COPERNICUS POD PRODUCT HANDBOOK

3RD GENERATION OF THE COPERNICUS PRECISE ORBIT DETERMINATION SERVICE (CPOD3)

Prepared by: X Digitally signed by Miguel Ángel Muñoz de la Torre Date: 2023.10.17 10:07:52 +02'00'

CPOD Team
Project Engineer

Approved by: X

J. Aguilar
Quality Manager

Authorised by: X Digitally signed by Carlos Fernández Martín Date: 2023.10.17 10:11:56 +02'00'

C. Fernández
Project Manager

Document ID:	GMV-CPOD3-PH-0001
DIL Code:	TD-10
Internal Code:	GMVAD 22705/23 V2/23
Version:	1.1
Date:	17/10/2023
ESA contract number:	4000139509/22/I-BG

DOCUMENT STATUS SHEET

Version	Date	Pages	Changes
1.0	21/07/2023	97	First version evolved from GMV-CPOD-TN-0009_v1.19_Copernicus POD Product Handbook in the frame of new CPOD3 contract. Modified sections with respect to this version are: - Inclusion of Sentinel-6 in background (section 2). - Removal of S1 attitude restituted product (section 2.8.1 and table 4.1). - Update of current applicable models to IGS20 (section 3). - Addition of SPOD_SYSTEMs v3.x.x (section 5.1, 5.58, 5.59, 5.60, 5.61).
1.1	17/10/2023	105	Replace Copernicus Open Access Hub (COAH) by Copernicus Data Space Ecosystem (CDSE) in table 1-1 and in sections 4.1, 4.4. Application of Differential Code Biases in section 3.3.1. Addition of new systems v3.4.x, v3.5.x and v3.6.x in table 5-1, and in new sections 5.62, 5.63 and 5.64. Correction of a typo in sections 5.59, 5.60, 5.61.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

1.1. PURPOSE

This document describes the Copernicus POD Product Handbook for the 3rd Generation of the Copernicus POD Service project.

1.2. SCOPE

This document is a deliverable by GMV in the frame of the 3rd Generation of the Copernicus POD Service project.

1.3. DEFINITIONS AND ACRONYMS

Acronyms used in this document and needing a definition are included in the following table:

Table 1-1: Acronyms

Acronym	Definition	Acronym	Definition
AD	Applicable Document	JPL	Jet Propulsion Laboratory
AGRA	Service of the atmospheric contribution to geopotential	LEO	Low Earth Orbit
ANTEX	Antenna Exchange Format	LRA	Laser Retro-reflector Array
ANX	Ascending Node	LRR	Laser Retro-reflector
AOC	Attitude, Orbit and Control	MD	Management Document
AOCS	Attitude and Orbit Control System	MERIS	MEdium Resolution Imaging Spectrometer
ARP	Antenna Reference Point	MOC	Mission Operations and Control
BRDC	Broadcast ephemeris file	MOE	Medium Orbit Ephemeris
CDSE	Copernicus Data Space Ecosystem	MSI	Multi-Spectral Instrument
CFI	Customer Furnished Items	MWR	Micro-Wave Radiometer
CIO	Celestial Intermediate Origin	NAPEOS	NAvigation Package for Earth Orbiting Satellites
CIP	Celestial Intermediate Pole	NASA	National Aeronautics and Space Agency
CMC	Centre of Mass Correction	NAVATT	NAVigation and ATTitude information
CNES	Centre National d'Études Spatiales	NAVSOL	Navigation Solution
CODE	Center for Orbit Determination in Europe	NEU	North-East-Up
COM	Centre of Mass	NOM	Normal Operational Mode
COSPAR	Committee on Space Research	NORAD	NORth American aerospace Defense command
COST-G	Combination Service for Time-variable Gravity fields	NPM	Normal Pointing Mode
CP	Carrier-Phase	NRLMSIS	U.S. Naval Research Laboratory - Mass Spectrometer and Incoherent Scatter radar model
CPF	Consolidated Prediction Format	NRO	Non-Rotating Origin
CPOD	Copernicus POD	NRT	Near Real Time
CPR	Cycle Per Revolution	NTC	Non Time Critical
CRD	Consolidated Range Data	OSV	Orbit State Vector
DIL	Document Item List	PCO	Phase Centre Offset
DLR	Deutsche Zentrum für Luft- und Raumfahrt	PCV	Phase Centre Variations
DORIS	Doppler Orbytography and Radiopositioning Integrated by Satellite	PDAP	Payload Data and Acquisition Processing
EC	European Commission	PDGS	Payload Data Ground Segment

Acronym	Definition	Acronym	Definition
EGP	External GPS Provider	PH	Product Handbook
EIGEN	European Improved Gravity model of the Earth by New techniques	POD	Precise Orbit Determination
EO	Earth Observation	POE	Precise Orbit Ephemeris
EOF	Earth Observation File	PRARE	Precise Range and Range-Rate Equipment
EOP	Earth Orientation Parameters	PSD	Post-Seismic Deformation
EPP	Earth Pointing Phase	PTF	Platform
ERA	Earth Rotation Angle	PVT	Position, Velocity and Timing
ERP	Earth Rotation Parameters	QC	Quality Control
ERS	European Remote Sensing	QWG	Quality Working Group
ESA	European Space Agency	RD	Reference Document
ESOC	European Space Operation Centre	REQ	Requirement
EUM	EUMETSAT	RINEX	Receiver Independent Exchange
EUMETSAT	EUropean organisation for the exploitation of METeorological SATellites	RMS	Root Mean Square
FFS	File Format Specification	RNX	RINEX
FOM	Flight Operation Manual	ROE	Rapid Orbit Ephemerides
FOS	Flight Operations System	ROP	Routine Operations Phase
FP	Final Presentation	SAD	Satellite Ancillary Data
FTP	File Transfer Protocol	SAR	Synthetic Aperture Radar
GCRS	Geocentric Celestial Reference System	SC	SpaceCraft
GFZ	GeoForschungsZentrum	SLR	Satellite Laser Ranging
GMES	Global Monitoring for Environment and Security	SOW	Statement of Work
GMF	Global Mapping Function	SPOT	Satellite pour l'Observation de la Terre
GNSS	Global Navigation Satellite System	SRAL	SAR Radar Altimeter
GPT	Global Pressure and Temperature model	SRD	Systems Requirements Document
GRACE	Gravity Recovery And Climate Experiment	SRP	Solar Radiation Pressure
GRGS	Groupe de Recherche de Géodésie Spatiale	STC	Short Time Critical
HKTM	House Keeping Telemetry	SVL	Svalbard
IAU	International Astronomical Union	TAI	Temps Atomique International
ICD	Interface Control Document	TBC	To Be Completed
ICDB	Instrument Characterization Data Base	TD	Technical Document
ID	Identifier	TIO	Terrestrial Intermediate Origin
IERS	International Earth Rotation Service	TIRS	Terrestrial Intermediate Reference System
IGS	International GNSS Service	TN	Technical Note
ILRS	International Laser Ranging Service	TT	Terrestrial Time
IMT	Instrument Measurement Time	USNO	United States Naval Observatory
IPF	Instrument Processing Facility	UTC	Coordinated Universal Time
IRI	International Reference Ionosphere	WRMS	Weighted RMS
ISB	Inter System Biases	XML	Extensible Markup Language
ITRF	International Terrestrial Reference Frame	YSM	Yaw Steering Mode
ITRS	International Terrestrial Reference System		

1.4. APPLICABLE AND REFERENCE DOCUMENTS

1.4.1. APPLICABLE DOCUMENTS

The following documents, of the exact issue shown, form part of this document to the extent specified herein. Applicable documents are those referenced in the Contract or approved by the Approval Authority. They are referenced in this document in the form [AD.X]:

Table 1-2: Applicable Documents

Ref.	Title	Code	Version	Date
[AD.1]	Sentinels POD Service File Format Specification	GMES-GSEG-EOPG-FS-10-0075	3.0	19/05/2023
[AD.2]	THIRD GENERATION OF THE COPERNICUS PRECISE ORBIT DETERMINATION (CPOD) SERVICE – SoW	ESA-EOPG-EOPGMQ-SOW-37 (Appendix 1 to AO/1-11046/22/I-BG)	1.2	20/01/2022

1.4.2. REFERENCE DOCUMENTS

The following documents, although not part of this document, extend or clarify its contents. Reference documents are those not applicable and referenced within this document. They are referenced in this document in the form [RD.X]:

Table 1-3: Reference Documents

Ref.	Title	Code	Version	Date
[RD.1]	S1 Mission Requirements Document	ES-RS-ESA-SY-0007	1.4	11/07/2005
[RD.2]	S2 Mission Requirements Document	EOP-SM/1163/MR-dr	2.1	08/03/2010
[RD.3]	S3 Mission Requirements Document	EOP-SMO/1151/MD-md	2.0	19/02/2007
[RD.4]	Sentinel-6 End-User Requirements Document	EUM/LEO-JASCS/REQ/12/0013	3E	29/01/2018
[RD.5]	Sentinel-6 System Requirements Document (SRD)	EUM/LEO-JASCS/SPE/12/0039	3G	17/12/2020
[RD.6]	Sentinel-1 Flight Operations Manual Volume 3 (AOC)	S1-MA-TASI-SC-0006	8.0	10/09/2014
[RD.7]	Sentinel-2 Spacecraft Operations Concept	GS2.TN.ASD.SY.00010	7.0	07/07/2011
[RD.8]	GMES SENTINEL S3 FOM: Attitude and Orbit Control Subsystem	S3-MA-TAF-SC-01462	3.0	
[RD.9]	McCarthy and Petit. IERS Conventions (2003). IERS Technical Note 32. ISBN: 3-89888-884-3	IERS Technical Note 32	N/A	2004
[RD.10]	Petit and Luzum. IERS Conventions (2010). IERS Technical Note 36. ISBN: 3-89888-9898-6.	IERS Technical Note 36	N/A	2010
[RD.11]	Update of CERES grids for Earth radiation pressure modelling	GMV-CPOD-MEM-0055	1.0	13/01/2021
[RD.12]	Sentinel-6 POD Context	JC-TN-ESA-SY-0420	1.4	01/02/2021
[RD.13]	Lemoine et al. (2019) CNES/GRGS RL04 Earth gravity field models, from GRACE and SLR data. DOI:10.5880/ICGEM.2019.010	N/A	N/A	2019
[RD.14]	Lyard et al. (2021) FES2014 global ocean tides atlas: design and performance. Ocean Sci 17, 615-649. DOI:10.5194/os-17-615-2021	N/A	N/A	2021
[RD.15]	Peter et al. (2022) COST-G gravity field models for precise orbit determination of Low Earth Orbiting Satellites. Adv Space Res 69(12), 4155-4168. DOI: 10.1016/j.asr.2022.04.005	N/A	N/A	2022

2. BACKGROUND

Copernicus is the Earth observation component of the European Union's Space programme, looking at our planet and its environment to benefit all European citizens.

The European Commission manages the Programme. It is implemented in partnership with the Member States, the European Space Agency (ESA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the European Centre for Medium-Range Weather Forecasts (ECMWF), EU Agencies and Mercator Ocean. General background documents on Copernicus are available at http://copernicus.eu/.

The final objective of the Copernicus initiative is the provision of services to users for application in several areas of high strategic and economic value and related to EU policies. For the scope of this document, the first three families (Sentinel-1, Sentinel-2, and Sentinel-3) are considered, as well as the Sentinel-6 mission:

- The **Sentinel-1** family of satellites, of imaging C-band radar, will ensure the long-term continuity of the historical C-band SAR data archive from the ERS and Envisat missions as well as continuity of data for user services, in particular those initiated within the Copernicus Service Elements program.
- The **Sentinel-2** family of satellites will ensure the future continuity of high-resolution optical missions such as Landsat and SPOT.
- The **Sentinel-3** family of satellites will ensure the future continuity of medium resolution sensors like MERIS, (A)ATSR and VGT, as well as of the Altimetry System (RA-2, MWR, DORIS) on board Envisat and on-board the ERS platforms (RA, MWR, PRARE).
- The **Sentinel-6** family of satellites will ensure continuity to the JASON series of operational missions providing high precision ocean altimetry measurements.

The objectives of the Sentinel-1, 2 & 3 missions are described in the related Mission Requirement Documents (ref. [RD.1], [RD.2] and [RD.3] respectively). The scientific objectives of the Sentinel-6 mission are described in the S6 User Requirements Document [RD.4] & S6 System Requirements Document [RD.5].

Within the Copernicus Program, the Copernicus Service Component is in charge of providing value-added data and services to the final users, while the Copernicus Space Component is responsible for providing to the Copernicus Service Component the necessary EO data and services.

A Ground Segment completes the Space Segment and is responsible for the operational generation and dissemination of the mission data to the Copernicus services.

2.1. COPERNICUS SENTINEL-1

Currently two satellites have been launched: Sentinel-1A was launched on 03 April 2014; Sentinel-1B was launched on 25 April 2016. Both satellites carry a C-band Synthetic Aperture Radar (SAR). Sentinel-1B was declared out of mission on 23/12/2021 due to an anomaly which prevent the use of the radar, although the satellite still remains in orbit under control by FOS.

A third Satellite (C unit) is foreseen to be launched in the time window [Q2 2023] time frame and will replace Sentinel-1A (or -1B). The Sentinel-1 D unit launch is intended in the time period [2024-2028].

Beyond, the main SAR instrument, the Sentinel-1 satellites are equipped with two dual-frequency GNSS receivers (relying on GPS constellation signals only for the A & B units and compatible with both GPS and GALILEO for the following C & D units) for the generation of the operational orbit products.

Sentinel-1 GNSS data is downlinked several times per orbit and the resulting GNSS L0 products made available to the POD service by the Sentinel-1 production service(s) for the generation of the Sentinel-1 POD files.

The operational Sentinel-1 orbit products generated by the CPOD Service correspond to:

- GNSS L1B RINEX products
- Predicted POD orbits (available before SAR data take acquisition)
- POD restituted orbits
- Precise POD products
- Auxiliary data Files (e.g., quaternions)

2.2. COPERNICUS SENTINEL-2

Currently two satellites have been launched: Sentinel-2A was launched on 23 June 2015; Sentinel-2B was launched on 07 March 2017. The two satellites are located on the same orbital plane, with the second one placed at 180 degrees of distance in true anomaly with respect to the first one. This way, both satellites have the same ground track, with the revisit time of the constellation being 5 days.

A third Satellite (C-unit) is foreseen to be launched in the January-June 2024 time frame to replace Sentinel-2A (or -2B). The Sentinel-2 D-unit launch is intended in the window 2025-2028.

Beyond, the main MSI instrument, the Sentinel-2 satellites are equipped with two dual-frequency GNSS receiver (relying on GPS constellation signals only for the A & B units and compatible with both GPS and GALILEO for the following C & D units) for the generation of the operational orbit products.

Sentinel-2 GNSS data is downlinked several times per orbit and the resulting GPSS L0 products made available to the POD service by the Sentinel-2 production service(s) for the generation of the Sentinel-2 POD files.

The operational Sentinel-2 orbit products generated by the CPOD service correspond to:

- GNSS L1B RINEX products
- Restituted POD orbits
- Auxiliary data Files (e.g., quaternions).

2.3. COPERNICUS SENTINEL-3

Currently two satellites, S3A and S3B, have been launched: Sentinel-3A was launched on 16 February 2016; Sentinel-3B was launched on 25 April 2018. For the nominal Routine operational Phase (ROP), the two satellites are phased at 140 degrees on the same orbital plane.

A third Satellite (C unit) is foreseen to be launched in the [Q4-2024, Q1 2025] time frame and will replace Sentinel-3A (or -3B). The Sentinel-3 D-unit launch is intended in the window 2025-2028.

The POD payload for the S3 satellites consists of:

- **GNSS receiver**: Navigation System based on a dual-frequency GNSS receiver (relying on GPS constellation signals only for the A & B units and compatible with both GPS and GALILEO for the following C & D units).
- **DORIS**: a Customer Furnished Item, which constitutes a complementary POD data provider for the Ground Segment as well as a potential backup to the GNSS Assembly for the specific commanding of the SRAL Open Loop tracking mode.
- **Laser Retro-reflector Array (LRA)**: The LRA is a passive sensor composed of an array of mirrors that provides a target for laser tracking measurements from the ground.

The operational Sentinel-3 orbit products generated by the CPOD service correspond to:

- GNSS L1B RINEX products.
- 'Rapid Ephemerides NRT' orbit products (for NRT L2 SRAL/MWR processing in less than 3 hours from sensing).
- 'Preliminary-STC' orbital products (for STC L2 SRAL/MWR processing in less than 48 hours).
- 'Precise-NTC' orbital products (for NTC L2 SRAL/MWR processing in less than 1 month).
- Preliminary and Precise Platform Auxiliary Data Files.
- Auxiliary data Files (e.g., quaternions).
- Precise predicted orbits in support of SLR tracking by ILRS (CPFs).

2.4. COPERNICUS SENTINEL-6

The Copernicus Sentinel-6 mission is built on heritage from the Jason series of ocean topography satellites and from ESA's CryoSat mission. This new mission is designed to complement ocean information from Sentinel-3.

A second Satellite (B unit) is foreseen to be launched in the [Q4 2025] time frame and be operated along with Sentinel-6 MF unit.

The POD payload for the S6 satellite consists of:

- **GNSS** Precise Orbit Determination (POD) Receiver, developed by ESA and derived from the GNSS Receiver on Sentinel-3.
- **DORIS** Receiver as on Jason-3 and Sentinel-3.
- **Laser Reflector Array** as on Jason-3, provided by NASA.

The operational Sentinel-6 orbit products generated by the CPOD service correspond to:

- GNSS L1B RINEX products.
- 'Rapid Ephemerides NRT' orbit products (for NRT L2 Altimetry processing in less than 3 hours from sensing).
- Auxiliary data Files (e.g., quaternions).

2.5. COPERNICUS PRECISE ORBIT DETERMINATION SERVICE

The Copernicus POD (Precise Orbit Determination) Service is part of the Copernicus Ground Segment operations for the Copernicus Sentinel missions and is in charge of the generation, provision and validation of precise orbital products and auxiliary data files for the Sentinel-1, Sentinel-2, Sentinel-3 and Sentinel-6 operations.

Beyond the provision of the orbit and platform files to the respective Sentinels operations, the CPOD Service is responsible for the assessment of the GNSS (Global Navigation Satellite System) receiver sensor performance on-board the Sentinel satellites, the quality of the generated products, as well as the improvement of the orbit products performance with the support of the Copernicus POD Quality Working Group.

The CPOD Service also guarantees the operational interface and liaising with the International Laser Range Satellite (ILRS) community, the different external data providers required for the GPS POD ground processing, as well as the CNES French Agency and EUMETSAT in the frame of the Sentinel-3 and Sentinel-6 mission.

In the time frame of the CPOD activity, the Sentinel A and/or B will be at some point replaced by the respective C or D unit, and Sentinel-6 MF will be complemented by the B unit.

2.6. COPERNICUS POD PRODUCT HANDBOOK OVERVIEW

The **Copernicus POD Service** takes care of the generation of the **orbital and auxiliary POD products** needed by the respective Sentinels PDGS/PDAP for the generation of the Sentinels Level-2 products.

As for any POD product, aside from any formatting aspect, the most important information describing the POD products is related to the **processing standards** used. Hence special focus is paid to this in this document. In particular, the following topics are treated:

- **Copernicus POD processing overview**, describing the processing standards.
- **Reference frame and time systems**, used throughout the complete POD service for the generation of the POD products.
- **Dynamical forces modelling**, used as part of the numerical integration of the equations of motion of the Sentinel satellites.
- **Measurements modelling**, including GNSS, SLR and DORIS measurements, used for the reconstruction of the measurements as part of the orbit determination processes.
- **Satellite modelling**, including both the mass and centre of gravity and the attitude laws of each of the Sentinel satellites.

Additionally, the **identifiers** used for each of the products, together with the **description** and **format** (file content and file naming) of each of the POD product files is also presented. These are based on the **file format specification** detailed in [AD.1].

2.7. SENTINELS GROUND SEGMENT OVERVIEW

Figure 2-1 shows a high-level diagram of the different elements of the ground segment of the Sentinel missions interacting with the Copernicus POD Service.

The Copernicus POD Service interacts with:

- **PDGSs/PDAP**: they are primarily in charge of receiving and processing the Sentinel instrument payload data, including HKTM data, ensuring that satellite tasking is performed according to the overall user requirements and satellite capabilities.
- **External Auxiliary and GNSS Providers**: these are entities external to the PDGSs providing geophysical and environmental data necessary for the POD computations (e.g., GNSS Orbits and Clocks, solar flux, geomagnetic activity, etc.).
- **CNES**: in the frame of the Sentinel-3 and -6 missions and in agreement with the ESA and EUMETSAT, the CNES French Agency generates operationally and delivers S-3 and S-6 orbital and attitude products with are disseminated towards the CPOD Service for Quality Control purposes.
- **FOSs**: they provide a data-access service to predicted and restituted orbit products, to platform information (e.g., manoeuvres, centre of mass, etc.) needed by the POD Service for processing activities. The respective Sentinel FOS informs the corresponding PDGS, and therefore the Copernicus POD Service, about planned manoeuvres.
- **QWG**: the mission of the Sentinels Quality Working Group is to ensure the evolution of the Copernicus POD Service in order to keep it in the state-of-the-art by proposing new algorithms, products, processing methodologies, etc.

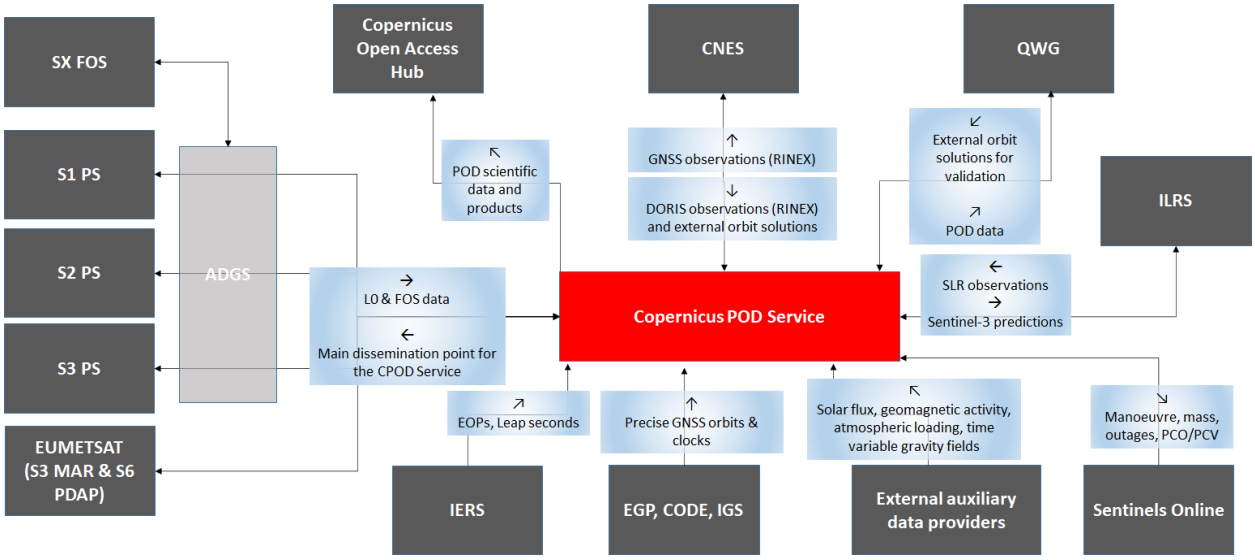

Figure 2-1: Overview of the Ground Segment elements interacting with the CPOD Service

2.8. COPERNICUS POD PRODUCTS OVERVIEW

2.8.1. SENTINEL-1

The main POD products generated by the Copernicus POD Service associated to the **Sentinel-1** mission are:

- **Predicted Orbit File**:
  - The position accuracy threshold is 1 m 2D 1-sigma RMS. The 2D refers to the along-track and cross-track directions.
  - The file is generated within 30 minutes from the reception of GNSS data in the POD FTP server.
  - The file coverage is four orbits from the last ascending node crossing (ANX) present in the GPS L0 input file.
- **Restituted Orbit File**:
  - The position accuracy threshold is 10 cm 2D 1-sigma RMS. The 2D refers to the along-track and cross-track directions.

  - The file is generated within 30 minutes from the reception of GNSS data in the POD FTP server.
  - The file coverage is one satellite orbit, from ascending node plus an overlap of 593 OSV before the satellite orbit time span.
- **Precise Orbit Ephemerides**:
  - The position accuracy threshold is 5 cm 3D 1-sigma RMS for S-1 POE orbit files.
  - Each file covers 26 hours (one complete day plus 1 hour before the start and after the end of the day – overlap of two hours between consecutive files).
  - Files are delivered within 20 days after data acquisition.
- **Daily GNSS L1B RINEX files**
- **Daily Processed Quaternions files**

2.8.2. SENTINEL-2

The main POD products generated by the Copernicus POD Service associated to the **Sentinel-2 mission** are:

- **Restituted Orbit File**:
  - The position accuracy threshold 3 m 3D 3-sigma RMS.
  - The file is generated within 30 minutes from reception of GNSS data in the POD FTP server. One file is generated for every dump.
  - The file coverage is equal to the latest PVT contained within the received satellite ancillary data that triggers such generation with 2 revolutions backwards (configurable). The state vector frequency is of 30 seconds by default (configurable). 5 orbital state vectors (configurable) are added after the period of the latest PVT.
- **Daily GNSS L1B RINEX files**
- **Daily Processed Quaternions files**

2.8.3. SENTINEL-3

The main POD products generated by the Copernicus POD Service associated to the **Sentinel-3 mission** are:

- **NRT Restituted Orbit File**:
  - The position accuracy threshold is 10 cm radial 1-sigma RMS with a target of 8 cm.
  - The file is generated within 10 minutes from the reception of GNSS input data.
  - The file coverage is equal to the input file coverage (GNSS data) plus at least 5 orbital state vectors (configurable) before and after the period of the GNSS data in input. One file is generated for each input received and contains orbital state vectors at fixed time steps of 10 seconds.
- **MOE Orbit File**:
  - The position accuracy threshold is 4 cm radial 1-sigma RMS with a target of 3 cm.
  - The file is generated per day with a latency of 36 hours.
  - The file coverage is 26 hours with orbital state vectors from d-3 at 22 h to d-2 at 24 h for the product corresponding to day d. Each file contains orbital state vectors at fixed time steps of 10 seconds.
- **POE Orbit File**:
  - The position accuracy threshold is 3 cm radial 1-sigma RMS with a target of 2 cm.
  - The file is generated per day with a latency of 28 days after data acquisition.
  - The file coverage 26 hours (one complete day plus 1 hour before the start and after the end of the day – overlap of two hours between consecutive files – configurable) and contains orbital state vectors at time steps of 10 seconds intervals (configurable).
- **NRT Platform Data File**:
  - The accuracy threshold of roll and pitch axis biases is 0.05 degrees (3-sigma RMS).
  - The accuracy threshold of yaw axis biases is 0.5 degrees (3-sigma RMS).

  - The file is generated together with the NRT Restituted Orbit file.
  - The file coverage is equal to the input GNSS data.
- **Preliminary Platform Data File**:
  - The accuracy threshold of roll and pitch axis biases is 0.05 degrees (3-sigma RMS).
  - The accuracy threshold of yaw axis biases is 0.5 degrees (3-sigma RMS).
  - The file is generated together with the MOE Orbit file.
  - The file coverage is equal to the MOE Orbit file with which it is generated.
- **Precise Platform Data File**:
  - The accuracy threshold of roll and pitch axis biases is 0.05 degrees (3-sigma RMS).
  - The accuracy threshold of yaw axis biases is 0.5 degrees (3-sigma RMS).
  - The file is generated together with the POE Orbit file.
  - The file coverage is equal to the POE Orbit file with which it is generated.
- **Hourly and Daily GNSS L1B RINEX files**
- **Daily Processed Quaternions files**

2.8.4. SENTINEL-6

The main POD product generated by the Copernicus POD Service associated to the **Sentinel-6 mission** is:

- **NRT Restituted Orbit Ephemerides (ROE)**:
  - The position accuracy threshold is 5 cm radial 1-sigma RMS with a target of 3 cm.
  - The file is generated within 10 minutes from the reception of GNSS input data.
  - The file coverage is equal to the input file coverage (GNSS data) plus 5 Orbital State Vectors (OSVs) before and after the period of the GNSS data in input (configurable). One file is generated for each input received and contains OSVs at fixed time steps of 10 seconds.
- **Hourly and Daily GNSS L1B RINEX files**
- **Daily Processed Quaternions files**

2.9. QUALITY FLAGGING DESCRIPTION

The orbital products consist of a XML file with time tagged orbital state vectors, each of them with a quality flag. The quality flags can be one of the following:

1. **NOMINAL**: this is the default flag if the processing is nominal (i.e., if any of the degraded flag have been set).
2. **DEGRADED-MANOEUVRE**: in case there is a manoeuvre in the interval covered by the orbital product, the state vectors, before and after the manoeuvre, are flagged accordingly.
3. **DEGRADED-OBSRESIDUALS**: in case the RMS of the pseudo-range or carrier-phase is above a certain threshold (independent per type of observable), all the state vectors in the orbital product are set with this flag.
4. **DEGRADED-OBSNUMBER**: in case the number of accepted measurements in the POD processing is below a certain threshold, all the state vectors in the orbital product are set with this flag.
5. **DEGRADED-OBSPERCENTAGE**: in case the percentage of accepted measurements in the POD processing is below a certain threshold, all the state vectors in the orbital product are set with this flag.
6. **DEGRADED-GAP**: the state vectors for which no observations were available or accepted are flagged accordingly.
7. **DEGRADED-OVERLAP**: in case the overlap with previous orbit RMS exceeds a set threshold in radial, along-track and cross-track directions, all state vectors are set with this flag.
8. **DEGRADED-NAVSOL**: in case the orbital product is based on the navigation solution, instead of a proper POD processing, all the state vectors in the orbital products are flagged accordingly.

The flags are presented hierarchically, meaning that the product is set with the first flag that is triggered according to the previous list.

3. COPERNICUS POD PROCESSING STANDARDS

3.1. REFERENCE FRAME AND TIME SYSTEM

The independent variable in the equations of motion is the time system TT (Terrestrial Time). The relationship of this abstract and uniform time scale to other time systems is well defined. The table below shows the relationship between various time systems and the contexts in which they are used.

Table 3-1: Information about the time systems

System	Relations	Notes	Standards
TAI	Fundamental time system	International Atomic Time	n/a
UTC	UTC=TAI-n1	n1 is the leap seconds	Tables from USNO
TT	TT=TAI+32.184s	N/A	IAU 2000/2006 space-time reference (IERS-2010 Conventions [RD.10])
GPS	GPS=TAI-19s	Relation between GPS and TAI is fixed at 19 s	Time-tag in sec since 12:00 January 01, 2000 GPS time
UT1	Associated to Earth rotation	Dependency with UTC provided as part of the EOPs	IERS-2010; Values from IERS and USNO

Earth Orientation here refers to the model for the orientation of the Earth-fixed reference relative to the inertial reference. The former is necessary for associating observations, models and observatories to the geographic locations, and the latter for dynamics, integration, and ephemerides.

Table 3-2: Information about the Earth-fixed and inertial reference frames

Frame	System	Realization
Inertial	GCRS	J2000.0 (IERS-2010 Conventions [RD.10])
Earth-fixed	ITRS	ITRF2020

The rotation between the Inertial and Earth-fixed frames is implemented as:

$$[GCRS] = Q(t)R(t)W(t)\ [ITRS],$$

Where:

- Q(t): transformation matrix arising from the motion of the celestial pole in the celestial reference system,
- R(t): transformation matrix arising from the rotation of the Earth around the axis associated with the pole,
- W(t): transformation matrix arising from the polar motion respectively [IERS-2010 Conventions] [RD.10].

The definitions of the GCRS and ITRS and the procedures for the transformation follow the IAU 2000/2006 resolutions.

3.1.1. POLAR MOTION AND UT1

The transformation matrix arising from the polar motion can be expressed as:

$$W(t) = R3(-s')R2(xp)R1(yp),$$

Where xp and yp are the polar coordinates of the Celestial Intermediate Pole (CIP) in the ITRS and s' is a quantity named TIO locator, which provides the position of the TIO on the equator of the CIP corresponding to the kinematical definition of the non-rotating origin (NRO) in the ITRS when the CIP is moving with respect to the ITRS due to polar motion.

The CIO based transformation matrix arising from the rotation of the Earth around the axis of the CIP can be expressed as:

$$R(t) = R3(-ERA)$$

Where ERA is the Earth Rotation Angle between the CIO and the TIO at date t on the equator of the CIP, which provides a rigorous definition of the sidereal rotation of the Earth.

The equinox-based transformation matrix R(t) for Earth rotation transforms from the TIRS to the true equinox and equator of date system. It uses Apparent Greenwich Sidereal Time, the angle between the equinox and the TIO, to represent the Earth's angle of rotation, instead of the ERA.

The conventional relationship definition UT1 from the Earth Rotation Angle (ERA) is given by the IERS-2010 Conventions:

$$ERA(Tu) = 2\ pi\ (0.7790572732640 + 1.00273781191135448\ Tu)$$

Where Tu = (Julian UT1 date – 2451545.0), and UT1 =UTC+(UT1-UTC), or equivalently (modulo 2pi), in order to reduce possible rounding errors. This definition of UT1 based on the fact that CIO is insensitive at the micro-arc-second level to the precession-nutation model and the observed celestial pole offsets.

The above relationship also provides the ERA corresponding to a given UT1.

Table 3-3: Information about the xp, yp and UT1 model

Values	Model	Notes
Xp, Yp and UT1	IERS EOP Bulletin A from USNO	Daily and sub-daily corrections applied in accordance with the IERS-2010 Conventions

3.1.2. PRECESSION AND NUTATION MODEL

Precession and Nutation are modelled using IAU 2000/2006 model (IERS-2010 Conventions). Reference epoch 2000.0 is used. The independent variable is TT since epoch J2000.0 (noon, 1st January 2000).

Ocean tidal diurnal/semidiurnal variations in xp, yp and UT1 applied according to IERS 2010 Conventions (ortho_eop.f).

High-frequency nutation: prograde diurnal polar motion corrections applied using IERS routines.

UT1 liberations applied using IERS routines.

dx and dy corrections for the nutation from the IERS EOP finals2000A files (.daily and .data) from USNO.

3.1.3. GNSS CONSTELLATION

It consists of all healthy satellites declared as such at any time by the corresponding GNSS control segments.

3.1.4. SLR COORDINATES (SENTINEL-[3, 6])

Mean station positions and velocities are taken from the ITRF2020 realisation of the ITRS in accordance with the IERS-2010 Conventions.

These only apply to Sentinel-3 and Sentinel-6 missions because they are the only ones equipped with a Laser Retro-Reflector (LRR) instrument.

Table 3-4: Information about the SLR coordinates

Values	Model	Notes
SLR Coordinates	ITRF2020	SLRF2020 realisation is used

3.1.5. DORIS COORDINATES (SENTINEL-[3, 6])

Mean station positions and velocities are taken from the ITRF2020 realisation of the ITRS in accordance with the IERS-2010 Conventions.

These only apply to Sentinel-3 and Sentinel-6 missions because they are the only ones equipped with a DORIS receiver on-board.

Table 3-5: Information about the DORIS coordinates

Values	Model	Notes
DORIS Coordinates	ITRF2020	DPOD2020 realisation is used

3.1.6. EARTH TIDES

Tidal displacements in accordance with the IERS-2010 Conventions:

- Solid Earth tide: IERS routines.
- Permanent tide: zero-frequency contribution left in tide model.
- Solid Earth pole tide: based on IERS 2010 mean pole.

3.1.7. ATMOSPHERIC LOADING

Not applied.

3.1.8. OCEAN LOADING (SENTINEL-[3, -6])

Ocean tide loading consistent with IERS-2010 Conventions is applied, with site-dependent amplitude and phases from Bos & Scherneck website for FES2014b tide model including CMC (Centre of Mass correction). North-East-Up (NEU) site displacements computed using hardisp.f from D. Agnew.

This only applies to Sentinel-3 and -6 because ground stations (to process SLR and DORIS) are involved.

Table 3-6: Information about the ocean loading displacement

Values	Model	Notes
Ocean loading displacement	FES2014b	Consistent with IERS-2010 Conventions

3.1.9. OCEAN POLE TIDES

Main terms (ΔC_{21} and ΔS_{21}) according to the IERS2010 Conventions are applied.

3.2. DYNAMICAL FORCE MODELLING

3.2.1. GRAVITY FIELD

3.2.1.1. Earth Gravity

To compute the geopotential, the COST-G FSM [RD.13] is used (see table below).

Table 3-7: Information about the Earth gravity field

Parameter	Value	Notes
GMe	3.986004415E+14	taken from COST-G FSM Dec 2022 update
Ae	6378136.30	taken from COST-G FSM Dec 2022 update
Nmax	90	fully normalized coefficients taken from corresponding COST-G FSM

The COST-G FSM contains time-variable coefficients represented by the trend, annual and semi-annual coefficients up to degree and order 90. The models are updated quarterly to follow up recent changes in the time-variable gravity field.

3.2.1.2. Solid Earth Tides

In order to consider the contribution of the solid Earth tides, corresponding accelerations are computed and added to the geopotential accelerations. This approach is equivalent to applying corrections to geopotential coefficients as specified in the IERS-2010 Conventions.

Table 3-8: Information about the solid Earth tides

Model	Description	Notes
Frequency independent terms	Corrections to C20, C21, S21, C22, S22, C30, C31, S31, C32, S32, C33, S33, C40, C41, S41, C42 and S42	IERS-2010 Conventions
	External Potential Love Numbers	IERS-2010 Conventions
	Anelasticity Contributions	IERS-2010 Conventions
Frequency dependent terms	Tidal corrections to C20, C21, S21, C22 and S22	21 long periodic, 49 diurnal and 2 semi-diurnal tides used
Permanent tide in C20	4.1736E-9	Included in these contributions (is implicitly removed from the value of the mean C20)

3.2.1.3. Ocean Tides

In order to consider the contribution of the ocean tides (and the atmospheric tides), corresponding accelerations are computed and added to the geopotential accelerations. This approach is equivalent to applying the corrections to geopotential coefficients as specified in the IERS-2010 Conventions.

Table 3-9: Information about the ocean tides

Model	Description	Notes
Tidal arguments & Amplitudes/Phases	Doodson 1921 & Schwiderski 1983	
Tidal harmonics	FES2014 [RD.14]	Containing 34 constituents. Admittance theory used to interpolate the minor constituents. Maximum degree and order used =90.

3.2.1.4. Atmospheric Tides

The atmosphere tides are delivered together with the GFZ AOD L1B product.

Table 3-10: Information about the atmospheric tides

Model	Description	Notes
Tidal arguments & Amplitudes/Phases	Doodson 1921 & Schwiderski 1983	
Tidal harmonics	GFZ AOD L1B RL06	Containing 12 constituents (3 diurnal, 6 semi-diurnal, and 3 tri-diurnal). Maximum degree and order used = 90

3.2.1.5. Atmospheric Gravity

The non-tidal variability in the atmosphere and ocean is computed through using the GFZ AOD L1B products (100x100), which are delivered on a daily basis with eight batches valid for 3 hours.

The corrections to the geopotential are available to degree and order 100. They are used up to degree and order 90 and are applied at the intermediate epoch through linear interpolation between the bracketing data points.

3.2.1.6. Third bodies

Unlike the geopotential accelerations, the perturbations due to the Sun, Moon and Solar system planets are directly computed as accelerations acting on the spacecraft. The direct effects of the objects on the satellite are evaluated using point-mass attraction formulas. The in-direct effects due to the acceleration of the Earth by the planets are also modelled as point-mass interactions. However, for the Moon, the indirect effects include the interaction between a point-mass perturbing object and an oblate Earth – the so-called Indirect J2 effect.

Table 3-11: Information about the third bodies

Model	Description
Third-Body Perturbation	Direct & Indirect terms of point-mass 3rd body perturbations
Indirect J2 Effect	Moon only
Planetary Ephemerides	JPL DE-421

3.2.1.7. Relativistic correction

The general relativistic contributions to the accelerations are computed as specified in the IERS-2010 Conventions, Section 10.2 including Lense-Thirring and de Sitter effects.

3.2.2. SURFACE FORCES AND EMPIRICAL

The non-gravitational forces acting on the Sentinel missions are modelled using the box-wing approach. In this approach the satellite is modelled in two parts; the box represents the non-rotating part of the satellite (relative to the satellite reference frame) and the wing represents the rotating panel such as the solar array.

For each of these panel surfaces the following properties are defined: the surface area, the direction of the normal vector in the satellite body fixed reference frame, the mean wall temperature, and, finally, the optical and infrared absorption and reflectivity coefficients. In addition, the rotation direction must be defined for the rotating panels. The actual rotation of the solar array is modelled (with possible misalignments included by the satellite) during the orbit determination process.

3.2.2.1. Radiation Pressure model

Direct radiation applied, Earth shadow model including umbra/penumbra from regularizing function.

3.2.2.2. Radiation pressure scale coefficient

To be determined using an accurate modelling of the satellite and thereafter kept fixed. Typically the Solar Radiation Pressure (SRP) coefficient is not estimated in LEO POD but fixed to an a priori value. The SRP is strongly correlated with the estimated drag and CPR parameters and thus cannot be easily or reliably estimated from short arcs. The SRP value may be estimated or improved from long-arc analysis.

The SRP coefficient is estimated for all satellites in the NRT chains. However, STC and NTC chains are characterized for using fixed SRP coefficients, such that:

- S-[126][AB] is set to 1.0.
- S-3A is set to 0.97.
- S-3B is set to 0.96.

3.2.2.3. Earth radiation

The Earth radiation pressure (ERP) modelling consists of two parts. The first one is the contribution of the Earth albedo (reflected visible spectrum) and the second part is the radiation of the Earth in the infrared (IR) spectrum. The ERP modelling is handled with Earth grids of a 2.5ºx2.5º resolution containing information on the Albedo and on the IR emission.

The Earth grids for ERP modelling are monthly averaged grids, twelve for Albedo and twelve for IR emission. The product, which is used for the update of the grids is CER_ES4_Terra+Aqua_Edition4 (https://asdc.larc.nasa.gov/project/CERES/CER_ES4_Terra+Aqua_Edition4, doi:10.5067/TERRA+AQUA/CERES/ES4_L3.004).

CER_ES4_Terra+Aqua_Edition4 is the Clouds and the Earth's Radiant Energy System (CERES) Earth Radiation Budget Experiment (ERBE)-like Time-Interpolated Top-of-the-Atmosphere (TOA) Fluxes Terra and Aqua Cross-track Edition4 product. The product is available in monthly files from July 2002 until present (e.g., https://opendap.larc.nasa.gov/opendap/CERES/ES4/Terra-Aqua_Edition4/). The latency of the products is about half a year. The products from July 2002 – June 2020 are used for the generation of the updated monthly averaged grid files.

3.2.2.4. Atmospheric density model

Table 3-12: Information about the atmospheric density model

Model	Value	Notes
Atmospheric density	NRLMSIS-2000	none
Thermospheric winds	HWM14	none

3.2.2.5. Drag coefficients

The drag coefficients are estimated:

- PRE products; 2 coefficients per 24 h (constrained with 1.0).
- NRT products: 10 coefficients per 24 h (constrained with 1.0).
- STC/NTC products: A single drag coefficient per arc is estimated (constrained with 0.3). On Sentinel-6A products, the value of the drag coefficient is fixed to 1.0.

3.2.2.6. Once-per-revolution empirical

For NRT products, when applied, 1 set every 12 h in along- and cross-track directions with sine/cosine coefficients are used. If a 32 h arc is used, then 3 sets are applied.

For STC/NTC products, when applied, 16 sets of constant, sine and cosine CPR coefficients are estimated in along- and cross-track directions. On Sentinel-6A STC/NTC products, 8 sets of constant, sine and cosine CPR coefficients are used.

3.3. MEASUREMENTS MODELLING

3.3.1. GNSS MEASUREMENTS

The CPOD Service computes the precise orbits of Sentinel-1, -2, -3 and -6 using GPS and Galileo observations. To compute the precise orbits of the LEO satellites, it is needed to use precise orbits and clocks of the GPS and Galileo constellations. These precise orbits are provided by the EGP. For the NRT and STC timeliness, the CPOD Service uses the products generated by ***magicGNSS***, while for the NTC, it uses the products generated by CODE.

The calculation of the GNSS orbits and clocks is typically done using a combination of GNSS signals in two different frequencies. The de-facto standard for GPS is to use 1W and 2W, while for Galileo, there are at least two standards, but most frequently it is 1C and 5Q (although 1C and 7Q is also used). The use of one or another combination of signals have an impact on the GNSS clocks estimated, which absorb the unknown instrumental biases of the signals selected. On the user side (i.e., in this case the CPOD Service doing POD), it is critical to either use the same signals, or to correct the GNSS observations by the instrumental bias between the signal used and the reference used by the EGP.

The instrumental biases between GNSS signals, within each GNSS constellation is provided through a SINEX file called Differential Code Bias (DCB), which values updated daily in the worst case (although the biases are expected to be quite constant).

Up to CPOD_SYSTEM_v3.5.0, the EGP (i.e., ***magicGNSS*** and CODE) are using the same combination of GNSS signals (see Table 3-13)

Table 3-13: Current GNSS signals used by the EGPs

	GPS	GALILEO
magicGNSS	1W, 2W	1C, 5Q
CODE	1W, 2W	1C, 5Q

The CPOD Service make use of the following GNSS signals (Table 3-14). From this table, it can be seen that with Sentinel-6A, there is already a problem with the GPS satellites from recent blocks (IIR-M, IIF

and III), as the GNSS receiver tracks 1C and 2L, instead of 1W and 2W. Prior to CPOD_SYSTEM_v3.4.0, an inter-system bias for those GPS blocks emitting 1C/2L was estimated and included in the GNSS measurement modelling. From that system, CPOD Service started receiving the differential code biases from ***magicGNSS*** and exchanged the inter-system bias estimation for the addition of the given DCB to the GPS signals 1C and 2L to align them with the GPS signals 1W and 2W.

Table 3-14: GNSS signals tracked by the Sentinel´s GNSS receivers

Mission	GPS	GALILEO
Sentinel-1, -2, -3 A & B	1C, 1W, 2W	N/A
Sentinel-6A	1C, 1W, 2W (block IIR) 1C, 2L (rest of blocks)	1C, 5Q

From CPOD_SYSTEM_v3.6.0, ***magicGNSS*** changes the reference signals used, to harmonize the GNSS products generated among different projects. The new reference is provided in Table 3-15 (in red highlighted the changes)

Table 3-15: New GNSS signals used by the EGPs

	GPS	GALILEO
magicGNSS	1C, 2W	1C, 7Q
CODE	1W, 2W	1C, 5Q

As a result of this change, the CPOD Service has made the adaptations to the system to align the GPS 1C signal to the GPS 1W signal, and the Galileo 7Q signal to the Galileo 5Q signal. This is done by applying the differential code bias provided by the EGP.

Table 3-16 provides a summary of the GNSS measurements modelling from CPOD_SYSTEM_v3.6.0.

Table 3-16: Modelling of GNSS Measurements

Parameter	Comment
GNSS products	PRE, NRT, STC: EGP (ref. signals GPS [1C, 2W], GAL [1C, 7Q]) NTC: CODE rapid/finals (ref. signals GPS [1W, 2W], GAL [1C, 5Q])
Iono-free GNSS signals	S-1, -2, -3: GPS [1W, 2W] S-6: GPS [1W, 2W], GPS [1C, 2L], GAL [1C, 5Q]
Differential code biases	S-1 (NTC), S-3 (NTC): No S-1 (PRE, NRT), -2 (NRT), -3 (NRT, STC), -6 (NRT): Yes (EGP)
Clock sampling	Every 10 s (every 30 s for Sentinel-6A ROE products)
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Down weighting law	None
Elevation cut-off angle	7 degrees
Satellite antenna	Correction from Centre-of-Mass to antenna reference point applied. Correction from antenna reference point to antenna phase centre applied through the ANTEX file. Official IGS ANTEX for GNSS satellites and specific ANTEX for Sentinel satellites.
Phase wind up	Applied
Receiver clock	Estimated every 10 s (every 30 s for Sentinel-3 and 6 ROE products).
Phase ambiguity	Estimated per GNSS pass. Integer ambiguity fixing is applied for NTC product line
Troposphere correction	No troposphere correction is applied as the measurements are between a GNSS satellite and an orbiting receiver with an orbit of around 700 km of altitude.

Parameter	Comment
Ionosphere correction	No ionosphere correction is applied as the GNSS measurements from the two frequencies available (dual frequency receiver) are linearly combined to remove the ionospheric delay to first order. Second and higher order of ionospheric effects are neglected.

3.3.2. SLR MEASUREMENTS (SENTINEL-[3, 6])

Table 3-17: Modelling of SLR Measurements

Parameter	Comment
Observation weight	8 cm for SLR two-way range measurements
Down weighting law	None
Elevation cut-off angle	10 degrees
Troposphere correction	Applied, Mendes-Pavlis following IERS-2003 [RD.9] Conventions update (not changed in IERS-2010 Conventions [RD.10]).
Retro reflector correction	Fixed offset value per satellite according to manufacture specifications.

3.3.3. DORIS MEASUREMENTS (SENTINEL-[3, 6])

DORIS measurements are not processed by the Copernicus POD Service routinely. These may, nevertheless, be included in reprocessing campaigns if deemed necessary.

Table 3-18: Modelling of DORIS Measurements

Parameter	Comment
Observation weight	4 mm/s for DORIS range-rate rate measurements
Down weighting law	None
Elevation cut-off angle	10 degrees
Troposphere correction	GMF/GPT with dry modelled by Saastamoinen, wet delay estimated per station-satellite pass.
Frequency bias	Estimated per satellite-station pass.
Time-tag bias	None

3.4. SATELLITE MODELLING

3.4.1. MASS AND CENTRE OF GRAVITY

Post-launch values from FOS (MOC for Sentinel-6A) with regular updates.

Table 3-19: Information about the mass and centre of gravity

Values	Model
Satellite mass	values to be obtained from FOS/MOC with regular updates
Satellite COM	values to be obtained from FOS/MOC with regular updates

3.4.2. ATTITUDE LAW

3.4.2.1. Sentinel-1

Quaternions with fall-back on theoretical attitude model (default) or pure theoretical attitude model in case of unavailability of the quaternions computed on-board. This means that quaternions computed on-board by the SAR are used primarily. In case of small gaps (less than 10 s), these quaternions are interpolated. In case of larger gaps, the attitude model is used instead. The attitude law of Sentinel-1 is summarised next based on [RD.6].

The Normal Pointing Mode (NPM) is the nominal operating mode during the Mission phase. The NPM supports the SAR P/L activity providing nominal earth pointing attitude plus attitude roll steering, fine pointing accuracy and stability performance. The nominal earth pointing attitude, as required to support SAR P/L, foresees the satellite attitude to be defined with respect to the Zero Doppler Reference frame as follows: the "x" spacecraft axis is aligned with the "x" Zero-Doppler Reference axis, the "y" and "z" spacecraft axes are rotated by a described steering angle. The Zero-Doppler Reference Frame has similar definition as the standard orbital reference frame except that the orbital velocity is corrected for Earth rotation, in order to keep the S/C X axis aligned with its velocity with respect to the Earth surface, and that the geocentric position vector is re-defined as perpendicular to the Earth Ellipsoid (geodetic position).

3.4.2.2. Sentinel-2

Quaternions with fall-back on theoretical attitude model (default) or pure theoretical attitude model in case of unavailability of the quaternions computed on-board. This means that quaternions computed on-board by the AOCS are used primarily. In case of small gaps (less than 10 s), these quaternions are interpolated. In case of larger gaps, the attitude model is used instead. The attitude law of Sentinel-2 is summarized next based on [RD.7].

The S-2 Normal Mode is Fine Pointing (AOC-NOM FP) for the MSI measurement phase. This is the standard mode for payload operation as it provides high accuracy pointing and knowledge. This mode corresponds to a geocentric point mode with yaw steering to reduce MSI image distortion.

3.4.2.3. Sentinel-3

Quaternions with fall-back on theoretical attitude model (default) or pure theoretical attitude model in case of unavailability of the quaternions computed on-board. This means that quaternions computed on-board by the AOCS are used primarily. In case of small gaps (less than 10 s), these quaternions are interpolated. In case of larger gaps, the attitude model is used instead. The attitude law of Sentinel-3 is summarized next based on [RD.8].

The Normal Operational Mode (NOM) is dedicated to the science mission. It provides basically through the Earth Pointing Phase (EPP) three axes stabilized Earth pointing attitude with accuracy and stability compliant with the payload requirements.

EPP allows performing Earth observation with four different pointing laws:

- Geodetic pointing.
- Geodetic pointing with yaw-steering in order to compensate the Earth rotation.
- Geocentric pointing.
- Geocentric pointing with yaw-steering in order to compensate the Earth rotation.

3.4.2.4. Sentinel-6

Quaternions with fall-back on theoretical attitude model (default) or pure theoretical attitude model in case of unavailability of the quaternions computed on-board. This means that quaternions computed on-board by the AOCS are used primarily. In case of small gaps (less than 10 s), these quaternions are interpolated. In case of larger gaps, the attitude model is used instead. The attitude law of Sentinel-6 is summarized next based on [RD.12].

The nominal attitude is geodetic pointing with yaw-steering in order to compensate the Earth rotation.

4. COPERNICUS POD PRODUCTS DEFINITION

4.1. PRODUCTS IDENTIFIER

Table 4-1 below summarises the POD Service products with indication on the applicability of each product to the Sentinel Mission.

Table 4-1: POD Service Products and Auxiliary Data Files Overview vs. Sentinels mission

Product Type	Description	Type	File Type	S-1	S-2	S-3	S-6
POD Orbit Files	Predicted Orbit File	NRT	AUX_PREORB	X			
	Restituted Orbit File	NRT	AUX_RESORB	X	X		
	Medium Orbit Ephemerides (MOE) Orbit File	STC	AUX_MOEORB			X	
	Precise Orbit Ephemerides (POE) Orbit File	NTC	AUX_POEORB	X		X	
	NRT Restituted Orbit File	NRT	ROE_AX			X	
	NRT Restituted Orbit Ephemerides (ROE)	NRT	ROE__AX				X
Auxiliary Files for Sentinels	Preliminary Platform Data for Sentinel-3	STC	AUX_PRLPTF			X	
	Precise Platform Data for Sentinel-3	NTC	AUX_PRCPTF			X	
	NRT Platform Data for Sentinel-3	NRT	SR_2_NRPPAX			X	
Hourly GNSS L1b RINEX files	Hourly GNSS L1b RINEX files for CNES	NRT	AUX_GNSSRX			X	
	Hourly GNSS L1b RINEX files for EUM	NRT	RNXH_AX				X
Daily GNSS L1b RINEX files	Daily GNSS L1b RINEX files for CNES	STC	AUX_GNSSRD			X	
	Daily GNSS L1b RINEX files for CDSE	STC	AUX_GNSSRD	X(*)	X(*)	X(*)	X(*)
	Daily GNSS L1b RINEX files for EUM	STC	RNXD_AX				X
Quaternions files	Quaternions files for CDSE	STC	AUX_PROQUA	X(*)	X(*)	X(*)	X(*)
CPF predictions	CPF predictions	STC	AUX_STCCPF			X(*)	

(*) Not used as input in the respective Sentinel PDGS/PDAP operational chain.

Table 4-2 summarises the POD Products that are generated for each Sentinel Mission.

Table 4-2: Copernicus POD Service Products vs. Sentinel Mission

Mission	POD Product
Sentinel-1	Predicted Orbit File
	Restituted Orbit File
	Precise Orbit Ephemerides (POE) Orbit File
	Daily GNSS L1B RINEX files for CDSE
	Quaternions files for CDSE
Sentinel-2	Restituted Orbit File
	Daily GNSS L1B RINEX files for CDSE
	Quaternions files for CDSE
Sentinel-3	NRT Restituted Orbit File
	NRT Platform Data
	Medium Orbit Ephemerides (MOE) Orbit File
	Precise Orbit Ephemerides (POE) Orbit File
	Hourly GNSS L1B RINEX files for CNES
	Daily GNSS L1B RINEX files for CNES

Mission	POD Product
	Daily GNSS L1B RINEX files for CDSE
	Quaternions files for CDSE
	CPF orbit predictions for the ILRS
	Preliminary Platform Data
	Precise Platform Data
Sentinel-6	NRT Restituted Orbit Ephemerides (ROE)
	Hourly GNSS L1b RINEX files for EUM
	Daily GNSS L1b RINEX files for EUM
	Daily GNSS L1B RINEX files for CDSE
	Quaternions files for CDSE

4.2. PRODUCTS DESCRIPTIONS

The description of each of the products is presented in the applicable document [AD.1].

4.3. PRODUCTS FORMATS

[AD.1] describes the format and file naming of each of the products as a direct application of the previous documents.

4.4. PRODUCTS ACCESIBILITY

All the information available for the general public and related to the different aspects of the Sentinels missions can be found in the Sentinel Online webpage (https://sentinel.esa.int/). The general public is allowed to access the CPOD products via the Copernicus Data Space Ecosystem (https://dataspace.copernicus.eu/). Table 4-3 summarises the current list of the CPOD products available on the CDSE.

Table 4-3: CPOD Products available on the ESA Copernicus Data Space Ecosystem

Mission	CPOD Product	Comments
S-1	Restituted Orbit File	The product backlog of last month is available
	POE Orbit File	The product backlog of the entire mission is available
	Daily GNSS L1B RINEX files for CDSE	The product backlog of the entire mission is available
	Quaternions files for CDSE	The product backlog of the entire mission is available
S-2	Daily GNSS L1B RINEX files for CDSE	The product backlog of the entire mission is available
	Quaternions files for CDSE	The product backlog of the entire mission is available
S-3	NRT Restituted Orbit File	The product backlog of last month is available
	Medium Orbit Ephemerides (MOE) Orbit File	The product backlog of last month is available
	Precise Orbit Ephemerides (POE) Orbit File	The product backlog of the entire mission is available
	Precise Platform Data	The product backlog of the entire mission is available
	Daily GNSS L1B RINEX files for CDSE	The product backlog of the entire mission is available
	Quaternions files for CDSE	The product backlog of the entire mission is available
S-6	NRT Restituted Orbit Ephemerides (ROE)	The product backlog of last month is available
	Daily GNSS L1B RINEX files for CDSE	The product backlog of the entire mission is available
	Quaternions files for CDSE	The product backlog of the entire mission is available

5. SYSTEM BASELINES

This section describes the evolutions of the CPOD system used to generate the POD products.

The approach used in the Copernicus POD Service is to have a common POD baseline (understood as the source code version of the different binaries) for all the Sentinel missions. This means that whenever a new system is deployed, all the products from all the missions are generated with the new baseline, even if this baseline does not contain any upgrade or change for a particular mission. As such, this section summarises the main changes in the different baselines and to which mission these changes apply.

5.1. SYSTEM CHANGES SUMMARY

Table 5-1 shows the main changes that have been implemented in the system and the system version in which they were implemented, as well as what missions are affected by that change. As explained before, the system change is done for all missions (i.e. the CPOD Service does not keep different system versions deployed operationally for different missions), but not all the changes effectively impact all missions.

Version SPOD_SYSTEM_v0.8.4 is used as reference. Details related to the described changes can be found in subsequent sections, specifying exactly which subsystems they are expected to have influence on. Moreover, configuration parameters are gathered, and modifications are clearly stated. Only changes affecting missions in flight have been considered in the following summary. Starting on SPOD_SYSTEM_v1.7.x, only major version changes which have an impact on POD products are reported in this document without details on sub-versions (which include minor modifications not directly impacting products).

Table 5-1: System changes summary (based on SPOD_SYSTEM_v0.8.4)

Version	Date	Change description	S-1	S-2	S-3	S-6
SPOD_SYSTEM_v0.8.5	29/09/2014	Remove an interval around manoeuvres in QC Reports to avoid spikes in comparisons	X			
		Use last 5 available EGP 24H products instead of only one to improve RESORB products accuracy	X			
SPOD_SYSTEM_v0.8.6	18/11/2014	Stop upload of S1 RESATT products to ftp	X			
		Use MPL_PREORB to obtain orbit number for S-1 NTC and NRT products	X			
SPOD_SYSTEM_v0.8.7	08/01/2015	Change the IERS standards from IERS2003 to IERS2010	X			
		Usage of the gravity field model EIGEN6S instead of the GRACE05	X			
		Usage of the ocean tide model EOT11a instead of FES2004	X			
SPOD_SYSTEM_v0.8.8	27/01/2015	New WRMS and editing sigma set to 5.0 instead of 3.0	X			
		Write RESATT in EO CFI frame	X			
SPOD_SYSTEM_v0.8.9	27/02/2015	Improve robustness of NTC and ESOC comparisons	X			
		Correct issues in the generation of attitude product	X			
SPOD_SYSTEM_v0.9.0	07/04/2015	Change the Napeos satellites IDs in database	X			
SPOD_SYSTEM_v0.9.1	24/06/2015	Use the navigation message as a basis for the construction of the STC or IGS files	X			
		Change RMS pseudo-range threshold to 1.0 m and adapt QC Reports threshold	X			
		Add option to interpolate attitude file for attitude products generation	X			
Sentinel-2A Launch (23/06/2015)						
SPOD_SYSTEM_v0.9.2	14/07/2015	Change NTC determination arc from 72h to 48h	X	X		
		Increase robustness of attitude processing	X	X		

Version	Date	Change description	S-1	S-2	S-3	S-6
SPOD_SYSTEM_v0.9.3	05/08/2015 (S-1) 29/07/2015 (S-2)	New attitude mode implemented for S-2A		X		
		Launch NTC processing 7 days into the past for S-2A		X		
SPOD_SYSTEM_v0.9.4	25/09/2015	Use constant set of state vectors to produce a proper RESORB for S2, according to ICD		X		
		Deploy new Antex file with information about S-1A nominal and redundant receiver, and S-2A nominal receiver	X	X		
SPOD_SYSTEM_v0.9.5	06/10/2015	Configure the quality flagging mechanism for S-2 PREORB products		X		
		Deploy updated Antex for S1A GPS redundant receiver and S2A nominal receiver	X	X		
SPOD_SYSTEM_v0.9.6	14/12/2015	Generate S-2 PREORB products only if there are SAD PDIs in the last 4 hours	X	X		
		Update Sentinel's ANTEX file		X		
		Update S3PODIPF (GPS L0 decoder) to improve accuracy of pseudo-ranges and avoid usage of GPS Ephemeris	X	X		
SPOD_SYSTEM_v0.10.0	25/01/2016	Update Box Wing Model for S-1A	X			
		Include a S-2 Box-Wing Model (previously it was using constant area)		X		
		Include a S-3 Box-Wing Model (not tested yet)			X	
Sentinel-3A Launch (17/02/2016)						
SPOD_SYSTEM_v1.0.0	18/02/2016	Updated GPS DBs (satellite.dat, transp.dat) Updated GPS Antex (igs08.atx) Updated ICDBs for format alignment	X	X	X	
		Included PassSegmentList module			X	
SPOD_SYSTEM_v1.0.1	08/03/2016	Updated Sentinel DBs (satellite.dat, transp.dat) for Sentinel-3A to align to launch values			X	
		Updated version of NAPEOS4S3PODIPF correcting attitude handling			X	
SPOD_SYSTEM_v1.0.2	11/03/2016	Corrected frame of reference transformation to Satellite Frame of Reference for S-3			X	
SPOD_SYSTEM_v1.0.3	05/03/2016	Corrected decoding of NAVATT files for generating quaternions using Packet Generation Timestamp			X	
SPOD_SYSTEM_v1.0.4	06/03/2016	Corrected Platform Data File frame of reference			X	
SPOD_SYSTEM_v1.0.5	13/04/2016	Updated ANTEX including S-3A GPSA receiver			X	
		Updated Sentinel transponder DB (transp.dat) with corrected information on SLR antenna			X	
		Add ILRS stations 1824, 1888, 1889, 1990 and 7827 to the station DB			X	
SPOD_SYSTEM_v1.0.6	20/04/2016	Updated Sentinel transponder DB (transp.dat) with corrected location of GNSS antennae for Sentinel-3A			X	
		Updated ANTEX including S-3A GPSA receiver using new antenna location, computed from 8 days of NTC executions			X	
		Change timeliness of S3 NTC to go 25 days			X	
SPOD_SYSTEM_v1.0.7	21/04/2016	Change Quality flags thresholds of Sentinel-3A to align to S-1A and S-2A values			X	
		Update Sentinel transponder DB (transp.dat) to update reference point of SRAL antenna			X	
		Modify S3PODIPF to generate NRT products based on the navigation solution when Bahn POD fails			X	

Version	Date	Change description	S-1	S-2	S-3	S-6
		Modify S3PODIPF to change permission of generated files to 644 explicitly			X	
Sentinel-1B Launch (22/04/2016)						
SPOD_SYSTEM_v1.0.8	30/05/2016	Update S3PODIPF to extract path for temporary NAPEOS files from Job Order output			X	
		Solve issue causing occasional incorrect Orbit Number in EOF NRT products	X	X	X	
SPOD_SYSTEM_v1.0.9	27/06/2016	Solve issue with S3PODIPF related to number of SV count in PTF			X	
		Deploy new ANTEX with S-1B information	X			
SPOD_SYSTEM_v1.0.10	06/09/2016	Update SLR stations selection policy to exclude tracking from biased stations			X	
		Update rsgaConv.bin to make it more robust against missing info in Solar Activity File	X	X	X	
		Change Bahn configuration for S-3 STC and NTC, and for S3PODIPF to use multi-tracks in case of manoeuvre			X	
		Change timeliness of hourly RINEX for CNES to 4.5h after sensing time			X	
SPOD_SYSTEM_v1.1.0	20/10/2016	Deploy new IPF to decode Sentinel-1 quaternions from SAR Annotation files	X			
		Change Bahn configuration for S-2 NRT orbits to use manoeuvre split arcs in case of manoeuvre		X		
		Change timeliness to launch PREORB 100min before predicted ANX		X		
		Add CMC handling in sp3 orbit generation	X	X	X	
		Correct expression of the solar radiation pressure partial derivative in the Box Wing Model	X	X	X	
SPOD_SYSTEM_v1.1.1	10/11/2016	Deploy new ANTEX with S-3A information computed by 90 days of residuals			X	
		The timeliness and coverage of the Medium Orbit Ephemerides Orbit Files (AUX_MOEORB) and Preliminary Platform Data Files (AUX_PRLPTF) has been adapted to the expectations of the S3 PDGS, such that the product with coverage d-2 at 22h to d-1 at 24h (GPS time) will be delivered before noon on day d.			X	
		The coverage of the Precise Orbit Ephemerides Orbit Files (AUX_POEORB) and Precise Platform Data Files (AUX_PRCPTF) has been change to d-1 22:00 until d+1 00:00 (GPS time)			X	
SPOD_SYSTEM_v1.2.0	13/12/2016	Include tool to reduce SAR Annotation Files, SAD PDI files, overlaps and duplicates from archive (affecting reprocessing)	X	X	X	
		The determination period of NTC products has been reduced from 48h to 32h (26h coverage + 3h in each border)	X	X	X	
		The minimum number of observations per epoch threshold has been modified from 4 to 1 for quality flagging (more appropriate for dynamic orbit determination).	X	X	X	
		Implement S-2 solar array rotation (rewinding during eclipse).		X		
		New gravity field model EIGEN.GRGS.RL03.v2.coef	X	X	X	
		Deploy first version of SLR ANTEX for S-3A based on LRR geometry			X	

Version	Date	Change description	S-1	S-2	S-3	S-6
		Deploy new ANTEX with S-1B information computed by 84 days of residuals	X			
SPOD_SYSTEM_v1.2.1	16/01/2017	The filename of CPF gets the epoch directly from the CPF itself			X	
		Two new chains (S?PODNTCREPRO-A/B and S?PODNTCRP-A/B) created for reprocessing NTC products	X	X	X	
SPOD_SYSTEM_v1.3.0	16/02/2017	Correct the unexpected peak that sometimes appeared in the Number of consecutive violated orbits figure.	X			
		Deploy a new GPS ANTEX (igs14_1935.atx)	X	X	X	
Sentinel-2B Launch (07/03/2017)						
SPOD_SYSTEM_v1.3.1	27/03/2017	Correct the unexpected peak that sometimes appeared in the Mean Local Solar Time figure.	X			
		Update header for ITRF14 realization in OrbUpd to generate sp3 orbits	X	X	X	
SPOD_SYSTEM_v1.3.2	18/05/2017	Change in CNES RINEX generation process to guarantee continuity between different execution			X	
SPOD_SYSTEM_v1.3.3	29/05/2017	New antex file deployed: sen08_1950.atx		X		
		New GPS antex file deployed: igs14_1949.atx	X	X	X	
		Change POD NTC/STC processing chain to avoid using broadcast navigation message information (BRDC) info if IGS/STC orbits available	X	X	X	
SPOD_SYSTEM_v1.3.4	19/06/2017	Generation and distribution of daily operational RINEX	X	X	X	
SPOD_SYSTEM_v1.3.5	27/07/2017	Include option to apply Differential Code Biases when using observations different than P1 and P2	X	X	X	
		Use 24H orbit file prediction for S3PODIPF near end of interval			X	
		Use Earth Orientation Parameters (EOPs) provided by EGP for S3PODIPF			X	
		Align all EGP clocks to broadcast navigation message for S3PODIPF			X	
		Implement clever selection of EGP inputs by S3PODIPF to avoid copying unneeded files			X	
SPOD_SYSTEM_v1.3.6	22/08/2017	Implement changes related to Post-Seismic Deformation (PSD)			X	
		Update source code to be compatible with SLES12 SP1 compiler, and with gfortran 4.6.1	X	X	X	
		Improvements for Quality Reports	X	X	X	
		New antex file deployed with Sentinel-2B 90-residual computation: sen08_1963.atx		X		
		New station database deployed pointing to ILRS2014 coordinate file (ILRS2014-ESOC.crd)	X	X	X	
SPOD_SYSTEM_v1.3.7	11/10/2017	Upgrade IPF to update RINEX files version to 3.03	X	X	X	
		Start processing GNSS RINEX for Copernicus Data Hub, including dissemination mechanisms	X	X	X	

Version	Date	Change description	S-1	S-2	S-3	S-6
SPOD_SYSTEM_v1.3.8	30/10/2017	Correct problem reported by LAND centre in S3PODIPF – degraded orbit when 24H orbit and clock do not correspond to same epoch (see NRTPODAR-11). Correct issues in preparation for S-3B: – The attitude product (SR_2_NRPPAX) generation rate has been changed to 10s, as per FFS – The box-wing model has been aligned to S-3A – The threshold for pseudorange RMS has been changed from 1.0 to 1.5 m to consider DEGRADED products to allow for L2C processing without DCBs			X	
SPOD_SYSTEM_v1.3.9	08/11/2017	Preliminary version of DORIS processing chain (DORIS-only and DORIS+GPS orbits) Adapt GETHF chains (mainly for S-2) to use trigger strategy - avoid stacking of processing executions Implement outlier detection mechanism for polynomial time computation in S3PODIPF Implement half cycle bias correction reading info from GPS Auxiliary Data (s-1,-3 and s-2b) or GPS Channel Status data (s-2a)	X	X	X	
SPOD_SYSTEM_v1.4.0	28/11/2017	Removal of temperature effects and configure HW bias to 23.5 m in the decoding tool (IPF)	X	X	X	
		Correction of half-cycle ambiguities in the decoding tool (IPF)	X	X	X	
		Align RINEX epochs to GPS time instead of IMT for all the orbital products, but the S-3 NRT ones	X	X	X	
		Enable the uploading of S-1B RESATT products in NRT time	X			
		Update location of S-3B antenna in DB			X	
SPOD_SYSTEM_v1.4.1	29/01/2018	Create processing chain to process DORIS operationally and DORIS+GPS			X	
		Prepare a new version of S3PODIPF with changes to do not use L2C with S-3B during commissioning			X	
		Create new S-3 interface from CPOD/EGP and LAND centre for S-3B			X	
SPOD_SYSTEM_v1.4.2	26/02/2018	Create chains to generate and distribute data for Sentinel OnLine	X	X	X	
		New ANTEX file with small corrections deployed: sen08_1989.atx	X	X	X	
		New satellite & transponder DBs with small corrections deployed: s3satellite1990100.dat & s3transp1990100.dat	X	X	X	
		New S3B ICDB was deployed: s3bicdb_1969.xml			X	
		Corrections on S3PODIPF for redundant receiver: – The generation of imt2gps file – Half cycle ambiguity – Decoding S2 L0 data	X	X	X	
Sentinel-3B Launch (25/04/2018)						
SPOD_SYSTEM_v1.4.3	08/05/2018	Update the SVL server IP address to trinity server			X	
		New satellite & transponder DBs with updated NORAD, COSPAR and SIC IDs for Sentinel-3B: s3satellite2000100.dat & s3transp2000100.dat			X	
SPOD_SYSTEM_v1.5.0	05/06/2018	Generate quaternions file merging real and simulated attitudes during data gaps.	X	X	X	

Version	Date	Change description	S-1	S-2	S-3	S-6
		Implement new mechanisms to fill EGP/magic gaps in case of FTP/internet failure	X	X	X	
		Modifications to correct application of North and East PCO values	X			
SPOD_SYSTEM_v1.5.1	04/10/2018	Preparation of the system for the processing of Sentinel-3B.			X	
		Implemented a satellite re-radiation model	X	X	X	
		Implemented a fixed solar array model for S1	X			
		Updated sentinels ANTEX to include information for S3B and updated sentransp.dat to include SLR ANTEX for S3B (the same that is used by S3A)			X	
		Updated IRI model and addition of NeQuick				
		Updated reference orbit of S3B			X	
		Updated IPF to correctly decode L0 data from both redundant and nominal receivers simultaneously.			X	
SPOD_SYSTEM_v1.5.2	30/10/2018	Implementation and operational usage of the Sentinel-2 Geocentric YSM attitude mode.		X		
SPOD_SYSTEM_v1.5.3	07/11/2018	Update the GPS databases to align them with the latest changes in the GPS constellation.	X	X	X	
		Update of the Sentinels databases to update the location of the y-axis coordinate of instruments on S-3A to match CNES/DLR configuration.			X	
SPOD_SYSTEM_v1.5.4	06/03/2019	Update GPS satellite and transponder DBs and include new GPS ANTEX according to the launch of the satellite GPS-74	X	X	X	
		Modify the format of the quaternions files' header as generated by the decoder L0 to L1b	X	X	X	
		Update AttComp program in order to properly tag the pitch and roll angles	X	X	X	
SPOD_SYSTEM_v1.5.5	14/10/2019	Quaternions products (AUX_PROQUA) can be generated by the system	X	X	X	
		Alignment of EGP 15M GPS and broadcast clocks products to EGP 24H GPS clocks products during the generation of NRT orbits	X	X	X	
		QC CPOD-CNES comparisons for S3 NRT & STC CPOD products against CNES MDO solution instead of CNES MGN solution			X	
		CPOD System able to process CRDs V2 and to generate CPFs V2. Additionally, CPFs V2 distributed to an intended folder inside the external FTP server			X	
		Enable the generation of S1 AUX_PREORB products	X			
		Update decoder to properly handle the GPS week rollover occurred on 07/04/2019	X	X	X	
		Update GPS ANTEX (igs14_2062.atx), GPS transponder DB (transp2062400.dat) and GPS satellite DB (satellite2062400.dat)	X	X	X	
SPOD_SYSTEM_v1.6.0	06/05/2020	The system has been updated to include the new models	X	X	X	
		The NTC products are now ambiguity fixed	X		X	
		Accuracy improvement on the S-2 PREORB products and the S-3 CPF Prediction files for the ILRS		X	X	
		Creation of the corresponding chains for being able to upload S-1 NRT/NTC and S-3 NRT/STC/NTC/PRCPTF products to the Copernicus Open Access Hub on a daily basis	X		X	

Version	Date	Change description	S-1	S-2	S-3	S-6
		Corrected an underperformance when merging GNSS 15M and 24H input files on the generation of the NRT products	X	X	X	
		Update GPS ANTEX file (igs14_2101.atx), GPS transponder DB (transp2104300.dat), and GPS satellite DB (satellite2104300.dat)	X	X	X	
SPOD_SYSTEM_v1.7.x	29/07/2020	Change of S-1 ARP configuration and updated ANTEX file for S-1 (sen08_2116.atx)	X			
		Correct bug in computation of water vapour for tropospheric estimation – impacting only SLR residuals analysis			X	
		Update of GPS ANTEX file (igs14_2114.atx)	X	X	X	
SPOD_SYSTEM_v1.8.x	23/09/2020	The system makes use of the GNSS products delivered by the new and backup external GNSS providers (EGPs)	X	X	X	
		The system is able to populate the S3PODIPF operational folders containing GNSS products with products from the backup EGP in case of an outage of the main EGP			X	
		The header of the clocks RINEX files has been updated to show the number of analysis clock references even if this number is equal to zero	X	X	X	
Sentinel-6A Launch (21/11/2020)						
SPOD_SYSTEM_v1.9.x	16/12/2020	Creation of Sentinel-6 chains to retrieve the Sentinel-6 inputs and generate the corresponding products				X
		Update IPF to decode Sentinel-6 input files				X
		Update the S-1 NTC chain in charge of the reprocessing	X			
		Update the thermospheric winds model to HWM14	X	X	X	X
		Update the planetary ephemerides to DE-421	X	X	X	X
		Update GPS ANTEX file (igs14_2134.atx) and Sentinels ANTEX file (sen08_2133.atx) and include new SLR ANTEX file for S-6A (slr_sent6a_2136.lrx)	X	X	X	X
		Update GPS transponder DB (transp2136200.dat) and GPS satellite DB (satellite2136200.dat)	X	X	X	X
SPOD_SYSTEM_v1.10.x	02/02/2020	To change the orbit parametrization of STC and NTC products to: - Estimate 16 empirical accelerations (constant, sine and cosine) in along and cross-track. - Fix the solar radiation pressure coefficient (per satellite) - To estimate a single drag coefficient.	X		X	
		The macro-model of Sentinel-1 has been updated to account for changes in the areas of the SAR and solar arrays	X			
		The albedo model has been updated with new mean VIS/IR maps using CERES data	X	X	X	X
		To reduce the timeliness of AUX_PROQUA	X	X	X	
		To create the STC and QC chains for Sentinel-6A mission				X
SPOD_SYSTEM_v1.11.x	14/06/2021	Updated quality control for the EGP	X	X	X	X
		Generation of S-6A NTC products				X
		The POD configuration of S-6A ROE products has been modified (GPS with ISB and 30 s observations)				X
		New ANTEX files for Sentinels satellites, GNSS satellites and Sentinel-6A LRR have been deployed				X

Version	Date	Change description	S-1	S-2	S-3	S-6
		The macro model for Sentinel-6A satellite has been updated				X
		The Sentinels transponder DB (sentransp.dat) has been updated				X
SPOD_SYSTEM_v2.0.X	23/11/2022	New ITRF-20 realization and standards	X	X	X	X
SPOD_SYSTEM_v3.0.X	30/01/2023	New POD SW (***FocusPOD***)	X	X	X	X
SPOD_SYSTEM_v3.1.X	13/02/2023	Bug fixes in ***FocusPOD***: correct decoding of GPS timestamps in GPS week roll-overs	X	X	X	X
		Bug fixes in ***FocusPOD***: correct CPF leap second field			X	
		Force alignment of S-3 Platform Files to Euler Angles around 0º			X	
SPOD_SYSTEM_v3.2.X	21/03/2023	Correct L0 decoding of S-6 RNX missing 1 Hz CP observations				X
		Update IGS and Sentinels ATX	X	X	X	X
		Add temperature calibration in S-6 RNX				X
SPOD_SYSTEM_v3.3.X	18/07/2023	Change gravity field model to COST-G	X	X	X	X
SPOD_SYSTEM_v3.4.X	31/07/2023	Exchange of S-6A NRT estimated inter-system bias to align iono-free signals GPS [1C, 2L] to the GNSS clocks' references GPS [1W, 2W] for the application of the corresponding differential code bias provided by the EGP. See section 3.3.1 for further information.				X
SPOD_SYSTEM_v3.5.X	04/09/2023	Application of S-6A yaw bias of -0.43 deg.				X
SPOD_SYSTEM_v3.6.X	17/10/2023	Application of differential code biases in all CPOD Service orbit products (except for NTC, which uses CODE's) to align the iono-free signals to new ***magicGNSS***' clock reference signals: GPS [1C, 2W] and GAL [1C, 7Q].	X	X	X	X

5.2. SPOD_SYSTEM_V0.8.4

Table 5-2: SPOD_SYSTEM_v0.8.4

Parameter	Comment
Applicable date	16/09/2014
Applicable FFS version and date	v1.13 from 13/06/2014
TAG	SPOD_SYSTEM_v0.8.4
POD SW	NAPEOS
Applicable missions	S-1A
Arc length	NRT: 24h; NTC: 72h
IERS Conventions	IERS 2003
Gravity Field	GRACE05
Ocean Tides	FES2004
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	6 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1810.atx
GNSS PCO/PCV	TBC
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	First version

5.3. SPOD_SYSTEM_V0.8.5

Table 5-3: SPOD_SYSTEM_v0.8.5

Parameter	Comment
Applicable date	29/09/2014
Applicable FFS version and date	v1.14 from 01/10/2014
TAG	SPOD_SYSTEM_v0.8.5
POD SW	NAPEOS
Applicable missions	S-1A
Arc length	NRT: 24h; NTC: 72h
IERS Conventions	IERS 2003
Gravity Field	GRACE05
Ocean Tides	FES2004
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	6 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1810.atx
GNSS PCO/PCV	TBC
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.4. SPOD_SYSTEM_V0.8.6

Table 5-4: SPOD_SYSTEM_v0.8.6

Parameter	Comment
Applicable date	18/11/2014
Applicable FFS version and date	v1.14 from 01/10/2014
TAG	SPOD_SYSTEM_v0.8.6
POD SW	NAPEOS
Applicable missions	S-1A
Arc length	NRT: 24h; NTC: 72h
IERS Conventions	IERS 2003
Gravity Field	GRACE05
Ocean Tides	FES2004
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	6 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1810.atx
GNSS PCO/PCV	TBC
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.5. SPOD_SYSTEM_V0.8.7

Table 5-5: SPOD_SYSTEM_v0.8.7

Parameter	Comment
Applicable date	08/01/2015
Applicable FFS version and date	v1.14 from 01/10/2014
TAG	SPOD_SYSTEM_v0.8.7
POD SW	NAPEOS
Applicable missions	S-1A
Arc length	NRT: 24h; NTC: 72h
IERS Conventions	**IERS 2010**
Gravity Field	**EIGEN6S**
Ocean Tides	**EOT11a**
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	6 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1810.atx
GNSS PCO/PCV	TBC
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.6. SPOD_SYSTEM_V0.8.8

Table 5-6: SPOD_SYSTEM_v0.8.8

Parameter	Comment
Applicable date	27/01/2015
Applicable FFS version and date	v1.14 from 01/10/2014
TAG	SPOD_SYSTEM_v0.8.8
POD SW	NAPEOS
Applicable missions	S-1A
Arc length	NRT: 24h; NTC: 72h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	6 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1810.atx
GNSS PCO/PCV	TBC
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.7. SPOD_SYSTEM_V0.8.9

Table 5-7: SPOD_SYSTEM_v0.8.9

Parameter	Comment
Applicable date	27/02/2015
Applicable FFS version and date	**v1.15 from 13/02/2015**
TAG	SPOD_SYSTEM_v0.8.9
POD SW	NAPEOS
Applicable missions	S-1A
Arc length	NRT: 24h; NTC: 72h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	6 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1810.atx
GNSS PCO/PCV	TBC
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.8. SPOD_SYSTEM_V0.9.0

Table 5-8: SPOD_SYSTEM_v0.9.0

Parameter	Comment
Applicable date	07/04/2015
Applicable FFS version and date	**v1.16 from 27/03/2015**
TAG	SPOD_SYSTEM_v0.9.0
POD SW	NAPEOS
Applicable missions	S-1A
Arc length	NRT: 24h; NTC: 72h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	6 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1810.atx
GNSS PCO/PCV	TBC
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.9. SPOD_SYSTEM_V0.9.1

Table 5-9: SPOD_SYSTEM_v0.9.1

Parameter	Comment
Applicable date	24/06/2015
Applicable FFS version and date	v1.16 from 27/03/2015
TAG	SPOD_SYSTEM_v0.9.1
POD SW	NAPEOS
Applicable missions	S-1A
Arc length	NRT: 24h; NTC: 72h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	6 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1810.atx
GNSS PCO/PCV	TBC
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.10. SPOD_SYSTEM_V0.9.2

Table 5-10: SPOD_SYSTEM_v0.9.2

Parameter	Comment
Applicable date	14/07/2015
Applicable FFS version and date	v1.16 from 27/03/2015
TAG	SPOD_SYSTEM_v0.9.2
POD SW	NAPEOS
Applicable missions	S-1A
Arc length	**NRT: 24h; NTC: 48h**
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	**10 parameters per 24 h**
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1810.atx
GNSS PCO/PCV	TBC
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.11. SPOD_SYSTEM_V0.9.3

Table 5-11: SPOD_SYSTEM_v0.9.3

Parameter	Comment
Applicable date	29/07/2015 (S-2A); 05/08/2015 (S-1A)
Applicable FFS version and date	v1.16 from 27/03/2015
TAG	SPOD_SYSTEM_v0.9.3
POD SW	NAPEOS
Applicable missions	S-1A, **S-2A**
Arc length	NRT: 24h; NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1810.atx
GNSS PCO/PCV	TBC
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.12. SPOD_SYSTEM_V0.9.4

Table 5-12: SPOD_SYSTEM_v0.9.4

Parameter	Comment
Applicable date	25/09/2015
Applicable FFS version and date	**v1.17 from 28/08/2015**
TAG	SPOD_SYSTEM_v0.9.4
POD SW	NAPEOS
Applicable missions	S-1A, S-2A
Arc length	NRT: 24h; NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_1862.atx**
GNSS PCO/PCV	TBC
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.13. SPOD_SYSTEM_V0.9.5

Table 5-13: SPOD_SYSTEM_v0.9.5

Parameter	Comment
Applicable date	06/10/2015
Applicable FFS version and date	v1.17 from 28/08/2015
TAG	SPOD_SYSTEM_v0.9.5
POD SW	NAPEOS
Applicable missions	S-1A, S-2A
Arc length	NRT: 24h; NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_1864.atx**
GNSS PCO/PCV	TBC
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.14. SPOD_SYSTEM_V0.9.6

Table 5-14: SPOD_SYSTEM_v0.9.6

Parameter	Comment
Applicable date	14/12/2015
Applicable FFS version and date	v1.17 from 28/08/2015
TAG	SPOD_SYSTEM_v0.9.6
POD SW	NAPEOS
Applicable missions	S-1A, S-2A
Arc length	NRT: 24h; NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_1873.atx**
GNSS PCO/PCV	TBC
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.15. SPOD_SYSTEM_V0.10.0

Table 5-15: SPOD_SYSTEM_v0.10.0

Parameter	Comment
Applicable date	25/01/2016
Applicable FFS version and date	**v1.18 from 18/12/2015**
TAG	SPOD_SYSTEM_v0.10.0
POD SW	NAPEOS
Applicable missions	S-1A, S-2A
Arc length	NRT: 24h; NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	**Yes**
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1873.atx
GNSS PCO/PCV	**igs08_1869.atx**
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Update Box Wing Model for S-1A assuming that the solar panels are not oriented perpendicularly to the Sun but fixed at an angle with respect to the satellite body. Implement new Box Wing Model for S-2A instead of assuming constant area. Implement new Box Wing Model for S-3 instead of assuming constant area.

5.16. SPOD_SYSTEM_V1.0.0

Table 5-16: SPOD_SYSTEM_v1.0.0

Parameter	Comment
Applicable date	18/02/2016
Applicable FFS version and date	v1.18 from 18/12/2015
TAG	SPOD_SYSTEM_v1.0.0
POD SW	NAPEOS
Applicable missions	S-1A, S-2A
Arc length	NRT: 24h; NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1873.atx
GNSS PCO/PCV	**igs08_1884.atx**
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.17. SPOD_SYSTEM_V1.0.1

Table 5-17: SPOD_SYSTEM_v1.0.1

Parameter	Comment
Applicable date	08/03/2016 (only for S-3)
Applicable FFS version and date	v1.18 from 18/12/2015
TAG	SPOD_SYSTEM_v1.0.1
POD SW	NAPEOS
Applicable missions	**S-3A**
Arc length	NRT: 24h; STC, NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1873.atx
GNSS PCO/PCV	igs08_1884.atx
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.18. SPOD_SYSTEM_V1.0.2

Table 5-18: SPOD_SYSTEM_v1.0.2

Parameter	Comment
Applicable date	11/03/2016 (only for S-3)
Applicable FFS version and date	v1.18 from 18/12/2015
TAG	SPOD_SYSTEM_v1.0.2
POD SW	NAPEOS
Applicable missions	**S-3A**
Arc length	NRT: 24h; STC, NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1873.atx
GNSS PCO/PCV	igs08_1884.atx
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Updated implementation of frame of reference transformations from Local Orbital Reference Frame to Satellite Reference Frame. This new implementation corrects a bias observed with respect to CNES orbits in the along-track component of around 275 cm

5.19. SPOD_SYSTEM_V1.0.3

Table 5-19: SPOD_SYSTEM_v1.0.3

Parameter	Comment
Applicable date	05/04/2016 (only for S-3)
Applicable FFS version and date	v1.18 from 18/12/2015
TAG	SPOD_SYSTEM_v1.0.3
POD SW	NAPEOS
Applicable missions	S-3A
Arc length	NRT: 24h; STC, NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1873.atx
GNSS PCO/PCV	igs08_1884.atx
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Modified IPF to decode quaternions from NAVATT files using Package Generation Timestamp from header. This solves the shift of 1s observed with respect to CNES quaternions and consequently, a bias of 0.06º observed in the pointing direction with respect to nadir between quaternions and simulated attitude

5.20. SPOD_SYSTEM_V1.0.4

Table 5-20: SPOD_SYSTEM_v1.0.4

Parameter	Comment
Applicable date	06/04/2016 (only for S-3)
Applicable FFS version and date	v1.18 from 18/12/2015
TAG	SPOD_SYSTEM_v1.0.4
POD SW	NAPEOS
Applicable missions	S-3A
Arc length	NRT: 24h; STC, NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1873.atx
GNSS PCO/PCV	igs08_1884.atx
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Modified generation of attitude products (Precise and Preliminary Platform Data files) to correct mismatch between Euler angles sequence. They were previously written as Roll – Pitch – Yaw but should have been written as Pitch – Roll – Yaw. Therefore, the Roll angle was written under the Pitch tag and vice versa. This has been corrected and angles are written in the appropriate sequence as per ICD.

5.21. SPOD_SYSTEM_V1.0.5

Table 5-21: SPOD_SYSTEM_v1.0.5

Parameter	Comment
Applicable date	13/04/2016 (only for S-3)
Applicable FFS version and date	v1.18 from 18/12/2015
TAG	SPOD_SYSTEM_v1.0.5
POD SW	NAPEOS
Applicable missions	S-3A
Arc length	NRT: 24h; STC, NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_1892.atx**
GNSS PCO/PCV	igs08_1884.atx
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Updated Sentinels Transponder DB to include corrections in the SLR Antenna Point of Reference after assembly of the SLR antenna. Updated ANTEX PCV map including information on S-3A GPSA. The ANTEX has been generated using (0, 0, 68) mm as North-East-Up values (same as S-1A and S-2A), and the azimuth dependent values computed using 2 iterations on residuals from 29/03/2016 until 06/04/2016. Add ILRS stations 1824, 1888, 1889, 1990 and 7827 to the station DB (station.dat), list of coordinates (ILRS08.CRD) and list of Ocean Loading Displacement (FES2004_CMC.blq).

5.22. SPOD_SYSTEM_V1.0.6

Table 5-22: SPOD_SYSTEM_v1.0.6

Parameter	Comment
Applicable date	20/04/2016 (only for S-3)
Applicable FFS version and date	v1.18 from 18/12/2015
TAG	SPOD_SYSTEM_v1.0.6
POD SW	NAPEOS
Applicable missions	S-3A
Arc length	NRT: 24h; STC, NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_1893.atx**
GNSS PCO/PCV	igs08_1884.atx
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Updated Sentinels Transponder DB to correct location of GNSS antennae. Previously the antenna mounting point was being used instead of the GPS Reference Frame origin. Additionally, GNSS-1 and GNSS-2 antennae location seem to be mixed up in the documentation. Updated ANTEX PCV map including information on S-3A GPSA computed with the new transponder DB. The ANTEX has been generated using (0, 0, 68) mm as North-East-Up values (same as S-1A and S-2A), and the azimuth dependent values computed using 2 iterations on residuals from NTC processing from 10/03/2016 until 17/03/2016. Under request of ESA, the timeliness of NTC has been reduced to 25 days after assessing that IGS inputs arrive typically with a timeliness of 22 days or smaller.

5.23. SPOD_SYSTEM_V1.0.7

Table 5-23: SPOD_SYSTEM_v1.0.7

Parameter	Comment
Applicable date	26/04/2016
Applicable FFS version and date	v1.18 from 18/12/2015
TAG	SPOD_SYSTEM_v1.0.7
POD SW	NAPEOS
Applicable missions	**S-1A, S-2A, S-3A**
Arc length	NRT: 24h; STC, NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1893.atx
GNSS PCO/PCV	igs08_1884.atx
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Updated Sentinels Transponder DB to correct location of SRAL antenna, used to generate the Platform Data file. Previously a wrong reference point was being used. Now, the transp.dat used the location of the so-called VERTEX point.

5.24. SPOD_SYSTEM_V1.0.8

Table 5-24: SPOD_SYSTEM_v1.0.8

Parameter	Comment
Applicable date	30/05/2016
Applicable FFS version and date	v1.18 from 18/12/2015
TAG	SPOD_SYSTEM_v1.0.8
POD SW	NAPEOS
Applicable missions	S-1A, S-2A, S-3A
Arc length	NRT: 24h; STC, NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1893.atx
GNSS PCO/PCV	igs08_1884.atx
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.25. SPOD_SYSTEM_V1.0.9

Table 5-25: SPOD_SYSTEM_v1.0.9

Parameter	Comment
Applicable date	27/06/2016
Applicable FFS version and date	v1.20 from 10/06/2016
TAG	SPOD_SYSTEM_v1.0.9
POD SW	NAPEOS
Applicable missions	S-1A, **S-1B,** S-2A, S-3A
Arc length	NRT: 24h; STC, NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_1904.atx**
GNSS PCO/PCV	igs08_1884.atx
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.26. SPOD_SYSTEM_V1.0.10

Table 5-26: SPOD_SYSTEM_v1.0.10

Parameter	Comment
Applicable date	06/09/2016
Applicable FFS version and date	v1.20 from 10/06/2016
TAG	SPOD_SYSTEM_v1.0.10
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-3A
Arc length	NRT: 24h; STC, NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1904.atx
GNSS PCO/PCV	igs08_1884.atx
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.27. SPOD_SYSTEM_V1.1.0

Table 5-27: SPOD_SYSTEM_v1.1.0

Parameter	Comment
Applicable date	20/10/2016
Applicable FFS version and date	v1.20 from 10/06/2016
TAG	SPOD_SYSTEM_v1.1.0
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-3A
Arc length	NRT: 24h; STC, NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1904.atx
GNSS PCO/PCV	igs08_1884.atx
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Update S-2 Bahn configuration to use manoeuvre split arcs in the POD Bahn determined by the presence of a manoeuvre. Thus, processing metrics and orbital accuracy improve significantly despite the occurrence of long manoeuvres. Correct expression of the solar radiation pressure partial derivative.

5.28. SPOD_SYSTEM_V1.1.1

Table 5-28: SPOD_SYSTEM_v1.1.1

Parameter	Comment
Applicable date	10/11/2016
Applicable FFS version and date	v1.20 from 10/06/2016
TAG	SPOD_SYSTEM_v1.1.1
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-3A
Arc length	NRT: 24h; STC, NTC: 48h
IERS Conventions	IERS 2010
Gravity Field	EIGEN6S
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_1916.atx**
GNSS PCO/PCV	igs08_1884.atx
SLR PCO/PCV (S-3/S-6)	N/A
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Adapt the timeliness of the Medium Orbit Ephemerides Orbit Files (AUX_MOEORB) and Preliminary Platform Dada Files (AUX_PRLPTF) to the expectations of the S3 PDGS, such that the product with coverage d-2 at 22 h (GPS time) to d-1 at 24 h (GPS time) will be delivered before noon on day d. Change the coverage of the Precise Orbit Ephemerides Orbit Files (AUX_POEORB) and Precise Platform Data Files (AUX_PRCPTF) to follow the specification, which specifies: "Each file covers 26 h (one complete day, in GPS time, plus 2 h before the start of the day – overlap of two hours between consecutive files)".

5.29. SPOD_SYSTEM_V1.2.0

Table 5-29: SPOD_SYSTEM_v1.2.0

Parameter	Comment
Applicable date	13/12/2016
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.2.0
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-3A
Arc length	NRT: 24h; **STC, NTC: 32h**
IERS Conventions	IERS 2010
Gravity Field	**EIGEN.GRGS.RL03.v2.coef**
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	1 set of sine and cosine CPR per 12 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_1925.atx**
GNSS PCO/PCV	igs08_1884.atx
SLR PCO/PCV (S-3/S-6)	**slr_sent3a_1924.lrx**
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	The solar array rotation law of Sentinel-2 has been implemented following a theoretical description, affecting mainly the solar array rewinding during eclipse. A new gravity field model (EIGEN.GRGS.RL03.v2.coef) has been implemented in order to include extrapolated drift rates for the coefficients outside the determination period (until mid-2014). Deploy a new ANTEX for S-1B generated from a residual analysis of 3 months NTC processing. Deploy a first version of an SLR ANTEX like correction based on the LRR geometry for Sentinel-3A.

5.30. SPOD_SYSTEM_V1.2.1

Table 5-30: SPOD_SYSTEM_v1.2.1

Parameter	Comment
Applicable date	16/01/2017
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.2.1
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-3A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1925.atx
GNSS PCO/PCV	igs08_1884.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.31. SPOD_SYSTEM_V1.3.0

Table 5-31: SPOD_SYSTEM_v1.3.0

Parameter	Comment
Applicable date	16/02/2017
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.3.0
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-3A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1925.atx
GNSS PCO/PCV	igs14_1935.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.32. SPOD_SYSTEM_V1.3.1

Table 5-32: SPOD_SYSTEM_v1.3.1

Parameter	Comment
Applicable date	27/03/2017
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.3.1
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-3A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1925.atx
GNSS PCO/PCV	igs14_1935.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.33. SPOD_SYSTEM_V1.3.2

Table 5-33: SPOD_SYSTEM_v1.3.2

Parameter	Comment
Applicable date	18/05/2017
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.3.2
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-3A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1925.atx
GNSS PCO/PCV	igs14_1935.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	CNES Hourly and Daily RINEX generation strategy has been modified to guarantee continuity in receiver time-scale and phases between consecutive executions from the processor

5.34. SPOD_SYSTEM_V1.3.3

Table 5-34: SPOD_SYSTEM_v1.3.3

Parameter	Comment
Applicable date	29/05/2017
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.3.3
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-3A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_1950.atx**
GNSS PCO/PCV	**igs14_1949.atx**
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.35. SPOD_SYSTEM_V1.3.4

Table 5-35: SPOD_SYSTEM_v1.3.4

Parameter	Comment
Applicable date	19/06/2017
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.3.4
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-3A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1950.atx
GNSS PCO/PCV	igs14_1949.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.36. SPOD_SYSTEM_V1.3.5

Table 5-36: SPOD_SYSTEM_v1.3.5

Parameter	Comment
Applicable date	27/07/2017
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.3.5
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-3A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1950.atx
GNSS PCO/PCV	igs14_1949.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Include option to apply Differential Code Biases when using observations different than P1 and P2 to form the ionospheric-free combination in GPS processing. Use Earth Orientation Parameters (EOPs) provided by EGP for S3PODIPF instead of the ones provided by USNO (kept as back-up).

5.37. SPOD_SYSTEM_V1.3.6

Table 5-37: SPOD_SYSTEM_v1.3.6

Parameter	Comment
Applicable date	22/08/2017
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.3.6
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, **S-2B,** S-3A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_1963.atx**
GNSS PCO/PCV	igs14_1949.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Implement changes related to Post-Seismic Deformation (PSD). New ANTEX file deployed with Sentinel-2B 90-residual computation: sen08_1963.atx.

5.38. SPOD_SYSTEM_V1.3.7

Table 5-38: SPOD_SYSTEM_v1.3.7

Parameter	Comment
Applicable date	11/10/2017
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.3.7
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1963.atx
GNSS PCO/PCV	igs14_1949.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.39. SPOD_SYSTEM_V1.3.8

Table 5-39: SPOD_SYSTEM_v1.3.8

Parameter	Comment
Applicable date	30/10/2017
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.3.8
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, **S-3B**
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1963.atx
GNSS PCO/PCV	igs14_1949.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.40. SPOD_SYSTEM_V1.3.9

Table 5-40: SPOD_SYSTEM_v1.3.9

Parameter	Comment
Applicable date	08/11/2017
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.3.9
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1963.atx
GNSS PCO/PCV	igs14_1949.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Implement half cycle bias correction reading info from GPS Auxiliary Data (S-1, -3 and S-2B) or GPS Channel Status data (S-2A).

5.41. SPOD_SYSTEM_V1.4.0

Table 5-41: SPOD_SYSTEM_v1.4.0

Parameter	Comment
Applicable date	28/11/2017
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.4.0
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1963.atx
GNSS PCO/PCV	igs14_1949.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Removal of temperature effects and configure HW bias to 23.5 m in the decoding tool (IPF). Correction of half-cycle ambiguities in the decoding tool (IPF). Align RINEX epochs to GPS time instead of IMT for all the orbital products, but the S-3 NRT ones. Update location of S-3B antenna in DB (nominal-redundant layout swapped w.r.t. S-3A).

5.42. SPOD_SYSTEM_V1.4.1

Table 5-42: SPOD_SYSTEM_v1.4.1

Parameter	Comment
Applicable date	29/01/2018
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.4.1
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1963.atx
GNSS PCO/PCV	igs14_1949.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Prepare a new version of S3PODIPF with changes to do not use L2C with S-3B during commissioning

5.43. SPOD_SYSTEM_V1.4.2

Table 5-43: SPOD_SYSTEM_v1.4.2

Parameter	Comment
Applicable date	26/02/2018
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.4.2
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_1989.atx**
GNSS PCO/PCV	igs14_1949.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.44. SPOD_SYSTEM_V1.4.3

Table 5-44: SPOD_SYSTEM_v1.4.3

Parameter	Comment
Applicable date	08/05/2018
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.4.3
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1989.atx
GNSS PCO/PCV	igs14_1949.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.45. SPOD_SYSTEM_V1.5.0

Table 5-45: SPOD_SYSTEM_v1.5.0

Parameter	Comment
Applicable date	05/06/2018
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.5.0
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_1989.atx
GNSS PCO/PCV	igs14_1949.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.46. SPOD_SYSTEM_V1.5.1

Table 5-46: SPOD_SYSTEM_v1.5.1

Parameter	Comment
Applicable date	04/10/2018
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.5.1
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_2006.atx**
GNSS PCO/PCV	**igs14_2006.atx**
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Implemented a satellite re-radiation model. Implemented a fixed solar array model for S1.

5.47. SPOD_SYSTEM_V1.5.2

Table 5-47: SPOD_SYSTEM_v1.5.2

Parameter	Comment
Applicable date	30/10/2018
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.5.2
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_2025.atx**
GNSS PCO/PCV	**igs14_2022.atx**
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Implementation and operational usage of the Sentinel-2 Geocentric YSM attitude mode

5.48. SPOD_SYSTEM_V1.5.3

Table 5-48: SPOD_SYSTEM_v1.5.3

Parameter	Comment
Applicable date	07/11/2018
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.5.3
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_2025.atx
GNSS PCO/PCV	igs14_2022.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Update of the Sentinels transponder and satellite databases to update the location of the y-axis coordinate of instruments on S-3A to match CNES/DLR configuration

5.49. SPOD_SYSTEM_V1.5.4

Table 5-49: SPOD_SYSTEM_v1.5.4

Parameter	Comment
Applicable date	06/03/2019
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.5.4
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_2025.atx
GNSS PCO/PCV	**igs14_2038.atx**
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	N/A

5.50. SPOD_SYSTEM_V1.5.5

Table 5-50: SPOD_SYSTEM_v1.5.5

Parameter	Comment
Applicable date	14/10/2019
Applicable FFS version and date	v1.21 from 15/11/2016
TAG	SPOD_SYSTEM_v1.5.5
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL03.v2.coef
Ocean Tides	EOT11a
Atmospheric gravity	AGRA
Atmospheric model	MSISE90
Thermospheric winds	**HWM93**
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	One per pass as float
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_2025.atx
GNSS PCO/PCV	**igs14_2062.atx**
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: IGS finals
Attitude	Quaternions
Additional comments	Update decoder to properly handle the GPS week rollover occurred on 07/04/2019

5.51. SPOD_SYSTEM_V1.6.0

Table 5-51: SPOD_SYSTEM_v1.6.0

Parameter	Comment
Applicable date	06/05/2020
Applicable FFS version and date	v1.24 from 18/11/2019
TAG	SPOD_SYSTEM_v1.6.0
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	**EIGEN.GRGS.RL04 TVG (120x120)**
Ocean Tides	**FES2014 (100x100, 142 tidal constituents)**
Atmospheric gravity	**GFZ AOD L1B RL06 (100x100)**
Atmospheric model	**MSISE00**
Thermospheric winds	HWM93
Estimated state-vector	One per determination arc
Macro-model	Yes
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	**NRT, STC: Float; NTC: Integer**
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_2025.atx
GNSS PCO/PCV	**igs14_2101.atx**
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; **NTC: CODE rapid/finals**
Attitude	Quaternions
Additional comments	N/A

5.52. SPOD_SYSTEM_V1.7.X

Table 5-52: SPOD_SYSTEM_v1.7.X

Parameter	Comment
Applicable date	29/07/2020
Applicable FFS version and date	v1.24 from 18/11/2019
TAG	SPOD_SYSTEM_v1.7.X
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL04 TVG (120x120)
Ocean Tides	FES2014 (100x100, 142 tidal constituents)
Atmospheric gravity	GFZ AOD L1B RL06 (100x100)
Atmospheric model	MSISE00
Thermospheric winds	HWM93
Estimated state-vector	One per determination arc
Macro-model	Yes with re-radiation
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	NRT, STC: Float; NTC: Integer
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_2116.atx**
GNSS PCO/PCV	**igs14_2114.atx**
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: CODE rapid/finals
Attitude	Quaternions
Additional comments	S-1 GPS Antenna Reference Point (ARP) configuration has been corrected.

5.53. SPOD_SYSTEM_V1.8.X

Table 5-53: SPOD_SYSTEM_v1.8.X

Parameter	Comment
Applicable date	23/09/2020
Applicable FFS version and date	v1.24 from 18/11/2019
TAG	SPOD_SYSTEM_v1.8.X
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL04 TVG (120x120)
Ocean Tides	FES2014 (100x100, 142 tidal constituents)
Atmospheric gravity	GFZ AOD L1B RL06 (100x100)
Atmospheric model	MSISE00
Thermospheric winds	HWM93
Estimated state-vector	One per determination arc
Macro-model	Yes with re-radiation
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	NRT, STC: Float; NTC: Integer
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_2116.atx
GNSS PCO/PCV	igs14_2114.atx
SLR PCO/PCV (S-3/S-6)	slr_sent3a_1924.lrx
GNSS products	NRT, STC: EGP; NTC: CODE rapid/finals
Attitude	Quaternions
Additional comments	S-1 GPS Antenna Reference Point (ARP) configuration has been corrected.

5.54. SPOD_SYSTEM_V1.9.X

Table 5-54: SPOD_SYSTEM_v1.9.X

Parameter	Comment
Applicable date	16/12/2020
Applicable FFS version and date	v1.24 from 18/11/2019
TAG	SPOD_SYSTEM_v1.9.X
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL04 TVG (120x120)
Ocean Tides	FES2014 (100x100, 142 tidal constituents)
Atmospheric gravity	GFZ AOD L1B RL06 (100x100)
Atmospheric model	MSISE00
Thermospheric winds	**HWM14**
Estimated state-vector	One per determination arc
Macro-model	Yes with re-radiation
Number of drag parameters	10 parameters per 24 h
Solar radiation pressure	Yes. One parameter per arc
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 3 set of sine and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	NRT, STC: Float; NTC: Integer
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_2133.atx**
GNSS PCO/PCV	**igs14_2134.atx**
SLR PCO/PCV (S-3/S-6)	S3: slr_sent3a_1924.lrx, **S6: slr_sent6a_2136.lrx**
GNSS products	NRT, STC: EGP; NTC: CODE rapid/finals
Attitude	Quaternions
Additional comments	The thermospheric winds model has been updated from model HWM93 to HWM14. The planetary ephemerides model has been updated from model DE-405 to DE-421.

5.55. SPOD_SYSTEM_V1.10.X

Table 5-55: SPOD_SYSTEM_v1.10.X

Parameter	Comment
Applicable date	02/02/2021
Applicable FFS version and date	v1.25 from 17/02/2021
TAG	SPOD_SYSTEM_v1.10.X
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL04 TVG (120x120)
Ocean Tides	FES2014 (100x100, 142 tidal constituents)
Atmospheric gravity	GFZ AOD L1B RL06 (100x100)
Atmospheric model	MSISE00
Thermospheric winds	HWM14
Estimated state-vector	One per determination arc
Macro-model	S1: macro_model_v9.txt (includes re-radiation) S2: macro_model_v4.txt + re-radiation S3: macro_model_v2.txt + re-radiation
Number of drag parameters	NRT: 10 per 24 h; **STC/NTC: 1 drag coefficient per arc**
Solar radiation pressure	**1 solar radiation pressure coefficient (fixed for STC/NTC products).**
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions **STC/NTC: 16 set of constant, sine, and cosine CPR per 32 h in along- and cross-track directions**
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds
Phase ambiguity	NRT, STC: Float; NTC: Integer
Observation sampling	10 seconds
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_2146.atx**
GNSS PCO/PCV	igs14_2134.atx
SLR PCO/PCV (S-3/S-6)	S3: slr_sent3a_1924.lrx, S6: slr_sent6a_2136.lrx
GNSS products	NRT, STC: EGP; NTC: CODE rapid/finals
Attitude	Quaternions
Additional comments	The albedo model has been updated with new mean VIS/IR maps using CERES data. The macro-model of S-1 has been updated to account for changes in the areas of the SAR and solar arrays.

5.56. SPOD_SYSTEM_V1.11.X

Table 5-56: SPOD_SYSTEM_v1.11.X

Parameter	Comment
Applicable date	14/06/2021
Applicable FFS version and date	**v2.0 from 01/04/2022**
TAG	SPOD_SYSTEM_v1.11.X
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B, S-6A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL04 TVG (120x120)
Ocean Tides	FES2014 (100x100, 142 tidal constituents)
Atmospheric gravity	GFZ AOD L1B RL06 (100x100)
Atmospheric model	MSISE00
Thermospheric winds	HWM14
Estimated state-vector	One per determination arc
Macro-model	S1: macro_model_v9.txt (includes re-radiation) S2: macro_model_v4.txt + re-radiation S3: macro_model_v2.txt + re-radiation S6: macro_model_v9.txt + re-radiation
Number of drag parameters	Estimated; NRT: 10 per 24 h; STC/NTC: 1 drag coefficient per arc
Solar radiation pressure	1 solar radiation pressure coefficient (fixed for STC/NTC products).
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 16 set of constant, sine, and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds (30 sec for S-6A NRT)
Phase ambiguity	NRT, STC: Float; NTC: Integer
Observation sampling	10 seconds (30 sec for S-6A NRT)
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen08_2156.atx**
GNSS PCO/PCV	**igs14_2156.atx**
SLR PCO/PCV (S-3/S-6)	S3: slr_sent3a_1924.lrx, S6: **slr_sent6a_2153.lrx**
GNSS products	NRT, STC: EGP; NTC: CODE rapid/finals
Attitude	Quaternions
Additional comments	N/A

5.57. SPOD_SYSTEM_V2.0.X

Table 5-57: SPOD_SYSTEM_v2.0.X

Parameter	Comment
Applicable date	23/11/2022
Applicable FFS version and date	v2.0 from 01/04/2022
TAG	SPOD_SYSTEM_v2.0.X
POD SW	NAPEOS
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B, S-6A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL04 TVG (120x120)
Ocean Tides	FES2014 (100x100, 142 tidal constituents)
Atmospheric gravity	GFZ AOD L1B RL06 (100x100)
Atmospheric model	MSISE00
Thermospheric winds	HWM14
Estimated state-vector	One per determination arc
Macro-model	S1: macro_model_v9.txt (includes re-radiation) S2: macro_model_v4.txt + re-radiation S3: macro_model_v2.txt + re-radiation S6: macro_model_v9.txt + re-radiation
Number of drag parameters	Estimated; NRT: 10 per 24 h; STC/NTC: 1 drag coefficient per arc
Solar radiation pressure	1 solar radiation pressure coefficient (fixed for STC/NTC products).
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 16 set of constant, sine, and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds (30 sec for S-6A NRT)
Phase ambiguity	NRT, STC: Float; NTC: Integer
Observation sampling	10 seconds (30 sec for S-6A NRT)
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_2156.atx
GNSS PCO/PCV	**igs20_2233.atx**
SLR PCO/PCV (S-3/S-6)	S3: slr_sent3a_1924.lrx, S6: slr_sent6a_2153.lrx
GNSS products	NRT, STC: EGP; NTC: CODE rapid/finals
Attitude	Quaternions
Additional comments	**System adapted to the new standards adopted to generate the ITRF-20**

5.58. SPOD_SYSTEM_V3.0.X

Table 5-58: SPOD_SYSTEM_v3.0.X

Parameter	Comment
Applicable date	30/01/2023
Applicable FFS version and date	v2.0 from 01/04/2022
TAG	SPOD_SYSTEM_v3.0.X
POD SW	**FocusPOD**
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B, S-6A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL04 TVG (120x120) w/ quadratic mean pole
Ocean Tides	FES2014 (100x100, 142 tidal constituents)
Atmospheric gravity	GFZ AOD L1B RL06 (100x100)
Atmospheric model	MSISE00
Thermospheric winds	**None**
Estimated state-vector	One per determination arc
Macro-model	S1: macro_model_v9.txt (includes re-radiation) S2: macro_model_v4.txt + re-radiation S3: macro_model_v2.txt + re-radiation S6: macro_model_v9.txt + re-radiation
Number of drag parameters	Estimated; NRT: 10 per 24 h; STC/NTC: 1 drag coefficient per arc
Solar radiation pressure	1 solar radiation pressure coefficient (fixed for STC/NTC products).
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 16 set of constant, sine, and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds (30 sec for S-3 and S-6 NRT)
Phase ambiguity	NRT, STC: Float; NTC: Integer
Observation sampling	10 seconds (30 sec for S-3 and S-6 NRT)
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees (GNSS)
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen08_2156.atx
GNSS PCO/PCV	igs20_2233.atx
SLR PCO/PCV (S-3/S-6)	S3: slr_sent3a_1924.lrx, S6: slr_sent6a_2153.lrx
GNSS products	NRT, STC: EGP; NTC: CODE rapid/finals
Attitude	Quaternions
Additional comments	**New POD SW used: FocusPOD**

5.59. SPOD_SYSTEM_V3.1.X

Table 5-59: SPOD_SYSTEM_v3.1.X

Parameter	Comment
Applicable date	13/02/2023
Applicable FFS version and date	v2.0 from 01/04/2022
TAG	SPOD_SYSTEM_v3.1.X
POD SW	FocusPOD
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B, S-6A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL04 TVG (120x120) **w/ linear pole**
Ocean Tides	FES2014 (100x100, 142 tidal constituents)
Atmospheric gravity	GFZ AOD L1B RL06 (100x100)
Atmospheric model	MSISE00
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	S1: macro_model_v9.txt (includes re-radiation) S2: macro_model_v4.txt + re-radiation S3: macro_model_v2.txt + re-radiation S6: macro_model_v9.txt + re-radiation
Number of drag parameters	Estimated; NRT: 10 per 24 h; STC/NTC: 1 drag coefficient per arc
Solar radiation pressure	1 solar radiation pressure coefficient (fixed for STC/NTC products).
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 16 set of constant, sine, and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds (30 sec for S-3 and S-6 NRT)
Phase ambiguity	NRT, STC: Float; NTC: Integer
Observation sampling	10 seconds (30 sec for S-6A NRT)
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees (GNSS)
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen20_2170.atx**
GNSS PCO/PCV	igs20_2233.atx
SLR PCO/PCV (S-3/S-6)	S3: slr_sent3a_1924.lrx, S6: slr_sent6a_2153.lrx
GNSS products	NRT, STC: EGP; NTC: CODE rapid/finals
Attitude	Quaternions
Additional comments	**IGS20 conventions for ambiguity fixing (considering emitters ARP)**

5.60. SPOD_SYSTEM_V3.2.X

Table 5-60: SPOD_SYSTEM_v3.2.X

Parameter	Comment
Applicable date	21/03/2023
Applicable FFS version and date	v2.0 from 01/04/2022
TAG	SPOD_SYSTEM_v3.2.X
POD SW	FocusPOD
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B, S-6A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	EIGEN.GRGS.RL04 TVG (120x120) w/ linear pole
Ocean Tides	FES2014 (100x100, 142 tidal constituents)
Atmospheric gravity	GFZ AOD L1B RL06 (100x100)
Atmospheric model	MSISE00
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	S1: macro_model_v9.txt (includes re-radiation) S2: macro_model_v4.txt + re-radiation S3: macro_model_v2.txt + re-radiation S6: macro_model_v9.txt + re-radiation
Number of drag parameters	Estimated; NRT: 10 per 24 h; STC/NTC: 1 drag coefficient per arc
Solar radiation pressure	1 solar radiation pressure coefficient (fixed for STC/NTC products).
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 16 set of constant, sine, and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds (30 sec for S-3 and S-6 NRT)
Phase ambiguity	NRT, STC: Float; NTC: Integer
Observation sampling	10 seconds (30 sec for S-6A NRT)
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees (GNSS)
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	**sen20_2236.atx**
GNSS PCO/PCV	**igs20_2258.atx**
SLR PCO/PCV (S-3/S-6)	S3: slr_sent3a_1924.lrx, S6: slr_sent6a_2153.lrx
GNSS products	NRT, STC: EGP; NTC: CODE rapid/finals
Attitude	Quaternions
Additional comments	**Temperature calibrations for S6 RNX**

5.61. SPOD_SYSTEM_V3.3.X

Table 5-61: SPOD_SYSTEM_v3.3.X

Parameter	Comment
Applicable date	18/07/2023
Applicable FFS version and date	v2.0 from 01/04/2022
TAG	SPOD_SYSTEM_v3.3.X
POD SW	FocusPOD
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B, S-6A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	**FSM_quarterly_GSM-2_MODEL_GRFO_COSTG_BF01_01op_2212.gfc**
Ocean Tides	FES2014 (**90x90**, 142 tidal constituents)
Atmospheric gravity	GFZ AOD L1B RL06 (**90x90**)
Atmospheric model	MSISE00
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	S1: macro_model_v9.txt (includes re-radiation) S2: macro_model_v4.txt + re-radiation S3: macro_model_v2.txt + re-radiation S6: macro_model_v9.txt + re-radiation
Number of drag parameters	Estimated; NRT: 10 per 24 h; STC/NTC: 1 drag coefficient per arc
Solar radiation pressure	1 solar radiation pressure coefficient (fixed for STC/NTC products).
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 16 set of constant, sine, and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds (30 sec for S-3 and S-6 NRT)
Phase ambiguity	NRT, STC: Float; NTC: Integer
Observation sampling	10 seconds (30 sec for S-6A NRT)
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees (GNSS)
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen20_2236.atx
GNSS PCO/PCV	igs20_2258.atx
SLR PCO/PCV (S-3/S-6)	S3: slr_sent3a_1924.lrx, S6: slr_sent6a_2153.lrx
GNSS products	NRT, STC: EGP; NTC: CODE rapid/finals
Attitude	Quaternions
Additional comments	N/A

5.62. SPOD_SYSTEM_V3.4.X

Table 5-62: SPOD_SYSTEM_v3.4.X

Parameter	Comment
Applicable date	31/07/2023
Applicable FFS version and date	**v3.0 from 21/07/2023**
TAG	SPOD_SYSTEM_v3.4.X
POD SW	FocusPOD
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B, S-6A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	FSM_quarterly_GSM-2_MODEL_GRFO_COSTG_BF01_01op_2212.gfc
Ocean Tides	FES2014 (90x90, 142 tidal constituents)
Atmospheric gravity	GFZ AOD L1B RL06 (90x90)
Atmospheric model	MSISE00
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	S1: macro_model_v9.txt (includes re-radiation) S2: macro_model_v4.txt + re-radiation S3: macro_model_v2.txt + re-radiation S6: macro_model_v9.txt + re-radiation
Number of drag parameters	Estimated; NRT: 10 per 24 h; STC/NTC: 1 drag coefficient per arc
Solar radiation pressure	1 solar radiation pressure coefficient (fixed for STC/NTC products).
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 16 set of constant, sine, and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds (30 sec for S-6A NRT)
Phase ambiguity	NRT, STC: Float; NTC: Integer
Observation sampling	10 seconds (30 sec for S-3 and S-6 NRT)
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees (GNSS)
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen20_2236.atx
GNSS PCO/PCV	igs20_2258.atx
SLR PCO/PCV (S-3/S-6)	S3: slr_sent3a_1924.lrx, S6: slr_sent6a_2153.lrx
GNSS products	PRE, NRT, STC: EGP **(ref. signals GPS [1W, 2W], GAL [1C, 5Q])** NTC: CODE rapid/finals **(ref. signals GPS [1W, 2W], GAL [1C, 5Q])**
Iono-free GNSS signals	**S-1, -2, -3: GPS [1W, 2W]** **S-6: GPS [1W, 2W], GPS [1C, 2L], GAL [1C, 5Q]**
Differential code biases	**S-1 (PRE, NRT, NTC), -2 (NRT), -3 (NRT, STC, NTC): No** **S-6 (NRT): Yes (EGP)**
Attitude	Quaternions

Parameter	Comment
Additional comments	**Prior to this system, S-6A NRT included an estimated inter-system bias to align iono-free signals GPS [1C, 2L] to the GNSS clocks' references GPS [1W, 2W]. This system exchanges this inter-system bias estimation for the application of the corresponding differential code bias provided by the EGP. See section 3.3.1 for further information.**

5.63. SPOD_SYSTEM_V3.5.X

Table 5-63: SPOD_SYSTEM_v3.5.X

Parameter	Comment
Applicable date	04/09/2023
Applicable FFS version and date	v3.0 from 21/07/2023
TAG	SPOD_SYSTEM_v3.5.X
POD SW	FocusPOD
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B, S-6A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	FSM_quarterly_GSM-2_MODEL_GRFO_COSTG_BF01_01op_2212.gfc
Ocean Tides	FES2014 (90x90, 142 tidal constituents)
Atmospheric gravity	GFZ AOD L1B RL06 (90x90)
Atmospheric model	MSISE00
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	S1: macro_model_v9.txt (includes re-radiation) S2: macro_model_v4.txt + re-radiation S3: macro_model_v2.txt + re-radiation S6: macro_model_v9.txt + re-radiation
Number of drag parameters	Estimated; NRT: 10 per 24 h; STC/NTC: 1 drag coefficient per arc
Solar radiation pressure	1 solar radiation pressure coefficient (fixed for STC/NTC products).
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 16 set of constant, sine, and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds (30 sec for S-3 and S-6 NRT)
Phase ambiguity	NRT, STC: Float; NTC: Integer
Observation sampling	10 seconds (30 sec for S-6A NRT)
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees (GNSS)
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen20_2236.atx
GNSS PCO/PCV	igs20_2258.atx
SLR PCO/PCV (S-3/S-6)	S3: slr_sent3a_1924.lrx, S6: slr_sent6a_2153.lrx
GNSS products	PRE, NRT, STC: EGP (ref. signals GPS [1W, 2W], GAL [1C, 5Q]) NTC: CODE rapid/finals (ref. signals GPS [1W, 2W], GAL [1C, 5Q])
Iono-free GNSS signals	S-1, -2, -3: GPS [1W, 2W] S-6: GPS [1W, 2W], GPS [1C, 2L], GAL [1C, 5Q]
Differential code biases	S-1 (PRE, NRT, NTC), -2 (NRT), -3 (NRT, STC, NTC): No S-6 (NRT): Yes (EGP)
Attitude	Quaternions

Parameter	Comment
	S-6A Yaw bias of -0.43 deg
Additional comments	**S-6A processed quaternions for CDSE/QWG apply the yaw bias from the applicable date.** **S-6A ROE products do not apply yaw bias yet (waiting for EUM confirmation).**

5.64. SPOD_SYSTEM_V3.6.X

Table 5-64: SPOD_SYSTEM_v3.6.X

Parameter	Comment
Applicable date	17/10/2023
Applicable FFS version and date	v3.0 from 21/07/2023
TAG	SPOD_SYSTEM_v3.6.X
POD SW	FocusPOD
Applicable missions	S-1A, S-1B, S-2A, S-2B, S-3A, S-3B, S-6A
Arc length	NRT: 24h; STC, NTC: 32h
IERS Conventions	IERS 2010
Gravity Field	FSM_quarterly_GSM-2_MODEL_GRFO_COSTG_BF01_01op_2212.gfc
Ocean Tides	FES2014 (90x90, 142 tidal constituents)
Atmospheric gravity	GFZ AOD L1B RL06 (90x90)
Atmospheric model	MSISE00
Thermospheric winds	None
Estimated state-vector	One per determination arc
Macro-model	S1: macro_model_v9.txt (includes re-radiation) S2: macro_model_v4.txt + re-radiation S3: macro_model_v2.txt + re-radiation S6: macro_model_v9.txt + re-radiation
Number of drag parameters	Estimated; NRT: 10 per 24 h; STC/NTC: 1 drag coefficient per arc
Solar radiation pressure	1 solar radiation pressure coefficient (fixed for STC/NTC products).
Empirical accelerations	NRT: 1 set of sine and cosine CPR per 12 h in along- and cross-track directions STC/NTC: 16 set of constant, sine, and cosine CPR per 32 h in along- and cross-track directions
Manoeuvre handling	Manoeuvre scale factors estimated in radial-, along- and cross-track directions.
Data gap handling	Yes. Dynamic propagation
Receiver clock rates	One every 10 seconds (30 sec for S-3 and S-6 NRT)
Phase ambiguity	NRT, STC: Float; NTC: Integer
Observation sampling	10 seconds (30 sec for S-6A NRT)
Observation weight	0.8 m for pseudo-range, 10 mm for phase
Elevation cut-off angle	7 degrees (GNSS)
Satellite mass and CoM	Obtained from the satellite mass property report
Sentinels PCO/PCV	sen20_2236.atx
GNSS PCO/PCV	**igs20_2274.atx**
SLR PCO/PCV (S-3/S-6)	S3: slr_sent3a_1924.lrx, S6: slr_sent6a_2153.lrx
GNSS products	PRE, NRT, STC: **EGP (ref. signals GPS [1C, 2W], GAL [1C, 7Q])** NTC: CODE rapid/finals (ref. signals GPS [1W, 2W], GAL [1C, 5Q])
Iono-free GNSS signals	S-1, -2, -3: GPS [1W, 2W] S-6: GPS [1W, 2W], GPS [1C, 2L], GAL [1C, 5Q]
Differential code biases	**S-1 (NTC), S-3 (NTC): No** **S-1 (PRE, NRT), -2 (NRT), -3 (NRT, STC), -6 (NRT): Yes (EGP)**
Attitude	Quaternions

Parameter	Comment
	S-6A Yaw bias of -0.43 deg
Additional comments	***magicGNSS* starts applying new clock reference signals: GPS [1C, 2W] and GAL [1C, 7Q]. This provokes the application of differential code biases in all CPOD Service orbit products (except for NTC, which uses CODE's) to align the iono-free signals to these new references.**

END OF DOCUMENT