EUREF Analysis Centres Workshop, 03/07 Nov. 2022

EPND research: towards a full harmonization with the National Realizations.

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ARANZADI zientzi elkartea . society of sciences sociedad de ciencias . société de sciences

1222·2022 800 ANNI

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Outline

1. EPN D.
2. EPN D research: towards the full harmonization with the National Realizations.
3. Case study: The GKU solution (National Realization for Slovakia).
4. Conclusions/Acknowledgements.

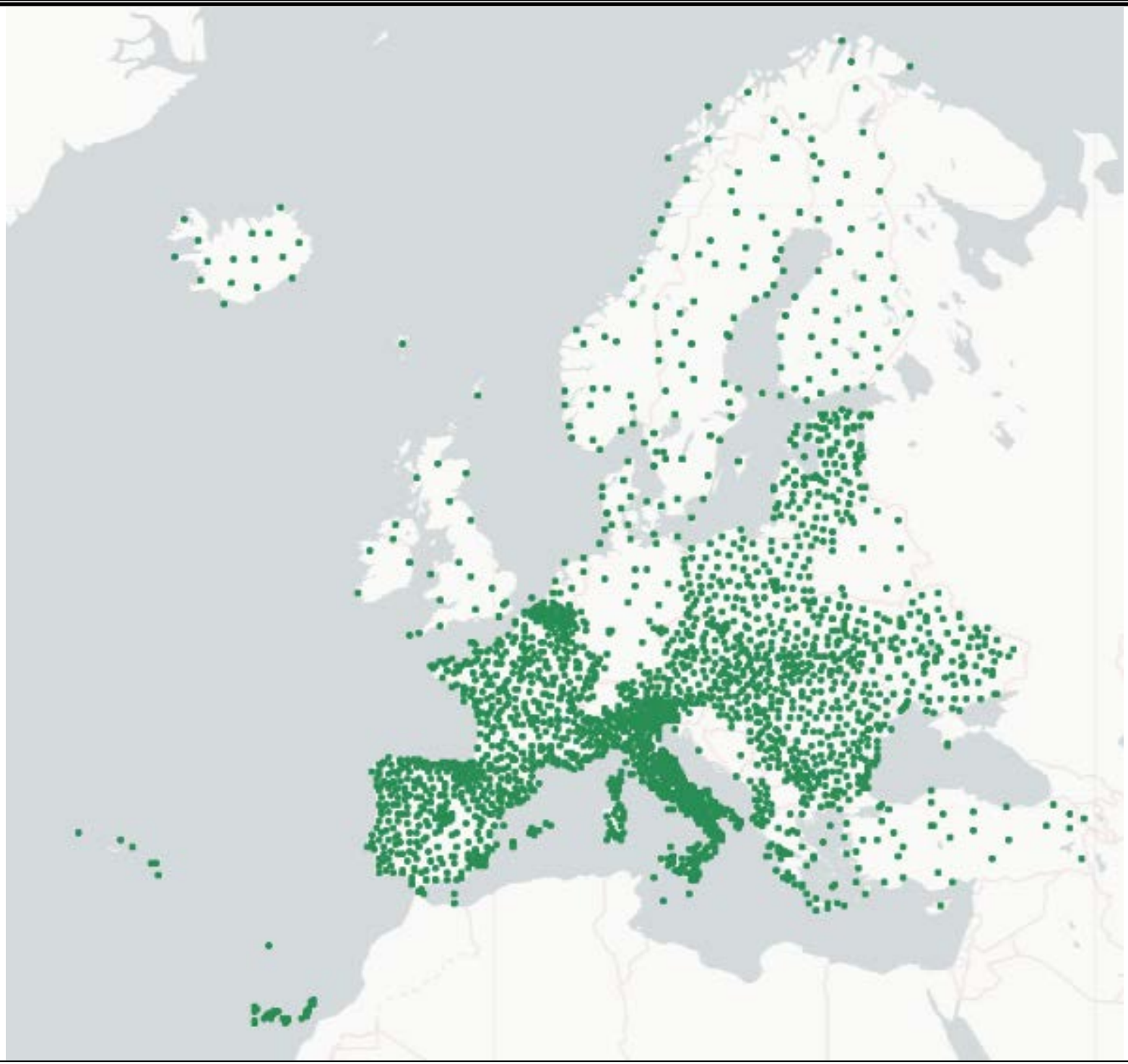
EPN Densification (EPND: A. Kenyeres; CATREF)

The EPND is based on the GNSS solutions provided by European Agencies and Analysis Centers that cover all Europe:

- Data provided in **SINEX** format (COV block),
- If **DAILY data are provided, weekly** solution is computed,
- A **week-wise solution** is computed with all the provided weekly files,
- All these week-wise solutions are combined to get the multiyear solution (P+V aligned to a certain EPN release),
- **Strictly use** the EPN/IGS discontinuities.

This is the current EPND computation procedure. Some remarks:

- This procedure has **full control** of the solutions.
- Each time we want to compute the cumulative solution, we must compute the **full dataset**.
- **Slow procedure** if we want to include new solutions (e.g. recomputed or new campaigns).
- In some cases, the Agencies have a larger dataset that leads to inconsistent number of solutions between EPND/NR.



EPN D research: towards the full harmonization with the National Realizations.

A **SEAMLESS** procedure to make the EPND and the NRs fully compliant:

- **Rigorous metadata validation** using **logsheets** (whenever available) vs **SINEX metadata** blocks,
- **EPND Discontinuities (non IGS/EPN)** are discussed with the station managers,
- **A cumulative solution is computed for each data provider**. All these combined solutions are merged in the very last step in a unique solution,
- Strictly use the EPN/IGS discontinuities. Software used: **BSW52**,
- Logsheet maintenance by the data providers: **A MUST!**

In this scenario:

- We have **full control** of the solutions.
- We can **easily include new solutions** (no need to start from scratch each time we compute the full EPND cumulative solution) regardless daily or weekly data are provided.
- **Discussion of the discontinuities**: fully harmonized and comparable solutions of EPND wrt the NRs.
- The solutions (time series) are uploaded to a dedicated AC-wise website to ease the feedback. Additional feedback is AC-wise provided, optionally by mail (see next slides).

The results help to provide the **feedback for the EUREF's EPND FINAL** product

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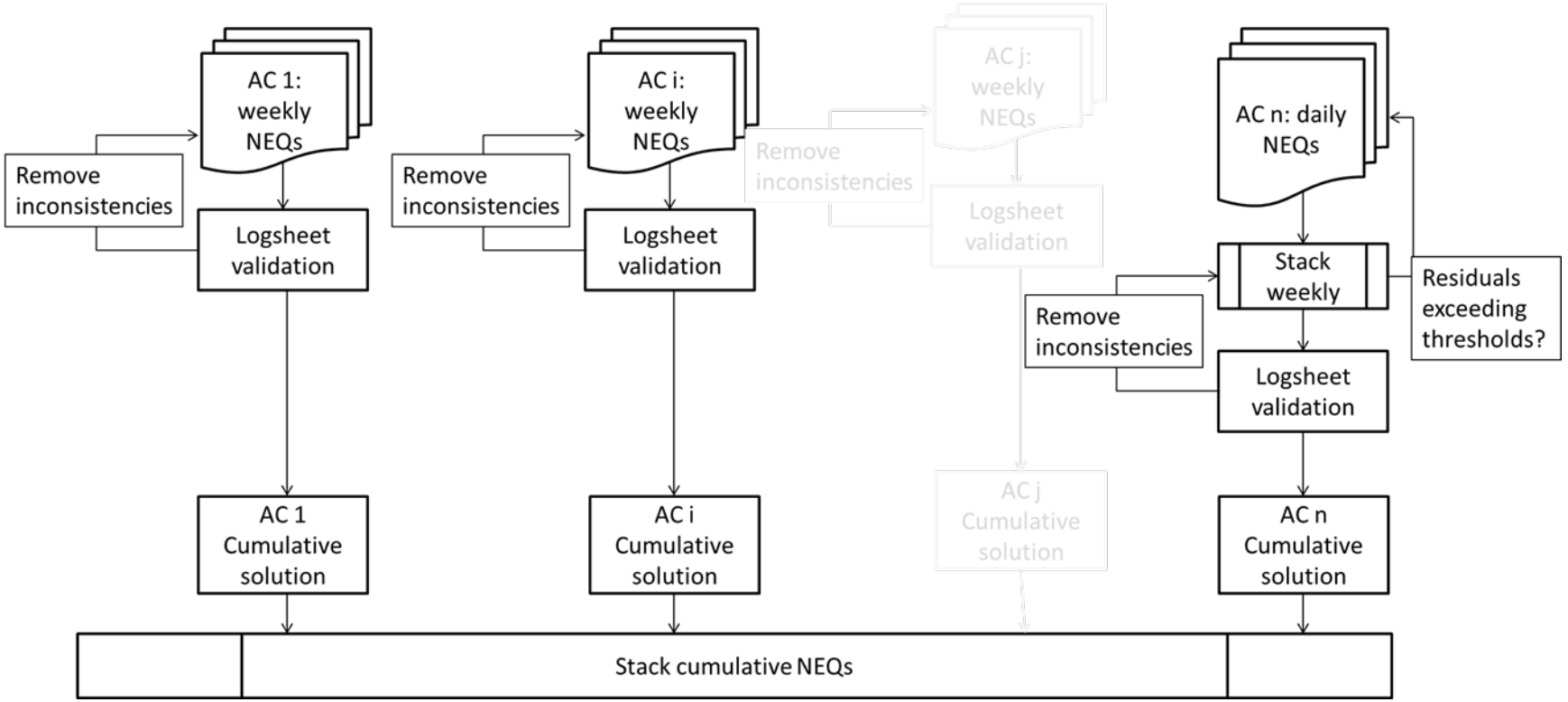

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Diagnostics table:

Metadata verification:

Block:

OBSERVATIONS	double header records removed, if found					
MARKER NAME	&	MARKER NUMBER				
OBSERVER	&	AGENCY				
RECEIVER TYPE	&	RECEIVER SER. NO.	&	RECEIVER FIRM. VERS.		
ANTENNA TYPE	&	ANTENNA SER. NO.				
APPROX POSITION X	&	APPROX POSITION Y	&	APPROX POSITION Z		
ANTENNA DELTA NORTH	&	ANTENNA DELTA EAST	&	ANTENNA DELTA UP		

Reported Inconsistencies (logsheet and RINEX header different):

ANTENNA TYPE
ANTENNA SER. NO.
ANTENNA DELTA UP
RECEIVER TYPE
RECEIVER SER. NO.
RECEIVER FIRM. VERS.

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Logsheets must be duly updated

```
log_ARA22187 | LRCA | RECEIVER TYPE         | corrected (LEICA GR30           -> LEICA GRX1200GGPRO  ) (source: lrca_20201214.log)
log_ARA22187 | MEQU | ANTENNA DELTA UP      | corrected (0.0771               -> 0.0350              ) (source: mequ_20220615.log)
log_ARA22187 | OSCA | APPROX POSITION X     | corrected (4736900.6352         -> 4773803.000         ) (source: osca_20201216.log)
log_ARA22187 | OSCA | APPROX POSITION Y     | corrected (-34213.6690          -> -73506.000          ) (source: osca_20201216.log)
log_ARA22187 | OSCA | APPROX POSITION Z     | corrected (4257470.7969         -> 4215454.000         ) (source: osca_20201216.log)
log_ARA22187 | OSCA | RECEIVER TYPE         | corrected (LEICA GR30           -> LEICA GR10          ) (source: osca_20201216.log)
log_ARA22187 | TN03 | ANTENNA DELTA UP      | corrected (0.0771               -> 0.0000              ) (source: tn03_20210831.log)
log_ARA22187 | VJOI | ANTENNA DELTA UP      | corrected (0.0935               -> 0.0940              ) (source: vjoi_20210312.log)
log_ARA22187 | ZUER | ANTENNA DELTA UP      | corrected (0.0771               -> 0.0350              ) (source: zuer_20201216.log)
log_ARA22197 | ALHA | RECEIVER TYPE         | corrected (LEICA GRX1200+GNSS   -> LEICA GRX1200GGPRO  ) (source: alha_20201214.log)
log_ARA22197 | ALIA | RECEIVER TYPE         | corrected (LEICA GRX1200+GNSS   -> TPS NETG3           ) (source: alia_20200710.log)
log_ARA22197 | BINE | ANTENNA DELTA UP      | corrected (0.0771               -> 0.0350              ) (source: bine_20220425.log)
log_ARA22197 | CALA | RECEIVER TYPE         | corrected (LEICA GRX1200GGPRO   -> TPS NETG3           ) (source: cala_20200710.log)
log_ARA22197 | CALH | RECEIVER TYPE         | corrected (LEICA GR50           -> LEICA GRX1200PRO    ) (source: calh_20200716.log)
log_ARA22197 | CSOS | RECEIVER TYPE         | corrected (TPS NET-G3A          -> TPS NETG3           ) (source: csos_20200710.log)
log_ARA22197 | EJEA | ANTENNA DELTA UP      | corrected (0.0771               -> 0.0000              ) (source: ejea_20200710.log)
log_ARA22197 | EJEA | RECEIVER TYPE         | corrected (LEICA GR50           -> TPS NETG3           ) (source: ejea_20200710.log)
log_ARA22197 | JUMA | RECEIVER TYPE         | corrected (LEICA GR30           -> LEICA GRX1200GGPRO  ) (source: juma_20201214.log)
log_ARA22197 | LP01 | RECEIVER TYPE         | corrected (TRIMBLE ALLOY        -> TRIMBLE NETR9       ) (source: lp01_20211015.log)
log_ARA22197 | LRCA | RECEIVER TYPE         | corrected (LEICA GR30           -> LEICA GRX1200GGPRO  ) (source: lrca_20201214.log)
log_ARA22197 | MEQU | ANTENNA DELTA UP      | corrected (0.0771               -> 0.0350              ) (source: mequ_20220615.log)
log_ARA22197 | OSCA | APPROX POSITION X     | corrected (4736900.6399         -> 4773803.000         ) (source: osca_20201216.log)
log_ARA22197 | OSCA | APPROX POSITION Y     | corrected (-34213.6688          -> -73506.000          ) (source: osca_20201216.log)
log_ARA22197 | OSCA | APPROX POSITION Z     | corrected (4257470.8003         -> 4215454.000         ) (source: osca_20201216.log)
log_ARA22197 | OSCA | RECEIVER TYPE         | corrected (LEICA GR30           -> LEICA GR10          ) (source: osca_20201216.log)
log_ARA22197 | TN03 | ANTENNA DELTA UP      | corrected (0.0771               -> 0.0000              ) (source: tn03_20210831.log)
log_ARA22197 | VJOI | ANTENNA DELTA UP      | corrected (0.0935               -> 0.0940              ) (source: vjoi_20210312.log)
log_ARA22197 | ZUER | ANTENNA DELTA UP      | corrected (0.0771               -> 0.0350              ) (source: zuer_20201216.log)
```

Warnings: USED stations, correct equipment

ERRORS:

```
log_ARA22137 | TIAS | ANTENNA TYPE          | Error (LEIAX1203+GNSS  NONE -> LEIAX1203+GNSS  LEIS) (source: tias_20210609.log)
log_ARA22147 | EJEA | ANTENNA TYPE          | Error (LEIAR20         LEIM -> TPSCR.G3        TPSH) (source: ejea_20200710.log)
log_ARA22147 | SNMG | ANTENNA TYPE          | Error (LEIAX1202GG     NONE -> LEIAX1203+GNSS  NONE) (source: snmg_20210609.log)
log_ARA22147 | TERR | ANTENNA TYPE          | Error (LEIAX1202GG     NONE -> LEIAX1203+GNSS  NONE) (source: terr_20210609.log)
log_ARA22147 | TIAS | ANTENNA TYPE          | Error (LEIAX1203+GNSS  NONE -> LEIAX1203+GNSS  LEIS) (source: tias_20210609.log)
log_ARA22157 | CALH | ANTENNA TYPE          | Error (LEIAR20         LEIM -> LEIAT504GG      LEIS) (source: calh_20200716.log)
log_ARA22157 | EJEA | ANTENNA TYPE          | Error (LEIAR20         LEIM -> TPSCR.G3        TPSH) (source: ejea_20200710.log)
log_ARA22157 | SNMG | ANTENNA TYPE          | Error (LEIAX1202GG     NONE -> LEIAX1203+GNSS  NONE) (source: snmg_20210609.log)
log_ARA22157 | TIAS | ANTENNA TYPE          | Error (LEIAX1203+GNSS  NONE -> LEIAX1203+GNSS  LEIS) (source: tias_20210609.log)
log_ARA22167 | CALH | ANTENNA TYPE          | Error (LEIAR20         LEIM -> LEIAT504GG      LEIS) (source: calh_20200716.log)
log_ARA22167 | EJEA | ANTENNA TYPE          | Error (LEIAR20         LEIM -> TPSCR.G3        TPSH) (source: ejea_20200710.log)
log_ARA22167 | SNMG | ANTENNA TYPE          | Error (LEIAX1202GG     NONE -> LEIAX1203+GNSS  NONE) (source: snmg_20210609.log)
log_ARA22167 | TIAS | ANTENNA TYPE          | Error (LEIAX1203+GNSS  NONE -> LEIAX1203+GNSS  LEIS) (source: tias_20210609.log)
log_ARA22177 | CALH | ANTENNA TYPE          | Error (LEIAR20         LEIM -> LEIAT504GG      LEIS) (source: calh_20200716.log)
log_ARA22177 | EJEA | ANTENNA TYPE          | Error (LEIAR20         LEIM -> TPSCR.G3        TPSH) (source: ejea_20200710.log)
log_ARA22187 | CALH | ANTENNA TYPE          | Error (LEIAR20         LEIM -> LEIAT504GG      LEIS) (source: calh_20200716.log)
log_ARA22187 | EJEA | ANTENNA TYPE          | Error (LEIAR20         LEIM -> TPSCR.G3        TPSH) (source: ejea_20200710.log)
log_ARA22197 | CALH | ANTENNA TYPE          | Error (LEIAR20         LEIM -> LEIAT504GG      LEIS) (source: calh_20200716.log)
log_ARA22197 | EJEA | ANTENNA TYPE          | Error (LEIAR20         LEIM -> TPSCR.G3        TPSH) (source: ejea_20200710.log)
```

EPN D research: towards the full harmonization with the National Realizations.

General website:

Introduction

Metadata Validation

AC-wise Combination

Validate your SINEX files!!

AC-wise Cumulative Investigations

Last update: 2022-10-30 14:11:42 GMT

here provided at your own risk!

In the AC-wise approach, we stack the data provided by each AC. Then, for each AC, a multiyear solution is computed. In the second step, all these AC-wise solutions are stacked altogether to get the multiyear combined solution.

AC Time Series (only the solutions of the individual AC is considered validated with the logsheets, if available) in a new window:

- ARA
- BUL
- CAT
- DEN
- EST
- EUR
- GKU
- MAO
- SWE

For each AC:

Introduction

Metadata Validation

AC-wise Combination

Validate your SINEX files!!

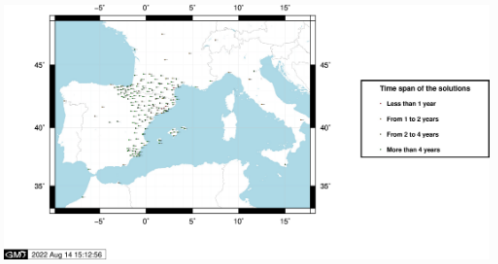
CAT (C2190) SOLUTION CONSIDERING ONLY THIS AC CLEANED NQ0s

Last update: 2022-08-14 13:12:48 GMT

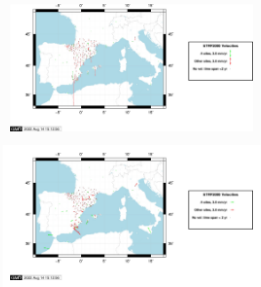
Outputs and other files:	
List of discontinuities	List of removed solutions
Antenna MODEL changes (no discontinuity)	Constrained velocities
Computed coordinates	Computed velocities (+3 years of data)
Quality Control:	
Class A Quality Control	Class A velocity Differences

Click on the different maps to get a higher resolution map.

Time Span of the Solutions



Velocities



Specific areas of the time series can be zoomed in and out by clicking and grabbing the mouse.
A double click will restore the time series to its original extension.

Time series (numer of sites: 212):

ABAN ACAL ACIN AGDE AGDS AGEN AICI AIO2 AIRM ALAC ALBA ALBI ALBM

ALC1 ALCA ALCO ALDA ALHA ALIA ALME ALOR ALSA AMUR APB1 ARAS ARIB

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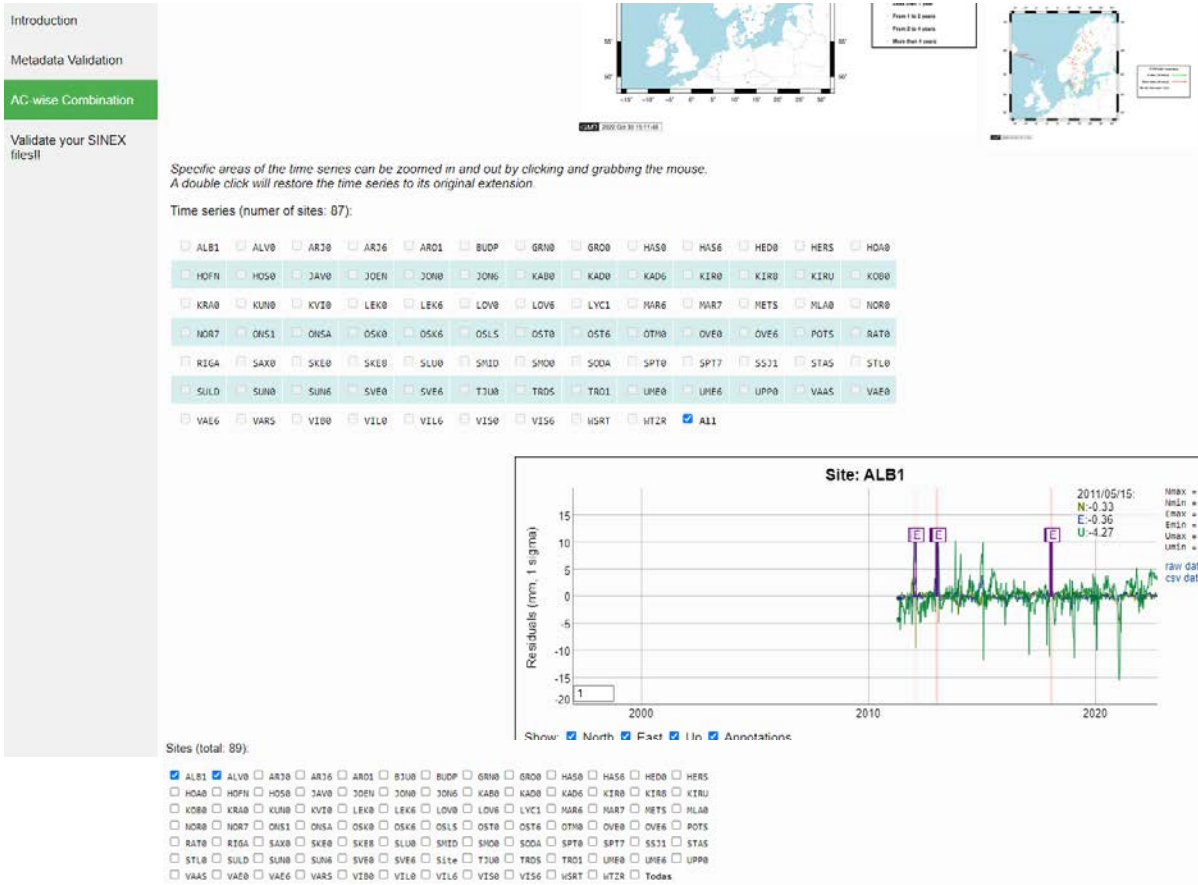
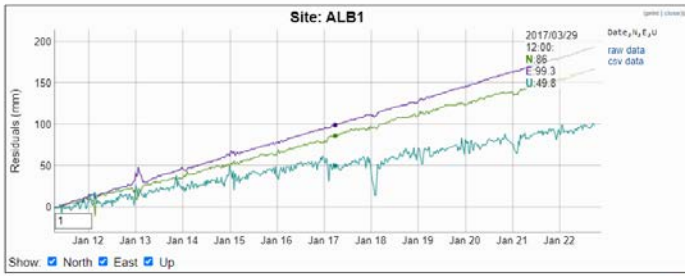
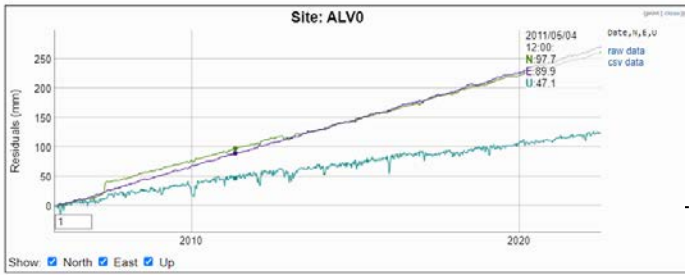
Time series for each AC
(in this example: SWE):



SINEX Time series
(NEU (projected to WGS84)
referred to first solution):





Case study: The GKU solution (National Realization for Slovakia).

The GKU NR and its EPN D analysi is provided as a case study of this research.

- The National GNSS Network of Slovakia (computed by the EUREF's GKU AC), with data spanning from 2007/01/01 to 2020/12/31 is used a collaborative example.
- Several EUREF GB members assisted the GKU in several processing stages (configuration of the least squares parameters, conversion of normal equations IGb08-datum based to IGS14, …).
- The agreement of the National GKU solution related to the EUREF EPND solution as well as to the AC-wise solution is provided:

	EUREF EPND						AC-wise					
	dN (mm)	dE (mm)	dUp (mm)	dVN (mm/year)	dVE (mm/year)	dVUp (mm/year)	dN (mm)	dE (mm)	dUp (mm)	dVN (mm/year)	dVE (mm/year)	dVUp (mm/year)
Mean	-0.16	-0.06	0.68	0.05	0.04	-0.22	0.27	-0.01	-0.25	-0.01	0.00	0.02
std.	1.14	1.11	2.18	0.15	0.14	0.26	0.64	0.43	1.20	0.10	0.09	0.20
min.	-4.88	-1.75	-8.15	-0.12	-0.54	-0.52	-1.63	-2.13	-4.83	-0.36	-0.16	-0.57
max.	1.73	5.65	3.59	0.52	0.37	0.86	3.67	1.00	3.58	0.39	0.60	0.68

Conclusions.

- Several ACs are providing data for this research.
- The final goal is to fully harmonize the EPND and the National Realizations.
- We rely on the information provided in the logsheets, so they must be correctly updated.
- In the upcoming months, a mail will be sent to all the ACs to kindly ask them to join this research. The only requisite is to upload the SINEX files they already produce to a dedicated server.
- SINEX files should be uploaded no later then after 5 weeks to provide updated solutions seamlessly.

Thanks to all the ACs that are providing data to this initiative