The Copernicus Sentinel-3 Mission: Getting Ready for Operations

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Sentinel-3 ESA development & operations teams
Sentinel-3A Status

S-3A Satellite on stand within the Acoustic Chamber at Thales Alenia Space in Cannes (Courtesy TAS-F)

Preparing the removal of the S-3A Satellite from the Thermal Vacuum Chamber at Thales Alenia Space in Cannes after testing (Courtesy of TAS-F)
Sentinel-3A Status

Platform readiness
- Sentinel-3A AIT progressing: Full satellite (including OLCI) integrated since early July 2014
- Mechanical and Thermal Test Campaigns successfully completed respectively by end 2014 and Q2 2015
- Alert on one component in SLSTR and MWR instruments which required preventive repair; completed for both SLSTR and MWR.

Payload readiness
- SRAL PFM instrument integrated on Satellite and tests complete.
- MWR PFM integrated on Sentinel-3A satellite.
- SLSTR FM2 integration into satellite completed after swap with un-calibrated PFM model.
- OLCI PFM re-integrated on Satellite after replacement of all OLCI-A cameras with those produced for OLCI-B (preventive measure following detection of a defective camera in Oct 2014 and risk of general issue not to be excluded)

Sentinel-3B Assembly, Integration and Test on-going
Launch Campaign

- S-3A to be launched from Plesetsk cosmodrome: launch confirmed for 10 December 2015

- Environmental and interfaces compatibility with Rockot successfully demonstrated during satellite environmental test campaign

- Export licenses for S-3A launch from Russia granted by relevant authorities

- Satellite transportation to Plesetsk has been booked, shipment ~end of October

- Detailed planning of the Launch campaign is finalised, last details depending on final launch date definition
Past months fundamental in defining the management and implementation of Copernicus Space Component and the Sentinels operations

1. Providing the overall context: EU Copernicus Regulation approved (applicable from 25 April 2014)
   - Establishes principle of a full, open and free data policy
   - Defines responsibilities for ESA and EUMETSAT
   - Defines the financial envelope for entire Copernicus context, i.e. services, in-situ and space components

2. Assigning roles to ESA and EUMETSAT:
   - EU-ESA agreement on implementation of Copernicus programme including transfer of ownership of the Sentinels (applicable from 1 Nov 2014)
   - EU-EUMETSAT agreement on the implementation of the Copernicus Programme including the transfer of ownership of certain assets (applicable from 7 Nov 2014)

NB: ESA and EUMETSAT share Sentinel-3 operations.
ESA and EUMETSAT share operational tasks

- **EU-ESA Agreement**
- **EU-EUM Agreement**
- **ESA-EUMETSAT coordination for the CSC operations**

**ESA**

- Operations, maintenance and evolution of
  - the Flight Operations Segment for LEOP and Commissioning phases
  - CSC shared multi-mission services (e.g. X-Band acquisition, POD)
  - the **Sentinel-3 Land Payload Data Ground Segment**
  - and Post-Launch space segment support activities

**EUMETSAT**

- Operations, maintenance and evolution of
  - the Flight Operations Segment for routine phase, including mission planning, and
  - EUMETSAT multi-mission (e.g. network) and specific facilities (e.g. processing, archiving, distribution) in support of the **Sentinel-3 Marine Payload Data Ground Segment**
ALL FACILITIES SUPPORTING S-3 GROUND SEGMENT ACTIVITIES ARE ESTABLISHED

Stations: Data Acquisition and Near Real Time Product Generation: Data downlink, data processing (NRT and offline)

For Sentinel-3: Svalbard

Processing and Archiving Centres (PAC): perform the Sentinels’ systematic non-time-critical data processing, the on-the-fly data processing for specific cases and the reprocessing in case of processing algorithms or calibration parameters upgrades.

For Sentinel-3: Archiving and offline processing centres
- DLR for OLCI processing and archiving
- CLS for SRAL processing and archiving
- ACRI for SLSTR and S-3 synergy products processing and archiving

EUMETSAT’s marine centre acts as PAC for marine products

Missions Performance Centre (MPC): Operational Quality Control, Expert Support Laboratories (ESL), Calibration and Validation

For Sentinel-3: consortium led by ACRI
**Sentinel-3: processing chains**

**OLCI Instrument**: Ocean & Land Colour L1B Products

**SLSTR Instrument**: Ocean & Land Colour Processing chain based on OLCI data, L1C: Hybrid processing chain based on combination of SLSTR and OLCI data, L2 Surface Temperatures Products

**SRAL Instrument**: Surface Temperature Processing chain based on SLSTR data, L2 Surface Topography Products

**MWR Instrument**: Topography processing chain based on altimeter radiometer and POD system data, L2 Surface Topography Products

**POD System**: L1C Synergy Products

**Synergy Products**: L1B Row

**Ocean & Land Colour L2 Products**: OLCI L1B

**SLSTR L1B**: SLSTR L1B

**L1C**: L1C

**Product delivery timeliness**:
- **Near-Real Time (< 3 hr)** availability of L2 products (and L1b)
- **STC/NTC** delivery of higher quality topography products
## Extending the S-3 core data product list

### EC requested to following changes to the baseline:

<table>
<thead>
<tr>
<th>Request</th>
<th>100% SAR</th>
<th>AOD/FRP</th>
<th>SYNERGY/LATENCY</th>
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<tbody>
<tr>
<td><strong>Focus on</strong></td>
<td>Operate SRAL in 100% SAR mode over land and ocean likewise (original baseline split LRM/SAR mode over land and ocean)</td>
<td>Provide both products operationally with certain resolution (pixel level), latency (NRT), format (BUFR, netcdf) etc</td>
<td>Improve latency for S-3 Synergy products (both full resolution products (SY_2_SYN) and reduced resolution (SY_2 VGP, SY_2_VG1, SY_2_V10) with a commitment of availability within 24 hours.</td>
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<td><strong>Status</strong></td>
<td><strong>Approved</strong></td>
<td>ESA and EUMETSAT agreed on updated technical implementation, with EC at present.</td>
<td><strong>Approved</strong></td>
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<td><strong>Schedule</strong></td>
<td>S-3A ramp-up, with the objective is to be ready to support the S-3A routine operations phase.</td>
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<td><strong>Implementation</strong></td>
<td><strong>S-3 will be the first mission to provide 100% SAR altimetry coverage!</strong> Implementation foresees also release of additional L1 data products</td>
<td><strong>TBD</strong></td>
<td>Orbital data products in 24h using forecasted aux files; Composite products in 72 hours latency guaranteed, 48 hours on best efforts basis</td>
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E1 Commissioning Phase

def today

Cal/Val Phase E1 Preparation

LAUNCH

SIOV check point

Instruments performance checkpoint

Cal/Val phase E1

Optical Instruments Calibration

Topo Instruments Calibration

Optical Products Initial Validation

Topo Products Initial Validation

Def Implement Rehearsal

6 months 6 months 2 weeks 4.5 months
Phase E1 data provision

Cal/Val (E1)

Starts with Instrument availability

Characterization of instrument performance
- Includes L0 and L1 products verification
- Initiate some L2 products Validation

IOCR
- Confirmed Satellite and Instrument performance
- Handover the responsibility to the Mission Manager

SIOV

Instr. performance Product verification
mid term Initial Product Validation

PDGS Commissioning

Starts with Mission data availability

Provides the products needed for Satellite Commissioning - Cal/Val (E1)

Gradual ramp-up of all products in early phase

L0 and L1 data from Payload for Cal/Val

L2 product verification and validation
Continuous product validation
Sentinel 1/2/3 Toolboxes

- Multi-mission Scientific Toolboxes
- Developed as open source software
- Common architecture
- Portable to a Cloud infrastructure

Download https://sentinels.copernicus.eu

STEP (Science Toolbox Exploitation Platform)

- EO science collaborative platform
- Technical forum and community animation
- Gathering user feedback and usage
- Communicating on results
- Cloud demonstrator (e.g. Land Training 2015)

Under preparation at http://step.esa.int/
Interaction with users: Data quality
The Copernicus Space Component Ground Segment data access is ensuring that all Sentinels core products are accessible to all users online.

- List of Sentinel baseline core products published in Sentinel Online portal
- Sentinel-1 data available since October 2014
- Sentinel-2 data planned for release in October 2015

Access to Sentinel products is made available via dedicated data hubs

- User can self-register to the data hubs
- All core products of the last 12 months of data is accessible via “rolling archives”
- Data download via terrestrial network (output rates up to 10 Gbps)

In addition, access to full Sentinels long-term archive will be made progressively available to all users online (when removing products from data hubs rolling archives)

- no gap in online products availability
For ESA:

- Data access system in operations since October 2014
- Open and free Sentinel-3 data access will follow same principle as for other Sentinels (e.g. S-1, S-2, S-5 Precursor), with different access routes depending on user typology

- **Sentinel Open Access Data Hub (simple online self registration)**
  - Dedicated access for Copernicus Core services
  - Dedicated access to Member States Collaborative Ground segment
  - Dedicated access to International Agreements

[link to site: sentinels.copernicus.eu]
Open & Free ‘Science and Other’ Data Access – In Operations

- Open and Free access
- Terms and Conditions for Sentinel data use and distribution published
- Self Registration and Sample Products open since Sentinel-1A launch
- Routine Data flow for S-1 opened on 3rd October 2014, S-2 data release planned for October 2015
- Rolling Archive:
  - In routine phase, at least the last 2 months of all Sentinels core products will be always available
  - Today ~12 months of data available, no data deleted
- Restriction of 2 concurrent downloads to ensure bandwidth availability for all users
- Automatic download through scripts
MAIN MESSAGES

- Readiness of Sentinel-3A platform and instrument integration and testing on track for a launch in November 2015
- Sentinel-3B readiness advanced, on track for a launch approx. 18 months after the A model
- EU-ESA and EU-EUMETSAT agreements signed and in place now, providing full coverage for S-3 mission operational costs and programmatic frame for joint operations between ESA and EUMETSAT
- All ground segment facilities supporting the Sentinel-3 operations are in place
- EC issued some change requests to mission baseline (SRAL 100% SAR operations; additional products: AOD, FRP; SYN within 24 h), which are presently under investigation and implementation
- Preparation for commissioning phase being finalised.
- ESA Data dissemination infrastructure in place and operational since October 2014. The ESA approach adopted for Sentinel-3 will follow same route as for other Sentinels (S-1, S-2, S5P)