



NASA GCMD Keywords

CEOS WGISS-47

Silver Spring, Maryland, USA, April 29-May 2, 2019

Hosted by the National Oceanic and Atmospheric
Administration (NOAA)

Michael Morahan IDN Coordinator

Michael.P.Morahan@nasa.gov

Tyler Stevens

tyler.b.stevens@nasa.gov



What Are The GCMD Keywords?

- Hierarchical set of controlled vocabulary covering Earth science disciplines that have been evolving for over 25 years.
- Contains
 - 12 published keyword types
 - Over 11,000 unique keywords
 - More than 100 defined keyword relationships

GCMD Earth Science Keywords

 AGRICULTURE (2094) agricultural aquatic sciences, agricultural chemicals, agricultural engineering, agricultural plant science, animal commodities show all...	 ATMOSPHERE (3427) aerosols, air quality, altitude, atmospheric chemistry, atmospheric electricity show all...
 BIOLOGICAL CLASSIFICATION (4299) animals/invertebrates, animals/vertebrates, bacteria/archaea, fungi, plants show all...	 BIOSPHERE (8176) ecological dynamics, ecosystems, vegetation show all...
 CLIMATE INDICATORS (684) atmospheric/ocean indicators, biospheric indicators, cryospheric indicators, land surface/agriculture indicators, paleoclimate indicators show all...	 CRYOSPHERE (3284) frozen ground, glaciers/ice sheets, sea ice, snow/ice show all...
 HUMAN DIMENSIONS (4251) boundaries, economic resources, environmental governance/management, environmental impacts, habitat conversion/fragmentation show all...	 LAND SURFACE (6423) erosion/sedimentation, frozen ground, geomorphic landforms/processes, land use/land cover, landscape show all...
 OCEANS (11549) aquatic sciences, bathymetry/seafloor topography, coastal processes, marine environment monitoring, marine geophysics show all...	 PALEOCLIMATE (1619) ice core records, land records, ocean/lake records, paleoclimate reconstructions show all...
 SOLID EARTH (3145) earth gases/liquids, geochemistry, geodetics, geomagnetism, geomorphic landforms/processes show all...	 SPECTRAL/ENGINEERING (3174) gamma ray, infrared wavelengths, lidar, microwave, platform characteristics show all...
 SUN-EARTH INTERACTIONS (445) ionosphere/magnetosphere dynamics, solar activity, solar energetic particle flux, solar energetic particle properties show all...	 TERRESTRIAL HYDROSPHERE (3520) glaciers/ice sheets, ground water, snow/ice, surface water, water quality/water chemistry show all...

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



Implementing Keywords and Relationships

1. Add Keyword
2. Add Alternate Label
3. Add Resource
4. Add Definition
5. Add Reference
6. Add Related Keyword

Each keyword created has a universally unique identifier (UUID) that does not change.

GCMD Keyword Editor

Edit Keyword | Reset Form | Print Keyword | Close Window

Keyword UUID: ea7fd15d-190d-43f3-bdd3-75fd88dc3f8

Broader Keyword: Platforms>Earth Observation Satellites

Preferred Label: Aqua

Alternate Label(s)

alternate	AQUA (AFTERNOON EQUATORIAL CROSSING TIME SATELLITE)	Remove
outdated	AQUA	Remove
primary	Earth Observing System, Aqua	Remove

Add Alternate Label

Resource(s)

image	https://gcmd.gsfc.nasa.gov/KeywordSearch/default/images/aqua.gif	Remove
provider	https://aqua.nasa.gov/	Remove

Add Resource

Definition: Aqua is a major international Earth Science satellite mission centered at NASA. Launched on May 4, 2002, the satellite has six different Earth-observing instruments on board and is named for the large amount of information being obtained about water in the Earth system from its stream of approximately 89 Gigabytes of data a day. The water variables being measured include almost all elements of the water cycle and involve water in its liquid, solid, and vapor forms. Additional variables being

Definition Reference: Enter reference for keyword definition

Related Keyword(s)

AMSR-E (instruments)	Remove	Edit
AMSU-A (instruments)	Remove	Edit
CERES-FM3 (instruments)	Remove	Edit
CERES-FM4 (instruments)	Remove	Edit
HSB (instruments)	Remove	Edit
MODIS (instruments)	Remove	Edit
AIRS (instruments)	Remove	Edit



A Look Behind The Scenes

Request for a list of platforms and their relationship to an instrument (AQUA has several related instruments):

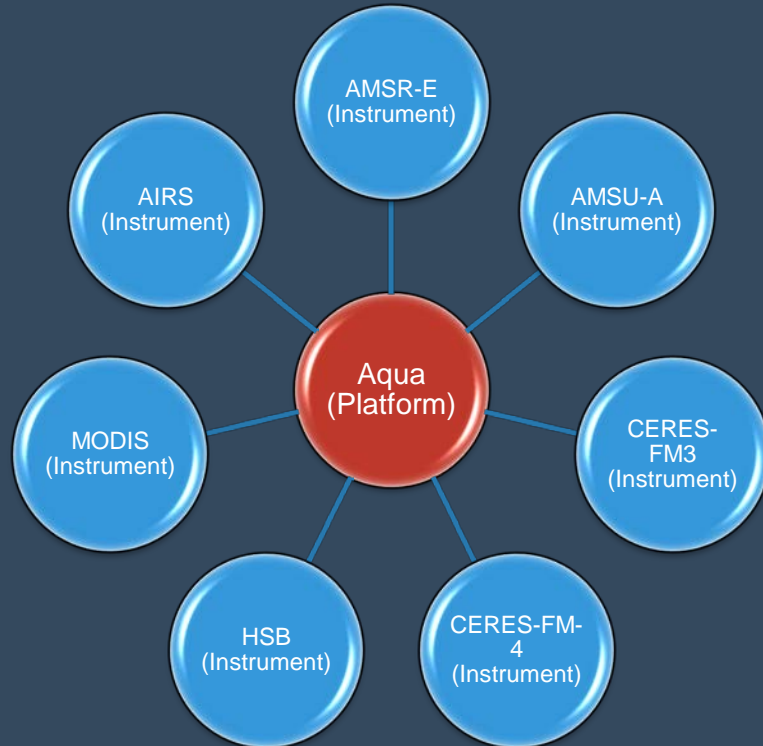
https://gcmdservices.gsfc.nasa.gov/kms/concept_relation/?scheme=platform_s&relation_type=has_instrument

```
{"prefLabel": "AQUA",  
  "scheme": "platforms",  
  "uuid": "ea7fd15d -190d-43f3-bdd3-75f5d88dc3f8",  
  "relatedConcepts": [  
    {"prefLabel": "AMSR -E",  
      "relationType": "has_instrument",  
      "uuid": "736038ef -c1ae-47c7-a50e-729474eeb3b1",  
      "scheme": "instruments"},  
    {"prefLabel": "AMSU -A",  
      "relationType": "has_instrument",  
      "uuid": "2a393a42 -ecf9-4137-b1ea-1c25692384b4",  
      "scheme": "instruments"}]
```



Visualizing Keyword Relationships

The example below shows a relationship between Platforms and Instruments. These instruments fly on the Aqua satellite.





Keyword Relationship Use Case: GCIS

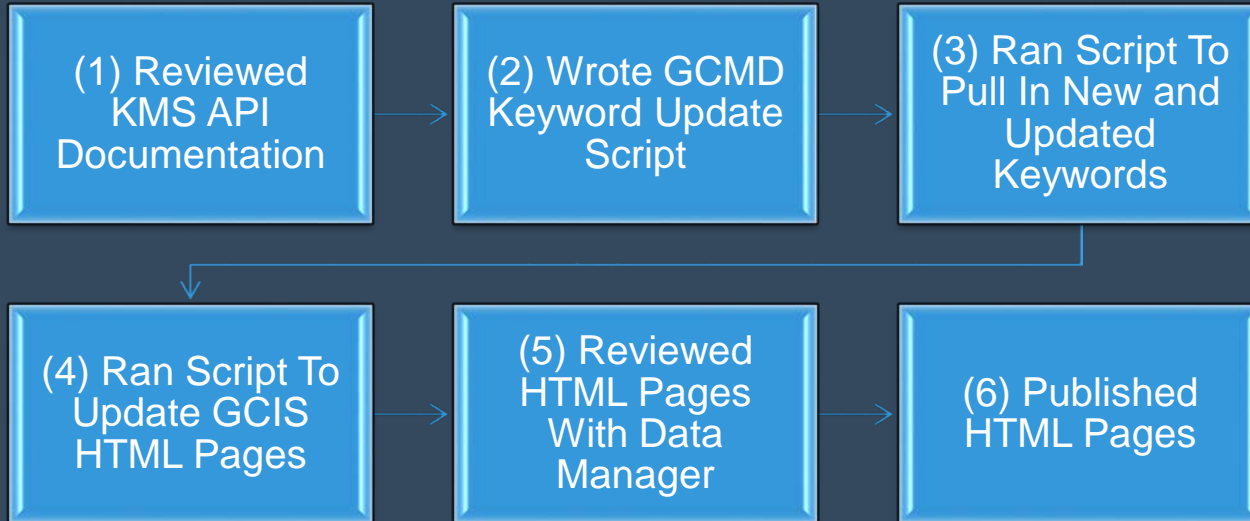
The Global Change Information System (GCIS) wanted to implement GCMD science keywords and associated relationships to describe figures, tables, chapters, etc. in the Fourth National Climate Assessment (NCA4).

<https://data.globalchange.gov/report/nca4/>

- Background:
 - The GCIS is working with NASA's Inter Agency Implementation and Advanced Concepts (IMPACT) team to improve the discovery of global change resources.
 - The MSFC IMPACT team is collaborating with the GCMD/IDN team to identify gaps in keywords based on the NCA4 review.
 - The GCMD is implementing keyword changes and defined relationships based on the gap analysis.

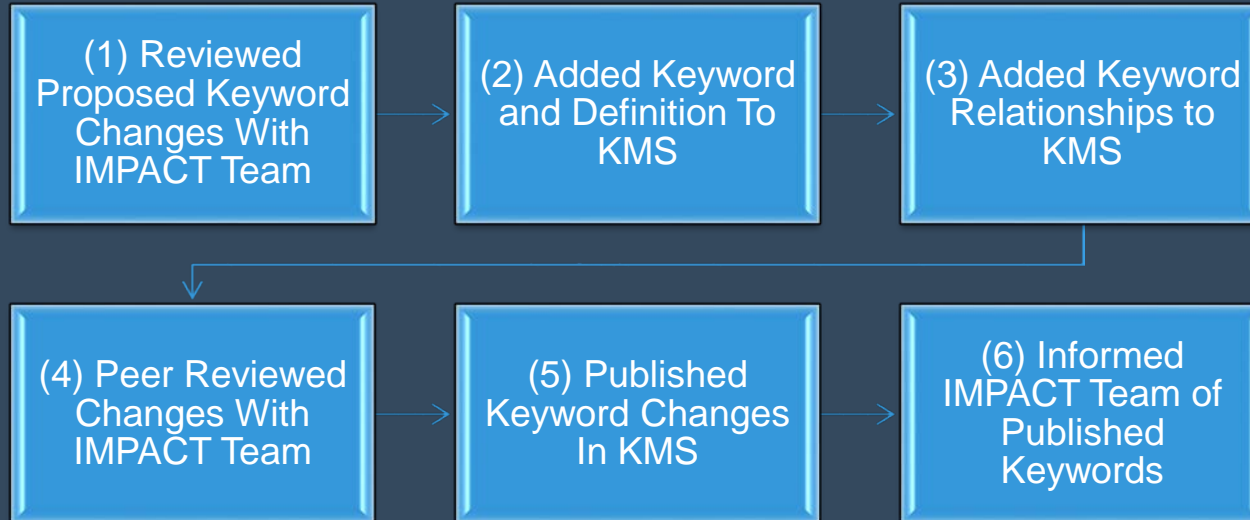


GCIS Implementation Process





GCMD Implementation Process





Result: GCIS Publication Page

USGCRP GCIS

Figure : precipitation-and-humidity-projections

Drying Effect of Warmer Air on Plants and Soils

Figure 21.3
North Carolina State University
Kenneth E. Kumkei

This figure appears in [chapter 21 of the impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment, Volume II report](#).

As air temperature increases in a warming climate, vapor pressure deficit (VPD) is projected to increase. VPD is the difference between how much moisture is in the air and the amount of moisture in the air at saturation (at 100% relative humidity). Increased VPD has a drying effect on plants and soils, as moisture transpires (from plants) and evaporates (from soil) into the air. (a) Cooler air can maintain less water as vapor, putting less demand for moisture on plants, while warmer air can maintain more water as vapor, putting more demand for moisture on plants. (b, c) The maps show the percent change in the moisture deficit of the air based on the projected maximum 5-day VPD by the late 21st century (2070–2099) for (b) lower and (c) higher scenarios (RCP4.5 and RCP8.5). Sources: U.S. Forest Service, NIOAA NCEI, and GCIS-NC.

Figure may be copyright protected and permission may be required. Contact original figure source for information.

This figure was created on May 30, 2017.
This figure was submitted on December 03, 2015.

This figure is composed of these images :

Regions Covered

- Midwest

Related NASA GCMD @ keywords

- HUMIDITY
- CLIMATE CHANGE IMPACT ASSESSMENT MODELS
- VAPOR PRESSURE
- EVAPOTRANSPIRATION
- PLANTS

You are viewing [/report/nca4/chapter/midwest/figure/precipitation-and-humidity-projections](#) in [HTML](#)

Alternatives: [JSON](#) [YAML](#) [Turtle](#) [ii Triplex](#) [JSON Triplex](#) [RDY+XML](#) [RDY+JSON](#) [Graphviz](#) [SVG](#)

GlobalChange.gov

<https://data.globalchange.gov/report/nca4/chapter/midwest/figure/precipitation-and-humidity-projections>



Result: GCIS Keyword Reference

USGCRP GCIS Search

gcmd_keyword : WATER VAPOR INDICATORS>HUMIDITY

[JSON](#) [YAML](#) [text](#) [HTML](#) [Turtle](#) [N-Triples](#) [JSON Triples](#) [RDF+XML](#) [RDF+JSON](#) [Graphviz](#) [SVG](#)

/gcmd_keyword/427e5121-a142-41cb-a8e9-a70b7f98eb6a

Relationships

publications	figure 21.3	finding 21.1			
gcmd_keywords	HUMIDITY>ABSOLUTE HUMIDITY	HUMIDITY>HUMIDITY MIXING RATIO	HUMIDITY>RELATIVE HUMIDITY	HUMIDITY>SATURATION SPECIFIC HUMIDITY	HUMIDITY>SPECIFIC HUMIDITY
parent	ATMOSPHERIC WATER VAPOR>WATER VAPOR INDICATORS				

Fields

definition	Generally, some measure of the water vapor content of air.
identifier	427e5121-a142-41cb-a8e9-a70b7f98eb6a
label	HUMIDITY
parent_identifier	005d192a-95b9-4fc2-afed-f07da3c3dc33
GCMD Metadata	427e5121-a142-41cb-a8e9-a70b7f98eb6a
Ancestors	HUMIDITY < WATER VAPOR INDICATORS < ATMOSPHERIC WATER VAPOR < ATMOSPHERE < EARTH SCIENCE < Science Keywords

GlobalChange.gov
U.S. Global Change Research Program

https://data.globalchange.gov/gcmd_keyword/427e5121-a142-41cb-a8e9-a70b7f98eb6a



Result: Related Publications



finding 21.1 : key-message-21-1

The Midwest is a major producer of a wide range of food and animal feed for national consumption and international trade. Increases in warm-season absolute humidity and precipitation have eroded soils, created favorable conditions for pests and pathogens, and degraded the quality of stored grain (*very likely, very high confidence*). Projected changes in precipitation, coupled with rising extreme temperatures before mid-century, will reduce Midwest agricultural productivity to levels of the 1980s without major technological advances (*likely, medium confidence*).

This finding is from chapter 21 of [Impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment, Volume II](#).

Process for developing key messages:

The chapter lead authors were identified in October 2016, and the author team was recruited in October and November 2016. Authors were selected for their interest and expertise in areas critical to the Midwest with an eye on diversity in expertise, level of experience, and gender. The writing team engaged in conference calls starting in December 2016, and calls continued on a regular basis to discuss technical and logistical issues related to the chapter. The Midwest chapter hosted an engagement workshop on March 1, 2017, with the hub in Chicago and satellite meetings in Iowa, Indiana, Michigan, and Wisconsin. The authors also considered other outreach with stakeholders, inputs provided in the public call for technical material, and incorporated the available recent scientific literature to write the chapter. Additional technical authors were added as needed to fill in the gaps in knowledge.

Discussion amongst the team members, along with reference to the Third National Climate Assessment and conversations with stakeholders, led to the development of six Key Messages based on key economic activities, ecology, human health, and the vulnerability of communities. In addition, care was taken to consider the concerns of tribal nations in the northern states of the Midwest. The Great Lakes were singled out as a special case study based on the feedback of the engagement workshop and the interests of other regional and sector chapters.

Note on regional modeling uncertainties

Interaction between the lakes and the atmosphere in the Great Lakes region (e.g., through ice cover, evaporation rates, moisture transport, and modified pressure gradients) is crucial to simulating the region's future climate (i.e., changes in lake levels or regional precipitation patterns). ¹² Globally recognized modeling efforts (i.e., the Coupled Model Intercomparison Project, or CMIP) do not include a realistic representation of the Great Lakes, simulating the influence of the lakes poorly or not at all. ³⁴⁵⁶⁷ Ongoing work to provide evaluation, analysis, and guidance for the Great Lakes region includes comparing this regional model data to commonly used global climate model data (CMIP) that are the basis of many products practitioners currently use (i.e., NCA, IPCC, NOAA State Climate Summaries). To address these challenges, a community of regional modeling experts are working to configure and utilize more sophisticated climate models that more accurately represent the Great Lakes' lake-land-atmosphere system to enhance the understanding of uncertainty to inform better regional decision-making capacity (see <http://glisa.umich.edu/projects/great-lakes-ensemble> for more information).

Description of evidence base:

Humidity is increasing. Feng et al. (2016) ⁸ show plots of trends in surface and 850 hPa specific humidity of 0.4 and 0.2 g/kg/decade, respectively, from 1979–2014 for the April–May–June period across the Midwest. These represent increases of approximately 5% and 3% per decade, respectively. Automated Surface Observing Stations in Iowa ⁹ having dew point records of this length and season show dew point temperature increases of about 1°F per decade. Brown and DeGaetano (2013) ¹⁰ show increasing dew points in all seasons throughout the Midwest. Observed changes in annual average maximum temperature for the Midwest over the 20th century (Vose et al. 2017, ¹¹ Table 6.1) have been less than 1°F. However, future projected changes in annual average temperature (Vose et al. 2017, ¹¹ Table 6.4), as well as in both warmest day of the year and warmest 5-day 1-in-10-year events (Vose et al. 2017, ¹¹ Table 6.5), are higher for the Midwest than in any other region of the United States.

<https://data.globalchange.gov/report/nca4/chapter/midwest/finding/key-message-21-1>



GCIS Script Details

USGCRP / [gcis-scripts](#) Watch 10 Star 0 Fork 12

Code Issues 0 Pull requests 0 Projects 0 Insights

Branch: master

[gcis-scripts / qa_scripts / update_gcmd_keywords /](#) Create new file Find file History

lomky GCMD 8.6 Update Latest commit def6bd on Apr 25, 2018

..

log	GCMD 8.6 Update	11 months ago
README.md	GCMD 8.6 Update	11 months ago
example_gcmd.xml	Created an update script for GCMD keywords. Bumps USGCRP/gcis#335	a year ago
update_gcmd_keywords.pl	GCMD 8.6 Update	11 months ago

README.md

GCMD Keyword Updating

Purpose

This script, when run, will update the GCMD keywords to the latest versions available from GCMD's XML endpoint.

A GCMD Keyword can have four states:

- **Up to date** - no changes are made in GCIS.
Checking keyword [...] - (Science Keywords) up to date
- **New** - this keyword is new to GCIS. Keyword is added to GCIS. Checking keyword [...] - (SNOW PELLETS) new to GCIS
- **Changed**
 - **Data** - the label and/or definition have changed. GCIS is updated.
Checking keyword [...] - (EARTH SCIENCE) label/definition differs!
 - **Moved** - the GCMD parent keyword is different. GCIS is updated.
Checking keyword [...] - (FLIGHT LEVEL WINDS) moved!
 - **Both** - label/definition and parent keyword differs. GCIS is updated twice.
Checking keyword [...] - (TURBULENCE) label/definition differs! (TURBULENCE) moved!
- **Defunct** - GCMD no longer has this keyword. GCIS is **not updated**.
Removing these keywords is a manual process. See [below](#)
Checking keyword [...] - (HYDROMETEORS) now defunct

See the [example_gcmd.xml](#) for the output format the script expects.



Conclusions

- GCMD keywords continue to evolve based on feedback from U.S. and international agencies, research universities, and scientific institutions.
- Implementing keyword relationships can be used to improve search and discovery of Earth science data and information.
- The process defined here could be reusable for other providers who want to implement the GCMD keywords and see associated relationships.
- You can contribute keywords by contacting the GCMD staff or sending an email to support@earthdata.nasa.gov.



Questions

Please provide questions/comments to:

michael.p.morahan@nasa.gov (KBR/WYLE)

valerie.dixon@nasa.gov (NASA)

christopher.s.lynnes@nasa.gov (NASA)



Background Information



Keyword Landing Page

- Learn More about the Keywords
- Access the GCMD Keywords
- Submit a Keyword Request
- See Keyword Release Announcements
- Review the Keyword Governance Document

SEARCH FOR ARTS, NEWS, ACTORS, AND INFORMATION

About EOSDS • Global Change Master Directory (GCMD) • Global Change Master Directory (GCMD) Keywords

GCMD Keyword Links (Earthdata Wiki)

Access the GCMD Keywords
Submit a Keyword Request
Keyword Release Announcements
Keyword Community Forum

More Resources

Global Change Master Directory (GCMD)
Common Metadata Repository (CMR)
EOSDIS Standards Office (ESO)
Keyword Governance and Community Guide Document
GCMD Keyword Viewer (Alpha)

Global Change Master Directory (GCMD) Keywords

The GCMD Keywords are a hierarchical set of controlled Earth Science vocabularies that help ensure Earth science data and services are described in a consistent and comprehensive manner and allow for the precise searching of collection-level metadata and subsequent retrieval of data and services. Initiated over twenty years ago, the GCMD Keywords are periodically analyzed for relevancy and will continue to be refined and expanded in response to user needs. The categories of GCMD Keywords are as follows.

- Earth Science
- Earth Science Services
- Data Centers
- Projects
- Instruments/Sensors
- Platforms/Sources
- Locations
- Horizontal Data Resolution
- Vertical Data Resolution
- Temporal Data Resolution
- URL Content Types
- Chronostratigraphic Units

The information provided on this page seeks to define how the GCMD Keywords are structured, used and accessed. It also provides information on how users can participate in the further development of the keywords.

GCMD Keyword Community Forum

The GCMD Keyword Community Forum provides keyword users and metadata providers with an area for discussion of topics related to the GCMD Keywords. Participants are invited to use this forum to ask questions, submit keyword requests, discuss trade-offs, and track the status of keyword requests.

More Information About the Keywords

- GCMD Keyword Structure
- Community Use of GCMD Keywords
- GCMD Keyword Governance and Community Guide Document

<https://earthdata.nasa.gov/about/gcmd/global-change-master-directory-gcmd-keywords>



GCMD KMS API

- The Keyword Management Service (KMS) is a RESTful web service for maintaining and accessing the keywords.
 - Retrieve the keywords as SKOS Concepts (RDF, JSON, OWL), XML, and CSV
 - Retrieve defined keyword relationships
 - Retrieve previous versions
 - Retrieve in different case (Native, Title Case, Upper Case, Lower Case)
 - Search by keyword pattern (i.e. Search by 'Terra')
- Help Documentation
 - <https://wiki.earthdata.nasa.gov/x/gwxNBQ>