

# International Laser Ranging Service

Carey Noll/Secretary (Carey.Noll@nasa.gov)  
Michael Pearlman/Director (mpearlman@cfa.harvard.edu)



Supporting geodetic and geophysical research  
and applications through Satellite Laser Ranging

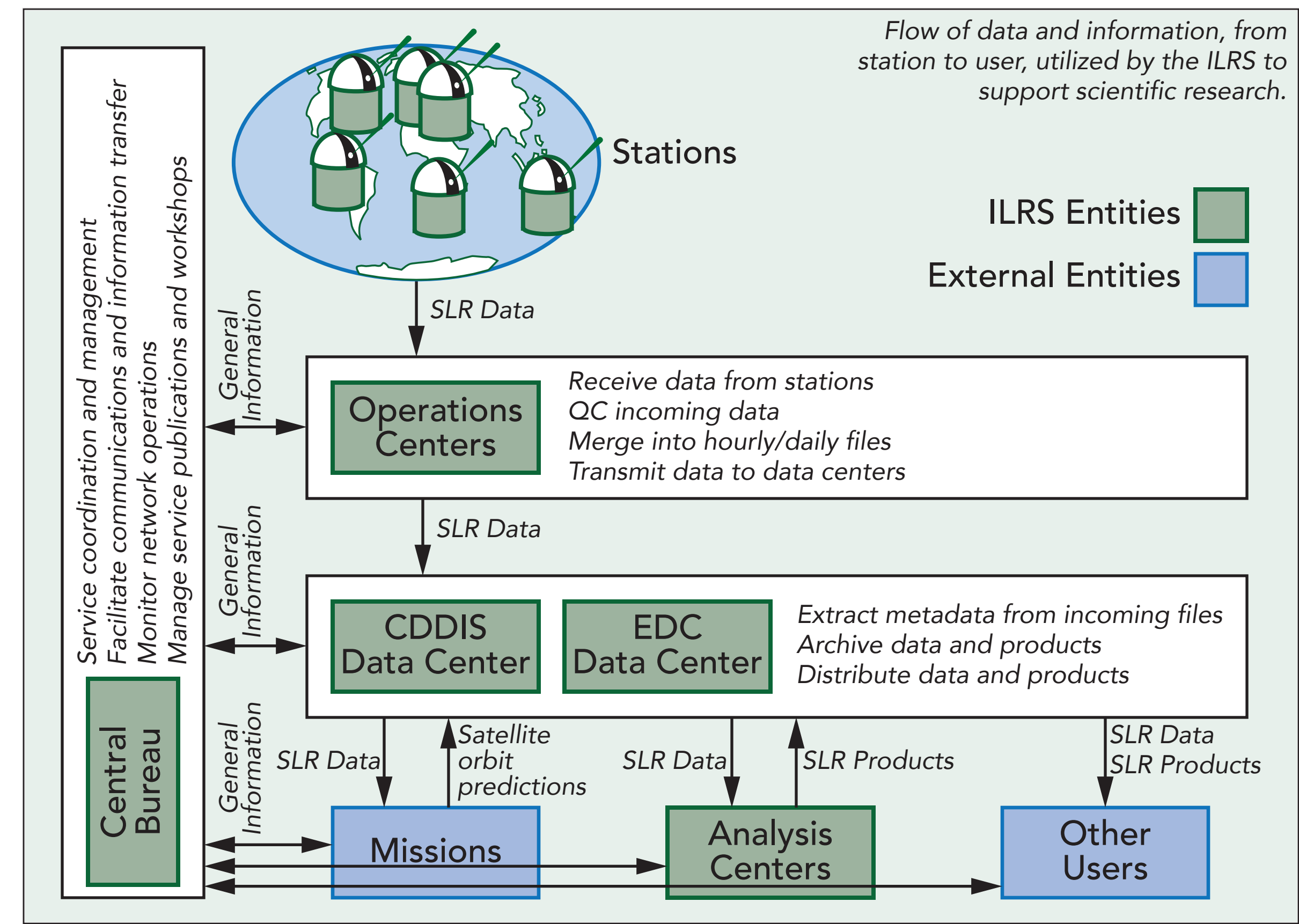
ILRS Central Bureau  
E-mail: [ilrs-cb@lists.nasa.gov](mailto:ilrs-cb@lists.nasa.gov)  
NASA Goddard Space Flight Center  
Code 690.1, Greenbelt, MD 20771, USA

<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.
- SLR data fundamentally contribute to the realization of the International Terrestrial Reference Frame (ITRF), uniquely defining its origin-geocenter, and, in combination with VLBI, its scale.
  - An accurate ITRF provides essential underpinning for robust determination of sea level rise, post-glacial rebound, loading response to current ice sheet melt, mountain uplift, etc.
- 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.
- The ILRS became a network member of the WDS in early 2013.
- All data and derived products are freely available to a global research community within hours through ILRS data centers:
  - Crustal Dynamics Data Information System (CDDIS)**, NASA GSFC (USA)
  - EuroLas Data Center (EDC)**, Deutsches Geodätisches Forschungsinstitut, Technische Universität München (Germany)
- Data:** SLR data consist of a distance or range (measured as round-trip laser time of flight, 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 stations for the ITRF
  - 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 and 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 improvement of the ITRF and 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
  - Tidally generated variations in atmospheric mass distribution
  - Calibration of microwave tracking techniques
  - Picosecond global time transfer experiments
  - Astrometric observations including determination of dynamic equinox, obliquity of the ecliptic, and precession constant
  - General relativistic, gravitational, and lunar physics studies
  - 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](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>

LAGEOS

Jason-3

LARES

APOLLO-14

Galileo

Etolon

GRACE

Starlette

Monument Pk. CA, USA

Shanghai, China

Greenbelt MD USA

Grasse, France

Zimmerwald, Switzerland

Herstmonceux, UK

Brasilia, Brazil

Badary, Russia

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.

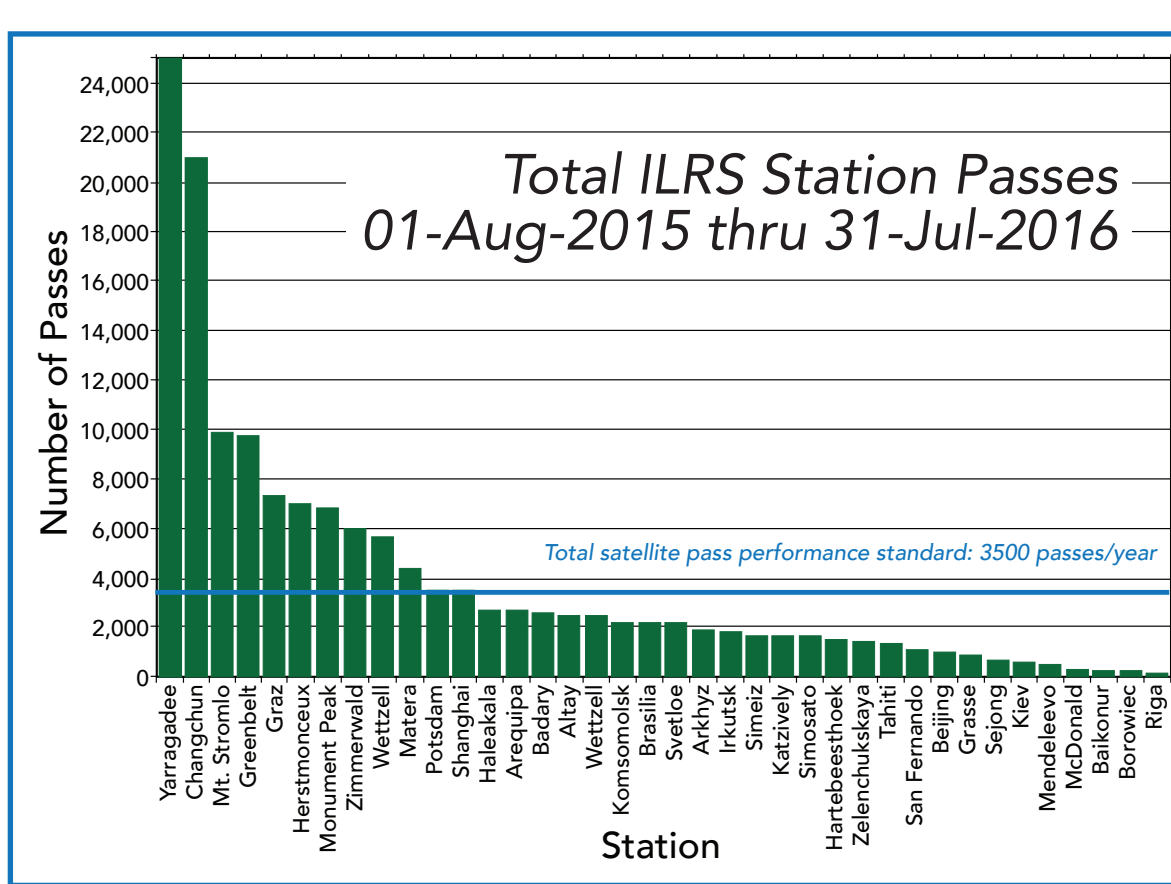
Photos courtesy of NASA, AIUB, ASI, CNES, GRGS, IPA, NSGF, OJC, "RPC" "PSI", SHAO

## 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 Control 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](mailto: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.

