International Laser Ranging Service (ILRS) Status

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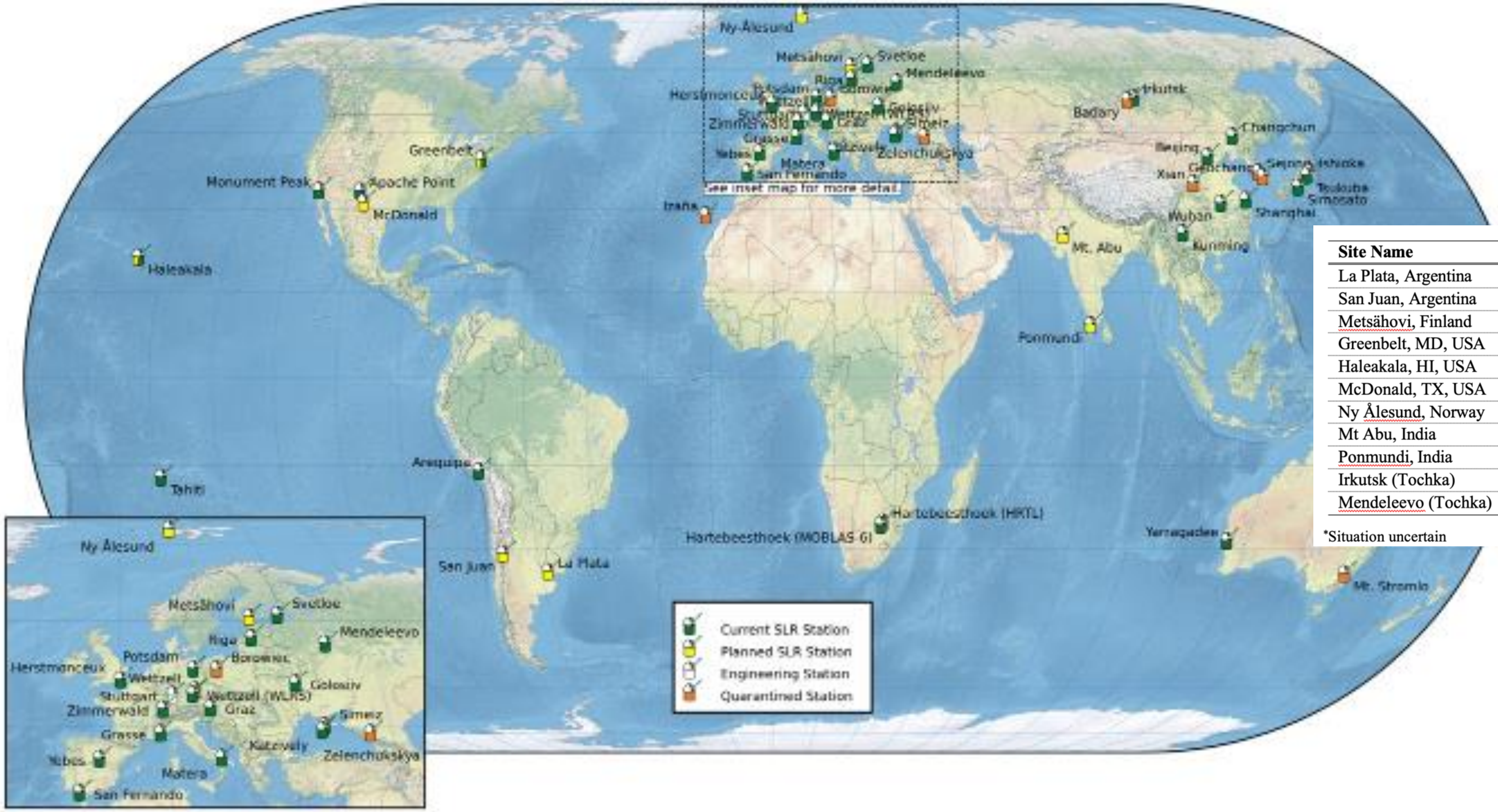
[4]NASA Goddard Space Flight Center
[5] Deutsches Geodätisches Forschungsinstitut/Technical University of Munich (DGFI/TUM)
[6]Observatoire de la Côte d'Azur (OCA)

ILRS Network (Current and Planned)

Current and Planned ILRS Network



Future Network Development

Site Name	Type	Agency
La Plata, Argentina	Upgraded core site	BKG, Germany
San Juan, Argentina	Upgraded SLR system	NAOC, China
Metsähovi, Finland	New SLR system	FGI, Finland
Greenbelt, MD, USA	Replacement core site	NASA, USA
Haleakala, HI, USA	Replacement core site	NASA, USA
McDonald, TX, USA	Replacement core site	NASA, USA
Ny Ålesund, Norway	New core site	NMA, Norway/NASA, USA
Mt Abu, India	New SLR site	ISRO, India
Ponmundi, India	New SLR site	ISRO, India
Irkutsk (Tochka)	New SLR site	VNIIFTRI, Russia
Mendeleevo (Tochka)	New SLR site	VNIIFTRI, Russia

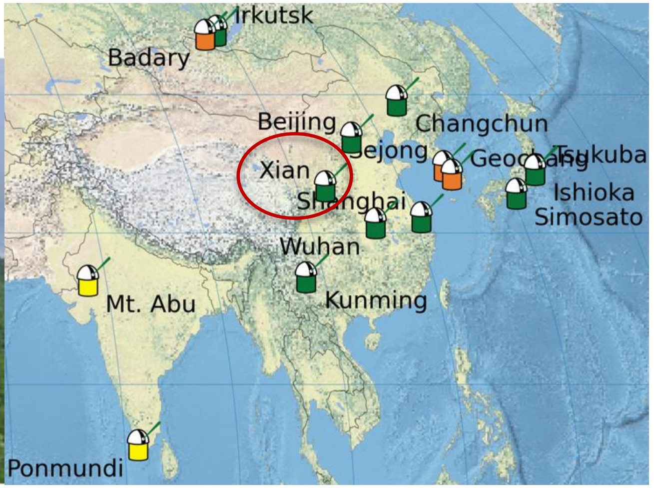
*Situation uncertain

New Stations in the ILRS Network (Xian, China)

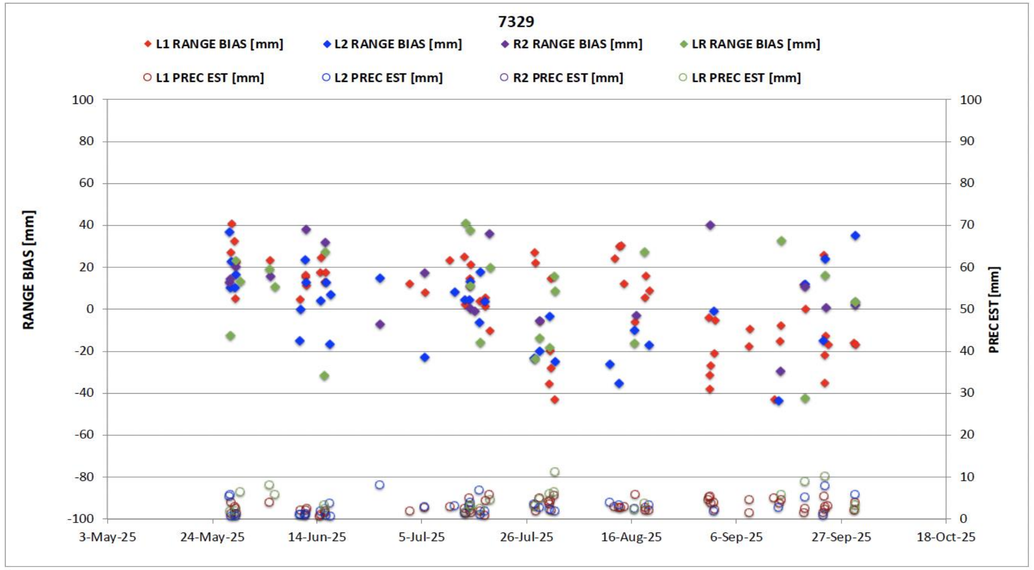
NTSC (7329) Xi’an Station, Shaanxi Province, China - National Time Service Center, Chinese Academy of Sciences (http://www.ntsc.ac.cn/)

Successfully completed quarantine in November 2025.

Primary Wavelength: 1064 nm
Primary Maximum Energy: 20 mJ
Secondary Wavelength: 532 nm
Secondary Max. Energy: 12 mJ
Transmit Energy Adjustable
Pulse Width (FWHM): 25 ps
Max. Repetition Rat: 1000 Hz
Full width Beam Divergence: 35”



Receiving Telescope Type: CASSEGRAIN, 1.05 m (Mount AZ-EL)
Transmitting Telescope Type: GALILEI, Aperture 0.2 m
Tracking Camera Type: CCD, 910H (Watec/Japan)
Field of View: 0.02 deg; Minimum Magnitude: 13 mag
Transmit/Receive Path: SEPARATE; Trans./Receive Switch: NONE
Max. Slew Rate (Az): 10 deg./s; Max. Slew Rate (El): 5 deg./s
Max Used Tracking Rate (Az): 4; Max Used Tracking Rate El : 1
Telescope Shelter: DOME; Daylight Filter Type: SPECTRAL FILTER;
Dayl. Filt. Bandwidth: 0.2 nm
Adjustable Attenuation: TRANSMIT; Adjustable Field of View;
Transmit/Receive Efficiency: 0.7/0.8



New Stations in the ILRS Network (Ishioka, Japan)

Omni-SLR, Ishioka, Japan

Concepts

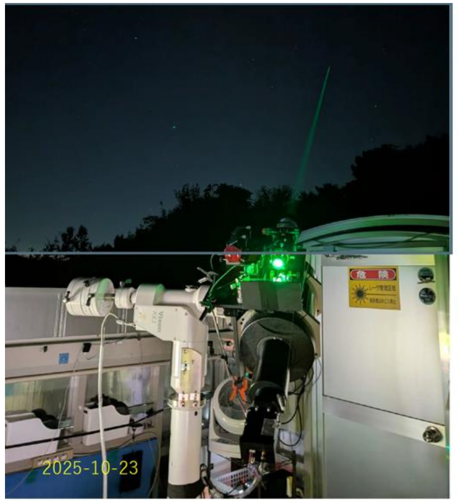
Compact: High mobility < 100 kg. Conveyable by a car. Low Energy Consumption < 100 W

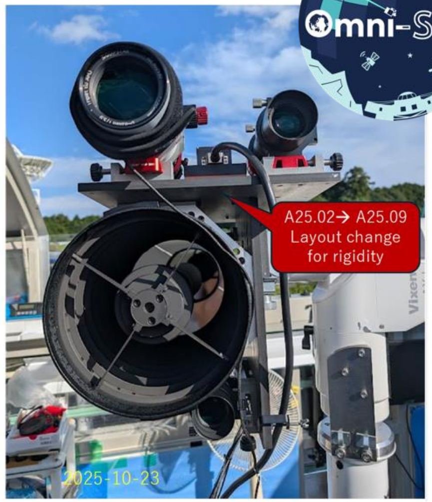
Very Low-cost: EUR/USD 50-60 k (current configuration, > in 2025). Key components = COTS.

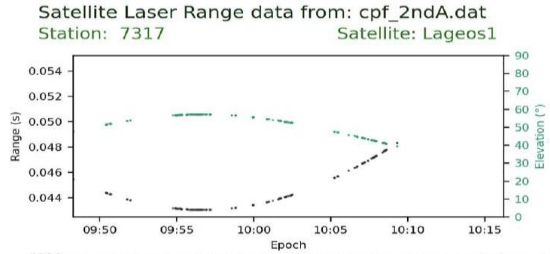
Multi-purpose: SLR + Time Transfer/ Space Communications/6G Airborne Comm,/Others.

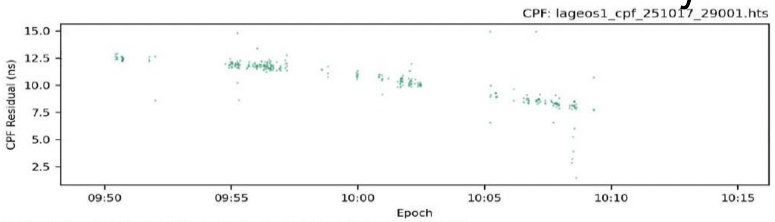
System

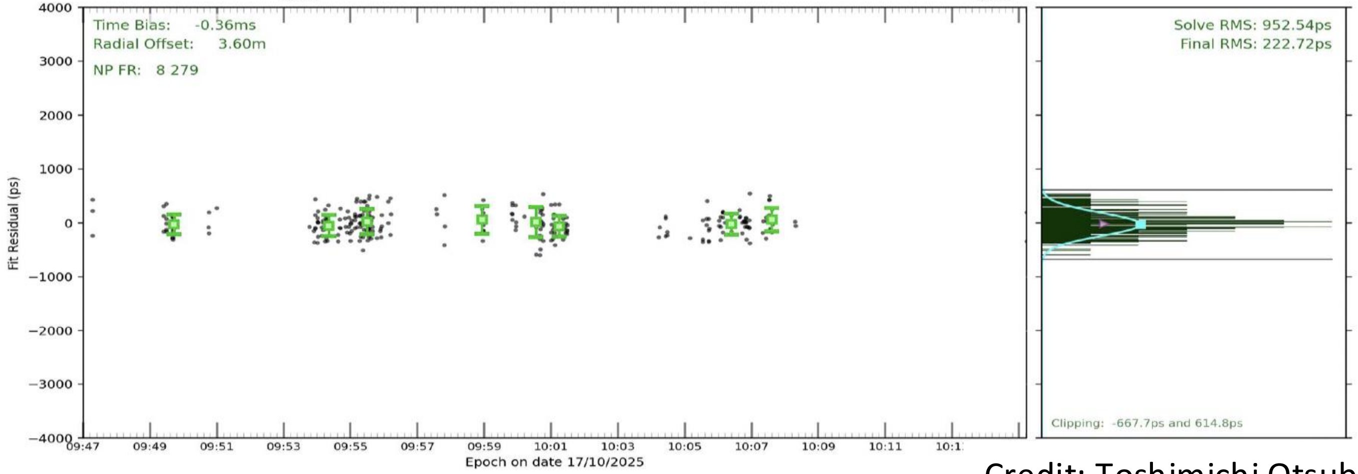
COTS products: 10 kHz ns-pulse laser (CryLAS), equatorial mount (Vixen), event timer (Swabian), MPPC detector (Hamamatsu), etc. Distributed system.

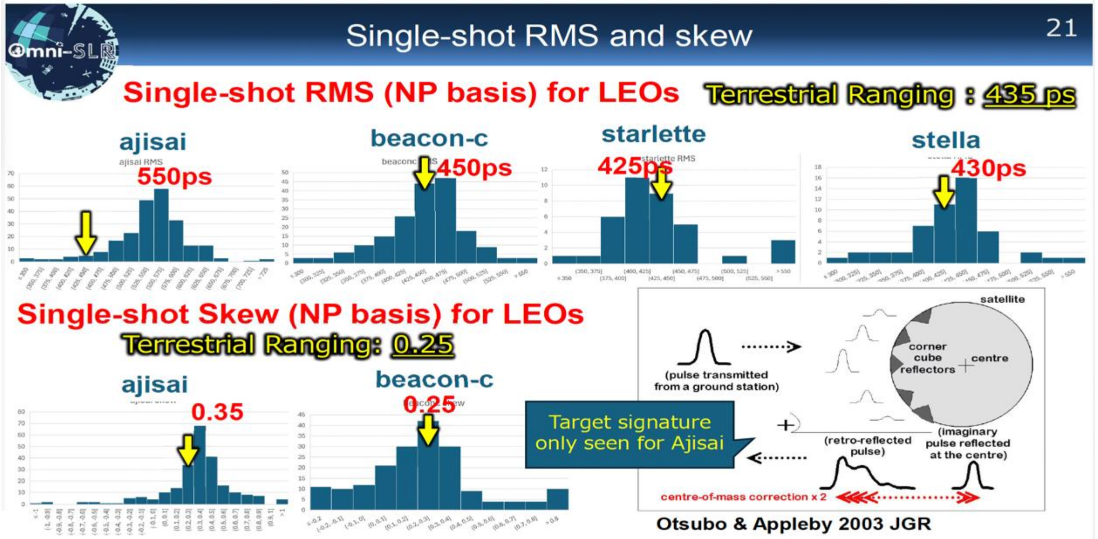












Credit: Toshimichi Otsubo

New Stations being added to the ILRS Network (Syowa, Antarctica)

Antarctic test approved

NIPR Exploratory Research Project

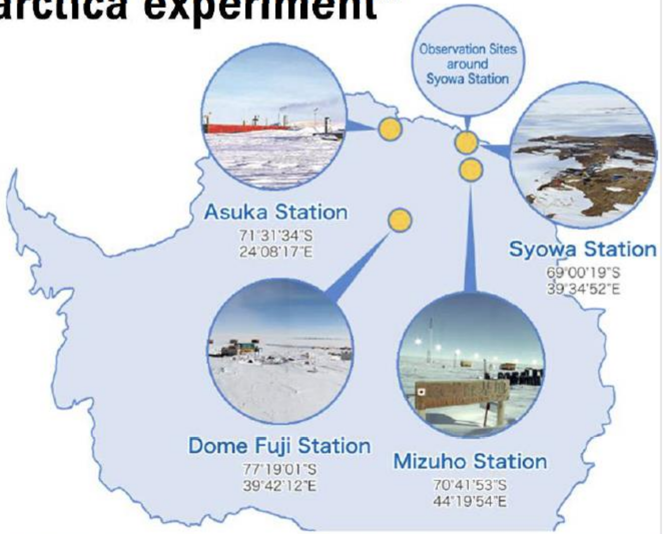
"Development of a compact SLR system for the first antarctica experiment"

3 years: FY2024 to FY2026. Syowa: 69S 35E.

FY2024-FY2025
Preliminary tests in Japan.

FY2025
A roll-off roof container to be installed at Syowa (if possible).

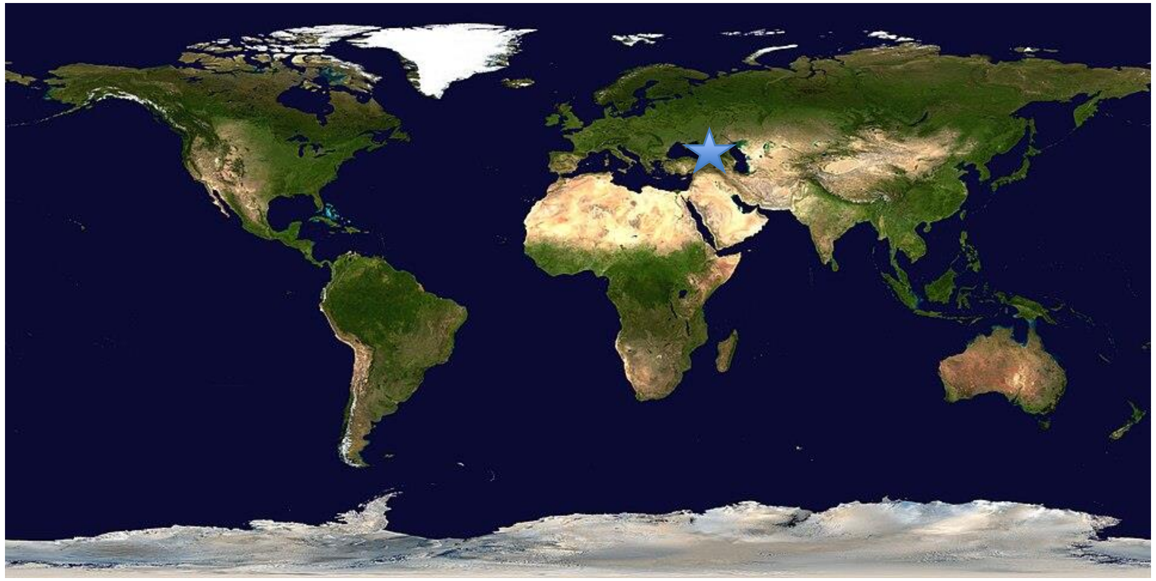
FY2026 (JARE68)
Shipped to Syowa (Nov 2026). **SLR test at Syowa (Jan-Feb 2027).**



→
Syowa's container
= 3.0 m x 2.4 m

Credit: Toshimichi Otsubo

SGSLR at Ny-Ålesund



- First Station will be deployed in Ny-Ålesund, Svalbard.
- Completed Pre-ship Review. Installation will begin June 2026.
- First data to the ILRS in August/September 2026.
- Fully Operational in October 2026.
- Part of the New NASA Space Geodesy Network, the station in Ny-Ålesund is being constructed in partnership with the Norwegian Mapping Authority.

Missions Supported by SLR and the ILRS

Geodetic Satellites

Satellite	LAGEOS-1	LAGEOS-2	LARES	Etalon-1/-2	Ajisai	Starlette/Stella	LARES-2
Inclination	109.8°	52.6°	69.5°	64.9°	50°	50° / 98.6°	70.16°
Perigee (km)	5,860	5,620	1,460	19,120	1,490	810/800	5,899

Other Scientific Missions

Satellite	Jason-3	ICESat-2	GRACE-FO	Sentinel-3A/3B	SWARM	SARAL	TerraSAR-X*
Inclination	66°	92°	89°	98.65°	92°	98.55°	97.44°
Perigee (km)	1,336	496	500	814.5	720	814	514

Satellite	Sentinel-6A	SWOT	Sentinel-6B
Inclination	66.042°	77.6°	66.042°
Perigee (km)	1,339	850	1,339

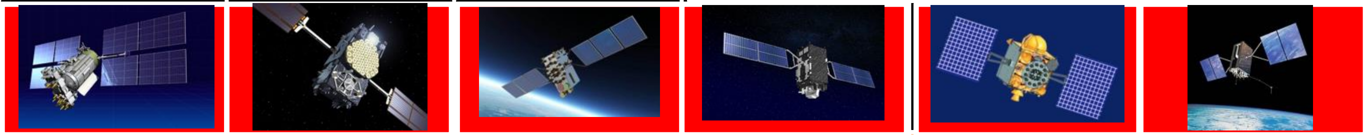
Geodetic

Altimetry

Geomagnetism and Gravity

GNSS

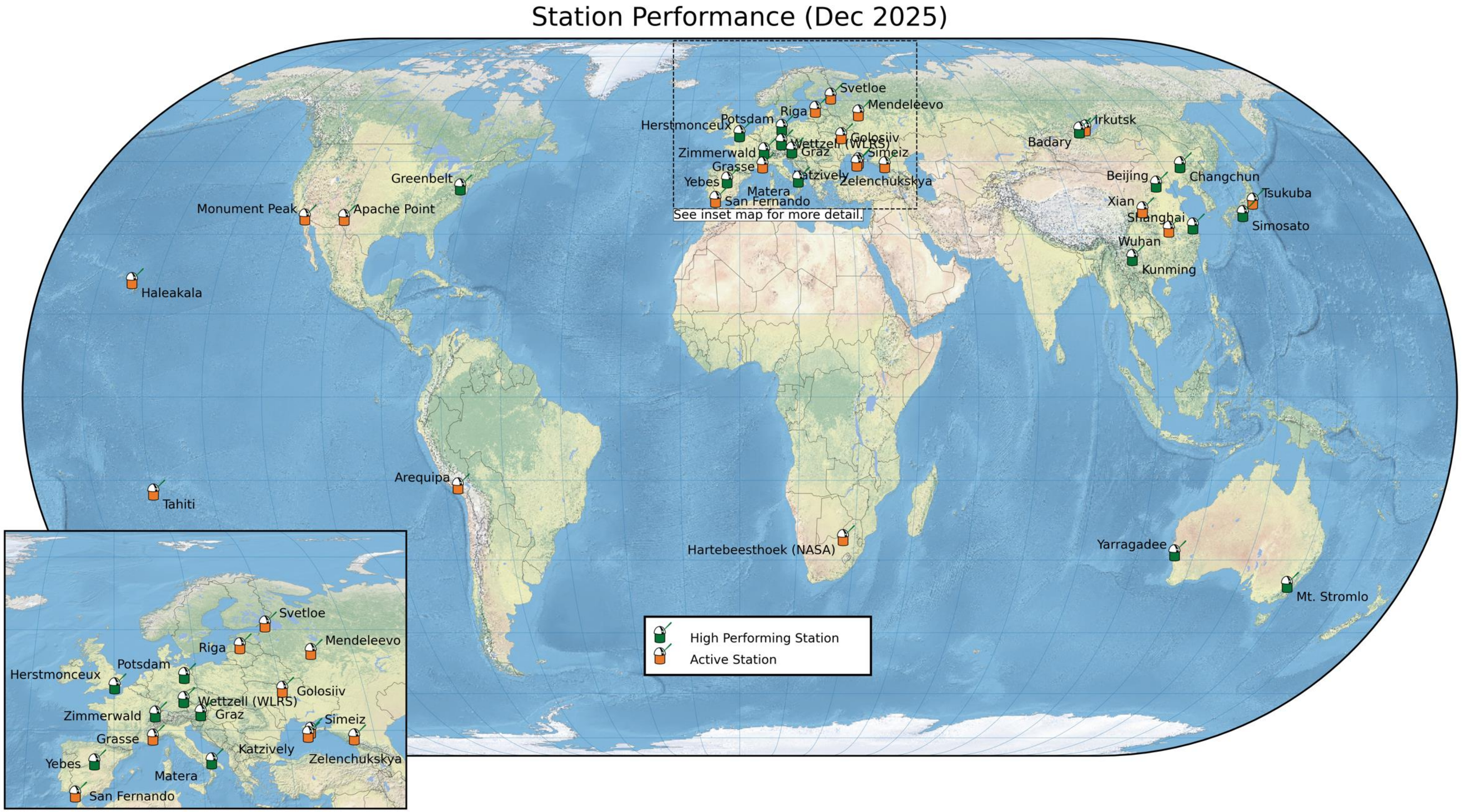
SAR



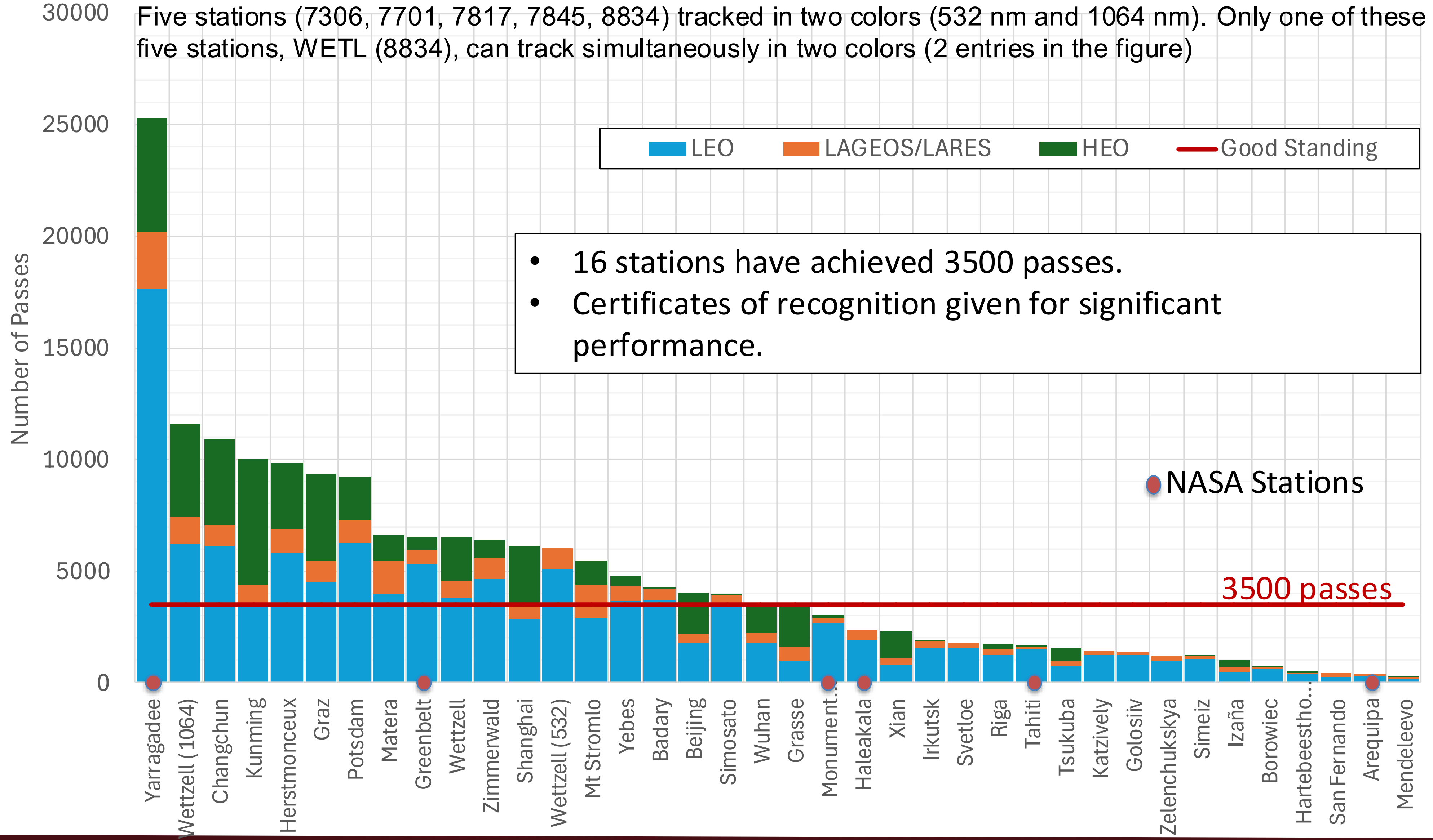
Constellation	GLONASS	Galileo	BeiDou	QZSS	IRNSS	GPS-III-SV09
Inclination	65°	56°	55.5°	45°	29°	55°
Perigee (km)	19,140	23,220	42,161	32,000	42,164	~12,550

+Space Debris Tracking

ILRS Network Performance (December 2025)



ILRS Satellite Tracking by Station (2025)

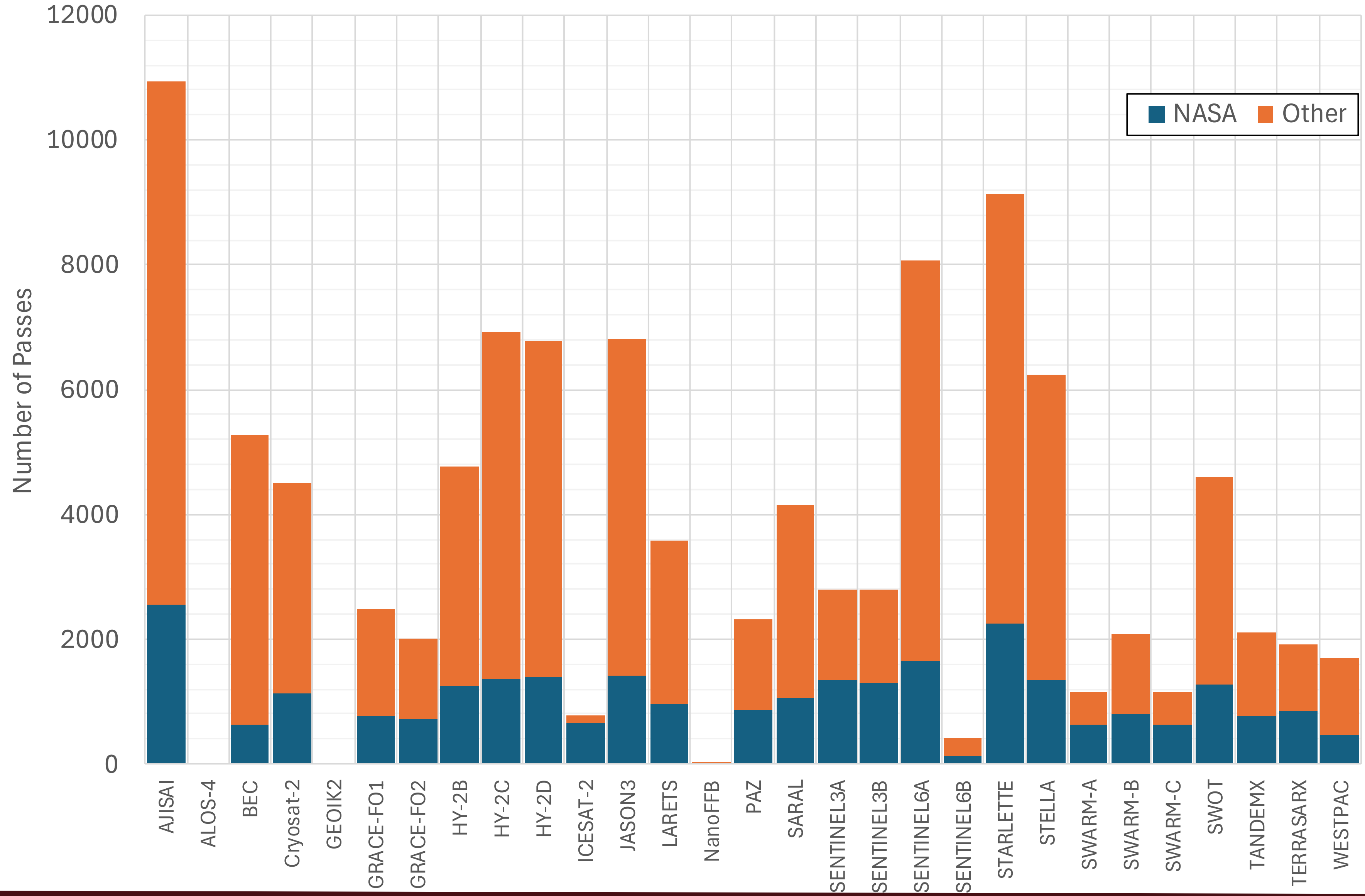


New SLR Missions Support Exciting Space Applications

**Student Involvement in designing, building, and data analysis*

Mission	Sponsor/Country	Application	Launch date
ALOS-4	JAXA/Japan	Observing and monitoring disaster-hit areas, forests, sea-ice, and monitoring infrastructure displacement.	Launched July 4th, 2024. Supported campaign from November 25th, 2024 through December 27th, 2025. Next campaign starts in May 2026 (TBD).
QZS-6	JAXA/Japan	Added to the QZSS constellation. 3 satellites are visible at all times from Asia-Oceania. Used in an integrated way with GPS for stable, high-precision positioning.	Launched Feb. 2nd, 2025. Tracking campaign from April 25 to June 27, 2025.
QPS-SAR-10	Institute for Q-shu Pioneers of Space, Inc. (iQPS Inc.)- JAXA/Japan	Small SAR satellite that provide Near-Real-Time Earth Observation. The objective of mission is to demonstrate the algorithm on QPS-SAR and evaluate an accuracy of PPP in orbit.	Launched May 17th, 2025. Support started in August 2025 (restricted tracking).
NANO-FF A/B*	Technical University of Berlin/Germany	Nanosatellites in Formation Flight (2U-CubeSats), to accurately monitor their relative positions, and demonstration different applications.	Launched Dec. 1st, 2023. Support of NANO-FF B started Dec. 19th, 2025.
e-kagaku-1*	The e-kagaku Association of Global Science and Education/Japan	Education of junior-high and high school students, fostering space engineers of next generation. Establishing learning methods for satellite systems. Demonstrating SLR using JAXA developed mini-Mt. FUJI retroreflectors.	Launched Sept. 14th, 2025. Lunched from ISS on October 10th SLR Ranging challenging/no successful (satellite flies aligned with magnetic field). Predictions stopped on Feb. 13th, 2026.
NGLR-1	NASA/University of Maryland	The lander delivered 10 NASA science payloads to the lunar surface, including the **Next Generation Lunar Retroreflector-1 (NGLR-1)**.	Lunched January 15th, 2025. Ranging since early March 2025.
Sentinel-6B	NASA/ESA/EUMETSAT/NOAA/CNES	Sentinel-6/Jason-CS mission is a joint oceanography mission to monitor global ocean circulation and sea-level. The Sentinel-6B/Jason-CSB satellite is the follow-on to the TOPEX/POSEIDON, Jason-1, Jason-2, Jason-3 and Sentinel-6A/Jason-CSA satellites.	Launched November 16th, 2025. Tracking started December 16th, 2025, when the satellite reached the mission orbit.

ILRS LEO Satellite Tracking (2025)



Galileo for Science Tracking Campaign (Jan. 2024-Feb. 2026)

Completed the ILRS Tracking Campaign at the end of February 2026, with more than 24,000 passes.

The G4S_2.0 project, funded by the **Italian Space Agency (ASI)**, performed a set of measurements in the field of **gravitation** with the **Galileo** satellites of the **Full Operational Capability (FOC)** constellation. Taking advantage of the accuracy of the on-board atomic clocks and, in particular, of **GSAT0201** and **GSAT0202**, it exploited their relatively high eccentricity (≅0.16).

Research Institutes Involved:

- ASI-CGS (Center for Space Geodesy) in Matera
- Istituto di Astrofisica e Planetologia Spaziali (IAPS/INAF) in Roma
- Osservatorio Astronomico di Torino (OATO/INAF) in Torino
- Politecnico (POLITO) in Torino

Galileo for Science Campaign Pass Totals (Aggregate)																
Pad	Location	101	102	103	201	202	203	205	206	208	209	210	211	212	221	**Total**
1873	Simeiz						1	1				1				**3**
1874	Mendeleevo 2								1			1				**2**
1884	Riga		21	26	26	18	18	28	23	13	19	31	26	14	19	**282**
7090	Yarragadee	321	322	328	305	279	130	132	166	156	235	183	242	149	149	**3097**
7105	Greenbelt	11	83	14	46	49	29	26	25	47	62	47	50	41	58	**588**
7110	Monument Peak	10	24	13	10	28	19	23	26	21	20	26	9	21	19	**269**
7124	Tahiti		2		3		2			2		1		2		**12**
7237	Changchun	177	173	165	139	138	174	130	130	157	156	125	117	160	163	**2104**
7249	Beijing	67	82	46	70	57	76	52	54	46	38	44	45	49	68	**794**
7306	Tsukuba	53	58	53	51	50	50	37	39	38	44	33	34	38	43	**621**
7329	Xian	21	20	21	21	22	22	13	26	15	18	19	21	14	24	**277**
7396	Wuhan	47	45	48	42	50	48	42	59	40	26	50	46	40	54	**637**
7501	Hartebeesthoek		1													**1**
7701	Izana	30	34	33	31	37	20	23	26	31	33	24	32	31	24	**409**
7810	Zimmerwald	28	35	46	33	27	18	23	30	33	28	32	25	24	22	**404**
7811	Borowiec	1		4	5	1	1		1	6	2	1				**22**
7817	Yebes	11	8	15	12	9	6	12	19	14	11	19	23	15	16	**190**
7819	Kunming	160	170	176	147	167	172	141	147	170	172	135	133	163	177	**2230**
7821	Shanghai	98	97	94	75	69	65	77	90	89	78	74	86	70	91	**1153**
7825	Mt Stromlo		161		144	146	84	75	58	51	140	66	88	36	17	**1066**
7827	Wettzell	42	42	40	42	55	34	41	41	30	37	36	44	37	35	**556**
7838	Simosato		7		7	5					2		7			**28**
7839	Graz	142	139	136	150	141	136	113	135	127	113	136	129	112	130	**1839**
7840	Herstmonceux	106	155	112	124	170	93	105	107	117	173	128	106	112	94	**1702**
7841	Potsdam	85	77	91	75	70	69	69	81	59	67	61	75	68	73	**1020**
7845	Grasse	111	98	95	139	132	73	92	115	92	112	114	97	82	88	**1440**
7941	Matera	38	166	40	250	228	33	32	39	41	111	146	147	34	50	**1355**
8834	Wettzell	18	212	153	179	208	155	124	138	108	187	123	171	118	133	**2027**
	Totals	1678	2334	1852	2327	2358	1731	1616	1782	1711	2093	1866	1964	1642	1768	**24128**

Legend
Elliptical Orbit

GENESIS (ESA) mission support – SLR WG5

SLR WG5 activities 2024 – 2025

Past & on-going activities:

- **2024:**
  - Optical Cross-Section (OCS) of the GENESIS LRR, and simulation studies.
  - Recommendation to increase the OCS of the SRD.

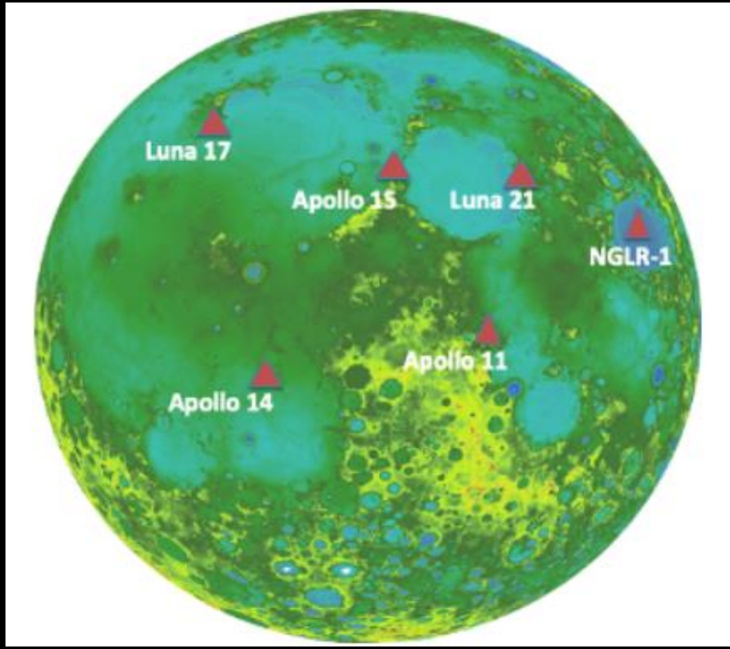
- **2025:**
  - Accuracy of the GENESIS LRR Range Correction.
  - Industry warns on the challenge to reach the initial requirement of 0.5mm @1 sigma.
  - Decision to accept the best state-of-the-art standard in the PDR.

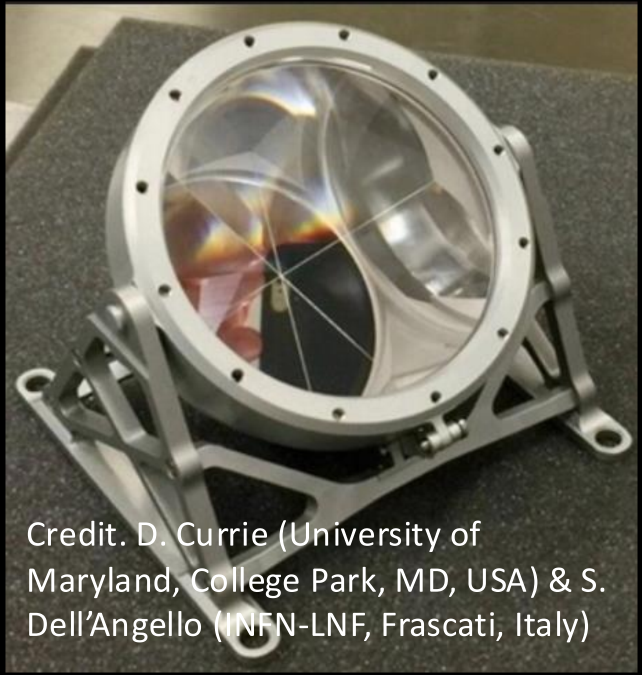
- **2026:**
  - Calibration plan (Estimating Center of Phase vs. Center of Mass with millimetric accuracy) (ongoing activity)

  Challenging requirement, and the object of the splinter meeting of March 2026, during the Genesis Science Workshop 2026, March 12-13, 2026, preceded by a Calibration meeting, March 11, 2026, at the Royal Belgian Institute of Natural Sciences, Brussels, Belgium. https://atpi.eventsair.com/genesis-science-workshop-2026/

Lunar Laser Ranging (LLR): a new Laser Retro-Reflector on the Moon

Credit: Firefly Aerospace
https://fireflyspace.com/missions/blue-ghost-mission-1/





Credit. D. Currie (University of Maryland, College Park, MD, USA) & S. Dell'Angello (INFN-LNF, Frascati, Italy)

The Next Generational Lunar Retroreflector (NGLR-1) was successfully delivered to the surface of the Moon on the Blue Ghost Lunar Lander in Mare Crisium, a large lunar basin at 17.0°N, 59.1°E in the northeast quadrant of the lunar nearside on March 2, 2025 at 08:34 UTC.

Three LLR stations of the ILRS have confirmed that they have successfully ranged to NGLR-1: Grasse (green and infrared), Wettzell (infrared), Apache-Point (green).

Great successes that paves the way of scientific outcomes in Fundamental Physics, Selenophysics/Selenodesy, Planetary Ephemeris in a near Future!

More information: https://ilrs.gsfc.nasa.gov/

ILRS ASC Accomplishments

LARES-2 pilot project & Contribution to ITRF2020-u2025

- In the past six months, the ILRS Analysis Standing Committee (ASC) has validated its operational processing of LARES-2, by producing daily and weekly SINEX series (v190, v90) that include LARES-2 in addition to the LAGEOS-1,2 and Etalon 1,2 satellites.
- J. C. Rodriguez (IGN Spain) has developed a new geodetic satellite Center-of-mass model (***com6.260112.tar.Z***) [available at https://datos-geodesia.ign.es/SLR/centre_of_mass_models/models/).
- The ILRS ASC has developed a new SINEX series (v330), adjusting station coordinates and EOP (2021.0 – 2026.0), adjusting all range biases, STAPOS, EOP parameters.
- Based on v330, updated the ILRS Data Handling File (DHF) to compute the ILRS contribution to ITRF2020-u2025. [*This last step is now underway*].

New ASC task force to update the list of core stations (for the geodetic datum).

• The ILRS ASC uses a list of 12 stations to define the geodetic datum stations of the ILRS. A working group has been established to review the performance of the ILRS stations, and update this list (*Linda Geisser (AIUB) is the chair of this WG*).

Recent Trends and Challenges

Recent Trends in missions supported:

- Continued support needed from next generation GNSS spacecraft.
- Increased number of requests for support from CubeSat missions, and others experiments with student participation.

Recent Trends in SLR Tracking Systems:

- Continued proliferation of higher repetition rate lasers, 4-5 kHz to 1 MHz.
- Proliferation of two-color systems.

  Note: The legacy station in Wettzell, Germany (8834) initiated tracking LEO and MEO satellites simultaneously in 2-color (1064 and 532 nm).
- Lost cost ultra transportable systems (OMNI-SLR).
- Proliferation of Leading Edge (LE) Detection Algorithms in data pre-processing.
- Remote Station Operations, a steppingstone to autonomous ranging.

24th International Workshop on Laser Ranging Buenos Aires, Argentina (Nov 2nd-6th, 2026).

BKG
Wir geben Orientierung.

Bundesamt für
Kartographie und Geodäsie

CONICET

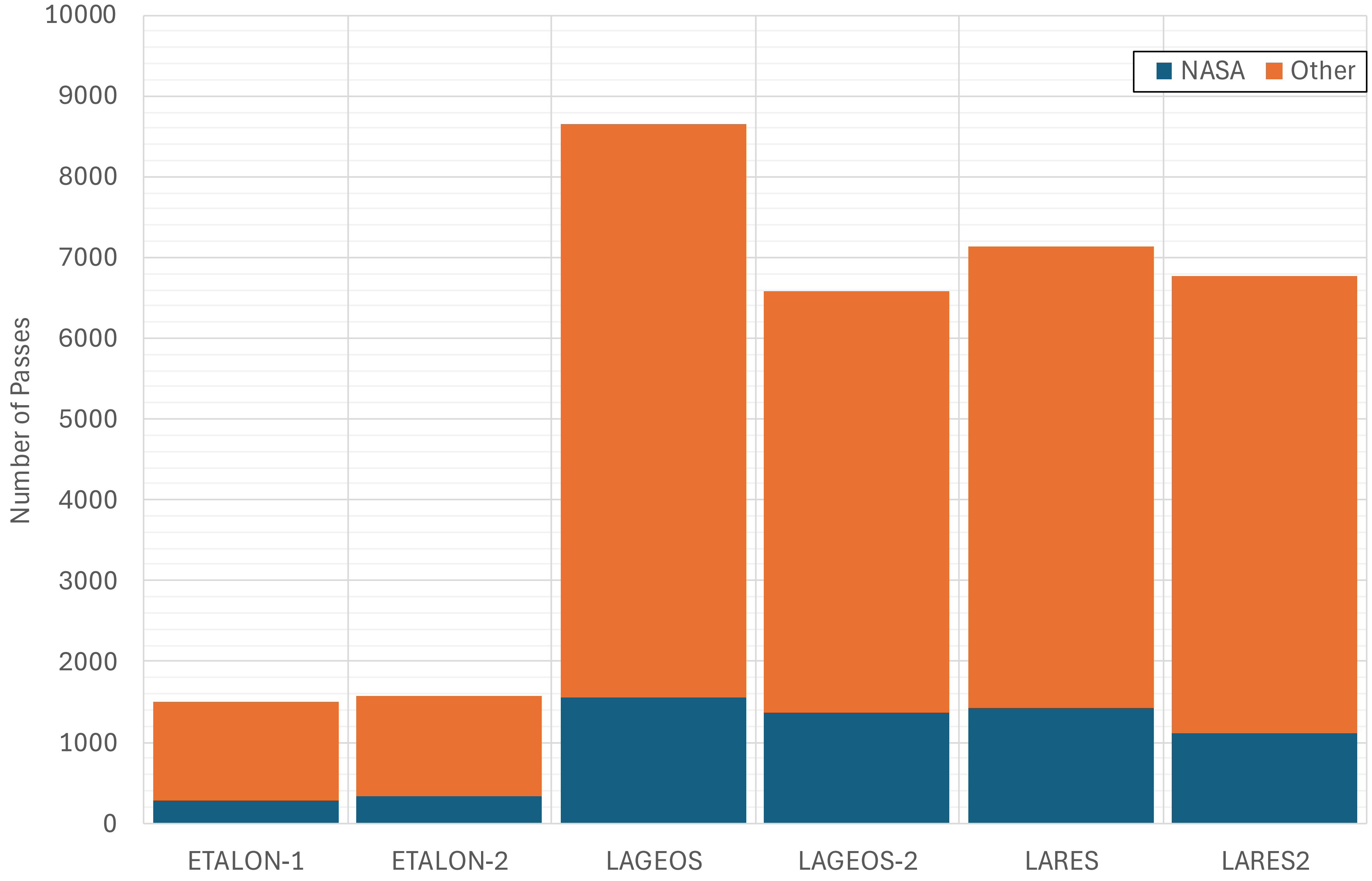
The **National Scientific and Technical Research Council** (Spanish: *Consejo Nacional de Investigaciones Científicas y Técnicas*, **CONICET**).

Backup Slides

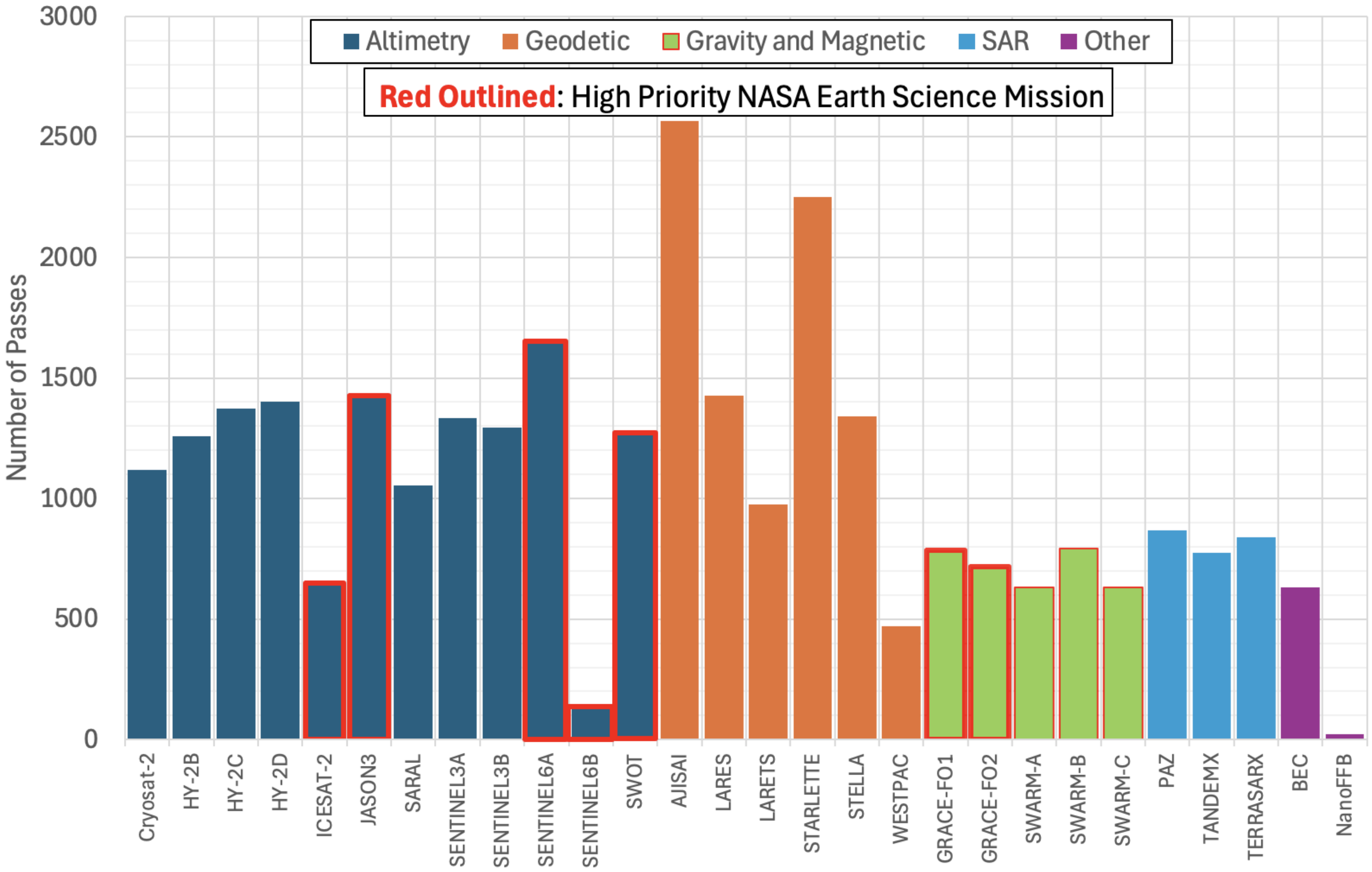
NASA's Space Geodesy Satellite Laser Ranging (SGSLR) System

- Millimeter-level range precision.
- Rapid satellite acquisition and data collection to support increasing number of satellites (>100) requiring tracking.
- Phased roll-out of automation capabilities:
  1. Local operator: Human present at station.
  2. Nearby-remote: Human operating from a nearby location with direct network connections.
  3. Remote: Human operating/monitoring over the internet from anywhere in the world.

ILRS Reference Frame Satellite Tracking (2025)



2025 NASA SLR Support of Low Earth Orbit Missions



ILRS GNSS Satellite Tracking (2025)