Sentinel-1 Mission Status
Pierre Potin, ESA

6th CCI COLOCATION MEETING
29 September–1 October 2015 | ESA–ESRIN | Frascati (Rome) Italy
Sentinel-1 full mission exploitation capacity based on the routine operations of the 2-satellite constellation gradually achieved
Sentinel-1A launched on 3 April 2014 on Soyuz from Kourou

Nominal orbit reached on 7 August 2014

Sentinel-1A commissioning phase completed on 23 September 2014

Data flow opened to all users worldwide on 3rd October 2014

Copernicus services (Marine and Emergency in particular) are operationally using Sentinel-1 data

Sentinel-1A Operational Qualification phase (ramp-up) completed with the 1st Yearly Routine Operations Review on 9 June 2015

Sentinel-1B satellite under development, launch foreseen in March-May 2016
✓ Overall very good performance of the satellite

✓ Flight Operations Segment (FOS) performance nominal, operations successfully on-going; after IOCR, the FOS migrated to the full Routine set-up and working practice, achieved by mid February 2015

✓ Very good performance of the Payload Data Ground Segment (PDGS), operations run smoothly, very high data throughput achieved already in early stages of the mission: more than 3 TB of products generated daily

✓ Level-0 and Level 1 products operationally qualified, level-2 products full operational qualification on-going (planned to be completed in coming weeks)

✓ First inter-orbit optical link campaign between Sentinel-1 and Alphasat Technology Demonstration Payload TDP-1 successfully performed in Autumn 2014. Routine characterisation phase currently on-going
Sentinel-1A observation scenario
Main components & thematic domains

Agriculture
Calibration/validation
Zonal mapping
Tectonic active areas and volcanoes / landslides and subsidence
Sea state
Sea-ice, icebergs, lake-ice
European coverage
Forestry
Maritime surveillance
Emergency
Security
Ice sheets, glaciers, permafrost and snow
Full consistent coverage in ascending and descending passes every 12 days

- IW mode, VV+VH polarisation

- Including Mediterranean Sea, Black Sea, Baltic Sea and North Sea, EEZ of continental Europe in the Atlantic Ocean

- Europe defined as EU-/ESA-/EEA-38 member states

- Including (especially tectonic active) parts of the Maghreb and Middle East to avoid coverage fragmentation due to instrument switches

- Core observation area, resulting from various requirements
Central Arctic:
- Acquisitions in EW mode, HH+HV polarisation
- Very high repeat frequency

Eastern/Western Arctic:
- Acquisitions in EW mode, HH+HV polarisation up to ~78 deg N, acquisitions in EW mode,
- HH polarisation further north
BLUE: Acquisitions in IW mode, VV+VH polarisation, every 12 days ascending and descending

BLACK: Acquisitions in IW mode, VV polarisation, every 12 days ascending or descending; repeat on the same track every 24 days

Stripmap mode (SM) acquisitions over selected small volcanic islands

Increased sampling density over supersites outside Europe

About one third of global landmass covered regularly under this frame
BLUE: Acquisitions in IW mode, VV +VH polarisation, every 12 days ascending and descending

BLACK: Acquisitions in IW mode, VV +VH polarisation, every 12 days in one pass
- Repeat over parts of SE-Asia
- IW VV+VH currently every 24 days, plus complementary acquisitions in IW VV
- North Andes and Tanzania covered with lower frequency (dedicated campaigns for forestry monitoring)

Agriculture focus:
- Mainly based on requirements from:
  - wet rice crop monitoring (GEOGLAM)
  - soil moisture retrieval

Forestry focus:
- Mainly based on requirements from:
  - GFOI
  - regions with high risk for illegal logging
  - Mostly cloudy tropical rainforests
**Sentinel-1A observation scenario**

**Ice sheets**

- **All year:** Acquisitions in IW mode, HH polarisation, every 12 days on selected tracks over the complete Greenland shore, the Antarctic Peninsula and the main outlet glaciers of Western Antarctica (Thwaites and Pine Island glacier)

- **Frequent:** Acquisitions over Svalbard in IW mode, HH polarisation

- **Campaigns:** IW mode, HH polarisation, 3-4 consecutive repeats on the same tracks.
  - **Greenland:** ASC + DSC tracks. Including Baffin and Ellesmere islands. Ideally twice a year
  - **Antarctica:** ASC or DSC. S1A can see up to 78.5 deg. S. One full campaign during Antarctic winter, one potential campaign (ice edge only) during Antarctic summer
Frequent acquisitions in IW mode, dual polarisation ASC + DSC, over North Sea, Baltic Sea, European coastal waters

Frequent acquisitions in IW and EW mode, ASC + DSC around Iceland, Azores and Canary islands

One pass coverage of EEZ in IW mode over French Islands in the Indian Ocean and around Newfoundland
Sentinel-1A observation scenario
Zonal mapping

- IW mode, VV+VH polarisation, one pass
- Acquisitions following a zonal approach, prime acquisition windows prevailing regional dry season conditions
- Continuous acquisition zones (e.g. Tectonic active areas) become upgraded to dual polarisation whenever they fall into a regional zonal acquisition window
- Revisit per zone several times a year
- Main driver: Emergency reference mapping, low frequency global applications (e.g. forest mapping, land use, urban area mapping...)
Sentinel-1A observation scenario
(current repeat cycle 60: from 30 Sep to 12 Oct 2015)

https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/observation-scenario
Sentinel-1A acquisition segments
(12-days repeat cycle: from 2 to 14 June 2015)

https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/
observation-scenario/acquisition-segments
Substantial Sentinel-1 satellite resources are routinely allocated to CMEMS:

- Sea-ice and iceberg monitoring
- Coverage includes the Arctic, Greenland waters, the Baltic Sea (during winter), ... as well as in the Southern Ocean around Antarctica

Data currently provided by the CSC core ground segment in Near Real Time over agreed areas

Dedicated data access infrastructure, tailored upon request from MyOcean:

- Operational since 30 September 2014
- Currently about 150 – 200 products disseminated per day
Sentinel-1 responded to a number of activations from the Copernicus Emergency Management Service:

- EMSR87 for floods in Bosnia-Herzegovina (May 2014)
- EMSR100 for floods and landslides in Italy (Sep 2014)
- EMSR107 for floods in Slovenia (Nov 2014)
- EMSR108 for floods and landslides in Italy (Nov 2014)
- EMSR111 related to the volcanic eruption at Fogo Island (Cape Verde) (Nov 2014)
- EMSR116 for floods in Malawi (Jan 2015)
- EMSR117 for floods in Greece (Feb 2015)
- EMSR118 for floods in Spain (Feb 2015)
- EMSR122 for floods in Greece (Mar 2015)
- EMSR125 for Earthquake in Nepal
- EMSR126 for algae bloom in French Guiana (May 2015)
Sentinel-1A coverage density map
- From Oct 2014 to 31 May 2015 -
Based on all GRD products on Scientific Data Hub
Sentinel-1A coverage
Available products over Greenland
- From 3rd Oct 2014 to 25 Sep 2015 -

Mode: IW HH

- 1303 GRDH products
- 1293 SLC products

Cumulative SAR operation
time of more than 9 hours
Sentinel-1A coverage
Available products over Antarctica
- From 3rd Oct 2014 to 25 Sep 2015 -

Mode: IW HH
- 2549 GRDH products
- 2458 SLC products

Cumulative SAR operation time of more than 18 hours
Overall Production Data Volume evolution

- Overall daily production has gradually increased during the Operations Qualification Phase, as a result of the increase of sensing time as well as the evolution of the systematic regional processing scenario.

- Overall daily production is the result of the production operations at all PDGS CGSs and PACs.

![Average Daily products volume made available to users (Fast24)]

More than 2TB of S1 operational user products available daily to users.
All data processed at SLC level over land and made available for download

All Land and Ice Masses systematically provided as IW SLC

All global tectonic/volcanic areas covered

About 1.4 TB of IW SLC data available daily
By 24 September 2015:

- **11,596 users registered** on the scientific data hub

- More than **2 million products downloaded** by users, representing 2.5 Petabytes of data

- Currently (29 Sep 2015) more than 269,000 products available for download
- S1 operations are nominally performing since S1A Launch: observation, production, product qualification and data access being gradually enhanced to maximize the mission exploitation.

- S1 L0/L1 user products are operationally qualified. S2 L2 OCN products geophysical validation will continue over the coming months.

- S1 operations paradigm with systematic processing of all data and open & free data access to all users is a major challenge but... it is being made possible.

- S1A operations qualification being completed... S1B operations arriving soon.
Thank you for your attention!

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

Sentinel Online web site: http://sentinels.copernicus.eu

West Greenland glaciers, Sentinel-1, 08 June 2015