

The ILRS Analysis Standing Committee (ASC) Planned Contribution to ITRF2020

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- SLR Error Budget
- Station Systematic Error Monitoring Pilot Project (SSEM PP)
- Correction of SLR data affected by gross (known) errors
- Modeling Updates in view of the ITRF2020 reanalysis
- Planning for the reanalysis for the ITRF2020 contribution product

Error Budget Components for SLR





ILRS ASC Plan for Generation of the ITRF2020 Products



- 1) Completion of the SSEM PP with new CoM Model and latest release of data @ -3ACs
- 2) Generation of the final table of systematics (New **Data Handling** File) **By end of 2019**
- 3) Generation of a 1-year test series with the inclusion of LARES (2017) TBD
- 4) Decisions taken at ASC Meeting in Paris, October 1, 2019:
 - I. Adoption of final target signature model (CoM corrections for missing/new sites) DONE
 - II. Adoption of gravity and tides models, and procedure for extending TVG into future years DONE
 - III. Adoption of the HF EOP model sanctioned by IERS Conventions DONE
 - IV. Adoption of the format for the SINEX section documenting the CoM and Systematics applied each week in each arc **DONE**
- 5) Generation of the ILRS series of SINEXs for the ITRF2020 (1983 to 2019) 2020-2021
 6) Combination of the initial SINEX series and iteration/correction of errors 2020-2021

Station Systematic Error Modeling Plans



- The model is obtained by estimating R_B simultaneously with all other parameters in a free adjustment
- The project is nearly complete with the data reanalysis (3 ACs missing):
 - Weekly estimation of coordinates, EOP and range biases R_B
 - Time frame: 1993-2019
 - Data: LAGEOS , LAGEOS-2 and Etalon 1 & 2 (one bias)
 - Time series with separate range biases for LAGEOS, combined for Etalons:
 - 1) Combination of the time series generated by the ILRS ACs PENDING 3 AC DELIVERIES
 - 2) Identification of bias discontinuities/changes over the 1993 2019 period ONCE (1) IS DONE
 - 3) Computation of mean range biases over periods exhibiting stable errors ONCE (2) IS DONE

ILRS-B Long-term Mean Bias from SSEM Time Series (7 ACs)





A time series of bias corrections will be developed for each system based on the long-term weekly estimates series.

The **mean bias** shown here is simply the weighted mean of these series for each system, to be used as a figure of merit in characterizing the performance of each system over time.

Red arrows indicate the major data contributing systems

Impact of Range Bias Correction on TRF Scale



 SSEM PP resulted in a significant change in the scale of the SLR network which is now much closer to that of the VLBI network.



Current Target Signature Model Errors (CoM)





E. C. Pavlis 10/08/2019

2019 Journées, Paris, France

NEW Center of Mass Offset Model: NERC-2018

- ILRS
- Newly developed NERC model improves CoM correction for all satellites, although the change is more significant for the Etalons:



Model updated on 2019/09/04

Final release: 190904

NERC results presented at ASC meeting 11/04/2018

ILRS Station Systematic Error Modeling



- At present, the modeling of the systematic errors for the standard ILRS products is based on information from site logs, historical and engineering reports, 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) for operational analyses:

with updates from ILRS/AWG reprocessing results 1873 --- mm A 95:001:00000 00:001:00000 R -270.00 7080 --- mm A 88:001:00000 89:349:00000 R -40.00 7080 --- mm A 90:094:00000 93:168:00000 R 25.00 IRLS/AWG 14/04/04 7080 --- mB A 95:065:00000 96:026:00000 P -2.10source CDDIS 7080 --- mB A 96:026:00000 96:116:00000 P -10.30 source CDDIS 7080 --- mB A 96:116:00000 96:130:00000 P -9.70 source CDDIS 7109 --- mm A 00:000:00000 88:347:00000 R 10.00 ILRS/AWG 09/05/06 7109 --- mm A 97:009:00000 97:018:00000 R 164.90 source CDDIS 7110 --- mm A 84:001:00000 84:136:00000 R 30.00 7110 --- mm A 87:300:00000 88:025:00000 R 30.00 7110 --- mm A 96:240:00000 96:277:00000 R 163.60 source CDDIS 7122 --- mm 30.00 A 84:122:00000 87:074:00000 R 7123 --- mm A 87:195:00000 87:282:00000 R -30.00 source CDDIS 7210 --- mm A 83:001:00000 87:255:00000 R 25.00 7210 --- mm A 87:255:00000 94:021:00000 R -37.00 7210 --- mm -11.00 A 94:021:00000 00:001:00000 R 7237 --- mm A 96:001:00000 98:001:00000 R 20.000 7237 --- mm -20.000 A 98:001:00000 02:171:00000 R 7237 --- ms A 17:038:04000 17:038:60600 U +1.0000Event Timer offset (cor. time=np time - cord.) 7237 --- ms A 17:037:43200 17:037:86400 U +1.0000Event Timer offset (cor. time=np time - cord.)

list of mandatory range biases to be applied on observation (ILRS/AWG Oct 2007)

A new version will be adopted at the end of the SSEM PP (end of 2019) and adopted for the ITRF2020 reanalysis and future operational products.

Example: ILRS-A Preliminary Results: Graz



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

E. C. Pavlis 10/08/2019

Example: ILRS-A Preliminary Results: Matera





ILRS Pilot Project on systematic errors (new CoM)





ILRS-A Preliminary Results: 20 Stations



ILRS Station Systematic Error Modeling





- Preliminary SSEM series were used already to identify breaks in the estimated biases;
- The final series will be reinspected to verify if no changes are in order or not;
- The final values will be adopted over each period from a weighted mean of the weekly estimates and their formal statistics;
- These will be input in the new
 "Data Handling" file to be used for the ITRF2020 reanalysis.

Documentation of Modeling in ILRS Products



* 1 2 *2345678901234567890 *	3 1234567890123456	4 789012345	5 56789012345	6 67890123456	7 7890123456	8 57890
+RANGE_BIAS_MODEL *SITE PT SOLN T STAR 1873 L1 501 L 18:2 1873 L2 501 L 18:2 1879 L1 501 L 18:2 1879 L2 501 L 18:2	T_DATE END_DAT 88:00000 18:295: 88:00000 18:295: 88:00000 18:295: 88:00000 18:295:	E RAN 00000 00000 00000 00000	NGE_BIAS ST -0.0193 -0.0193 0.0193 0.0193 0.0193	D_DEV 1.000 1.000 1.000 1.000		
* 1 2	3	4	5	6	7	8
*23456789012345678901234567890123456789012345678901234567890123456789012345678901234567890						
+TIMING_BIAS_MODEL						
*CODE PT_ UNIT T STA	RT_DATE END_DA	TE M	E-VALUE_	STD_DEV	_E-RATE	_CMNTS_
1824 us A 10:	126:00000 10:127	:00000 T	-17.7	50 1.000	0.0000	
1824 us A 10:	132:00000 10:133	:00000 T	-5.7	50 1.000	0.0000	
1824 us A 12:	084:68460 12:085	:00000 T	-24.4	00 5.000	0.0000	
1873 us A 09:	059:00000 09:110	:00000 T	-21.7	50 50.000	-0.2600	c.drift
1873 us A 09:	324:00000 10:095	:00000 T	2.0	00 50.000	0.0750	c.drift
1873 us A 10:	096:00000 10:159	:00000 T	6.1	50 50.000	0.4000	c.drift
1873 us A 10:	350:00000 11:064	:00000 T	-380.0	00 50.000	-9.0000	c.drift
* 1 2 *2345678901234567890	3	4 789012345	5 56789012345	6 67890123456	7 7890123456	8 57890
*						
+CoM MODEL						
*SITE PT SOLN T STAR	T_DATE END_DAT	E	COM_CORR			
1873 L1 501 L 18:2	88:00000 18:295:	00000	0.1234			
1873 L2 501 L 18:2	88:00000 18:295:	00000	0.1234			
1879 L1 501 L 18:2	88:00000 18:295:	00000	0.1234			
1879 L2 501 L 18:2	88:00000 18:295:	00000	0.1234			

- Applied corrections for measurement biases, timing biases and the "target signature offset—aka CoM correction" will always be documented in each SINEX file based on actually applied values;
- The entries will reflect the station complement that appears in the specific week and only for the data used for the solution;
- The example given here is roughly what was discussed and decided at the Tuesday ASC meeting and it will be finalized after review by the ASC.





- Quality control of ILRS data and products remains our top priority
- Dedicated ASC activities monitor system stability and systematics and will soon become the operational mode for official products
- The station systematic errors can explain ~1ppb in the VLBI-SLR scale difference
- Modeling is continuously improved to assure mm-accuracy and documentation of the applied models will be available with all future products, including the series submitted for ITRF2020.



We thank the ILRS ACs for their dedication and support and

Thank you for your attention!

Impact of Range Biases on TRF Origin: T_X





Impact of Range Biases on TRF Origin: T_Y





Impact of Range Biases on TRF Origin: Tz





Modeled vs Estimated Biases: TRF T_z



Modeled vs Estimated Biases: TRF Scale



ILRS Preliminary Combination Results (JCET v230) - SSEM PP



