



# Supporting GEOs through the Crustal Dynamics Data Information System

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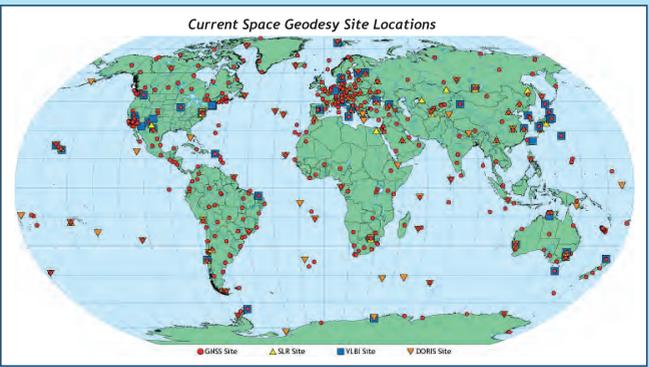
## Crustal Dynamics Data Information System

**Background:**

- The Crustal Dynamics Data Information System (CDDIS) is NASA's active archive of space geodesy data, products, and information using Global Navigation Satellite System/GNSS, Satellite Laser Ranging/SLR, Very Long Baseline Interferometry/VLBI, and Doppler Orbitography and Radio-positioning Integrated by Satellite/DORIS.
- The system has provided data archiving and distribution support to a global research community for over thirty years.
- The system is supported through NASA's Earth Observing System Data and Information System (EOSDIS) and is one of its distributed data centers, serving a wide, diverse user community.
- The largest CDDIS user community comes from the services within the International Association of Geodesy (IAG).
- The contents of the CDDIS archive are utilized for geodetic studies, e.g., plate tectonics, earthquake displacements, Earth orientation, Earth's surface deformation, Earth's gravity field, etc.
- The CDDIS archive also plays an interdisciplinary role in supporting the derivation of a Terrestrial Reference Frame (the foundation for virtually all airborne, space-based and ground-based Earth observations), precise orbit determination (POD) for NASA/international missions, atmospheric studies, etc.
- The CDDIS is now a regular member of the International Council for Science (ICSU) World Data System (WDS). The WDS strives to enable open and long-term access to multidisciplinary scientific data, data services, products and information. Membership in the WDS will promote the CDDIS and the ILRS to new user communities and show its commitment to the quality of our data and services.

### Archive Contents:

- Data:
  - Stations in the GNSS, SLR/LLR, VLBI, and DORIS networks generate point data on a multi-day, daily, hourly, and/or sub-hourly basis
  - GNSS: 500+ sites tracking GPS, GLONASS, and new GNSS (Galileo, QZSS, Beidou)
  - Laser Ranging (SLR and LLR): ~40 sites tracking 60+ satellites (including the Moon)
  - VLBI: 45 sites
  - DORIS: 58 sites tracking 5 satellites
- Products:
  - Precise network station positions (for the International Terrestrial Reference Frame, ITRF)
  - Satellite orbits (for precise orbit determination, POD)
  - Station and satellite clocks (for timing)
  - Earth rotation parameters
  - Positions of celestial objects (for Celestial Reference Frame, CRF)
  - Atmospheric parameters (Ionosphere total electron content/TEC, and Troposphere zenith path delay/ZPD)
- Metadata information:
  - Non-standard metadata, data type specific
  - Extracted from incoming files
  - Internal access to metadata database



### Archive Statistics:

- File size is typically <2Mb/data "granule", <10Mb/derived product "granule"
- Archive size: ~8.1Tb
- Ingest rate: ~2.75Gb (30K files)/day
- Distribution rate: ~240Gb (~2.4M files)/day
- Data (L1, L1B), products (L2) derived from these data, and information about data and products
- Multi-day, daily, hourly, sub-hourly
- Varying latencies (minutes, hours, days)

### Archive Usage:

- The CDDIS contains data and derived products from over 1500 observing sites located at about 1000 locations around the world, going back in time as far as 1975.
- The archive is updated with new data/product files on varying time scales, dependent on the data type, from a sub-daily basis to weekly basis.
- Users require continuous access to data for generation of products on pre-determined schedules.
- The average user of the CDDIS accesses the contents of the archive through anonymous ftp by means of automated scripts executed on predefined schedules (typically sub-daily).
- Analysts can use this method for data transfer because they are familiar with the structure of the online archive and thus know what files they require, their availability schedule, and where to find them within the online structure.

## The CDDIS and the IAG

- CDDIS is the principal data center for the geometric supporting services created under the umbrella of the International Association of Geodesy (IAG):
  - International GNSS Service (IGS)
  - International Laser Ranging Service (ILRS)
  - International VLBI Service for Geodesy and Astrometry (IVS)
  - International DORIS Service (IDS)
- These services function as cooperating federations dedicated to a particular type of data (e.g., GNSS, SLR, VLBI, or DORIS)
- The services provide data and products on an operational basis to geodesy analysts as well as a broader scientific community and are an example of a successful model of community management
- Successful operation through cooperation of many international organizations who leverage their respective limited resources to all levels of service functionality
- The CDDIS user community primarily consists of analysts supporting the services within the International Association of Geodesy.
- These groups produce derived products (e.g., positions of observing stations, Earth orientation parameters, precise satellite orbits, etc.) for use by a broader scientific community.
- The CDDIS has extensive partnerships through the IAG serving as one of the primary data centers for the geometric services and its observing system, the Global Geodetic Observing System (GGOS)

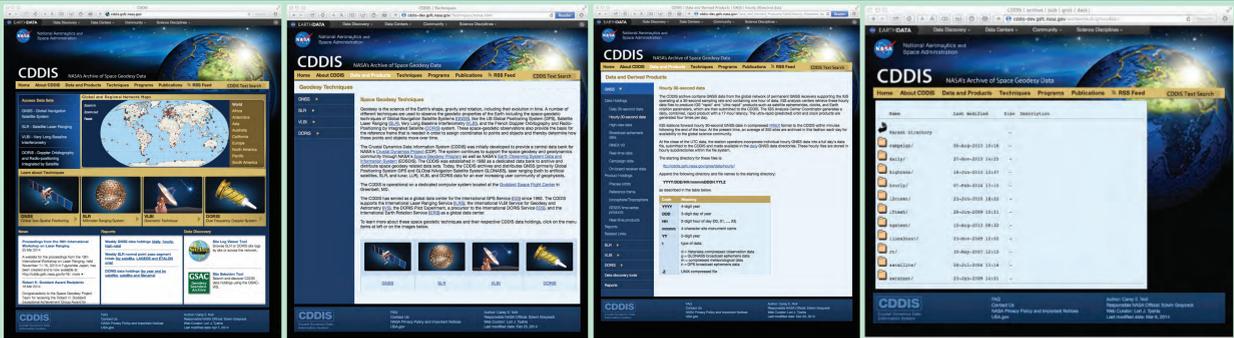
## Recent CDDIS Developments

### New CDDIS Website:

- The CDDIS website has been redesigned and incorporates improved navigation.
- The design, development, and implementation process included a content review and update.
- The new website features access to the SiteLogViewer application, a map selection tool and the CDDIS data discovery application.
- A data discovery tool, based upon the GSAC-WS, the Geodesy Seamless Archive Center - Web Services, allows users to search CDDIS metadata to discover CDDIS data, products, and information.
- The new website provides links to the EOSDIS EarthData web applications.
- The new CDDIS website was made operational in March 2014.

### Archive Access

- The CDDIS archive is now accessible through http as well as ftp.
- The new access method provides flexibility for the user community.



## SiteLogViewer Application

### Background -- Station Site Logs:

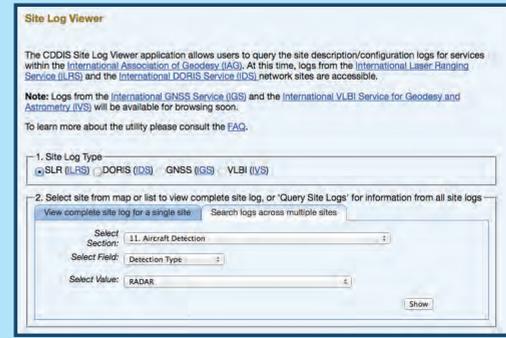
- Each of the IAG's geometric services coordinates measurements from a global network of stations
- Accurate, consistent information about the stations in these networks is vital for data analysis
- Each service has implemented a "site log" that is completed by the station or network operator
- Site logs are formatted ASCII text descriptions of the space geodesy station's location, environment, equipment, co-located instrumentation, and organization/contact information
- Station personnel report changes in the system's configuration, etc. by adding information to the log
- Thus the form serves as a historical collection of major changes during the lifetime of a system's installation
- Each station's site log form is a key source for understanding how the station's configuration has changed over time

### Use Cases:

- Users need to query the logs for a particular system to understand station configuration
- Users need to determine which sites have equipment with a particular configuration
- The CDDIS has developed an application, the SiteLogViewer, for the enhanced display and comparison of the contents of these site logs \*
- Through the SiteLogViewer application, users can:
  - Display a complete site log, section by section
  - Display contents of all site logs for a specified topic (site log section)
  - Search the contents of all site logs for a specified parameter value



The main screen for the SiteLogViewer application. The user has selected the ILRS radio button to view site information from the International Laser Ranging Service. A zoomable map shows all sites in the ILRS network.



The user now wants to determine which sites in the ILRS network have a particular type of equipment installed. To view multiple logs, the user has selected the "Search logs across multiple sites" tab. This tab allows the user to select a single section of the site log to:

- View a specified section for all site logs or
- Select a field within a section and specify a value for that field from a drop down menu

In this example, the "Aircraft Detection" section of the ILRS site logs is selected from the drop down list. The user selects "Detection Type" from the list of fields in this section and then selects "RADAR" from the list of possible values for this field.

Query Results For: 11. Aircraft Detection - Detection Type - RADAR

Site Name	SiteLogFileName	SubsectionNumber	Detection Type
TIGO-SLR, Concepcion (con)	conl_20100929.log	11.01	RADAR
Daedeok (daek)	daek_20121022.log	11.01	RADAR
Tanegashima (GUTS) (gms)	gmsl_20140109.log	11.01	RADAR
NGSLR (got)	gotl_20130603.log	11.01	RADAR
Goddard Geophysical Astronomical Observatory (god)	godl_20140116.log	11.01	RADAR
Hartebeeshoek Radio Astronomy Observatory (hart)	hart_20121011.log	11.01	RADAR
Hemmonous (hert)	hert_20140109.log	11.01	RADAR

The results show a table of information extracted from the site log, listing those laser ranging sites using a RADAR for Aircraft Detection. The "Get CSV" button will create a file of these results in comma-separated values format for use in other applications (e.g., Excel).

\* Note: The official responsibility for receipt and maintenance of each service's logs remains with the service. The CDDIS regularly ingests the logs into a database developed for the SiteLogViewer application. The application also provides a link to the official site log and service to ensure the user has access to the latest information.

## Future Activities

### Data Discovery Developments:

- Developing web applications for display of data holdings to aid in discovering data available from the CDDIS
- Queries will allow users to enter spatial and temporal parameters to determine sites of interest

### CDDIS Real-Time Activities:

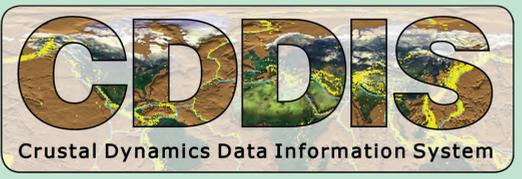
- In support of the IGS Real-Time Service (RTS), the CDDIS has installed a real-time caster using the Ntrip (Network Transport of RTCM via Internet Protocol) software on an available, dedicated server (called a caster) for receiving and serving (broadcasting) real-time GNSS data streams.
- System disseminates differential correction data or other kinds of GNSS streaming data to stationary or mobile users over the Internet.
- Mobile users obtain corrections/data from reference stations in real-time to improve positioning
- Real-time products include:
  - Data streams from a global network of high-quality GNSS receivers
  - Orbits
  - Satellite clock solutions
- Products enable real-time precise point positioning at global scales used in scientific research and hazard detection applications.
- CDDIS has begun the process to capture incoming streams for generation and comparison of high-rate data files.
- CDDIS real-time activities will require user authentication which will be handled through a NASA GSFC User Registration System (URS)
  - User registration provides authentication required for RTS
  - Allows gathering of metrics for usage
- Testing continues on the CDDIS caster installation and the Ntrip user registration module

### System Upgrades:

- CDDIS is in the process of procuring a hardware refresh
- System will be located within EOSDIS infrastructure, which will provide for expanded bandwidth and increased redundancy
- Operations on new system expected in late fall, 2014

### More Information/Feedback:

- The data used in this study were acquired as part of NASA's Earth Science Data Systems and archived and distributed by the Crustal Dynamics Data Information System (CDDIS):  
C. Noll, The Crustal Dynamics Data Information System: A resource to support scientific analysis using space geodesy, Advances in Space Research, Volume 45, Issue 12, 15 June 2010, Pages 1421-1440, ISSN 0273-1177, DOI: 10.1016/j.asr.2010.01.018.
- The staff welcomes feedback on the CDDIS and in particular the ideas expressed in this poster; contact Carey Noll (Carey.Noll@nasa.gov).



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