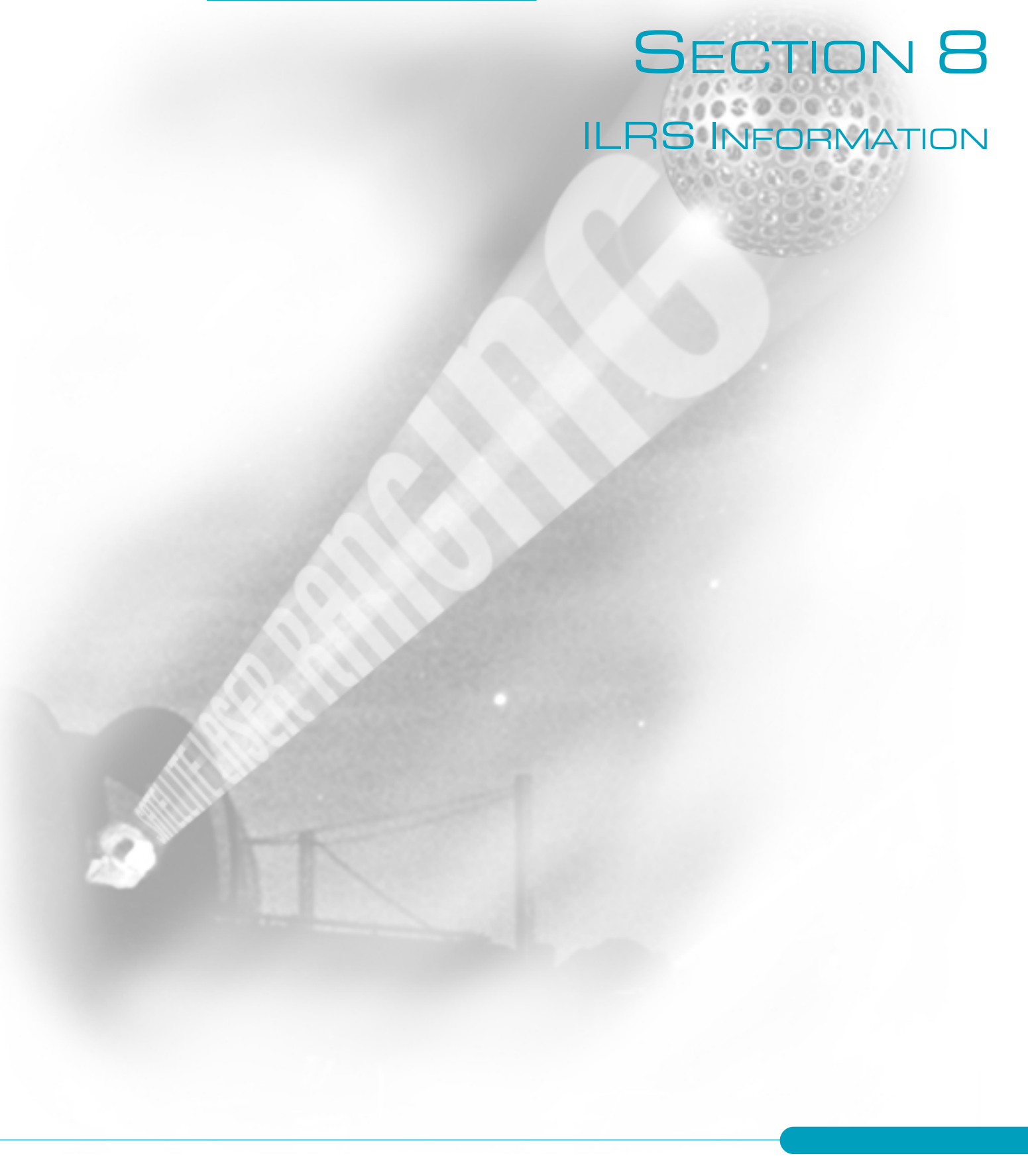


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# SECTION 8

## ILRS INFORMATION





## SECTION 8 – ILRS INFORMATION

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### 8.1 ILRS Terms of Reference

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#### 1.0 INTRODUCTION

##### 1.1 Charter and Affiliations

The International Laser Ranging Service (ILRS) is an established Service within Section II, Advanced Space Technology, of the International Association of Geodesy (IAG). The primary objective of the ILRS is to provide a service to support, through Satellite and Lunar Laser Ranging data and related products, geodetic and geophysical research activities as well as International Earth Rotation Service (IERS) products important to the maintenance of an accurate International Terrestrial Reference Frame (ITRF). The service also develops the necessary standards/specifications and encourages international adherence to its conventions.

##### 1.2 Services

The ILRS collects, merges, archives and distributes Satellite Laser Ranging (SLR) and Lunar Laser Ranging (LLR) observation datasets of sufficient accuracy to satisfy the objectives of a wide range of

scientific, engineering, and operational applications and experimentation. These data sets are used by the ILRS to generate a number of scientific and operational data products including but not limited to:

- Earth orientation parameters (polar motion and length of day)
- Three-dimensional coordinates and velocities of the ILRS tracking stations
- 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

The accuracy of SLR/LLR data products is sufficient to support a variety of scientific and operational applications including:

- Co-determination, with other space geodetic techniques, of the International Terrestrial Reference Frame (ITRF), especially as it relates to center-of-mass and scale
- 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,  $G$
- Lunar physics including the dissipation of rotational energy, shape of the core-mantle boundary (Love Number  $k_2$ ), and free librations and stimulating mechanisms
- Solar System ties to the International Celestial Reference Frame (ICRF)

### 1.3 Amendments to the ILRS Terms of Reference

A proposal to amend the ILRS Terms of Reference can be made in writing to the Chairperson of the Governing Board (see Section 3.0) by any ILRS Associate Member (see Section 4.1). Proposed amendments will be forwarded by email to all ILRS Associate Members of record for comment and amended as necessary by the Chairperson prior to a Governing Board vote. Associate Members will be given two weeks to comment. Final approval of any such amendment requires a 2/3 affirmative vote of the Governing Board. Proposed amendments to the Terms and subsequent Board actions will be summarized and presented to the Associate Members by the Chairperson at the next General Assembly.

## 2. PERMANENT COMPONENTS OF THE ILRS

The ILRS accomplishes its mission through the following permanent components:

- Tracking Stations and Subnetworks

- Operations Centers
- Global and Regional Data Centers
- Analysis, Lunar Analysis, and Associate Analysis Centers
- Central Bureau

The characteristics and responsibilities of these entities is described in the following subsections.

## 2.1 Tracking Stations and Subnetworks

ILRS Tracking Stations range to a constellation of approved satellites (including the Moon), contained in a list of satellites compiled and approved by the ILRS Governing Board, through the use of state of the art laser tracking equipment and data transmission facilities which allow for a rapid (at least daily) data transmission to one or more Operations and/or Data Centers (see below). The stations must meet data accuracy, quantity, and timeliness requirements which are specified in separate documents. The tracking data produced by the ILRS stations are regularly and continuously analyzed by at least one ILRS Analysis Center or one mission-specific Associate Analysis Center. Tracking Stations may be organized into regional or institutional subnetworks.

## 2.2 Operations Centers

The Operational Centers are in direct contact with tracking sites organized in a subnetwork. Their tasks typically include the collection and merging of data from the subnetwork, initial data quality checks, data reformatting into a uniform format, compression of data files if requested, maintenance of a local archive of the tracking data, and the electronic transmission of data to a designated ILRS Data Center. Operational Centers may also provide the tracking sites with sustaining engineering, communications links, and other technical support. In addition, Operational Centers can perform limited services for the entire network. Individual tracking stations can also perform part or all of the tasks of an Operational Center themselves.

## 2.3 Data Centers

### 2.3.1 Regional Data Centers

The Regional Data Centers reduce traffic on electronic networks. They collect reformatted tracking data from Operational Data Centers and/or individual tracking stations, maintain a local archive of the data received and, in some cases, transmit these data to the Global Data Centers. Regional Data Centers may also meet the requirements for Operational Centers and Global Data Centers (as defined in the previous and following paragraphs) of strictly regional network operations and duplicate activities of Global Data Centers to facilitate easy access to the information and products.

### 2.3.2 Global Data Centers

The Global Data Centers are the primary interfaces to the Analysis Centers and the outside user community. Their primary tasks include the following:

- Receive/retrieve, archive and provide on-line access to tracking data received from the Operational/Regional Data Centers
- Provide on-line access to ancillary information such as site information, occupation histories, meteorological data, site specific engineering data, etc.

- Receive/retrieve, archive and provide on-line access to ILRS scientific data products received from the Analysis Centers
- Backup and secure ILRS data and products

## 2.4 Analysis Centers

The analysis centers fall into three categories: Analysis Centers, Lunar Analysis Centers, and Associate Analysis Centers.

### 2.4.1 Analysis Centers

The Analysis Centers receive and process tracking data from one or more data centers for the purpose of producing ILRS products. The Analysis Centers are committed to produce the products, without interruption, at an interval and with a time lag specified by the Governing Board to meet ILRS requirements. The products are delivered to the Global Data Centers, to the IERS (as per bilateral agreements), and to other bodies, using designated standards. At a minimum, the Analysis Centers must process the global LAGEOS-1 and LAGEOS-2 data sets and are encouraged to include other geodetic satellites in their solutions.

The Analysis Centers provide, as a minimum, Earth orientation parameters on a weekly or sub-weekly basis, as well as other products, such as station coordinates, on a yearly basis or as otherwise required by the IERS. The Analysis Centers also provide a second level of quality assurance on the global data set by monitoring individual station range and time biases via the fitted orbits (primarily the LAGEOS 1 and 2 satellites) used in generating the quick-look science results.

### 2.4.2 Associate Analysis Centers

Associate Analysis Centers are organizations that produce special products, such as satellite predictions, time bias information, precise orbits for special-purpose satellites, station coordinates and velocities within a certain geographic region, or scientific data products of a mission-specific nature. Associate Analysis Centers are encouraged to perform additional quality control functions through the direct comparison of individual Analysis Center products and/or the creation of "combined" solutions, perhaps in combination with data from other space geodetic techniques (e.g. VLBI, GPS, GLONASS, DORIS, PRARE, etc.), in support of the IERS International Terrestrial Reference Frame (ITRF) or precise orbit determination. Organizations with the desire of eventually becoming Analysis Centers may also be designated as Associate Analysis Centers by the Governing Board until they are ready for full scale operation.

### 2.4.3 Lunar Analysis Centers

Lunar Analysis Centers process normal point data from the Lunar Laser Ranging (LLR) stations and generate a variety of scientific products including precise lunar ephemerides, librations, and orientation parameters which provide insights into the composition and internal makeup of the Moon, its interaction with the Earth, tests of General Relativity, and Solar System ties to the International Celestial Reference Frame.

## 2.5 Central Bureau

The Central Bureau (CB) is responsible for the daily coordination and management of the ILRS in a manner consistent with the directives and policies established by the Governing Board. The primary functions of the CB are to facilitate communications and information transfer within the ILRS and between the ILRS and the external scientific community, coordinate ILRS activities, maintain a list of satellites approved for tracking support and their priorities, promote compliance to ILRS network standards, monitor network operations and quality assurance of data, maintain ILRS documentation and databases, produce reports as required, and organize meetings and workshops.

Although the Chairperson of the Governing Board is the official representative of the ILRS to external organizations, the CB, consonant with the directives established by the Governing Board, is responsible for the day-to-day liaison with such organizations.

The CB coordinates and publishes all documents required for the satisfactory planning and operation of the Service, including standards/specifications regarding the performance, functionality and configuration requirements of all elements of the Service including user interface functions.

The CB operates the communication center for the ILRS. It produces and/or maintains a hierarchy of documents and reports, in both hard copy and electronic form, including network information, standards, newsletters, electronic bulletin board, directories, summaries of ILRS performance and products, and an Annual Report.

The Central Bureau may propose to the Governing Board names of individuals to be considered by the ILRS Associates for election as members at large to help ensure the proper representation of important contributing organizations.

The responsibilities and activities of the Central Bureau may be distributed between different groups and organizations according to written agreements and charters.

In summary, the Central Bureau performs a long term coordination and communication role to ensure that ILRS participants contribute to the Service in a consistent and continuous manner and that they adhere to ILRS standards.

The Central Bureau is headed by a Central Bureau Director, who is an ex-officio member of the ILRS Governing Board. The Secretary of the GB is also provided by the Central Bureau.

### 3.0 GOVERNING BOARD

#### 3.1 Roles and Responsibilities

The Governing Board is responsible for the general directions in which the ILRS is providing its services. It defines the official ILRS products, decides upon the satellites to be included in the ILRS tracking list, accepts standards and procedures prepared and proposed by the individual bodies of the ILRS and ensures, through its chairperson, the contact to other services and organizations.

The GB exercises general control over the activities of the Service including modifications to the organization that would be appropriate to maintain efficiency and reliability, while taking full advantage of the advances in technology and theory.

Most GB decisions are to be made by consensus or by a simple majority vote of the members, provided that there is a quorum consisting of at least ten members of the GB. In case of lack of a quorum the voting is by mail or email. Changes in Terms of References and the Chairperson of the GB can be made by a 2/3 majority of the members of the GB, i.e., by twelve or more votes.

### 3.2 Membership

The Governing Board consists of both appointed and elected members. The appointed members include:

Director of the Central Bureau	1
Secretary of the Central Bureau	1
President of IAG Sect. II or Com.VIII (CSTG)	1

Members elected by their peers within the ILRS Associates include:

NASA SLR Network representatives	2
EUROLAS Network representatives	2
WPLTN Network representatives	2
Analysis and Associate Analysis Centers' representatives	2
Data centers' representative	1
LLR Representative	1
At-Large Members	2
IERS Representative	1
Total	16

The appointed members are considered ex-officio and are not subject to institutional restrictions. The elected board positions are nominated and elected by members of the ILRS components they represent for a two-year term. The At-Large members are intended to compensate for under-representation among the various components of the ILRS or to provide additional skills or knowledge of use to the Board in carrying out its duties. At-Large members are elected by the entire body of ILRS Associates. The total GB membership should be properly balanced in all respects with regard to supporting organizations, skill mix, geography, etc.

### 3.3 Nomination and Election of Members

ILRS Associate Members (see Section 4.1), together with the GB, may nominate and vote for the elected members of the GB. The Call for Nominations and GB Elections will be conducted by the Central Bureau via official email lists and will be held approximately every two years prior to the International Workshop on Laser Ranging. Newly elected GB members will be installed at the next semiannual meeting. With the exception of At-Large members, GB nominees must be associated with the relevant ILRS component (e.g. Analysis, Data Centers, Lunar, etc.), and only ILRS Associate Members officially associated with that component, as determined by the official email lists maintained by the CB, may participate in the election of their representative. The full ILRS membership can vote for At-Large members. The GB will be final arbiter on an individual's qualifications for a particular elected post on the Board. Election is by a simple majority of votes received. In the unlikely event of a tie vote, the GB will make the final selection in Executive Session.

### 3.4 Election and Role of Chairperson



The GB Chairperson is elected by the Board from among its members for a term of two years, renewable for three terms. Nomination and selection of the Chairperson is carried out in GB Executive Session during the biannual Workshop Meeting. The Chairperson does not vote, except in case of a tie. He/she is the official representative of the ILRS to external organizations.

### 3.5 Frequency of Meetings

The Board shall endeavor to meet semiannually and at such other times as shall be considered appropriate or opportune by the Chairperson or at the request of at least eight Governing Board members. Whenever possible and appropriate, the GB and CB will jointly sponsor a General Assembly twice per year for the benefit of the ILRS Associates. The logistics (schedule, location, advertising, etc.) for the General Assembly are the responsibility of the CB.

### 3.6 Rights and Privileges of GB Members

Members of the GB shall become IAG Fellows with the appropriate rights and privileges following two years of recognized service.

### 3.7 Analysis and Lunar Coordinators

The laser ranging technique is a broad based one. As an observational technique, the division between lunar laser ranging and artificial satellite laser ranging has become largely a historical one. However, present differences in many areas related to observations (e.g., predictions and data formats) are still being reconciled. It must also be recognized that the major data analysis packages that are presently used for artificial satellite analysis are not yet equipped to deal with lunar laser ranging observations and most of the LLR analysis packages are equally not yet compatible with SLR observations. Thus, it is prudent to maintain separate LLR and SLR coordinators for an, as yet, undefined time into the future. The SLR and LLR coordinators must work within their own disciplines to maintain observational and data integrities. However, they must also work together in an effort to unify both techniques, bringing together the best of both, and, when possible, learning from the other.

The Analysis and Lunar Coordinators are elected by the GB from its own membership and serve as the two voting ILRS representatives on the IERS Directing Board. The IERS in turn designates a representative to serve as an ex-officio voting member of the ILRS Governing Board.

The Analysis Coordinator is a voting member of the ILRS Governing Board and is elected by the Governing Board as the ILRS representative to the IERS Directing Board. Under a reciprocal arrangement, the IERS designates a representative to serve as a voting member on the ILRS Governing Board. The Lunar Coordinator may represent the ILRS as a deputy voting member on the IERS Directing Board in the Analysis Coordinator's absence and may otherwise attend IERS Board meetings at their discretion in a non-voting advisory capacity.

The Analysis Coordinator chairs the Analysis Working Group which includes, at a minimum, the Lunar Coordinator, one representative from each of the Global Analysis Centers and may contain representatives of Associate Analysis Centers as well.

The responsibility of the Analysis Coordinator is to monitor the Analysis Centers' activities to ensure that the ILRS objectives are carried out. Specific expectations include global data quality control, station

performance evaluation and reporting, and continued development of appropriate analysis standards and formats for the final science products. The Analysis Coordinator is also responsible for the appropriate combination of designated Analysis Centers products into a single and coherent set of products.

The Analysis Coordinator ensures that the ILRS products produced by the ILRS Analysis and Associate Analysis Centers conform with IERS requirements and standards.

### 3.8 Working Groups

The Governing Board, at its discretion, can create or disband Working Groups. A Working Group (WG) may be either permanent (Standing) or temporary (Ad-Hoc) in nature. Standing Working Groups are created by the GB to carry out continuously evolving business of the ILRS. Occasionally, Ad-Hoc Working Groups are appointed to carry out special investigations or tasks of a temporary or interdisciplinary nature.

The valid activities for the various Working Groups are defined by their Charters. Modifications to the charters of existing WG's can be submitted by the corresponding Coordinator for approval by the Governing Board. In order to create a new WG, the sponsor must submit a proposed charter, which clearly states the goals and responsibilities of the new group, for approval by the GB.

The Coordinator of each Standing WG is selected by the GB from amongst its members to ensure close coupling of the WG with the GB and its goals. The WG Coordinator can independently appoint additional members to the WG from among the other GB members, ILRS Associate Members or ILRS Correspondents (see below). The WG Coordinator may also designate a Deputy to act on his/her behalf in his/her absence. All GB members, with the exception of the ex-officio members and the Chairperson, are required to serve on at least one of the Standing Working Groups.

The Coordinator for Ad-Hoc Working Groups may be chosen, at the discretion of the Board, from outside its membership in order to best fulfill the goals of that WG.

Currently, the Standing Working Groups are:

- Missions
- Data Formats and Procedures
- Networks and Engineering
- Analysis

## 4.0 DEFINITIONS

### 4.1 ILRS Associate Members

Persons affiliated with recognized ILRS institutions and who routinely participate in any of the ILRS activities (management, missions, tracking, engineering, operations, data analysis, archiving, etc.) are eligible to be ILRS Associate Members. To gain official membership in the ILRS, an approved ILRS institution must submit the person's name, email, and primary ILRS function in the organization to the Central Bureau. ILRS Associate Members do not have to be employed by their institution sponsor; they merely need to provide a recognized ILRS-related service to the sponsoring institution under a contractual or cooperative arrangement. The Associate's stated function will determine his/her eligibility to nominate and/or vote for specific GB representatives as described in Section 3.3.

Associate Members may attend open (non-executive) ILRS meetings which are announced to the general community by the CB, place nominations for elected GB posts, vote in ILRS elections, and serve on the Governing Board if appointed or elected. A directory, electronic and/or hard copy, of ILRS Associate Members, and their approved association with a particular component of the ILRS, is maintained by the CB.

ILRS Associate Members are considered IAG Affiliates with the corresponding rights and privileges.

#### 4.2 ILRS Correspondents

ILRS Correspondents are persons on a mailing list maintained by the Central Bureau, who do not actively participate in the ILRS but who either express interest in receiving ILRS publications, wish to participate in workshops or scientific meetings organized by the ILRS, or generally are interested in ILRS activities. Ex-officio ILRS Correspondents are the following persons:

- IAG General Secretary
- President of IAG Section V

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## 8.2 ILRS Website Reference Card

March 2000

ILRS Station Information



ILRS Network

**ILRS Data, Algorithms, and Formats**

**Daily Normal Point (NP) Data**

Normal point algorithm:  
[http://ilrs.gsfc.nasa.gov/np\\_algo.html](http://ilrs.gsfc.nasa.gov/np_algo.html)

ILRS NP format overview:  
[http://ilrs.gsfc.nasa.gov/np\\_for\\_mat\\_intro.html](http://ilrs.gsfc.nasa.gov/np_for_mat_intro.html)

ILRS NP format (SLR & LLR):  
[http://ilrs.gsfc.nasa.gov/np\\_for\\_mat.html](http://ilrs.gsfc.nasa.gov/np_for_mat.html)

NP data access (root directory):  
<ftp://cddis.gsfc.nasa.gov/pub/ilrs/np/>  
<ftp://ftp.dgfi.badw-muenchen.de/pub/laser/qldata/>

LLR NP data access (root directory):  
<ftp://cddis.gsfc.nasa.gov/pub/ilrs/llr/>  
<ftp://ftp.dgfi.badw-muenchen.de/pub/laser/qlldata/>

Data centers NP file naming conventions:  
 CDDIS - daily ([www.cddis.nasa.gov/](http://www.cddis.nasa.gov/))  
 CDDIS - monthly ([www.cddis.nasa.gov/](http://www.cddis.nasa.gov/))  
 EDC - daily ([www.edc.nasa.gov/](http://www.edc.nasa.gov/))  
 EDC - monthly ([www.edc.nasa.gov/](http://www.edc.nasa.gov/))

**Daily SLR Full-Rate (FR) Data**

ILRS FR format:  
[http://ilrs.gsfc.nasa.gov/fr\\_format\\_v3.html](http://ilrs.gsfc.nasa.gov/fr_format_v3.html)

FR data access:  
<ftp://cddis.gsfc.nasa.gov/pub/ilrs/fr/>  
<ftp://ftp.dgfi.badw-muenchen.de/pub/laser/frdata/>

**ILRS Analysis Information**

International Terrestrial Reference Frame (ITRF):  
<http://hpiers.obspm.fr/iers/biers/ine/relsyframes/itrf/ITRF.htm>

SINEX format:  
[ftp://cddis.gsfc.nasa.gov/pub/for\\_mats/sinex\\_1\\_format](ftp://cddis.gsfc.nasa.gov/pub/for_mats/sinex_1_format)

**ILRS Reports**

ILRS Meeting Minutes:  
[http://ilrs.gsfc.nasa.gov/ilrs\\_reports.html](http://ilrs.gsfc.nasa.gov/ilrs_reports.html)

**System Performance**

Weekly/Daily Reports:  
[http://ilrs.gsfc.nasa.gov/imission\\_analysis.html](http://ilrs.gsfc.nasa.gov/imission_analysis.html)

Quarterly Report Card:  
<http://ilrs.gsfc.nasa.gov/performance.html>

ILRS Station Information



ILRS Network

**Site Identifiers**

DOMES procedure:  
[http://ilrs.gsfc.nasa.gov/domes\\_and\\_domes.html](http://ilrs.gsfc.nasa.gov/domes_and_domes.html)

Site Occupation Designator (SOD) procedure:  
<http://ilrs.gsfc.nasa.gov/sod.html>

SOD and DOMES numbers of current sites:  
[http://ilrs.gsfc.nasa.gov/sod\\_domes.htm](http://ilrs.gsfc.nasa.gov/sod_domes.htm)

SLR System SODs:  
<ftp://cddis.gsfc.nasa.gov/pub/sois/sois.txt>

SLR Site Coordinates:  
<ftp://cddis.gsfc.nasa.gov/pub/sois/sois.coord.txt>

SLR Site Eccentricities:  
<ftp://cddis.gsfc.nasa.gov/pub/sois/sois.ecc.txt>

Site Configuration Reporting Procedure:  
[http://ilrs.gsfc.nasa.gov/sois\\_conf\\_proc.html](http://ilrs.gsfc.nasa.gov/sois_conf_proc.html)

Configuration file(s) access:  
<ftp://ftp.dgfi.badw-muenchen.de/pub/laser/sois/>

Site Information:  
[http://ilrs.gsfc.nasa.gov/sois\\_problems\\_index.html](http://ilrs.gsfc.nasa.gov/sois_problems_index.html)

ILRS Central Bureau  
 NASA GSFC  
 Code 930.1  
 Greenbelt, MD 20771 USA

WWW: <http://ilrs.gsfc.nasa.gov/>  
 E-mail: [dbj@ilrs.gsfc.nasa.gov](mailto:dbj@ilrs.gsfc.nasa.gov)  
 Webmaster: [ilrsweb@ilrs.gsfc.nasa.gov](mailto:ilrsweb@ilrs.gsfc.nasa.gov)  
 Phone: +1 301-614-5869  
 Fax: +1 301-614-5870



**ILRS Quick Reference Card**

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

The ILRS is based on a global network of approximately forty permanently operating geodetic quality satellite and lunar laser ranging systems in support of more than twenty geodetic, oceanographic, and special purpose satellite missions. The station normal point data are archived daily at the two Global Data Centers.

Three Analysis Centers process LAGEOS data and regularly provide earth orientation parameters, site coordinates, and station quality assessment. Eighteen Associate Analysis Centers produce mission specific products such as satellite predictions, precise orbit, and earth's gravity field coefficients.

Four Lunar Analysis Centers process lunar data and generate precise lunar ephemerides, librations, and orientation parameters.

The Central Bureau is responsible for the maintenance of the ILRS web site and the daily management and coordination of this service consistent with the policies established by the internationally elected Governing Board.



**International Laser Ranging Service**



### ILRS General Information

ILRS Science:  
<http://ilrs.gsfc.nasa.gov/science.html>

ILRS Bibliography:  
<http://ilrs.gsfc.nasa.gov/biblio.html>

ILRS Meeting Schedules:  
<http://ilrs.gsfc.nasa.gov/meetings.html>

ILRS Activities:  
<http://ilrs.gsfc.nasa.gov/activities.html>

Terms of Reference:  
<http://ilrs.gsfc.nasa.gov/termsref.html>

SLR Overview:  
<http://ilrs.gsfc.nasa.gov/slr/over.pdf>

Governing Board:  
<http://ilrs.gsfc.nasa.gov/gvb.html>

Satellite Missions:  
<http://ilrs.gsfc.nasa.gov/missions.html>

Stations:  
<http://ilrs.gsfc.nasa.gov/stations.html>

Analysis Centers:  
[http://ilrs.gsfc.nasa.gov/analysis\\_centers.html](http://ilrs.gsfc.nasa.gov/analysis_centers.html)

Working Groups:  
<http://ilrs.gsfc.nasa.gov/working.html>

Central Bureau:  
<http://ilrs.gsfc.nasa.gov/central.html>

### Global Data Centers

www:  
[http://cdlisa.gsfc.nasa.gov/cddlis\\_who.me.html](http://cdlisa.gsfc.nasa.gov/cddlis_who.me.html)  
<http://www.dgfi.badw-muenchen.de/cddlis.html>

Anonymous ftp access (root directory):  
<ftp://cdlisa.gsfc.nasa.gov/pub/slr>  
<ftp://ftp.dgfi.badw-muenchen.de/pub/lsr>

### ILRS Working Groups (WG)

**WG Activities**

Data Formats and Procedures (D&P):  
[http://ilrs.gsfc.nasa.gov/data\\_activities.html](http://ilrs.gsfc.nasa.gov/data_activities.html)

Rapid LEO Predictions:  
<http://ilrs.gsfc.nasa.gov/leo.html>

Analysis:  
[http://ilrs.gsfc.nasa.gov/analysis\\_activities.html](http://ilrs.gsfc.nasa.gov/analysis_activities.html)

Missions:  
[http://ilrs.gsfc.nasa.gov/missions\\_activities.html](http://ilrs.gsfc.nasa.gov/missions_activities.html)

Navalics and Engineering (N&E):  
[http://ilrs.gsfc.nasa.gov/networks\\_activities.html](http://ilrs.gsfc.nasa.gov/networks_activities.html)

Center of Mass and Signal Processing (SP):  
[http://ilrs.gsfc.nasa.gov/tiger\\_activities.html](http://ilrs.gsfc.nasa.gov/tiger_activities.html)

### ILRS Directory and E-Mail

ILRS personnel directory:  
[http://ilrs.gsfc.nasa.gov/ilrs\\_directory.html](http://ilrs.gsfc.nasa.gov/ilrs_directory.html)

**ILRS Email Explorers**

Governing Board:  
[ilrs@ilrs.gsfc.nasa.gov](mailto:ilrs@ilrs.gsfc.nasa.gov)

Central Bureau:  
[cb@ilrs.gsfc.nasa.gov](mailto:cb@ilrs.gsfc.nasa.gov)

Stations:  
[ilrssta@ilrs.gsfc.nasa.gov](mailto:ilrssta@ilrs.gsfc.nasa.gov)

Analysis and Associate Analysis Centers:  
[ilrsac@ilrs.gsfc.nasa.gov](mailto:ilrsac@ilrs.gsfc.nasa.gov)  
[ilrsaac@ilrs.gsfc.nasa.gov](mailto:ilrsaac@ilrs.gsfc.nasa.gov)

Data Centers:  
[ilrsdc@ilrs.gsfc.nasa.gov](mailto:ilrsdc@ilrs.gsfc.nasa.gov)

ILRS Associates and Correspondents (SLRMail):  
[slrmal@dgfi.badw-muenchen.de](mailto:slrmal@dgfi.badw-muenchen.de)

SLRMail Procedure:  
<http://ilrs.gsfc.nasa.gov/slrmail.html>

Archive of SLRMail messages:  
<ftp://cdlisa.gsfc.nasa.gov/pub/points/slrmail/>  
<ftp://ftp.dgfi.badw-muenchen.de/pub/lsr/messages/slrmail>

**Working Groups:**

D&P - [ilrsdftp@ilrs.gsfc.nasa.gov](mailto:ilrsdftp@ilrs.gsfc.nasa.gov)  
 Analysis - [ilrsanwg@ilrs.gsfc.nasa.gov](mailto:ilrsanwg@ilrs.gsfc.nasa.gov)  
 Missions - [ilrsmwg@ilrs.gsfc.nasa.gov](mailto:ilrsmwg@ilrs.gsfc.nasa.gov)  
 N&E - [ilrsnewg@ilrs.gsfc.nasa.gov](mailto:ilrsnewg@ilrs.gsfc.nasa.gov)  
 SP - [ilrsesp@ilrs.gsfc.nasa.gov](mailto:ilrsesp@ilrs.gsfc.nasa.gov)

### WWW Links

**Mirror Sites:**  
<http://galileo.crjgo.jpl.nasa.gov>  
[http://www.dgfi.badw-muenchen.de/cddlis/ilrs\\_who.me.html](http://www.dgfi.badw-muenchen.de/cddlis/ilrs_who.me.html)

**Agencies:**  
<http://ilrs.gsfc.nasa.gov/agencylinks.html>

**Analysis Centers:**  
<http://ilrs.gsfc.nasa.gov/analysislinks.html>

**Satellite Missions:**  
<http://ilrs.gsfc.nasa.gov/satellitelinks.html>

**Stations:**  
<http://ilrs.gsfc.nasa.gov/stationlinks.html>

### ILRS Mission Information

**Satellite Missions:**  
<http://ilrs.gsfc.nasa.gov/missions.html>

**Satellite Tracking Priorities:**  
<http://ilrs.gsfc.nasa.gov/priorities.html>

**Satellite IDs, Bin Sizes, Orbit Info:**  
[http://ilrs.gsfc.nasa.gov/satellite\\_list.html](http://ilrs.gsfc.nasa.gov/satellite_list.html)

**Mission Support Request Form:**  
<http://ilrs.gsfc.nasa.gov/issup.html>

**Satellite Support History:**  
[http://ilrs.gsfc.nasa.gov/slr\\_ssr\\_history.html](http://ilrs.gsfc.nasa.gov/slr_ssr_history.html)

**Satellite Predictions (Including Lunar) Tuned IRV (TIRV) format:**  
[ftp://cdlisa.gsfc.nasa.gov/pub/irvformats/irvformat\\_TIRV\\_format.html](ftp://cdlisa.gsfc.nasa.gov/pub/irvformats/irvformat_TIRV_format.html)

**TIRV format model:**  
<http://ilrs.gsfc.nasa.gov/irv.html>

**TIRV access:**  
<ftp://cdlisa.gsfc.nasa.gov/pub/predicts/>  
<ftp://ftp.cer.utexas.edu/pub/lsr/ephemeris/>  
<ftp://fdgfi.badw-muenchen.de/pub/lsr/predictions/>

**Lunar Ephemeris:**  
<ftp://files.nerc-mnlwood.ac.uk/nerc/lsr/ephemeris/>

**NORAD 2-line element format:**  
[http://ilrs.gsfc.nasa.gov/academy/rocket\\_sci/orbmech/statel/2line.html](http://ilrs.gsfc.nasa.gov/academy/rocket_sci/orbmech/statel/2line.html)

**NORAD 2-line element access:**  
<http://ce.lestrak.com/MORA/Detailed/index.html>  
<http://log.spa.nato.allied.com/scripts/foxtweb/llapp01>

**Main user format:**  
<http://ilrs.gsfc.nasa.gov/manoeuvre.html>

**Main user file to files:**  
<http://ilrs.gsfc.nasa.gov/maneuvers.html>

**Drag function format:**  
[http://ilrs.gsfc.nasa.gov/drag\\_function.html](http://ilrs.gsfc.nasa.gov/drag_function.html)

**Drag function algorithm:**  
[http://ilrs.gsfc.nasa.gov/drag\\_function\\_algorithm.html](http://ilrs.gsfc.nasa.gov/drag_function_algorithm.html)

**Time bias function (TBF) format:**  
[http://ilrs.gsfc.nasa.gov/tbf\\_function\\_format.html](http://ilrs.gsfc.nasa.gov/tbf_function_format.html)

**TBF description:**  
[http://ilrs.gsfc.nasa.gov/tbf\\_format\\_intro.html](http://ilrs.gsfc.nasa.gov/tbf_format_intro.html)

**TBF access:**  
<ftp://cdlisa.gsfc.nasa.gov/pub/reports/tbf/>  
<ftp://fdgfi.badw-muenchen.de/pub/lsr/tbfaccess/>

**Prediction centers:**  
[http://ilrs.gsfc.nasa.gov/predictions\\_centers.html](http://ilrs.gsfc.nasa.gov/predictions_centers.html)

## 8.3 ILRS Website Map

**ILRS Home Page at NASA in the USA**  
**mirrored sites at EDC in Germany and CRL in Japan**

<b>About the ILRS</b>	<b>Stations</b>	<b>Reports</b>
Terms of Reference	Configurations	Analysis Reports
ILRS Bibliography	Contacts	Bulletins
Central Bureau	Coordinates	Campaign Reports
Governing Board	Data Anomalies	ILRS Bibliography
History	DOMES Procedure	ILRS Meetings Reports
Join the ILRS	Eccentricity Database	Laser Workshop Reports
Meetings	Network Map	Performance Report Cards
Network Map	News	SLR/LLR CSTG Reports
Organization Chart	Site Pressure Profiles	SLReport
Acronyms	Site Identifiers	Special Reports
<b>Mail Services</b>	Site Log Database	Station Data Anomalies
SLRMail	Site Log Procedure	Station Status Reports
SLReport	Site Log Search Feature	<b>What's New</b>
URGENT	SOD Procedure	Campaign/Missions News
ILRSPred	Status Reporting	Meetings News
ILRS Exploders	System Performance	Station News
<b>Contact the ILRS</b>	<b>Products/Formats/Procedures</b>	
Directory of Associates	<b>Normal Points (NP)</b>	<b>Links</b>
Associate Locator	NP Availability	Agencies
<b>Working Groups (WG)</b>	NP Transmission Procedures	Altimetry
<b>Analysis</b>	NP Data Flow (table)	Analysis Centers
Activities and Meetings	NP Format Overview	Data Centers
Pilot Projects	NP Format	Earthquake/Tectonics
Actions	NP Algorithm	Earth Rotation
Charter	NP Format/Data Integrity QC	El Niño and La Niña
Members & Exploder	<b>Predictions</b>	Geodetic Services
<b>Networks and Engineering</b>	Prediction Availability	Gravity Models
Activities and Meetings	Prediction Centers	Laser Safety
Actions	Prediction Types	Missions
Charter	TIRV Format	Stations
Members & Exploder	TIRV Force Models	Useful
DF&P WG Charter	Maneuver Notification	Y2K
DF&P WG Members	Drag Function	
DF&P WG Activities	Time Bias Function	
LEO Rapid Predictions	<b>Fullrate (FR)</b>	
Missions WG Charter	FR Availability	
Missions WG Members	FR Format	
Missions WG Activities	<b>Site Positions and Velocities</b>	
SP (Tiger) WG Charter	SLR Coordinates (ITRF2000)	
SP (Tiger) WG Members	SLR Coordinates (text file)	
SP (Tiger) WG Activities	ILRS Sinex Description	
Refraction Study Group Activities	<b>Data Flow</b> (NP and Predictions)	
<b>Satellite Missions</b>	<b>Science/Analysis</b>	
Campaign/Mission News	ILRS Bibliography	
Campaign Reports	IERS Conventions (1996 and 2000)	
List of Missions	Analysis Centers	
Mission Analysis Reports	Analysis Data Products	
Mission Parameters	Mission Analysis Reports	
Mission Support History	ITRF Yearly Solutions	
Priorities	SLR and Earth Science	
Request Tracking Support	Science meetings	
Link Budget Calculations	<b>Engineering/Technology</b>	
	Collocation Results	
	Performance Evaluation	
	SLR Applications	
	SLR Animation	
	Link Budget Calculations	

Date: 04 December 2001

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## 8.4 Network Performance Report Card for 2000

Location	Station Number										D					Operational Compliance		
		LEO Pass Total	LAG Pass Total	High Pass Total	Pass Total	LEO NP Total	LAGEOS NP Total	High NP Total	Total NP	Minutes of Track	SS RMS	NP RMS	Short Term	Long Term	% of good LAGEOS NP	Data Latency (hours)	Format Revision	Site logs
Baseline		1000	400	100	1500								20	10	95	12	1	yes
Mt. Stromlo	7849	3937	1460	1005	6402	47387	14638	6247	68272	78600	10	2	19	3	98	22	1	yes
Yarragadee	7090	3502	1124	1438	6064	56345	13888	9396	79629	93673	10	2	11	2	98	2	1	yes
Monument Peak	7110	4326	832	601	5759	69578	9239	4895	83712	66223	8	2	14	2	98	3	1	yes
Greenbelt	7105	3626	713	381	4720	57682	7740	2635	68057	48074	10	2	10	2	98	3	1	yes
Herstmonceux	7840	2644	829	503	3976	34871	9646	2556	47073	43706	16	3	12	3	100	2	1	yes
Graz	7839	2570	604	712	3886	58708	8682	6129	73519	66508	8	2	11	3	100	18	1	yes
Grasse	7835	3180	533	50	3763	66706	6513	365	73584	34738	16	2	13	3	99	5	1	yes
San Fernando	7824	2941	421	0	3362	51821	3639	0	55460	24502	45	10	35	28	63	2	1	yes
McDonald	7080	2053	590	531	3174	29353	5353	2351	37057	31687	13	3	15	3	99	2	1	yes
Zimmerwald	7810	2007	530	161	2698	30509	6311	1365	38185	29940	25	4	13	3	98	2	1	yes
Changchun	7237	1909	288	238	2435	28923	2518	1780	33221	23709	16	8	23	8	86	5	1	yes
Wetzell	8834	1232	593	416	2241	17752	5707	1905	25364	27039	24	5	28	8	89	20	1	yes
Simosato	7838	1536	272	76	1884	29366	3035	626	33027	19206	33	7	23	9	97	2	0	yes
Arequipa	7403	1503	188	0	1691	20086	1750	0	21836	10520	7	3	15	5	96	5	1	yes
Potsdam	7836	1365	217	45	1627	19706	2097	231	22034	11598	16	4	21	8	93	11	1	yes
Beijing	7249	1119	195	89	1403	15020	1380	518	16918	10545	20	8	41	11	54	11	1	yes
Shanghai	7837	918	201	283	1402	13209	1968	1813	16990	17505	17	6	31	9	85	8	1	yes
Grasse (LLR)	7845	0	269	957	1226	0	3994	3352	7346	24748	24	4	12	4	98	16	1	yes
Tateyama	7339	769	318	119	1206	10814	3179	626	14619	13388	13	3	23	8	82	7	1	no
Tahiti	7124	803	279	0	1082	12180	3085	0	15265	10697	10	2	24	5	93	3	1	yes
Riga	1884	914	117	0	1031	18008	1551	0	19559	8091	24	8	29	32	83	5	1	yes
Kunming	7820	613	269	71	953	7854	2727	453	11034	10585	42	10	57	60	57	12	0	yes
Kashima	7335	633	237	57	927	8707	2195	321	11223	9274	17	5	27	13	92	6	1	no
Borowiec	7811	633	138	26	797	11078	1762	108	12948	7619	29	7	20	11	91	2	1	yes
Koganei	7328	544	140	52	736	6460	1459	292	8211	6762							1	yes

ILRS Information

Location	Station Number										D					Operational Compliance		
		LEO Pass Total	LAG Pass Total	High Pass Total	Pass Total	LEO NP Total	LAGEOS NP Total	High NP Total	Total NP	Minutes of Track	SS RMS	NP RMS	Short Term	Long Term	% of good LAGEOS NP	Data Latency (hours)	Format Revision	Site logs
Wuhan	7231	483	116	134	733	7143	1421	932	9496	9966	23	7	26		86	2	1	yes
Matera	7939	569	70	0	639	10674	792	0	11466	5280	154	35	52	21	42	4	1	no
Maidanak 2	1864	361	122	104	587	4590	831	320	5741	4814		10	42	29	75	42	0	no
Miura	7337	373	156	37	566	4786	1429	192	6407	5667								no
Metsahovi2	7806	474	52	11	537	8671	766	61	9498	4372	24	6	25		73	11	1	yes
Helwan	7831	411	15	0	426	4828	75	0	4903	1804	19	24	36		50	7	0	yes
Hartebeesthoek	7501	243	78	26	347	3026	773	163	3962	3514	10	2	31		91	4	1	yes
Beijing (TROS)	7343	250	42	39	331	3879	535	257	4671	3622	26	10	57		29	11	1	yes
Golosiv	1824	277	0	0	277	4964	0	0	4964	1437							1	yes
Haleakala	7210	179	34	10	223	2094	253	68	2415	1556	12	6	15		99	17	1	yes
Komsomolsk	1868	167	15	26	208	1969	76	67	2112	1195							0	no
Katsively	1893	140	46	20	206	2097	357	106	2560	1936	51	6	26		69	64	0	yes
Mendeleevo	1870	183	0	0	183	1260	0	0	1260	395						19	0	no
Simeiz	1873	100	26	4	130	1136	204	26	1366	926	73	48	48		18	15	0	no
Cagliari	7548	60	18	0	78	935	90	0	1025	568								yes
Riyadh	7832	3	0	0	3	83	0	0	83	27							0	yes

## 8.5 ILRS Network Statistics

Table 8.5-1 Low Orbiting Satellites

Site Name	Station	CHAMP	SUNSAT	ERS-1	ERS-2	STAR.	STEL	WEST	GFO-1	BE-C	TOPEX	AJISAI	Total
Ajaccio (FTLRS)	7848	0	0	0	0	0	0	0	0	0	0	0	0
Arequipa	7403	16	0	2	156	224	215	7	105	177	280	321	1,503
Beijing	7249	7	8	0	53	160	86	15	63	186	245	304	1,127
Beijing (TROS)	7343	8	0	0	17	22	22	4	15	45	55	63	251
Borowiec	7811	6	0	7	95	98	57	33	59	28	158	92	633
Cagliari	7548	0	0	0	11	4	5	0	1	4	8	27	60
Changchun	7237	21	17	4	151	331	168	40	116	232	410	419	1,909
Grasse	7835	113	106	98	481	356	351	221	289	280	558	327	3,180
Grasse	7845	0	0	0	0	0	0	0	0	0	0	0	0
Graz	7839	44	49	55	283	331	314	146	192	296	477	383	2,570
Greenbelt (MOB-7)	7105	39	79	48	260	633	263	102	271	595	557	779	3,626
Haleakala	7210	2	0	0	13	16	22	2	6	37	34	47	179
Hartebeesthoek	7501	1	0	0	10	41	28	7	14	10	53	79	243
Helwan	7831	0	0	3	34	56	53	0	2	82	79	102	411
Herstmonceux	7840	61	62	46	264	360	292	169	248	191	498	453	2,644
Kashima	7335	2	0	8	15	143	49	6	19	92	106	193	633
Katzively	1893	2	2	0	16	16	19	0	15	11	31	28	140
Kiev	1824	4	0	0	45	28	16	0	44	19	93	28	277
Koganei	7328	0	3	7	18	98	47	6	13	87	96	169	544
Komsomolsk	1868	0	0	2	19	35	9	2	7	13	43	37	167
Kunming	7820	0	0	0	13	90	69	1	13	126	123	187	622
Maidanak	1864	0	0	2	46	54	45	11	19	47	80	58	362
Matera	7939	1	0	4	27	98	25	0	27	85	140	165	572
Matera (MLRO)	7941	0	0	0	0	0	0	0	0	0	0	0	0
McDonald	7080	6	37	21	187	253	167	31	162	484	331	375	2,054
Mendeleevo	1870	0	0	0	42	10	22	10	26	0	46	27	183
Metsahovi	7806	25	14	5	87	23	59	31	80	1	84	65	474
Miura	7337	0	1	2	5	75	32	3	7	57	61	130	373
Monument Peak	7110	44	73	27	268	680	347	128	291	852	633	982	4,325
Mount Stromlo	7849	56	40	40	275	923	450	194	186	0	699	1,074	3,937
Potsdam	7836	75	17	24	178	187	196	54	95	50	309	180	1,365
Riga	1884	82	0	11	208	55	97	0	145	11	200	105	914
Riyadh	7832	0	0	0	2	3	0	0	0	0	4	8	17
San Fernando	7824	56	74	64	278	422	357	26	187	483	434	562	2,943
Santiago De Cuba	1953	0	0	0	2	0	0	0	0	3	3	2	10
Sarapul	1871	0	0	0	0	0	0	0	0	0	0	0	0
Shanghai	7837	3	8	2	44	111	115	28	46	201	138	224	920
Simeiz	1873	0	0	0	0	15	8	0	1	7	44	25	100
Simosato	7838	7	4	17	106	230	130	1	77	327	264	373	1,536
Tahiti	7124	4	0	4	67	150	124	26	52	1	164	211	803
Tateyama	7339	3	2	6	31	151	78	22	13	138	117	208	769
Tokyo	7308	0	0	0	0	0	0	0	0	0	0	0	0
Wetzell	8834	0	7	11	65	197	107	5	56	92	377	315	1,232
Wetzell (TIGO)	7594	0	0	0	0	0	0	0	0	0	0	0	0
Wuhan	7231	1	5	0	21	67	46	7	29	112	69	126	483
Yarragadee	7090	151	112	70	316	539	343	237	350	7	541	836	3,502
Zimmerwald	7810	28	17	7	139	344	206	65	146	227	421	407	2,007
<b>Totals:</b>		868	737	597	4,348	7,629	5,039	1,640	3,487	5,696	9,063	10,496	49,600

Table 8.5-2 High Orbiting Satellites

Site Name	Station	LAG-1	LAG-2	ETA-1	ETA-2	GPS-35	GPS-36	MOON	Total
Ajaccio (FTLRS)	7848	0	0	0	0	0	0	0	0
Arequipa	7403	96	92	0	0	0	0	0	188
Beijing	7249	113	86	11	8	1	1	0	220
Beijing (TROS)	7343	34	10	6	9	0	0	0	59
Borowiec	7811	75	64	0	0	0	0	0	139
Cagliari	7548	0	19	0	0	0	0	0	19
Changchun	7237	143	146	31	37	0	0	0	357
Grasse	7835	285	248	4	4	5	3	0	549
Grasse	7845	150	119	78	86	95	74	789	1,391
Graz	7839	335	269	43	57	48	31	0	783
Greenbelt (MOB-7)	7105	377	349	19	19	13	11	0	788
Haleakala	7210	21	15	0	0	0	0	0	36
Hartebeesthoek	7501	42	56	1	0	0	0	0	99
Helwan	7831	9	6	0	0	0	0	0	15
Herstmonceux	7840	489	341	69	65	54	59	0	1,077
Kashima	7335	133	104	3	10	1	0	0	251
Katziwely	1893	8	38	3	2	2	0	0	53
Kiev	1824	0	0	0	0	0	0	0	0
Koganei	7328	88	52	6	3	0	0	0	149
Komsomolsk	1868	12	3	4	2	1	0	0	22
Kunming	7820	142	130	19	20	0	3	0	314
Maidanak	1864	45	81	23	7	4	11	0	171
Matera	7939	34	36	0	0	0	0	0	70
Matera (MLRO)	7941	0	0	0	0	0	0	0	0
McDonald	7080	282	339	64	62	60	54	96	957
Mendeleevo	1870	0	0	0	0	0	0	0	0
Metsahovi	7806	45	7	0	2	0	0	0	54
Miura	7337	80	76	1	2	0	0	0	159
Monument Peak	7110	433	427	27	31	18	17	0	953
Mount Stromlo	7849	781	692	158	147	37	35	0	1,850
Potsdam	7836	113	104	0	1	0	0	0	218
Riga	1884	49	68	0	0	0	0	0	117
Riyadh	7832	2	2	1	1	0	0	0	6
San Fernando	7824	217	214	0	0	0	0	0	431
Santiago De Cuba	1953	0	0	0	0	0	0	0	0
Sarapul	1871	0	0	0	0	0	0	0	0
Shanghai	7837	94	107	9	18	2	1	0	231
Simeiz	1873	18	8	0	0	0	0	0	26
Simosato	7838	158	114	7	6	0	0	0	285
Tahiti	7124	133	154	0	0	0	0	0	287
Tateyama	7339	176	144	10	23	6	8	0	367
Tokyo	7308	0	0	0	0	0	0	0	0
Wettzell	8834	338	267	48	63	36	35	0	787
Wettzell (TIGO)	7594	0	0	0	0	0	0	0	0
Wuhan	7231	41	77	6	16	2	1	0	143
Yarragadee	7090	614	526	203	237	159	158	0	1,897
Zimmerwald	7810	331	201	11	14	8	0	0	565
<b>Totals:</b>		6,536	5,791	865	952	552	502	885	16,083

Table 8.5-3 GLONASS Satellites

Site Name	Station	GL-66	GL-71	GL-72	GL-75	GL-76	GL-77	GL-78	GL-79	GL-80	GL-81	GL-82	GL-84	Total	Grand
Ajaccio (FTLRS)	7848	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arequipa	7403	0	0	0	0	0	0	0	0	0	0	0	0	0	1,691
Beijing	7249	0	0	18	5	5	0	8	13	14	1	4	0	68	1,415
Beijing (TROS)	7343	0	0	10	7	2	3	4	0	0	0	0	0	26	336
Borowiec	7811	0	0	1	0	0	0	5	17	9	0	0	0	32	804
Cagliari	7548	0	0	0	0	0	0	0	0	0	0	0	0	0	79
Changchun	7237	0	0	49	0	0	0	24	48	49	0	0	0	170	2,436
Grasse	7835	0	0	4	0	0	0	4	9	17	0	0	0	34	3,763
Grasse	7845	0	0	69	0	0	0	46	84	107	0	0	0	306	1,697
Graz	7839	30	0	33	49	60	66	77	44	64	52	59	0	534	3,887
Greenbelt (MOB-7)	7105	0	0	60	0	0	0	86	64	174	0	0	0	384	4,798
Haleakala	7210	0	0	0	0	0	0	13	0	1	0	0	0	14	229
Hartebeestoeck	7501	0	0	0	0	0	0	31	0	15	0	0	0	46	388
Helwan	7831	0	0	0	0	0	0	0	0	0	0	0	0	0	426
Herstmonceux	7840	0	0	81	0	0	0	49	46	81	0	0	0	257	3,978
Kashima	7335	0	0	22	0	0	0	0	4	10	0	7	0	43	927
Katzively	1893	0	1	2	0	0	0	0	8	3	0	0	0	14	207
Kiev	1824	0	0	0	0	0	0	0	0	0	0	0	0	0	277
Koganei	7328	0	0	21	0	0	0	0	8	13	1	0	0	43	736
Komsomolsk	1868	0	0	3	0	0	0	0	7	9	0	0	0	19	208
Kunming	7820	0	0	16	0	0	0	11	4	0	0	0	0	31	967
Maidanak	1864	0	0	9	0	0	0	1	22	27	0	0	0	59	592
Matera	7939	0	0	0	0	0	0	0	0	0	0	0	0	0	642
Matera (MLRO)	7941	0	0	0	0	0	0	0	0	0	0	0	0	0	0
McDonald	7080	0	0	43	0	0	0	75	40	115	0	0	0	273	3,284
Mendeleevo	1870	0	0	0	0	0	0	0	0	0	0	0	0	0	183
Metsahovi	7806	0	0	0	0	0	0	3	2	4	0	0	0	9	537
Miura	7337	0	0	16	0	0	0	0	9	9	0	0	0	34	566
Monument Peak	7110	0	0	104	0	0	0	126	216	251	0	0	1	698	5,976
Mount Stromlo	7849	0	0	118	0	0	0	122	153	245	0	0	0	638	6,425
Potsdam	7836	0	0	6	0	0	0	12	9	17	0	0	0	44	1,627
Riga	1884	0	0	0	0	0	0	0	0	0	0	0	0	0	1,031
Riyadh	7832	0	0	0	0	0	0	0	0	0	0	0	0	0	23
San Fernando	7824	0	0	0	0	0	0	0	0	0	0	0	0	0	3,374
Santiago De Cuba	1953	0	0	0	0	0	0	0	0	0	0	0	0	0	10
Sarapul	1871	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shanghai	7837	22	0	29	29	20	28	0	31	30	30	35	0	254	1,405
Simeiz	1873	0	0	0	0	0	0	4	0	0	0	0	0	4	130
Simosato	7838	0	0	10	0	0	0	11	22	20	0	0	0	63	1,884
Tahiti	7124	0	0	0	0	0	0	0	0	0	0	0	0	0	1,090
Tateyama	7339	0	0	22	0	0	0	0	20	23	0	7	0	72	1,208
Tokyo	7308	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wetzell	8834	0	0	65	0	0	0	47	73	102	0	0	0	287	2,306
Wetzell (TIGO)	7594	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wuhan	7231	12	0	24	14	13	12	17	17	0	0	0	0	109	735
Yarragadee	7090	0	0	227	0	0	0	148	246	399	0	0	1	1,021	6,420
Zimmerwald	7810	0	0	24	0	0	0	18	32	55	0	0	0	129	2,701
<b>Totals:</b>	<b>47 sta.</b>	64	1	1,086	104	100	109	942	1,248	1,863	84	112	2	5,715	71,398

## 8.6 ILRS Components

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### ILRS Central Bureau

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NASA Goddard Space Flight Center (GSFC), USA

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### Global Data Centers

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Crustal Dynamics Data Information System (CDDIS), NASA GSFC, USA

EUROLAS Data Center (EDC), Deutsches Geodätisches ForschungsInstitut (DGFI), Germany

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### Regional Data Centers

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Shanghai Observatory, Academia Sinica, China

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### Operations Center

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Russian Mission Control Center (MCC), Russia

University of Texas at Austin, Center for Space Research (CSR), USA

NASA Goddard Space Flight Center (NASA GSFC), USA

University of Texas at Austin, USA

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### Analysis Centers

---

Delft University of Technology (DUT), The Netherlands

Russian Mission Control Center (MCC), Russia

University of Texas at Austin, Center for Space Research (CSR), USA

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### Lunar Analysis Centers

---

Observatoire de Paris, France

Forschungseinrichtung Satellitengeodäsie (FESG), Germany

Jet Propulsion Laboratory (JPL), USA

University of Texas at Austin, USA

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### Associate Analysis Centers

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Austrian Academy of Sciences, Austria

Australian Surveying and Land Information Group (AUSLIG), Australia

Academia Sinica, China

Observatoire de la Côte d'Azur/Centre d'Etudes et de Recherches Géodynamiques et  
Astrométrie (OCA/CERGA), France

Bundesamt für Kartographie und Geodäsie (BKG), Germany

Deutsches Geodätisches ForschungsInstitut (DGFI), Germany

European Space Agency/ESA Space Operations Center (ESA/ESOC), Germany

GeoForschungsZentrum, Germany

Agenzia Spaziale Italiana/Centro de Geodesia Spaziale (ASI/CGS), Italy

Forsvarets ForskningsInstitut (Norwegian Defence Research Establishment), Finland

Institute of Applied Astronomy, Russia

Institute of Astronomy of the Russian Academy of Sciences, Russia

Institute of Metrology for Time and Space, Russia

Astronomical Institute, University of Berne (AIUB), Switzerland

Main Astronomical Observatory of the National Academy of Sciences of the Ukraine  
(GAOUA), Ukraine

Natural Environment Research Council, United Kingdom

University of Newcastle, United Kingdom

NASA Goddard Space Flight Center (GSFC), USA

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**Stations/Subnetworks**

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MOBLAS-5 (AUSLIG and NASA), Australia  
Mt. Stromlo (AUSLIG), Australia  
Graz (Austrian Academy of Sciences), Austria  
Beijing (Chinese Academy of Surveying and Mapping), China  
Changchun, Kunming, Shanghai (Chinese Academy of Sciences), China  
Wuhan and TROS (State Seismological Bureau), China  
Helwan Observatory, Egypt  
Metsahovi (Finnish Geodetic Institute), Finland  
FTLRS, Grasse LLR and SLR (GRGS/CNES), France  
MTLRS-1, TIGO-SLR, WLRS (BKG), Germany  
Potsdam (GFZ), Germany  
MLRO and SAO-1 Matera (ASI/CGS), Italy  
Astronomical Observatory of Cagliari, Italy  
KEYSTONE (CRL), Japan  
Simosato (JHD), Japan  
Riga (Astronomical Institute of University of Latvia), Latvia  
MTLRS-2 (DUT), The Netherlands  
TLRS-3 (NASA), Peru  
Borowiec (Space Research Centre of PAS), Poland  
Mendeleev (IMVP VNIIFTRI), Russia  
Komsomolsk (RSA and SRI for Precision Instrument Engineering), Russia  
SALRO (KACST), Saudi Arabia  
MOBLAS-6 (NASA and HartRAO), South Africa  
San Fernando (Real Instituto y Observatorio de la Armada), Spain  
Zimmerwald (AIUB), Switzerland  
Katzively (RSA and SRI for Precision Instrument Engineering), Ukraine  
Kiev (GAOUA), Ukraine  
Simeiz, Ukraine  
Herstmonceux (NERC), United Kingdom  
MOBLAS-8 (NASA and UPF), French Polynesia  
MOBLAS-4, -6, -7, TLRS-4, HOLLAS, MLRS (NASA), USA  
Maidanak (RSA and SRI for Precision Instrument Engineering), Uzbekistan

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Austrian Academy of Sciences	Austria
Academia Sinica	China
Chinese Academy of Surveying and Mapping	China
State Seismological Bureau	China
Yunnan Observatory	China
Technical University of Prague	Czech Republic
National Research Institute of Astronomy and Geophysic (NRIAG)	Egypt
Finnish Geodetic Institute	Finland
Observatoire de la Côte d'Azur/Centre d'Etudes et de Recherches Géodynamiques et Astrométrie (OCA/CERGA)	France
Observatoire de Paris	France
Bundesamt für Kartographie und Geodäsie (BKG)	Germany
Deutsches Geodätisches Forschungsinstitut (DGFI)	Germany
European Space Agency (ESA)	Germany
Forschungseinrichtung Satellitengeodäsie (FESG), Technical University of Munich	Germany
GeoForschungsZentrum (GFZ)	Germany
Astronomical Observatory of Cagliari	Italy
Italian Space Agency (ASI)	Italy
Communications Research Laboratory (CRL)	Japan
Japanese Hydrographic Department (JHD)	Japan
Astronomical Observatory, University of Latvia	Latvia
Division for Electronics, Forsvarets Forskningsinstitutt (FFI)	Norway
Space Research Centre of the Polish Academy of Sciences (PAS)	Poland
Institute of Applied Astronomy (IAA)	Russia
Institute of Astronomy of the Russian Academy of Sciences (INASAN)	Russia
Institute of Metrology for Time and Space (IMVP)	Russia
Mission Control Centre (MCC)	Russia
Russian Space Agency (RSA)	Russia
Space Research Institute (SRI) for Precision Instrument Engineering	Russia
King Abdulaziz City for Science and Technology (KACST)	Saudi Arabia
Real Instituto y Observatorio de la Armada	Spain
Astronomical Institute, University of Berne (AIUB)	Switzerland
Delft University of Technology (DUT)	The Netherlands
Crimean Astronomical Observatory	Ukraine
Lebedev Physical Institute in the Crimea	Ukraine
Main Astronomical Observatory (MAO) of the National Academy of Sciences of Ukraine	Ukraine
Natural Environment Research Council (NERC)	United Kingdom
University of Newcastle Upon Tyne	United Kingdom
Jet Propulsion Laboratory (JPL)	USA
National Aeronautics and Space Administration Goddard Space Flight Center (NASA GSFC)	USA
University of Hawaii	USA
University of Texas at Austin	USA
University of Texas, Center for Space Research (CSR)	USA



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## 8.9 List of Acronyms

AAC	Associate Analysis Center
AC	Analysis Center
ACT	Australian Capital Territory
ADEOS	Advanced Earth Observing Satellite
AFSPC	Air Force Space Command (USA)
AGU	American Geophysical Union
AIUB	Astronomical Institute of Berne (Switzerland)
ALOS	Advanced Land Observing Satellite
AMU	Amplitude Measuring Unit
APD	Avalanche Photo Diode
APRGP	Asia-Pacific Regional Geodetic Project
APSG	Asia-Pacific Space Geodynamics Project
ASCII	American Standard Code for Information Interchange
ASI	Agenzia Spaziale Italiana (Italian Space Agency)
AUSLIG	Australian Surveying and Land Information Group
AVN	Allgemeine Vermessungs-Nachrichten (Germany)
AWG	Analysis Working Group
Az/El	Azimuth/Elevation
BE-C	Beacon Explorer C
BKG	Bundesamt für Kartographie und Geodäsie (Germany)
CAL/VAL	Calibration/Validation
CB	Central Bureau
CCD	Charged Coupled Device
CDDIS	Crustal Dynamics Data Information System (USA)
CDP	Crustal Dynamics Project
CERGA	Centre d'Etudes et de Recherches Géodynamiques et Astrométrie (France)
CF	Constant Fraction
CfA	Center for Astrophysics (USA)
CGS	Centro de Geodesia Spaziale (Italy)
CHAMP	CHALLENGING Mini-Satellite Payload
CIS	Conventional Inertial System
CNES	Centre National d'Etudes Spatiales (France)
CNS	Communication, Navigation, Surveillance (USA)
CODE	Center for Orbit Determination in Europe
COM	Center Of Mass
COSPAR	Committee on Space Research
CPU	Central Processing Unit
CRL	Communications Research Laboratory (Japan)
C-SPAD	Compensated Single Photoelectron Avalanche Detector
CSR	Center for Space Research (USA)
CSRIFS	Combined Square Root Information Filter and Smoother
CSTG	International Coordination of Space Techniques for Geodesy and Geodynamics
DANOF	Department of Fundamental Astronomy of the Paris Observatory (France)

DEC	Digital Equipment Corporation
DEOS	Delft Institute for Earth-Oriented Space Research (The Netherlands)
DFPWG	Data Formats and Procedures Working Group
DGFI	Deutsches Geodätisches Forschungs Institut (Germany)
DOD	Department of Defense (USA)
DOGS	DGFI Orbit and Geodetic Parameter Estimation System (Germany)
DOMES	Directory Of MERIT Sites
DORIS	Doppler Orbitography and Radiopositioning Integrated by Satellite
DUT	Delft University of Technology (The Netherlands)
DXO	Dual Crossover
EDC	EUROLAS Data Center (Germany)
EGS	European Geophysical Society
ELV	Expendable Launch Vehicle
ENVISAT	ENVironmental SATellite
EOP	Earth Orientation Parameter
EOS	Electro Optical Systems (Australia)
ERS	European Remote Sensing Satellite
ESA	European Space Agency
ESE	Earth Science Enterprise (USA)
ESOC	ESA Space Operations Center (Germany)
ETS	Engineering Test Satellite
EUROLAS	European Laser Consortium
FAA	Federal Aviation Administration (USA)
FAQ	Frequently Asked Question
FDR	Foundation for Research Development (South Africa)
FESG	Forschungseinrichtung Satellitengeodäsie (Research Facility for Space Geodesy, Germany)
FFI	Forsvarets ForskningsInstitut (Norwegian Defense Research Establishment)
FGAN	Forschungsgesellschaft für Angewandte Naturwissenschaften (Germany)
FR	Full Rate
FTLRS	French Transportable Laser Ranging System
FTP	File Transfer Protocol
GAOUA	Main Astronomical Observatory of the National Academy of Sciences of Ukraine
GB	Gigabyte
GB	Governing Board
GeoDAF	Geodetical Data Archive Facility (Italy)
GeodIS	Geodetic Information System (Germany)
GEOS	Geodetic and Earth Orbiting Satellite
GEOSAT	Geodesy Satellite
GFO	GEOSAT Follow-On (USA)
GFZ	GeoForschungsZentrum (Germany)
GGAO	Goddard Geophysical and Astronomical Observatory (USA)
GIS	Geographic Information System
GLAS	Geoscience Laser Altimeter System
GLONASS	Global Navigation Satellite System
GLONASS	Global'naya Navigatsionnaya Sputnikovaya Sistema



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GM	Gravity Model
GNP	Generic Normal Point Processing
GOCE	Gravity Field and Steady-state Ocean Circulation Explorer
GP-B	Gravity Probe B
GRL	Geophysical Research Letters
GPS	Global Positioning System
GRACE	Gravity Recovery And Climate Experiment
GRGS	Groupe de Recherches de Géodésie Spatiale (France)
GSFC	Goddard Space Flight Center (USA)
H2A/LRE	Laser Ranging Experiment
HARTRAO	Hartebeesthoek Radio Astronomy Observatory (South Africa)
HOLLAS	Haleakala Laser Station (USA)
HQ	Headquarters
HTSI	Honeywell Technology Solutions, Inc. (USA)
H/W	Hardware
IA/RAS	Institute of Astronomy/Russian Academy of Sciences
IAA	Institute of Applied Astronomy, Russia
IAG	International Association of Geodesy
IAPG	Institut für Astronomische und Physikalische Geodäsie (Germany)
IAU	International Astronomical Union
ICESat	Ice Cloud and Land Elevation Satellite
ICRF	International Celestial Reference Frame
ICRS	International Celestial Reference System
IERS	International Earth Rotation Service
IGEX	International GLONASS Experiment
IGLOS-PP	International GLONASS Service Pilot Project
IGN	Institut Geographique National (France)
IGS	International GPS Service for Geodynamics
ILRS	International Laser Ranging Service
IMVP	Institute of Metrology for Time and Space (Russia)
INASAN	Institute of Astronomy of the Russian Academy of Sciences
IRV	Inter-Range Vector
ISRO	Indian Space Research Organization
ISTRAC	ISRO Telemetry Tracking and Command Network (India)
ITRF	International Terrestrial Reference Frame
ITRS	International Terrestrial Reference System
ITSS	Raytheon Information Technology and Scientific Services (USA)
IUGG	International Union of Geodesy and Geophysics
IVS	International VLBI Service for Geodesy and Astrometry
JCET	Joint Center for Earth Systems Technology (USA)
JGM	Joint Gravity Model
JGR	Journal of Geophysical Research
JHD	Japanese Hydrographic Department
JPL	Jet Propulsion Laboratory (USA)
KACST	King Abdulaziz City for Science and Technology (Saudi Arabia)

LAGEOS	LASer GEOdynamics Satellite
LAN	Local Area Network
LEO	Low Earth Orbit
LIDAR	Light Detection and Ranging
LLR	Lunar Laser Ranging
LOD	Length Of Day
LRA	Laser Retroreflector Array
LRE	Laser Retroreflector Experiment
L+T	Swiss Federal Office of Topography
LURE	LUNar Ranging Experiment
MAO	Main Astronomical Observatory (Ukraine)
MCC	Mission Control Center (Russia)
MCEP	Mean Celestial Ephemeris Pole
MCP	Micro Channel Plate
MEDLAS	Mediterranean Laser Campaign
MEO	Medium Earth Orbit
MERIT	Monitoring of Earth Rotation and Intercomparison of Techniques
MIT	Massachusetts Institute of Technology (USA)
MLRO	Matera Laser Ranging Observatory (Italy)
MLRS	McDonald Laser Ranging System (USA)
MOBLAS	MOBile LASer Ranging Systemv
MOM	Mobile Optical Mount
MTLRS	Modular Transportable Laser Ranging System
MWG	Missions Working Group
NAPEOS	Navigation Package for Earth Observation Satellites
NASA	National Aeronautics and Space Administration (USA)
NASDA	National Space Development Agency (Japan)
NCL	University of Newcastle Upon Tyne (United Kingdom)
NERC	Natural Environment Research Council (United Kingdom)
NEWG	Networks and Engineering Working Group
Nd: YAG	Neodymium Yttrium Aluminum Garnet
NIMA	National Imagery and Mapping Agency (USA)
NMF	Niell Mapping Function
NNG	Near Earth Navigation and Geodesy
NP	Normal Point
NRIAG	National Research Institute of Astronomy and Geophysics (Egypt)
NRL	Naval Research Laboratory (USA)
NW&E	Networks and Engineering Working Group
OCA	Observatoire de la Côte d'Azur (France)
OD	Orbit Determination
PAS	Polish Academy of Sciences
P-PET	Portable Pico Event Timer
PC	Personal Computer
PCGIAP	Permanent Committee for GIS Infrastructure for Asia and the Pacific

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PDF	Portable Document Format
PM	Polar Motion
PMT	Photo Multiplier Tube
PM/UT	Polar Motion/Universal Time
POD	Precise Orbit Determination
POLAC	Paris Observatory Lunar Analysis Center (France)
PRARE	Precise Range and Range-rate Equipment
PRC	People's Republic of China
PRN	Pseudo Random Noise
QC	Quality Control
QL	Quick-Look
QLDAC	Quick-Look Data Analysis Center (The Netherlands)
R&D	Research and Development
RAM	Random Access Memory
RITSS	Raytheon Information Technology and Scientific Services (USA)
RMS	Root Mean Square
RRA	RetroReflector Array
RSA	Russian Space Agency
RSG	Refraction Study Group
SALRO	Saudi Arabian Laser Ranging Observatory (Saudi Arabia)
SAO	Smithsonian Astrophysical Observatory (USA)
SAR	Synthetic Aperture Radar
SC	Station Coordinates
SENH	Solid Earth and Natural Hazards
SETIC	Selective Time-Interval Counter
SG	Study Group
SINEX	Software Independent Exchange Format
SLR	Satellite Laser Ranging
SNR	Signal to Noise Ratio
SOD	Site Occupation Designator
SP	Signal Processing
SPAD	Single Photoelectron Avalanche Detector
SPIE	International Society for Optical Engineering
SPWG	Signal Processing Working Group
SRI	Space Research Institute (Russia)
SRIF	Square Root Information Array
SRS	Stanford Research Systems
SSC	Set of Station Coordinates
SSV	Set of Station Velocities
STARSHINE	Student Tracked Atmospheric Research Satellite for Heuristic International Networking Experiment
SUNSAT	Stellenbosch UNiversity SATellite (South Africa)
SV	Station Velocities
S/W	Software
SXO	Single Crossover

TAI	International Atomic Time
TB	TerraByte
TBF	Time Bias Function
TCP/IP	Transmission Control Protocol/INTERnet Protocol
TIGO	Transportable Integrated Geodetic Observatory
TIRV	Tuned Inter-Range Vector
TLRS	Transportable Laser Ranging System
TOPEX	Ocean TOPography Experiment
TP	Technical Publication
T/P	TOPEX/Poseidon
TRANET	TRAnsit NETwork
TRF	Terrestrial Reference Frame
TROS	TRansportable Observation Station
TROS	Transportable Range Observation System
TUM	Technical University of Munich (Germany)
UK	United Kingdom
UMBC	University of Maryland Baltimore County (USA)
UPF	Université de la Polynésie Française (French Polynesia)
UPS	Uninterruptible Power Supply
URL	Uniform Resource Locator
US	United States
USA	United States of America
USNO	United States Naval Observatory
UT	Universal Time
UT	University of Texas (USA)
UTC	Universal Coordinated Time
UTOPIA	University of Texas Orbit Processor (USA)
UTX	University of Texas (USA)
UTXM	University of Texas McDonald Observatory Lunar Analysis Center (USA)
VCL	Vegetation Canopy Lidar
VLBI	Very Long Baseline Interferometry
VNIIFTRI	All-Russian Scientific Research Institute for Physical-Technical and Radiotechnical Measurements (Russia)
VOL	Variation Of Latitude
WEGENER	Working Group of European Geoscientists for the Establishment of Networks for Earthquake Research
WESTPAC	Western Pacific Laser Tracking Network Satellite
WG	Working Group
WLRS	Wetzell Laser Ranging System (Germany)
WPLTN	Western Pacific Laser Tracking Network
WWW	World Wide Web
Y2K	Year 2000