The CDDIS and Space Geodesy Data Archiving

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CDDIS
Crustal Dynamics Data Information System

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CDDIS Overview

- Crustal Dynamics Data Information System, NASA's active archive of space geodesy (GNSS, laser ranging, VLBI, and DORIS) data, products, and information
- Established in 1982 as a dedicated data bank to archive and distribute all Crustal Dynamics Project-acquired data and information about these data
- CDDIS is central to the data management component of NASA's Space Geodesy Project
- CDDIS has extensive partnerships through the International Association of Geodesy (IAG) serving as one of the primary data centers for the IAG services and its observing system GGOS (Global Geodetic Observing System)
- CDDIS is one of 12 Earth Observation System Data and Information System (EOSDIS) data centers

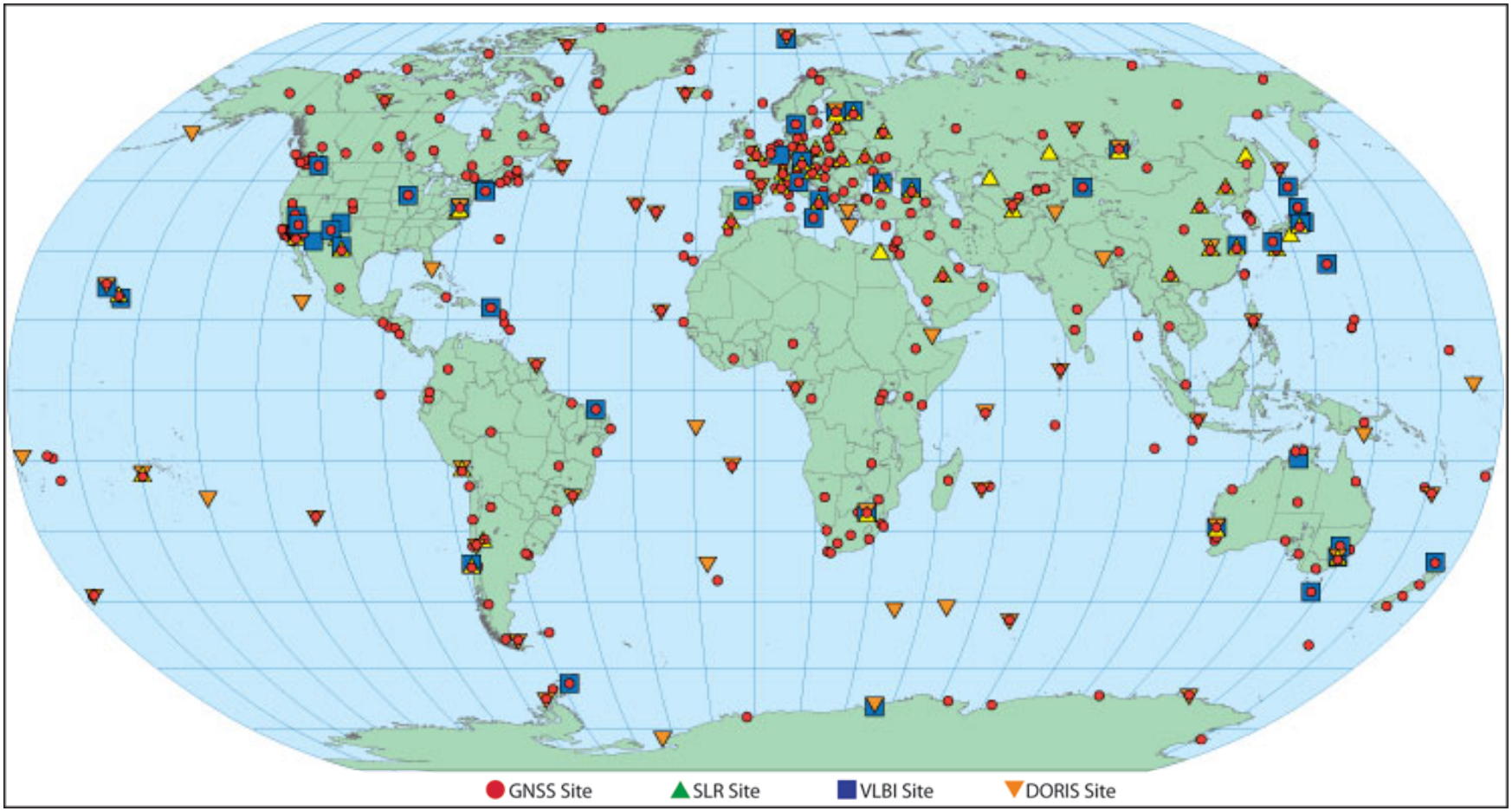
CDDIS Support of IAG Services

- CDDIS is the principle data center supporting the International Earth Rotation and Reference Frame Service (IERS) and the services created under 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)
- Provides infrastructure for populating CDDIS archive
- Primary user community for CDDIS archive

International Geodetic Services

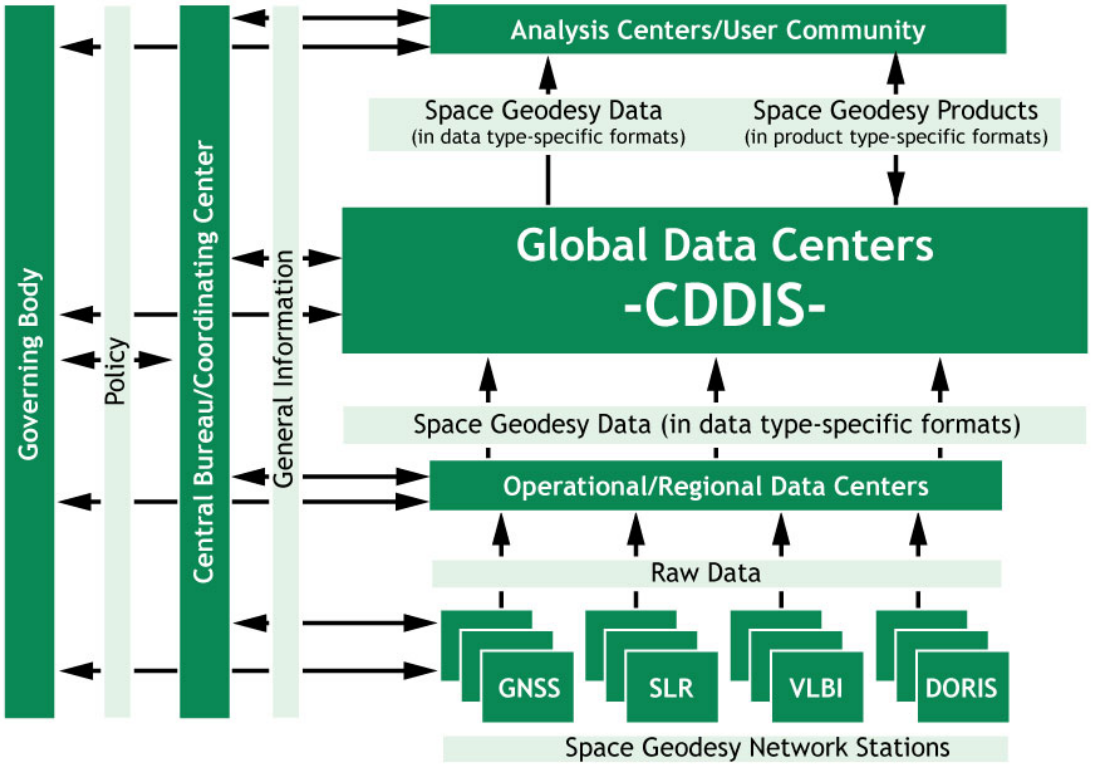
- The IAG established international, cooperative partnerships to facilitate research on a global scale
- Multi-level cooperation: networks, data centers, analysis groups
- The IAG's geometric services, IGS, ILRS, IVS, IDS, function as cooperating federations dedicated to a particular type of data
- Provide data and products on an operational basis to geodesy analysts as well as a broader scientific community
- Examples of a successful model of community management:
  - Develop standards
  - Self-regulating
  - Monitor performance
  - Define and deliver products using pre-determined schedules
- Successful operation through cooperation of many international organizations who leverage their respective limited resources to all levels of service functionality

Global Networks of the IGS, ILRS, IVS, IDS



Data/Products: From Source to User

- IAG geometric services are principle means by which data flow from station to user
- Each technique uses a similar data flow to get data from network sites to the user
- Infrastructure established within each service



Data Flow Details

- GNSS: International GNSS Service (IGS)
  - Network stations transmit data to operational/regional/global data centers
  - Prior to transmission to final archive, data are QC'd and translated into standard format (RINEX)
  - Data ideally transmitted hourly and daily (30-second sampling) and streamed in real-time (1-second sampling) with file transmission in 15-minute intervals
- SLR: International Laser Ranging Service (ILRS)
  - Network stations transmit data to one of two operational data centers, NASA GSFC or EDC at DGFI Munich
  - Stations provide data in standard format (CRD)
  - ODC QC's data and transmits data to global data centers
  - Data ideally transmitted hourly
- VLBI: International VLBI Service for Geodesy and Astrometry (IVS)
  - Data flow tightly coordinated by the IVS Coordinating Center at NASA GSFC
  - Stations transmit data to correlators
  - Experiment data flows through established paths to IVS data centers
- DORIS: International DORIS Service (IDS)
  - Data flow from network beacons to satellite
  - SSALTO in France coordinates receipt of DORIS data from satellite providers and provides all QC, pre-processing, and formatting prior to transmission to IDS Global Data Centers

CDDIS Archive Summary

- 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.
- The majority of CDDIS user community are 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 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).

CDDIS Archive Contents: Space Geodesy Data and Products

- 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
  - Laser Ranging (SLR and LLR): 40+ sites tracking 60+ satellites (including the Moon)
  - VLBI: 45 sites
  - DORIS: 58 sites tracking 5 satellites
  - Stations in the GNSS, SLR/LLR, VLBI, and DORIS networks generate point data on a multi-day, daily, hourly, and/or sub-hourly basis
- 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)
  - …
  - Products provided weekly, daily basis

CDDIS Archive Summary

- Archive size: ~8.1 Tb
- Ingest rate: ~4.5 Gb/60K files per day
- Distribution rate: ~180+Gb/day, ~1.4M files/day
- File size is typically <2Mb/data “granule”, <10Mb/derived product “granule”
- Easy to add new data types/data sets
- Files:
  - Data, products derived from these data, and information about data and products
  - Multi-day, daily, hourly, sub-hourly
  - Varying latencies (minutes, hours, days)
- Metadata:
  - Non-standard, data type specific
  - Extracted from data (not all products) and loaded into relational database
  - Internal access to database

Analysis Requirements

- Each of the IAG geometric services have official analysis centers (ACs) that provide derived products on an operational basis under strict schedules
- Examples include station positions, Earth orientation parameters, atmospheric parameters, satellite orbits
- Each service has identified an Analysis Center Coordinator (ACC) who combines the individual AC solutions into an official service product
- Both AC and official service products are archived at global data centers (e.g., CDDIS) for access by a broader scientific community