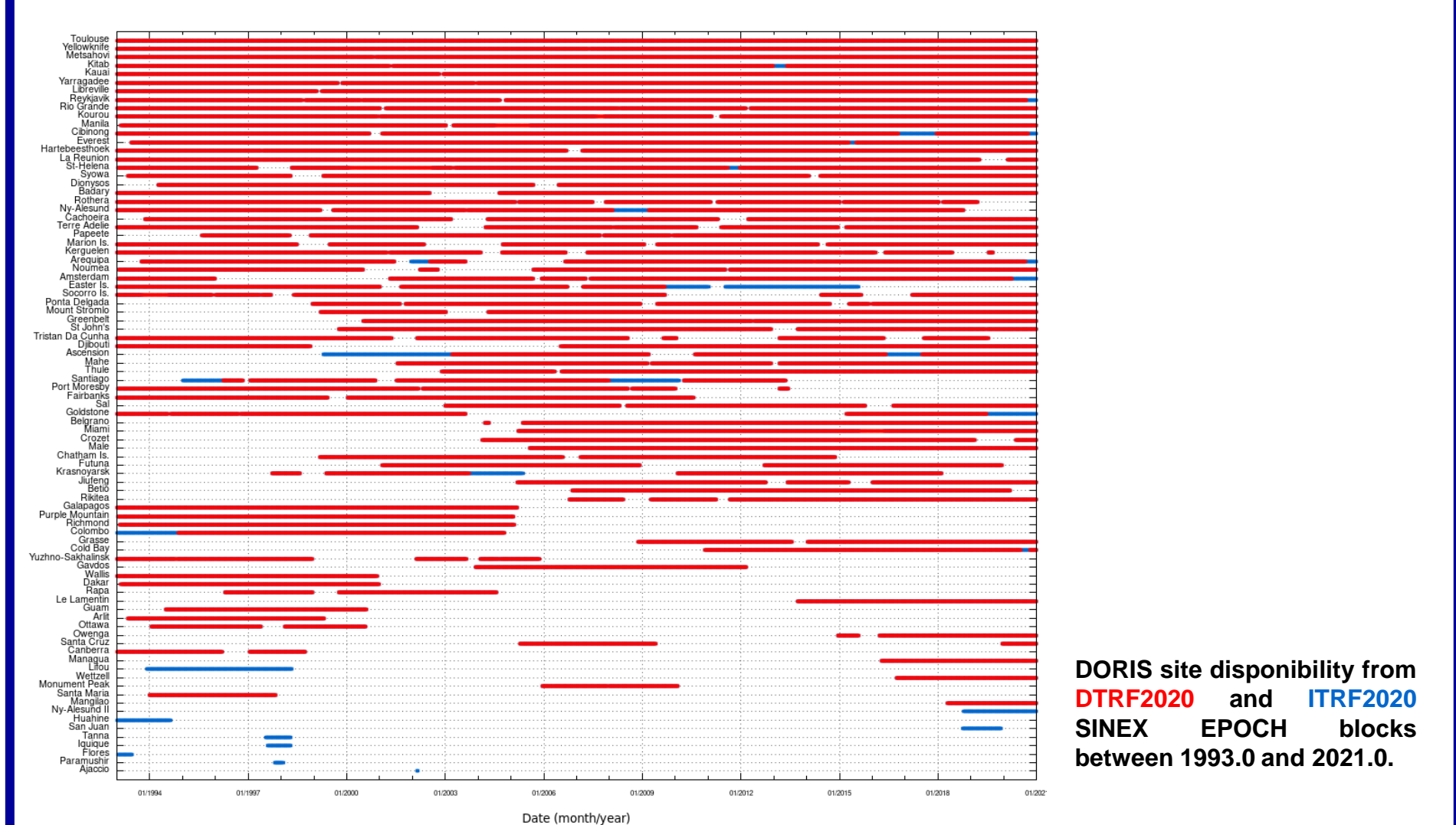
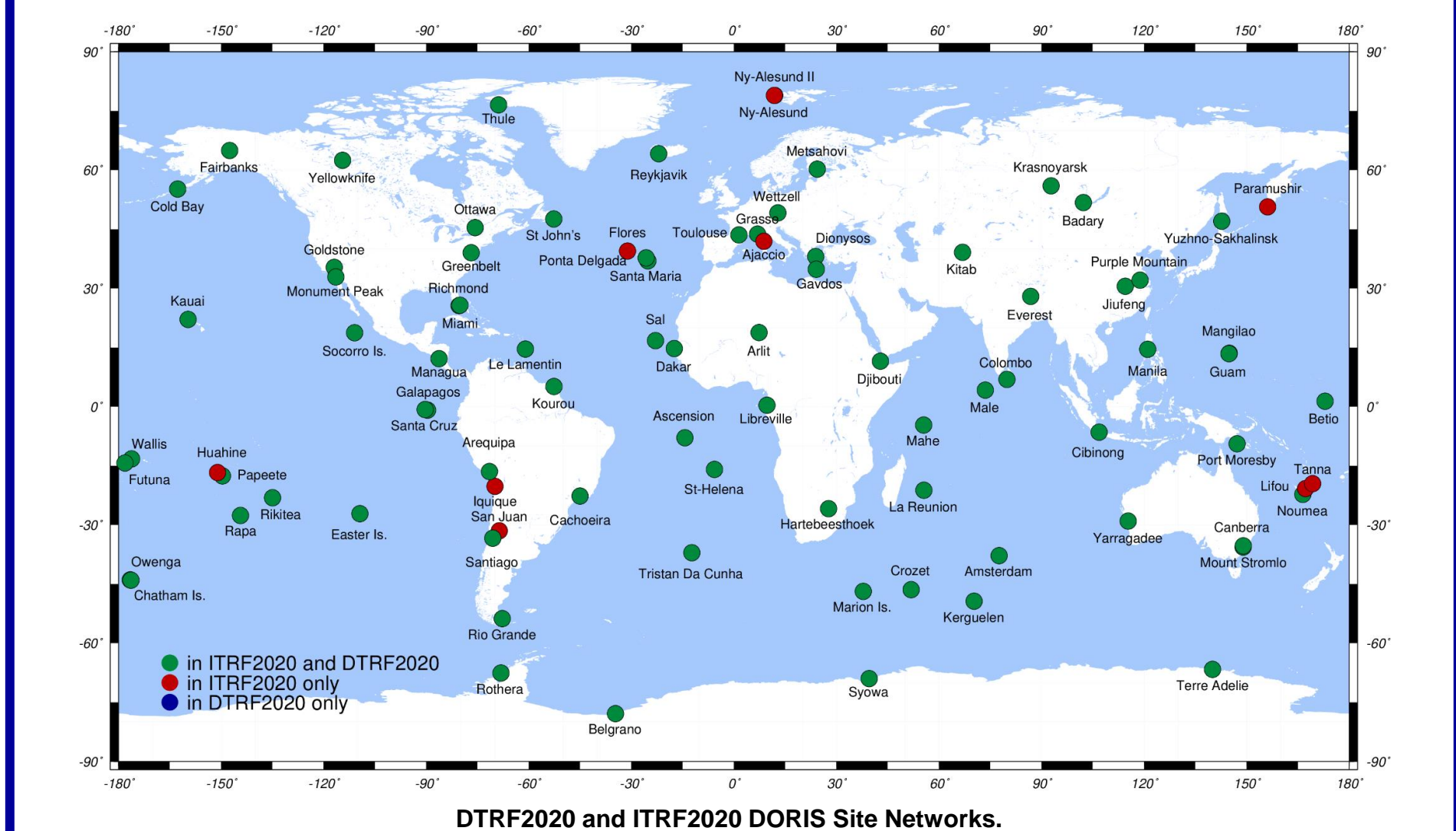


Abstract

In the context of the 2020 realization of the International Terrestrial Reference Frame, the three IERS Production Centers (DGFI, IGN and JPL) delivered three independent solutions from the contributions of the four space geodetic techniques (DORIS, GNSS, SLR and VLBI). Even if these three ITRF2020 realizations are based on the same input, they differ on several points such as the space geodetic techniques weighting, the coordinate time series discontinuities and on the modelling of the station displacements. In this study, we use the coordinate time series of the two hundred DORIS stations from 1993.0 to 2022.5 as benchmark to investigate the characteristics of the ITRF2020 and DTRF2020 realizations. After presentation of the overall performance of these two TRF realizations in terms of geocenter, scale and mean velocities, we assess the quality of the weekly restitution of the DORIS station positions by the DTRF2020, and ITRF2020 solutions. Then, we make benefit of the one and a half year since the ending of the ITRF2020 time period to evaluate these two 2020 TRF solutions in terms of prediction of the DORIS station positions. Finally, we will estimate the impact of the DTRF2020 and ITRF2020 solutions on DORIS precise orbit determination.

ITRF2020 & DTRF2020 DORIS Solutions



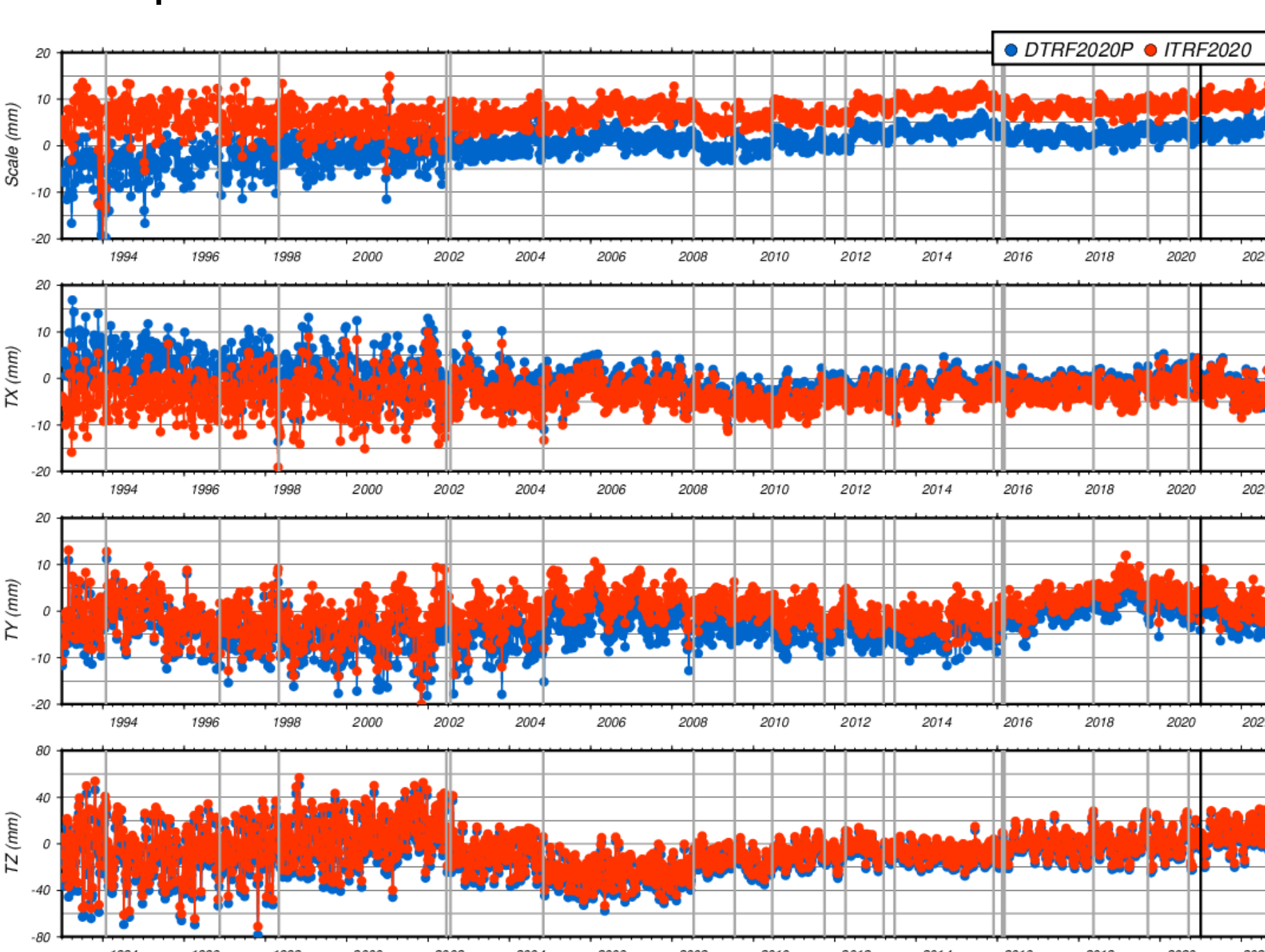
	DTRF2020	ITRF2020
Scale definition	VLBI and GNSS	VLBI (up to 2013.75) and SLR (since 1997.7)
Origin definition	SLR	SLR
Number of Sites	78	87
Number of Stations	192	201
Number of discontinuities	93 @ 56 stations @ 41 sites	86 @ 54 stations @ 38 sites
Number of position/velocity sets	272	287
Number of sites with post-seismic deformation correction	1	8

□ DGFI did not include sites with less than 2.5 years of observation: Ajaccio, Flores, Huahine, Iquique, Lifou, Ny-Ålesund II, Paramushir, San Juan and Tana → 9 sites/stations less compared to ITRF2020.

□ In addition, DGFI did not provide mean positions and velocities for 12 time segments associated with 9 stations (Arequipa, Ascension, Colombo, Easter-Island, Everest, Goldstone, Krasnoyarsk, Ny-Ålesund, Santiago).

ITRF2020 & DTRF2020 DORIS Scale and Geocenter

IDS 20 (extension of the IDS contribution to ITRF2020) scale and geocenter with respect to DTRF2020 and ITRF2020 from 1993.0 to 2022.75.



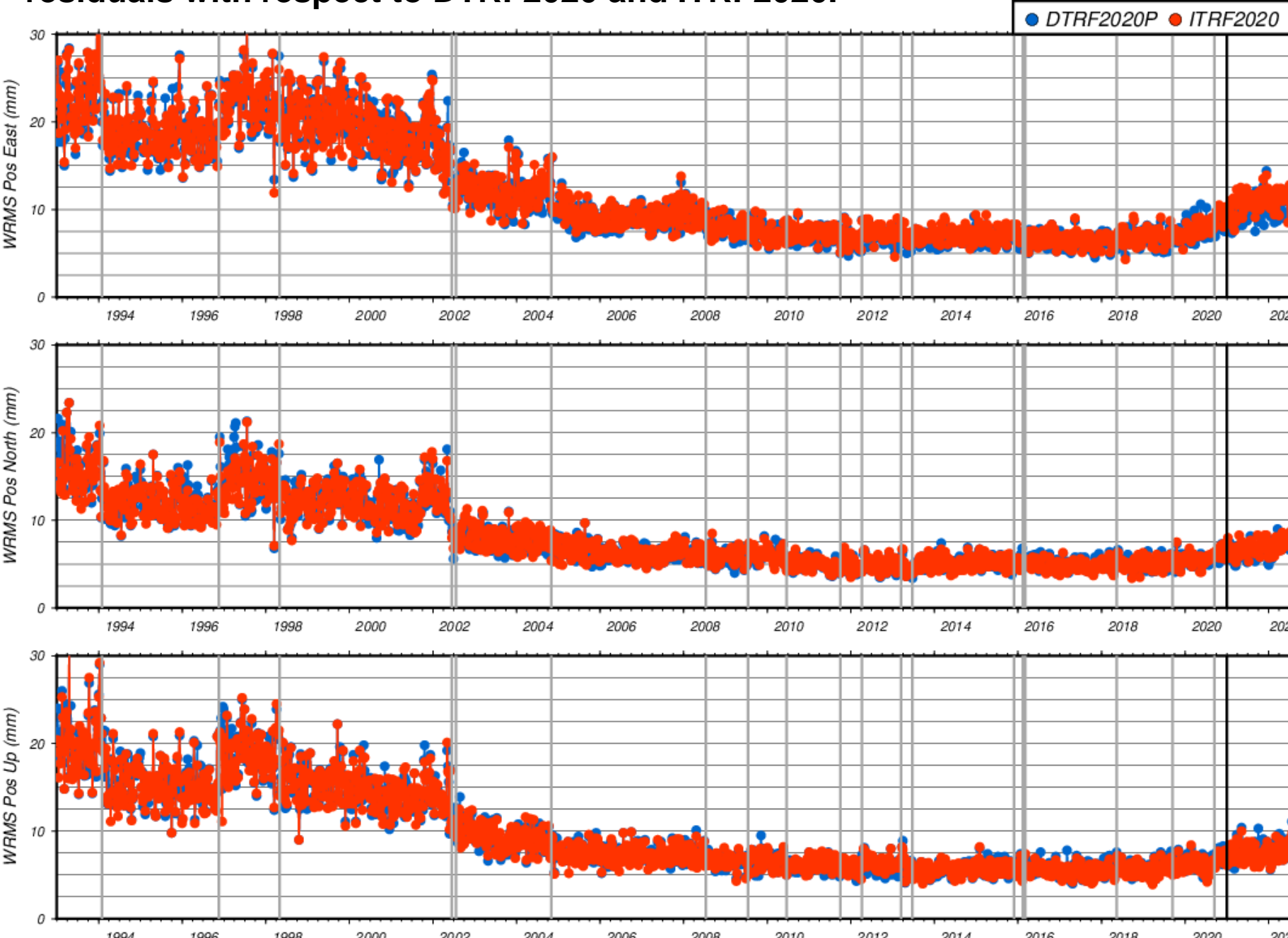
Time Period	DTRF2020	ITRF2020
1993.0-2002.5	-3.17 ± 3.90 (0.51)	5.43 ± 3.85 (0.21)
2002.5-2008.5	0.69 ± 1.72 (0.27)	6.87 ± 1.75 (0.43)
2008.5-2022.75	2.15 ± 1.58 (0.25)	8.22 ± 1.73 (0.26)
1993.0-2002.5	2.01 ± 4.42 (-0.58)	-3.58 ± 4.41 (0.88)
2002.5-2008.5	-1.00 ± 3.01 (-0.86)	-3.16 ± 3.03 (0.89)
2008.5-2022.75	-1.85 ± 2.24 (0.18)	-3.20 ± 2.55 (0.26)
1993.0-2002.5	-4.47 ± 4.71 (-0.67)	-1.86 ± 4.72 (-0.28)
2002.5-2015.9	-4.00 ± 3.47 (0.93)	1.10 ± 3.92 (0.92)
2015.9-2022.75	-2.41 ± 2.92 (0.44)	1.07 ± 2.92 (0.27)
1993.0-2002.5	-5.83 ± 21.81 (2.82)	0.17 ± 21.80 (2.67)
2002.5-2008.5	-21.85 ± 12.39 (-3.75)	-17.42 ± 12.31 (-3.78)
2008.5-2022.75	-5.87 ± 9.19 (1.58)	-2.45 ± 9.20 (1.48)

Main statistics (mean, std in mm and trend in mm/yr) of the IDS 20 Helmert parameters with respect to DTRF2020 and ITRF2020.

- Scale differences must be mostly explained by DTRF2020 and ITRF2020 scale definitions (VLBI+GNSS vs SLR+VLBI).
- Scale and Tx differences up to 2005.0 may also be related to handling of the DORIS stations equipped with Alcatel antennas.

ITRF2020 & DTRF2020 DORIS Station Positioning

IDS 20 (extension of the IDS contribution to ITRF2020) station position residuals with respect to DTRF2020 and ITRF2020.



Time Period	DTRF2020	ITRF2020
1993.0-2002.5	19.88 ± 2.29	19.94 ± 3.37
2002.5-2008.5	10.35 ± 2.00	10.46 ± 1.95
2008.5-2022.75	6.95 ± 0.97	7.20 ± 0.96
2021.6-2022.75	10.09 ± 1.25	10.01 ± 1.19
1993.0-2002.5	13.06 ± 2.68	12.81 ± 2.49
2002.5-2008.5	6.97 ± 1.32	7.02 ± 1.31
2008.5-2022.75	5.24 ± 0.75	5.22 ± 0.77
2021.6-2022.75	6.63 ± 0.90	7.09 ± 0.87
1993.0-2002.5	16.28 ± 3.31	16.11 ± 3.21
2002.5-2015.9	8.25 ± 1.46	8.17 ± 1.47
2008.5-2022.75	6.00 ± 0.82	5.98 ± 0.82
2021.6-2022.75	7.80 ± 1.02	7.58 ± 0.92

- Similar East, North and Up performance and patterns for DTRF2020 and ITRF2020.
- Degradation post-2021.0 is mostly due to the time evolution of the DORIS station network.

DORIS POD Tests with DTRF2020 and ITRF2020

□ DORIS Processing context
DORIS data have been processed with GINS/DYNAMO software taking into account IERS conventions and IDS recommendations for the ITRF2020 realization. We compared DPOD2014_05 vs ITRF2020 and vs DTRF2020. DORIS data used:

- TOPEX from year 1994 (P1), 1999 (P2) and 2004 (P3)
- Jason-2 from year 2009 (P4) and 2014 (P5)
- Jason-3 from year 2019 (P6)

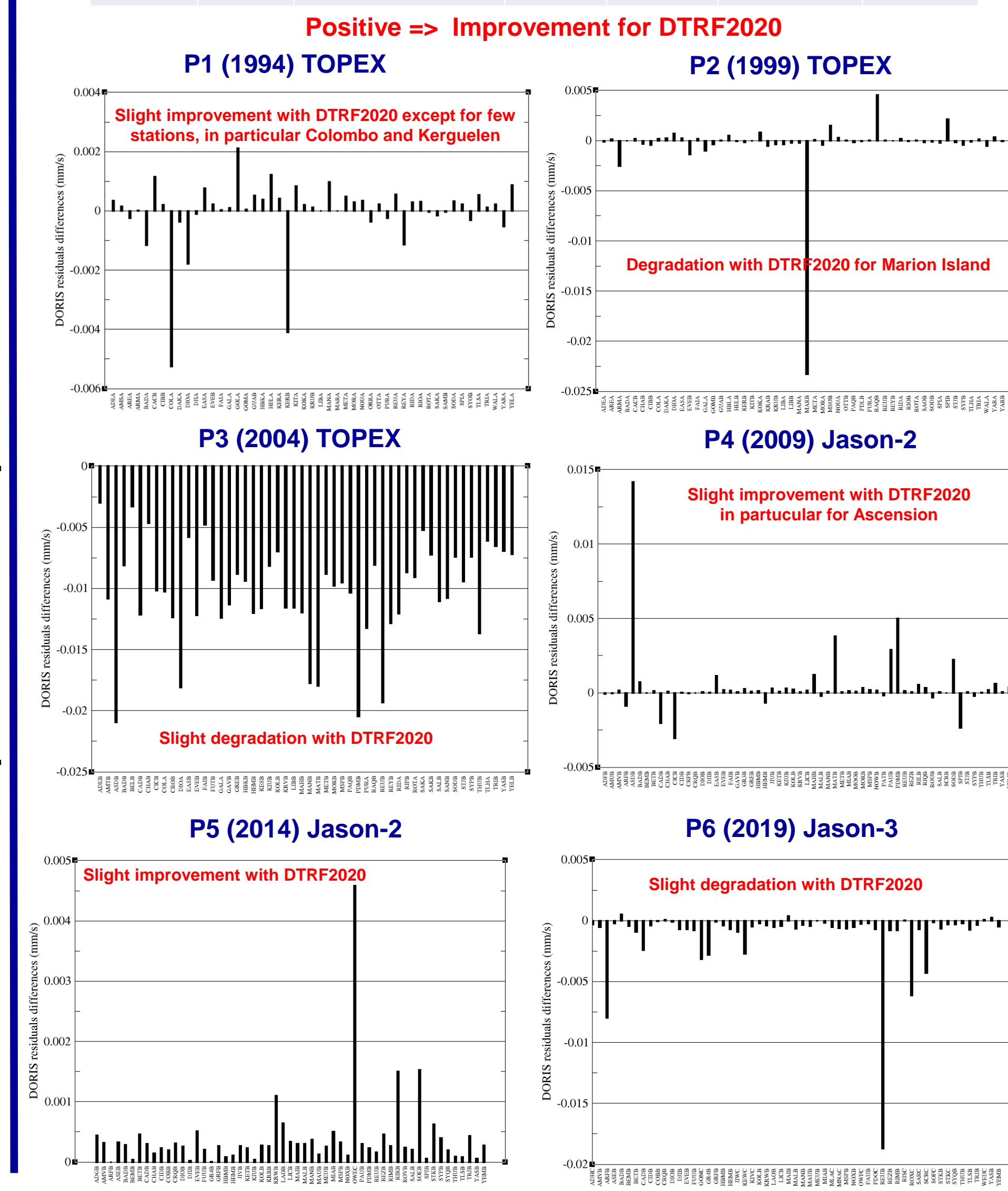
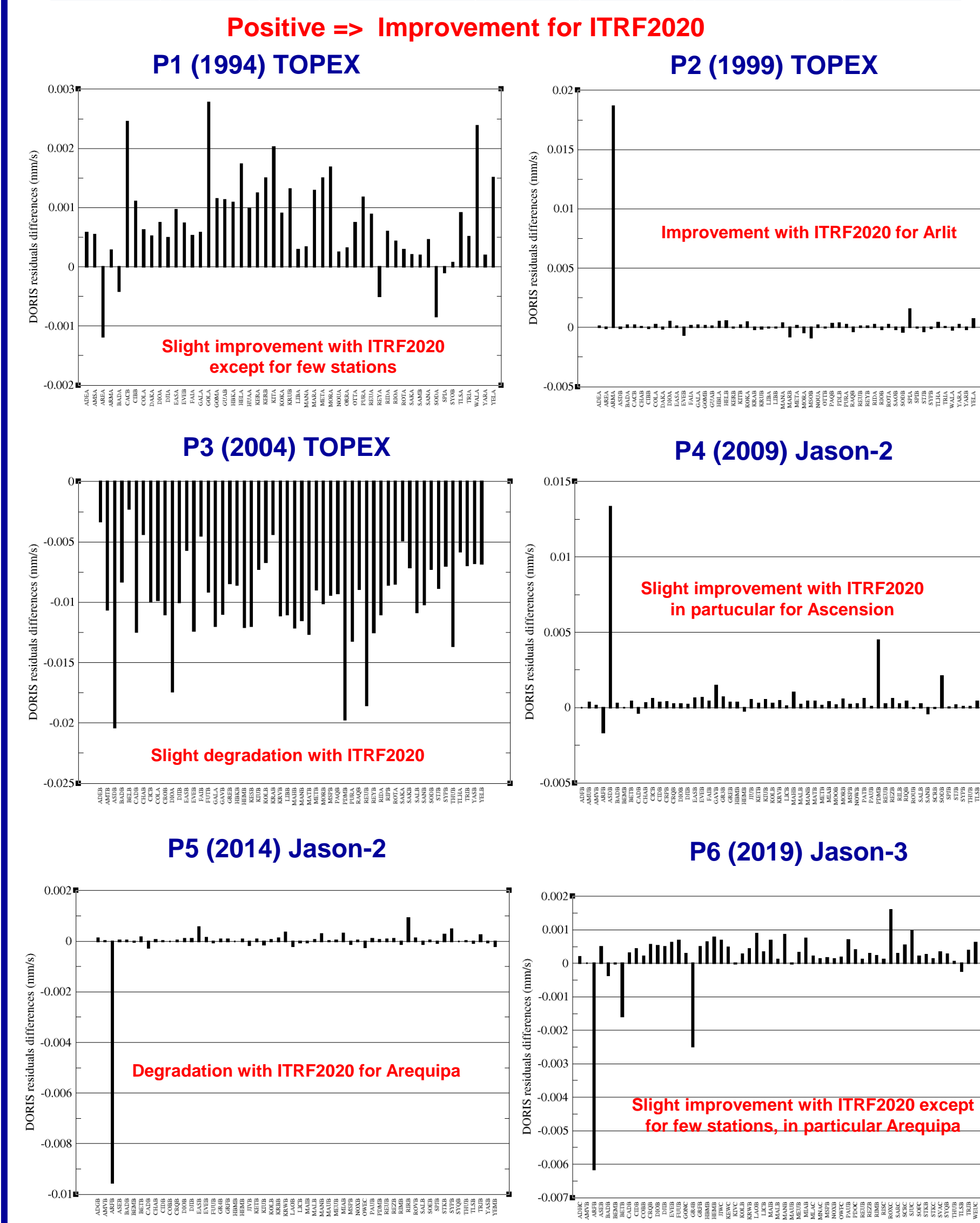
DORIS residuals RMS differences global and by station

□ DORIS residuals comparison DPOD2014 - ITRF2020

Period	Satellite	Difference	No. stations	maximum	minimum	mean
P1 (1994)	TOPEX	DPOD14-ITRF2020	51	0.00277 GOLA	-0.00118 AREA	+0.00076
P2 (1999)	TOPEX	DPOD14-ITRF2020	54	0.01865 ARMA	-0.00084 MSOB	+0.00042
P3 (2004)	TOPEX	DPOD14-ITRF2020	54	-0.00227 BELB	-0.02037 ASDB	-0.00975
P4 (2009)	Jason-2	DPOD14-ITRF2020	60	0.01334 ASDB	-0.00165 ARFB	+0.00057
P5 (2014)	Jason-2	DPOD14-ITRF2020	59	0.00091 RIMB	-0.00954 ARFB	-0.00011
P6 (2019)	Jason-3	DPOD14-ITRF2020	59	0.00160 ROXC	-0.00615 ARFB	+0.00086

□ DORIS residuals comparison DPOD2014 - DTRF2020

Period	Satellite	Difference	No. stations	maximum	minimum	mean
P1 (1994)	TOPEX	DPOD14-DTRF2020	49	0.00212 GOLA	-0.00525 COLA	-0.00002
P2 (1999)	TOPEX	DPOD14-DTRF2020	53	0.00455 RAQB	-0.02330 MARB	-0.00039
P3 (2004)	TOPEX	DPOD14-DTRF2020	52	-0.00301 ADEB	-0.02094 ASDB	-0.01036
P4 (2009)	Jason-2	DPOD14-DTRF2020	59	0.01416 ASDB	-0.00305 CICB	+0.00046
P5 (2014)	Jason-2	DPOD14-DTRF2020	55	0.00458 OWEC	-0.00001 ARFB	+0.00039
P6 (2019)	Jason-3	DPOD14-DTRF2020	57	0.00051 BADB	-0.01870 REUB	-0.00157



Conclusions

- ITRF2020 and DTRF2020 DORIS versions are based on the IDS contribution to the ITRF2020 (IDS 16 weekly SINEX files).
- ITRF2020 includes more stations/sites than DTRF2020 since DGFI rejected 9 sites with short time spans (shorter than 2.5 years).
- In addition, DGFI did not provide 12 time segments of 9 stations.
- IDS 19 (extension of IDS 16) scales wrt DTRF2020 and ITRF2020 show an overall bias mostly due to the DTRF2020 and ITRF2020 scale definitions.
- IDS 19 scale and X-translation wrt DTRF2020 and ITRF2020 depict trend differences up to late 2004. These patterns may be due to how the beacons equipped with Alcatel antennas were processed. Note that a new Alcatel phase law was implemented for the ITRF2020.
- DTRF2020 and ITRF2020 give very similar IDS 19 station position residuals results.
- DORIS POD tests with ITRF2020 and DTRF2020 DORIS residuals RMS differences global and by station

DPOD2014-v5 vs ITRF2020
Very small differences but: slight improvement with ITRF2020 except in 2004 and note a degradation for Arequipa in 2014 and in 2019, an improvement for Ascension in 2009

DPOD2014-v5 vs DTRF2020
Very small differences but: slight improvement with DTRF2020 in 2014 slight degradation in 1999, 2004 and 2019 and note an improvement for Ascension in 2009