

COPERNICUS POD REGULAR SERVICE REVIEW JAN - DEC 2022 COPERNICUS SENTINEL-1, -2, -3 AND -6 PREC

COPERNICUS SENTINEL-1, -2, -3 AND -6 PRECISE ORBIT DETERMINATION SERVICE (CPOD)

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1. INTRODUCTION

1.1. PURPOSE

This document describes the results of the Copernicus POD (CPOD) Regular Service Review (RSR) #27 covering the period between January and December 2022 (both included), in the frame of the Copernicus POD Service. It applies to the satellites Sentinel-1A, -1B, -2A, -2B, -3A, -3B and -6A, which are all in their Routine Operational Phase (ROP).

1.2. SCOPE

This document is a deliverable by GMV in the frame of the Copernicus POD Service.

This document has been prepared by GMV with contributions from **AIUB**, **CLS**, **CNES**, **DLR**, **ESOC**, **EUMETSAT**, **GFZ**, **GSFC**, **JPL**, **TU Delft**, **TU Graz**, **and TUM** (inputs to prepare Section 3).

1.3. DEFINITIONS AND ACRONYMS

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

Acronym	Definition	Acronym	Definition
AGRA	Service of the atmospheric contribution to geopotential	KPI	Key Performance Indicator
AIUB	Astronomical Institute University of Bern	LRR	Laser Retro-reflector
ANX	Ascending Node	MACP	Manoeuvre Acceleration Profile
ARP	Antenna Reference Point	MLI	Multi Layered Insulation
BRDC	Broadcast ephemeris file	MSI	Multi-Spectral Instrument
CLS	Collecte Localisation Satellites	NAPEOS	NAvigation Package for Earth Orbiting Satellites
CNES	Centre National d'Études Spatiales	NASA	National Aeronautics and Space Agency
CODE	Center for Orbit Determination in Europe	NAVATT	NAVigation and ATTitude information
CPF	Consolidated Prediction Format	NAVSOL	Navigation Solution
CPOD	Copernicus POD	NCR	Non-Conformance Report
DCB	Differential Code Biases	NOAA	National Oceanic and Atmospheric Administration
DIL	Document Item List	NRT	Near Real Time
DLR	Deutsche Zentrum für Luft- und Raumfahrt	NTC	Non Time Critical
DOP	Dilution of Precision	ODA	On-Line Data Access
DORIS	Doppler Orbytography and Radiopositioning Integrated by Satellite	OFLPOD	Offline POD
DORNAV	Doris Navigation	OLCI	Ocean & Land Colour Instrument
DOY	Day of Year	OPOD	Offline POD
DPM	Data Processing Model	OSV	Orbit State Vector
ECMWF	European Center for Medium-range Weather Forecasts	JPL	Jet Propulsion Laboratory
EDDS	External Data Distribution System	PAC	Processing Archiving Centre
EGP	External GPS Provider	PCO	Phase Centre Offset
EIGEN	European Improved Gravity model of the Earth by New techniques	PDAP	Payload Data and Acquisition Processing
EOF	Earth Observation File	PDGS	Payload Data Ground Segment
EOP	Earth Orientation Parameters	PDI	Product Data Item

Table 1-1: Acronyms



Acronym	Definition	Acronym	Definition
ERA	Earth Rotation Angle	PDMC	Payload Data Management Centre
ESA	European Space Agency	PDOP	Position DOP
ESOC	European Space Operation Centre	PFS	Product Format Specification
EUM	EUMETSAT	PMP	Project Management Plan
EUMETSAT	EUropean organisation for the exploitation of METeorological SATellites	POD	Precise Orbit Determination
FES	Finite Element Solution	POE	Precise Orbit Ephemeris
FFS	File Format Specification	PRN	Pseudo-Random Number
FFT	Fast Fourier Transform	PVT	Position, Velocity and Timing
FOS	Flight Operations System	QWG	Quality Working Group
FPA	Focal Plane Assembly	RINEX	Receiver Independent Exchange
FTP	File Transfer Protocol	RMS	Root Mean Square
FTPS	File Transfer Protocol Secure	ROE	Rapid Orbit Ephemerides
GDOP	Geometric DOP	ROP	Routine Operations Phase
GFZ	Geo Forschungs Zentrum	RSGA	Report of Solar-Geophysical Activity
GHOST	GPS High Precision Orbit Determination Software Tools	RSR	POD Regular Service Review
GINS	Géodesie par Intégrations Numériques Simultanées	SAD	Satellite Ancillary Data
GIPSY- OASIS	GNSS-Inferred Positioning System and Orbit Analysis Simulation Software	SALP	Service d'Altimetrie et Localisation Precise
GIPSY-X	GNSS-Inferred Positioning System X	SAR	Synthetic Aperture Radar
GMES	Global Monitoring for Environment and Security	SLA	Service Level Agreement
GNSS	Global Navigation Satellite System	SLR	Satellite Laser Ranging
GOCO	Gravity Observation Combination	SoL	Sentinel Online
GPS	Global Positioning System	SPR	Software Problem Report
GRGS	Groupe de Recherche de Géodésie Spatiale	SRAL	SAR Radar Altimeter
GSFC	Goddard Space Flight Center	STC	Short Time Critical
нктм	House Keeping Telemetry	STD	Standard Deviation
ICD	Interface Control Document	STM	Surface Topography Mission
IERS	International Earth Rotation Service	SWIR	Short Wave InfraRed
IGS	International GNSS Service	TBD	To Be Decided
ILRS	International Laser Ranging Service	TDOP	Time DOP
INT	Integration Room	TUD	Technische Universiteit Delft
IPF	Instrument Processing Facility	тим	Technische Universität München
ITRF	International Terrestrial Reference Frame	UTC	Coordinated Universal Time

Service

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	GMV-CPOD-FFS-0001	2.0	2022/04/01
CPOD	© GMV 2023; all rights reserved	Copernicus POD Regular Service	e Review Jar	1 - Dec 2022



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Ref.	Title	Code	Version	Date
[AD.2]	Sentinel-1 PDGS to Copernicus POD Service ICD	GMV-CPOD-ICD-0009	2.1	2022/11/04
[AD.3]	Copernicus POD Service to Sentinel-1 PDGS ICD	GMV-CPOD-ICD-0008	2.1	2022/11/04
[AD.4]	External Auxiliary Data Providers to Copernicus POD Service ICD	GMV-CPOD-ICD-0002	2.0	2021/06/02
[AD.5]	Sentinel-2 PDGS and Copernicus POD Service ICD	GMV-CPOD-ICD-0010	2.1	2022/11/04
[AD.6]	Sentinel-3 PDGS to Copernicus POD Service ICD	GMV-CPOD-ICD-0012	2.1	2022/11/04
[AD.7]	Copernicus POD Service to Sentinel-3 PDGS ICD	GMV-CPOD-ICD-0011	2.1	2022/11/04
[AD.8]	EUMETSAT and Copernicus POD Service ICD for Sentinel-6A	GMV-CPOD-ICD-0007	1.3	2022/05/20

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]	Sentinel-1 properties for GPS POD	GMV-GMESPOD-TN-0025	1.4	2019/09/16
[RD.2]	Sentinel-2 properties for GPS POD	GMV-GMESPOD-TN-0026	1.4	2019/09/16
[RD.3]	Sentinel-3 properties for GPS POD	GMV-GMESPOD-TN-0027	1.8	2020/05/18
[RD.4]	Sentinel-6 POD Context	JC-TN-ESA-SY-0420	1.4	2021/02/01



2. OVERVIEW OF THE COPERNICUS POD SERVICE OPERATIONS

The Copernicus POD (CPOD) Service is currently operating seven satellites in their Routine Operational Phase (ROP). Table 2-1 shows the launch date of each satellite.

Table 2-1: Launch dates of Sentinel-1	L, -2,	, -3 and	-6 missions
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Unit	Sentinel-1	Sentinel-2	Sentinel-3	Sentinel-6
Α	2014/04/03	2015/06/23	2016/02/16	2020/11/21
В	2016/04/25	2017/03/07	2018/04/25	_

During this phase, the main activities of the Copernicus POD Service have been:

- Operation of the Service by monitoring the system.
- Resolution of the anomalies and SPRs detected during the operations.
- Execution of comparisons against external orbital products to check the quality of the CPOD Service products.
- Evolution of the system.
- Preparation of material for conferences and workshops related to POD.

This document describes the activities performed and results obtained in the period from 2022/01/01 until 2022/12/31 both included, with Sentinel-1A, -1B, -2A, -2B, -3A, -3B and -6A by the CPOD Service.

This document reports on:

- Accuracy results of the orbital products when compared against external validation centres in Section 3 with additional information in Annex D.
- **GNSS sensor performance analysis** using GNSS data related to a particular day tracked by every Sentinel in Section 4.
- Altimeter Crossover Analysis of Sentinel-3 and Sentinel-6 satellites in Section 5 with additional information in Annex E.
- List of tracking **SLR stations** in Annex A.
- Description of the **POD processing of each QWG solution** in Annex B.
- Description of the Weights calculation for the generation of the combined orbit solution in Annex C.
- A summary of the **Product Performance** in Annex F.



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3. VALIDATION OF THE CPOD SERVICE ORBIT PRODUCTS

This chapter reports on the orbital accuracy attainable by the CPOD Service with the current system. To perform an external validation of the orbital products, the different external validation centres processed the complete reported period. Not all the centres provide solutions all the time because of the difficulties handling manoeuvres and gaps of data. In any case, the long period provides sufficient information to conclude on the actual accuracy of the orbital products computed by the CPOD Service.

Each external centre used its own POD software tools and configuration. Annex B contains a description of the POD set-up used by each of the processing centres composing the external validation (i.e., AIUB, CLS, CNES, CPOD, DLR, ESOC, EUM, GFZ, GSFC, JPL, TUD, TUG, and TUM). Table 3-1 summarises all these centres and the orbit solutions provided by each of them.

Name of centre	Label of centre	Label of the orbit solution/s provided
Astronomical Institute of the University of Bern	AIUB	AIUB AING (non-gravitational)
Collecte Localisation Satellites	CLS	GRGG
Centre National d'Études Spatiales	CNES	CNES (operational solution) CNGE (reprocessed with GPS+GAL+DORIS)
Copernicus POD Service	CPOD	CPOD (operational solution) CPOF (solution with new developments) CPOK (kinematic solution)
Deutsche Zentrum für Luft- und Raumfahrt	DLR	DLRR
European Space Operation Centre	ESOC	ESOC
European organisation for the exploitation of Meteorological Satellites	EUM	EUMB (Bernese GNSS software)
Deutsches GeoForschungsZentrum	GFZ	GFZZ
Goddard Space Flight Center	GSFC	GSFC
Jet Propulsion Laboratory	JPL	JPLL
Technische Universiteit Delft	TUD	TUDF
Technische Universität Graz	TUG	TUGG
Technische Universität München	TUM	ТИММ

Table 3-1: List of the QWG centres and orbit solutions provided by them

This chapter presents the comparison between a combined solution and all orbit solutions provided by all centres (included CPOD Service). The combined orbit solution per each satellite has been generated considering all orbital solutions. It has been done with proper weights and following an "IGS-like" approach (see Annex C). The analysis of SLR observations for S-3A, S-3B and S-6A is provided as well. All these statistics will be shown for the period that includes the dates from **2022/01/01** (i.e., 21906 GPS week) to **2023/12/31** (i.e., 22426 GPS week). It important to remind that the orbit comparison of S-3 and S-6 missions include the orbit solutions from CNES, EUM, CLS, GFZ, GSFC (only S-6) and JPL centres, which are not included in S-1 and S-2 missions. The GRGG orbit solution is based on DORIS data only and the CNES orbit solution also includes GNSS+DORIS observations simultaneously. The GSFC solution is based on SLR+DORIS. This RSR document continues the analysis considering the geographical and spectral distribution of the orbital comparisons started on the previous RSR.

This chapter finally includes the quality control of S-3 and S-6 STC products generated by CPOD, CNES, and TUD.



3.1. SENTINEL-1A

3.1.1. STATISTICS OF THE GENERATION OF THE SOLUTION COMB

Figure 3-1 shows the daily distribution per orbit solution of the weights used to generate the combined Sentinel-1A orbit solution. A summary of these values can be found in Table 3-2, where the mean values of these calculated weights are presented. It must be remarked that a higher value on the weights means a more contribution of the orbit solution to the generation of the combined orbit solution.



Figure 3-1: Sentinel-1A COMB generation – Daily weights of ALL orbit solutions

Daily Weights						
Orbit Solution	Centre	Mean				
AING	AIUB	0.18				
AIUB	AIUB	0.13				
CPOF	CPOD	0.20				
DLRR	DLR	0.15				
ESOC	ESOC	0.08				
TUDF	TUD	0.16				
TUGG	TUG	0.15				
тимм	тим	0.08				

Table 3-2: Sentinel-1A COMB generation – Mean of the daily weights of ALL orbit solutions

3.1.2. TEMPORAL EVOLUTION OF THE ORBITS COMPARISONS

Figure 3-2 shows the temporal evolution of the orbit comparisons [3D RMS] between all Sentinel-1A orbit solutions provided by the different QWG centres and the combined orbit solution. A summary of these orbit comparisons can be found in Figure 3-3 and Table 3-3, where the mean of the daily RMS is calculated not only for the 3D RMS but also for other satellite components.







Figure 3-3: Sentinel-1A orbit comparisons – Mean of daily RMS [cm] (All vs. COMB [radial, along, cross and 3D RMS])

Orbit Comparisons (Mean of daily RMS [cm])								
Orbit	Contro		Satellite component					
Solution	Centre	Radial	Along-track	Cross-track	3D	Typical		
AING	AIUB	0.20	0.17	0.19	0.32	0.19		
AIUB	AIUB	0.37	0.25	0.22	0.50	0.29		
CPOD	CPOD	0.34	0.38	0.32	0.60	0.35		
CPOF	CPOD	0.23	0.22	0.17	0.37	0.21		
СРОК	CPOD	0.38	0.43	0.42	0.72	0.41		
DLRR	DLR	0.37	0.21	0.21	0.48	0.27		

Table 3-3: Sentinel-1A orbit comparisons	- Mean of daily RMS [cm] (All vs. C	COMB)
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Orbit Comparisons (Mean of daily RMS [cm])						
Orbit Solution Centre	Satellite component					
	Radial	Along-track	Cross-track	3D	Typical	
ESOC	ESOC	0.30	0.42	0.67	0.85	0.49
TUDF	TUD	0.37	0.28	0.29	0.56	0.32
TUGG	TUG	0.23	0.31	0.25	0.47	0.27
тимм	тим	0.34	0.47	0.44	0.74	0.43

The Sentinel-1A orbit solutions generated by the CPOD Service show a performance in line with the results obtained on the other solutions.

3.1.3. GEOGRAPHICAL ANALYSIS

Figure 3-4 shows the 3D RMS orbit comparisons calculated on the previous subsection projected on an equi-rectangular map plot. Each cell of the map contains the mean value of all orbit comparisons falling on this cell during the reported period.





Figure 3-4: Sentinel-1A geographical analysis – Average of the 3D RMS orbit comparisons (All vs. COMB)

3.1.4. SPECTRAL ANALYSIS

Figure 3-5 shows the FFT of the 3D RMS orbit comparisons calculated on the previous subsection.





Figure 3-5: Sentinel-1A spectral analysis – 3D RMS orbit comparisons (All vs. COMB)



3.2. SENTINEL-1B

3.2.1. STATISTICS OF THE GENERATION OF THE SOLUTION COMB

Figure 3-6 shows the daily distribution per orbit solution of the weights used to generate the combined Sentinel-1B orbit solution. A summary of these values can be found in Table 3-4, where the mean values of these calculated weights are presented. It must be remarked that a higher value on the weights means a more contribution of the orbit solution to the generation of the combined orbit solution.



Figure 3-6: Sentinel-1B COMB generation – Daily weights of ALL orbit solutions

Daily Weights						
Orbit Solution	Centre	Mean				
AING	AIUB	0.18				
AIUB	AIUB	0.12				
CPOF	CPOD	0.20				
DLRR	DLR	0.16				
ESOC	ESOC	0.08				
TUDF	TUD	0.14				
TUGG	TUG	0.16				
тимм	тим	0.08				

 Table 3-4: Sentinel-1B COMB generation – Mean of the daily weights of ALL orbit solutions

3.2.2. TEMPORAL EVOLUTION OF THE ORBITS COMPARISONS

Figure 3-7 shows the temporal evolution of the orbit comparisons [3D RMS] between all Sentinel-1B orbit solutions provided by the different QWG centres and the combined orbit solution. A summary of these orbit comparisons can be found in Figure 3-8 and Table 3-5, where the mean of the daily RMS is calculated not only for the 3D RMS but also for other satellite components.











Table 3-5: Sentinel-1B orbit comparisons – Me	ean of daily RMS [cm] (All vs. COMB)	

Orbit Comparisons (Mean of daily RMS [cm])							
Orbit Solution Cent			Satellite component				
	Centre	Radial	Along-track	Cross-track	3D	Typical	
AING	AIUB	0.17	0.13	0.17	0.28	0.16	
AIUB	AIUB	0.29	0.25	0.25	0.46	0.27	
CPOD	CPOD	0.27	0.34	0.29	0.53	0.30	
CPOF	CPOD	0.18	0.18	0.16	0.30	0.17	
СРОК	CPOD	0.35	0.39	0.37	0.64	0.37	
DLRR	DLR	0.35	0.19	0.19	0.45	0.26	



Orbit Comparisons (Mean of daily RMS [cm])							
Orbit	Contro	Satellite component					
Solution		Radial	Along-track	Cross-track	3D	Typical	
ESOC	ESOC	0.27	0.38	0.64	0.80	0.46	
TUDF	TUD	0.35	0.27	0.30	0.54	0.31	
TUGG	TUG	0.18	0.21	0.20	0.34	0.20	
тимм	тим	0.33	0.43	0.42	0.69	0.40	

The Sentinel-1B orbit solutions generated by the CPOD Service show a performance in line with the results obtained on the other solutions.

3.2.3. GEOGRAPHICAL ANALYSIS

Figure 3-9 shows the 3D RMS orbit comparisons calculated on the previous subsection projected on an equi-rectangular map plot. Each cell of the map contains the mean value of all orbit comparisons falling on this cell during the reported period.





Figure 3-9: Sentinel-1B geographical analysis – Average of the 3D RMS orbit comparisons (All vs. COMB)

3.2.4. SPECTRAL ANALYSIS

Figure 3-10 shows the FFT of the 3D RMS orbit comparisons calculated on the previous subsection.





Figure 3-10: Sentinel-1B spectral analysis – 3D RMS orbit comparisons (All vs. COMB)



3.3. SENTINEL-2A

3.3.1. STATISTICS OF THE GENERATION OF THE SOLUTION COMB

Figure 3-11 shows the daily distribution per orbit solution of the weights used to generate the combined Sentinel-2A orbit solution. A summary of these values can be found in Table 3-6, where the mean values of these calculated weights are presented. It must be remarked that a higher value on the weights means a more contribution of the orbit solution to the generation of the combined orbit solution.



Figure 3-11: Sentinel-2A COMB generation – Daily weights of ALL orbit solutions

Daily Weights						
Orbit Solution	Centre	Mean				
AING	AIUB	0.18				
AIUB	AIUB	0.10				
CPOF	CPOD	0.15				
DLRR	DLR	0.13				
ESOC	ESOC	0.09				
TUDF	TUD	0.11				
TUGG	TUG	0.15				
тимм	тим	0.11				

Table 3-6: Sentinel-2A COMB generation – Mean of the daily weights of ALL orbit solutions

3.3.2. TEMPORAL EVOLUTION OF THE ORBITS COMPARISONS

Figure 3-12 shows the temporal evolution of the orbit comparisons [3D RMS] between all Sentinel-2A orbit solutions provided by the different QWG centres and the combined orbit solution. A summary of these orbit comparisons can be found in Figure 3-13 and Table 3-7, where the mean of the daily RMS is calculated not only for the 3D RMS but also for other satellite components.









Orbit Comparisons (Mean of daily RMS [cm])							
Orbit	Contro	Satellite component					
Solution		Radial	Along-track	Cross-track	3D	Typical	
AING	AIUB	0.20	0.16	0.15	0.30	0.17	
AIUB	AIUB	0.63	0.36	0.21	0.76	0.44	
CPOD	CPOD	0.30	0.34	0.29	0.54	0.31	
CPOF	CPOD	0.23	0.21	0.17	0.36	0.21	
СРОК	CPOD	0.37	0.41	0.28	0.62	0.36	
DLRR	DLR	0.33	0.23	0.21	0.47	0.27	

Table 3-7: Sentinel-2A orbit comparisons	- Mean of daily RMS [cm] (All vs. C	COMB)
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Orbit Comparisons (Mean of daily RMS [cm])							
Orbit	Contro		Sa	Satellite component			
Solution		Radial	Along-track	Cross-track	3D	Typical	
ESOC	ESOC	0.26	0.36	0.43	0.62	0.36	
TUDF	TUD	0.31	0.28	0.34	0.55	0.32	
TUGG	TUG	0.22	0.30	0.23	0.45	0.26	
тимм	тим	0.30	0.30	0.25	0.50	0.29	

The Sentinel-2A orbit solutions generated by the CPOD Service show a performance in line with the results obtained on the other solutions.

3.3.3. GEOGRAPHICAL ANALYSIS

Figure 3-14 shows the 3D RMS orbit comparisons calculated on the previous sub section projected on an equi-rectangular map plot. Each cell of the map contains the mean value of all orbit comparisons falling on this cell during the reported period.





Figure 3-14: Sentinel-2A geographical analysis – Average of the 3D RMS orbit comparisons (All vs. COMB)

3.3.4. SPECTRAL ANALYSIS



Figure 3-15 shows the FFT of the 3D RMS orbit comparisons calculated on the previous sub section.



Figure 3-15: Sentinel-2A spectral analysis – 3D RMS orbit comparisons (All vs. COMB)



3.4. SENTINEL-2B

3.4.1. STATISTICS OF THE GENERATION OF THE SOLUTION COMB

Figure 3-16 shows the daily distribution per orbit solution of the weights used to generate the combined Sentinel-2B orbit solution. A summary of these values can be found in Table 3-8, where the mean values of these calculated weights are presented. It must be remarked that a higher value on the weights means a more contribution of the orbit solution to the generation of the combined orbit solution.



Figure 3-16: Sentinel-2B COMB generation – Daily weights of ALL orbit solutions

Daily Weights							
Orbit Solution	Centre	Mean					
AING	AIUB	0.19					
AIUB	AIUB	0.10					
CPOF	CPOD	0.16					
DLRR	DLR	0.13					
ESOC	ESOC	0.09					
TUDF	TUD	0.09					
TUGG	TUG	0.16					
тимм	тим	0.11					

 Table 3-8: Sentinel-2B COMB generation – Mean of the daily weights of ALL orbit solutions

3.4.2. TEMPORAL EVOLUTION OF THE ORBITS COMPARISONS

Figure 3-17 shows the temporal evolution of the orbit comparisons [3D RMS] between all Sentinel-2B orbit solutions provided by the different QWG centres and the combined orbit solution. A summary of these orbit comparisons can be found in Figure 3-18 and Table 3-8, where the mean of the daily RMS is calculated not only for the 3D RMS but also for other satellite components.







Figure 3-18: Sentinel-2B orbit comparisons – Mean of daily RMS [cm] (All vs. COMB [radial, along, cross and 3D RMS])

Table 3-9: Sentinel-2B orbit comparisons – Mean of daily RMS [cm] (All vs. COMB)						
Orbit Comparisons (Mean of daily RMS [cm])						

	Orbit Comparisons (Mean of daily RMS [cm])							
Orbit Solution	Centre	Satellite component						
		Radial	Along-track	Cross-track	3D	Typical		
AING	AIUB	0.21	0.19	0.15	0.33	0.19		
AIUB	AIUB	0.71	0.40	0.22	0.86	0.50		
CPOD	CPOD	0.30	0.37	0.29	0.57	0.33		
CPOF	CPOD	0.24	0.25	0.19	0.41	0.24		
СРОК	CPOD	0.38	0.47	0.28	0.67	0.39		
DLRR	DLR	0.34	0.26	0.22	0.49	0.28		



Orbit Comparisons (Mean of daily RMS [cm])							
Orbit	Contro	Satellite component					
Solution		Radial	Along-track	Cross-track	3D	Typical	
ESOC	ESOC	0.28	0.41	0.48	0.70	0.41	
TUDF	TUD	0.33	0.31	0.52	0.71	0.41	
TUGG	TUG	0.23	0.32	0.22	0.46	0.27	
тимм	тим	0.34	0.34	0.26	0.56	0.32	

The Sentinel-2B orbit solutions generated by the CPOD Service show a performance in line with the results obtained on the other solutions.

3.4.3. GEOGRAPHICAL ANALYSIS

Figure 3-19 shows the 3D RMS orbit comparisons calculated on the previous sub section projected on an equi-rectangular map plot. Each cell of the map contains the mean value of all orbit comparisons falling on this cell during the reported period.





Figure 3-19: Sentinel-2B geographical analysis – Average of the 3D RMS orbit comparisons (All vs. COMB)

3.4.4. SPECTRAL ANALYSIS



Figure 3-20 shows the FFT of the 3D RMS orbit comparisons calculated on the previous sub section.



Figure 3-20: Sentinel-2B spectral analysis – 3D RMS orbit comparisons (All vs. COMB)


3.5. SENTINEL-3A

3.5.1. STATISTICS OF THE GENERATION OF THE SOLUTION COMB

Figure 3-21 shows the daily distribution per orbit solution of the weights used to generate the combined Sentinel-3A orbit solution. A summary of these values can be found in Table 3-10, where the mean values of these calculated weights are presented. It must be remarked that a higher value on the weights means a more contribution of the orbit solution to the generation of the combined orbit solution.



Figure 3-21: Sentinel-3A COMB generation – Daily weights of ALL orbit solutions

Table 3-10: Sentinel-3A COMB	generation – Mean of the dail	y weights of ALL orbit solutions

Daily Weights					
Orbit Solution	Centre	Mean			
AING	AIUB	0.13			
AIUB	AIUB	0.09			
CNES	CNES	0.07			
CPOF	CPOD	0.13			
DLRR	DLR	0.09			
ESOC	ESOC	0.09			
GFZZ	GFZ	0.08			
JPLL	JPL	0.07			
TUDF	TUD	0.08			
TUGG	TUG	0.11			
тимм	тим	0.09			

3.5.2. TEMPORAL EVOLUTION OF THE ORBITS COMPARISONS

Figure 3-22 and Figure 3-23 show the temporal evolution of the orbit comparisons [radial and 3D RMS] between all Sentinel-3A orbit solutions provided by the different QWG centres and the combined



orbit solution. A summary of these orbit comparisons can be found in Figure 3-24 and Table 3-11, where the mean of the daily RMS is calculated not only for the 3D RMS but also for other satellite components.



Figure 3-22: Sentinel-3A orbit comparisons – All vs. COMB [radial RMS; cm]



Figure 3-23: Sentinel-3A orbit comparisons – All vs. COMB [3D RMS; cm]



Figure 3-24: Sentinel-3A orbit comparisons – Mean of daily RMS [cm] (All vs. COMB [radial, along, cross and 3D RMS])

Orbit Comparisons (Mean of daily RMS [cm])									
Orbit	Combra	Satellite component							
Solution	Centre	Radial	Along-track	Cross-track	3D	Typical			
AING	AIUB	0.24	0.23	0.20	0.40	0.23			
AIUB	AIUB	0.84	0.30	0.29	0.95	0.55			
CNES	CNES	0.47	0.77	0.55	1.07	0.62			
CPOD	CPOD	0.33	0.34	0.32	0.59	0.34			
CPOF	CPOD	0.30	0.26	0.24	0.49	0.28			
СРОК	CPOD	0.39	0.47	0.30	0.69	0.40			
DLRR	DLR	0.36	0.26	0.29	0.55	0.32			
ESOC	ESOC	0.29	0.34	0.47	0.66	0.38			
EUMB	EUMB	1.30	2.50	1.01	3.20	1.85			
GFZZ	GFZ	0.46	0.85	0.42	1.08	0.62			
GRGG	GRG	0.69	2.36	1.94	3.21	1.85			
JPLL	JPL	0.44	0.34	0.69	0.90	0.52			
TUDF	TUD	0.24	0.28	0.55	0.69	0.40			
TUGG	TUG	0.48	0.32	0.30	0.67	0.39			
тимм	тим	0.31	0.29	0.34	0.55	0.32			

Table 3-11: Sentinel-3A orbit comparisons – Mean of daily RMS [cm] (All vs. COMB)

The Sentinel-3A orbit solutions generated by the CPOD Service show a performance in line with the results obtained on the other solutions.



3.5.3. GEOGRAPHICAL ANALYSIS

Figure 3-25 shows the 3D RMS orbit comparisons calculated on the previous sub section projected on an equi-rectangular map plot. Each cell of the map contains the mean value of all orbit comparisons falling on this cell during the reported period.





Figure 3-25: Sentinel-3A geographical analysis – Average of the radial RMS orbit comparisons (All vs. COMB)

3.5.4. SPECTRAL ANALYSIS

Figure 3-26 shows the FFT of the 3D RMS orbit comparisons calculated on the previous sub section.







Figure 3-26: Sentinel-3A spectral analysis – Radial RMS orbit comparisons (All vs. COMB)



3.5.5. SLR VALIDATION

Figure 3-27 shows the accepted Sentinel-3A observations that the SLR stations have retrieved from the tracking of Sentinel-3A satellite during the reported period.



Figure 3-27: Sentinel-3A SLR validation – Number of accepted SLR observations

The SLR residuals showed below have been calculated by removing a constant bias affecting their generation. These biases are computing using the COMB solution, using all elevations, and estimating a single value for the whole period. Table 3-12 summarises the range biases per SLR station that have been considered during the processing of the SLR residuals.

Two-Range Biases			Tw	ses			
SLR st	tation	Pipe [mm]		SLR s	tation	Dir - [
Monument	Code	Bias [mm]		Monument	Code	Blas [mm]	
7090	YARL	9.39		7825	STL3	4.08	
7105	GODL	1.74		7839	GRZL	6.02	
7110	MONL	8.81		7840	HERL	-2.46	
7119	HA4T	20.04		7841	РОТЗ	-23.53	
7501	HARL	16.27		7941	МАТМ	-20.23	
7810	ZIML	3.81		8834	WETL	-	

Table 3-12: Sentinel-3A SLR validation – Estimated two-range blases per SLR statio	Table 3-12: Sentinel-3A	SLR validation -	Estimated two-range	biases per SLR station
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Figure 3-28 presents the temporal evolution of the Sentinel-3A SLR residuals that have been calculated from each orbit solution. The white spaces that can be found in the plots of the figure are due to punctual missing orbit solutions mainly caused by either manoeuvres or large gaps of data. Despite this fact, all SLR residuals of the different orbit solutions have behaved nominally, obtaining similar values as previous RSR documents. As a comment, the CNES SLR residuals may be higher than expected since the orbit solution **CNES** makes use of a POE-F standard, and the orbits have not been treated consistently regarding the geocentre motion they apply.

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Figure 3-28: Sentinel-3A SLR validation – SLR residuals [cm]

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The previous outcome is summarised in Figure 3-29 and Table 3-13 where the mean, standard deviation (STD) and RMS values of the calculated SLR residuals are shown.



Figure 3-29: Sentinel-3A SLR validation – SLR residuals [cm] (mean, STD, and RMS)

	SLR Residuals [cm]						
Orbit Solution	Centre	Mean	Standard Deviation	RMS			
AING	AIUB	0.11	0.69	0.69			
AIUB	AIUB	-0.49	0.69	0.84			
CNES	CNES	0.16	0.86	0.87			
CPOD	CPOD	0.13	0.71	0.72			
CPOF	CPOD	0.14	0.68	0.70			
СРОК	CPOD	0.02	0.76	0.76			
DLRR	DLR	0.09	0.73	0.74			
ESOC	ESOC	0.11	0.77	0.78			
EUMB	EUMB	-0.51	1.12	1.23			
GFZZ	GFZ	0.04	0.99	0.99			
GRGG	GRG	0.09	1.72	1.72			
JPLL	JPL	0.24	0.80	0.84			
TUDF	TUD	0.07	0.73	0.74			
TUGG	TUG	-0.30	0.78	0.84			
тимм	тим	0.03	0.73	0.73			
СОМВ	-	0.01	0.68	0.68			

Table 3-13: Sentinel-3A SLR validation – SLR residuals [cm] (mean, STD, and RMS)

The Sentinel-3A orbit solutions generated by the CPOD Service show a performance in line with the results obtained on the other solutions.



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3.5.6. ORBIT COMPARISONS OF S-3A STC ORBIT SOLUTIONS

The operational S-3 STC solutions from the CPOD Service (labelled as CPOS), CNES (the MDO solution, which has been labelled as CNER), and two TUD solutions are compared here against the combined solution.

TUD generates two STC orbit solutions for Sentinel-3A, which have been labelled as **TUDU** and **TUDR**. These STC orbit solutions are based on ultra GNSS products from JPL (using standard clocks) and rapid GNSS products from JPL (with high-rate clocks), respectively.

Figure 3-30 shows the radial RMS accuracy of the orbit solutions for all the reported period. As seen in the figure, the TUD solutions offer the best performance, similar to the performance shown by the TUDF NTC solution, thanks to the use of integer ambiguity resolution.



Figure 3-30: Sentinel-3A orbit comparisons – All (STC) vs. COMB [radial RMS; cm]

A more detailed distribution of the obtained accuracy can be found in Table 3-14, where the percentiles of the radial RMS is calculated for different thresholds.

Product Accuracy						
Thursday	Percentage of Fulfilment					
Inreshold	CNER	CPOR	TUDR	TUDU		
< 1 cm	87.84 %	93.60 %	99.52 %	98.88 %		
< 2 cm	99.68 %	98.08 %	99.68 %	99.68 %		
< 3 cm	99.68 %	98.24 %	99.68 %	99.68 %		
< 4 cm	99.68 %	98.56 %	99.68 %	99.68 %		

Table 3-14: Sentinel-3A STC (all) solutions – Accuracy percentiles (orbit comparisons against COMB solution [radial RMS], respectively)



3.6. SENTINEL-3B

3.6.1. STATISTICS OF THE GENERATION OF THE SOLUTION COMB

Figure 3-31 shows the daily distribution per orbit solution of the weights used to generate the combined Sentinel-3B orbit solution. A summary of these values can be found in Table 3-15, where the mean values of these calculated weights are presented. It must be remarked that a higher value on the weights means a more contribution of the orbit solution to the generation of the combined orbit solution.



Figure 3-31: Sentinel-3B COMB generation – Daily weights of ALL orbit solutions

Table 2-1ELS	continul_2P CO	AP concretion	- Moon of	the daily	woights of	ALL orbit colut	lione
Table 2-12: 2	entinei-36 CO	nd generation	i – mean oi	the daily	weights of	ALL OIDIL SOIUL	lions

Daily Weights						
Orbit Solution	Centre	Mean				
AING	AIUB	0.13				
AIUB	AIUB	0.09				
CNES	CNES	0.06				
CPOF	CPOD	0.13				
DLRR	DLR	0.09				
ESOC	ESOC	0.09				
GFZZ	GFZ	0.08				
JPLL	JPL	0.06				
TUDF	TUD	0.10				
TUGG	TUG	0.11				
тимм	тим	0.08				

3.6.2. TEMPORAL EVOLUTION OF THE ORBITS COMPARISONS

Figure 3-32 and Figure 3-33 show the temporal evolution of the orbit comparisons [radial and 3D RMS] between all Sentinel-3B orbit solutions provided by the different QWG centres and the combined



orbit solution. A summary of these orbit comparisons can be found in Figure 3-34 and Table 3-16, where the mean of the daily RMS is calculated not only for the 3D RMS but also for other satellite components.







Figure 3-33: Sentinel-3B orbit comparisons – All vs. COMB [3D RMS; cm]



Figure 3-34: Sentinel-3B orbit comparisons – Mean of daily RMS [cm] (All vs. COMB [radial, along, cross and 3D RMS])

Orbit Comparisons (Mean of daily RMS [cm])									
Orbit	Contro	Satellite component							
Solution	Centre	Radial	Along-track	Cross-track	3D	Typical			
AING	AIUB	0.19	0.17	0.18	0.31	0.18			
AIUB	AIUB	0.65	0.26	0.23	0.75	0.43			
CNES	CNES	0.43	0.75	0.55	1.04	0.60			
CPOD	CPOD	0.27	0.31	0.28	0.50	0.29			
CPOF	CPOD	0.22	0.20	0.19	0.36	0.21			
СРОК	CPOD	0.37	0.42	0.29	0.63	0.37			
DLRR	DLR	0.36	0.23	0.24	0.49	0.28			
ESOC	ESOC	0.23	0.30	0.40	0.56	0.32			
EUMB	EUMB	1.13	2.42	0.99	3.04	1.76			
GFZZ	GFZ	0.42	0.81	0.42	1.03	0.59			
GRGG	GRG	0.68	2.43	2.17	3.40	1.96			
JPLL	JPL	0.35	0.31	0.68	0.83	0.48			
TUDF	TUD	0.22	0.24	0.32	0.47	0.27			
TUGG	TUG	0.25	0.31	0.27	0.49	0.28			
тимм	тим	0.32	0.28	0.30	0.52	0.30			

Table 3-16: Sentinel-3B orbit comparisons – Mean of daily RMS [cm] (All vs. COMB)

The Sentinel-3B orbit solutions generated by the CPOD Service show a performance in line with the results obtained on the other solutions.



3.6.3. GEOGRAPHICAL ANALYSIS

Figure 3-35 shows the 3D RMS orbit comparisons calculated on the previous sub section projected on an equi-rectangular map plot. Each cell of the map contains the mean value of all orbit comparisons falling on this cell during the reported period.





Figure 3-35: Sentinel-3B geographical analysis – Average of the radial RMS orbit comparisons (All vs. COMB)

3.6.4. SPECTRAL ANALYSIS



Figure 3-36 shows the FFT of the 3D RMS orbit comparisons calculated on the previous sub section.



Figure 3-36: Sentinel-3B spectral analysis – Radial RMS orbit comparisons (All vs. COMB)



3.6.5. SLR VALIDATION

Figure 3-37 shows the accepted Sentinel-3B observations that the SLR stations have retrieved from the tracking of Sentinel-3B satellite during the reported period.



Figure 3-37: Sentinel-3B SLR validation – Number of accepted SLR observations

The SLR residuals showed below have been calculated by removing a constant bias affecting their generation. These biases are computing using the COMB solution, using all elevations, and estimating a single value for the whole period. Table 3-17 summarises the range biases per SLR station that have been considered during the processing of the SLR residuals.

Tw	Two-Range Biases			Two-Range Biases			
SLR s	tation	Ding [mm]		SLR st	tation	Ding [mm]	
Monument	Code	Bias [mm]		Monument	Code	Dias [mm]	
7090	YARL	9.84		7825	STL3	-	
7105	GODL	2.01		7839	GRZL	7.46	
7110	MONL	8.82		7840	HERL	-1.81	
7119	HA4T	19.52		7841	РОТЗ	-23.11	
7501	HARL	15.70		7941	МАТМ	-18.66	
7810	ZIML	3.66		8834	WETL	-	

Table 3-17: Sentinel-3B SLR validation	 Estimated 	two-range l	biases pei	r SLR s	tation
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Figure 3-38 presents the temporal evolution of the Sentinel-3B SLR residuals that have been calculated from each orbit solution. The white spaces that can be found in the plots of the figure are due to punctual missing orbit solutions mainly caused by either manoeuvres or large gaps of data. Despite this fact, all SLR residuals of the different orbit solutions have behaved nominally, obtaining similar values as previous RSR documents. As a comment, the CNES SLR residuals may be higher than expected since the orbit solution **CNES** makes use of a POE-F standard, and the orbits have not been treated consistently regarding the geocentre motion they apply.

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Figure 3-38: Sentinel-3B SLR validation – SLR residuals [cm]

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The previous outcome is summarised in Figure 3-39 and Table 3-18 where the mean, standard deviation (STD) and RMS values of the calculated SLR residuals are shown.



Figure 3-39: Sentinel-3B SLR validation – SLR residuals [cm] (mean, STD and RMS)

SLR Residuals [cm]					
Orbit Solution	Centre	Mean	Standard Deviation	RMS	
AING	AIUB	0.07	0.73	0.73	
AIUB	AIUB	-0.36	0.75	0.83	
CNES	CNES	0.09	0.89	0.89	
CPOD	CPOD	0.07	0.73	0.74	
CPOF	CPOD	0.08	0.72	0.73	
СРОК	CPOD	0.06	0.80	0.80	
DLRR	DLR	0.06	0.76	0.76	
ESOC	ESOC	0.02	0.76	0.76	
EUMB	EUMB	-0.46	1.14	1.23	
GFZZ	GFZ	0.03	0.96	0.96	
GRGG	GRG	-0.06	1.73	1.74	
JPLL	JPL	0.17	0.76	0.78	
TUDF	TUD	-0.03	0.72	0.72	
TUGG	TUG	-0.07	0.83	0.83	
тимм	тим	0.02	0.77	0.77	
СОМВ	-	0.00	0.71	0.71	

Table 3-18: Sentinel-3B SLR validation – SLR residuals [cm] (mean, STD and RMS)

The Sentinel-3B orbit solutions generated by the CPOD Service show a performance in line with the results obtained on the other solutions.



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3.6.6. ORBIT COMPARISONS OF S-3B STC ORBIT SOLUTIONS

The operational S-3 STC solutions from the CPOD Service (labelled as CPOS), CNES (the MDO solution, which has been labelled as CNER), and two TUD solutions are compared here against the combined solution.

TUD generates two STC orbit solutions for Sentinel-3B, which have been labelled as **TUDU** and **TUDR**. These STC orbit solutions are based on ultra GNSS products from JPL (using standard clocks) and rapid GNSS products from JPL (with high-rate clocks), respectively.

Figure 3-40 shows the radial RMS accuracy of the orbit solutions for all the reported time period. As seen in the figure, the TUD solutions offer the best performance, similar to the performance shown by the TUDF NTC solution, thanks to the use of integer ambiguity resolution.



Figure 3-40: Sentinel-3B orbit comparisons – All (STC) vs. COMB [radial RMS; cm]

A more detailed distribution of the obtained accuracy can be found in Table 3-19, where the percentiles of the radial RMS is calculated for different thresholds.

Product Accuracy						
Threshold	Percentage of Fulfilment					
	CNER	CPOR	TUDR	TUDU		
< 1 cm	92.80 %	95.84 %	99.84 %	99.20 %		
< 2 cm	99.84 %	98.40 %	99.84 %	99.84 %		
< 3 cm	99.84 %	99.20 %	99.84 %	99.84 %		
< 4 cm	99.84 %	99.20 %	99.84 %	99.84 %		

Table 3-19: Sentinel-3B STC (all) solutions – Accuracy percentiles (orbit comparisons
against COMB solution [radial RMS], respectively)



3.7. SENTINEL-6A

3.7.1. STATISTICS OF THE GENERATION OF THE SOLUTION COMB

Figure 3-41 shows the daily distribution per orbit solution of the weights used to generate the combined Sentinel-6A orbit solution. A summary of these values can be found in Table 3-20 where the mean values of these calculated weights are presented. It must be remarked that a higher value on the weights means a more contribution of the orbit solution to the generation of the combined orbit solution.





Table 2 20. Continal CA COMP	non-untion Many of the		I arkit calutiona
Table 3-20: Sentinel-6A COMB	generation – Mean of the d	daily weights of AL	L OFDIT SOLUTIONS

Daily Weights					
Orbit Solution	Centre	Mean			
AING	AIUB	0.14			
AIUB	AIUB	0.10			
CNES	CNES	0.09			
CPOF	CPOD	0.10			
DLRR	DLR	0.11			
ESOC	ESOC	0.09			
GFZZ	GFZ	0.07			
JPLL	JPL	0.05			
TUDF	TUD	0.08			
TUGG	TUG	0.10			
тимм	тим	0.09			

3.7.2. TEMPORAL EVOLUTION OF THE ORBITS COMPARISONS

Figure 3-42 and Figure 3-43 show the temporal evolution of the orbit comparisons [radial and 3D RMS] between all Sentinel-6A orbit solutions provided by the different QWG centres and the combined



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orbit solution. A summary of these orbit comparisons can be found in Figure 3-44 and Table 3-21, where the mean of the daily RMS is calculated not only for the 3D RMS but also for other satellite components.







Figure 3-43: Sentinel-6A orbit comparisons – All vs. COMB [3D RMS; cm]



Figure 3-44: Sentinel-6A orbit comparisons – Mean of daily RMS [cm] (All vs. COMB [radial, along, cross and 3D RMS])

Orbit Comparisons (Mean of daily RMS [cm])							
Orbit Solution	Centre	Satellite component					
		Radial	Along-track	Cross-track	3D	Typical	
AING	AIUB	0.25	0.30	0.26	0.48	0.28	
AIUB	AIUB	0.49	0.34	0.39	0.72	0.42	
CNES	CNES	0.38	0.70	0.50	0.96	0.55	
CPOD	CPOD	0.39	0.98	0.52	1.18	0.68	
CPOF	CPOD	0.24	0.41	0.39	0.62	0.36	
СРОК	CPOD	0.37	0.61	0.51	0.89	0.51	
DLRR	DLR	0.33	0.64	0.37	0.84	0.48	
ESOC	ESOC	0.24	0.39	0.73	0.88	0.51	
EUMB	EUMB	0.85	1.33	1.09	1.93	1.12	
GFZZ	GFZ	0.56	1.11	0.63	1.42	0.82	
GRGG	GRG	0.61	2.24	2.73	3.65	2.11	
GSFC	GSFC	0.54	1.84	1.54	2.52	1.45	
JPLL	JPL	0.21	1.01	0.73	1.27	0.73	
TUDF	TUD	0.30	0.49	0.69	0.91	0.53	
TUGG	TUG	0.38	0.71	0.56	1.00	0.58	
тимм	тим	0.44	0.48	0.38	0.78	0.45	

Table 3-21: Sentinel-6A orbit comparisons – Mean of daily RMS [cm] (All vs. COMB)

The Sentinel-6A orbit solutions generated by the CPOD Service show a performance in line with the results obtained on the other solutions.



3.7.3. GEOGRAPHICAL ANALYSIS

Figure 3-25 shows the 3D RMS orbit comparisons calculated on the previous sub section projected on an equi-rectangular map plot. Each cell of the map contains the mean value of all orbit comparisons falling on this cell during the reported period.





Figure 3-45: Sentinel-3A geographical analysis – Average of the radial RMS orbit comparisons (All vs. COMB)



3.7.4. SPECTRAL ANALYSIS



Figure 3-46 shows the FFT of the 3D RMS orbit comparisons calculated on the previous sub section.







Figure 3-46: Sentinel-6A spectral analysis – Radial RMS orbit comparisons (All vs. COMB)

3.7.5. SLR VALIDATION

Figure 3-47 shows the accepted Sentinel-6A observations that the SLR stations have retrieved from the tracking of Sentinel-6A satellite during the reported period.



Figure 3-47: Sentinel-6A SLR validation – Number of accepted SLR observations

The SLR residuals showed below have been calculated by removing a constant bias affecting their generation. These biases are computing using the COMB solution, using all elevations, and estimating a single value for the whole period. Table 3-22 summarises the range biases per SLR station that have been considered during the processing of the SLR residuals.



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Table 3-22: Sentinel-6A SLR validation – Estimated two-range biases per SLR station

Two-Range Biases			Two-Range Biases		ses	
SLR station		Ding [mm]	SLR station		Dine Free	
Monument	Code	Blas [mm]	Monument	Code	BIAS [mi	
7090	YARL	11.48		7825	STL3	15.27
7105	GODL	1.66		7839	GRZL	4.84
7110	MONL	9.64		7840	HERL	-1.17
7119	HA4T	19.82		7841	РОТЗ	-26.75
7501	HARL	22.24		7941	МАТМ	-18.39
7810	ZIML	6.61		8834	WETL	0.47

Figure 3-48 presents the temporal evolution of the Sentinel-6A SLR residuals that have been calculated from each orbit solution. The white spaces that can be found in the plots of the figure are due to punctual missing orbit solutions mainly caused by either manoeuvres or large gaps of data. Despite this fact, all SLR residuals of the different orbit solutions have behaved nominally, obtaining similar values as previous RSR documents. As a comment, the CNES SLR residuals may be higher than expected since the orbit solution CNES makes use of a POE-F standard, and the orbits have not been treated consistently regarding the geocentre motion they apply.



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Figure 3-48: Sentinel-6A SLR validation – SLR residuals [cm]

The previous outcome is summarised in Figure 3-49 and Table 3-23 where the mean, standard deviation (STD) and RMS values of the calculated SLR residuals are shown.





Figure 3-49: Sentinel-6A	SLR validation – Sl	_R residuals [cm]	(mean, STD and RMS)

Table 3-23: Sentinel-6A SLR validation – SLR residua	als [cm] (mean, STD and RMS)
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SLR Residuals [cm]								
Orbit Solution	Centre	Mean	Standard Deviation	RMS				
AING	AIUB	-0.12	0.81	0.82				
AIUB	AIUB	0.20	0.87	0.89				
CNES	CNES	-0.09	0.95	0.95				
CPOD	CPOD	-0.10	0.99	0.99				
CPOF	CPOD	-0.07	0.83	0.84				
СРОК	CPOD	-0.03	0.91	0.91				
DLRR	DLR	-0.02	0.99	0.99				
ESOC	ESOC	0.07	0.81	0.81				
EUMB	EUMB	0.14	1.30	1.30				
GFZZ	GFZ	0.09	1.15	1.16				
GRGG	GRG	-0.10	1.94	1.94				
GSFC	GSFC	-0.02	1.10	1.10				
JPLL	JPL	-0.10	0.84	0.84				
TUDF	TUD	0.07	0.78	0.78				
TUGG	TUG	-0.02	0.97	0.97				
тимм	тим	0.07	0.90	0.90				
СОМВ	-	0.00	0.73	0.73				

The Sentinel-6A orbit solutions generated by the CPOD Service show a performance in line with the results obtained on the other solutions.



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3.7.6. ORBIT COMPARISONS OF S-6A STC ORBIT SOLUTIONS

The operational S-6 STC solutions from the CPOD Service (labelled as CPOS), CNES (the MOED solution, which has been labelled as CNER), and TUD rapid solution are compared here against the combined solution.

TUD is currently generating one STC orbit solution for Sentinel-6A, which has been labelled as **TUDR.** This STC orbit solution is based on rapid GNSS products from JPL (with high-rate clocks).

Figure 3-40 shows the radial RMS accuracy of the orbit solutions for all the reported time period. As seen in the figure, the TUD solutions offer the best performance, similar to the performance shown by the TUDF NTC solution, thanks to the use of integer ambiguity resolution.



Figure 3-50: Sentinel-6A orbit comparisons – All (STC) vs. COMB [radial RMS; cm]

A more detailed distribution of the obtained accuracy can be found in Table 3-24, where the percentiles of the radial RMS is calculated for different thresholds.

Product Accuracy								
Thus should	Percentage of Fulfilment							
Inreshold	CNER	CPOR	TUDR					
< 1 cm	98.17 %	98.86 %	100.00 %					
< 2 cm	99.67 %	99.35 %	100.00 %					
< 3 cm	100.00 %	99.35 %	100.00 %					
< 4 cm	100.00 %	99.35 %	100.00 %					

Table 3-24: Sentinel-6A STC (all) solutions – Accuracy percentiles (orbit comparisons
against COMB solution [radial RMS], respectively)



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4. GNSS SENSOR PERFORMANCE ANALYSIS

The proper operation of the GNSS receiver is paramount in the POD processing, as it is based on GNSS measurements. Thus, this section is intended to analyse the GNSS sensor performance of each Sentinel. A very detailed analysis, taking the observations corresponding to every single day of the reported period, would overshoot the sought aim, which is to provide a general insight of the current GNSS status. Instead, a particular epoch has been chosen, **2022/12/10** for all Sentinels, except for Sentinel-1B, which ended at the end of June 2022, and therefore, the selected date is **2022/06/18**, in which neither gaps nor manoeuvres took place (for any Sentinel). For this day, the GNSS data required for generating the corresponding NTC product (in S-1, S-2 and S-3) and STC product (in S-6, since it includes GPS+GAL, whereas its NTC uses only GAL) have been processed (i.e., the complete day plus four hours in its boundaries for S-1 and S-2; adding six hours before the beginning of the day and two hours after its end for S-3; and adding five hours before the beginning of the day and three hours after its end for S-6) to extract some valuable metrics that will be presented in the subsequent sections. Of course, the outcome obtained for the studied day can be generalized for the whole period.

4.1. TRACKING ANALYSIS

To assess the quality of the receiver, the observations are analysed geometrically and statistically. In Figure 4-1 and Figure 4-2, all observations tracked during the selected time interval (from GPS and GAL, respectively) are projected on the antenna frame, where the radial coordinate is the elevation angle from 90° (zenith) to 0° and the polar coordinate is equivalent to the antenna azimuth, oriented in a way where the zero-degree azimuth corresponds to the flight direction. It can be seen that the elevation cut-off angle is about 7°-10°. Furthermore, C1C observations are available slightly before the others, which also leads to a higher number of C1C observations. Indeed, as Figure 4-3 depicts, the frequency at which 8 simultaneous observations in S-1, S-2 and S-3 (i.e., the maximum number according to the receiver capabilities) are tracked is higher in the case of the C1C code, followed by the C2W code. Additionally, it is important to point out that most of the time the eight channels of the receiver are tracking the GPS signals at once, reflecting on its good performance. Regarding S-6, the maximum channel occupancy of 18 channels is never met, being the mean value for both constellations around 13. In this case, the frequency at which 8 or more simultaneous observations are tracked is again higher in GPS-C1C but followed by C2L code instead of C2W code.





Figure 4-1: Projection of GPS observations onto the antenna frame (on 2022/12/10)











Figure 4-3: Histogram of GNSS observations (on 2022/12/10)

The results shown in Figure 4-3 for one particular day can be widened by keeping track of the daily average number of GPS and GAL satellites tracked by the S-1A and S-1B satellites (see Figure 4-4), the S-2A and S-2B satellites (see Figure 4-5), the S-3A and S-3B satellites (see Figure 4-6) and the S-6A satellite (see Figure 4-7 and Figure 4-8). For these Sentinel satellites and all mission days, the daily average number of tracked GPS satellites falls between 7.5 and 8, whereas the daily average number of tracked GAL satellites falls between 6 and 7. This unveils a near-optimal performance of the GNSS receivers on board.





Figure 4-4: Daily average number of GPS satellites tracked by the S-1A and S-1B satellites since the beginning of the missions



Figure 4-5: Daily average number of GPS satellites tracked by the S-2A and S-2B satellites since the beginning of the missions



Figure 4-6: Daily average number of GPS satellites tracked by the S-3A and S-3B satellites since the beginning of the missions





Figure 4-7: Daily average number of GPS satellites tracked by the S-6A satellite since the beginning of the missions



Figure 4-8: Daily average number of GAL satellites tracked by the S-6A satellite since the beginning of the missions

4.2. ANALYSIS OF SIGNAL STRENGTH

Figure 4-9 and Figure 4-10 show the signal-to-noise ratios C/N_0 observed for GPS and GAL signals, respectively, as a function of elevation. Note that S1W values are not shown in Figure 4-9 since they are not directly available. These values should match the values obtained by S2W. S1C has a C/N₀ that ranges between 50-60 dB-Hz at zenith, and drop down to 35-45 dB-Hz at cut-off elevation; whereas, in the case of S2W, two bands can be distinguished, one ranging between 45-55 dB-Hz at zenith and 10-25 dB-Hz around the cut-off elevation, and the other spanning 55-60 dB-Hz at zenith and 25-35 dB-Hz at cut-off elevation. These values are in agreement with expectations and show that the receivers are working well. With respect to the dual band of S2W, it is observed that power levels are split in two separate bands. GPS satellites from blocks IIF and IIR-M can change the power level depending on the geographical location, so the S2W curves on the upper side correspond to those satellites transmitting higher power over specific geographical locations. The fact that the scattering of points evolves with a certain dispersion is due to the C/N_0 is not symmetric with respect to the azimuth: the closer the measurements to the flight direction region, the lower noise they have. Regarding S-6A, both S1C and S2W follow a similar behaviour than the one explained previously but showing only the lower band of S2W. GPS S2L and GAL S5Q signals depict a slightly better performance than C1C, but in the same ranges.



Sentinel-1A

ି S2W

Elevation (deg)

S1C

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Sentinel-1B

S1C 0 S2W

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Elevation (deg)



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Figure 4-9: Signal strength of GPS observations (on 2022/12/10)



Figure 4-10: Signal strength of GAL observations (on 2022/12/10)

4.3. DILUTION OF PRECISION (DOP) PARAMETERS

The Dilution of Precision (DOP) is an indicator of the uncertainties caused by the tracked GNSS satellites geometrical distribution and temporal errors (i.e., related to the clock biases) with respect to the receiver. These values are desired to be small to guarantee a heterogeneous distribution of them.



Three different DOP parameters are commonly defined: the Position DOP (PDOP), which accounts only for the geometrical part; the Time DOP (TDOP), which accounts for the temporal errors, and the Geometric DOP (GDOP), which gathers both effects. Figure 4-11 shows their evolution along the studied time interval (i.e., the day 2022/12/10) for each Sentinel. Despite the noise, the values are quite stable: GDOP oscillates around 2.5-3; PDOP takes slightly lower values, around 2-2.5; and TDOP has the smallest values (as expected), around 1-1.5.





Figure 4-11: Evolution of Dilution of Precision (DOP) Parameters (on 2022/12/10)



4.4. GNSS USO FREQUENCY

The Ultra Stable Oscillator (USO), on-board the satellites Sentinel-3A, -3B and Sentinel-6A, generates a pulse used by the GNSS receiver and called Instrument Measurement Time (IMT).

Assuming that this frequency does not change, there will be no significant drift between the GNSS Time (GPST) computed by the GNSS receiver and the IMT. Figure 4-12 shows the daily drift of each USO for Sentinel-3, and Figure 4-13 for Sentinel-6.











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5. ALTIMETER CROSS-OVER ANALYSIS

As part of the yearly Regular Service Review, the institutions TU Delft and TU Munich have performed an altimeter cross-over analysis using the data and products of Sentinel-3 and Sentinel-6A missions during year 2022. The following subsections describe the analysis independently performed by each institution.

5.1. TU DELFT ANALYSIS

Satellite altimeter crossover residual statistics have been generated, tabulated, and plotted for all the available Sentinel-3A/3B/6A (also identified by S3A, S3B and S6A) orbit solutions. A crossover is a location where ascending and descending passes intersect. On this location, the altimeter scans the same location at different epochs. By subtracting these measurements, the height of the mean sea surface is removed (as it corresponds to the same area), leaving only as residual a combination of these elements:

- Altimetry observation noise
- Sea surface variability, i.e., the change of sea surface height between the time of ascending
- passage and the time of descending passes
- The errors of the altimeter height corrections (troposphere, ionosphere, tides)
- The difference of radial orbit determination errors between the ascending and descending passes.

A satellite altimetry crossover residual then puts an upper limit to the orbital radial error, which typically is (significantly) higher than the real radial error due to the rest of the elements described above. As a rough rule of thumb, the upper limit for the radial orbit determination error is RMS/p2 (RMS = Root-Mean-Square).

The Tables and Figures below include the results of the crossover analysis for the year 2022. Table 1 provides an overview of the precise orbit solutions that have been included in the analysis. Table 2 displays the number of daily solutions for 2022. If this number is equal to 365, all days are covered. A lower number indicates that periods or days are missing, e.g., possibly due to implementations that do not estimate manoeuvres. Crossovers are formed when the time difference between altimeter observations taken at a descending and ascending passage is at a maximum of 13.5 days for Sentinel-3A and Sentinel-3B. When Sentinel-6A is involved, this maximum is equal to 10 days because of its repeat period. Crossovers are formed in monthly batches.

The yearly statistics for all orbit solutions are displayed in Tables 3 and 4. The yearly statistics are obtained by combining the associated monthly statistics. Table 3 applies to the single-satellite crossovers, whereas Table 4 applies to dual-satellite crossovers. The crossovers are produced by the TU Delft Radar Altimeter Database System (RADS). Please note that the orbits provided as part of the nominal altimeter products in RADS are referred to as REF. The dual-satellite crossovers allow for checking the consistency between the altimeter products of the different Sentinel satellites. The left half of these Tables contains the statistics for all found crossovers (unedited), whereas the right part contains the statistics when applying a 3.5-editing. In case NaN is specified, this means that the associated orbit solution provides satellite heights that are anomalous, possibly due to days with manoeuvres and/or instabilities in the orbit determination process. Also, when many crossovers are edited out (difference between 3rd and 6th column), this is an indication that the associated orbit solution does not have a homogeneous quality over the full year of 2022.

If the specified number of unedited crossovers differs from this number for the REF solution, this indicates that daily solutions are missing. For example, for TUG 325 daily solutions are available for Sentinel-3A and and 326 for Sentinel-S3B compared to 365 for the full year. For GSFC, only the first half of 2022 is covered for Sentinel-6A.

Looking at solutions that cover the full year and looking at both the unedited and edited statistics for the single-satellite crossovers, the lowest and comparable RMS values are obtained for the TUDF and CNES solutions for Sentinel-3A and Sentinel-3B. It is remarkable to see the almost equal performance for the Short-Time-Critical (stc) TUDF and CNES solutions (including the TUDF Ultrarapid solution



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stcu). For Sentinel-6A, lowest RMS values are obtained for the JPL solutions, with several solutions very close, including CPOD, CPOF and TUDF. Also, here especially the TUDF stc solution leads to almost the same RMS values. Please note that because of several anomalies in several solutions, the generation of the COMB solution is not straightforward and appears to suffer from excursions. Similar tendencies can be observed for the dual-satellite crossovers (Table 4).

Figures 1-4 display the yearly mean and RMS for respectively the single- and dual-satellite crossover residuals after 3.5-editing. Most solutions result in comparable RMS values for Sentinel-3B and Sentinel-6A, except for the ESOC solution, but it is noted that for some solutions (many) more crossovers are edited out and/or not all days are covered for 2022. For Sentinel-3A, again a high RMS value is obtained for the ESOC solution, but also for the TUG, EUMB, TUM, AING and AIUB solutions. Ideally, the mean is equal to zero for both single- and dual-satellite crossovers. A mean that is significantly deviating from zero is an indication of systematic errors in the associated orbit solution, or in cases of dual-satellite crossovers possible altimeter biases. For single-satellite crossovers this may for example be due to a (slight) off-centring of the orbit, and for dual-satellite crossovers for example by an inconsistency in the (radial) phase centre offsets or the accelerometer calibration. In case of anomalies in the mean values, this requires however a more rigorous investigation, which is beyond the scope of this crossover analysis. For the single-satellite crossovers (Figure 1), deviating means (above 1 cm) can be observed for the TUG, ESOC and EUMB solutions for Sentinel-3A, and the ESOC solution for Sentinel-3B and Sentinel-6A. For the dual-satellite crossovers (Figure 3), the largest excursions in the mean can be observed for the ESOC, EUMB and AIUB solutions for different Sentinel satellites. Again, the stc solutions do not display significant excursions, confirming that these solutions are of high quality (Figures 2 and 4).

Figures 5-16 display the geographically averaged single-satellite crossover residuals for all orbit solutions and Sentinel satellites. Only residuals with an absolute value below 35 cm were selected. In general, similar patterns can be observed, with slight occasional increased levels such as close to South-America or in the Southern Pacific for the CNES stc solution (Figure 5, Figure 9 and Figure 13). Figure 17 provides just one example of the variance of the crossover residuals, which predominantly displays well-known sea surface height variability connected with strong current systems.

Figures 18-29 display the geographically averaged dual-satellite crossover residuals for all orbit solutions and Sentinel pairs. Also here, only residuals with an absolute value below 35 cm were selected. Again, in general, similar patterns can be observed, with occasional anomalies. These Figures con-firm the relatively large means for certain solutions (Table 4), as displayed for example in Figure 18 for AIUB and Figure 20 for EUMB. In addition, e.g., an East-West asymmetry appears to be visible for the CNES stc solution (Figures 22 and 26).

Finally, the long Tables 5 and 6 contain all the monthly statistics for the single- and dual-satellite crossovers. This allows to zoom in a bit more regarding possible anomalies for the several orbit solutions for the Sentinel satellites, and to identify periods that are not covered by a certain solution.

Identifier	S3A	S3B	S6A	Affiliation
REF	Yes	Yes	Yes	Reference RADS
AING	Yes	Yes	Yes	Astronomical Institute, University of Bern
AIUB	Yes	Yes	Yes	Astronomical Institute, University of Bern (Non-Gravitational)
CNES	Yes	Yes	Yes	Centre National d' Etudes Spatiales
CNES_stc	Yes	Yes	Yes	Centre National d'Études Spatiales (Short Time Critical)
СОМВ	Yes	Yes	Yes	Combined
CPOD	Yes	Yes	Yes	Copernicus POD Service (operational solution)
CPOD_stc	Yes	Yes	Yes	Copernicus POD Service (Short Time Critical)

Table 5-1: Overview of precise orbit solutions used in the crossover analysis





Identifier	S3A	S3B	S6A	Affiliation
CPOF	Yes	Yes	Yes	Copernicus POD Service (solution with new developments)
СРОК	Yes	Yes	Yes	Copernicus POD Service (kinematic solution)
DLR	Yes	Yes	Yes	Deutsche Zebtrum für Luft- und Raumfahrt
ESOC	Yes	Yes	Yes	European Space Operations Centre
EUMB	Yes	Yes	Yes	European organisation for the exploitation of Meteorological Satellites
GFZ	Yes	Yes	Yes	Deutsches GeoForschungsZentrum
GRG	Yes	Yes	Yes	Groupe de Recherche de Géodésie Spatiale
GSFC	No	No	Yes	Goddard Space Flight Center
JPL	Yes	Yes	Yes	Jet Propulsion Laboratory
TUDF	Yes	Yes	Yes	Technische Universiteit Delft
TUDF_stc	Yes	Yes	Yes	Technische Universiteit Delft (Short Time Critical)
TUDF_stcu	Yes	Yes	Yes	Technische Universiteit Delft (Ultrarapid Short Time Critical)
TUG	Yes	Yes	Yes	Technische Universität Graz
TUM	Yes	Yes	Yes	Technische Universität München

Table 5-2: Number of daily solutions in 2022

Identifier	S3A	S3B	S6A
AING	351	352	361
AIUB	351	352	361
CNES	365	365	365
CNES_stc	365	365	365
СОМВ	365	365	365
CPOD	365	365	365
CPOD_stc	365	365	365
CPOF	365	365	365
СРОК	365	365	365
DLR	365	365	365
ESOC	338	346	345
EUMB	349	352	360
GFZ	361	361	365
GRG	365	365	365
GSFC	0	0	176
JPL	365	365	365
TUDF	365	365	365
TUDF_stc	365	365	365
TUDF_stcu	365	365	0
TUG	325	326	359
TUM	349	351	361



5.1.1. SINGLE-SATELLITE CROSSOVERS DIFFERENCES

Table 5-3: Statistics of single-satellite Sentinel-3A/3B/6A altimeter crossover difference residuals for the full year of 2022, where crossovers are generated in monthly batches. The single-satellite crossover differences are obtained by subtracting the ascending from the descending legs. The maximum time difference between the legs is 13.5 days for Sentinel-3A/3B and 10.0 days for Sentinel-6A (values in cm).

Satellite	Solution	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
	REE	327223	-0.02	6 94	321871	-0.04	5 69
	AING	327223	21.05	NaN	303251	0.62	8 86
	ATUB	327223	9.58	NaN	303157	0.79	8.78
	CNES	327223	-0.02	6.94	321874	-0.04	5.69
	CNES stc	327223	-0.22	7	322060	-0.24	5.78
	COMB	327223	-0.57	70.58	321680	-0.02	5.74
	CPOD	327223	-0.13	32.26	321803	-0.09	5.67
	CPOD stc	327223	-0.47	32.83	320031	-0.36	5.81
	CPOF	327223	-0.08	32.26	321774	-0.03	5.66
	СРОК	327223	0.75	NaN	321246	-0.08	5.67
S3A	DLR	327223	0.05	7.07	321906	0.03	5.73
	ESOC	327223	15.62	NaN	309844	5.85	20.86
	EUMB	327223	-4.31	NaN	302078	1.49	10.58
	GFZ	327223	-1.19	NaN	313179	-0.31	5.73
	GRG	327223	-8.38	NaN	289885	-0.07	5.75
	JPL	327223	0.12	7.09	321857	0.11	5.68
	TUDF	327223	-0.04	6.92	321828	-0.06	5.67
	TUDF_stc	327223	-0.06	6.93	321844	-0.08	5.67
	TUDF_stcu	327223	-0.09	6.95	321880	-0.11	5.69
	TUG	302015	38.72	NaN	282282	1.46	11.32
	TUM	327223	-1.31	NaN	301516	0.84	9.71
	REF	325006	-0.02	6.93	319520	-0.02	5.66
	AING	325006	-5.41	NaN	298028	-0.03	5.68
S3B	AIUB	325006	3.24	NaN	298034	0.13	5.7
	CNES	325006	-0.02	6.94	319525	-0.02	5.66
	CNES_stc	325006	-0.18	6.99	319644	-0.19	5.73
	COMB	325006	-0.42	38.28	319335	0.02	5.69
	CPOD	325006	-0.14	25.35	319474	-0.08	5.63
	CPOD_stc	325006	-0.37	25.92	317839	-0.3	5.76
	CPOF	325006	-0.08	25.34	319414	-0.02	5.61
S3B	СРОК	325006	-0.11	25.35	319432	-0.06	5.63
550	DLR	325006	0.08	7.01	319527	0.07	5.7
	ESOC	325006	16.27	NaN	300174	2.22	13.49
	EUMB	325006	10.9	NaN	298092	0.37	5.75
	GFZ	325006	-0.3	NaN	313977	-0.19	5.66
	GRG	325006	17.53	NaN	293620	-0.03	5.74
	JPL	325006	0.12	6.93	319430	0.12	5.63
	TUDF	325006	-0.06	6.92	319444	-0.06	5.63
	TUDF_stc	325006	-0.08	6.92	319475	-0.08	5.64
	TUDF_stcu	325006	-0.08	6.99	319474	-0.08	5.65
	TUG	300177	6.2	NaN	274302	0.02	5.67

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Satellite	Solution	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
	TUM	325006	36.52	NaN	296658	0.15	5.62
	REF	422001	0.07	6.07	415713	0.06	5.09
	AING	422001	-0.62	NaN	406694	0.05	5.13
	AIUB	422001	-1.81	NaN	406708	0.05	5.16
	CNES	422001	-0.53	NaN	411877	0.07	5.09
	CNES_stc	422001	-0.06	NaN	412154	0.11	5.14
	СОМВ	422001	-1.28	NaN	411926	0.07	5.11
	CPOD	422001	0.05	6.09	415737	0.05	5.11
	CPOD_stc	422001	-0.02	8.69	414687	-0.03	5.19
	CPOF	422001	0.08	6.07	415730	0.08	5.09
	CPOK	422001	-2.17	NaN	415570	0.07	5.1
S6A	DLR	422001	0.05	6.11	415854	0.05	5.14
	ESOC	422001	-9.88	NaN	362874	2.19	12.99
	EUMB	422001	8.96	NaN	404175	0.04	5.23
	GFZ	422001	0.11	6.12	415772	0.1	5.14
	GRG	422001	39.36	NaN	369350	-0.05	5.26
	GSFC	224530	5.4	NaN	218720	0.09	4.94
	JPL	422001	0.07	6.07	415728	0.06	5.08
	TUDF	422001	0.08	6.08	415721	0.08	5.1
	TUDF_stc	422001	0.09	6.08	415732	0.08	5.1
	TUG	422001	11.13	NaN	401775	0.09	5.16
	TUM	422001	6.37	NaN	406615	0.04	5.11





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Figure 5-1: Statistics of single-satellite Sentinel-3A/3B/6A altimeter crossover difference residuals for the full year of 2022 based on monthly batches; values after editing with $3.5 - \sigma$



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5.1.2. DUAL-SATELLITE CROSSOVERS DIFFERENCES

Table 5-4: Statistics of dual-satellite Sentinel-3A/3B/6A altimeter crossover difference residuals for the full year of 2022, where crossovers are generated in monthly batches. The dual-satellite crossover differences are obtained by taking one of the satellites for the first leg and the other for the second leg. The maximum time difference between the legs is 13.5 days for Sentinel- 3A/3B and 10.0 days for Sentinel-6A (values in cm).

Satellite	Solution	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
	REF	652010	0.12	6.89	641193	0.12	5.69
	AING	629404	8.53	NaN	595774	0.14	5.74
	AIUB	629388	-0.71	NaN	595743	0.4	5.76
	CNES	652010	0.12	6.89	641190	0.12	5.69
3A_3B	CNES_stc	652010	0.15	6.95	641564	0.15	5.77
	СОМВ	652010	-0.01	63.96	640889	0.2	5.74
	CPOD	652010	0.12	8.52	641101	0.12	5.67
	CPOD_stc	652010	0.15	10.3	637786	0.12	5.81
	CPOF	652010	0.13	8.52	640997	0.13	5.65
	СРОК	651801	-0.96	NaN	640590	0.27	5.68
	DLR	652010	0.13	6.99	641208	0.13	5.73
	ESOC	606596	3.67	NaN	569734	0.98	9.67
	EUMB	625857	15.81	NaN	591441	0.41	5.82
	GFZ	645071	1.5	NaN	626626	0.17	5.71
	GRG	647964	19.66	NaN	631149	0.12	5.75
	JPL	652010	0.12	6.98	641075	0.12	5.67
	TUDF	652010	0.11	6.87	641096	0.11	5.67
	TUDF_stc	652010	0.1	6.88	641123	0.1	5.67
	TUDF_stcu	652010	0.11	6.93	641172	0.11	5.69
	TUG	579607	6.75	NaN	547416	0.58	5.74
	TUM	632515	14.79	NaN	591587	0.17	5.67
	REF	966848	0.91	6.2	952558	0.9	5.2
	AING	956435	7.54	NaN	905143	0.95	5.25
	AIUB	956422	4.59	NaN	905065	2.37	5.7
	CNES	962340	1.55	NaN	947850	0.9	5.2
	CNES_stc	962547	0.52	NaN	948742	0.94	5.31
	СОМВ	962338	-1.41	NaN	947604	1.23	5.3
	CPOD	966848	0.91	12	952541	0.91	5.21
	CPOD_stc	966848	0.86	13.2	949384	0.96	5.3
	CPOF	966848	0.92	12	952446	0.92	5.19
6A_3A	CPOK	966848	2.27	NaN	951486	1.19	5.27
	DLR	966848	1.21	6.33	952725	1.19	5.3
	ESOC	920926	2.45	NaN	857666	2.75	12.2
	EUMB	954207	9.76	NaN	895509	2.49	5.82
	GFZ	966848	1.03	NaN	938888	1.28	5.34
	GRG	966848	29.63	NaN	845377	0.98	5.37
	JPL	966848	0.85	6.26	952483	0.84	5.18
	TUDF	966848	1.18	6.24	952583	1.17	5.25
	TUDF_stc	966848	1.24	6.25	952593	1.22	5.27
	TUG	878069	2.54	NaN	828491	1.64	5.41





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Satellite	Solution	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
	TUM	959397	-7.43	NaN	900454	1.27	5.3
	REF	965729	0.78	6.17	951478	0.76	5.17
	AING	955272	1.07	NaN	906846	0.79	5.22
	AIUB	955254	3.37	NaN	906973	1.95	5.54
	CNES	961202	2.17	NaN	946743	0.76	5.17
	CNES_stc	961486	3.77	NaN	947592	0.81	5.28
	СОМВ	961197	2.27	NaN	946648	1.01	5.25
	CPOD	965729	0.75	28.59	951545	0.78	5.18
	CPOD_stc	965729	0.72	29.17	948386	0.82	5.28
	CPOF	965729	0.75	28.59	951447	0.77	5.17
6A 20	СРОК	965729	-1.26	NaN	951258	0.89	5.2
OA_3D	DLR	965729	1.06	6.27	951635	1.05	5.27
	ESOC	919511	15.64	NaN	863729	1.71	9.23
	EUMB	952987	12.7	NaN	904315	2.06	5.64
	GFZ	965729	3.37	NaN	942038	1.1	5.29
	GRG	965729	-7.83	NaN	858806	0.83	5.36
	JPL	965729	0.71	6.16	951374	0.7	5.15
	TUDF	965729	1.06	6.21	951500	1.04	5.22
	TUDF_stc	965729	1.11	6.22	951497	1.1	5.23
	TUG	877535	-2.67	NaN	831941	1.04	5.26
	TUM	958275	3.19	NaN	904982	1.09	5.26







Figure 5-2: Statistics of dual-satellite Sentinel-3A/3B/6A altimeter crossover difference residuals for the full year of 2022 based on monthly batches; values after editing with $3.5-\sigma$



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5.1.3. GEOGRAPHICAL CORRELATED ERRORS

Figure 5-3 displays the geographically averaged single-satellite crossover residuals for the REF orbit solutions and Sentinel-3A/3B/6A satellites. Only residuals with an absolute value below 35 cm were selected. Section G.3 in Annex E displays similar plots for all orbital solutions. In general, similar patterns can be observed, with occasional anomalies, such as in the South-West area for the GRG Sentinel-6A solution.



Figure 5-3: Mean Sentinel-3A/3B/6A – REF solution, single-satellite altimeter crossover difference residuals as a function of geographical location for 2022 (ascending minus descending)

Figure 5-4 provides just one example of the variance of the crossover residuals, which predominantly displays well-known sea surface height variability connected with strong current systems.



Figure 5-4: Sentinel-6A variability of single-satellite altimeter crossover difference residuals as a function of geographical location for 2022 (ascending minus descending). Orbit product is from TU Delft. This pattern predominantly shows well-known sea surface variability (e.g., due to Gulfstream, Agulhas, Kuro-Shio, Falkland current, etc.)



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Section G.4 in Annex E to display the geographically averaged dual-satellite crossover residuals for all orbit solutions and Sentinel pairs. Also here, only residuals with an absolute value below 35 cm were selected. And also here, in general, similar patterns can be observed, with occasional anomalies. The most striking deviating pictures are obtained for the GRG Sentinel-6A combination with Sentinel-3A and Sentinel 3-B.

5.1.4. CROSS-OVER EVOLUTIONS

Finally, the Figure 5-5 to Figure 5-8 shows the monthly evolution of the statistics for the single- and dual-satellite crossovers. Sections G.1 and G.2 in Annex E show the tables with all values allowing to zoom in a bit more regarding possible anomalies for the several orbit solutions for the Sentinel satellites.







Figure 5-5: Monthly evolution of single-satellite crossovers after editing with 3.5-σ (mean)



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Figure 5-6: Monthly evolution of single-satellite crossovers after editing with $3.5 - \sigma$ (RMS)



Figure 5-7: Monthly evolution of dual-satellite crossovers after editing with 3.5-σ (mean)





Figure 5-8: Monthly evolution of dual-satellite crossovers after editing with 3.5- σ (RMS)



5.2. TUM ANAYSIS

This chapter reports on the sea surface height (SSH) crossover analysis performed for the altimetry satellites Sentinel-3A, Sentinel-3B, and Sentinel-6A in combination with Jason-3. The analysis is performed for each orbit solution based on exactly the same altimetry data set (observed ranges and geophysical corrections), so that the different solutions can be inter-compared. For Jason-3 the CNES orbit solution that is part of the GDR data set is used for all runs. It should also be noted that Jason-3 changed its orbit in April 2022 and has not flown in tandem with Sentinel-6A since then. Moreover, it is important to keep in mind, that all analyses are based on SSH crossover differences, and the values not only contain orbit errors but also effects from other parameters involved (sea level, altimetric range, geophysical corrections).

Altimetry data used in this study was downloaded from EUMETSAT CODA system. Only NTC data are used. In case of Sentinel-6A Laser Ranging data was used. Compared to the last report (year 2021), the versions of the input altimetry data have changed, so the results are not directly comparable.

The analyses are performed for 15 orbit solutions (COMB, CPOD, CPOF, CPOK, CNES, GRG, ESOC, EUMB, TUM, TUDF, AIUB, AING, DLR, JPL, GFZ).

The analyses are based on single-satellite crossover differences (i.e. between ascending and descending passes of one mission) as well as on multi-mission crossover differences (i.e. between all available pass-crossings of the missions involved). The multi-mission crossover analysis (MMXO) follows the approach published by Bosch et al. (2014).

5.2.1. SINGLE-SATELLITE CROSSOVER DIFFERENCES

Single-satellite crossover differences are built between ascending and descending passes of each mission. The maximum time difference allowed is 2 days. The plots show the standard deviations of the crossover differences per Jason cycle (i.e. 10 days), limited within +/- 55 degrees latitude. The latter is necessary to allow an inter-comparison between missions with different inclination and to exclude sea-ice covered ocean areas. Per 10 days, between 1000 and 2000 crossover differences are available for interpretation, covering the entire open oceans. In order to emphasize the differences between the orbit solutions, the values are plotted with respect to the combined orbit solution (COMB). Positive values indicate larger standard deviations than COMB, negative ones smaller values. In addition, averaged values for the full year 2022 are shown and provided as numbers in a table.

The results show that most of the orbit solutions behave quite similarly to each other and perform better than the combined solution (COMB), i.e. show negative differences. Solution EUMB shows for all three satellites higher crossover differences than the other solutions. GFZ, GRG, and DLR show some periods with extreme outliers, the latter solution only for Sentinel-3b. These values have not been removed in the overall statistics.

Overall, the solutions from TUM (Sentinel-3A), CPOF (Sentinel-3B) and JPL (Sentinel-6A) perform best. TUDF and CNES also show a good performance. The mean crossover differences are all non-significant because they are substantially smaller than the standard deviations. However, it is noticeable that they are much smaller for Sentinel-6A than for both Sentinel-3 satellites.



Figure 5-9: Standard deviation of Sentinel-3A single-satellite crossover differences (globally, per 10 days) of different orbit solutions, relative to COMB solution



Figure 5-10: Standard deviation of Sentinel-3B single-satellite crossover differences (globally, per 10 days) of different orbit solutions, relative to COMB solution





Figure 5-11: Standard deviation of Sentinel-6A single-satellite crossover differences (globally, per 10 days) of different orbit solutions, relative to COMB solution









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Figure 5-12: Mean (left) and standard deviations (right) of single-satellite crossover differences for Sentinel-3a (top), Sentinel-3b (middle), and Sentinel-6a (bottom)

Orbit	Sentinel-3A	Sentinel-3B	Sentinel-6A
СОМВ	-0.002269 ± 0.043731	-0.001734 ± 0.043089	0.001090 ± 0.043725
AIUB	-0.000999 ± 0.043557	-0.000865 ± 0.043171	0.000754 ± 0.044274
CNES	-0.002625 ± 0.043073	-0.002291 ± 0.042710	0.000959 ± 0.043397
ESOC	-0.001692 ± 0.043384	-0.001330 ± 0.043057	0.001020 ± 0.043745
CPOD	-0.002925 ± 0.043131	-0.002716 ± 0.042622	0.000912 ± 0.043535
DLR	-0.002588 ± 0.043821	-0.001875 ± 0.043469	0.000894 ± 0.043957
TUDF	-0.002773 ± 0.043056	-0.002679 ± 0.042761	0.001110 ± 0.043444
TUM	-0.002662 ± 0.043050	-0.000730 ± 0.042749	0.001088 ± 0.043589
CPOF	-0.002505 ± 0.043166	-0.002211 ± 0.042592	0.001115 ± 0.043423
JPL	-0.000685 ± 0.043063	-0.000375 ± 0.042699	0.000890 ± 0.043341
GFZ	-0.005623 ± 0.044868	-0.004218 ± 0.043091	0.001306 ± 0.043890
GRG	-0.003180 ± 0.044013	-0.002180 ± 0.044505	-0.000266 ± 0.049012
EUMB	0.000231 ± 0.044419	0.001406 ± 0.044088	0.001047 ± 0.045054
AING	-0.002725 ± 0.043510	-0.002270 ± 0.043119	0.000916 ± 0.043935
СРОК	-0.003265 ± 0.043336	-0.002801 ± 0.042749	0.001167 ± 0.043575

Table 5-5: Mean and standard deviation of single-satellite crossover differences	(±55			
degrees latitude), in [m]				

5.2.2. RADIAL ERRORS

Using the method of multi-mission crossover analysis as described by Bosch et al. (2014), radial errors are calculated for each mission. For the analyses, means and standard deviations of radial errors per 10-day Jason cycle are computed. These values are a measure of the consistency of the data with respect to the Jason-3 dataset, which was used as the reference for these investigations. The orbit solution used for Jason-3 is the official POD-F version (from CNES), which is part of the altimetry product used (SGDR-F).

Since the mean values also include potential differences in the range of the altimetry systems, the main interest is in the scatter of the radial errors, represented by their standard deviations. For better clarity, the time series are referenced to the COMB orbit solution. As for the single-satellite statistics, negative differences indicate better values than COMB.



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In general, the analysis shows differences between the standard deviations of less than 2 mm. Individual outliers can be identified, especially for GFZ, DLR, and GRG (Sentinel-6 only). The EUMB solution shows the largest standard deviations for all satellites. This is particularly clear for Sentinel-6. GRG shows increased values for both Sentinel-3 satellites in the last quarter of 2022. The smallest standard deviations can be observed for TUM (Sentinel-3) and JPL (Sentinel-6).

The mean values cannot be interpreted as a performance metric because the true errors (e.g. due to instrument offsets) are not known. A separation of the effects of the orbit from the other factors influencing the SSH determination cannot be made with certainty. What is remarkable, however, are the significantly higher values for AIUB and EUMB for Sentinel-3. This indicates a difference in the scale of the solutions.



Figure 5-13: Standard deviation of Sentinel-3A radial errors (globally, per 10 days) of different orbit solutions, relative to COMB solution



Figure 5-14: Standard deviation of Sentinel-3B radial errors (globally, per 10 days) of different orbit solutions, relative to COMB solution




Figure 5-15: Standard deviation of Sentinel-36 radial errors (globally, per 10 days) of different orbit solutions, relative to COMB solution









Figure 5-16: Mean (left) and standard deviations (right) of radial errors for Sentinel-3a (top), Sentinel-3b (middle), and Sentinel-6a (bottom)

	Sentinel-3A	Sentinel-3B	Sentinel-6A
СОМВ	0.008905 ± 0.016964	0.006116 ± 0.017887	0.003880 ± 0.011963
AIUB	0.016491 ± 0.016489	0.011682 ± 0.017671	0.000792 ± 0.012515
CNES	0.006781 ± 0.016569	0.004846 ± 0.017827	0.004474 ± 0.011652
ESOC	0.006680 ± 0.016674	0.004739 ± 0.017881	0.003444 ± 0.011853
CPOD	0.006906 ± 0.016656	0.004946 ± 0.017624	0.004895 ± 0.012007
DLR	0.008808 ± 0.017005	0.006683 ± 0.018153	0.004440 ± 0.012224
TUDF	0.008176 ± 0.016615	0.006349 ± 0.017808	0.003686 ± 0.011755
TUM	0.009540 ± 0.016440	0.006992 ± 0.017611	0.003927 ± 0.012126
CPOF	0.006515 ± 0.016644	0.004443 ± 0.017661	0.004647 ± 0.011798
JPL	0.005370 ± 0.016508	0.003406 ± 0.017668	0.004145 ± 0.011583
GFZ	0.008349 ± 0.019490	0.005555 ± 0.018811	0.002304 ± 0.012452
GRG	0.005685 ± 0.017226	0.003523 ± 0.019669	0.003739 ± 0.024371
EUMB	0.019410 ± 0.017190	0.014508 ± 0.018359	0.002209 ± 0.013521
AING	0.007585 ± 0.016734	0.005237 ± 0.017936	0.005434 ± 0.012129
СРОК	0.008818 ± 0.016829	0.005265 ± 0.017804	0.004484 ± 0.011853

Tahle	5-6. Me	an and	standard	deviation	of radial	errors	(+55	dearees	latitude)	in	[m]
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5.2.3. GEOGRAPHICALLY CORRELATED ERRORS

Based on the radial errors, geographically correlated mean errors (GCE) can be computed (Bosch et al., 2014), which indicate geographical patterns mainly influenced by the satellite orbits. In addition to the GCE, relative GCE with respect to Jason-3 (for each orbit solution) and with respect to COMB solution (of the same satellite) are also computed. **Figure 5-17** shows only the GCE for the COMB solution of each satellite, as all orbit solutions look very similar to each other. The relative GCE for each individual orbit solution is then shown with respect to COMB. Overall statistics are given for both the absolute GCE and the GCE with respect to Jason-3.

The patterns visible in GCE are quite different for the different solutions. Some orbits seem to have degradations for single tracks, visible as stripes following the satellite ground tracks (e.g. EUMB). Some others show large-scale differences, especially GRG for Sentinel-6, which are related to differences in the realisation of the origin (see next section).



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Overall, the differences among the various orbit solutions are quite small and do not exceed 5 mm. The smallest scatter in GCE is achieved by the JPL orbit solution for all three satellites. CNES solutions fits best to Jason-3, probably since the same POD strategy/parameters are used (the Jason-3 dataset is also based on a CNES orbit solution). The second best solution in terms of consistency with Jason-3 is CPOF.



Figure 5-17: GCE of COMB orbit solution for three satellites (left: absolute as defined by MMXO; right: relative to Jason-3)



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Figure 5-18: Sentinel-3A GCE differences for various orbit solutions with respect to COMB



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Figure 5-19: Sentinel-3B GCE differences for various orbit solutions with respect to COMB











Figure 5-20: Sentinel-6A GCE differences for various orbit solutions with respect to COMB

















Figure 5-21: Standard deviations of abs. GCE (left) and GCE wrt Jason-3 (right)



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Table 5-7: Mean and standard deviation of GCE (±55 deg latitude), in [m]

Orbit	Sentinel-3A	Sentinel-3B	Sentinel-6A
СОМВ	-0.000763 ± 0.003037	-0.000754 ± 0.003221	-0.000172 ± 0.002070
AIUB	-0.000921 ± 0.003116	-0.000947 ± 0.003362	0.000035 ± 0.002048
CNES	-0.000659 ± 0.003032	-0.000739 ± 0.003174	-0.000167 ± 0.002049
ESOC	-0.000823 ± 0.003090	-0.000886 ± 0.003291	-0.000008 ± 0.002230
CPOD	-0.000654 ± 0.003087	-0.000731 ± 0.003227	-0.000026 ± 0.002345
DLR	-0.001035 ± 0.003227	-0.000982 ± 0.003410	-0.000213 ± 0.002049
TUDF	-0.000827 ± 0.003086	-0.000781 ± 0.003310	-0.000166 ± 0.002160
TUM	-0.000879 ± 0.003238	-0.000949 ± 0.003405	-0.000229 ± 0.002058
CPOF	-0.000729 ± 0.002987	-0.000718 ± 0.003202	-0.000099 ± 0.002059
JPL	-0.000760 ± 0.002859	-0.000664 ± 0.003016	-0.000177 ± 0.001987
GFZ	-0.000475 ± 0.003061	-0.000711 ± 0.003283	-0.000419 ± 0.002228
GRG	-0.000886 ± 0.003309	-0.000956 ± 0.003612	0.000057 ± 0.002773
EUMB	-0.000837 ± 0.003224	-0.000861 ± 0.003471	-0.000332 ± 0.002205
AING	-0.000662 ± 0.003022	-0.000762 ± 0.003238	-0.000050 ± 0.002082
СРОК	-0.000704 ± 0.002996	-0.000843 ± 0.003253	-0.000028 ± 0.002017

Table 5-8: Mean and standard deviation of GCE relative to Jason-3(±55 deg latitude), in [m]

Orbit	Sentinel-3A	Sentinel-3B	Sentinel-6A
СОМВ	-0.001302 ± 0.003345	-0.001310 ± 0.003483	-0.000706 ± 0.002731
AIUB	-0.001606 ± 0.003533	-0.001641 ± 0.003728	-0.000643 ± 0.002600
CNES	-0.001263 ± 0.003234	-0.001355 ± 0.003316	-0.000763 ± 0.002326
ESOC	-0.001336 ± 0.003489	-0.001411 ± 0.003618	-0.000502 ± 0.002920
CPOD	-0.001121 ± 0.003472	-0.001208 ± 0.003561	-0.000485 ± 0.002935
DLR	-0.002007 ± 0.003603	-0.001962 ± 0.003758	-0.001171 ± 0.002864
TUDF	-0.001373 ± 0.003508	-0.001340 ± 0.003695	-0.000700 ± 0.002932
TUM	-0.001764 ± 0.003541	-0.001837 ± 0.003674	-0.001097 ± 0.002790
CPOF	-0.001170 ± 0.003332	-0.001171 ± 0.003498	-0.000529 ± 0.002716
JPL	-0.001319 ± 0.003437	-0.001231 ± 0.003544	-0.000727 ± 0.002718
GFZ	-0.000990 ± 0.003497	-0.001233 ± 0.003721	-0.000915 ± 0.003047
GRG	-0.001565 ± 0.003645	-0.001641 ± 0.003949	-0.000605 ± 0.003383
EUMB	-0.001684 ± 0.003899	-0.001716 ± 0.004062	-0.001183 ± 0.003074
AING	-0.001037 ± 0.003389	-0.001147 ± 0.003592	-0.000426 ± 0.002769
СРОК	-0.001186 ± 0.003525	-0.001336 ± 0.003718	-0.000496 ± 0.002632

5.2.4. ORIGIN

In order to analyse the temporal variations of the main GCE pattern, differences in the center-of-origin realization between different orbit solutions can be calculated according to the formulae provided in Bosch et al. (2014). All values are with respect to Jason-3. In addition to the differences in x,y, and z, differences in range bias (dr) are also shown, which include scale differences of the orbit solutions.



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The jump that is visible for Sentinel-3 in dr has nothing to do with the satellite orbits, but with an update of the processing of the altimeter observations. In mid-June, the CODA altimeter data was changed from baseline 4 to baseline 5, reducing an offset in the data. What is visible, however, is the difference between EUMB and AIUB and all other orbit solutions. There seems to be a scale difference wrt Jason-3, which is not visible in Sentinel-6.

The centre-of-origin shifts behave very homogeneously for all orbit solutions, so they are rather due to general differences between the missions and not to concrete differences in the orbit calculation. Only in dz larger deviations can be seen. Here, the CNES solution stands out in particular, which is more consistent with the Jason-3 solutions, especially in the summer months. This applies to all three satellites, but is best seen for Sentinel-6, because here all the other solutions show a relatively clear seasonal effect, which is only not visible in the CNES solution. This better consistency with Jason-3 (for which a CNES orbit was also used) does not necessarily mean that this solution is actually better than all the others.





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sentinel3a



Figure 5-22: Center-of-origin realization of different Sentinel-3A orbit solutions relative to Jason-3



sentinel3b



Figure 5-23: Center-of-origin realization of different Sentinel-3B orbit solutions relative to Jason-3





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sentinel6a



Figure 5-24: Center-of-origin realization of different Sentinel-6A orbit solutions relative to Jason-3

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Table 5-9: Mean differences in dx with respect to Jason-3 in [m]

Orbit	Sentinel-3A	Sentinel-3B	Sentinel-6A
COMB	0.001306 ± 0.001969	0.001528 ± 0.002254	0.000667 ± 0.002211
AIUB	0.001806 ± 0.002106	0.002222 ± 0.002323	0.000917 ± 0.002278
CNES	0.000750 ± 0.001920	0.001028 ± 0.002154	0.000667 ± 0.001354
ESOC	0.001278 ± 0.002388	0.001583 ± 0.002431	0.000750 ± 0.001920
CPOD	0.001139 ± 0.002030	0.001500 ± 0.002255	0.000750 ± 0.001441
DLR	0.001472 ± 0.001936	0.001917 ± 0.002314	0.000528 ± 0.002048
TUDF	0.001361 ± 0.002002	0.001806 ± 0.002319	0.001083 ± 0.001320
TUM	0.001056 ± 0.001899	0.001500 ± 0.002115	0.000194 ± 0.001243
CPOF	0.000667 ± 0.001972	0.001028 ± 0.002327	0.000167 ± 0.001443
JPL	0.001111 ± 0.001912	0.001389 ± 0.002099	0.000861 ± 0.001512
GFZ	0.000750 ± 0.002314	0.001222 ± 0.002136	0.000778 ± 0.001601
GRG	0.002583 ± 0.002793	0.003028 ± 0.003050	-0.000722 ± 0.001820
EUMB	0.002444 ± 0.002088	0.002639 ± 0.002474	0.001194 ± 0.002158
AING	0.001639 ± 0.002070	0.001917 ± 0.002431	0.000917 ± 0.002046
СРОК	0.001194 ± 0.002011	0.001472 ± 0.002205	0.000861 ± 0.001397

Table 5-10: Mean differences in dy with respect to Jason-3 in [m]

Orbit	Sentinel-3A	Sentinel-3B	Sentinel-6A
СОМВ	0.000861 ± 0.002263	0.001056 ± 0.002198	0.001167 ± 0.001641
AIUB	0.000972 ± 0.002398	0.000944 ± 0.002356	0.001417 ± 0.002087
CNES	0.000694 ± 0.001997	0.000806 ± 0.001761	0.000556 ± 0.001091
ESOC	0.001694 ± 0.002413	0.001722 ± 0.002129	0.001528 ± 0.001518
CPOD	0.002056 ± 0.002333	0.002139 ± 0.002084	0.001778 ± 0.001530
DLR	-0.000222 ± 0.002250	-0.000194 ± 0.002209	-0.000028 ± 0.001691
TUDF	0.002333 ± 0.002427	0.002472 ± 0.002386	0.002444 ± 0.001442
TUM	0.000056 ± 0.002415	0.000056 ± 0.002356	0.000167 ± 0.001740
CPOF	0.001111 ± 0.002424	0.001139 ± 0.002226	0.001278 ± 0.001539
JPL	0.002139 ± 0.002263	0.002167 ± 0.002217	0.002000 ± 0.001528
GFZ	0.002000 ± 0.002625	0.002250 ± 0.002442	0.001694 ± 0.001777
GRG	0.001000 ± 0.002438	0.000972 ± 0.002398	0.003556 ± 0.002587
EUMB	0.001222 ± 0.002262	0.001250 ± 0.002314	0.001167 ± 0.001756
AING	0.001167 ± 0.002327	0.001167 ± 0.002179	0.001500 ± 0.001787
СРОК	0.001389 ± 0.002384	0.001639 ± 0.002226	0.000806 ± 0.001450



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Table 5-11: Mean differences in dz with respect to Jason-3 in [m]

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Orbit	Sentinel-3A	Sentinel-3B	Sentinel-6A
СОМВ	-0.001250 ± 0.002861	-0.000917 ± 0.002929	-0.002778 ± 0.003284
AIUB	-0.001139 ± 0.003102	-0.000667 ± 0.003046	-0.001583 ± 0.004232
CNES	0.000194 ± 0.003026	0.000556 ± 0.003122	-0.001556 ± 0.001423
ESOC	-0.001417 ± 0.002607	-0.001000 ± 0.002667	-0.003139 ± 0.003497
CPOD	-0.000917 ± 0.002842	-0.000500 ± 0.002804	-0.002750 ± 0.003183
DLR	-0.001500 ± 0.002774	-0.001194 ± 0.002787	-0.003194 ± 0.003695
TUDF	-0.000500 ± 0.002920	-0.000222 ± 0.002830	-0.002833 ± 0.003508
TUM	-0.000833 ± 0.002920	-0.000694 ± 0.002998	-0.003083 ± 0.002919
CPOF	-0.001417 ± 0.002871	-0.001083 ± 0.002842	-0.002750 ± 0.003345
JPL	-0.001167 ± 0.002744	-0.000778 ± 0.002810	-0.002222 ± 0.003172
GFZ	-0.001722 ± 0.003123	-0.001556 ± 0.003337	-0.003444 ± 0.004099
GRG	-0.000528 ± 0.003059	0.000222 ± 0.002992	-0.001167 ± 0.004072
EUMB	-0.002667 ± 0.003153	-0.002361 ± 0.003155	-0.003167 ± 0.004106
AING	-0.001500 ± 0.002824	-0.001083 ± 0.002822	-0.002556 ± 0.003329
СРОК	-0.002389 ± 0.002870	-0.002056 ± 0.002981	-0.002694 ± 0.003264

Table 5-12: Mean differences in dr with respect to Jason-3 in [m]

Orbit	Sentinel-3A	Sentinel-3B	Sentinel-6A
СОМВ	0.008917 ± 0.010444	0.006167 ± 0.012255	0.003139 ± 0.001032
AIUB	0.016778 ± 0.009835	0.012083 ± 0.011793	0.000083 ± 0.001441
CNES	0.007028 ± 0.010337	0.005250 ± 0.012341	0.004000 ± 0.001509
ESOC	0.006722 ± 0.010442	0.005000 ± 0.012286	0.002556 ± 0.001039
CPOD	0.006917 ± 0.010243	0.005139 ± 0.012227	0.004056 ± 0.001104
DLR	0.008889 ± 0.010030	0.006778 ± 0.011998	0.003556 ± 0.001442
TUDF	0.008444 ± 0.010431	0.006639 ± 0.012261	0.003083 ± 0.001498
TUM	0.009667 ± 0.010195	0.007278 ± 0.012075	0.003333 ± 0.002698
CPOF	0.006361 ± 0.010395	0.004389 ± 0.012316	0.003778 ± 0.001083
JPL	0.005472 ± 0.010224	0.003500 ± 0.012203	0.003528 ± 0.001213
GFZ	0.007972 ± 0.010790	0.005500 ± 0.012770	0.001611 ± 0.001568
GRG	0.006250 ± 0.010202	0.004361 ± 0.012093	0.003056 ± 0.001290
EUMB	0.019222 ± 0.009953	0.014417 ± 0.011885	0.001389 ± 0.002252
AING	0.007500 ± 0.010278	0.005361 ± 0.012221	0.004472 ± 0.001190
СРОК	0.008444 ± 0.010128	0.005167 ± 0.012128	0.003444 ± 0.001279



ANNEX A. LIST OF SLR STATIONS

The following table provides the monument, code, location, and other relevant information about the SLR stations that have ever tracked any of the Sentinel-3 and Sentinel-6 satellites.

Monument	Code	Location Name (Country)	Closed / Inactive	Allowed to Track S-3 Satellites	Used for SLR Validation ^(*)
1824	GLSL	Golosiiv (Ukraine)		Х	
1873	SIML	Simeiz (Ukraine)		Х	
1884	RIGL	Riga (Latvia)		Х	
1888	SVEL	Svetloe (Russia)		Х	
1889	ZELL	Zelenchukskya (Russia)		Х	
1890	BADL	Badary (Russia)		Х	
1893	KTZL	Katsively (Ukraine)		Х	
7080	MDOL	McDonald Observatory, TX (USA)	Х		
7090	YARL	Yarragadee (Australia)		Х	Х
7105	GODL	Greenbelt, MD (USA)		Х	Х
7110	MONL	Monument Peak, CA (USA)		Х	Х
7119	HA4T	Haleakala, Hawaii (USA)		Х	Х
7124	THTL	Tahiti (French Polynesia)		Х	
7237	CHAL	Changchun (China)			
7249	BEIL	Beijing (China)		Х	
7396	JFNL	Wuhan (China)			
7403	AREL	Arequipa (Peru)		х	
7501	HARL	Hartebeesthoek (South Africa)		Х	х
7810	ZIML	Zimmerwald (Switzerland)		х	х
7811	BORL	Borowiec (Poland)		Х	
7819	KUN2	Kunming (China)			
7821	SHA2	Shanghai (China)		Х	
7824	SFEL	San Fernando (Spain)		х	
7825	STL3	Mt. Stromlo (Australia)		Х	х
7838	SISL	Simosato (Japan)			
7839	GRZL	Graz (Austria)		Х	х
7840	HERL	Herstmonceux (UK)		х	х
7841	POT3	Potsdam (Germany)		Х	х
7845	GRSM	Grasse, (France)			
7941	MATM	Matera (Italy)		Х	х
8834	WETL	Wettzell (Germany)			х
^(*) Group of SLR stations that is used for SLR validation of Section 3.5.5, Section 3.6.5 and Section 3.7.5.					

Table A-1: List of the SLR stations



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ANNEX B. DESCRIPTION OF THE POD PROCESSING OF EACH QWG SOLUTIONS

The following tables present the POD processing overview for each orbit solution provided by the different centres of the QWG.

D.1. AING, AIUB, CNES, CPOD

Table B-1: Data processing summary (I)

Data Processing Summary						
	Analysis Centre (Orbit Solution)					
	AING (AIUB)	AIUB (AIUB)	CNES (CNES)	CPOD (GMV)		
Contact	Adrian Jäggi (adrian.jaeggi@aiub.unibe.ch)	Adrian Jäggi (adrian.jaeggi@aiub.unibe.ch)	Flavien Mercier (flavien.mercier@cnes.fr)	Jaime Fernández (jfernandez@gmv.com)		
Additional contacts	Daniel Arnold (daniel.arnold@aiub.unibe.ch)	Daniel Arnold (daniel.arnold@aiub.unibe.ch)	Alexandre Couhert (alexandre.couhert@cnes.fr)	copernicuspod@gmv.com		
Software						
Name and version	Bernese GNSS Software v5.3	Bernese GNSS Software v5.3	ZOOM 6.0	NAPEOS		
Arc Cut						
Arc lengths	24 h	24 h	36 h	32 h		
Handle of manoeuvres	Only days processed w/o manoeuvres	Only days processed w/o manoeuvres	Manoeuvres are calibrated in the POD process	Manoeuvres are calibrated in the POD process		
Handle of data gaps	No	No	Yes	Yes		
Reference System						
Polar motion and UT1	CODE final (rapid) products for S1, S2, S3 (for S6)	CODE final (rapid) products for S1, S2, S3 (for S6)	IERS14-C04	IERS finals2000A.data		
Pole model	IERS 2010 Conventions	IERS 2010 Conventions	IERS 2010 Conventions (linear pole model)	IERS 2010 Conventions		
Precession/Nutation	IERS 2010 Conventions	IERS 2010 Conventions	IAU 2006/2000A	IERS 2010 Conventions		
Geocenter	n/a	n/a	n/a	n/a		
Satellite Reference						
Mass and centre of gravity	Variable with input from FOS	Variable with input from FOS	Variable with input from FOS	Variable with input from FOS		



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	Data Processing Summary						
		Analysis Centre	(Orbit Solution)				
Parameter/Model	AING (AIUB)	AIUB (AIUB)	CNES (CNES)	CPOD (GMV)			
Attitude model	S1: Quaternions S2: Quaternions S3: Quaternions S6: Quaternions	S1: Quaternions S2: Quaternions S3: Quaternions S6: Quaternions	S3: Nominal attitude law S6: Quaternions	S1: Quaternions S2: Quaternions S3: Quaternions S6: Quaternions			
GNSS antenna reference point (X,Y,Z)	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	Adjusted	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]			
GNSS antenna orientation (Euler angles, Z,Y,X)	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	Nadir pointing	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]			
DORIS Reference Point (X,Y,Z)	n/a	n/a	n/a	n/a			
SLR Reference Point (X,Y,Z)	n/a	n/a	n/a	n/a			
Gravity							
Gravity field (static)	GOCO05s (120x120)	GOCO06s (120x120)	GRACE+SLR CNES/GRGS RL04 [EIGEN.GRGS.RL04.v1 (90x90)]	EIGEN.GRGS.RL04 TVG (120x120)			
Gravity field (time varying)	IERS 2010 Conventions	IERS 2010 Conventions	Drift/annual/semi-annual/bias piece wise linear terms up to degree/order 90	Drift/annual/semi-annual piece wise linear terms up to degree/order 90			
Solid Earth tides	Applied (IERS 2010)	Applied (IERS 2010)	Applied (IERS 2010)	Applied (IERS 2010)			
Ocean tides	EOT11A (50x50)	EOT11A (50x50)	FES2014	FES2014 (100x100, 142 tidal constituents)			
Atmospheric gravity	None	None	AOD1B RL06 (100x100)	GFZ AOD L1B RL06 (100x100)			
Atmospheric tides	None	None	AOD1B RL06 (100x100)	GFZ AOD L1B RL06 (100x100)			
Earth pole tide	IERS 2010	IERS 2010	IERS 2010	IERS 2010			
Ocean pole tide	IERS 2010	IERS 2010	IERS 2010	IERS 2010			
Third bodies	Sun, Moon, Planets DE421	Sun, Moon, Planets DE421	Sun, Moon, Planets INPOP08	Sun, Moon, Planets DE-421			
Relativity	n/a	n/a	n/a	n/a			
Surface Forces and Empiricals							



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	Data Processing Summary			
Devenuence (Model		Analysis Centre	(Orbit Solution)	
Parameter/Model	AING (AIUB)	AIUB (AIUB)	CNES (CNES)	CPOD (GMV)
Radiation pressure model	Macro model	No explicit modelling	Box-wing model	Box-wing model (with re-radiation)
Earth radiation	Albedo and infrared	No explicit modelling	Albedo and Infra-red applied (Knocke et al. 1988)	Albedo and Infra-red applied
Total Solar Irradiance (TSI)	n/a	n/a	n/a	n/a
Atmospheric density model	DTM2013	No explicit modelling	NRLMSISE-00	msise00
Radiation pressure coefficient	1/day	No explicit modelling	Fixed (1.0)	Fixed 1 coefficient to 1.0
Drag coefficients	1/day	No explicit modelling	Fixed (1.0)	Estimated 1 coefficient per arc (constrained with 0.3)
1/rev empiricals	n/a	n/a	1/rev along track and cross track per orbit, constrained (5E-10, 2E-9)	Estimated 16 sets per arc: Alo: constant, sin+cos Cro: constant, sin+cos (constrained with 10e-12 km/s^2, 10e-11 km/s^2)
Other empiricals	Piecewise constant empiricals in R,S,W, every 6', constrained to zero with 5E-10 m/s^2	Piecewise constant empiricals in R,S,W, every 6' (constrained)	Constant empirical accelerations along track at 30 min intervals constrained (1E-9 m/s2)	n/a
GNSS Measurements				
Relativity	Applied	Applied	Applied (IGS conventions, Shapiro)	Applied (IERS 2010)
Sampling	10 s	10 s	30 s	10 s
Observations	Iono-free linear combination of phase measurements	Iono-free linear combination of phase measurements	Iono-free linear combinations of phase and pseudo-range (normal points) measurements	Iono-free linear combinations of phase and pseudo-range measurements
Weight	n/a	n/a	2 m (pseudo-range) / 20 mm (carrier- phase)	0.8 m (pseudo-range) / 10 mm (carrier- phase)
Elevation angle cut-off	0 deg	0 deg	10 deg	7 deg
Down-weighting law	None	None	Applied for DORIS data	None
Antenna phase-centre wind-up correction	Applied	Applied	Applied	Applied
Antenna phase-centre variation	Applied (AIUB maps)	Applied (AIUB maps)	Applied (CNES map)	Applied (sen08_2170.atx)
GNSS/DORIS Parameters				



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Data Processing Summary					
Devenue dev (Medel	Analysis Centre (Orbit Solution)				
Parameter/Model	AING (AIUB)	AIUB (AIUB)	CNES (CNES)	CPOD (GMV)	
Receiver clocks	Per epoch, every 10 s	Per epoch, every 10 s	Per epoch, every 30 s	Per epoch, every 10 s	
Receiver ambiguities	Estimated (integer)	Estimated (integer)	Estimated (integer)	Estimated (integer)	
GNSS orbits	Fixed (CODE final products, CODE rapid products for S6A)	Fixed (CODE final products, CODE rapid products for S6A)	Fixed (GRG finals)	Fixed (CODE final, CODE rapid for S6A)	
GNSS clocks	Fixed (CODE final products, 5 s clocks, CODE rapid products for S6A)	Fixed (CODE final products, 5 s clocks, CODE rapid products for S6A)	Fixed (GRG finals)	Fixed (CODE final, 5 s, CODE rapid for S6A)	
GNSS satellite biases	n/a	n/a	n/a	CODE finals	
DORIS troposphere	n/a	n/a	GPT2/VMF1 + one gradient per station in North & East directions	n/a	
DORIS coordinates	n/a	n/a	DPOD2014	n/a	
SLR Coordinates	n/a	n/a	n/a	n/a	
SLR Troposphere	n/a	n/a	n/a	n/a	
SLR Mapping Function	n/a	n/a	n/a	n/a	
SLR Elevation Cutoff Angle	n/a	n/a	n/a	n/a	
DORIS Ground Antenna Phase Law	n/a	n/a	n/a	n/a	
DORIS Elevation Cutoff Angle	n/a	n/a	n/a	n/a	
DORIS Elevation Down-weighting Function	n/a	n/a	n/a	n/a	



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D.2. CPOF, CPOK, DLR, EUMB

Table B-2: Data processing summary (II)

Data Processing Summary						
Devenue tex (Medel		Analysis Centre (Orbit Solution)				
Parameter/Model	CPOF (GMV)	CPOK (GMV)	DLR (DLR)	EUMB (EUMETSAT)		
Contact	Jaime Fernández (jfernandez@gmv.com)	Jaime Fernández (jfernandez@gmv.com)	Martin Wermuth (martin.wermuth@dlr.de)	Francisco Sancho (francisco.sancho@eumetsat.int)		
Additional contacts	copernicuspod@gmv.com	copernicuspod@gmv.com	Oliver Montenbruck (oliver.montenbruck@dlr.de) Stefan Hackel (stefan.hackel@dlr.de)	Sebastiano Padovan (sebastiano.padovan@ external.eumetsat.int)		
Software						
Name and version	NAPEOS	NAPEOS	GHOST 2276	Bernese GNSS Software v5.3		
Arc Cut						
Arc lengths	32 h	24 h	30 h	24 h		
Handle of manoeuvres	Manoeuvres are calibrated in the POD process	Manoeuvres are calibrated in the POD process	Manoeuvres are calibrated in the POD process	Only days processed w/o manoeuvres		
Handle of data gaps	Yes	Yes	Yes	No		
Reference System						
Polar motion and UT1	IERS finals2000A.data	IERS finals2000A.data	igs96p02.erp	CODE final products		
Pole model	IERS 2010 Conventions	IERS 2010 Conventions	n/a	IERS 2010 Conventions		
Precession/Nutation	IERS 2010 Conventions	IERS 2010 Conventions	IERS 2010 Conventions	IERS 2010 Conventions		
Geocenter	n/a	n/a	n/a	n/a		
Satellite Reference						
Mass and centre of gravity	Variable with input from FOS	Variable with input from FOS	Variable with input from FOS	Variable with input from FOS		
Attitude model	S1: Quaternions S2: Quaternions S3: Quaternions S6: Quaternions	S-1: Quaternions S-2: Quaternions S-3: Quaternions S-6: Quaternions	S1: Nominal attitude law S2: Quaternions S3: Quaternions S6: Quaternions	S-3: Quaternions S6A: Quaternions		



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Data Processing Summary				
		Analysis Centre	(Orbit Solution)	
Parameter/Model	CPOF (GMV)	CPOK (GMV)	DLR (DLR)	EUMB (EUMETSAT)
GNSS antenna reference point (X,Y,Z)	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	S-3: [RD.3] S-6: [RD.4]
GNSS antenna orientation (Euler angles, Z,Y,X)	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	S-3: [RD.3] S-6: [RD.4]
DORIS Reference Point (X,Y,Z)	n/a	n/a	n/a	n/a
SLR Reference Point (X,Y,Z)	n/a	n/a	n/a	n/a
Gravity				
Gravity field (static)	GSM-2_MODEL_GRFO_COSTG_ BF01_01op.qmp.coef_2203 (90x90)	n/a	GOCO03S (100x100)	EGM2008 (120x120)
Gravity field (time varying)	Drift/annual/semi-annual piece wise linear terms up to degree/order 90	n/a	n/a	IERS 2010 Conventions
Solid Earth tides	Applied (IERS 2010)	n/a	Applied	Applied (IERS 2010)
Ocean tides	FES2014 (100x100, 142 tidal constituents)	n/a	Applied (FES 2004)	FES 2004 (50x50)
Atmospheric gravity	GFZ AOD L1B (100x100)	n/a	n/a	None
Atmospheric tides	GFZ AOD L1B (100x100)	n/a	n/a	None
Earth pole tide	IERS 2010	n/a	n/a	IERS 2010
Ocean pole tide	IERS 2010	n/a	n/a	IERS 2010
Third bodies	Sun, Moon, Planets DE-421	n/a	Sun, Moon (analytical series)	Sun, Moon, Planets DE405
Relativity	n/a	n/a	n/a	n/a
Surface Forces and Empiricals				
Radiation pressure model	Box-wing model (with re-radiation)	n/a	Macro-model	No explicit modelling
Earth radiation	Albedo and Infra-red applied	n/a	Albedo and Infra-red	No explicit modelling
Total Solar Irradiance (TSI)	n/a	n/a	n/a	n/a



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	Data Processing Summary				
Darameter (Medel		Analysis Centre	(Orbit Solution)		
Parameter/Model	CPOF (GMV)	CPOK (GMV)	DLR (DLR)	EUMB (EUMETSAT)	
Atmospheric density model	msise00	n/a	NRLMSISE-00, macro model, drag, lift	No explicit modelling	
Radiation pressure coefficient	Fixed 1 coefficient (S-[126] to 1.0, S-3A to 0.97 and S-3B to 0.96)	n/a	1 per arc (estimated)	No explicit modelling	
Drag coefficients	Estimated 1 coefficient per arc (constrained with 0.3)	n/a	1 per arc (estimated)	No explicit modelling	
1/rev empiricals	Estimated 16 sets per arc: Alo: constant, sin+cos Cro: constant, sin+cos (constrained with 10e-12 km/s^2, 10e-11 km/s^2)	n/a	n/a	n/a	
Other empiricals	n/a	n/a	Constant empirical accelerations in RTN at 10 min intervals (constrained to zero)	Piecewise constant empiricals in R,S,W, every 6' (constrained)	
GNSS Measurements					
Relativity	Applied (IERS 2010)	Applied (IERS 2010)	Applied	Applied	
Sampling	10 s	10 s	30 s	10 s	
Observations	Iono-free linear combinations of phase and pseudo-range measurements	Iono-free linear combinations of phase and pseudo-range measurements	Iono-free linear combinations of phase and pseudo-range measurements (undifferenced)	Iono-free linear combinations of phase measurements (pseudo-range measurements only used for clock synchronisation)	
Weight	0.8 m (pseudo-range) / 10 mm (carrier- phase)	0.8 m (pseudo-range) / 10 mm (carrier- phase)	1 m (pseudo-ranges), 10 mm (carrier- phase)	n/a	
Elevation angle cut-off	7 deg	7 deg	0 deg	10 deg	
Down-weighting law	None	None	None	None	
Antenna phase-centre wind-up correction	Applied	Applied	Applied	Applied	
Antenna phase-centre variation	Applied (sen08_2170.atx)	Applied (sen08_2170.atx)	Applied (DLR maps)	S3A/B: Applied (AIUB maps) S6A: Applied (In-flight calibrated AIUB maps)	
GNSS/DORIS Parameters					
Receiver clocks	Per epoch, every 10 s	Per epoch, every 10 s	Per epoch, every 10 s	Per epoch, every 10 s	



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Data Processing Summary						
		Analysis Centre (Orbit Solution)				
Parameter/Model	CPOF (GMV)	CPOK (GMV)	DLR (DLR)	EUMB (EUMETSAT)		
Receiver ambiguities	Estimated (integer)	Estimated (fixed)	Estimated (integer)	Estimated (float)		
GNSS orbits	Fixed (CODE final, CODE rapid for S6A)	Fixed (CODE final, CODE rapid for S6A)	Fixed (CODE final)	Fixed (CODE finals)		
GNSS clocks	Fixed (CODE final, 5 s, CODE rapid for S6A)	Fixed (CODE final, 5 s, CODE rapid for S6A)	Fixed (CODE final, 5 s)	Fixed (CODE finals, 5 s clocks)		
GNSS satellite biases	CODE finals	CODE finals	CODE final	n/a		
DORIS troposphere	n/a	n/a	n/a	n/a		
DORIS coordinates	n/a	n/a	n/a	n/a		
SLR Coordinates	n/a	n/a	n/a	n/a		
SLR Troposphere	n/a	n/a	n/a	n/a		
SLR Mapping Function	n/a	n/a	n/a	n/a		
SLR Elevation Cutoff Angle	n/a	n/a	n/a	n/a		
DORIS Ground Antenna Phase Law	n/a	n/a	n/a	n/a		
DORIS Elevation Cutoff Angle	n/a	n/a	n/a	n/a		
DORIS Elevation Down-weighting Function	n/a	n/a	n/a	n/a		



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D.3. ESOC, GFZ, GRG, GSCF

Table B-3: Data processing summary (III)

Data Processing Summary				
		Analysis Centre	(Orbit Solution)	
Parameter/Model	ESOC (ESOC)	GFZ (GFZ)	GRG (CLS)	GSC (GSFC)
Contact	Francesco Gini (francesco.gini@esa.int)	Patrick Schreiner (patrick.schreiner@gfz-potsdam.de)	Capdeville Hugues (hcapdeville@groupcls.com)	Nikita Zelensky (nzelensk@umd.edu)
Additional contacts	Erik Schoenemann (Erik.Schoenemann@esa.int)	Anton Reinhold (reinh_a@gfz-potsdam.de) Frank Flechtner (frank.flechtner@gfz-potsdam.de)	Lemoine Jean-Michel (Jean- Michel.Lemoine@cnes.fr)	Frank Lemoine (Frank.G.Lemoine@nasa.gov)
Software				
Name and version	NAPEOS 4.7	EPOS-OC (v6.74)	GINS/DYNAMO	GEODYN version 2002
Arc Cut				
Arc lengths	30 h	28 h (beginning and end cut to 24 h)	84 h	~10 days (1 cycle)
Handle of manoeuvres	Only days processed w/o manoeuvres and observation gaps<=1h	Only days processed w/o manoeuvres	Manoeuvres are calibrated in the POD process	Truncate arcs at manoeuvres
Handle of data gaps	Yes	Yes	Yes	No
Reference System				
Polar motion and UT1	IERS Bulletin A (IERS rapids)	IERS Bulletin A/B	IERS14-C04	IERS Bulletin A daily
Pole model	IERS 2010 Conventions	Linear Meanpole (J. Ries 07/2017)	IERS 2010 Conventions (linear pole model)	IERS 2017 (linear mean pole)
Precession/Nutation	IERS 2010 Conventions	IERS 2010 Conventions	IERS 2010 Conventions	IAU2000A
Geocenter	n/a	n/a	n/a	Altamimi et al. (2016) (annual model)
Satellite Reference				
Mass and centre of gravity	Variable with input from FOS	Variable with input from FOS	Variable with input from FOS	Variable with input from FOS
Attitude model	Nominal attitude law S6A: Quaternions	S-3: Quaternions S6A: Quaternions	S-3: Nominal attitude law	S6: Quaternions



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Data Processing Summary				
Deve we show (Mardal		Analysis Centre	(Orbit Solution)	
Parameter/Model	ESOC (ESOC)	GFZ (GFZ)	GRG (CLS)	GSC (GSFC)
GNSS antenna reference point (X,Y,Z)	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	S3A-GPSA: +2.8810 / -0.1900 / -0.7940 m S3B-GPSA: +2.8810 / -0.2000 / -0.7940 m S6A-GPS-N: +2.474830 / +0.000120 / -1.080310 m S6A-GPS-R: +2.874860 / +0.000160 / -1.080310 m	S-3: [RD.3] S-6: [RD.4]	S-6: [RD.4]
GNSS antenna orientation (Euler angles, Z,Y,X)	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	S3A-GPSA: Boresight: +0.0000 / +0.0000 / -1.0000 Azimuth: +1.0000 / +0.0000 / +0.0000 S3B-GPSA: Boresight: +0.0000 / +0.0000 / -1.0000 Azimuth: +1.0000 / +0.0000 / +0.0000 S6A-GPS-N: Boresight: -0.0002360 / +0.0000000 / - 1.0000000 Azimuth: +1.0000000 / -0.0007070 / - 0.0002360 S6A-GPS-R: Boresight: +0.0004700 / -0.0001180 / - 0.9999990 Azimuth: -1.0000000 / +0.0004700 / - 0.0004700	S-3: [RD.3] S-6: [RD.4]	S-6: [RD.4]
DORIS Reference Point (X,Y,Z)	n/a	n/a	n/a	S6 (iono-free)
SLR Reference Point (X,Y,Z)	n/a	S3A:1.13403/0.647905/0.80118 S3B:1.13403/0.637905/0.80118 S6A:1.624841/-0.400638/0.664777	n/a	n/a
Gravity				
Gravity field (static)	EIGEN.GRGS.RL04.MEAN-FIELD with quadratic_mean_pole	GOCO06s (120x120)	EIGEN-GRGS.RL04-v2.MEAN-FIELD (95x95)	GOCO05s
Gravity field (time varying)	Drift/annual/semi-annual piece wise linear terms up to degree/order 80	GOCO06s (120x120)	Drift/annual/semi-annual piece wise linear terms up to degree/order 95	L >= 6. GOC005s. $L = 2$ to 5. derived from SLR/DORIS low degree solutions.



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	Data Processing Summary			
		Analysis Centre	(Orbit Solution)	
Parameter/Model	ESOC (ESOC)	GFZ (GFZ)	GRG (CLS)	GSC (GSFC)
Solid Earth tides	Applied (IERS 2010)	IERS 2010	Applied (IERS 2010)	IERS2010
Ocean tides	EOT11a (50x50)	FES2014 (100x100)	FES2014	GOT4.10c
Atmospheric gravity	AOD1B RL06 (100x100)	AOD1B RL07 (180x180)	AOD1B RL06 (100x100)	AOD1B RL06 (99x99)
Atmospheric tides	Ray-Ponte 2003	BB2003	AOD1B RL06 (100x100)	Dobslaw et al (2017)
Earth pole tide	IERS 2010	IERS 2010	IERS 2010	IERS 2010
Ocean pole tide	IERS 2010	Desai (30x30)	IERS 2010	IERS 2010
Third bodies	Sun, Moon, Planets DE405	FERRARI77, DE430	Sun, Moon, Planets DE421	Sun, Moon, Planets DE421
Relativity	n/a	Applied	n/a	Schwarzchild, Lense-Thirring, DeSitter applied
Surface Forces and Empiricals				
Radiation pressure model	S1,2,3: QWG Box-wing model S6: ESOC Box-wing model	Macro model	Box-wing model	Bow-wing modlel
Earth radiation	Albedo and Infra-red applied	Heurtel	Albedo and Infra-red applied	Knocke et al. (1988)
Total Solar Irradiance (TSI)	n/a	Analytically variable	n/a	1360.45 W/m**2 (Kopp and Lean, 2011)
Atmospheric density model	Fixed	MSISE-90	DTM2000	MSIS-86 (Hedin, 1987)
Radiation pressure coefficient	1 per day	S3: 1 per arc (estimated) S6: 1 set per arc (estimated)	1 per day but strongly constrained	1 per arc (pre-estimated)
Drag coefficients	S1,2,3: 18 sets in along (constant/sine/cosine) and cross track (sine/cosine) S6: 18 sets in along (constant/sine/cosine) and cross track (constant/sine/cosine)	5 per arc (estimated)	1 per 4 h (estimated)	3 /day (estimated)
1/rev empiricals	n/a	1/rev (sin/cos) along- and cross-track direction every 75', polygonal amplitude modelling, constrained	2 sets per arc in along-track and cross- track direction (sin/cos)	Along-track & Cross-track OPR/day
Other empiricals	Fixed	n/a	n/a	N/A



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Data Processing Summary				
		Analysis Centre	(Orbit Solution)	
Parameter/Moder	ESOC (ESOC)	GFZ (GFZ)	GRG (CLS)	GSC (GSFC)
GNSS Measurements				
Relativity	Applied (IERS 2010)	Applied	Applied	
Sampling	10 s	30 s	10 s	
Observations	S1,2,3: GPS Iono-free linear combinations of phase and pseudo-range measurements S6: Galileo Iono-free linear combinations of phase and pseudo-range measurements	Iono-free linear combinations of phase and pseudo-range measurements (zero differenced)	Iono-free linear combination	
Weight	1.0 m (pseudo-range) / 10 mm (carrier- phase)	S3A: 0.60 m (pseudo-ranges), 4.0 mm (carrier-phase) S3B: 0.60 m (pseudo-ranges), 4.0 mm (carrier-phase) S6A: 1.05 m (pseudo-ranges), 4.8 mm (carrier-phase)	n/a	
Elevation angle cut-off	7 deg	0 deg	10 deg	
Down-weighting law	None	None	For elevation 620_; weight of the observation is multiplied by the square of the elevation divided by 400 with elevation in degrees	
Antenna phase-centre wind-up correction	Applied	Applied	Applied	
Antenna phase-centre variation	Applied S1,2,3: sen08_2025_S1_mod.atx S6: s6a_PCVB3_wtNOAZI.atx	Applied (GFZ inflight calibration)	n/a	
GNSS/DORIS Parameters				
Receiver clocks	Per epoch, every 10 s	Per epoch, every 30 s	n/a	
Receiver ambiguities	Estimated (integer)	Estimated (CS fixed)	n/a	
GNSS orbits	Fixed (ESOC COP Final GPS and Galileo)	Fixed (consistent model constellation, 30s)	n/a	



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Data Processing Summary				
		Analysis Centre	(Orbit Solution)	
Parameter/Model	ESOC (ESOC)	GFZ (GFZ)	GRG (CLS)	GSC (GSFC)
GNSS clocks	Fixed (ESOC COP Final GPS and Galileo)	Fixed (consistent model constellation, 30s)	n/a	
GNSS satellite biases	ESOC final	n/a	n/a	
DORIS troposphere	n/a	n/a	GPT2+VMF1 + one gradient per station in North East directions	GPT/VMF-1
DORIS coordinates	n/a	n/a	ITRF2014 (DPOD2014)	DPOD2014v5
SLR Coordinates	n/a	n/a	n/a	SLRF2014/v200428
SLR Troposphere	n/a	n/a	n/a	Sastamoinen (1972)
SLR Mapping Function	n/a	n/a	n/a	Mendes et al. (2005)
SLR Elevation Cutoff Angle	n/a	n/a	n/a	15 deg
DORIS Ground Antenna Phase Law	n/a	n/a	n/a	Applied. Tourain et al. (2016)
DORIS Elevation Cutoff Angle	n/a	n/a	n/a	10 deg
DORIS Elevation Down-weighting Function	n/a	n/a	n/a	1/sin(elev)**(1/2)



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D.4. JPL, TUDF, TUG, TUM

Table B-4: Data processing summary (IV)

Data Processing Summary				
		Analysis Centre	(Orbit Solution)	
Parameter/Model	JPL (JPLL)	TUDF (TU Delft)	TU Graz (TUGG)	TUM (TUM)
Contact	Shailen Desai (shailen.d.desai@jpl.nasa.gov)	Wim Simons (W.J.F.Simons@tudelft.nl)	Torsten Mayer-Gürr (mayer- guerr@tugraz.at)	Bingbing Duan (bingbing.duan@tum.de)
Additional contacts	Shailen Desai (shailen.d.desai@jpl.nasa.gov)	Pieter Visser (P.N.A.M.Visser@tudelft.nl)	Barbara Süsser-Rechberger (barbara.suesser-rechberger@tugraz.at)	Urs Hugentobler (urs.hugentobler@bv.tum.de)
Software				
Name and version	GIPSY-OASIS (v6.4)	GIPSY-X (v1.7)	GROOPS (https://github.com/groops- devs/groops)	Bernese GNSS Software v5.3 (mod)
Arc Cut				
Arc lengths	30 h	30 h	24 h	30 h
Handle of manoeuvres	Manoeuvres are detected and handled in the POD process	Manoeuvres are calibrated in the POD process	Only days processed w/o manoeuvres and gaps	Only days processed w/o manoeuvres
Handle of data gaps	Yes	Yes	No	No
Reference System				
Polar motion and UT1	JPL Final products	JPL Final / Rapid_GE (S6A) products	TUG	IERS finals2000A.data
Pole model	IERS 2010 Conventions (linear mean pole)	IERS 2010 Conventions	IERS 2010 Conventions	IERS 2010 Conventions
Precession/Nutation	IERS 2010 Conventions	IERS 2010 Conventions	IERS 2010 Conventions	IERS 2010 Conventions
Geocenter	n/a	n/a	n/a	n/a
Satellite Reference				
Mass and centre of gravity	Variable with input from FOS	Variable with input from FOS	from *.mhf files	Variable with input from FOS
Attitude model	S-3: Quaternions S-6: Quaternions	S-1: Quaternions S-2: Quaternions S-3: Quaternions S-6: Quaternions	S1: Quaternions S2: Quaternions S3: Quaternions S6: Quaternions	S-1: Nominal attitude law S-2: Quaternions S-3: Quaternions S-6: Quaternions



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Data Processing Summary					
Parameter/Model	Analysis Centre (Orbit Solution)				
	JPL (JPLL)	TUDF (TU Delft)	TU Graz (TUGG)	TUM (TUM)	
GNSS antenna reference point (X,Y,Z)	S-3: [RD.3] S-6: [RD.4]	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	S1A-GPSA: -0.9371 / +0.3321 / +0.1310 m S1A-GPSB: -0.9465 / +0.5587 / +0.2362 m S1B-GPSA: -0.9371 / +0.3321 / +0.1310 m S2A-GPSA: +0.2320 / +0.2275 / -0.8100 m S2B-GPSA: +0.2320 / +0.2275 / -0.8100 m S3A-GPSA: +2.8810 / -0.1900 / -0.7940 m S3B-GPSA: +2.8810 / -0.2000 / -0.7940 m S6A-GPSA: +2.47483 / +0.00012 / -1.08031 m	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	



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Data Processing Summary					
Parameter/Model	Analysis Centre (Orbit Solution)				
	JPL (JPLL)	TUDF (TU Delft)	TU Graz (TUGG)	TUM (TUM)	
GNSS antenna orientation (Euler angles, Z,Y,X)	S-3: [RD.3] S-6: [RD.4]	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	S1A-GPSA: Boresight: -0.2315 / +0.4018 / -0.8860 Azimuth: +0.0372 / -0.9064 / -0.4207 S1A-GPSB: Boresight: -0.2315 / +0.4018 / -0.8860 Azimuth: +0.0372 / -0.9064 / -0.4207 S1B-GPSA: Boresight: -0.2315 / +0.4018 / -0.8860 Azimuth: +0.0372 / -0.9064 / -0.4207 S2A-GPSA: Boresight: -0.2590 / +0.0000 / -0.9660 Azimuth: +0.0000 / +1.0000 / +0.0000 S2B-GPSA: Boresight: -0.2590 / +0.0000 / -0.9660 Azimuth: +0.0000 / +1.0000 / -0.9660 Azimuth: +0.0000 / +0.0000 / -0.9660 Azimuth: +1.0000 / +0.0000 / -0.9660 Azimuth: +1.0000 / +0.0000 / -1.0000 S3B-GPSA: Boresight: +0.0000 / +0.0000 / -1.0000 Azimuth: +1.0000 / +0.0000 / -1.0000 Azimuth: +0.0000 / +0.0000 / -1.0000	S-1: [RD.1] S-2: [RD.2] S-3: [RD.3] S-6: [RD.4]	
DORIS Reference Point (X,Y,Z)	n/a	n/a		n/a	
SLR Reference Point (X,Y,Z)	n/a	n/a		n/a	
Gravity					
Gravity field (static)	EIGEN.GRGS.RL04.MEAN-FIELD with linear mean pole (200x200)	EIGEN.GRGS.RL04.MEAN-FIELD with quadratic_mean_pole (200X200)	GOCO06s (180x180)	EIGEN GL04C (120x120)	
Gravity field (time varying)	Drift/annual/semi-annual/bias piece wise linear terms up to degree/order 90	Drift/annual/semi-annual piece wise lineair terms up to degree/order 90	GOC006s	Drift of 20, 30, 40	
Solid Earth tides	Applied (IERS2010)	Applied (IERS 2010)	IERS 2010	Applied (IERS 2010)	

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Data Processing Summary					
Parameter/Model	Analysis Centre (Orbit Solution)				
	JPL (JPLL)	TUDF (TU Delft)	TU Graz (TUGG)	TUM (TUM)	
Ocean tides	GOT4.8AC (50x50)	Applied (FES2004)	FES2014b (180x180)	FES2004 (50x50)	
Atmospheric gravity	AOD1B RL06 (100x100)	AOD1B RL06 (180x180)	AOD1B RL06 (180x180)	None	
Atmospheric tides	None	n/a	AOD1B RL06	None	
Earth pole tide	IERS 2010	IERS 2010	IERS 2010 (secular mean pole)	IERS 2010	
Ocean pole tide	IERS 2010	IERS 2010	IERS 2010 (secular mean pole)	IERS 2010	
Third bodies	Sun, Moon, Planets DE421	Sun, Moon, Planets JPL DE421	Sun, Moon, Planets DE431	Sun, Moon, Planets DE405	
Relativity	n/a	n/a	IERS 2010	n/a	
Surface Forces and Empiricals					
Radiation pressure model	Box-wing model	Box-wing model	Macro model	Box-wing model	
Earth radiation	Albedo	Albedo	CERES monthly mean (Vis and IR)	Box-wing for Albedo and Infra-red	
Total Solar Irradiance (TSI)	n/a	n/a		n/a	
Atmospheric density model	DTM2000	DTM2000	DTM2020	MSISE-90	
Radiation pressure coefficient	Fixed to 1.0	S123: 1 per arc (estimated) S6: Fixed to 1.020506	fixed	1 per arc (estimated)	
Drag coefficients	1 per arc (estimated)	1 per arc (estimated) S6A: Fixed (1.0)	fixed	1 per arc (estimated)	
1/rev empiricals	In along-track and cross-track directions (sine/cosine), constrained 2e-9 m/s2	In along-track and cross-track directions (sine/cosine), constrained 5e-9 m/s2		2 sets in along-track and cross-track direction (with sin/cos signals)	
Other empiricals	Constant empirical accelerations in cross- track and along-track directions, updated every 30 minutes (constrained 1e-9 m/s2)	Constant empirical accelerations in radial, cross-track and (for Sentinel 3 and 6 along-track) directions, updated every ~10 minutes (T/600), constrained 5e-9 m/s2. Biases (S3: daily) removed in radial and cross-track direction.	Empirical accelerations in along, cross, radial, as linear splines with nodes every 20 min , constrained 1e-9 m/s2	Stoch. velocity changes every 15 min (constr. 5e-7m/s2)	
GNSS Measurements					
Relativity	Applied	Applied	Applied	Applied	
Sampling	S3: 30 s S6: 300 s	30 s	S1/S6: 10s, S2/S3: 1s	30 s for S6A, 10 s for others	

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Data Processing Summary					
Parameter/Model	Analysis Centre (Orbit Solution)				
	JPL (JPLL)	TUDF (TU Delft)	TU Graz (TUGG)	тим (тим)	
Observations	Iono-free linear combinations of phase and pseudo-range measurements (undifferenced)	Iono-free linear combinations of phase and pseudo-range GPS measurements (undifferenced) S6A: Iono-free linear combinations of phase and pseudo-range Galileo (1C_5Q) + GPS Legacy (1W_2W) measurements (undifferenced)	All available code and phase measurements withhout linear combinations (raw observation approach)	Iono-free linear combinations of phase and pseudo-range measurements	
Weight	1.0 m (pseudo-range) / 10 mm (carrier- phase)	1.0 m (pseudo range) / 10 mm (carrier- phase)	Azimuth, elevation depedent, estimated from residuals	n/a	
Elevation angle cut-off	0 deg	0 deg	0 deg	0 deg	
Down-weighting law	S3: 1/sin(elev) S6: None	None	Robust modified M-Huber estimator	None	
Antenna phase-centre wind-up correction	Applied	Applied (IGS model)	Applied	Applied (IGS model)	
Antenna phase-centre variation	Applied (JPL inflight calibration)	Applied (sen08_2170.atx)	sen08_2170.atx	Applied (sen08_2170.atx)	
GNSS/DORIS Parameters					
Receiver clocks	S3: Per epoch, every 30 s S6: Per epoch, every 300 s	Per epoch, every 30 s (no relativistic corrections applied)	Per epoch	Per epoch, every 10 s	
Receiver ambiguities	Estimated (integer)	Estimated (resolved, typically 80% (S1,S2,S3) and 90% (S6A G(1W_2W)+E(1C_5Q)	Estimated (integer)	Estimated (resolved, typically more than 95%)	
GNSS orbits	Fixed (JPL Final / IGS14)	Fixed (JPL GPS Final / IGb14) S6A: Fixed (JPL GNSS Rapid_GE / IGb14)	Fixed (TUG / IGS14 /IGS20)	Fixed (CODE final, CODE rapid for S6A)	
GNSS clocks	S3: Fixed (JPL Final / IGS14, 30 s clocks) S6: Fixed (JPL Final / IGS14, 300 s clocks)	Fixed (JPL GPS Final / IGb14, 30 s clocks) S6A: Fixed (JPL GNSS Rapid_GE / IGb14, 300 s clocks)	Fixed (TUG 30s, densified with CODE final 5s)	Fixed (CODE final, 5 s, CODE rapid for S6A)	
GNSS satellite biases	n/a	S6A: Constellation bias estimated (GPS Legacy (1W_2W) comes from AGGA 2)	Fixed (TUG), Estimated for Sentinels	n/a	
DORIS troposphere	n/a	n/a		n/a	
DORIS coordinates	n/a	n/a		n/a	


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Data Processing Summary					
		Analysis Centre	(Orbit Solution)		
Parameter/Model	JPL (JPLL)	TUDF (TU Delft)	TU Graz (TUGG)	тим (тим)	
SLR Coordinates	n/a	n/a		n/a	
SLR Troposphere	n/a	n/a		n/a	
SLR Mapping Function	n/a	n/a		n/a	
SLR Elevation Cutoff Angle	n/a	n/a		n/a	
DORIS Ground Antenna Phase Law	n/a	n/a		n/a	
DORIS Elevation Cutoff Angle	n/a	n/a		n/a	
DORIS Elevation Down-weighting Function	n/a	n/a		n/a	



ANNEX C. WEIGHTS CALCULATION FOR THE GENERATION OF THE COMB ORBIT SOLUTION

The current annex aims to clarify how the combined orbit solution (and its weights) is computed.

Firstly, it deserves to be pointed out that the combined orbit solution for a particular satellite and a particular day is computed by averaging the state vectors, which contain the position and the velocity at time t^* , $\mathbf{SV}(t^*) = [\mathbf{r}(t^*) \mathbf{v}(t^*)]^T$, of the different solutions as follows (each orbit solution is represented by the index j),

$$\mathbf{SV}_{comb}(t^*) = \frac{\sum_j \mathbf{SV}_j(t^*)/w_j}{\sum_j 1/w_j},$$

where $1/w_j$ denotes the weight associated to each orbit solution j at a particular day. These weights are a measurement of the (inverse) distance between the orbits of each institution and the simple arithmetic mean combination (i.e., a priori combined solution setting $1/w_j = 1$). Let d_j be the module of the distance between the position of the a priori combined solution, r_0 , and the position of the solution for institution j, r_j , at time t^* . This is:

$$d_j(t^*) = |r_0(t^*) - r_j(t^*)|$$

If \mathbf{d}_j is the vector made up by the distances d_j computed for every t^* of the temporal discretization (defined by the combination step, which is equal to 30 seconds), a value \overline{w}_j has been defined as the median (instead of mean to avoid overlaps) of \mathbf{d}_j . To ease their usage, these values are scaled with the following scaling factor:

$$sc = \max\{\overline{w}_1, \overline{w}_2, \dots, \overline{w}_i, \dots\}$$

Computing w_j as $w_j = \frac{\overline{w}_j}{sc}$, the wanted weight, $1/w_j$, corresponding to a particular day for institution *j* is obtained.



ANNEX D.VALIDATION OF THE CPOD SERVICE ORBIT PRODUCTS (OTHER STATISTICS)

As a complement of Section 3, the mean of the daily average of each orbit comparisons is shown for each satellite and orbit solution.

F.1. SENTINEL-1A



Figure D-1: Sentinel-1A orbit comparisons – Mean of daily average [cm] (All vs. COMB [radial, along, cross and 3D RMS])

Orbit Comparisons (Mean of daily average [cm])						
Orbit	Contro	Sa	atellite compone	ent		
Solution	Centre	Radial	Along-track	Cross-track		
AING	AIUB	0.05	-0.04	0.03		
AIUB	AIUB	-0.21	0.04	-0.03		
CPOD	CPOD	0.10	-0.05	0.05		
CPOF	CPOD	0.14	0.00	0.02		
СРОК	CPOD	0.13	0.01	0.27		
DLRR	DLR	-0.16	0.02	-0.07		
ESOC	ESOC	0.06	-0.11	-0.27		
TUDF	TUD	0.04	-0.00	0.10		
TUGG	TUG	0.10	-0.02	0.07		
тимм	тим	-0.08	0.15	-0.04		

Table D-1: Sentinel-1A orbit comparisons	– Mean of daily average [cm] (All vs. COMB)
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F.2. SENTINEL-1B



Figure D-2: Sentinel-1B orbit comparisons – Mean of daily average [cm] (All vs. COMB [radial, along, cross and 3D RMS])

	Orbit Comparisons (Mean of daily average [cm])					
Orbit	Contro	Sa	itellite compone	ent		
Solution	Centre	Radial	Along-track	Cross-track		
AING	AIUB	0.02	-0.01	0.02		
AIUB	AIUB	-0.11	-0.00	-0.03		
CPOD	CPOD	0.09	-0.05	0.04		
CPOF	CPOD	0.09	0.02	0.02		
СРОК	CPOD	0.10	0.03	0.26		
DLRR	DLR	-0.16	0.03	-0.06		
ESOC	ESOC	0.01	-0.10	-0.31		
TUDF	TUD	0.11	-0.03	0.12		
TUGG	TUG	0.07	-0.04	0.06		
тимм	тим	-0.10	0.17	-0.01		

Table D-2: Sentinel-1B orbit comparisons – Mean of daily average [cm] (All vs. COMB)



F.3. SENTINEL-2A



Figure D-3: Sentinel-2A orbit comparisons – Mean of daily average [cm] (All vs. COMB [radial, along, cross and 3D RMS])

Table D-3:	Sentinel-2A	orbit comparisons -	- Mean of daily	/ average	[cm] (All vs.	COMB)

Orbit Comparisons (Mean of daily average [cm])						
Orbit	Contro	Sa	Satellite component			
Solution	Centre	Radial	Along-track	Cross-track		
AING	AIUB	0.12	-0.04	0.04		
AIUB	AIUB	-0.55	0.21	0.03		
CPOD	CPOD	0.11	-0.02	0.05		
CPOF	CPOD	0.11	0.06	0.04		
СРОК	CPOD	0.11	0.01	0.05		
DLRR	DLR	-0.05	0.06	0.07		
ESOC	ESOC	0.12	-0.22	-0.05		
TUDF	TUD	0.05	0.04	-0.18		
TUGG	TUG	0.08	-0.05	-0.02		
тимм	тим	-0.03	-0.06	0.01		



F.4. SENTINEL-2B



Figure D-4: Sentinel-2B orbit comparisons – Mean of daily average [cm] (All vs. COMB [radial, along, cross and 3D RMS])

Orbit Comparisons (Mean of daily average [cm])						
Orbit	Contro	Sa	Satellite component			
Solution	Centre	Radial	Along-track	Cross-track		
AING	AIUB	0.12	-0.06	0.03		
AIUB	AIUB	-0.63	0.23	0.10		
CPOD	CPOD	0.13	-0.06	0.10		
CPOF	CPOD	0.13	0.03	0.10		
СРОК	CPOD	0.09	0.02	0.06		
DLRR	DLR	-0.05	0.05	0.11		
ESOC	ESOC	0.14	-0.24	-0.22		
TUDF	TUD	0.10	0.05	-0.44		
TUGG	TUG	0.08	-0.06	0.03		
тимм	тим	-0.04	-0.06	0.08		

Table D-4: Sentinel-2B orbit comparisons – Mean of daily average [cm] (All vs. COMB)



F.5. SENTINEL-3A



Figure D-5: Sentinel-3A orbit comparisons – Mean of daily average [cm] (All vs. COMB [radial, along, cross and 3D RMS])

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Table D-5: Sentinel-3A	OFDIT COMDATISONS	– mean of daily	v averade i cr	TICAILVS.	COMBI
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Orbit Comparisons (Mean of daily average [cm])					
Orbit	Contro	Satellite component			
Solution	Centre	Radial	Along-track	Cross-track	
AING	AIUB	0.15	0.00	0.12	
AIUB	AIUB	-0.78	0.09	0.19	
CNES	CNES	0.20	0.01	-0.07	
CPOD	CPOD	0.21	-0.01	0.17	
CPOF	CPOD	0.23	0.02	0.16	
СРОК	CPOD	0.06	-0.02	0.09	
DLRR	DLR	-0.00	-0.06	0.19	
ESOC	ESOC	0.21	-0.18	-0.25	
EUMB	EUMB	-0.98	-0.26	-0.53	
GFZZ	GFZ	0.10	-0.16	0.03	
GRGG	GRG	0.23	-0.23	0.03	
JPLL	JPL	0.35	0.06	-0.58	
TUDF	TUD	0.06	0.02	-0.48	
TUGG	TUG	-0.38	0.01	0.11	
тимм	тим	-0.05	0.05	0.18	



F.6. SENTINEL-3B



Figure D-6: Sentinel-3B orbit comparisons – Mean of daily average [cm] (All vs. COMB [radial, along, cross and 3D RMS])

Orbit Comparisons (Mean of daily average [cm])					
Orbit	Contro	Satellite component			
Solution	Centre	Radial	Along-track	Cross-track	
AING	AIUB	0.09	0.03	0.08	
AIUB	AIUB	-0.58	0.09	0.08	
CNES	CNES	0.12	-0.00	0.12	
CPOD	CPOD	0.13	0.01	0.09	
CPOF	CPOD	0.16	0.03	0.07	
СРОК	CPOD	0.12	-0.02	0.08	
DLRR	DLR	-0.07	0.03	0.09	
ESOC	ESOC	0.13	-0.14	-0.05	
EUMB	EUMB	-0.79	-0.26	0.45	
GFZZ	GFZ	0.07	-0.12	0.00	
GRGG	GRG	0.14	-0.69	0.24	
JPLL	JPL	0.27	0.06	-0.56	
TUDF	TUD	-0.04	-0.03	-0.18	
TUGG	TUG	-0.02	-0.04	0.05	
тимм	тим	-0.09	0.03	0.08	

Table D-6: Sentinel-3B orbit comparisons – Mean of daily average [cm] (All vs. COMB)



F.7. SENTINEL-6A



Figure D-7: Sentinel-6A orbit comparisons – Mean of daily average [cm] (All vs. COMB [radial, along, cross and 3D RMS])

Table D-7: Sentinel-6A orbit comparisons –	Mean of daily average	[cm] (All vs. COMB)
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Orbit Comparisons (Mean of daily average [cm])					
Orbit	Contro	Satellite component			
Solution	Centre	Radial	Along-track	Cross-track	
AING	AIUB	-0.16	0.03	-0.16	
AIUB	AIUB	0.30	0.03	-0.26	
CNES	CNES	-0.11	0.02	0.23	
CPOD	CPOD	-0.10	0.02	-0.26	
CPOF	CPOD	-0.08	0.01	-0.25	
СРОК	CPOD	-0.04	-0.00	-0.28	
DLRR	DLR	-0.01	0.03	-0.22	
ESOC	ESOC	0.04	0.06	0.55	
EUMB	EUMB	0.22	0.23	-0.21	
GFZZ	GFZ	0.15	0.11	-0.16	
GRGG	GRG	-0.04	0.16	0.37	
GSFC	GSFC	0.04	-0.67	0.60	
JPLL	JPL	-0.06	-0.93	0.56	
TUDF	TUD	0.01	0.13	0.56	
TUGG	TUG	-0.02	0.09	-0.04	
тимм	тим	0.02	0.04	-0.23	



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ANNEX E. ALTIMETER CROSS-OVER ANALYSIS

This annex provides detail information of the TU Delft cross-over analysis.

G.1. STATISTICS OF SINGLE SATELLITE S-3A/3B/6A ALTIMETER CROSSOVER DIFFERENCE RESIDUALS PER MONTH FOR 2022

Statistics of single-satellite Sentinel-3A/3B/6A altimeter crossover difference residuals per month for 2022, where crossovers are generated in monthly batches. The single-satellite crossover differences are obtained by subtracting the ascending from the descending legs. The maximum time difference between the legs is 13.5 days for Sentinel-3A/3B and 10.0 days for Sentinel-6A (values in cm).

S-3A

Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3A	AING	jan	27773	56.13	NaN	27540	7.87	23.1
S3A	AING	feb	25094	33.27	NaN	23196	0.47	5.42
S3A	AING	mar	28104	47.48	NaN	25476	0.02	5.42
S3A	AING	apr	25046	21.67	NaN	22601	-0.11	5.46
S3A	AING	may	24035	9.29	NaN	21796	-0.12	5.63
S3A	AING	jun	24845	61.37	NaN	22423	-0.44	5.61
S3A	AING	jul	27226	33.95	NaN	24797	-0.41	5.58
S3A	AING	aug	31241	32.33	NaN	29064	-0.58	5.86
S3A	AING	sep	31693	-0.45	7.36	31153	-0.46	5.89
S3A	AING	oct	30403	-0.97	NaN	28666	-0.02	6.22
S3A	AING	nov	25475	35.85	NaN	23473	0.23	5.8
S3A	AING	dec	26288	-4.08	NaN	23066	0.52	6.09
S3A	AING	tot	327223	21.05	NaN	303251	0.62	8.86
S3A	AIUB	jan	27773	19.35	NaN	27523	7.94	22.75
S3A	AIUB	feb	25094	38.93	NaN	23202	0.71	5.46
S3A	AIUB	mar	28104	-5.14	NaN	25484	0.27	5.43
S3A	AIUB	apr	25046	39.99	NaN	22604	0.03	5.46
S3A	AIUB	may	24035	14.84	NaN	21790	0.03	5.62
S3A	AIUB	jun	24845	31.9	NaN	22430	-0.29	5.62
S3A	AIUB	jul	27226	83.9	NaN	24788	-0.28	5.55
S3A	AIUB	aug	31241	14.13	NaN	29059	-0.42	5.83
S3A	AIUB	sep	31693	-0.28	7.35	31163	-0.29	5.9
S3A	AIUB	oct	30403	49.93	NaN	28660	0.18	6.23
S3A	AIUB	nov	25475	41.88	NaN	23379	0.4	5.83
S3A	AIUB	dec	26288	8.69	NaN	23075	0.75	6.15
S3A	AIUB	tot	327223	9.58	NaN	303157	0.79	8.78
S3A	CNES	jan	27773	0.45	6.63	27294	0.34	5.48
S3A	CNES	feb	25094	0.43	6.42	24695	0.43	5.42
S3A	CNES	mar	28104	0	6.67	27628	0	5.42
S3A	CNES	apr	25046	-0.13	6.74	24624	-0.15	5.43
S3A	CNES	may	24035	-0.08	6.75	23664	-0.1	5.59
S3A	CNES	jun	24845	-0.39	6.72	24450	-0.41	5.59
S3A	CNES	jul	27226	-0.36	6.84	26751	-0.36	5.56
S3A	CNES	aug	31241	-0.44	6.94	30804	-0.47	5.8
S3A	CNES	sep	31693	-0.33	7.34	31145	-0.34	5.86





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3A	CNES	oct	30403	-0.04	7.59	29892	0.01	6.18
S3A	CNES	nov	25475	0.25	7.01	25059	0.25	5.71
S3A	CNES	dec	26288	0.48	7.35	25868	0.47	6.06
S3A	CNES	tot	327223	-0.02	6.94	321874	-0.04	5.69
S3A	CNES_stc	jan	27773	0.21	6.66	27309	0.09	5.53
S3A	CNES_stc	feb	25094	0.31	6.51	24720	0.3	5.54
S3A	CNES_stc	mar	28104	-0.16	6.73	27660	-0.17	5.54
S3A	CNES_stc	apr	25046	-0.43	6.8	24641	-0.47	5.52
S3A	CNES_stc	may	24035	-0.46	6.82	23670	-0.48	5.67
S3A	CNES_stc	jun	24845	-0.62	6.75	24470	-0.63	5.65
S3A	CNES_stc	jul	27226	-0.65	6.91	26761	-0.64	5.66
S3A	CNES_stc	aug	31241	-0.63	7.02	30808	-0.67	5.9
S3A	CNES_stc	sep	31693	-0.34	7.4	31163	-0.37	5.96
S3A	CNES_stc	oct	30403	-0.12	7.66	29916	-0.09	6.28
S3A	CNES_stc	nov	25475	0.09	7.11	25065	0.08	5.83
S3A	CNES_stc	dec	26288	0.23	7.38	25877	0.22	6.12
S3A	CNES_stc	tot	327223	-0.22	7	322060	-0.24	5.78
S3A	СОМВ	jan	27773	0.58	10.83	27289	0.4	5.52
S3A	СОМВ	feb	25094	0.52	6.44	24693	0.51	5.43
S3A	СОМВ	mar	28104	-0.48	39.02	27617	0.07	5.44
S3A	СОМВ	apr	25046	-0.09	8.88	24621	-0.08	5.46
S3A	СОМВ	may	24035	-0.04	6.8	23679	-0.07	5.66
S3A	СОМВ	jun	24845	-0.37	6.77	24468	-0.4	5.67
S3A	СОМВ	jul	27226	-0.43	8.97	26751	-0.4	5.6
S3A	СОМВ	aug	31241	-2.56	99.95	30798	-0.51	5.82
S3A	СОМВ	sep	31693	-0.39	7.35	31152	-0.4	5.88
S3A	СОМВ	oct	30403	-0.17	22.82	29891	0.02	6.2
S3A	СОМВ	nov	25475	0.3	7.04	25064	0.3	5.76
S3A	СОМВ	dec	26288	-3.42	17.7	25657	0.52	6.22
S3A	СОМВ	tot	327223	-0.57	70.58	321680	-0.02	5.74
S3A	CPOD	jan	27773	0.3	6.7	27274	0.23	5.49
S3A	CPOD	feb	25094	0.3	6.41	24704	0.3	5.42
S3A	CPOD	mar	28104	-0.11	6.67	27619	-0.11	5.41
S3A	CPOD	apr	25046	-0.2	6.72	24621	-0.23	5.4
S3A	CPOD	may	24035	-0.13	6.73	23662	-0.16	5.56
S3A	CPOD	jun	24845	-0.36	6.69	24443	-0.38	5.55
S3A	CPOD	jul	27226	-0.99	9.45	26742	-0.34	5.51
S3A	CPOD	aug	31241	-0.42	6.92	30797	-0.45	5.77
S3A	CPOD	sep	31693	-0.34	7.33	31138	-0.35	5.84
S3A	CPOD	oct	30403	-0.08	7.59	29891	-0.03	6.17
S3A	CPOD	nov	25475	0.15	7.02	25053	0.15	5.71
S3A	CPOD	dec	26288	0.45	7.34	25859	0.44	6.05
S3A	CPOD	tot	327223	-0.13	32.26	321803	-0.09	5.67
S3A	CPOD_stc	jan	27773	0	6.7	27278	-0.09	5.51
S3A	CPOD_stc	feb	25094	-0.14	6.43	24707	-0.15	5.45
S3A	CPOD_stc	mar	28104	-0.59	6.73	27645	-0.61	5.52





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3A	CPOD_stc	apr	25046	-0.64	6.76	24637	-0.67	5.48
S3A	CPOD_stc	may	24035	-0.65	6.77	23670	-0.67	5.63
S3A	CPOD_stc	jun	24845	-0.63	6.73	24444	-0.64	5.6
S3A	CPOD_stc	jul	27226	-1.12	9.45	26761	-0.48	5.58
S3A	CPOD_stc	aug	31241	-1.23	20.84	28898	-0.43	6.69
S3A	CPOD_stc	sep	31693	-0.25	7.34	31156	-0.26	5.89
S3A	CPOD_stc	oct	30403	-0.2	7.62	29910	-0.16	6.24
S3A	CPOD_stc	nov	25475	-0.12	7.04	25059	-0.12	5.76
S3A	CPOD_stc	dec	26288	-0.05	7.32	25866	-0.05	6.04
S3A	CPOD_stc	tot	327223	-0.47	32.83	320031	-0.36	5.81
S3A	CPOF	jan	27773	0.38	6.67	27279	0.29	5.49
S3A	CPOF	feb	25094	0.38	6.42	24699	0.37	5.41
S3A	CPOF	mar	28104	-0.04	6.65	27617	-0.04	5.39
S3A	CPOF	apr	25046	-0.15	6.71	24616	-0.18	5.38
S3A	CPOF	may	24035	-0.1	6.72	23654	-0.12	5.53
S3A	CPOF	jun	24845	-0.33	6.68	24434	-0.35	5.51
S3A	CPOF	jul	27226	-0.96	9.45	26739	-0.31	5.48
S3A	CPOF	aug	31241	-0.39	6.9	30798	-0.42	5.74
S3A	CPOF	sep	31693	-0.3	7.31	31140	-0.31	5.82
S3A	CPOF	oct	30403	-0.03	7.58	29893	0.02	6.16
S3A	CPOF	nov	25475	0.22	7.01	25053	0.23	5.71
S3A	CPOF	dec	26288	0.52	7.35	25852	0.52	6.04
S3A	CPOF	tot	327223	-0.08	32.26	321774	-0.03	5.66
S3A	СРОК	jan	27773	0.5	6.69	27266	0.41	5.49
S3A	СРОК	feb	25094	0.47	6.42	24699	0.47	5.42
S3A	СРОК	mar	28104	-0.07	6.68	27626	-0.08	5.43
S3A	СРОК	apr	25046	-0.24	6.72	24618	-0.27	5.39
S3A	СРОК	may	24035	-0.26	6.73	23662	-0.29	5.56
S3A	СРОК	jun	24845	-0.48	6.69	24441	-0.49	5.54
S3A	СРОК	jul	27226	-0.44	6.8	26734	-0.44	5.49
S3A	СРОК	aug	31241	-8.12	NaN	30615	-0.53	5.76
S3A	СРОК	sep	31693	-0.27	11.71	31137	-0.37	5.84
S3A	СРОК	oct	30403	-0.06	7.6	29895	-0.02	6.19
S3A	СРОК	nov	25475	19.86	NaN	24709	0.17	5.71
S3A	СРОК	dec	26288	0.57	7.37	25844	0.57	6.05
S3A	СРОК	tot	327223	0.75	NaN	321246	-0.08	5.67
S3A	DLR	jan	27773	0.51	6.75	27281	0.42	5.57
S3A	DLR	feb	25094	0.55	6.45	24699	0.53	5.44
S3A	DLR	mar	28104	0.1	6.7	27637	0.09	5.47
S3A	DLR	apr	25046	-0.05	6.74	24618	-0.07	5.42
S3A	DLR	may	24035	-0.02	6.77	23670	-0.05	5.62
S3A	DLR	jun	24845	-0.31	6.75	24457	-0.34	5.63
S3A	DLR	jul	27226	-0.31	6.85	26754	-0.3	5.57
S3A	DLR	aug	31241	-0.38	6.93	30821	-0.41	5.81
S3A	DLR	sep	31693	-0.3	7.34	31156	-0.31	5.87
S3A	DLR	oct	30403	0.03	7.62	29891	0.1	6.21





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3A	DLR	nov	25475	0.29	7.04	25070	0.3	5.77
S3A	DLR	dec	26288	0.67	8.44	25852	0.56	6.18
S3A	DLR	tot	327223	0.05	7.07	321906	0.03	5.73
S3A	ESOC	jan	27773	28.15	NaN	27523	13.83	31.09
S3A	ESOC	feb	25094	95.16	NaN	23196	0.57	5.44
S3A	ESOC	mar	28104	67.98	NaN	27786	8.26	25.05
S3A	ESOC	apr	25046	84.94	NaN	22601	-0.04	5.47
S3A	ESOC	may	24035	56.97	NaN	23753	8.02	24.56
S3A	ESOC	jun	24845	52.15	NaN	22428	-0.4	5.64
S3A	ESOC	jul	27226	52.56	NaN	23787	-0.39	5.58
S3A	ESOC	aug	31241	-5.81	NaN	30806	6.65	23.1
S3A	ESOC	sep	31693	57.21	NaN	29628	-0.33	5.86
S3A	ESOC	oct	30403	84.7	NaN	30084	17.66	34.82
S3A	ESOC	nov	25475	2.1	NaN	25187	11.03	27.36
S3A	ESOC	dec	26288	38.05	NaN	23065	0.62	6.11
S3A	ESOC	tot	327223	15.62	NaN	309844	5.85	20.86
S3A	EUMB	jan	27773	19.93	NaN	27518	8.17	22.7
S3A	EUMB	feb	25094	55.9	NaN	23209	1.05	5.59
S3A	EUMB	mar	28104	87.39	NaN	23393	0.4	5.46
S3A	EUMB	apr	25046	-6.37	NaN	22613	0.25	5.53
S3A	EUMB	may	24035	52.26	NaN	21791	0	5.62
S3A	EUMB	jun	24845	/0.8	NaN	21/35	-0.26	5.65
S3A	EUMB	jui	27226	19.1	Nain	24795	-0.42	5.62
S3A C2A	EUMB	aug	31241	/1.15		29050	-0.37	5.83
53A		sep	31693	-0.11	7.34 NaN	31141	-0.12	5.85
SJA			30403	41.41	Nan	28000	0.30	0.28
SJA		doc	25475	-5.57	NaN	23080	1.12	6.24
SJA S3A	EUMB	tot	20200	-4.31	NaN	302078	1.13	10.58
SJA S3A	CE7	ian	277223	-4.51	6.64	272078	-0.30	5 40
S3A	GFZ	feb	27773	-0.22	6 44	27295	-0.23	5 44
S3A	GFZ GFZ	mar	28104	-0.62	7.8	27612	-0.71	5 48
S3A	GFZ	apr	25046	38.87	NaN	22595	-0.29	5.42
S3A	GFZ	may	24035	90.86	NaN	21760	-0.27	5.54
S3A	GFZ	iun	24845	-3.72	NaN	22405	-0.52	5.53
S3A	GFZ	jul	27226	-0.41	6.93	26716	-0.47	5.55
S3A	GFZ	aug	31241	8.02	NaN	29047	-0.53	5.82
S3A	GFZ	sep	31693	-0.42	7.34	31143	-0.44	5.86
S3A	GFZ	oct	30403	-0.19	7.64	29907	-0.14	6.24
S3A	GFZ	nov	25475	0.96	22.15	24906	0.09	5.78
S3A	GFZ	dec	26288	26.53	25.77	25092	0.31	6.29
S3A	GFZ	tot	327223	-1.19	NaN	313179	-0.31	5.73
S3A	GRG	jan	27773	NaN	NaN	0	0	0
S3A	GRG	feb	25094	0.37	6.45	24708	0.36	5.47
S3A	GRG	mar	28104	53.37	NaN	25762	-0.06	5.42
S3A	GRG	apr	25046	-0.09	6.76	24621	-0.13	5.44





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3A	GRG	may	24035	-0.09	6.76	23654	-0.12	5.57
S3A	GRG	jun	24845	-0.27	6.71	24453	-0.28	5.58
S3A	GRG	jul	27226	-0.39	6.82	26732	-0.37	5.51
S3A	GRG	aug	31241	87.6	NaN	29320	-0.47	5.83
S3A	GRG	sep	31693	-0.3	7.34	31140	-0.31	5.86
S3A	GRG	oct	30403	0.1	7.67	29914	0.15	6.3
S3A	GRG	nov	25475	0.15	7.14	25055	0.15	5.85
S3A	GRG	dec	26288	53.61	NaN	24526	0.41	6.21
S3A	GRG	tot	327223	-8.38	NaN	289885	-0.07	5.75
S3A	JPL	jan	27773	0.55	6.65	27305	0.45	5.53
S3A	JPL	feb	25094	0.54	6.44	24700	0.54	5.44
S3A	JPL	mar	28104	0.15	7.21	27617	0.1	5.42
S3A	JPL	apr	25046	-0.02	6.72	24622	-0.05	5.4
S3A	JPL	may	24035	0.03	6.72	23657	0.01	5.54
S3A	JPL	jun	24845	-0.22	6.68	24442	-0.24	5.53
S3A	JPL	jul	27226	-0.22	6.81	26752	-0.22	5.52
S3A	JPL	aug	31241	-0.31	7.99	30786	-0.26	5.75
S3A	JPL	sep	31693	-0.15	7.32	31144	-0.16	5.84
S3A	JPL	oct	30403	0.12	7.59	29904	0.16	6.19
S3A	JPL	nov	25475	0.4	7.02	25055	0.4	5.72
S3A	JPL	dec	26288	0.63	7.33	25873	0.62	6.05
S3A	JPL	tot	327223	0.12	7.09	321857	0.11	5.68
S3A	REF	jan	27773	0.45	6.63	27286	0.34	5.47
S3A	REF	feb	25094	0.43	6.42	24694	0.43	5.42
S3A	REF	mar	28104	0	6.67	27628	0	5.42
S3A	REF	apr	25046	-0.13	6.74	24624	-0.15	5.43
S3A	REF	may	24035	-0.08	6.75	23664	-0.1	5.59
S3A	REF	jun	24845	-0.39	6.72	24449	-0.41	5.59
S3A	REF	jul	27226	-0.36	6.84	26752	-0.36	5.56
S3A	REF	aug	31241	-0.44	6.93	30811	-0.47	5.8
S3A	REF	sep	31693	-0.33	7.34	31148	-0.34	5.86
S3A	REF	oct	30403	-0.04	7.59	29893	0.01	6.18
S3A	REF	nov	25475	0.25	7.01	25053	0.25	5.71
S3A	REF	dec	26288	0.48	7.35	25869	0.47	6.06
S3A	REF	tot	327223	-0.02	6.94	321871	-0.04	5.69
S3A	TUDF	jan	27773	0.38	6.62	27294	0.28	5.47
S3A	TUDF	feb	25094	0.32	6.43	24704	0.31	5.44
S3A	TUDF	mar	28104	-0.08	6.66	27622	-0.09	5.41
S3A	TUDF	apr	25046	-0.14	6.73	24619	-0.16	5.4
S3A	TUDF	may	24035	-0.12	6.73	23657	-0.16	5.55
S3A	TUDF	jun	24845	-0.37	6.68	24441	-0.39	5.53
S3A	TUDF	jul	27226	-0.34	6.79	26742	-0.34	5.49
S3A	TUDF	aug	31241	-0.41	6.9	30806	-0.44	5.76
S3A	TUDF	sep	31693	-0.31	7.32	31144	-0.33	5.84
S3A	TUDF	oct	30403	-0.05	7.58	29896	0	6.18
S3A	TUDF	nov	25475	0.23	7.02	25054	0.23	5.72





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3A	TUDF	dec	26288	0.48	7.33	25849	0.48	6.01
S3A	TUDF	tot	327223	-0.04	6.92	321828	-0.06	5.67
S3A	TUDF_stc	jan	27773	0.36	6.62	27291	0.25	5.47
S3A	TUDF_stc	feb	25094	0.32	6.43	24703	0.32	5.44
S3A	TUDF_stc	mar	28104	-0.1	6.67	27629	-0.11	5.43
S3A	TUDF_stc	apr	25046	-0.17	6.73	24621	-0.19	5.41
S3A	TUDF_stc	may	24035	-0.16	6.73	23655	-0.19	5.55
S3A	TUDF_stc	jun	24845	-0.38	6.69	24441	-0.4	5.53
S3A	TUDF_stc	jul	27226	-0.35	6.79	26745	-0.35	5.5
S3A	TUDF_stc	aug	31241	-0.42	6.9	30806	-0.45	5.76
S3A	TUDF_stc	sep	31693	-0.34	7.33	31149	-0.35	5.85
S3A	TUDF_stc	oct	30403	-0.09	7.58	29890	-0.04	6.17
S3A	TUDF_stc	nov	25475	0.19	7.02	25054	0.19	5.72
S3A	TUDF_stc	dec	26288	0.48	7.33	25860	0.49	6.03
S3A	TUDF_stc	tot	327223	-0.06	6.93	321844	-0.08	5.67
S3A	TUDF_stcu	jan	27773	0.33	6.63	27296	0.22	5.48
S3A	TUDF_stcu	feb	25094	0.28	6.44	24700	0.27	5.45
S3A	TUDF_stcu	mar	28104	-0.09	6.7	27639	-0.09	5.46
S3A	TUDF_stcu	apr	25046	-0.19	6.75	24631	-0.22	5.45
S3A	TUDF_stcu	may	24035	-0.18	6.74	23651	-0.21	5.55
S3A	TUDF_stcu	jun	24845	-0.44	6.69	24444	-0.46	5.55
S3A	TUDF_stcu	jul	27226	-0.38	6.82	26751	-0.38	5.54
S3A	TUDF_stcu	aug	31241	-0.43	6.91	30798	-0.46	5.76
S3A	TUDF_stcu	sep	31693	-0.32	7.33	31140	-0.34	5.84
S3A	TUDF_stcu	oct	30403	-0.08	7.6	29897	-0.04	6.2
S3A	TUDF_stcu	nov	25475	0.13	7.06	25068	0.14	5.78
S3A	TUDF_stcu	dec	26288	0.39	7.39	25865	0.4	6.05
S3A	TUDF_stcu	tot	327223	-0.09	6.95	321880	-0.11	5.69
S3A	TUG	jan	27773	58.19	NaN	27528	7.94	22.88
S3A	TUG	feb	25094	53.93	NaN	23207	0.69	5.46
S3A	TUG	mar	28104	31.17	NaN	25488	0.24	5.45
S3A	TUG	apr	25046	58.05	NaN	22602	0.03	5.47
S3A	TUG	may	24035	10.1	NaN	21792	0.04	5.64
S3A	TUG	jun	24845	20.94	NaN	22427	-0.34	5.63
S3A	TUG	jul	27226	94.42	NaN	27020	7.05	22.99
S3A	TUG	aug	31241	68.24	NaN	29058	-0.48	5.85
S3A	TUG	sep	31693	-0.35	7.35	31154	-0.36	5.89
S3A	TUG	oct	30403	0	NaN	28653	0.13	6.21
S3A	TUG	nov	25475	36.92	NaN	22281	0.37	5.85
S3A	TUG	dec	1080	0.07	5.31	1072	0.14	4.66
S3A	TUG	tot	302015	38.72	NaN	282282	1.46	11.32
S3A	TUM	jan	27773	98	NaN	27367	9.35	26.79
S3A	TUM	feb	25094	49.01	NaN	23198	0.39	5.41
S3A	TUM	mar	28104	4.11	NaN	25455	-0.05	5.36
S3A	TUM	apr	25046	49.51	NaN	22589	-0.15	5.38
S3A	TUM	may	24035	18.01	NaN	21763	-0.08	5.51





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3A	TUM	jun	24845	21.96	NaN	22403	-0.22	5.49
S3A	TUM	jul	27226	NaN	NaN	23404	-0.15	5.48
S3A	TUM	aug	31241	4.04	NaN	29040	-0.25	5.76
S3A	TUM	sep	31693	-0.21	7.31	31137	-0.22	5.81
S3A	TUM	oct	30403	83.01	NaN	28657	0.07	6.19
S3A	TUM	nov	25475	25.62	NaN	23458	0.18	5.72
S3A	TUM	dec	26288	51.83	NaN	23045	0.43	6.01
S3A	TUM	tot	327223	-1.31	NaN	301516	0.84	9.71

S-3B

Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3B	AING	jan	27714	38.11	NaN	25171	0.4	5.39
S3B	AING	feb	24720	21.17	NaN	23035	0.52	5.38
S3B	AING	mar	28048	41.59	NaN	25288	0.06	5.44
S3B	AING	apr	24774	19.37	NaN	21708	-0.06	5.5
S3B	AING	may	24612	27.21	NaN	22775	-0.13	5.62
S3B	AING	jun	24537	21.65	NaN	23075	-0.43	5.53
S3B	AING	jul	26858	-0.47	6.76	26433	-0.47	5.53
S3B	AING	aug	30956	10.65	NaN	28563	-0.53	5.8
S3B	AING	sep	31490	11.52	NaN	28779	-0.46	5.84
S3B	AING	oct	30036	44.63	NaN	26250	0.07	6.23
S3B	AING	nov	25327	1.44	NaN	23272	0.36	5.73
S3B	AING	dec	25934	12.35	NaN	23679	0.54	6.05
S3B	AING	tot	325006	-5.41	NaN	298028	-0.03	5.68
S3B	AIUB	jan	27714	-4.48	NaN	25177	0.58	5.43
S3B	AIUB	feb	24720	0.81	NaN	23022	0.74	5.4
S3B	AIUB	mar	28048	54.45	NaN	25294	0.28	5.46
S3B	AIUB	apr	24774	35.95	NaN	21712	0.07	5.52
S3B	AIUB	may	24612	5.04	NaN	22775	-0.01	5.63
S3B	AIUB	jun	24537	66.47	NaN	23081	-0.31	5.54
S3B	AIUB	jul	26858	-0.37	6.74	26428	-0.36	5.51
S3B	AIUB	aug	30956	22.43	NaN	28552	-0.41	5.77
S3B	AIUB	sep	31490	51.18	NaN	28768	-0.31	5.83
S3B	AIUB	oct	30036	71.94	NaN	26267	0.26	6.27
S3B	AIUB	nov	25327	-7.38	NaN	23281	0.49	5.79
S3B	AIUB	dec	25934	11.45	NaN	23677	0.71	6.1
S3B	AIUB	tot	325006	3.24	NaN	298034	0.13	5.7
S3B	CNES	jan	27714	0.39	6.51	27242	0.36	5.36
S3B	CNES	feb	24720	0.44	6.55	24300	0.42	5.38
S3B	CNES	mar	28048	-0.01	6.71	27556	0.01	5.43
S3B	CNES	apr	24774	-0.09	6.53	24394	-0.08	5.47
S3B	CNES	may	24612	-0.1	6.88	24205	-0.14	5.57
S3B	CNES	jun	24537	-0.46	6.8	24141	-0.43	5.48
S3B	CNES	jul	26858	-0.4	6.72	26430	-0.4	5.49
S3B	CNES	aug	30956	-0.47	6.87	30496	-0.46	5.77





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3B	CNES	sep	31490	-0.36	7.34	30933	-0.37	5.85
S3B	CNES	oct	30036	0.08	7.64	29476	0.1	6.19
S3B	CNES	nov	25327	0.35	7.07	24881	0.35	5.69
S3B	CNES	dec	25934	0.48	7.33	25471	0.49	6.01
S3B	CNES	tot	325006	-0.02	6.94	319525	-0.02	5.66
S3B	CNES_stc	jan	27714	0.08	6.56	27259	0.05	5.44
S3B	CNES_stc	feb	24720	0.26	6.62	24312	0.24	5.48
S3B	CNES_stc	mar	28048	-0.14	6.76	27572	-0.13	5.5
S3B	CNES_stc	apr	24774	-0.35	6.58	24395	-0.34	5.52
S3B	CNES_stc	may	24612	-0.45	6.89	24200	-0.48	5.59
S3B	CNES_stc	jun	24537	-0.55	6.81	24149	-0.5	5.5
S3B	CNES_stc	jul	26858	-0.67	6.77	26444	-0.67	5.58
S3B	CNES_stc	aug	30956	-0.65	6.94	30518	-0.64	5.88
S3B	CNES_stc	sep	31490	-0.31	7.41	30956	-0.32	5.94
S3B	CNES_stc	oct	30036	0.1	7.7	29495	0.1	6.28
S3B	CNES_stc	nov	25327	0.22	7.12	24865	0.21	5.74
S3B	CNES_stc	dec	25934	0.32	7.38	25479	0.33	6.08
S3B	CNES_stc	tot	325006	-0.18	6.99	319644	-0.19	5.73
S3B	СОМВ	jan	27714	0.5	6.56	27242	0.46	5.41
S3B	СОМВ	feb	24720	-0.83	65.54	24279	0.54	5.39
S3B	СОМВ	mar	28048	0.09	6.72	27553	0.11	5.44
S3B	СОМВ	apr	24774	-1.36	70.34	24377	-0.01	5.5
S3B	СОМВ	may	24612	-0.06	7.63	24216	-0.08	5.64
S3B	СОМВ	jun	24537	-0.52	18.67	24146	-0.38	5.54
S3B	СОМВ	jul	26858	-0.43	6.76	26432	-0.43	5.53
S3B	СОМВ	aug	30956	-0.51	7.48	30504	-0.48	5.8
S3B	СОМВ	sep	31490	-0.41	7.88	30925	-0.4	5.85
S3B	СОМВ	oct	30036	-1.43	83.84	29466	0.12	6.22
S3B	СОМВ	nov	25327	0.25	19.68	24881	0.41	5.74
S3B	СОМВ	dec	25934	-0.26	18.89	25314	0.59	6.09
S3B	СОМВ	tot	325006	-0.42	38.28	319335	0.02	5.69
S3B	CPOD	jan	2//14	0.28	6.49	2/250	0.25	5.35
S3B	CPOD	feb	24720	0.32	6.56	24296	0.29	5.3/
S3B	CPOD	mar	28048	-0.13	6.69	27554	-0.12	5.41
S3B	CPOD	apr	24774	-0.19	6.51	24392	-0.18	5.44
S3B	CPOD	may	24612	-0.17	6.85	24183	-0.21	5.5
53B 63D	CPOD	jun	24537	-0.42	6.77	24139	-0.39	5.45
S3B	CPOD	jui	26858	-0.39	6.68	26425	-0.38	5.44
S3B	CPOD	aug	30956	-0.77	57.82	30489	-0.44	5.74
S3B	CPOD	sep	31490	-0.68	54.31	30934	-0.38	5.83
53B 635	CPOD	oct	30036	0.02	7.64	294/5	0.04	6.18
538		nov	25327	0.24	/.06	248/3	0.24	5.68
S3B	CPOD	dec	25934	0.41	/.3	25464	0.41	5.96
53B	CPOD :	tot	325006	-0.14	25.35	319474	-0.08	5.63
S3B	CPOD_stc	jan	27714	0.02	6.49	27244	-0.02	5.35
S3B	CPOD_stc	feb	24720	-0.01	6.58	24303	-0.05	5.38





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3B	CPOD_stc	mar	28048	-0.6	6.73	27567	-0.59	5.47
S3B	CPOD_stc	apr	24774	-0.56	6.56	24404	-0.56	5.51
S3B	CPOD_stc	may	24612	-0.62	6.9	24207	-0.66	5.6
S3B	CPOD_stc	jun	24537	-0.66	6.8	24148	-0.63	5.5
S3B	CPOD_stc	jul	26858	-0.52	6.73	26434	-0.52	5.51
S3B	CPOD_stc	aug	30956	-0.84	60.38	28758	-0.45	6.6
S3B	CPOD_stc	sep	31490	-0.56	54.32	30943	-0.27	5.88
S3B	CPOD_stc	oct	30036	0.01	7.67	29503	0.01	6.26
S3B	CPOD_stc	nov	25327	0.05	7.08	24862	0.06	5.69
S3B	CPOD_stc	dec	25934	-0.05	7.3	25466	-0.04	5.98
S3B	CPOD_stc	tot	325006	-0.37	25.92	317839	-0.3	5.76
S3B	CPOF	jan	27714	0.37	6.5	27246	0.34	5.35
S3B	CPOF	feb	24720	0.41	6.56	24289	0.38	5.36
S3B	CPOF	mar	28048	-0.05	6.68	27542	-0.04	5.38
S3B	CPOF	apr	24774	-0.13	6.5	24393	-0.12	5.43
S3B	CPOF	may	24612	-0.13	6.84	24185	-0.16	5.5
S3B	CPOF	jun	24537	-0.38	6.75	24133	-0.35	5.42
S3B	CPOF	jul	26858	-0.36	6.67	26409	-0.35	5.4
S3B	CPOF	aug	30956	-0.73	57.82	30488	-0.39	5.71
S3B	CPOF	sep	31490	-0.63	54.31	30924	-0.34	5.8
S3B	CPOF	oct	30036	0.09	7.63	29466	0.1	6.16
S3B	CPOF	nov	25327	0.31	7.05	24873	0.31	5.67
S3B	CPOF	dec	25934	0.49	/.31	25466	0.5	5.98
S3B	CPOF	tot	325006	-0.08	25.34	319414	-0.02	5.61
S3B	CPOK	jan fals	27714	0.5	6.51	27248	0.46	5.37
S3B	CPOK	TED	24720	0.52	6.57	24290	0.49	5.37
53B 620	CPOK	mar	28048	-0.06	6.69	27545	-0.05	5.4
530	CPOK	apr	24774	-0.19	0.52	24397	-0.10	5.45
530	CPOK	iun	24012	-0.20	6.05	24177	-0.31	5.5
53B	CPOK	juli	24337	-0.53	6.68	24141	-0.5	5.44
S3B	CPOK	aug	30956	-0.87	57.81	30483	-0.52	5.73
S3B	СРОК	sen	31490	-0.69	54.31	30933	-0.4	5.75
S3B	СРОК	oct	30036	0.07	7.64	29467	0.08	6.17
S3B	СРОК	nov	25327	0.34	7.07	24872	0.34	5.69
S3B	СРОК	dec	25934	0.57	7.33	25463	0.58	6
S3B	СРОК	tot	325006	-0.11	25.35	319432	-0.06	5.63
S3B	DLR	ian	27714	0.53	6.58	27242	0.48	5.42
S3B	DLR	feb	24720	0.62	6.64	24268	0.57	5.41
S3B	DLR	mar	28048	0.13	6.7	27548	0.14	5.41
S3B	DLR	apr	24774	0	6.66	24368	-0.02	5.53
S3B	DLR	may	24612	-0.03	6.9	24214	-0.06	5.6
S3B	DLR	, jun	24537	-0.35	6.81	24153	-0.31	5.52
S3B	DLR	jul	26858	-0.35	6.73	26429	-0.34	5.5
S3B	DLR	aug	30956	-0.4	6.86	30498	-0.39	5.77
S3B	DLR	sep	31490	-0.31	7.34	30928	-0.31	5.84





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3B	DLR	oct	30036	0.23	8.04	29490	0.23	6.27
S3B	DLR	nov	25327	0.4	7.12	24901	0.42	5.78
S3B	DLR	dec	25934	0.6	7.39	25488	0.6	6.1
S3B	DLR	tot	325006	0.08	7.01	319527	0.07	5.7
S3B	ESOC	jan	27714	39.87	NaN	25178	0.48	5.41
S3B	ESOC	feb	24720	14.19	NaN	23035	0.58	5.4
S3B	ESOC	mar	28048	85.35	NaN	24126	0.12	5.45
S3B	ESOC	apr	24774	54.9	NaN	21699	-0.02	5.51
S3B	ESOC	may	24612	-3.88	NaN	22774	-0.09	5.62
S3B	ESOC	jun	24537	27.06	NaN	23065	-0.4	5.53
S3B	ESOC	jul	26858	-0.44	6.77	26445	-0.44	5.56
S3B	ESOC	aug	30956	54.49	NaN	28563	-0.48	5.8
S3B	ESOC	sep	31490	37.32	NaN	28771	-0.38	5.83
S3B	ESOC	oct	30036	30.08	NaN	29451	16.74	34.49
S3B	ESOC	nov	25327	22.38	NaN	24911	7.15	21.73
S3B	ESOC	dec	25934	39.42	NaN	22156	0.65	6.06
S3B	ESOC	tot	325006	16.27	NaN	300174	2.22	13.49
S3B	EUMB	jan	27714	26.44	NaN	25196	1.03	5.57
S3B	EUMB	feb	24720	69.59	NaN	23035	1.1	5.51
S3B	EUMB	mar	28048	22.54	NaN	25302	0.49	5.53
S3B	EUMB	apr	24774	1.1	NaN	21711	0.35	5.57
S3B	EUMB	may	24612	9.16	NaN	22772	0.08	5.65
S3B	EUMB	jun	24537	NaN	NaN	23076	-0.21	5.54
S3B	EUMB	jul	26858	-0.43	6.8	26447	-0.43	5.59
S3B	EUMB	aug	30956	58.44	NaN	28548	-0.32	5.76
S3B	EUMB	sep	31490	70.15	NaN	28769	-0.04	5.82
S3B	EUMB	oct	30036	0.98	NaN	26273	0.45	6.31
S3B	EUMB	nov	25327	56.25	NaN	23286	0.98	5.87
S3B	EUMB	dec	25934	33.12	NaN	23677	1.21	6.18
S3B	EUMB	tot	325006	10.9	NaN	298092	0.37	5.75
S3B	GFZ	jan	27714	-0.29	6.53	27242	-0.33	5.38
S3B	GFZ	feb	24/20	-0.24	6.62	24279	-0.25	5.37
S3B	GFZ	mar	28048	-0.62	6.74	27551	-0.61	5.46
S3B	GFZ	apr	24774	11.86	NaN	21689	-0.17	5.46
S3B	GFZ	may	24612	9.18		22749	-0.16	5.51
S3B	GFZ	jun	24537	-0.45	6.//	24142	-0.42	5.46
S3B C2D	GFZ	jui	26858	-0.39	6.69	26418	-0.39	5.43
S3B C2D	GFZ	aug	30956	-0.37	0.80	30495	-0.35	5.76
S3B C2D	GFZ	sep	31490	-0.33	7.35	30930	-0.35	5.86
S3B	GFZ	OCT	30036	0.45		28379	0.06	6.24
53B 630		nov	25327	0.33	7.09	24874	0.33	5./2
538		aec	25934	21.8	27.04	25229	0.48	6
S3B	GFZ	tot	325006	-0.3	NaN	313977	-0.19	5.66
53B	GRG	jan	2//14	0.36	6.56	2/261	0.32	5.44
S3B	GRG	feb	24720	67.17	NaN	0	0	0
S3B	GRG	mar	28048	0	6.73	27554	0.01	5.45





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3B	GRG	apr	24774	0.21	8.34	24071	-0.08	5.68
S3B	GRG	may	24612	-0.18	6.87	24195	-0.2	5.56
S3B	GRG	jun	24537	-0.3	6.78	24139	-0.26	5.45
S3B	GRG	jul	26858	-0.34	6.7	26425	-0.32	5.46
S3B	GRG	aug	30956	-0.46	6.87	30509	-0.44	5.78
S3B	GRG	sep	31490	-0.18	7.35	30938	-0.19	5.86
S3B	GRG	oct	30036	29.97	NaN	28153	0.23	6.31
S3B	GRG	nov	25327	0.21	7.16	24889	0.2	5.81
S3B	GRG	dec	25934	0.48	7.45	25486	0.47	6.17
S3B	GRG	tot	325006	17.53	NaN	293620	-0.03	5.74
S3B	JPL	jan	27714	0.51	6.5	27248	0.47	5.37
S3B	JPL	feb	24720	0.57	6.66	24291	0.53	5.39
S3B	JPL	mar	28048	0.09	6.7	27546	0.1	5.4
S3B	JPL	apr	24774	-0.01	6.62	24381	-0.02	5.45
S3B	JPL	may	24612	0	6.84	24190	-0.03	5.51
S3B	JPL	jun	24537	-0.28	6.76	24141	-0.24	5.44
S3B	JPL	jul	26858	-0.22	6.67	26419	-0.21	5.42
S3B	JPL	aug	30956	-0.26	6.83	30496	-0.26	5.73
S3B	JPL	sep	31490	-0.17	7.32	30931	-0.19	5.82
S3B	JPL	oct	30036	0.23	7.67	29465	0.23	6.19
S3B	JPL	nov	25327	0.49	7.07	24862	0.49	5.67
S3B	JPL	dec	25934	0.61	7.3	25460	0.62	5.97
S3B	JPL	tot	325006	0.12	6.93	319430	0.12	5.63
S3B	REF	jan	27714	0.39	6.51	27241	0.36	5.36
S3B	REF	feb	24720	0.44	6.55	24301	0.42	5.38
S3B	REF	mar	28048	-0.01	6.71	27553	0.01	5.42
S3B	REF	apr	24774	-0.09	6.53	24394	-0.08	5.46
S3B	REF	may	24612	-0.1	6.88	24206	-0.14	5.57
S3B	REF	jun	24537	-0.45	6.8	24139	-0.43	5.48
S3B	REF	jul	26858	-0.4	6.72	26432	-0.4	5.49
S3B	REF	aug	30956	-0.47	6.87	30494	-0.46	5.77
S3B	REF	sep	31490	-0.36	7.34	30937	-0.36	5.85
S3B	REF	oct	30036	0.08	7.64	29477	0.1	6.19
S3B	REF	nov	25327	0.35	7.07	24878	0.35	5.69
S3B	REF	dec	25934	0.48	7.33	25468	0.49	6
S3B	REF	tot	325006	-0.02	6.93	319520	-0.02	5.66
S3B	TUDF	jan	27714	0.33	6.51	27245	0.3	5.37
S3B	TUDF	feb	24720	0.33	6.54	24298	0.3	5.37
S3B	TUDF	mar	28048	-0.11	6.69	27549	-0.1	5.4
S3B	TUDF	apr	24774	-0.15	6.52	24391	-0.13	5.45
S3B	TUDF	may	24612	-0.16	6.85	24187	-0.2	5.52
S3B	TUDF	jun	24537	-0.44	6.77	24141	-0.4	5.45
S3B	TUDF	jul	26858	-0.41	6.68	26413	-0.4	5.42
S3B	TUDF	aug	30956	-0.45	6.84	30491	-0.44	5.73
S3B	TUDF	sep	31490	-0.37	7.32	30927	-0.38	5.82
S3B	TUDF	oct	30036	0.03	7.64	29471	0.04	6.18





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3B	TUDF	nov	25327	0.32	7.07	24876	0.31	5.69
S3B	TUDF	dec	25934	0.46	7.3	25455	0.47	5.96
S3B	TUDF	tot	325006	-0.06	6.92	319444	-0.06	5.63
S3B	TUDF_stc	jan	27714	0.32	6.51	27254	0.29	5.38
S3B	TUDF_stc	feb	24720	0.33	6.55	24296	0.31	5.37
S3B	TUDF_stc	mar	28048	-0.11	6.7	27559	-0.1	5.42
S3B	TUDF_stc	apr	24774	-0.18	6.53	24394	-0.17	5.46
S3B	TUDF_stc	may	24612	-0.18	6.85	24189	-0.22	5.52
S3B	TUDF_stc	jun	24537	-0.45	6.77	24138	-0.42	5.44
S3B	TUDF_stc	jul	26858	-0.42	6.69	26408	-0.41	5.42
S3B	TUDF_stc	aug	30956	-0.45	6.84	30495	-0.45	5.74
S3B	TUDF_stc	sep	31490	-0.38	7.32	30928	-0.39	5.82
S3B	TUDF_stc	oct	30036	0	7.64	29476	0	6.19
S3B	TUDF_stc	nov	25327	0.27	7.06	24879	0.26	5.69
S3B	TUDF_stc	dec	25934	0.45	7.31	25459	0.46	5.97
S3B	TUDF_stc	tot	325006	-0.08	6.92	319475	-0.08	5.64
S3B	TUDF_stcu	jan	27714	0.29	6.51	27248	0.26	5.37
S3B	TUDF_stcu	feb	24720	0.33	6.55	24297	0.31	5.38
S3B	TUDF_stcu	mar	28048	-0.09	6.71	27556	-0.08	5.44
S3B	TUDF_stcu	apr	24774	-0.24	7.23	24387	-0.18	5.49
S3B	TUDF_stcu	may	24612	-0.2	6.86	24187	-0.22	5.53
S3B	TUDF_stcu	jun	24537	-0.48	6.77	24138	-0.45	5.45
S3B	TUDF_stcu	jul	26858	-0.44	6.7	26420	-0.43	5.45
S3B	TUDF_stcu	aug	30956	-0.44	6.84	30493	-0.44	5.74
S3B	TUDF_stcu	sep	31490	-0.35	7.33	30930	-0.36	5.82
S3B	TUDF_stcu	oct	30036	0.03	7.69	29471	0.02	6.21
S3B	TUDF_stcu	nov	25327	0.28	7.11	24884	0.27	5.75
S3B	TUDF_stcu	dec	25934	0.41	7.31	25463	0.42	5.98
S3B	TUDF_stcu	tot	325006	-0.08	6.99	319474	-0.08	5.65
S3B	TUG	jan	2//14	36.57	NaN	25176	0.54	5.4
S3B	TUG	feb	24720	27.9	NaN	23034	0.68	5.4
S3B C2D	TUG	mar	28048	56.19	INAIN	24134	0.23	5.46
530	TUG	apr	24774	-5.55	NaN	21704	0.03	5.51
53D 53D	TUG	iun	24012	12.00	NaN	22779	-0.03	5.04
S3B	TUG	iul	24337	-0.42	6.76	25071	-0.42	5 54
S3B	TUG	aun	30956	39.51	NaN	28563	-0.46	5.79
S3B	TUG	sen	31490	51.85	NaN	28775	-0.39	5.83
S3B	TUG	oct	30036	55.82	NaN	26257	0.18	6.25
S3B	TUG	nov	25327	22.03	NaN	23282	0.46	5.81
S3B	TUG	dec	1105	0.18	5.81	1092	0.29	4.98
S3B	TUG	tot	300177	6.2	NaN	274302	0.02	5.67
S3B	TUM	jan	27714	NaN	NaN	25168	0.44	5.37
S3B	TUM	feb	24720	-3.86	NaN	23026	0.54	5.36
S3B	TUM	mar	28048	NaN	NaN	24110	0.1	5.37
S3B	TUM	apr	24774	48.93	NaN	21693	0.05	5.44





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3B	TUM	may	24612	50.7	NaN	22736	0.07	5.48
S3B	TUM	jun	24537	32.71	NaN	23065	-0.07	5.44
S3B	TUM	jul	26858	-0.09	6.67	26410	-0.08	5.4
S3B	ТИМ	aug	30956	53.93	NaN	28539	-0.12	5.71
S3B	TUM	sep	31490	-5.5	NaN	28755	-0.14	5.77
S3B	ТИМ	oct	30036	5.39	NaN	26238	0.23	6.21
S3B	ТИМ	nov	25327	10.23	NaN	23263	0.41	5.69
S3B	ТИМ	dec	25934	51.48	NaN	23655	0.54	5.97
S3B	TUM	tot	325006	36.52	NaN	296658	0.15	5.62

S-6A

Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A	AING	jan	40723	0.09	5.76	40159	0.07	4.93
S6A	AING	feb	36446	0.06	5.48	35933	0.04	4.67
S6A	AING	mar	42197	24.12	NaN	38886	0.08	4.82
S6A	AING	apr	38888	0.16	5.76	38399	0.16	4.96
S6A	AING	may	37150	-0.01	6.22	36605	0	5.25
S6A	AING	jun	33235	29.85	NaN	30573	-0.19	5.22
S6A	AING	jul	32568	0.08	6.13	32089	0.08	5.22
S6A	AING	aug	31303	0.26	6.37	30804	0.27	5.32
S6A	AING	sep	29852	0.09	6.57	29327	0.11	5.27
S6A	AING	oct	31790	1.43	NaN	28927	-0.01	5.41
S6A	AING	nov	31431	-0.16	6.42	30936	-0.18	5.37
S6A	AING	dec	36418	-9.64	NaN	34056	0.12	5.29
S6A	AING	tot	422001	-0.62	NaN	406694	0.05	5.13
S6A	AIUB	jan	40723	-0.08	5.82	40108	-0.08	4.94
S6A	AIUB	feb	36446	0.19	5.51	35963	0.18	4.73
S6A	AIUB	mar	42197	-1.72	NaN	38884	0.08	4.84
S6A	AIUB	apr	38888	0.12	5.78	38416	0.13	5
S6A	AIUB	may	37150	0.02	6.27	36610	0.02	5.3
S6A	AIUB	jun	33235	53.55	NaN	30586	-0.2	5.27
S6A	AIUB	jul	32568	0.12	6.14	32089	0.12	5.23
S6A	AIUB	aug	31303	0.22	6.37	30805	0.22	5.32
S6A	AIUB	sep	29852	0.06	6.58	29330	0.08	5.29
S6A	AIUB	oct	31790	40.73	NaN	28914	0.16	5.42
S6A	AIUB	nov	31431	-0.13	6.45	30946	-0.15	5.4
S6A	AIUB	dec	36418	-6.17	NaN	34057	0.01	5.32
S6A	AIUB	tot	422001	-1.81	NaN	406708	0.05	5.16
S6A	CNES	jan	40723	0.04	5.6	40131	0.02	4.74
S6A	CNES	feb	36446	0.01	5.46	35928	0	4.65
S6A	CNES	mar	42197	0.08	5.72	41583	0.08	4.79
S6A	CNES	apr	38888	0.28	5.75	38396	0.29	4.95
S6A	CNES	may	37150	0.08	6.2	36603	0.08	5.22
S6A	CNES	jun	33235	-2.49	NaN	31214	-0.12	5.21
S6A	CNES	jul	32568	0.02	6.1	32080	0.02	5.17





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A	CNES	aug	31303	0.26	6.35	30799	0.26	5.29
S6A	CNES	sep	29852	0.06	6.56	29331	0.07	5.27
S6A	CNES	oct	31790	0.03	6.65	31260	0.02	5.38
S6A	CNES	nov	31431	-5.56	NaN	28682	-0.04	5.32
S6A	CNES	dec	36418	0.1	6.32	35870	0.1	5.24
S6A	CNES	tot	422001	-0.53	NaN	411877	0.07	5.09
S6A	CNES_stc	jan	40723	0.01	5.67	40171	-0.02	4.84
S6A	CNES_stc	feb	36446	-0.01	5.49	35950	-0.03	4.7
S6A	CNES_stc	mar	42197	0.08	5.77	41609	0.08	4.86
S6A	CNES_stc	apr	38888	0.28	5.78	38423	0.28	5.01
S6A	CNES_stc	may	37150	0.16	6.24	36611	0.17	5.27
S6A	CNES_stc	jun	33235	-0.09	6	32810	-0.11	5.22
S6A	CNES_stc	jul	32568	13.02	NaN	30801	-0.03	5.21
S6A	CNES_stc	aug	31303	0.31	6.37	30806	0.32	5.33
S6A	CNES_stc	sep	29852	0.2	6.6	29333	0.2	5.31
S6A	CNES_stc	oct	31790	0.11	6.7	31273	0.1	5.46
S6A	CNES_stc	nov	31431	0.09	6.44	30942	0.07	5.4
S6A	CNES_stc	dec	36418	13.41	NaN	33425	0.3	5.27
S6A	CNES_stc	tot	422001	-0.06	NaN	412154	0.11	5.14
S6A	СОМВ	jan	40723	0.06	5.63	40142	0.04	4.78
S6A	СОМВ	feb	36446	0.13	5.49	35928	0.12	4.68
S6A	СОМВ	mar	42197	0.13	5.74	41601	0.13	4.82
S6A	СОМВ	apr	38888	0.12	5.75	38396	0.13	4.95
S6A	СОМВ	may	37150	0	6.22	36593	0	5.23
S6A	СОМВ	jun	33235	4.8	NaN	31214	-0.1	5.24
S6A	СОМВ	jul	32568	0.12	6.13	32085	0.12	5.21
S6A	СОМВ	aug	31303	0.19	6.36	30809	0.2	5.32
S6A	СОМВ	sep	29852	0.07	6.57	29325	0.09	5.27
S6A	СОМВ	oct	31790	0.05	6.67	31260	0.04	5.41
S6A	СОМВ	nov	31431	23.35	NaN	28685	-0.12	5.33
S6A	СОМВ	dec	36418	0.09	6.35	35888	0.1	5.29
S6A	СОМВ	tot	422001	-1.28	NaN	411926	0.07	5.11
S6A	CPOD	jan	40723	0.05	5.61	40123	0.03	4.75
S6A	CPOD	feb	36446	-0.06	5.46	35922	-0.08	4.64
S6A	CPOD	mar	42197	-0.05	5.72	41578	-0.05	4.79
S6A	CPOD	apr	38888	0.29	5.75	38406	0.29	4.96
S6A	CPOD	may	37150	0.1	6.25	36615	0.11	5.29
S6A	CPOD	jun	33235	-0.07	5.99	32809	-0.09	5.21
S6A	CPOD	jul	32568	-0.05	6.09	32093	-0.05	5.18
S6A	CPOD	aug	31303	0.23	6.36	30810	0.23	5.31
S6A	CPOD	sep	29852	0.05	6.57	29324	0.05	5.27
S6A	CPOD	oct	31790	-0.11	6.66	31264	-0.13	5.4
S6A	CPOD	nov	31431	-0.09	6.43	30928	-0.11	5.36
S6A	CPOD	dec	36418	0.3	6.36	35865	0.31	5.27
S6A	CPOD	tot	422001	0.05	6.09	415737	0.05	5.11
S6A	CPOD_stc	jan	40723	0.1	5.63	40119	0.08	4.76





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A	CPOD_stc	feb	36446	-0.37	5.5	35943	-0.39	4.71
S6A	CPOD_stc	mar	42197	-0.18	5.75	41594	-0.19	4.83
S6A	CPOD_stc	apr	38888	0.3	5.77	38406	0.29	4.99
S6A	CPOD_stc	may	37150	0.09	6.22	36601	0.1	5.24
S6A	CPOD_stc	jun	33235	-0.22	6.02	32825	-0.25	5.26
S6A	CPOD_stc	jul	32568	-0.04	6.11	32086	-0.04	5.19
S6A	CPOD_stc	aug	31303	0.39	23.57	29691	0.44	6.04
S6A	CPOD_stc	sep	29852	-0.05	6.58	29345	-0.05	5.3
S6A	CPOD_stc	oct	31790	-0.48	6.71	31270	-0.51	5.48
S6A	CPOD_stc	nov	31431	-0.13	6.45	30939	-0.15	5.4
S6A	CPOD_stc	dec	36418	0.28	6.35	35868	0.29	5.27
S6A	CPOD_stc	tot	422001	-0.02	8.69	414687	-0.03	5.19
S6A	CPOF	jan	40723	0.06	5.6	40118	0.03	4.72
S6A	CPOF	feb	36446	-0.06	5.45	35928	-0.08	4.64
S6A	CPOF	mar	42197	-0.05	5.71	41579	-0.05	4.78
S6A	CPOF	apr	38888	0.31	5.74	38408	0.31	4.95
S6A	CPOF	may	37150	0.14	6.25	36624	0.15	5.3
S6A	CPOF	jun	33235	-0.02	5.97	32804	-0.05	5.18
S6A	CPOF	jul	32568	-0.02	6.09	32091	-0.02	5.18
S6A	CPOF	aug	31303	0.29	6.34	30794	0.3	5.28
S6A	CPOF	sep	29852	0.1	6.56	29329	0.12	5.26
S6A	CPOF	oct	31/90	-0.05	6.65	31262	-0.06	5.38
S6A	CPUF	nov	31431	-0.07	6.42	30931	-0.08	5.35
SOA	CPOF	tet	422001	0.32	6.07	415720	0.34	5.25
SOA		ion	422001	0.00	5.07	415730	0.06	5.09
SGA	CPOK	fob	36446	-0.05	5.0	35028	-0.07	4.73
SGA	CPOK	mar	42107	-0.03	5 72	41582	-0.07	4.05
S6A		apr	38888	-0.03	5.72	38402	-0.03	4.79
S6A	CPOK	may	37150	0.22	6.28	36622	0.25	5 32
S6A	CPOK	iun	33235	-0.04	7 44	32806	-0.03	5.32
S6A	СРОК	iul	32568	-0.22	NaN	32006	0.02	5.18
S6A	СРОК	aug	31303	0.26	6.34	30795	0.26	5.28
S6A	СРОК	sep	29852	0.09	6.61	29333	0.1	5.28
S6A	СРОК	oct	31790	12.94	NaN	31174	-0.01	5.39
S6A	СРОК	nov	31431	0	6.42	30930	-0.02	5.35
S6A	СРОК	dec	36418	14.2	NaN	35856	0.27	5.26
S6A	СРОК	tot	422001	-2.17	NaN	415570	0.07	5.1
S6A	DLR	jan	40723	0.03	5.64	40147	0.01	4.79
S6A	DLR	feb	36446	0.12	5.5	35940	0.11	4.7
S6A	DLR	mar	42197	0.15	5.76	41610	0.15	4.85
S6A	DLR	apr	38888	0.14	5.78	38421	0.14	5
S6A	DLR	may	37150	-0.01	6.24	36617	-0.01	5.29
S6A	DLR	jun	33235	-0.13	6.01	32807	-0.16	5.24
S6A	DLR	jul	32568	0.09	6.14	32096	0.1	5.23
S6A	DLR	aug	31303	0.16	6.38	30814	0.17	5.34





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A	DLR	sep	29852	0.09	6.59	29339	0.11	5.3
S6A	DLR	oct	31790	0.06	6.69	31259	0.05	5.44
S6A	DLR	nov	31431	-0.07	6.48	30914	-0.1	5.37
S6A	DLR	dec	36418	-0.02	6.36	35890	0	5.3
S6A	DLR	tot	422001	0.05	6.11	415854	0.05	5.14
S6A	ESOC	jan	40723	74.21	NaN	35422	-0.01	4.76
S6A	ESOC	feb	36446	59.63	NaN	28317	0.2	4.58
S6A	ESOC	mar	42197	19.99	NaN	38889	0.03	4.81
S6A	ESOC	apr	38888	0.24	5.76	38393	0.24	4.95
S6A	ESOC	may	37150	35.47	NaN	11415	67.01	67.57
S6A	ESOC	jun	33235	1	NaN	30572	0.03	5.22
S6A	ESOC	jul	32568	61.85	NaN	25860	0.05	5.18
S6A	ESOC	aug	31303	0.25	6.36	30804	0.26	5.31
S6A	ESOC	sep	29852	-0.02	6.57	29325	-0.01	5.27
S6A	ESOC	oct	31790	15.29	NaN	28917	0.15	5.4
S6A	ESOC	nov	31431	-0.15	6.42	30925	-0.17	5.36
S6A	ESOC	dec	36418	46.09	NaN	34035	0.13	5.29
S6A	ESOC	tot	422001	-9.88	NaN	362874	2.19	12.99
S6A	EUMB	jan	40723	-0.29	5.77	40162	-0.31	4.94
S6A	EUMB	feb	36446	0.45	5.6	35964	0.43	4.82
S6A	EUMB	mar	42197	39.37	NaN	38905	0.15	4.94
S6A	EUMB	apr	38888	-0.06	5.84	38423	-0.05	5.07
S6A	EUMB	may	37150	5.07	NaN	33895	-0.03	5.36
S6A	EUMB	jun	33235	25.14	NaN	30598	-0.01	5.4
S6A	EUMB	jul	32568	0.26	6.18	32103	0.26	5.28
S6A	EUMB	aug	31303	-0.21	6.44	30838	-0.19	5.43
S6A	EUMB	sep	29852	-0.13	6.63	29347	-0.11	5.35
S6A	EUMB	oct	31790	10.07	NaN	28925	0.63	5.51
S6A	EUMB	nov	31431	0.12	6.48	30950	0.11	5.44
S6A	EUMB	dec	36418	21.21	NaN	34065	-0.34	5.37
S6A	EUMB	tot	422001	8.96	NaN	404175	0.04	5.23
S6A	GFZ	jan	40723	-0.15	5.66	40154	-0.18	4.82
S6A	GFZ	feb	36446	0.53	5.5	35920	0.51	4.69
S6A	GFZ	mar	42197	0.42	5.76	41590	0.43	4.84
S6A	GFZ	apr	38888	-0.02	5.78	38431	-0.02	5.02
S6A	GFZ	may	37150	-0.15	6.23	36602	-0.14	5.25
S6A	GFZ	jun	33235	0.3	6.03	32820	0.28	5.26
S6A	GFZ	jul	32568	0.13	6.13	32097	0.13	5.23
S6A	GFZ	aug	31303	-0.23	6.38	30798	-0.22	5.33
S6A	GFZ	sep	29852	-0.06	6.61	29322	-0.05	5.31
S6A	GFZ	oct	31790	0.5	6.71	31260	0.49	5.45
S6A	GFZ	nov	31431	0.03	6.43	30931	0.01	5.37
S6A	GFZ	dec	36418	-0.06	6.45	35847	-0.03	5.34
S6A	GFZ	tot	422001	0.11	6.12	415772	0.1	5.14
S6A	GRG	jan	40723	-0.1	5.64	40151	-0.12	4.8
S6A	GRG	feb	36446	0.12	5.49	35937	0.1	4.69





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A	GRG	mar	42197	NaN	NaN	0	0	0
S6A	GRG	apr	38888	0.06	5.78	38405	0.07	4.99
S6A	GRG	may	37150	-0.3	6.21	36601	-0.28	5.23
S6A	GRG	jun	33235	2.29	57.63	31632	0	5.37
S6A	GRG	jul	32568	0.01	6.14	32100	0.02	5.24
S6A	GRG	aug	31303	-0.17	6.37	30821	-0.17	5.34
S6A	GRG	sep	29852	-0.16	6.61	29350	-0.15	5.34
S6A	GRG	oct	31790	4.05	69.77	28956	0.13	6.01
S6A	GRG	nov	31431	-0.14	6.46	30940	-0.16	5.41
S6A	GRG	dec	36418	-0.42	23.71	34457	0.01	5.66
S6A	GRG	tot	422001	39.36	NaN	369350	-0.05	5.26
S6A	GSFC	jan	40723	0.08	5.62	40138	0.06	4.76
S6A	GSFC	feb	36446	0.04	5.47	35934	0.03	4.67
S6A	GSFC	mar	42197	19.41	NaN	38871	0.01	4.82
S6A	GSFC	apr	38888	0.27	5.78	38402	0.27	4.99
S6A	GSFC	may	37150	0.09	6.22	36609	0.1	5.25
S6A	GSFC	jun	29126	12.87	NaN	28766	0.05	5.22
S6A	GSFC	jul	0	0	0	0	0	0
S6A	GSFC	aug	0	0	0	0	0	0
S6A	GSFC	sep	0	0	0	0	0	0
S6A	GSFC	oct	0	0	0	0	0	0
S6A	GSFC	nov	0	0	0	0	0	0
S6A	GSFC	dec	0	0	0	0	0	0
S6A	GSFC	tot	224530	5.4	NaN	218720	0.09	4.94
S6A	JPL	jan	40723	-0.07	5.58	40126	-0.09	4.72
S6A	JPL	feb	36446	0.1	5.46	35933	0.08	4.65
S6A	JPL	mar	42197	0.11	5.71	41568	0.12	4.77
S6A	JPL	apr	38888	0.15	5.74	38414	0.16	4.95
S6A	JPL	may	37150	0.08	6.19	36601	0.09	5.21
S6A	JPL	jun	33235	0.12	5.97	32816	0.09	5.2
S6A	JPL	jul	32568	0.07	6.09	32087	0.07	5.17
S6A	JPL	aug	31303	0.1	6.34	30806	0.11	5.29
S6A	JPL	sep	29852	0	6.56	29334	0.01	5.27
S6A	JPL	oct	31790	0.18	6.65	31251	0.18	5.37
S6A	JPL	nov	31431	-0.05	6.41	30932	-0.07	5.35
S6A	JPL	dec	36418	0	6.33	35860	0.01	5.23
S6A	JPL	tot	422001	0.07	6.07	415728	0.06	5.08
S6A	REF	jan	40723	0.04	5.6	40125	0.02	4.73
S6A	REF	feb	36446	0.01	5.46	35927	0	4.65
S6A	REF	mar	42197	0.08	5.72	41580	0.08	4.79
S6A	REF	apr	38888	0.28	5.75	38397	0.29	4.95
S6A	REF	may	37150	0.08	6.2	36605	0.08	5.23
S6A	REF	jun	33235	-0.12	5.98	32808	-0.14	5.2
S6A	REF	jul	32568	0.02	6.1	32086	0.02	5.18
S6A	REF	aug	31303	0.25	6.35	30798	0.26	5.29
S6A	REF	sep	29852	0.06	6.56	29331	0.07	5.26





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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A	REF	oct	31790	0.03	6.65	31252	0.02	5.38
S6A	REF	nov	31431	-0.04	6.41	30931	-0.06	5.34
S6A	REF	dec	36418	0.1	6.32	35873	0.11	5.24
S6A	REF	tot	422001	0.07	6.07	415713	0.06	5.09
S6A	TUDF	jan	40723	-0.13	5.6	40126	-0.16	4.74
S6A	TUDF	feb	36446	0.18	5.47	35934	0.16	4.66
S6A	TUDF	mar	42197	0.16	5.72	41579	0.16	4.79
S6A	TUDF	apr	38888	0.16	5.76	38415	0.16	4.98
S6A	TUDF	may	37150	0.02	6.2	36587	0.03	5.2
S6A	TUDF	jun	33235	0.13	5.98	32810	0.1	5.2
S6A	TUDF	jul	32568	0.12	6.09	32085	0.12	5.17
S6A	TUDF	aug	31303	0	6.35	30801	0.01	5.3
S6A	TUDF	sep	29852	-0.01	6.57	29328	0.01	5.27
S6A	TUDF	oct	31790	0.34	6.68	31257	0.34	5.41
S6A	TUDF	nov	31431	0.04	6.43	30934	0.02	5.37
S6A	TUDF	dec	36418	0.01	6.34	35865	0.03	5.25
S6A	TUDF	tot	422001	0.08	6.08	415721	0.08	5.1
S6A	TUDF_stc	jan	40723	-0.12	5.6	40122	-0.15	4.73
S6A	TUDF_stc	feb	36446	0.19	5.47	35938	0.17	4.66
S6A	TUDF_stc	mar	42197	0.16	5.72	41588	0.16	4.8
S6A	TUDF_stc	apr	38888	0.16	5.76	38416	0.16	4.98
S6A	TUDF_stc	may	37150	0.02	6.2	36585	0.03	5.2
S6A	TUDF_stc	jun	33235	0.13	5.98	32811	0.1	5.2
S6A	TUDF_stc	jul	32568	0.12	6.09	32085	0.12	5.17
S6A	TUDF_stc	aug	31303	0	6.35	30799	0.01	5.29
S6A	TUDF_stc	sep	29852	-0.01	6.57	29330	0.01	5.27
S6A	TUDF_stc	oct	31790	0.35	6.68	31256	0.34	5.41
S6A	TUDF_stc	nov	31431	0.04	6.43	30935	0.02	5.37
S6A	TUDF_stc	dec	36418	0.02	6.34	35867	0.03	5.25
S6A	TUDF_stc	tot	422001	0.09	6.08	415732	0.08	5.1
S6A	TUG	jan	40723	27.99	NaN	37079	0.02	4.78
S6A	TUG	feb	36446	7.66	NaN	34053	0.16	4.71
S6A	TUG	mar	42197	-5.07	NaN	38868	0.21	4.83
S6A	TUG	apr	38888	0.08	5.77	38392	0.09	4.97
S6A	TUG	may	37150	-0.05	6.23	36603	-0.05	5.26
S6A	TUG	jun	33235	-6.84	NaN	30576	-0.21	5.23
S6A	TUG	jul	32568	0.15	6.17	32093	0.16	5.27
S6A	TUG	aug	31303	0.14	6.38	30831	0.15	5.36
S6A	TUG	sep	29852	0.01	6.57	29328	0.03	5.27
S6A	TUG	oct	31790	56.3	NaN	28922	0.07	5.42
S6A	TUG	nov	31431	-0.03	6.45	30938	-0.05	5.4
S6A	TUG	dec	36418	52.67	NaN	34092	0.44	5.52
S6A	TUG	tot	422001	11.13	NaN	401775	0.09	5.16
S6A	TUM	jan	40723	0.32	5.63	40136	0.29	4.77
S6A	TUM	feb	36446	-0.52	5.49	35938	-0.54	4.69
S6A	TUM	mar	42197	26.35	NaN	38874	0.07	4.81



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Satellite	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A	TUM	apr	38888	-0.09	5.75	38414	-0.09	4.97
S6A	TUM	may	37150	0.48	6.23	36613	0.49	5.26
S6A	TUM	jun	33235	68.96	NaN	30556	-0.17	5.2
S6A	TUM	jul	32568	0.04	6.09	32083	0.04	5.17
S6A	TUM	aug	31303	0.03	6.34	30802	0.03	5.29
S6A	TUM	sep	29852	0.22	6.58	29335	0.24	5.3
S6A	TUM	oct	31790	50.57	NaN	28906	-0.27	5.41
S6A	TUM	nov	31431	-0.06	6.42	30930	-0.08	5.36
S6A	TUM	dec	36418	24.06	NaN	34028	0.37	5.3
S6A	TUM	tot	422001	6.37	NaN	406615	0.04	5.11

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G.2. STATISTICS OF DUAL-SATELLITE SENTINEL-3A/3B/6A ALTIMETER CROSSOVER DIFFERENCE RESIDUALS PER MONTH FOR 2022

Statistics of dual-satellite Sentinel-3A/3B/6A altimeter crossover difference residuals per month for 2022, where crossovers are generated in monthly batches. The dual-satellite crossover differences are obtained by always taking one of the satellites for the first leg and the other for the second leg. The maximum time difference between the legs is 13.5 days for Sentinel-3A_3B and 10.0 days for Sentinel-6A_3A/3B (values in cm).

S-3A - S-3B

Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3A_S3B	AING	jan	51812	13.9	NaN	48698	0.17	5.52
S3A_S3B	AING	feb	48247	51.32	NaN	46061	0.16	5.41
S3A_S3B	AING	mar	54030	20.75	NaN	50758	0.17	5.45
S3A_S3B	AING	apr	47723	4.45	NaN	44055	0.17	5.52
S3A_S3B	AING	may	46823	6.38	NaN	44583	0.21	5.67
S3A_S3B	AING	jun	47279	-9.02	NaN	45316	0.19	5.64
S3A_S3B	AING	jul	52094	-4.35	NaN	51117	0.17	5.59
S3A_S3B	AING	aug	60367	23.12	NaN	57362	0.06	5.88
S3A_S3B	AING	sep	63207	11.08	NaN	59846	0.12	5.86
S3A_S3B	AING	oct	59258	46.38	NaN	54704	0.06	6.17
S3A_S3B	AING	nov	49247	12.46	NaN	46656	0.12	5.78
S3A_S3B	AING	dec	49317	15.65	NaN	46618	0.15	6.16
S3A_S3B	AING	tot	629404	8.53	NaN	595774	0.14	5.74
S3A_S3B	AIUB	jan	51812	-6.77	NaN	48717	0.41	5.58
S3A_S3B	AIUB	feb	48254	9.96	NaN	46089	0.41	5.47
S3A_S3B	AIUB	mar	54022	15.3	NaN	50758	0.42	5.48
S3A_S3B	AIUB	apr	47717	15.78	NaN	44057	0.41	5.54
S3A_S3B	AIUB	may	46823	34.62	NaN	44586	0.47	5.69
S3A_S3B	AIUB	jun	47281	24.98	NaN	45317	0.43	5.65
S3A_S3B	AIUB	jul	52094	-5.31	NaN	51116	0.43	5.59
S3A_S3B	AIUB	aug	60355	24.73	NaN	57355	0.31	5.87
S3A_S3B	AIUB	sep	63207	12.35	NaN	59829	0.39	5.87
S3A_S3B	AIUB	oct	59258	17.45	NaN	54727	0.33	6.21
S3A_S3B	AIUB	nov	49251	46.13	NaN	46571	0.4	5.83
S3A_S3B	AIUB	dec	49314	30.34	NaN	46621	0.4	6.23
S3A_S3B	AIUB	tot	629388	-0.71	NaN	595743	0.4	5.76
S3A_S3B	CNES	jan	55461	0.12	6.68	54470	0.13	5.46
S3A_S3B	CNES	feb	49790	0.13	6.45	48994	0.13	5.4
S3A_S3B	CNES	mar	56184	0.15	6.6	55244	0.14	5.44
S3A_S3B	CNES	apr	49722	0.16	6.54	48899	0.16	5.48
S3A_S3B	CNES	may	48698	0.15	6.66	47966	0.16	5.62
S3A_S3B	CNES	jun	49303	0.13	6.66	48545	0.14	5.56
S3A_S3B	CNES	jul	54031	0.14	6.74	53141	0.14	5.55
S3A_S3B	CNES	aug	62133	0.09	6.88	61261	0.07	5.84
S3A_S3B	CNES	sep	63207	0.12	7.24	62134	0.09	5.86
S3A_S3B	CNES	oct	60435	0.07	7.56	59261	0.05	6.09





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3A_S3B	CNES	nov	50861	0.06	7.11	49970	0.1	5.71
S3A_S3B	CNES	dec	52185	0.11	7.26	51305	0.12	6.08
S3A_S3B	CNES	tot	652010	0.12	6.89	641190	0.12	5.69
S3A_S3B	CNES_stc	jan	55461	0.14	6.72	54503	0.14	5.53
S3A_S3B	CNES_stc	feb	49790	0.17	6.53	49025	0.17	5.51
S3A_S3B	CNES_stc	mar	56184	0.15	6.66	55288	0.14	5.53
S3A_S3B	CNES_stc	apr	49722	0.16	6.6	48921	0.16	5.55
S3A_S3B	CNES_stc	may	48698	0.15	6.7	47993	0.17	5.68
S3A_S3B	CNES_stc	jun	49303	0.15	6.67	48567	0.16	5.59
S3A_S3B	CNES_stc	jul	54031	0.18	6.81	53172	0.19	5.65
S3A_S3B	CNES_stc	aug	62133	0.16	6.96	61301	0.15	5.95
S3A_S3B	CNES_stc	sep	63207	0.18	7.3	62159	0.15	5.95
S3A_S3B	CNES_stc	oct	60435	0.11	7.62	59315	0.09	6.2
S3A_S3B	CNES_stc	nov	50861	0.09	7.2	50004	0.13	5.83
S3A_S3B	CNES_stc	dec	52185	0.12	7.3	51316	0.13	6.14
S3A_S3B	CNES_stc	tot	652010	0.15	6.95	641564	0.15	5.77
S3A_S3B	СОМВ	jan	55461	0.1	19.03	54493	0.22	5.53
S3A_S3B	СОМВ	feb	49790	0.72	39.15	48982	0.22	5.42
S3A_S3B	СОМВ	mar	56184	-0.39	44.59	55245	0.23	5.46
S3A_S3B	СОМВ	apr	49722	1.05	67.28	48893	0.25	5.52
S3A_S3B	СОМВ	may	48698	0.27	29.03	47970	0.24	5.68
S3A_S3B	СОМВ	jun	49303	0.22	6.7	48584	0.23	5.64
S3A_S3B	СОМВ	jul	54031	0.24	6.81	53154	0.24	5.61
S3A_S3B	СОМВ	aug	62133	-0.57	57.73	61248	0.16	5.86
S3A_S3B	СОМВ	sep	63207	0.22	7.27	62127	0.2	5.87
S3A_S3B	СОМВ	oct	60435	1.02	63.63	59269	0.14	6.13
S3A_S3B	СОМВ	nov	50861	0.13	7.36	49966	0.17	5.75
S3A_S3B	СОМВ	dec	52185	-3.13	82.1	50958	0.15	6.21
S3A_S3B	СОМВ	tot	652010	-0.01	63.96	640889	0.2	5.74
S3A_S3B	CPOD	jan	55461	0.15	6.71	54445	0.14	5.46
S3A_S3B	CPOD	feb	49790	0.13	6.45	48973	0.13	5.38
S3A_S3B	CPOD	mar	56184	0.15	6.59	55256	0.14	5.44
S3A_S3B	CPOD	apr	49722	0.15	6.52	48887	0.16	5.44
S3A_S3B	CPOD	may	48698	0.15	6.64	47961	0.16	5.58
S3A_S3B	CPOD	jun	49303	0.14	6.63	48537	0.14	5.52
S3A_S3B	CPOD	jul	54031	0.2	13.64	53132	0.14	5.51
S3A_S3B	CPOD	aug	62133	0.09	6.86	61247	0.07	5.81
S3A_S3B	CPOD	sep	63207	0.09	13.89	62133	0.09	5.84
S3A_S3B	CPOD	oct	60435	0.06	7.56	59263	0.04	6.09
S3A_S3B	CPOD	nov	50861	0.06	7.12	49982	0.1	5.72
S3A_S3B	CPOD	dec	52185	0.12	7.24	51285	0.13	6.04
S3A_S3B	CPOD	tot	652010	0.12	8.52	641101	0.12	5.67
S3A_S3B	CPOD_stc	jan	55461	0.17	6.72	54447	0.15	5.48
S3A_S3B	CPOD_stc	feb	49790	0.14	6.47	49004	0.15	5.41
S3A_S3B	CPOD_stc	mar	56184	0.16	6.64	55285	0.15	5.52
S3A_S3B	CPOD_stc	apr	49722	0.15	6.57	48920	0.15	5.52





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3A_S3B	CPOD_stc	may	48698	0.14	6.69	47998	0.15	5.67
S3A_S3B	CPOD_stc	jun	49303	0.14	6.67	48550	0.14	5.57
S3A_S3B	CPOD_stc	jul	54031	0.2	13.67	53147	0.14	5.57
S3A_S3B	CPOD_stc	aug	62133	0.32	19.82	57681	0.07	6.74
S3A_S3B	CPOD_stc	sep	63207	0.12	13.9	62156	0.13	5.89
S3A_S3B	CPOD_stc	oct	60435	0.07	7.59	59303	0.05	6.15
S3A_S3B	CPOD_stc	nov	50861	0.06	7.14	49997	0.09	5.77
S3A_S3B	CPOD_stc	dec	52185	0.12	7.24	51298	0.12	6.05
S3A_S3B	CPOD_stc	tot	652010	0.15	10.3	637786	0.12	5.81
S3A_S3B	CPOF	jan	55461	0.16	6.7	54428	0.15	5.45
S3A_S3B	CPOF	feb	49790	0.13	6.45	48978	0.14	5.38
S3A_S3B	CPOF	mar	56184	0.16	6.58	55234	0.15	5.41
S3A_S3B	CPOF	apr	49722	0.16	6.51	48874	0.17	5.42
S3A_S3B	CPOF	may	48698	0.16	6.63	47964	0.17	5.57
S3A_S3B	CPOF	jun	49303	0.14	6.61	48533	0.15	5.5
S3A_S3B	CPOF	jul	54031	0.21	13.63	53108	0.15	5.48
S3A_S3B	CPOF	aug	62133	0.1	6.84	61236	0.08	5.78
S3A_S3B	CPOF	sep	63207	0.1	13.88	62120	0.1	5.82
S3A_S3B	CPOF	oct	60435	0.07	7.55	59250	0.05	6.08
S3A_S3B	CPOF	nov	50861	0.07	7.11	49977	0.11	5.71
S3A_S3B	CPOF	dec	52185	0.13	7.25	51295	0.14	6.06
S3A_S3B	CPOF	tot	652010	0.13	8.52	640997	0.13	5.65
S3A_S3B	СРОК	jan	55461	0.32	6.72	54453	0.31	5.49
S3A_S3B	СРОК	red	49790	0.29	6.46	48983	0.29	5.39
53A_53D	CPUK	mar	40722	0.31	0.01	22222	0.3	5.45 E 44
53A_53B	CPUK	арг	49722	0.31	0.03	48879	0.32	5.44 E.C
53A_53D	CPOK	iup	40090	0.3	6.62	47966	0.31	5.0
53A_53D	CPOK	jun	49303 54021	0.29	6.71	40540 52110	0.3	5.52
S3A_S3B		Jui	62076	12.29	NoN	61071	0.29	5.91
S3A_S3B	CPOK	son	63207	0.20	16.04	62131	0.21	5.84
S3A S3B	CPOK	oct	60435	0.23	7 56	59266	0.24	6.1
S34 S3B	CPOK	nov	50709	-0.37	NaN	49629	0.2	5 72
S3A_S3B	СРОК	dec	52185	0.28	7.27	51298	0.28	6.09
S3A_S3B	СРОК	tot	651801	-0.96	NaN	640590	0.27	5.68
S3A S3B	DLR	ian	55461	0.16	6.78	54457	0.15	5.55
S3A S3B	DLR	feb	49790	0.14	6.51	48980	0.15	5.43
S3A S3B	DLR	mar	56184	0.16	6.61	55264	0.15	5.46
S3A S3B	DLR	apr	49722	0.17	6.6	48869	0.18	5.51
S3A_S3B	DLR	may	48698	0.17	6.68	47967	0.18	5.64
S3A S3B	DLR	, jun	49303	0.15	6.68	48572	0.16	5.61
S3A_S3B	DLR	jul	54031	0.16	6.75	53144	0.16	5.56
S3A_ S3B	DLR	aug	62133	0.11	6.89	61260	0.09	5.84
S3A_S3B	DLR	sep	63207	0.14	7.24	62106	0.12	5.85
S3A_S3B	DLR	oct	60435	0.05	7.82	59295	0.05	6.16
S3A_S3B	DLR	nov	50861	0.08	7.15	49978	0.11	5.77





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3A_S3B	DLR	dec	52185	0.13	7.79	51316	0.1	6.19
S3A_S3B	DLR	tot	652010	0.13	6.99	641208	0.13	5.73
S3A_S3B	ESOC	jan	48528	40.84	NaN	45318	0.14	5.51
S3A_S3B	ESOC	feb	48401	54.12	NaN	46075	0.14	5.43
S3A_S3B	ESOC	mar	52396	35.02	NaN	47587	0.14	5.47
S3A_S3B	ESOC	apr	47921	NaN	NaN	44064	0.14	5.53
S3A_S3B	ESOC	may	45441	13.4	NaN	42862	0.19	5.68
S3A_S3B	ESOC	jun	47480	24.46	NaN	45327	0.15	5.66
S3A_S3B	ESOC	jul	51144	-1.79	NaN	49893	0.15	5.62
S3A_S3B	ESOC	aug	58341	16.26	NaN	54939	0.03	5.88
S3A_S3B	ESOC	sep	61783	32.41	NaN	58242	0.09	5.86
S3A_S3B	ESOC	oct	49903	80.17	NaN	49090	9.97	27.24
S3A_S3B	ESOC	nov	45705	-1.93	NaN	41359	0.12	5.78
S3A_S3B	ESOC	dec	49553	79.64	NaN	44978	0.14	6.18
S3A_S3B	ESOC	tot	606596	3.67	NaN	569734	0.98	9.67
S3A_S3B	EUMB	jan	51822	23.52	NaN	48736	0.44	5.7
S3A_S3B	EUMB	feb	48243	48.04	NaN	46125	0.42	5.61
S3A_S3B	EUMB	mar	51778	30.02	NaN	48544	0.44	5.54
S3A_S3B	EUMB	apr	47723	5.9	NaN	44086	0.42	5.61
S3A_S3B	EUMB	may	46823	10.8	NaN	44592	0.48	5.71
S3A_S3B	EUMB	jun	46767	43.88	NaN	44603	0.45	5.68
S3A_S3B	EUMB	jul	52216	21.58	NaN	51119	0.44	5.64
S3A_S3B	EUMB	aug	60520	35.12	NaN	57381	0.3	5.88
S3A_S3B	EUMB	sep	63207	12.51	NaN	59861	0.41	5.87
S3A_S3B	EUMB	oct	59424	21	NaN	54757	0.33	6.26
S3A_S3B	EUMB	nov	47799	55.76	NaN	44980	0.4	5.9
S3A_S3B	EUMB	dec	49535	35.48	NaN	46657	0.4	6.32
S3A_S3B	EUMB	tot	625857	15.81	NaN	591441	0.41	5.82
S3A_S3B	GFZ	jan	55461	0.16	6.69	54493	0.16	5.49
S3A_S3B	GFZ	feb	49790	0.16	6.5	48967	0.17	5.4
S3A_S3B	GFZ	mar	56184	0.23	7.26	55258	0.18	5.5
S3A_S3B	GFZ	apr	47921	49.5	NaN	44042	0.21	5.47
S3A_S3B	GFZ	may	46980	57.96	NaN	44577	0.27	5.6
S3A_S3B	GFZ	jun	47466	26.85	NaN	46437	0.24	5.54
S3A_S3B	GFZ	jul	54031	0.27	6.78	53085	0.25	5.53
S3A_S3B	GFZ	aug	60550	3.61	NaN	59401	0.11	5.84
S3A_S3B	GFZ	sep	63207	0.16	7.24	62140	0.13	5.87
S3A_S3B	GFZ	oct	60435	-8.98	NaN	58129	0.1	6.15
S3A_S3B	GFZ	nov	50861	-0.39	16.41	49823	0.15	5.76
S3A_S3B	GFZ	dec	52185	-7.06	73.76	50274	0.18	6.19
S3A_S3B	GFZ	tot	645071	1.5	NaN	626626	0.17	5.71
S3A_S3B	GRG	jan	55461	62.66	NaN	52263	0.16	5.54
S3A_S3B	GRG	feb	49790	47.18	NaN	47690	0.15	5.45
S3A_S3B	GRG	mar	54479	8.23	NaN	53326	0.18	5.47
S3A_S3B	GRG	apr	49722	0.26	7.45	48604	0.17	5.58
S3A_S3B	GRG	may	48698	0.16	6.68	47970	0.17	5.63





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3A_S3B	GRG	jun	49303	0.12	6.65	48554	0.13	5.55
S3A_S3B	GRG	jul	54031	0.12	6.73	53131	0.12	5.53
S3A_S3B	GRG	aug	60906	-6.38	NaN	59684	0.06	5.85
S3A_S3B	GRG	sep	63207	0.14	7.24	62144	0.11	5.87
S3A_S3B	GRG	oct	60435	13.02	NaN	57906	0.01	6.25
S3A_S3B	GRG	nov	50861	0.05	7.23	49996	0.09	5.86
S3A_S3B	GRG	dec	51071	9.42	NaN	49881	0.12	6.22
S3A_S3B	GRG	tot	647964	19.66	NaN	631149	0.12	5.75
S3A_S3B	JPL	jan	55461	0.15	6.69	54486	0.14	5.49
S3A_S3B	JPL	feb	49790	0.12	6.5	48983	0.13	5.41
S3A_S3B	JPL	mar	56184	0.18	6.94	55226	0.14	5.43
S3A_S3B	JPL	apr	49722	0.15	6.59	48871	0.16	5.44
S3A_S3B	JPL	may	48698	0.15	6.63	47959	0.17	5.57
S3A_S3B	JPL	jun	49303	0.14	6.62	48547	0.14	5.52
S3A_S3B	JPL	jul	54031	0.14	6.71	53131	0.14	5.51
S3A_S3B	JPL	aug	62133	0.06	7.49	61226	0.08	5.79
S3A_S3B	JPL	sep	63207	0.12	7.22	62121	0.1	5.83
S3A_S3B	JPL	oct	60435	0.07	7.58	59252	0.06	6.1
S3A_S3B	JPL	nov	50861	0.06	7.12	49987	0.1	5.73
S3A_S3B	JPL	dec	52185	0.12	7.24	51286	0.13	6.04
S3A_S3B	JPL	tot	652010	0.12	6.98	641075	0.12	5.67
S3A_S3B	REF	jan	55461	0.12	6.68	54475	0.12	5.4/
S3A_S3B	REF	red	49790	0.13	6.45	48992	0.13	5.4
S3A_S3B	REF	mar	56184	0.15	6.6	55248	0.14	5.44
S3A_S3B		арг	49722	0.10	0.54	48901	0.16	5.48
53A_53D		iup	48698	0.15	0.00	47966	0.16	5.02 E EC
		Jun	49303 E4031	0.13	6.00	40041 50100	0.14	5.50
53A_53D		Jui	62122	0.14	6.74	61257	0.14	5.55
53A_53D		aug	62207	0.09	0.00	621237	0.07	5.04
S3A_S3B		oct	60435	0.12	7.24	59267	0.09	5.00
S3A S3B	DEE	nov	50861	0.07	7.50	49970	0.05	5 71
S34 S3B	REF	dec	52185	0.00	7.26	51306	0.1	6.08
S3A_S3B	REF	tot	652010	0.12	6.89	641193	0.12	5.69
S3A_S3B	TUDE	ian	55461	0.14	6.67	54472	0.14	5.46
S3A S3B	TUDF	feb	49790	0.13	6.45	48994	0.13	5.4
S3A S3B	TUDF	mar	56184	0.15	6.59	55266	0.14	5.44
S3A S3B	TUDF	apr	49722	0.15	6.53	48884	0.15	5.45
S3A S3B	TUDF	may	48698	0.13	6.64	47963	0.15	5.59
S3A S3B	TUDF	jun	49303	0.11	6.63	48544	0.12	5.52
S3A_S3B	TUDF	jul	54031	0.13	6.7	53107	0.13	5.48
S3A_S3B	TUDF	aug	62133	0.08	6.85	61240	0.06	5.79
S3A S3B	TUDF	sep	63207	0.11	7.22	62131	0.09	5.84
S3A S3B	TUDF	oct	60435	0.04	7.56	59238	0.02	6.08
S3A_ S3B	TUDF	nov	50861	0.05	7.12	49974	0.08	5.73
S3A_S3B	TUDF	dec	52185	0.08	7.24	51283	0.09	6.04





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3A_S3B	TUDF	tot	652010	0.11	6.87	641096	0.11	5.67
S3A_S3B	TUDF_stc	jan	55461	0.13	6.67	54465	0.13	5.46
S3A_S3B	TUDF_stc	feb	49790	0.13	6.45	48993	0.13	5.4
S3A_S3B	TUDF_stc	mar	56184	0.15	6.6	55266	0.14	5.45
S3A_S3B	TUDF_stc	apr	49722	0.15	6.53	48893	0.15	5.46
S3A_S3B	TUDF_stc	may	48698	0.12	6.64	47964	0.14	5.59
S3A_S3B	TUDF_stc	jun	49303	0.1	6.63	48542	0.12	5.52
S3A_S3B	TUDF_stc	jul	54031	0.12	6.7	53118	0.12	5.49
S3A_S3B	TUDF_stc	aug	62133	0.08	6.85	61251	0.06	5.8
S3A_S3B	TUDF_stc	sep	63207	0.11	7.22	62127	0.08	5.83
S3A_S3B	TUDF_stc	oct	60435	0.04	7.56	59243	0.03	6.08
S3A_S3B	TUDF_stc	nov	50861	0.04	7.12	49973	0.07	5.72
S3A_S3B	TUDF_stc	dec	52185	0.08	7.24	51288	0.1	6.04
S3A_S3B	TUDF_stc	tot	652010	0.1	6.88	641123	0.1	5.67
S3A_S3B	TUDF_stcu	jan	55461	0.13	6.67	54466	0.13	5.46
S3A_S3B	TUDF_stcu	feb	49790	0.12	6.47	49000	0.13	5.42
S3A_S3B	TUDF_stcu	mar	56184	0.14	6.62	55267	0.13	5.47
S3A_S3B	TUDF_stcu	apr	49722	0.19	6.99	48895	0.16	5.5
S3A_S3B	TUDF_stcu	may	48698	0.13	6.65	47971	0.14	5.61
S3A_S3B	TUDF_stcu	jun	49303	0.12	6.63	48537	0.13	5.52
S3A_S3B	TUDF_stcu	jul	54031	0.13	6.72	53124	0.13	5.52
S3A_S3B	TUDF_stcu	aug	62133	0.07	6.86	61243	0.05	5.8
S3A_S3B	TUDF_stcu	sep	63207	0.1	7.22	62129	0.08	5.84
S3A_S3B	TUDF_stcu	oct	60435	0.05	7.6	59252	0.03	6.11
S3A_S3B	TUDF_stcu	nov	50861	0.07	7.17	50001	0.1	5.79
S3A_S3B	TUDF_stcu	dec	52185	0.08	/.2/	51287	0.1	6.05
S3A_S3B	TUDF_stcu	tot	652010	0.11	6.93	641172	0.11	5.69
S3A_S3B	TUG	jan 6-1-	51815	-6.56	INAIN	48692	0.59	5.55
S3A_S3B	TUG	Teb	48254	26.21	NaN	46077	0.6	5.48
	TUG	IIIdi	34023	9.1	NaN	49580	0.0	5.51
53A_53D	TUG	apr	47723	01.55	NaN	44042	0.01	5.55
S3A_S3B	TUG	iun	40822	1/ 03	NaN	44390	0.03	5.72
S3A_S3B	TUG	juli	50754	17.11	NaN	43522	0.02	5.63
S3A S3B	TUG	Jur	60369	0.87	NaN	57356	0.01	5.80
S3A S3B	TUG	sen	63207	19.66	NaN	59842	0.5	5.89
S34 S38	TUG	oct	59258	-8.97	NaN	54702	0.50	6 19
S3A S3B	TUG	nov	47927	60.84	NaN	45375	0.45	5.88
S34 S38	TUG	dec	2172	00.04	5 3	2147	0.33	4 84
S3A S3B	TUG	tot	579607	6 75	NaN	547416	0.57	5 74
S34 S38	тим	ian	51053	75.09	NaN	47203	0.50	5 47
S3A_S3B	тим	feb	48615	32.15	NaN	46065	0.19	5 39
S3A S3B	тим	mar	54539	81 74	NaN	49591	0.19	5 39
S3A_S3B	тим	apr	48286	61.88	NaN	44060	0.19	5 44
S3A S3B	тим	mav	47423	27.92	NaN	44587	0.15	5.57
S3A S3B	тим	iun	47723	10.86	NaN	45278	0.23	5.57
55, _550	1011	Jun	77722	10.00	nun	75270	0.22	5.52





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S3A_S3B	TUM	jul	51421	63.61	NaN	49661	0.2	5.48
S3A_S3B	TUM	aug	60897	65.54	NaN	57334	0.1	5.78
S3A_S3B	TUM	sep	63207	55.6	NaN	59839	0.16	5.81
S3A_S3B	TUM	oct	59647	60.9	NaN	54693	0.09	6.13
S3A_S3B	TUM	nov	49655	33	NaN	46679	0.15	5.73
S3A_S3B	TUM	dec	50050	21.51	NaN	46597	0.18	6.06
S3A_S3B	TUM	tot	632515	14.79	NaN	591587	0.17	5.67

S-6A – S-3A

Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A_S3A	AING	jan	92985	33.01	NaN	85028	1.23	5.02
S6A_S3A	AING	feb	83831	31.67	NaN	79917	1.18	4.86
S6A_S3A	AING	mar	92426	12.18	NaN	87512	1.06	4.96
S6A_S3A	AING	apr	88745	-9.56	NaN	83980	1.22	5.1
S6A_S3A	AING	may	83736	-3.5	NaN	79325	1.26	5.43
S6A_S3A	AING	jun	74218	27.47	NaN	70009	1	5.34
S6A_S3A	AING	jul	75192	25.05	NaN	71221	0.67	5.2
S6A_S3A	AING	aug	72340	-0.54	NaN	69148	1.04	5.44
S6A_S3A	AING	sep	68751	0.69	6.85	67563	0.71	5.46
S6A_S3A	AING	oct	69937	21.22	NaN	67013	0.51	5.45
S6A_S3A	AING	nov	72517	0.47	NaN	68794	0.59	5.46
S6A_S3A	AING	dec	81757	20.78	NaN	75633	0.72	5.4
S6A_S3A	AING	tot	956435	7.54	NaN	905143	0.95	5.25
S6A_S3A	AIUB	jan	92985	27.18	NaN	85005	2.7	5.59
S6A_S3A	AIUB	feb	83831	28.01	NaN	79944	2.61	5.42
S6A_S3A	AIUB	mar	92403	20.42	NaN	87521	2.37	5.41
S6A_S3A	AIUB	apr	88745	5.55	NaN	83999	2.54	5.59
S6A_S3A	AIUB	may	83736	11.7	NaN	79320	2.73	5.97
S6A_S3A	AIUB	jun	74222	8.34	NaN	70019	2.4	5.79
S6A_S3A	AIUB	jul	75192	8.51	NaN	71235	1.97	5.53
S6A_S3A	AIUB	aug	72340	11.74	NaN	69140	2.34	5.84
S6A_S3A	AIUB	sep	68751	2	7.12	67584	2.02	5.8
S6A_S3A	AIUB	oct	69957	12.93	NaN	67030	1.84	5.76
S6A_S3A	AIUB	nov	72517	8.54	NaN	68612	2.06	5.82
S6A_S3A	AIUB	dec	81743	35.61	NaN	75656	2.57	5.99
S6A_S3A	AIUB	tot	956422	4.59	NaN	905065	2.37	5.7
S6A_S3A	CNES	jan	92985	1.22	5.75	91689	1.22	4.91
S6A_S3A	CNES	feb	83831	1.13	5.57	82691	1.12	4.83
S6A_S3A	CNES	mar	95532	0.91	5.72	94279	0.92	4.89
S6A_S3A	CNES	apr	88745	1.07	5.84	87615	1.06	5.04
S6A_S3A	CNES	may	83736	1.37	6.29	82599	1.34	5.41
S6A_S3A	CNES	jun	74826	13.52	NaN	73742	1.02	5.32
S6A_S3A	CNES	jul	75192	0.6	6.14	74083	0.58	5.17
S6A_S3A	CNES	aug	72340	1.04	6.55	71194	1.02	5.41
S6A_S3A	CNES	sep	68751	0.66	6.84	67566	0.68	5.44
S6A_S3A	CNES	oct	72600	0.55	6.86	71287	0.5	5.43





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A_S3A	CNES	nov	69910	-4.17	NaN	68536	0.44	5.37
S6A_S3A	CNES	dec	83892	0.69	6.37	82569	0.69	5.32
S6A_S3A	CNES	tot	962340	1.55	NaN	947850	0.9	5.2
S6A_S3A	CNES_stc	jan	92985	1.36	5.85	91766	1.34	5.05
S6A_S3A	CNES_stc	feb	83831	1.34	5.71	82782	1.33	5.01
S6A_S3A	CNES_stc	mar	95532	1.08	5.82	94348	1.08	5.02
S6A_S3A	CNES_stc	apr	88745	1.24	5.96	87662	1.22	5.19
S6A_S3A	CNES_stc	may	83736	1.35	6.37	82655	1.32	5.52
S6A_S3A	CNES_stc	jun	76727	1.03	6.21	75758	1	5.38
S6A_S3A	CNES_stc	jul	73725	0	NaN	72552	0.56	5.27
S6A_S3A	CNES_stc	aug	72340	1.03	6.62	71233	1.01	5.5
S6A_S3A	CNES_stc	sep	68751	0.62	6.93	67631	0.64	5.57
S6A_S3A	CNES_stc	oct	72600	0.55	6.94	71340	0.51	5.55
S6A_S3A	CNES_stc	nov	72517	0.41	6.63	71337	0.38	5.49
S6A_S3A	CNES_stc	dec	81058	-4.03	NaN	79678	0.6	5.39
S6A_S3A	CNES_stc	tot	962547	0.52	NaN	948742	0.94	5.31
S6A_S3A	COMB	jan	92985	1.38	21.9	91710	1.51	5.04
S6A_S3A	COMB	feb	83831	1.46	5.67	82707	1.45	4.94
S6A_S3A	СОМВ	mar	95532	0.93	33.88	94279	1.31	5.01
S6A_S3A	СОМВ	apr	88745	1.38	24.81	87610	1.48	5.16
S6A_S3A	СОМВ	may	83736	1.64	6.45	82622	1.62	5.52
S6A_S3A	СОМВ	jun	74824	-3.93	NaN	73758	1.3	5.41
S6A_S3A	СОМВ	jul	75192	0.99	6.5	74079	0.98	5.25
S6A_S3A	СОМВ	aug	72340	0.5	61.16	71185	1.35	5.5
S6A_S3A	СОМВ	sep	68751	1.01	6.89	67553	1.03	5.5
S6A_S3A	СОМВ	oct	72600	0.83	7.05	71270	0.79	5.47
S6A_S3A	COMB	nov	69910	25.44	NaN	68556	0.81	5.44
S6A_S3A	СОМВ	dec	83892	-1.52	59.6	82275	0.9	5.47
S6A_S3A	СОМВ	tot	962338	-1.41	NaN	947604	1.23	5.3
S6A_S3A	CPOD	jan	92985	1.26	5.81	91595	1.23	4.92
S6A_S3A	CPOD	feb	83831	1.19	5.58	82692	1.18	4.84
S6A_S3A	CPOD	mar	95532	0.93	5.72	94282	0.93	4.89
S6A_S3A	CPOD	apr	88745	1.09	5.84	87629	1.08	5.05
S6A_S3A	CPOD	may	83736	1.3	6.29	82616	1.27	5.42
S6A_S3A	CPOD	jun	76727	1.07	6.17	75716	1.05	5.31
S6A_S3A	CPOD	jul	75192	0.51	37.34	74084	0.69	5.17
S6A_S3A	CPOD	aug	72340	1.07	6.57	71207	1.05	5.44
S6A_S3A	CPOD	sep	68751	0.72	6.85	67577	0.74	5.46
S6A_S3A	CPOD	oct	72600	0.51	6.87	71293	0.47	5.44
S6A_S3A	CPOD	nov	72517	0.47	6.56	71291	0.45	5.4
S6A_S3A	CPOD	dec	83892	0.64	6.38	82559	0.63	5.31
S6A_S3A	CPOD	tot	966848	0.91	12	952541	0.91	5.21
S6A_S3A	CPOD_stc	jan	92985	1.37	5.85	91641	1.34	4.99
S6A_S3A	CPOD_stc	feb	83831	1.29	5.64	82725	1.29	4.91
S6A_S3A	CPOD_stc	mar	95532	0.91	5.77	94330	0.91	4.95
S6A_S3A	CPOD_stc	apr	88745	1.19	5.89	87619	1.18	5.1




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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A_S3A	CPOD_stc	may	83736	1.31	6.29	82632	1.28	5.43
S6A_S3A	CPOD_stc	jun	76727	1.05	6.19	75710	1.03	5.34
S6A_S3A	CPOD_stc	jul	75192	0.54	37.34	74111	0.71	5.22
S6A_S3A	CPOD_stc	aug	72340	-0.22	21.04	67759	0.96	6.1
S6A_S3A	CPOD_stc	sep	68751	0.76	6.86	67587	0.78	5.48
S6A_S3A	CPOD_stc	oct	72600	0.56	6.9	71322	0.52	5.5
S6A_S3A	CPOD_stc	nov	72517	0.55	6.59	71323	0.52	5.44
S6A_S3A	CPOD_stc	dec	83892	0.72	6.38	82625	0.72	5.35
S6A_S3A	CPOD_stc	tot	966848	0.86	13.2	949384	0.96	5.3
S6A_S3A	CPOF	jan	92985	1.27	5.79	91600	1.25	4.91
S6A_S3A	CPOF	feb	83831	1.2	5.58	82678	1.2	4.83
S6A_S3A	CPOF	mar	95532	0.95	5.72	94272	0.95	4.88
S6A_S3A	CPOF	apr	88745	1.12	5.84	87622	1.11	5.04
S6A_S3A	CPOF	may	83736	1.31	6.29	82623	1.28	5.42
S6A_S3A	CPOF	jun	76727	1.07	6.16	75702	1.05	5.3
S6A_S3A	CPOF	jul	75192	0.5	37.34	74081	0.68	5.16
S6A_S3A	CPOF	aug	72340	1.05	6.55	71189	1.02	5.41
S6A_S3A	CPOF	sep	68751	0.69	6.84	67568	0.72	5.44
S6A_S3A	CPOF	oct	72600	0.5	6.86	71281	0.45	5.42
S6A_S3A	CPOF	nov	72517	0.46	6.55	71282	0.43	5.38
S6A_S3A	CPOF	dec	83892	0.64	6.37	82548	0.63	5.3
S6A_S3A	CPOF	tot	966848	0.92	12	952446	0.92	5.19
S6A_S3A	CPOK	jan	92985	1.54	5.86	91638	1.52	5.02
S6A_S3A	СРОК	feb	83831	1.49	5.66	82695	1.49	4.93
S6A_S3A	CPOK	mar	95532	1.26	5.8	94300	1.25	4.98
S6A_S3A	CPOK	apr	88745	1.36	5.9	87626	1.35	5.11
S6A_S3A	СРОК	may	83736	1.56	6.37	82625	1.53	5.51
S6A_S3A	СРОК	jun	76727	1.29	6.32	75701	1.27	5.36
S6A_S3A	СРОК	jul	75192	28.96	NaN	74006	0.93	5.22
S6A_S3A	СРОК	aug	72340	9.35	NaN	70920	1.23	5.47
S6A_S3A	CPOK	sep	68751	0.97	9.77	67566	0.94	5.49
S6A_S3A	CPOK	oct	72600	33.91	NaN	71194	0.7	5.48
S6A_S3A	CPOK	nov	72517	13.87	NaN	70674	0.72	5.4
S6A_S3A	CPOK	dec	83892	-6.84	NaN	82541	1.07	5.39
S6A_S3A	CPOK	tot	966848	2.27	NaN	951486	1.19	5.27
S6A_S3A	DLR	jan	92985	1.46	5.88	91650	1.44	5.03
S6A_S3A	DLR	feb	83831	1.4	5.66	82699	1.39	4.93
S6A_S3A	DLR	mar	95532	1.27	5.84	94318	1.27	5.03
S6A_S3A	DLR	apr	88745	1.41	5.94	87631	1.4	5.16
S6A_S3A	DLR	may	83736	1.57	6.36	82622	1.54	5.5
S6A_S3A	DLR	jun	76727	1.26	6.23	75714	1.24	5.38
S6A_S3A	DLR	jul	75192	0.92	6.2	74108	0.9	5.25
S6A_S3A	DLR	aug	72340	1.28	6.62	71209	1.26	5.5
S6A_S3A	DLR	sep	68751	0.94	6.9	67578	0.97	5.52
S6A_S3A	DLR	oct	72600	0.83	6.91	71295	0.79	5.5
S6A_S3A	DLR	nov	72517	0.93	6.64	71308	0.89	5.48





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A_S3A	DLR	dec	83892	1.06	6.94	82593	1.04	5.48
S6A_S3A	DLR	tot	966848	1.21	6.33	952725	1.19	5.3
S6A_S3A	ESOC	jan	87982	44.97	NaN	87044	9.48	24.85
S6A_S3A	ESOC	feb	74868	7.36	NaN	70698	1.35	4.89
S6A_S3A	ESOC	mar	92869	50.97	NaN	84110	1.16	4.97
S6A_S3A	ESOC	apr	88745	10.05	NaN	83977	1.29	5.11
S6A_S3A	ESOC	may	67506	29.75	NaN	59402	1.37	5.47
S6A_S3A	ESOC	jun	74508	71.59	NaN	70016	1.12	5.37
S6A_S3A	ESOC	jul	68503	18.78	NaN	62139	0.83	5.23
S6A_S3A	ESOC	aug	72340	35.97	NaN	66325	1.14	5.46
S6A_S3A	ESOC	sep	68751	22.03	NaN	65808	0.89	5.5
S6A_S3A	ESOC	oct	70350	14.86	NaN	69550	11.37	27.99
S6A_S3A	ESOC	nov	72517	10.12	NaN	62974	0.62	5.4
S6A_S3A	ESOC	dec	81987	37.72	NaN	75623	0.76	5.41
S6A_S3A	ESOC	tot	920926	2.45	NaN	857666	2.75	12.2
S6A_S3A	EUMB	jan	92985	6.37	NaN	85096	2.71	5.65
S6A_S3A	EUMB	feb	83831	12.49	NaN	79976	2.49	5.44
S6A_S3A	EUMB	mar	92397	20.12	NaN	84001	2.39	5.49
S6A_S3A	EUMB	apr	88745	7.95	NaN	84069	2.86	5.82
S6A_S3A	EUMB	may	80665	18.95	NaN	76314	3.03	6.15
S6A_S3A	EUMB	jun	74508	-6.99	NaN	69034	2.73	6.02
S6A_S3A	EUMB	jul	75192	24.12	NaN	71289	2.23	5.7
S6A_S3A	EUMB	aug	72340	10.3	NaN	69164	2.35	5.9
S6A_S3A	EUMB	sep	68751	1.95	7.15	67599	1.97	5.83
S6A_S3A	EUMB	oct	70307	60.85	NaN	67051	1.84	5.82
S6A_S3A	EUMB	nov	72517	-9.75	NaN	66227	2.35	5.95
S6A_S3A	EUMB	dec	81969	17.86	NaN	75689	2.71	6.1
S6A_S3A	EUMB	tot	954207	9.76	NaN	895509	2.49	5.82
S6A_S3A	GFZ	jan	92985	1.81	5.95	91745	1.81	5.17
S6A_S3A	GFZ	feb	83831	1.68	5.73	82692	1.68	5
S6A_S3A	GFZ	mar	95532	1.55	6.38	94268	1.52	5.08
S6A_S3A	GFZ	apr	88745	17.72	NaN	83989	1.51	5.18
S6A_S3A	GFZ	may	83736	-9.84	NaN	79311	1.56	5.49
S6A_S3A	GFZ	jun	76727	12.54	NaN	72560	1.27	5.42
S6A_S3A	GFZ	jul	75192	1.13	6.31	74020	1.09	5.3
S6A_S3A	GFZ	aug	72340	6.48	NaN	69153	1.45	5.56
S6A_S3A	GFZ	sep	68751	0.98	6.91	67584	1	5.54
S6A_S3A	GFZ	oct	72600	0.7	6.93	71318	0.66	5.53
S6A_S3A	GFZ	nov	72517	0.34	16.44	70989	0.87	5.46
S6A_S3A	GFZ	dec	83892	0.64	69.42	81259	0.69	5.51
S6A_S3A	GFZ	tot	966848	1.03	NaN	938888	1.28	5.34
S6A_S3A	GRG	jan	92985	NaN	NaN	0	0	0
S6A_S3A	GRG	feb	83831	1.2	5.63	82735	1.18	4.91
S6A_S3A	GRG	mar	95532	75.95	NaN	88035	1.17	4.99
S6A_S3A	GRG	apr	88745	1.19	5.91	87637	1.18	5.13
S6A_S3A	GRG	may	83736	1.37	6.32	82642	1.33	5.46





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A_S3A	GRG	jun	76727	-0.34	39.82	74385	1.07	5.43
S6A_S3A	GRG	jul	75192	0.86	6.19	74123	0.84	5.25
S6A_S3A	GRG	aug	72340	11.28	NaN	69388	1.08	5.49
S6A_S3A	GRG	sep	68751	0.81	6.91	67602	0.84	5.54
S6A_S3A	GRG	oct	72600	-0.79	49.67	68632	0.56	5.81
S6A_S3A	GRG	nov	72517	0.6	6.65	71322	0.58	5.51
S6A_S3A	GRG	dec	83892	13.13	NaN	78876	0.74	5.63
S6A_S3A	GRG	tot	966848	29.63	NaN	845377	0.98	5.37
S6A_S3A	JPL	jan	92985	1.22	5.76	91673	1.21	4.92
S6A_S3A	JPL	feb	83831	1.08	5.55	82702	1.07	4.81
S6A_S3A	JPL	mar	95532	0.92	5.93	94260	0.91	4.87
S6A_S3A	JPL	apr	88745	0.98	5.81	87612	0.97	5.01
S6A_S3A	JPL	may	83736	1.21	6.24	82596	1.18	5.35
S6A_S3A	JPL	jun	76727	0.97	6.14	75711	0.95	5.28
S6A_S3A	JPL	jul	75192	0.65	6.12	74086	0.63	5.16
S6A_S3A	JPL	aug	72340	0.95	7.21	71171	0.97	5.39
S6A_S3A	JPL	sep	68751	0.6	6.84	67576	0.62	5.44
S6A_S3A	JPL	oct	72600	0.42	6.86	71277	0.38	5.42
S6A_S3A	JPL	nov	72517	0.43	6.55	71254	0.4	5.36
S6A_S3A	JPL	dec	83892	0.56	6.35	82565	0.56	5.29
S6A_S3A	JPL	tot	966848	0.85	6.26	952483	0.84	5.18
S6A_S3A	REF	jan	92985	1.22	5.74	91681	1.21	4.91
S6A_S3A	REF	feb	83831	1.13	5.57	82698	1.12	4.83
S6A_S3A	REF	mar	95532	0.91	5.72	94281	0.92	4.89
S6A_S3A	REF	apr	88745	1.07	5.84	87615	1.06	5.04
S6A_S3A	REF	may	83736	1.37	6.29	82600	1.34	5.42
S6A_S3A	REF	jun	76727	1.04	6.17	75710	1.02	5.31
S6A_S3A	REF	jul	75192	0.6	6.14	74084	0.58	5.17
S6A_S3A	REF	aug	72340	1.04	6.55	71194	1.02	5.41
S6A_S3A	REF	sep	68751	0.66	6.84	67562	0.68	5.44
S6A_S3A	REF	oct	72600	0.55	6.86	71283	0.5	5.43
S6A_S3A	REF	nov	72517	0.49	6.55	71282	0.46	5.38
S6A_S3A	REF	dec	83892	0.69	6.37	82568	0.69	5.32
S6A_S3A	REF	tot	966848	0.91	6.2	952558	0.9	5.2
S6A_S3A	TUDF	jan	92985	1.53	5.81	91683	1.52	4.99
S6A_S3A	TUDF	feb	83831	1.45	5.64	82699	1.43	4.91
S6A_S3A	TUDF	mar	95532	1.19	5.77	94279	1.18	4.94
S6A_S3A	TUDF	apr	88745	1.34	5.9	87621	1.33	5.11
S6A_S3A	TUDF	may	83736	1.48	6.31	82602	1.45	5.44
S6A_S3A	TUDF	jun	76727	1.27	6.21	75722	1.25	5.37
S6A_S3A	TUDF	jul	75192	1.02	6.18	74089	1	5.22
S6A_S3A	TUDF	aug	72340	1.34	6.61	71199	1.31	5.48
S6A_S3A	TUDF	sep	68751	0.96	6.89	67572	0.98	5.5
S6A_S3A	TUDF	oct	72600	0.82	6.91	71318	0.78	5.51
S6A_S3A	TUDF	nov	72517	0.81	6.59	71276	0.79	5.43
S6A_S3A	TUDF	dec	83892	0.82	6.38	82523	0.82	5.31





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A_S3A	TUDF	tot	966848	1.18	6.24	952583	1.17	5.25
S6A_S3A	TUDF_stc	jan	92985	1.6	5.83	91680	1.59	5.01
S6A_S3A	TUDF_stc	feb	83831	1.49	5.66	82699	1.48	4.92
S6A_S3A	TUDF_stc	mar	95532	1.26	5.78	94276	1.26	4.96
S6A_S3A	TUDF_stc	apr	88745	1.4	5.91	87625	1.39	5.13
S6A_S3A	TUDF_stc	may	83736	1.52	6.32	82603	1.49	5.45
S6A_S3A	TUDF_stc	jun	76727	1.3	6.22	75729	1.28	5.38
S6A_S3A	TUDF_stc	jul	75192	1.02	6.18	74091	1.01	5.22
S6A_S3A	TUDF_stc	aug	72340	1.34	6.61	71198	1.31	5.48
S6A_S3A	TUDF_stc	sep	68751	0.96	6.88	67581	0.98	5.51
S6A_S3A	TUDF_stc	oct	72600	0.85	6.91	71308	0.81	5.51
S6A_S3A	TUDF_stc	nov	72517	0.86	6.6	71272	0.83	5.43
S6A_S3A	TUDF_stc	dec	83892	1.05	6.42	82531	1.06	5.35
S6A_S3A	TUDF_stc	tot	966848	1.24	6.25	952593	1.22	5.27
S6A_S3A	TUG	jan	89547	28.14	NaN	81598	1.9	5.17
S6A_S3A	TUG	feb	81548	1.11	NaN	77570	1.71	5.05
S6A_S3A	TUG	mar	92387	-2.15	NaN	87497	1.75	5.16
S6A_S3A	TUG	apr	88745	10.84	NaN	83968	1.94	5.32
S6A_S3A	TUG	may	83736	-0.27	NaN	79310	1.86	5.6
S6A_S3A	TUG	jun	74222	20.8	NaN	70012	1.7	5.53
S6A_S3A	TUG	jul	75192	63.53	NaN	69156	1.54	5.42
S6A_S3A	TUG	aug	72340	24.14	NaN	69138	1.78	5.63
S6A_S3A	TUG	sep	68751	1.29	6.94	67554	1.31	5.56
S6A_S3A	TUG	oct	69929	39.73	NaN	67020	1.08	5.55
S6A_S3A	TUG	nov	72517	11.54	NaN	66695	1.36	5.63
S6A_S3A	TUG	dec	9155	28.23	NaN	8973	0.59	5.39
S6A_S3A	TUG	tot	878069	2.54	NaN	828491	1.64	5.41
S6A_S3A	TUM	jan	92985	-9.43	NaN	82331	1.39	4.96
S6A_S3A	TUM	feb	83831	-4.41	NaN	79918	1.27	4.87
S6A_S3A	TUM	mar	93226	58.33	NaN	87522	1.15	4.95
S6A_S3A	TUM	apr	88745	17.37	NaN	83976	1.64	5.19
S6A_S3A	TUM	may	83736	-8.28	NaN	79334	2.1	5.66
S6A_S3A	TUM	jun	74992	17.24	NaN	70039	1.75	5.52
S6A_S3A	TUM	jul	75192	12.65	NaN	69151	1.29	5.29
S6A_S3A	TUM	aug	72340	18.07	NaN	69141	1.61	5.56
S6A_S3A	TUM	sep	68751	1.19	6.93	67578	1.21	5.55
S6A_S3A	TUM	oct	70712	10.12	NaN	67056	0.54	5.48
S6A_S3A	TUM	nov	72517	23.98	NaN	68781	0.46	5.39
S6A_S3A	TUM	dec	82370	NaN	NaN	75627	0.68	5.35
S6A_S3A	TUM	tot	959397	-7.43	NaN	900454	1.27	5.3

S-6A – S-3B

Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A_S3B	AING	jan	93100	9.17	NaN	88278	1	4.94
S6A_S3B	AING	feb	83044	-1.76	NaN	79659	1.01	4.8
S6A_S3B	AING	mar	92367	-9.8	NaN	87329	0.92	4.95





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A_S3B	AING	apr	88360	10.6	NaN	82134	1.04	5.07
S6A_S3B	AING	may	85140	4.47	NaN	81318	1.03	5.37
S6A_S3B	AING	jun	73998	9.2	NaN	71345	0.83	5.29
S6A_S3B	AING	jul	75210	0.52	6.16	74162	0.52	5.24
S6A_S3B	AING	aug	72244	-4.99	NaN	68577	0.92	5.45
S6A_S3B	AING	sep	68789	17.3	NaN	64919	0.58	5.39
S6A_S3B	AING	oct	69555	26.03	NaN	64130	0.35	5.49
S6A_S3B	AING	nov	72212	4.35	NaN	68495	0.47	5.48
S6A_S3B	AING	dec	81253	5.95	NaN	76500	0.59	5.3
S6A_S3B	AING	tot	955272	1.07	NaN	906846	0.79	5.22
S6A_S3B	AIUB	jan	93100	21.87	NaN	88260	2.22	5.35
S6A_S3B	AIUB	feb	83044	10.89	NaN	79673	2.2	5.21
S6A_S3B	AIUB	mar	92347	24.04	NaN	87343	1.97	5.26
S6A_S3B	AIUB	apr	88360	15.74	NaN	82160	2.11	5.42
S6A_S3B	AIUB	may	85140	3.18	NaN	81326	2.22	5.76
S6A_S3B	AIUB	jun	73999	19.69	NaN	71346	1.98	5.61
S6A_S3B	AIUB	jul	75210	1.56	6.35	74183	1.56	5.46
S6A_S3B	AIUB	aug	72244	5.04	NaN	68575	1.98	5.74
S6A_S3B	AIUB	sep	68789	11.68	NaN	64919	1.63	5.61
S6A_S3B	AIUB	oct	69572	33.08	NaN	64145	1.42	5.68
S6A_S3B	AIUB	nov	72212	-7.13	NaN	68512	1.65	5.74
S6A_S3B	AIUB	dec	81237	10.56	NaN	76531	2.2	5.75
S6A_S3B	AIUB	tot	955254	3.37	NaN	906973	1.95	5.54
S6A_S3B	CNES	jan	93100	1.02	5.66	91768	1.04	4.84
S6A_S3B	CNES	feb	83044	0.97	5.57	81823	0.96	4.76
S6A_S3B	CNES	mar	95468	0.78	5.75	94158	0.77	4.87
S6A_S3B	CNES	apr	88360	0.93	5.8	87252	0.92	5.01
S6A_S3B	CNES	may	85140	1.15	6.28	83985	1.14	5.35
S6A_S3B	CNES	jun	74627	9.22	NaN	73587	0.89	5.28
S6A_S3B	CNES	jul	75210	0.47	6.14	74162	0.46	5.22
S6A_S3B	CNES	aug	72244	0.94	6.46	71142	0.91	5.44
S6A_S3B	CNES	sep	68789	0.59	6.91	67560	0.58	5.37
S6A_S3B	CNES	oct	72251	0.4	6.81	71026	0.39	5.45
S6A_S3B	CNES	nov	69587	10.73	NaN	68335	0.34	5.42
S6A_S3B	CNES	dec	83382	0.6	6.36	81945	0.58	5.25
S6A_S3B	CNES	tot	961202	2.17	NaN	946743	0.76	5.17
S6A_S3B	CNES_stc	jan	93100	1.13	5.75	91844	1.13	4.97
S6A_S3B	CNES_stc	feb	83044	1.12	5.69	81892	1.11	4.91
S6A_S3B	CNES_stc	mar	95468	0.96	5.83	94222	0.94	4.99
S6A_S3B	CNES_stc	apr	88360	1.11	5.91	87312	1.09	5.16
S6A_S3B	CNES_stc	may	85140	1.15	6.33	84022	1.13	5.43
S6A_S3B	CNES_stc	jun	76529	0.91	6.2	75587	0.88	5.35
S6A_S3B	CNES_stc	jul	73772	24.46	NaN	72621	0.45	5.3
S6A_S3B	CNES_stc	aug	72244	0.95	6.51	71165	0.91	5.52
S6A_S3B	CNES_stc	sep	68789	0.55	6.98	67597	0.54	5.47
S6A_S3B	CNES_stc	oct	72251	0.41	6.89	71104	0.39	5.59





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A_S3B	CNES_stc	nov	72212	0.32	6.51	71139	0.28	5.52
S6A_S3B	CNES_stc	dec	80577	13.7	NaN	79087	0.52	5.35
S6A_S3B	CNES_stc	tot	961486	3.77	NaN	947592	0.81	5.28
S6A_S3B	СОМВ	jan	93100	1.21	5.72	91803	1.22	4.92
S6A_S3B	СОМВ	feb	83044	0.93	29.25	81827	1.21	4.84
S6A_S3B	СОМВ	mar	95468	1.1	5.83	94181	1.08	4.97
S6A_S3B	СОМВ	apr	88360	0.71	49.27	87252	1.26	5.11
S6A_S3B	СОМВ	may	85140	1.36	6.59	84012	1.34	5.44
S6A_S3B	COMB	jun	74622	11.5	NaN	73591	1.09	5.35
S6A_S3B	COMB	jul	75210	0.78	6.19	74173	0.77	5.28
S6A_S3B	COMB	aug	72244	1.2	6.51	71139	1.17	5.49
S6A_S3B	COMB	sep	68789	0.8	8.93	67574	0.82	5.42
S6A_S3B	COMB	oct	72251	-0.15	58.66	71035	0.57	5.49
S6A_S3B	COMB	nov	69587	9.9	NaN	68356	0.62	5.47
S6A_S3B	COMB	dec	83382	-0.27	28.06	81705	0.77	5.33
S6A_S3B	COMB	tot	961197	2.27	NaN	946648	1.01	5.25
S6A_S3B	CPOD	jan	93100	1.03	5.66	91770	1.05	4.84
S6A_S3B	CPOD	feb	83044	1.04	5.59	81819	1.03	4.77
S6A_S3B	CPOD	mar	95468	0.8	5.74	94154	0.78	4.87
S6A_S3B	CPOD	apr	88360	0.96	5.8	87267	0.95	5.02
S6A_S3B	CPOD	may	85140	1.09	6.28	84000	1.07	5.36
S6A_S3B	CPOD	jun	76529	0.94	6.15	75545	0.92	5.27
S6A_S3B	CPOD	jul	75210	0.58	6.14	74173	0.57	5.22
S6A_S3B	CPOD	aug	72244	0.97	6.61	71140	0.94	5.45
S6A_S3B	CPOD	sep	68789	0.08	4.82	67575	0.64	5.39
S6A_S3B	CPOD	oct	72251	0.37	6.82	71042	0.35	5.47
S6A_S3B	CPOD	nov	72212	0.37	6.45	71120	0.34	5.45
S6A_S3B	CPOD	dec	83382	0.54	6.36	81940	0.52	5.24
S6A_S3B	CPOD	tot	965729	0.75	28.59	951545	0.78	5.18
S6A_S3B	CPOD_stc	jan	93100	1.11	5.7	91811	1.13	4.9
S6A_S3B	CPOD_stc	feb	83044	1.11	5.64	81851	1.1	4.84
S6A_S3B	CPOD_stc	mar	95468	0.77	5.77	94175	0.75	4.9
S6A_S3B	CPOD_stc	apr	88360	1.07	5.85	87253	1.07	5.08
S6A_S3B	CPOD_stc	may	85140	1.1	6.28	83985	1.08	5.36
S6A_S3B	CPOD_stc	jun	76529	0.94	6.18	75547	0.92	5.31
S6A_S3B	CPOD_stc	jul	75210	0.63	6.17	74168	0.62	5.25
S6A_S3B	CPOD_stc	aug	72244	-0.03	22.01	67831	0.83	6.19
S6A_S3B	CPOD_stc	sep	68789	0.12	4.83	67580	0.68	5.42
S6A_S3B	CPOD_stc	oct	72251	0.42	6.86	71074	0.41	5.53
S6A_S3B	CPOD_stc	nov	72212	0.45	6.47	71142	0.43	5.48
S6A_S3B	CPOD_stc	dec	83382	0.62	6.37	81969	0.61	5.27
S6A_S3B	CPOD_stc	tot	965729	0.72	29.17	948386	0.82	5.28
S6A_S3B	CPOF	jan	93100	1.04	5.65	91777	1.05	4.84
S6A_S3B	CPOF	feb	83044	1.04	5.58	81811	1.03	4.76
S6A_S3B	CPOF	mar	95468	0.82	5.74	94154	0.8	4.86
S6A_S3B	CPOF	apr	88360	0.98	5.79	87268	0.97	5.01





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A_S3B	CPOF	may	85140	1.09	6.28	83979	1.07	5.35
S6A_S3B	CPOF	jun	76529	0.93	6.13	75547	0.91	5.26
S6A_S3B	CPOF	jul	75210	0.56	6.13	74148	0.56	5.2
S6A_S3B	CPOF	aug	72244	0.94	6.59	71124	0.91	5.42
S6A_S3B	CPOF	sep	68789	0.05	4.82	67563	0.61	5.37
S6A_S3B	CPOF	oct	72251	0.35	6.81	71040	0.33	5.46
S6A_S3B	CPOF	nov	72212	0.35	6.44	71112	0.31	5.43
S6A_S3B	CPOF	dec	83382	0.53	6.35	81924	0.51	5.22
S6A_S3B	CPOF	tot	965729	0.75	28.59	951447	0.77	5.17
S6A_S3B	CPOK	jan	93100	1.13	5.68	91773	1.15	4.87
S6A_S3B	CPOK	feb	83044	1.17	5.63	81826	1.16	4.82
S6A_S3B	CPOK	mar	95468	0.97	5.78	94144	0.95	4.9
S6A_S3B	CPOK	apr	88360	1.07	5.83	87249	1.07	5.05
S6A_S3B	CPOK	may	85140	1.2	6.32	83998	1.17	5.41
S6A_S3B	CPOK	jun	76529	0.99	7.04	75557	0.99	5.3
S6A_S3B	СРОК	jul	75210	15.25	NaN	74057	0.67	5.22
S6A_S3B	СРОК	aug	72244	1.01	6.6	71131	0.98	5.44
S6A_S3B	СРОК	sep	68789	0.13	4.82	67546	0.69	5.38
S6A_S3B	СРОК	oct	72251	-9.34	NaN	70950	0.42	5.47
S6A_S3B	СРОК	nov	72212	0.5	6.46	71102	0.47	5.45
S6A_S3B	СРОК	dec	83382	-0.97	NaN	81925	0.8	5.28
S6A_S3B	СРОК	tot	965729	-1.26	NaN	951258	0.89	5.2
S6A_S3B	DLR	jan	93100	1.22	5.73	91808	1.23	4.94
S6A_S3B	DLR	feb	83044	1.23	5.68	81842	1.21	4.87
S6A_S3B	DLR	mar	95468	1.14	5.84	94181	1.12	4.99
S6A_S3B	DLR	apr	88360	1.25	5.95	87190	1.25	5.14
S6A_S3B	DLR	may	85140	1.34	6.35	84020	1.32	5.44
S6A_S3B	DLR	jun	76529	1.11	6.2	75548	1.09	5.33
S6A_S3B	DLR	jul	75210	0.77	6.2	74180	0.76	5.29
S6A_S3B	DLR	aug	72244	1.18	6.51	71133	1.15	5.5
S6A_S3B	DLR	sep	68789	0.85	6.96	67575	0.84	5.44
S6A_S3B	DLR	oct	72251	0.72	7.07	71040	0.68	5.54
S6A_S3B	DLR	nov	72212	0.81	6.52	71117	0.77	5.51
S6A_S3B	DLR	dec	83382	0.97	6.46	82001	0.95	5.38
S6A_S3B	DLR	tot	965729	1.06	6.27	951635	1.05	5.27
S6A_S3B	ESOC	jan	88104	-2.01	NaN	82727	1.21	4.92
S6A_S3B	ESOC	feb	74166	36.88	NaN	69939	1.21	4.83
S6A_S3B	ESOC	mar	92799	82.83	NaN	85427	1.01	4.95
S6A_S3B	ESOC	apr	88360	59.57	NaN	82140	1.13	5.08
S6A_S3B	ESOC	may	68584	2.55	NaN	64048	1.14	5.43
S6A_S3B	ESOC	jun	74290	10.7	NaN	71352	0.98	5.32
S6A_S3B	ESOC	jul	68505	34.98	NaN	66054	0.69	5.29
S6A_S3B	ESOC	aug	72244	27.92	NaN	68576	1.05	5.48
S6A_S3B	ESOC	sep	68789	42.77	NaN	64904	0.78	5.41
S6A_S3B	ESOC	oct	69973	13.58	NaN	68777	10.42	27.48
S6A_S3B	ESOC	nov	72212	15.44	NaN	65932	0.54	5.49





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A_S3B	ESOC	dec	81485	88.18	NaN	73853	0.67	5.32
S6A_S3B	ESOC	tot	919511	15.64	NaN	863729	1.71	9.23
S6A_S3B	EUMB	jan	93100	33.48	NaN	88382	2.18	5.4
S6A_S3B	EUMB	feb	83044	10.65	NaN	79713	2.07	5.23
S6A_S3B	EUMB	mar	92344	22.71	NaN	87373	1.96	5.34
S6A_S3B	EUMB	apr	88360	-1.88	NaN	82177	2.44	5.61
S6A_S3B	EUMB	may	82005	15.97	NaN	78235	2.53	5.92
S6A_S3B	EUMB	jun	74288	44.75	NaN	71380	2.29	5.8
S6A_S3B	EUMB	jul	75210	1.82	6.46	74212	1.8	5.6
S6A_S3B	EUMB	aug	72244	25.29	NaN	68620	1.95	5.79
S6A_S3B	EUMB	sep	68789	19.68	NaN	64929	1.57	5.65
S6A_S3B	EUMB	oct	69928	17.37	NaN	64193	1.43	5.75
S6A_S3B	EUMB	nov	72212	25.31	NaN	68526	1.94	5.87
S6A_S3B	EUMB	dec	81463	48.02	NaN	76575	2.32	5.86
S6A_S3B	EUMB	tot	952987	12.7	NaN	904315	2.06	5.64
S6A_S3B	GFZ	jan	93100	1.57	5.84	91819	1.59	5.06
S6A_S3B	GFZ	feb	83044	1.49	5.74	81806	1.48	4.91
S6A_S3B	GFZ	mar	95468	1.37	5.88	94176	1.36	5.03
S6A_S3B	GFZ	apr	88360	16.77	NaN	82137	1.32	5.14
S6A_S3B	GFZ	may	85140	18.25	NaN	81317	1.29	5.41
S6A_S3B	GFZ	jun	76529	1.1	6.21	75560	1.09	5.36
S6A_S3B	GFZ	jul	75210	0.88	6.21	74175	0.88	5.3
S6A_S3B	GFZ	aug	72244	1.33	6.57	71158	1.3	5.57
S6A_S3B	GFZ	sep	68789	0.86	7	67580	0.85	5.48
S6A_S3B	GFZ	oct	72251	-2.94	NaN	69621	0.47	5.55
S6A_S3B	GFZ	nov	72212	0.75	6.5	71114	0.71	5.5
S6A_S3B	GFZ	dec	83382	-3.94	89.2	81575	0.54	5.31
S6A_S3B	GFZ	tot	965729	3.37	NaN	942038	1.1	5.29
S6A_S3B	GRG	jan	93100	1.12	5.73	91822	1.13	4.93
S6A_S3B	GRG	feb	83044	NaN	NaN	1	NaN	79.36
S6A_S3B	GRG	mar	95468	97.67	NaN	90924	0.96	4.96
S6A_S3B	GRG	apr	88360	0.86	7.06	86523	1	5.15
S6A_S3B	GRG	may	85140	1.11	6.29	84000	1.09	5.37
S6A_S3B	GRG	jun	76529	-0.53	40.73	74177	0.93	5.38
S6A_S3B	GRG	jul	75210	0.73	6.2	74164	0.72	5.28
S6A_S3B	GRG	aug	72244	0.98	6.51	71158	0.95	5.5
S6A_S3B	GRG	sep	68789	0.71	6.97	67620	0.7	5.48
S6A_S3B	GRG	oct	72251	7.15	NaN	66851	0.42	5.85
S6A_S3B	GRG	nov	72212	0.49	6.53	71144	0.47	5.54
S6A_S3B	GRG	dec	83382	0.39	17.53	80422	0.62	5.6
S6A_S3B	GRG	tot	965729	-7.83	NaN	858806	0.83	5.36
S6A_S3B	JPL	jan	93100	1	5.64	91764	1.02	4.82
S6A_S3B	JPL	feb	83044	0.92	5.59	81807	0.91	4.74
S6A_S3B	JPL	mar	95468	0.78	5.73	94159	0.76	4.86
S6A_S3B	JPL	apr	88360	0.85	5.82	87261	0.83	5
S6A_S3B	JPL	may	85140	0.99	6.23	83954	0.97	5.28





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A_S3B	JPL	jun	76529	0.84	6.12	75542	0.82	5.25
S6A_S3B	JPL	jul	75210	0.52	6.12	74147	0.51	5.19
S6A_S3B	JPL	aug	72244	0.89	6.44	71131	0.86	5.41
S6A_S3B	JPL	sep	68789	0.52	6.91	67566	0.52	5.37
S6A_S3B	JPL	oct	72251	0.27	6.82	71015	0.26	5.45
S6A_S3B	JPL	nov	72212	0.33	6.44	71097	0.3	5.42
S6A_S3B	JPL	dec	83382	0.46	6.34	81931	0.45	5.22
S6A_S3B	JPL	tot	965729	0.71	6.16	951374	0.7	5.15
S6A_S3B	REF	jan	93100	1.02	5.66	91769	1.04	4.84
S6A_S3B	REF	feb	83044	0.97	5.57	81821	0.96	4.76
S6A_S3B	REF	mar	95468	0.78	5.75	94162	0.77	4.87
S6A_S3B	REF	apr	88360	0.93	5.79	87244	0.91	5.01
S6A_S3B	REF	may	85140	1.15	6.27	83989	1.14	5.35
S6A_S3B	REF	jun	76529	0.91	6.15	75546	0.89	5.28
S6A_S3B	REF	jul	75210	0.47	6.14	74163	0.46	5.22
S6A_S3B	REF	aug	72244	0.94	6.46	71141	0.91	5.43
S6A_S3B	REF	sep	68789	0.59	6.91	67566	0.58	5.37
S6A_S3B	REF	oct	72251	0.4	6.81	71025	0.39	5.45
S6A_S3B	REF	nov	72212	0.39	6.44	71112	0.36	5.43
S6A_S3B	REF	dec	83382	0.6	6.36	81940	0.58	5.24
S6A_S3B	REF	tot	965729	0.78	6.17	951478	0.76	5.17
S6A_S3B	TUDF	jan	93100	1.31	5.72	91772	1.32	4.91
S6A_S3B	TUDF	feb	83044	1.28	5.63	81842	1.27	4.83
S6A_S3B	TUDF	mar	95468	1.06	5.79	94142	1.04	4.92
S6A_S3B	TUDF	apr	88360	1.21	5.85	87271	1.2	5.08
S6A_S3B	TUDF	may	85140	1.28	6.3	83986	1.26	5.37
S6A_S3B	TUDF	jun	76529	1.16	6.19	75536	1.15	5.32
S6A_S3B	TUDF	jul	75210	0.9	6.18	74160	0.89	5.26
S6A_S3B	TUDF	aug	72244	1.25	6.51	71153	1.23	5.51
S6A_S3B	TUDF	sep	68789	0.9	6.95	67563	0.89	5.43
S6A_S3B	TUDF	oct	72251	0.7	6.86	71047	0.69	5.52
S6A_S3B	TUDF	nov	72212	0.73	6.48	71099	0.69	5.47
S6A_S3B	TUDF	dec	83382	0.76	6.37	81929	0.74	5.25
S6A_S3B	TUDF	tot	965729	1.06	6.21	951500	1.04	5.22
S6A_S3B	TUDF_stc	jan	93100	1.39	5.74	91774	1.4	4.93
S6A_S3B	TUDF_stc	feb	83044	1.33	5.64	81838	1.32	4.85
S6A_S3B	TUDF_stc	mar	95468	1.13	5.8	94133	1.12	4.93
S6A_S3B	TUDF_stc	apr	88360	1.26	5.87	87271	1.25	5.1
S6A_S3B	TUDF_stc	may	85140	1.33	6.3	83978	1.31	5.38
S6A_S3B	TUDF_stc	jun	76529	1.19	6.2	75542	1.18	5.33
S6A_S3B	TUDF_stc	jul	75210	0.91	6.18	74160	0.9	5.26
S6A_S3B	TUDF_stc	aug	72244	1.26	6.51	71152	1.23	5.51
S6A_S3B	TUDF stc	sep	68789	0.91	6.95	67570	0.9	5.42
S6A_S3B	TUDF stc	oct	72251	0.72	6.86	71054	0.71	5.52
S6A S3B	TUDF stc	nov	72212	0.77	6.48	71101	0.74	5.48
S6A_S3B	TUDF_stc	dec	83382	0.98	6.4	81924	0.98	5.29





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Satellites	Solution	Month	Nr. unedited	Mean	RMS	3.5σ edited	Mean	RMS
S6A_S3B	TUDF_stc	tot	965729	1.11	6.22	951497	1.1	5.23
S6A_S3B	TUG	jan	89664	25.59	NaN	84832	1.25	4.94
S6A_S3B	TUG	feb	80754	25.31	NaN	77483	1.1	4.84
S6A_S3B	TUG	mar	92332	25.66	NaN	85398	1.16	5.01
S6A_S3B	TUG	apr	88360	-8.08	NaN	82142	1.32	5.14
S6A_S3B	TUG	may	85140	11.25	NaN	81339	1.19	5.43
S6A_S3B	TUG	jun	73999	58.7	NaN	71339	1.1	5.35
S6A_S3B	TUG	jul	75210	0.95	6.24	74181	0.94	5.33
S6A_S3B	TUG	aug	72244	18.83	NaN	68581	1.22	5.52
S6A_S3B	TUG	sep	68789	11.87	NaN	64897	0.73	5.39
S6A_S3B	TUG	oct	69546	-2.64	NaN	64139	0.5	5.51
S6A_S3B	TUG	nov	72212	28.07	NaN	68512	0.83	5.56
S6A_S3B	TUG	dec	9285	97.33	NaN	9098	0.28	5.43
S6A_S3B	TUG	tot	877535	-2.67	NaN	831941	1.04	5.26
S6A_S3B	TUM	jan	93100	12.52	NaN	88275	1.12	4.87
S6A_S3B	TUM	feb	83044	26.11	NaN	79672	1.07	4.81
S6A_S3B	TUM	mar	93162	22.55	NaN	85435	0.96	4.93
S6A_S3B	TUM	apr	88360	54.22	NaN	82133	1.45	5.14
S6A_S3B	TUM	may	85140	13.44	NaN	81291	1.86	5.55
S6A_S3B	TUM	jun	74790	11.23	NaN	71371	1.58	5.44
S6A_S3B	TUM	jul	75210	1.13	6.22	74151	1.12	5.3
S6A_S3B	TUM	aug	72244	38.5	NaN	68581	1.46	5.55
S6A_S3B	TUM	sep	68789	19.87	NaN	64918	1.07	5.46
S6A_S3B	TUM	oct	70350	13.34	NaN	64182	0.36	5.51
S6A_S3B	TUM	nov	72212	15.82	NaN	68484	0.3	5.45
S6A_S3B	TUM	dec	81874	-8.22	NaN	76489	0.52	5.26
S6A_S3B	TUM	tot	958275	3.19	NaN	904982	1.09	5.26



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G.3. MEAN SINGLE-SATELLITE ALTIMETER CROSSOVER DIFFERENCE RESIDUALS AS A FUNCTION OF GEOGRAPHICAL LOCATION FOR 2022 (ASCENDING MINUS DESCENDING)

S-3A





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S-6A







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G.4. MEAN DUAL-SATELLITE ALTIMETER CROSSOVER DIFFERENCE RESIDUALS AS A FUNCTION OF GEOGRAPHICAL LOCATION FOR 2022 (ASCENDING MINUS DESCENDING)

S-3A – S-3B









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S-6A – S-3A















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S-6A – S-3B









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ANNEX F. PRODUCT PERFORMANCE

As a complement of the Regular Service Review, a summary of the performances of each of the POD products generated for Sentinel-1, -2, -3 and -6 is presented in terms of orbit comparisons and accuracy percentiles. Predicted, NRT and STC products comprise the period of the RSR #27, whereas the NTC products are shown from the beginning of each mission.

This section is prepared following the same format as the document to be sent to Sentinel Online.

H.1. SENTINEL-1

The operational Sentinel-1 AUX_PREORB, AUX_RESORB and AUX_POEORB solutions from the CPOD Service are compared here against the combined solution (COMB), which is computed as a weighted mean of several external solutions provided by the CPOD QWG. The AUX_PREORB solution is divided into its two orbits in order to analyse the difference between the first and the second prediction.

In the following figures, the position accuracy of each orbit solution is shown (in 2D or 3D RMS depending on the requirement). Each figure is presented along with the distribution of the obtained accuracy metrics, where the percentiles of these metrics are calculated for different thresholds.

The period of time for AUX_PREORB and AUX_RESORB products correspond to the latest RSR report. The period of time of the AUX_POEORB products includes the whole mission. Orbit comparisons considered as outliers (i.e., those mostly generated from periods of time with manoeuvres or data gaps) have been filtered-out from the statistics shown below.

AUX_PREORB (1st orbit)





Table F-1: Sentinel-1 AUX_PREORB (1st orbit) products – Accuracy percentiles (they are calculated from the orbit comparisons against COMB solution [2D RMS])

	Product Accuracy							
Thus she lid	Percentage of Fulfilment							
Inresnoia	Sentinel-1A	Sentinel-1B						
5 cm	20.60 %	18.18 %						
10 cm	55.14 %	53.63 %						
20 cm	80.64 %	78.71 %						
50 cm	96.29 %	95.55 %						
100 cm	99.38 %	99.44 %						



AUX_PREORB (2nd orbit)



Figure F-2: Sentinel-1 AUX_PREORB (2nd orbit) products – Orbit comparisons against COMB solution [2D RMS; cm] (the accuracy requirement is shown with a blue line; vertical lines indicate periods of manoeuvres or data gaps)

Table F-2: Sentinel-1 AUX_PREORB (2nd orbit) products – Accuracy percentiles (they are
calculated from the orbit comparisons against COMB solution [2D RMS])

Product Accuracy			
	Percentage of Fulfilment		
Inreshold	Sentinel-1A	Sentinel-1B	
5 cm	0.57 %	0.39 %	
10 cm	10.57 %	10.41 %	
20 cm	32.33 %	32.70 %	
50 cm	66.36 %	66.75 %	
100 cm	88.05 %	87.75 %	

AUX_RESORB







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Table F-3: Sentinel-1 AUX_RESORB products – Accuracy percentiles (they are calculated from the orbit comparisons against COMB solution [2D RMS])

Product Accuracy		
	Percentage of Fulfilment	
Threshold	Sentinel-1A	Sentinel-1B
1 cm	0.15 %	0.02 %
2 cm	28.83 %	27.96 %
3 cm	83.22 %	82.80 %
5 cm	98.36 %	98.92 %
10 cm	99.37 %	99.69 %

AUX_POEORB



Figure F-4: Sentinel-1 AUX_POEORB products – Orbit comparisons against COMB solution [3D RMS; cm] (the accuracy requirement is shown with a blue line; neither gaps nor manoeuvres are depicted in this case)

Table F-4: Sentinel-1 orbit comparisons – Accuracy percentiles (the accuracy percentiles are from AUX_POEORB against COMB solution [3D RMS])

Product Accuracy		
Thursday 14	Percentage of Fulfilment	
Inresnoia	Sentinel-1A	Sentinel-1B
0.5 cm	81.78 %	86.46 %
1 cm	98.84 %	98.93 %
2 cm	99.75 %	99.55 %
3 cm	99.84 %	99.64 %
5 cm	99.91 %	99.87 %



H.2. SENTINEL-2

The operational Sentinel-2 AUX_PREORB and AUX_RESORB solutions from the CPOD Service are compared here against the combined solution (COMB), which is computed as a weighted mean of several external solutions provided by the CPOD QWG.

In the following figures, the position accuracy of each orbit solution is shown (in 2D or 3D RMS depending on the requirement). Each figure is presented along with the distribution of the obtained accuracy metrics, where the percentiles of these metrics are calculated for different thresholds.

The period of time for AUX_PREORB and AUX_RESORB products correspond to the latest RSR report. Orbit comparisons considered as outliers (i.e., those mostly generated from periods of time with manoeuvres or data gaps) have been filtered-out from the statistics shown below.

AUX_PREORB



Figure F-5: Sentinel-2 AUX_PREORB products – Orbit comparisons against COMB solution [2D RMS; cm] (the accuracy requirement expressed as 1-sigma, if appears, is shown with a blue line; vertical lines indicate periods of manoeuvres or data gaps)

Table F-5: Sentinel-2 AUX_PREORB products – Accuracy percentiles (they are calculated from the orbit comparisons against COMB solution [2D RMS])

Product Accuracy			
	Percentage of Fulfilment		
Inreshold	Sentinel-2A	Sentinel-2B	
10 cm	1.80 %	1.51 %	
20 cm	18.52 %	19.15 %	
50 cm	63.27 %	64.73 %	
100 cm	88.20 %	89.52 %	
330 cm	100.00 %	100.00 %	



Figure F-6: Sentinel-2 AUX_RESORB products – Orbit comparisons against COMB solution [3D RMS; cm] (the accuracy requirement expressed as 1-sigma, if appears, is shown with a blue line; vertical lines indicate periods of manoeuvres or data gaps)

 Table F-6: Sentinel-2 AUX_RESORB products – Accuracy percentiles (they are calculated from the orbit comparisons against COMB solution [3D RMS])

Product Accuracy		
	Percentage of Fulfilment	
Inreshold	Sentinel-2A	Sentinel-2B
3 cm	71.02 %	70.99 %
5 cm	98.20 %	98.60 %
10 cm	99.67 %	99.63 %
50 cm	99.97 %	99.95 %
100 cm	100.00 %	100.00 %



H.3. SENTINEL-3

The operational Sentinel-3 SR___ROE_AX solutions from the Marine and Land centres are compared here against the combined solution (COMB), which is computed as a weighted mean of several external solutions provided by the CPOD QWG. Orbit comparisons for the operational Sentinel-3 AUX_MOEORB and AUX_POEORB solutions from the CPOD Service are also provided against the same COMB solution.

In the following figures, the position accuracy of each orbit solution is shown (in radial RMS as per requirement). Each figure is presented along with the distribution of the obtained accuracy metrics, where the percentiles of these metrics are calculated for different thresholds.

The period of time for SR___ROE_AX and AUX_MOEORB products correspond to the latest RSR report. The period of time of the AUX_POEORB products includes the whole mission. Orbit comparisons considered as outliers (i.e., those mostly generated from periods of time with manoeuvres or data gaps) have been filtered-out from the statistics shown below.

SR___ROE_AX



Figure F-7: Sentinel-3A SR___ROE_AX products – Orbit comparisons against COMB solution [radial RMS; cm] (the accuracy requirement is shown with a blue line; vertical lines indicate periods of manoeuvres or data gaps)



Figure F-8: Sentinel-3B SR___ROE_AX products – Orbit comparisons against COMB solution [radial RMS; cm] (the accuracy requirement is shown with a blue line; vertical lines indicate periods of manoeuvres or data gaps)



Table F-7: Sentinel-3 SR____ROE_AX products – Accuracy percentiles (they are calculated from the orbit comparisons against COMB solution [radial RMS])

Product Accuracy				
	Percentage of Fulfilment			
Threshold	S	·ЗА	S	-3B
	MAR	CPOD	MAR	CPOD
1 cm	34.18 %	38.09 %	40.28 %	45.12 %
2 cm	85.78 %	88.51 %	87.75 %	91.01 %
3 cm	98.54 %	98.58 %	99.09 %	98.95 %
5 cm	99.97 %	99.90 %	99.92 %	99.86 %
10 cm	99.97 %	99.97 %	99.95 %	99.98 %

AUX_MOEORB



Figure F-9: Sentinel-3 AUX_MOEORB products – Orbit comparisons against COMB solution [radial RMS; cm] (the accuracy requirement is shown with a blue line; vertical lines indicate periods of manoeuvres or data gaps)

Table F-8: Sentinel-3 AUX_MOEORB products – Accuracy percentiles (they are calculated from the orbit comparisons against COMB solution [radial RMS])

Product Accuracy			
Thursday	Percentage of Fulfilment		
Inresnoia	Sentinel-3A	Sentinel-3B	
0.5 cm	1.45 %	4.68 %	
1 cm	94.35 %	96.61 %	
2 cm	98.87 %	99.19 %	
3 cm	99.03 %	100.00 %	
4 cm	99.35 %	100.00 %	

AUX_POEORB



Sentinel-3: AUX_POEORB vs. COMB [Radial RMS] Sentinel-3A + Sentinel-3B • 4 Orbital Difference (cm) 0.52±0.19 (RMS 0.56) 0.39±0.14 (RMS 0.41) 3 2 1 0 2018 2021 2022 2023 2017 2019 2020 Coverage Date (2016 - 2022)

Figure F-10: Sentinel-3 AUX_POEORB products – Orbit comparisons against COMB solution [radial RMS; cm] (the accuracy requirement is shown with a blue line; neither gaps nor manoeuvres are depicted in this case)

 Table F-9: Sentinel-3 AUX_POEORB products – Accuracy percentiles (they are calculated from the orbit comparisons against COMB solution [radial RMS])

Product Accuracy			
Thus she she	Percentage of Fulfilment		
Inresnoia	Sentinel-3A	Sentinel-3B	
0.25 cm	1.38 %	20.00 %	
0.5 cm	41.54 %	78.20 %	
1 cm	99.76 %	99.94 %	
2 cm	99.96 %	100.00 %	
3 cm	99.96 %	100.00 %	


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H.4. SENTINEL-6

The operational Sentinel-6 ROE__AX solution from the CPOD Service is compared here against the combined solution (COMB), which is computed as a weighted mean of several external solutions provided by the CPOD QWG.

In the following figure, the position accuracy of each orbit solution is shown (in radial RMS as per requirement). The figure is presented along with the distribution of the obtained accuracy metrics, where the percentiles of these metrics are calculated for different thresholds.

The period of time for ROE__AX products correspond to the latest RSR report. Orbit comparisons considered as outliers (i.e., those mostly generated from periods of time with manoeuvres or data gaps) have been filtered-out from the statistics shown below.

ROE__AX



Figure F-11: Sentinel-6A ROE__AX products – Orbit comparisons against COMB solution [radial RMS; cm] (the accuracy requirement is shown with a blue line; vertical lines indicate periods of manoeuvres or data gaps)

Table F-10: Sentinel-6A ROE__AX products – Accuracy percentiles (they are calculated from the orbit comparisons against COMB solution [radial RMS])

Product Accuracy	
Threshold	Percentage of Fulfilment
	Sentinel-6A
1 cm	51.85 %
2 cm	95.06 %
3 cm	99.79 %
4 cm	100.00 %
5 cm	100.00 %





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