Reference Frame Coordination Status Report

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ROYAL OBSERVATORY OF BELGIUM

EUREF Symposium, Göteborg, Sweden, 24 May 2023

Context and Outline

- Last EUREF Reference Frame Product (C2235) in IGb14
- Comparison of C2235 with IGS20 and IGS cumulative solution in IGS20
- EPN Repro 3 / EPN Historical Data Center

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EUREF Reference Frame Product (C2235)

Last solution in IGb14

EPN Reference Frame Product

- Reference Frame Product C2235 (February 2023): 01-01-1996 -- 12-11-2022
  - Switch to IGS20: GPS week 2238, 27-11-2022
  - No added value to have a solution C2238 compared to C2235
    - C2235 is the last IGb14 Reference Frame Product that will be published

- New Reference Frame Product will be based on Repro 3 and aligned to IGS20

- Until Reference frame product based on Repro3 is published:
  - Mix of IGb14 and IGS20

    ⇒It will not be published
  - Monitoring of EPN Station Position Time series

    ⇒ done using Extended timeseries (updated on a daily basis)
    - Final Daily combined SINEX in IGb14 (Repro2+Operational)
    - Rapid Daily combined SINEX in IGS20 (limited number of ACs)
    - Final Daily combined SINEX in IGS20 (not yet available)

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Extended Position Time Series for monitoring (1)

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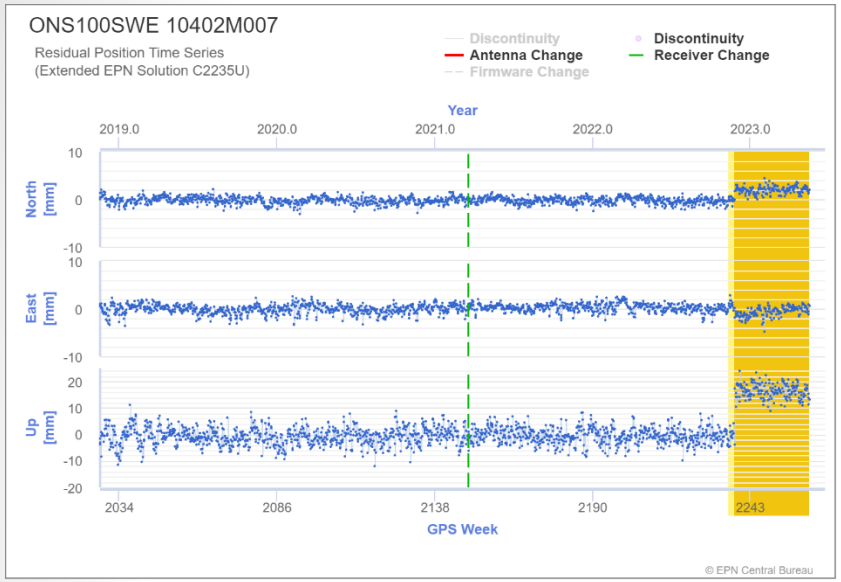
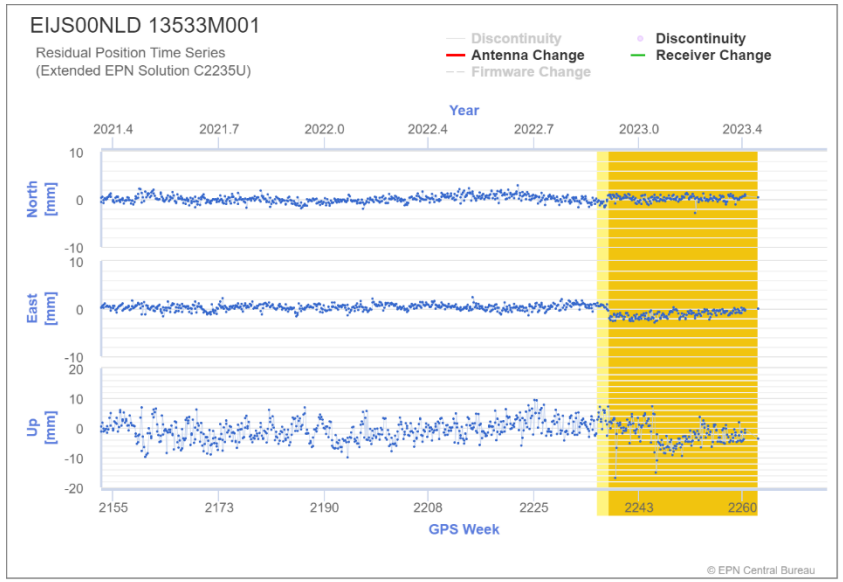
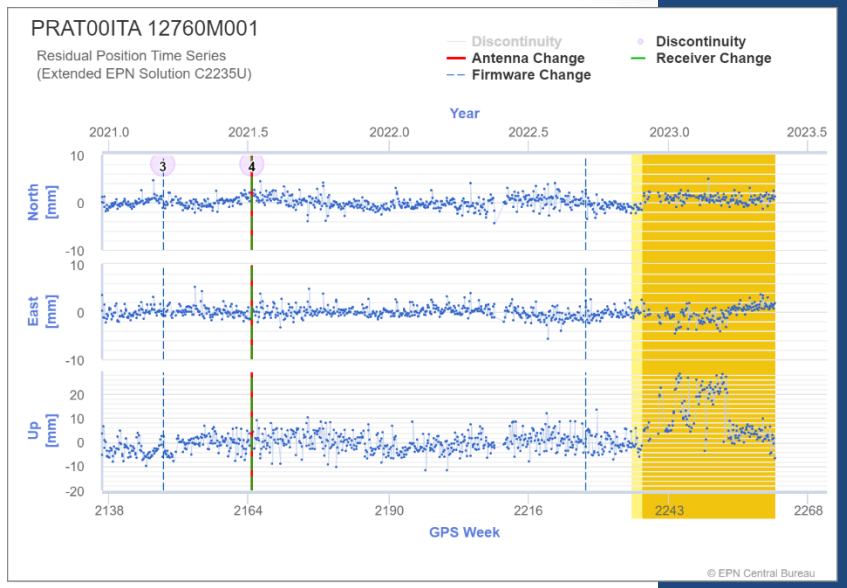
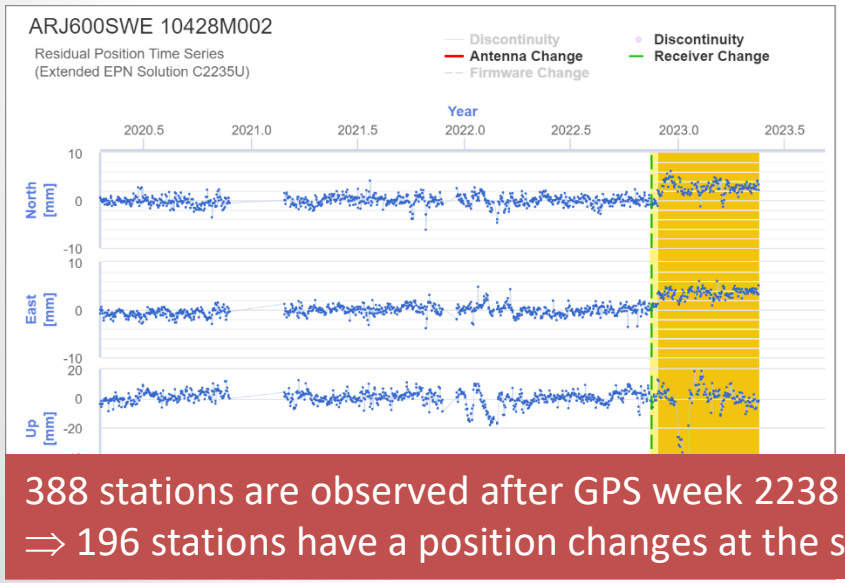
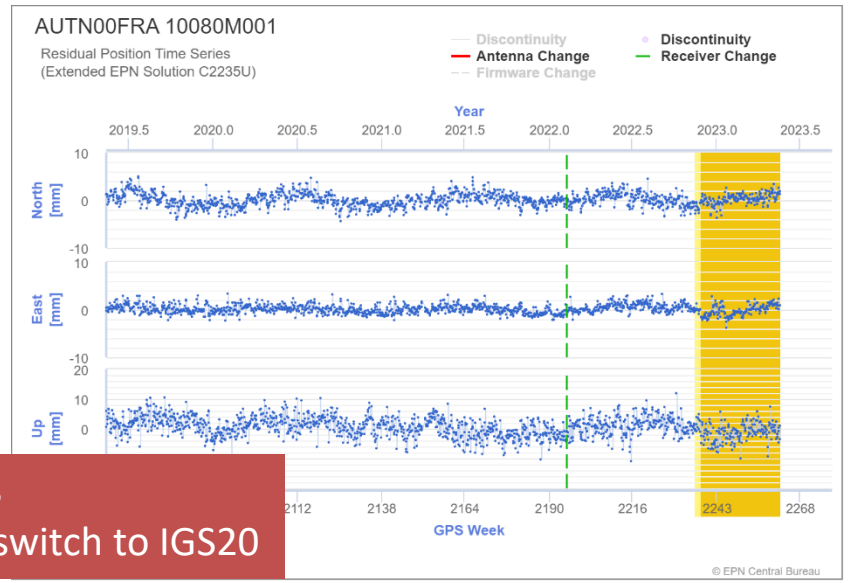
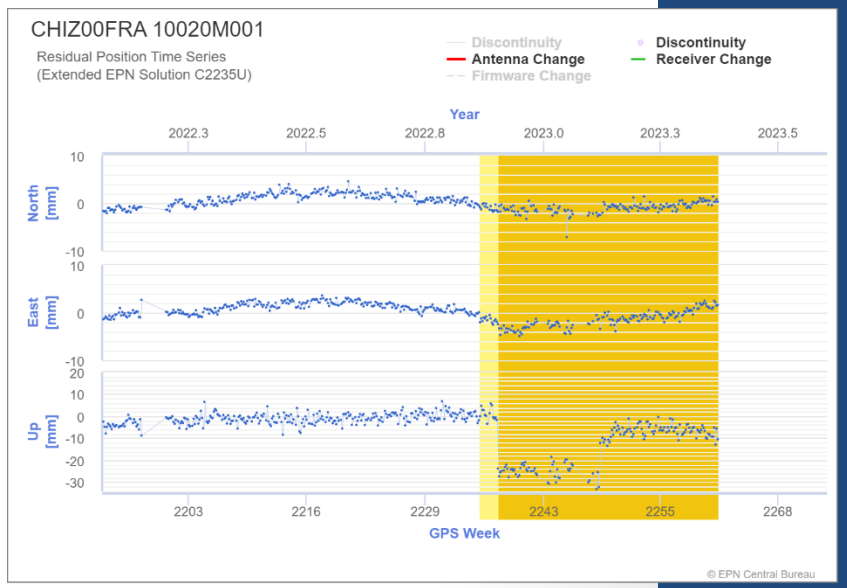








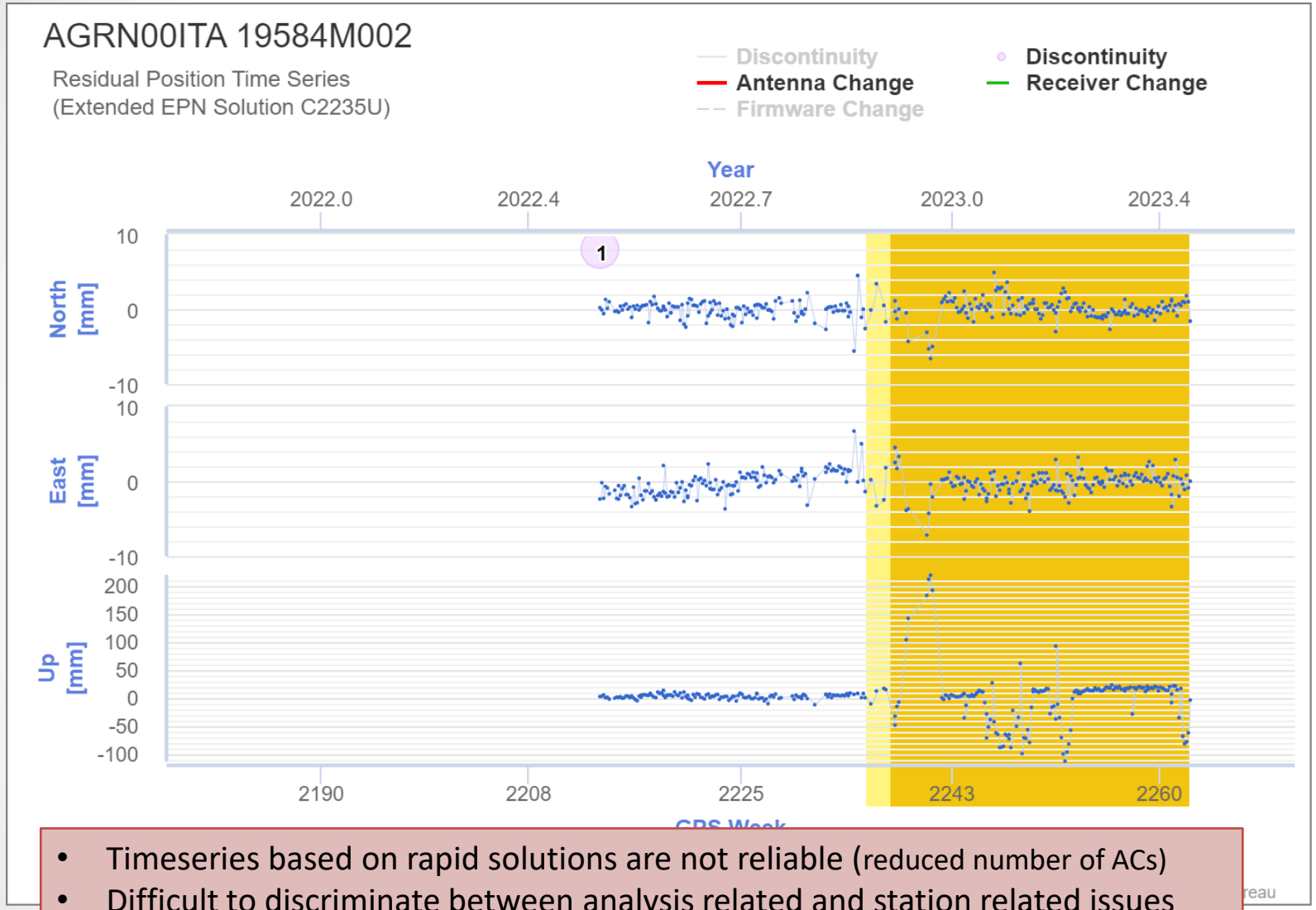


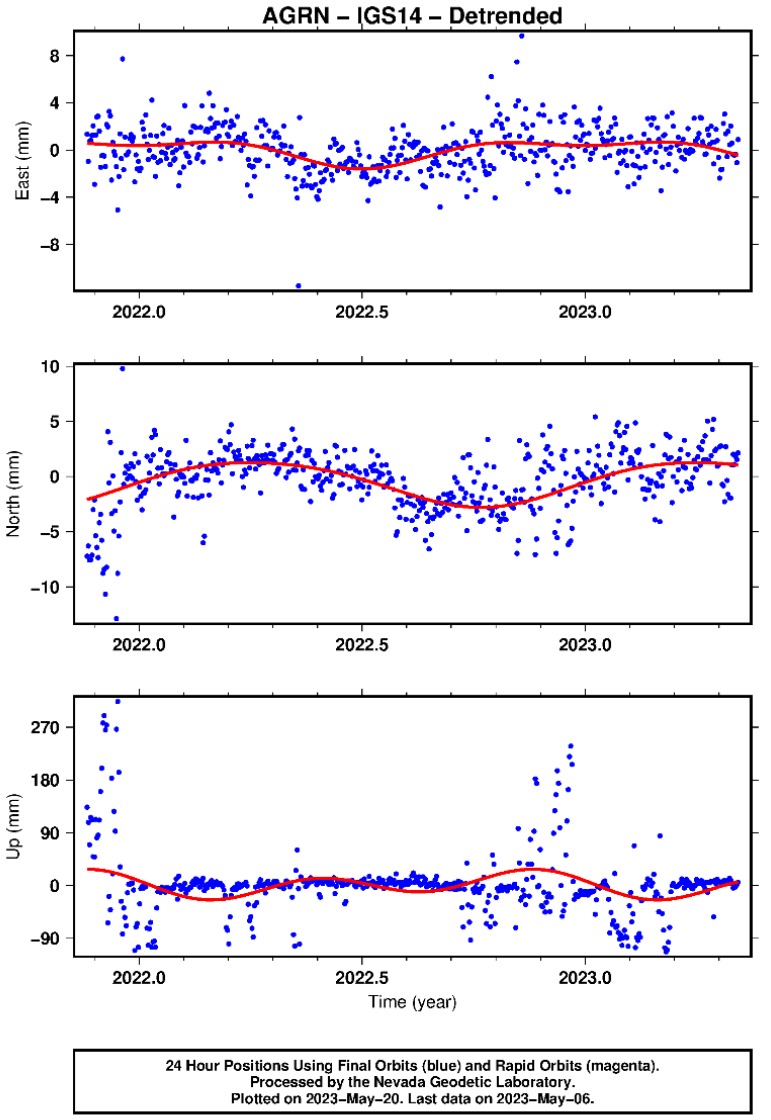


388 stations are observed after GPS week 2238

⇒ 196 stations have a position changes at the switch to IGS20

Extended Position Time Series for monitoring (2)





- Timeseries based on rapid solutions are not reliable (reduced number of ACs)
- Difficult to discriminate between analysis related and station related issues
- Urgent need for final combined solutions in IGS20
- **Availability of operational final combined EPN product in IGS20 with ALL ACs participating is crucial to correctly monitor the EPN stations**

http://geodesy.unr.edu/NGLStationPages/stations/AGRN.sta

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Comparison of C2235 with IGS20 and IGS cumulative solution (IGS20)

Stations

IGS20
and IGS cumulative solution in IGS20

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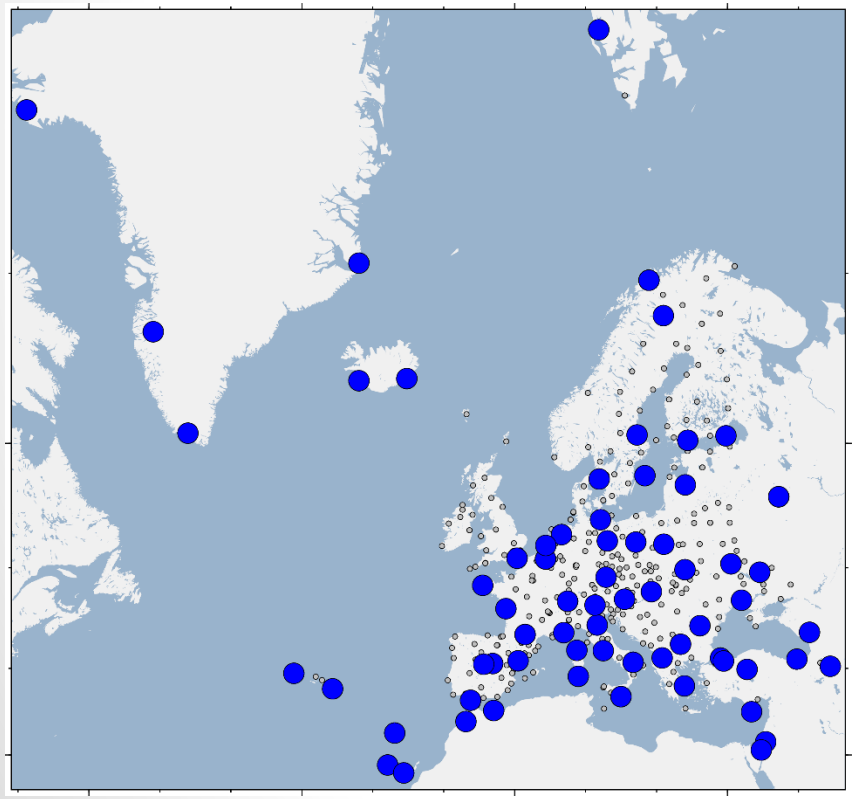
EPN Stations in IGS20

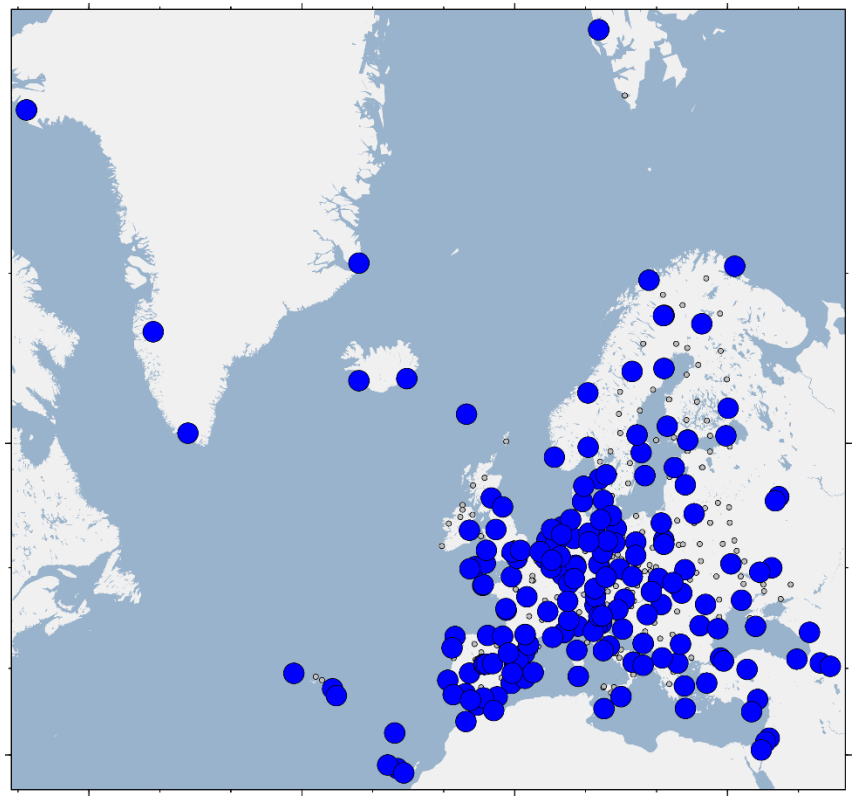
74 Stations



EPN Stations
in IGS cumulative SINEX solution

IGS0OPSSNX_1994002_2023077_00U_SOL.SNX

219 Stations



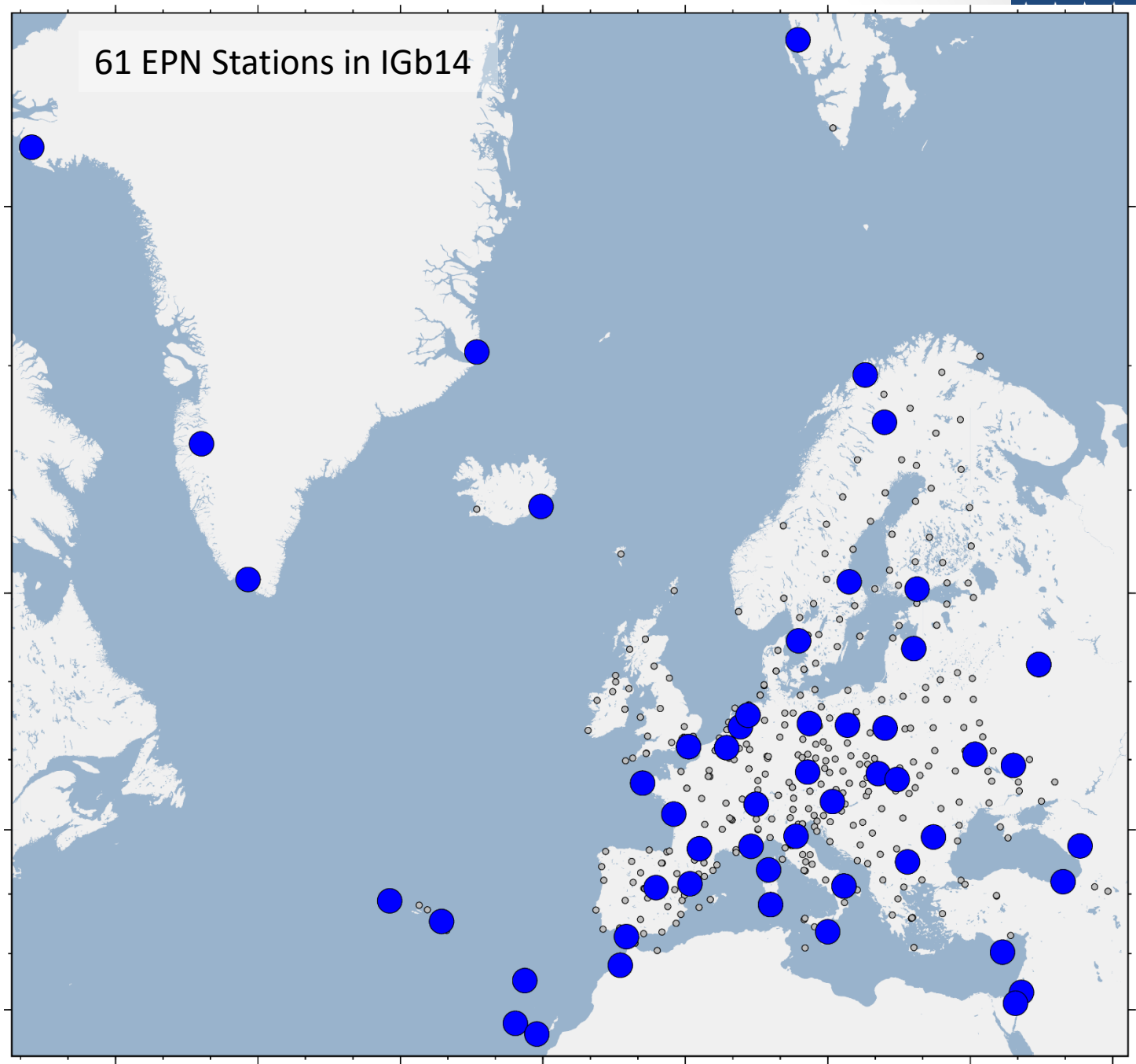
[IGSMAIL-8331] IGS cumulative SINEX solution resumes

IGS cumulative SINEX solution

- long-term solution based on the stacking of:
  - daily IGS repro3 combined SINEX solutions for GPS weeks 730 to 2237 (made consistent with IGS20/igs20.atx)
  - daily IGS operational combined SINEX solutions for GPS weeks 2238 to 2253
- aligned in origin, scale and orientation wrt IGS20
- updated every 8 weeks

IGb14/IGS20

- EPN Stations in IGb14: 61

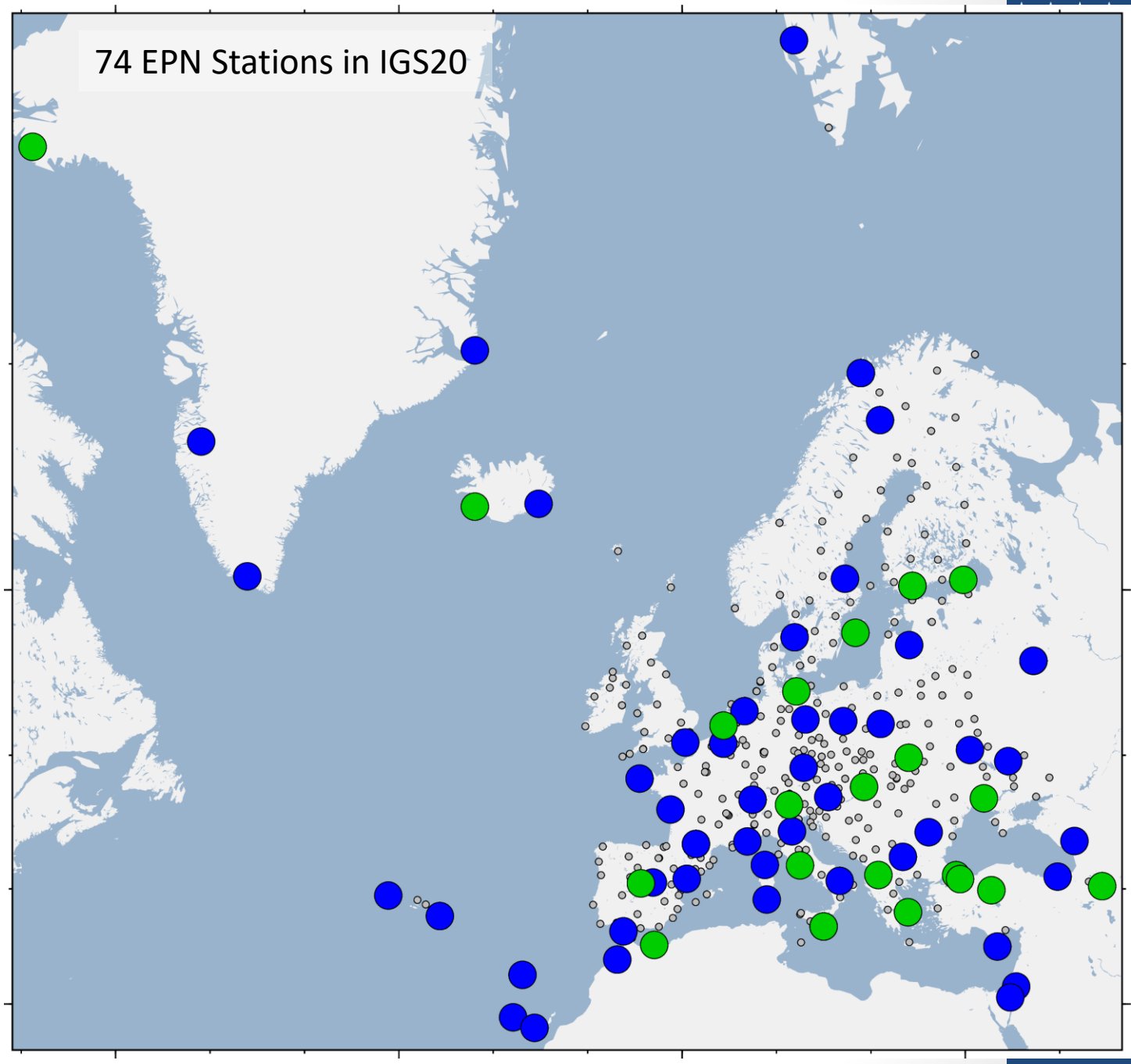


IGb14/IGS20

- 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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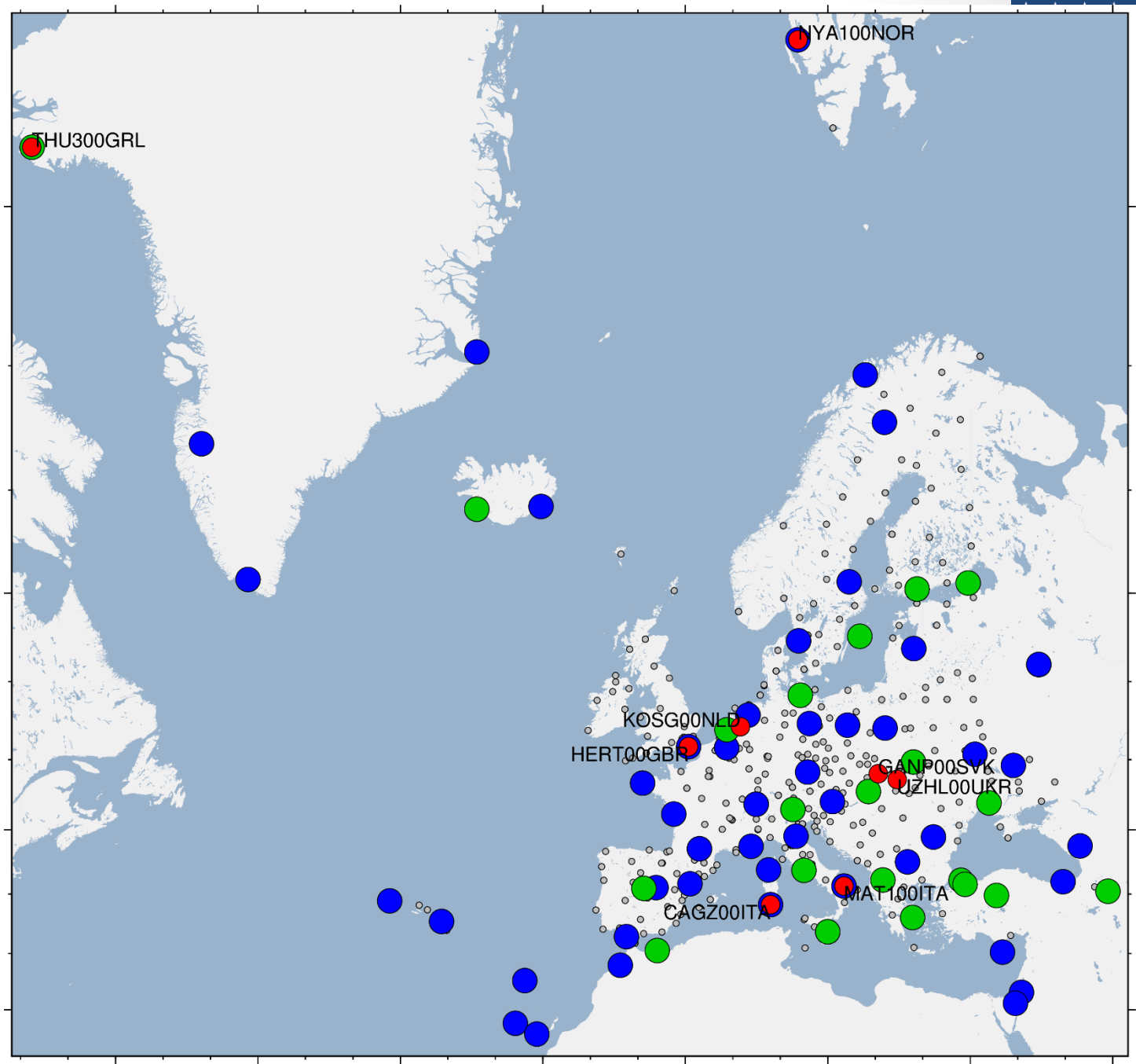
SULP00UKR, SVTL00RUS, THU100GRL,
TUBI00TUR, VIS000SWE, WARN00DEU

- 8 Stations removed

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



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Comparison of C2235 with IGS20 and IGS cumulative solution (IGS20)

Post Seismic Deformation Models

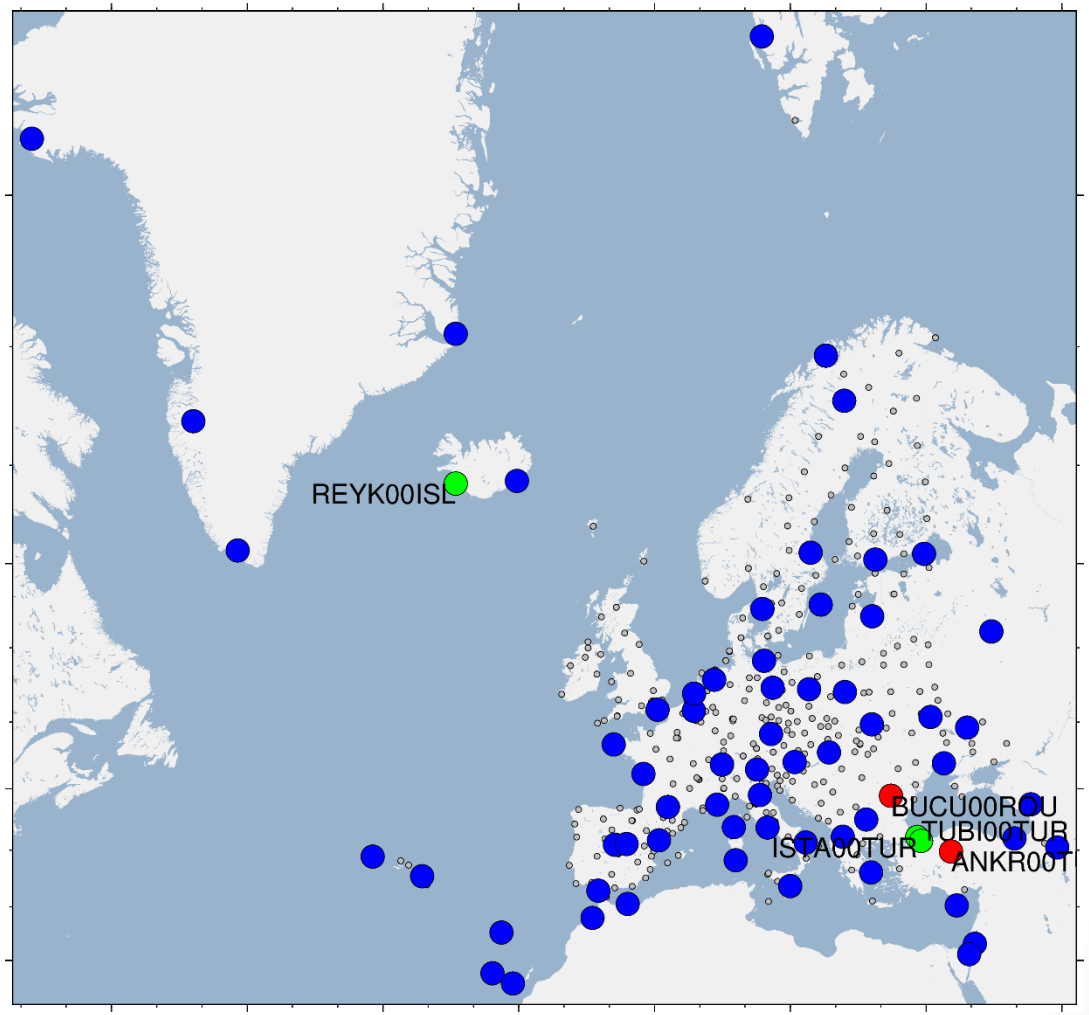
Stations with Post Seismic Deformation Models

- 5 EPN Stations with Post Seismic Deformation Models in IGb14/ITRF2014

  ANKR00TUR
  BUCU00ROU
  ISTA00TUR
  REYK00ISL
  TUBI00TUR

- 3 EPN Stations with Post Seismic Deformation Models in IGS20/ITRF2020

  ~~ANKR00TUR~~
  ~~BUCU00ROU~~
  ISTA00TUR
  REYK00ISL
  TUBI00TUR



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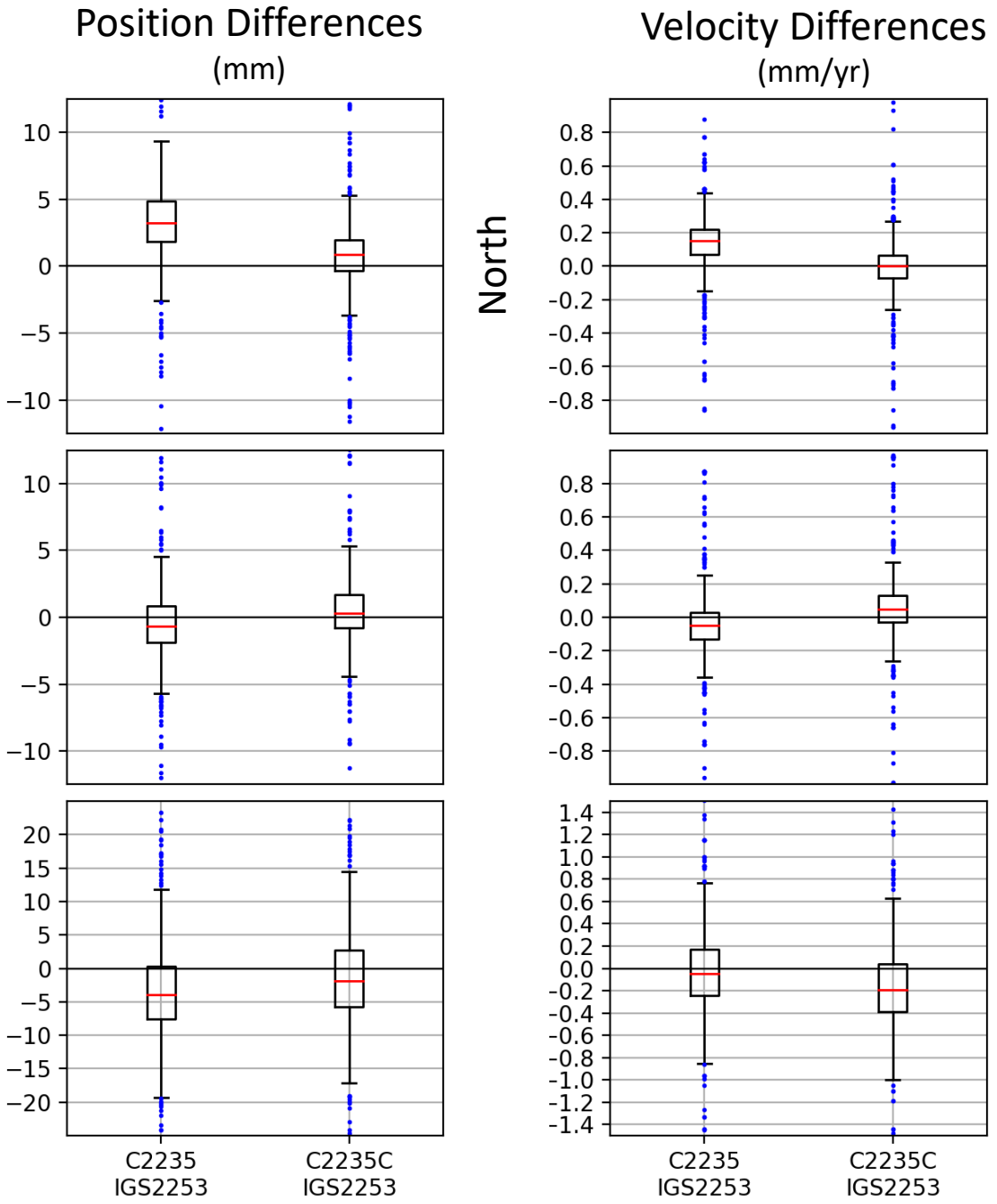
Comparison of C2235 with IGS20 and IGS cumulative solution (IGS20)

Positions and Velocities

Position and Velocity Differences

- Comparison between
  - C2235 (IGb14) and IGS cumulative (IGS20)
- Systematic effect:
  - Positions: mainly North and Up components are affected with a median ~ 7 mm
  - Velocities: mainly North component is affected with a median of 0.3 mm/yr
- Systematic effect is reduced when applying transformation parameters between ITRF2014 and ITRF2020



Transformation Parameters from ITRF2020 to ITRF2014

14 transformation parameters from ITRF2020 to ITRF2014 have been estimated using 131 stations listed in the core network list and located at 105 sites shown on *fig.2*.

	T1 mm	T2 mm	T3 mm	D 10-9	R1 mas	R2 mas	R3 mas
	-1.4	-0.9	1.4	-0.42	0.000	0.000	0.000
±	0.2	0.2	0.2	0.03	0.007	0.006	0.007
Rates	0.0	-0.1	0.2	0.00	0.000	0.000	0.000
±	0.2	0.2	0.2	0.03	0.007	0.006	0.007

table.2: Transformation parameters at epoch 2015.0 and their rates from ITRF2020 to ITRF2014 (ITRF2014 minus ITRF2020)

https://itrf.ign.fr/en/solutions/ITRF2020#transformation-parameters-from-itrf2020-to-itrf2014

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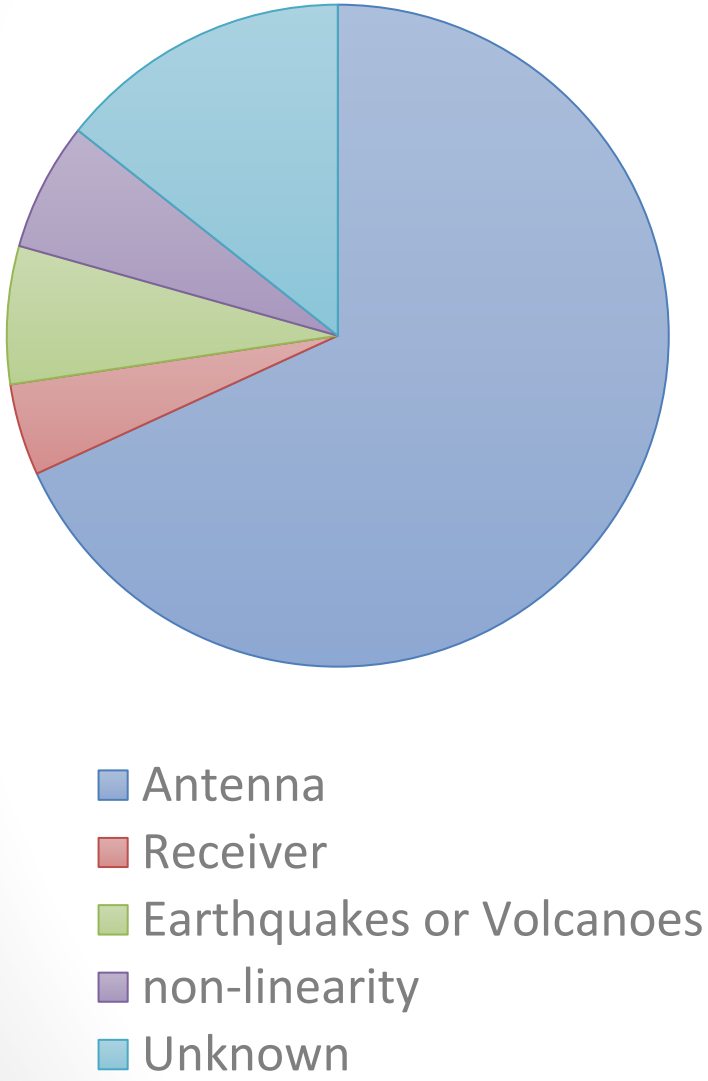
Comparison of C2235 with IGS20 and IGS cumulative solution (IGS20)

Position and Velocity discontinuities

Position and Velocity Discontinuities in IGS20



- 223 position discontinuities
- 30 velocity changes affecting 15 stations:

ANKR00TUR GLSV00UKR HOFN00ISL ISTA00TUR KELY00GRL
LPAL00ESP MIKL00UKR NYAL00NOR QAQ100GRL REYK00ISL
SCOR00GRL SFER00ESP SOFI00BGR TRO100NOR TROM00NOR

- Comparison with EPN discontinuity list: 43 stations have different discontinuities
- It will require more investigations
  - POTS00DEU, TRO100NOR, …

The EPN discontinuity list will be revised

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Comparison of C2235 with IGS20 and IGS cumulative solution (IGS20)

Time Series

More complete time series in IGS Repro 3

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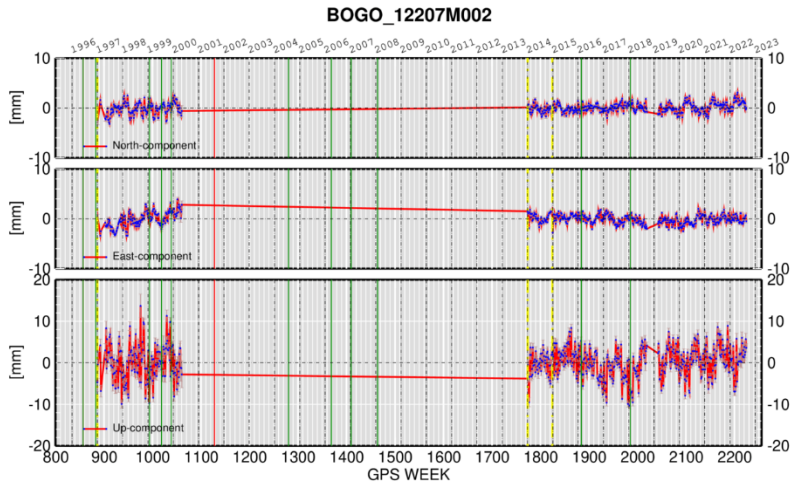
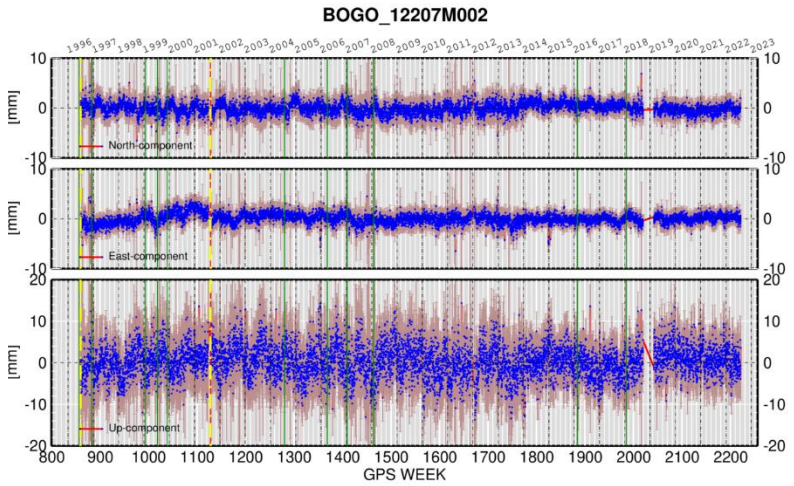
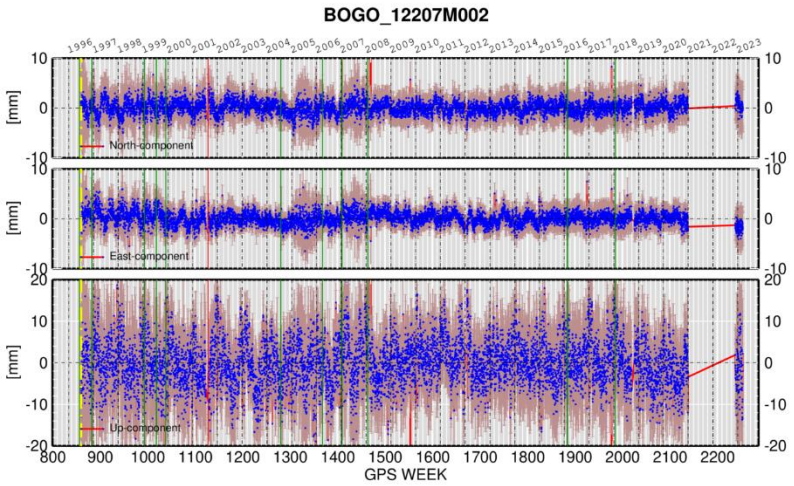
IGS Repro 2



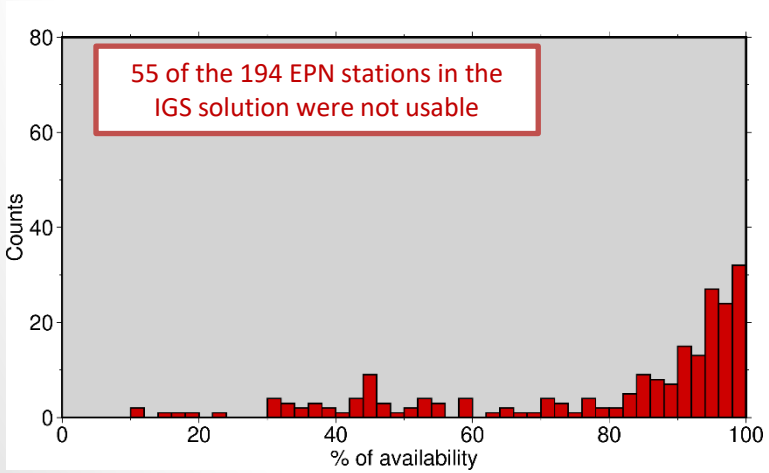
EPN Repro 2



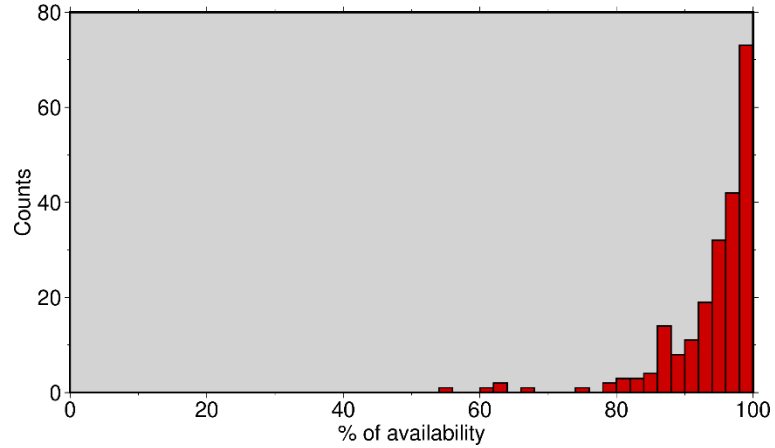
IGS Repro 3



IGS solution IGS22P47



EPN solution C2235



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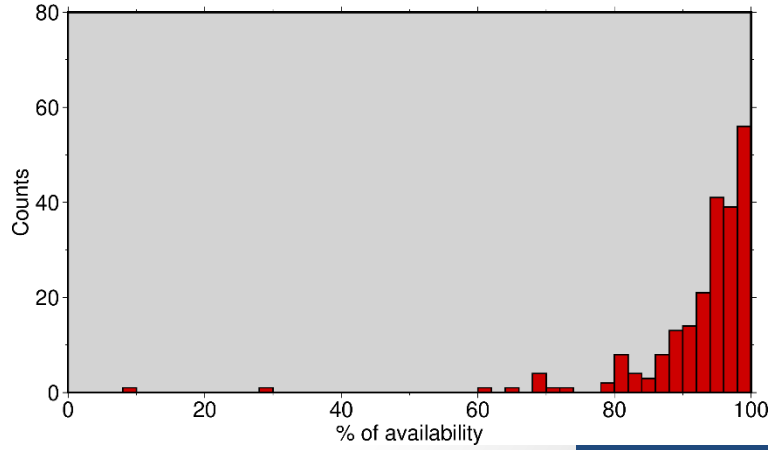

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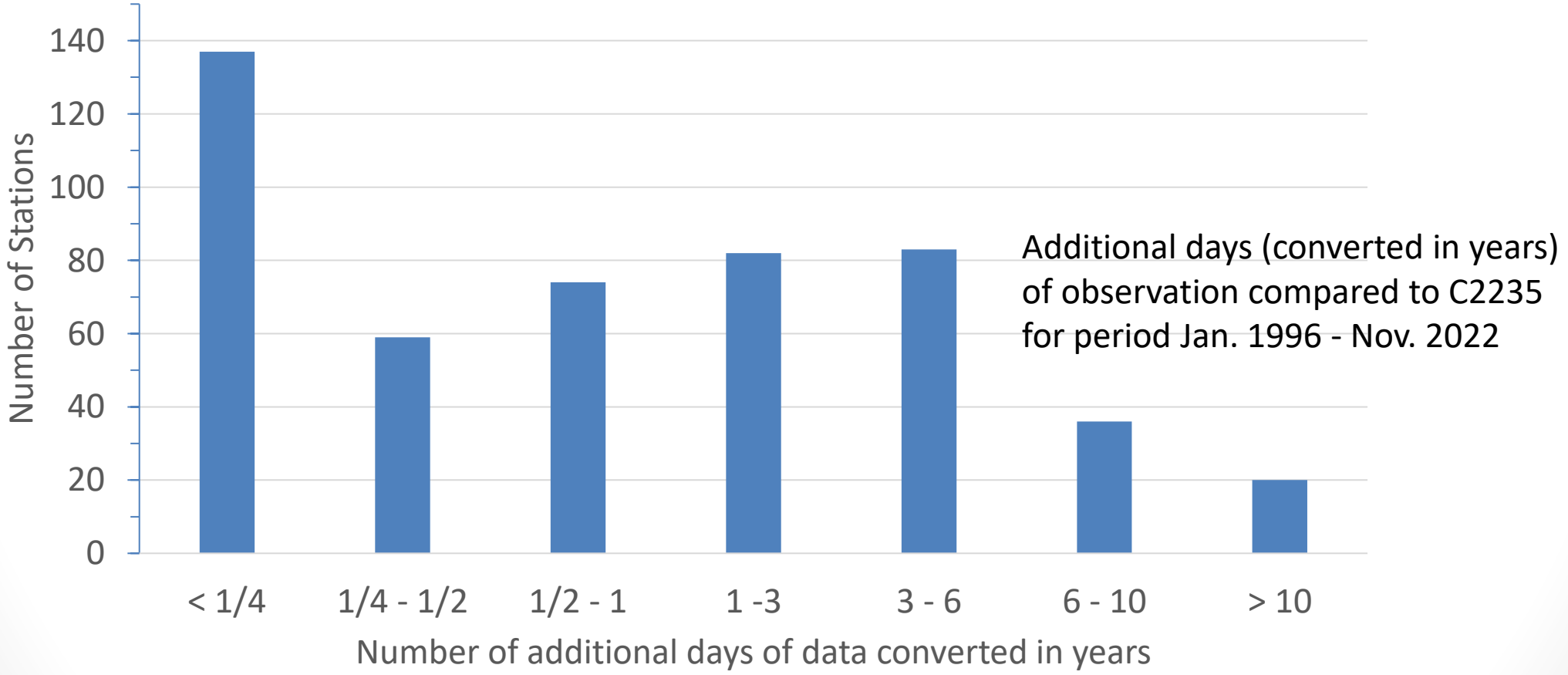
EPN Historical Data Center

EPN Historical Data Center

- Effort to gather missing historical data for the EPN stations
- Screening of external time series
- Contact Station Manager



EPN Historical Data Center

Longer time series
More reliable velocity estimates ☺

Station Managers:

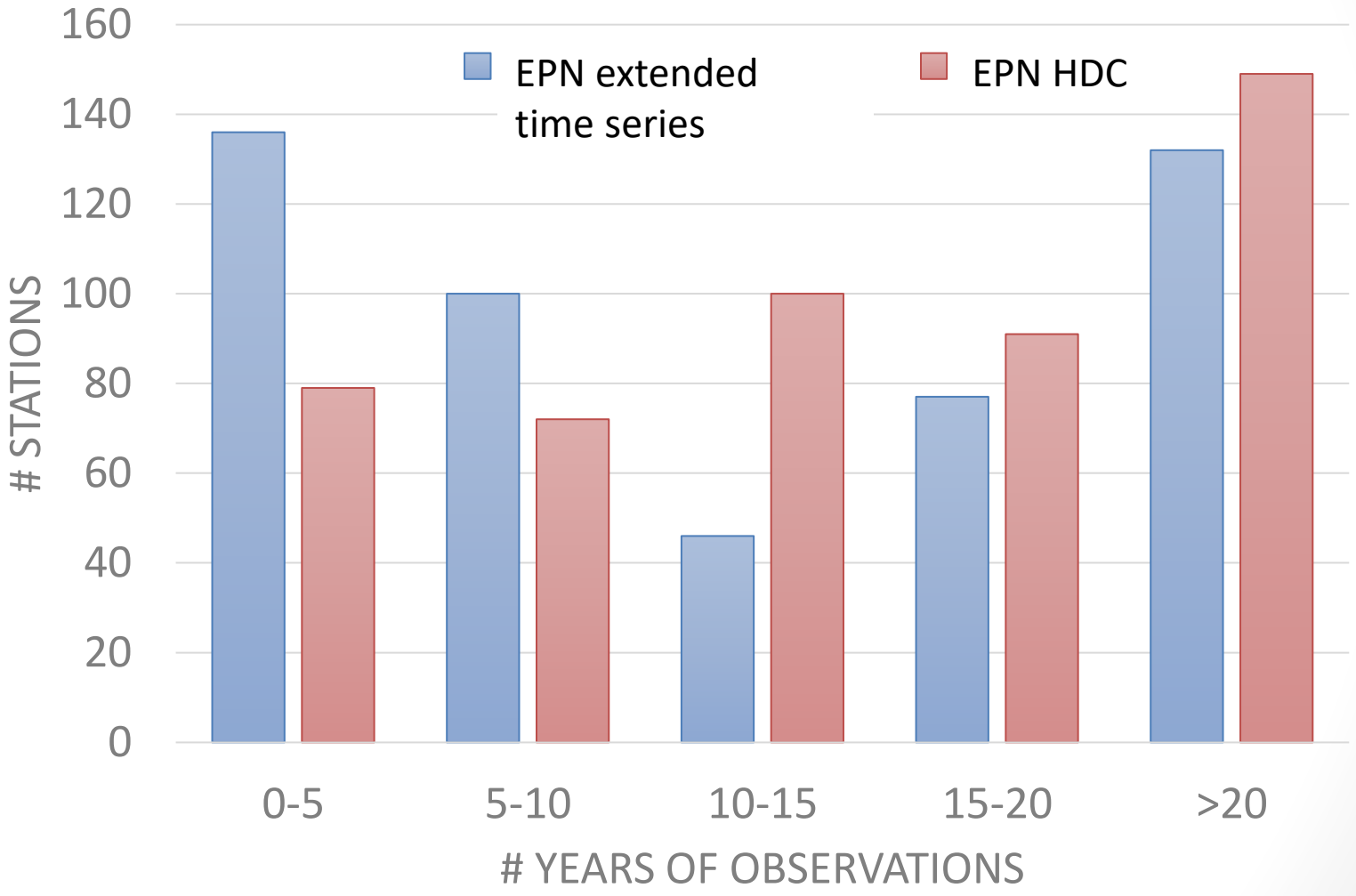
If you have additional data, please contact EPNCB !

RINEX headers can be corrected by EPNCB

We just need valid station metadata

Analysis Centers:

please make sure that you process **all data** available at the **EPN Historical Data Center**



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Conclusions

- Reference Frame Product
  - C2235: last EPN Reference Frame Product in IGb14
  - Futur Reference Frame Product will be based on Repro 3 and aligned to IGS20
  - No product based on a mix of IGb14 and IGS20
  - Monitoring of EPN Stations: Urgent need for final combined solutions in IGS20
    - ⇒ Availability of operational final combined EPN product in IGS20 with ALL ACs participating is crucial to correctly monitor the EPN stations

- IGS repro 3
  - IGS20: More EPN reference stations in IGS20
  - IGS cumulative solution in IGS20: more stations and more complete time series

- EPN repro 3:
  - EPN Historical Data Center contains more data than what is today in the EPN position time series
  - Longer time series for EPN stations ⇒ better velocity estimates ☺
  - Message to Station Managers: if you have **additional data,** please contact EPNCB !
  - Message to ACs: please make sure that you process **all data** from the **EPN Historical Data Center**

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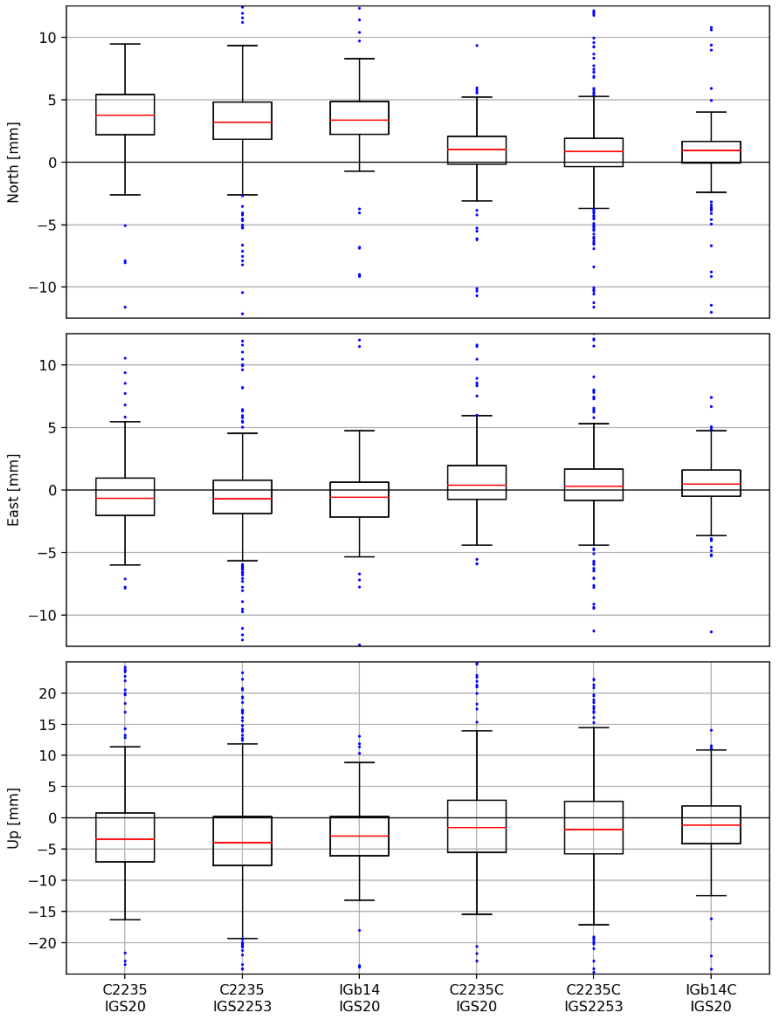
Position and Velocity Differences

After applying transformation parameters from ITRF2014 to ITRF2020

Reduction of the systematic effect for the positions and velocities

Position Differences



Velocity Differences