CDDIS 2001 Global Data Center Report

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1 Introduction

The Crustal Dynamics Data Information System (CDDIS) has supported the International GPS Service (IGS) as a global data center since 1992. The CDDIS activities within the IGS during 2001 are summarized below; this report also includes any changes or enhancements made to the CDDIS during the past year. General CDDIS background and system information can be found in the CDDIS data center summary included in the *IGS 1994 Annual Report* (Noll, 1995) as well as the subsequent updates (Noll, 1996, Noll, 1997, Noll, 1998, Noll, 1999, and Noll, 2001).

2 System Description

The CDDIS archive of IGS data and products are accessible worldwide through anonymous ftp. The CDDIS is located at NASA's Goddard Space Flight Center (GSFC) and is accessible to users 24 hours per day, seven days per week.

2.1 Computer Architecture

The CDDIS is operational on a dedicated UNIX server. All GPS data and product files are archived in a single filesystem, accessible through anonymous ftp, and are stored in UNIX compressed format. At present, nearly 100 Gbytes of on-line magnetic disk space is devoted to the storage of daily GPS tracking data and products. GPS data since 1997 and IGS products since 1992 are available on-line.

3 Archive Content

As a global data center for the IGS, the CDDIS is responsible for archiving and providing access to both GPS data from the global IGS network as well as the products derived from the analyses of these data.

3.1 GPS Tracking Data

The GPS user community has access to the on-line and near-line archive of GPS data available through the global archives of the IGS. Operational and regional data centers provide the interface to the network of GPS receivers for the IGS global data centers. Over twenty of these IGS data centers, shown in Table 1 make data available to the CDDIS from selected receivers on a daily (and sometimes hourly) basis. The CDDIS also accesses the archives of the other two IGS global data centers, Scripps Institution of Oceanography (SIO) in La Jolla California and the Institut Géographique National (IGN) in Paris France, to retrieve (or receive) data holdings not

routinely transmitted to the CDDIS by an operational or regional data center. Table 2 lists the data sources and their respective sites that were transferred daily to the CDDIS in 2001. Over 70K station days from 232 distinct GPS receivers were archived at the CDDIS during the past year; a complete list of these sites can be found at URL *ftp://cddisa.gsfc.nasa.gov/pub/reports/gpsdata/cddis_summary.2001*.

3.1.1 Daily GPS Data Files

Once the daily RINEX data files arrive at the CDDIS, these data are quality-checked, summarized, and archived to public disk areas in daily subdirectories; the summary and inventory information are also loaded into an on-line data base.

The CDDIS daily GPS tracking archive consists of observation (in both "compact" and compressed RINEX format), navigation, and meteorological data, all in compressed (UNIX compression) RINEX format. Furthermore, summaries of the observation files are generated by the UNAVCO quality-checking program TEQC (Estey 1999) and are used for data inventory and quality reporting purposes. During 2001, the CDDIS archived data on a daily basis from an average of 200 stations. In 2001, the CDDIS GPS data archive totaled over 50 Gbytes in volume; this figure represents data from nearly 62K observation days. Of the 170 or more sites archived each day at the CDDIS, not all are of "global" interest; some, such as those in Southern California, are regionally oriented. The CDDIS receives data from these sites as part of its NASA archiving responsibilities.

At this time, the CDDIS on-line archive of daily GPS data contains data from January 1997 through the present. Prior to mid-2001, these data are available in compact RINEX only; later data are archived in both compact RINEX and uncompacted RINEX formats. As the disks supporting this archive fill up, older uncompact RINEX observation data are deleted.

The majority of the data delivered to and archived in the CDDIS during 2001 was available to the user community within six hours after the observation day. Nearly sixty percent of the data from the global sites delivered to the CDDIS were available within three hours of the end of the observation day.

3.1.2 Hourly GPS Data Files

Since 2000, many IGS operational/regional data centers transmit hourly data files to the global data centers. Within minutes of receipt, the files are archived to separate subdirectories (*/gps/nrtdata*) by day and hour on the CDDIS. These data are retained on-line for three days. After that time, the hourly data files are deleted; the daily file, transmitted through normal channels with a typical delay of one to two hours, will have been received and archived already and thus the hourly data are of little use. Furthermore, to ensure the most rapid delivery of these data to the user community, no validation or checks on data quality are performed. In 2001, approximately sixty percent of these hourly data files were available to the user community within 15 minutes of the end of the hour. GPS sites supplying hourly data to the CDDIS in 2001 are denoted by an * in Table 2; over 100 sites transmitted hourly data files to the global data centers in 2001.

The site-specific ephemeris data files for each hour are decompressed and then appended to a single file that contains the orbit information for all GPS satellites for the day up through that hour. This merged ephemeris data file, named *hourddd0.yyn.Z* (where *ddd* is the day of year and

yy is the year), is then copied to the daily subdirectory in the hourly filesystem (*/gps/nrtdata/yyddd*). At the end of the day, this file is copied to the corresponding subdirectory under the daily filesystem (*/gps/gpsdata/yyddd/yyn*) and renamed to *brdcdd0yyn.Z*. Users can thus download this single daily file instead of all broadcast ephemeris files from the individual stations.

3.1.3 High-Rate GPS Data Files

In May of 2001, the CDDIS began the archive of high-rate (typically one-second) GPS data in support of the IGS Pilot Project for Low Earth Orbiting (LEO) Missions. The data are made available to the CDDIS from four sources, JPL, GFZ, ASI, and GOPE. The RINEX data are archived in files containing fifteen minutes of data using the filenaming convention *ssssdddhmi.yyt.Z* where ssss is the monument name, ddd is the day of year, *h* is the hour (a-z), *mi* is the minute (00, 15, 30, 45), yy is the year, and *t* is the file type (d, m, n). On average during 2001, the CDDIS archived high-rate data from 35 sites totaling approximately 250 Mbytes per day. Table 3 lists the high-rate sites archived at the CDDIS in 2001.

3.2 Meteorological Data

The CDDIS currently receives meteorological data from over fifty sites, as noted in Table 2. The meteorological data provided are dry temperature, relative humidity, and barometric pressure at thirty minute sampling intervals. These data are stored on CDDIS with the daily GPS observation and navigation data files in parallel subdirectories.

3.3 IGS Products

The seven IGS data analysis centers (ACs) retrieve the GPS tracking data on a daily basis from the global data centers to produce daily orbit and clock products as well as weekly Earth rotation parameters (ERPs) and station position solutions; the seven IGS associate analysis centers (AACs) also retrieve IGS data and products to produce station position solutions. The CDDIS archives the products generated by both types of IGS analysis centers. These files are delivered to the CDDIS by the IGS analysis centers to individual user accounts, copied to the central disk archive, and made available in compressed format on the CDDIS by automated routines that execute several times per day. The IGS Analysis Coordinator then accesses the CDDIS (or one of the other global analysis centers) on a regular basis to retrieve these products and derive the combined IGS orbits, clock corrections, and Earth rotation parameters as well as to generate reports on data quality and statistics on product comparisons. The CDDIS currently provides on-line access through anonymous ftp or the web to all IGS products generated since the start of the IGS Test Campaign in June 1992.

Regional Network Associate Analysis Centers (RNAACs) routinely generate station position solutions for regional networks in Software INdependent EXchange (SINEX) format. The three Global Network AACs (GNAACs) perform a comparison of these files and submit the resulting SINEX files to the CDDIS. The GNAACs also access the SINEX files from the IGS ACs and RNAACs and produced comparison and combined, polyhedron station position solutions. The CDDIS provides “short-SINEX” files, designated with an *.ssc* extension, for all AC and AAC SINEX files. These files contain the site information from the SINEX file but no matrices. All

RNAAC solution files are also stored in the weekly IGS product subdirectories. The official IGS combined weekly SINEX solutions and cumulative combined SINEX solutions generated by the IGS Reference Frame Coordinator are also available in the weekly IGS product subdirectories.

Both the rapid (designated IGR) and the predicted orbit, clock and ERP (designated IGP) combined products generated by the IGS Analysis Coordinator continued to be available through 2001. Furthermore, a new product, the IGS ultra-rapid combination (designated IGU) were made available twice daily. The IGS global data centers, including the CDDIS, download the rapid, predicted, and ultra-rapid products from the Analysis Coordinator and made them available in a timely fashion to ensure their usefulness to the user community.

The CDDIS also continued to archive combined troposphere estimates in directories by GPS week (i.e., */gps/products/wwww/trop,* where *wwww* is the GPS week number). Global ionosphere maps of total electron content (TEC) from the IONEX AACs were also archived in subdirectories by day of year (i.e., */gps/products/ionex/yyyy* where *yyyy* is the four-digit year). The CDDIS archived products generated by the individual analysis centers contributing to the IGS LEO Pilot Project (LEO-PP). Thirteen AACs have thus far submitted products for review by the LEO-PP analysis coordinator; these files are archived in subdirectories by AAC within filesystem */gps/products/leopp*.

3.4 Supporting Information

Daily status files of GPS data holdings, reflecting timeliness of the data delivered as well as statistics on number of data points, cycle slips, and multipath continue to be generated by the CDDIS. By accessing these files, the user community can receive a quick look at a day's data availability and quality by viewing a single file. The daily status files are available through the web at URL *ftp://cddisa.gsfc.nasa.gov/pub/reports/gpsstatus/*. The daily status files are also archived in the daily GPS data directories.

Ancillary information to aid in the use of GPS data and products are also accessible through the CDDIS. Weekly and yearly summaries of IGS tracking data archived at the CDDIS are generated on a routine basis and distributed to the IGS user community through IGS Report mailings. These summaries are accessible through the web at URL *ftp://cddisa.gsfc.nasa.gov/pub/reports/gpsdata*. The CDDIS also maintains an archive of and indices to IGS Mail, Report, and Network messages.

4 GLONASS Data and Products

During 2001, the CDDIS continued as a global data center for GLONASS data and products in support of the IGLOS-PP Call for Participation issued in 2000. The CDDIS archived GLONASS data from over fifty sites totaling nearly 12K station days of data; the data centers and sites active during 2001 are shown in Table 4. GLONASS products from four analysis centers (BKG, CODE, ESA, and MCC) as well as the Analysis Coordinator (at the Technical University of Vienna) were also made available to the public. GLONASS data and products are accessible via anonymous ftp in the filesystem */igex*. Through 2001, the CDDIS continued to archive both GLONASS data and products in a filesystem separate from IGS data and products.

4 System Usage

Figures 1 through 3 summarize the monthly usage of the CDDIS for the retrieval of GPS and GLONASS data and products for 2001. Figure 1 illustrates the amount of GPS and GLONASS data retrieved by the user community during 2001, categorized by satellite (GPS or GLONASS) and type (daily, hourly, high-rate). Nearly 25 million files were transferred in 2001, with an average of over two million files per month. Furthermore, nearly 16K GPS product files were retrieved each month from the CDDIS; less than 100 GLONASS product files were retrieved each month. Figures 2 and 3 illustrate the profile of users accessing the CDDIS IGS archive during 2001. Most accesses were through network gateways, which did not yield sufficient information about the user. Figure 3 displays the usage information by geographic region; the majority of CDDIS users are from hosts in North America.

5 Publications

The CDDIS staff attended several conferences during 2001 and presented papers on or conducted demos of their activities within the IGS, including:

- "2000 IGS Data Center Reports" (Carey Noll) for 2000 IGS Annual Report (submitted in 2001, to be published in 2002)
- "CDDIS 2000 Global Data Center Report" (Carey Noll) for 2000 IGS Technical Report (submitted in 2001, to be published in 2002)
- "The Crustal Dynamics Data Information System CDDIS -- NASA's Space Geodesy Data Archive at Science Data Centers Symposium, Pasadena, CA, March 2001
- CDDIS Support of the LEO Pilot Project at IGS LEO Pilot Project Planning Meeting, Potsdam, Germany, February 2001

Electronic versions of these and other publications can be accessed through the CDDIS on-line documentation page on the web at URL *http://cddisa.gsfc.nasa.gov/reports.html*.

6 Future Plans

6.1 Computer System Enhancements

The AlphaServer 4000 computer supporting the CDDIS has been operational for over four years. Additional RAID disk space may be procured in 2002, as well as a dedicated tape backup system. Purchase of a LINUX-based server will also be investigated.

6.2 Changes in the Data Archive

In late 2000, the International GLONASS Pilot Project (IGLOS-PP) steering committee recommended the incorporation of GLONASS data into the IGS data stream. Plans are to complete this transition in mid-2002.

The CDDIS proposed to serve as a data center supporting the IGS Pilot Project for Low Earth Orbiting (LEO) Missions in 2000. The CDDIS has already begun archiving high-rate data in support of the pilot project; in 2002, the CDDIS will archive space-borne GPS receiver data from selected missions (e.g., SAC-C and CHAMP).

7 Contact Information

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

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Greenbelt, MD 20771		*http://cddis.nasa.gov*

8 Acknowledgments

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9 References

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Noll, C. E. "CDDIS Global Data Center Report" in *IGS 1998 Technical Report*. November 1999.
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Table 1: Data centers delivering data to the CDDIS in 2001

ASI	Italian Space Agency in Matera, Italy
AUSLIG	Australian Survey and Land Information Group in Belconnen, Australia
AWI	Alfred Wegener Institute for Polar and Marine Research in Bremerhaven, Germany
BKG	Bundesamt für Kartographie und Geodäsie in Frankfurt, Germany
CASM	Chinese Academy of Surveying and Mapping in Beijing, China
CNES	Centre National d'Etudes Spatiales in Toulouse, France
CRL	Communications Research Laboratory in Tokyo, Japan
CSIR	Council for Scientific and Industrial Research in Pretoria, South Africa
DGFI	Deutsches Geodätisches ForschungsInstitut in Munich, Germany
DLR	Deutsches Zentrum fuer Luft und Raumfahrt in Neustrelitz, Germany
DNR	Department of Natural Resources in Queensland, Australia
ENRI	Electronic Navigation Research Institute in Tokyo, Japan
ESOC	European Space Operations Centre in Darmstadt, Germany
GFZ	GeoforschungsZentrum in Potsdam, Germany
GOP	Geodetic Observatory Pecny in Ondrejov, Czech Republic
GSI	Geographical Survey Institute in Tsukuba, Japan
IMVP	Institute of Metrology for Time and Space in Mendeleevo, Russia
JPL	Jet Propulsion Laboratory in Pasadena, California
KAO	Korean Astronomy Observatory in Taejeon, Korea
NGI	National Geography Institute in Suwon
NIMA	National Imagery and Mapping Agencyin St. Louis, Missouri
NOAA/GL	NOAA's Geosciences Laboratory Operational Data Center (GODC) in Rockville, Maryland
NPL	National Physical Laboratory in Teddington, United Kingdom
NRCan	Natural Resources of Canada in Ottawa, Canada
NSTFL	National Standard Time and Frequency Laboratory in Taoyuan, Taiwan
PGC	Pacific Geoscience Centre, NRCan in Sidney, Canada
PGF	Pacific GPS Facility in Honolulu, Hawaii
RDAAC	Regional GPS Data Acquisition and Analysis Center on Northern Eurasia in Moscow, Russia
UNAVCO	University NAVSTAR Consortium in Boulder, Colorado
UNB	University of New Brunswick in Fredericton, Canada
USGS	United States Geological Survey in Reston, Virginia

Table 2: Sources of GPS data transferred to the CDDIS in 2001

Source	Sites								No. Sites
AUSLIG	ALIC KARR*	CAS1 *LAE1**	CEDU MAC1*	COCO* MAW1	DARW STR1*	DAV1* TID1	HOB2* TOW2*	JAB1 YAR2*	**16**
AWI	GOUG	VESL							**2**
BKG	EBRE UZHL	HOFN*[m] WTZT	*NPLD* YEBE*	NVSK	ORID	*POLV*	*SULP*[m]	TUBI	**11**
CASM	BJFS[m]								**1**
CNES	GRAS	HARB*	KERG*	NKLG*	THTI*	*TLSE*			**6**
CRL	*KGN0*[m]	*KGNI*	*KSMV*						**3**
DGFI	BRAZ								**1**
ESA	KIRU*	KOUR*	MALI*	MAS1*	PERT*	VILL*			**6**
GFZ	KIT3[m] URUM[m]	KSTU* ZWEN*[m]	LPGS	OBER/*2**	POTS*[m]	RIOG*	*ULAB*	UNSA*	**10**
GSI	SYOG	TSKB							**2**
IGN	ANKR HERS*[m] (KSTU) NOUM (THTI)	BOR1* (HOFN*[m]) LHAS[m] NTUS TRO1	BRUS*[m] IRKT (LPGS) NYA1 TROM	(EBRE) JOZE (MAS1) NYAL WSRT	GLSV (KERG) MATE*[m] OHIG WTZR*[m]	(GRAS) (KIRU) MDVO ONSA* ZECK	GRAZ*[m] (KIT3) METS[m] (POTS) ZIMM*[m]	(HARB) KOSG NICO REYK*[m] (ZWEN[m])	**27** **(40)**
JPL	AOA1* CORD* GOLD* KRAK *MSKU** SANT* TIDB*	AREQ* CRO1* GUAM* KWJ1* NLIB* SELE USUD*	ASC1 DGAR HARV* MAD2* NSSP* SEY1 XIAN	AUCK*[m] EISL* HRAO*[m] MADR* PIE1* SHAO YAR1	*BREW** FAIR*[m] IISC* *MBAR**[m] PIMO* *SIMO**	CASA GALA* JPLM*[m] MCM4* POL2 SUTH*	CHAT*[m] GODE* KELY* MDO1*[m] QUIN* THU1*	CIC1* GOL2* KOKB*[m] MKEA* RBAY* TID2*	**52**
KAO	DAEJ								**1**
NGI	SUWN								**1**
NIMA	BAHR[m]								**1**
NOAA/GL	AMC2 FORT SOL1[m]	AOML[m] *FREE* SSIA*	*ASPA** GUAT* *TEG1**	BARB HNPT TEGU*	BARH*[m] JAMA USNA	BRMU (KELY) USNO[m]	EPRT* MANA* WES2[m]	ESTI* SLOR* WUHN[m]	**23** **(24)**
NRCan	(ALBH[m]) (HOLB) SCH2*[m]	ALGO*[m] *HOLM* STJO*[m]	*CAGS* *INVK* (UCLU)	CHUR*[m] (NANO) (WHIT[m])	(CHWK) NRC1*[m] (WILL)	(DRAO*) NRC2* (WSLR)	(DUBO) PRDS*[m] YELL*[m]	(FLIN) *RESO*	**12** **(23)**
NSTFL	*TWTF*[m]								**1**
PGC	ALBH*[m] WHIT*[m]	CHWK WILL	DRAO*[m] WSLR	DUBO	FLIN	HOLB	NANO	UCLU*	**11**
PGF	*CFAG* *MAUI**	*FALE* *PARC*	*HILO* *SUVA*	*HNLC* *VALP*	*KOUC*	*LHUE*	*MALD*	*MANZ*	**12**
RDAAC	ARTU YAKZ	BILI YSSK[m]	MAG0[m]	*MOBN*	NRIL[m]	PETP[m]	TIXI	*YAKT*[m]	**10**
SIO	AMMN *RABT*	BAKO RAMO	DRAG SIO3[m]	INEG[m] VNDP[m]	KODK	MONP	PIN1	PVE3	**12**
UNAVCO	CHUM (SELE)	KAYT SUMK	KAZA TALA	KUNM TVST	(NSSP)	PODG	(POL2)	RIOP	**9** **(12)**
USGS	AMUN	PALM							**2**
Totals:	**232 daily GPS sites from 24 data centers during 2001** **108 hourly GPS sites during 2001[1]**								

Notes: Sites in () indicate backup delivery route
Sites in *italics* indicate sites new to the CDDIS in 2001
* Indicates site also providing hourly data to the CDDIS in 2001
[m] Indicates site providing meteorological data to the CDDIS in 2001
[1]Hourly GPS data also available from: CAGL, HFLK, MEDI, PENC, SFER, SCUB, UPAD

Table 3: Sources of GPS high-rate data transferred to the CDDIS in 2001

Source	Sites								No. Sites
ASI	MATE								**1**
GOP	GOPE								**1**
GFZ	BAN2	JOGJ	KSTU	LPGM	MIZU	NYA2	OBEM	OUS2	**13**
	POTM	SUTM	TASH	ULAB	ZWEN				
JPL	BREW	CORD	CRO1	FAIR	GALA	GODF	GOLD	GUAM	**25**
	HRAO	IISC	KELY	KOKB	MADR	MBAR	MCMZ	MKEA	
	MOBN	MSKU	NRIL	OKC2	PIMO	SANT	TIDB	USUD	
	YAKT								
Totals:	**50 high-rate sites from 4 data centers during 2001**								

Table 4: Sources of GLONASS data transferred to the CDDIS in 2001

Source	Sites								No. Sites
AUSLIG	DARR	DAVR	LINR	STR2	YARR				**5**
BKG	*BOGI**	BORG	BRUG	DLFT	*DREJ**	GJOV*	GOPE*	GRAB	**33**
	*HELJ**	HERP	*HUEG*	KR0G	*LEIJ**	LHAZ	*MAT1*	*METZ*	
	MR6G	MTBG	*OHIZ*	OS0G	REYZ	*SP0G/T0**	THU2	TIGZ	
	*TITZ**	*UNFE**	VS0G	VSLD	WROC*	*WTZJ**	WTZZ*	ZIMJ	
	ZIMZ								
CSIR	CSIR								**1**
DLR	NTZ1*								**1**
DNR	SUNM								**1**
ENRI	MTKA								**1**
GSFC	GODZ								**1**
D. Hogarth	DWH1ᵐ								**1**
IGN	BIPD	REUN							**2**
IMVP	*IRKJ*	*KHAJ*	*MDVJ*	*NOVJ*					**4**
NPL	*NPLF*								**1**
UNB	*UNB1**								**1**
USGS	CRAR								**1**
Totals:	**53 daily GPS+GLONASS sites from 15 data centers during 2001**								
	15 hourly GPS+GLONASS sites during 2001								

Notes: Sites in *italics* indicate sites new to the CDDIS in 2001
ᵐ Indicates site providing meteorological data to the CDDIS in 2001
* Indicates site also providing hourly data to the CDDIS in 2001

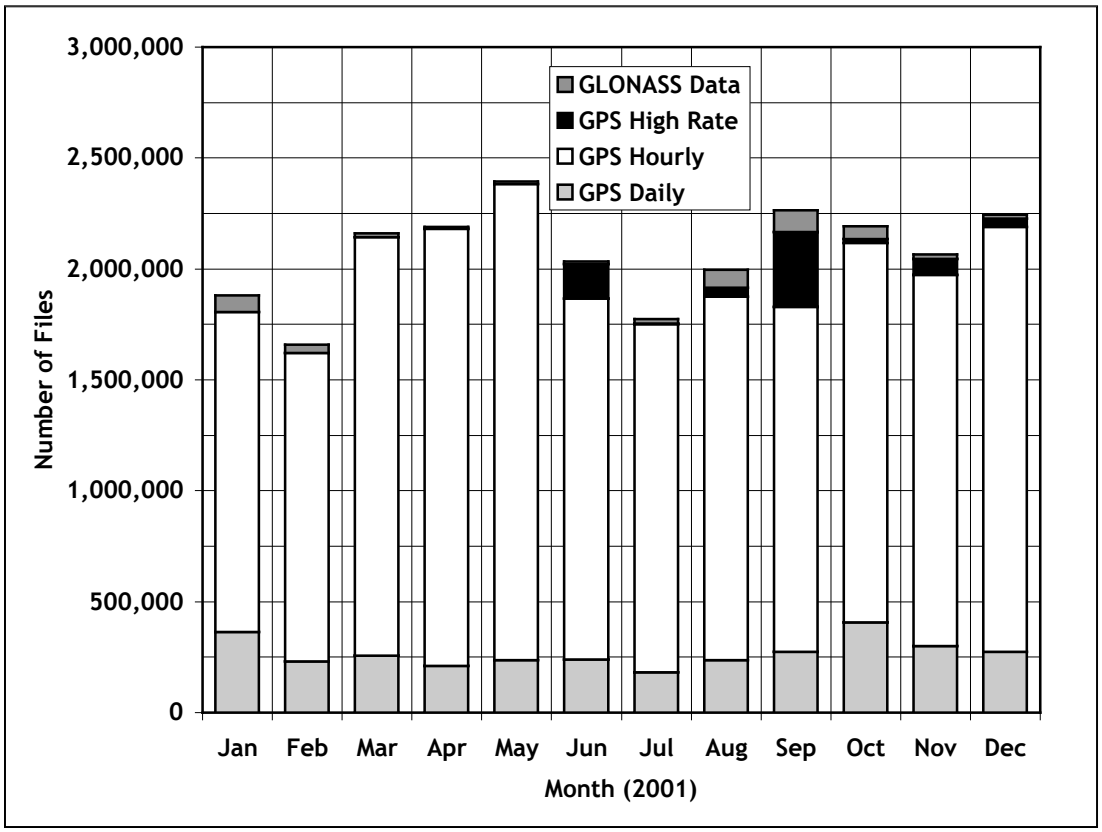

Figure 1: Number of GPS data files transferred from the CDDIS in 2001

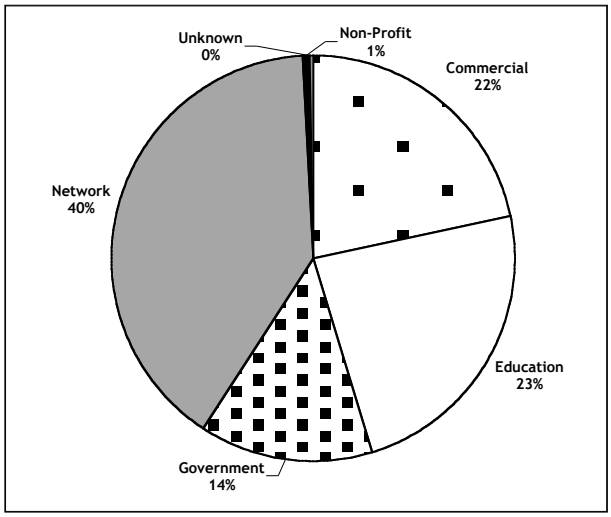

Figure 2: Distribution of IGS users of the CDDIS in 2001

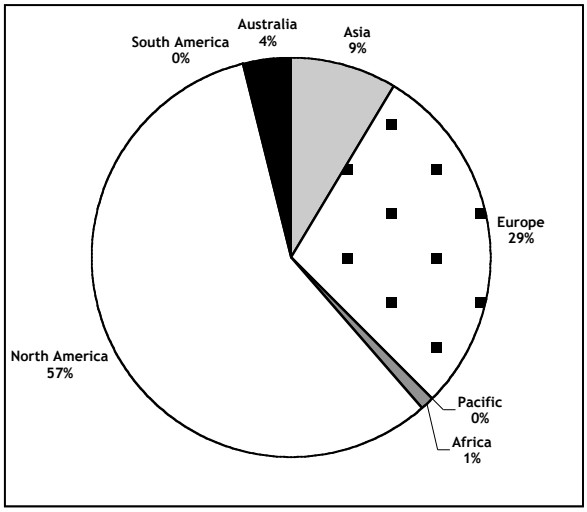

Figure 3: Geographic distribution of IGS users of the CDDIS in 2001