



DPOD2014: a new DORIS extension of ITRF2014 for Precise Orbit Determination

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- **Elaboration scheme of the new DPOD2014.**
- **DPOD2014 validation**
 - Internal validation by the IDS Combination Center.
 - External validation by the DPOD validation Group.
- **Preliminary conclusions.**
- **What's next ?**

- **DPOD2014 is constructed by the IDS Combination Center as a DORIS cumulative position/velocity solution based on the IDS combined series.**
- **DPOD2014 does not include Post-Seismic Deformation corrections. Pure linear displacement model.**
- **In order to include most of all the DORIS stations, the IDS CC developed a new combined series (ids 12).**
 - One station is included as soon as it is treated by at least 2 ACs (3 for ids 09).
 - No more condition on the length of the observation period per site (2.5 yrs in ids 09).
 - stations treated by at most 1 AC is not in the DPOD2014 (ex: stations before 1993.0).
- **New sites (with less than 2.5 years of observations): velocities are constrained to velocities from either a GNSS/SLR/VLBI ITRF2014 site (ex: LAOB↔LMMF) or a global tectonic model (ex: GEODVEL, MORVEL).**

The DPOD2014 construction consists of 5 main steps:

- 1. Construction of the IDS combined series from the six IDS Analysis Center multi-satellite weekly solutions starting in 1993.0.**
- 2. Update of the position discontinuity and velocity constraint files.**
 - These two files are updated after analysis of the station coordinate time series.
 - Velocity constraints are used to constrain velocities to the same value over multiple segments unless a velocity discontinuity was observed.
- 3. Update of the DORIS-to-DORIS tie vector file from IGN.**

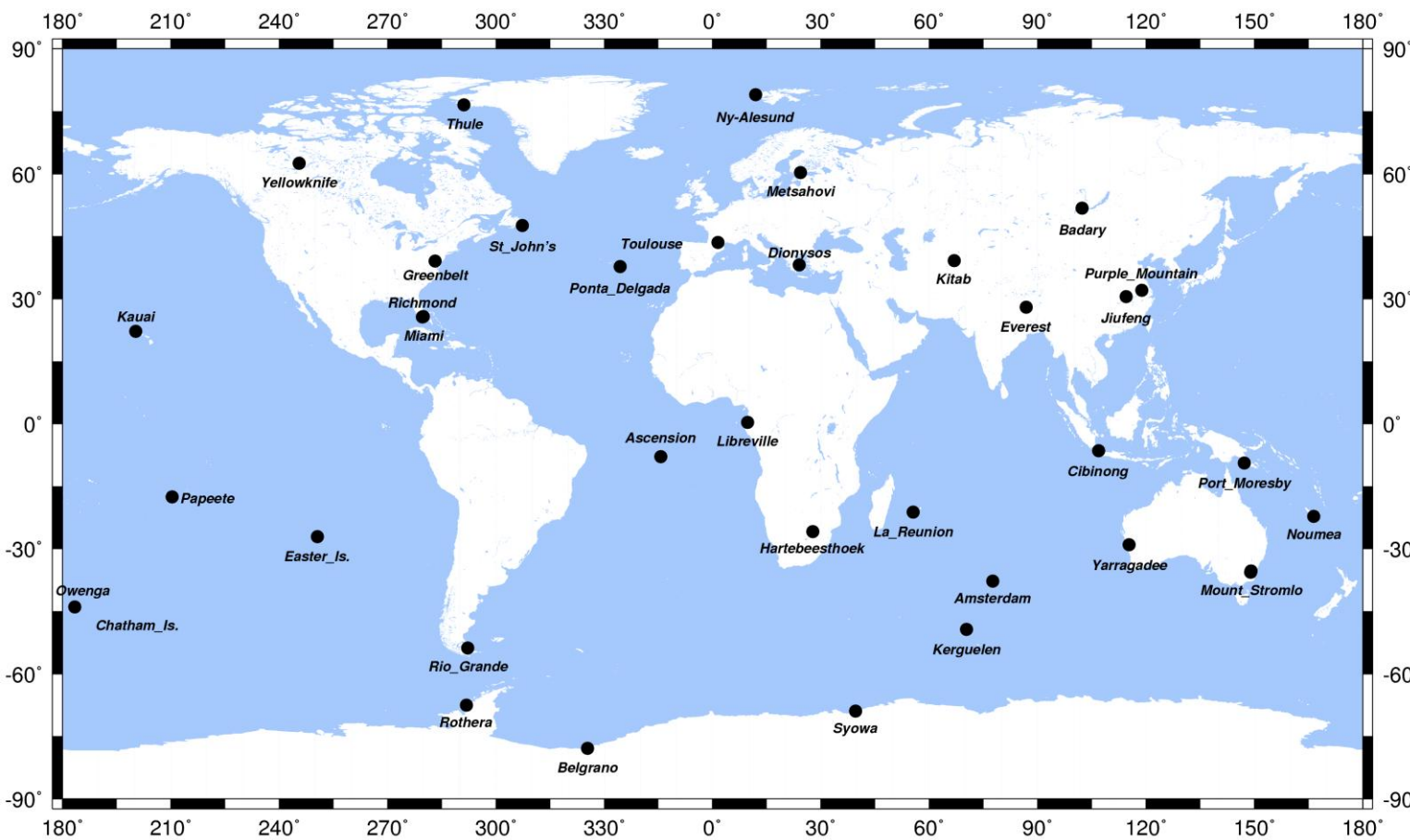
The DORIS-to-DORIS tie vector is used to constrain station positions.
- 4. Update of the DORIS core network used to align by No-Net-Rotation (NNR) condition the solution on ITRF2014.**
- 5. Computation of the cumulative solution by stacking of the weekly solution files with the IGN CATREF software.**

DORIS core network

To be a core site, a DORIS site must:

- Have more than 500 weeks of observations.
- Not be located in seismic zone.
- Be included in ITRF2014.

The network includes 36 sites with 17 sites in the northern hemisphere.



The internal validation is a first quality check done by the IDS CC before delivering the DPOD solution to the validation team. The internal validation consists in looking at:

1. The station position residuals.

2. The DORIS-to-DORIS tie vector residuals.

Differences between the DPOD2014 coordinates of 2 successive stations (at the starting date of the most recent station) and the IGN tie vector.

3. The position and velocity differences with ITRF2014.

The position differences are estimated at the mean epoch of the observations.

4. The DORIS-to-GPS tie vector discrepancies at co-located sites.

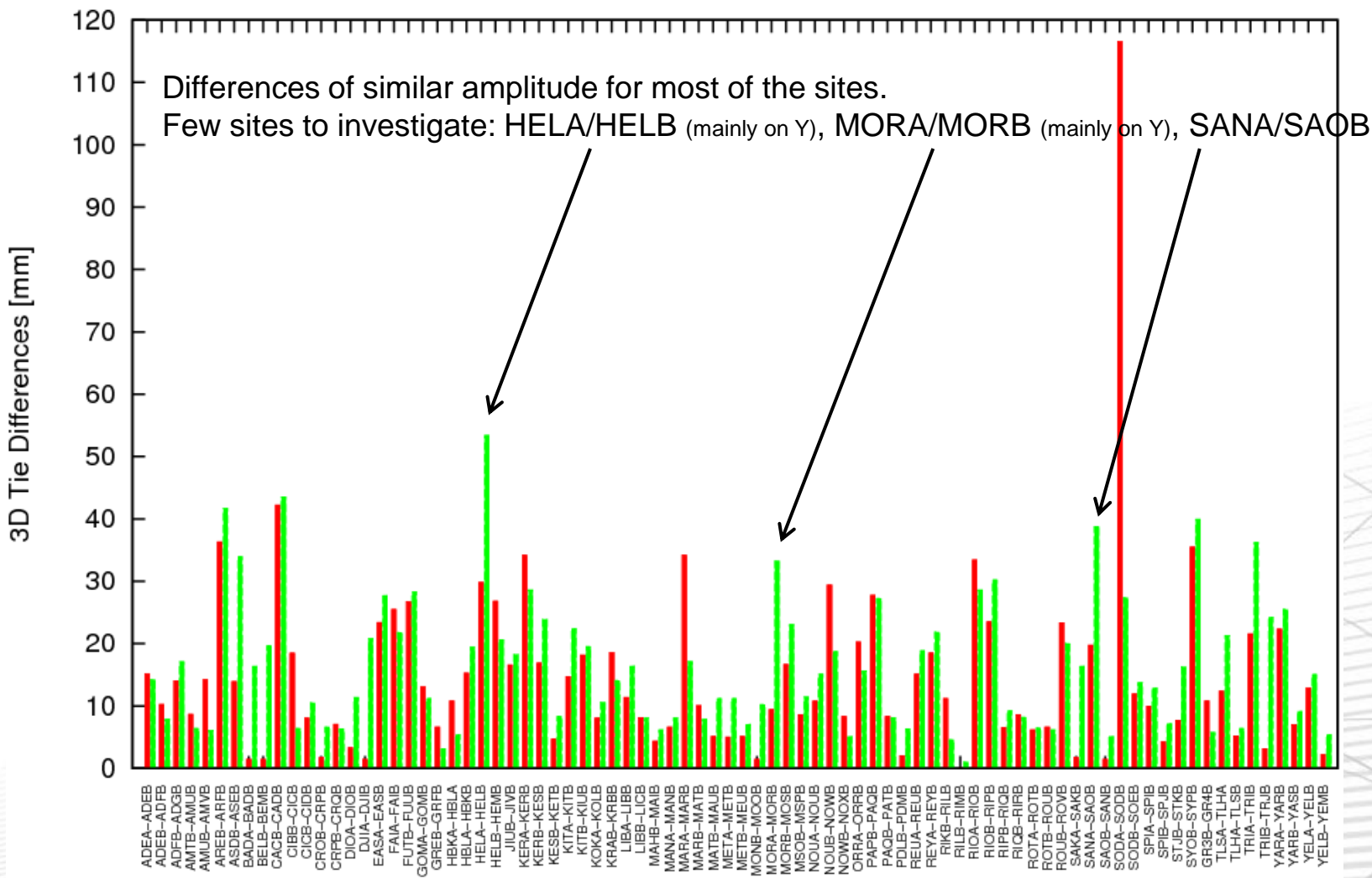
Differences between the DPOD2014 and the ITRF2014-IGS positions (at the starting date of the most recent station) and the IGN tie vector.

5. The prediction and analysis of the position formal errors at T+3 years.

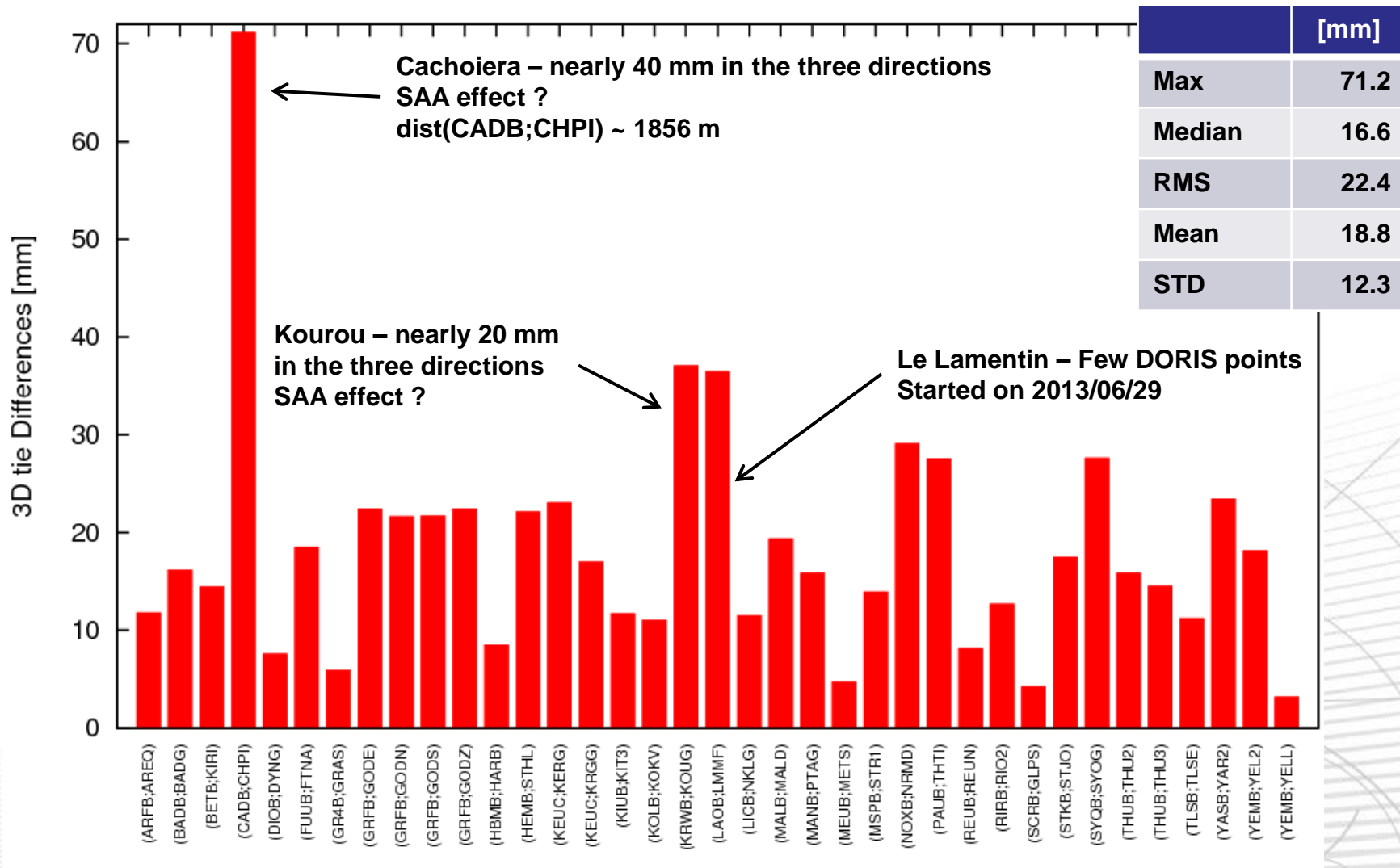


DORIS-to-DORIS tie vector residuals

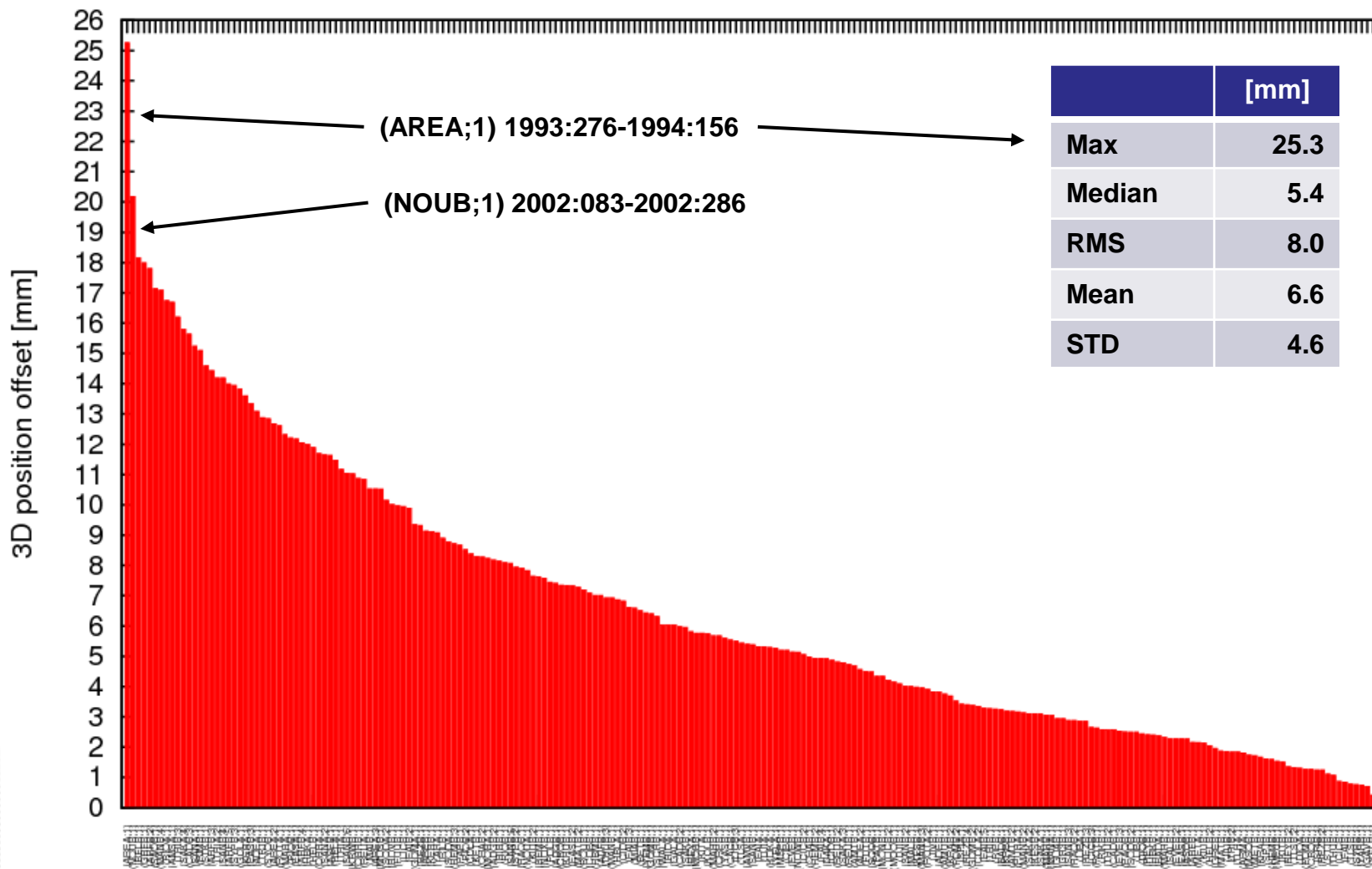
DPOD2014 vs ITRF2014



DORIS-to-GNSS tie vector discrepancies



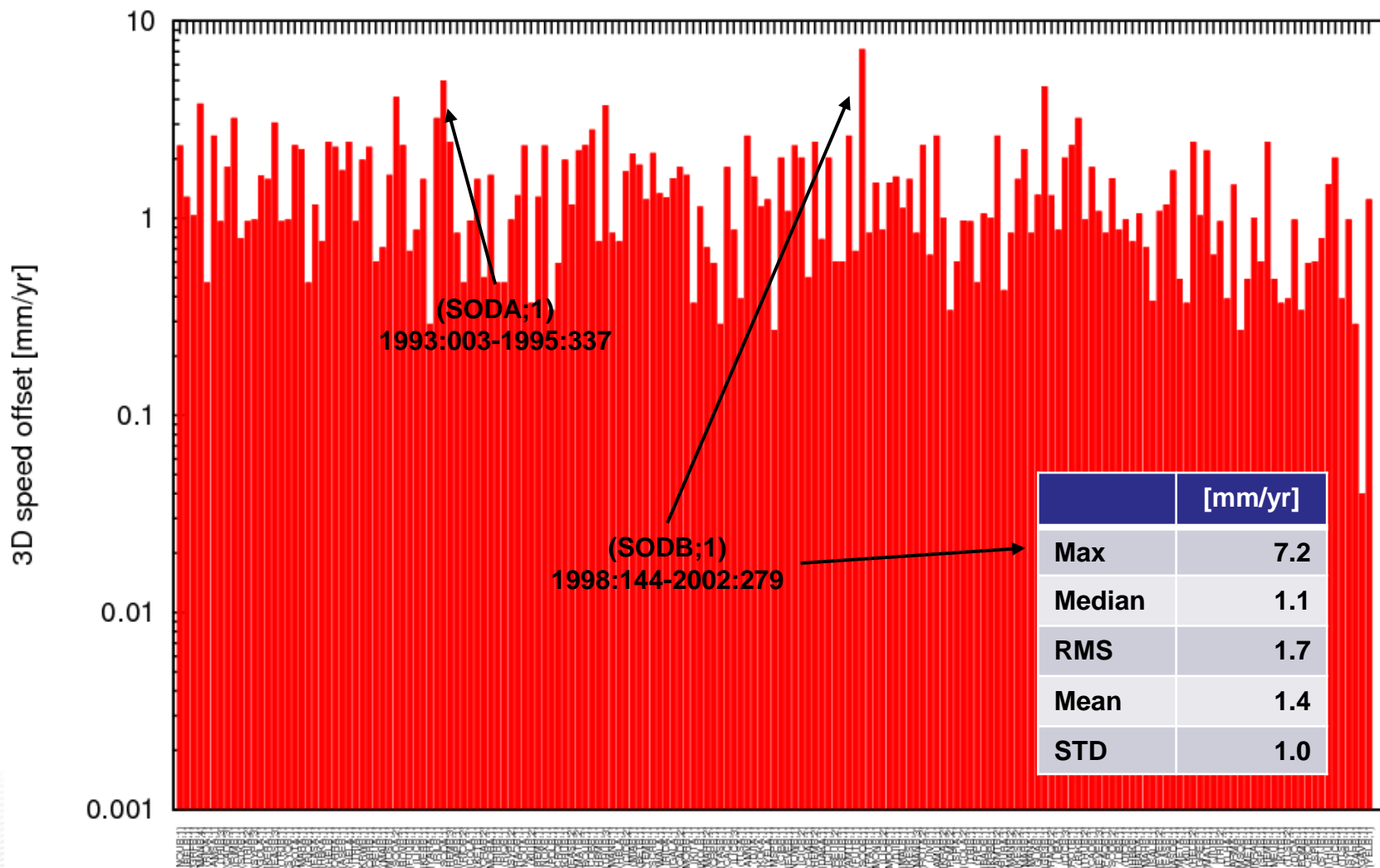
Position differences with ITRF2014





<http://ids-doris.org>

Velocity differences with ITRF2014

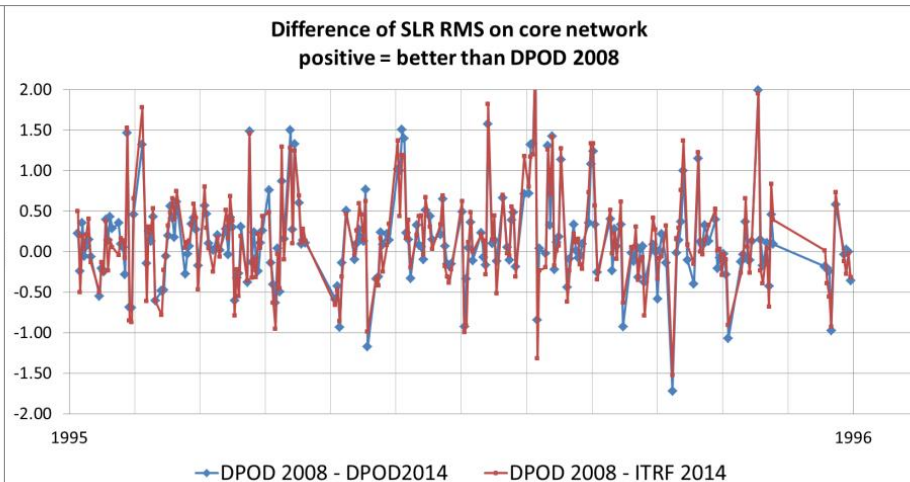
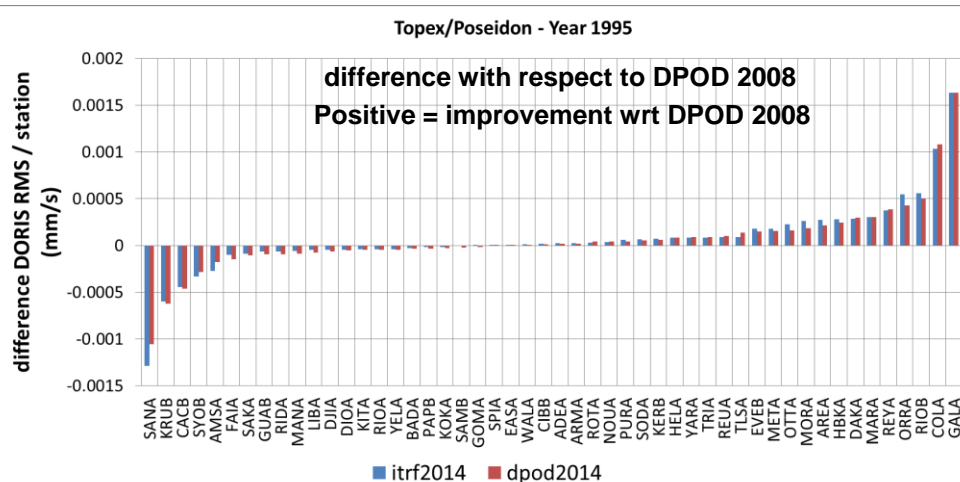


To validate the DPOD2014 for POD, an independent group was created. That group is composed by: P. Willis (chair), F. Lemoine, N. Zelensky, A. Couhert and H. Ait Lakbir.

The validation tests include to:

- Verify that all DORIS stations are provided in the DPOD solution.
- Verify that the coordinates of the new stations are consistent with the latest available DORIS data.
- Verify that POD solutions are not degraded by looking at:
 - ✓ DORIS residuals and comparisons with ITRF2014 and DPOD2008 performances.
 - ✓ SLR residuals and comparisons with ITRF2014 and DPOD2008 performances.
 - ✓ Long term orbit drift as shown with the Mean Z ITRF2008 orbit differences.
 - ✓ JPL16a radial orbit differences.
 - ✓ ...

TOPEX/Poseidon DORIS residual summary 1992/09/25 – 2004/11/02 (cycles 1-446)



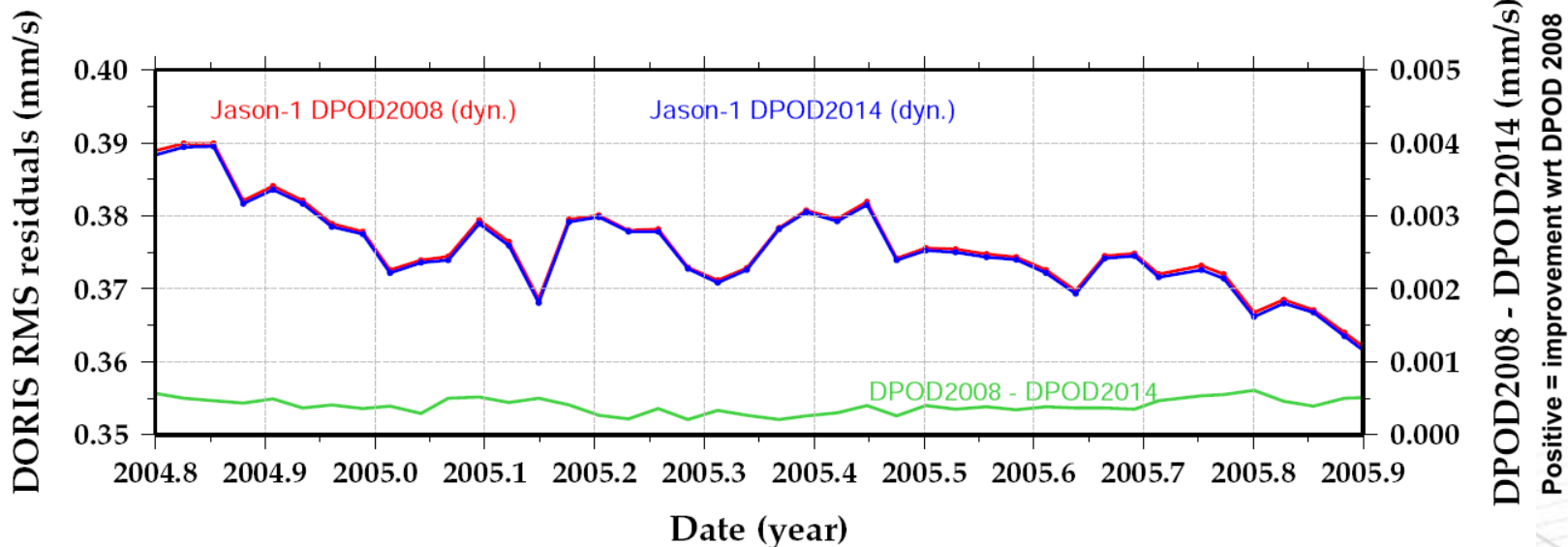
Test SLR+DORIS orbits	DORIS points	SLR points	DORIS RMS (mm/s)	SLR RMS (cm)	Xover * RMS (cm)
std1504 (ITRF2008)	55690	5213	0.4953	1.553	5.611
itr2014_augmented	55777	5211	0.4955	1.581	5.612
dpod2014	55950	5211	0.4950	1.580	5.611

* independent TOPEX altimeter GDR data cycles 1-446

itr2014_augmented = itr2014 + 32 stations added from DPOD2008.v15 using 14-parameter transform



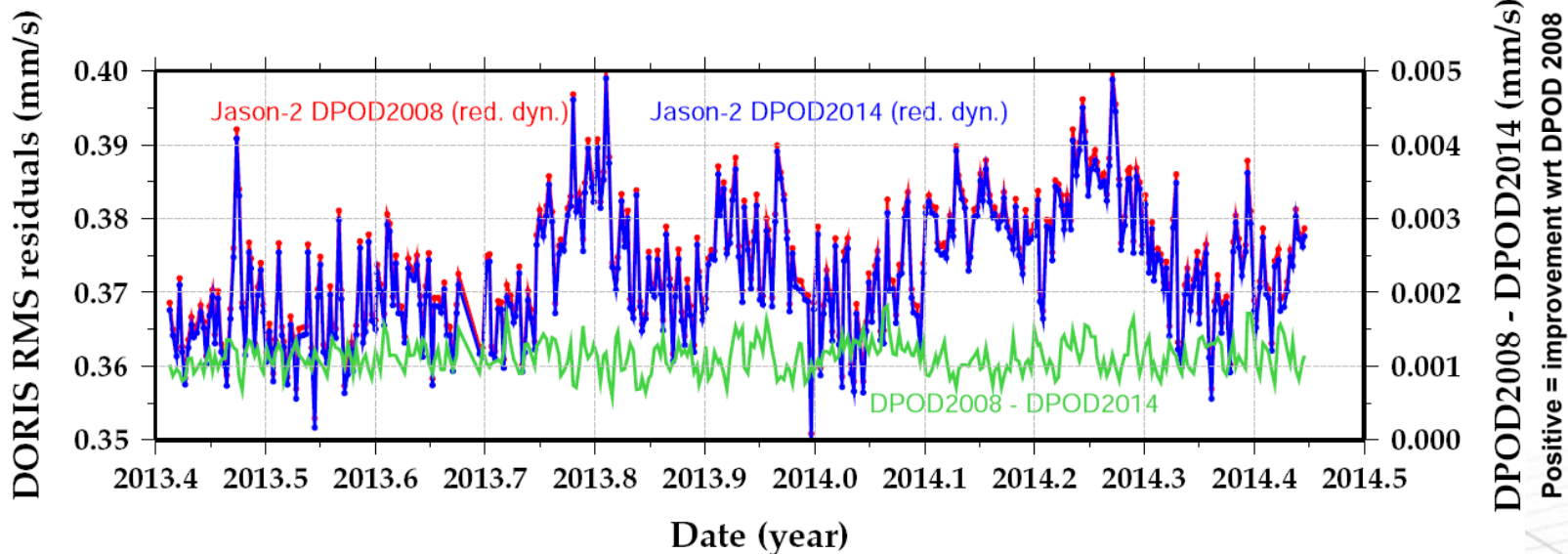
Jason-1



Test SLR+DORIS orbits	DORIS points	SLR points	DORIS RMS (mm/s)	SLR RMS (cm)	Xover * RMS (cm)
std1504 (ITRF2008)	110639	4101	0.3668	0.741	5.506
itrf2014_augmented	110590	4100	0.3666	0.741	5.503
dpod2014	110716	4100	0.3666	0.741	5.504

* independent altimeter GDR data cycles 1-259

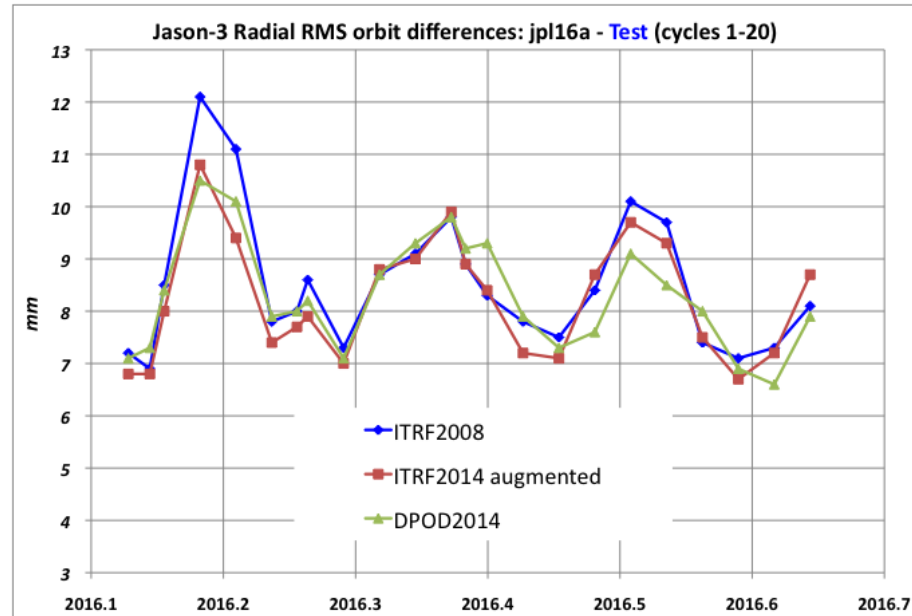
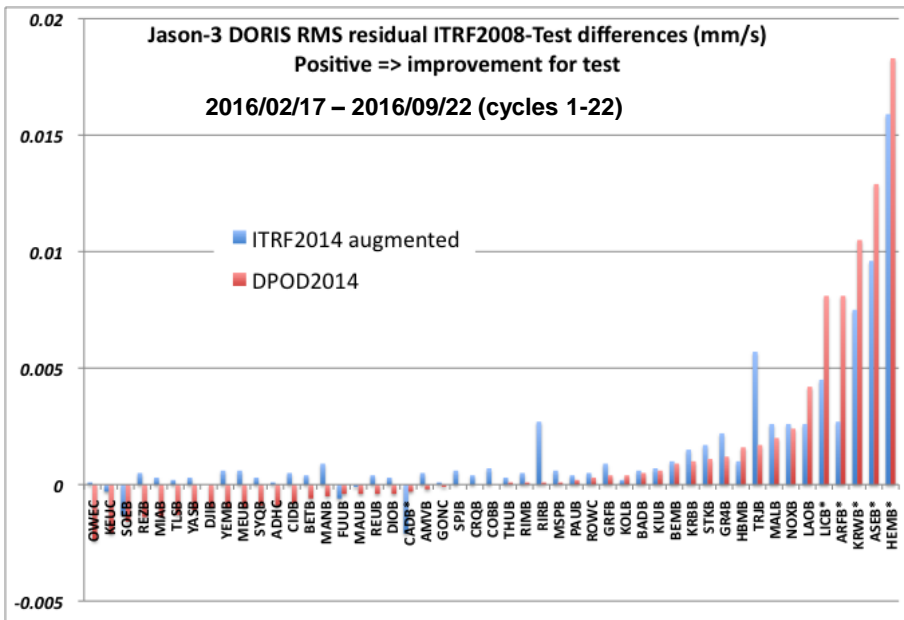
itrf2014_augmented = itrf2014 + 32 stations added from DPOD2008.v15 using 14-parameter transform



Test	DORIS points	SLR points	DORIS RMS (mm/s)	SLR RMS (cm)	Xover * RMS (cm)
std1504 (ITRF2008)	162513	4109	0.3810	0.877	5.325
itrf2014_augmented	162394	4211	0.3798	0.824	5.321
dpod2014	161605	4209	0.3799	0.824	5.321

* independent altimeter GDR data cycles 1-297

itrf2014_augmented = itrf2014 + 32 stations added from DPOD2008.v15 using 14-parameter transform



Test SLR+DORIS orbits	DORIS points	SLR points	DORIS RMS (mm/s)	SLR RMS (cm)	Xover * RMS (cm)
std1504_saa ** (ITRF2008)	148839	2257	0.4034	0.938	5.327
itrf2014_aug_saa	152461	2256	0.4030	0.863	5.325
dpod2014_saa	142621	2256	0.4015	0.840	5.321

* independent altimeter GDRT data cycles 1-19

** SAA DORIS stations down-weighted

Preliminary Conclusions

- **The IDS Combination Center elaborated a new DPOD2014 which differs by construction to the previous DPOD (DPOD2005, DPOD2008). As a cumulative position/velocity solution, the new DPOD is similar to IGb08 and to a less extent (as DPOD2014 does not include PSD corrections) to IGS14.**
- **So far, the new DPOD2014 show slightly improvements in POD compared to ITRF2008, ITRF2014 and DPOD2008. Stations that do not show improvement wrt DPOD2008 need further investigations.**
- **WARNING:**
 - **The newest stations will be not part of the DPOD2014 due to the delay of the IDS routine delivery (every 3 months with 3 months of delay). As with DPOD2008, the coordinates and velocities of these stations must be extracted from the DORISmails.**

What's next ?

- **External validation to be continued.**
- **As soon as the external validation group gives the green light, the DPOD2014 will be available via the IDS Data Centers (CDDIS, IGN) and via the IDS ftp site.**
- **The IDS CC plans to update the DPOD2014 every 3 months. Each time, the validation process will be turned on.**
- **Room of improvements:**
 - **Downweighting of SAA stations for Jason-2 and Jason-3 (if done at the Analysis Center level in the multi-satellite combination).**
 - **Including of stations before 1992 (ARLA, KRUA, RICA, SIGA, SOCA, TROA) if at least 2 ACs agree to treat these data).**