# GMES SENTINEL-3: A MISSION FOR OPERATIONAL OCEANOGRAPHY

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http://www.esa.int/GMES

## Background & Mission Objectives

The Sentinel-3 Mission (S-3) is part of the Global Monitoring for Environment and Security (GMES/Kopernikus) European initiative. S-3 is an operational mission in high-inclination, low-earth orbit designed to acquire global coverage microwave, optical and thermal data for operational oceanography and global land applications with near-real-time product delivery (< 3hrs). The S-3 mission implements 3 core missions to deliver continuity to existing ones:

- ♦ Ocean/land colour data, at least at the level of the Envisat/MEdium Resolution Imaging Spectrometer (MERIS) instrument
- ♦ Sea/Land Surface Temperature, at least at the level of quality of the Envisat/Advanced Along-Track Scanning Radiometer (AATSR) instrument
- ♦ Sea surface and land ice topography data at least at the level of quality of the Envisat Radar Altimeter (RA) system
- ♦ SPOT-Vegetation continuity products exploiting synergy between collocated data streams from optical instruments

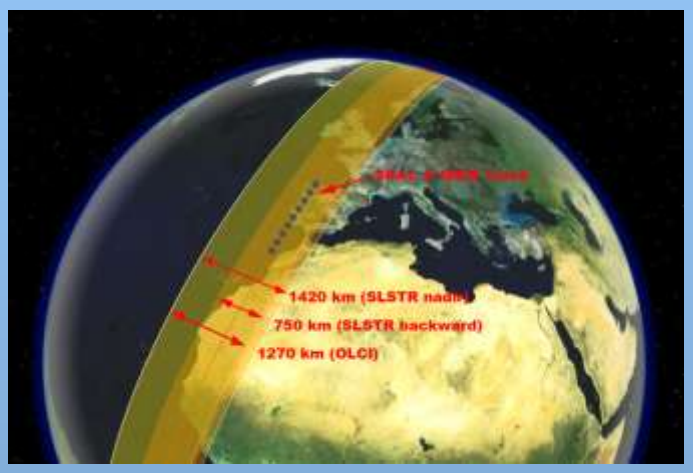
For oceanic applications, the S-3 mission will deliver continuity to existing ones ESAs ERS and Envisat missions with ocean/land colour data, sea/land surface temperature estimates and sea surface and land ice topography at least at the level of corresponding Envisat instruments, the Medium Resolution Imaging Spectrometer (MERIS) and the Advanced Along-Track Scanning Radiometer (AATSR) and the Envisat Radar Altimeter (RA).

### Optical Mission Payload

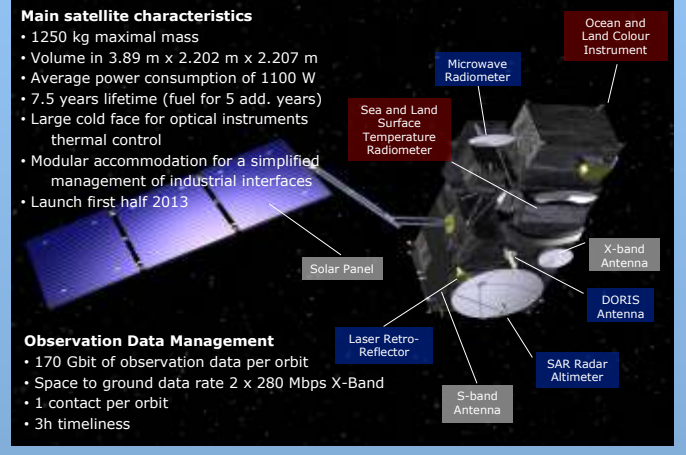
- Ocean and Land Color Instrument (OLCI)
- Sea and Land Surface Temperature Radiometer (SLSTR)

### Topography Mission Payload

- Ku-/C-band Synthetic Aperture Radar Altimeter (SRAL)
- MicroWave Radiometer (Bi-frequency)
- Precise Orbit Determination (POD) including
  - GNSS Receiver
  - DORIS
  - Laser Retro-Reflector




**Main satellite characteristics**
- 1250 kg maximal mass
- Volume in 3.89 m x 2.202 m x 2.207 m
- Average power consumption of 1100 W
- 7.5 years lifetime (fuel for 5 add. years)
- Large cold face for optical instruments thermal control
- Modular accommodation for a simplified management of industrial interfaces
- Launch first half 2013




**Observation Data Management**
- 170 Gbit of observation data per orbit
- Space to ground data rate 2 x 280 Mbps X-Band
- 1 contact per orbit
- 3h timeliness

## Marine & Land Services

Marine

| GMES Initial Service GMES | Sentinel–3 Requirement |
|---|---|
| Marine & Coastal Environment | sea-surface topography. mesoscale circulation. water quality. sea-surface temperature. wave height and wind. sediment load and Transport, eutrophication. |
| Polar Environment monitoring | sea-ice edge, concentration, extent and thickness, ice surface temperature. |
| Maritime Security | ocean-current forecasting water transparency. wind and wave height. |
| Global Change Ocean | global sea-level rise. global ocean warming. ocean $CO_2$ flux. |

Land

| GMES Initial Service GMES | Sentinel–3 Requirement |
|---|---|
| Global Change Land | forest cover change mapping. soil degradation Mapping. |
| Land Cover & Land Use Change | land use mapping Vegetation indices. |
| Forest Monitoring | forest cover mapping. |
| Flood Security Early Warning | regional land-cover mapping. drought monitoring. |
| Humanitarian Aid | land use mapping. |
| Air Pollution (Local to Regional Scales) | aerosol concentration. |
| Risk Management (flood & Fires) | burned scar mapping. fire detection. |

## Orbit Selection

**Key requirements for orbit selection :**

- **Sun-synchronous frozen orbit close to 800 km**
  - Required for continuity of optical observations
- **Topography mission requirements**
  - Repeat cycle > 20 days
    - needed for optimum Topography mission spatial sampling
  - Minimization of aliasing
- **Ocean Colour mission requirements**
  - 2-day global coverage with 2 satellites, 4 days with one
    - implies a sub-cycle of 4 days
  - Local time of observation shall be > 10 h to avoid morning haze
- **Sea Surface Temperature mission requirements**
  - Local time at node shall be < 11 h to avoid skin effects

| Orbit type | Repeating frozen SSO |
|---|---|
| Repeat cycle | 27 days (14 + 7/27 orbits/day) |
| LTDN | 10:00 |
| Average altitude | 815 km |
| Inclination | 98.65 deg |

## 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)

**Optical missions:** 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)**

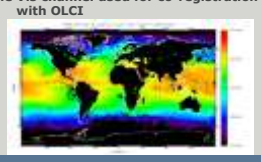
## SLSTR Overview

**Conical scanning imaging radiometer with dual view capability**
- Heritage from (A)TSR serie on ERS-1/2, ENVISAT

**Geom. Performance:**
- Nadir swath: 74° (1420 km typ)
- Dual view swath: 49° (750 km typ)
- Nadir swath covering OLCI swath

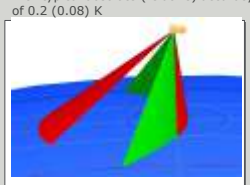
**Spectr. Performance: 9 spectral bands**
- Visible: 555 | 659 | 865 nm
- SWIR: 1.38 | 1.61 | 2.25 µm
- TIR : 3.74 | 10.85 | 12 µm

**One Vis channel used for co-registration with OLCI**



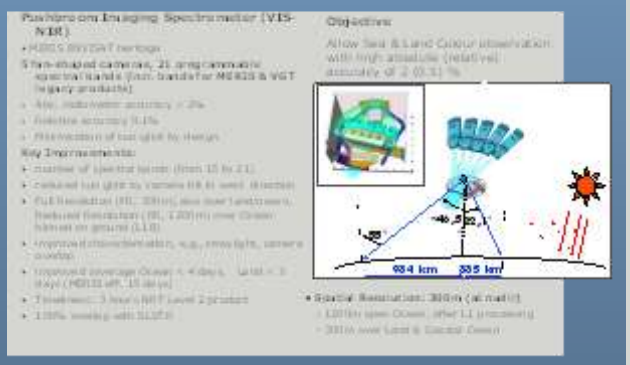
**Objective**

Allow Sea & Land temperature retrieval with typical absolute (relative) accuracy of 0.2 (0.08) K



**Innovation (compared to AATSR):**
- 3 instead of 1 mechanism, due to wider swath (2 scanners and one flip mechanism)
- More complex front-end & electronics (more channels)
- New detector technology, multiple pixels (higher resol.)

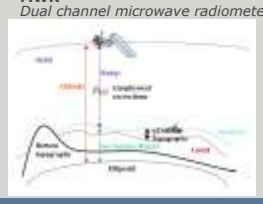
## OLCI Overview




## Topography Mission

- **Observed surfaces**
  - Open ocean, coastal ocean
  - Ice sheets (interiors and margins)
  - Sea ice
  - In-land water (rivers & lakes)

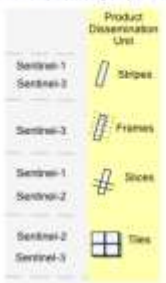
**Topography package:**
- **SRAL**
  *Dual frequency Ku/C band Radar Altimeter, with SAR mode and open loop tracking (CryoSat/Jason heritage)*
- **MWR**
  *Dual channel microwave radiometer*



- **Precise Orbit determination**
  - *GPS receiver*
  - *Doris navigation receiver*
  - *Laser retroreflector*

## Sentinels Core Products Approach 1/3 Products coverage

The Payload Data Ground Segments implement specific products apportionment in-line with mission characteristics, products data volume and compatibility with similar missions

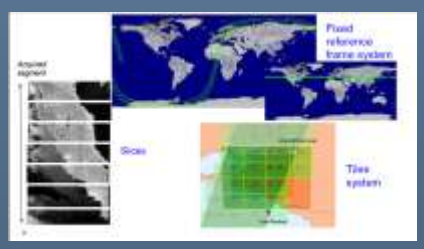



A stripe coincides either with a complete dump or large acquisition segment (e.g. pole to pole)

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 defined geographic projection




### Sentinel-3 Core PDGS Optical geophysical parameters list

## Sentinel-3 core PDGS Topography products

- **S3 topography products are inherited from the one currently generated for Jason-2 and ENVISAT missions.**
- **In addition, improvements obtained as part of recent studies (ESA/CRYOSAT, CNES/PISTACH, CNES/SLOOP, ESA/COASTALT, …) have been implemented in the detailed processing models.**
- **Production will be insured by PDGS ground segment. Marine products will be managed by EUMETSAT, Land products will be managed by ESA**