



## **CEGRN 2021 Meeting**

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# **Review of the available data since 1994, of their processing and of the scientific results**

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## Outline

1. Introduction: the CEGRN Network.
2. Data in Brief (DiB): The Central European GNSS Research Network (CEGRN) 1996 – 2017 dataset.
3. Combination procedure.
4. Results.
5. Data available after 2017.
6. Future work.
7. Conclusions

## **The CEGRN Network (EUREF and CEGRN MoU signed in Chisinau, Moldova, 2011)**

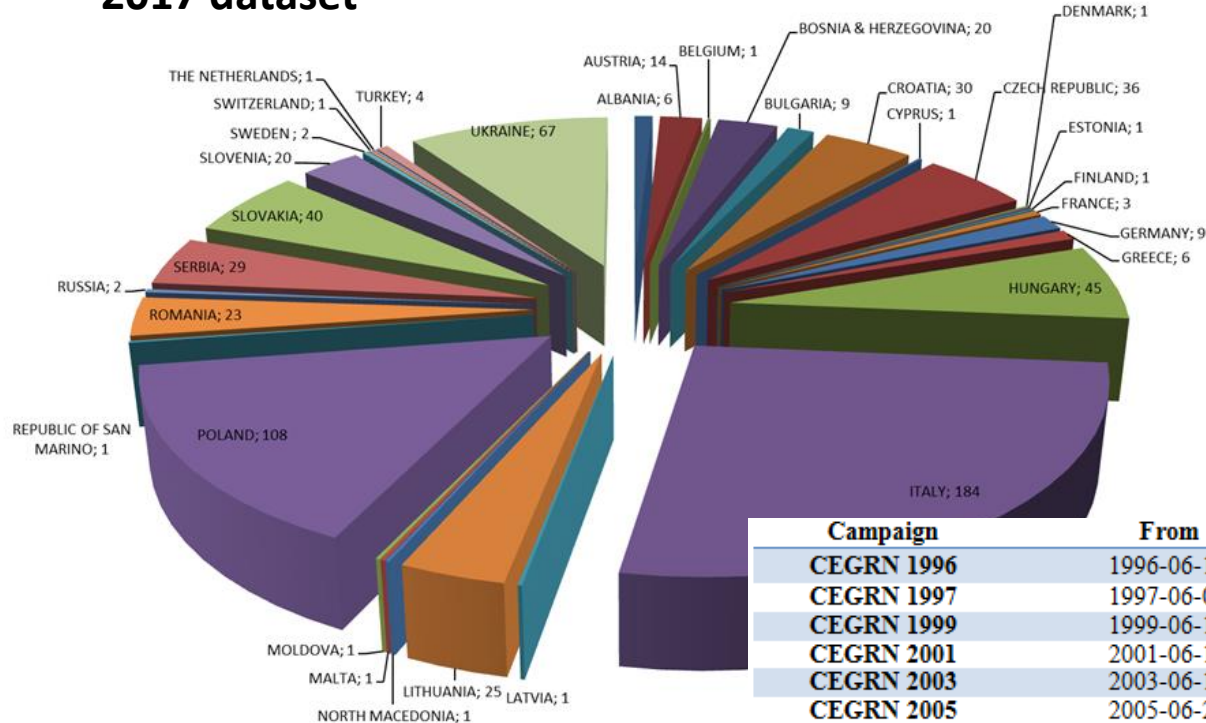
The main objective of the CEGRN network is the monitoring of present day crustal surface deformations in Central Europe. The main study areas cover the Adriatic Microplate, the Balkans and Dinarides, the Carpathians, the Eastern Alps and the Pannonian Basin, being all of them active tectonic zones. The long term project is running since 1994 and was sponsored twice by EU projects: CERGOP-1 and CERGOP-2 (Environment Central European Geodynamics Project, funded by the European Union from 2003 to 2006) under the 5th Framework Programme.

For this purpose, Agencies of the CEGRN Consortium provide observations in standard RINEX format since 1994.

The CEGRN Network contributes to the following EUREF Working Groups:

- European Dense Velocities Working Group (2017-now): Chaired by E. Brockmann
- EPN Densification Working Group (2015 - now): Chaired by A. Kenyeres
- Deformation Models Working Group (2012-now): Chaired by M. Lidberg

## Data in Brief (DiB): The Central European GNSS Research Network (CEGRN) 1996 – 2017 dataset



In 2017, for the first time in CEGRN, weekly SINEX files are combined

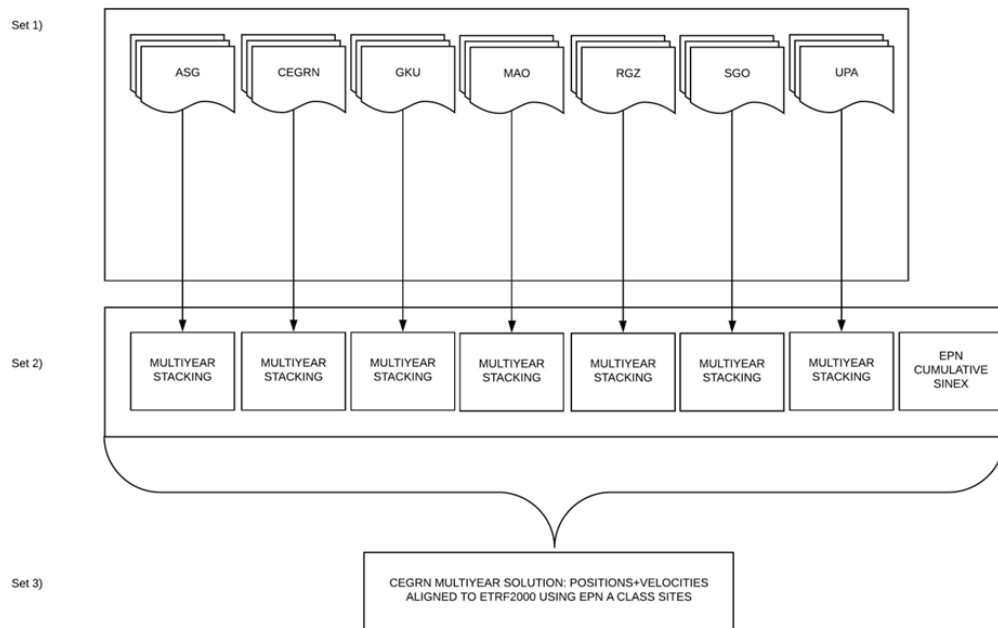
Campaign	From	To	Number of sites
CEGRN 1996	1996-06-10	1996-06-15	51
CEGRN 1997	1997-06-04	1997-06-10	44
CEGRN 1999	1999-06-14	1999-06-19	62
CEGRN 2001	2001-06-17	2001-06-23	57
CEGRN 2003	2003-06-16	2003-06-21	77
CEGRN 2005	2005-06-20	2005-06-25	106
CEGRN 2007	2007-06-18	2007-06-23	95
CEGRN 2009	2009-06-22	2009-06-27	85
CEGRN 2011	2011-06-20	2011-06-25	89
CEGRN 2013	2013-06-16	2013-06-22	178
CEGRN 2015	2015-06-14	2015-06-20	184
CEGRN 2017	2017-06-11	2017-06-17	1104

## **Data in Brief (DiB): The Central European GNSS Research Network (CEGRN) 1996 – 2017 dataset**

Besides the CEGRN RINEX observation files, the Agencies providing SINEX standard solutions are:

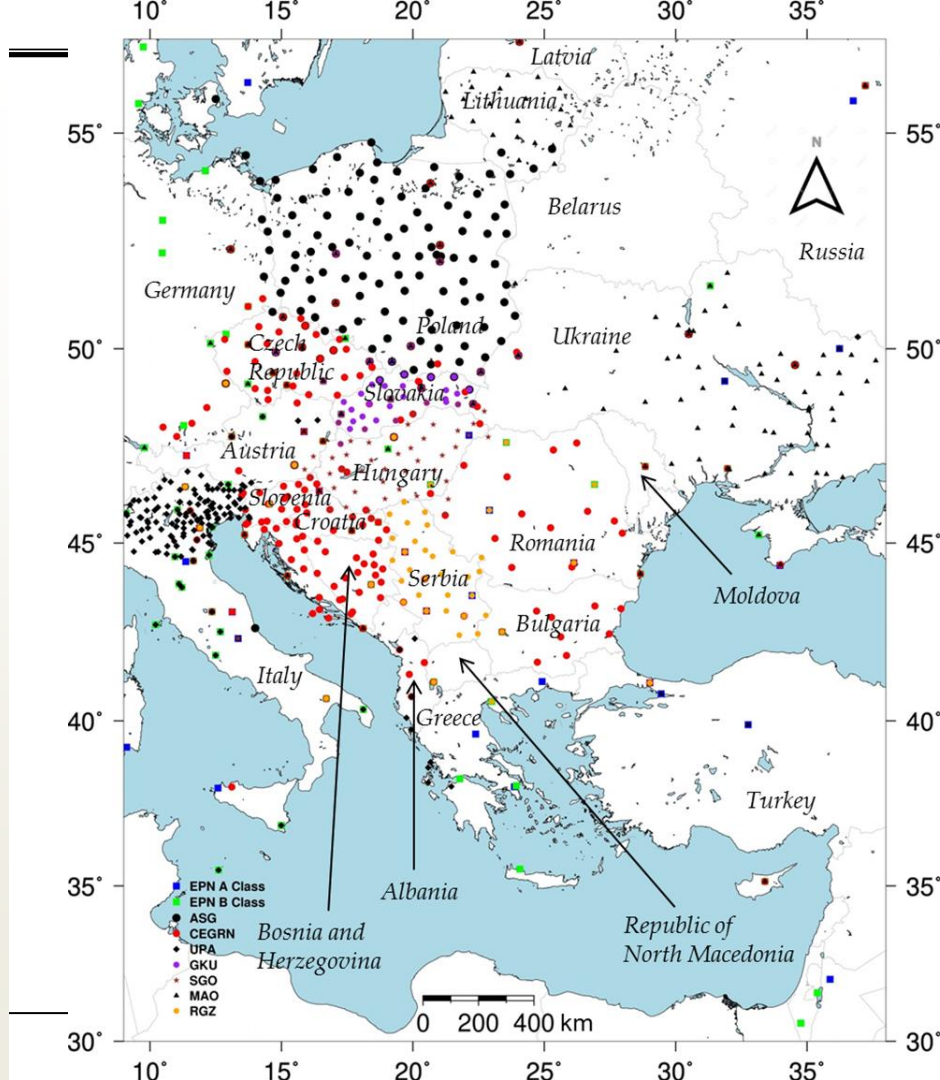
- ASG (*Główny Urząd Geodezji i Kartografii*, Poland): solutions from 2009 to 2015.
- GKU (*Geodetický a Kartografický Ústav*, Slovakia): solutions from 2007 to 2017.
- MAO (Main Astronomical Observatory, National Academy of Sciences of Ukraine): solutions from 2001 to 2017.
- EPN (European Permanent Network): solutions from 1996 to 2017.
- RGZ (*Republički geodetski zavod*, Serbia): solutions from 2009 to 2015.
- SGO (Satellite Geodetic Observatory, Hungary): solutions from 2011 to 2017.
- UPA (University of Padova, Italy): solutions from 2011 to 2017.
- LIT (Institute of Geodesy, Vilnius Gediminas Technical University, Vilnius): 2011 to 2017

**Combination procedure: data provided by each AC are stacked in multi-year solution. Then, all these AC-wise multiyear solutions are combined in a unique solution.**

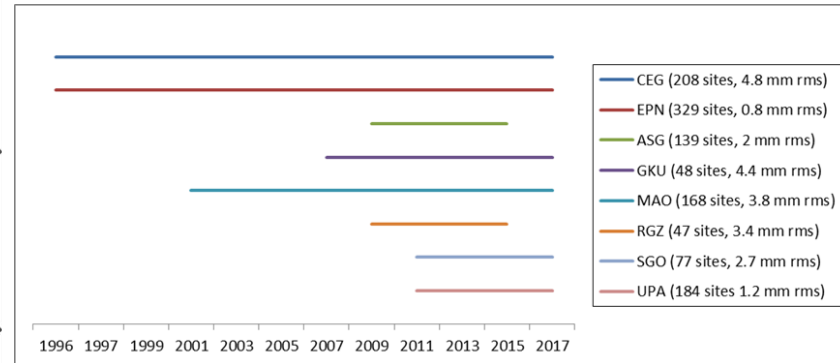


Discontinuities: EPN release Cxxxx. We will use the latest one available (C1980 for the DiB paper).

Minimum constraints are used in both, positions and velocities on the class A stations (Cxxxx).



Time span and rms of the Individual solutions w.r.t. the combined solution.



## Results

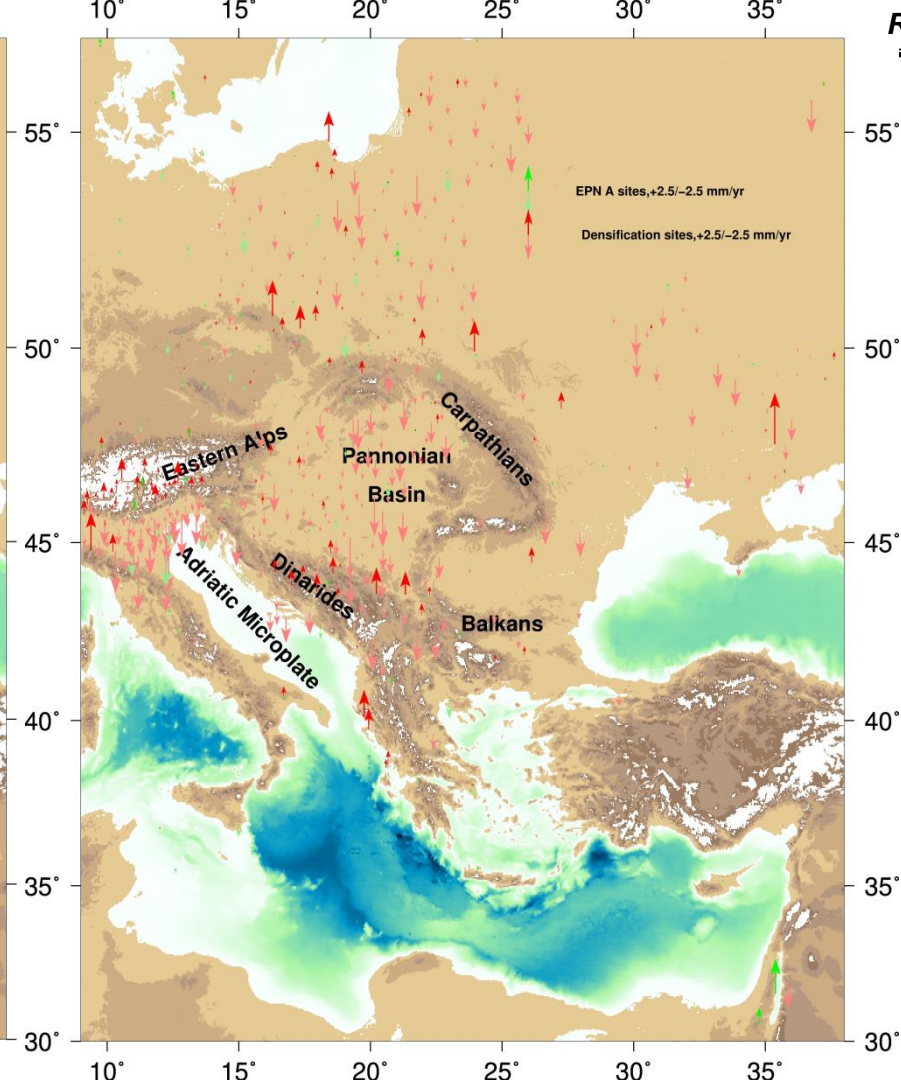
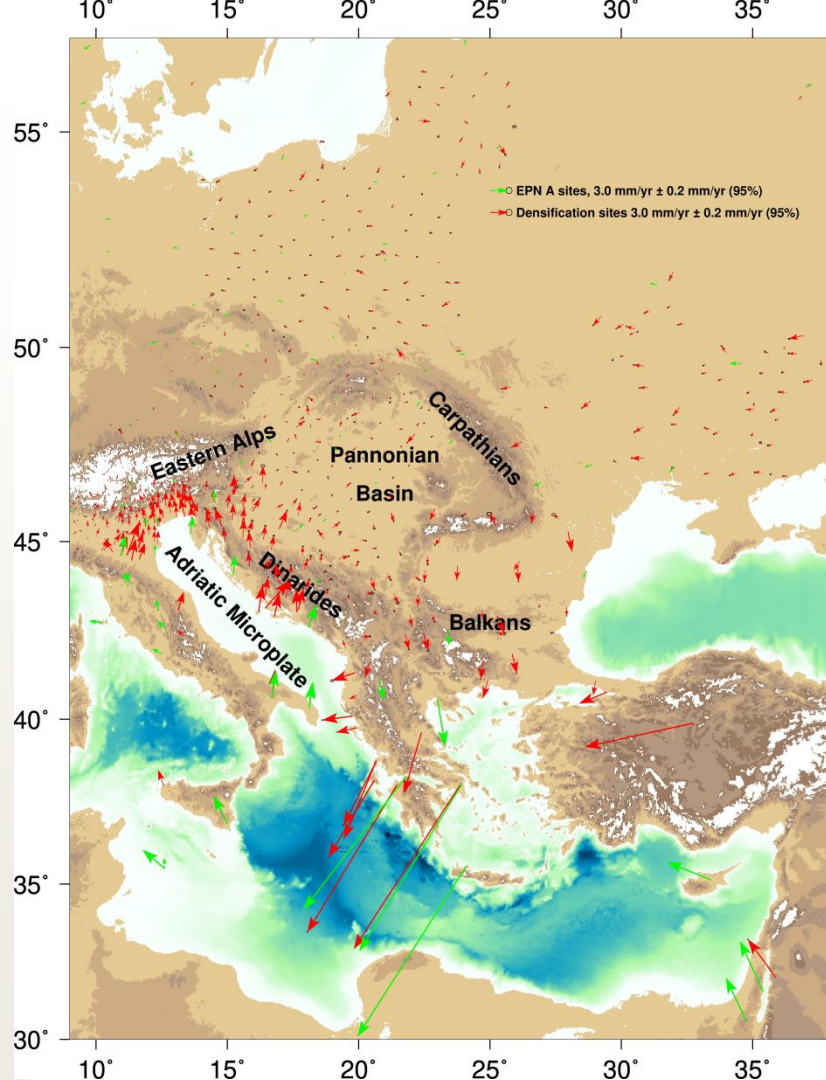
1) Helmert transformation parameters of the individual solutions with respect to the combined CEGRN at epoch 2010.0. For each individual solution, the number of reference stations (Class A sites) is provided. Rms is the root mean square of the common coordinate differences at the reference epoch. TX, TY, TZ are the translations of the origin of each subnetwork relative to the combined network; likewise, RX, RY and RZ represents rotations about the X, Y and Z axis and scale is the scale difference, in parts per billion (ppb).

	Class A Sites	Rms (mm)	TX (mm)	TY (mm)	TZ (mm)	RX (mas)	RY (mas)	RZ (mas)	Scale (ppb)
EPN	234	0.8	-0.2	-0.3	0.1	0.0	0.0	0.0	0.0
CEG	50	4.8	-13.4	6.7	14.7	0.0	-0.6	0.2	-0.6
MAO	71	3.8	-0.5	-3.5	8.7	0.2	-0.2	-0.1	-0.7
GKU	15	4.4	16.7	-29.0	-2.5	0.6	0.4	-0.9	0.9
ASG	35	2.0	5.3	-17.4	7.1	0.5	0.0	-0.5	-0.2
RGZ	17	3.4	56.5	-44.7	-21.0	1.1	1.8	-1.1	-1.8
UPA	22	1.2	-3.0	3.0	6.2	0.0	-0.2	0.0	0.0
SGO	19	2.7	20.0	-7.4	-5.6	0.2	0.6	-0.3	-0.3

2) Rms of the N, E, Up, VN, VE, and VUp between the computed class A coordinates and velocities (234 sites; 690 stations if SNs are considered) and the C1980 release.

N (mm)	E (mm)	Up (mm)	Vn (mm/yr)	Ve (mm/yr)	VUp (mm/yr)
0.0 ± 1.1	0.5 ± 1.0	0.1 ± 2.7	0.06 ± 0.13	-0.07 ± 0.12	0.38 ± 0.28





## **Data available for the 2019 Campaign**

RINEX observation files :

- Albania (IGEO): 8
- Czech Republic: CZEPOS: 28; VESOG: 5
- Lithuania (LIT): 38, from which Latvia (5) and Poland (2)
- Macedonia (MAKPOS): 15
- Moldova (INGEOCAD): 10
- Romania (ANCPI): observations from 5 stations are not usable (wrong RNX 3.04 format). Data usable for 3 other stations.
- Slovenia (GIS/GURS): 23
- Ukraine (MAO): 138

SINEX files:

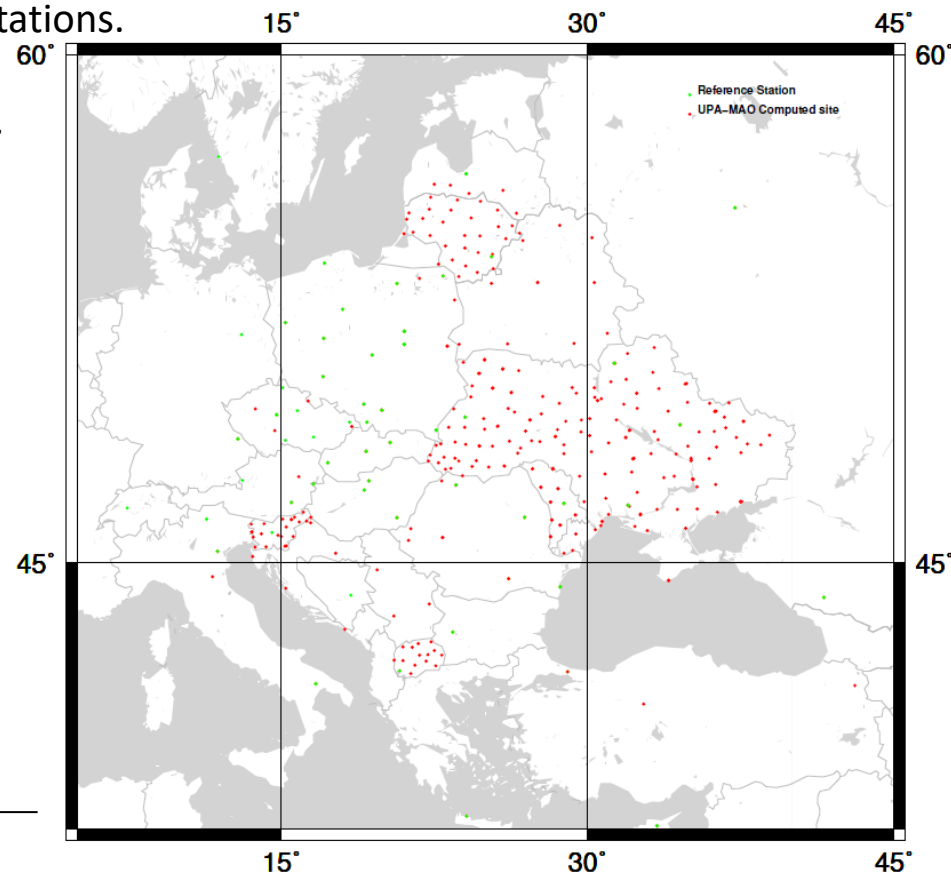
- Poland: ASG; VRSNet; TPINet
- Slovakia (GKU)
- Ukraine (MAO)
- Italy (UPA)
- EPN (EUREF)

## 2019 Campaign Status:

- All the RINEX files received until September 2017, computed (UPA): 117 stations.
- RINEX processed at MAO (during 2021): 266 stations.
- Waiting for RINEX files (SGO, CZEPOS, GKU)?
- Waiting for missing SINEX files (LIT, RGZ, SGO).

Full 2019 Campaign will be computed in the upcoming weeks, when missing files are available.

Already computed stations:



## Conclusions

- We show the CEGRN analysis from 1996 to 2017 (both campaigns included).
- We show the status of the CEGRN 2019 campaign.
- A different combination model of the normal equations is successfully used: multiyear AC-wise adjustment.
- The full dataset (Data in Brief, Volume 27, December 2019, 104762) is available at: <https://doi.org/10.1016/j.dib.2019.104762>
- The velocity field was used to compute the “Present day geokinematics of Central Europe” (Journal of Geodynamics, Volume 132, December 2019, 101652: <https://doi.org/10.1016/j.jog.2019.101652>
- The next CEGRN campaign is scheduled for June 2021.
- We must express our most sincere gratitude to all the people, Agencies and Institutions that are involved in the CEGRN.

## Future Work

- Compute the full CEGRN 2019 and 2021.
- Re-compute the CEGRN network, applying IGS antenna latitude dependent corrections due to the IGb08 to IGS14 switch (IGb08-based SINEX files).

**Questions? Suggestions?**

**Thank you for your attention**