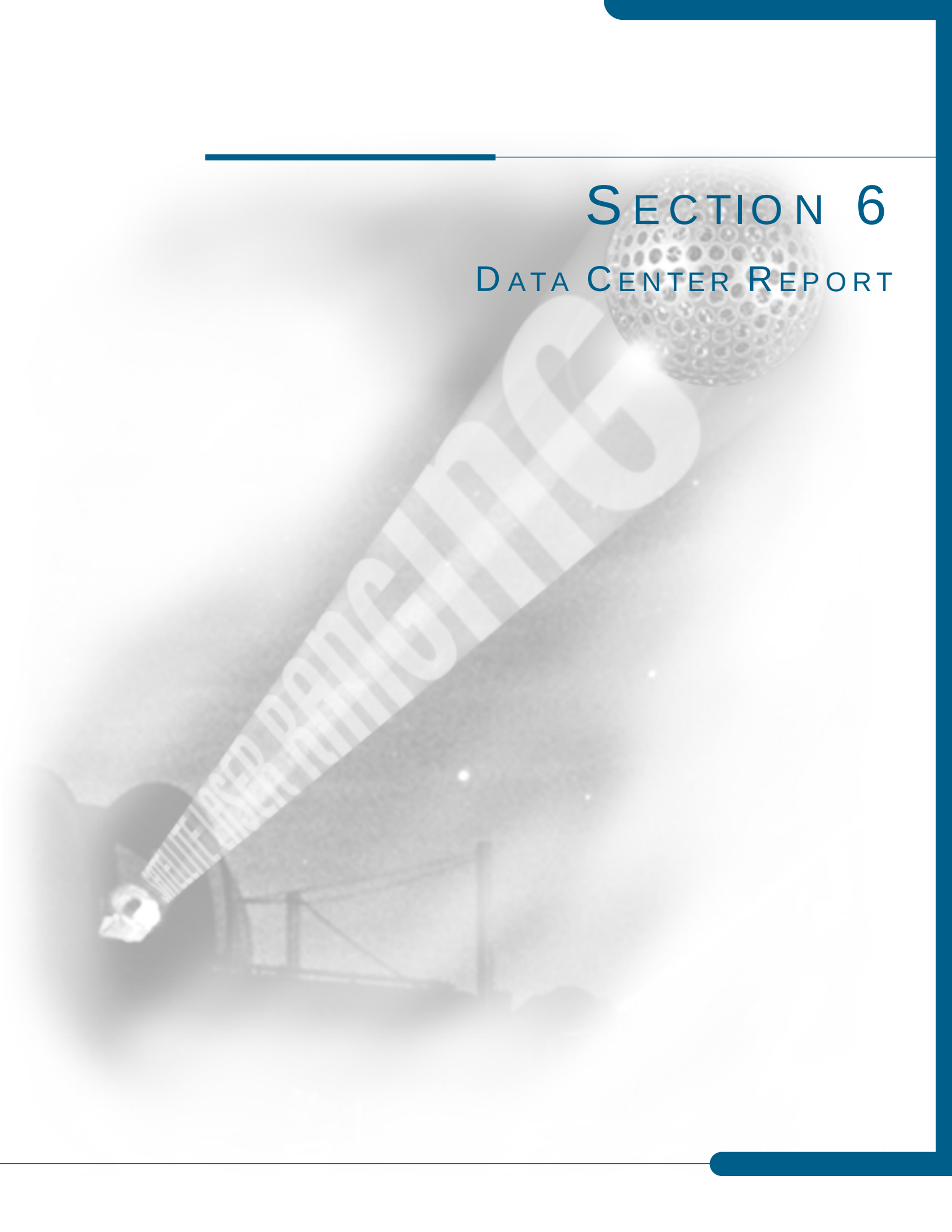
# SECTION 6

## DATA CENTER REPORT



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# SECTION 6 - DATA CENTER REPORTS

In late 1998, the International Laser Ranging Service began operations. Two global data centers and one regional data center currently support the service. Global data centers archive data from the entire ILRS network and provide access to these holdings to the general user community. Furthermore, global data centers archive products derived from the ILRS data as well as any ancillary information, such as site logs, coordinates and eccentricities, relevant electronic communications, and summaries of data holdings. Regional data centers archive data from a subset of the ILRS network; currently, the single ILRS data center at Shanghai is responsible for archiving data for the Asian region. The ILRS data centers and their main contact person are listed in Table 6-1. Operations centers are also listed here for completeness; further discussion on these centers can be found in the operations center section of this annual report.

| Data Center | Main Contact |
|---|---|
| ***Global Data Centers*** | |
| Crustal Dynamics Data Information System (CDDIS), USA | Carey Noll |
| EUROLAS Data Center (EDC), Germany | Wolfgang Seemueller |
| ***Regional Data Centers*** | |
| Shanghai Data Center, People's Republic of China | Tan Detong |
| ***Operations Centers*** | |
| NASA/Honeywell Technical Solutions, Inc. (HTSI), USA | David Carter |
| Mission Control Center (MCC), Russian Space Agency, Russia | Vladimir Glotov |
| Center for Space Research (CSR), University of Texas at Austin, USA | Richard Eanes |
| McDonald Observatory, University of Texas at Austin, USA | Peter Shelus |

***Table 6-1. Data Centers Supporting the ILRS***

The ILRS utilized previously developed data flow paths to provide laser ranging data (both to orbiting satellites and the moon) to the user community. This data flow is show in Figure 6-1. Table 6-2 lists the laser stations by network and operations/data center; this table illustrates which of the operations or data centers, Honeywell Technical Services, Inc. (HTSI) or the EUROLAS Data Center (EDC), these stations transmit their data to. At a minimum, laser stations forward their data to operations/data centers on a daily basis where they are merged into files by day and satellite for transmission to the global data centers where they are archived. Currently, the two ILRS global data centers make their data holdings available in different directory and file structures as will be discussed in their individual reports. These centers exchange their recently received data at least once per day to ensure that their holdings are equalized and that users can continue to reliably access data should one center be unavailable.

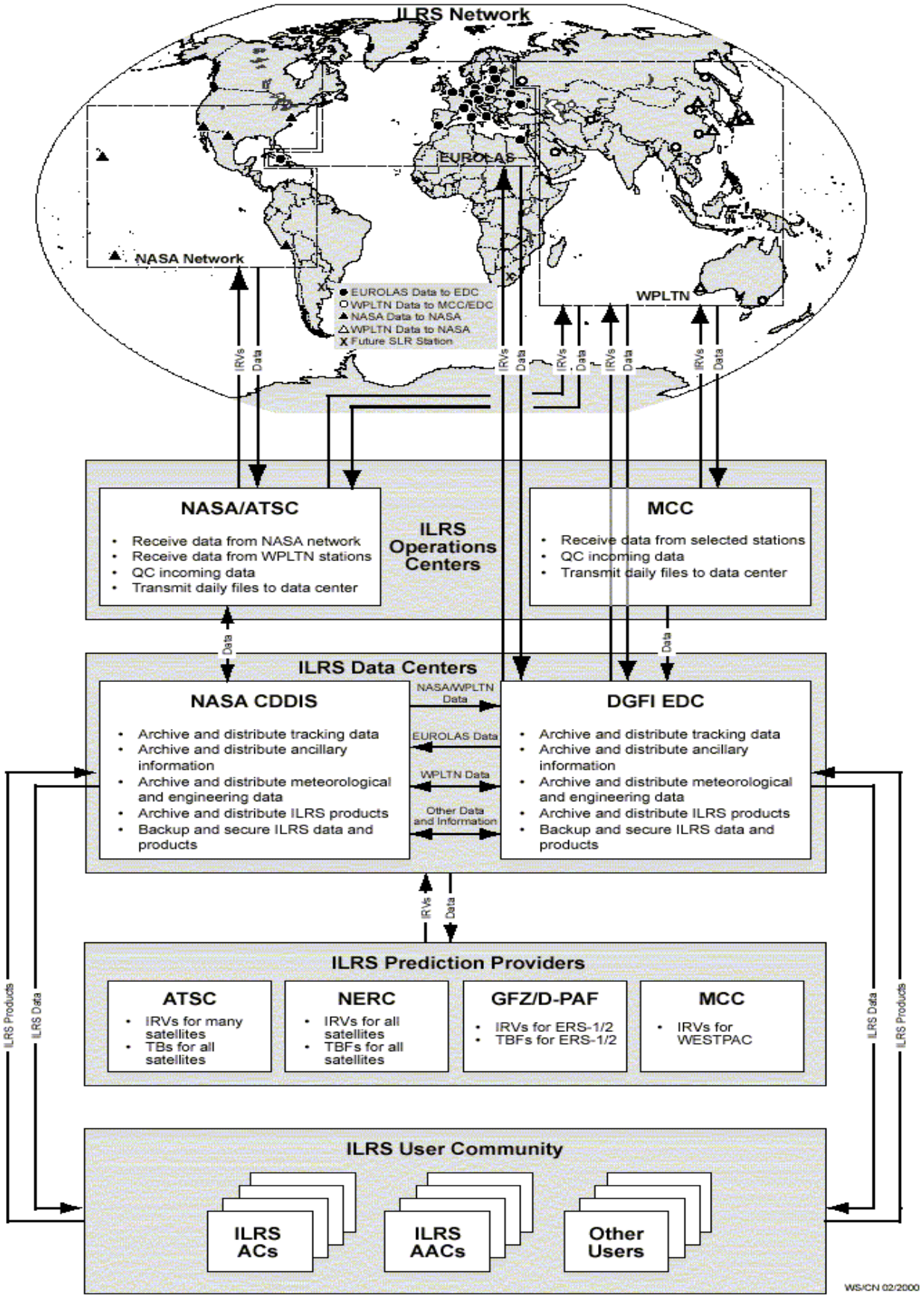


*Figure 6-1. ILRS Data Flow*

| | | |
|---|---|---|
| **NASA Stations** | | |
| *Greenbelt, MD, USA* | *Monument Peak, CA, USA* | *Arequipa, Peru* |
| *Haleakala, HI, USA* | *McDonald Obs., TX, USA* | *Tahiti, French Polynesia* |
| **WPLTN Stations** | | |
| *Kashima, Japan* | Beijing, China | Komsomolsk, Russia |
| *Koganei, Japan* | *Changchun, China* | Mendeleevo, Russia |
| *Miura, Japan* | Kunming, China | Sarapul, Russia |
| *Tateyama, Japan* | *Shanghai, China* | Maidenak, Uzbekistan |
| *Simosato, Japan* | Wuhan, China | Mt. Stromlo, Australia |
| Tokyo, Japan *† | Riyadh, Saudi Arabia † | *Yaragadee, Australia* |
| **EUROLAS Stations** | | |
| Potsdam, Germany | Herstmonceux, UK | Borowiec, Poland |
| Wettzell, Germany | San Fernando, Spain | Riga, Latvia |
| Grasse SLR, France | Matera, Italy | Katzively, Ukraine |
| Grasse LLR, France | Cagliari, Italy | Kiev, Ukraine † |
| Graz, Austria | Metsahovi, Finland | Simeiz, Ukraine † |
| Zimmerwald, Switzerland | Helwan, Egypt | Santiago de Cuba *† |

*Notes:* * indicates cooperating SLR station providing data but not part of ILRS
† indicates SLR station not providing data during 1999
SLR stations in *italics* flow data to HTSI; others flow data to EDC

***Table 6-2. ILRS Stations by Network and Operations/Data Center***

In 1999, over 70,000 passes were recorded by a network of 39 SLR systems. All laser ranging data were made available through the ILRS global data centers, the principle source of data for the user community.

Several current and future SLR missions require data more frequently than once per day in order to update their precise orbit information. Therefore, in 2000, the ILRS will develop data flow, file naming, and other requirements of the infrastructure to permit rapid availability of SLR data and satellite predictions to the user community. Furthermore, operations centers and satellite orbit prediction providers will begin daily generation of satellite prediction files in the tuned IRV format.

# 6.1 GLOBAL DATA CENTERS

## 6.1.1 CDDIS REPORT

Carey Noll, *Crustal Dynamics Data Information System*

### *INTRODUCTION*

The Crustal Dynamics Data Information System (CDDIS) has supported the archive and distribution of laser ranging data (both lunar and satellite) since its inception in 1982. This report summarizes the current and future plans of the CDDIS with respect to the International Laser Ranging Service (ILRS). Included here is background information about the CDDIS, its computer architecture, staffing, and archive contents, as well as future plans for the system within the ILRS.

### *BACKGROUND*

The CDDIS has been operational since September 1982, serving the international space geodesy and geodynamics community. This data archive was initially conceived to support NASA's Crustal Dynamics Project. Since the end of this successful program in 1991, the CDDIS has continued to support the science community through NASA's Space Geodesy Program (SGP) and the Solid Earth and Natural Hazards (SENH) activity. The main objectives of the CDDIS are to store all geodetic data products acquired by NASA programs in a central data bank, to maintain information about the archival of these data, and to disseminate these data and information in a timely manner to authorized investigators and cooperating institutions. Furthermore, science support groups analyzing these data submit their resulting data sets to the CDDIS on a regular basis. Thus, the CDDIS is a central facility providing users access to raw and analyzed data to facilitate scientific investigation. A large portion of the CDDIS holdings of GPS, GLONASS, laser ranging, VLBI, and DORIS data are stored on-line for remote access. Information about the system is available via the WWW at the URL:

http://cddisa.gsfc.nasa.gov/cddis_welcome.html

The CDDIS successfully responded to the 1998 Call for Participation in the International Laser Ranging Service (ILRS). This response stated that the CDDIS would support data center activities by providing access to an archive of laser ranging data, both to orbiting satellites (SLR) and to the moon (LLR). This archive consists of data (SLR on-site normal points, SLR full-rate, and LLR normal points), information about these data, and products derived from these data.

### *SYSTEM DESCRIPTION*

The CDDIS archive of laser ranging data and products are accessible to the public via anonymous ftp and the WWW at

ftp://cddisa.gsfc.nasa.gov/pub/slr and

ftp://cddisa.gsfc.nasa.gov/pub /reports

## COMPUTER ARCHITECTURE

The CDDIS is operational on a dedicated Compaq/Digital Equipment Corporation (DEC) AlphaServer 4000 running the UNIX operating system. This facility currently has over 300 Gbytes of on-line magnetic disk storage; approximately twenty Gbytes will be devoted to laser ranging activities. The CDDIS is located at NASA's Goddard Space Flight Center (GSFC) in Greenbelt Maryland and is accessible to users 24 hours per day, seven days per week.

## STAFFING

Currently, a staff consisting of one NASA civil service employee and three contractor employees with Raytheon Information Technology and Scientific Services (RITSS) supports all CDDIS activities:

- Ms. Carey Noll, CDDIS Manager
- Dr. Maurice Dube, Head, CDDIS contractor staff and senior programmer
- Ms. Ruth Kennard, request coordinator
- Ms. Laurie Batchelor, data technician

## ARCHIVE CONTENT

### *SLR Data*

The CDDIS receives on-site normal point data on a daily basis from two sources: the NASA operations center managed by Honeywell Technical Services, Inc. (HTSI) and the EUROLAS data center (EDC) at the Deutsches Geodätisches ForschungsInstitut (DGFI) in Munich, Germany. Both sources deposit their data files to their individual user accounts on the CDDIS computer. EDC deposits a single file containing all data from all satellites tracked by over twenty stations in EUROLAS and the WPLTN and transmitted to their data center in the last 24-hour period. HTSI receives data from the seven NASA and NASA-partnership stations as well as seven other global stations each day. HTSI also retrieves the single file deposited by EDC at the CDDIS. The data from these two sources are then merged and compiled into several daily files, one containing data received at HTSI in the last 24 hours, one containing these data as well as data sent by EDC, and individual files by satellite, each also containing all data received in the last 24 hours. These three types of files containing normal point data are then transmitted to the CDDIS and are available to the user community. The data are in the ILRS normal point format and stored in uncompressed ASCII files.

The CDDIS staff has created automated routines that peruse the accounts of the two sources of laser data and copy new files to the public disk areas. The content and structure of the ILRS global data center at the CDDIS is shown in Table 6.1.1-1 below. Data are archived in daily files where each file contains all data received at the operations and other global data centers within the last 24 hour period. Thus, a daily file could contain data recorded any time 24 hours prior to the date. Typically, the file contains data from the previous one to two days. However, at times laser stations transmit data several days or weeks old that have been corrected or recently checked for quality. Since the date in the file name does not reflect the date of the data itself, the CDDIS staff create merged, time-sorted files containing a month of data. These files are stored in the satellite-specific subdirectories by year and are created about thirty days after the end of the month. This delay ensures that nearly all of the month's data is captured.

| Directory | File Name | Description |
|---|---|---|
| **Data Directories** | | |
| slr/slrql/allsat/*yyyy* | all_ql*yymmdd*.all | SLR on-site normal point data files for all satellites and stations, year *yyyy* or *yy,* month *mm,* and day *dd* |
| | nasa_ql*yymmdd*.dat | SLR on-site normal point data files for all satellites and NASA stations only, year *yyyy* or *yy,* month *mm,* and day *dd* |
| | ql_allsat_*yymmdd* | SLR on-site normal point data files for all satellites and EDC stations only, year *yyyy* or *yy,* month *mm,* and day *dd* |
| slr/slrql/*satname*/*yyyy* | new_ql*yymmdd.sat* | SLR on-site normal point data files for satellite *satname* or *sat*, year *yyyy* or *yy,* month *mm,* and day *dd* |
| slr/slrfr/*satname*/*yyyy* | *satname_ver.yymm*.Z | Monthly SLR full-rate data files for satellite *satname* and year *yyyy* or *yy,* month *mm,* and version *ver* |
| slr/slrfr/*satname*/*yyyy*/daily/*ssss* | *ssss_yymmdd_ver.satname*.Z | Daily SLR full-rate data files for satellite *satname*, year *yyyy* and station *ssss* or *yy,* month *mm,* day *dd*,, and version *ver* |
| slr/slrnpt/*satname*/*yyyy* | *satname_ver.yymm*.Z | Monthly SLR normal point data files derived from full-rate data for satellite *satname* and year *yyyy* or *yy,* month *mm,* and version *ver* |
| slr/llrnpt/*yyyy* | llr_npt.*yymm*.Z | Monthly LLR normal point data files for year *yyyy* or *yy,* and month *mm* |
| **Other Directories** | | |
| pub/reports/slrweek/*yyyy* | slrql_week.*sdate_edate*<br>slrql_week.*yymm* | Weekly SLR data reports for year *yyyy* or *yy* and start date *sdate* and end date *edate* or month *mm* |
| pub/predicts/*satname* | *satname*_ephemeris*no_ yymmdd.source* | Daily SLR satellite prediction files for the current year for satellite *satname* and source *source* |
| pub/predicts/*yyyy* | *satname*_ephemeris_*yyyy. source* | Yearly SLR satellite prediction files for year *yyyy* and source *source* |
| pub/reports/slrmail | slrmail.#### | SLRMail archive, message number #### |

***Table 6.1.1-1. CDDIS Directory Structure for ILRS Data and Information***

During 1999, all LLR stations began transmitting lunar laser data in the ILRS normal point format for inclusion in the data stream already established for SLR data. Therefore, lunar and satellite laser ranging data are available in the daily files discussed above.

In addition to normal point data, the CDDIS receives full-rate data from a subset of the global tracking network. Since full-rate data is a minimally supported product within the ILRS, many stations do not transmit these data. The NASA operations center transmits full-rate data from several stations to the CDDIS on a daily basis; these data are archived by satellite and station. If available, the CDDIS retrieves any full-rate data archived at EDC and creates merged files on a monthly basis for each satellite. At this time, the individual daily satellite files of full-rate data are removed from the public archive.

### *SLR Products*

During 1999, the CDDIS archived SLR product files for an ILRS Analysis Working Group pilot project to compare individual analysis center solutions of station positions and Earth orientation parameters. These solutions were deposited to the CDDIS by the Analysis Centers and copied to public disk areas within the SLR data directories. This procedure will serve as a test for future routine submission of laser data solutions.

### *Supporting Information*

The CDDIS anonymous ftp archive and web site provides access to many types of ancillary data used with laser ranging data. This information includes site occupation histories, coordinates, and eccentricities, SLR satellite prediction and time bias files, format documents, SLR data reports (quantity and quality), and historic SLRMail messages. These files are updated as new information is received via e-mail, ftp, etc. from the global SLR community.

## *ILRS WEB SITE*

Since the ILRS Central Bureau and the CDDIS are both located within the Laboratory for Terrestrial Physics at NASA GSFC, the CDDIS computer facility hosts the ILRS web site. An alias for host *cddisa.gsfc.nasa.gov*, *ilrs.gsfc.nasa.gov*, was established for the ILRS web site. Thus, users can view the central ILRS web site at:

http://ilrs.gsfc.nasa.gov

More details on the web site can be found in the Central Bureau section of this annual report (see Section 2).

## *FUTURE PLANS*

The ILRS is looking to standardize the data products available through the global data centers. Therefore, the CDDIS, in conjunction with the EDC, will study ways to archive data in a common directory structure and file naming convention. This commonality will ensure a way for users to retrieve data from either data center with a minimal amount of change to existing data download scripts. In addition, some SLR missions will require a more frequent distribution of data since a daily update of the satellite orbit may not be sufficient. The CDDIS and EDC staff will study the impact of this requirement on the ILRS data flow and develop plans for handling these data, reducing the latency and increasing the frequency of data availability at their respective archives.

Various SLR missions now require satellite prediction information more often than the standard weekly product. Therefore, operations centers supporting the ILRS are planning to issue SLR satellite prediction files on a daily basis. The ILRS global data centers will make these files available and retain them for approximately one month. The daily files will then be merged into monthly prediction files and eventually yearly prediction files to reduce the number of individual files archived.

### *CONTACT INFORMATION*

To obtain more information about the CDDIS archive of ILRS data and products, contact:

Ms. Carey E. Noll
Manager, CDDIS
Code 920.1
NASA GSFC
Greenbelt, MD 20771
USA

Phone: (301) 614-6542
Fax: (301) 614-5970
E-mail: noll@cddis.gsfc.nasa.gov
WWW: http://cddisa.gsfc.nasa.gov/cddis_welcome.html

## 6.1.2 EDC REPORT

Wolfgang Seemueller, *Deutsches Geodatisches Forschungs Institut*

### *INTRODUCTION*

EDC was founded in August 1991 by an agreement between the Consortium of European Satellite Laser Ranging Stations and DGFI. In November 1998, the International Laser Ranging Service (ILRS) began operations, with all its permanent components. Two global ILRS data centers, CDDIS/NASA and EDC/DGFI, and one regional data center in Shanghai for the Asian region were established. Their functions are described in the terms of reference of the ILRS. In general, the global ILRS data centers are responsible for archiving and distributing laser observation data, ancillary data and all other relevant information, as well as ILRS products.

### *FUNCTIONS PROVIDED*

Functions provided are:

- automatic archive and distribution of recently-delivered data (at least once per day)
- providing the observation data to all users at a public ftp server
- running SLRMAIL, SLREPORT, and SLRTBF email exploders
- archiving and distribution of IRVs of all satellites
- automatic processing to archive and provide SLR station change and configuration log files
- mirror of the ILRS web pages at EDC
- providing web pages of EDC in the DGFI Information System GeodIS
- special services for data delivery on request

### *BACKGROUND*

In the late 1990's the European Satellite Laser Ranging stations had a great interest in the establishment of a data center for the EUROLAS network to take over the data archiving and distribution as well as the communication between the SLR stations and data/analysis centers. DGFI proposed to EUROLAS to operate the EUROLAS Data Center (EDC). Because of its demonstrated capabilities to collect and

disseminate large space geodetic data volumes (FR data) and to communicate via international communication links, the EDC at DGFI was accepted by EUROLAS in August 1991. An agreement specifies the arrangements agreed upon on the basis of which the EDC will be organized and operated. Figure 6.1.2-1 shows the EUROLAS SLR stations within the ILRS network.

Until recently, the on-site normal points from Western Pacific Laser Tracking Network (WPLTN) stations for the satellites ERS-1 and ERS-2 (and GFZ-1) operated by GFZ Potsdam were also sent to EDC. After the formation of the WPLTN, all stations were asked to send their data to the data center of their choice, but only to one. Therefore, the Russian stations operated by the Mission Control Center (MCC) in Moscow send their data to the EDC while other stations send their data to either the EDC or CDDIS (see data flow chart in the Data Center Reports Introduction, Section 6).

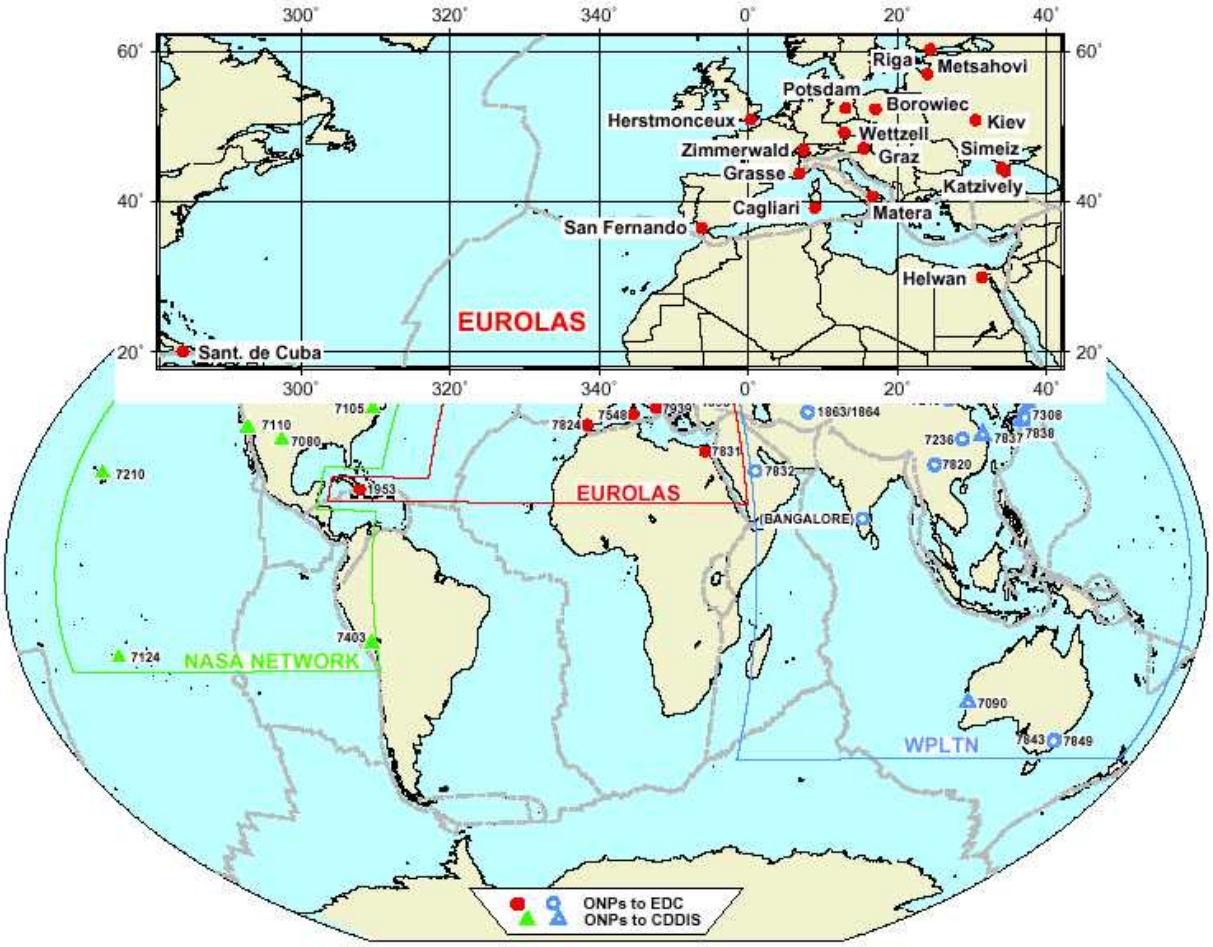


***Figure 6.1.2-1 EUROLAS Stations within the Global ILRS Network***

## *FACILITIES/SYSTEMS/CURRENT STATUS*

| | |
|---|---|
| Machine: | Pentium Pro 200, 128 Mbyte |
| Operating System: | LINUX |
| Storage space: | 10 GigaByte |
| Backup facilities: | IBM ADSTAR Distributed Storage Manager (1000 TerraByte) Mirror of the EDC machine to a second similar machine |

## ARCHIVE CONTENT

Laser observation data for all satellites, in the form of on-site normal points and older full-rate data, are available from the EDC ftp server (or alternatively through the EDC web pages). The table in Section 8.5 shows a report of the data holdings for the year 1999. The summaries per month for all satellites and all SLR stations are available at the EDC ftp server under pub/laser/messages/slreport.

## KEY POINTS OF CONTACT

| |
|---|
| ***Contact person for EDC:*** |
| Wolfgang Seemueller<br>DGFI<br>Marstallplatz 8<br>D-80539 Muenchen /Germany |
| ***Telephone:*** |
| +49/089/23031109 |
| ***Fax:*** |
| +49/089/23031240 |
| ***E-mail:*** |
| seemueller@dgfi.badw-muenchen.de<br>edc@dgfi.badw-muenchen.de<br>slrmail@dgfi.badw-muenchen.de<br>slreport@dgfi.badw-muenchen.de<br>slrtbf@dgfi.badw-muenchen.de |
| ***Web Page:*** |
| http://www.dgfi.badw-muenchen.de/edc/edc.html |
| ***FTP:*** |
| ftp.dgfi.badw-muenchen.de (anonymous) |
| ***ILRS Web Pages (mirror of ILRS Web pages at CDDIS):*** |
| http://www.dgfi.badw-muenchen.de/edc/ilrs/ilrs_home.html |

## FUTURE PLANS

At the ILRS General Meeting in Florence in September 1999 it was recommended to establish the same directory structure at both ILRS Global Data Centers CDDIS and EDC. Therefore the CDDIS and EDC should make arrangements to have the same tree structure at both sites, at least from a specified directory onward. It is also necessary to have a file naming convention inside this structure.

Upcoming Low Earth Orbiting (LEO) satellites will require the implementation of a faster data exchange procedure. The same constraint is valid for the distribution of the IRVs for these satellites.

## REFERENCES

For further information, readers are directed to the reports of the former CSTG SLR/LLR Subcommission Meeting Report and ILRS General Meeting Reports at the ILRS Web pages at:

http://ilrs.gsfc.nasa.gov/ilrs_reports.html and

http://ilrs.gsfc.nasa.gov/biblio.html

# 6.2 REGIONAL DATA CENTERS

## 6.2.1 SHANGHAI OBSERVATORY DATA CENTER REPORT

Zhang Zhongping, *Shanghai Regional Data Center*

### *BACKGROUND*

The Shanghai Regional Date Center (SRDC) was established in 1991 as an archive for the SLR data obtained by the Chinese SLR stations. It is located at the Center for Astro-Geodynamics Research, Shanghai Observatory, Chinese Academy of Sciences.

SLR full-rate data are available from Shanghai since 1983, Wuhan since 1985, and Changchun since 1987. Prior to August of 1995, the SLR full-rate data from the Chinese SLR stations were sent to the SRDC on floppy disks and were then mailed to the CDDIS or EDC on 1/2 inch tapes by the SRDC once per year. In 1996, the SRDC stopped mailing full-rate tapes to the CDDIS and EDC when the CSTG recommended the discontinuation of full-rate data archiving in favor of on-site normal points. The SRDC continues to archive the full-rate data from five Chinese stations, including Beijing since 1995 and Kunming since 1999.

### *FACILITIES/SYSTEMS*

- Computer: Sun Server 3002
- Operation System: Unix
- Storage space: 30 GB

### *CURRENT STATUS*

The Chinese stations mail their full-rate data to the SRDC once every three months. The SRDC stores these data in MERIT-II format on compact disks, which are openly available to the researchers. The summary of the data of the Chinese SLR stations can be found in Table 6.2.1-1 below and at the address:

http://center.shao.ac.cn/APSG/Newsletter/index.htm

### *KEY POINTS OF CONTACT*

Zhang Zhongping, Manager of SRDC

Tan Detong

Tang Wenfang

## *FUTURE PLANS*

The SRDC will be part of the Asia-Pacific Space Geodynamics (APSG) Data Center and will archive the data from all SLR stations in the APSG/WPLTN. The SLR data of the SRDC will be stored on-line for remote access.

| | SHANGHAI Pass/obs. | WUHAN Pass/obs. | CHANGCHUN Pass/obs. | BEIJING Pass/obs. | KUNMIN Pass/obs. | TOTAL Pass/obs. |
|---|---|---|---|---|---|---|
| 1983 | 8/97 | | | | | |
| 1984 | 43/707 | | | | | |
| 1985 | 2/225 | 15/1,252 | | | | |
| 1986 | 22/2,972 | | | | | |
| 1987 | 76/5,534 | | 3/178 | | | |
| 1988 | 82/6,800 | 10/1,731 | 12/968 | | | |
| 1989 | 119/7,281 | 50/7,254 | | | | 169/14,535 |
| 1990 | 436/ 143,127 | 121/37,814 | | | | 558/180,949 |
| 1991 | 403/90,782 | 140/28,194 | 49/7,628 | | | 591/126,612 |
| 1992 | 538/118,390 | 288/67,918 | 309/70,045 | | | 1,135/256,353 |
| 1993 | 408/94,841 | 187/50,035 | 745/167,229 | | | 1,340/312,105 |
| 1994 | 454/157,695 | 247/66,061 | 996/195,657 | 70/15,869 | | 1,767/435,281 |
| 1995 | 591/289,962 | 118/33,210 | 948/178,850 | 356/79,748 | | 2,013/581,770 |
| 1996 | 599/307,202 | 250/67,916 | 1,158/357,009 | 518/75,813 | | 2,525/807,940 |
| 1997 | 1,118/477,652 | 206/47,919 | 2,621/1,199,969 | 1,511/377,501 | | 5,453/2,103,426 |
| 1998 | 883/479,795 | 191/49,975 | 2,673/1,005,524 | 803/226,754 | | 4,550/1,762,048 |
| 1999 | 1,510/1,041,927 | 68/23,034 | 2,560/867,861 | 1,069/339,486 | 505/488,812 | 5,644/2,738,086 |

***Table 6.2.1-1. Summary of the Observations of Chinese SLR Network***