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New Era, New Opportunity, Is GES DISC Ready for Big Data Challenge?

AGU American Geophysical Union

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NASA/Goddard EARTH SCIENCES DATA and INFORMATION SERVICES CENTER (GES DISC)

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Abstract

The new era of Big Data has opened doors for many new opportunities, as well as new challenges, for both Earth science research/application and data communities. As one of the twelve NASA data centers - Goddard Earth Sciences Data and Information Services Center (GES DISC), one of our great challenges has been how to help research/application community efficiently (quickly and properly) accessing, visualizing and analyzing the massive and diverse data in natural hazard research, management, or even prediction. GES DISC has archived over 2000 TB data on premises and distributed over 23,000 TB of data since 2010. Our data has been widely used in every phase of natural hazard management and research, i.e. long term risk assessment and reduction, forecasting and predicting, monitoring and detection, early warning, damage assessment and response.

The big data challenge is not just about data storage, but also about data discoverability and accessibility, and even more, about data migration/mirroring in the cloud. This paper is going to demonstrate GES DISC's efforts and approaches of evolving our overall Web services and powerful Giovanni (Geospatial Interactive Online Visualization ANd aNalysis Infrastructure) tool into further improving data discoverability and accessibility. Prototype works will also be presented.

Analysis Ready/Optimized Data Storage

Data stores optimized for temporal analysis - data rods

[2]Teng, W., H. Rui, R. Strub, and B. Vollmer, 2016. Optimal reorganization of NASA earth science data for enhanced accessibility and usability for the hydrology community, *Journal of the American Water Resources Association* (JAWRA), 52(4), 825-835, doi:10.1111/1752-1688.12405.

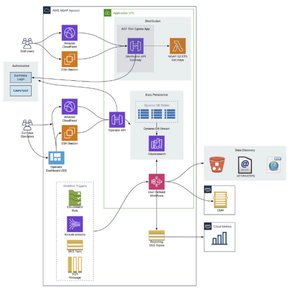
- Data rods is in on-prem production, will be migrated to Cloud in two years
- Both Parquet and Zarr are prototyped in Cloud Giovanni; one of them will be selected in Cloud production next year
- Both Parquet and Zarr can be deployed on-prem too

Analytics Optimized Data Stores – Parquet, Zarr

- Parquet is a columnar data store, which:
  - is highly compressible
  - provides efficient querying with SQL-like language
  - permits query of an entire data set spread across multiple files
  - is supported by big data frameworks, cloud providers
  - **but has no notion of "N-dimensional arrays"**
- Zarr is a Python implementation of chunked, compressed, N-dimensional arrays:
  - makes large datasets easily accessible to distributed computing
  - works well on both local file systems and cloud object stores (also for Parquet)
  - can store customized metadata alongside the data

Cloud Data Migration - Cumulus

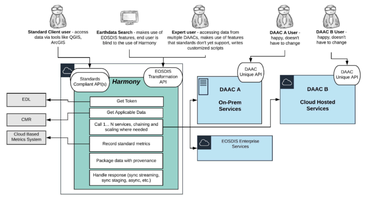
Cumulus Deployment Architecture



- Cumulus – ESDIS project for "native" cloud-based data ingest, archive, distribution and management system
- Benefit:
  - Scalable performance
  - Co-location of data to facility data fusion
- GES DISC is migrating two datasets (IMERG and MERRA2) to Earthdata cloud using Cumulus
- Expect to achieve parallel operation (in cloud and on-prem) by September 2020
- Future dataset migration includes:
  - AIRS L2
  - OCO 2/3 L2 data comparison
  - OMI and TROPOMI L2 Comparison
  - Selected L3 Data Rods

Cloud Data Services - Harmony

Harmony Architecture



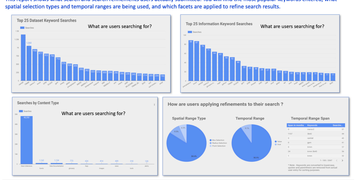
- Increase usage and ease of use of EOSDIS data
- Focus on opportunities when multiple DAAC's data all exist in the Earthdata Cloud
- Users can work seamlessly with data from different DAACs in ways previously not possible
- GES DISC is evaluating services to migrate to Harmony and expect to have some services in operation later in 2020

Deep Study User Metrics

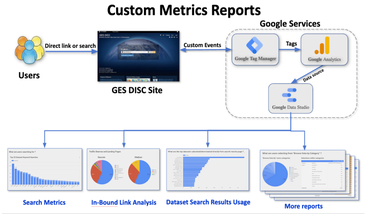
Standard "Out-of-the-box" Metrics

Search Metrics / Search Refinement Report (4/1/19 – 9/30/19)

This report shows what search and search refinements users actually submitted. You will find the most popular keywords entered, what spatial selection types and temporal ranges are being used, and which facets are applied to refine search results.

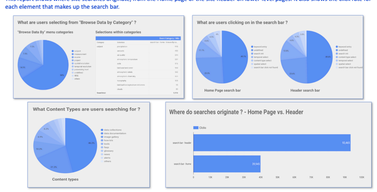


Custom Metrics Reports



Search Bar Usage Report (4/1/19 – 9/30/19)

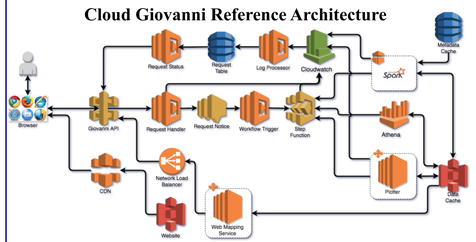
This report shows where site searches originate, from the Home page or the site header on lower-level pages. It also shows the click rate for each element that makes up the search bar.

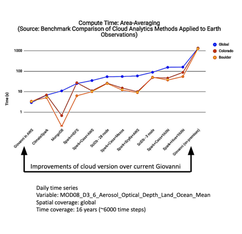


- Better understanding of user behavior
- Improve search relevancy
- Determine data service needs
- Future – use AI/ML to study user metrics

Cloud Giovanni

Cloud Giovanni Reference Architecture





- Achieved closed to fixed-cost (per request) both in clock time and dollar amount
- Extreme reduction in compute cost: < $5 per month for a service which operationally is a cause of frequent server overloading
- Portable Cloud-based data store
- Certain computationally intensive services saw a 500x increase in performance (from 1.5 hours to 11 seconds)
- Expected in Earthdata Cloud operationally next year.

Conclusions

- GES DISC is moving high-value data into AWS to test core archival functions and cloud analytics.
- For more information on GES DISC cloud efforts, please contact the author.

Acronyms

ESDIS - Earth Science Data and Information System
MERRA2 – Modern-Era retrospective analysis for Research and Applications, Version 2
OCO – Orbiting Carbon Observatory
DAAC - Data Active Archive Center
AIRS – Atmospheric Infrared Sounder
TROPOMI – Tropospheric Monitoring Instrument
IMERG – Integrated Multi-satellite Retrievals for GPM
OMI – Ozone Monitoring Instrument
EOSDIS – Earth Observing System Data and Information System

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- IN12B-14 - Integrated Analysis of Multiple User Metrics - A "Sequel"; and Introducing the Google Analytic
- IN13B-0708 - Cloud Giovanni: Reining in Costs and Improving Performance with Analytical Data Stores using Scalable Serverless Architecture