

International Laser Ranging Service

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Supporting geodetic and geophysical research
and applications through Satellite Laser Ranging

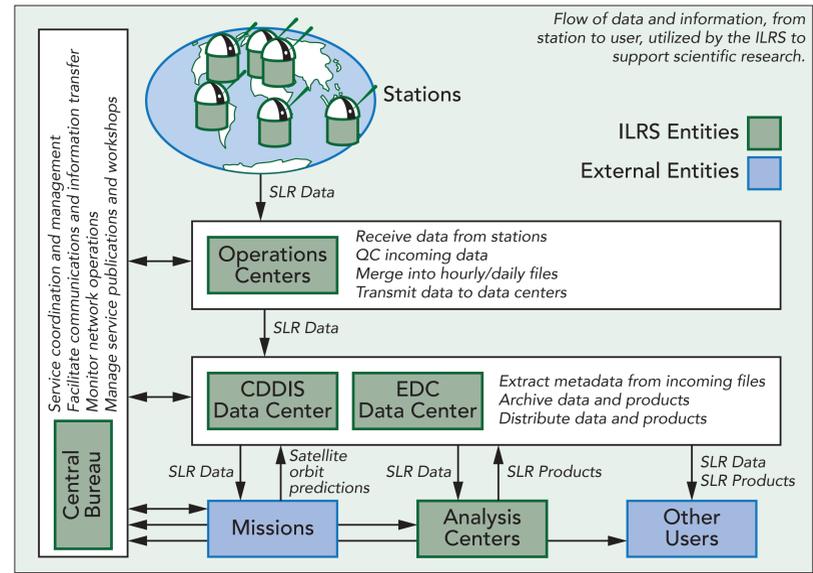
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<http://ilrs.gsfc.nasa.gov>

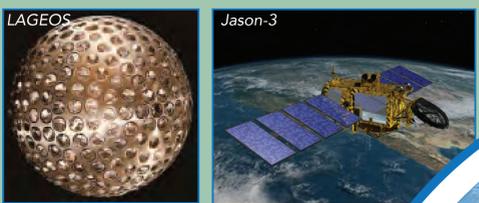
BACKGROUND

- The International Laser Ranging Service (ILRS) provides global satellite and lunar laser ranging (SLR and LLR) data and their related products to support geodetic and geophysical research and other applications.
- The ILRS is one of the space geodetic services of the International Association of Geodesy (IAG). The ILRS is a cooperative federation supported by global institutions providing their own funding for their respective activities.
- All data and derived products are freely available to global research community through ILRS data centers
 - + Crustal Dynamics Data Information System (CDDIS), NASA GSFC (USA)
 - + EuroLas Data Center (EDC), Deutsches Geodtisches Forschungsinstitut (Germany)
- Data: SLR data consist of a distance or range (round-trip, station to satellite and back) and time, together with data correction information such as atmospheric effects, which are to be applied to the data
- Products: SLR and LLR data sets used by ILRS to generate a number of scientific and operational data products including:
 - + Earth orientation parameters (polar motion and length of day)
 - + Station coordinates and velocities of the ILRS tracking systems
 - + Time-varying geocenter coordinates
 - + Static and time-varying coefficients of the Earth's gravity field
 - + Centimeter accuracy satellite ephemerides
 - + Fundamental physical constants
 - + Lunar ephemerides and librations
 - + Lunar orientation parameters
- Applications: Accuracy of SLR/LLR data products is sufficient to support a variety of scientific and operational applications:
 - + Realization of global accessibility to and the improvement of the International Terrestrial Reference Frame (ITRF)
 - + Monitoring three dimensional deformations of the solid Earth
 - + Monitoring Earth rotation and polar motion
 - + Support the monitoring of variations in the topography and volume of the liquid Earth (ocean circulation, mean sea level, ice sheet thickness, wave heights, etc.)
 - + Tidally generated variations in atmospheric mass distribution
 - + Calibration of microwave tracking techniques
 - + Picosecond global time transfer experiments
 - + Astrometric observations including determination of the dynamic equinox, obliquity of the ecliptic, and the precession constant
 - + Gravitational and general relativistic studies including Einstein's Equivalence Principle, the Robertson-Walker b parameter, and time rate of change of the gravitational constant
 - + Lunar physics including the dissipation of rotational energy, shape of the core-mantle boundary (Love Number k2), and free librations and stimulating mechanisms
 - + Solar System ties to the International Celestial Reference Frame (ICRF)

ABOUT SLR AND THE ILRS

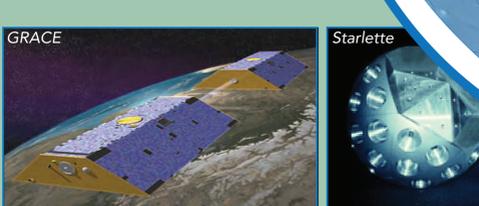
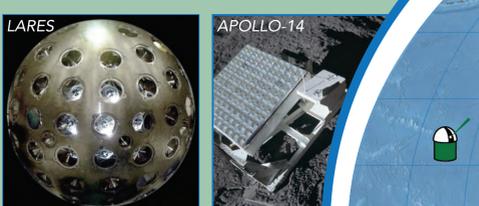


- Network Stations: continuous operation with timely flow of data to operations centers
- Operations Centers: interface to stations and perform data quality control and conversion to standard formats
- Data Centers: receive, archive, and distribute station data from operations centers and derived products from Analysis Centers
- Analysis Centers: generate derived products (e.g., station coordinates, precise satellite orbits, etc.)
- Central Bureau: manages service, coordinates activities at all levels, facilitates communication (e.g., website, mailing lists, etc.)
- Governing Board: general oversight of service, provide future direction



A subset of the 80+ satellites supported by the ILRS:
http://ilrs.gsfc.nasa.gov/missions/satellite_missions/index.html

A few of the SLR systems in the ILRS network:
<http://ilrs.gsfc.nasa.gov/network/index.html>



The ILRS network consists of over 40 stations providing routine laser ranging to over 80 satellites equipped with laser retro-reflectors as well as reflectors left on the Moon by U.S. and Russian missions.



Photos courtesy of NASA, AIUB, ASI, CNES, GRGS, IPA, NSGF, OJC, "RPC" "PSI", SHAO

SUCCESSSES

- ILRS develops the necessary global standards/specifications and encourages international adherence to its conventions
- Update of ILRS Terms of Reference now underway
- Network of tracking stations expanding and upgrading
 - + NASA's Space Geodesy Project upgrading current stations and adding new stations to enhance global network
 - + New Russian overseas stations enhancing spatial and temporal coverage
- List of target satellites continues to expand as new missions utilize SLR for orbit determination and other applications; recent growth in GNSS tracking
- Official orbital data product on LAGEOS and Etalon satellites now operational
- New Data Quality Board established to address laser ranging data quality issues
- Early use of optical receivers in space as a step toward optical transponder for extended range

CHALLENGES

- Increasing global coverage of laser ranging stations; many geographic gaps still exist
- Implementing new systems and upgrades to overcome the present anachronistic mix of new and old technologies
- Improving data quality as the ILRS strives for mm accuracy
- Supporting an ever increasing list of targets, many now at GNSS and synchronous altitudes
- Supporting new missions in order to contribute to a broader range of scientific and operational applications
- Developing new retroreflector designs to increase range accuracy and signal link

BEST PRACTICES

- ILRS develops the necessary global standards/specifications and encourages international adherence to its conventions
- Multiple Data Centers for reliability and redundancy
- Metadata made available by Data Centers for SLR data and products to enable data discovery
- Website provides information for all components, users, and proper practices
 - + Links are provided to extensive information on the ILRS network stations including performance assessments and data quality evaluations
 - + Descriptions of supported satellite missions (current, future, and past) are provided to aid in station acquisition and data analysis
- Central Bureau coordinates activities within the service
- Frequent workshops held to exchange information on science, technology, operations, and upcoming activities
- Standing Committees and Study Groups to focus on specific technical and operational areas

MORE INFORMATION/FEEDBACK

- The ILRS welcomes feedback on the service and the material presented in this poster. For more information about the ILRS, contact the ILRS Central Bureau at: ilrs-cb@lists.nasa.gov
- More information about the ILRS is available from the ILRS website at: <http://ilrs.gsfc.nasa.gov> and from the publication: Pearlman, M.R., Degnan, J.J., and Bosworth, J.M., "The International Laser Ranging Service", Advances in Space Research, Vol. 30, No. 2, pp. 135-143, July 2002, DOI:10.1016/S0273-1177(02)00277-6.

