

A satellite with gold-colored thermal blankets and solar panels is shown in space, orbiting Earth. The Earth's surface is visible below, showing blue oceans and green landmasses. The background is a dark starry sky.

Comparison between DPOD2014 and ITRF2020 : Impact on the DORIS satellite orbits



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Outline

- Context
- Network discrepancies
- DORIS satellite orbits :
 - . ITRF2020 : Impact of annual and semi-annual signals
 - . Comparison ITRF2020 vs DPOD2014

Context

- New release of ITRF : ITRF2020

Main change compared to ITRF2014 :

In addition to the post-seismic modeling, it is possible to add annual and semi-annual signals to the station coordinates (signals provided in CM or CF). Here, as we compute orbits, we will use the signals provided in CM.

Goals :

- Study the contribution of these annual and semi-annual signals for the calculation of DORIS satellite orbits
- Compare ITRF2020 with PSD only or with PSD and annual and semi-annual signals with DPOD2014 (frame aligned to ITRF2014, linear model – pos + vel)

Context

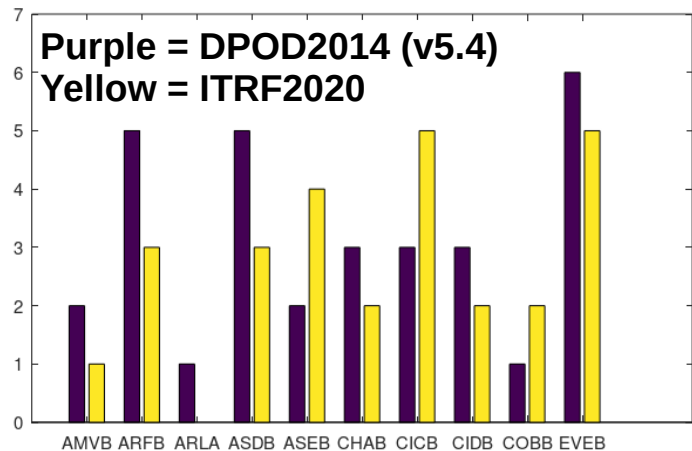
We have computed few years of DORIS data for 5 satellites with NASA/JPL GipsyX software :

SPOT2 (1998-2003), SPOT5(2005-2007), Jason-2 (2010-2013), SARAL (2015-2016) and Sentinel-3A (2017-2020)

For each satellite, daily orbital arcs with 6h of overlap, stations and EOPs are **FIXED**, 3 a-priori station coordinates used : DPOD2014 (v5.4 - 2021/08/31), ITRF2020 without annual and semi-annual signals and ITRF2020 with annual and semi-annual signals

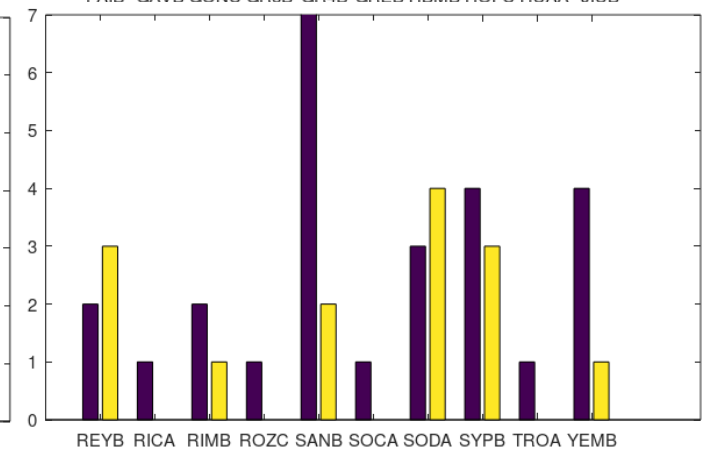
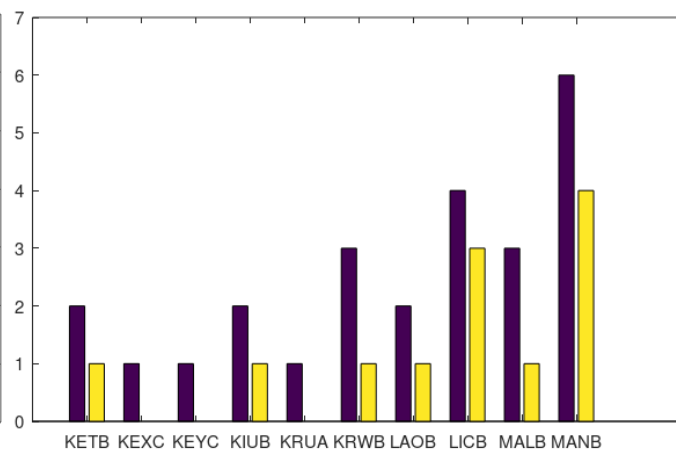
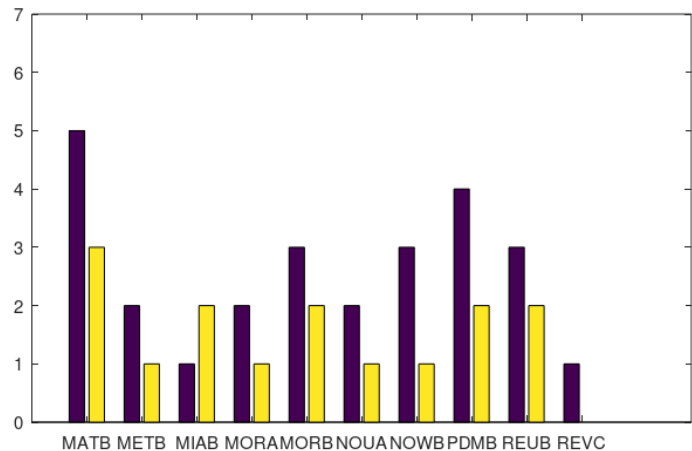
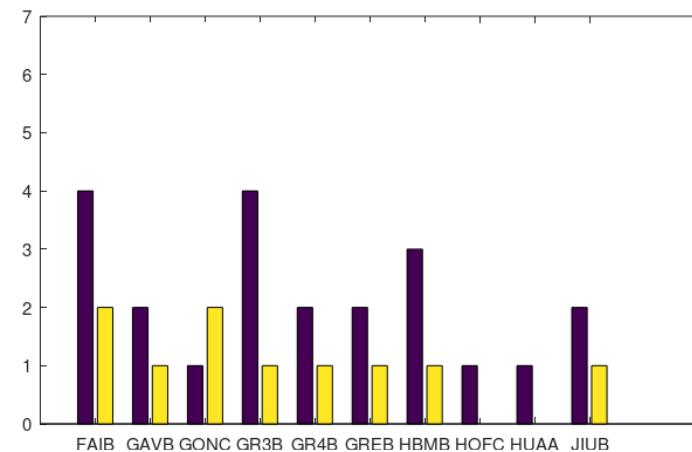
	SPOT2	SPOT5	Jason-2	Sentinel-3A	SARAL
DPOD2014	SP2_DPOD	SP5_DPOD	JA2_DPOD	S3A_DPOD	SRL_DPOD
ITRF2020 wo periodic terms	SP2_ITRF_PSD	SP5_ITRF_PSD	JA2_ITRF_PSD	S3A_ITRF_PSD	SRL_ITRF_PSD
ITRF2020 w periodic terms	SP2_ITRF_ALL	SP5_ITRF_ALL	JA2_ITRF_ALL	S3A_ITRF_ALL	SRL_ITRF_ALL

Network Discrepancies

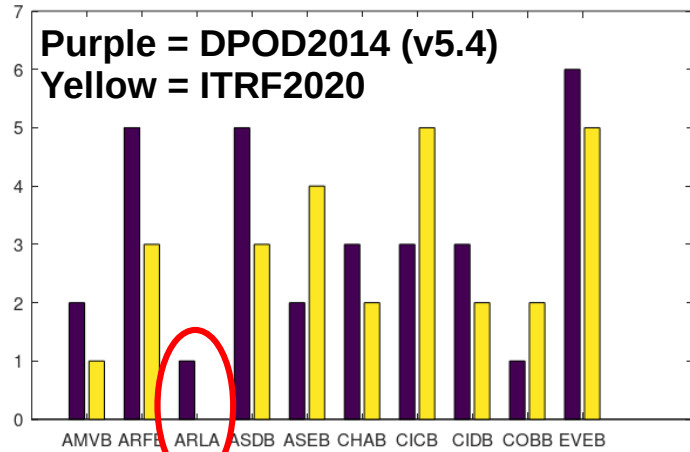


Stations with different
soln number between
ITRF2020
and
DPOD2014 (v5.4)

Purple = DPOD2014 (v5.4)
Yellow = ITRF2020

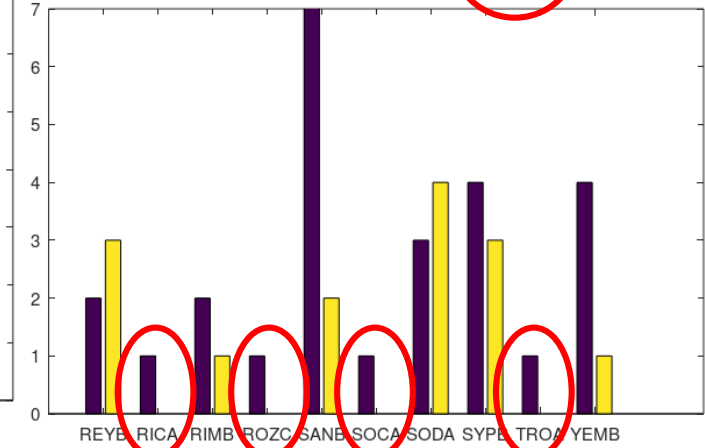
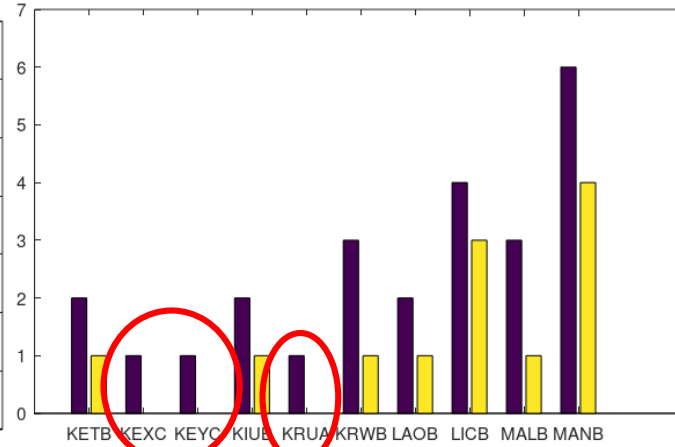
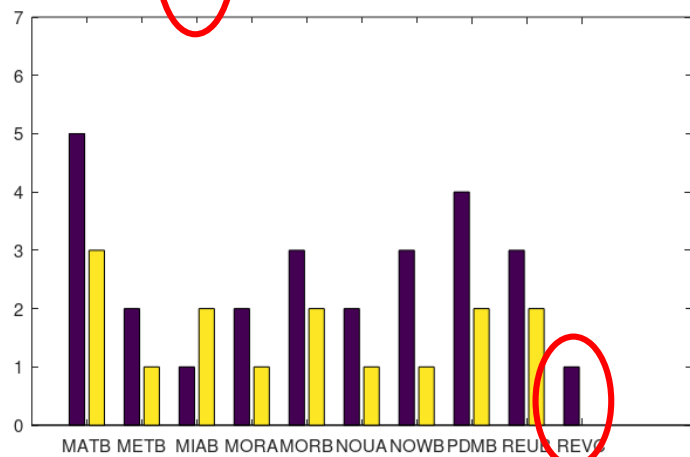
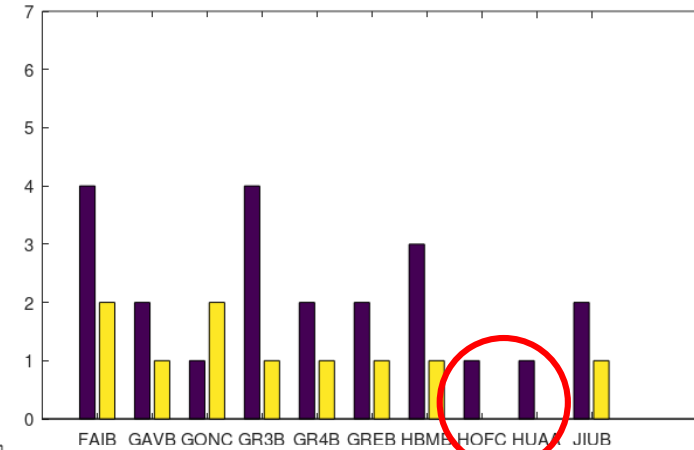


Network Discrepancies

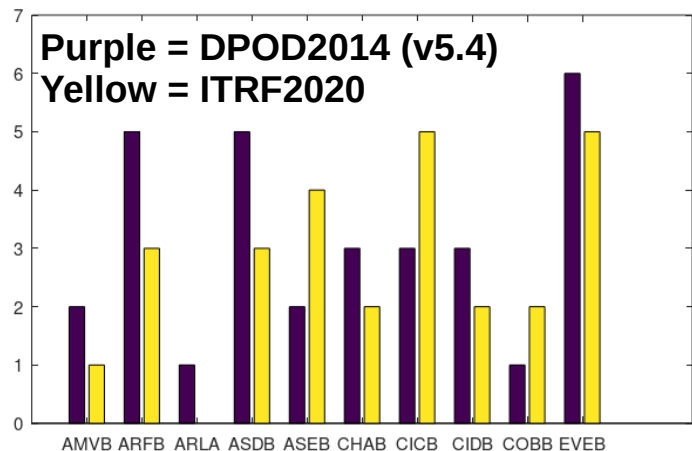


10 stations without any coordinates in ITRF2020

Two cases :
- After 2020
- Before 1994

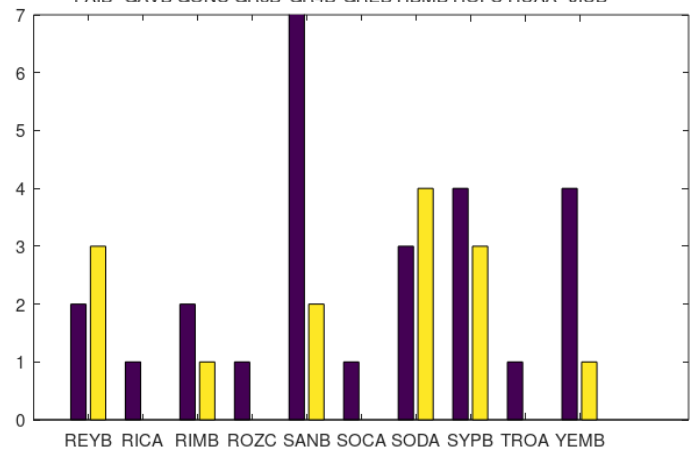
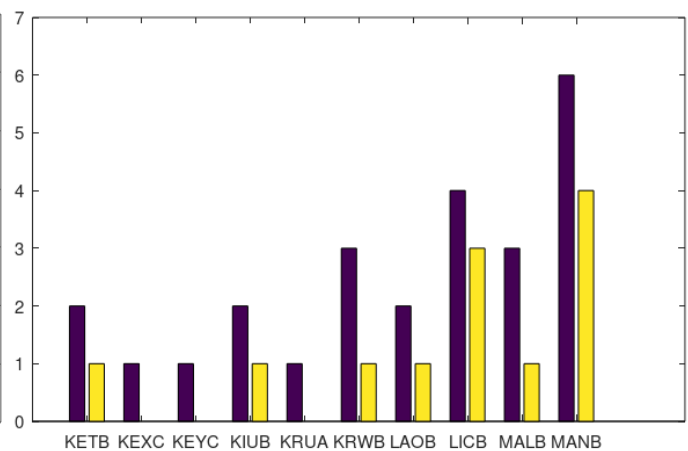
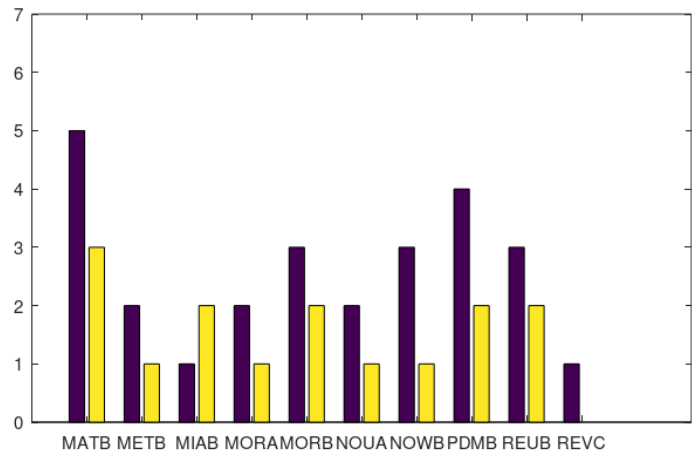
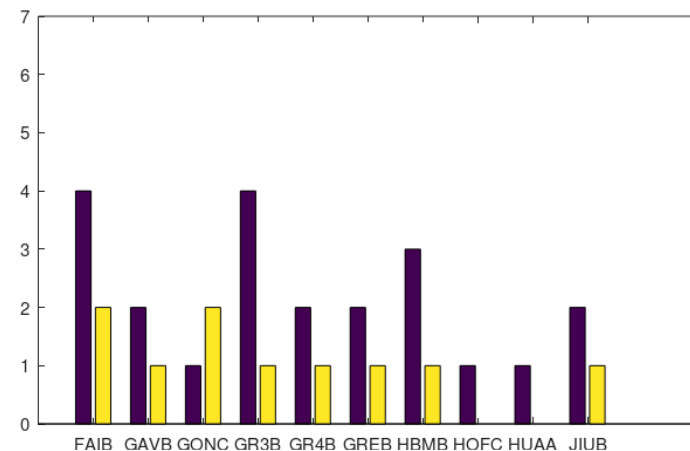


Network Discrepancies



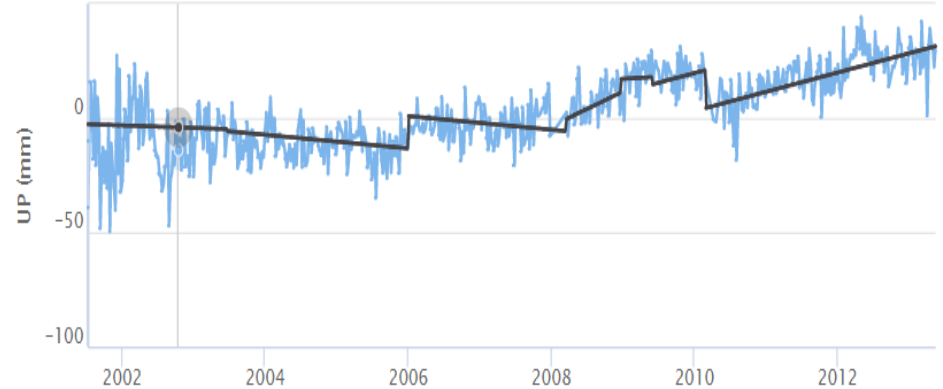
7 stations with more soln in ITRF2020

33 stations with more soln in DPOD2014



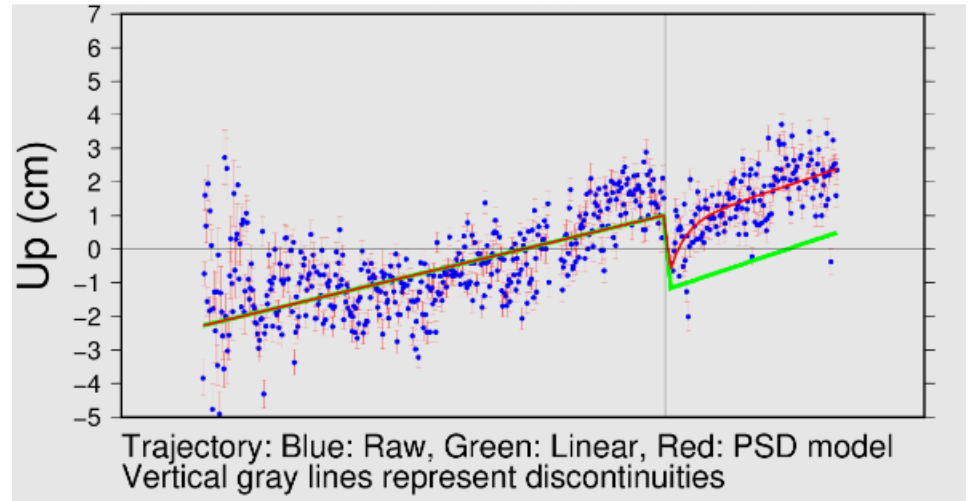
Differences mainly due to the PSD model of ITRF :

DPOD 2014

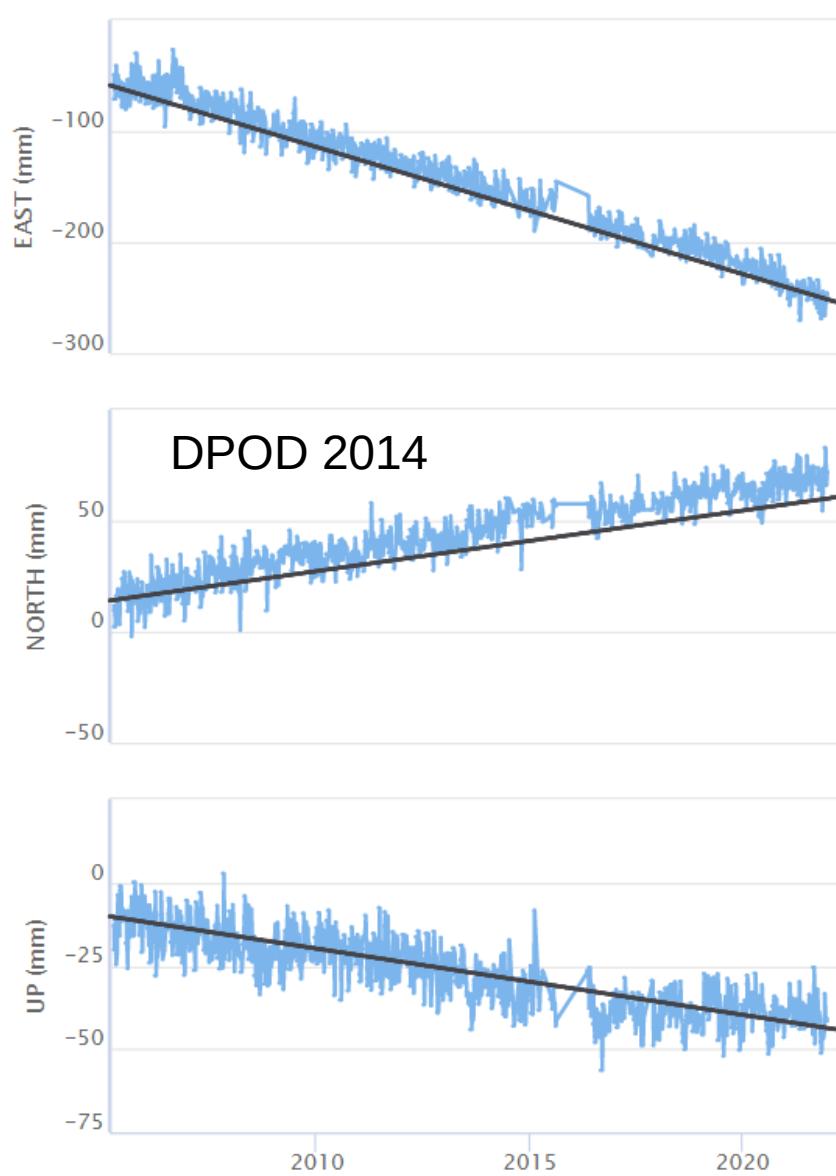


- Example :
Station SANB (Chili) :
8 soln in DPOD2014 (v5.4)
2 soln in ITRF2020

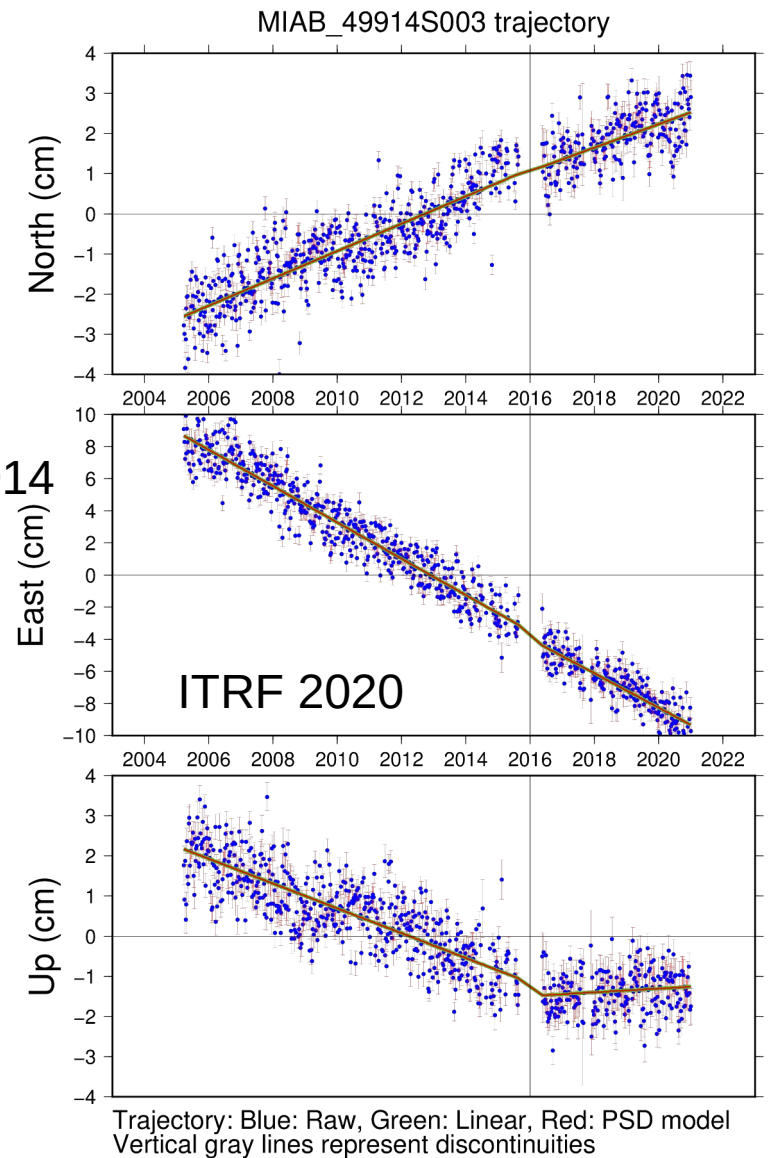
ITRF 2020



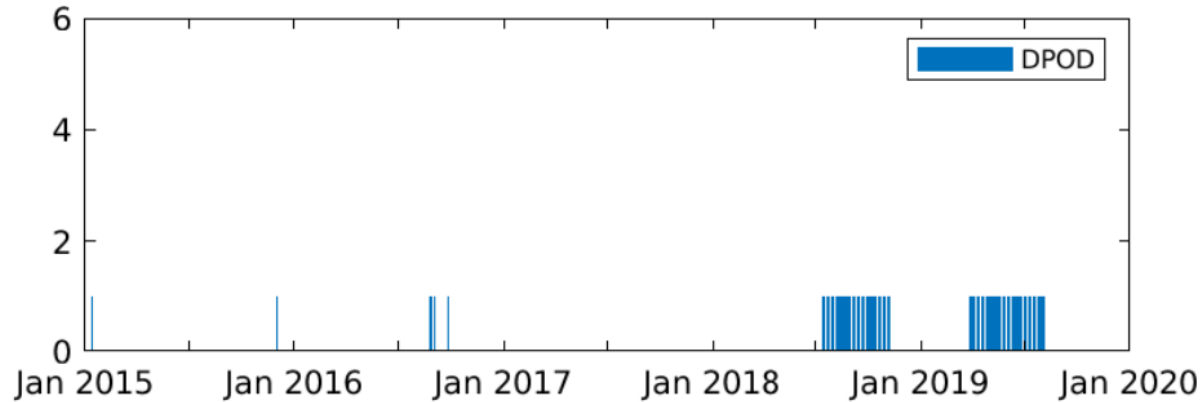
Extract from the web service of IDS website
(<https://apps.ids-doris.org/apps/stcdtool.html>)
And from itrf web site (<https://itrf.ign.fr/en/timeseries>)



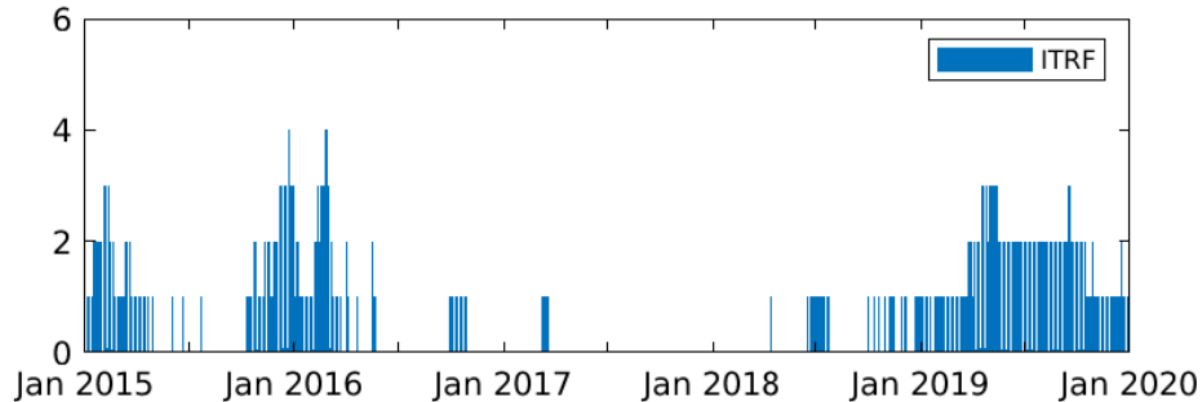
Station MIAB
(Miami)
1 soln in DPOD2014
2 in ITRF2020



Network Discrepancies



Number of stations with coordinates in ITRF2020 and not in DPOD2014 (v5.4)



Number of stations with coordinates in DPOD2014 (v5.4) and not ITRF2020

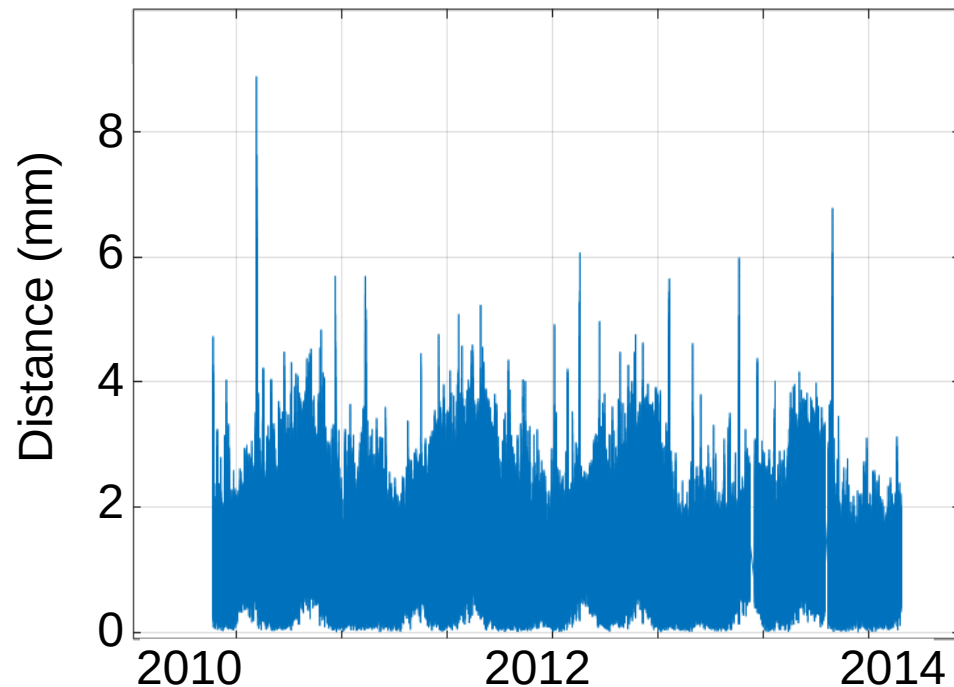
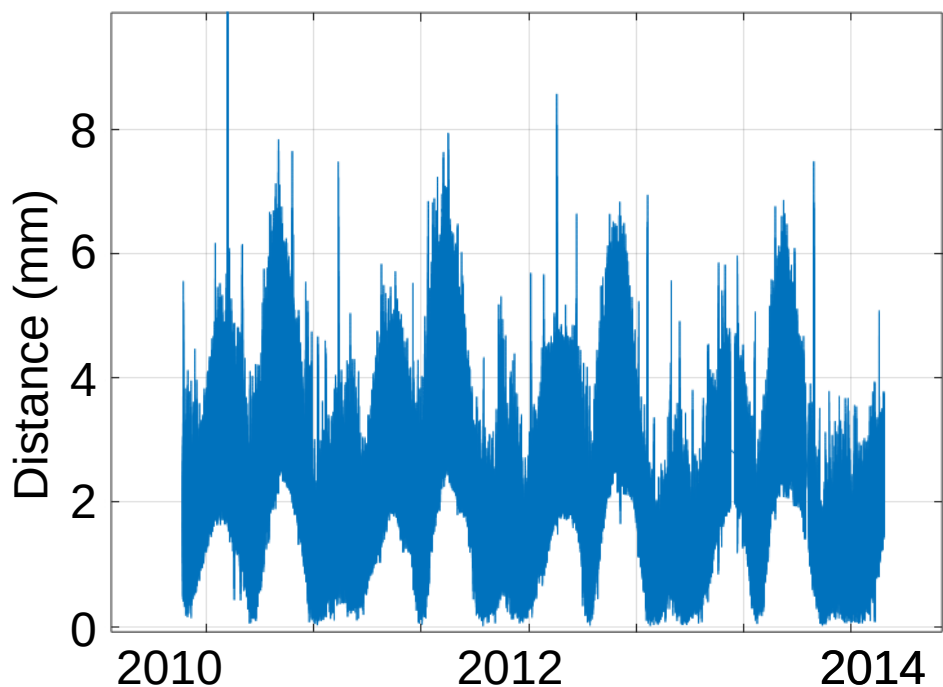
ITRF2020 : Impact of annual and semi-annual signals

	R (mm)	T (mm)	N (mm)
S3A	0,4 ± 0,2	0,7 ± 0,2	0,5 ± 0,2
SRL	0,3 ± 0,2	0,6 ± 0,2	1,3 ± 0,6
JA2	0,3 ± 0,1	0,9 ± 0,2	1,1 ± 0,4
SP5	0,4 ± 0,2	0,7 ± 0,2	0,6 ± 0,2
SP2	0,4 ± 0,2	0,9 ± 0,7	0,8 ± 0,7

Mean and std of daily RMS of differences between orbits computed with ITRF2020 + periodic signals and orbits with ITRF2020 without periodic signals

Differences mainly sub-mm

ITRF2020 : Impact of annual and semi-annual signals



Distance between orbits from JA2_ITRF_ALL and JA2_ITRF_PSD

Left : Non corrected from potential frame discrepancies

Right : Corrected via estimation of translations, rotations and scale factor

ITRF2020 : Impact of annual and semi-annual signals

7 parameters estimated between SAT_ITRF_ALL and SAT_ITRF_PSD

For each time series (Tx, Ty, Tz, DD, Rx, Ry, Rz), we estimates bias, drift, annual and semi-annual signals

Values close to 0,1 mm for all estimated parameters except for the Tz annual signal

	S3A	SRL	JA2	SP5	SP2
Tz annual signal (mm)	2,2 ± 0,1	1,8 ± 0,1	2,3 ± 0,1	2,3 ± 0,1	1,4 ± 0,0

ITRF2020 vs DPOD2014

Two comparisons :

One « internal » comparison between our solutions ITRF2020 and DPOD2014
(only the a priori TRF change – same other models and parameter estimated)

One « external » solution by comparing our solutions to POD SSA orbits
(POD SSA orbits provided from 2010, computed with other on-board techniques if present,
other models and parameters, especially a geocenter motion is added)

ITRF2020 vs DPOD2014

Mean and std of daily RMS of differences between orbits computed with ITRF2020 + periodic signals or DPOD2014

	R (mm)	T (mm)	N (mm)
S3A	1,9 ± 1,2	6,7 ± 2,9	8,1 ± 3,7
SRL	3,7 ± 2,0	11,0 ± 4,7	12,2 ± 6,0
JA2	2,2 ± 0,8	7,7 ± 2,8	10,3 ± 4,5
SP5	1,0 ± 0,6	3,4 ± 1,5	5,3 ± 1,8
SP2	0,8 ± 0,4	2,2 ± 1,4	3,8 ± 2,2

ITRF2020 vs DPOD2014

	SAT_ITRF_ALL vs POD SSA orbits			SAT_DPOD vs POD SSA orbits		
SAT	R (mm)	T (mm)	N (mm)	R (mm)	T (mm)	N (mm)
S3A	6,5 ± 1,3	24,9 ± 7,1	19,7 ± 6,2	6,1 ± 1,3	24,9 ± 7,2	18,5 ± 5,2
SRL	8,1 ± 2,8	36,5 ± 18,2	27,4 ± 9,2	6,8 ± 2,4	33,6 ± 18,9	25,1 ± 8,2
JA2	5,9 ± 1,6	20,7 ± 4,3	23,2 ± 8,5	5,5 ± 1,4	19,2 ± 4,0	20,6 ± 7,0

Same order of magnitude, DPOD2014 seems a little closer to SSA orbits

ITRF2020 vs DPOD2014

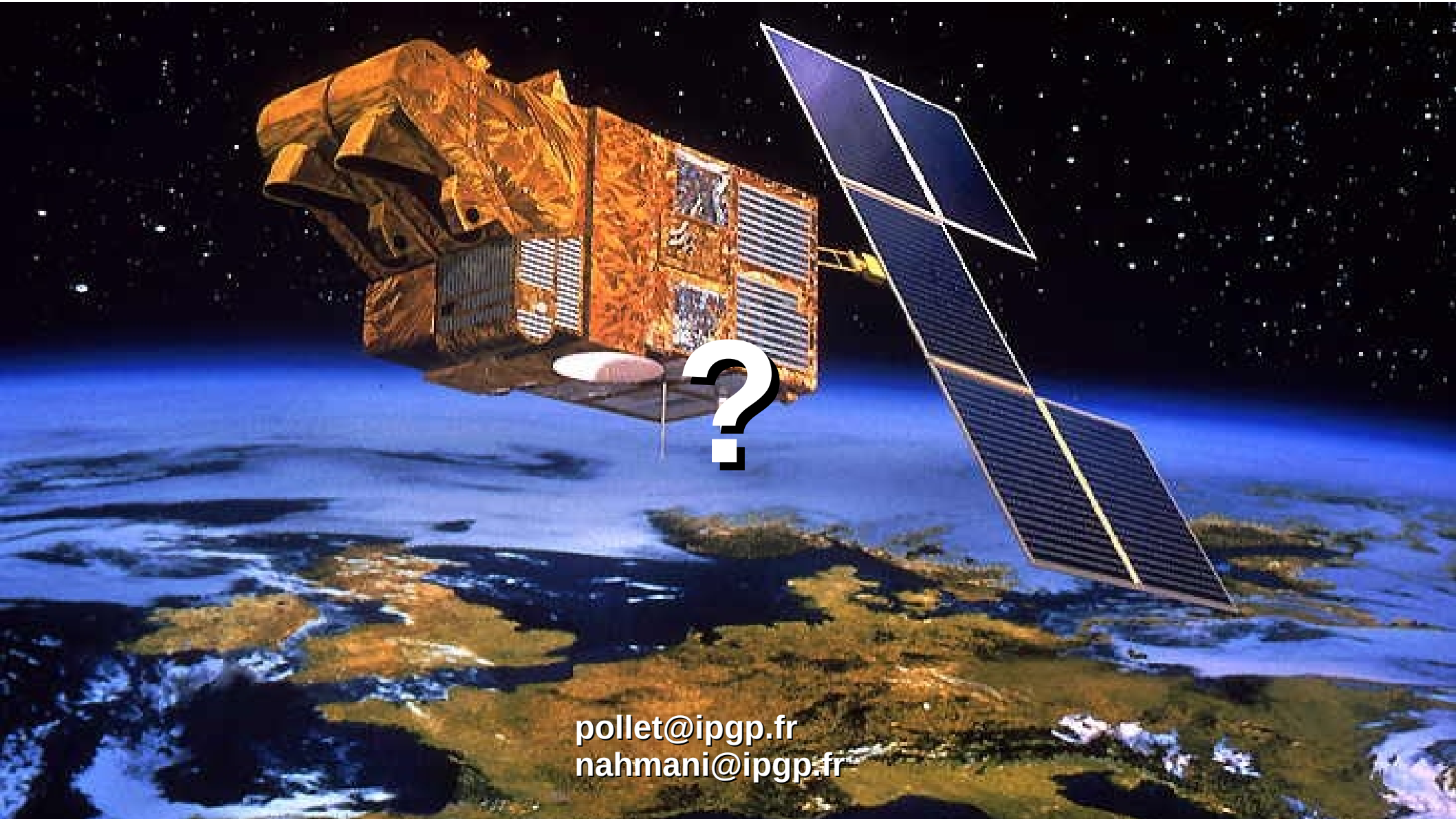
Tz annual signal

	S3A	SRL	JA2	SP5	SP2
ITRF_ALL vs DPOD	1,7 ± 0,3	2,4 ± 0,7	1,6 ± 0,2	2,3 ± 0,2	2,1 ± 0,2
DPOD vs SSA	5,1 ± 0,4	7,0 ± 0,5	6,4 ± 0,4	No SSA orbits before 2010	
ITRF_ALL vs SSA	3,6 ± 0,6	4,4 ± 0,8	5,0 ± 0,5		

Tz annual signal closer to the SSA origin with ITRF2020 compared to DPOD

Conclusion

- ITF2020 + periodic signals (annual and semi-annual) seems to improve the Tz annual signal of the orbit frame.
- No other significant difference between using or no using the ITRF2020P periodic signals.
- Significant difference of orbit (especially T, N) between using ITRF2020P and DPOD
 - * Due to the PSD models ?
 - * Due to the network discrepancy ?



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