Project Title	Prototype of HPC/Data Infrastructure for On-demand Services
Project Acronym	PHIDIAS
Grant Agreement No.	INEA/CEF/ICT/A2018/1810854
Start Date of Project	01.09.2019
Duration of Project	36 Months
Project Website	www.phidias-hpc.eu

D3.1.1 – Common Information Model

Work Package	**WP 3**
Lead Author (Org)	**Jean-Christophe Desconnets (IRD)**
Contributing Author(s) (Org)	Romain Bouvier (IRD), Dorian Ginane (Geomatys)
Due Date	**01.09.2020**
Date	11.01.2021
Version	**V1.0**

Dissemination Level

X	PU: Public
	PP: Restricted to other programme participants (including the Commission)
	RE: Restricted to a group specified by the consortium (including the Commission)
	CO: Confidential, only for members of the consortium (including the Commission)

The PHIDIAS project has received funding from the European Union's Connecting Europe Facility under grant agreement n° INEA/CEF/ICT/A2018/1810854.

Versioning and contribution history

Version	Date	Author	Notes
0.1	21.09.2020	Jean-Christophe Desconnets	Template and V0.1
0.2	9.10.2020	Dorian Ginane	section future work
0.3	14.10.2020	Romain Bouvier	examples of metadata and annex
0.9	16.10.2020	Jean-Christophe Desconnets	overall reading and update
1.0	19.10.2020	Jean-Christophe Desconnets	adding section 4.2.2.3
1.1	24.11.2020	Jean-Christophe Desconnets	Improvement of the document according to the comments of the two reviewers : Olivier Rouchon and Nicolas Cazenave

The PHIDIAS project has received funding from the European Union's Connecting Europe Facility under grant agreement n° INEA/CEF/ICT/A2018/1810854.

Table of Contents

The PHIDIAS project has received funding from the European Union's Connecting Europe Facility under grant agreement n° INEA/CEF/ICT/A2018/1810854.

TERMINOLOGY

Terminology/Acronym	Description
SOSA	a lightweight ontology for Sensors Observations Samples and Actuators
PROV-O	Provenance ontology
O & M	Observation and Measurement, an OGC specifications
W3C	World Wide Web Consortium
OGC	The OGC is an international consortium of academic, industry and government organizations that collaboratively develop open standards for geospatial and location services.
IRI	Internationalized Resource Identifier
URI	Uniform Resource Identifier
FAIR	*Findable*, *Accessible*, *Interoperable*, *Reusable*

The PHIDIAS project has received funding from the European Union's Connecting Europe Facility under grant agreement n° INEA/CEF/ICT/A2018/1810854.

Executive Summary

This project aims at developing a consolidated and shared HPC and Data service by building on pre-existing and emerging infrastructure in order to create a federation of “user to infrastructure” services. Specifically, PHIDIAS Consortium will further develop and provide new services to better discover, manage and process spatial, marine and environmental data. Nowadays, in the digital era, High-Performance Computing is the key-asset for major advances and a fundamental resource for the future of the European Union. The usage of so-called supercomputing is largely increasing as well as the number of data-intensive critical applications. This turning point is involving multiple Stakeholders and fragment of our society:

- Industry and Small-Medium Enterprises are counting on the power of supercomputers to develop innovative, faster and cost-effective solutions and diminish time to market for their products and services to the bare minimum.
- Modern Science requires the full capacity of high computing to successfully achieve significant discoveries and progress.
- The transition from petascale to exascale is in full course and it represents a window of opportunity for Europe.

The European Commission will complement the European Data Infrastructure under the European Cloud initiative with a long-term and large-scale flagship initiative on quantum-technologies. The objective is to release the complete potential of quantum which holds the promise to solve computational problems beyond current supercomputers. In this framework, European Council adopted in September 2018 the regulation that established the European High-Performance Computing Joint Undertaking (EuroHPC Joint Undertaking) to gather European and other participating countries efforts and resources with a view to building in Europe a top-notch supercomputing and data infrastructure within a competitive innovation ecosystem in relevant technologies and applications.

PHIDIAS answers INEA CEF Public Open Data Call for proposals, mostly focusing on the 3rd objective: “Creation of generic access services to increase the HPC and data capacities of the European Data Infrastructure”.

Following the rationale behind the EuroHPC Joint Undertaking Initiative to underpin the ambition of making European exascale achievable in a short time whilst developing a pan-European HPC infrastructure and HPC-based services, PHIDIAS is going to propose generic workflow for massive scientific data by combining computing, dissemination and archiving resources in a single framework in order to make this process this going forward.

The common information model is at the heart of the implementation of the project's FAIR principles. It should ensure interoperable access and interdisciplinary understanding (beyond the silos of the Earth's compartments) of the data and data services proposed by WP4, WP5 and WP6.

It is on this conceptual basis that the functionalities of discovery, browsing and access to the primary data and products resulting from the processing chains of the 3 compartments of the Earth dealt with in the project can then be declined.
This model will provide a common vision of the digital resources to be shared and thus enable the harmonization of the descriptions (metadata) of these resources in order to offer within the common data repository a unified view of the data and their generic access by ad hoc services.
The main benefit of the proposed common information model is that it extends the technical description, usually provided by existing metadata models, with the observation context description enabling the need of a user viewpoint. Moreover, following the FAIR principles, the common information model specifies the semantics of its elements using ontologies and vocabularies, and reuses as much as possible ontological and terminological existing resources.

1. Rationale

On a global scale, the oceans, the atmosphere and the biosphere are undergoing major changes, of unprecedented speed, with varied regional and local effects. The strong interaction with human societies requires a better understanding of the multiple challenges impacting our societies: climate change, pollution, land, climate and health risks, energy and biological resources, digital transition... These challenges call for an indispensable development of knowledge about the Earth system, the living world and human societies. The Earth system is a complex socio-ecosystem composed of physical, chemical and biological environments that evolve and interact with each other on a very broad continuum of time and space scales. Predicting the evolutions, trajectories and extreme events that affect the Earth system and anticipating their societal impacts needs knowledge of their history and an understanding of how they function. This requires scientific work based on the integrated and cross-referenced collection and analysis of numerous data from experiments carried out in the laboratory or in the field, from observations on land, at sea, from airborne or from space, and from data derived from modelling. The complexity of the systems and processes studied and the immense progress in data resolution and precision mean that work on a specific theme, or on a specific compartment of the Earth system, increasingly requires the integration of information or data from many fields. It has become essential to implement multi- or interdisciplinary approaches that request easy access to qualified data from other thematic areas as well as to products (transformed data) that can be easily used by non-specialists in the field.

Facilitating access to these multi-source data, developing quality products and services that meet the "FAIR" principles for all compartments of the Earth system and their interactions, from the Earth's core to the limits of the atmosphere, while fully integrating the biosphere, is a major challenge and a necessity to be able to undertake the opening up of data from the different communities studying the Earth system. Responding to this challenge requires interoperable service platforms for storage, retrieval and analysis.

The PHIDIAS project is a prefiguration and an opportunity to initiate the work leading to the deployment of the Data Terra digital research infrastructure. To do this, the Common Data Repository (CDR) must offer a federated and coherent view of the data managed at the level of each thematic data center (WP). It should enable the resources available to a human being to be discovered, just as with a "machine-to-machine" system, with a view in particular to making the data usable by other IR services and to interoperate with external systems.

To do this, the Common Information Model (CIM) must structure the CDR and provide a metadata model that provides a description of all the resources to be discovered and exploited. From the user's point of view, the Common Information Model must allow the discovery of the primary data of the 3 use cases, the discovery of the data produced by the implemented processing chains as well as the processing chains or processing units themselves deployed and available for use.

It is therefore important to semantically guide the user from the expression of his search to the usual expression of the knowledge he has of data from other compartments of the Earth so that he, and beyond data services, can discover and access data coming from other disciplines (compartment) in order for example to combine them with his own data for the purpose of executing a new processing

or for the purpose of experimenting a new analysis. For this, it is necessary to build links between "similar" or "complementary" data. These requirements and needs lead us to propose a common model built on the Observation paradigm that is shared by the disciplines of the project.

In addition, and in order to meet the needs of data mapping between them and their enrichment by annotations coming from community terminologies (GCMD, Convention CF, British Ocean Data Center, TaxRef, ...) we propose to build the Common information Model using the recommendations and technologies of the W3C in terms of data representation for the semantic web or web of data. Indeed, the technologies and recommendations of the semantic web allow to functionally meet the discovery needs expressed above.

2. Requirements

2.1 FAIR principles implementation

The Common Information Model (CIM) must provide access to the data produced, workflow and processing unit in accordance with FAIR principles. To do this, the CIM must enable data description for multi-viewpoint discovery. The oceanologist as well as the atmospheric scientist must be able to discover data essential to these studies observed in another part of the Earth. This is done using standardized metadata identified by their URI.
The CIM must also allow the description of the data formats and their location in order to access the data on the basis of standard web or community protocols. The CIM must also provide information concerning the user license associated with the data and access restrictions if necessary.
Finally, with regard to the products resulting from processing workflows, the CIM must be able to provide information on the provenance of the data which allows at least a knowledge of the processing that was at the origin of the data, or even information allowing the quality of the data to be assessed, including its suitability for the intended reuse.

2.2 2-Steps search

The nature and structuring of the data made available by the data centers associated with the PHIDIAS project are extremely varied. The number of data corresponding to series of observations such as the temperature measurement of a sensor on a drifting buoy or point clouds representing an atmospheric phenomenon can quickly be considerable. Their sizes can also be very large. This diversity is strongly related to the nature of the properties, phenomena measured, the temporal and spatial accuracy of the sensor. Their aggregation, encapsulation most often depends on the discipline and the tools available. In practice, the data from observations can be highly aggregated and come with a general description at the scale of what will be called a collection or poorly aggregated to a level of granularity that will be called a granule or a dataset. In order to set the ideas on these two notions, we give below examples of data collection and granule for the 3 compartments of the Earth system present in the project.

For example, for the **Aeris center** (atmosphere compartment) and in the framework of the IAGOS experiment, a collection of airborne data corresponds to all IAGOS flights during which a set of

measurements along the plane's path are carried out (e.g. ozone and temperature profiles). A spatial data collection is a set of data acquired by the same platform, the same instrument.

For the **THEIA center** (continental surfaces compartment), a collection of very high resolution spatial data is a set of images from the same platform/instrument on a given territory, for a given level of processing and a given year. A granule corresponds to a scene for a given level of processing and a given date.

For the **Odatis center** (Ocean compartment), a collection of spatial data corresponds to a homogeneous dataset in terms of processing level, applied treatments and input data. As for the granule, it corresponds to an occurrence. Simulation model results are presented at the scale of a data collection. It gathers the family of products output from the model (30 physical variables) or all the runs with the same model parameters.

Concerning the needs for data discovery and the necessary efficiency of a search engine to ensure the discovery, it seems essential to build a two-step search: 1) a search on the collections then 2) a search on the granules of the identified collections. This makes it possible to envisage a discovery system that can scale up to several million granules while ensuring precise and intelligent (algorithmically costly) discovery at the collection level. The data model must be able to address this operational concern.

3. Expected functionalities

The Common Information Model is intended to cover four main system functionalities. Priority is given to the discovery function of collections and data granules. The four main features are briefly described below:

The **discovery** of data from the different thematic data centers at two levels of granularity:

- Collection level (is an aggregate of granules),
- Granule level (a granule being part of one and only one collection).

From the entry point of the system, the CIM must allow for the discovery of data from the different use cases Atmosphere, Continental surfaces and Oceans. It must also allow discovering the data produced by the processing chains that will be deployed by the different WPs. Finally, it will also have to ensure the discovery of the available transformation tools (unit processing, processing chain) (or at least the different diffusion modalities) or even prototyping tools or resources available to launch large processing operations on a dataset.

The **downloading of data** at the "granularity" level. The objective is that the CIM can provide information on the location of the data and in particular the description of endpoints and associated methods to query their APIs and retrieve the data. In particular, we will cite the description of standardized web services such as: WFS, WCS, SOS, OpenDAP.

The **visualization of data** which according to the case, spatial, in situ and the type of in situ data can cover functionalities to be specified. For example, concerning spatial data, the visualization can be limited to a quick look or can use a WMS, WMTS service. Concerning the visualization of in-situ data - time series, other services must be implemented.

The exploitation of data processing services, which can be pre-processing services or data processing services – even if today, it is not a priority for a first implementation. The CIM, via descriptions that concern the definition of measurement units, those of observed variables, the characterization of the spatial representation of the dataset (object, 2D, 3D, 4D matrix) or its temporal accuracy (daily, decadal, monthly, ...) must provide data services, workflows, the necessary information to ensure the configuration and execution "machine to machine".

4. Common information model

4.1 Domain Model

The observation paradigm is relevant to the issues of interoperability and interdisciplinarity that we are targeting. Indeed, it allows us to clarify the reification of the act of observation and its context through its main properties, namely the Feature of Interest, the procedure, the observed property and the data resulting from the observation. **This formalization is particularly interesting to ensure the discovery of the data associated with an observation by focusing not on the characteristics of the data but on the context of the observation which allows a user-centered discovery.**
Moreover, the valuation of the properties of the observation through the use of thematic terminology recognized and standardized from a syntactic and semantic point of view allows to envisage the subsequent mapping (alignment) of concepts and their terms from one discipline to another. Finally, the implementation of the Common Information Model following the recommendations of the W3C (World Wide Web Consortium) allows us to consider in a natural way the enrichment of information attached to data by external terminological or ontological resources that will allow over time to associate to the data description the representation of objects and systems studied and the associated measurement networks.

Data models based on the observation paradigm have been developed over the years. This paradigm considers an observation as an act that results in the estimation of the value of a feature property and involves the application of a specified protocol, such as using a sensor, instrument, algorithm or process chain [Cox, 2013]. The most popular data models are Observations and Measurements (O&M) [Cox, 2013] and the Extensible Observation Ontology (OBOE) [Madin et al., 2018]. SOSA (Sensor, Observation, Sample, and Actuator) [Janowicz et al., 2018] and its extension, SSN-EXT, proposed by [Cox et al ., 2020] is a standalone core ontology which aligns primarily with O & M data model (and secondarily with OBOE) and that allow the use of observation paradigm with W3C semantic Web ontologies.
Aligned with the O&M data model specified by the Open Geospatial Consortium[1] (OGC), SOSA describes itself as a light-weight ontology for modelling acts of observation, sampling and actuation, using sensors, samplers and actuator respectively. With respect to acts of observation, SOSA shares a similar if not identical conceptual basis as OGC/ISO O&M. SSN/SOSA is formulated as an RDF vocabulary expressed in RDF/OWL. Focusing mainly on observation perspective, we will use only the classes and relationships involved in Observation part of SOSA. Figure 1 provides an overview of the core classes and properties that are specifically related to modeling Observations.

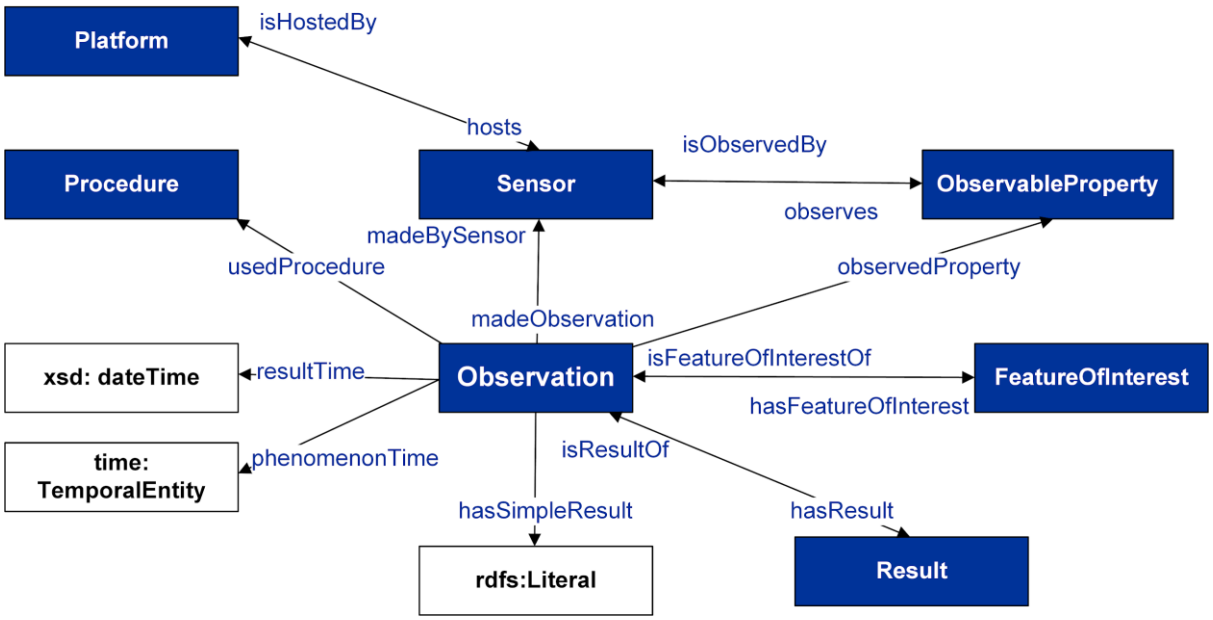


Figure 1 : Classes and relationships involved in Observation (SOSA) [Janowicz et al., 2018]

SSN-EXT [Cox et al., 2020] extends SOSA ontology with two new concepts very relevant for our purposes 1) the notion of ultimate feature-of-interest for an act of observation, sampling, or actuation, alongside the link to the (proximate) feature-of-interest, which might be a sample and allow to well differentiate feature closed to the observation protocol (proximate feature) and ultimate feature of interest which real study feature 2) the notion of homogeneous collections of observations, in which one or more observations properties (feature-of-interest, observed-property, procedure, sensor,...) may be shared by all members of the collection (Figure 2). This extension is also aligned with OBOE as shown in [Cox et al., 2020; Madin et al., 2018].

The presented data models are usually adopted in environmental and life sciences for providing a description at data level. This description has to be complemented with metadata, presented hereinafter, to describe datasets in its entirety, see Figure 2, and promote theirs sharing and reuse.

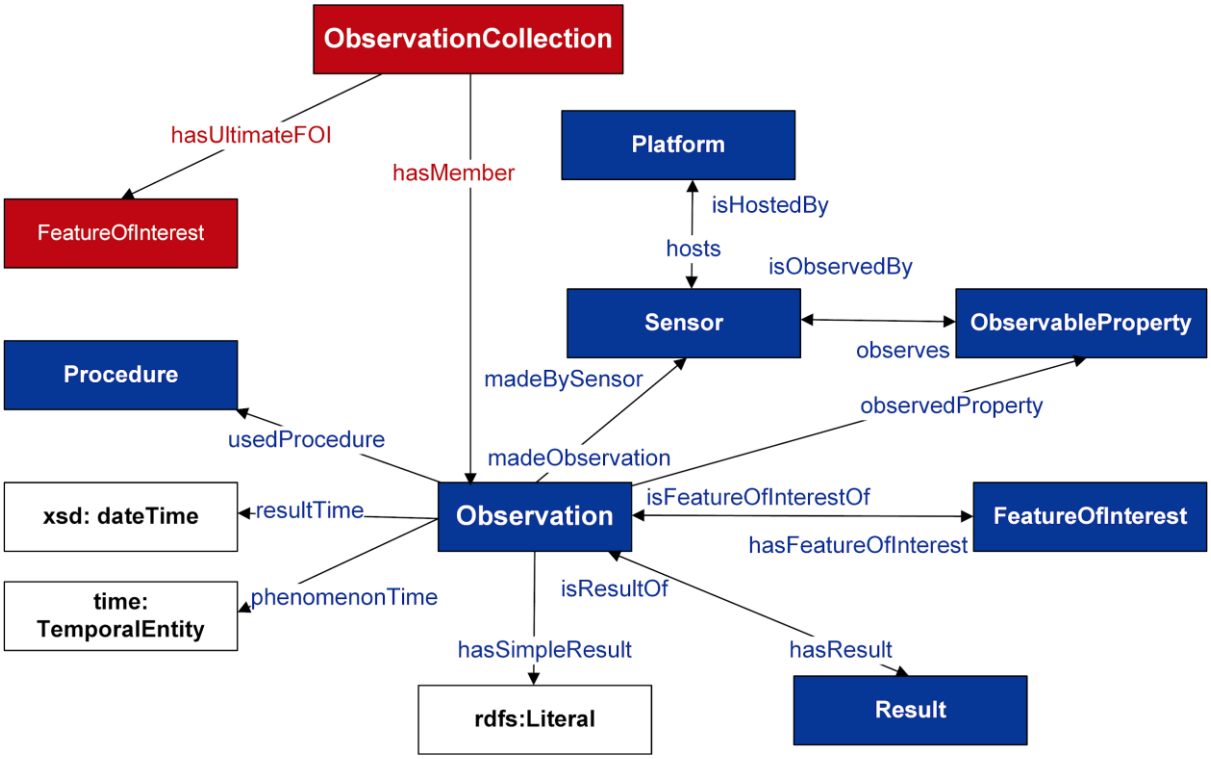


Figure 2: Extensions to the Semantic Sensor Network Ontology [Cox et al., 2020]

4.2 Metadata model

4.2.1 Semantic Web-based approach

To strengthen the discovery and reuse of very large amount of data for interdisciplinary purposes, we suggest to uniformly represent datasets originating from different disciplines using a common description, which is based on the observation paradigm; more precisely, we suggest the exploitation of the SOSA observation model as a metadata model. Our motivation is based on the fact that it is more relevant and realistic, from an implementation point of view, to exploit it at metadata-level rather than observational data-level. Indeed, environmental data are very heterogeneous, extremely numerous and voluminous on which efficient discovery and integration functions can be built.

We provide a metadata model that, embodying a user-centric viewpoint, satisfies the description needs of different communities; it characterizes a dataset based on multiple aspects that are associated with an observation (i.e. object of interest, observed property, collection protocol, spatial and temporal extents); these high level of abstraction elements, shared and understood by the majority of the environmental community, are then used, simultaneously or not, for discovering and evaluating the relevance of a dataset depending on the focus of the disciplines involved in a study (usually different disciplines privilege different aspects for discovering and evaluating datasets);

We present an ontology-based approach which reuses and takes advantage of the SOSA ontology and its extension, SSN-EXT as core model. We also reuse and integrate SOSA with well-defined ontologies which offer data provenance information using PROV-O or introduce data representation which contextualize observation and scientific point of view on temporal, spatial or thematic dimensions reusing SWEET, TIME or SKOS ontologies. Finally, the Complex Properties Model is mapped with SOSA to support observable complex properties that meet frequently in environmental observation.

The metadata model resulting from this study adds semantics to metadata providing a more efficient discoverability of data, an high level of semantic interoperability and enabling highly added-value services for portals dedicated to interdisciplinary research projects such as visualization, data analysis or on-demand processing service

4.2.2 Proposed metadata model

4.2.2.1 General overview

The proposed metadata model (see Figure 3) uses the concept of observation as a common conceptualization paradigm across disciplines. An observation is an activity that results in the approximation of the values of a property of a feature of interest. It consists of the application of a particular procedure using a digital or human sensor, an algorithm, or a process chain [Cox, 2013]. The procedure for acquiring the observation from the physical environment can be in-situ, remotely, or ex-situ based on the sampling location [Cox, 2013]. Using a procedure, a dataset is generated which is the composition of results originating from different observations. Each result represents a dataset characterized by a single feature of interest [Cox, 2013]. To construct a metadata model, an ontology-based formalism is used for representing its schema and the relations between its elements. The use of ontologies allows us to minimize heterogeneity problems (Kashyap and Sheth, 1998). For instance, IRI[1] associations enable the normalization of metadata records by avoiding duplicates. Moreover, we reused, as much as possible existing resources making extensive use of vocabulary included in the state-of-the-art ontologies or onto terminologies such as : DCAT [Maali et al., 2014], SOSA [Janowicz et al., 2018], SSN-EXT [Cox, 2020], TIME [Cox and Little, 2020], DCTERMS [DCMI Usage Board, 2020], PROV [Lebo et al., 2013], and CITO [Shotton and Peroni, 2018]. The W3C web semantic vocabularies foundations are also considered, i.e. RDFS, FOAF, GEOSPARQL and SKOS ontologies. Although, the proposed model (see Fig. 5) is based on several ontologies as listed above, a few of them which are the most important towards our contribution are described below:

(i) SOSA is the major fundamental ontology on which our proposed model is based on (see Fig. 1). It is used for specifying metadata elements bringing observation context which is understandable for the main part of end-users targeted. It defines a set of observations as a collection giving the main properties of the observation context (see Fig. 2) [Janowicz et al., 2018].

(ii) Data Catalog Vocabulary (DCAT) is used in our model for describing the dataset characteristics. DCAT takes charge of structural and administrative metadata commonly implemented with data providers metadata schemas such as ISO 19115. DCAT is an RDF vocabulary that is designed to enable interoperability between existing published data catalogs on the web [Maali et al., 2014]. It allows the data publishers to describe their datasets using a standard vocabulary to facilitate the usage and aggregation of metadata from different multiple data catalogs on the web.

(iii) Semantic Web for Earth and Environmental Terminology (SWEET) ontology is used for discovery and use of Earth science and environmental data (DiGiuseppe et al., 2014). For the development of

the model, the class “representation (REPR)” is used from this ontology to provide spatial and temporal dataset granularities in the model (Maali et al., 2014) required to evaluate the fitness for use of the dataset and for some cases quantitative description (temporal or spatial resolution) of dataset to run a processing chain.

(vi) The PROV Ontology (PROV-O) is used to provide a set of classes, properties, and restrictions for representing and interchanging provenance data generated in different systems [Lebo et al., 2013]. The alignment of SOSA classes with PROV-O Entity, Activity classes offers to potentially describe precisely the dataset provenance as it is necessary for dataset coming from complex and nested processing chains (e.g, global climate model simulation). It also allows the lineage of various dataset following the different steps of processing.

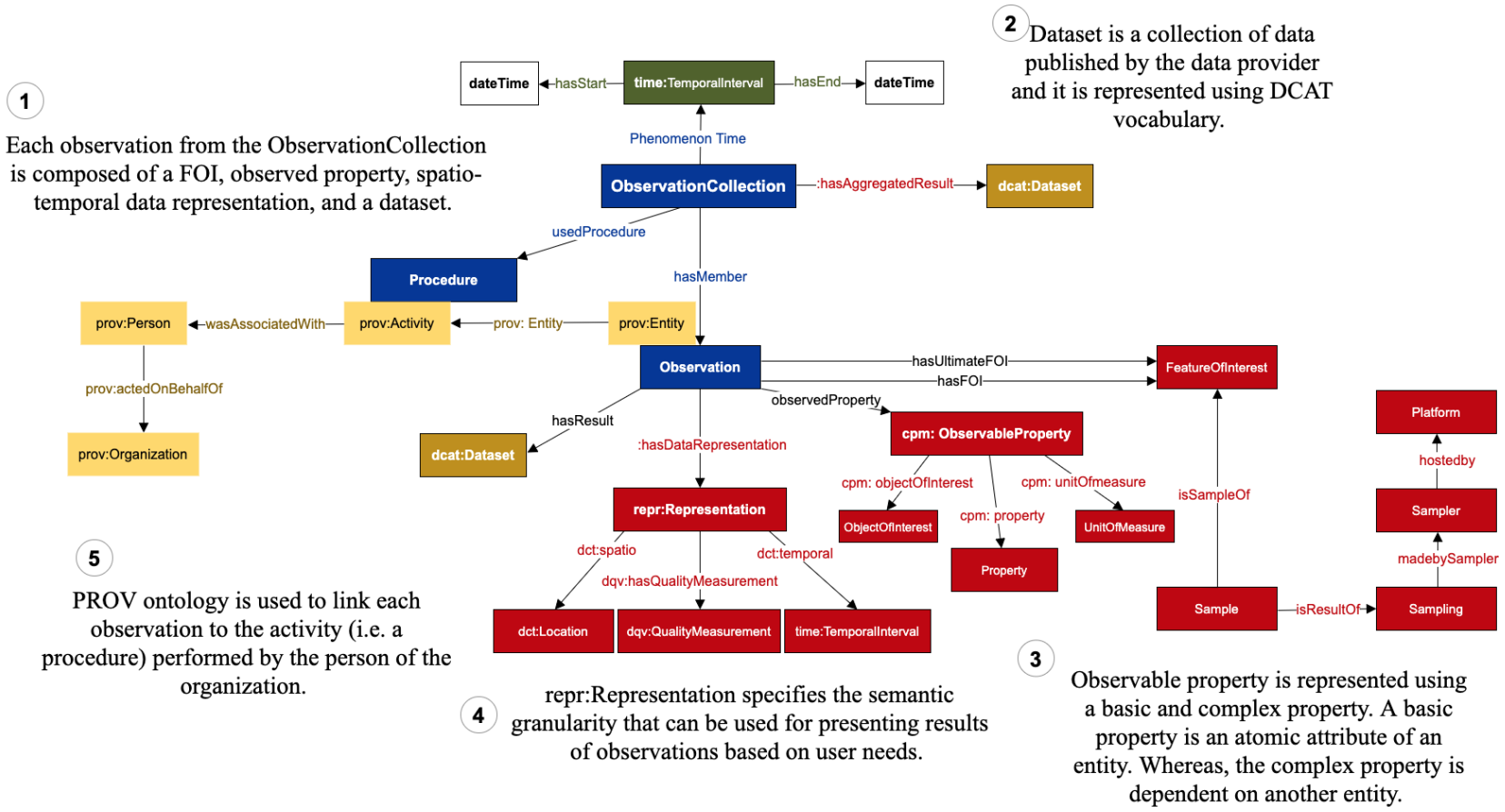


Figure 3 : Proposed metadata model (Beretta et *al.*, submitted)

4.2.2.2 Classes and properties

All classes and properties can be found in annex (Annex 1: Metadata model classes and properties)

4.2.2.3 Examples

These examples show the potential for describing metadata according to the proposed metadata model. In order to check and verify the relevance of the proposed model, we give below some examples of use based on existing metadata sets extracted from thematic center catalogs. We will then find the AERIS, THEIA and ODATIS centers.

Atmosphere use case (WP 4)

The selected example from AERIS (https://www.aeris-data.fr/catalogue/) is a data collection providing all vertical profiles over the airports visited by the IAGOS fleet around the world. The profiles match the take-off and landing phases of the flights. Many Observable Properties can be found with different resultTime in this collection, depending on sensors and planes activities.

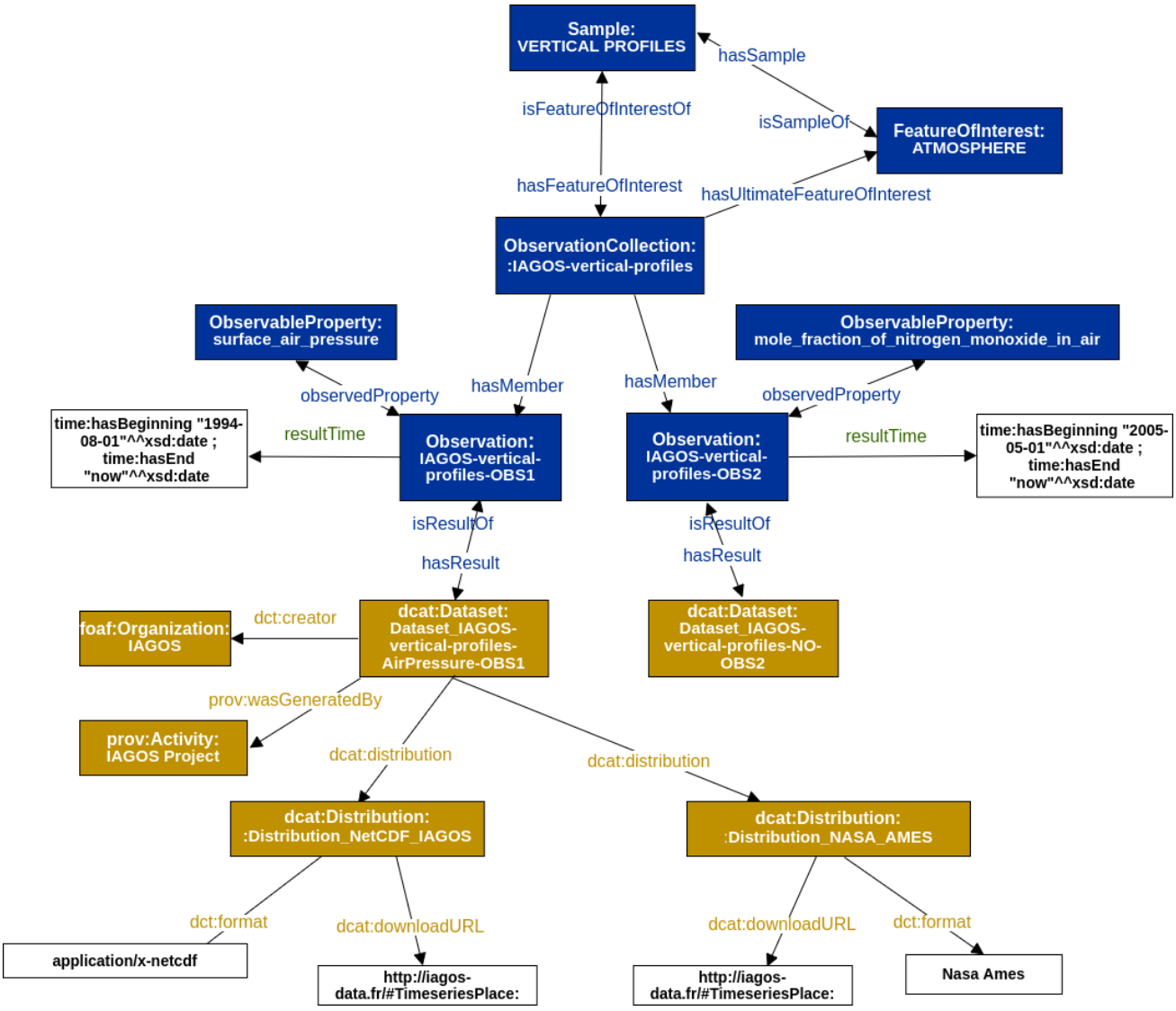


Figure 4: Example of metadata instance transformed with the PHIDIAS metadata model (coming from AERIS catalogue - vertical profile)

The selected example can be found here : https://sedoo.aeris-data.fr/catalogue/rest/metadatarecette/id/61e54760-86ba-4b69-804b-06a7793f9104 . The representation of this example can be found in Annex 2 (Annex 2: Vertical Profile - IAGOS (AERIS) metadata translation in Turtle (.ttl).

Land surface use case (WP 5)

This example from DINAMIS center (https://catalogue-dinamis.data-terra.org) is a satellite imagery from the platform Spot-6 acquired during the EQUIPEX-GEOSUD project. Finally, many metadata collections are represented here for group similar properties and increase the search facilities.

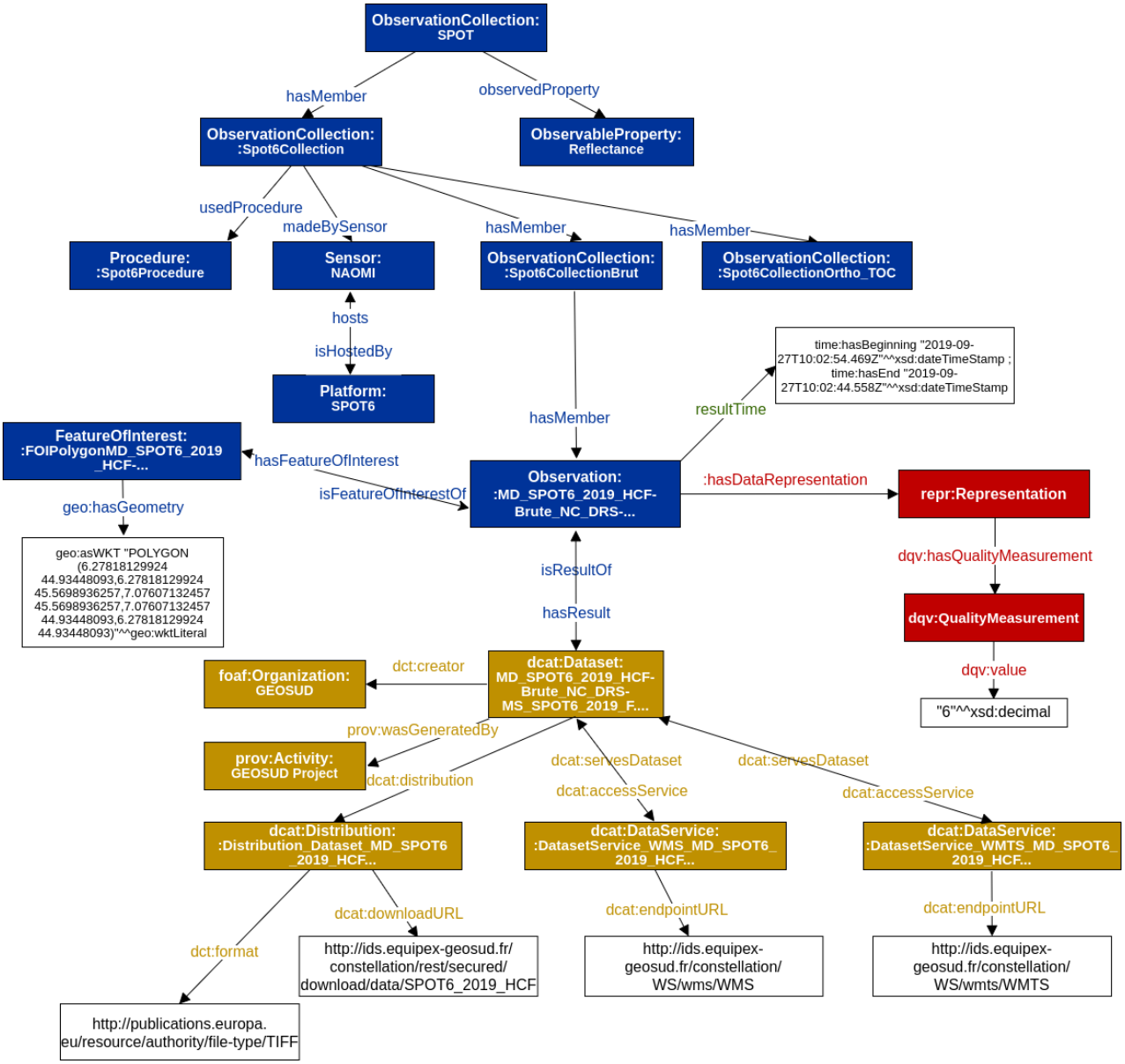


Figure 5: Example of metadata instance transformed with the PHIDIAS metadata model (coming from DINAMIS catalogue - SPOT6 satellite imagery)

The selected example can be found here : https://catalogue-dinamis.data-terra.org/arlas/explore/dinamis/_search?f=metadata.core.identity.identifier%3Aeq%3AMD_SPOT6_2019_HCF-Brute_NC_DRS-MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161&pretty=false&flat=false&&&size=1&max-age-cache=120 . The representation of this example can be found in Annex 3 (Annex 3: Spot6 imagery metadata translation in Turtle (.ttl))

Oceans use case (WP 6)

This example from ODATIS center (https://www.odatis-ocean.fr/donnees-et-services/access-to-data/catalog-complet) is a collection of data from monitoring network for phytoplankton and hydrology in coastal waters. A very large number of observation points are listed on the observation network, and this, in many coastal areas of metropolitan France. The network objective was the analysis of environmental factors, so a certain number of Observable Properties are present in this collection. Finally, the data time period is between 2006 and 2016.

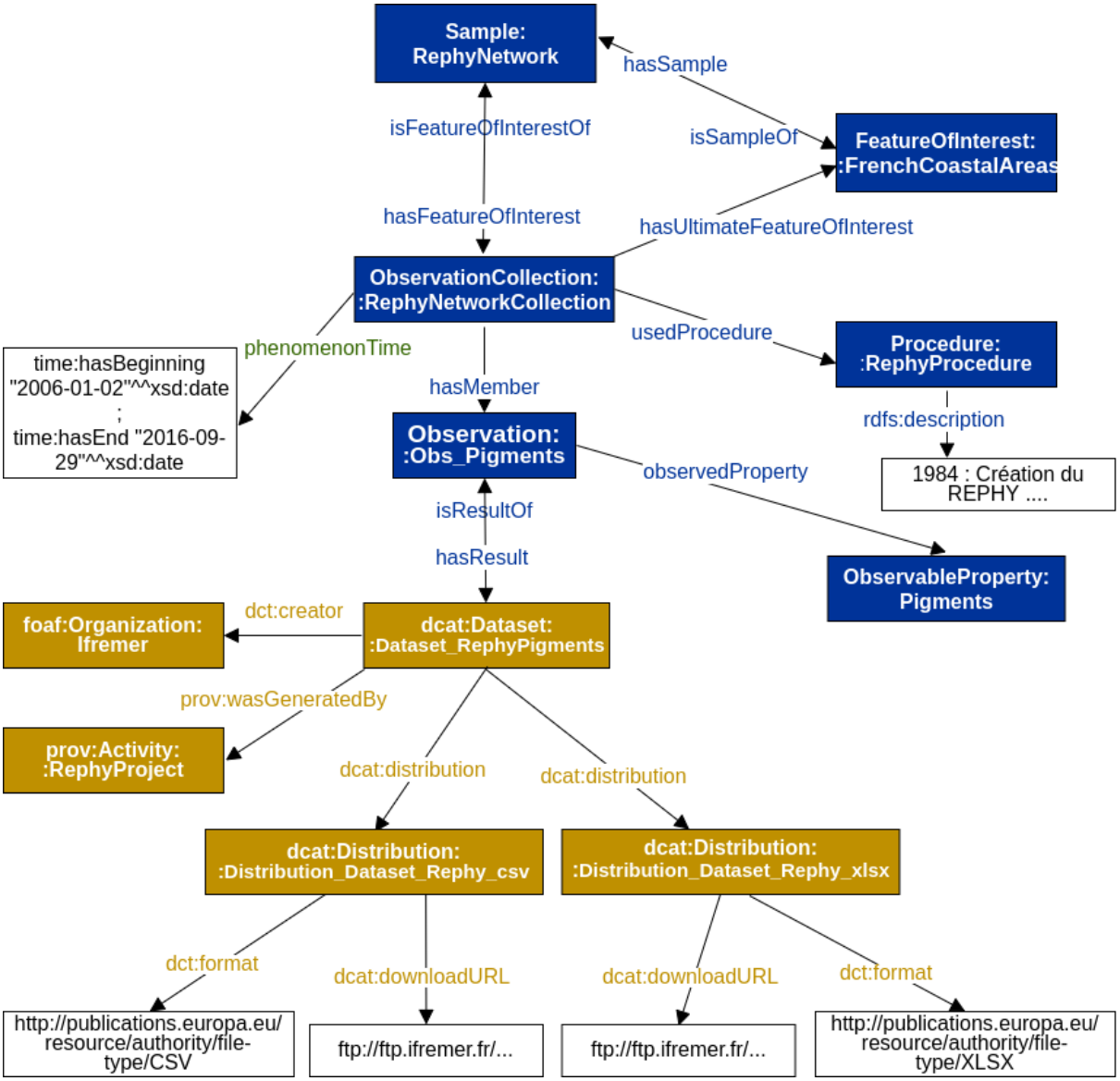
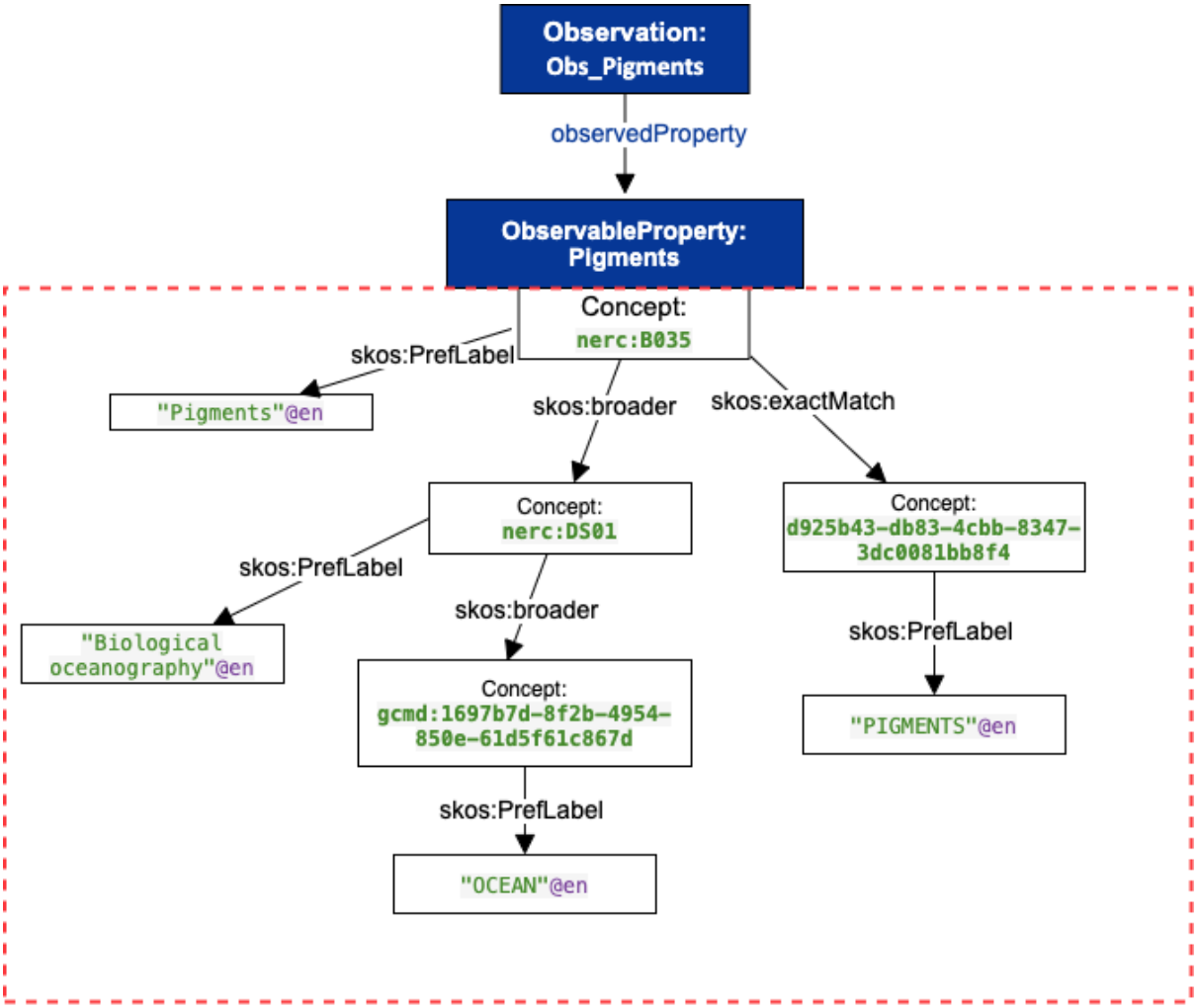


Figure 6: Example of metadata instance transformed with the metadata model (coming from ODATIS Catalogue - REPHY Network)

The selected example can be found here : https://www.odatis-ocean.fr/donnees-et-services/acces-aux-donnees/catalogue-complet#/metadata/c5dd9e6f-b45f-4cd6-984d-95d13c8d1f1f . The representation of this example can be found in Annex 4 (Annex 4: Rephy Network (ODATIS) data translation in Turtle (.ttl)

4.3 Standardisation and enrichment of metadata value using SKOS

Each transformation uses as much as possible standardised terminology coming from the relevant disciplinary domain. The figure 5 gives an example of use of GCMD terms (Global Change Master Directory: https://earthdata.nasa.gov/earth-observation-data/find-data/gcmd/gcmd-keywords) to instanciate the ObservableProperty or FeatureOfInterest classes. Note that the use of hierarchy GCMD (skos:broader property) or NERC or CF Convention allows to enrich the metadata and gives various views (broader or narrower) which will be exploited during the data discovery or browsing process by an user. We focus only the use of SKOS relation on ObservableProperty (figure 7) but other metadata classes like FeatureOfInterest, Sensor or Platform can be also enriched by terminological ontologies.




```
nerc:B035
a sosa:ObservableProperty ;
skos:prefLabel "Pigments"@fr, "Pigments"@en ;
skos:exactMatch <http://custom.shared.obj.ch/concept#799392ff-2f05-48c8-96e0-
5646e4307f04> ;
skos:exactMatch gcmd:ed925b43-db83-4cbb-8347-3dc0081bb8f4 ;
skos:broader nerc:DS01 .

nerc:DS01
a skos:Concept ;
skos:prefLabel "Biological oceanography"@en ;
skos:definition "The biological oceanographic science domain"@en;
skos:broader gcmd:91697b7d-8f2b-4954-850e-61d5f61c867d .
```

Figure 7: ObservableProperty “Pigment” is enriched with NERC and GCMD SKOS thesaurus. the red dashed rectangle included the skos concepts and their properties

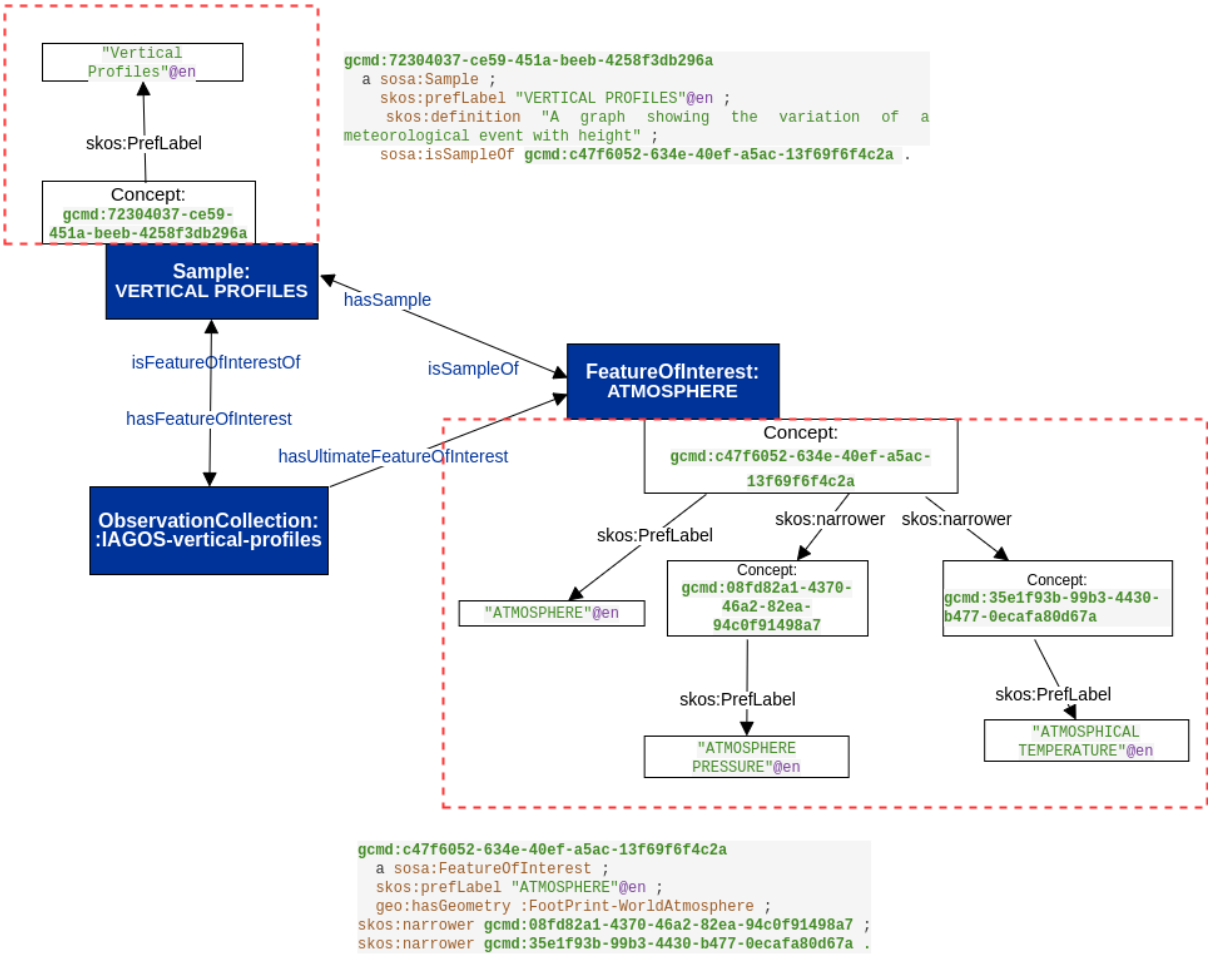


Figure 8: Sample “Vertical profiles” and Feature of Interest “Atmosphere” are enriched with NERC and GCMD SKOS thesaurus. the red dashed rectangle included the skos concepts and their properties

5. Use of common information model in PHIDIAS architecture

The proposed metadata model constitutes the metadata schema on which the business catalog (see figure 8) PHIDIAS will host the description of data, services and processing. According to the PHIDIAS project deliverable names, the business catalog corresponds to common metadata repository (CMR). In contrast to the technical catalog or IRODS catalog (tool and information to retrieve data in a storage space according to criteria (size, dates, format, sources and some metadata specific to the data), the PHIDIAS business catalog is a tool and metadata to retrieve data according to "business needs" among business properties of the data : spatial and temporal coverage, observed property (variable temperature, radiation, reflectance,...). The data structuration (format) and its distribution facilities are given, legal constraints and administration information about producer, owner... : raw data, products, data service, processing chain, data processes. The general approach to populated the business catalog is detailed below in 6.1 Development of automated transformation.

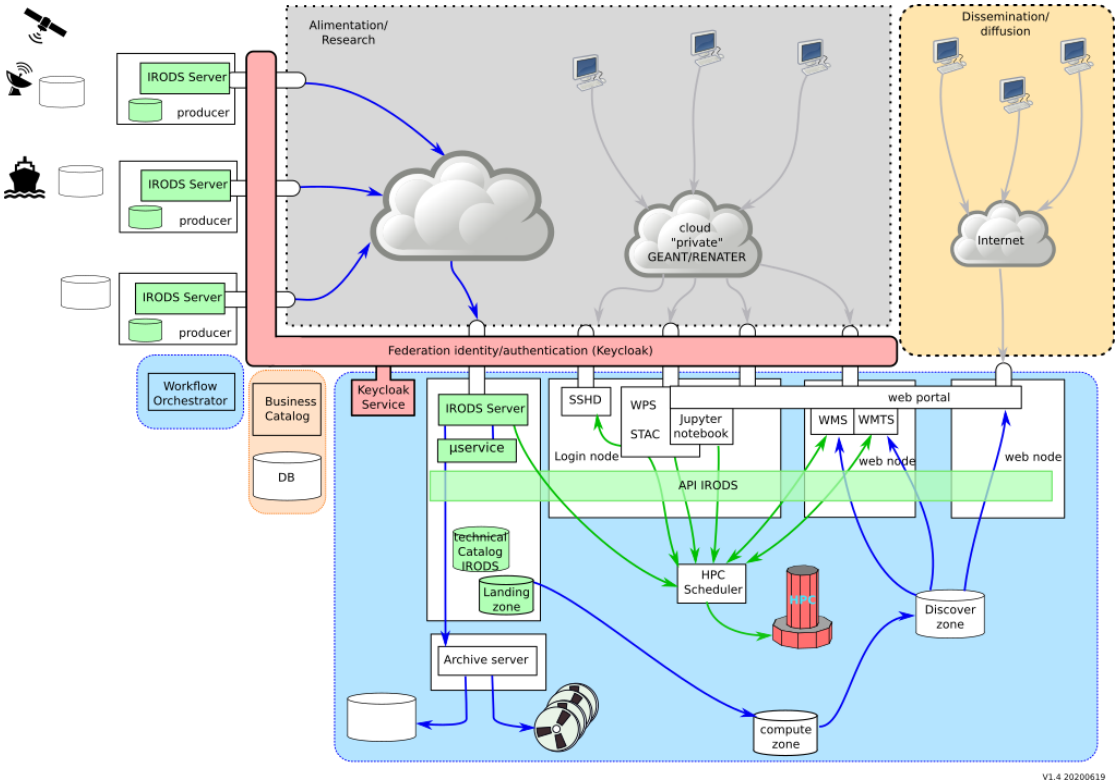


Figure 8 : Overview of PHIDIAS architecture - technical point of view (source: PHIDIAS WP2)

6. Future work

Regarding the defined model and the Phidias platform architecture and use cases, we can divide the future work as follows :

6.1 Development of automated transformation

The first task consists of developing transformation chains that :

- transform the original metadata to the Phidias metadata model,
- enrich the original metadata with the concepts and vocabularies provided by the SOSA model and the thesaurus used for the project,
- align and standardize the resource descriptions

A different transformation will apply to each set of metadata provided in the different WPs. These transformations will allow the Phidias portal to present and use a rich and consistent description of the resource. These tasks will part of implementation common metadata repository tasks identified in the Work Package 3, task 3.2. first implementation of transformation chains will be provided in march 2021.

6.2 Implementation of the Phidias data portal

The Phidias data portal will be composed of three differents sub-modules :

- A landing website where it will be possible to discover the different families of datasets provided by the Phidias infrastructure,

- A catalog that references all the datasets available through the Phidias portal,
- A Jupyter environment that allows manipulation of the Phidias datasets via a notebook that will exploit the Examind DataCube solution.

Landing part

The structure of the landing web-site will be built using the content of the Phidias metadata and the links between concepts included therein.

This part of the portal will permit discovery of the thematic domains addressed by the Phidias project, and the kinds of resources available within those domains.

Users can browse between the different concepts and at the end, launch a search on the concept they have chosen.

Catalog

The catalog will allow the user to find data and services available from the Phidias project. Search terms and results will be based on the metadata model and concept.

This will allow the construction of search functionalities based on the network of linked search concepts.

All these implementations are part of Common Metadata Repository which is implemented in task 3.2. the delivery will be done on march 2021.

7. Acknowledgements

The theoretical basis of the results presented in this deliverable was provided by the work of two post-doctoral students Valentina Beretta (MIDN, IRD) and Muhammad Arslan (MIDN, IRD) supervised by Jean-Christophe Desconnets and Isabelle Mougenot (ESPACE-DEV, University of Montpellier) with funding from IRD.

8. References

V. Beretta, J-C Desconnets, I. Mougenot, M. Arslan, J. Barde & V. Chaffard (2020) : A user-centric metadata model to foster sharing and reuse of multidisciplinary datasets in environmental and life sciences. submitted Computers and Geoscience journal.

S. Cox. Geographic information—observations and measurements v2. Ogc abstract specification. 2013.

S. Cox and C. Little. Time Ontology in OWL. W3C recommendation, 2020. URL: https://www.w3.org/TR/2020/CR-owl-time-20200326/

S. Cox. Extensions to the Semantic Sensor Network Ontology. W3C recommendation, 2020. URL: https://www.w3.org/TR/2020/WD-vocab-ssn-ext-20200116/

N. DiGiuseppe, L.C. Pouchard, and N.F. Noy. SWEET ontology coverage for earth system sciences. Earth Science Informatics, 7(4), pp.249-264. 2014

[DCMI Usage Board, 2020]

DCMI Usage Board. DCMI Metadata Terms, 2020. URL: https://www.dublincore.org/specifications/dublin-core/dcmi-terms/

K. Janowicz, A. Haller, S. J. Cox, D. Le Phuoc, andM. Lefrançois. Sosa: A lightweight ontology for sensors, observations, samples, and actuators.

T. Lebo, S. Sahoo, and D. McGuinness. PROV-O: The PROV Ontology, 2013. URL:https://www.w3.org/TR/prov-o/

F. Maali, J. Erickson, and P. Archer. Data catalog vocabulary (dcat). W3C recommendation, 2014. URL: https://www.w3.org/TR/vocab-dcat-2/

J. Madin, S. Bowers,M. Schildhauer, S.Krivov, D. Pennington, and F.Villa. An ontology for describing and synthesizing ecological observation. Journal of Web Semantics, 2018.

D. Shotton, and S. Peroni. CiTO, the Citation Typing Ontology, 2018. URL: https://sparontologies.github.io/cito/current/cito.html data. Ecological informatics, 2(3):279–296

9. Annex

Annex 1 : Metadata model classes and properties

Semantic Sensor Network Ontology (SOSA)
URL : https://www.w3.org/TR/vocab-ssn/

Class: ObservableProperty

OWL Class	sosa:ObservableProperty
Definition	An observable quality (property, characteristic) of a FeatureOfInterest.

OWL Property	sosa:isObservedBy
Definition	Relation between an ObservableProperty and the Sensor able to observe it.
Domain	sosa:ObservableProperty
Range	sosa:Sensor

Class: Observation

OWL Class	sosa:Observation
Definition	Act of carrying out an (Observation) Procedure to estimate or calculate a value of a

	property of a FeatureOfInterest. Links to a Sensor to describe what made the Observation and how; links to an ObservableProperty to describe what the result is an estimate of, and to a FeatureOfInterest to detail what that property was associated with.

OWL Property	sosa:phenomenonTime
Definition	An observable quality (property, characteristic) of a FeatureOfInterest.
Domain	sosa:Observation, sosa:Sampling
Range	time:TemporalEntity

OWL Property	sosa:observedProperty
Definition	An observable quality (property, characteristic) of a FeatureOfInterest.
Domain	sosa:Observation
Range	sosa:ObservableProperty

OWL Property	sosa:madeBySensor
Definition	Relation between an Observation and the Sensor which made the Observations.
Domain	sosa:Observation
Range	sosa:Sensor

Class: Sensor

OWL Class	sosa:Sensor
Definition	Device, agent (including humans), or software (simulation) involved in, or implementing, a Procedure. Sensors respond to a Stimulus, e.g., a change in the environment, or Input data composed from the Results of prior Observations, and generate a Result. Sensors can be hosted by Platforms.

OWL	sosa:observes

Property	
Definition	Relation between a Sensor and an ObservableProperty that it is capable of sensing.
Domain	sosa:Sensor
Range	sosa:ObservableProperty

OWL Property	sosa:madeObservation
Definition	Relation between a Sensor and an Observation made by the Sensor.
Domain	sosa:Sensor
Range	sosa:Observation

Class: Sample

OWL Class	sosa:Sample
Definition	Feature which is intended to be representative of a FeatureOfInterest on which Observations may be made.

OWL Property	sosa:hasSample
Definition	Relation between a FeatureOfInterest and the Sample used to represent it.
Domain	sosa:FeatureOfInterest
Range	sosa:Sample

OWL Property	sosa:isSampleOf
Definition	Relation from a Sample to the FeatureOfInterest that it is intended to be representative of.
Domain	sosa:Sample
Range	sosa:FeatureOfInterest

Class: Sampling

OWL Class	sosa:Sampling
Definition	An act of Sampling carries out a (Sampling) Procedure to create or transform one or more Samples.

OWL Property	sosa:madeBySampler
Definition	Relation linking an act of Sampling to the Sampler (sampling device or entity) that made it.
Domain	sosa:Sampling
Range	sosa:Sampler

Class: Sampler

OWL Class	sosa:Sampler
Definition	A device that is used by, or implements, a (Sampling) Procedure to create or transform one or more samples.

OWL Property	sosa:madeSampling
Definition	Relation between a Sampler (sampling device or entity) and the Sampling act it performed.
Domain	sosa:Sampler
Range	sosa:Sampling

Class: FeatureOfInterest

OWL Class	sosa:FeatureOfInterest

Definition	The thing whose property is being estimated or calculated in the course of an Observation to arrive at a Result, or whose property is being manipulated by an Actuator, or which is being sampled or transformed in an act of Sampling.

OWL Property	sosa:hasFeatureOfInterest
Definition	A relation between an Observation and the entity whose quality was observed, or between an Actuation and the entity whose property was modified, or between an act of Sampling and the entity that was sampled.
Domain	sosa:Observation, sosa:Sampling
Range	sosa:FeatureOfInterest, sosa:Sample

OWL Property	sosa:isFeatureOfInterestOf
Definition	A relation between a FeatureOfInterest and an Observation about it or an Actuation acting on it, or an act of Sampling that sampled it.
Domain	sosa:FeatureOfInterest, sosa:Sample
Range	sosa:Observation, sosa:Sampling

Class: Result

OWL Class	sosa:Result
Definition	The Result of an Observation, Actuation, or act of Sampling. To store an observation's simple result value one can use the hasSimpleResult property.

OWL Property	sosa:hasResult
Definition	Relation linking an Observation and a Sensor or Actuator and a Result, which contains a value representing the value associated with the observed Property.
Domain	sosa:Observation, sosa:Sampling
Range	sosa:Result, sosa:Sample

OWL Property	sosa:isResultOf
Definition	Relation linking a Result to the Observation or Actuation that created or caused it.
Domain	sosa:Result, sosa:Sample
Range	sosa:Observation, sosa:Sampling

OWL Property	sosa:hasSimpleResult
Definition	The simple value of an Observation or Actuation.
Domain	sosa:Observation, sosa:Actuation
Range	Not specified

OWL Property	sosa:resultTime
Definition	The result time is the instant of time when the Observation, Actuation or Sampling activity was completed.
Domain	sosa:Observation, sosa:Sampling
Range	xsd:dateTime

Class: Procedure

OWL Class	sosa:Procedure
Definition	A workflow, protocol, plan, algorithm, or computational method specifying how to make an Observation, create a Sample, or make a change to the state of the world (via an Actuator). A Procedure is re-usable, and might be involved in many Observations, Samplings, or Actuations. It explains the steps to be carried out to arrive at reproducible Results.

OWL Property	sosa:usedProcedure
Definition	A relation to link to a re-usable Procedure used in making an Observation, an Actuation, or a Sample, typically through a Sensor, Actuator or Sampler.

Domain	sosa:Observation, sosa:Sampling
Range	sosa:Procedure

Class: Platform

OWL Class	sosa:Procedure
Definition	A Platform is an entity that hosts other entities, particularly Sensors, Actuators, Samplers, and other Platforms.

OWL Property	sosa:hosts
Definition	Relation between a Platform and a Sensor, Actuator, Sampler, or Platform, hosted or mounted on it.
Domain	sosa:Platform
Range	sosa:Sensor, sosa:Sampler, sosa:Platform

OWL Property	sosa:isHostedBy
Definition	Relation between a Sensor, or Actuator, Sampler, or Platform, and the Platform that it is mounted on or hosted by.
Domain	sosa:Sensor, sosa:Sampler, sosa:Platform
Range	sosa:Platform

SSN-ext Ontology

URL : https://www.w3.org/TR/vocab-ssn/

Class: ObservationCollection

OWL Class	sosa:ObservationCollection
Definition	Collection of one or more observations, whose members share a common value for one or more property.

OWL Property	sosa:hasMember
Definition	Link to a member of a collection of observations that share the same value for one or more of the characteristic properties
Domain	sosa:ObservationCollection
Range	sosa:Observation or sosa:ObservationCollection

OWL Property	sosa:hasOriginalSample
Definition	Link to the original sample that is related to the context sample through a chain of isSampleOf relations
Domain	sosa:Sample
Range	sosa:Sample

OWL Property	sosa:hasUltimateFeatureOfInterest
Definition	Link to the ultimate feature of interest of an observation or act of sampling. This is useful when the proximate feature of interest is a sample of the ultimate feature of interest, directly or transtitively.
Domain	sosa:Observation or sosa:Sampling
Range	sosa:FeatureOfInterest

Data Catalog Vocabulary (DCAT-V2)

URL : https://www.w3.org/TR/vocab-dcat-2/

Class: Dataset

RDF Class	dcat:Dataset
Definition	A collection of data, published or curated by a single agent, and available for access or download in one or more representations.

RDF Property	dcat:temporalResolution
Definition	Minimum time period resolvable in the dataset.
Domain	Not specified
Range	xsd:duration

RDF Property	dct:spatial
Definition	The geographical area covered by the dataset.
Domain	Not specified
Range	dct:Location (A spatial region or named place)

RDF Property	dct:creator
Definition	The entity responsible for producing the resource.
Domain	Not specified
Range	foaf:Agent

RDF Property	dct:contributor
Definition	An entity responsible for making contributions to the resource.
Domain	Not specified
Range	foaf:Agent

RDF Property	dct:publisher
Definition	The entity responsible for making the item available.
Domain	Not specified
Range	foaf:Agent

RDF Property	dcat:contactPoint
Definition	Relevant contact information for the cataloged resource. Use of vCard is recommended [VCARD-RDF].
Domain	Not specified
Range	vcard:Kind

RDF Property	dct:title
Definition	A name given to the record.
Domain	Not specified
Range	rdfs:Literal

RDF Property	dct:issued
Definition	Date of formal issuance (e.g., publication) of the item.
Domain	Not specified
Range	rdfs:Literal encoded using the relevant ISO 8601 Date and Time compliant string [DATETIME] and typed using the appropriate XML Schema datatype [XMLSCHEMA11-2] (xsd:gYear, xsd:gYearMonth, xsd:date, or xsd:dateTime).

RDF Property	dcat:landingPage
Definition	A Web page that can be navigated to in a Web browser to gain access to the catalog, a dataset, its distributions and/or additional information.
Domain	Not specified
Range	foaf:Document

Class: RightsStatement

RDF	dct:RightsStatement

Class	
Definition	A statement about the intellectual property rights (IPR) held in or over a resource, a legal document giving official permission to do something with a resource, or a statement about access rights.

RDF Property	dct:rights
Definition	A statement that concerns all rights not addressed with dct:license or dct:accessRights, such as copyright statements.
Domain	Not specified
Range	dct:RightsStatement

RDF Property	dct:license
Definition	A legal document under which the resource is made available.
Domain	Not specified
Range	dct:LicenseDocument

RDF Property	dct:accessRights
Definition	Information about who can access the resource or an indication of its security status.
Domain	Not specified
Range	dct:RightsStatement

Class: Distribution

RDF Class	dcat:Distribution
Definition	A specific representation of a dataset. A dataset might be available in multiple serializations that may differ in various ways, including natural language, media-type or format, schematic organization, temporal and spatial resolution, level of detail or profiles (which might specify any or all of the above).

RDF Property	dcat:distribution
Definition	An available distribution of the dataset.
Domain	dcat:Dataset
Range	dcat:Distribution

RDF Property	dcat:accessURL
Definition	A URL of the resource that gives access to a distribution of the dataset. E.g. landing page, feed, SPARQL endpoint.
Domain	dcat:Distribution
Range	rdfs:Resource

RDF Property	dcat:downloadURL
Definition	The URL of the downloadable file in a given format. E.g. CSV file or RDF file. The format is indicated by the distribution's dct:format and/or dcat:mediaType
Domain	dcat:Distribution
Range	rdfs:Resource

RDF Property	dct:format
Definition	The file format of the distribution.
Domain	Not specified
Range	dct:MediaTypeOrExtent

RDF Property	dcat:mediaType
Definition	The media type of the distribution as defined by IANA [IANA-MEDIA-TYPES].
Domain	dcat:Distribution

Range	dct:MediaType

RDF Property	dcat:compressFormat
Definition	The compression format of the distribution in which the data is contained in a compressed form, e.g. to reduce the size of the downloadable file.
Domain	Not specified
Range	dct:MediaType

RDF Property	dcat:packageFormat
Definition	The package format of the distribution in which one or more data files are grouped together, e.g. to enable a set of related files to be downloaded together.
Domain	Not specified
Range	dct:MediaType

Class: DataService

RDF Class	dcat:DataService
Definition	A collection of operations that provides access to one or more datasets or data processing functions.

RDF Property	dct:conformsTo
Definition	An established standard to which the described resource conforms.
Domain	Not specified
Range	dct:Standard ("A basis for comparison; a reference point against which other things can be evaluated." [DCTERMS])

RDF Property	dcat:endpointURL
Definition	The root location or primary endpoint of the service (a Web-resolvable IRI).

Domain	dcat:DataService
Range	rdfs:Resource

RDF Property	dcat:endpointDescription
Definition	A description of the services available via the end-points, including their operations, parameters etc.
Domain	dcat:DataService
Range	rdfs:Resource

RDF Property	dcat:servesDataset
Definition	A collection of data that this data service can distribute.
Domain	Not specified
Range	dcat:Dataset

RDF Property	dct:type
Definition	The nature or genre of the resource.
Domain	Not specified
Range	rdfs:Class

RDF Property	dct:identifier
Definition	A unique identifier of the item.
Domain	Not specified
Range	rdfs:Literal

RDF Property	dct:description

Definition	A free-text account of the item.
Domain	Not specified
Range	rdfs:Literal

PROV Ontology (PROV-O)

URL : https://www.w3.org/TR/prov-o/

Class: Agent

OWL Class	prov:Agent
Definition	An entity is a physical, digital, conceptual, or other kind of thing with some fixed aspects; entities may be real or imaginary.

Class: Entity

OWL Class	prov:Entity
Definition	An entity is a physical, digital, conceptual, or other kind of thing with some fixed aspects; entities may be real or imaginary.

OWL Property	prov:wasAssociatedWith
Definition	An activity association is an assignment of responsibility to an agent for an activity, indicating that the agent had a role in the activity. It further allows for a plan to be specified, which is the plan intended by the agent to achieve some goals in the context of this activity.
Domain	prov:Activity
Range	prov:Agent

OWL Property	prov:wasGeneratedBy

Definition	Generation is the completion of production of a new entity by an activity. This entity did not exist before generation and becomes available for usage after this generation.
Domain	prov:Entity
Range	prov:Activity

Class: Activity

OWL Class	prov:Activity
Definition	An activity is something that occurs over a period of time and acts upon or with entities; it may include consuming, processing, transforming, modifying, relocating, using, or generating entities.

OWL Property	prov:entity
Definition	The prov:entity property references an prov:Entity which influenced a resource. This property applies to an prov:EntityInfluence, which is given by a subproperty of prov:qualifiedInfluence from the influenced prov:Entity, prov:Activity or prov:Agent.
Domain	prov:EntityInfluence
Range	prov:Entity

Class: Person

OWL Class	prov:Person
Definition	Person agents are people.

Class: Organization

OWL Class	prov:Organization

Definition	An organization is a social or legal institution such as a company, society, etc.

OWL Property	prov:actedOnBehalfOf
Definition	An object property to express the accountability of an agent towards another agent. The subordinate agent acted on behalf of the responsible agent in an actual activity.
Domain	prov:Agent
Range	prov:Agent

Representation (Repr) Ontology

Based on : https://www.w3.org/TR/vocab-dcat-2/ & https://www.w3.org/TR/vocab-dqv/

Class: Representation

RDF Class	repr:Representation
Definition	Temporal and spatial data representation. Should be on collection or observation level. This kind of class associated with his properties should represent the resolution product, his temporal recurrence and data precision.

RDF Property	dct:temporal
Definition	The temporal period that the dataset covers.
Domain	Not specified
Range	dct:PeriodOfTime (An interval of time that is named or defined by its start and end dates)

RDF Property	dqv:hasQualityMeasurement
Definition	Refers to the performed quality measurements. Quality measurements can be performed to any kind of resource (e.g., a dataset, a linkset, a graph, a set of triples). However, in the DQV context, this property is generally expected to be used in statements in which subjects are instances of dcat:Dataset or dcat:Distribution.

Domain	Not specified
Range	dqv:QualityMeasurement

RDF Property	dct:spatial
Definition	The geographical area covered by the dataset.
Domain	Not specified
Range	dct:Location

Complex Property Model (CPM) Ontology

URL : http://purl.org/voc/cpm

Class: ObservableProperty

OWL Class	cpm:ObservableProperty
Definition	At its simplest an ObservableProperty simply carries a reference to a phenomenon definition in a codelist with optional units of measure. However an ObservableProperty definition may be augmented using Constraints and/or Statistical Measures to create a more full definition of the observed property.

OWL Property	cpm:unitOfMeasure
Definition	unit of measure
Domain	cpm:ObservableProperty
Range	Not specified

OWL Property	cpm:property
Definition	property
Domain	cpm:ObservableProperty
Range	cpm:Property

OWL Property	cpm:objectOfInterest
Definition	objectOfInterest
Domain	cpm:ObservableProperty
Range	cpm:ObjectOfInterest

Class: CompositeObservableProperty

OWL Class	cpm:CompositeObservableProperty
Definition	Usually, when performing multiple observations on one featureOfInterest, one provides a separate ObservableProperty element for each Phenomenon being observed. However, in certain cases where either a) there is a strong link between the Phenomena or b) the multiple phenomena are clearly observed as part of the same Observation, these Phenomena may be provided together in one Observation. In this case a CompositeObservableProperty can be defined that groups together multiple Phenomena (ObservableProperty) into one CompositeObservableProperty element.

Class: ObjectOfInterest

OWL Class	cpm:ObjectOfInterest
Definition	The substance, taxon or other physical/chemical phenomenon of the Feature Of Interest that is being observed.

Class: Property

OWL Class	cpm:Property
Definition	The property of the environment which the ObservableProperty is describing.

Annex 2 : Vertical Profile - IAGOS (AERIS) metadata translation

The metadata representation in accordance to the metadata model is expressed in Turtle (Terse RDF Triple Language) here:

```
@prefix time: <http://www.w3.org/2006/time#> .
```

```
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix geo: <http://www.opengis.net/ont/geosparql#> .
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix sosa: <http://www.w3.org/ns/sosa/> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix geo: <http://www.opengis.net/ont/geosparql#> .
@prefix sf: <http://www.opengis.net/ont/sf#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix dct: <http://purl.org/dc/terms/> .
@prefix dcat: <http://www.w3.org/ns/dcat#> .
@prefix qudt-unit-1-1: <http://qudt.org/1.1/vocab/unit#> .
@prefix qudt-1-1: <http://qudt.org/1.1/schema/qudt#> .
@prefix repr: <representation> .
@prefix dqv: <http://www.w3.org/ns/dqv#> .
@prefix gn: <http://www.geonames.org/ontology#> .
@prefix : <http://example.org/> .
@prefix prov: <http://www.w3.org/ns/prov#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
#---------------------------------
#        Observation Collection
#---------------------------------
:IAGOS-vertical-profiles-
  a sosa:ObservationCollection ;
  skos:prefLabel "IAGOS vertical profiles"@en, "Profils verticaux IAGOS"@fr ;
  rdfs:description "This dataset provides all vertical profiles over the airports
visited by the IAGOS fleet. The profiles match the take-off and landing phases of
the flights. The dataset includes values of all species measured by IAGOS
instrumentation with a time acquisition resolution of 4 seconds as well as
meteorological fields provided by the aircraft or the ECMWF"@en;
 sosa:hasMember :IAGOS-vertical-profiles-OBS1, :IAGOS-vertical-profiles-OBS2 ;
sosa:hasUltimateFeatureOfInterest
<https://gcmdservices.gsfc.nasa.gov/kms/concept/c47f6052-634e-40ef-a5ac-
13f69f6f4c2a> ;
  sosa:hasFeatureOfInterest
<https://gcmdservices.gsfc.nasa.gov/kms/concept/72304037-ce59-451a-beeb-
4258f3db296a> .

<https://gcmdservices.gsfc.nasa.gov/kms/concept/72304037-ce59-451a-beeb-
4258f3db296a>
  a sosa:Sample ;
  skos:prefLabel "VERTICAL PROFILES"@en ;
  skos:definition "A graph showing the variation of a meteorological event with
height" ;
  sosa:isSampleOf :FOIWorldAtmosphere .

<https://gcmdservices.gsfc.nasa.gov/kms/concept/c47f6052-634e-40ef-a5ac-
13f69f6f4c2a>
  a sosa:FeatureOfInterest ;
  skos:prefLabel "ATMOSPHERE"@en ;
  skos:definition "A gaseous envelope gravitationally bound to a celestial body
(e.g., a planet, its satellite, or a star)."@en ;
  geo:hasGeometry :FootPrint-WorldAtmosphere ;
  skos:narrower     <https://gcmdservices.gsfc.nasa.gov/kms/concept/08fd82a1-4370-
46a2-82ea-94c0f91498a7> ;
skos:narrower  <https://gcmdservices.gsfc.nasa.gov/kms/concept/35e1f93b-99b3-4430-
b477-0ecafa80d67a> ;
skos:narrower
<https://gcmdservices.gsfc.nasa.gov/kms/concept/b9c56939-c624-467d-b196-
e56a5b660334> .

:FootPrint-WorldAtmosphere
  a sf:Polygon;
  geo:asWKT "POLYGON(90 180, -90 -180, 90 180, 90 -180)"^^geo:wktLiteral .

<https://gcmdservices.gsfc.nasa.gov/kms/concept/08fd82a1-4370-46a2-82ea-
94c0f91498a7>  a skos:Concept ;
```

```
   skos:prefLabel "ATMOSPHERIC PRESSURE"@en ;
  skos:definition "The pressure exerted by the atmosphere as a consequence of
gravitational attraction exerted upon the "column" of air lying directly above the
point in question."@en .

<https://gcmdservices.gsfc.nasa.gov/kms/concept/35e1f93b-99b3-4430-b477-
0ecafa80d67a> a skos:Concept ;
   skos:prefLabel "ATMOSPHERIC TEMPERATURE"@en ;
  skos:definition "A measure of temperature at different levels of the Earth's
atmosphere."@en .

<https://gcmdservices.gsfc.nasa.gov/kms/concept/b9c56939-c624-467d-b196-
e56a5b660334> a skos:Concept ;
   skos:prefLabel "ATMOSPHERIC CHEMISTRY"@en ;
  skos:definition "Measurements of chemical constituents in the atmosphere including
the major (non-H2O) greenhouse gases (CO2, CH4, CFC, N2O)."@en .


#
# Observation - 1
#
:IAGOS-vertical-profiles-OBS1
  a sosa:Observation ;
  sosa:observedProperty  <https://mmisw.org/ont/cf/parameter/surface_air_pressure>
;
  sosa:hasResult :Dataset_IAGOS-vertical-profiles-AirPressure-OBS1 ;
  sosa:resultTime :timeIAGOS-vertical-profiles-AirPressure-OBS1 .
<https://mmisw.org/ont/cf/parameter/surface_air_pressure>
  a sosa:ObservableProperty ;
  rdfs:label "surface_air_pressure" ;
  skos:prefLabel "Surface Pressure" ;
  skos:definition "The surface called 'surface' means the lower boundary of the
atmosphere. Air pressure is the force per unit area which would be exerted when the
moving gas molecules of which the air is composed strike a theoretical surface of
any orientation."@en ;
  qudt-1-1:unit "Pa" ;
  skos:broader <https://gcmdservices.gsfc.nasa.gov/kms/concept/b54de5cd-4475-4c7b-
acbc-4eb529b9396e> .
:timeIAGOS-vertical-profiles-AirPressure-OBS1
  a time:Interval ;
  time:hasBeginning "1994-08-01"^^xsd:date ;
  time:hasEnd "now"^^xsd:date .
#
#  Dataset
#
:Dataset_IAGOS-vertical-profiles-AirPressure-OBS1
  a dcat:Dataset ;
  dct:title "Dataset : IAGOS-vertical-profiles-SurfaceAirPressure-OBS1"@en ;
  dct:identifier "" ;
  dcat:keyword <https://gcmdservices.gsfc.nasa.gov/kms/concept/72304037-ce59-451a-
beeb-4258f3db296a>   ,   <https://gcmdservices.gsfc.nasa.gov/kms/concept/8bce0691-
74e9-4363-8d1f-d453a318c62b> , :IAGOS_verticalprofil_processing   ;
  dct:issued "now"^^xsd:date ;
  dcat:contactPoint "http://www.iagos.org" ;
  dct:publisher :IAGOS ;
  dct:creator :IAGOS ;
  dct:contributor :IAGOS ;
  dcat:distribution :Distribution_Dataset_IAGOS-vertical-profiles-AirPressure-OBS1
;
  dcat:landingPage "https://www.aeris-data.fr/catalogue/" ;
  prov:wasGeneratedBy :IAGOSVerticalProfilProject ;
  dct:rights :RightsResultIAGOS-vertical-profiles-AirPressure-OBS1 .
 :IAGOS
  a foaf:Organization ;
  foaf:name "IAGOS" .
#
#  Project
#
```

```
:IAGOSVerticalProfilProject
  rdf:type prov:Activity ;
  rdfs:label "IAGOS Project"@en, "Projet IAGOS"@fr ;
  rdfs:seeAlso "https://www.aeris-data.fr/" .
#
#  Rights
#
:RightsResultIAGOS-vertical-profiles-AirPressure-OBS1
  a dct:RightsStatement ;
  dct:license "unknown" ;
  dct:accessRights "unknown" ;
  dct:rights :OtherRightsIAGOS-vertical-profiles-AirPressure-OBS1 .
:OtherRightsIAGOS-vertical-profiles-AirPressure-OBS1
  a dct:RightsStatement ;
  rdfs:label "IAGOS data policy" ;
  rdf:about "http://iagos-data.fr/#CMSConsultPlace:DATA_POLICY" .
#
#  Distribution
#
:Distribution_Dataset_IAGOS-vertical-profiles-AirPressure-OBS1
  a dcat:Distribution ;
  dcat:accessURL "http://iagos-data.fr/#TimeseriesPlace:" ;
  dcat:downloadURL "http://iagos-data.fr/#TimeseriesPlace:" ;
  dct:title "Portail de données IAGOS"@fr, "IAGOS data portal"@en ;
  dct:format "application/x-netcdf" ;
  dcat:packageFormat       <http://publications.europa.eu/resource/authority/file-
type/NETCDF> .
:Distribution_Dataset_IAGOS-vertical-profiles-AirPressure-OBS1
  a dcat:Distribution ;
  dcat:accessURL "http://iagos-data.fr/#TimeseriesPlace:" ;
  dcat:downloadURL "http://iagos-data.fr/#TimeseriesPlace:" ;
  dct:title "Portail de données IAGOS"@fr, "IAGOS data portal"@en ;
  dct:format "Nasa Ames" ;
  dcat:packageFormat <https://vest.agrisemantics.org/node/20106> .
<https://vest.agrisemantics.org/node/20106>
  a dcat:MediaType ;
  rdfs:label "Nasa Ames Format" ;
  rdfs:comment "The NASA Ames Format for Data Exchange, often referred to as NASA
Ames Format, grew out of NASA aircraft campaigns and was first formalised at the
Ames Research Centre, California, during the 1987 Stratosphere Troposphere Exchange
Project (STEP), when uniform rules to record data were needed to facilitate the
data exchange between the participants and allow shared use of a minimised amount
of software to analyse and display different datasets. The issue was that the
adopted data format should meet the following requirements: it had to be portable
(readable on any machine by any programming language); it had to be self-describing
(that is, the data had to include an attachment containing all the information
needed to read, understand and interpret them – thus ensuring the reader's autonomy);
it had to be readable by humans (to retain the benefit of its self-description!).
  The first and third requirements implied the adoption of a text format (namely
ASCII). The second condition was met by including in each data file a header
containing the descriptive information (metadata).
  Very well suited to field campaigns involving several teams that need to share
their observations, the NASA Ames Format is not well adapted to very voluminous
datasets. In this case, although less portable, a binary format is recommended.
  Any set of functions of 1 to 4 variables can be recorded using the NASA Ames
format, which makes it particularly suitable for atmospheric datasets, whether
modelled or observed. Some NASA Ames file format indices are better adapted to
airborne platforms (balloons, aircraft).".
#
# Observation - 2
#
:IAGOS-vertical-profiles-OBS2
  a sosa:Observation ;
  sosa:observedProperty
<https://mmisw.org/ont/cf/parameter/mole_fraction_of_nitrogen_monoxide_in_air> ;
  sosa:hasResult :Dataset_IAGOS-vertical-profiles-NO-OBS2 ;
  sosa:resultTime :timeIAGOS-vertical-profiles-NO-OBS2 .
<https://mmisw.org/ont/cf/parameter/mole_fraction_of_nitrogen_monoxide_in_air>
```

```
  a sosa:ObservableProperty ;
  rdfs:label "mole_fraction_of_nitrogen_monoxide_in_air" ;
  skos:prefLabel "Mole fraction of nitrogen monoxide in air"@en ;
  skos:definition "Mole fraction is used in the construction
mole_fraction_of_X_in_Y, where X is a material constituent of Y."@en ;
  qudt-1-1:unit "ppb" ;
  skos:broader <https://gcmdservices.gsfc.nasa.gov/kms/concept/e82ebd1c-8241-4ca0-
95a9-a6e1432519cd> .
:timeIAGOS-vertical-profiles-NO-OBS2
  a time:Interval ;
  time:hasBeginning "2005-05-01"^^xsd:date ;
  time:hasEnd "now"^^xsd:date .
:Dataset_IAGOS-vertical-profiles-NO-OBS2
  a dcat:Dataset ;
  dct:title "Dataset : IAGOS-vertical-profiles-NO-OBS2"@en ;
  dct:identifier "" ;
  dcat:keyword <https://gcmdservices.gsfc.nasa.gov/kms/concept/72304037-ce59-451a-
beeb-4258f3db296a>   ,   <https://gcmdservices.gsfc.nasa.gov/kms/concept/8bce0691-
74e9-4363-8d1f-d453a318c62b> , :IAGOS_verticalprofil_processing  ;
  dct:issued "now"^^xsd:date ;
  dcat:contactPoint "http://www.iagos.org" ;
  dct:publisher :IAGOS ;
  dct:creator :IAGOS ;
  dct:contributor :IAGOS ;
  dcat:distribution :Distribution_Dataset_IAGOS-vertical-profiles-NO-OBS2 ;
  dcat:landingPage "https://www.aeris-data.fr/catalogue/" ;
  prov:wasGeneratedBy :IAGOSVerticalProfilProject ;
  dct:rights :RightsResultIAGOS-vertical-profiles-NO-OBS2 .
:IAGOS
  a foaf:Organization ;
  foaf:name "IAGOS" .
<https://gcmdservices.gsfc.nasa.gov/kms/concept/72304037-ce59-451a-beeb-
4258f3db296a>
  a skos:Concept ;
  skos:prefLabel "VERTICAL PROFILES" ;
  skos:definition "A graph showing the variation of a meteorological event with
height."@en .
<https://gcmdservices.gsfc.nasa.gov/kms/concept/8bce0691-74e9-4363-8d1f-
d453a318c62b>
  a skos:Concept ;
  skos:prefLabel "AIRCRAFT" ;
  skos:definition "An AIRCRAFT is a machine or device, such as an airplane,
helicopter, glider, or dirigible, that is capable of atmospheric flight"@en ;
  skos:related <https://gcmdservices.gsfc.nasa.gov/kms/concept/72304037-ce59-451a-
beeb-4258f3db296a> .
:IAGOS_verticalprofil_processing
  a skos:Concept ;
  skos:prefLabel "L2 processing" ;
  skos:related <https://gcmdservices.gsfc.nasa.gov/kms/concept/72304037-ce59-451a-
beeb-4258f3db296a> .
:IAGOSVerticalProfilProject
  a prov:Activity ;
  rdfs:label "IAGOS Project"@en ;
  rdfs:seeAlso "https://www.aeris-data.fr/" .
:RightsResultIAGOS-vertical-profiles-NO-OBS2
  a dct:RightsStatement ;
  dct:license "unknown" ;
  dct:accessRights "unknown" ;
  dct:rights :OtherRightsIAGOS-vertical-profiles-NO-OBS2 .
:OtherRightsIAGOS-vertical-profiles-NO-OBS2
  a dct:RightsStatement ;
  rdfs:label "IAGOS data policy" ;
  rdf:about "http://iagos-data.fr/#CMSConsultPlace:DATA_POLICY" .
#
#  Distribution
#
:Distribution_Dataset_IAGOS-vertical-profiles-NO-OBS2
  a dcat:Distribution ;
```

```
  dcat:accessURL "http://iagos-data.fr/#TimeseriesPlace:" ;
  dcat:downloadURL "http://iagos-data.fr/#TimeseriesPlace:" ;
  dct:title "Portail de données IAGOS"@fr, "IAGOS data portal"@en ;
  dct:format "application/x-netcdf" ;
  dcat:packageFormat       <http://publications.europa.eu/resource/authority/file-
type/NETCDF> .
:Distribution_Dataset_IAGOS-vertical-profiles-NO-OBS2
  a dcat:Distribution ;
  dcat:accessURL "http://iagos-data.fr/#TimeseriesPlace:" ;
  dcat:downloadURL "http://iagos-data.fr/#TimeseriesPlace:" ;
  dct:title "Portail de données IAGOS"@fr, "IAGOS data portal"@en ;
  dct:format "Nasa Ames" ;
  dcat:packageFormat <https://vest.agrisemantics.org/node/20106> .
<https://vest.agrisemantics.org/node/20106>
  a dcat:MediaType ;
  rdfs:label "Nasa Ames Format" ;
  rdfs:comment "The NASA Ames Format for Data Exchange, often referred to as NASA
Ames Format, grew out of NASA aircraft campaigns and was first formalised at the
Ames Research Centre, California, during the 1987 Stratosphere Troposphere Exchange
Project (STEP), when uniform rules to record data were needed to facilitate the
data exchange between the participants and allow shared use of a minimised amount
of software to analyse and display different datasets. The issue was that the
adopted data format should meet the following requirements: it had to be portable
(readable on any machine by any programming language); it had to be self-describing
(that is, the data had to include an attachment containing all the information
needed to read, understand and interpret them – thus ensuring the reader's autonomy);
it had to be readable by humans (to retain the benefit of its self-description!).
  The first and third requirements implied the adoption of a text format (namely
ASCII). The second condition was met by including in each data file a header
containing the descriptive information (metadata).
  Very well suited to field campaigns involving several teams that need to share
their observations, the NASA Ames Format is not well adapted to very voluminous
datasets. In this case, although less portable, a binary format is recommended.
  Any set of functions of 1 to 4 variables can be recorded using the NASA Ames
format, which makes it particularly suitable for atmospheric datasets, whether
modelled or observed. Some NASA Ames file format indices are better adapted to
airborne platforms (balloons, aircraft)." .
#
# SKOS concepts
#
<https://gcmdservices.gsfc.nasa.gov/kms/concept/b54de5cd-4475-4c7b-acbc-
4eb529b9396e>
  a skos:Concept ;
  skos:prefLabel "SURFACE PRESSURE "@en ;
  skos:definition "In meteorology, the atmospheric pressure at a given location on
the earth's surface.";
  skos:broader <https://gcmdservices.gsfc.nasa.gov/kms/concept/08fd82a1-4370-46a2-
82ea-94c0f91498a7> .
<https://gcmdservices.gsfc.nasa.gov/kms/concept/08fd82a1-4370-46a2-82ea-
94c0f91498a7>
  a skos:Concept ;
  skos:prefLabel "ATMOSPHERIC PRESSURE "@en ;
  skos:definition "The pressure exerted by the atmosphere as a consequence of
gravitational attraction exerted upon the 'column' of air lying directly above the
point in question.";
  skos:broader <https://gcmdservices.gsfc.nasa.gov/kms/concept/c47f6052-634e-40ef-
a5ac-13f69f6f4c2a> .
<https://gcmdservices.gsfc.nasa.gov/kms/concept/e82ebd1c-8241-4ca0-95a9-
a6e1432519cd>
  a skos:Concept ;
  skos:prefLabel "NITROGEN OXIDES"@en ;
  skos:definition "TNitrogen Oxides - NOx (pronounced 'nox') are produced from high
temperature combustion in air. They are nitrogen oxide and nitrogen dioxide.
[Science News; v146; 260-262; 1994] [Science; v242;555-558;1988.]" ;
  skos:broader <https://gcmdservices.gsfc.nasa.gov/kms/concept/9e5ec924-2fd3-4cbb-
a7eb-ffde114d0cb9> .
<https://gcmdservices.gsfc.nasa.gov/kms/concept/9e5ec924-2fd3-4cbb-a7eb-
ffde114d0cb9>
```

```
  a skos:Concept ;
  skos:prefLabel "NITROGEN COMPOUNDS"@en ;
  skos:definition "Nitrogen (N) is the most abundant constituent of the atmosphere
(78.09%). Nitrogen enters the atmosphere from volcanoes, and from the decay of
organic matter. It is removed from the atmosphere by nitrogen-fixing bacteria.
Nitrogen compounds are very reactive and play integral roles in the production and
destruction of ozone in the atmosphere." ;
  skos:broader <https://gcmdservices.gsfc.nasa.gov/kms/concept/b9c56939-c624-467d-
b196-e56a5b660334> .
<https://gcmdservices.gsfc.nasa.gov/kms/concept/b9c56939-c624-467d-b196-
e56a5b660334>
 a skos:Concept ;
  skos:prefLabel "ATMOSPHERIC CHEMISTRY"@en ;
  skos:definition "Measurements of chemical constituents in the atmosphere including
the major (non-H2O) greenhouse gases (CO2, CH4, CFC, N2O)." ;
  skos:broader <https://gcmdservices.gsfc.nasa.gov/kms/concept/c47f6052-634e-40ef-
a5ac-13f69f6f4c2a> .
<https://gcmdservices.gsfc.nasa.gov/kms/concept/c47f6052-634e-40ef-a5ac-
13f69f6f4c2a>
  a skos:Concept ;
  skos:prefLabel "ATMOSPHERE"@en ;
  skos:definition "https://earthdata.nasa.gov/learn/discipline/atmosphere" .
<https://gcmdservices.gsfc.nasa.gov/kms/concept/72304037-ce59-451a-beeb-
4258f3db296a>
  a skos:Concept ;
  skos:prefLabel "VERTICAL PROFILES"@en ;
  skos:definition "A graph showing the variation of a meteorological event with
height."@en .
<https://gcmdservices.gsfc.nasa.gov/kms/concept/8bce0691-74e9-4363-8d1f-
d453a318c62b>
  a skos:Concept ;
  skos:prefLabel "AIRCRAFT"@en ;
  skos:definition "An AIRCRAFT is a machine or device, such as an airplane,
helicopter, glider, or dirigible, that is capable of atmospheric flight"@en ;
  skos:related <https://gcmdservices.gsfc.nasa.gov/kms/concept/72304037-ce59-451a-
beeb-4258f3db296a> .
:IAGOS_verticalprofil_processing
  a skos:Concept ;
  skos:prefLabel "L2 processing"@en ;
  skos:related <https://gcmdservices.gsfc.nasa.gov/kms/concept/72304037-ce59-451a-
beeb-4258f3db296a> .
```

Annex 3 : Spot-6 imagery (THEIA/DINAMIS) metadata translation in Turtle (.ttl)

The metadata representation in accordance to the metadata model is expressed in Turtle (Terse RDF Triple Language) here:

```
@prefix time: <http://www.w3.org/2006/time#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix geo: <http://www.opengis.net/ont/geosparql#> .
@prefix ex: <http://example.org/ssn-ext-example/> .
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix sosa: <http://www.w3.org/ns/sosa/> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix geo: <http://www.opengis.net/ont/geosparql#> .
@prefix sf: <http://www.opengis.net/ont/sf#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix dct: <http://purl.org/dc/terms/> .
@prefix dcat: <http://www.w3.org/ns/dcat#> .
@prefix qudt-unit-1-1: <http://qudt.org/1.1/vocab/unit#> .
@prefix qudt-1-1: <http://qudt.org/1.1/schema/qudt#> .
@prefix repr: <acompleter.fr> .
@prefix dqv: <http://www.w3.org/ns/dqv#> .
```

```
@prefix gn: <http://www.geonames.org/ontology#> .
@prefix : <http://example.org/ssn-ext-example/> .
@prefix sdmx-attribute: <http://purl.org/linked-data/sdmx/2009/attribute#> .
@prefix prov: <http://www.w3.org/ns/prov#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
#-------------Super Collection--------------
:SpotCollection
  a sosa:ObservationCollection ;
  skos:prefLabel "Collection d'images de la plateforme SPOT" ;
  rdfs:description "Rassemble toutes les images des différentes missions SPOT : 1-
2-3-4-5-6-7" ;
  sosa:hasMember     :Spot6Collection,     :Spot7Collection,     :Spot5Collection,
:Spot4Collection, :Spot3Collection,:Spot2Collection, :Spot1Collection ;
  sosa:observedProperty :PixelsValues .
#-----------------------------------
#        Observation Collection - 1
#-----------------------------------
:Spot6Collection
  a sosa:ObservationCollection ;
  skos:prefLabel "Collection d'images SPOT6"@fr, "Spot6 image Collection"@en ;
  rdfs:description "Rassemble toutes les images de la plateforme SPOT6"@fr ;
  sosa:hasMember :Spot6CollectionBrut, :Spot6CollectionOrtho_TOC ;
  sosa:madeBySensor      <https://gcmdservices.gsfc.nasa.gov/kms/concept/a3200684-
34e6-4007-a247-111725a111f8> ;
  sosa:usedProcedure :Spot6Procedure .
<https://gcmdservices.gsfc.nasa.gov/kms/concept/a3200684-34e6-4007-a247-
111725a111f8>
  a sosa:Sensor ;
  skos:prefLabel "NAOMI"@en ;
  rdfs:description "https://www.wmo-sat.info/oscar/instruments/view/639";
  sosa:isHostedBy   <https://gcmdservices.gsfc.nasa.gov/kms/concept/b5b5a3c9-a393-
4766-a7d6-ef6c97969e78> ;
  sosa:observes :PixelsValues .
<https://gcmdservices.gsfc.nasa.gov/kms/concept/b5b5a3c9-a393-4766-a7d6-
ef6c97969e78>
  a sosa:Plateform ;
  skos:prefLabel "SPOT6"@en .
:Spot6Procedure
  a sosa:Procedure;
  rdfs:description                                    "https://www.intelligence-
airbusds.com/files/pmedia/public/r12784_9_spot6-7_fiche_technique.pdf".
#
#----------- Collection 1.1  ---------------
#
:Spot6CollectionBrut
  a sosa:ObservationCollection ;
  skos:prefLabel  "Collection  d'images  SPOT6  BRUT"@fr,  "BRUT  Spot6  image
Collection"@en ;
  rdfs:description "Collection d'images SPOT6 avec le niveau de traitement BRUT
aussi appelé 'Restore Sensor'" ;
  sosa:hasMember                                  :MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161 .
#
# Observation - 1
#
:MD_SPOT6_2019_HCF-Brute_NC_DRS-MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161
  a sosa:Observation ;
  sosa:hasFeatureOfInterest                  :FOIMD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161 ;
  skos:prefLabel                                 "MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161" ;
  sosa:hasResult                           :ResultMD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161;
  sosa:resultTime              :TimeIntervalResultMD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161 ;
  repr:hasDataRepresentation                     :MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161_Representation .
:FOIMD_SPOT6_2019_HCF-Brute_NC_DRS-MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161
```

```
  a sosa:FeatureOfInterest ;
  skos:prefLabel    "FootPrint    de    l'image    MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161" ;
  geo:hasGeometry                        :FOIPolygonMD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161 ;
  skos:broader <https://gcmdservices.gsfc.nasa.gov/kms/concept/6a426480-c58f-4b6b-
8e35-0975b7f6edb5> .
:FOIPolygonMD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161
  a sf:Polygon ;
  geo:asWKT        "POLYGON        (6.27818129924        44.93448093,6.27818129924
45.5698936257,7.07607132457  45.5698936257,7.07607132457  44.93448093,6.27818129924
44.93448093)"^^geo:wktLiteral .
:TimeIntervalResultMD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161
  a time:Interval ;
  time:hasBeginning "2019-09-27T10:02:54.469Z"^^xsd:dateTimeStamp ;
  time:hasEnd "2019-09-27T10:02:44.558Z"^^xsd:dateTimeStamp .
:Dataset_MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161
  a dcat:Dataset ;
  dct:title      "Imagery      dataset      :      MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161"@en ;
  dct:identifier                                    "MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161" ;
  dcat:keyword       <http://vocabs.lter-europe.net/EnvThes/USLterCV_806>       ,
<http://lod.nal.usda.gov/nalt/46939> , <Spot6_Brut_Processing>  ;
  dct:issued "2019-09-27"^^xsd:date ;
  dcat:contactPoint "http://ids.equipex-geosud.fr/" ;
  dct:publisher :GEOSUD ;
  dct:creator :GEOSUD ;
  dct:contributor :GEOSUD ;
  dcat:distribution          :Distribution_Dataset_MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161 ;
  dcat:landingPage "https://catalogue-dinamis.data-terra.org/" ;
  prov:wasGeneratedBy :GEOSUDProject ;
  dcat:accessService           :DatasetService_WMS_MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161,
:DatasetService_WMTS_MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161 .
:GEOSUD
  a foaf:Organization ;
  foaf:name "EQUIPEX GEOSUD" .
#
#  Distribution
#
:Distribution_Dataset_MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161
  a dcat:Distribution ;
  dcat:accessURL                                                    "http://ids.equipex-
geosud.fr/constellation/rest/secured/download/data/SPOT6_2019_HCF-Brute_NC_DRS-
MS/SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161.tar.gz" ; #SHOULD be used for the
URL of a service or location that can provide access to this distribution, typically
through a Web form, query or API call.
  dcat:downloadURL                                                  "http://ids.equipex-
geosud.fr/constellation/rest/secured/download/data/SPOT6_2019_HCF-Brute_NC_DRS-
MS/SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161.tar.gz" ;
  dct:title "GEOSUD Dataset distribution imagery"@en ;
  dct:format <http://publications.europa.eu/resource/authority/file-type/TIFF> ;
  dcat:mediaType <https://www.iana.org/assignments/media-types/image/tiff> ;
  dcat:packageFormat       <http://publications.europa.eu/resource/authority/file-
type/TAR>                        ;                        #https://www.intelligence-
airbusds.com/files/pmedia/public/r1986_9_spot_formatdimap_fr_sept2010.pdf
  dcat:compressFormat                        <http://www.iana.org/assignments/media-
types/application/gzip> ;
```

```
  dct:rights                          :RightsResultMD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161 .
:RightsResultMD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161
  a dct:RightsStatement ;
  dct:license                                                    "http://ids.equipex-
geosud.fr/documents/10180/17044/license_spot67_telemesure/ebb0588b-0827-4008-86bd-
9c8545e8ca34" ;
  dct:accessRights "unknown" .
:DatasetService_WMS_MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161
  a dcat:DataService ;
  dct:conformsTo <http://www.opengis.net/def/serviceType/ogc/wms/1.1> ;
  dct:description "IDS-GEOSUD WMS DataService"@en ;
  dct:identifier "SPOT6_2019_HCF-Brute_NC_DRS-MS" ;
  dct:title "IDS-GEOSUD WMS Server"@en ;
  dct:type <http://purl.org/dc/dcmitype/Service> ;
  dct:type                                <https://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceType/view> ;
  dcat:endpointURL <http://ids.equipex-geosud.fr/constellation/WS/wms/WMS> ;
  dcat:endpointDescription "A classical service WMS and queries associated" ;
  dcat:servesDataset                      :Dataset_MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161 .
:DatasetService_WMTS_MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161
  a dcat:DataService ;
  dct:conformsTo <http://www.opengis.net/def/serviceType/ogc/wmts> ;
  dct:description "IDS-GEOSUD WMTS DataService"@en ;
  dct:identifier "SPOT6_2019_HCF-Brute_NC_DRS-MS-styled-Spot6_RVB" ;
  dct:title "IDS-GEOSUD WMTS Server"@en ;
  dct:type <http://purl.org/dc/dcmitype/Service> ;
  dct:type                                <https://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceType/view> ;
  dcat:endpointURL <http://ids.equipex-geosud.fr/constellation/WS/wmts/WMTS> ;
  dcat:endpointDescription "A classical service WMTS and queries associated" ;
  dcat:servesDataset                      :Dataset_MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161 .
:GEOSUDProject
  a prov:Activity ;
  rdfs:label "GEOSUD Project"@en ;
  rdfs:seeAlso "http://ids.equipex-geosud.fr/" .
:MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161_Representation
  a repr:Representation ;
  dqv:hasQualityMeasurement                    :MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161_RepresentationSpatialGranularityAgg
regatedObservation .
:MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161_RepresentationSpatialGranularityAgg
regatedObservation
  a dqv:QualityMeasurement;
  dqv:isMeasurementOf                          :MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161SpatialResolutionAsMeterDistance ;
  dqv:value "6"^^xsd:decimal ;
  sdmx-attribute:unitMeasure                  <http://www.ontology-of-units-of-
measure.org/resource/om-2/metre> .
:MD_SPOT6_2019_HCF-Brute_NC_DRS-
MS_SPOT6_2019_FRANCE_HCF_BRUT_NC_GEOSUD_MS_161SpatialResolutionAsMeterDistance
a  dqv:Metric ;
  skos:definition "Spatial resolution of rdf:type dataset expressed as meter"@en ;
  dqv:expectedDataType xsd:decimal ;
  dqv:inDimension dqv:precision  .
#
#----------- Collection 1.2  ---------------
#
:Spot6CollectionOrtho_TOC
  a sosa:ObservationCollection ;
```

```
  skos:prefLabel "Collection d'images SPOT6 ORTHO TOC"@fr, "ORTHO TOC Spot6 image
Collection"@en ;
  rdfs:description "Collection d'images SPOT6 avec le niveau de traitement ORTHO
TOC" ;
  sosa:hasMember :5394513640067453 .
#
# Observation - 2
#
:5394513640067453
  a sosa:Observation ;
  sosa:hasFeatureOfInterest :FOI5394513640067453 ;
  sosa:resultTime :TimeIntervalResult5394513640067453 ;
  skos:prefLabel "5394513640067453" ;
  sosa:hasResult :Result5394513640067453 ;
  repr:hasDataRepresentation :5394513640067453_Representation  .
:FOI5394513640067453
  a sosa:FeatureOfInterest ;
  skos:prefLabel "FootPrint de l'image 5394513640067453";
  geo:hasGeometry  :FOIPolygon5394513640067453 ;
  skos:broader <https://gcmdservices.gsfc.nasa.gov/kms/concept/6a426480-c58f-4b6b-
8e35-0975b7f6edb5> .
:FOIPolygon5394513640067453
  a sf:Polygon ;
  geo:asWKT      "POLYGON      ((0.5574409e2      -0.21392448e2,0.55154308e2      -
0.21386994e2,0.55160997e2  -0.20845348e2,0.55748643e2  -0.20850651e2,0.5574409e2  -
0.21392448e2))"^^geo:wktLiteral .
:TimeIntervalResult5394513640067453
  a time:Interval ;
  time:hasBeginning "2020-06-01T06:06:58Z"^^xsd:dateTimeStamp ;
  time:hasEnd "2020-06-01T06:06:58Z"^^xsd:dateTimeStamp .
:Dataset_5394513640067453
  a dcat:Dataset ;
  dct:title "Imagery dataset : 5394513640067453"@en ;
  dct:identifier "5394513640067453" ;
  dcat:keyword       <http://vocabs.lter-europe.net/EnvThes/USLterCV_806>       ,
<http://lod.nal.usda.gov/nalt/68451> , <Spot6_ORTHO_TOC_Processing>  ;
  dct:issued "2019-09-27"^^xsd:date ;
  dcat:contactPoint "https://www.kalideos.fr/" ;
  dct:publisher :Kalideos ;
  dct:creator :Kalideos ;
  dct:contributor :Kalideos ;
  dcat:distribution :Distribution_Dataset_5394513640067453 ;
  dcat:landingPage "https://catalogue-dinamis.data-terra.org/" ;
  prov:wasGeneratedBy :GEOSUDProject ;
  dcat:accessService :DatasetService_WMS_5394513640067453 .
:Kalideos
  a foaf:Organization ;
  foaf:name "Kalideos" .
#
#  Distribution
#
:Distribution_Dataset_5394513640067453
  a dcat:Distribution ;
  dcat:accessURL     "https://www.kalideos.fr/resto2/collections/KALCNES/e67937f3-
2c7f-5dd9-979f-da1517487e3e/download" ;
  dcat:downloadURL   "https://www.kalideos.fr/resto2/collections/KALCNES/e67937f3-
2c7f-5dd9-979f-da1517487e3e/download" ;
  dct:title "Kalideos Dataset Distribution Imagery"@en ;
  dct:format <http://publications.europa.eu/resource/authority/file-type/TIFF> ;
  dcat:mediaType <https://www.iana.org/assignments/media-types/image/tiff> ;
  dcat:packageFormat "unknown" ;
  dcat:compressFormat                    <http://www.iana.org/assignments/media-
types/application/zip> ;
  dct:rights :RightsResult5394513640067453 .
:RightsResult5394513640067453
  a dct:RightsStatement ;
```

```
  dct:license                                                    "http://ids.equipex-
geosud.fr/documents/10180/17044/license_spot67_telemesure/ebb0588b-0827-4008-86bd-
9c8545e8ca34" ;
  dct:accessRights "unknown" .
:DatasetService_WMS_5394513640067453
  a dcat:DataService ;
  dct:conformsTo <http://www.opengis.net/def/serviceType/ogc/wms/1.1> ;
  dct:description "Display full resolution product on map"@en ;
  dct:identifier "5394513640067453" ;
  dct:title "IDS-GEOSUD WMS Server"@en ;
  dct:type <http://purl.org/dc/dcmitype/Service> ;
  dct:type                                  <https://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceType/view> ;
  dcat:endpointURL   "https://www.kalideos.fr/resto2/collections/KALCNES/e67937f3-
2c7f-5dd9-979f-
da1517487e3e/wms?map=20200601/5394513640067453/5394513640067453.map&LAYERS=dotclou
d&FORMAT=image%2Fpng&TRANSITIONEFFECT=resize&TRANSPARENT=true&VERSION=1.1.1&SERVIC
E=WMS&REQUEST=GetMap&STYLES=&SRS=EPSG%3A3857&WIDTH=256&HEIGHT=256&bbox={bbox-epsg-
3857}" ;
  dcat:endpointDescription "unknown" ;
  dcat:servesDataset :Dataset_5394513640067453 .
:KALIDEOSProject
  rdf:type prov:Activity ;
  rdfs:label "KALIDEOS Project"@en ;
  rdfs:seeAlso "https://www.kalideos.fr/" .
:5394513640067453_Representation
  a repr:Representation ;
  dqv:hasQualityMeasurement
:5394513640067453_RepresentationSpatialGranularityAggregatedObservation .
:5394513640067453_RepresentationSpatialGranularityAggregatedObservation
  a dqv:QualityMeasurement;
  dqv:isMeasurementOf :5394513640067453SpatialResolutionAsMeterDistance ;
  dqv:value "1.25"^^xsd:decimal ;
  sdmx-attribute:unitMeasure                    <http://www.ontology-of-units-of-
measure.org/resource/om-2/metre> .
:5394513640067453SpatialResolutionAsMeterDistance
a  dqv:Metric ;
  skos:definition "Spatial resolution of rdf:type dataset expressed as meter"@en ;
  dqv:expectedDataType xsd:decimal ;
  dqv:inDimension dqv:precision  .
#
# @SKOS terminology
#
  <https://gcmdservices.gsfc.nasa.gov/kms/concept/83150c54-5da8-4ee8-9579-
19b95a8dc10c>
  a skos:Concept ;
  skos:prefLabel "SPECTRAL/ENGINEERING"@en ;
  skos:definition "unknown" .
<https://gcmdservices.gsfc.nasa.gov/kms/concept/6a426480-c58f-4b6b-8e35-
0975b7f6edb5>
  a skos:Concept ;
  skos:prefLabel "Land Surface"@en ;
  skos:definition "Refers to the surface area and features on the surface of the
Earth." ;
  rdfs:description "https://earthdata.nasa.gov/learn/discipline/land" .
:PixelValue
  a sosa:ObservableProperty;
  skos:prefLabel "Pixels values"@en, "Valeurs des pixels"@fr ;
  skos:definition "Pixels values"@en ;
  skos:broader <http://dbpedia.org/resource/Radiometry> .
<http://dbpedia.org/resource/Radiometry>
  a skos:concept;
  skos:prefLabel "Radiometry"@en, "Radiometrie"@fr ;
  skos:definition "Radiometry is a set of techniques for measuring electromagnetic
radiation, including visible light. Radiometric techniques in optics characterize
the distribution of the radiation's power in space, as opposed to photometric
techniques, which characterize the light's interaction with the human eye.
Radiometry is distinct from quantum techniques such as photon counting. The use of
```

```
radiometers to determine the temperature of objects and gasses by measuring
radiation flux is called pyrometry. Handheld pyrometer devices are often marketed
as infrared thermometers. "@en ;
  skos:broader <https://gcmdservices.gsfc.nasa.gov/kms/concept/83150c54-5da8-4ee8-
9579-19b95a8dc10c> .
<http://vocabs.lter-europe.net/EnvThes/USLterCV_806>
  a skos:Concept ;
  skos:prefLabel "satellite imagery" ;
  skos:definition "Satellite imagery consists of images of Earth or other planets
collected by artificial satellites."@en ;
  skos:broader <http://vocabs.lter-europe.net/EnvThes/USLterCV_263> .
<http://vocabs.lter-europe.net/EnvThes/USLterCV_263>
  a skos:Concept ;
  skos:prefLabel "imagery"@en .
<http://lod.nal.usda.gov/nalt/68451>
  a skos:Concept ;
  skos:prefLabel "panchromatic imagery"@en ;
  skos:broader <http://lod.nal.usda.gov/nalt/35112> .
<http://lod.nal.usda.gov/nalt/35112>
  a skos:Concept ;
  skos:prefLabel "remote sensing"@en ;
  skos:related <http://bartoc-skosmos.unibas.ch/nalt/en/page/46939> .
<Spot6_ORTHO_TOC_Processing>
  a skos:Concept ;
  skos:prefLabel "ORTHO TOC processing"@en ;
  skos:altLabel "Ortho Level" ;
  rdfs:comment "Ortho Top Of Canopy Spot6 level processing" ;
  skos:related <http://vocabs.lter-europe.net/EnvThes/USLterCV_806> .

  <http://vocabs.lter-europe.net/EnvThes/USLterCV_806>
  a skos:Concept ;
  skos:prefLabel "satellite imagery" ;
  skos:definition "Satellite imagery consists of images of Earth or other planets
collected by artificial satellites."@en ;
  skos:broader <http://vocabs.lter-europe.net/EnvThes/USLterCV_263> .
<http://vocabs.lter-europe.net/EnvThes/USLterCV_263>
      a skos:Concept ;
      skos:prefLabel "imagery"@en .
<http://lod.nal.usda.gov/nalt/46939>
  a skos:Concept ;
  skos:prefLabel "multispectral imagery" ;
  skos:broader <http://lod.nal.usda.gov/nalt/175> .
<http://lod.nal.usda.gov/nalt/175>
  a skos:Concept ;
  skos:prefLabel "spectral analysis"@en .
<Spot6_Brut_Processing>
  a skos:Concept ;
  skos:prefLabel "Brut processing" ;
  skos:altLabel "Sensor Level" ;
  rdfs:comment "Minimum Spot6 level processing" ;
  skos:related <http://vocabs.lter-europe.net/EnvThes/USLterCV_806> .
```

Annex 4 : Rephy Network (ODATIS) data translation in Turtle (.ttl)

The metadata representation in accordance to the metadata model is expressed in Turtle (Terse RDF Triple Language) here:

```
@prefix time: <http://www.w3.org/2006/time#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix geo: <http://www.opengis.net/ont/geosparql#> .
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix sosa: <http://www.w3.org/ns/sosa/> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix geo: <http://www.opengis.net/ont/geosparql#> .
@prefix sf: <http://www.opengis.net/ont/sf#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
```

```
@prefix dct: <http://purl.org/dc/terms/> .
@prefix dcat: <http://www.w3.org/ns/dcat#> .
@prefix qudt-unit-1-1: <http://qudt.org/1.1/vocab/unit#> .
@prefix qudt-1-1: <http://qudt.org/1.1/schema/qudt#> .
@prefix repr: <representation> .
@prefix dqv: <http://www.w3.org/ns/dqv#> .
@prefix gn: <http://www.geonames.org/ontology#> .
@prefix : <http://example.org/> .
@prefix prov: <http://www.w3.org/ns/prov#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
#---------------------------------
#        Observation Collection
#---------------------------------
:RephyNetworkCollection
  a sosa:ObservationCollection ;
  skos:prefLabel "Données du réseau de surveillance du REPHY"@fr, "REPHY
monitoring network data"@en ;
  rdfs:description "Réseau d'Observation et de Surveillance du Phytoplancton et de
l'Hydrologie dans les eaux littorales. Ce jeu présente plusieurs fichiers de
paramètres distincts mesurés entre 2006 et 2016 sur les lieux de surveillance : -
Température, Salinité, Oxygène dissous, et Turbinité (FNU ou NFU) des masses d'eau
- CHLORO-PHEO : ce sont les mesures de concentration en Chlorophylle a et
Pheopigment - NUTRIMENTS : ce sont les mesures de concentration en nutriments
(ammonium, phosphate, silicate, nitrate+nitrite) - Flores phytoplanctoniques
totales (FLORTOT) : c'est l'identification et le dénombrement de toutes les
espèces phytoplanctoniques pouvant être identifiées dans les conditions
d'observation, c'est à dire globalement toutes les espèces dont la taille est
supérieure à 20 µm, et celles dont la taille est inférieure mais qui sont en
chaîne. Les espèces plus petites sont dénombrées seulement quand elles concernent
des espèces potentiellement toxiques (ex : Chrysochromulina). Flores
phytoplanctoniques indicatrices (FLORIND) : c'est l'identification et le
dénombrement de tous les taxons présents à une concentration supérieure à 100 000
cellules par litre (toxiques ou non) ; des taxons avérés toxiques pour le
consommateur et présents sur nos côtes, c'est à dire les genres ou les espèces
suivants : Alexandrium, Dinophysis, Pseudo-nitzschia et Ostreopsis, quelle que
soit leur concentration ; des espèces suivantes connues pour produire des toxines
lipophiles : Gonyaulax spinifera, Lingulodinium polyedra, Protoceratium
reticulatum, Prorocentrum lima. Il peut y avoir des taxons supplémentaires, en cas
de besoin local ou ponctuel. Flores phytoplanctoniques partielle (FLORPAR) : ce
sont des flores simplifiées pour lesquelles aucune contrainte n'est imposée :
elles peuvent même être réduites à un seul genre ou espèce."@fr;
  sosa:hasMember :Obs_Pigments, :Obs_Salinite ;
  sosa:phenomenonTime :TimeInterval_REPHY ;
  sosa:hasUltimateFeatureOfInterest :FrenchCoastalAreas ;
  sosa:usedProcedure :RephyProcedure .
:TimeInterval_REPHY
  a time:Interval ;
  time:hasBeginning "2006-01-02"^^xsd:date ;
  time:hasEnd "2016-09-29"^^xsd:date .
:FrenchCoastalAreas
  a sosa:FeatureOfInterest ;
  skos:prefLabel "French coastal area"@en, "Zones cotières françaises"@fr ;
  geo:hasGeometry  :BboxREPHY .
:RephyNetwork
  a sosa:Sample ;
  skos:prefLabel "Rephy Network"@fr, "Reseau Rephy"@en ;
  rdfs:description "Réseau d'Observation et de Surveillance du Phytoplancton et de
l'Hydrologie dans les eaux littorales." ;
  sosa:isSampleOf :FrenchCoastalAreas .
:BboxREPHY
  a sf:Polygon ;
  geo:asWKT "POLYGON(2.22917617066 48.8624978545, xxx.xx yy.yyy, xxx.xx yyy.yyy,
xx.xx yyy.yyy )"^^geo:wktLiteral .
:RephyProcedure
  a sosa:Procedure ;
  skos:prefLabel "Rephy Procedure"@fr, "Rephy Procedure"@en ;
  rdfs:description "1984 : Création du REPHY 1987 : Début de la bancarisation des
données (BD IDS II) 1988 : Mise en place de la surveillance des toxines
```

```
paralysantes 1996 : Mise en service de la base Quadrige avec récupération des
données anciennes 1999 : Début de la mise en oeuvre d'un système qualité 2004 :
Mise en place du dispositif de contrôle de surveillance, adapté aux exigences de
la DCE 2005 : Première évaluation de la qualité des masses d'eaux pour l'élément
phytoplancton dans le cadre de la DCE; Surveillance systématique des toxines
lipophiles dans les zones à risque en période à risque 2008 : Démarrage contrôle
opérationnel pour l'élément de qualité phytoplancton dans le cadre de la DCE.
Coordinateur : Service Valorisation de l'Information pour la Gestion Intégrée et
la Surveillance de l'IFREMER (PDG-RBE-VIGIES). Producteurs des données :
Laboratoire Environnement-Ressources de Boulogne (ODE-LITTORAL-LER-BL), Normandie
(ODE-LITTORAL-LER-N), Bretagne-Nord (ODE-LITTORAL-LER-BN), Bretagne Occidentale
(ODE-LITTORAL-LER-BO), Morbihan - Pays de Loire (ODE-LITTORAL-LER-MPL), Pertuis
Charentais (ODE-LITTORAL-LER-PC), Arcachon (ODE-LITTORAL-LER-AR), Languedoc -
Rousillon (ODE-LITTORAL-LER-LR), et Provence - Azur - Corse (ODE-LITTORAL-LER-
PAC). Les données sont archivées dans la base Quadrige² de l'Ifremer, référence
nationale des données de surveillance des eaux littorales. Avertissement : Pour un
même passage (lieu, date), il peut y avoir plusieurs échantillons analysés. Ils
sont différenciés par le champ Echantillon : Identifiant interne. Dans le fichier
FLORTOT (flore totale), il peut y avoir un nombre de taxons très bas (jusqu'à 1
seul taxon), principalement en Méditerranée. Les données n'ont pas encore été
toutes qualifiées, certaines d'entre elles ne sont pas encore validées, elles sont
donc susceptibles de contenir des erreurs. L'utilisation de ces données et leur
traitement sont sous votre responsabilité. Les données non-validées sont
identifiables par l'absence de date dans le champs 'Date de validation du
résultat'. Ces données ayant été extraites en janvier 2017, les données peuvent
être incomplètes pour les mois de fin d'année 2016."@fr .
#---------------------------------
#        Observation 1
#---------------------------------
:Pigments
  a sosa:Observation ;
  skos:prefLabel "Observation des pigments présents dans les eaux côtières
françaises"@fr ;
  sosa:observedProperty <http://vocab.nerc.ac.uk/collection/P03/current/B035/> ;
  sosa:hasFeatureOfInterest :RephyNetwork ;
  sosa:hasResult :Dataset_RephyPigments .
<http://vocab.nerc.ac.uk/collection/P03/current/B035/>
  a sosa:ObservableProperty ;
  skos:prefLabel "Pigments"@fr, "Pigments"@en ;
  skos:definition "This group incorporates plant pigment concentration parameters
and uncalibrated readings from instruments that make in-situ pigment measurements,
such as fluorometer voltages. The grouping includes measurements on pigments in
the particulate phase of the water column (expressed as pigment mass per unit
volume/mass of water), pigments in sediment (expressed as pigment mass per unit
mass or volume of sediment) and zooplankton gut pigment contents (expressed as
pigment mass per individual)."@en ;
  rdfs:description "https://www.odatis-ocean.fr/ressources/ressources-
thematiques/disciplines-de-recherche/biogeochimie-marine/pigments" ;
  skos:exactMatch <http://custom.shared.obj.ch/concept#799392ff-2f05-48c8-96e0-
5646e4307f04> ;
  skos:exactMatch <https://gcmdservices.gsfc.nasa.gov/kms/concept/ed925b43-db83-
4cbb-8347-3dc0081bb8f4> ;
  skos:broader <http://vocab.nerc.ac.uk/collection/P08/current/DS01/> ;
  skos:broader <http://vocab.nerc.ac.uk/collection/P08/current/DS02/> .
#
#  Dataset
#
:Dataset_RephyPigments
  a dcat:Dataset ;
  dct:title "Dataset : Rephy pigments"@en, "Dataset : Rephy pigments"@fr ;
  dct:identifier "c5dd9e6f-b45f-4cd6-984d-95d13c8d1f1f" ;
  dcat:keyword <http://custom.shared.obj.ch/concept#296cbeef-84cc-4c04-a43a-
c9938a67a7f8> , <http://www.mysite.org/thesaurus#f1a8a360-6bf9-4f20-86be-
cbd6405b02d1>   ;
  dct:issued "2017-12-11"^^xsd:date ;
  dcat:contactPoint "coord.rephy@ifremer.fr" ;
  dct:publisher :RephyPigmentsAgent ;
  dct:creator :RephyPigmentsAgent ;
```

```
  dct:contributor :RephyPigmentsAgent ;
  dcat:distribution :Distribution_Dataset_RephyPigment_1,
:Distribution_Dataset_RephyPigment_2 ;
  dcat:landingPage "https://www.odatis-ocean.fr/donnees-et-services/acces-aux-
donnees/catalogue-complet#/metadata/c5dd9e6f-b45f-4cd6-984d-95d13c8d1f1f" ;
  prov:wasGeneratedBy :REPHYProject ;
  dct:rights :RightsResultRephyPigment .
:RephyPigmentsAgent
  a foaf:Organization ;
  foaf:name "Ifremer" .
<http://custom.shared.obj.ch/concept#296cbeef-84cc-4c04-a43a-c9938a67a7f8>
  a skos:Concept ;
  skos:prefLabel "/Observations in-situ/Réseaux"@fr, "/in-situ
observations/Networks"@en  .
<http://www.mysite.org/thesaurus#f1a8a360-6bf9-4f20-86be-cbd6405b02d1>
  a skos:Concept ;
  skos:prefLabel "Dispositifs de surveillance"@fr, "Monitoring devices"@en .
#
#  Project
#
:REPHYProject
  a prov:Activity ;
  rdfs:label "Rephy Project"@en, "Projet Rephy"@fr ;
  rdfs:seeAlso "https://wwz.ifremer.fr/lerpc/Activites-et-
Missions/Surveillance/REPHY" .
#
#  Rights
#
:RightsResultRephyPigment
  a dct:RightsStatement ;
  dct:license "http://www.etalab.gouv.fr/pages/licence-ouverte-open-licence-
5899923.html" ;
  dct:accessRights "PUBLIC" .
#
#  Distribution
#
:Distribution_Dataset_Rephy_csv
  a dcat:Distribution ;
  dcat:accessURL
"ftp://ftp.ifremer.fr/ifremer/sextant_data/DCSMM_EVAL2018/SOURCES/IFREMER/REPHY/Q2
_Extraction_REPHY_CHLORO-PHEO_FLORIND_FLORPAR_FLORTOT_NUTRIMENTS_temp-sal-O2-
turb_2006-2016_CSV.zip" ; #SHOULD be used for the URL of a service or location
that can provide access to this distribution, typically through a Web form, query
or API call.
  dcat:downloadURL
"ftp://ftp.ifremer.fr/ifremer/sextant_data/DCSMM_EVAL2018/SOURCES/IFREMER/REPHY/Q2
_Extraction_REPHY_CHLORO-PHEO_FLORIND_FLORPAR_FLORTOT_NUTRIMENTS_temp-sal-O2-
turb_2006-2016_CSV.zip" ;
  dct:title "Accès FTP aux données (Format csv)"@fr ;
  dct:format <http://publications.europa.eu/resource/authority/file-type/CSV> ;
  dcat:mediaType <http://www.iana.org/assignments/media-types/text/csv> ;
  dcat:packageFormat <https://www.iana.org/assignments/media-
types/application/zip>
:Distribution_Dataset_Rephy_xlsx
  a dcat:Distribution ;
  dcat:accessURL
"ftp://ftp.ifremer.fr/ifremer/sextant_data/DCSMM_EVAL2018/SOURCES/IFREMER/REPHY/Q2
_Extraction_REPHY_CHLORO-PHEO_FLORIND_FLORPAR_FLORTOT_NUTRIMENTS_temp-sal-O2-
turb_2006-2016_CSV.zip" ; #SHOULD be used for the URL of a service or location
that can provide access to this distribution, typically through a Web form, query
or API call.
  dcat:downloadURL
"ftp://ftp.ifremer.fr/ifremer/sextant_data/DCSMM_EVAL2018/SOURCES/IFREMER/REPHY/Q2
_Extraction_REPHY_CHLORO-PHEO_FLORIND_FLORPAR_FLORTOT_NUTRIMENTS_temp-sal-O2-
turb_2006-2016_CSV.zip" ;
  dct:title "Accès FTP aux données (Format xlsx)"@fr ;
  dct:format <http://publications.europa.eu/resource/authority/file-type/XLSX> ;
```

```
  dcat:mediaType <http://www.iana.org/assignments/media-
types/application/vnd.openxmlformats-officedocument.spreadsheetml.sheet> ;
  dcat:packageFormat <https://www.iana.org/assignments/media-
types/application/zip> .
  #
  # linked SKOS terminological hierarchy
  #
<http://vocab.nerc.ac.uk/collection/A05/current/EV_PHYT/1/>
  a skos:Concept ;
  skos:prefLabel "Phytoplankton biomass and diversity"@en ;
  rdfs:description
"https://goosocean.org/components/com_oe/oe.php?task=download&id=38709&version=1.0
&lang=1&format=1" .

<http://vocab.nerc.ac.uk/collection/P03/current/B035/>
  a skos:Concept ;
  skos:prefLabel "Pigments"@en ;
  skos:definition "This group incorporates plant pigment concentration parameters
and uncalibrated readings from instruments that make in-situ pigment measurements,
such as fluorometer voltages. The grouping includes measurements on pigments in
the particulate phase of the water column (expressed as pigment mass per unit
volume/mass of water), pigments in sediment (expressed as pigment mass per unit
mass or volume of sediment) and zooplankton gut pigment contents (expressed as
pigment mass per individual)."@en ;
  rdfs:description "https://www.odatis-ocean.fr/ressources/ressources-
thematiques/disciplines-de-recherche/biogeochimie-marine/pigments" ;
  skos:exactMatch <http://custom.shared.obj.ch/concept#799392ff-2f05-48c8-96e0-
5646e4307f04> ;
  skos:exactMatch <https://gcmdservices.gsfc.nasa.gov/kms/concept/ed925b43-db83-
4cbb-8347-3dc0081bb8f4> ;
  skos:broader <http://vocab.nerc.ac.uk/collection/P08/current/DS01/> ;
  skos:broader <http://vocab.nerc.ac.uk/collection/P08/current/DS02/> .
<https://gcmdservices.gsfc.nasa.gov/kms/concept/ed925b43-db83-4cbb-8347-
3dc0081bb8f4>
  a skos:Concept ;
  skos:prefLabel "PIGMENTS"@en ;
  skos:definition "Colored organic compounds synthesized by organisms. Names of
specific pigments are included as detailed variables under Pigments."@en ;
  skos:broader <https://gcmdservices.gsfc.nasa.gov/kms/concept/6eb3919b-85ce-4988-
8b78-9d0018fd8089> .
<https://gcmdservices.gsfc.nasa.gov/kms/concept/6eb3919b-85ce-4988-8b78-
9d0018fd8089>
  a skos:Concept ;
  skos:prefLabel "OCEAN CHEMISTRY"@en ;
  skos:definition "Scientific field of study pertaining to the composition and
properties of seawater. Variables include concentrations of seawater's constituent
materials. For variables pertaining to seawater salinity, see the Term
Salinity/Density."@en ;
  skos:broader <https://gcmdservices.gsfc.nasa.gov/kms/concept/91697b7d-8f2b-4954-
850e-61d5f61c867d> ;
  skos:exactMatch <http://vocab.nerc.ac.uk/collection/P08/current/DS02/> .
<http://vocab.nerc.ac.uk/collection/P08/current/DS01/>
  a skos:Concept ;
  skos:prefLabel "Biological oceanography"@en ;
  skos:definition "The biological oceanographic science domain"@en;
  rdfs:description "https://www.odatis-ocean.fr/ressources/ressources-
thematiques/disciplines-de-recherche/biologie-marine" ;
  skos:broader <https://gcmdservices.gsfc.nasa.gov/kms/concept/91697b7d-8f2b-4954-
850e-61d5f61c867d> .
<http://vocab.nerc.ac.uk/collection/P08/current/DS02/>
  a skos:Concept ;
  skos:prefLabel "Chemical oceanography"@en ;
  skos:definition "The biological oceanographic science domain"@en ;
  rdfs:description "https://www.odatis-ocean.fr/ressources/ressources-
thematiques/disciplines-de-recherche/biogeochimie-marine/" ;
  skos:broader <https://gcmdservices.gsfc.nasa.gov/kms/concept/91697b7d-8f2b-4954-
850e-61d5f61c867d> .
```

```
<https://gcmdservices.gsfc.nasa.gov/kms/concept/91697b7d-8f2b-4954-850e-
61d5f61c867d>
  a skos:Concept ;
  skos:prefLabel "Oceans"@en ;
  skos:definition "Ocean is a very large expanse of sea, in particular, each of
the main areas into which the sea is divided geographically."@en ;
  rdfs:description "https://earthdata.nasa.gov/learn/discipline/ocean" .
```