

Copernicus Sentinels overview & Sentinel-2 mission status



Bianca Hoersch

**Sentinel-2 Mission Manager
ESA**

...securing long term continuity of systematic observations from Space



2011

2015

2020

2030

Access to Contributing Missions

S-1 A/B/C/D

S-1 A/B 2nd Generation

S-2 A/B/C/D

S-2 A/B 2nd Generation

S-3 A/B/C/D

S-3 A/B 2nd Generation

S-4 A/B (on MTG)

S-5 Precursor

S-5 A/B/C (on MetOp-SG)

S-6 A/B

FIRST LAUNCH
3.04.2014

SECOND LAUNCH
APR 2016

FIRST LAUNCH
23.06.2015

SECOND LAUNCH
Q4/2016

FIRST LAUNCH
16.02.2016

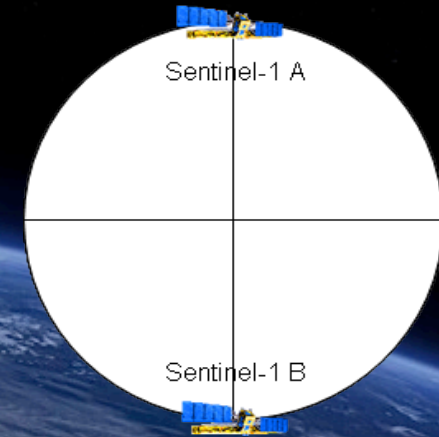
FIRST LAUNCH
2016



Sentinel-1: Mission Profile



- Mission based on 2 satellites
- C-band Radar instrument
- Sun-synchronous orbit at 693 km altitude
- Inclination: 98.18°
- 7 years lifetime
- Consumables for 12 years
- Mean LST: 18:00h at ascending node
- 12-day repeat cycle at Equator (6 days with 2 satellites)



➤ Sentinel-1A **nominal routine operations continue**

- Validation of Level-2 Ocean core products on-going

➤ **Latest Achievements** and *Issues*:

- An average of **3 TB of products** is generated daily (formal target was 1.6 TB/day)
- Support provided to several Copernicus Emergency service and Charter activations
- Completion of Ground Segment configuration update in support of B-model commissioning
- *Few short mission unavailability experienced in last quarter linked to known PDHT sw issue. A further patch is under final validation before upload to S-1A*
- Sentinel-1 GS Constellation Review passed

➤ **Upcoming Milestones**

- Finalise EDRS-Sentinel1A user commissioning preparations



→ **More details on
planning see
Johannes'
S-1 presentation**

Main objectives of the Sentinels operations strategy:

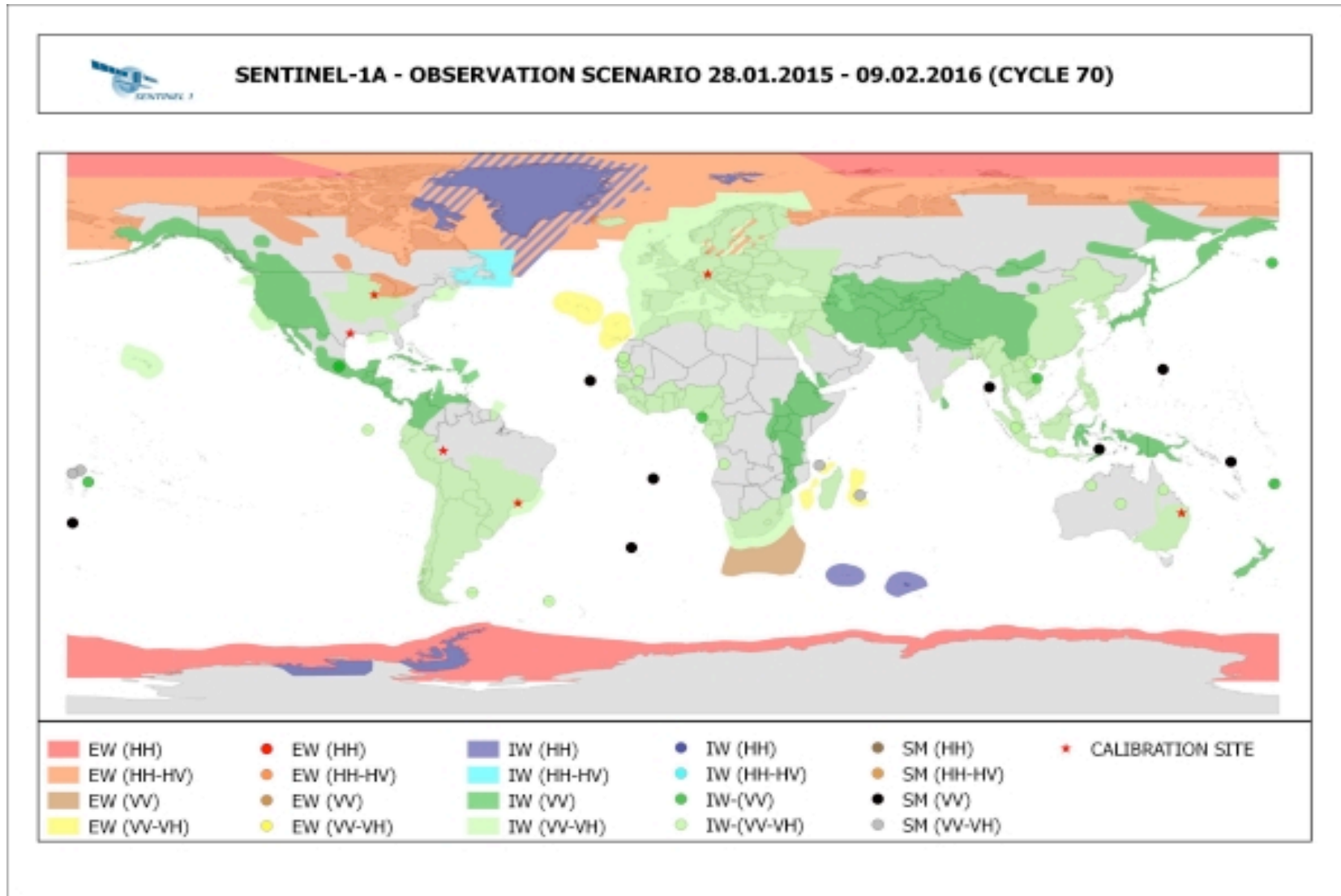
- Reliable provision of Sentinels core products to Copernicus users
- Ensure systematic and routine operational activities

Sentinels operations approach:

- Sentinels are operated via a **pre-defined background** observation plan
- Scenario is updated on a regular basis (e.g. 6-months) taking into account user requirements evolution
- All Sentinels acquired data is **systematically downlinked and processed** to generate a predefined list of **core products** within specific timeliness



Sentinel-1 observation scenario regularly published online

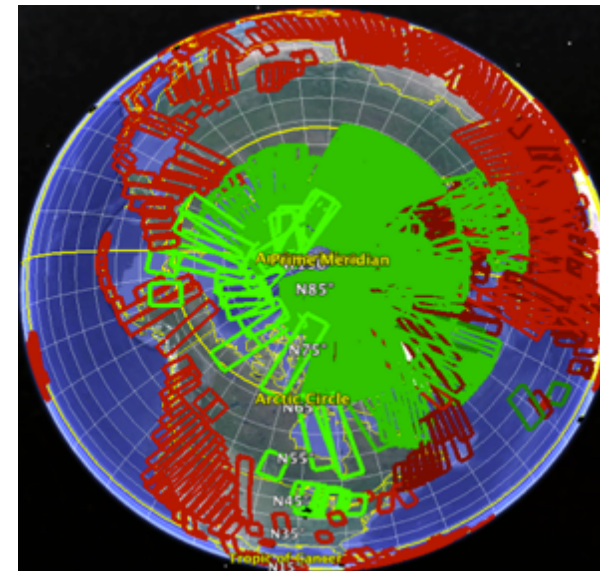
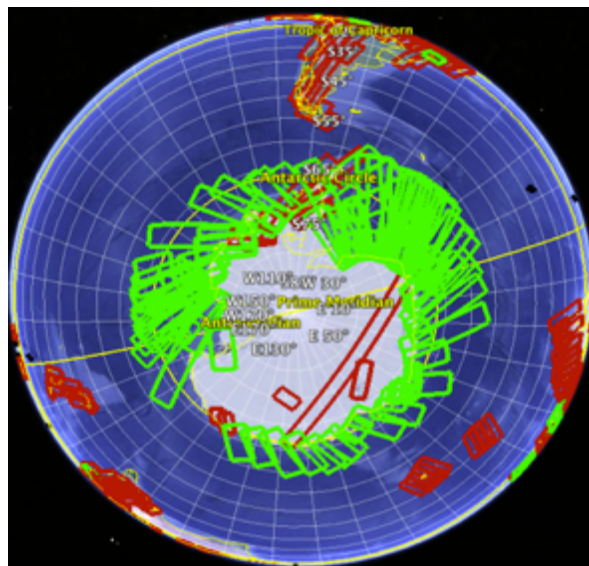
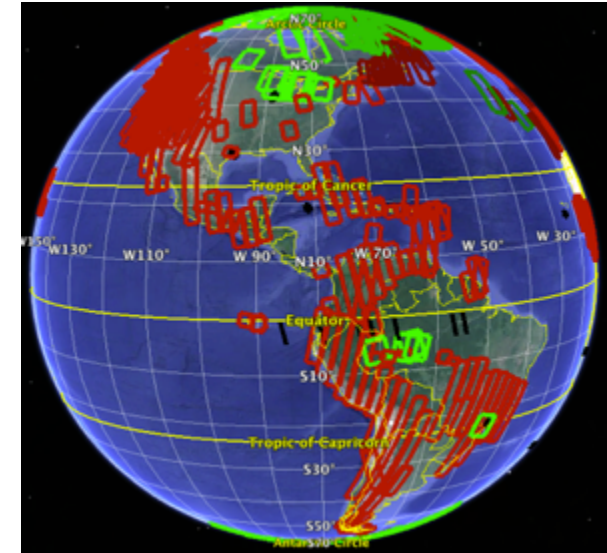
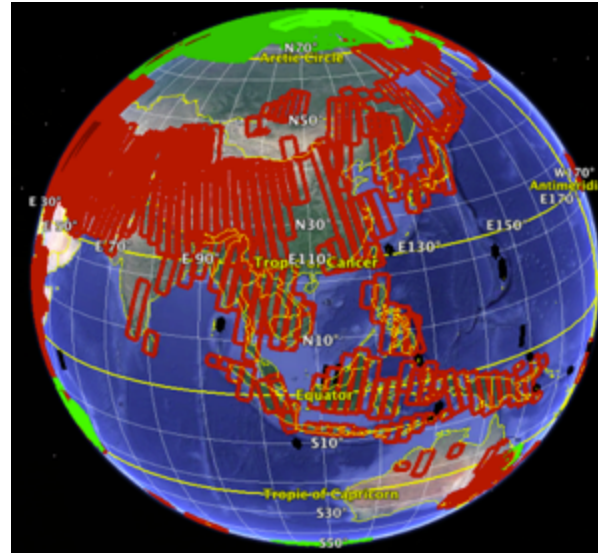
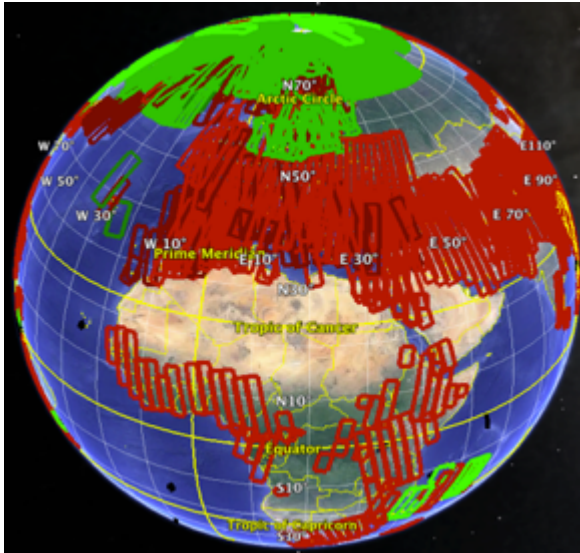


<https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/observation-scenario>

Sentinel-1 acquisition segments regularly published online



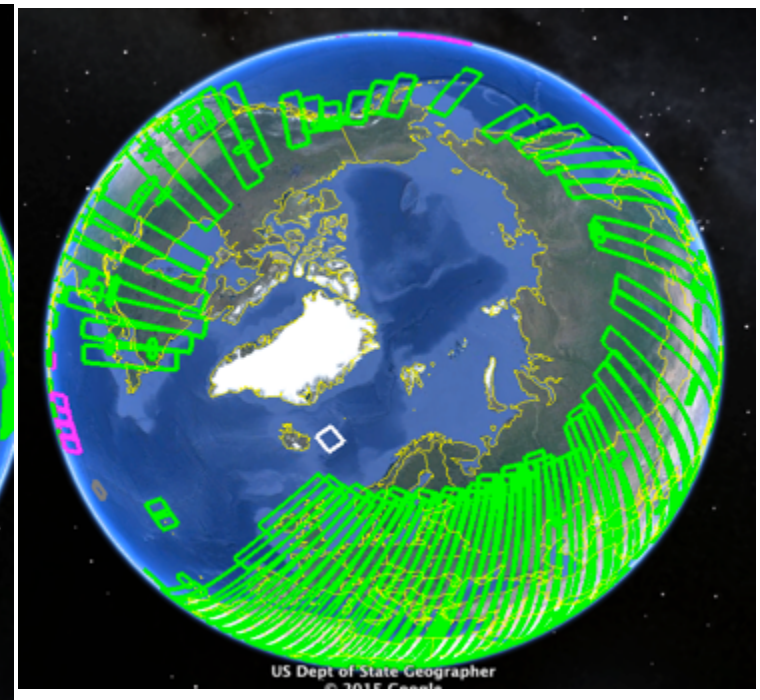
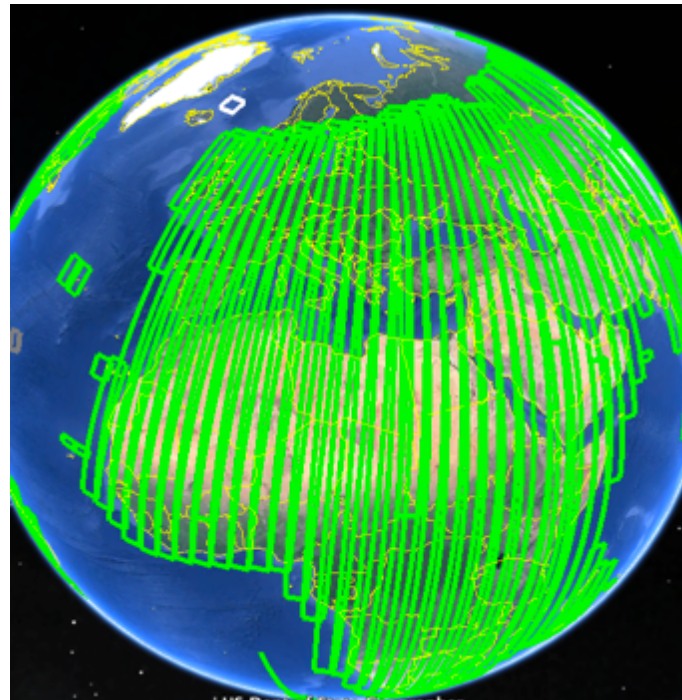
(12-days repeat cycle: example cycle 66, from 11 to 23 December 2015)



Sentinel-2 Observation scenario, acquisition plans online



1. Currently observation of **average 10.5 min/orbit** (i.e. >60% of average observation time in full operations)
 - Systematically Europe & Africa on every orbit
 - The rest of the world within a certain time interval: currently this is 30 days, and will be progressively reduced over the coming months to reach 10 days
2. observation plan is published ahead of every repeat cycle as kml at <https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-2/acquisition-plans>



Sentinel Data – Online Access



<http://sentinels.copernicus.eu>

<http://scihub.copernicus.eu>

Scientific Hub API Hub S-2 PreOpsHub User Guide Roadmap

Access Points

Scientific Hub : access point for all sentinel mission with access to the interactive graphical user interface.
API Hub : access point for API users with no graphical interface. All API users regularly downloading the latest S-1 data are encouraged to use this access point for a better performance.
Sentinel-2 Pre-operational Hub : pre-operational access point for all users to Sentinel-2 data. Login credentials are `gsasent` / `gsasent`.

Due to the massive increase of requests on the Scientific Data Hub that have been creating performance issues in the recent days, a support site, named the API Hub, is now being operated in parallel to the Scientific Data Hub. This API Hub is dedicated to users of the scripting interface.

The API Hub Access is currently available only for users registered on SciHub before the 21st of December 2016 UTC. The same user credentials are valid to access this site.

The API Hub may be accessed through the URL <https://scihub.copernicus.eu/apihub/>. This implies that the OpenSearch API is published at <https://scihub.copernicus.eu/apihub/search> and the OpenData API is published at <https://scihub.copernicus.eu/apihub/odata/v1>. The API Hub is managed with the same quota restrictions, i.e. a limit of two parallel downloads per user. The site is publishing precisely the same data content as the Scientific Data Hub, with all new data as of the 15th November. A rolling policy for the Hub will be established following the first month of monitored operations.

Statistics

2352 products published in the last 24h (SciHub + API Hub)	11549 products downloaded in the last 24h (SciHub + API Hub)	405499 queries responded in the last 24h (SciHub + API Hub)
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Latest News [all the news](#)

1. ESA and Hub Software (DHuS) provides an **open source Web Interface**
2. Users can set scripts to **automatically download data**

OPEN AND FREE

sentinel data hub

Scientific and Other Access

Copernicus
The European Earth Observation Programme

Access for Copernicus Services

COMING SOON

Access for International Agreements

COMING SOON

Access for Collaborative Ground Segment

click to access data

The screenshot displays the Sentinel-1 Scientific Data Hub interface. At the top, there are navigation tabs for Overview, Search, Profile, Cart, and About. A search bar is visible with the text 'Italy' entered. Below the search bar, a map of Europe shows data coverage areas in blue. A list of products is displayed below the map, with columns for Date, Instrument, Mode, and Size. A terminal window at the bottom shows a shell script for querying the data hub, with a blue arrow pointing from the map area to the terminal.

- ❑ Simple self Registration
- ❑ Routine Data flow opened in October 2014 for S1, in Dec 2015 for S2
- ❑ Rolling Archive
 - Currently all data generated since October 2014 is online
- ❑ APIs provided for automatic downloads via scripts
- ❑ Quota restriction of 2 concurrent downloads to ensure bandwidth availability for all users

Sentinel-2 Pre-Operations Hub

Insert search criteria...

Display 1 to 25 of 745 products.

Request Done: (footprint:"Intersects(POLY(15.1432568773876,-49.31053112500002 5(129.818343625 15.1432568773876)))") AN

S2A S2A_OPER_PRD_MSIL1C_PDMC_20160...
Download URL: [https://scihub.copernicus.eu/s2/odata/v1/Products\('44433011-2a10-4bc0-9594-cf217ac86c16'\)/\\$value](https://scihub.copernicus.eu/s2/odata/v1/Products('44433011-2a10-4bc0-9594-cf217ac86c16')/$value)
Mission: Sentinel-2; Instrument: MSI

S2A S2A_OPER_PRD_MSIL1C_PDMC_20160...
Download URL: [https://scihub.copernicus.eu/s2/odata/v1/Products\('44433011-2a10-4bc0-9594-cf217ac86c16'\)/\\$value](https://scihub.copernicus.eu/s2/odata/v1/Products('44433011-2a10-4bc0-9594-cf217ac86c16')/$value)
Mission: Sentinel-2; Instrument: MSI

S2A S2A_OPER_PRD_MSIL1C_PDMC_20160...
Download URL: [https://scihub.copernicus.eu/s2/odata/v1/Products\('44433011-2a10-4bc0-9594-cf217ac86c16'\)/\\$value](https://scihub.copernicus.eu/s2/odata/v1/Products('44433011-2a10-4bc0-9594-cf217ac86c16')/$value)
Mission: Sentinel-2; Instrument: MSI

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Download URL: [https://scihub.copernicus.eu/s2/odata/v1/Products\('44433011-2a10-4bc0-9594-cf217ac86c16'\)/\\$value](https://scihub.copernicus.eu/s2/odata/v1/Products('44433011-2a10-4bc0-9594-cf217ac86c16')/$value)
Mission: Sentinel-2; Instrument: MSI

S2A S2A_OPER_PRD_MSIL1C_PDMC_20160...
Download URL: [https://scihub.copernicus.eu/s2/odata/v1/Products\('44433011-2a10-4bc0-9594-cf217ac86c16'\)/\\$value](https://scihub.copernicus.eu/s2/odata/v1/Products('44433011-2a10-4bc0-9594-cf217ac86c16')/$value)
Mission: Sentinel-2; Instrument: MSI

S2A S2A_OPER_PRD_MSIL1C_PDMC_20160...
Download URL: [https://scihub.copernicus.eu/s2/odata/v1/Products\('44433011-2a10-4bc0-9594-cf217ac86c16'\)/\\$value](https://scihub.copernicus.eu/s2/odata/v1/Products('44433011-2a10-4bc0-9594-cf217ac86c16')/$value)
Mission: Sentinel-2; Instrument: MSI

Products per page: 25 << < page

S2A_OPER_PRD_MSIL1C_PDMC_20160111T005457_R128_V20151218T165535_20151218T165535

[https://scihub.copernicus.eu/s2/odata/v1/Products\('44433011-2a10-4bc0-9594-cf217ac86c16'\)/\\$value](https://scihub.copernicus.eu/s2/odata/v1/Products('44433011-2a10-4bc0-9594-cf217ac86c16')/$value)

Footprint

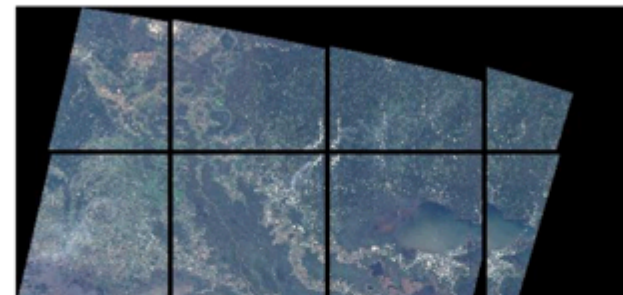


Attributes

Summary

Date: 2015-12-18T16:55:35.000Z
Instrument: MSI
Satellite: Sentinel-2
Size: 3.49 GB

Quicklook



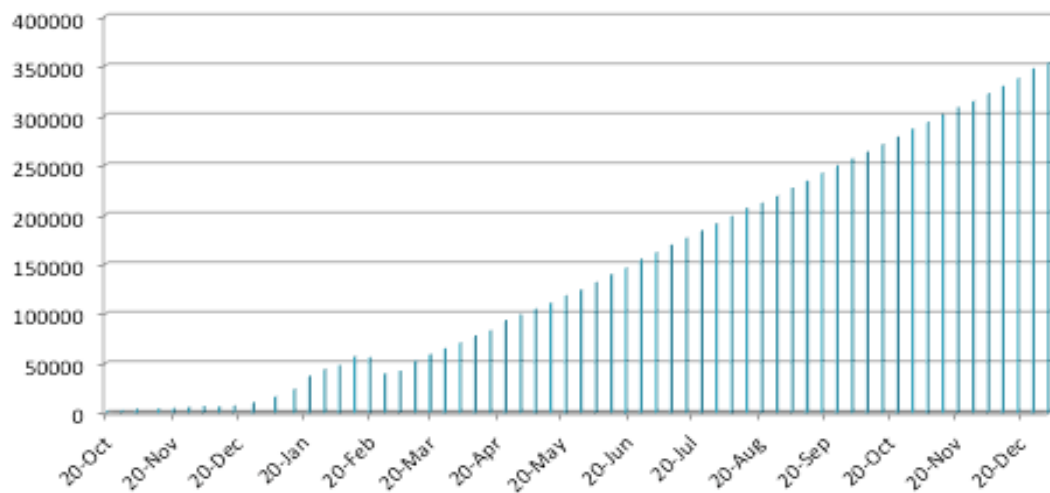
Inspector

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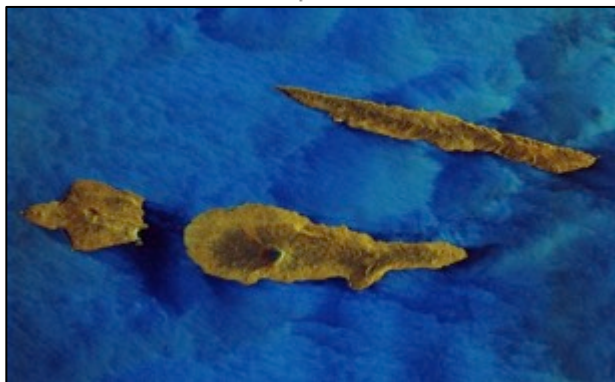
- AUX_DATA
- DATASTRIP
- GRANULE

**Full Sentinel-1A production available online:
more than 400,000 products**

Number of Sentinel-1A products available for download

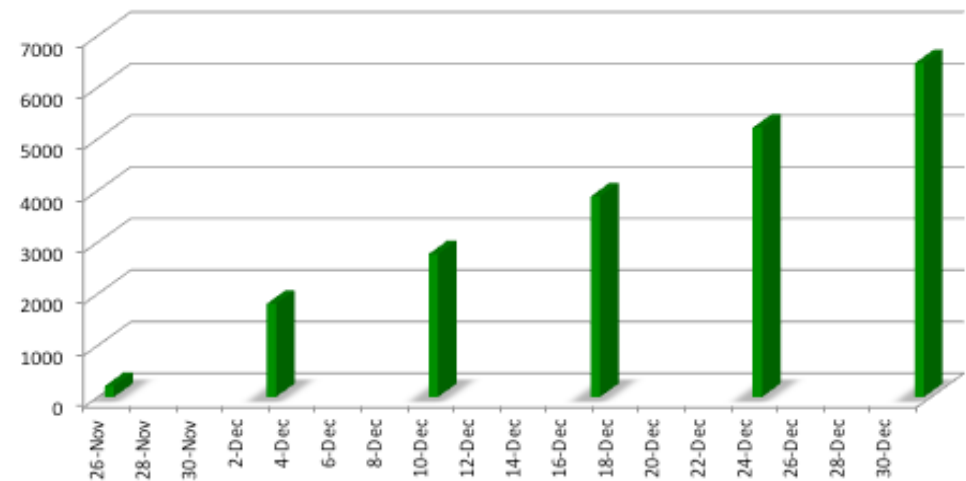


■ Number of Sentinel-1A products available for download



**Full Sentinel-2A production available online since data opening:
more than 13,000 products**

Number of Sentinel-2A products available for download

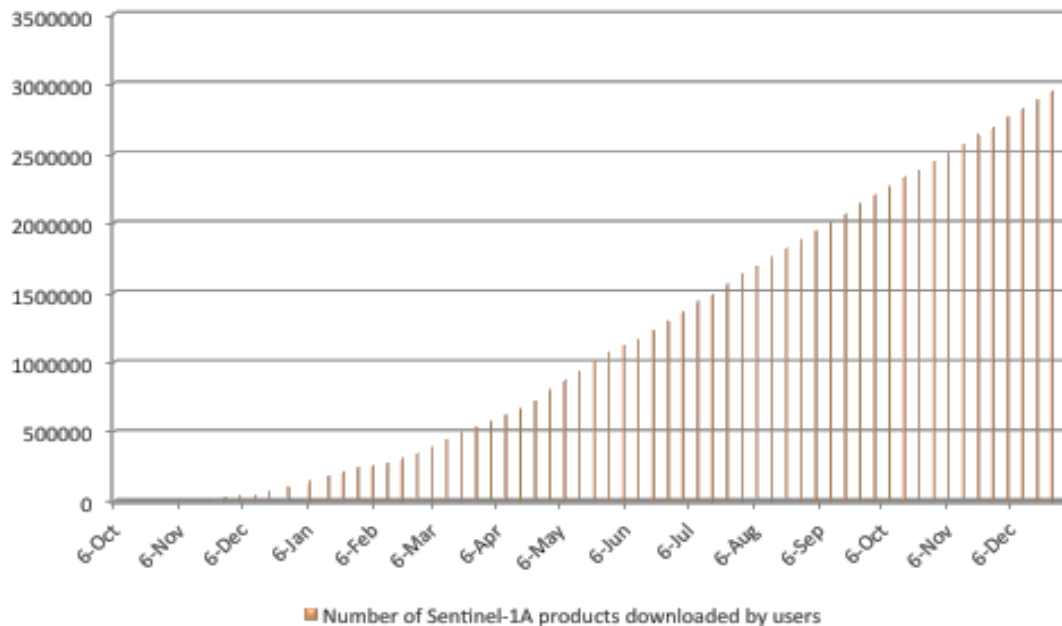


■ Number of Sentinel-2A products available for download



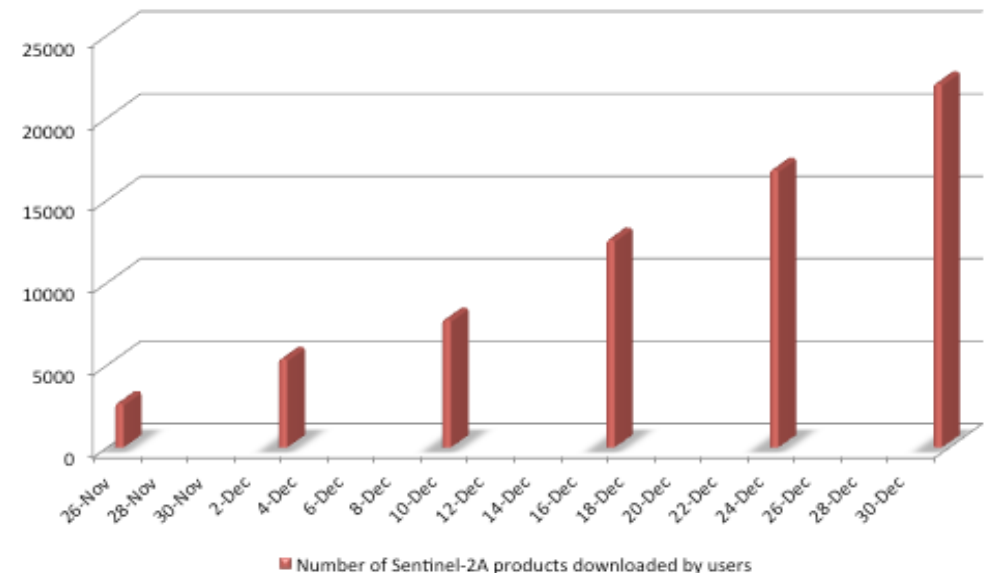
**Some 3 million Sentinel-1 products downloaded in 2015:
Approx. 3.5 Petabytes of downloaded data**

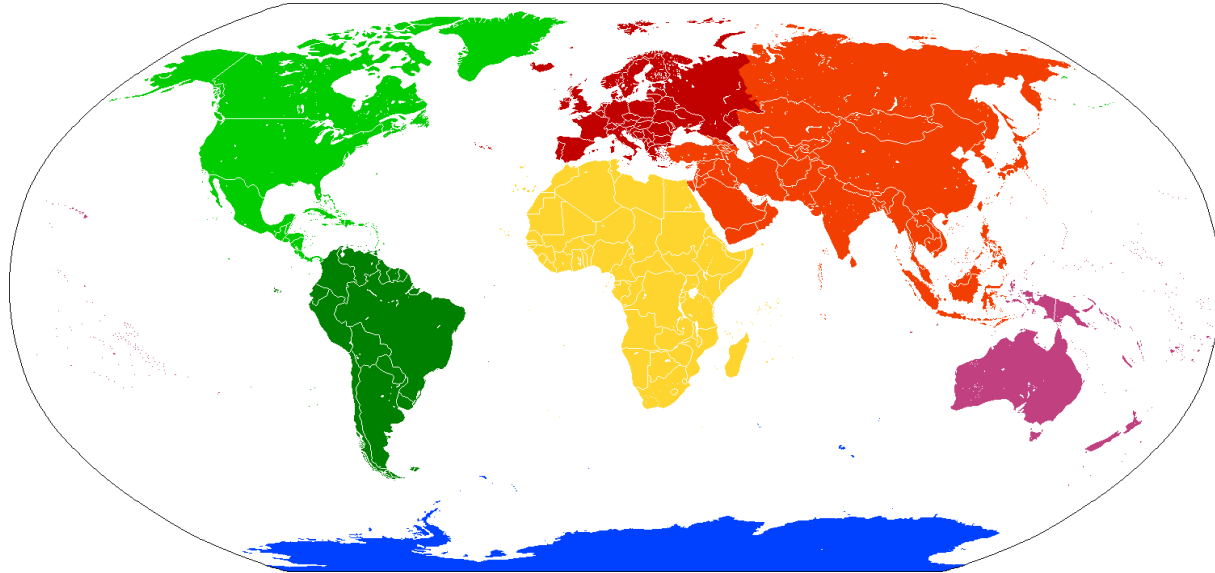
Number of Sentinel-1A products downloaded by users



**95,000 Sentinel-2 products downloaded since December 2015:
approx. 95 Terabytes of data**

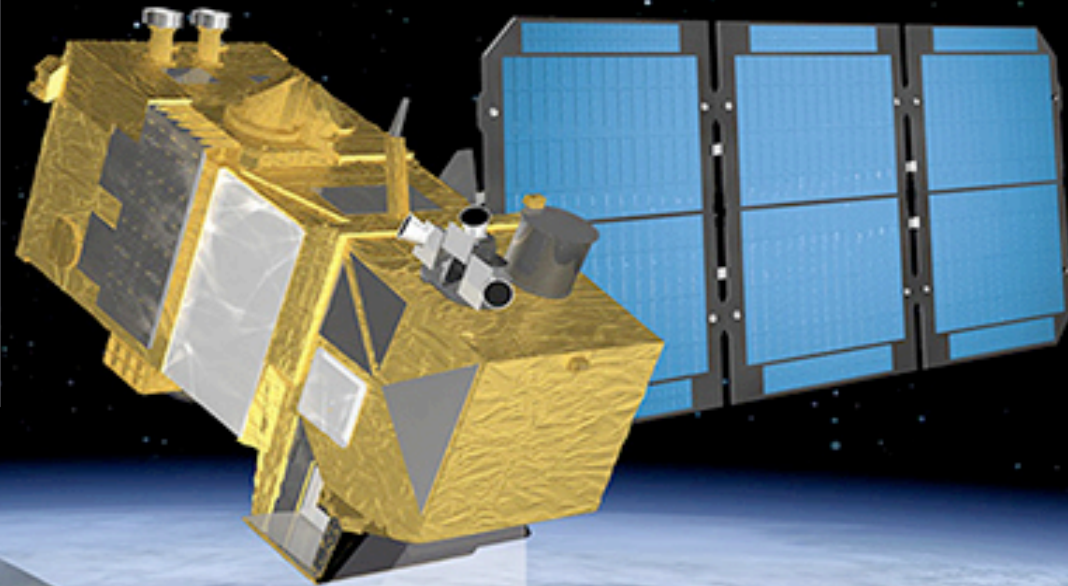
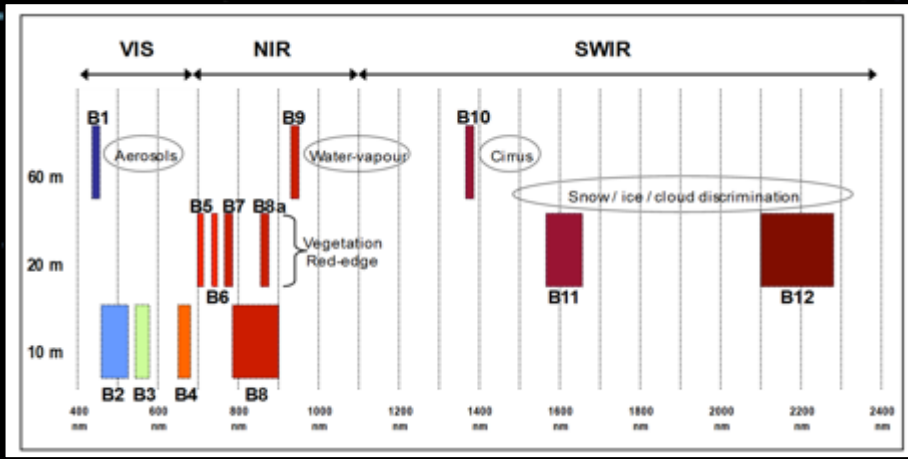
Number of Sentinel-2A products downloaded by users



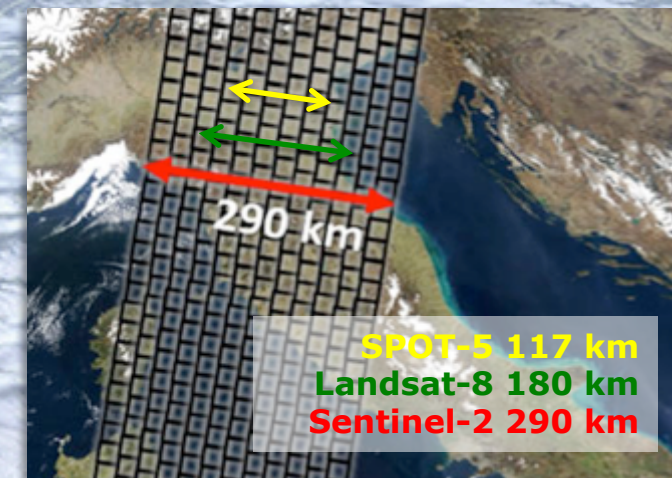


Statistics elaborated based on users self registration

Continent	Number of user registrations since start of operations (March 2014)
Africa	740
Asia	3982
Europe	10831
North America	2095
South America	2090
Australia	309
Antarctica	3



- 13 spectral bands in the Visible (VIS), Near Infrared (NIR), Short Wave Infrared (SWIR)
- Ground pixel resolution of 10m, 20m, 60m (for atmospheric correction) across a 290 km swath



1. Sentinel-2A launched 23 June 2015
2. Expert session 29-30 Sep 2015: first data assessment by selected experts
3. Data access opening 3rd December with data since after 28 November 2015
4. Ramp-up Phase continues
 - a. 3 X-band station in operations now
 - b. MMFU Software update uploaded on 15 December, since then 1/2 day outage on 19-20 Dec, 31 Jan and 20 Feb 2016 → second MMFU software update in preparation
 - c. Some delay in data access via Copernicus Hub for short periods of time occurred, nominally data available within 5 hours from sensing on average
 - d. Reprocessing campaign ongoing for data before 28 November: Level-0 finalised, L-1 starting. Expected finalisation end of Q2/2016. **Data will become available on the Hubs gradually as they are reprocessed.**
 - 1st priority: Relevant orbits for Copernicus European coverages summer 2015
 - All the rest in 'forward sequential' mode: summer 2015 → 27 November 2015

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 coastline**
- The **whole Mediterranean Sea** as well as all inland water bodies and closed

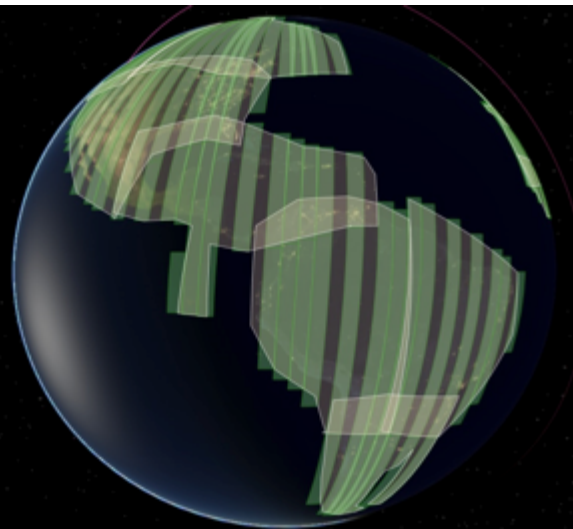


- Europe and Africa systematically covered every cycle every 10 days
 - Iceland included
 - Americas covered every 30 days, once over 3 cycles
-
- North and South America acquisitions

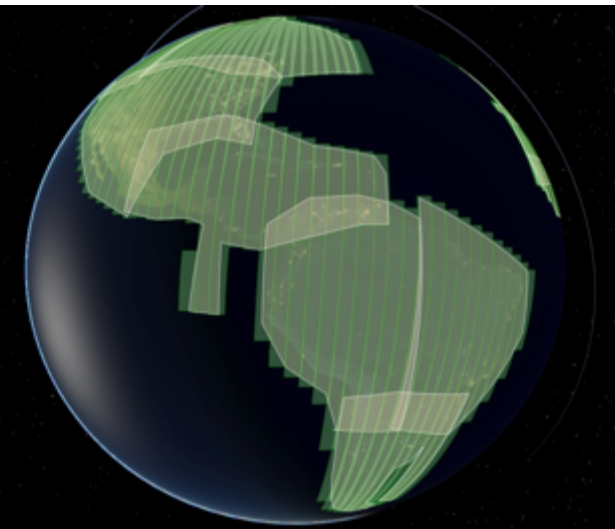
CYCLE 1



CYCLE 2



CYCLE 3

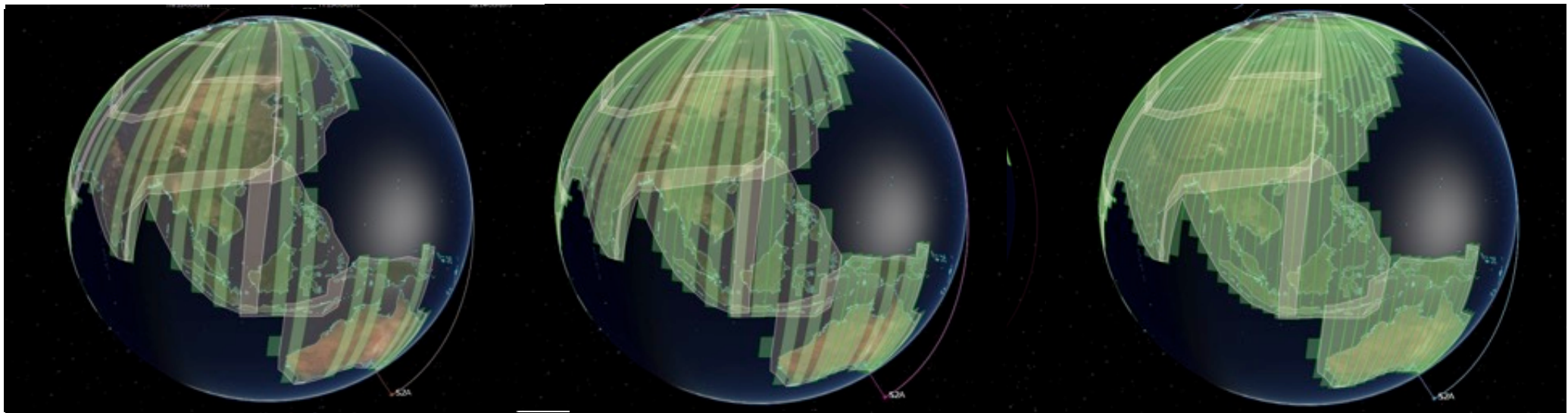


- Asia & Oceania covered every 30 days, once over 3 cycles

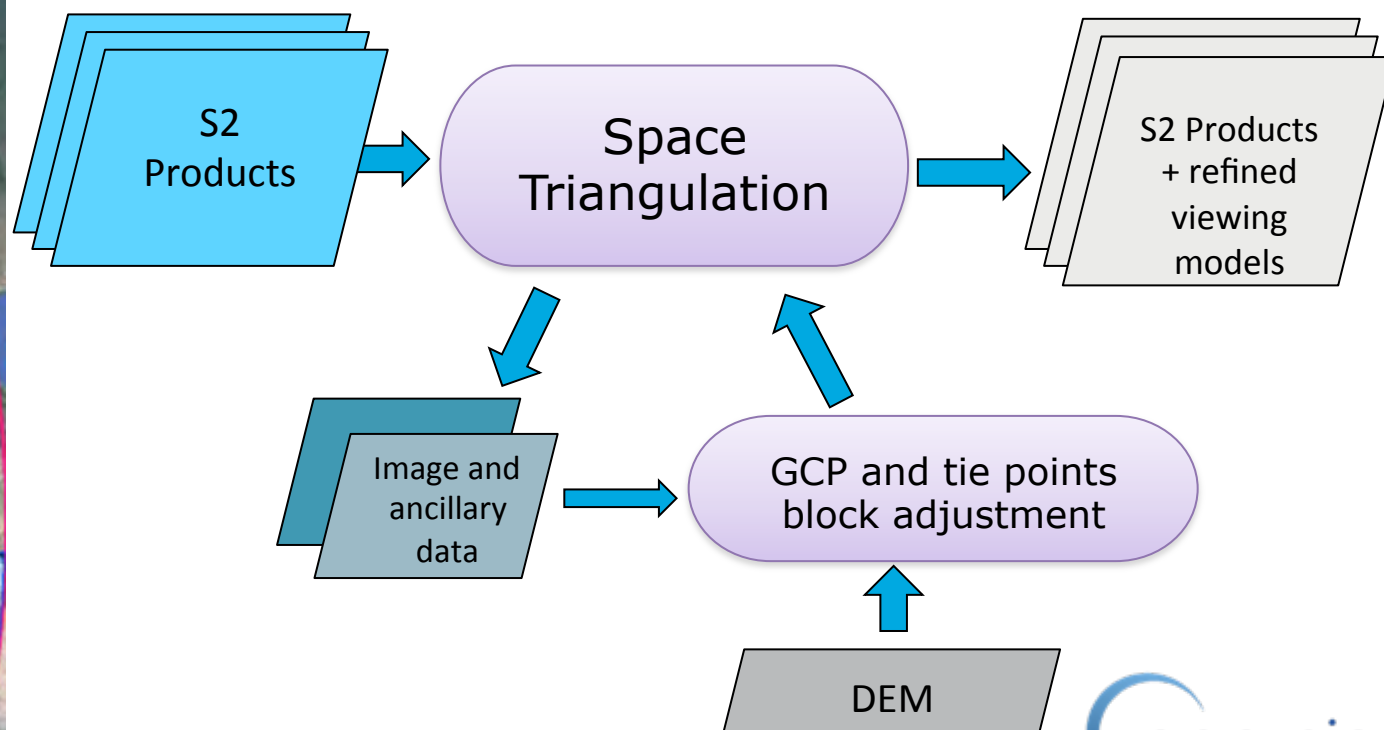
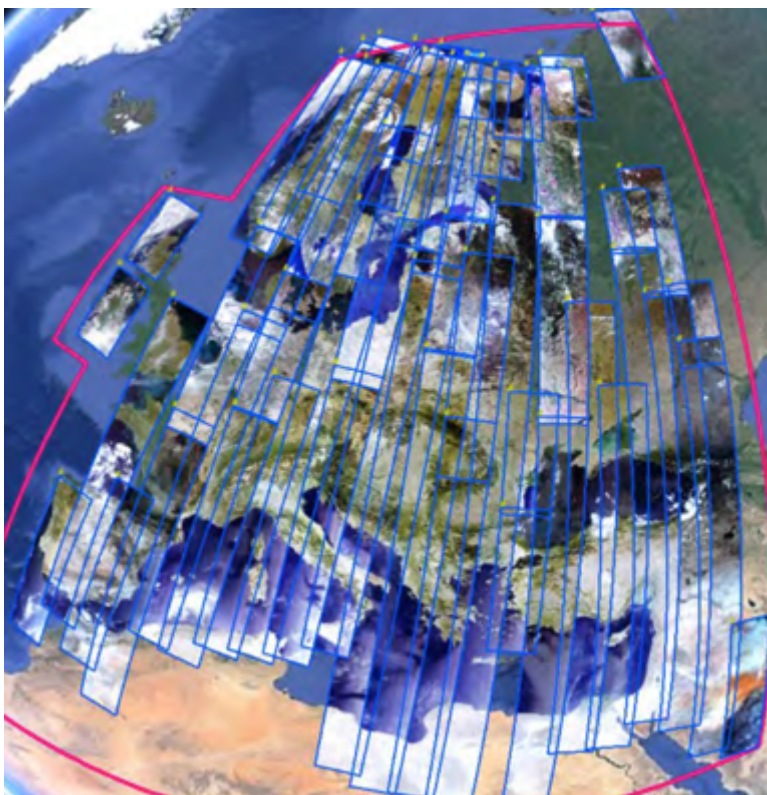
CYCLE 1

CYCLE 2

CYCLE 3

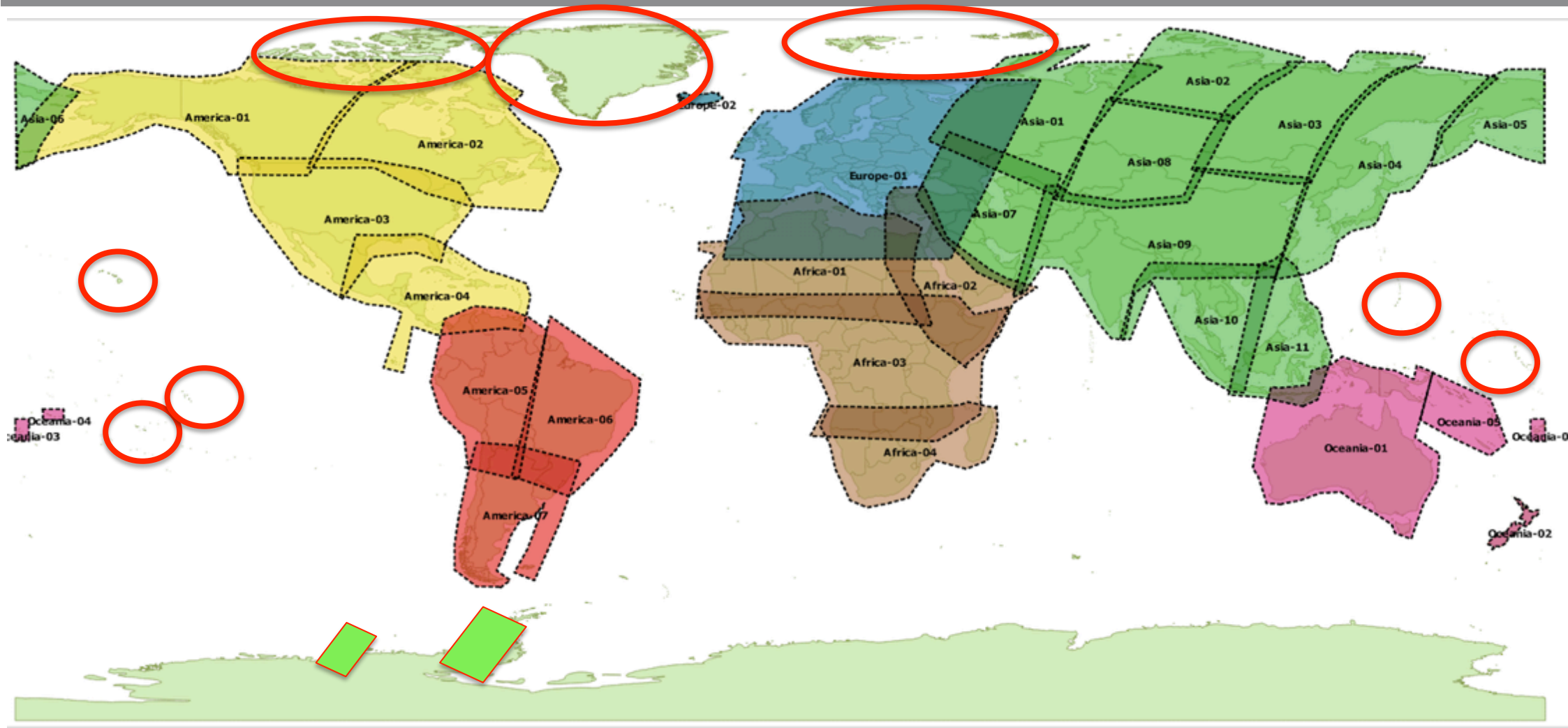


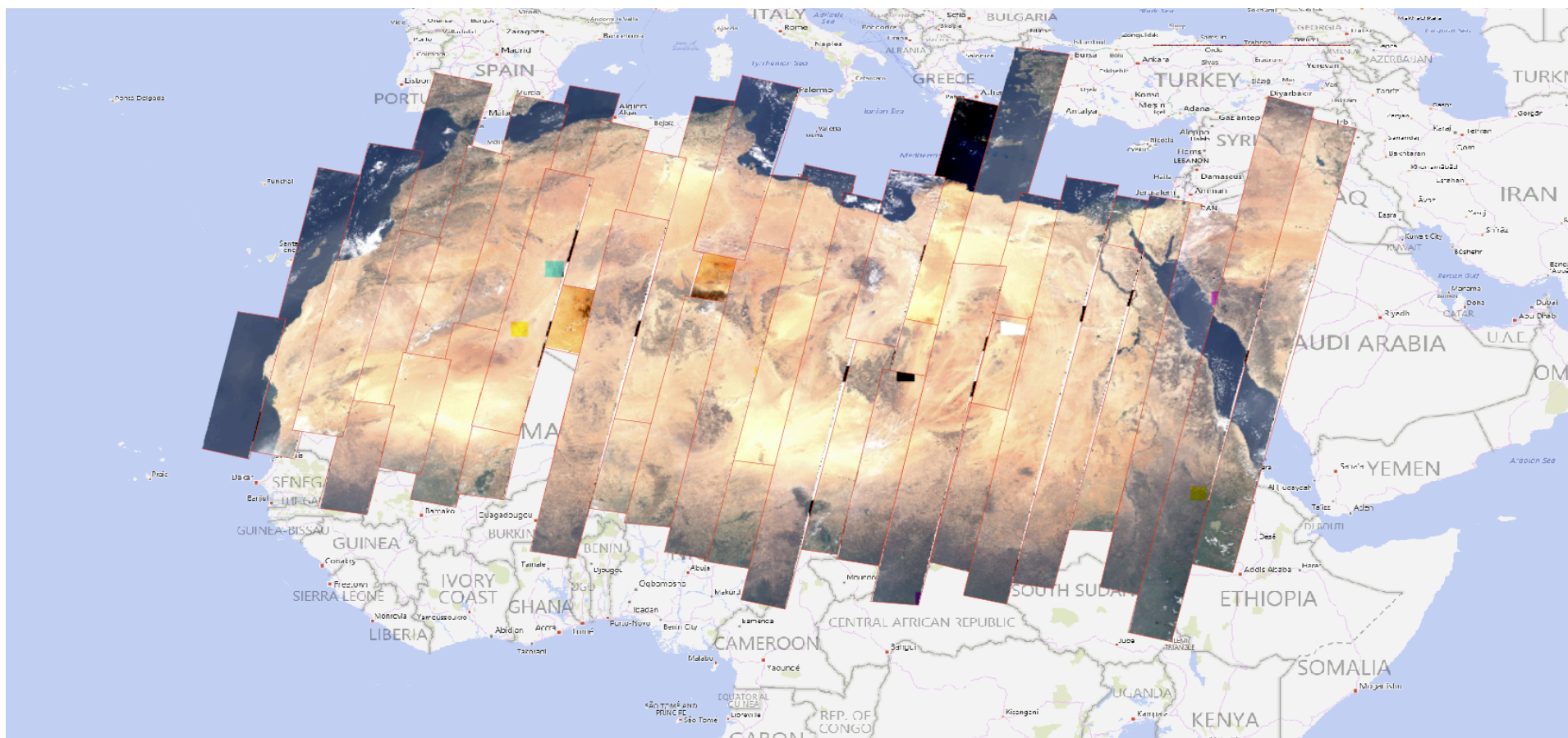
- **Objective:** To obtain a full repeat cycle dataset of well-localized mono-spectral Level-1B images (band 4) which will be used as reference images in the processing chain
- **Methodology:** Massive spatio-triangulation on large blocks
- **A set of blocks defined:** see next slides



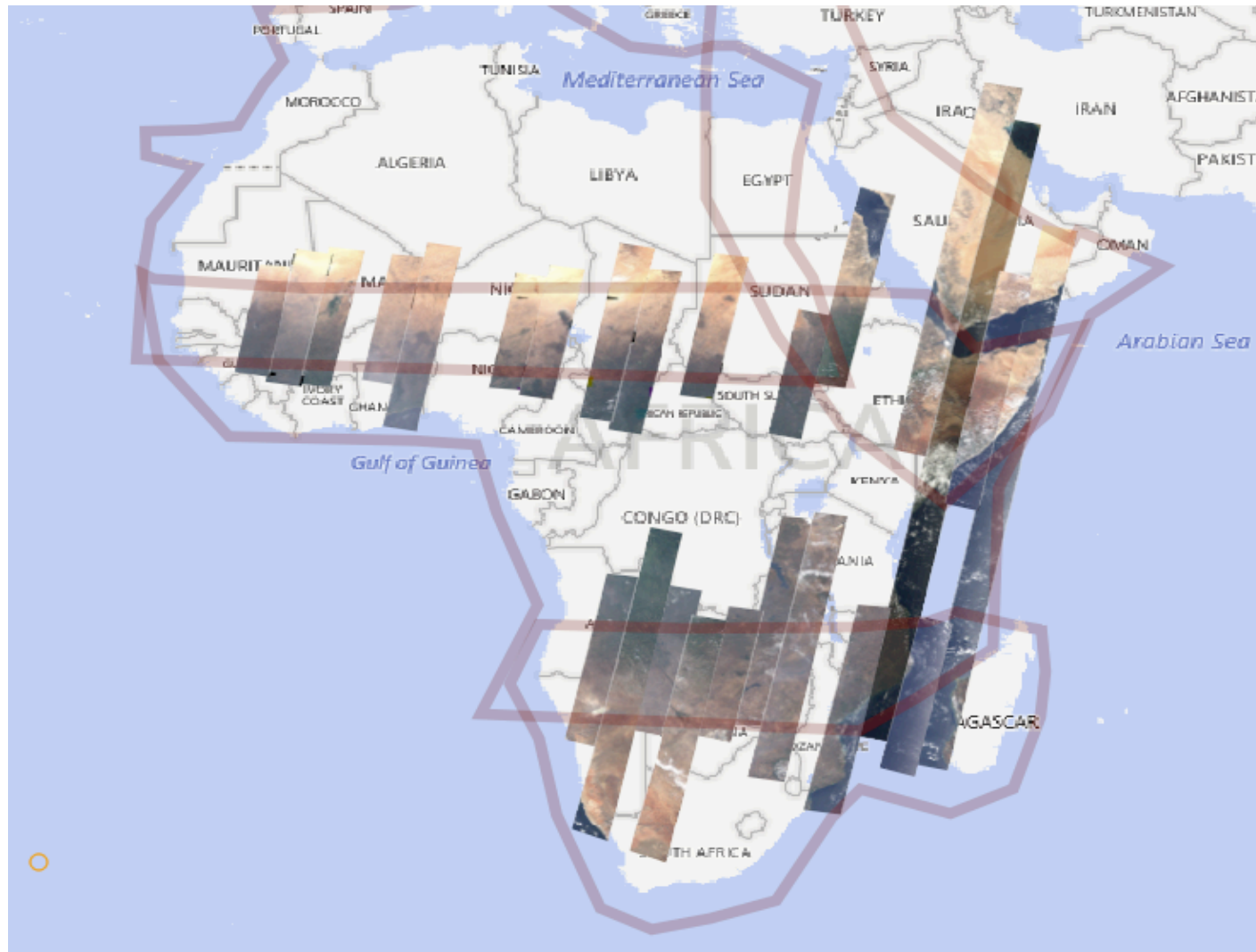
Sentinel-2 Global Reference image blocks

- ... **work in progress**

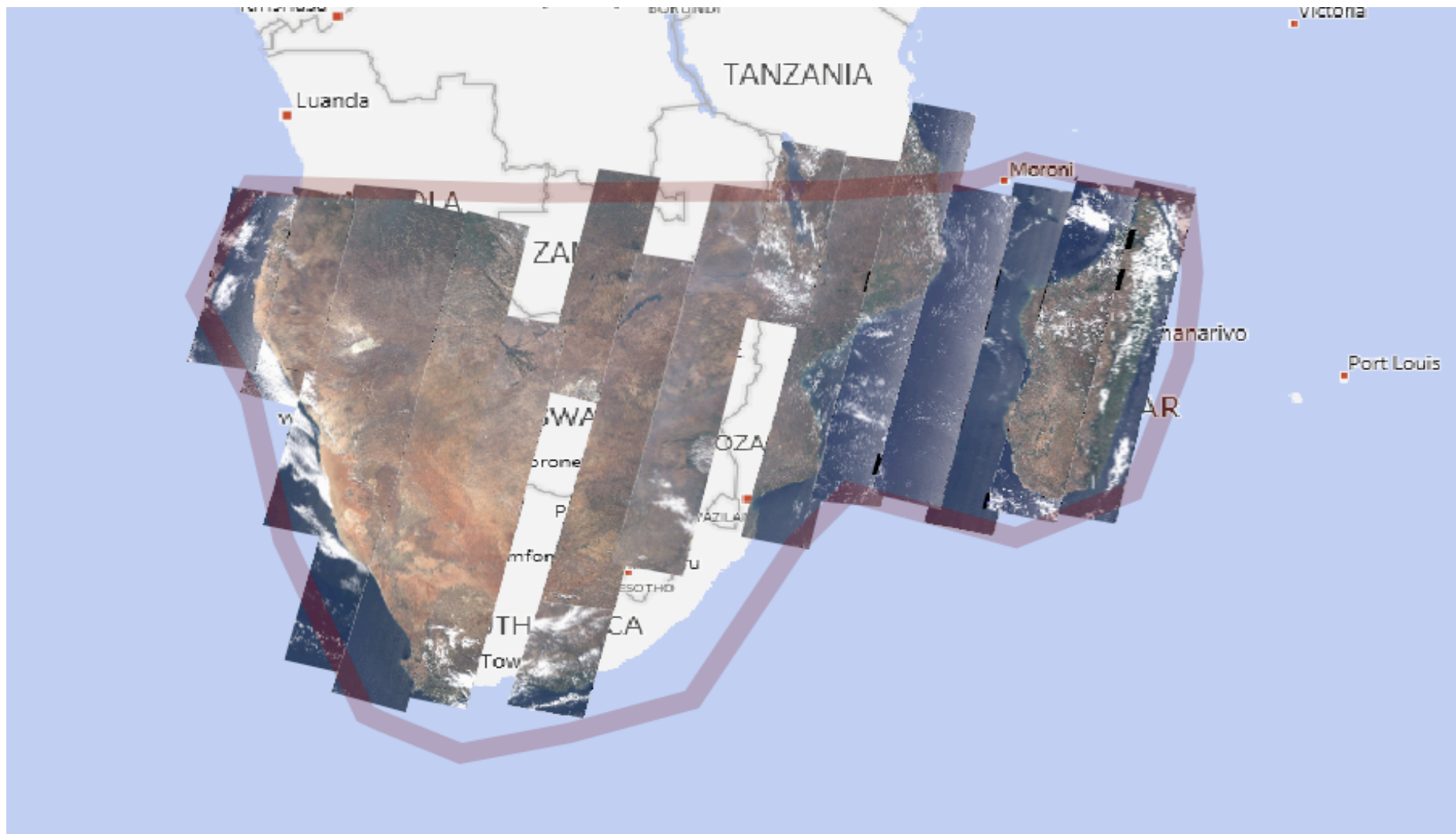




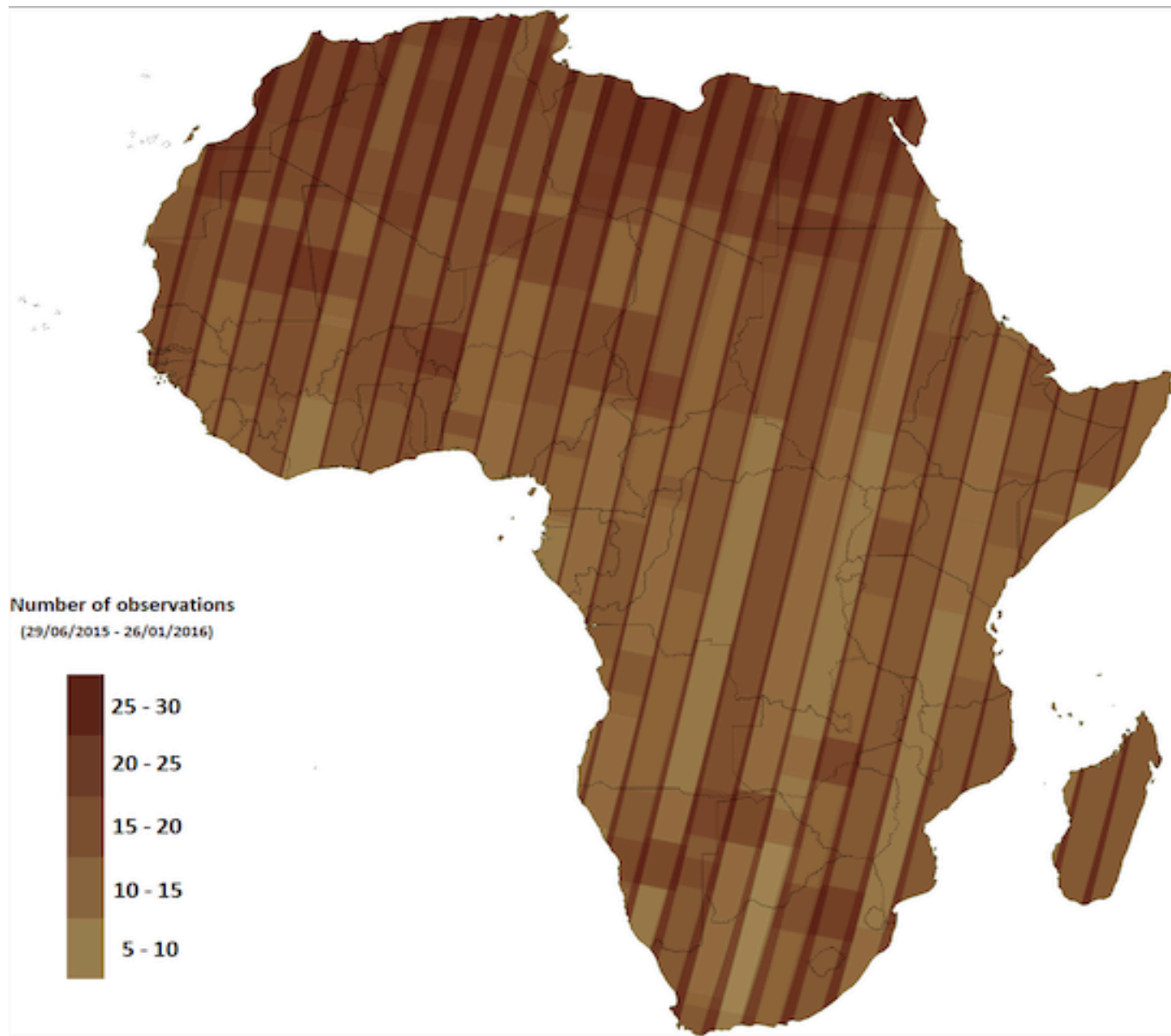
Selection of a set of 48 non-cloudy images on North Africa for GRI Africa-01 sub-block.



Pre-selection of non-cloudy images for GRI Africa-02 and Africa-03 sub-blocks.






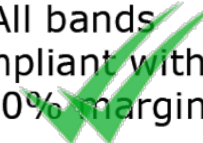
Pre-selection of non-cloudy images for GRI Africa-04 sub-block.



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)
Level-1C	Top-of-atmosphere reflectances in cartographic geometry	Systematic	Long-term	~500 MB (each 100x100km²)
Level-2A	Bottom-of-atmosphere reflectances in cartographic geometry (prototype product)	On user side* (using Sentinel-2 Toolbox**)	N/A	~600 MB (each 100x100km ²)

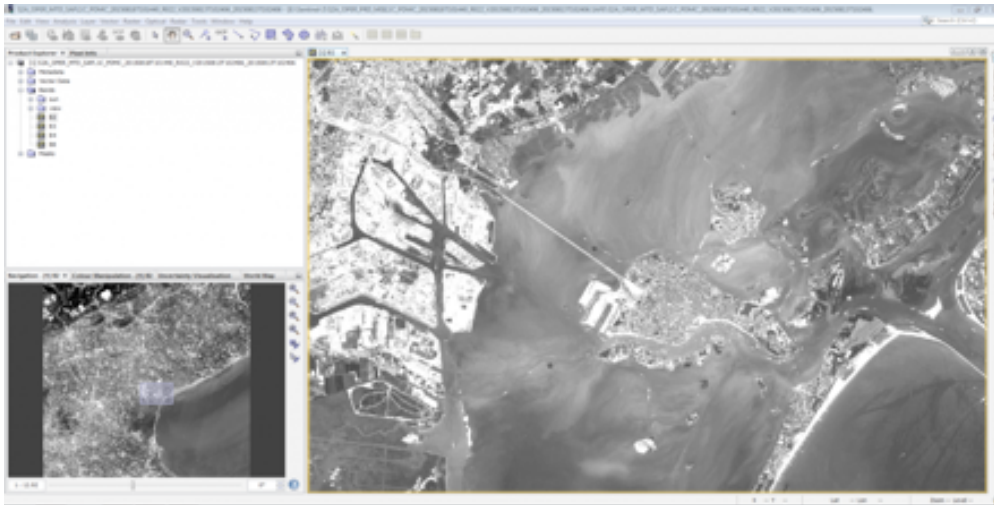
*: Systematic global production of L2A is currently being prepared with EC

** : <https://sentinel.esa.int/web/sentinel/toolboxes/sentinel-2>

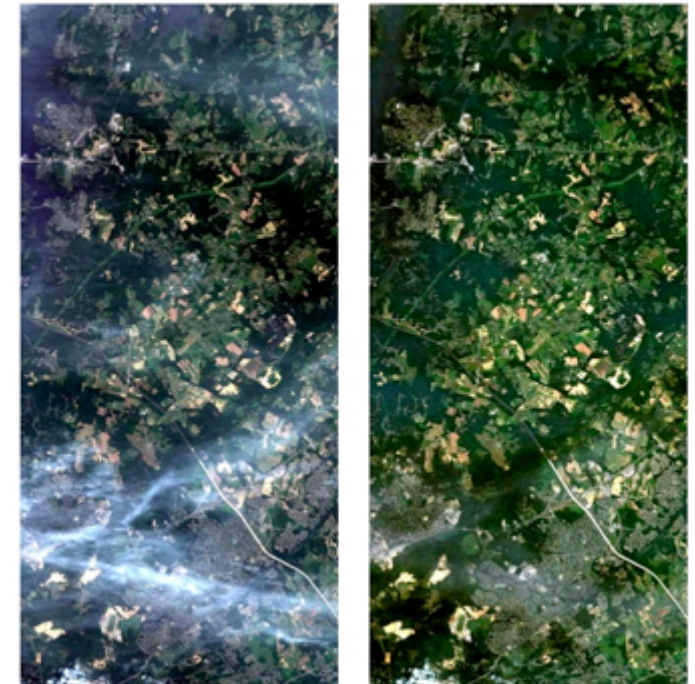
Requirement	Description	Measured performance
Absolute geolocation (without ground control points)	The geo-location uncertainty shall be better than 20 m at 2σ confidence level (without Ground Control Points).	< 10 m at 2σ 
Multi-spectral registration	The inter-channel spatial co-registration of any two spectral bands shall be better than 0.30 of the coarser achieved spatial sampling distance of these two bands at 3σ confidence level.	< 0.23 m at 3σ 
Absolute radiometric uncertainty	The absolute radiometric uncertainty shall be better than 5 % (goal 3%) for the set of bands specified in [SSRD] over the reduced dynamic range.	B1, B2, B3, B4: < $2\% \pm 2\%$ 
SNR	The Signal-to-Noise Ratio (SNR) shall be higher than the values specified in [SSRD].	All bands compliant with > 20% margin 

data quality report on-line at
<https://sentinels.copernicus.eu/documents/247904/685211/Sentinel-2+Data+Quality+Report>

- ✓ The Sentinel-2 toolbox (SNAP) includes a rich set of visualisation, analysis and processing tools



- ✓ It also integrates the ESA Level-2A atmospheric processor Sen2Cor (TOA → BOA + classification options)



TOA Level-1C image data (left)
associated BOA image data (right)

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

1. Gradual increase of data acquisition from 10.5 to 15 min/orbit over the next few months
2. Continued ramp-up phase, with gradual increase of acquisition and processing capacity and further improvement of products quality, including start of S2 QWG and **S2VT meetings + harmonise L8-S2 (and heritage missions) further**
3. Reprocessing campaign conclusion: readiness assumed in Q2/2016
4. **Operational readiness** of S2A is planned for IOCR+9 months, ~ July 2016
5. Start of **systematic surface reflectance (L2A) processing** for S2
6. Moving towards **'a-la-carte' data access** later 2016
7. Sentinel-2B ready for launch in Q4 2016
8. Commissioning of **EDRS-A** launch 29 Jan 2016: phase-in of an additional data downlink capacity during Q3/2016!

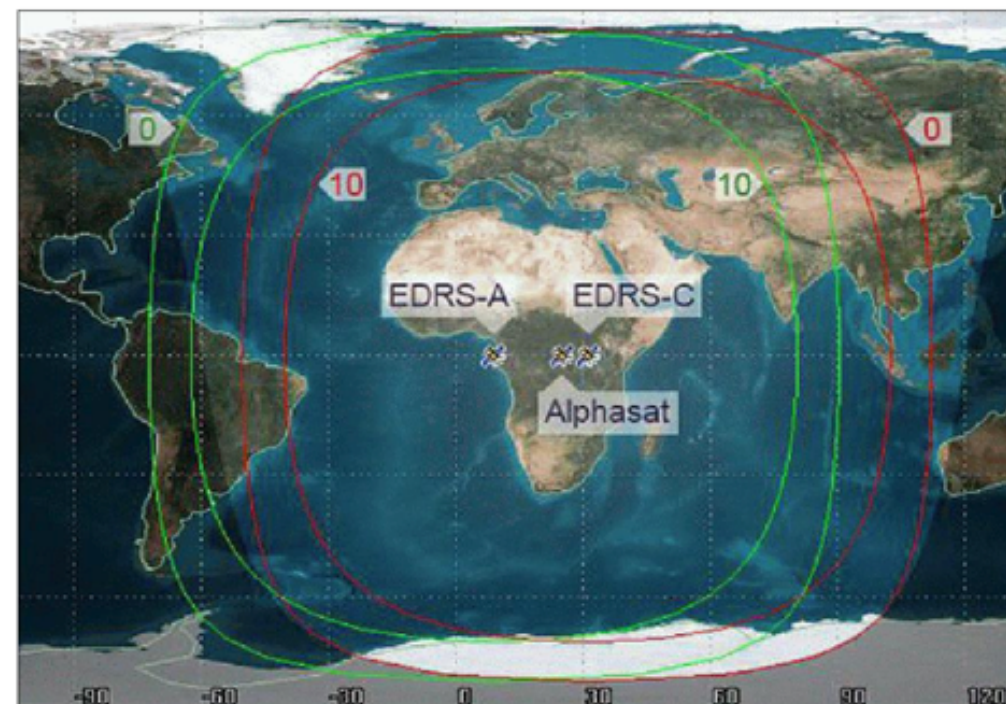


Figure 14: Orbital positions as well as visibility contours for 0° and 10° elevation of the EDRS spacecraft (green – EDRS-A, red – EDRS-C), image credit: EDRS consortium ²³

Gobabeb (S2 cal/val site), Namibia
28 Sep 2015
[4-3-2]



ESA Sentinel app:
available in iTunes

Copernicus Programme: copernicus.eu

Sentinel Online: sentinels.copernicus.eu

CSC Data Access: spacedata.copernicus.eu