A Global SLR-only Reference Frame

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A Global SLR-only Reference Frame

Current Status:

- Official **ILRS products**   ---- >   time series of station positions and EOP
  Station velocities estimation   ---- >   ITRF realization

Goal:

- Global Reference Frame (Station position **and** Station velocities)
  for the ILRS network stations obtained using only solutions contributed to the ILRS official products

Application:

- Possible generation of an internal ILRS reference frame to be **updated more frequently** than the ITRF

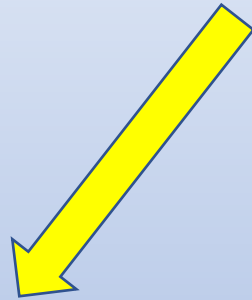# A Global SLR-only Reference Frame

Outline

1. Globk workflows

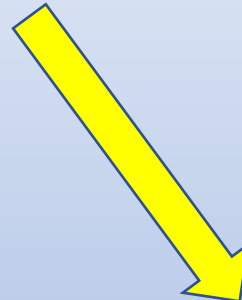2. Setup Used

3. Results and Analysis

Globk Workflow

Software used: Globk

Designed to combine geodetic results together (SLR, GNSS, VLBI,…)

To generate

Time series   **Velocity field**

Globk Workflows

Inputs

«Quasi» Observations

+ Apriori Ref. Frame
+ Discont. File
+ Eop tables
+ Setup

Loosely constrained solutions with a priori parameter information, parameters estimations and full covariance matrices

← Sinex files

Kalman filter
(~ sequential least square)

Translation, rotation, and scale estimated by a **minimization** horizontal positions and velocities **residuals of core site**

Historical Series

Global estimates
Station Positions
Station Velocities

- **Selection Criteria for Sinex**:
max X^2 / max prefit differences /max rotations

- **Selection Criteria for stations**
Geographically / minimun datas

Parameters to be estimated

Loose solutions

- **Selection of core site**
By name or sigmas criterion.

- **Selection of Helmert Parameters**
Translation , Rotations , Scale

- **Iterations**

Constrained solutions

Historical Series

Reference Frame

+ Helmert Parameters

Setup

Main Setup

INPUT

Primary Sources:

1461 weekly (v410) Sinex (1993-2021)	
First Sinex	asi.pos+eop.930102.v410.snx
Last Sinex	asi.pos+eop.210102.v410.snx

Apriori Files:

Reference Frame ----> ITRF2020 (SLRF2020)

Polar Motions ----> Bulletin A values from finals.data [finals.all (IAU2000)]

Discontinuity File: ITRF2020-soln-slr.snx

Loose solution

Historical Series

Global estimates
Station Positions
Station Velocities

Constrained solution

Historical Series

Reference Frame

Setups

Selection Criteria	Max residual adj. w.r.t. A Priori	Max «whole» rotation w.r.t. current solution
	0,5 m	10 mas

Parameter to Estimate	σ Positions (up/east/north)	σ Velocities (up/east/north)
Position only	1 m	-----------
Position&Velocities	1 m	0,1 m/yr
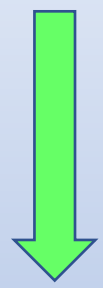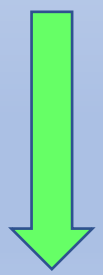
Helmert Parameters to Estimate	Translations – Rotations - Scale	

«Core site» selection criteria	Residual/Sigma threshold	Threshold on UP sigma
	3	3

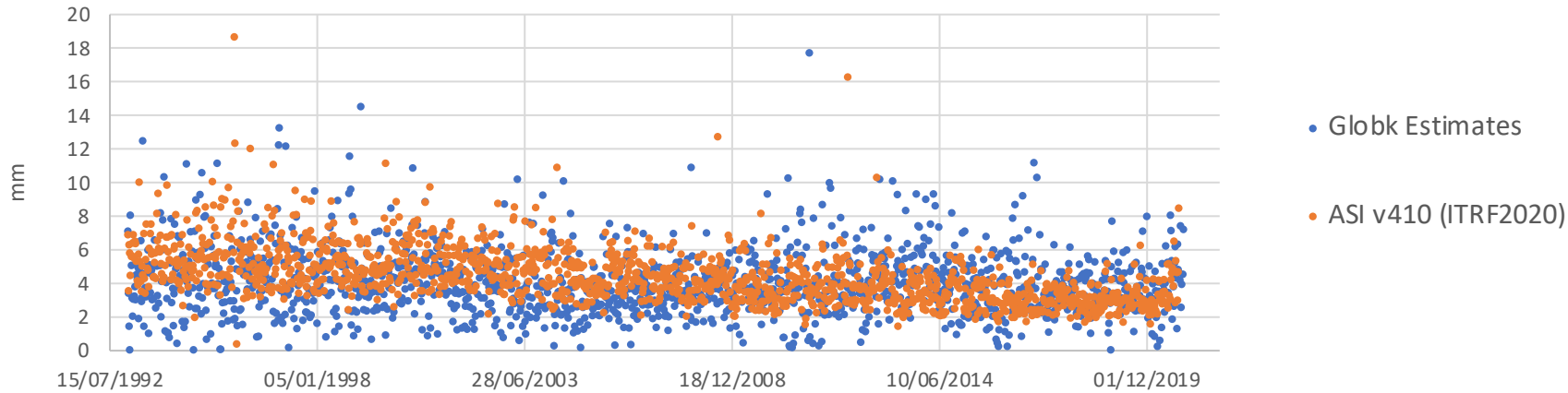$$\frac{\sigma_h{}^2 - \sigma_{h_{med}}{}^2}{\sigma_{h_{med}}{}^2 - \sigma_{h_{best}}{}^2} < 3$$

Analysis & Results

Historical Series

Historical Series

Position-only estimation

3D WRMS (historical Series)

- Globk Estimates
- ASI v410 (ITRF2020)

ASI v410 (ITRF2020) (mean)	Globk Estimates (mean)
4,43 mm	4,07 mm
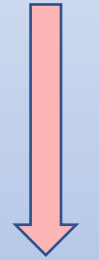
Core sites

WRMS of residuals
of position coordinates
w.r.t. ITRF2020

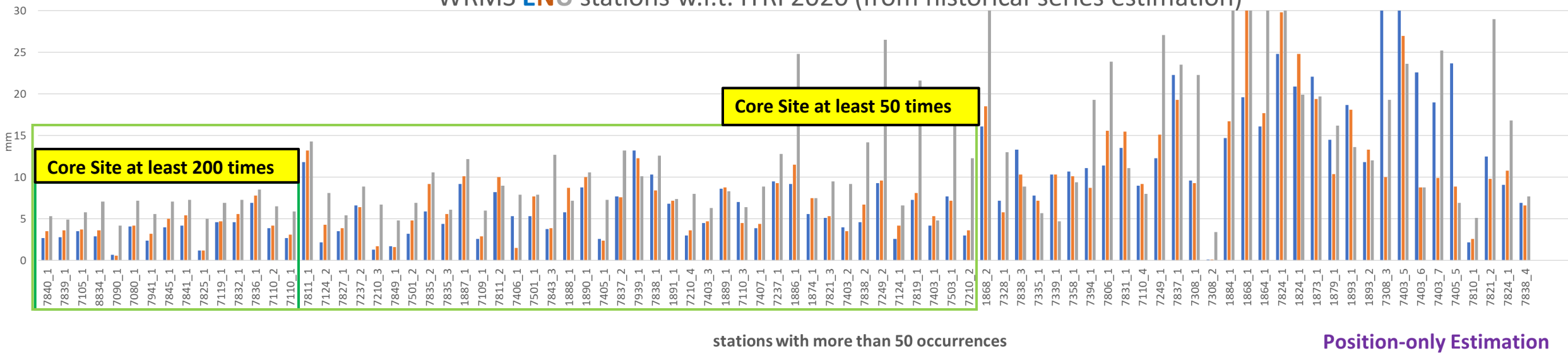(Globk Estimates)

WRMS Solutions (historical Series)

- Nord (mean) 2.23 mm
- Est (mean) 2.36 mm
- Up (mean) 5.96 mm

Solution Estimated (and constrained) by globk/glorg
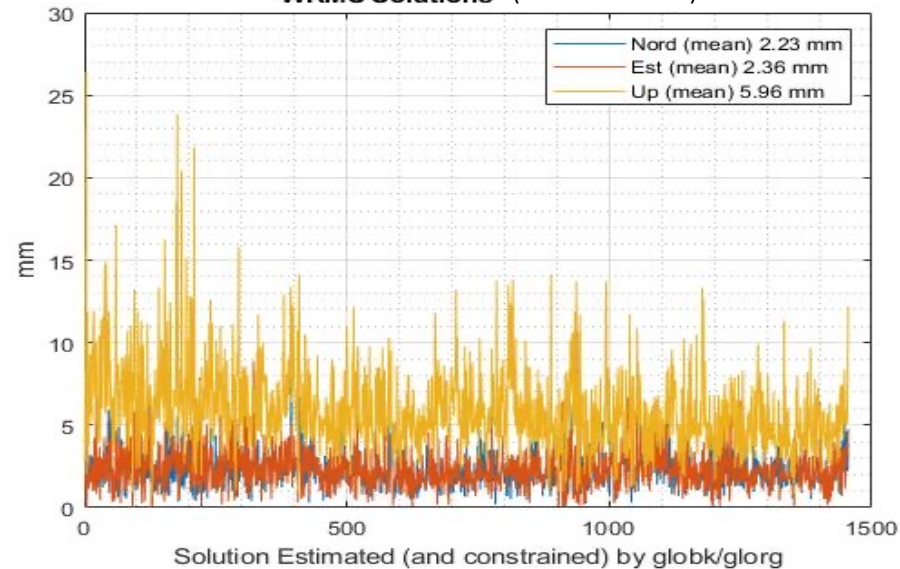
North (mean)	East (mean)	Up (mean)
2,23 mm	2,36 mm	5,96 mm

Historical Series

Position-only estimation

Station by Station

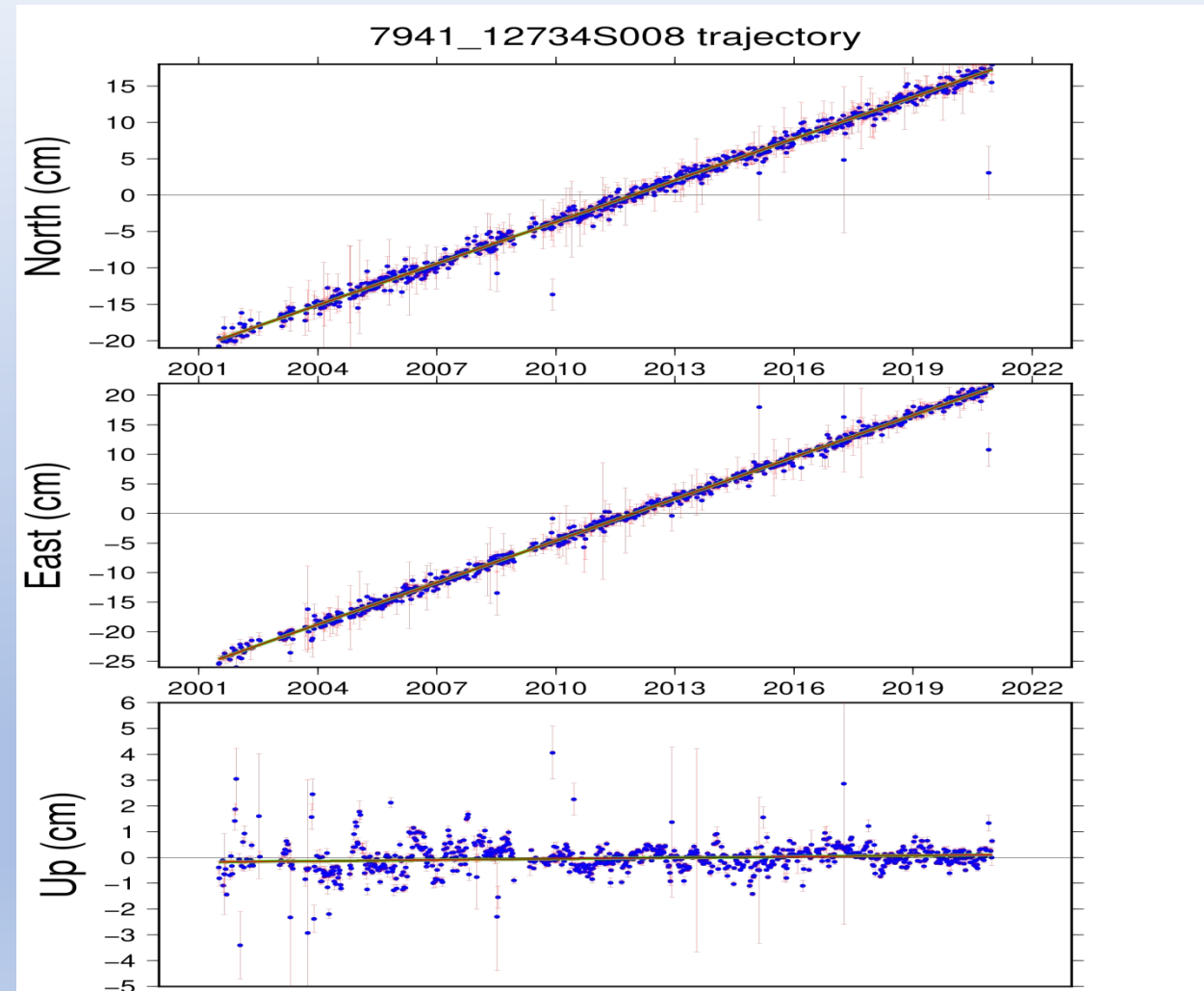WRMS ENU stations w.r.t. ITRF2020 (from historical series estimation)
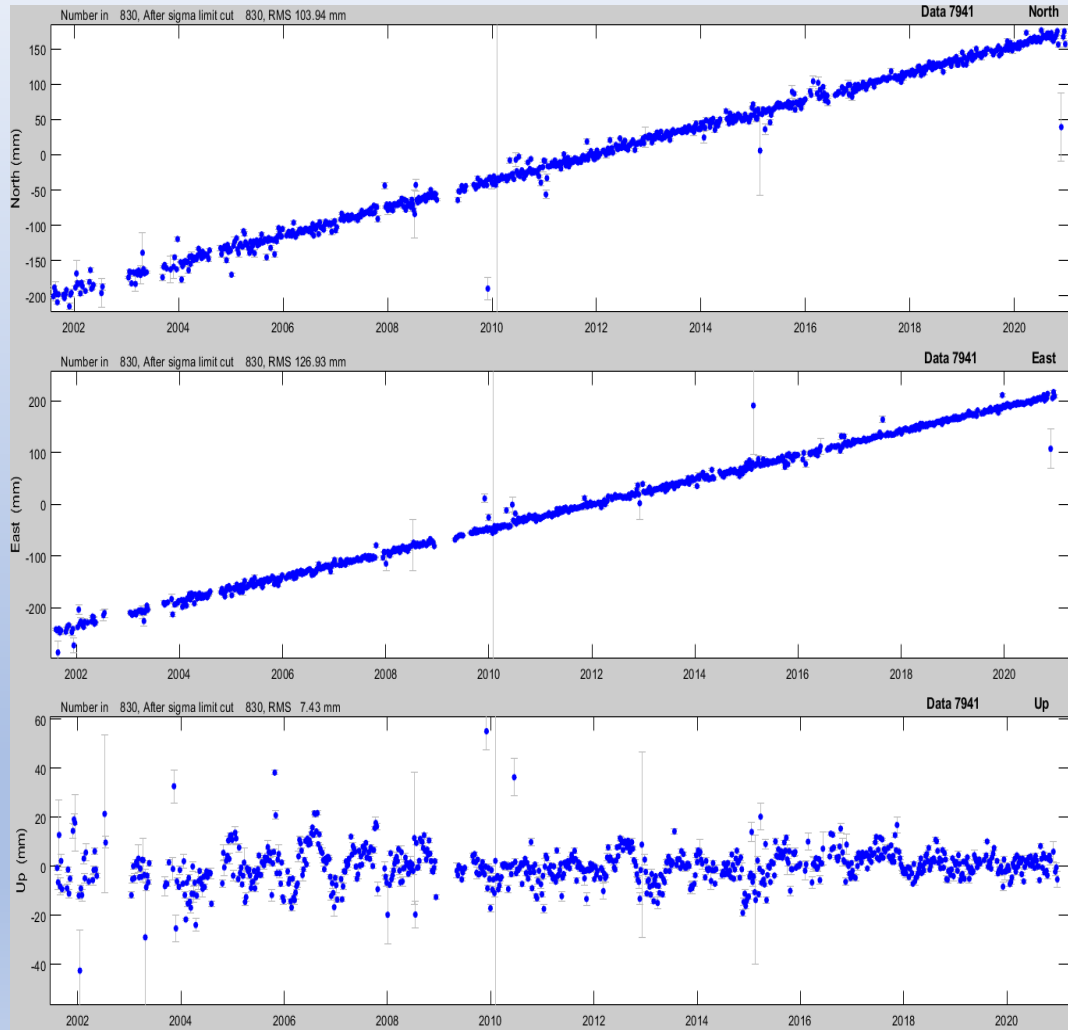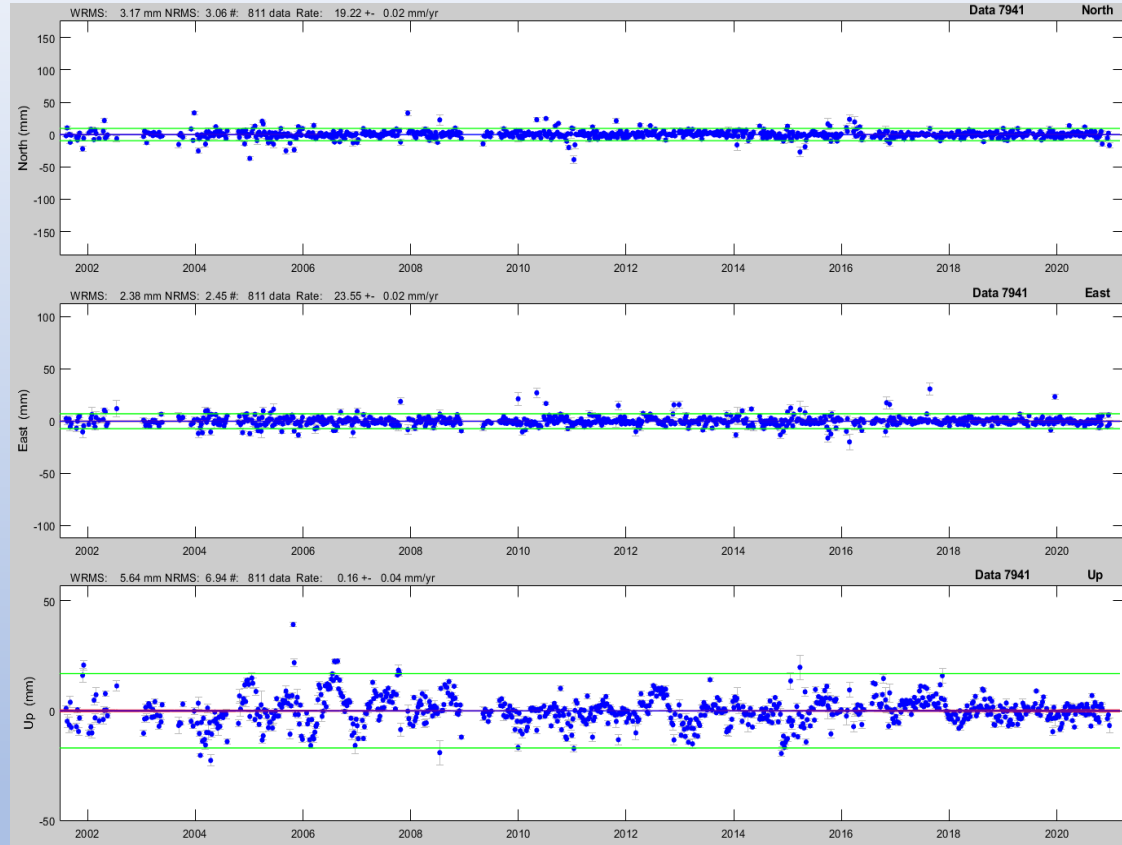
Historical Series

Globk Estimates

From IGN (ITRF2020)

Historical Series

Globk Estimates

From IGN (ITRF2020)
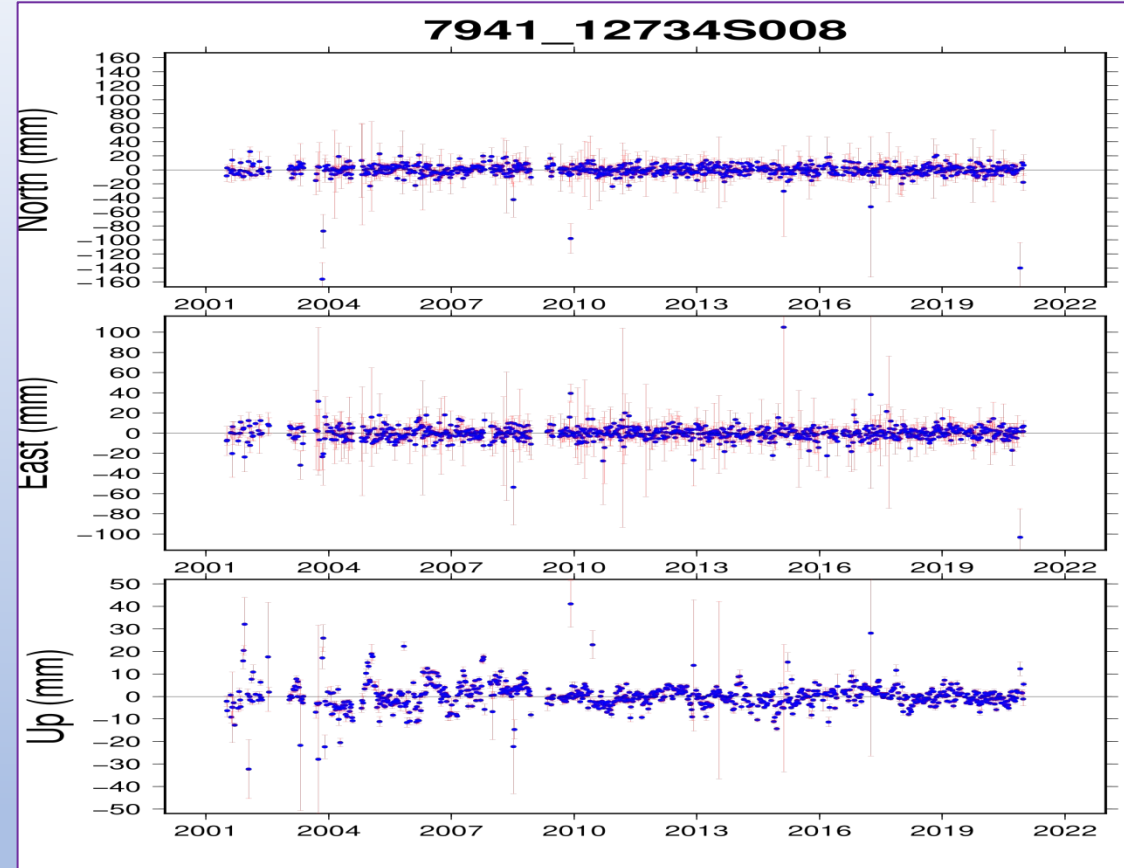
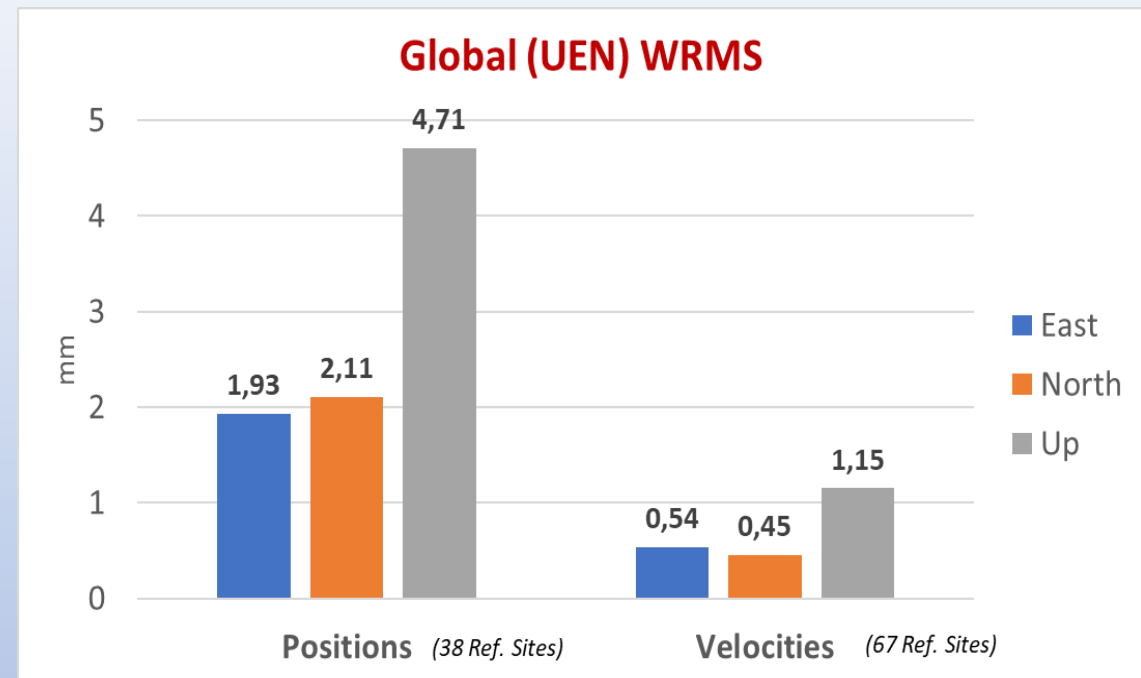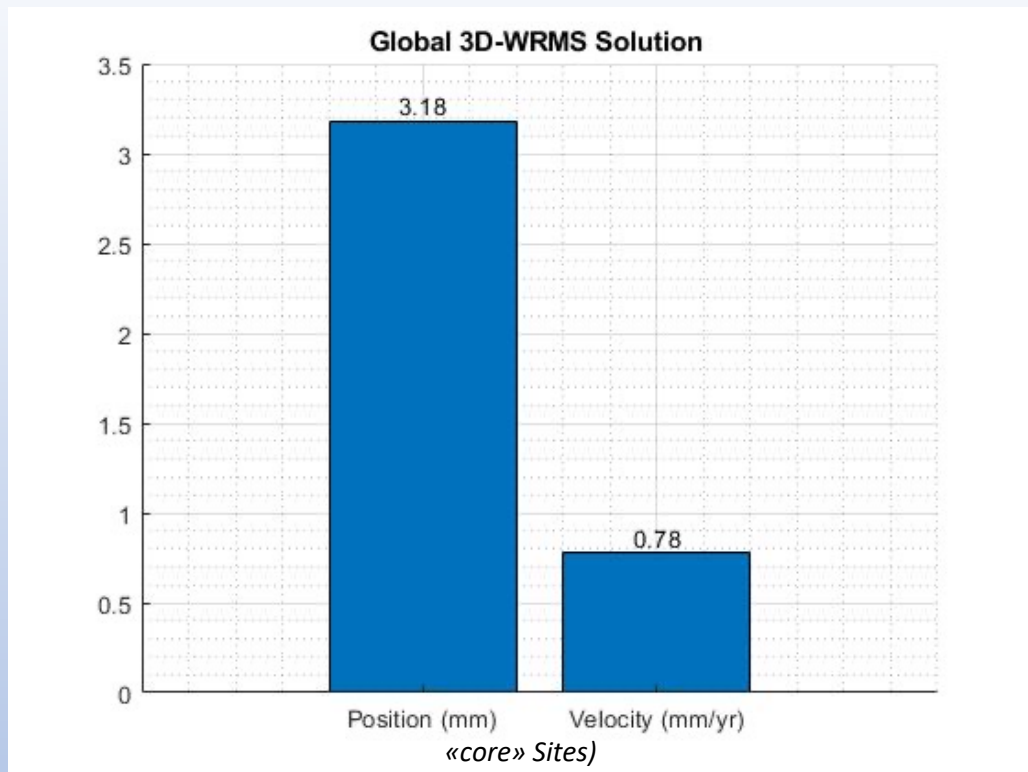| WRMS	
Nord	3,17 mm
East	2,38 mm
Up	5,64 mm

WRMS of residuals of globk Estimates w.r.t. ITRF2020

Matera (7941): DeTrended

Analysis & Results

Reference Frame

Ref. Frame comparison w.r.t. ITRF2020

Global 3D-WRMS Solution
- 3.18 — Position (mm)
- 0.78 — Velocity (mm/yr)
«core» Sites)

Global (UEN) WRMS

Positions (38 Ref. Sites): East 1,93 — North 2,11 — Up 4,71
Velocities (67 Ref. Sites): East 0,54 — North 0,45 — Up 1,15

WRMS and (UEN) for the "core" sites used at the last iteration for constraining during the minimization of the residuals on the estimation of the Helmert Parameters w.r.t. ITRF2020.
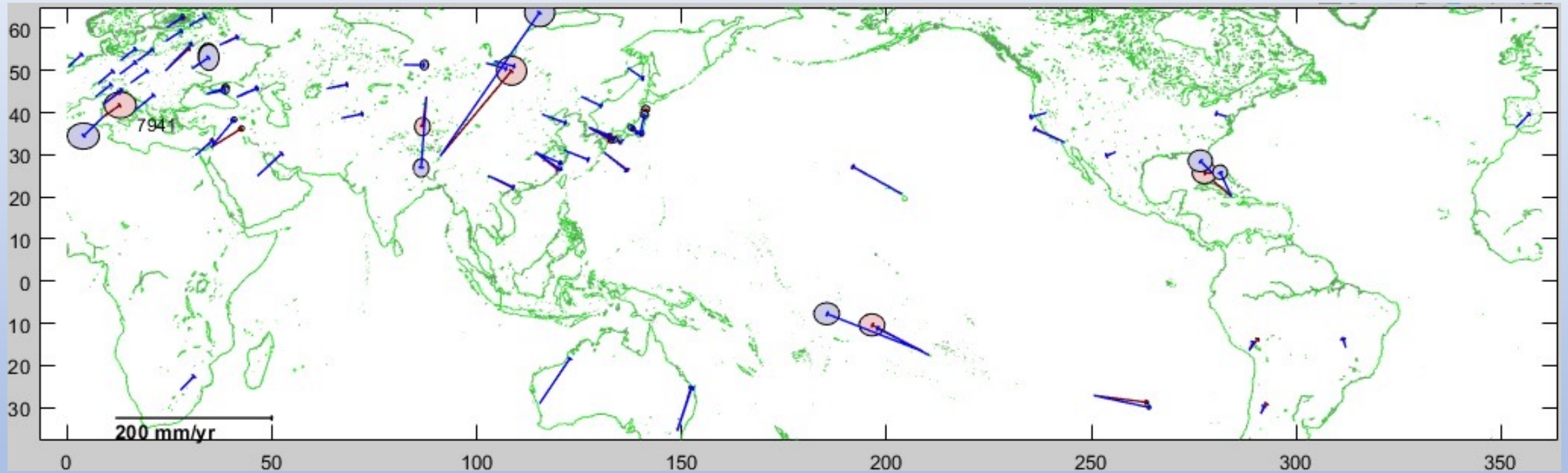
Helmert	X Tra (mm)	Y Tra	Z Tra	Scale	X Rot	Y Rot	Z Rot
Pos.	-0,1 ± 0,79	-0,91 ± 0,66	-0,24 ± 0,73	0,38 ± 0,20	-11.04 ± 0,02	-1,8 ± 0,02	3,18 ± 0,02
Rate	-0,11 ± 0,09	-0,08 ± 0,08	-0,17 ± 0,08	0,052 ± 0,025	-0,009 ± 0,003	0,006 ± 0,003	-0,01 ± 0,003

Units:
mm
mas
ppb
mm/yr
mas/yr
ppb/yr

Ref. Frame Estimates

Blue: Globk Estimate   Red: ITRF2020
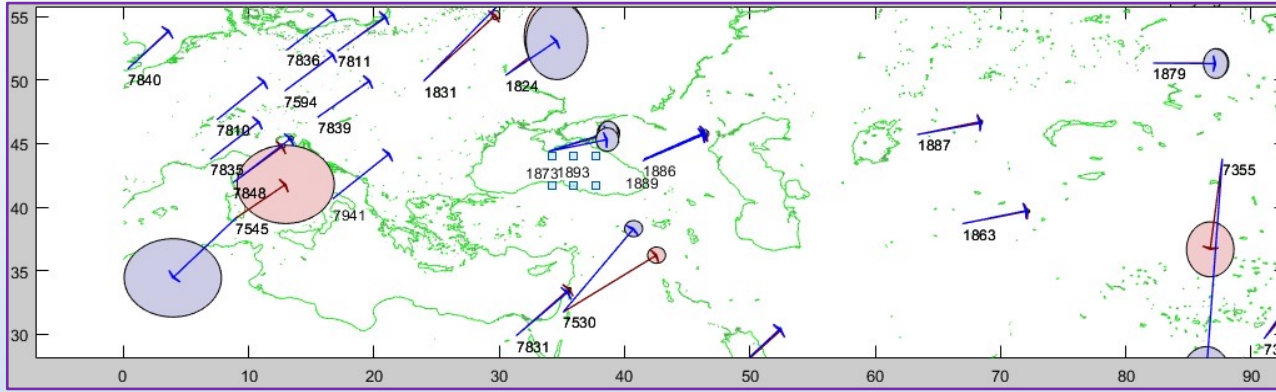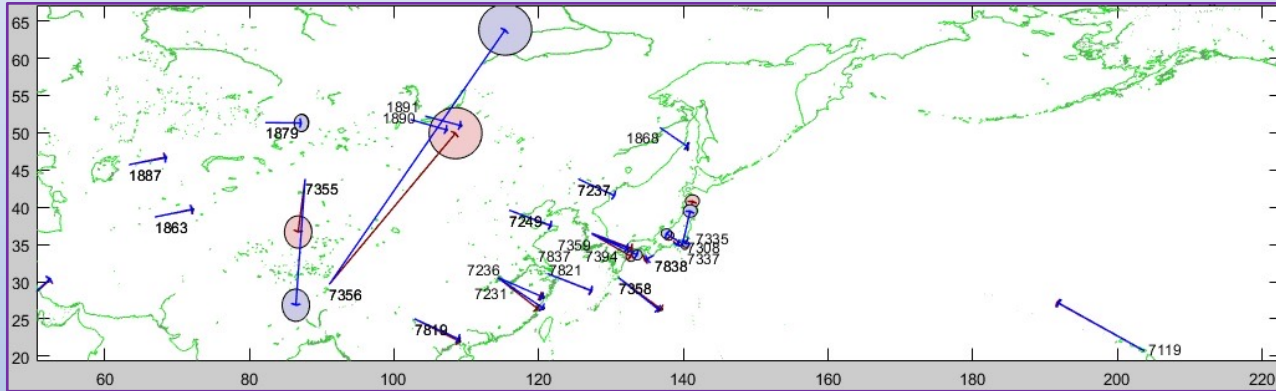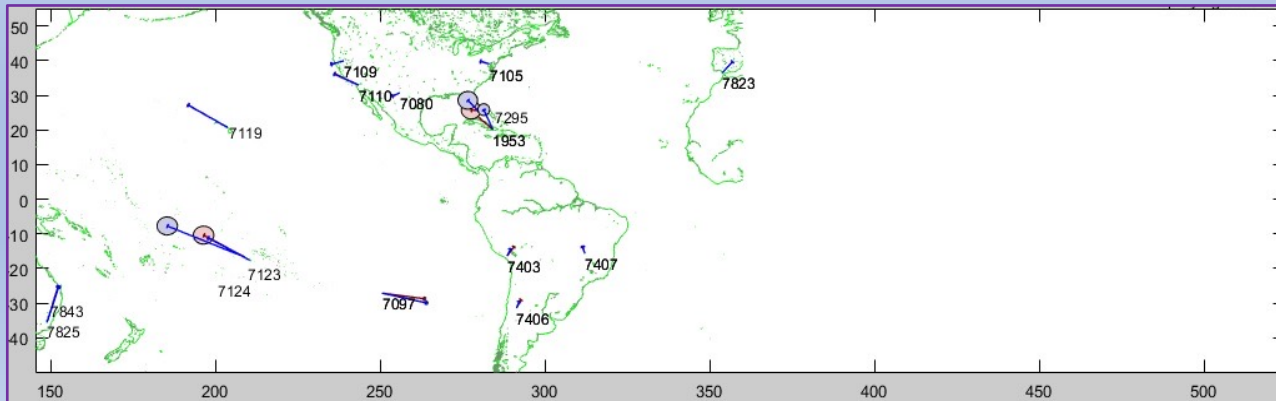

Sigma Up to:

10 mm/yr

Ref. Frame Estimates

Europe

7545: 11 data
7530: 37 data
7355: 24 data

Globk Estimate

Asia

7356: 13 data
7355: 24 data

**America**

Sigma Up to:
10 mm/yr

• Ref. Frame Estimates

* Position adjustments from globk.org : Date Tue Oct 25 15:02:51 CEST 2022

* Long	Lat	Epos	Npos	dEp	dNp	E +-	N +-	Rne	Hpos	dHp	H +- Site
* deg	deg	mm	mm	mm	mm	mm	mm		mm	mm	mm
353.79469	36.46526	3.17	3.11	3.17	3.11	3.38	3.90	0.013	-40.60	-40.60	9.04 7824_GPS
353.79469	36.46526	0.22	4.75	0.22	4.75	1.01	1.06	0.016	-14.53	-14.53	2.47 7824_G1B*
353.79378	36.46279	4.92	9.16	4.92	9.16	2.71	3.65	0.202	-39.57	-39.57	4.94 7823_GPS
312.13471	-15.77307	5.80	-3.46	5.80	-3.46	1.10	1.02	0.005	2.72	2.72	1.07 7407_GPS*

* Velocity field from globk.org   RMDUP N RMNAM N : Date Tue Oct 25 15:02:51 CEST 2022

* Long	Lat	Evel	Nvel	dEv	dNv	E +-	N +-	Rne	Hvel	dHv	H +- Site
* deg	deg	mm/yr	mm/yr	mm/yr	mm/yr	mm/yr	mm/yr		mm/yr	mm/yr	mm/yr
353.79469	36.46526	16.64	17.62	0.01	0.09	0.11	0.13	0.005	-3.22	-2.05	0.29 7824_GPS
353.79469	36.46526	16.64	17.62	0.01	0.09	0.11	0.13	0.005	-3.22	-2.05	0.29 7824_G1B*
353.79378	36.46279	16.64	17.62	0.01	0.09	0.11	0.13	0.005	-3.22	-2.05	0.29 7823_GPS
312.13471	-15.77307	-3.22	11.43			0.39	0.37	-0.012	-2.47	0.33	0.45 7407_GPS*
291.37684	-31.50862	4.25	10.33	-3.06	-3.17	0.21	0.19	-0.012	2.06	0.77	0.22 7406_GPS*
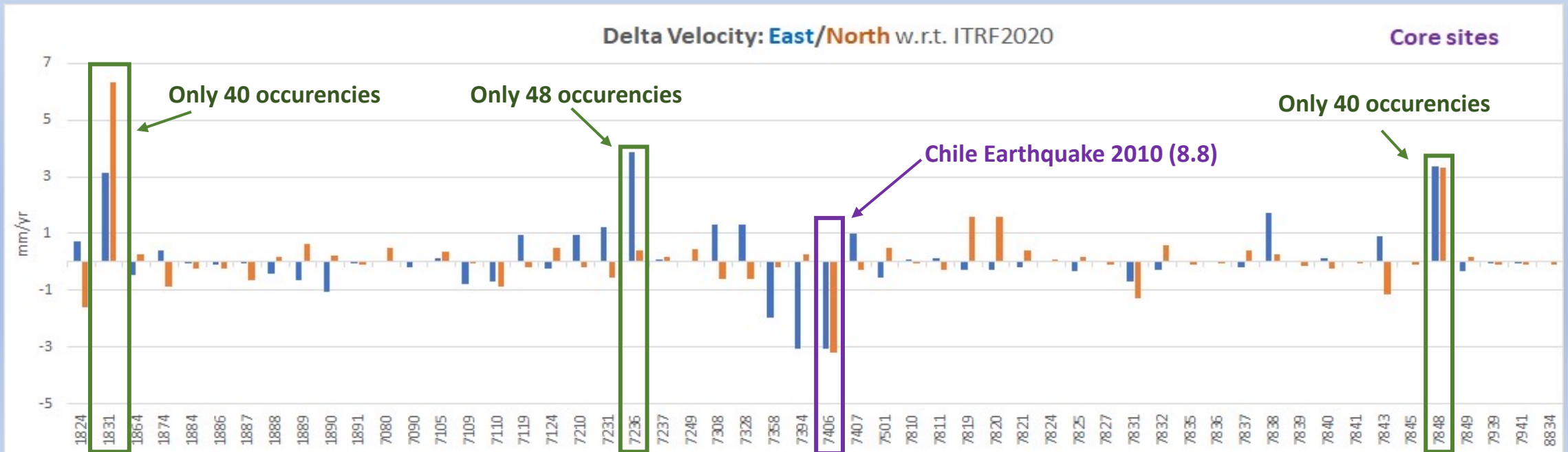
Conclusions

- Global Only-SLR Reference frame

- Good agreement with ITRF2020

- Possible product to be updated more frequently than ITRF

- Improvements using the ITRF2020 PSD model

Thank you

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