Reference Frame Coordination Report

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ROYAL OBSERVATORY OF BELGIUM

EUREF Symposium 2024-06-05, Barcelona , Spain

Context

- In November 2022, switch of EPN daily product to IGS20, no EPN Reference Frame Product since the switch.

- C2235: last EPN Reference Frame Product in IGb14 published in January 2023

- Hybrid cumulative solution based on a mix of daily combined SINEX in IGb14 and IGS20 has been processed and aligned to IGb14 on a regular basis for monitoring purpose

No plan to publish it, but...

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Hybrid Solution: C2295 (IGS20)

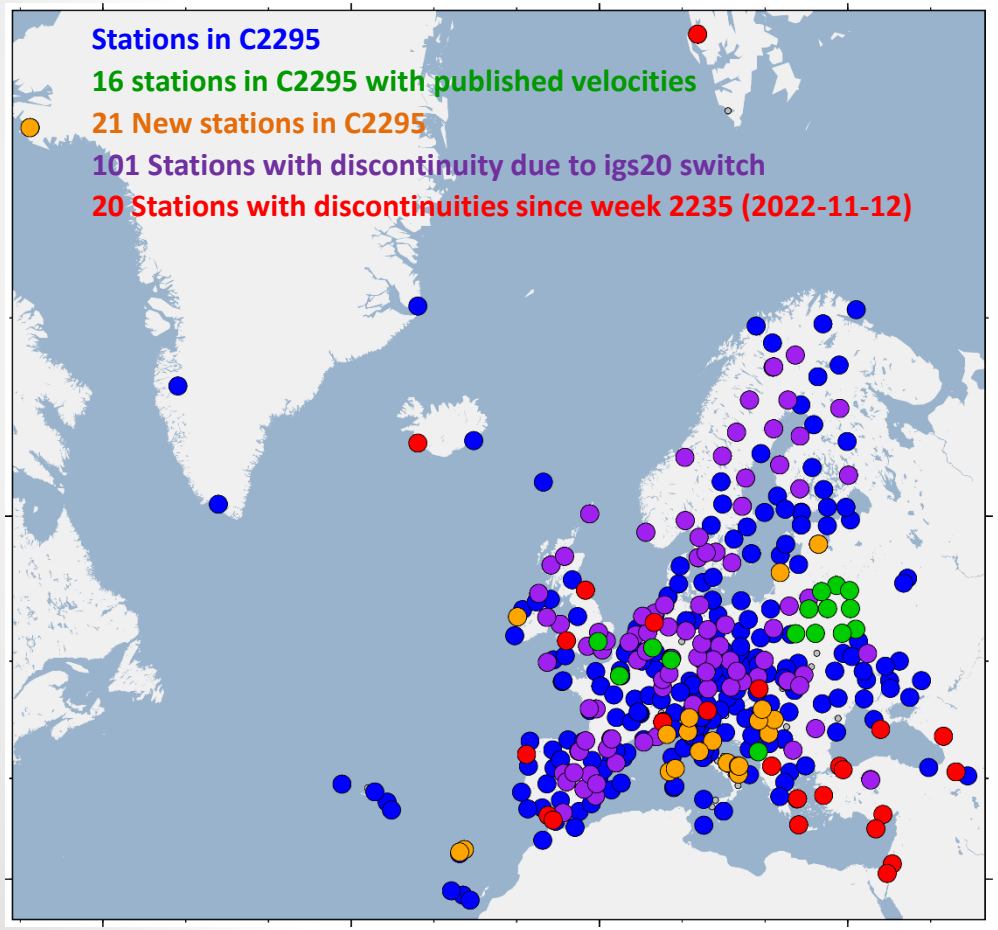
Is it a good solution?

Internal consistency?

Agreement with the global reference frame solution (IGS20)

EPN Stations in C2295 (igs20)

507 Stations



- Hybrid cumulative solution
  - Based on daily combined solutions
    - Final Daily combined SINEX in IGb14 (Repro2+Operational) before nov. 2022
    - Final Daily combined SINEX in IGS20 after nov. 2022
    - Aligned to **IGS20**
- 492 stations
- Period coverage: 1996-01-01 - 2024-01-06
- aligned in origin, scale and orientation wrt IGS20 using 54 reference stations

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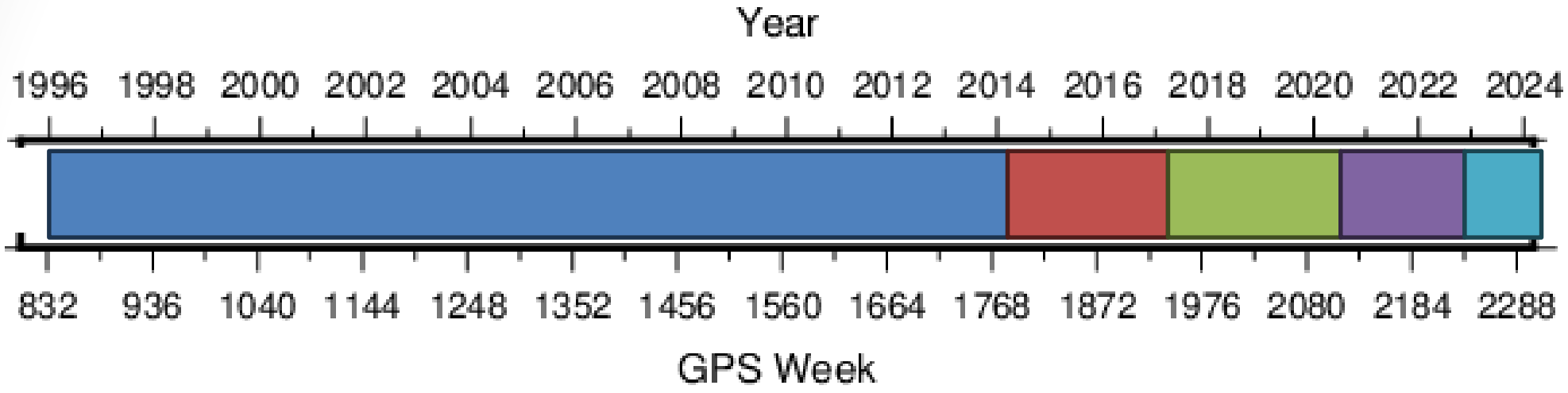
Internal Consistency

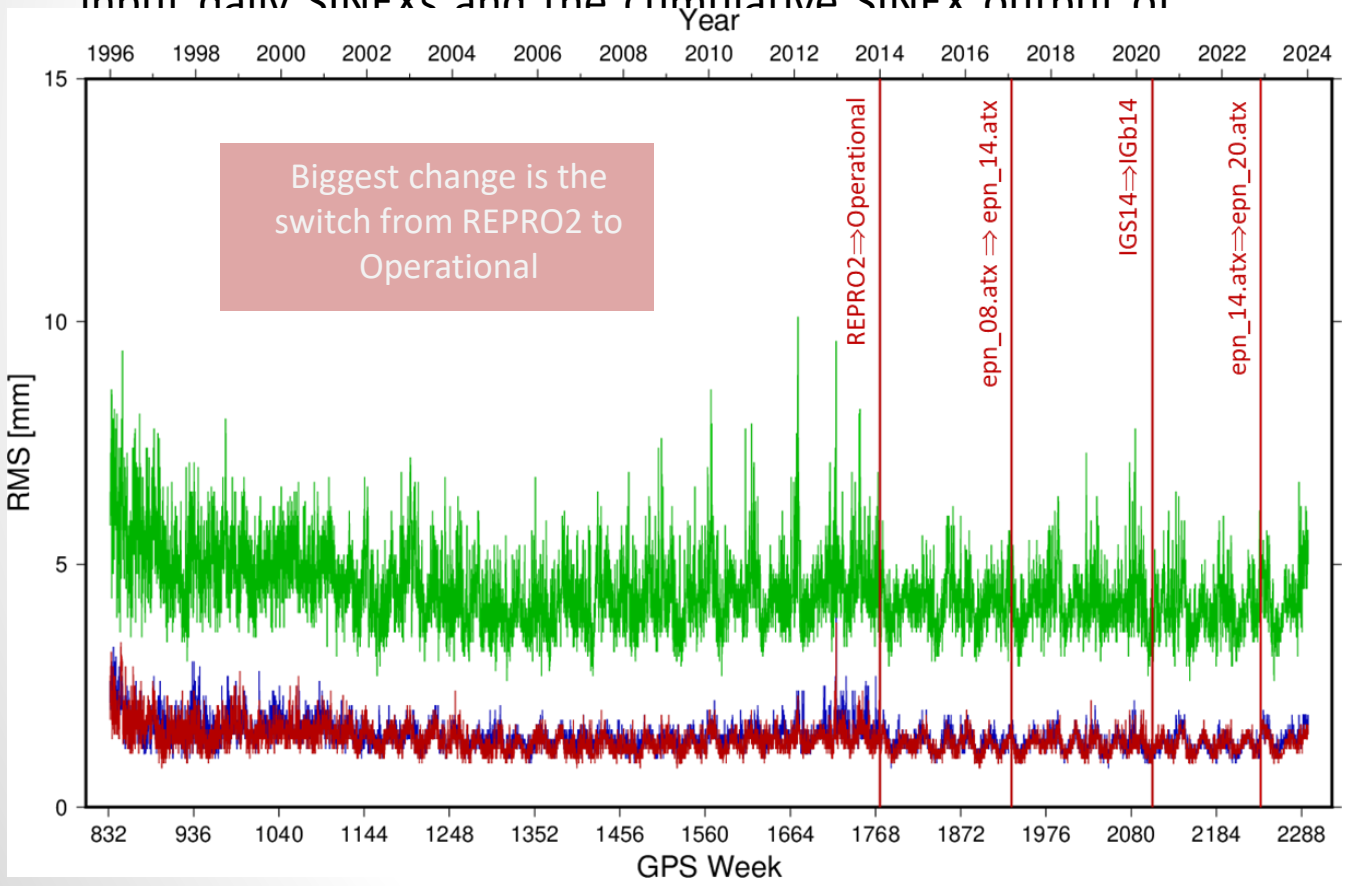
Hybrid Solution C2295 aligned to IGS20

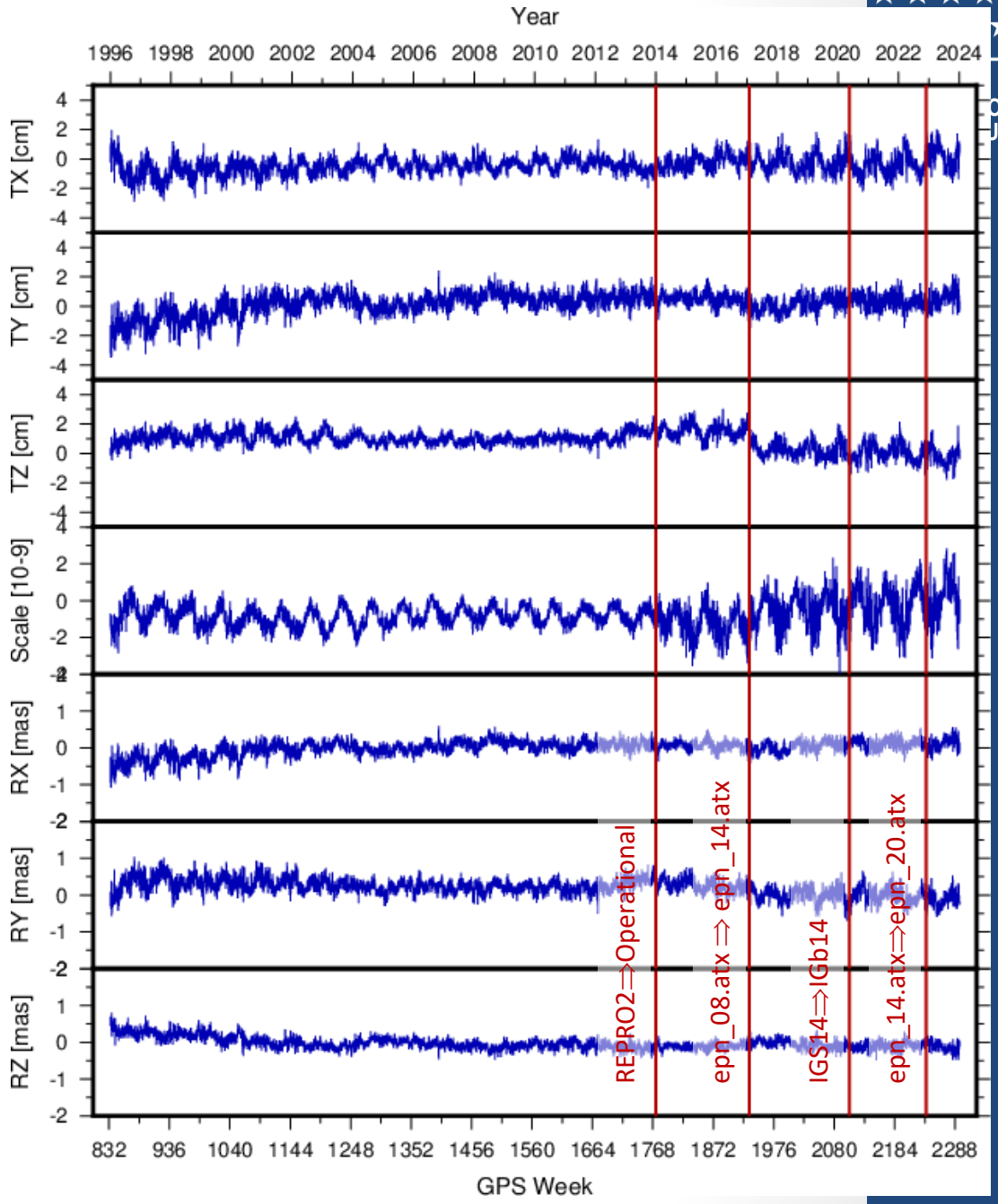


From	To	Type	Antenna Calibration	Offsets	Aligned to
0834 – 1 1996-01-01	**1773 – 2** 2013-12-31	REPRO2	epn_08.atx (igs08.atx)	Offsets from igs08 to igs14 applied	-
1773 – 3 2014-01-01	**1933 – 6** 2017-01-29	OPERATIONAL	epn_08.atx (igs08.atx)	Offsets from igs08 to igs14 applied	-
1934 – 0 2017-01-29	**2105 – 6** 2020-05-16	OPERATIONAL	epn_14.atx (igs14.atx)		IGS14
2106 – 0 2020-05-17	**2237 – 6** 2022-11-26	OPERATIONAL	epn_14.atx (igs14.atx)		IGb14
2238 – 0 2022-11-27	**2295 – 6** 2024-01-06	OPERATIONAL	epn_20.atx (igs20.atx)		IGS20

Internal consistency of the hybrid solution: Transformation Parameters

Transformation parameters between the individual input daily SINEXs and the cumulative SINEX output of





Position and velocity discontinuities

Position and Velocity Discontinuities

- To align the hybrid solution to IGS20, you need to **harmonize** with the IGS solution.

- Update of the position and velocity discontinuities to fit IGS (IGS20) discontinuity list
  - EPN stations $\in$ IGS cumulative solution:
    - Position and velocity discontinuities from IGS20 ftp://igs-rf.ign.fr/pub/discontinuities/soln.snx
    - Add necessary new discontinuities (EPN specific or recent)
  - EPN stations $\notin$ IGS cumulative solution:
    - Same position and velocity discontinuities as C2235 + recent discontinuities

- Lot of changes in the discontinuity list C2295 compared to C2235: 218 stations with a change in the modeling
  - Positions: 981 position discontinuities affecting 347 stations
    - 215 stations with different discontinuities
  - Velocities: 73 velocity change affecting 44 stations
    - 41 stations with a different way of modelling the velocity change

- This list will change with the REPRO3 based solution:
  - 20 are affected by the switch from REPRO2 to operational (2013-12-29)
  - 12 stations are affected by the switch from epn08 to epn14 (2017-01-29)
  - 101 stations affected by discontinuities due to IGS20 switch (2022-11-27)

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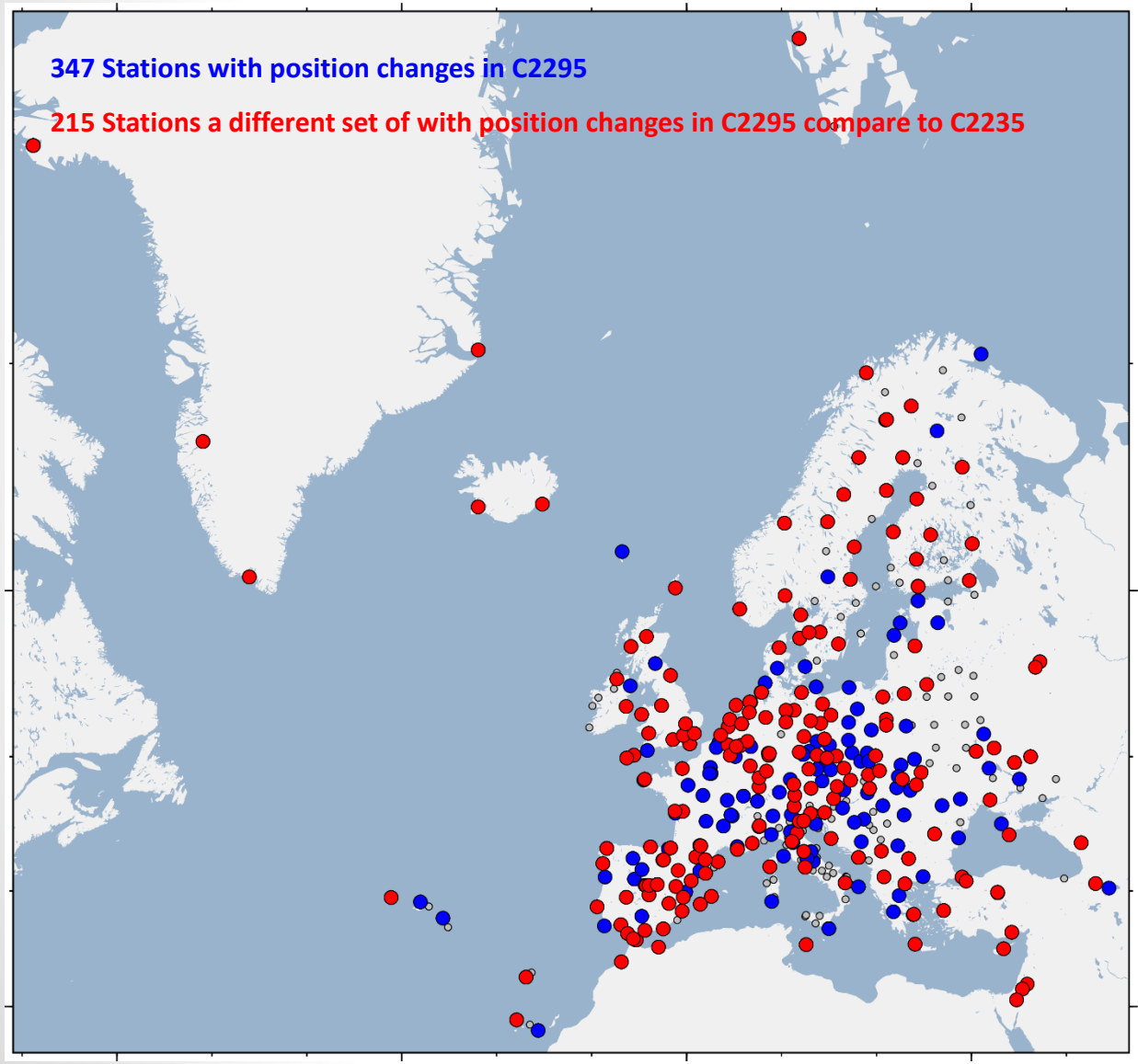
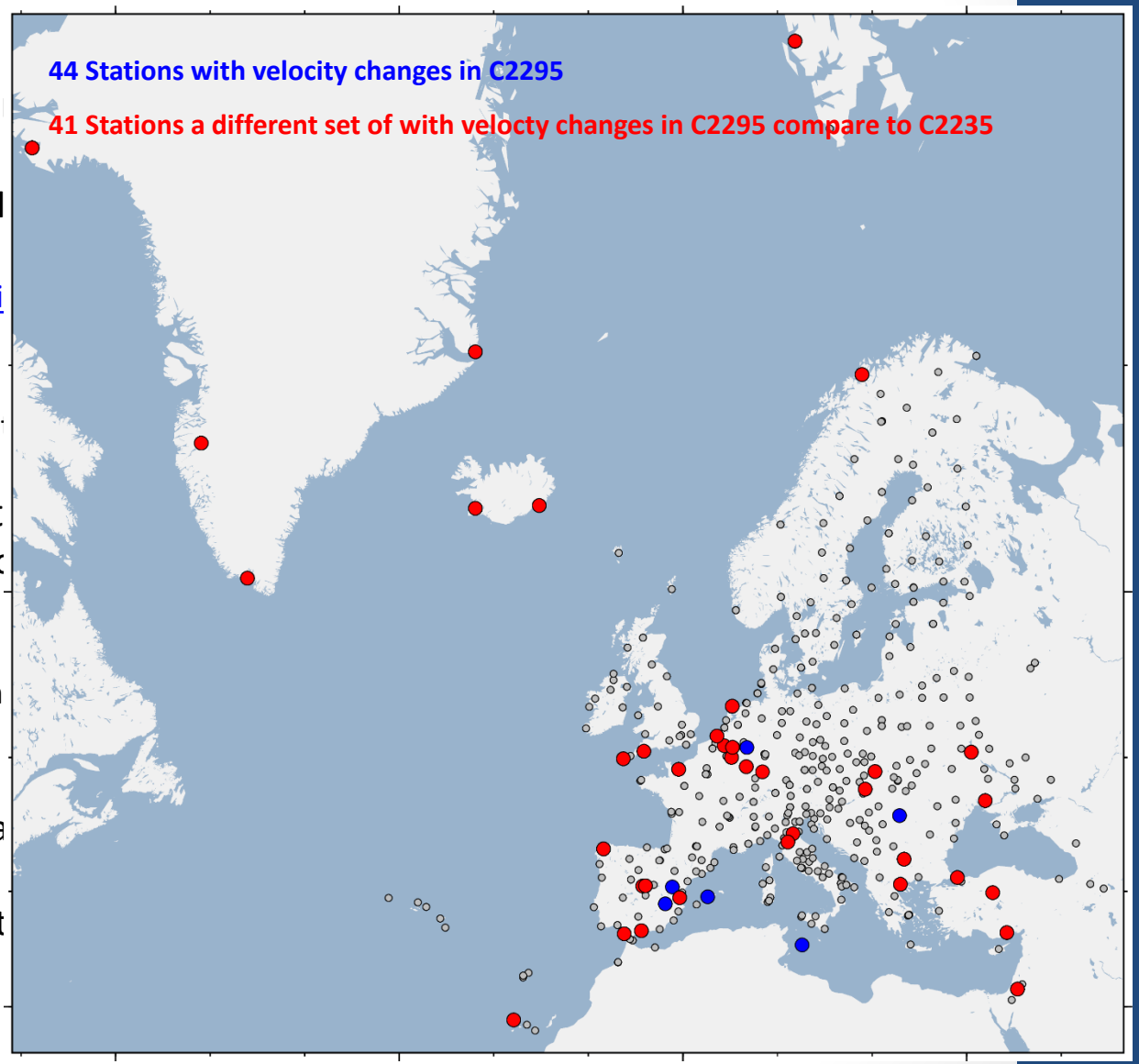
Position and Velocity Discontinuities





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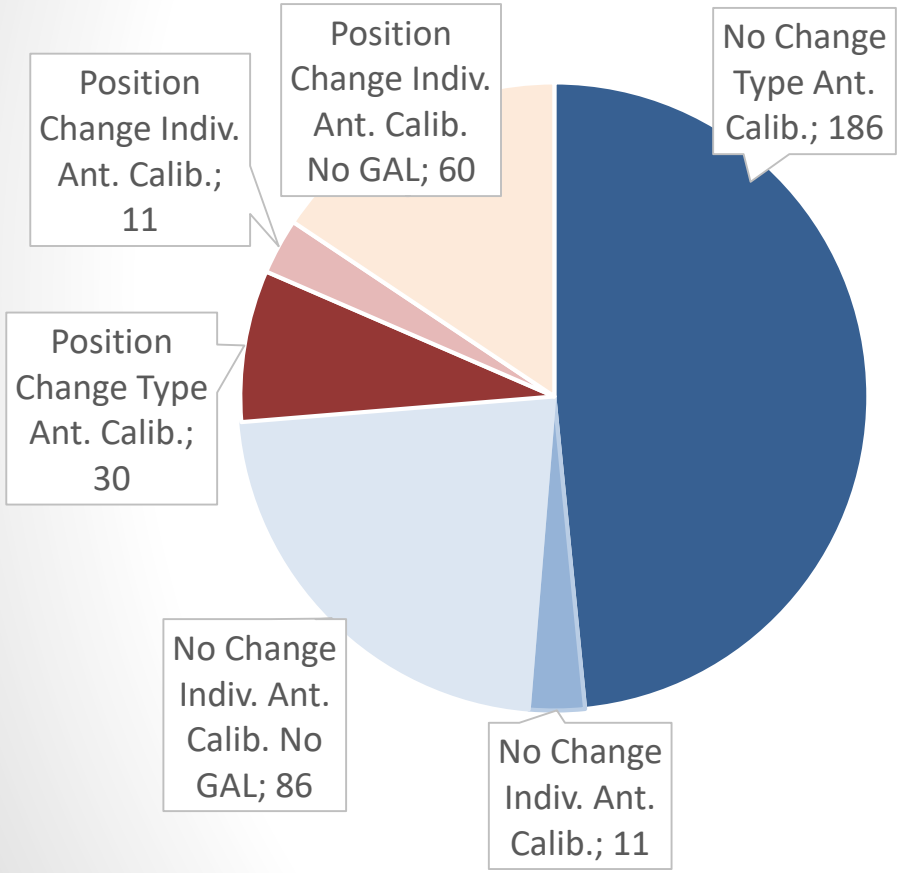
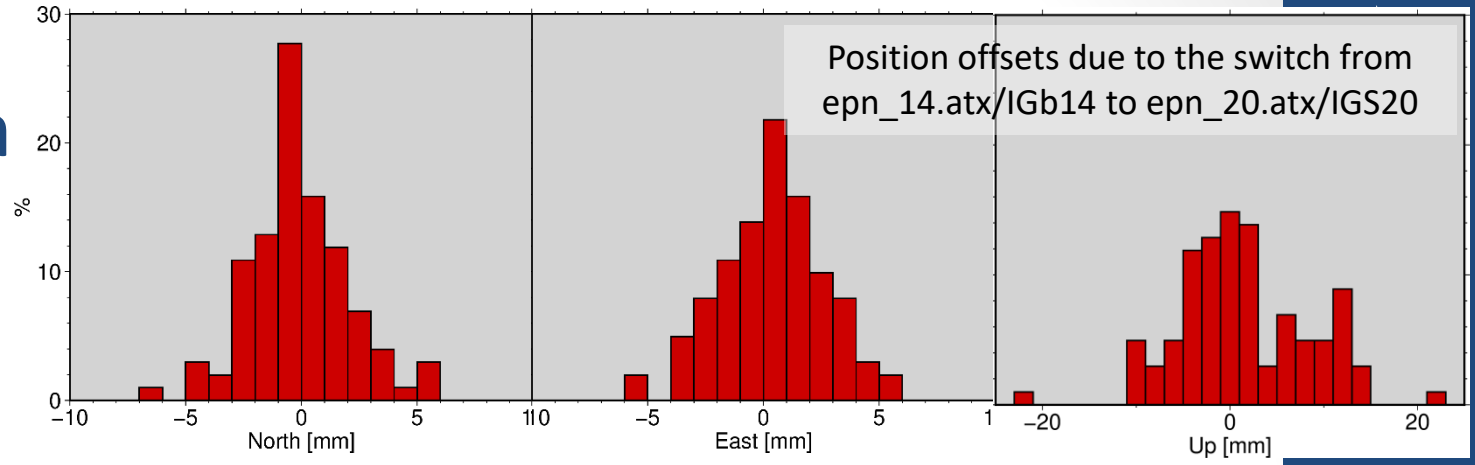
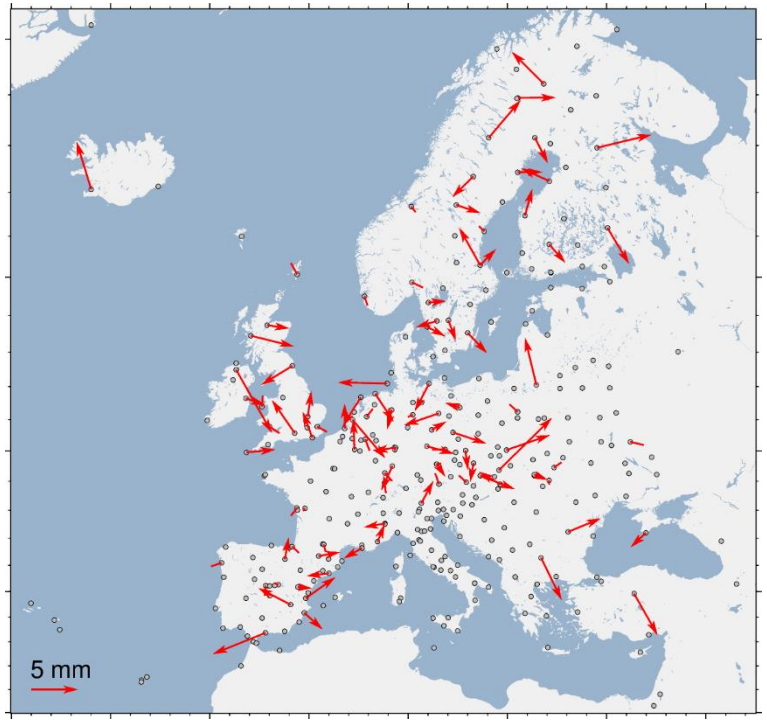
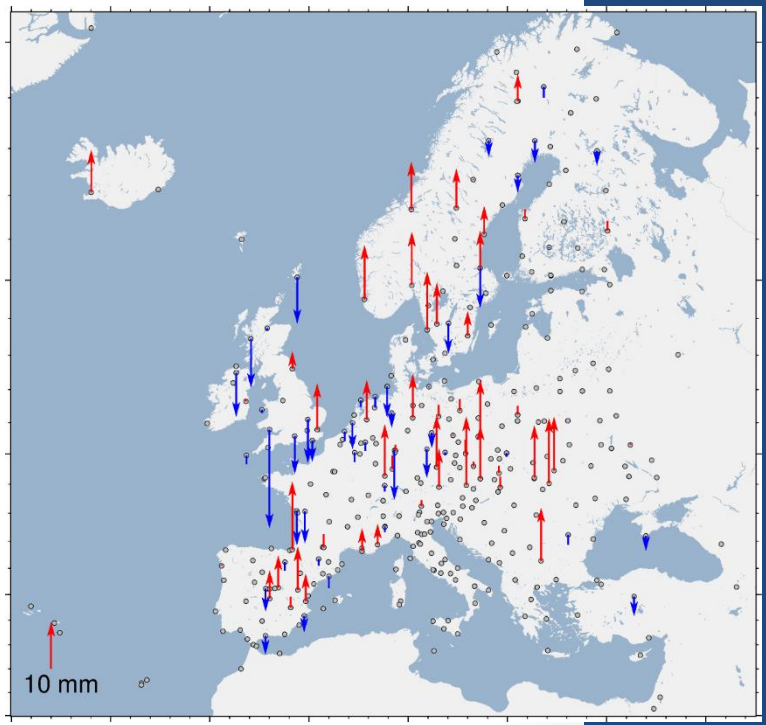
Position offsets due to the switch from epn_14.atx/IGb14 to epn_20.atx/IGS20









384 stations are observing during the switch from epn_14.atx/IGb14 to epn_20.atx/IGS20

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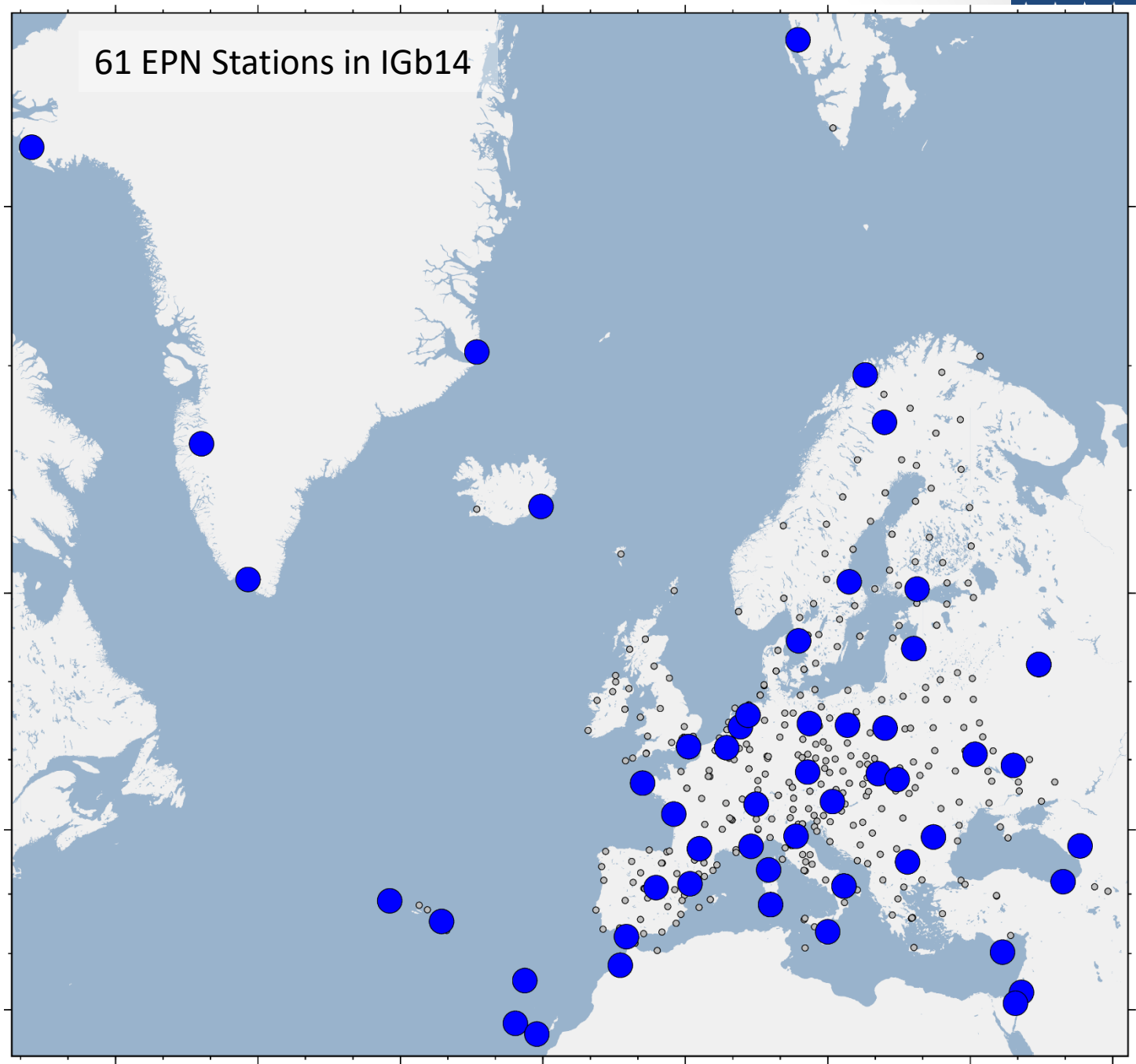
Comparison with IGS20

IGb14/IGS20

- EPN Stations in IGb14: 61

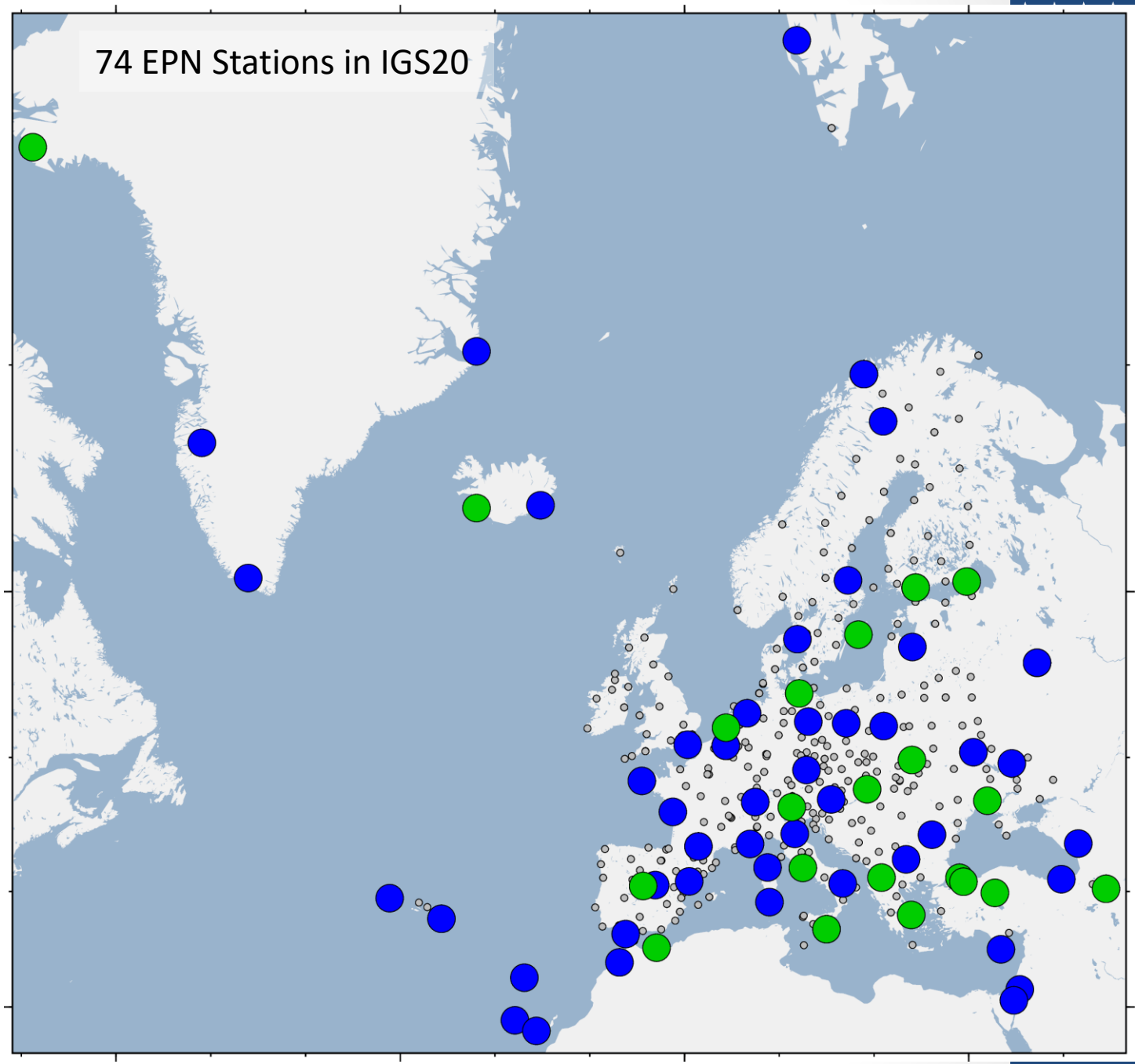


IGb14/IGS20

- EPN Stations in IGb14: 61
- EPN Stations in IGS20: 74

- 21 New Stations compared to IGb14

ANKR00TUR, BZRG00ITA, CEBR00ESP,
DLF100NLD, DYNG00GRC, ISTA00TUR,
M0SE00ITA, MELI00ESP, MET300FIN,
MIKL00UKR, NOTO00ITA, NSSP00ARM,
ORID00MKD, PENC00HUN, REYK00ISL,
SULP00UKR, SVTL00RUS, THU100GRL,
TUBI00TUR, VIS000SWE, WARN00DEU



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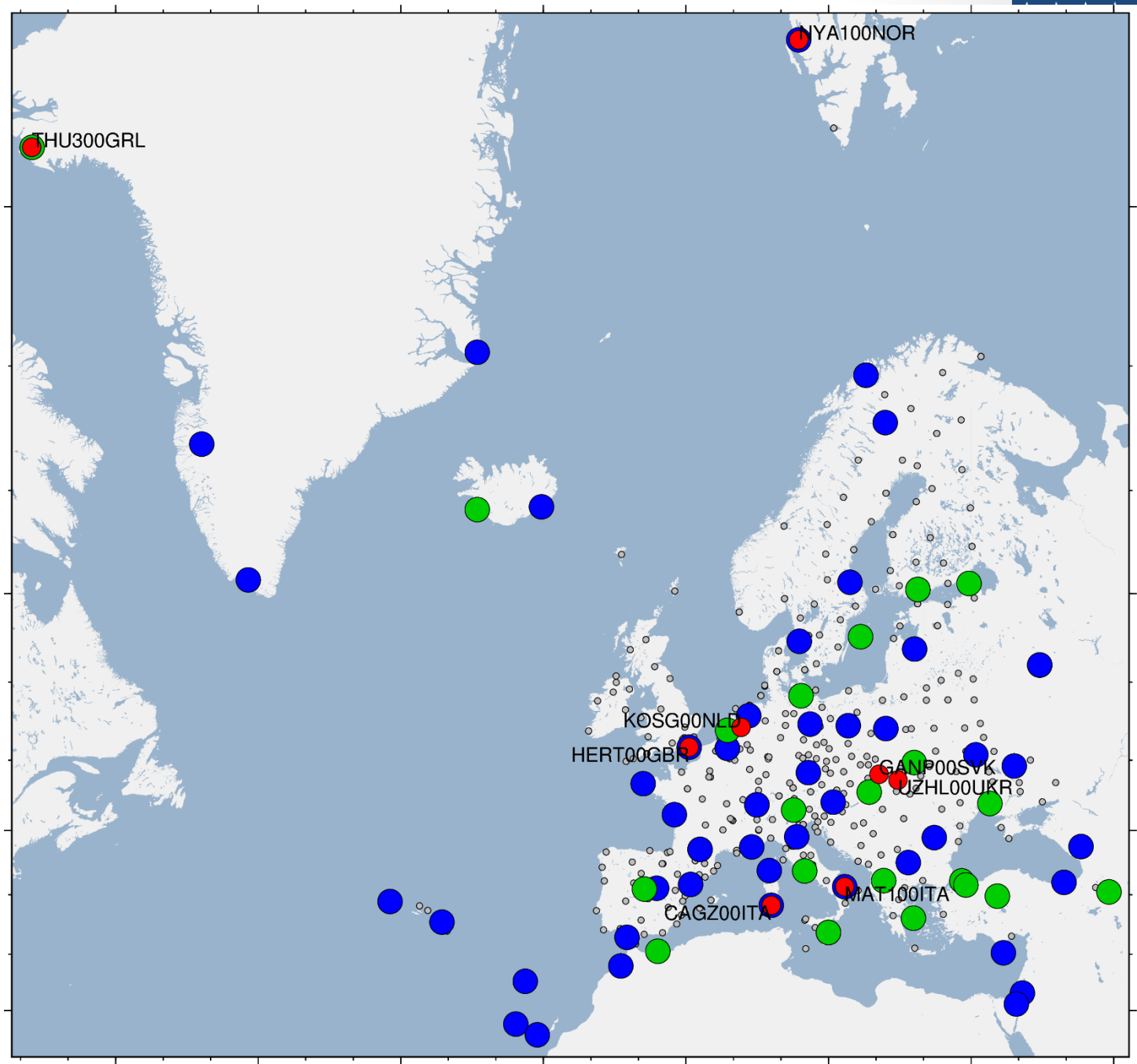
SULP00UKR, SVTL00RUS, THU100GRL,
TUBI00TUR, VIS000SWE, WARN00DEU

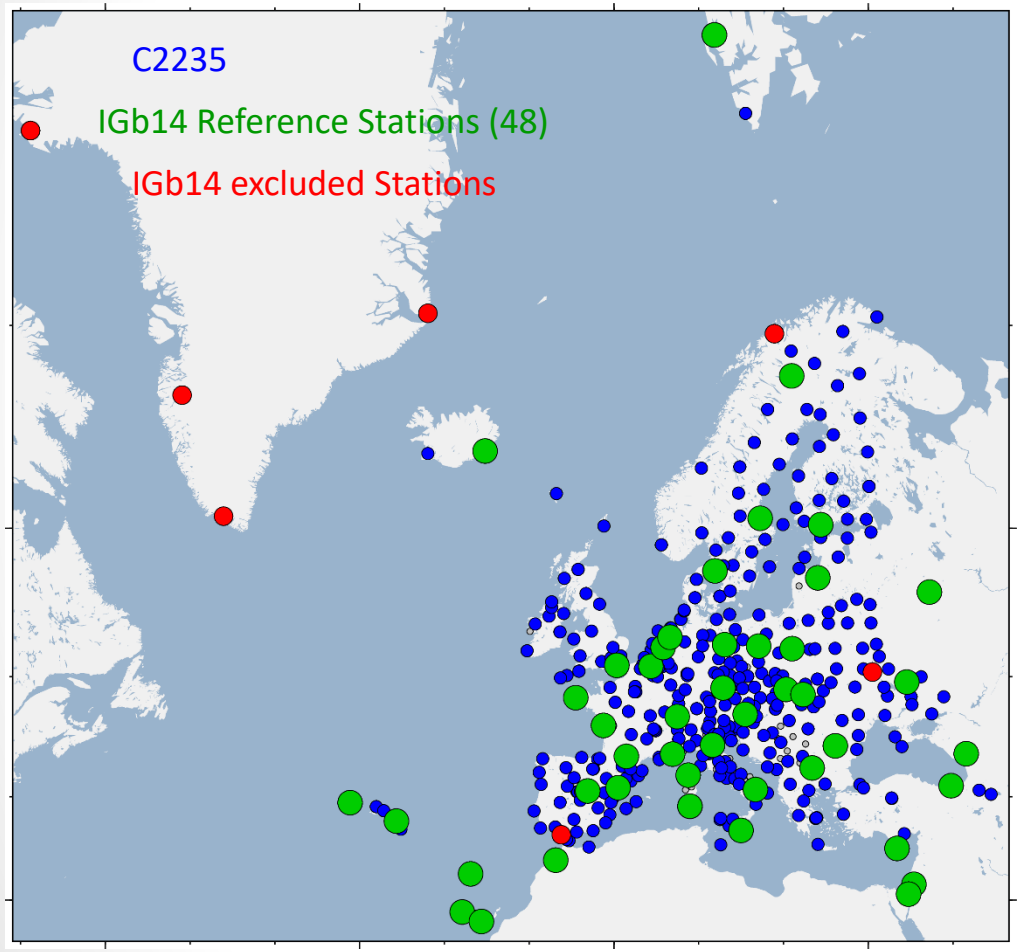
- 8 Stations removed

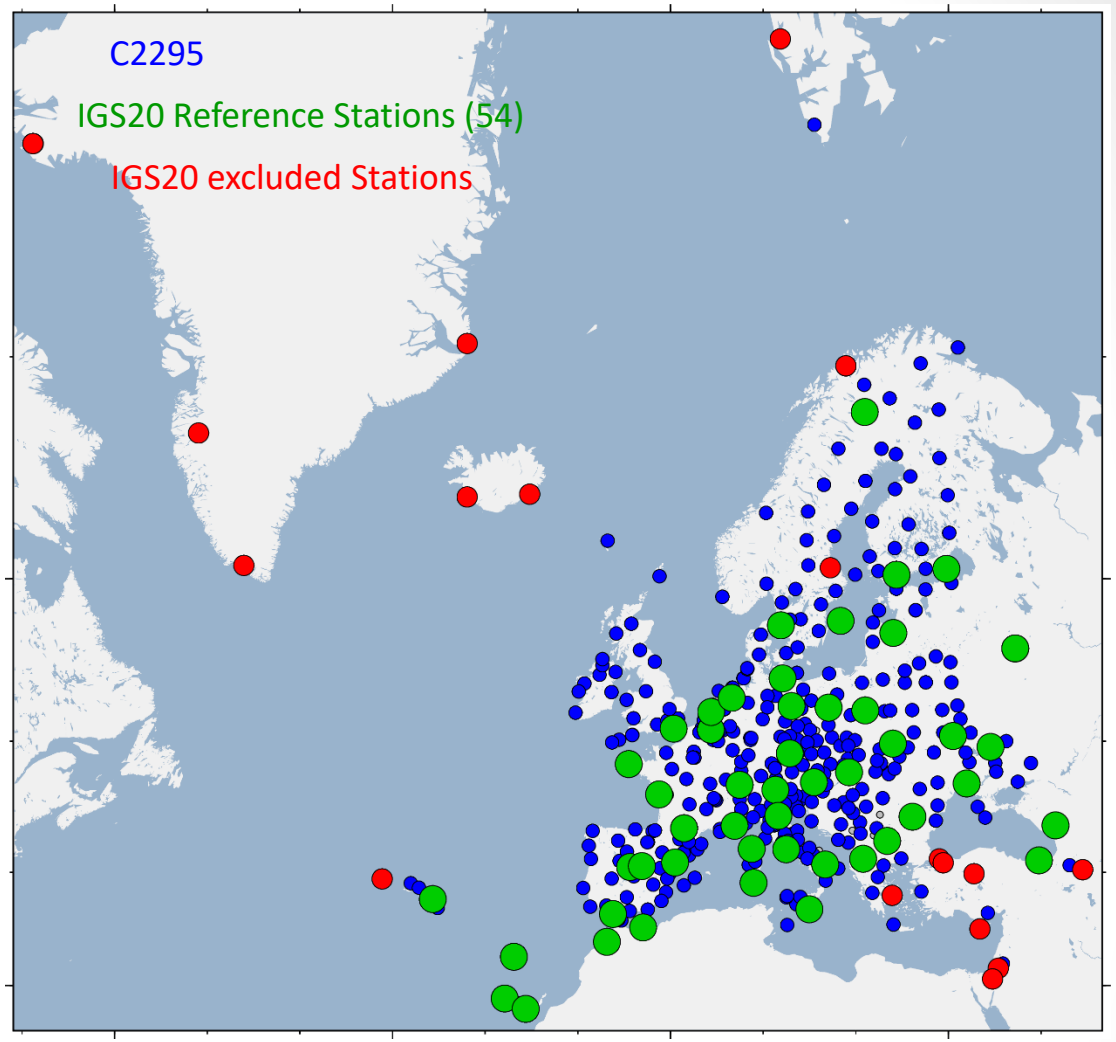
CAGZ00ITA, GANP00SVK, HERT00GBR,
KOSG00NLD, MAT100ITA, NYA100NOR,
THU300GRL, UZHL00UKR



Hybrid Solution: C2295 (IGS20)

Reference Stations in C2235 (igb14)





Reference Stations in C2295 (igs20)

- More stations
- But degradation of the coverage of the chosen reference stations
- We should expect a better agreement with EPN REPRO3

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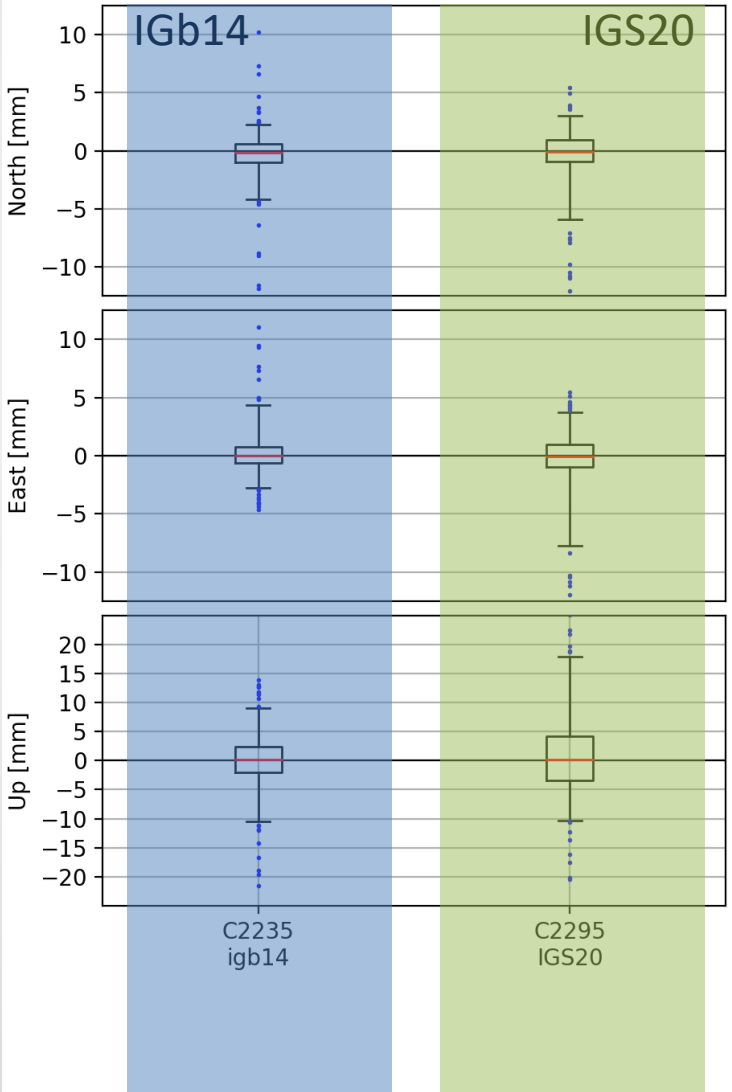
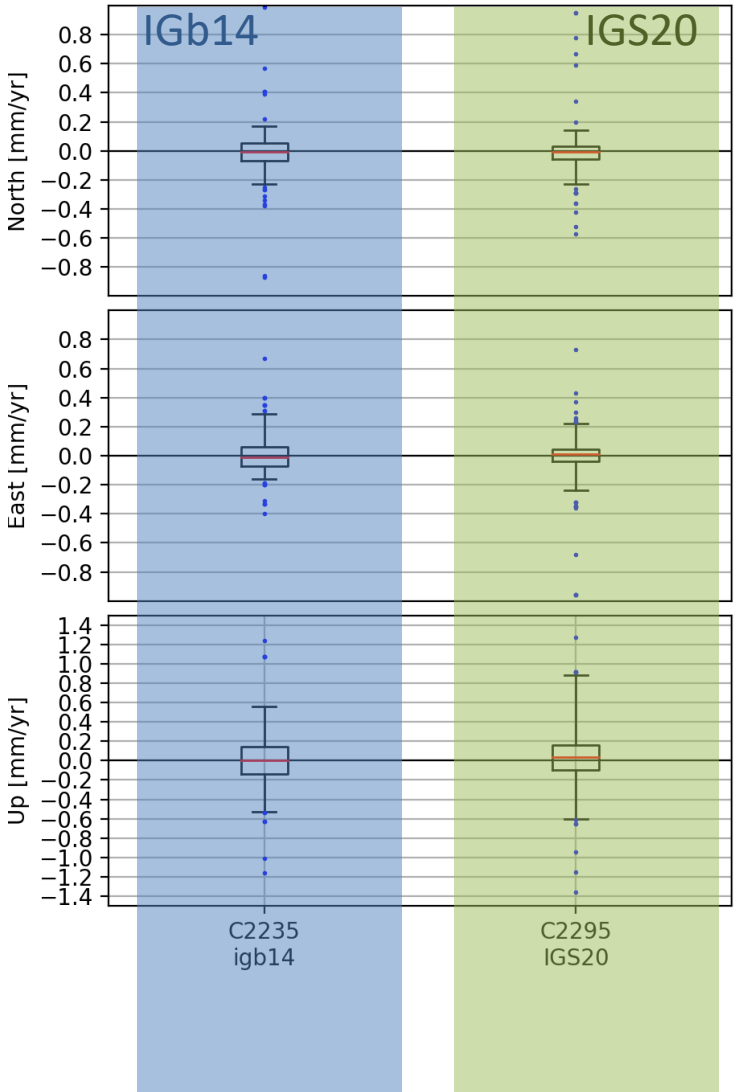
Agreement with IGb14 or IGS20

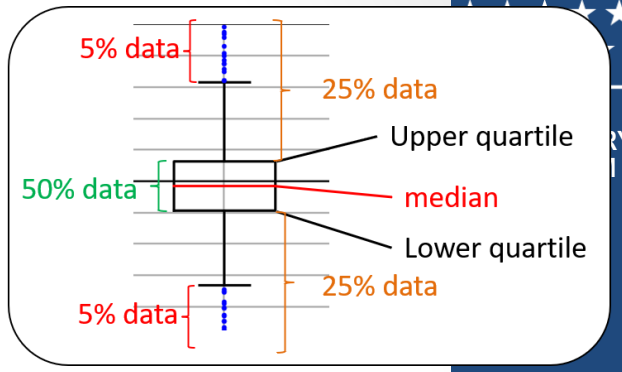
Comparison of the C2235 with IGb14 and C2295 with IGS20

Position differences



Velocity differences





Degradation of the agreement between C2295 and IGS20 compared to the agreement C2235 and IGb14 for the positions

No systematic effect for positions or velocities! Global alignment is reliable.

Recent Positions outcome of the hybrid solution provide valuable up to date coordinates in IGS20.

Historical positions should be used with care.

ETRF2020

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Horizontal Velocity field in ETRF2020

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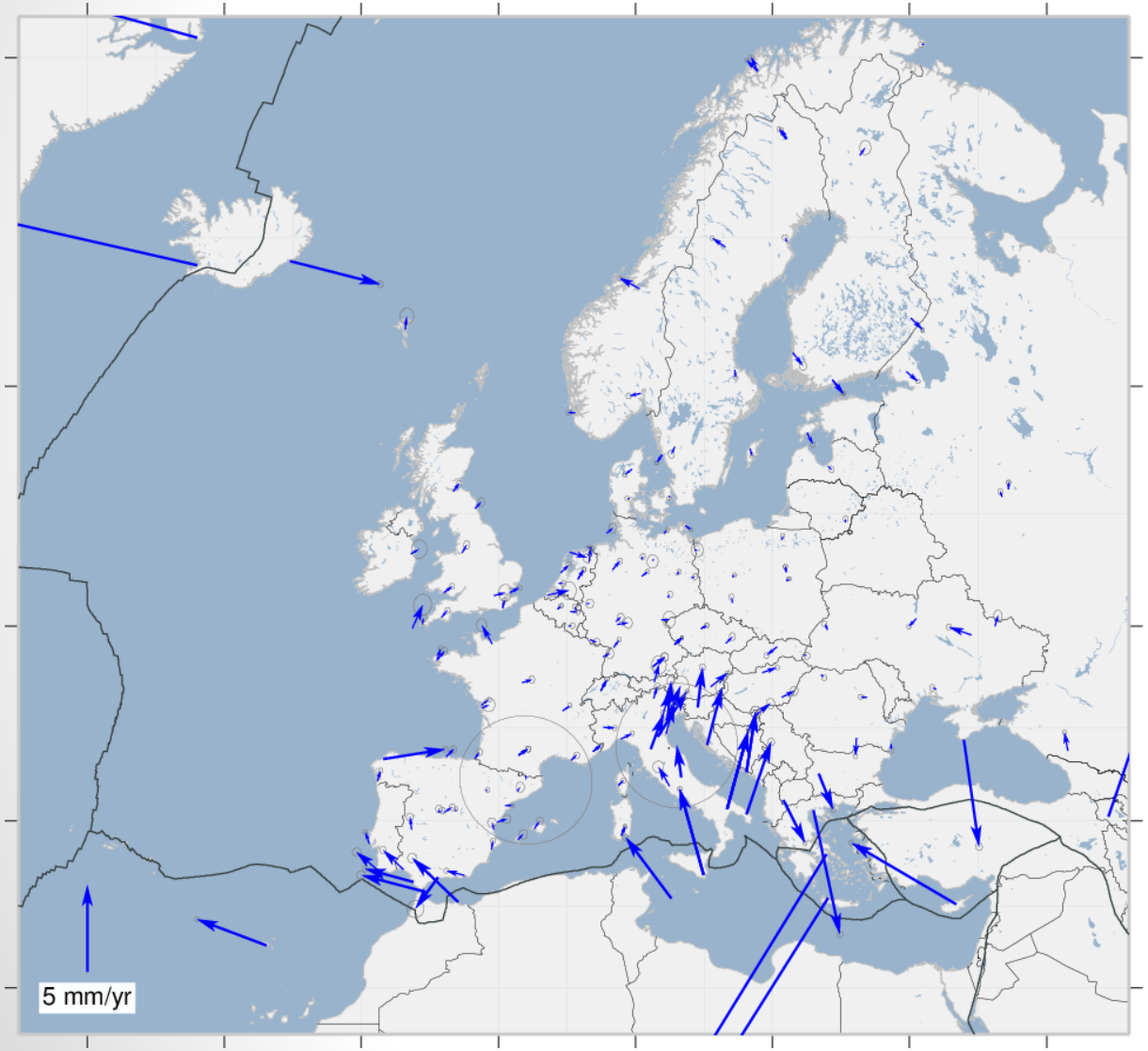
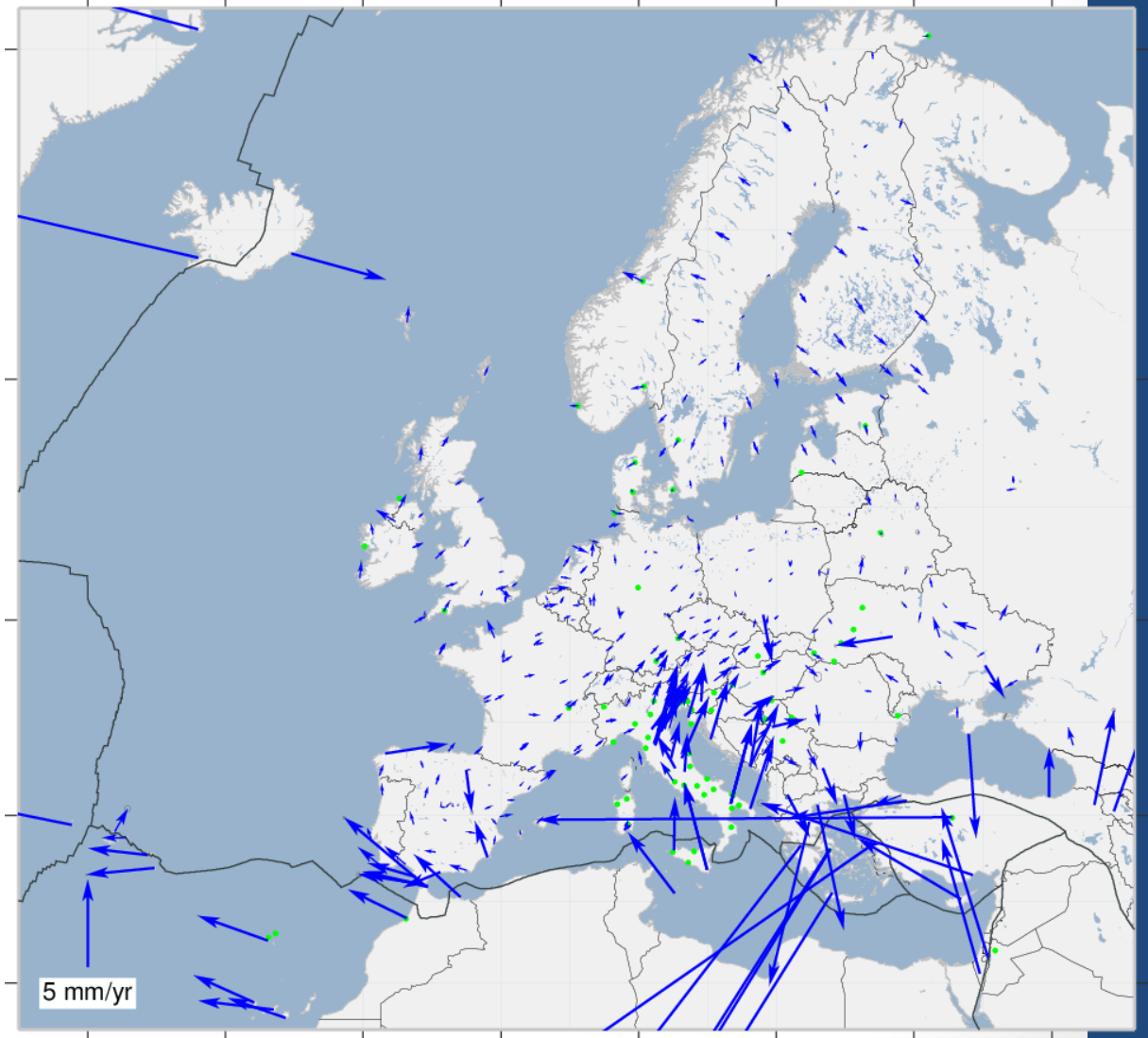
ETRF2020 (http://etrs89.ensg.ign.fr/pub/ETRF2020.SNX.gz)



C2295 in ETRF2020



Vertical Velocity field in ETRF2020

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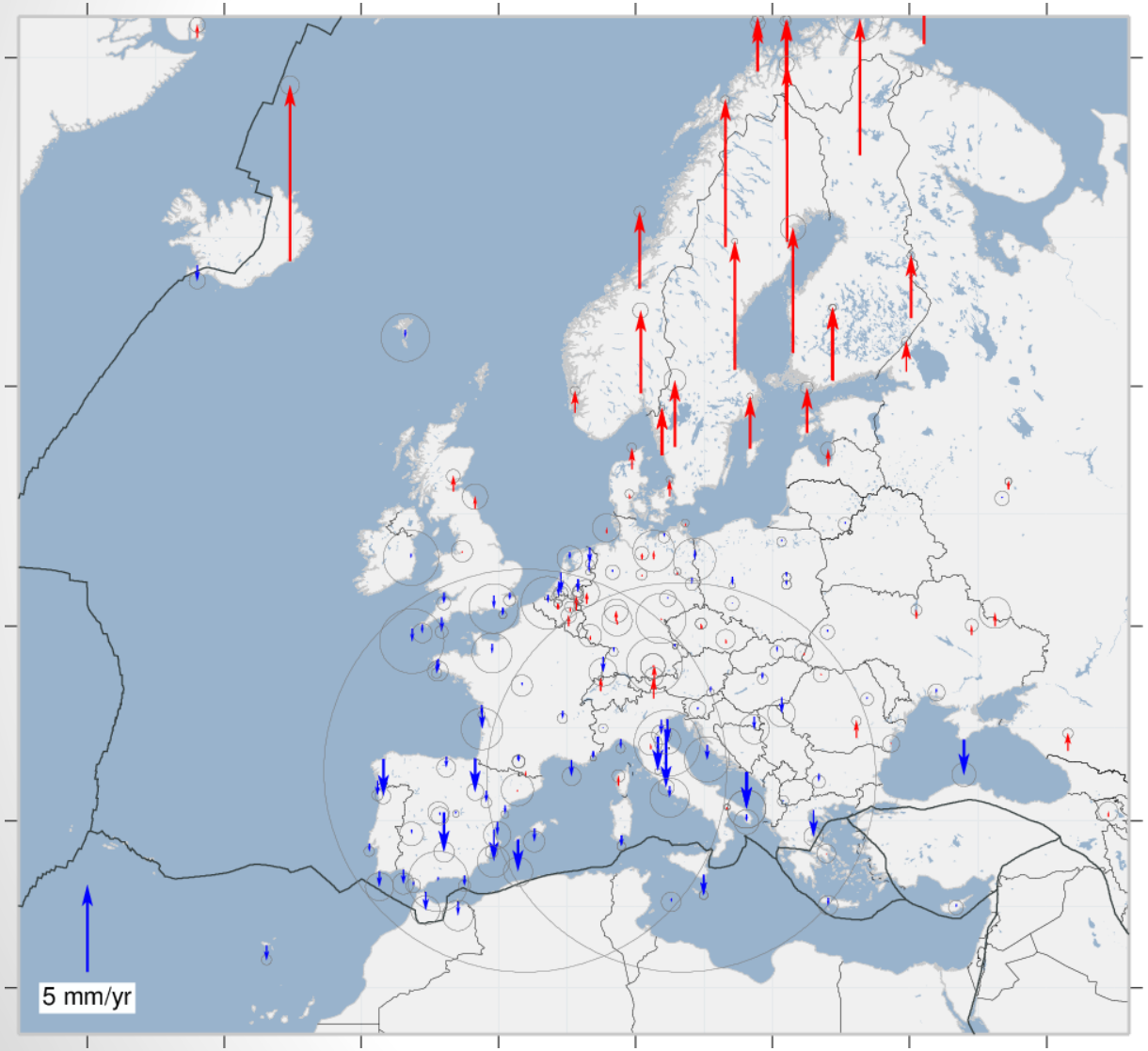
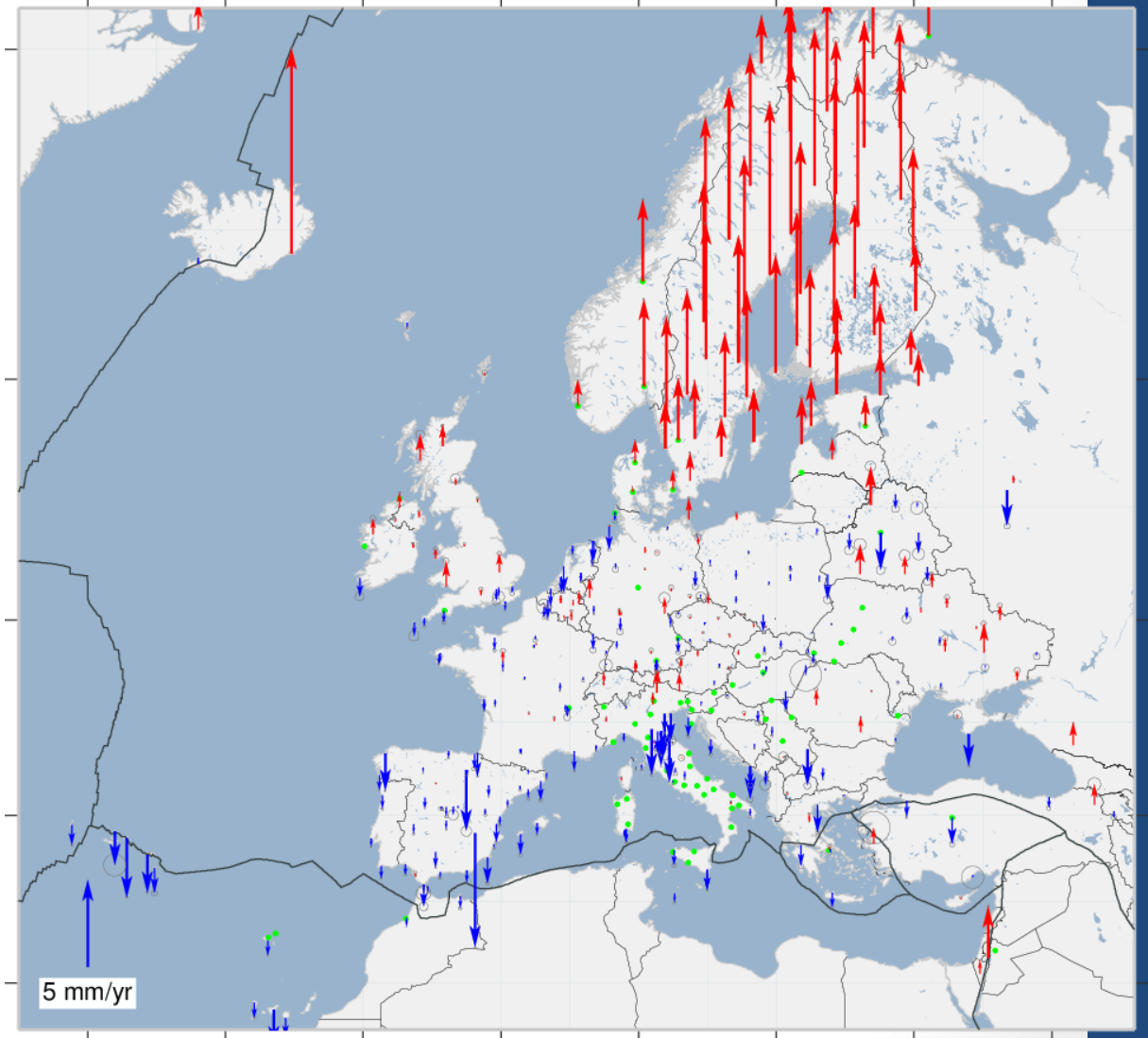
ETRF2020 (http://etrs89.ensg.ign.fr/pub/ETRF2020.SNX.gz)



C2295 in ETRF2020



Conclusions

Conclusion

- Since the last EPN Reference Frame Product
  - 16 stations are ready to have published velocities
  - 21 new stations
  - 101 stations with position changes due to switch to epn_20.atx/IGS20
  - 20 stations with additional offsets
- While waiting for the cumulative solution based on REPRO3

  ⇒ **Hybrid cumulative solution** C2295 based on a **mix of IGb14 and IGS20** daily combined solutions and aligned to **IGS20**
- This product is **not suitable** as Reference Frame to align **official densification**
- But, it can provide a nice solution with **up-to-date station coordinates** for **daily monitoring** while waiting for the REPRO3 solution

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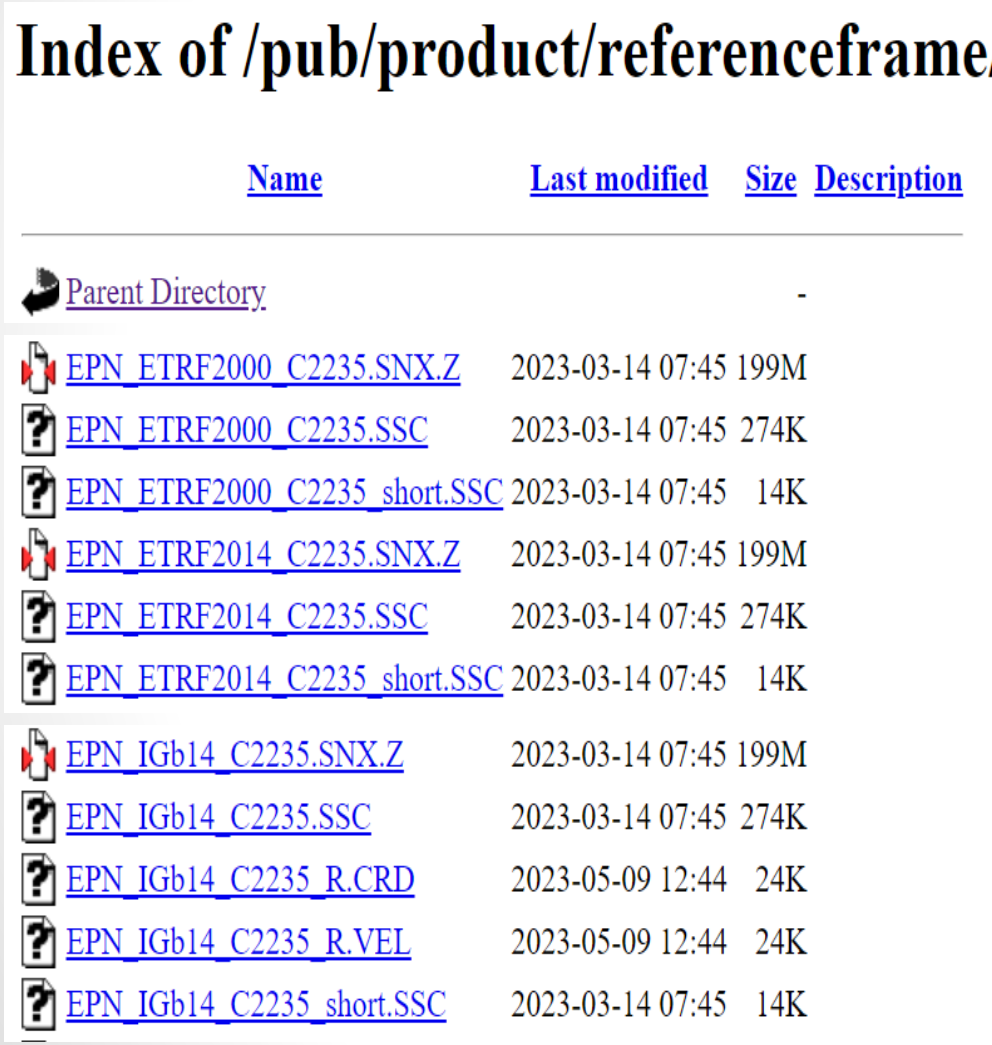
Question: What do you need?



Index of /pub/product/referenceframe/C2235

Name	Last modified	Size	Description
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EPN_ETRF2000_C2235.SSC	2023-03-14 07:45	274K	
EPN_ETRF2000_C2235_short.SSC	2023-03-14 07:45	14K	
EPN_ETRF2014_C2235.SNX.Z	2023-03-14 07:45	199M	
EPN_ETRF2014_C2235.SSC	2023-03-14 07:45	274K	
EPN_ETRF2014_C2235_short.SSC	2023-03-14 07:45	14K	
EPN_IGb14_C2235.SNX.Z	2023-03-14 07:45	199M	
EPN_IGb14_C2235.SSC	2023-03-14 07:45	274K	
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EPN_IGb14_C2235_R.VEL	2023-05-09 12:44	24K	
EPN_IGb14_C2235_short.SSC	2023-03-14 07:45	14K	

- SINEX SSC files in IGS20, ETRF2000, ETRF2014, ETRF2020 will be published using long file name:

EUR0EXPSNX_1996001_2024006_00U_SOL_IGS20.SNX.Z
EUR0EXPSNX_1996001_2024006_00U_SOL_ETRF2000.SNX.Z
EUR0EXPSNX_1996001_2024006_00U_SOL_ETRF2014.SNX.Z
EUR0EXPSNX_1996001_2024006_00U_SOL_ETRF2020.SNX.Z

- What about the files EPN_IGb14_C2235_short.SCC?
  - Is there a need for those files?
  - Please come and discuss with me about what you need.
  - Email: Juliette.Legrand@oma.be

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