Federated Space-Time Query for Earth Science Data Using OpenSearch Conventions

ESIP Federated Search Cluster
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• Finding Earth science data: why so difficult???

• Space-Time Query with OpenSearch

• Client and server developments
Finding Earth science data: why so difficult???
Many phenomena require space-time searches for distributed data

- E.g., Effect of Arctic Oscillation on precipitation in Greenland
  - GC-Net station data
  - AO indices
  - AIRS atmospheric profiles
  - ECMWF model output
  - NCEP model output, etc.

- Potential data providers:
  - Large data centers
  - Universities
  - Data collection sites
  - Value-added providers
  - Individual investigators
Obtaining satellite data today is tedious, hit-or-miss

Step 1: Search through multiple directories for the right datasets
  – “Did I find them all?”

Steps 2-N:
  Foreach data_provider
    Learn_search_interface()
    Search_for_data_files()
    Fetch_data_files()
    Load_data_into_analysis_tool()
  End foreach

Ideally, you would want your analysis tool to find and fetch data based on the current work context
Space-Time Data Query with OpenSearch
OpenSearch is a simple, extensible, embeddable, machine-callable convention

- **www.opensearch.org**
  - “a collection of simple formats for the sharing of search results”
- **OpenSearch Description Document (XML)**
  - Describes a search engine so that it can be used by search clients (incl. Firefox and IE)
  - Specifies syntax for URL-based queries
  - Extensions proposed for Geospatial and Time queries
OpenSearch templates provide the keys to querying heterogeneous search engines

- **OpenSearch Description Document includes URL template:**

  ```xml
  <os:Url type="application/atom+xml" template="http://mirador.gsfc.nasa.gov/cgi-bin/mirador/granlist.pl?dataSet=AIRS2RET.005&page=1&maxgranules={count}&pointLocation={geo:box}&endTime={time:end}&startTime={time:start}&format=atom">
  ```

- **Just replace placeholders with search criteria and fetch the URL**
Data query with space and time works better as a 2-step process

- Search for datasets then granules (files) within selected datasets
- Most dataset-level queries have
  - small results set (dozens)
  - low precision: precision = desiderata / total
- Space-time granule queries for a given dataset have
  - large results set (tens of thousands)
  - high precision
- Combining both in one step would produce
  - enormous results set (dozens * tens of thousands)
  - with low precision

OpenSearch Description Documents provide a path to a recursive two-step search
Recursive OpenSearch begins with a dataset discovery phase.

Dataset Discovery

Granule Search

Client → Dataset Query Engine

dataset query → dataset results

Dataset Query Engine → OpenSearch Description Document Store

link to OpenSearch Description Document for granule-level search

Granule Query Engine
Dataset results link to OpenSearch Description documents

Dataset Discovery

Client → Dataset Query Engine

- dataset query
- dataset results

Granule Search

OpenSearch Description Request

OpenSearch Description Document Store

Granule Query Engine

with template for granule queries
Templates from OpenSearch Description
Documents enable granule query construction

Dataset Discovery

Client

Dataset Query Engine

dataset query

dataset results

OpenSearch Description Request

OpenSearch Description Document

Granule Query Engine

granule query

granule results

Granule Search
The ESIP Federated Search Cluster is defining conventions for a 2-step space time query

- Earth Science Information Partners
  - Consortium of >90 organizations working with remotely sensed Earth observation information
  - Clusters: focus groups to work specific topics

- Federated Search cluster for ESIP community conventions
  - 2-Step (Recursive) OpenSearch
Client and Server Developments
Federated OpenSearch aspects make adoption easier

- Simple / lightweight
- Standards-based, but extensible
- Embeddable
  - In web pages, documents, workflows, analysis tools...
A client can be as simple as an XSLT

- Attach a stylesheet to the OpenSearch Description Document
  - Renders the document in the browser as a search form
Several groups are developing servers and clients

- Servers following ESIP Federated Search conventions
  - ACCESS-NEWS
  - EOS Clearinghouse (ECHO)
  - Global Hydrology Resource Center
  - Goddard Earth Sciences Data and Information Services Center (GES DISC)*
  - MODIS Adaptive Processing System
  - National Snow and Ice Data Center

- Clients
  - Mirador (GES DISC)
  - Talkoot (University of Alabama--Huntsville)
  - Reference implementation / test script (GES DISC)*
Future Plans

• Develop / recruit clients

• Support access to Web Services
  – Format conversion, subsetting, OPeNDAP, OGC
  – Servicecasting
    • Atom-based approach to advertising services for ESIP data

• Shrink-wrapped toolset for deploying Recursive OpenSearch servers?
Federated space-time query can be
• lightweight
• inexpensive
• grassroots