# *Sentinel-6 Validation Team Call*

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## *Change Record*

| *Version* | *Date* | *Description of Changes* |
|---|---|---|
| 1 | 18/11/2019 | Initial version for review by MPWG |
| 1A | 22/01/2020 | Version with revisions by MPWG |
| 1B | 23/01/2020 | Version coordinated by EUMETSAT and ESA. |
| 1C | 06/02/2020 | Removed unrelated references |
| 1D | 17/02/2020 | Updated Figure 1; removed “Jason-CS” where applicable; added ALT L1 PFS as reference document |

# *Table of Contents*

# 1 INTRODUCTION

This document sets out a joint EUMETSAT-ESA Call for a Sentinel-6 Validation Team (S6VT) to provide external validation inputs to the Sentinel-6 Mission. It defines the purpose of the team, the expectations from S6VT members, sets out the boundaries for data provision, and presents the mechanisms and roadmap to initiate the Call.

A template for prospective members of the S6VT to submit their proposed activities and request membership of the S6VT is provided. Finally, a schedule and points of contact for this call are presented.

## 1.1 Purpose of the S6VT

EUMETSAT-ESA seek the involvement of the altimetry scientific community with experience in conducting scientific verification and validation of Sentinel-6 type data, field experiments and campaigns.

The aim of this call is:

*"To engage world-class expertise and activities, through mutual benefit collaboration, that support the implementation of the Sentinel-6 validation activities and ensure the best possible outcomes for the Sentinel-6 Mission".*

This call is open to relevant and interested groups and individuals worldwide; group responses are particularly welcome.

The S6VT will be an international body with people being selected from this specific S6VT call, or from a similar call from NASA/NOAA (ROSES OSTST) specifically issued to select US proposals, or from a similar call from CNES (TOSCA). Because existing NASA, NOAA and CNES ROSES/TOSCA calls already included requests for validation support of Sentinel-6, researchers successfully funded under those existing teams will be invited to join the S6VT, until new ROSES/TOSCA selections are made.

## 1.2 Reference Documents

| | | |
|---|---|---|
| RD-1 | Sentinel-6 End User Requirements Document (EURD) | EUM/LEO-JASCS/REQ/12/0013, issue v3E |
| RD-2 | Cal/Val Concept Plan | ESA JC-PL-ESA-MI-0500, issue 2 rev 1 |
| RD-3 | Jason-CS/Sentinel-6 ALT Level 2 Product Format Specification (L1 ALT PFS) | EUM/LEO-JASCS/SPE/17/899201, issue 4 |
| RD-4 | Jason-CS/Sentinel-6 ALT Level 1 NetCDF Dump | EUM/LEO-JASCS/SPE/17/947129, issue 4 |
| RD-5 | Jason-CS/Sentinel-6 ALT Level 2 Product Format Specification (L2 ALT PFS) | EUM/LEO-JASCS/SPE/17/901187, issue 4 |
| RD-6 | Jason-CS/Sentinel-6 ALT Level 2 NetCDF Dump | EUM/LEO-JASCS/SPE/17/957846, issue 4 |
| RD-7 | Jason-CS/Sentinel-6 Generic Product Format Specification (GPFS) | EUM/LEO-JASCS/SPE/17/897975, issue 4 |

# 2 BACKGROUND

## 2.1 The Sentinel-6 Mission

Sentinel-6 is a collaborative Copernicus mission implemented and co-funded by the European Commission, the European Space Agency (ESA), EUMETSAT and the US, through NASA and the National Oceanic and Atmospheric Administration (NOAA), with support from CNES.

The two successive Copernicus Sentinel-6 satellites (A and B), to be launched in November 2020 and 2025, will fly the same specific non-synchronous low-Earth orbit as the series of European/US TOPEX/Poseidon and Jason satellites to continue the high-precision ocean altimetry mission delivered for more than 27 years. The initial Europe-US partnership involved NASA and CNES, through TOPEX/Poseidon, then NOAA and EUMETSAT became involved when the mission gained operational status with Jason-2. The Jason-3 mission already involved the European Union, which funds its European operations through the Copernicus Programme, and ESA, which contributed financially to the development of the Jason-3 satellite.

Both Copernicus Sentinel-6 satellites will thus provide, until at least 2030, the most accurate source of observations of the mean sea level and ocean circulation and the reference altimeter observations against which other altimeter measurements, such as those from Sentinel-3, will be calibrated.

The Copernicus Sentinel-6 mission will extend the unique climate record initiated in 1992 by the TOPEX/Poseidon mission (1992-2006) and continued by Jason (2001-2013), Jason-2 (2008-2019) and Jason-3, launched in 2016.

The Sentinel-6 mission is an operational mission on the reference repetitive orbit from the TOPEX/Jason series. The core payload of the Sentinel-6 mission is the Poseidon-4 (synthetic aperture radar altimeter), supported by the AMR-C (climate quality advanced microwave radiometer). Precise Orbit Determination relies on a DORIS receiver (Doppler Orbitography and Radiopositioning Integrated by Satellite), a GNSS receiver (Global Navigation Satellite System) and a LRA (Laser Retroreflector Array).

The main improvements with respect to previous altimetry missions is the interleaved mode for the altimeter allowing simultaneous measurements in Low Resolution Mode (LRM) and SAR mode and an improved microwave radiometer specifically designed to fulfil mission requirements on the wet tropospheric correction.

Like its predecessors, the Sentinel-6 satellites will fly on a non sun-synchronous orbit at a mean altitude of 1336 km, with an inclination of 66° and a repeat cycle of 10 days. Notably, a12 month tandem phase with Sentinel-6 and Jason-3 will be conducted at the start of the mission to fully characterise the relationship between the two missions in support of the long-term climate record and maintenance of the altimetry reference mission status.

## 2.2 Overview of early Mission timeline

The Sentinel-6 Mission is expected to be launched in November 2020 and will enter a up to 12-months satellite commissioning phase (Phase E1) followed by a routine operations phase (Phase E2) for the remainder of its operational life. Phase E1 will conclude with an In-Orbit Commissioning Review (IOCR) that marks the formal transition to the routine operational Phase E2. Figure 1 provides an overview of the Sentinel-6 Commissioning phase between Launch and IOCR (and the continuation into the routine E2 phase) that indicates all major sub-phases with their main activities, target dates for products dissemination to S6VT and verification workshops.

Formal intermediate technical check-points are also foreseen in Phase E1 to summarise and review the achievements at earlier stages.

Pre-launch activities include all Sentinel-6 Satellite and launch campaign activities after the Flight Acceptance Review (FAR) until lift-off. During this phase of the mission preparation, rehearsals for validation activities are expected to take place (e.g., data acquisition coordination, data flow tests, test of read code, planning of campaigns etc).

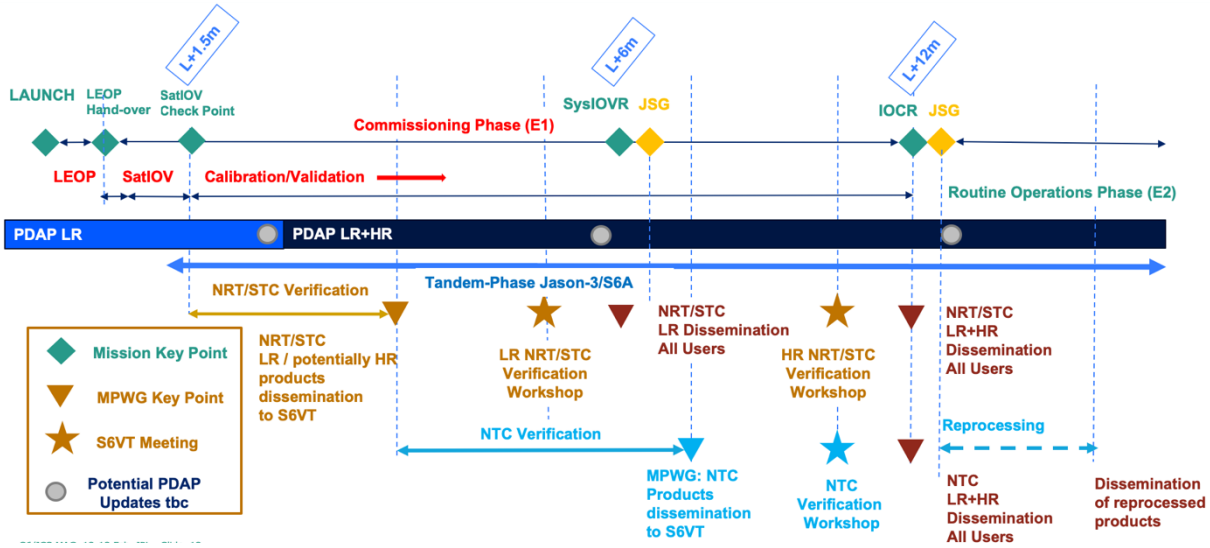


***Figure 1: Sentinel-6 A commissioning phase (E1) timeline overview and start of Routine Operations Phase (E2) highlighting key events and expected data availability.***

The E1 Commissioning Phase includes three major sub-phases:

1. The Launch and Early Orbit Phase (LEOP): nominal duration 3 days. This covers launch, satellite acquisition and attitude control, normal mode health checks, etc.
2. The Satellite (spacecraft and instruments) In-Orbit Verification (SIOV) phase: expected duration is 1.5 months. During SIOV a systematic and incremental verification of all nominal platform and payload functionalities will take place together with a full characterization of the satellite resources (e.g. pointing, attitude, power, etc.) to support the mission objectives. Payload instruments will be switched ON and tested and limited (Level 0 and Level 1B) data flows established.
3. The instrument calibration, product verification, and initial product validation (Cal/Val-E1) phase: duration up to 10.5 months. Payload instruments will be active with increasing access to Level 0, Level 1B and Level 2 data flows in Near Real Time (NRT), Short Time Critical (STC) and Non Time Critical (NTC) that are essential for all validation activities.

The IOCR milestone concludes the Commissioning Phase for Sentinel-6A. In consultation with the partners, this review shall:

- Confirm the status of the Sentinel-6A satellite and the supporting multi-partner ground segment ready for routine operations;
- Confirm mission products performances and stability and endorse the baseline of public disseminated Sentinel-6A operational products;
- Confirm readiness of the Sentinel-6A to become the new operational reference mission.

Following successful IOCR and close-out of Phase-E1, the Mission then enters a routine phase E2 during which the services of Sentinel-6 will be fully operational. Validation activities during this phase of the mission will consider all products over all timescales and all regions. It is anticipated that validation activities, together with on-going system and data monitoring, will continue throughout the mission lifetime, nominally 5.5 years after IOCR.

## 2.3 Main meetings

Three S6VT meetings are planned pre-launch and during the Commissioning phase:

- S6VT prelaunch meeting (October 2020): where the new selected S6VT members will meet for the first time and present their contribution to the validation activities; where EUMETSAT will deliver information on the foreseen products (content, format, access) and a consolidated timeline for commissioning activities;
- S6VT NRT/STC verification workshop (5 months after launch): where the S6VT members will report on the quality of the NRT/STC products (LRM and potentially SAR);
- S6VT NTC verification workshop (11 months after launch): where the S6VT members will report on the quality of the NTC products (LRM and SAR). The outcome of this meeting will support the preparation of the IOCR.

# 3 SPECIFIC OBJECTIVES OF THE CALL

The intention of this call is to create a Sentinel-6 scientific validation team, called the S6VT, to provide structured coordination of the international activities that contribute to Sentinel-6 validation.

The S6VT will bring together world-leaders in relevant mission validation activities to provide independent validation evidence, experimental data and recommendations from such work that will be reported formally to EUMETSAT and ESA to characterise the quality and performance of the Mission. Specifically, under this call, the Agencies seek the interest of institutes, research groups and scientists with expertise to address the following:

- Altimeter validation experiments and support of calibration activities;
- Microwave radiometer validation experiments and support of calibration activities;
- Precise Orbit Determination (POD) validation experiments and support of calibration activities;
- Level 1 and Level 2 product validation experiments and support of calibration activities.
- User product development and detailed investigation of Level 1 and Level 2 processing algorithms.
- Proposal for evolution of Level 1 and Level 2 processing algorithms and ancillary models.

A description of proposed validation contributions, the approaches and experiences to address these areas forms part of the response to this call.

# 4 FUNDING

There will be no EUMETSAT or ESA funding under this call. Applicants should secure their own funding.

# 5 OVERVIEW OF VALIDATION TEAM ACTIVITIES

Members of the S6VT will be expected to play an active role in Sentinel-6 products and processing validation. Members of the S6VT may expect to participate in some, or all, of the following activities:

- Integration of their proposed work within a wider scientific and technical framework, and the establishment of collaborative linkages between specialists within and external to the S6VT sub-groups.
- Participation in the establishment of detailed validation planning for the Commissioning phase (E1) and operations/routine phase (E2) well in advance of the S6 launch.
- Support the Sentinel-6 EUMETSAT and ESA teams during the Sentinel-6 In-Orbit Commissioning activities, especially to prepare the IOCR, which will be held approximately 12 months (TBC) after launch.
- Participation in post-launch data product and retrieval algorithm validation, and on-going monitoring of satellite performance and data quality.
- Recommendation for specific satellite related operations required for special validation activities agreed by the Agencies.
- Support the Agencies in the definition, in the light of post launch experience, of reprocessing algorithms to be applied to the Level 1 and Level 2 products.

# 6 DATA PROVISION

Members of the S6VT will have access to a range of Sentinel-6 data products, according to a ramp-up scenario following the launch and early operations phase (see Figure 1). During phase E1 and phase E2 (exploitation phase), data access will be guaranteed to S6VT members through agreed mechanisms.

*Selected S6VT members will get privileged access to Sentinel-6 data during the Commissioning phase in order to support the project activities performed by the Sentinel-6 partners. They will not be allowed to release any Sentinel-6 data or analysis thereof or publish their work before the announced date of public dissemination of the products to all users.*

In some cases, a proposed activity may require access to other, third party data whose supply is beyond the capability of the proposers. Provision of EUMETSAT and ESA third party mission data is foreseen within the existing constraints and data policy restrictions. While the Agencies cannot generally undertake to supply all data, proposers are requested to identify such data, so that, during the planning phase, the S6VT and Agencies may, where possible, provide support for data access.

As part of the proposal submission, applicants are required to indicate their needs for satellite data products. S6VT members may be requested to refine these data requirements as part of the planning activity taking account the relevant operational constraints.

The baseline of products to be made available to the S6VT members is provided in Figure 2, and data volumes can be found in [RD-4] and [RD-6].

| Product | Latency | Format | Data Access |
|---|---|---|---|
| ALT Low Resolution (LRM) | NRT | BUFR | L2 |
| | | NetCDF | L2 |
| | STC | NetCDF | L1b, L2 |
| | NTC | NetCDF | L1b, L2 |
| ALT High Resolution (SAR) | NRT | BUFR | L2 |
| | | NetCDF | L2 |
| | STC | NetCDF | L1a, L1b, L2 |
| | NTC | NetCDF | L1a, L1b, L2 |
| MWR | NRT | NetCDF | L2 |
| | STC | NetCDF | L2 |
| | NTC | NetCDF | L2 |

Note: ALT Level 2 NetCDF products: reduced (1-Hz only) and standard (1-Hz and 20-Hz)

***Figure 2. Products available to S6VT users during Commissioning.***

# 7 ORGANISATION

The implementation of the Sentinel-6 Validation Team will be as follows:

1. Publication of the S6VT Call at the ESA EOPI web site (https://earth.esa.int/aos/S6VT)
2. Submission of proposals explaining the scope of proposed validation activities and associated data requirements.
3. Internal panels of EUMETSAT and ESA will review all proposals for this call to confirm that the proposal is of sufficient quality and relevance.
4. Confirmation that proposals have been accepted in coordination between the collaborating project partners.
5. A collaborative agreement will be established with the Validation Team members formalising the terms and conditions of the collaboration.
6. In coordination with the Agencies, the S6VT will plan and execute validation and support the on-going monitoring of the Sentinel-6 satellite system and data products working with the Sentinel-6 Cal/Val Concept Plan [RD-2].

## 7.1 Rolling Call

The call will be implemented as a rolling call with distinct deadlines for proposal submissions on a regular basis. The call is designed this way to provide the widest opportunity for the S6VT to engage with the mission. Proposals will be reviewed and those accepted by the project scientists of the EUMETSAT and ESA partners, will be added to the register of approved validation activities for Sentinel-6 that will be maintained by the Agencies. The register will be open to all so that it can be used as a resource to foster better integration and collaboration between validation teams and the Agencies' activities.

The Call will include at least the following documents:

1. The Call Text (this document)
2. Sentinel-6 EURD [RD-1]
3. Sentinel-6 Cal/Val Concept Plan [RD-2]
4. Sentinel-6 Format Specifications [RD-3 through RD-7]

The call will be published on the S6VT web site at www.s6vt.org with detailed submission via https://earth.esa.int/aos/S6VT

## 7.2 Proposal Submission and Guidelines

Detailed submission guidelines are available at https://earth.esa.int/files/S6VT_Guidelines . Proposals shall be submitted in electronic format using the template provided at https://earth.esa.int/aos/S6VT and printed in Section 9 of this document.

## 7.3 Evaluation criteria

Internal panels of EUMETSAT and ESA will review the proposals received in response to this call and recommend acceptance, with a final decision taken by the joint Sentinel-6 Mission Management Team. The following criteria will be used in the evaluation of all proposals:

a) Relevance of the proposed project to the objectives of Sentinel-6 validation and/or retrieval activity;

b) Scientific quality and integrity of the proposed work;

c) Collaborative benefit derived from participation as S6VT member;

d) Feasibility and probability of success;

e) Credibility of proposed underlying financial support and available infrastructure.

## 7.4 S6VT Call Schedule

| *Date* | *Activity* |
|---|---|
| February 2020 | Opening of the call |
| 31 April 2020 | Deadline for submission of first proposals |
| May 2020 | Notification of evaluation results to the S6VT |
| TBD 2020 | First S6VT meeting coordinated by Project Scientists at EUMETSAT |

# 8 FURTHER INFORMATION

Further information regarding this call may be found on the Web site dedicated to the Sentinel-6 Validation Team call and can also be obtained from the ESA EO Help Desk.

## 8.1 EUMETSAT contact

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## 8.2 ESA contact

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# 9 TEMPLATE FOR S6VT VALIDATION TEAM CALL PROPOSAL SUBMISSION

| | |
|---|---|
| **Validation Project Title and acronym**<br>*Short title and acronym if relevant* | |
| **1.0 S6VT Lead team member name and address**<br>*Name of organisation, institution, company* | |
| **1.1 Support team member names and addresses [0..n]**<br>*Name of Support team member Name of organisation, institution, company, consortium* | |
| **1.2 Description of the team**<br>*Summary of the team composition and its strength* | |
| **2.0 Executive Summary of activity (500 words)**<br>*Include: problem to be addressed, team description, approach taken and expected outcomes* | |
| **3.0 Introduction and Background**<br>*Relevance of the proposed activity to the objectives of Sentinel-6 validation and/or retrieval activity* | |
| **3.1 Statement of the validation activity**<br>*Clear statement of the problems to be addressed by the team in relation to Sentinel-6 verification and validation (link to relevant EURD)* | |
| **3.2 Aim and Objectives**<br>*Single aim statement and supporting objectives to reach the aim* | |
| **3.3 Scientific Approach**<br>*Overview of the top-level approach taken* | |
| **3.4 Scientific Methodology**<br>*Describe the proposed methodology to perform the work (e.g., field experiments, availability of and interdependencies from other data sources, infrastructures, etc)* | |
| **4.0 Data**<br>*General overview of data requirements* | |
| **4.1 Sentinel-6 Data required**<br>*Access to Sentinel-6 core data products, area of interest (global, specific region) and timeline (rough order of magnitude for data volume to be provided);* | |
| **4.2 Third Party Mission (TPM) Data Required**<br>*Access TPM data products, area of interest and timeline (rough order of magnitude for data volume to be provided)* | |
| **4.3 Other EO data**<br>*Please list any other EO data you plan to use* | |
| **4.4 Validation Data to be collected**<br>*Summary of in situ and other validation data that will be collected during the project* | |
| **5.0 Expected Results and outcomes from the work**<br>*Clear statements of expected outcomes from the activity* | |
| **6.0 Planning**<br>*Summary overview of planning* | |
| **6.1 Proposed schedule** | |

| | |
|---|---|
| *Please provide a schedule for the project starting before the Mission launch* | |
| **6.2 Availability of (e.g. national) funding**<br>*Please describe funding that you plan to use for this activity* | |
| **6.3 Availability of supporting infrastructure and data sources**<br>*Please describe supporting infrastructures/groups and data* | |
| **6.4 Risk analysis**<br>*Please provide a top-level list of the critical risks for the activity* | |
| **7.0 Tools**<br>*Please list any supporting tools and processing software: processors, toolboxes, on demand processing infrastructure (e.g. GPOD), network, interfaces, access to other than Sentinel-6 data for validation activities.* | |
| **8.0 Collaborative benefit derived from participation as S6VT member**<br>*Please explain the benefits that you see to being part of the S6VT.* | |
| **9.0 Feedback to Agencies**<br>*Summary of expected results to be reported to EUMETSAT and ESA on regular basis in shape of reports, cal/val data, and attendance to validation meetings* | |