INSPIRE
Infrastructure for Spatial Information in Europe

D2.8.III.15 Data Specification on Oceanographic Geographical Features – Draft Guidelines

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Foreword
How to read the document?

This document describes the *"INSPIRE data specification on Oceanographic Geographical Features – Guidelines"* version 2.0 as developed by the Thematic Working Group (TWG) *Oceanographic geographical features / Sea regions* using both natural and a conceptual schema language. This version is now available for the public consultation. Based on the results of the consultation (received comments and the testing reports), the final version 3.0 will be prepared by the TWGs.

The data specification is based on a common template used for all data specifications and has been harmonised using the experience from the development of the Annex I data specifications.

This document provides guidelines for the implementation of the provisions laid down in the draft Implementing Rule for spatial data sets and services of the INSPIRE Directive.

This document includes two executive summaries that provide a quick overview of the INSPIRE data specification process in general, and the content of the data specification on *Oceanographic Geographical Features* in particular. We highly recommend that managers, decision makers, and all those new to the INSPIRE process and/or information modelling should read these executive summaries first.

The UML diagrams (in Chapter 5) offer a rapid way to see the main elements of the specifications and their relationships. The definition of the spatial object types, attributes, and relationships are included in the Feature Catalogue (also in Chapter 5). People having thematic expertise but not familiar with UML can fully understand the content of the data model focusing on the Feature Catalogue. Users might also find the Feature Catalogue especially useful to check if it contains the data necessary for the applications that they run. The technical details are expected to be of prime interest to those organisations that are/will be responsible for implementing INSPIRE within the field of *Oceanographic Geographical Features.*

The technical provisions and the underlying concepts are often illustrated by examples. Smaller examples are within the text of the specification, while longer explanatory examples and descriptions of selected use cases are attached in the annexes.

In order to distinguish the INSPIRE spatial data themes from the spatial object types, the INSPIRE spatial data themes are written in *italics.*

The document will be publicly available as a 'non-paper'. It does not represent an official position of the European Commission, and as such cannot be invoked in the context of legal procedures.

Interoperability of Spatial Data Sets and Services – General Executive Summary

The challenges regarding the lack of availability, quality, organisation, accessibility, and sharing of spatial information are common to a large number of policies and activities and are experienced across the various levels of public authority in Europe. In order to solve these problems it is necessary to take measures of coordination between the users and providers of spatial information. The Directive 2007/2/EC of the European Parliament and of the Council adopted on 14 March 2007 aims at establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) for environmental policies, or policies and activities that have an impact on the environment.

INSPIRE will be based on the infrastructures for spatial information that are created and maintained by the Member States. To support the establishment of a European infrastructure, Implementing Rules addressing the following components of the infrastructure are being specified: metadata, interoperability of spatial data themes (as described in Annexes I, II, III of the Directive) and spatial data services, network services and technologies, data and service sharing, and monitoring and reporting procedures.

INSPIRE does not require collection of new data. However, after the period specified in the Directive[1] Member States have to make their data available according to the Implementing Rules.

Interoperability in INSPIRE means the possibility to combine spatial data and services from different sources across the European Community in a consistent way without involving specific efforts of humans or machines. It is important to note that "interoperability" is understood as providing access to spatial data sets through network services, typically via Internet. Interoperability may be achieved by either changing (harmonising) and storing existing data sets or transforming them via services for publication in the INSPIRE infrastructure. It is expected that users will spend less time and efforts on understanding and integrating data when they build their applications based on data delivered within INSPIRE.

In order to benefit from the endeavours of international standardisation bodies and organisations established under international law their standards and technical means have been utilised and referenced, whenever possible.

To facilitate the implementation of INSPIRE, it is important that all stakeholders have the opportunity to participate in specification and development. For this reason, the Commission has put in place a consensus building process involving data users, and providers together with representatives of industry, research and government. These stakeholders, organised through Spatial Data Interest Communities (SDIC) and Legally Mandated Organisations (LMO)[2], have provided reference materials, participated in the user requirement and technical[3] surveys, proposed experts for the Data Specification Drafting Team[4] and Thematic Working Groups[5].

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[1] For all 34 Annex I,II and III data themes: within two years of the adoption of the corresponding Implementing Rules for newly collected and extensively restructured data and within 5 years for other data in electronic format still in use

[2] Number of SDICs and LMOs on 8/6/2011 was 461 and 249 respectively

[3] Surveys on unique identifiers and usage of the elements of the spatial and temporal schema,

[4] The Data Specification Drafting Team has been composed of experts from Austria, Belgium, Czech Republic, France, Germany, Greece, Italy, Netherlands, Norway, Poland, Switzerland, UK, and the European Environmental Agency

[5] The Thematic Working Groups of Annex II and III themes have been composed of experts from Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Netherlands, Norway, Poland, Romania, Slovakia, Spain, Sweden, Switzerland, Turkey, UK, the European Commission, and the European Environmental Agency

This open and participatory approach was successfully used during the development of the data specification on Annex I data themes as well as during the preparation of the Implementing Rule on Interoperability of Spatial Data Sets and Services[6] for Annex I spatial data themes.,

The development framework elaborated by the Data Specification Drafting Team aims at keeping the data specifications of the different themes coherent. It summarises the methodology to be used for the data specifications and provides a coherent set of requirements and recommendations to achieve interoperability. The pillars of the framework are four technical documents:

- The Definition of Annex Themes and Scope[7] describes in greater detail the spatial data themes defined in the Directive, and thus provides a sound starting point for the thematic aspects of the data specification development.

- The Generic Conceptual Model[8] defines the elements necessary for interoperability and data harmonisation including cross-theme issues. It specifies requirements and recommendations with regard to data specification elements of common use, like the spatial and temporal schema, unique identifier management, object referencing, a generic network model, some common code lists, etc. Those requirements of the Generic Conceptual Model that are directly implementable will be included in the Implementing Rule on Interoperability of Spatial Data Sets and Services.

- The Methodology for the Development of Data Specifications[9] defines a repeatable methodology. It describes how to arrive from user requirements to a data specification through a number of steps including use-case development, initial specification development and analysis of analogies and gaps for further specification refinement.

- The "Guidelines for the Encoding of Spatial Data"[10] defines how geographic information can be encoded to enable transfer processes between the systems of the data providers in the Member States. Even though it does not specify a mandatory encoding rule it sets GML (ISO 19136) as the default encoding for INSPIRE.

Based on these framework documents and following the successful development of the Annex I Data specifications (Technical Guidelines) and the Implementing Rules, the new Thematic Working Groups have created the INSPIRE data specification for each Annex II and III theme. These documents – at the version 2.0 – are now publicly available for INSPIRE stakeholders for consultation. The consultation phase covers expert review as well as feasibility and fitness-for-purpose testing of the data specifications.

The structure of the data specifications is based on the "ISO 19131 Geographic information - Data product specifications" standard. They include the technical documentation of the application schema, the spatial object types with their properties, and other specifics of the spatial data themes using natural language as well as a formal conceptual schema language[11].

A consolidated model repository, feature concept dictionary, and glossary are being maintained to support the consistent specification development and potential further reuse of specification elements. The consolidated model consists of the harmonised models of the relevant standards from the ISO

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[6] Commission Regulation (EU) No 1089/2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services, published in the Official Journal of the European Union on 8th of December 2010.

[7] *http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.3_Definition_of_Annex_Themes_and_scope_v3.0.pdf*

[8] *http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.5_v3.3.pdf*

[9] *http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.6_v3.0.pdf*

[10] *http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.7_v3.2.pdf*

[11] UML – Unified Modelling Language

19100 series, the INSPIRE Generic Conceptual Model, and the application schemas[12] developed for each spatial data theme. The multilingual INSPIRE Feature Concept Dictionary contains the definition and description of the INSPIRE themes together with the definition of the spatial object types present in the specification. The INSPIRE Glossary defines all the terms (beyond the spatial object types) necessary for understanding the INSPIRE documentation including the terminology of other components (metadata, network services, data sharing, and monitoring).

By listing a number of requirements and making the necessary recommendations, the data specifications enable full system interoperability across the Member States, within the scope of the application areas targeted by the Directive. They will be published (version 3.0) as technical guidelines and will provide the basis for the content of the Amendment of the Implementing Rule on Interoperability of Spatial Data Sets and Services for data themes included in Annex II and III of the Directive. The Implementing Rule Amendment will be extracted from the data specifications keeping in mind short and medium term feasibility as well as cost-benefit considerations. The Implementing Rule will be legally binding for the Member States.

In addition to providing a basis for the interoperability of spatial data in INSPIRE, the data specification development framework and the thematic data specifications can be reused in other environments at local, regional, national and global level contributing to improvements in the coherence and interoperability of data in spatial data infrastructures.

[12] Conceptual models related to specific areas (e.g. INSPIRE themes)

Oceanographic Geographical Features – Executive Summary

The INSPIRE Oceanographic Geographical Features (abbreviated to "Ocean Features" or "OF") theme describes the physical and chemical characteristics of the sea, properties such as 'sea surface temperature' or 'salinity'. These characteristics are typically modelled as set of point data, e.g. temperature observations from a fixed monitoring station, or as gridded data e.g. sea wave height observations from a satellite.

The OF theme is closely related to the INSPIRE Sea Regions theme, which describes what describes what most people would refer to as "the sea" i.e. the actual water bodies. To further clarify the distinction between the OF and SR themes we use the following definition:

> "Sea Region is a defined area of common (physical) characteristics. An Ocean Feature represents the (physical or chemical) properties of the Sea Region. A Sea Region may have other properties that are not an Ocean Feature, for example bathymetry (Elevation theme) and properties of the sea bed." A Sea Region will typically be represented as a vector dataset whereas an Ocean Feature will be a grid dataset or other coverage type".

So an Oceanographic Geographical Feature will typically be used to describe some physical or chemical property of a Sea Region. E.g. "Mean wave height of the North Sea", where "North Sea" is a defined Sea Region feature type. Similarly, whereas a Sea Region defines the extent of the sea for a given tidal state (e.g. Mean High Water) , the Oceanographic Geographical Feature would define the changes in tidal level over time, e.g. from a tide gauge.

The Ocean Features theme employs the ISO 19156 Observations and Measurements standard for consistent encoding of observation-related metadata.

There are three themes that are particularly important in their relationships to Oceanographic Geographic Features and these are:

- Sea Regions (SR): Oceanographic Geographic Features always contain information about a Sea Region.
- Environmental Monitoring Facilities (EF): The process used to derive Oceanographic Geographical Features will involve one or more Environmental Monitoring Facilities.
- Atmospheric Conditions and Meteorological Geographical Features (AC,MF): It is also noted that on a data level there is a great deal of similarity between measurements made in the seas and oceans and measurements made in the atmosphere so the data models have been harmonised where appropriate.

Other data representations do exist, however point observations and grid observations account for the vast majority of interoperability use cases in the scope of INSPIRE. Other data representations will be considered for subsequent revisions.

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The Drafting Team Data Specifications included:
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The Consolidated UML repository has been set up by Michael Lutz, Anders Friis-Christensen, and Clemens Portele. The INSPIRE Registry has been developed by Angelo Quaglia and Michael Lutz. The INSPIRE Feature Concept Dictionary and Glossary has been consolidated by Darja Lihteneger. The data specification testing has been coordinated by Martin Tuchyna. The Testing communication tools have been set up by Loizos Bailas, Karen Fullerton and Nicole Ostländer. Web communication and tools for the consultations have been developed by Karen Fullerton and Hildegard Gerlach.

The stakeholders participated, as Spatial Data Interested Communities (SDIC) or Legally Mandated Organisations (LMO), in different steps of the development of the data specification development framework documents and the technical guidelines, providing information on questionnaires and user surveys, participating in the consultation process and workshops, testing the draft data specifications and supporting the work of their members in the Thematic Working Groups and Drafting Team Data Specifications.

Contact information

Vanda Nunes de Lima
European Commission Joint Research Centre
Institute for Environment and Sustainability
Spatial Data Infrastructures Unit
TP262, Via Fermi 2749
I-21027 Ispra (VA)
ITALY
E-mail: vanda.lima@jrc.ec.europa.eu
Tel.: +39-0332-7865052
Fax: +39-0332-7866325
http://ies.jrc.ec.europa.eu/
http://ec.europa.eu/dgs/jrc/
http://inspire.jrc.ec.europa.eu/

Table of contents

1 Scope

This document specifies a harmonised data specification for the spatial data theme *Oceanographic Geographical Features* as defined in Annex III of the INSPIRE Directive.

This data specification provides the basis for the drafting of Implementing Rules according to Article 7 (1) of the INSPIRE Directive [Directive 2007/2/EC]. The entire data specification will be published as implementation guidelines accompanying these Implementing Rules.

2 Overview

2.1 Name

INSPIRE data specification for the theme Oceanographic Geographical Features.

2.2 Informal description

Definition:

An Oceanographic Geographical Feature (Ocean Feature) is defined as “Physical conditions of oceans (currents, salinity, wave heights, etc.).”
[Directive 2007/2/EC]

Description:
Historical versions of the theme definition are found in the INSPIRE IMS and Scoping papers which define an Ocean Feature as:

- The measurable physical conditions of oceans e.g. salinity, oxygen, other chemical components, currents. Representation e.g. as grids or other spatial organisation. Based on measurements directly or combined with models. (INSPIRE IMS, 2003)
- Physical conditions of oceans (e.g. currents, salinity, etc) represented as lines, grids or points. Includes spatial data sets based on measurements, on models or on a combination thereof and includes measurement locations (INSPIRE Scoping, 2004)
- Although the scope of the Directive says ‘physical conditions of the oceans’, the intent is for both physical and chemical conditions of the ocean. This is consistent with the Directive text that considers ‘salinity’ to be within scope and the INSPIRE scoping papers.

From these descriptions we expand the definition as follows:

- An OF is essentially a coverage (ISO 19126) describing the ocean. Examples in common use are
  - 1D Points / PointSeries such as the results of an instrument at a fixed location measuring parameters over time
  - 2D Grids / GridSeries such as data from a numerical model or satellite over a gridded field and (optionally) repeated over time

IR Requirement 1	Oceanographic Geographical Features shall be represented as Points and Grids. Although other representations are possible, Points and Grids are most commonly used and other representations are primarily for scientific investigation rather than providing a statement on the conditions of the ocean. Implementing other representations would be unduly complex and provide higher burdens on MS with limited benefit at this stage.

Recommendation 1	An Oceanographic Geographical Feature may describe the physical conditions of the seabed such as sediment type or grain size. Originally it was excluded, however to be consistent with SeaRegions::SeaBedCover it is included in this theme.

- The data can be an observation or simulation. As a simulation, forecasts of OF are allowed.
- The OF specification does not prescribe the property or phenomena of the ocean, only its representation. This is covered in more detail in the section on Data Capture.
- A OF is application or intent agnostic, i.e. it is not bound to any particular domain of application. For example suspended sediments measured for water quality reporting are treated in the same way as suspended sediments measured for coastal erosion management. The user may however choose to process the data in different ways.

Examples of Ocean Features

Based on the above scope, the following are examples of Ocean Features.

- Measurements of water temperature and salinity recorded by a buoy or fixed instrument at sea for the purpose of water quality reporting
- Measurements of ocean waves recorded by a buoy for the purpose of understanding a coastal flood hazards
- Gridded measurements of ocean colour an earth observation satellite for the purpose of defining regions for water quality reporting.

What an Ocean Feature is not

- Direct measurements of biological parameters such as phytoplankton[13], zooplankton or any marine specifies counts
- Derived statistics and climates based on observation and measurements[14]
    - E.g. exceedance plot, wave rose, isolines
- An Atmospheric Geograpical Feature (AF – AnnexIII)
    - Winds for example are part of Atmosphere
- Elevation (EL – AnnexII)
    - Bathymetric measurements of the ocean depths

[13]Measurements of ocean colour can be used to determine parameters such as Chl-a and these are within the scope of Sea Regions.

[14] Such analysis is subjective to a particular purpose and does not result in a coverage. It would be expected that this information would be an attribute of a specialised Sea Region such as a Natural Risk Zone.

- A SeaRegion (SR – Annex III)
    - Contours or areas of the Sea classified by their physical or chemical conditions

2.3 Normative References

[Directive 2007/2/EC] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

[ISO 19107] EN ISO 19107:2005, Geographic Information – Spatial Schema

[ISO 19108] EN ISO 19108:2005, Geographic Information – Temporal Schema

[ISO 19108-c] ISO 19108:2002/Cor 1:2006, Geographic Information – Temporal Schema, Technical Corrigendum 1

[ISO 19111] EN ISO 19111:2007 Geographic information - Spatial referencing by coordinates (ISO 19111:2007)

[ISO 19113] EN ISO 19113:2005, Geographic Information – Quality principles

[ISO 19115] EN ISO 19115:2005, Geographic information – Metadata (ISO 19115:2003)

[ISO 19118] EN ISO 19118:2006, Geographic information – Encoding (ISO 19118:2005)

[ISO 19123] EN ISO 19123:2007, Geographic Information – Schema for coverage geometry and functions

[ISO 19135] EN ISO 19135:2007 Geographic information – Procedures for item registration (ISO 19135:2005)

[ISO 19138] ISO/TS 19138:2006, Geographic Information – Data quality measures

[ISO 19139] ISO/TS 19139:2007, Geographic information – Metadata – XML schema implementation

[ISO 19156] ISO/TS FDIS 19156:2011, Observations and Measurements

[OGC 06-103r3] Implementation Specification for Geographic Information - Simple feature access – Part 1: Common Architecture v1.2.0

NOTE This is an updated version of "EN ISO 19125-1:2006, Geographic information – Simple feature access – Part 1: Common architecture". A revision of the EN ISO standard has been proposed.

[Regulation 1205/2008/EC] Regulation 1205/2008/EC implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata

2.4 Terms and definitions

General terms and definitions helpful for understanding the INSPIRE data specification documents are defined in the INSPIRE Glossary[15].

2.5 Symbols and abbreviations

AC-MF	Atmospheric Conditions & Meteorological Geographical Features (INSPIRE Data Specification)
CSML	Climate Science Modelling Language
EC	European Commission
EF	Environmental Monitoring Facilities (INSPIRE Data Specification)
EU	European Union
GML	Geography Markup Language
INSPIRE	Infrastructure for Spatial Information in Europe
ISO	International Organization for Standardization
LMO	Legally Mandated Organisation
OF	Oceanographic Geographical Feature
O&M	ISO 19156 Observations and Measurements
SDIC	Spatial Data Interest Community
SLD	Styled Layer Descriptor
SOS	OGC Sensor Observation Service
SR	Sea Regions (INSPIRE Data Specification)
TWG	Thematic Working Group
UML	Unified Modeling Language
URI	Uniform Resource Identifier
WCS	OGC Web Coverage Service
WFS	OGC Web Feature Service
WMS	OGC Web Map Service

2.6 Notation of requirements and recommendations

To make it easier to identify the mandatory requirements and the recommendations for spatial data sets in the text, they are highlighted and numbered.

IR Requirement X Requirements that are reflected in the Implementing Rule on interoperability of spatial data sets and services are shown using this style.

DS Requirement X Requirements that are not reflected in the Implementing Rule on interoperability of spatial data sets and services are shown using this style.

Recommendation 1 Recommendations are shown using this style.

[15] The INSPIRE Glossary is available from http://inspire-registry.jrc.ec.europa.eu/registers/GLOSSARY

2.7 Conformance

DS Requirement 1	Any dataset claiming conformance with this INSPIRE data specification shall pass the requirements described in the abstract test suite presented in Annex A.

3 Specification scopes

This data specification does not distinguish different specification scopes, but just considers one general scope.

NOTE For more information on specification scopes, see [ISO 19131:2007], clause 8 and Annex D.

4 Identification information

NOTE Since the content of this chapter was redundant with the overview description (section 2) and executive summary, it has been decided that this chapter will be removed in v3.0.

5 Data content and structure

IR Requirement 2	Spatial data sets related to the theme *Oceanographic Geographical Features* shall be provided using the spatial object types and data types specified in the application schema(s) in this section.

IR Requirement 3	Each spatial object shall comply with all constraints specified for its spatial object type or data types used in values of its properties, respectively.

Recommendation 2	The reason for a void value should be provided where possible using a listed value from the VoidValueReason code list to indicate the reason for the missing value.

NOTE The application schema specifies requirements on the properties of each spatial object including its multiplicity, domain of valid values, constraints, etc. All properties have to be reported, if the relevant information is part of the data set. Most properties may be reported as “void”, if the data set does not include relevant information. See the Generic Conceptual Model [INSPIRE DS-D2.5] for more details.

5.1 Basic notions

This section explains some of the basic notions used in the INSPIRE application schemas. These explanations are based on the GCM [DS-D2.5].

5.1.1 Stereotypes

In the application schemas in this sections several stereotypes are used that have been defined as part of a UML profile for use in INSPIRE [INSPIRE DS-D2.5]. These are explained in Table 1 below.

Table 1 – Stereotypes (adapted from [INSPIRE DS-D2.5])

Stereotype	Model element	Description
applicationSchema	Package	An INSPIRE application schema according to ISO 19109 and the Generic Conceptual Model.
featureType	Class	A spatial object type.
type	Class	A conceptual, abstract type that is not a spatial object type.
dataType	Class	A structured data type without identity.
union	Class	A structured data type without identity where exactly one of the properties of the type is present in any instance.
enumeration	Class	A fixed list of valid identifiers of named literal values. Attributes of an enumerated type may only take values from this list.
codeList	Class	A flexible enumeration that uses string values for expressing a list of potential values.
placeholder	Class	A placeholder class (see definition in section 5.1.2).
voidable	Attribute, association role	A voidable attribute or association role (see definition in section 5.1.3).
lifeCycleInfo	Attribute, association role	If in an application schema a property is considered to be part of the life-cycle information of a spatial object type, the property shall receive this stereotype.
version	Association role	If in an application schema an association role ends at a spatial object type, this stereotype denotes that the value of the property is meant to be a specific version of the spatial object, not the spatial object in general.

5.1.2 Placeholder and candidate types

Some of the INSPIRE Annex I data specifications (which were developed previously to the current Annex II+III data specifications) refer to types that thematically belong and were expected to be fully specified in Annex II or III spatial data themes. Two kinds of such types were distinguished:

- *Placeholder types* were created as placeholders for types (typically spatial object types) that were to be specified as part of a future spatial data theme, but which was already used as a value type of an attribute or association role in this data specification.

  Placeholder types received the stereotype «placeholder» and were placed in the application schema package of the future spatial data theme where they thematically belong. For each placeholder, a definition was specified based on the requirements of the Annex I theme. The Annex II+III TWGs were required to take into account these definitions in the specification work of the Annex II or III theme.

  If necessary, the attributes or association roles in the Annex I data specification(s) that have a placeholder as a value type shall be updated if necessary.

- *Candidate types* were types (typically spatial object types) for which already a preliminary specification was given in the Annex I data specification. Candidate types did not receive a specific stereotype and were placed in the application schema package of the future spatial data theme where they thematically belong. For each candidate type, a definition and attributes and association roles were specified based on the requirements of the Annex I theme. The Annex II+III TWGs were required to take into account these specifications in the specification work of the Annex II or III theme.

  If the type could not be incorporated in the Annex II or III data specification according to its preliminary specification, it should be moved into the application schema of the Annex I theme where it had first been specified. In this case, the attributes or association roles in the Annex I data specification(s) that have the type as a value type shall be updated if necessary.

Open issue 1: For all Annex II+III themes for which placeholders and candidate types were specified in an Annex I data specification, it should be clearly indicated in the data specification, how the placeholder and candidate types were taken into account. If the proposed solution would require any changes to an Annex I data specification (and the corresponding section in the IR for interoperability of spatial data sets and services), this should also be clearly indicated.

A thorough investigation of the implications of the proposed changes of candidate types (in particular related to requirements of Annex I maintenance) will have to be performed for v3.0 of the data specifications.

5.1.3 Voidable characteristics

If a characteristic of a spatial object is not present in the spatial data set, but may be present or applicable in the real world, the property shall receive this stereotype.

If and only if a property receives this stereotype, the value of *void* may be used as a value of the property. A *void* value shall imply that no corresponding value is contained in the spatial data set maintained by the data provider or no corresponding value can be derived from existing values at reasonable costs, even though the characteristic may be present or applicable in the real world.

It is possible to qualify a value of void in the data with a reason using the VoidValueReason type. The VoidValueReason type is a code list, which includes the following pre-defined values:

- *Unpopulated*: The characteristic is not part of the dataset maintained by the data provider. However, the characteristic may exist in the real world. For example when the “elevation of the water body above the sea level” has not been included in a dataset containing lake spatial objects, then the reason for a void value of this property would be ‘Unpopulated’. The characteristic receives this value for all objects in the spatial data set.
- *Unknown*: The correct value for the specific spatial object is not known to, and not computable by the data provider. However, a correct value may exist. For example when the “elevation of the water body above the sea level” *of a certain lake* has not been measured, then the reason for a void value of this property would be ‘Unknown’. This value is applied on an object-by-object basis in a spatial data set.

NOTEIt is expected that additional reasons will be identified in the future, in particular to support reasons / special values in coverage ranges.

The «voidable» stereotype does not give any information on whether or not a characteristic exists in the real world. This is expressed using the multiplicity:

- If a characteristic may or may not exist in the real world, its minimum cardinality shall be defined as 0. For example, an if an Address may or may not have a house number, the multiplicity of the corresponding property shall be 0..1.

- If at least one value for a certain characteristic exists in the real world, the minimum cardinality shall be defined as 1. For example, if an Administrative Unit always has at least one name, the multiplicity of the corresponding property shall be 1..*.

In both cases, the «voidable» stereotype can be applied. A value (the real value or void) only needs to be made available for properties that have a minimum cardinality of 1.

5.1.4 Code lists and Enumerations

5.1.4.1. Style

All code lists and enumerations use the following modelling style:

- No initial value, but only the attribute name part, is used.
- The attribute name conforms to the rules for attributes names, i.e. is a lowerCamelCase name. Exceptions are words that consist of all uppercase letters (acronyms).

5.1.4.2. Governance of code lists

Two types of code lists are defined in INSPIRE. These two types are distinguished using the tagged value "extendableByMS" in the UML data model:

- *Code lists that **may not** be extended by Member States.* For these code lists, the tagged value is set to "false". They shall be managed centrally in the INSPIRE code list register, and only values from that register may be used in instance data.
- *Code lists that **may** be extended by Member States.* For these code lists, the tagged value is set to "true".

5.2 Application schema Oceanographic Geographical Features

5.2.1 Description

5.2.1.1. Narrative description and UML Overview

An Oceanographic Geographic Feature (abbreviated to "Ocean Feature" or "OF") describes the physical and chemical phenomena of a sea region (known as 'SeaArea' in the Inspire Sea Regions model).

Some examples of Ocean Features are:

- A time series of measurements of water level from a tide guage
- A satellite gridded field of ocean colour
- A one off sea surface temperature measurement made by hand with a themometer
- An ocean climate model predicting future changes of salinity over time on a model grid.
- Ex-situ measurement of suspended sediment concentration.

In each of these cases some estimation of the value of a property (water level, ocean colour, temperature, salinity) is made using some procedure. For the OF theme we directly build upon the ISO 19156 Observations and Measurements specification which already describes these relationships between the observation (or simulation) event, the observed property, the procedure used and the feature of interest.

By building on the 19156 standard model it is expected that interoperability between domains will be increased. Non-specialist software will be able to interrogate Ocean Features and at least identify the feature of interest, the observation time, the location etc. if it understands ISO 19156.

Four specialisations of OM_Observation are included in the feature catalogue to cater for the most common representations for OceanFeatures: PointObservation, PointSeriesObservation, GridObservation, GridSeriesObservation. We also introduce a convenience class 'PointCollection' which may be used to group together otherwise independent PointObservaitons.

The four specialiastions essentially add constraints to the model which characterise the result of the observaiton and the sampling regime used. For example, a PointSeriesObservation is a timeseries at a single point, so the 'Spatial Sampling Feature' in 19156 must be a SamplingPoint, and the 'phenomenonTime' must be a time period i.e. it must be a time series. The type of the result must be a time series coverage. This pattern has been modelled on Climate Science Modelling Language version 3 (OGC Pending Docs 11_021) which extends ISO 19156.

Although other representations are in existence (such as ProfileObservation), these are primarily for 'scientific' intra-community data exchange and not for cases where data needs to be exchanged between other INSPIRE themes. To avoid unnecessary complexity with trying to incorporate all possible representations, INSPIRE limits Ocean Features to these five types.

This INSPIRE OF data specification does not specify which phenomena of the ocean (e.g. temperature, salinty) are being observed. The phenomena are described by the ‘observedProperty’ attribute of the Observation featureType. We introduce some stub classes (see Figure 2) in the OF model to indicate that there is an intention to harmonise the way we refer to observed properties from external vocabularies.

In addition the OF theme does not specify what phenomena should be fall within scope of the theme, it simply states that where there is a mandate to measure or observe a parameter in accordance with European Legislation is should be exchanged according to this specification.

It is important to note that the process of the observation is partly described by the Environmental Monitoring Facilities theme and that the OF theme is primary concerned with the result of the observation theme. Again we use a stub class to indicate the intention to provide a crosss theme approach to linking observations to Environmental Monitoring Facilities.

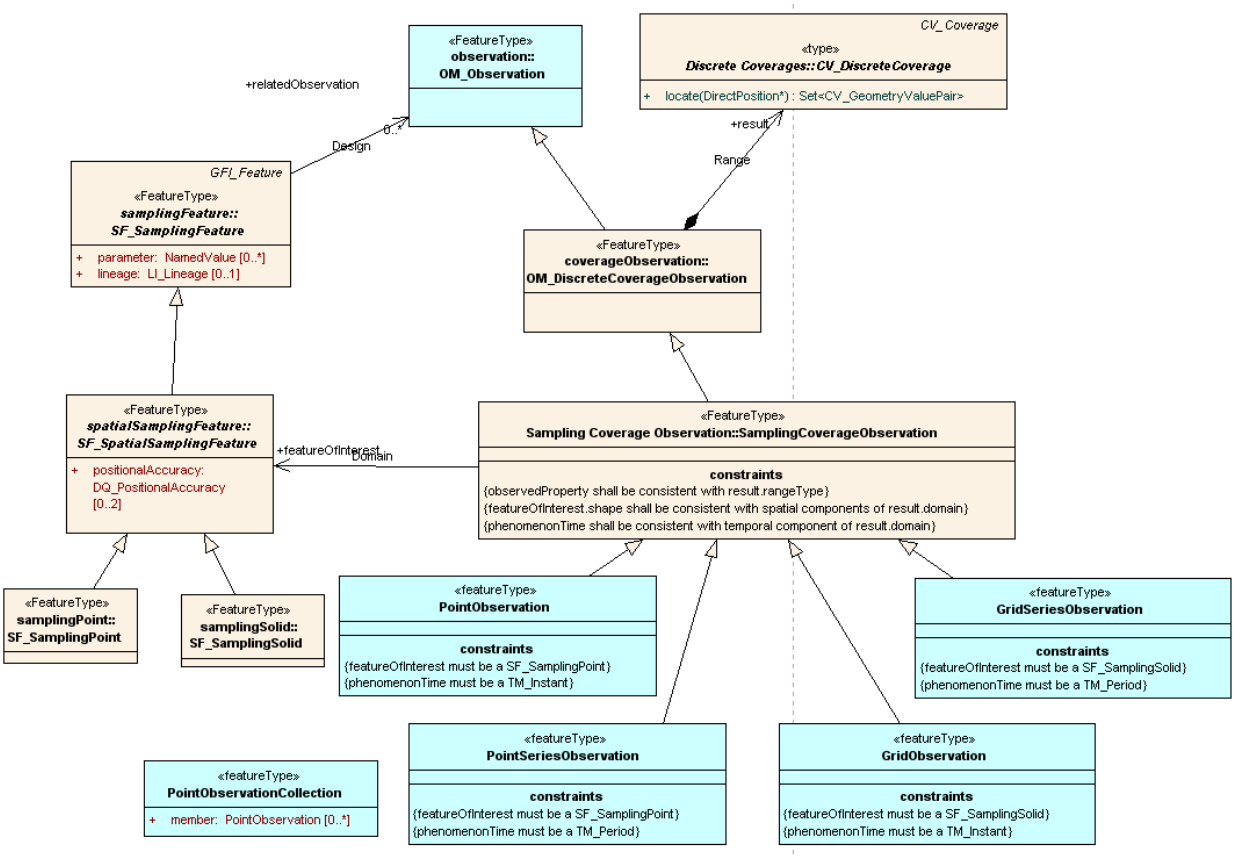


Figure 1 – UML class diagram: Overview of the Oceanographic Geographical Features **application schema**

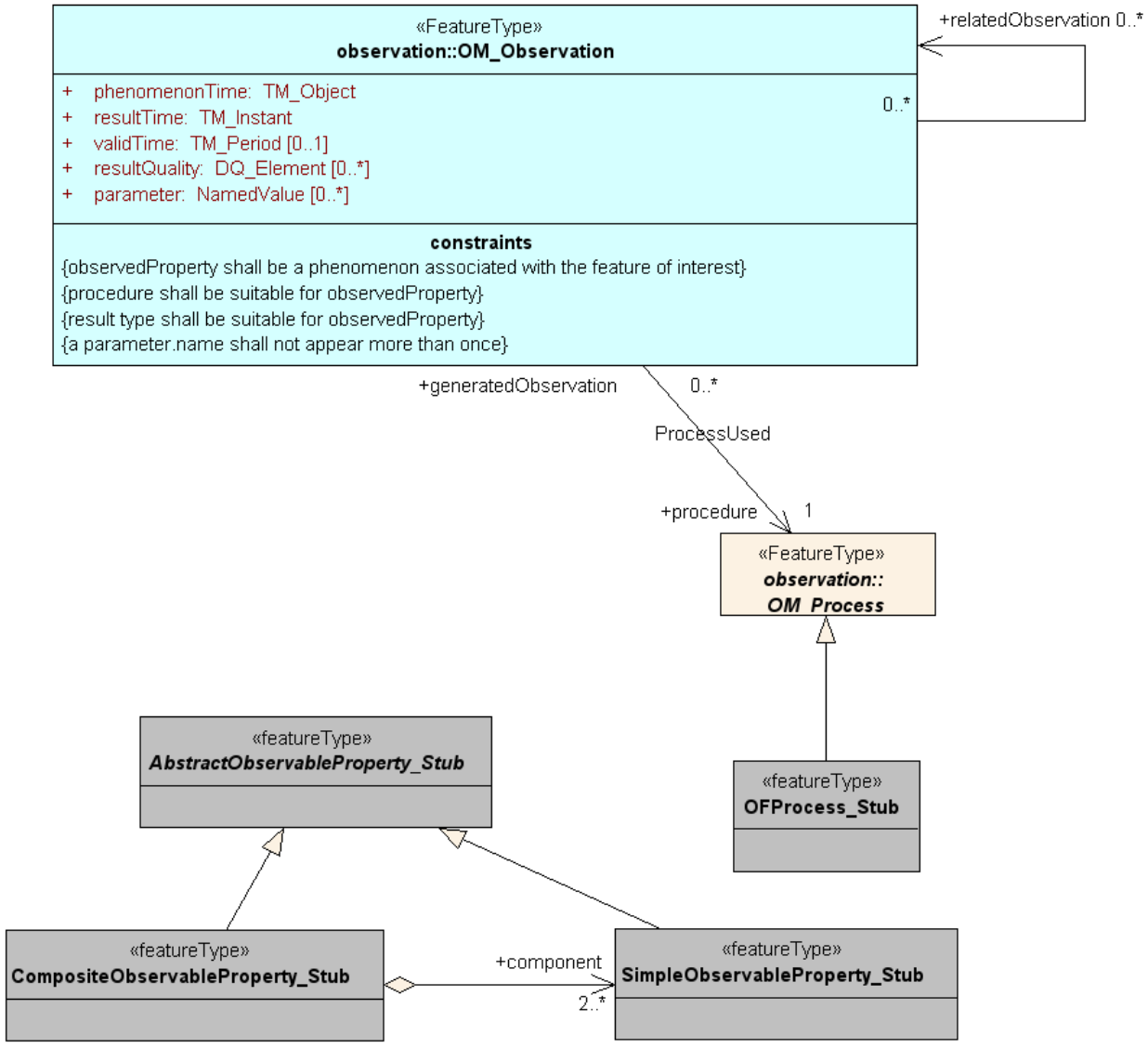


Figure 2 – UML class diagram: Stub classes used in Version 2.0

5.2.1.2. Consistency between spatial data sets

The O&M SamplingCoverageObservation consistency constraints are used to ensure that:

- the rangeType of the observation result is consistent with the phenomenon measured
- the phenomenon time of the observation is consistent with the temporal aspect of the coverage result
- the spatial components of the sampling feature shall be consistent with the observation result.

In addition, the OF consistency constraints are used to ensure that:

- the feature of interest of the observation is an appropriate spatial sampling feature
- the phenomenonTime of the observation is either a time instant or period, as appropriate
- the result of the observation is the appropriate coverage type (not shown in UML)

For the individual classes, the consistency rules are as follows:

PointObservation

- The feature of interest must be a sampling point, SF_SamplingPoint
- The phenomenon time must be a single time instant

- The result must be a MultiPointCoverage with a single point in the domain.
- This is consistent with a *single* measurements at a single point in time and space

PointSeriesObservation

- The feature of interest must be a sampling point, SF_SamplingPoint
- The phenomenon time must be a time period, corresponding to the start and end times of the observation event.
- The result must be a ReferenceableGridCoverage in a spatio-temporal reference system
- This is consistent with a *time series* of measurements at a single point in space

GridObservation

- The feature of interest must be a surface or solid, SF_SamplingSurface or SF_SamplingSolid
- The phenomenon time must be a single time instant
- The result must be a ReferenceableGridCoverage with a single point in the temporal domain.
- This is consistent with a *single* grid of data at an instant in time.

GridSeriesObservation

- The feature of interest must be a surface or solid, SF_SamplingSurface or SF_SamplingSolid
- The phenomenon time must be a time period, corresponding to the start and end times of the observation event.
- The result must be a ReferenceableGridCoverage with multiple timesteps in the domain.
- This is consistent with *multiple* timesteps of data on the same spatial grid.

5.2.1.3. Identifier management

There are no special requirements for identifier management.

5.2.1.4. Modelling of object references

The phenomena types (e.g. Temperature, Salinity) referenced by the 'observedProperty' attribute of the 'SamplingCoverageObservation' shall not be governed by this schema but shall be in external vocabularies.

Open issue 2: It is necessary to determine which, if any, external vocabularies should be recommended or mandated for use in this data specification.
e.g. Two possible candidates that have been identified are:

SeaDataNet vocabularies
CF Standard names

Question for SDICs/LMOs: Do you have any particular views on which vocabularies, if any, should be recommended or mandated? If so, please provide feedback on this issue.

5.2.1.5. Geometry representation

The geometry of a coverage type observation is a key attribute of the sampling feature. As such, spatial elements are an intrinsic part of the result (the 'domain' of the coverage – e.g. the point or points for which measurements exist). So for example, a PointSeriesObservation represents a timeseries of data at a specific spatial location, and a GridObservation represents measurements at a number of discrete spatial locations. The geometry of the grid is not necessarily simple.

5.2.1.6. Temporality representation

The application schema uses the derived attributes "beginLifespanObject" and "endLifespanObject" to record the lifespan of a spatial object.

The attributes "beginLifespanVersion" specifies the date and time at which this version of the spatial object was inserted or changed in the spatial data set. The attribute "endLifespanVersion" specifies the date and time at which this version of the spatial object was superseded or retired in the spatial data set.

NOTE 1 The attributes specify the beginning of the lifespan of the version in the spatial data set itself, which is different from the temporal characteristics of the real-world phenomenon described by the spatial object. This lifespan information, if available, supports mainly two requirements: First, knowledge about the spatial data set content at a specific time; second, knowledge about changes to a data set in a specific time frame. The lifespan information should be as detailed as in the data set (i.e., if the lifespan information in the data set includes seconds, the seconds should be represented in data published in INSPIRE) and include time zone information.

NOTE 2 Changes to the attribute "endLifespanVersion" does not trigger a change in the attribute "beginLifespanVersion".

Recommendation 3 If life-cycle information is not maintained as part of the spatial data set, all spatial objects belonging to this data set should provide a void value with a reason of "unpopulated".

There is an important temporal aspect to the sampling coverage observations. The 'phenomenonTime' of the Observation represents the bounding time envelope or instant for any observation event. For time series features (PointSeriesObservation, GridSeriesObservation) the temporal axis of the domain of the coverage result will describe the full temporal detail of the observation (when each measurement was made).

5.2.2 Feature catalogue

Table 3 - Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue Oceanographic Geographical Features
Scope	Oceanographic Geographical Features
Version number	0.1
Version date	2010-10-27
Definition source	INSPIRE data specification Oceanographic Geographical Features

Table 4 - Types defined in the feature catalogue

Type	Package	Stereotypes	Section
AbstractObservableProperty_Stub	Oceanographic Geographical Features	«featureType»	5.2.2.1.1
CompositeObservableProperty_Stub	Oceanographic Geographical Features	«featureType»	5.2.2.1.2
GridObservation	Oceanographic Geographical Features	«featureType»	5.2.2.1.3
GridSeriesObservation	Oceanographic Geographical Features	«featureType»	5.2.2.1.4
OFProcess_Stub	Oceanographic Geographical Features	«featureType»	5.2.2.1.5

Type	Package	Stereotypes	Section
PointObservation	Oceanographic Geographical Features	«featureType»	5.2.2.1.6
PointObservationCollection	Oceanographic Geographical Features	«featureType»	5.2.2.1.7
PointSeriesObservation	Oceanographic Geographical Features	«featureType»	5.2.2.1.8
SimpleObservableProperty_Stub	Oceanographic Geographical Features	«featureType»	5.2.2.1.9

5.2.2.1. Spatial object types

5.2.2.1.1. AbstractObservableProperty_Stub

AbstractObservableProperty_Stub (abstract)	
Definition:	Observable Property defines the physical property observed. This is an abstract class.
Description:	The Observaitons & Measurements model (ISO 19156) states that the 'observedProperty' can be of type any. This class is an abstract base class that may be extended to create sensible Observable Property structures suitable for the O&M observedProperty. It is anticipated that some level of X-TWG harmonisation will take place on the exact structure of this class and it's subtypes. For version 2.0 we use a stub.
Status:	Proposed
Stereotypes:	«featureType»
URI:	null

5.2.2.1.2. CompositeObservableProperty_Stub

CompositeObservableProperty_Stub	
Subtype of:	AbstractObservableProperty_Stub
Definition:	A composite observable property made up of two or more SimpleObservablePropertys.
Description:	Where multiple phenomena are observed they may be grouped together using this CompositeObservableProperty. It is anticipated that some level of X-TWG harmonisation will take place on the exact structure of this class and it's subtypes. For version 2.0 we use a stub.
Status:	Proposed
Stereotypes:	«featureType»
URI:	null
Association role: component	
Value type:	SimpleObservableProperty_Stub
Multiplicity:	2..*

5.2.2.1.3. GridObservation

GridObservation	
Subtype of:	SamplingCoverageObservation
Definition:	The *Grid* observationis a *CSML Static Observation* representing a gridded field at a single time instant. source: CSML (Climate Science Modelling Langauge, OGC Pending Documents 11-021)
Description:	A GridObservation is an observation of some phenomenon (or phenomena) over a gridded field. E.g. Output from a model, or rectified, georeferenced satellite data. The result of a *Grid*Observation is a discrete coverage within a compound spatiotemporal CRS where the domain consists of a two- or three-dimensional grid of points, all having the same time instant temporal component.

GridObservation	
Status:	Proposed
Stereotypes:	«featureType»
URI:	null
Constraint: featureOfInterest must be a SF_SamplingSolid	
Natural language:	inv: self.featureOfInterest->forAll(oclIsKindOf(SF_SamplingSolid))
Constraint: phenomenonTime must be a TM_Instant	
Natural language:	inv: self.phenomenonTime.oclIsKindOf(TM_Instant)

5.2.2.1.4. GridSeriesObservation

GridSeriesObservation	
Subtype of:	SamplingCoverageObservation
Definition:	The *GridSeries* observation (Figure 14) is a *CSML Time Series Observation* representing an evolving gridded field at a succession of time instants. source: CSML (Climate Science Modelling Langauge, OGC Pending Documents 11-021)
Description:	A GridSeriesObservation is a time series of gridded fields representing the same phenomenon (or phenomena) over a series of times. E.g. Ocean model output. The result of a *GridSeriesO*bservation is a discrete coverage within a compound spatiotemporal CRS where the domain consists of a series of two- or three-dimensional grids of points, each at a successive time instant.
Status:	Proposed
Stereotypes:	«featureType»
URI:	null
Constraint: featureOfInterest must be a SF_SamplingSolid	
Natural language:	inv: self.featureOfInterest->forAll(oclIsKindOf(SF_SamplingSolid))
Constraint: phenomenonTime must be a TM_Period	
Natural language:	inv: self.phenomenonTime.oclIsKindOf(TM_Period)

5.2.2.1.5. OFProcess_Stub

OFProcess_Stub	
Subtype of:	OM_Process
Definition:	A placeholder class for the Process defintion which acknowledges X-TWG work in this area.
Description:	An Ocean Features observation should describe the process used in the observation. This process should, where appropriate, include a link to an INSPIRE Environmental Monitoring Facility. The exact nature of this linkage is under review and is the subject of X-TWG harmonisation discussion. For now we use a stub class as a placeholder in the model.
Status:	Proposed
Stereotypes:	«featureType»
URI:	null

5.2.2.1.6. PointObservation

PointObservation	
Subtype of:	SamplingCoverageObservation

PointObservation	
Definition:	The *Point* observation (Figure 9) is a *CSML Static Observation* that represents a measurement of a property at a single point in time and space. source: CSML (Climate Science Modelling Langauge, OGC Pending Documents 11-021)
Description:	The PointObservation represents a single measurement or estimation of a property at a single point in time and space.
Status:	Proposed
Stereotypes:	«featureType»
URI:	null

Constraint: featureOfInterest must be a SF_SamplingPoint

Natural language:	inv: self.featureOfInterest->forAll(oclIsKindOf(SF_SamplingSolid))

Constraint: phenomenonTime must be a TM_Instant

Natural language:	inv: self.phenomenonTime.oclIsKindOf(TM_Instant)

5.2.2.1.7. PointObservationCollection

PointObservationCollection	
Definition:	Collection of PointObservations
Description:	The PointObservationCollection is simply a collection of PointObservations. In the case where it is useful to group together a set of otherwise independent PointObservations the PointObservationCollection should be used to make this grouping. The grouping may be made on any basis e.g. it may be useful to group together PointObservations made by the same instrument or Environmental Facility, or in a particular measurement campaign. Each member of the PointObservationCollection must be a single PointObservation.
Status:	Proposed
Stereotypes:	«featureType»
URI:	null

Attribute: member

Value type:	PointObservation
Definition:	A member of the collection, must be a PointObservation.
Description:	
Multiplicity:	0..*

5.2.2.1.8. PointSeriesObservation

PointSeriesObservation	
Subtype of:	SamplingCoverageObservation
Definition:	The *PointSeries* observation (Figure 10) is a *CSML Time Series Observation* that represents a time-series of point measurements of a property at a fixed location in space. source: CSML (Climate Science Modelling Langauge, OGC Pending Documents 11-021)
Description:	A PointSeriesObservation is a time series of observations made at the same fixed spatial location e.g. Measurements made repeatedly by a fixed monitoring instrument.
Status:	Proposed
Stereotypes:	«featureType»
URI:	null

Constraint: featureOfInterest must be a SF_SamplingPoint

PointSeriesObservation	
Natural language:	inv: self.featureOfInterest->forAll(oclIsKindOf(SF_SamplingPoint))
Constraint: phenomenonTime must be a TM_Period	
Natural language:	inv: self.phenomenonTime.oclIsKindOf(TM_Period)

5.2.2.1.9. SimpleObservableProperty_Stub

SimpleObservableProperty_Stub	
Subtype of:	AbstractObservableProperty_Stub
Definition:	A simple observable property. The basePhenomenon is a link to a definition in a catalogue or registry.
Description:	It is anticipated that some level of X-TWG harmonisation will take place on the exact structure of this class and it's subtypes. For version 2.0 we use a stub.
Status:	Proposed
Stereotypes:	«featureType»
URI:	null

5.2.2.2. Imported types (informative)

This section lists definitions for feature types, data types and enumerations and code lists that are defined in other application schemas. The section is purely informative and should help the reader understand the feature catalogue presented in the previous sections. For the normative documentation of these types, see the given references.

5.2.2.2.1. OM_Process

OM_Process (abstract)	
Package:	INSPIRE_DS_Model::INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19156 Observations and Measurements::ISO FDIS 19156:2011 Observations and Measurements::Observation schema::observation [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.2.2. SamplingCoverageObservation

SamplingCoverageObservation	
Package:	INSPIRE_DS_Model::INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19156 Observations and Measurements::ISO FDIS 19156:2011 Observations and Measurements::Sampling Coverage Observation [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

6 Reference systems

6.1 Coordinate reference systems

6.1.1 Datum

IR Requirement 4 For the coordinate reference systems used for making available the INSPIRE spatial data sets, the datum shall be the datum of the European Terrestrial Reference System 1989 (ETRS89) in areas within its geographical scope, and the datum of the International Terrestrial Reference System (ITRS) or other geodetic coordinate reference systems compliant with ITRS in areas that are outside the geographical scope of ETRS89. Compliant with the ITRS means that the system definition is based on the definition of the ITRS and there is a well established and described relationship between both systems, according to EN ISO 19111.

6.1.2 Coordinate reference systems

IR Requirement 5 INSPIRE spatial data sets shall be made available using one of the three-dimensional, two-dimensional or compound coordinate reference systems specified in the list below.

Other coordinate reference systems than those listed below may only be used for regions outside of continental Europe. The geodetic codes and parameters for these coordinate reference systems shall be documented, and an identifier shall be created, according to EN ISO 19111 and ISO 19127.

1. Three-dimensional Coordinate Reference Systems
   - Three-dimensional Cartesian coordinates
   - Three-dimensional geodetic coordinates (latitude, longitude and ellipsoidal height), using the parameters of the GRS80 ellipsoid

2. Two-dimensional Coordinate Reference Systems
   - Two-dimensional geodetic coordinates, using the parameters of the GRS80 ellipsoid
   - Plane coordinates using the Lambert Azimuthal Equal Area projection and the parameters of the GRS80 ellipsoid
   - Plane coordinates using the Lambert Conformal Conic projection and the parameters of the GRS80 ellipsoid
   - Plane coordinates using the Transverse Mercator projection and the parameters of the GRS80 ellipsoid

3. Compound Coordinate Reference Systems
   - For the horizontal component of the compound coordinate reference system, one of the two-dimensional coordinate reference systems specified above shall be used
   - For the vertical component on land, the European Vertical Reference System (EVRS) shall be used to express gravity-related heights within its geographical scope
   - Other vertical reference systems related to the Earth gravity field shall be used to express gravity-related heights in areas that are outside the geographical scope of EVRS. The geodetic codes and parameters for these vertical reference systems shall be documented and an identifier shall be created, according to EN ISO 19111 and ISO 19127
   - For the vertical component measuring the depth of the sea floor, where there is an appreciable tidal range, the Lowest Astronomical Tide shall be used as reference surface. In marine areas without an appreciable tidal range, in open oceans and effectively in waters that are deeper than 200 m, the depth of the sea floor shall be referenced to the Mean Sea Level
   - For the vertical component measuring depths above the sea floor in the free ocean, barometric pressure shall be used
   - For the vertical component in the free atmosphere, barometric pressure, converted to height using ISO 2533:1975 International Standard Atmosphere shall be used

6.1.3 Display

IR Requirement 6 For the display of the INSPIRE spatial data sets with the View Service specified in D003152/02 Draft Commission Regulation implementing Directive 2007/2/EC of the European Parliament and of the Council as regards Network Services, at least the two dimensional geodetic coordinate system shall be made available.

6.1.4 Identifiers for coordinate reference systems

IR Requirement 7 For referring to the non-compound coordinate reference systems listed in this Section, the identifiers listed below shall be used.

For referring to a compound coordinate reference system, an identifier composed of the identifier of the horizontal component, followed by a slash (/), followed by the identifier of the vertical component, shall be used.

- ETRS89-XYZ for Cartesian coordinates in ETRS89
- ETRS89-GRS80h for three-dimensional geodetic coordinates in ETRS89 on the GRS80 ellipsoid
- ETRS89-GRS80 for two-dimensional geodetic coordinates in ETRS89 on the GRS80
- EVRS for height in EVRS
- LAT for depth of the sea floor, where there is an appreciable tidal range
- MSL for depth of the sea floor, in marine areas without an appreciable tidal range, in open oceans and effectively in waters that are deeper than 200m
- ISA for pressure coordinate in the free atmosphere
- PFO for Pressure coordinate in the free ocean
- ETRS89-LAEA for ETRS89 coordinates projected into plane coordinates by the Lambert Azimuthal Equal Area projection
- ETRS89-LCC for ETRS89 coordinates projected into plane coordinates by the Lambert Conformal Conic projection
- ETRS89-TMzn for ETRS89 coordinates projected into plane coordinates by the Transverse Mercator projection

6.2 Temporal reference system

IR Requirement 8 The Gregorian Calendar shall be used for as a reference system for date values, and the Universal Time Coordinated (UTC) or the local time including the time zone as an offset from UTC shall be used as a reference system for time values.

6.3 Theme-specific requirements and recommendations on reference systems

There are no theme-specific requirements or recommendations on reference systems.

7 Data quality

This chapter includes a description of data quality elements and sub-elements as well as the associated data quality measures (section 7.1). The selected data quality measures should be used to evaluate quality of data sets for a specific data quality element / sub-element. The evaluation can be performed at the level of spatial object, spatial object type, dataset or dataset series.

The results of the evaluation are then reported at the spatial object type or dataset level in metadata utilising the same data quality elements and measures (see chapter 8).

NOTE The selection of appropriate data quality measures represents the first step towards the harmonisation of documenting data quality.

In addition, for some of the data quality elements described in section 7.1, minimum data quality requirements or recommendations may be defined. These are described in the section 1.2.

Recommendation 1 If data quality information is required at spatial object level then it should be modelled in the data model as an attribute of a relevant spatial object type.

7.1 Data quality elements and measures

Recommendation 2 To evaluate and report the data quality of data sets related to the spatial data theme **Oceanographic Geographical Features**, the elements and measures listed in Table 2 should be used.

Table 2 – Data quality elements for evaluating and reporting the data quality of data sets related to the spatial data theme Oceanographic Geographical Features

Section	Data quality element and sub-element
7.1.1	Completeness – Commission
7.1.2	Completeness – Omission

7.1.1 Completeness – Commission

Commission should be documented using the rate of excess items.

Name	Rate of excess items
Alternative name	–
Data quality element	Completeness
Data quality sub-element	Commission
Data quality basic measure	Error rate
Definition	Number of excess items in the dataset in relation to the number of items that should have been present.
Description	A data value should be present for every spatial-temporal location. For example for a PointSeriesObservation, a data value should be present for every time instant declared.
Evaluation scope	spatial object type: PointObservation, PointSeriesObservation, GridObservation, GridSeriesObservation

Reporting scope	data set
Parameter	–
Data quality value type	Real, percentage, ratio (example: 0,0189 ; 98,11% ; 11:582)
Data quality value structure	–
Source reference	–
Example	-
Measure identifier	3 (ISO 19138)

7.1.2 Completeness – Omission

Omission should be documented using the rate of missing items.

Name	**Rate of missing items**
Alternative name	–
Data quality element	Completeness
Data quality sub-element	Omission
Data quality basic measure	Error rate
Definition	Number of missing items in the dataset in relation to the number of items that should have been present.
Description	A data value should be present for every spatial-temporal location. For example for a PointSeriesObservation, a data value should be present for every time instant declared.
Evaluation scope	spatial object type: PointObservation, PointSeriesObservation, GridObservation, GridSeriesObservation
Reporting scope	data set
Parameter	–
Data quality value type	Real, percentage, ratio (example: 0,0189 ; 98,11% ; 11:582)
Data quality value structure	–
Source reference	–
Example	-
Measure identifier	7 (ISO 19138)

7.2 Minimum data quality requirements and recommendations

No minimum data quality requirements are defined.

8 Dataset-level metadata

Metadata can be reported for each individual spatial object (spatial object-level metadata) or once for a complete dataset or dataset series (dataset-level metadata). Spatial object-level metadata is fully described in the application schema (section 5**).** If data quality elements are used at spatial object level, the documentation shall refer to the appropriate definition in section 7. This section only specifies dataset-level metadata elements.

For some dataset-level metadata elements, in particular on data quality and maintenance, a more specific scope can be specified. This allows the definition of metadata at sub-dataset level, e.g. separately for each spatial object type. When using ISO 19115/19139 to encode the metadata, the following rules should be followed:

- The scope element (of type DQ_Scope) of the DQ_DataQuality subtype should be used to encode the scope.
- Only the following values should be used for the level element of DQ_Scope: Series, Dataset, featureType.
- If the level is featureType the levelDescription/MDScopeDescription/features element (of type Set< GF_FeatureType>) shall be used to list the feature type names.

NOTEThe value featureType is used to denote spatial object type.

Mandatory or conditional metadata elements are specified in Section 8.1. Optional metadata elements are specified in Section 8. The tables describing the metadata elements contain the following information:

- The first column provides a reference to a more detailed description.
- The second column specifies the name of the metadata element.
- The third column specifies the multiplicity.
- The fourth column specifies the condition, under which the given element becomes mandatory (only for Table 3 and Table 4).

8.1 Common metadata elements

IR Requirement 9	The metadata describing a spatial data set or a spatial data set series related to the theme Oceanographic **Geographical Features** shall comprise the metadata elements required by Regulation 1205/2008/EC (implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata) for spatial datasets and spatial dataset series (Table 3) as well as the metadata elements specified in Table 4.

Table 3 – Metadata for spatial datasets and spatial dataset series specified in Regulation 1205/2008/EC (implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata)

Metadata Regulation Section	Metadata element	Multiplicity	Condition
1.1	Resource title	1	
1.2	Resource abstract	1	
1.3	Resource type	1	
1.4	Resource locator	0..*	Mandatory if a URL is available to obtain more information on the resource, and/or access related services.
1.5	Unique resource identifier	1..*	
1.7	Resource language	0..*	Mandatory if the resource includes textual information.

2.1	Topic category	1..*	
3	Keyword	1..*	
4.1	Geographic bounding box	1..*	
5	Temporal reference	1..*	
6.1	Lineage	1	
6.2	Spatial resolution	0..*	Mandatory for data sets and data set series if an equivalent scale or a resolution distance can be specified.
7	Conformity	1..*	
8.1	Conditions for access and use	1..*	
8.2	Limitations on public access	1..*	
9	Responsible organisation	1..*	
10.1	Metadata point of contact	1..*	
10.2	Metadata date	1	
10.3	Metadata language	1	

Table 4 – Mandatory and conditional common metadata elements

INSPIRE Data Specification Oceanographic Geographical Features **Section**	**Metadata element**	**Multiplicity**	**Condition**
8.1.1	Coordinate Reference System	1	
8.1.2	Temporal Reference System	0..*	Mandatory, if the spatial data set or one of its feature types contains temporal information that does not refer to the Gregorian Calendar or the Coordinated Universal Time.
8.1.3	Encoding	1..*	
8.1.4	Character Encoding	0..*	Mandatory, if an encoding is used that is not based on UTF-8.
8.1.5	Data Quality – Logical Consistency – Topological Consistency	0..*	Mandatory, if the data set includes types from the Generic Network Model and does not assure centreline topology (connectivity of centrelines) for the network.

8.1.1 Coordinate Reference System

Metadata element name	Coordinate Reference System
Definition	Description of the coordinate reference system used in the dataset.
ISO 19115 number and name	13. referenceSystemInfo
ISO/TS 19139 path	referenceSystemInfo
INSPIRE obligation / condition	mandatory
INSPIRE multiplicity	1
Data type(and ISO 19115 no.)	189. MD_CRS
Domain	Either the referenceSystemIdentifier (RS_Identifier) or the projection (RS_Identifier), ellipsoid (RS_Identifier) and datum (RS_Identifier) properties shall be provided. *NOTEMore specific instructions, in particular on pre-defined values for filling the referenceSystemIdentifier attribute should be agreed among Member States* during the implementation phase to support interoperability.
Implementing instructions	
Example	referenceSystemIdentifier: code: ETRS_89 codeSpace: INSPIRE RS registry
Example XML encoding	<gmd:referenceSystemInfo> <gmd:MD_ReferenceSystem> <gmd:referenceSystemIdentifier> <gmd:RS_Identifier> <gmd:code> <gco:CharacterString>ETRS89 </gco:CharacterString> </gmd:code> <gmd:codeSpace> <gco:CharacterString>INSPIRE RS registry</gco:CharacterString> </gmd:codeSpace> </gmd:RS_Identifier> </gmd:referenceSystemIdentifier> </gmd:MD_ReferenceSystem> </gmd:referenceSystemInfo>
Comments	

8.1.2 Temporal Reference System

Metadata element name	Temporal Reference System
Definition	Description of the temporal reference systems used in the dataset.
ISO 19115 number and name	13. referenceSystemInfo
ISO/TS 19139 path	referenceSystemInfo
INSPIRE obligation / condition	Mandatory, if the spatial data set or one of its feature types contains temporal information that does not refer to the Gregorian Calendar or the Coordinated Universal Time.
INSPIRE multiplicity	0..*
Data type(and ISO 19115 no.)	186. MD_ReferenceSystem

Domain	No specific type is defined in ISO 19115 for temporal reference systems. Thus, the generic MD_ReferenceSystem element and its reference SystemIdentifier (RS_Identifier) property shall be provided. *NOTEMore specific instructions, in particular on pre-defined values for filling the referenceSystemIdentifier attribute should be agreed among* Member States during the implementation phase to support interoperability.
Implementing instructions	
Example	referenceSystemIdentifier: code: GregorianCalendar codeSpace: INSPIRE RS registry
Example XML encoding	<gmd:referenceSystemInfo> <gmd:MD_ReferenceSystem> <gmd:referenceSystemIdentifier> <gmd:RS_Identifier> <gmd:code> <gco:CharacterString>GregorianCalendar</gco:CharacterString> </gmd:code> <gmd:codeSpace> <gco:CharacterString>INSPIRE RS registry</gco:CharacterString> </gmd:codeSpace> </gmd:RS_Identifier> </gmd:referenceSystemIdentifier> </gmd:MD_ReferenceSystem> </gmd:referenceSystemInfo>
Comments	

8.1.3 Encoding

Metadata element name	**Encoding**
Definition	Description of the computer language construct that specifies the representation of data objects in a record, file, message, storage device or transmission channel
ISO 19115 number and name	271. distributionFormat
ISO/TS 19139 path	distributionInfo/MD_Distribution/distributionFormat
INSPIRE obligation / condition	mandatory
INSPIRE multiplicity	1
Data type (and ISO 19115 no.)	284. MD_Format
Domain	See B.2.10.4. The property values (name, version, specification) specified in section 9 shall be used **to document the default** and alternative encodings.
Implementing instructions	
Example	name: Oceanographic **Geographical Features** GML application schema version: version **2.0**, GML, version 3.2.1 specification: D2.8.III**.**15 Data Specification on Oceanographic **Geographical Features** – Draft Guidelines

Example XML encoding	<gmd:MD_Format> <gmd:name> <gco:CharacterString> **Oceanographic Geographical Features** GML application schema </gco:CharacterString> </gmd:name> <gmd:version> <gco:CharacterString>**2.0**, GML, version 3.2.1</gco:CharacterString> </gmd:version> <gmd:specification> <gco:CharacterString>D2.8.**III**.**15** Data Specification on **Oceanographic Geographical Features** – Draft Guidelines</gco:CharacterString> </gmd:specification> </gmd:MD_Format>
Comments	

8.1.4 Character Encoding

Metadata element name	**Character Encoding**
Definition	The character encoding used in the data set.
ISO 19115 number and name	
ISO/TS 19139 path	
INSPIRE obligation / condition	Mandatory, if an encoding is used that is not based on UTF-8.
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	
Domain	
Implementing instructions	
Example	-
Example XML encoding	<gmd:characterSet> <gmd:MD_CharacterSetCode codeListValue="8859part2" codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/ML_gmxCodelists.xml#CharacterSetCode">8859-2</gmd:MD_CharacterSetCode> </gmd:characterSet>
Comments	

8.1.5 Data Quality – Logical Consistency – Topological Consistency

Metadata element name	**Data Quality – Logical Consistency – Topological Consistency**
Definition	Correctness of the explicitly encoded topological characteristics of the dataset as described by the scope
ISO 19115 number and name	18. dataQualityInfo
ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	Mandatory, if the data set includes types from the Generic Network Model and does not assure centreline topology (connectivity of centrelines) for the network.
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	115. DQ_TopologicalConsistency
Domain	Lines 100-107 from ISO 19115

Implementing instructions	This metadata should be filled, at least, with these elements: - valueUnit: UnitOfMeasure - value: Record
Example	
Example XML encoding	
Comments	See clauses on topological consistency in section 7 for detailed information. This metadata element is mandatory if connectivity is not assured for network centrelines in the dataset. In this case the *Connectivity tolerance* parameter – as described in section 7 – must be provided in order to ensure automatic and unambiguous creation of centreline topology in post-process.

8.2 Metadata elements for reporting data quality

Recommendation 3 For reporting the results of the data quality evaluation quantitatively, the data quality elements and measures defined in chapter 7 should be used.

The scope for reporting may be different from the scope for evaluating data quality (see section 7). If data quality is reported at the data set or spatial object type level, the results are usually derived or aggregated.

Metadata element name	**See chapter 7**
Definition	See chapter 7
ISO 19115 number and name	80. report
ISO/TS 19139 path	dataQualityInfo/*/report
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	Corresponding DQ_xxx element from ISO 19115, e.g. 109. DQ_CompletenessCommission
Domain	Lines 100-107 from ISO 19115 100. nameOfMeasure : CharacterString [0..*] 101. measureIdentification : MD_Identifier [0..1] 102. measureDescription : CharacterString [0..1] 103. evaluationMethodType : DQ_EvaluationMethodTypeCode [0..1] 104. evaluationMethodDescription : CharacterString [0..1] 105. evaluationProcedure : CI_Citation [0..1] 106. dateTime : DateTime [0..*] 107. result : DQ_Result [1..2]

Implementing instructions	**Recommendation 4** For each DQ result included in the metadata, at least the following properties should be provided: 100. nameOfMeasure NOTE This should be the name as defined in Chapter 7. 103. evaluationMethodType 104. evaluationMethodDescription NOTE If the reported data quality results are derived or aggregated (i.e. the scope levels for evaluation and reporting are different), the derivation or aggregation should also be specified using this property. 106. dateTime NOTE This should be data or range of dates on which the data quality measure was applied. 107. result NOTE This should be of type DQ_QuantitativeResult
Example	
Example XML encoding	
Comments	See Chapter 7 for detailed information on the individual data quality elements and measures to be used.

Open issue 3: In the ongoing revision of ISO 19115 and development of new ISO 19157 standard (Geographic Information – Data quality), a new element is introduced (DQ_DescriptiveResult). This element enables to describe and report qualitative results of the data quality evaluation and could be used instead of DQ_QuantitativeResult. Once the new (version of the) standards are approved, these guidelines will be revisited and be updated if necessary.

Open issue 4: For reporting compliance with minimum data quality requirements and recommendations specified in section 7, the INSPIRE conformity metadata element should be used.

However, since this issue is part of the larger discussion on the Abstract Test Suite and the definition of conformance classes for the data specification, detailed instructions on how to provide metadata on compliance with minimum data quality requirements and recommendations will only be provided for v3.0.

8.3 Theme-specific metadata elements

No mandatory theme-specific metadata elements are defined for this theme.
No optional theme-specific metadata elements are defined for this theme.

8.4 Guidelines on using metadata elements defined in Regulation 1205/2008/EC

8.4.1 Conformity

The *Conformity* metadata element defined in Regulation 1205/2008/EC allows to report the conformance with the Implementing Rule for interoperability of spatial data sets and services or another specification. The degree of conformity of the dataset can be *Conformant* (if the dataset is fully conformant with the cited specification), *Not Conformant* (if the dataset does not conform to the cited specification) or *Not evaluated* (if the conformance has not been evaluated).

Recommendation 5 The Conformity metadata element should be used to report conceptual consistency with this INSPIRE data specification. The value of Conformant should be used for the Degree element only if the dataset passes all the requirements described in the abstract test suite presented in Annex A. The Specification element should be given as follows:
- title: “INSPIRE Data Specification on <Theme Name> – Draft Guidelines”
- date:
  - dateType: publication
  - date: 2011-06-20

Open issue 5: Conformance testing is still an open issue under discussion.

Instructions on conformance testing and a common abstract test suite (including detailed instructions on how to test specific requirements) will be added at a later stage.

This may also lead to an update of the recommendations on how to fill the conformity metadata element.

8.4.2 Lineage

Recommendation 6 Following the ISO 19113 Quality principles, if a data provider has a procedure for quality validation of their spatial data sets then the data quality elements listed in the Chapters 7 and 8 should be used. If not, the *Lineage* metadata element (defined in Regulation 1205/2008/EC) should be used to describe the overall quality of a spatial data set.

According to Regulation 1205/2008/EC, lineage “is a statement on process history and/or overall quality of the spatial data set. Where appropriate it may include a statement whether the data set has been validated or quality assured, whether it is the official version (if multiple versions exist), and whether it has legal validity. The value domain of this metadata element is free text”.

The Metadata Technical Guidelines based on EN ISO 19115 and EN ISO 19119 specify that the statement sub-element of LI_Lineage (EN ISO 19115) should be used to implement the lineage metadata element.

Recommendation 7 To describe the transformation steps and related source data, it is recommended to use the following sub-elements of LI_Lineage:
- For the description of the transformation process of the local to the common INSPIRE data structures, the LI_ProcessStep sub-element should be used.
- For the description of the source data the LI_Source sub-element should be used.

NOTE 1 This recommendation is based on the conclusions of the INSPIRE Data Quality Working Group to avoid overloading of the overall lineage statement element with information on the transformation steps and related source data.

NOTE 2 In order to improve the interoperability, domain templates and instructions for filling these free text elements (descriptions) may be specified in an Annex of this data specification.

Open issue 6: The suggested use of the LI_Lineage sub-elements needs to be discussed as part of the maintenance of the INSPIRE metadata Technical Guidelines.

8.4.3 Temporal reference

According to Regulation 1205/2008/EC, at least one of the following temporal reference metadata elements shall be provided: temporal extent, date of publication, date of last revision, date of creation. If feasible, the date of the last revision of a spatial data set should be reported using the *Date of last revision* metadata element.

9 Delivery

9.1 Delivery medium

DS Requirement 2	Data conformant to this INSPIRE data specification shall be made available through an INSPIRE network service.

DS Requirement 3	All information that is required by a calling application to be able to retrieve the data through the used network service shall be made available in accordance with the requirements defined in the Implementing Rules on Network Services.

EXAMPLE 1 Through the Get Spatial Objects function, a download service can either download a pre-defined data set or pre-defined part of a data set (non-direct access download service), or give direct access to the spatial objects contained in the data set, and download selections of spatial objects based upon a query (direct access download service). To execute such a request, some of the following information might be required:

- the list of spatial object types and/or predefined data sets that are offered by the download service (to be provided through the Get Download Service Metadata operation),
- and the query capabilities section advertising the types of predicates that may be used to form a query expression (to be provided through the Get Download Service Metadata operation, where applicable),
- a description of spatial object types offered by a download service instance (to be proviced through the Describe Spatial Object Types operation).

EXAMPLE 2 Through the Transform function, a transformation service carries out data content transformations from native data forms to the INSPIRE-compliant form and vice versa. If this operation is directly called by an application to transform source data (e.g. obtained through a download service) that is not yet conformant with this data specification, the following parameters are required:
Input data (mandatory). The data set to be transformed.

Source model (mandatory, if cannot be determined from the input data). The model in which the input data is provided.
Target model (mandatory). The model in which the results are expected.
Model mapping (mandatory, unless a default exists). Detailed description of how the transformation is to be carried out.

9.2 Encodings

9.2.1 Default Encoding(s)

DS Requirement 4	Data conformant to the application schema(s) defined in section 5 shall be encoded using the encoding(s) specified in this section.

9.2.1.1. Default encoding for application schema <application schema name>

Name: OceanFeatures GML Application Schema
Version: version 2.0 GML, version 3.2.1
Specification: D2.8.**III**.**15** Data Specification on **Oceanographic Geographical Features** – Draft Guidelines
Character set: UTF-8

The GML Application Schema is distributed in a zip-file separately from the data specification document.

9.2.2 Alternative Encoding(s)

For practical reasons it is recognised that coverage data is often much too large to be encoded fully in GML. In these circumstances it is recognised that certain binary encodings must be an acceptable alternative for storing the *coverage result* of an OceanFeature observation. In these cases the OceanFeatures GML application schema should still be provided and the 'result' should be a reference to the appropriate file, or part of file, containing the coverage, rather than embedding the coverage inline as GML.

Open issue 7: A recommended scheme must be developed for linking to binary files from GML application schemas.

Recommendation 8	It is recommended that the encodings specified in this section are suitable payloads for the coverage result of an Ocean Feature

9.2.2.1. Alternative encoding for application schema OceanFeatures –NetCDF3

Name: NetCDF
Version: 3
Specification: http://www.opengeospatial.org/standards/netcdf
Character set: n/a

9.2.2.1.1. Encoding rule(s) used

9.2.2.2. Alternative encoding for application schema OceanFeatures –NetCDF4

Name: NetCDF
Version: 4
Specification: http://www.unidata.ucar.edu/software/netcdf/

Character set: n/a

9.2.2.2.1. Encoding rule(s) used

9.2.2.3. Alternative encoding for application schema OceanFeatures –HDF4

Name: HDF
Version: 4
Specification: http://www.hdfgroup.org/products/hdf4/

Character set: n/a

9.2.2.3.1. Encoding rule(s) used

9.2.2.4. Alternative encoding for application schema OceanFeatures –HDF5

Name: HDF
Version: 5
Specification: http://www.hdfgroup.org/HDF5/
Character set: n/a

9.2.2.4.1. Encoding rule(s) used

10 Data Capture

The Oceanographic Geographic Features specification provides a framework for spatial data interoperability for data sets that represent ocean phenomena such as ‘temperature’ or ‘currents’. To mandate this framework for all and every oceanographic data set would not be practical and is not the intent of INSPIRE. Accordingly the Data Capture criteria are particularly important for this theme.

10.1 Phenomena and Data Collection Method

INSPIRE does not mandate which ocean phenomena should be made available under the INSPIRE legislation. The Oceanographic Geographic Feature specification recommends a codelist that can be used to identify the phenomena in the dataset, but it does not expect that all phenomena in the codelist should be made available under the scope of INSPIRE.

The following list is an indication of the type of phenomena that should be considered for inclusion (note this list is non-exhaustive).

- Current Velocity

- Salinity
- Sea Temperature
- Water Level
- Wave Direction
- Wave Height
- Wave Period

Open issue 8: Which phenomena vocabularies should be recommended for Ocean Features?

Similarly INSPIRE regulations are not intended to apply to oceanographic data collection for the purpose of scientific investigation only. It applies only to data that is required to be routinely reported for sustained monitoring and environmental compliance, this includes national scale reporting such as in accordance with the Water Framework Directive, but also data required to be collected at a more local scale in accordance with the requirements of the Environmental Impact Assessment Directive.

IR Requirement 10 The specification for how an Oceanographic Geographical Feature should be created in terms of which phenomena should be in the dataset and the data collection and processing methods shall be specified in legislation which relate to reporting of environmental conditions.

Recommendation 9 Any observations included in an Oceanographic Geographical Feature dataset should be linked to a corresponding Environmental Monitoring Facility dataset describing how the phenomena was collected. This link should be made according to the recommendations in document D2.9.

Open issue 9: The precise nature of this link has not yet been confirmed but it will be a simple linkage of some description. The Environmental Monitoring Facility also has the reverse link to Observations.

Recommendation 10 Ocean Features are an inherent property of a Sea Region (SR – Annex III). A useful test as to whether an Ocean Feature falls under the scope of the Inspire Directive is that it can be used to define a particular Sea Region. For example ocean currents or may be useful for defining a Sea Region, but fluorescence is not.

As an example of the interrelation of Sea Regions and Ocean Features - a Sea Region may be classified according to its environmental status. Hence if the objective is that a Sea Region must obtain 'good environmental status' then clearly all (physical and chemical) parameters required to be measured to demonstrate good environmental status will fall within the scope of the INSPIRE Oceanographic Geographical Feature theme.

10.2 Data transformations

Open issue 10: There is an open question about data transformation. For example, my data set of Temperature is represented as a unstructured mesh - do I need to transform it to a grid to comply with Inspire. Likewise, if my data is a 'pointCloud' do I need to transform it to grid?

10.3 Spatial and Temporal Range of a Data set

INSPIRE does not mandate a minimum or maximum temporal or spatial range of a dataset.

IR Requirement 11 The minimum or maximum spatial and temporal range of a dataset shall be covered by Legislation mandating the collection of the data.

Recommendation 11 Even where legislation does not mandate the maximum temporal or spatial range of a dataset it would good practice to extend and maintain the range of the dataset "going forward" such that longer term datasets are created.

10.4 Spatial and Temporal Resolution of a Data set

INSPIRE does not mandate a minimum or maximum temporal or spatial resolution of a dataset.

IR Requirement 12 The minimum or maximum spatial and temporal resolution of a dataset shall be covered by Legislation mandating the collection of the data.

10.5 Aggregation Levels

Datasets of oceanographic data will be generated by a processing chain comprising several production levels. INSPIRE Legislation does not apply at all levels of this processing chain, it should only applies at the level it is used as input to the management of the environment to underpin decision making, not at the level of scientific investigation

Recommendation 12 The Oceanographic Geographical Feature specification does not apply to instrument level data, sample level data or raw, unprocessed data. It will apply at processed and corrected data corresponding to geophysical parameters.

Recommendation 13 Data used to support data generation such as calibration and validation data is excluded from the scope of INSPIRE

10.6 Numerically Generated Data

Some Oceanographic Geographical Features will be generated by numerical models, namely forecasts, hindcasts and nowcasts. Such data will fall within the scope of INSPIRE, however where this data is generated by statistical methods to assess uncertainty or spread in the data (e.g. ensemble forecasting) it will not be necessary to publish such supporting data, only the aggregated data (see Recommendation 3 and 4).

Recommendation 14 Numerically generated data should be limited to aggregated data or, where appropriate, 'best available' result of the simulation and not every simulation scenario.

11 Portrayal

This clause defines the rules for layers and styles to be used for portrayal of the spatial object types defined for this theme.

In section 11.1, the *types* of layers are defined that are to be used for the portrayal of the spatial object types defined in this specification. A view service may offer several layers of the same type, one for each dataset that it offers on a specific topic.

Section **Error! Reference source not found.** specifies the styles that shall be supported by INSPIRE view services for each of these layer types.

In section **Error! Reference source not found.**, further styles can be specified that represent examples of styles typically used in a thematic domain. It is recommended that also these styles should be supported by INSPIRE view services, where applicable.

Where XML fragments are used in these sections, the following namespace prefixes apply:
- sld="http://www.opengis.net/sld" (WMS/SLD 1.1)
- se="http://www.opengis.net/se" (SE 1.1)
- ogc="http://www.opengis.net/ogc" (FE 1.1)

IR Requirement 13	If an INSPIRE view services supports the portrayal of data related to the theme **Oceanographic Geographical Features**, it shall provide layers of the types specified in this section.

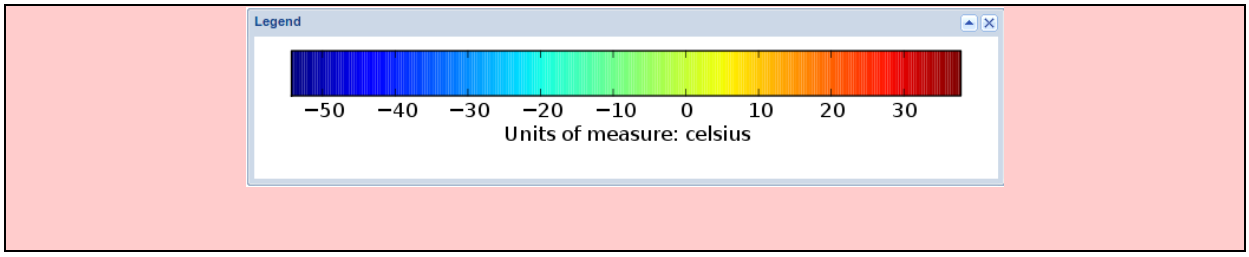
DS Requirement 5	If an INSPIRE view network service supports the portrayal of spatial data sets corresponding to the spatial data theme **Oceanographic Geographical Features**, it shall support the styles specified in section **Error! Reference source not found.**. If no user-defined style is specified in a portrayal request for a specific layer to an INSPIRE view service, the default style specified in section **Error! Reference source not found.** for that layer shall be used.

Recommendation 15	In addition to the styles defined in section **Error! Reference source not found.**, it is recommended that, where applicable, INSPIRE view services also support the styles defined in section **Error! Reference source not found.**.

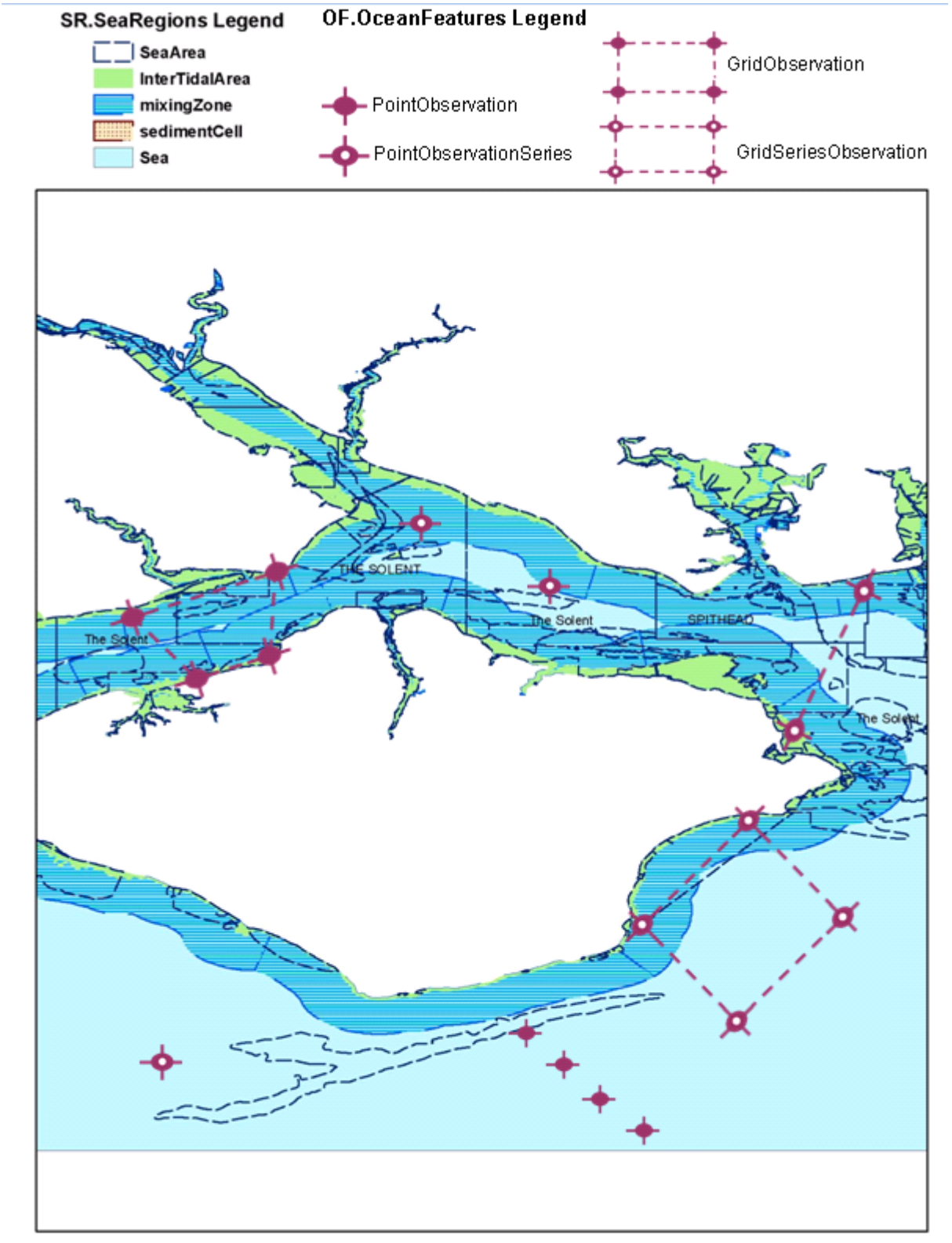
11.1 Layers to be provided by INSPIRE view services

Open issue 11: There is cross-theme discussion on portrayal of coverages. It is recognised that meaningful portrayal is dependent on the range phenonema, and long term some form of registry would need to be established to realise this. It was agreed that as a minimum the geospatial extent of the domain should be displayed, but not any symbolisation related to the range set.

Open issue 12: One consideration is being whether a generic portrayal of the domain values in a coverage is meaningful, for example application of a ‘default’ colour ramp. As a general suggestion it may be appropriate to recommend the use of the “Jet” colourmap from the National Center for Supercomputer Applications (See diagram for illustration of colourscale) as it is a generic blue – red colour map that is well supported in software.



We also recommend standard portrayal for grid bounding boxes and point locations to be used in discovery services etc. as shown in the following image.


SR.SeaRegions Legend
SeaArea
InterTidalArea
mixingZone
sedimentCell
Sea
OF.OceanFeatures Legend
PointObservation
PointObservationSeries
GridObservation
GridSeriesObservation
THE SOLENT
The Solent
The Solent
SPITHEAD
The Solent

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[ISO 19103] ISO/TS 19103:2005, Geographic information – Conceptual schema language

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[ISO 19108] EN ISO 19108:2005 Geographic information - Temporal schema (ISO 19108:2002)

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[OGC 06-103r3] Implementation Specification for Geographic Information - Simple feature access – Part 1: Common Architecture v1.2.0

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Annex A
(normative)

Abstract Test Suite

Any dataset conforming to this INSPIRE data specification shall meet all requirements specified in this document.

Open issue 13: Conformance testing is still an open issue under discussion.

Instructions on conformance testing and a common abstract test suite (including detailed instructions on how to test specific requirements) will be added at a later stage.

Annex B
(informative)
Use cases

This annex describes the use cases that were used as a basis for the development of this data specification.

B.1 *Measuring Salinity for Water Quality Purposes.*

Use Case Description	
Name	Water salinity reporting.
Primary actor	Water Information Analyst
Goal	To create maps/plots of water salinity over time for a network of fixed monitoring stations at sea.
System under consideration	Fixed monitoring instruments at sea.
Importance	medium
Description	To take daily measurements from a network of fixed instruments measuring water salinity. Encode this data using the Ocean Features application schema and create maps or plots of the information showing the change in salinity over time.
Pre-condition	Salinity measurements recorded at known times for a network of monitoring stations for which the location of the stations is known.
Post-condition	Water salinity data set and maps.
Flow of Events – Basic Path	
Step 1.	Acquire daily values for water salinity data.
Step 2.	Encode as a set of Ocean Features PointSeriesObservations.
Step 3.	Publish **Water Salinity Time Series Dataset**
Step 4.	Expose Water Salinity Time Series through Sensor Observation Service
Step 5.	Plot individual observations in plotting service.
Flow of Events – Alternative Paths	
	NONE
Data set: Daily measurements from individual monitoring stations	
Description	Data streamed from individual monitoring stations
Type	input
Data provider	Instrument operator
Geographic scope	Area of interest
Thematic scope	-
Scale, resolution	Daily temporal resolution
Delivery	adhoc
Documentation	-

Use Case Description	
Data set: Water Salinity Time Series Dataset	
Description	Water salinity time series for coastal region.
Type	output
Data provider	Water analyst
Geographic scope	Area of interest
Thematic scope	PointSeriesObservation types. Observed property is salinity.
Scale, resolution	n/a
Delivery	WFS, SOS
Documentation	-

B.2 *Coastal Flood Hazard Map*

Use Case Description	
Name	<Coastal Flood Hazard Mapping>
Primary actor	<Hydraulic Engineer>
Goal	<To construct a map of the hazard faced by coastal communities from flooding form the sea from extreme waves>
System under consideration	<Hydraulic Model >
Importance	<high>
Description	Establish a map that shows the extreme of waves predicted at a given coastal location. The map shows the wave extreme wave height (m). This task negates the affect of surge effects and is based on a hindcast of measured wave data.
Pre-condition	<Hydraulic model for waves and suitable offshore measured wave data>
Post-condition	<Dataset of wave heights along the shoreline at HAT.>
Flow of Events – Basic Path	
Step 1.	For the area of interest Intersect **seaArea at HAT (SR)** with bathymetry (EL) to create a dataset of sea depth.
Step 2.	Use sea depth data set to build a hydraulic wave model for transforming offshore wave conditions inshore.
Step 3.	Generate a wave climate from a pointObservationSeries of wave height and wave direction.
Step 4.	Use the hydraulic model to transform the wave climate from its observed location to the shoreline.
Step 5	Repeat process to establish nearshore wave climate at a number of locations along the shoreline.
Flow of Events – Alternative Paths	
None	
Data set: <SeaArea>	
Description	< Vector data set of Sea Area at HAT>
Type	Input
Data provider	<National Hydrographic or marine mapping Agency>

Use Case Description	
Geographic scope	<Local>
Thematic scope	< SeaArea (SR Theme)>
Scale, resolution	<1:10,000>
Delivery	<FTP download or WFS>
Documentation	<->
Data set: <Bathymetry>	
Description	<Coverage data set of bathymetry>
Type	Input
Data provider	< National Hydrographic or marine mapping Agency>
Geographic scope	<Local>
Thematic scope	<Bathymetry (EL theme)
Scale, resolution	<1:10,000>
Delivery	<FTP download or WFS>
Documentation	<->
Data set: <Offshore Wave Data>	
Description	<Wave height and direction observed for a period of ideally 10 years or more>
Type	Input
Data provider	<National or European Environment Agency>
Geographic scope	<Regional>
Thematic scope	< Point Observation Series (OF Theme)>
Scale, resolution	<1:10,000>
Delivery	<SOS>
Documentation	<->
Data set: <Extreme Wave Data>	
Description	<Extreme Wave height predicted at locations along a shoreline>
Type	Output
Data provider	<National or European Environment Agency>
Geographic scope	<Local>
Thematic scope	< Point Observation Collection (OF Theme)>
Scale, resolution	<1:10,000>
Delivery	<WFS>
Documentation	<->

B.3 *Water quality reporting based on satellite data*

Use Case Description	
Name	Satellite based water quality reporting
Primary actor	Water Information Analyst
Goal	Create a dataset containing chlorophyll concentration grids for a series of times.
System under consideration	GIS
Importance	medium
Description	To create a gridded time series dataset of chlorophyll concentration.
Pre-condition	Satellite data with chlorophyll concentration indexed.
Post-condition	Dataset created with a time series of coverages showing chlorophyll concentrations. Published via WMS and SOS.
Flow of Events – Basic Path	
Step 1.	Begin with NetCDF data for individual satellite observations
Step 2.	Create **GridSeriesObservation chlorophyll concentration dataset** describing the individual data files as a time series
Step 3.	Publish GridSeriesObservation via Sensor Observation Service
Step 4.	Publish images of chlorophyll concentration via INSPIRE View Service (WMS)
Step 5.	Publish images of chlorophyll concentration via WCS.
Flow of Events – Alternative Paths	
	NONE
Data set: Satellite data binary files showing chlorophyll concentration	
Description	Satellite observations showing chlorophyll index
Type	input
Data provider	Downstream satellite data provider
Geographic scope	Global
Thematic scope	-
Scale, resolution	10km grid
Delivery	Adhoc
Documentation	-
Data set: Observation time series of chlorophyll concentration	
Description	Chlorophylll concentration time series dataset
Type	output
Data provider	Anaylst
Geographic scope	European Seas
Thematic scope	GridSeriesObservation with chlorophyll concentration as observed property
Scale, resolution	10km grid
Delivery	WMS, WCS, SOS

Use Case Description	
Documentation	-

B.4 *Comparing numerical model predictions with actual observations*

Use Case Description	
Name	Prediction model evaluation.
Primary actor	Environmental Analyst
Goal	To determine whether a prediction model is functioning accurately.
System under consideration	Numerical model, ocean-based sensors.
Importance	high
Description	An environmental analyst needs to compare measured values (say of temperature) at several locations against numerical model predictions. This is crucial to determine the suitability and accuracy of the model predictions.
Pre-condition	Data measurements recorded at known times for several monitoring stations and a numerical model for the same time period.
Post-condition	Plots showing trends and comparisons between actual measurements and predicted values.
Flow of Events – Basic Path	
Step 1.	Acquire observed measurement data as a set of OF PointSeriesObservations.
Step 2.	Acquire numerical model predictions as a OF GridSeriesObservation.
Step 3.	For each location where there is a OF PointSeriesObservation, plot the trend against the same location in the GridSeriesObservation.
Step 4.	Analyse results to assess accuracy of prediction model.
Step 5.	Recalibrate model, or adjust future predictions according to analysis as appropriate.
Flow of Events – Alternative Paths	
	NONE
Data set: Daily measurements from individual monitoring stations as OF PointSeriesObservation	
Description	Data streamed from individual monitoring stations
Type	input
Data provider	Instrument operator
Geographic scope	Area of interest
Thematic scope	PointSeriesObservation types.
Scale, resolution	As appropriate
Delivery	SOS, WFS
Documentation	-
Data set: Numerical model outputs as OF GridSeriesObservation	
Description	Numerical model data
Type	input

Use Case Description	
Data provider	Modelling group.
Geographic scope	Area of interest
Thematic scope	GridSeriesObservation types.
Scale, resolution	n/a
Delivery	SOS, WCS
Documentation	-
Data set: Comparison trend plots	
Description	Comparison of actual measurements with numerical model data
Type	output
Data provider	Environmental Analyst
Geographic scope	Area of interest
Thematic scope	-
Scale, resolution	As appropriate
Delivery	-
Documentation	-