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sentinel-1

→ ESA'S RADAR OBSERVATORY MISSION FOR COPERNICUS OPERATIONAL SERVICES

sentinel-1

→ ESA'S RADAR OBSERVATORY MISSION FOR COPERNICUS OPERATIONAL SERVICES

Last update May 2017

MISSION OBJECTIVES

European polar orbiting radar observatory providing continuity of SAR data for operational applications. These applications include:

› monitoring sea ice zones and the arctic environment
› surveillance of marine environment
› monitoring land surface motion risks
› mapping of land surfaces; forest, water and soil, agriculture
› mapping in support of humanitarian aid in crisis situations

MISSION PROFILE

› Sentinel-1A launch date: 3 April 2014 on Soyuz from CSG (Kourou)
› Sentinel-1B launch date: 25 April 2016 on Soyuz from CSG (Kourou)
› Sentinel-1C and D launch readiness after 2020
› 7 years lifetime (consumables for 12 years)
› Sun-synchronous orbit at 693 km altitude
› Inclination: 98.18°
› Mean LST: 18:00h at ascending node
› 6-day repeat cycle at Equator with the two satellites
› 175 orbits/cycle each satellite
› 96h operative autonomy
› Max eclipse duration: 19 minutes

SATELLITE PLATFORM

› 3 axis stabilized, yaw/pitch/roll steering (zero Doppler)
› 0.01° attitude accuracy (3σ each axis)
› Right looking flight attitude
› 10 m orbit knowledge (each axis, 3σ) using GPS
› Spacecraft availability: 0.998
› Launch mass: 2300 kg (incl. 130 kg fuel)
› Solar array power: 5900 W (End-of-Life)
› Battery capacity: 324 Ah
› Science data storage capacity: 1410 Gbit (End-of-life)
› X-Band Payload Data downlink and Optical Payload Data downlink through EDRS for Payload Data at 520 Mbps;
› S-Band TT&C link with TC at 64 kbps and TM at 128 kbps and 2 Mbps

SATELLITE PAYLOAD

C-Band SAR

› Centre frequency: 5.405 GHz
› Polarisation: VV, VH, HH, HV
› Incidence angle: 20° - 45°
› Radiometric accuracy: 1 dB (3σ)
› NESZ: -22 dB
› DTAR: -22 dB
› PTAR: -28 dB

AIS Instrument for SAR data augmentation for marine surveillance applications (Sentinel-1C and D)

› Frequency Range: 156 – 163 MHz
› AIS Channels: 87B, 88B, 75 and 76
› AIS Message Support: ITU-R M. 1371-5

Four nominal operational modes designed for inter-operability with other systems:

› Strip Map Mode with 80 km swath and 5x5 m (range x azimuth) spatial resolution
› Interferometric Wide-Swath Mode with 250 km swath, 5x20 m (range x azimuth) spatial resolution and burst synchronisation for interferometry
› Extra-Wide-Swath Mode with 400 km swath and 20x40 m (range x azimuth) spatial resolution
› Wave Mode with 5x5 m (range x azimuth) spatial resolution leap-frog sampled images of 20x20 km at 100 km along the orbit, with alternating 23° and 36.5° incidence angles.

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sentinel-2

→ THE OPERATIONAL COPERNICUS OPTICAL HIGH RESOLUTION LAND MISSION

sentinel-2

→ THE OPERATIONAL COPERNICUS OPTICAL HIGH RESOLUTION LAND MISSION

Last update May 2017

MISSION OBJECTIVES

European wide-swath high-resolution twin satellites super-spectral imaging mission designed for data continuity & enhancement of Landsat and SPOT-type missions, for COPERNICUS operational land and security services. These applications include:

› land cover, usage and change-detection-maps
› geophysical variable maps (leaf chlorophyll content, leaf water content, leaf area index, etc.)
› risk mapping
› fast images for disaster relief

MISSION PROFILE

› Sentinel-2A launch date 23 June 2015 (CET) with VEGA from Kourou
› Sentinel-2B launch date 7 March 2017 (CET) with VEGA from Kourou
› 7 years lifetime (consumables for 12 years)
› Sun Synchronous Orbit at 786 km mean altitude
› Mean Local Time at Descending Node: 10:30
› Twin satellites on the same orbit, 180° apart from each other
› Global revisit time: 5 days with 2 satellites (3 days at 45° latitude)
› Land coverage: -56° to + 83° latitude
› Observation mode: ~40 min/orbit, nadir pointing
› Geo-Location: 20 m (3σ) without Ground Control Points
› 15 days of operative autonomy

SATELLITE PLATFORM

› 3 axis stabilized earth pointing
› Star tracker, inertial measurement unit and 2-band GPS receiver for precise attitude and position knowledge
› Propellant: 117 kg Hydrazine (N_2H_4), 60 kg margin
› Onboard attitude knowledge: <10 μrad (2σ)
› Launch mass: 1140 kg
› Satellite dimensions (Stowed): 3.4 m x 1.8 m x 2.35 m
› Electical power: Solar Array: 7.2 m^2, 1700 W (EOL)
› Satellite power consumption: 1.4 kW (nominal mode)
› Payload data storage capacity:
  › 2 Gbits (End-of-Life) TM/TC storage capacity;
  › 2.4 Tbit (EOL) mission data storage capacity
› Communication links:
  › X-Band Science Data transmission: 520 Mbps (8 psk);
  › Optical Communication Payload for mission data retrieval through EDRS at 600 Mbps;
  › S-Band TT&C: 64 kbps up with authenticated/ encrypted commands, 2018 kbps down
› Data rate: 490 Mb after on-board compression
› Thermal control: passive with Deep Space Radiator. Thermistor controlled Heater Circuits
› Reliability: > 0.7
› Availability: 97%

SATELLITE PAYLOAD

MSI (Multi Spectral Instrument)
› Imaging principle: filter based push broom imager
› Telescope design: Three mirror anastigmatic telescope with Silicon Carbide mirrors and structure, and dichroic beam splitter to separate VNIR and SWIR spectral channels
› Mass: 290 kg/ Power consumption: 250 W
› Electronics: front end, video and compression electronics, including state-of-the-art wavelet-based data compression
› Combination of on-board absolute calibration with a solar diffuser covering the full FoV, dark calibration over ocean at night, and vicarious calibration over ground targets
› 13 spectral bands: 443 nm– 2190 nm (including 3 bands for atmospheric corrections)
› Spectral resolution: 1 nm– 180 nm
› Spatial resolution: 10 m, 20 m and 60 m
› Swath: 290 km
› Radiometric resolution/accuracy: 12 bit / < 5%

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sentinel-3

→ COPERNICUS MEDIUM RESOLUTION LAND AND OCEAN MISSION

sentinel-3

→ COPERNICUS MEDIUM RESOLUTION LAND AND OCEAN MISSION

Last update May 2017

MISSION OBJECTIVES

European global land and ocean monitoring mission. It provides 2 day global coverage Earth observation data (with 2 satellites) for sea and land applications with real-time products delivery in less than 3 hours.
These services include applications such as:

› sea and land colour data, in continuation of MERIS (Envisat)
› sea and land surface temperature, in continuation of AATSR (Envisat)
› sea-surface and land-ice topography, in continuation of Envisat altimetry
› along-track SAR for coastal zones, in-land water and sea ice topography
› vegetation products through synergy between optical instruments

MISSION PROFILE

› Sentinel-3A launch date: 16 Feb 2016 on Rockot from Plesetsk & Sentinel-3B on Rockot from Plesetsk
› 7 year lifetime (consumables for 12 years)
› Sun-synchronous orbit @ 814.5 km over geoid
› Mean LST: 10:00 at Descending Node
› 27-days repeat cycle (14+7/27 orbits per day)
› Inclination 98.65º
› Operational configuration comprises 2 satellites

SATELLITE PLATFORM

› Gyroless, 3 axis stabilized platform with 3 star tracker heads, 4 reaction wheels and magnetic off-loading
› Geodetic pointing and yaw steering
› 8x1N hydrazine thrusters for in-plane & out-out plane manoeuvres
› 3 m accuracy real-time onboard orbit determination based on GPS and Kalman filtering
› Launch Mass: 1180 kg (with maturity and system margins, and fuel)
› Stowed dimensions (mm): (H) 3710, (W) 2202, (L) 2207
› Power: 2.1 kW rotary wing with 10 m^2 triple junction GaAs European solar cells; Li Ion Battery Capacity: 160 Ah
› Communication links:
› 64 kbps uplink, 1 Mbps downlink S-band command and control link (with ranging)
› 2 x 280 Mbps X-band science data downlink
› 384 Gbit solid state mass memory
› Autonomy: position timeline and onboard sun ephemeris for greater than 2 weeks nominal autonomous operations

SATELLITE PAYLOAD

OLCI (Ocean and Land Colour Instrument)
› Swath width: 1270 km, with 5 tilted cameras
› Spatial sampling: 300 m @ SSP
› Spectrum: 21 bands [0.4-1.02] µm
› Radiometric accuracy: 2% abs, 0.1% rel

SLSTR (Sea and Land Surface Temperature Radiometer)
› Swath width: 180 rpm dual view scan, 1420 km (nadir) / 750 km (backwards)
› Spatial sampling: 500 m (VIS, SWIR), 1 km (MWIR, TIR)
› Spectrum: 9 bands [0.55-12] µm
› Noise equivalent dT: 50 mK (TIR) at 270K

SRAL (Sentinel-3 Ku/C Radar Altimeter)
› Radar measurement modes: LRM and SAR
› Tracking modes: closed and open-loop
› Pulse repetition frequency: 1.9 KHz(LRM), 17.8 KHz (SAR)
› Total range error: 3 cm

MWR (MicroWave Radiometer)
› dual 23.8/36.5 GHz
› Radiometric accuracy 3K absolute (0.6 K relative)

POD (Precise Orbit Determination)
› GPS, LRR and DORIS (3 cm final accuracy after processing)

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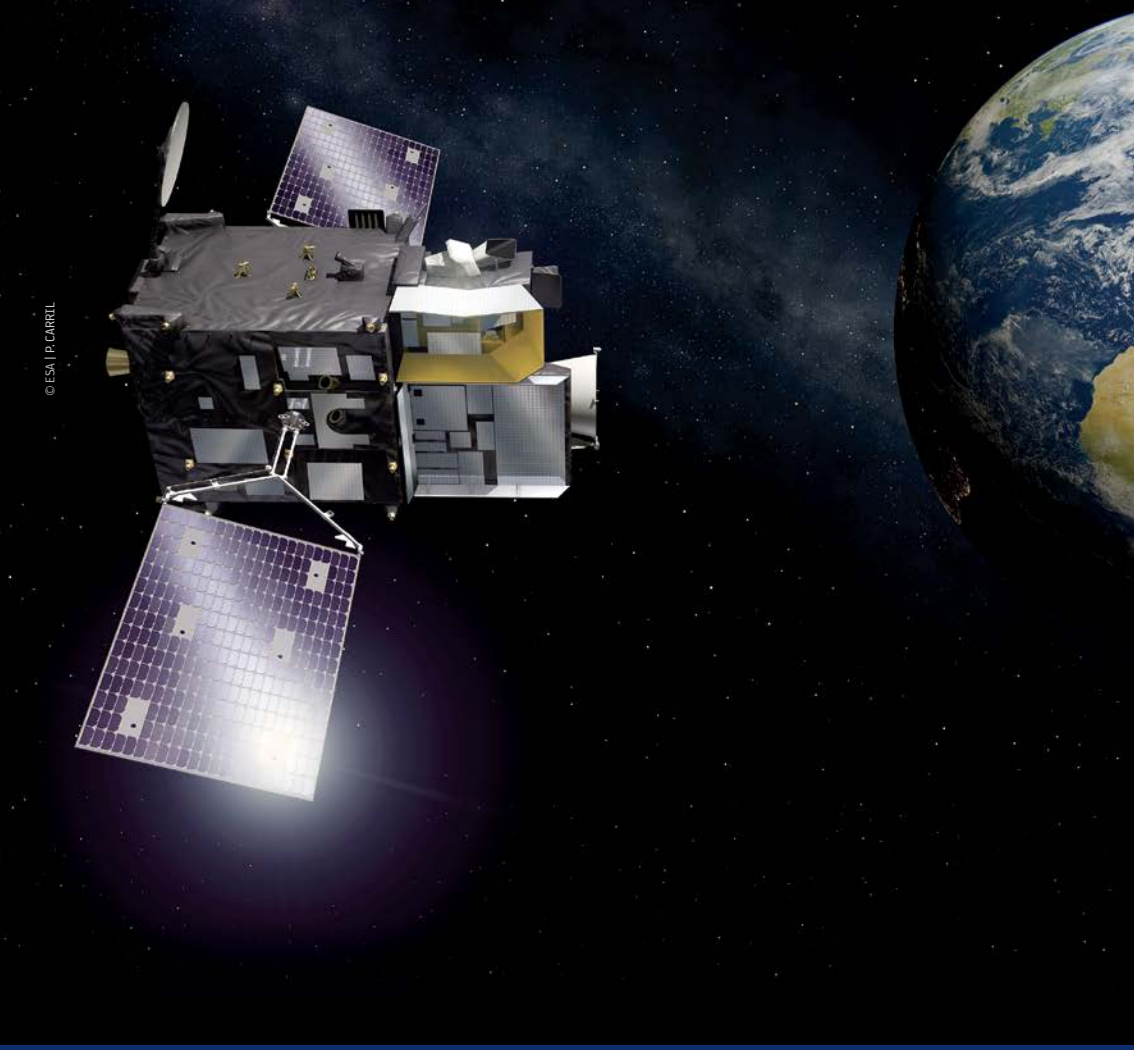
sentinel-4

→ COPERNICUS GEOSTATIONARY ATMOSPHERIC MISSION



sentinel-4

→ COPERNICUS GEOSTATIONARY ATMOSPHERIC MISSION

Last update May 2017

MISSION OBJECTIVES

The Sentinel-4 mission covers the needs for continuous monitoring from a geostationary orbit of the atmospheric chemistry in order to support air quality monitoring and forecast over the skies of Europe. The main data products will be O_3 (Ozone), NO_2 (Nitrogen dioxide), SO_2 (Sulfur dioxide), HCHO (Formaldehyde) and aerosol optical depth, which will be generated about every hour at a high spatial resolution.

The Sentinel-4 UVN instrument is a high resolution spectrometer covering the
› ultraviolet (305-400 nm),
› visible (400-500 nm)
› near-infrared (750-775 nm) bands.
The spatial resolution is 8 km while the spectral resolution in the three wavelength bands ranges between 0.12 and 0.50 nm.

MISSION PROFILE

Two Sentinel-4 instruments will be embarked respectively on two Meteosat Third Generation-Sounder satellites (MTG-S1 and MTG-S2).
Coverage of Europe and of North Africa (Sahara) is achieved by scanning an area of 8.8° East-West x 16.6° North-South (full angles, w/o margins) with a repeat cycle of about 60 minutes.

SATELLITE PAYLOAD

Number of units
The instrument will be composed of 3 units:
› the Main Optical Unit which contains the optical and detection chain
› the Instrument Control Unit
› the Scan Drive Electronics Unit

Instrument Characteristics
› Allocated mass: 200 kg
› Allocated mean power: 180 W
› Data Rate during acquisition = <30 Mbps
› Mission reliability = >0.75 @ 8.5 years

Imaging coverage and instrument field of view
From the MTG-S satellite, the accessible area is 8.8° EW x 16.6° N-S (full angles – w/o margins), assuming a 180°-satellite yaw flip by the MTG-S satellite. Because of the yaw flip of the MTG-S satellite every 6 months, the 2-axis mechanism will allow to point both the northern and southern hemisphere. The instrument has a N-S field of view of: 3.4° (instantaneous during acquisition).

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sentinel-5p

→ COPERNICUS LOW EARTH ORBIT ATMOSPHERIC MISSION

sentinel-5 precursor

→ COPERNICUS LOW EARTH ORBIT ATMOSPHERIC MISSION

Last update May 2017

MISSION OBJECTIVES

The Sentinel-5 precursor is a UV-VIS-NIR-SWIR spectrometer payload derived through tailoring of Sentinel-5 specifications, e.g. priority to spectral resolution, coverage, spatial sampling distance, signal-to-noise ratio and only high priority bands. It will bridge the gap between Envisat/EOS Aura and Sentinel-5.

It will provide measurements of elements of atmospheric chemistry at high temporal and spatial resolution. Also, it will increase the frequency of cloud-free observations required for the study of troposphere variability. In particular the Sentinel-5 Precursor mission is expected to provide measurements of O_3, NO_2, SO_2, CH_4, CO and aerosol.

MISSION PROFILE

› Lifetime: 7 years
› Orbit: sun-synchronous, 824 km
› Inclination: 98.730°.
› Repeat cycle: 16-days, 227 orbits repeat cycle
› Launcher: ROCKOT
› 72h operative autonomy

SATELLITE PLATFORM

› Astrobus L 250 M from Airbus Defence and Space
› 3 axis stabilised with yaw steering
› Launch Mass: 820 kg (incl. 82 kg fuel)
› Spacecraft Power: 1500 W (EOL), 430 W average power consumption
› Battery Capacity: 156 Ah
› Data Storage Capacity: 480 Gbit (EOL) using flash-memory technology
› Communication Links: S-Band TT&C with 64 kbps uplink and 128 kbps-1 Mbps downlink with ranging and coherency, X-Band Science Data downlink at 310 Mbps OQPSK
› Propulsion: Mono-propellant hydrazine

SATELLITE PAYLOAD

› Type: UV-VIS-NIR-SWIR push-broom grating spectrometer called TROPOMI
› UVN module of TROPOMI provided as a national contribution by the Netherlands
› Number of Channels: 4
› Spectral Range: 270-500 nm, 675-775 nm, 2305-2385 nm
› Spectral Resolution: 0.25-1.1 nm
› Observation Mode: Nadir pointing, global daily coverage, ground pixel 7x7 km^2
› Radiometric Accuracy: 2% approximately
› Mass: 200 kg
› Power: 120 W average
› Data Volume: 140 Gbits/orbit

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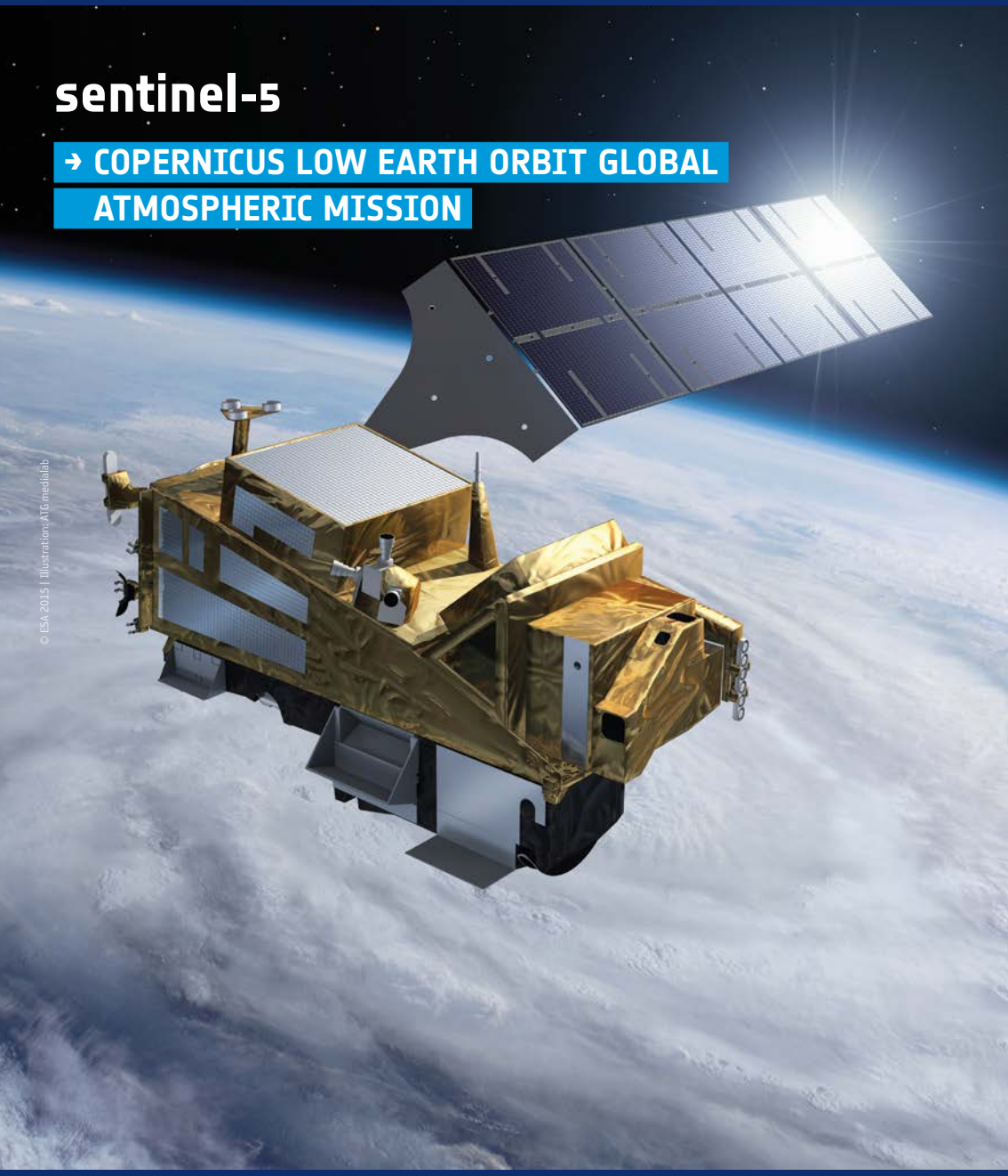
sentinel-5

→ COPERNICUS LOW EARTH ORBIT GLOBAL ATMOSPHERIC MISSION



sentinel-5

→ COPERNICUS LOW EARTH ORBIT GLOBAL ATMOSPHERIC MISSION

Last update May 2017

MISSION OBJECTIVES

The Sentinel-5 mission covers the needs for continuous monitoring of the atmospheric chemistry at high temporal and spatial resolution from a low-Earth orbit. The mission will provide coherent and long-term information on atmospheric variables in support of European policies and for the benefit of European citizens. The main data products will be O_3, NO_2, SO_2, HCHO, CO, CH_4 and aerosol optical depth, enabling services addressing global air quality monitoring and composition-climate interaction. In particular, it will provide daily analysis of the atmosphere at various space and time scales, key information on long range transport of atmospheric pollutants, initial and boundary conditions for air quality models and sustained monitoring of green-house gases, aerosols and reactive gases.

MISSION PROFILE

› The Sentinel-5 instrument will be embarked on the MetOp-SG satellite A.
› Global coverage is achieved with a daily revisit time.
› Orbit: 830 km Sun-synchronous, 98.701° inclination
› 29-day repeat cycle
› Mean Local Sun Time: 09:30 at the Descending Node
› Total number of models: 3, launched at 7 years interval
› Total mission operational lifetime: 21 years

SATELLITE PAYLOAD

Instrument Elements:
The instrument is composed of the following three units:
› the Instrument Optical Module which contains the optical and detection parts
› the Detection Support Electronics
› the Instrument Control Subsystem

Instrument Characteristics:
› Allocated Mass is 295 kg
› Allocated Average Power is 250 W
› Data Rate during acquisition <= 20 Mbps
› Mission reliability >= 0.75 @ 7.5 years

Instrument Coverage:
The Sentinel-5 instrument is a high resolution spectrometer, covering the following wavelengths bands:
› ultraviolet (270-370 nm),
› visible (370-500 nm)
› near-infrared (685-773 nm)
› short-wave infrared (1590-1675 & 2305-2385 nm)
The instrument consists of 5 spectrometers, in a push-broom configuration with a 108° instantaneous Field-of-View. The UV, Visible and Near-Infrared channels will be acquired using a set of three CCDs, while the Short-Wave Infrared channels will be acquired with two Mercury-Cadmium-Telluride active-pixel sensor arrays. The spatial resolution is about 7 km at Nadir and the spectral resolution ranges between 0.25 nm for the longest wavelengths and 1.0 nm at the shortest wavelengths.

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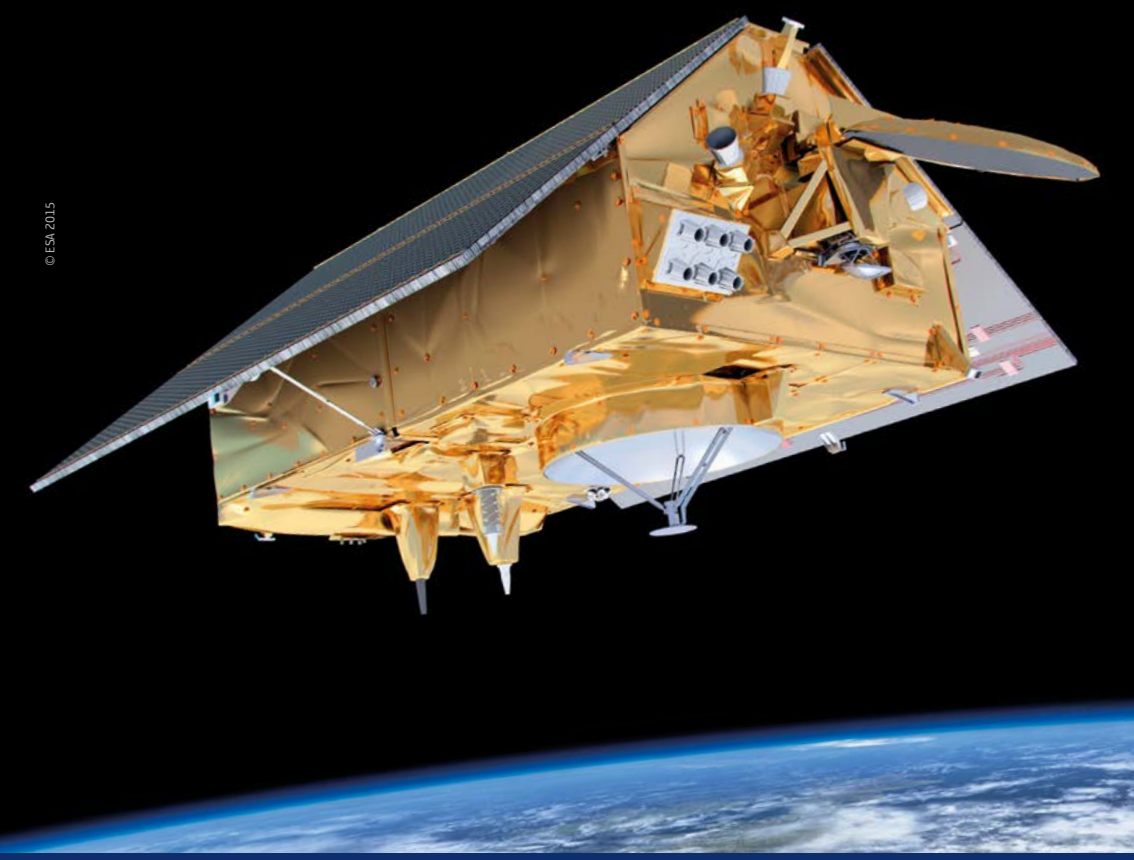
sentinel-6 (jason-cs)

→ OCEAN TOPOGRAPHY MISSION



sentinel-6 (jason-cs)

→ OCEAN TOPOGRAPHY MISSION

Last update May 2017

MISSION OBJECTIVES

Sentinel-6 will quantify and monitor sea level variability and the rate of sea level rise both globally and regionally to support marine meteorology and operational oceanography services.
It will be the reference mission in the CEOS virtual altimeter constellation and continue the long-term data series from the TOPEX/Poseidon, Jason- 1, Jason-2, and Jason-3 altimeters.

MISSION PROFILE

› LEO, non sun-synchronous orbit at 1336 km mean altitude
› 10 days repeat cycle with 66^0 inclination
› 5.5 years (including 6 months commissioning). Consumables for an additional 2 years
› Launch service procured by NASA for both A & B models

SATELLITE PLATFORM

Configuration based on CryoSat with most equipment mounted on nadir panel and increased solar array area using deployable flaps. Monopropellant propulsion system with 214kg fuel for orbit maintenance and perigee lowering at end of life (passive re-entry within 25 years).
› Dimensions (flight configuration) 5.30 m x 4.17 m x 2.35 m
› Mass 1440 kg
› Power 891 W average consumption
› Data volume: order of magnitude 1200 Gbit/day
› On-board storage by SSR 496 Gbits (beginning of life)
› X-band data downlink: 150 Mbps at 8.090 GHz
› S-band TTC link: 16kbps uplink, 32kbps/1Mbps downlink

SATELLITE PAYLOAD

Poseidon-4 (SAR Radar Altimeter): provides state of the art measurements for the retrieval of sea-surface height, wave height and wind speed. The new design of this radar altimeter represents a step improvement in performances over heritage altimeters.
AMR-C (Climate-quality microwave radiometer NASA-JPL contribution): used to derive total water column content used to correct the slowing of radar altimeter pulses. The design includes the capability, over heritage instruments, for high resolution retrievals close to the coastline and inland water bodies.
GNSS–POD Receiver: provides GNSS measurements for Precise Orbit Determination (POD) using signals from the GPS and Galileo constellations.
DORIS: provides data used for POD required for the altimeter retrievals and drives the timing of the Poseidon-4.
Laser Retroreflector Array (NASA-JPL contribution): used to allow satellite laser ranging facilities track the satellite as part of POD.
GNSS-RO (NASA-JPL contribution): measures the angle of GPS signals that bend (Radio Occultation) through the atmosphere. It generates profiles of tropospheric temperature, pressure and humidity as a function of altitude in the atmosphere.