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**A MetOcean metadata profile for WCS2.0**

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1. Abstract

This document defines a MetOcean profile consisting of an information model and an XML encoding for the following three WCS2.0 operations:

1. *GetCapabilities -* a WCS server describes the services and operations via a GetCapabilities document.
2. *DescribeCoverage* *-* a WCS server describes the contents of a specific coverage via a DescribeCoverage document.
3. *DescribeCoverageCollection -* a server groups together coverages in a collection and exposes them as a service. A WCS server describes the contents of a specific coverage collection via a DescribeCoverageCollection document.

Metadata and vocabularies are defined that provide interoperability of these operations and documents using common semantics. The information model proposed supports MetOcean specific concepts, but these may be useful in other communities.

1. Keywords

The following are keywords to be used by search engines and document catalogues.

WCS, coverage, collection, meteorology, oceanography, NWP, analysis, data mask, observation, measurement, O&M.

1. Preface

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The Open Geospatial Consortium shall not be held responsible for identifying any or all such patent rights.

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1. Submitting organizations

The following organizations submitted this Document to the Open Geospatial Consortium Inc.

Met Office, UK

1. Submitters

All questions regarding this submission should be directed to the editor or the submitters:

|  |  |
| --- | --- |
| Name | Company |
| Peter Trevelyan | Met Office, UK |

1. Scope

The purpose of this Met Ocean profile of WCS2.0 is to define the metadata returned in the response documents resulting from the WCS2.0 operations: GetCapabilities, DescribeCoverage and DescribeCoverageCollection; and for use within the meteorological and oceanographic communities.

This work has been done by members of the OGC MetOcean Domain Working Group.

1. Conformance

This profile defines a UML conceptual model and an XML encoding schema for describing MetOcean metadata to be used with WCS2.0

Requirements for two standardization target types are considered:

* UML models
* XML instances (e.g. XML documents)

Conformance with this standard shall be checked using all the relevant tests specified in Annex A (normative) and Annex B (normative) of this document. The framework, concepts, and methodology for testing, and the criteria to be achieved to claim conformance are specified in the OGC Compliance Testing Policies and Procedures and the OGC Compliance Testing web site[[1]](#footnote-1).

In order to conform to this OGC™interface standard, a software implementation shall choose to implement:

1. Any one of the conformance levels specified in Annex A (normative) or Annex B (normative).

All requirements-classes and conformance-classes described in this document are owned by the standard(s) identified.

1. References

The following normative documents contain provisions that, through referenced in this text, constitute provisions of this document. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

OGC 08-131r3 – The Specification Model – A Standard for Modular Specification

ISO 19103:2005 – Geographic information - Conceptual schema language

ISO 8601:2004 - Data elements and interchange formats – Information interchange – Representation of dates and times

OGC Abstract Specification Topic 1 – Feature geometry (aka ISO 19107)

OGC Abstract Specification Topic 2 – Spatial Referencing by Coordinates (aka ISO 19111:2007)

OGC Abstract Specification Topic 6 – Schema for Coverage geometry and functions (aka ISO 19123:2005)

OGC Abstract Specification Topic 11 – Geographic information — Metadata (aka ISO 19115:2014)

OGC Abstract Specification Topic 20 – Observations and Measurements (aka ISO 19156:2011)

OGC 07-036 Geography Mark-up Language (aka ISO 19136:2007 or GML3.2.1)

OGC® Web Coverage Service 2.0 Interface Standard - Core OGC Document 09-110r4 <http://www.opengeospatial.org/standards/wcs>

OGC Observations and Measurements v2.0 XML OGC Document 10-025r1 <http://www.opengis.net/doc/IS/OMXML/2.0>

OGC SWE Common Data Model Encoding Standard v2.0 OGC Document 08-094r1 [http://www.opengis.net/doc/IS/SWECommon/2.0](http://www.opengis.net/doc/IS/SWECommon/2.0%20)

Unified Code for Units of Measure (UCUM) – Version 1.9, 2013

Unified Modelling Language (UML). Version 2.3. May 2010

Extensible Mark-up Language (XML) – Version 1.0 (Fourth Edition), August 2006

XML Schema – Version 1.0 (Second Edition), October 2004

1. Terms and Definitions

This document uses the terms defined in Sub-clause 5.3 of [OGC 06-121r8], which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this standard.

For the purposes of this document, the following additional terms and definitions apply. There is some variation in the specific use of some technical terms within the meteorological domain. We have attempted to follow common usage, referring where possible to the WMO No.306[*http://www.wmo.int/pages/prog/www/WMOCodes*](http://www.wmo.int/pages/prog/www/WMOCodes)*.*

* 1. numerical weather prediction model

[mathematical model](http://en.wikipedia.org/wiki/Mathematical_model) of the atmosphere and oceans used to [predict the weather](http://en.wikipedia.org/wiki/Weather_forecasting) based on current weather conditions and are normally run at set times each day.

Synonyms: forecast model, NWP Model.

EXAMPLE The ECMWF model that runs twice per day and creates a ten day prediction of the global atmosphere.

* 1. reference time

nominal start time at the beginning of a specific forecast model run.

Synonym: model run time.

NOTE: “reference time” will used in preference to “model run time” as it is more generic and includes services that may be continually updated.

* 1. verification time

time at which a forecast becomes verifiable.

Synonym: validity time.

NOTE: Forecast models running with different reference times will have, for some fields, the same verification time if the durations of the different model runs overlap.

* 1. data mask

a means to indicate which elevations and times are available for each parameter output from a forecast model as they may not be regular (see Section 7 and Figure 2).

NOTE: A data mask is described using a “referenceable Grid Coverage”.

* 1. GRIB

WMO (World Meteorological Organisation) format for gridded binary data exchanged between member countries, including a controlled vocabulary defined in tables.

* 1. [Web Coverage Service](http://www.opengeospatial.org/standards/wcs) 2.0 (WCS2.0)

standard created by the OGC that refers to the exchange of geospatial information as ‘coverages’: digital geospatial information representing space-varying phenomena.

* 1. GetCapabilities operation

request to a WCS server for a list of what operations and services (“capabilities”) are being offered by that server.

* 1. DescribeCoverage

request to a WCS server for additional information about a coverage that a client wants to query. It returns information about the CRS, the metadata, the domain, the range and the formats available. A client generally will need to issue a DescribeCoverage request before it can make the proper GetCoverage request.

* 1. DescribeCoverageCollection

request to the WCS server for additional information about a CoverageCollection that a client wants to query. It returns information about the metadata and the domain.

1. Conventions
	1. Abbreviated terms

GML Geography Mark-up Language

O&M Observations and Measurements

OGC Open Geospatial Consortium

MetOcean Meteorological/Oceanographic

NWP Numerical Weather Prediction

SWE OGC Sensor Web Enablement

UML Unified Modeling Language

WCS2.0 OGC Web Coverage Service version 2.0

WMO World Meteorological Organisation

XML W3C Extensible Markup Language

XSD W3C XML Schema Definition Language

* 1. Schema language

The XML implementation specified in this Standard is described using the XML Schema language (XSD) [XML Schema Part 1: Structures, XML Schema Part 2: Datatypes] and Schematron [ISO/IEC 19757-3, Information technology — Document Schema Definition

Languages (DSDL) — Part 3: Rule-based validation — Schematron].

* 1. UML notation

The diagrams that appear in this standard are presented using the Unified Modeling Language (UML) static structure diagram.

**Note:** Within the context of this standard, the following color scheme is used to identify the package in which the class exists. This is just for informative purposes.

 Tan: Defined within this standard

 Blue: WCS2.0 (Web Coverage Service v2.0)

 Red: ISO19156 – Observations & Measurements

 Green: ISO19115 – The MetOcean Metadata

1. Vocabularies

This standard defines a number of properties that require the use of codes or vocabulary items. In some cases a list of terms is provided. Where no codes are provided (the link to the WMO registry is in italics), it is expected that a list will be developed in the future, or a local code list may be used. A summary of the vocabularies is shown in Table 1. The joint OGC/WMO Met-Ocean Domain Working Group (MetOceanDWG) is responsible for managing the content of these vocabularies. Once agreement is reached for definitions, the MetOceanDWG should submit updates to the OGC Naming Authority.

Table 1 Summary of vocabularies within this standard

| **Code list** | **Package(s)** | **Code items defined** |
| --- | --- | --- |
| DisciplineCode | MetOceanNwpModel | Yes |
| TypeOfDataCode | MetOceanNwpModel  | Yes |
| SignificanceOfReferenceTimeCode | MetOceanNwpModel  | Yes |
| ProductionStatusCode | MetOceanNwpModel | Yes |
| TypeOfCalendarCode | MetOceanNwpModel | Yes |

1. Non-Normative (Informative) Material

The MetOcean profile for WCS2.0 is an initiative of the MetOceanDWG to develop international standards and address interoperability of meteorological and oceanographic information systems.

The need for this work arises out of the need to transfer ever increasing amounts of data across networks. This can only be done by sub-setting the data on the server and transferring the relevant data to client. The obvious candidate for this service is the OGC WCS2.0 that was designed to extract and subset coverages. It is therefore logical to extend this standard to accommodate MetOcean specific metadata, although this has some challenges due to the multi-dimensional nature of MetOcean data. Some of these extra dimensions are non-geodetic (e.g. vertical pressure) and are irregular (time).

* 1. WCS2.0

The WCS2.0 core standard and core extensions (see below) cover most of the operations (specifically GetCapabilities, DescribeCoverage and DescribeCoverageCollections required by the MetOcean community, but the metadata (other than basic WCS) needs to be community specific. Currently, the only profile is for the Earth Observing community.

WCS Core Extensions

* WCS CoverageCollections, version 1.0.0, OGC 15-044
* WCS Range Subsetting Extension, version 1.0.0, OGC 12-040
* WCS Scaling Extension, version 1.0.0, OGC 12-039
* WCS Range Subsetting version 1.0 OGC 12-040
* WCS Interpolation Extension, version 1.0.0, OGC 12-049
* WCS CRS Extension version 1.0 OGC 11-053
	1. Key Concepts
		1. A Short NWP (Numerical Weather Prediction) Primer

The term “NWP model” refers to a computer model used to forecast the future state of the ocean/ atmosphere. A NWP model is normally “run” at a set time and repeated at regular intervals during the day; this “start” time is known (amongst the MetOcean community), as the “model run time” i.e. a notional starting point. All forecast times for a specific model run are therefore relative to this “reference” time. It is important to know that “reference time” will used in preference to “model run time” as it is more generic and includes services that may be continually updated.

* + 1. Coverages

Coverages represent digital geospatial information representing space/time-varying phenomena. OGC Abstract Topic 6 [OGC 07-011] – which is identical to ISO 19123 – defines an abstract model of coverages. This is concretized by the Geography Markup Language (GML) 3.2 [07-036], an XML grammar written in XML Schema for the description of application schema (see Figure 1). A typical NWP forecast model data may expressed as a set of coverages typically, but not exclusively rectified grid coverages, i.e. coverages whose horizontal domain is a rectified Grid. A typical model run contains literally thousands of 2D coverages each with a unique identifier. The metadata to describe this soon becomes unmanageable and the problem can be simplified by identifying, where possible, “4D Coverages”.

As mentioned in the ISO definition, the concept of “coverage” is central to the representation of many common weather observations and forecasts. Weather datasets that fall into the category of coverages include point measurements, wind profiles, model grids, and time series measurements at a single point. Of particular interest to aviation are weather properties observed or forecast along a trajectory, which can also be represented as a “coverage”.

* + 1. 4D Coverages

A typical numerical model has a number of different vertical coordinates; for example: pressure, height above mean sea level, height above ground, surface, max wind level etc. By definition a coverage instance is defined, among other things, by the DomainSet (see diagram below). The problem can be simplified by identifying, where possible, “4D Coverages”. The number of coverages dramatically reduces to a manageable number (e.g. typically less than 20) and this is done by defining the temporal and vertical axes through the use of metadata. A “4D Coverage” must, by definition, share the horizontal and spatial/temporal domains.



Figure 1 UML Diagram representing the coverage model.

* + 1. Data Masking

Even when the coverage is to be extended to other dimensions, e.g. time and vertical, there is an added complication as the data coverage may well be irregular, i.e. not all the data are available for every time and level. For example; air temperature may not be present for every output time-step at every specified level. It is therefore a challenge to present the output as a 4D coverage given the irregularity of the data (See Figure 2).

T+0

T+18

T+ 6

T+12

1000.0hPa

950.0hPa

850.0hPa

500.0hPa

300.0hPa

250.0hPa

200.0hPa

T+24

T+36

T+48

T+60

T+72

**(1,1)**

**(**1000.0,0**)**

**(**850.0,6**)**

**(0,0)**

**(8,6)**

**Missing**

**Present**

**(1,0)**

Figure 2 Diagram representing the irregularity of the time and vertical axes and the sparsity of the output in the coverage model

This diagram illustrates irregular nature of the time and vertical axis as well as the “Swiss Cheese” nature of the output. It is possible to enumerate the axes, but not all data will be available at each of the coordinates.

* + - 1. **Enumerating the axes**

The mechanism chosen to solve these two issues is by the use of a data mask and this is illustrated in Figure 2. The data mask is defined using a “Referencable Grid Coverage” as described by GML Application Schema Coverage OGC 09-146r2 (*Referenceable Grid Coverages are coverages whose internal grid structure can be mapped to a coordinate reference system by some general transformation. They differ from rectified grid coverages in that the coordinate transformation is not necessarily affine*). The domain set is used to enumerate the temporal and vertical axes of the “coverage”. The coordinate reference system (CRS) is by reference see (<http://codes.wmo.int/grib2/codeflag/4.5>) and the units of measure are hPa as defined within the element “axis labels”).

The temporal axis is specified as hours relative to the start (i.e. reference time) and the forecast hours relative to the model reference time. The CRS for time is again by reference:- <http://codes.wmo.int/grib2/codeflag/1.2> (note this is the WMO registry to define type of time intervals), the units are in hours (as used in axis labels), but could be minutes/years etc.

* + - 1. **Data sparsity**

The second issue addresses the problem that data are not always present at each model level/forecast time. This is solved by using the “range set” part of the coverage using a tuple list to indicate if data are present, i.e. a “1” if present and a “0” if not. Each “data mask” is then a parameter.

* + 1. CoverageCollections

A coverage collection is a very useful mechanism for grouping together coverages into a collection, very similar to a feature collection. This mechanism for grouping coverages is very powerful and allows, for example, a description of an image mosaic in terms of the full mosaic and the constituent images. In the case of Numerical weather Prediction models the output (a set of coverages) may be grouped together by a common spatial/temporal domain, so allowing a specific model instance (aka model “run”) to be described by a single identifier i.e. a collection identifier.

* 1. The basic Observation type

The major elements of the model are indicated in bold and modelled through associations in the UML model. In addition, an observation has the following attributes and associations:

* parameter (optional): for arbitrary event-specific parameters, e.g. instrument settings
* phenomenonTime (mandatory): the time that the result applies to the feature of interest
* resultQuality (optional): the quality of the result
* resultTime (mandatory): the time when the result becomes available (e.g. if postprocessing or laboratory analysis is required, it might be different to the phenomenonTime)
* validTime (optional): the time period during which the result is intended to be used (e.g. if a meteorological forecast is modelled as an observation, then it is intended to be used during a specific period of time)
* relatedObservation (optional): related observations providing important context for understanding the result
* metadata (optional): descriptive metadata
* featureOfInterest (mandatory): The association Domain shall link the OM\_Observation to the GFI\_Feature that is the subject of the observation and carries the observed property. This feature has the role featureOfInterest with respect to the observation.
* observedProperty (mandatory): The association Phenomenon shall link the OM\_Observation to the GFI\_PropertyType for which the OM\_Observation:result provides an estimate of its value. The property type has the role observedProperty with respect to the observation.
* result: The association Range shall link the OM\_Observation to the value generated by the procedure. The value has the role result with respect to the observation.
* procedure: The association ProcessUsed shall link the OM\_Observation to the OM\_Process (6.2.3) used to generate the result. The process has the role procedure with respect to the observation.
	+ 1. NWP Observation metadata mapping on Observations and Measurements

To represent Earth Observation metadata, this profile extends the Observations and Measurements properties with MetOcean specific information. Figure 3shows the relationship of MetOceanNWPObservation and MetOceanNwpModel to O&M

1. UML Model (normative)
	1. Requirements class: MetOceanNwpObservation

|  |
| --- |
| **Requirements Class** |
| **http://www.opengis.net/spec/metocean/1.0/req/uml-MetOceanNwpObservation** |
| **Requirement** |  **/observed-property**The observed property of the OM\_Observation type shall be a link the WMO code definitions as described in the GRIB tables. |
| **Requirement** |  **/result-quality** The MetOceanNwpObservation shall have a resultQuality property (from OM\_Observation) that points to a ResultMask. |
| **Requirement** |  **/feature-of-interest**The ‘featureOfInterest’ property of the OM\_Observation element shall reference a MetOceanNWPModel that is an instance of SF\_SpatialSamplingPoint (from ISO 19156:2011 Spatial Sampling Features). |
| **Requirement** |  **/phenomenon-time**The MetOceanNwpObservation shall have a phenomenon time that is a time period denoting the validity period of the forecast. |
| **Requirement** |  **/resultmask**The ResultMask shall through the specialisation of gmd:result reference a TimeHeight Mask of type “ReferenceableGridCoverage”. |



Figure 3 – MetOceanNwpObservation UML

* + 1. Requirements class overview

The MetOceanNwpObservation requirements class defines how metadata appropriate to the MetOcean community will be expressed as part of the responses to a WCS2.0 DescribeCoverageCollection and DescribeCoverage request.

* + 1. MetOceanNwpObservation

Gauging observations are defined as a specialised type OM\_Observation from ISO19156, with the following restrictions:

* The feature of interest is the entity about which the observation is made. Meteorological observations or forecasts clearly relate to the real world. For example, we may observe the weather for Newton Abbot or provide a weather forecast for the North Atlantic European area. However, there is a level of abstraction to resolve: An observation of the weather for the town of Newton Abbot happens at some representative location within the town or some representative locale nearby. The forecast domain for the North Atlantic European area is specified so that it covers the areas for which a forecast is required. In each case, the observation event relates to some sampling regime that is a proxy for the real entity of interest (e.g. the site of the weather station, or the extent of the forecast domain). The observation or forecast is not directly related to real-world entities. ISO 19156 Observations and Measurements provides a conceptual model for describing this layer of indirection: Sampling Features.
* The sampling feature is related to the real world via the property <sam:sampledFeature>. Further specializations of Sampling Feature are provided based on spatial topology (SF\_SpatialSamplingFeature and sub-types thereof). In all cases identified thus far in meteorology, it appears useful to describe an observation, measurement or forecast with respect to the sampling regime (e.g. the Sampling Feature) and indirectly refer to the real-world entity for which the Sampling Feature is a proxy. In this profile the property “sampled feature” will be a link to a reference to the numerical model used in the forecasting process.
* The observed property references WMO GRIB2 code tables that list, by product <http://codes.wmo.int/grib2/codeflag/4.1>
* The process is a simple description the will be a reference to an external document describing the model used in the forecast simulation.
* The resultQuality will point to the data mask used to enumerate the temporal and vertical axes as well as provide information on whether or not a parameter is available at a particular time/level.

Table 2 MetOceanNwpObservation properties

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| phenomenon time | time-period when the result is relevant; The begin Position of the time period is also the “Reference time of the forecast” | TM\_Object | 1 |
| result time | *issue time* (e.g. **result time**) i.e the time when the entire NWP model output was published | TM\_Instant | 1 |
| procedure | Reference to supporting documentation (attribute "documentationRef"); e.g. online documentation describing the procedure in detail | PredictionProcess | 1 |
| resultQuality | A reference to a pertaining TimeHeight mask is stored, together with the name of the physical parameter to which it corresponds. A Time-Height Mask is a 2-D ReferenceableGridCoverage with height/time axes and Boolean range values. Such a mask serves to indicate areas where all range values, across the whole horizontal extent, contain only nil values This serves as a hint to applications as to which regions contain “interesting” (i.e., non-nil) values. | ResultMask | 0,1 |
| feature-of-interest | The ‘featureOfInterest’ property of the OM\_Observation element is a reference the element metocean:MetOceanNwpModel. | MetOceanNwpModel. | 1 |
| observedProperty | the OM\_Observation model allows only a single instance of <om:observedProperty>. In the case of the NWP model, a many individual physical properties may be measured; everything from air temperature to sea-surface state. The observed property definition *must* be referenced remotely (e.g. via xlink); it cannot be specified in-line within the document. | ParameterCategoryCode(See <http://codes.wmo.int/grib2/codeflag/4.1>) | 1 |

* + 1. MetOceanNwpModel

The properties relating to a NWP model as used in weather, climate and ocean forecast models:

Table 3 MetOceanNwpModel

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| sams:shape | The observed area (or its projection) on the ground i.e. the footprint of the numerical model. | ModelFootprint | 1 |
| metOceanMetadata | A slot for any MetOcean specific metadata | MetOceanMetadata |  |

* + 1. MetOceanNwpModelMetadata

The metadata for the NWP Model:

Table 4 MetOceanNwpModelMetadata

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| discipline | This table is used to indicate the discipline of the processed data contained within a specified Coverage. (this will reference WMO GRIB2 table 0.0) | DisciplineCode | 1 |
| typeOfData | A code to indicate if the what of kind of NWP product, e.g. analysis, forecast, analysis and forecast etc.(this will reference WMO GRIB2 table 1.4) | TypeOfDataCode | 1 |
| significanceOfReferenceTime |  This defines the meaning of “Reference Time (this will reference WMO GRIB2 table 1.2) | SignificanceOfReferenceTimeCode | 1 |
| originatingCentre | NATIONAL/INTERNATIONAL ORIGINATING CENTERS(this will reference WMO GRIB2 table 0) | OriginatingCentreCode | 1 |
| productionStatusOfData | The code used to indicate the production status, e.g. operational, research etc(this will reference WMO GRIB2 table 1.3) | ProductionStatusOfDataCode | 1 |
| TypeOfCalendar | The code used to indicate the type of calendar being used e.g. Gregorian, 360 day (often used by climate models), (this will reference WMO GRIB2 table 1.6) | TypeOfCalendarCode | 1 |

* + 1. ModelFootprint

A description of the horizontal domain of the NWP model:

Table 5 ModelFootprint

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| horizontalDomain | The observed area (or its projection) on the ground i.e. the footprint of acquisition | Gml:Polygon | 1 |

* + 1. PredictionProcess

The properties relating to a NWP model as used in weather and ocean forecast models:

Table 6 PredictionProcess

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| metce:Process | Reference to supporting documentation (attribute "documentationRef"); e.g. online documentation describing a well known document (e.g. using the element <gml:description> | gml:description | 1 |

* + 1. ResultMask

The properties relating to a NWP model as used in weather and ocean forecast models:

Table 7 ResultMask

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| gmd:result | A reference to a pertaining TimeHeight mask via ParameterMask. | ParameterMask | 1 |

* + 1. ParameterMask

The properties relating to a NWP model as used in weather and ocean forecast models:

Table 8 ParameterMask

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| timeHeightMask | A reference to a pertaining TimeHeight mask is stored, together with the name of the physical parameter to which it corresponds, A Time-Height Mask is a 2-D ReferenceableGridCoverage with height/time axes and Boolean range values. Such a mask serves to indicate areas where all range values, across the whole horizontal extent, contain only nil values This serves as a hint to applications as to which regions contain “interesting” (i.e., non-nil) values. | TimeHeightMask | 1 |

* + 1. DisciplineCode

A type capturing the relevant scientific discipline:

Table 9 DisciplineCode code items

| **Code item** | **Definition** | **URL** |
| --- | --- | --- |
| Meteorological Products | Meteorological products | <http://codes.wmo.int/grib2/codeflag/0.0/_1> |
| Hydrological Products | Hydrological Products | <http://codes.wmo.int/grib2/codeflag/0.0/_1> |
| Land Surface Products | Land Surface Products | <http://codes.wmo.int/grib2/codeflag/0.0/_2> |
| Space products | Space products | <http://codes.wmo.int/grib2/codeflag/0.0/_3> |
| Oceanographic products | Oceanographic products | <http://codes.wmo.int/grib2/codeflag/0.0/_10> |

* + 1. TypeOfDataCode

A type code capturing the type of products:

Table 10 TypeOfDataCode code items

| **Code item** | **Definition** | **URL** |
| --- | --- | --- |
| Analysis Products | Analysis Products | <http://codes.wmo.int/grib2/codeflag/1.4> |
| Forecast Products | Forecast Products | <http://codes.wmo.int/grib2/codeflag/1.4> |
| Analysis and Forecast Products | Analysis and Forecast Products | <http://codes.wmo.int/grib2/codeflag/1.4> |
| Control Forecast Products | Control Forecast Products | <http://codes.wmo.int/grib2/codeflag/1.4> |
| Perturbed Forecast Products | Perturbed Forecast Products | <http://codes.wmo.int/grib2/codeflag/1.4> |
| Control and Perturbed Forecast Products | Control and Perturbed Forecast Products | <http://codes.wmo.int/grib2/codeflag/1.4> |
| Processed Satellite Observations | Processed Satellite Observations | <http://codes.wmo.int/grib2/codeflag/1.4> |

* + 1. SignificanceOfReferenceTimeCode

A type code capturing the significance of the reference time:

Table 11 SignificanceOfReferenceTimeCode code Items

| **Code item** | **Definition** | **URL** |
| --- | --- | --- |
| Analysis | The reference time of the analysis | [*http://codes.wmo.int/grib2/codeflag/1.2*](http://codes.wmo.int/grib2/codeflag/1.2) |
| Start of Forecast | All forecast times are relative to this Reference time | [*http://codes.wmo.int/grib2/codeflag/1.2*](http://codes.wmo.int/grib2/codeflag/1.2) |
| Verifying Time of Forecast | The reference time is used to denote the validity time of the forecast | [*http://codes.wmo.int/grib2/codeflag/1.2*](http://codes.wmo.int/grib2/codeflag/1.2) |
| Observation Time | The Reference time is used to denote the time of observation. | [*http://codes.wmo.int/grib2/codeflag/1.2*](http://codes.wmo.int/grib2/codeflag/1.2) |

* + 1. OriginatingCentreCode

A code list to describe the way the section observation has been terminated. This is referenced by <http://codes.wmo.int/grib2/codeflag/0>

* + 1. ProductionStatusCode

A type code capturing the significance of the reference time:

Table 12 ProductionStatusCode code Items

| **Code item** | **Definition** | **URL** |
| --- | --- | --- |
| Operational Products | Operational Products | [*http://codes.wmo.int/grib2/codeflag/1.3*](http://codes.wmo.int/grib2/codeflag/1.3) |
| Operational Test Products | Operational Test Products | [*http://codes.wmo.int/grib2/codeflag/1.3*](http://codes.wmo.int/grib2/codeflag/1.3) |
| Research Products | Research Products | [*http://codes.wmo.int/grib2/codeflag/1.3*](http://codes.wmo.int/grib2/codeflag/1.3) |
| Re-Analysis Products | Re-Analysis Products | [*http://codes.wmo.int/grib2/codeflag/1.3*](http://codes.wmo.int/grib2/codeflag/1.3) |

* + 1. TypeOfCalendarCode

A type code capturing the significance of the reference time:

Table 13 TypeOfCalendarCode code Items

| **Code item** | **Definition** | **URL** |
| --- | --- | --- |
| Gregorian | Gregorian | [*http://codes.wmo.int/grib2/codeflag/1.6*](http://codes.wmo.int/grib2/codeflag/1.6) |
| 360-day | 360-day | [*http://codes.wmo.int/grib2/codeflag/1.6*](http://codes.wmo.int/grib2/codeflag/1.6) |
| 365-day (see Note 1) | 365-day (Essentially a non-leap year) | [*http://codes.wmo.int/grib2/codeflag/1.6*](http://codes.wmo.int/grib2/codeflag/1.6) |
| Proleptic Gregorian | Proleptic Gregorian(Extends the Gregorian calendar indefinitely in the past) | [*http://codes.wmo.int/grib2/codeflag/1.6*](http://codes.wmo.int/grib2/codeflag/1.6) |

* 1. Requirements class: WCSGetCapabilitiesMetOceanProfile

|  |
| --- |
|  **Requirements Class** |
| **http://www.opengis.net/spec/metocean/1.0/req/uml- WCSGetCapabilitiesMetOceanProfile** |
|  **Requirement** |  **/wcs-extension**a wcs:Extension property shall reference a MetOceanGroup. |
|  **Requirement** |  **/metocean-collection-summary**the MetOceanCollectionSummary shall not contain any duplicate collection identifiers. |
| **Requirement** |  **/metocean-collection**the MetOceanCollection shall not contain any duplicate coverage identifiers. |



Figure 4 MetOcean GetCapabilities UML

* + 1. Requirements class overview

The WCSGetCapabilitiesMetOceanProfile requirements class defines how metadata appropriate to the MetOcean community will be expressed as part of the responses to a WCS2.0 GetCapabilities request. The MetOcean profile provides a method of grouping together coverages (see Figure 4), the intended benefit being the reduction in the size of GetCapabilities response. Additional detail regarding coverage collections is dealt with the DescribeCoverageCollection (see 8.3)

* + 1. wcs:Extension

Even though this is not part of the MetOcean profile it is show the relationship between this extension point and the MetOcean specific metadata:

Table 14 wcs:Extension properties

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| metoceanExtensionProperty | Extends the metadata in the GetCapabilities response to include MetOcean specific detail.(this is done because wcs:Extension is type “any” | MetOceanGroup | 1 |

* + 1. MetOceanGroup

Meteorological and oceanographic data is by nature hierarchical and the ability to group entities together is important. Thus a set of NWP model runs may be grouped together and as each model run is a collection of coverages; this forms a natural hierarchy that can now be expressed.

Table 15 MetOceanGroup properties

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| metoceanGroupName | The name given to any grouping that has a significant meaning.” | NCName | 1 |
| metOceanCollectionSummary | Summary of a coverage of type MetOceanCollectionSummary | MetOceanCollectionSummary | 1 |

* + 1. MetOceanCollectionSummary

The summary of the coveragecollection, specifically the bounding area that contains the coveragecollection and a name the most common usage being that of a “model name” e.g. UKGlobal.

Table 16 MetOceanCollectionSummary properties

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| metoceanCollectionSummaryName | The name of a collectionSummary | NCName | 1 |
| gml:boundedBy | The bounding box that contains the coveragecollection. | gml:Envelope | 1 |

* + 1. MetOceanCollection

A “top level” description of each of the “CoverageCollections” contained within the each group.

Table 17 MetOceanCollection properties

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| metoceanCollectionId | The identifier of a specific collection. (this identifier may be used as an input argument to a DescribeMetOceanCollection) | NCName | 1 |
| metOceanReferenceTime | The reference time of the collection if needed. (see code table  | gml:timePosition |  0,1 |
| metOceanCollectionServiceInstance | This allows for the possibility of each collection residing on a different server. | anyURI | 0,1 |

Note: the reference time is particularly useful if referring to a specific model run, often characterised by the time (Reference Time) that defines the reference time for the forecast times.

* 1. Requirements class: MetOceanDescribeCoverageCollection

|  |
| --- |
| **Requirements Class** |
|  **http://www.opengis.net/spec/metocean/1.0/req/uml-metocean-describe-coverage-collection** |
| **Requirement** |  **/metocean-collection-description**A MetOceanCollectionDescription shall reference a MetOceanNwpObservation through an extension property gmlcov:metadata.  |
| **Requirement** |  **/metocean-metocean-nwp-observation**The resultQuality property element shall be empty. |



Figure 5 MetOceanCoverageCollection UML

* + 1. Requirements class overview

Coverage collections are a very useful way of aggregating coverages that have a relationship to each other. For example, a typical forecast model run (or set of analyses) can be properly described as a collection of coverages. In meteorlogy and oceanography, this is a very common idea.

* + 1. MetOceanCollectionDescription

Metadata relating to the each coverageCollection:

Table 18 MetOceanCollectionDescription properties

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| metOceanCollectionId | The identifier of the MetOceanCollection.  | NCName | 0..1 |
| gml:boundedBy | The bounding box that contains the coverageCollection. | gml:Envelope | 1 |
| metOceanReferenceTime | The reference time of the collection if needed. (see Note in the summary)  | gml:timePosition | 1 |
| gmlcov:metadata | The extension point for metadata in point for Metadata.(note gmlcov:Extension is type “any”.  | gmlcov:Extension | 1 |

* + 1. gmlcov:Extension for MetOceanNwpObservation

A MetOceanNwpObservation is a more specialised Observation (as defined by O&M) that adds specific metadata:

Table 19 gmlcov:Extension metOceanCollectionProperty

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| metOceanCollectionProperty | The metadata is contained within the MetOceanNwpObservation class(see section 8.1) | MetOceanNwpObservation | 1 |

* 1. Requirements class: MetOceanDescribeCoverage

|  |
| --- |
| **Requirements Class** |
| **http://www.opengis.net/spec/metocean/1.0/req/uml-metocean-describe-coverage** |
| **Requirement** | **/metocean-coverage-metadata-property**The metOceanCoverage property shall reference a MetOceanNwpObservation. |



Figure 6 MetOceanDescribeCoverage response UML

* + 1. Requirements class overview

Each coverage is described by using the MetOceanNwpObservation object. A full description is given in Section 8.1. A data mask does not have to be used, but it is much more efficient way for temporal and vertical axes to be enumerated. The “domainSet” in the core DescribeCoverage Response (not to be confused with the domainSet specified in the data mask as part of the metadata, see Figure 1) only supports a 2D geometry.

* + 1. gmlcov:Extension

Even though this is not part of the MetOcean profile it is show the relationship between this extension point and the MetOcean specific metadata:

Table 20 gmlcov:Extension properties

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| extensionProperty | References the Metadata section.  | MetOceanCoverageMetadata | 0..1 |

* + 1. MetOceanCoverageMetadata

A MetOceanNwpObservation is a more specialised Observation (as defined by O&M) that adds specific metadata and is used by MetOceanCoverageDescription:

Table 21 MetOceanCoverageMetadata properties

| **Name** | **Definition** | **Data types and values** | **Multiplicity** |
| --- | --- | --- | --- |
| metOceanCoverageMetadataProperty | The metadata is contained within the MetOceanNwpObservation class(see section 8.1) | MetOceanNwpObservation | 1 |

1. XML Encoding (normative)

This section defines the XML encoding of the WCS MetOcean metadata profile UML model. The mappings of the core types are in Table 21:

**Table 21 Mapping of MetOcean profile UML to XML**

| **MetOcean UML** | **MetOcean XML** |
| --- | --- |
| MetOceanNwpObservation | MetOceanNwpObservation |
| WCSGetCapabilitiesMetOceanProfile | WCSGetCapabilitiesMetOceanProfile |
| DescribeCoverageCollection | DescribeCoverageCollection |
| MetOceanDescribeCoverage | MetOceanDescribeCoverage |

* 1. Requirements class: MetOceanNwpObservation XML

|  |
| --- |
|  **Requirements Class** |
| http://www.opengis.net/spec/req/metocean/1.0/req/xml-nwpobservation |
|  **Requirement** |  **/observation-type**A MetOceanNwpObservation shall be derived from the OM\_Observation type, with restrictions defined in this requirements class.  |
|  **Requirement** |  **/observed-property**The ‘observedProperty’ property of the MetOceanNwpObservation element shall be reference a vocabulary term that defines in the WMO GRIB tables by using a xlink reference to the WMO register. |
|  **Requirement** |  **/feature-of-interest**The ‘featureOfInterest’ property of the MetOceanNwpObservation element shall reference a MetOceanNWPModel that is an instance of SF\_SpatialSamplingPoint (from ISO 19156:2011 Spatial Sampling Features). |
|  **Requirement** |  **/resultQuality**The resultQuality property of the MetOceanNwpObservation shall reference a timeHeight mask through a specialization of the gmd:AbstractDQ\_ResultType.  |
|  **Requirement** |  **/shape**The shape property of a SF\_SpatialSamplingPoint shall reference a ModelFootprint  |
|  **Requirement** |  **/metadata**The ‘name’ element of the specific metadata element shall be encoded using gml:ReferenceType and have an xlink:href value of the form xlink:href="http://codes.wmo.int/grib2/codeflag/0” xlink:title="originatingCentre"/>.  |

* 1. Requirements class: WCSGetCapabilitiesMetOceanProfile XML

|  |
| --- |
|  **Requirements Class** |
|  http://www.opengis.net/spec/req/metocean/1.0/req/xml-WCSGetCapabilitiesMetOceanProfile |
|  **Requirement** |  **/wcs-extension**A wcs:Extension property shall be a MetOceanGroup. |

* 1. Requirements class: MetOceanDescribeCoverageCollection XML

|  |
| --- |
|  **Requirements Class** |
| http://www.opengis.net/spec/req/metocean/1.0/req/xml-MetOceanDescribeCoverageCollection |
|  **Requirement** |  **/metocean-collection-description**A MetOceanCollectionDescription shall reference a MetOceanNwpObservation through an extension property gmlcov:metadata. |
|  **Requirement** | **/metocean-metocean-nwp-observation**The resultQuality property element shall be empty. |

* 1. Requirements class: MetOceanDescribeCoverage XML

|  |
| --- |
|  **Requirements Class** |
|  http://www.opengis.net/spec/req/metocean/1.0/req/xml-nwpobservation |
|  **Requirement** | **/metocean-metocean-coverage-metadata-property**The metOceanCollection property shall reference a MetOceanNwpObservation. |

1. UML Conformance Class Abstract Test Suite (normative)
	1. Conformance class: MetOceanNwpObservation

|  |
| --- |
| **Conformance Class** |
| **http://www.opengis.net/spec/metocean/1.0/conf/uml-MetOceanNwpObservation** |
|  | **/observed-property** |
|  | Requirement | /req/uml-MetOceanNwpObservation/observed-property |
|  | Test purpose | To ensure that the observed property of the OM\_Observation type links the WMO code definitions as described in the GRIB tables. |
|  | Test method | Inspect the model and pass if there is a link to the GRIB tables. |
|  | Test type | Conformance |
|  | **/result-quality** |
|  | Requirement | /req/uml-MetOceanNwpObservation/result-quality |
|  | Test purpose | To ensure the MetOceanNwpObservation has resultQuality property (from OM\_Observation) that points to a ResultMask. |
|  | Test method | Inspect the model and pass if the resultQuality references a ResultMask. |
|  | Test type | Conformance |
|  | **/feature-of-interest**  |
|  | Requirement | /req/uml-MetOceanNwpObservation/result-quality/feature-of-interest |
|  | Test purpose | Ensure that the ‘featureOfInterest’ property of OM\_Observation shall reference a MetOceanNWPModel type that is an instance of SF\_SpatialSamplingPoint (from ISO 19156:2011 Spatial Sampling Features). |
|  | Test method | Inspect the OM\_Observation:featureOfInterest property and pass if it is that is an instance of SF\_SpatialSamplingPoint (from ISO 19156:2011 Spatial Sampling Features). |
|  | Test type | Conformance |
|  | **/phenomenon-time** |
|  | Requirement | /req/MetOceanNwpObservation/result-quality/phenomenon-time |
|  | Test purpose | To ensure that the MetOceanNwpObservation shall have a phenomenon time that is a time period denoting the validity period of the forecast. |
|  | Test method | Inspect the MetOceanNwpObservation to ensure that the phenomenon time is restricted to a time period denoting the validity period of the forecast. |
|  | Test type | Conformance |
|  | **/resultmask** |
|  | Requirement | /req/MetOceanNwpObservation/result-quality/resultmask |
|  | Test purpose | To ensure that the ResultMask shall through the specialisation of gmd:result reference a TimeHeight Mask of type “ReferenceableGridCoverage”. |
|  | Test method | Inspect the ResultMask property and pass if it is references a TimeHeight Mask of type “ReferenceableGridCoverage”  |
|  | Test type | Conformance |

* 1. Conformance class: WCSGetCapabilitiesMetOceanProfile

|  |
| --- |
| **Conformance Class** |
| **http://www.opengis.net/spec/metocean/1.0/conf/uml-WCSGetCapabilitiesMetOceanProfile** |
|  | **/wcs-extension** |
|  | Requirement | /req/ WCSGetCapabilitiesMetOceanProfile /wcs-extension |
|  | Test purpose | Ensure the wcs:Extension property references a MetOceanGroup |
|  | Test method | Inspect the wcs:Extension property and pass if it references a MetOceanGroup |
|  | Test type | Conformance |
|  | **/metocean-collection-summary** |
|  | Requirement | /req/ WCSGetCapabilitiesMetOceanProfile / metocean-collection-summary |
|  | Test purpose | the MetOceanCollectionSummary shall not contain any duplicate collection identifiers. |
|  | Test method | Pass if there are no duplicate collectionCollection identifiers referenced. |
|  | Test type | Conformance |
|  | **/metocean-collection** |
|  | Requirement | /req/WCSGetCapabilitiesMetOceanProfile/ metocean-collection |
|  | Test purpose | the MetOceanCollection shall not contain any duplicate coverage identifiers. |
|  | Test method | Pass if there are no duplicate coverage identifiers referenced. |
|  | Test type | Conformance |

* 1. Conformance class: MetOceanDescribeCoverageCollection

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| --- |
| **Conformance Class** |
| **http://www.opengis.net/spec/metocean/1.0/conf/uml-MetOceanDescribeCoverageCollection** |
|  | **/metocean-collection-description** |
|  | Requirement | /req/MetOceanDescribeCoverageCollection/collection-description |
|  | Test purpose | To ensure the MetOceanCollectionDescription references a MetOceanNwpObservation through an extension property gmlcov:metadata. |
|  | Test method | Pass if MetOceanCollectionDescription references a MetOceanNwpObservation through an extension property gmlcov:metadata.. |
|  | Test type | Conformance |
|  | **metocean-metocean-nwp-observation**  |
|  | Requirement | /req/MetOceanDescribeCoverageCollection /metocean-metocean-nwp-observation |
|  | Test purpose | The resultQuality property shall be empty. |
|  | Test method | Pass ifThe resultQuality property is empty |
|  | Test type | Conformance |

* 1. Conformance class: MetOceanDescribeCoverage

|  |
| --- |
| **Conformance Class** |
| **http://www.opengis.net/spec/metocean/1.0/conf/uml- metocean-describe-coverage** |
|  | **/metocean-coverage-metadata-property** |
|  | Requirement | /req/ MetOceanDescribeCoverage/metocean-coverage-metadata-property |
|  | Test purpose | The metOceanCoverage property shall reference a MetOceanNwpObservation. |
|  | Test method | Pass if the The metOceanCoverage property references a MetOceanNwpObservation |
|  | Test type | Conformance |
|  | Test type | Conformance |

1. Example of a MetOceanDescribeCoverage response

<?xml version="1.0" encoding="UTF-8"?>
<wcs:CoverageDescriptions>
 <wcs:CoverageDescription gml:id="UK">
 <gml:boundedBy>
 <gml:Envelope axisLabels="lat long" srsDimension="2"
 srsName="http://www.opengis.net/def/crs/EPSG/0/4326" uomLabels="deg deg">
 <gml:lowerCorner>-90.0 0.0</gml:lowerCorner>
 <gml:upperCorner>90.0 360.0</gml:upperCorner>
 </gml:Envelope>
 </gml:boundedBy>
 <wcs:CoverageId>UK\_GLOBAL\_2012-05-15T00.00.00Z\_ISBL</wcs:CoverageId>
 <gmlcov:metadata>
 <gmlcov:Extension>
 <metocean:extensionProperty>
 <metocean:MetOceanCoverageMetadata>
 <metocean:metOceanCoverageProperty>
 <metocean:MetOceanNwpObservation gml:id="NwpObservation">
 <om:phenomenonTime>
 <gml:TimePeriod gml:id="TimeRange">
 <gml:beginPosition>2015-05-15T00:00:00Z</gml:beginPosition>
 <gml:endPosition>2015-05-20T00:00:00Z</gml:endPosition>
 </gml:TimePeriod>
 </om:phenomenonTime>
 <om:resultTime>
 <gml:TimeInstant gml:id="arrival\_time\_on\_system">
 <gml:timePosition>2015-05-15T03:30:00Z</gml:timePosition>
 </gml:TimeInstant>
 </om:resultTime>
 <om:procedure>
 <metce:Process>
 <gml:description>A description relating to the Model creating the forecast</gml:description>
 </metce:Process>
 </om:procedure>
 <om:parameter>
 <om:NamedValue>
 <om:name xlink:href="http://www.codes.wmo.int/GRIB2/table1.2/referenceTime"/>
 <om:value>
 <gml:TimeInstant gml:id="referenceTime">
 <gml:timePosition>2015-05-15T00:00:00Z</gml:timePosition>
 </gml:TimeInstant>
 </om:value>
 </om:NamedValue>
 </om:parameter>
 <om:observedProperty xlink:href="http://codes.wmo.int/grib2/codeflag/4.1" xlink:title="ParametrCategoryByDiscipline"/>
 <om:featureOfInterest>
 <metocean:MetOceanNwpModel gml:id="NWP">
 <sam:type
 xlink:href="http://www.opengis.net/def/samplingFeatureType/OGC-OM/2.0/SF\_SamplingSurface"/>
 <sam:sampledFeature
 xlink:href="http://metoffice.gov.uk/NwpModel/UKGlobal/V6.1/Exeter"
 xlink:title="Model Used"/>
 <sams:shape>
 <metocean:ModelFootprint
 gml:id="Model\_Boundary-Geometry2">
 <metocean:horizontalDomain>
 <gml:Polygon gml:id="Model\_Boundary-Geometry"
 uomLabels="deg deg" axisLabels="lat long"
 srsDimension="2"
 srsName="http://www.opengis.net/def/crs/EPSG/0/4326">
 <gml:exterior>
 <gml:LinearRing>
 <gml:posList> -90.0 -180.0 90.0 -180.0 90.0 180.0
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 </gml:LinearRing>
 </gml:exterior>
 </gml:Polygon>
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 <metocean:metOceanNwpModelMetadata>
 <metocean:MetOceanNwpModelMetadata>
 <metocean:discipline xlink:href="http://codes.wmo.int/grib2/codeflag/0.0/discipline"
 xlink:title="Meteorological Products"/>
 <metocean:typeOfData xlink:href="http://codes.wmo.int/grib2/codeflag/1.4/typeOfData"
 xlink:title="Forecast Products"/>
 <metocean:signifcanceOfReferenceTime xlink:href="http://codes.wmo.int/grib2/codeflag/1.2/significanceOfReferenceTime"
 xlink:title="Start of Forecast"/>
 <metocean:originatingCentre
 xlink:href="http://codes.wmo.int/grib2/codeflag/0/originatingCentre"
 xlink:title="Uk Met Office Exeter"/>
 <metocean:productionStatusOfData xlink:href="http://codes.wmo.int/grib2/codeflag/1.3/productionStatusOfData"
 xlink:title="Operational Products"/>
 <metocean:typeOfCalendarUsed xlink:href="http://codes.wmo.int/grib2/codeflag/1.6/typeOfCalendarUsed"
 xlink:title="Gregorian"/>
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 <metocean:rangeComponent>Temperature/RelativeHumidity/DewpointTemperature</metocean:rangeComponent>
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 <gml:boundedBy>
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 <gml:upperCorner>90.0 360.0</gml:upperCorner>
 </gml:Envelope>
 </gml:boundedBy>
 <gml:domainSet>
 <gmlrgrid:ReferenceableGridByArray gml:id="ex" dimension="2"
 srsName="http://www.opengis.net/def/crs-combine?
 1=http://www.codes.wmo.int/GRIB2/table4.5/IsobaricSurface&amp;
 2=http://http://codes.wmo.int/grib2/codeflag/4.11"
 axisLabels="pressurealtitude forecast\_time" uomLabels="hPa hours">
 <gml:limits>
 <gml:GridEnvelope>
 <gml:low>1000 0</gml:low>
 <gml:high>200 144</gml:high>
 </gml:GridEnvelope>
 </gml:limits>
 <gml:axisLabels>pressurealtitude forecast\_time</gml:axisLabels>
 <gml:posList>
 1000 0 850 0 700 0 500 0 300 0 250 0 200 0
 1000 3 850 3 700 3 500 3 300 3 250 3 200 3
 1000 6 850 6 700 6 500 6 300 6 250 6 200 6
 1000 12 850 12 700 12 500 12 300 12 250 12 200 12
 1000 24 850 24 700 24 500 24 300 24 250 24 200 24
 1000 48 850 48 700 48 500 48 300 48 250 48 200 48
 1000 72 850 72 700 72 500 72 300 72 250 72 200 72
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 1000 120 850 120 700 120 500 120 300 120 250 120 200 120
 1000 144 850 144 700 144 500 144 300 144 250 144 200 144
 </gml:posList>
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 </gmlrgrid:ReferenceableGridByArray>
 </gml:domainSet>
 <gml:rangeSet>
 <gml:DataBlock>
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 1 1 1 1 1 1 1
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 1 0 1 0 1 0 1
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 </metocean:metOceanCoverageProperty>
 </metocean:MetOceanCoverageMetadata>
 </metocean:extensionProperty>
 </gmlcov:Extension>
 </gmlcov:metadata>
 <gml:domainSet>
 <gml:RectifiedGrid dimension="2" gml:id="UK\_NWP\_Global\_MODEL\_GRID">
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 <gml:origin>
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 srsName="http://www.opengis.net/def/crs/EPSG/0/4326">
 <gml:pos>-180 -90</gml:pos>
 </gml:Point>
 </gml:origin>
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 </gml:domainSet>
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 <swe:description>air\_temperature</swe:description>
 <swe:nilValues/>
 <swe:uom code="C"/>
 <swe:constraint>
 <swe:AllowedValues>
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 <swe:significantFigures>4</swe:significantFigures>
 </swe:AllowedValues>
 </swe:constraint>
 </swe:Quantity>
 </swe:field>
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 <swe:Quantity
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 <swe:description>relative\_humidity</swe:description>
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 <swe:constraint>
 <swe:AllowedValues>
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 </swe:field>
 <swe:field name="DewpointTemperature">
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 </swe:AllowedValues>
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 <wcs:nativeFormat>image/tiff</wcs:nativeFormat>
 </wcs:ServiceParameters>
 </wcs:CoverageDescription>
</wcs:CoverageDescriptions>

1. <http://cite.opengeospatial.org/> [↑](#footnote-ref-1)