



Earth Observation Center

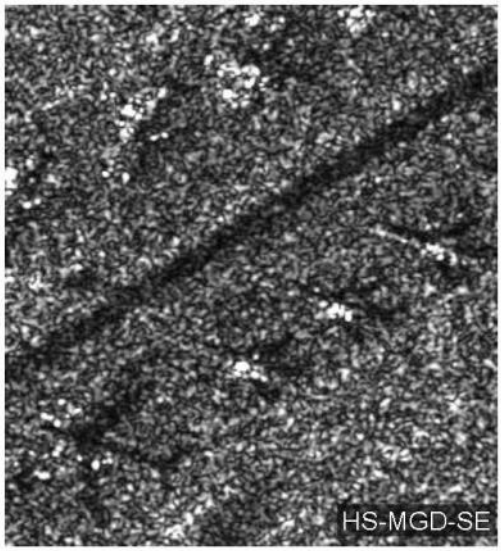
Oberpfaffenhofen, multipol



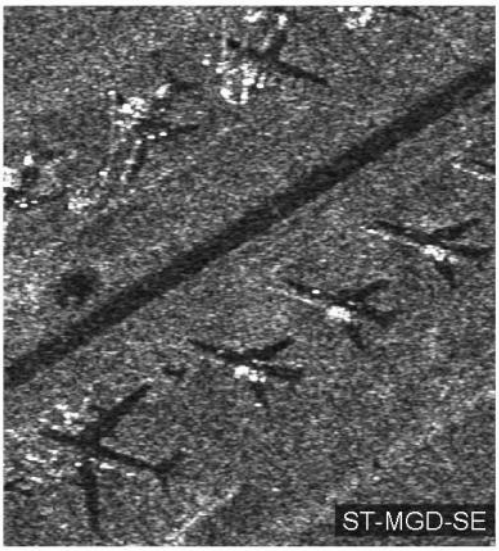


Earth Observation Center

New TerraSAR-X-Staring-Spotlight-Product in 2013



1,2m (az) x 1,2m (rg) @ 1,0 ENL



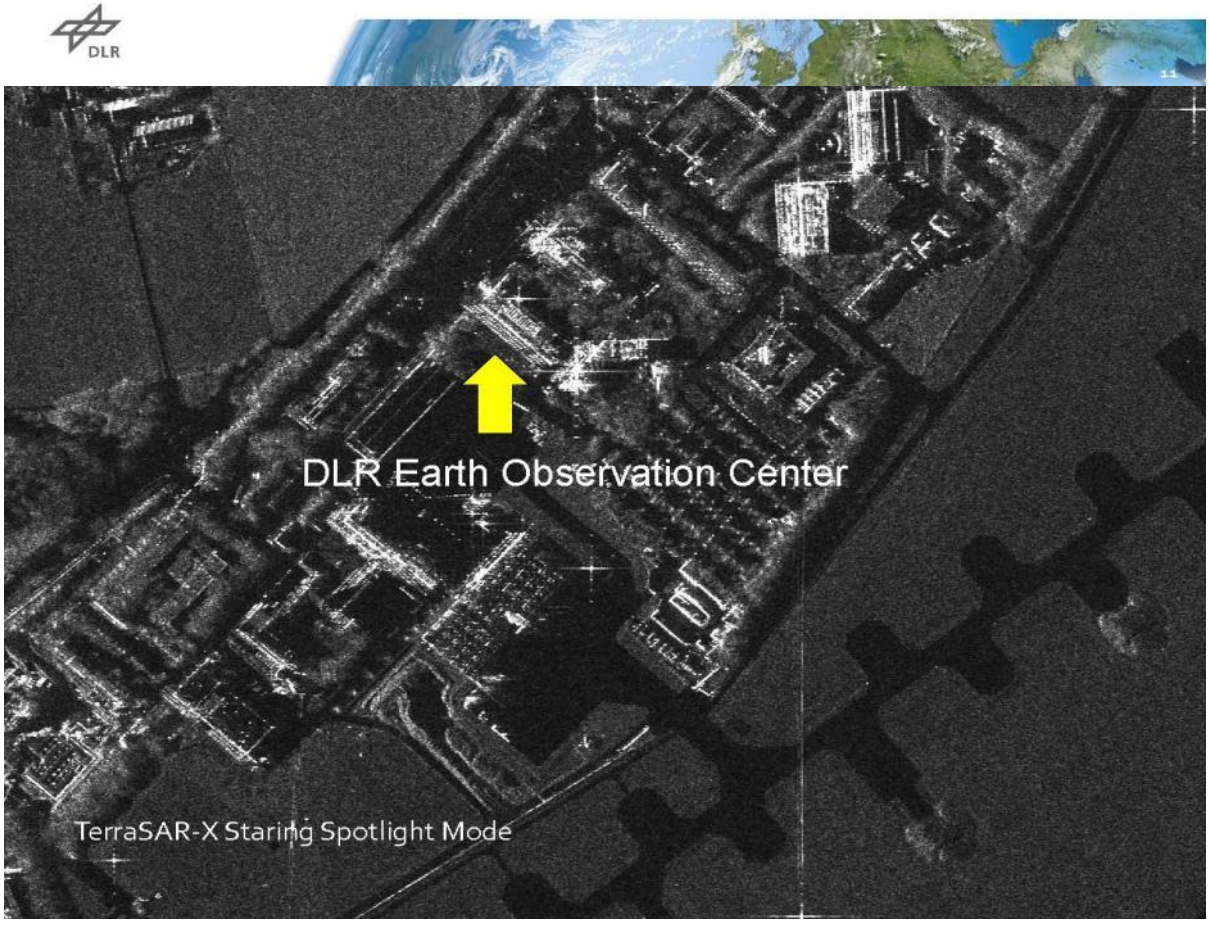
0,5m (az) x 1,2m (rg) @ 2,4 ENL

DLR

Earth Observation Center

New Product: TerraSAR-X Staring Spotlight Mode
size 3x5 km resolution < 1 m

DLR



Earth Observation Center

Satellite Data Security Act

The permit … must be granted if the dissemination of data in the individual case does not harm the vital security interests of the Federal Republic of Germany, does not disturb the peaceful coexistence of nations and does not substantially impair the foreign relations of the Federal Republic of Germany.

Ein Service der juris GmbH - www.juris.de -

Gesetz zum Schutz vor Gefährdung der Sicherheit der Bundesrepublik Deutschland durch das Verbreiten von hochwertigen Erdfernerkundungsdaten (Satellitendatensicherheitsgesetz - SatDSiG)

SatDSiG

Ausfertigungsdatum: 23.11.2007

Vollzitat:

"Satellitendatensicherheitsgesetz vom 23. November 2007 (BGBl. I S. 2590)"

Fußnote

Textnachweis ab: 1.12.2007

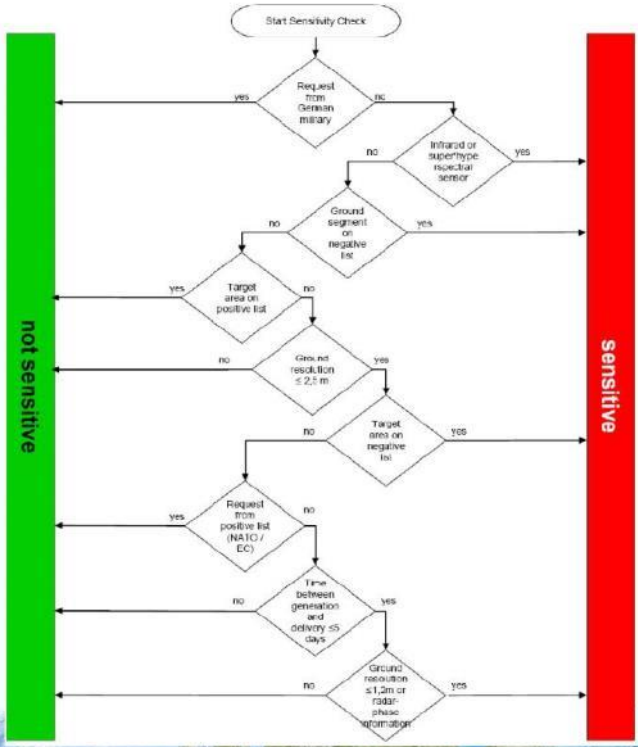
Inhaltsübersicht

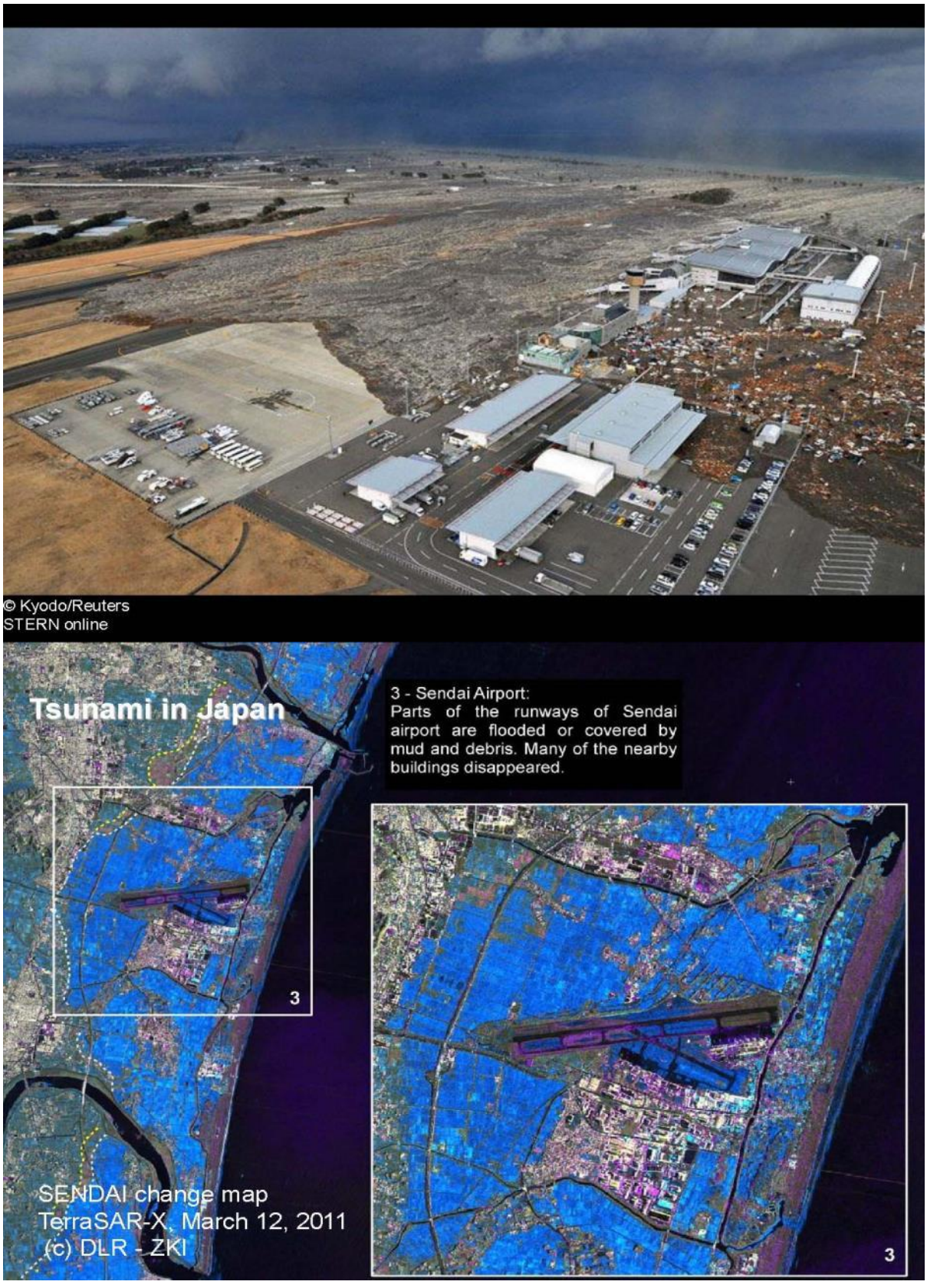
-1-

Earth Observation Center

SatDSiG Check

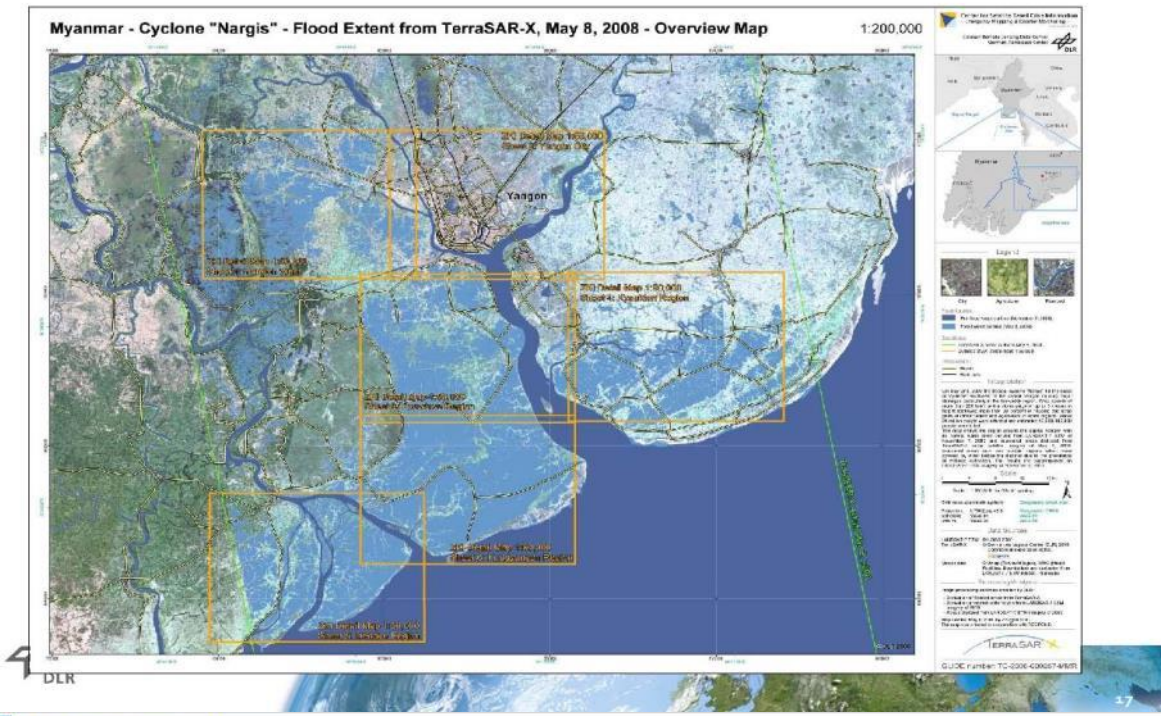
- Special users and sensors?
- Area Sensed?
- Resolution and Phase. < 2,5 m/ 1,2 m (SpotLight Mode)?
- User?
- „Sensitive" does not deny the acceess, but requires individual check by BAFA

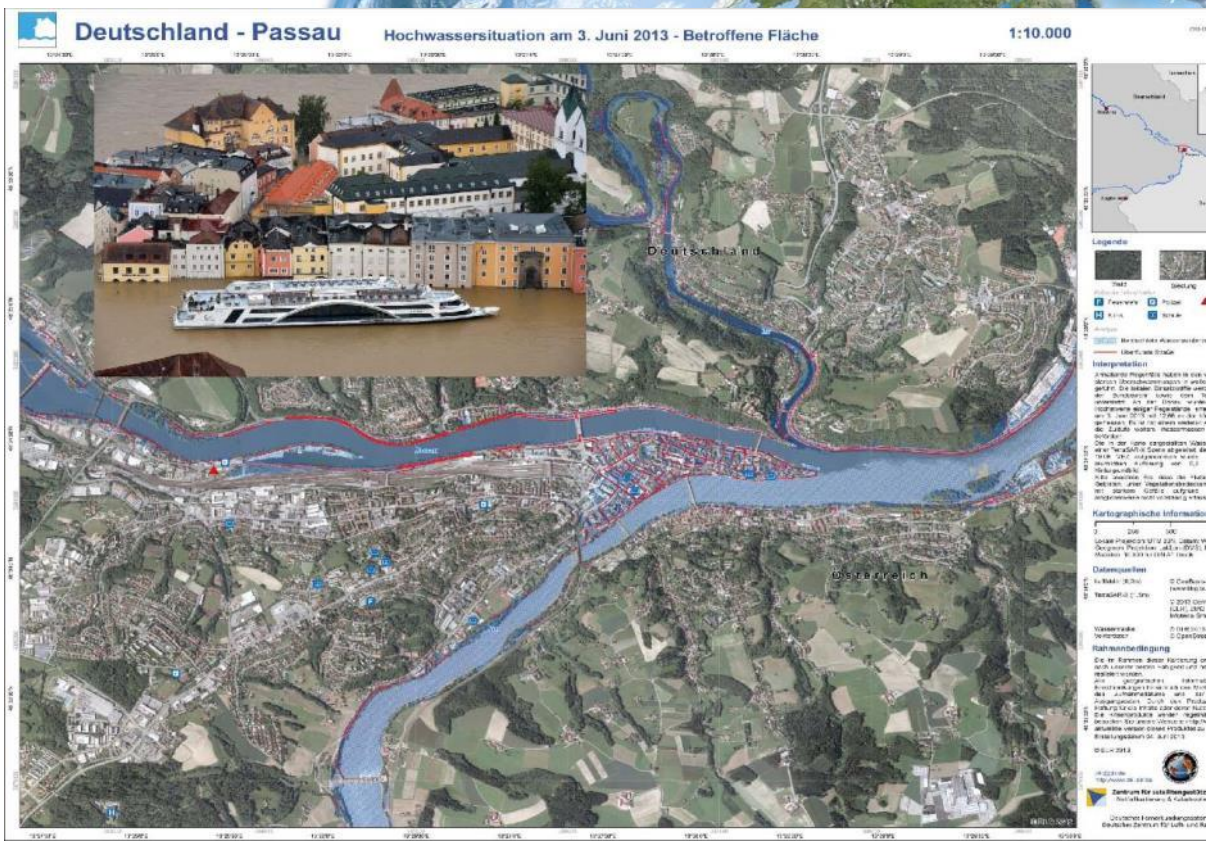



© Kyodo/Reuters
STERN online
Tsunami in Japan
3 - Sendai Airport:
Parts of the runways of Sendai airport are flooded or covered by mud and debris. Many of the nearby buildings disappeared.
3
SENDAI change map
TerraSAR-X, March 12, 2011
(c) DLR - ZKI
3

Earth Observation Center

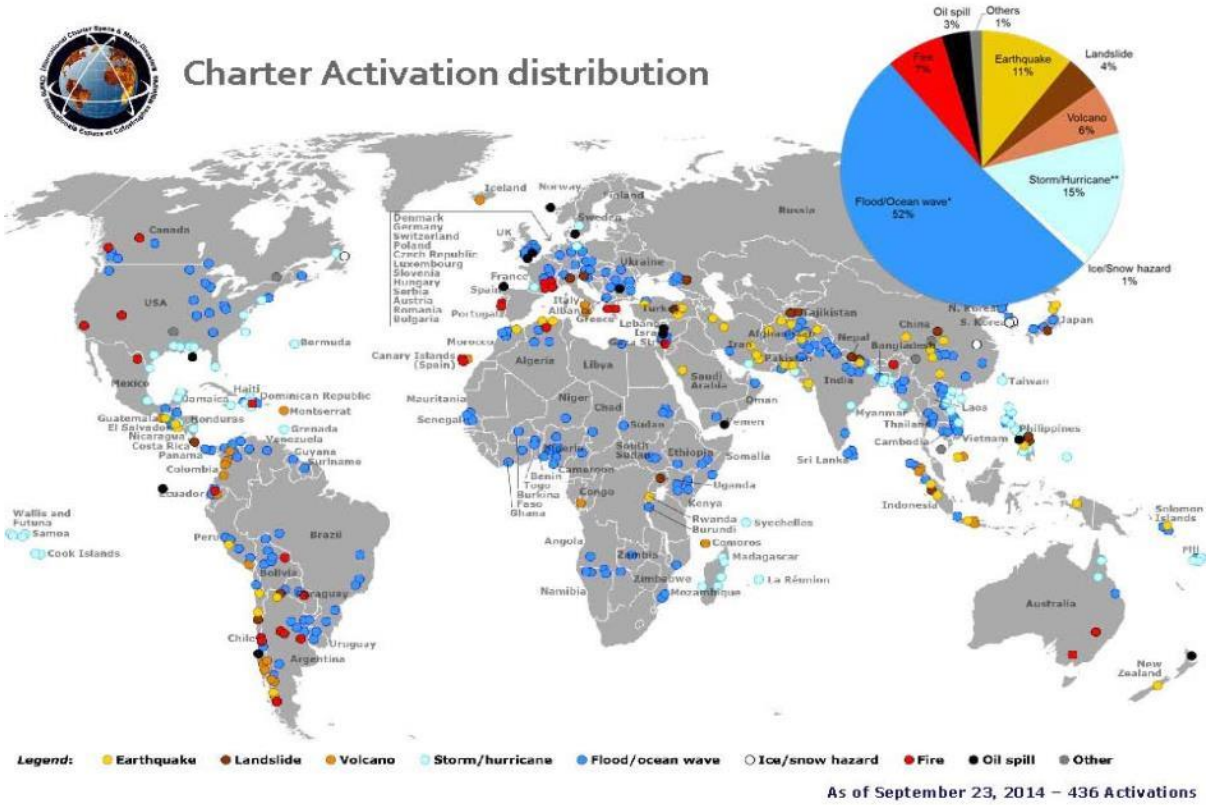
Cyclone Nargis over Myanmar – May 2008

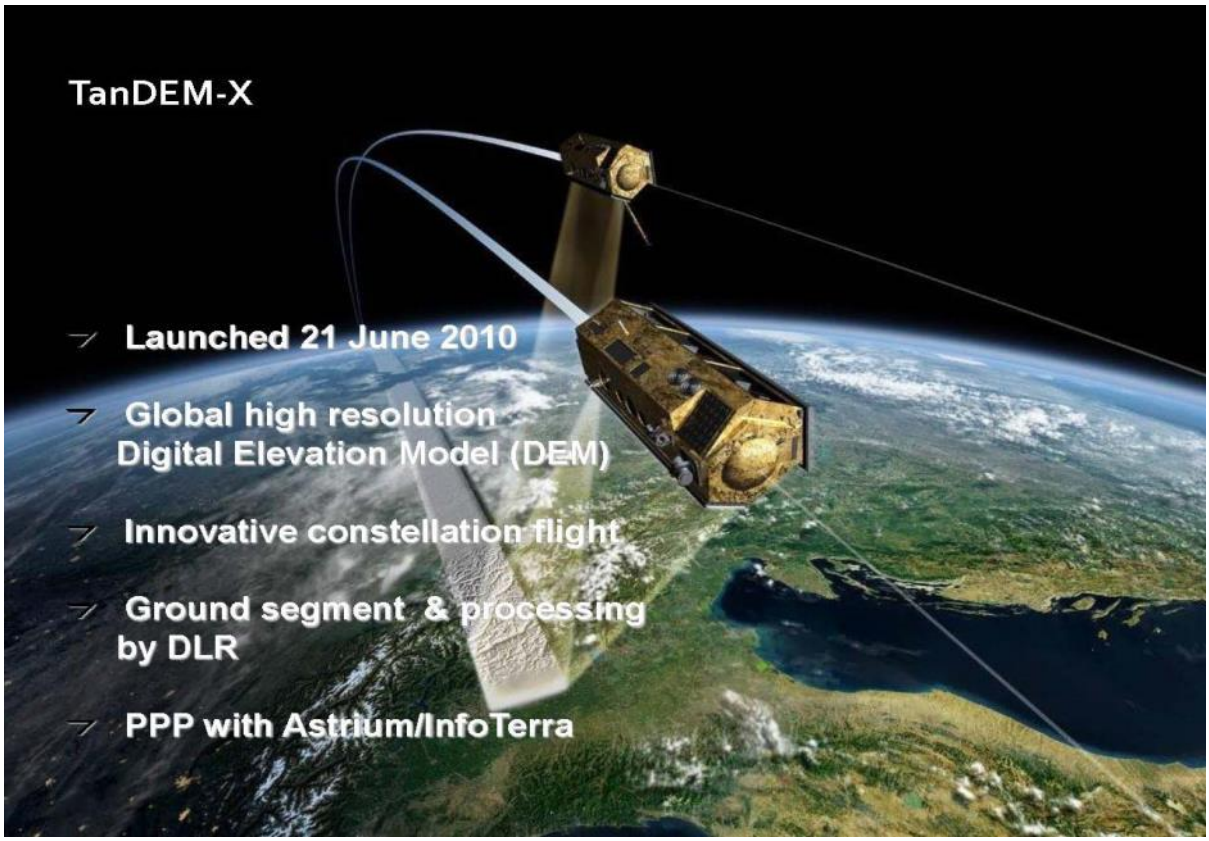





DEUTSCHLAND - Halle (Saale)
Hochwassersituation am 05. Juni 2013 - Betroffene Fläche
1:30.000
Saale
Legende
ZKI
Zentrum für Satellitenbasierte Kriseninformation
www.zki.dlr.de

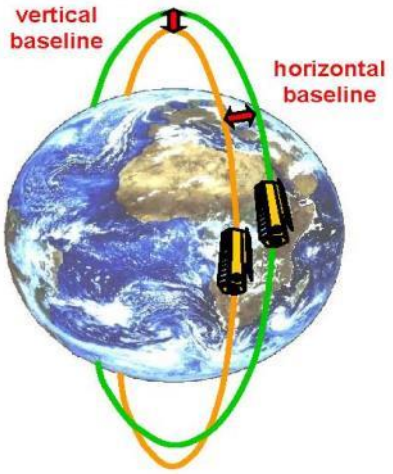

International Charter on
Space and Major
Disasters
KARI
CSA ASC
INPE
cnes
JAXA
EUMETSAT
esa
USGS
science for a changing world
International Charter Space & Major Disasters
Charte Internationale Espace et Catastrophes Majeures
UK SPACE
dmc
International Imaging
NOAA
DLI
DLR
CONAE
An International agreement among participating Space Agencies to provide space-based data and information in support of relief efforts during emergencies caused by major disasters.

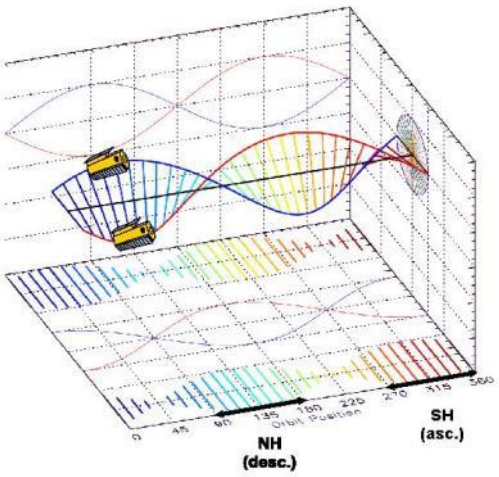

Charter Activation distribution
Oil spill 3%
Others 1%
Earthquake 11%
Landslide 4%
Volcano 6%
Storm/Hurricane** 15%
Flood/Ocean wave* 52%
Ice/Snow hazard 1%
Legend: Earthquake Landslide Volcano Storm/hurricane Flood/ocean wave Ice/snow hazard Fire Oil spill Other
As of September 23, 2014 – 436 Activations



Earth Observation Center

Collision Avoidance

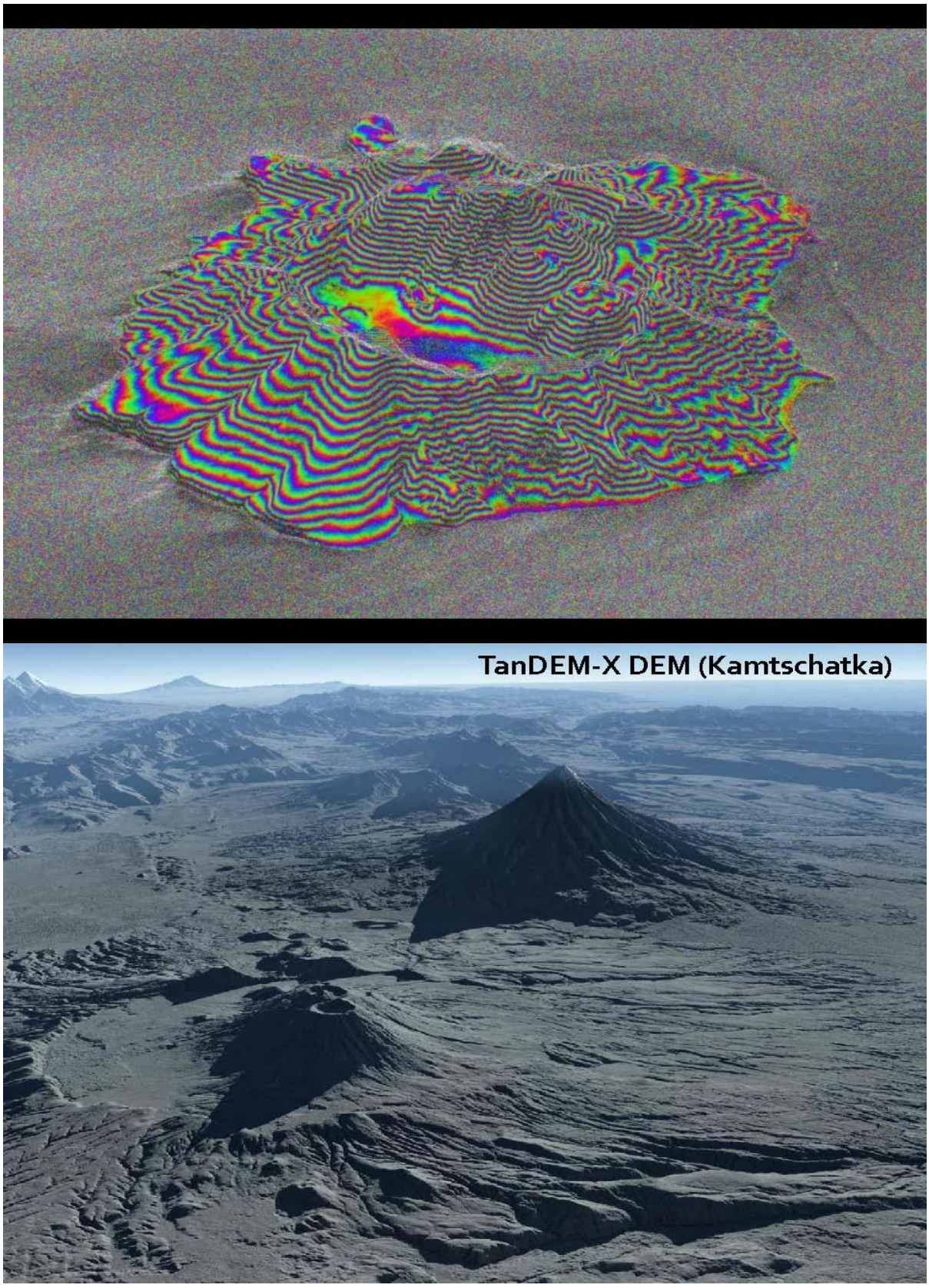




HELIX satellite formation enables safe operation

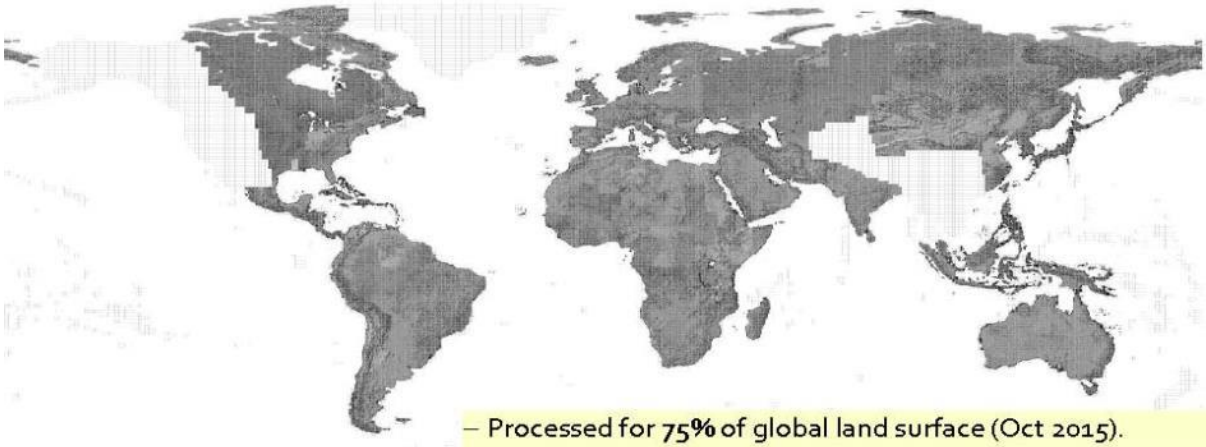
- *horizontal cross-track separation at equator by different ascending nodes*
- *vertical (radial) separation at poles by orbits with different eccentricity vectors*

DLR


TanDEM-X DEM (Kamtschatka)

Earth Observation Center

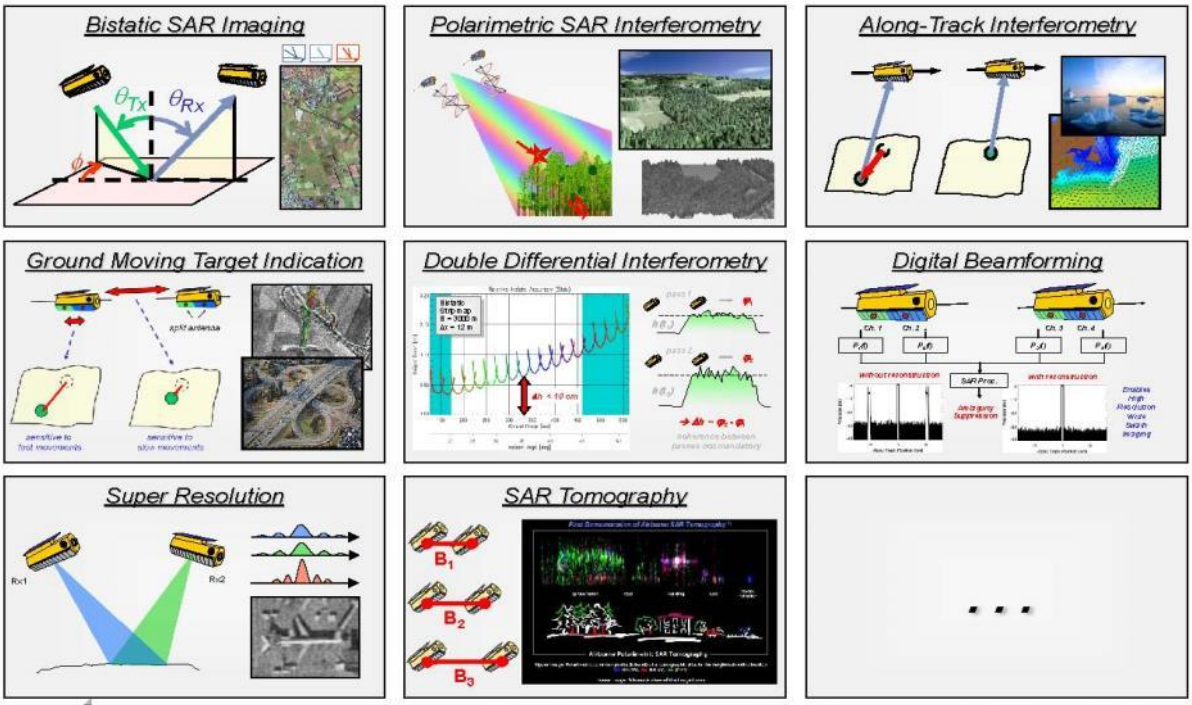
Final TanDEM-X DEM Product (1°x1° Tiles with 12 m resolution)



- Processed for **75%** of global land surface (Oct 2015).
- Global absolut height error at +/- 1,13m (Spec is +/- 10m for 90% of data)
- 98,6% of tiles meet all quality/accuracy criteria

DLR

Earth Observation Center



DLR


Human Footprint: Urbanization
Global Urban Footprint
– Binary mask of all artificial (vertical) structures
– Spatial resolution 0.4 arcsec (12.5 m)
– Global coverage by ~180.000 TerraSAR-X annd TanDEM-X Data takes (~300 TB).
– SAR Coverage by TerraSAR-X and TanDEM-X between 2011 and 2013;
GUF
Worldbank
Global Urban Footprint (GUF), based on TanDEM-X SAR data © DLR

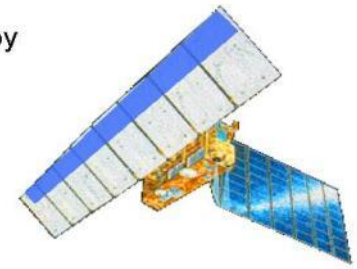
Earth Observation Center

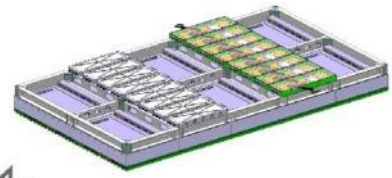
Global Urban Footprint (GUF), Cyprus based on TanDEM-X SAR data © 2015 DLR

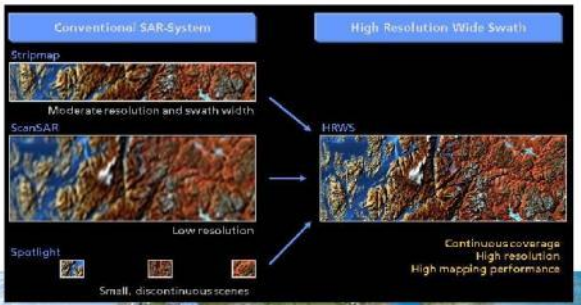
Earth Observation Center

HRWS: "High Resolution Wide Swath"

- SAR performance potential beyond today's limitations by incorporating Digital Beamforming functions
- integrated antenna demonstrator in final development
  - to be realized and tested by end 2015
- aiming for a HRWS mission around 2022+
  - start Phase 0/A by 2016/17







DLR

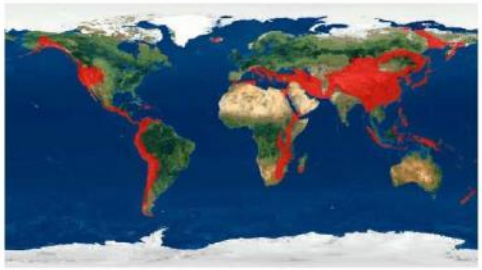
Earth Observation Center

Tandem-L: SAR- Technology to respond to global challenges

Tandem-L-Proposal:
L-Band-SAR for operational monitoring of

- Earth quakes/ volcanoes
- biomass
- cryosphere
- soil moisture

In cooperation with national and international partners

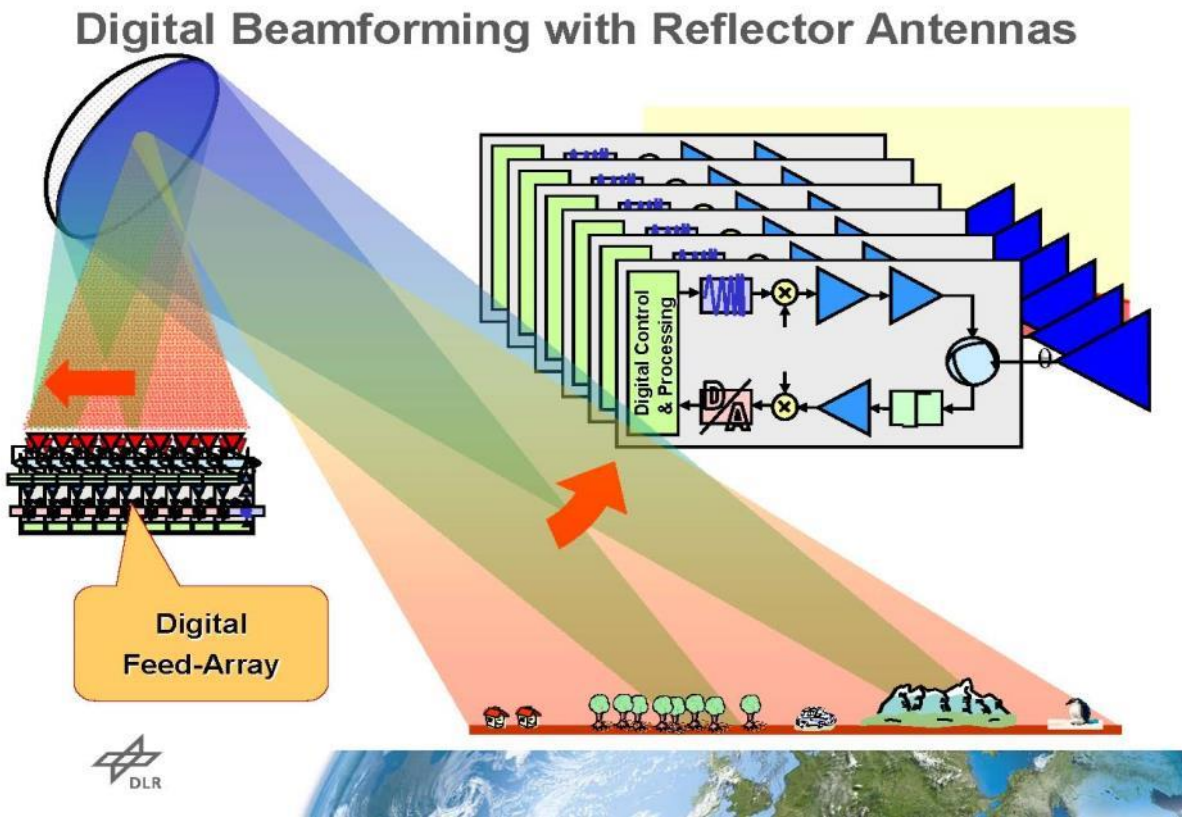


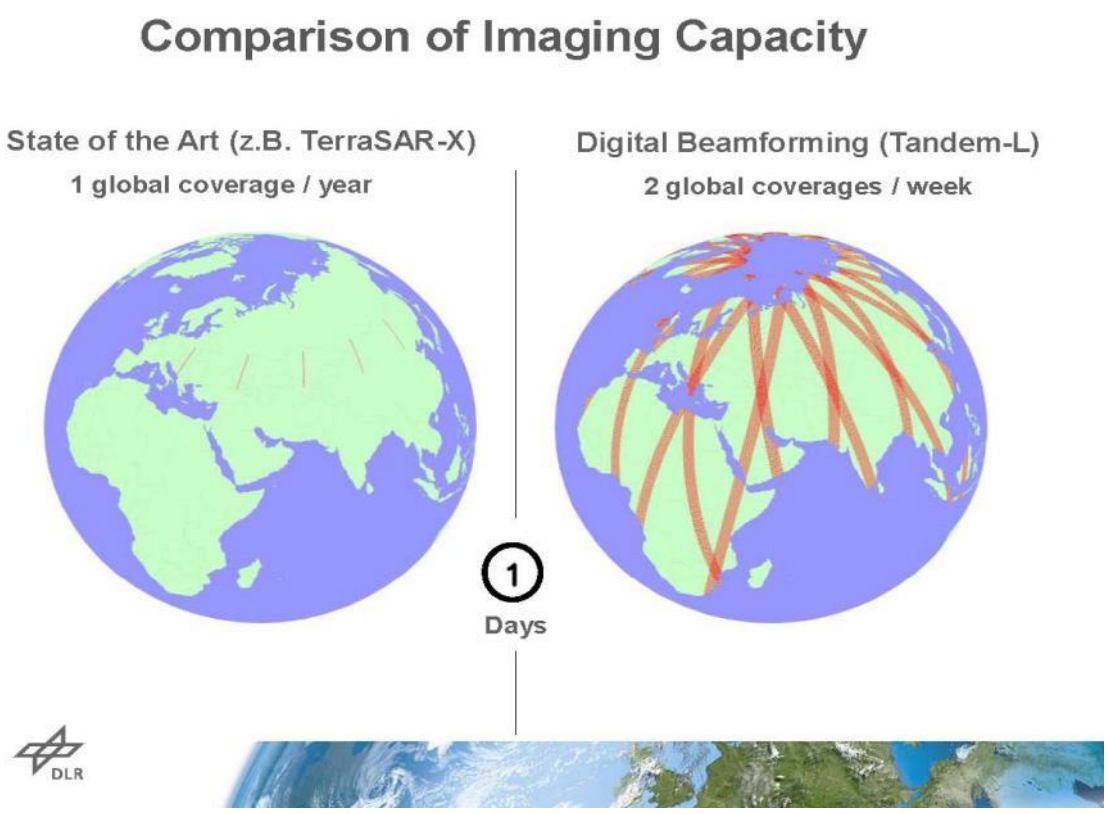
DLR

Earth Observation Center

Tandem-L-Formation

DLR


Digital Beamforming with Reflector Antennas
Digital Control & Processing
Digital Feed-Array
DLR


Comparison of Imaging Capacity
State of the Art (z.B. TerraSAR-X)
1 global coverage / year
Digital Beamforming (Tandem-L)
2 global coverages / week
1
Days
DLR

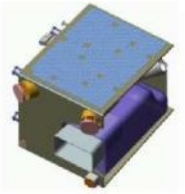
Earth Observation Center

RapidEye

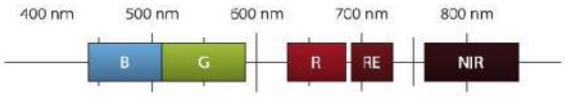
RapidEye™
geo facts turned into knowledge

- **Owner**
  - Initially: PPP between German companies and DLR
  - After insovancy: Canadian (Blackbridge) and German investors
  - Since mid 2015: PlanetLabs
- **Constellation**
  - Five active micro satellites in constellation, 3 planes
- **Lauch date**
  - August 2008
- **Prime Instrument**
  - Optical 5 bands
  - 6,5 m res. / 80km swath
  - 5 mio sqkm/ day imaging capacity
- **Science data access: DLR/ RESA**

BlackBridge
Delivering the World

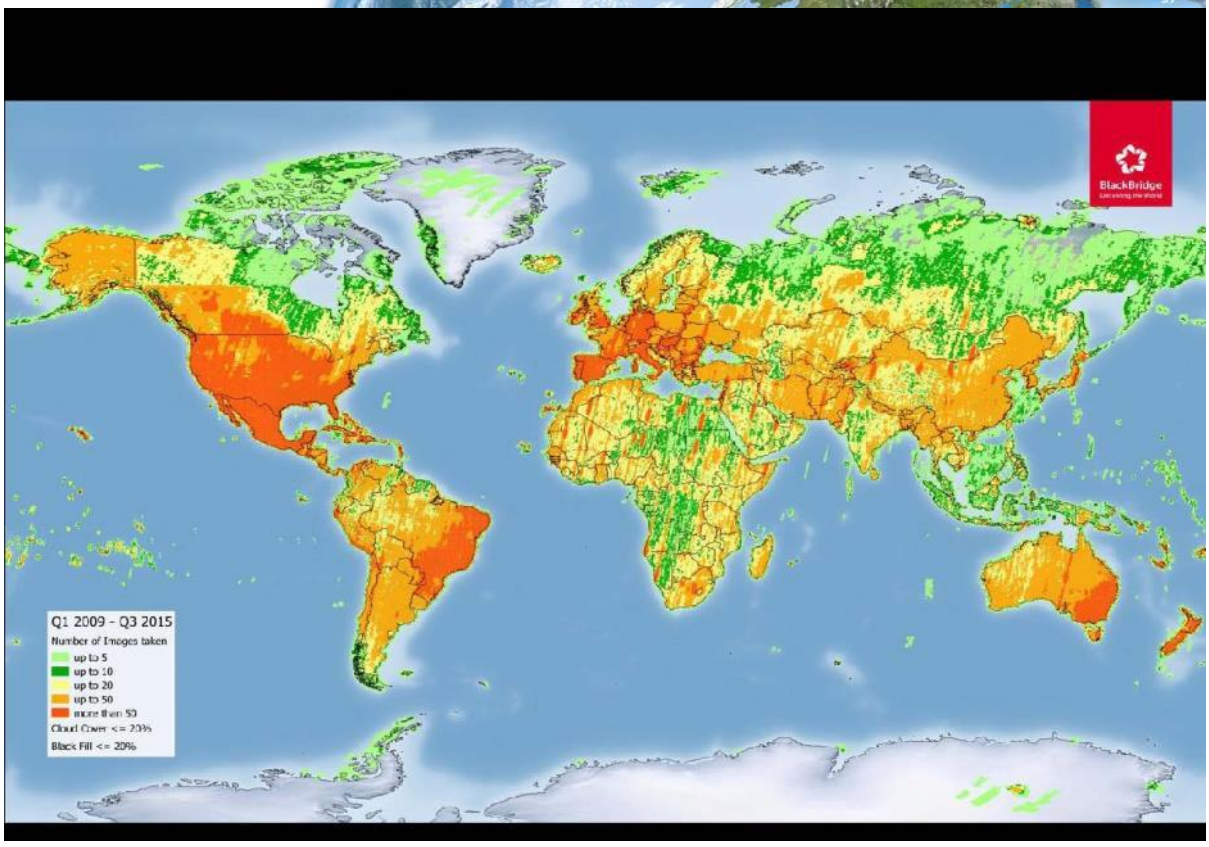


PLANET LABS



DLR

37

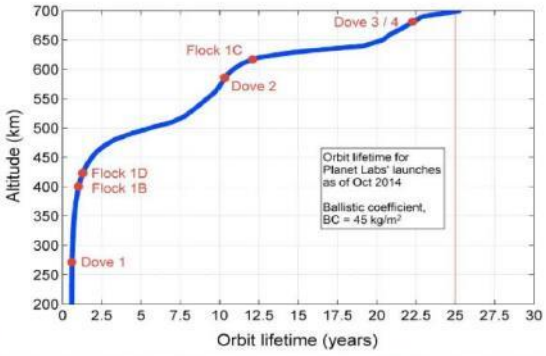



BlackBridge
Delivering the World
Auckland, New Zealand | Collected on July 14, 2012
BlackBridge
Delivering the World
Turkey RapidEye Mosaic

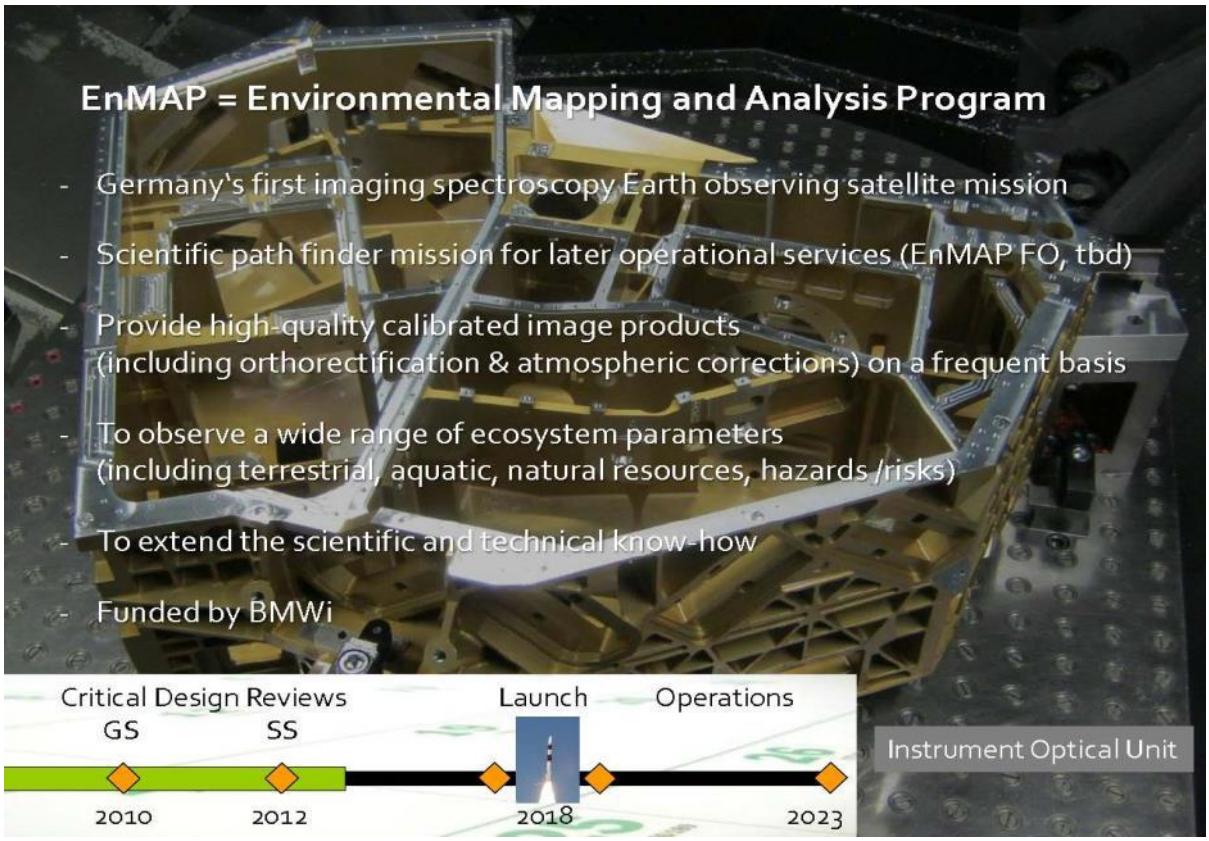
Earth Observation Center

Doves - PlanetLabs

- **Owner**
  - PlanetLabs, USA (founded 2010)
  - Venture Capital 183mioUS$ (Oct 2015)
  - Agile Aerospace
- **Constellation**
  - Multiple of 3U cubsats: doves
  - > 100 doves launched (< 100 still active)
  - Daily global coverage in 2016
- **Lauch**
  - Various, piggy pack to ISS supply and other launchers
- **Orbit**
  - Polar
  - ISS
- **Prime Instrument**
  - Optical red, green, blue @ 12 bit
  - 3-5 m res.

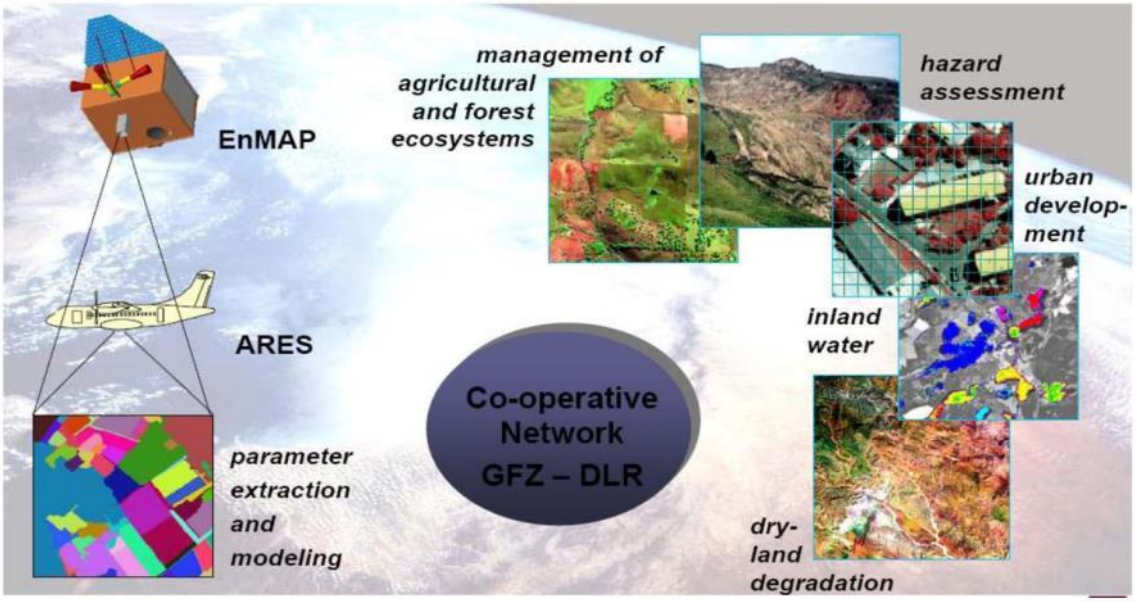


DLR

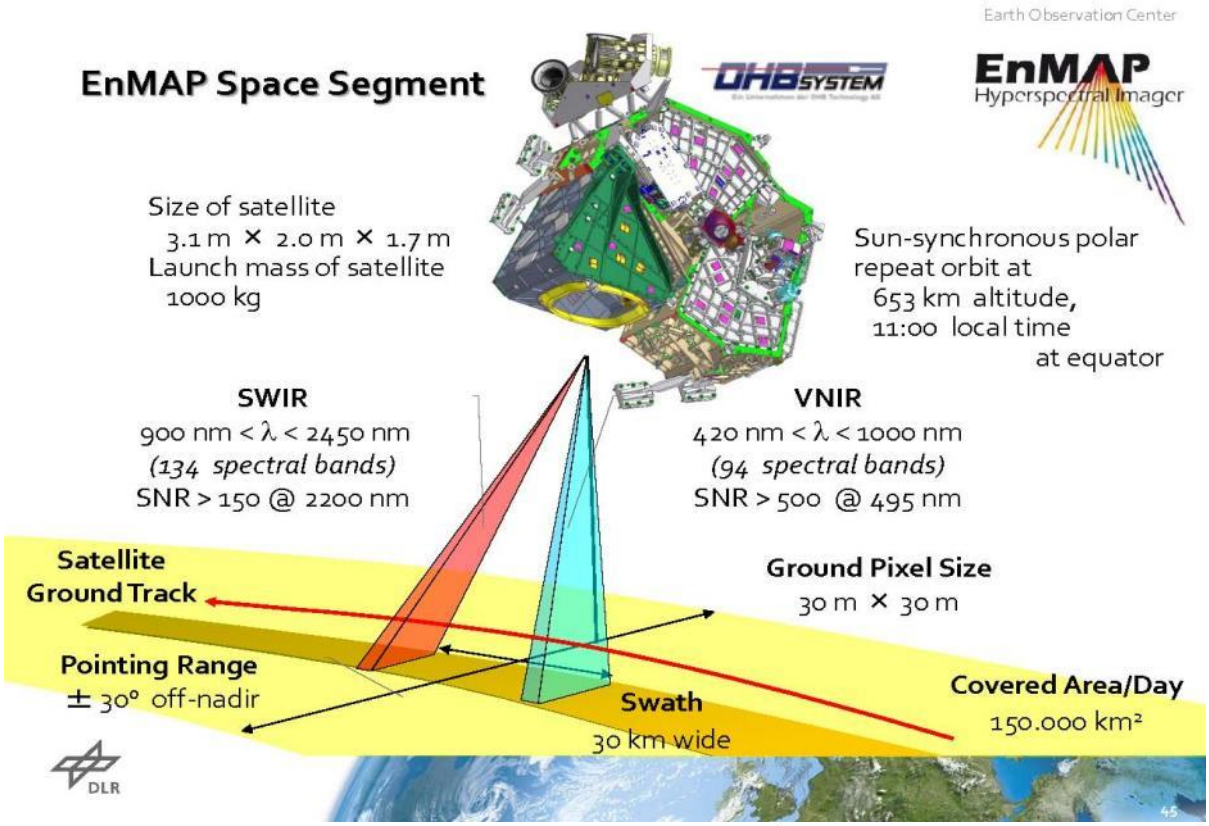


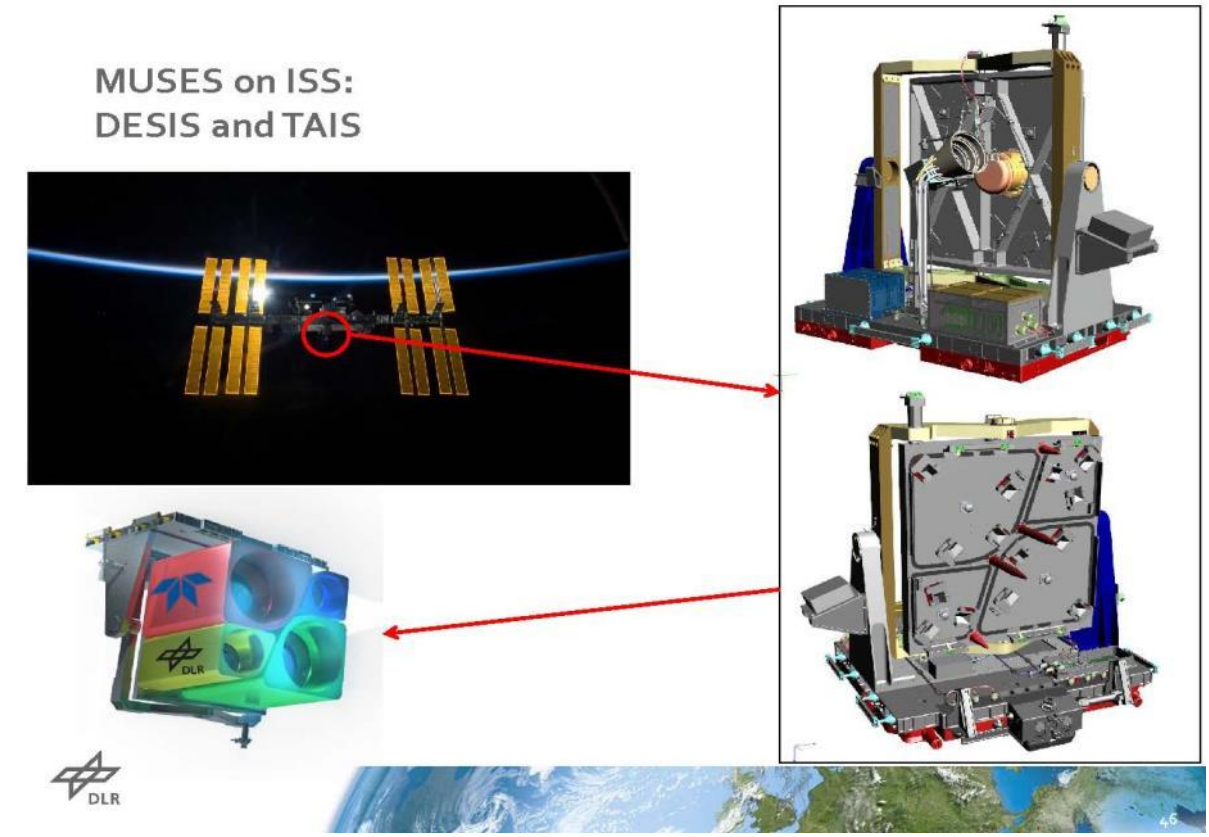
Earth Observation Center

EnMAP Science and Applications



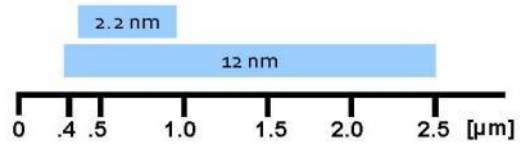
DLR

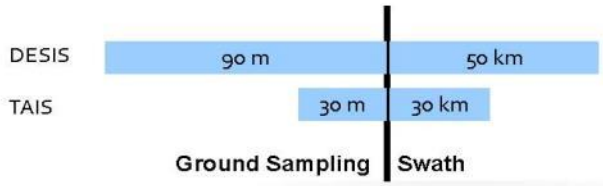

Earth Observation Center
EnMAP Space Segment
OHB SYSTEM
EnMAP
Hyperspectral Imager
Size of satellite
3.1 m × 2.0 m × 1.7 m
Launch mass of satellite
1000 kg
Sun-synchronous polar
repeat orbit at
653 km altitude,
11:00 local time
at equator
SWIR
900 nm < λ < 2450 nm
(134 spectral bands)
SNR > 150 @ 2200 nm
VNIR
420 nm < λ < 1000 nm
(94 spectral bands)
SNR > 500 @ 495 nm
Satellite
Ground Track
Ground Pixel Size
30 m × 30 m
Pointing Range
± 30° off-nadir
Swath
30 km wide
Covered Area/Day
150.000 km²
DLR

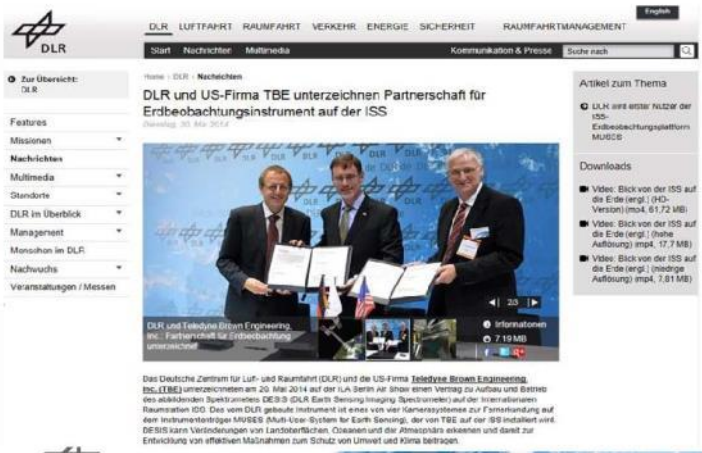

MUSES on ISS:
DESIS and TAIS
DLR

Earth Observation Center

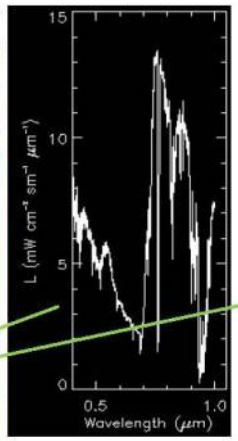
DESIS and TAIS Parameter



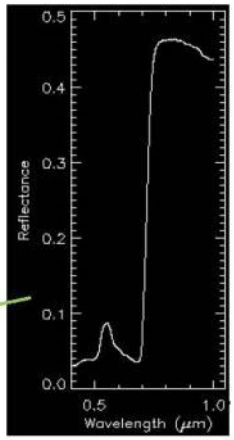




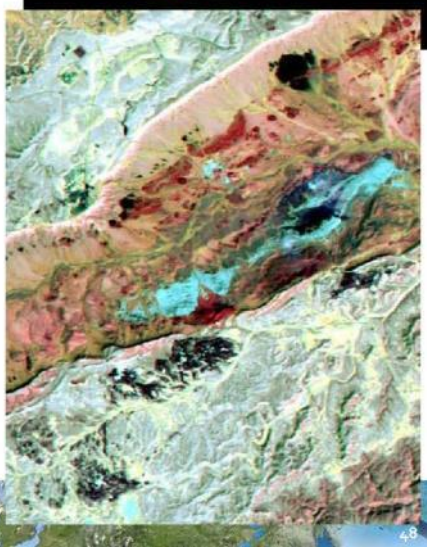
Earth Observation Center



Simulated DESIS Data based on HICO



Simulated TAIS Data based on HyMap



Earth Observation Center

FireBIRD Mission

- Constellation of 2 Satellites:
  - TET-1 (Launch 22. Juli 2012),
  - BIROS (launch planned 2016 with PLSV)
- Orbit:
  - 505 km, sun synchronous, orbiting in 94,6 Minutes
- Senors:
  - 2 Infrared cameras and a 3-channel VIS-Camera

Band Nr.	Spektrale Eigenschaft	Wellenlänge(nm)
1	Grün	460 - 560
2	Rot	565 - 725
3	Nahes Infrared (NIR)	790 - 930
4	Mittleres Infrarot (MW)	3400 - 4200
5	Langwelliges Infrarot (LW)	8500 - 9300

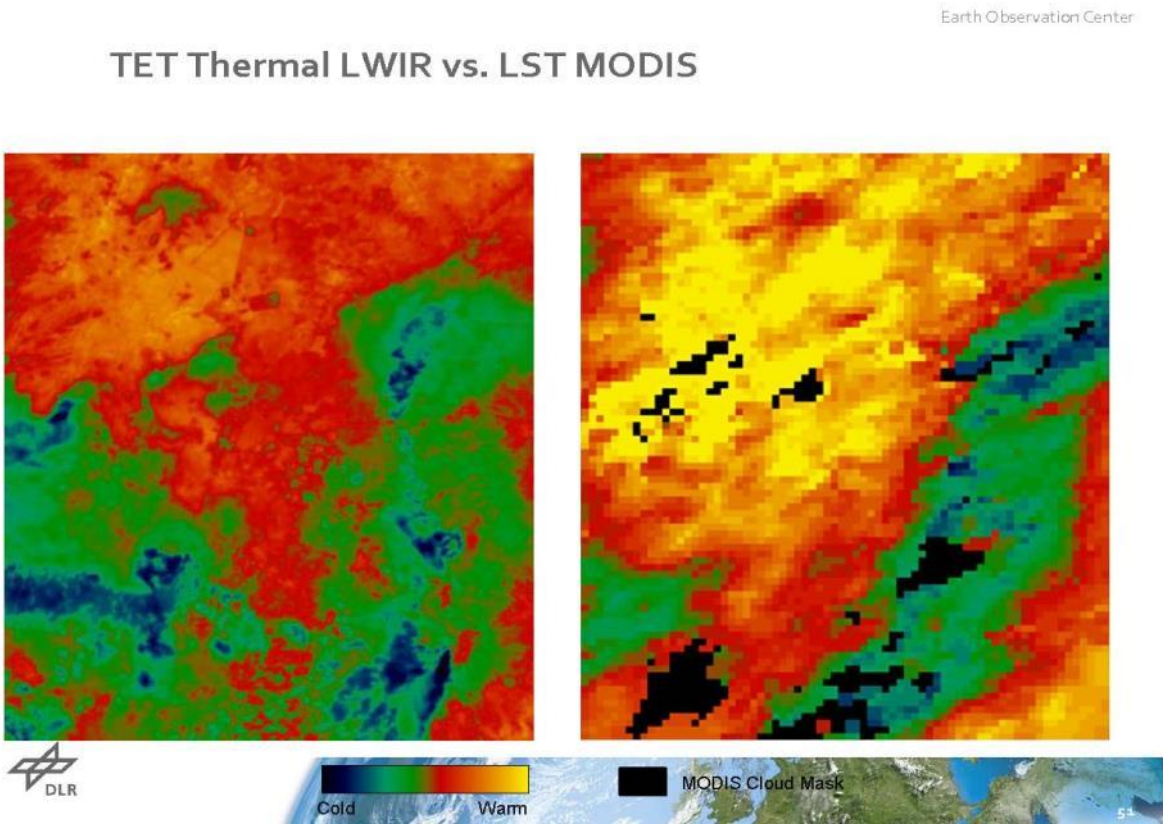
DLR

Earth Observation Center

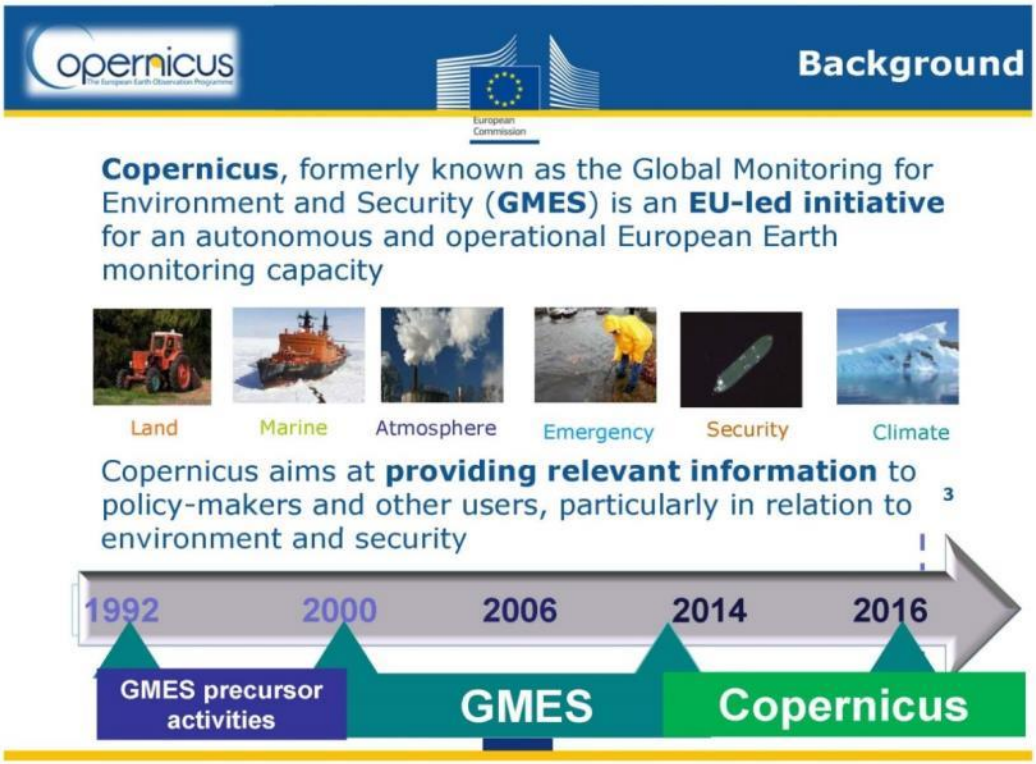
FireBIRD Data and imaging modi

	Räumliche Auflösung (m)					Szenengröße (km)	
Aufnahme Modus	Grün	Rot	NIR	MW	LW	Szenen-breite	Szenen-länge
Feuer Modus (Tag)	156	156	156	165	165	167	1120
Feuer Modus (Nacht)				165	165	167	3000
VIS 1 -Grün	39			165	165	167	400
VIS 1 -Rot		39		165	165	167	400
VIS 1 -NIR			39	165	165	167	400
VIS 3	39	39	39	165	165	83	400

DLR


Earth Observation Center
TET Thermal LWIR vs. LST MODIS
DLR
Cold
Warm
MODIS Cloud Mask

7 Overview of the Copernicus Security Service - Rui Meneses, EC


Background
Copernicus, formerly known as the Global Monitoring for Environment and Security (GMES) is an EU-led initiative for an autonomous and operational European Earth monitoring capacity
Land
Marine
Atmosphere
Emergency
Security
Climate
Copernicus aims at providing relevant information to policy-makers and other users, particularly in relation to environment and security
3
1992
2000
2006
2014
2016
GMES precursor activities
GMES
Copernicus


Background
GMES
SECURITY – one of the six Copernicus Services
A complex and sensitive issue
1. Security and concerns everything and everyone
Heterogeneous communities with different cultures
Governance issues, Data and Information sensitivity
2. Space observations can contribute but often not main source of information
3. Satellite technology best at monitoring slow changes (in particular environmental parameters)

Background

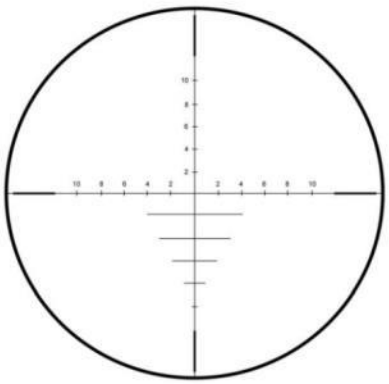
2007 – EU Institute for Security Studies

Workshop on
The Security dimension of GMES
EC/EU Council with relevant stakeholders
(ESA, EDA, EUMS, EUSC, EMSA, EC-JRC, MSs)

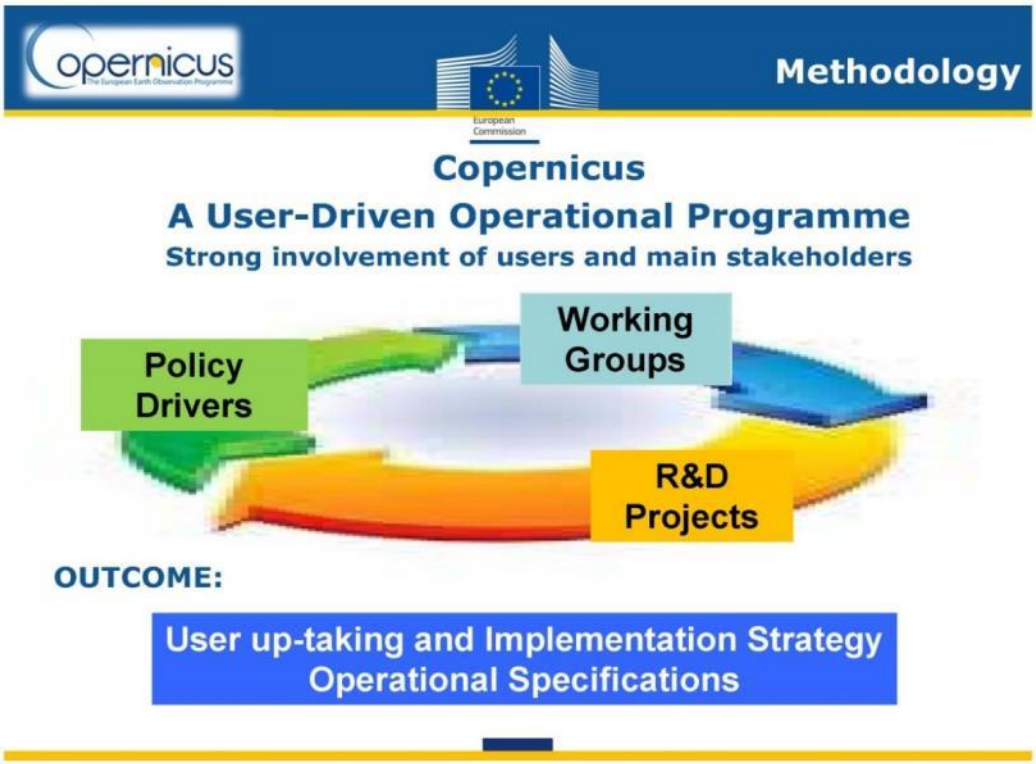
Over 100 participants
Government, Think-tanks, Intl. organisations &agencies

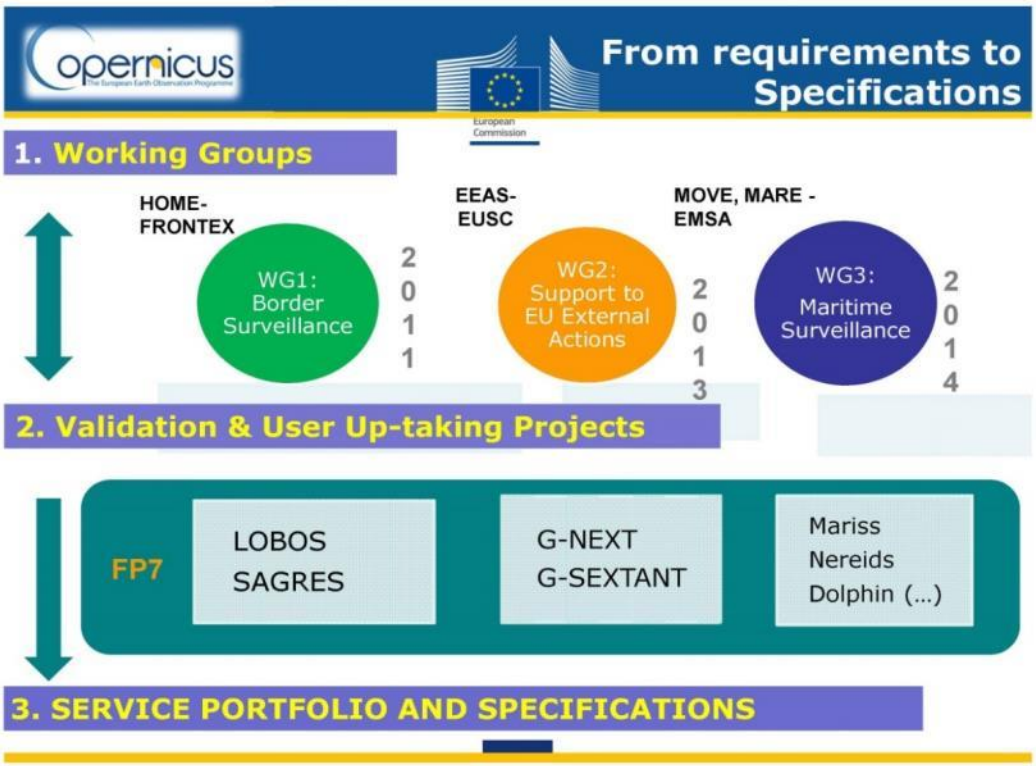
Copernicus Security Scope:

- Border surveillance (land, sea)
- Support to EU External Actions
- Maritime Surveillance

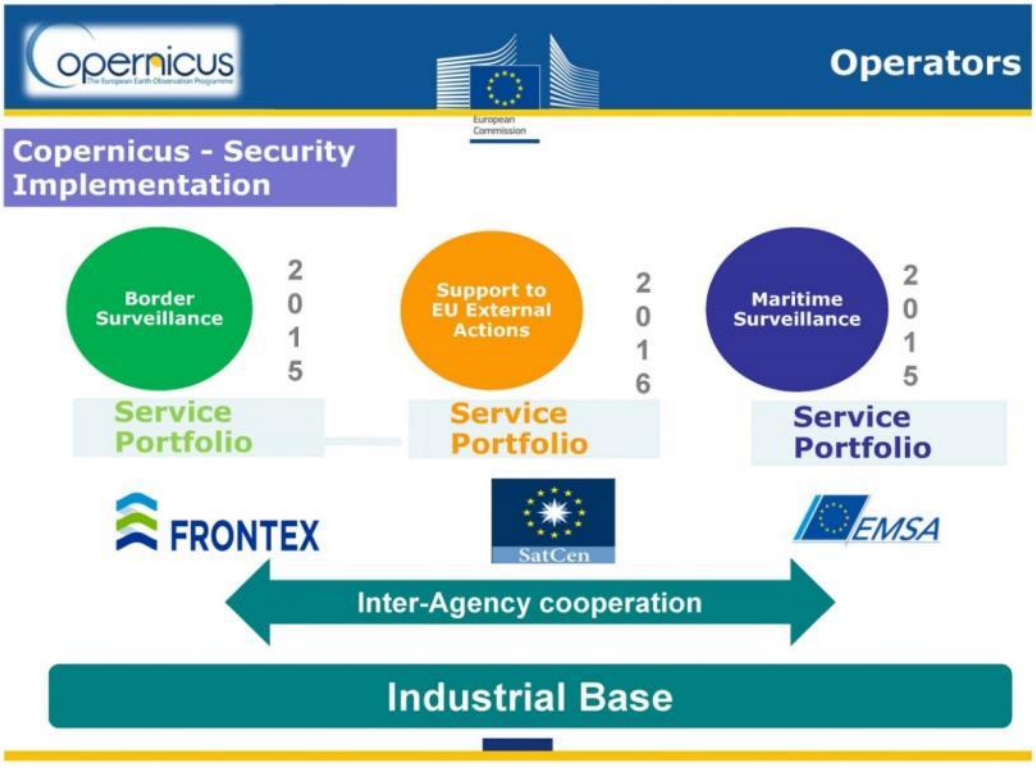


2. user mobilisation & scope

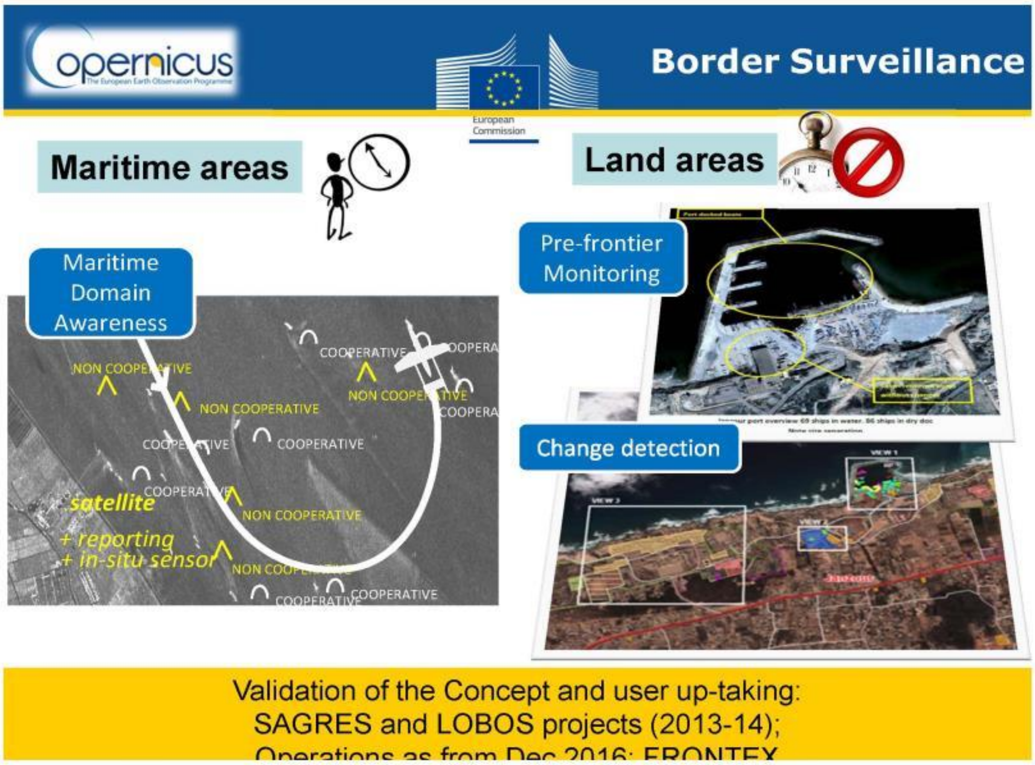

Methodology
Copernicus
A User-Driven Operational Programme
Strong involvement of users and main stakeholders
Working Groups
Policy Drivers
R&D Projects
OUTCOME:
User up-taking and Implementation Strategy
Operational Specifications


From requirements to Specifications
1. Working Groups
HOME-FRONTEX
WG1: Border Surveillance
2011
EEAS-EUSC
WG2: Support to EU External Actions
2013
MOVE, MARE - EMSA
WG3: Maritime Surveillance
2014
2. Validation & User Up-taking Projects
FP7
LOBOS
SAGRES
G-NEXT
G-SEXTANT
Mariss
Nereids
Dolphin (...)
3. SERVICE PORTFOLIO AND SPECIFICATIONS


opernicus
European Commission
Implementation Aspects
Operators
Regulation establishing the Copernicus Programme COM(2013) 312
Article 12
The Commission may entrust, in part or in full, where duly justified by the special nature of the action and specific expertise of the Union body the implementation tasks described in Article 4 to competent Union bodies. Among such agencies are:
DELEGATION OF OPERATIONS FOR SECURITY APPLICATIONS:
(a) the European Environment Agency (EEA);
(b) the European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union (FRONTEX); - Nov 2015
(c) the European Maritime Safety Agency (EMSA); - Nov 2015
(d) the European Union Satellite Centre (EUSC) (*) planned mid-2016


opernicus
European Commission
Operators
Copernicus - Security Implementation
Border Surveillance
2015
Support to EU External Actions
2016
Maritime Surveillance
2015
Service Portfolio
Service Portfolio
Service Portfolio
FRONTEX
SatCen
EMSA
Inter-Agency cooperation
Industrial Base


opernicus
Border Surveillance
European Commission
BORDER SURVEILLANCE
Delegation of Operations to
FRONTEX
Since Nov 2015
Scope: Support to EUROSUR

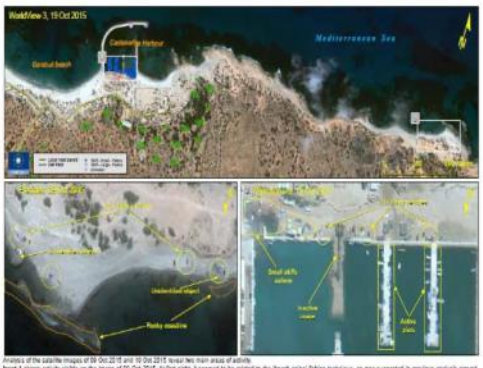

opernicus
Border Surveillance
European Commission
Maritime areas
Land areas
Maritime Domain Awareness
NON COOPERATIVE
COOPERATIVE
satellite
+ reporting
+ in-situ sensor
Pre-frontier Monitoring
Change detection
Validation of the Concept and user up-taking:
SAGRES and LOBOS projects (2013-14);

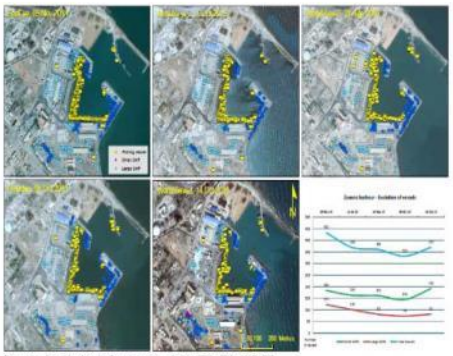
FRONTEX

EUROSUR FUSION SERVICES
8 Services

Coastal Monitoring Service | Pre Frontier Monitoring Service | Reference Imagery / Mapping | Maritime Surveillance of an Area of Interest | Vessel Detection Service | Vessel Tracking and Reporting | Anomaly Detection Service | Environmental Assessment

example





COPERNICUS BORDER SURVEILLANCE SERVICES

13

FRONTEX

FRONTEX

EUROSUR FUSION SERVICES

Coastal Monitoring Service | Pre Frontier Monitoring Service | Reference Imagery / Mapping | Maritime Surveillance of an Area of Interest | Vessel Detection Service | Vessel Tracking and Reporting | Anomaly Detection Service | Environmental Assessment

example

COPERNICUS BORDER SURVEILLANCE SERVICES

14

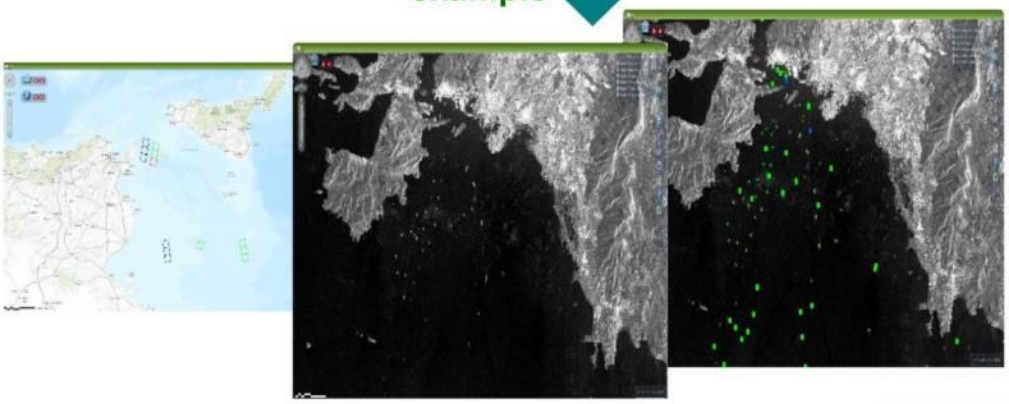
FRONTEX

FRONTEX

EUROSUR FUSION SERVICES

Coastal Monitoring Service | Pre Frontier Monitoring Service | Reference Imagery / Mapping | Maritime Surveillance of an Area of Interest | Vessel Detection Service | Vessel Tracking and Reporting Service | Anomaly Detection Service | Environmental Assessment

example



15 COPERNICUS BORDER SURVEILLANCE SERVICES FRONTEX

Copernicus

European Commission

Support to EU External Actions

SUPPORT TO EU EXTERNAL ACTIONS (SEA)

Delegation of Operations to

SatCen

Expected mid-2016

opernicus

European Commission

Support to EU External Actions

Support to EU External Actions

Aims at providing:

Geo-spatial intelligence and information for situational awareness

Rapid on-demand geo-spatial information

For crisis prevention, preparedness and response capacities, particularly in conflict situations

Specific support to CFSP-CSDP and other security user needs

Complementary to the **Emergency Management Service**
Shares common processing capabilities

opernicus

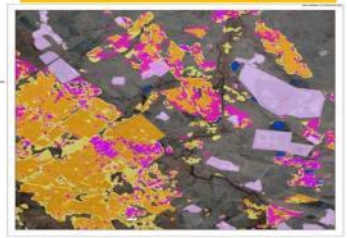
European Commission

Support to EU External Actions

SEA - Service Portfolio

– Reference Mapping
– Road Status Assessment
– Conflict Damage Assessment
– Critical Infrastructure Analysis
– Support to Evacuation Plans
– Crisis Situation Mapping
– Border Mapping
– Camp Analysis & Monitoring
– Activity Reports

Including monitoring of Cultural Heritage



Support to EU External Actions

SEA - Service Portfolio

New tools & services

- Engaging users in new application domains
- Bringing products to an operational maturity level
  - – humanitarian crisis
  - – natural resources
  - – land conflicts situation awareness
  - – border surveillance (outside EU borders)
  - – illicit crops
  - – monitoring of nuclear sites and activities

Validation of the concept and user up-taking:
G-NEXT and G-MOSAIC projects (2013-14);
Operations as from mid – 2016 (planned) : EUSC

Support to Maritime Surveillance

SUPPORT TO MARITIME SURVEILLANCE

Delegation of Operations to

EMSA

Since Dec -2015

Support to Maritime Surveillance

Maritime Surveillance

An Integrated approach

Underpinning principle: Share data for economy of scale in surveillance costs

Need to take into consideration data policy and sensitivity aspects

- Border Control
- Maritime Safety and Security
- Defence
- Customs Authorities
- Law enforcement
- Marine Environment
- Fisheries Control

WG on Maritime Surveillance

May 2014 :

- Implementation Recommendations
- Service Portfolio

Validation of the concept and user up-taking: Several R&D projects;
Operations as from early 2016 : EMSA

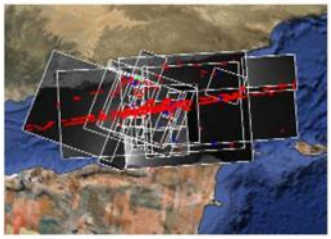
Support to Maritime Surveillance

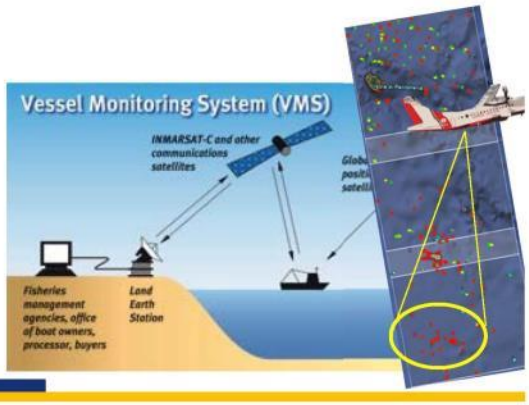
Maritime Surveillance

Combination of Technology / **Data Fusion**

- Satellite data (radar, optical)
- Vessel reporting systems (AIS, VMS, LRIT)
- UAV surveillance

Novel sensor concepts





Support to Maritime Surveillance

Data Fusion

e.g. Anti-piracy support for merchant fleet monitoring

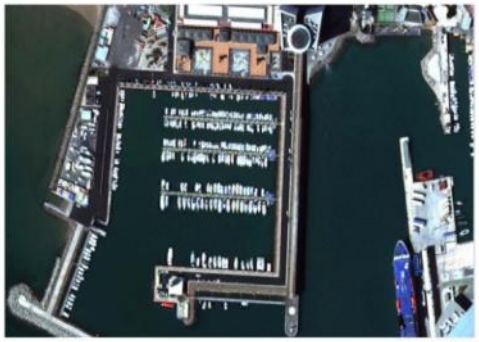
EMSA data	EUNAVFOR data
EU LRIT	Int. LRIT up to 85%
Sat-AIS	Piracy Risk register (incl. measures, communication info)
Ship-AIS	Piracy incidents

Courtesy of EMSA

Image Interpretation

e.g. Ports Monitoring

- Optical satellite imagery
- Potential source for value added information (e.g. surveillance)



Conclusions

- Setting up the Copernicus Security service has been a challenging exercise; hard to be comprehensive and bridge the dual-use civil/defence gap (this is far beyond Copernicus)
- The space segment can serve only part of requirements and other observation capacities (space and /or non-space) are needed (who pays for it?)


opernicus
Conclusions
Extensive work has been done to mobilize communities and identify their needs.
Coordination mechanisms have been put in place for complementary actions with the Emergency Management Service.
Pre-operational services started 2013 with the involvement of end-users (Border Surveillance SAGRES and LOBOS) , Support to External Actions (G-NEXT and G-SEXTANT)
Maritime Surveillance service portfolio defined early 2014
Delegation of operations for Border Surveillance to FRONTEX (Nov 2015), Maritime Surveillance to EMSA (Dec 2015) and specific arrangements with EUSC for SEA, all supported by Industrial capacities
Operations as from 2016


opernicus
Conclusions
European Commission
Monitoring of Cultural Heritage will be part of the Support to EU External Action Service (SEA) Portfolio as from mid-2016
We are interested in hearing about the experience of participants in this domain.

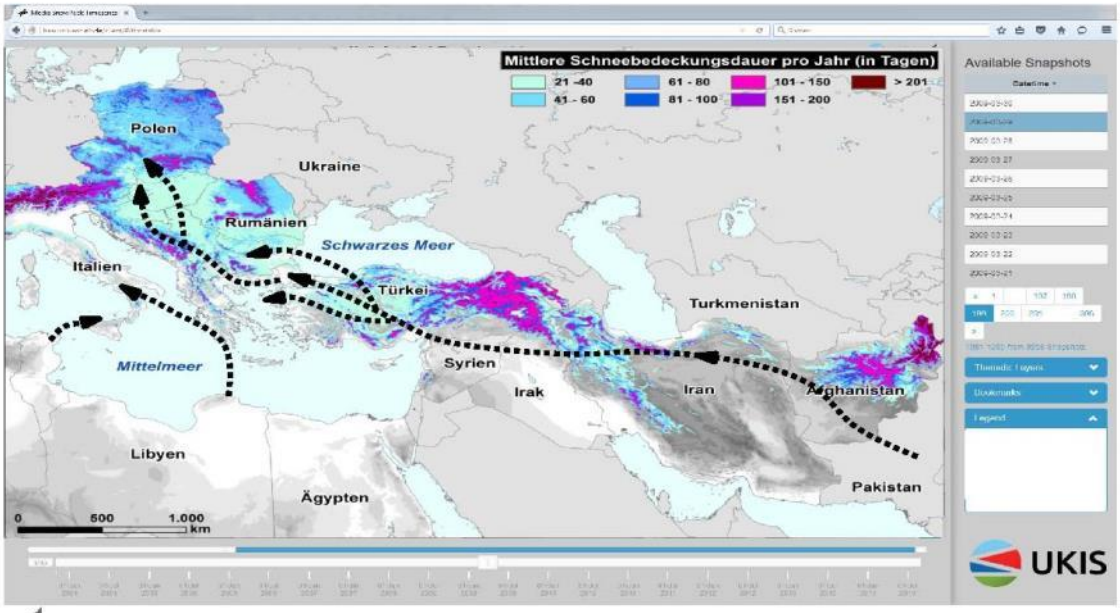
4.7 Summary and Potential contributions of Copernicus to preserve the world cultural heritage - Gunder Schreier, DLR


opernicus
The European Earth Observation Programme
GMES
Copernicus Core Services
LAND
ATMOSPHERE
DISASTERS
RAPID MAPPING
CLIMATE CHANGE
OCEANS
CIVIL SECURITY


Refugee Camp
Al Zaatari
Quelle © THW
Al Zaatari, Jordania
13.01.2014
0
500 m

Earth Observation Center

„Migration Sentinel"



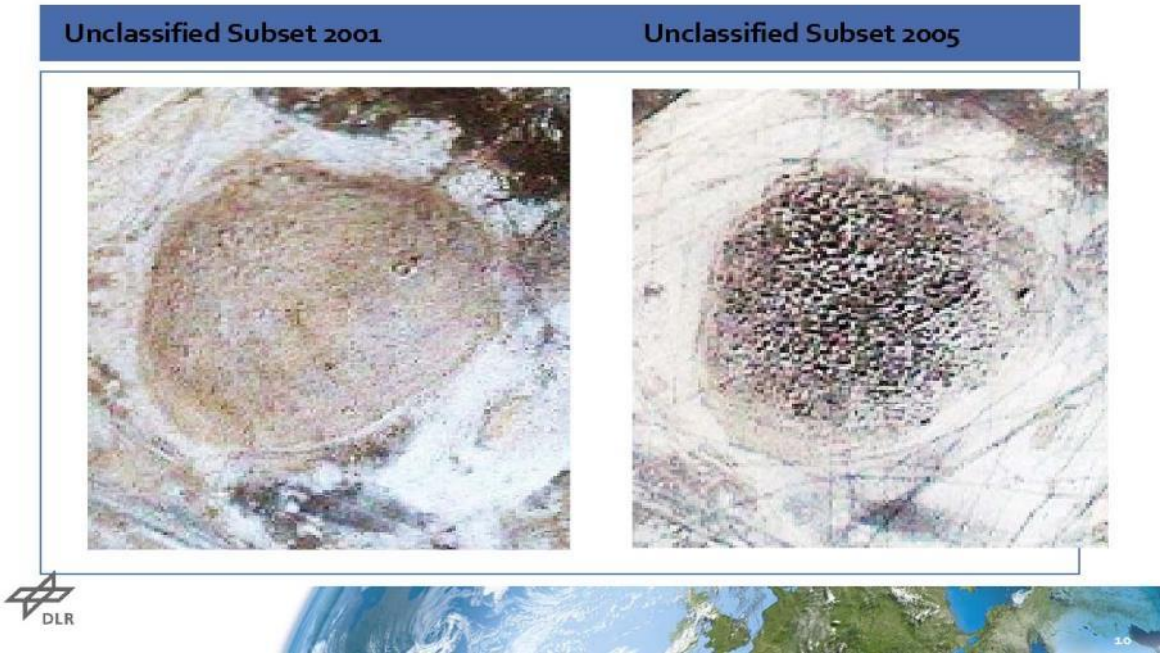
DLR

Earth Observation Center

Looting in the antique city Isin, 3.000 - 2.000 . B. C.

Earth Observation Center

Uruk: Change detection to identify looting



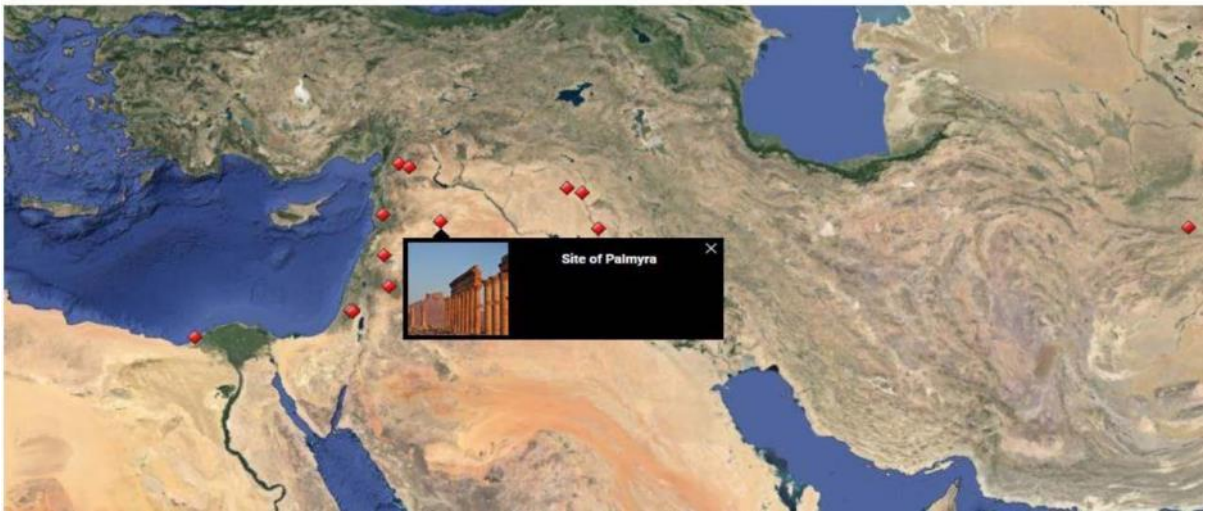
Looting: not just a problem in the middle east

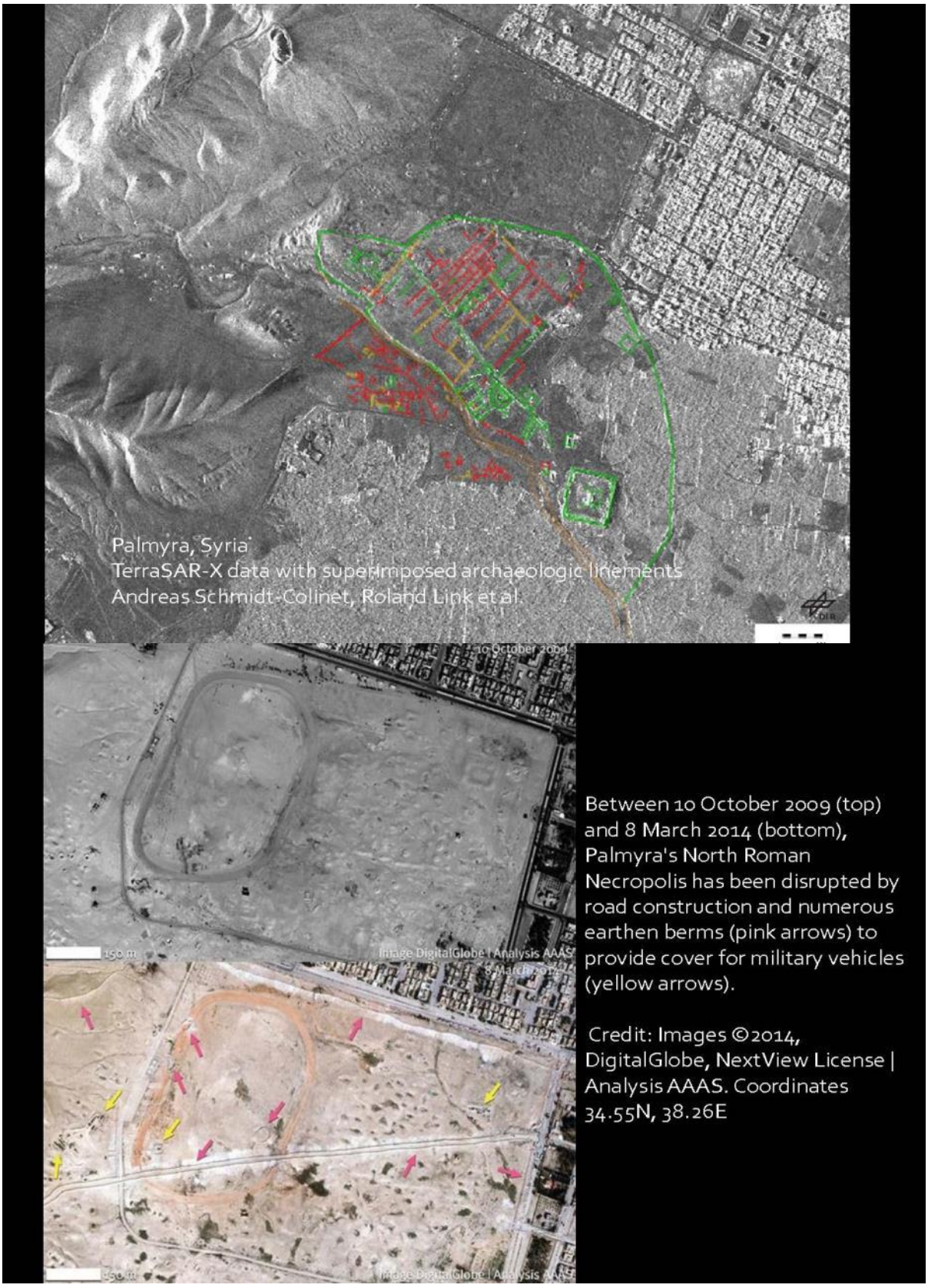
DLR

Earth Observation Center

List of World Heritage in Danger

The 48 properties which the World Heritage Committee has decided to include on the List of World Heritage in danger in accordance with Article 11 (4) of the *Convention*.





Between 10 October 2009 (top) and 8 March 2014 (bottom), Palmyra's North Roman Necropolis has been disrupted by road construction and numerous earthen berms (pink arrows) to provide cover for military vehicles (yellow arrows).

Credit: Images ©2014, DigitalGlobe, NextView License | Analysis AAAS. Coordinates 34.55N, 38.26E


Deutsches Fernerkundungsdatenzentrum
DLR-ZKI: Palmyra – Temple of Bel: destroyed by IS (30.08.2015)
Pre-Event (Image: WorldView 2, Date: 27. August 2015)
Post-Event (Image: WorldView 2, Date: 02. September 2015)
Geo:
GEOconnexion
©European Space Imaging / DigitalGlobe
DLR


Baal Temple Palmyra
Earth Observation Center
DLR
AFP Photo/Süddeutsche Zeitung

Baal Temple Palmyra

Earth Observation Center

AFP Photo/ Süddeutsche Zeitung

The New York Times

If All Else Fails, 3D Models and Robots Might Rebuild Palmyra

theguardian

After Palmyra, the message to Isis: what you destroy, we will rebuild

Newsweek

World

New Images Show ISIS's Destruction of Palmyra But Also a City Preserved

SPIEGEL ONLINE

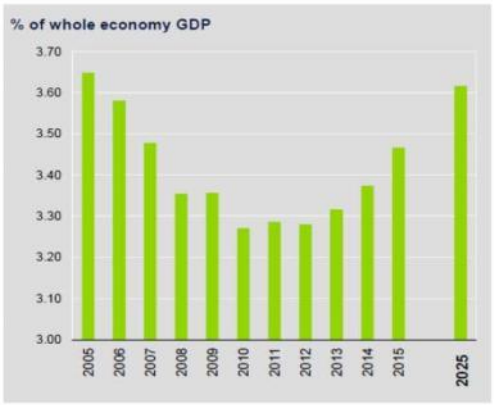
Welterbestätte: Archäologen planen Wiederaufbau von Palmyra

Earth Observation Center

WHS: an economic factor - Europe

Source: WTTC: The Economic Impact of Travel & Tourism in Europe 2015

EUROPE: DIRECT CONTRIBUTION OF TRAVEL & TOURISM TO GDP



The total contribution of Travel & Tourism to GDP (including wider effects from investment, the supply chain and induced income impacts, see page 2) was USD2,136.0bn in 2014 (9.2% of GDP) and is expected to grow by 2.4% to USD2,188.0bn (9.4% of GDP) in 2015.

It is forecast to rise by 2.6% pa to USD2,833.1bn by 2025 (9.8% of GDP).

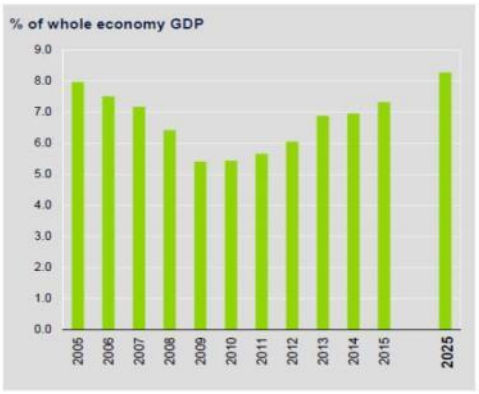
DLR

Earth Observation Center

WHS: an economic factor - Cyprus

Source: WTTC: The Economic Impact of Travel & Tourism in Cyprus 2015

CYPRUS: DIRECT CONTRIBUTION OF TRAVEL & TOURISM TO GDP



The total contribution of Travel & Tourism to GDP (including wider effects from investment, the supply chain and induced income impacts, see page 2) was EUR3,404.9mn in 2014 (21.3% of GDP) and is expected to grow by 5.5% to EUR3,593.6mn (22.4% of GDP) in 2015.

It is forecast to rise by 4.2% pa to EUR5,419.8mn by 2025 (25.5% of GDP).

DLR

Earth Observation Center

PATRIMONIO MUNDIAL • WORLD HERITAGE • PATRIMOINE MONDIAL

DLR

Earth Observation Center

In the year 2000 UNESCO and ESA launched the
Open Initiative on the use of space technologies for heritage

(Over 60 space partners reacted)

http://www.unesco.org/science/remotesensing/

But no activity since about 2009!!

Over 60 space partners located in 33 countries

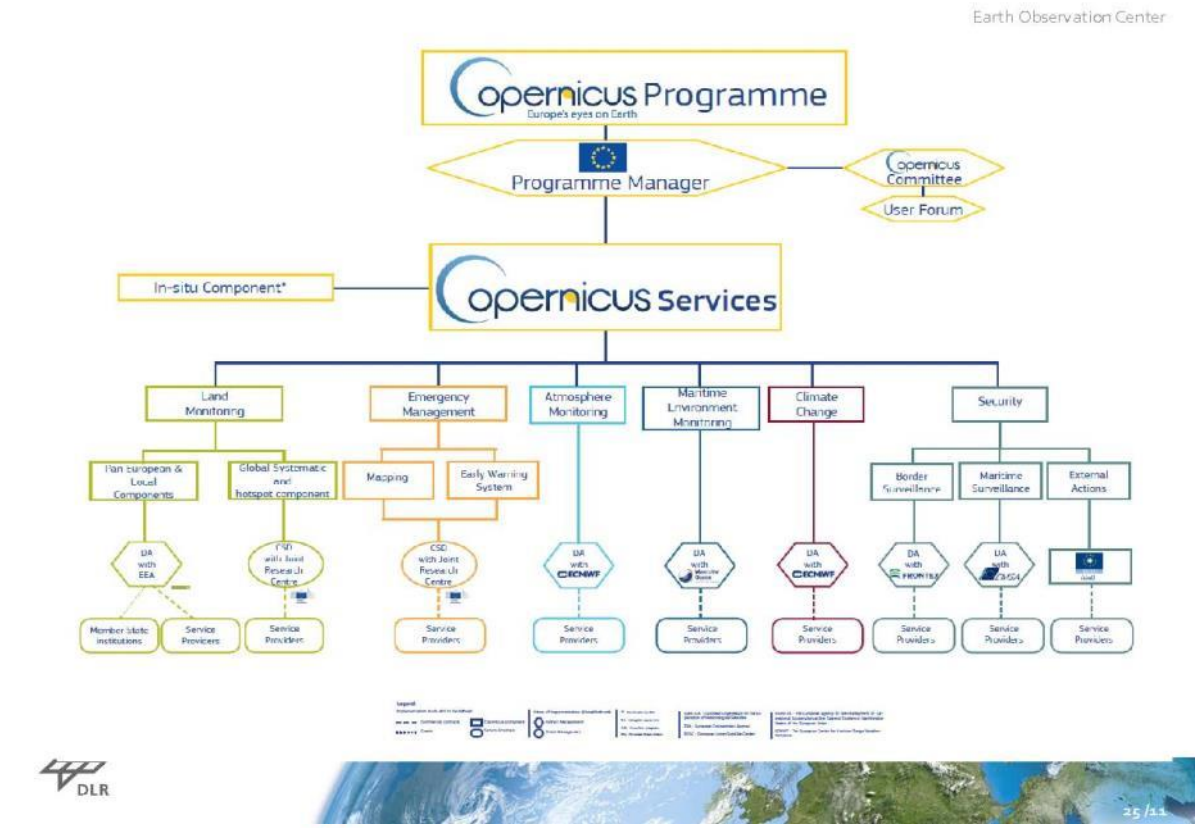
DLR

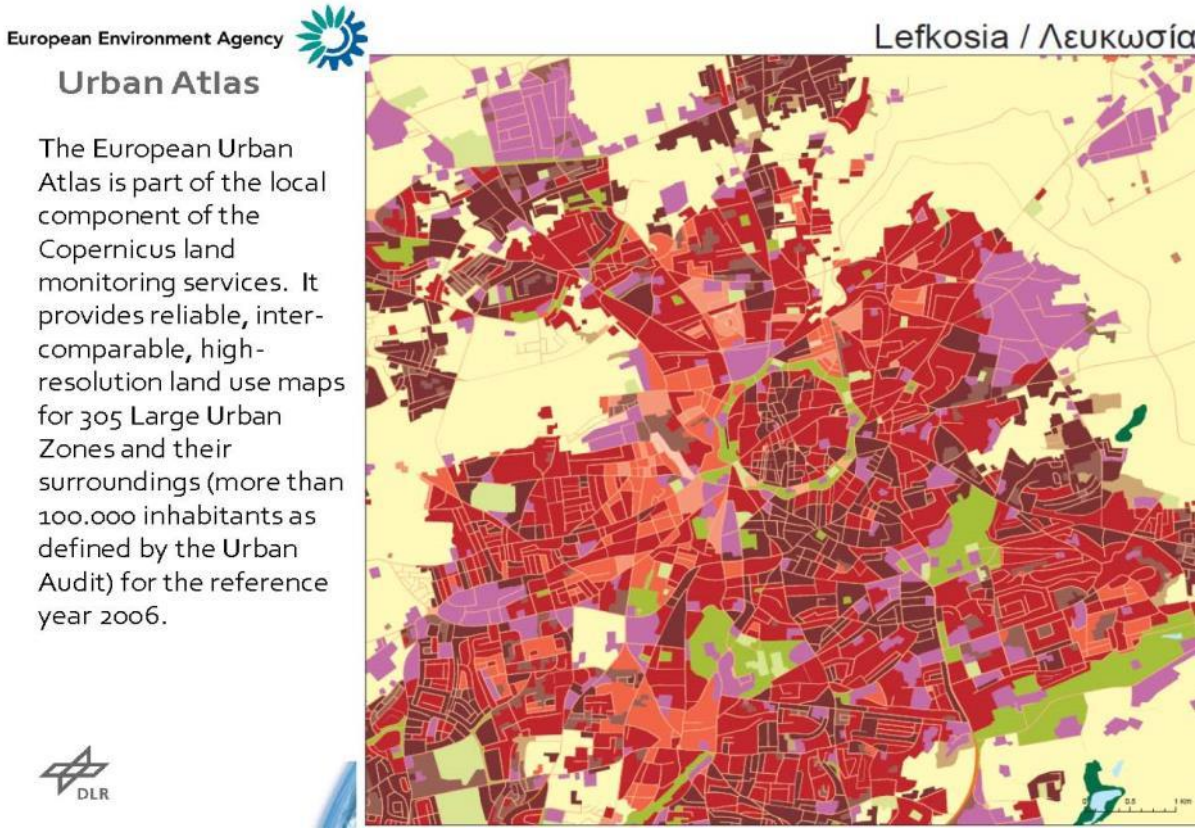
Earth Observation Center

World Heritage Monitoring in Copernicus

- Facts and requirements for World Heritage Monitoring
  - No immediate economic impact/return
  - High impact/ long term impact on society (and economy)
  - No clear national/ international responsability/ funding
  - Very strong European interest/ European heritage
  - Related to „environment" & „security" (& „culture")
  - Well established European science base
  - Global perspective/ independend monitoring
  - Space data helps (but is only part of many data required)
- Data required
  - Long term continuity/ decades → Copernicus Programme
  - High – very high resolution → Copernicus Data Warehouse

DLR

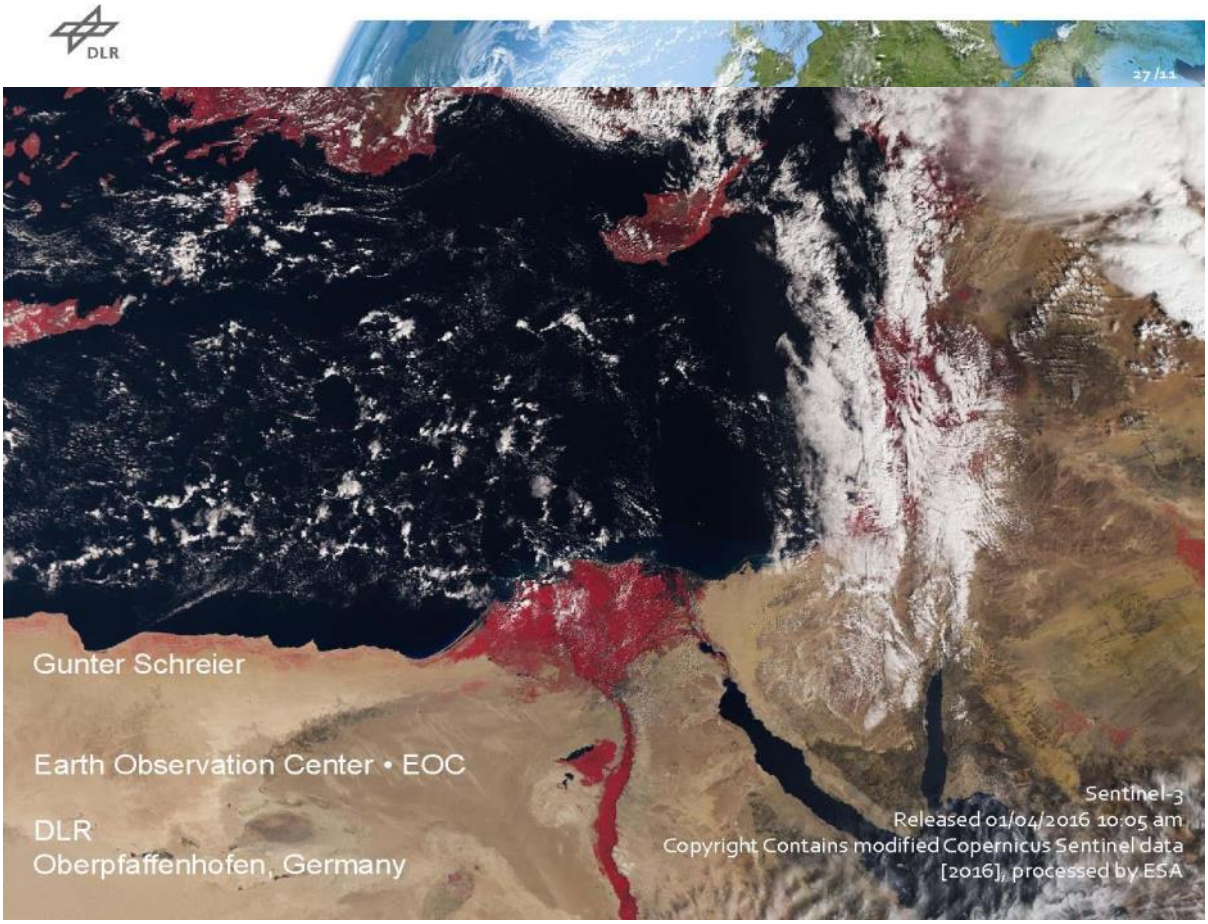

Earth Observation Center
Copernicus Programme
Europe's eyes on Earth
Programme Manager
Copernicus Committee
User Forum
In-situ Component*
Copernicus Services
Land Monitoring
Emergency Management
Atmosphere Monitoring
Maritime Environment Monitoring
Climate Change
Security
Pan-european & Local Components
Global Systematic and hotspot component
Mapping
Early Warning System
Border Surveillance
Maritime Surveillance
External Actions
Service Providers
DLR
25/11


European Environment Agency
Urban Atlas
The European Urban Atlas is part of the local component of the Copernicus land monitoring services. It provides reliable, inter-comparable, high-resolution land use maps for 305 Large Urban Zones and their surroundings (more than 100.000 inhabitants as defined by the Urban Audit) for the reference year 2006.
Lefkosia / Λευκωσία
DLR

Earth Observation Center

World Heritage Monitoring as a Copernicus Core Service

- World Heritage Monitoring fits well into Copernicus Core Service Portfolio
  - Land Monitoring/ Urban Atlas Extention (?)
  - Security/ External Actions (?)
- Needs European Implementing Agency
  - Delegation Agreement by the European Commission
  - National counterparts in each member state
- Needs „critical" amount of support from „users" and „policy"
- Needs European legal and policy framework to be supported



There are numerous options for implementing these needs, based on exiting and newly created initiatives and programs. Amongst these are:

a) Implement the improved access to EO data by, e.g.
   - "reviving" the UNESCO "Open Initiative"
   - Expanding the Charter on Space and Major Disasters
   - Creating a new initiative

b) Create a framework of regular applications by e.g.
   - Using the GEOSS framework to coordinate the work as part of its societal challenges
   - Implementing "CH site monitoring" as part of the Copernicus Core Service "Security"

c) Support research & development, by e.g.:
   - Using programs, interested in international development such as the World Bank
   - Using national and international research programs, such as the European H2020
   - Have an improved exchange on new developments in international science and technology organizations
   - Have better training, education (e.g. dedicated curricula, summer schools) on this topic.

3. Global Monitoring of Environment and Security

Copernicus

Earth Observation Center

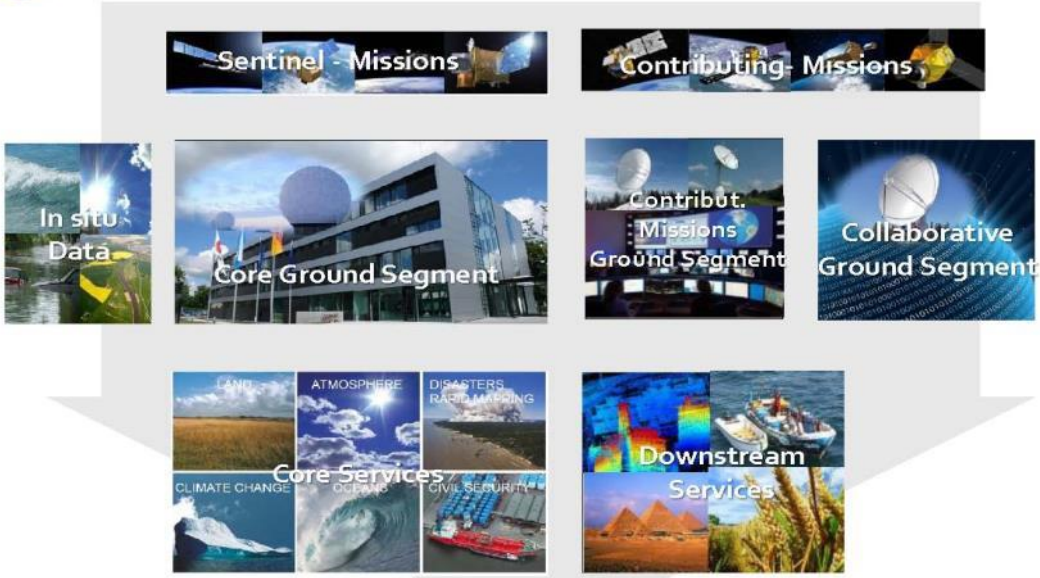
Copernicus

- Teil der europäischen Raumfahrtstrategie
  - Galileo & Copernicus (GMES= Global Monitoring for Environment and Security)
- Geführt von der Europäischen Kommission, Entwicklung des Raumsegments durch die ESA, Nutzung nationaler Missionen, Entwicklung der Dienste durch Kommission
- Implementierung durch:
  - ESA GMES space component (incl. ground segment interfaces)
  - EU FP7 Space budget (R&D budget)
- Langfristig finanziert durch:
  - Mittelfristiger Finanzhaushalt der Kommission
  - 3,786 B€ (2014-2020ff)
- Governance durch Europäische Kommission

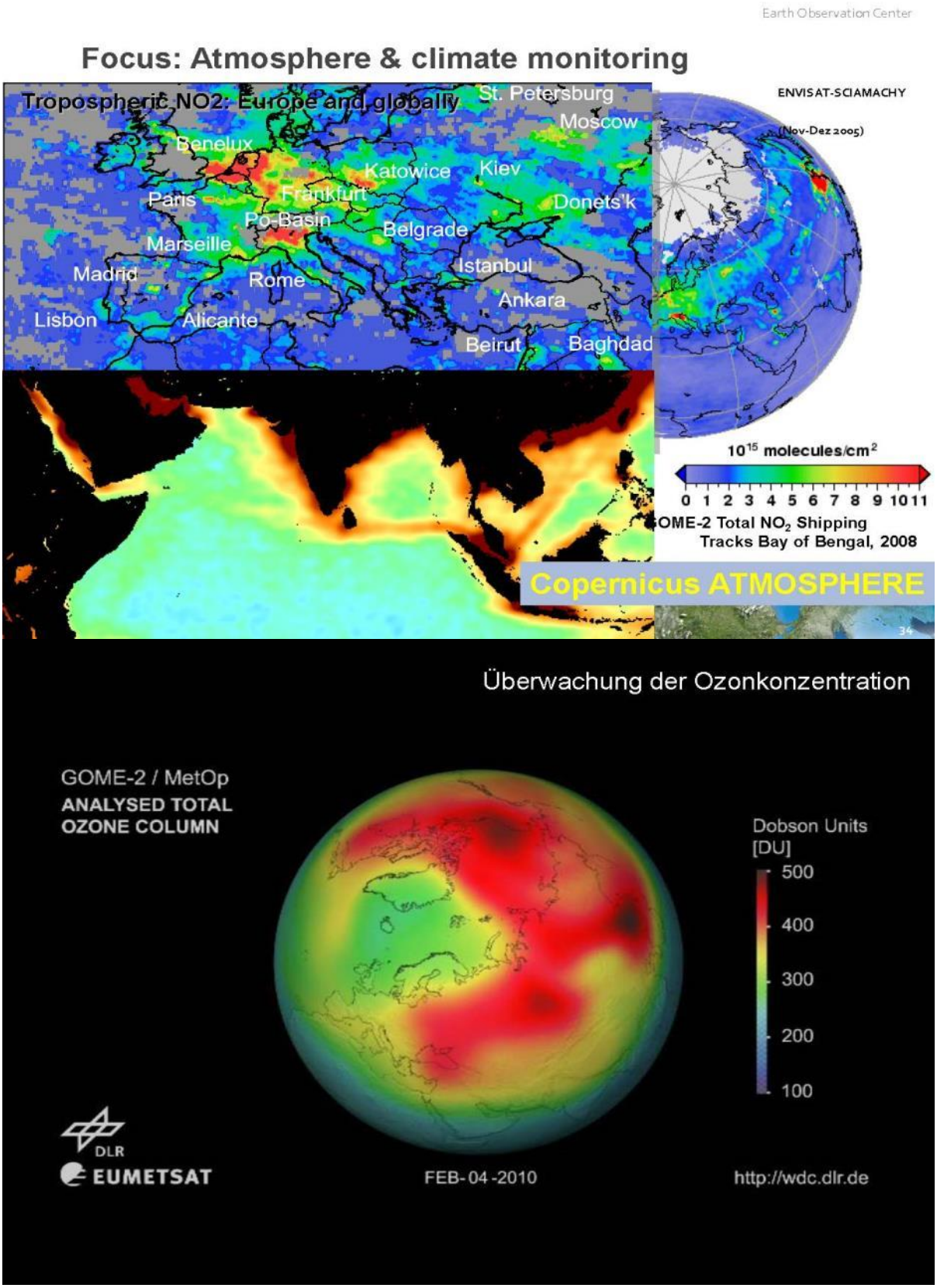
DLR

Earth Observation Center

Copernicus



DLR


Earth Observation Center
Focus: Atmosphere & climate monitoring
Tropospheric NO2: Europe and globally
St. Petersburg
Moscow
Benelux
Katowice
Kiev
Paris
Frankfurt
Donets'k
Po-Basin
Belgrade
Marseille
Istanbul
Madrid
Rome
Ankara
Lisbon
Alicante
Beirut
Baghdad
ENVISAT-SCIAMACHY
(Nov-Dez 2005)
10^15 molecules/cm^2
0 1 2 3 4 5 6 7 8 9 10 11
GOME-2 Total NO2 Shipping
Tracks Bay of Bengal, 2008
Copernicus ATMOSPHERE
Überwachung der Ozonkonzentration
GOME-2 / MetOp
ANALYSED TOTAL
OZONE COLUMN
Dobson Units
[DU]
500
400
300
200
100
DLR
EUMETSAT
FEB-04-2010
http://wdc.dlr.de

Earth Observation Center

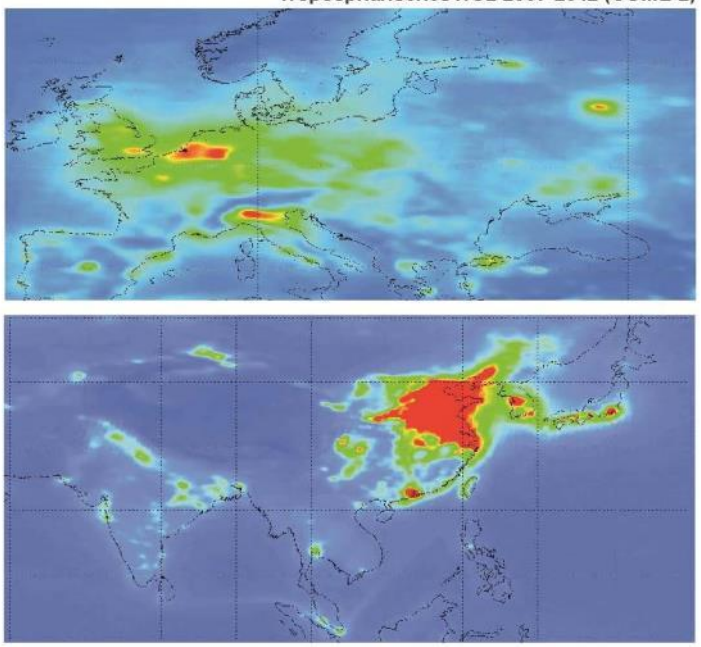
Anwendungen – Luftverschmutzung

– Nutzung von GOME-2

– reaktive Spurengase (z.B. NO2, SO2, HCHO)

– urbane und regionale Hot Spots

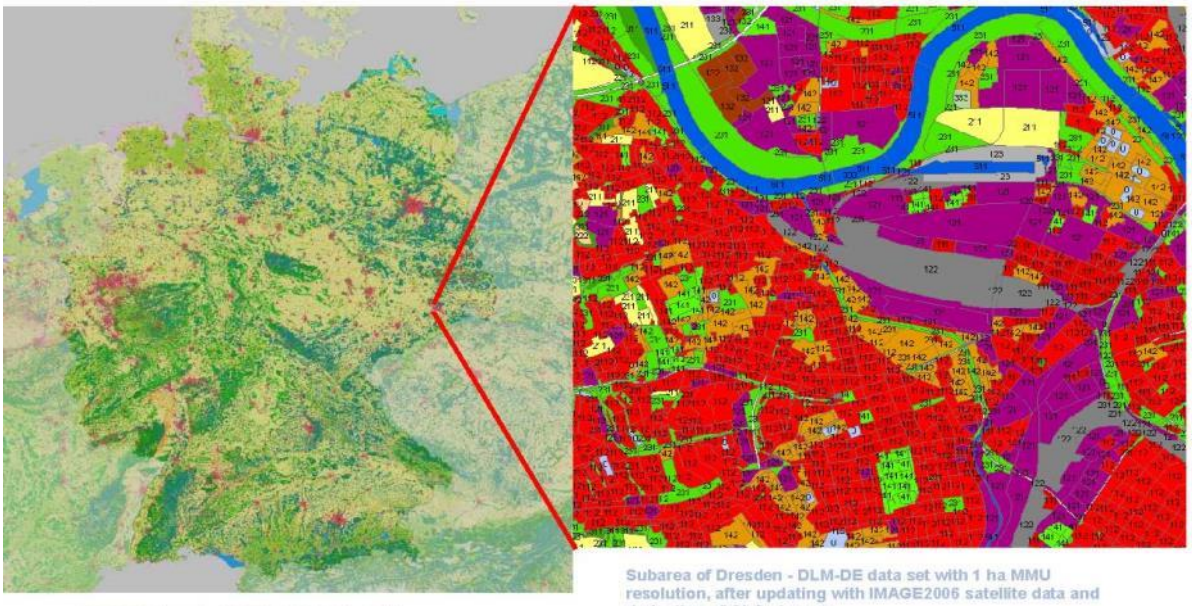
– Schwerpunkt: Ostasien/China



DLR

Earth Observation Center

European Land Use – Land Use Change



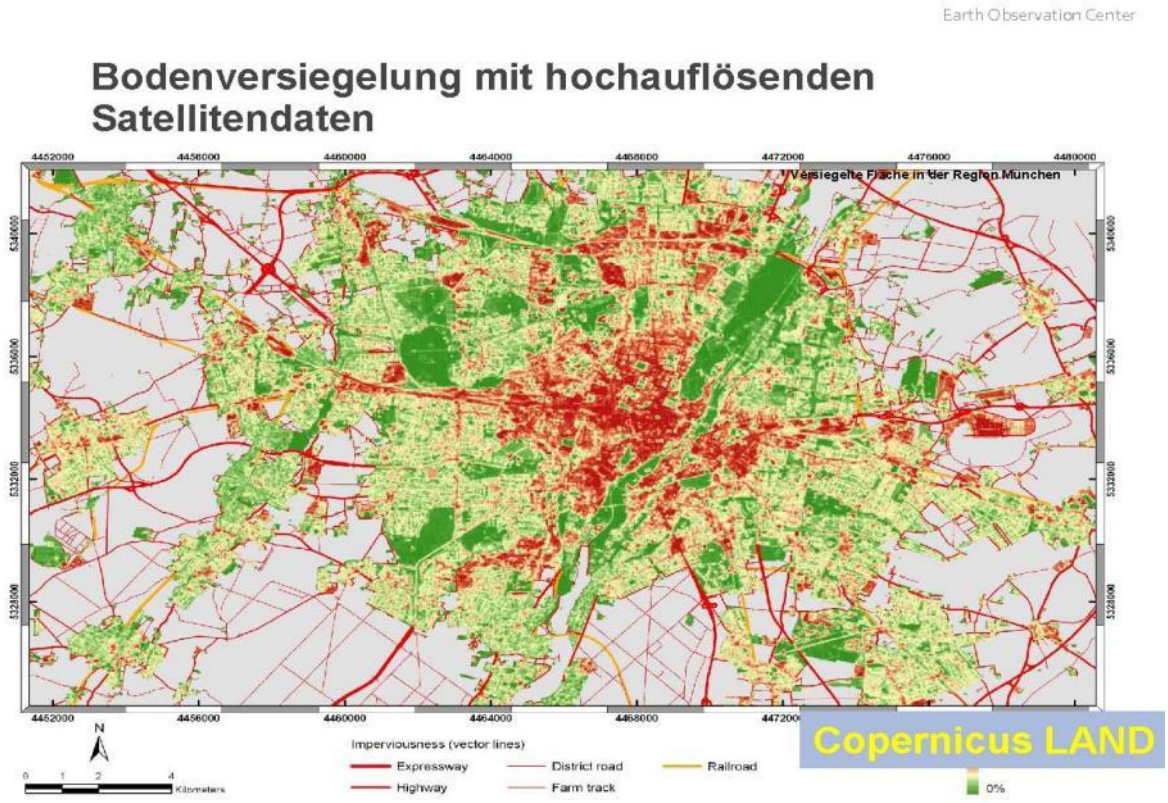
CLC 2000: Landsat-7 ETM+ (1999 to 2001)

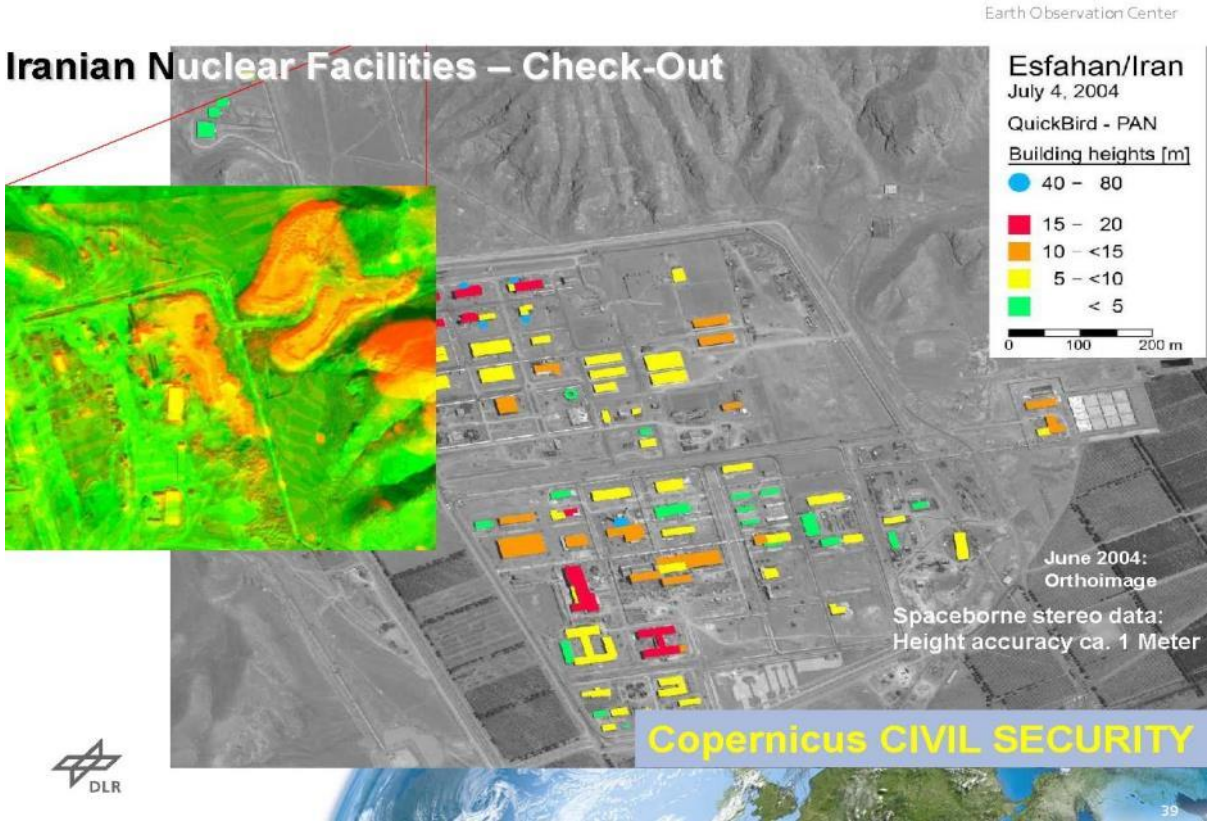
Subarea of Dresden - DLM-DE data set with 1 ha MMU resolution, after updating with IMAGE2006 satellite data and deduction of CLC classes

Copernicus LAND

DLR

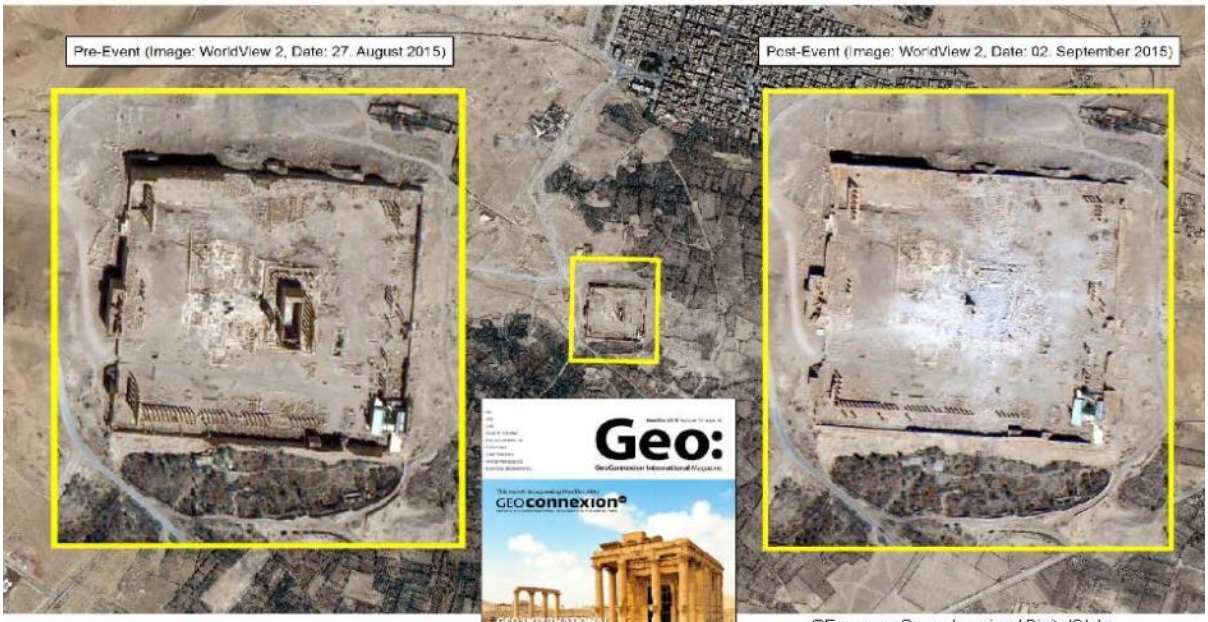
37


Earth Observation Center
Bodenversiegelung mit hochauflösenden Satellitendaten
Versiegelte Fläche in der Region München
4452000
4456000
4460000
4464000
4468000
4472000
4476000
4480000
5340000
5336000
5332000
5328000
N
0 1 2 4
Kilometers
Imperviousness (vector lines)
Expressway
Highway
District road
Farm track
Railroad
0%
Copernicus LAND


Earth Observation Center
Iranian Nuclear Facilities – Check-Out
Esfahan/Iran
July 4, 2004
QuickBird - PAN
Building heights [m]
40 – 80
15 – 20
10 – <15
5 – <10
< 5
0 100 200 m
June 2004:
Orthoimage
Spaceborne stereo data:
Height accuracy ca. 1 Meter
Copernicus CIVIL SECURITY
DLR
39

Deutsches Fernerkundungsdatenzentrum

ZKI: Palmyra – Temple of Bel: destroyed by IS (30.08.2015)



DLR

Earth Observation Center

Copernicus: Was kostet das? Wer zahlt dafür?

Europäische Kommission

Forschungsrahmen Programm 6 (vor 2007)	102 Mio €
Forschungsrahmen Programm 7 (2007-13)	1300 Mio €
GMES Initial Operations (2011-13)	107 Mio €
Copernicus Programm (2014-20)	4340 Mio €

Europäische Raumfahrtagentur; ESA

GMES Service Evolution (2002-16)	135 Mio €
Copernicus Space Component (2006-20)	2347 Mio €
Total (bis 2020)	**ca 8800 Mio €**

Plus nationale Copernicus Initiativen

o € für den Nutzer von Daten & Diensten

DLR

Haushalt des Bundesfamilienministeriums in 2015: 8,5 Mrd€ ~ 2,8% Gesamthaushalt