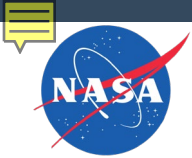




# Global Change Master Directory (GCMD) Keywords

An Overview - 12/5/2023

Valere Dixon ([valerie.dixon@nasa.gov](mailto:valerie.dixon@nasa.gov)), NASA ESDIS



# Way back in the 1990s...

... with the Landsat missions of the 70's and 80's fueling a growing demand for Earth science & observation data, NASA created the Global Change Master Directory (GCMD).

Around the same time, NASA became involved in the international Committee on Earth Observation Satellites ([CEOS](#)), and GCMD (by way of the International Directory Network ([IDN](#))) became NASA's main contribution to enabling international cooperation and collaboration of Earth Observation data.

A catalog for NASA's Earth Science data, the GCMD grew alongside the Earth Observing System Data and Information System ([EOSDIS](#)), which was conceived to archive and disseminate Earth science data.

It took 20 years for the two projects to officially merge within the Earth Science Data and Information System ([ESDIS](#)) Project, though the technologies of the two projects had been growing increasingly co-dependent for years.

Through all the consolidation and renaming of tools and applications, the [GCMD Keywords](#) - a hierarchical controlled vocabulary that describes Earth science data, services, variables and more - remain.

GCMD's Keywords remain essential to search and discovery and many core ESDIS services.



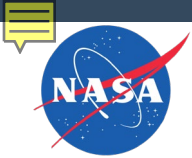
<https://ceos.org/>

<https://idn.ceos.org/index.html>

<https://www.earthdata.nasa.gov/eosdis>

<https://www.earthdata.nasa.gov/esdis>

<https://www.earthdata.nasa.gov/learn/find-data/idn/gcmd-keywords>



# GCMD Today

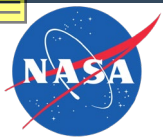
GCMD Keywords are ever-evolving to suit the needs of NASA's EOSDIS community. The following are current GCMD tools:

- The [GCMD Keyword Viewer](#) is a Graphical User Interface to navigate the GCMD Keyword hierarchies.
- The [Keyword Management System \(KMS\)](#) is a RESTful web service Application Programming Interface (API) for the GCMD Keywords, enabling access to the keywords as Simple Knowledge Organization System (SKOS) objects; there's also a [Static KMS Directory](#). See the [User's Guide](#) for more information.
- The [GCMD Keyword Forum](#), part of the Earthdata Forum, provides keyword users and metadata providers with an area for discussion of topics related to GCMD Keywords; to ask questions, submit keyword requests, discuss trade -offs, learn about Keyword releases, etc.



<https://gcmd.earthdata.nasa.gov/KeywordViewer/>  
<https://gcmd.earthdata.nasa.gov/kms/>  
<https://gcmd.earthdata.nasa.gov/static/kms/>

<https://wiki.earthdata.nasa.gov/display/ED/KMS+User%27s+Guide>  
<https://forum.earthdata.nasa.gov/app.php/tag/GCMD+Keywords>



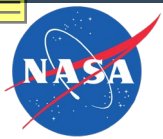
# GCMD Keyword Viewer

- While the Earth Science keyword category is most commonly known and referenced, GCMD Keywords house controlled vocabularies in many other categories too.
- The GCMD Keyword Viewer provides an easy to navigate interface that allows users to explore the various categories at length.

<https://gcmd.earthdata.nasa.gov/KeywordViewer/>



The screenshot displays the GCMD Keyword Viewer interface. At the top, there is a navigation bar with the NASA Earthdata logo, a search bar, and a 'Find a DAAC' dropdown. Below this, the main header shows 'EARTHDATA GCMD Keyword Viewer'. A search bar contains 'Keyword' and 'Version: 16.6', with a 'Timestamp: Tue Aug 15 11:58:57 EDT 2023' on the right. A sidebar on the left shows a tree view of categories: 'Keywords' > 'Earth Science' > 'AGRICULTURE' > 'AGRICULTURAL AQUATIC SCIENCES' > 'AQUACULTURE'. The main content area shows details for 'AQUACULTURE', including its full path, UUID (8916dafb-5ad5-45c6-ab64-3500ea1e9577), category (Earth Science), and 14 collections in CMR. It also includes a definition, a reference to the National Resources Inventory Glossary, and a link to 'AGRICULTURAL AQUATIC SCIENCES' under the 'Broader' section. A 'Change Logs' section with a 'More...' link is at the bottom.



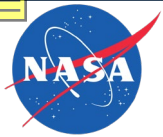
# KMS RESTful API

- The KMS is a RESTful API, allowing navigation through the URL itself.

```
<capabilities version="0.5">
  <software>
    <version>3.1.0</version>
    <build>KMS-23.2.4.2</build>
    <compiled>2023-06-11 04:20</compiled>
  </software>
  <documentation>
    https://wiki.earthdata.nasa.gov/display/ED/KMS+User%27s+Guide
  </documentation>
  <termsOfUse>
    https://cdn.earthdata.nasa.gov/conduit/upload/5182/KeywordsCommunityGuide_Baseline_v1_SIGNED_FINAL.pdf
  </termsOfUse>
  <urls>
    <a name="get_status" href="/status" params="format=[xml|html]" action="N/A"/>
    <a name="get_concept_fullpaths" href="/concept_fullpaths/concept_uuid/{conceptId}" params="None" action="GET"/>
    <a name="get_concept" href="/concept/{conceptId}[. {format}]" params="format=[rdf|xml]&version={label}" action="GET, PUT, DELETE"/>
    <a name="get_concept_schemes" href="/concept_schemes" params="version={label}" action="GET"/>
    <a name="get_concepts_by_scheme" href="/concepts/concept_scheme/{conceptScheme}" params="format=[rdf|xml|json|csv]&version={label}&page_num=&page_size=" action="GET, POST"/>
    <a name="get_concepts_by_scheme_pattern" href="/concepts/concept_scheme/{conceptScheme}/pattern/{pattern}" params="format=[rdf|xml]&version={label}" action="GET"/>
    <a name="get_concepts_all" href="/concepts" params="format=[rdf|xml]&version={label}" action="GET"/>
    <a name="get_concepts_root" href="/concepts/root" params="format=[rdf|xml]&version={label}" action="GET"/>
    <a name="get_concepts_by_pattern" href="/concepts/pattern/{pattern}" params="format=[rdf|xml]&version={label}" action="GET"/>
    <a name="get_concept_by_short_name" href="/concept/short_name/{short_name}" params="version=&scheme=" action="GET"/>
    <a name="get_concept_by_alt_label" href="/concept/alt_label/{alt_label}" params="version=&scheme=" action="GET"/>
    <a name="get_concept_versions" href="/concept_versions/version_type/{versionType}" params="None" action="GET"/>
  </urls>
</capabilities>
```

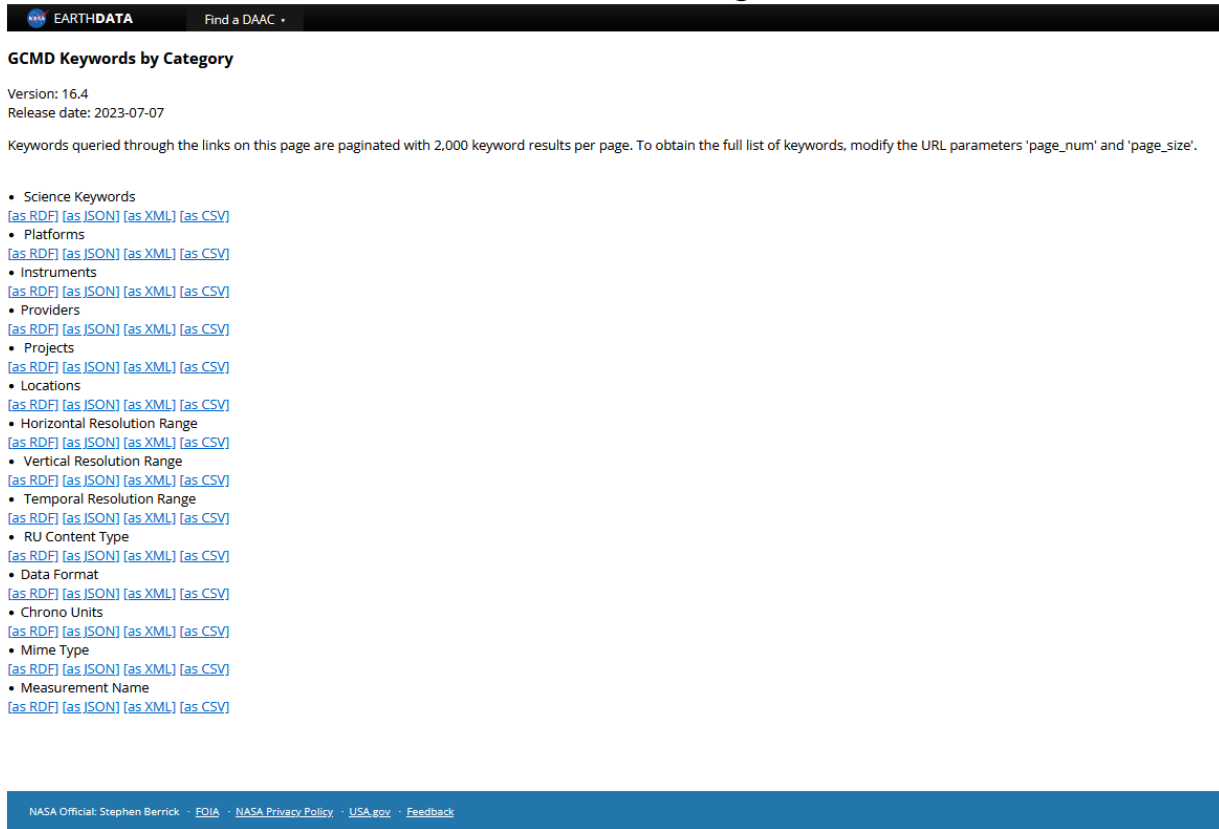
<https://gcmd.earthdata.nasa.gov/kms/>





# KMS Static Directory

- The Static Keyword Directory offers keyword categories as static RDF, JSON, XML, or CSV files.



The screenshot shows the top of the KMS Static Directory website. At the top left is the NASA logo. To its right is the text "EARTHDATA" with a small globe icon, and "Find a DAAC" with a dropdown arrow. Below this is the heading "GCMD Keywords by Category". Underneath, it says "Version: 16.4" and "Release date: 2023-07-07". A paragraph explains that keywords are paginated with 2,000 results per page and that URL parameters 'page\_num' and 'page\_size' can be used to get the full list. A long list of keyword categories follows, each with a bullet point and four links: "as RDF", "as JSON", "as XML", and "as CSV". The categories listed are: Science Keywords, Platforms, Instruments, Providers, Projects, Locations, Horizontal Resolution Range, Vertical Resolution Range, Temporal Resolution Range, RU Content Type, Data Format, Chrono Units, Mime Type, and Measurement Name.

**EARTHDATA** Find a DAAC ▾

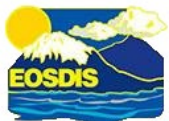
## GCMD Keywords by Category

Version: 16.4  
Release date: 2023-07-07

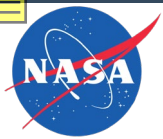
Keywords queried through the links on this page are paginated with 2,000 keyword results per page. To obtain the full list of keywords, modify the URL parameters 'page\_num' and 'page\_size'.

- Science Keywords  
[\[as RDF\]](#) [\[as JSON\]](#) [\[as XML\]](#) [\[as CSV\]](#)
- Platforms  
[\[as RDF\]](#) [\[as JSON\]](#) [\[as XML\]](#) [\[as CSV\]](#)
- Instruments  
[\[as RDF\]](#) [\[as JSON\]](#) [\[as XML\]](#) [\[as CSV\]](#)
- Providers  
[\[as RDF\]](#) [\[as JSON\]](#) [\[as XML\]](#) [\[as CSV\]](#)
- Projects  
[\[as RDF\]](#) [\[as JSON\]](#) [\[as XML\]](#) [\[as CSV\]](#)
- Locations  
[\[as RDF\]](#) [\[as JSON\]](#) [\[as XML\]](#) [\[as CSV\]](#)
- Horizontal Resolution Range  
[\[as RDF\]](#) [\[as JSON\]](#) [\[as XML\]](#) [\[as CSV\]](#)
- Vertical Resolution Range  
[\[as RDF\]](#) [\[as JSON\]](#) [\[as XML\]](#) [\[as CSV\]](#)
- Temporal Resolution Range  
[\[as RDF\]](#) [\[as JSON\]](#) [\[as XML\]](#) [\[as CSV\]](#)
- RU Content Type  
[\[as RDF\]](#) [\[as JSON\]](#) [\[as XML\]](#) [\[as CSV\]](#)
- Data Format  
[\[as RDF\]](#) [\[as JSON\]](#) [\[as XML\]](#) [\[as CSV\]](#)
- Chrono Units  
[\[as RDF\]](#) [\[as JSON\]](#) [\[as XML\]](#) [\[as CSV\]](#)
- Mime Type  
[\[as RDF\]](#) [\[as JSON\]](#) [\[as XML\]](#) [\[as CSV\]](#)
- Measurement Name  
[\[as RDF\]](#) [\[as JSON\]](#) [\[as XML\]](#) [\[as CSV\]](#)

NASA Official: Stephen Berrick · [EOIA](#) · [NASA Privacy Policy](#) · [USA.gov](#) · [Feedback](#)



<https://gcmd.earthdata.nasa.gov/static/kms/>



# KMS User's Guide

- The KMS User's Guide walks you through how to use either KMS functionalities.
- Note: KMS is primarily for programmatic use of GCMD's Keywords.

Earthdata Wiki Spaces

Pages / Earthdata Documentation / GCMD Keywords

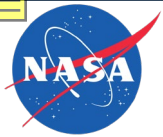
## KMS User's Guide

Created by Scott Ritz, last modified on Jan 26, 2023

- 1 Introduction
  - 1.1 SKOS Concept
- 2 REST paths
  - 2.1 Connections
  - 2.2 Concept Resource
  - 2.3 Concepts - Root
  - 2.4 Concepts - By Pattern
  - 2.5 Concepts - By Concept Scheme + Pattern
  - 2.6 Concepts By Alternate Label Resource
  - 2.7 Concepts By Full Path Resource
  - 2.8 Concepts Name Resource
  - 2.9 Concepts Relation Resource
  - 2.10 Concept Schemes Resource
  - 2.11 Concept Versions Resource
  - 2.12 Concepts In Concept Scheme Resource
- 3 Governance of Keywords
- 4 Keyword URLs
  - 4.1 KMS API Capabilities (Links to an XML formatted file)
  - 4.2 KMS Static Directory
  - 4.3 Keywords Community Forum
- 5 Contact Us



<https://wiki.earthdata.nasa.gov/display/ED/KMS+User%27s+Guide>



# GCMD Keyword Forum

- The GCMD Keyword Forum is where the keyword community, from scientists to metadata curators to academics, can propose and discuss changes or additions to the GCMD Keywords.
- It is also where new Keyword releases, which nominally occur every two weeks, are announced.

EARTHDATA Find a DAAC

GCMD Keywords are the Newest Addition to the Earthdata Forum. See the [Announcement](#).

EARTHDATA Forum

Welcome to the Earthdata User Forum! Here, subject matter experts from several NASA Distributed Active Archive Centers (DAAC) can discuss general questions, research needs and data applications. Users can query how to access, view and interpret the data.

Quick links FAQ Data Recipes Login

Home GCMD Keywords

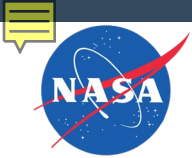
### GCMD Keywords

New Question Search this forum

9 questions Page 1 of 1

QUESTIONS	REPLIES	LAST POST
<b>GCMD Keyword Forum Transitions To The New Earthdata Forum</b> by <b>tstevens</b> » Wed May 19, 2021 7:46 am America/New_York GCMD Keywords	0	by <b>tstevens</b> View the latest post Wed May 19, 2021 7:46 am America/New_York
<b>ASDC Request for New GCMD Keywords</b> by <b>mebuzano</b> » Tue May 18, 2021 11:18 am America/New_York GCMD Keywords	3	by <b>sriz</b> View the latest post Tue May 18, 2021 3:59 pm America/New_York
<b>Prior GCMD Keyword Releases</b> by <b>tstevens</b> » Mon May 17, 2021 3:42 pm America/New_York GCMD Keywords	0	by <b>tstevens</b> View the latest post Mon May 17, 2021 3:42 pm America/New_York
<b>New GCMD keywords for GRACE/GRACE-FO mission</b> by <b>wenhaoli</b> » Tue May 11, 2021 1:07 pm America/New_York GCMD Keywords Ocean	5	by <b>wenhaoli</b> View the latest post Mon May 17, 2021 3:10 pm America/New_York
<b>NASA GCMD Keywords Version 10.1 Released (2021-05-14)</b> by <b>sriz</b> » Fri May 14, 2021 1:25 pm America/New_York GCMD Keywords	0	by <b>sriz</b> View the latest post Fri May 14, 2021 1:25 pm America/New_York





# Keyword Uses in EOSDIS

A consistent vocabulary is crucial to enabling programmatic search & discovery and compatibility across tools and services.

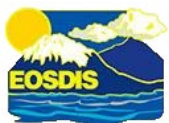
- CMR and Earthdata Search rely on the controlled vocabularies of GCMD Keywords to work
- Keyword changes and additions come through the Forum, with broad potentially impactful changes put through an ESDIS Standards Coordination Office (ESCO) community review
  - <https://www.earthdata.nasa.gov/esdis/esco>

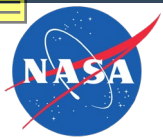
GCMD Keywords has also contributed to Machine Learning (ML) tooling:

- GCMD Keyword Recommender (GKR), embedded within our Metadata Management Tool, suggests science keywords to curators
  - GKR is an ML-driven application that suggests science keywords to metadata curators based on a collection metadata record's abstract and description
- Science Services Keywords have been recently introduced to describe ML Training and Model data

Inter-agency collaboration:

- NOAA/USGS/NASA re-consolidation of Science Keywords
  - Atmosphere and Oceans keywords reconciled and released in GCMD (v10.0 and v12.0, respectively)
  - Sun-Earth Interactions in progress
- CEOS partner agencies use various GCMD Keywords in their Earth Observation collection metadata...
  - [Numerous United States and International Agencies](#)
- ...which is housed in the ESDIS Common Metadata Repository (CMR) and made discoverable via the IDN at:  
<https://search.earthdata.nasa.gov/search?portal=idn>
  - IDN is a portal of Earthdata Search, the ESDIS search client that makes NASA and CEOS Earth Science data (CMR's contents) discoverable





# Earthdata Search

Search Client for CMR

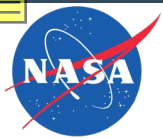
Search & Facet filters  
based off of CMR Tags  
and GCMD Keywords

The screenshot displays the Earthdata Search web application. At the top, there is a search bar with the text "Search for collections or topics". Below the search bar, there are navigation icons and a "Filter Collections" section. The filter section includes a "Features" dropdown and a "Keywords" section with "2 Selected" items. The "Atmosphere" category is checked, and a list of sub-categories with their respective counts is shown:

- Atmosphere
- Aerosols 702
- Air Quality 439
- Altitude 382
- Atmospheric Chemistry 1257
- Atmospheric Chemistry/Carbo... 7
- Atmospheric Chemistry/Halon... 2
- Atmospheric Chemistry/Nitrog... 7
- Atmospheric Chemistry/Oxyg... 6
- Atmospheric Electricity 60
- Atmospheric Phenomena
- Drought 1
- Storms 2
- Atmospheric Pressure 592
- Atmospheric Radiation 1079
- Atmospheric Temperature 1068
- Atmospheric Water Vapor 1313
- Atmospheric Winds 655

The main content area shows "3 Matching Collections". The first collection is "MODIS/Terra Temperature and Water Vapor Profiles 5-Min L2 Swath 5km - NRT", with 1,811 granules and a status of "2017-10-11 ongoing". The second collection is "MODIS/Aqua Temperature and Water Vapor Profiles 5-Min L2 Swath 5km - NRT", with 1,818 granules and a status of "2017-10-20 ongoing". The third collection is "Vegetation Drought Response Index (VegDRI)", with 0 granules and a status of "1970-01-01 ongoing". A map on the right side of the interface shows a geographical view of the United Kingdom and France, with a scale bar indicating 1000 km and 500 miles.





# GCMD Keyword Recommender (GKR)

Within the Metadata Management Tool, the GKR suggests science keywords based on other content within the collection metadata; in this case, the test record's abstract consisted of:

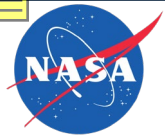
*“Test file for water vapor and humidity in tropical jungles”*

and the GKR suggested these Atmosphere keywords



The screenshot shows the EarthData Metadata Management Tool (MMT) interface. The top navigation bar includes the NASA logo, 'EARTHDATA Metadata Management Tool', a search bar, and a user profile for Valerie Dixon. Below the navigation bar, there are tabs for 'MANAGE COLLECTIONS', 'MANAGE VARIABLES', 'MANAGE SERVICES', 'MANAGE TOOLS', and 'MANAGE CMR'. A green notification banner at the top indicates 'Collection Draft Updated Successfully!'. The main content area shows the 'Descriptive Keywords' section, with a 'Save & Jump To:' dropdown menu set to 'Descriptive Keywords'. Below this, there is a section for 'Science Keywords' with a 'Recommended Keywords' box. The box contains the following text: 'Based on your Abstract, the MMT automatically suggests recommended keywords [RECOMMENDED] for your collection. To associate a recommended keyword to your collection, click the [icon] next to the keyword. Once associated to the collection, the keyword will display a green check [checkmark]. To remove a keyword once it's been associated, click the [icon] next to the keyword.' Below this text is a list of recommended keywords, each with a plus sign icon: 'EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC WINDS > UPPER LEVEL WINDS [RECOMMENDED]', 'EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC PRESSURE > ATMOSPHERIC PRESSURE MEASUREMENTS [RECOMMENDED]', 'EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC WATER VAPOR > WATER VAPOR INDICATORS > HUMIDITY [RECOMMENDED]', 'EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC TEMPERATURE > UPPER AIR TEMPERATURE [RECOMMENDED]', 'EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC TEMPERATURE > SURFACE TEMPERATURE > AIR TEMPERATURE [RECOMMENDED]', 'EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC CHEMISTRY > OXYGEN COMPOUNDS > OZONE [RECOMMENDED]', 'EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC WATER VAPOR > WATER VAPOR INDICATORS > WATER VAPOR [RECOMMENDED]', and 'EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC TEMPERATURE > SURFACE TEMPERATURE > DEW POINT TEMPERATURE [RECOMMENDED]'. At the bottom, there is a search bar for keywords with 'EARTH SCIENCE' entered.





# GCMD Tomorrow

## Hierarchical keywords -> Semantic Ontology!

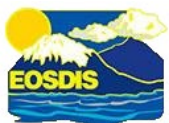
- But how...? When? With what resources?
- Earth Science Information Partners (ESIP) Semantic Web for Earth and Environmental Terminology (SWEET) is a start, maybe

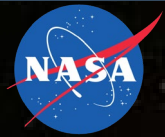
## Knowledge Graph?

- We use GraphQL and GraphDB for metadata associations in CMR
- Currently lack the expertise and priority to look into how to use Graph for GCMD Keywords and/or associations, but there's a path started

## Low-Hanging Fruit

- Create Unique ID's for each Keyword
  - And cite *those* in metadata so minor keyword updates don't invalidate records





# Thank you!

Please reach out any time!

Valerie Dixon

[valerie.dixon@nasa.gov](mailto:valerie.dixon@nasa.gov)

NASA Earth Science Data & Information System

<https://www.earthdata.nasa.gov/>