



Status of Sentinels -1, -2 and -3 and the Data Policy

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Sentinel 1 – SAR imaging

All weather, day/night applications, interferometry

2014 (A), 2015+ (B)



Sentinel 2 – Multispectral imaging

Land applications: urban, forest, agriculture,..
Continuity of Landsat, SPOT

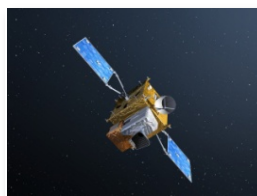
2014 (A), 2015+ (B)



Sentinel 3 – Ocean and global land monitoring

Wide-swath ocean colour, vegetation, sea/land
surface temperature, altimetry

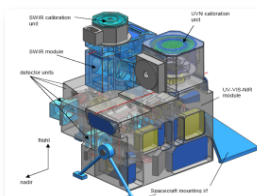
2014 (A), 2015+ (B)



Sentinel 4 – Geostationary atmospheric

Atmospheric composition monitoring, trans-
boundary pollution

2018



Sentinel 5 and Precursor – Low-orbit atmospheric

Atmospheric composition monitoring

2014 (5P), 2019



Sentinel-1

Sentinel-1: C-band SAR mission



- ✓ **GMES C-band radar imaging mission for ocean, land and emergency services**
- ✓ **Data continuity of ERS and ENVISAT missions**
- ✓ **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.
- ✓ **The Sentinel-1 mission is based on a constellation of 2 satellites**
Sentinel-1A to be launched in **February (March – May) 2014**
Sentinel-1B launch date is late 2015 (TBC)



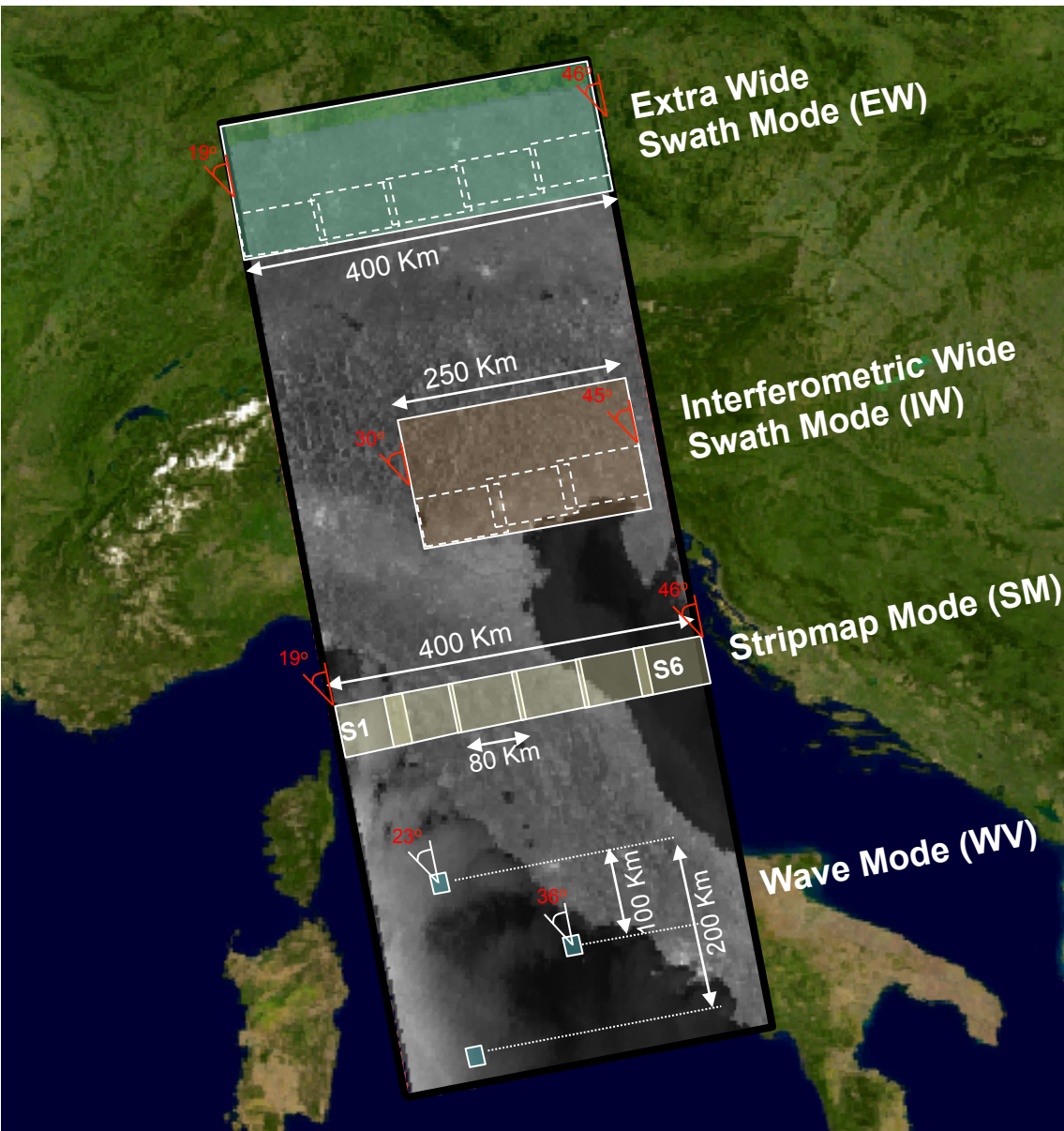
Sentinel-1: launch dates



- ✓ Sentinel-1A is ready for launch in February 2014 according to the current schedule.
- ✓ EC puts priority on launch of the Galileo satellites
- ✓ Arianespace offers launch window for S-1 from March to May 2014
- ✓ Launch of Sentinel-1B is planned late September 2015



Sentinel-1 SAR Modes



Sentinel-1 SAR can be operated in 4 exclusive imaging modes with different resolution and coverage:

Mode Rate	SAR Mode
High Bit Rate (HBR)	IW
	EW
	SM (S1 → S6)
Low Bit Rate (LBR)	WV

Polarisation schemes for IW, EW and SM:

- single polarisation: HH or VV
- dual polarisation: HH+HV or VV+VH

For Wave mode: HH or VV

For all of these operating modes, the same family of core products is available to the users

High level strategy during Full Operations Capacity

- Optimum use of SAR duty cycle (25 min/orbit for 1 satellite), taking into account the various constraints (e.g. limitation in number of X-band RF switches, mode transition times)
- **Wave Mode** continuously operated **over open oceans**, with lower priority w.r.t. the other high rate modes
- IW or EW modes operated over pre-defined geographical areas:
 - ✓ **Over land**: pre-defined mode is **IWS**
 - ✓ **Over seas and polar areas, and ocean relevant areas**: pre-defined mode is either **IWS** or **EWS**
- The Full Operations Capacity is reached with the 2-satellite constellation

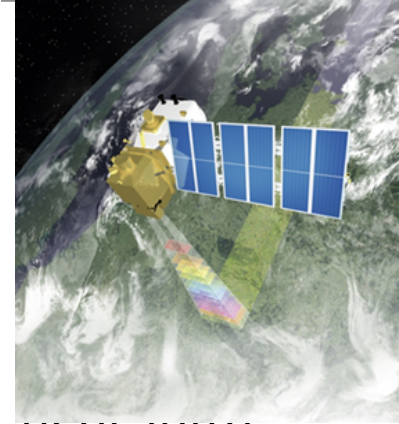


Sentinel-2

Sentinel-2: Multispectral Optical Mission

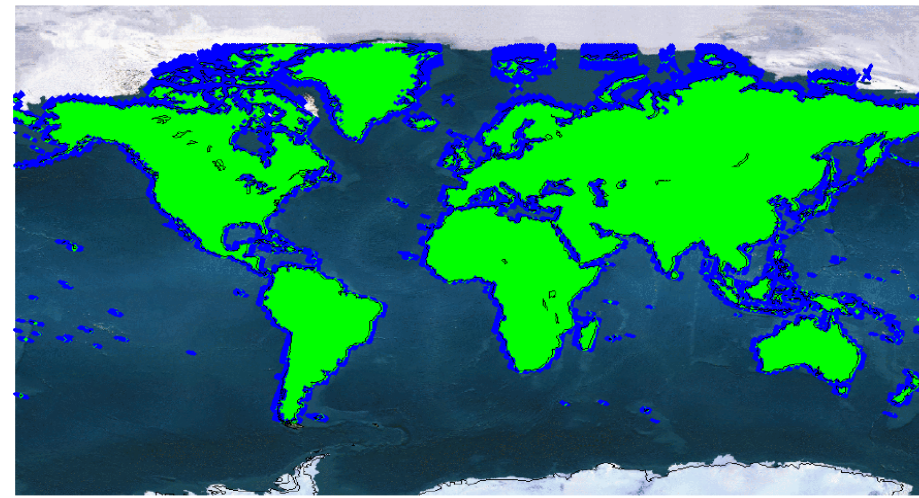


- ✓ **2 satellites** in twin formation, **launch Sep 2014** (and Q2 2015)
- ✓ **Orbit:** Sun-synchronous at 786 km (14+3/10 revs/day), with **LTDN 10:30 AM**
- ✓ **Revisit: 5 days** at equator (with 2 satellites) under same viewing conditions;
- ✓ **Multispectral Instrument:** pushbroom with 13 bands in the visible, near infra red (VNIR) and short wave infra-red (SWIR) part of the spectrum
 - High **spatial resolution:** 10m, 20m and 60m;
 - Wide **field of view:** 290 km
 - **Duty cycle:** average 17 min/orbit, maximum 32 min /orbit
 - **Lifetime:** 7.25 years, extendable to 12 years
 - **Onboard mission data storage:** 2.4 Tbits



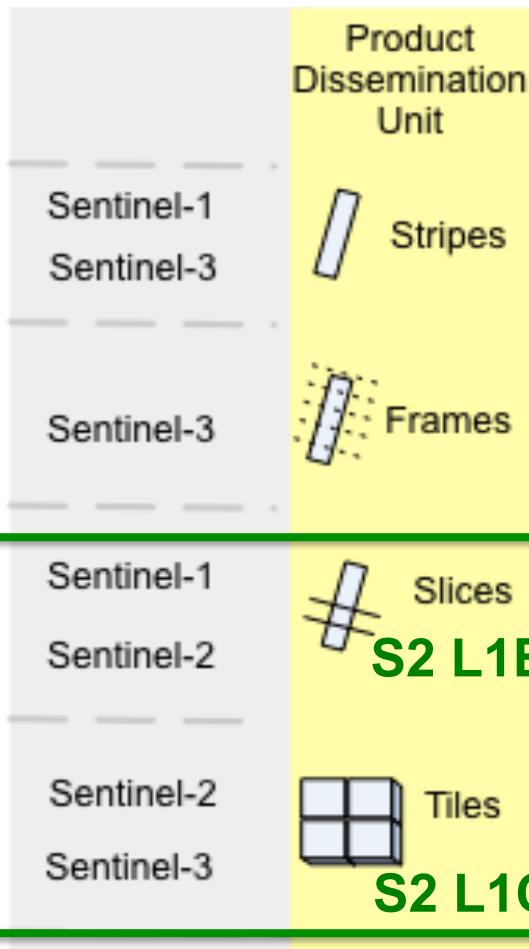
Geographical Coverage:

- All land masses 56° S bis 83° N incl. major islands (>100 km²)
- All EU islands < 20 km off the coast
- All Mediterranean
- Inland waters and all closed seas



- X band downlink with data rate of **490 Mbit/s** (after on-board wavelet compression) → **50x ENVISAT MERIS/FR**
- average **~17 minutes of instrument MSI operation/orbit**
- **800 GB per day** compressed raw data (~170 DVDs),
i.e. **400 TB per year** from 1 satellite
- Equivalent **continuous raw data supply rate of ~170 Mbps** (compressed) to be sustained on ground for 2 satellites
- One **100km x 100km portion** of MSI image weights
~ 500 Mbytes (J2K compressed)

To cut the big volumes challenge ... into pieces !



A **stripe** coincides either with a complete dump or large acquisition segment (e.g. pole to pole)

A **frame** is identified by means of a fixed reference system based on along track coordinate and along orbit cycle coordinate

A **slice** corresponds to pre-defined time interval of measurement data

A **tile** corresponds to image subset remapped into a well-defined geographic projection

Sentinel-3

Sentinel-3: Instrument payload

OPTICAL MISSION PAYLOAD

SLSTR nadir: 1420km

Offset westward from nadir

SLSTR oblique: 750 km

Centred at nadir

OLCI: 1270 km

Westward inclination to avoid sunglint;
Fully within SLSTR nadir and oblique
swath

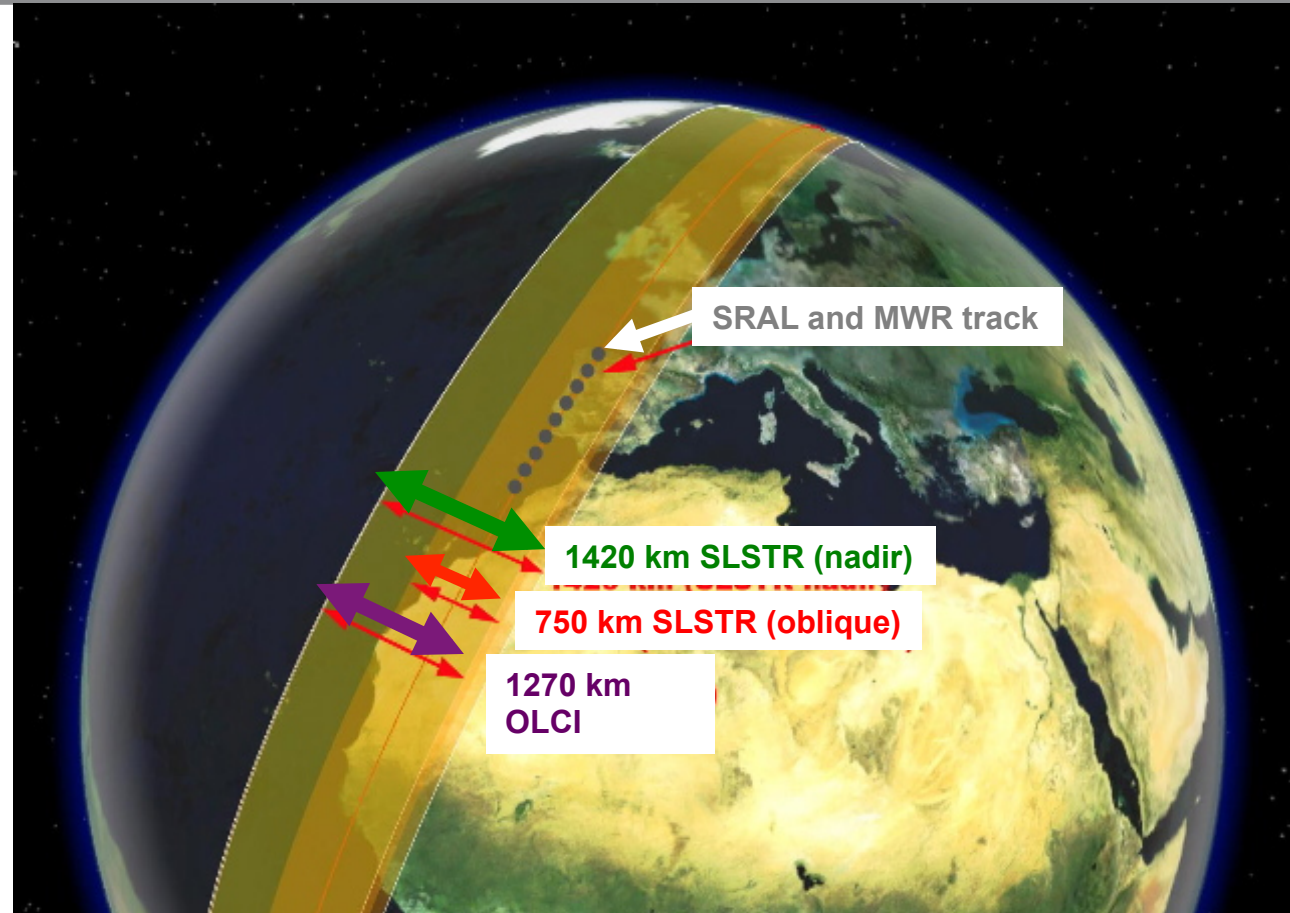
TOPOGRAPHY MISSION PAYLOAD

SRAL: > 2km

Centred at nadir and fully within
SLSTR and OLCI swath

MWR: 20 km

Centred at nadir and fully co-located
with SRAL



Ocean and Land Colour Instrument (OLCI) comparison to MERIS



Pushbroom Imaging Spectrometer (VIS-NIR)

MERIS Heritage (general design and radiometric performance)

Key Improvements:

- number of spectral bands (increase from 15 to 21 bands ranging from 400 – 1020 nm)
- reduced sun glint by camera tilt in west direction
- 300m over over all land/ocean surfaces
- Calibration applied in ground segment
- improved characterisation, e.g., straylight, BRDF, spectral calibration
- camera overlap data provided to users
- improved coverage Ocean < 4 days, Land < 3 days (MERIS eff. 15 days)
- Timeliness: 3 hours NRT Level 2 product
- 100% overlap with SLSTR



Baltic bloom, MERIS
11 July 2010.

=> improved L2 products (e.g., Cla, PFTs, HAB, Transparency, TSM, Turbidity, NDVI, MGVI, MTCI, faPAR, LAI)

Sentinel-3 Revisit time and coverage

Key elements of the Sentinel-3 mission are:

Topography Mission:
ground track repeatability,
dense spatial sampling



Ground tracks after 1 complete cycle (27 days)
S3A & S3B

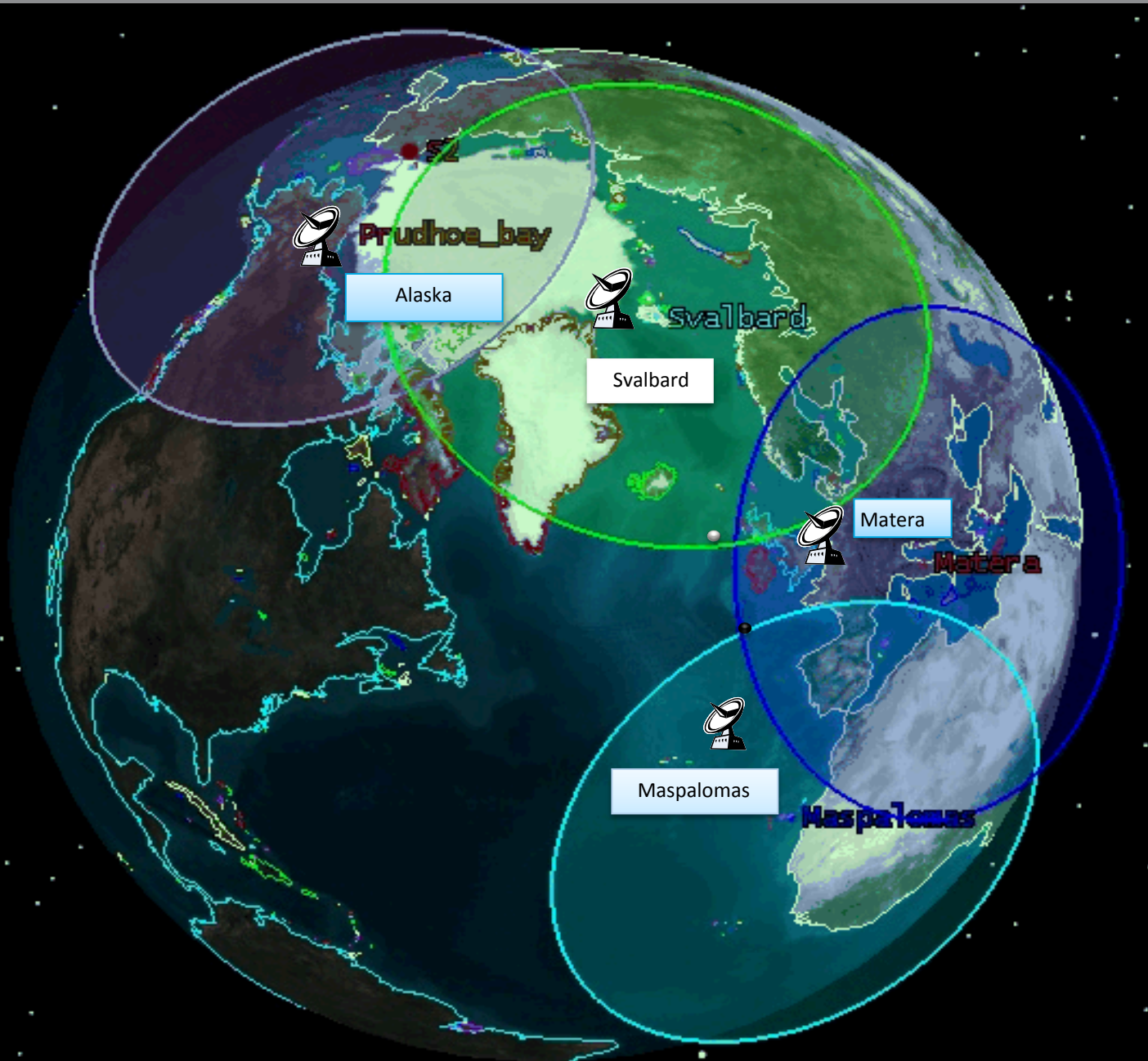
Optical Mission:
Short Revisit times for optical payload,
even with 1 single satellite

		Revisit at Equator	Revisit for latitude > 30°	Spec.
Ocean Colour (Sun-glint free, day only)	1 Satellite	< 3.8 days	< 2.8 days	< 2 days
	2 Satellites	< 1.9 days	< 1.4 days	
Land Colour (day only)	1 Satellite	< 2.2 days	< 1.8 days	< 2 days
	2 Satellites	< 1.1 day	< 0.9 day	
SLSTR dual view (day and night)	1 Satellite	< 1.9 days	< 1.5 days	< 4 days
	2 Satellites	< 0.9 day	< 0.8 day	

- Near-Real Time (< 3 hr) availability of the L2 products
- Slow Time Critical (STC) (1 to 2 days) delivery of higher quality products for assimilation in models (e.g. SSH, SST)

Copernicus Ground Segment

Core Ground Stations Network



Core Ground Stations:

- Matera



- Maspalomas



- Svalbard



- Alaska

... later EDRS
to be added

The Copernicus Space Component (CSC) Operations Concept relies on a CSC Ground Segment consisting of:

- **A CSC Core Ground Segment**, with CSC-funded Functions and Elements, providing :
 - the primary access to Sentinel Missions data as well as
 - the coordinating access functions to Contributing Missions data

- **a CSC (Sentinel) Collaborative Ground Segment**, with non CSC-funded Functions and Elements, providing:
 - a supplementary access to Sentinel Missions data, i.e. either through specific data acquisition services, or specific data products
 - **the frame for international cooperation (next step after Member States)**

Copernicus Data Policy

CSC data access funding

- ❑ Development of the CSC data dissemination platforms is co-funded by the European Union and the European Space Agency
- ❑ Operations of the CSC data dissemination platforms are funded by the European Union
- ❑ Operations of the CSC data dissemination platforms in support of ESA's Member States Sentinels Collaborative Ground Segment are funded by ESA

Sentinel data access: collaborative agreements

- ❑ ESA is establishing collaborative agreements with its MS as concerns Sentinel data access
- ❑ Similarly EU will lead the establishment of international collaborative agreements. ESA will provide technical support



Sentinel data ownership

- ❑ Sentinels ownership, including data, is currently with ESA
- ❑ Transfer of ownership to the EU is envisaged during the initial operations phase

Copernicus Data Policy is legally established in the related European Commission Delegated Regulation which defines:

- ❑ Conditions for full and open access to information produced by the Copernicus services and of data collected through the Copernicus dedicated infrastructure (e.g. Sentinels spacecraft)
- ❑ Criteria for restricting access to that information and data
- ❑ Conditions for user registration

Users shall have free, full and open access to Copernicus / GMES dedicated data and Copernicus service information

❑ To access download services, users shall register online on the Copernicus dissemination platforms. Registration shall be free of charge. No registration is required for discovery services and view services

❑ Access to Copernicus dedicated data and Copernicus service information shall be given for the purpose of the following use in so far as it is lawful: reproduction, distribution, communication to the public, adaptation, modification and combination with other data and information

❑ Specific restrictions may be applied mainly where the open dissemination of Copernicus dedicated data and Copernicus service information presents an unacceptable degree of risk to the security interests of the EU or its Member States

❑ Where the requests for access exceed the capacity of the Copernicus dissemination platforms, access to Copernicus resources may be reserved to specific user typologies (e.g. public services, industry, research organisations, ...)

- Sentinel-1A launch: spring 2014
- Sentinel-2 A launch: late 2014
- Sentinel-3 A launch: late 2014
- Data policy: free, full and open access