

Sentinel-1 Mission Overview and Status

Pierre Potin, ESA

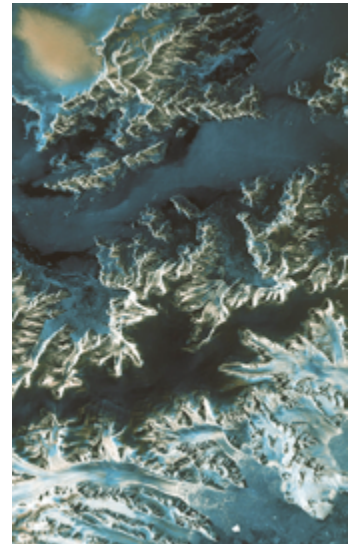
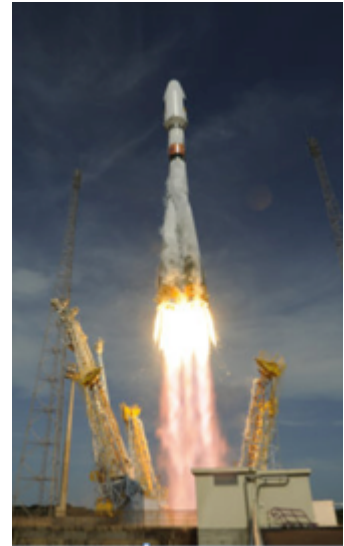
Mapping Water Bodies from Space

18 March 2015, ESRIN

Sentinel-1 mission status



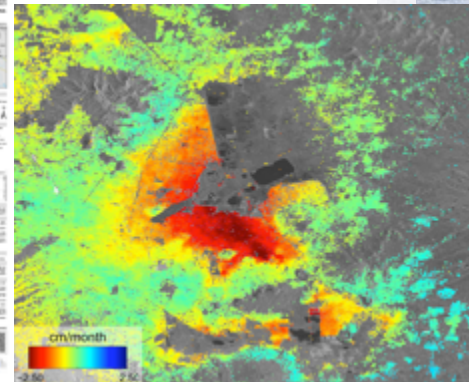
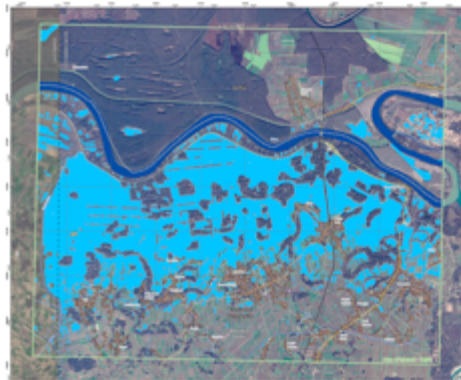
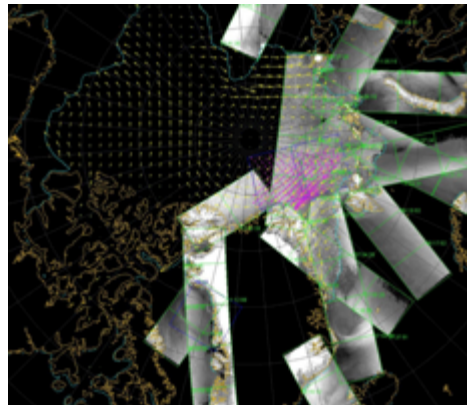
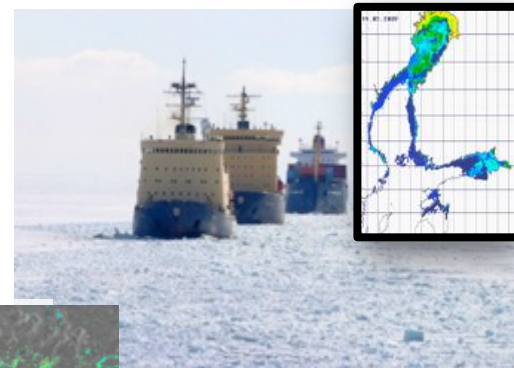
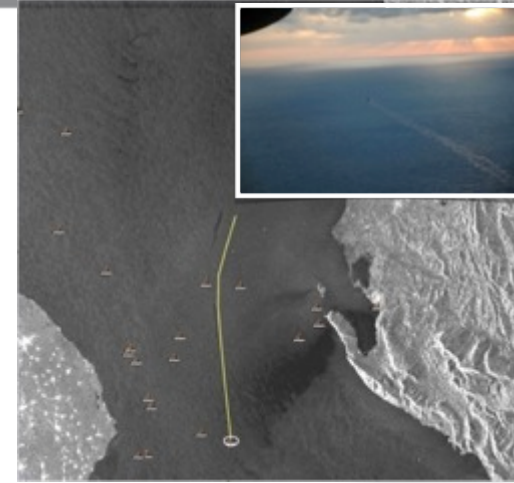
- ✓ Sentinel-1A launched on 3 April 2014 on Soyuz from Kourou
- ✓ Nominal orbit reached on 7 August 2014
- ✓ Sentinel-1A commissioning phased completed on 23 September 2014
- ✓ Sentinel-1A Operational Qualification phase on-going
- ✓ Data flow opened to all users worldwide since 3rd October 2014
- ✓ Satellite and ground segment status and performance are nominal
- ✓ Sentinel-1B satellite under procurement, launched foreseen in early 2016



Sentinel-1: C-band SAR mission



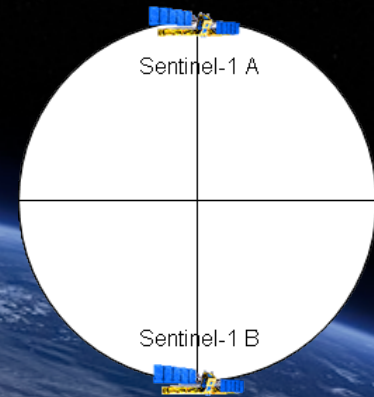
- ✓ **Data continuity of ERS and ENVISAT missions**
- ✓ **Copernicus radar imaging mission for ocean, land, emergency**
- ✓ **Applications:**
 - monitoring sea ice zones and the arctic environment
 - surveillance of marine environment (e.g. oil spill monitoring)
 - maritime security (e.g. ship detection)
 - wind, wave, current monitoring
 - monitoring of land surface motion (subsidence, landslide, tectonics, volcanoes, etc.)
 - support to emergency / risk management (e.g. flooding, etc.) and humanitarian aid in crisis situations
 - mapping of land surfaces: forest, water and soil, agriculture, etc.



Sentinel-1: Mission Profile

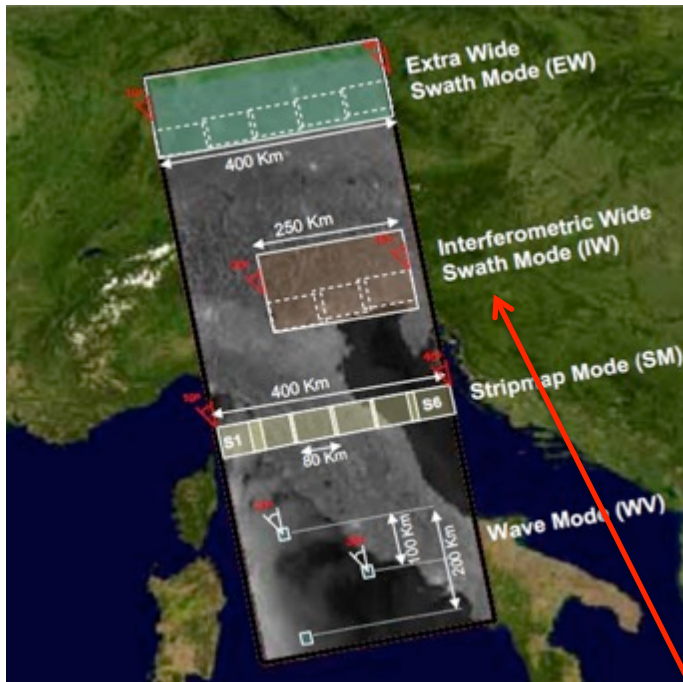


- Mission based on 2 satellites
- C-band Radar instrument
- Sun-synchronous orbit at 693 km altitude
- Inclination: 98.18°
- 7 years lifetime
- Consumables for 12 years
- Mean LST: 18:00h at ascending node
- 12-day repeat cycle at Equator (6 days with 2 satellites)
- 96h operative onboard autonomy



Sentinel-1 Operational Modes

Operational Modes



Main mode over land

Resolution (1 look)	Swath Width	Polarisation
20 x 40 m ²	> 400 km	HH+HV or VV+VH
5 x 20 m ²	> 250 km	HH+HV or VV+VH
5 x 5 m ²	> 80 km	HH+HV or VV+VH
5 x 5 m ²	20 x 20 km ² at 100 km spacing	HH or VV

Image Acquisition in Interferometric Wide Swath mode (IW)



Terrain Observation
by Progressive Scans
(TOPS)

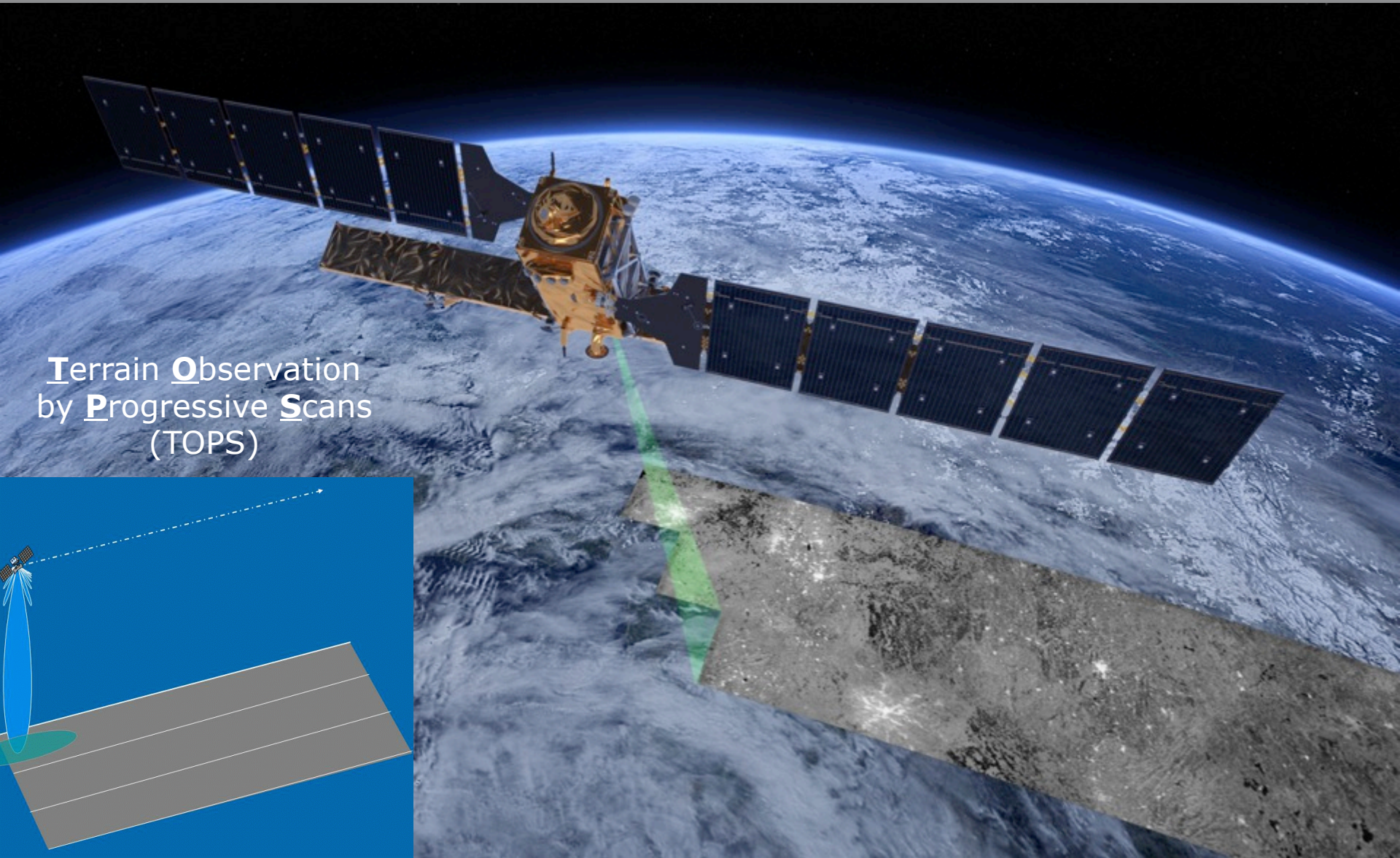
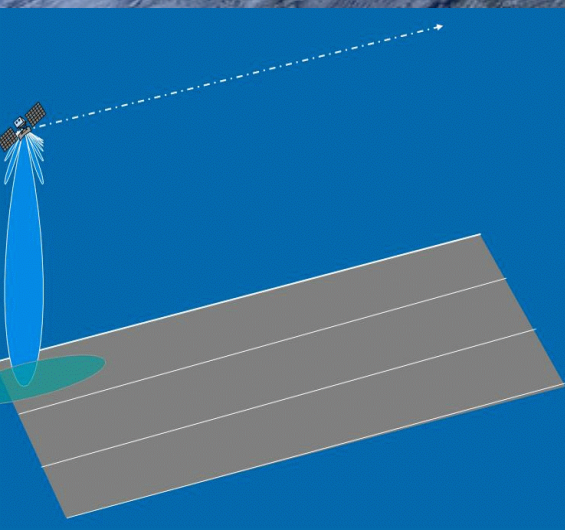
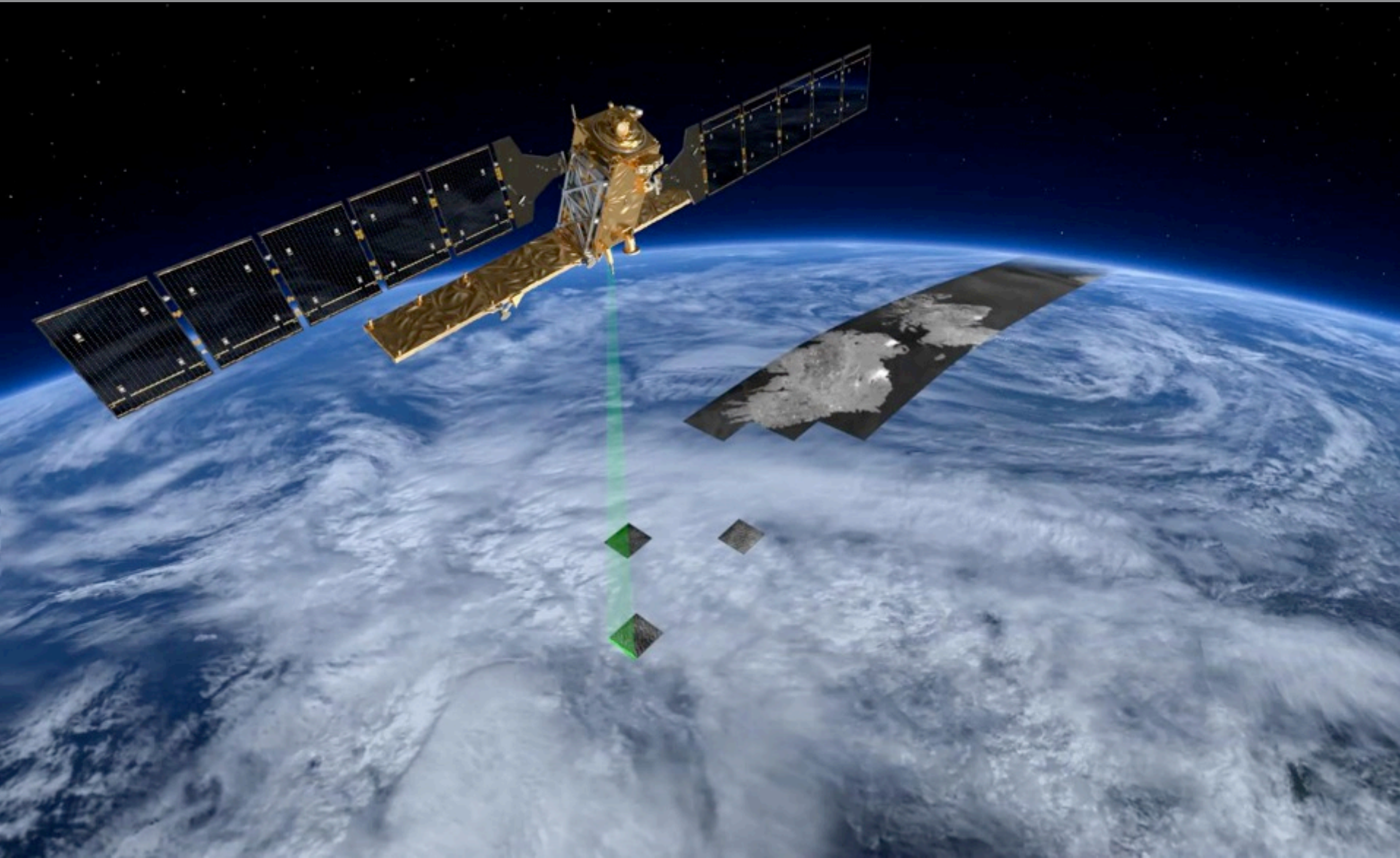


Image Acquisition in Wave Mode (VW) (used over open oceans)



LEVEL-0 PRODUCTS

Compressed, unprocessed instrument source packets, with additional annotations and auxiliary information to support the processing.

LEVEL-1 PRODUCTS

Level-1 Slant-Range Single-Look Complex Products (SLC):

Focused data in slant-range geometry, single look, containing phase and amplitude information.

Level-1 Ground Range Detected Geo-referenced Products (GRD):

Focused data projected to ground range, detected and multi-looked.

Data is projected to ground range using an Earth ellipsoid model, maintaining the original satellite path direction and including complete geo-reference information.

LEVEL-2 PRODUCTS

Level-2 Ocean products

Ocean wind field, swell wave spectra and surface radial velocity information as derived from SAR data.

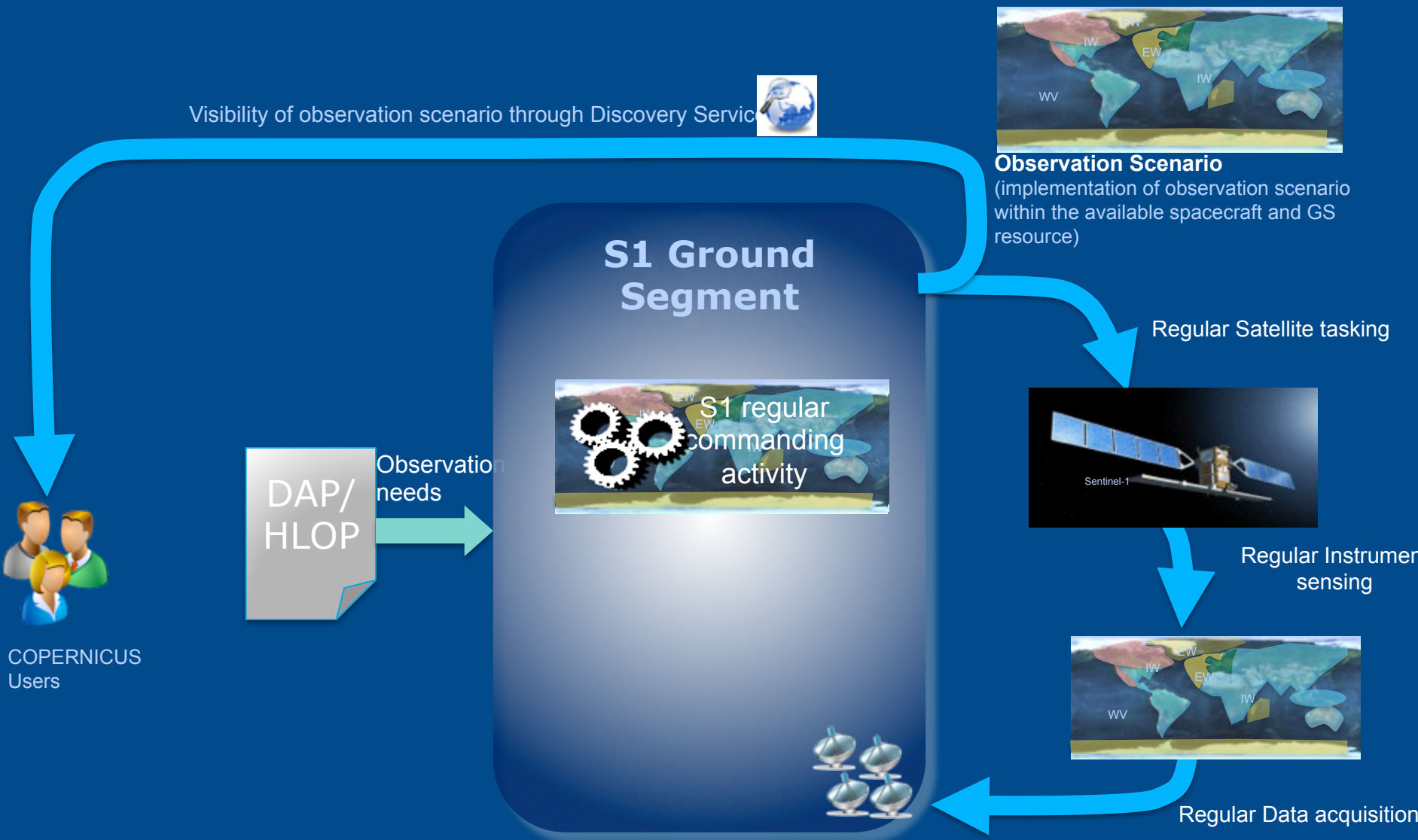
Sentinel-1 Level 1 Operational Product characteristics



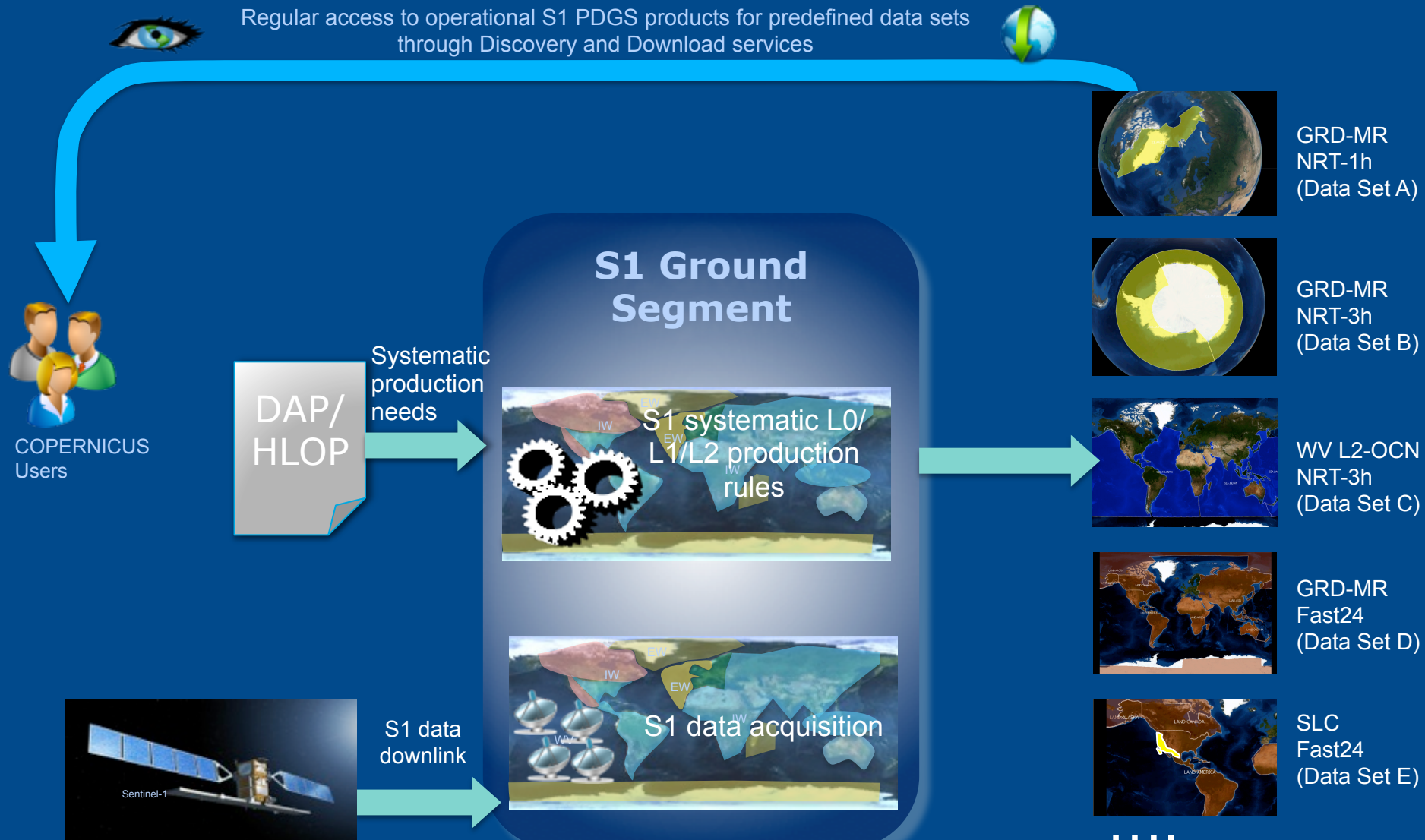
Acq. Mode	Product Type	Resolution Class	Resolution [Rng x Azi] [m]	Pixel Spacing [Rng x Azi]	No. Looks [Rng x Azi]	ENL
SM	SLC	-	1.7 x 4.3 to 3.6 x 4.9	1.5 x 3.6 to 3.1 x 4.1	1 x 1	1
	GRD	FR	9 x 9	4 x 4	2 x 2	3.9
		HR	23 x 23	10 x 10	6 x 6	34.4
		MR	84 x 84	40 x 40	22 x 22	464.7
IW	SLC	-	2.7 x 22 to 3.5 x 22	2.3 x 17.4 to 3 x 17.4	1	1
	GRD	HR	20 x 22	10 x 10	5 x 1	4.9
		MR	88 x 89	40 x 40	22 x 5	105.7
EW	SLC	-	7.9 x 42 to 14.4 x 43	5.9 x 34.7 to 12.5 x 34.7	1 x 1	1
	GRD	HR	50 x 50	25 x 25	3 x 1	3
		MR	93 x 87	40 x 40	6 x 2	12
WV	SLC	-	2.0 x 4.8 and 3.1 x 4.8	1.7 x 4.1 and 2.7 x 4.1	1 x 1	1
	GRD	MR	52 x 51	25 x 25	13 x 13	139.7

- For Ground Range Products, the resolution corresponds to the mid range value at mid orbit altitude, averaged over all swaths.
- For SLC SM/IW/EW products, the resolution and pixel spacing are provided from lowest to highest incidence angle. For SLC WV products, the resolution and pixel spacing are provided for beams WV1 and WV2.
- For SLC products, the range coordinate is in slant range. All the other products are in ground range. European Space Agency

Sentinel-1 Systematic acquisition & production concept



Sentinel-1 Systematic acquisition & production concept

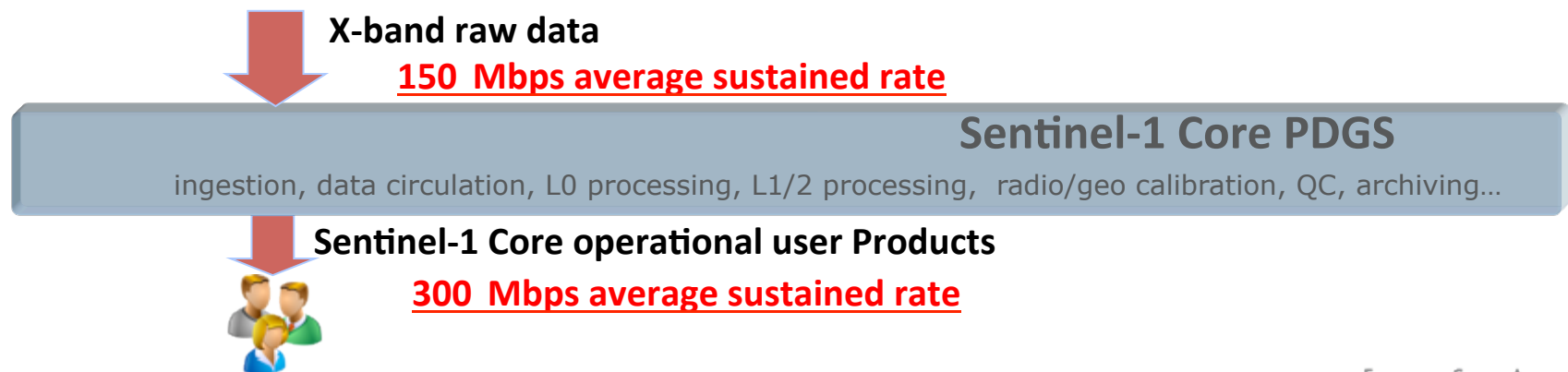


Sentinel-1: un-precedent data volume



With the Sentinel-1 instrument characteristics and mission operations concept, data volume handling is a major challenge both for Ground Segment operations and also for user data access and management

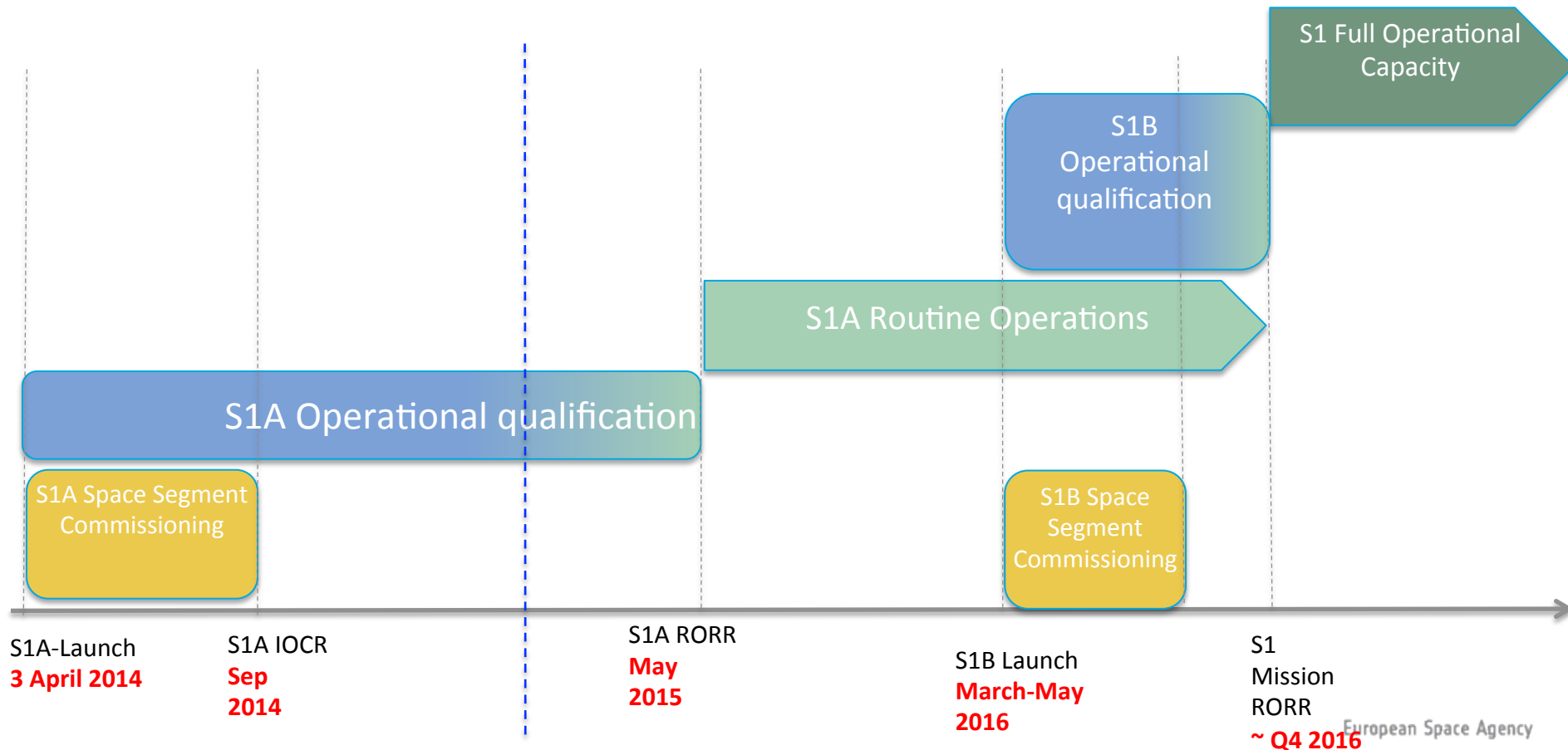
- Systematic generation of **Level-0 products: about 1.5 TB per day** (both satellites) to be generated, real time quality checked and archived
- Systematic processing to **Level-1 products: about 1.7 TB per day** (both satellites) to be generated, real time quality checked and archived
- **To be disseminated to users with an on-line data access**



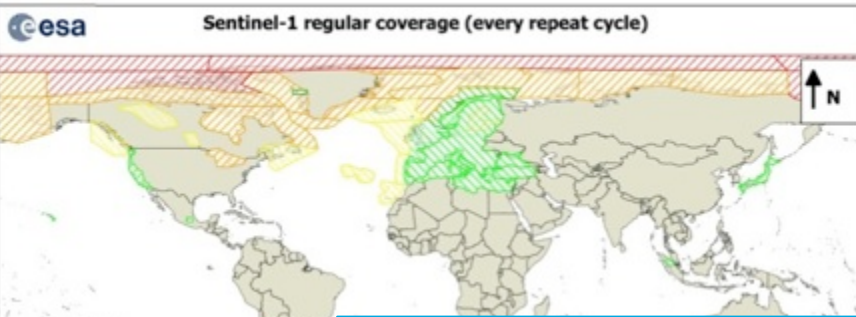
Operational qualification phase leading to the Routine Operations



Sentinel-1 full mission exploitation capacity based on the routine operations of the 2-satellite constellation
→ gradually achieved

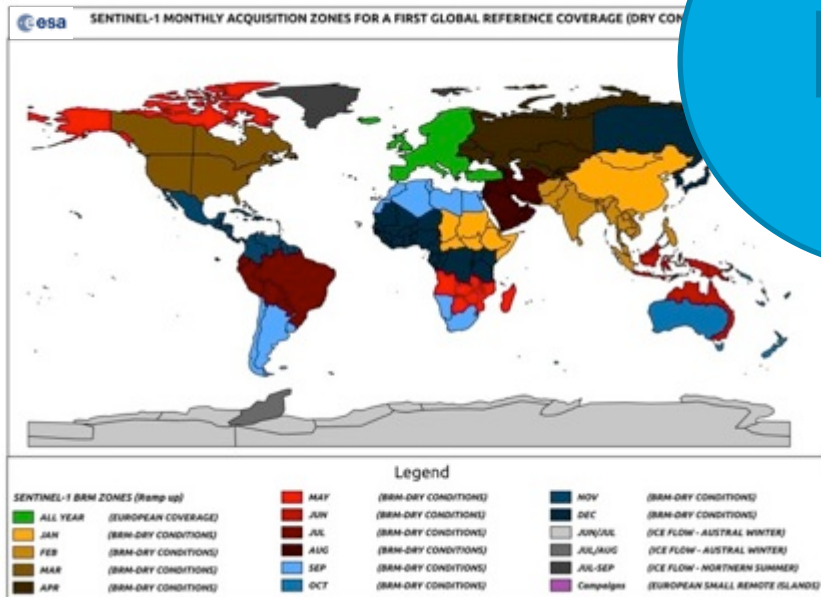
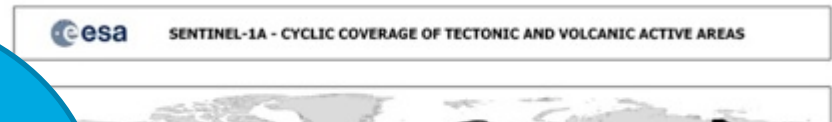


Sentinel-1A observation scenario - Approach for the Ramp-Up phase



- Consistent European coverage
- Sea-ice (focus European Arctic), sea state, maritime surveillance
- Major risk areas (tectonic and

- Cyclic one-pass coverage of tectonic and volcanic active areas



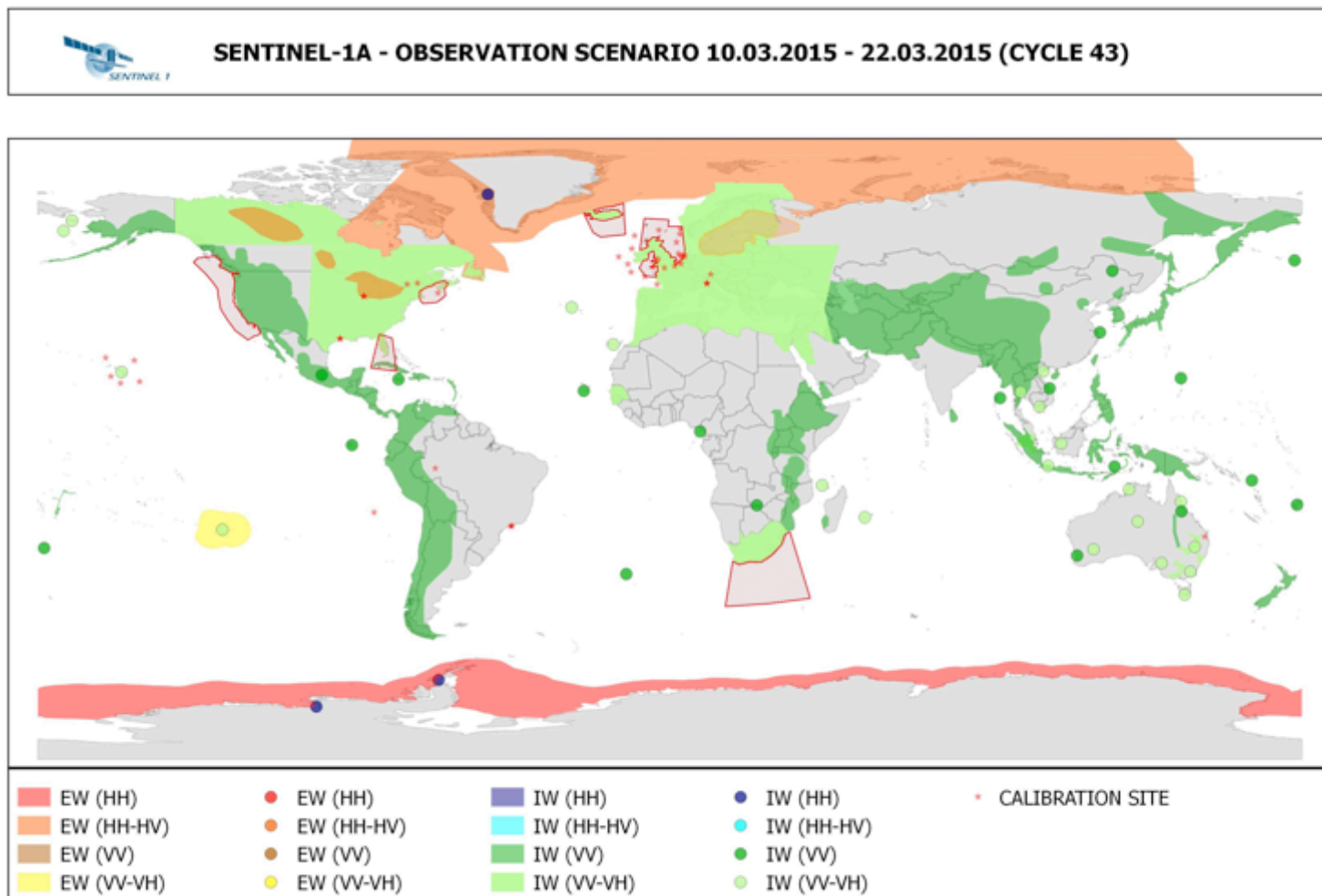
- IWS mod
- One pass
- Fulfil req requests reference

Various additional requests addressing smaller local to regional zones to be acquired

- during repetitive campaigns (e.g. ice-sheets)
- with medium frequency
- considering seasonal constraints
- to be gradually introduced into the routine observation scenario

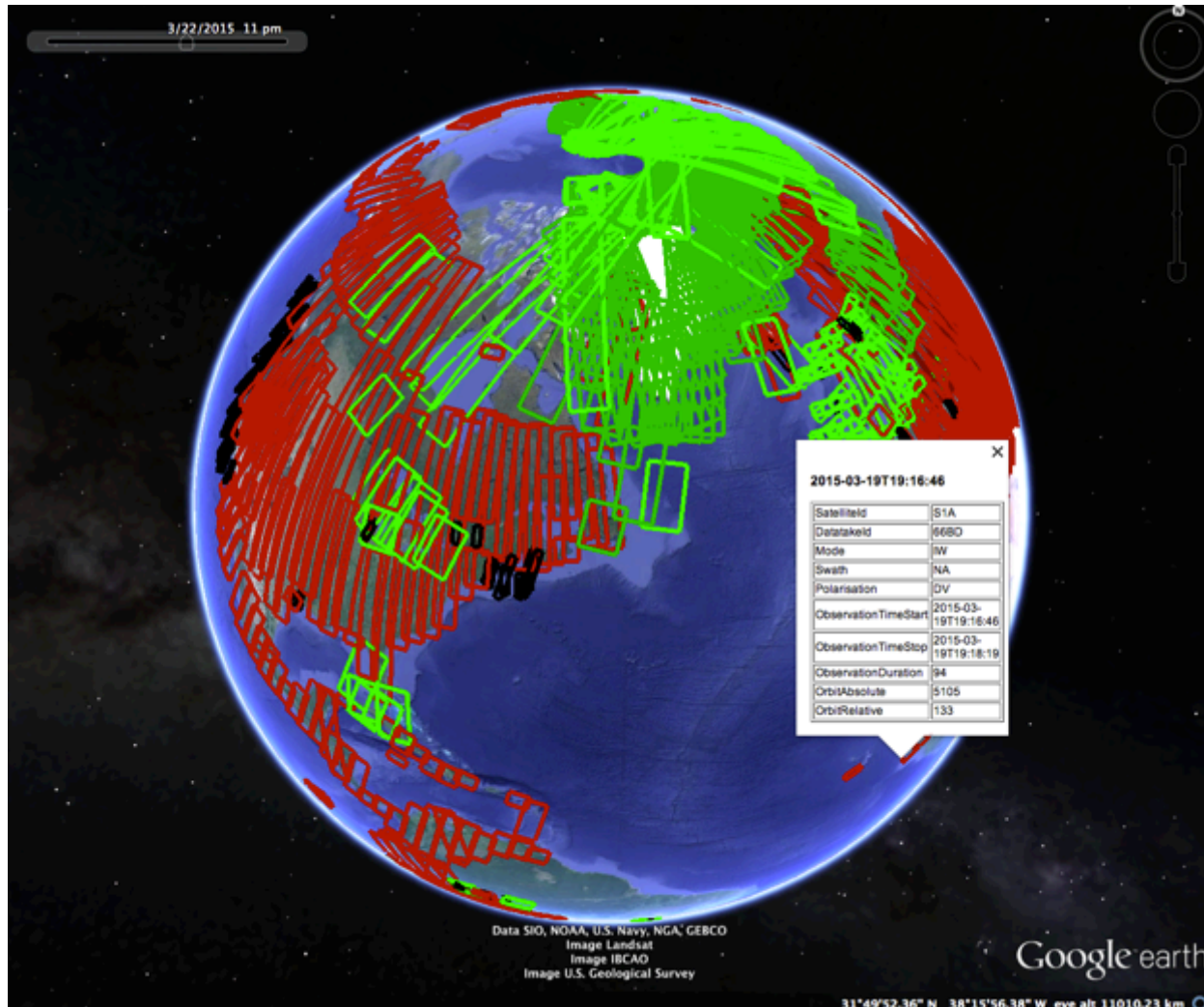
Sentinel-1A observation scenario

(one 12-days repeat cycle: from 10 to 22 March 2015)



Sentinel-1A acquisition segments

(one 12-days repeat cycle: from 10 to 22 March 2015)





Welcome to Sentinel Online



OPEN AND FREE

SENTINEL-1 DATA ACCESS

The Sentinel Data Access Infrastructure has been tailored to answer the needs of the different user typologies.

[Read more](#)

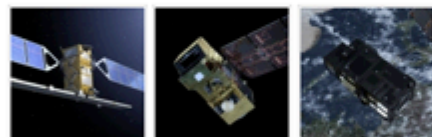
COMING SOON

Access for International Agreements

Access for Collaborative Ground Segment

click to access data

Sentinel Missions



Learn more about the Sentinel missions here, with comprehensive information about mission objectives, spacecraft design, instrument payloads and data products, as well as the latest mission news.

[Read more](#)

Thematic Areas



There are many applications for the data acquired from the Sentinel missions.

The Thematic Areas expand on six main categories: land management, marine environment, atmosphere, emergency response, security and climate change.

[Read more](#)

Sentinel News

- Sentinel-1 Level-1 SLC Production Scenario
- Sentinel-1 detailed observation scenario
- Sentinel-1 Product Format change

Events

- Sentinel-3 for Science Workshop
- ATMOS 2015 - Advances in Atmospheric
- See all Sentinel Events

Browse to Other Sites

- [EU Copernicus](#)
- [ESA Copernicus](#)
- [Observing the Earth](#)
- [Earth Online](#)
- [CSCDA](#)
- [Disasters Charter](#)
- [ESA Climate Change Initiative](#)
- [Ground Segment Coordination Body \(GSCB\)](#)
- [eoPortal](#)

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Latest Results

<http://sentinel.esa.int>

Sentinel Data Access Landscape



You are here [Home](#) > [Data Access](#)



- Data Access Navigator

OPEN AND FREE

sentinel data hub

Scientific and Other Access

Copernicus
For European Earth Observation Programme

Access for Copernicus Services

COMING SOON

Access for International Agreements

Access for Collaborative Ground Segment

click to access data

Data Access

Data Access Home

- Data Access in a nutshell
- Sentinel Data Access Description
- Use Typologies and available Services
- Sentinel Catalogue
- Available Data Collections
- Access to Sentinel-1 Data
- Data Access FAQs

- Data Access News

- Intermittent unavailability of latest Sentinel-1 products on the Scientific Data Hub
- Major upgrade of the Scientific Data Hub

Sentinel Data Access Overview – Sentinel Online

<https://sentinel.esa.int/web/sentinel/sentinel-data-access>

Open & Free 'Science and Other' Data Access – Initial Operations



esa Sentinel-1 Scientific Data Hub

Welcome to the Sentinel-1 Scientific/Other use Data Hub

The Sentinel-1 Scientific Data Hub provides free and open access to a Rolling Archive of Sentinel-1 Level-0 and Level-1 user products. Products are available for the following Sentinel-1 acquisition modes:

- Strip Map (SM)
- Interferometric Wide Swath (IWS)
- Extra Wide Swath (EWS)

Level-0 products and Level-1 Ground Range Detected (GRD) products are available for all performed acquisitions. Level-1 Single Look Complex (SLC) products are available for acquisitions performed over specific regions of interest.

The S-1 Scientific Data Hub Rolling Archive maintains the latest 2 months of products for download via HTTP. The target of the 2 months rolling archive will be reached in progression starting from a rolling period of 2 weeks commencing on the 31st of October.

A maximum of 2 concurrent downloads per user is allowed in order to ensure a download capacity for all users.

The Sentinel-1 Level-1 products are preliminary quality Operational product qualification, including absolute radi

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TERMS AND CONDITIONS FOR THE USE AND DISTRIBUCTION OF SENTINEL DATA

Agreed by and between:
The European Space Agency (hereinafter referred to as ESA or the Agency)
and
The User

Whereas the Agency, under the ESA – IT (GMS) Agreement (ESA/IT/02) is charged with managing the GMS Space Component (SC) Programme;

Whereas the access to Sentinel data is governed by:

- ESA's Sentinel Data Policy (ESA/PM/00000000, v1.0) establishing guidelines for a free and open access to Sentinel data and thus providing the basis for the GMS Space Component (SC) Data Operations Concept (ESA/PM/00000000, v1.0); and
- The Commission Delegated Regulation (EU) No 1238/2014 of 12 July 2014 supplementing Regulation (EU) No 912/2010 of the European Parliament and of the Council on the European Earth monitoring programme (GEMS) by establishing registration and licensing conditions for GEMS users and defining criteria for restricting access to GEMS distributed data and GEMS service information;

Whereas the present Terms and Conditions for the use and distribution of Sentinel data govern Sentinel data which has not been assessed "restricted". Whereas the User has accepted or intends to accept such Sentinel data via a European data dissemination platform, mirror sites, direct acquisition from the Sentinel satellites, via ESOS or other online services providing Sentinel data in its any kind of format or to access to Sentinel data from whatever network or legal source.

The parties agree, that the User shall be granted the right to use and distribute the Sentinel data according to the following Terms and Conditions:

1. Definitions

- ESA/ the agency means the European Space Agency;
- User means any public or private entity or natural person having accepted these Terms and Conditions in order to use, offer, publish or distribute Sentinel data;
- Sentinel data means all data and products, generated on the basis of observations acquired by sensors borne on the Sentinel-1 to S-6, the Sentinel-1 Processor missions, developed by ESA in the name of the European Space Agency;
- Primary Product/ Sentinel Data means any original Sentinel data including processed and unprocessed data;
- Derived Products are products derived from Primary Products retaining a clear correlation to the original sensor information and do not contain a significant intellectual or creative achievement made by the User. For the purpose of these Terms and Conditions, Derived Products include – for example – but are not limited to, histogram thresholded images, orthorectified images, re-sampled and rescaled images, mosaics and mosaics of mosaics and other derived data;
- Derivative Works are products derived from primary products or Derived Products which do not have a transferable correlation with the original sensor information and which contain a significant intellectual or creative achievement made by the User. For the purpose of these Terms and Conditions, Derivative Works include – for example – but are not limited to, land cover classifications, vegetation indices, interferograms etc.

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Version 1.0 | Sep 2014

- Open and Free access
- Terms and Conditions for Sentinel data use and distribution published
- Self Registration and Sample Products open since S-1A launch
- Routine Data flow opened on 3rd October
- Rolling Archive
 - target of latest 2 months data at least (not operated yet, today 5.5 months of data available...)
 - no timeliness guarantee
- Quota restriction of 2 concurrent downloads to ensure bandwidth availability for all users

“Scientific / Other use” access to Sentinel-1



https://scihub.esa.int/

European Commission

Sentinel-1 Scientific Data Hub

esa

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Search

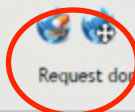
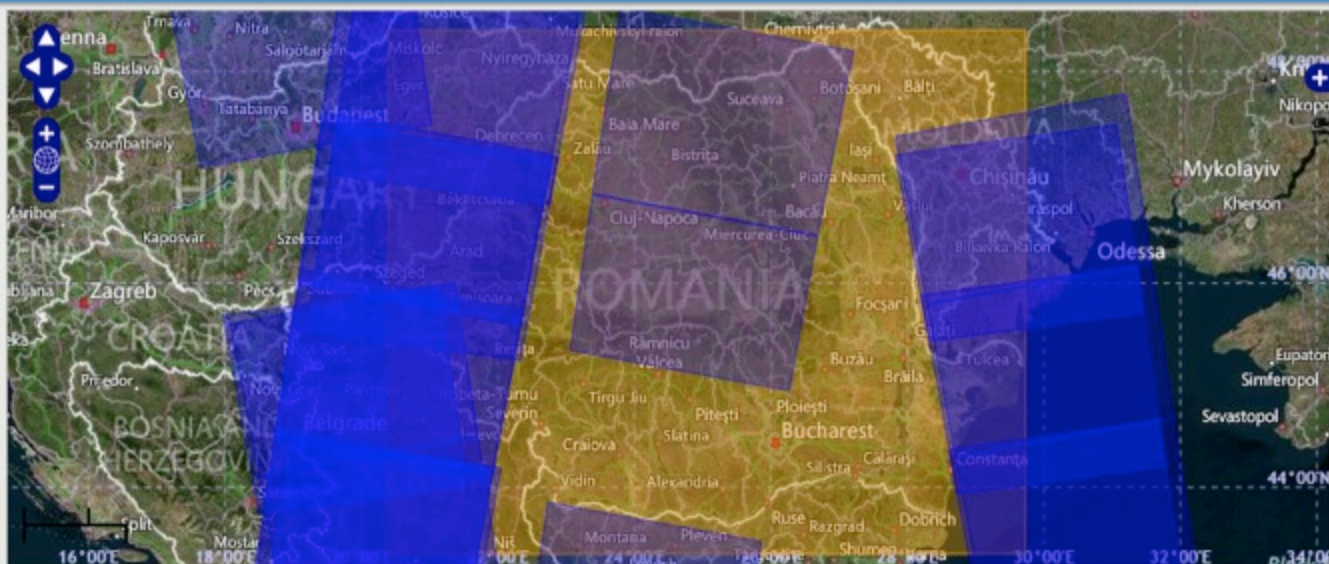
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Search

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Display 1 to 23 of 23 products



S1A_IW_GRDH_1SDV_20141004T044457_20141004T044522_002675_002FBB_10EC
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Date : 2014-10-04T04:46:12.460Z, Instrument : SAR-C, Mode : IW, Satellite : Sentinel-1, Size : 1 GB



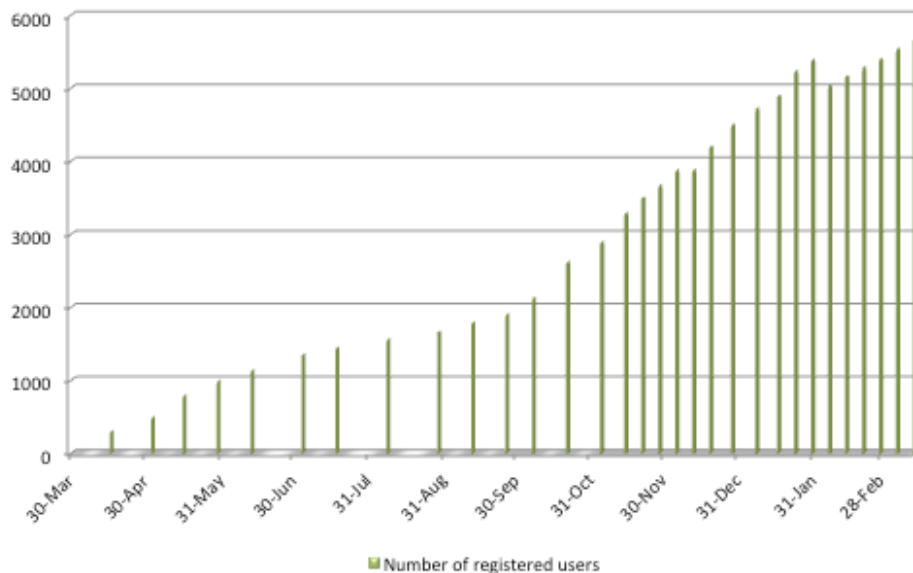
Sentinel-1 User and Data Statistics ("Scientific / Other Use" data hub)



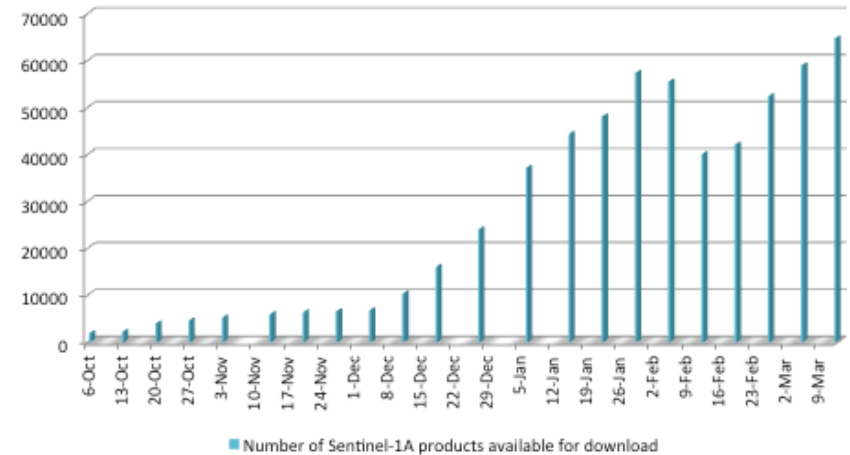
By 12 March 2015:

- ✓ **5676** registered users
- ✓ **64673** products available for download
- ✓ **448293** products downloaded by users, representing about **580 TB** of data

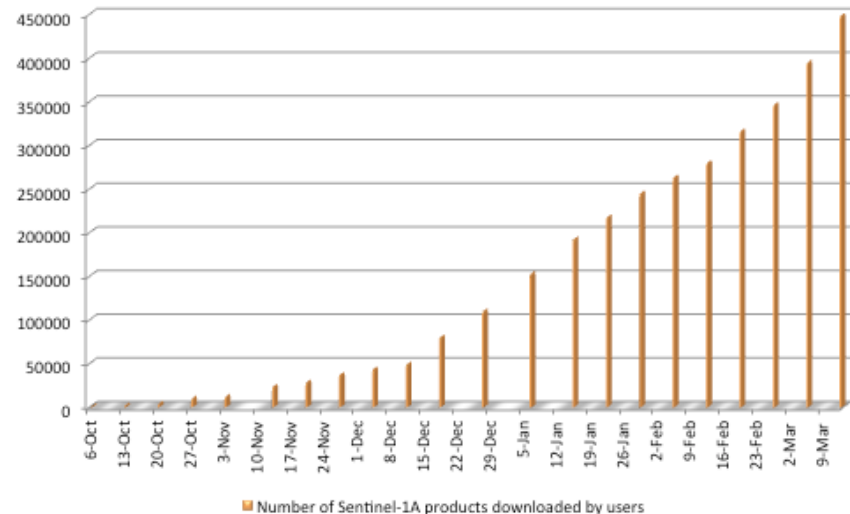
Number of registered users since registration opening on 30 March 2014



Number of Sentinel-1A products available for download



Number of Sentinel-1A products downloaded by users



Weekly Mission Status Reports available online



<https://sentinel.esa.int/web/sentinel/missions/sentinel-1/mission-status>



sentinel-1

→ RADAR VISION FOR COPERNICUS

Mission Status Report 1

Reference Period: 3 April - 7 April 2014

Mission Status

- Sentinel-1A was successfully launched from Kourou on 3 April 2014, 21:02 UTC
- The Launch and Early Orbit Phase (LEOP) was successfully performed according to the planned timeline and declared closed on 6 April at 16:00 UTC
- The Commissioning Phase has started

Satellite

The LEOP covered the main following key activities:

- Deployments of the solar panels (including rotation) and of the Synthetic Aperture Radar (SAR) antenna
- Achievement of Satellite Nominal Mode and ACS Nominal Pointing Mode
- Switch ON and initial checks of the spacecraft sub-systems
- First operations of the X-Band Transmitter and the SAR instrument (3 min of Wave mode)

In addition, a collision avoidance manoeuvre was performed on 5 April

Ground Segment

- The Flight Operations Segment performed nominal during the complete 3 days of LEOP
- First X-band data acquisition took place at the Matera ground station on 6 April, early morning
- First SAR instrument data acquisition was performed on 6 April. The related measurement was successfully processed at UK-PAC
- The FOS and the PDGS were declared ready to support the commissioning phase

Outlook

- Start of platform and payload commissioning activities
- First SAR acquisitions driven by the operational PDGS mission planning system are planned to start on 9 April, as part of the initial verification and calibration activities
- Start of orbit manoeuvre sequence to acquire the target reference orbit.

Report prepared by the ESA Sentinel-1 Team -



sentinel-1

→ RADAR VISION FOR COPERNICUS

Mission Status Report 45

Reference Period: 3 March 2015 - 9 March 2015

Mission status

- The Sentinel-1A operational qualification phase is on-going. The first yearly Routine Operations Review is planned early June 2015
- The opening of the Sentinel-1 data flow to all users took place on 3rd October. Data can be accessed from: <https://sentinel.esa.int>
- The implementation of the ramp-up observation scenario is on-going, including in particular the coverage of a first set of Copernicus Services areas of interest, of European land and coastal waters, of a set of global tectonic/volcanic areas, as well as of other specific targets worldwide for various applications. The observation plan is gradually complemented with observations outside the above areas to achieve a full mapping of all land areas worldwide before the end of the ramp-up phase. See an overview at: <https://sentinel.esa.int/web/sentinel/missions/sentinel-1/observation-scenario>
- The use of Sentinel-1A data by the pre-operational precursor of the Copernicus Marine Environment Monitoring Service MyOcean for sea-ice and iceberg monitoring activities is on-going
- Sentinel-1A responded to an activation from the International Charter Space and Major Disasters for an eruption of the Villarica Volcano in Chile. See more at: <https://www.disasterscharter.org/web/guest/activations/-/article/volcano-in-ch-19>
- The Sentinel-1A spacecraft is in a stable state, operating in Nominal Mission Mode (NMM), with all sub-systems working on prime units
- The Flight Operations Segment (FOS) ensuring the monitoring, control and commanding of the satellite is operating nominally. Orbit control manoeuvres are performed once a week
- X-Band data acquisitions are routinely performed over Matera, Gvalbard and Maspalomas X-band core stations
- The acquired data are circulated within the PDGS, systematically processed to Level-0 and Level-1 products and archived. Level-2 product operational qualification is on-going
- Operations are performed regularly at the Processing and Archiving Centres (DLR-PAC and UK-IPAC). All other PDGS operational services (i.e. Mission Performance, Precise Orbit Determination, Wide Area Network) are operating nominally
- The detailed observation plan in the form of instrument acquisition segments will from now on regularly be published through XML files on Sentinel Online at: <https://sentinel.esa.int/web/sentinel/missions/sentinel-1/production-scenario>
- The areas where acquired data is systematically processed to Level-1 SLC products have been extended on 4 March. The current SLC production can be consulted at: <https://sentinel.esa.int/web/sentinel/missions/sentinel-1/production-scenario>
- By mid-March, a slight change in the Level-1 and 2 product format specification will be introduced. More details at: <https://sentinel.esa.int/web/sentinel/missions/sentinel-1/news/-/article/sentinel-1-level-1-2-product-format-specifications-version-2-0-released>
- By 5 March:
 - A total of 5541 users have self-registered
 - Since the opening of the regular data flow on 3 October:
 - about 62000 products are currently available on-line for download
 - 394496 product download have been made by users, corresponding to 521 TB of data
- The overall operations mission performance is nominal

Outlook

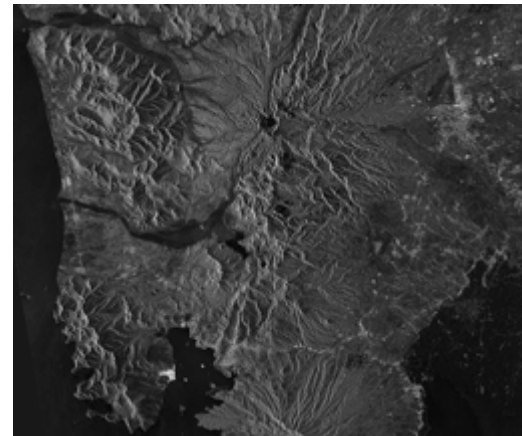
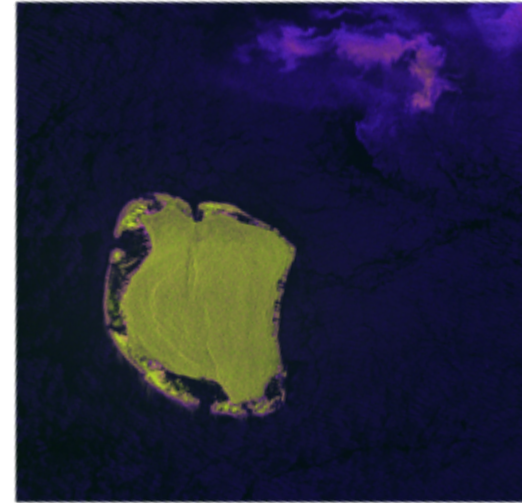
- Continuation of ramp-up mission operations

Report prepared by the ESA Sentinel-1 Team -



Concluding remarks

- ✓ Mission overall in a very good status
- ✓ Various elements of the system operating nominally
- ✓ Mission capacity currently being further increased (incl. observation and production scenarios)
- ✓ Very high expectations from the various user communities (operational services, science, value-adding, etc.)
- ✓ Applications in various thematic domains already demonstrated
- ✓ Outstanding efforts made by various teams !



Thank you for your attention !

EU Copernicus web site:
<http://www.copernicus.eu/>

Sentinel Online web site:
<http://sentinel.esa.int>