

# ARA-DAC Weekly Analysis Result: 2317 (GFA)

## Technical Report

**GPS Week: 2317 (GFA)**

<http://geolabpasaia.org/gnss/ARA-euref/>

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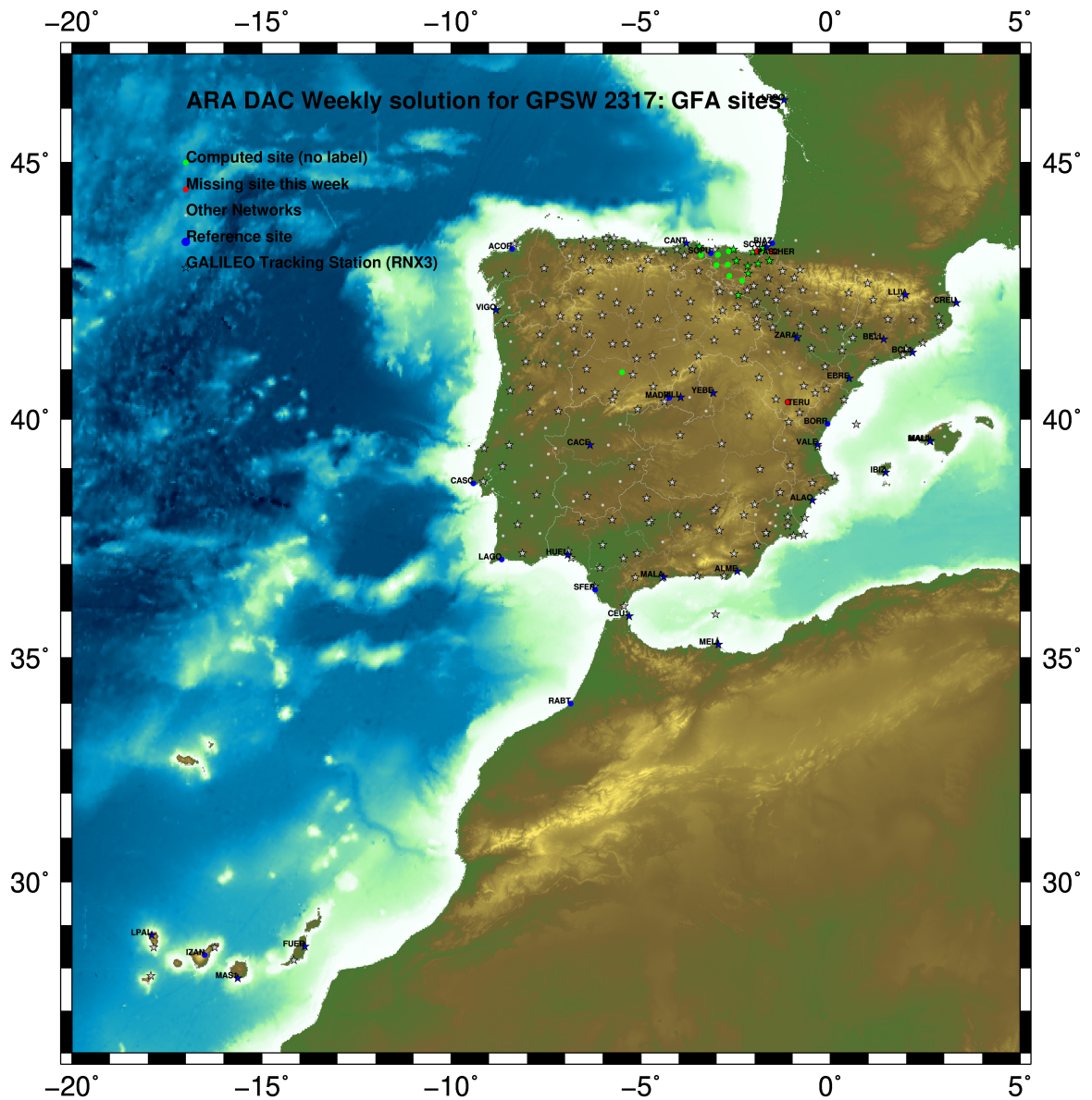


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# 1 Introduction

In may 2015 ARA (EUREF's acronym of the ARANZADI's Department of Applied Geodesy), kicks off as a EUREF's Operational Center. In July 2015, the Densification solutions ARA computes routinely in a weekly basis start being submitted to the EUREF's EPN Densification Project.

# 2 Map of Computed Sites



GM 2024 Jul 04 11:48:27

Fig.1: Computed Sites for GPS Week2317 (GFA)

### 3 Main Computation Parameters

The main parameters considered in the ARA analysis follow strictly the EPN recommendations.

- Preprocessing: Independent baselines are defined by the criterion of maximum common observations. Cycle slips are fixed with the MAUPRP program, analysing triple phase differences for each independent baseline. If MAUPRP does not fix all slips for one station, that station is edited out.
- Basic Observable : Carrier phase,  $L_1$  and  $L_2$ ; a priori sigma of single differences: 0.002 m.
  - sampling (for ambiguity resolution): 30 s
  - sampling (for final processing): 180 s
  - Systems: GPS+GLONASS observations are used (Galileo is used if available starting GPS week 1986)
- Modelled observable: Double differences of carrier phase using different combinations based on the distance.
- Ground antenna phase center calibrations: Group APCV used from the PCV\_COD.I20 file and individual calibrations from EPNC\_20.ATX. In case no calibration values of an antenna/radome pairs are not available for a certain GNSS system at some station, the observation of this/these GNSS/GNSSs are excluded from the analysis of that station.
- Reference sites: the latest IGS cumulative solution is used to align our solution to the latest IGS20 release, regularly updated and available at: IGS0OPSSNX\_1994002\_00U\_00U\_CRD.SNX.gz. Following the EUREF guidelines, no other individual calibrations are included in the analysis starting GPSW 2238 (IGS20); also applies to repro3 solutions, which are based on IGS20 standards.
- Troposphere:
  - minimum elevation is 3 deg.; elevation dependent weighting.
  - VMF3 mapping function. ZPD parameters are estimated using the VMF3 mapping function.
  - CHENHER gradient estimation model.
- Ionosphere: no a priori model, ionospheric effect almost removed by iono free combination.
- Ocean Loading: FES2014b (Scherneck).
- Atmospheric loading: not corrected, following the latest recommendations for IGS20 products.
- Tidal displacements:
  - Mean pole model : IERS2010\_v1.2.0
  - Subdaily pole model: DESAI2016
  - Nutation model : IAU2000R06

### 4 Estimated Parameters

- Adjustment: Least Squares
- Rejection Criteria:  $3\sigma$  rms of single differences, in the weekly combination of daily normal equations (ADDNEQ)
- Station coordinates: minimum constraints (MC) to IGS sites (only translations).
- Troposphere: 3 deg. After having obtained coordinates valid for the entire week, tropospheric zenith delay is solved at each site at intervals of 1 hour throughout the week, holding the coordinates constrained at the weekly values.

- Ionospheric: second and third "High Order Ionosphere (HOI)" corrections used, using CODE files, to improve Ambiguity Resolution.
- Satellite clock bias: not estimated because are eliminated by double differencing the phase data.
- Receiver clock bias: not estimated because are eliminated by double differencing the phase data.
- Orbits and ERPs: CODE's orbits and ERP for both rapid and final solutions. DE421 planetary ephemeris and JGM3 Earth geopotential model is used.
- Ambiguity: an advanced ambiguity resolution (AR) scheme is included:
  - Code-Based Widelane (WL) and Narrow Line (NR) AR for baselines shorter than 6000km, a Melbourne-Wuebbena wide-lane and narrow-lane AR is computed.
  - Phase-Based Widelane ( $L_5$ ) AR for baselines shorter than 200km, the code-based wide-lane AR is replaced by a phase-only wide-lane with a subsequent narrow-lane AR.
  - Quasi-Ionosphere-Free (QIF) AR for the remaining real-valued ambiguities for baselines shorter than 2000km.
  - Direct  $L_1/L_2$  AR for baselines shorter than 20km
- AR Verification: Each baseline is processed by introducing the resolved integer ambiguities and checking the residuals. If there is any problem, the ambiguities are re-initialized.

## 5 Computed Coordinates

In this section the adjusted coordinates are summarized. Note that the sites with an A flag are the computed ones, whereas sites flagged as W (IGS cumulative solution) are the ones used in the Minimal Constraints condition.

### 5.1 IGS20

The Reference Frame considered in this section is the IGS20 (IGS cumulative solution), mapped from 2015.0 to the observation epoch.

ARA FINAL WEEKLY COMBINATION: FINAL ORBITS 04-JUL-24 10:33

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LOCAL GEODETIC DATUM: IGS20 EPOCH: 2024-06-05 11:59:45

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG	SYSTEM
111	ACOR 13434M001	4594489.51811	-678367.31481	4357066.32940	W	G
39	ALDA 19383M001	4687280.10638	-190876.47196	4308107.01627	A	GR
50	ALSA 19419M001	4677250.78078	-176770.29954	4319079.93689	A	GRE
53	AMUR 19388M001	4661499.39437	-244591.16183	4332269.93998	A	GR
384	BLAZ 10074M002	4634455.99106	-124344.88063	4365785.51185	W	GR
101	BIDA 00000M000	4644177.76052	-145778.22782	4354832.53473	A	GR
113	BRZR 19387M001	4662220.93649	-220769.80271	4333309.49521	A	GR
573	CACE 13447M001	4899866.45872	-544566.94145	4033770.26683	W	GRE
592	CANT 13438M001	4625924.26228	-307096.14218	4365771.61771	W	GRE
908	CREU 13432M001	4715420.06700	273178.15510	4271946.90087	W	GRE
135	EBRE 13410M001	4833519.93331	41537.48820	4147461.77416	W	GRE
180	ELGE 19353S001	4657557.33962	-202241.37572	4338991.94492	A	GRE
182	EMAZ 17001M001	4645924.15939	-276949.77558	4347759.62931	A	GR
209	GERN 19389M001	4642811.26509	-217222.83147	4353278.93429	A	GR
257	HOND 15012M002	4640529.26074	-145675.88985	4358781.81260	A	GRE
235	IGEL 19352S001	4645951.37290	-165574.40832	4352550.47945	A	GRE
240	ISPS 19484M001	4640596.42545	-206963.68198	4356391.97392	A	GRE
245	KAST 19499M001	4646949.02119	-240747.17374	4348015.04982	A	GR
252	LARE 19440M001	4632831.90279	-279026.05004	4360314.48618	A	GRE
256	LAZK 19354S001	4666098.28720	-178186.09644	4330463.73011	A	GRE
261	LEIT 19428M001	4663520.88140	-155858.62471	4334519.94442	A	GRE
334	ORND 19427M001	4659695.72145	-130864.64000	4338948.94162	A	GRE
493	PASA 19351S001	4644909.00376	-156644.97471	4353623.13439	A	GRE
553	RID1 13448M002	4708447.77250	-199490.18747	4284089.79393	A	GRE
558	SALA 13469M001	4803054.43556	-462130.97475	4158379.13702	A	GR
526	SCDA 10088M002	4639940.44892	-136224.84827	4359552.48094	W	GRE
715	SOPU 19386M001	4643997.85258	-255913.81264	4350063.19748	W	GR
493	VITO 19385M001	4679397.64609	-218436.40963	4314899.42665	A	GR
616	YEBE 13420M001	4848724.51707	-261631.83171	4123094.38878	W	GRE
655	ZARA 13462M001	4773803.11331	-73505.88843	4215454.15440	W	GRE

### 5.2 ETRF2000 (ETRS89) Coordinates

European Terrestrial Reference System, 1989 (ETRS89) is realized by ETRF2000 (Boucher and Altamimi, 2011) and (Altamimi, 2017).

CONVERT TO ETRF2000 04-JUL-24 10:33

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LOCAL GEODETIC DATUM: ETRF2000 EPOCH: 2024-06-05 11:59:45

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG	SYSTEM
111	ACOR 13434M001	4594489.86239	-678367.95089	4357065.84936	W	
39	ALDA 19383M001	4687280.51316	-190877.11838	4308106.53504	A	
50	ALSA 19419M001	4677251.19037	-176770.94470	4319079.45674	A	
53	AMUR 19388M001	4661499.79579	-244591.80525	4332269.46025	A	
384	BLAZ 10074M002	4634456.41157	-124345.52044	4365785.03618	W	
101	BIDA 00000M000	4644178.17722	-145778.86887	4354832.05791	A	
113	BRZR 19387M001	4662221.34124	-220770.44617	4333309.01576	A	
573	CACE 13447M001	4899866.79499	-544567.61413	4033769.76188	W	
592	CANT 13438M001	4625924.65790	-307096.78143	4365771.14022	W	
908	CREU 13432M001	4715420.53396	273177.50689	4271946.42361	W	
135	EBRE 13410M001	4833520.35866	41536.82489	4147461.28333	W	
180	ELGE 19353S001	4657557.74735	-202242.01856	4338991.46613	A	
182	EMAZ 17001M001	4645924.55766	-276950.41720	4347759.15049	A	
209	GERN 19389M001	4642811.67194	-217223.47255	4353278.45658	A	
257	HOND 15012M002	4640529.67778	-145676.53046	4358781.33610	A	
235	IGEL 19352S001	4645951.78672	-165575.04965	4352550.00220	A	
240	ISPS 19484M001	4640596.83395	-206964.32277	4356391.49655	A	
245	KAST 19499M001	4646949.42441	-240747.81539	4348014.57142	A	
252	LARE 19440M001	4632832.30179	-279026.69006	4360314.00848	A	
256	LAZK 19354S001	4666098.69752	-178186.74024	4330463.25091	A	
261	LEIT 19428M001	4663521.29509	-155859.26815	4334519.46576	A	
334	ORND 19427M001	4659696.13890	-130865.28289	4338948.46365	A	
493	PASA 19351S001	4644909.41889	-156645.61588	4353622.65735	A	
553	RID1 13448M002	4708447.17615	-199490.83646	4284089.31072	A	
558	SALA 13469M001	4803054.79322	-462131.63572	4158378.64178	A	
526	SCDA 10088M002	4639940.86731	-136225.48878	4359552.00462	W	
715	SOPU 19386M001	4643998.25390	-255914.45396	4350062.71913	W	
493	VITO 19385M001	4679398.04966	-218437.05516	4314899.94572	A	
616	YEBE 13420M001	4848724.89918	-261632.49775	4123093.89237	W	
655	ZARA 13462M001	4773803.52854	-73506.54494	4215453.66722	W	

### 5.3 ETRF2014 (ETRS89) Coordinates

European Terrestrial Reference System, 1989 (ETRS89) is realized by ETRF2014 (Boucher and Altamimi, 2011) and (Altamimi, 2017).

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CONVERT TO ETRF2014                                04-JUL-24 10:33
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LOCAL GEODETIC DATUM: ETRF2014                    EPOCH: 2024-06-05 11:59:45
NUM  STATION NAME      X (M)      Y (M)      Z (M)  FLAG  SYSTEM
111  ACDR 13434M001    4594489.82246 -678367.98765 4357065.90190  W
 39  ALDA 19383M001    4687280.47070 -190877.15656 4308106.58745  A
 50  ALSA 19419M001    4677251.14797 -176770.98298 4319079.50918  A
 53  AMUR 19388M001    4661499.75380 -244591.84335 4332269.51271  A
384  BIAZ 10074M002    4634456.36946 -124345.55911 4365785.08879  W
101  BIDA 00000M000    4644178.13508 -145778.90742 4354832.11048  A
113  BRZR 19387M001    4662221.29916 -220770.48435 4333309.06822  A
 573  CACE 13447M001    4899866.75115 -544567.65001 4033769.81357  W
 592  CANT 13438M001    4625924.61651 -307096.81946 4365771.19276  W
 908  CREU 13432M001    4715420.48938  273177.46711 4271946.47627  W
135  EBRE 13410M001    4833520.31365  41536.78651 4147461.33546  W
180  ELGE 19353S001    4657557.70526 -202242.05683 4338991.51863  A
182  EMAZ 17001M001    4645924.51596 -276950.45525 4347759.20298  A
209  GERN 19389M001    4642811.63006 -217223.51084 4353278.50912  A
257  HOND 15012M002    4640529.63568 -145676.56902 4358781.38868  A
235  IGEL 19352S001    4645951.74463 -165575.08811 4352550.05475  A
240  ISPS 19484M001    4640596.79206 -206964.36110 4356391.54910  A
245  KAST 19499M001    4646949.38257 -240747.85357 4348014.62393  A
252  LARE 19440M001    4632832.26023 -279026.72816 4360314.06101  A
256  LAZK 19354S001    4666098.65524 -178186.77857 4330463.30339  A
261  LEIT 19428M001    4663521.25277 -155859.30657 4334519.51826  A
334  ORON 19427M001    4659696.09653 -130865.32143 4338948.51617  A
493  PASA 19351S001    4644909.37677 -156645.65438 4353622.70991  A
553  RIO1 13448M002    4708447.13348 -199490.87451 4284089.36306  A
558  SALA 13469M001    4803054.75030 -462131.67236 4158378.69374  A
526  SOGA 10088M002    4639940.82518 -136225.52738 4359552.05721  W
715  SOPU 19386M001    4643998.21214 -255914.49210 4350062.77164  W
493  VITO 19385M001    4679398.00739 -218437.09327 4314897.99814  A
616  YEBE 13420M001    4848724.85509 -261632.53493 4123093.94427  W
655  ZARA 13462M001    4773803.48466 -73506.58317 4215453.71944  W

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## 6 Quality Control

### 6.1 Mean and Daily Repeatabilities

In this section, the mean and daily repeatabilities of the sites are shown. Repeatabilities refer to the IGS20 solution and are given with respect to the Local frame (North-East-Up).

GFA FINAL WEEKLY COMBINATION: FINAL ORBITS 04-JUL-24 10:33

Station	#Days	Weekday 0123456	Repeatability (mm)		
			N	E	U
ACOR 13434M001	2	XX	0.88	2.11	7.37
ALDA 19383M001	5	XXXX X	0.81	0.68	4.39
ALSA 19419M001	7	XXXXXX	0.59	0.72	2.05
AMUR 19388M001	7	XXXXXX	0.55	1.08	5.65
BIAZ 10074M002	7	XXXXXX	0.81	0.70	3.37
BIDA 00000M000	7	XXXXXX	0.92	0.81	2.87
BRZR 19387M001	7	XXXXXX	0.64	1.00	3.33
CACE 13447M001	7	XXXXXX	0.78	1.33	3.24
CANT 13438M001	7	XXXXXX	0.58	0.54	4.82
CREU 13432M001	7	XXXXXX	1.06	1.48	1.89
EBRE 13410M001	7	XXXXXX	0.68	1.02	3.02
ELGE 19353S001	7	XXXXXX	0.60	0.66	1.99
EMAZ 17001M001	7	XXXXXX	1.49	1.35	2.02
GERN 19389M001	7	XXXXXX	1.28	0.98	2.69
HOND 15012M002	7	XXXXXX	0.46	0.85	2.07
IGEL 19352S001	7	XXXXXX	0.73	0.84	2.15
ISPS 19484M001	7	XXXXXX	0.62	0.70	2.59
KAST 19499M001	7	XXXXXX	0.88	0.72	3.74
LARE 19440M001	7	XXXXXX	0.57	0.67	2.36
LAZK 19354S001	7	XXXXXX	0.96	1.11	2.83
LEIT 19428M001	7	XXXXXX	0.87	0.68	1.60
ORON 19427M001	7	XXXXXX	0.53	0.54	2.59
PASA 19351S001	7	XXXXXX	0.91	0.97	2.01
RI01 13448M002	7	XXXXXX	0.50	0.77	4.27
SALA 13469M001	5	XXXX	0.79	0.93	3.53
SCDA 10088M002	7	XXXXXX	0.88	1.43	2.18
SOPU 19386M001	7	XXXXXX	0.63	0.97	3.37
VITD 19385M001	7	XXXXXX	0.54	0.62	2.49
YEBE 13420M001	7	XXXXXX	0.80	0.61	1.84
ZARA 13462M001	7	XXXXXX	0.78	0.91	3.35

Comparison of individual solutions:

ACOR 13434M001	N	0.88	-0.42	0.77					
ACOR 13434M001	E	2.11	0.23	2.10					
ACOR 13434M001	U	7.37	0.97	-7.30					
ALDA 19383M001	N	0.81	0.17	1.05	0.61	-0.64			0.83
ALDA 19383M001	E	0.68	0.34	0.56	0.80	0.52			-0.72
ALDA 19383M001	U	4.39	-2.64	-2.20	-1.59	5.62			5.59
ALSA 19419M001	N	0.59	-0.83	0.44	0.10	0.70	0.11	0.82	0.19
ALSA 19419M001	E	0.72	0.27	-0.25	1.50	0.05	0.05	0.83	0.10
ALSA 19419M001	U	2.05	-0.86	-2.88	-0.87	1.69	0.40	1.48	3.19
AMUR 19388M001	N	0.55	-0.39	-0.32	-0.28	-0.29	0.38	0.41	1.04
AMUR 19388M001	E	1.08	0.58	0.46	-0.54	0.02	0.29	1.48	1.98
AMUR 19388M001	U	5.65	-0.45	-0.40	-8.48	1.04	-0.74	3.10	10.41
BIAZ 10074M002	N	0.81	0.63	-0.04	0.18	0.65	1.19	0.28	-1.24
BIAZ 10074M002	E	0.70	0.30	0.50	0.43	0.97	0.89	0.75	-0.27
BIAZ 10074M002	U	3.37	-1.39	-0.13	-1.37	-4.60	-0.00	2.38	6.12
BIDA 00000M000	N	0.92	0.58	0.82	-0.79	-1.00	1.12	1.08	-0.24
BIDA 00000M000	E	0.81	-0.44	0.09	0.47	1.02	1.35	0.83	0.13
BIDA 00000M000	U	2.87	-2.27	-1.08	0.05	1.82	-0.19	-2.28	5.89
BRZR 19387M001	N	0.64	-0.11	-0.04	0.54	0.98	0.29	-0.15	1.04
BRZR 19387M001	E	1.00	-0.45	1.24	0.09	1.20	-0.78	1.15	0.91
BRZR 19387M001	U	3.33	-2.45	1.67	-1.82	-1.08	-3.87	2.10	5.81
CACE 13447M001	N	0.78	1.11	-0.44	-0.49	-0.65	-0.21	-1.06	-0.67
CACE 13447M001	E	1.33	0.57	-2.30	1.07	-0.07	0.66	0.56	-1.75
CACE 13447M001	U	3.24	2.03	1.81	-5.59	-3.34	2.24	-2.79	0.72
CANT 13438M001	N	0.58	-0.19	-0.31	-0.84	0.53	0.68	0.66	0.20
CANT 13438M001	E	0.54	0.01	0.05	0.66	0.00	0.26	1.13	-0.01
CANT 13438M001	U	4.82	4.37	1.78	-7.15	-1.34	-5.08	5.56	2.78
CREU 13432M001	N	1.06	0.08	2.36	0.30	0.31	-0.77	0.62	0.19
CREU 13432M001	E	1.48	-0.82	-0.76	0.31	0.57	1.09	2.21	2.30
CREU 13432M001	U	1.89	-2.41	1.01	1.72	1.48	2.26	1.86	-0.87
EBRE 13410M001	N	0.68	0.33	0.93	0.99	0.84	-0.09	-0.03	0.38
EBRE 13410M001	E	1.02	0.57	-0.33	1.59	1.08	-0.24	1.13	0.84
EBRE 13410M001	U	3.02	4.78	-3.37	2.86	3.00	-0.07	-1.25	-1.37
ELGE 19353S001	N	0.60	-0.00	0.52	0.27	-0.42	0.68	0.88	0.64
ELGE 19353S001	E	0.66	0.30	0.73	0.70	0.75	0.25	0.88	-0.28
ELGE 19353S001	U	1.99	-2.72	-0.77	-1.23	-0.23	-0.06	2.01	3.17
EMAZ 17001M001	N	1.49	-0.25	-1.48	1.69	1.88	2.04	0.56	-0.45
EMAZ 17001M001	E	1.35	0.02	-1.13	1.66	2.14	0.87	0.86	-0.92
EMAZ 17001M001	U	2.02	-2.70	1.76	-0.72	-1.59	1.39	-0.39	3.01
GERN 19389M001	N	1.28	-1.17	-1.53	-0.39	1.00	0.95	0.92	1.78
GERN 19389M001	E	0.98	1.06	1.57	0.01	-0.83	0.13	0.06	1.21
GERN 19389M001	U	2.69	-1.70	-0.48	-4.52	-0.63	-0.91	0.93	4.22
HOND 15012M002	N	0.46	-0.32	0.69	-0.02	0.70	-0.05	0.42	0.19
HOND 15012M002	E	0.85	-0.23	0.64	0.07	0.94	0.84	1.47	-0.31
HOND 15012M002	U	2.07	-2.18	-1.27	0.76	2.18	1.94	-1.90	2.58
IGEL 19352S001	N	0.73	0.50	-0.75	-0.25	0.11	-0.24	0.87	1.24
IGEL 19352S001	E	0.84	0.26	-0.22	1.09	-0.04	0.76	1.54	-0.04
IGEL 19352S001	U	2.15	1.01	-1.90	-1.87	3.97	1.37	-1.21	0.71
ISPS 19484M001	N	0.62	0.87	0.26	-0.09	0.02	1.13	-0.36	-0.17
ISPS 19484M001	E	0.70	0.23	0.20	1.37	0.90	-0.03	0.33	0.27
ISPS 19484M001	U	2.59	0.68	-2.41	-4.18	0.62	-0.44	-1.26	3.78
KAST 19499M001	N	0.88	-0.72	-0.61	0.21	0.29	-0.06	0.73	1.75
KAST 19499M001	E	0.72	-0.42	0.76	0.25	1.25	0.48	0.63	0.34
KAST 19499M001	U	3.74	4.18	-1.03	-4.86	-2.82	-3.96	1.00	4.17
LARE 19440M001	N	0.57	0.48	-0.58	0.94	0.55	0.15	0.39	0.23
LARE 19440M001	E	0.67	0.55	0.26	0.93	0.85	-0.52	0.62	-0.31
LARE 19440M001	U	2.36	1.29	-1.78	-2.55	0.69	-1.63	4.05	1.58
LAZK 19354S001	N	0.96	-1.45	0.59	-0.29	0.38	1.63	0.32	0.26
LAZK 19354S001	E	1.11	1.96	-0.12	0.74	-1.42	0.03	0.84	0.54
LAZK 19354S001	U	2.83	-1.41	2.20	-3.84	-0.75	0.93	0.00	5.01
LEIT 19428M001	N	0.87	1.26	1.13	-0.40	-0.57	0.45	0.33	-0.96

LEIT 19428M001	E	0.68	0.52	0.18	1.26	-0.24	0.27	0.88	-0.10
LEIT 19428M001	U	1.60	-0.65	0.89	-2.53	1.34	1.98	0.20	1.43
ORDN 19427M001	N	0.53	0.22	-0.24	-0.48	-0.84	0.26	0.70	0.25
ORDN 19427M001	E	0.54	-0.18	0.92	0.78	0.18	0.25	-0.42	-0.05
ORDN 19427M001	U	2.59	2.79	2.73	1.54	-0.69	-1.14	-0.44	4.54
PASA 19351S001	N	0.91	0.84	0.57	-0.82	-0.75	1.63	0.09	0.11
PASA 19351S001	E	0.97	-0.73	0.42	1.09	0.12	0.40	1.87	0.08
PASA 19351S001	U	2.01	1.30	-0.79	-0.75	3.37	-2.36	-0.33	2.11
RID1 13448M002	N	0.50	-0.25	0.40	0.42	-0.28	0.30	0.95	0.16
RID1 13448M002	E	0.77	0.61	0.71	0.85	0.31	0.84	0.39	-1.02
RID1 13448M002	U	4.27	1.85	-0.48	-5.97	-3.69	2.51	1.15	6.98
SALA 13469M001	N	0.79	-0.76	-0.67	0.35	-1.04	0.50		
SALA 13469M001	E	0.93	0.33	0.16	1.18	0.29	1.36		
SALA 13469M001	U	3.53	-5.86	-0.49	0.43	-1.01	3.74		
SCDA 10088M002	N	0.88	-0.86	-0.12	0.40	0.77	1.08	1.36	-0.28
SCDA 10088M002	E	1.43	-1.45	-0.09	1.97	1.60	1.90	0.32	0.18
SCDA 10088M002	U	2.18	-1.96	0.62	-2.05	1.67	1.74	0.98	3.64
SOPU 19386M001	N	0.63	0.74	-0.16	0.20	0.08	1.26	-0.38	-0.13
SOPU 19386M001	E	0.97	-0.36	0.67	0.88	0.89	-0.97	0.83	1.38
SOPU 19386M001	U	3.37	-4.69	-1.33	-3.11	-2.76	3.67	1.01	3.53
VITO 19385M001	N	0.54	-0.50	0.69	0.27	0.88	0.38	-0.01	0.21
VITO 19385M001	E	0.62	0.29	0.23	0.13	0.66	0.02	1.20	0.50
VITO 19385M001	U	2.49	-0.34	-1.65	-2.23	1.48	0.46	3.60	3.74
YEBE 13420M001	N	0.80	-0.76	0.11	-1.61	0.16	0.60	0.51	-0.03
YEBE 13420M001	E	0.61	0.47	0.31	0.52	1.07	0.64	0.14	0.30
YEBE 13420M001	U	1.84	-1.30	-1.80	0.25	3.10	0.01	-2.34	0.49
ZARA 13462M001	N	0.78	-0.19	-0.36	0.64	-0.60	1.46	-0.73	0.21
ZARA 13462M001	E	0.91	-0.07	-0.34	1.15	-0.44	0.26	0.78	1.63
ZARA 13462M001	U	3.35	-4.74	0.69	1.99	4.51	-1.58	3.88	-1.62



## 6.2 Datum verification

In this section, the datum verification is shown. A 3 parameter Helmert 3D (3 translations) is computed to the minimally constrained sites.

TRANSFORMATION IN EQUATORIAL SYSTEM (X, Y, Z):  
RESIDUALS IN LOCAL SYSTEM (NORTH, EAST, UP)

LIST OF REMOVED STATIONS:

OUTLIER CRITERIA:                   15.00   15.00   20.00

ITERATION   1: CREU 13432M001       -4.65   -18.30   -29.69

ITERATION   2: ACDR 13434M001        7.34   -21.36    3.91

NUM	NAME	FLG	RESIDUALS IN MILLIMETERS		
1	ACDR 13434M001	I W	7.53	-21.92	4.01
2	ALAC 13433M001	I W	0.00	-0.80	-2.33
3	ALME 13437M001	I W	-0.79	-0.31	1.14
4	BCL1 19482M001	I W	-0.42	-1.44	4.25
5	BELL 13431M001	I W	-0.53	0.27	5.64
6	BIAZ 10074M002	I W	0.50	0.55	-0.15
7	BORR 13480M001	I W	-2.62	-0.07	2.78
8	BRST 10004M004	I W	-1.75	-1.65	2.85
9	CACE 13447M001	I W	0.53	1.94	2.09
10	CANT 13438M001	I W	-0.08	1.34	-0.20
11	CASC 13909S001	I W	1.21	-0.44	4.12
12	CEU1 13449M002	I W	-0.31	-0.54	-3.82
13	CREU 13432M001	A W	-4.50	-19.30	-30.44
14	EBRE 13410M001	I W	0.08	1.40	3.12
16	FLRS 31907M001	I W	-0.94	-2.80	-8.25
17	FUER 31330M001	I W	0.84	-0.58	-2.75
19	HUEL 13451M001	I W	2.21	3.49	-9.83
20	IBIZ 13454S001	I W	-0.80	0.21	3.07
21	IZAN 31309M002	I W	-0.32	-0.67	-4.32
22	LAGO 13903M001	I W	0.74	0.44	-0.71
23	LLIV 13436M001	I W	-3.19	0.37	5.14
24	LPAL 81701M001	I W	2.38	-0.08	-6.43
25	LROC 10023M001	I W	1.06	-0.56	2.77
26	MADR 13407S012	I W	1.27	2.68	-4.68
27	MAL1 13444M002	I W	2.74	-1.58	-0.48
28	MALA 13443M001	I W	1.92	-2.03	1.59
29	MALL 13444M001	I W	-0.92	-0.76	4.21
30	MAS1 31303M002	I W	-0.56	-1.67	2.01
31	MELI 19379M001	I W	0.29	-0.38	-2.07
32	PDEL 31906M004	I W	-0.67	-0.22	2.60
33	RABT 35001M002	I W	0.74	-2.02	-7.59
34	SCOA 10088M002	I W	-2.57	-0.25	-9.01
35	SFER 13402M004	I W	-2.48	-3.38	-0.35
36	SOPU 19386M001	I W	-0.51	0.86	2.28
37	VALE 13439M001	I W	-1.24	1.06	-4.47
38	VIGO 13450M001	I W	1.16	2.04	2.74
39	VILL 13406M001	I W	-1.29	-0.42	0.37
40	YEBE 13420M001	I W	-0.30	-0.36	4.03
41	ZARA 13462M001	I W	-1.00	-0.86	-0.42
42	ZIMM 14001M004	I W	-0.73	-1.42	10.36
RMS / COMPONENT			1.40	1.45	4.49
IQR			1.66	1.30	5.59
MEAN			-0.17	-0.23	-0.02
MEDIAN			-0.31	-0.37	0.76
MIN			-3.19	-3.38	-9.83
MAX			2.74	3.49	10.36
OVERALL RMS/IQR/MAX(3D)			2.84	2.27	10.66
					HUEL 13451M001 #SUM
ALL RMS / COMPONENT			1.96	4.88	6.58
ALL IQR			1.72	1.84	6.24
ALL MEAN			-0.08	-1.25	-0.68
ALL MEDIAN			-0.31	-0.40	0.76
ALL MIN			-4.50	-21.92	-30.44
ALL MAX			7.53	3.49	10.36
OVERALL RMS/IQR/MAX(3D)			4.87	2.66	36.32
					CREU 13432M001 #SUM_ALL

NUMBER OF PARAMETERS : 3  
NUMBER OF STATIONS : 38  
NUMBER OF COORDINATES : 114  
RMS OF TRANSFORMATION : 2.84 MM

PARAMETERS:

TRANSLATION IN X : 0.59 +- 0.46 MM  
TRANSLATION IN Y : 1.05 +- 0.46 MM  
TRANSLATION IN Z : 0.39 +- 0.46 MM

NUMBER OF ITERATIONS : 3

ACCEPTED STATIONS : 38 95.00 %  
VERIFIED STATIONS : 0 0.00 %  
REJECTED STATIONS : 2 5.00 %

LIST OF VERIFIED/REJECTED STATIONS

### 6.3 Adjustment Statistics

In this section, the summary of the global adjustment and not subnetworks are shown. Also, the Helmert parameters of the combined solution with respect to the daily solutions are shown.

```
* STATISTICAL PARAMETER-----VALUE(S)-----
NUMBER OF OBSERVATIONS          19143219
NUMBER OF UNKNOWN(S)           192221
NUMBER OF DEGREES OF FREEDOM    18950998
PHASE MEASUREMENTS SIGMA       0.00100
SAMPLING INTERVAL (SECONDS)     180
VARIANCE FACTOR                 2.147500430648643
```

## 7 Equipment

### 7.1 Receiver List

Serial numbers not shown.

```
*SITE PT SOLN T DATA_START_ DATA_END_ DESCRIPTION----- S/N_ FIRMWARE___
ACOR A 1 P 24:154:00000 24:155:86370 LEICA GR50 -----
ALDA A 1 P 24:154:00000 24:160:86370 LEICA GR30 -----
ALSA A 1 P 24:154:00000 24:160:86370 LEICA GR50 -----
AMUR A 1 P 24:154:00000 24:160:86370 LEICA GR30 -----
BIAZ A 1 P 24:154:00000 24:160:86370 SPECTRA SP90M -----
BIDA A 1 P 24:154:00000 24:160:86370 LEICA GR10 -----
BRZR A 1 P 24:154:00000 24:160:86370 LEICA GR30 -----
CACE A 1 P 24:154:00000 24:160:86370 TRIMBLE NETR9 -----
CANT A 1 P 24:154:00000 24:160:86370 LEICA GR10 -----
CREU A 1 P 24:154:00000 24:160:86370 LEICA GR50 -----
EBRE A 1 P 24:154:00000 24:160:86370 LEICA GR50 -----
ELGE A 1 P 24:154:00000 24:160:86370 LEICA GR30 -----
EMAZ A 1 P 24:154:00000 24:160:86370 LEICA GR30 -----
GERN A 1 P 24:154:00000 24:160:86370 LEICA GR30 -----
HOND A 1 P 24:154:00000 24:160:86370 LEICA GR50 -----
IGEL A 1 P 24:154:00000 24:160:86370 LEICA GR30 -----
ISPS A 1 P 24:154:00000 24:160:86370 TRIMBLE NETR9 -----
KAST A 1 P 24:154:00000 24:160:86370 LEICA GR30 -----
LARE A 1 P 24:154:00000 24:160:86370 LEICA GR50 -----
LAZK A 1 P 24:154:00000 24:160:86370 LEICA GR30 -----
LEIT A 1 P 24:154:00000 24:160:86370 LEICA GR50 -----
ORON A 1 P 24:154:00000 24:160:86370 LEICA GR50 -----
PASA A 1 P 24:154:00000 24:160:86370 LEICA GR30 -----
RI01 A 1 P 24:154:00000 24:160:86370 LEICA GR25 -----
SALA A 1 P 24:154:00000 24:158:86370 LEICA GR50 -----
SCDA A 1 P 24:154:00000 24:160:86370 LEICA GR50 -----
SOPU A 1 P 24:154:00000 24:160:86370 LEICA GR30 -----
VITO A 1 P 24:154:00000 24:160:86370 LEICA GR30 -----
YEBE A 1 P 24:154:00000 24:160:86370 LEICA GR50 -----
ZARA A 1 P 24:154:00000 24:160:86370 TRIMBLE NETR9 -----
```

### 7.2 Antennas

Serial number ONLY provided in case individual calibrations are used.

```
*SITE PT SOLN T DATA_START_ DATA_END_ DESCRIPTION----- S/N_ DAZI
ACOR A 1 P 24:154:00000 24:155:86370 LEIAT504 LEIS -----
ALDA A 1 P 24:154:00000 24:160:86370 LEIAS10 NONE -----
ALSA A 1 P 24:154:00000 24:160:86370 LEIAR10 NONE -----
AMUR A 1 P 24:154:00000 24:160:86370 LEIAS10 NONE -----
BIAZ A 1 P 24:154:00000 24:160:86370 LEIAR25 LEIT -----
BIDA A 1 P 24:154:00000 24:160:86370 LEIAS10 NONE -----
BRZR A 1 P 24:154:00000 24:160:86370 LEIAS10 NONE -----
CACE A 1 P 24:154:00000 24:160:86370 TRM29659.00 NONE -----
CANT A 1 P 24:154:00000 24:160:86370 LEIAR25_R4 LEIT -----
CREU A 1 P 24:154:00000 24:160:86370 LEIAR25_R4 NONE -----
EBRE A 1 P 24:154:00000 24:160:86370 LEIAR25_R4 NONE -----
ELGE A 1 P 24:154:00000 24:160:86370 LEIAR25_R4 LEIT -----
EMAZ A 1 P 24:154:00000 24:160:86370 LEIAS10 NONE -----
GERN A 1 P 24:154:00000 24:160:86370 LEIAS10 NONE -----
HOND A 1 P 24:154:00000 24:160:86370 LEIAR20 LEIM -----
IGEL A 1 P 24:154:00000 24:160:86370 LEIAR20 LEIM -----
ISPS A 1 P 24:154:00000 24:160:86370 TRM59900.00 SCIS -----
KAST A 1 P 24:154:00000 24:160:86370 LEIAS10 NONE -----
LARE A 1 P 24:154:00000 24:160:86370 LEIAR20 LEIM -----
LAZK A 1 P 24:154:00000 24:160:86370 LEIAR25_R4 LEIT -----
LEIT A 1 P 24:154:00000 24:160:86370 LEIAR10 NONE -----
ORON A 1 P 24:154:00000 24:160:86370 LEIAR10 NONE -----
PASA A 1 P 24:154:00000 24:160:86370 LEIAR20 LEIM -----
RI01 A 1 P 24:154:00000 24:160:86370 LEIAR25_R4 LEIT -----
SALA A 1 P 24:154:00000 24:158:86370 LEIAR25 NONE -----
SCDA A 1 P 24:154:00000 24:160:86370 TRM5971.00 NONE -----
SOPU A 1 P 24:154:00000 24:160:86370 LEIAS10 NONE -----
VITO A 1 P 24:154:00000 24:160:86370 LEIAS10 NONE -----
YEBE A 1 P 24:154:00000 24:160:86370 LEIAR20 LEIM -----
ZARA A 1 P 24:154:00000 24:160:86370 TRM29659.00 NONE -----
```

### 7.3 Eccentricities

```

*
*SITE PT SOLN T DATA_START__ DATA_END_____ AXE ARP->BENCHMARK(M)-----
ACOR A 1 P 24:154:00000 24:155:86370 UNE 3.0460 0.0000 0.0000
ALDA A 1 P 24:154:00000 24:160:86370 UNE 0.0000 0.0000 0.0000
ALSA A 1 P 24:154:00000 24:160:86370 UNE 0.0000 0.0000 0.0000
AMUR A 1 P 24:154:00000 24:160:86370 UNE 0.0000 0.0000 0.0000
BIAZ A 1 P 24:154:00000 24:160:86370 UNE 0.0000 0.0000 0.0000
BIDA A 1 P 24:154:00000 24:160:86370 UNE 0.0000 0.0000 0.0000
BRZR A 1 P 24:154:00000 24:160:86370 UNE 0.0771 0.0000 0.0000
CACE A 1 P 24:154:00000 24:160:86370 UNE 0.0600 0.0000 0.0000
CANT A 1 P 24:154:00000 24:160:86370 UNE 3.0490 0.0000 0.0000
CREU A 1 P 24:154:00000 24:160:86370 UNE 0.0770 0.0000 0.0000
EBRE A 1 P 24:154:00000 24:160:86370 UNE 0.0770 0.0000 0.0000
ELGE A 1 P 24:154:00000 24:160:86370 UNE 0.0000 0.0000 0.0000
EMAZ A 1 P 24:154:00000 24:160:86370 UNE 0.0350 0.0000 0.0000
GERN A 1 P 24:154:00000 24:160:86370 UNE 0.0771 0.0000 0.0000
HOND A 1 P 24:154:00000 24:160:86370 UNE 0.0771 0.0000 0.0000
IGEL A 1 P 24:154:00000 24:160:86370 UNE 0.0000 0.0000 0.0000
ISPS A 1 P 24:154:00000 24:160:86370 UNE 0.0350 0.0000 0.0000
KAST A 1 P 24:154:00000 24:160:86370 UNE 0.0350 0.0000 0.0000
LARE A 1 P 24:154:00000 24:160:86370 UNE 0.0000 0.0000 0.0000
LAZK A 1 P 24:154:00000 24:160:86370 UNE 0.0000 0.0000 0.0000
LEIT A 1 P 24:154:00000 24:160:86370 UNE 0.0000 0.0000 0.0000
ORDN A 1 P 24:154:00000 24:160:86370 UNE 0.0000 0.0000 0.0000
PASA A 1 P 24:154:00000 24:160:86370 UNE 0.0000 0.0000 0.0000
RI01 A 1 P 24:154:00000 24:160:86370 UNE 0.0606 0.0000 0.0000
SALA A 1 P 24:154:00000 24:158:86370 UNE 0.0600 0.0000 0.0000
SCDA A 1 P 24:154:00000 24:160:86370 UNE 0.0000 0.0000 0.0000
SOPU A 1 P 24:154:00000 24:160:86370 UNE 0.0771 0.0000 0.0000
VITO A 1 P 24:154:00000 24:160:86370 UNE 0.0000 0.0000 0.0000
YEBE A 1 P 24:154:00000 24:160:86370 UNE 0.0600 0.0000 0.0000
ZARA A 1 P 24:154:00000 24:160:86370 UNE 3.2590 0.0000 0.0000

```

## 8 References

C. Boucher and Z. Altamimi (2011): *Specifications for reference frame fixing in the analysis of a EUREF GPS campaign*. [etrs89.ensg.ign.fr/memo-V8.pdf](https://etrs89.ensg.ign.fr/memo-V8.pdf)

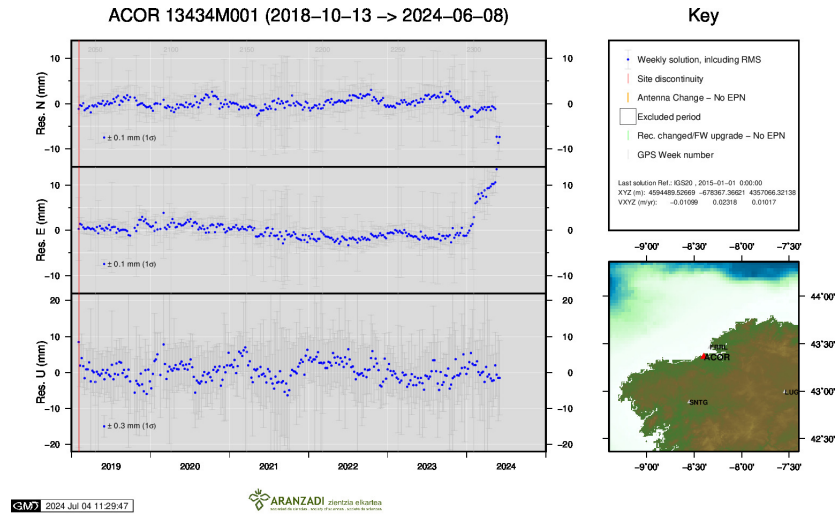
EPN Coordination Group and the EPN Central Bureau (2018): *Guidelines for the EPN Analysis Centres*. [epncb.oma.be/documentation/guidelines/guidelines\\_analysis\\_centres.pdf](https://epncb.oma.be/documentation/guidelines/guidelines_analysis_centres.pdf)

Johnston, G., Riddell, A., Hausler, G. (2017). The International GNSS Service. Teunissen, Peter J.G., Montenbruck, O. (Eds.), Springer Handbook of Global Navigation Satellite Systems (1st ed., pp. 967-982). Cham, Switzerland: Springer International Publishing. DOI: 10.1007/978-3-319-42928-1

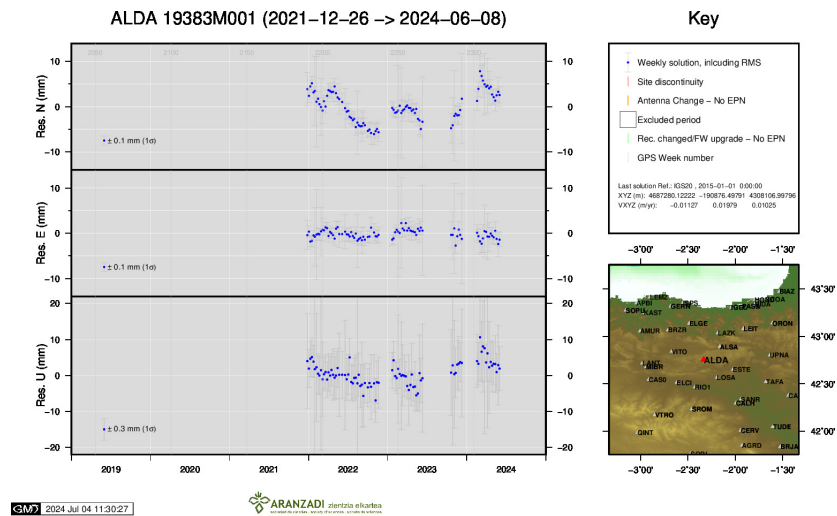
Z. Altamimi (2018): *EUREF Technical Note 1: Relationship and Transformation between the International and the European Terrestrial Reference Systems*. [etrs89.ensg.ign.fr/pub/EUREF-TN-1.pdf](https://etrs89.ensg.ign.fr/pub/EUREF-TN-1.pdf)

## 9 Cumulative Time Series

Time series of stations. Latest plots at: <http://geolabpasaia.org/gnss/ARA-net/TSeries/>, or click on the caption of each image.

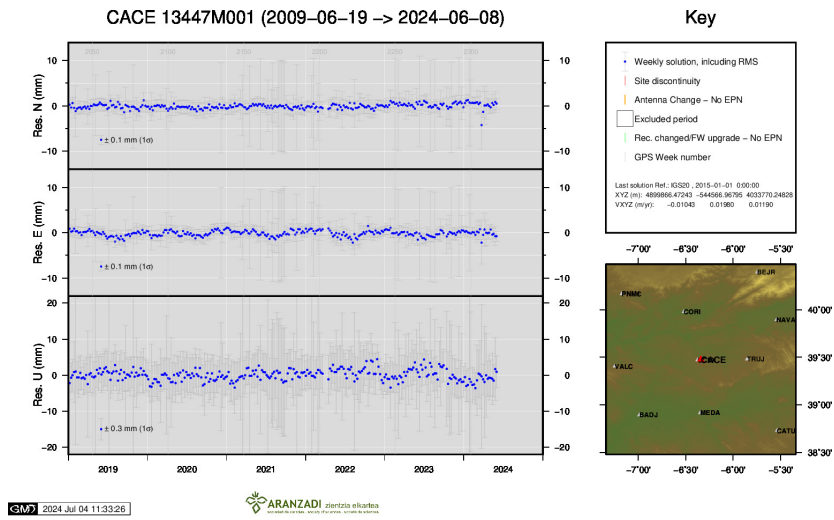


1 ) ACOR

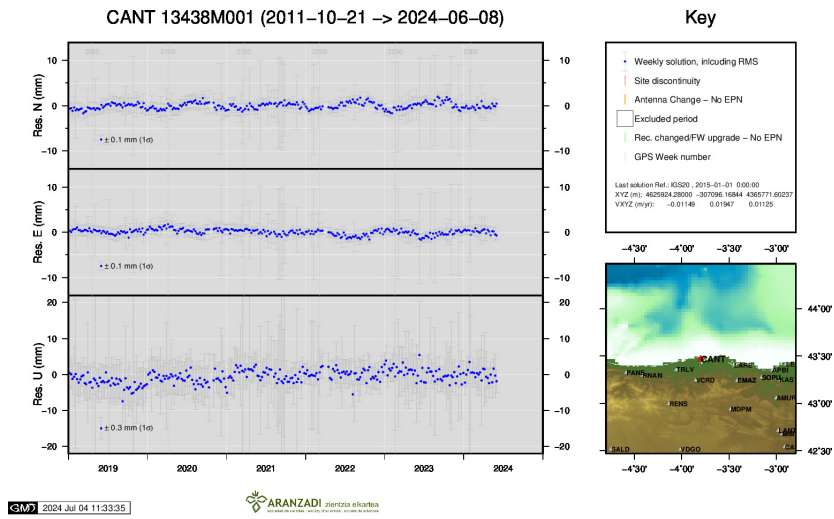


2 ) ALDA

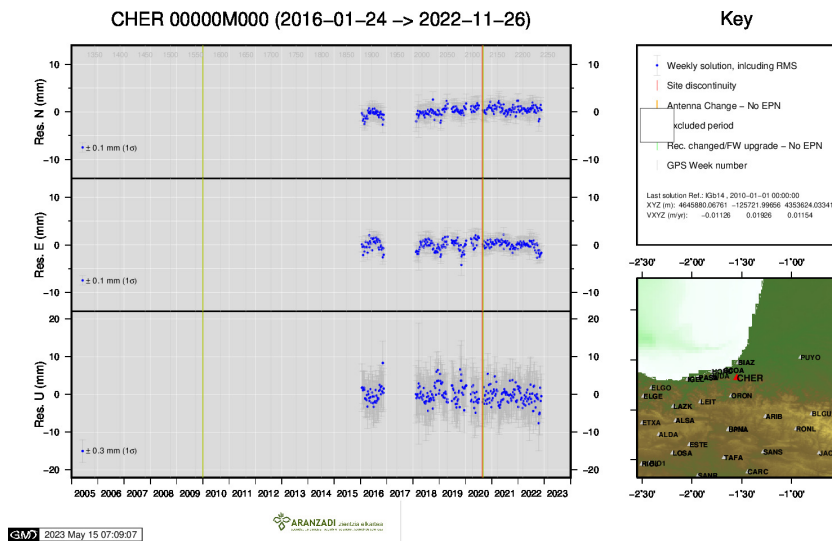




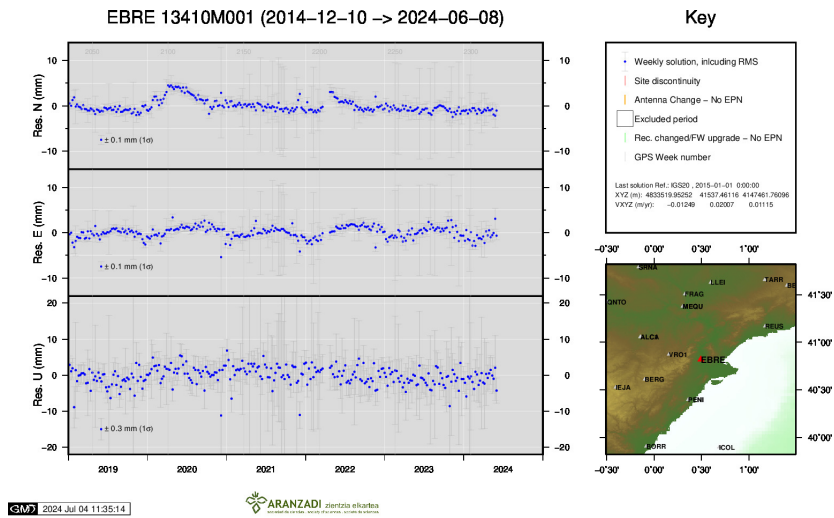
6 ) CACE



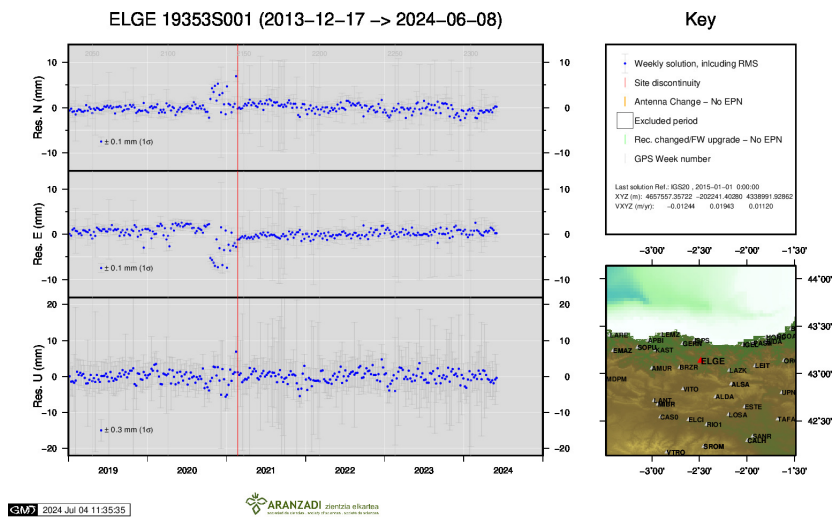
7 ) CANT



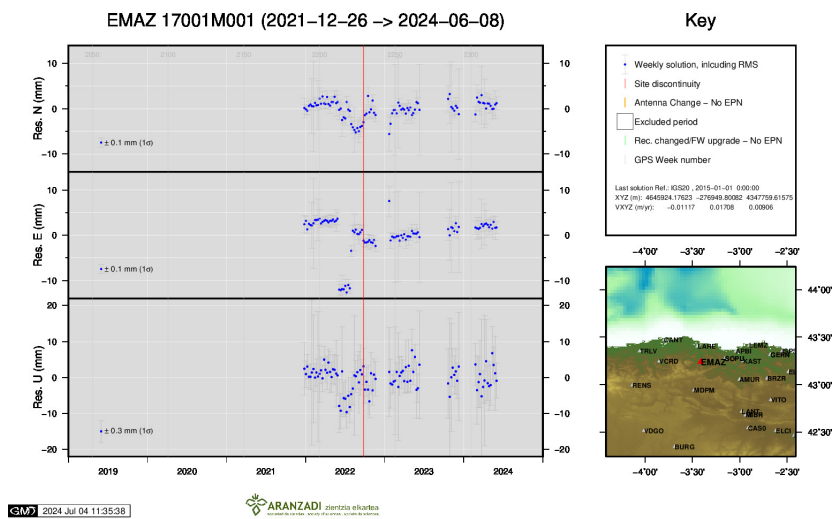
8 ) CHER



9 ) EBRE



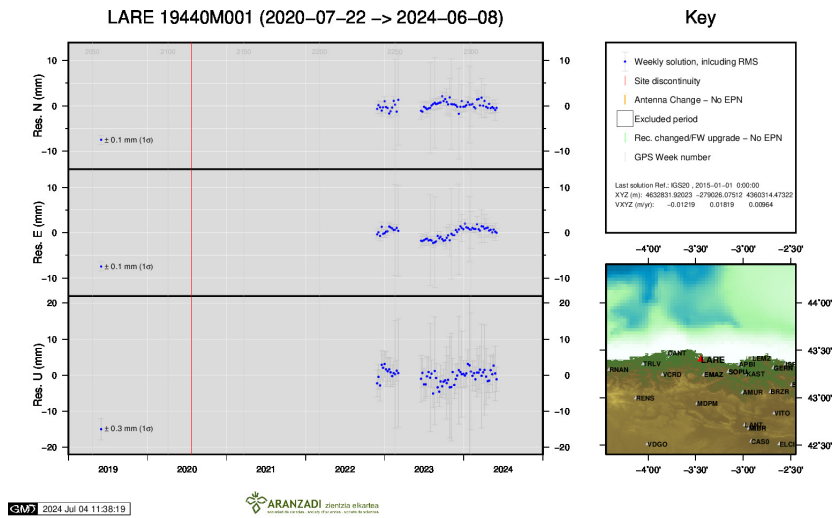
10 ) ELGE



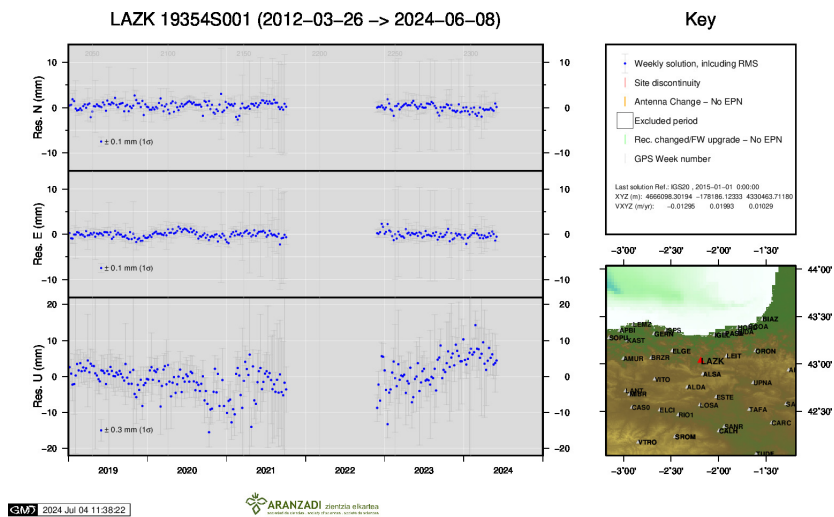
11 ) EMAZ



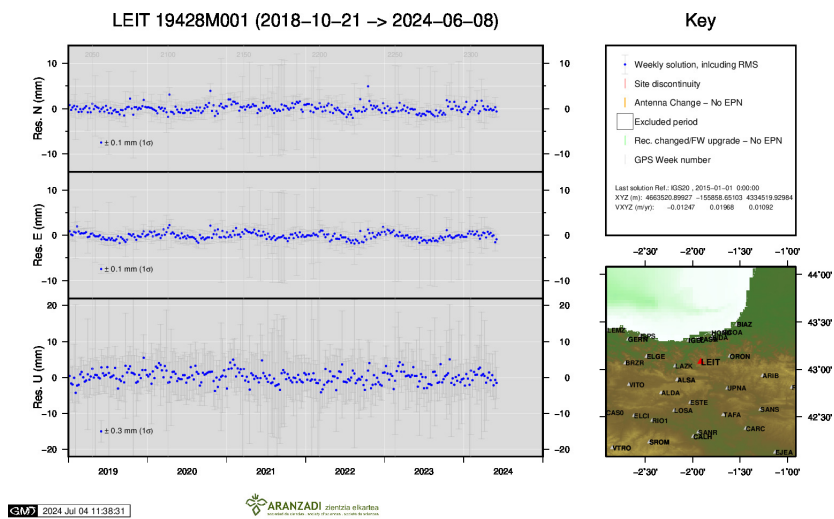




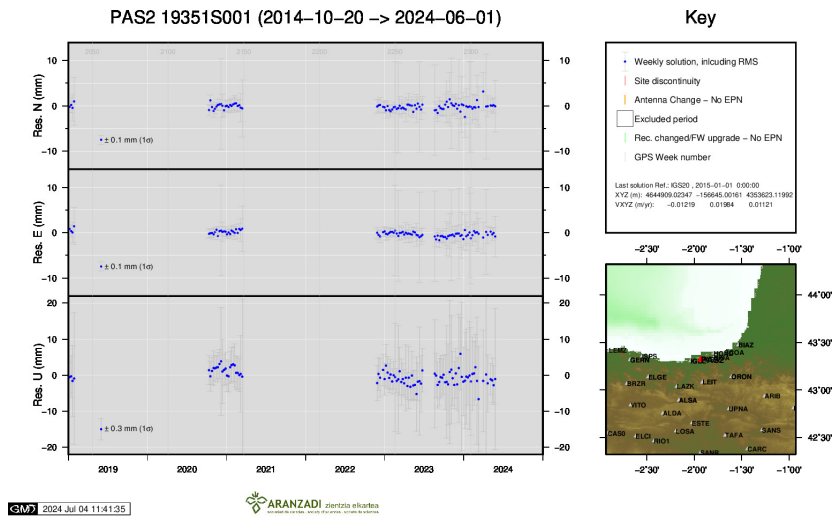
15 ) LARE



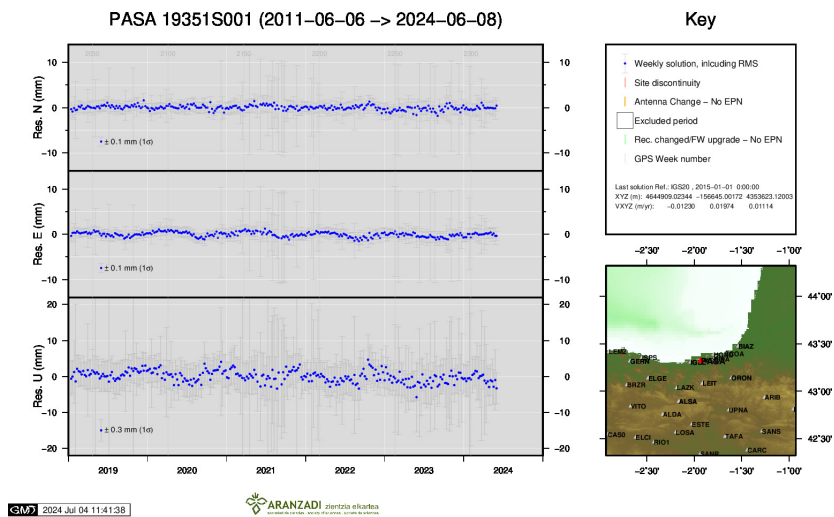
16 ) LAZK



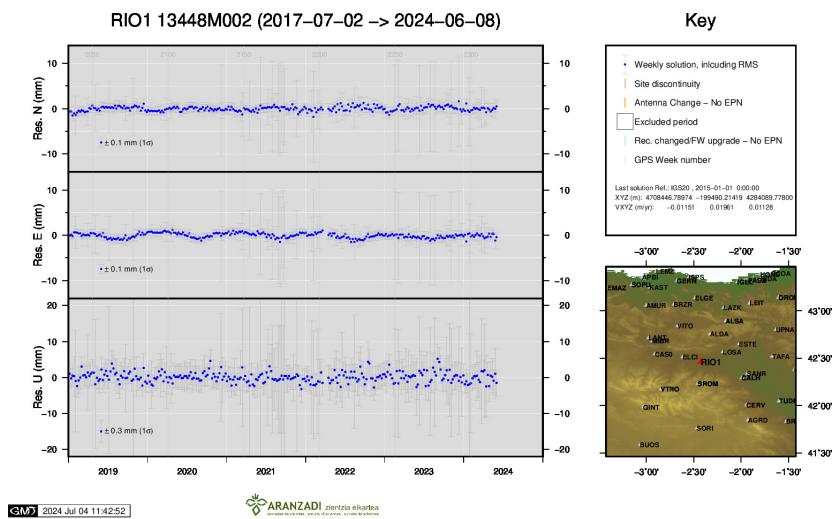
17 ) LEIT



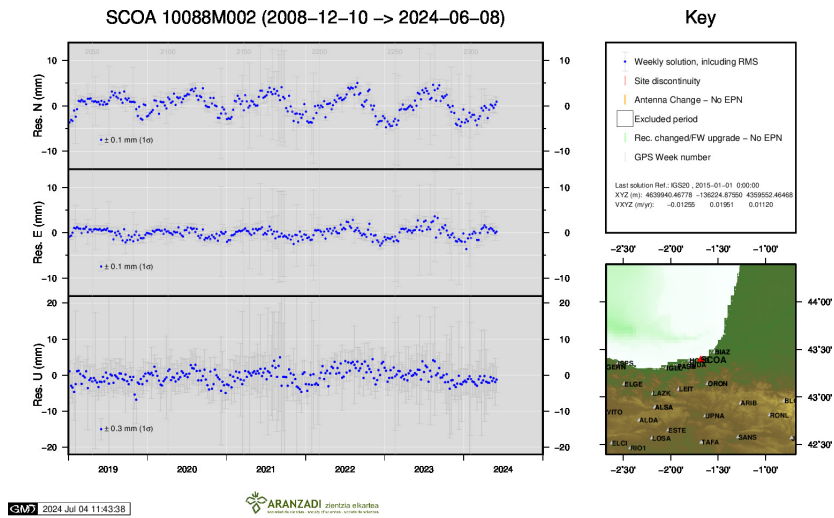
18 ) PAS2



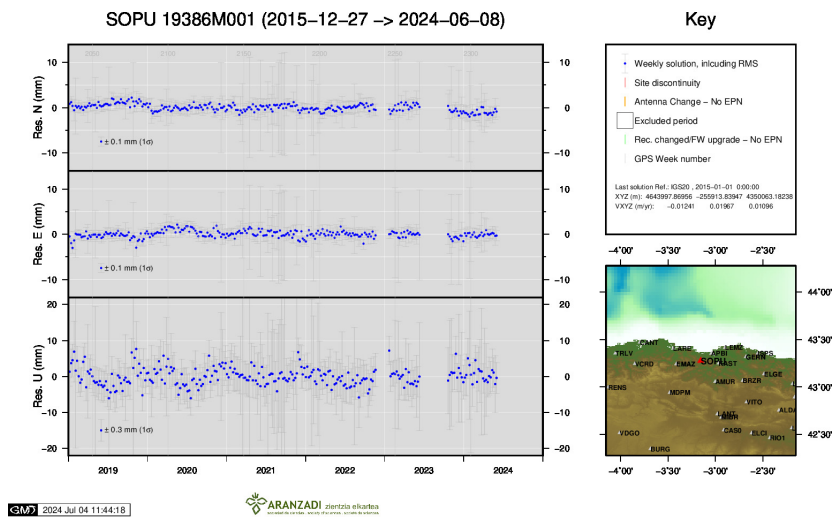
19 ) PASA



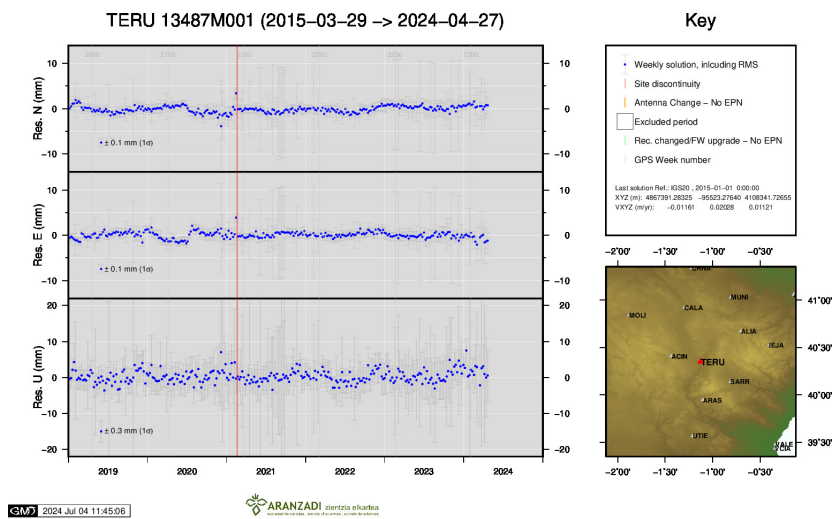
20 ) RIO1



21 ) SCOA



22 ) SOPU



23 ) TERU

