



# SLR Data: from Station to User

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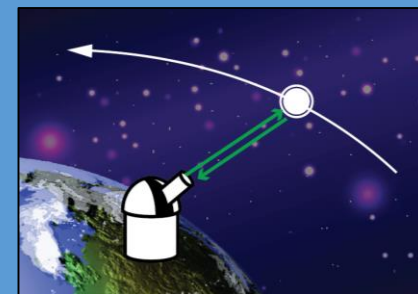
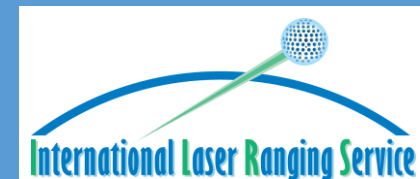
## Outline

- Background
- ILRS data flow
- DCs and DCs
- Getting data
- ILRS website

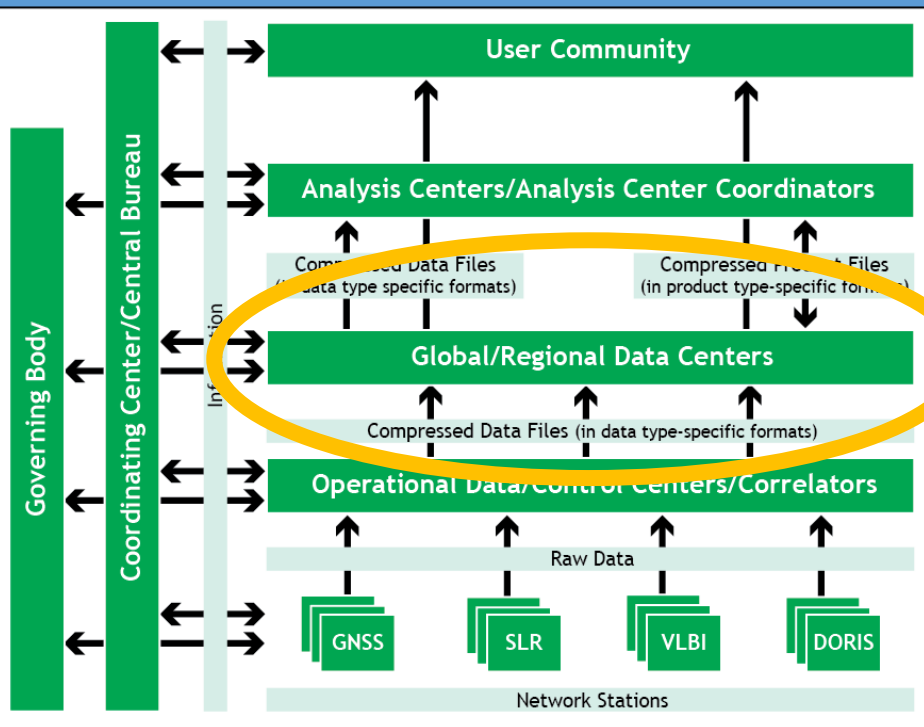
# International Laser Ranging Service



- The ILRS provides laser ranging data and products on an operational basis to geodesy analysts as well as a broader scientific community
- ILRS is one of four services within the International Association for Geodesy (IAG) supporting space geodesy
- IAG established these services to facilitate international cooperation and scientific research
  - ◆ Networks
  - ◆ Data centers
  - ◆ Analysis groups
- Services perform successful operations through cooperation of many international organizations, leveraging their respective resources to all levels of service functionality



# ILRS: SLR data and products



ILRS services use a hierarchy of data centers to distribute data from network to users:

- **Network Stations**
  - ◆ Operate continuously
  - ◆ Transmit data in timely fashion
- **Data Centers**
  - ◆ Interface to network stations
  - ◆ Perform QC and data conversion activities
  - ◆ Archive data for access to analysis centers and users
- **Analysis Centers**
  - ◆ Generate products to users
- **Central Bureau/Coordinating Center**
  - ◆ Manage service
  - ◆ Facilitate communications
  - ◆ Coordinate activities
- **Governing Body**
  - ◆ Provide general oversight of service
  - ◆ Determine future direction

# ILRS data centers



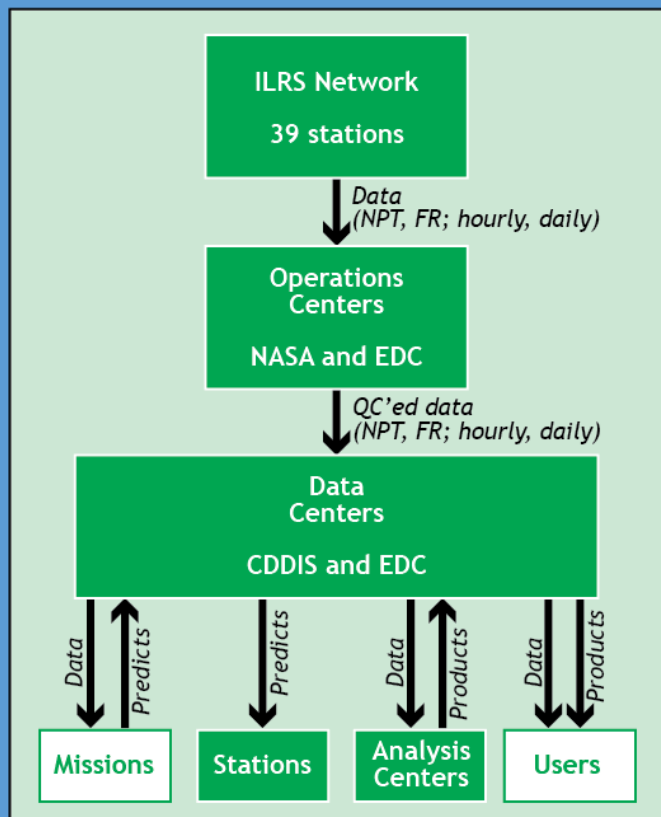
- Two data centers (DCs) support the ILRS:
  - ◆ Crustal Dynamics Data Information System (CDDIS), NASA GSFC, Greenbelt, MD USA
  - ◆ EUROLAS Data Center (EDC), DGF1-TUM, Munich, GERMANY
- ILRS DCs are the primary interfaces to the Analysis Centers (ACs) and the global user community
  - ◆ Receive, archive, and provide online access to SLR data, derived products, and supporting information
  - ◆ Ensure the integrity of ILRS data and products
  - ◆ Provide reliability and redundancy
- CDDIS hosts ILRS website (<https://ilrs.gsfc.nasa.gov>)
  - ◆ Central source of information for all aspects of the service
  - ◆ Descriptions of:
    - ILRS organization, components, data, and products
    - Network stations, including performance assessments, data quality evaluations, etc.
    - Supported satellite missions (current, future, and past)

- SLR data:
  - ◆ Normal point data: compresses full set of data (full-rate) by sampling pass over time, based upon a specified minimum number of data points (bin size)
  - ◆ Full-rate data: include all valid laser returns obtained during a satellite pass
- Official ILRS products
  - ◆ Station coordinates and EOP ("pos+eop"), generated daily
  - ◆ Precise orbits (LAGEOS-1, -2 and Etalon-1, -2), generated weekly
- Satellite orbit predictions
  - ◆ For all satellites currently tracked by network, generated daily
  - ◆ Required by stations to find satellites for tracking

# ILRS DC archive contents



Type	Frequency	Main directory	~Size	Format
<b>Data</b>	From network of 39 stations (currently)			
Normal points	Daily, hourly, monthly	/slr/data/npt_crd/SATELLITE/YYYY/	1 MB/hour, 75MB/day	CRD
Full-rate	Daily, monthly	/slr/data/fr_crd/SATELLITE/YYYY/	300 MB/day	CRD
<b>Products</b>	From 7 analysis centers and 2 combination centers (currently)			
Station coordinates, EOP	Daily	/slr/products/pos+eop	1 MB/day	SINEX
Precise orbits	Weekly	/slr/products/orbits	3 MB/week	SP3C
<b>Predictions</b>	From ~25 providers for 115+ satellites (currently)			
Satellite orbit predictions	Daily	/slr/cpf_predicts/YYYY/SATELLITE	15 MB/day	CPF



- ILRS operations centers (OCs)

- ◆ NASA and EDC
- ◆ Collect data from sub-networks
- ◆ Quality check (QC) data
- ◆ Create merged daily/hourly files
- ◆ Transmit data to DCs

- ILRS data centers (DCs)

- ◆ CDDIS and EDC
- ◆ Archive ILRS data, products, predictions
- ◆ Provide access to ACs and users
- ◆ Provide backup archives

# SLR data at ILRS data centers



- DCs (EDC and NASA) exchange data (normal point/NPT and full-rate/FR) received in previous time interval (last 1 hour or last 24 hours) and deliver to DCs (CDDIS and EDC)
- EDC and NASA DCs merge each other's files to create combined files for archive at DCs
- EDC archives its SLR data as:
  - ◆ Daily and monthly files by satellite containing all data FOR a given day/month
- CDDIS archives its SLR data as:
  - ◆ Single daily/hourly file containing all data from all satellites received WITHIN the last 1/24 hours
  - ◆ Daily files by satellite containing all data received WITHIN the last 24 hours
  - ◆ Monthly files by satellite containing all data FOR a given month
- Therefore, CDDIS and EDC DCs contain the same data but store them in different types of files



# Getting SLR data (NPT examples)



## *If you want:*

- All data for all satellites submitted in the last 24 hours, get:
  - ◆ CDDIS: [https://cddis.nasa.gov/archive/slr/data/npt\\_crd/allsat/YYYY/allsat\\_YYMMDD.Z](https://cddis.nasa.gov/archive/slr/data/npt_crd/allsat/YYYY/allsat_YYMMDD.Z)
- All data for all satellites submitted in the last 1 hour, get:
  - ◆ CDDIS: [https://cddis.nasa.gov/archive/slr/data/npt\\_crd/allsat/YYYY/allsat\\_YYMMDDHHMM.npt](https://cddis.nasa.gov/archive/slr/data/npt_crd/allsat/YYYY/allsat_YYMMDDHHMM.npt)
- Data for one satellite submitted in the last 24 hours, get:
  - ◆ CDDIS: [https://cddis.nasa.gov/archive/slr/data/npt\\_crd/SATELLITE/YYYY/SATELLITE\\_YYMMDD.npt](https://cddis.nasa.gov/archive/slr/data/npt_crd/SATELLITE/YYYY/SATELLITE_YYMMDD.npt)
- Data for one satellite for a particular time period, get:
  - ◆ CDDIS: [https://cddis.nasa.gov/archive/slr/data/npt\\_crd/SATELLITE/YYYY/SATELLITE\\_YYMM.Z](https://cddis.nasa.gov/archive/slr/data/npt_crd/SATELLITE/YYYY/SATELLITE_YYMM.Z)
  - ◆ EDC: [ftp://edc.dgfi.tum.de/slr/data/npt\\_crd/SATELLITE/YYYY/SATELLITE\\_YYMMDD.npt](ftp://edc.dgfi.tum.de/slr/data/npt_crd/SATELLITE/YYYY/SATELLITE_YYMMDD.npt)  
[ftp://edc.dgfi.tum.de/slr/data/npt\\_crd/SATELLITE/YYYY/SATELLITE\\_YYMM.npt](ftp://edc.dgfi.tum.de/slr/data/npt_crd/SATELLITE/YYYY/SATELLITE_YYMM.npt)

# Getting ILRS products, predictions



## *If you want:*

- ILRS products:
  - ◆ CDDIS: <https://cddis.nasa.gov/archive/slr/products/PRODUCT>
  - ◆ EDC: <ftp://edc.dgfi.tum.de/slr/products/PRODUCT>
  - ◆ **PRODUCT=**
    - *pos+eop* for reference frame products
    - *orbits* for precise orbit solutions (LAGEOS-1, -2, Etalon-1, -2)
- Satellite predictions:
  - ◆ CDDIS: [https://cddis.nasa.gov/archive/slr/cpf\\_predicts/YYYY/SATELLITE](https://cddis.nasa.gov/archive/slr/cpf_predicts/YYYY/SATELLITE)
  - ◆ EDC: [ftp://edc.dgfi.tum.de/slr/cpf\\_predicts/YYYY/SATELLITE](ftp://edc.dgfi.tum.de/slr/cpf_predicts/YYYY/SATELLITE)

# Who to contact



- CDDIS:

- ◆ Help desk: *support-cddis@earthdata.nasa.gov*
- ◆ CDDIS Manager, Carey Noll: *carey.noll@nasa.gov*

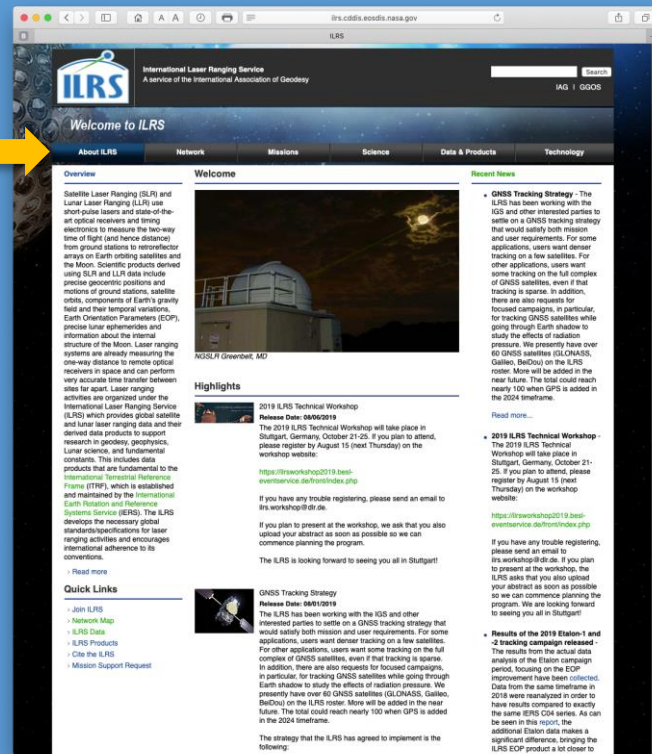
- EDC:

- ◆ Help desk: *christian.schwatke@tum.de*
- ◆ EDC Manager, Christian Schwatke: *christian.schwatke@tum.de*

# ILRS website: <https://ilrs.gsfc.nasa.gov>



- Network
  - ◆ Station configuration information (site logs)
  - ◆ Station data quality reports
- Missions
  - ◆ Satellite, retroreflector characteristics
  - ◆ ILRS satellite tracking lists
  - ◆ ILRS priority list
- Data
  - ◆ Formats
- Products
  - ◆ Data analysis reports (AACs)
- Reports
  - ◆ Workshop proceedings
  - ◆ Bibliography



# ILRS website: network+station info



- Network info
  - ◆ Map
  - ◆ Lists of stations
  - ◆ Site logs
  - ◆ Plots of data quantity, quality by station and by satellite
- Station performance reporting
  - ◆ Report cards
  - ◆ Performance assessment

International Laser Ranging Service  
A service of the International Association of Geodesy

Home » Network » System Performance » Monthly Station Performance Maps » 2019 » 07

### Monthly Station Performance Assessment

August 1, 2018 through July 31, 2019

Please note the following:

- On maps that depict performance with differently sized "bubbles", the size of the bubble does not reflect coverage of what's tracked but to what extent the parameter is met.
- Stations that are not capable of ranging to GNSS are not assessed on GNSS parameters; furthermore, these stations are not assessed on their compliance to the ILRS priority list because the list includes GNSS satellites.

**Available maps:**

Click on a map title to view map. Click again on map title to close map.  
While viewing a map, hover over a station with your mouse to view information for that station.

**General**

- Comprehensive Score
- Number of Lunar Passes Tracked (Note: this is not a requirement, it only shows who participates in LLR tracking)
- Total Number of Passes: 3500 Minimum (Note: this requirement needs to be discussed by the ILRS CB)

Total Number of Passes (All Satellites)  
(2018-08-01 to 2019-07-31)  
ILRS Standard: 3500

Export to plot >

- Total Number of Passes (All Satellites) - Percentage of ILRS standard
- Total Normal Points per Pass (All Satellites)

**Priority List Adherence**

- Minimum of 1% of Passes Tracked are from the Top 10 Satellites on the Priority List: 1% Minimum
- Minimum of 15% of Passes Tracked are from the Top 20 Satellites on the Priority List: 15% Minimum
- Percentage of Satellites Tracked not on the Priority List: 35% Maximum
- Percentage of Distinct Satellites on the Priority List Tracked: 25% Minimum

**Allometry**

- Total Number of LEO Passes: 2300 Minimum

**Quick Links**

- Network Map
- List of Stations
- Monthly Report Card
- Quarterly Report Card
- Network Status Page
- Potsdam CPF time bias service
- Procedure for estimating laser beam divergence
- Recent Station Upgrades
- Network station application form
- Revised ILRS station screening process at ILRS Operative Centers (NASA and EDC)

# ILRS website: mission info



- Satellite information

- ◆ Lists of supported missions (current, past/other, future)

- ◆ Mission parameters

- Orbit information

- Retroreflector characteristics

- Array offsets

- ◆ Graphs of data quantity, quality by station

- Other information

- ◆ Satellite priorities

- ◆ Satellite parameters (e.g., CoM)

**ILRS Mission Priorities as of August 15, 2019**

The ILRS has ordered its tracking priority list according to satellite orbital parameters and special project needs. Tracking priorities have been ordered as follows:

1. Priorities decrease with:
  - a. increasing orbital altitude; and
  - b. increasing orbital inclination (at a given altitude).
2. Priority of some satellites may then be increased to intensify support for:
  - a. active missions (such as altimetry);
  - b. special campaigns (such as IDEX 98); or
  - c. post-launch intensive tracking phases; and
3. Some slight reordering may be done to give higher priority to missions with increased importance to the analysis community.

Stations may adjust priorities to accommodate local conditions such as system capabilities, weather, and special program interests. The ILRS priority list includes several high priority GNSS satellites. All of the remaining GNSS satellites, included on the Current or Past/Other satellites lists, can be tracked by the stations on an as time available basis; selection of targets should be determined by the stations for data yield, but stations are asked to try to diversify among all three constellations because we need some data on all three.

Satellite sponsors request for tandem mission, satellites be tracked on alternate passes.

**Related Links:**

- Prediction Providers
- Prediction Types
- Normal point bin size recommendations
- Past Priority Lists
- Mission Tracking Feedback on NESC Forum

**Current Priority List** [Get CSV](#)

Priority	Mission	ILRS Name	COSPAC ID	SIC	Sponsor	Altitude (km)	Inclination (degrees)	Comments
1	LightSat-2	lightsat2	1903629	4202	The Planetary Society	720	24	
2	GRACE-FO-1z	gracefo1	1804701	0124	NASA, JPL, and the German Research Centre for Geosciences (GFZ)	500	89	1-month campaign
3	ICESat-2	icesat2	1807001	6873	NASA	496	92	Restricted tracking; authorization required
4	CryoSat-2	cryosat2	1001301	8006	ESA	450-720	92	
5	PAZ	paz	1802001	2501	HIDESAT	514	97.44	
6	TanDEM-X	tandemx	1003001	6202	Interneta/ DLN/DFZ/CSR	514	98	Tandem with TerraSAR-X
7	TerraSAR-X	terasarx	0702601	6201	Interneta/ DLN/DFZ/CSR	514	97.44	Tandem with TanDEM-X
8	SNET-4	snet4	1801408	6207	Technische Universität Berlin	600	97.6	
9	SNET-3	snet3	1801408	6206	Technische Universität Berlin	600	97.6	
10	SNET-2	snet2	1801407	6205	Technische Universität Berlin	600	97.6	
11	SNET-1	snet1	1801410	6204	Technische Universität Berlin	600	97.6	
12	TechnoSat	technosat	1704205	6203	Technische Universität Berlin	600	97.6 - 97.9 degrees w.r.t. across	3-month campaign
13	STSAT-2c	stsat2c	1303001	3804	MEST KAIST	300-	89	

# More information



- Workshop proceedings website:
  - ◆ [https://cddis.nasa.gov/2019\\_Technical\\_Workshop/](https://cddis.nasa.gov/2019_Technical_Workshop/)
- First "SLR School" website (presentations, etc.):
  - ◆ [https://cddis.nasa.gov/2019\\_Technical\\_Workshop/SLR\\_School/index.html](https://cddis.nasa.gov/2019_Technical_Workshop/SLR_School/index.html)
- Handout from this presentation (useful links):
  - ◆ [https://cddis.nasa.gov/2019\\_Technical\\_Workshop/SLR\\_School/docs/DClinks.pdf](https://cddis.nasa.gov/2019_Technical_Workshop/SLR_School/docs/DClinks.pdf)

