Federal Agency for Cartography and Geodesy

BKG
Wir geben Orientierung.

Status report about the European Vertical Reference Frame

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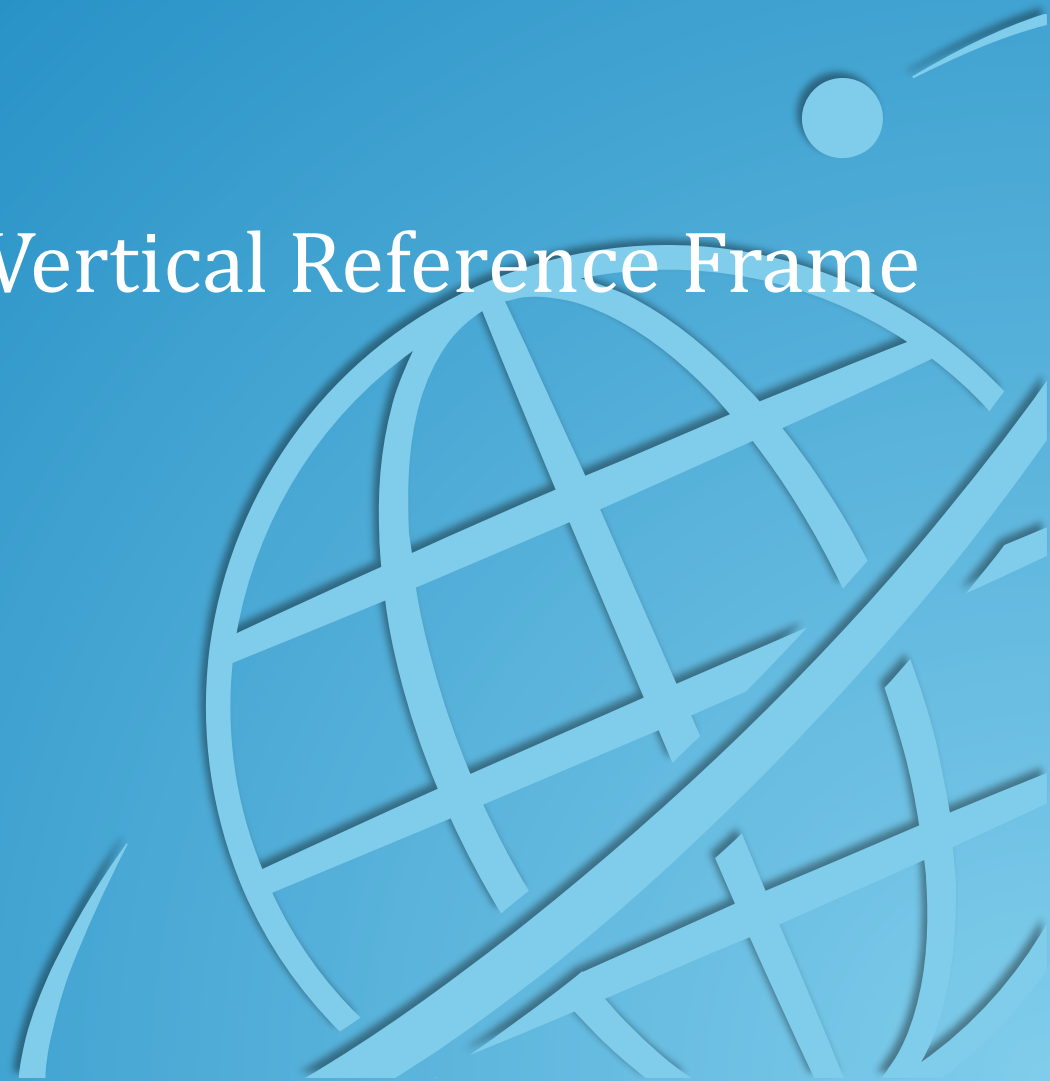


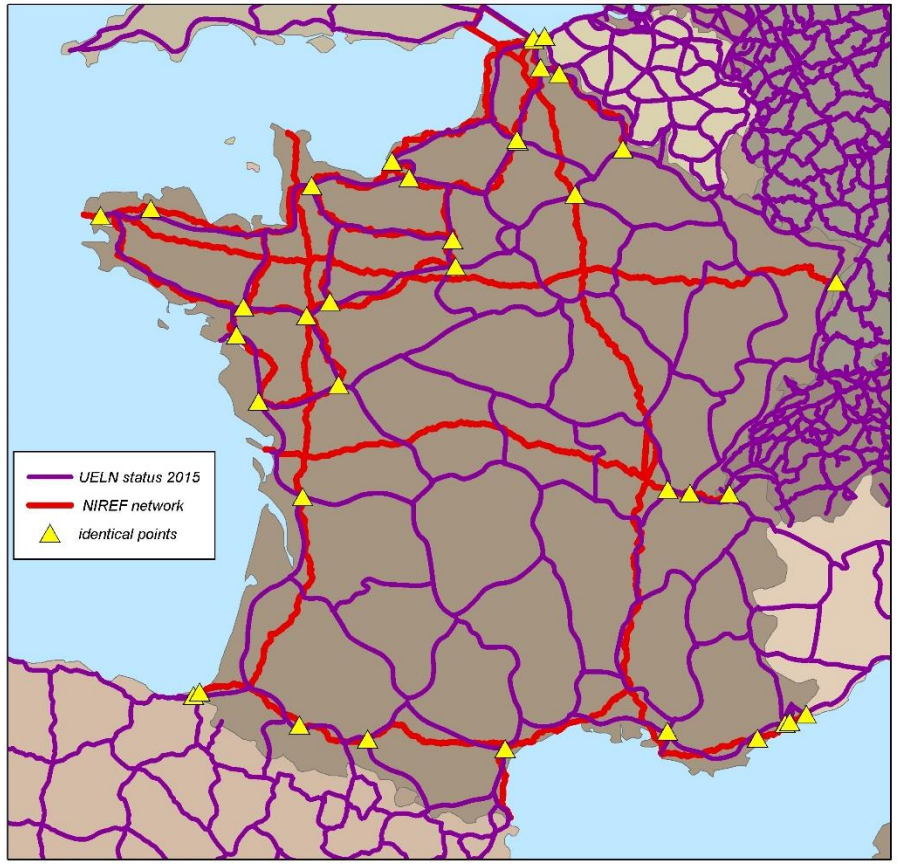
Outline

1. News in UELN
   a. Data of France
   b. Border connections to Austria
   c. Leveling network of Moldova
2. New GNSS/leveling data (EHRS_CP)
   a. Overview
   b. Examples

Status of French leveling data in EVRF2019

To remind:

- IGN69 leveling data were measured mostly in the 1960s
- Tilt of IGN69 of 23 cm in N-S direction
- Only 349 observations between nodal points are available in the EVRS data base
- Establishing of a new zero order leveling network NIREF – stepwise expansion
- EVRF2019 contains NIREF data between 1983-2014
- Density of NIREF is too low to replace IGN
- Only nodal points of IGN available at BKG → Combination of IGN and NIREF by only 37 identical points



Update of French leveling data

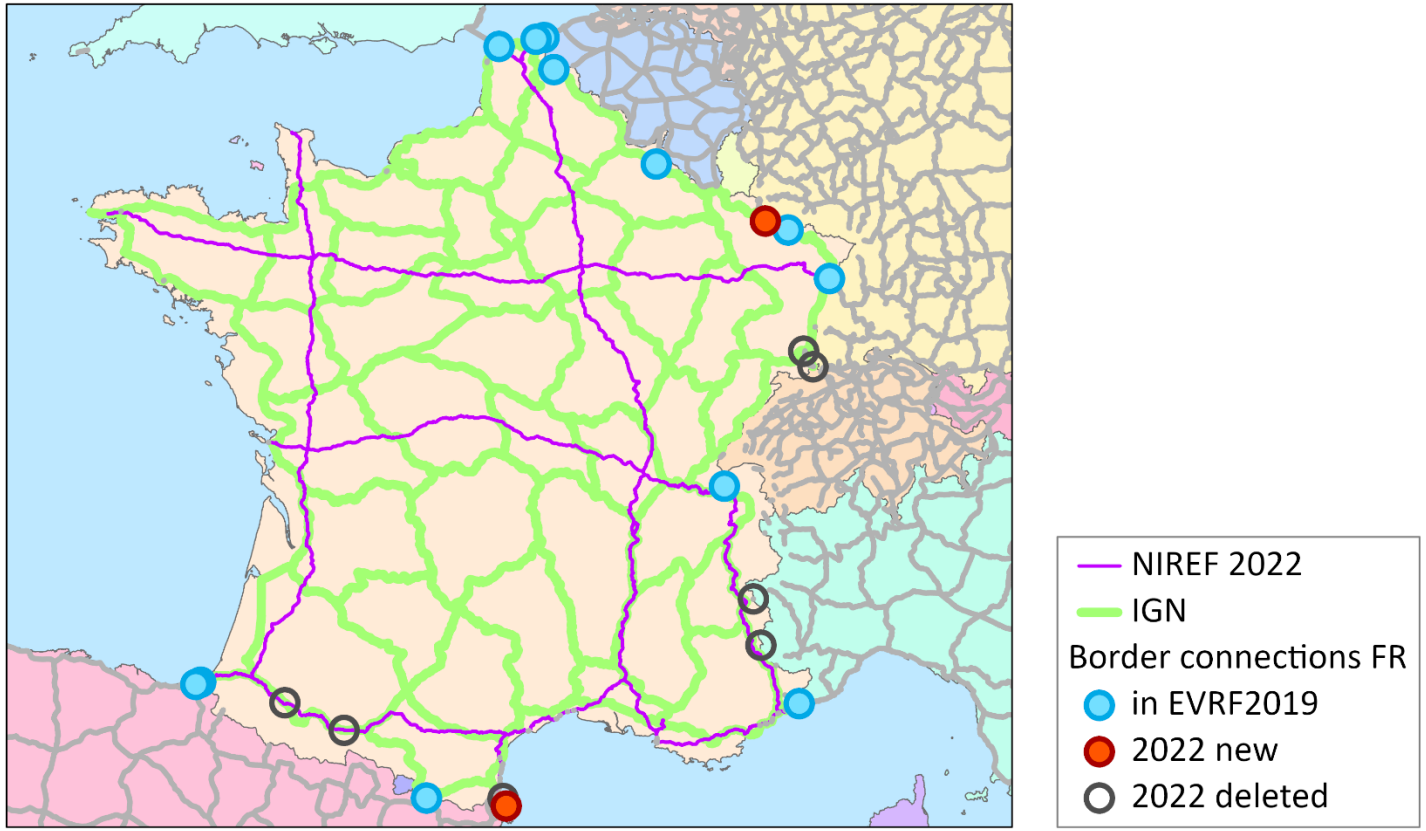
In the context of the WG “European Unified Height Reference”, France provided updated leveling data:

- Reprocessed data of IGN69 – including all line points: ca. 24000 height differences 1961-2001
- NIREF data: ca. 8000 measurements between 1983-2018
- After some data cleaning, the both networks were adjusted together
- Availability of intermediate line points in IGN69 allows us to find more connections to NIREF network and to neighboring countries
- Much more identical points: 2500 in new combination, 37 in EVRF2019
- Including in a preliminary “EVRF2022”
- Higher accuracy of the reprocessed IGN69 data:

French leveling data	**Combined adjustment of IGN69+NIREF (VCE)**		***In „EVRF2022“ adjustment (VCE)***	
	IGN	NIREF	*IGN*	*NIREF*
	S_0 in kgal·mm			
old (as in EVRF2019)	2.08	1.29	*2.63*	*1.23*
new (delivered 2022)	**1.45**	**0.91**	***1.59***	***1.24***

Border connections to France

- 2 new border connections have been found
- some previous connections are not part of the IGN data anymore
- After including these connections from the old IGN-file, some outliers arose
- Additional measurements by France in 2022
- Furthermore, new border connections to Switzerland, Germany, Belgium, Spain are considered by France for the next years



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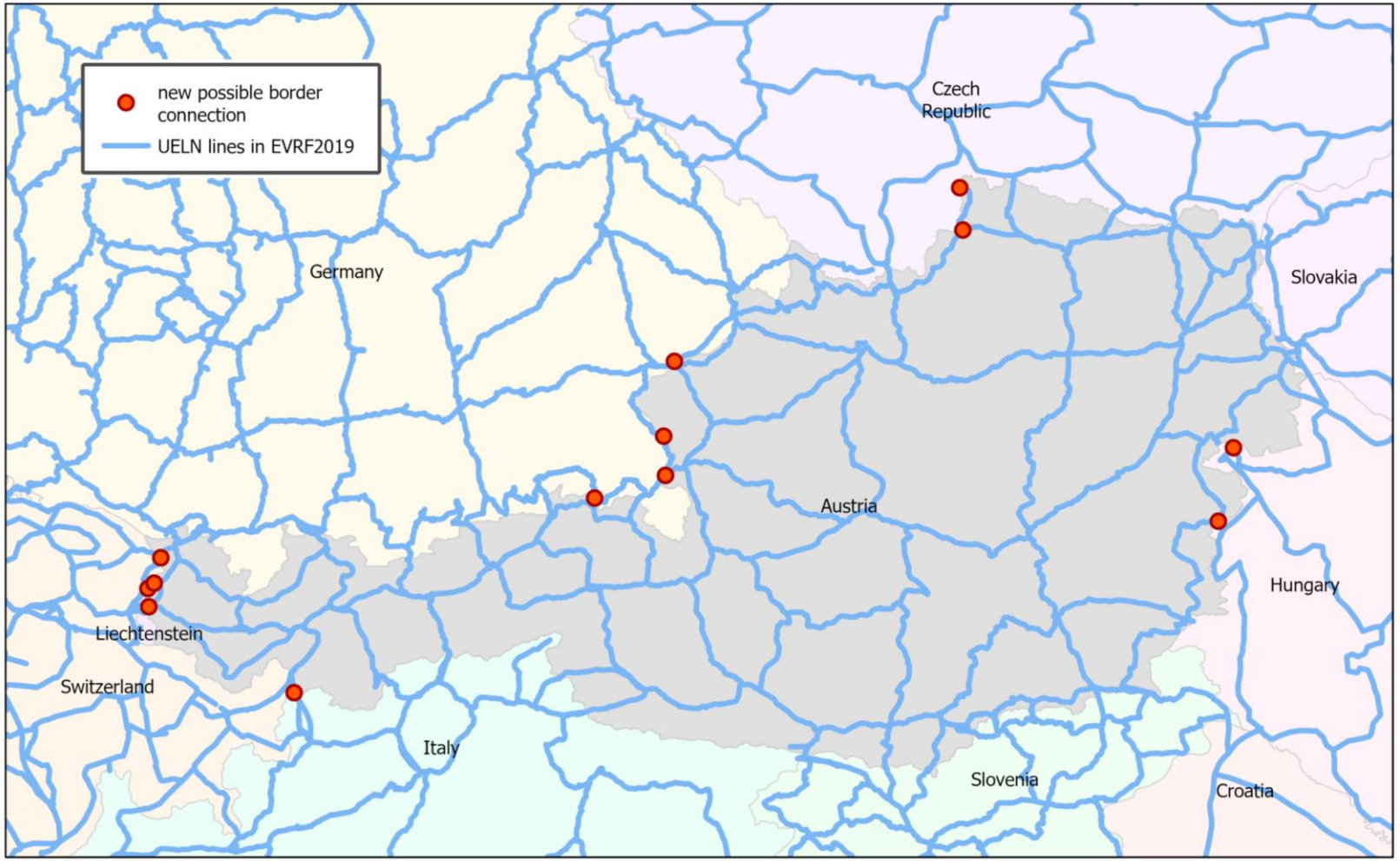
Additional border connections to Austria

- Data set with all leveling data of Austria available at UELN data center
- Height differences belong to different epochs between 1932 and 2018, not prepared for common adjustment
- Usage in EVRF2019 for establishing of connections between Austria and the new networks of Italy and Slovenia
- In the meantime, the connections to all neighboring countries of Austria have been checked
- Some old measurements from the 1950s are not usable any more
- usable connections have been found to
  - Hungary (2)
  - Czech Republic – 2. order network (2)
  - Germany (4)
  - Switzerland (4)

Additional border connections to Austria



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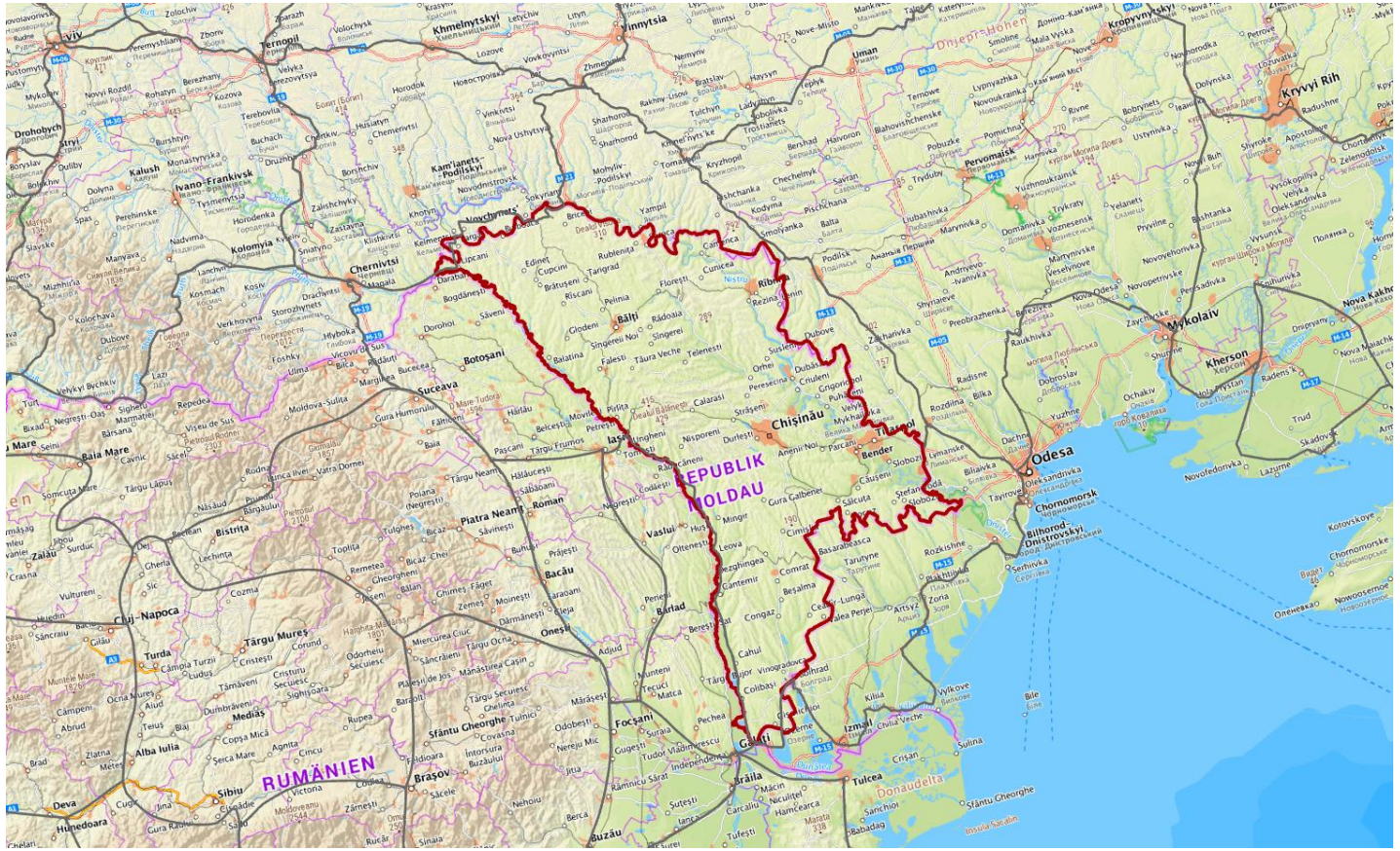
Leveling data of Moldova (1)

- Integration of leveling data of Moldova is planned
- November 2022: Visit of Moldova in the scope of a TAIEX expert mission: “Integration of Leveling Network of the Republic of Moldova in UELN”

***TAIEX** is the Technical Assistance and Information Exchange instrument of the European Commission. TAIEX supports public administrations with regard to the approximation, application and enforcement of EU legislation as well as facilitating the sharing of EU best practices.*



Leveling data of Moldova (2)

- Agreement about integration of leveling network of Moldova into UELN has been made
- Leveling network of Moldova was measured 2008-2021
- Handing over of measured height differences with (old) normal height corrections during the visit
- Test adjustment of the measured height differences resulted in standard deviation of 1.3mm/km
- For computation of geopotential differences, coordinates and gravity values are necessary and have to be prepared
- Providing of coordinates and gravity values is scheduled for middle of 2023
- Integration into UELN by 5 border connections (3 RO, 2 UA)

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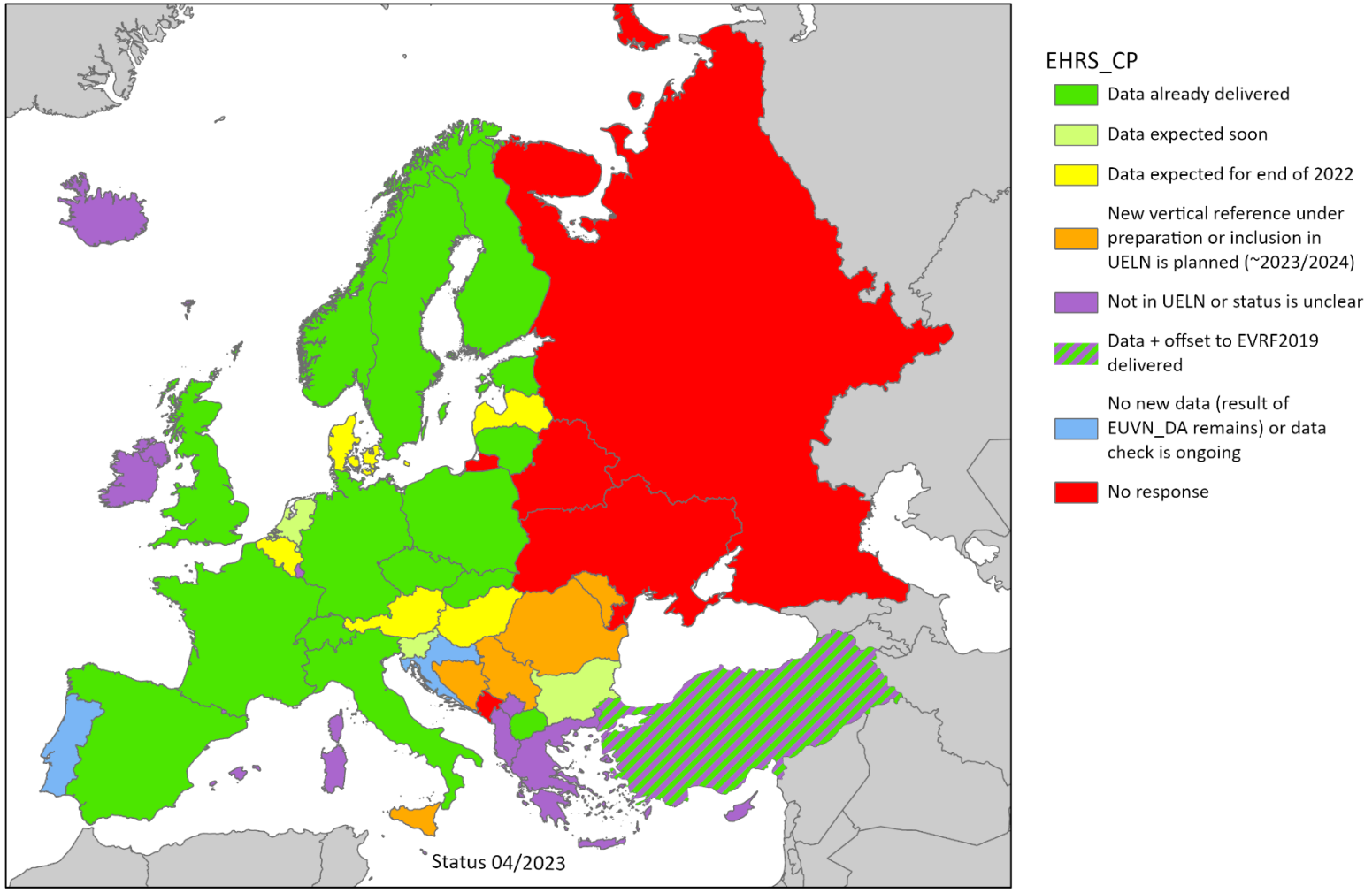
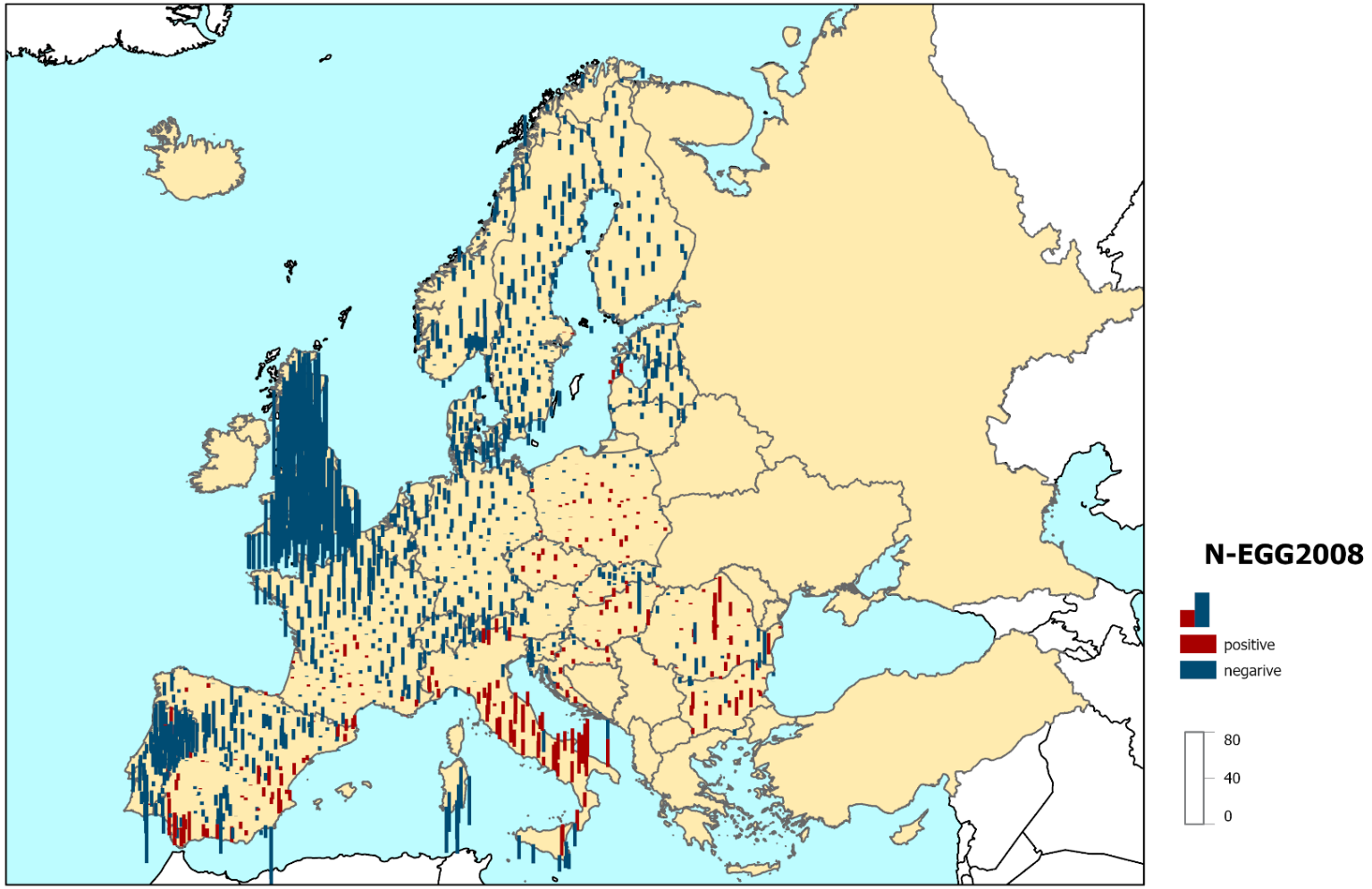
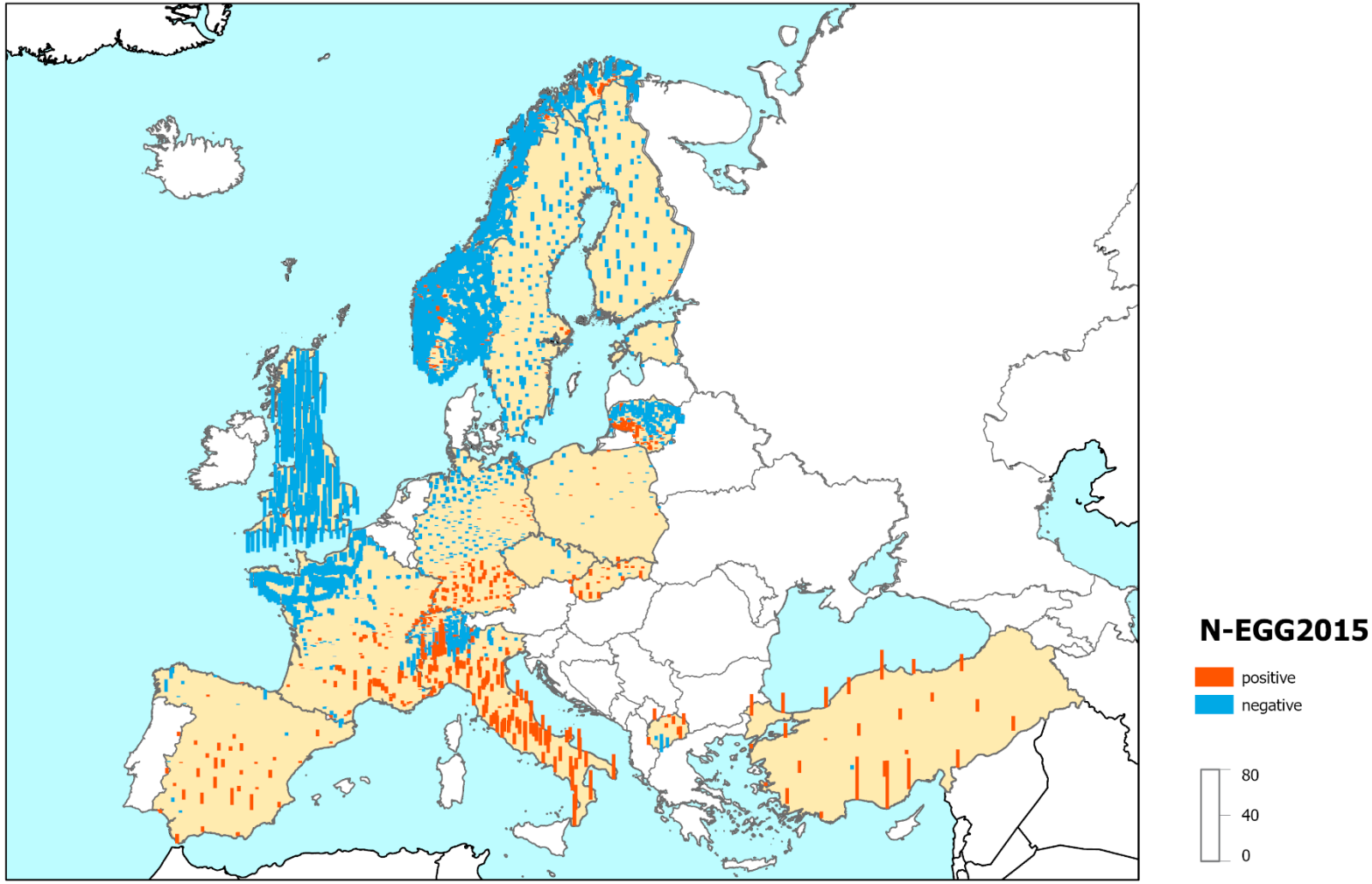
Status of the EHRS_CP



EUVN_DA (2009): Differences h(ell)-H(EVRF2007) – EGG2008 in cm



EHRS_CP (2023): Differences h(ell)-H(EVRF2019) – EGG2015 in cm



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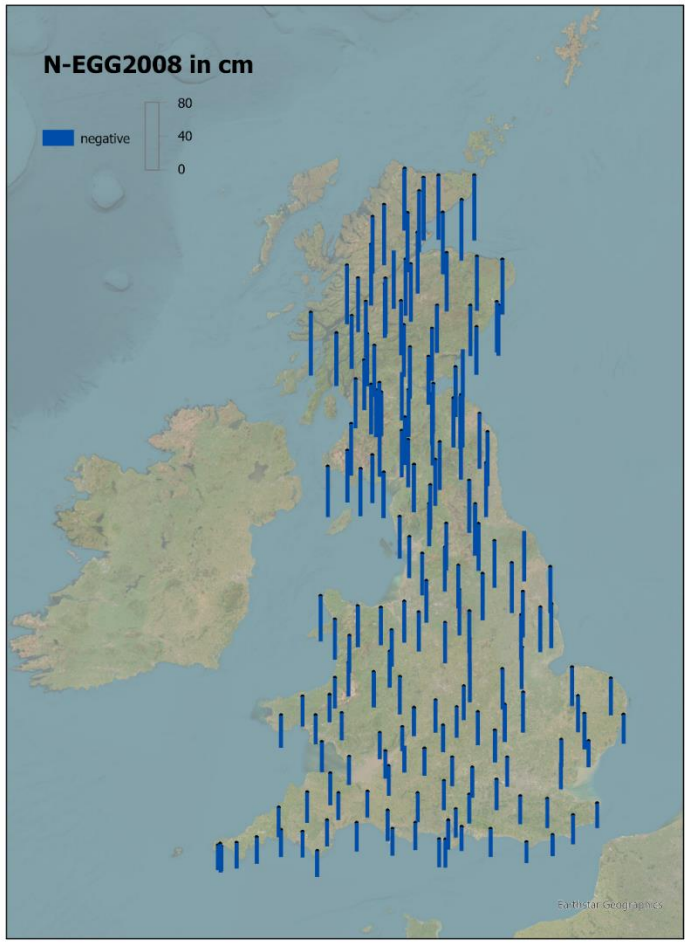
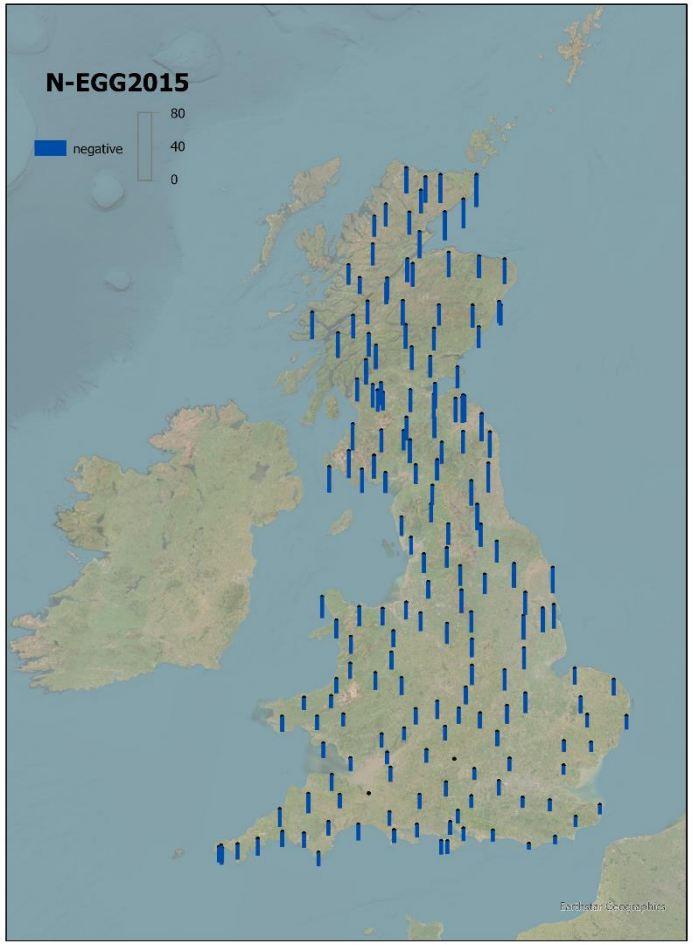
Comparison GNSS/leveling stations in Great Britain (2009/2022)

Differences h(ell)-H(EVRF2007)-EGG2008 in cm

Standard dev. : 12.0 cm
Average: -43.5 cm



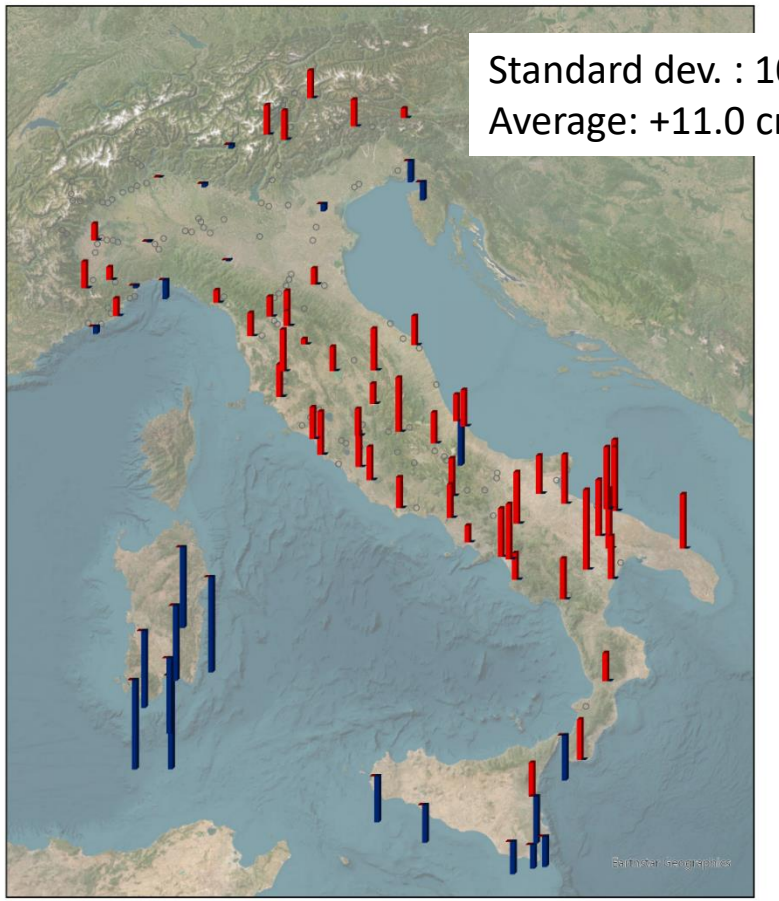
Differences h(ell)-H(EVRF2019)-EGG2015 in cm



Standard dev. : 5.9cm
Average: -22.3 cm

Comparison GNSS/leveling stations in Italy (2009/2022)

Differences h(ell)-H(EVRF2007)-EGG2008 in cm

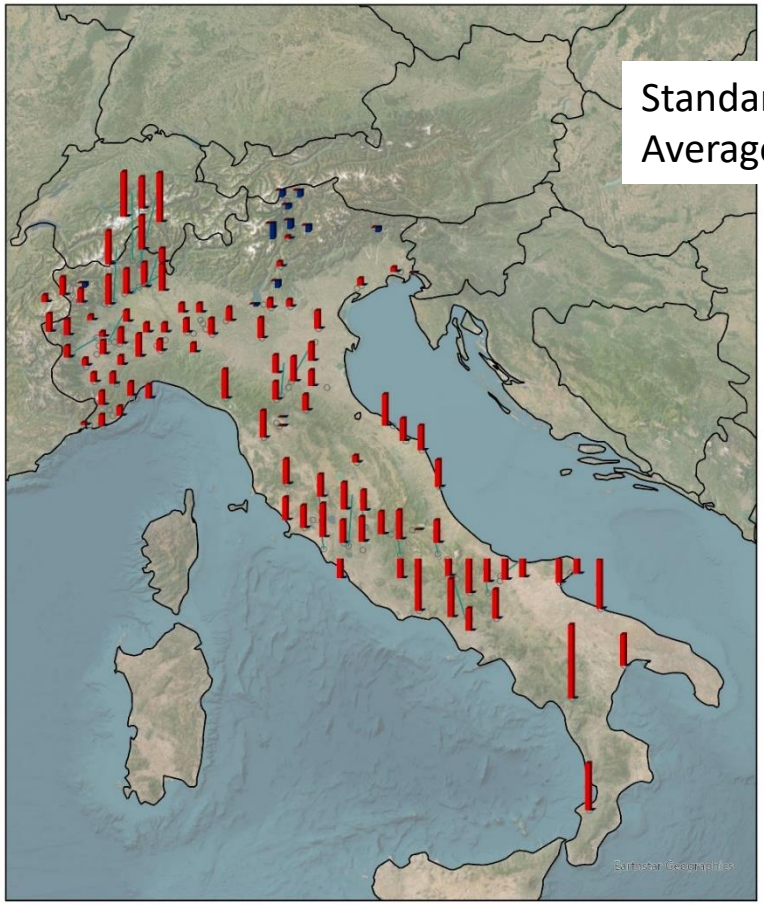


Standard dev. : 10.0 cm
Average: +11.0 cm

positive
negative

30
15
0

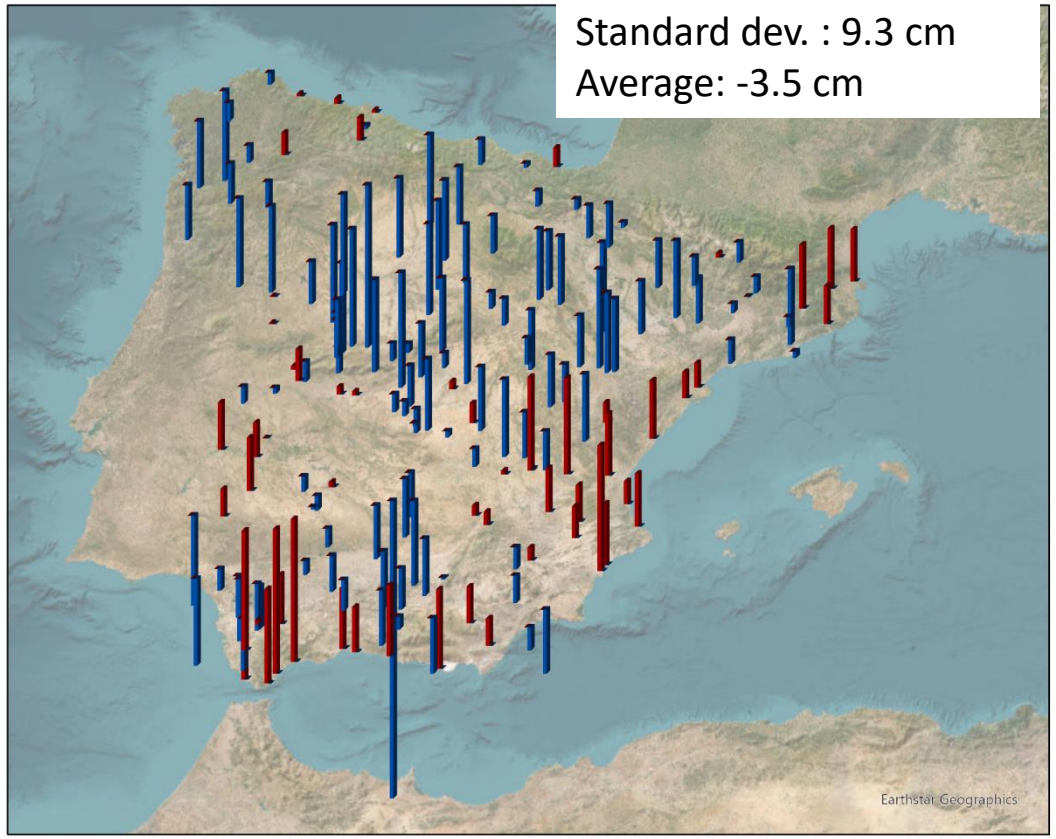
Differences h(ell)-H(EVRF2019)-EGG2015 in cm



Standard dev. : 6.7 cm
Average: +7.9 cm

Comparison GNSS/leveling stations in Spain (2009/2022)

EUVN_DA (2009): Differences h(ell)-H(EVRF2007)-EGG2008 in cm

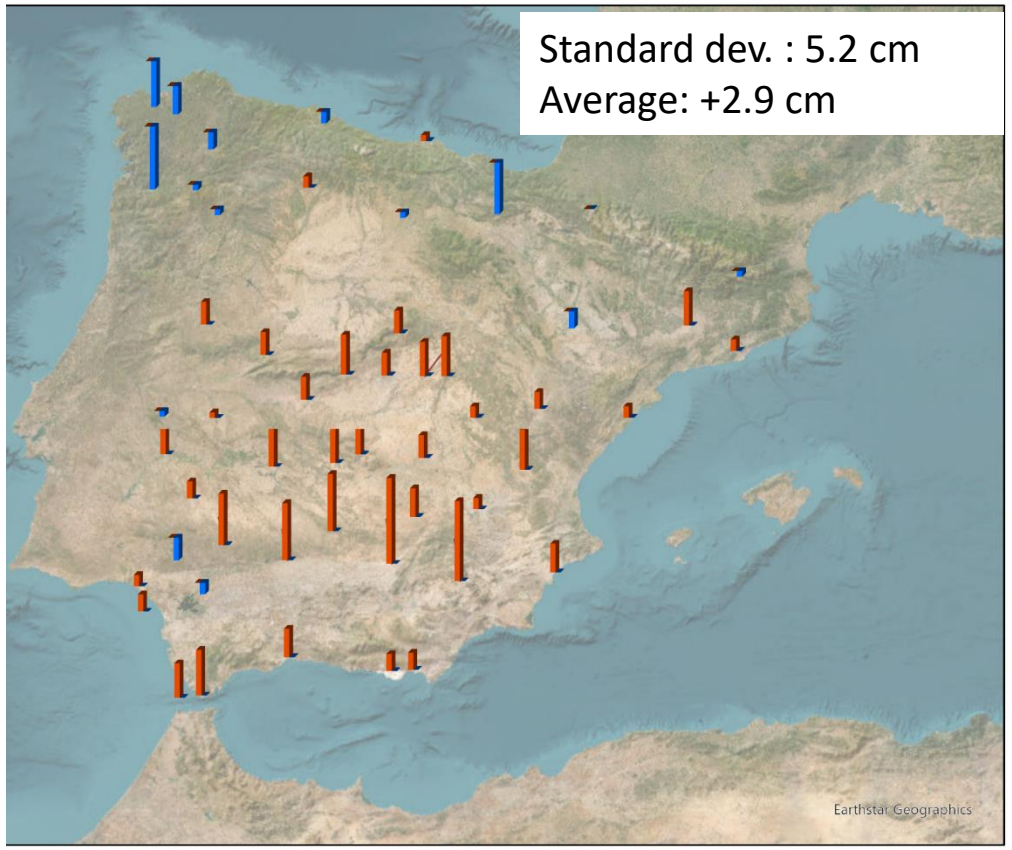


N-EGG2015

positive
negative

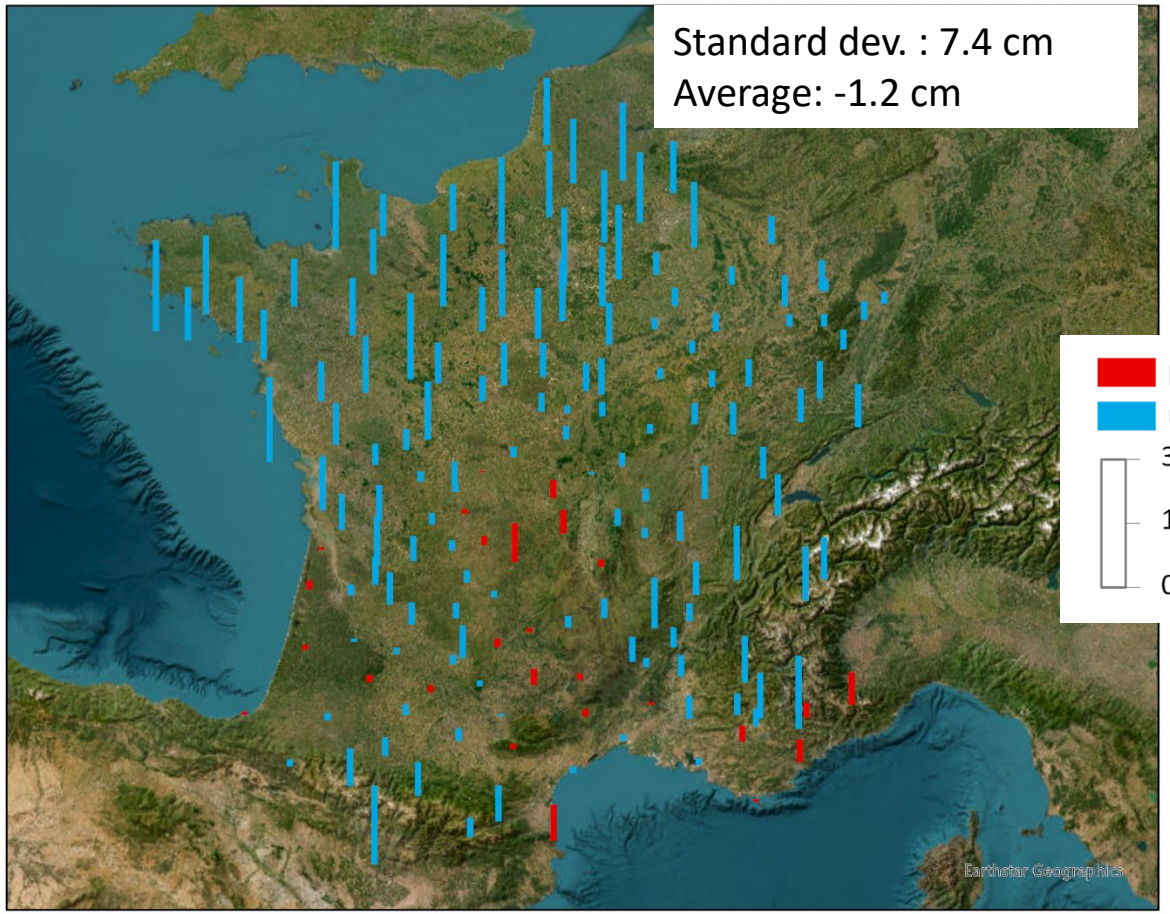
20
10
0

EHRS_CP (2023): Differences h(ell)-H(EVRF2019) -EGG2015 in cm

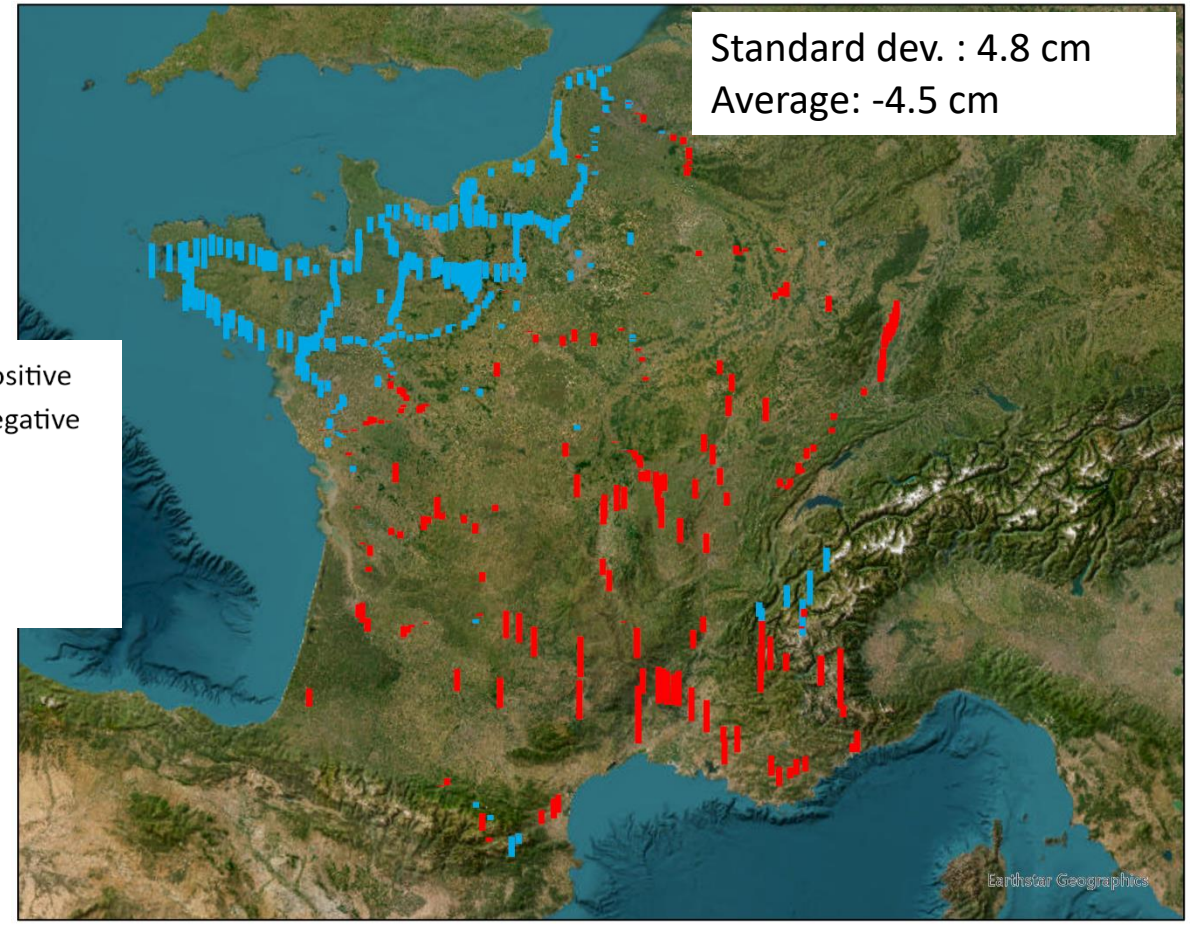


Comparison GNSS/leveling stations in France (2009/2022)

EUVN_DA (2009): Differences h(ell)-H(EVRF2007)-EGG2008 in cm



EHRS_CP (2023): Differences h(ell)-H(EVRF2019) -EGG2015 in cm



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Thank you for your kind attention!

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