Enhanced ILRS analysis for ITRF2020

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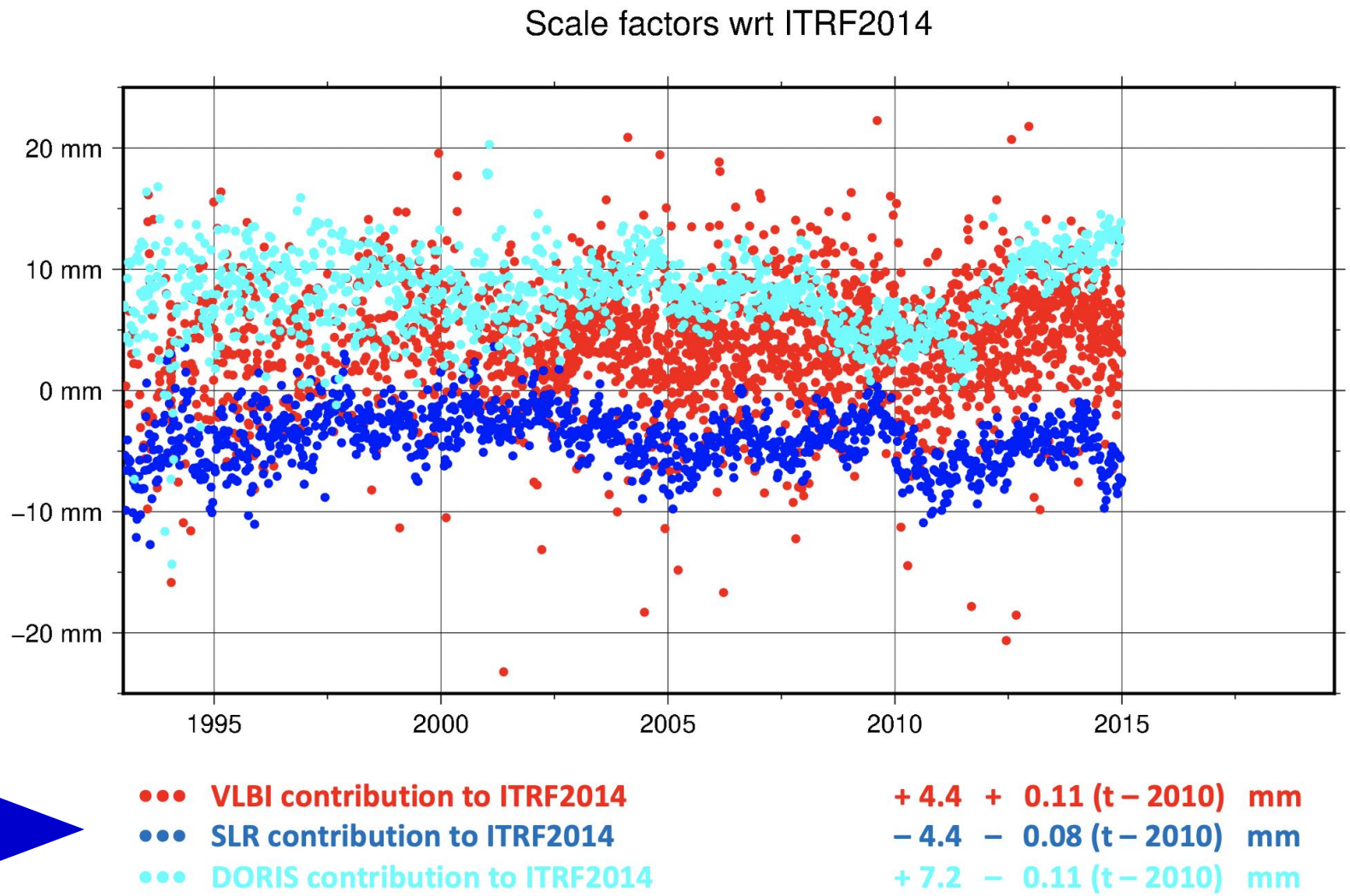
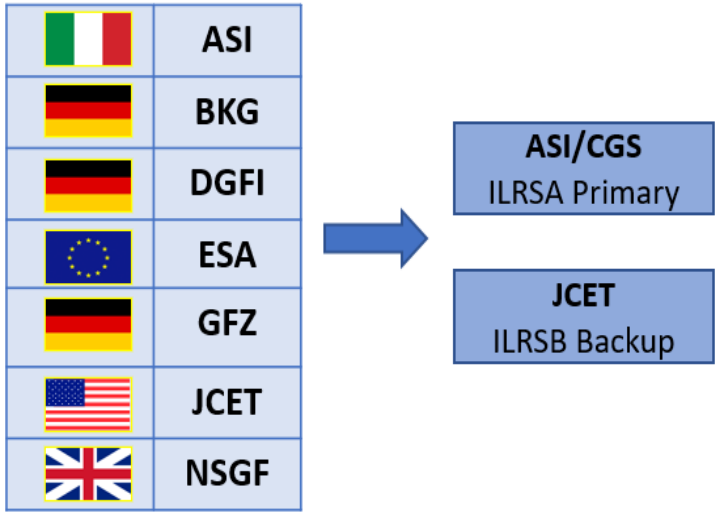
SLR Scale in ITRF2014 Systematically Different



VLBI - SLR = 8.8 mm ≈ 1.375 ppb

Credits: ITRS Center, ILRS ASC Meeting, Oct. 1st, 2019, Observatoire de Paris

Station Systematic Error Modeling (SSEM) in ITRF2020



- In 2015 ILRS launched a multi-year effort to address and resolve the SLR scale issue: Station Systematic Error Modeling Pilot Project (**SSEM PP**) to estimate RBIAS simultaneously with the station positions

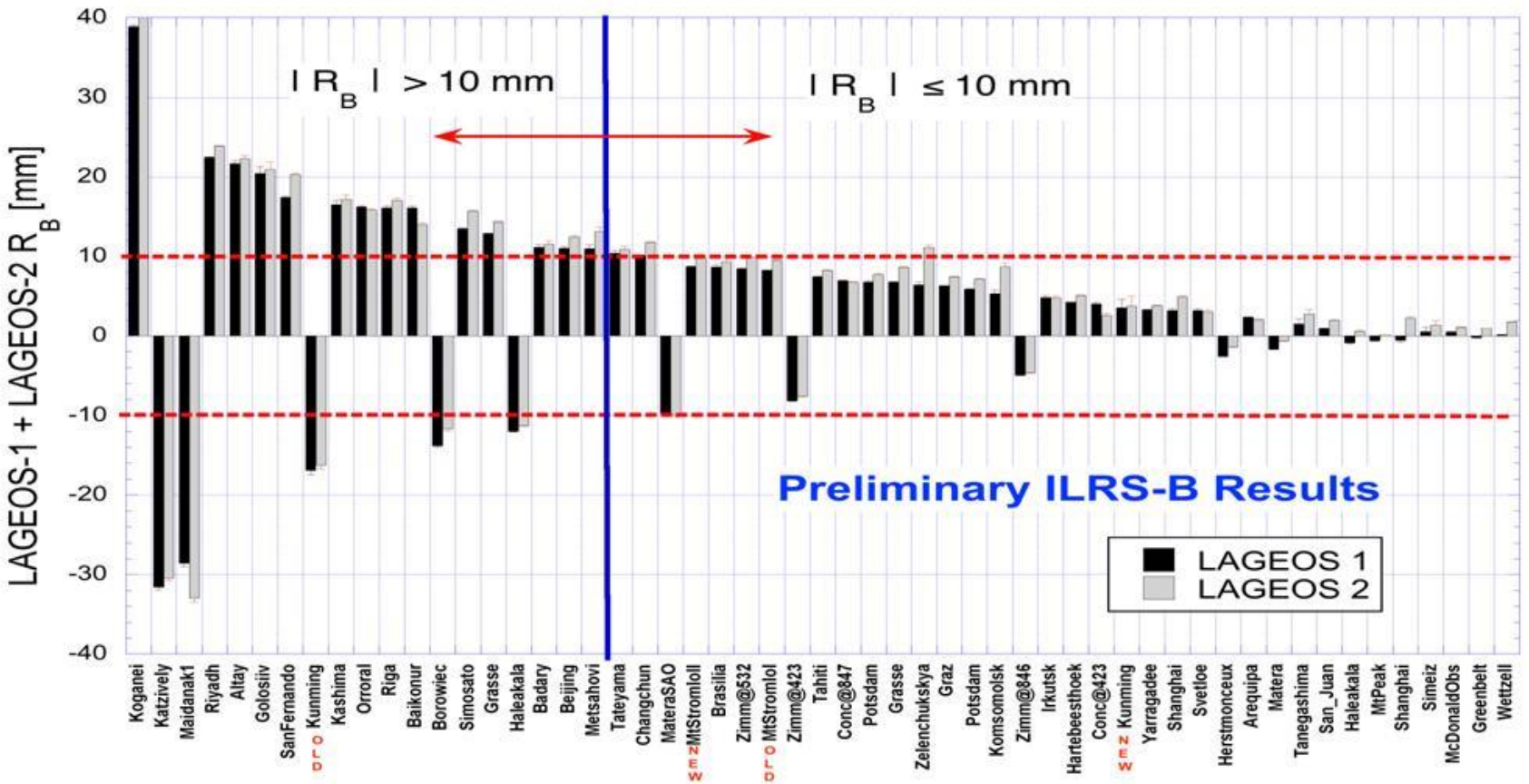
- Analysis since **01/1993.**
- Weekly estimation of coordinates, EOP and range biases RB
- Time frame for the Pilot Project: 1993 – 2020 for ITRF2020 and currently extended to 06/2022
- Data: LAGEOS , LAGEOS 2, ETALON1-2
- Time series with separate range biases for LAGEOS, combined for ETALON
- Update of the Data Handling file with a set of mean range biases obtained from the combined time series

Reanalysis since 1993 (both ACs and CCs) in weekly arcs adopting the new data handling file and production of SINEX files submitted to IERS for ITRF.

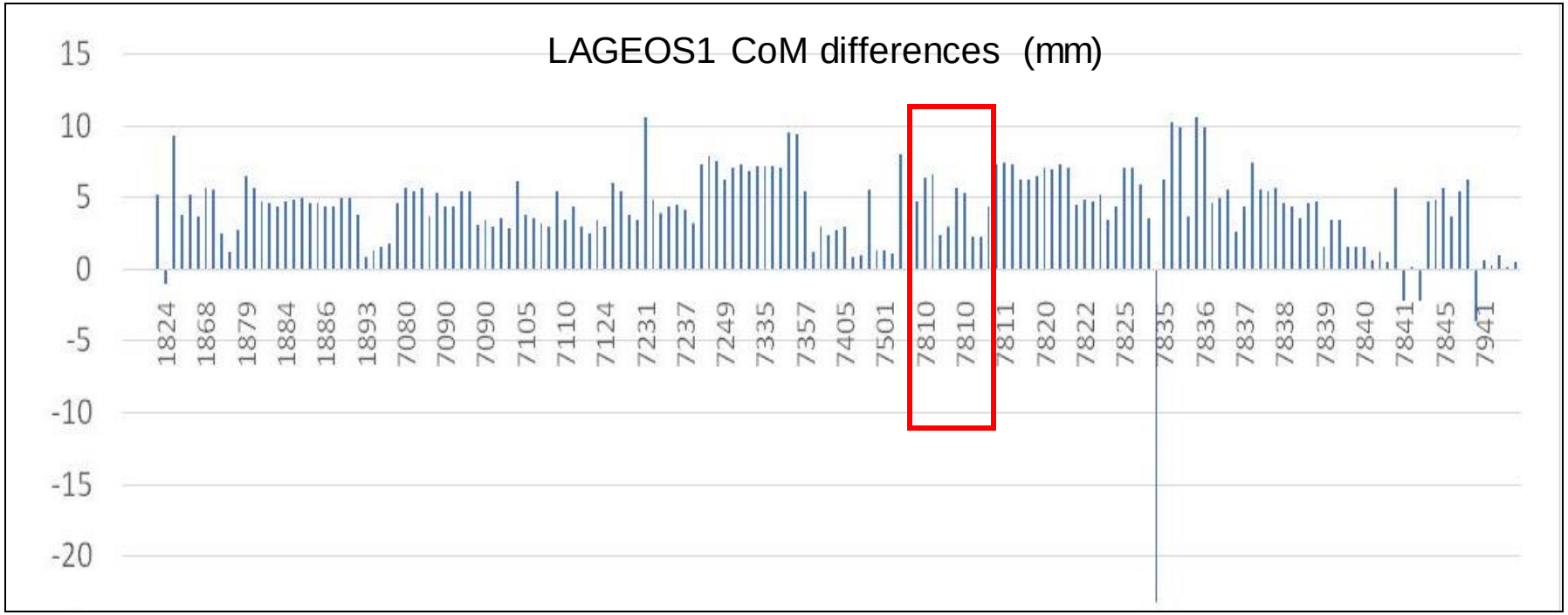
Reanalysis 1983-1992 (both ACs and CCs) and production of SINEX files submitted to IERS

- 15-day estimation of coordinates, EOP and range biases RB
- Data: LAGEOS

The starting point of Combined Range Biases



The updated satellite Centre of Mass model

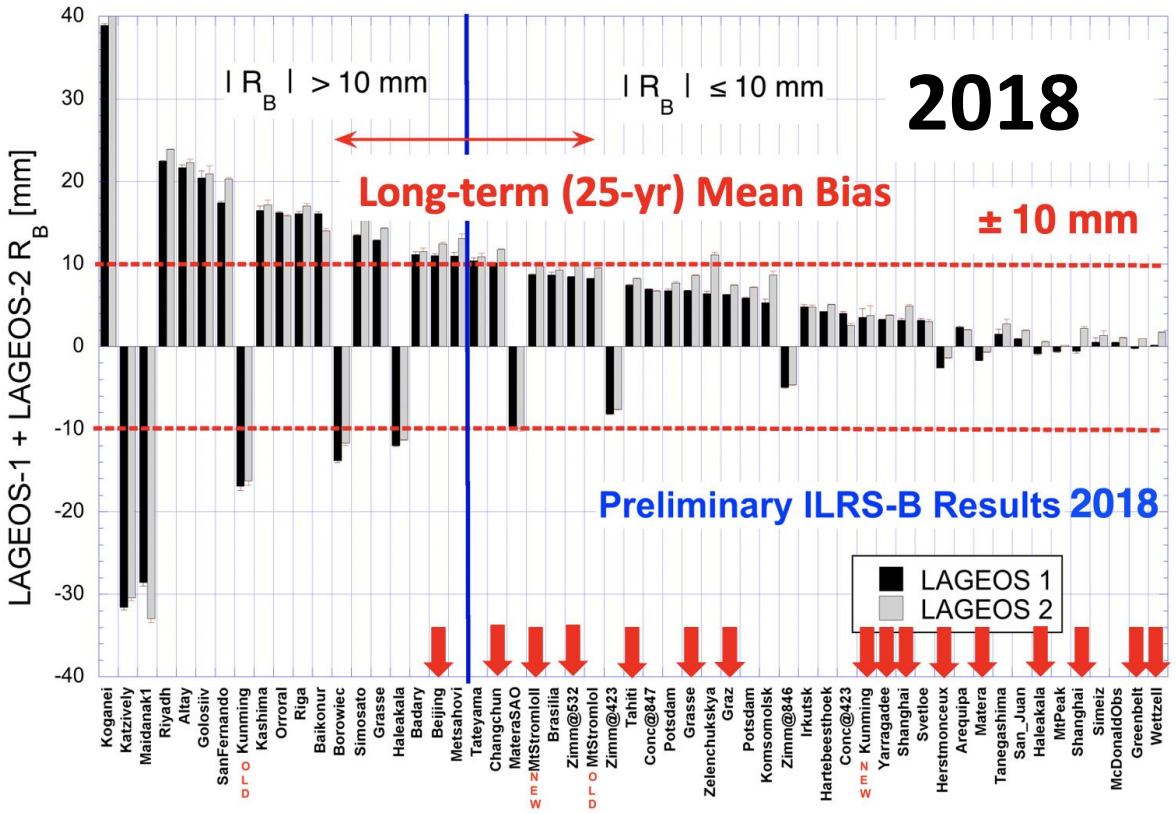


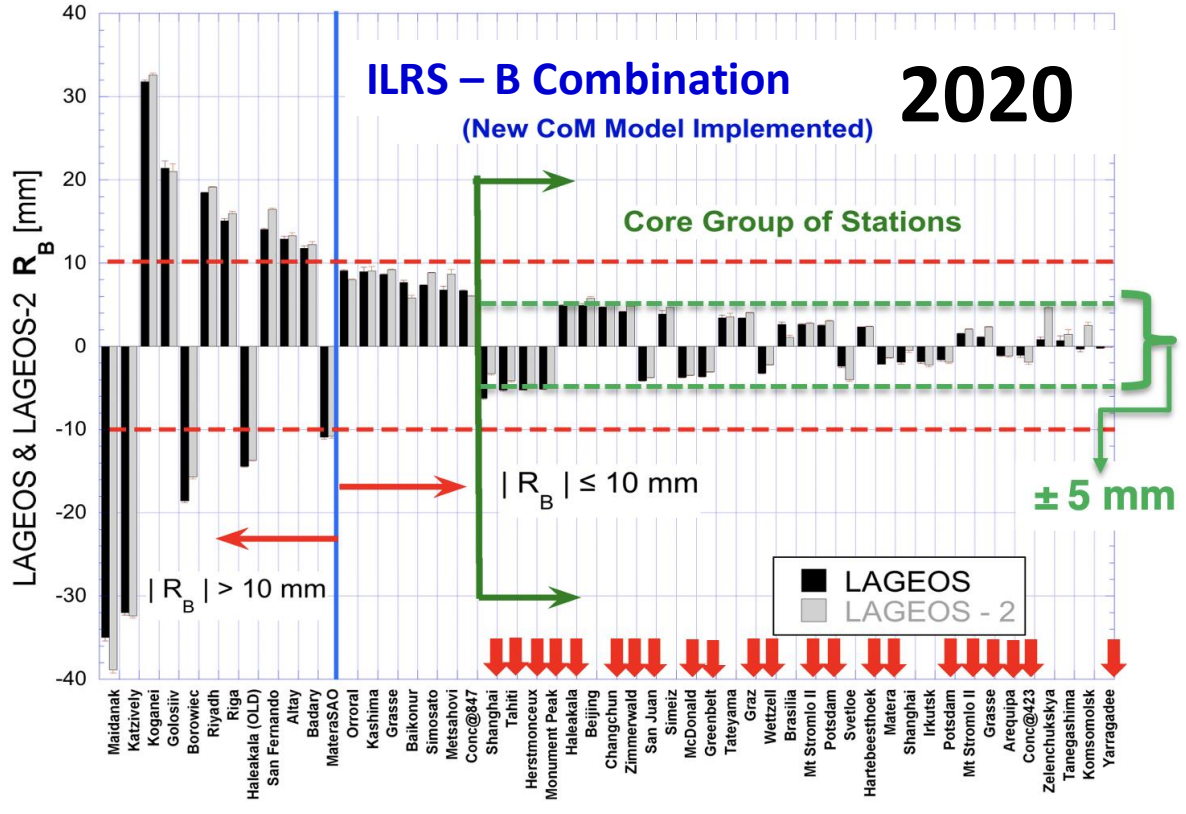
Old CoM model					New CoM model		
7810	1/1/1980	30/4/1995	**251**		01/01/1983	01/06/1995	**244,6**
					01/01/1986	01/06/1995	**244,4**
7810	2/1/1996	9/3/2001	**245**		01/01/1997	09/03/2001	**242,6**
7810	9/3/2001	18/2/2008	**248**		09/03/2001	11/03/2003	**245,0**
7810	4/3/2008	31/12/2050	**249**		11/03/2003	03/02/2006	**243,4**
					03/02/2006	18/02/2008	**243,7**
					01/01/2002	18/02/2006	**246,8**
					18/06/2006	18/02/2008	**246,7**
					18/02/2008	01/01/2050	**244,7**

Work done by J. Rodriguez, T. Otsubo, G. Appleby

The effect of the new CoM model

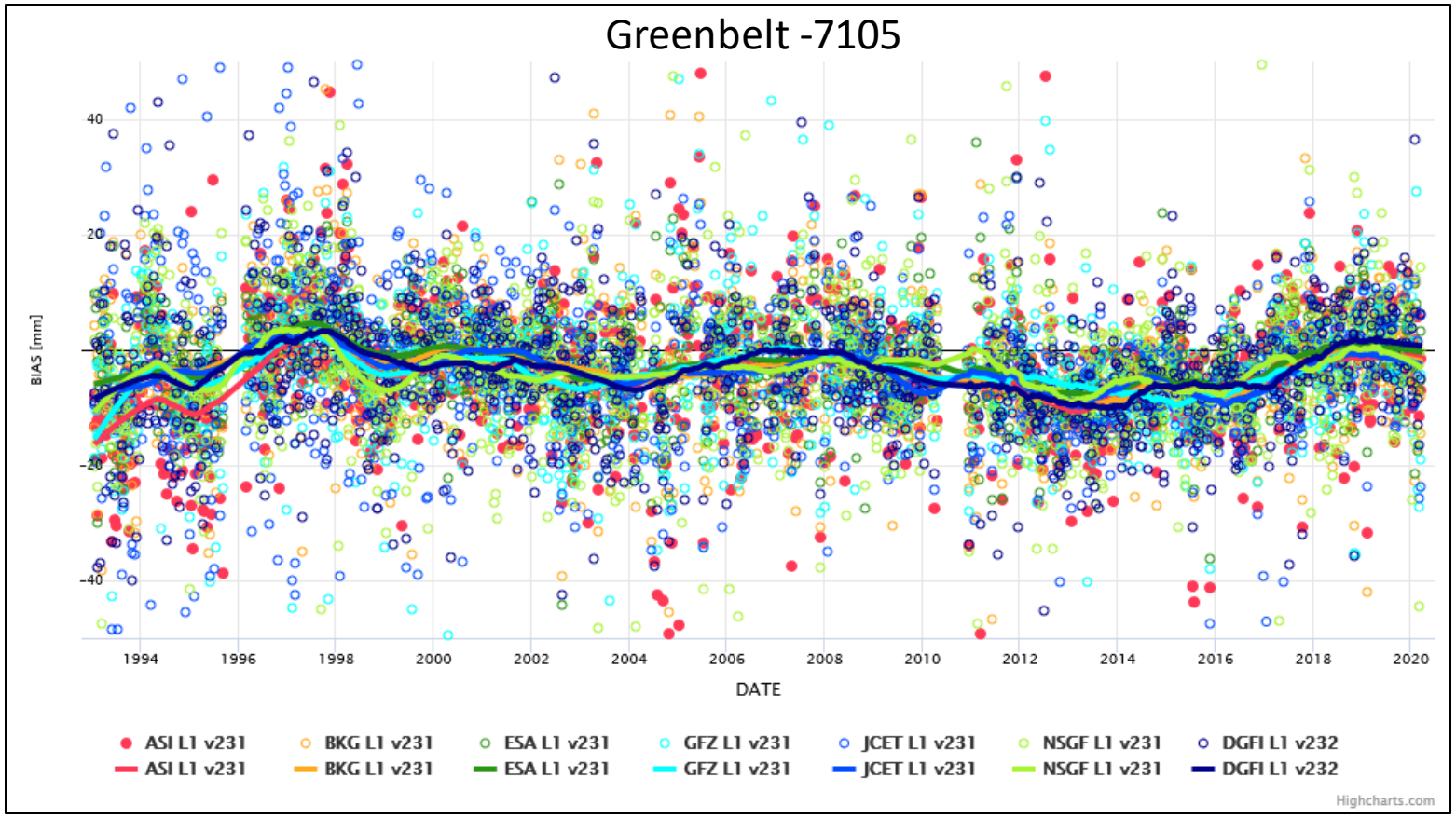
Long-term mean biases for Core stations reduced by 50%





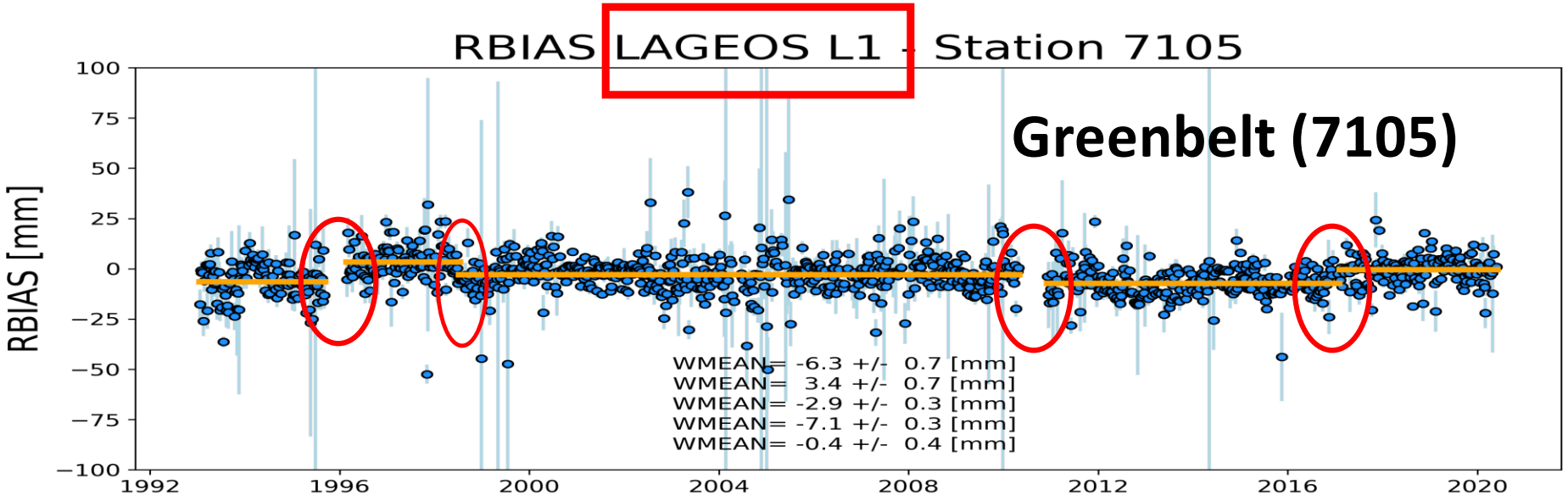
Range bias estimation in the SSEM Pilot Project

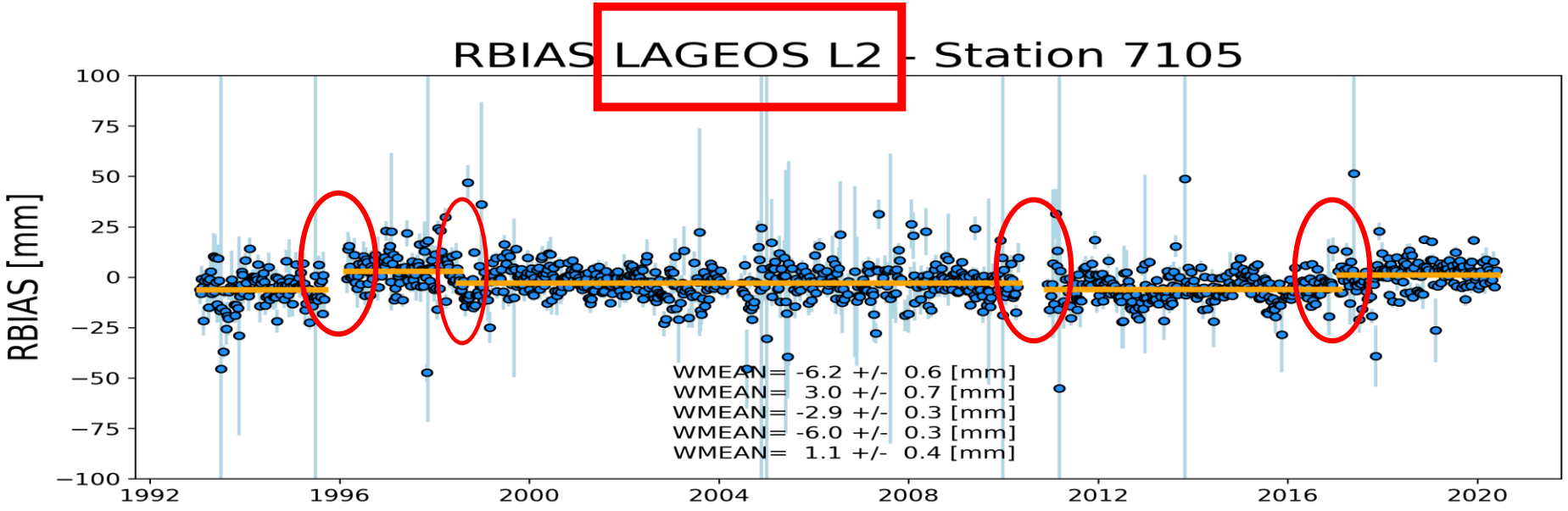
- Changes in stations systematic behaviour were identified in the combined series and in consultation with available station logs. Estimates were used as *a priori* in the reanalysis for ITRF2020.



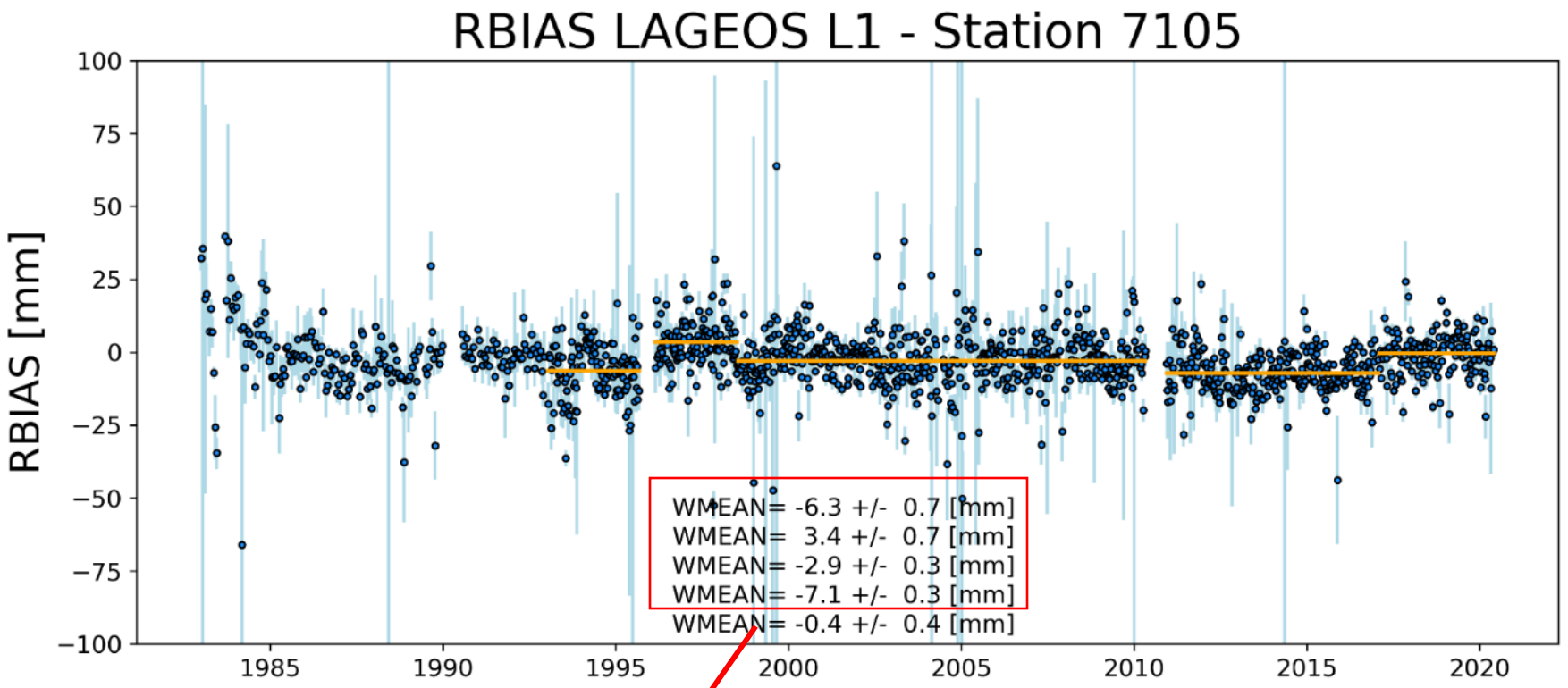
http://geodesy.jcet.umbc.edu/ILRS_AWG_MONITORING/

Identifying all breaks





The construction of the Data Handling file



+MODEL/RANGE_BIAS

*CODE PT SOLN T START_DATE__ END_DATE____ M __E-VALUE___ STD_DEV _E-RATE__ UNIT CMNTS

.....

7105 51 501 A 93:017:00000 95:253:00000 R -6.3 0.7 mm

7105 51 501 A 96:056:00000 98:193:00000 R 3.4 0.7 mm

7105 51 501 A 98:193:00000 10:122:00000 R -2.9 0.3 mm

7105 51 501 A 10:339:00000 17:029:00000 R -7.1 0.3 mm

.....

The Data Handling file

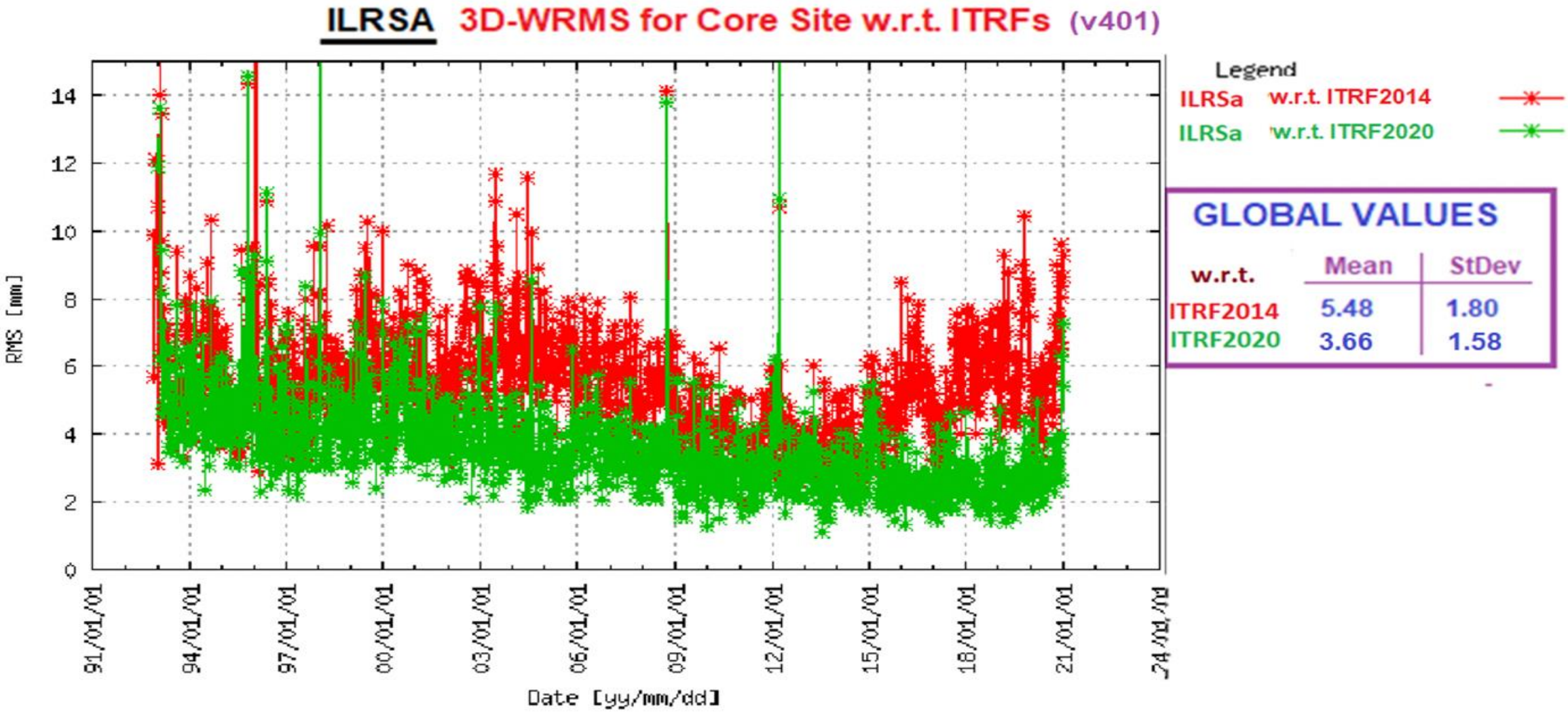
+MODEL/RANGE_BIAS
*List of mandatory systematic errors to be applied on observations

+SOLUTION/DATA_HANDLING
* list of data to be deleted
* list of mandatory arc dependent biases to be estimated
* meteo correction

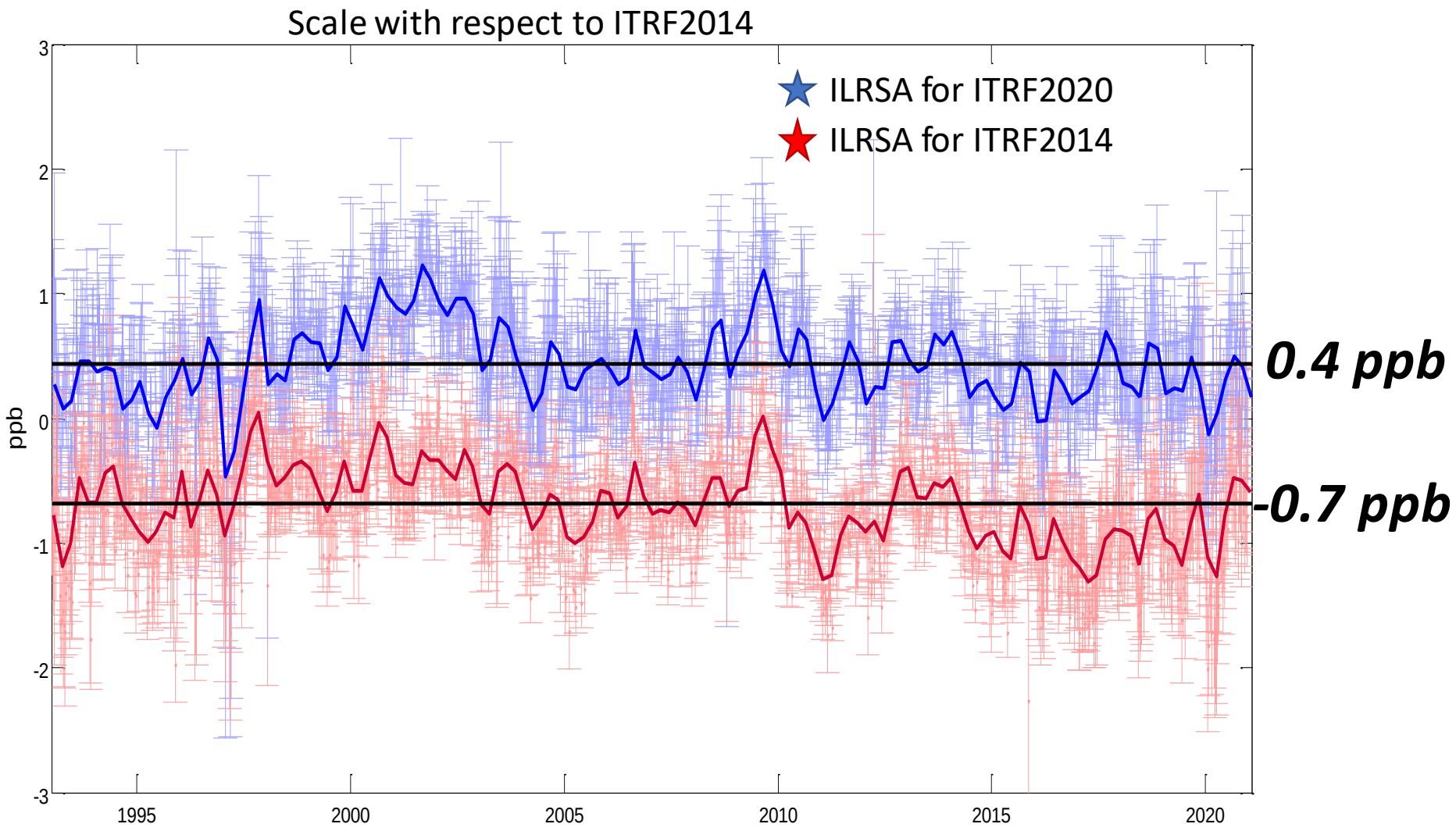
+MODEL/TIME_BIAS
* Time Biases including the
* T2L2 Tb and Tb-rate DATA RECORDS
* which are significant for LARES and higher orbits (range equivalent >10 mm)

and
** SECTION WITH OPTIONAL CORRECTIONS COMMENTED with "*"

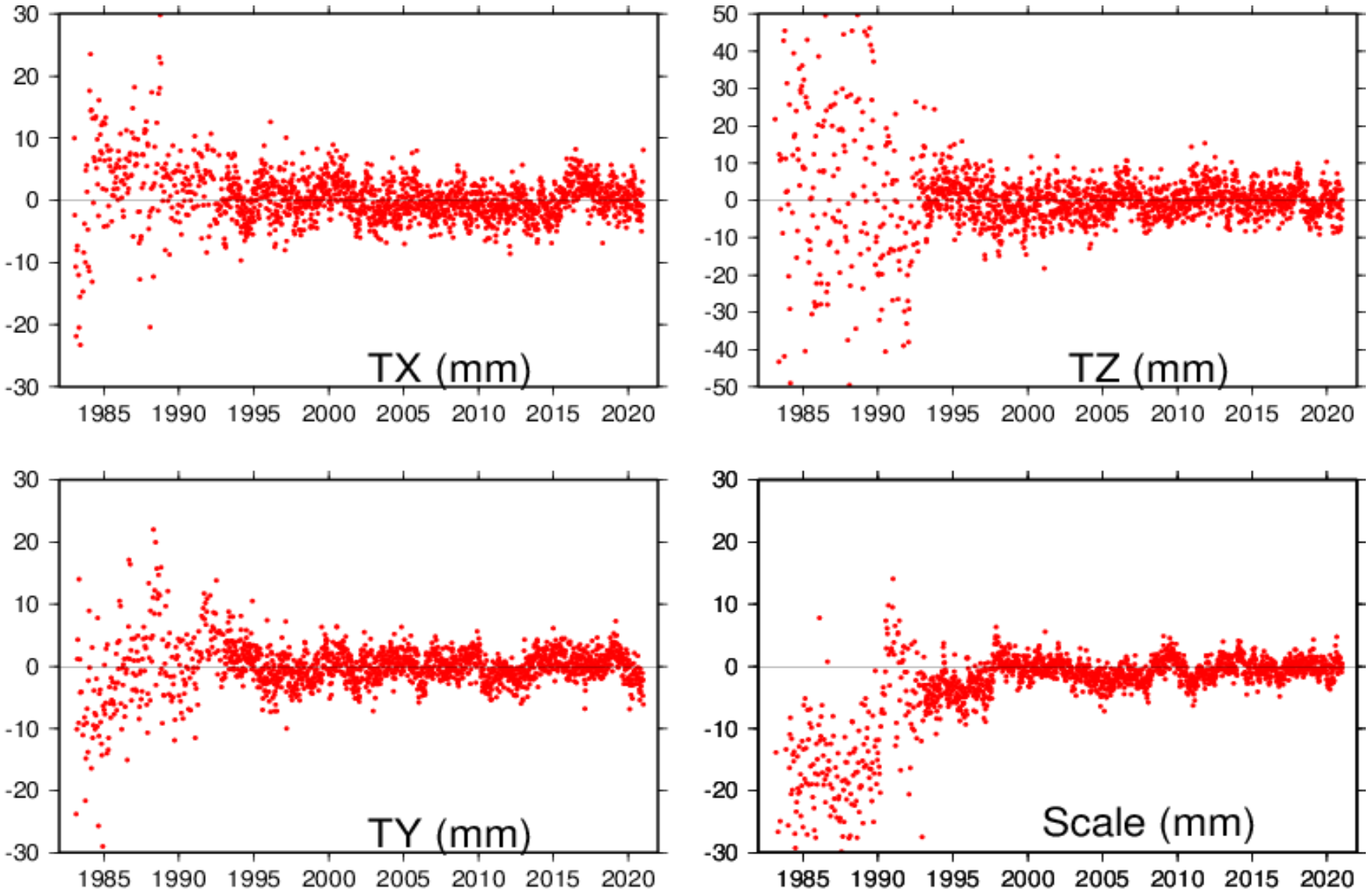
Core Site Position Tests: ITRF2020 vs ITRF2014



Impact on the scale

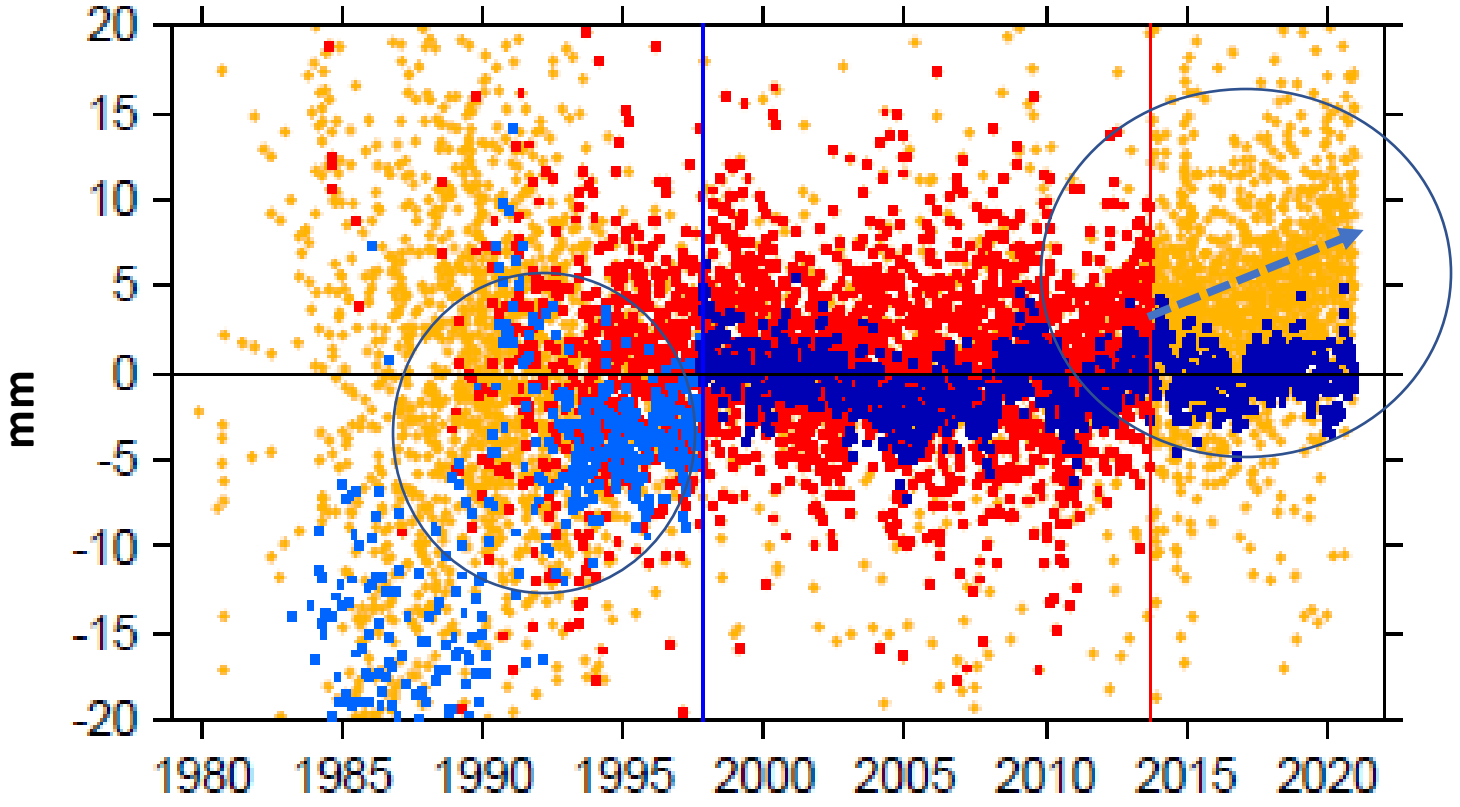


Scale and Geocenter with respect to ITRF2020



https://itrf.ign.fr/en/solutions/ITRF2020

Scales with respect to ITRF2020



- Orange: all VLBI Sessions
- **Red: Selected VLBI Sessions**
- **Light blue: all SLR time series**
- **Dark blue: Selected SLR time series**

Scale offset between SLR & VLBI is 0.15 ppb (1 mm at the equator)

Ref: Altamimi et al , 2022

Evaluation of ITRF2020 vs ITRF2014

- The PSD model fits well the effects of earthquakes on the coordinates
- Improvements in the 3D-WRMS for the core sites
- Improvements in coordinate offsets, for both, core and non-core stations
- Improvements in the Helmert parameters' mean values and scatter:

Scale	W_{mean} (mm)	σ- W_{Mean} (mm)	Slope (mm/yr)	σ- Slope (mm/yr)
vs ITRF2014	2,654	0,069	-0,028	0,009
vs ITRF2020	-0,743	0,063	0,084	0,008

Summary

- The ILRS ASC stablished a new analysis approach for its contribution to ITRF2020;
- It will be implemented in the operational series after adoption of ITRF2020 (2023);
- The complete SLR series for the 38-year period 1983 – 2021 will be reanalyzed;
- The new bias model (SSEM-X) will be publicly available and maintained current over the coming years.

From nearly 1 cm ΔScale(SLR-VLBI) to 1 mm !!!