Developments at CDDIS to Support Real-Time and RINEX V3

Abstract: The Crustal Dynamics Data Information System (CDDIS) supports data archiving and distribution activities for the space geodesy and geodynamics community. The archive consists of GNSS, SLR, VLBI, and DORIS data and products derived from these data. The CDDIS is one of NASA's Earth Observing System Data and Information System (EOSDIS) distributed active archive centers (DAACs). The CDDIS data system and its archive are key components in several of the operational services within the IAG and GGOS, including the IGS, the ILRS, the IVS, the IDS, and the IERS. The CDDIS has served as a Global Data Center for the IGS since its start in June 1992. Today, the CDDIS provides on-line access to nearly 500 GNSS sites, as well as over 345 hourly and 200 high-rate sites, on a daily basis. GNSS data in RINEX V3 format, supporting multi-GNSS tracking from an additional 125 sites, are also available through the system. The CDDIS archive structure has been modified to accommodate new data sets and, in particular, integration of RINEX V3, multi-GNSS data into the operational IGS directory structure. The CDDIS also expanded its support of the IGS by implementing a real-time caster for the IGS Real-Time Service (RTS). The CDDIS real-time caster has been successfully operating for more than a year. This poster will include background information about the system and its user communities, and information about these updates and enhancements to the CDDIS to support the IGS RTS and the transition to operational support of RINEX V3.
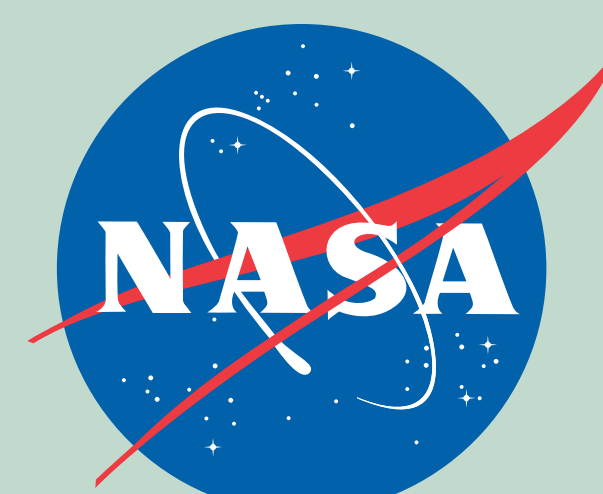
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CDDIS Real-Time Activities

Real-time GNSS at CDDIS:
- In early 2015, the CDDIS caster became operational, allowing CDDIS to become the third primary caster supporting the IGS Real-Time Service (RTS) along with the IGSCB and BKG casters
- NTRIP software used to transmit real-time GNSS data and derived product streams through the CDDIS caster
- Thus far, CDDIS makes streams available from nearly 200 globally distributed real-time GNSS receivers and 37 derived product streams
- A username/password is required to access streams (required for all IGS RTS casters)
- CDDIS developed an interface to an EOSDIS system for user registration and access
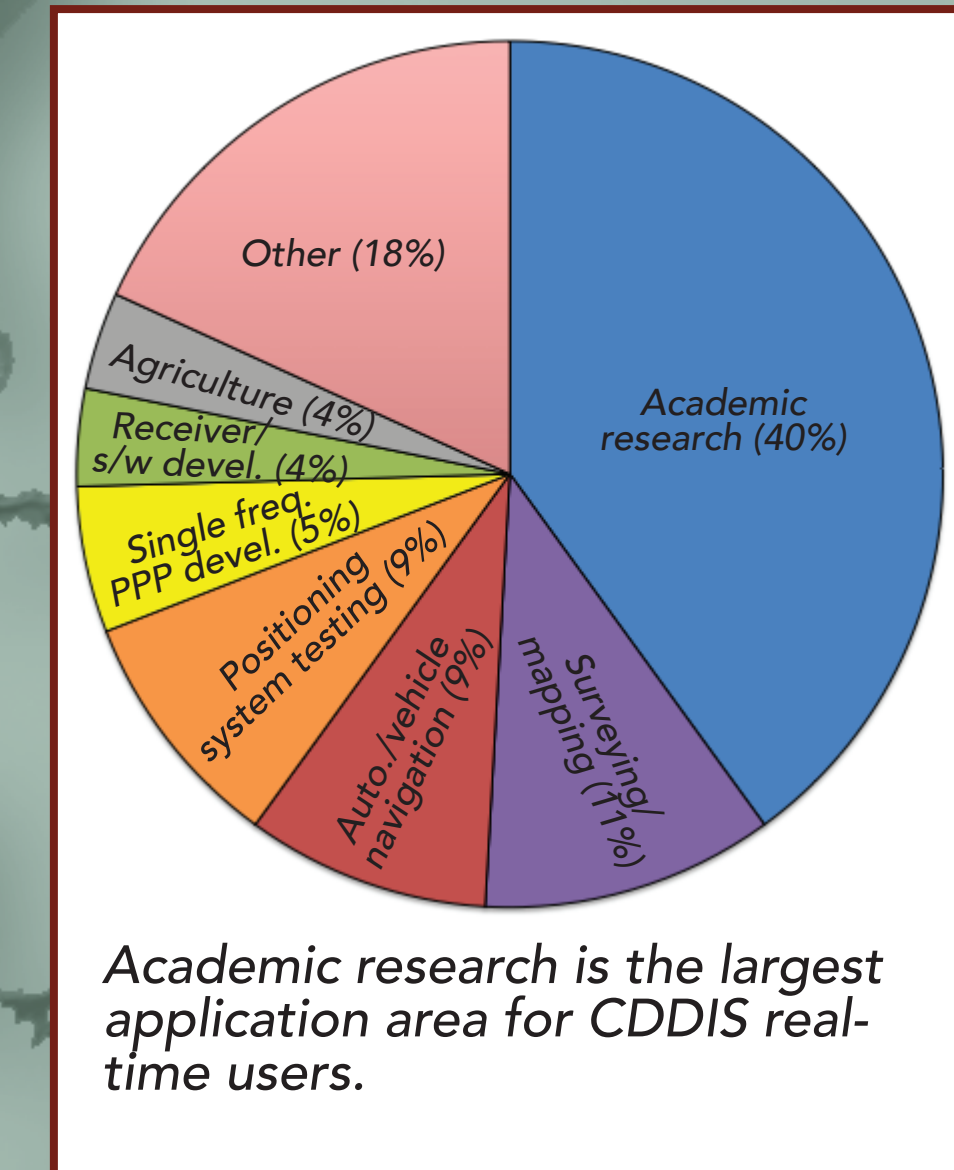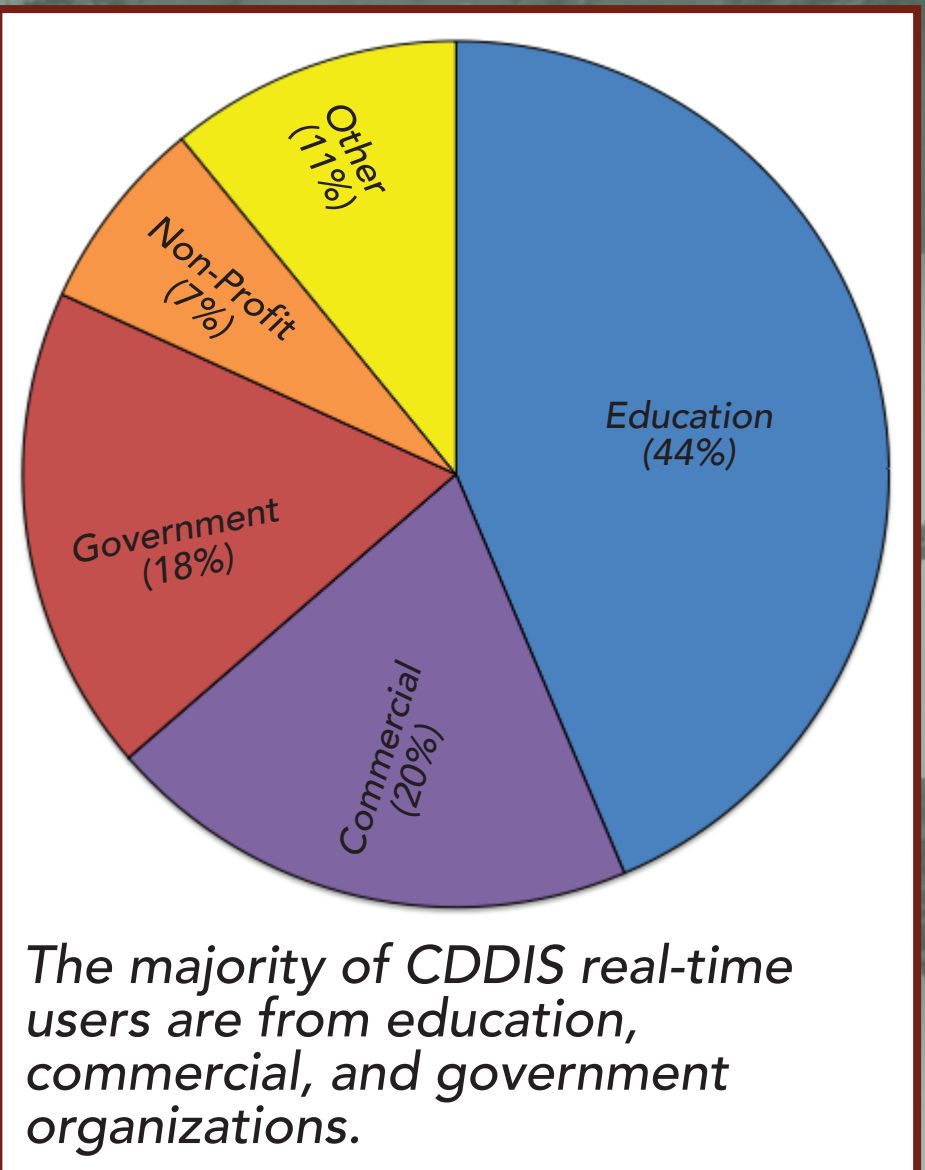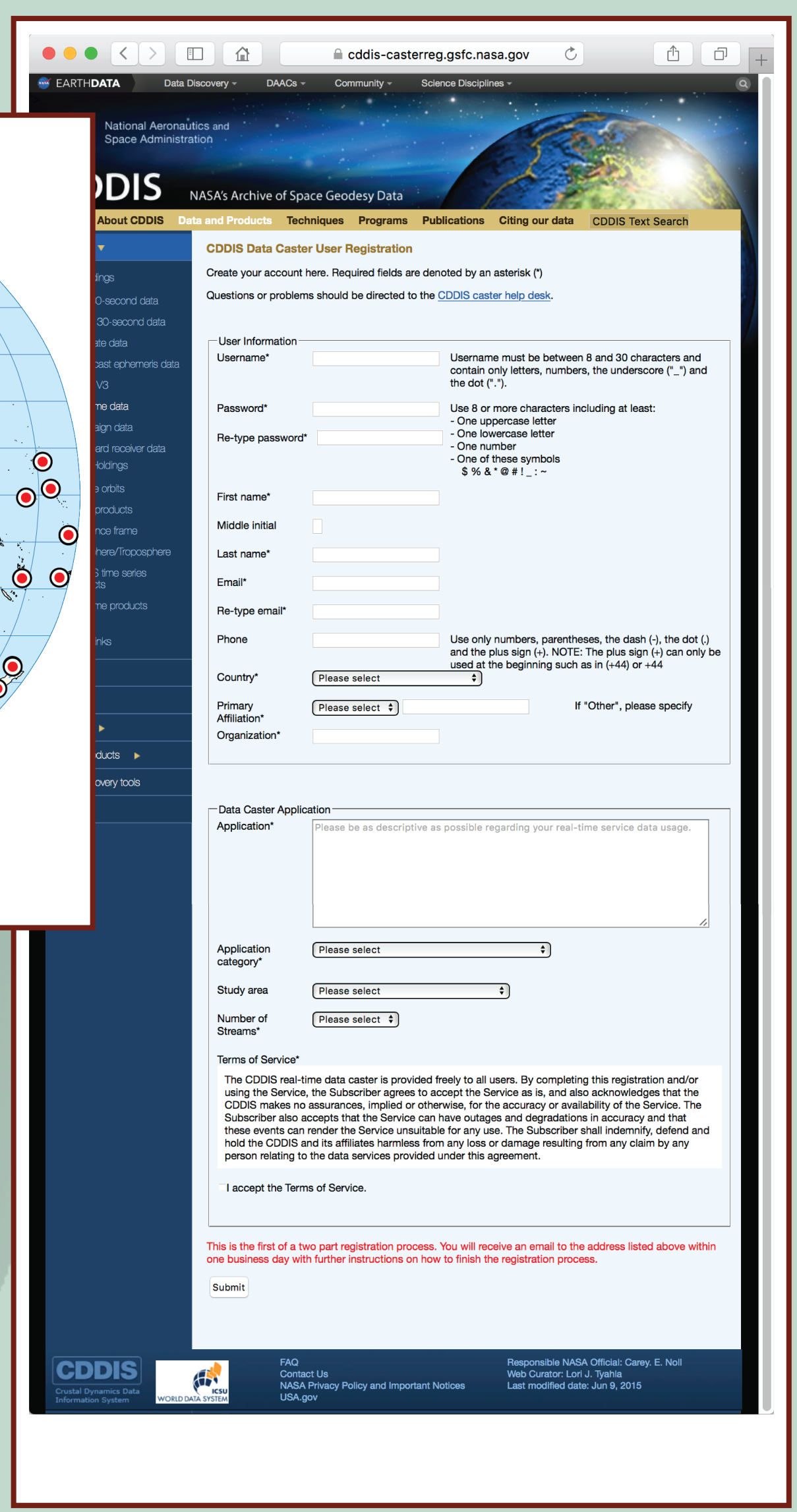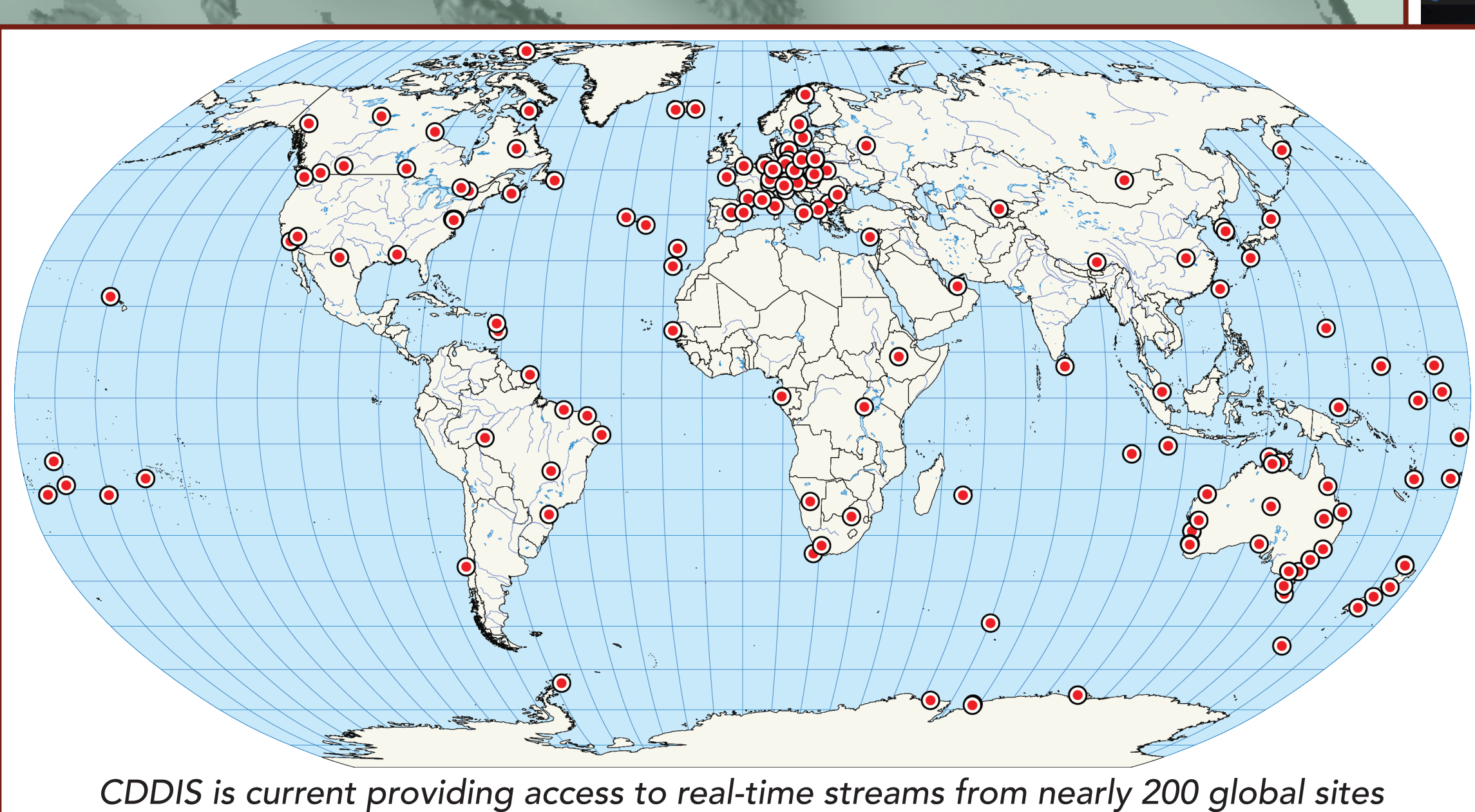
Caster User Registration/Sign-on:
- Users of IGS RTS casters, including the CDDIS caster, must register and utilize a username/password for access
- CDDIS has access to a world-class user registration process from EOSDIS, which currently has over 170,000 users in its system
- CDDIS developed software to interface its NTRIP caster with this EOSDIS user registration system (URS)
- Registration process is accomplished in near real-time
- Once registered within the EOSDIS system, the user has access to the entire suite of EOSDIS products across all twelve EOSDIS data centers
- Over 50 users have registered for access since the start of the CDDIS real-time service

Process:
- New users access the registration form on the CDDIS caster website and completes the form with the required information
- User submits the form and an email is generated with a validation link; user clicks on the link within the email and the URS system validates the form data
- CDDIS staff grant the user access to CDDIS caster; typical 24-hour turn-around on full registration process
- User now has access to the CDDIS caster as well as other EOSDIS data center applications

Future plans:
- Add more streams to CDDIS caster
  - Data streams from global real-time capable sites in NASA network (GDGPS)
  - Data streams from other real-time providers
- Capture streams into high-rate files (mainly for those sites not supplying high-rate data directly to CDDIS)
- Develop software to capture caster usage monitoring/statistic capture
- Update registration pages to use new version of EOSDIS Earthdata Login (formerly called URS)

CDDIS is current providing access to real-time streams from nearly 200 global sites

The majority of CDDIS real-time users are from education, commercial, and government organizations.

Academic research is the largest application area for CDDIS real-time users.

Screen capture of the webpage showing the list of streams available from the CDDIS caster

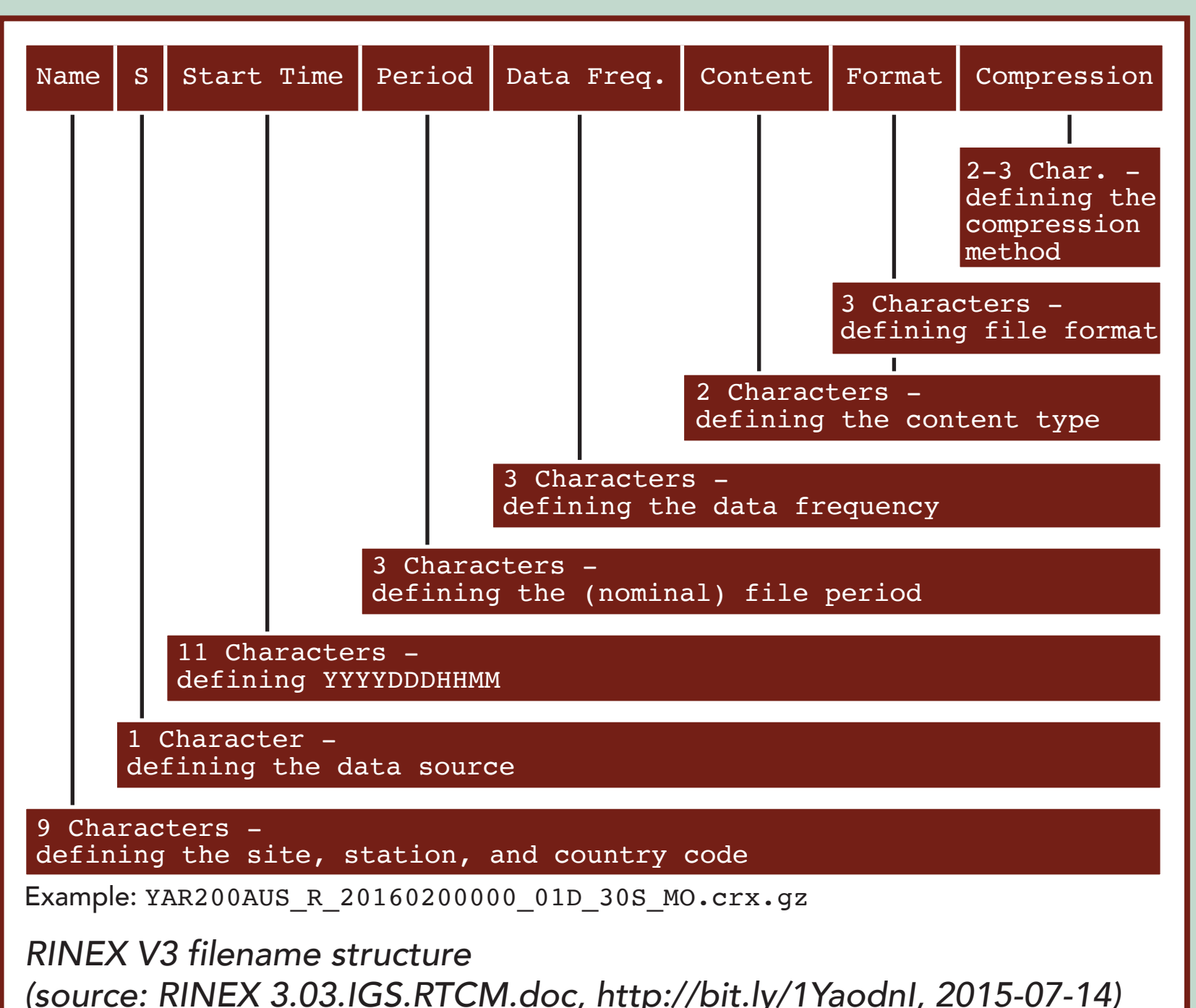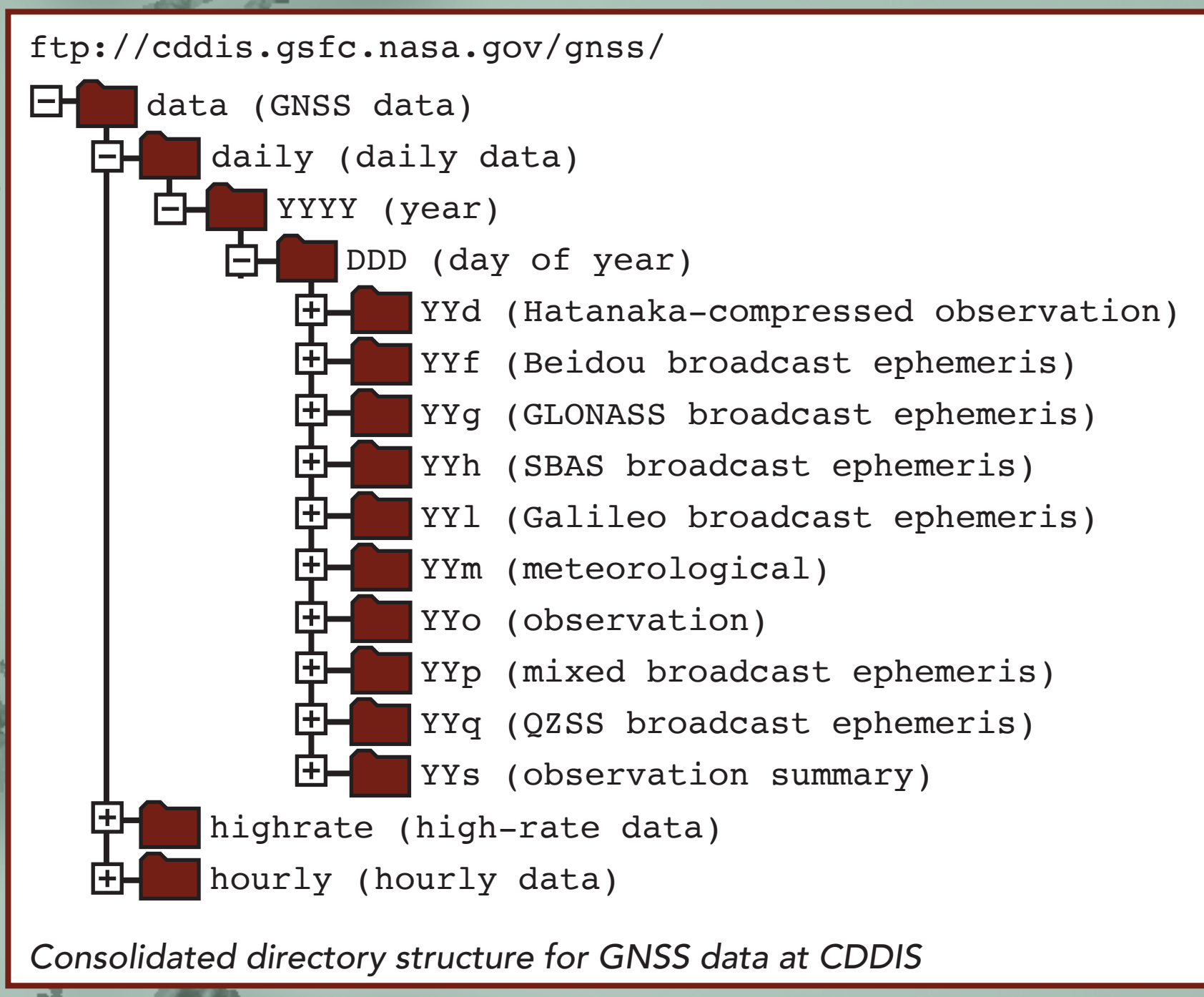## RINEX V3 GNSS Data Support and Integration

Background:
- CDDIS has supported the IGS Multi-GNSS Experiment (MGEX) since its start in early 2011
- Multi-GNSS data available in RINEX V3 format
- Data archived in a campaign directory structure at CDDIS and participating IGS data centers:
  `ftp://cddis.gsfc.nasa.gov/gnss/data/campaign/mgex`
- Thus, these data were archived separately from the official IGS network and operational data streams (files in RINEX V2/2.10/2.11 format), archived at:
  `ftp://cddis.gsfc.nasa.gov/gnss/data/daily`
  `ftp://cddis.gsfc.nasa.gov/gnss/data/hourly`
  `ftp://cddis.gsfc.nasa.gov/gnss/data/high-rate`
- IGS Infrastructure Committee (IC) developed a RINEX V3 transition plan to integrate these stations and data into the official, operational IGS infrastructure

Rationale for Integration:
- MGEX has been a successful activity for the IGS in data generation, transmission, archive, distribution, and analysis
- RINEX V3 is an adopted IGS standard (since 2012)
- Agreed upon goal from the 2014 IGS Workshop "one network and one archive"
- Files in RINEX V2 and RINEX V3 formats utilized same 8.3.Z filename format
- This filename format sometimes caused confusion/problems or data overwrites at DCs
- Used an old compression scheme; RINEX V3 filename format uses GZIP for compression

Implementation:
- IC's RINEX 3 transition plan specified steps to integrate V3 stations and their data into IGS operations
- In mid-2014, stations and operations centers began submitting data using the "long" filename format specified in the RINEX V3 documentation
- In November 2015, MGEX stations became IGS stations, i.e., part of the operational IGS network
- At CDDIS, and other DCs and starting with data from 2016, all RINEX V3 data using the RINEX V3 filenaming convention are archived in the "operational" GNSS data archive structure:
 `ftp://cddis.gsfc.nasa.gov/gnss/data/daily`
  `ftp://cddis.gsfc.nasa.gov/gnss/data/hourly`
  `ftp://cddis.gsfc.nasa.gov/gnss/data/highrate`
- Operational IGS data directories at CDDIS contain
  - Files using 8.3.Z naming convention in RINEX V2 format
  - Files using "long" naming convention in RINEX V3 format
- Implies GNSS data now available in both RINEX V2 and V3 formats in same operational subdirectories at CDDIS
- MGEX (campaign) data directories continue to contain files in RINEX V3 format using 8.3.Z naming convention:
  `ftp://cddis.gsfc.nasa.gov/gnss/data/campaign/mgex/daily`
  `ftp://cddis.gsfc.nasa.gov/gnss/data/campaign/mgex/hourly`
  `ftp://cddis.gsfc.nasa.gov/gnss/data/campaign/mgex/highrate`
- Therefore, data from multi-GNSS sites can be found in both directory structures with different filenames
- IGS station operators that can only support RINEX V2 can continue to do so during 2016

Near-Term Activities:
- Generate files using RINEX V3 filename format for those sites only supplying data in RINEX V3 format using short, 8.3.Z filenames
- Incorporate gfzrnx tool (*http://semisys.gfz-potsdam.de/semisys/*) in CDDIS operations to create these files
- Update daily status file format and other routine reports for RINEX V3 data supplied using long filenames

Consolidated directory structure for GNSS data at CDDIS

Daily status file showing RINEX V3 data available at CDDIS

*RINEX V3 filename structure
(source: RINEX 3.03.IGS.RTCM.doc, http://bit.ly/1Yaodnl, 2015-07-14)*

Status of Data Holdings Using RINEX V3 Filename Structure:
- Sources (#sites/type): ESA (9/D+H+HR), GA (21/D), BKG/Wettzell (9/D+H), IGN (2/D+H), ASI (1/D), ROB (1/D+H)
- 40+ sites providing daily data from 7 sources (~135 total sites provide daily data in RINEX V3 format)
- 16+ sites providing hourly data from 4 sources (~50 total sites provide hourly data in RINEX V3 format)
- 9 sites providing high-rate data from 1 source (~50 total sites provide high-rate data in RINEX V3 format)

RINEX V3 data available at the CDDIS
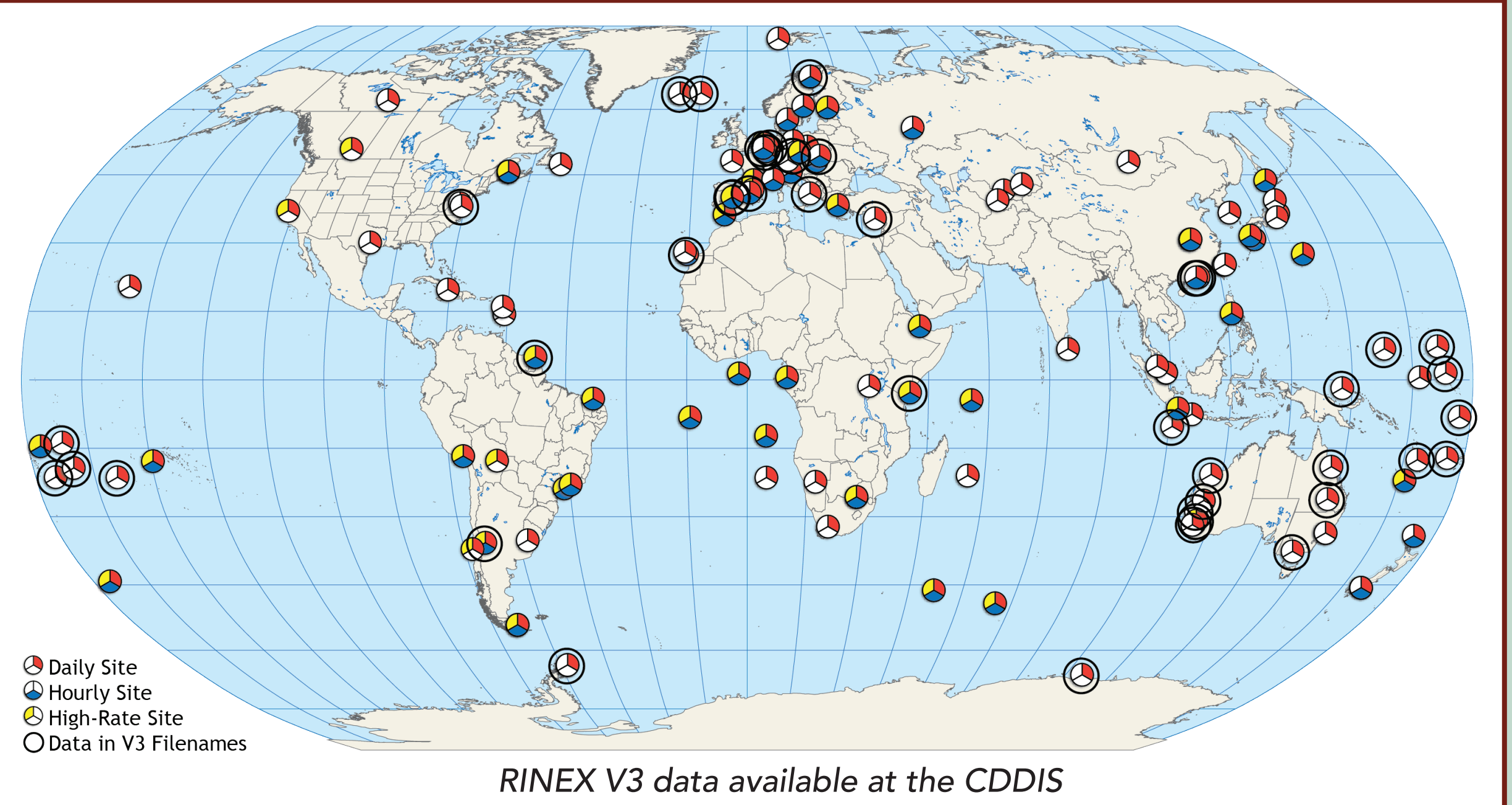
More Information/Feedback:

- The staff welcomes feedback on the CDDIS and in particular the ideas expressed in this poster; contact: Carey Noll (Carey.Noll@nasa.gov)