

ABSTRACT

The Crustal Dynamics Data Information System (CDDIS) provides essential support for the Global Geodetic Observing System (GGOS) by operating a data and product archive for the main geodetic techniques. As GGOS matures and grows, the CDDIS adopts the latest data practices to strengthen its support for the community and ensure quality products are available in a timely manner. To this end, the CDDIS is continually refining its software backend, performing developments such as the 2023 implementation of a middleware processing system, which is successfully being used in operation to provide GNSS-based Upper Atmospheric Realtime Disaster Information and Alert Network (GUARDIAN) and Global Differential GPS System (GDGPS) products. In addition, the CDDIS has 1) released new data and products, 2) performed updates to facilitate navigation of the archive, and 3) made it easier to cite the data and products being added. This poster explores the breadth of work done at the CDDIS and provides highlights of the latest developments.

What is CDDIS?

Overview

The CDDIS was established in 1982 and currently supports GGOS as an essential archive for geodetic data and products. Below is a list of the techniques the CDDIS supports and the QR code provides a link to the variety of data and products derived from these techniques:

- Global Navigation Satellite Systems (GNSS)
- Laser ranging – satellite (SLR) and lunar (LLR)
- Doppler Orbitography and Radio-positioning Integrated by Satellite (DORIS)
- Very Long Baseline Interferometry (VLBI)

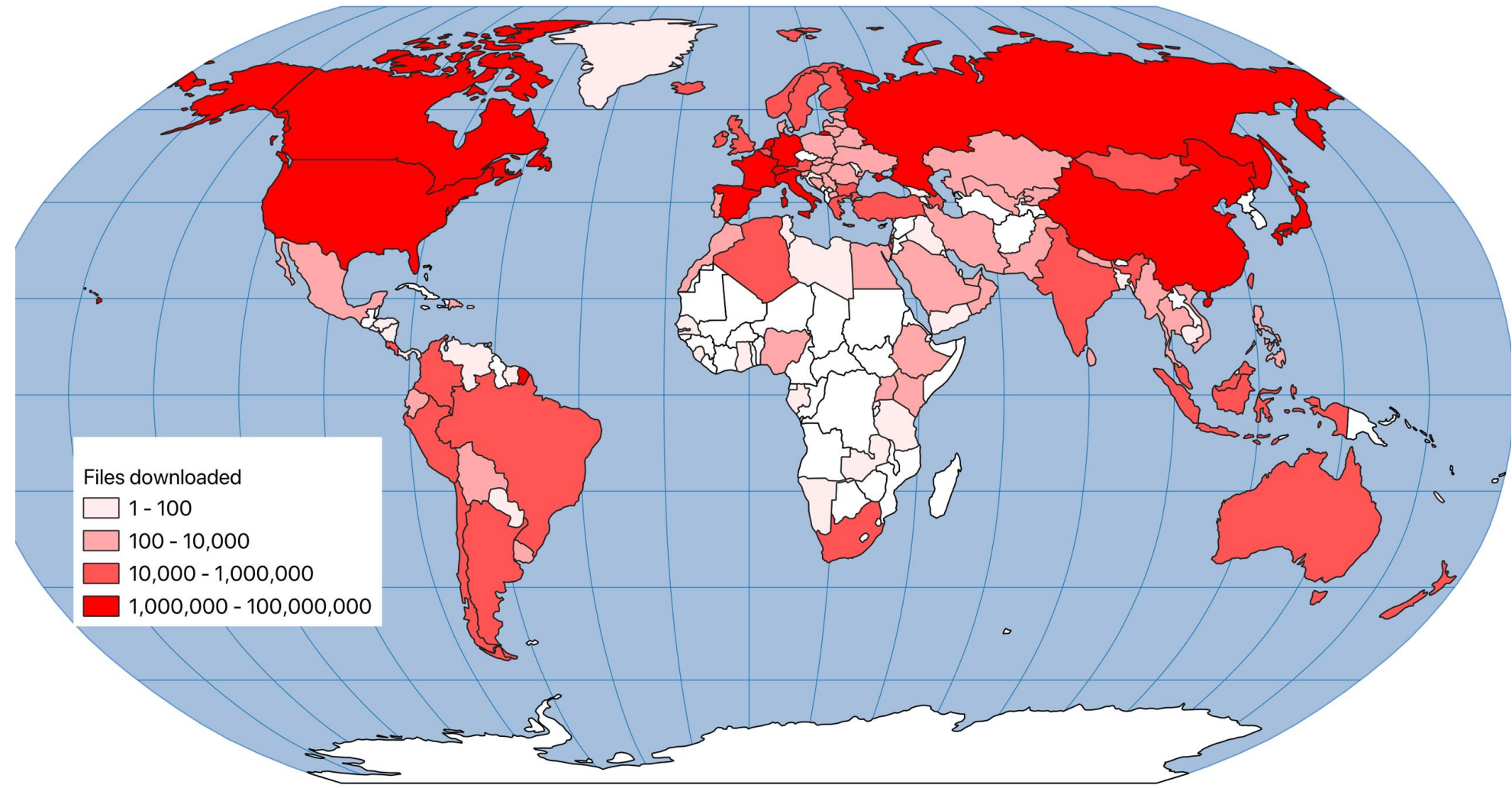


Figure 1: Total Number of Files Downloaded by Country from the CDDIS in 2023

Highlights

- A study of the IGS data centers found that there’s a high dependency on the CDDIS which is also the largest archive
- Updates and configuration improvements to hardware and software for GNSS Real-Time System shows improved performance for users
- IGS Analysis Center Coordinator (ACC) term will start January 1, 2025

NEW - VGOS and SWIN DATA

Description: The VGOS Database is comprised of Very Long Baseline Array (VLBI) level 2 observational and supporting data (including observations, standard deviations, station coordinates, and more) and derived products. They are stored and exchanged in the vgosDB format, the International VLBI Service for Geodesy and Astrometry (IVS) standard format for storing, transmitting, and archiving VLBI data. vgosDB datasets are comprised of NetCDF and ASCII files which contain almost all the information that is required to process a single VLBI session.

CDDIS
SWIN DOI
Landing
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VGOS DOI
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The CDDIS also stores the VLBI Distributed FX (DiFX) Level 1A correlator (raw) output as SWIN files. These constitute the primary VLBI dataset for a given experiment; all other data products are derived from analysis of the primary dataset, including vgosDB. The correlator output is a collection of files that provide the following:

1. Time series of auto-correlations at all the observing stations that participated in the experiment and cross-correlations between all baselines of observing stations
2. Time series of amplitudes and phases of phase calibration signals
3. Correlator control files
4. Auxiliary files created by the correlator and used during correlation
5. The metadata file.

Spectral and temporal resolution is variable.

NEW - ITRF2020

Description: "The ILRS contribution to ITRF2020 consists of a pair of time series of weekly and bi-weekly station position estimates along with daily and 3-day averaged Earth Orientation Parameters (X-pole, Y-pole and excess Length-Of-Day (LOD)) estimated over 7-day arcs (1993.0 – 2021.0) and 15-day arcs for the period 1983.0-1993.0, aligned to the calendar weeks (Sunday to Saturday), starting from January 1983. Each solution is obtained through the combination of loosely constrained weekly/biweekly solutions submitted by each of the seven official ILRS Analysis Centers. Both, the individual and combined solutions have followed strict standards agreed upon within the ILRS Analysis Standing Committee (ASC) to provide ITRS products of the highest possible quality." (The ILRS contribution to ITRF2020, E. C. Pavlis (GESTAR II/UMBC & NASA Goddard 61A) and V. Luceri (e-GEOS S.p.A., ASI/CGS))



Changes to Archive Structure for ITRF Versions:

Originally, the ITRF versions were spread over various directories. For clarity, the ITRFs were moved to: https://cddis.nasa.gov/archive/slr/products/REPRO_SERIES/

Note on the ITRF Analysis Center (AC) Files:

The ITRF AC files were used to create the ITRF combined solutions. These files are available, however quality control for format issues was not performed on the files under after they had been used to create the combined solution. A README file is available in the archive listing issues users may encounter:

https://cddis.nasa.gov/archive/slr/products/REPRO_SERIES/REPRO2020/ilrs2020_individual_ac/ReadMe.txt

NEW - Lunar Reconnaissance Orbiter-Laser Ranging (LRO-LR) Full-Rate Data

Description: Lunar Orbiter Laser Altimeter (LOLA) one-way laser ranging full rate data. These files contain the full rate data (all ranges collected) as delivered from the ground stations participating in one way ranging. Each file is an aggregate of full rate data collected for every station on a particular day. Note that this does not constitute the official data delivered by the LOLA mission; for these data, please visit the LOLA Planetary Data System listed in the reference. The ground station only data may be useful for those who wish to do their own transmit-receive pairing from onboard spacecraft data.



Landing Pages, DOIs, and Web Unification

Description: Digital Object Identifiers (DOIs) are key to ensuring credit is provided to data and product providers along with provenance tracking. The CDDIS has been working to update and create DOIs for all its data and product holdings. To ensure it’s easy for users to find the applicable DOIs for their work, ReadMe files which provide an overview of files available in the CDDIS archive, are being updated to include the landing pages. The landing pages contain through information about the data/products and include information on how to cite the data DOIs. The SLR README file has been updated to this standard and reflects recent archive reorganization efforts.

Please note that spring 2025, the CDDIS website will move from <https://cddis.nasa.gov/> to <https://earthdata.nasa.gov/>. This is due to the Web Unification Project led by NASA’s Earth Science Data Systems (ESDS), an effort to consolidate all Distributed Active Archive Center (DAAC) websites into the Earthdata website by 2026.

# Primary Directory Structure	
Below is a summary of the directory structure with applicable links to Landing Pages with DOIs. Please cite the DOIs in your publications. Please note that directories in bold indicates that the files in the directory are in the most recent format.	
## Data	
Directory	Data/Product and Landing Page
/slr/data/	Full-rate SLR data
/slr/data/fr/	Monthly and daily satellite full-rate files
/slr/data/fr/SNAME/YYYY/	- Monthly: https://cddis.nasa.gov/Data_and_Derived_Products/SLR/slr_data_monthly_fr.html
	- Daily: https://cddis.nasa.gov/Data_and_Derived_Products/SLR/slr_data_daily_fr.html
	Summary of the satellite full-rate files
/slr/data/fr/SNAME/YYYY/sum/	https://cddis.nasa.gov/Data_and_Derived_Products/SLR/slr_data_monthlysum_fr.html
/slr/data/fr/SNAME/daily/SSSS/	Daily satellite full-rate files
/slr/data/fr/SNAME/npt/	- Daily: https://cddis.nasa.gov/Data_and_Derived_Products/SLR/slr_data_daily_fr.html
/slr/data/fr_crd/	Monthly satellite normal point data and summary files from full-rate
/slr/data/fr_crd/SNAME/YYYY/	https://cddis.nasa.gov/Data_and_Derived_Products/SLR/slr_data_monthlysum_fr.html
	Full-rate SLR data (CRD V1 format)
/slr/data/fr_crd/SNAME/YYYY/sum/	Monthly and daily satellite full-rate files
	- Monthly: https://cddis.nasa.gov/Data_and_Derived_Products/SLR/slr_data_monthly_fr.html
	- Daily: https://cddis.nasa.gov/Data_and_Derived_Products/SLR/slr_data_daily_fr.html
/slr/data/fr_crd/SNAME/YYYY/sum/	Summary files for the monthly full-rate data
/slr/data/fr_crd/quarantine/SSSS/	https://cddis.nasa.gov/Data_and_Derived_Products/SLR/slr_data_monthlysum_fr.html
slr/data/fr_crd_v2/	Station quarantine data
/slr/data/fr_crd_v2/SNAME/YYYY/	Full-rate SLR data (CRD V2 format)
	Monthly and daily satellite full-rate files
	- Monthly: https://cddis.nasa.gov/Data_and_Derived_Products/SLR/slr_data_monthly_fr.html
	- Daily: https://cddis.nasa.gov/Data_and_Derived_Products/SLR/slr_data_daily_fr.html
/slr/data/fr_crd_v2/SNAME/YYYY/sum/	Summary files for the monthly full-rate data
	https://cddis.nasa.gov/Data_and_Derived_Products/SLR/slr_data_monthlysum_fr.html

Figure 2: Partial Screenshot of the SLR README File

System Updates for Improved Performance

Description: The CDDIS continuously works to improve its performance, resilience, and user experience. A focus on the backend has ensured improved reliability and data availability. Below, the CDDIS would like to highlight some of the key items developed this year:

Ingest Processing Software Upgrade - Version 4

Developed at the CDDIS, Version 4 of Ingest Processing is an improved software package that aims to meet the needs of data providers and users by ensuring conformity to standards and reducing delays in processing. Middleware processes the uploads immediately as they are uploaded, significantly reducing the delay from upload to archive placement.

Datasets are identified as distinct collections and incoming files are identified and processed accordingly. All incoming files are checked against generic software before moving to specific processing. At this point each incoming file is checked against ingest software that is written specifically for this dataset. Any errors are handled, and files that pass the quality checks are moved to the archive.

Advantages

- File in – file out processing
- Significantly improved ingest speeds
- Dedicated hardware for each technique
- Scalable architecture

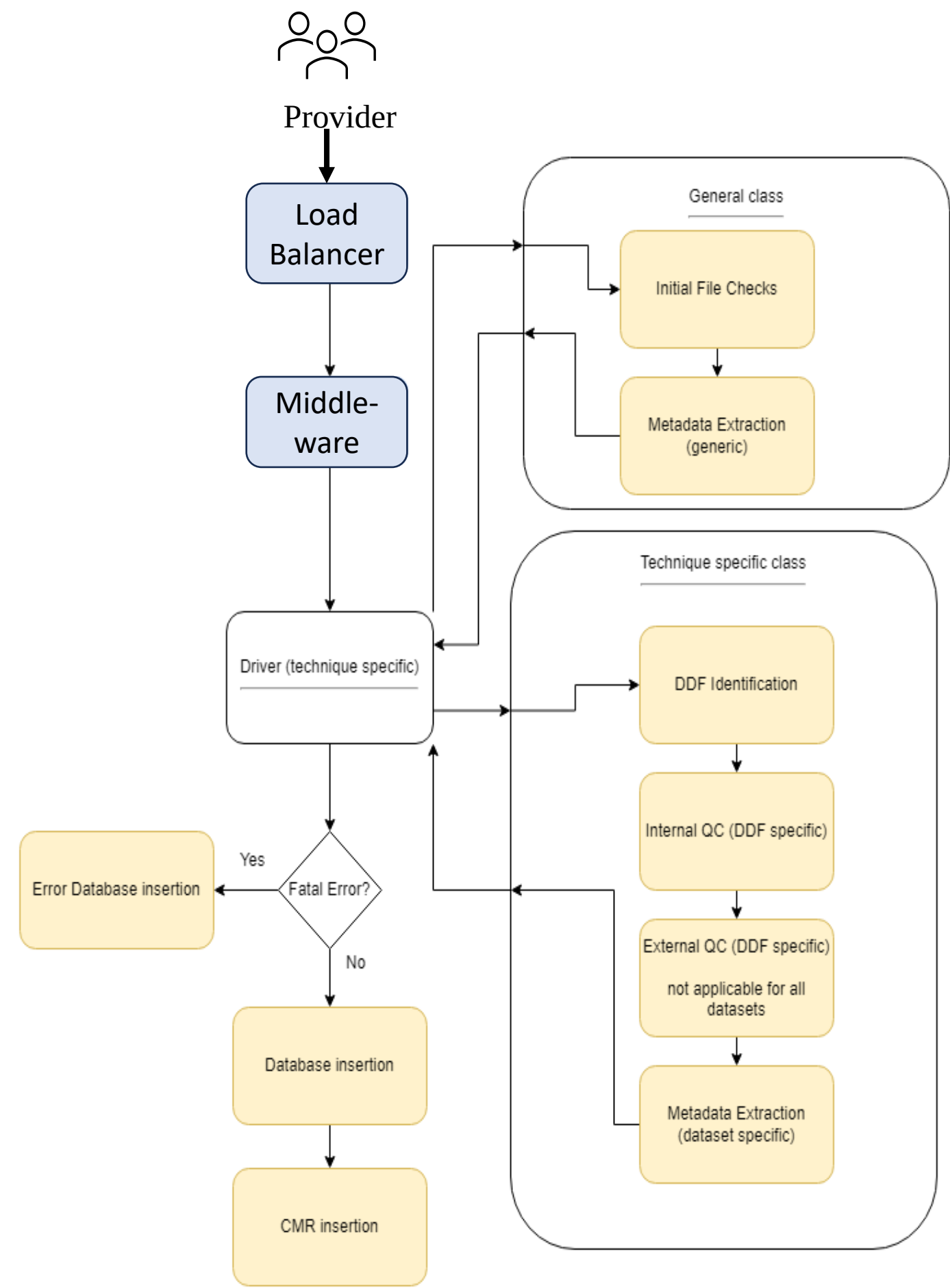


Figure 3: The CDDIS Processing V4 Software Flow Diagram

The CDDIS will be implementing this approach overtime to all the techniques

Database

- Memory related DB crashes issues removed with transition to new hardware that features twice as much RAM.
- Began maintaining physical restored backups of the cddis-metrics databases. Working towards automation of this process.
- Working towards maintaining automated physical restored backups of the cddis-web database.

Engineering

- Transition from 1Gb to 10Gb network connections for CDDIS’ real-time Networked Transport of RTCM via Internet Protocol (NTRIP) caster stream.
- Homogenization of CDDIS server operating systems.
- Many improvements to monitoring and maintenance procedures.

NASA Earth Science Cloud Migration

Description: The CDDIS has paused its transition to the Earthdata Cloud until further notice.

Please note that, even when the CDDIS transitions to the cloud, users will still be able to download data to their servers and the original archive structure will still be maintained. NASA’s ESDS is also investing in helping scientists transition to the cloud through training initiatives.

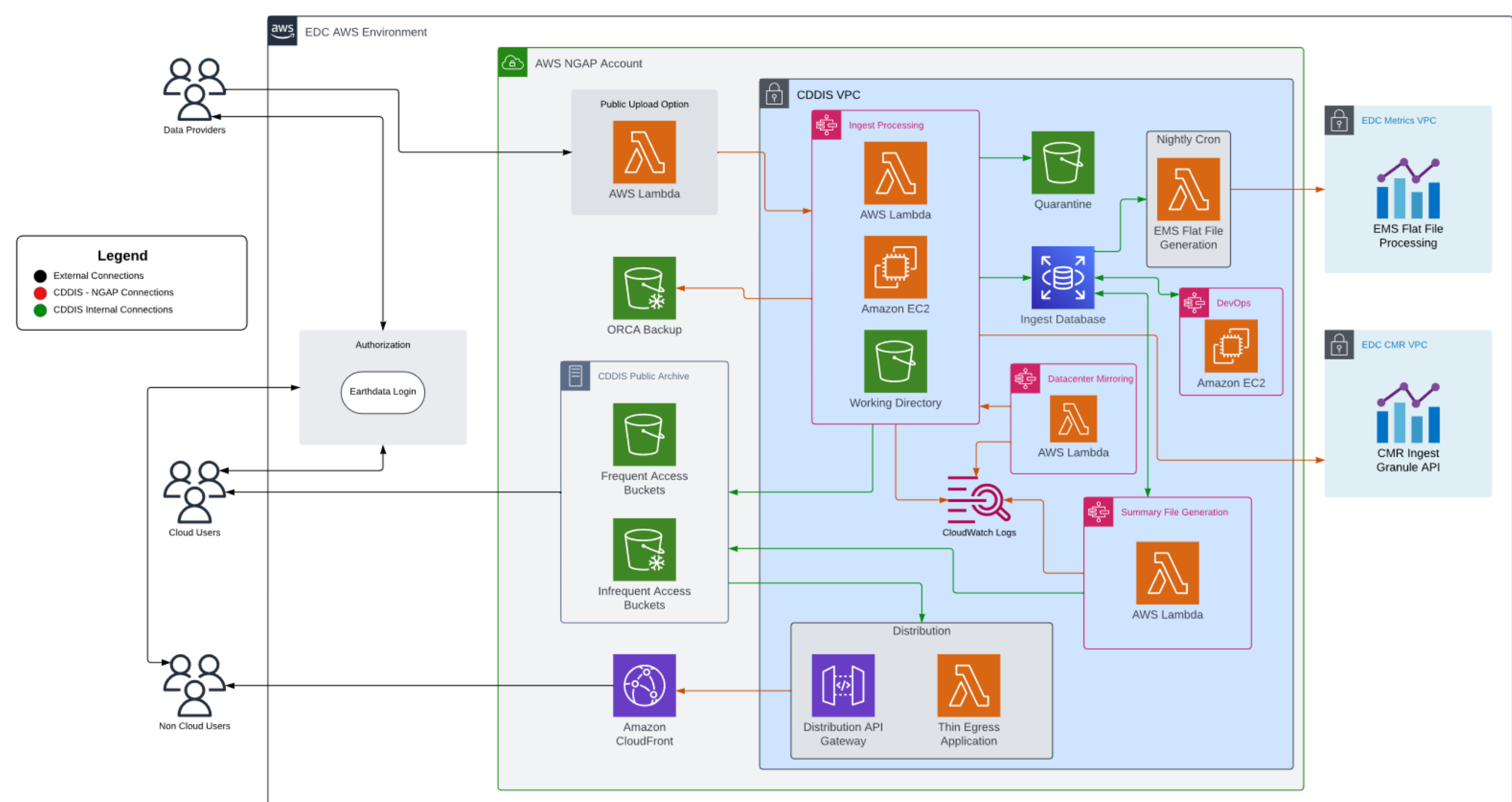


Figure 4: The CDDIS Flow Diagram for onboarding to the Cloud