

DTRF2020 UPDATE: CHALLENGES AND FIRST RESULTS

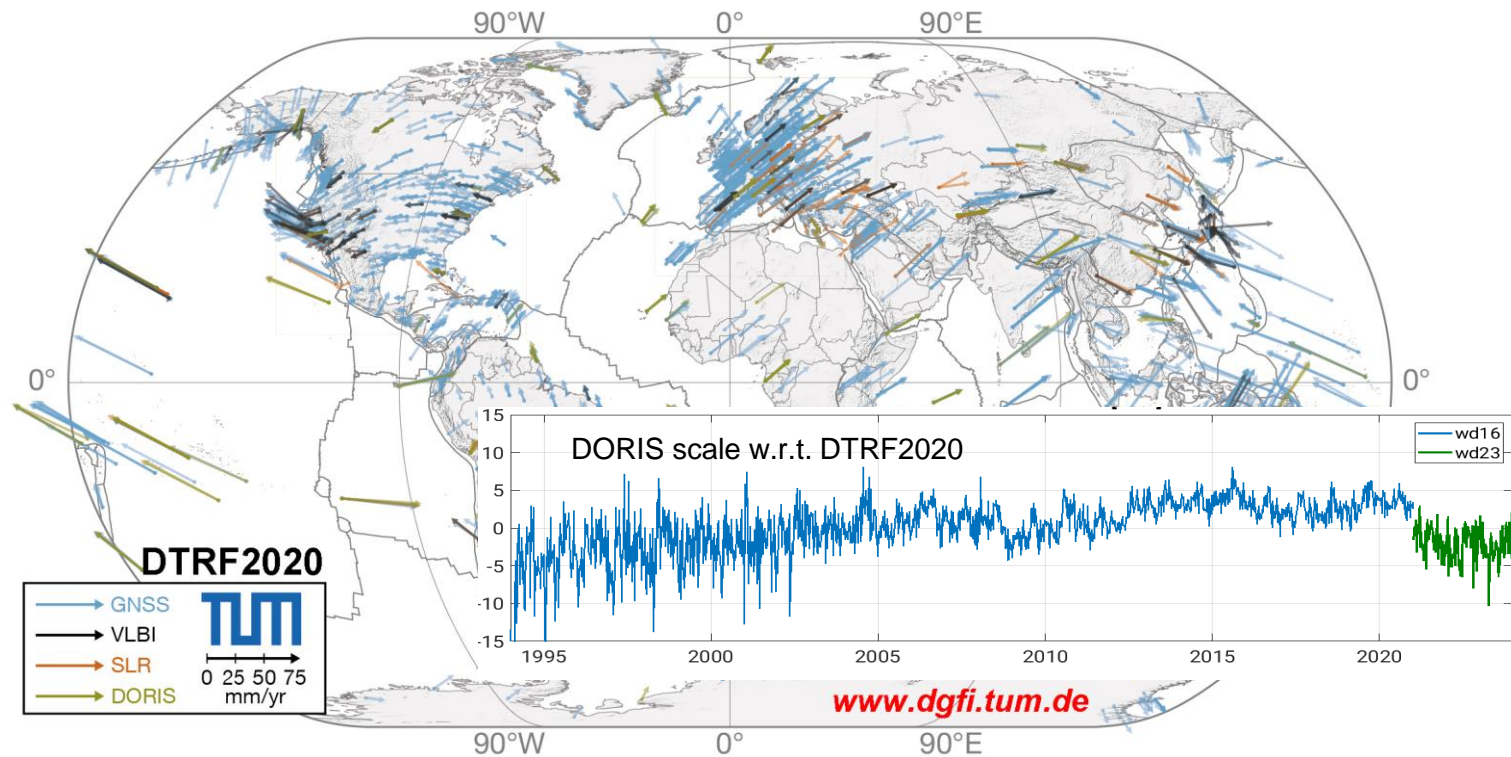
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IDS Workshop 2024

September 4, 2024 - September 5, 2024



**Session: IDS processing and
Terrestrial Reference Frame**

Contributions of IAG Technique Services for xTRF2020 extension

	IGS 	ILRS 	IDS 	IVS 
SINEX Series 2021.0 - 2024.0	IGS1R03: until GPS week 2237 IGS1OPS: from GPS week 2238 consistent to R03	ilrsa:v85	ids:wd23	ivs comprising 97 VGOS sessions
Number of files	1098 daily	159 weekly	157 weekly	663 sessions
Number of (changing) AC	IGS1R03: 10 IGS1OPS: 9 (2 new, 3 missing)	7	4 (1 new)	12 (2 new, 1 missing)
Number of stations included	1343 (316 new)	41	68	57

→ Furthermore: New models in case of all techniques!

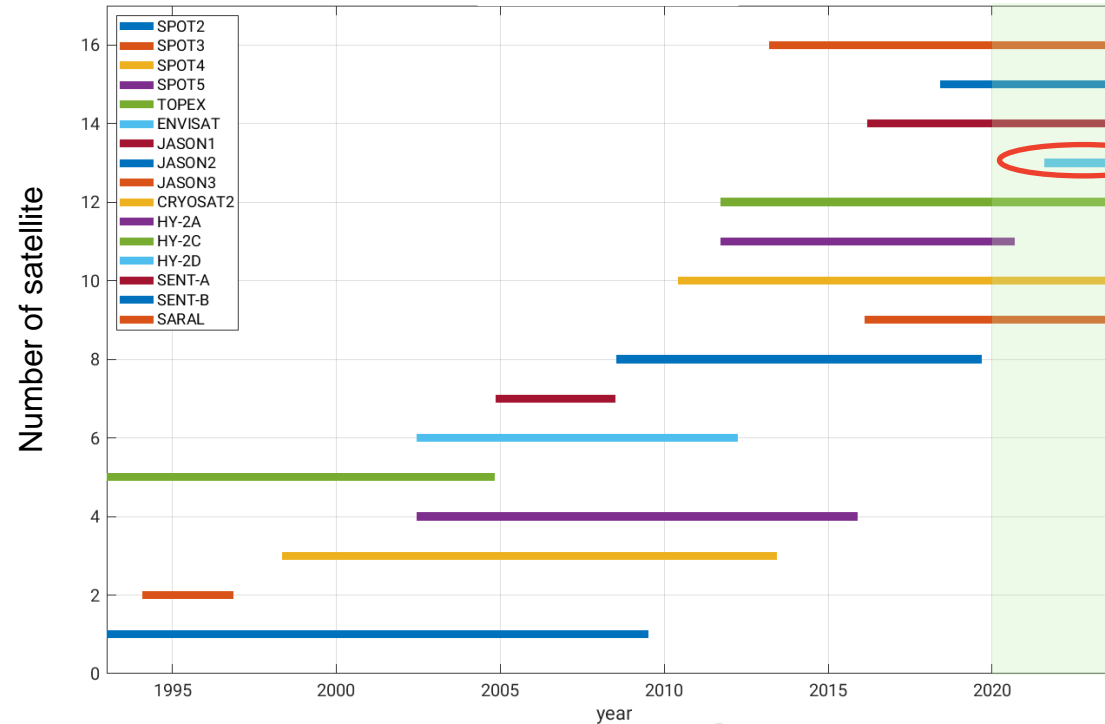
DORIS input data series

DTRF2020 – wd16

- Number of stations: 192,
41 continue observing after 2021.0
- Number of satellites: 15,
max 8 in parallel
- Number of AC: 4

DTRF2020ext – wd23

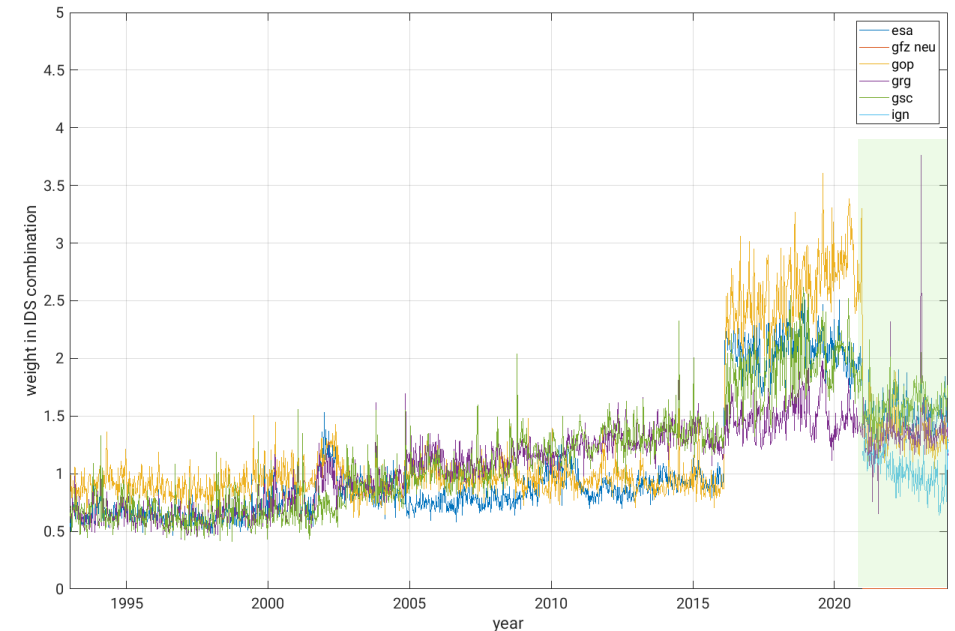
- Number of stations: 68
- Number of satellites: 8 (new: HY-2D)
- Number of AC: 5 (new: IGN)



New satellite HY-2D

DORIS satellites sorted by missions and start epoch of satellite observations

Weights of AC contributions in IDS weekly combination extracted from SINEX files. (AC GFZ: weight of zero)



DORIS processing

1) Analysis of input data series (SINEX files)

2) Computation of DORIS weekly solutions 1993-2024.0

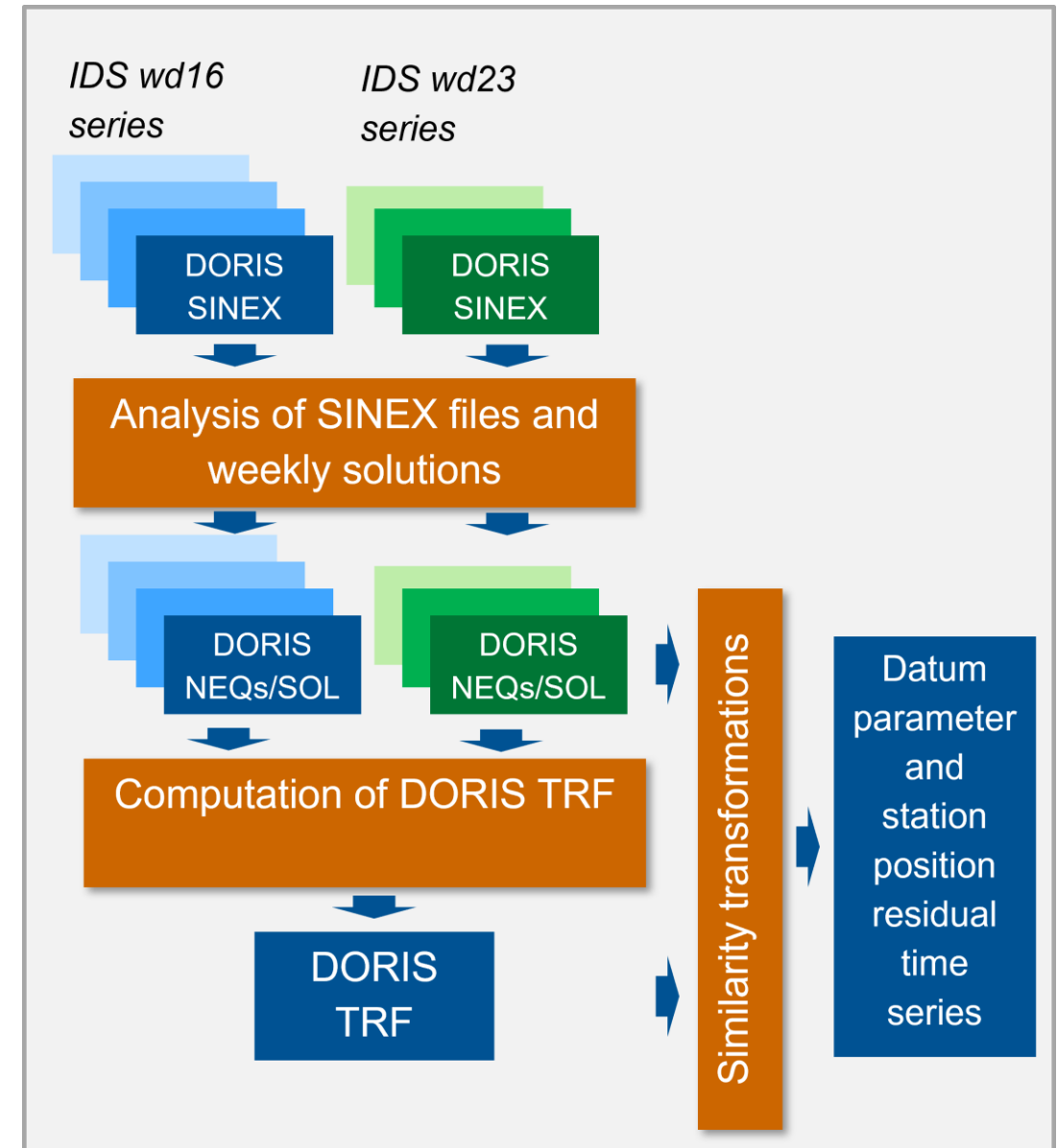
- setting up 6 (scale still included for scale analysis) or 7 Helmert transformation parameters to reconstruct the singularities w.r.t. the datum parameters which are needed in DTRF2020ext computation

3) Computation of a DORIS TRF solution

- from the full observation history (1993-2024.0)
- “combining” wd16 and wd23 series

4) Generation of scale time series and station position residual time series

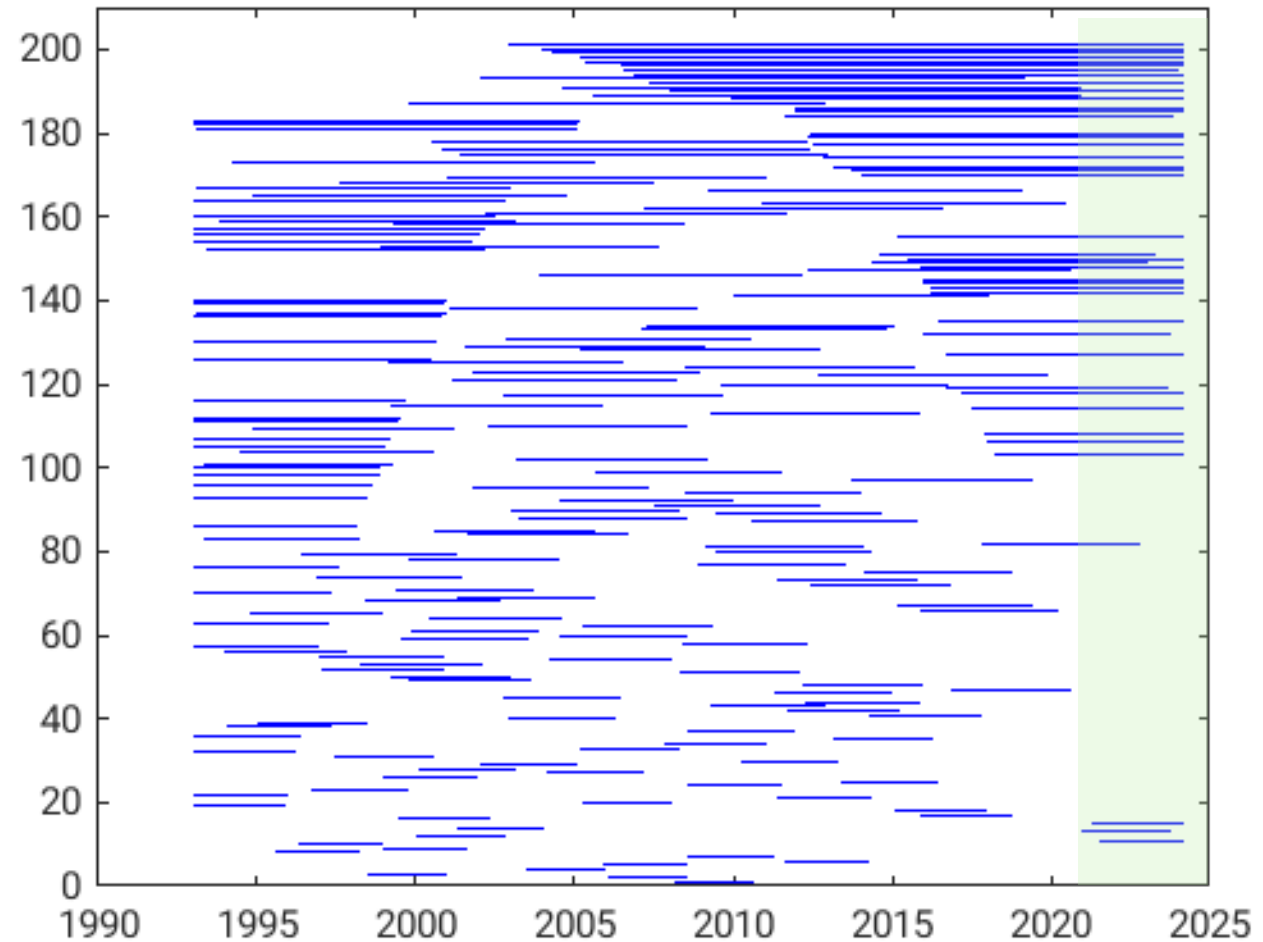
- by 7-parameter similarity transformation of weekly DORIS solutions w.r.t. DORIS TRF solution



Distribution of observations over time

Length of observation time span per station position solution (station/solution number)

- Stations are sorted by length of observation time span
 - Discontinuities at epoch 2021.0 are not yet considered
 - New stations with time-spans < 2.5 years are reduced
- More stations with longer time-spans including three new stations:
 10204S001 HOFC (Höfn)
 91201S010 KEYC (Kerguelen)
 97401S004 REVC (La Reunion)
- Anyway, the problem of two not well connected observation eras remains, of course → weak long-term stability



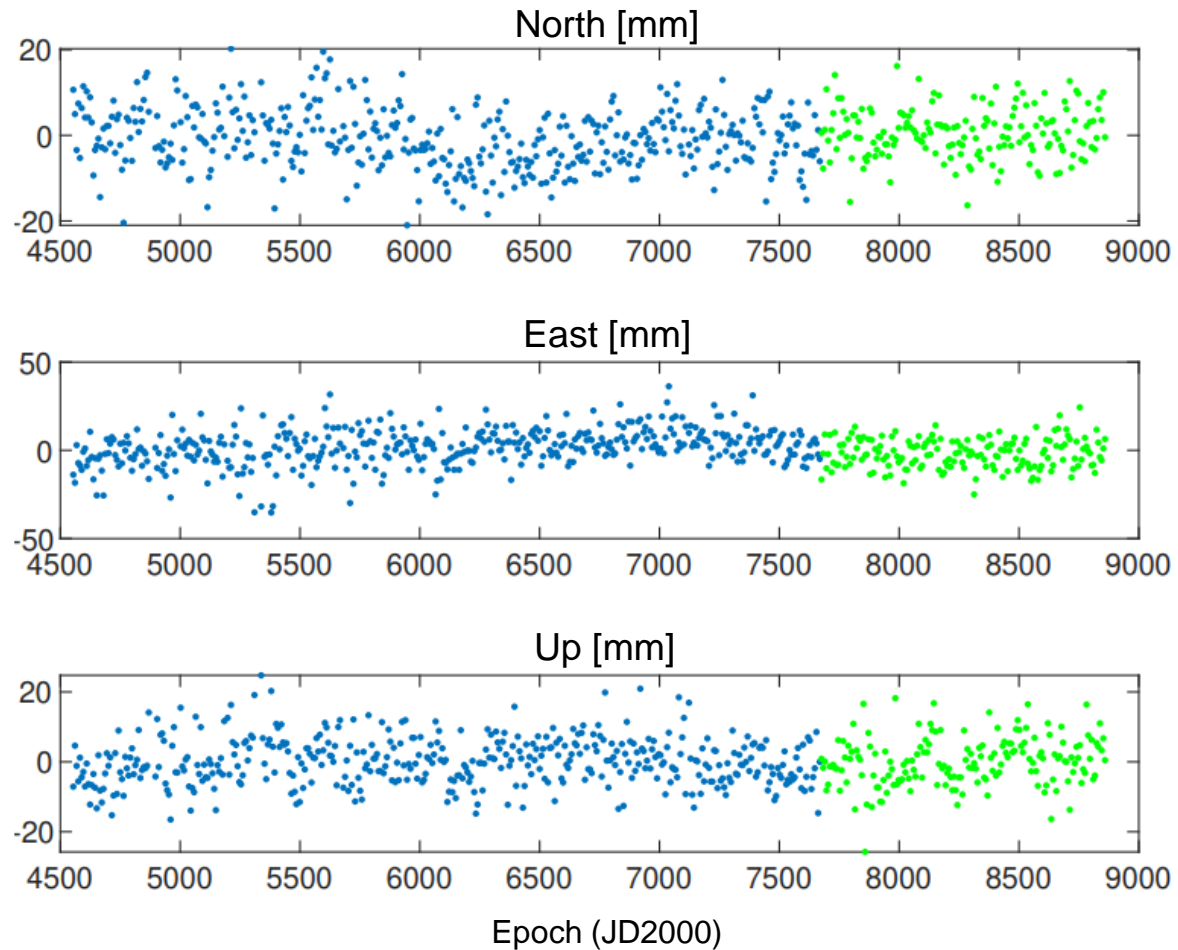
Station position time series

Continuity of station position time series at epoch 2021.0: transition from wd16 to wd23 series

Example for high consistency

Station: Manille, Philippines

- wd16
- wd23



Station position time series

Continuity of station position time series at epoch 2021.0: transition from wd16 to wd23 series

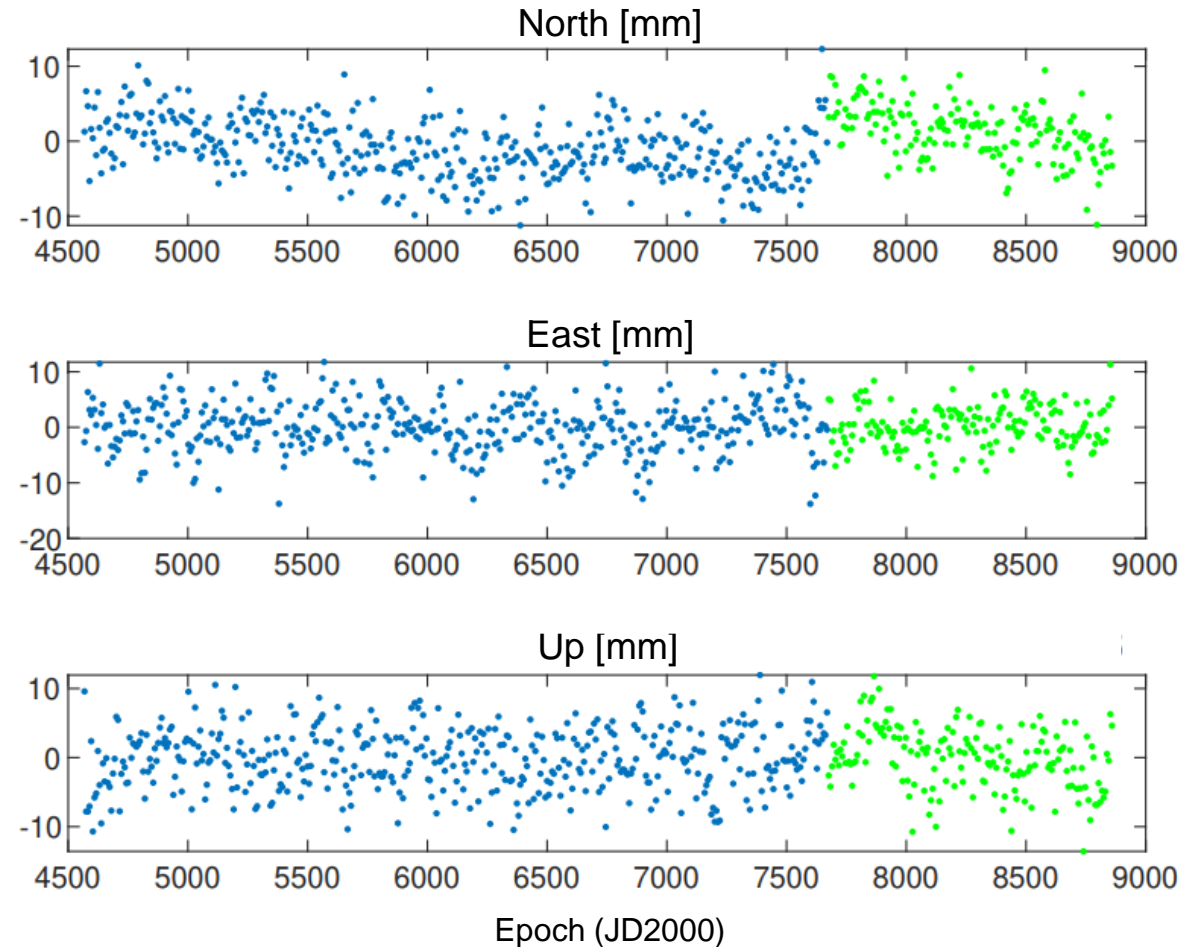
Example for low consistency

Station: Metsähovi, Finland

- wd16
- wd23

→ Discontinuity in position and velocity
(North and up)

→ Most of the stations show position and/or
velocity changes at epoch 2021.0!



Station position time series

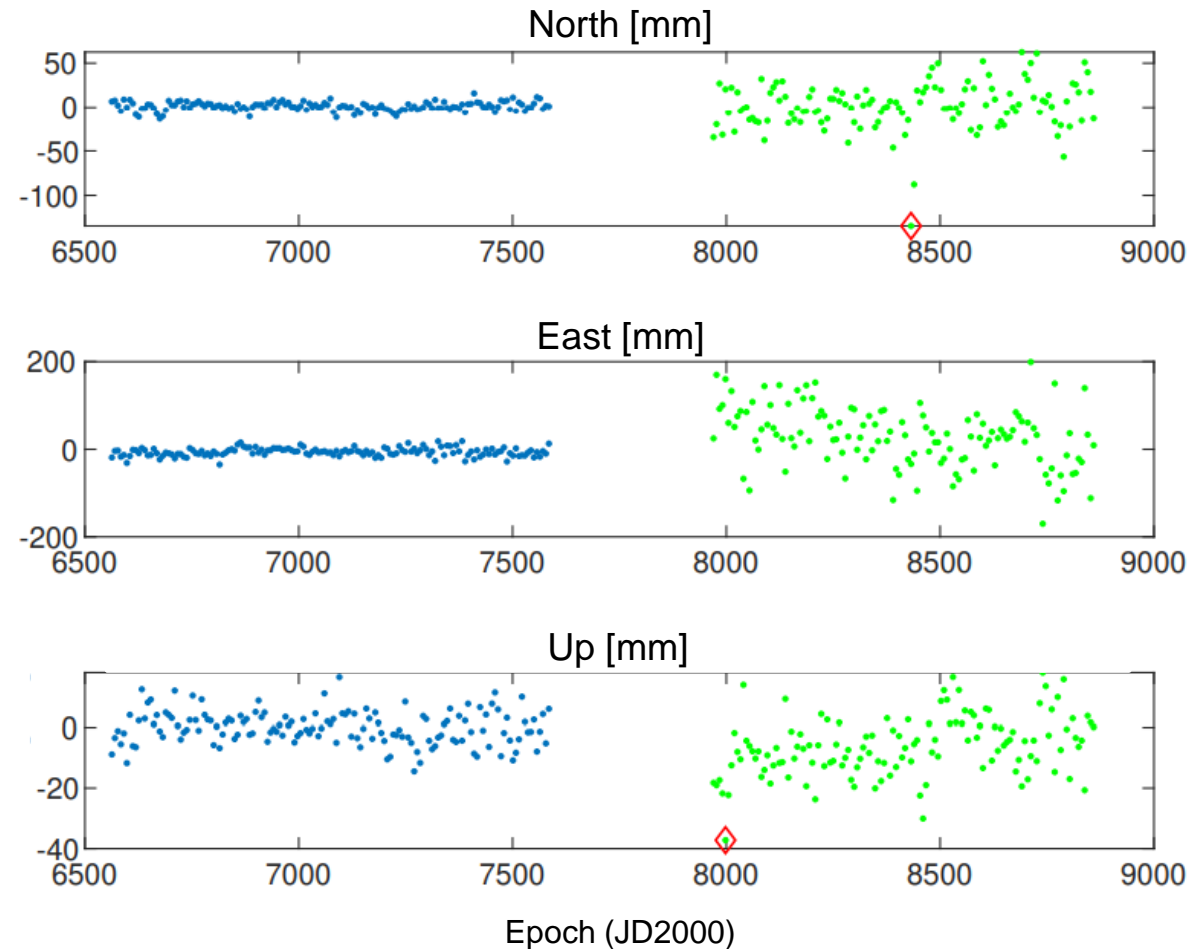
Continuity of station position time series at epoch 2021.0: transition from wd16 to wd23 series

Example for change in time series scatter

Station: Cibinong, Indonesia

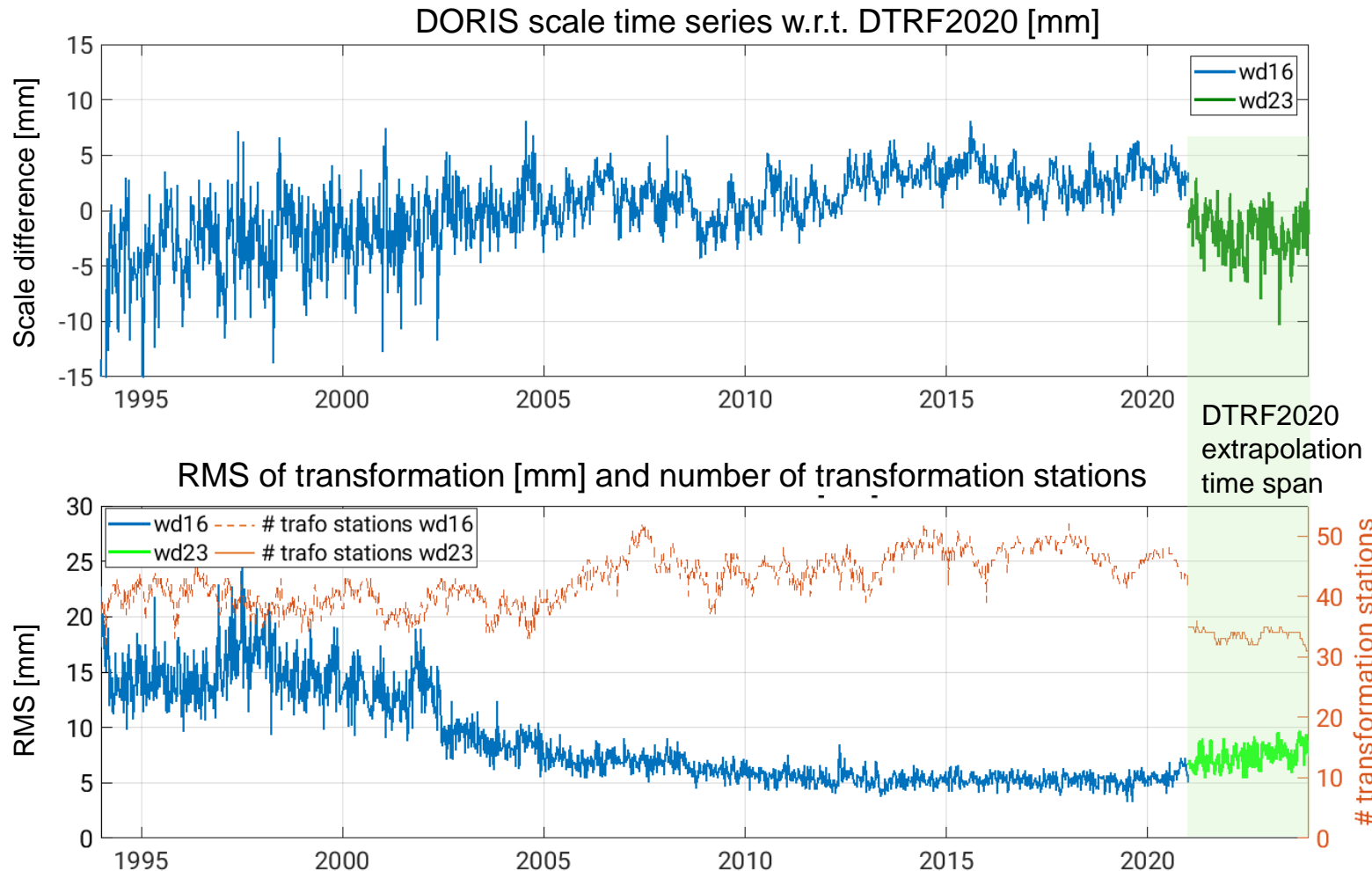
- wd16
- wd23
- outlier

→ Increase of time series' scatter



DORIS scale time series w.r.t. DTRF2020

DORIS scale time series derived from weekly solutions with 6 Helmert parameters set up



Significant change in DORIS scale realization?

→ Offset and larger scatter for wd23 compared to wd16

DORIS TRF solution

Discontinuities: to weaken the long-term stability as little as possible, only 4 discontinuities at epoch 2021.0 are introduced

Station	Effect
MEUB	Jump in North
HEMB	Jump and velocity change in North
SARC	Jump and velocity change in Up
YEMB	Jump and velocity change in all components

RMS of transformation of DORIS TRFext to DORIS TRF for DTRF2020

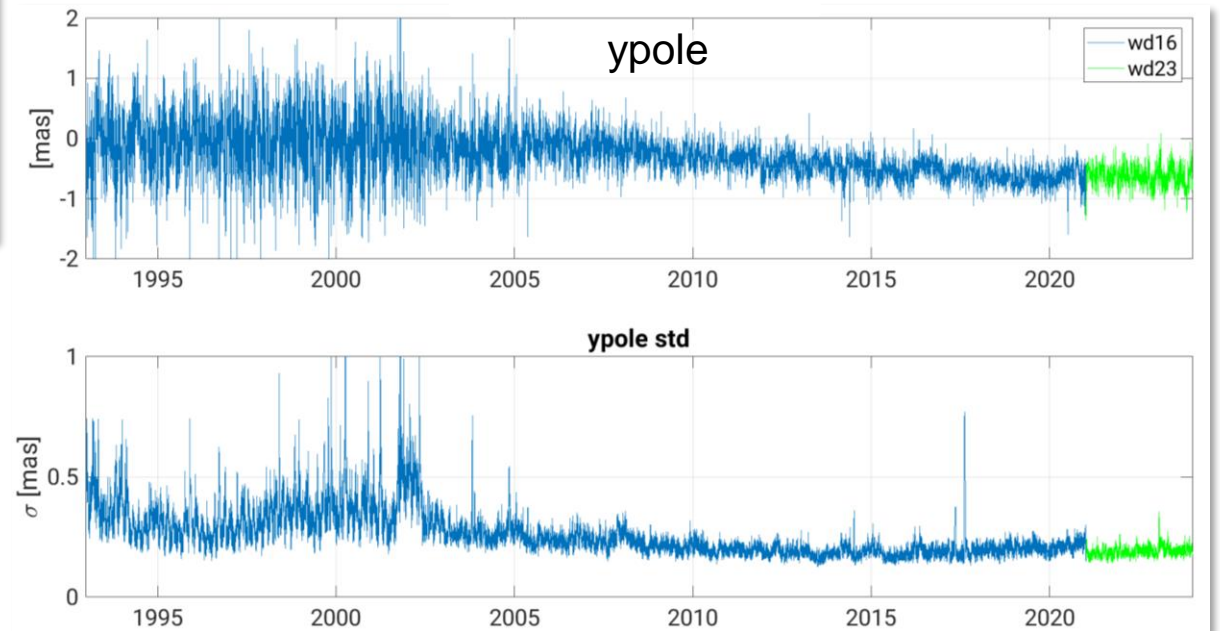
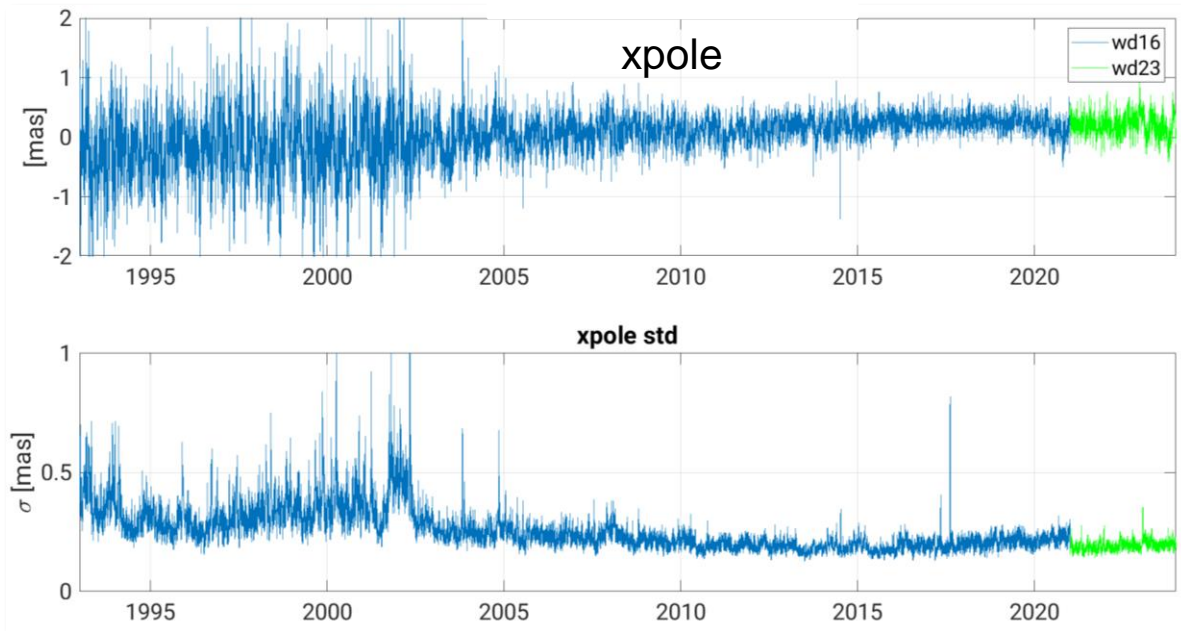
- Positions: 1.34 mm
- Velocities: 0.15 mm/yr



Impact of both, unconsidered discontinuities and weak long-term stability

DORIS TRF solution - EOP

EOP series consistently estimated with DORIS extended TRF: difference series w.r.t. IERS 20 C04



- Widely consistent: only small offsets and drift changes
- Standard deviations decrease clearly

Summary and Conclusion

Consistency for wd16 and wd23 series provided for xTRF2020 extension

- Good for xpole and ypole and a few stations position time series
- Not ideal for many station position and the scale time series

→ Reasons are not yet fully clear, but the number and weights of AC might play a role.

- First extended DORIS TRF solution computed with 4 additional discontinuities only, to not further weaken the long-term stability.

Questions w.r.t. the challenges in the DORIS TRF computation:

- What is the reason for the significant changes of AC weights at epoch 2016.0 in the wd16 series?
- What can be the reasons for the differences between wd16 and wd23 series (figured out as changes in station positions and velocities as well as in the RMS of station position time series)?
Are model changes be performed from wd16 to wd23? Does the number and the weighting of the AC might play a role?
- Would it be possible to improve the SINEX series wd16 and wd23 in terms of their consistency? Otherwise the computation of an high-precise and long-term stable DORIS TRF is not possible.