CDDIS Data Center Report

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Abstract This report summarizes the activities during the years 2023 through 2024 and provides details into the future plans of the Crustal Dynamics Data Information System (CDDIS) with respect to the International VLBI Service for Geodesy and Astrometry (IVS). The structure of this report is as follows: 1) General CDDIS information, 2) Technical CDDIS archive details, 3) Staffing details, 4) 2023–2024 accomplishments, and 5) Future goals.

1 General Information

The Crustal Dynamics Data Information System (CDDIS) is one of NASA's Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive Centers (DAACs). EOSDIS Data Centers serve a diverse user community and are tasked to provide facilities to search for and access science data and products. The CDDIS is also a regular member of the International Science Council (ISC, https://council.science/) World Data System (WDS, https://www.worlddatasystem.org) and the Earth Science Information Partners (ESIP, https://www.esipfed.org).

The CDDIS has supported the archiving and distribution of Very Long Baseline Interferometry (VLBI) data since its inception in 1982. The CDDIS is a central facility that provides users access to data and derived products to facilitate scientific investigation. The full CDDIS archive of Global Navigation Satellite System (GNSS), VLBI, Doppler Orbitography and Radio-positioning Integrated by Satellite (DORIS), and Satellite Laser Ranging (SLR) data and products is available online for remote access. Information about the system is available via the web at the URL: https://cddis.nasa.gov. (Note: Due to the Web Unification effort, this URL is planned to be replaced by https://www.earthdata.nasa.gov/centers/cddis-daac around June 2025 [see Section 5: Future Plans].) In addition to the IVS, the CDDIS actively supports other International Association of Geodesy (IAG) services including the International GNSS Service (IGS), the International Laser Ranging Service (ILRS), and the International DORIS Service (IDS), as well as the International Earth Rotation and Reference Systems Service (IERS) and the IAG's observing system, the Global Geodetic Observation System (GGOS). The on-going and future plans for the CDDIS support of the IVS are discussed in sections below.

1.1 System Usage

The CDDIS has a large international user community. In the year 2023, over 1,000 unique IP addresses downloaded data from the archive, resulting in over 20 TB of downloads across nearly 5 million files. In 2024, these numbers were 880 unique IPs, 25 TB of downloads, and 3 million files downloaded. The increase in the overall size of downloads, despite a decrease in overall downloads, is likely due to an increase in SWIN file usage.

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1.2 Accessing the Archive

Today, users access the CDDIS archive through anonymous encrypted ftp and https (approximately 1/3 and 2/3 of total downloads, respectively). Https access is available via browser and via command line (e.g., cURL or Wget), while ftp-ssl access is available by command line. As per U.S. Government and NASA directives, the CDDIS terminated unencrypted ftp access on 1 November 2020. The https protocol is as efficient as ftp transfer and is without the firewall/router issues of ftp. Archive access through the https protocol utilizes the same NASA single sign-on system, the EOSDIS Earthdata Login utility, as is used for the file uploads. Before using the https protocol to access the CDDIS archive, new users must initially access the webpage, https://cddis.nasa.gov/archive, to establish an account and authorize access. This page will then redirect the user to the Earthdata Login page. Earthdata Login allows users to easily search and access the full breadth of all twelve EOSDIS DAAC archives. Earthdata Login also allows CDDIS staff to know our users better, which will then allow us to improve CDDIS capabilities. Once an account is established, the user has all permissions required to access the CDDIS archive using the https protocol, via a web browser, or via a command line interface to script and automate file retrieval. In addition, ftp-ssl access, an extension of ftp using TLS (transport layer security), can be used for scripting downloads from the CDDIS archive. The ftp-ssl is the option most similar to standard unencrypted anonymous ftp. As with https, ftp-ssl will satisfy U.S. Government/NASA requirements for encryption. Examples of using these protocols, including help with the cURL and Wget commands, are available on the CDDIS website. Users are encouraged to consult the available documentation at https://cddis.nasa.gov/About/CDDIS_File_Download_Documentation.html as well as various presentations on these updates to the CDDIS archive access (see https://cddis.nasa.gov/Publications/Presentations.html).

2 System Description

The CDDIS archive of VLBI data and products is accessible to the public through encrypted ftp at gdc.cddis.eosdis.nasa.gov and https at https://cddis.nasa.gov/archive. Note: plans are in place to maintain this **archive** URL even after the Web Unification efforts. The **archive** URL may be deprecated in the more distant future. In other words, for the near term, the archive will remain at the same address in an attempt to minimize disruption of user automated archive access.

2.1 Archive Contents

The CDDIS has supported GSFC VLBI and IVS archiving requirements since 1979 and 1999, respectively. The IVS Data Center content and structure is shown in Table 1 (a figure illustrating the flow of information, data, and products between the various IVS components was presented in the CDDIS submission to the IVS 2000 Annual Report). The CDDIS has established a file upload system for providing IVS data, product, and information files to the archive. Using specified filenames, Operation and Analysis Centers upload files to this system. Automated archiving routines peruse upload directories at regular intervals and move any new data to the appropriate public disk area. These routines migrate the data based on the filename Data Definition File (DDF) to the appropriate directory as described in Table 1. Software on the CDDIS host computer, as well as all other IVS Data Centers, facilitates equalization of data and product holdings among these Data Centers by placing all new received data/products into a RECENT directory for action by the other Data Centers. The RECENT directory is used to facilitate mirroring between the IVS Data Centers located at the CDDIS, the Bundesamt für Kartographie und Geodäsie (BKG), and the Observatoire de Paris (OPAR). Mirroring has been performed since 2021. The public file system in Table 1 on the CDDIS computer consists of a data area, which includes auxiliary files (e.g., experiment schedule information and session logs) and VLBI data. A products disk area is also established to house analysis products from the individual IVS Analysis Centers as well as the official combined IVS products. A documents disk area contains format, software, and other descriptive files.

Table 1 IVS data and product directory structure.

Directory	Description
Data Directories	
vlbi/ivsdata/aux/yyyy/ssssss	Auxiliary files for year yyyy and session ssssss
	These files include log files, wx files, cable files, schedule files, correlator notes.
vlbi/ivsdata/db/yyyy	VLBI database files for year yyyy
vlbi/ivsdata/ngs/yyyy	VLBI data files in NGS card image format for year yyyy
vlbi/ivsdata/swin/yyyy	VLBI SWIN files for year yyyy
vlbi/ivsdata/vgosdb/yyyy	VLBI data files in vgosDB format for year yyyy
Product Directories	
vlbi/ivsproducts/crf	CRF solutions
vlbi/ivsproducts/daily_sinex	Daily SINEX solutions
vlbi/ivsproducts/eopi	EOP-I solutions
vlbi/ivsproducts/eops	EOP-S solutions
vlbi/ivsproducts/int_sinex	Intensive SINEX solutions
vlbi/ivsproducts/trf	TRF solutions
vlbi/ivsproducts/trop	Troposphere solutions
Project Directories	
vlbi/ITRF2013	IVS contributions to the ITRF 2013 efforts
vlbi/ITRF2014	IVS contributions to the ITRF 2014 solution
vlbi/ivs-pilotbl	IVS Analysis Center pilot project (baseline)
Other Directories	
vlbi/ivscontrol	IVS control files (Master Schedule, etc.)
vlbi/ivsdocuments	IVS document files (solution descriptions, etc.)
vlbi/raw	Raw VLBI data
vlbi/ivsformats	IVS File Format Definitions

2.2 File Submission

The CDDIS utilizes an https-based protocol method for the delivery of files from suppliers of data and products. The validation is performed through the EOSDIS Earthdata Login system, the same system used for access to the CDDIS real-time caster. The file uploads can be performed through a webpage interface or a command line application that can perform an http "post" operation, which is more commonly used for scripting. This process allows data suppliers to authenticate through the Earthdata Login system and provide their files through https to CDDIS for ingest into the archive. More information on the CDDIS file upload system, including an FAQ, is available at URL: https://cddis.nasa.gov/About/CDDIS_File_Upload_Documentation.html.

2.3 Ingest Processing

Starting in 2018, the CDDIS worked with the GSFC VLBI staff to transition code for processing incoming VLBI-related files into a new, common file ingest software. This new common ingest software would be shared with the other IVS global Data Centers to ensure that a common quality control (QC) and metadata process was shared across the global Data Centers. In late 2020, CDDIS moved its entire VLBI ingest process to this new collaborative process. Several changes were made to enable more rapid acceptance of new data and product files by the incorporation of DDFs. These DDFs are unique to each file type and specify a range of QC and metadata requirements for each file type. These, in turn, are parsed by the ingest software to determine the QC and metadata actions to accomplish for each incoming file before acceptance into the archive.

3 Staff

The CDDIS strives to contribute at least 0.5 FTE for support to the IVS. During the years of 2023 through 2024, Taylor Yates (taylor.a.yates@nasa.gov) held the position of CDDIS VLBI representative. Much

of the success of CDDIS VLBI operations during those years, and beyond, should be attributed to her. Starting in January of 2025, the role of CDDIS VLBI representative was passed to Colin McLaughlin (colin.mclaughlin@nasa.gov). In 2025, Colin will undergo training in VLBI and the CDDIS operational system. He will contribute to meetings like the IVS Technical Operations Workshop (TOW) in Westford, Massachusetts, and the International VLBI Technology Workshop in Gothenburg, Sweden. He will begin working towards the goals set out in Section 5: Future plans.

As the CDDIS DAAC scientist, Justine Woo (Justine.y.woo@nasa.gov) will also contribute to the IVS. Justine's contributions to CDDIS have been paramount in building the successful ingest processing system that is the backbone of the entire archive. Justine will help train Colin and integrate him with the IVS. She will build material to showcase the CDDIS within the context of the IVS to be presented at the IVS Technical Operations Workshop and/or the International VLBI Technology Workshop.

4 Current Status and Activities

During the years 2023 through 2024, the CDDIS continued to support the IVS through regular operations and development efforts such as 1) aiding new and existing providers with upload support, 2) aiding users with their download scripts, 3) validating ongoing mirroring with other IVS Data Centers, and 4) working with the IVS to ensure functioning quality control code that integrates with the CDDIS quality control.

Additionally, the CDDIS had several key contributions to the IVS, including, but not limited to, the following: 1) The CDDIS deployed scripts to process historical VLBI data into the archive, 2) The CDDIS remediated 2022 and older VLBI files in the archive to comply with the "yyyymmdd-ssssss" vgosDB naming convention for the master schedule, and 3) CDDIS transitioned our archive to accommodate the new Earth Orientation Parameter (EOP) Series format announced by the IVS, along with the new naming convention.

5 Future Plans

The primary goal of CDDIS is to support its providers and users through maximum archive uptime. Additionally, the CDDIS strives to maintain accurate mirroring of our partners, IVS Data Centers BKG and OPAR. The CDDIS is also working towards larger scale improvements. These include the following.

1) Further Digital Object Identifier (DOI) completeness. The CDDIS already provides DOI where available. Going forward, the CDDIS will continue to work with the IVS and uploaders to help to provide accurate DOIs which properly cite and give credit to those involved in data and product curation, including station operators, correlators, and researchers. DOIs will be posted to CDDIS landing pages.

2) Providing support for vgosDB files with ZIP compression. Currently, vgosDBs are archived using tar. We wish to work with the IVS to also provide support for .zip compression. One key advantage of this is the ability to access a file from a .zip archive without needing to unpack the entire archive. This change will need to be coordinated through the IVS to ensure minimal interruption to operations.

3) Work towards upgrading the VLBI ingest processing system from V3 to V4. V4 Ingest Processing will utilize digital data files (DDFs) which contain metadata that are used to perform quality control on incoming files. These DDFs will be used in conjunction with existing IVS quality control. Regression testing will be built out to validate updates to V4.

4) Contributing to the Web Unification effort. NASA wishes to establish more consistency across its websites to provide a more streamlined public face for users.

The CDDIS will support this effort from migration of landing pages to a new address. Note: The CDDIS will provide communication to the IVS regarding these efforts to minimize impact to uploaders and users. Note: After the migration, the current (February 2025) CDDIS links will redirect to the address. The redirects will eventually be deprecated.