ARA-DAC Weekly Analysis Result: 2241 (GFA)

Technical Report

GPS Week: 2241 (GFA)

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

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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

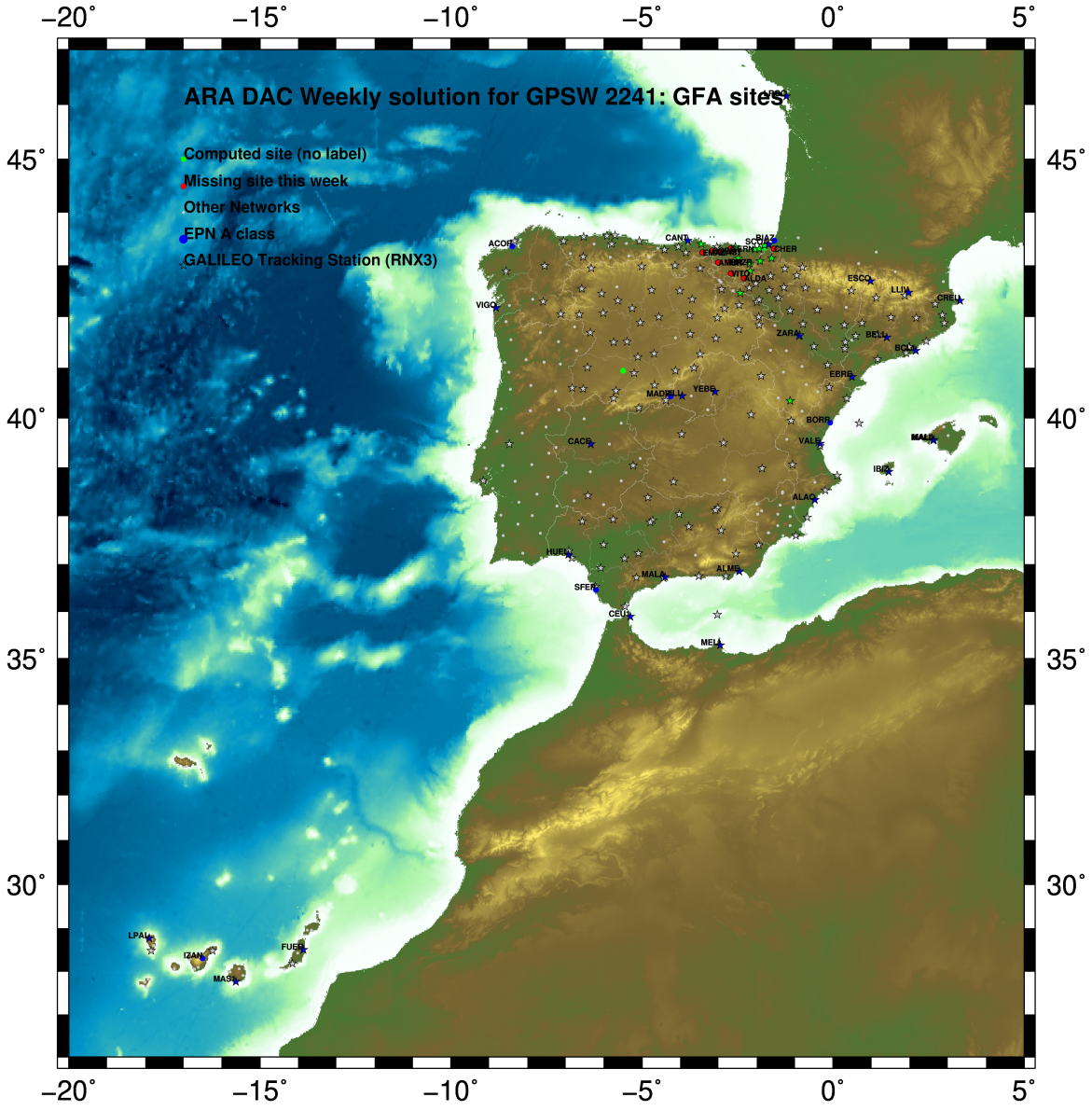

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Fig.1: Computed Sites for GPS Week2241 (GFA)

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 observatione of this/theese 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*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 21-DEC-23 12:48

LOCAL GEODETIC DATUM: IGS20 EPOCH: 2022-12-21 11:59:45

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG	SYSTEM
111	ACOR 13434M001	4594489.53197	-678367.36793	4357066.32425	W	G
50	ALSA 19419M001	4677250.79712	-176770.33022	4319079.91180	A	GRE
384	BIAZ 10074M002	4634456.01292	-124344.90790	4365785.49653	W	GR
101	BIDA 00000M000	4644177.78584	-145778.25694	4354832.52136	A	GR
573	CACE 13447M001	4899866.47208	-544566.96716	4033770.24715	W	GRE
592	CANT 13438M001	4625924.28292	-307096.16784	4365771.60338	W	GRE
908	CREU 13432M001	4715420.08932	273178.12877	4271946.88658	W	GRE
135	EBRE 13410M001	4833519.95337	41537.46190	4147461.76064	W	GRE
180	ELGE 19353S001	4657557.36068	-202241.40125	4338991.93232	A	GRE
257	HOND 15012M002	4640529.28226	-145675.91848	4358781.79734	A	GRE
235	IGEL 19352S001	4645951.39284	-165574.43540	4352550.46925	A	GRE
240	ISPS 19484M001	4640596.44315	-206963.71006	4356391.95407	A	GRE
252	LARE 19440M001	4632831.92449	-279026.07407	4360314.47390	A	GRE
256	LAZK 19354S001	4666098.30681	-178186.12145	4330463.71522	A	GRE
261	LEIT 19428M001	4663520.89919	-155858.65055	4334519.92683	A	GRE
334	ORON 19427M001	4659695.74152	-130864.66931	4338948.92915	A	GRE
345	PAS2 19351S001	4644909.02728	-156645.00178	4353623.12027	A	GRE
493	PASA 19351S001	4644909.02743	-156645.00187	4353623.12027	A	GRE
553	RIO1 13448M002	4708446.79011	-199490.21411	4284089.77732	A	GRE
558	SALA 13469M001	4803054.45083	-462131.00238	4158379.11908	A	GR
526	SCOA 10088M002	4639940.47342	-136224.87834	4359552.46360	W	GRE
443	TERU 13487M001	4867391.28258	-95523.27619	4108341.72622	A	GRE
616	YEBE 13420M001	4848724.53099	-261631.85883	4123094.37068	W	GRE
655	ZARA 13462M001	4773803.13095	-73505.91742	4215454.13718	W	GRE

5.2 ETRF2000 (ETRS89) Coordinates

European **T**errestrial **R**eference **S**ystem, **1989** (**ETRS89**) is realized by ETRF2000 (Boucher and Altamimi, 2011) and (Altamimi, 2017).

CONVERT TO ETRF2000 21-DEC-23 12:48

LOCAL GEODETIC DATUM: ETRF2000 EPOCH: 2022-12-21 11:59:45

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG	SYSTEM
111	ACOR 13434M001	4594489.86408	-678367.97571	4357065.86227	W	
50	ALSA 19419M001	4677251.19186	-176770.94672	4319079.44972	A	
384	BIAZ 10074M002	4634456.41813	-124345.51928	4365785.03874	W	
101	BIDA 00000M000	4644178.18740	-145778.86951	4354832.06247	A	
573	CACE 13447M001	4899866.79651	-544567.61004	4033769.76130	W	
592	CANT 13438M001	4625924.66426	-307096.77868	4365771.14384	W	
908	CREU 13432M001	4715420.53907	273177.50933	4271946.42727	W	
135	EBRE 13410M001	4833520.36322	41536.82799	4147461.28832	W	
180	ELGE 19353S001	4657557.75364	-202242.01553	4338991.47155	A	
257	HOND 15012M002	4640529.68414	-145676.53062	4358781.33876	A	
235	IGEL 19352S001	4645951.79164	-165575.04823	4352550.00995	A	
240	ISPS 19484M001	4640596.83684	-206964.32237	4356391.49466	A	
252	LARE 19440M001	4632832.30908	-279026.68565	4360314.01416	A	
256	LAZK 19354S001	4666098.70225	-178186.73665	4330463.25405	A	
261	LEIT 19428M001	4663521.29786	-155859.26540	4334519.46618	A	
334	ORON 19427M001	4659696.14379	-130865.28364	4338948.46916	A	
345	PAS2 19351S001	4644909.42733	-156645.61446	4353622.66117	A	
493	PASA 19351S001	4644909.42748	-156645.61455	4353622.66117	A	
553	RIO1 13448M002	4708447.17916	-199490.83428	4284089.31230	A	
558	SALA 13469M001	4803054.79577	-462131.63404	4158378.64253	A	
526	SCOA 10088M002	4639940.87659	-136225.49039	4359552.00519	W	
443	TERU 13487M001	4867391.67150	-95523.91443	4108341.24921	A	
616	YEBE 13420M001	4848724.89938	-261632.49535	4123093.89301	W	
655	ZARA 13462M001	4773803.53110	-73506.54481	4215453.66836	W	

5.3 ETRF2014 (ETRS89) Coordinates

European **T**errestrial **R**eference **S**ystem, **1989** (**ETRS89**) is realized by ETRF2014 (Boucher and Altamimi, 2011) and (Altamimi, 2017).

CONVERT TO ETRF2014 21-DEC-23 12:48

LOCAL GEODETIC DATUM: ETRF2014 EPOCH: 2022-12-21 11:59:45

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG	SYSTEM
111	ACOR 13434M001	4594489.82367	-678368.01302	4357065.91409	W	
50	ALSA 19419M001	4677251.14907	-176770.98549	4319079.50144	A	
384	BIAZ 10074M002	4634456.37563	-124345.55842	4365785.09063	W	
101	BIDA 00000M000	4644178.14487	-145778.90853	4354832.11432	A	
573	CACE 13447M001	4899866.75234	-544567.64651	4033769.81230	W	
592	CANT 13438M001	4625924.62245	-307096.81720	4365771.19567	W	
908	CREU 13432M001	4715420.49420	273177.46913	4271946.47920	W	
135	EBRE 13410M001	4833520.31794	41536.78912	4147461.33975	W	
180	ELGE 19353S001	4657557.71115	-202242.05429	4338991.52332	A	
257	HOND 15012M002	4640529.64165	-145676.56966	4358781.39061	A	
235	IGEL 19352S001	4645951.74915	-165575.08717	4352550.06177	A	
240	ISPS 19484M001	4640596.79455	-206964.36119	4356391.54648	A	
252	LARE 19440M001	4632832.26710	-279026.72424	4360314.06598	A	
256	LAZK 19354S001	4666098.65959	-178186.77546	4330463.30581	A	
261	LEIT 19428M001	4663521.25515	-155859.30430	4334519.51796	A	
334	ORON 19427M001	4659696.10104	-130865.32265	4338948.52096	A	
345	PAS2 19351S001	4644909.38482	-156645.65344	4353622.71301	A	
493	PASA 19351S001	4644909.38497	-156645.65353	4353622.71301	A	
553	RIO1 13448M002	4708447.13611	-199490.87283	4284089.36393	A	
558	SALA 13469M001	4803054.75249	-462131.67123	4158378.69379	A	
526	SCOA 10088M002	4639940.83407	-136225.52946	4359552.05706	W	
443	TERU 13487M001	4867391.62633	-95523.95266	4108341.30046	A	
616	YEBE 13420M001	4848724.85497	-261632.53307	4123093.94422	W	
655	ZARA 13462M001	4773803.48690	-73506.58353	4215453.71987	W	

6 Quality Control

6.1 Mean and Daily Repeatabilities

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

GFA FINAL WEEKLY COMBINATION: FINAL ORBITS 21-DEC-23 12:48

Station	#Days	Weekday 0123456	Repeatability (mm) N	E	U
ACOR 13434M001	7	XXXXXXX	2.39	0.87	2.78
ALSA 19419M001	7	XXXXXXX	3.00	4.99	7.38
BIAZ 10074M002	7	XXXXXXX	1.10	1.37	5.54
BIDA 00000M000	7	XXXXXXX	0.99	0.84	4.65
CACE 13447M001	7	XXXXXXX	0.69	0.64	1.71
CANT 13438M001	7	XXXXXXX	1.04	1.58	3.33
CREU 13432M001	7	XXXXXXX	2.05	0.84	2.04
EBRE 13410M001	7	XXXXXXX	2.08	1.52	5.85
ELGE 19353S001	7	XXXXXXX	2.83	3.85	3.86
HOND 15012M002	7	XXXXXXX	1.10	0.93	3.44
IGEL 19352S001	7	XXXXXXX	3.58	1.56	4.97
ISPS 19484M001	7	XXXXXXX	1.61	2.76	7.25
LARE 19440M001	7	XXXXXXX	1.22	1.58	6.55
LAZK 19354S001	7	XXXXXXX	2.33	3.82	7.16
LEIT 19428M001	7	XXXXXXX	3.82	1.58	3.85
ORON 19427M001	7	XXXXXXX	4.62	1.13	4.41
PAS2 19351S001	7	XXXXXXX	2.08	1.12	3.11
PASA 19351S001	7	XXXXXXX	2.08	1.15	2.78
RIO1 13448M002	7	XXXXXXX	0.57	0.52	3.58
SALA 13469M001	7	XXXXXXX	0.61	0.72	2.56
SCOA 10088M002	4	XXX X	2.05	1.32	5.86
TERU 13487M001	7	XXXXXXX	0.67	0.84	1.60
YEBE 13420M001	7	XXXXXXX	0.44	0.40	2.20
ZARA 13462M001	7	XXXXXXX	0.62	0.63	2.04

Comparison of individual solutions:

ACOR 13434M001	N	2.39	1.56	-3.89	1.34	-0.19	1.08	2.97	2.22
ACOR 13434M001	E	0.87	1.32	-0.74	-0.25	-0.78	0.02	1.26	0.17
ACOR 13434M001	U	2.78	4.03	-3.75	-2.90	-0.88	1.07	2.01	-1.27
ALSA 19419M001	N	3.00	-1.59	-5.69	3.54	-0.04	1.26	-1.35	1.79
ALSA 19419M001	E	4.99	2.65	6.19	3.52	-4.23	-0.66	-8.55	0.42
ALSA 19419M001	U	7.38	-13.98	7.31	-2.68	5.21	4.66	-1.65	4.33
BIAZ 10074M002	N	1.10	-0.37	0.06	-0.95	1.16	-0.40	-0.29	2.16
BIAZ 10074M002	E	1.37	-1.61	-0.54	0.22	-1.74	-1.95	-0.96	-0.74
BIAZ 10074M002	U	5.54	3.12	1.79	10.29	-1.34	-2.88	1.14	-7.35
BIDA 00000M000	N	0.99	-0.26	-0.08	-0.04	1.07	1.52	-1.40	0.64
BIDA 00000M000	E	0.84	-0.74	-0.10	-0.69	-0.83	-1.34	-0.16	-0.84
BIDA 00000M000	U	4.65	-2.63	6.79	3.53	-6.06	-2.80	1.93	-3.99
CACE 13447M001	N	0.69	0.20	-0.63	0.20	-0.97	-0.22	1.04	-0.59
CACE 13447M001	E	0.64	0.21	-1.11	-0.89	0.52	0.23	-0.13	-0.20
CACE 13447M001	U	1.71	1.56	1.30	2.82	-0.64	-2.05	0.46	0.83
CANT 13438M001	N	1.04	0.98	2.25	-0.27	-0.14	0.15	-0.00	0.56
CANT 13438M001	E	1.58	-1.22	-2.15	0.68	-1.18	-1.04	-0.67	-2.32
CANT 13438M001	U	3.33	1.19	4.67	4.20	-3.63	2.32	-0.33	-2.66
CREU 13432M001	N	2.05	-2.00	3.25	2.28	-1.38	-0.23	-1.78	-0.62
CREU 13432M001	E	0.84	-0.90	-0.02	1.61	-0.25	-0.65	-0.12	-0.56
CREU 13432M001	U	2.04	-2.99	-0.93	1.83	-2.49	1.20	-1.99	0.56
EBRE 13410M001	N	2.08	-1.09	-0.94	-1.19	2.96	2.63	-2.57	-0.15
EBRE 13410M001	E	1.52	-0.89	-0.38	-0.48	1.18	-1.32	2.78	-1.39
EBRE 13410M001	U	5.85	-3.66	-2.73	-1.40	-9.31	9.28	2.21	2.17
ELGE 19353S001	N	2.83	1.07	-1.77	-5.66	0.40	1.11	3.23	-0.22
ELGE 19353S001	E	3.85	-3.21	-2.71	-0.33	-2.20	-3.46	5.47	4.95
ELGE 19353S001	U	3.86	-2.99	0.64	-4.14	-6.37	3.44	2.44	-2.10
HOND 15012M002	N	1.10	0.69	0.26	-2.06	0.79	1.10	-0.25	0.72
HOND 15012M002	E	0.93	-0.08	-0.17	-1.06	-0.32	-1.45	-0.11	-1.35
HOND 15012M002	U	3.44	-0.21	2.01	5.82	-3.92	-2.04	-0.49	-3.62
IGEL 19352S001	N	3.58	5.30	0.86	-0.70	-3.07	-2.18	-3.66	4.49
IGEL 19352S001	E	1.56	-1.65	-0.42	-0.54	-1.16	-1.51	-1.50	2.34
IGEL 19352S001	U	4.97	-5.42	7.48	4.41	-6.18	-1.70	0.99	-1.11
ISPS 19484M001	N	1.61	-0.76	2.50	2.21	-0.61	-1.11	1.49	0.12
ISPS 19484M001	E	2.76	-4.01	-1.29	2.38	-3.23	-2.09	0.03	-2.73
ISPS 19484M001	U	7.25	-7.33	10.32	10.81	0.11	0.95	-1.65	-5.91
LARE 19440M001	N	1.22	0.84	1.83	1.08	0.88	-0.44	-1.45	0.85
LARE 19440M001	E	1.58	-1.61	1.56	-1.07	-1.79	-1.15	0.81	-1.89
LARE 19440M001	U	6.55	-3.30	10.30	10.36	-2.25	-2.73	-3.82	-2.47
LAZK 19354S001	N	2.33	-3.81	1.81	-2.68	-1.17	-0.21	1.97	1.50
LAZK 19354S001	E	3.82	-4.81	-0.44	-1.10	-0.32	-3.28	6.59	2.93
LAZK 19354S001	U	7.16	-0.21	1.10	-5.99	-7.02	-2.04	14.46	2.88
LEIT 19428M001	N	3.82	-0.78	0.58	7.15	-0.42	-0.24	-4.34	-4.03
LEIT 19428M001	E	1.58	1.26	2.04	1.39	-0.36	-1.43	-1.95	-1.11
LEIT 19428M001	U	3.85	-3.70	-3.20	1.92	-3.45	4.85	4.10	3.00
ORON 19427M001	N	4.62	-2.61	9.52	1.49	-2.34	-1.45	-3.83	2.51
ORON 19427M001	E	1.13	-1.76	-0.58	-0.90	1.67	0.69	0.00	-0.30
ORON 19427M001	U	4.41	4.78	-4.94	-5.49	-0.66	1.48	0.72	6.01
PAS2 19351S001	N	2.08	-0.60	1.66	1.22	0.05	1.33	0.97	-4.32
PAS2 19351S001	E	1.12	-1.13	-0.35	-0.05	-0.07	-0.55	-0.03	-2.41
PAS2 19351S001	U	3.11	-3.36	2.66	2.99	-3.90	-0.30	2.42	-3.07
PASA 19351S001	N	2.08	-0.55	1.67	1.33	0.32	1.38	1.09	-4.24
PASA 19351S001	E	1.15	-1.50	-0.29	0.04	-0.03	-0.44	0.01	-2.33
PASA 19351S001	U	2.78	-2.78	2.18	3.01	-3.99	-0.24	1.89	-2.29
RIO1 13448M002	N	0.57	-1.01	0.49	-0.00	-0.61	-0.32	-0.04	-0.48
RIO1 13448M002	E	0.52	-0.13	0.09	0.15	0.23	0.50	0.94	-0.60
RIO1 13448M002	U	3.58	-1.97	0.40	6.50	1.45	3.40	-4.11	-0.27
SALA 13469M001	N	0.61	-0.23	0.76	0.43	0.27	0.15	0.79	-0.84
SALA 13469M001	E	0.72	-0.07	0.96	-1.39	-0.03	-0.10	0.47	-0.09
SALA 13469M001	U	2.56	-0.57	1.76	3.18	-0.34	-3.87	2.30	2.34
SCOA 10088M002	N	2.05		0.96	-2.75	0.61		1.92	
SCOA 10088M002	E	1.32		-1.53	-1.29	0.83		0.71	
SCOA 10088M002	U	5.86		0.24	7.88	-6.28		1.15	
TERU 13487M001	N	0.67	-0.38	-0.97	0.59	0.55	-0.67	-0.26	0.66
TERU 13487M001	E	0.84	0.18	0.33	-1.14	-0.15	1.11	-0.67	1.03
TERU 13487M001	U	1.60	-0.58	-0.30	0.29	-3.02	2.36	-0.40	-0.04
YEBE 13420M001	N	0.44	-0.04	0.43	0.35	0.60	-0.02	0.55	-0.47

YEBE	13420M001	E	0.40	-0.07	-0.37	-0.30	0.73	-0.25	0.21	-0.29
YEBE	13420M001	U	2.20	0.83	-1.81	2.41	3.59	-2.05	0.50	1.37
ZARA	13462M001	N	0.62	-0.32	0.18	-0.09	-0.07	0.00	-1.42	-0.34
ZARA	13462M001	E	0.63	-0.34	-0.00	-0.39	0.13	-0.25	1.42	0.17
ZARA	13462M001	U	2.04	0.77	-1.93	-0.57	1.31	2.50	3.28	1.30

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 |       1.51     -0.44     -4.45 |   |
|   2 | ALAC 13433M001   | I W |      -0.04      0.14      2.80 |   |
|   3 | ALME 13437M001   | I W |      -1.04     -0.09      3.52 |   |
|   4 | BCL1 19482M001   | I W |      -0.53      1.20     -1.32 |   |
|   5 | BELL 13431M001   | I W |       0.99      0.62      1.26 |   |
|   6 | BIAZ 10074M002   | I W |       2.28      0.25     -2.47 |   |
|   7 | BORR 13480M001   | I W |      -0.53     -3.40     -0.42 |   |
|   8 | BRST 10004M004   | I W |       0.63     -2.02      5.37 |   |
|   9 | CACE 13447M001   | I W |       1.16      0.18      3.12 |   |
|  10 | CANT 13438M001   | I W |       1.35     -0.22     -5.08 |   |
|  11 | CEU1 13449M002   | I W |       0.39     -0.45      0.33 |   |
|  12 | CREU 13432M001   | I W |      -1.52     -2.11     -5.29 |   |
|  13 | EBRE 13410M001   | I W |      -0.14     -0.06     -1.64 |   |
|  14 | ESCO 13435M001   | I W |      -1.98      0.80      5.10 |   |
|  15 | FUER 31330M001   | I W |      -1.07     -1.00     -0.72 |   |
|  16 | HUEL 13451M001   | I W |       0.28      1.65     -4.82 |   |
|  17 | IBIZ 13454S001   | I W |       0.41      0.98      3.63 |   |
|  18 | IZAN 31309M002   | I W |      -2.80     -0.38     -1.01 |   |
|  19 | LLIV 13436M001   | I W |      -0.08      1.44      3.58 |   |
|  20 | LPAL 81701M001   | I W |      -1.21     -1.55     -4.17 |   |
|  21 | LROC 10023M001   | I W |       0.90      0.94     -2.36 |   |
|  22 | MADR 13407S012   | I W |      -2.83     -0.75     -3.80 |   |
|  23 | MAL1 13444M002   | I W |       1.28      1.10     -1.69 |   |
|  24 | MALA 13443M001   | I W |       2.64     -2.32      1.71 |   |
|  25 | MALL 13444M001   | I W |      -0.50      0.40      4.30 |   |
|  26 | MAS1 31303M002   | I W |      -3.33     -2.37      1.25 |   |
|  27 | MELI 19379M001   | I W |      -1.14      0.20      2.70 |   |
|  28 | SCOA 10088M002   | I W |       3.38      2.87    -12.17 |   |
|  29 | SFER 13402M004   | I W |      -1.41     -2.23      3.02 |   |
|  30 | VALE 13439M001   | I W |       0.26      2.25     -0.50 |   |
|  31 | VIGO 13450M001   | I W |       1.19      2.55      3.88 |   |
|  32 | VILL 13406M001   | I W |      -0.80      0.43      5.37 |   |
|  33 | YEBE 13420M001   | I W |      -0.29     -0.42      4.90 |   |
|  34 | ZARA 13462M001   | I W |       0.33      1.05     -0.85 |   |
|  35 | ZIMM 14001M004   | I W |       1.39      0.33      0.53 |   |
|     |                  |     |                                |   |
-------------------------------------------------------------------
|     | RMS / COMPONENT  |     |       1.52      1.46      3.90 |   |
|     | IQR              |     |       2.23      1.73      5.88 |   |
|     | MEAN             |     |      -0.02     -0.01      0.10 |   |
|     | MEDIAN           |     |      -0.04      0.18      0.33 |   |
|     | MIN              |     |      -3.33     -3.40    -12.17 |   |
|     | MAX              |     |       3.38      2.87      5.37 |   |
-------------------------------------------------------------------
        OVERALL RMS/IQR/MAX(3D)        2.56      2.41     12.95       SCOA 10088M002      #SUM
-------------------------------------------------------------------
| ALL | RMS / COMPONENT  |     |       1.52      1.46      3.90 |   |
| ALL | IQR              |     |       2.23      1.73      5.88 |   |
| ALL | MEAN             |     |      -0.02     -0.01      0.10 |   |
| ALL | MEDIAN           |     |      -0.04      0.18      0.33 |   |
| ALL | MIN              |     |      -3.33     -3.40    -12.17 |   |
| ALL | MAX              |     |       3.38      2.87      5.37 |   |
-------------------------------------------------------------------
  ALL   OVERALL RMS/IQR/MAX(3D)        2.56      2.41     12.95       SCOA 10088M002      #SUM_ALL


NUMBER OF PARAMETERS  :     3
NUMBER OF STATIONS    :    35
NUMBER OF COORDINATES :   105
RMS OF TRANSFORMATION :    2.56 MM


PARAMETERS:

TRANSLATION IN  X     :          0.00     +-  0.43    MM
TRANSLATION IN  Y     :         -0.00     +-  0.43    MM
TRANSLATION IN  Z     :         -0.00     +-  0.43    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                       20195922
 NUMBER OF UNKNOWNS                             193264
 NUMBER OF DEGREES OF FREEDOM                 20002658
 PHASE MEASUREMENTS SIGMA                      0.00100
 SAMPLING INTERVAL (SECONDS)                       180
 VARIANCE FACTOR                    19.275243313081422
```

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 22:352:00000 22:358:86370 LEICA GR50           ----- -----------
 ALDA  A    1 P 22:352:00000 22:358:86370 LEICA GR30           ----- -----------
 ALSA  A    1 P 22:352:00000 22:358:86370 LEICA GR50           ----- -----------
 AMUR  A    1 P 22:352:00000 22:358:86370 LEICA GR30           ----- -----------
 BIAZ  A    1 P 22:352:00000 22:358:86370 SPECTRA SP90M        ----- -----------
 BIDA  A    1 P 22:352:00000 22:358:86370 LEICA GR10           ----- -----------
 BRZR  A    1 P 22:352:00000 22:358:86370 LEICA GR30           ----- -----------
 CACE  A    1 P 22:352:00000 22:358:86370 TRIMBLE NETR9        ----- -----------
 CANT  A    1 P 22:352:00000 22:358:86370 LEICA GR10           ----- -----------
 CREU  A    1 P 22:352:00000 22:358:86370 LEICA GR50           ----- -----------
 EBRE  A    1 P 22:352:00000 22:358:86370 LEICA GR50           ----- -----------
 ELGE  A    1 P 22:352:00000 22:358:86370 LEICA GR30           ----- -----------
 EMAZ  A    1 P 22:352:00000 22:358:86370 LEICA GR30           ----- -----------
 GERN  A    1 P 22:352:00000 22:358:86370 LEICA GR30           ----- -----------
 HOND  A    1 P 22:352:00000 22:358:86370 LEICA GR50           ----- -----------
 IGEL  A    1 P 22:352:00000 22:358:86370 LEICA GR30           ----- -----------
 ISPS  A    1 P 22:352:00000 22:358:86370 TRIMBLE NETR9        ----- -----------
 KAST  A    1 P 22:352:00000 22:358:86370 LEICA GR30           ----- -----------
 LARE  A    1 P 22:352:00000 22:358:86370 LEICA GR50           ----- -----------
 LAZK  A    1 P 22:352:00000 22:358:86370 LEICA GR30           ----- -----------
 LEIT  A    1 P 22:352:00000 22:358:86370 LEICA GR50           ----- -----------
 ORON  A    1 P 22:352:00000 22:358:86370 LEICA GR50           ----- -----------
 PAS2  A    1 P 22:352:00000 22:358:86370 STONEX SC2200        ----- -----------
 PASA  A    1 P 22:352:00000 22:358:86370 LEICA GR30           ----- -----------
 RIO1  A    1 P 22:352:00000 22:358:86370 LEICA GR25           ----- -----------
 SALA  A    1 P 22:352:00000 22:358:86370 LEICA GR50           ----- -----------
 SCOA  A    1 P 22:352:00000 22:358:86370 LEICA GR50           ----- -----------
 SOPU  A    1 P 22:352:00000 22:358:86370 LEICA GR30           ----- -----------
 TERU  A    1 P 22:352:00000 22:358:86370 LEICA GR50           ----- -----------
 VITO  A    1 P 22:352:00000 22:358:86370 LEICA GR30           ----- -----------
 YEBE  A    1 P 22:352:00000 22:358:86370 LEICA GR50           ----- -----------
 ZARA  A    1 P 22:352:00000 22:358:86370 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 22:352:00000 22:358:86370 LEIAT504        LEIS ----- 
 ALDA  A    1 P 22:352:00000 22:358:86370 LEIAS10         NONE ----- 
 ALSA  A    1 P 22:352:00000 22:358:86370 LEIAR10         NONE ----- 
 AMUR  A    1 P 22:352:00000 22:358:86370 LEIAS10         NONE ----- 
 BIAZ  A    1 P 22:352:00000 22:358:86370 LEIAR25         LEIT ----- 
 BIDA  A    1 P 22:352:00000 22:358:86370 LEIAS10         NONE ----- 
 BRZR  A    1 P 22:352:00000 22:358:86370 LEIAS10         NONE ----- 
 CACE  A    1 P 22:352:00000 22:358:86370 TRM29659.00     NONE ----- 
 CANT  A    1 P 22:352:00000 22:358:86370 LEIAR25.R4      LEIT ----- 
 CREU  A    1 P 22:352:00000 22:358:86370 LEIAR25.R4      NONE ----- 
 EBRE  A    1 P 22:352:00000 22:358:86370 LEIAR25.R4      NONE ----- 
 ELGE  A    1 P 22:352:00000 22:358:86370 LEIAR25.R4      LEIT ----- 
 EMAZ  A    1 P 22:352:00000 22:358:86370 LEIAS10         NONE ----- 
 GERN  A    1 P 22:352:00000 22:358:86370 LEIAS10         NONE ----- 
 HOND  A    1 P 22:352:00000 22:358:86370 LEIAR20         LEIM ----- 
 IGEL  A    1 P 22:352:00000 22:358:86370 LEIAR20         LEIM ----- 
 ISPS  A    1 P 22:352:00000 22:358:86370 TRM59900.00     SCIS ----- 
 KAST  A    1 P 22:352:00000 22:358:86370 LEIAS10         NONE ----- 
 LARE  A    1 P 22:352:00000 22:358:86370 LEIAR20         LEIM ----- 
 LAZK  A    1 P 22:352:00000 22:358:86370 LEIAR25.R4      LEIT ----- 
 LEIT  A    1 P 22:352:00000 22:358:86370 LEIAR10         NONE ----- 
 ORON  A    1 P 22:352:00000 22:358:86370 LEIAR10         NONE ----- 
 PAS2  A    1 P 22:352:00000 22:358:86370 LEIAR20         LEIM ----- 
 PASA  A    1 P 22:352:00000 22:358:86370 LEIAR20         LEIM ----- 
 RIO1  A    1 P 22:352:00000 22:358:86370 LEIAR25.R4      LEIT ----- 
 SALA  A    1 P 22:352:00000 22:358:86370 LEIAR25         NONE ----- 
 SCOA  A    1 P 22:352:00000 22:358:86370 TRM55971.00     NONE ----- 
 SOPU  A    1 P 22:352:00000 22:358:86370 LEIAS10         NONE ----- 
 TERU  A    1 P 22:352:00000 22:358:86370 LEIAR20         LEIM ----- 
 VITO  A    1 P 22:352:00000 22:358:86370 LEIAS10         NONE ----- 
 YEBE  A    1 P 22:352:00000 22:358:86370 LEIAR20         LEIM ----- 
 ZARA  A    1 P 22:352:00000 22:358:86370 TRM29659.00     NONE ----- 
```

7.3 Eccentricities

```
*                                        UP_____ NORTH___ EAST____
*SITE PT SOLN T DATA_START__ DATA_END____ AXE ARP->BENCHMARK(M)_________
 ACOR  A    1 P 22:352:00000 22:358:86370 UNE   3.0460   0.0000   0.0000
 ALDA  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 ALSA  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 AMUR  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 BIAZ  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 BIDA  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 BRZR  A    1 P 22:352:00000 22:358:86370 UNE   0.0771   0.0000   0.0000
 CACE  A    1 P 22:352:00000 22:358:86370 UNE   0.0600   0.0000   0.0000
 CANT  A    1 P 22:352:00000 22:358:86370 UNE   3.0490   0.0000   0.0000
 CREU  A    1 P 22:352:00000 22:358:86370 UNE   0.0770   0.0000   0.0000
 EBRE  A    1 P 22:352:00000 22:358:86370 UNE   0.0770   0.0000   0.0000
 ELGE  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 EMAZ  A    1 P 22:352:00000 22:358:86370 UNE   0.0350   0.0000   0.0000
 GERN  A    1 P 22:352:00000 22:358:86370 UNE   0.0771   0.0000   0.0000
 HOND  A    1 P 22:352:00000 22:358:86370 UNE   0.0771   0.0000   0.0000
 IGEL  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 ISPS  A    1 P 22:352:00000 22:358:86370 UNE   0.0350   0.0000   0.0000
 KAST  A    1 P 22:352:00000 22:358:86370 UNE   0.0350   0.0000   0.0000
 LARE  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 LAZK  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 LEIT  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 ORON  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 PAS2  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 PASA  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 RIO1  A    1 P 22:352:00000 22:358:86370 UNE   0.0606   0.0000   0.0000
 SALA  A    1 P 22:352:00000 22:358:86370 UNE   0.0600   0.0000   0.0000
 SCOA  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 SOPU  A    1 P 22:352:00000 22:358:86370 UNE   0.0771   0.0000   0.0000
 TERU  A    1 P 22:352:00000 22:358:86370 UNE   0.0600   0.0000   0.0000
 VITO  A    1 P 22:352:00000 22:358:86370 UNE   0.0000   0.0000   0.0000
 YEBE  A    1 P 22:352:00000 22:358:86370 UNE   0.0600   0.0000   0.0000
 ZARA  A    1 P 22:352:00000 22:358:86370 UNE   3.2590   0.0000   0.0000
```

8 Inconsistencies (logsheet-RINEX metadata)

The following inconsistencies were found comparing the data available in the logsheets and the RINEX headers:

```
2023-12-20 14:25 UTC | ISPS3520.22O | RECEIVER FIRM. VERS. |  5.30 -> 5.22 (source: isps00esp_20230913.log
2023-12-20 17:14 UTC | ISPS3530.22O | RECEIVER FIRM. VERS. |  5.30 -> 5.22 (source: isps00esp_20230913.log
2023-12-20 20:06 UTC | ISPS3540.22O | RECEIVER FIRM. VERS. |  5.30 -> 5.22 (source: isps00esp_20230913.log
2023-12-21 01:33 UTC | ISPS3550.22O | RECEIVER FIRM. VERS. |  5.30 -> 5.22 (source: isps00esp_20230913.log
2023-12-21 04:17 UTC | ISPS3560.22O | RECEIVER FIRM. VERS. |  5.30 -> 5.22 (source: isps00esp_20230913.log
2023-12-21 07:04 UTC | ISPS3570.22O | RECEIVER FIRM. VERS. |  5.30 -> 5.22 (source: isps00esp_20230913.log
2023-12-21 09:53 UTC | ISPS3580.22O | RECEIVER FIRM. VERS. |  5.30 -> 5.22 (source: isps00esp_20230913.log
2023-12-20 14:25 UTC | LARE3520.22O | RECEIVER FIRM. VERS. |  4.52/7.711 -> 4.31/7.403 (source: lare00esp_20230308.log
2023-12-20 17:14 UTC | LARE3530.22O | RECEIVER FIRM. VERS. |  4.52/7.711 -> 4.31/7.403 (source: lare00esp_20230308.log
2023-12-20 20:06 UTC | LARE3540.22O | RECEIVER FIRM. VERS. |  4.52/7.711 -> 4.31/7.403 (source: lare00esp_20230308.log
2023-12-21 01:33 UTC | LARE3550.22O | RECEIVER FIRM. VERS. |  4.52/7.711 -> 4.31/7.403 (source: lare00esp_20230308.log
2023-12-21 04:17 UTC | LARE3560.22O | RECEIVER FIRM. VERS. |  4.52/7.711 -> 4.31/7.403 (source: lare00esp_20230308.log
2023-12-21 07:04 UTC | LARE3570.22O | RECEIVER FIRM. VERS. |  4.52/7.711 -> 4.31/7.403 (source: lare00esp_20230308.log
2023-12-21 09:53 UTC | LARE3580.22O | RECEIVER FIRM. VERS. |  4.52/7.711 -> 4.31/7.403 (source: lare00esp_20230308.log
```

9 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

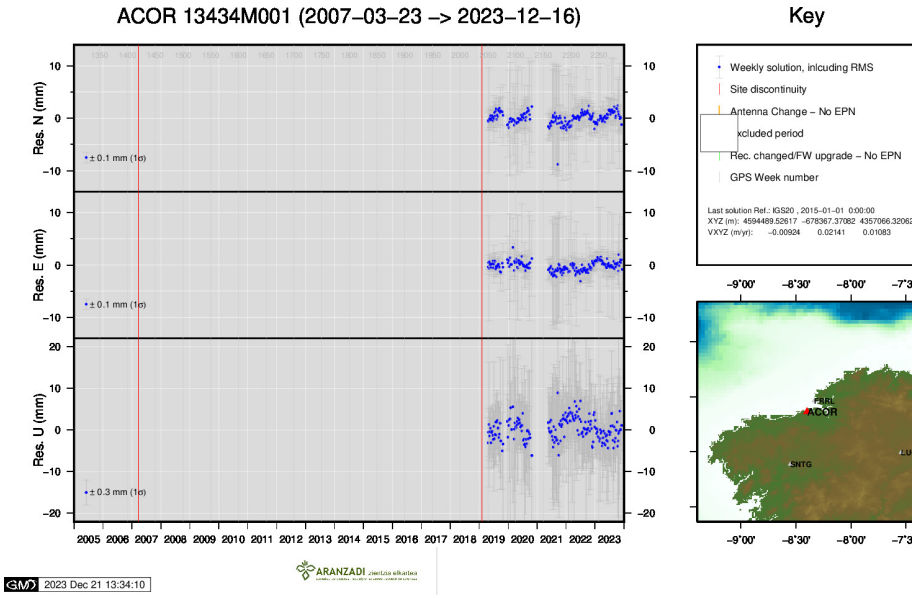
EPN Coordination Group and the EPN Central Bureau (2018): *Guidelines for the EPN Analysis Centres.* epncb.oma.be/$_d$*ocumentation/guidelines/guidelines*$_a$*nalysis*$_c$*entres.pdf*

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

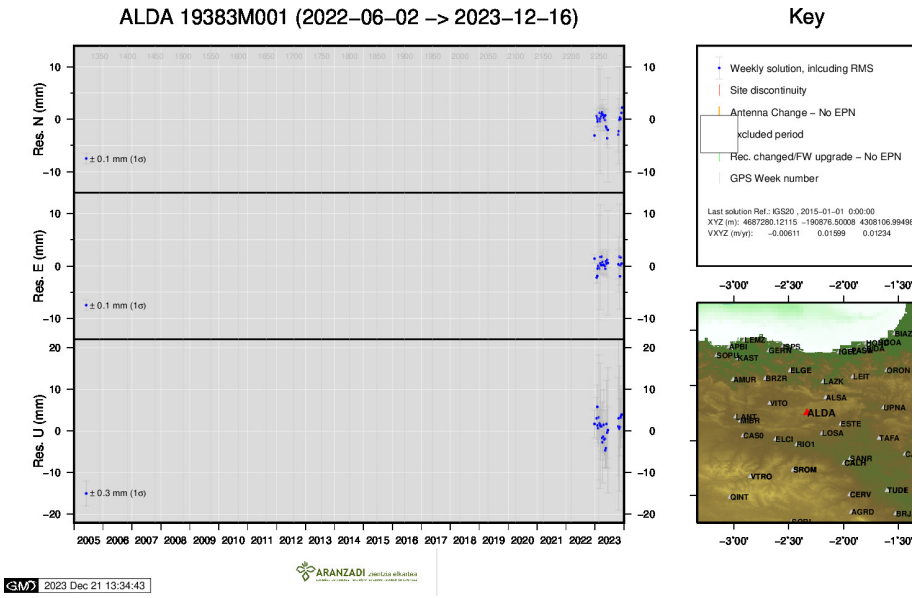
Z. Altamimi (2018): *EUREF Technical Note 1: Relationship and Transformation between the International and the European Terrestrial Reference Systems.* etrs89.ensg.ign.fr/pub/EUREF-TN-1.pdf

10 Cumulative Time Series

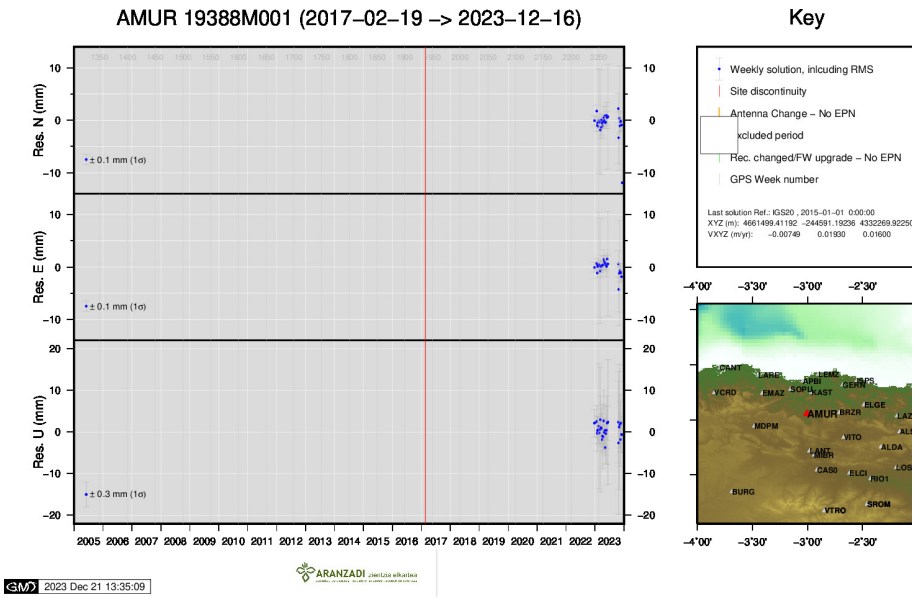
Time series of stations. Latest plots at: http://geolabpasaia.org/gnss/ARA-net/TSeries/, or click on the caption of each image.



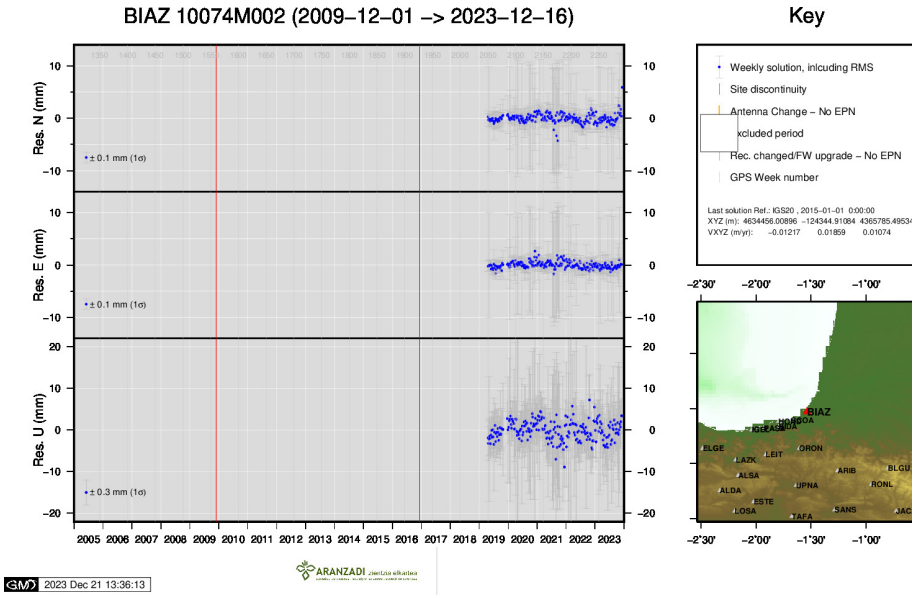
1) ACOR



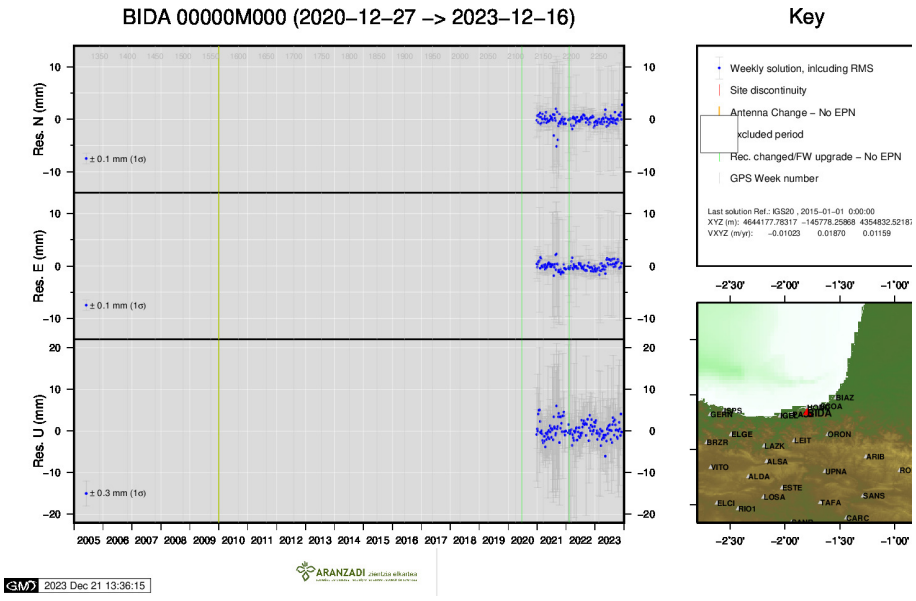
2) ALDA



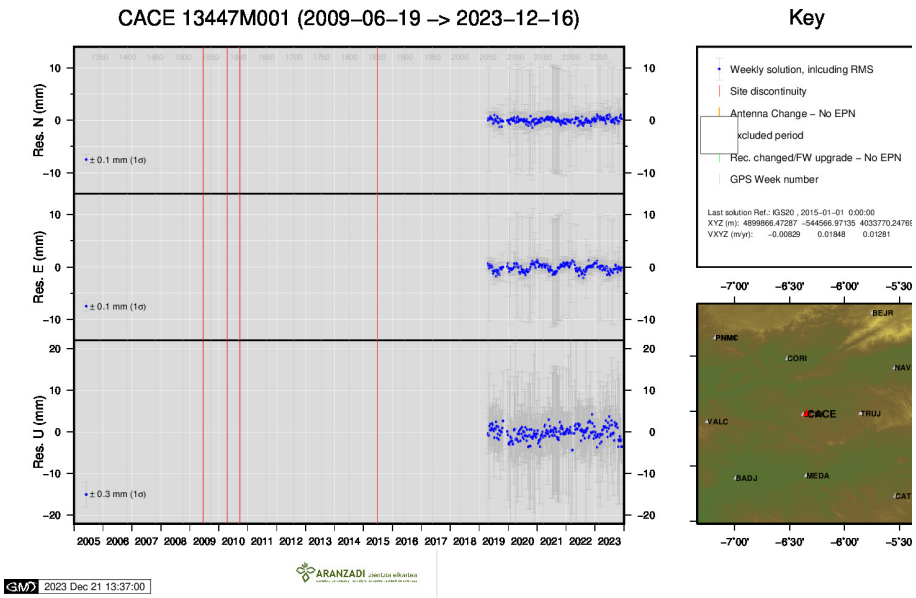
3) AMUR



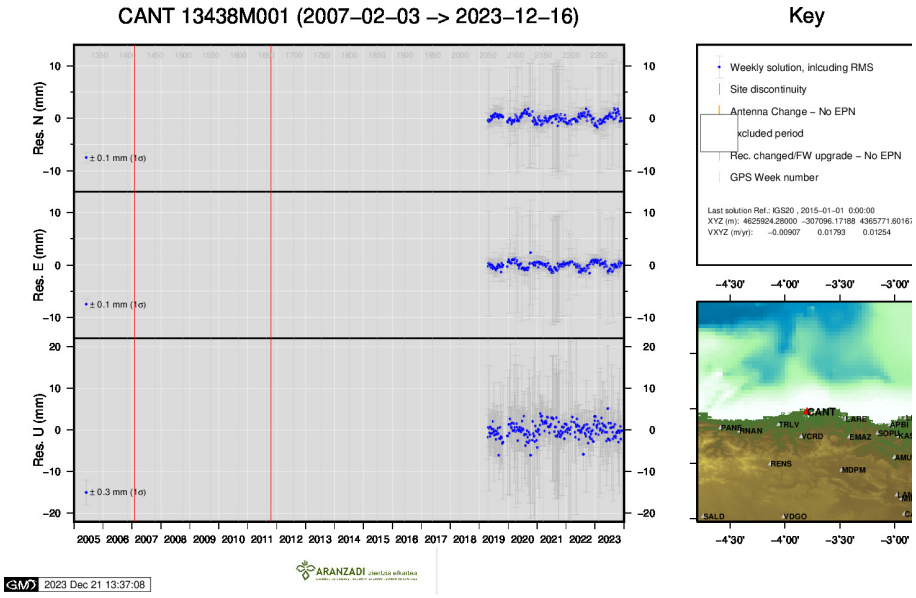
4) BIAZ



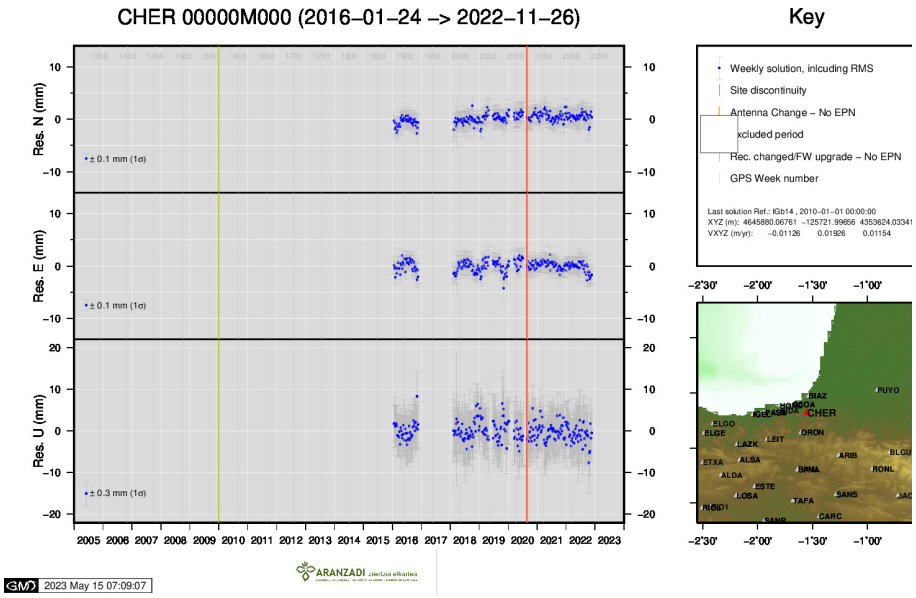
5) BIDA



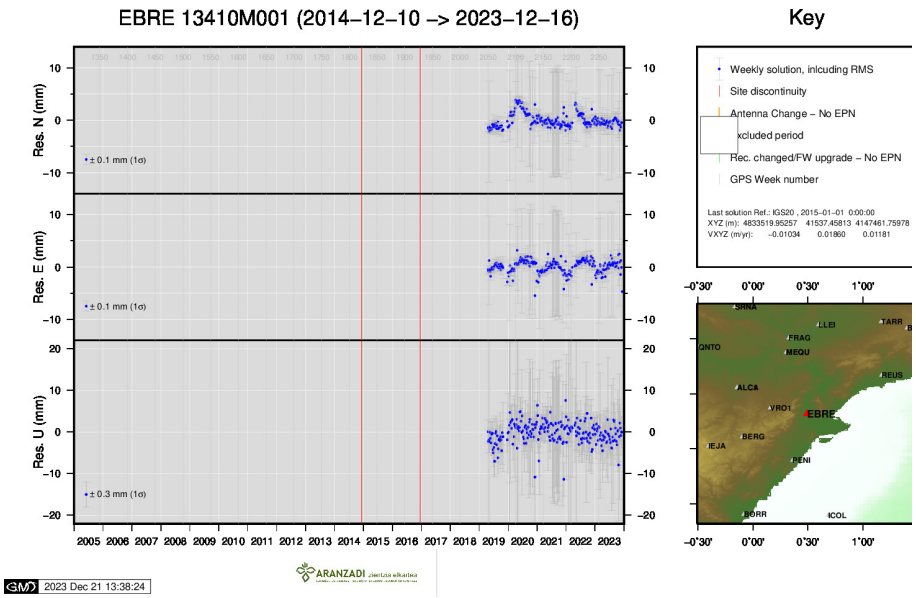
6) CACE



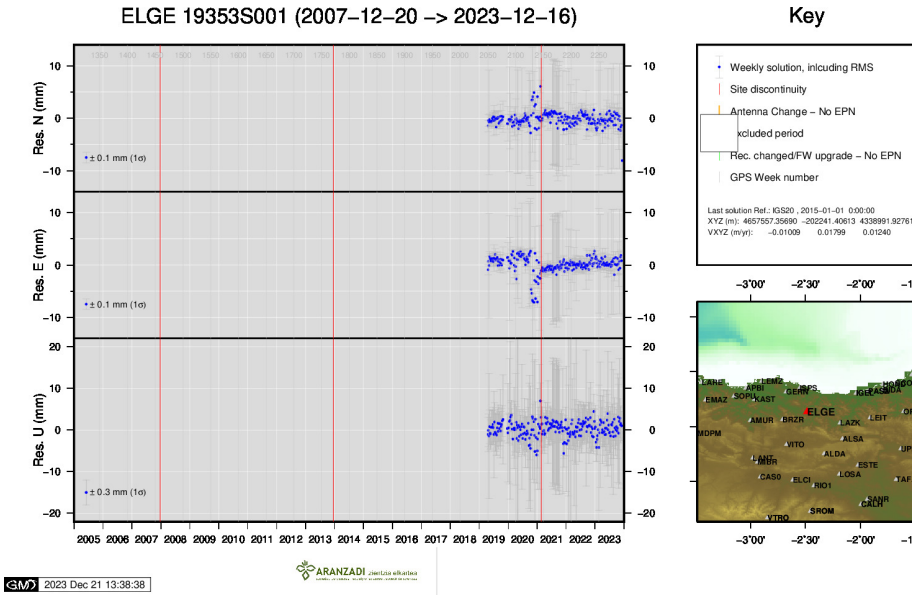
7) CANT



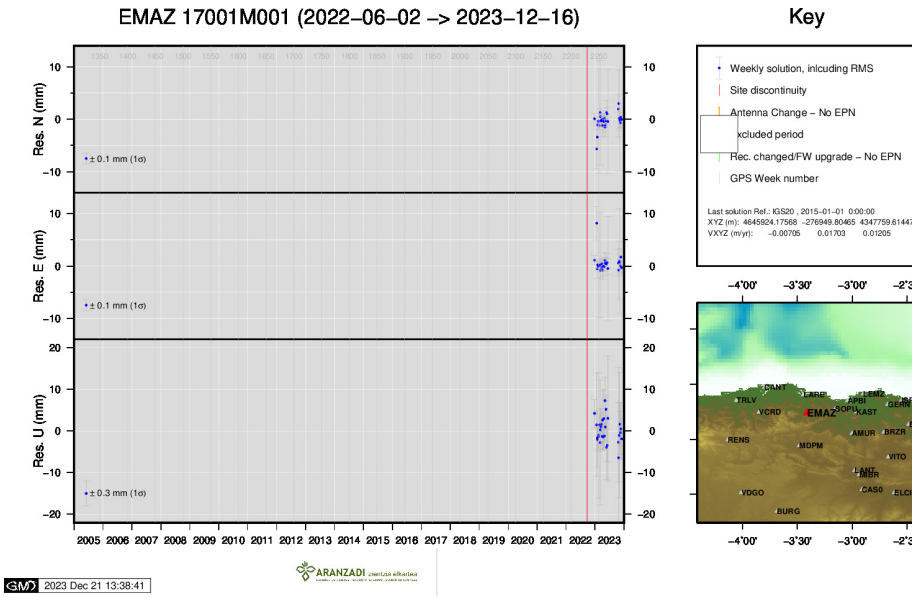
8) CHER



9) EBRE



10) ELGE



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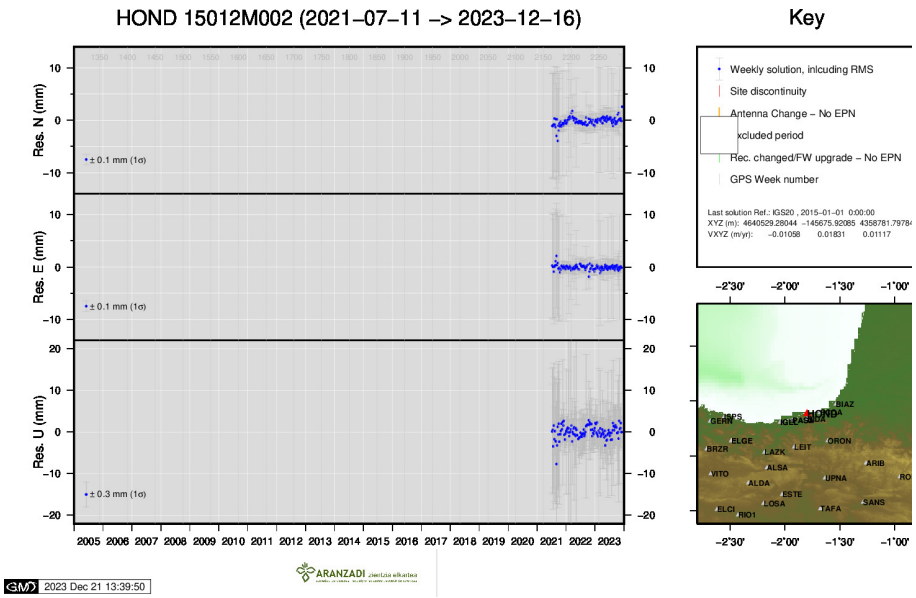

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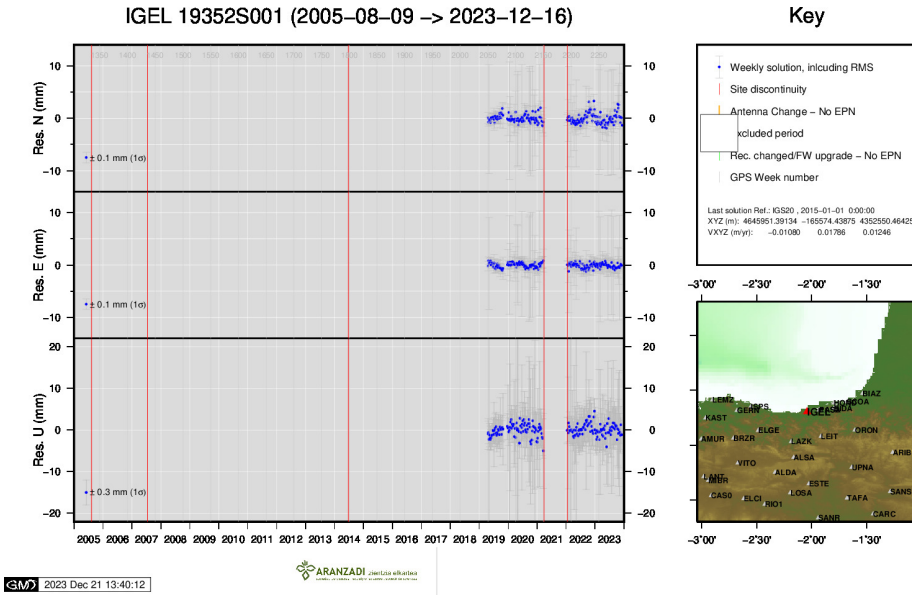

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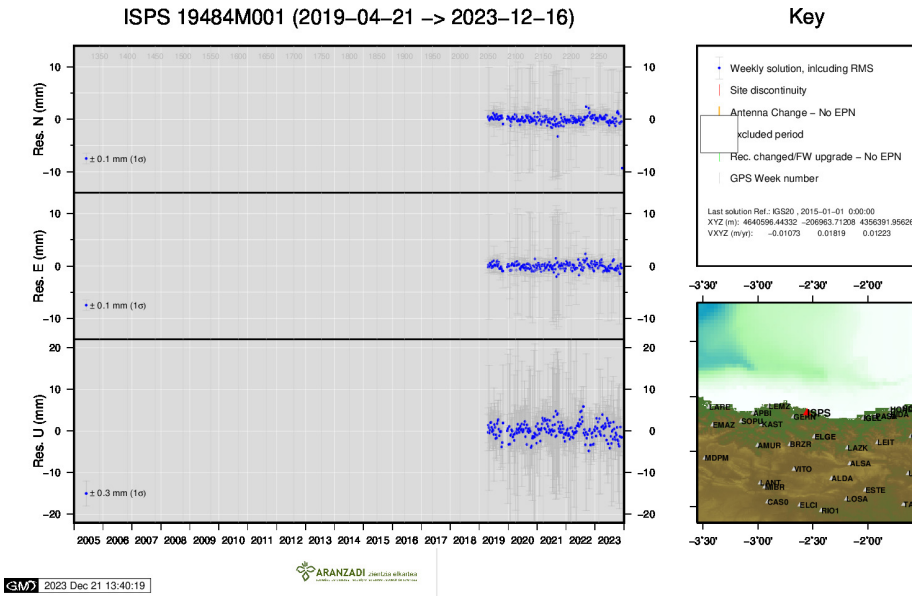

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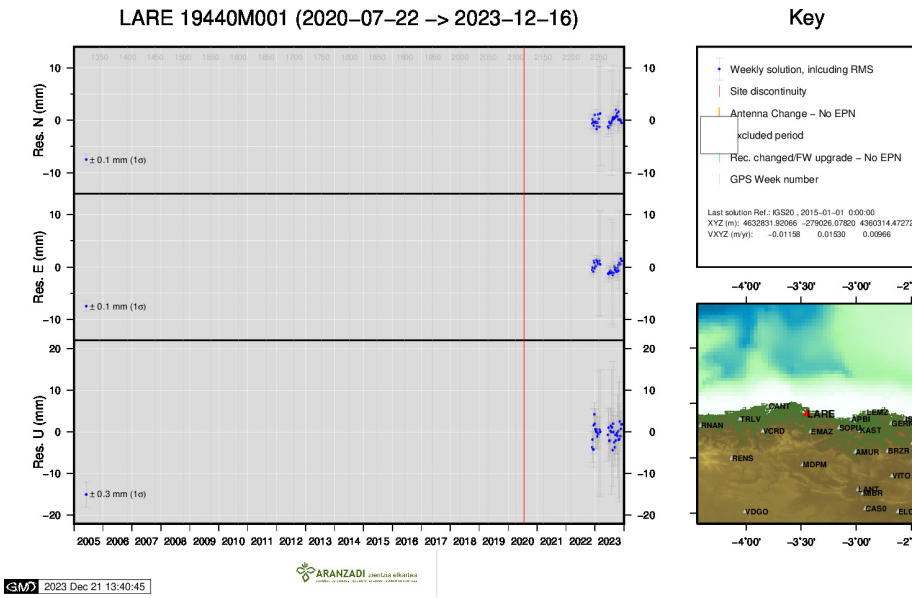
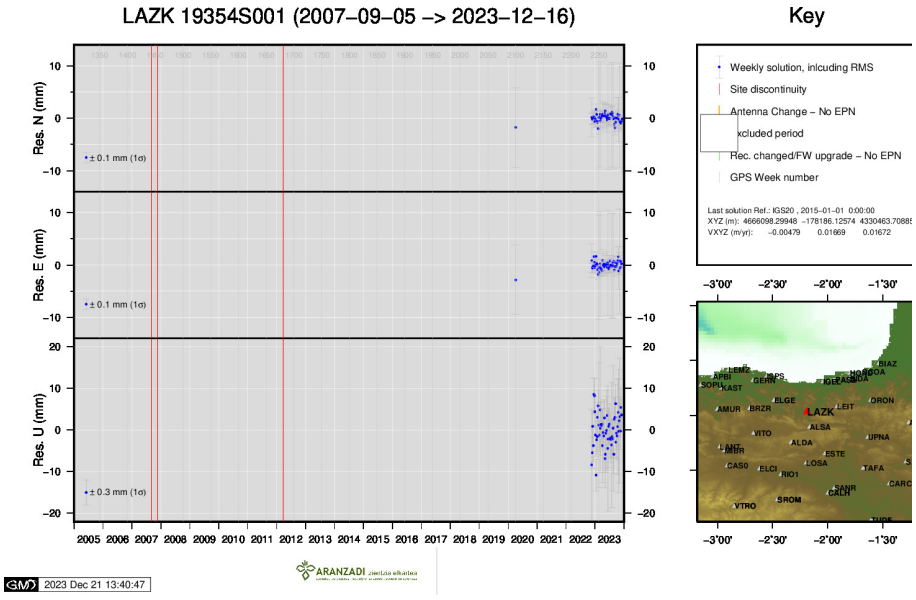
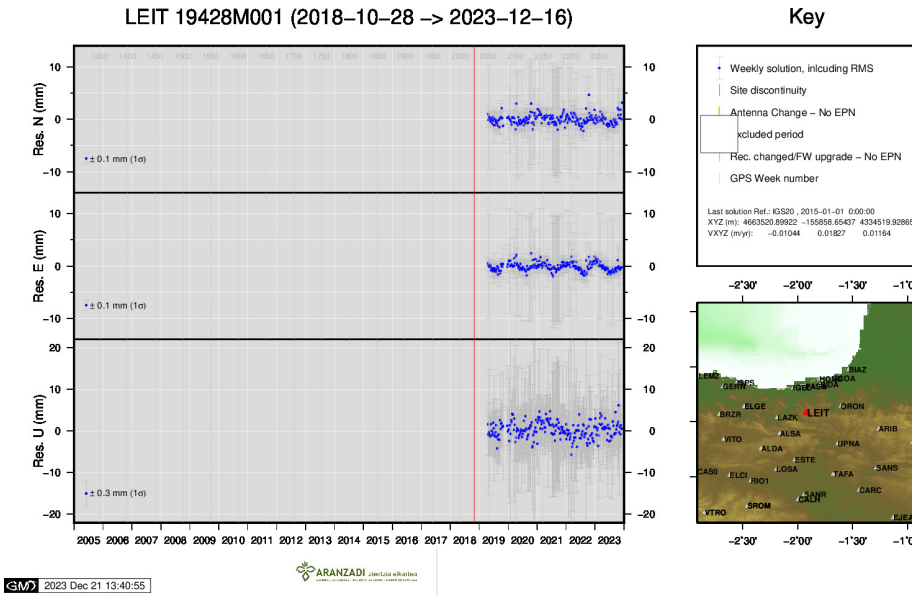


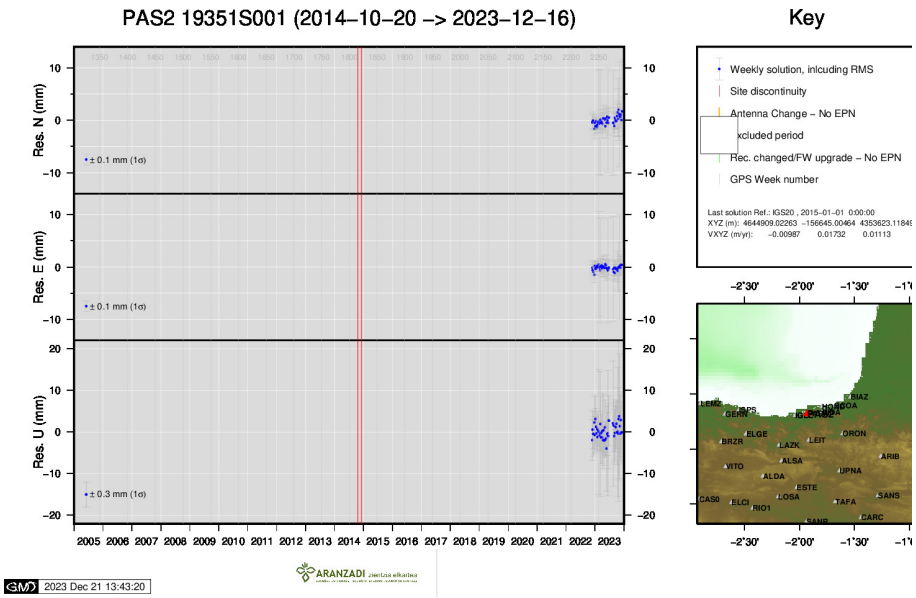
15) LARE



16) LAZK



17) LEIT



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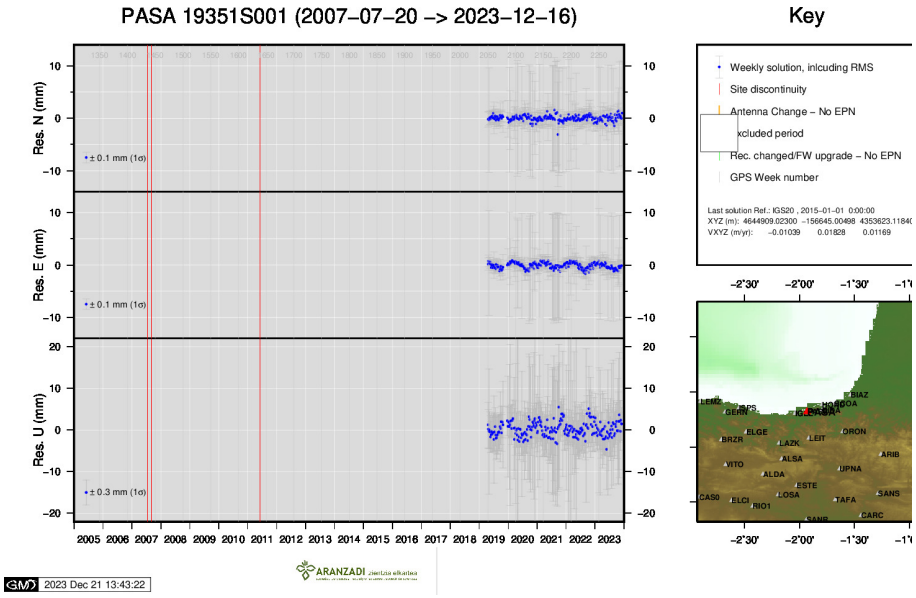

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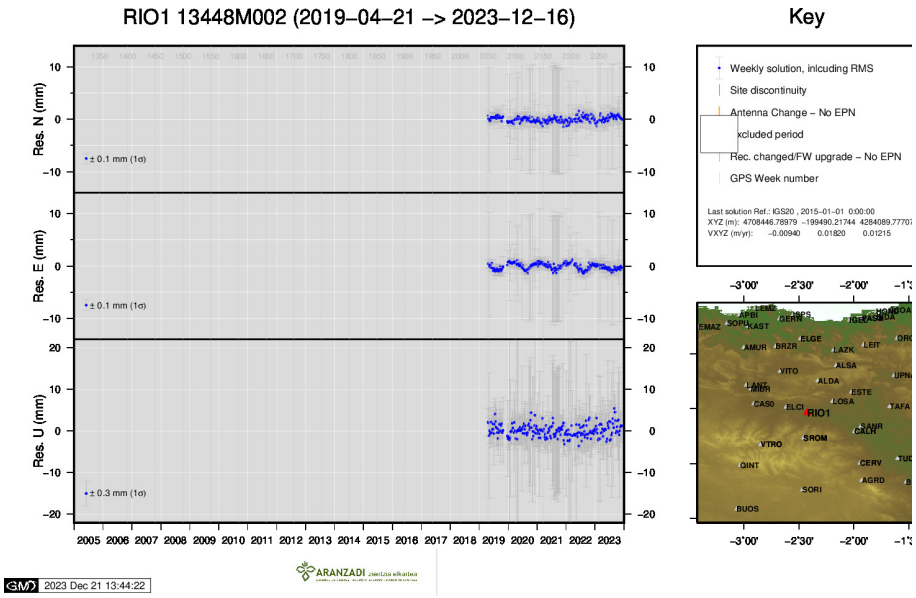

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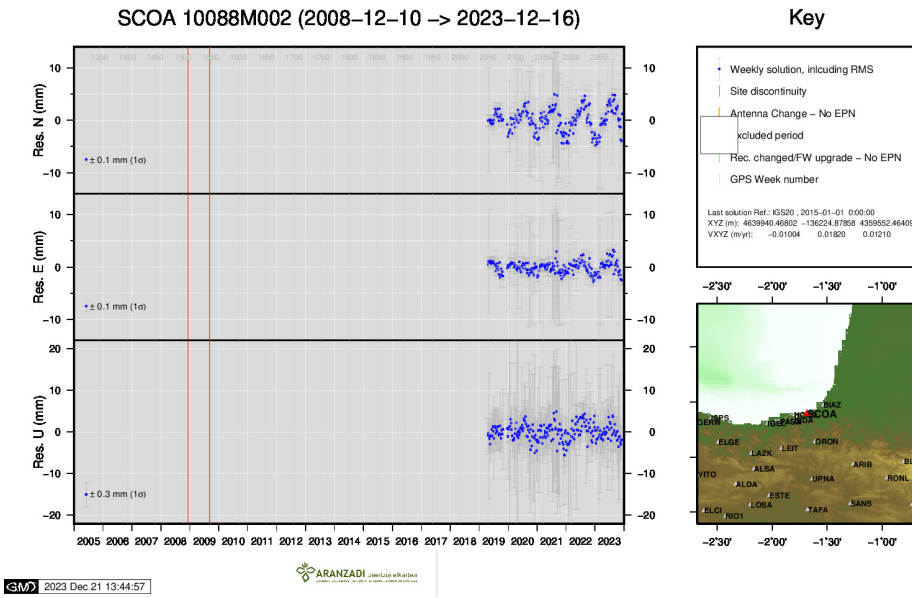

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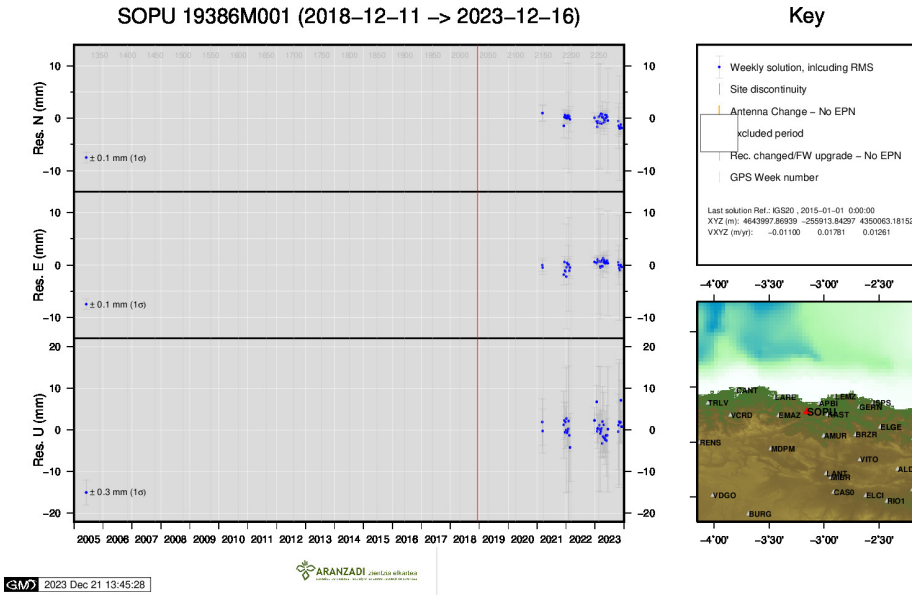

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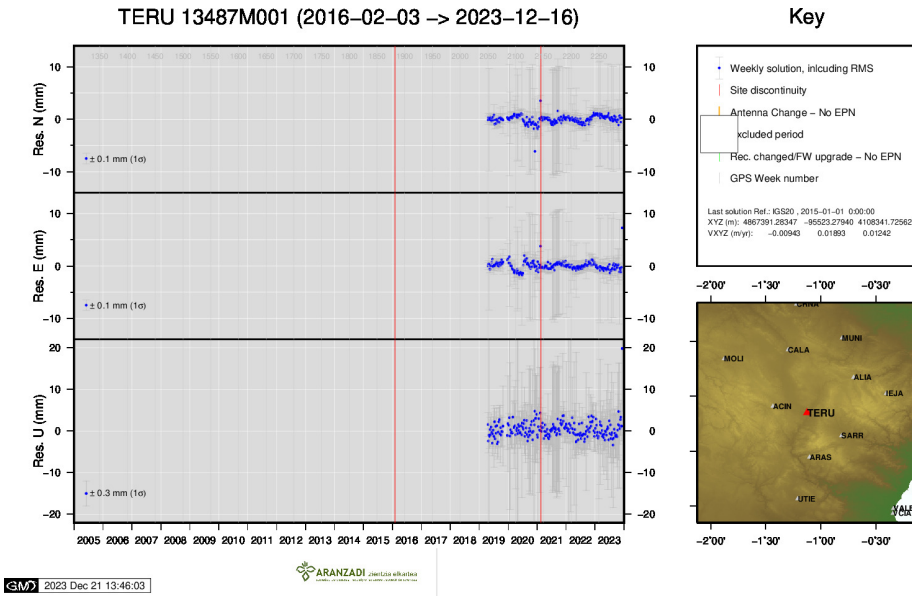

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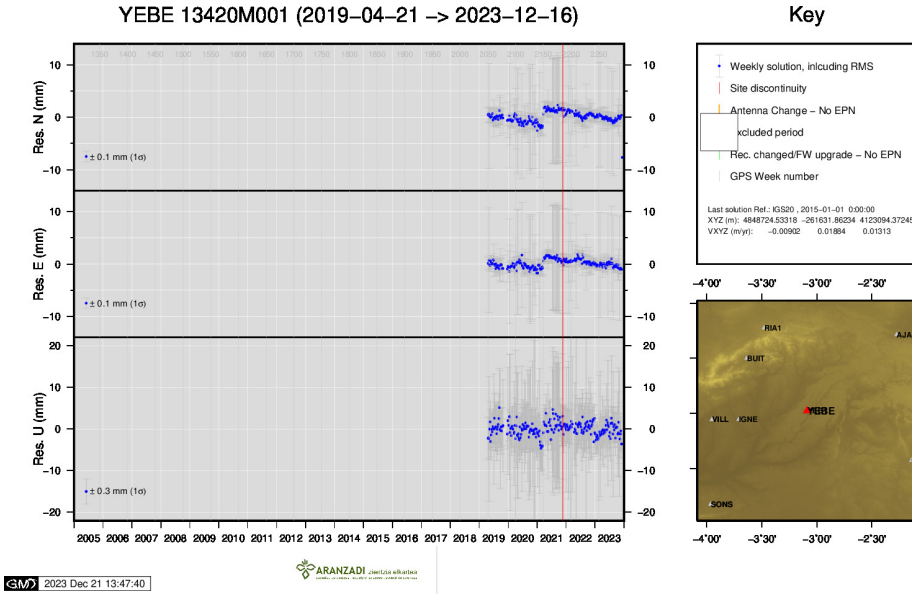

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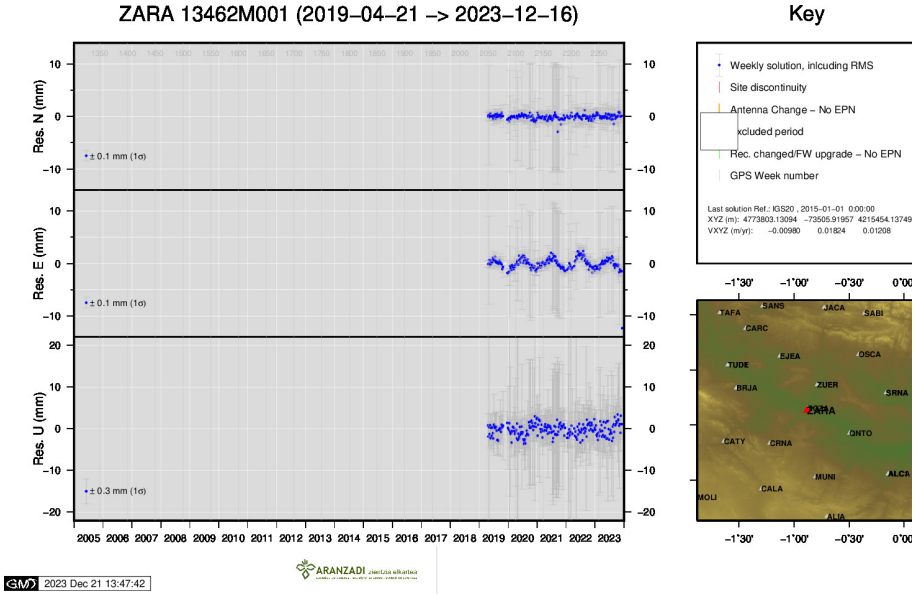

25) ZARA