

Sentinel-2 mission status & Contributing Mission datasets relevant to Belgian users

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Proba-V Mission Manager

The BRIGHT side of Remote Sensing

Brussels, 25 October 2016

Copernicus Space Component: the dedicated Sentinels ...



S1A/B: Radar Mission

3 Apr 2014/25 Apr 2016



See next presentation



S4A/B: Geostationary Atmospheric Chemistry Mission

2021/2027



S5P: Low Earth Orbit Atmospheric Chemistry Mission

Mar 2017



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

2021/2027



S6A/B: Altimetry Mission

2020/2025

Sentinel-2

Superspectral imaging mission



Mission profile

- ❑ **Two** Spacecraft operating in twin configuration
- ❑ Sun-synchronous orbit **786 km, LTDN 10:30 AM**
- ❑ Multispectral instrument with **13** spectral bands (**VIS, NIR & SWIR**), at **10, 20** and **60 m** spatial resolution
- ❑ **290 km** swath width
- ❑ **5 days** revisit at Equator with 2 satellites
- ❑ **7 years** design life time, consumables for 12 years

2015

2020

2030

Sentinel-2 A/B/C/D



Capacity is key! Europe in few minutes

Norway:
290.000km²
covered in
4 minutes



Half of Spain:
250.000km²
In 2 minutes!

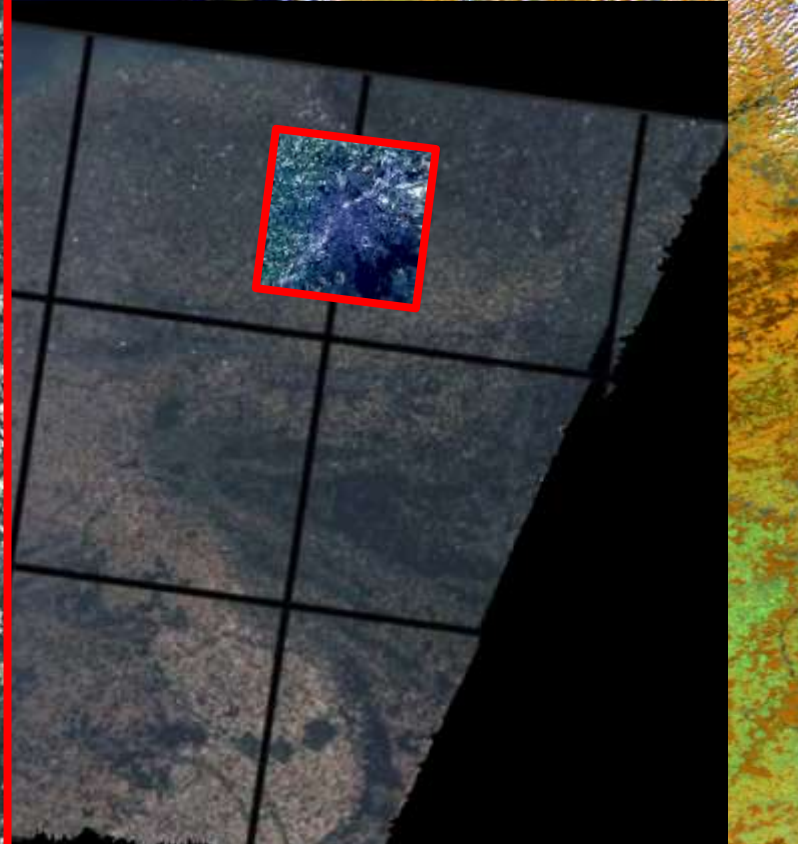
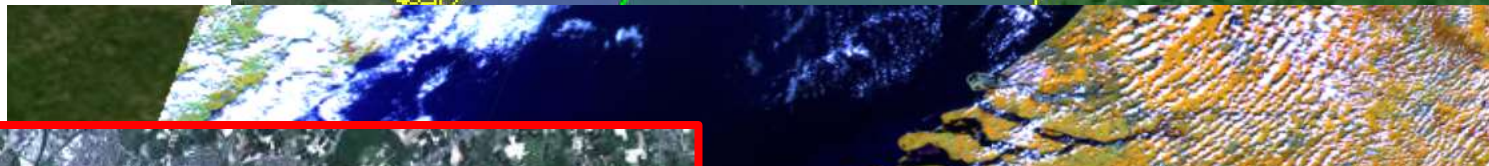


Belgium, 8-9 Sep 2016

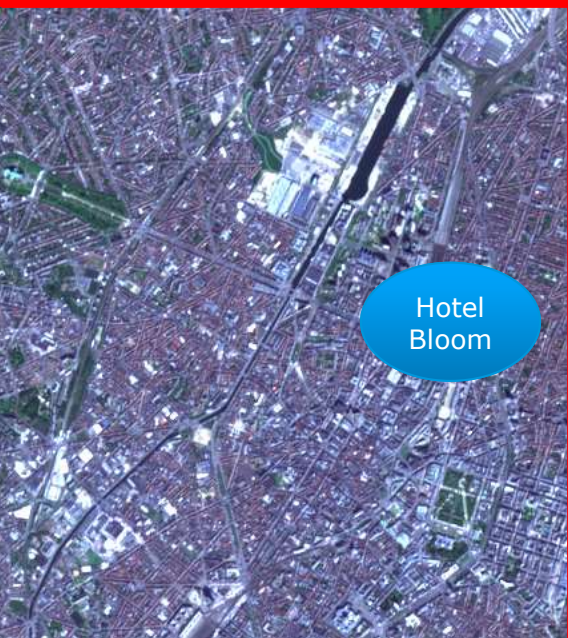
seen by Proba-V

& Sentinel-2

Large Swath!



Sharp details at 10m!



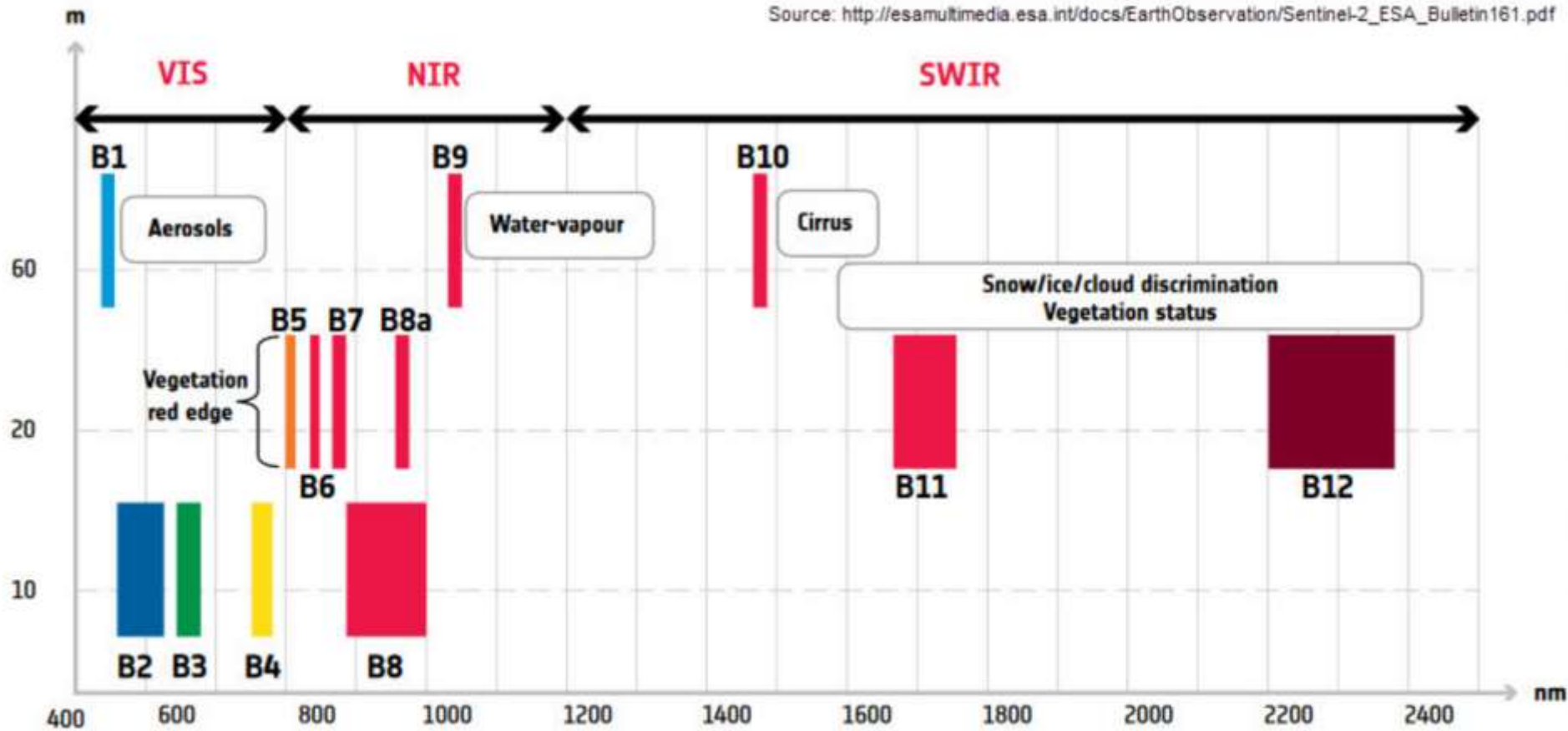
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Super-spectral imaging

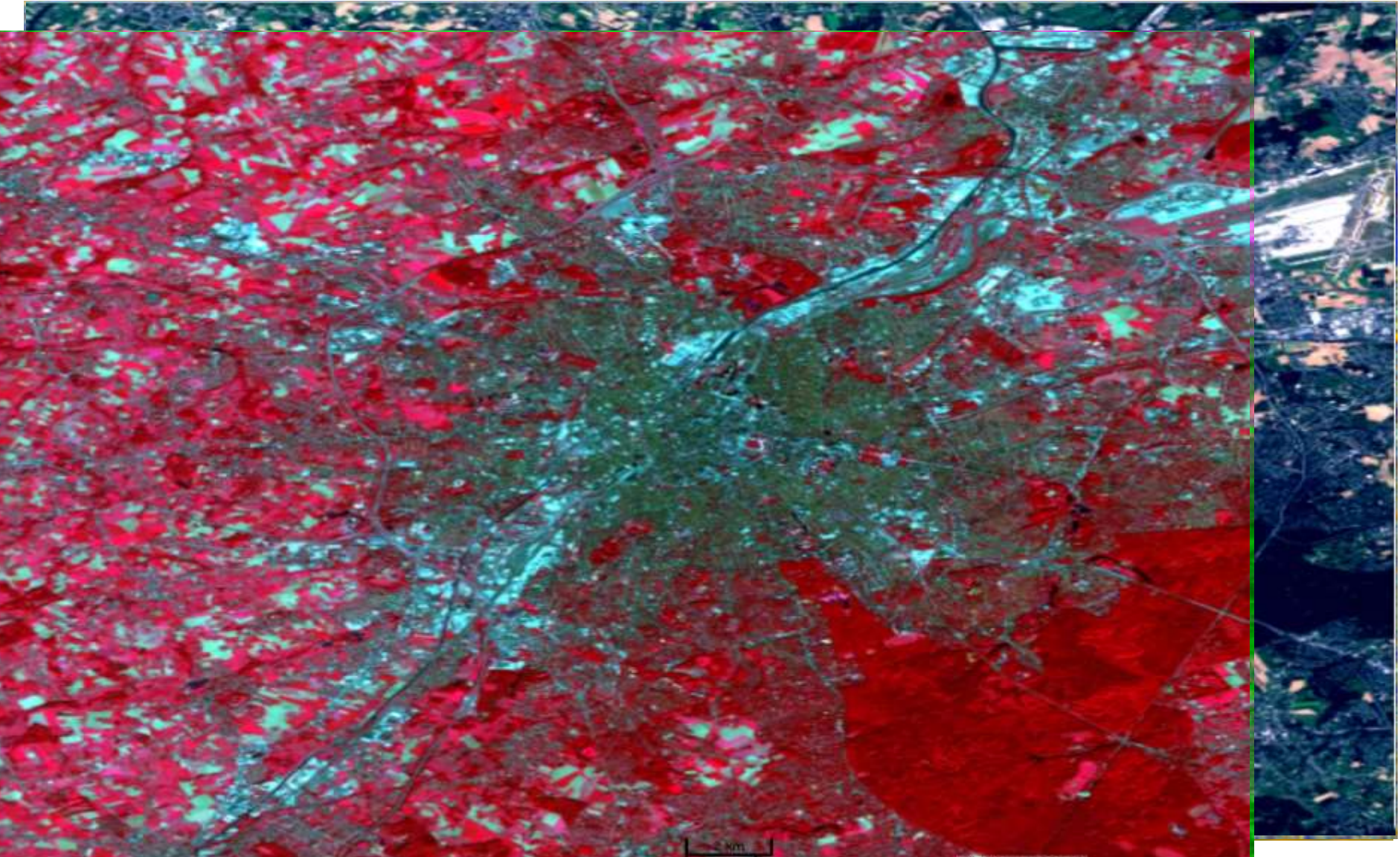


Source: http://esamultimedia.esa.int/docs/EarthObservation/Sentinel-2_ESA_Bulletin161.pdf



↑ Spatial resolution versus wavelength: Sentinel-2's span of 13 spectral bands, from the visible and the near-infrared to the shortwave infrared at different spatial resolutions ranging from 10 to 60 m on the ground, takes land monitoring to an unprecedented level

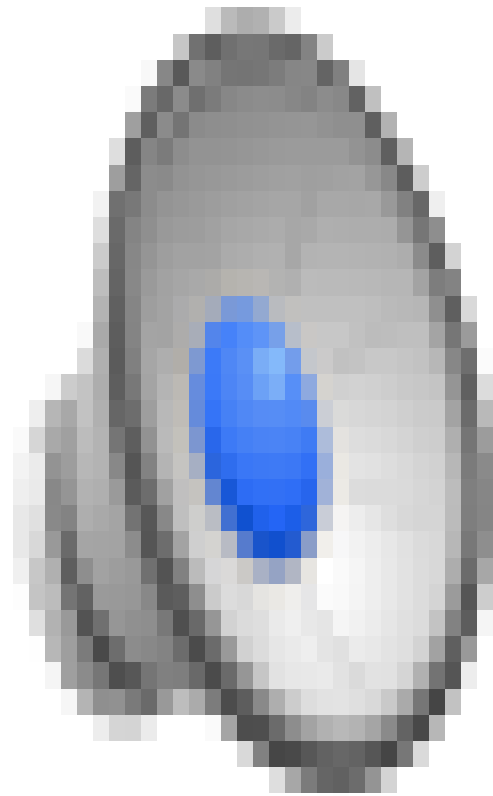
Multi-Spectral and Multi-Mission: Brussels (Proba-V, S2, S1) acquired on 8/9 September



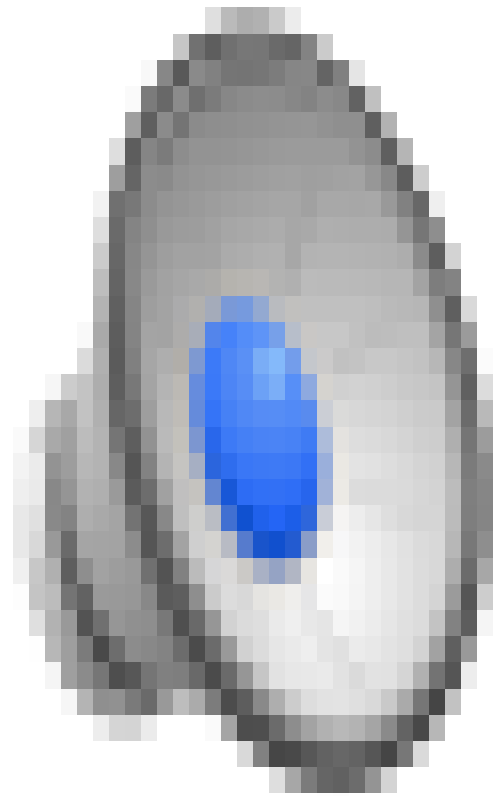
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Revisit is KEY!

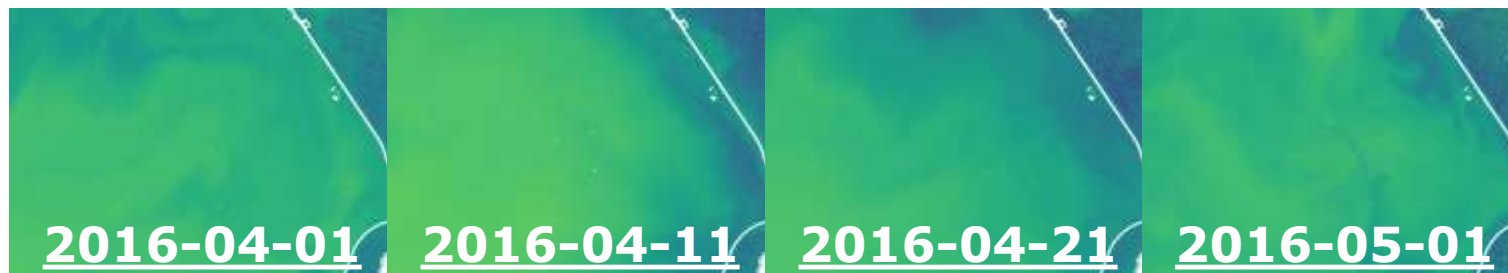


Revisit is KEY!

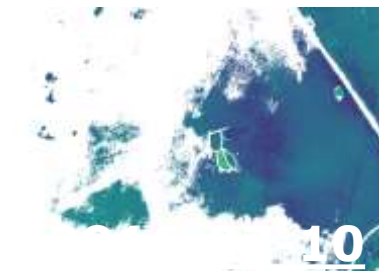




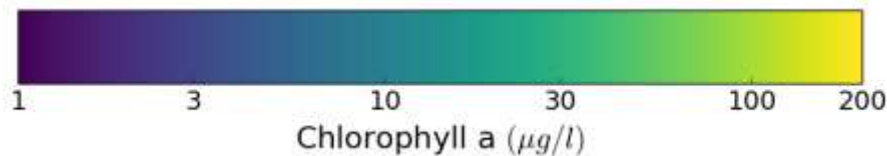
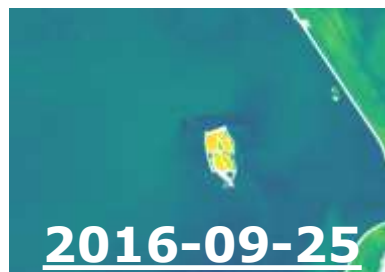
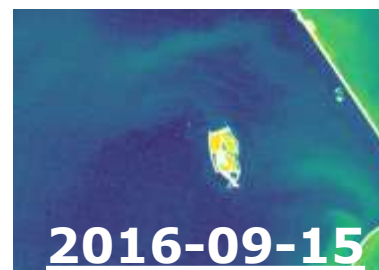
Time series of the Marker Wadden dredging, captured by L8 and S2 on 13 cloud-free days.



L8
only



L8
only



Chl-a during the Marker Wadden dredging, using Gons (2005) with red, red-edge, and NIR bands on S2.

DATA TSUNAMI

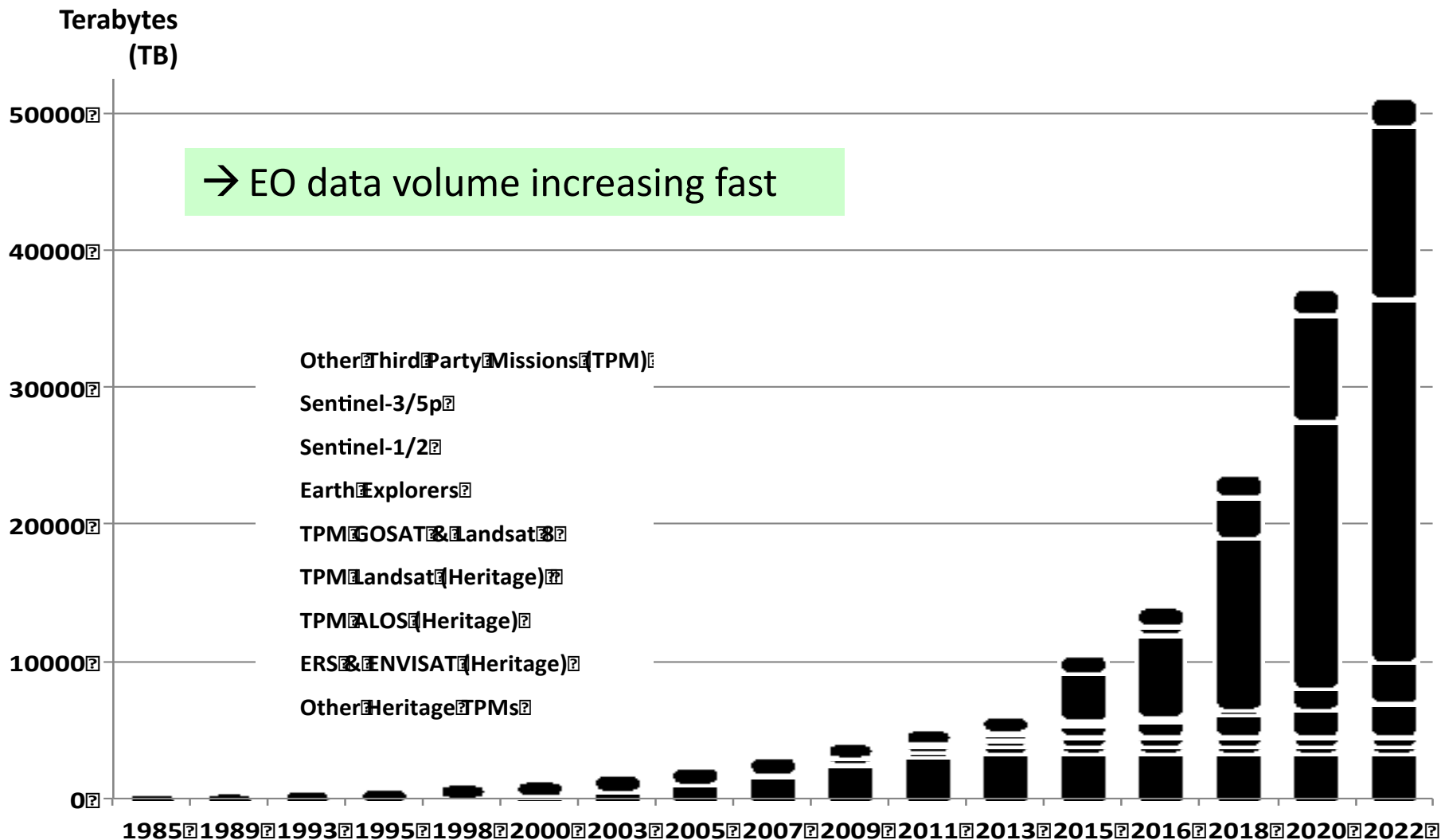
A gathering tide of satellite imagery is headed our way

Are we ready?



	Spot-5	Landsat-8	Sentinel-2
Swath	60 km	180 km	290 km
Resolution multi-spectral	5m, 10m	30m	10m, 20m
Spectral bands	4 (+1)	9 (+2 TIR)	13
Typical Product size	190 MB (10m) 760 MB (5m)	1GB (2GB)	500MB (tile)/10GB (full swath)
Yearly volume	~800 TB (total Spot sats L1)	250 TB (L1T)	1.4 PB (2 sats, L1C) 3 PB (2 sats L1C+L2A)

Increasing volume of EO data



Sentinel-2 acquisition plan



The Sentinel-2 baseline observation scenario systematically covers all land surfaces between 56° South latitude and 84° North latitude, 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 coastline
- The whole Mediterranean Sea as well as all inland water bodies and closed seas



Currently 10 days revisit in Europe, Africa and Greenland

Rest of the World in 20 days (=14.2min/orbit)

→ 10 days revisit of all land masses to be reached Q1/2017, using EDRS service / 4th X-band station

Sentinel-2 acquisition plan published online ahead of every repeat cycle at <https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-2/acquisition-plans>



Exceptionally Antarctica 17-27 Oct 2016



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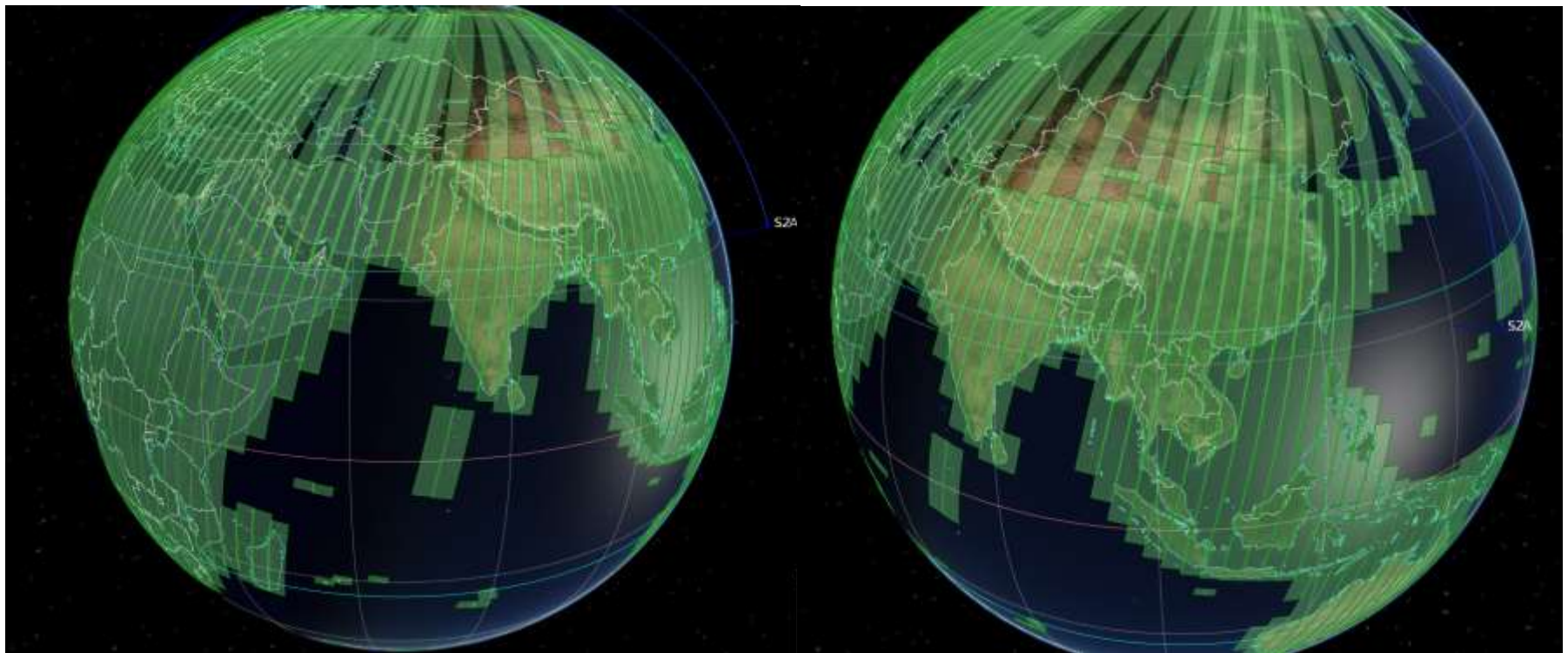
European Space Agency

Sentinel-2 acquisition plan: "Winter 2016"



CYCLE 1: Validity from 25 October to 04 November 2016.

- Europe, Africa and Greenland systematic coverage every 10 days
- Oceania (Australia, New Zealand, Solomon Islands, New Caledonia, Micronesia etc.) + Asia (Thailand, Vietnam, Indonesia, Japan, etc.) under 37 deg with a 10 days revisit



Sentinel-2 acquisition plan: "Winter 2016" Alternating Cycle



CYCLE 2: Validity from 04 November to 14 November 2016.

- Europe, Africa and Greenland systematic coverage every 10 days
- America + Samoa, Tonga, etc with a 10 days revisit cycle



Sentinel-2 Products



Name	High-level Description	Production	Preservation Strategy	Volume
Level-1B	Top-of-atmosphere radiances in sensor geometry	Systematic	Long-term	~27 MB (each 25x23km ²)

Excellent geometric and radiometric quality

In preparation

*: Systematic global production of L2A is currently being prepared.

** : <https://sentinels.copernicus.eu/web/sentinel/toolboxes/sentinel-2>



S2 Data Quality Overview

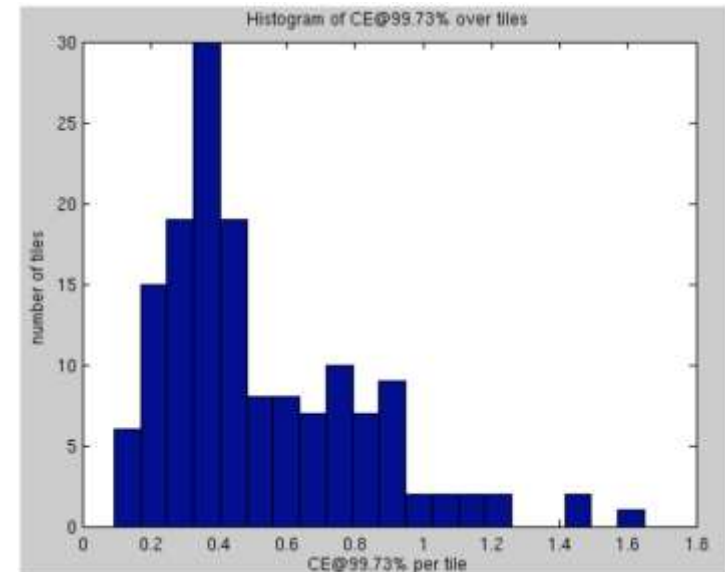
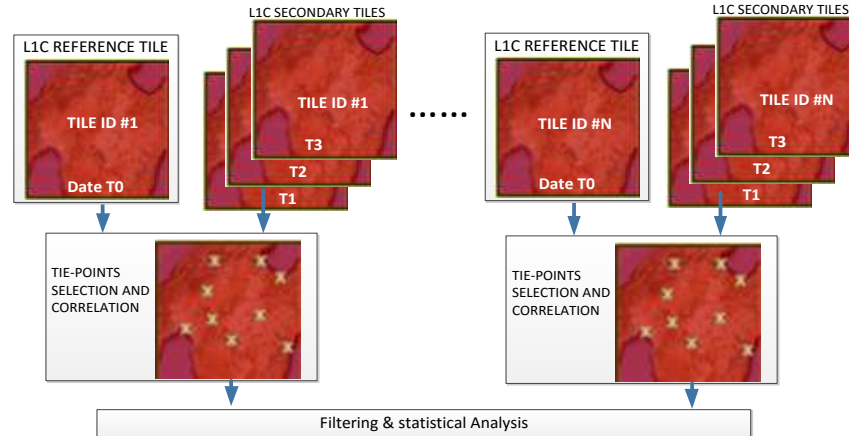


✓Excellent product data quality:

Requirement	Description	Measured performance
Absolute geolocation (without ground control points)	The geo-location uncertainty shall be better than 20 m at 2σ confidence level (without Ground Control Points).	< 10 m at 2σ
Multi-spectral Registration	The inter-channel spatial co-registration of any two spectral bands shall be better than 0.30 of the coarser achieved spatial sampling distance of these two bands at 3σ confidence level.	< 0.26 pixel at 3σ
Absolute radiometric uncertainty	The absolute radiometric uncertainty shall be better than 5 % (goal 3%).	B1 to B9: < $5\% \pm 2\%$
SNR	The Signal-to-Noise Ratio (SNR) shall be higher than specified values	All bands compliant with > 20% margin

Multi-temporal Registration

- **Method:** Correlation of L1C tiles acquired with same relative orbits at various dates.
- **Results:** 105 L1C tiles (covering 53 geographic tiles) analyzed over the world without geometric refinement.

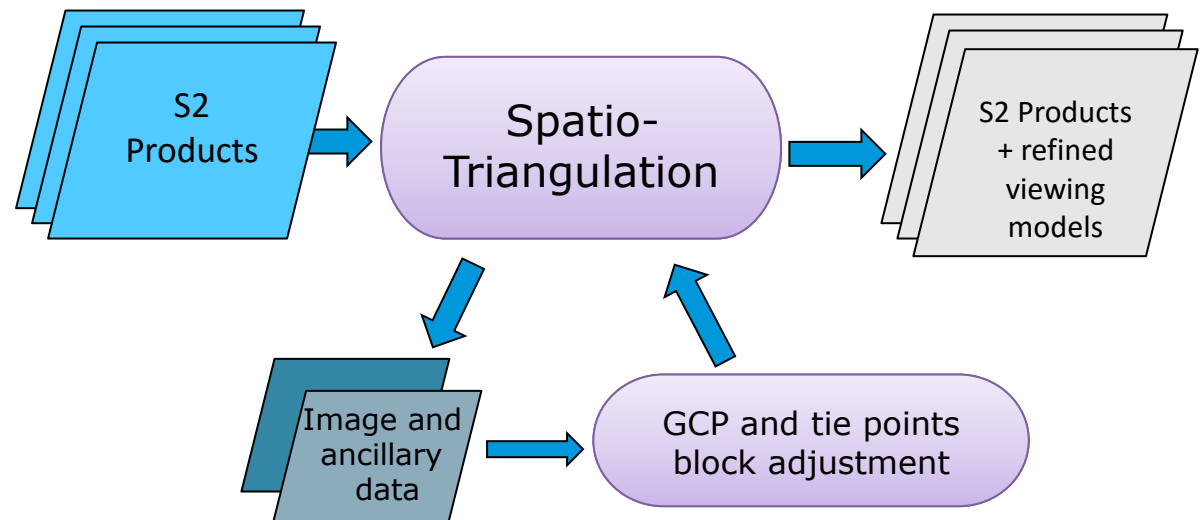
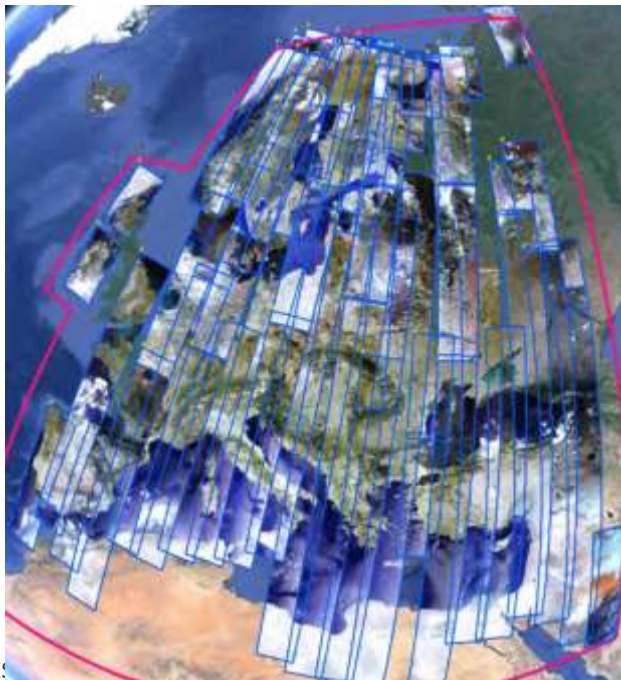


- ✓ **CE at 95.45% is 1.12 pixel**
- ✓ **Not yet compliant with requirement (0.3 pixel)**
- ✓ Expected to become complaint with the geometric refinement using a **Global Reference Image (GRI)**.

Measured Performances / L1 Geometry

GRI (Global Reference Image)

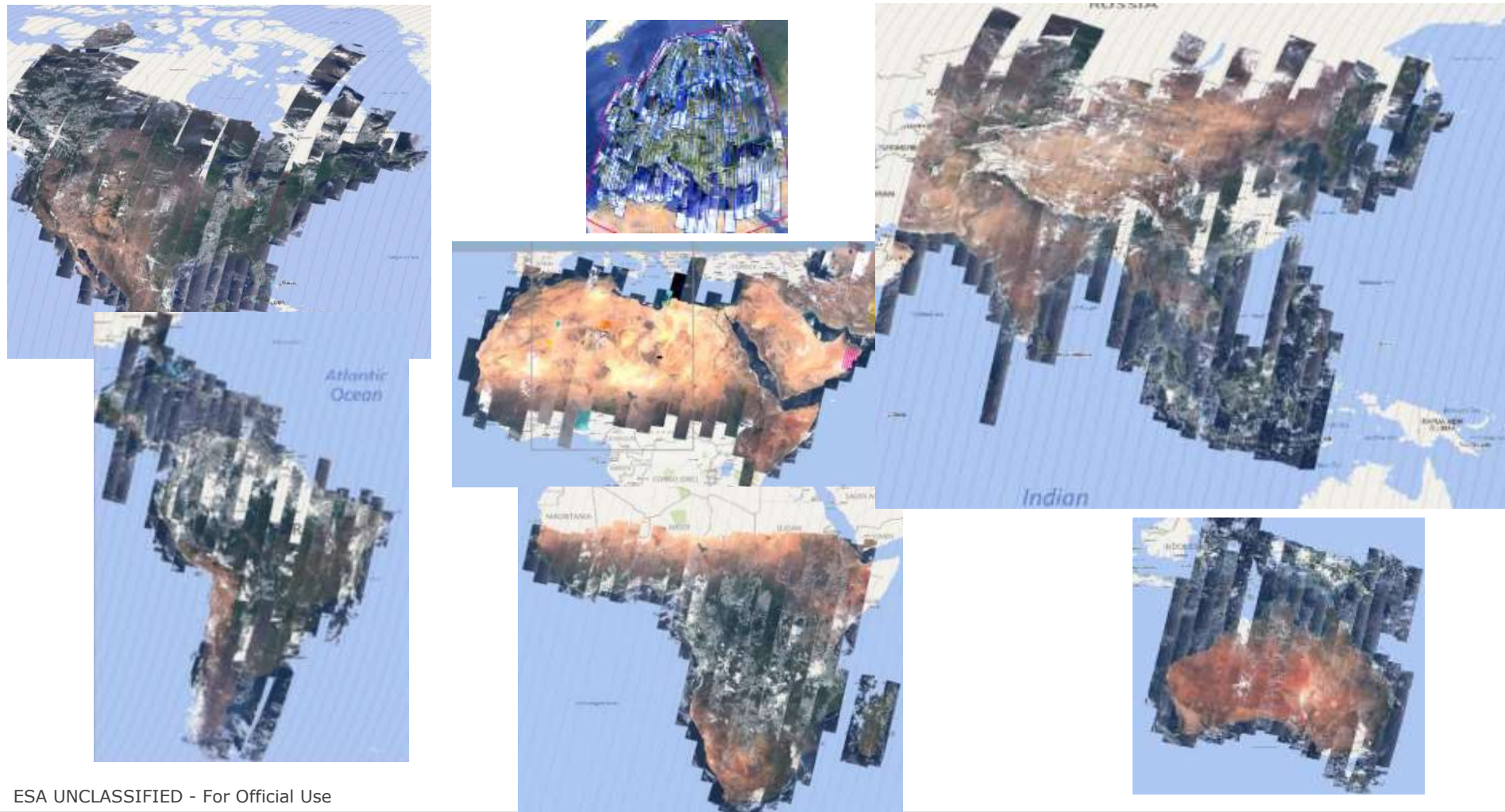
- Objective:** To obtain a full repeat cycle dataset of well-localized mono-spectral Level-1B images (band 4) which will be used as reference images in the processing to improve geolocation and multi-temporal registration.
- Methodology:** Massive spatio-triangulation on large blocks.



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GRI Construction Status

- ✓ European GRI will be completed (including validation) by Q4 2016.
- ✓ Worldwide GRI will be completed (including validation) by Q4 2017.



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Processing Baselines and Anomalies

✓ <https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-2/data-quality-report>

Anomaly ID	Title	02.00	02.01		02.02	02.03	02.04
		Deployed 23/11/2015	Deployed 27/01/2016	Deployed 31/03/2016	Deployed 03/05/2016	Deployed 09/06/2016	Deployed 15/06/2016
3	Incorrect tile numbering	yes					
4	Instrument Measurement Time MTD	yes	yes	yes	yes	yes	yes
5	Minimum Reflectance "0"	yes	yes				

Next evolution step ~end October:

- addition of **True Colour Images** (TCI) = RGB histogram equalized in JPEG2000
- shorter **filename**
- Sample data released, <https://scihub.copernicus.eu/news/News00106>
- **See PSD V14**

<https://sentinels.copernicus.eu/documents/247904/685211/Sentinel-2-Products-Specification-Document-Draft>

Call for S2 Validation Team



<http://esaconferencebureau.com/2016-events/16c20/home>



1st sentinel-2 validation team meeting

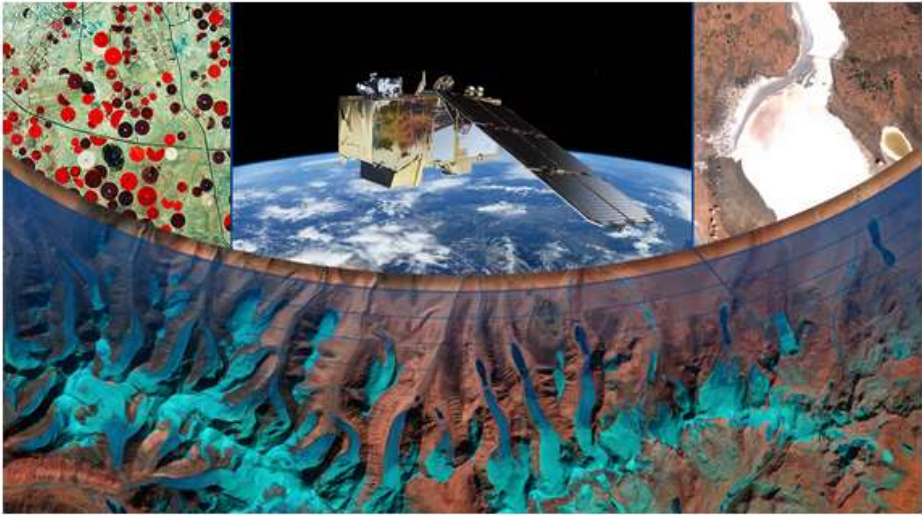
European Space Agency

List of events

- Home
- Objectives
- Deadlines
- Registration
- Abstract Submission
- Venue
- Contact
- Organizing Committee
- Hotel

1st Sentinel-2 Validation Team Meeting

28-29 November 2016
ESRIN, Frascati, Rome (Italy)



The Copernicus Sentinel-2A satellite was launched in June 2015. A second satellite, Sentinel-2B, will be launched early 2017 completing the deployment of the Sentinel-2 constellation. Calibration and validation activities are carried out operationally by ESA's Mission Performance Centre (MPC).

These activities can be complemented with the expertise from independent teams such as the experts involved in relevant Cal/Val international groups, or by individual principal investigators, users, laboratories, and institutions.

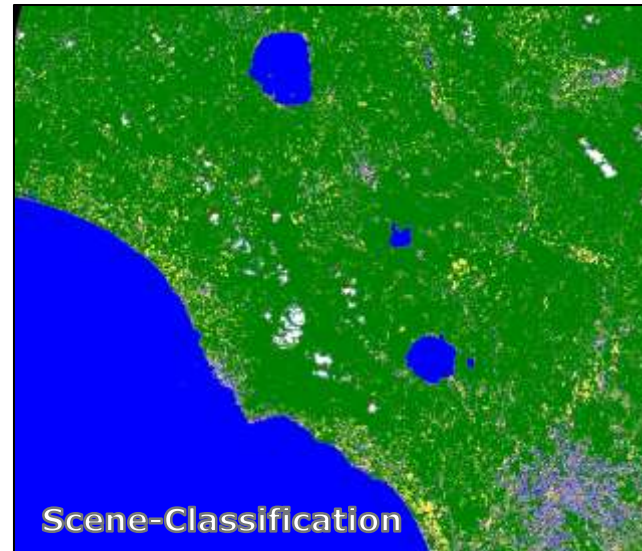
These experts are invited to be part of the so-called Sentinel-2 Validation Team (S2VT). The work performed by the S2VT will complement on a best-effort and with no supply of funds basis, the baseline validation activities.

Registration and abstract submission opening	22 September 2016
Registration and abstract submission closing	06 November 2016
Notification of acceptance and preliminary programme	18 November 2016
Release of the final programme at the meeting	



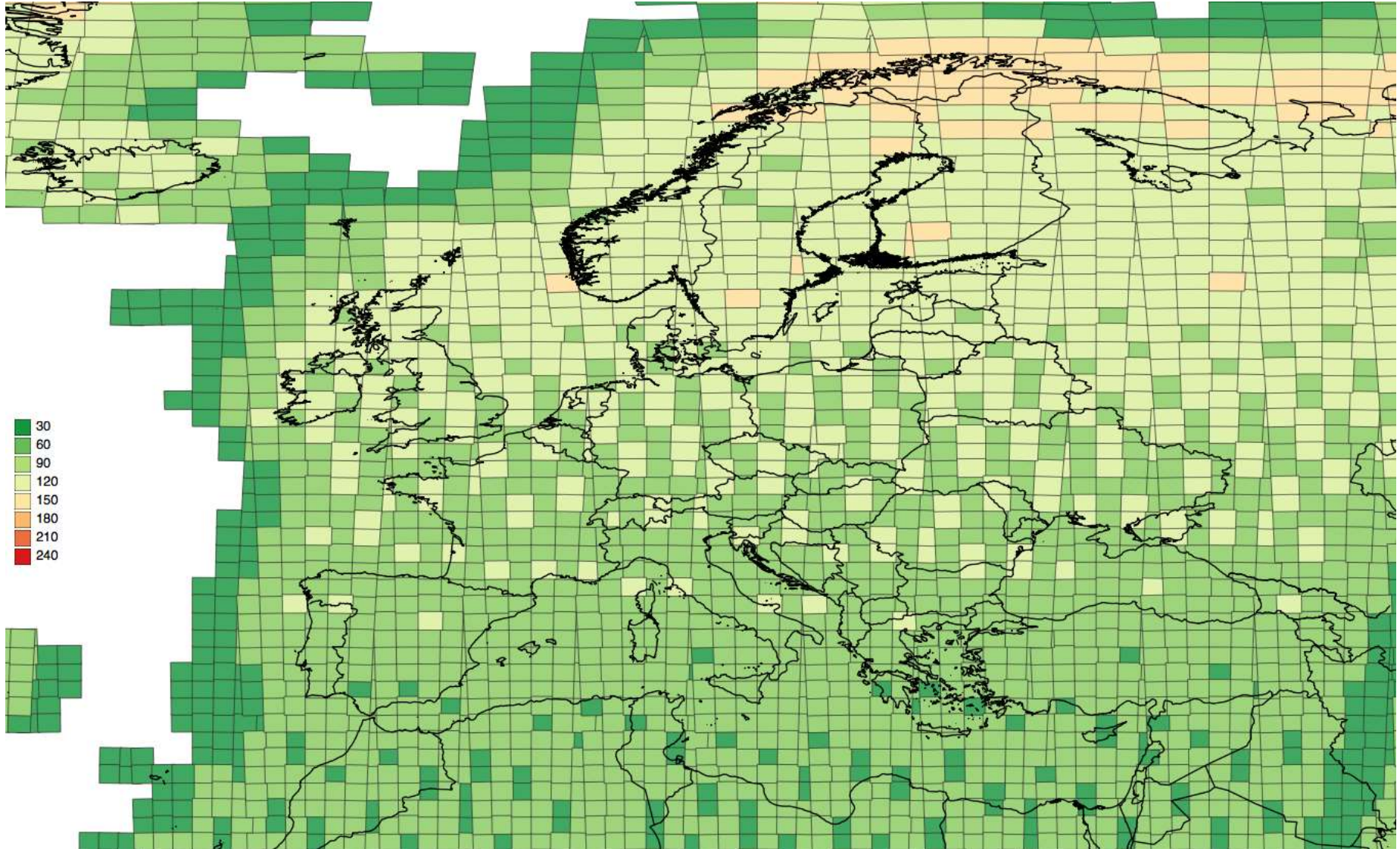
L2A Pilot Pre-Operational Production

- Pilot production of L2A over Europe to be released in the next 1-2 weeks
- The Sen2Cor processor has been integrated in the ESA-RSS environment (Research and Support System).
- It will daily generate up to 250GB of L2A products data (~600 Tiles/Day).
- L2A output products will be made available, through <http://scihub.esa.int>
- Products granularity of resulting L2A will be the same of L1C available on SciHub.



Label	Classification
0	NO_DATA
1	SATURATED_OR_DEFECTIVE
2	DARK_AREA_PIXELS
3	CLOUD_SHADOWS
4	VEGETATION
5	BARE_SOILS
6	WATER
7	CLOUD_LOW_PROBABILITY
8	CLOUD_MEDIUM_PROBABILITY
9	CLOUD_HIGH_PROBABILITY
10	THIN_CIRRUS
11	SNOW

90-120 acquisitions over Belgium since June 2015

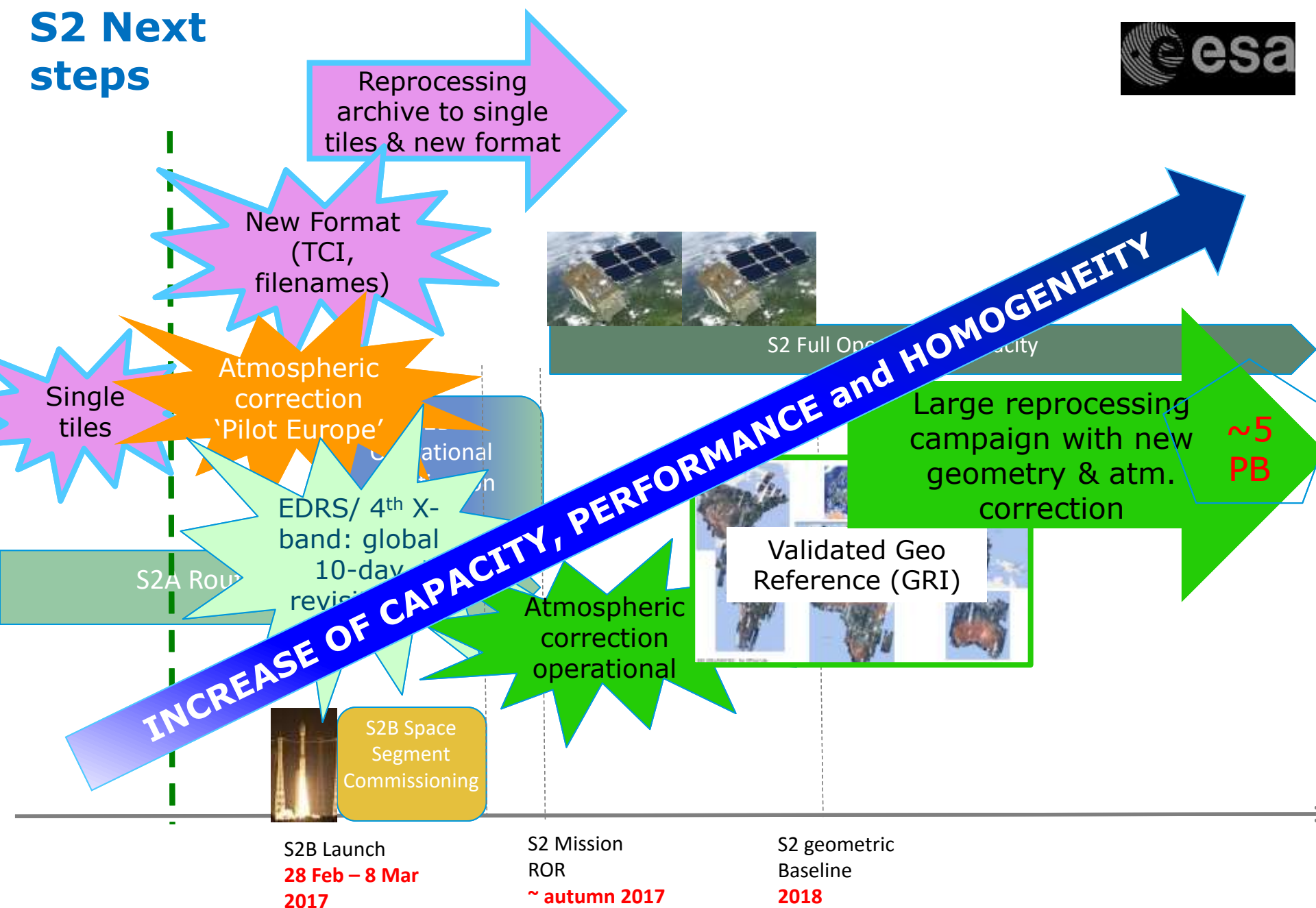


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European Space Agency

S2 Next steps



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<http://spacedata.copernicus.eu>

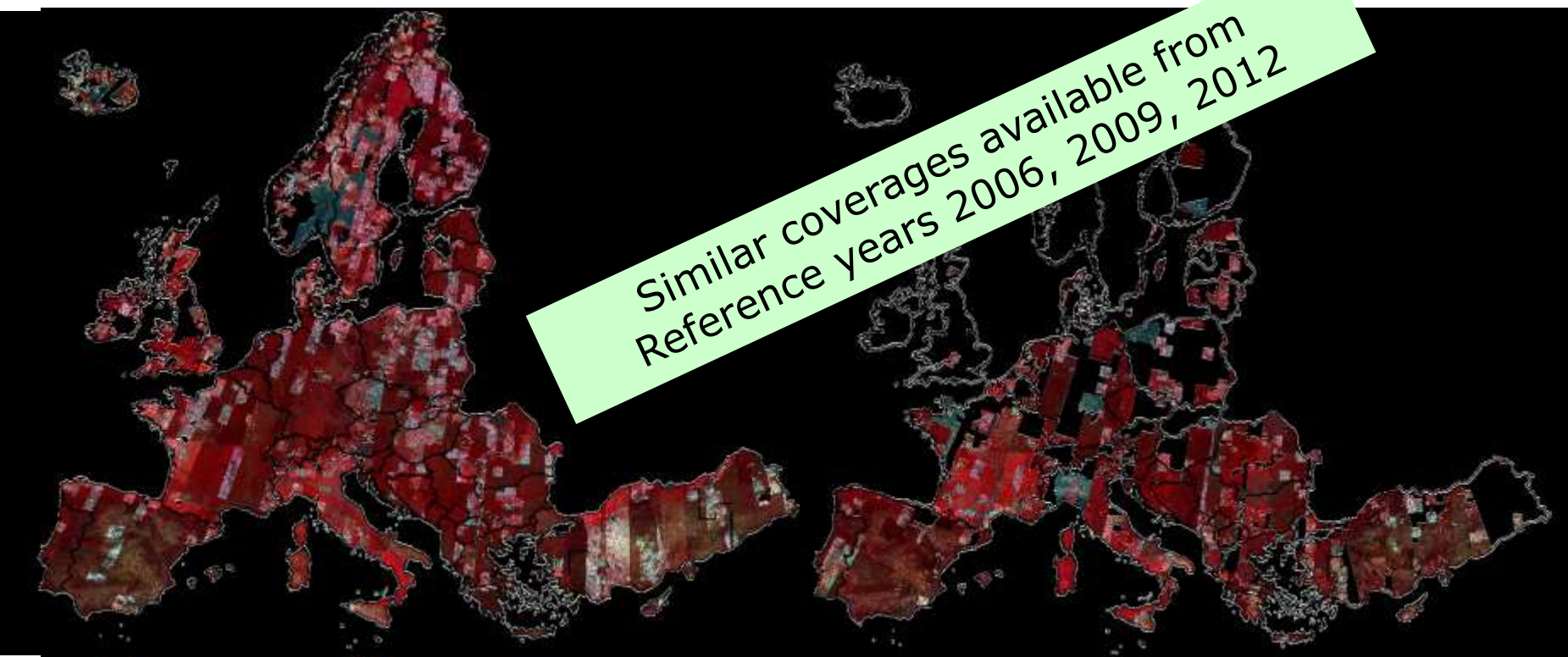
DATA FROM CONTRIBUTING MISSIONS RELEVANT TO BELGIAN USERS

High resolution coverages Europe



~TWO High Resolution (10-20m) optical coverages of 39 European States (EEA-39) + islands + French DOMs acquired in the vegetation periods of 2014-2015.

Final consolidation ongoing, final gap filling can be done with Sentinel-2



COV#1 accepted + conditionally accepted scenes

COV#2 accepted + conditionally accepted (partially compliant) scenes

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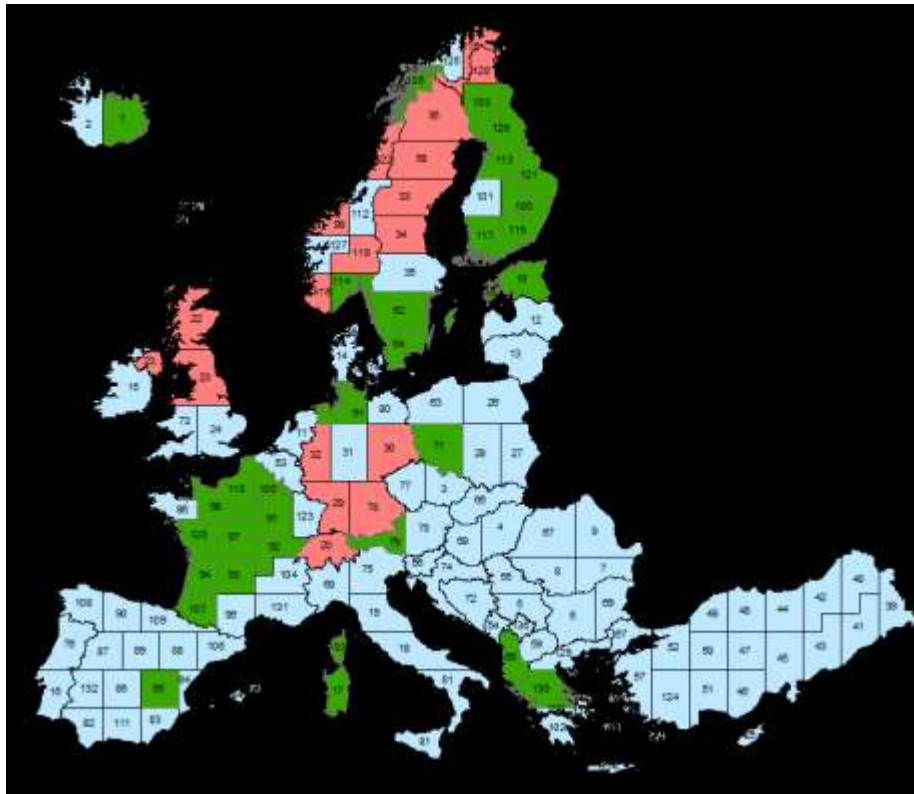


Very High resolution coverage Europe

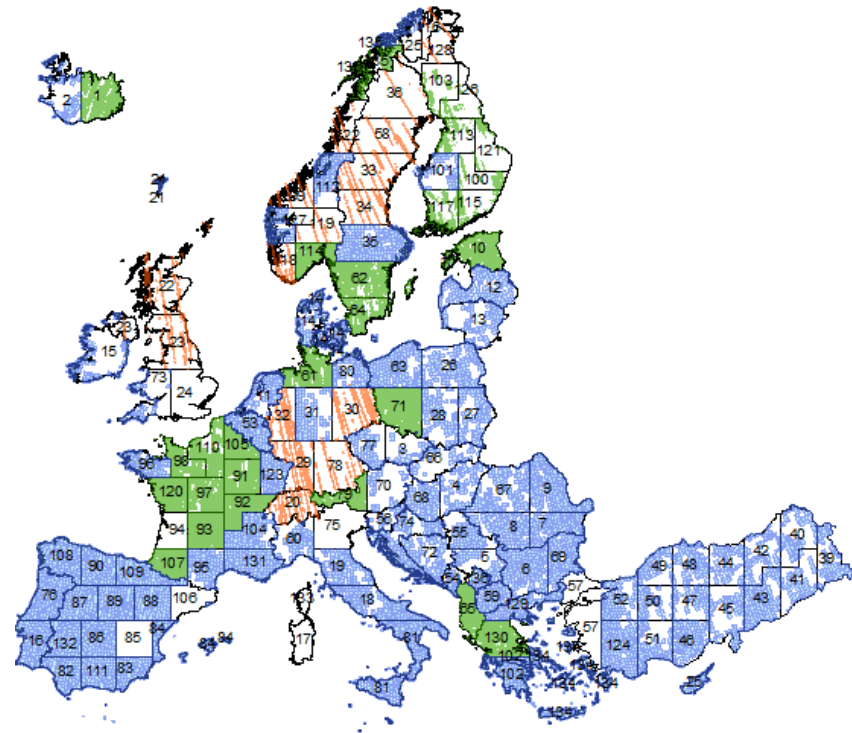


Status
19/10/2016

Very High Resolution ($\leq 1\text{m}$ pan, 2-4m MS) optical coverage of 39 European States (EEA-39) + islands + French DOMs acquired in the vegetation periods 2014-2015-2016.



Large Regions allocation per data provider
AIRBUS: 93 with **Pleiades** (2014-2016)
EUSI: 31 with **WorldView-3**, **WorldView-2**, **GeoEye-1** (2014-2016)
DEIMOS: 17 with **DEIMOS-2** (2015-2016)



Overall coverage proposed, Data assessment is still on-going, in parallel to 2016 acquisition campaign coverage proposal;

FOCUS on BELGIUM, 1



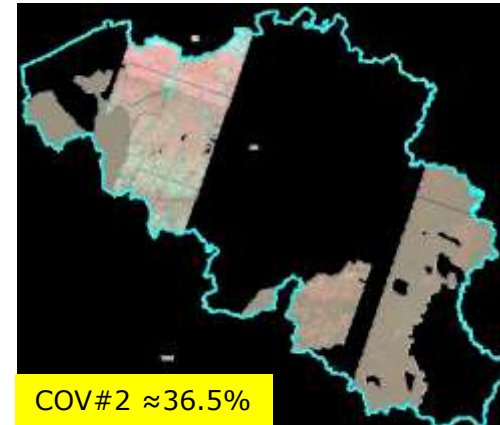
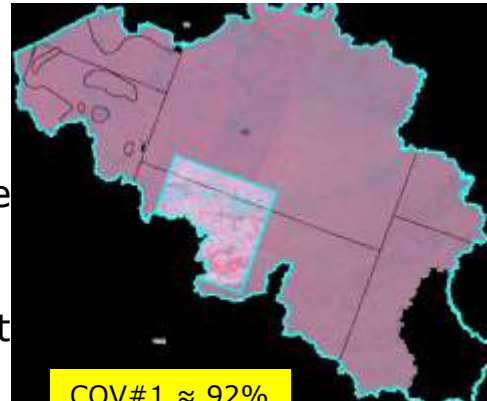
HR_IMAGE_2015

COV#1: 7 IR07 + 1 SPOT-5

COV#2: 3 IR07 + 4 SPOT-5

Plus SPOT-5 scenes already delivered
In 2015.

Sentinel-2 data selection see next

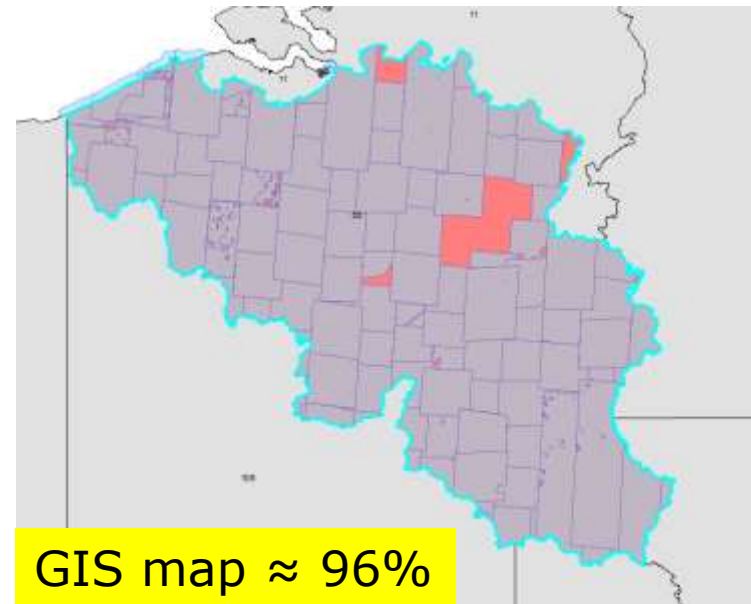
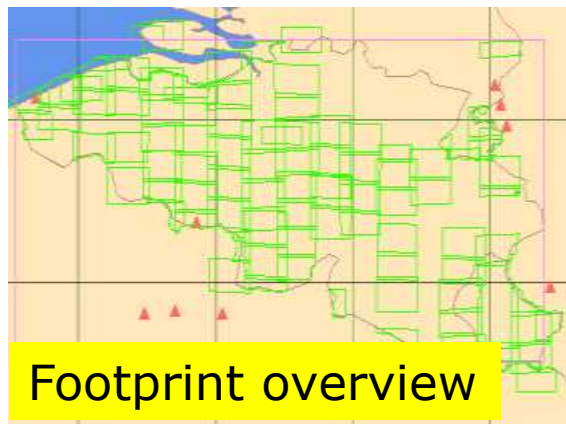


VHR_IMAGE_2015

LR_53, status: CLOSED

124 PH scenes proposed and sent to production.

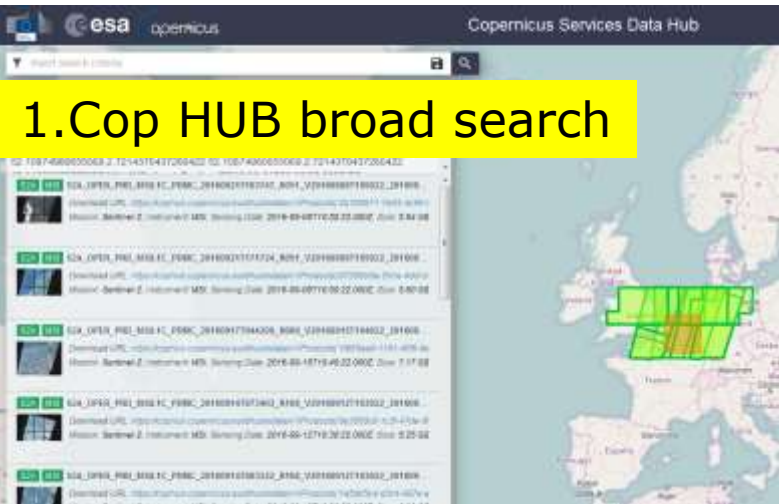
105 currently available at CDS



FOCUS on BELGIUM, 2

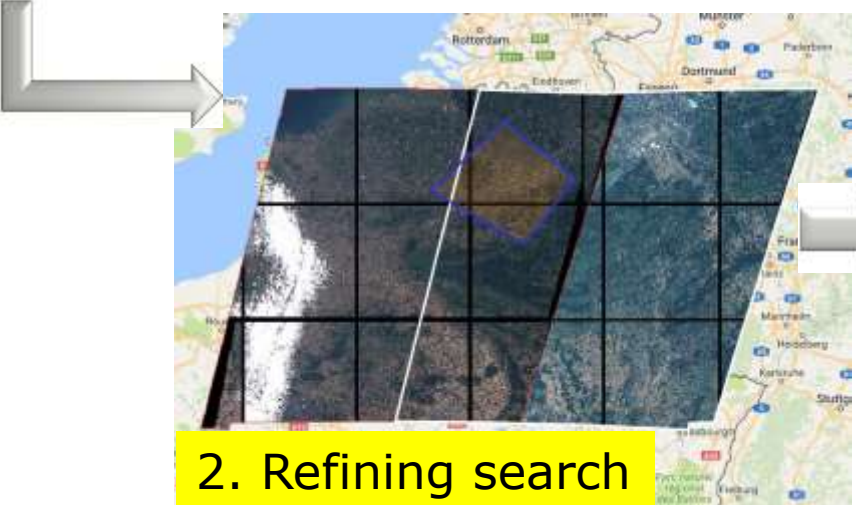
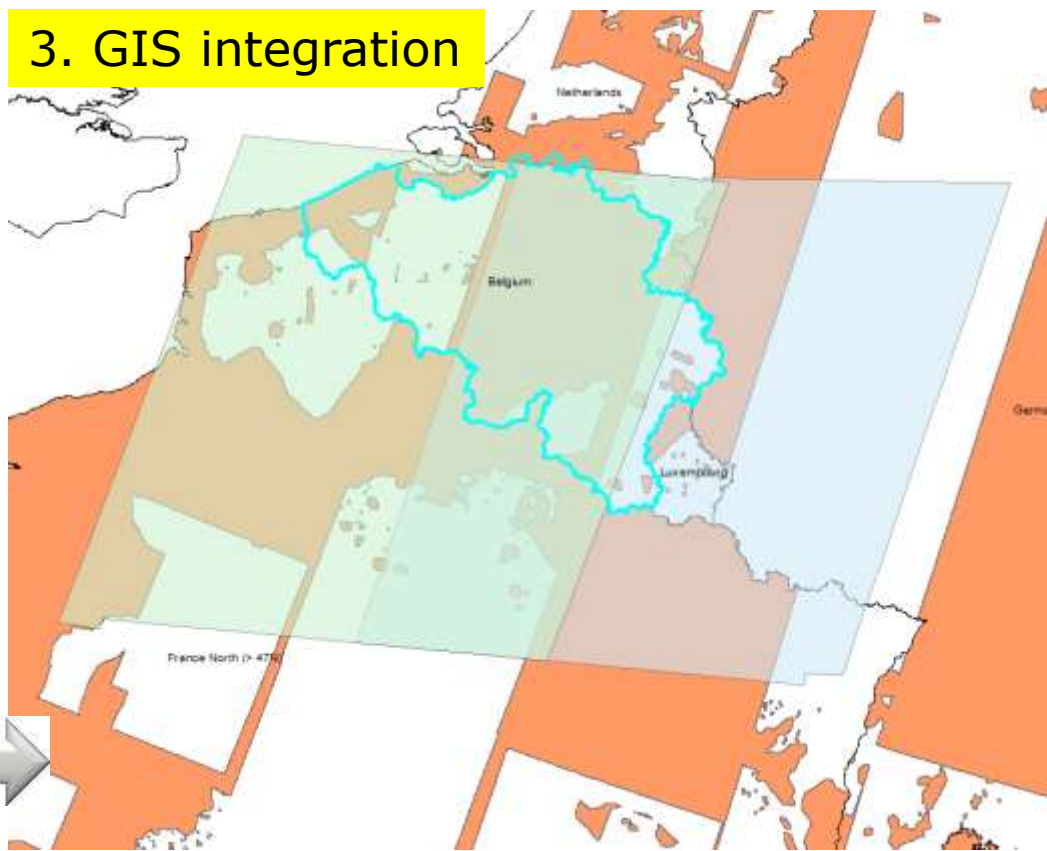


Extended time window: 1 June → 15 September



1. Cop HUB broad search

3. GIS integration



2. Refining search

→ 2 Sentinel-2A passes acquired on Aug 26 (cc1%), & Sep 08 (cc 8%), 2016 are well covering COV#2 GAPS



CSC Missions Management On-Line

Copernicus Programme: copernicus.eu

Sentinel Online: sentinels.copernicus.eu

CSC Data Access: spacedata.copernicus.eu

 ESA Sentinel app: available for iOS and Android