CDDIS Global Data Center Report

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1 Introduction

The Crustal Dynamics Data Information System (CDDIS) has supported the International GPS Service for Geodynamics (IGS) as a global data center since 1992. The CDDIS activities within the IGS during 1996 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).

2 System Description

The CDDIS archive of IGS data and products are accessible worldwide by way of a password-protected user account. New users can contact the CDDIS staff to obtain the required username and password, as well as general instructions on the host computer, directory structure, and data availability.

2.1 Computer Architecture

The CDDIS is operational on a dedicated Digital Equipment Corporation (DEC) VAX 4000 Model 200 running the VMS operating system. 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. The CDDIS is available to users globally through electronic networks using TCP/IP (Transmission Control Protocol/Internet Protocol) and DECnet (VAX/VMS networking protocol), through dial-in service (currently, up to 9600-baud) and through the GTE SprintNet system. During 1996, two additional disk drives were installed, bringing the current on-line magnetic storage capacity of the system to nearly thirty Gbytes.

At this time, two magnetic disk drives, totaling 6.4 Gbytes in volume, are devoted to the storage of the daily GPS tracking data. A dual-drive, rewriteable optical disk system provides additional on-line disk storage for GPS data as well as the long-term archive medium for GPS data on the CDDIS. With the current nearly 120 station network, only four days of GPS tracking data can be stored on a single side of one of these platters. The older data continues to be stored on these optical disks and can easily be requested for mounting and downloading remotely by the user. Alternatively, if the request for older data is relatively small, data are downloaded to magnetic disk, providing temporary on-line access. A 4.3 Gbyte magnetic disk drive is devoted to the on-line storage of IGS products, special requests, and supporting information.

3 Archive Content

As a global data 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. For the CDDIS, the following operational or regional data centers make data available to the CDDIS from selected receivers on a daily basis:

- Australian Survey and Land Information Group (AUSLIG) in Belconnen, Australia
- European Space Agency (ESA) in Darmstadt, Germany
- GeoforschungsZentrum (GFZ) in Potsdam, Germany
- Geographical Survey Institute (GSI) in Tsukuba, Japan
- NOAA's Geosciences Laboratory (GL/NOAA) Operational Data Center (GODC) in Rockville, Maryland
- Korean Astronomy Observatory in Taejeon, Korea
- Jet Propulsion Laboratory (JPL) in Pasadena, California
- National Imagery and Mapping Agency (NIMA), formerly Defence Mapping Agency (DMA), in St. Louis, Missouri
- Natural Resources of Canada (NRCan) in Ottawa, Canada
- University NAVSTAR Consortium (UNAVCO) in Boulder, Colorado

In addition, the CDDIS accesses 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 a regional data center. Table 1 lists the data sources and their respective sites that were transferred daily to the CDDIS in 1996; Table 2 presents detailed information on the sites whose data were archived in the CDDIS during the past year.

Once they 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. Typically, the archiving routines on the CDDIS are executed several times a day for each source in order to coincide with their automated delivery processes. During 1996, these procedures were modified to increase their execution frequency. In general, the procedures for archiving the GPS tracking data are fully automated, requiring occasional monitoring only, for replacement data sets or re-execution because of system or network problems.

The CDDIS GPS tracking archive consists of observation, navigation, and meteorological data, all in compressed (UNIX compression) RINEX format. Furthermore, summaries of the observation files are generated by the UNAVCO quality-checking (QC) program and are used for data inventory and quality reporting purposes. During 1996, the CDDIS archived data on a daily basis from an average of 105 stations; toward the end of the year, this number increased to nearly 120 stations. Under the current 120 station network configuration, about 120 days worth of GPS data are available on-line to users at one time. Each site produces approximately 0.6 Mbytes of data per day; thus, one day's worth of GPS tracking data, including the summary and meteorological data files, totals nearly seventy Mbytes. For 1996, the CDDIS GPS data archive totaled over 26 Gbytes in volume; this figure represents data from over 40K observation days. Of the 120 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.

The majority of the data delivered to and archived on the CDDIS during 1996 was available to the user community within 24 hours after the observation day. As shown in Figure 1, nearly one quarter of the data from all sites delivered to the CDDIS were available within six hours of the end of the observation day; nearly fifty percent were available within twelve hours. These data delivery statistics are comparable, as shown in Figure 2, for the current set of nearly seventy "global stations", processed by three or more IGS Analysis Centers on a daily basis. Figure 3 presents the data availability information by global station; a few of the sites were not operational for a majority of 1996 and the statistics could reflect delays due to the initiation of the new data flow. These

statistics were derived from the results of the daily archive report utilities developed by the IGS Central Bureau and executed several times each day on the CDDIS.

3.2 IGS Products

The seven IGS data analysis centers (ACs) retrieve the GPS tracking data daily from the global data centers to produce daily orbit products and weekly Earth rotation parameters (ERPs) and station position solutions; the nine 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 a central disk archive, and made available in ASCII format (generally uncompressed) on the CDDIS by automated routines that execute several times per day. The Analysis Coordinator for the IGS, located at NRCan, 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. Users interested in obtaining precision orbits for use in general surveys and regional experiments can also download the IGS products. The CDDIS currently provides on-line access to all IGS products generated since the start of the IGS Test Campaign in June 1992. As of 1996, access to the on-line archive of CDDIS products can also be performed through the World Wide Web (WWW) as well as through ftp.

During 1996, Regional Network Associate Analysis Centers (RNAACs) began the generation and submission of station position solutions for regional networks in Software INdependent EXchange (SINEX) format. The three Global Network AACs (GNAACs) continued their comparison of these files during 1996 and submitted the resulting SINEX files to the CDDIS. The current set of RNAACs participating in the IGS are:

- AUSLIG
- EUREF through the Center for Orbit Determination (CODE), Astronomical Institute of Berne (AIUB), Switzerland
- Geophysical Institute, University of Alaska in Fairbanks, AK
- GSI
- Pacific Geoscience Centre, NRCan in Sidney, British Columbia, Canada
- Deutsches Geodätisches ForschungsInstitute (DGFI) in Munich, Germany

The three participating GNAACs are:

- JPL
- Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts
- University of Newcastle upon Tyne in Newcastle, Great Britain

The GNAACs accessed the SINEX files from the IGS ACs and RNAACs and produced comparison and combined, polyhedron station position solutions.

The derived products from the IGS ACs are typically delivered to the CDDIS within ten days of the end of the observation week; delivery times for AAC products vary, but average 25 days for regional solutions. Figure 4 presents the average delay during 1996, in days and by source, of products delivered to the CDDIS, including the AACs operational during 1996. The statistics were computed based upon the arrival date of the solution summary file for the week. The time delay of the IGS products and the combined SINEX solutions are dependent upon the timeliness of the individual IGS analysis centers; on average, the combined orbit is generated within one to two days of receipt of data from all analysis centers and is typically available to the user community within ten days.

The rapid orbit and ERP products generated by the IGS Analysis Coordinator were also made available to the IGS global data centers starting in June 1996. These products are produced daily, within 24 hours UTC; automated procedures at the CDDIS download these files from NRCan in a timely fashion.

3.3 Meteorological Data

In 1995, the CDDIS and GSFC's Very Long Baseline Interferometry (VLBI) group began providing meteorological data from selected global GPS stations collocated with VLBI antennas. Meteorological data from the Greenbelt MD, Fairbanks AK, Kokee Park HI, Westford MA and Wettzell Germany VLBI stations has been sent to the CDDIS routinely. These data are extracted from VLBI logs and converted into RINEX format at the CDDIS. The meteorological data provided are dry temperature, relative humidity, and barometric pressure at thirty minute sampling intervals. The data are acquired and downloaded by the VLBI site personnel on a best effort basis with typically a one to three day delay. In 1996, additional IGS sites began providing meteorological data from collocated sensors; these stations are: Bahrain, Kitab Uzbekistan, Lhasa Tibet, Oberpfaffenhofen and Potsdam Germany, and Reykjavík Iceland. These data are stored on CDDIS with the daily GPS observation and navigation data files in parallel subdirectories.

3.4 Supporting Information

In early 1996, the CDDIS staff developed software to create and maintain daily status files of GPS data holdings. The automated CDDIS archiving procedures were modified to execute the quality UNAVCO QC program which analyzes the daily observation file and generates a summary file containing various statistics on these data. Routines then browse these summary files and update the daily status file with statistics on number of data points, cycle slips, and multipath. Furthermore, information from the RINEX header, such as receiver and antenna type, antenna height, marker name and number, are extracted to provide checks against the system configuration information available through the IGS Central Bureau Information System (CBIS). Data latency (in hours) is also computed and provided for each station. Replacement data is processed and reflected in this file by way of a version column. The summary files created by the QC program are also stored on the CDDIS in lieu of the previously-generated CDDIS summary file. The daily status files are loaded into the CDDIS data base for reporting purposes. The staff can then easily generate reports on the timeliness of data deliveries and data quality of the IGS stations. The user community can receive a quick look at a day's data availability and quality by downloading a single file. Furthermore, monthly summaries of the data quality for the IGS sites are also generated. Both the daily and monthly status files are available through the WWW at URL `http://cddis.gsfc.nasa.gov/gpsstatus/.`

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 now accessible through the WWW at URL `http://cddis.gsfc.nasa.gov/gpsdata/gpsdata_list.html`. The CDDIS also maintains an archive of and indices to IGS Mail, Report, and Network messages.

4 System Usage

Figures 5 through 7 summarize the monthly usage of the CDDIS for the deposit and retrieval of GPS data during 1996. These figures were produced daily by automated routines that peruse the log files created by each network access of the CDDIS. Figure 5 illustrates the amount of data retrieved during 1996. Over one million files were transferred in 1996, totaling approximately 360 Gbytes in volume. Averaging these figures, users transferred 90K files per month, totaling nearly 30 Gbytes in size. The chart in Figure 6 details the total number of host accesses per month with the number of distinct (i.e., unique) hosts per month shown as an overlay. Here, a host access is defined as an initiation of an ftp session; this session may transfer a single file, or many files. Figure 7 illustrates the profile of users accessing the system during 1996; these figures represent the number of distinct hosts in a particular country or organization. Nearly half of the users of GPS data available from the CDDIS come from U.S. government agencies, universities, or corporations.

The figures referenced above present statistics for routine access of the on-line CDDIS GPS data archives. However, a significant amount of staff time is expended on fielding inquiries about the IGS and the CDDIS data archives as well as identifying and making data available from the off-line archives. Table 3 summarizes the type and amount of special requests directed to the CDDIS staff during 1996. To satisfy requests for off-line data, the CDDIS staff must copy data from the optical disk archive to an on-line magnetic disk area, or for larger requests, mount the optical disks in a scheduled fashion, coordinating with the user as data are downloaded.

5 Publications

The CDDIS staff attended several conferences during 1996 and presented papers on or conducted demos of their activities within the IGS, including:

- "Flow, Archiving, and Distribution of Global GPS Data and Products for the IGS and the Role of the Crustal Dynamics Data Information System (CDDIS)" (Carey E. Noll and Maurice P. Dube) was presented at the Workshop on Improving the DGPS Infrastructure for Earth and Atmospheric Science Applications in March 1996

Hypertext versions of this and other publications can be accessed through the CDDIS on-line documentation page on the WWW at URL `http://cddis.gsfc.nasa.gov/documents.html`.

6 Future Plans

6.1 Computer System Enhancements

Procurement of a replacement hardware platform for the CDDIS VAX system was undertaken in early 1997. This system will be a DEC AlphaServer 4000 running the UNIX operating system; the system will initially have thirty Gbytes of on-line magnetic disk storage but will soon be augmented with as much as an additional sixty Gbytes. A significant amount of the CDDIS staff time will be spent during 1997 developing data processing and archiving routines for this new system. The staff hopes to have all GPS data activities transferred to the UNIX platform by late 1997.

An area of ongoing concern to the CDDIS staff is the ability to respond to special requests for older, off-line GPS data. Currently, this is a time-consuming activity for the staff since all older data are stored on optical disks in VAX VMS file format and the CDDIS VAX system is equipped with only two optical disk drives. The future CDDIS AlphaServer system under UNIX will not be equipped with these magneto-optical drives; therefore, a new medium for long-term storage of the historic GPS archive must be identified. The CDDIS staff has decided to utilize CD-ROMs for this archive and a procurement of a CD recordable system will be undertaken in 1997. This system will have the capability of recording up to five copies of a CD. The existing GPS archive on magneto-optical disks (in VAX/VMS format) will be migrated to CD-ROM. The data will most likely be written to CD-ROM by GPS week. Furthermore, purchase of a CD-ROM jukebox will be investigated in the hopes of delivery in late 1997.

6.2 Changes in the Data Archive

Tests are currently underway to incorporate a "compact RINEX" into the IGS data flow. This software, developed by Hatanaka Yuki (GSI) and Werner Gurtner (AIUB), when used with UNIX compression, reduces the size of the RINEX data by approximately a factor of eight (as compared to approximately 2.5 with using UNIX compression alone). Plans are for testing at the IGS data centers to commence in early 1997.

An area of continual concern for the IGS community is that of the timeliness of the RINEX data deliveries to the global data centers. The CDDIS along with all groups involved in data flow will focus heavily in 1997 in improving the speed at which data flows through various levels of data centers to reach the global data center. As can be seen in Figure 1, more data needs to be available

within six hours than current statistics show in order to reliably generate predicted and rapid orbits required by an ever-increasing user community, particularly for new applications such as atmospheric analyses. Improvements in automated data downloading procedures as well as RINEX compression software will greatly aid in the reduction of these time delays.

The CDDIS staff will also install new procedures to check the RINEX header information, ensuring it conforms to information reported in the site logs stored at the IGS Central Bureau. This information is currently extracted as part of the QC routines; data base software will be developed to further validate selected RINEX header fields.

As stated earlier, in 1995 the CDDIS began archiving meteorological data from VLBI and GPS collocated sites. These sites are equipped with sensors utilized during VLBI experiments. During 1997, however, a new field system will be installed in many of the VLBI sites which will automate data handling, including data from these meteorological sensors. It is hoped that this capability will enable more VLBI/GPS collocated sites to submit meteorological data to the IGS data stream.

At a business meeting in March 1997, the IGS Governing Board recommended that efforts begin to make GLONASS data available to the IGS user community. A minimal data flow will be established initially, with a more formal, data center oriented flow to follow as user needs and data volume are assessed. The CDDIS plans to establish on-line directories for these data and to incorporate GLONASS data in normal data processing procedures.

The CDDIS staff often receives requests from users for the daily broadcast ephemeris file (denoted `BRDCddd0.yyN_Z`). To reduce the amount of time spent on these requests by the CDDIS staff, a new disk area has been established (`GPS3:[GPSDATA.BRDC.yyyy]`) to store the historic BRDC files.

6.3 Changes in the Product Archive

Starting in early 1997, the IGS Analysis Center Coordinator began generating predicted orbit, clock, and Earth rotation parameter combinations based upon the individual ACs' predicted solutions. These solutions, designated IGP, are available within 0.5 hours of the beginning of the observation day. The IGS global data centers, including the CDDIS, will make these products available as soon as possible each day to ensure the timely utility to the user community.

7 Contact Information

To obtain more information about the CDDIS or a username and password to access the IGS archive of data and products, contact:

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WWW: `http://cddis.gsfc.nasa.gov/cddis.html`

8 Acknowledgments

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9 References

Noll, C. E. "CDDIS Global Data Center Report" in *IGS 1994 Annual Report*. September 1995.

Table 1.
Sources of GPS Data Transferred to the CDDIS

Source	Sites								No. Sites
AUSLIG	CAS1	COCO	DAV1	HOB2	MAC1				**5**
NOAA/GL	BRMU	FORT	HNPT	KELY	RCM5/6	SOL1	USNA	WES2	**9**
	WUHN								
NRCan	ALBH	ALGO	CHUR	DRAO	DUBO	FLINN	STJO	WHIT	**9**
	YELL								
ESA	KIRU	KOUR	MALI	MAS1	PERT	VILL			**6**
GFZ	KIT3	LPGS	OBER	POTS	ZWEN				**5**
GSI	TAIW	TSKB							**2**
IGN	ANKR	BOR1	BRUS	EBRE	GRAS	GRAZ	HART	HERS	**25**
	IRKT	JOZE	KERG	(KIRU)	(KIT3)	KOSG	LHAS	(LPGS)	**(31)**
	(MAS1)	MATE	MDVO	METS	NYAL	OHIG	ONSA	PAMA	
	(POTS)	REYK	TROM	WETT	WTZR	ZIMM	(ZWEN)		
JPL	AOA1	AREQ	ASC1	AUCK	AZU1	BOGT	BRAZ	CARR	**56**
	CASA	CAT1	CHAT	CICE	CIT1	CRO1	CSN1	DGAR	
	EISL	FAIR	GALA	GODE	GOL2	GOLD	GUAM	HARV	
	HRAO	IISC	JPLM	KOKB	KRAK	KWJ1	LBCH	MADR	
	MCM4	MDO1	MKEA	MOIN	NLIB	OAT2	PIE1	QUIN	
	SANT	SEY1	SHAO	SNI1	SPK1	THU1	TID2	TIDB	
	UCLP	USC1	USUD	WHC1	WHI1	WLSN	XIAN	YAR1	
NIMA	BAHR								**1**
KAO	TAEJ								**1**
SIO	MONP	PIN1	PVEP	SIO3	VNDP				**5**
UNAVCO	POL2								**1**
Totals:						**125 sites from 12 data centers**			

Note: Sites in () indicate backup delivery route

Table 2.
1996 GPS Data Holdings of the CDDIS

Site Name	N. Lat.	E. Long.	Mon. Name	Source	Receiver Type	Start Date	End Date	No. Days
Albert Head	48° 23'	-123° 29'	ALBH	NRCan	ROGUE SNR-8000	01-Jan-96	31-Dec-96	366
Algonquin	45° 57'	-78° 04'	ALGO	NRCan	ROGUE SNR-8000	01-Jan-96	31-Dec-96	366
Ankara	39° 53'	32° 45'	ANKR	IGN	ROGUE SNR-8000	01-Jan-96	31-Dec-96	267
Annapolis	38° 36'	76° 18'	USNA	NOAA	ROGUE SNR-8000	13-Jan-96	31-Dec-96	354
AOA, Westlake	34° 10'	-118° 50'	AOA1	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	350
Arequipa	-16° 28'	-71° 38'	AREQ	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	339
Ascension Island	-07° 58'	-14° 49'	ASC1	JPL	ROGUE SNR-8000	21-Apr-96	31-Dec-96	247
Auckland	-35° 33'	174° 28'	AUCK	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	360
Azusa	34° 07'	-117° 54'	AZU1	JPL	ROGUE SNR-8000	26-Jul-96	31-Dec-96	97
Bahrain	26° 13'	50° 37'	BAHR	NIMA	ASHTECH Z-XIID	23-Jun-96	31-Dec-96	181
Bangalore	12° 59'	77° 40'	IISC	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	254
Bermuda	32° 21'	-64° 39'	BRMU	NOAA	ROGUE SNR-8000	01-Jan-96	31-Dec-96	365
Bishkek	42° 32'	74° 28'	POL2	UNAVCO	ROGUE SNR-8000	01-Jan-96	31-Dec-96	292
Bogotá	04° 38'	-74° 05'	BOGT	JPL	ROGUE SNR-8000	19-Feb-96	12-Dec-96	230
Borowiec	52° 17'	17° 05'	BOR1	IGN	ROGUE SNR-8000	01-Jan-96	31-Dec-96	363
Brasília	-15° 57'	-47° 53'	BRAZ	JPL	ROGUE SNR-8000	29-Aug-96	31-Dec-96	108
Brussels	50° 18'	04° 13'	BRUS	IGN	ROGUE SNR-8000	01-Jan-96	31-Dec-96	354
Carr Hill	35° 53'	-120° 26'	CARR	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	361
Casey	-66° 16'	110° 32'	CAS1	AUSLIG	ROGUE SNR-8100	01-Jan-96	31-Dec-96	295
Catalina Island	32° 13'	-118° 12'	CAT1	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	364
Chatham Island	-43° 58'	-176° 34'	CHAT	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	365
Churchill	58° 27'	-94° 00'	CHUR	NRCan	ROGUE SNR-8000	18-Jun-96	31-Dec-96	184
CIT, Pasadena	34° 09'	-118° 08'	CIT1	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	366
Cocos Island	-12° 12'	96° 50'	COCO	AUSLIG	ROGUE SNR-8100	13-Jun-96	31-Dec-96	147
Davis	-68° 34'	77° 58'	DAV1	AUSLIG	ROGUE SNR-8100	02-Feb-96	29-Dec-96	266
Diego Garcia	-07° 12'	72° 15'	DGAR	JPL	ROGUE SNR-8000	09-May-96	31-Dec-96	235
Easter Island	-27° 09'	-109° 23'	EISL	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	342
Ensenada	31° 15'	-116° 09'	CICE	JPL	ROGUE SNR-8000	03-Jan-96	31-Dec-96	348
Fairbanks	64° 58'	-147° 29'	FAIR	JPL	ROGUE SNR-8	01-Jan-96	16-Apr-96	106
					ROGUE SNR-8000	17-Apr-96	31-Dec-96	258
Flin Flon	54° 44'	-101° 59'	FLIN	NRCan	ROGUE SNR-8000	08-Jun-96	31-Dec-96	206
Fortaleza	-03° 45'	-38° 35'	FORT	NOAA	ROGUE SNR-8000	01-Jan-96	31-Dec-96	363
Galapagos Island	00° 54'	-89° 03'	GALA	JPL	ROGUE SNR-8000	29-Mar-96	31-Dec-96	218
Goldstone	35° 15'	-116° 47'	GOL2	JPL	ROGUE SNR-8000	29-May-96	31-Dec-96	214
			GOLD	JPL	ROGUE SNR-8	01-Jan-96	30-Dec-96	342
Grasse	43° 45'	06° 55'	GRAS	IGN	ROGUE SNR-12 RM	03-Oct-96	31-Dec-96	78
					ROGUE SNR-8100	01-Jan-96	06-May-96	127
Graz	47° 04'	15° 30'	GRAZ	IGN	ROGUE SNR-8	01-Jan-96	24-Jun-96	175
					ROGUE SNR-8000	25-Jun-96	31-Dec-96	189
Greenbelt	39° 01'	-76° 50'	GODE	JPL	ROGUE SNR-8100	01-Jan-96	31-Dec-96	350
Guam	13° 28'	144° 45'	GUAM	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	365
Hartebeesthoek	-25° 53'	27° 42'	HART	IGN	ROGUE SNR-8	01-Jan-96	03-Mar-96	61
					ROGUE SNR-8000	29-Apr-96	31-Dec-96	220
			HRAO	JPL	ROGUE SNR-8000	27-Sep-96	19-Nov-96	53
Harvest Platform	34° 28'	-120° 41'	HARV	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	358
Herstmonceux	50° 52'	00° 20'	HERS	IGN	ROGUE SNR-8C	01-Jan-96	31-Dec-96	361
Hobart	-42° 48'	147° 26'	HOB2	AUSLIG	ROGUE SNR-8100	06-Feb-96	31-Dec-96	236
Horn Point	38° 36'	-76° 08'	HNPT	NOAA	ROGUE SNR-12 RM	01-Jan-96	31-Dec-96	366
Irkutsk	52° 18'	104° 15'	IRKT	IGN	ROGUE SNR-8000	01-Jan-96	31-Dec-96	354
Jozefoslaw	51° 02'	21° 30'	JOZE	IGN	TRIMBLE 4000SSE	01-Jan-96	31-Dec-96	360
Kellyville	66° 59'	-50° 57'	KELY	NOAA	ROGUE SNR-8000	01-Jan-96	31-Dec-96	298
Kerguelen	-49° 21'	70° 16'	KERG	IGN	ROGUE SNR-8C	01-Jan-96	31-Dec-96	357
Kiruna	67° 32'	20° 09'	KIRU	ESA	ROGUE SNR-8100	01-Jan-96	31-Dec-96	365

Kitab	39° 08'	66° 53'	KIT3	GFZ	ROGUE SNR-8000	01-Jan-96	30-Dec-96	333
Kokee Park	22° 08'	-159° 40'	KOKB	JPL	ROGUE SNR-8000	11-Jan-96	31-Dec-96	353
Kootwijk	52° 11'	05° 49'	KOSG	IGN	ROGUE SNR-12	02-Feb-96	31-Dec-96	333
					ROGUE SNR-8	01-Jan-96	01-Feb-96	27
Kourou	05° 08'	-52° 37'	KOUR	ESA	ROGUE SNR-8C	01-Jan-96	31-Dec-96	360
Kwajalein	09° 24'	167° 29'	KWJ1	JPL	ROGUE SNR-8000	17-Mar-96	31-Dec-96	280
L'Ebre	40° 82'	00° 49'	EBRE	IGN	TRIMBLE 4000SSE	29-Jan-96	30-Dec-96	160
La Plata	-34° 31'	-57° 33'	LPGS	GFZ	ROGUE SNR-8000	01-Jan-96	31-Dec-96	338
Lac du Bonnet	50° 16'	-95° 52'	DUBO	NRCan	ROGUE SNR-8000	18-Oct-96	31-Dec-96	75
Lhasa	29° 25'	91° 07'	LHAS	IGN	ROGUE SNR-8000	01-Jan-96	31-Dec-96	303
Limon	09° 59'	-83° 06'	MOIN	JPL	ROGUE SNR-8000	25-Feb-96	30-Dec-96	54
Long Beach	33° 28'	-118° 09'	LBCH	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	364
Macquarie Island	-54° 30'	158° 56'	MAC1	AUSLIG	ROGUE SNR-8100	01-Jan-96	31-Dec-96	193
Madrid	40° 26'	-04° 15'	MADR	JPL	ROGUE SNR-8	01-Jan-96	31-Dec-96	362
Malindi	-03° 14'	40° 08'	MALI	ESA	ROGUE SNR-8C	01-Jan-96	31-Dec-96	343
Mammoth Lakes	37° 38'	-118° 57'	CASA	JPL	ROGUE SNR-8000	01-Jan-96	29-Dec-96	333
			KRAK	JPL	ROGUE SNR-8000	25-Jul-96	25-Dec-96	141
Maspalomas	27° 46'	-15° 38'	MAS1	ESA	ROGUE SNR-12 RM	18-Apr-96	31-Dec-96	253
					ROGUE SNR-8100	01-Jan-96	17-Apr-96	96
Matera	40° 39'	16° 42'	MATE	IGN	ROGUE SNR-8	01-Jan-96	08-Jul-96	190
					ROGUE SNR-8100	09-Jul-96	31-Dec-96	176
Mauna Kea	19° 48'	-155° 28'	MKEA	JPL	ROGUE SNR-12 RM	10-Oct-96	31-Dec-96	82
					ROGUE SNR-8000	27-Sep-96	09-Oct-96	13
McDonald	30° 41'	-104° 01'	MDO1	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	359
McMurdo	-77° 51'	166° 40'	MCM4	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	361
Mendeleevo	37° 14'	56° 02'	MDVO	IGN	TRIMBLE 4000SSE	01-Jan-96	31-Dec-96	363
Metsahovi	60° 13'	24° 24'	METS	IGN	ROGUE SNR-8100	01-Jan-96	31-Dec-96	345
Monument Peak	32° 53'	-116° 25'	MONP	SIO	ASHTECH LPZ-XII	01-Jan-96	30-Dec-96	355
Mount Wilson	34° 13'	-118° 04'	WLSN	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	337
North Liberty	41° 46'	-91° 34'	NLIB	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	356
Northridge	34° 15'	-118° 31'	CSN1	JPL	ROGUE SNR-8000	02-May-96	31-Dec-96	243
Ny Ålesund	78° 56'	11° 52'	NYAL	IGN	ROGUE SNR-8	01-Jan-96	31-Dec-96	348
O'Higgins	-63° 19'	-59° 54'	OHIG	IGN	ROGUE SNR-8000	12-Jan-96	31-Dec-96	347
Oatt Mountain	34° 20'	-118° 36'	OAT2	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	366
Oberpfaffenhofen	48° 05'	11° 17'	OBER	GFZ	ROGUE SNR-8000	27-Oct-96	31-Dec-96	62
Onsala	57° 24'	11° 56'	ONSA	IGN	ROGUE SNR-8000	01-Jan-96	31-Dec-96	362
Palos Verdes	33° 45'	-118° 24'	PVEP	SIO	TRIMBLE 4000SSE	01-Jan-96	31-Dec-96	360
Pamate	-17° 34'	-149° 34'	PAMA	IGN	ROGUE SNR-8100	01-Jan-96	31-Dec-96	354
Pasadena	34° 12'	-118° 10'	JPLM	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	357
Penticton	49° 19'	-119° 37'	DRAO	NRCan	ROGUE SNR-8000	01-Jan-96	31-Dec-96	366
Perth	-31° 58'	115° 49'	PERT	ESA	ROGUE SNR-8100	01-Jan-96	31-Dec-96	362
Pie Town	34° 18'	-108° 07'	PIE1	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	366
Pinyon Flat	33° 37'	-116° 27'	PIN1	SIO	ASHTECH Z-XIID	01-Jan-96	31-Dec-96	347
Potsdam	52° 23'	13° 04'	POTS	GFZ	ROGUE SNR-8000	01-Jan-96	31-Dec-96	363
Quincy	39° 58'	-120° 56'	QUIN	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	364
Reykjavík	64° 09'	-22° 00'	REYK	IGN	ROGUE SNR-8000	12-Jan-96	31-Dec-96	348
Richmond	25° 37'	-80° 23'	RCM5	NOAA	ROGUE SNR-8000	01-Jan-96	03-Nov-96	276
			RCM6	NOAA	ROGUE SNR-8000	01-Nov-96	31-Dec-96	58
Saddle Peak	34° 04'	-188° 39'	SPK1	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	355
Saint John's	47° 36'	-52° 41'	STJO	NRCan	ROGUE SNR-8000	01-Jan-96	31-Dec-96	359
San Nicolas Isl.	33° 15'	-119° 31'	SNI1	JPL	ROGUE SNR-8000	01-Jan-96	28-Jul-96	58
Santiago	-33° 09'	-70° 40'	SANT	JPL	ROGUE SNR-8	01-Jan-96	18-May-96	132
					ROGUE SNR-8000	17-Jul-96	10-Sep-96	50
					ROGUE SNR-8100	11-Sep-96	31-Dec-96	112
Scripps	32° 52'	-117° 15'	SIO3	SIO	ASHTECH Z-XII3	01-Jan-96	31-Dec-96	357
Seychelles	-04° 41'	55° 30'	SEY1	JPL	ROGUE SNR-8000	03-Jan-96	11-Feb-96	20
Shanghai	31° 11'	121° 26'	SHAO	JPL	ROGUE SNR-8100	01-Jan-96	31-Dec-96	355
Solomons Island	38° 19'	-76° 27'	SOL1	NOAA	ROGUE SNR-8000	06-Mar-96	31-Dec-96	300

					TRIMBLE 4000SSE	01-Jan-96	05-Mar-96	59
St. Croix	17° 45'	-64° 35'	CRO1	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	364
Taejon	36° 12'	127° 16'	TAEJ	KAO	TRIMBLE 4000SSE	01-Jan-96	01-Jan-97	357
Taipei	25° 01'	121° 32'	TAIW	GSI	ROGUE SNR-800	01-Jan-96	31-Dec-96	362
Thule	76° 21'	-68° 18'	THU1	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	363
Tidbinbilla	-35° 24'	148° 59'	TID2	JPL	ROGUE SNR-8000	26-Jul-96	31-Dec-96	159
			TIDB	JPL	ROGUE SNR-8	01-Jan-96	31-Dec-96	365
Tromsø	69° 40'	18° 56'	TROM	IGN	ROGUE SNR-8	01-Jan-96	31-Dec-96	344
Tsukuba	36° 06'	140° 05'	TSKB	GSI	ROGUE SNR-8100	01-Jan-96	31-Dec-96	366
UCLA, Los Angeles	34° 04'	-118° 27'	UCLP	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	366
USC, Los Angeles	34° 01'	-118° 18'	USC1	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	357
Usuda	36° 08'	138° 22'	USUD	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	366
Vandenberg	34° 34'	-120° 30'	VNDP	SIO	ASHTECH LPZ-XII	01-Jan-96	31-Dec-96	353
Villafranca	42° 11'	-01° 27'	VILL	ESA	ROGUE SNR-8100	01-Jan-96	31-Dec-96	365
Westford	42° 37'	-71° 29'	WES2	NOAA	ROGUE SNR-8000	01-Jan-96	31-Dec-96	364
Wettzell	49° 09'	12° 53'	WETT	IGN	ROGUE SNR-800	01-Jan-96	31-Dec-96	363
			WTZR	IGN	ROGUE SNR-8000	10-Jan-96	31-Dec-96	354
Whitehorse	60° 43'	-135° 05'	WHIT	NRCan	ROGUE SNR-8000	07-Jun-96	31-Dec-96	201
Whittier College	33° 59'	-118° 02'	WHC1	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	351
Whittier Library	33° 59'	-118° 02'	WHI1	JPL	ROGUE SNR-8000	01-Jan-96	31-Dec-96	363
Wuhan	30° 35'	114° 19'	WUHN	NOAA	ROGUE SNR-8000	03-Jan-96	30-Dec-96	272
Xi'an	34° 22'	109° 13'	XIAN	JPL	ROGUE SNR-8000	18-May-96	31-Dec-96	178
Yaragadee	-29° 03'	115° 21'	YAR1	JPL	ROGUE SNR-8	01-Jan-96	31-Dec-96	343
Yellowknife	62° 29'	-114° 29'	YELL	NRCan	ROGUE SNR-12	20-Dec-96	31-Dec-96	12
					ROGUE SNR-8000	01-Jan-96	18-Dec-96	353
Zimmerwald	46° 53'	07° 28'	ZIMM	IGN	TRIMBLE 4000SSE	01-Jan-96	31-Dec-96	364
Zvenigorod	55° 24'	36° 30'	ZWEN	GFZ	ROGUE SNR-8000	01-Jan-96	31-Dec-96	348
138 occupations at 125 sites								38,343

Table 3.
Summary of Special Requests for GPS Data and Information in 1996

Type of Request	Totals
General IGS/CDDIS information	~115 requests (phone, fax, e-mail)
Off-line GPS data	~120 requests (phone, fax, e-mail)
Amount of off-line data requested	~50,150 station days†
Volume of off-line data requested	~30 Gbytes

Notes: †In this context, a station day is defined as one day's worth of GPS data (observation and navigation file in RINEX format)

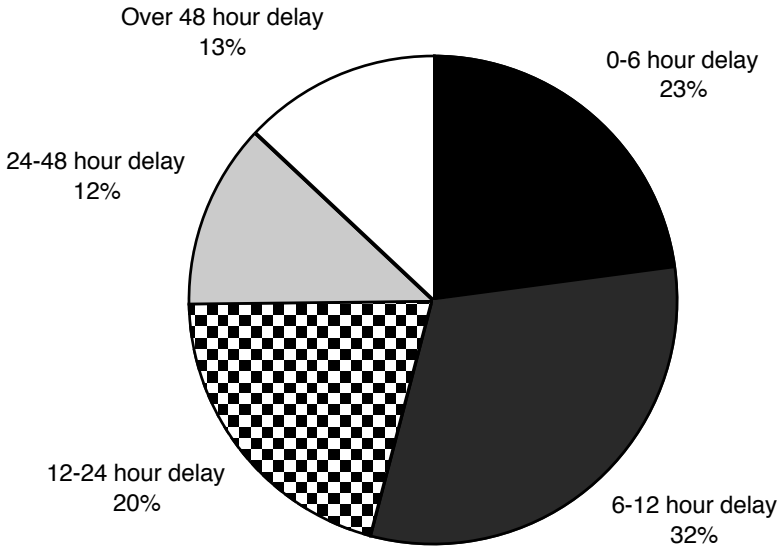

Figure 1. Median Delay in GPS Data Delivery (All Sites) to the CDDIS in 1996

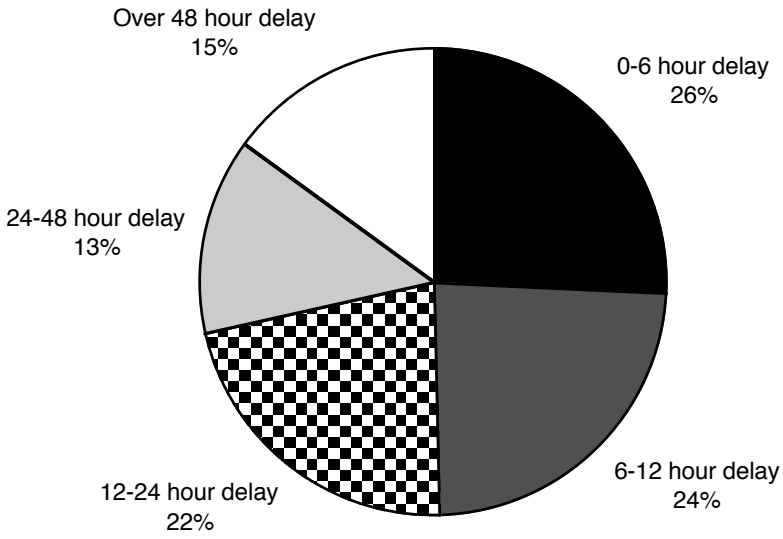

Figure 2. Median Delay in GPS Data Delivery (Global Sites) to the CDDIS in 1996

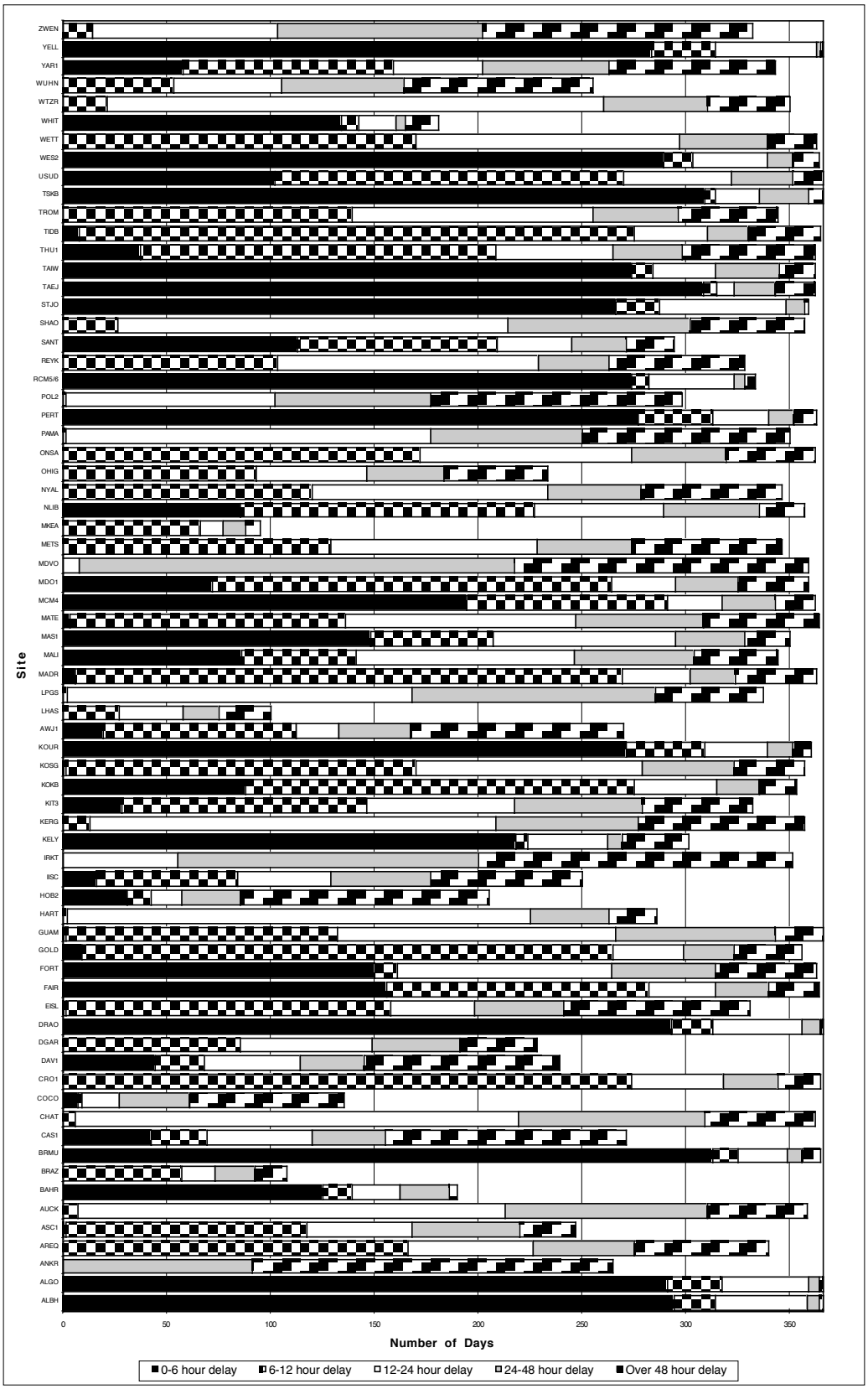

Figure 3. Median Delay in GPS Data Delivery (by Global Site) to the CDDIS in 1996

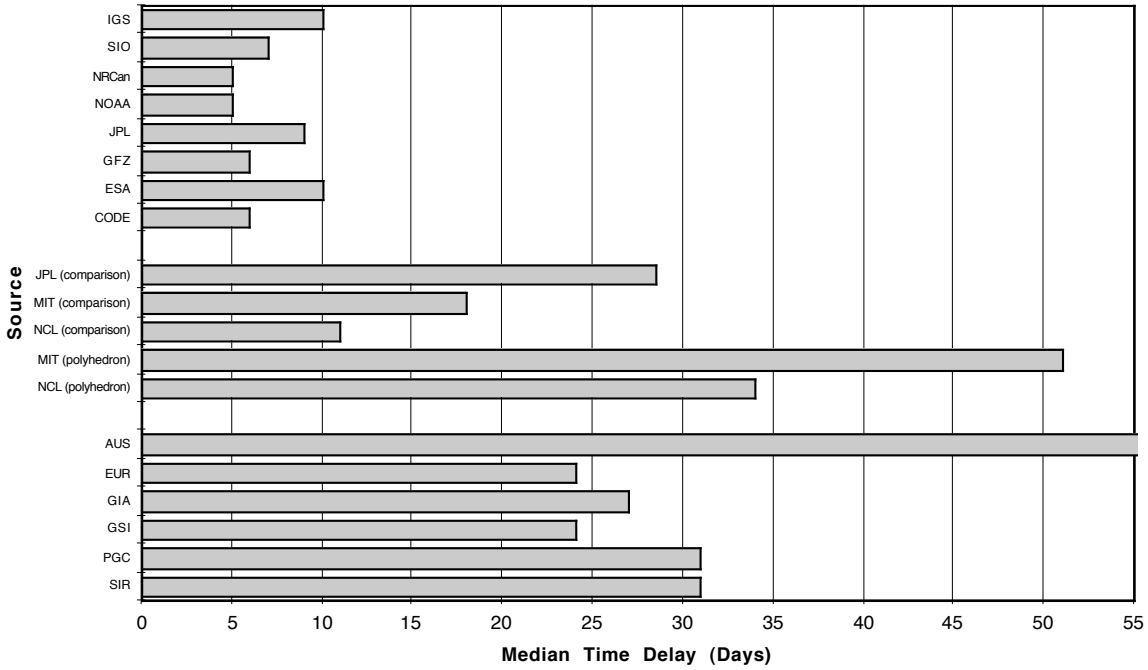

Figure 4. Median Delay in GPS Product Delivery to the CDDIS (by Source) in 1996

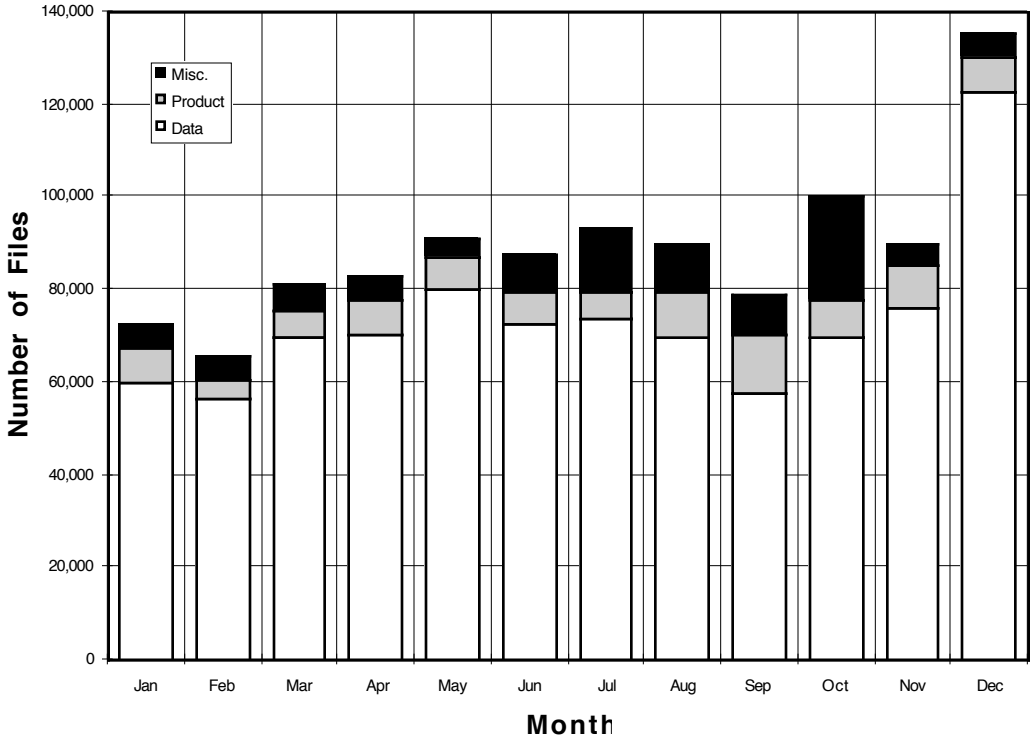

Figure 5. Number of GPS Related Files Transferred to/from the CDDIS in 1996

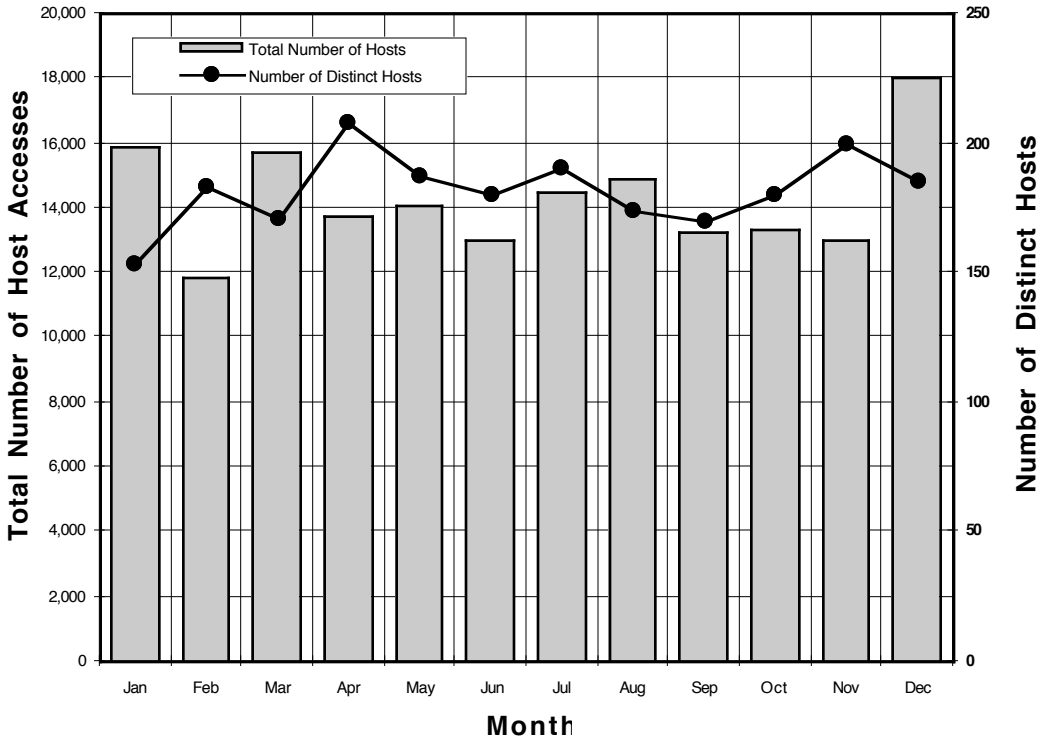

Figure 6. Number of Hosts Accessing GPS Data and Products on the CDDIS in 1996

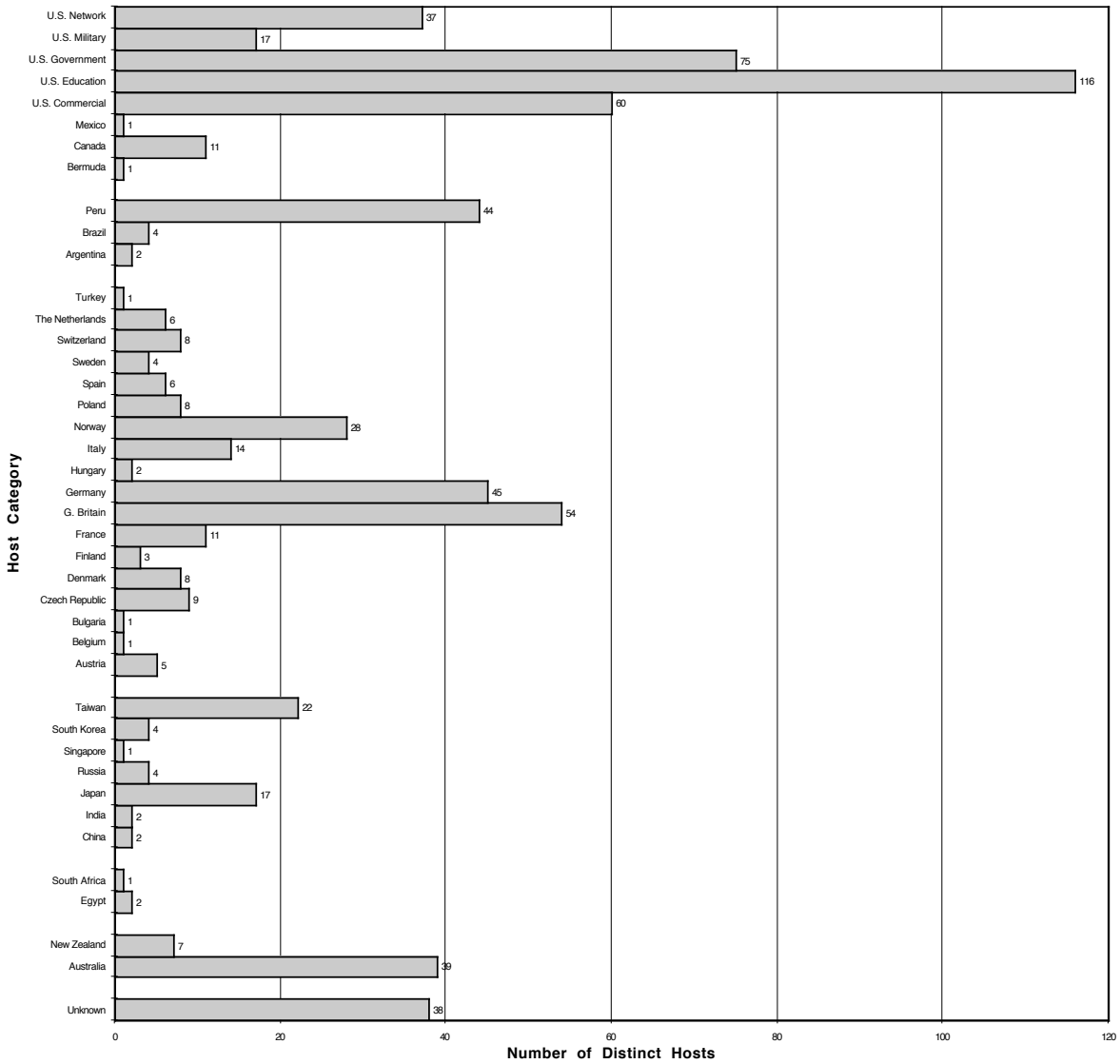

Figure 7. Distribution of IGS Users of the CDDIS in 1996