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Abstract

Description of the use of vocabularies in the CLIPC project, based on the NERC Vocabulary Servers.

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CAPACITIES

Content

Introduction

CLIPC will provide as much as possible technical documentation, explanation of terms used, and links to existing technical documentation. This part is covered by several services:
Providing definitions and documentation of the calculation and processing services implemented in the portal to generate the Tier 1, Tier 2 and Tier 3 data products.
Providing definitions of the search terms in the data discovery service
Make use of the definitions and hierarchy in the SeaDataNet / NERC vocabularies
Use references to CCI documentation, which is loosely structured. Planned to import/map to BODC vocabularies via SKOS.

For the data discovery service and well as technical documentation the integration and extension of the NERC vocabulary services is a key development within the CLIPC project. A short overview will be provided in this chapter. More information on the background and use is provided in Annex 3.
CLIPC climate datasets are very diverse in origin. Although they are often already harmonised within their domain, the syntax and semantics is different. Using standardised vocabularies is a very important step in harmonised discovery and access to datasets. The NERC Vocabulary Service can assist in mapping the discovery terms to 1 single system, to optimise search and discovery.

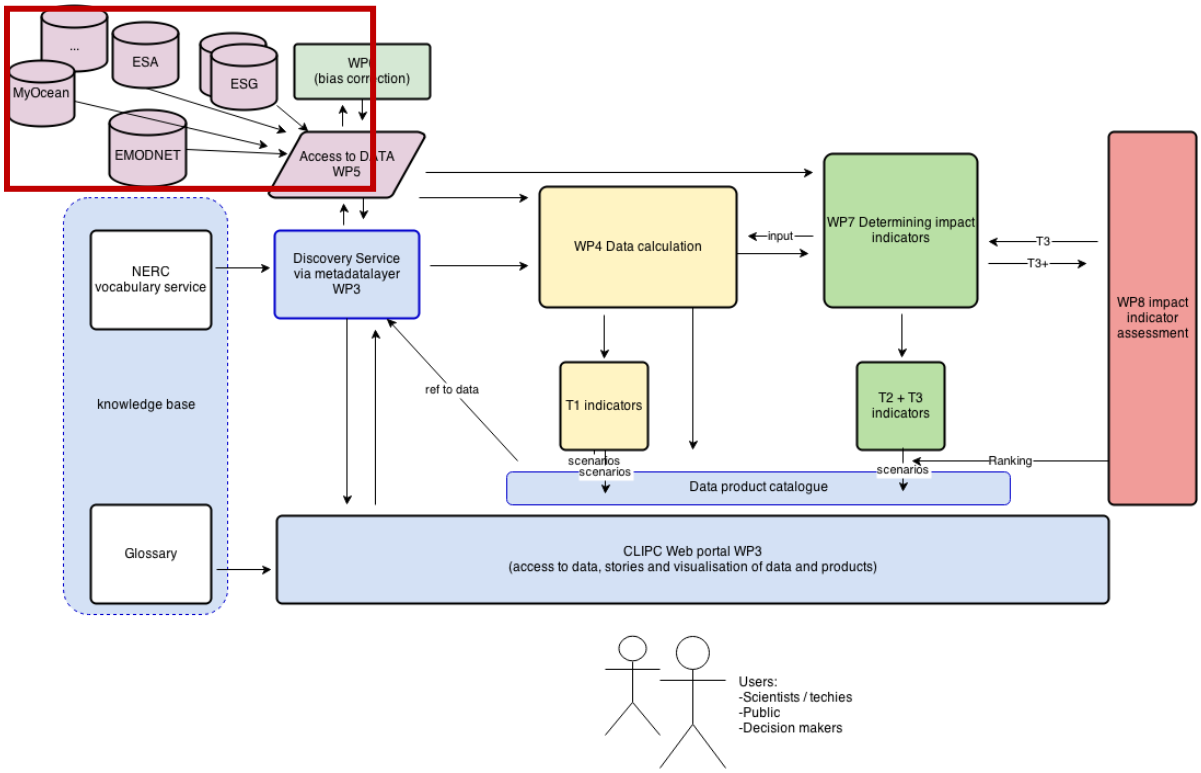
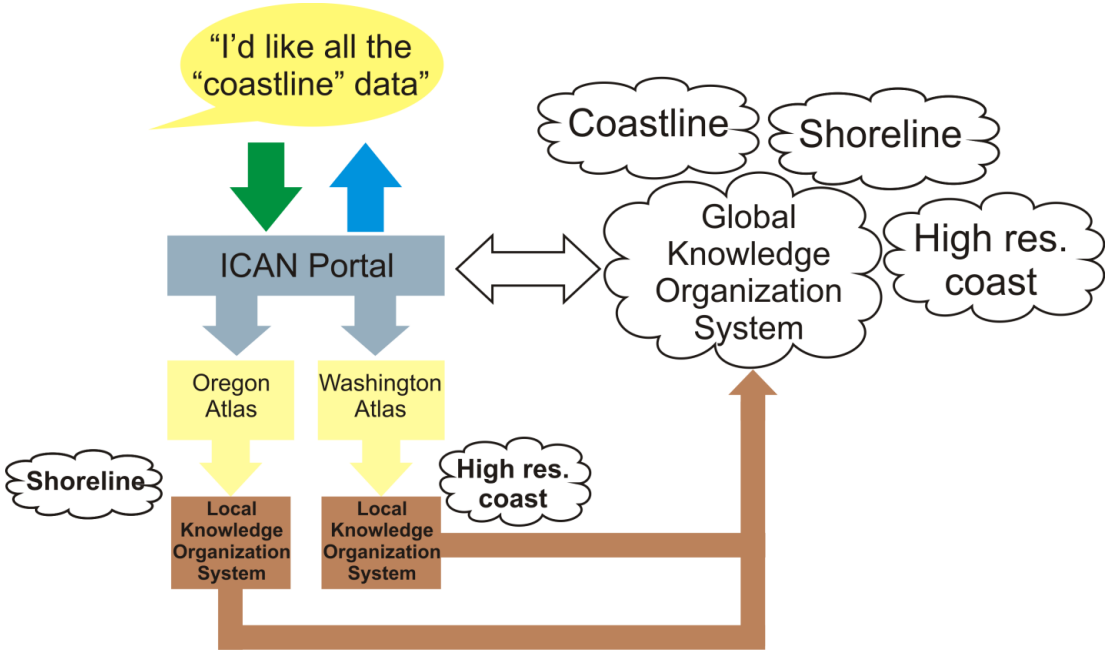


Figure: Position of vocabulary service to support search in various data infrastructures

Why use a "knowledge organization system"?

One scenario for using knowledge organization systems is to search through the local data catalogues for a given data keyword from a central portal. For example, as illustrated below, a user arrives at the portal and requests "coastline" data. The portal software is connected to a global knowledge organization system which is aware that "coastline" is related to both "shoreline" and "high resolution coastline". The user request and this information from the global knowledge organization system are then passed on to the local atlases which search on "coastline", "shoreline" and "high resolution coastline". The local atlases then return the relevant data to the portal and then to the user. This is an implementation of so-called "smart-search"[1].



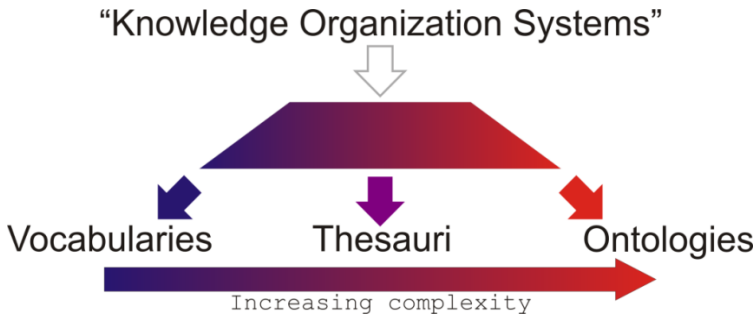
A diagram illustrating one use for knowledge organization systems.

Other uses of knowledge organization systems include populating metadata elements with standardized content which can be verified and validated by software services; dynamically populating drop down lists in websites and software applications; dynamically moving a metadata record from one metadata scheme to another; and the validation of input parameters and their associated units in Open Geospatial Consortium Web Processing Services.

1. What are vocabularies, thesauri and ontologies?

Knowledge organization systems fall broadly into three groups: vocabularies, thesauri and ontologies. These three groups show increasing complexity in their structure as illustrated in the diagram below.

[1] Latham, S. E.; Cramer, R.; Grant, M.; Kershaw, P.; Lawrence, B. N.; Lowry, R.; Lowe, D.; O'Neill, K.; Miller, P.; Pascoe, S.; Pritchard, M.; Snaith, H.; Woolf, A. (2009) The NERC DataGrid services. *Philosophical Transactions of the Royal Society A*, 367 (1890). 1015-1019.



The "semantic spectrum" shows the increasing complexity of different forms of knowledge organization system. After McGuinness (2003)[2].

A vocabulary can be either a list of terms or a list of terms and some text providing a definition of the term. A vocabulary ensures that terms are used, and spelt, consistently. A vocabulary can be extended in its power by providing definitions of concepts.

Thesauri expand the knowledge contained within a vocabulary by adding information about the relationships between the terms of the vocabulary. These relationships fall broadly into three categories:

- Synonyms – the current term is synonymous with a given, different term. e.g. "dogs" is synonymous with "canines".
- Broader relations – the current term has a more specific definition than a given different term. e.g. "dogs" has a broader relationship to "pets"
- Narrower relations – the current term has a less specific definition than a given different term. e.g. "dogs" has a narrower relationship to "terriers"

In a more complex thesaurus, the concepts at the top of the hierarchy of broader and narrower relations may be stated explicitly, rather than being inferred by software agents. A well known example of this form is the Yahoo! web directory[3] or the categorisation of auctions on the eBay homepage[4]. eBay has terms such as "Antiques", "Coins" and "Sporting Goods" as the top level in its hierarchy. Narrower terms sit below these, for example "Sporting Goods" contains "Football", "Golf" and "Sailing". These terms sit above those which are narrower still, "Sailing" having such narrower terms as "Clothing & Shoes", "Life Jackets" and "Rope". In the context of environmental sciences, the Global Change Master Directory[5] can be seen to work in this way. For example, "Oceans" is at the top level, with "Coastal Processes" beneath it and terms such as "Beaches" and "Coastal Elevation" beneath that.

These more complex thesauri also introduce a fourth category of relationship between concepts, that of a "loose relationship". That is where two terms have a relationship that is not of the broader or narrower type or a synonymous relationship, e.g. "domesticated dogs" are "loosely related" to "wild dogs". These loose relationships may allow different pathways to the discovery of a term, making the resource what is known as "orthogonal". For example, eBay has "Walking, Hiking, Trail" in its "Fashion" auction categories and "Boots & Shoes"

[2] Deborah L. McGuinness. (2003) Ontologies Come of Age. In Dieter Fensel, James Hendler, Henry Lieberman, and Wolfgang Wahlster (eds). *Spinning the Semantic Web: Bringing the World Wide Web to Its Full Potential*. Massachusetts Institute of Technology Press.

[3] http://dir.yahoo.com/

[4] http://www.ebay.com/

[5] http://gcmd.nasa.gov/

in its "Sporting Goods" auction categories. If these two were loosely mapped a search for "walking boots" could yield auction results from both categories.
A thesaurus may be expanded to an ontology by declaring a term to belong to a particular class; or the addition of property information to the term; or the restriction of values that data associated with the term may take. An ontology class is used to define a type which can be used to group related terms. For example, if eBay defined the class of "auction" particular individual terms belonging to the "auction" class could be "English auction", "blind auction" or "Dutch auction".

How to define the content of a knowledge organization system?

2. What is the scope of the knowledge organization system?

While it might be tempting to want to describe and define every imaginable concept in a new knowledge organization system, this would be a very time consuming and frustrating process, and would not make best use of other, pre-existing resources. Instead, it is much better to take the time to identify the specific domain that needs to be described by the terms you wish to define, for example coastal erosion, or names and extents of beaches. In this way work in building the knowledge organization system is tightly defined and the content is coherent, well understood and should not replicate existing resources.

3. Identifying the content

3.1 How narrow or broad should a term definition be?

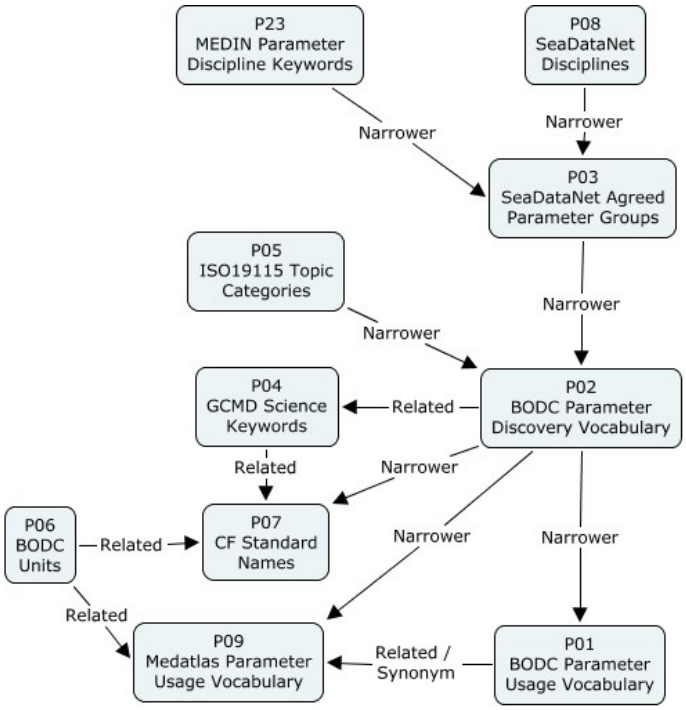
The challenge of integrating data and information of different kinds at different levels of detail is well defined in computer science literature[6,7]. In the area of semantics on the World Wide Web, the level of detail a term can describe is known as its granularity. For a given level of a knowledge organization system the definitions of a term may be as broad or as narrow as is necessary, as long as they are not ambiguous.
However, when building a hierarchical thesaurus, it is important that concepts defined at the same level of the hierarchy maintain a similar degree of granularity. If the thesaurus is imagined as a pyramid, making a concept at a given level too narrow or broad in its definition is like placing a too small or too large brick in the wall of the pyramid, and makes the structure unstable. For example, "body of water" should not sit at the same level as "lake" or "reservoir", as these are terms with a narrower relationship or a finer granularity.

3.2 Linking term definitions together

As described above, the definition of terms by themselves is useful but the impact of the work can be greatly extended by providing relationships which link the terms together to form

[6] Fonseca, F., Egenhofer, M., Davis, C., and Câmara, G. (2002) Semantic Granularity in Ontology-Driven Geographic Information Systems. *AMAI Annals of Mathematics and Artificial Intelligence - Special Issue on Spatial and Temporal Granularity* 36(1-2): 121-151.
[7] Yan, X., Lau, R.Y.K, Song, D., Li, X., Ma, J. (2011) Towards a Semantic Granularity Model for Domain Specific Information Retrieval. *ACM Transactions on Information Systems (TOIS)*. In press.

networks of knowledge. This enhances the ability of a user to find data labelled with a given term or to translate the metadata from one mark up scheme to another. Relationships can be thought of simply as broader and narrower (for example, in the diagram below the BODC Parameter Discovery Vocabulary is narrower than the SeaDataNet Agreed Parameter Groups and vice versa); loosely related (the BODC Parameter Usage and MEDATLAS Parameter Usage vocabularies are of similar granularity and are linked this way); and synonyms where two terms may be used interchangeably.



An example from the NERC Vocabulary Server Error! Bookmark not defined. **to show how identifying relationships between terms builds a network of parameter definitions.**

4. Ensuring the quality of the content of the Knowledge Organization System

There are two aspects to providing quality assurance, or governance, for a knowledge organization system. The first is to ensure the quality of the content of the knowledge organization system. This includes the names and definitions of terms and the relationships between the terms. A well tested mechanism for managing content governance is setting up an e-mail list of interested parties on which requests for new terms and mappings can be discussed. This is the model which has been implemented by: the Climate and Forecast[8] netCDF metadata conventions group; the SeaDataNet and MarineXML Vocabulary Content Governance Group (SeaVoX)[9]; and the NETMAR ontology governance body[10]. The role of the content governance group is analogous to the International Organization for Standardization (ISO) definition of a "control body"[11].

[8] http://cf-pcmdi.llnl.gov/
[9] https://www.bodc.ac.uk/data/codes_and_formats/seavox/
[10] http://netmar.nersc.no/
[11] http://www.dgiwg.org/Terminology/faq-other.php

The second aspect is assuring the technical quality of the system. This includes ensuring that the knowledge organization system is available with the greatest possible up-time; the representation of the system is valid in the chosen scheme (e.g. extensible markup language, XML); and the various versions of the concepts, collections and scheme are maintained and accessible. For example, within the SeaDataNet project this technical governance is provided by the British Oceanographic Data Centre as the developer and maintainer of the NERC Vocabulary Server**Error! Bookmark not defined.** (NVS). The role of the technical governance group is analogous to the ISO definition of a "register manager"[11].

Making the content available

5. The NERC Vocabulary Server

The NERC Vocabulary Server provides access to lists of standardised terms that cover a broad spectrum of disciplines of relevance to the oceanographic and wider community.

Using standardised sets of terms (otherwise known as "controlled vocabularies") in metadata and to label data solves the problem of ambiguities associated with data markup and also enables records to be interpreted by computers. This opens up data sets to a whole world of possibilities for computer aided manipulation, distribution and long term reuse.

An example of how computers may benefit from the use of controlled vocabularies is in the summing of values taken from different data sets. For instance, one data set may have a column labelled "Temperature of the water column" and another might have "water temperature" or even "temperature". To the human eye, the similarity is obvious but a computer would not be able to interpret these as the same thing unless all the possible options were hard coded into its software. If data are marked up with the same terms, this problem is resolved.

In the real world, it is not always possible or agreeable for data providers to use the same terms. In such cases, controlled vocabularies can be used as a medium to which data centres can map their equivalent terms.

The controlled vocabularies delivered by the NERC Vocabulary Server contain the following information for each term:

- Key — a compact permanent identifier for the term, designed for computer storage rather than human readability
- Term — the text string representing the term in human-readable form
- Abbreviation — a concise text string representing the term in human-readable form where space is limited
- Definition — a full description of what is meant by the term

All of the vocabularies are fully versioned and a permanent record is kept of all changes made.

5.1 Connectivity

Consumers may access the Vocabulary Server either using the ReSTful URIs described below or via SOAP.

SOAP is a design of Application Programming Interface (API) for exchanging structured information across computer networks as the result of calls to web services. It relies upon XML (eXstensible Markup Language) documents for passing messages.

SOAP consumers should generate their client implementation from the Web Service Description Language (WSDL) documentation available athttp://vocab.nerc.ac.uk/vocab2.wsdl

SPARQL is standard query language for interrogating knowledge stores such as NVS2.0. The SPARQL endpoint may be found athttp://vocab.nerc.ac.uk/sparql from where queries may be entered directly and the return format chosen. Once users are comfortable with this interface and with building SPARQL queries, they may take the resulting URLs and use them to access the SPARQL endpoint programmatically.

5.2 Collection, concept and scheme URIs

Collections, concepts and schemes are presented to the Server as Uniform Resource Identifiers (URIs), or in this case actually URLs, in the following syntax.

Collections — A concept collection is useful where a group of concepts shares something in common, and it is convenient to group them under a common label. In NVS2.0, concept collections are synonymous with controlled vocabularies or code lists.

http://vocab.nerc.ac.uk/collection/
http://vocab.nerc.ac.uk/collection/colRef/colVer/
e.g. http://vocab.nerc.ac.uk/collection/P03/current/
http://vocab.nerc.ac.uk/collection/colRef/colVer/status/
e.g. http://vocab.nerc.ac.uk/collection/P03/current/accepted/

Concepts — A Simple Knowledge Organization System (SKOS) concept can be viewed as an idea or notion; a unit of thought. The notion of a SKOS concept is useful when describing the conceptual or intellectual structure of a knowledge organization system and when referring to specific ideas or meanings established within that system.

http://vocab.nerc.ac.uk/collection/colRef/colVer/conRef/
e.g. http://vocab.nerc.ac.uk/collection/P03/current/D005/

Schemes — A concept scheme can be viewed as an aggregation of one or more SKOS concepts. Semantic relationships (links) between those concepts may also be viewed as part of a concept scheme. A concept scheme is therefore useful for containing the concepts registered in multiple concept collections that relate to each other as a single semantic unit, such as a thesaurus.

http://vocab.nerc.ac.uk/scheme/
http://vocab.nerc.ac.uk/scheme/schemeRef/
e.g. http://vocab.nerc.ac.uk/scheme/ICANDIS/

where

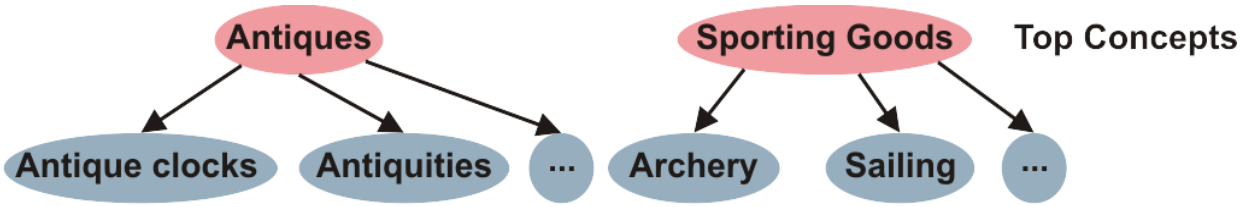
- http://vocab.nerc.ac.uk/collection/ and http://vocab.nerc.ac.uk/scheme/ respectively provide catalogues of the available concept collections and concept schemes.
- colRef is an internal opaque identifier for the concept collection, e.g. P02 for the SeaDataNet Parameter Discovery Vocabulary.
- colVer may be a valid concept collection version number or 'current' to specify the latest version of the collection.
- status may be 'all', 'accepted' or 'deprecated' to indicate whether all concepts related to a collection should be returned, or only the accepted or deprecated concepts.
- conRef is an internal opaque identifier for the concept within the concept collection, e.g. TEMP for 'Temperature of the water column' in the SeaDataNet Parameter Discovery Vocabulary.
- schemeRef is an internal opaque identifier for the concept scheme, e.g. ICANCOERO for the International Coastal Atlas Network Coastal Erosion Thesaurus.

6. Simple Knowledge Organization System

On the NERC Vocabulary Server (NVS), knowledge organization systems are built upon the World Wide Web Consortium's Simple Knowledge Organization System[12] (SKOS) standard. SKOS is designed to provide a method for the online publication of controlled vocabularies and thesauri. The NVS platform is used by many projects and groups to publish collections of vocabulary terms and thesauri. A brief overview of SKOS is therefore provided below.
SKOS is based upon concepts that it defines as a "unit of thought", i.e. an idea or notion such as "shoreline emergency access" or "oil spill". Concepts may also carry other information, such as their relationships to other concepts and information about their provenance and version history. SKOS provides the means for grouping those concepts together as either collections or schemes. A SKOS collection is a grouping of concepts which share something in common and can be conveniently grouped under a common label, for example "SeaDataNet agreed parameter groups" or "ISO19115 topic categories". Similarly, SKOS concept schemes are also groupings of concepts but the relationships between the concepts are a part of the concept scheme. For example, if the eBay auction categories were published as a

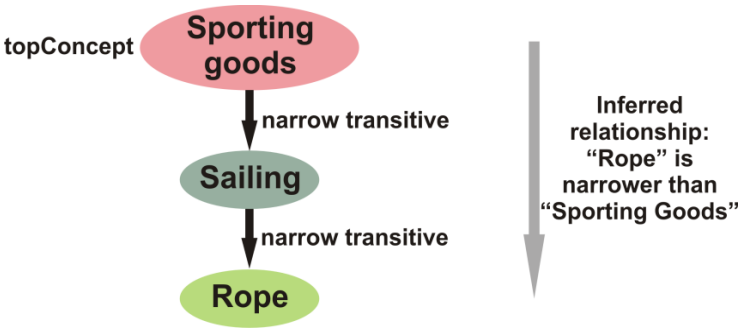
[12] http://www.w3.org/2004/02/skos/

concept scheme, "Antiques" and "Sporting Goods" can be identified as SKOS `topConcepts`, the broadest definitions in the pyramids of concepts. The narrower concept definitions such as "Antique Clocks" and "Sailing" can also be delivered in the concept scheme, including their position in the hierarchy of concepts, as illustrated below. Therefore, concept schemes are a useful model for the publication of thesauri, for example the "ICAN coastal erosion thesaurus."



An illustrative example of top concepts in SKOS, and the first level of their associated narrower terms.

SKOS also defines three forms of relationship between concepts. A concept may be broader or narrower than another concept, or related to another concept. The related attribute allows the loose mapping of one concept to another, allowing the resource to become orthogonal (see page 5). The broader and narrower attributes allow the construction of a hierarchy. If a concept belongs to a hierarchical scheme and is an entry point to that hierarchy (that is, at the top of the tree) it can be declared as a SKOS topConcept. For concepts in the same scheme, the broader and narrower relations may be said to be transitive; that is a concept two levels below a given concept can be inferred to be narrower than the concept in question without explicitly stating a relationship. For example (and illustrated below), eBay has "Sporting Goods" as a top level auction category, or a topConcept. Narrower than this is "Sailing", and still narrower is "Rope". If these relationships were declared as transitive "Rope" could be inferred to be narrower than "Sporting Goods", which is not explicit in the non-transitive SKOS narrower relationship.



An illustration of transitive relations in SKOS using terms from the eBay classification of auctions.

The differences between SKOS concept collections and concept schemes are very limited in the W3C's specification. Schemes are used on NVS as a discovery tool for concepts, and collections to store and publish concepts and for referencing their identifiers.

NVS has additionally extended the SKOS model to allow synonyms to be identified using the Web Ontology Language's[13] `sameAs` attribute. This clearly allows the labelling of the relationship between two concepts which are identical, which is not a feature of the basic SKOS model.

[13] http://www.w3.org/TR/owl2-overview/

7. Adding Content to the NERC Vocabulary Server

a) Incorporating a Knowledge Organization System

The simplest way to develop a new controlled vocabulary or thesaurus (or propose new content for an existing vocabulary or thesaurus) for incorporation within the framework is to create two worksheets in a spreadsheet: one for concept names and definitions; the other for relationships between concepts.

The first worksheet, illustrated below, should contain columns for

1. Concept key
    - An identifier for the concept, unique within the vocabulary. It does not need to carry any meaning.
2. Concept name and title
3. Concept alternative name (e.g. abbreviation)
4. Concept definition.

Concept Key	Concept name and title	Concept alternative name	Concept definition
74PQ	Plymouth Quest	PQ	`{"title": "RV","callsign": "MEEU8", "platformClass": "research vessel", "commissioned": "2004-03-24","previous_name": "Sigurbjorg"}`

Each concept must only occupy one row of the worksheet. If the definition needs to carry some structured information (such as information regarding the identity of a ship's hull or the bounding box of a geographic area), this should be encoded using an alternative to XML, such as the JavaScript Object Notation (JSON) standard, i.e. enclosed in curly brackets and formed of "key":"value" pairs separated by commas. For example:

```
{"title": "RV", "callsign": "MEEU8", "platformClass": "research vessel",
"commissioned": "2004-03-24","previous_name": "Sigurbjorg"}
```

The second worksheet should contain three columns describing the relationship between concepts:

1. Subject
    - The subject of the sentence describing the relationship.
2. Relationship
    - Narrower, broader, related or sameAs mapping.
3. Object
    - The object of the sentence describing the relationship.

Subject	Relationship	Object
74PQ ("Plymouth Quest")	Is narrower than	http://vocab.nerc.ac.uk/collection/L06/current/31/ ("research vessel")

74PQ ("Plymouth Quest")	Is narrower than	http://vocab.nerc.ac.uk/collection/L19/current/SDNKG04 ("platform")

Once complete, the spreadsheet should be submitted to enquiries@bodc.ac.uk along with supporting information about the domain scope of the concepts, the content governance for the knowledge organization system and the name and contact details for those authorised to make changes to the resource. The supporting information for the ICAN Coastal Erosion thesaurus, for example, is:

- Domain scope: "Thesaurus containing coastal erosion dataset (including GIS layer) terms compiled by ICAN and mapped to a global thesaurus. Includes both markup and discovery terms from the mapped components."
- Content governance: "International Coastal Atlas Network"

The knowledge organization system will be deployed on the NERC Vocabulary Server and further updates can be made by authorised persons through a web interface accessed from the British Oceanographic Data Centre website[14].

b) Accessing the Knowledge Organization System

Once deployed within the NERC Vocabulary Server, a knowledge organization system can be accessed in much the same way as a web site, using Uniform Resource Locators[15] (URLs) to navigate the NVS. The base URL for the NVS is:

http://vocab.nerc.ac.uk

Catalogues of the SKOS concept collections and schemes hosted on the NVS can be accessed at:

http://vocab.nerc.ac.uk/collection/
http://vocab.nerc.ac.uk/scheme/

Once the identifier for an individual collections or schemes is known, it can then be accessed from:

http://vocab.nerc.ac.uk/collection/*collection_id*/current/

e.g. http://vocab.nerc.ac.uk/collection/C17/current/ is the URL for the International Council for the Exploration of the Seas platform codes collection from which the example worksheets above were taken

http://vocab.nerc.ac.uk/scheme/*scheme_id*/current/

e.g. http://vocab.nerc.ac.uk/scheme/ICANCOERO/current/ is the URL for the ICAN Coastal Erosion thesaurus

Finally, an individual concept can be accessed through this form of URL:

http://vocab.nerc.ac.uk/collection/*collection_id*/current/*concept_id*/

e.g. http://vocab.nerc.ac.uk/collection/C17/current/74PQ/ gives access to the concept definition for "Plymouth Quest" which was described in the example worksheets above

[14] https://www.bodc.ac.uk/data/codes_and_formats/vocabulary_editor/
[15] http://en.wikipedia.org/wiki/Url

The collection URLs also provide a mechanism for accessing any concepts which have been removed from the collection (known as deprecation), or only those concepts which are currently accepted members of the collection or all the concepts which have ever been part of the collection (the default if neither deprecated, accepted or all is specified as a suffix to the collection URL):

http://vocab.nerc.ac.uk/collection/*collection_id*/current/deprecated/
http://vocab.nerc.ac.uk/collection/*collection_id*/current/accepted/
http://vocab.nerc.ac.uk/collection/*collection_id*/current/all/

The ../current/../ portion of the URLs given in this section is a shortcut to the most recent version of the collection or scheme. This can be replaced with an integer value in order to retrieve a given version of a collection or scheme.

In addition to this URL based access, application developers can make use of Simple Object Access Protocol (SOAP)[16] based access described in the associated Web Services Description Language (WSDL) document[17].

8. Bridging to existing Knowledge Organization Systems

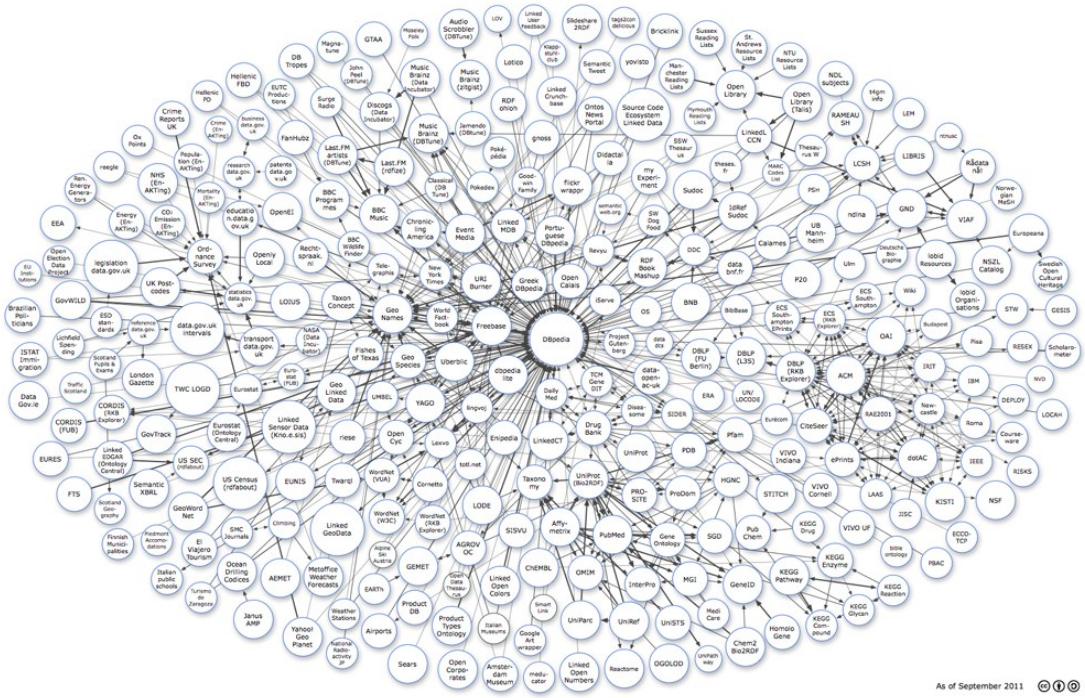
Labelling data and metadata using a knowledge organization system is a first step to making those data interoperable with other datasets. However, if the knowledge organization system has defined relationships to other systems the likelihood of the metadata and data being discovered and reused alongside other data increases. Linked data is an initiative of the World Wide Web Consortium to create a web of data described knowledge organization systems. The diagram on the next page shows how this web of data is highly interconnected.

A range of environmental science and geospatial knowledge organization systems exist that may be of interest for bridging a new knowledge organization system too. These include those stored in the NVS and the Marine Metadata Interoperability Ontology Registry and Repository**Error! Bookmark not defined.**; the European Environment Agency General Multilingual Environmental Thesaurus**Error! Bookmark not defined.**; and GeoNames[18]. Relationships between a concept in the NVS and any external concept can be specified in the same way as the internal mappings (see page 6) but with the NVS URL replaced by the URL of the external concept as the object of the relationship. For example:

```
http://vocab.nerc.ac.uk/collection/P21/current/MS10360/ (sulphides)
"broader"
http://www.eionet.europa.eu/gemet/concept/4350 (inorganic substances)

http://vocab.nerc.ac.uk/collection/C19/current/3_1_2_1/ (Adriatic Sea)
"sameAs"
http://sws.geonames.org/3183462/
```

[16] http://en.wikipedia.org/wiki/SOAP
[17] http://vocab.nerc.ac.uk/v2.wsdl
[18] http://www.geonames.org/



The Linking Open Data project cloud[19].

Incorporating knowledge organization systems in metadata

In overview, the web address (URL) of a term defined in a knowledge organization system should be incorporated within a metadata document, in the appropriate field. This may be as either a string, in an XML element such as `gco:CharacterString`, or as a reference from an anchor field, using the `xlink:href="http://..."` syntax.

Using CF-Standard Names to SeaDataNet Parameter Discovery Term links

Queries may be issued against the NERC Vocabulary Server using the SPARQL standard at http://vocab.nerc.ac.uk/sparql. Below is a template query which returns the SeaDataNet Parameter Discovery Terms related to the CF Standard Name "air_temperature".

```
PREFIX skos:<http://www.w3.org/2004/02/skos/core#>
SELECT DISTINCT ?standardNameLabel ?p02Uri
WHERE
{
  BIND ('air_temperature' as ?standardName)
  ?standardNameUri skos:prefLabel ?standardNameLabel
  FILTER CONTAINS(str(?standardNameUri),'/collection/P07/')
  FILTER (LANG(?standardNameLabel) = 'en')
  FILTER (str(?standardNameLabel) = str(lcase(?standardName))).
  ?standardNameUri ?rel ?p02Uri
```

[19] http://richard.cyganiak.de/2007/10/lod/imagemap.html

```
        FILTER CONTAINS(str(?p02Uri),'/collection/P02/')
    }
```

The URL of this query is
http://vocab.nerc.ac.uk/sparql/sparql?query=PREFIX+skos%3A%3Chttp%3A%2F%2Fwww.w3.org%2F2004%2F02%2Fskos%2Fcore%23%3E%0D%0ASELECT+DISTINCT+%3FstandardNameLabel+%3Fp02Uri%0D%0AWHERE%0D%0A%7B%0D%0A++++BIND+%28%27air_temperature%27+as+%3FstandardName%29%0D%0A++++%3FstandardNameUri+skos%3AprefLabel+%3FstandardNameLabel%0D%0A++++FILTER+CONTAINS%28str%28%3FstandardNameUri%29%2C%27%2Fcollection%2FP07%2F%27%29%0D%0A++++FILTER+%28LANG%28%3FstandardNameLabel%29+%3D+%27en%27%29%0D%0A++++FILTER+%28str%28%3FstandardNameLabel%29+%3D+str%28lcase%28%3FstandardName%29%29%29.%0D%0A++++%3FstandardNameUri+%3Frel+%3Fp02Uri%0D%0A++++FILTER+CONTAINS%28str%28%3Fp02Uri%29%2C%27%2Fcollection%2FP02%2F%27%29%0D%0A%7D&output=text The final &output parameter may be changed from “text” to “xml”, “json”, “csv” or “tsv” depending on which format the consumer wishes to receive.

As of 19th December 2014, 2123 CF Standard names are mapped to the SeaDataNet Parameter Discover Vocabulary, leaving 664 not mapped. The unmapped CF Standard Names are listed below

age_of_stratospheric_air
age_of_surface_snow
air_density
angle_of_rotation_from_east_to_x
angle_of_rotation_from_east_to_y
angle_of_rotation_from_solar_azimuth_to_platform_azimuth
area_fraction
area_fraction_below_surface
atmosphere_absolute_vorticity
atmosphere_boundary_layer_thickness
atmosphere_convective_available_potential_energy
atmosphere_convective_available_potential_energy_wrt_surface
atmosphere_convective_inhibition
atmosphere_convective_inhibition_wrt_surface
atmosphere_convective_mass_flux
atmosphere_downdraft_convective_mass_flux
atmosphere_dry_energy_content
atmosphere_dry_static_energy_content
atmosphere_energy_content
atmosphere_enthalpy_content
atmosphere_heat_diffusivity

atmosphere_kinetic_energy_content
atmosphere_level_of_free_convection
atmosphere_level_of_free_convection_wrt_surface
atmosphere_lifting_condensation_level
atmosphere_lifting_condensation_level_wrt_surface
atmosphere_mass_content_of_aromatic_compounds
atmosphere_mass_content_of_ethanol
atmosphere_mass_content_of_formaldehyde
atmosphere_mass_content_of_hox_expressed_as_hydrogen
atmosphere_mass_content_of_hydrogen_cyanide
atmosphere_mass_content_of_hydrogen_peroxide
atmosphere_mass_content_of_hydroperoxyl_radical
atmosphere_mass_content_of_hydroxyl_radical
atmosphere_mass_content_of_methanol
atmosphere_mass_content_of_methyl_hydroperoxide
atmosphere_mass_content_of_methyl_peroxy_radical
atmosphere_mass_content_of_molecular_hydrogen
atmosphere_mass_content_of_oxygenated_hydrocarbons
atmosphere_mass_content_of_peroxy_radicals
atmosphere_mass_content_of_radon
atmosphere_mass_content_of_volcanic_ash
atmosphere_mass_of_air_per_unit_area
atmosphere_mass_per_unit_area
atmosphere_moles_of_ethanol
atmosphere_moles_of_formaldehyde
atmosphere_moles_of_hox_expressed_as_hydrogen
atmosphere_moles_of_hydrogen_cyanide
atmosphere_moles_of_hydrogen_peroxide
atmosphere_moles_of_hydroperoxyl_radical
atmosphere_moles_of_hydroxyl_radical
atmosphere_moles_of_methanol
atmosphere_moles_of_methyl_hydroperoxide
atmosphere_moles_of_methyl_peroxy_radical
atmosphere_moles_of_molecular_hydrogen
atmosphere_moles_of_radon
atmosphere_moles_of_xylene
atmosphere_momentum_diffusivity
atmosphere_net_rate_of_absorption_of_longwave_energy
atmosphere_net_rate_of_absorption_of_shortwave_energy
atmosphere_net_upward_convective_mass_flux
atmosphere_net_upward_deep_convective_mass_flux
atmosphere_net_upward_shallow_convective_mass_flux

atmosphere_optical_thickness_due_to_aerosol
atmosphere_optical_thickness_due_to_ambient_aerosol
atmosphere_potential_energy_content
atmosphere_relative_vorticity
atmosphere_specific_convective_available_potential_energy
atmosphere_stability_k_index
atmosphere_stability_showalter_index
atmosphere_stability_total_totals_index
atmosphere_surface_drag_coefficient_of_heat
atmosphere_surface_drag_coefficient_of_momentum
atmosphere_updraft_convective_mass_flux
bedrock_altitude
bedrock_altitude_change_due_to_isostatic_adjustment
biomass_burning_carbon_flux
brightness_temperature_anomaly
brunt_vaisala_frequency_in_air
burned_area
burned_area_fraction
canopy_height
canopy_temperature
carbon_content_of_products_of_anthropogenic_land_use_change
carbon_mass_flux_into_soil_from_litter
carbon_mass_flux_into_soil_from_vegetation_excluding_litter
change_in_atmosphere_energy_content_due_to_change_in_sigma_coordinate_wrt_surface_pressure
change_in_energy_content_of_atmosphere_layer_due_to_change_in_sigma_coordinate_wrt_surface_pressure
change_over_time_in_sea_water_specific_potential_enthalpy
convection_time_fraction
dimensionless_exner_function
dissipation_in_atmosphere_boundary_layer
downward_dry_static_energy_flux_due_to_diffusion
downward_eastward_momentum_flux_in_air
downward_eastward_momentum_flux_in_air_due_to_diffusion
downward_heat_flux_at_ground_level_in_snow
downward_heat_flux_at_ground_level_in_soil
downward_heat_flux_in_air
downward_heat_flux_in_soil
downward_northward_momentum_flux_in_air
downward_northward_momentum_flux_in_air_due_to_diffusion
downward_sea_ice_basal_salt_flux
downward_water_vapor_flux_in_air_due_to_diffusion

dry_energy_content_of_atmosphere_layer
dry_static_energy_content_of_atmosphere_layer
eastward_atmosphere_dry_static_energy_transport_across_unit_distance
eastward_atmosphere_water_transport_across_unit_distance
eastward_atmosphere_water_vapor_transport_across_unit_distance
eastward_mass_flux_of_air
eastward_momentum_flux_correction
eastward_water_vapor_flux
eastward_water_vapor_flux_in_air
eastward_water_vapor_transport_across_unit_distance_in_atmosphere_layer
effective_radius_of_cloud_condensed_water_particles_at_cloud_top
effective_radius_of_cloud_liquid_water_particle
effective_radius_of_cloud_liquid_water_particle_at_liquid_water_cloud_top
electromagnetic_wavelength
enthalpy_content_of_atmosphere_layer
equilibrium_line_altitude
ertel_potential_vorticity
fast_soil_pool_carbon_content
freezing_level_altitude
freezing_temperature_of_sea_water
geopotential
gross_primary_productivity_of_biomass_expressed_as_carbon
harmonic_period
heterotrophic_respiration_carbon_flux
horizontal_atmosphere_dry_energy_transport
horizontal_dry_energy_transport_in_atmosphere_layer
integral_of_sea_water_potential_temperature_wrt_depth_expressed_as_heat_content
integral_of_surface_downward_eastward_stress_wrt_time
integral_of_surface_downward_northward_stress_wrt_time
kinetic_energy_content_of_atmosphere_layer
kinetic_energy_dissipation_in_atmosphere_boundary_layer
lagrangian_tendency_of_atmosphere_sigma_coordinate
land_cover_lccs
land_ice_basal_melt_rate
land_ice_basal_x_velocity
land_ice_basal_y_velocity
land_ice_calving_rate
land_ice_lwe_basal_melt_rate
land_ice_lwe_calving_rate
land_ice_lwe_surface_specific_mass_balance
land_ice_lwe_surface_specific_mass_balance_rate
land_ice_surface_specific_mass_balance

land_ice_surface_specific_mass_balance_flux
land_ice_surface_specific_mass_balance_rate
land_ice_vertical_mean_x_velocity
land_ice_vertical_mean_y_velocity
land_ice_x_velocity
land_ice_y_velocity
leaf_carbon_content
liquid_water_content_of_permafrost_layer
litter_carbon_content
litter_carbon_flux
magnitude_of_heat_flux_in_sea_water_due_to_advection
magnitude_of_surface_downward_stress
mass_concentration_of_aromatic_compounds_in_air
mass_concentration_of_biomass_burning_dry_aerosol_in_air
mass_concentration_of_coarse_mode_ambient_aerosol_in_air
mass_concentration_of_diatoms_expressed_as_nitrogen_in_sea_water
mass_concentration_of_ethanol_in_air
mass_concentration_of_flagellates_expressed_as_nitrogen_in_sea_water
mass_concentration_of_formaldehyde_in_air
mass_concentration_of_hox_expressed_as_hydrogen_in_air
mass_concentration_of_hydrogen_cyanide_in_air
mass_concentration_of_hydrogen_peroxide_in_air
mass_concentration_of_hydroperoxyl_radical_in_air
mass_concentration_of_hydroxyl_radical_in_air
mass_concentration_of_methanol_in_air
mass_concentration_of_methyl_hydroperoxide_in_air
mass_concentration_of_methyl_peroxy_radical_in_air
mass_concentration_of_molecular_hydrogen_in_air
mass_concentration_of_oxygenated_hydrocarbons_in_air
mass_concentration_of_peroxy_radicals_in_air
mass_concentration_of_pm10_ambient_aerosol_in_air
mass_concentration_of_pm1_ambient_aerosol_in_air
mass_concentration_of_pm2p5_ambient_aerosol_in_air
mass_concentration_of_radon_in_air
mass_fraction_of_aromatic_compounds_in_air
mass_fraction_of_cloud_ice_in_air
mass_fraction_of_convective_cloud_ice_in_air
mass_fraction_of_ethanol_in_air
mass_fraction_of_formaldehyde_in_air
mass_fraction_of_hox_expressed_as_hydrogen_in_air
mass_fraction_of_hydrogen_cyanide_in_air
mass_fraction_of_hydrogen_peroxide_in_air

mass_fraction_of_hydroperoxyl_radical_in_air
mass_fraction_of_hydroxyl_radical_in_air
mass_fraction_of_methanol_in_air
mass_fraction_of_methyl_hydroperoxide_in_air
mass_fraction_of_methyl_peroxy_radical_in_air
mass_fraction_of_molecular_hydrogen_in_air
mass_fraction_of_peroxy_radicals_in_air
mass_fraction_of_radon_in_air
mass_fraction_of_stratiform_cloud_ice_in_air
mass_fraction_of_stratiform_cloud_liquid_water_in_air
medium_soil_pool_carbon_content
miscellaneous_living_matter_carbon_content
mole_concentration_of_diatoms_expressed_as_nitrogen_in_sea_water
mole_concentration_of_diatoms_in_sea_water_expressed_as_nitrogen
mole_concentration_of_ethanol_in_air
mole_concentration_of_formaldehyde_in_air
mole_concentration_of_hox_expressed_as_hydrogen_in_air
mole_concentration_of_hydrogen_cyanide_in_air
mole_concentration_of_hydrogen_peroxide_in_air
mole_concentration_of_hydroperoxyl_radical_in_air
mole_concentration_of_hydroxyl_radical_in_air
mole_concentration_of_mesozooplankton_expressed_as_nitrogen_in_sea_water
mole_concentration_of_mesozooplankton_in_sea_water_expressed_as_nitrogen
mole_concentration_of_methanol_in_air
mole_concentration_of_methyl_hydroperoxide_in_air
mole_concentration_of_methyl_peroxy_radical_in_air
mole_concentration_of_microzooplankton_expressed_as_nitrogen_in_sea_water
mole_concentration_of_microzooplankton_in_sea_water_expressed_as_nitrogen
mole_concentration_of_molecular_hydrogen_in_air
mole_concentration_of_organic_detritus_in_sea_water_expressed_as_nitrogen
mole_concentration_of_organic_detritus_in_sea_water_expressed_as_silicon
mole_concentration_of_phytoplankton_expressed_as_iron_in_sea_water
mole_concentration_of_phytoplankton_expressed_as_nitrogen_in_sea_water
mole_concentration_of_phytoplankton_expressed_as_phosphorus_in_sea_water
mole_concentration_of_phytoplankton_expressed_as_silicon_in_sea_water
mole_concentration_of_phytoplankton_in_sea_water_expressed_as_nitrogen
mole_concentration_of_radon_in_air
mole_fraction_of_aldehydes_in_air
mole_fraction_of_dichlorine_in_air
mole_fraction_of_ethanol_in_air
mole_fraction_of_formaldehyde_in_air
mole_fraction_of_hox_expressed_as_hydrogen_in_air

mole_fraction_of_hydrogen_peroxide_in_air
mole_fraction_of_hydrogen_sulfide_in_air
mole_fraction_of_hydroperoxyl_radical_in_air
mole_fraction_of_hydroxyl_radical_in_air
mole_fraction_of_methanol_in_air
mole_fraction_of_methlyglyoxal_in_air
mole_fraction_of_methyl_hydroperoxide_in_air
mole_fraction_of_methyl_peroxy_radical_in_air
mole_fraction_of_molecular_hydrogen_in_air
mole_fraction_of_radon_in_air
moles_of_molecular_hydrogen_in_atmosphere
net_downward_radiative_flux_at_top_of_atmosphere_model
net_primary_mole_productivity_of_biomass_expressed_as_carbon_by_calcareous_phytoplankton
net_primary_mole_productivity_of_biomass_expressed_as_carbon_by_diatoms
net_primary_mole_productivity_of_biomass_expressed_as_carbon_by_diazotrophs
net_primary_mole_productivity_of_biomass_expressed_as_carbon_by_miscellaneous_phytoplankton
net_primary_mole_productivity_of_biomass_expressed_as_carbon_by_phytoplankton
net_primary_mole_productivity_of_biomass_expressed_as_carbon_by_picophytoplankton
net_primary_mole_productivity_of_biomass_expressed_as_carbon_due_to_nitrate_utilization
net_primary_production_of_biomass_expressed_as_carbon_per_unit_volume_in_sea_water
net_primary_productivity_of_biomass_expressed_as_carbon
net_primary_productivity_of_biomass_expressed_as_carbon_accumulated_in_leaves
net_primary_productivity_of_biomass_expressed_as_carbon_accumulated_in_roots
net_primary_productivity_of_biomass_expressed_as_carbon_accumulated_in_wood
net_primary_productivity_of_carbon_accumulated_in_leaves
net_primary_productivity_of_carbon_accumulated_in_roots
net_primary_productivity_of_carbon_accumulated_in_wood
net_rate_of_absorption_of_longwave_energy_in_atmosphere_layer
net_rate_of_absorption_of_shortwave_energy_in_atmosphere_layer
northward_atmosphere_dry_static_energy_transport_across_unit_distance
northward_atmosphere_heat_transport
northward_atmosphere_water_transport_across_unit_distance
northward_atmosphere_water_vapor_transport_across_unit_distance
northward_eliassen_palm_flux
northward_eliassen_palm_flux_in_air
northward_heat_flux_due_to_eddy_advection
northward_heat_flux_in_air_due_to_eddy_advection
northward_mass_flux_of_air
northward_momentum_flux_correction
northward_water_vapor_flux

northward_water_vapor_flux_in_air
northward_water_vapor_transport_across_unit_distance_in_atmosphere_layer
number_concentration_of_ambient_aerosol_in_air
number_concentration_of_cloud_liquid_water_particles_in_air
number_concentration_of_cloud_liquid_water_particles_in_air_at_liquid_water_cloud_top
number_concentration_of_coarse_mode_ambient_aerosol_in_air
number_concentration_of_ice_crystals_in_air
number_concentration_of_ice_crystals_in_air_at_ice_cloud_top
number_concentration_of_nucleation_mode_ambient_aerosol_in_air
number_of_days_with_air_temperature_above_threshold
number_of_days_with_air_temperature_below_threshold
number_of_days_with_lwe_thickness_of_precipitation_amount_above_threshold
number_of_days_with_wind_speed_above_threshold
ocean_momentum_xy_biharmonic_diffusivity
ocean_momentum_xy_laplacian_diffusivity
ocean_montgomery_potential
ocean_s_coordinate_g1
ocean_s_coordinate_g2
ocean_tracer_bolus_biharmonic_diffusivity
ocean_tracer_bolus_laplacian_diffusivity
ocean_tracer_epineutral_biharmonic_diffusivity
ocean_tracer_epineutral_laplacian_diffusivity
ocean_tracer_xy_biharmonic_diffusivity
ocean_tracer_xy_laplacian_diffusivity
ocean_vertical_diffusivity
ocean_vertical_heat_diffusivity
ocean_vertical_momentum_diffusivity
ocean_vertical_momentum_diffusivity_due_to_background
ocean_vertical_momentum_diffusivity_due_to_convection
ocean_vertical_momentum_diffusivity_due_to_form_drag
ocean_vertical_momentum_diffusivity_due_to_tides
ocean_vertical_salt_diffusivity
ocean_vertical_tracer_diffusivity
ocean_vertical_tracer_diffusivity_due_to_background
ocean_vertical_tracer_diffusivity_due_to_convection
ocean_vertical_tracer_diffusivity_due_to_tides
ocean_vertical_tracer_diffusivity_due_to_wind_mixing
ocean_volume_fraction
optical_thickness_of_atmosphere_layer_due_to_aerosol
optical_thickness_of_atmosphere_layer_due_to_ambient_aerosol
permafrost_layer_thickness
platform_id

platform_name
potential_energy_content_of_atmosphere_layer
potential_vorticity_of_atmosphere_layer
product_of_air_temperature_and_omega
product_of_air_temperature_and_specific_humidity
product_of_eastward_sea_water_velocity_and_salinity
product_of_eastward_sea_water_velocity_and_temperature
product_of_eastward_wind_and_air_temperature
product_of_eastward_wind_and_geopotential_height
product_of_eastward_wind_and_northward_wind
product_of_eastward_wind_and_omega
product_of_eastward_wind_and_specific_humidity
product_of_eastward_wind_and_upward_air_velocity
product_of_geopotential_height_and_omega
product_of_northward_sea_water_velocity_and_salinity
product_of_northward_sea_water_velocity_and_temperature
product_of_northward_wind_and_air_temperature
product_of_northward_wind_and_geopotential_height
product_of_northward_wind_and_omega
product_of_northward_wind_and_specific_humdity
product_of_northward_wind_and_specific_humidity
product_of_northward_wind_and_upward_air_velocity
product_of_omega_and_air_temperature
product_of_omega_and_specific_humidity
product_of_specific_humidity_and_omega
product_of_upward_air_velocity_and_air_temperature
product_of_upward_air_velocity_and_specific_humidity
radiation_wavelength
root_carbon_content
runoff_amount
runoff_amount_excluding_baseflow
runoff_flux
scattering_angle
sea_ice_transport_across_line
sea_water_age_since_surface_contact
sea_water_mass
sea_water_mass_per_unit_area
sea_water_specific_potential_enthalpy
sea_water_volume
sensor_band_central_radiation_frequency
sensor_band_central_radiation_wavelength
sensor_band_central_radiation_wavenumber

sensor_band_identifier
shallow_convection_time_fraction
slow_soil_pool_carbon_content
snow_soot_content
snow_temperature
snow_thermal_energy_content
soil_carbon_content
soil_hydraulic_conductivity_at_saturation
soil_respiration_carbon_flux
soil_suction_at_saturation
soil_thermal_capacity
soil_thermal_conductivity
solar_azimuth_angle
solar_elevation_angle
solar_zenith_angle
sound_frequency
sound_intensity_in_air
sound_intensity_in_water
sound_intensity_level_in_air
sound_intensity_level_in_water
sound_pressure_in_air
sound_pressure_in_water
sound_pressure_level_in_air
sound_pressure_level_in_water
specific_convective_available_potential_energy
specific_dry_energy_of_air
specific_gravitational_potential_energy
specific_kinetic_energy_of_air
specific_kinetic_energy_of_sea_water
specific_potential_energy
speed_of_sound_in_air
spell_length_of_days_with_air_temperature_above_threshold
spell_length_of_days_with_air_temperature_below_threshold
spell_length_of_days_with_lwe_thickness_of_precipitation_amount_above_threshold
spell_length_of_days_with_lwe_thickness_of_precipitation_amount_below_threshold
square_of_brunt_vaisala_frequency_in_air
square_of_upward_air_velocity
station_description
station_wmo_id
subsurface_litter_carbon_content
subsurface_runoff_amount
subsurface_runoff_flux

surface_bidirectional_reflectance
surface_downward_heat_flux_in_snow
surface_downward_x_stress_correction
surface_downward_y_stress_correction
surface_downwelling_photon_flux_in_sea_water
surface_downwelling_photon_radiance_in_sea_water
surface_downwelling_photon_spherical_irradiance_in_sea_water
surface_downwelling_radiance_in_sea_water
surface_downwelling_radiative_flux_in_sea_water
surface_downwelling_radiative_flux_per_unit_wavelength_in_air
surface_downwelling_spectral_radiative_flux_in_air
surface_drag_coefficient_for_heat_in_air
surface_drag_coefficient_for_momentum_in_air
surface_drag_coefficient_in_air
surface_frozen_carbon_dioxide_amount
surface_geopotential
surface_litter_carbon_content
surface_microwave_emissivity
surface_net_downward_radiative_flux
surface_net_downward_radiative_flux_where_land
surface_net_upward_radiative_flux
surface_ratio_of_upwelling_radiance_emerging_from_sea_water_to_downwelling_radiative_flux_in_air
surface_roughness_length
surface_roughness_length_for_heat_in_air
surface_roughness_length_for_momentum_in_air
surface_runoff_amount
surface_runoff_flux
surface_snow_and_ice_melt_flux
surface_snow_and_ice_refreezing_flux
surface_snow_and_ice_sublimation_flux
surface_snow_melt_amount
surface_snow_melt_and_sublimation_heat_flux
surface_snow_melt_flux
surface_snow_melt_heat_flux
surface_snow_sublimation_amount
surface_snow_sublimation_heat_flux
surface_upward_water_vapor_flux_in_air
surface_upwelling_radiance_in_air
surface_upwelling_radiance_in_air_emerging_from_sea_water
surface_upwelling_radiance_in_air_reflected_by_sea_water
surface_upwelling_radiance_in_sea_water

tendency_of_air_density
tendency_of_atmosphere_dry_energy_content
tendency_of_atmosphere_enthalpy_content_due_to_advection
tendency_of_atmosphere_kinetic_energy_content_due_to_advection
tendency_of_atmosphere_mass_content_of_alcohols_due_to_emission_from_agricultural_production
tendency_of_atmosphere_mass_content_of_alcohols_due_to_emission_from_agricultural_waste_burning
tendency_of_atmosphere_mass_content_of_alcohols_due_to_emission_from_energy_production_and_distribution
tendency_of_atmosphere_mass_content_of_alcohols_due_to_emission_from_forest_fires
tendency_of_atmosphere_mass_content_of_alcohols_due_to_emission_from_industrial_processes_and_combustion
tendency_of_atmosphere_mass_content_of_alcohols_due_to_emission_from_residential_and_commercial_combustion
tendency_of_atmosphere_mass_content_of_alcohols_due_to_emission_from_savanna_and_grassland_fires
tendency_of_atmosphere_mass_content_of_alcohols_due_to_emission_from_solvent_production_and_use
tendency_of_atmosphere_mass_content_of_alcohols_due_to_emission_from_waste_treatment_and_disposal
tendency_of_atmosphere_mass_content_of_black_carbon_dry_aerosol_due_to_emission_from_industrial_processes_and_combustion
tendency_of_atmosphere_mass_content_of_chlorinated_hydrocarbons_due_to_emission_from_forest_fires
tendency_of_atmosphere_mass_content_of_chlorinated_hydrocarbons_due_to_emission_from_land_transport
tendency_of_atmosphere_mass_content_of_chlorinated_hydrocarbons_due_to_emission_from_savanna_and_grassland_fires
tendency_of_atmosphere_mass_content_of_chlorinated_hydrocarbons_due_to_emission_from_solvent_production_and_use
tendency_of_atmosphere_mass_content_of_chlorinated_hydrocarbons_due_to_emission_from_waste_treatment_and_disposal
tendency_of_atmosphere_mass_content_of_esters_due_to_emission_from_land_transport
tendency_of_atmosphere_mass_content_of_esters_due_to_emission_from_solvent_production_and_use
tendency_of_atmosphere_mass_content_of_esters_due_to_emission_from_waste_treatment_and_disposal
tendency_of_atmosphere_mass_content_of_ethers_due_to_emission_from_agricultural_production
tendency_of_atmosphere_mass_content_of_ethers_due_to_emission_from_forest_fires
tendency_of_atmosphere_mass_content_of_ethers_due_to_emission_from_land_transport

tendency_of_atmosphere_mass_content_of_ethers_due_to_emission_from_residential_and_commercial_combustion
tendency_of_atmosphere_mass_content_of_ethers_due_to_emission_from_savanna_and_grassland_fires
tendency_of_atmosphere_mass_content_of_ethers_due_to_emission_from_solvent_production_and_use
tendency_of_atmosphere_mass_content_of_ethers_due_to_emission_from_waste_treatment_and_disposal
tendency_of_atmosphere_mass_content_of_formaldehyde_due_to_dry_deposition
tendency_of_atmosphere_mass_content_of_formaldehyde_due_to_emission_from_agricultural_production
tendency_of_atmosphere_mass_content_of_formaldehyde_due_to_emission_from_agricultural_waste_burning
tendency_of_atmosphere_mass_content_of_formaldehyde_due_to_emission_from_energy_production_and_distribution
tendency_of_atmosphere_mass_content_of_formaldehyde_due_to_emission_from_forest_fires
tendency_of_atmosphere_mass_content_of_formaldehyde_due_to_emission_from_industrial_processes_and_combustion
tendency_of_atmosphere_mass_content_of_formaldehyde_due_to_emission_from_land_transport
tendency_of_atmosphere_mass_content_of_formaldehyde_due_to_emission_from_residential_and_commercial_combustion
tendency_of_atmosphere_mass_content_of_formaldehyde_due_to_emission_from_savanna_and_grassland_fires
tendency_of_atmosphere_mass_content_of_formaldehyde_due_to_emission_from_waste_treatment_and_disposal
tendency_of_atmosphere_mass_content_of_hydrogen_cyanide_due_to_dry_deposition
tendency_of_atmosphere_mass_content_of_hydrogen_peroxide_due_to_dry_deposition
tendency_of_atmosphere_mass_content_of_ketones_due_to_emission_from_agricultural_production
tendency_of_atmosphere_mass_content_of_ketones_due_to_emission_from_agricultural_waste_burning
tendency_of_atmosphere_mass_content_of_ketones_due_to_emission_from_energy_production_and_distribution
tendency_of_atmosphere_mass_content_of_ketones_due_to_emission_from_forest_fires
tendency_of_atmosphere_mass_content_of_ketones_due_to_emission_from_industrial_processes_and_combustion
tendency_of_atmosphere_mass_content_of_ketones_due_to_emission_from_land_transport
tendency_of_atmosphere_mass_content_of_ketones_due_to_emission_from_residential_and_commercial_combustion

tendency_of_atmosphere_mass_content_of_ketones_due_to_emission_from_savanna_and_grassland_fires
tendency_of_atmosphere_mass_content_of_ketones_due_to_emission_from_solvent_production_and_use
tendency_of_atmosphere_mass_content_of_ketones_due_to_emission_from_waste_treatment_and_disposal
tendency_of_atmosphere_mass_content_of_molecular_hydrogen_due_to_dry_deposition
tendency_of_atmosphere_mass_content_of_molecular_hydrogen_due_to_emission_from_forest_fires
tendency_of_atmosphere_mass_content_of_molecular_hydrogen_due_to_emission_from_savanna_and_grassland_fires
tendency_of_atmosphere_mass_content_of_nmvoc_due_to_emission_from_agricultural_production
tendency_of_atmosphere_mass_content_of_nmvoc_due_to_emission_from_agricultural_waste_burning
tendency_of_atmosphere_mass_content_of_nmvoc_due_to_emission_from_energy_production_and_distribution
tendency_of_atmosphere_mass_content_of_nmvoc_due_to_emission_from_forest_fires
tendency_of_atmosphere_mass_content_of_nmvoc_due_to_emission_from_industrial_processes_and_combustion
tendency_of_atmosphere_mass_content_of_nmvoc_due_to_emission_from_land_transport
tendency_of_atmosphere_mass_content_of_nmvoc_due_to_emission_from_maritime_transport
tendency_of_atmosphere_mass_content_of_nmvoc_due_to_emission_from_residential_and_commercial_combustion
tendency_of_atmosphere_mass_content_of_nmvoc_due_to_emission_from_savanna_and_grassland_fires
tendency_of_atmosphere_mass_content_of_nmvoc_due_to_emission_from_solvent_production_and_use
tendency_of_atmosphere_mass_content_of_nmvoc_due_to_emission_from_waste_treatment_and_disposal
tendency_of_atmosphere_mass_content_of_organic_acids_due_to_emission_from_agricultural_production
tendency_of_atmosphere_mass_content_of_organic_acids_due_to_emission_from_agricultural_waste_burning
tendency_of_atmosphere_mass_content_of_organic_acids_due_to_emission_from_energy_production_and_distribution
tendency_of_atmosphere_mass_content_of_organic_acids_due_to_emission_from_forest_fires
tendency_of_atmosphere_mass_content_of_organic_acids_due_to_emission_from_industrial_processes_and_combustion

tendency_of_atmosphere_mass_content_of_organic_acids_due_to_emission_from_residential_and_commercial_combustion
tendency_of_atmosphere_mass_content_of_organic_acids_due_to_emission_from_savanna_and_grassland_fires
tendency_of_atmosphere_mass_content_of_organic_acids_due_to_emission_from_waste_treatment_and_disposal
tendency_of_atmosphere_mass_content_of_trimethylbenzene_due_to_emission_from_energy_production_and_distribution
tendency_of_atmosphere_mass_per_unit_area
tendency_of_atmosphere_mass_per_unit_area_due_to_advection
tendency_of_atmosphere_moles_of_ethanol
tendency_of_atmosphere_moles_of_formaldehyde
tendency_of_atmosphere_moles_of_hox_expressed_as_hydrogen
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tendency_of_atmosphere_moles_of_hydrogen_peroxide
tendency_of_atmosphere_moles_of_hydroperoxyl_radical
tendency_of_atmosphere_moles_of_hydroxyl_radical
tendency_of_atmosphere_moles_of_methanol
tendency_of_atmosphere_moles_of_methyl_hydroperoxide
tendency_of_atmosphere_moles_of_methyl_peroxy_radical
tendency_of_atmosphere_moles_of_molecular_hydrogen
tendency_of_atmosphere_moles_of_radon
tendency_of_atmosphere_potential_energy_content_due_to_advection
tendency_of_bedrock_altitude
tendency_of_dry_energy_content_of_atmosphere_layer
tendency_of_dry_static_energy_content_of_atmosphere_layer
tendency_of_enthalpy_content_of_atmosphere_layer_due_to_advection
tendency_of_kinetic_energy_content_of_atmosphere_layer_due_to_advection
tendency_of_land_ice_thickness
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tendency_of_mass_fraction_of_cloud_ice_in_air_due_to_advection
tendency_of_mass_fraction_of_cloud_ice_in_air_due_to_diffusion
tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air
tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air_due_to_advection
tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air_due_to_autoconversion_to_rain
tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air_due_to_autoconversion_to_snow
tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air_due_to_boundary_layer_mixing
tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air_due_to_cloud_microphysics

tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air_due_to_condensation_and_evaporation
tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air_due_to_icefall
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_accretion_to_snow
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_advection
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_aggregation
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_bergeron_findeisen_process_from_cloud_liquid
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_boundary_layer_mixing
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_cloud_microphysics
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_convective_detrainment
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_deposition_and_sublimation
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_evaporation_of_melting_ice
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_heterogeneous_nucleation_from_cloud_liquid
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_heterogeneous_nucleation_from_cloud_liquid_water
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_heterogeneous_nucleation_from_water_vapor
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_homegeneous_nucleation
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_homogeneous_nucleation
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_icefall
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_melting_to_cloud_liquid
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_melting_to_cloud_liquid_water
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tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_riming_from_cloud_liquid
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_riming_from_cloud_liquid_water
tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_riming_from_rain
tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air
tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_accretion_to_rain
tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_accretion_to_snow
tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_advection

tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_autoconversion
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tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_boundary_layer_mixing
tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_cloud_microphysics
tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_condensation_and_evaporation
tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_condensation_and_evaporation_from_boundary_layer_mixing
tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_condensation_and_evaporation_from_convection
tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_condensation_and_evaporation_from_longwave_heating
tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_condensation_and_evaporation_from_pressure_change
tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_condensation_and_evaporation_from_shortwave_heating
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tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_convective_detrainment
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tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_homogeneous_nucleation
tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_melting_from_cloud_ice
tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_riming
tendency_of_middle_atmosphere_moles_of_molecular_hydrogen
tendency_of_mole_concentration_of_dissolved_inorganic_phosphorus_in_sea_water_due_to_biological_processes
tendency_of_mole_concentration_of_dissolved_inorganic_silicon_in_sea_water_due_to_biological_processes
tendency_of_moles_of_molecular_hydrogen_in_atmosphere
tendency_of_moles_of_molecular_hydrogen_in_middle_atmosphere
tendency_of_moles_of_molecular_hydrogen_in_troposphere
tendency_of_ocean_potential_energy_content
tendency_of_ocean_potential_energy_content_due_to_background
tendency_of_ocean_potential_energy_content_due_to_tides
tendency_of_potential_energy_content_of_atmosphere_layer_due_to_advection

tendency_of_potential_energy_content_of_ocean_layer_due_to_convection
tendency_of_potential_energy_content_of_ocean_layer_due_to_diffusion
tendency_of_specific_humidity_due_to_stratiform_cloud_and_precipitation_and_boundary_layer_mixing
tendency_of_troposphere_moles_of_molecular_hydrogen
tendency_of_upward_air_velocity
tendency_of_upward_air_velocity_due_to_advection
thermodynamic_phase_of_cloud_water_particles_at_cloud_top
time_sample_difference_due_to_collocation
toa_adjusted_radiative_forcing
toa_bidirectional_reflectance
toa_brightness_temperature_bias_at_standard_scene_due_to_intercalibration
toa_brightness_temperature_of_standard_scene
toa_cloud_radiative_effect
toa_instantaneous_radiative_forcing
toa_longwave_cloud_radiative_effect
toa_net_downward_radiative_flux
toa_outgoing_radiance_per_unit_wavenumber
toa_outgoing_radiance_per_unit_wavenumber_mean_within_collocation_scene
toa_outgoing_radiance_per_unit_wavenumber_mean_within_collocation_target
toa_outgoing_radiance_per_unit_wavenumber_stdev_within_collocation_scene
toa_outgoing_radiance_per_unit_wavenumber_stdev_within_collocation_target
toa_shortwave_cloud_radiative_effect
tropopause_adjusted_radiative_forcing
tropopause_instantaneous_radiative_forcing
troposphere_mole_content_of_formaldehyde
troposphere_mole_content_of_glyoxal
upward_air_velocity
upward_air_velocity_expressed_as_tendency_of_sigma
upward_dry_static_energy_flux_due_to_diffusion
upward_eastward_momentum_flux_in_air_due_to_nonorographic_eastward_gravity_waves
upward_eastward_momentum_flux_in_air_due_to_nonorographic_westward_gravity_waves
upward_eastward_momentum_flux_in_air_due_to_orographic_gravity_waves
upward_eastward_stress_at_sea_ice_base
upward_eliassen_palm_flux
upward_eliassen_palm_flux_in_air
upward_flux_of_eastward_momentum_due_to_nonorographic_eastward_gravity_waves
upward_flux_of_eastward_momentum_due_to_nonorographic_westward_gravity_waves
upward_flux_of_eastward_momentum_due_to_orographic_gravity_waves
upward_geothermal_heat_flux_at_sea_floor
upward_heat_flux_at_ground_level_in_snow
upward_heat_flux_at_ground_level_in_soil

upward_heat_flux_in_air
upward_heat_flux_in_sea_water_due_to_convection
upward_latent_heat_flux_in_air
upward_mass_flux_of_air
upward_northward_stress_at_sea_ice_base
upward_sea_ice_basal_heat_flux
upward_sensible_heat_flux_in_air
upward_water_vapor_flux_in_air
upward_water_vapor_flux_in_air_due_to_diffusion
vertical_air_velocity_expressed_as_tendency_of_pressure
vertical_air_velocity_expressed_as_tendency_of_sigma
vertical_component_of_ocean_xy_tracer_diffusivity
virtual_salt_flux_into_sea_water
virtual_salt_flux_into_sea_water_due_to_newtonian_relaxation
virtual_salt_flux_into_sea_water_due_to_sea_ice_thermodynamics
water_flux_correction
water_flux_into_sea_water_due_to_sea_ice_thermodynamics
water_flux_into_sea_water_from_icebergs
water_flux_into_sea_water_without_flux_correction
water_flux_out_of_sea_ice_and_sea_water
water_flux_out_of_sea_water
water_flux_out_of_sea_water_due_to_newtonian_relaxation
water_flux_out_of_sea_water_due_to_sea_ice_thermodynamics
water_sublimation_flux
wood_carbon_content
wood_debris_carbon_content
x_heat_flux_in_sea_water_due_to_advection
y_heat_flux_in_sea_water_due_to_advection
zenith_angle