# ARA-DAC Weekly Analysis Result: 2294 (GFA)

Technical Report

**GPS Week: 2294 (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

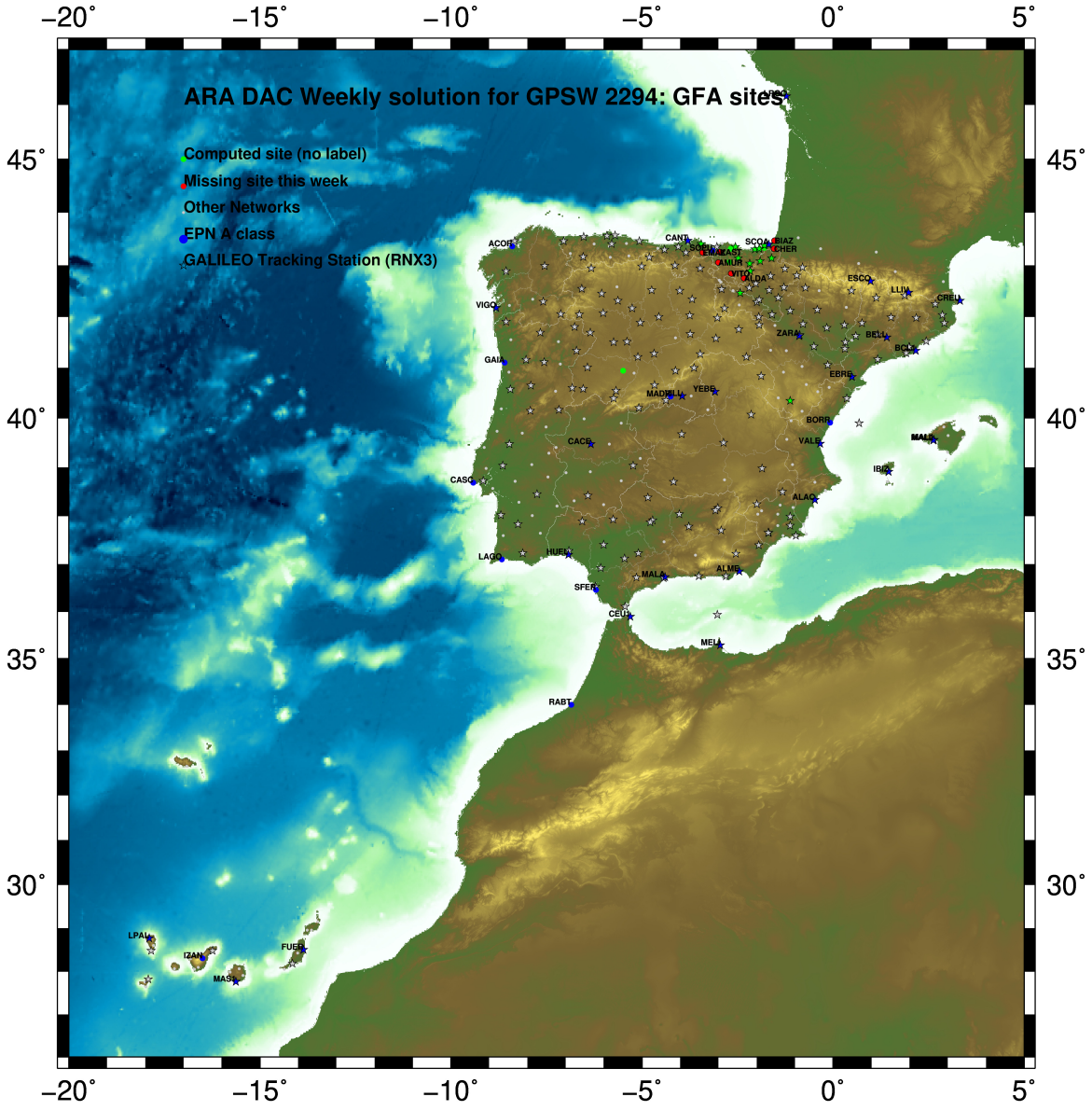



**Fig.1: Computed Sites for GPS Week2294 (GFA)**

# 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                      16-JAN-24 13:34
------------------------------------------------------------------------------
LOCAL GEODETIC DATUM: IGS20             EPOCH: 2023-12-27 11:59:45

NUM  STATION NAME           X (M)          Y (M)          Z (M)     FLAG     SYSTEM

111  ACOR 13434M001    4594489.51912  -678367.34443  4357066.32950    W      G
 50  ALSA 19419M001    4677250.78699  -176770.30829  4319079.92722    A      GRE
101  BIDA 00000M000    4644177.77156  -145778.23581  4354832.52989    A      GR
113  BRZR 19387M001    4662220.94513  -220769.81228  4333309.48885    A      GR
573  CACE 13447M001    4899866.46173  -544566.94770  4033770.25757    W      GRE
592  CANT 13438M001    4625924.26872  -307096.14940  4365771.60885    W      GRE
908  CREU 13432M001    4715420.07674   273178.14638  4271946.89462    W      GRE
135  EBRE 13410M001    4833519.94158    41537.47930  4147461.76823    W      GRE
180  ELGE 19353S001    4657557.34737  -202241.38400  4338991.93707    A      GRE
209  GERN 19389M001    4642811.27125  -217222.83642  4353278.92517    A      GR
257  HOND 15012M002    4640529.27042  -145675.89877  4358781.80710    A      GRE
235  IGEL 19352S001    4645951.37960  -165574.41731  4352550.47390    A      GRE
240  ISPS 19484M001    4640596.42988  -206963.69020  4356391.96404    A      GRE
252  LARE 19440M001    4632831.90954  -279026.05643  4360314.48123    A      GRE
256  LAZK 19354S001    4666098.29452  -178186.10504  4330463.72175    A      GRE
261  LEIT 19428M001    4663520.88883  -155858.63222  4334519.93728    A      GRE
334  ORON 19427M001    4659695.73193  -130864.65007  4338948.93606    A      GRE
345  PAS2 19351S001    4644909.01256  -156644.98305  4353623.12848    A      GRE
493  PASA 19351S001    4644909.01276  -156644.98303  4353623.12824    A      GRE
553  RIO1 13448M002    4708446.77943  -199490.19519  4284089.78544    A      GRE
558  SALA 13469M001    4803054.44005  -462130.98333  4158379.12869    A      GR
526  SCOA 10088M002    4639940.45767  -136224.85880  4359552.46887    W      GRE
715  SOPU 19386M001    4643997.85977  -255913.82087  4350063.18969    W      GR
443  TERU 13487M001    4867391.27373   -95523.25707  4108341.73657    A      GRE
616  YERE 13420M001    4848724.52260  -261631.84052  4123094.38294    W      GRE
655  ZARA 13462M001    4773803.11955   -73505.89957  4215454.14646    W      GRE
```

## 5.2 ETRF2000 (ETRS89) Coordinates

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

```
CONVERT TO ETRF2000                                             16-JAN-24 13:34
------------------------------------------------------------------------------
LOCAL GEODETIC DATUM: ETRF2000          EPOCH: 2023-12-27 11:59:45

NUM  STATION NAME           X (M)          Y (M)          Z (M)     FLAG     SYSTEM

111  ACOR 13434M001    4594489.85971  -678367.97194  4357065.85492    W
 50  ALSA 19419M001    4677251.19208  -176770.94477  4319079.45253    A
101  BIDA 00000M000    4644178.18368  -145778.86824  4354832.05849    A
113  BRZR 19387M001    4662221.34545  -220770.44708  4333309.01486    A
573  CACE 13447M001    4899866.79442  -544567.61136  4033769.75840    W
592  CANT 13438M001    4625924.66002  -307096.78005  4365771.13679    W
908  CREU 13432M001    4715420.53849   273177.50687  4271946.42279    W
135  EBRE 13410M001    4833520.36224    41536.82489  4147461.28300    W
180  ELGE 19353S001    4657557.75063  -202242.01820  4338991.46374    A
209  GERN 19389M001    4642811.67364  -217223.46888  4353278.45290    A
257  HOND 15012M002    4640529.68287  -145676.53077  4358781.33602    A
235  IGEL 19352S001    4645951.78888  -165575.05001  4352550.00208    A
240  ISPS 19484M001    4640596.83390  -206964.32237  4356391.49211    A
252  LARE 19440M001    4632832.30418  -279026.68784  4360314.00896    A
256  LAZK 19354S001    4666098.70033  -178186.74019  4330463.24801    A
261  LEIT 19428M001    4663521.29797  -155859.26700  4334519.46407    A
334  ORON 19427M001    4659696.14478  -130865.28432  4338948.46353    A
345  PAS2 19351S001    4644909.42312  -156645.61560  4353622.65687    A
493  PASA 19351S001    4644909.42332  -156645.61558  4353622.65663    A
553  RIO1 13448M002    4708447.17866  -199490.83546  4284089.30774    A
558  SALA 13469M001    4803054.79386  -462131.63543  4158378.63911    A
526  SCOA 10088M002    4639940.87145  -136225.49070  4359551.99797    W
715  SOPU 19386M001    4643998.25670  -255914.45357  4350062.71678    W
443  TERU 13487M001    4867391.67284   -95523.91594  4108341.24651    A
616  YERE 13420M001    4848724.90056  -261632.49762  4123093.89220    W
655  ZARA 13462M001    4773803.53022   -73506.54727  4215453.66483    W
```

## 5.3 ETRF2014 (ETRS89) Coordinates

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

CONVERT TO ETRF2014 16-JAN-24 13:34

LOCAL GEODETIC DATUM: ETRF2014 EPOCH: 2023-12-27 11:59:45

| NUM | STATION NAME | X (M) | Y (M) | Z (M) | FLAG | SYSTEM |
|---|---|---|---|---|---|---|
| 111 | ACOR 13434M001 | 4594489.81964 | -678368.00887 | 4357065.90725 | W | |
| 50 | ALSA 19419M001 | 4677251.14957 | -176770.98320 | 4319079.50476 | A | |
| 101 | BIDA 00000M000 | 4644178.14142 | -145778.90693 | 4354832.11084 | A | |
| 113 | BRZR 19387M001 | 4662221.30325 | -220770.48542 | 4333309.06711 | A | |
| 573 | CACE 13447M001 | 4899866.75048 | -544567.64742 | 4033769.80988 | W | |
| 592 | CANT 13438M001 | 4625924.61850 | -307096.81823 | 4365771.18912 | W | |
| 908 | CREU 13432M001 | 4715420.49383 | 273177.46697 | 4271946.47523 | W | |
| 135 | EBRE 13410M001 | 4833520.31715 | 41536.78636 | 4147461.33492 | W | |
| 180 | ELGE 19353S001 | 4657557.70842 | -202242.05662 | 4338991.51601 | A | |
| 209 | GERN 19389M001 | 4642811.63164 | -217223.50731 | 4353278.50522 | A | |
| 257 | HOND 15012M002 | 4640529.64065 | -145676.56947 | 4358781.38838 | A | |
| 235 | IGEL 19352S001 | 4645951.74667 | -165575.08862 | 4352550.05441 | A | |
| 240 | ISPS 19484M001 | 4640596.79189 | -206964.36085 | 4356391.54443 | A | |
| 252 | LARE 19440M001 | 4632832.26249 | -279026.72609 | 4360314.06128 | A | |
| 256 | LAZK 19354S001 | 4666098.65794 | -178186.77866 | 4330463.30027 | A | |
| 261 | LEIT 19428M001 | 4663521.25554 | -155859.30557 | 4334519.51635 | A | |
| 334 | ORON 19427M001 | 4659696.10230 | -130865.32300 | 4338948.51584 | A | |
| 345 | PAS2 19351S001 | 4644909.38089 | -156645.65424 | 4353622.70921 | A | |
| 493 | PASA 19351S001 | 4644909.38109 | -156645.65422 | 4353622.70897 | A | |
| 553 | RIO1 13448M002 | 4708447.13588 | -199490.87366 | 4284089.35986 | A | |
| 558 | SALA 13469M001 | 4803054.75083 | -462131.67224 | 4158378.69085 | A | |
| 526 | SCOA 10088M002 | 4639940.82920 | -136225.52944 | 4359552.05034 | W | |
| 715 | SOPU 19386M001 | 4643998.21482 | -255914.49185 | 4350062.76907 | W | |
| 443 | TERU 13487M001 | 4867391.62786 | -95523.95381 | 4108341.29825 | A | |
| 616 | YEBE 13420M001 | 4848724.85637 | -261632.53497 | 4123093.94390 | W | |
| 655 | ZARA 13462M001 | 4773803.48624 | -73506.58564 | 4215453.71684 | 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 16-JAN-24 13:34

| Station | #Days | Weekday 0123456 | Repeatability (mm) N | E | U |
|---|---|---|---|---|---|
| ACOR 13434M001 | 7 | XXXXXXX | 1.10 | 0.56 | 2.75 |
| ALSA 19419M001 | 7 | XXXXXXX | 0.93 | 0.79 | 2.20 |
| BIDA 00000M000 | 6 | XXXXXX | 0.58 | 0.64 | 3.00 |
| BRZR 19387M001 | 7 | XXXXXXX | 2.01 | 1.56 | 3.06 |
| CACE 13447M001 | 7 | XXXXXXX | 1.04 | 0.49 | 2.65 |
| CANT 13438M001 | 7 | XXXXXXX | 0.45 | 0.37 | 1.77 |
| CREU 13432M001 | 7 | XXXXXXX | 0.55 | 0.41 | 3.30 |
| EBRE 13410M001 | 7 | XXXXXXX | 0.55 | 0.31 | 1.31 |
| ELGE 19353S001 | 7 | XXXXXXX | 0.91 | 1.33 | 4.77 |
| GERN 19389M001 | 7 | XXXXXXX | 1.76 | 0.98 | 4.82 |
| HOND 15012M002 | 7 | XXXXXXX | 0.70 | 0.50 | 2.48 |
| IGEL 19352S001 | 7 | XXXXXXX | 1.66 | 0.74 | 2.38 |
| ISPS 19484M001 | 7 | XXXXXXX | 1.18 | 0.63 | 3.03 |
| LARE 19440M001 | 7 | XXXXXXX | 1.74 | 0.56 | 1.89 |
| LAZK 19354S001 | 7 | XXXXXXX | 1.06 | 0.85 | 3.72 |
| LEIT 19428M001 | 7 | XXXXXXX | 0.77 | 0.52 | 2.27 |
| ORON 19427M001 | 7 | XXXXXXX | 0.51 | 0.90 | 3.56 |
| PAS2 19351S001 | 4 | XXXX | 0.47 | 1.20 | 2.71 |
| PASA 19351S001 | 7 | XXXXXXX | 0.45 | 0.84 | 2.42 |
| RIO1 13448M002 | 7 | XXXXXXX | 0.72 | 0.56 | 2.57 |
| SALA 13469M001 | 7 | XXXXXXX | 0.47 | 0.78 | 1.69 |
| SCOA 10088M002 | 7 | XXXXXXX | 0.52 | 0.85 | 3.59 |
| SOPU 19386M001 | 7 | XXXXXXX | 0.91 | 1.18 | 3.02 |
| TERU 13487M001 | 7 | XXXXXXX | 0.59 | 0.26 | 2.98 |
| YEBE 13420M001 | 7 | XXXXXXX | 0.38 | 0.41 | 0.92 |
| ZARA 13462M001 | 7 | XXXXXXX | 0.37 | 0.55 | 2.07 |

Comparison of individual solutions:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ACOR 13434M001 | N | 1.10 | -1.17 | 0.39 | 1.64 | -1.47 | -0.18 | -0.94 | 0.03 |
| ACOR 13434M001 | E | 0.56 | -0.59 | -0.79 | 0.59 | -0.35 | -0.26 | 0.48 | -0.34 |
| ACOR 13434M001 | U | 2.75 | 1.84 | 1.30 | 1.38 | 5.72 | -1.12 | -1.13 | -1.73 |
| ALSA 19419M001 | N | 0.93 | -0.33 | 1.27 | 1.28 | 0.28 | -0.54 | 0.28 | -1.19 |
| ALSA 19419M001 | E | 0.79 | -0.05 | 0.72 | 0.18 | -1.62 | 0.22 | 0.35 | -0.67 |
| ALSA 19419M001 | U | 2.20 | -1.40 | -0.57 | 0.52 | -1.18 | 4.84 | 1.17 | -0.60 |
| BIDA 00000M000 | N | 0.58 | | -0.87 | 0.30 | 0.68 | 0.35 | 0.50 | 0.01 |
| BIDA 00000M000 | E | 0.64 | | 0.33 | -1.04 | -0.04 | -0.28 | 0.89 | -0.03 |
| BIDA 00000M000 | U | 3.00 | | -0.83 | -0.93 | 0.80 | 5.63 | 0.92 | 3.21 |
| BRZR 19387M001 | N | 2.01 | 0.81 | 1.35 | 1.09 | -2.79 | 1.28 | 1.20 | -3.12 |
| BRZR 19387M001 | E | 1.56 | -0.32 | 0.58 | 0.17 | -0.97 | 1.87 | 1.04 | -2.94 |
| BRZR 19387M001 | U | 3.06 | -2.32 | 4.59 | -0.86 | 2.30 | -0.61 | 1.69 | 4.54 |
| CACE 13447M001 | N | 1.04 | 0.64 | -0.52 | 0.40 | 0.03 | -2.37 | -0.12 | -0.05 |
| CACE 13447M001 | E | 0.49 | 0.12 | -0.27 | 0.11 | 0.44 | 0.94 | -0.01 | 0.50 |
| CACE 13447M001 | U | 2.65 | -0.75 | -3.90 | -0.76 | -3.04 | 1.53 | 3.58 | -1.17 |
| CANT 13438M001 | N | 0.45 | -0.65 | 0.25 | 0.05 | -0.40 | -0.44 | 0.01 | 0.62 |
| CANT 13438M001 | E | 0.37 | -0.14 | 0.25 | -0.54 | -0.32 | 0.54 | 0.24 | -0.08 |
| CANT 13438M001 | U | 1.77 | 1.35 | -0.16 | 2.34 | 2.28 | 1.15 | 1.74 | -1.38 |
| CREU 13432M001 | N | 0.55 | -0.29 | 0.60 | -0.44 | -0.06 | 0.29 | 0.98 | 0.36 |
| CREU 13432M001 | E | 0.41 | -0.81 | 0.16 | 0.04 | -0.06 | 0.45 | 0.35 | 0.08 |
| CREU 13432M001 | U | 3.30 | -0.46 | -2.98 | 1.93 | 3.02 | -6.56 | 0.26 | 0.40 |
| EBRE 13410M001 | N | 0.55 | -0.60 | 0.84 | -0.01 | 0.23 | 0.66 | 0.44 | -0.25 |
| EBRE 13410M001 | E | 0.31 | -0.42 | 0.23 | -0.12 | 0.49 | 0.12 | -0.14 | -0.21 |
| EBRE 13410M001 | U | 1.31 | 0.36 | -1.39 | -0.98 | 0.53 | -2.02 | -1.49 | 0.85 |
| ELGE 19353S001 | N | 0.91 | -1.52 | 0.43 | -0.08 | 0.92 | 1.01 | -0.62 | -0.38 |
| ELGE 19353S001 | E | 1.33 | -0.39 | 0.02 | -1.15 | -1.58 | -0.11 | 0.07 | 2.58 |
| ELGE 19353S001 | U | 4.77 | -0.70 | -3.73 | -3.09 | 4.51 | 9.15 | 0.94 | 2.78 |
| GERN 19389M001 | N | 1.76 | -1.58 | 2.62 | 1.20 | 1.22 | -0.40 | -1.46 | -2.02 |
| GERN 19389M001 | E | 0.98 | -1.70 | 1.07 | -0.09 | 1.07 | -0.44 | 0.00 | -0.61 |
| GERN 19389M001 | U | 4.82 | 8.62 | -0.52 | -3.06 | 2.33 | -3.67 | -0.74 | 5.99 |
| HOND 15012M002 | N | 0.70 | -0.91 | 0.33 | 0.76 | -0.89 | 0.29 | 0.73 | -0.23 |
| HOND 15012M002 | E | 0.50 | -0.71 | 0.54 | -0.37 | -0.50 | 0.37 | 0.23 | -0.37 |
| HOND 15012M002 | U | 2.48 | 1.17 | -1.70 | -0.23 | 2.82 | 4.67 | 1.44 | 0.84 |
| IGEL 19352S001 | N | 1.66 | -1.85 | -0.43 | -0.37 | 3.26 | -0.79 | -0.87 | 0.87 |
| IGEL 19352S001 | E | 0.74 | -0.64 | 1.00 | -0.09 | -1.18 | -0.48 | 0.41 | 0.27 |
| IGEL 19352S001 | U | 2.38 | 1.75 | 0.02 | 1.13 | 2.05 | 4.24 | 2.20 | -1.60 |
| ISPS 19484M001 | N | 1.18 | -1.12 | 1.24 | 0.67 | 0.34 | -2.10 | -0.06 | 0.77 |
| ISPS 19484M001 | E | 0.63 | 0.81 | -0.10 | 0.12 | -0.10 | -0.98 | 0.47 | -0.73 |
| ISPS 19484M001 | U | 3.03 | 2.05 | 0.88 | 3.11 | 3.47 | 2.26 | 1.94 | -4.44 |
| LARE 19440M001 | N | 1.74 | 0.56 | 1.90 | 0.84 | -0.28 | -2.59 | -2.34 | 1.17 |
| LARE 19440M001 | E | 0.56 | -0.74 | 1.00 | -0.32 | 0.11 | 0.41 | -0.14 | 0.13 |
| LARE 19440M001 | U | 1.89 | 1.58 | 2.08 | -1.24 | 3.40 | 0.73 | -0.06 | -0.95 |
| LAZK 19354S001 | N | 1.06 | -1.11 | 0.59 | 0.70 | -1.55 | 0.68 | 0.64 | 1.20 |
| LAZK 19354S001 | E | 0.85 | -0.35 | 0.72 | -0.61 | -0.34 | -1.39 | 0.03 | 1.12 |
| LAZK 19354S001 | U | 3.72 | -2.74 | -2.99 | 1.77 | 6.32 | 3.48 | -3.37 | -0.28 |
| LEIT 19428M001 | N | 0.77 | 0.26 | 1.42 | 0.29 | -0.87 | -0.49 | 0.59 | 0.20 |
| LEIT 19428M001 | E | 0.52 | -0.91 | -0.34 | 0.12 | 0.56 | -0.19 | -0.49 | 0.23 |
| LEIT 19428M001 | U | 2.27 | -0.73 | -2.61 | 0.21 | 2.29 | 3.12 | -1.62 | 2.42 |
| ORON 19427M001 | N | 0.51 | -0.43 | 1.07 | 0.06 | -0.03 | -0.21 | 0.33 | 0.18 |
| ORON 19427M001 | E | 0.90 | -0.54 | 0.07 | -0.47 | -1.94 | 0.15 | 0.61 | -0.47 |
| ORON 19427M001 | U | 3.56 | 0.12 | -1.95 | 0.21 | 5.28 | 0.06 | 0.19 | 6.66 |
| PAS2 19351S001 | N | 0.47 | | | | -0.69 | 0.04 | 0.31 | 0.30 |
| PAS2 19351S001 | E | 1.20 | | | | -0.18 | 1.19 | 0.43 | -1.64 |
| PAS2 19351S001 | U | 2.71 | | | | 1.96 | 2.54 | -0.41 | 3.40 |
| PASA 19351S001 | N | 0.45 | -0.88 | 0.13 | 0.46 | 0.03 | -0.11 | 0.42 | -0.06 |
| PASA 19351S001 | E | 0.84 | -0.95 | 0.46 | -0.42 | 0.03 | 1.27 | 0.08 | -1.16 |
| PASA 19351S001 | U | 2.42 | 1.27 | -0.22 | -1.54 | 0.59 | 4.12 | 1.14 | 3.56 |
| RIO1 13448M002 | N | 0.72 | -0.58 | 1.15 | -0.13 | 0.00 | 1.10 | -0.39 | 0.24 |
| RIO1 13448M002 | E | 0.56 | -0.53 | 0.57 | -0.83 | 0.52 | -0.50 | 0.21 | -0.20 |
| RIO1 13448M002 | U | 2.57 | -1.14 | -2.48 | -0.42 | 0.05 | 0.40 | 5.23 | 2.10 |
| SALA 13469M001 | N | 0.47 | 0.01 | -0.27 | 0.78 | 0.22 | -0.67 | -0.01 | -0.38 |
| SALA 13469M001 | E | 0.78 | -0.65 | 0.26 | -0.08 | 0.34 | 1.36 | 0.80 | -0.74 |
| SALA 13469M001 | U | 1.69 | -2.00 | -1.01 | 2.06 | 0.24 | 1.64 | 1.68 | 1.48 |
| SCOA 10088M002 | N | 0.52 | -0.54 | 0.37 | -0.10 | 0.79 | 0.39 | 0.11 | -0.62 |
| SCOA 10088M002 | E | 0.85 | -0.13 | 0.57 | -0.05 | -1.32 | -1.14 | 0.89 | -0.38 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SCOA | 10088M002 | U | 3.59 | 0.71 | -3.55 | 0.08 | 6.72 | 3.65 | 0.48 | 2.33 |
| SOPU | 19386M001 | N | 0.91 | -0.70 | 0.28 | 1.43 | -1.35 | -0.62 | 0.18 | 0.36 |
| SOPU | 19386M001 | E | 1.18 | 0.48 | 1.75 | 0.19 | 0.01 | -1.04 | 0.10 | -1.98 |
| SOPU | 19386M001 | U | 3.02 | 2.64 | 3.30 | 0.92 | -4.15 | 3.15 | 2.96 | 0.31 |
| TERU | 13487M001 | N | 0.59 | -0.02 | 0.59 | -0.06 | -0.14 | 0.61 | 0.99 | 0.60 |
| TERU | 13487M001 | E | 0.26 | 0.02 | 0.12 | -0.26 | 0.41 | -0.27 | -0.14 | 0.22 |
| TERU | 13487M001 | U | 2.98 | 1.49 | -2.26 | 1.49 | 1.10 | -4.96 | -4.01 | 1.37 |
| YEBE | 13420M001 | N | 0.38 | -0.64 | 0.15 | 0.03 | 0.27 | -0.50 | 0.00 | 0.33 |
| YEBE | 13420M001 | E | 0.41 | -0.14 | 0.04 | -0.07 | 0.18 | 0.95 | 0.17 | -0.05 |
| YEBE | 13420M001 | U | 0.92 | 0.71 | 1.63 | -0.66 | 0.47 | 0.74 | 0.55 | 0.65 |
| ZARA | 13462M001 | N | 0.37 | -0.39 | -0.35 | -0.18 | -0.19 | 0.45 | 0.26 | 0.45 |
| ZARA | 13462M001 | E | 0.55 | -0.30 | 0.17 | -0.41 | -0.77 | -0.52 | 0.83 | 0.01 |
| ZARA | 13462M001 | U | 2.07 | 3.71 | -0.54 | -0.18 | 0.86 | 0.20 | -2.70 | 1.91 |

## 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        -3.60    -44.92    -77.57
ITERATION   2: ESCO 13435M001       -70.52     42.85     11.42
ITERATION   3: GAIA 13902M001         4.81     -8.53     37.09
```

| NUM | NAME | FLG | RESIDUALS IN MILLIMETERS | | | |
|---|---|---|---|---|---|---|
| 1 | ACOR 13434M001 | I W | 1.87 | -1.06 | 0.92 | |
| 2 | ALAC 13433M001 | I W | -0.07 | 0.11 | 1.80 | |
| 3 | ALME 13437M001 | I W | -0.89 | -0.41 | 0.97 | |
| 4 | BCL1 19482M001 | I W | -1.18 | 0.83 | 3.44 | |
| 5 | BELL 13431M001 | I W | 0.77 | 0.54 | 3.31 | |
| 6 | BORR 13480M001 | I W | -2.32 | -3.55 | 0.24 | |
| 7 | BRST 10004M004 | I W | 1.27 | -0.72 | 2.23 | |
| 8 | CACE 13447M001 | I W | 0.66 | 0.46 | 5.32 | |
| 9 | CANT 13438M001 | I W | 1.89 | 0.72 | 1.10 | |
| 10 | CASC 13909S001 | I W | 0.72 | -1.10 | 1.50 | |
| 11 | CEU1 13449M002 | I W | 0.55 | -0.06 | -3.74 | |
| 12 | CREU 13432M001 | I W | -5.38 | -45.36 | -78.23 | * |
| 13 | EBRE 13410M001 | I W | 0.96 | 2.24 | 1.11 | |
| 14 | ESCO 13435M001 | I W | -72.20 | 43.62 | 12.66 | * |
| 15 | FLRS 31907M001 | I W | -1.81 | -5.51 | -7.58 | |
| 16 | FUER 31330M001 | I W | -2.12 | -0.93 | -1.14 | |
| 17 | GAIA 13902M001 | I W | 4.93 | -8.76 | 38.06 | * |
| 18 | HUEL 13451M001 | I W | 0.84 | 2.22 | -8.70 | |
| 19 | IBIZ 13454S001 | I W | -0.30 | 1.24 | 0.87 | |
| 20 | IZAN 31309M002 | I W | -3.44 | -1.38 | -0.88 | |
| 21 | LAGO 13903M001 | I W | -0.88 | -1.86 | 0.75 | |
| 22 | LLIV 13436M001 | I W | -2.04 | 0.93 | 3.01 | |
| 23 | LPAL 81701M001 | I W | -1.73 | -0.66 | -5.97 | |
| 24 | LROC 10023M001 | I W | 0.94 | 0.97 | 1.52 | |
| 25 | MADR 13407S012 | I W | -2.80 | -0.05 | -3.30 | |
| 26 | MAL1 13444M002 | I W | 2.04 | 0.73 | -0.34 | |
| 27 | MALA 13443M001 | I W | 2.35 | -1.38 | 1.21 | |
| 28 | MALL 13444M001 | I W | -1.50 | 1.51 | 1.83 | |
| 29 | MAS1 31303M002 | I W | -3.71 | -2.92 | -0.40 | |
| 30 | MELI 19379M001 | I W | -1.05 | 0.22 | 2.50 | |
| 31 | PDEL 31906M004 | I W | -1.32 | -1.84 | -0.23 | |
| 32 | RABT 35001M002 | I W | -0.24 | -0.84 | -5.72 | |
| 33 | SCOA 10088M002 | I W | 3.27 | 2.45 | -6.48 | |
| 34 | SFER 13402M004 | I W | 0.03 | -2.04 | 2.01 | |
| 35 | SOPU 19386M001 | I W | 1.24 | 1.17 | 2.32 | |
| 36 | VALE 13439M001 | I W | 0.27 | 2.63 | -1.08 | |
| 37 | VIGO 13450M001 | I W | 0.77 | -0.25 | 2.89 | |
| 38 | VILL 13406M001 | I W | -0.75 | -1.28 | 2.93 | |
| 39 | YEBE 13420M001 | I W | -1.01 | 0.54 | 3.39 | |
| 40 | ZARA 13462M001 | I W | 0.19 | 2.42 | 0.42 | |
| 41 | ZIMM 14001M004 | I W | 1.02 | 0.64 | 5.12 | |
| | RMS / COMPONENT | | 1.65 | 1.74 | 3.39 | |
| | IQR | | 2.27 | 2.03 | 3.20 | |
| | MEAN | | -0.20 | -0.14 | 0.19 | |
| | MEDIAN | | -0.02 | 0.03 | 1.04 | |
| | MIN | | -3.71 | -5.51 | -8.70 | |
| | MAX | | 3.27 | 2.63 | 5.32 | |
| | OVERALL RMS/IQR/MAX(3D) | | 2.40 | 2.34 | 9.54 | FLRS 31907M001 #SUM |
| ALL | RMS / COMPONENT | | 11.58 | 10.18 | 14.28 | |
| ALL | IQR | | 2.44 | 2.21 | 3.38 | |
| ALL | MEAN | | -1.96 | -0.38 | -0.50 | |
| ALL | MEDIAN | | -0.07 | -0.05 | 1.10 | |
| ALL | MIN | | -72.20 | -45.36 | -78.23 | |
| ALL | MAX | | 4.93 | 43.62 | 38.06 | |
| ALL | OVERALL RMS/IQR/MAX(3D) | | 12.13 | 2.78 | 90.59 | CREU 13432M001 #SUM_ALL |

```
NUMBER OF PARAMETERS  :     3
NUMBER OF STATIONS    :    38
NUMBER OF COORDINATES :   114
RMS OF TRANSFORMATION :    2.40 MM


PARAMETERS:

TRANSLATION IN  X     :          -0.73     +-  0.39    MM
TRANSLATION IN  Y     :           0.40     +-  0.39    MM
TRANSLATION IN  Z     :           1.77     +-  0.39    MM


NUMBER OF ITERATIONS  :     3


ACCEPTED STATIONS     :    38    92.68 %
VERIFIED STATIONS     :     0     0.00 %
REJECTED STATIONS     :     3     7.32 %


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                       18531461
 NUMBER OF UNKNOWNS                             180763
 NUMBER OF DEGREES OF FREEDOM                 18350698
 PHASE MEASUREMENTS SIGMA                      0.00100
 SAMPLING INTERVAL (SECONDS)                       180
 VARIANCE FACTOR                    18.213661635171505
```

# 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 23:358:00000 23:364:86370 LEICA GR50           ----- -----------
 ALSA  A    1 P 23:358:00000 23:364:86370 LEICA GR50           ----- -----------
 BIDA  A    1 P 23:359:00000 23:364:86370 LEICA GR10           ----- -----------
 BRZR  A    1 P 23:358:00000 23:364:86370 LEICA GR30           ----- -----------
 CACE  A    1 P 23:358:00000 23:364:86370 TRIMBLE NETR9        ----- -----------
 CANT  A    1 P 23:358:00000 23:364:86370 LEICA GR10           ----- -----------
 CREU  A    1 P 23:358:00000 23:364:86370 LEICA GR50           ----- -----------
 EBRE  A    1 P 23:358:00000 23:364:86370 LEICA GR50           ----- -----------
 ELGE  A    1 P 23:358:00000 23:364:86370 LEICA GR30           ----- -----------
 GERN  A    1 P 23:358:00000 23:364:86370 LEICA GR30           ----- -----------
 HOND  A    1 P 23:358:00000 23:364:86370 LEICA GR50           ----- -----------
 IGEL  A    1 P 23:358:00000 23:364:86370 LEICA GR30           ----- -----------
 ISPS  A    1 P 23:358:00000 23:364:86370 TRIMBLE NETR9        ----- -----------
 LARE  A    1 P 23:358:00000 23:364:86370 LEICA GR50           ----- -----------
 LAZK  A    1 P 23:358:00000 23:364:86370 LEICA GR30           ----- -----------
 LEIT  A    1 P 23:358:00000 23:364:86370 LEICA GR50           ----- -----------
 ORON  A    1 P 23:358:00000 23:364:86370 LEICA GR50           ----- -----------
 PAS2  A    1 P 23:361:00000 23:364:86370 STONEX SC2200        ----- -----------
 PASA  A    1 P 23:358:00000 23:364:86370 LEICA GR30           ----- -----------
 RIO1  A    1 P 23:358:00000 23:364:86370 LEICA GR25           ----- -----------
 SALA  A    1 P 23:358:00000 23:364:86370 LEICA GR50           ----- -----------
 SCOA  A    1 P 23:358:00000 23:364:86370 LEICA GR50           ----- -----------
 SOPU  A    1 P 23:358:00000 23:364:86370 LEICA GR30           ----- -----------
 TERU  A    1 P 23:358:00000 23:364:86370 LEICA GR50           ----- -----------
 YEBE  A    1 P 23:358:00000 23:364:86370 LEICA GR50           ----- -----------
 ZARA  A    1 P 23:358:00000 23:364:86370 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 23:358:00000 23:364:86370 LEIAT504          LEIS -----
 ALSA  A    1 P 23:358:00000 23:364:86370 LEIAR10           NONE -----
 BIDA  A    1 P 23:359:00000 23:364:86370 LEIAS10           NONE -----
 BRZR  A    1 P 23:358:00000 23:364:86370 LEIAS10           NONE -----
 CACE  A    1 P 23:358:00000 23:364:86370 TRM29659.00       NONE -----
 CANT  A    1 P 23:358:00000 23:364:86370 LEIAR25.R4        LEIT -----
 CREU  A    1 P 23:358:00000 23:364:86370 LEIAR25.R4        NONE -----
 EBRE  A    1 P 23:358:00000 23:364:86370 LEIAR25.R4        NONE -----
 ELGE  A    1 P 23:358:00000 23:364:86370 LEIAR25.R4        LEIT -----
 GERN  A    1 P 23:358:00000 23:364:86370 LEIAS10           NONE -----
 HOND  A    1 P 23:358:00000 23:364:86370 LEIAR20           LEIM -----
 IGEL  A    1 P 23:358:00000 23:364:86370 LEIAR20           LEIM -----
 ISPS  A    1 P 23:358:00000 23:364:86370 TRM59900.00       SCIS -----
 LARE  A    1 P 23:358:00000 23:364:86370 LEIAR20           LEIM -----
 LAZK  A    1 P 23:358:00000 23:364:86370 LEIAR25.R4        LEIT -----
 LEIT  A    1 P 23:358:00000 23:364:86370 LEIAR10           NONE -----
 ORON  A    1 P 23:358:00000 23:364:86370 LEIAR10           NONE -----
 PAS2  A    1 P 23:361:00000 23:364:86370 LEIAR20           LEIM -----
 PASA  A    1 P 23:358:00000 23:364:86370 LEIAR20           LEIM -----
 RIO1  A    1 P 23:358:00000 23:364:86370 LEIAR25.R4        LEIT -----
 SALA  A    1 P 23:358:00000 23:364:86370 LEIAR25           NONE -----
 SCOA  A    1 P 23:358:00000 23:364:86370 TRM55971.00       NONE -----
 SOPU  A    1 P 23:358:00000 23:364:86370 LEIAS10           NONE -----
 TERU  A    1 P 23:358:00000 23:364:86370 LEIAR20           LEIM -----
 YEBE  A    1 P 23:358:00000 23:364:86370 LEIAR20           LEIM -----
 ZARA  A    1 P 23:358:00000 23:364:86370 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 23:358:00000 23:364:86370 UNE   3.0460   0.0000   0.0000
 ALSA  A    1 P 23:358:00000 23:364:86370 UNE   0.0000   0.0000   0.0000
 BIDA  A    1 P 23:359:00000 23:364:86370 UNE   0.0000   0.0000   0.0000
```

```
BRZR  A    1 P 23:358:00000 23:364:86370 UNE   0.0771   0.0000   0.0000
CACE  A    1 P 23:358:00000 23:364:86370 UNE   0.0600   0.0000   0.0000
CANT  A    1 P 23:358:00000 23:364:86370 UNE   3.0490   0.0000   0.0000
CREU  A    1 P 23:358:00000 23:364:86370 UNE   0.0770   0.0000   0.0000
EBRE  A    1 P 23:358:00000 23:364:86370 UNE   0.0770   0.0000   0.0000
ELGE  A    1 P 23:358:00000 23:364:86370 UNE   0.0000   0.0000   0.0000
GERN  A    1 P 23:358:00000 23:364:86370 UNE   0.0771   0.0000   0.0000
HOND  A    1 P 23:358:00000 23:364:86370 UNE   0.0771   0.0000   0.0000
IGEL  A    1 P 23:358:00000 23:364:86370 UNE   0.0000   0.0000   0.0000
ISPS  A    1 P 23:358:00000 23:364:86370 UNE   0.0350   0.0000   0.0000
LARE  A    1 P 23:358:00000 23:364:86370 UNE   0.0000   0.0000   0.0000
LAZK  A    1 P 23:358:00000 23:364:86370 UNE   0.0000   0.0000   0.0000
LEIT  A    1 P 23:358:00000 23:364:86370 UNE   0.0000   0.0000   0.0000
ORON  A    1 P 23:358:00000 23:364:86370 UNE   0.0000   0.0000   0.0000
PAS2  A    1 P 23:361:00000 23:364:86370 UNE   0.0000   0.0000   0.0000
PASA  A    1 P 23:358:00000 23:364:86370 UNE   0.0000   0.0000   0.0000
RIO1  A    1 P 23:358:00000 23:364:86370 UNE   0.0606   0.0000   0.0000
SALA  A    1 P 23:358:00000 23:364:86370 UNE   0.0600   0.0000   0.0000
SCOA  A    1 P 23:358:00000 23:364:86370 UNE   0.0000   0.0000   0.0000
SOPU  A    1 P 23:358:00000 23:364:86370 UNE   0.0771   0.0000   0.0000
TERU  A    1 P 23:358:00000 23:364:86370 UNE   0.0600   0.0000   0.0000
YEBE  A    1 P 23:358:00000 23:364:86370 UNE   0.0600   0.0000   0.0000
ZARA  A    1 P 23:358:00000 23:364:86370 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:

```
2024-01-14 05:09 UTC | LARE3580.23O | RECEIVER FIRM. VERS. |  4.70/7.813 -> 4.61/7.811 (source: lare00esp_20230308.log
2024-01-14 08:04 UTC | LARE3590.23O | RECEIVER FIRM. VERS. |  4.70/7.813 -> 4.61/7.811 (source: lare00esp_20230308.log
2024-01-14 10:56 UTC | LARE3600.23O | RECEIVER FIRM. VERS. |  4.70/7.813 -> 4.61/7.811 (source: lare00esp_20230308.log
2024-01-14 13:51 UTC | LARE3610.23O | RECEIVER FIRM. VERS. |  4.70/7.813 -> 4.61/7.811 (source: lare00esp_20230308.log
2024-01-16 10:39 UTC | LARE3620.23O | RECEIVER FIRM. VERS. |  4.70/7.813 -> 4.61/7.811 (source: lare00esp_20230308.log
2024-01-14 19:27 UTC | LARE3630.23O | RECEIVER FIRM. VERS. |  4.70/7.813 -> 4.61/7.811 (source: lare00esp_20230308.log
2024-01-14 23:13 UTC | LARE3640.23O | RECEIVER FIRM. VERS. |  4.70/7.813 -> 4.61/7.811 (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

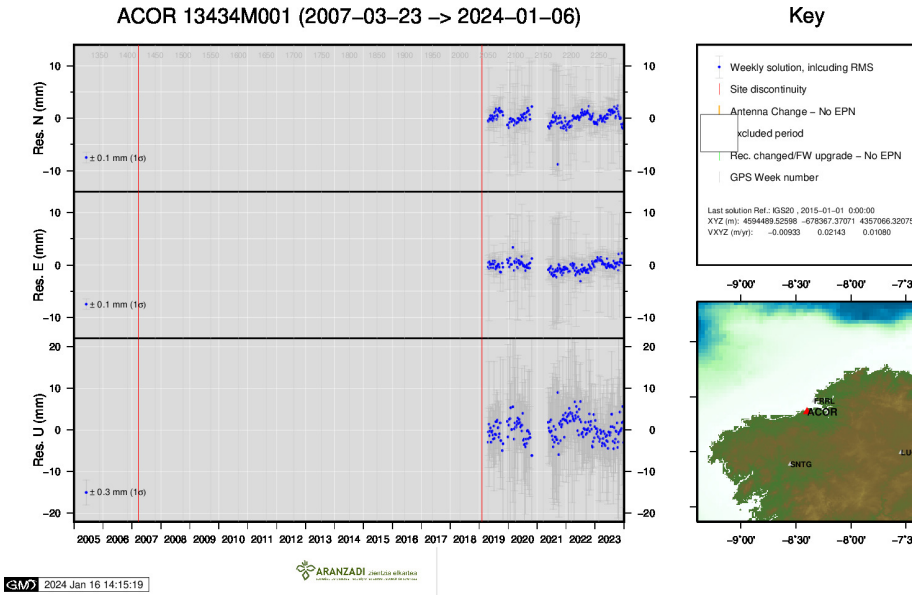
EPN Coordination Group and the EPN Central Bureau (2018): *Guidelines for the EPN Analysis Centres.* epncb.oma.be/$_d$*ocumentation/guidelines/guidelines*$_a$*nalysis*$_c$*entres.pdf*

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

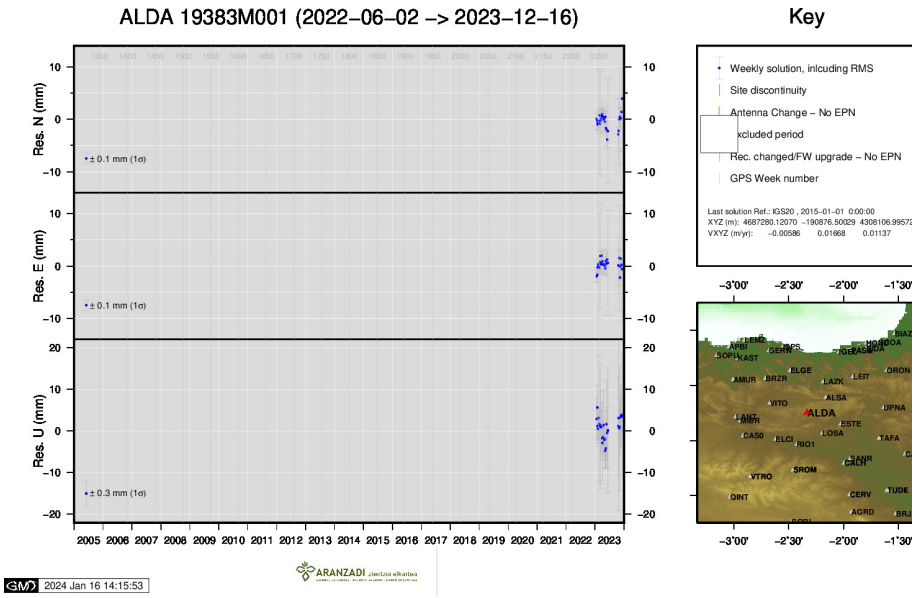
Z. Altamimi (2018): *EUREF Technical Note 1: Relationship and Transformation between the International and the European Terrestrial Reference Systems.* etrs89.ensg.ign.fr/pub/EUREF-TN-1.pdf

# 10 Cumulative Time Series

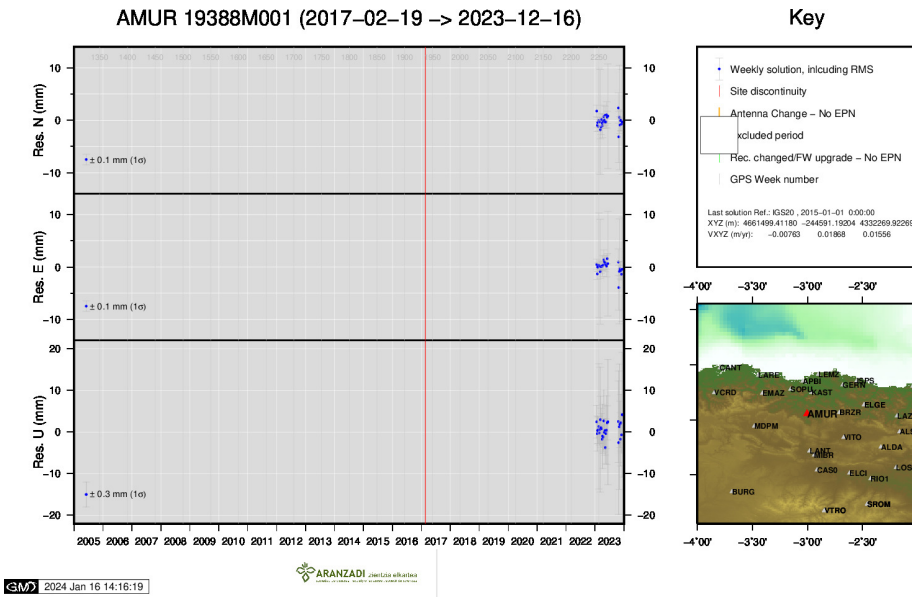
Time series of stations. Latest plots at: http://geolabpasaia.org/gnss/ARA-net/TSeries/, or click on the caption of each image.



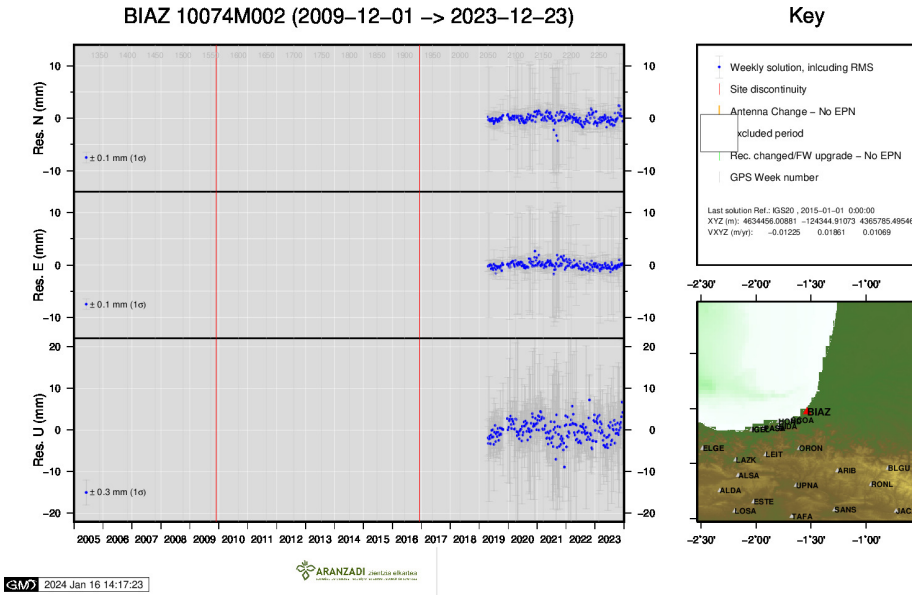

1 ) ACOR



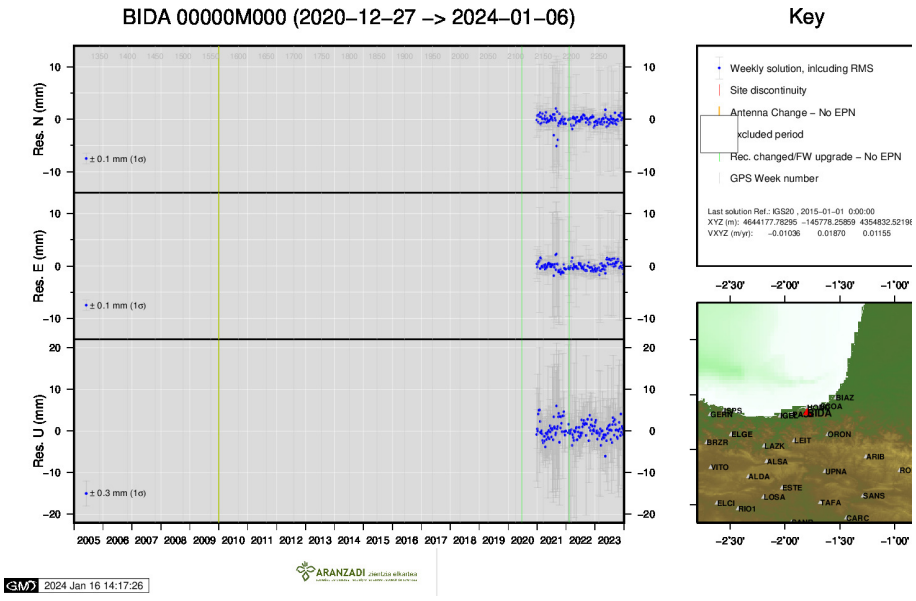

2 ) ALDA



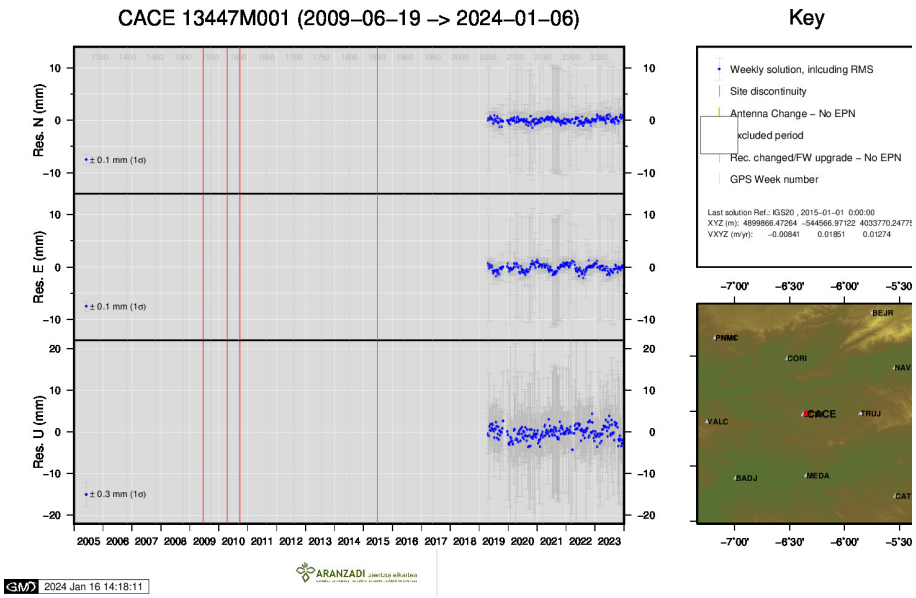

3 ) AMUR



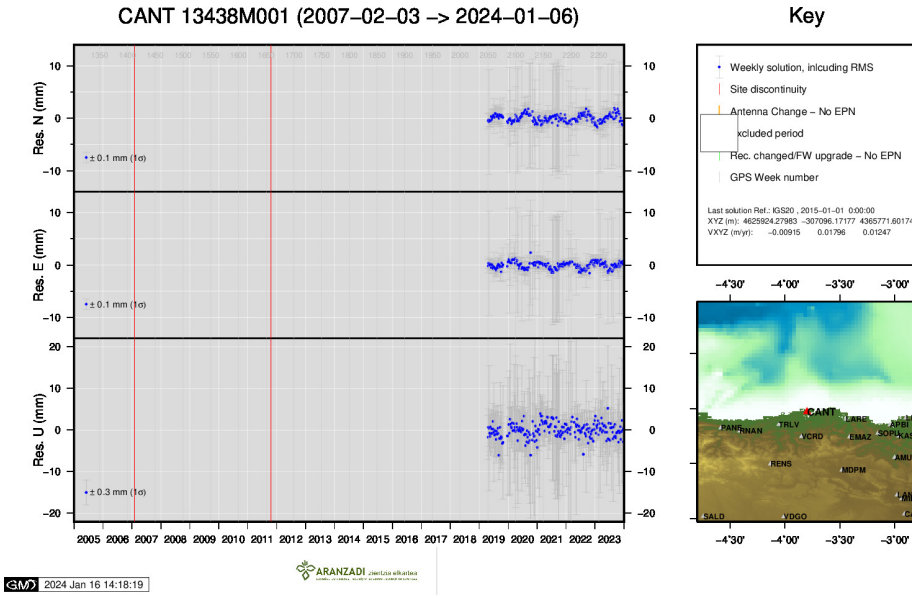

4 ) BIAZ



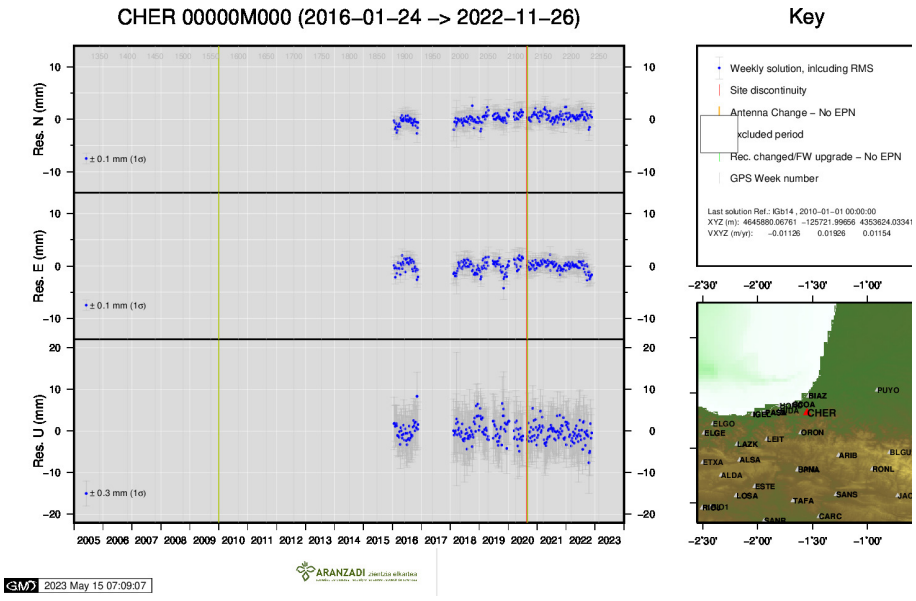

5 ) BIDA



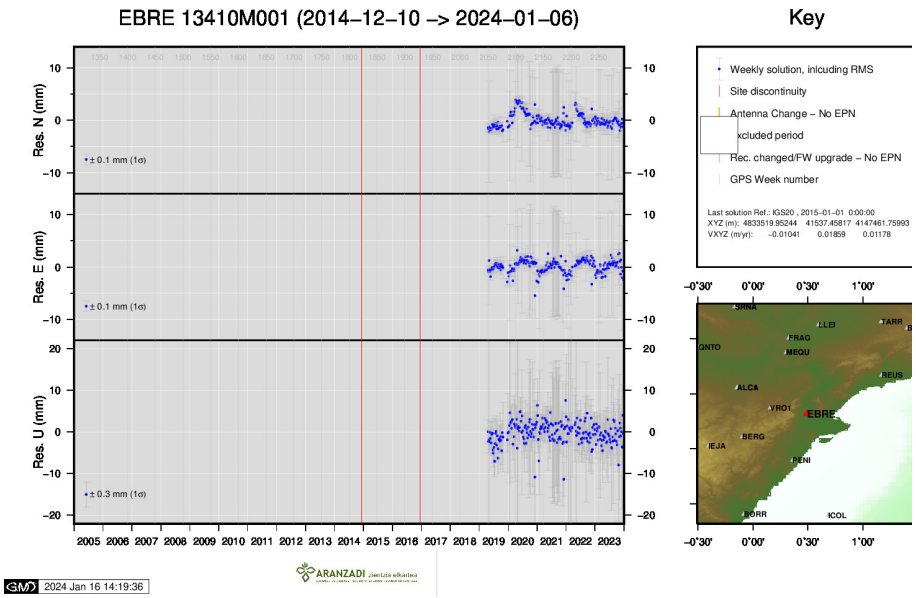

6 ) CACE



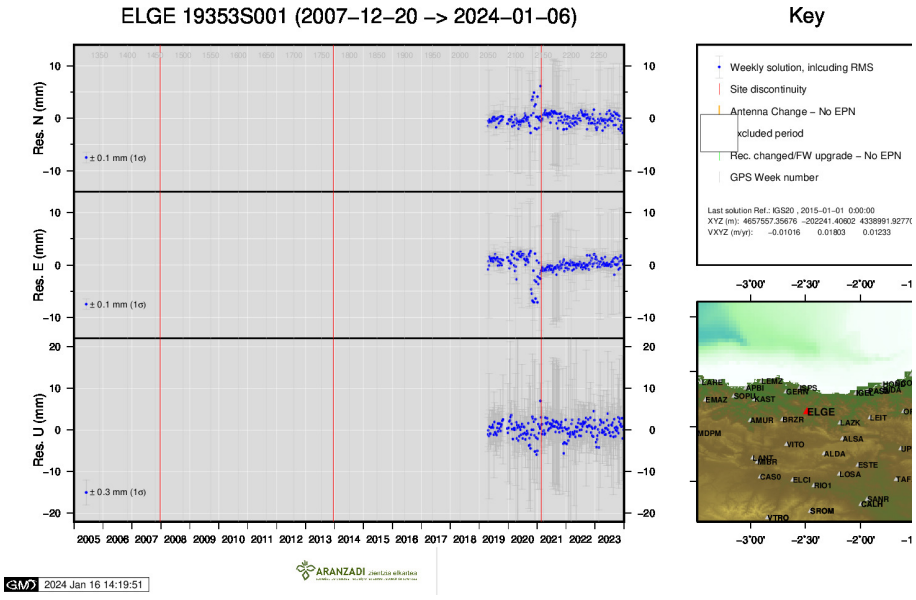

7 ) CANT



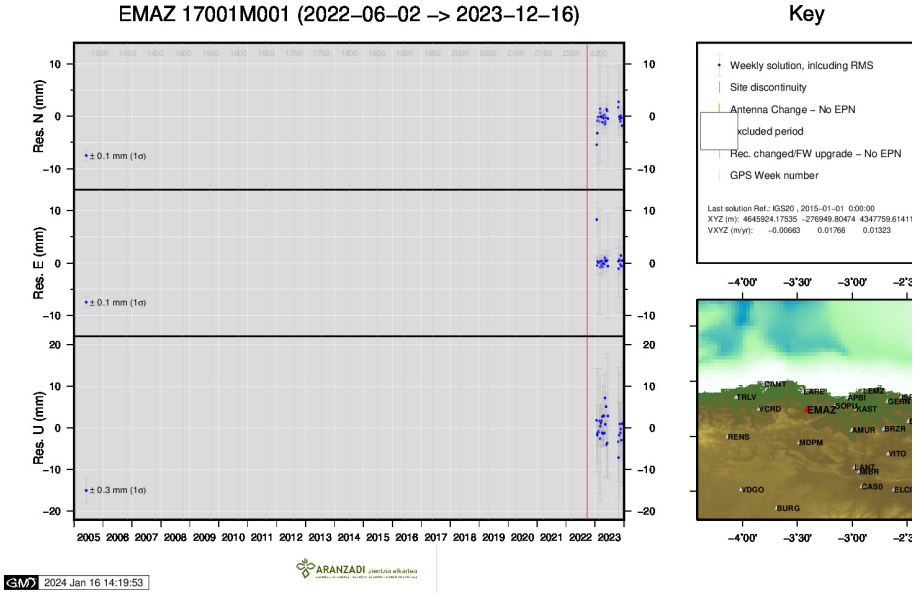

8 ) CHER



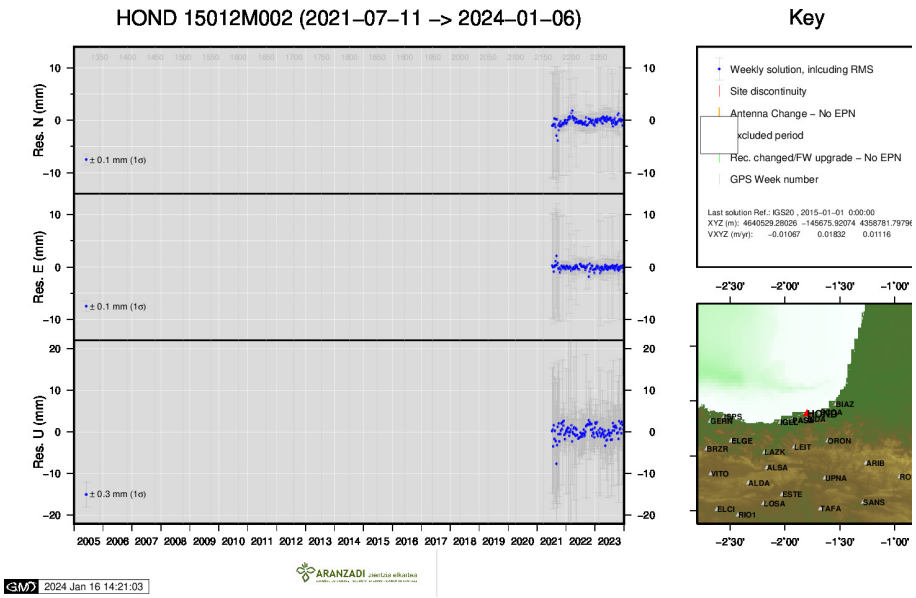

9 ) EBRE




10 ) ELGE




11 ) EMAZ

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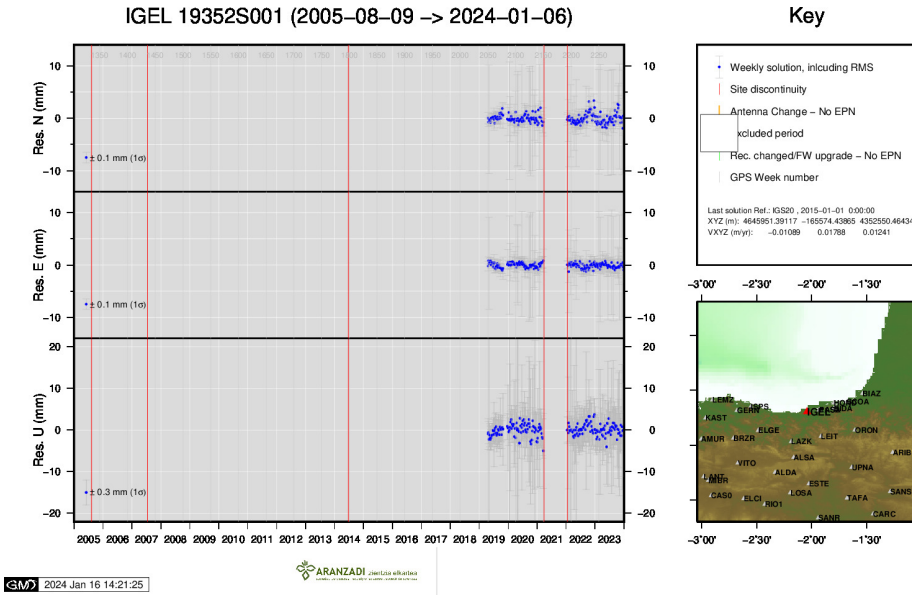
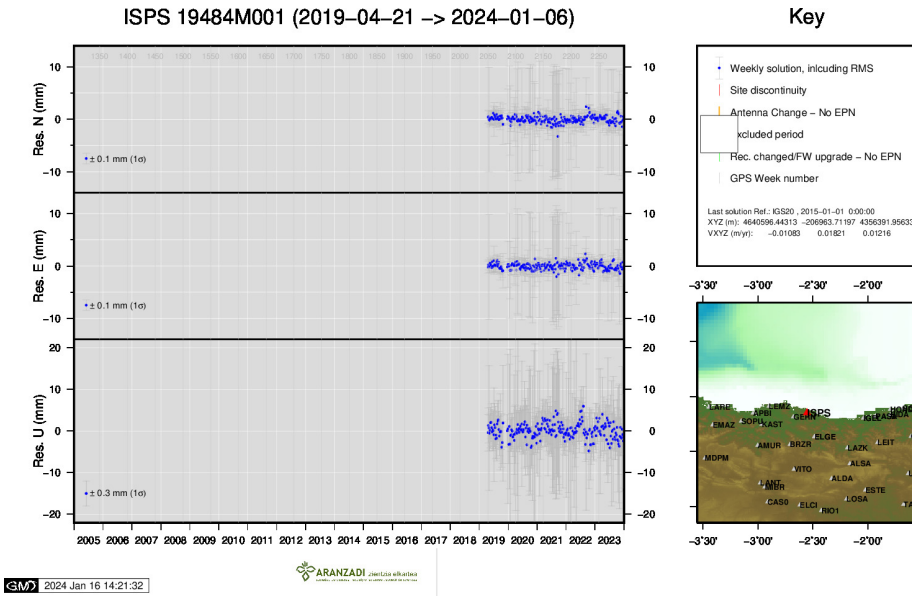



13 ) IGEL

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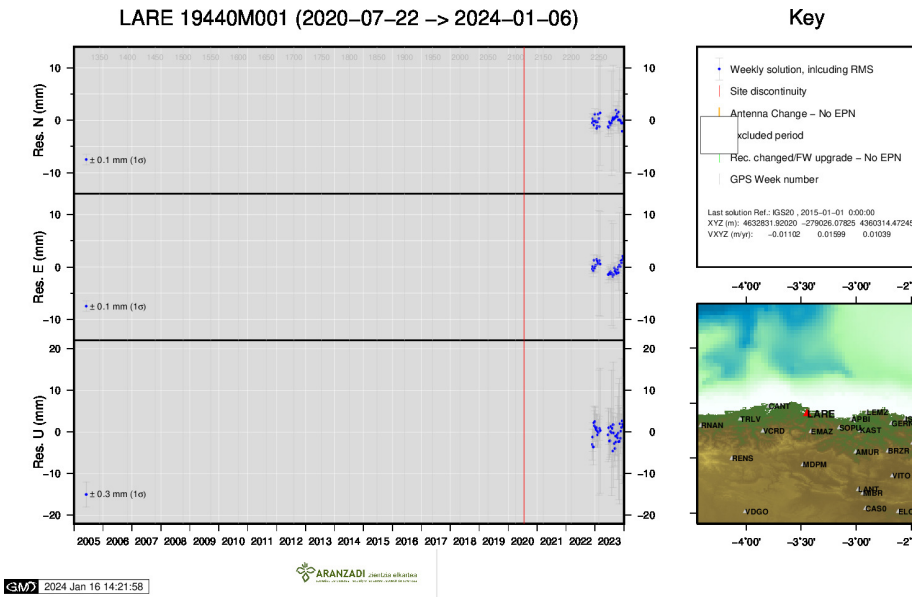
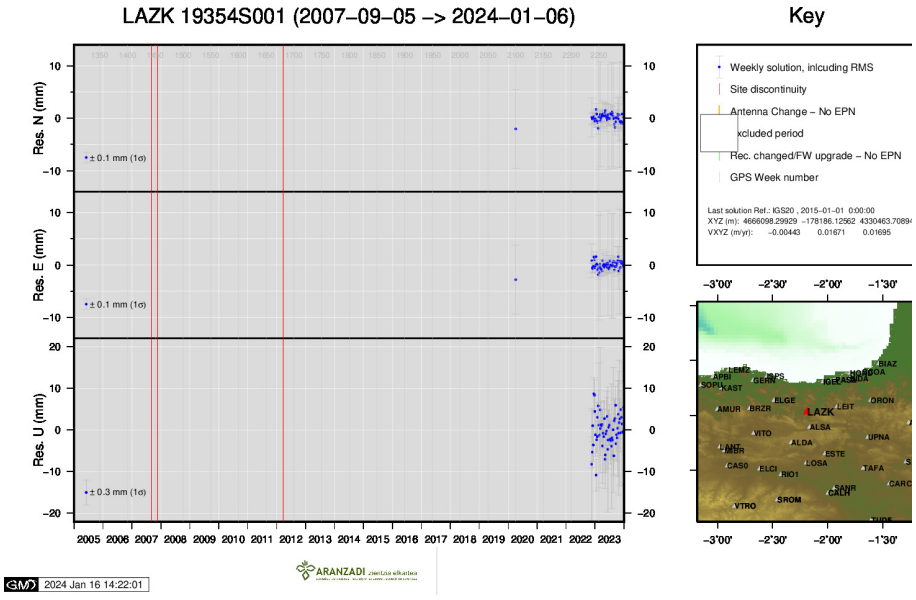



15 ) LARE

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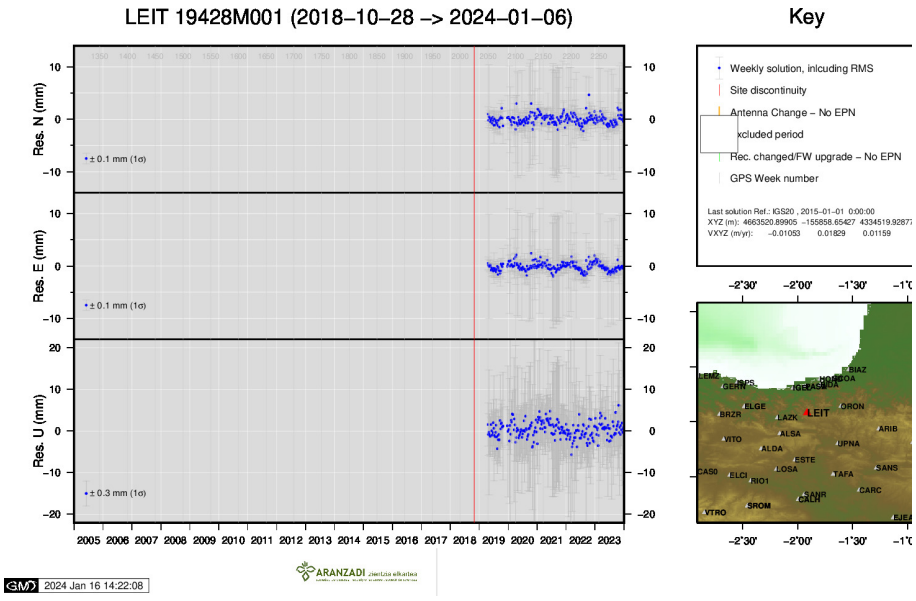


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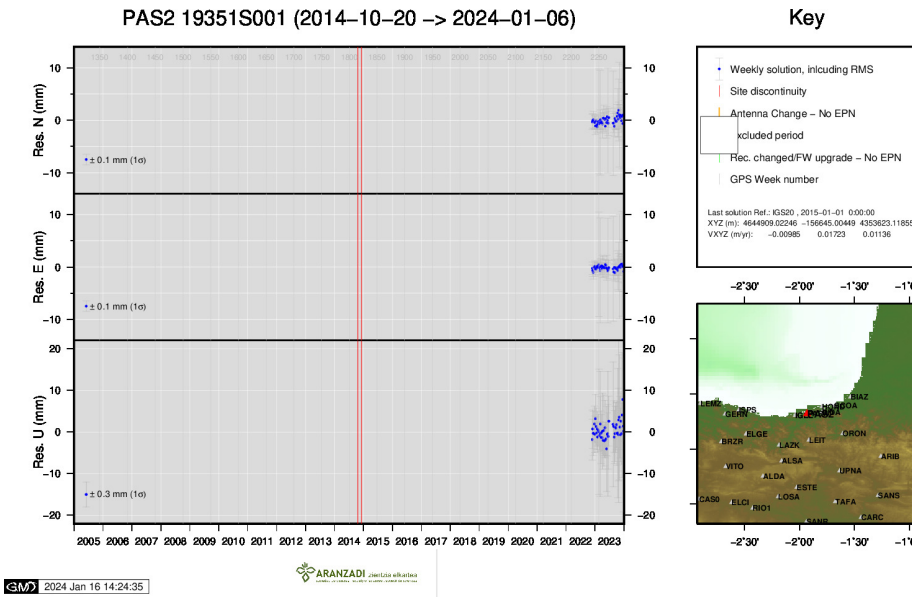
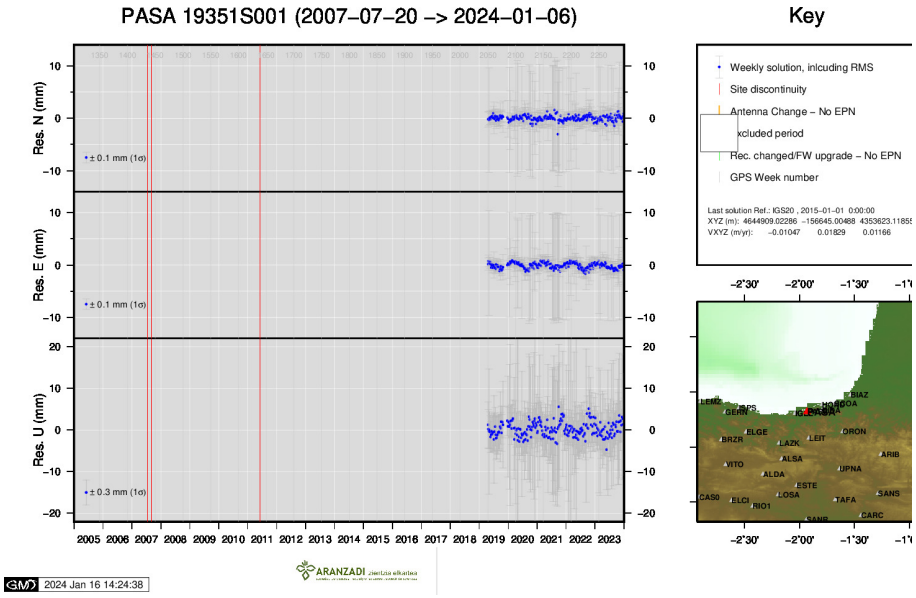
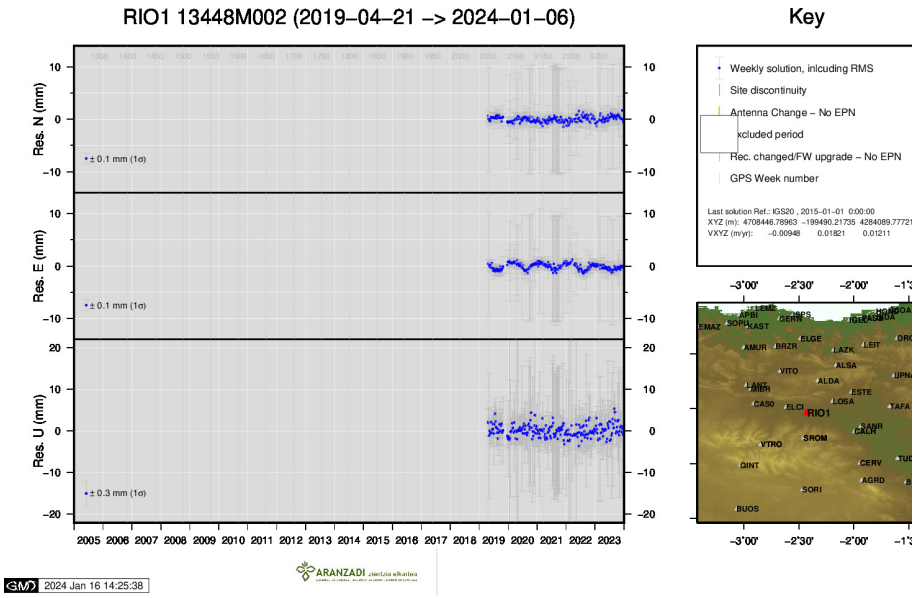


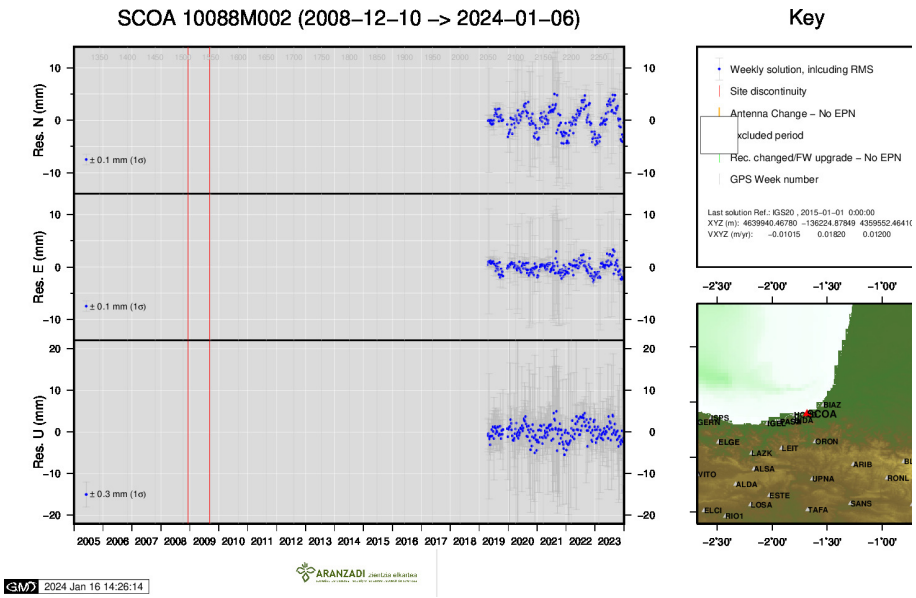

18 ) PAS2



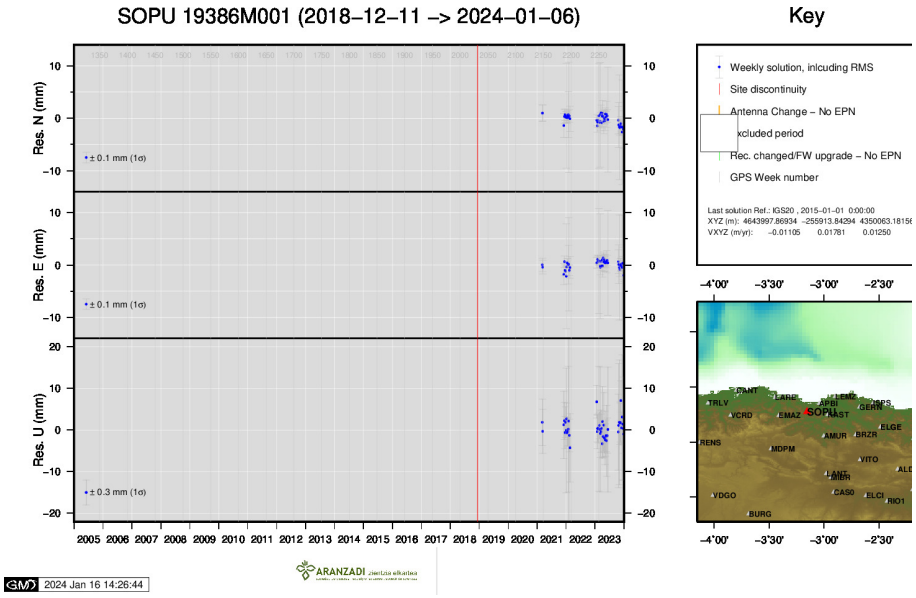

19 ) PASA



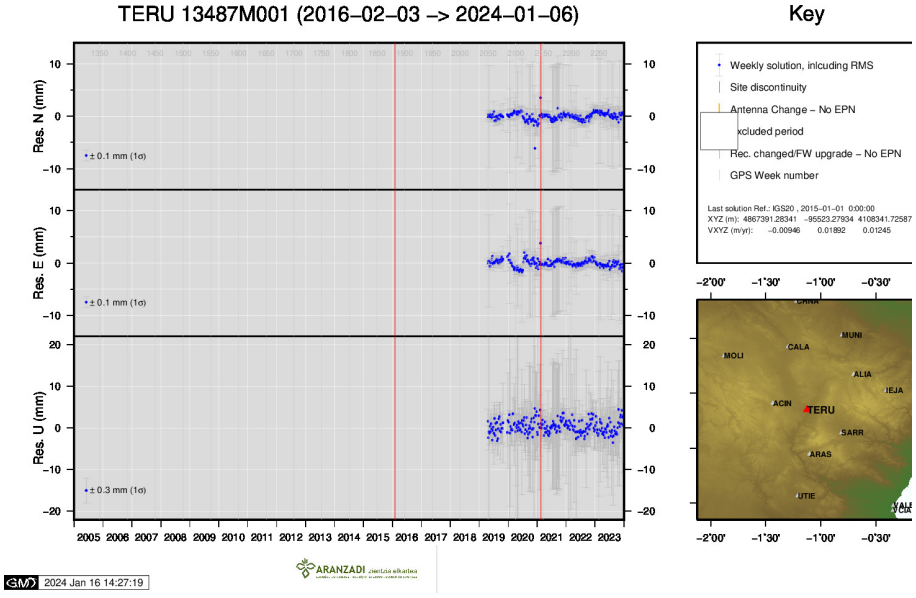

20 ) RIO1




21 ) SCOA




22 ) SOPU

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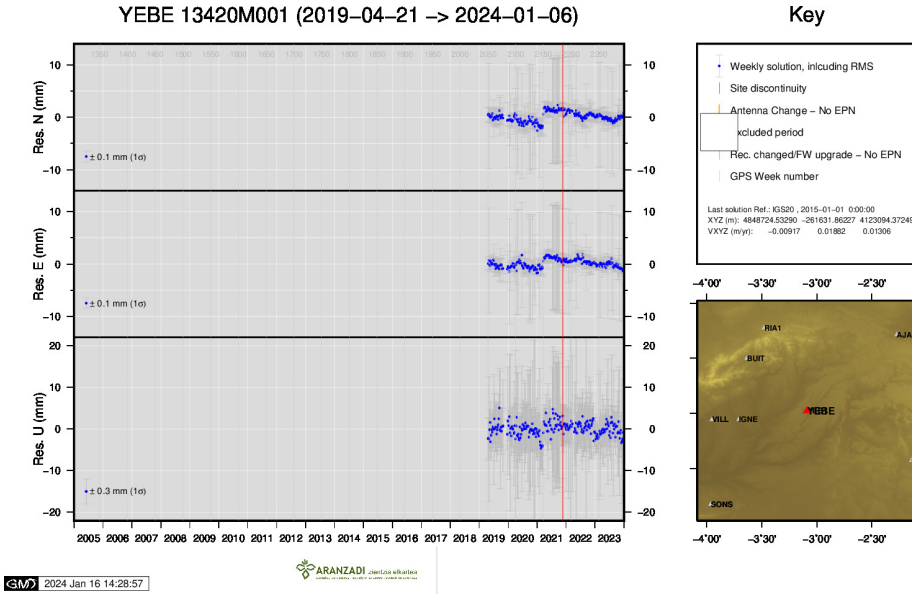
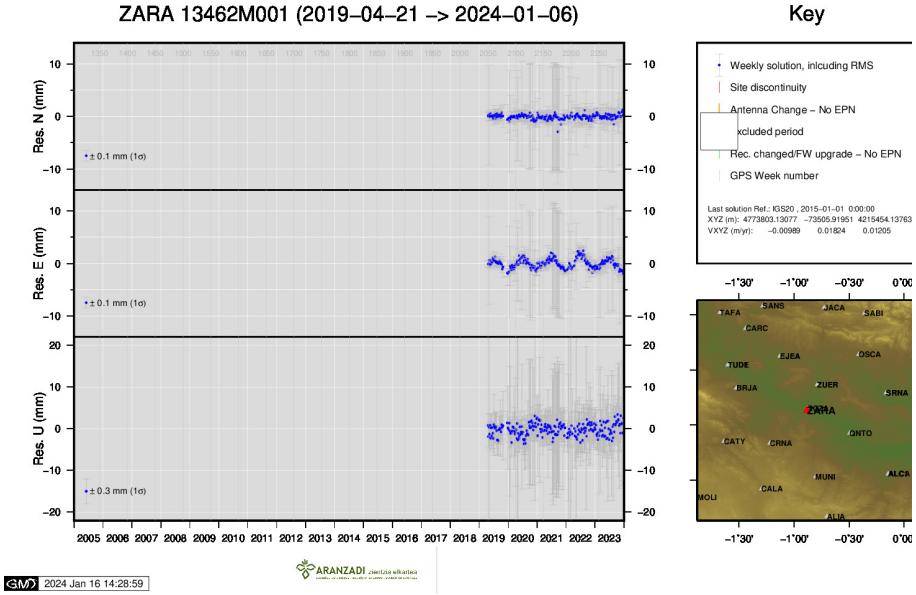



24 ) YEBE




25 ) ZARA