NASA GSFC/JCET ILRS Analysis Center Contribution to ITRF2020-u2025 Development

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Summary

The NASA GSFC/UMBC Joint Center for Earth Systems Technology (JCET) ILRS Analysis Center supports the International Laser Ranging Service (ILRS) through routine SINEX submissions, network validation, and contributions toward future updates of the International Terrestrial Reference Frame (ITRF). As an ILRS Analysis Center (AC) and the designated ILRS backup combination center (ILRS-B), JCET/NASA GSFC generates daily and weekly SINEX solutions and combines contributions from eight ILRS ACs to produce the ILRS-B solution, complementing the official ILRS-A solution provided by ASI for the ITRF Combination Centers (DGFI, JPL & IGN).

Since April 2025, the ILRS AC's have produced new operational series that incorporate LARES-2 tracking data. The ILRS Analysis Standing Committee (ASC) has verified that adding LARES-2 improves the geodetic coverage and the ILRS contribution to the ITRF. In the preparation to develop the ILRS contribution to ITRF2020-u2025, the ILRS AC's have developed operational SINEX series (v90, v190) including LARES-2, to verify their ability to deliver operational products with the new satellite, and to validate their LARES-2 processing. For the ITRF2020-u2025 contribution, all AC's were requested to process data from 2021.0 to 2026.0, adjusting all station range biases on a weekly basis, along with station coordinates and Earth Orientation Parameters (EOP). For this SINEX series, known as v330, the ILRS ACs adopted the new version of the Center-of-mass model supplied by J.C.Rodriguez (com6.260112.tar.gz, available from https://datos-geodesia.ign.es/SLR/centre_of_mass_models/models/). We review the performance of the v330 SINEX series in terms of the Helmert Parameters of the AC and ILRSB solutions and provide a summary of the range biases found for ILRS stations.

Processing steps for the contribution to ITRF2020-u2025

1. Update models and reference files

- ❑ Update station- and satellite-specific target signature models, including newly added stations and CoM corrections.
- ❑ Update SLR2020 + ILRS ECC file:
  - add new stations and eccentricities
  - correct known issues

Date of Last station validation (*after entry of station into quarantine*)

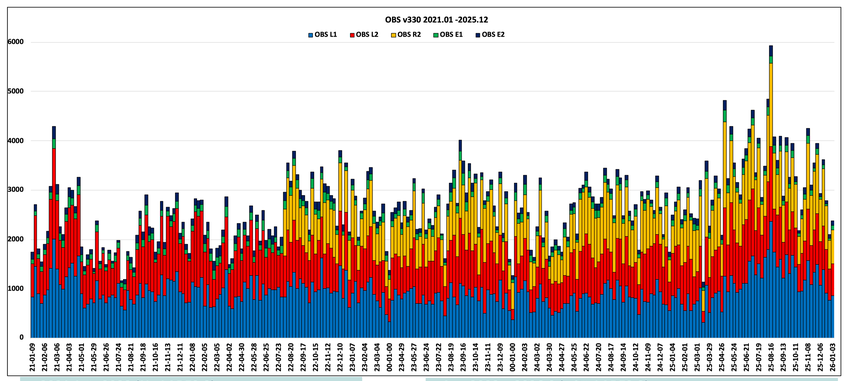
Station	Date of Validation	LAGEOS1		LAGEOS2		LARES2		LARES	
		PREC EST [mm]	RANGE BIAS [mm]	PREC EST [mm]	RANGE BIAS [mm]	PREC EST [mm]	RANGE BIAS [mm]	PREC EST [mm]	RANGE BIAS [mm]
Wettzell (WETL, 8834) @ 1064nm	2/26/21	1.2 ± 0.8	9.1 ± 13.1	1.8± 1.3	5.0 ± 14.3	--	--	2.0 ± 1.0	-7.5± 20.0
Izana (IZ1L, 7701) @ 1064nm	04/24/2021 (New station for the ILRS network!)	2.1 ± 1.2	-3.1 ± 9.8	1.7 ± 0.9	-0.6± 11.4	--	--	3.9 ± 2.2	5.3 ± 22.3
Beijing (BEIL, 7249) @ 532nm	5/30/22	3.5 ± 1.2	-64.4 ± 18.8	3.4 ± 1.1	-66.8 ± 13.9	--	--	4.4 ± 1.6	-80.0± 51.7
Wettzell (SOSW, 7827)	10/20/22	2.3 ± 1.5	9.6 ± 11.3	2.0 ± 1.3	4.6 ± 7.4	--	--	2.9± 1.8	14.1 ± 32.2
Golosiiv, (GLSL, 1824) @ 532nm	5/24/23	5.9 ± 2.8	-207.9 ± 101.2	6.6 ± 4.5	-153.6 ± 103.5	--	--	15.3 ± 15.0	-152.8 ± 89.2
Matera, (MATM, 7941) @ 532nm	6/15/23	2.5 ± 1.3	-4.0 ± 30.1	2.2 ± 1.5	-2.2 ± 23.0	--	--	3.1 ± 1.7	-19.9 ± 36.4
Tsukuba (TKBL, 7306) @ 532nm	06/12/2023 (New station for the ILRS network!)	3.0 ± 1.8	9.3 ± 22.0	1.9 ± 1.4	16.3 ± 18.7	--	--	3.1 ± 1.4	5.9 ± 34.5
Beijing (BEIL, 7249) @ 532nm	10/25/2023	2.7 ± 1.3	-32.7 ± 8.7	1.8 ± 1.6	-26.6 ± 15.2	1.5 ± 1.1	-25.6 ± 17.2	4.2 ± 2.5	-34.1 ± 31.0
Tsukuba (TKBL, 7306) @ 532nm	3/28/24	3.2 ± 1.5	-11.7 ± 15.7	3.1 ± 2.1	3.0 ± 18.3	3.0 ± 1.6	-0.5 ± 23.3	4.5 ± 2.3	0.7 ± 26.3
Mt. Stromlo (STL3, 7825) @ 532nm	8/16/24	2.6 ± 1.0	1.3 ± 12.1	2.7 ± 1.4	5.1 ± 8.9	2.8 ± 1.4	4.4 ± 16.2	4.6 ± 2.8	13.0 ± 27.5
Yebes (YEBL, 7817) @ 1064nm	10/07/2024 (New station for the ILRS network!)	2.4± 1.2	-6.5 ± 13.5	2.1± 1.0	-5.3 ± 9.3	2.7± 1.5	5.3 ± 16.0	5.6 ± 4.9	-0.2 ± 22.4
Matera, (MATM, 7941) @ 532nm	12/17/24	2.4 ± 1.0	-5.9 ± 8.1	2.0 ± 1.0	-3.6 ± 11.2	2.2 ± 1.2	-5.5 ± 13.0	3.1 ± 1.4	-1.9 ± 15.6
Herstmonceux (HARL, 7840) @ 532nm	3/31/25	1.7 ± 0.5	1.5 ± 4.9	1.9 ± 0.7	2.9 ± 6.1	4.3 ± 1.6	11.3 ± 17.1	2.8 ± 1.3	4.4 ± 11.0
Zimmerwald (ZIML, 7810) @ 532nm	04/09/2025	2.4 ± 0.9	13.1 ± 7.1	2.7 ± 1.1	12.4 ± 6.6	3.4 ± 1.3	17.3 ± 10.1	3.4 ± 1.8	12.0 ± 17.9
Wettzell (SOSW, 7827) @ 850 nm	4/14/25	2.0 ± 0.7	-4.8 ± 6.6	2.0 ± 0.6	-4.1 ± 6.3	2.9 ± 1.4	-3.1 ± 10.0	4.4 ± 2.8	-3.6 ± 19.3
San Fernando (SFEL, 7824) @ 532nm	10/17/2025	5.0 ± 1.8	-7.0 ± 10.6	4.9 ± 1.5	-2.8 ± 8.7	4.2 ± 1.4	-4.4 ± 7.7	4.7 ± 1.9	-2.6 ± 19.4
Hartebeesthoek (7501) @ 532nm	11/04/2025	3.5 ± 1.0	-13.0 ± 9.2	3.3 ± 1.1	-13.7 ± 9.7	3.8 ± 1.5	-12.3 ± 10.7	5.0 ± 2.0	-9.5 ± 26.5
Xian (NTSC, 7329) @ 532nm	12/04/2025 (New station for the ILRS network!)	3.0 ± 1.4	2.3 ± 21.0	2.9 ± 2.1	0.9 ± 19.4	3.2 ± 2.1	10.8 ± 18.2	4.7 ± 2.7	5.7 ± 22.6

2. Prepare observational data

- ❑ Re-download SLR observations from **EDC/CDDIS** for **2021.0–2026.0**, including:
  - data released from de-quarantined stations
  - data from newly commissioned stations

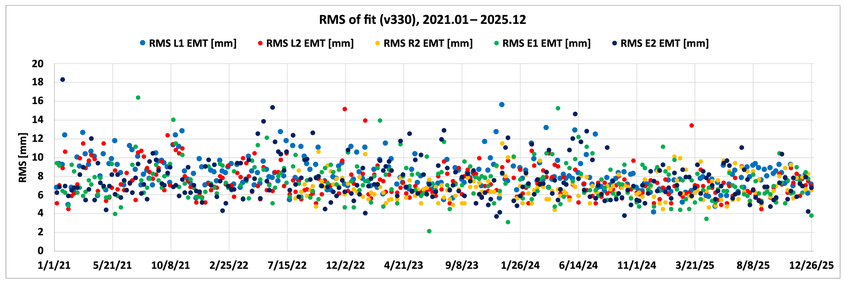
3. Reprocessing Weekly v330 from 2021.01-2025.12 for LARES-2 Integration into the ILRS Operational Products

The ILRS Analysis Centers began reprocessing and submitting v330-format solutions. Version v330 covers the full period starting in January 2021. In addition, v330 performs a range bias estimation for all stations included in the data, including LARES-2, which enhances geodetic coverage and contributes to improved reference frame realization and the long-term stability of ILRS and ITRF products

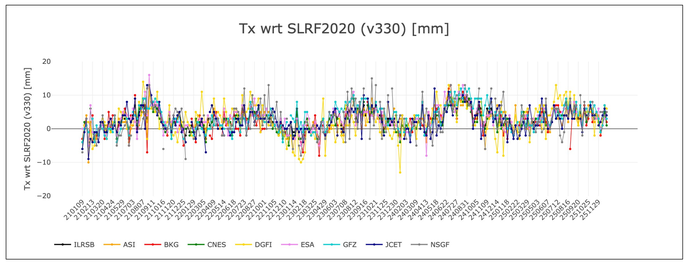


2021-July 2022 (No LARES-2)				
RMS [mm]	L1	L2	E1	E2
Mean	9.0	7.9	7.9	7.9
STD	2.4	1.8	2.8	2.4
No Obs	**L1**	**L2**	**E1**	**E2**
Mean	979	929	132	126
Total	80280	76141	10843	10360

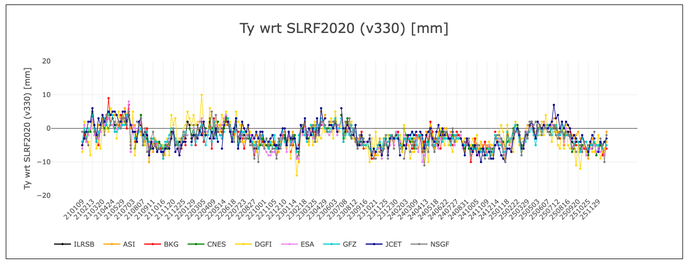
Aug 2022 – 2026.0 (with LARES-2)					
RMS [mm]	L1	L2	R2	E1	E2
Mean	7.9	7.0	6.8	7.2	7.4
STD	1.6	1.5	1.3	1.9	2.0
No Obs	**L1**	**L2**	**R2**	**E1**	**E2**
Mean	958	857	851	117	114
Total	169612	151703	150563	20777	20122



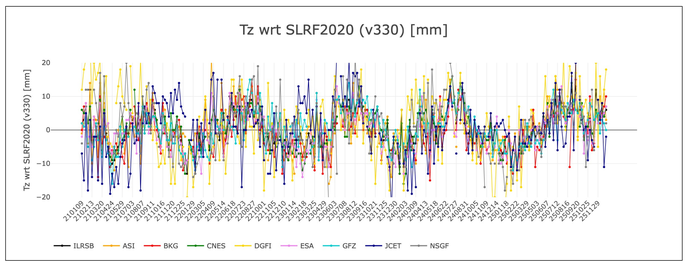
ILRSB status: v330, Helmert Parameters of AC's and the ILRS-B combination



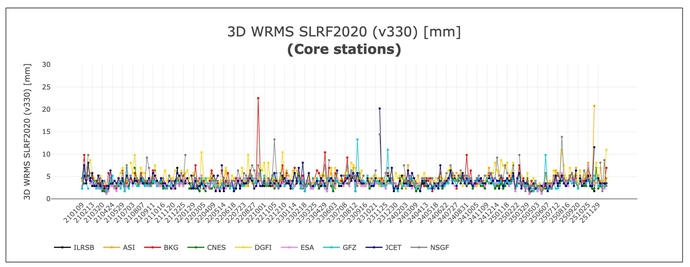
AC	Mean ± STDDEV
ILRSB	3.11 ± 3.00
ASI	2.42 ± 3.23
BKG	2.54 ± 3.67
CNES	2.40 ± 3.12
DGFI	2.70 ± 4.61
ESA	3.09 ± 3.35
GFZ	3.43 ± 3.64
JCET	2.41 ± 3.66
NSGF	2.79 ± 4.76



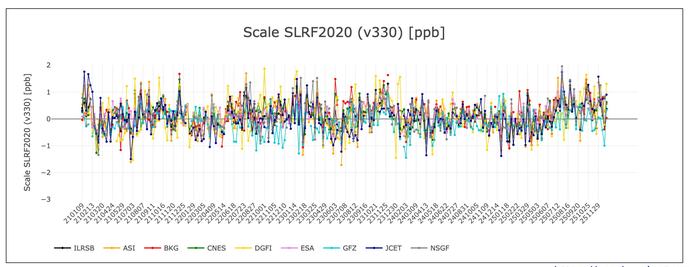
AC	Mean ± STDDEV
ILRSB	-2.93 ± 2.74
ASI	-2.26 ± 3.23
BKG	-2.74 ± 3.04
CNES	-2.66 ± 2.75
DGFI	-2.64 ± 3.61
ESA	-2.95 ± 3.08
GFZ	-2.64 ± 2.65
JCET	-2.14 ± 3.50
NSGF	-2.77 ± 3.30



AC	Mean ± STDDEV
ILRSB	0.46 ± 5.70
ASI	0.67 ± 6.47
BKG	-0.90 ± 6.29
CNES	0.45 ± 5.82
DGFI	1.66 ± 9.60
ESA	-0.19 ± 5.69
GFZ	0.53 ± 5.73
JCET	0.18 ± 8.45
NSGF	1.35 ± 8.47



AC	Mean ± STDDEV
ILRSB	3.22 ± 0.98
ASI	3.98 ± 1.57
BKG	4.30 ± 1.85
CNES	3.29 ± 0.99
DGFI	4.84 ± 1.65
ESA	3.40 ± 0.94
GFZ	3.56 ± 1.28
JCET	4.04 ± 1.63
NSGF	4.70 ± 1.91

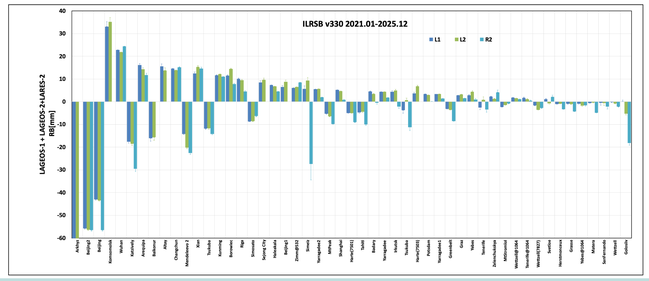


AC	Mean ± STDDEV
ILRSB	0.06 ± 0.39
ASI	0.07 ± 0.56
BKG	0.21 ± 0.51
CNES	0.19 ± 0.43
DGFI	0.15 ± 0.64
ESA	0.18 ± 0.39
GFZ	-0.12 ± 0.44
JCET	0.04 ± 0.59
NSGF	0.17 ± 0.55

https://geodesy.jcet.umbc.edu/ILRSB_REPORT/

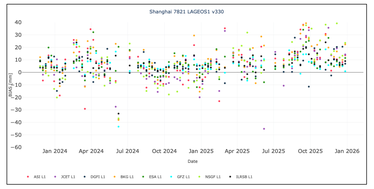
ILRSB RANGE BIAS Status v330

For the v330 SINEX Series, all station biases are adjusted. This series, which includes LARES-2 is part of the pilot project to include the satellite in the ILRS products. We calculate the average bias by station and satellite, considering the AC contributions. The average mean bias was computed from January 2021 to February 2026.

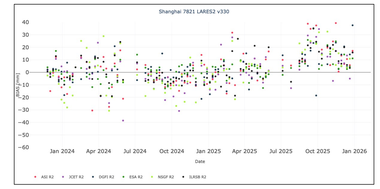


ILRSB RANGE BIAS Status v330 per station and AC

Shanghai 7821: *v330 Range biases for LAGEOS-1 (left) and LARES-2 (right) by AC and for ILRS-B*

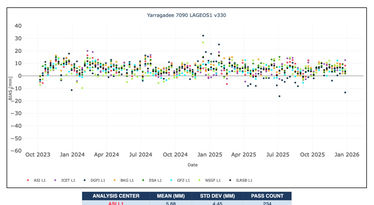


ANALYSIS CENTER	MEAN (MM)	STD DEV (MM)	PASS COUNT
ASI L1	7.24	17.20	86
JCET L1	4.63	14.23	87
DGFI L1	4.80	8.21	76
BKG L1	11.29	15.93	85
ESA L1	7.05	8.78	87
GFZ L1	5.83	7.29	85
NSGF L1	6.79	15.80	85
ILRSB L1	6.41	7.02	87

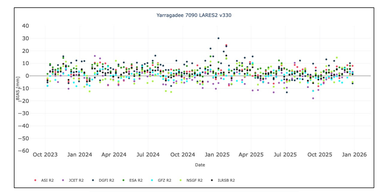


ANALYSIS CENTER	MEAN (MM)	STD DEV (MM)	PASS COUNT
ASI R2	4.11	15.49	90
JCET R2	1.83	14.03	88
DGFI R2	2.82	10.82	75
BKG R2	0.00	0.00	0
ESA R2	2.27	9.26	89
GFZ R2	0.00	0.00	0
NSGF R2	2.47	17.89	88
ILRSB R2	2.89	11.16	92

Yarragadee 7090: *v330 Range biases for LAGEOS-1 (left) and LARES-2 (right) by AC and for ILRS-B*

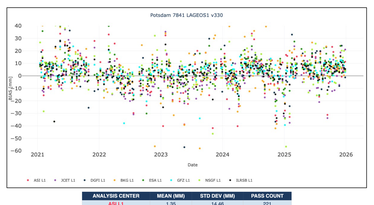


ANALYSIS CENTER	MEAN (MM)	STD DEV (MM)	PASS COUNT
ASI L1	5.68	4.43	234
JCET L1	5.41	4.93	234
DGFI L1	4.77	7.34	234
BKG L1	6.87	4.04	234
ESA L1	7.03	3.33	234
GFZ L1	4.59	3.79	234
NSGF L1	4.66	5.55	224
ILRSB L1	5.64	3.25	117

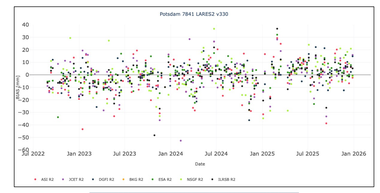


ANALYSIS CENTER	MEAN (MM)	STD DEV (MM)	PASS COUNT
ASI R2	2.65	5.00	117
JCET R2	-0.90	8.70	117
DGFI R2	4.96	6.97	117
BKG R2	0.00	0.00	0
ESA R2	4.64	3.52	117
GFZ R2	0.15	3.71	117
NSGF R2	0.87	5.69	113
ILRSB R2	1.99	3.23	117

Potsdam 7841: *v330 Range biases for LAGEOS-1 (left) and LARES-2 (right) by AC and for ILRS-B*



ANALYSIS CENTER	MEAN (MM)	STD DEV (MM)	PASS COUNT
ASI L1	1.35	14.46	221
JCET L1	-0.05	12.47	220
DGFI L1	2.39	13.83	208
BKG L1	2.80	15.74	204
ESA L1	4.06	10.24	220
GFZ L1	3.49	7.96	214
NSGF L1	3.07	13.78	216
ILRSB L1	2.65	8.69	226



ANALYSIS CENTER	MEAN (MM)	STD DEV (MM)	PASS COUNT
ASI R2	-1.82	13.45	155
JCET R2	-1.83	14.03	152
DGFI R2	0.20	13.09	133
BKG R2	-95.43	0.00	1
ESA R2	0.82	10.71	153
GFZ R2	0.00	0.00	0
NSGF R2	-0.50	13.94	137
ILRSB R2	-1.15	9.55	156

https://geodesy.jcet.umbc.edu/BIAS_v330/

4. Update ILRS metadata

- ❑ Update the **ILRS DHF** to reflect:
- new stations
- operational status changes

5. Reprocess ILRS products (final stage)

Reprocess **weekly v90/v100** using updated Update SLR2020, ILRS ECC file, DHF and data,

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