

# ARA-DAC Weekly Analysis Result: 2309 (GFA)

## Technical Report

**GPS Week: 2309 (GFA)**

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

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Report generated on 2024/05/01 at 20:23:42

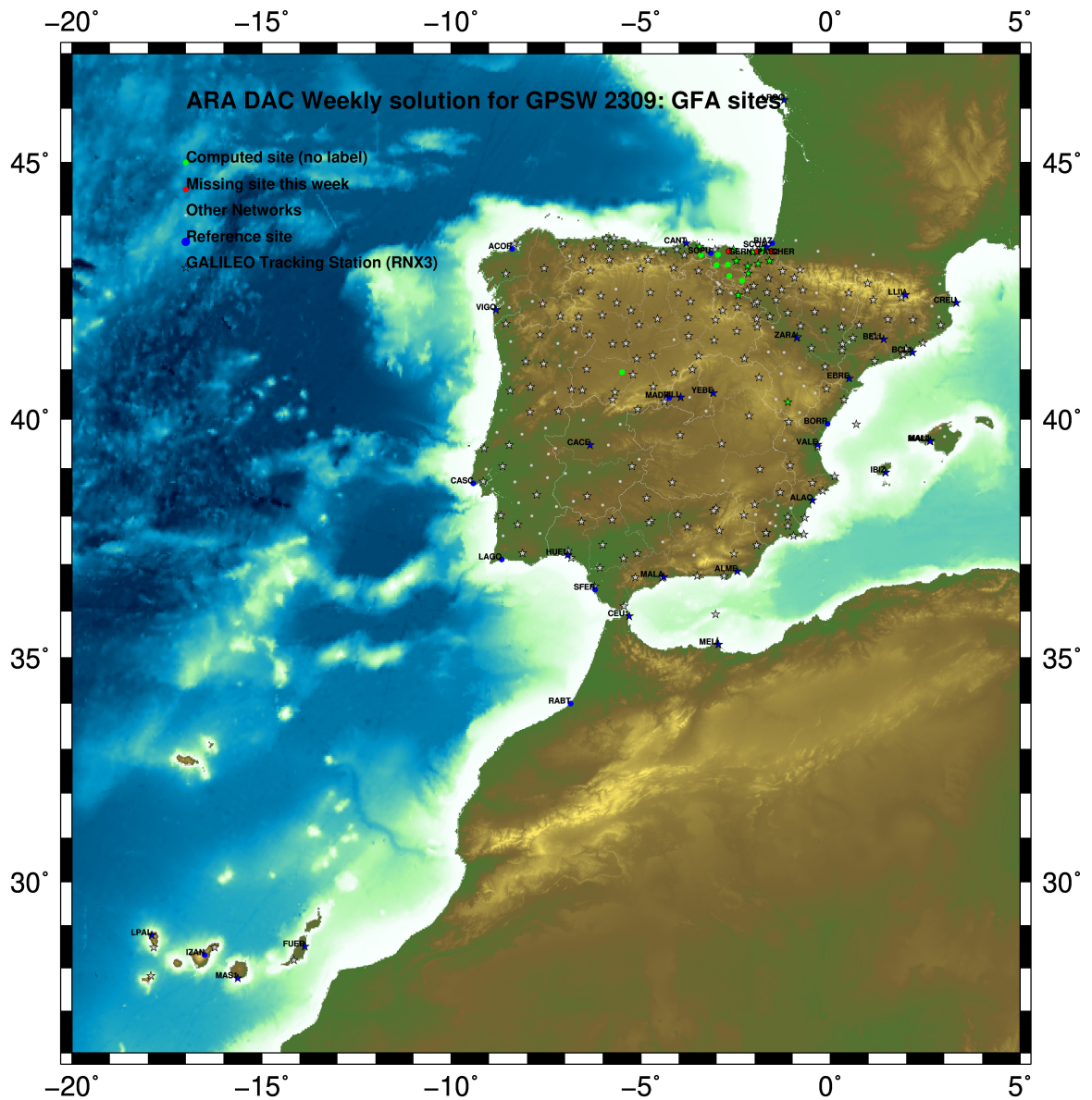


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# 1 Introduction

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



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Fig.1: Computed Sites for GPS Week2309 (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.

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ARA FINAL WEEKLY COMBINATION: FINAL ORBITS                                01-MAY-24 19:03
-----
LOCAL GEODETIC DATUM: IGS20                EPOCH: 2024-04-10 11:59:45
-----
NUM STATION NAME          X (M)          Y (M)          Z (M)    FLAG  SYSTEM
-----
111 ACRD 13434M001        4594489.51209      -678367.32712   4357066.33074   W      G
 39 ALDA 19383M001        4687280.10835      -190876.47374   4308107.01707   A      GR
 50 ALSA 19419M001        4677250.78050      -176770.30198   4319079.93103   A      GRE
 53 AMUR 19388M001        4661499.39713      -244591.16453   4332269.93554   A      GR
384 BIAZ 10074M002        4634455.99569      -124344.88232   4365785.51121   W      GR
101 BIDA 00000M000        4644177.76305      -145778.23055   4354832.53306   A      GR
113 BRZR 19387M001        4662220.93614      -220769.80638   4333309.49014   A      GR
573 CACE 13447M001        4899866.45739      -544566.94197   4033770.26190   W      GRE
592 CANT 13438M001        4625924.26546      -307096.14318   4365771.61560   W      GRE
908 CREU 13432M001        4715420.06963      273178.15193   4271946.89614   W      GRE
135 EBRE 13410M001        4833519.93546      41537.48382    4147461.77250   W      GRE
180 ELGE 19353S001        4657557.34219      -202241.37788   4338991.94152   A      GRE
182 EMAZ 17001M001        4645924.15959      -276949.77674   4347759.62579   A      GR
257 HOND 15012M002        4640529.26458      -145675.89282   4358781.81167   A      GRE
235 IGEL 19352S001        4645951.37427      -165574.41034   4352550.47678   A      GRE
240 ISPS 19484M001        4640596.42641      -206963.68306   4356391.97016   A      GRE
245 KAST 19499M001        4646949.02129      -240747.17584   4348015.04513   A      GR
252 LARE 19440M001        4632831.90391      -279026.05121   4360314.48544   A      GRE
256 LAZK 19354S001        4666098.28746      -178186.09861   4330463.72529   A      GRE
261 LEIT 19428M001        4663520.88986      -155858.62578   4334519.94235   A      GRE
334 ORDN 19427M001        4659695.72358      -130864.64294   4338948.93719   A      GRE
493 PASA 19351S001        4644909.00600      -156644.97675   4353623.13169   A      GRE
553 RID1 13448M002        4708446.77567      -199490.19020   4284089.79237   A      GRE
558 SALA 13469M001        4803054.43665      -462130.97697   4158379.13381   A      GR
526 SCDA 10088M002        4639940.45073      -136224.84932   4359552.47700   W      GRE
715 SOPU 19386M001        4643997.85248      -255913.81464   4350063.19282   W      GR
443 TERU 13487M001        4867391.26897      -95523.25286   4108341.74129   A      GR
493 VITO 19385M001        4679397.64880      -218436.41203   4314898.42223   A      GR
616 YEBE 13420M001        4848724.51668      -261631.83407   4123094.38538   W      GR
655 ZARA 13462M001        4773803.11528      -73505.89198   4215454.15294   W      GRE
    
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### 5.2 ETRF2000 (ETRS89) Coordinates

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

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CONVERT TO ETRF2000                                                    01-MAY-24 19:03
-----
LOCAL GEODETIC DATUM: ETRF2000                EPOCH: 2024-04-10 11:59:45
-----
NUM STATION NAME          X (M)          Y (M)          Z (M)    FLAG  SYSTEM
-----
111 ACRD 13434M001        4594489.85509      -678367.96022   4357065.85260   W
 39 ALDA 19383M001        4687280.51358      -190877.11713   4308106.53775   A
 50 ALSA 19419M001        4677251.18852      -176770.94412   4319079.45278   A
 53 AMUR 19388M001        4661499.79702      -244591.80494   4332269.45771   A
384 BIAZ 10074M002        4634456.41459      -124345.51914   4365785.03742   W
101 BIDA 00000M000        4644178.17816      -145778.86860   4354832.05813   A
113 BRZR 19387M001        4662221.33935      -220770.44683   4333309.01258   A
573 CACE 13447M001        4899866.79241      -544567.61151   4033769.75896   W
592 CANT 13438M001        4625924.65958      -307096.77944   4365771.14000   W
908 CREU 13432M001        4715420.53477      273177.50674   4271946.42277   W
135 EBRE 13410M001        4833520.35918      41536.82360    4147461.28362   W
180 ELGE 19353S001        4657557.74837      -202242.01771   4338991.46463   A
182 EMAZ 17001M001        4645924.55635      -276950.41536   4347759.14887   A
257 HOND 15012M002        4640529.68002      -145676.53044   4358781.33706   A
235 IGEL 19352S001        4645951.78651      -165575.04867   4352550.00142   A
240 ISPS 19484M001        4640596.83335      -206964.32085   4356391.49468   A
245 KAST 19499M001        4646949.42297      -240747.81449   4348014.56863   A
252 LARE 19440M001        4632832.30139      -279026.68824   4360314.00963   A
256 LAZK 19354S001        4666098.69621      -178186.73940   4330463.24799   A
261 LEIT 19428M001        4663521.29497      -155859.26621   4334519.46559   A
334 ORDN 19427M001        4659696.13943      -130865.28283   4338948.46111   A
493 PASA 19351S001        4644909.41954      -156645.61492   4353622.65654   A
553 RID1 13448M002        4708447.17779      -199490.83616   4284089.31107   A
558 SALA 13469M001        4803054.79297      -462131.63486   4158378.64054   A
526 SCDA 10088M002        4639940.86752      -136225.48684   4359552.00257   W
715 SOPU 19386M001        4643998.25227      -255914.45296   4350062.71636   W
443 TERU 13487M001        4867391.67096      -95523.91757   4108341.24754   A
493 VITO 19385M001        4679398.05084      -218437.05454   4314897.94321   A
616 YEBE 13420M001        4848724.89735      -261632.49700   4123093.89094   W
655 ZARA 13462M001        4773803.52892      -73506.54543   4215453.66769   W
    
```

### 5.3 ETRF2014 (ETRS89) Coordinates

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

CONVERT TO ETRF2014		01-MAY-24 19:03				
LOCAL GEODETIC DATUM: ETRF2014		EPOCH: 2024-04-10 11:59:45				
NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG	SYSTEM
111	ACDR 13434M001	4594489.81511	-678367.99704	4357065.90507	W	
39	ALDA 19383M001	4687280.47108	-190877.15537	4308106.59008	A	
50	ALSA 19419M001	4677251.14608	-176770.98245	4319079.50515	A	
53	AMUR 19388M001	4661499.75499	-244591.84309	4332269.51010	A	
384	BLAZ 10074M002	4634456.37244	-124345.55786	4365785.08996	W	
101	BIDA 00000M000	4644178.13598	-145778.90720	4354832.11062	A	
113	BRZR 19387M001	4662221.29723	-220770.48506	4333309.06498	A	
573	CACE 13447M001	4899866.74854	-544567.64746	4033769.81057	W	
592	CANT 13438M001	4625924.61814	-307096.81752	4365771.19246	W	
908	CREU 13432M001	4715420.49017	273177.46693	4271946.47535	W	
135	EBRE 13410M001	4833520.31414	41536.78517	4147461.33567	W	
180	ELGE 19353S001	4657557.70624	-202242.05604	4338991.51705	A	
182	EMAZ 17001M001	4645924.51460	-276950.45346	4347759.20128	A	
257	HOND 15012M002	4640529.63788	-145676.56905	4358781.38956	A	
235	IGEL 19352S001	4645951.74438	-165875.08718	4352550.05389	A	
240	ISPS 19484M001	4640596.79142	-206964.35924	4356391.54715	A	
245	KAST 19499M001	4646949.38109	-240747.85272	4348014.62106	A	
252	LARE 19440M001	4632832.25979	-279026.72639	4360314.06209	A	
256	LAZK 19354S001	4666098.65390	-178186.77778	4330463.30040	A	
261	LEIT 19428M001	4663521.25261	-155859.30468	4334519.51801	A	
334	ORON 19427M001	4659696.09702	-130865.32141	4338948.51356	A	
493	PASA 19351S001	4644909.37739	-156645.65347	4353622.70902	A	
553	RI01 13448M002	4708447.13507	-199490.87426	4284089.36334	A	
558	SALA 13469M001	4803054.75001	-462131.67155	4158378.69242	A	
526	SOA 10088M002	4639940.82535	-136225.52548	4359552.05508	W	
715	SOPU 19386M001	4643998.21047	-255914.49115	4350062.76879	W	
443	TERU 13487M001	4867391.62604	-95523.95534	4108341.29941	A	
493	VITO 19385M001	4679398.00852	-218437.09271	4314897.99555	A	
616	YEBE 13420M001	4848724.85322	-261632.53424	4123093.94277	W	
655	ZARA 13462M001	4773803.48501	-73506.58370	4215453.71983	W	

## 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 01-MAY-24 19:03

Station	#Days	Weekday 0123456	Repeatability (mm)		
			N	E	U
ACOR 13434M001	6	XXXX XX	1.27	1.19	2.37
ALDA 19383M001	7	XXXXXX	1.36	1.11	6.24
ALSA 19419M001	7	XXXXXX	1.88	0.84	4.10
AMUR 19388M001	7	XXXXXX	0.88	2.15	5.00
BLAZ 10074M002	6	XXXXXX	0.68	1.25	4.89
BIDA 00000M000	7	XXXXXX	0.84	0.95	2.24
BRZR 19387M001	7	XXXXXX	0.98	1.68	3.18
CACE 13447M001	7	XXXXXX	1.14	0.90	3.58
CANT 13438M001	7	XXXXXX	1.37	0.82	2.19
CREU 13432M001	7	XXXXXX	1.32	0.95	1.91
EBRE 13410M001	7	XXXXXX	0.73	1.77	2.89
ELGE 19353S001	7	XXXXXX	0.95	1.35	2.23
EMAZ 17001M001	7	XXXXXX	1.57	1.11	4.27
HOND 15012M002	7	XXXXXX	0.97	0.76	3.44
IGEL 19352S001	7	XXXXXX	1.28	0.67	1.66
ISPS 19484M001	7	XXXXXX	1.29	2.36	3.93
KAST 19499M001	7	XXXXXX	0.77	0.67	2.45
LARE 19440M001	7	XXXXXX	0.58	1.24	1.99
LAZK 19354S001	7	XXXXXX	0.92	1.17	4.84
LEIT 19428M001	7	XXXXXX	1.54	1.45	4.91
ORDN 19427M001	7	XXXXXX	3.81	0.66	3.87
PASA 19351S001	7	XXXXXX	1.58	0.80	2.40
RI01 13448M002	7	XXXXXX	2.16	1.28	3.08
SALA 13469M001	6	XXXX XX	0.40	0.44	1.26
SCDA 10088M002	7	XXXXXX	1.45	0.87	4.32
SOPU 19386M001	7	XXXXXX	1.08	1.65	2.58
TERU 13487M001	3	XX	0.30	1.83	4.05
VITO 19385M001	7	XXXXXX	1.40	0.92	2.36
YEBE 13420M001	7	XXXXXX	0.46	0.76	1.39
ZARA 13462M001	7	XXXXXX	0.68	1.28	2.88

Comparison of individual solutions:

ACOR 13434M001	N	1.27	1.87	-0.66	-1.37	0.80	-1.20	-0.40
ACOR 13434M001	E	1.19	-1.07	-0.78	1.89	1.02	0.69	-0.46
ACOR 13434M001	U	2.37	-1.49	-0.69	4.38	-0.89	1.65	-1.61
ALDA 19383M001	N	1.36	-0.15	-0.59	-0.88	1.75	-1.51	-1.95
ALDA 19383M001	E	1.11	1.67	1.13	0.53	-1.66	-0.36	-0.54
ALDA 19383M001	U	6.24	0.68	7.63	-3.77	-11.91	4.14	0.63
ALSA 19419M001	N	1.88	1.27	2.19	0.47	-3.48	-1.03	-1.11
ALSA 19419M001	E	0.84	0.99	-1.03	-1.09	-0.13	-0.40	-0.77
ALSA 19419M001	U	4.10	2.62	-0.23	0.68	-6.16	5.96	-2.69
AMUR 19388M001	N	0.88	0.98	-1.80	0.07	0.35	-0.22	-0.26
AMUR 19388M001	E	2.15	0.05	-4.97	-0.50	-0.12	0.31	0.47
AMUR 19388M001	U	5.00	2.45	7.56	2.46	-6.73	1.15	-3.16
BLAZ 10074M002	N	0.68	-0.10	0.45	-0.94	0.22	-0.90	-0.62
BLAZ 10074M002	E	1.25	-0.37	1.18	0.39	-1.00	-1.55	-1.67
BLAZ 10074M002	U	4.89	4.46	7.62	-0.62	-3.80	-0.78	-5.10
BIDA 00000M000	N	0.84	1.30	0.17	-0.64	-0.55	-1.01	-0.87
BIDA 00000M000	E	0.95	-0.29	-1.03	-1.61	-0.78	-0.05	-0.16
BIDA 00000M000	U	2.24	0.29	0.86	3.73	0.31	0.88	-2.51
BRZR 19387M001	N	0.98	0.01	-0.57	-0.55	1.60	-1.38	-0.77
BRZR 19387M001	E	1.68	-0.65	-3.87	0.53	-0.49	-0.35	0.20
BRZR 19387M001	U	3.18	-1.35	3.82	3.76	-4.23	1.45	1.91
CACE 13447M001	N	1.14	-2.22	-0.88	0.19	0.57	1.14	0.52
CACE 13447M001	E	0.90	-0.02	-1.60	-0.39	0.54	-0.44	0.65
CACE 13447M001	U	3.58	4.60	-5.69	-1.08	3.49	1.91	0.55
CANT 13438M001	N	1.37	1.34	1.46	-1.81	-0.50	-1.62	-1.00
CANT 13438M001	E	0.82	0.80	0.20	0.08	-1.01	0.19	-1.34
CANT 13438M001	U	2.19	-0.86	3.40	0.77	-0.05	1.95	0.69
CREU 13432M001	N	1.32	1.58	0.13	0.55	-2.28	-1.13	-0.77
CREU 13432M001	E	0.95	0.73	0.45	-1.29	0.36	-0.86	-1.44
CREU 13432M001	U	1.91	-3.50	0.80	1.08	1.65	-1.31	1.36
EBRE 13410M001	N	0.73	0.84	-0.58	-1.24	-0.14	0.13	-0.58
EBRE 13410M001	E	1.77	1.55	1.02	-3.79	-0.66	-0.24	0.13
EBRE 13410M001	U	2.89	-0.08	2.56	-4.53	4.28	-0.84	-0.79
ELGE 19353S001	N	0.95	-0.29	-0.97	-1.91	0.61	-0.16	0.33
ELGE 19353S001	E	1.35	-0.96	1.29	0.56	-2.66	-0.47	-0.51
ELGE 19353S001	U	2.23	-2.81	0.15	3.49	-1.10	2.76	-0.43
EMAZ 17001M001	N	1.57	-0.57	2.65	-2.21	0.67	-1.14	-0.67
EMAZ 17001M001	E	1.11	-0.17	0.99	2.20	-0.92	-0.08	-0.74
EMAZ 17001M001	U	4.27	4.46	8.15	-1.73	-0.42	-2.06	-1.86
HOND 15012M002	N	0.97	1.43	-0.41	-1.54	-0.02	0.02	-0.69
HOND 15012M002	E	0.76	0.29	-1.59	-0.52	-0.08	-0.72	-0.32
HOND 15012M002	U	3.44	-1.90	6.73	0.63	-0.94	2.33	-2.53
IGEL 19352S001	N	1.28	1.73	0.91	-1.80	-0.93	-1.31	-0.39
IGEL 19352S001	E	0.67	-0.23	0.33	-0.50	-0.89	-0.65	-1.03
IGEL 19352S001	U	1.66	0.79	1.03	-0.43	-1.98	2.66	0.43
ISPS 19484M001	N	1.29	1.58	-0.11	-2.15	0.87	-1.34	-0.42
ISPS 19484M001	E	2.36	2.24	-0.15	-0.39	0.28	0.75	-5.13
ISPS 19484M001	U	3.93	-5.16	0.26	5.60	-2.58	5.24	0.52
KAST 19499M001	N	0.77	0.29	0.55	-1.39	-0.40	-0.82	-0.55
KAST 19499M001	E	0.67	-0.41	0.10	-1.17	-0.78	-0.35	-0.21
KAST 19499M001	U	2.45	1.91	2.90	1.36	-3.12	0.59	2.34
LARE 19440M001	N	0.58	0.21	-0.30	-0.88	-0.42	-0.91	-0.18
LARE 19440M001	E	1.24	2.49	-1.41	-0.67	-0.46	0.57	-0.34
LARE 19440M001	U	1.99	3.79	2.44	-0.18	-1.26	-0.03	-1.26
LAZK 19354S001	N	0.92	1.42	-0.35	-1.26	-0.35	-0.50	0.06
LAZK 19354S001	E	1.17	1.28	1.10	-0.57	-1.52	-0.89	-1.38
LAZK 19354S001	U	4.84	1.67	6.87	2.24	-7.35	0.81	-4.10
LEIT 19428M001	N	1.54	1.01	2.50	-0.91	-0.31	-0.46	-2.01
LEIT 19428M001	E	1.45	1.40	1.64	-1.31	-1.73	-0.01	-1.71
LEIT 19428M001	U	4.91	-2.60	8.40	-0.28	-7.34	-2.08	0.39
ORDN 19427M001	N	3.81	1.05	-9.11	0.66	0.38	-0.82	0.53

ORDN 19427M001	E	0.66	-0.44	-0.80	-0.71	-0.65	-0.25	-0.85	-0.20
ORDN 19427M001	U	3.87	4.56	6.35	0.17	0.90	-5.04	1.42	-0.66
PASA 19351S001	N	1.58	1.07	2.30	-2.18	-0.20	-1.15	-1.57	-0.16
PASA 19351S001	E	0.80	-0.25	-1.72	-0.41	-0.17	-0.26	-0.54	0.52
PASA 19351S001	U	2.40	-3.08	3.64	0.30	0.00	2.81	-1.03	-1.71
RIO1 13448M002	N	2.16	0.85	-0.41	-2.93	3.84	-1.43	-1.14	-0.65
RIO1 13448M002	E	1.28	1.38	-2.13	-0.44	-1.47	-0.37	0.13	0.92
RIO1 13448M002	U	3.08	0.70	2.28	0.36	-1.74	2.78	-3.75	-5.13
SALA 13469M001	N	0.40	-0.06	0.42	-0.48	-0.04		-0.53	-0.32
SALA 13469M001	E	0.44	0.43	-0.49	0.67	0.17		-0.23	-0.15
SALA 13469M001	U	1.26	1.17	1.34	0.18	0.56		-2.09	0.12
SCDA 10088M002	N	1.45	-0.98	-0.28	-0.73	-0.65	-2.99	1.28	0.11
SCDA 10088M002	E	0.87	-1.28	0.36	-0.20	-0.50	-0.98	-1.02	0.71
SCDA 10088M002	U	4.32	5.55	5.98	-2.49	-2.43	2.28	-3.08	-4.28
SOPU 19386M001	N	1.08	0.49	0.22	-2.26	0.29	-1.16	0.44	0.06
SOPU 19386M001	E	1.65	0.69	-2.24	-3.17	0.08	0.42	-0.07	0.76
SOPU 19386M001	U	2.58	2.07	4.40	-1.45	-2.56	2.10	0.41	-1.81
TERU 13487M001	N	0.30	0.24	-0.03	0.34				
TERU 13487M001	E	1.83	2.21	1.24	-0.47				
TERU 13487M001	U	4.05	0.87	3.93	-4.07				
VITO 19385M001	N	1.40	1.22	-2.32	-1.56	-0.14	0.82	0.36	1.30
VITO 19385M001	E	0.92	1.05	-1.83	-0.14	-0.40	-0.39	-0.33	-0.43
VITO 19385M001	U	2.36	-1.25	-1.97	2.07	-2.85	0.77	-1.39	-3.62
YEBE 13420M001	N	0.46	-0.87	-0.42	-0.03	0.21	0.11	-0.13	0.49
YEBE 13420M001	E	0.76	0.87	0.43	0.67	-0.39	-0.94	-0.68	0.75
YEBE 13420M001	U	1.39	-0.11	-1.32	1.86	2.00	0.15	0.47	-1.45
ZARA 13462M001	N	0.68	-0.16	-0.75	-1.07	0.39	0.37	-0.59	-0.63
ZARA 13462M001	E	1.28	1.02	0.94	-2.20	-0.95	-0.99	-0.69	0.84
ZARA 13462M001	U	2.88	1.66	3.13	2.36	-2.73	0.64	-4.11	-2.62

## 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

NUM	NAME	FLG	RESIDUALS IN MILLIMETERS		
1	ACOR 13434M001	I W	1.12	-10.92	7.02
2	ALAC 13433M001	I W	-0.79	0.37	1.38
3	ALME 13437M001	I W	-0.91	0.09	1.11
4	BCL1 19482M001	I W	-0.64	0.83	2.30
5	BELL 13431M001	I W	-1.05	0.96	5.86
6	BIAZ 10074M002	I W	1.48	0.23	-2.12
7	BORR 13480M001	I W	-2.42	-0.63	-0.25
8	BRST 10004M004	I W	0.55	-2.06	5.24
9	CACE 13447M001	I W	0.93	0.87	6.85
10	CANT 13438M001	I W	1.06	0.38	-0.37
11	CASC 13909S001	I W	1.46	-1.12	3.32
12	CEU1 13449M002	I W	-0.73	0.96	-3.84
13	CREU 13432M001	A W	-2.74	-11.28	-18.28
14	EBRE 13410M001	I W	0.17	3.79	3.39
16	FLRS 31907M001	I W	-0.17	0.22	-5.44
17	FUER 31330M001	I W	-0.71	0.45	-3.59
19	HUEL 13451M001	I W	0.54	2.62	-6.99
20	IBIZ 13454S001	I W	-0.98	1.91	1.27
21	IZAN 31309M002	I W	-1.20	0.29	-8.71
22	LAGO 13903M001	I W	0.11	-1.16	2.67
23	LLIV 13436M001	I W	-3.67	1.93	1.85
24	LPAL 81701M001	I W	1.94	0.67	-11.03
25	LROC 10023M001	I W	0.96	0.36	5.12
26	MADR 13407S012	I W	-0.83	1.74	3.91
27	MAL1 13444M002	I W	3.04	0.10	-7.72
28	MALA 13443M001	I W	1.37	-1.02	3.41
29	MALL 13444M001	I W	-1.58	0.61	4.04
30	MAS1 31303M002	I W	-1.80	-1.86	-3.72
31	MELI 19379M001	I W	-0.84	1.10	2.22
32	PDEL 31906M004	I W	0.32	-1.30	-3.20
33	RABT 35001M002	I W	0.35	-1.54	-9.33
34	SCOA 10088M002	I W	-1.06	-1.06	-6.68
35	SFER 13402M004	I W	-1.34	-2.23	2.20
36	SOPU 19386M001	I W	0.28	1.08	6.22
37	VALE 13439M001	I W	-0.53	3.20	-0.76
38	VIGO 13450M001	I W	1.45	1.00	2.14
39	VILL 13406M001	I W	-0.38	-0.55	4.54
40	YEBE 13420M001	I W	-0.42	0.20	7.11
41	ZARA 13462M001	I W	-1.12	0.79	-0.17
42	ZIMM 14001M004	I W	-0.14	1.09	9.31
RMS / COMPONENT			1.35	2.87	5.86
IQR			1.75	2.02	7.63
MEAN			-0.22	-0.22	0.01
MEDIAN			-0.40	0.37	1.61
MIN			-3.67	-11.28	-18.28
MAX			3.04	3.79	9.31
OVERALL RMS/IQR/MAX(3D)			3.85	2.54	21.65
					CREU 13432M001 #SUM
ALL RMS / COMPONENT			1.35	2.87	5.86
ALL IQR			1.75	2.02	7.63
ALL MEAN			-0.22	-0.22	0.01
ALL MEDIAN			-0.40	0.37	1.61
ALL MIN			-3.67	-11.28	-18.28
ALL MAX			3.04	3.79	9.31
ALL OVERALL RMS/IQR/MAX(3D)			3.85	2.54	21.65
					CREU 13432M001 #SUM_ALL

NUMBER OF PARAMETERS : 3  
NUMBER OF STATIONS : 40  
NUMBER OF COORDINATES : 120  
RMS OF TRANSFORMATION : 3.85 MM

PARAMETERS:

TRANSLATION IN X : -0.00 +- 0.61 MM  
TRANSLATION IN Y : 0.00 +- 0.61 MM  
TRANSLATION IN Z : -0.00 +- 0.61 MM

NUMBER OF ITERATIONS : 1

### 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          19507623
NUMBER OF UNKNOWNNS             195117
NUMBER OF DEGREES OF FREEDOM    19312506
PHASE MEASUREMENTS SIGMA        0.00100
SAMPLING INTERVAL (SECONDS)     180
VARIANCE FACTOR                  25.932462932445542
```

## 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 24:098:00000 24:104:86370 LEICA GR50 -----
ALDA A 1 P 24:098:00000 24:104:86370 LEICA GR30 -----
ALSA A 1 P 24:098:00000 24:104:86370 LEICA GR50 -----
AMUR A 1 P 24:098:00000 24:104:86370 LEICA GR30 -----
BIAZ A 1 P 24:098:00000 24:103:86370 SPECTRA SP90M -----
BIDA A 1 P 24:098:00000 24:104:86370 LEICA GR10 -----
BRZR A 1 P 24:098:00000 24:104:86370 LEICA GR30 -----
CACE A 1 P 24:098:00000 24:104:86370 TRIMBLE NETR9 -----
CANT A 1 P 24:098:00000 24:104:86370 LEICA GR10 -----
CREU A 1 P 24:098:00000 24:104:86370 LEICA GR50 -----
EBRE A 1 P 24:098:00000 24:104:86370 LEICA GR50 -----
ELGE A 1 P 24:098:00000 24:104:86370 LEICA GR30 -----
EMAZ A 1 P 24:098:00000 24:104:86370 LEICA GR30 -----
HOND A 1 P 24:098:00000 24:104:86370 LEICA GR50 -----
IGEL A 1 P 24:098:00000 24:104:86370 LEICA GR30 -----
ISPS A 1 P 24:098:00000 24:104:86370 TRIMBLE NETR9 -----
KAST A 1 P 24:098:00000 24:104:86370 LEICA GR30 -----
LARE A 1 P 24:098:00000 24:104:86370 LEICA GR50 -----
LAZK A 1 P 24:098:00000 24:104:86370 LEICA GR30 -----
LEIT A 1 P 24:098:00000 24:104:86370 LEICA GR50 -----
ORON A 1 P 24:098:00000 24:104:86370 LEICA GR50 -----
PASA A 1 P 24:098:00000 24:104:86370 LEICA GR30 -----
RI01 A 1 P 24:098:00000 24:104:86370 LEICA GR25 -----
SALA A 1 P 24:098:00000 24:104:86370 LEICA GR50 -----
SCDA A 1 P 24:098:00000 24:104:86370 LEICA GR50 -----
SOPU A 1 P 24:098:00000 24:104:86370 LEICA GR30 -----
TERU A 1 P 24:098:00000 24:100:86370 LEICA GR50 -----
VITO A 1 P 24:098:00000 24:104:86370 LEICA GR30 -----
YEBE A 1 P 24:098:00000 24:104:86370 LEICA GR50 -----
ZARA A 1 P 24:098:00000 24:104:86370 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 24:098:00000 24:104:86370 LEIAT504 LEIS -----
ALDA A 1 P 24:098:00000 24:104:86370 LEIAS10 NONE -----
ALSA A 1 P 24:098:00000 24:104:86370 LEIAR10 NONE -----
AMUR A 1 P 24:098:00000 24:104:86370 LEIAS10 NONE -----
BIAZ A 1 P 24:098:00000 24:103:86370 LEIAR25 LEIT -----
BIDA A 1 P 24:098:00000 24:104:86370 LEIAS10 NONE -----
BRZR A 1 P 24:098:00000 24:104:86370 LEIAS10 NONE -----
CACE A 1 P 24:098:00000 24:104:86370 TRM29659.00 NONE -----
CANT A 1 P 24:098:00000 24:104:86370 LEIAR25.R4 LEIT -----
CREU A 1 P 24:098:00000 24:104:86370 LEIAR25.R4 NONE -----
EBRE A 1 P 24:098:00000 24:104:86370 LEIAR25.R4 NONE -----
ELGE A 1 P 24:098:00000 24:104:86370 LEIAR25.R4 LEIT -----
EMAZ A 1 P 24:098:00000 24:104:86370 LEIAS10 NONE -----
HOND A 1 P 24:098:00000 24:104:86370 LEIAR20 LEIM -----
IGEL A 1 P 24:098:00000 24:104:86370 LEIAR20 LEIM -----
ISPS A 1 P 24:098:00000 24:104:86370 TRM59900.00 SCIS -----
KAST A 1 P 24:098:00000 24:104:86370 LEIAS10 NONE -----
LARE A 1 P 24:098:00000 24:104:86370 LEIAR20 LEIM -----
LAZK A 1 P 24:098:00000 24:104:86370 LEIAR25.R4 LEIT -----
LEIT A 1 P 24:098:00000 24:104:86370 LEIAR10 NONE -----
ORON A 1 P 24:098:00000 24:104:86370 LEIAR10 NONE -----
PASA A 1 P 24:098:00000 24:104:86370 LEIAR20 LEIM -----
RI01 A 1 P 24:098:00000 24:104:86370 LEIAR25.R4 LEIT -----
SALA A 1 P 24:098:00000 24:104:86370 LEIAR25 NONE -----
SCDA A 1 P 24:098:00000 24:104:86370 TRM55971.00 NONE -----
SOPU A 1 P 24:098:00000 24:104:86370 LEIAS10 NONE -----
TERU A 1 P 24:098:00000 24:100:86370 LEIAR20 LEIM -----
VITO A 1 P 24:098:00000 24:104:86370 LEIAS10 NONE -----
YEBE A 1 P 24:098:00000 24:104:86370 LEIAR20 LEIM -----
ZARA A 1 P 24:098:00000 24:104:86370 TRM29659.00 NONE -----
```

### 7.3 Eccentricities

```

*
*SITE PT SOLN T DATA_START__ DATA_END_____ AXE ARP->BENCHMARK(M)-----
ACOR A 1 P 24:098:00000 24:104:86370 UNE 3.0460 0.0000 0.0000
ALDA A 1 P 24:098:00000 24:104:86370 UNE 0.0000 0.0000 0.0000
ALSA A 1 P 24:098:00000 24:104:86370 UNE 0.0000 0.0000 0.0000
AMUR A 1 P 24:098:00000 24:104:86370 UNE 0.0000 0.0000 0.0000
BIAZ A 1 P 24:098:00000 24:103:86370 UNE 0.0000 0.0000 0.0000
BIDA A 1 P 24:098:00000 24:104:86370 UNE 0.0000 0.0000 0.0000
BRZR A 1 P 24:098:00000 24:104:86370 UNE 0.0771 0.0000 0.0000
CACE A 1 P 24:098:00000 24:104:86370 UNE 0.0600 0.0000 0.0000
CANT A 1 P 24:098:00000 24:104:86370 UNE 3.0490 0.0000 0.0000
CREU A 1 P 24:098:00000 24:104:86370 UNE 0.0770 0.0000 0.0000
EBRE A 1 P 24:098:00000 24:104:86370 UNE 0.0770 0.0000 0.0000
ELGE A 1 P 24:098:00000 24:104:86370 UNE 0.0000 0.0000 0.0000
EMAZ A 1 P 24:098:00000 24:104:86370 UNE 0.0350 0.0000 0.0000
HOND A 1 P 24:098:00000 24:104:86370 UNE 0.0771 0.0000 0.0000
IGEL A 1 P 24:098:00000 24:104:86370 UNE 0.0000 0.0000 0.0000
ISPS A 1 P 24:098:00000 24:104:86370 UNE 0.0350 0.0000 0.0000
KAST A 1 P 24:098:00000 24:104:86370 UNE 0.0350 0.0000 0.0000
LARE A 1 P 24:098:00000 24:104:86370 UNE 0.0000 0.0000 0.0000
LAZK A 1 P 24:098:00000 24:104:86370 UNE 0.0000 0.0000 0.0000
LEIT A 1 P 24:098:00000 24:104:86370 UNE 0.0000 0.0000 0.0000
ORDN A 1 P 24:098:00000 24:104:86370 UNE 0.0000 0.0000 0.0000
PASA A 1 P 24:098:00000 24:104:86370 UNE 0.0000 0.0000 0.0000
RID1 A 1 P 24:098:00000 24:104:86370 UNE 0.0606 0.0000 0.0000
SALA A 1 P 24:098:00000 24:104:86370 UNE 0.0600 0.0000 0.0000
SCDA A 1 P 24:098:00000 24:104:86370 UNE 0.0000 0.0000 0.0000
SOPU A 1 P 24:098:00000 24:104:86370 UNE 0.0771 0.0000 0.0000
TERU A 1 P 24:098:00000 24:100:86370 UNE 0.0600 0.0000 0.0000
VITO A 1 P 24:098:00000 24:104:86370 UNE 0.0000 0.0000 0.0000
YEBE A 1 P 24:098:00000 24:104:86370 UNE 0.0600 0.0000 0.0000
ZARA A 1 P 24:098:00000 24:104:86370 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)

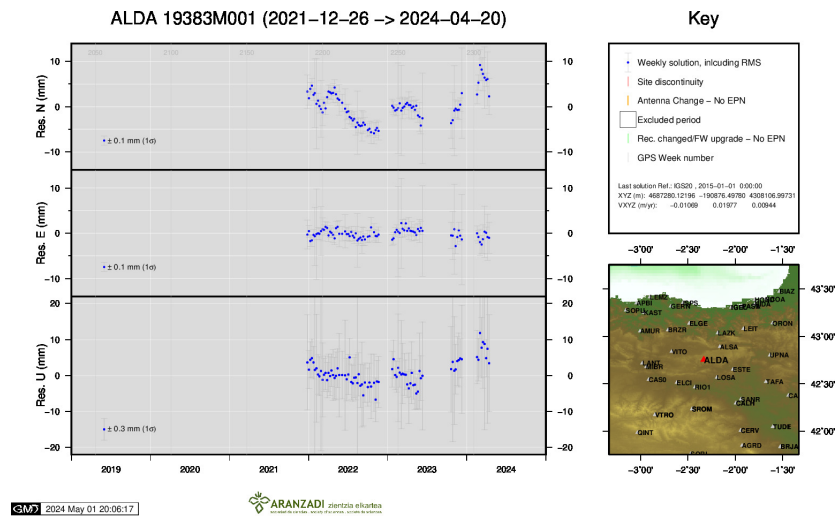
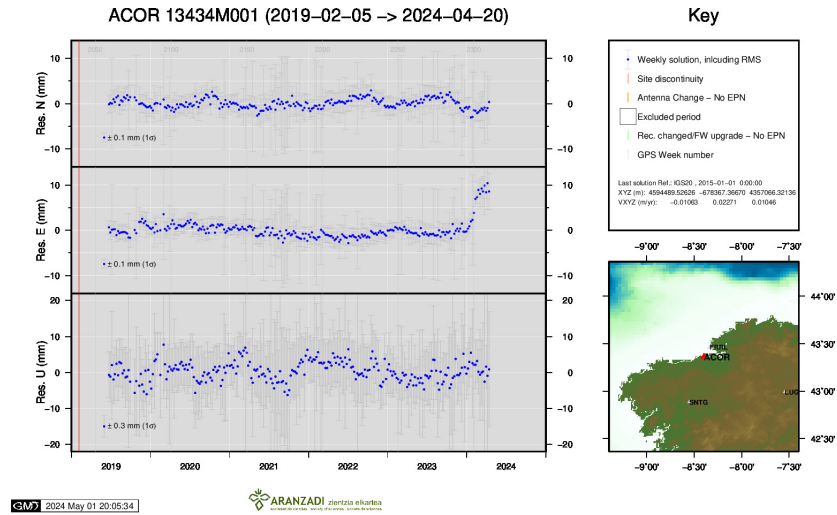
Johnston, G., Riddell, A., Hausler, G. (2017). The International GNSS Service. Teunissen, Peter J.G., Montenbruck, O. (Eds.), Springer Handbook of Global Navigation Satellite Systems (1st ed., pp. 967-982). Cham, Switzerland: Springer International Publishing. DOI: 10.1007/978-3-319-42928-1

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)

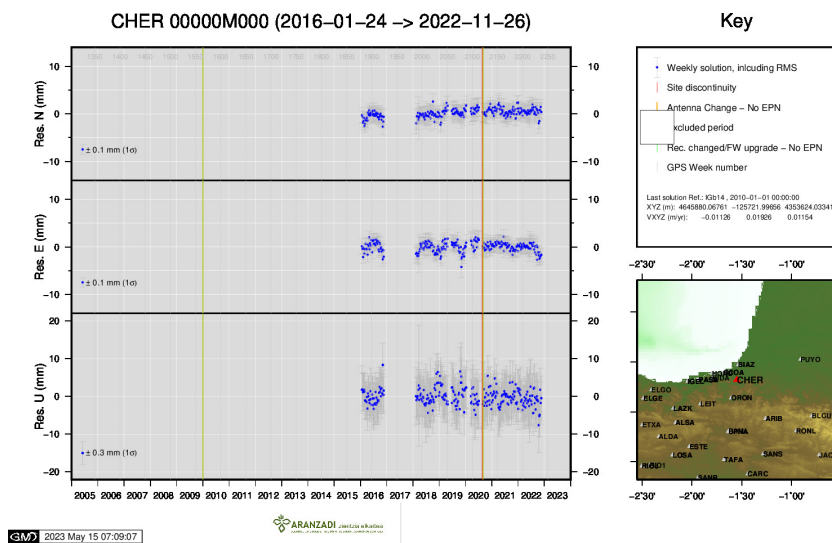
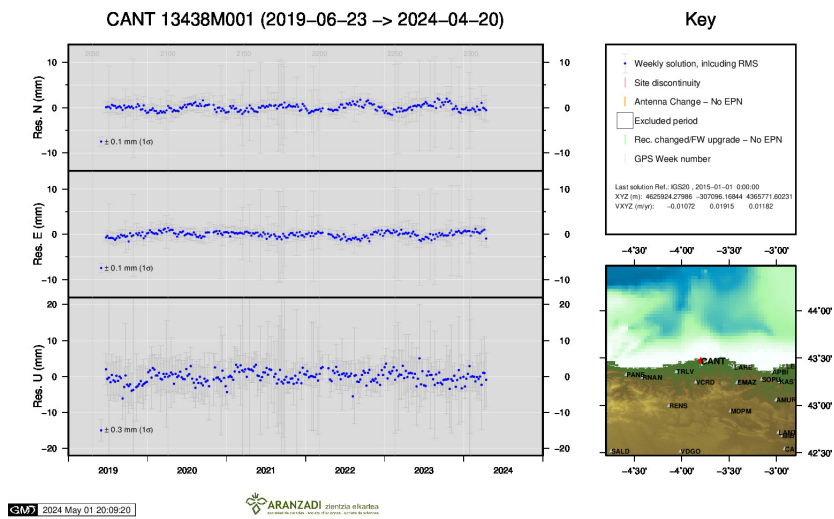
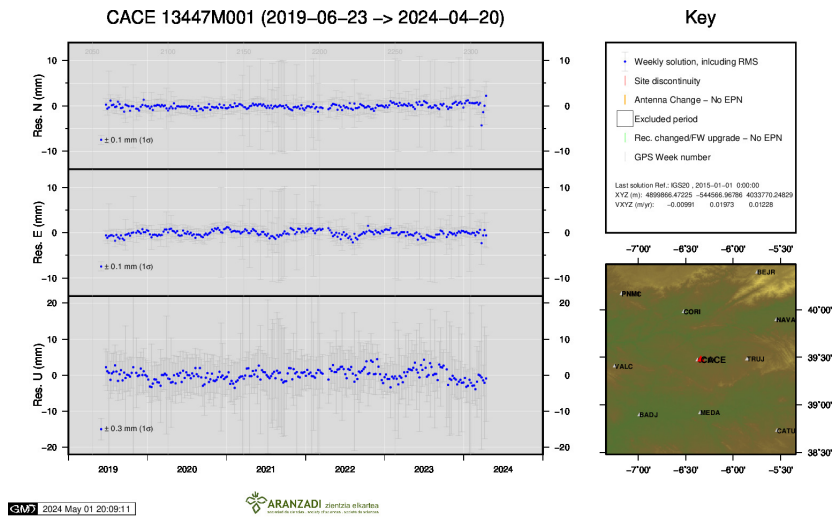


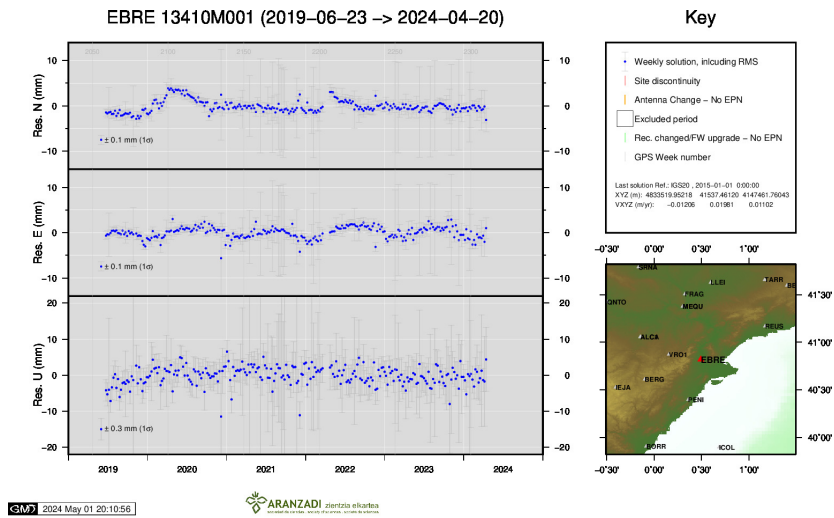
## 9 Cumulative Time Series

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

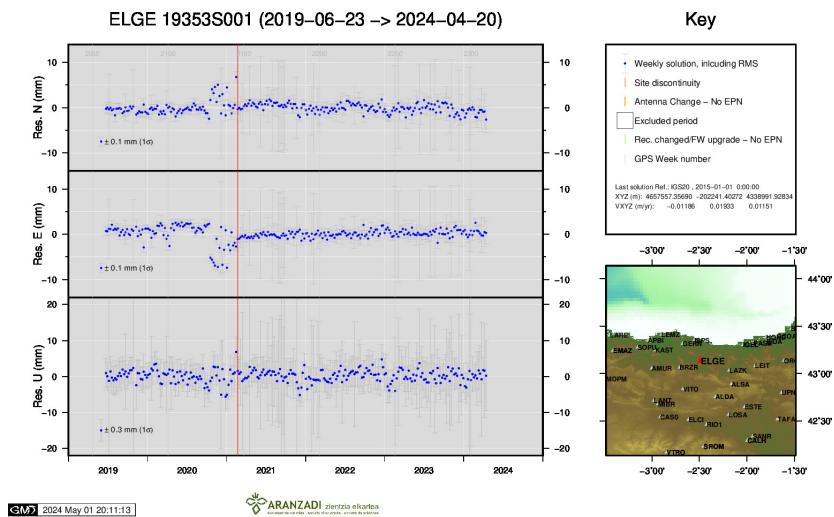




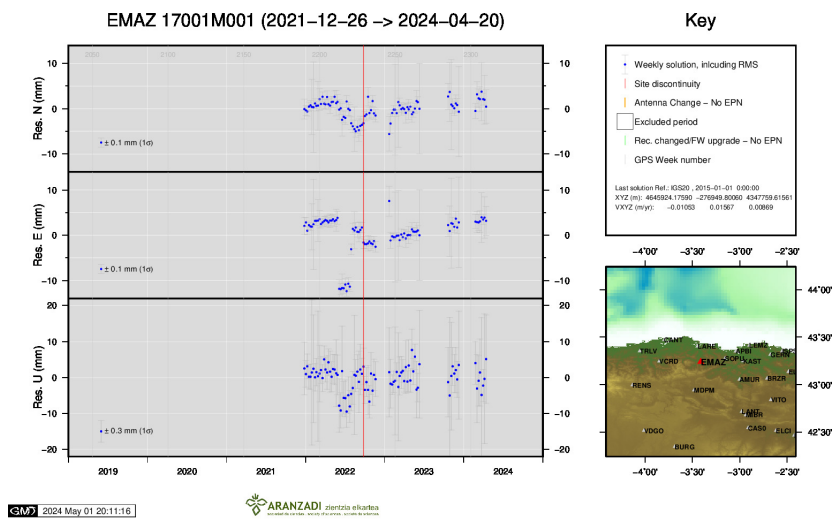




9 ) EBRE



10 ) ELGE



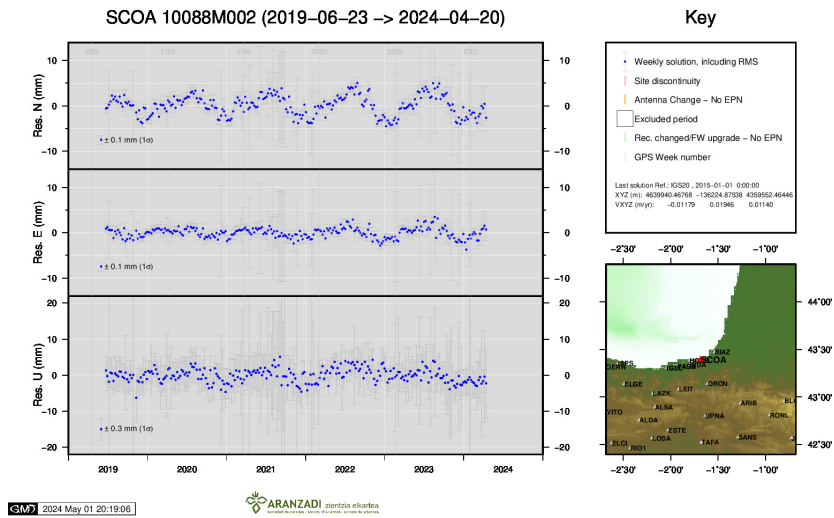
11 ) EMAZ



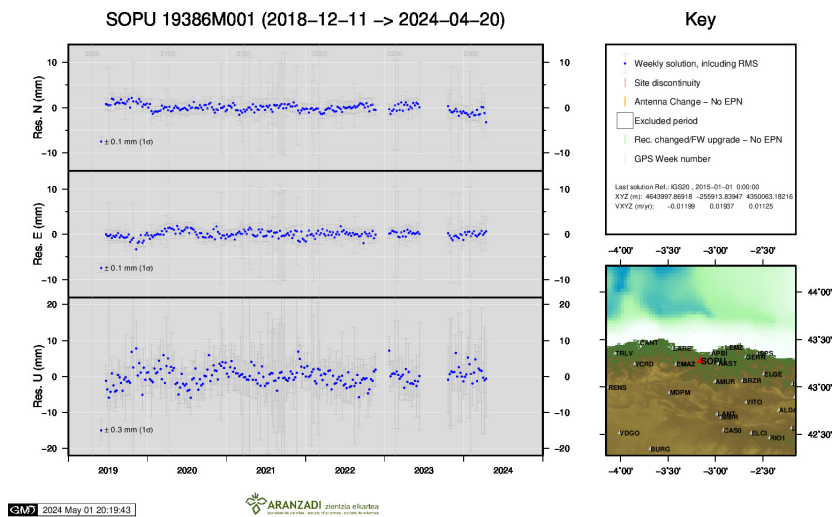




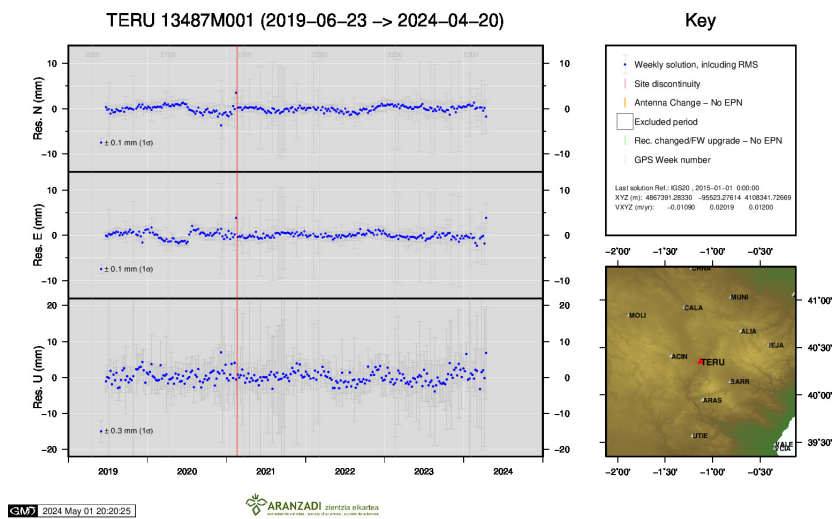




21 ) SCOA

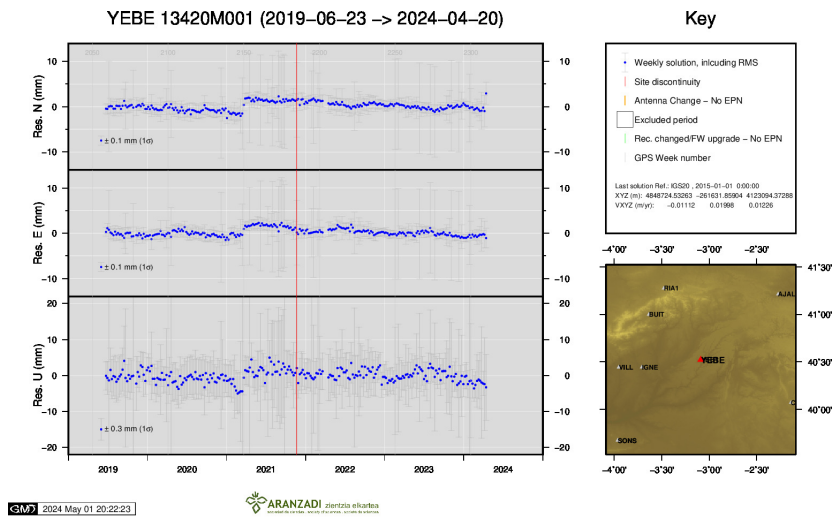


22 ) SOPU

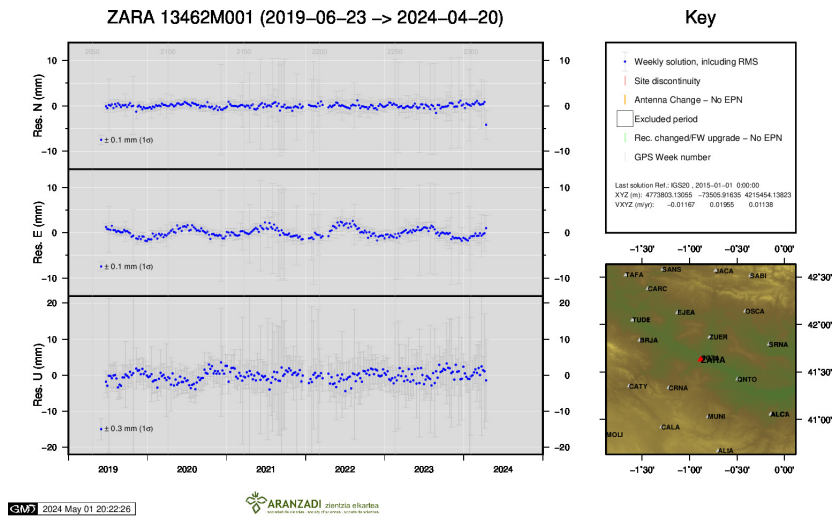


23 ) TERU





24 ) YEBE



25 ) ZARA