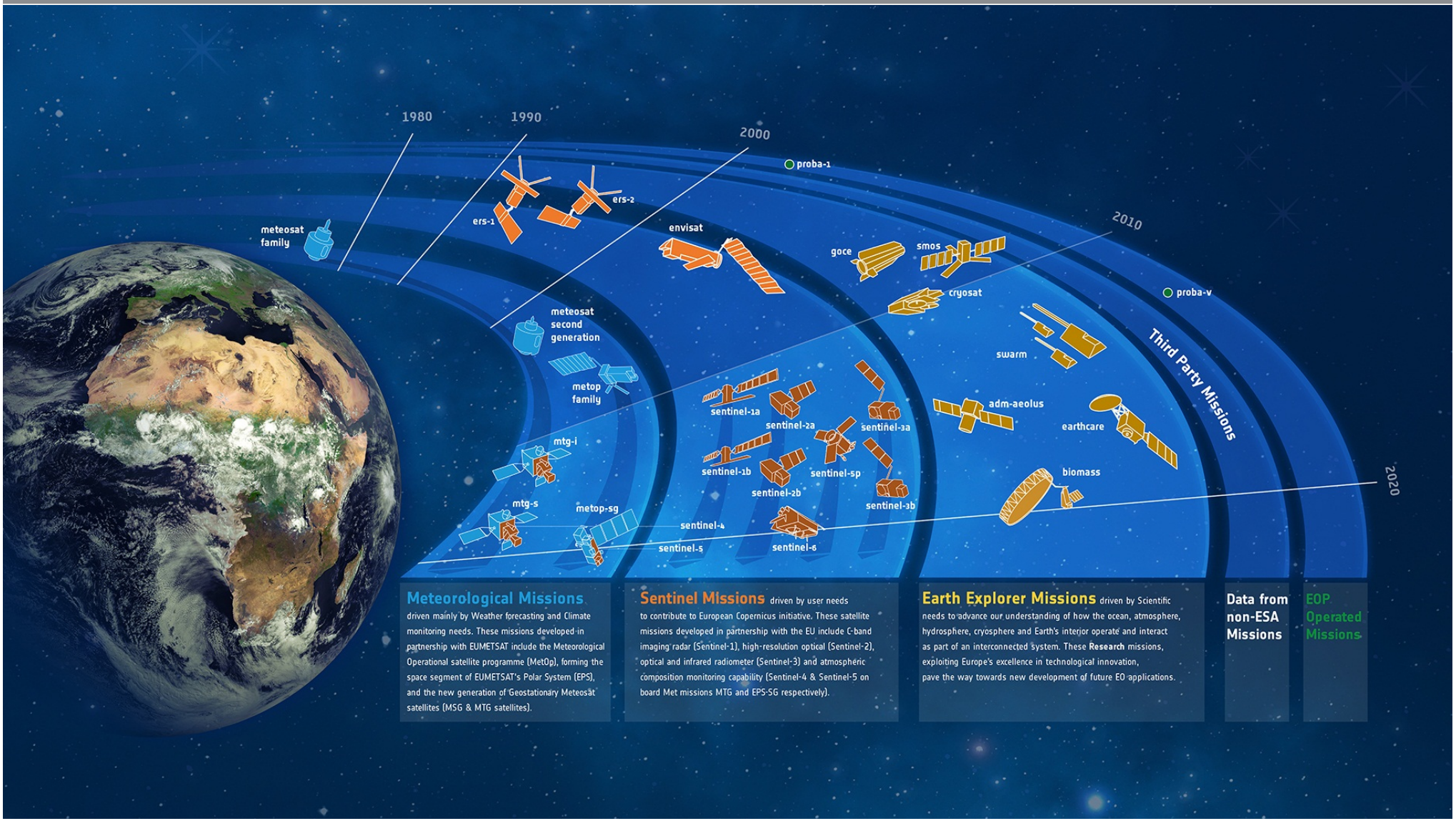
Copernicus – An operational long-term European Earth Observation System

MultiTemp 2015, Annecy, 22 July 2015

Simon Jutz, ESA

Head, Copernicus Space Office
Earth Observation Programmes Directorate

ESA Earth Observation Programmes



The Beginnings of Earth Observation

Civil EO goes back to 1972 (Landsat-1)

Shortcomings of the first decades:

- Typically one-off satellites
- Difficult and costly data access
- Dominated by governmental needs
- Very little use by commercial entities or the general public

The Dawn of Copernicus

At around 2000, Europe took stock of the situation and reflected a way forward

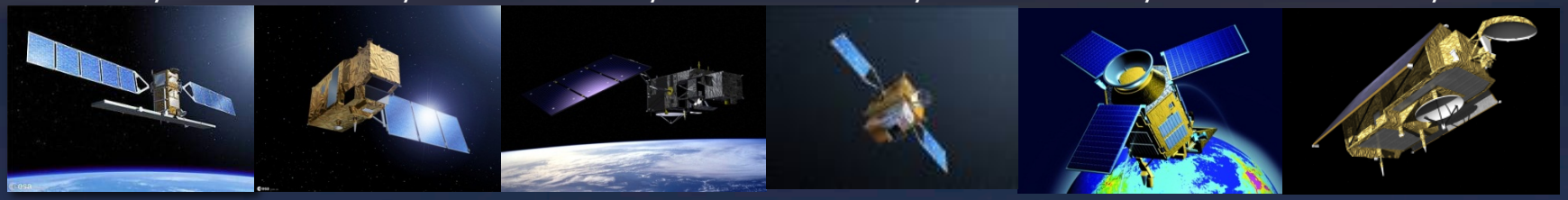
Need for a new approach

GMES as a conceptual vision (1998 Baveno manifesto)

16 years passed between conceptual vision and launch of the first satellite (Sentinel-1A)

Copernicus: A New Generation of Data Sources

Sent-1A/B | Sent-2A/B | Sent-3A/B | Sent-4A/B | Sent-5/5P | Sent-6A/B



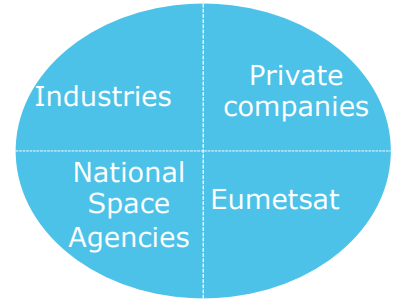
- Copernicus is a European space flagship programme led by the European Union
- ESA coordinates the space component
- Copernicus provides the necessary data for operational monitoring of the environment and for civil security
- Free and open data policy

Components & Competences

Coordinators:

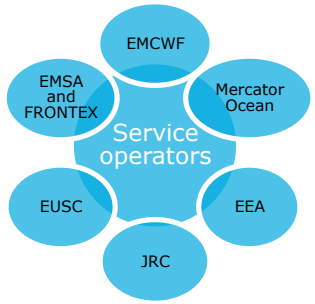
Partners:

Space Component



Overall Programme Coordination

Services Component



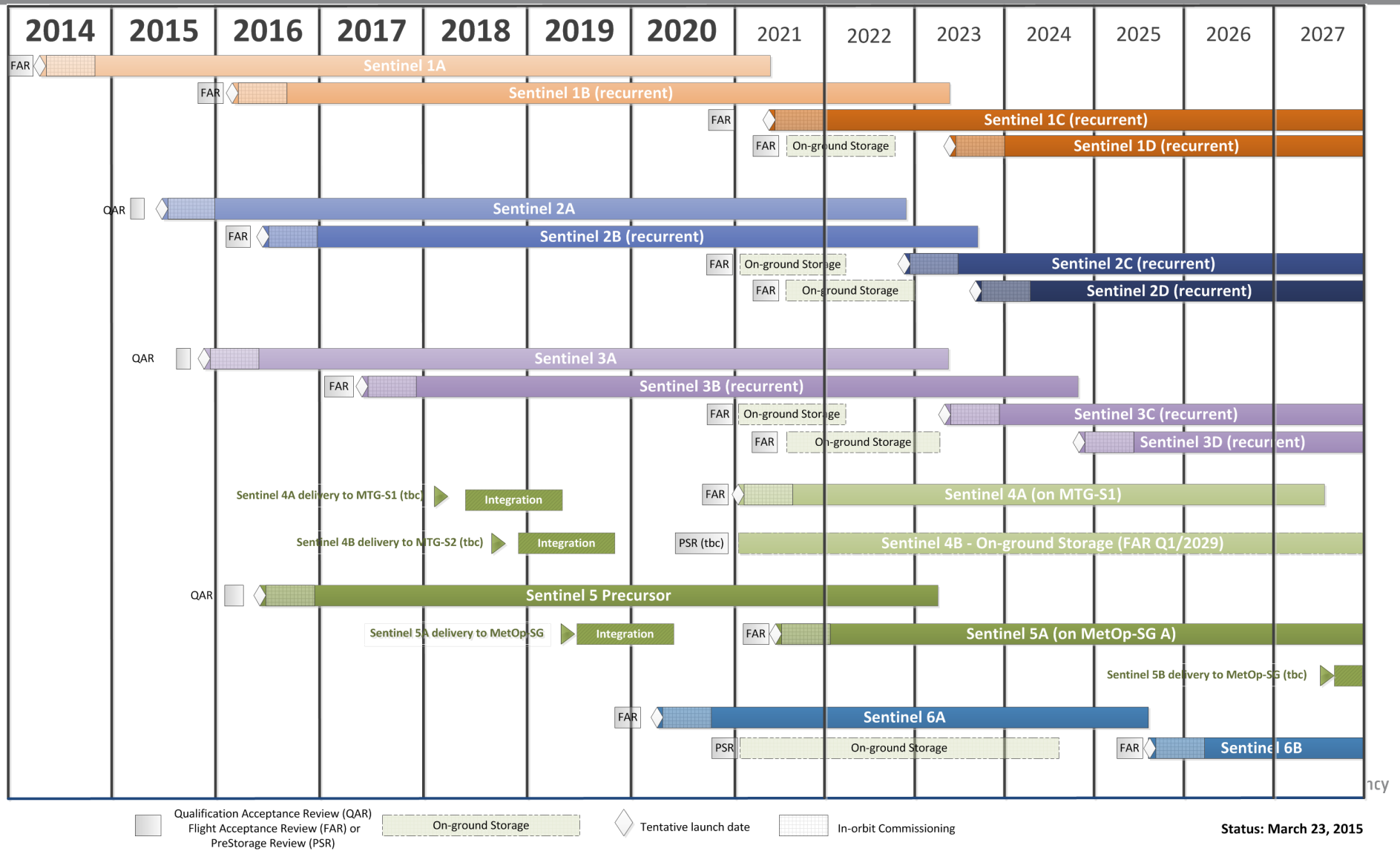
In-situ data are supporting the Space and Services Components

The Sentinel Family

The world's most comprehensive suite of EO missions

- S1: Radar Mission
- S2: High Resolution Optical Mission
- S3: Medium Resolution Imaging and Altimetry Mission
- S4: GEO Atmospheric Chemistry Mission
- S5P/S5: LEO Atmospheric Chemistry Missions
- S6/Jason-CS: Altimetry Mission

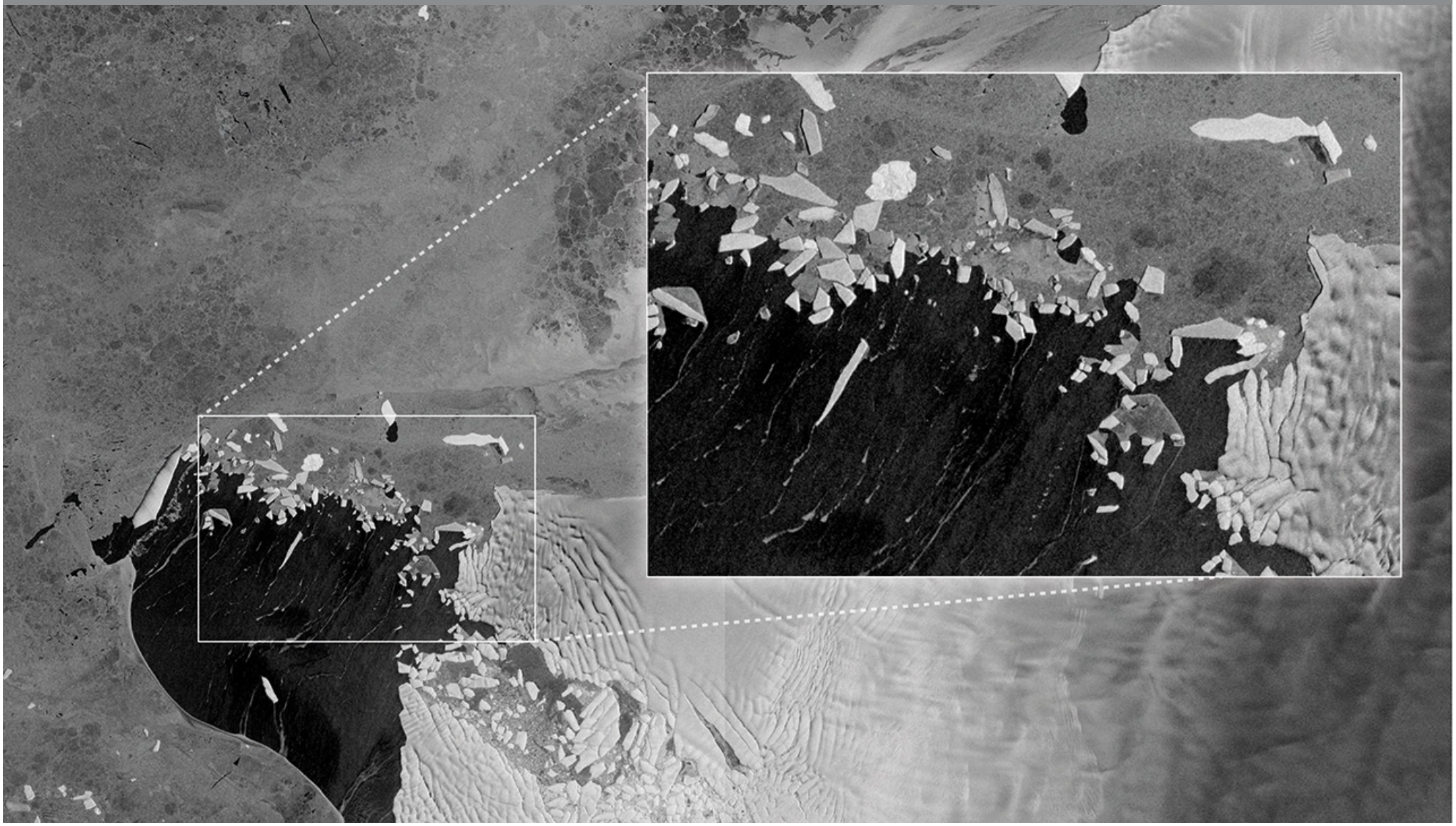
… with a long-term operational perspective



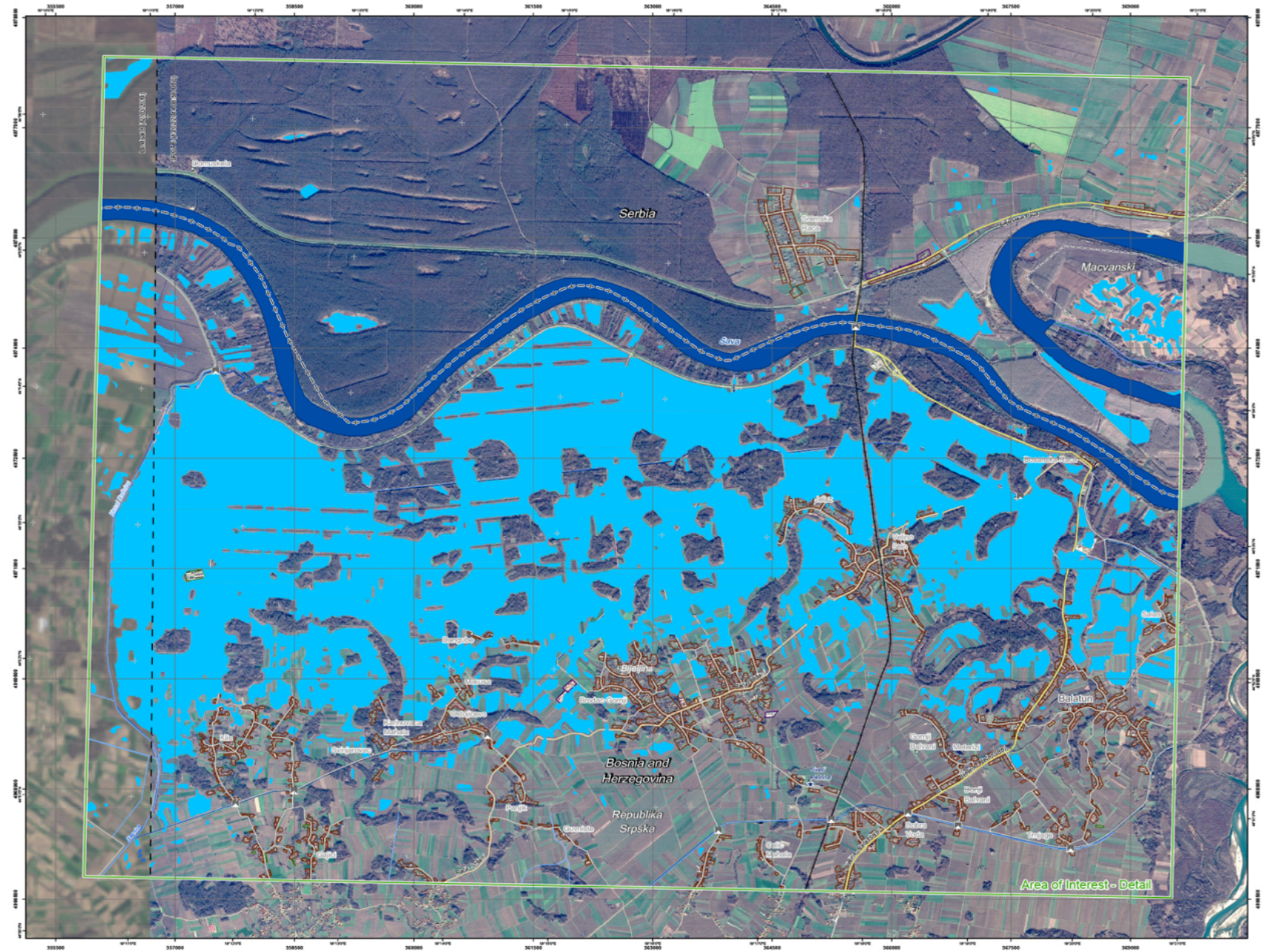
Launch of Sentinel-1A

- 3 April 2014
- Kourou spaceport
- Soyuz-2 rocket
- Once fully operational, Copernicus will be the World's most comprehensive Earth observation system
- A **quantum leap** in many ways…

First Images of Sentinel-1A



36 Years of Radar Vision



GLIDE number: FF-2014-000059-BIH
Activation ID: EMSR-087
Product N.: 07Balatun, v1

Balatun - BOSNIA AND HERZEGOVINA Flood - 13/05/2014

Delineation Map - Detail

Production date: 27/05/2014

Cartographic Information

1:22500

Full color ISO A1, high resolution (300 dpi)

0 0.5 1 2 km

N

Grid: WGS 1984 UTM Zone 34N map coordinate system
Tick marks: WGS 84 geographical coordinate system

Legend

Crisis Information
Flooded Area (24/05/2014 16:31 UTC)
General Information
Area of Interest
Sensor Footprint
Administrative boundaries
International Boundary
Region
Hydrology
River
Stream
Canal
River
Lake
Reservoir
Point of Interest
Religious
Transportation
Bridge
Railway
Primary Road
Secondary Road
Local Road
Settlements
Populated Place
Residential
Agricultural
Cemetery
Industrial
Religious
Transportation

Consequences within the detail AOI on 24/05/2014

			Affected	Total in AOI
Flooded area		sq. km	3422.1	
Estimated population		inhabitants	1000	81440
Settlements	Residential	sq. km	4.1	472.6
	Agricultural	sq. km	6.7	3.1
	Cemetery	sq. km	0	0.6
	Industrial	sq. km	1.2	9.5
	Transportation	sq. km	0	4.2
	Religious	sq. km	0	0.6
Transportation	Primary roads	km	0.5	19.5
	Secondary roads	km	1.6	11.6
	Local Roads	km	7.6	86.2
	Railways	km	0	11.6
	Bridges	No.	1	10

Map Information

On 13 May 2014, heavy rainfalls and widespread flooding hit large parts of Bosnia and Herzegovina. Heavy rainfall continued to affect large parts, in particular the region of Doboj and Zenica. The core users of the maps are Disaster Response Authorities involved in operations.

Data Sources

Inset maps based on: Administrative boundaries (URC 2013, GISCO 2010, ©EuroGeographics), Hydrology, Transportation (Natural Earth, 2012, CCM River DB © EU-JRC 2007), Settlements (Geonames, 2013).
Sentinel-1A (acquired on 24/05/2014 16:31 UTC, GSD 10 m) provided by the European Space Agency.
Pre-event: SPOT6 © Airbus Defence and Space (acquired on 13/02/2014 08:58 UTC, GSD 2.6 m, 0% cloud coverage), all rights reserved, Landsat © U.S. Geological Survey (acquired on 12/03/2014, GSD 15 m, approx. 0% cloud coverage).
Base vector layers based on OpenStreetMap © OpenStreetMap contributors, GeoNames (approx. 1:10.000, extracted on 21/05/2014), refined by ITHACA. Source information is included in vector data.
Population data: Landscan 2010 © UT BATTELLE, LLC.
Elevation data: EU-DEM (25 m posting). Height in meters above mean sea level.
All Data sources are complete and with no gaps.

Dissemination/Publication

No restrictions on the publication of the mapping apply.
Delivery formats are GeoTIFF, GeoPDF, GeoJPEG and vectors (shapefile and KML formats).

Framework

The products elaborated in the framework of current mapping in rush mode activation are realized to the best of our ability, within a very short time frame during a crisis, optimising the available data and information. All geographic information has limitations due to scale, resolution, date and interpretation of the original data sources. The products are compliant with GIO-EMS RUSH Product Portfolio specifications.

Map Production

The present map shows the flood delineation in the area of Balatun (BOSNIA AND HERZEGOVINA).
The basic topographic features are derived from public datasets, refined by means of visual interpretation of pre-event orthoimagery from SPOT6 © Airbus Defence and Space (acquired on 13/02/2014 08:58 UTC, GSD 2.6 m, 0% cloud coverage).
Thematic layers, assessing the delineation of the event have been derived from post-event image: Sentinel-1A (acquired on 24/05/2014 16:31 UTC, GSD 10 m) provided by the European Space Agency.
All satellite images have been radiometrically enhanced and coregistered to the pre-event image.
The estimated geometric accuracy of this product is 6.6 m CE90 or better, from native positional accuracy of the background satellite image.
The estimated thematic accuracy of this product is 85% or better, based on previous experience in using high-resolution SAR for flood extent delineation. Please be aware that the thematic accuracy might be lower in urban and forested areas due to known limitations of the analysis technique.
Map produced on 27/05/2014 by ITHACA under contract 257219 with the European Commission. All products are © of the European Commission.
Name of the release inspector (quality control): GAF AG (DGO).
E-mail: rush@sems-gmes.eu

Map products available at http://emergency.copernicus.eu/mapping/list-of-components/EMSR087

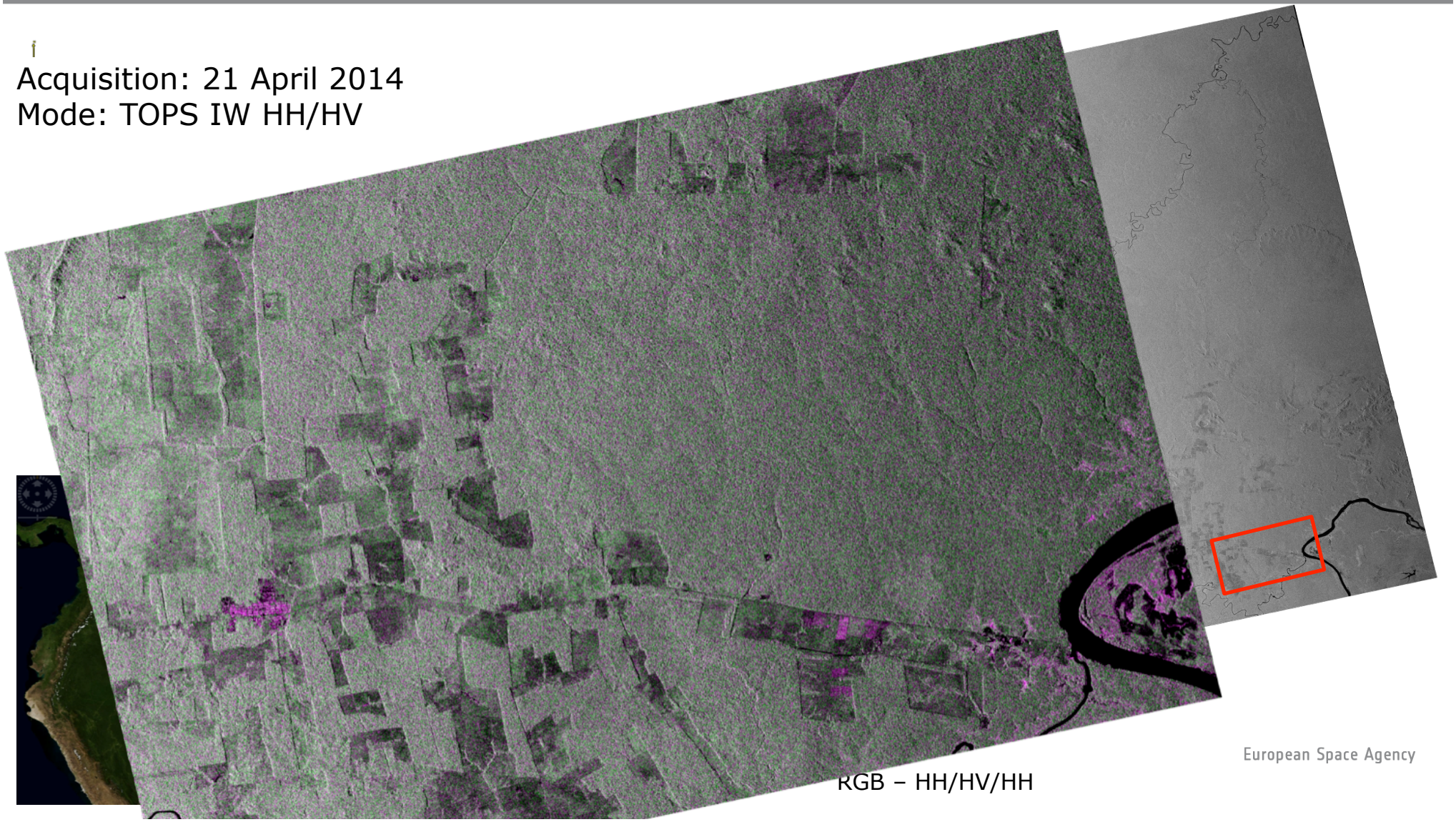
Flood

Civil Protection
Response
Delineation Map - Detail
Planning
Sentinel-1A (c) European Space Agency
13-05-2014

Copernicus

Sentinel-1A - Deforestation over Brazil

Acquisition: 21 April 2014
Mode: TOPS IW HH/HV



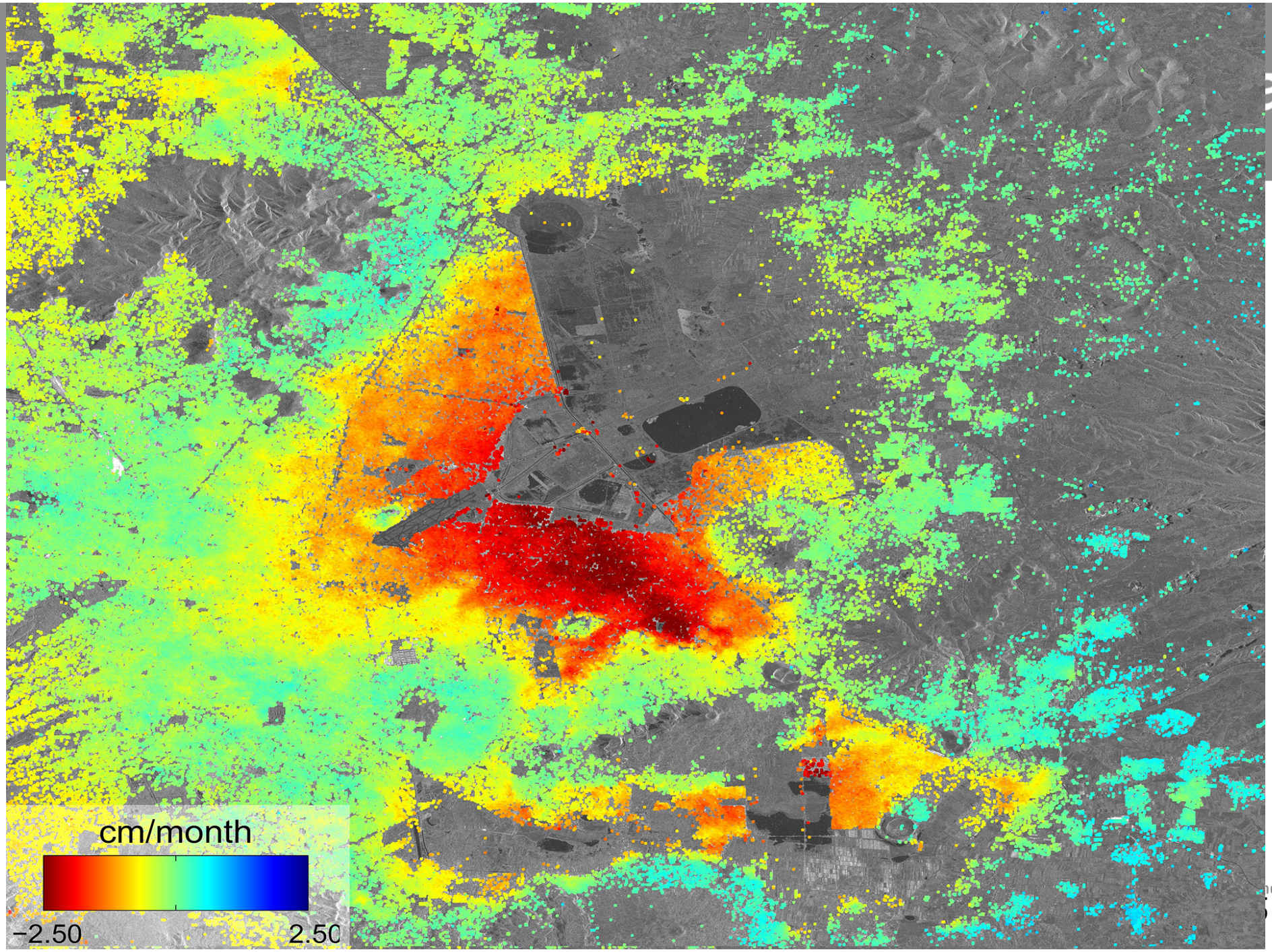
RGB – HH/HV/HH

European Space Agency

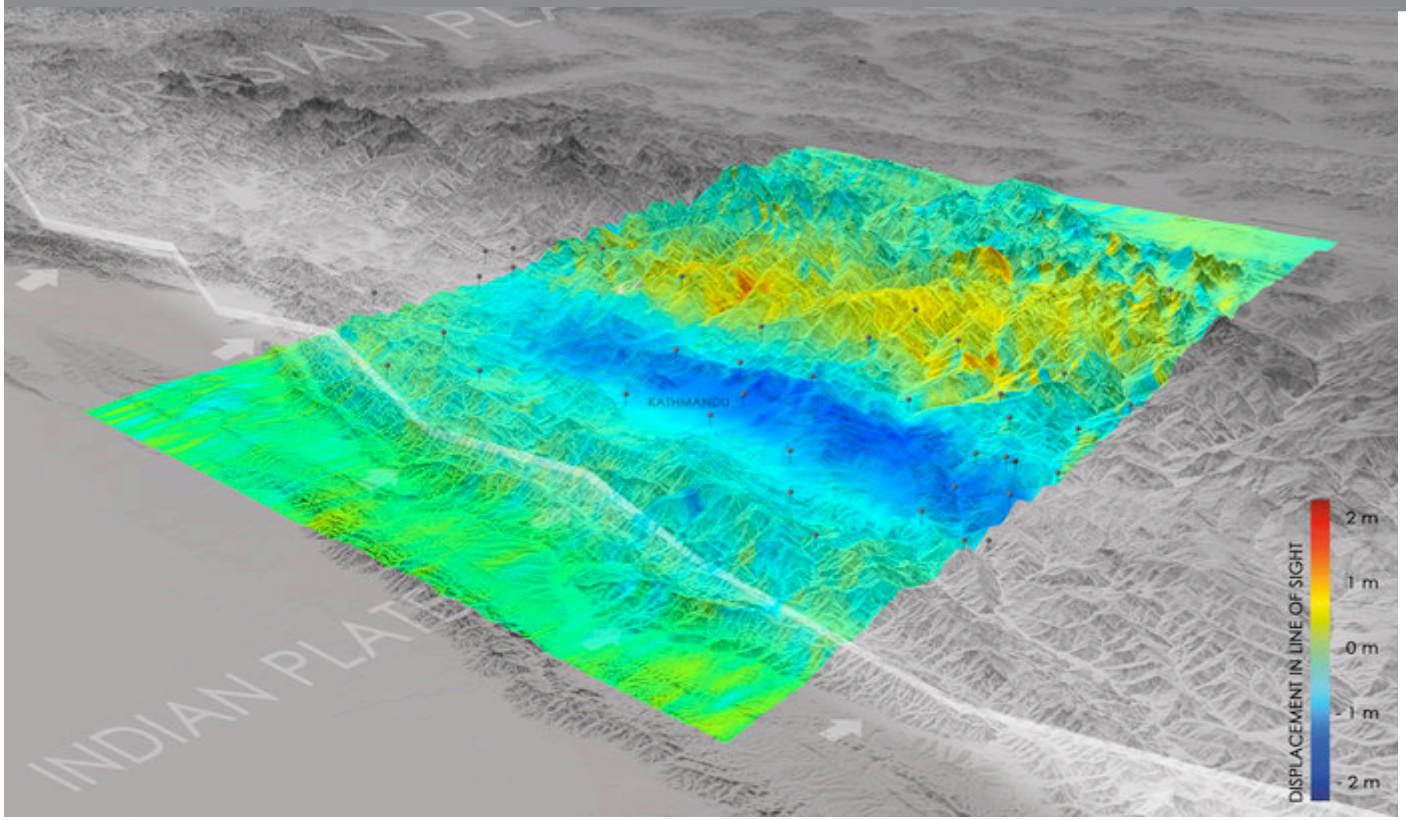
First Oil Spills Detected by Sentinel-1

Sentinel-1A TOPS EW VV/VH
acquired on 19 April 2014

Sentinel-1A TOPS EW HH/HV
acquired on 25 April 2014


cm/month
−2.50
2.50

Nepal Earthquake (25 April 2015)



Based on Sentinel-1A acquisitions on 17 and 29 April 2015 (ie before and after the 25 April earthquake)

Courtesy DLR / EOC

- Near the boundary of the Indian and Eurasian tectonic plates
- Blue shows areas of uplift of up to 0.8 m towards the satellite (called 'line of sight') which could be caused by a vertical uplift of 1 m
- Yellow area depicts areas of subsidence
- A horizontal north–south shift of up to 2 m was detected

Sentinel-2A launch

- 23 June 2015
- Kourou
- Vega VV05

Sentinel-2: ID-Card

13 spectral bands: VIS–NIR–SWIR

4 new bands in the red edge tailored to vegetation monitoring

Spatial resolution: 10m / 20m (60 m for atmospheric correction)

Best radiometric, geometric and spectral performance in its category

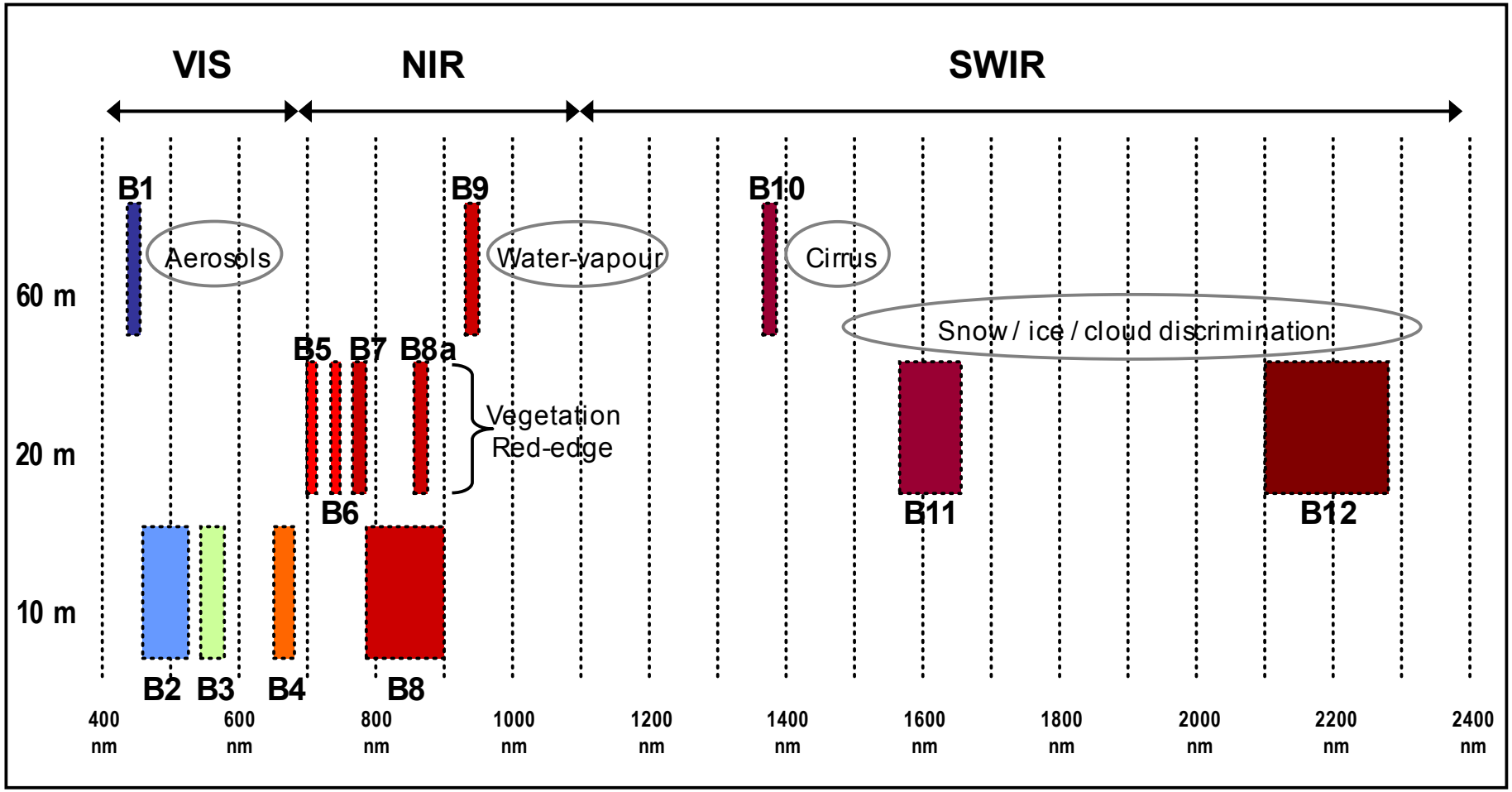
Sun synchronous orbit; 786 km mean altitude; inclination 98.62°

Swath: 290 km with global geometric revisit of 5 days at equator with 2 satellites

Lifetime: 7 years, extendable to 12 years

Long term data guarantee beyond 2030

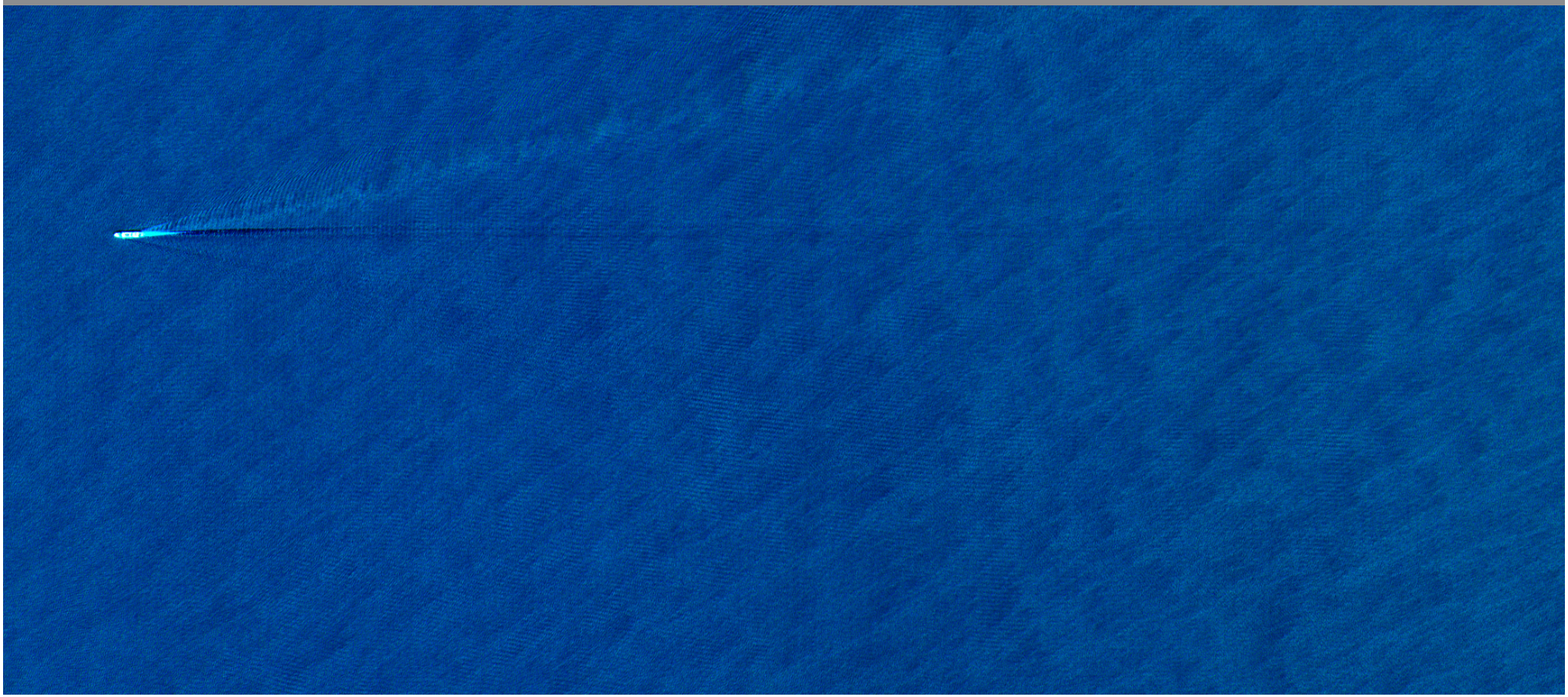
Sentinel-2: Spectral Bands



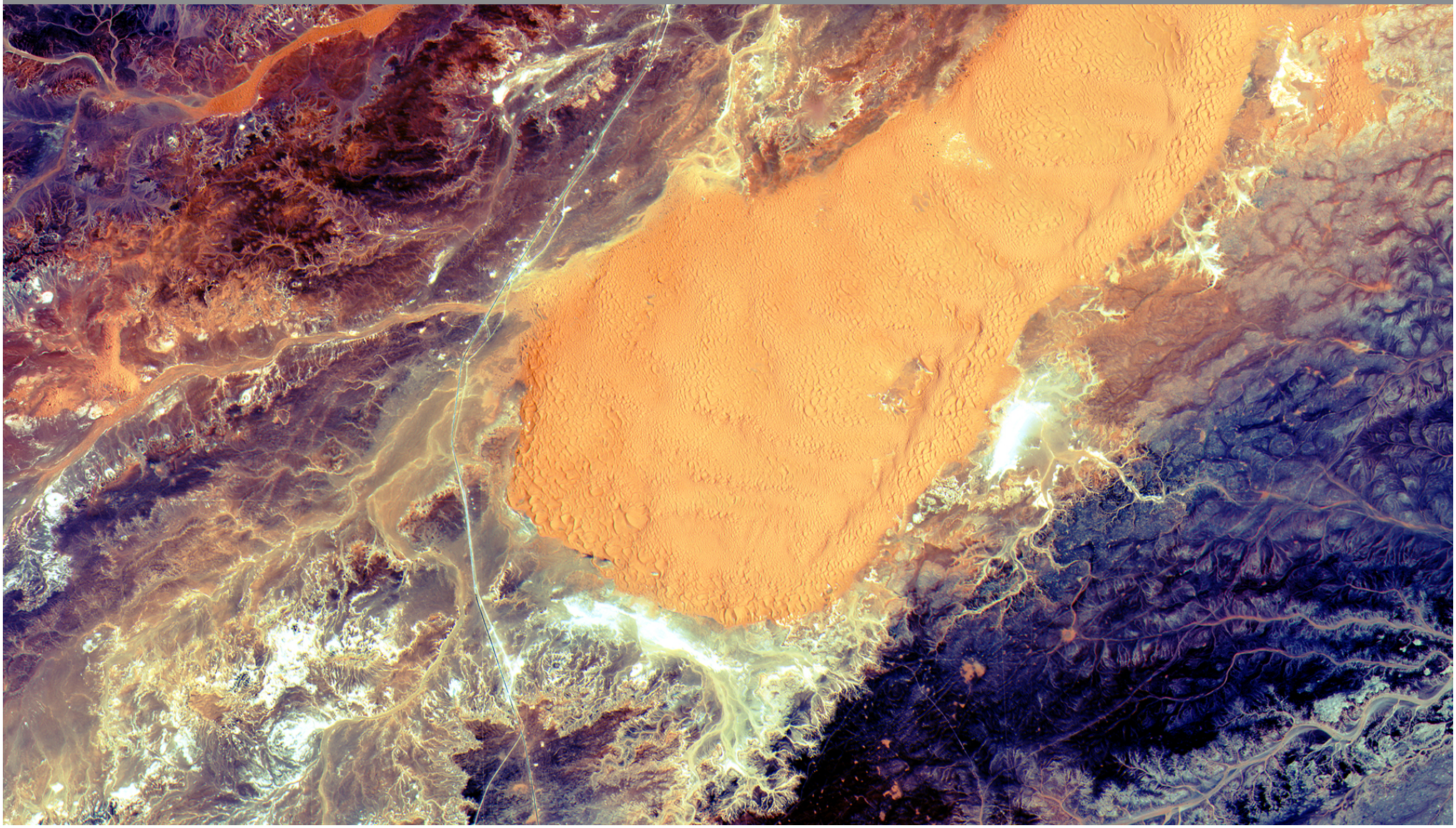
Sentinel-2A: First images

European Space Agency

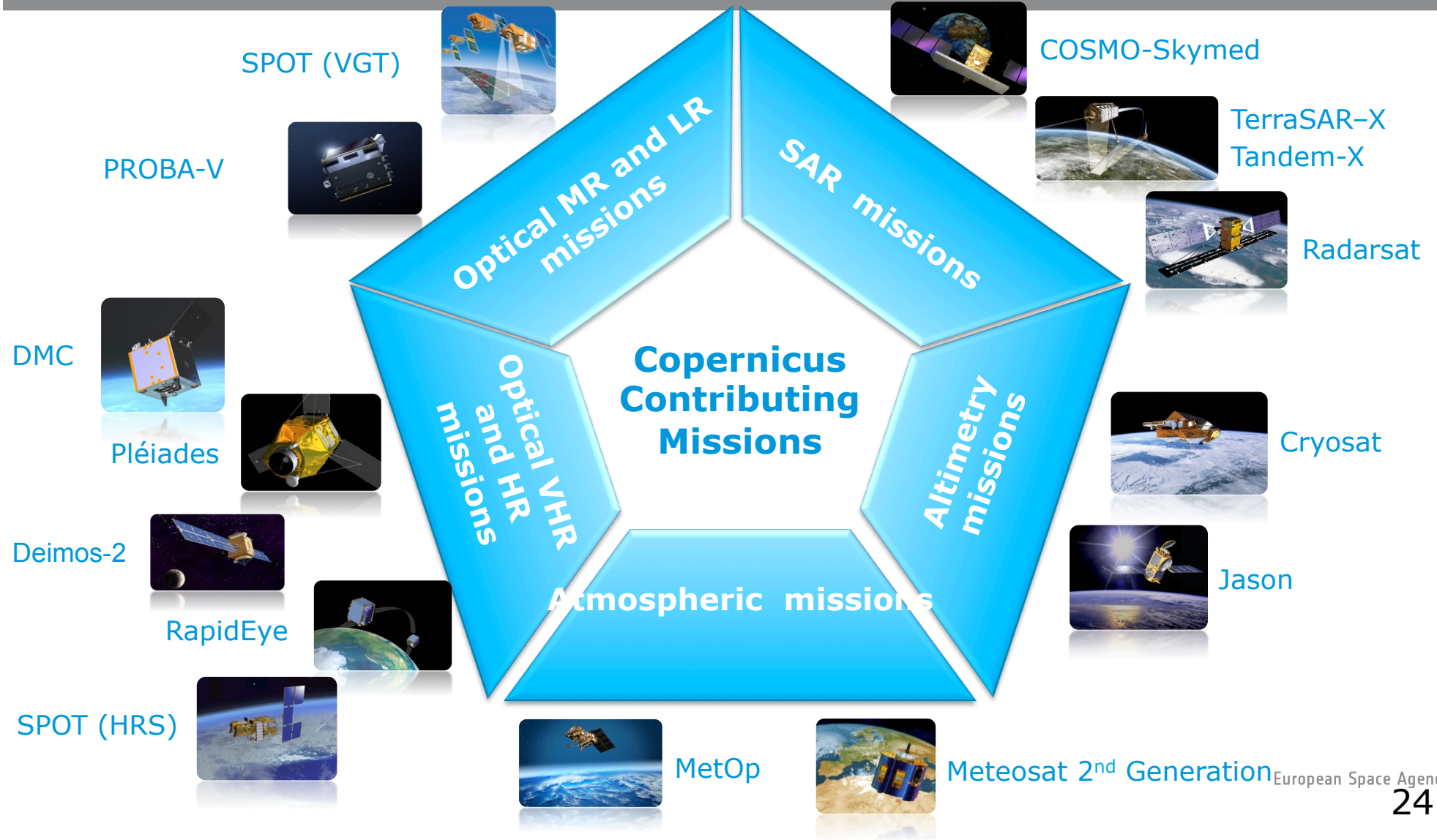
Sentinel-2A: First images



Sentinel-2A: First images



Copernicus Contributing Missions



21st Century: New Societal Challenges

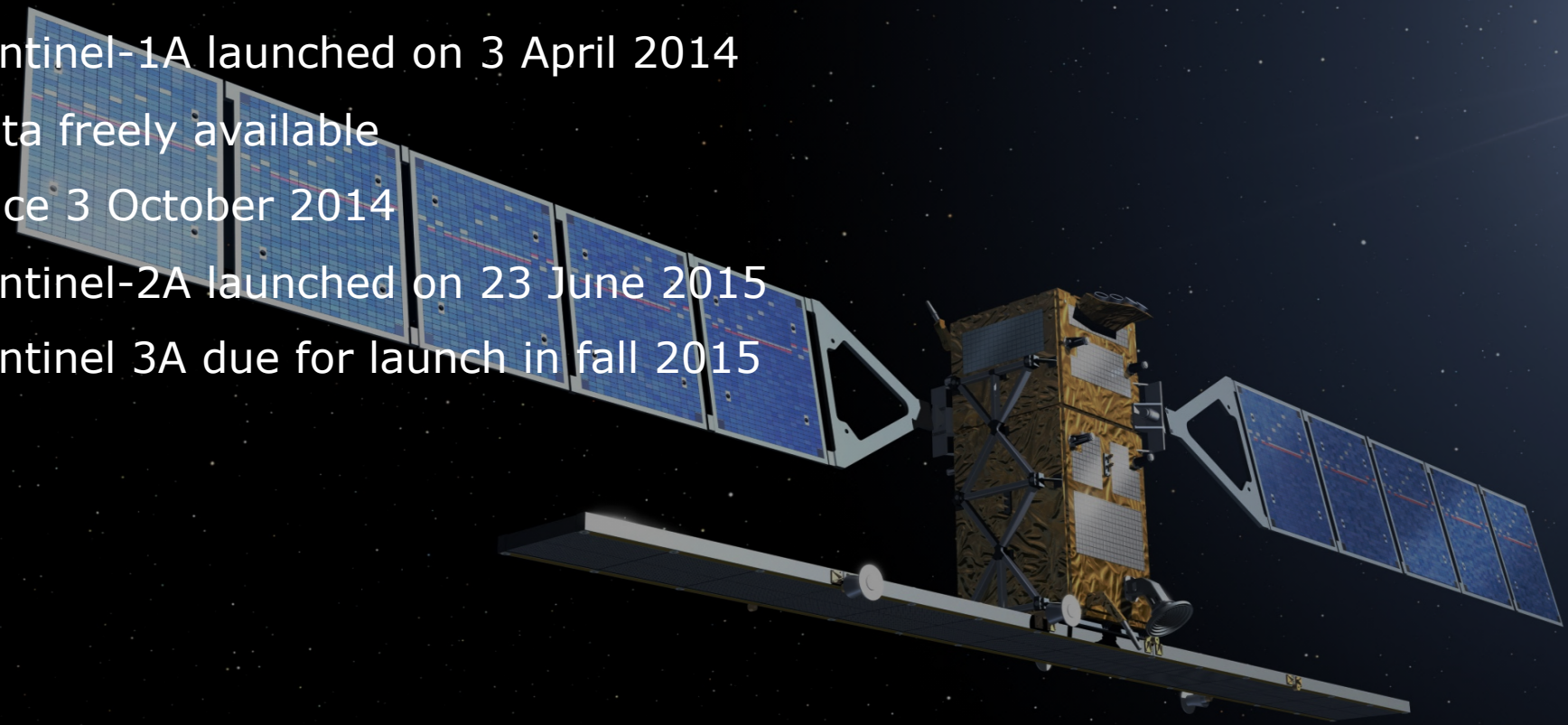
- Population Growth
- Food Security
- Energy
- Pollution
- Geo-Hazards
- Climate Change

Important contribution of Copernicus

Copernicus Services Component

Copernicus – Current Status

- Operations secured until 2021
- Infrastructure secured until 2028-2030
- Sentinel-1A launched on 3 April 2014
- Data freely available
  since 3 October 2014
- Sentinel-2A launched on 23 June 2015
- Sentinel 3A due for launch in fall 2015



Sentinel data are free for everyone

Copernicus Space Component
Data Access Portal

sentinels.copernicus.eu

Copernicus Services Access

Scientific / Other Access Hub

Collaborative Access Hub

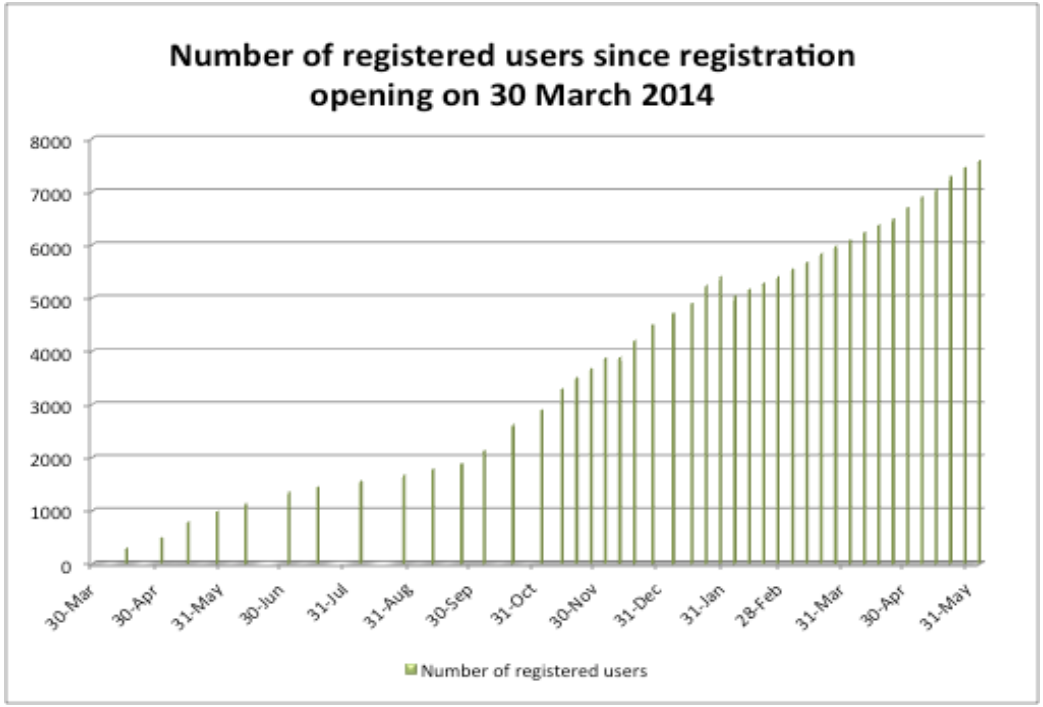
International Agreements Access Hub

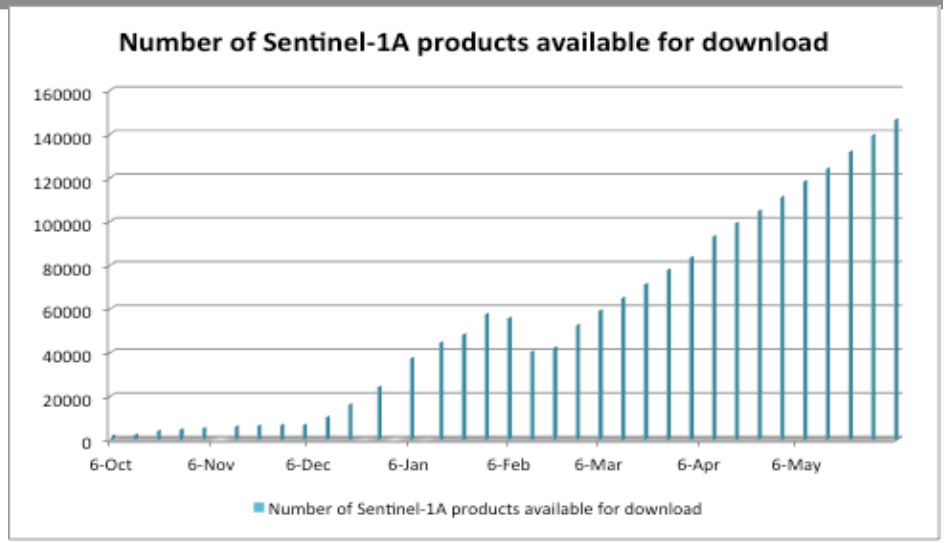
Sentinel-1 User and Data Statistics ("Scientific / Other Use" data hub)

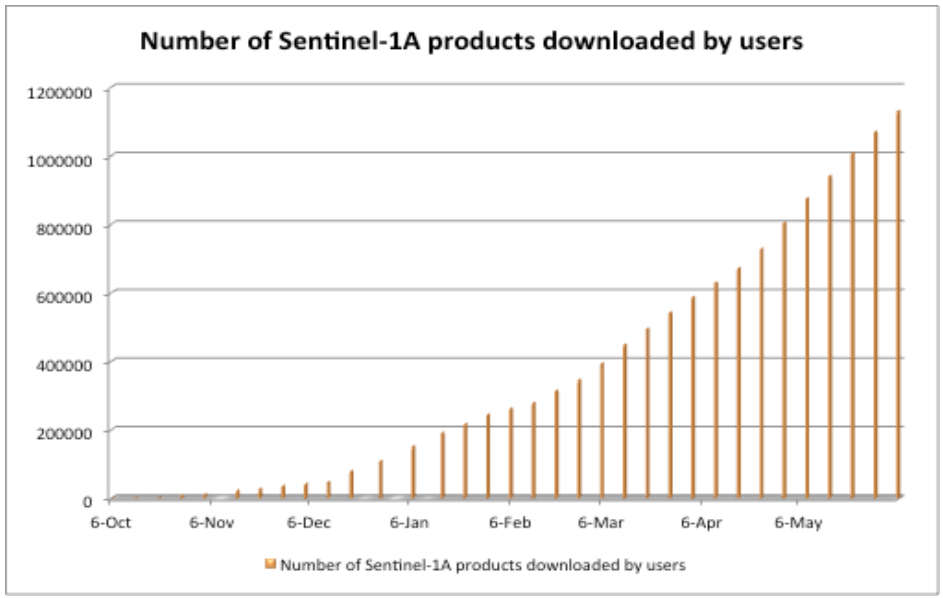
By 4 June 2015:

- ✓ **7586 registered users**
- ✓ **1,030,000 products downloaded by users, representing 1.37 Petabyte of data**

Currently (8 June) more than 150,000 products available for download







Copernicus creates economic growth and jobs

2026-2030 **potential Copernicus benefits =**

€ 130 B or around

€ 6.9 B / year =

0.2% of the EU current annual GDP

- "Money where it matters – how the EU budget delivers value to you"
EC, MEMO/11/469, Brussels, 29 June 2011

1 € spent by European tax payer on Copernicus
→ **public return of 10€** can be expected

- "The Socio-Economic Benefits of GMES"
ESPI report 39, November 2011

Creation of up to 83.000 jobs

- Former Vice President of the European Commission, Antonio Tajani

Stimulating growth & attracting young people

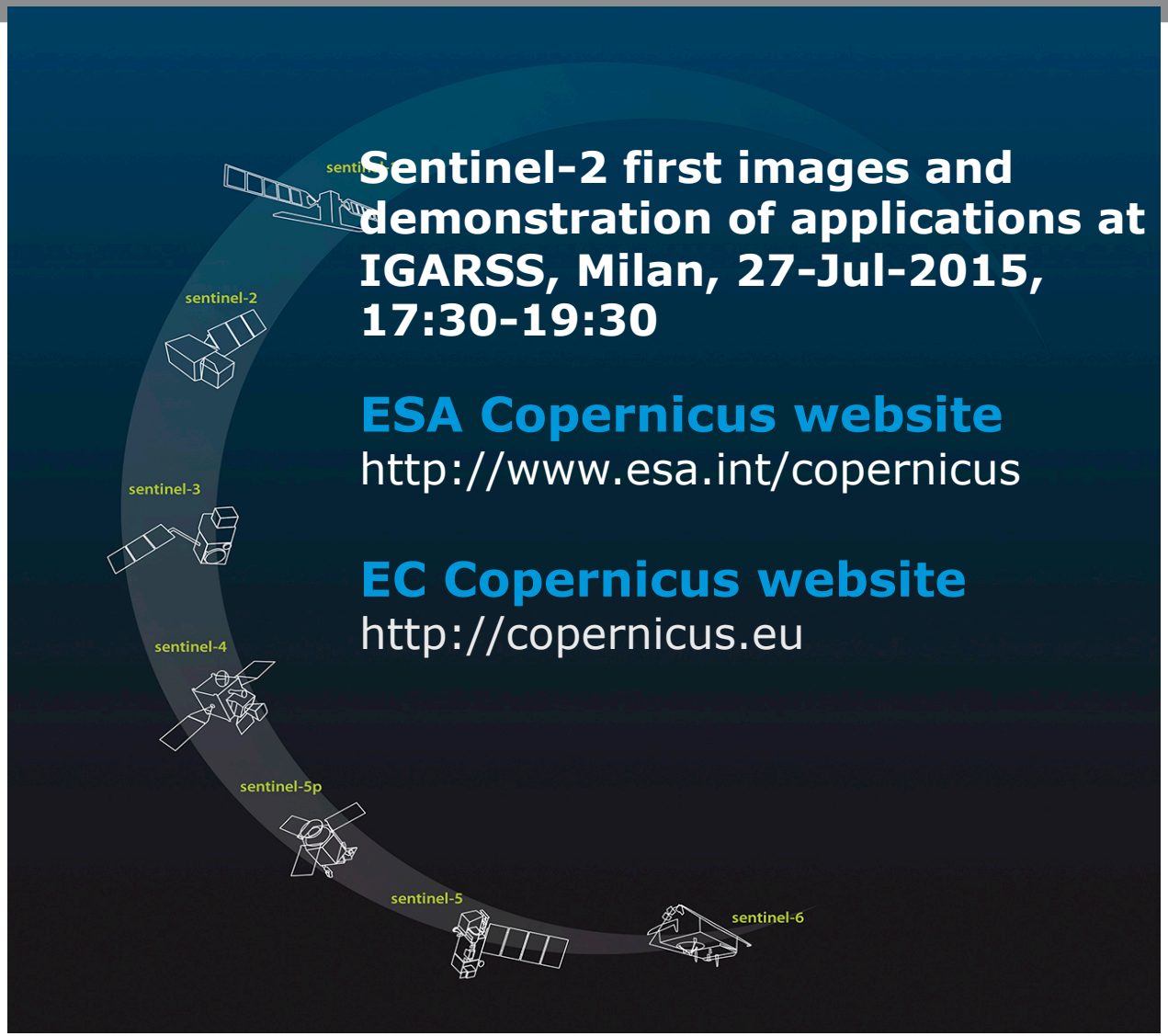
the European Earth Monitoring Competition

www.copernicus-masters.com

Conclusions – A Vision for 2030 and beyond

- Sentinels kick off a new age of Earth observation
- Transition from R&D to operational mode
- Long term availability
- Innovative services and applications

Interested In More?



PRAGUE 09-13 MAY 2016

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