

Systematic error monitoring and modeling in ILRS data and products for ITRF2020

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ILRS Activities to Control Systematic Errors

- Quality Control Board (QCB) addressing laser ranging data quality issues via monthly telecons
- Daily analysis for quality control (QC) of range and time biases
- Undergoing activities for an operational service to monitor the long-term performance of stations at the mm level
- Developing improved target signature models (CoM correction)
- Monitoring the station clock performance with T2L2 on Jason-2. Time bias has small but non-negligible effects on station positioning; its effect is transferred on station coordinates (east-west component)
- Improved data accuracy by replacement of time-interval counter units (TIU) with event timers (ET)

Station Systematic Error Modeling

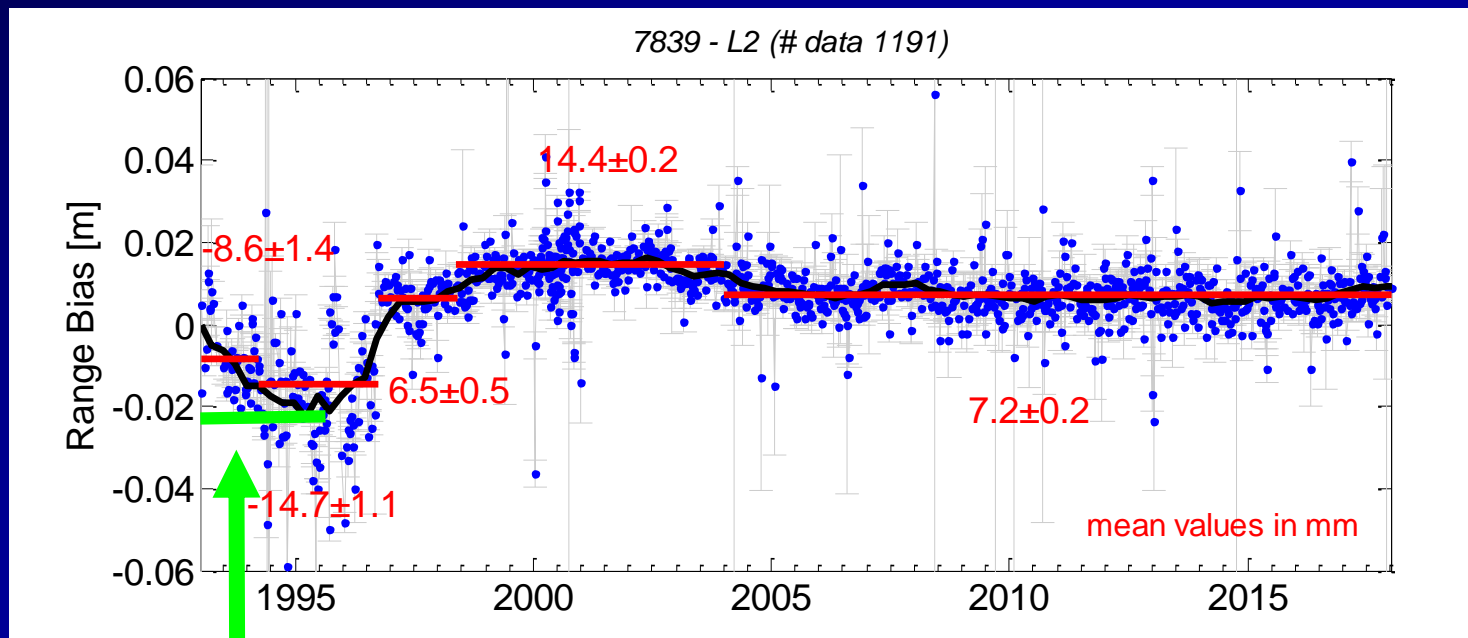
- To date, the modeling of the systematic errors for the standard ILRS products is based on information from historical and engineering reports, site logs, communication with the stations and, if required, a direct estimation of the suspected errors
- A data handling file is available at the ILRS website and maintained by the Analysis Standing Committee (ASC)

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* list of mandatory range biases to be applied on observation (ILRS/AWG Oct 2007)  
* with updates from ILRS/AWG reprocessing results  
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1873 --- rarr A 95:001:00000 00:001:00000 R -270.00  
7080 --- rarr A 88:001:00000 89:349:00000 R -40.00  
7080 --- rarr A 90:094:00000 93:168:00000 R 25.00 IRLS/AWG 14/04/04  
7080 --- rarr A 95:065:00000 96:026:00000 P -2.10 source CDDIS  
7080 --- rarr A 96:026:00000 96:116:00000 P -10.30 source CDDIS  
7080 --- rarr A 96:116:00000 96:130:00000 P -9.70 source CDDIS  
7109 --- rarr A 00:000:00000 88:347:00000 R 10.00 IRLS/AWG 09/05/06  
7109 --- rarr A 97:009:00000 97:018:00000 R 164.90 source CDDIS  
7110 --- rarr A 84:001:00000 84:136:00000 R 30.00  
7110 --- rarr A 87:300:00000 88:025:00000 R 30.00  
7110 --- rarr A 96:240:00000 96:277:00000 R 163.60 source CDDIS  
7122 --- rarr A 84:122:00000 87:074:00000 R 30.00  
7123 --- rarr A 87:195:00000 87:282:00000 R -30.00 source CDDIS  
7210 --- rarr A 83:001:00000 87:255:00000 R 25.00  
7210 --- rarr A 87:255:00000 94:021:00000 R -37.00
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Station Systematic Error Modeling

- The ILRS ASC is going to adopt a new model for the range biases strongly motivated by the need to remove the VLBI-SLR scale difference
- The model will be obtained estimating R_B simultaneously with all other parameters
- A Pilot Project is currently ongoing with the data reanalysis:
 - Weekly estimation of coordinates, EOP and range biases R_B
 - Time frame: **1993-2018**
 - Data: LAGEOS , LAGEOS 2, ETALON1-2
 - Time series with separate range biases for LAGEOS, combined for ETALON
 - Combination of the time series estimated by the ILRS ACs
 - Computation of mean range biases over medium/long time scale

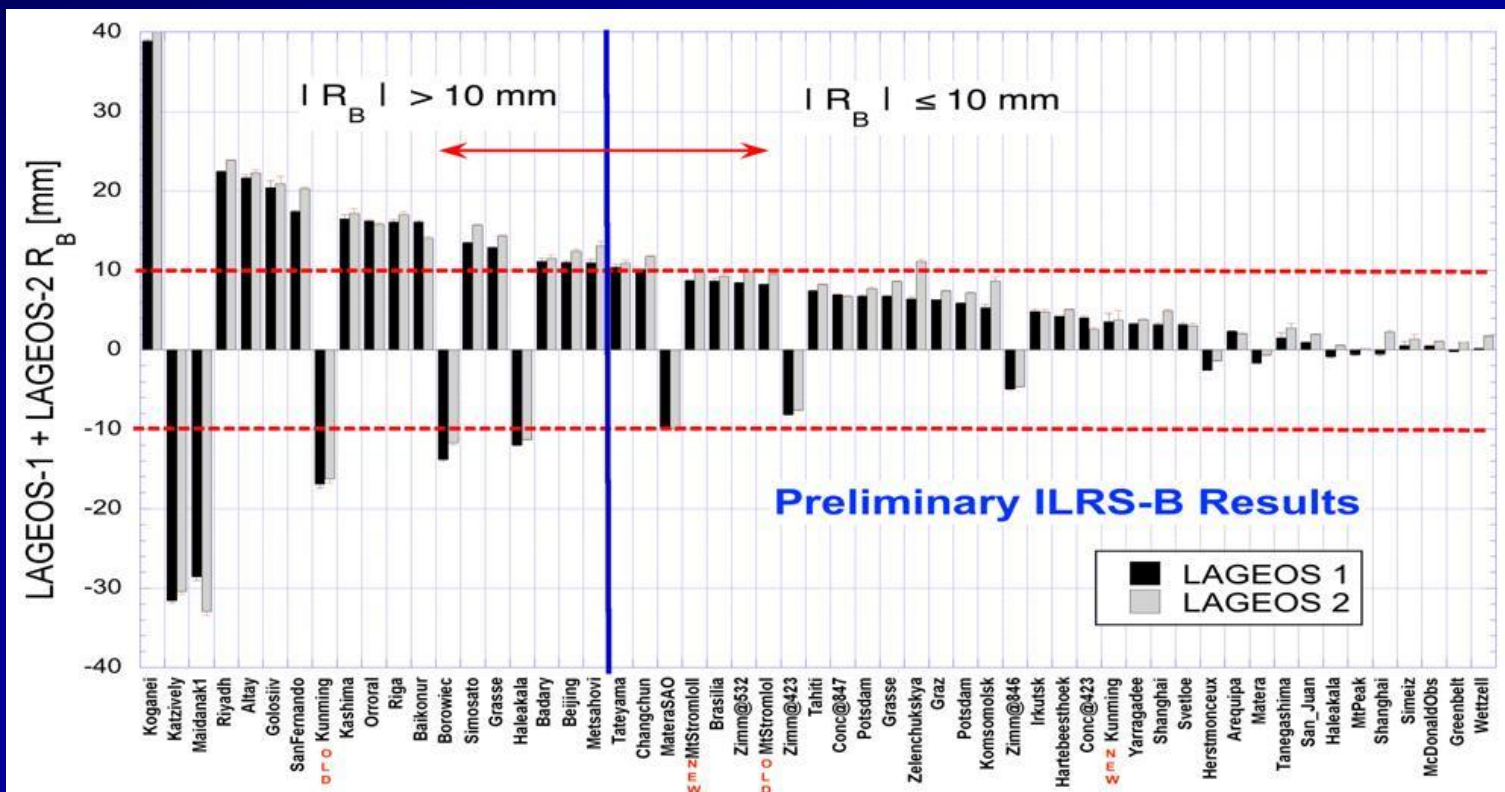
GRAZ: ILRSA time series for LAGEOS-2



Green line represents the actual bias value used in the analysis, as reported in the adopted data handling file

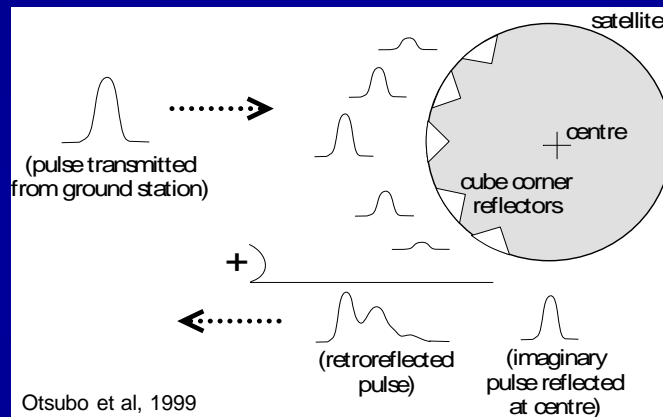
7839 --- mm A 83:001:00000 96:272:00000 R -22.00

Preliminary results



Target signature model errors

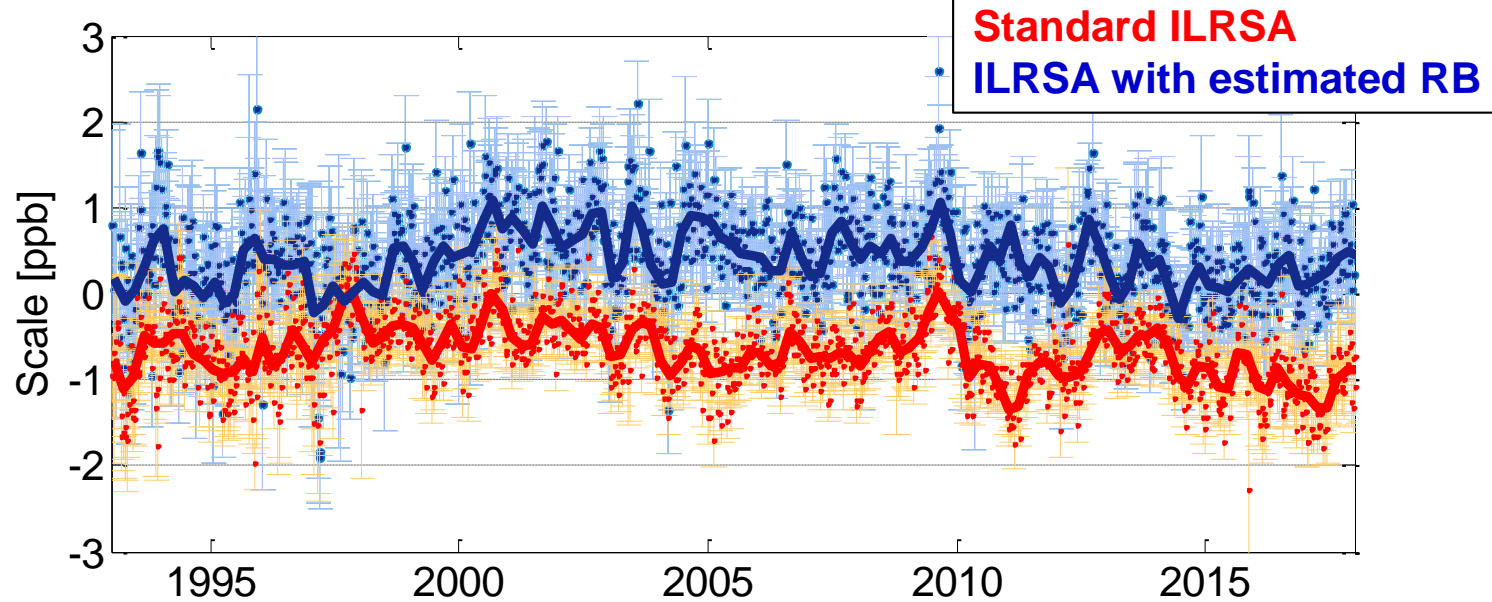
The estimated long-term biases for several stations pointed to CoM errors as one of the plausible sources of these errors



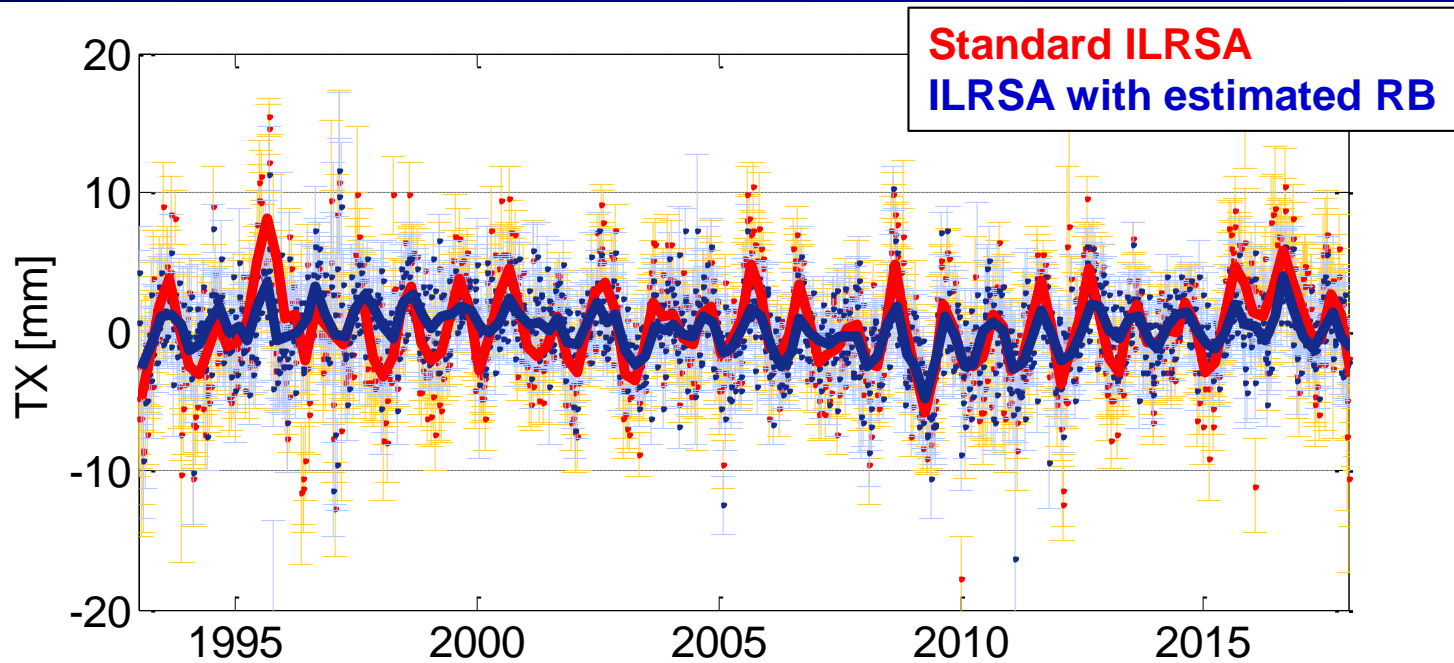
New models suggest errors as high as 6 mm

pad ID	Name	length (ps)	Detector	Configuration (single, few, multi)	Editing Level ($\times\sigma$)	Calib. St. error (mm)	LAGEOS St. error (mm)	LAGEOS CoM range (mm)	LAGEOS CoM ADOPTED (mm)
1873	Simeiz	350	PMT	No CNTL	2.0	60	70	248-244	246
1879	Altay	150	PMT	No CNTL	2.5	20	36	254-248	251
1884	Riga	130	PMT	CNTLD s->m	2.0	10	15	252-248	250
7080	McDonald	200	MCP	CNTLD s->m	3.0	8.5	13	250-248	249
7090	Yaragadee	200	MCP	CNTLD f->m	3.0	4.5	10	250-248	249
7105	Greenbelt	200	MCP	CNTLD f->m	3.0	5	10	250-248	249
7110	Mon. Peak	200	MCP	CNTLD f->m	3.0	5	10	250-248	249
7119	Haleakala	200	MCP	CNTLD f->m	3	4.5	10	250-248	249
7124	Tahiti	200	MCP	CNTLD f->m	3.0	6	10	250-248	249
7237	Changchung	200	CSPAD	CNTLD s->m	2.5	10	15	250-245	248
7249	Beijing	200	CSPAD	No CNTL, m	2.5	8	15	255-247	251

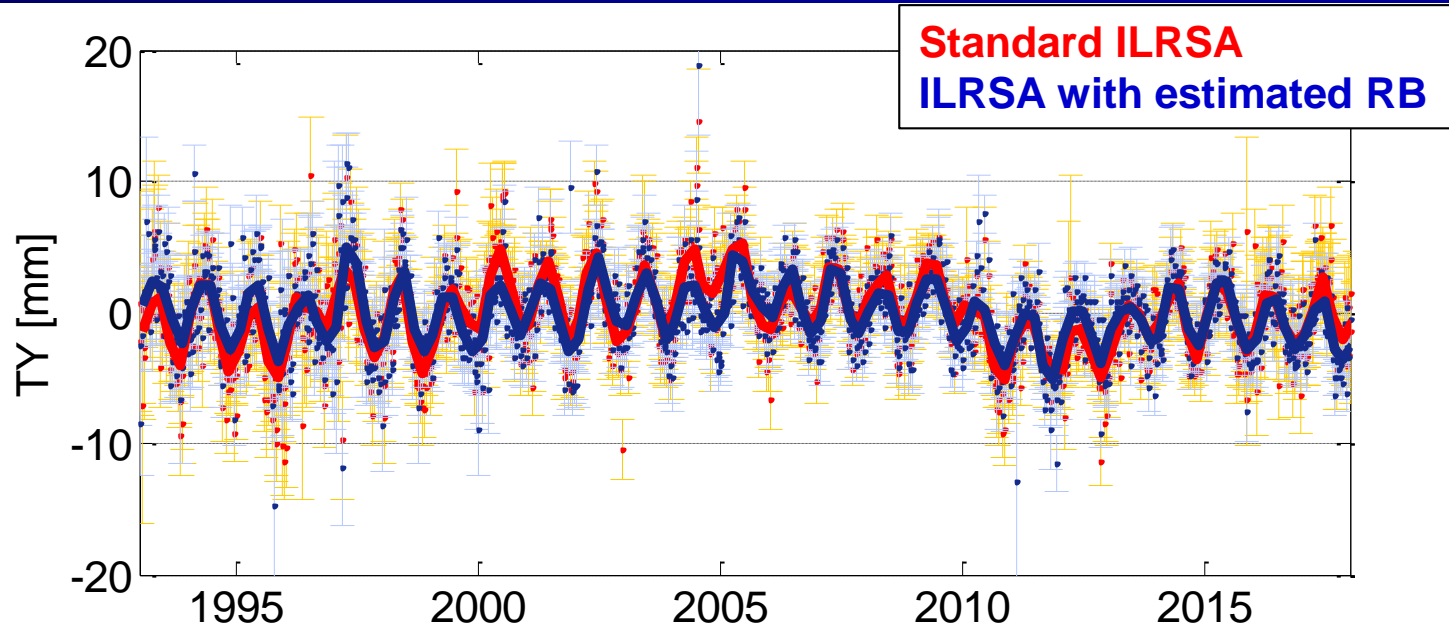
Impact on the ILRSA scale w.r.t. ITRF2014



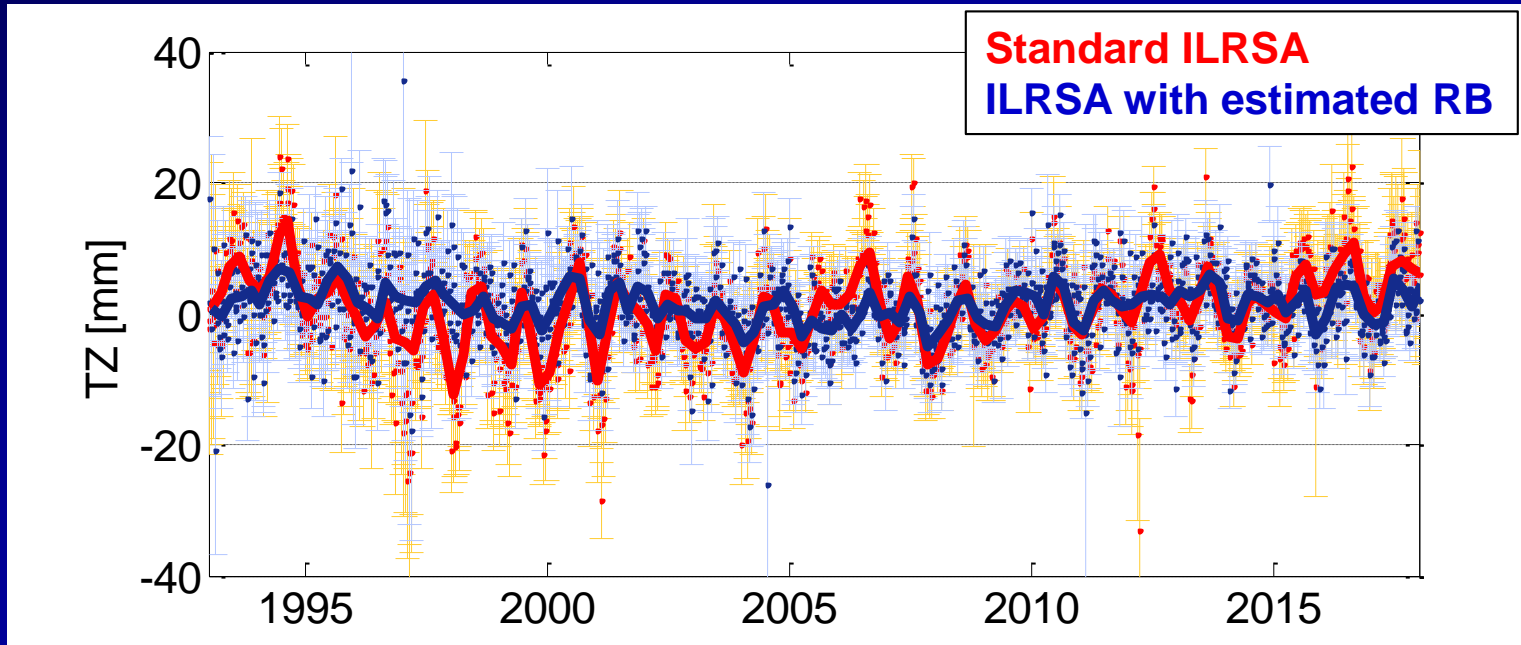
Impact on the ILRSA TX w.r.t. ITRF2014



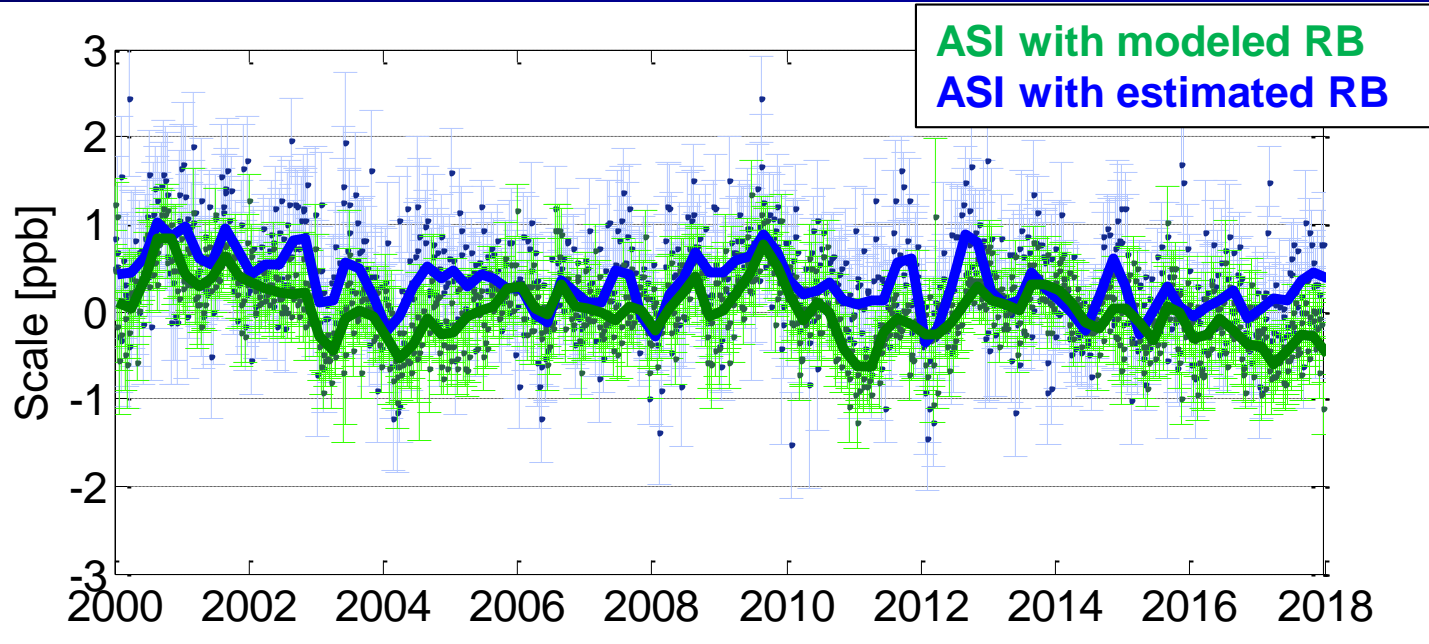
Impact on the ILRSA TY w.r.t. ITRF2014



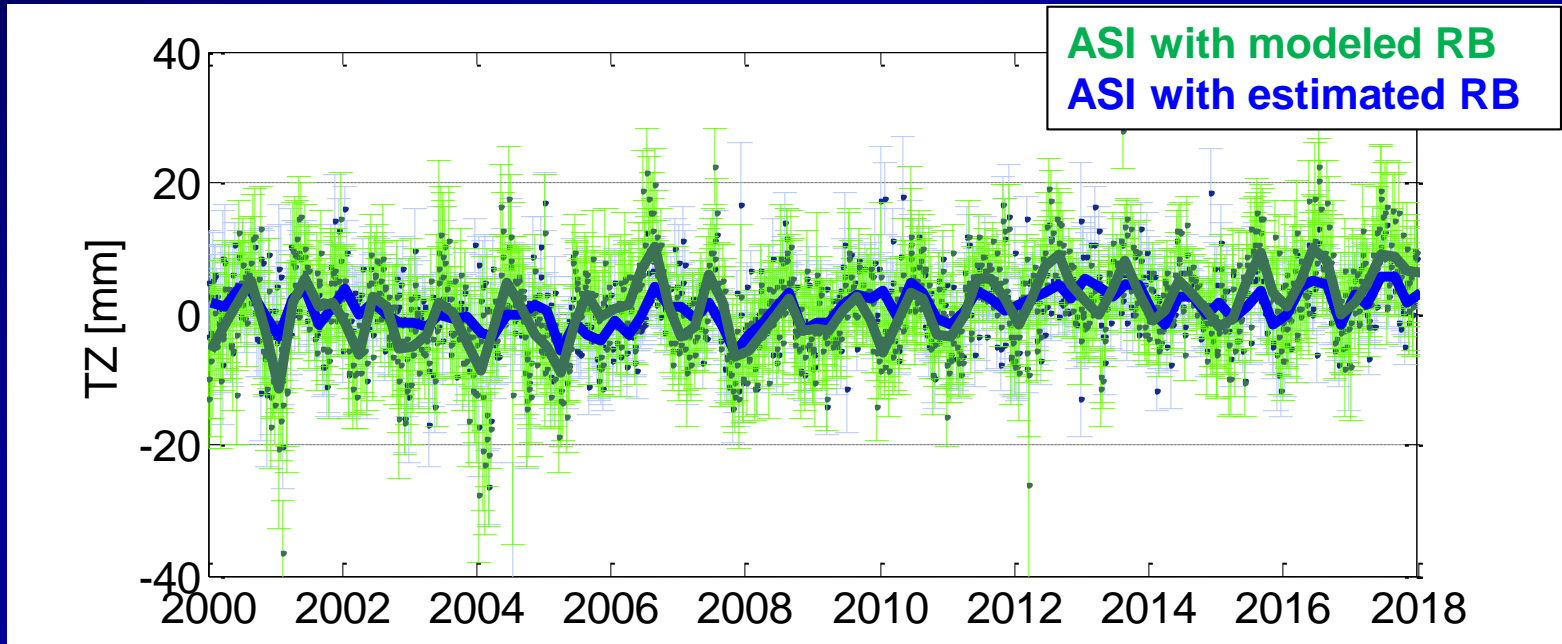
Impact on the ILRSA TZ w.r.t. ITRF2014



Preliminary results with the new RB table



Preliminary results with the new RB table



Towards the operational phase

- Preliminary table of mean range biases available for all stations
- New satellite Center of Mass model to be soon delivered
- Full reanalysis to take into account the new satellite Center of Mass corrections
- Mean station systematic errors inserted into the ILRS data handling file
- Start of the operational service to routinely keep the table updated
- Use of the updated data handling file for all the official ILRS products, ITRF included

Summary

- ❑ Quality control of the ILRS data and products is our top priority
- ❑ Dedicated ASC activities to monitor system stability and systematics that will turn into an operational service
- ❑ The station systematic errors can explain ~ 1 ppb in the VLBI-SLR scale difference
- ❑ Modeling is continuously improved to assure mm-accuracy (e. g. Time biases, satellite CoM correction)