IN11C-3623 Recent Developments in Space Geodesy Data Discovery at the CDDIS

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Abstract: The Crustal Dynamics Data Information System (CDDIS) supports data archiving and distribution activities for the space geodesy and geodynamics community. The main objectives of the system are to store space geodesy and geodynamics related data products 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 a global scientific research community. The archive consists of GNSS, laser ranging, VLBI, and DORIS data sets and products derived from these data. The CDDIS is one of NASA's Earth Observing System Data and Information System (EOSDIS) distributed data centers; EOSDIS data centers serve a diverse user community and are tasked to provide data discovery tools to search and access science data and products. The CDDIS data system and its archive is a key component in several of the operational services within the International Association of Geodesy (IAG) and its project the Global Geodetic Observing System (GGOS), including the IGS, the International DORIS Service (IDS), the International Laser Ranging Service (ILRS), the International VLBI Service for Geodesy and Astrometry (IVS), and the International Earth Rotation Service (IERS).

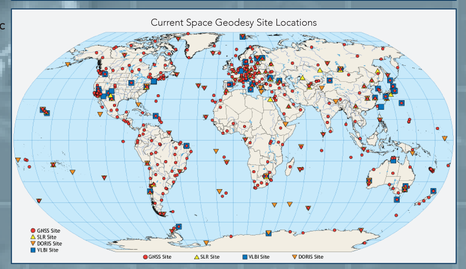
Crustal Dynamics Data Information System

Background:

- The Crustal Dynamics Data Information System (CDDIS) is NASA's active archive of space geodesy data, products, and information (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 CDDIS is funded by NASA/ESDIS but cooperates extensively with the international 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.

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: 530+ sites tracking GPS, GLONASS, and new GNSS (Galileo, QZSS, Beidou)
  - Laser Ranging (SLR and LLR): ~40 sites tracking 70+ satellites (including the Moon)
  - VLBI: 45 sites
  - DORIS: 58 sites tracking 5 satellites
- Products:
  - Precise network station positions (for ITRF)
  - Satellite orbits (for POD)
  - Station and satellite clocks (for timing)
  - Earth rotation parameters
  - Positions of celestial objects (for CRF)
  - Atmospheric parameters (Ionosphere TEC, Troposphere 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: ~11.1Tb
- Ingest rate: ~8.5Gb (75K files)/day
- Distribution rate: ~250Gb (~1.7M 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 principle 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 examples 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, GGOS (Global Geodetic Observing System)

International Laser Ranging Service · IGS International GNSS Service · IVS · IDS · EPS · IAG · IAG GGOS · ICSU World Data System

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
- 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 initial page of the SiteLogViewer application displays a list of system types:

- *GNSS site logs (from the IGS)*
- *SLR site logs (from the ILRS)*
- *DORIS site logs (from the IDS)*
- *VLBI site logs (from the IVS)*

The user first selects a technique/system type. Once a technique is selected (e.g., IGS/GNSS) the map is populated with the locations of all IGS GNSS sites archived at the CDDIS.

Two tabs are available:

- *View Complete Site Logs -- view a full site log (all sections) for one site*
- *Query Site Logs -- view one section of all site logs; this option also allows the user to search the contents of one section of all site logs for a specified parameter value*

In these examples, the user selects a site from the map, views the drop down menu, and selects one of the GNSS stations from this drop down menu (site at NASA GSFC in Greenbelt, MD).

The resulting page shows four tabs for the GGAO site:

- *A list of sections found in the site log on the left, with the contents of the highlighted section on the right.*
- *A zoom-able map of the selected site's location*
- *A collection of images of the station and surroundings.*
- *A diagram of the site's GNSS antenna*

The "New Query" button will allow the user to view another single site log or multiple logs.

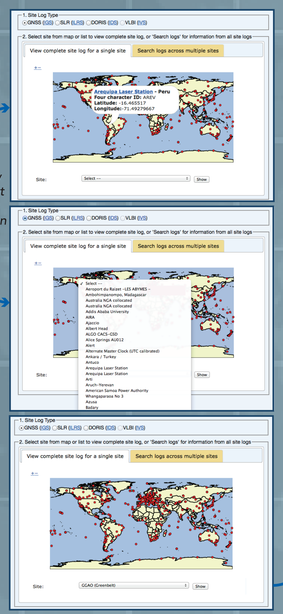
The user returns to the SiteLogViewer home page and selects the SLR (ILRS) radio button to view site information from the International Laser Ranging Service. A zoom-able map shows all sites in the ILRS network. The user now wants to determine which sites in the ILRS network have a particular type of equipment installed.

To view multiple logs, the user selects the "Query Site Logs" tab. This tab allows the user to select a single section of the site log to:

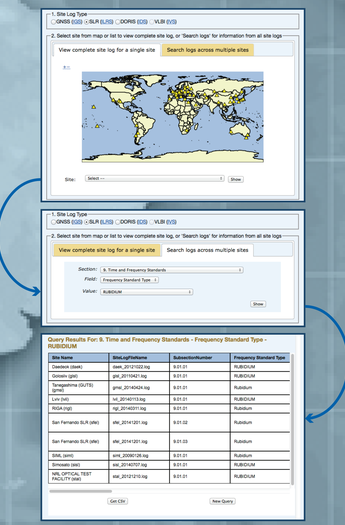
- *View a specified section for all site logs or*
- *Select a field within a section and specify a value for that field from a drop down menu*

In this example, the "Time and Frequency Standard" section of the ILRS site logs is selected from the drop down list. The user selects "Frequency Standard Type" from the list of fields in this section and then selects "H-MASER" (hydrogen maser) from the list of possible values for this field.

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



Select by map point or drop down menu



New Data Discovery Application

Background:

- A new web application, the CDDIS Archive Explorer, is currently under development to display data holdings to aid in discovering data available through the CDDIS
- The application will allow users to enter spatial, temporal, target, or site identification parameters to determine sites of interest
- Beta version currently available for internal testing; additional development underway

Use Cases:

- Develop a search/metadata interface tool for CDDIS to:
  - Aid users in discovery of CDDIS data, products, and information
  - Aid staff in archive management
  - Promote CDDIS data holdings to a larger community (e.g., through metadata standards)
- Specify (any/all):
  - Temporal: Year, date/time, range
  - Spatial: Region, latitude/longitude, range
  - Target: Satellite (SLR, DORIS)
  - Designation: Station name/number/code/DOMES number

Results:

- Map of sites satisfying specifications
- List of sites satisfying specifications
- List of data holdings satisfying specifications
- Metadata relevant to selection
- Site log for site selection

Next Steps in Application Development:

- Improve user interface
- Site selection through map interface
- Include additional query options (by target, by site identifier)
- Include links to data holdings for download

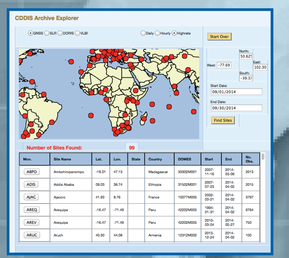
The initial page of the data discovery application displays a list of system types (GNSS, SLR, DORIS, VLBI), a spatial specification window to allow the user to enter spatial subsetting through a map interface or a bounding box, and a temporal specification window to allow the user to specify date range.

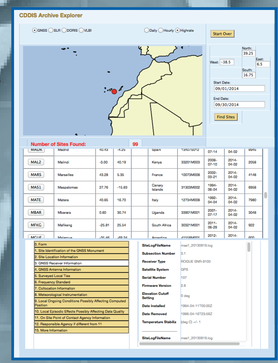
In this example, the user specifies a query for GNSS high-rate data holdings with a bounding box centering on Africa and a time period of September 01-30, 2014.

The resulting page shows two sections:

- *A map of sites satisfying the spatial subset and temporal bounds*
- *The corresponding list of sites satisfying these bounds*

Continuing this example, the user then selects a specific site, Maspalomas, to view additional information. The next page displays the location of the site on a map and additional information from the IGS site log for the MAS1 GNSS site.





More Information/Feedback:

- Data and products are 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)

CDDIS Crustal Dynamics Data Information System

CEN 12/10/2014