New EPN multi-year solution expressed in IGS14

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With contributions of
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ROYAL OBSERVATORY OF BELGIUM

Brussels, 25 October 2017

LAC Workshop

EPN combined daily SINEXs: Status

From	To	Type	Antenna Calibration	Offsets
0834 – 1 1996/001 1996-01-01	**1772 – 6** 2013/362 2013-12-28	EPN-Repro2	epn_08.atx (igs08.atx)	Applied
1773 – 0 2013/363 2013-12-29	**1933 – 6** 2017/028 2017-01-29	ROUTINE	epn_08.atx (igs08.atx)	Applied
1934 – 0 2017/028 2017-01-29	**1940 – 6** 2017/077 2017-03-18	ROUTINE	epn_14.atx (igs14.atx)	-

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Switch from epn_08.atx to epn_14.atx

New EPN solution: new features

	C1934	New
Reference frame	IGb08	IGS14
Input SINEXs	weekly	daily
Reference frame epoch	2005.0	2010.0
Earthquake modelling for ITRF stations	Several linear trends	Post-seismic deformation modelled for ANKR00TUR, BUCU00ROU, ISTA00TUR, REYK00ISL, TUBI00TUR
Annual and semi-annual estimated	no	yes
Discontinuity list	C1934	Update
Software	CATREF	CATREF
Align to IGxxx with	translation, rotation, scale	translation, rotation, scale

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New combined multi-year solution

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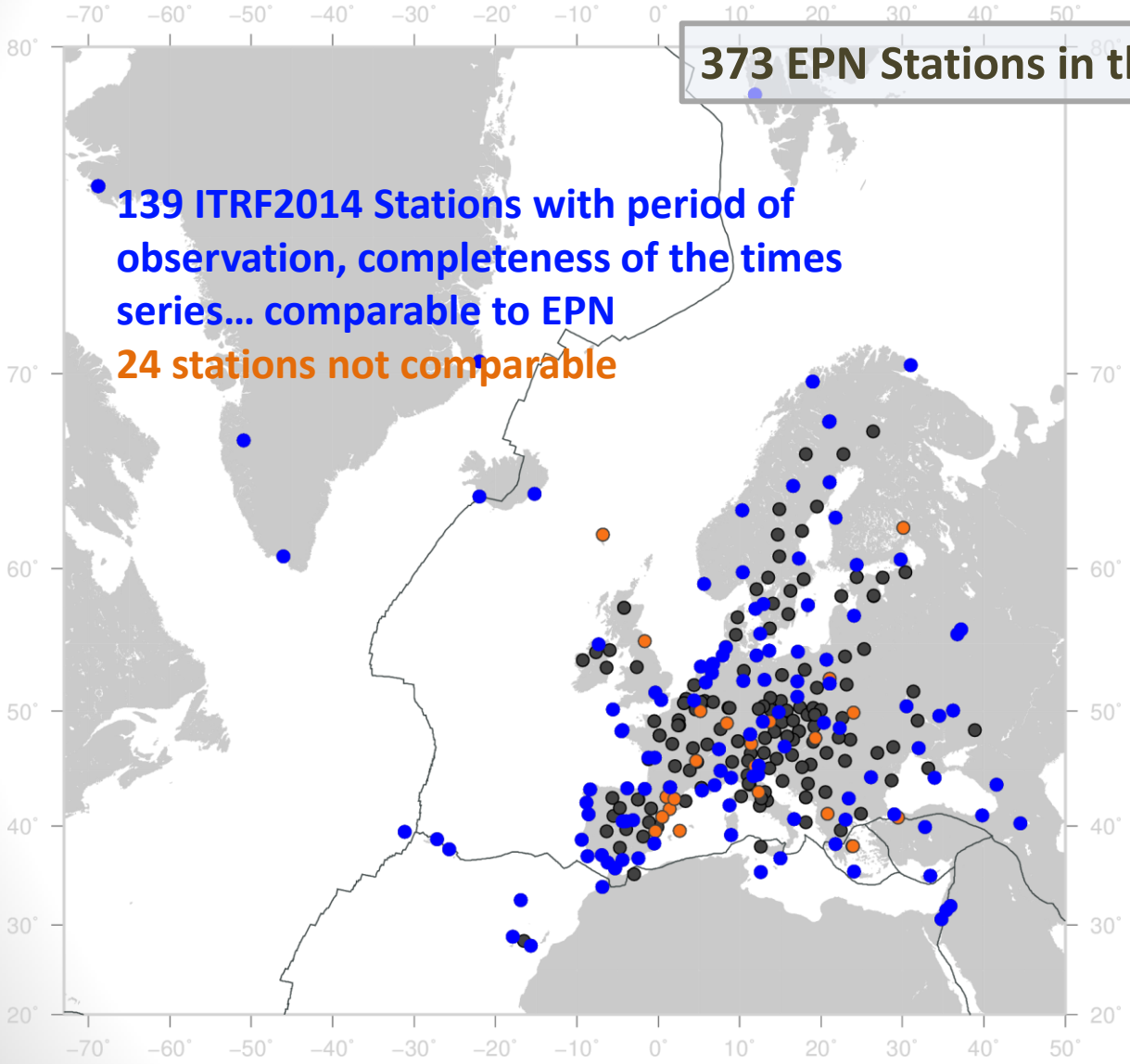
EPN Network

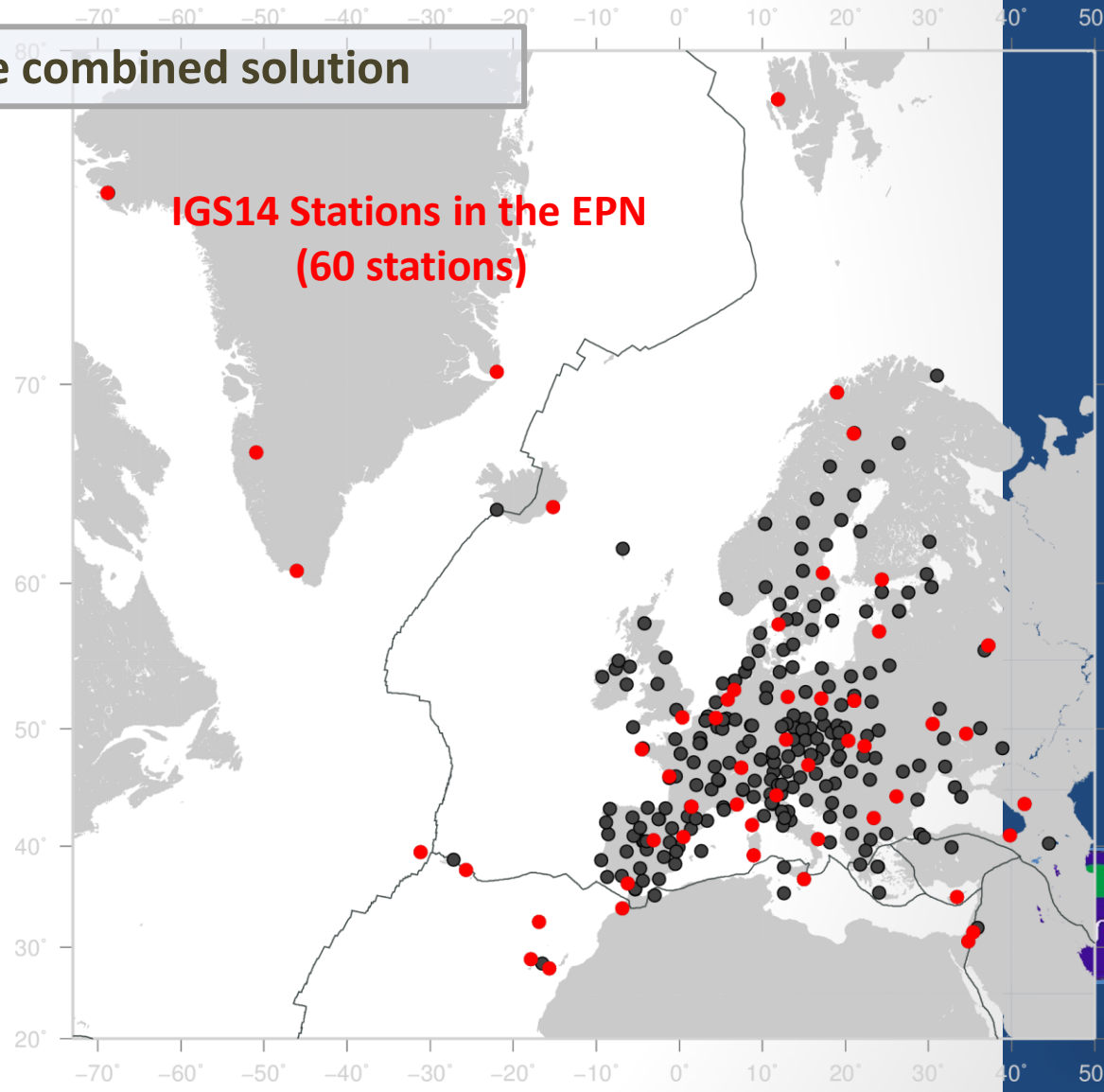
373 EPN Stations in the combined solution

139 ITRF2014 Stations with period of observation, completeness of the times series… comparable to EPN

24 stations not comparable



IGS14 Stations in the EPN (60 stations)



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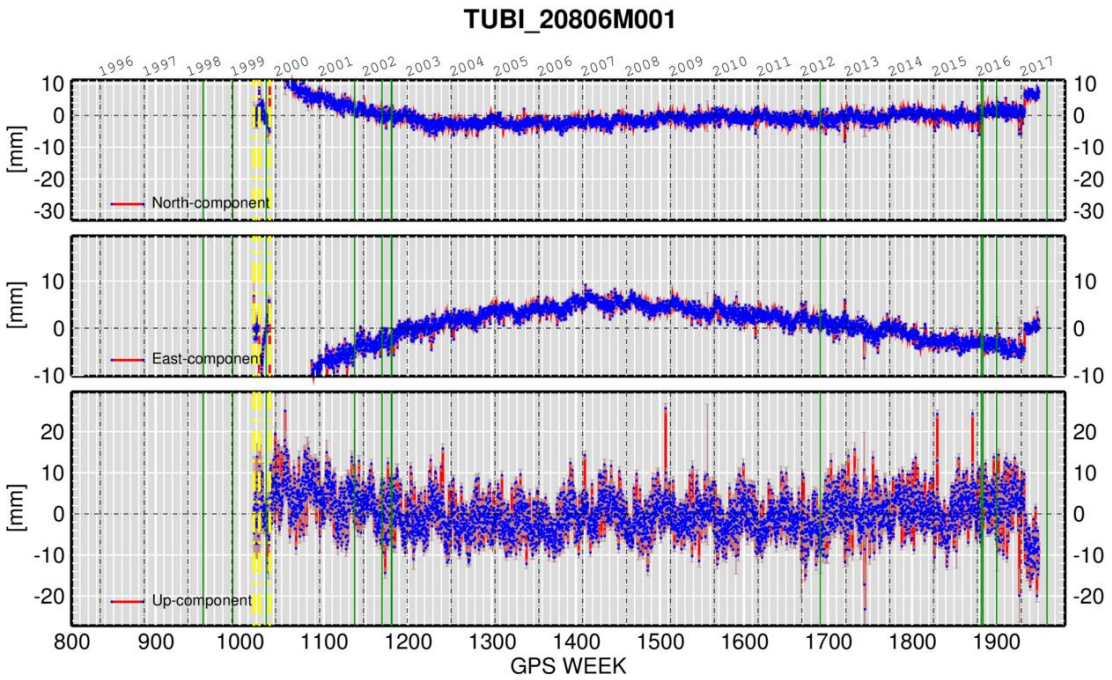
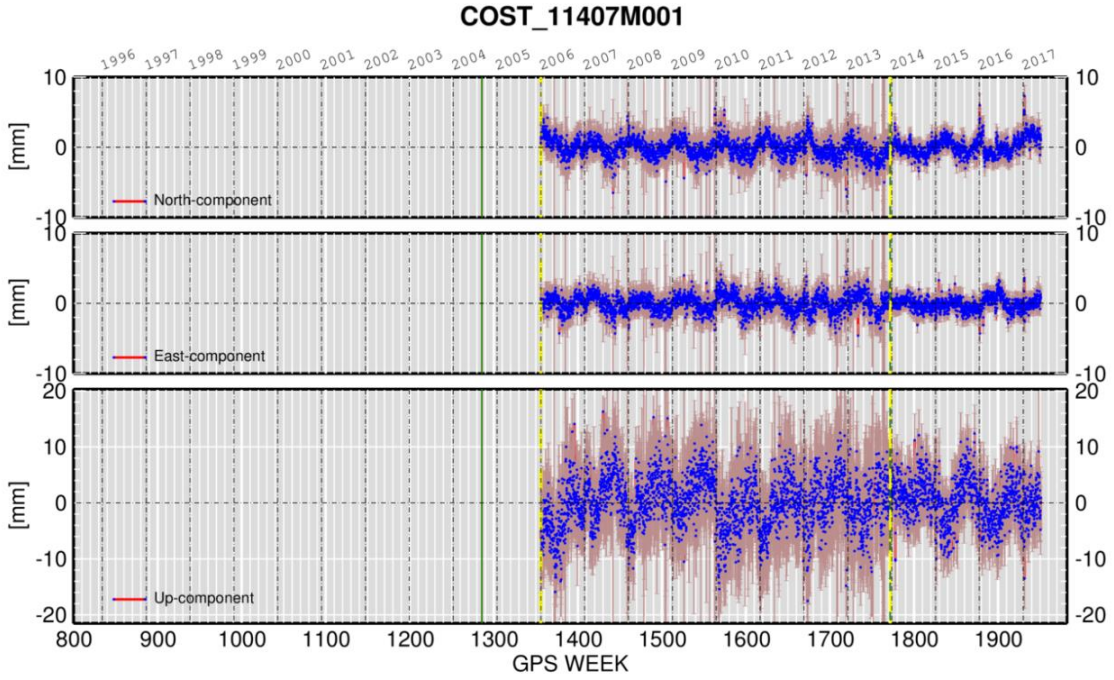
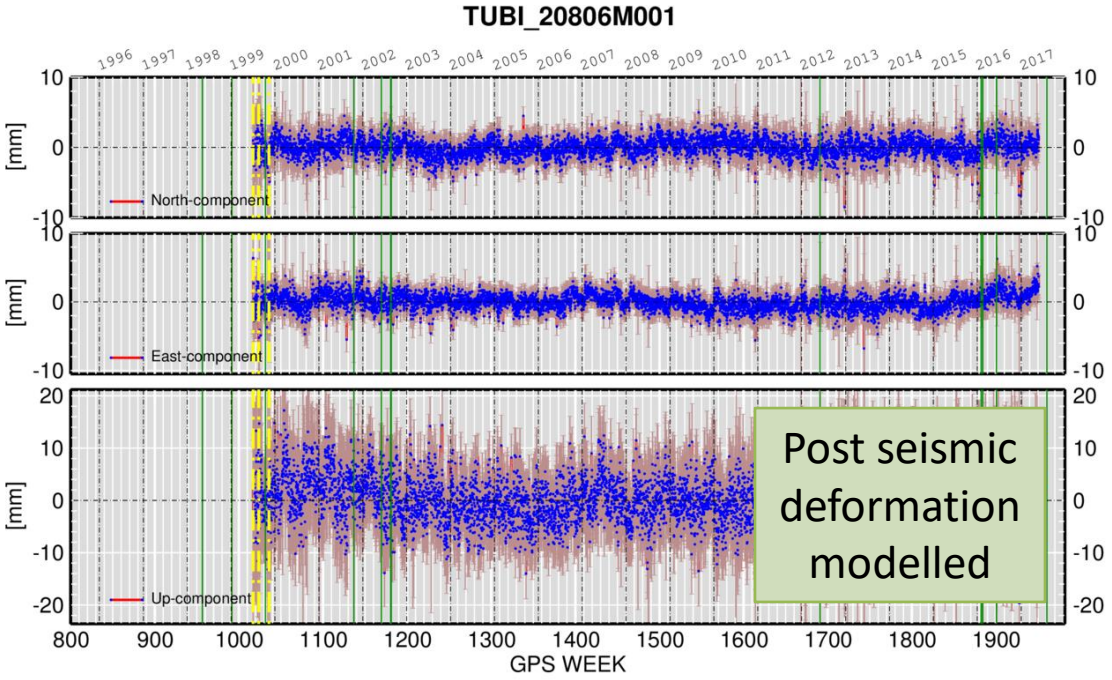
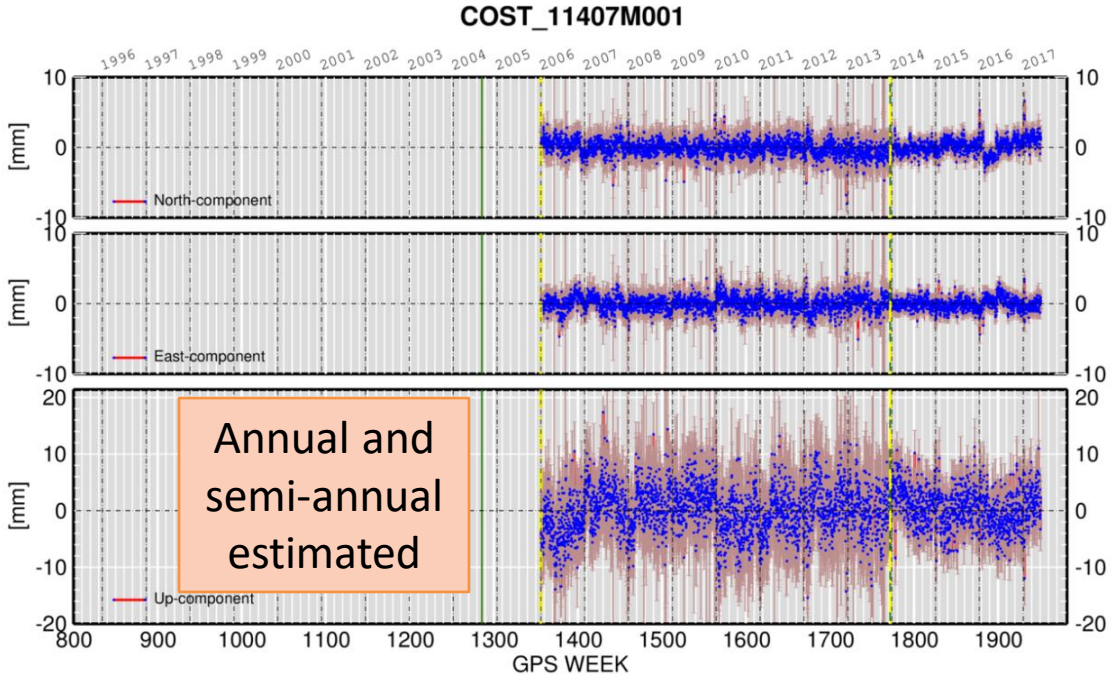

TUBI_20806M001
North-component
East-component
Up-component
[mm]
GPS WEEK

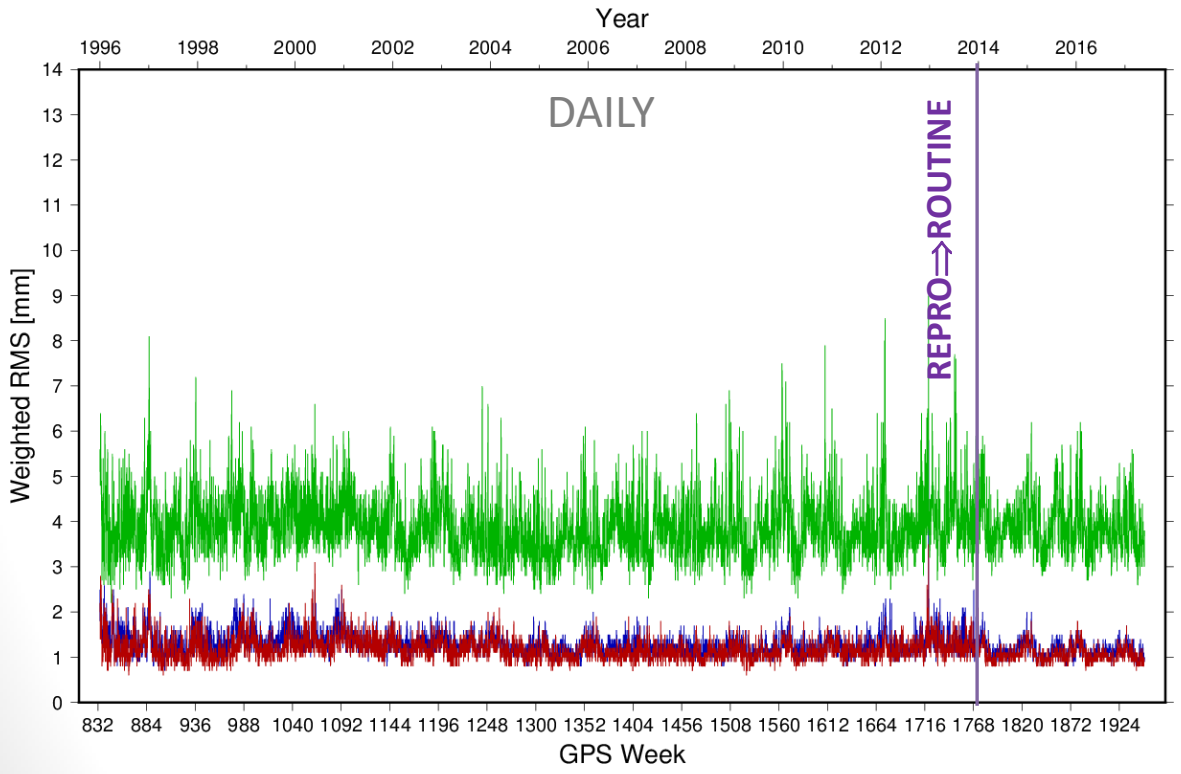

COST_11407M001
North-component
East-component
Up-component
[mm]
GPS WEEK

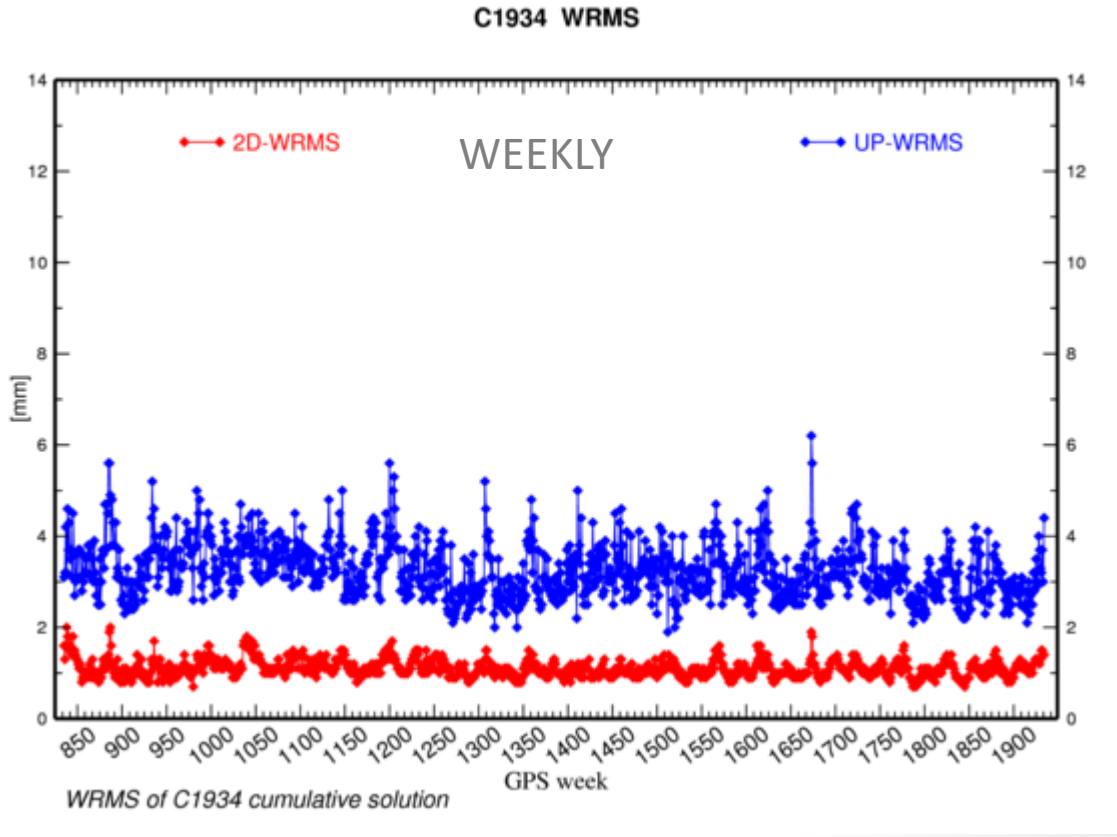

TUBI_20806M001
North-component
East-component
Up-component
[mm]
GPS WEEK
Post seismic deformation modelled


COST_11407M001
North-component
East-component
Up-component
[mm]
GPS WEEK
Annual and semi-annual estimated

TEST

Weighted RMS: comparison wrt C1934





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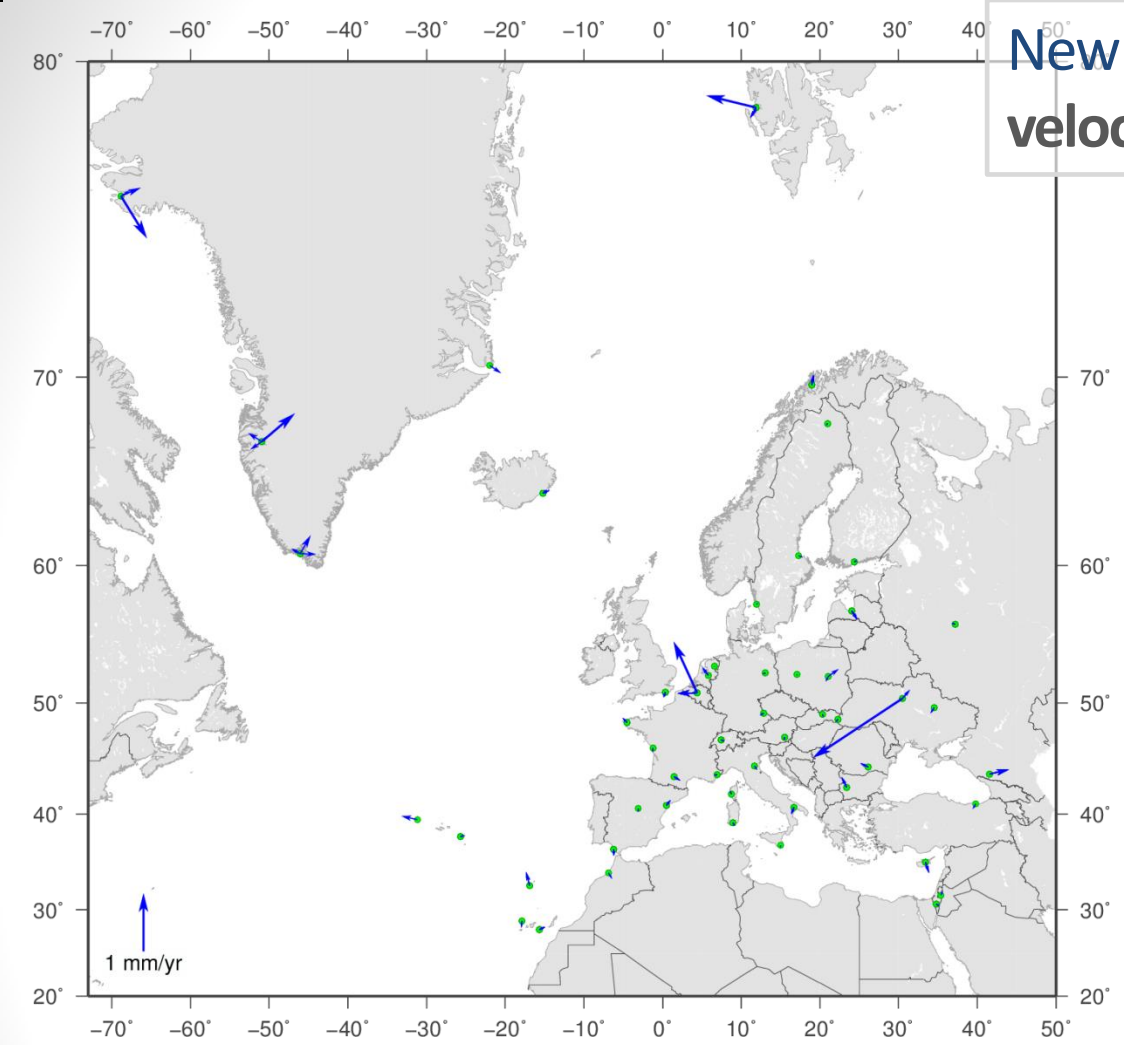
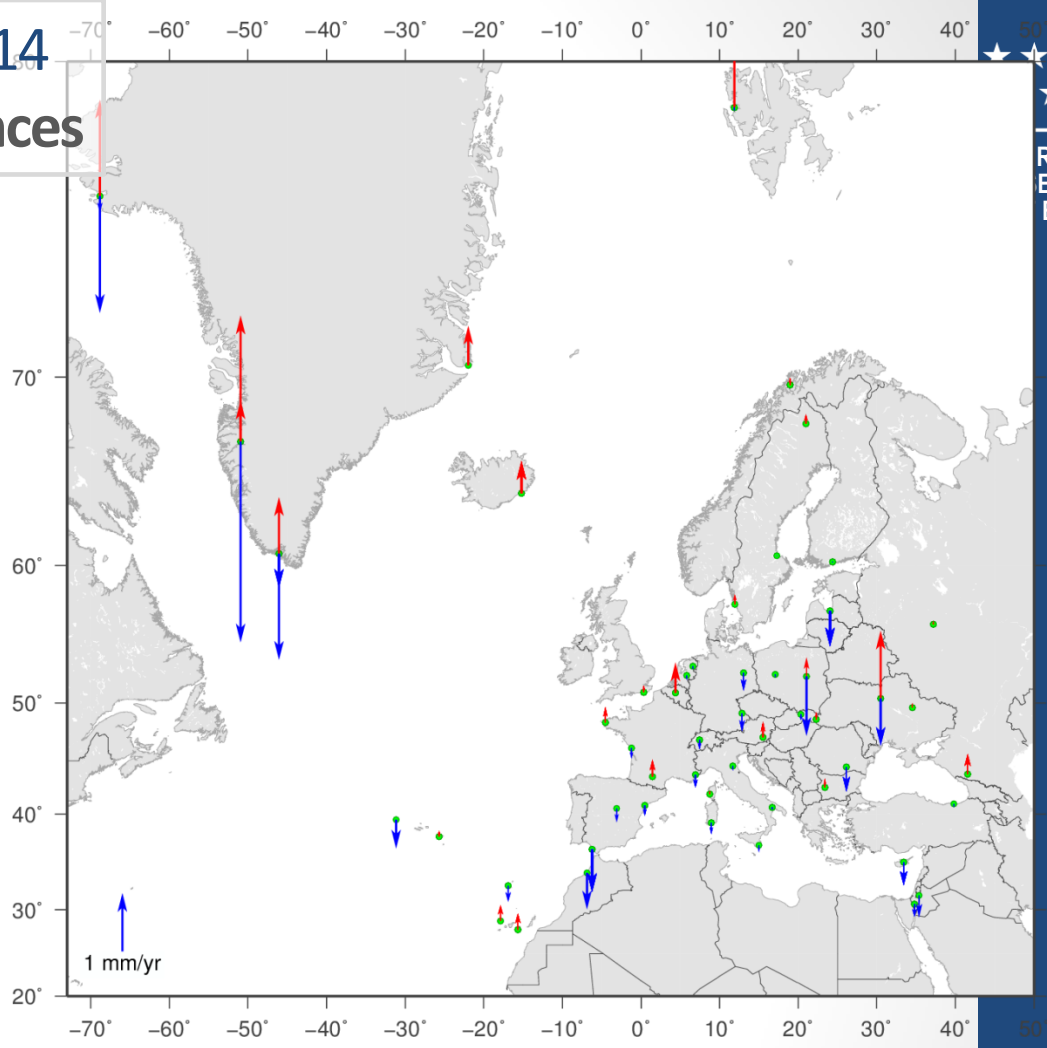
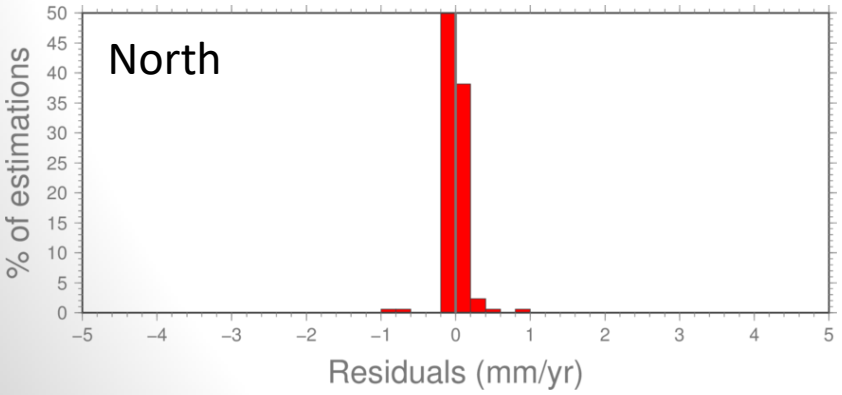
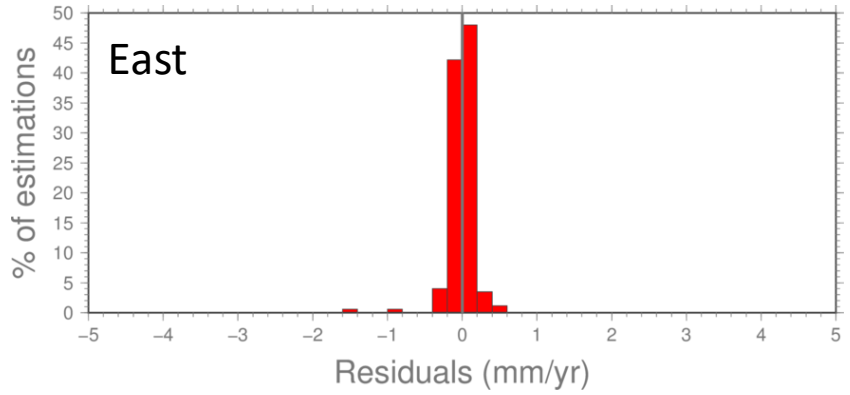
Comparison with IGS14 and C1934 solutions

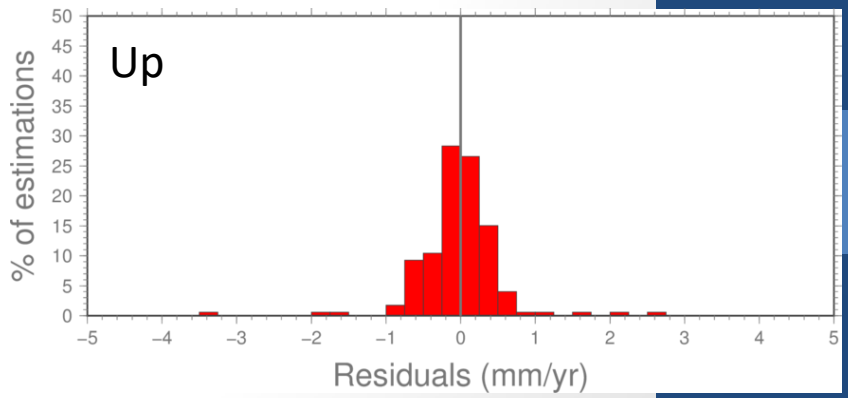
New EPN vs IGS14 velocity differences











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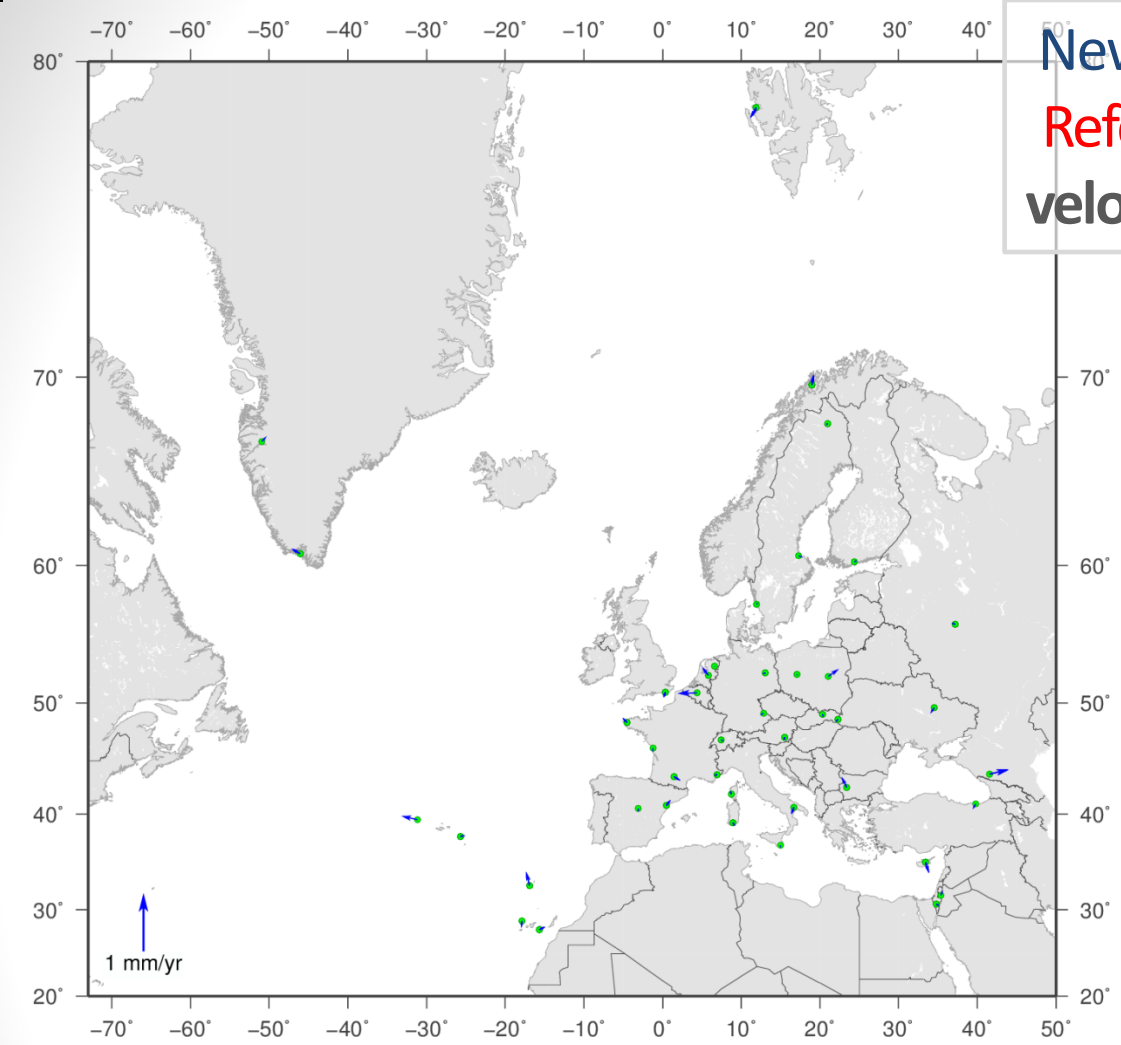
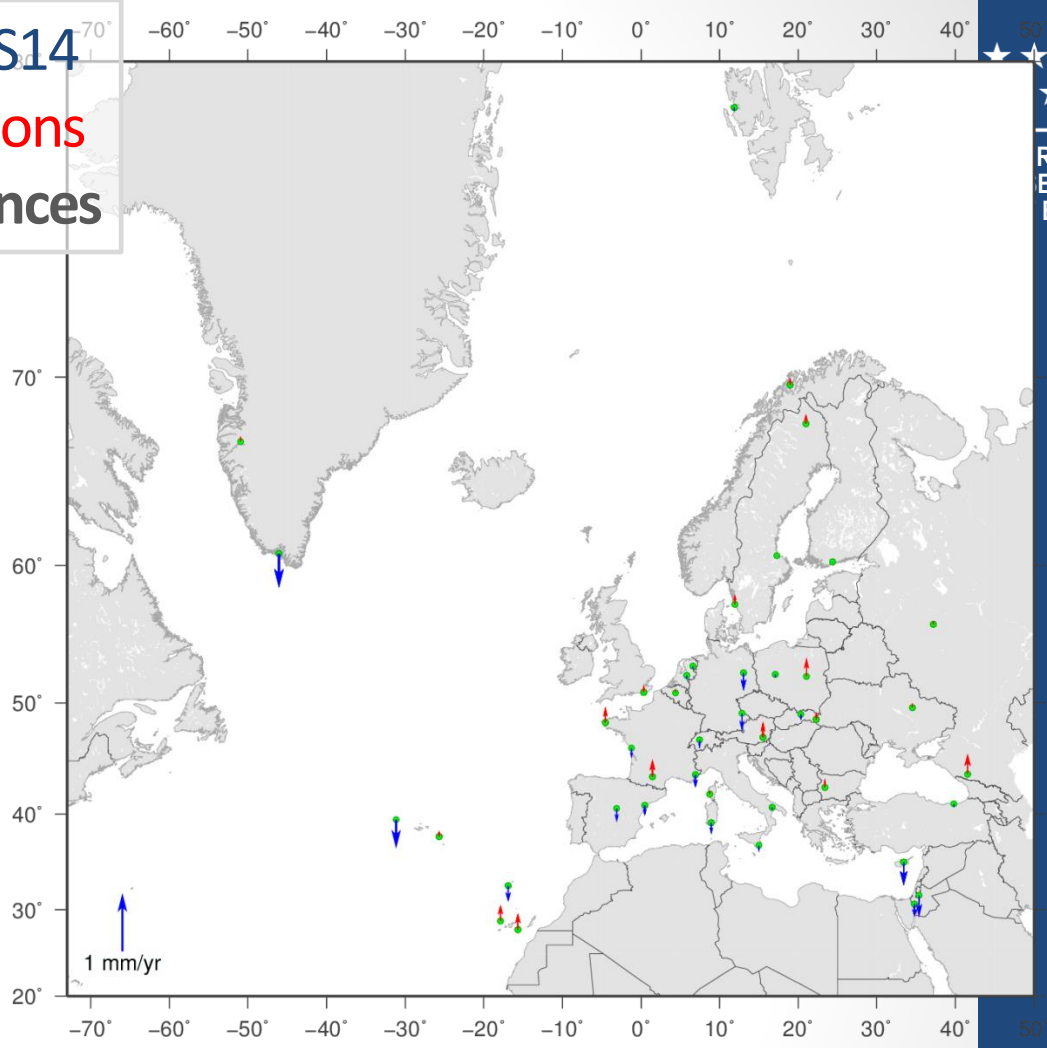
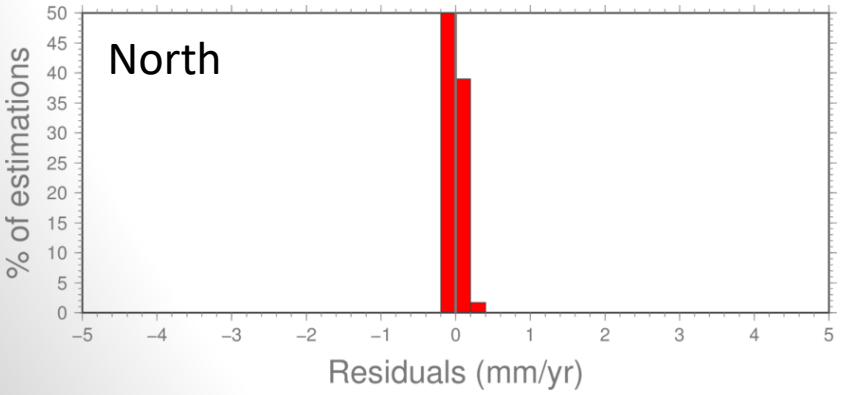
New EPN vs IGS14

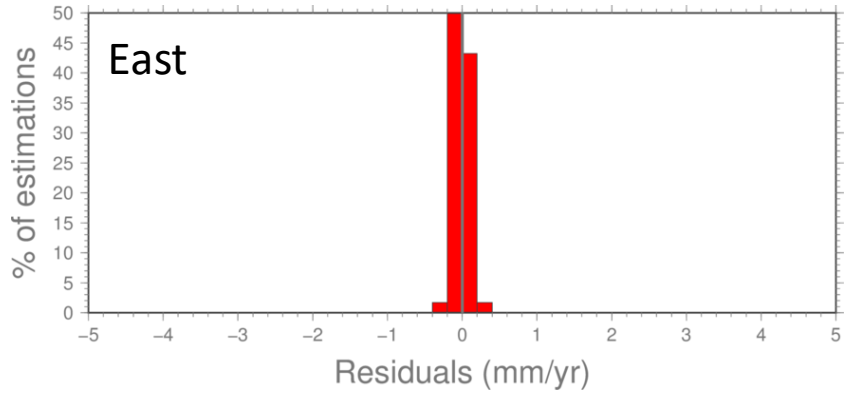
Reference stations

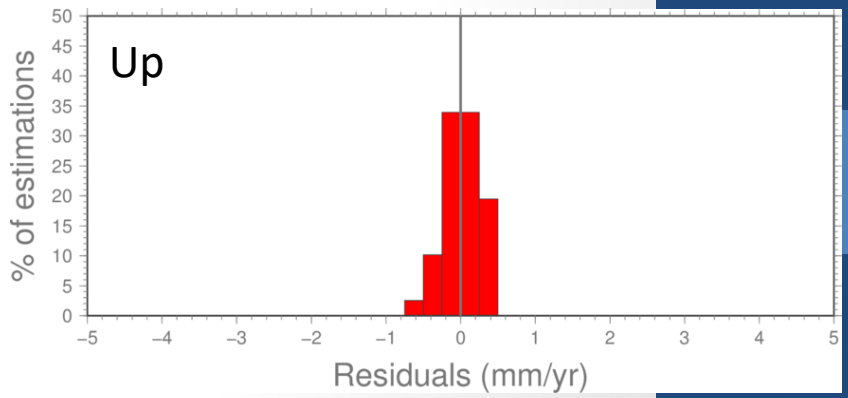
velocity differences











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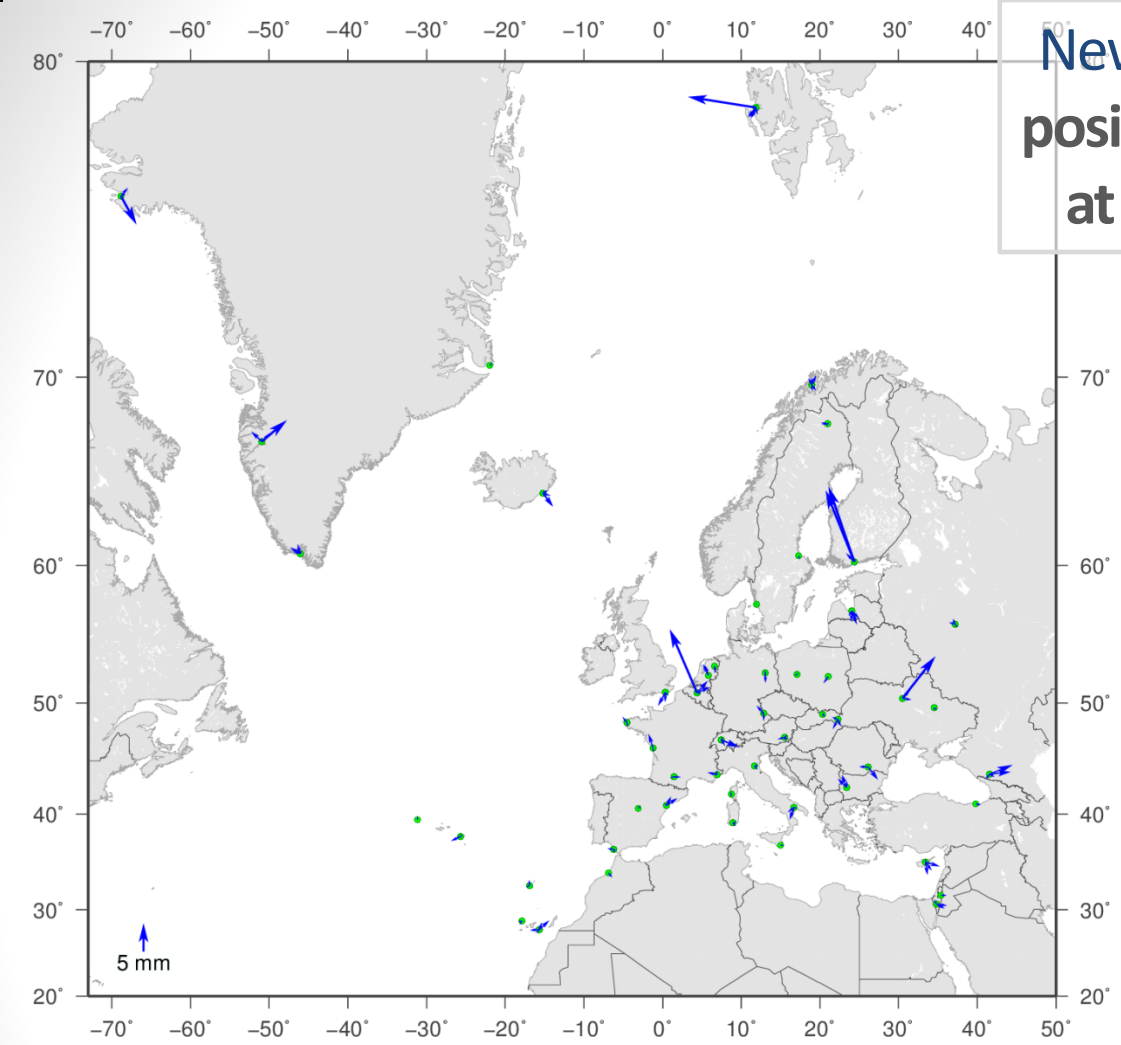
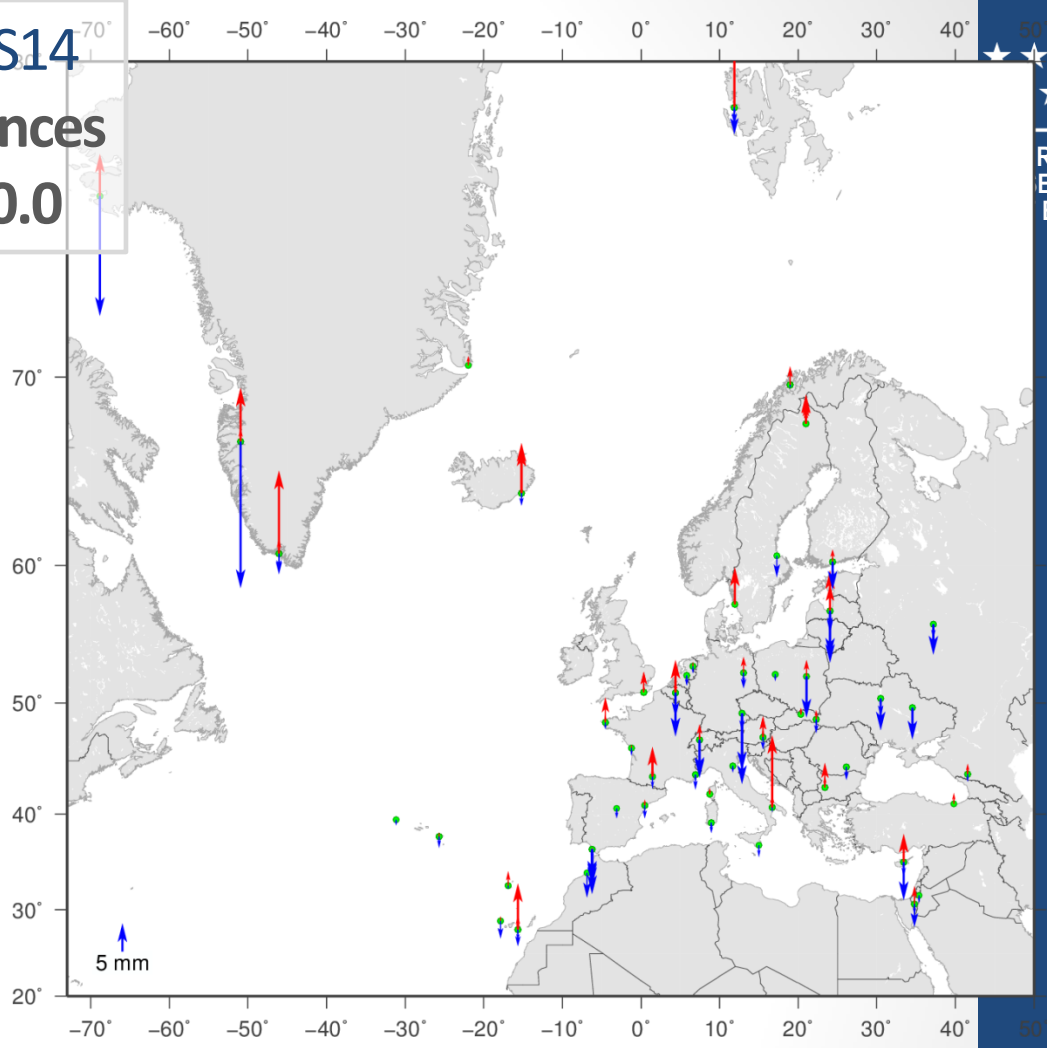
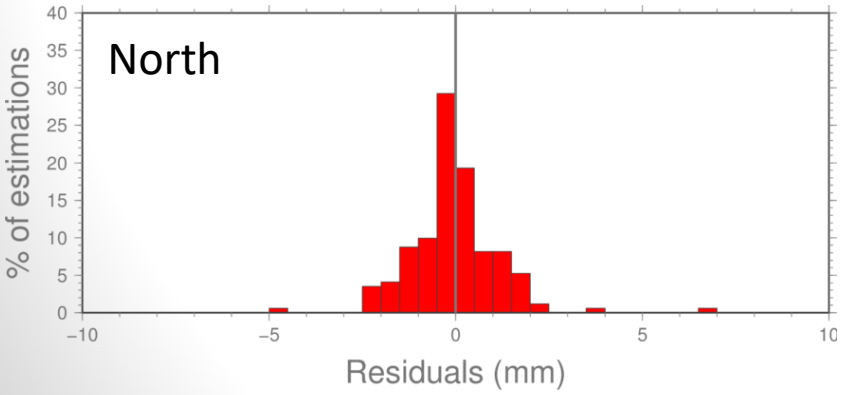
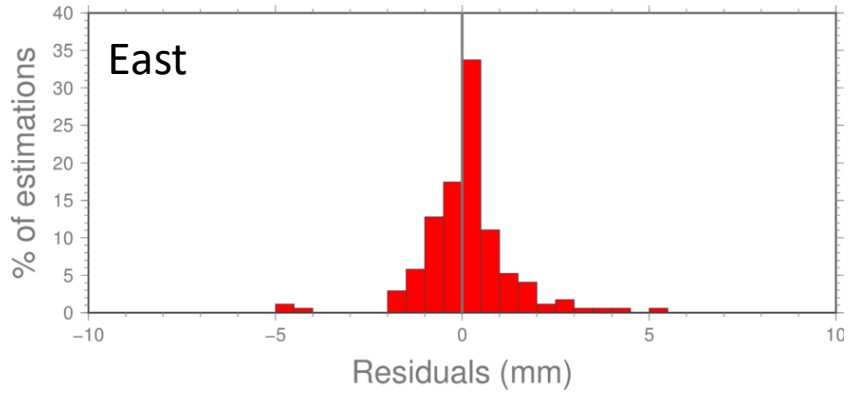
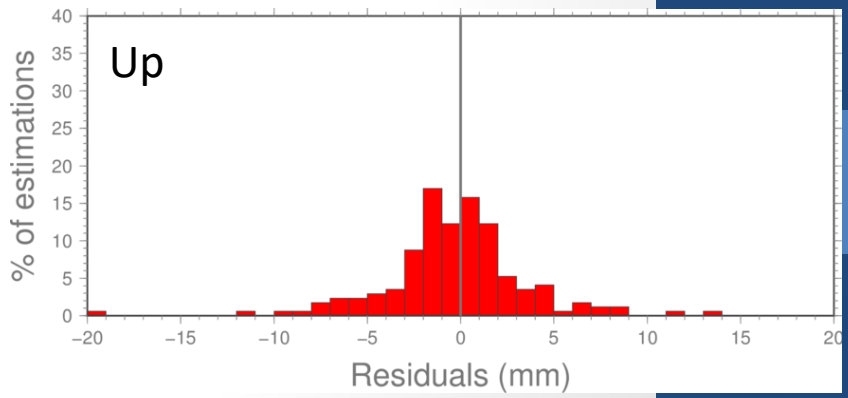
New EPN vs IGS14 position differences at epoch 2010.0











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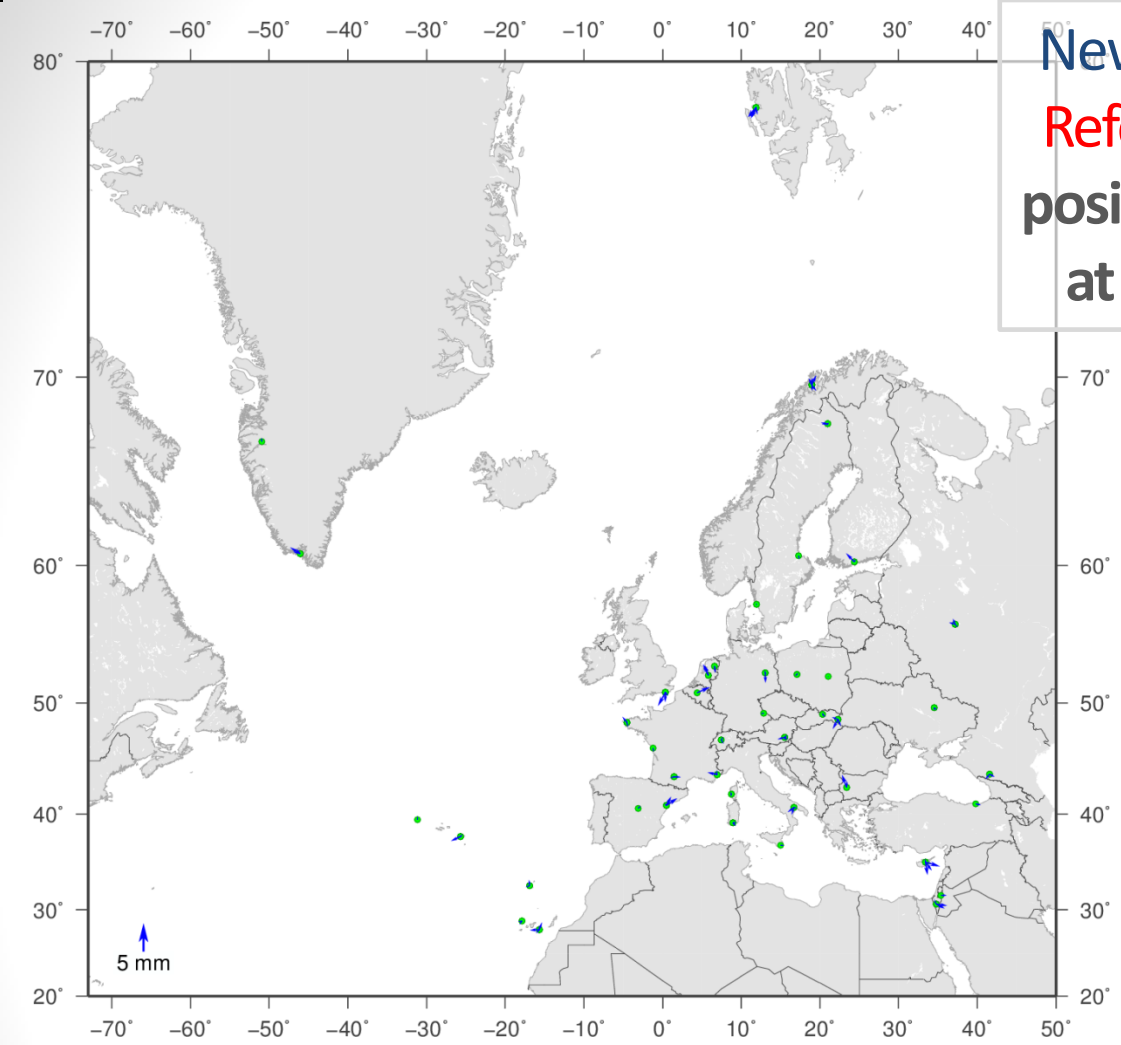
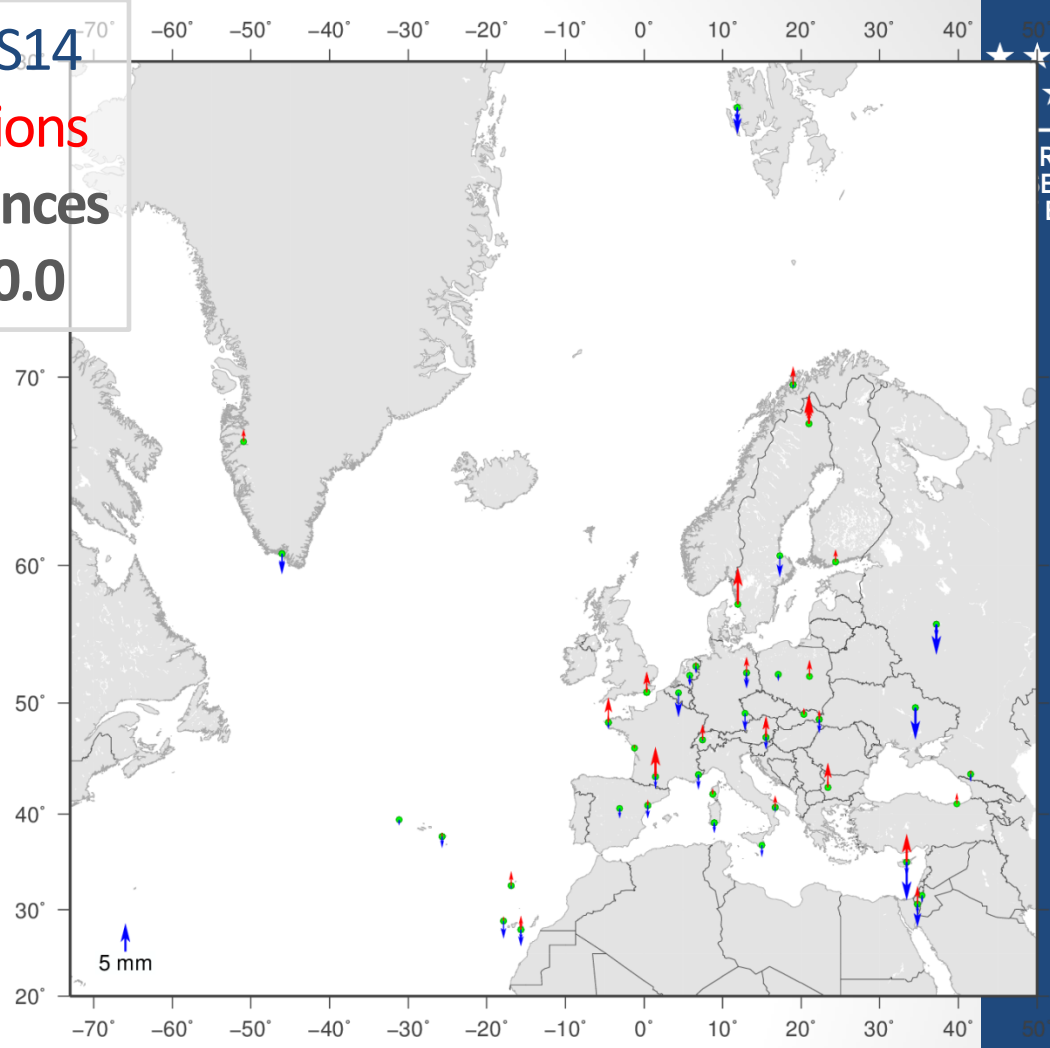
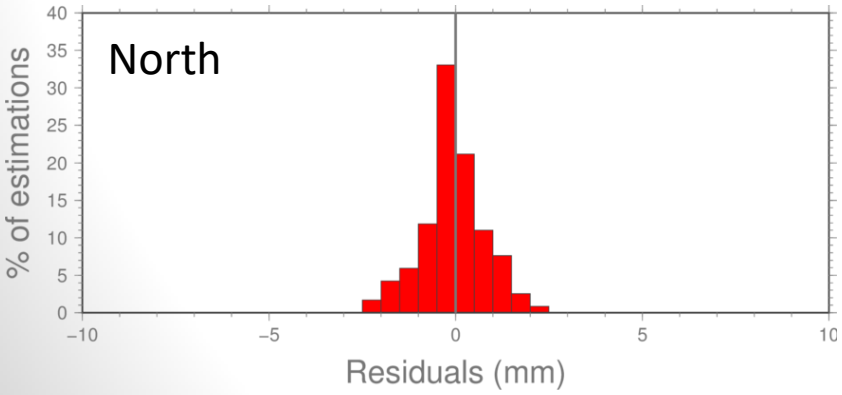
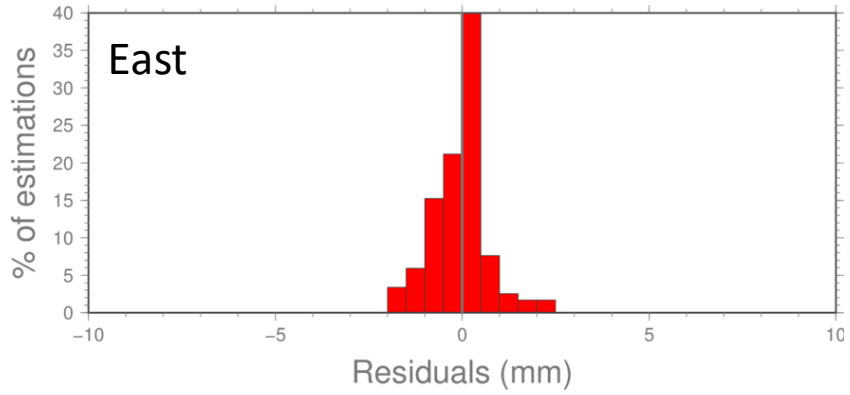
New EPN vs IGS14

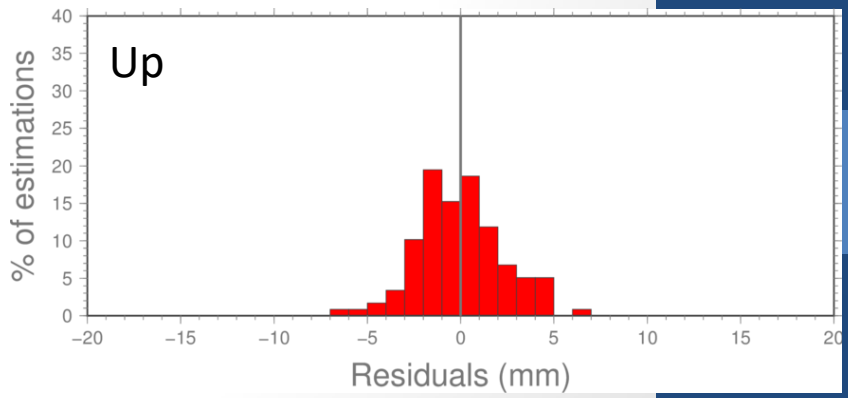
Reference stations position differences at epoch 2010.0







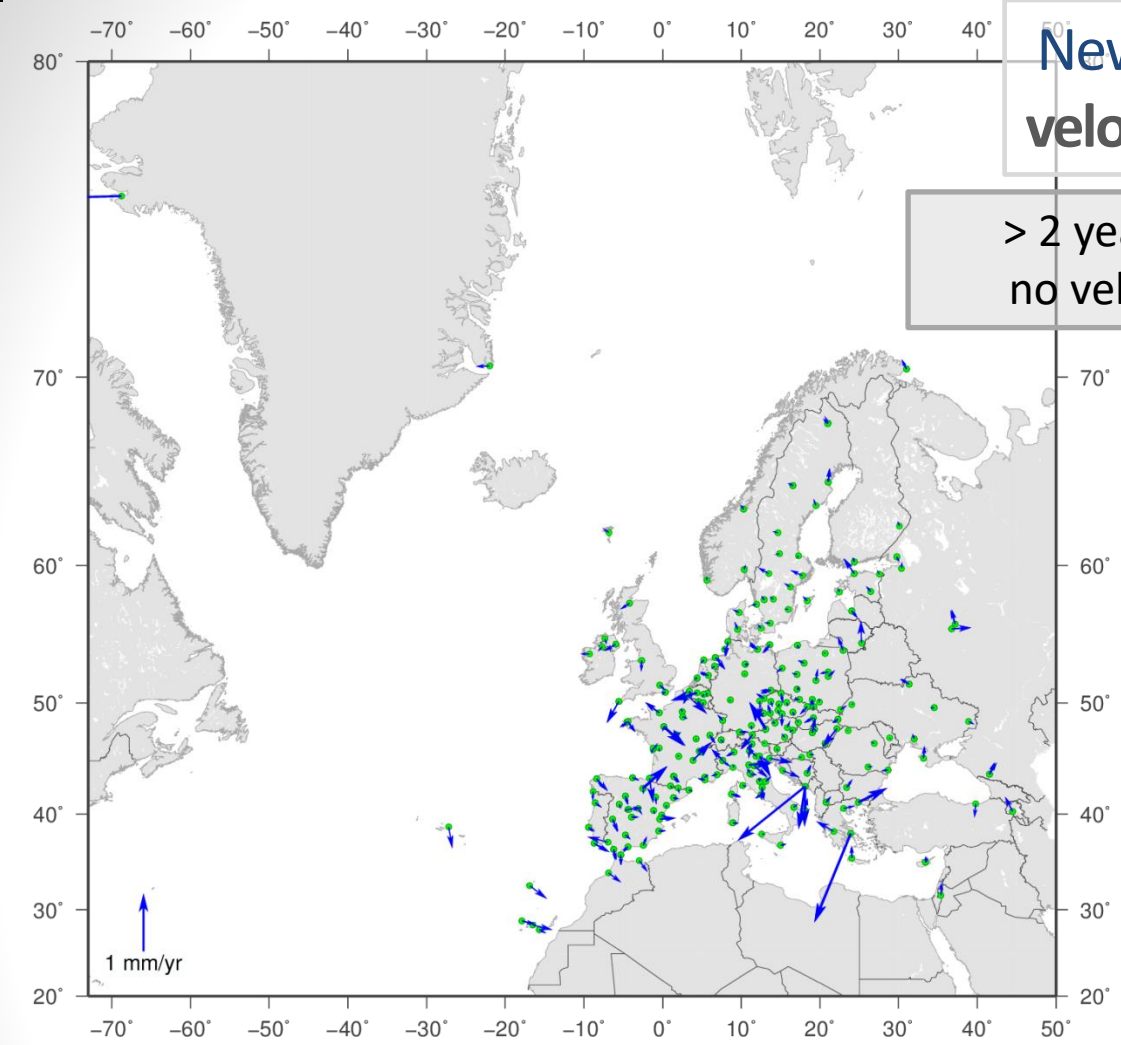


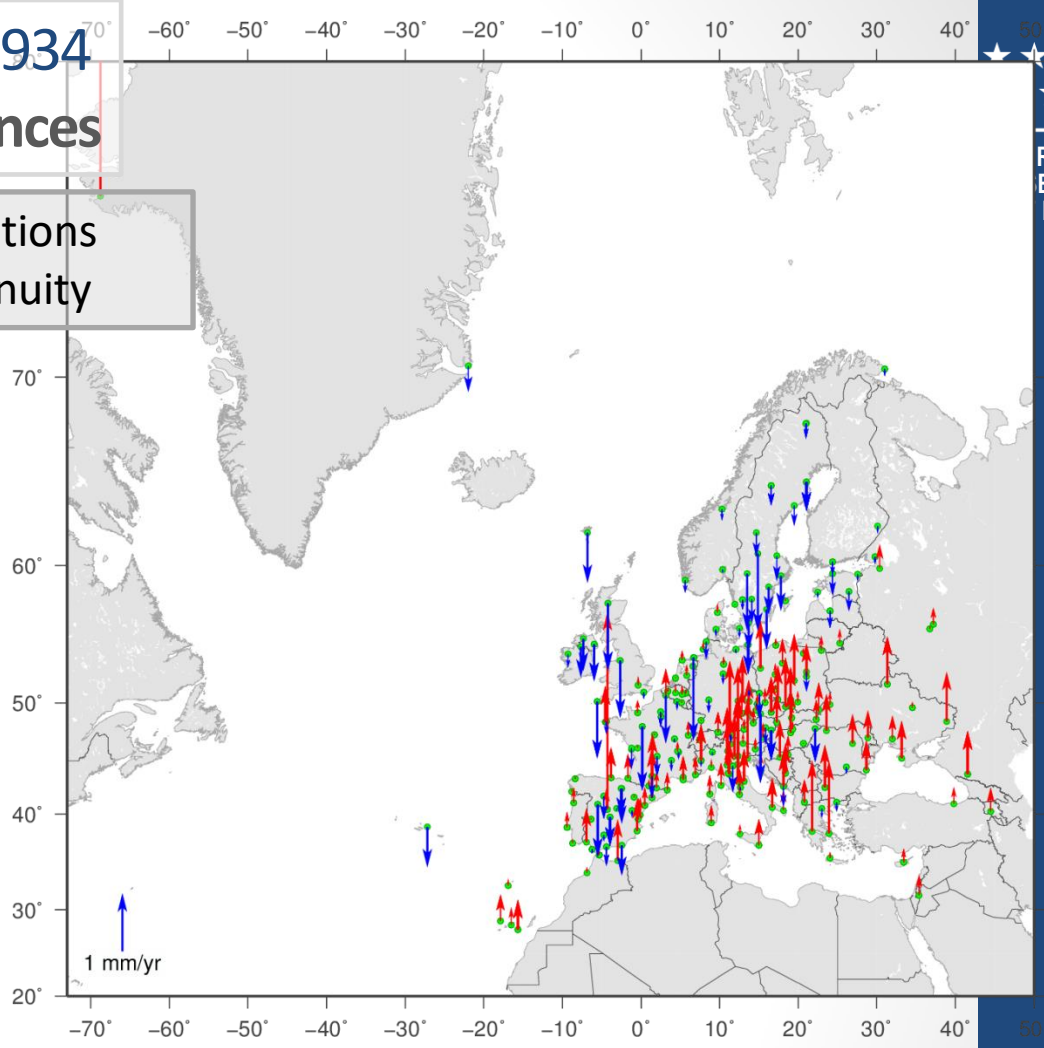


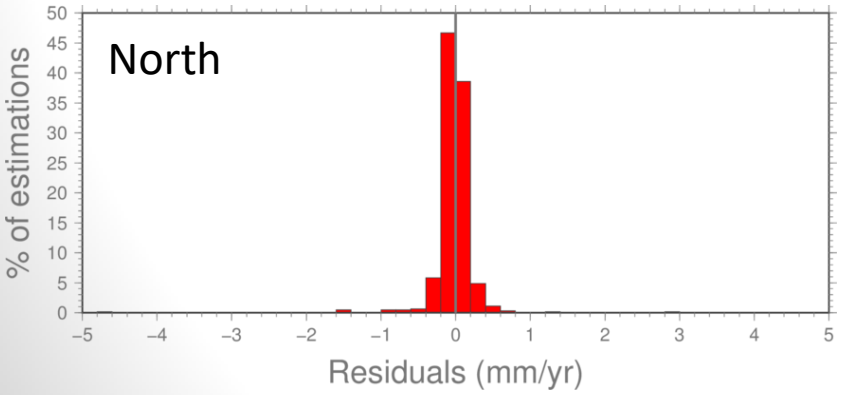
ROYAL OBSERVATORY BELGIUM

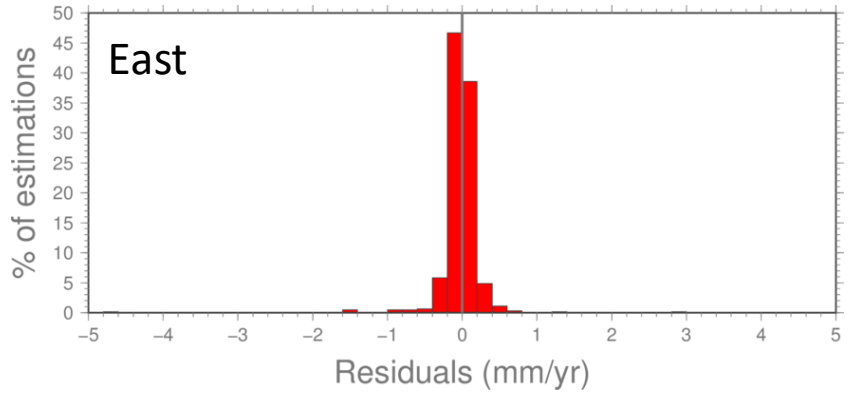
New EPN vs C1934 velocity differences

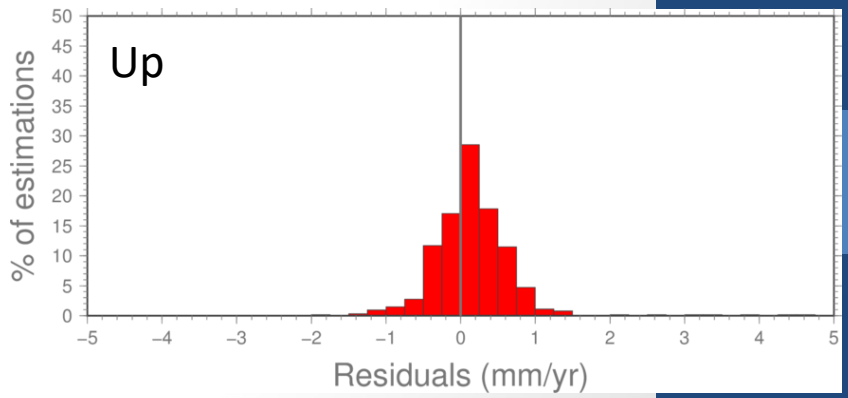
> 2 years of observations
> no velocity discontinuity











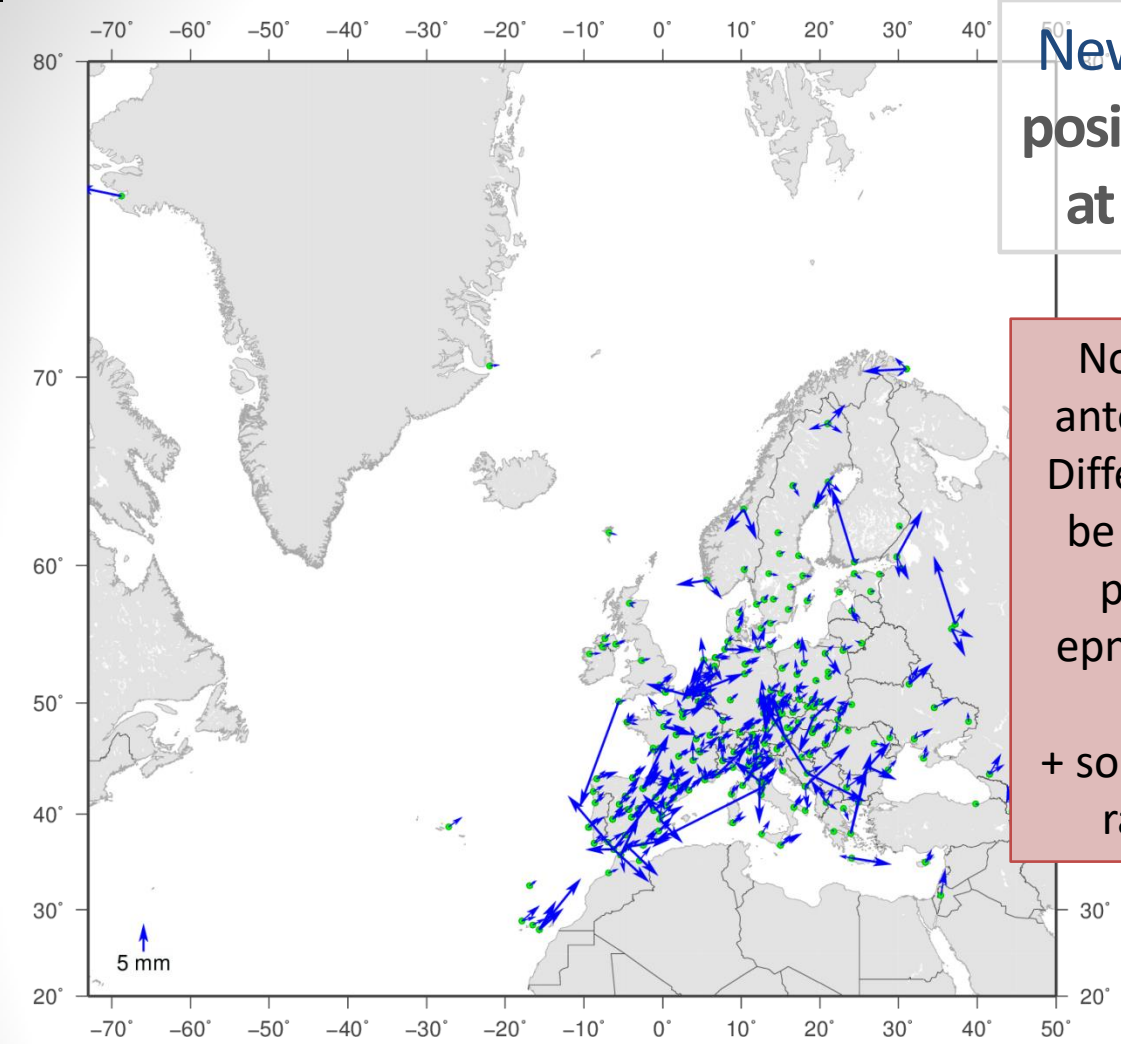
ROYAL OBSERVATORY BELGIUM

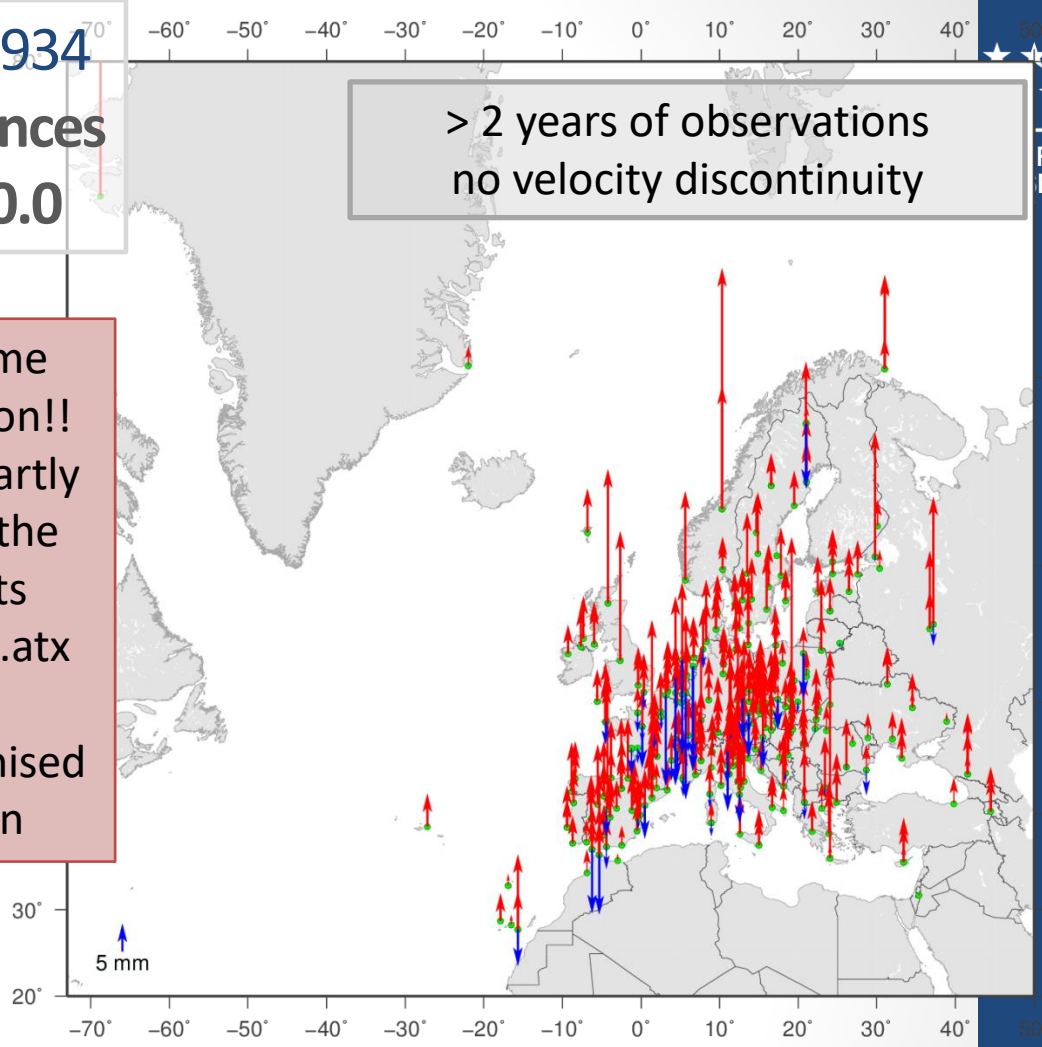
New EPN vs C1934 position differences at epoch 2010.0

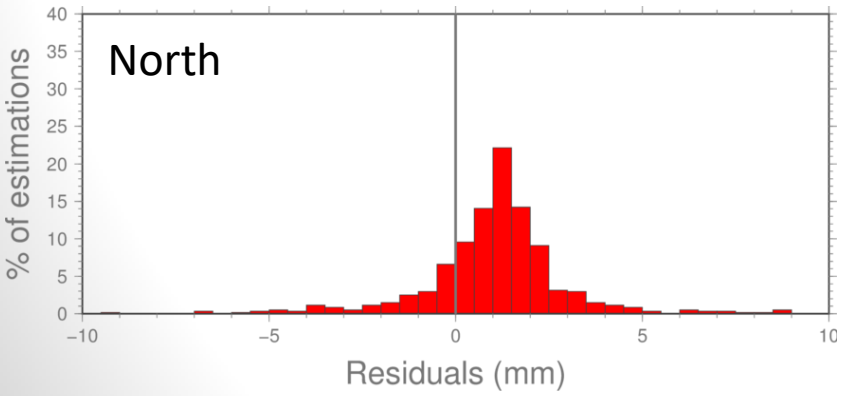
> 2 years of observations
> no velocity discontinuity

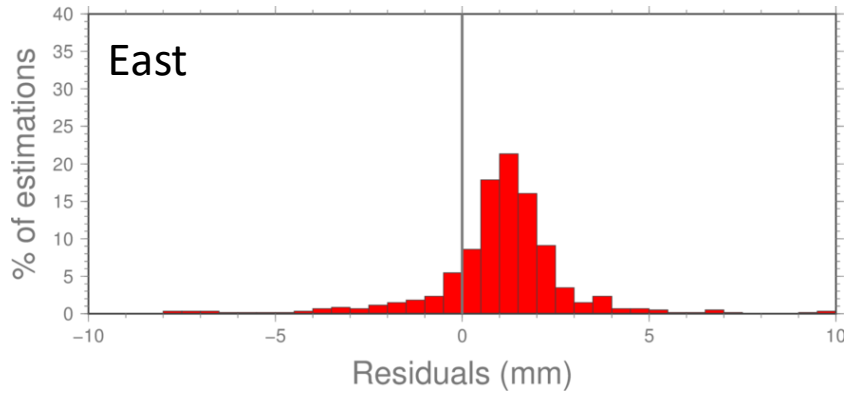
Not with the same antenna calibration!! Differences can partly be explained by the positions offsets epn08.atx/epn14.atx

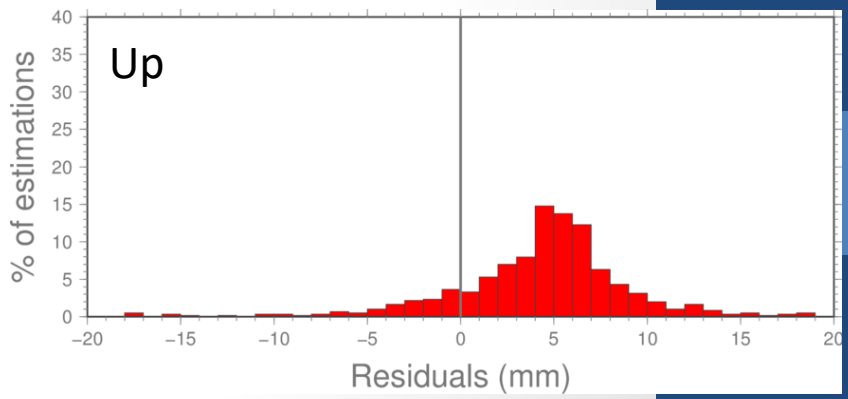
+ soln not harmonised raw comparison











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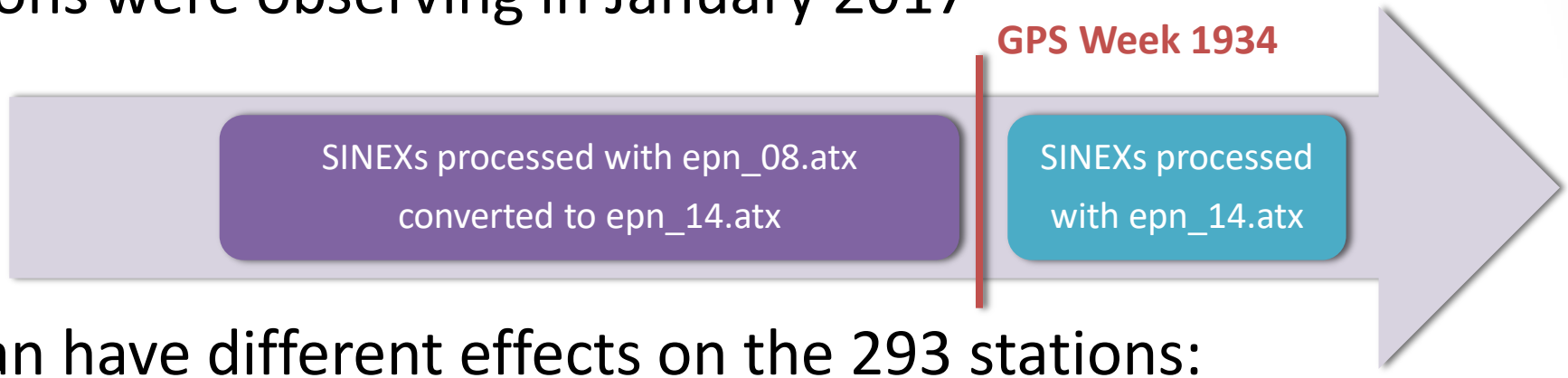
Impact of the switch from epn_08.atx to epn_14.atx

ROYAL OBSERVATORY OF BELGIUM

Impact of the switch from epn_08.atx to epn_14.atx at day 029/2017

293 stations were observing in January 2017

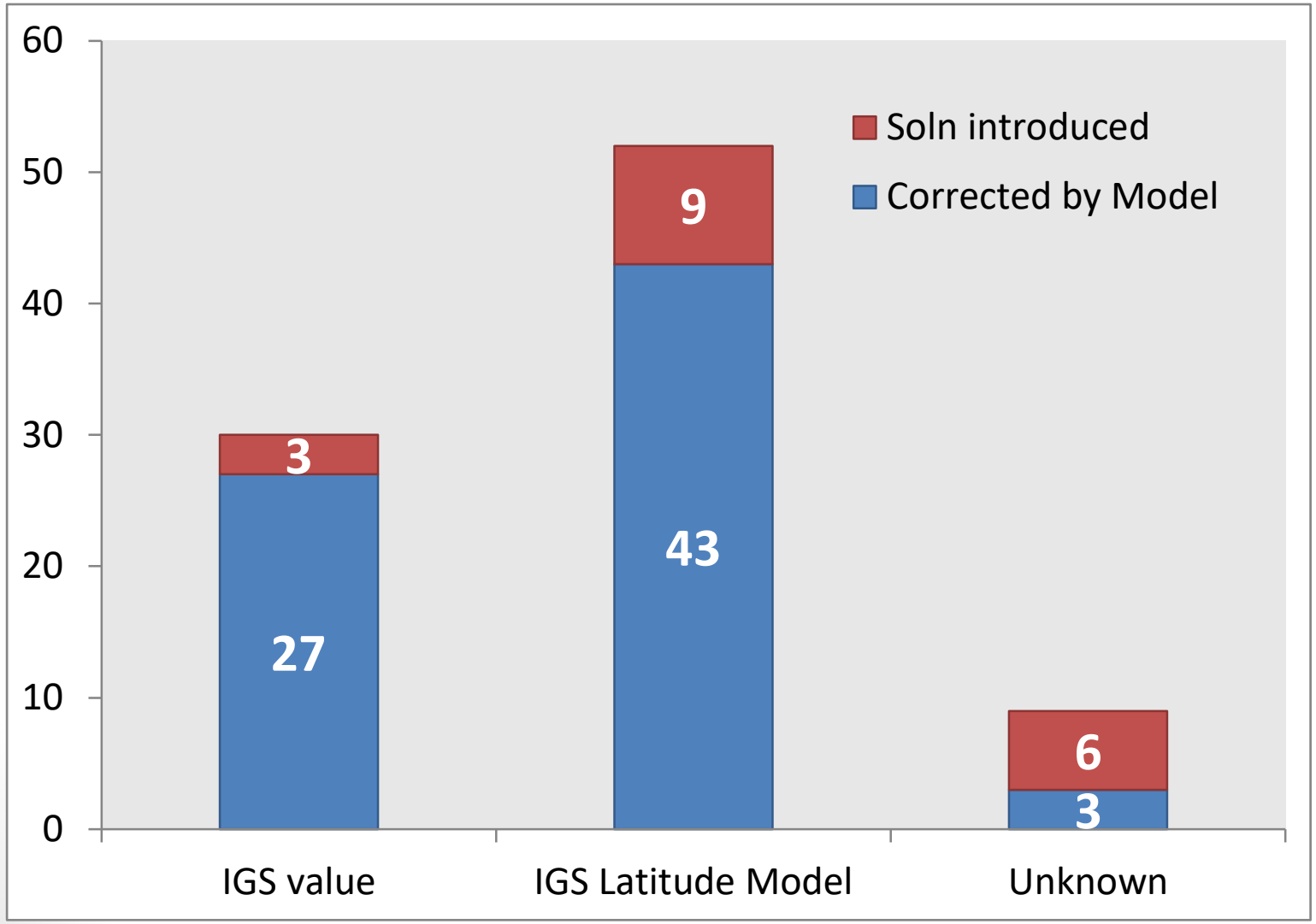


Switch can have different effects on the 293 stations:

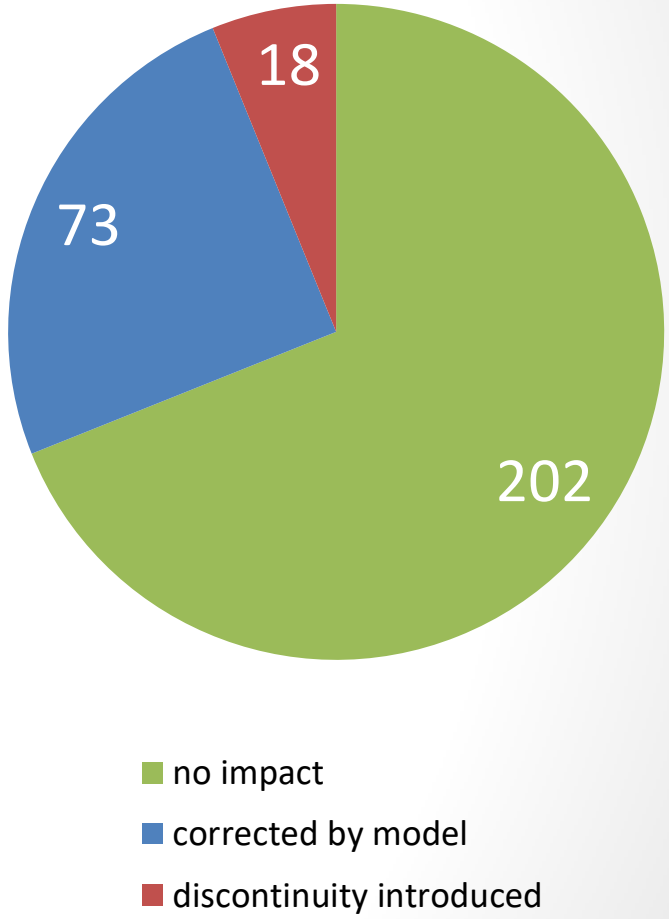
- the antenna model has not changed => No impact (202 stations)
- the antenna model has changed
  - we have a value for the position offset:
    - estimated by the IGS for the station/antenna (30 stations)
    - modelled with the IGS latitude dependent model (52 stations)
  - we don't have any value to model the discontinuity (9 stations)

ROYAL OBSERVATORY OF BELGIUM

Impact of the switch from epn_08.atx to epn_14.atx at day 029/2017



293 stations were observing in January 2017



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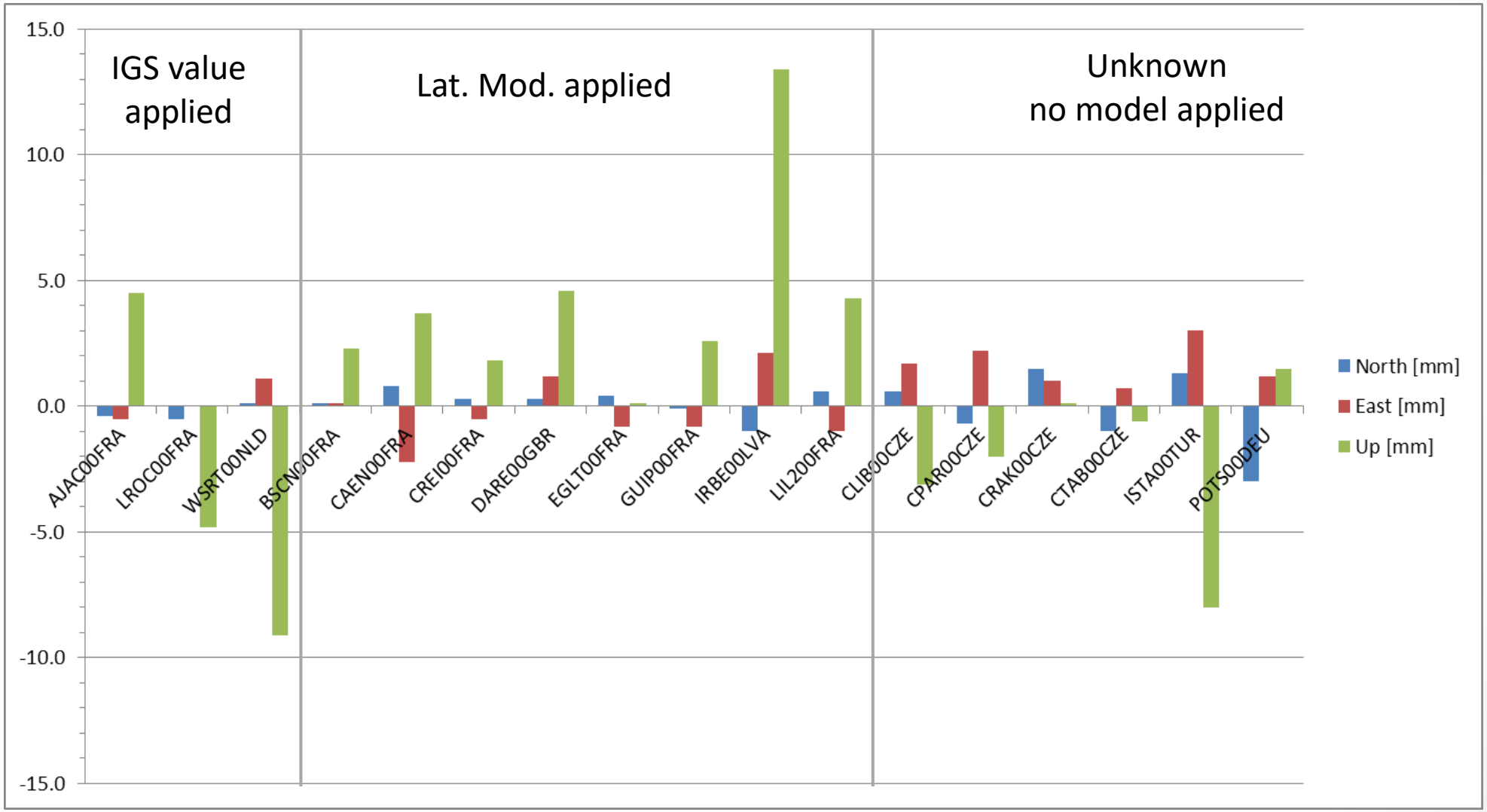
Position change at epn_08.atx to epn_14.atx switch



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Impact of the switch from EPN-repro2 to Routine

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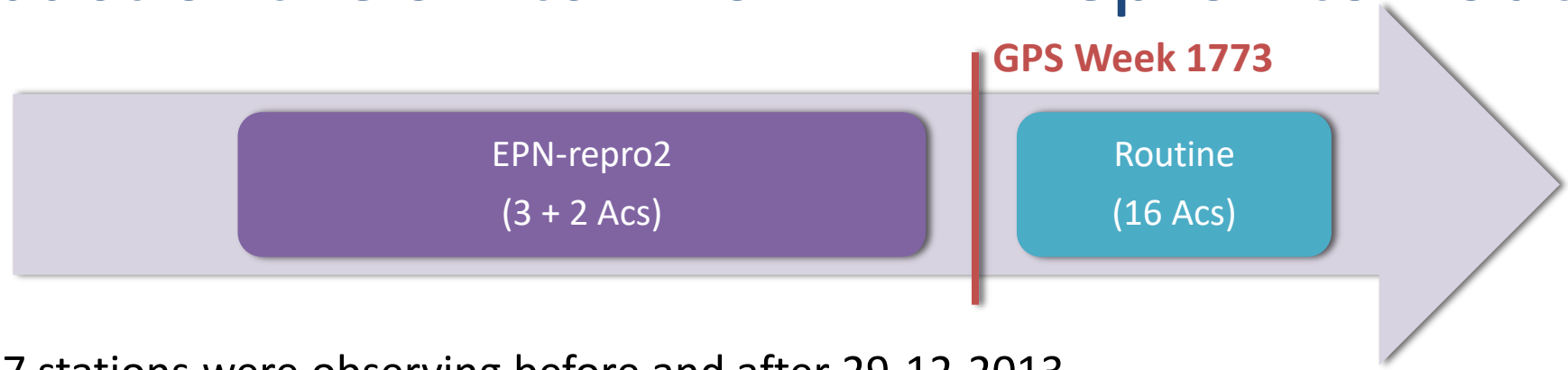
Impact of the switch from EPN-repro2 to Routine



- 257 stations were observing before and after 29-12-2013

- Different level of noise before and after the switch for some of the stations
- A jump clearly affects some stations
  - Introducing a discontinuity is not always the best option
  - 39 stations with a discontinuity introduced

- small offsets but unfortunately cannot be neglected

- Reference stations with discontinuity (BUCU00ROU, GLSV00UKR, KIRU00SWE, MAR600SWE, NYA100NOR, POTS00DEU, RABT00MAR)

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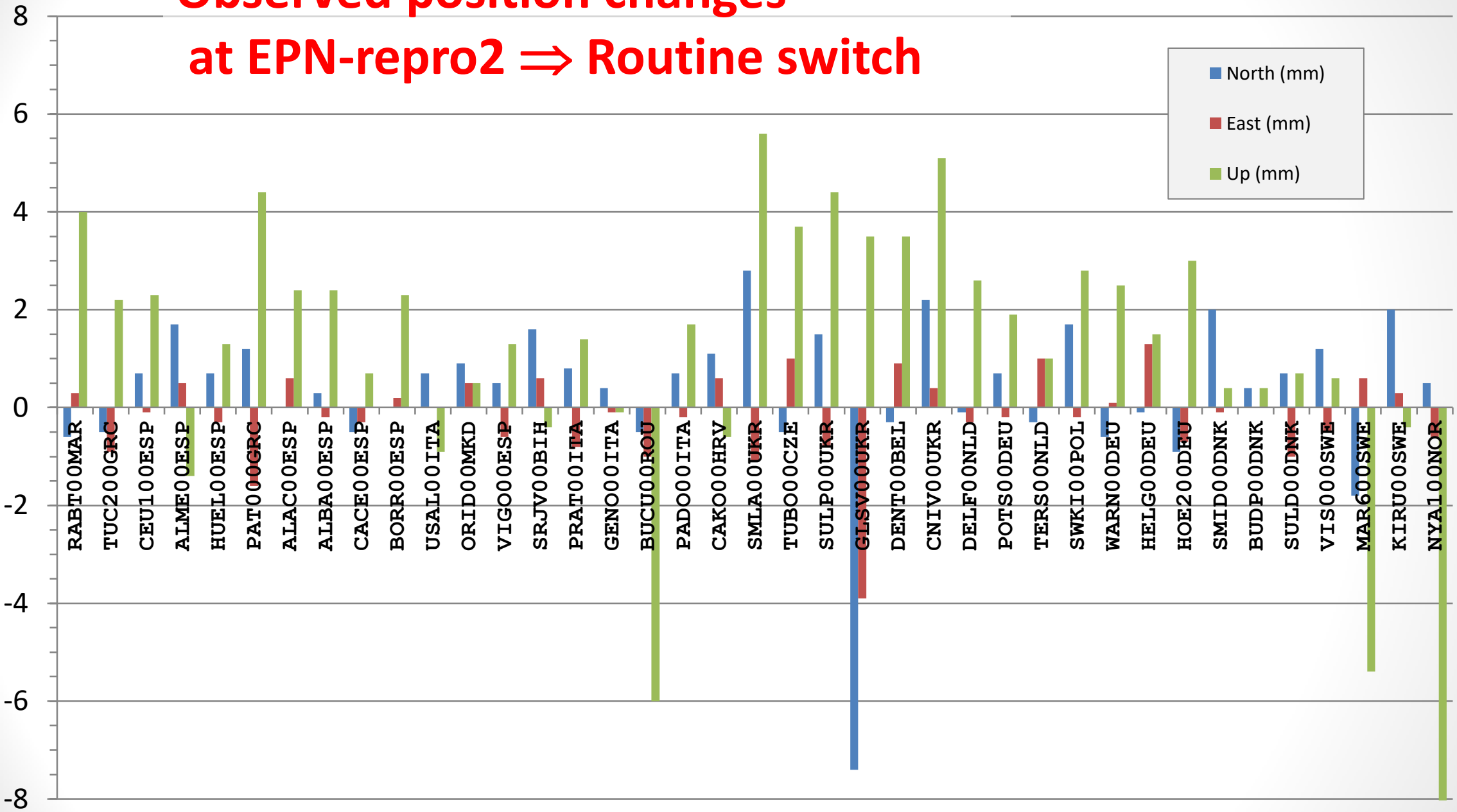
Observed position changes at EPN-repro2 ⇒ Routine switch



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Position and Velocity Discontinuities

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Position and Velocity discontinuities

- List revised
  - Former list, IGS14, IGS and ITRF2014 (for good stations) list used
  - quality checks have been used, de-trended time series with jumps have been checked, test with and without have been done (especially in case of disagreement)
  - 9 IGS14 stations with a different discontinuity (to be discussed with IGS)

- Several clear velocity changes are observed:
  - 20 stations – 9 are IGS14 (6 same, 3 different) (to be discussed with IGS)
  - Check and validate (tectonic, collocated/twin stations)

- Stations with non linear behaviour: to be investigated

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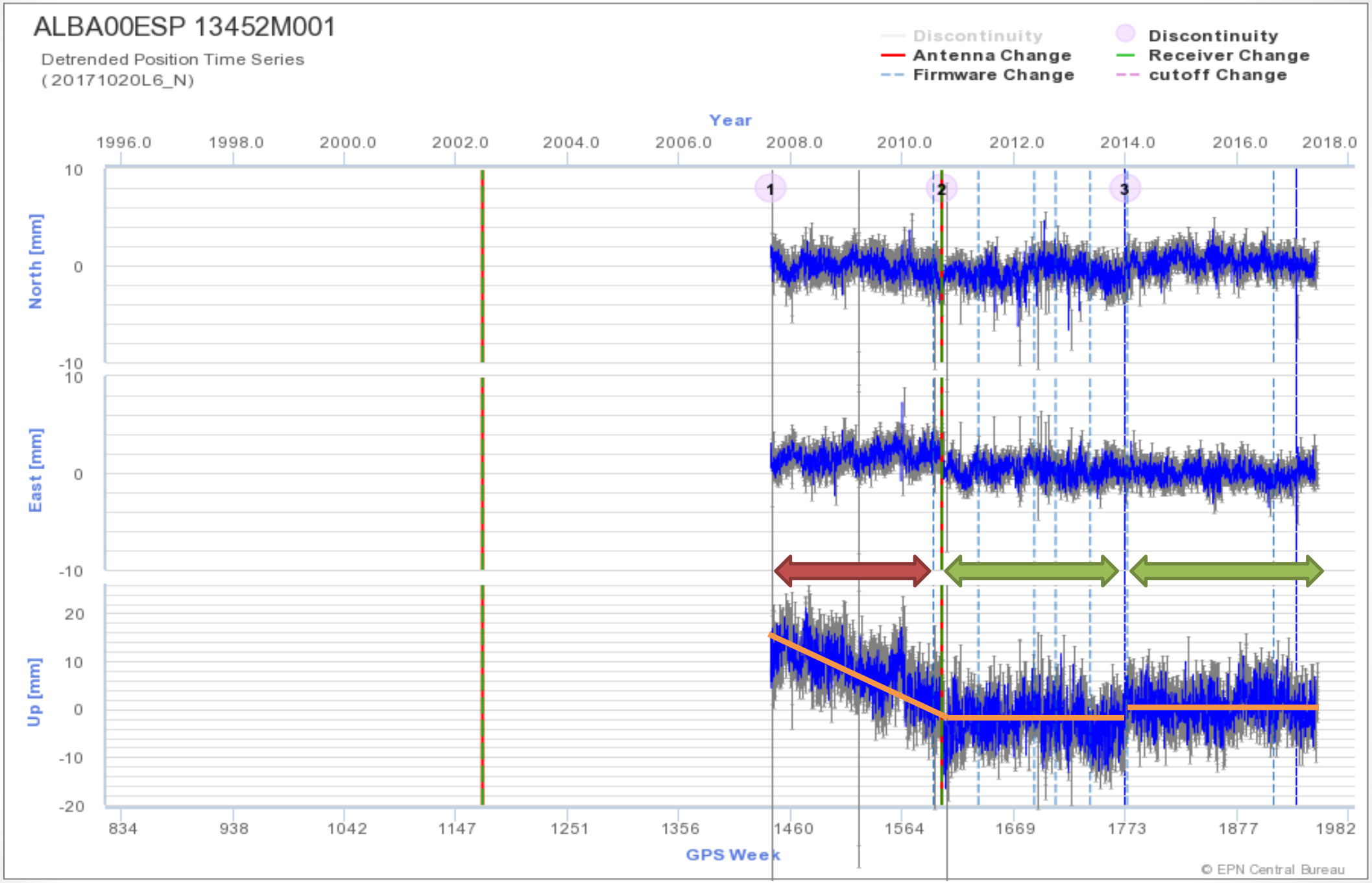

ROYAL OBSERVATORY OF BELGIUM

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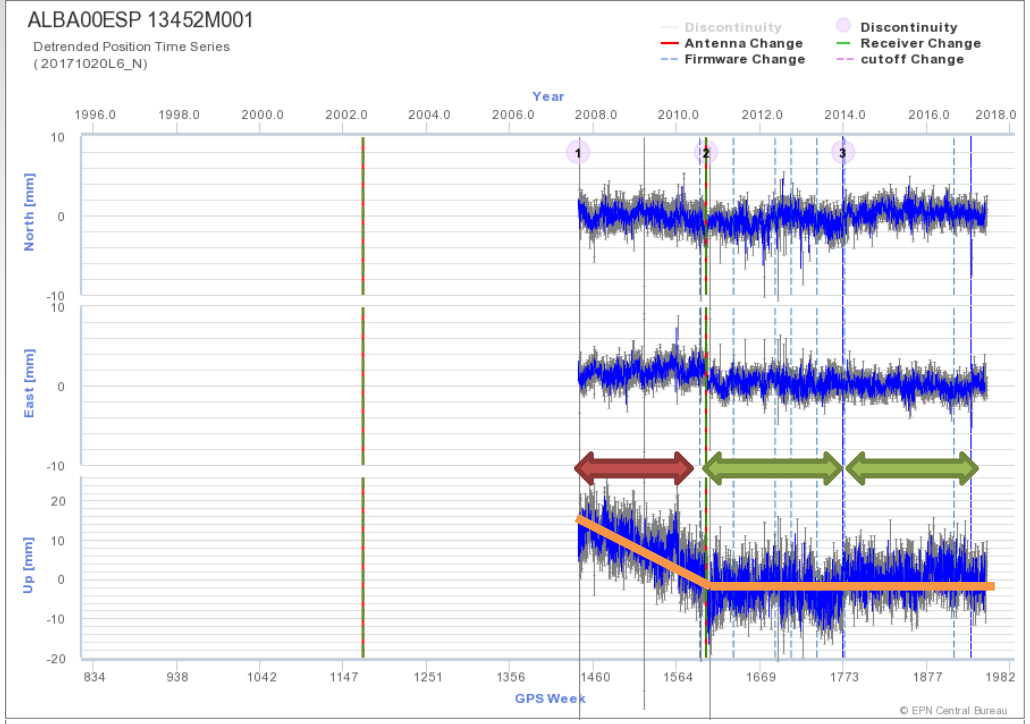

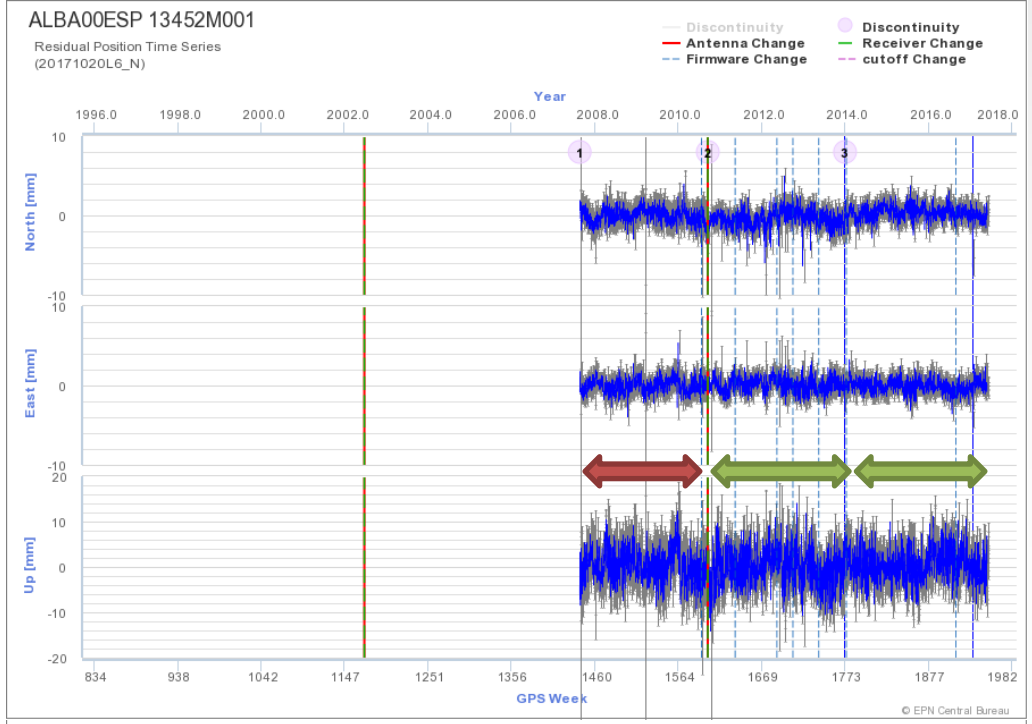

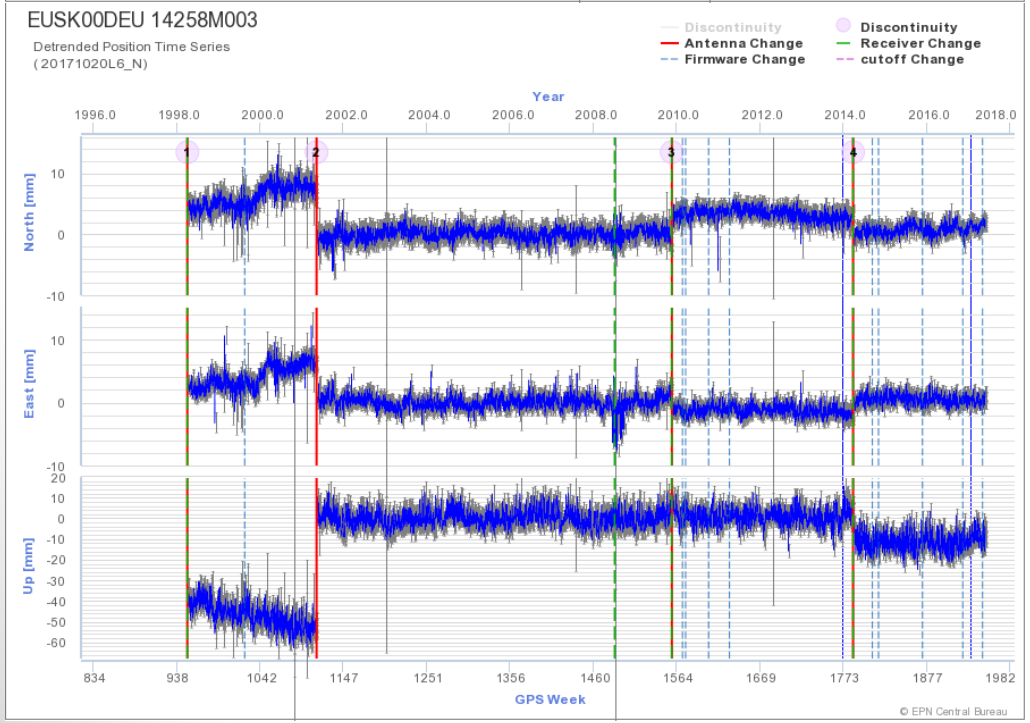

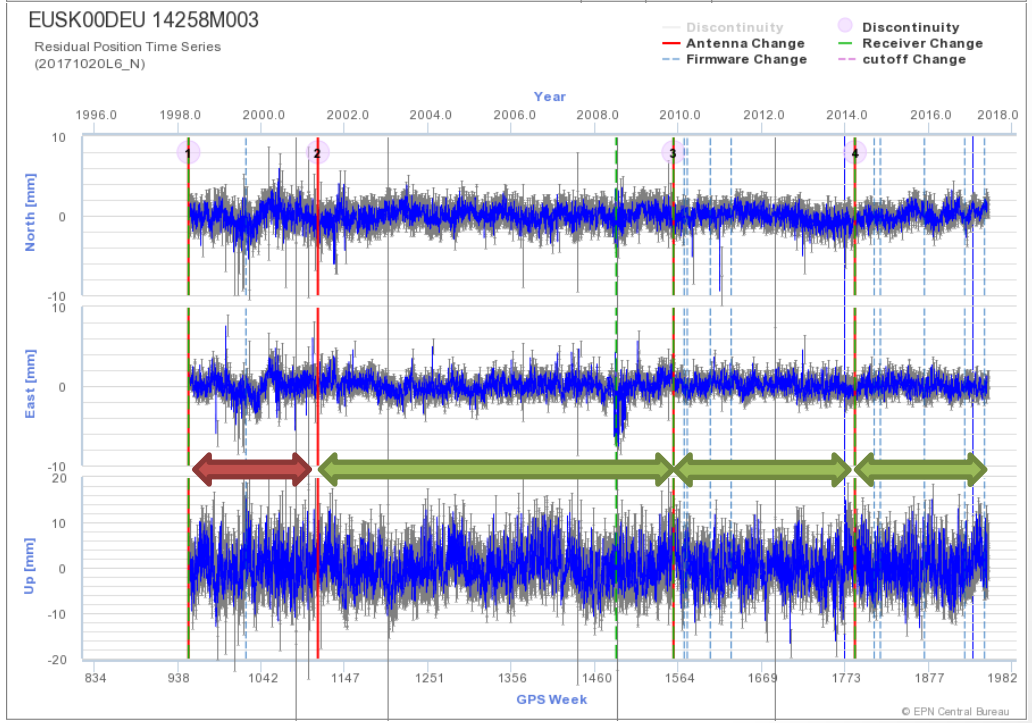

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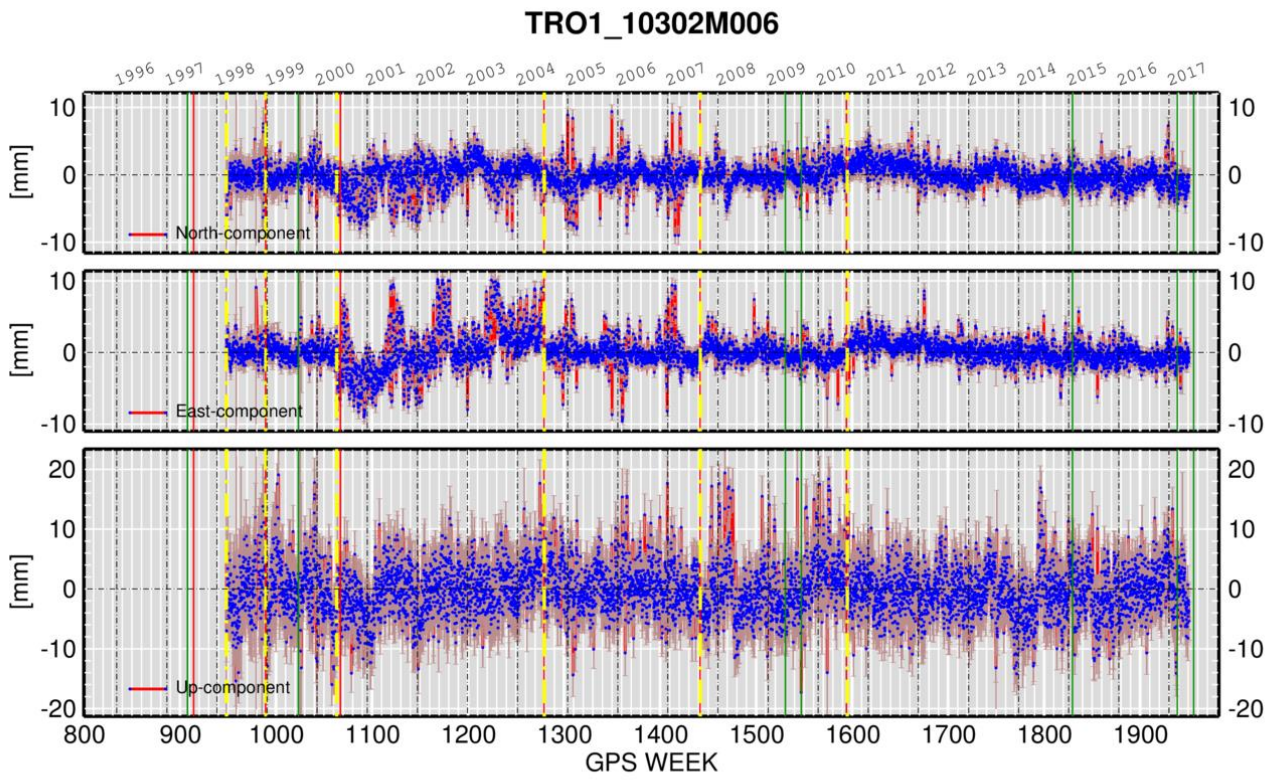
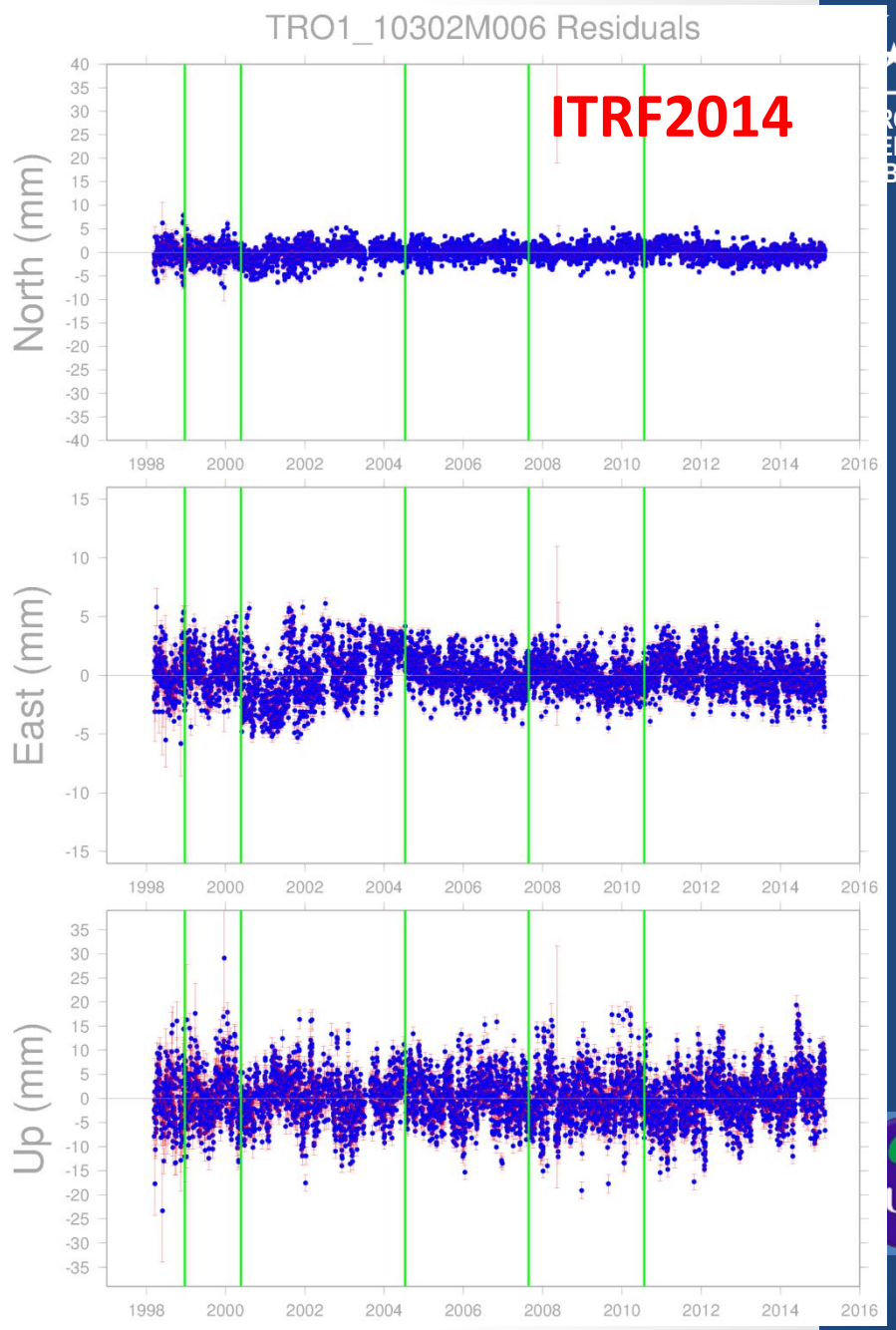
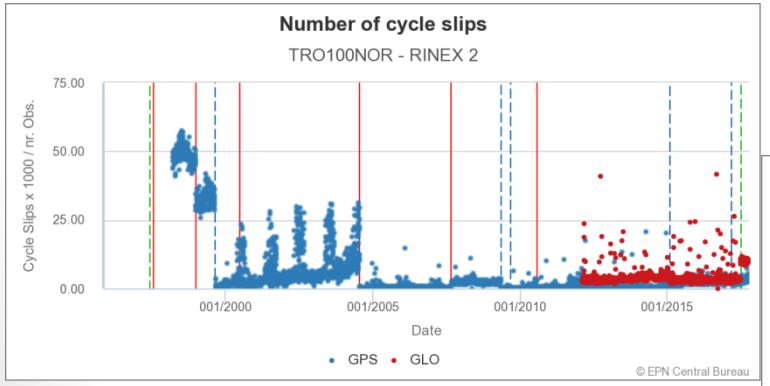
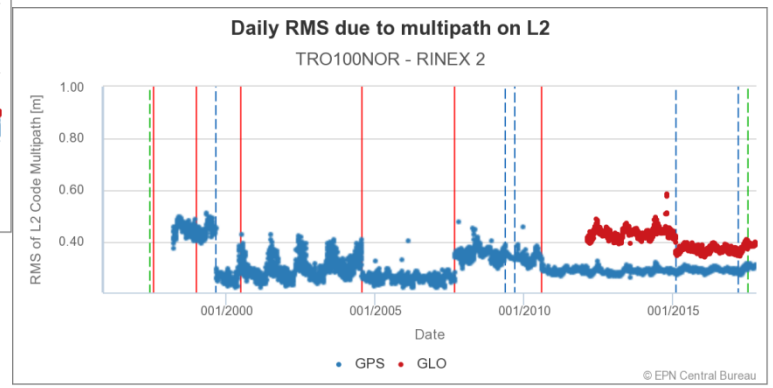
euref









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Velocity Fields

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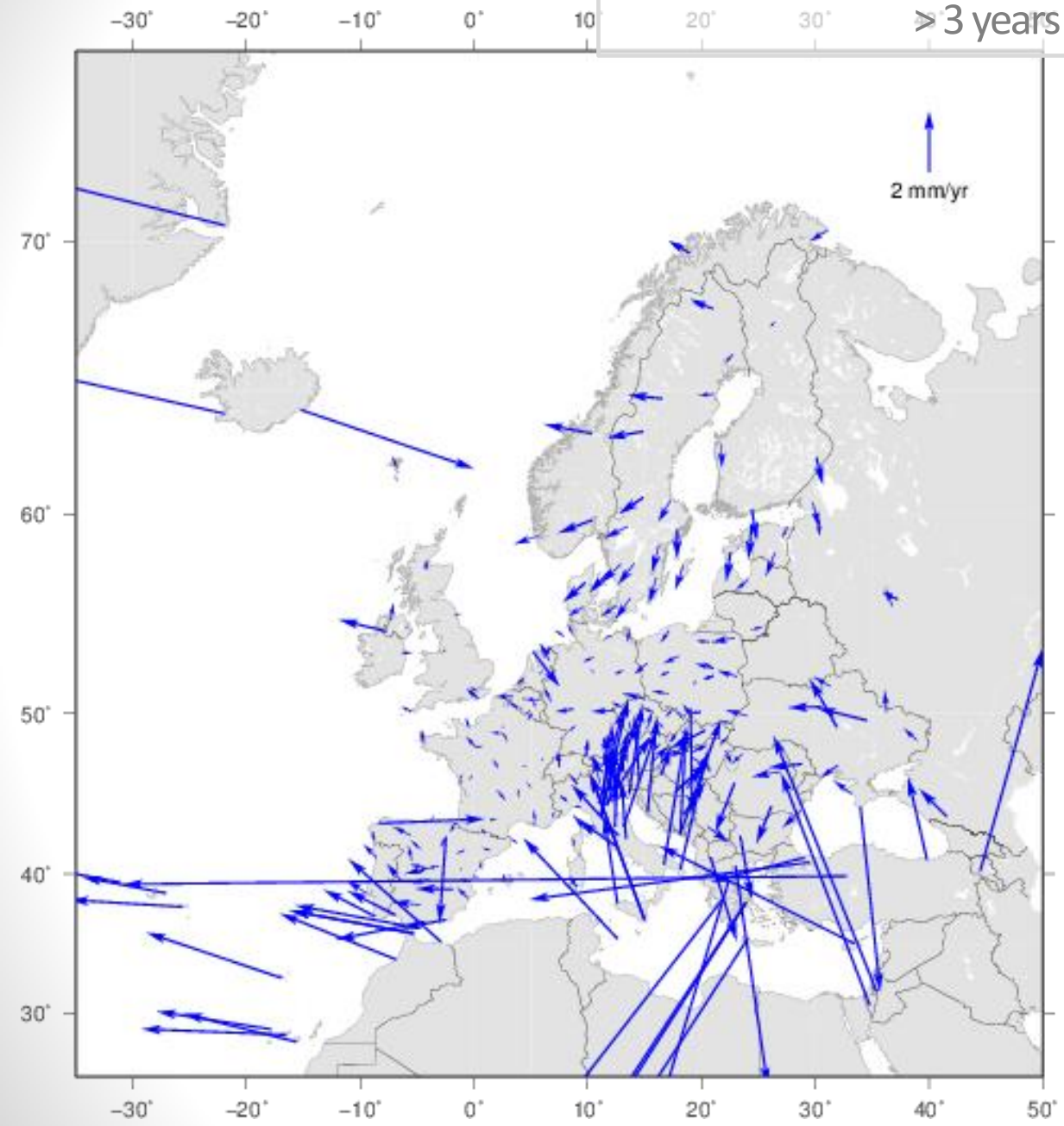
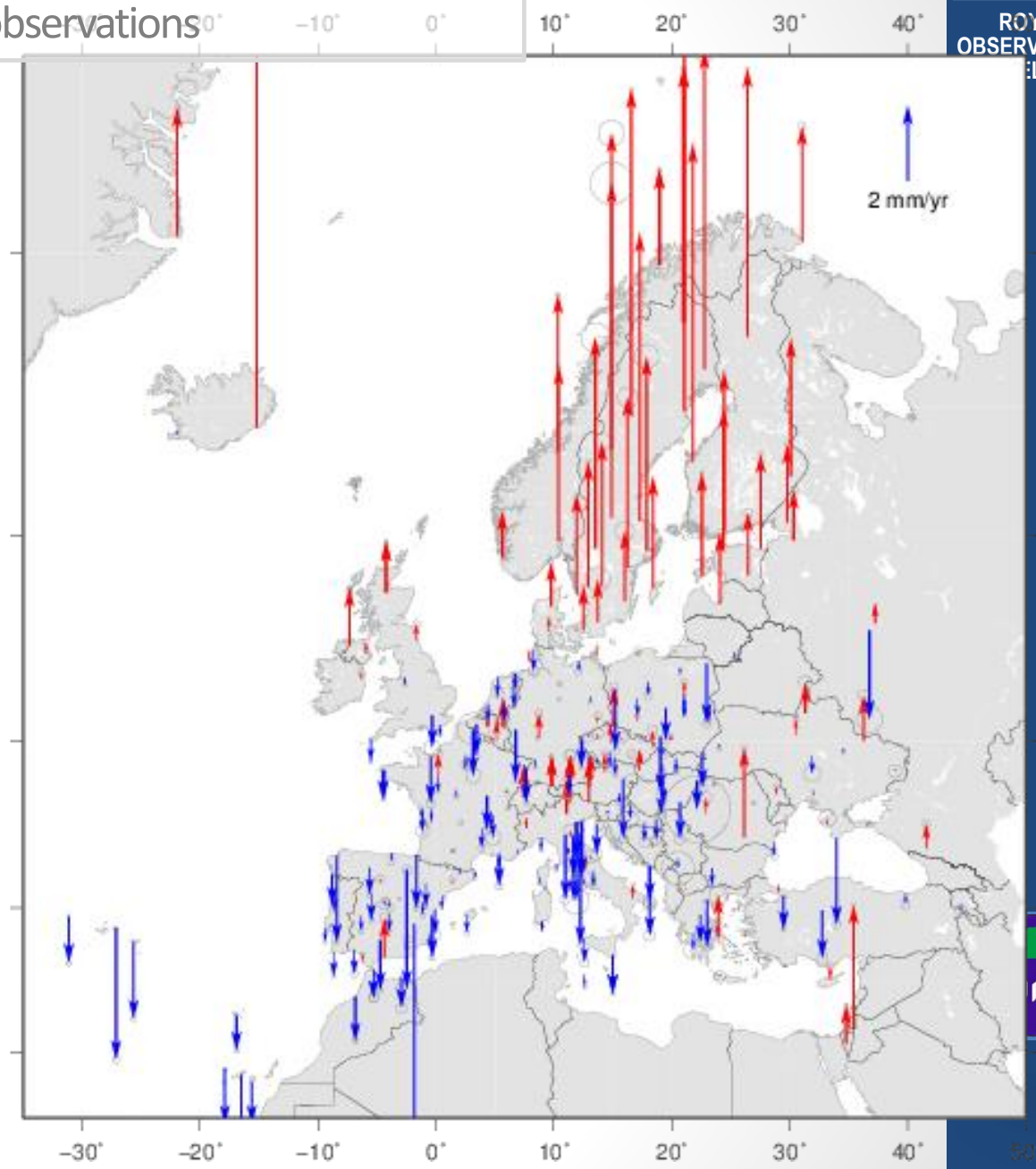
EPN velocity field wrt Eurasian plate fixed

> 3 years of observations





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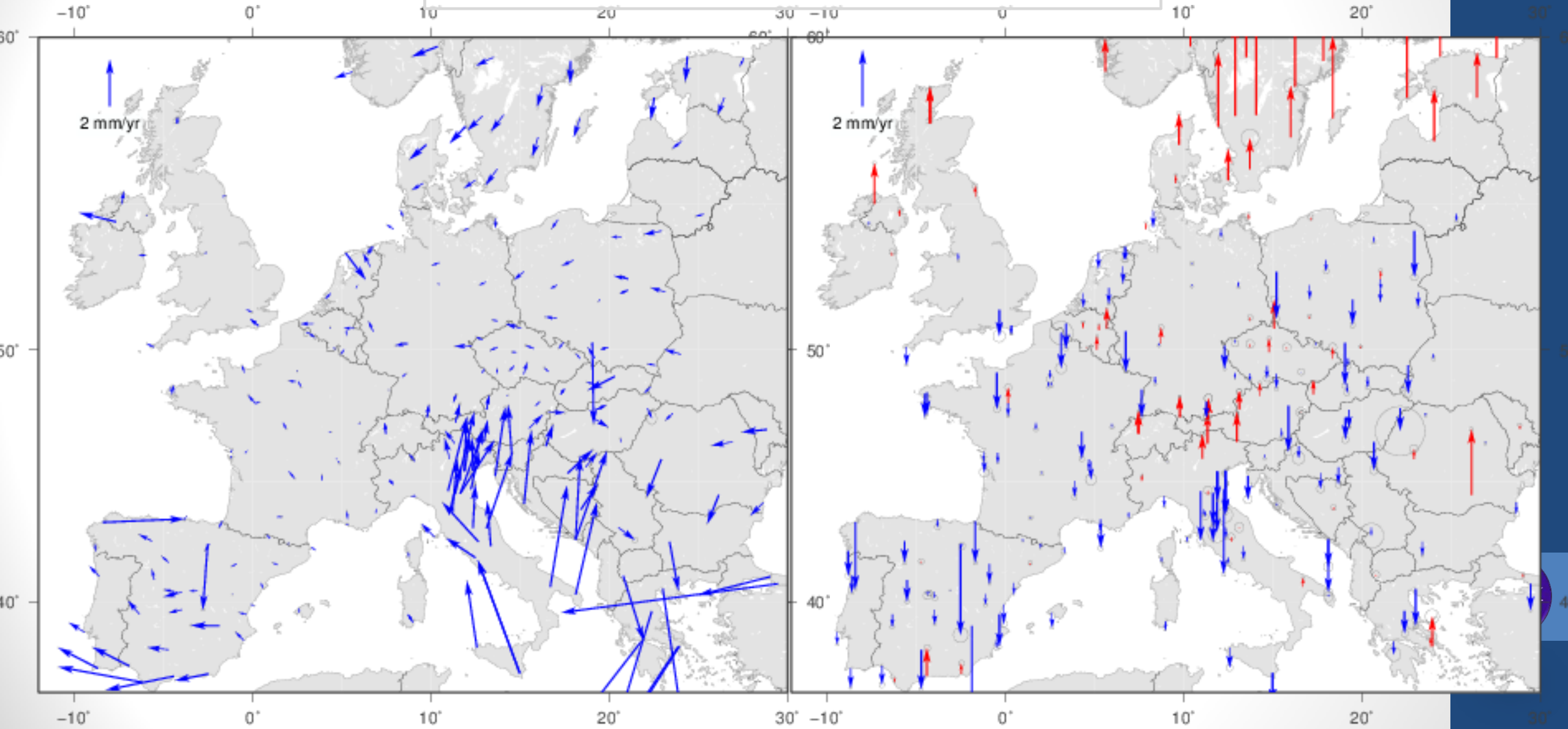
EPN velocity field wrt Eurasian plate fixed

> 3 years of observations

ZOOM



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Conclusions

- Agreement of the new EPN solution with IGS14 is really good.
- Ice melting in Greenland entails changes in the vertical motion and make the Greenland stations weaker for reference frame definition
- Post seismic deformation modelling improved a lot the stations where it has been applied **ANKR00TUR, BUCU00ROU, ISTA00TUR, REYK00ISL, TUBI00TUR**
- Annual and semi-annual estimations allows to improve the residual position time series and help a lot in the discontinuity detection
- Velocity changes: bad period with velocity changes or non linear behaviour are observed for some stations: more investigation in the future
- Current solution (after minor revision) have been accepted by the governing board and will be release within ~ 2 months after implementation at epncb web site

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Thank you

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