THE SENTINEL-3 MISSION OVERVIEW

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1. INTRODUCTION

In the frame of the Global Monitoring for Environment and Security (GMES) programme ESA is currently implementing the Sentinel-3 mission [3], [4]. It is designed as a constellation of two identical polar orbiting satellites, separated by 180 deg, for the provision of long-term operational marine and land monitoring services. These services include the generation of land and ocean colour products, sea and land surface temperature, vegetation products and sea, ice and land surface topography. With a planned launch in 2013 of the first satellite, the Sentinel-3 mission will provide valuable information for scientists and policy makers in the European Union and its Member States for the next decades. The operational character of this mission implies a high level of availability of the data products and fast delivery time, which have been important design drivers for the mission.

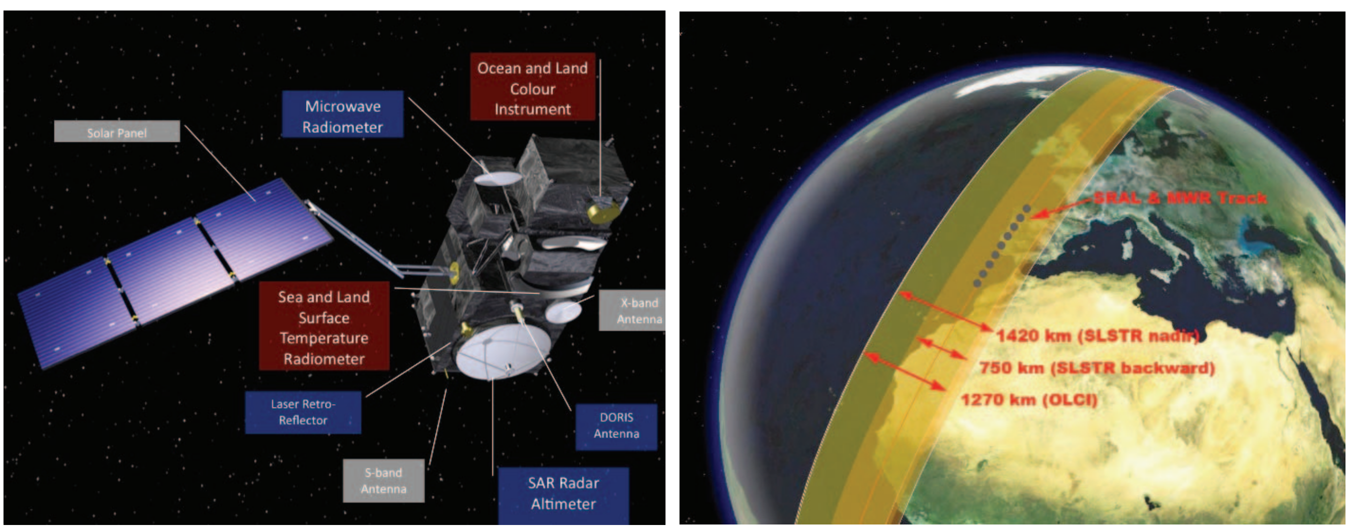

Figure 1: Payload on Sentinel-3 Satellte (left) and different instrument field of views (right)

2. MISSION CONCEPT

As payload, Sentinel-3 spacecraft accommodates two large optical instruments OLCI and SLSTR [1], and the Topography payload [2] consisting of a Radar Altimeter (SRAL) and a Microwave Radiometer (MWR) plus a suite of instruments for precise orbit determination (POD).

The obit selection was the result of a trade-off between the constraints imposed by all sensors, and namely:

- short revisit time for the optical instruments, which imposed an orbit sub-cycle of 4 days,
- long orbit cycle, implying short spacing between ground tracks, suitable for mesoscale ocean topography
- observations with sun illumination conditions similar to ENVISAT, for mission continuity.

This has been accomplished by two satellites simultaneously flying in the same orbit offset by ~180 degrees. The resulting orbit is polar, sun-synchronous (98.6 deg inclination), with a mean altitude of 815 km and a repeat cycle of 27 days (14+7/27 revolutions per day). The local time of the equator crossing (LTDN) is 10:00 a.m.

Sentinel-3 satellite, although carrying five main instruments, is a medium size spacecraft. Its estimated mass of 1250 kg and its height of less than 4 m, making it compatible with the VEGA launcher considered as baseline and Eurockot, as backup

3. TOPOGRAPHY PAYLOAD

The dual-frequency (C/Ku-band) nadir looking radar altimeter SRAL performs range measurements over different types of surfaces. While range measurements are sampled with the Ku-band frequency, the C-band observations are mainly used to correct for ionospheric effects. The instrument includes several measurement modes, calibration modes and support modes. The two measurement modes are a low resolution mode and an enhanced synthetic aperture radar mode. Each measurement mode can be operated either in closed-loop tracking for which the echo is tracked autonomously or in open-loop tracking where the a-priori knowledge of the tracking parameters over the targeted surface are provided in real time by the onboard precise orbit determination package. Finally, the instrument not only retrieves the classical parameters used in the oceanography field such as the Sea Surface Height, the Significant Wave Height and the sea wind speed but it also performs range measurements over the following surfaces: Sea ice, Ice sheet interiors (e.g. Antarctic plateau), Ice margins and In-land waters.

The microwave radiometer observations are used to correct the delay of the radar altimeter signal due to the water vapour contained in the Earths atmosphere. It operates at 23.8 GHz and 36.5 GHz covering a bandwidth of 200 MHz in each channel. The radiometer employs a single offset reflector of 60 cm in diameter and two separate feeds for the two channels. Calibration is achieved through a dedicated horn antenna pointing at the cold sky.

The POD package includes a high precision dual frequency GPS receiver, a Laser Retro Reflector and a DORIS instrument.

4. OPTICAL PAYLOAD

The primary mission objective of the optical payload /1/ is to ensure the continuation of the successful ENVISAT observations of MERIS (MEdium Resolution Imaging Spectrometer) for ocean colour and land cover and AATSR (Advanced Along Track Scanning Radiometer) for sea surface temperature. In addition, due to the overlapping field of view from both optical sensors new applications will emerge from the combined exploitation of all spectral channels. The combination of the orbit and the extended instrument swaths for two spacecrafts flying simultaneously achieve full ocean coverage within 1.9 days. (considering OLCI sun-glint, but not clouds). Land surfaces are covered in just 1.1 days by the common swath of both sensors.

The Ocean and Land Colour Instrument (OLCI) design has strong heritage from MERIS with additional and modified spectral channels, different camera arrangements and simplified on-board processing. OLCI is a push-broom imaging spectrometer, with 5 camera modules to cover the complete field-of-view (FOV) spanning over 68.6 deg. across the satellite track.

The Sea and Land Surface Temperature Radiometer (SLSTR), based on ENVISAT's Advanced Along Track Scanning Radiometer (AATSR), is designed to observe ocean and land surface temperatures with high accuracy. This requires the observation of a given zone in dual view, with different observation angles. On SLSTR, this is achieved by the implementation of two separate scan mechanisms, providing a large near-nadir swath and a smaller backwards-looking swath of 750 km. SLSTR accommodates 9 plus 2 additional channels, 3 in the visible and near infrared range, 3 in the short-wave infrared range, 1 in mid-infrared range and 2 in the thermal infrared range. The two channels allow Fire detection.

5. SPACECRAFT OPERATION AND DATA PROCESSING

The spacecraft routine operation will be highly autonomous in the sense that no frequent space to ground dialogue is required by the nominal missions of Sentinel-3, in particular, the Sentinel-3 mission does not require any specific request from a User.

All Sentinel-3 instruments are continuously in measurement or calibration modes. Only over the eclipse part of the orbit, all channels of OLCI and the VIS channels of SLSTR are automatically switched off. The different altimeter measurement modes for different surface types are commanded via an on-board stored Position Schedule, holding all commands necessary for a full repeat cycle of 385 orbits, which corresponds to approximately 27 days. The on-board Position Schedule also includes the commands to perform the downlink sessions in S- and X-band. S-band is used to communicate with the Command and Control station, while X-band is used to download all recorded measurement data to the baseline Core Ground station and to download to selected Local Ground stations measurement data recorded in their visibility.

In addition, a high level of autonomy for fault management is required for the satellite, in particular, no single-failure shall end the routine measurement phase. To fulfil this requirement, the satellite shall be able to localize the failed unit, to isolate it and to replace it with the redundant one. As a full autonomous reconfiguration is considered as risky, it is restrained to the platform units only, whereas any payload instrument subject to a failure is switched-off individually, and normal measurement mode is continued with the other instruments.

For the user community various types of data products will be disseminated: Level 1b,c and higher level products. In addition to classical calibrated and geo-located Top-Of-Atmosphere radiances values at Level 1b a new defined Level 1c synergy product of overlapping OLCI and SLSTR channels will be generated. This product will include accurate instrument-to-instrument co-registration information allowing the user any choice for a common output grid. Level 1c will be the basis for operational products like land surface reflection and aerosol estimates and opens the door for future synergy products e.g coastal applications. All Level 1 data is the baseline for all higher level processing enabling the generation of Level 2&3 products directly following the footsteps of ENVISAT and SPOT/VGT.

The timeliness of the data delivery will allow transmitting Level 0 to the Core Ground Station in less than 2 hours after acquisition. The generation of Level 1 products is regarded as near real time, being less than 3 hours. The required delivery times of Level 2 depend mainly on the user/service (e.g., forecasting centres or climate applications) and will be indicated at a later stage of the project.

CONCLUSION

GMES Sentinel-3 is a series of operational satellites that will guarantee access to an uninterrupted flow of robust global data products. Together with the other Sentinels, this mission will fulfil the monitoring needs of the GMES marine and land services and climate research communities. The improved design of the topography and the optical payload will ensure high quality RS data for the next decades to come.

6. REFERENCES

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